REPORT
2015012432

AMEREN MISSOURI RUSH ISLAND ENERGY CENTER
EVALUATION OF CCR UNITS
40 CFR PART 257
JEFFERSON COUNTY, MISSOURI

Prepared for

Ameren MISSOURI

Prepared by

REITZ & JENS, INC.
CONSULTING ENGINEERS

October 2021

The Professional whose signature and personal seal appear hereon assumes responsibility only for what appears in the attached report and disclaims (pursuant to Section 327.411 RSMo) any responsibility for all other plans, estimates, specifications, reports, or other documents or instruments not sealed by the undersigned Professional relating to or intended to be used for any part or parts of the project to which this report refers.

AMEREN MISSOURI RUSH ISLAND ENERGY CENTER
EVALUATION OF CCR UNITS
40 CFR PART 257
JEFFERSON COUNTY, MISSOURI

TABLE OF CONTENTS

Section — Page

1.0 INTRODUCTION 1
1.1 Purpose 1
2.0 RUSH ISLAND ENERGY CENTER CCR UNIT 2
2.1 Owner and Operator 2
2.2 CCR Unit Location 2
2.3 CCR Unit Identification and Purpose 2
2.4 CCR Unit Watershed 2
2.5 Geomorphology and Foundation Geology 2
2.6 Surveillance, Maintenance and Repair of the CCR Units 3
3.0 RCPA 7
3.1 History of Construction 7
3.2 Modifications to Embankment Geometry and Operation 8
3.3 Foundation and Abutment Geology 9
3.4 Embankment Material 10
3.5 Operating Pool Surface Elevations 10
3.6 CCR Unit Outlet Works 10
3.7 Impounded CCR 10
3.8 Instrumentation 11
3.9 Structural Instability 11
4.0 PERIODIC HAZARD POTENTIAL CLASSIFICATION 12
5.0 PERIODIC STRUCTURAL STABILITY ASSESSMENT 13
6.0 PERIODIC SAFETY FACTOR ASSESSMENT 14
7.0 HYDROLOGIC AND HYDRAULIC CAPACITY REQUIREMENTS 15
8.0 CLOSURE 16
9.0 REFERENCES 17

LIST OF FIGURES

Figure 1 ..... Site Map
Figure 2 ..... USGS 7.5 Minute Quadrangle Map for Rush Island Energy Center
Figure 3 ..... Channel Diversion Berm Construction 1.0
Figure 4 ..... Channel Diversion Berm Construction 2.0
Figure 5 ..... Channel Diversion Berm Construction 3.0
Figure 6 ..... Summary of 2015 Slope Rehabilitation
Figure 7 ..... Ash Pond Slope Modifications, Typical Slope Modification Sections Sheet 1
Figure 8 ..... Ash Pond Slope Modifications, Typical Slope Modification Sections Sheet 2
Figure 9 .....RCPA Slurry Wall Plan

LIST OF TABLES

Table 1 .....Ameren Missouri dam safety inspection condition codes
Table 2 .....RCPA
Table 3 .....RCPA volume and depth of impounded CCR

LIST OF APPENDICES

APPENDIX A RCPA OPERATIONS AND MAINTENANCE MANUAL
BECHTEL 1971 BORING LOGS
2010 RCPA OPERATING PERMIT APPLICATION
2014 CONETEC DATA REPORT
APPENDIX B PERIODIC HAZARD CLASSIFICATION
APPENDIX C PERIODIC STRUCTURAL STABILITY ASSESSMENT
APPENDIX D PERIODIC SAFETY FACTOR ASSESSMENT
APPENDIX E HYDROLOGY AND HYDRAULICS

AMEREN MISSOURI RUSH ISLAND ENERGY CENTER
EVALUATION OF CCR UNITS
ST. LOUIS COUNTY, MISSOURI

1.0 INTRODUCTION

The Rush Island Energy Center (REC) is located in southern Jefferson County, Missouri, in the Mississippi River floodplain. The plant is south of the City of Festus and north of the City of Bloomsdale. The REC has one active surface impoundment; however, this CCR unit is no longer receiving CCR, has been dewatered and is currently being closed. The surface impoundment is located just west of the Mississippi River and north of Isle du Bois Creek. The Rush Island Dam is in Sections 3 and 4, Township 39 North, Range 7 East of the 5th Principal Meridian. An aerial showing the surface impoundment is attached as Figure 1.

The Rush Island Dam is a single stage industrial dam. The perimeter of the dam has a length of approximately 9,750-lineal feet and a maximum height of 46 feet. The upstream and downstream slopes of the dam are sloped at 3 horizontal (H) to 1 vertical (V). The Rush Island Dam is permitted by the Missouri Department of Natural Resources (MDNR) under registration permit ID No. MO-40179. The RCPA no longer receives CCRs, has been dewatered and is currently being closed. The impoundment is no longer used for CCR disposal and water treatment.

1.1 Purpose

The purpose of this report is to document evaluations and assessments completed for the Ameren Missouri Rush Island Energy Center CCR Unit as required by select sections within 40 CFR Part 257, the final rule to regulate the disposal of CCR as solid waste under Subtitle D of the Resource Conservation and Recovery Act (RCRA). Specifically, Reitz & Jens completed assessments and evaluations as required by:

A. §257.73(c)(1), History of Construction
B. §257.73(a)(2), Periodic Hazard Potential Classification
C. §257.73(d)(1), Periodic Structural Stability Assessment
D. §257.73(e)(1), Periodic Safety Factor Assessment
E. §257.82, Hydrologic and Hydraulic Capacity Requirements, and
F. §257.83(b), Inspection Requirements for CCR Surface Impoundments

The evaluations and assessments required by §257.73(c)(1) are discussed in the body of this report. The evaluations and assessments required by the remaining applicable sections of 40 CFR Part 257 are contained in the Appendices.

2.0 RUSH ISLAND ENERGY CENTER CCR UNIT

2.1 Owner and Operator

The CCR Units at the REC are owned and operated by Ameren Missouri. REC plant personnel have the primary responsibility of CCR unit operation. The REC is located at 100 Big Hollow Road in Festus, Missouri 63028. The Ameren Missouri Dam Safety Group performs CCR unit inspections and reviews all updates to the Operations and Maintenance (O&M) Manual. A copy of the 2010 O&M manual is included in Appendix A. The Ameren Missouri Dam Safety Group is located at 3700 South Lindbergh Boulevard in St. Louis, Missouri 63127.

2.2 CCR Unit Location

The CCR Units are located as identified on the most recent USGS 7.5-minute Danby, MO topographic quadrangle map in Sections 3 and 4, Township 39 North, and Range 7 East. A partial plot of the USGS topographic quadrangle map showing the location of the REC is attached as Figure 2.

2.3 CCR Unit Identification and Purpose

There is one active surface impoundment at the REC, which is called RCPA. The RCPA is currently being closed. Historically the surface impoundment was used to store CCR, water retention, water clarification and alkalinity adjustment prior to discharge through Outfall #002 of NPDES permit number MO-0000043. The CCR stored within the surface impoundment is bottom and fly ash. RCPA is registered with the MDNR Dam and Reservoir Safety Program because the height of the perimeter embankment is greater than 35 feet. The State of Missouri registration permit ID number for the dam is MO-40179.

2.4 CCR Unit Watershed

The REC is located adjacent to the Mississippi River within 100-year floodplain at approximately river mile 139.5 above the mouth of the Ohio River. According to the current Flood Insurance Rate Map (FIRM), the regulatory 100-year flood elevation at the site is el. 405 to 406. The Mississippi River is to the east of the CCR unit. Isle du Bois Creek runs along the south side of the CCR unit. Outfall #002 discharges into the Mississippi River. The total tributary area of the REC is 261 acres. The REC does not receive rainfall run-off from areas outside of the facility.

2.5 Geomorphology and Foundation Geology

The geology at the REC consists of natural alluvium, approximately 110 to 160 feet thick, deposited by the Mississippi River, which is underlain by Paleozoic Era sedimentary rocks of the Ordovician System.

The natural alluvium generally consists of 10 to 30 feet of clays and silts at the ground surface. The upper stratum of clays and silts is underlain by 80 to 130 feet of fine to coarse sand, with intermittent silt and clay lenses. Some gravel is present in the lower part of the sand stratum. Limestone rock exists beneath the alluvium, and the depth to rock generally decreases from east to west.

Groundwater levels at the REC closely follow the stage of the adjacent Mississippi River, but typically range from about el. 365 to 375 (Bechtel, 1971). The Upper Mississippi River System Flow Frequency Study by the St. Louis District USACE (2003) lists 50% and 1.0% flood frequency water surface profiles as el. 388.2 and 404.0 feet, in that order. The 1% flood elevation presented on the current FIRM ranges from about 405.0 to 406.0.

2.6 Surveillance, Maintenance and Repair of the CCR Units

The Rush Island Fly Ash Pond Dam O&M manual outlines objectives, responsibilities, and procedures for Ameren personnel who are responsible for the management of the CCR units. The embankments of the CCR units are visually inspected weekly by Ameren plant operations staff. Ameren Missouri Dam Safety Group personnel perform annual inspections and periodic inspections or assessments with plant operations staff. In addition, the Ameren Missouri Dam Safety Group may conduct unannounced safety inspections. Descriptions of each type of inspection or assessment are included in the following sections. Checklists used during inspection of the CCR Units are included in the attached O&M manual.

2.6.1 Surveillance

2.6.1.1 Weekly Inspections

Weekly inspections are conducted by plant staff or support staff familiar with the pond/dam. The weekly inspections consist of visually inspecting the crest and slopes of each ash pond embankment to identify new or changed conditions. Checklists are completed and are made available to the Dam Safety Group for review.

2.6.1.2 Annual Inspection

These inspections are conducted annually by the plant staff and the Ameren Missouri Dam Safety Group staff. The annual inspection is a detailed visual inspection of the ash pond embankment crest, interior and exterior slopes, downstream toe area, inlet/outlet works, and appurtenant structures.

An inspection report is to be prepared by the Ameren Missouri Dam Safety Group staff that includes a description of the observations of the visual inspection, photographs of the facilities taken during the inspection, and a written evaluation of the results. A record of maintenance activities for the ash pond embankments is also kept current by the Ameren Missouri Dam Safety Group.

2.6.1.3 Periodic Structural Stability Assessments

The Periodic Structural Stability Assessments are conducted every 5 years by the Ameren Missouri Dam Safety Group staff to document whether the design, construction, operation, and maintenance of the CCR unit is consistent with recognized and generally accepted good engineering practices for the maximum volume of CCR and CCR wastewater which can be impounded therein in general accordance with 40 CFR Part §257.73(d)(1).

Ameren Missouri Dam Safety Group staff will prepare a periodic structural stability assessment report which at a minimum will document whether the CCR unit has been designed, constructed, operated, and maintained with:

i. Stable foundations and abutments;
ii. Adequate slope protection to protect against surface erosion, wave action, and adverse effects of sudden drawdown;
iii. Dikes (embankments) mechanically compacted to a density sufficient to withstand the range of loading conditions in the CCR unit;
iv. Vegetated slopes of dikes and surrounding areas not to exceed a height of 6 inches above the slope of the dike, except for slopes which have an alternate form of slope protection;
v. A single spillway or a combination of spillways designed, constructed, operated, and maintained to adequately manage flow during and following the peak discharge from the design flood event. The spillways must be either of non-erodible construction and designed to carry sustained flows; or earth or grass-lined and designed to carry short-term, infrequent flows at non-erosive velocities where sustained flows are not expected;
vi. Hydraulic structures underlying the base of the CCR unit or passing through the dike of the CCR unit that maintain structural integrity and are free of significant deterioration, deformation, distortion, bedding deficiencies, sedimentation, and debris which may negatively affect the operation of the hydraulic structure;
vii. For CCR units with downstream slopes which can be inundated by the pool level of an adjacent water body, such as a river, stream or lake, downstream slopes that maintain structural stability during low pool of the adjacent water body or sudden drawdown of the adjacent water body.

If a deficiency or a release is identified during the periodic assessment, Ameren Missouri will remedy the deficiency or release as soon as feasible and prepare documentation detailing the corrective measures taken.

2.6.1.4 Periodic Hazard Potential Classification

Ameren Missouri Dam Safety Group staff will update the hazard potential classification every 5 years in general accordance with 40 CFR Part §257.73(a)(2). Ameren Missouri Dam Safety Group staff will prepare documentation of the hazard potential classification of each CCR unit as either high hazard potential CCR surface impoundment, a significant hazard potential CCR surface impoundment, or a low hazard potential CCR surface impoundment, and the basis for each hazard potential classification. Ameren Missouri Dam Safety Group staff will prepare and maintain a written Emergency Action Plan if it is determined that a CCR unit is either a high hazard potential surface impoundment or a significant hazard surface impoundment.

2.6.1.5 Periodic Safety Factor Assessment

Ameren Missouri Dam Safety Group staff will conduct periodic safety factor assessments every 5 years in general accordance with 40 CFR Part §257.73(e)(1). The periodic safety factor assessments will be conducted for each CCR unit and will document whether the calculated factors of safety for each CCR unit achieve the minimum safety factors specified in §257.73(e)(1) for the critical cross section of the embankment. The critical cross section is the cross section anticipated to be the most susceptible of all

cross sections to structural failure based on appropriate engineering considerations, including loading conditions. The safety factor assessments will be supported by appropriate engineering calculations.

2.6.1.6 Periodic Inflow Design Flood Control System Plan

Ameren Missouri Dam Safety Group staff will prepare an inflow design flood control system plan every 5 years in general accordance with 40 CFR Part §257.82. The plan will document how the inflow design flood control system has been designed, constructed, operated and maintained to adequately manage flow by definition or regulation into the CCR surface impoundment during and following the peak discharge of the inflow design flood. The inflow design flood is the probable maximum flood for a high hazard potential CCR surface impoundment, the 1000-year flood for a significant hazard potential CCR surface impoundment, the 100-year flood for a low hazard potential CCR surface impoundment, and the 25-year flood for an incised surface impoundment.

2.6.1.7 Special Inspections

Special inspections are conducted when extreme events which may impact stability (seismic activity, severe flooding, etc.) occur. Special inspections are similar to the annual inspection but may be focused on a particular area. If conditions are discovered during a weekly or annual inspection which create concern for the REC plant, personnel, or surrounding properties, a special inspection will be conducted. Responsibility for performance of special inspections will be evaluated based on the severity of the event and potential damage.

2.6.1.8 Unannounced Inspections

The Ameren Missouri Chief Dam Safety Engineer (CDSE) may conduct unannounced inspections at the site as deemed appropriate. The inspection may include a visual inspection of the facility, a review of the inspection documentation, and interviews with plant personnel to review their understanding of the required inspection procedures.

2.6.1.9 Inspection Findings

Observations made during the inspections are rated with a condition code as shown in the following Table 1. The timeliness of response to deficiencies observed depends on the severity of the condition.

Table 1 - Ameren Missouri dam safety inspection condition codes

Condition Code	Description
EC	Emergency Condition. A serious dam safety condition exists that need immediate action. Emergency measures implemented as instructed by Chief Dam Safety Engineer; pool draw down, emergency repairs, work stoppage, plant stoppage.
IM	Item needing immediate maintenance to restore or ensure its safety and integrity. Remediation should be complete within 1 month or as required.

Condition Code	Description
MM	Minor Maintenance. Item needing minor maintenance and/or repairs within the year. The safety or integrity of the item is not yet imperiled.
OB	Condition requires regular observation and potential future minor maintenance.
GC	Good Condition.
NO	No observation possible.
NI	Not Inspected. State reason in comment column.

2.6.2 Maintenance and Repair of the CCR Units

The O&M requires that timely repairs must be made after problem areas are identified. The plant engineer is to specify the work to be completed using Ameren's Work Control Process and provide direction to correct items noted in the operation and maintenance, and engineering inspections. The work request by the plant engineer will be reviewed with the Dam Safety Group to ensure proper emphasis has been placed on the request. The O&M specifies the minimum maintenance activities and requires that maintenance activities be documented. The O&M further specifies that no alterations or repairs to structural elements should be made without the approval of the Chief Dam Safety Engineer and the concurrence of the MDNR Water Resources Center.

3.0 RCPA

3.1 History of Construction

RCPA was brought online in 1976. The pond is commonly referred to as the "Ash Pond". An aerial map of the impoundment showing the embankment centerline, perimeter ditch, and spillway locations is presented in Figure 1. The RCPA no longer receives CCRs, has been dewatered and is currently being closed.

As-built drawings for the impoundment prior to closure are presented in the O&M manual in Appendix A. RCPA consists of a ring dam impounding an area of approximately 114 acres. The impounded area was divided by an internal berm constructed of CCR. The area to the north of the berm was used for CCR sedimentation and disposal, and an area to the south of the berm, known as the "polish pond", was used for final sedimentation and water detention. The portion used for disposal has an area of approximately 85 acres, and the polish pond has an area of approximately 29 acres. The disposal area received process water for bottom ash and fly ash deposition. Bottom ash was sluiced to the pond, and nearly all of the bottom ash was beneficially used. Fly ash was sluiced and pneumatically transported to the pond. Fly ash that was pneumatically transported was wetted at the point of discharge and flows into long narrow trenches. These trenches were periodically excavated and the fly ash is stockpiled on site within the impoundment.

Historically flow from the disposal area was routed to the polish pond through a ditch running along the west side of the impoundment. This ditch also receives stormwater runoff from the plant area and coal pile. The principal spillway for the RCPA was located in the polish pond and consisted of a 24-inch diameter HDPE pipe that was upturned to an elevation of 388 feet on the upstream end. A check valve was installed on the downstream end and the invert elevation is approximately 372.5 feet. Flow through this pipe and the pool elevation was regulated by two motor operated butterfly valves. The valves were operated in the field. The RCPA also contained an emergency spillway which was located along the west side ditch in the disposal area. The emergency spillway was a 75-foot-wide broad crested weir with an invert elevation of 407.2 feet. Both spillways were removed or abandoned in place as part of closure.

A summary of pertinent data for the RCPA is summarized in Table 2.

Table 2 – RCPA

CCR Unit	Maximum Pond Area (acres)	Maximum Dam Height (feet)	Minimum Crest Width (feet)	Crest Length (feet)	Upstream Slope Steepness (H:V)	Downstream Slope Steepness (H:V)
RCPA	114	46.0	14	9,750	3:1	3:1

3.2 Modifications to Embankment Geometry and Operation

3.2.1 1991 Ash Pond Discharge, Piping & Sampling Modifications

The original plans for the principal spillway show two, 36-inch diameter CMP conduits. As-built plans dated 1991 show that the northern most conduit was slip-lined with a 24-inch diameter HDPE pipe, and new butterfly valves, duckbill valve, concrete headwall and anchor pad, and grouted riprap were installed. Ameren reports that the southern conduit was abandoned and grouted closed.

3.2.2 Interior Berm Construction

In the period from 1999 to 2002, the interior berm was constructed. The berm runs east and west and divides the RCPA into two areas. The north side is used for primarily for settlement and ash disposal, and the south side for water detention and secondary settlement. The interior berm was constructed from compacted bottom ash. Initially, at least part of the runoff from the north side of the pond was through a small gravity-controlled sluice gate structure and 24-inch conduit. However, this structure and conduit are no longer used, and flow is conveyed to the polish pond through an interior ditch on the west side of the impoundment.

3.2.3 2008 Monopole Construction

In 2007 and 2008 a transmission line was constructed to serve the new Holcim cement plant just south of the impoundment. Some of the transmission line towers are just upstream and adjacent to the embankment dam on the west side of the impoundment. The transmission line consists of monopole towers with drilled pier foundations. The bottoms of the tower foundations are at least 45 feet below the top of the dam, and these are judged to have no effect on its stability.

3.2.3 2010 Riprap Placement and Emergency Spillway Construction

In 2010 riprap was installed on portions of the upstream and downstream slopes to repair existing erosion features and help prevent future erosion from occurring. Approximately 180 lineal feet of riprap was installed on the downstream slopes and 1,300 lineal feet on the upstream slopes. Riprap was also installed to armor the banks of the outlet channel. At the same time an emergency spillway was constructed near the northwest corner of the impoundment. The emergency spillway is a 75-foot-wide broad crested weir. Portions of the upstream and downstream slopes adjacent to the spillway are armored with riprap.

3.2.4 2010 MDNR Permit Registration

The RCPA was permitted as a Class III Industrial Water Retention Dam by MDNR in 2010. The report Missouri Dam Safety Permit Application was prepared by Reitz & Jens, Inc. and is an attachment to the O&M manual in Appendix A. The surface impoundment was inspected in 2015 by the MDNR Dam and Reservoir Safety Program and the operating permit was extended for 5 years to 2020.

3.2.5 2013 Isle du Bois Creek Bank Erosion Repairs

On January 31, 2013 significant bank erosion occurred along Isle du Bois Creek near it's confluence with the Mississippi River. At the time of the erosion there was high flow on Isle du Bois Creek and the

Mississippi River was at a low river stage. Bank erosion occurred on an outside bend in the creek just before the confluence, which encroached upon the south side of the RCPA embankment and caused sloughing of the downstream slope. The USACE armored the location with riprap in 2006. Ameren rebuilt the eroded section by first constructing a riprap dike to prevent further erosion, and then placing compacted soil fill behind the dike. As-built plans of the repairs are shown in Figure 3 to 5.

3.2.6 2015 Slope Rehabilitation

An inspection in early 2015 identified erosion features and a small shallow slide on the east embankment slope. Approximately 1,500 lineal feet of the east embankment downstream slope was graded so that the slope was uniformly 3H to 1V and armored with riprap. The extents of the shallow slide were excavated, and the slope rebuilt with fill compacted in lifts. In addition, woody vegetation was cleared on the west side of the embankment. Details of the 2015 rehabilitation work are shown in Figures 6 to 8.

3.2.7 2015 Slurry Wall and Operational Changes

To address seepage occurring at the toe of the downstream slope on the east side of the pond, in 2015 Ameren constructed a slurry wall approximately 1,300 feet long and 30 feet deep. The wall started approximately 75 feet north of the double swing gate and continued south. Piezometric monitoring of groundwater levels inside the pond identified elevated levels near the "wetting head". The wetting head is used to condition fly ash that is pneumatically transported to the impoundment. The wetting head was subsequently moved further towards the inside of the pond. The approximate extents of the slurry wall are shown in Figure 9.

3.2.8 Closure Construction (2019 to 2021)

Closure of RCPA was initiated in 2019 and is planned to be complete in 2021. Closure includes grading the remaining exposed CCR to facilitate drainage and capping the CCR with Closure Turf. The principal and emergency spillways have been abandoned or removed. Stormwater is routed to 9 stormwater outlets through the perimeter embankment.

3.3 Foundation and Abutment Geology

The natural surface elevation of the site prior to construction of the impoundment varied from about el. 380 to 388 feet. The foundation of the embankment ring dam is generally on alluvial clays and silts at the natural ground surface. The interior of the pond was excavated to create storage and obtain fill to raise the plant site and construct the embankment dam. The original design plans call for the bottom of the pond at el. 330 feet. Draft borings for a geotechnical investigation report for a proposed landfill indicate that the bottom of the pond may have been dredged as deep as el. 320.

The foundation soils generally consist of an upper stratum of clays and silts 10 to 30 feet thick underlain by fine to coarse sand about 80 to 120 feet thick (Bechtel, 1971). Some gravel exists in the lower part of the sand stratum. Silt and clay lenses are also present in the sand formation. Limestone rock exists beneath the alluvium, and the depth to rock generally decreases from east to west.

Geotechnical investigations which document the foundation geology at the RCPA are presented in Appendix A.

3.4 Embankment Material

There are no construction documents or records for the RCPA ring dam. The embankment fill was constructed of the less permeable material excavated from the interior of the impoundment. Borings through the embankment were conducted in 2010 and are presented in Appendix A. The embankment fill generally consists of clays and silts with varying amounts of sand. The dry density of the embankment fill ranged from 88.8 to 104.1 pcf, with an average dry density of about 95.2 pcf. The undrained shear strength (s_u) of the fill typically ranges from about 800 to 1600 psf.

3.4.1 Liner Design Criteria

An owner/operator of an existing surface impoundment must document whether such unit was constructed with a liner meeting the requirements of 40 CFR §257.71. The RCPA was not constructed with a liner and is considered to be an existing unlined CCR surface impoundment.

3.5 Operating Pool Surface Elevations

The RCPA has been dewatered and is currently being closed.

3.6 CCR Unit Outlet Works

During closure construction the principal spillway was grouted closed and the emergency spillway was removed. Rainfall falling within the footprint of the RCPA is routed over closure turf to 9 different stormwater outlets located around the perimeter embankment.

3.7 Impounded CCR

RCPA impounds bottom and fly ash. Table 3 summarizes the estimated volume and depth of the CCR stored in the unit.

Table 3 - RCPA approximate volume and depth of impounded CCR

CCR Unit	Est. Volume of CCR (CY)	Approximate Bottom Elev. of CCR Unit (feet)	Est. Maximum CCR Elev. (feet)	Est. Average Depth of CCR (feet)	Est. Maximum Depth of CCR (feet)
RCPA	12,964,032	320	414	70	92

The dry fly ash from the REC is very pozzolanic and self-hardening. Mixtures of the fly ash with moisture contents of up to 70% harden within 30 minutes. The unconfined compressive strength of molded fly ash at moisture contents of 15 to 20% was about 3200 pounds per square inch (psi), which is similar to Portland cement concrete.

In-situ test results from twelve seismic cone penetration tests and five flat plate dilatometer tests conducted through the impounded CCR in 2014 are presented in Appendix A (ConeTec, 2014).

The bottom ash from REC is comparable to cohesionless, well-graded sand with some fine gravel and little fines. The dry unit weight of compacted bottom ash in the field would be on the order of 81.5 to 84.3 pcf.

3.8 Instrumentation

The staff gage used for monitoring the RCPA pool level has been removed. The RCPA has been dewatered and is currently being closed.

Piezometers and monitoring wells have been installed upstream and downstream of the embankment for water level monitoring and groundwater sampling. Bi-monthly piezometer readings from March 10, 2016 to May 19, 2020 were provided by Ameren. The water level readings are maintained in Ameren's facility operating records.

3.9 Structural Instability

As described in section 3.2.5, there was significant bank erosion along Isle du Bois Creek on January 31, 2013. At the time of the erosion there was high flow on Isle du Bois Creek and the Mississippi River was at a low river stage. Bank erosion occurred on an outside bend in the creek just before the confluence, which encroached upon the south side of the RCPA embankment and caused sloughing of the downstream slope. Subsequently, Ameren rebuilt the section by constructing a rock wedge and placing compacted fill. As-built plans of the repairs are shown in Figure 3 to 5.

4.0 PERIODIC HAZARD POTENTIAL CLASSIFICATION

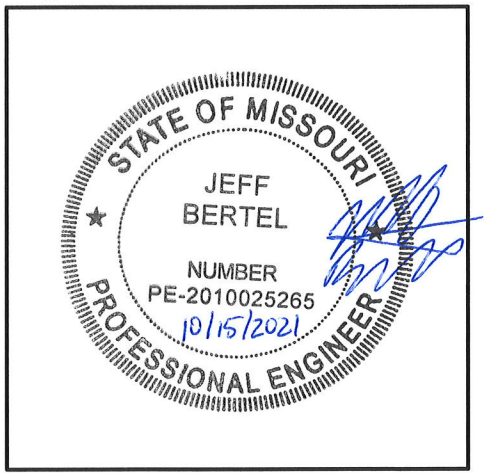
40 CFR Part 257
Periodic Hazard Potential Classification Assessments for CCR Surface Impoundments
§257.83(a)(2)

The 2020 Periodic Hazard Potential Classification Assessment was conducted for active CCR surface impoundment RCPA at the Rush Island Energy Center. The CCR surface impoundment is low hazard potential because failure of the impoundment is not expected to cause a loss of human life, and the environmental impacts losses are expected to be low. Economic and lifeline losses are generally limited to the owner. The hazard potential classification was completed in general accordance with *Federal Guidelines for Dam Safety: Hazard Potential Classification for Dams* by the Federal Emergency Management Agency (January 2004).

CCR Unit	Hazard Potential Classification
RCPA	Low

Refer to Appendix B for the 2020 Periodic Hazard Potential Classification report. The first subsequent assessment of the hazard potential must be conducted within 5 years of this initial assessment.

Engineer's Seal



Jeff Bertel, P.E.
License: PE-2010025265
Date: October 15, 2021

5.0 PERIODIC STRUCTURAL STABILITY ASSESSMENT

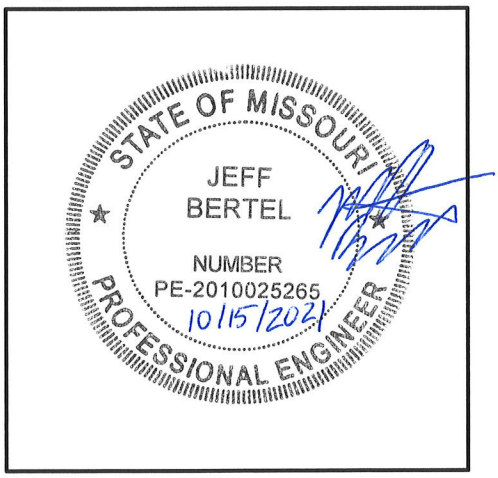
40 CFR Part 257
Periodic Structural Stability Assessment for CCR Surface Impoundments §257.73(d)(1)

The 2020 Periodic Structural Stability Assessment was conducted for the active CCR surface impoundment RCPA at the Rush Island Energy Center. The structural stability assessment was completed in general accordance with 40 CFR Part §257.73(d)(1). Assessment of the Unit found no structural stability deficiencies, no significant issues with the current operations and maintenance, and that the design and construction are adequate, however some corrective measures were recommended.

Requirement	RCPA
Initial periodic assessment was completed in general accordance with the requirements of 40 CFR Part §257.73(d)(1)	Yes

Refer to Appendix C for the 2020 Periodic Structural Stability Assessment report. The first subsequent Periodic Structural Stability Assessment must be conducted within 5 years of this initial assessment.

Engineer's Seal



Jeff Bertel, P.E.
License: PE-2010025265
Date: October 15, 2021

6.0 PERIODIC SAFETY FACTOR ASSESSMENT

40 CFR Part 257
Periodic Safety Factor Assessment for CCR Surface Impoundments §257.73(e)(1)

The initial periodic safety factor assessment for RCPA were completed in October 2016. RCPA has been dewatered and is currently being closed. Haley & Aldrich, Inc. completed analyses of RCPA for the closed condition. Haley & Aldrich's report is included in Appendix D. The initial periodic safety factor assessment was completed by Reitz & Jens, and is also included in Appendix D.

7.0 HYDROLOGIC AND HYDRAULIC CAPACITY REQUIREMENTS

40 CFR Part 257
Initial Hydrologic and Hydraulic Capacity Requirements for CCR Surface Impoundment §257.82

The initial inflow design flood control system plan was completed for the active CCR surface impoundment RCPA at the Rush Island Energy Center in 2016. RCPA has been dewatered and is currently being closed. Stormwater falling within the footprint of these impoundments is actively managed by the closure contractor to prevent overtopping of the perimeter embankment. During closure construction the principal spillway was grouted closed, and the emergency spillway was removed. Rainfall falling within the footprint of the RCPA is routed over closure turf to 9 different stormwater outlets located around the perimeter embankment.

8.0 CLOSURE

The preceding history of construction is regarded as a living document. If there is a significant change to any information or are periodic updates, Ameren must update the relevant information and place it in the facility's operating record.

9.0 REFERENCES

Ameren Missouri. (2010). "Operation and Maintenance Manual; Rush Island Fly Ash Pond Dam, Festus, Missouri, Jefferson County, ID No. MO 40179." Dam Safety and Hydro Engineering, St. Louis, Missouri.

Bechtel (1971). "Soil and Foundation Investigation, Rush Island Plant, Union Electric Company, St. Louis, Missouri." Volume 1. McClelland Engineers.

ConeTec (2014). "ConeTec Field Report, Presentation of In Situ Test Results for: Rush Island, Festus, Missouri." Haley & Aldrich.

Environmental Protection Agency. (2015). "Hazardous and Solid Waste Management System; Disposal of Coal Combustion Residuals From Electric Utilities; Final Rule." 40 CFR Parts 257 and 261., Vol. 80, No. 74.

USACE St. Louis District. (2003). "Upper Mississippi River System Flow Frequency Study Hydrology & Hydraulics." Appendix D.



Legend

Embankment

Spillway

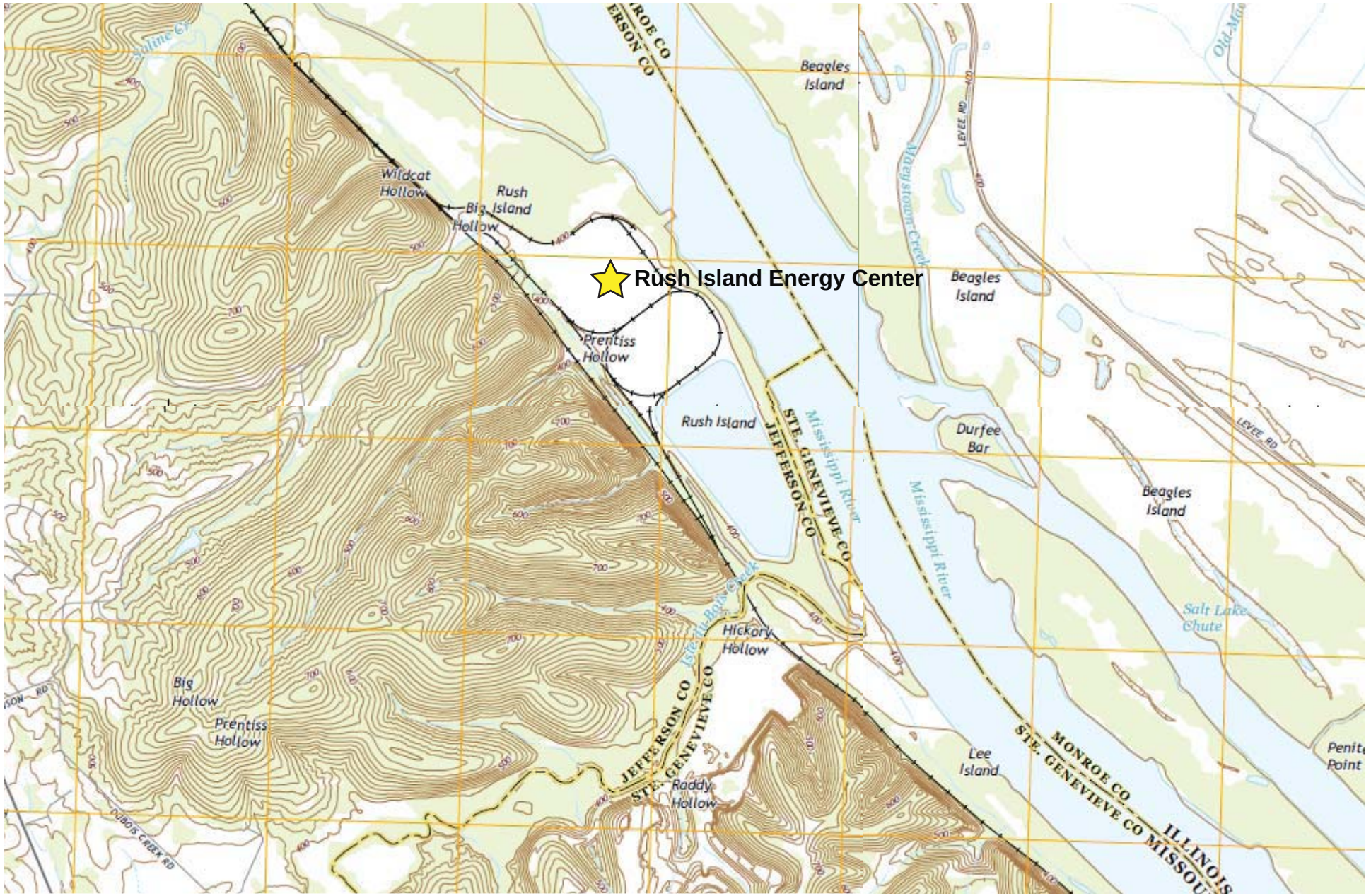
N

0 250 500 Feet

AMEREN MISSOURI
RUSH ISLAND ENERGY CENTER
ACTIVE CCR SURFACE IMPOUNDMENTS
FIGURE 1

Ameren MISSOURI

REITZ & JENS, INC. CONSULTING ENGINEERS



Ameren Missouri
Rush Island Energy Center
CCR Unit Evaluation
USGS 7.5 minute quadrangle map

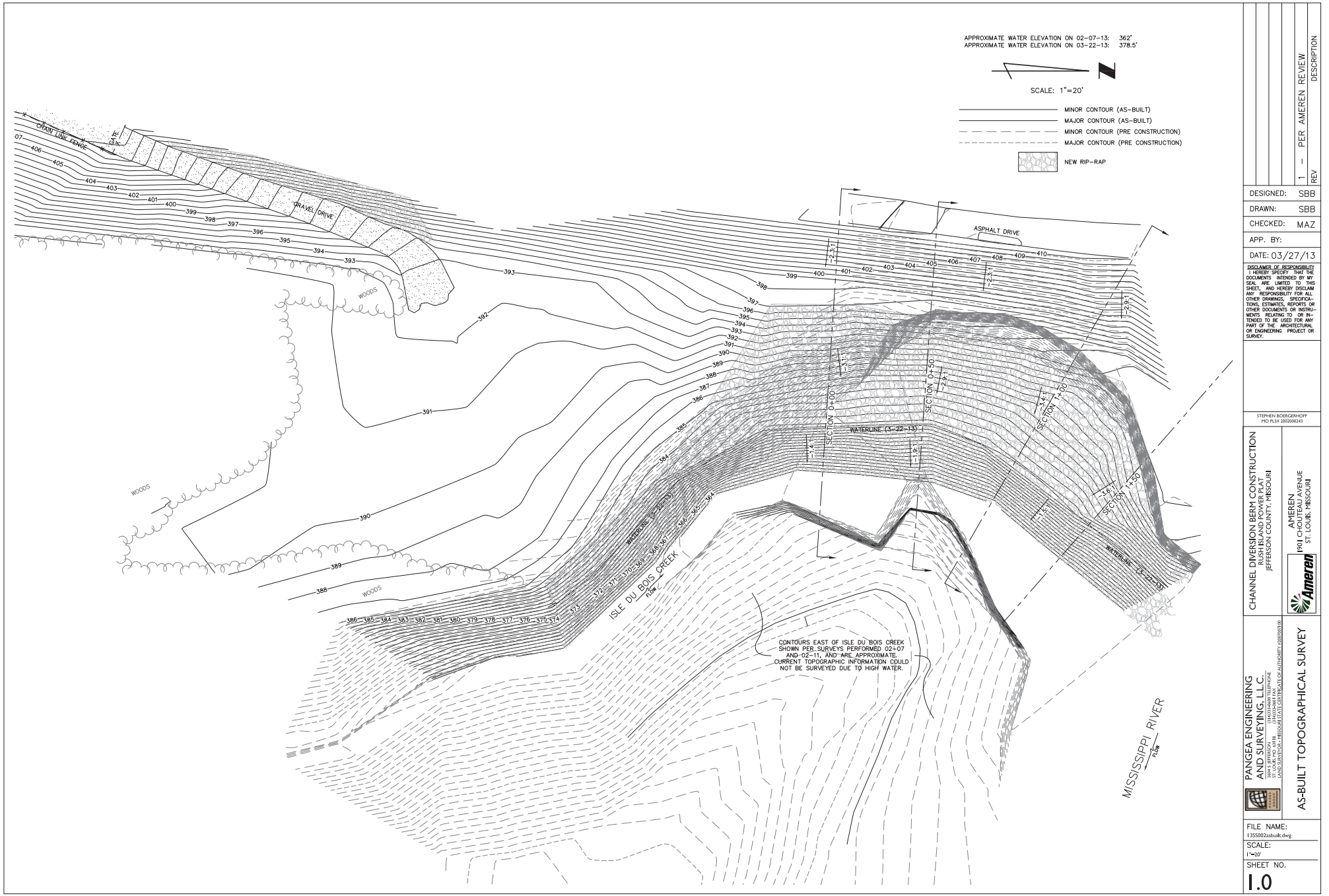
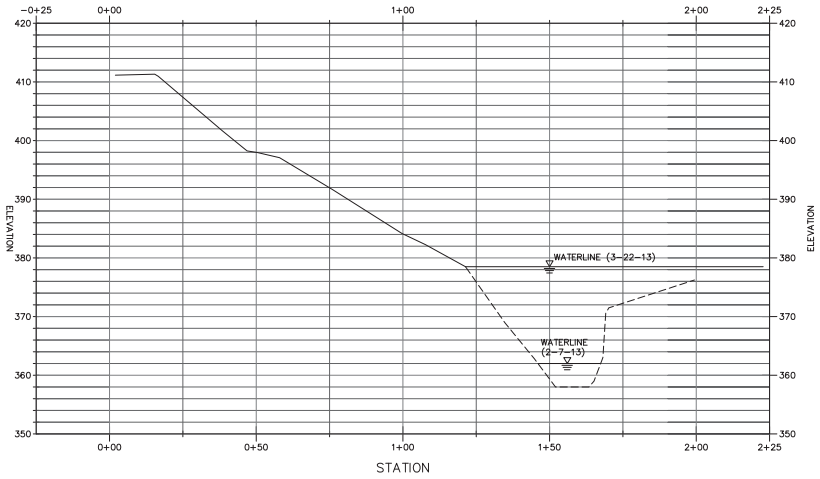
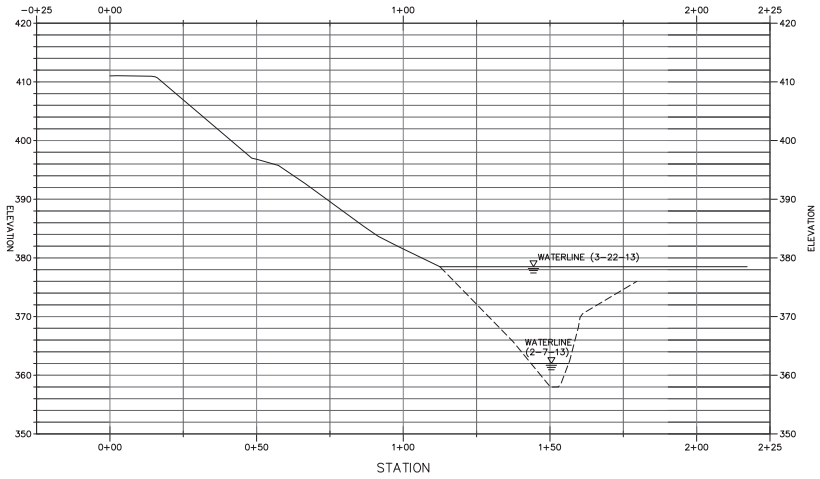

APPROXIMATE WATER ELEVATION ON 02-07-13: 362'
APPROXIMATE WATER ELEVATION ON 03-22-13: 378.5'
SCALE: 1"=20'
MINOR CONTOUR (AS-BUILT)
MAJOR CONTOUR (AS-BUILT)
MINOR CONTOUR (PRE CONSTRUCTION)
MAJOR CONTOUR (PRE CONSTRUCTION)
NEW RIP-RAP
CHAIN LINK FENCE
GATE
GRAVEL DRIVE
ASPHALT DRIVE
WOODS
WATERLINE (3-22-13)
SECTION 0+00
SECTION 0+50
SECTION 1+00
SECTION 1+50
ISLE DU BOIS CREEK
FLOW
CONTOURS EAST OF ISLE DU BOIS CREEK SHOWN PER SURVEYS PERFORMED 02-07 AND 02-11, AND ARE APPROXIMATE. CURRENT TOPOGRAPHIC INFORMATION COULD NOT BE SURVEYED DUE TO HIGH WATER.
MISSISSIPPI RIVER
FLOW
1 - PER AMEREN REVIEW
REV
DESCRIPTION
DESIGNED: SBB
DRAWN: SBB
CHECKED: MAZ
APP. BY:
DATE: 03/27/13
DISCLAIMER OF RESPONSIBILITY
I HEREBY SPECIFY THAT THE DOCUMENTS INTENDED BY MY SEAL ARE LIMITED TO THIS SHEET, AND HEREBY DISCLAIM ANY RESPONSIBILITY FOR ALL OTHER DRAWINGS, SPECIFICATIONS, ESTIMATES, REPORTS OR OTHER DOCUMENTS OR INSTRUMENTS RELATING TO OR INTENDED TO BE USED FOR ANY PART OF THE ARCHITECTURAL OR ENGINEERING PROJECT OR SURVEY.
STEPHEN BOERGERHOFF
MO PLS# 2002000243
CHANNEL DIVERSION BERM CONSTRUCTION
RUSH ISLAND POWER PLAT
JEFFERSON COUNTY, MISSOURI
AMEREN
1901 CHOUTEAU AVENUE
ST. LOUIS, MISSOURI
Ameren
PANGEA ENGINEERING AND SURVEYING, L.L.C.
2604 S. JEFFERSON
ST. LOUIS, MO 63118
(314)333-4600 TELEPHONE
(314)333-4601 FAX
LAND SURVEYOR - MISSOURI STATE CERTIFICATE OF AUTHORITY #2002000100
AS-BUILT TOPOGRAPHICAL SURVEY
FILE NAME:
13SS002asbuilt.dwg
SCALE:
1"=20'
SHEET NO.
1.0

Figure 3

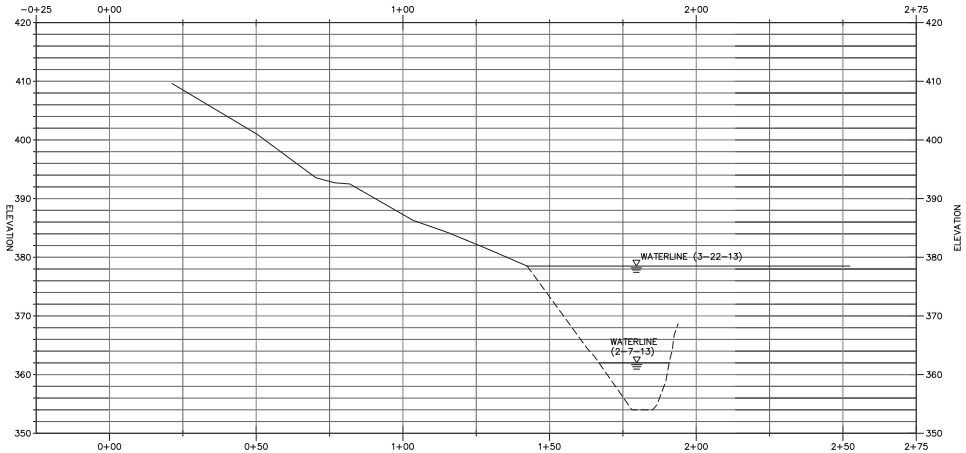
SECTION 0+00



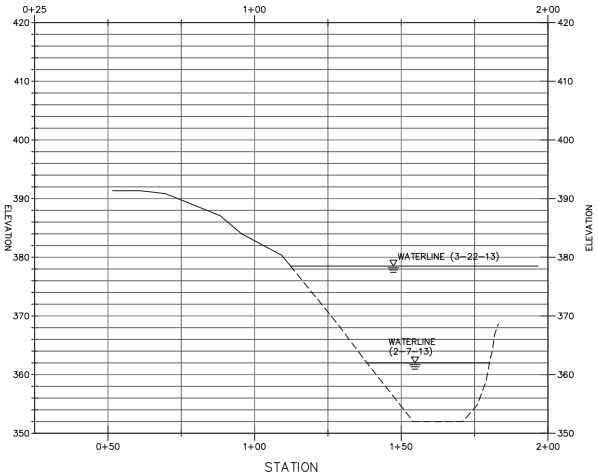
SECTION 0+50



SECTION 1+00



SECTION 1+50



REV	DESCRIPTION
1	PER AMEREN REVIEW

DESIGNED: SBB
DRAWN: SBB
CHECKED: MAZ
APP. BY:
DATE: 03/27/13

DISCLAIMER OF RESPONSIBILITY
I HEREBY SPECIFY THAT THE DOCUMENTS INTENDED BY MY SEAL ARE LIMITED TO THIS SHEET, AND HEREBY DISCLAIM ANY RESPONSIBILITY FOR ALL OTHER DRAWINGS, SPECIFICATIONS, ESTIMATES, REPORTS OR OTHER DOCUMENTS OR INSTRUMENTS RELATING TO OR INTENDED TO BE USED FOR ANY PART OF THE ARCHITECTURAL OR ENGINEERING PROJECT OR SURVEY.

STEPHEN BOERGERHOFF
MO PLS# 2002000243

CHANNEL DIVERSION BERM CONSTRUCTION
RUSH ISLAND POWER PLAT
JEFFERSON COUNTY, MISSOURI

AMEREN
1901 CHOUTEAU AVENUE
ST. LOUIS, MISSOURI

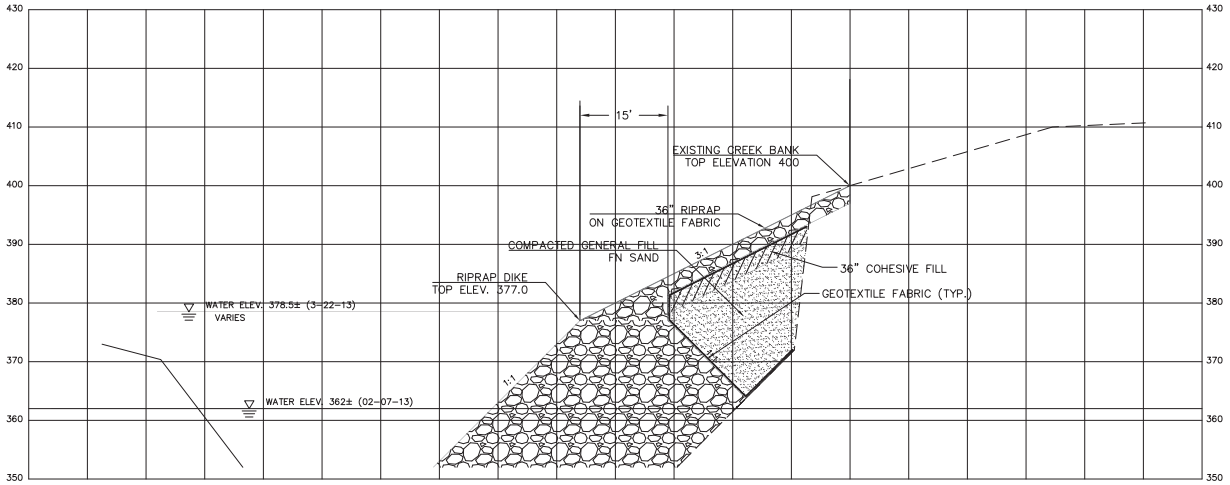
PANGEA ENGINEERING AND SURVEYING, L.L.C.
2404 S. JEFFERSON
ST. LOUIS, MO 63118
(314)333-4600 TELEPHONE
(314)333-4601 FAX
LAND SURVEYOR - MISSOURI STATE CERTIFICATE OF AUTHORITY #2002002100

AS-BUILT CROSS SECTIONS

FILE NAME: 13SS002asbuilt.dwg
SCALE: 1"=10'
SHEET NO. 2.0

Figure 4

TYIPICAL SECTION DETAIL



REV	DESCRIPTION
1	PER AMEREN REVIEW

DESIGNED: SBB
DRAWN: SBB
CHECKED: MAZ
APP. BY:
DATE: 03/27/13

DISCLAIMER OF RESPONSIBILITY
I HEREBY SPECIFY THAT THE DOCUMENTS INTENDED BY MY SEAL ARE LIMITED TO THIS SHEET, AND HEREBY DISCLAIM ANY RESPONSIBILITY FOR ALL OTHER DRAWINGS, SPECIFICATIONS, ESTIMATES, REPORTS OR OTHER DOCUMENTS OR INSTRUMENTS RELATING TO OR INTENDED TO BE USED FOR ANY PART OF THE ARCHITECTURAL OR ENGINEERING PROJECT OR SURVEY.

STEPHEN BOERGERHOFF
MO PLS# 2002000243

CHANNEL DIVERSION BERM CONSTRUCTION
RUSH ISLAND POWER PLAT
JEFFERSON COUNTY, MISSOURI

AMEREN
1901 CHOUTEAU AVENUE
ST. LOUIS, MISSOURI

PANGEA ENGINEERING AND SURVEYING, L.L.C.
2604 S. JEFFERSON
ST. LOUIS, MO 63118
(314)333-0600 TELEPHONE
(314)333-0601 FAX
LAND SURVEYOR - MISSOURI STATE CERTIFICATE OF AUTHORITY #2002007100

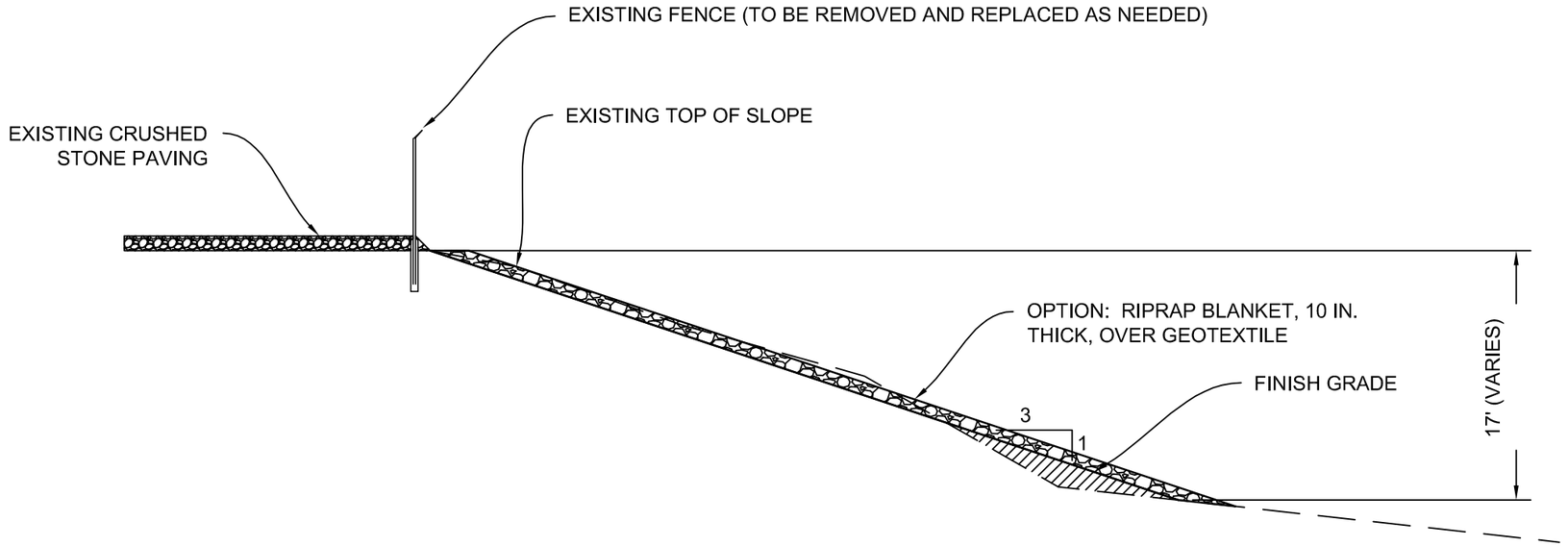
TYPICAL CROSS SECTION DETAIL

FILE NAME: 13SS002asbuilt.dwg
SCALE: N.T.S.
SHEET NO. 3.0

Figure 5

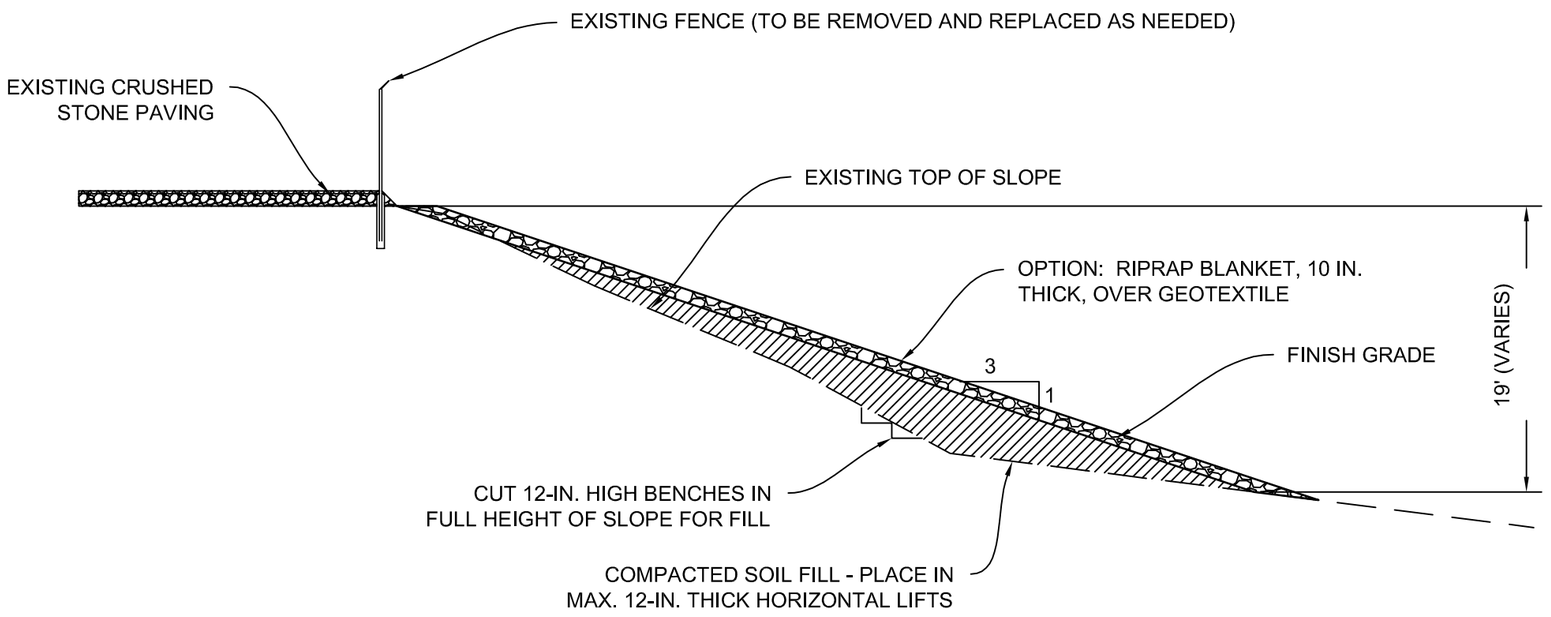

Section A
Use *Slide Repair Section* details for construction, as noted on pages 2 and 4 of *Ameren Missouri Rush Island Energy Center Ash Pond Bank Modification, Reitz & Jens* drawing. This area extends for approximately 300 feet or 150 feet north and south of section shown herein.
A
B
1400 feet
Section B
Use *Typical Slope Modification Section – With Fill* details for construction, as noted on pages 1 and 3 of *Ameren Missouri Rush Island Energy Center Ash Pond Bank Modification, Reitz & Jens* drawing. This area extends for approximately 300 feet or 150 feet north and south of section shown herein.
100 feet
Balance of work
Use *Typical Slope Modification Section – Cut* and *–Cut (Alternate)* details for construction, as noted on pages 1 and 3 of *Ameren Missouri Rush Island Energy Center Ash Pond Bank Modification, Reitz & Jens* drawing. This applies to areas outside Sections A and B, within the remaining length for the 1500 feet of embankment to be addressed.
Removal of woody vegetation
Remove all woody vegetation from the embankment to expose the toe, leaving a minimum 30' buffer between the adjacent creek bank and the edge of the woody growth. Growth west of the toe can be left undisturbed.
2300 feet

Figure 6



TYPICAL SLOPE MODIFICATION SECTION - CUT

SCALE: 1 IN. = 10 FEET



TYPICAL SLOPE MODIFICATION SECTION - WITH FILL

SCALE: 1 IN. = 10 FEET

NOTES:

1. CHAIN-LINK FENCE REMOVAL AND REPLACEMENT SHALL COMPLY WITH AMEREN STAND. SPEC. SEC. 02831 AND SHALL BE THE SAME DIMENSIONS AND CONSTRUCTION AS THE EXISTING FENCE.
2. SOIL FILL PLACEMENT AND COMPACTION SHALL COMPLY WITH AMEREN STAND. SPEC. SEC. 02200, SHALL BE CLASSIFIED (ASTM) AS ML, SM, CL, SC, OR GC, AND MINIMUM DRY UNIT WGT. SHALL BE 95% OF THE MAX. DRY UNIT WEIGHT PER ASTM D698 STANDARD PROCTOR TEST.
3. OPTION: RIPRAP BLANKET SHALL BE MoDOT SEC. 609.60, TYPE 2, WITH PREDOMINANT ROCK SIZE OF 6 IN., MAX. ROCK SIZE OF 10 IN., WITH NO MORE THAN 15% LESS THAN 3 IN.
4. RIPRAP IF SELECTED BY AMEREN SHALL BE UNDERLAIN BY A GEOTEXTILE WHICH SHALL BE NEEDLE-PUNCHED NON-WOVEN POLYPROPYLENE FIBERS WITH GRAB TENSILE STRENGTH (ASTM D4632) OF 300 LBS. OR MORE AT 50% ELONGATION, TRAPEZOID TEAR STRENGTH OF 115 LBS. OR MORE, PUNCTURE STRENGTH (ASTM D4833) OF 175 LBS, UV RESISTANCE (ASTM D4355) OF 70% STRENGTH AFTER 500 HRS.
5. UNSUITABLE EXCAVATED MATERIAL SHALL BE STOCKPILED IN AN AREA DESIGNATED BY AMEREN.
6. EXCAVATED MATERIAL WHICH IS SUITABLE FOR FILL MAY BE STOCKPILED AND USED IN EMBANKMENT REPAIRS.

BEFORE YOU DIG – DRILL – BLAST
1-800-344-7483
(TOLL FREE)
MISSOURI ONE CALL SYSTEM, INC.

REITZ & JENS, INC.
CONSULTING ENGINEERS
1055 Corporate Square Drive
St. Louis, Missouri 63132
314.993.4132

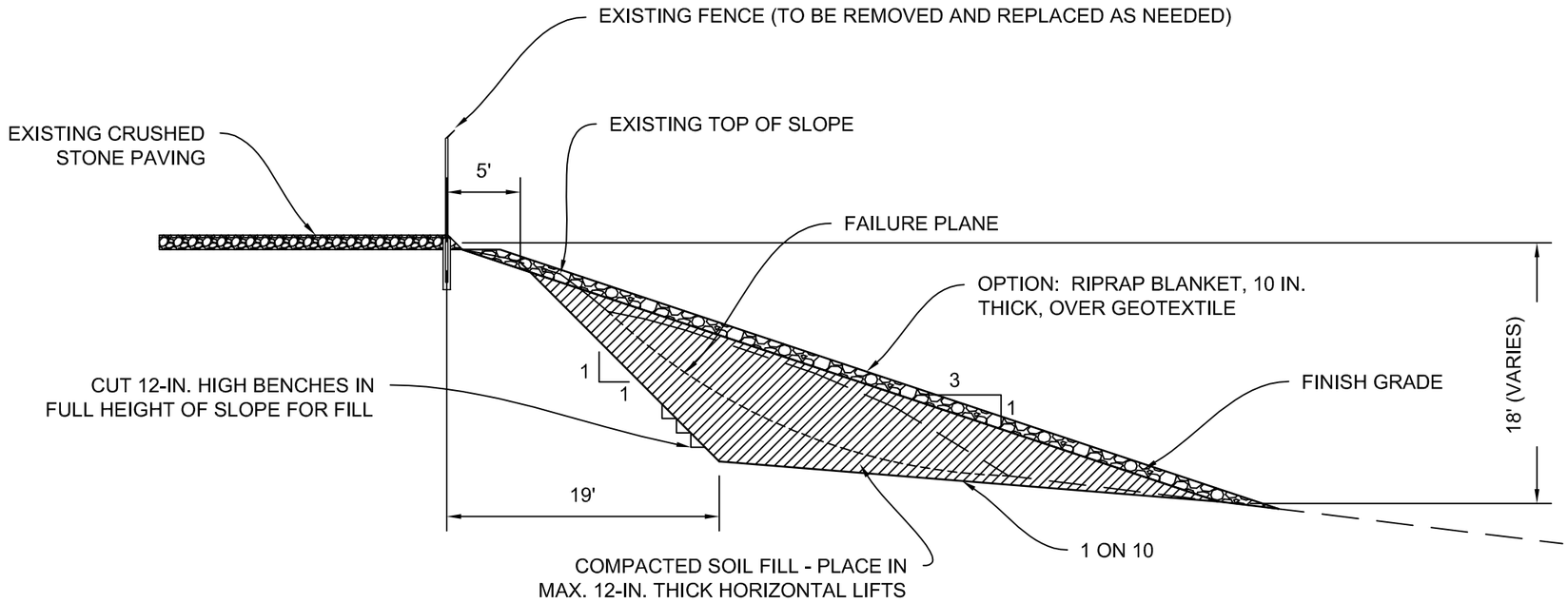
Designed J. Bertel
Checked J. Fouse
Drawn J. Bertel
Issued 5/27/15

AMEREN MISSOURI
3700 S. Lindbergh Blvd.
St. Louis, Missouri 63127

Ameren Missouri Rush Island Energy Center
Ash Pond Slope Modification,
Typical Slope Modification Sections

SHEET 1 OF 4

Figure 7



SLIDE REPAIR SECTION

SCALE: 1 IN. = 10 FEET

NOTES:

1. CHAIN-LINK FENCE REMOVAL AND REPLACEMENT SHALL COMPLY WITH AMEREN STAND. SPEC. SEC. 02831 AND SHALL BE THE SAME DIMENSIONS AND CONSTRUCTION AS THE EXISTING FENCE.
2. SOIL FILL PLACEMENT AND COMPACTION SHALL COMPLY WITH AMEREN STAND. SPEC. SEC. 02200, SHALL BE CLASSIFIED (ASTM) AS SP, SM, CL, SC, OR GC, AND MINIMUM DRY UNIT WGT. SHALL BE 95% OF THE MAX. DRY UNIT WEIGHT PER ASTM D698 STANDARD PROCTOR TEST.
3. OPTION: RIPRAP BLANKET SHALL BE MoDOT SEC. 609.60, TYPE 2, WITH PREDOMINANT ROCK SIZE OF 6 IN., MAX. ROCK SIZE OF 10 IN., WITH NO MORE THAN 15% LESS THAN 3 IN.
4. RIPRAP IF SELECTED BY AMEREN SHALL BE UNDERLAIN BY A GEOTEXTILE WHICH SHALL BE NEEDLE-PUNCHED NON-WOVEN POLYPROPYLENE FIBERS WITH GRAB TENSILE STRENGTH (ASTM D4632) OF 300 LBS. OR MORE AT 50% ELONGATION, TRAPEZOID TEAR STRENGTH OF 115 LBS. OR MORE, PUNCTURE STRENGTH (ASTM D4833) OF 175 LBS, UV RESISTANCE (ASTM D4355) OF 70% STRENGTH AFTER 500 HRS.
5. THE MATERIAL IN THE SLIDE AREA SHALL BE EXCAVATED TO THE MINIMUM DEPTHS AS SHOWN.
6. UNSUITABLE EXCAVATED MATERIAL SHALL BE STOCKPILED IN AN AREA DESIGNATED BY AMEREN.
7. EXCAVATED MATERIAL WHICH IS SUITABLE FOR FILL MAY BE STOCKPILED AND USED IN EMBANKMENT REPAIRS.

BEFORE YOU DIG – DRILL – BLAST
1-800-344-7483
(TOLL FREE)
MISSOURI ONE CALL SYSTEM, INC.

REITZ & JENS, INC.
CONSULTING ENGINEERS
1055 Corporate Square Drive
St. Louis, Missouri 63132
314.993.4132

Designed J. Bertel
Checked J. Fouse
Drawn J. Bertel
Issued 5/27/15

AMEREN MISSOURI
3700 S. Lindbergh Blvd.
St. Louis, Missouri 63127

Ameren Missouri Rush Island Energy Center
Ash Pond Bank Modification,
Slide Repair Section

Figure 8


~500 Feet
1300 + 30 Feet on each end
B1
~1200 Feet
Spoils and staging area
~1400 Feet
Area between the redlines will be inaccessible during the project to all but slurry wall vendor. There may be exceptions but will have to be coordinated in advance within weekly construction meetings.
Area A
Area B

Figure 9

APPENDIX A

RCPA OPERATIONS AND MAINTENANCE MANUAL
BECHTEL 1971 BORING LOGS
2010 RCPA OPERATING PERMIT APPLICATION
2014 CONETEC DATA REPORT

OPERATION AND MAINTENANCE MANUAL

RUSH ISLAND FLYASH POND DAM
FESTUS, MISSOURI
JEFFERSON COUNTY
ID NO. MO 40179

NOVEMBER 18, 2010

DAM SAFETY & HYDRO ENGINEERING
3700 S. LINDBERGH BLVD
ST. LOUIS, MO 63127

OPERATION AND MAINTENANCE PLAN
RUSH ISLAND FLYASH DAM
JEFFERSON COUNTY, MO

TABLE OF CONTENTS

TITLE ..... PAGE

SECTION 1 - GENERAL

Reasons for Development and Dissemination of the O&M Manual 1
General Responsibilities Concerning Dams 2

SECTION 2 – DEFINITIONS.....3

SECTION 3 - INFORMATION ABOUT THE DAM

Location 6
Description of Dam and Appurtenances.....6
Hazard Classification.....6
Purpose of Dam.....7
Pertinent Data.....7

SECTION 4 - OPERATION ACTIVITIES

Normal Operation 8
Instrumentation Monitoring Data 8
Types of Dam Inspections 8

SECTION 5 - MAINTENANCE ACTIVITIES.....11

SECTION 6 – EMERGENCY CONDITIONS 13

FIGURES

Figure 1 Location Map
Figure 2 Aerial View

APPENDICES

Appendix A Operation and Maintenance Inspection Checklist
Appendix B Engineering Inspection Form
Appendix C Herbicides
Appendix D Supplemental Calculations
Appendix E Project Drawings

SECTION 1

GENERAL

This operation and maintenance plan, (hereafter referred to as the O&M Manual), outlines objectives, proposed policies, responsibilities, and procedures for Ameren personnel who are responsible for the management of the Rush Island Flyash Pond Dam.

REASONS FOR DEVELOPMENT AND DISSEMINATION OF THE O&M MANUAL

Division 22 of the Rules of Department of Natural Resources, Chapter 2 entitled "Permits" details the need for a permit. Paragraph 1 under section 10 CSR 22-2.010 includes the following statement:

> "The owner of a proposed new dam thirty-five feet (35') or more in height is required to obtain a construction permit and a safety permit for his/her dam and reservoir. The owner of an existing dam thirty-five feet (35') or more in height is required to obtain a registration permit within the time set forth in 10 CSR 22-2.020(2)."

Division 22 of the Rules of Department of Natural Resources, Chapter 3 entitled "Permit Requirements" details the registration permit requirements of a dam. Paragraph 1B under section 10 CSR 22-3.030 includes the following statement:

> "Proper maintenance and operation of a dam and reservoir are critical to the continuing safety of a dam and reservoir and to public safety, life and property. A maintenance program shall be required and shall include the following items: erosion control on the embankment; monitoring emergency spillway flow rates; vegetation control; spillway maintenance; emergency action plans; maintenance and monitoring of seepage devices, if any; and maintenance and monitoring of instruments used, if any, to observe the stability of the dam."

Thus, it is a requirement of all dam owners who have dams that fall under the jurisdiction of the Missouri Department of Natural Resources to operate and maintain the dams safely.

As a dam owner, Ameren is responsible for the safety of the public and for maintaining the structures within the Ameren's jurisdiction for both safety and economy. The overall public interest is served by providing a document to serve as a basis for the safe and economical operation and maintenance of the dam during both emergency and day-to-day conditions.

GENERAL RESPONSIBILITIES CONCERNING DAMS

Shift Supervisor

Contacts local agencies when emergency conditions exist at the Rush Island Flyash Pond Dam.

Plant Engineer

Ensures operation and maintenance program is being implemented as outlined in this document. Ensures performance of weekly inspections. Performs annual assessment of the Operation and Maintenance Manual.

Chief Dam Safety Engineer

Reviews all updates to the Operation and Maintenance Manual.

Dam Safety Group

Performs annual dam inspection with Plant Engineer.

SECTION 2

DEFINITIONS

Abutment - That part of the valley side or concrete walls against which the dam is constructed. Right and left abutments are those on respective sides of an observer when viewed looking downstream.

Appurtenant Works - The structures or machinery auxiliary to dams that are built to operate and maintain dams; such as outlet works, spillways, gates, valves, channels, etc.

Boil - A stream of water discharging from the ground surface downstream of the dam carrying with it a volume of soil that is distributed around the hole formed by the discharging water.

Berm - A horizontal step or bench in the sloping profile of an embankment dam.

Breach - A break, gap, or opening (failure) in a dam that releases impoundment water.

Concrete Block - An erosion protection method using interlocking concrete blocks, usually with openings that are filled with soil and grass.

Core - A zone of material of low permeability in an earthen dam.

Dam - A barrier built for impounding or diverting the flow of water.

Dike (Levee) - An embankment or structure built alongside a river to prevent high water from flooding bordering land.

Drain, Layer or Blanket - A layer of pervious material in a dam to facilitate the drainage of the embankment, including such items as a toe drain, a weep hole, and a chimney drain.

Drawdown - The resultant lowering of water surface level due to the controlled release of water from the impoundment.

Embankment - Fill material, usually earth or rock, placed with sloping sides.

Earthen Dam - Any dam constructed of excavated natural materials.

Emergency Action Plan - A predetermined plan of action to be taken to reduce the potential for property damage and loss of lives.

Failure - An incident resulting in the uncontrolled release of water from a dam.

Freeboard - The vertical distance between a stated water level and the top of a dam.

Gate or Valve - In general, a device in which a leaf or member is moved across the waterway to control or stop the flow.

Groin - The junction of the upstream or downstream face of the dam with the valley wall.

Maintenance - The upkeep, involving labor and materials, necessary for efficient operation of dams and their appurtenant works.

Operation - The administration, management, and performance needed to operate the dam and appurtenant works.

Operation and Maintenance Inspection - Inspections conducted by the Plant Engineer. These inspections are frequent visual inspections of the dam surface and appurtenant works.

Outlet - An opening through which water can freely discharge for a particular purpose from an impoundment.

Phreatic Surface - The upper surface of saturation in an embankment.

Piping - The progressive development of internal erosion by seepage, appearing downstream as a hole or seam, discharging water that contains soil particles.

Riprap - A layer of large stones, broken rock or precast blocks placed in a random fashion, usually on the upstream slope of an embankment dam, on a reservoir shore, or on the sides of a channel as a protection against current, wave and ice action.

Silt/Sediment - Soil particles and debris in an impoundment.

Slump/Slide Area - A portion of earth embankment that moves downslope, sometimes suddenly, often with cracks developing.

Spillway System - A structure or structures over or through which flows are discharged. If the flow is controlled by gates, it is considered a controlled spillway. If the elevation of the spillway crest is the only control of the flows, it is considered an uncontrolled spillway.

Emergency Spillway - A spillway designed to operate very infrequently, only during exceptionally large floods, usually constructed of materials expected to erode slowly.

Principal Spillway - The main spillway that controls both normal and flood flows and is constructed of non-erodible materials.

Auxiliary Spillway - A spillway that works in conjunction with the principal spillway to control flood flows and is constructed of non-erodible materials.

Stilling Basin - A basin constructed to dissipate the energy of fast flowing water, such as from a spillway, and to protect the stream bed from erosion.

Toe of Embankment - The junction of the face of the dam with the ground surface in the floodplain upstream or downstream of the dam.

Trash Rack - A structure of metal or concrete bars located in the waterway at an intake to prevent the entry of floating or submerged debris.

SECTION 3

INFORMATION ABOUT THE DAM

LOCATION

The Rush Island Flyash Dam is located in Southern Jefferson County, Missouri, in the Mississippi floodplain. The plant is south of the City of Festus and north of the City of Bloomsdale. The Mississippi is located just east of the plant. The dam is located adjacent to the Mississippi River in the southwest quarter of Section 3, Township 39 North, Range 7 East of the 5th Principal Meridian.

DESCRIPTION OF DAM AND APPURTENANCES

The Rush Island Dam is a single stage industrial dam. The perimeter of the dam has a length of approximately 9,750-lineal feet and a maximum height of 46-ft. The low point in the dam is elevation 407.2 and occurs at the emergency spillway. The upstream and downstream faces of the dam slope generally at 3 Horizontal (H) to 1 Vertical (V).

An interior levee constructed from compacted bottom ash divides the south pond (Polish Pond) from the north pond (active ash accumulation). The flyash pond to the north of the internal dike is near capacity, and the ash is disposed into excavated pits within this area using a wetted dry ash nozzle. The polish pond is a final settling pond that receives ash, plant process water, and the entire plant stormwater runoff.

The primary spillway consists of one 24-in HDPE pipe which is upturned to an elevation of 388-ft on the upstream end. A check valve is installed on the downstream end and the invert elevation is approximately 372.5-ft. Flow through this pipe and the pool elevation is regulated by two motor operated butterfly valves. The valves are operated in the field.

A 75-ft wide broad crested weir emergency spillway is located on the west side of the flyash pond. The emergency spillway is constructed of MODOT Type 4 Rip-Rap on the upstream and downstream slopes. The crest of the emergency spillway is constructed of aggregate sufficient to withstand design flows. A copy of the emergency spillway calculations are provided in ***Appendix D***.

HAZARD CLASSIFICATION

Rush Island Flyash Pond Dam is classified as a Class III, LOW HAZARD POTENTIAL. The flyash pond is located along the upstream side of the Isle du Bois Creek that empties into the Mississippi River. In this area the creek forms the south boundary line of Jefferson County. There are no residences or highways downstream of the dam or other public infrastructure. If the ring levee dam were to fail the discharge would flow immediately or eventually into the river depending on where a failure occurs. There is no threat to life

downstream of this dam in a potential inundation zone.

PURPOSE OF DAM

The dam forms a pond known as Rush Island Fly Ash Pond. The reservoir is used for coal combustion sedimentation storage.

PERTINENT DATA

Pertinent data about the dam, appurtenant works, and reservoir is presented in Table 1.

TABLE 1
PROJECT DATA

Drainage Area	261-Acres
Dam:	
Type	Earth Embankment
Elevation, Top of Dam	Varies from 412.2 to 408.2 (407.2 – Flow Line of Emergency Spillway)
Height Above Streambed	46 feet
Upstream Slope	3:1 (Horizontal to Vertical)
Downstream Slope	3:1 (Horizontal to Vertical)
Length	9,750 feet
Top Width	14 feet
Reservoir:	
Elevation, Normal Pool	398 feet
Area, Normal Pool (Polish Pond)	27.26 acres
Elevation, Max. Pool	407.2 feet
Area, Maximum Pool (Polish Pond)	29.62 acres
Freeboard, Normal Pool	9.2 feet
Outlet Works:	
Inlet Invert Elevation	388 feet
Outlet Invert Elevation	372.5 feet
Emergency Spillway:	
Type	75’ Broad Crested Weir (Elevation 407.2 feet)

SECTION 4

OPERATION ACTIVITIES

NORMAL OPERATION

The normal pool elevation is 398-ft (~9.2 ft of freeboard). The pond is regulated by an outfall that discharges into the Mississippi River. Flow through the pipe and the pool elevation of the flyash pond is regulated by two motor operated butterfly valves. The valves are operated in the field. If the primary spillway should become inoperable, supplemental pumps can be used to lower the level of the pond.

INSTRUMENTATION MONITORING DATA

There is a staff gage in the southeast portion of the flyash pond to obtain pool elevations. The staff gage is checked daily to insure that the reservoir level is at or below the standard operating level of 398-feet.

TYPES OF DAM INSPECTIONS

Weekly visual inspections are conducted at the dam by plant operations staff. The Ameren Missouri Dam Safety Group performs annual inspections with plant operations. Engineering inspections are performed every five years. In addition, the Ameren Missouri Dam Safety Group may conduct unannounced safety inspections. The following sections describe each type of inspection.

Weekly Inspection:

Weekly inspections are conducted by plant staff or support staff familiar with the pond/dam. The weekly inspection consists of visually inspecting the crest and slopes of the dam to identify any new or changed conditions. Checklists are completed and are made available to the Dam Safety Group for review. A recommended inspection checklist for the weekly inspection is included in ***Appendix A.***

Annual Inspection:

These inspections are conducted annually by the plant staff and the Ameren Missouri Dam Safety Group staff. The annual inspection is a detailed visual inspection of the dam crest, interior and exterior slopes, downstream toe area, inlet/outlet works, and appurtenant structures. A recommended inspection checklist for the annual inspection is included in ***Appendix A.***

Records: An inspection Report is to be prepared by the Ameren Missouri Dam Safety Group staff that includes a description of the observations of the visual inspection, photographs of the facilities taken during the inspection, and a written evaluation of the results. A record of

activities occurring at the dam is to be kept current by the Ameren Missouri Dam Safety Group.

Special Inspection:

These inspections are conducted when extreme events which my impact dam stability (seismic activity, severe flooding, etc.). Special inspections are similar to the annual inspection, but may be focused on a particular area. If conditions are discovered during a weekly or annual inspection which create concern for the plant or dam safety staff, a special inspection will be conducted. Responsibility for performance of special inspections will be evaluated based on severity of the event. A recommended inspection checklist for the special inspection is included in ***Appendix A.***

Unannounced Inspections

The Ameren Missouri Chief Dam Safety Engineer (CDSE) may conduct unannounced inspections at the site as deemed appropriate. The inspection may include a visual inspection of the facility, a review of the inspection documentation, and interviews with plant personnel to review their understanding of the required inspection procedure.

Engineering Inspection:

The engineering inspection is to be conducted by a qualified engineer approved by Ameren. The inspection will provide a thorough evaluation of the condition of the dam and appurtenances. ***Appendix B*** is an example of the inspection report form that is to be utilized for these inspections.

Frequency: The Rush Island Flyash Pond Dam is classified as a CLASS III, LOW HAZARD POTENTIAL dam. Class III dams are to be inspected once every five years.

Records: The Dam Inspection Report form, ***Appendix B***, will be completed by the inspecting engineer and will be signed and sealed by a Missouri Registered Professional Engineer. This report will document problem areas and deficiencies; recommend remedial actions for problem areas; and establish time requirements for dealing with the problems. The original report will be retained in Ameren's Rush Island Flyash Pond Dam file, and a copy of the report will be submitted to the Missouri Department of Natural Resources, Water Resources Center.

The records should be reviewed during the Engineering Inspection. The records should contain the following documentation:

(1) Completed operation and maintenance inspection checklists

(2) Additional visual observations

(3) A list of maintenance performed

(4) A list of any unusual occurrences at the dam

(5) Instrumentation monitoring data (seepage quantities and pond level)

(6) A copy of the engineering inspection reports

(7) A copy of the annual inspections and the annual owner's statements

SECTION 5

MAINTENANCE ACTIVITIES

Timely repairs are a must after problem areas have been identified. The Plant Engineer is to specify the work and provide direction to correct items noted in the operation and maintenance and engineering inspections. Such items include mowing, seeding, tree and brush removal, painting, replacing riprap, repairing fences and locks, clearing debris, etc. The maintenance activities specified in the following sections are minimum requirements. Maintenance activities should be documented (Refer to Records Page 11). NOTE: NO alterations or repairs to structural elements should be made without the approval of the Chief Dam Safety Engineer and the concurrence of the Missouri Department of Natural Resources, Water Resource Center.

Debris: Remove all trash, logs and other debris that may obstruct flow from the outlet works.

Concrete Block and Rip Rap: Replace or level blocks and rip rap as needed to provide adequate protection against erosion.

Vegetation Control:

(1) A good grass cover on the embankment should be maintained by seeding, fertilizing and mulching areas that are refilled, barren, or thinly vegetated. Seeding mixtures used for maintenance reseeding shall result in cover compatible with adjacent cover.

(2) Grassed areas such as the embankment and areas beyond the embankment toe for a distance of approximately 20 feet should be mowed at least twice annually, where physically accessible.

(3) All eroded areas should be filled and compacted, reseeded, fertilized and mulched to establish a thick erosion resistant cover.

(4) All trees and brush on the dam embankment should be removed to prevent development of a root system that could provide seepage paths. Herbicides utilized for tree and brush control are discussed in Appendix C.

(5) All brush and trees should be removed to a distance of approximately 20 feet beyond the toe of the dam, where physically accessible.

Animal Damage: Rodent holes should be filled with compacted clay dirt and reseeded. If rodents become a nuisance, an effective rodent control program as approved by the Missouri Department of Natural Resources District Wildlife Biologist should be implemented.

Concrete: Spalled and cracked areas on concrete structures should be patched to guard against any further deterioration of the structure. Concrete construction joints should be filled with a suitable joint filler, such as a bituminous sealant, to protect against weathering.

Drains: All drains and weep holes should be kept open and functional by cleaning them of silt and debris.

Painting: All metal work, fencing, railing, etc. should be properly prepared and repainted as necessary to protect against rusting.

Signs: All warning signs and staff gages should be maintained (repaired, painted, or replaced) as needed.

Sedimentation: As sediment accumulates in the reservoir, less storage is available for the control of flood waters from the watershed. Efforts should be made to work with the U.S. Department of Agriculture, Natural Resources Conservation Service and the upstream land owners to minimize the sediment being transported to the reservoir. A location for the placement of the sediment removed from the reservoir (if upstream of the dam, above the top of the dam) should be determined.

SECTION 6

EMERGENCY CONDITIONS

If a condition arises where there is a possibility of dam failure, the following plan will be put into effect (Refs. Rush Island EIP RI-EIP-DAMINT-16 and RI-EIP-NOTIFY-17).

(1) The pond level will be lowered by the primary spillway, and closely monitoring the area for changes in conditions. If the primary spillway should become inoperable, supplemental pumps will be used to lower the level of the pond.

(2) The following agencies would be notified by Ameren concerning the status of the dam. These agencies will inform the public as to what action would be taken. Ameren will do whatever possible to minimize damage at downstream locations.

A. Jefferson County Sheriff	636-797-5000
B. Jefferson County Emergency Management	636-797-5381
C. MDNR –Water Resources Center	573-751-2867
D. Army Corps of Engineers (St. Louis District)	314-331-8567
E. MDNR – Dam Safety	573-368-2175
F. Ameren Chief Dam Safety Engineer	314-210-4356

FIGURES

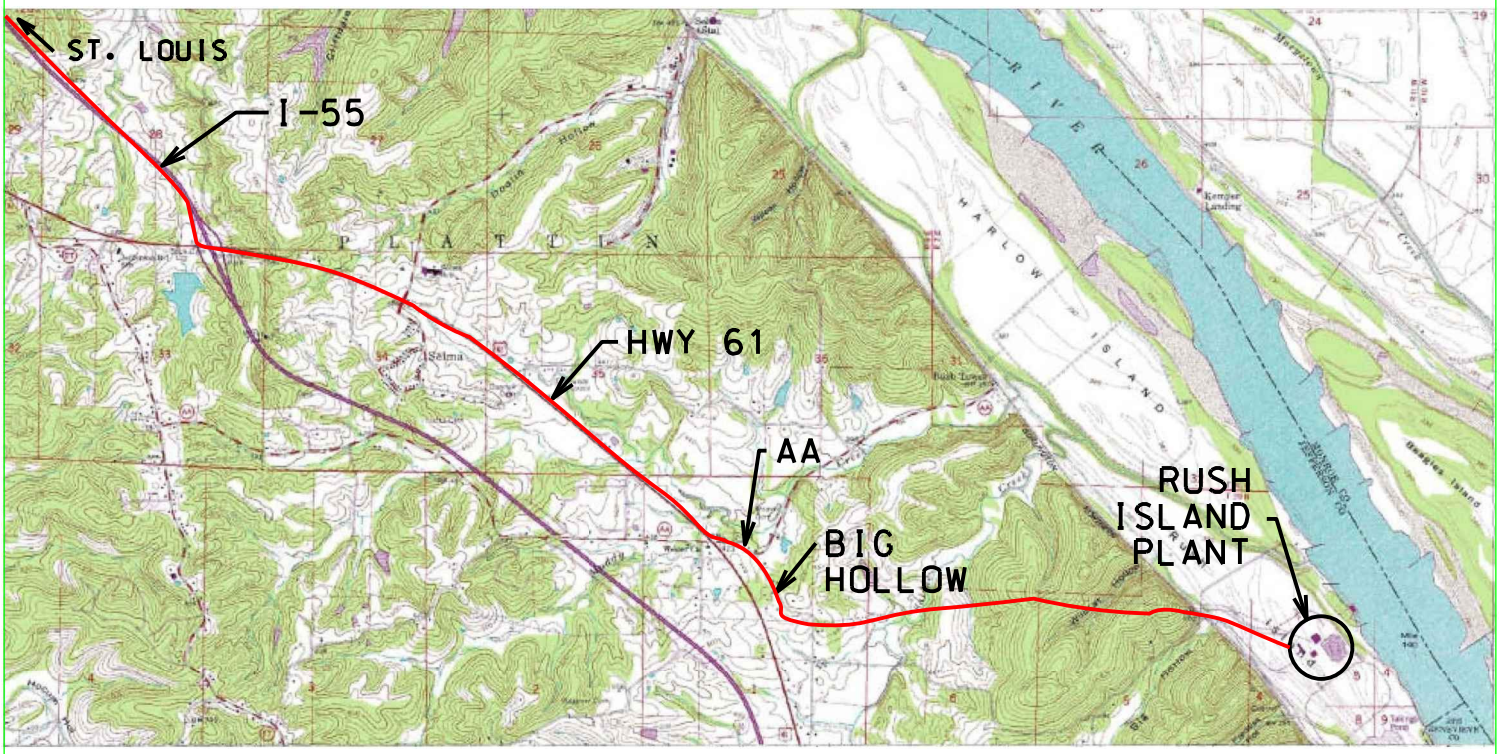


FIGURE 1
RUSH ISLAND PROJECT
LOCATION MAP

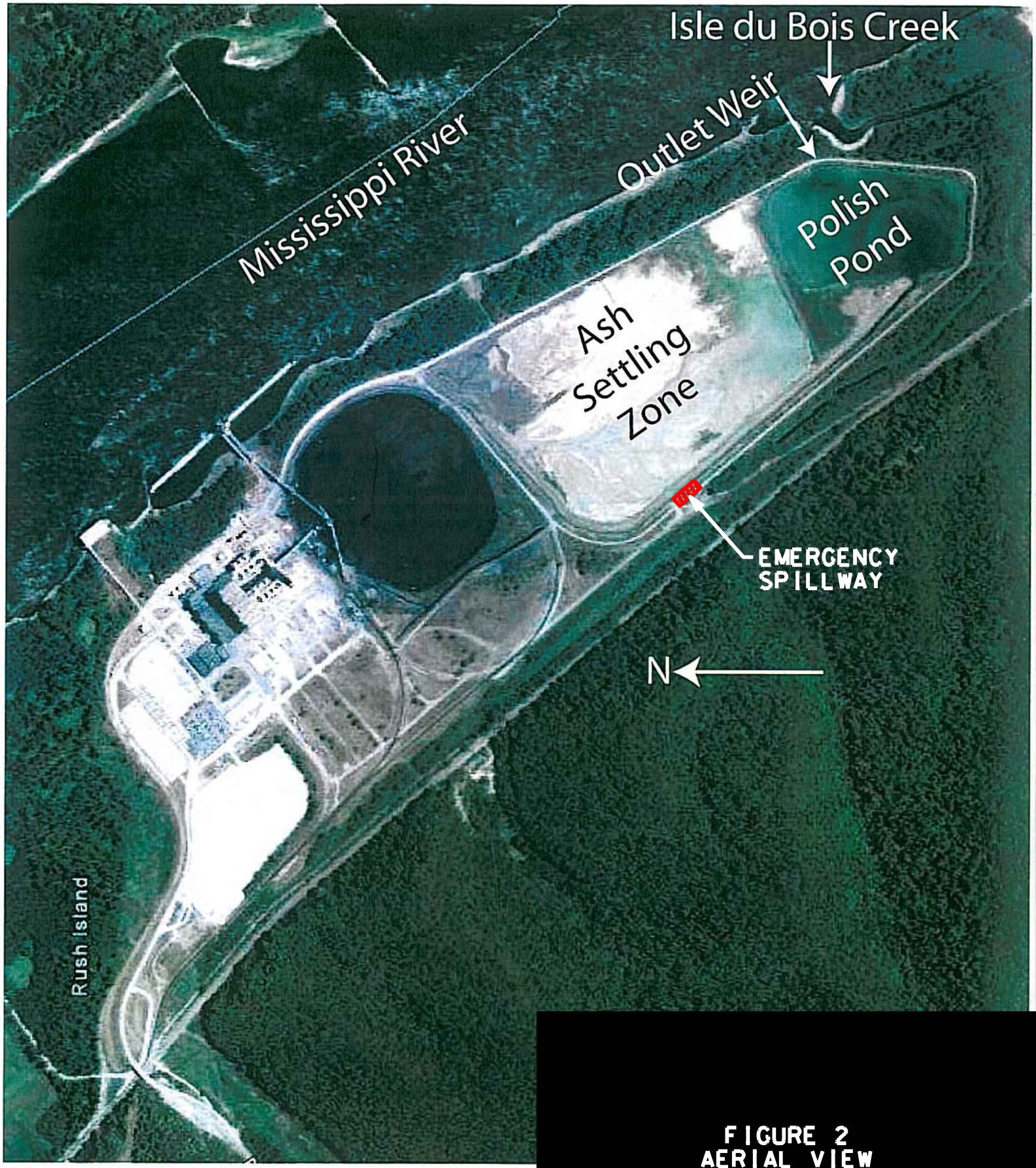


FIGURE 2
AERIAL VIEW
RUSH ISLAND PLANT

APPENDIX A

INSPECTION CHECKLISTS

Rush Island Fly Ash / Bottom Ash Pond
Weekly Inspection Checksheet

Date	
Inspector	
Pond Level	
Temperature	
Weather	

	Item	Condition Code *	Comments
Inlet and Outlet	Structure / Supports		
	Obstruction		
	Leakage		
	Outfall Condition		
	Other		
Earth Embankment	Vertical & Horizontal Alignment of Crest		
	Seepage		
	Erosion		
	Vegetation		
	Unusual Movement or Cracking		
	Other		

Condition Codes

EC = Emergency Condition. A serious dam safety condition exists that needs immediate action. Emergency measures implemented as instructed by Chief Dam Safety Engineer; pool draw down, work stoppage, plant stoppage.
IM = Item needing immediate maintenance to restore or ensure its safety or integrity. Remediation should be completed within 1 month.
MM = Item needing minor maintenance and/or repairs within the year. The safety or integrity of the item is not yet imperiled.
OB = Condition requires regular observation to ensure that the condition does not become worse.
GC = Good Codition.
NE = No evidence of a problem.
NI = Not Inspected. Reason should be stated in comment

Rush Island Ash Pond
Annual Inspection Checksheet

Date	
Inspector	
Pond Level	
Temperature	
Weather	

	Item	Condition Code *	Comments
Inlet and Outlet	Obstruction		
	Inlet Condition		
	Leakage		
	Outfall Condition		
	Outfall Gate		
	Other		
Earth Embankment	Vertical & Horizontal Alignment of Crest		
	Liner		
	Seepage		
	Erosion		
	Fencing		
	Vegetation		
	Unusual Movement or Cracking At or Beyond Toe		
	Other		

Condition Codes

EC = Emergency Condition. A serious dam safety condition exists that needs immediate action. Emergency measures implemented as instructed by Chief Dam Safety Engineer; pool draw down, work stoppage, plant
IM = Item needing immediate maintenance to restore or ensure its safety or integrity. Remediation should be completed within 1 month.
MM = Item needing minor maintenance and/or repairs within the year. The safety or integrity of the item is not yet imperiled.
OB = Condition requires regular observation to ensure that the condition does not become worse.
GC = Good Codition.
NE = No evidence of a problem.
NI = Not Inspected. Reason should be stated in comment

Rush Island Ash Pond
Special Inspection Checksheet

Date	
Inspector	
Pond Level	
Temperature	
Weather	

	Item	Condition Code *	Comments
Inlet and Outlet	Obstruction		
	Inlet Condition		
	Leakage		
	Outfall Condition		
	Outfall Gate		
	Other		
Earth Embankment	Vertical & Horizontal Alignment of Crest		
	Liner		
	Seepage		
	Erosion		
	Fencing		
	Vegetation		
	Unusual Movement or Cracking At or Beyond Toe		
	Other		

Condition Codes

EC = Emergency Condition. A serious dam safety condition exists that needs immediate action. Emergency measures implemented as instructed by Chief Dam Safety Engineer; pool draw down, work stoppage, plant
IM = Item needing immediate maintenance to restore or ensure its safety or integrity. Remediation should be completed within 1 month.
MM = Item needing minor maintenance and/or repairs within the year. The safety or integrity of the item is not yet imperiled.
OB = Condition requires regular observation to ensure that the condition does not become worse.
GC = Good Codition.
NE = No evidence of a problem.
NI = Not Inspected. Reason should be stated in comment

APPENDIX B

ENGINEERING INSPECTION FORM

OWNER INSPECTION CHECKLIST

NAME OF DAM: _____ DATE INSPECTED: _____
COUNTY: _____ WEATHER: _____
I.D. NO.: _____ TEMPERATURE: _____
DOWNSTREAM ENV. ZONE: _____ POOL ELEVATION: _____
TYPE OF DAM: _____ PERSON MAKING INSPECTION: _____

Directions: Mark an "X" in the YES or NO column. If an item does not apply, write "NA" in the REMARKS column. (If possible, identify any changes since the last inspection under REMARKS)

ITEM	YES	NO	REMARKS
1. CREST			
a. Any visual settlements?			
b. Misalignment?			
c. Cracking?			
2. UPSTREAM SLOPE			
a. Adequate grass cover?			
b. Any erosion?			
c. Are trees growing on slope?			
d. Longitudinal cracks?			
e. Transverse cracks?			
f. Adequate riprap protection?			
g. Any stone deterioration?			
h. Visual depressions or bulges?			
i. Visual settlements?			
j. Debris or trash present?			
3. DOWNSTREAM SLOPE			
a. Adequate grass cover?			
b. Any erosion?			
c. Are trees growing on slope?			
d. Longitudinal cracks?			
e. Transverse cracks?			
f. Visual depressions or bulges?			
g. Visual settlements?			
h. Is the toe drain dry?			
i. Are the relief wells flowing?			
j. Are boils present at the toe?			
k. Is seepage present?			
l. Soft or spongy zones present?			

OWNER INSPECTION CHECKLIST (cont.)			
ITEM	YES	NO	REMARKS
m. Are foundation drainpipes:			
(1) Broken, bent, or missing?			
(2) Corroded or rusted?			
(3) Obstructed?			
(4) Is discharge carrying sediment?			
4. ABUTMENT CONTACTS			
a. Any erosion?			
b. Visual differential movement?			
c. Any cracks noted?			
d. Is seepage present?			
5. PRINCIPAL SPILLWAY INLET			
a. Do concrete surfaces show:			
(1) Spalling?			
(2) Cracking?			
(3) Erosion?			
(4) Scaling?			
(5) Exposed reinforcement?			
(6) Other?			
b. Do the joints show:			
(1) Displacement or offset?			
(2) Loss of joint material?			
(3) Leakage?			
c. Metal appurtenances?			
(1) Corrosion present?			
(2) Breakage present?			
(3) Anchor system secure?			
d. Trashrack operational?			
6. PRINCIPAL SPILLWAY CONDUIT			
a. Is the conduit concrete?			
b. Do concrete surfaces show:			
(1) Spalling?			
(2) Cracking?			
(3) Erosion?			
(4) Scaling?			
(5) Exposed reinforcement?			
(6) Other?			

OWNER INSPECTION CHECKLIST (cont.)			
ITEM	YES	NO	REMARKS
c. Do the joints show:			
(1) Displacement or offset?			
(2) Loss of joint material?			
(3) Leakage?			
d. Is the conduit metal?			
(1) Corrosion present?			
(2) Protective coatings adequate?			
(3) Is the conduit misaligned?			
e. Is there seepage around the conduit?			
7. STILLING BASIN			
a. Do concrete surfaces show:			
(1) Spalling?			
(2) Cracking?			
(3) Erosion?			
(4) Scaling?			
(5) Exposed reinforcement?			
(6) Other?			
b. Do the joints show:			
(1) Displacement or offset?			
(2) Loss of joint material?			
(3) Leakage?			
c. Do the energy dissipators and riprap show:			
(1) Signs of deterioration?			
(2) Are they covered with debris?			
(3) Other?			
d. Is the channel:			
(1) Eroding or backcutting?			
(2) Sloughing?			
(3) Obstructed?			
e. Is released water:			
(1) Undercutting the outlet?			
(2) Eroding the embankment?			
8. EMERGENCY SPILLWAY			
a. Does spillway concrete show:			
(1) Spalling?			
(2) Cracking?			
(3) Erosion?			

OWNER INSPECTION CHECKLIST (cont.)			
ITEM	YES	NO	REMARKS
(4) Scaling?			
(5) Exposed reinforcement?			
(6) Other?			
b. Do the joints show:			
(1) Displacement or offset?			
(2) Loss of joint material?			
(3) Leakage?			
c. Is the spillway in rock or soil?			
(1) Are slopes eroding?			
(2) Are slopes sloughing?			
(3) Other?			
d. Is the discharge channel:			
(1) Eroding or backcutting?			
(2) Obstructed?			
(3) Is vegetative cover adequate?			
e. Has released water:			
(1) Eroded the embankment?			
(2) Undercut the outlet?			
(3) Other?			
f. Is weir in good condition?			
9. GATES			
a. Are the flood gates and valves:			
(1) Located upstream and downstream?			
(2) Broken or bent?			
(3) Corroded or rusted?			
(4) Periodically maintained?			
(5) Operational?			
(6) Date last operated.			
b. Is there a low-level gate?			
c. Is the low-level gate operational?			
10. RESERVOIR CONTROL			
a. Recent upstream development?			
b. Slides in reservoir area?			
c. Change in reservoir operation?			
d. Large impoundment upstream?			
11. INSTRUMENTATION			
a. List types of instrumentation.			

OWNER INSPECTION CHECKLIST (cont.)			
ITEM	YES	NO	REMARKS
b. In good condition?			
c. Read periodically?			
d. Is data available?			
12. AREA DOWNSTREAM			
a. Recent downstream development?			
b. Seepage or wetness?			
13. OTHER COMMENTS:			

This dam was inspected by: _____

APPENDIX C

HERBICIDES

HERBICIDES

Site personnel should check with the Missouri Department of Natural Resources, Regional Fisheries Biologist and the Regional Wildlife Biologist before using any herbicide. Read the product label prior to use and follow the use directions and precautions accordingly.

On March 1, 1979 the U.S. Environmental Protection Agency (U.S.E.P.A.) halted the use of the herbicide 2, 4, 5-T in parks and recreation areas. The use of silvex (2, 4, 5-TP) around water has also been banned.

Some examples of approved herbicides are:

1)	Tordon RTU by DOW Chemical. (Can be obtained with blue dye.)
2)	WEEDONE 170 by Union Carbide
3)	WEEDONE, 2, 4-DP by Union Carbide
4)	A 1% to 2% solution of ROUNDUP
5)	Garlon by DOW Chemical
6)	Banvel by Sandoz

Your distributor may carry brand name herbicides other than those listed above. Be certain that the product does not contain the ingredients 2, 4, 5-T or 2, 4, 5-TP. An example of an unacceptable product is ESTERON 2, 4, 5 by DOW Chemical.

APPENDIX D

SUPPLEMENTAL CALCULATIONS

REITZ & JENS, INC.
CONSULTING ENGINEERS

DATE 7/12/10

PROJECT RUSH ISLAND ASH POND
SUBJECT SPILLWAY HYD.
BY DSE CHK'D _____ SHEET 6 OF _____

SUPPLEMENTAL CALCS - MDNR RESPONSE

#1. INSTALL AN EMERG. OVERFLOW SPILLWAY, OR ARMOUR THE LOW SPOT.

- AMEREN REQUESTED A LOWERED OVERFLOW TO AVOID HAVING TO FILL IN NUMEROUS DIPS IN THE TOP OF LEVEE.

  TRY LOW OVERFLOW @ 407.2 WHICH IS 12" BELOW 408.2 (LOWEST SPOT ON EXIST. PERIMITER)

A 75' LONG BROAD CRESTED SPILLWAY WILL PEAK AT 408.14 IF ALL OTHER OUTLETS ARE CLOSED AND H_2O STARTS AT 407.2. (SEE ATTACHED ROUTING SUMMARY SHEET AND ROUTING COMPUTATIONS) FOR A 100 yr 24 hr STORM.

⟹ RECOMMEND USING 75' LONG SPILLWAY W/ TRAFFICABLE SIDE SLOPES.

MAX. FLOW IS 177 cfs. D = 0.94'

$$A = 0.94 \times \left(\frac{75 + 75 + 2 \times 0.94 \times 10}{2}\right)$$

$$= 79.3 \text{ ft}^2$$

$v = 177/79.3 = 2.23$ fps. Approach vel.

Weir crossing $v = 2 \times 2.23 = 4.43$ fps

from plate 29 for 5 fps use 0.3' stone use 4" Stone properly bedded & nested w/ FILLER SIZES.

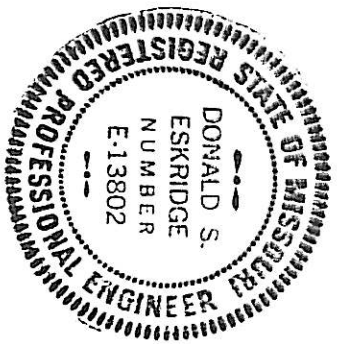
STATE OF MISSOURI
DONALD S. ESKRIDGE
NUMBER E-13802
REGISTERED PROFESSIONAL ENGINEER
7/15/2010

Table of Results
Hydrologic computations

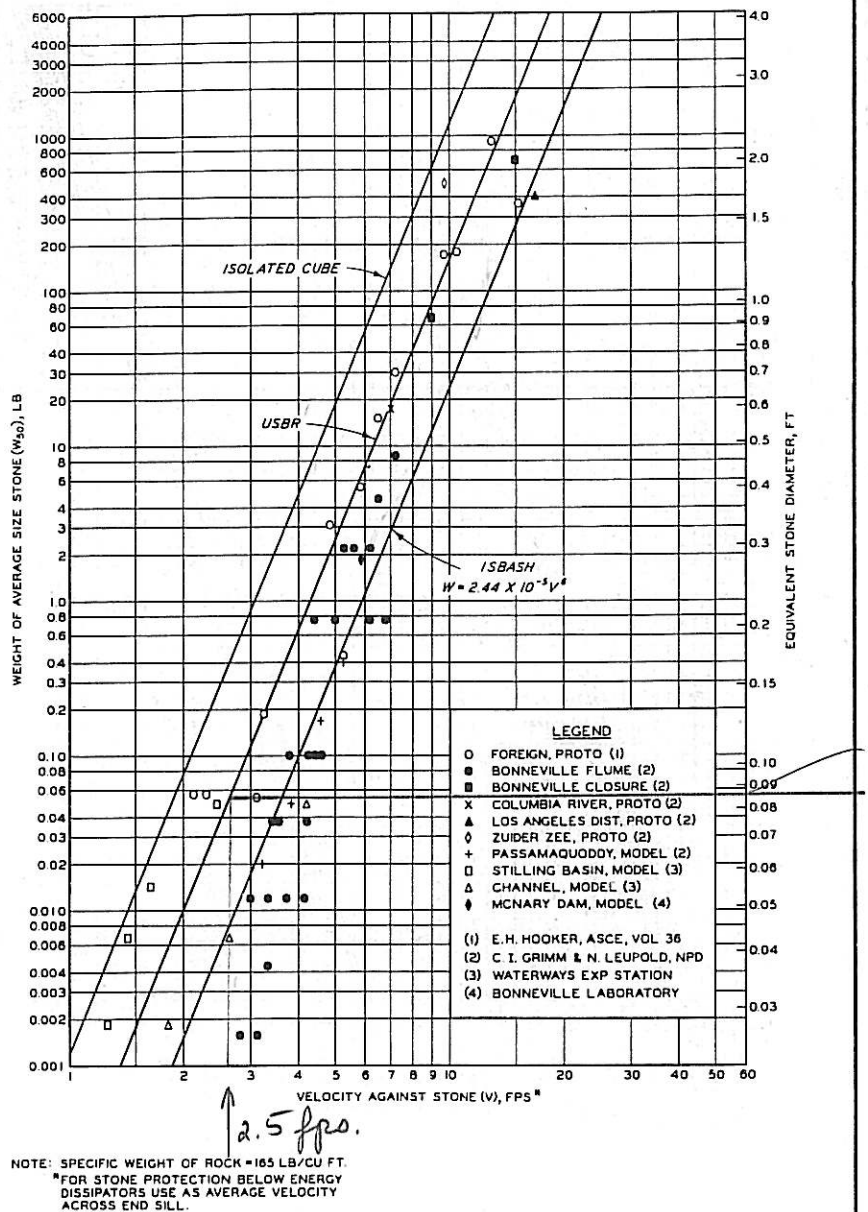
Rush Island Ash Pond Storm Routing

File	Rainfall duration	frequency	Pond Start Elevtion	Base Flow from Plant	Maximum Stage	Max. Outflow cfs	Total Storage ac-ft	Remarks
Trial 03	24 hr	100 yr	395	15 cfs	399.55	27.97	116	8.1 ac Ash delta at 395
Trial 04	24 hr	100 yr	395	20 cfs	399.87	28.95	124	8.1 ac Ash delta at 395
Trial 05	24 hr	100 yr	403	20 cfs	407.44	27.93	126	No Ash Delta @ 403
Trial 09	24 hr	100 yr	398	20 cfs	402.55	28.27	125.2	Ash Delta Submerged @ 397
From Hand computations (sheet 4) - for a blocked outlet pipe								
	24 hr	100 yr	395	20 cfs	401.43	0	167.188	8.1 ac Ash delta at 395
	24 hr	100 yr	398	20 cfs	404.05	0	167.188	Ash Delta Submerged @ 397
	24 hr	100 yr	403	20 cfs	408.88	0	167.188	Stage is higher than 408.2 lowpoint
Trial 06	6 hr	100 yr	395	20 cfs	398.25	23.51	79.8	8.1 ac Ash delta at 395
Trial 07	6 hr	100 yr	403	20 cfs	405.88	22.38	80.3	No Ash Delta @ 403
Trial 08	6 hr	100 yr	398	20 cfs	400.93	22.68	80.21	Ash Delta Submerged @ 397
added June 18, 2010								
Trial 10	24 hr	100 yr	407.2	20 cfs	407.99	183.7	23.6	100 ft long rock lined spillway with 407.2 crest
Trial 11	24 hr	100 yr	407.2	20 cfs	408.14	177	27.84	75 ft long rock lined spillway with 407.2 crest

Note: 100 yr - 24 hour storm - 7.10 inches
100 yr - 6 hour storm - 5.20 inches
Souirce - Bulletin 71, Huff & Angel



sheet 8 of

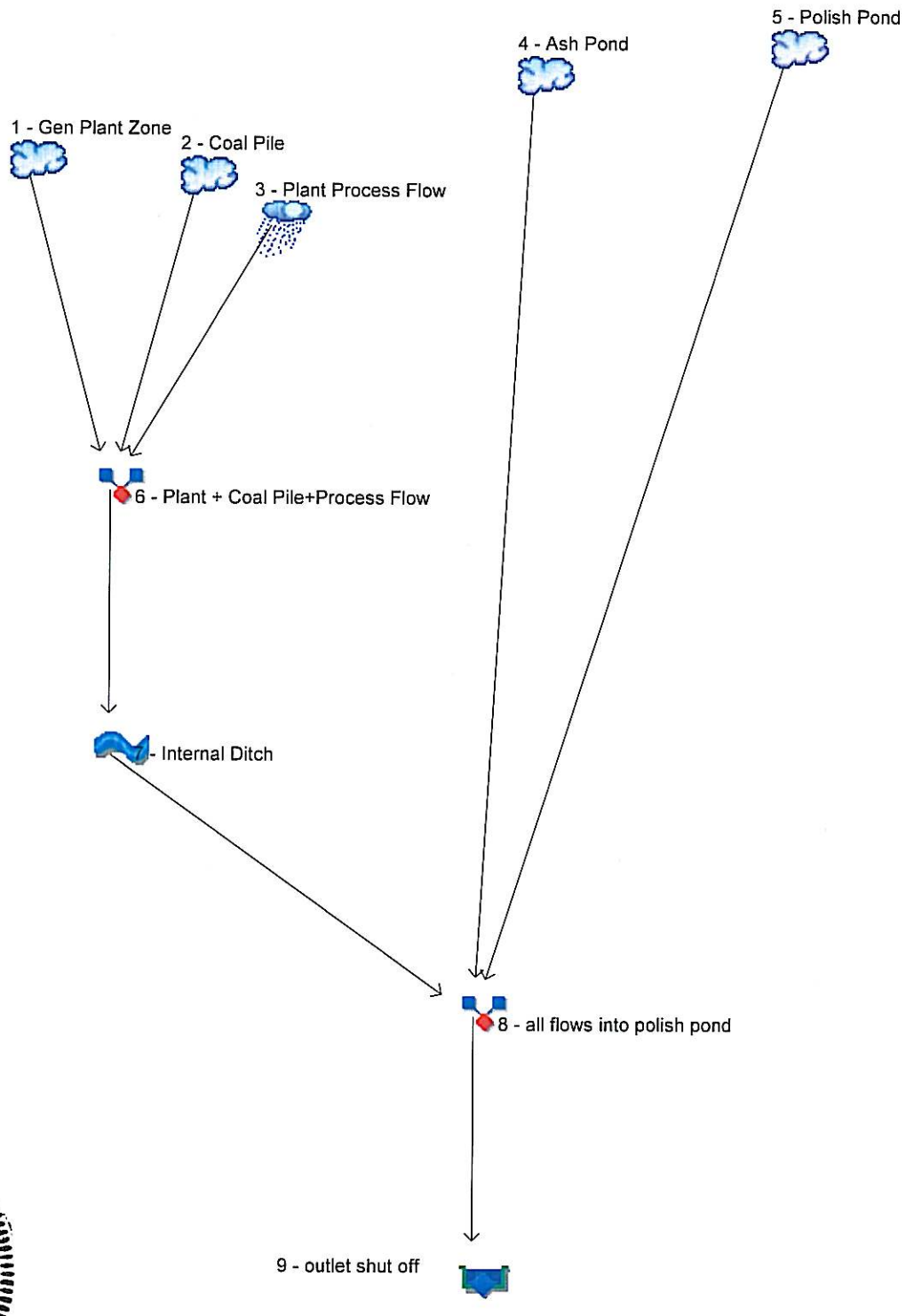


VELOCITY VS STONE WEIGHT

SEE TEXT PAGE 36

Plate 29

Watershed Model Schematic



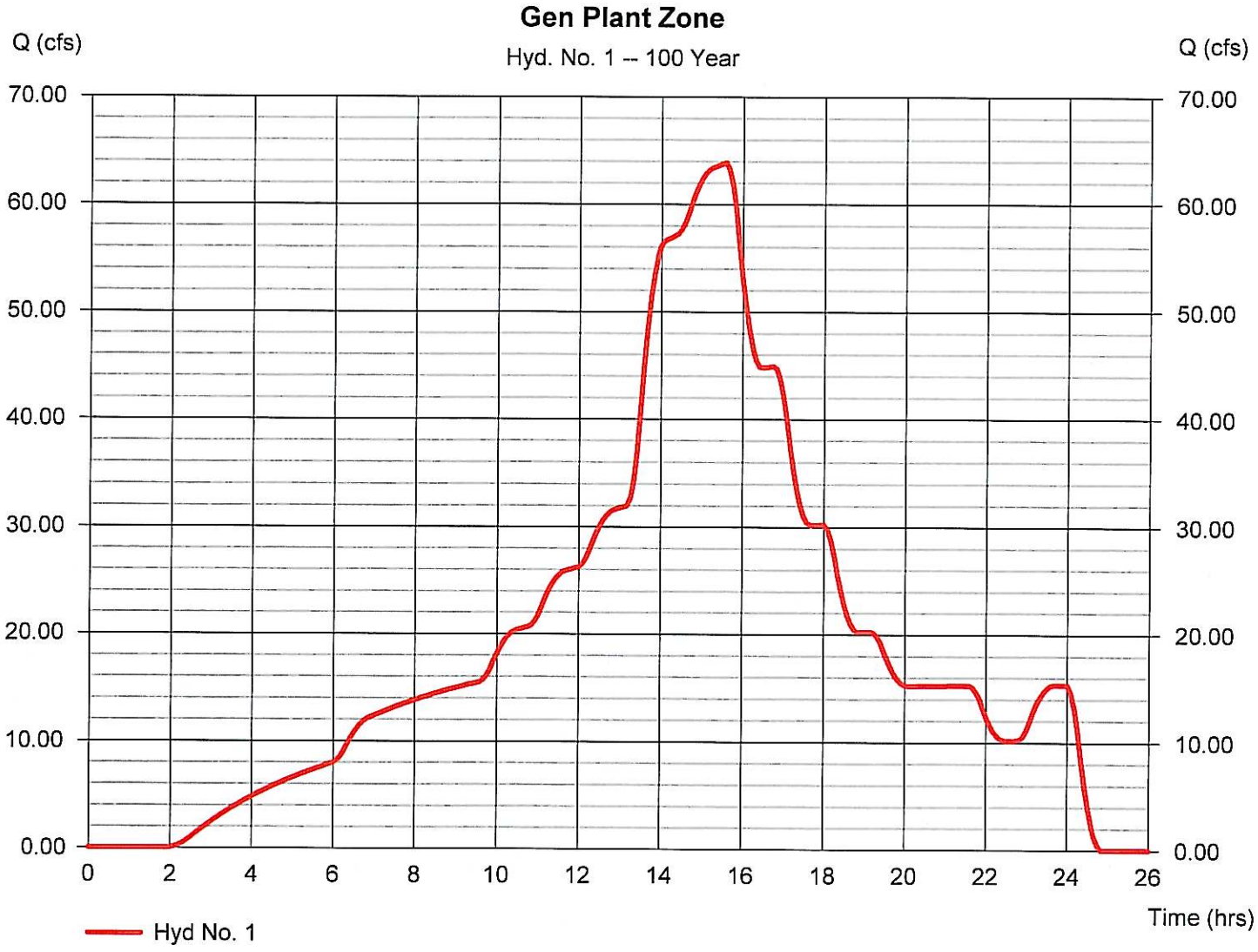


Hydrograph Report

Hyd. No. 1

Gen Plant Zone

Hydrograph type	= SCS Runoff	Peak discharge	= 63.88 cfs
Storm frequency	= 100 yrs	Time to peak	= 15.58 hrs
Time interval	= 5 min	Hyd. volume	= 40.508 acft
Drainage area	= 86.300 ac	Curve number	= 86
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= USER	Time of conc. (Tc)	= 30.00 min
Total precip.	= 7.10 in	Distribution	= Huff-3rd
Storm duration	= 24.00 hrs	Shape factor	= 484



Hydrograph Report

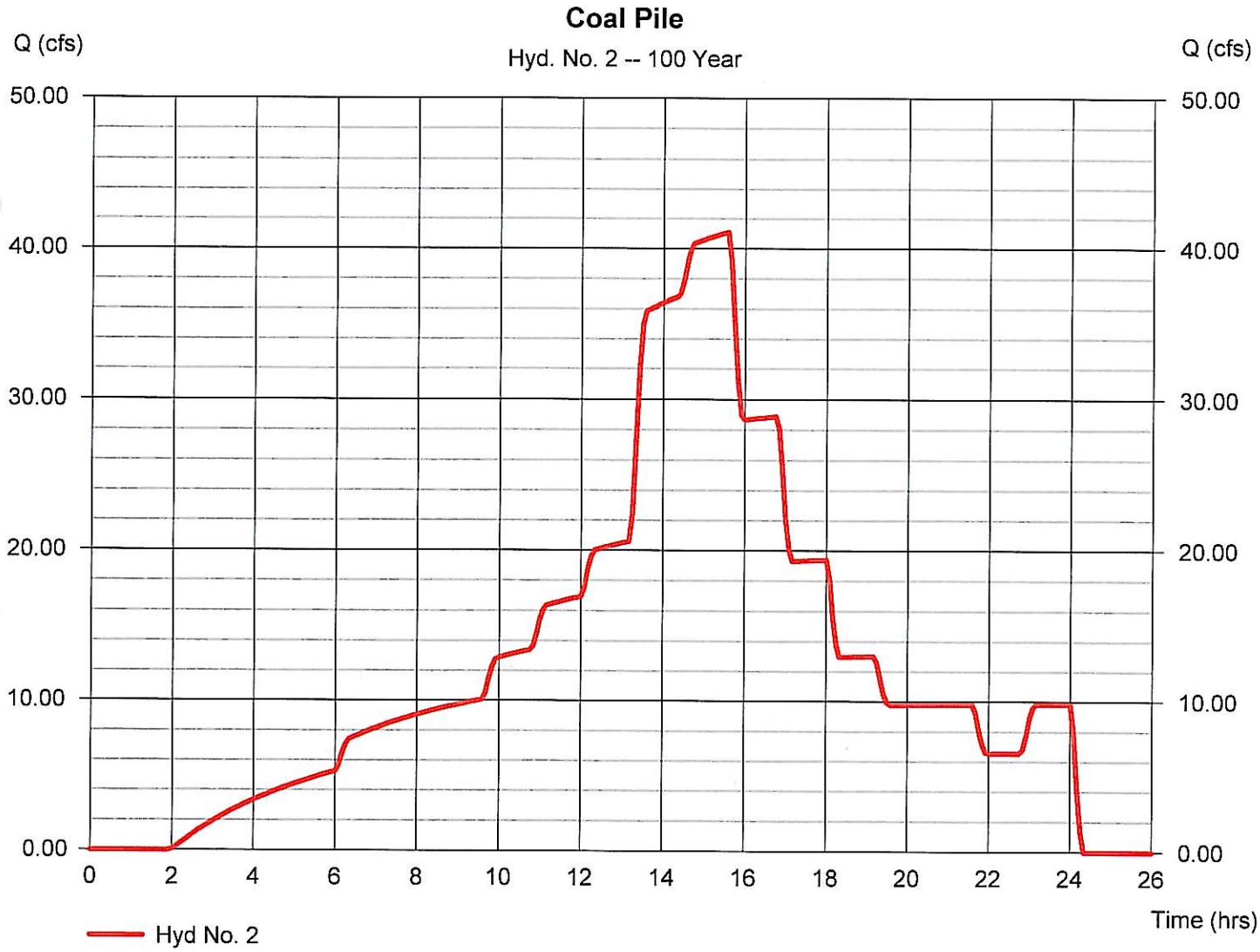
Hydraflow Hydrographs by Intelisolve v9.23

Wednesday, Jun 30, 2010

Hyd. No. 2

Coal Pile

Hydrograph type	= SCS Runoff	Peak discharge	= 41.10 cfs
Storm frequency	= 100 yrs	Time to peak	= 15.58 hrs
Time interval	= 5 min	Hyd. volume	= 25.944 acft
Drainage area	= 60.800 ac	Curve number	= 86
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= USER	Time of conc. (Tc)	= 12.00 min
Total precip.	= 7.10 in	Distribution	= Huff-3rd
Storm duration	= 24.00 hrs	Shape factor	= 484

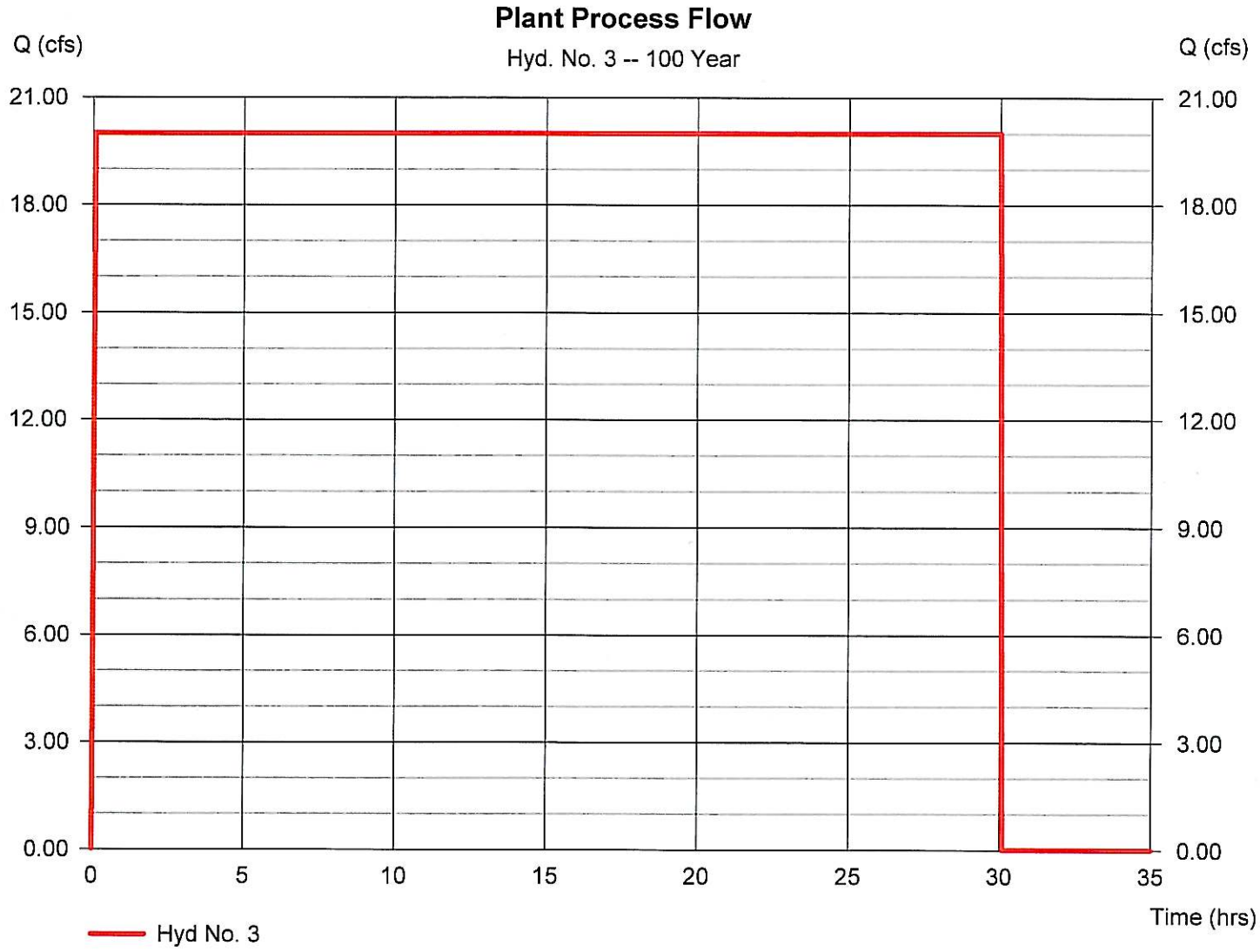


Hydrograph Report

Hyd. No. 3

Plant Process Flow

Hydrograph type	= Manual	Peak discharge	= 20.00 cfs
Storm frequency	= 100 yrs	Time to peak	= 0.08 hrs
Time interval	= 5 min	Hyd. volume	= 49.587 acft

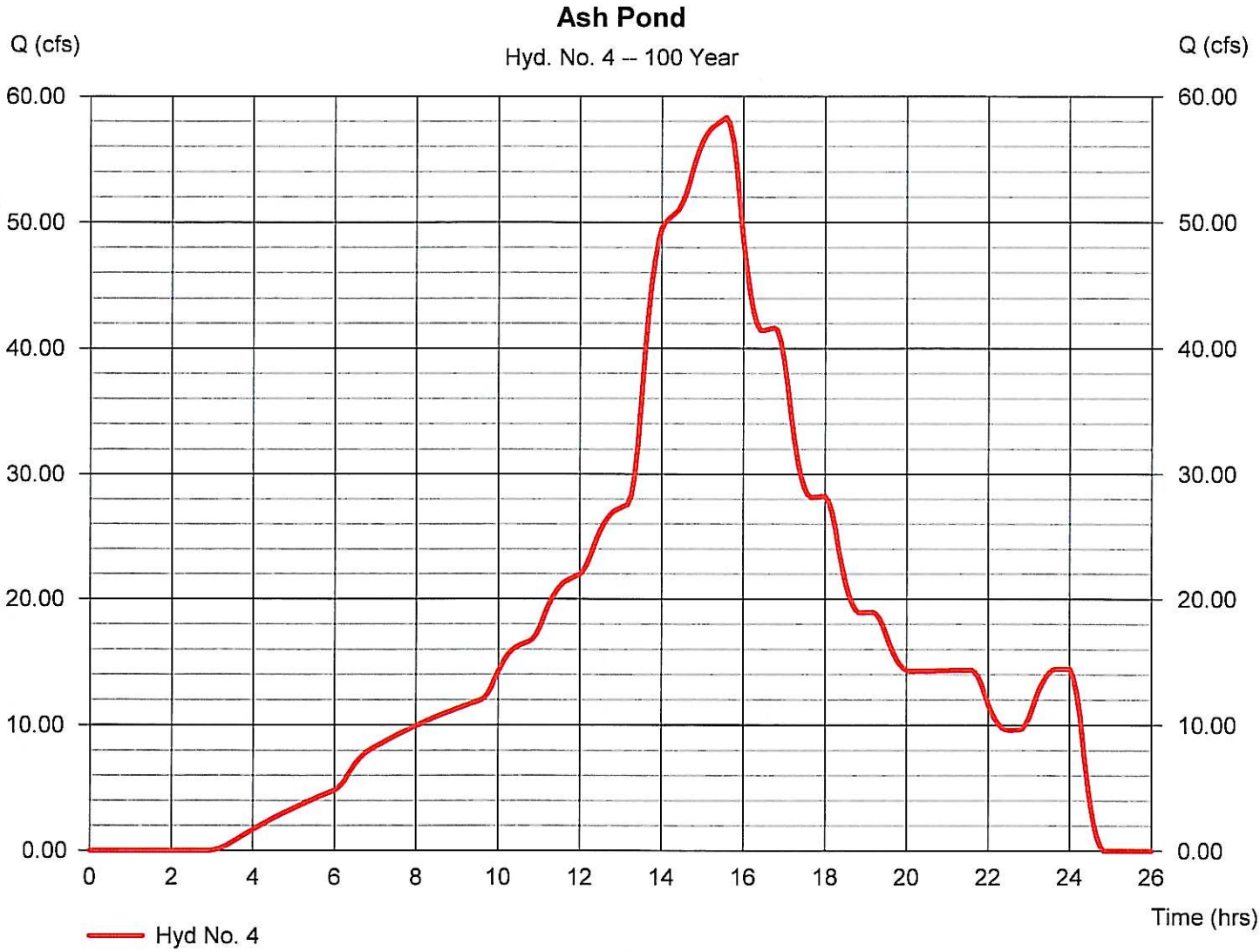


Hydrograph Report

Hyd. No. 4

Ash Pond

Hydrograph type	= SCS Runoff	Peak discharge	= 58.35 cfs
Storm frequency	= 100 yrs	Time to peak	= 15.58 hrs
Time interval	= 5 min	Hyd. volume	= 34.925 acft
Drainage area	= 84.900 ac	Curve number	= 80
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= USER	Time of conc. (Tc)	= 33.00 min
Total precip.	= 7.10 in	Distribution	= Huff-3rd
Storm duration	= 24.00 hrs	Shape factor	= 484

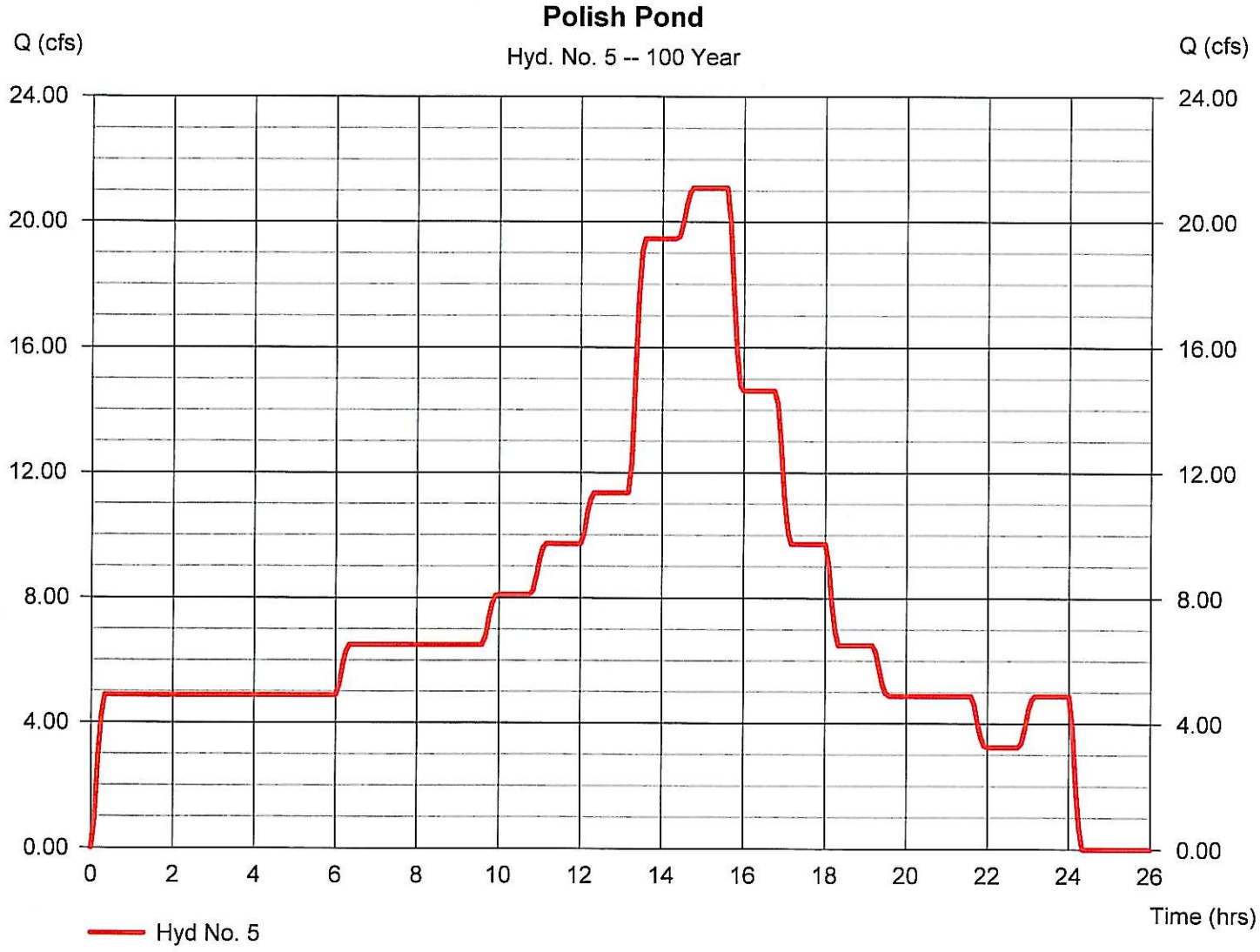


Hydrograph Report

Hyd. No. 5

Polish Pond

Hydrograph type	= SCS Runoff	Peak discharge	= 21.09 cfs
Storm frequency	= 100 yrs	Time to peak	= 15.42 hrs
Time interval	= 5 min	Hyd. volume	= 16.086 acft
Drainage area	= 29.000 ac	Curve number	= 100
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= USER	Time of conc. (Tc)	= 10.00 min
Total precip.	= 7.10 in	Distribution	= Huff-3rd
Storm duration	= 24.00 hrs	Shape factor	= 484



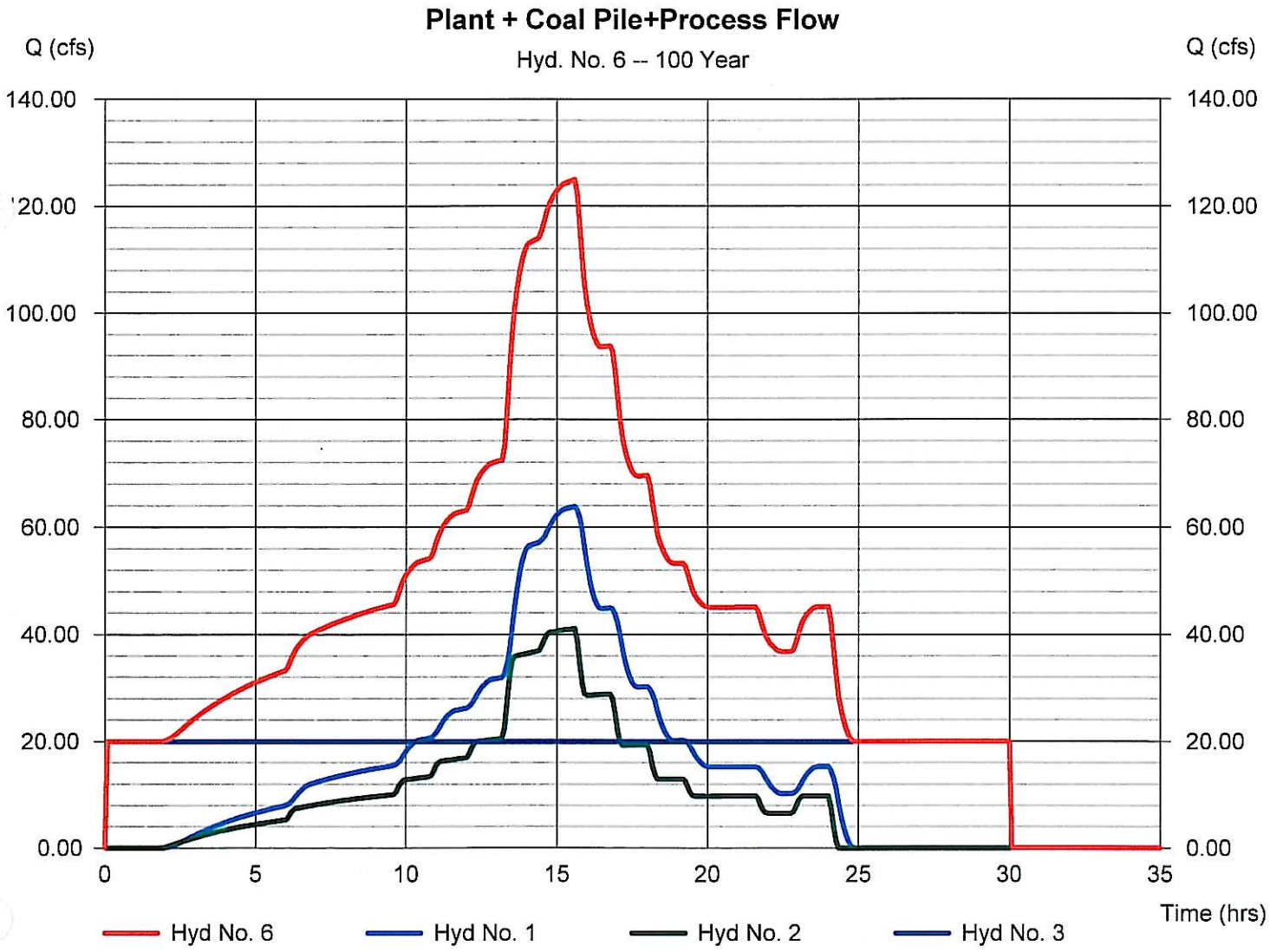
Hydrograph Report

Hydraflow Hydrographs by Intelisolve v9.23 — Wednesday, Jun 30, 2010

Hyd. No. 6

Plant + Coal Pile+Process Flow

Hydrograph type	= Combine	Peak discharge	= 124.99 cfs
Storm frequency	= 100 yrs	Time to peak	= 15.58 hrs
Time interval	= 5 min	Hyd. volume	= 116.039 acft
Inflow hyds.	= 1, 2, 3	Contrib. drain. area	= 147.100 ac



Hydrograph Report

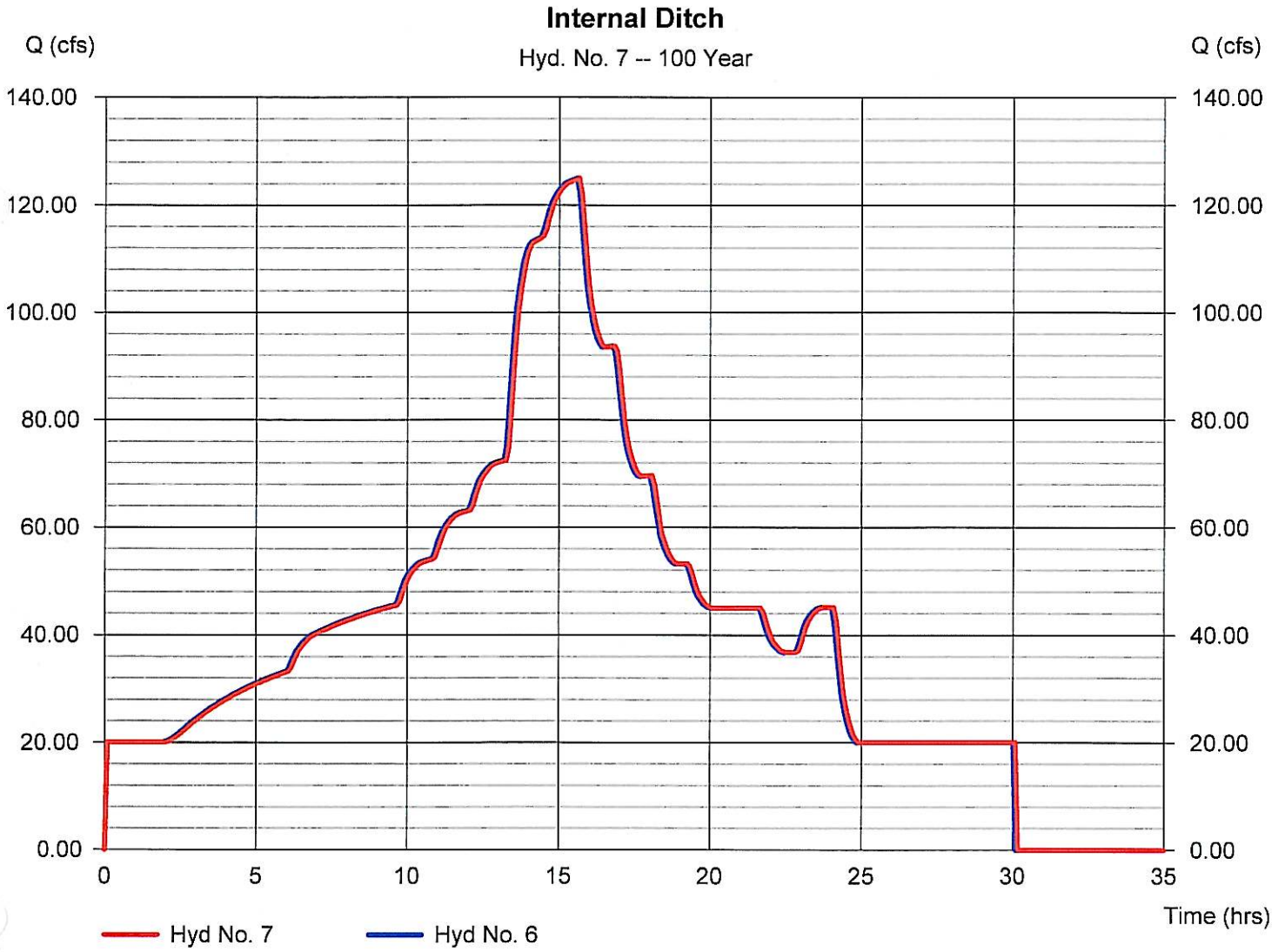
Hydraflow Hydrographs by Intelisolve v9.23 — Wednesday, Jun 30, 2010

Hyd. No. 7

Internal Ditch

Hydrograph type	= Reach	Peak discharge	= 124.99 cfs
Storm frequency	= 100 yrs	Time to peak	= 15.67 hrs
Time interval	= 5 min	Hyd. volume	= 116.177 acft
Inflow hyd. No.	= 6 - Plant + Coal Pile+Process Flow	Section type	= Trapezoidal
Reach length	= 1800.0 ft	Channel slope	= 0.3 %
Manning's n	= 0.009	Bottom width	= 10.0 ft
Side slope	= 0.5:1	Max. depth	= 8.0 ft
Rating curve x	= 1.886	Rating curve m	= 1.516
Ave. velocity	= 7.86 ft/s	Routing coeff.	= 0.9967

Modified Att-Kin routing method used.

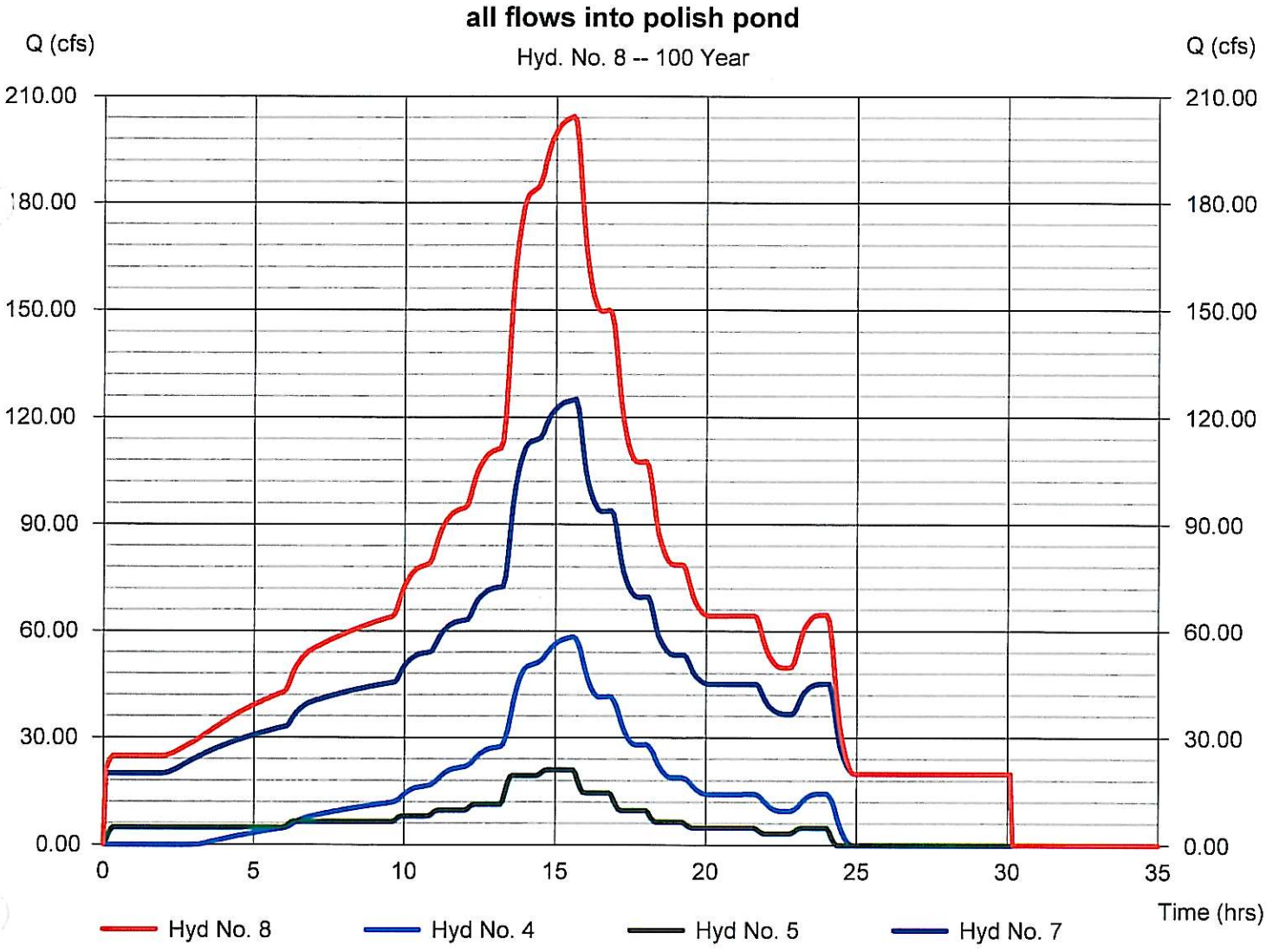


Hydrograph Report

Hyd. No. 8

all flows into polish pond

Hydrograph type	= Combine	Peak discharge	= 204.24 cfs
Storm frequency	= 100 yrs	Time to peak	= 15.58 hrs
Time interval	= 5 min	Hyd. volume	= 167.188 acft
Inflow hyds.	= 4, 5, 7	Contrib. drain. area	= 113.900 ac



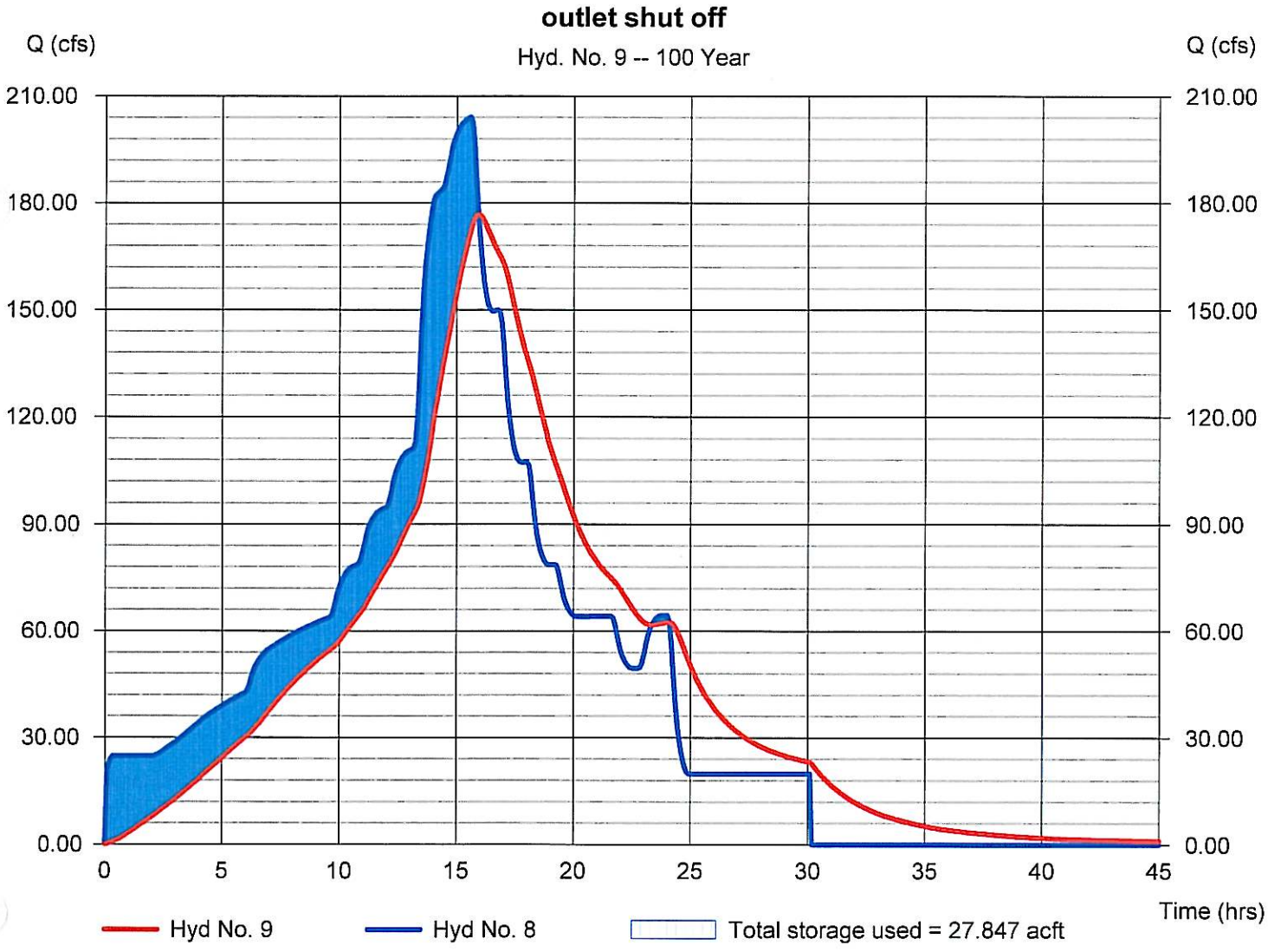
Hydrograph Report

Hyd. No. 9

outlet shut off

Hydrograph type	= Reservoir	Peak discharge	= 177.00 cfs
Storm frequency	= 100 yrs	Time to peak	= 15.92 hrs
Time interval	= 5 min	Hyd. volume	= 167.187 acft
Inflow hyd. No.	= 8 - all flows into polish pond	Max. Elevation	= 408.14 ft
Reservoir name	= Polish pond	Max. Storage	= 27.847 acft

Storage Indication method used.



Pond No. 2 - Polish pond

Pond Data

Contours - User-defined contour areas. Average end area method used for volume calculation. Begining Elevation = 407.20 ft

Stage / Storage Table

Stage (ft)	Elevation (ft)	Contour area (sqft)	Incr. Storage (acft)	Total storage (acft)
0.00	407.20	1,290,247	0.000	0.000
0.40	407.60	1,293,296	11.862	11.862
0.80	408.00	1,296,345	11.890	23.752
1.30	408.50	1,299,830	14.900	38.652
1.80	409.00	1,303,315	14.940	53.592
2.30	409.50	1,307,017	14.981	68.573
2.80	410.00	1,310,720	15.024	83.597

Culvert / Orifice Structures

	[A]	[B]	[C]	[PrfRsr]
Rise (in)	Inactive	Inactive	Inactive	Inactive
Span (in)	= 0.00	0.00	0.00	0.00
No. Barrels	= 0	0	0	0
Invert El. (ft)	= 0.00	0.00	0.00	0.00
Length (ft)	= 0.00	0.00	0.00	0.00
Slope (%)	= 0.00	0.00	0.00	n/a
N-Value	= .013	.013	.013	n/a
Orifice Coeff.	= 0.60	0.60	0.60	0.60
Multi-Stage	= n/a	No	No	No

Weir Structures

	[A]	[B]	[C]	[D]
Crest Len (ft)	= 75.00	Inactive	Inactive	Inactive
Crest El. (ft)	= 407.20	0.00	0.00	0.00
Weir Coeff.	= 2.60	3.33	3.33	3.33
Weir Type	= Broad	---	---	---
Multi-Stage	= No	No	No	No

Exfil.(in/hr) = 0.000 (by Wet area)

TW Elev. (ft) = 0.00

Note: Culvert/Orifice outflows are analyzed under inlet (ic) and outlet (oc) control. Weir risers checked for orifice conditions (ic) and submergence (s).

Stage / Storage / Discharge Table

Stage ft	Storage acft	Elevation ft	Clv A cfs	Clv B cfs	Clv C cfs	PrfRsr cfs	Wr A cfs	Wr B cfs	Wr C cfs	Wr D cfs	Exfil cfs	User cfs	Total cfs
0.00	0.000	407.20	---	---	---	---	0.00	---	---	---	---	---	0.000
0.40	11.862	407.60	---	---	---	---	49.33	---	---	---	---	---	49.33
0.80	23.752	408.00	---	---	---	---	139.53	---	---	---	---	---	139.53
1.30	38.652	408.50	---	---	---	---	289.03	---	---	---	---	---	289.03
1.80	53.592	409.00	---	---	---	---	470.91	---	---	---	---	---	470.91
2.30	68.573	409.50	---	---	---	---	680.18	---	---	---	---	---	680.18
2.80	83.597	410.00	---	---	---	---	913.63	---	---	---	---	---	913.63

APPENDIX E

PROJECT DRAWINGS

SIZE E

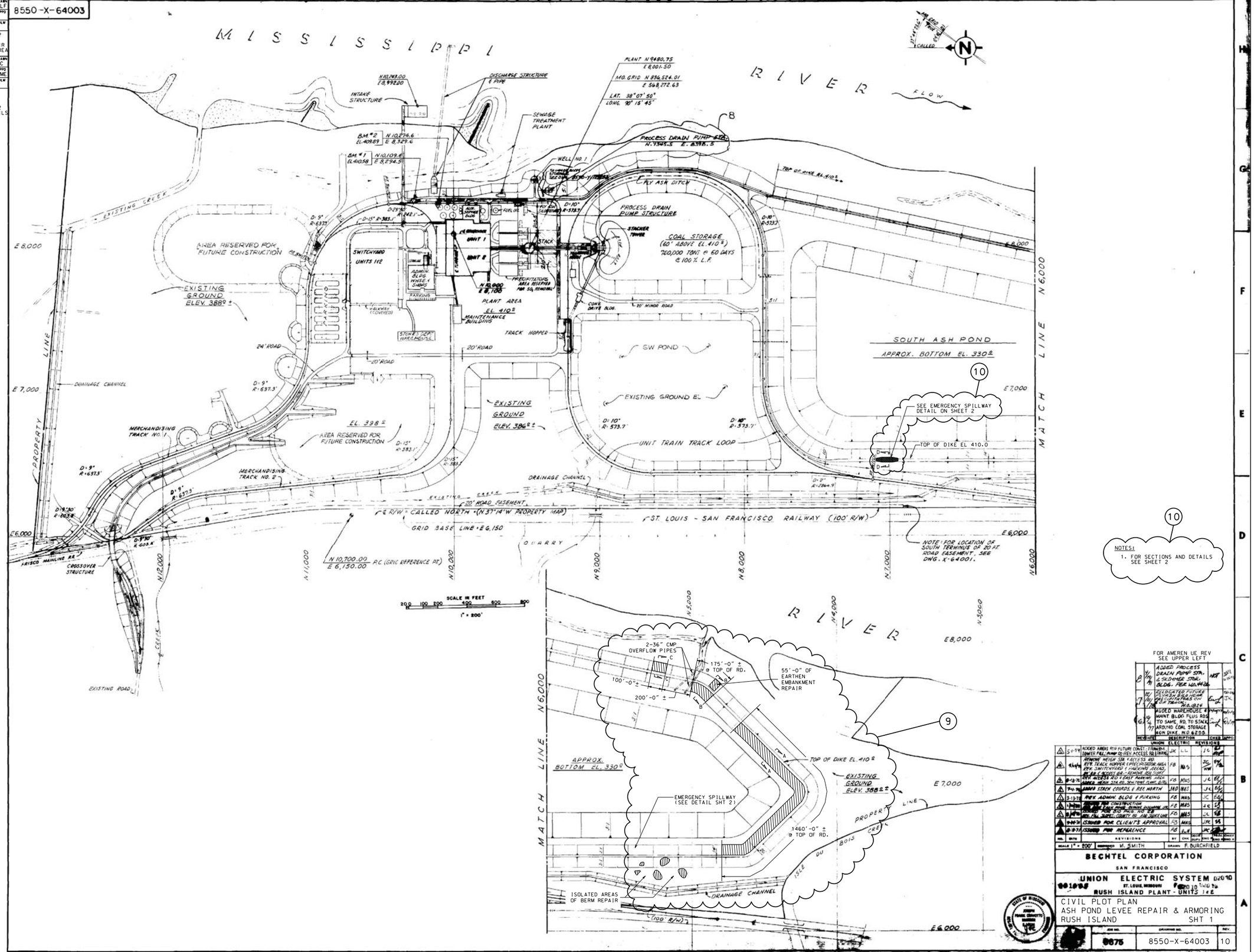
REV	DATE	DRAWN
9	042210	DLF
CHKD	SUPV	APPD
NOT		
B.O.		FILM

ADD RIPRAP TO WATER SIDE: REPAIR DAMAGED AREA

REV	DATE	DRAWN
10	062310	TC
CHKD	SUPV	APPD
KAJ	KAJ	CME
B.O.		FILM

ADD EMERGENCY SPILLWAY ADDED SHT2 MOVED DTAILS TO SHT2

8550-X-64003



10

NOTES:
1. FOR SECTIONS AND DETAILS SEE SHEET 2

9

FOR AMEREN UE REV SEE UPPER LEFT

NO.	DATE	REVISIONS	BY	CHK	SUPV	ENG	PROJ MGR
B	11/11/11	ADDED PROCESS DRAIN PUMP STR. & SILOMER STRG. BLDG. PER MO.4426	MAT				
A	11/11/10	RELOCATED FUTURE FLOW SM. SOLIDS CONCENTRATORS OUT OF TRAFFIC PER MO.4264					
9	6/24/10	ADDED WAREHOUSE & MAINT BLDG PLUS RDS TO SAME, RD. TO STACK, AROUND COAL STORAGE & DIKE, MO 4255					
NO.	DATE	REVISIONS	BY	CHK'D	SUPV'D	ENG'D	PROJ MGR'D
5	5-7-79	ADDED AREAS FOR FUTURE CONST.; FINISH EL. RAMP TO REV. ACCESS RD. GRADE	JK	LL		JC	
4	4-4-79	REMOVE HEIGH STA. ACCESS RD. REV. TRACK, HOPPER & PRECIPITATOR AREA REV. SWITCHYARD & PARKING AREAS, REV. E. ACCESS RD. & REMOVE RDS. TO ASH POND	FB	MAS		JC	
3	3-6-79	REV ACCESS RD. & EAST PARKING AREA	FB	MAS		JC	
2	2-16-79	REMOVE HEIGH STA. RD. SEW. TREAT. PLANT, & STA.	FB	MAS		JC	
1	1-10-79	ADDED STACK COORDS. & REV. NORTH ACCESS RD.	MD	MAS		JC	
0	3-13-78	REV. ADMIN. BLDG. & PARKING	FB	MAS		JC	
A	1-9-78	REV. FOR CONSTRUCTION DRAWING NO.	FB	MAS		JC	
B	9-8-77	REV. FOR CLIENT'S APPROVAL	FB	MAS		JC	
A	8-9-77	REV. FOR CLIENT'S APPROVAL	FB	MAS		JC	
	7-27-77	ISSUED FOR CLIENT'S APPROVAL	FB	MAS		JC	
	6-27-77	ISSUED FOR REFERENCE	FB	LLB		JC	

SCALE 1" = 200' W. SMITH DRAWN F. BURCHFIELD

BECHTEL CORPORATION
SAN FRANCISCO

UNION ELECTRIC SYSTEM
ST. LOUIS, MISSOURI
RUSH ISLAND PLANT - UNITS 1 & 2

CIVIL PLOT PLAN
ASH POND LEVEE REPAIR & ARMORING
RUSH ISLAND SHT 1

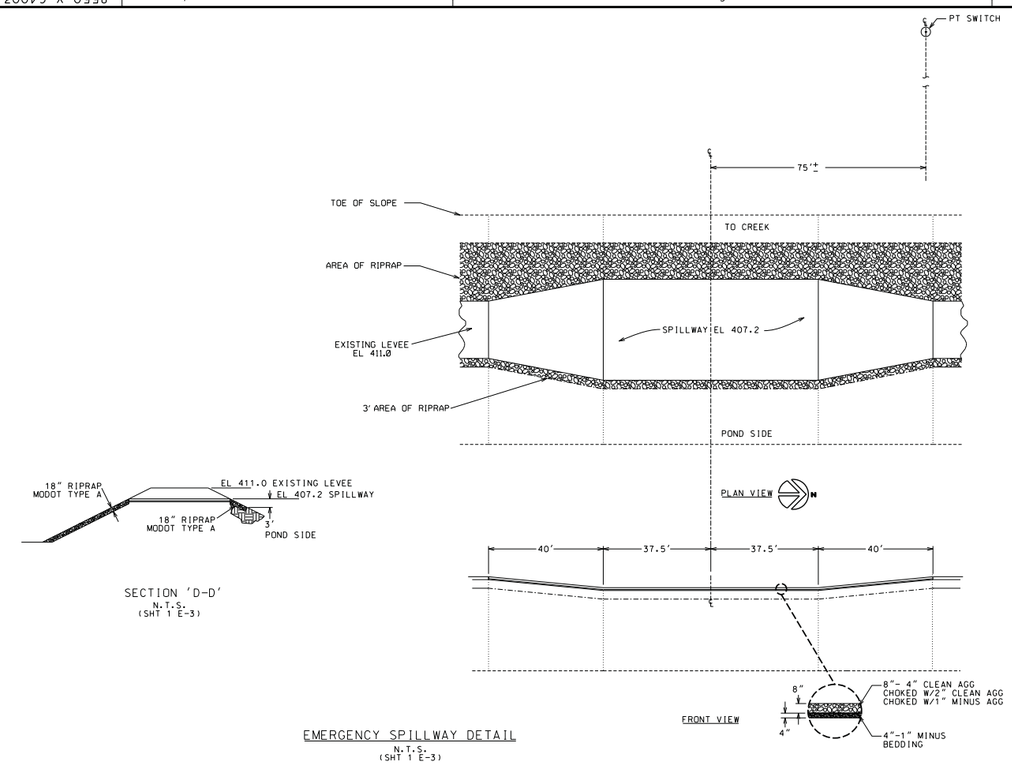
JOB NO.	DRAWING NO.	REV.
6875	8550-X-64003	10

PRINT DIST.

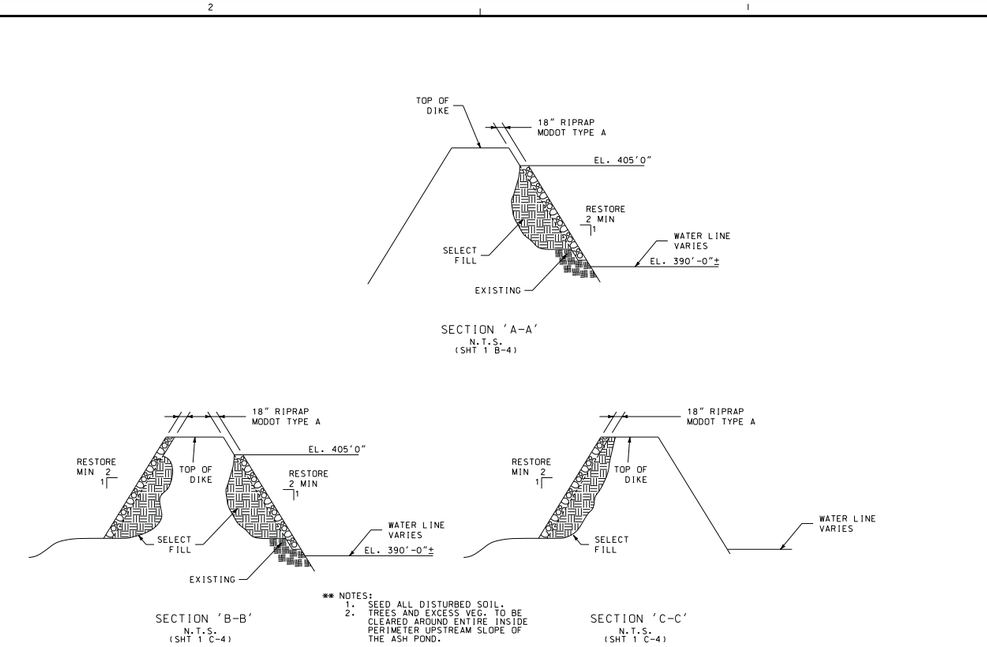
REVISIONS		
REV.	W.O.	
REV O	DATE 062310	DRAWN TC
CHKD KAJ	SUPV KAJ	APPD GME
W.O.		FILM

CREATE SHT 2 ADD SPILLWAY DETAIL AND MVE SECTIONS TO THIS SHT FRM SHT1

8550-X-64003



EMERGENCY SPILLWAY DETAIL
N.T.S.
(SHT 1 E-3)



** NOTES:
1. SEED ALL DISTURBED SOIL.
2. TREES AND EXCESS VEG. TO BE CLEARED AROUND ENTIRE INSIDE PERIMETER UPSTREAM SLOPE OF THE ASH POND.

APPROVED FOR CONSTRUCTION
JOB NO. INITIALS

NOTICE OF LIMITED RESPONSIBILITY

THE RESPONSIBILITY OF THE UNDERSIGNED ENGINEER IS LIMITED TO THE DESIGN WORK SHOWN ON PROJECT DRAWINGS AND DOCUMENTS BEARING HIS/HER SEAL, SIGNATURE OR INITIALS. HE/SHE DOES NOT HAVE AUTHORITY OVER THE PROJECT AS A WHOLE. THE UNDERSIGNED DISCLAIMS ANY RESPONSIBILITY FOR WORK DONE UNDER SUBSEQUENT REVISIONS AND ANY OTHER DOCUMENTS ASSOCIATED WITH THE PROJECT WHICH DO NOT BEAR HIS/HER SEAL, SIGNATURE OR INITIALS.

PREPARED FOR Ameren UE

DRAWN 6/23/10 CALZA	CIVIL PLOT PLAN
CHKD. K A JONES	ASH POND LEVEE REPAIR & ARMORING SECTIONS AND DETAILS SHT 2
SUPV. K A JONES	
APPD. EBERHART	LOCATION 001008 — CLASS 02010
Ameren — ST. LOUIS, MISSOURI	8550-X-64003 — REV. 0

37-13-070 Rev. 9-95

OKEBORDERS

PRINT DIST.

REVISIONS

REV.	W.O.	
——	——	
REV 2	DATE 09898	DRAWN RWV
CHKD	SUPV	APPD
W.O.		FILM

CHNG COORDINATES

8550-X-92765

E 8500

E 7500

E 6500

N 8000

N 7500

N 7000

N 6500

N 6000

N 5500

N 5000

N 4500

N

SCALE IN FEET
20.0 100 200 300 400
1" = 100'

NAIL SET (NOT TO SCALE)
N. 5887.529
E. 7883.598
EL. 411.58

NAIL SET (NOT TO SCALE)
N. 5884.537
E. 6281.539
EL. 401.39

ASH POND #591

Elev. Top Mon. 410.97'
Mon. #1
N. 6398.520
E. 8391.624

Elev. Top Mon. 410.70'
Mon. #2
GONE-1998

Elev. Top Mon. 409.40'
Mon. #3
N. 6098.948
E. 7599.598

Elev. Top Mon. 412.48'
Mon. #503
N. 4593.408
E. 7724.909

Elev. Top Mon. 411.23'
Mon. #502
N. 4085.980
E. 6981.800

Elev. Top Iron Pipe 411.41'

N. 4199.378'
E. 6917.283'

N. 4135.79'
E. 3785.79'

S. 32°00' E. 2845.03' to 3526'

Base Line S. 32°00' E. 2845.03' to 3526'

E 2+50

E 1+50

E 0+50

S. 0+50
E. 0.00

S. 32°00'

135'

S. 0.00'
E. 0.00'

Elev. Top Iron Pipe 408.89'
N. 6324.804
E. 6320.049

Elev. Top Mon. 408.88'
Mon. #500
N. 6173.388
E. 6429.261

Iron Pipe S. 5+00
Elev. Top Pipe 409.89'

Iron Pipe S. 10+00
Elev. Top Pipe 410.08'

Iron Pipe S. 15+00
Elev. Top Pipe 410.44'

Iron Pipe S. 20+00
Elev. Top Pipe 411.45'

Iron Pipe S. 23+00
Elev. Top Pipe 410.74'

Base Line S. 0° 03' 16" E.

90°

Note
N. 4504.803
E. 6351.127 Plt. Coordinates

SUPERSEDES 8550-X-92765 REV! DATE 3-13-84

NOTICE OF LIMITED RESPONSIBILITY
THE RESPONSIBILITY OF THE UNDERSIGNED ENGINEER IS LIMITED TO THE DESIGN WORK SHOWN ON PROJECT DRAWINGS AND DOCUMENTS BEARING HIS SIGNATURE AND SEAL. THE ENGINEER DOES NOT HAVE AUTHORITY OVER THE PROJECT AS A WHOLE, THE UNDERSIGNED DISCLAIMS ANY RESPONSIBILITY FOR WORK DONE UNDER THE PROJECT WHICH IS NOT SHOWN ON DRAWINGS BEARING HIS SEAL AND THE PROJECT WHICH DO NOT BEAR HIS/HER SEAL, SIGNATURE OR INITIALS.

DRAWN 3-16-84 R. WEBER	PROPERTY PLAN SURVEY	
CHKD. 3-16-84 H. PFIFFNER	ASH POND #591	
SUPV. HEM	INSTRUMENT PT. LOCATION	
APPD.	LOCATION 001008	RUSH ISLAND PLANT — CLASS 0210
UNION ELECTRIC COMPANY ST. LOUIS, MO.	8550-X-92765	REV. 2

8550-X-092765

37-0-069 Rev. 5-85

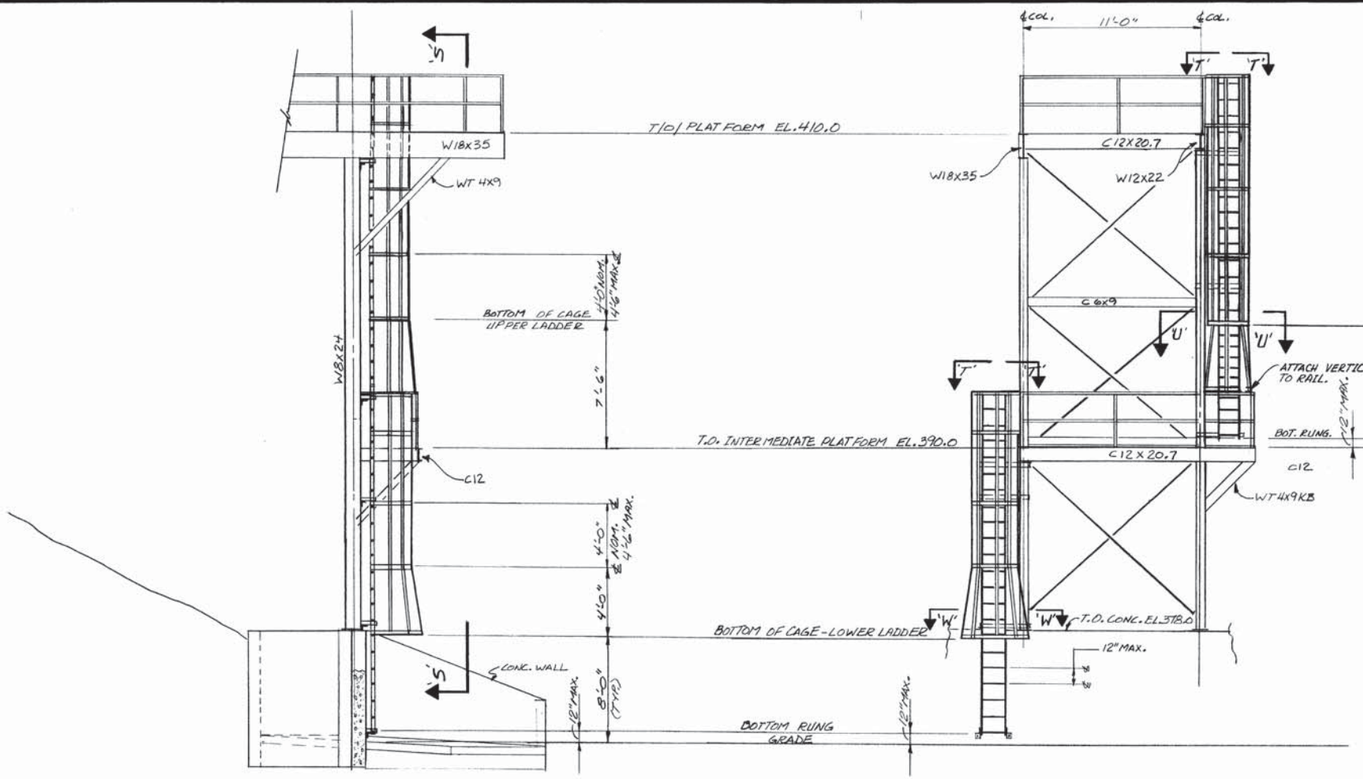
PRINT DIST.

REVISIONS

REV	M C	
0	E1/2	F

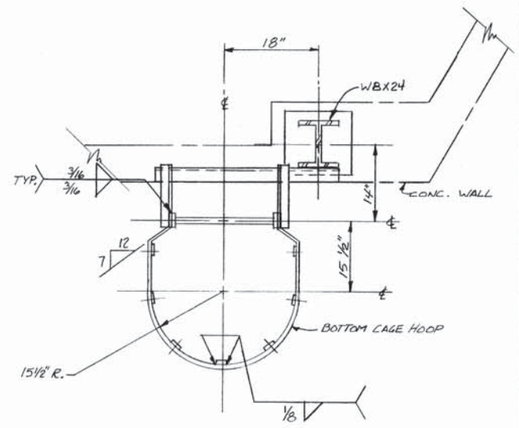
FIRST ISSUE

8550-Y-124127



ELEVATION 'S-S'

NO SCALE

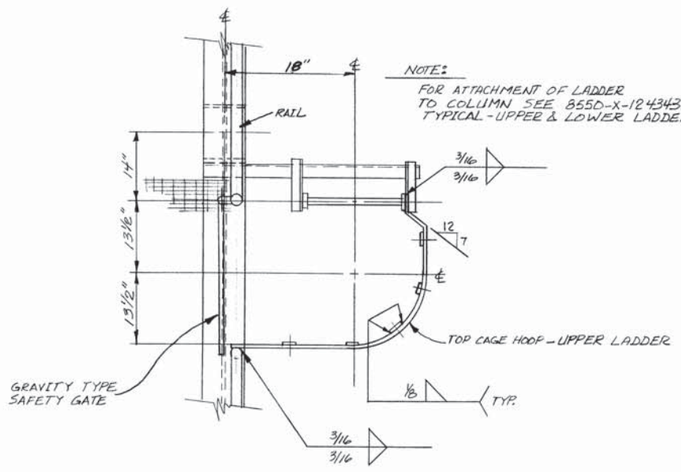


SECTION 'W-W'

AT LOWER LADDER NO SCALE

ELEVATION AT LADDERS

NO SCALE



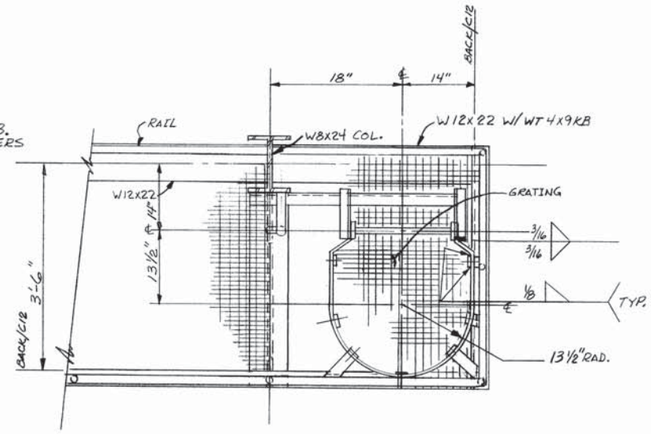
NOTE:

FOR ATTACHMENT OF LADDER TO COLUMN SEE 8550-X-124343. TYPICAL - UPPER & LOWER LADDERS

SECTION 'T-T'

AT UPPER LADDER - SHOWN
AT LOWER LADDER - OPPOSITE HAND

NO SCALE



SECTION 'U-U'

AT UPPER LADDER NO SCALE

NOTES:

1. ALL WORK TO BE DONE IN ACCORDANCE WITH UNION ELECTRIC SPECIFICATION EC-2438.

REFERENCE DRAWING:

STRUCTURE ASSEMBLY AND DETAILS ------ 8550-X-124343

NOTICE OF LIMITED RESPONSIBILITY

THE RESPONSIBILITY OF THE UNDERSIGNED ENGINEER IS LIMITED TO THE DESIGN WORK SHOWN ON PROJECT DRAWINGS AND DOCUMENTS BEARING HIS/HER SEAL, SIGNATURE OR INITIALS. HE/SHE DOES NOT HAVE AUTHORITY OVER THE PROJECT AS A WHOLE. THE UNDERSIGNED DISCLAIMS ANY RESPONSIBILITY FOR WORK DONE UNDER SUBSEQUENT REVISIONS AND ANY OTHER DOCUMENTS ASSOCIATED WITH THE PROJECT WHICH DO NOT BEAR HIS/HER SEAL, SIGNATURE OR INITIALS.

DRAWN 9-28-91 MSB
CHKD. NOT CHKD.
SUPV. [illegible]
APPD. 11-4-91 R. KINDER

STRUCTURE-STEEL FRAMING & DETS.
LADDER DETAILS
ASH POND DISCHARGE 1991 MODS.

LOCATION 001008 RUSH ISLAND PLANT CLASS 04060

UNION ELECTRIC COMPANY ST. LOUIS, MO.

8550-Y-124127 REV. 0

37-13-118 Rev. 4-73

8550-X-124340

REVISIONS

REV	BY	DATE	
0	MJB	4/12	FIRST ISSUE

ROAD (ROCK DRIVE)

EL. 410.0 / EL. 400.0 / EL. 390.0 / EL. 380.0 / EL. 370.0

WATER LEVEL

389.94 TOP OF PIPE (EXIST.)

390.3 FLOWLINE 375.92

397.11 400.18 404.53 408.49 409.94 410.58 410.80 410.52 408.93 TOP OF SLOPE 406.07 401.14 397.80 394.53 390.98 388.73 388.19 387.16 TOP OF SLOPE 382.16

382.54 FLOWLINE

36"ϕ CMP (EXISTING)

STATIONING IS ALONG ℄ OF 36"ϕ PIPE (C.M.P.)

SECTION 'A-A' @ NORTH DISCHARGE

N. 5100 21+32.03 2+00 1+90 1+80 1+70 1+60 1+50 N. 5050 1+40 1+30 1+20 1+10 1+00 0+90 0+80 0+70 0+60 0+50 N. 5000 0+40 0+30 0+20 0+10 0+00

EXISTING SLOUGH TO MISSISSIPPI RIVER

N. 4929.445
E. 7817.772
INV. EL. 372.49

(NEW RIPRAP (REF. DWG. 8560-X-124343)

N. 4892.199
E. 7813.703
INV. EL. 372.70'

EXIT

VALVE MOTOR OPER. SEE 8500-X-124341

FOR ENLARGED PLAN AND DETAILS SEE 8500-X-124341

30°

N. 4950 N. 4900

E. 7800

℄ EXISTING 36"ϕ C.M.P. (232.03 L.F.) 4.33% GRADE

NEW METAL PLATFORM SEE 8560-X-124343

EXISTING 36"ϕ C.M.P. (203.44 L.F.) 6.05% GRADE

NEW 24"ϕ PIPE INSIDE OF 36"ϕ C.M.P. (HDPE PIPE)

EL. 410.33 ℄ ROCK DRIVE

EL. 410.42 ℄ OF ROCK DRIVE

EL. 410.66 ℄ ROCK DRIVE

EL. 410.80 ℄ ROAD @ ℄ PIPE

EL. 409.70 TOP OF SLOPE

EL. 406.70

EL. 409.10 TOP OF SLOPE

EL. 410.16

EL. 410.00

E. 7750

CO2 CONTROL VLV. (NEW)

EXIST. 2½" DIA. PIPE GUARDS

EXIST. CO2 VALVE STA. (SEE ENLARGED PLAN) 8500-X-124341
N. 5058.072
E. 7739.492

4'x4' CONC. PAD

EL. 409.97 TOP OF SLOPE

EL. 410.75 ℄ ROCK DRIVE

NEW POWER POLE W/ U.E. DUSK TO DAWN LIGHT

6'x6' SAMPLE CONTROL HOUSE (NEW) SEE 8550-Y-124342 (SEE NOTE-2) (PLACE PARALLEL TO ROAD)

4' 3'

54'± ℄ 18 FT. WIDE ROCK DRIVE

NEW 6"ϕ SCH. 40 GUARD POSTS SEE 8550-X-640126

ROCK AREA (EXIST.)

EDGE OF ROCK AREA

EL. 398.10

EL. 400.04

EL. 402.24

EL. 404.63

EL. 406.83

N. 5012.667
E. 7736.973
EL. 410.64 EL. 407.60

EL. 396.01 TOP OF WALL

EL. 391.89 BASE OF WALL

EXIST. RAMP

EXIST. PLATFORM

N. 5050
E. 7700
EL. 396.63

N. 5031.070
E. 7705.726

EL. 390.30 EDGE OF WATER

EL. 391.0

EL. 394.24 TOP OF WALL

EL. 391.49 BOT. WALL

EL. 390.3 EDGE OF WATER

EL. 397.10

EL. 400.40

E. 7700

EXISTING RETAINING WALL

EXIST. RAMP

3"PVC (TYP.) SEE NOTE-2

EXIT POINT TO BE AT EL. 392.0.

FLEX HOSE EXIST.

PROVIDE NEW CO2 INJECTOR PIPING SEE 8500-X-124341

N. 5117.821
E. 7682.305
INV. EL. 382.54'

'A'

5'

10' RAD MIN.

ASH POND

SKIMMER BOOM - EXIST. (TYP.) SEE 8550-X-640126

PROVIDE REP-RAP 10" MINUS 2'0" THK.

RIP-RAP - 8" MINUS, 1'6" THK.

5' RAD MIN.

N. 5038.790
E. 7665.513
INV. EL. 385.31'

N. 5050 N. 5000 N. 4950

PLAN @ ASH POND DISCHARGE

NO SCALE

NOTES:

1. ALL WORK TO BE DONE IN ACCORDANCE WITH U.E. SPECIFICATION EC-2438.
2. FIELD ROUTE SAMPLE SUPPLY FROM POINT AT EXIT OF 24"ϕ PIPE TO SAMPLE CONTROL HOUSE AND SAMPLE DRAIN FROM SAMPLE CONTROL HOUSE TO ASH POND. ALL PER U.E. ENGINEERING APPROVAL. SAMPLE DRAIN TO BE 3"ϕ PVC PIPE & SUPPLY TO BE 2" SCH. 80. ALL PIPE TO BE BURIED A MINIMUM 3'-0" BELOW GRADE. DRAIN PIPE TO EXIT DIKE SURFACE AT EL. 392.0'. RIP-RAP TO EDGE OF WATER.

REFERENCE DRAWINGS:

PIPING - CO2 & SAMPLING ---------- 8550-X-124341
STL - PLATFORM ---------- 8550-Y-124343
BLDG - SAMPLE CONTROL HOUSE ---------- 8550-Y-124342

NOTICE OF LIMITED RESPONSIBILITY
THE RESPONSIBILITY OF THE UNDERSIGNED ENGINEER IS LIMITED TO THE DESIGN WORK SHOWN ON PROJECT DRAWINGS AND DOCUMENTS BEARING HIS/HER SEAL, SIGNATURE OR INITIALS. HE/SHE DOES NOT HAVE AUTHORITY OVER THE PROJECT AS A WHOLE. THE UNDERSIGNED DISCLAIMS ANY RESPONSIBILITY FOR WORK DONE UNDER SUBSEQUENT REVISIONS AND ANY OTHER DOCUMENTS ASSOCIATED WITH THE PROJECT WHICH DO NOT BEAR HIS/HER SEAL, SIGNATURE OR INITIALS.

STATE OF MISSOURI — KARL D. GAUS — NUMBER E-21805 — REGISTERED PROFESSIONAL ENGINEER

DRAWN 8-19-91 M. BRUNS	PROPERTY-PLAN & SURVEY ASH POND DISCHARGE, PIPING, & SAMPLING MODIFICATIONS
CHKD. MBT CHKD	
SUPV. KDG	
APPD. 11-27-91 K.D.G.	LOCATION 000005 — RUSH ISLAND PLANT — CLASS 0300
UNION ELECTRIC COMPANY ST. LOUIS, MO.	8550-X-124340 — REV. 0

* 8550-X-124340 *

37-13-269 Rev. 2-73

PRINT DIST.

REVISIONS

REV	BY	DATE
0	EJD	2/12 (E)

FIRST ISSUE

8550-X-124341

ROCK DRIVE

EXISTING 2½"ϕ GUARD POSTS

EXIST. CO2 RISER (SUPPLY)
N. 5056.088
E. 7744.439

12" NEW
2'-6" (EXISTING) CO2 SUPPLY
6" NEW
6" NEW
1'-6" NEW
1" PIPE
4'-10" NEW
EXIST. 5" PIPE
EXIST. LIFE JACKET CABINET
NEW ½" CONTROL VALVE W/ ACTUATOR IN WATER TIGHT NEMA ENCLOSURE. (12"W x 18"H x 24"D MIN.)
(VALVE & ACTUATOR FURNISHED BY U.E. & INSTALLED BY CONTRACTOR)
1"ϕ x ½" RED. INSERT (TYP.)
EXIST. FLEX HOSE
EXIST. FLEX-PIPE CO2 SUPPLY
EXISTING 4'FT x 4'FT. CONCRETE PAD
EXIST. 1" PIPE (CO2)
EXISTING METAL PLATFORM
8'-0"
1'-0"
2'-0"
1'-0"

N

TO CO2 INJECTOR AT SKIMMER BOOM SEE DETAIL

PLAN @ CO2 VALVE STATION

6" NEW
2'-6" EXISTING
18" NEW
NEW 1" SCH. 80 PIPE NIPPLE
NEW 1" SCH. 80 PIPE
EXIST. 4 PIPE STAND
NEW ½" CONTROL VALVE WITH ACTUATOR IN NEMA WATER TIGHT ENCLOSURE. (12"H x 18"W x 24"D MIN.) MOUNT TO EXISTING 5" ϕ PIPE. (VALVE & ACTUATOR FURNISHED BY U.E. INSTALLED BY CONTRACTOR)
EXISTING
EXISTING
4'-6"
9'-6"
GRADE EL. 410±
EXIST. FLEX PIPE
EXISTING CO2 SUPPLY RISER

ELEVATION 'C-C' @ CO2 VALVE STATION

2"ϕ TO SAMPLE CONTROL BLDG.
2" CHECK VLV.
2" SCH. 80 GALV.
2"-115 NPT
2" SCH. 80 GALV. TYP.
2" GLOBE VLV.
CAP CLEANOUT
2" FULL PORT BALL VLV.
POWER SUPPLY
SUBMERSIBLE SAMPLE PUMP
8'-0" ±
1'-0"
1'-0"
24"ϕ HDP PIPE

SECTION 'F-F'

24"ϕ x 2" HDPE
2" GALV. SCH. 80

DETAIL @ SAMPLE PIPE ATTACHMENT

NEW CONC. RETAINING WALL & SPILL WAY SEE 8550-X-124343
NEW MOTOR OPERATORS FOR BUTTER FLY VALVES
TO RIVER
7'-0"
3'-0"
2'-6" CLR.
4'-6" CLR.
2'-4½"
NEW 24"ϕ HDP PIPE BELOW
NEW 24" BUTTERFLY VALVES BELOW
NEW METAL ACCESS PLATFORM T.O.S. EL. 410.0 SEE 8550-X-124343
2" SCH. 80 SAMPLE LINE TO SAMPLE CONTROL BLDG.
EXIST 36"ϕ CMP INV. EL. 372.49 STA. 0+00
SUBMERSIBLE SAMPLE PUMP & PIPING BELOW

PLAN @ VALVE MOTOR OPERATORS
(NORTH DISCHARGE EXIT)

3'-0"
NEW MOTOR OPERATORS (FURNISHED BY U.E. INSTALLED BY CONTRACTOR)
FLOOR STANDS MOUNT TO PLATFORM STEEL
3'-9.5"
PLATFORM STEEL EL. 410.0
DRIVE SHAFTS DOWN TO VLV. ACTUATORS.

ELEVATION @ VLV. MOTOR OPERATORS

EXIST. SKIMMER
PROVIDE FLANGE EL. 388.0'
WATER LEVEL 390.3'
TO CO2 VALVE STATION SEE DETAIL
ϕ PIPE
GROUT BETWEEN PIPES
EXIST. GRADE
EXIST. 36"CMP. CUT BACK
NEW 24"ϕ HDP PIPE
TO RIVER
NEW HDP 90° EL.
INV. EL. 382.54
CONCRETE ANCHOR (SEE NOTE-4)
3'-0"

DETAIL @ NORTH SKIMMER

NOTE: REMOVE TOP SET OF VALVES (½") AND FLOW METER.
6"
3'-6"
NEW 1" SCH. 80 PIPE
EXIST. 5" PIPE
½" PIPE SCH. 80
NEW ½" CONTROL VALVE & ENCLOSURE
NEW 1" UNION TYP. EACH SIDE OF CONTR. VLV.
1"ϕ x ½" RED. INSERT
EXIST. CO2 SUPPLY
TO CO2 INJECTOR 1" EXIST.
EXISTING
3'-1½"
5'-3½"
2'-0½"
GRADE EL. 410± (EXIST.)

ELEVATION 'B-B' @ CO2 VALVE STATION

24"ϕ PIPE
3"x¼" STRAP
INV. EL. 372.49
PROTECTIVE SLEEVES
THREADED ROD (GALV.) TYP. W/HEX NUTS
PIPE ROLL FOR 24" HDP PIPE
NOTE: FOR CONCRETE DESIGN SEE 8500-X-124343
4"x4"x¼" ∠ (TYP) W/HEX NUTS

SECTION 'D-D'

7'-0"
1'-0"
2"ϕ SCH. 80 SAMPLE FILL (SEE NOTE-2)
DRIVE SHAFTS UP TO MOTOR OPERATORS
FOR LADDER OVER PIPE SEE ELEV. 'K-K' 8550-X-124343
PIPE SLEEVE
TO SAMPLE CONTROL HOUSE
EXIST. 36"ϕ CMP (5'-0" BACK FROM EXIT END)
FILL VOIDS BETWEEN PIPES WITH GROUT
2" CHECK VLV.
SAMPLE PUMP
2" GLOBE VALVE
3'-0"
24"ϕ BUTTERFLY VALVE (NEW) WAFER STYLE TYP. OF 2
(FURNISHED BY U.E./INSTALLED BY CONTRACTOR)
PROTECTIVE SLEEVES TYP.
ϕ 24"ϕ HDP PIPE
INV. EL. 372.49 MAX
24" SLIP ON BACK WATER VALVE
RIP-RAPP COATED W/ CONCRETE
PIPE ROLL FOR 24"ϕ PIPE - TYP.

DETAIL @ ASH POND DRAIN EXIT TO RIVER
(AT NORTH DISCHARGE EXIT)

24" BUTTERFLY VALVE
DRIVE SHAFT
2" SQ. NUT.
ACTUATOR
24"ϕ HDP PIPE

SECTION 'E-E'

CAP
1" BALL VLV.
3/16
MODIFIED BLIND FLANGE
FROM CO2 VALVE STATION 1" SCH. 80 GALV. PIPE CONNECT TO EXIST. FLEX HOSE. (NOTE-2)
WATER LEVEL EL. 390.3
GRADE
4" HDP PIPE
GROUT
EXIST. 36"ϕ CMP
BRANCH SADDLE
NEW 24" HDP PIPE
TO RIVER
CUT PIPE END @ 45°

DETAIL @ CO2 INJECTION

NOTES:
1. ALL WORK TO BE DONE PER UNION ELEC. SPEC. EC-2438.
2. ALL 1"ϕ SCH. 80 PIPING ABOVE GROUND TO BE GALVANIZED. ALL 1" SCH. 80 PIPING BELOW GROUND TO BE COMMON CARBON STEEL.
3. ALL PIPING, 2" & SMALLER TO BE SCHEDULE 80.
4. INSTALL CONCRETE ANCHOR SO AS TO PREVENT SEEPAGE OF WATER INTO EXIST. 36"ϕ CMP.

8550-X-124341

THIS DRAWING HAS NO SCALE

NOTICE OF LIMITED RESPONSIBILITY
THE RESPONSIBILITY OF THE UNDERSIGNED ENGINEER IS LIMITED TO THE DESIGN SHOWN ON PROJECT DRAWINGS HAVE DOCUMENTS BEARING HIS/HER SEAL SIGNATURE OR INITIALS. HE/SHE DOES NOT HAVE AUTHORITY OVER THE PRODUCT AS A WHOLE. THE UNDERSIGNED DISCLAIMS ANY RESPONSIBILITY FOR WORK DONE UNDER SUBSEQUENT REVISIONS AND ANY OTHER DOCUMENTS ASSOCIATED WITH THE PROJECT WHICH DO NOT BEAR HIS/HER SEAL SIGNATURE OR INITIALS.

STATE OF MISSOURI KARL D. GAUS NUMBER E-21805 REGISTERED PROFESSIONAL ENGINEER

DRAWN 8-21-91 M. BEUNS	PIPING-INSTAL. & DETAILS ASH POND DISCHARGE, PIPING, & SAMPLING MODIFICATIONS		
CHKD. NOT CHKD			
SUPV.			
APPD.	LOCATION 001008	RUSH ISLAND PLANT	CLASS 05030
UNION ELECTRIC COMPANY ST. LOUIS, MO.	8550-X-124341		REV. 0

4 3 M 2 1

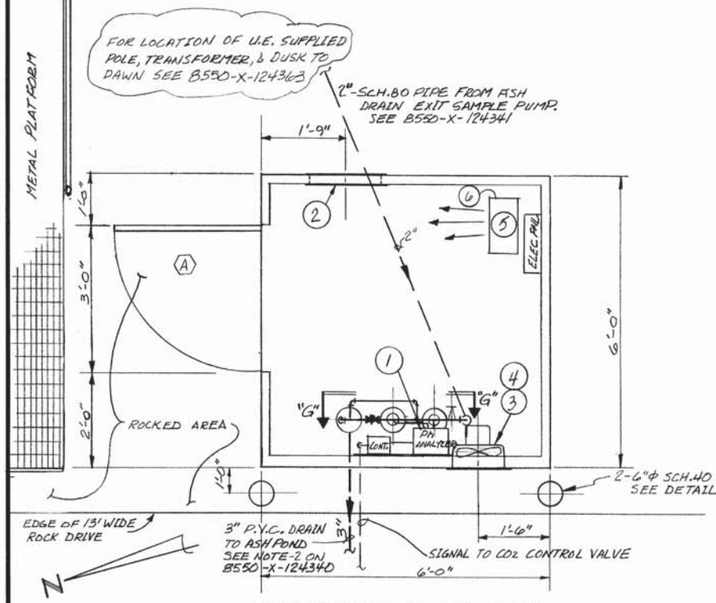
PRINT DIST.

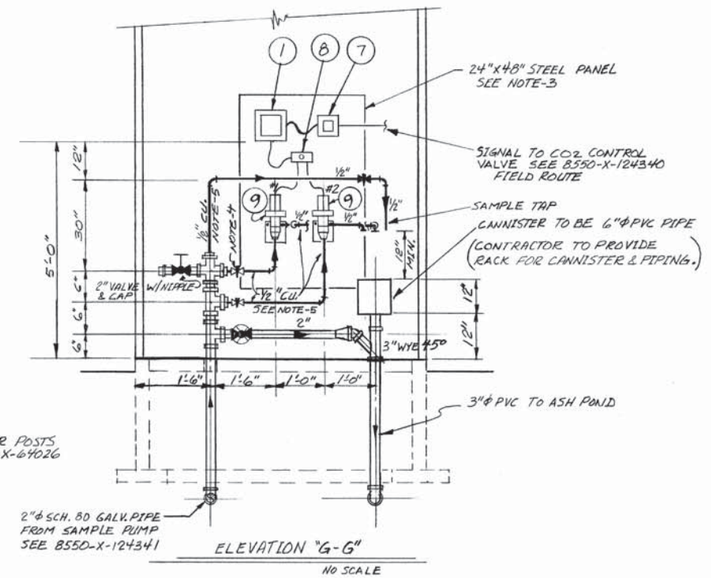
REVISIONS

REV			
0	E1/2	E	

FIRST ISSUE

8550-Y-124342





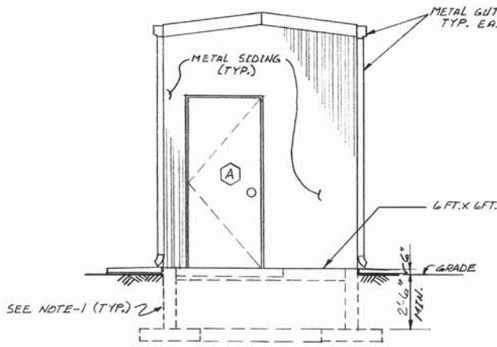
EQUIPMENT BILL OF MATERIALS

ITEM NO.	ITEM QTY.	DESCRIPTION	REMARKS
1	1	#pH400-P-U-1*A/U MICROPROCESSOR pH ANALYZER YOKOGAWA	MOUNT ON STL. PANEL SEE NOTE-3 BY U.E. CO.
2	1	INLET LOUVER - RUSKIN MODEL ELC 6375D COMBINATION LOUVER, 18"X18", EXTRUDED ALUMINUM, DRAINABLE BLADE, 6" DEPTH, MILL FINISH, FLANGED FRAME, INSECT SCREEN, WITH BARBER-COLEMAN MODEL MA-418-500 W/AUX. END SWITCH.	
3	1	EXHAUST FAN - NEW YORK BLOWER MODEL E82-H W/ MOTOR SIDE FAN GUARD, AUTOMATIC SHUTTER, 115V, 1ϕ MOTOR.	
4	1	THERMOSTAT (EXHAUST FAN) BARBER-COLEMAN #TC-4111. MOUNT SENSING BULB ON EXHAUST FAN GUARD.	
5	1	UNIT HEATER - MARLEY "Q-MARK" MODEL MUH-03-B1. 3.0 KW, 208V, 1ϕ, WITH WALL & CEILING MOUNTING BRACKET #MMB-5, WITH POWER DISCONNECT SWITCH MPDS-25.	
6	1	THERMOSTAT (UNIT HEATER) MARLEY "Q-MARK" MODEL WR-1E30-5.	MOUNT ON WALL 3'-6" AFF.
7	1	#UT35-A13301*A/SPD CONTROLLER YOKOGAWA	MOUNT ON STL. PNL SEE NOTE-3 BY U.E. CO.
8	1	SWITCH BOX	MOUNT ON STL. PNL. SEE NOTE-3 BY U.E. CO.
9	2	FLOW-THROUGH SENSOR ASSEMBLY #FF20-S33-FNU-C2-SA-T YOKOGAWA	MOUNT ON STL. PNL SEE NOTE-3 BY U.E. CO.

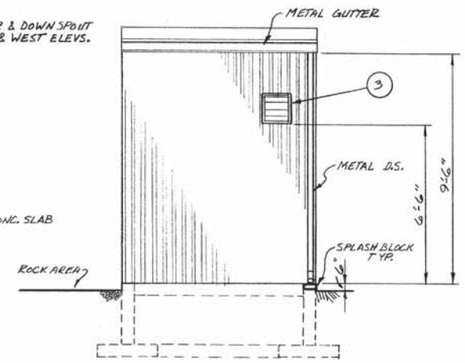
DOOR SCHEDULE

DOOR NO.	DOOR SIZE	DESCRIPTION
A	1-3°x7°x1¾"	HOLLOW METAL FLUSH TYPE DOOR (INSULATED) W/ PRESSED METAL FRAME (5½" STD.), 1½ PAIR FULL MORTISED 2 B.B HINGE - 4½"x4½" x 0.134 GA. HOSPITAL TYPE. PROVIDE "LCN" 4040 DOOR CLOSER, LOCKSET B&B, BEST CYLINDER & CONSTRUCTION CORE. PROVIDE FLOOR MOUNTED STOP W/ HOLD OPEN IVES 449. DOOR TO BE FULLY WEATHERSTRIPPED, HAVE ALUMINUM THRESHOLD (NATIONAL GUARD #525) & DOOR BOTTOM SEAL (NATIONAL GUARD #19). ALL HARDWARE US 26D FINISH.

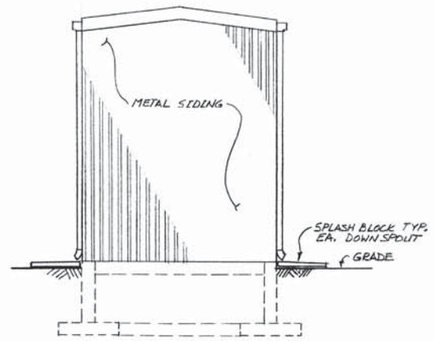
NOTES:
1). ALL HARDWARE TO BE US 26D FINISH.
2). LOCKSETS TO RECIEVE "BEST" CYLINDERS. PERMANENT CORES TO BE PROVIDED BY UNION ELECTRIC CO..
3). CONSTRUCTION CORES TO BE PROVIDED BY CONTRACTOR.



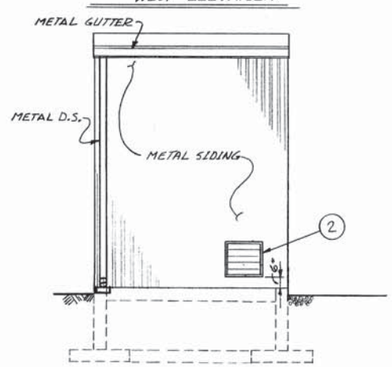
NORTH ELEVATION



WEST ELEVATION



SOUTH ELEVATION



EAST ELEVATION

NOTES:
1). CONCRETE TO BE DESIGNED BY BUILDING MANUFACTURER.
2). CONCRETE TO HAVE MINIMUM COMPRESSIVE STRENGTH OF 3,000 PSI AFTER 28 DAYS.
3). 24"x48" STEEL PNL. & ITEMS 1, 7, & 9 FURNISHED BY U.E. CO. & INSTALLED BY CONTRACTOR. PIPING & ELECTRICAL CONNS. BY CONTRACTOR.
4). VALVES FOR ½" COPPER TUBING TO SENSORS TO BE WHITEY NEEDLE VALVES, BRONZE BODY, TYPICAL.
5). COPPER TUBING CONNECTIONS TO BE MADE WITH SWAGLOK FITTINGS.
6). ALL WORK TO BE DONE PER UNION ELECTRIC SPECIFICATION #2438.

8550-Y-124342

REFERENCE DRAWINGS:

PROPERTY - PLAN	8550-X-124340
PIPING DETAILS	8550-X-124341
BUILDING SERVICES	8550-X-124363

NOTICE OF LIMITED RESPONSIBILITY
THE RESPONSIBILITY OF THE UNDERSIGNED ENGINEER IS LIMITED TO THE DESIGN WORK SHOWN ON PROJECT DRAWINGS AND DOCUMENTS BEARING HIS/HER SEAL, SIGNATURE OR INITIALS. HE/SHE DOES NOT HAVE AUTHORITY OVER THE PROJECT AS A WHOLE. THE UNDERSIGNED DISCLAIMS ANY RESPONSIBILITY FOR WORK DONE UNDER SUBSEQUENT REVISIONS AND ANY OTHER DOCUMENTS ASSOCIATED WITH THE PROJECT WHICH DO NOT BEAR HIS/HER SEAL, SIGNATURE OR INITIALS.

STATE OF MISSOURI
KARL D. GAUS
NUMBER E-21805
REGISTERED PROFESSIONAL ENGINEER

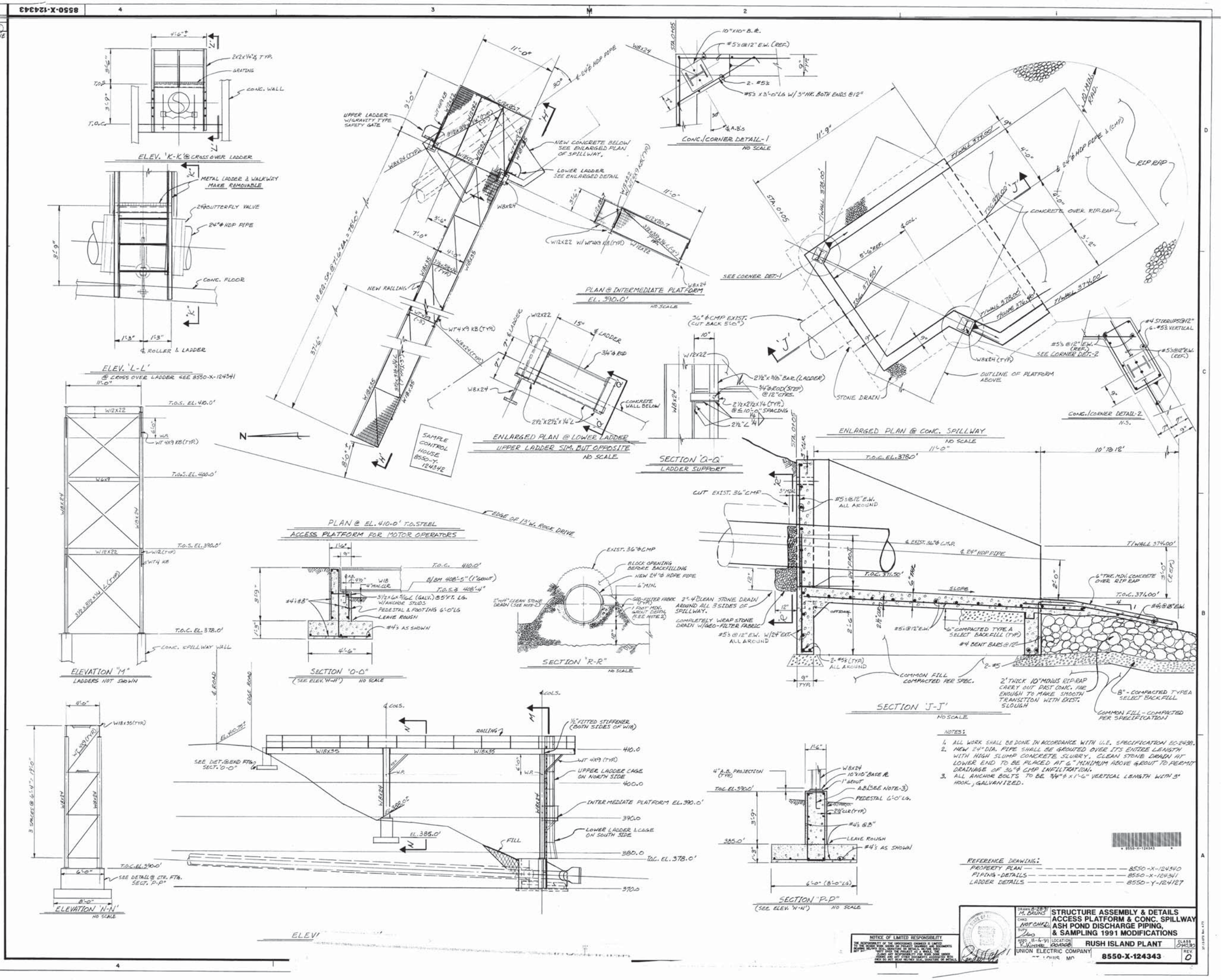
DRAWN 8-24-91 M.BRUNS
CHKD. NOT CHKD.
SUPV. [illegible]
APPD. 9/4/91 [signature]

BUILDING-ARCHITECTURAL PLAN SAMPLE CONTROL BUILDING ASH POND DISCHARGE PIPING, SAMPLING 1991 MODIFICATIONS

LOCATION 001008 — RUSH ISLAND PLANT — CLASS 03020

UNION ELECTRIC COMPANY ST. LOUIS, MO. — 8550-Y-124342 — REV. 0

32-13-118 Rev. 4-73



NOTES:

1. ALL WORK SHALL BE DONE IN ACCORDANCE WITH U.E. SPECIFICATION EC-2438.
2. NEW 24" DIA. PIPE SHALL BE GROUTED OVER ITS ENTIRE LENGTH WITH HIGH SLUMP CONCRETE SLURRY. CLEAN STONE DRAIN AT LOWER END TO BE PLACED AT 6" MINIMUM ABOVE GROUT TO PERMIT DRAINAGE OF 36"Ø CMP INFILTRATION.
3. ALL ANCHOR BOLTS TO BE 3/4"Ø x 1'-6" VERTICAL LENGTH WITH 3" HOOK, GALVANIZED.

REFERENCE DRAWING:

PROPERTY PLAN	8550-X-124340
PIPING-DETAILS	8550-X-124341
LADDER DETAILS	8550-Y-124127

NOTICE OF LIMITED RESPONSIBILITY

DRAWN 8-28-91 M. BRUNS	STRUCTURE ASSEMBLY & DETAILS ACCESS PLATFORM & CONC. SPILLWAY ASH POND DISCHARGE PIPING, & SAMPLING 1991 MODIFICATIONS
CHKD. NOT CHKD.	
APPD. 11-6-91 R. KINDER	LOCATION 001008 RUSH ISLAND PLANT CLASS 04030
UNION ELECTRIC COMPANY ST. LOUIS, MO	8550-X-124343 REV. 0

PRINT DIST.

REVISIONS			
REV.	W.O.		
0			

FIRST ISSUE

REV	DATE	DRAWN
1	00804	MSB
CHKD	SUPV	APPD
NOT		
W.O.		FILM

ADDED FIBER OPTIC AND ELECTRICAL CABLING FOR PERIM. FENCING & GATES

8550-X-159053

MISSISSIPPI RIVER

DIRECTION OF FLOW

INTAKE STRUCTURE

CONTINUOUS BARGE UNLOADER

SEE ENLARGED CBU ENTRANCE PLAN

ASH LOADING FACILITY

DISCHARGE STRUCTURE

LIGHTING

TYMETAL SLIDE GATE #5

UNIT-1

UNIT-2

STACKER HOUSE

DOUBLE SWING GATES 30' OPENING

4' PERSONNEL GATE

ASH POND DISCHARGE STRUCTURE

GATE

SWITCH YARD

SERVICE BLDG.

MAINT. BLDG.

CONVEYOR

COAL STORAGE

PARKING

STORES DEPT.

TRACK HOPPER

ASH POND

TYMETAL SLIDE GATE #8

SEE ENLARGED CONSTRUCTION ENTRANCE PLAN

3 EXISTING SURVEY MONUMENTS TO REMAIN INSIDE OF PERIMETER FENCING

2"X2" C. & 4"X1½" C.

SEE ENLARGED ENTRANCE PLAN

RAILROAD TRACK

ASH POND

PROPERTY LINE

DRAINAGE CANAL

ST. LOUIS-SAN FRANSISCO R.R.

REPAIR 100' OF FENCE IN THIS AREA

TIE NEW FENCE INTO EXISTING FENCE, PERMANENTLY LOCK EXISTING GATE

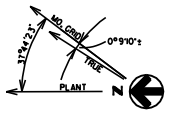
INSTALL 180' NEW MODOT TYPE A GUARDRAIL (MATCH EXISTING)

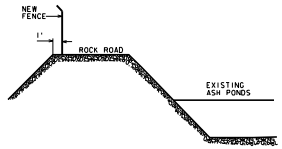
PLANT ENTRANCE

CREEK

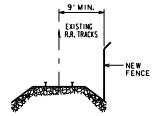
SITE PLAN

SCALE: 1" = 300'

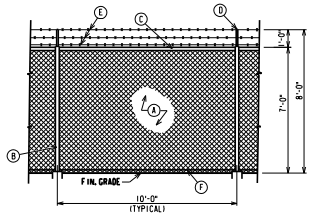


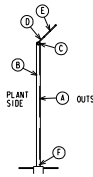


SECTION AROUND ASH PONDS



SECTION FENCE ALONG TRACKS





(A) CHAIN LINK FABRIC - #9 GAUGE STEEL WIRE, WOVEN IN 2" MESH, W/ A CLASS II ALUM. COATING

(B) LINE POST - 2⅜" O.D. GALV. STEEL PIPE

(C) TOP RAIL - 1⅝" O.D. GALV. STEEL PIPE

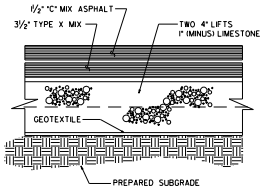
(D) EXTENSION ARM - ARRANGED TO CARRY 3 STRANDS OF BARBED WIRE, 45° TO OUTSIDE

(E) BARBED WIRE - COPPERWELD STEEL CO. "ALUMOWELD" FOUR POINT IOWA TYPE LIGHT WEIGHT

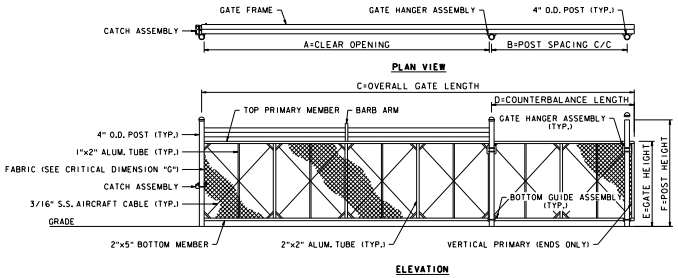
(F) BOTTOM TENSION WIRE - #7 GAUGE ALUMINUM COATED SPRING WIRE OR CRIMPED WIRE

FENCE DETAIL

NO SCALE



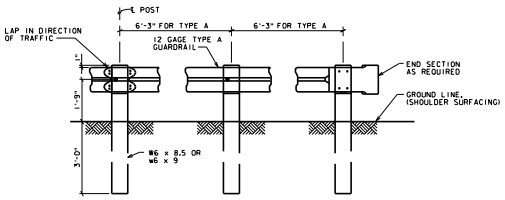
ASPHALT PAVEMENT SECT.

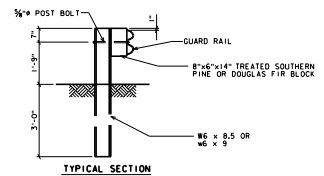


TYMETAL HEAVY DUTY SLIDE GATE

N.T.S.

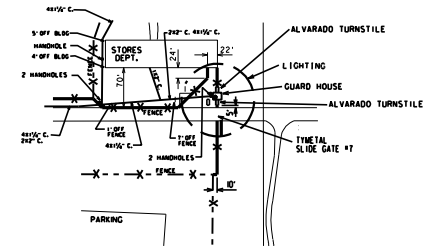
CRITICAL DIMENSION CHART								
GATE NUMBER	1	2	3	4	5	6	7	8
A CLEAR OPENING	20'	30'	30'	30'	20'	20'	30'	30'





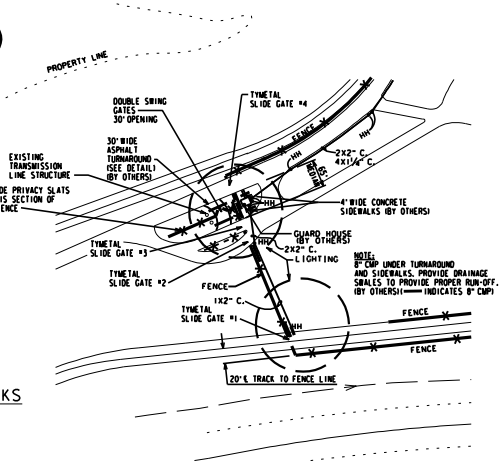
GUARDRAIL DETAIL

MODOT TYPE A GUARDRAIL



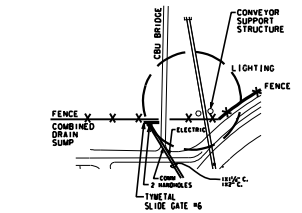
ENLARGED CONSTRUCTION ENTRANCE PLAN

SCALE: 1" = 100'



ENLARGED ENTRANCE PLAN

SCALE: 1" = 100'



ENLARGED CBU ENTRANCE PLAN

SCALE: 1" = 100'

LEGEND

NEW FENCE

EXISTING FENCE

NOTICE OF LIMITED RESPONSIBILITY

PREPARED FOR AMEREN

DESIGN 032703 P.DITT	PROPERTY-2003 SECURITY UPGRADES PERIMETER FENCING-& NEW GUARD HOUSES
CHK/REV NOT CHECKED	
SUPV. 032703 SCOTT A. HELD	
APPD. 032703 B. POETKER	LOCATION 001008 RUSH ISLAND PLANT — CLASS 0201D
AMEREN	ST. LOUIS, MISSOURI 8550-X-159053 — REV. 1

...\CAD\PROJECTS\RI\STR\159053.dgn 06/21/2010 9:35:04 AM

VOLUME I

SOIL AND FOUNDATION INVESTIGATION
RUSH ISLAND PLANT
UNION ELECTRIC COMPANY
ST. LOUIS, MISSOURI

* * *

Report

to

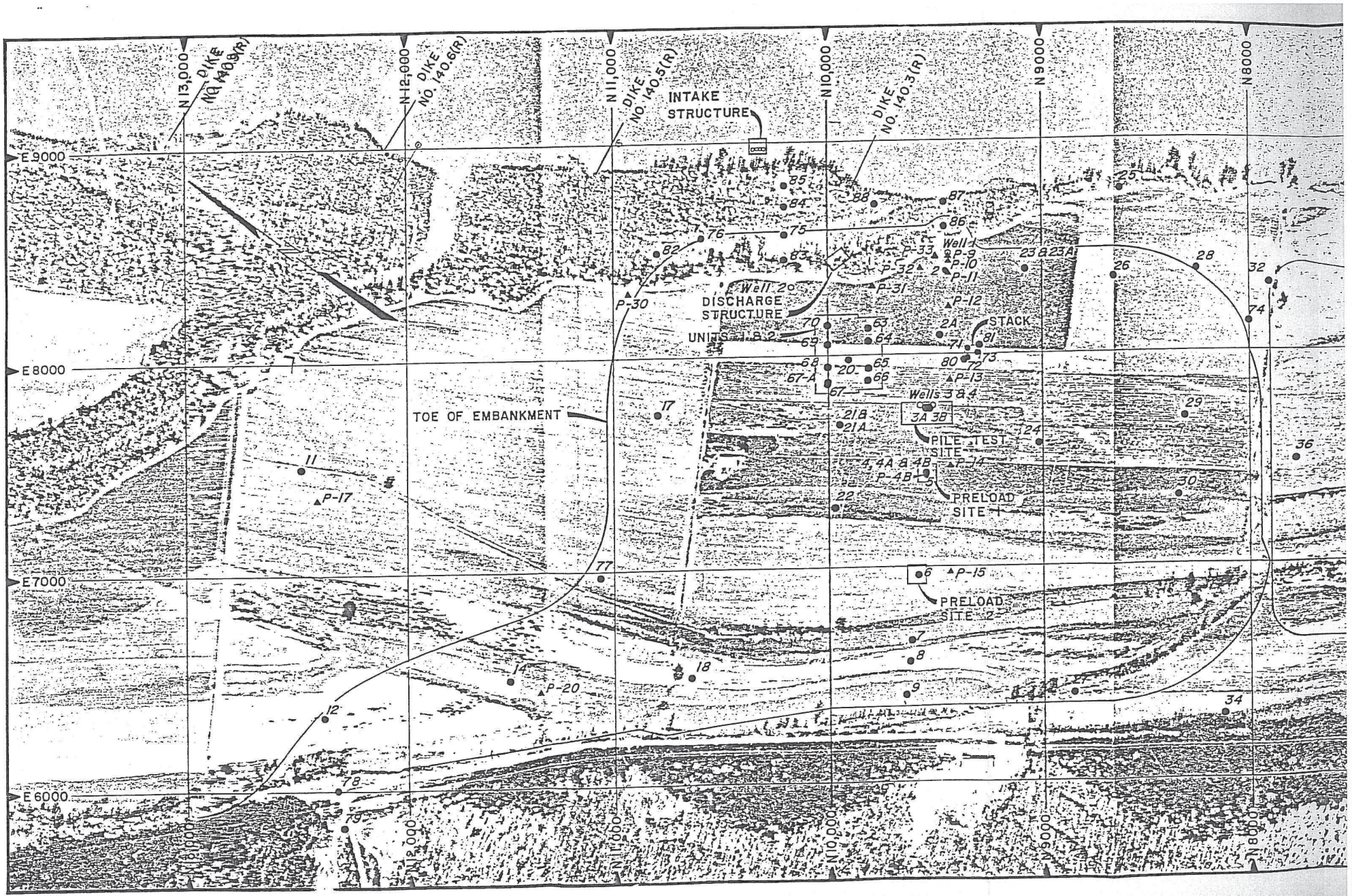
BECHTEL CORPORATION
Engineers-Constructors
San Francisco, California

* * *

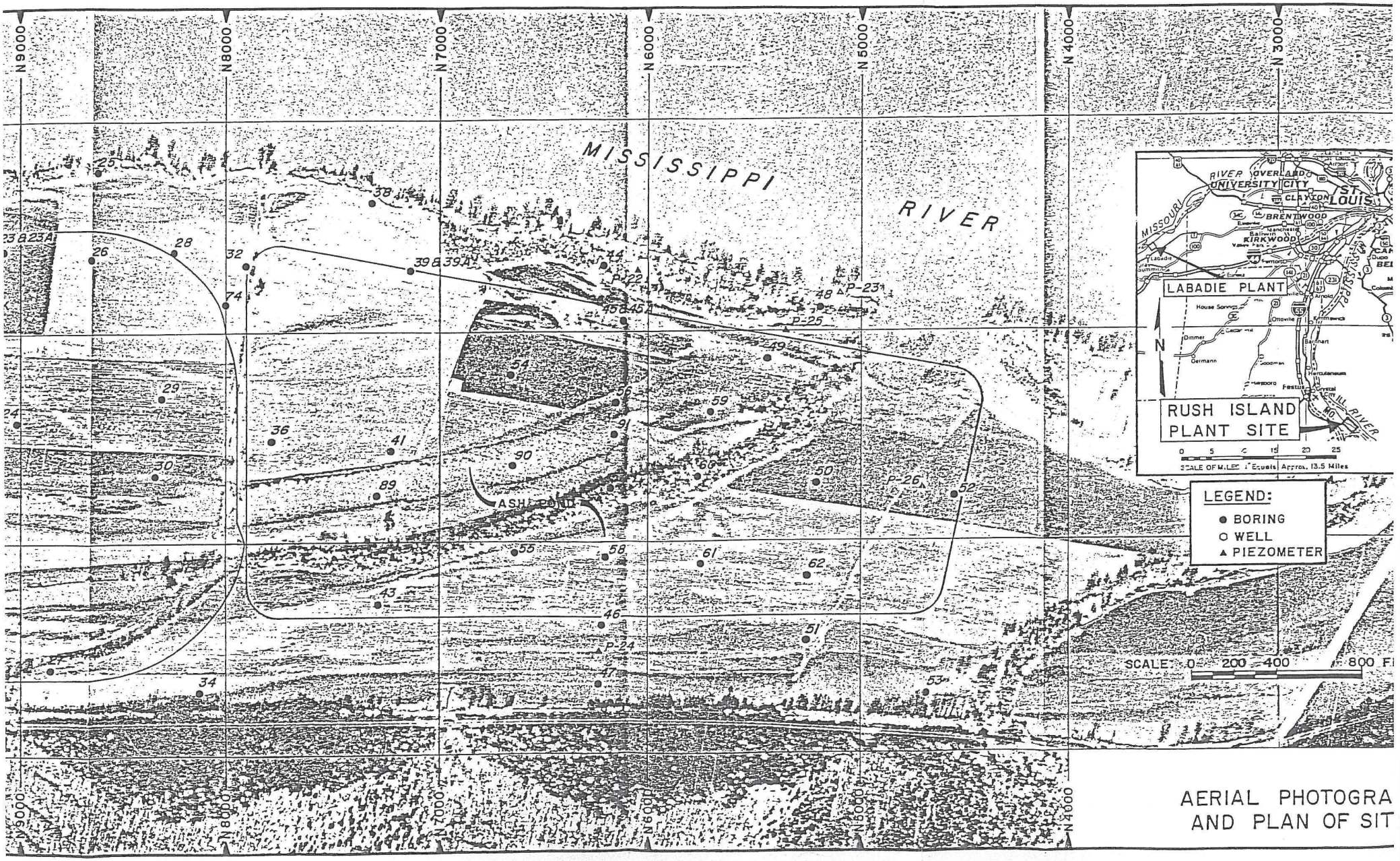
by

McCLELLAND ENGINEERS, INC.
Soil and Foundations consultants
St. Louis, Missouri

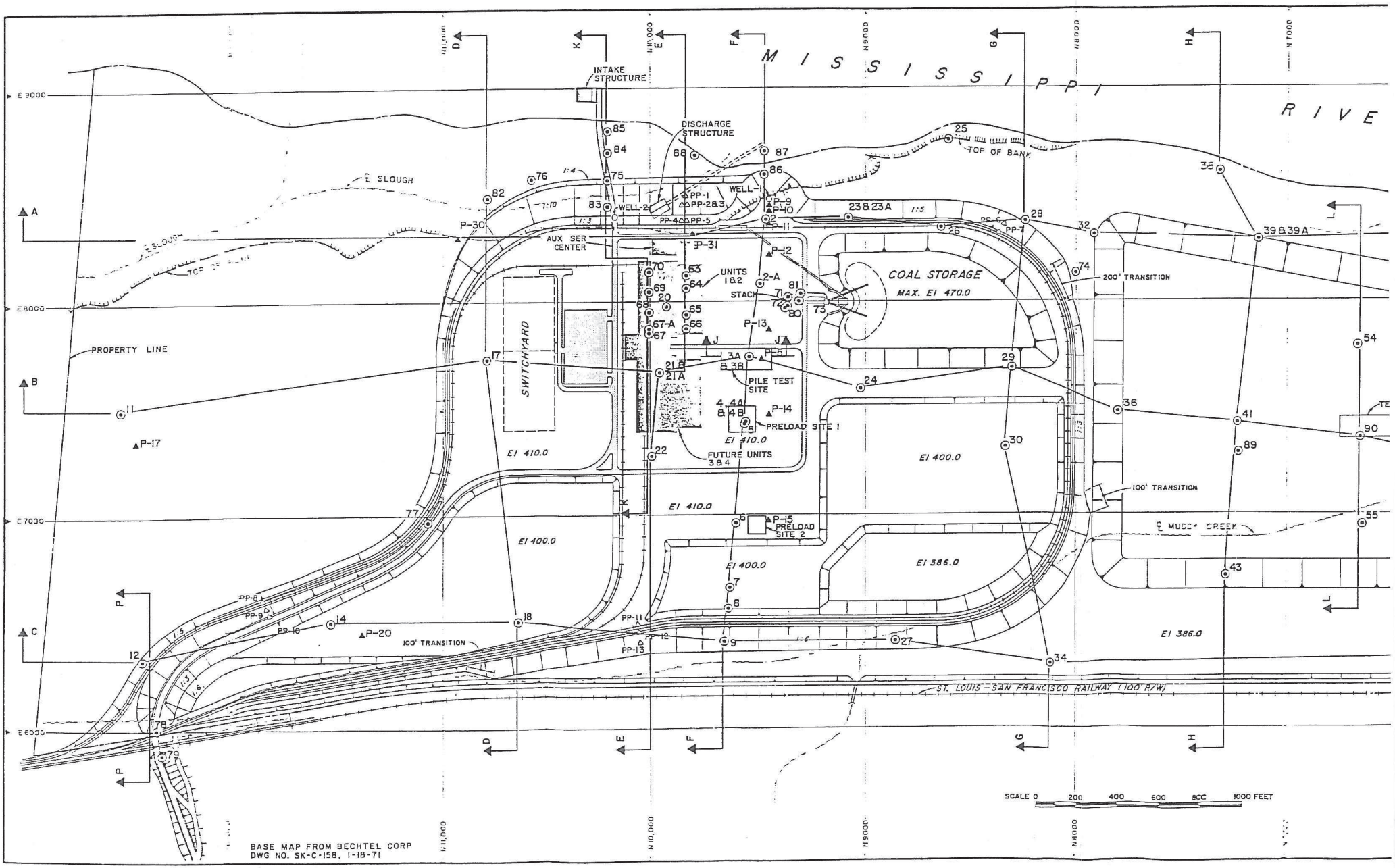
May 1971



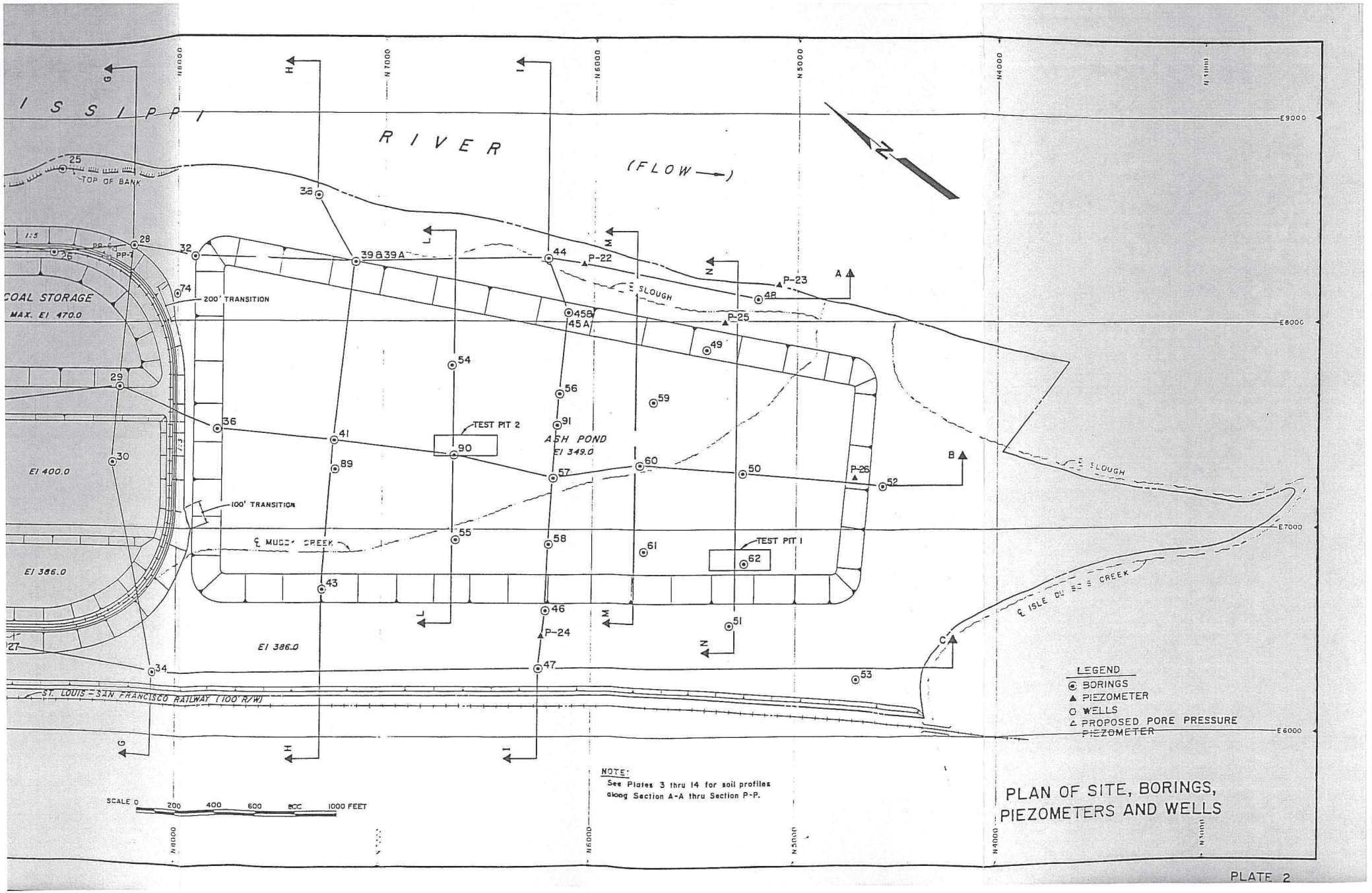
N 13,000
DIKE NO. 140.9(R)
N 12,000
DIKE NO. 140.6(R)
N 11,000
DIKE NO. 140.5(R)
N 10,000
DIKE NO. 140.3(R)
N 9000
N 8000
E 9000
E 8000
E 7000
E 6000
INTAKE STRUCTURE
DISCHARGE STRUCTURE
UNITS 1 & 2
Well 2
Well 1
STACK
Wells 3 & 4
3A 3B
PILE TEST SITE
4, 4A & 4B
P-4B
PRELOAD SITE 1
PRELOAD SITE 2
TOE OF EMBANKMENT
P-30
P-17
P-20
P-15
P-14
P-13
P-12
P-11
P-10
P-9
P-31
P-32
P-33
23 & 23A
2A
21A
21B



AERIAL PHOTOGRA
AND PLAN OF SIT



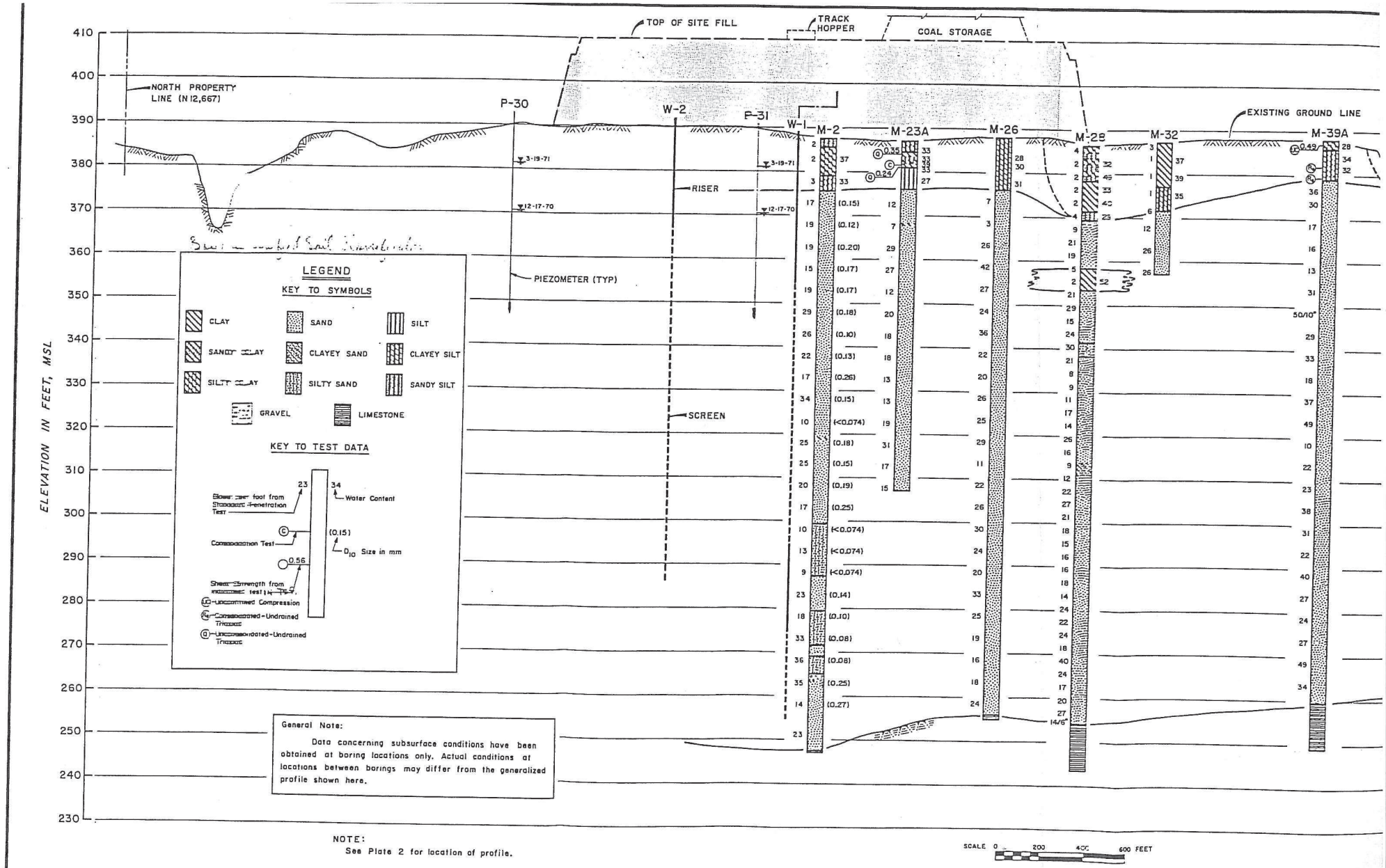
McCLELLAND ENGINEERS



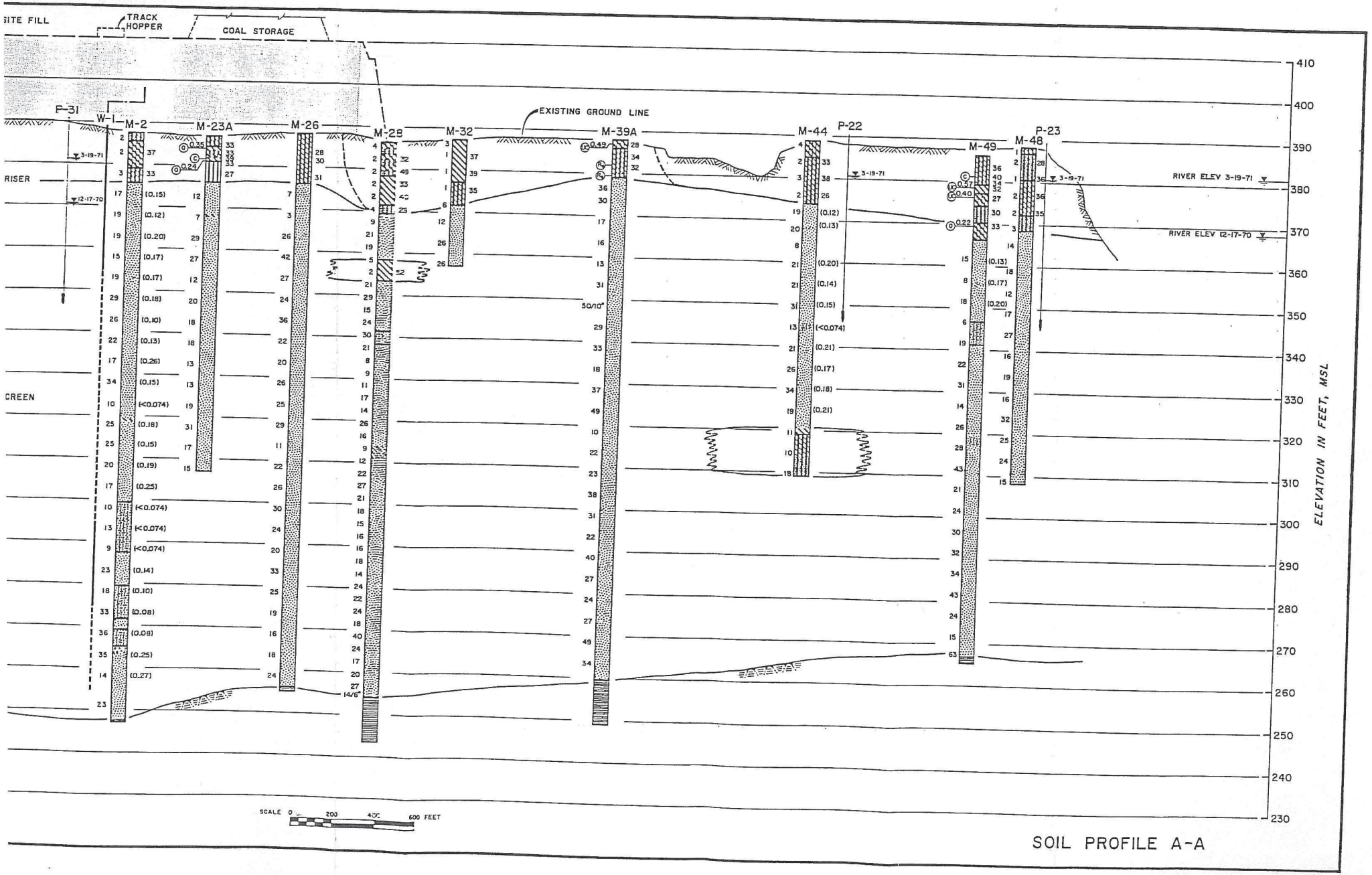
NOTE:
See Plates 3 thru 14 for soil profiles along Section A-A thru Section P-P.

PLAN OF SITE, BORINGS, PIEZOMETERS AND WELLS

PLATE 2

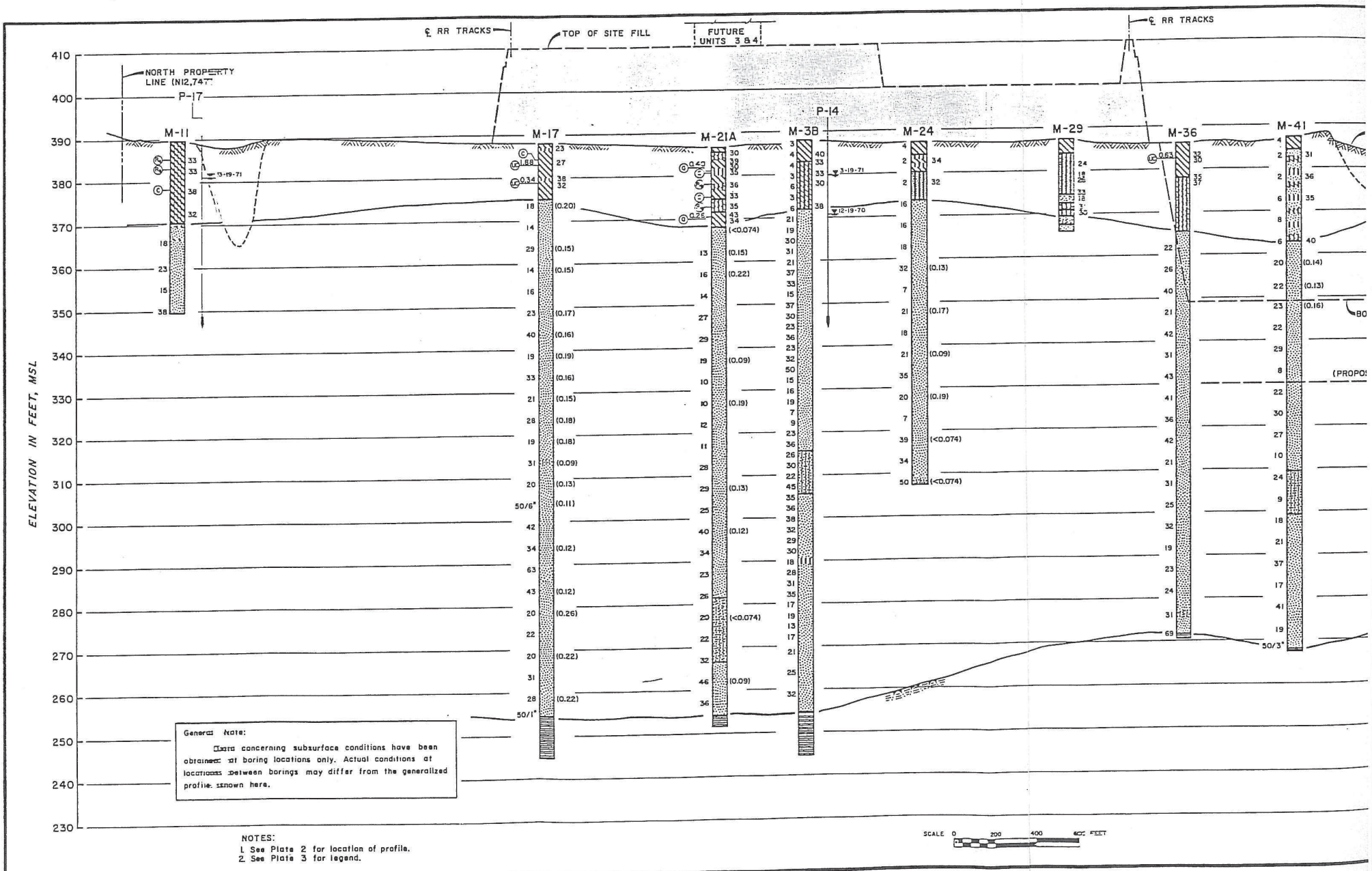


McCLELLAND ENGINEERS

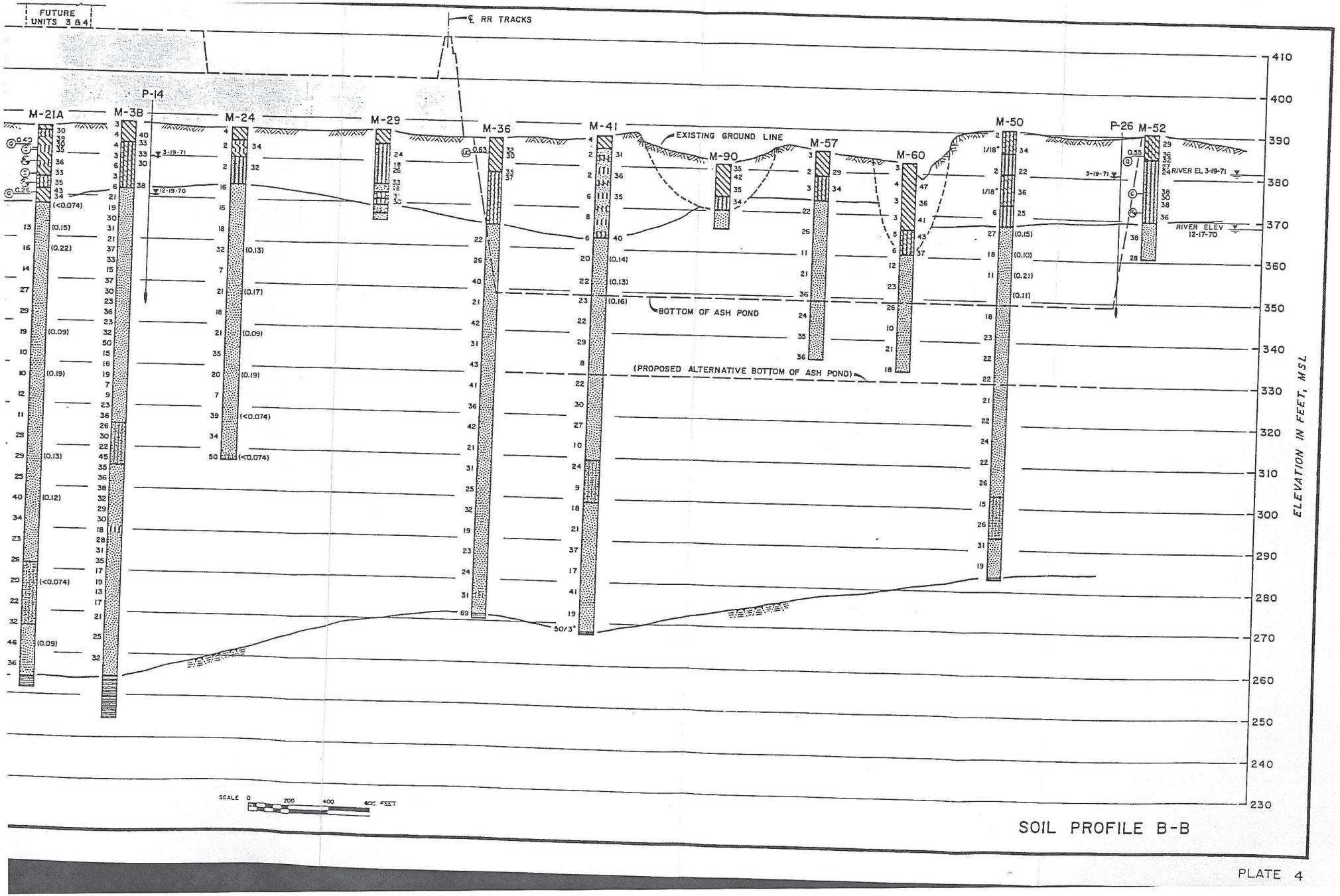


SOIL PROFILE A-A

PLATE 3

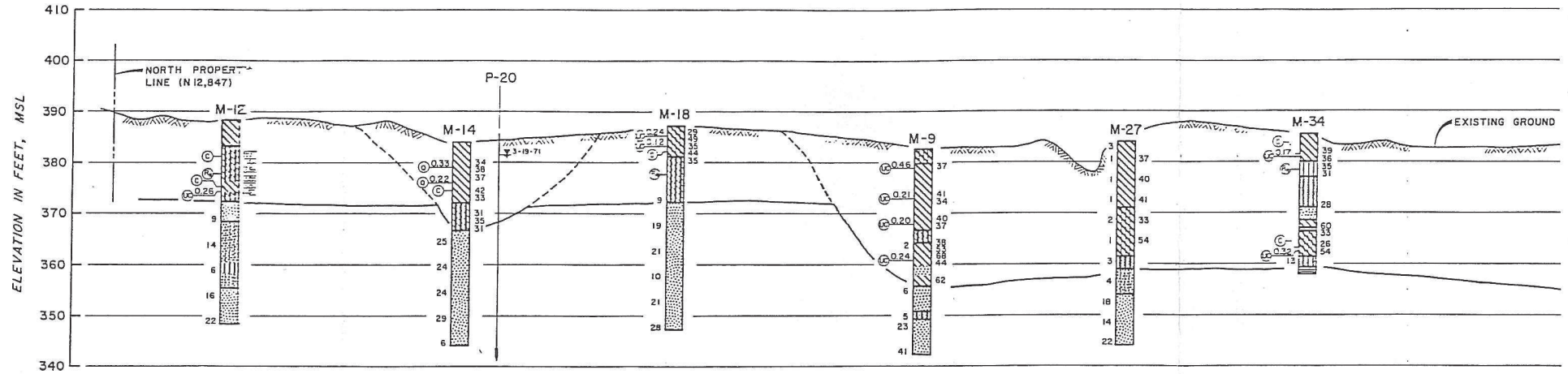


McCLELLAND ENGINEERS



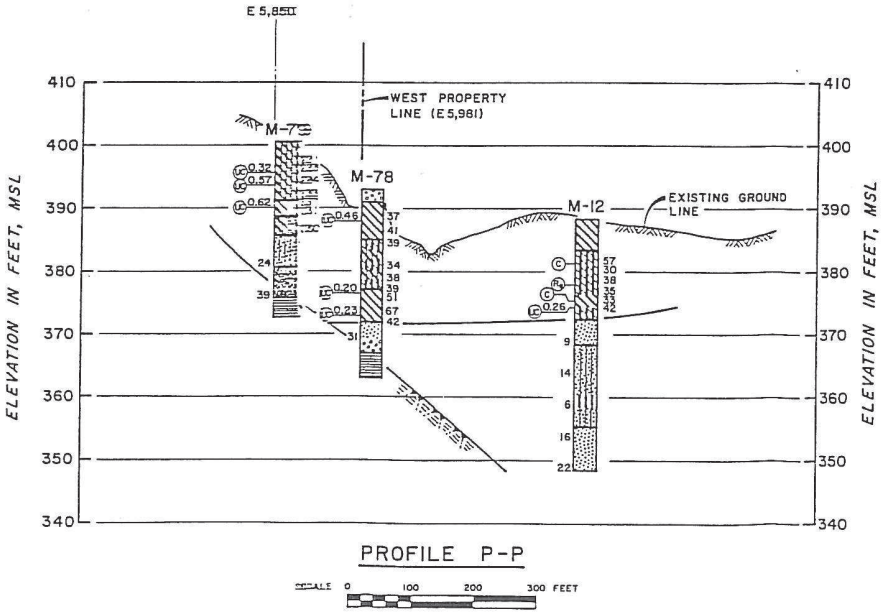
SOIL PROFILE B-B

PLATE 4



PROFILE C-C

SCALE 0 200 400 600 FEET



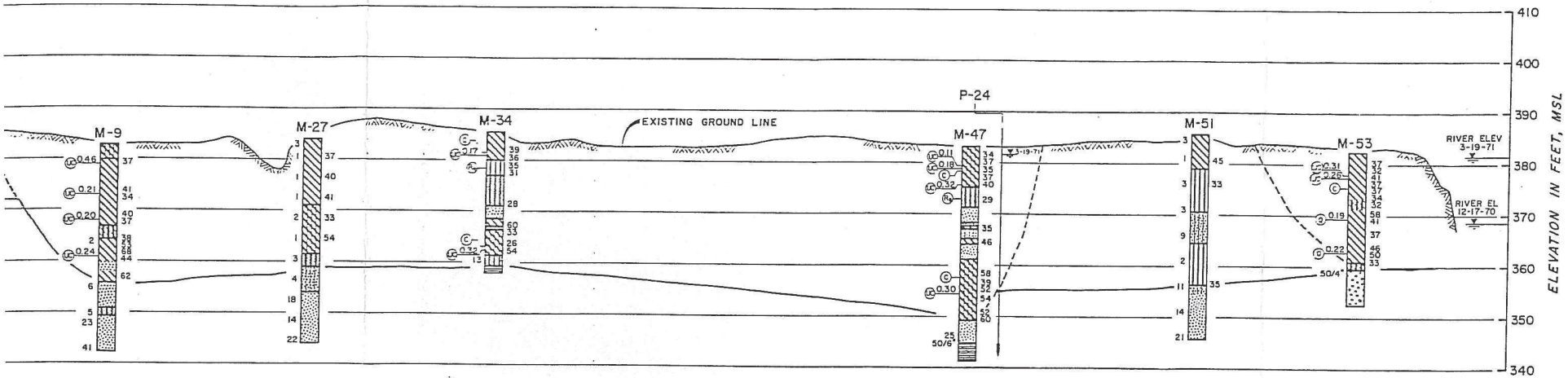
PROFILE P-P

SCALE 0 100 200 300 FEET

General Note:

Data concerning subsurface conditions have been obtained at boring locations only. Actual conditions at locations between borings may differ from the generalized profile shown here.

NOTES:
1. See Plate 2 for location of profile.
2. See Plate 3 for legend.



PROFILE C-C

SCALE 0 200 400 600 FEET

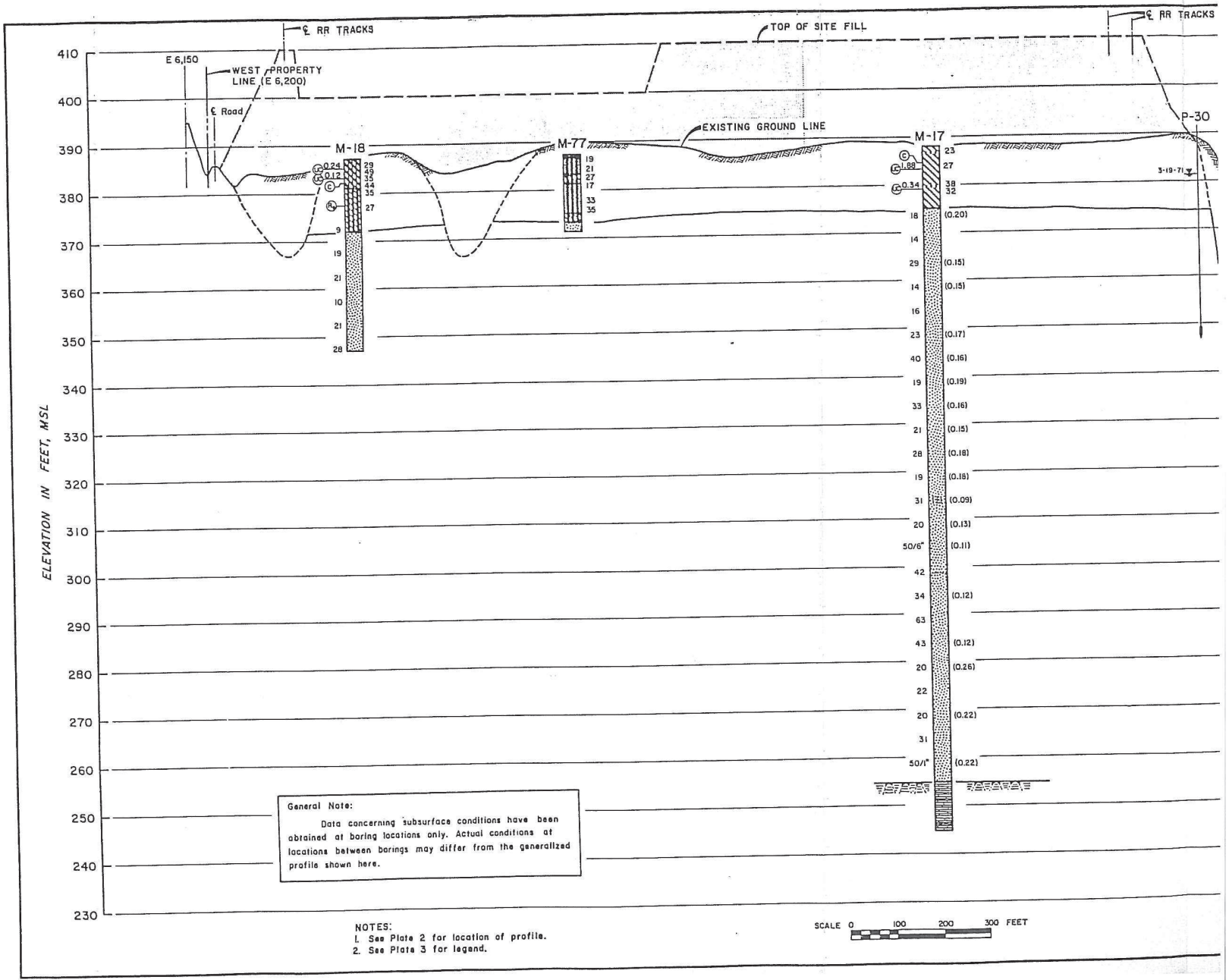
General Note:

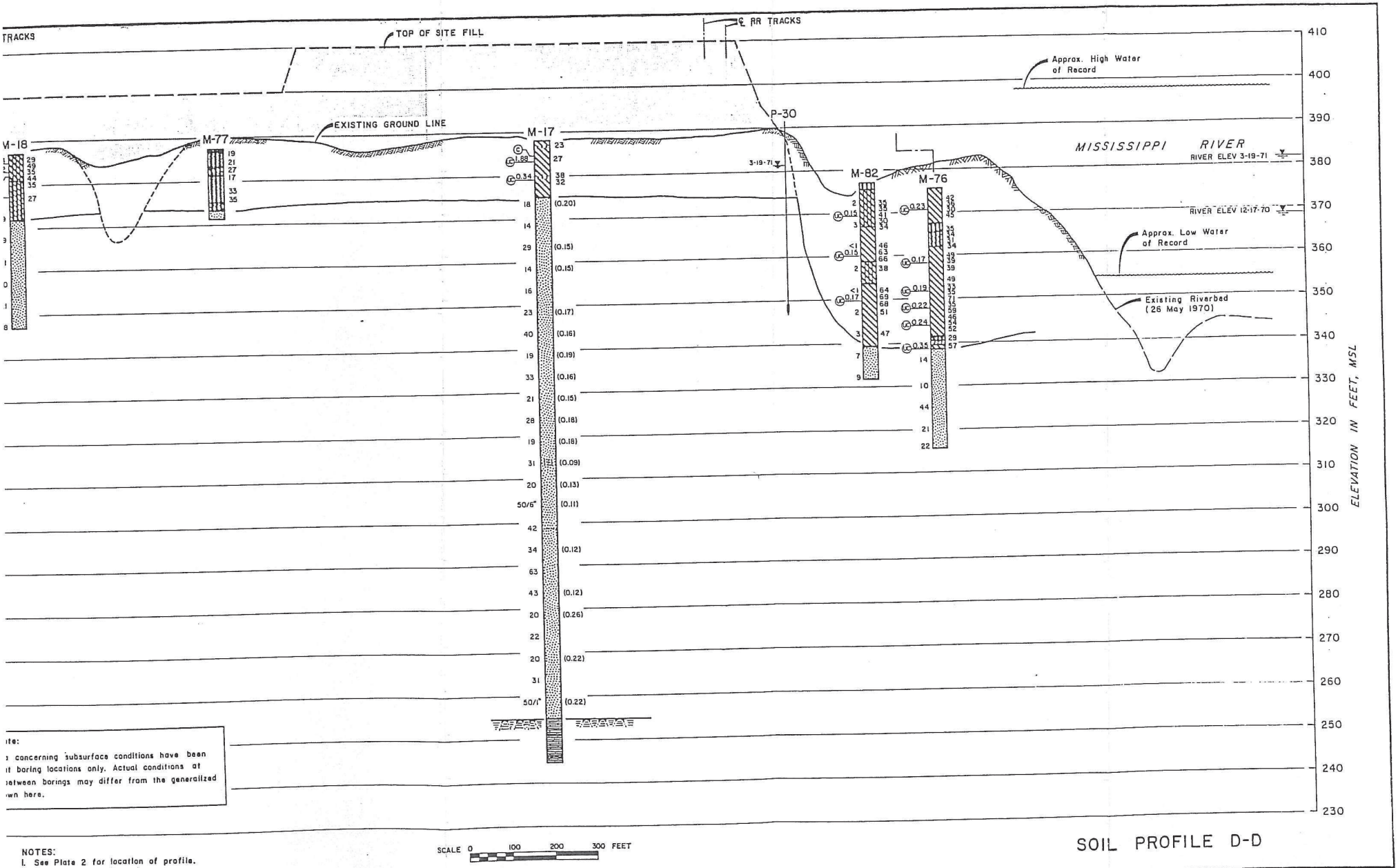
Data concerning subsurface conditions have been obtained at boring locations only. Actual conditions at locations between borings may differ from the generalized profile shown here.

NOTES:
1. See Plate 2 for location of profile.
2. See Plate 3 for legend.

SOIL PROFILES C-C AND P-P

PLATE 5


℄ RR TRACKS
TOP OF SITE FILL
℄ RR TRACKS
E 6,150
WEST PROPERTY LINE (E 6,200)
℄ Road
EXISTING GROUND LINE
P-30
M-18
M-77
M-17
3-19-71
ELEVATION IN FEET, MSL
410
400
390
380
370
360
350
340
330
320
310
300
290
280
270
260
250
240
230
General Note:
Data concerning subsurface conditions have been obtained at boring locations only. Actual conditions at locations between borings may differ from the generalized profile shown here.
NOTES:
1. See Plate 2 for location of profile.
2. See Plate 3 for legend.
SCALE 0 100 200 300 FEET

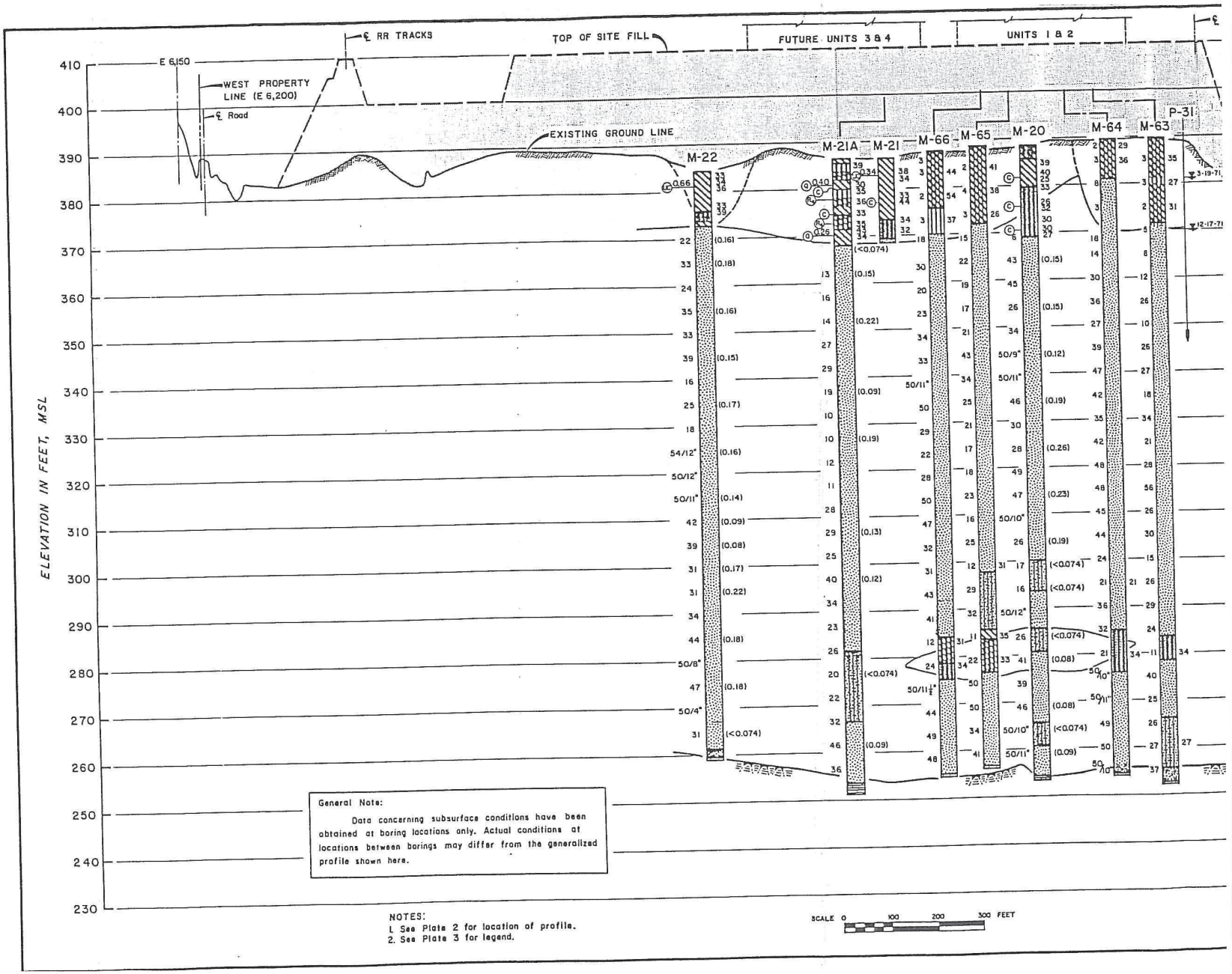


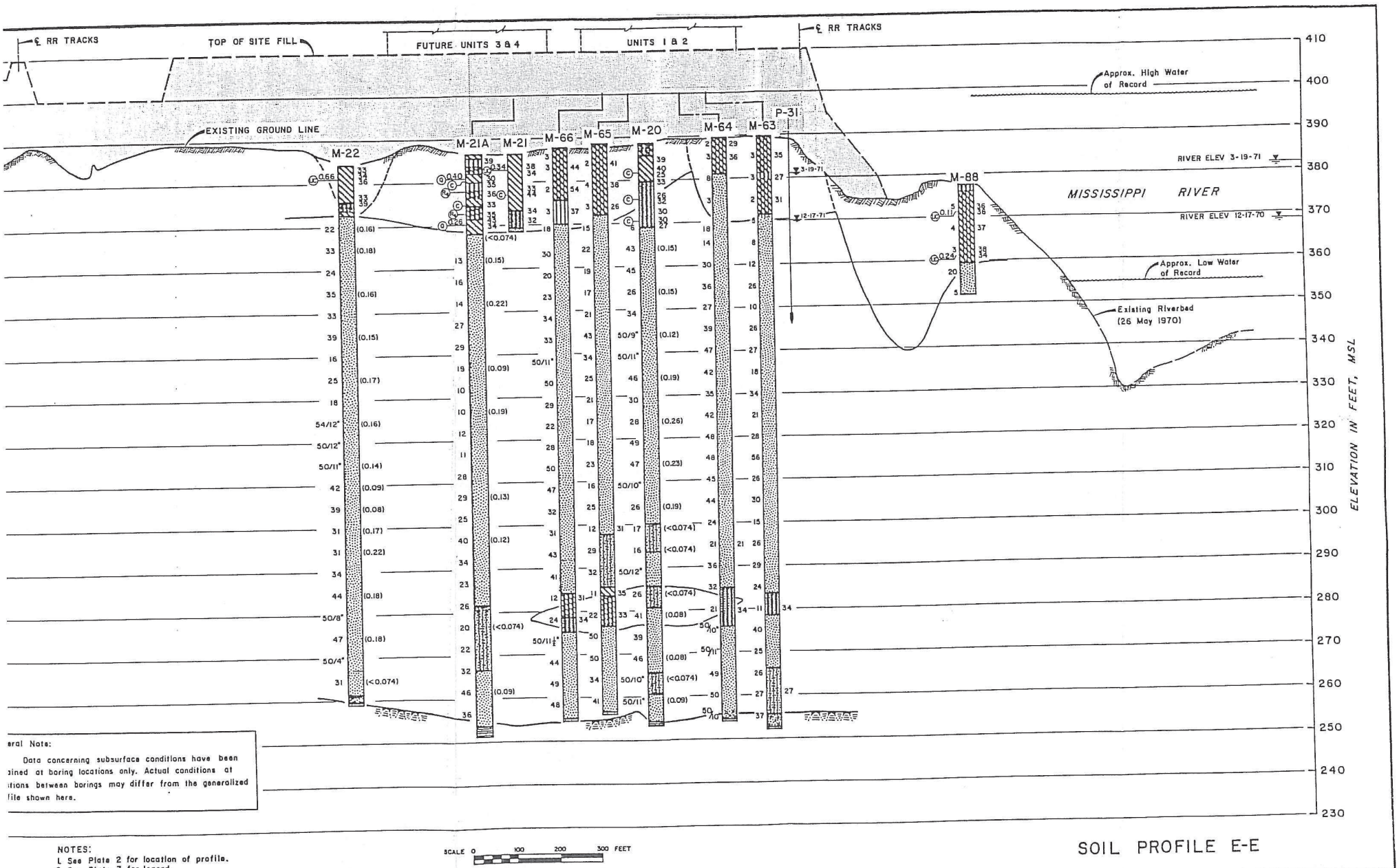
NOTES:
1. See Plate 2 for location of profile.
2. See Plate 3 for legend.

SCALE 0 100 200 300 FEET

SOIL PROFILE D-D

PLATE 6


℄ RR TRACKS
TOP OF SITE FILL
FUTURE UNITS 3 & 4
UNITS 1 & 2
E 6,150
WEST PROPERTY LINE (E 6,200)
℄ Road
EXISTING GROUND LINE
M-22
M-21A
M-21
M-66
M-65
M-20
M-64
M-63
P-31
ELEVATION IN FEET, MSL
410
400
390
380
370
360
350
340
330
320
310
300
290
280
270
260
250
240
230
General Note:
Data concerning subsurface conditions have been obtained at boring locations only. Actual conditions at locations between borings may differ from the generalized profile shown here.
NOTES:
1. See Plate 2 for location of profile.
2. See Plate 3 for legend.
SCALE 0 100 200 300 FEET



eral Note:

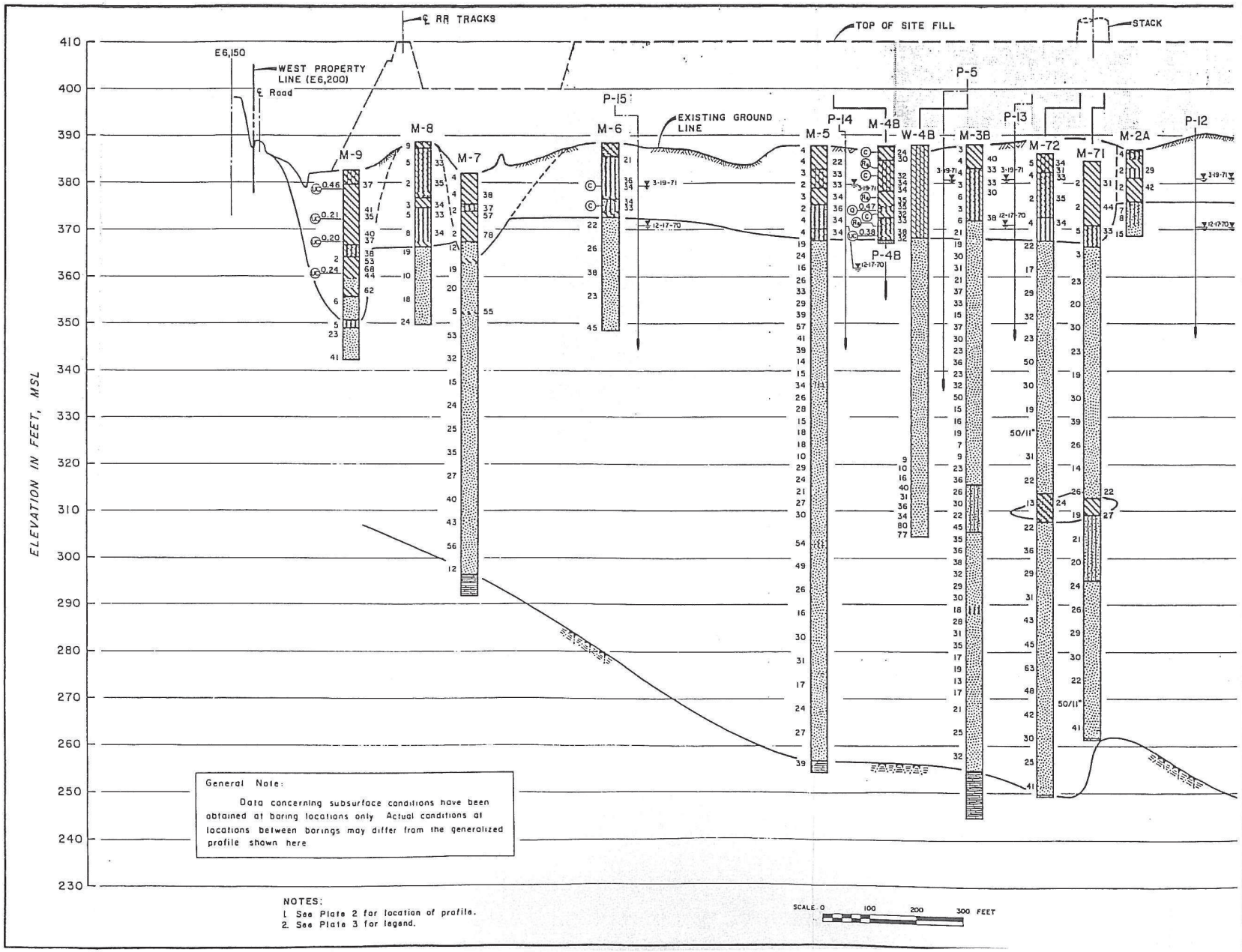
Data concerning subsurface conditions have been ained at boring locations only. Actual conditions at itions between borings may differ from the generalized file shown here.

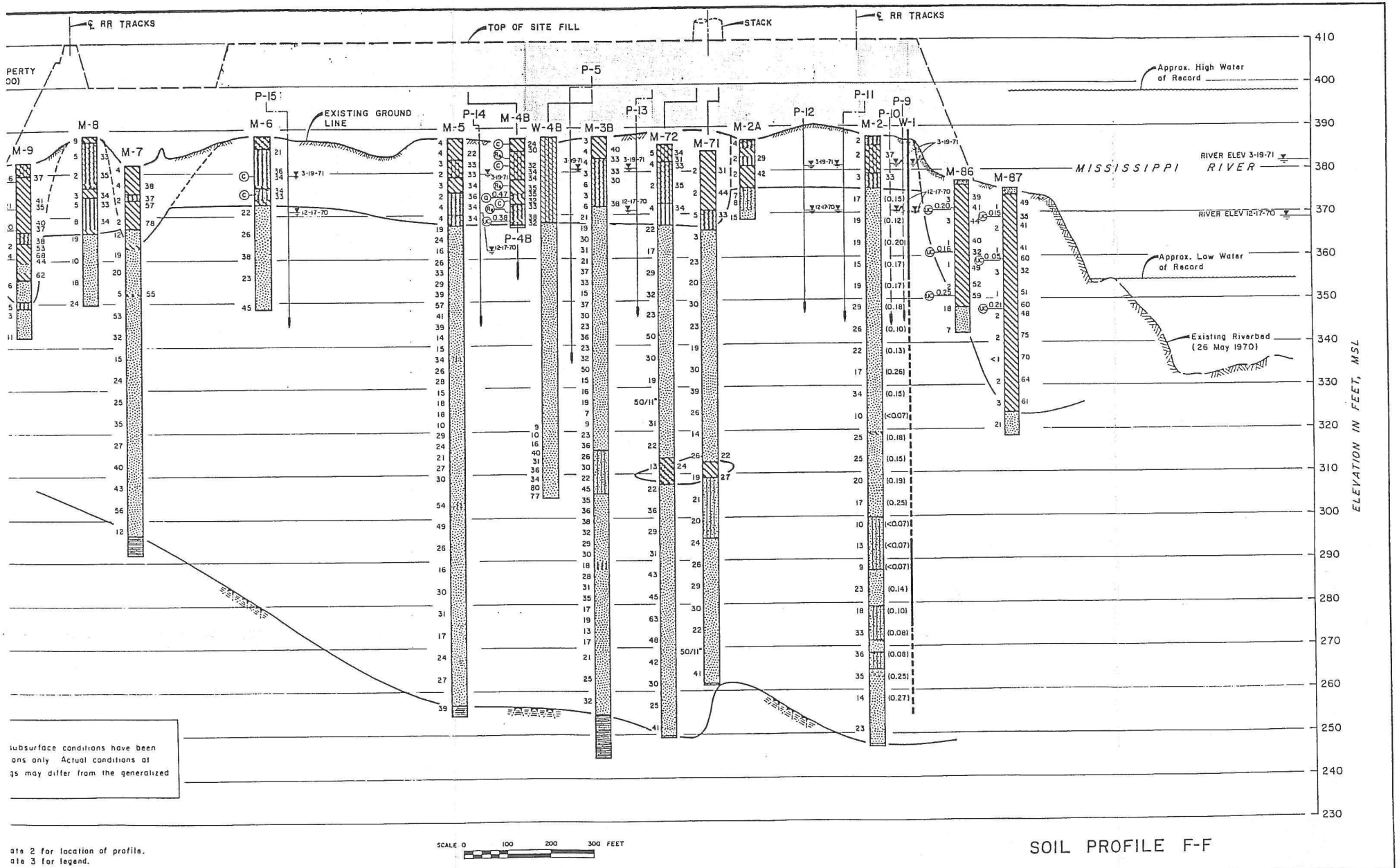
NOTES:
1. See Plate 2 for location of profile.
2. See Plate 3 for legend.

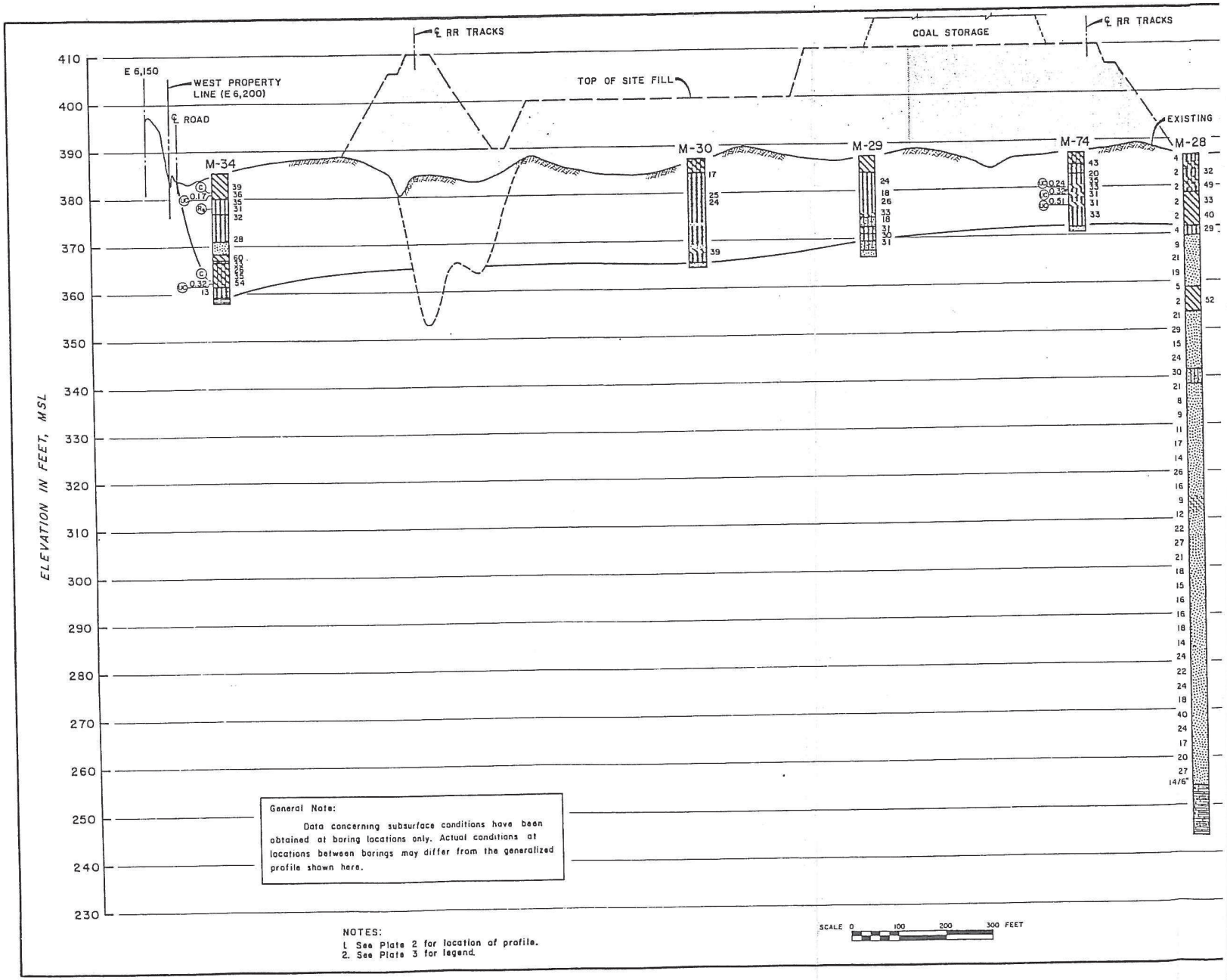
SCALE 0 100 200 300 FEET

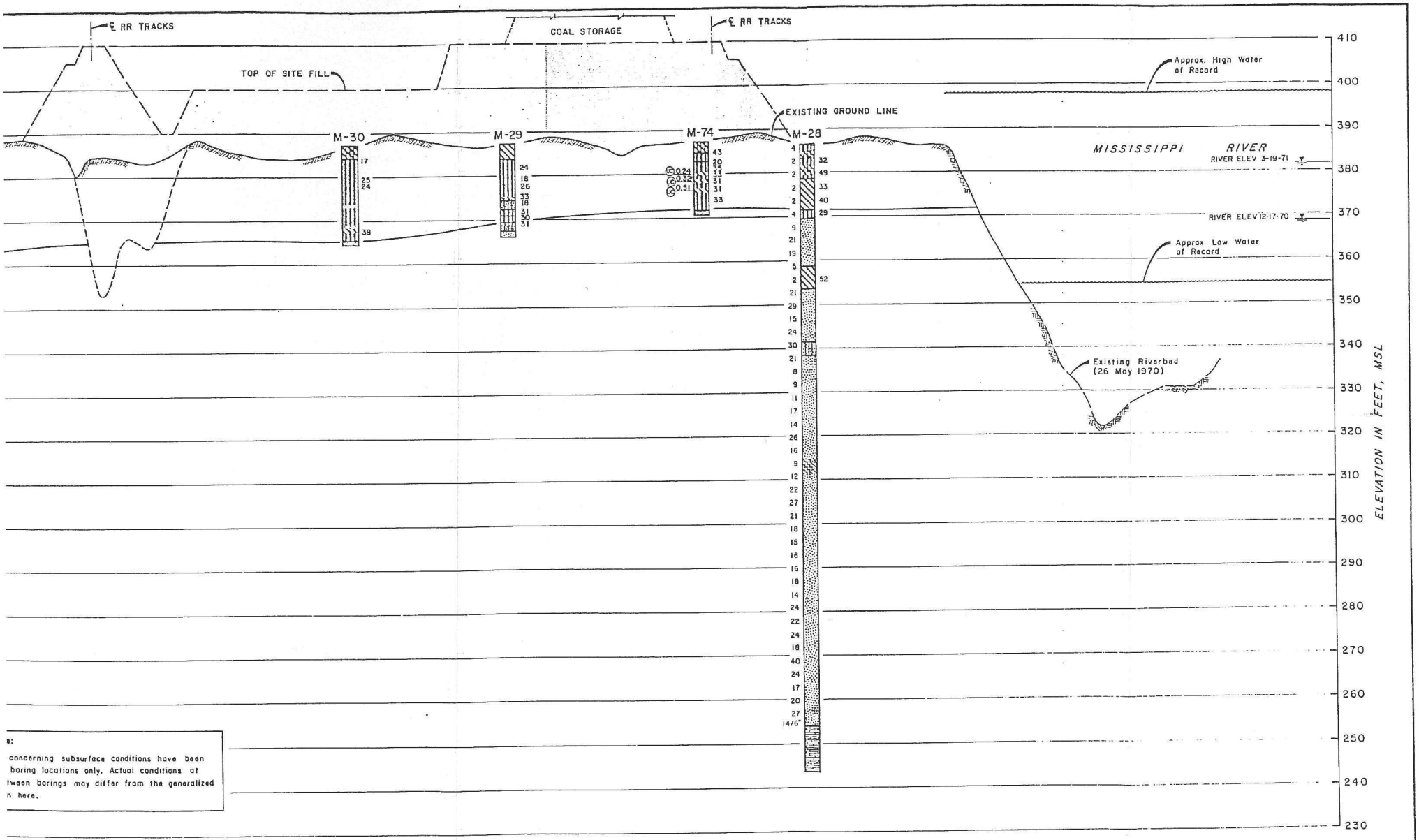
SOIL PROFILE E-E

PLATE 7


℄ RR TRACKS
TOP OF SITE FILL
STACK
E6,150
WEST PROPERTY LINE (E6,200)
℄ Road
EXISTING GROUND LINE
M-9
M-8
M-7
M-6
M-5
P-15
P-14
M-4B
W-4B
M-3B
M-72
M-71
M-2A
P-5
P-13
P-12
P-48
3-19-71
12-17-70
ELEVATION IN FEET, MSL
410
400
390
380
370
360
350
340
330
320
310
300
290
280
270
260
250
240
230
SCALE 0 100 200 300 FEET
General Note:
Data concerning subsurface conditions have been obtained at boring locations only. Actual conditions at locations between borings may differ from the generalized profile shown here.
NOTES:
1. See Plate 2 for location of profile.
2. See Plate 3 for legend.


℄ RR TRACKS
TOP OF SITE FILL
STACK
℄ RR TRACKS
PERTY
00)
P-5
P-15
EXISTING GROUND LINE
P-14
M-4B
W-4B
M-38
P-13
M-72
M-71
M-2A
P-12
P-11
P-10
P-9
W-1
M-2
M-8
M-6
M-5
M-9
M-7
P-4B
Approx. High Water of Record
MISSISSIPPI RIVER
RIVER ELEV 3-19-71
RIVER ELEV 12-17-70
M-86
M-87
Approx. Low Water of Record
Existing Riverbed (26 May 1970)
3-19-71
12-17-70
ELEVATION IN FEET, MSL
410
400
390
380
370
360
350
340
330
320
310
300
290
280
270
260
250
240
230
ubsurface conditions have been
ons only Actual conditions at
gs may differ from the generalized
ate 2 for location of profile.
ate 3 for legend.
SCALE 0 100 200 300 FEET
SOIL PROFILE F-F


℄ RR TRACKS
COAL STORAGE
℄ RR TRACKS
E 6,150
WEST PROPERTY LINE (E 6,200)
℄ ROAD
TOP OF SITE FILL
EXISTING
M-34
M-30
M-29
M-74
M-28
ELEVATION IN FEET, MSL
410
400
390
380
370
360
350
340
330
320
310
300
290
280
270
260
250
240
230
General Note:
Data concerning subsurface conditions have been obtained at boring locations only. Actual conditions at locations between borings may differ from the generalized profile shown here.
NOTES:
1. See Plate 2 for location of profile.
2. See Plate 3 for legend.
SCALE 0 100 200 300 FEET



e:

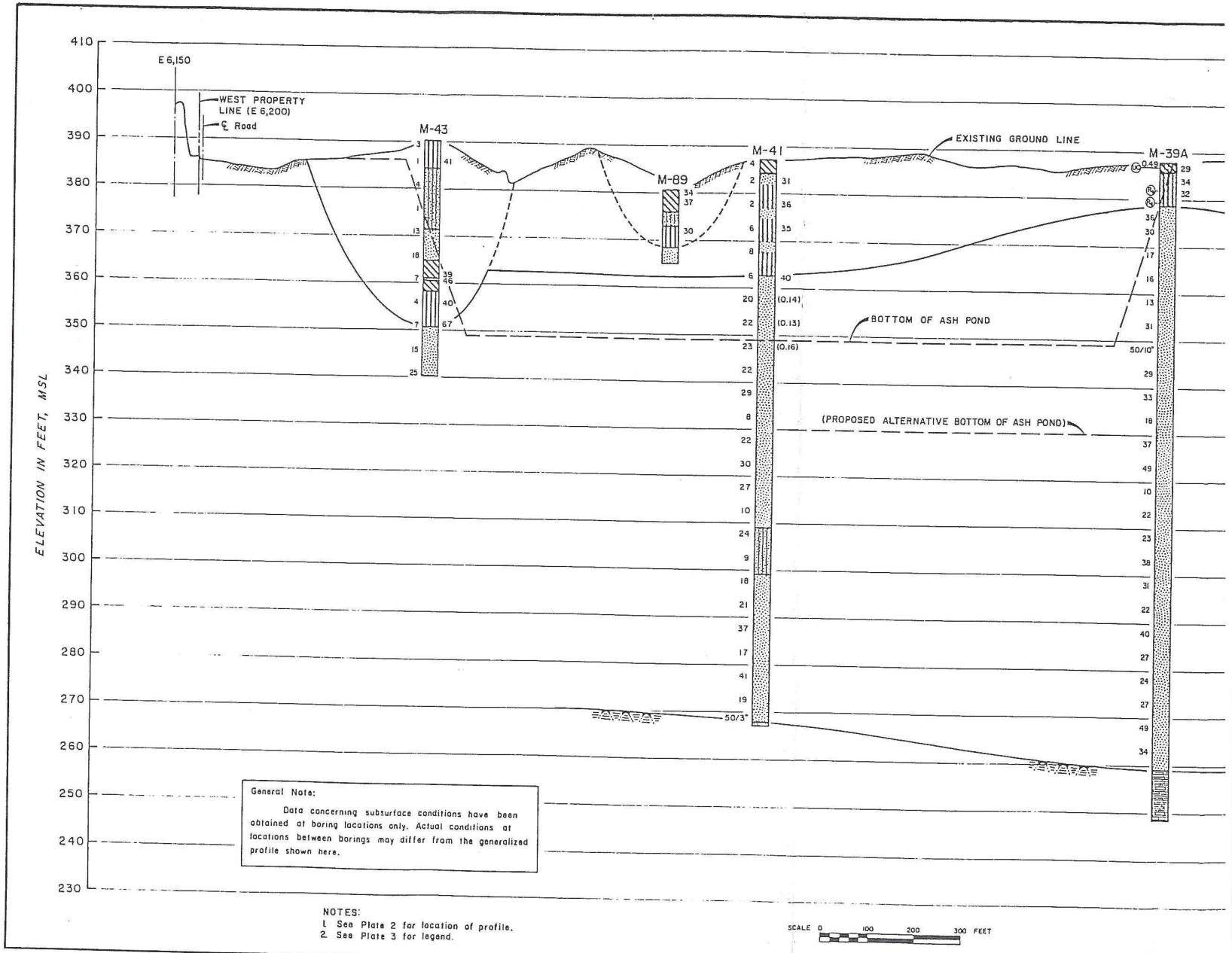
concerning subsurface conditions have been boring locations only. Actual conditions at tween borings may differ from the generalized n here.

NOTES:
1. See Plate 2 for location of profile.
2. See Plate 3 for legend.

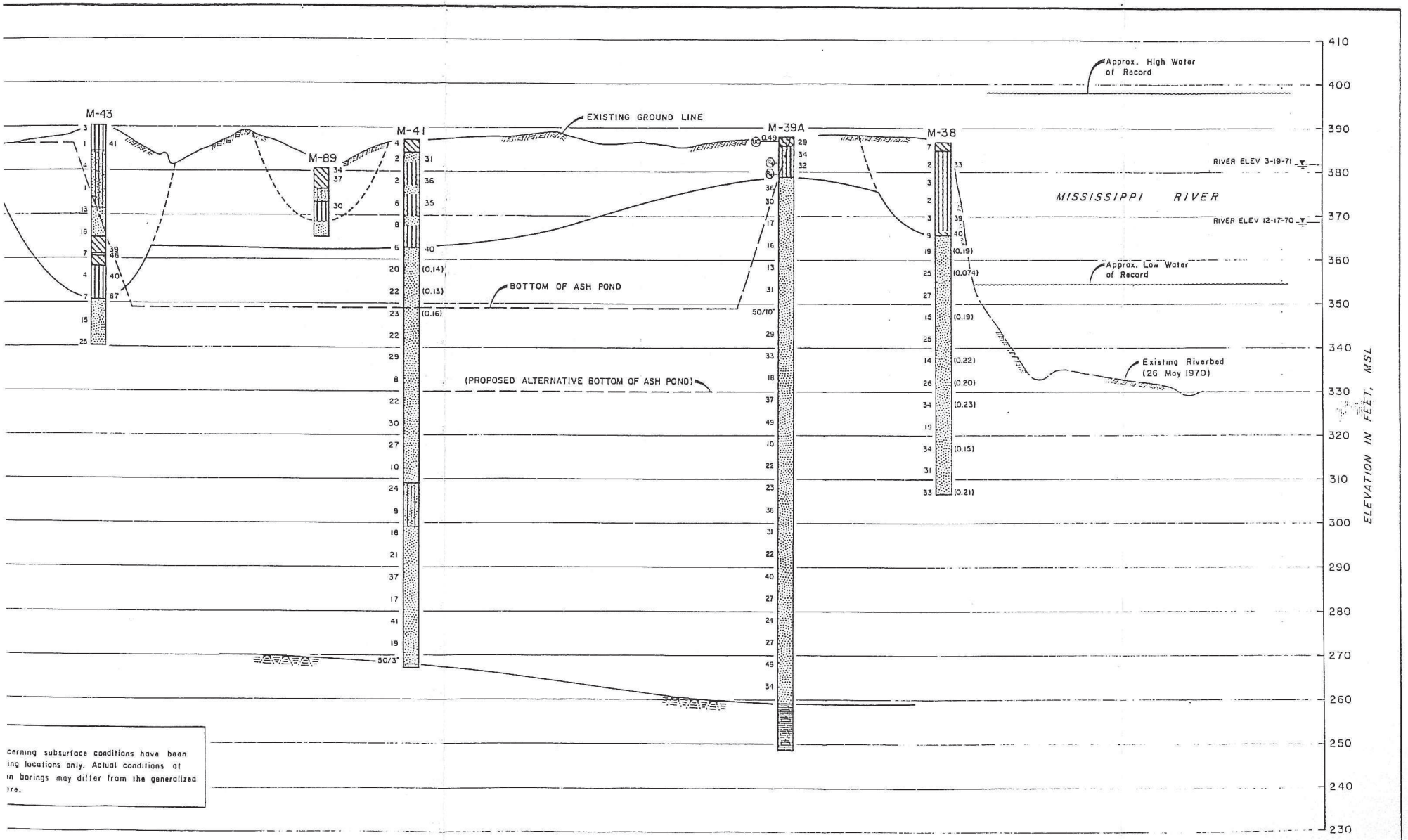
SCALE 0 100 200 300 FEET

SOIL PROFILE G-G

PLATE 9



McCLELLAND ENGINEERS

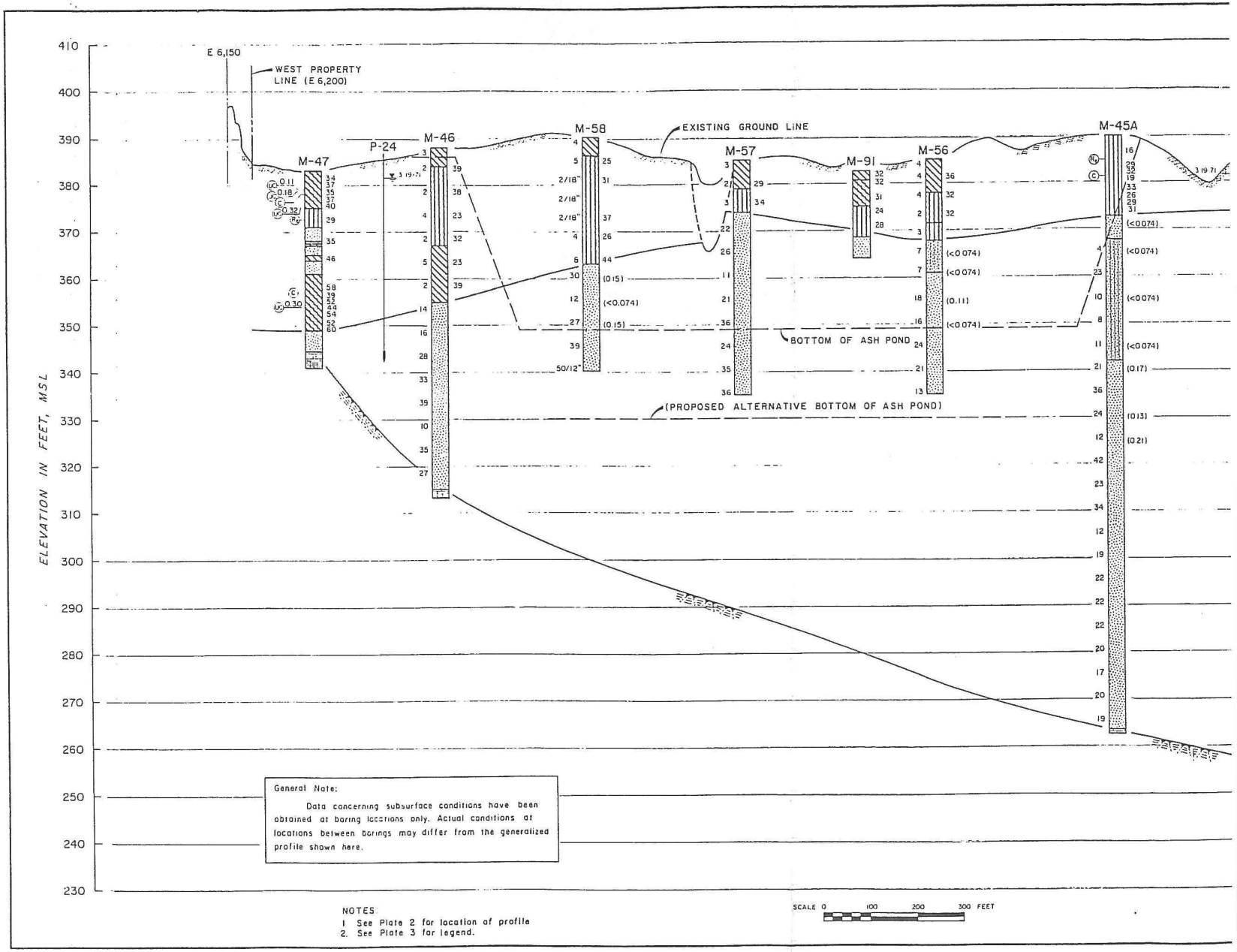


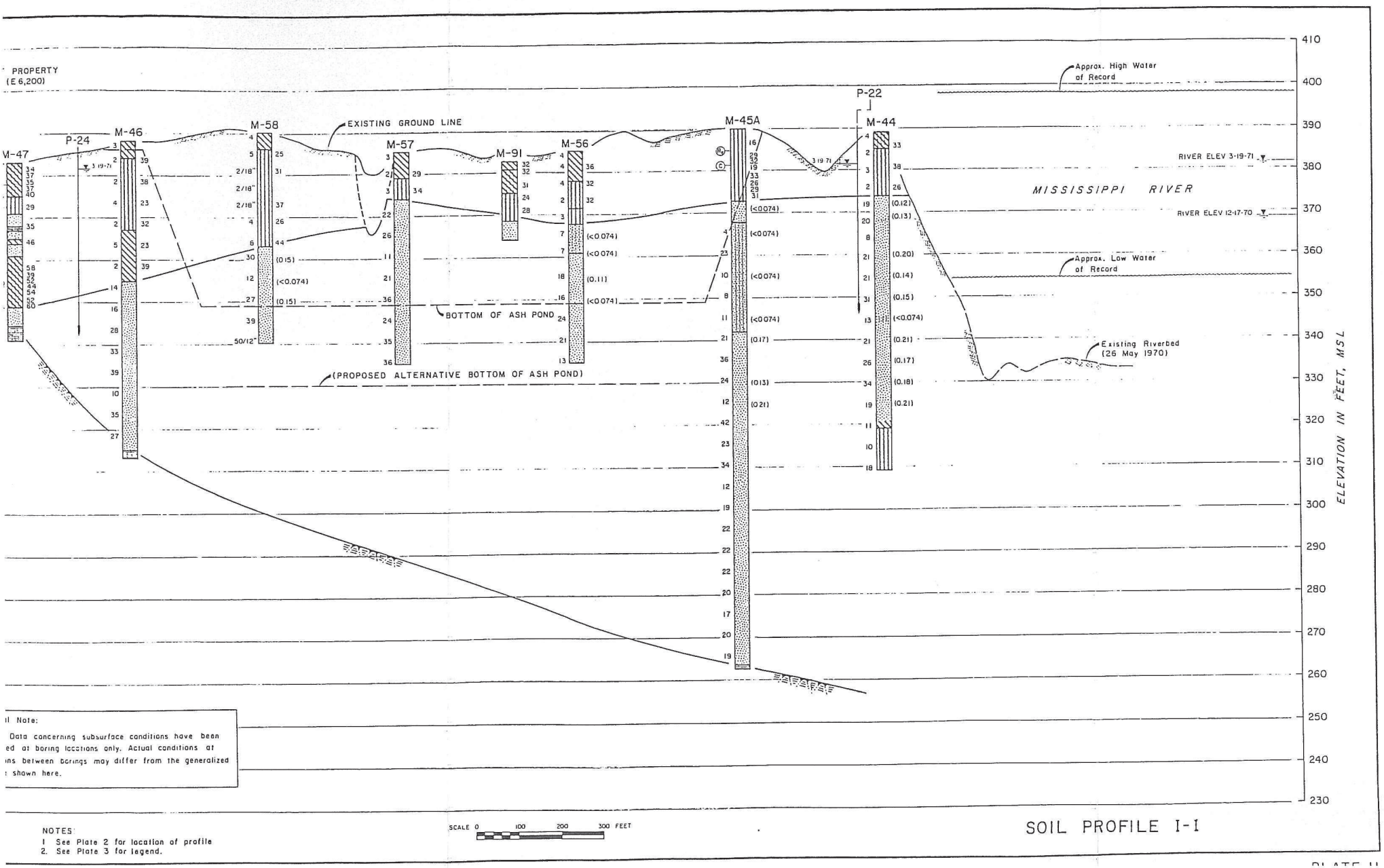
cerning subsurface conditions have been
ing locations only. Actual conditions at
in borings may differ from the generalized
ere.

NOTES:
1. See Plate 2 for location of profile.
2. See Plate 3 for legend.

SCALE 0 100 200 300 FEET

SOIL PROFILE H-H


E 6,150
WEST PROPERTY LINE (E 6,200)
EXISTING GROUND LINE
M-47
P-24
M-46
M-58
M-57
M-91
M-56
M-45A
BOTTOM OF ASH POND
(PROPOSED ALTERNATIVE BOTTOM OF ASH POND)
ELEVATION IN FEET, MSL
410
400
390
380
370
360
350
340
330
320
310
300
290
280
270
260
250
240
230
General Note:
Data concerning subsurface conditions have been obtained at boring locations only. Actual conditions at locations between borings may differ from the generalized profile shown here.
NOTES:
1 See Plate 2 for location of profile
2. See Plate 3 for legend.
SCALE 0 100 200 300 FEET



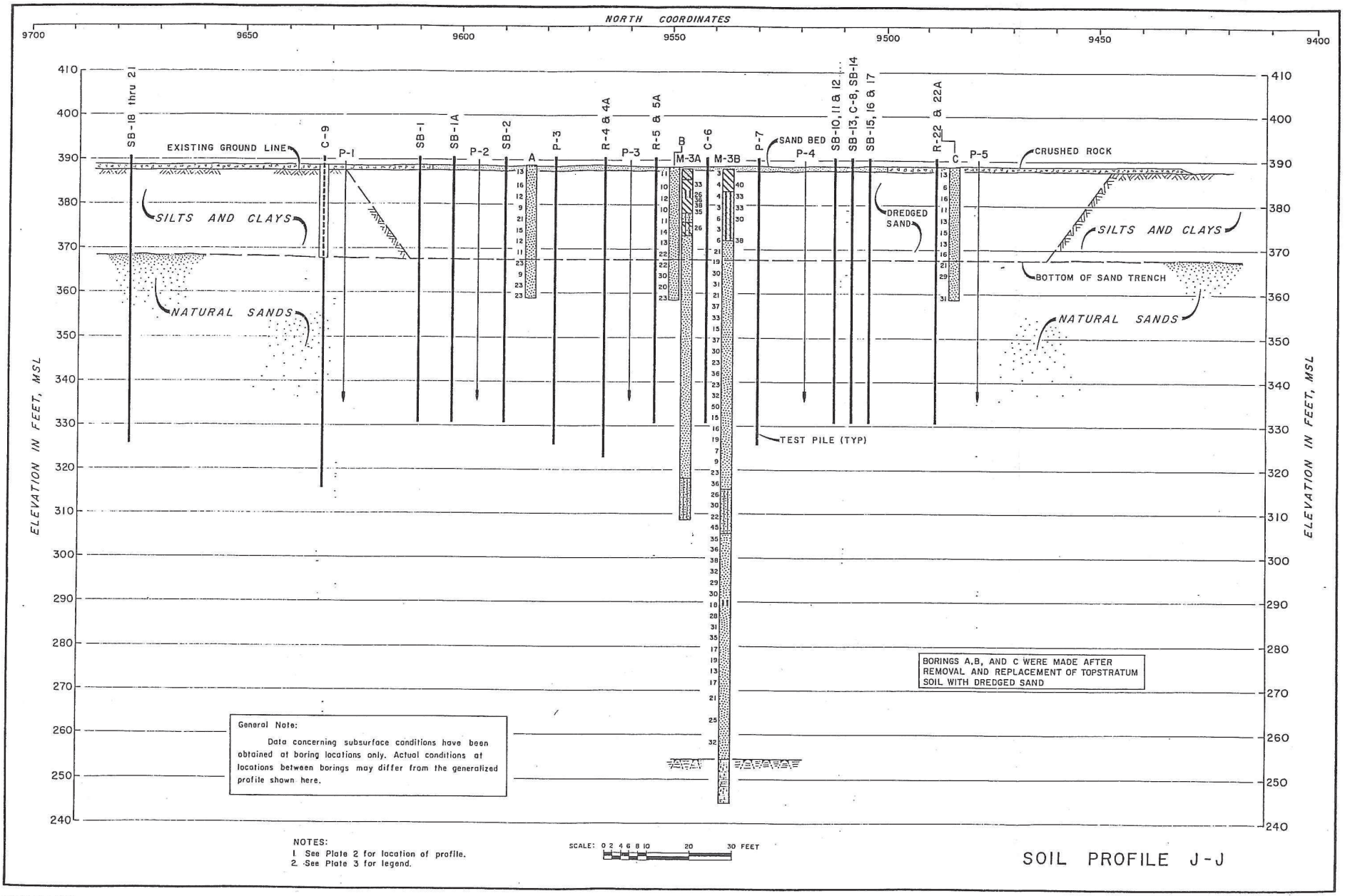
Note:
Data concerning subsurface conditions have been ed at boring locations only. Actual conditions at ins between borings may differ from the generalized shown here.

NOTES:
1. See Plate 2 for location of profile
2. See Plate 3 for legend.

SCALE 0 100 200 300 FEET

SOIL PROFILE I-I

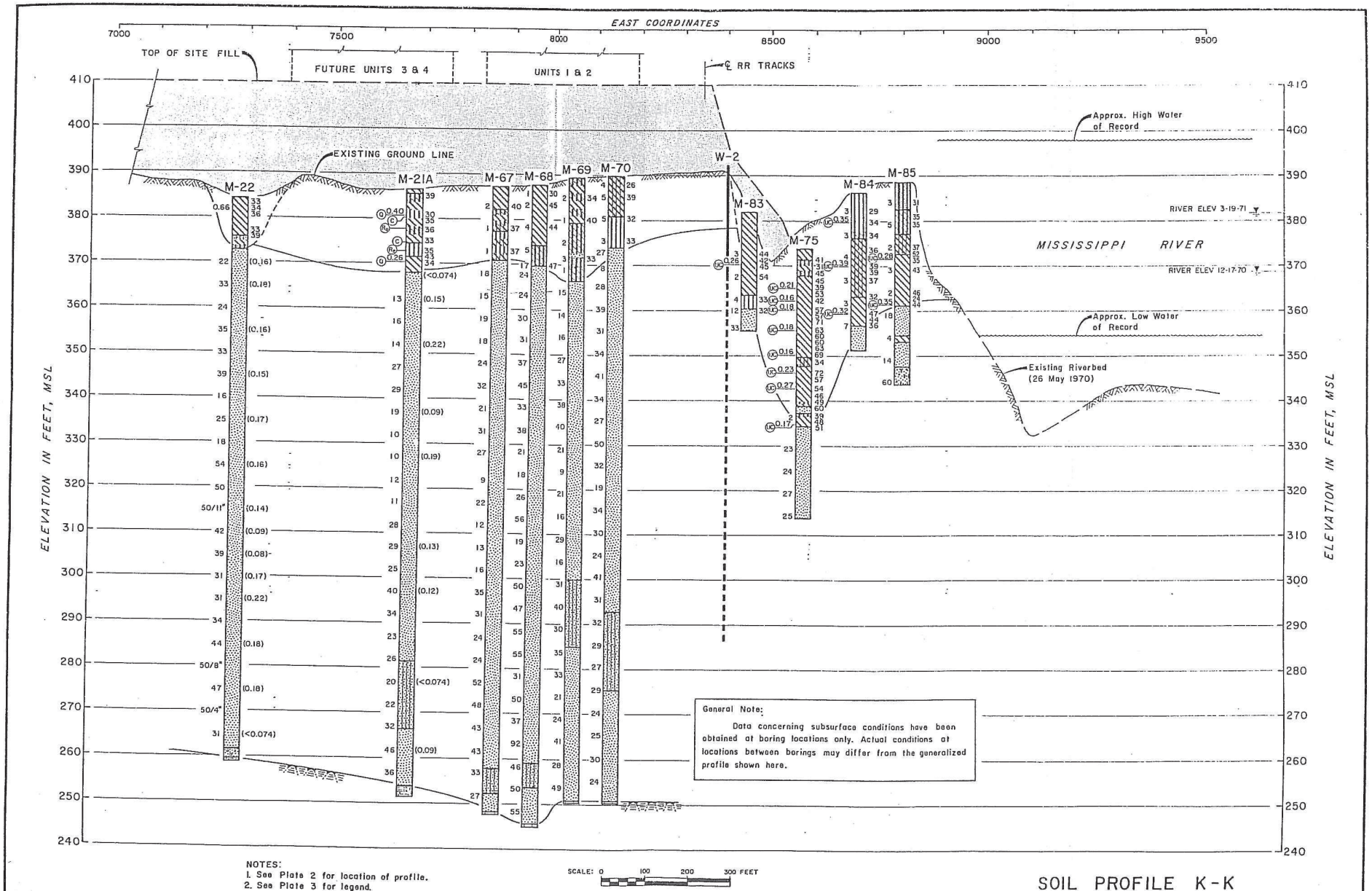
PLATE 11



SOIL PROFILE J-J

McCLELLAND ENGINEERS

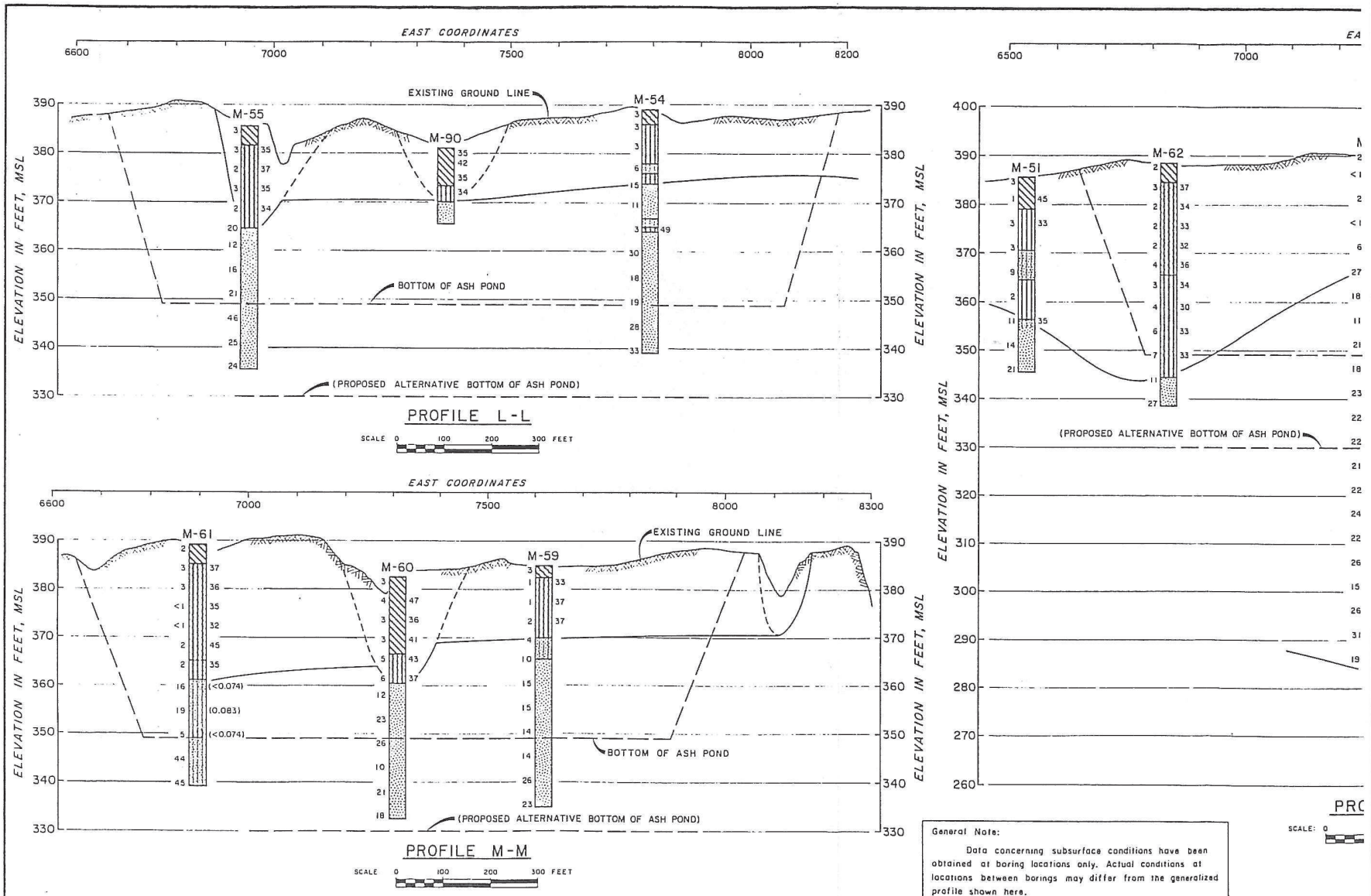
PLATE 12



SOIL PROFILE K-K

McCLELLAND ENGINEERS

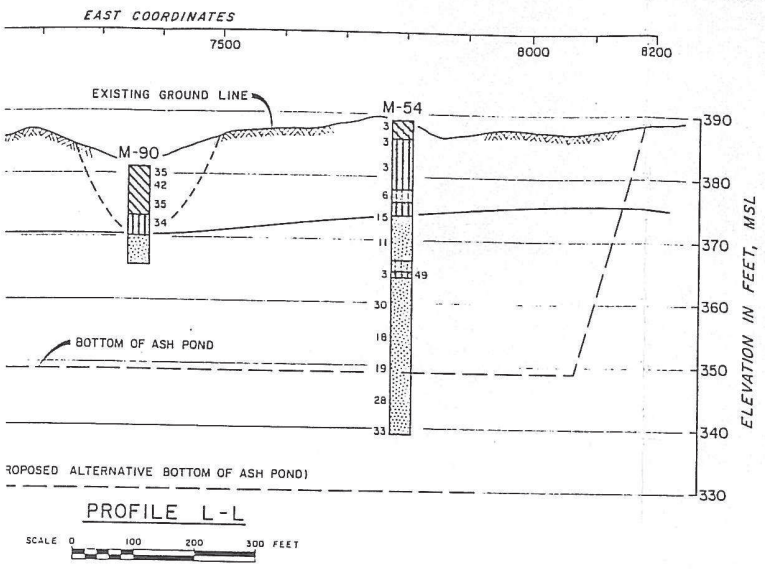
PLATE 13



General Note:

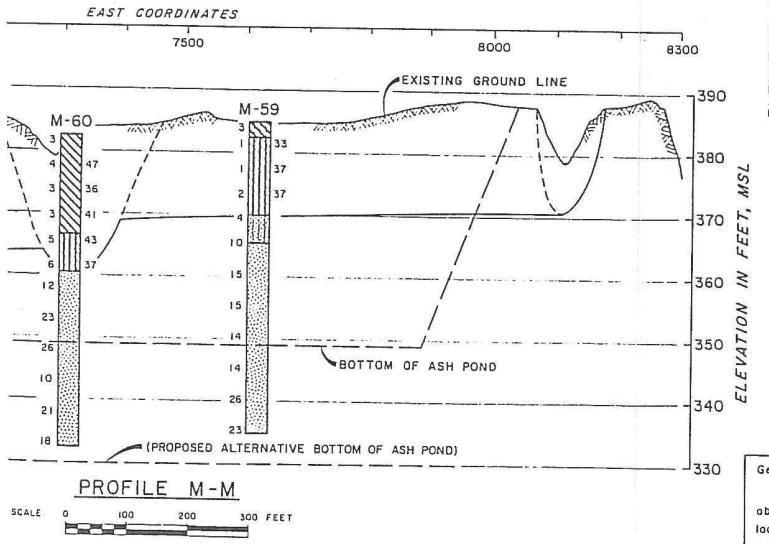
Data concerning subsurface conditions have been obtained at boring locations only. Actual conditions at locations between borings may differ from the generalized profile shown here.

NOTES:
1. See Plate 2 for location of profile.
2. See Plate 3 for legend.



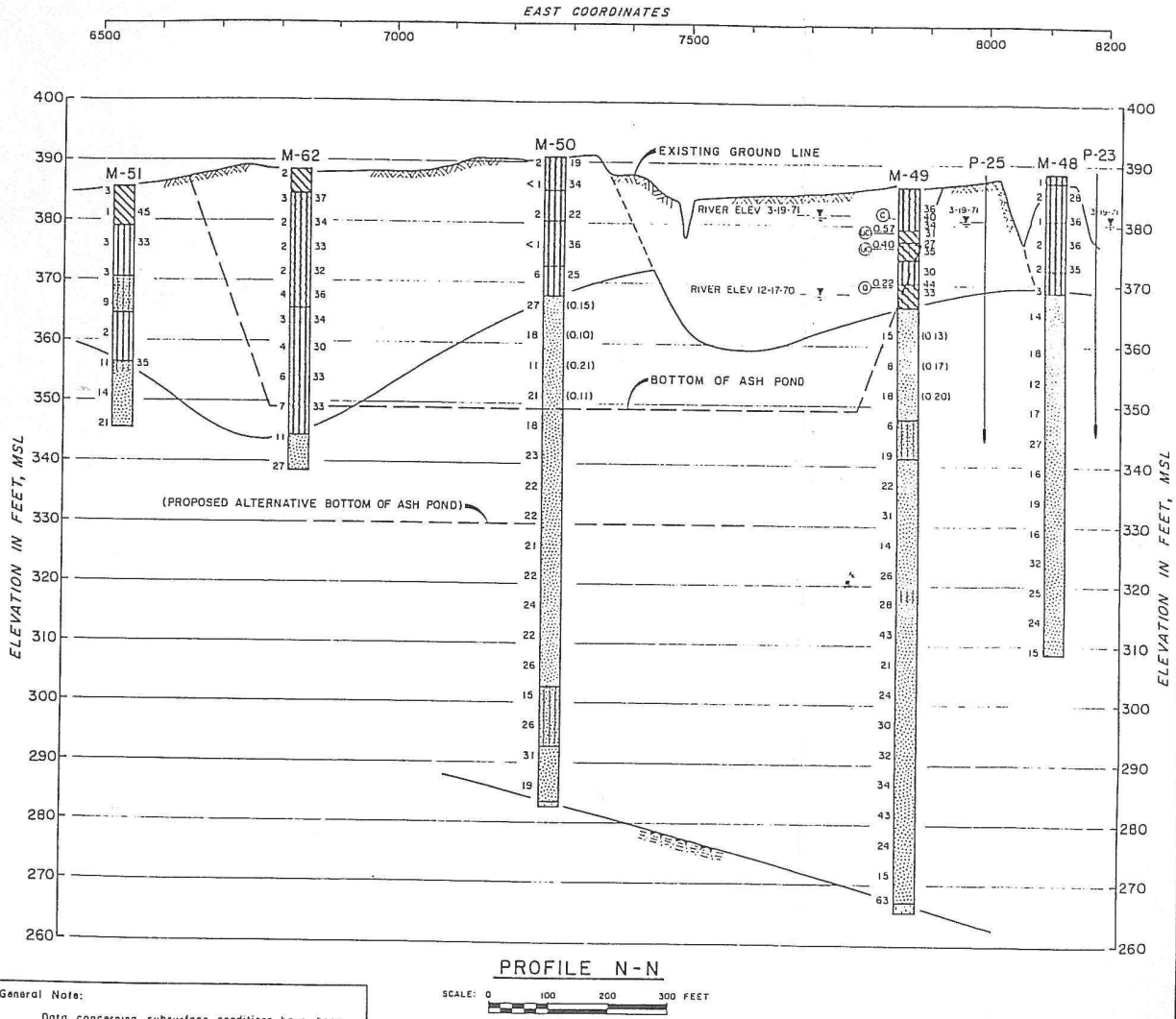
PROFILE L-L

SCALE 0 100 200 300 FEET



PROFILE M-M

SCALE 0 100 200 300 FEET



PROFILE N-N

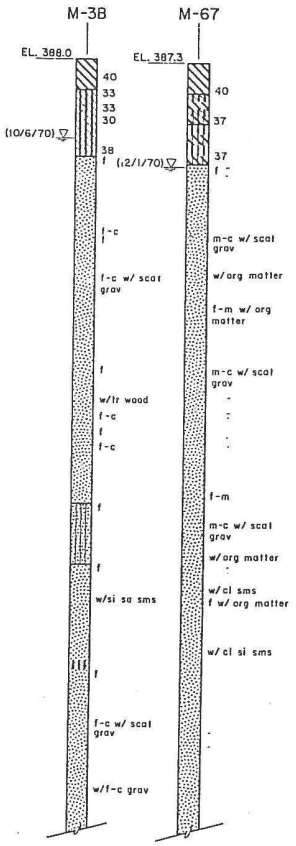
SCALE: 0 100 200 300 FEET

General Note:

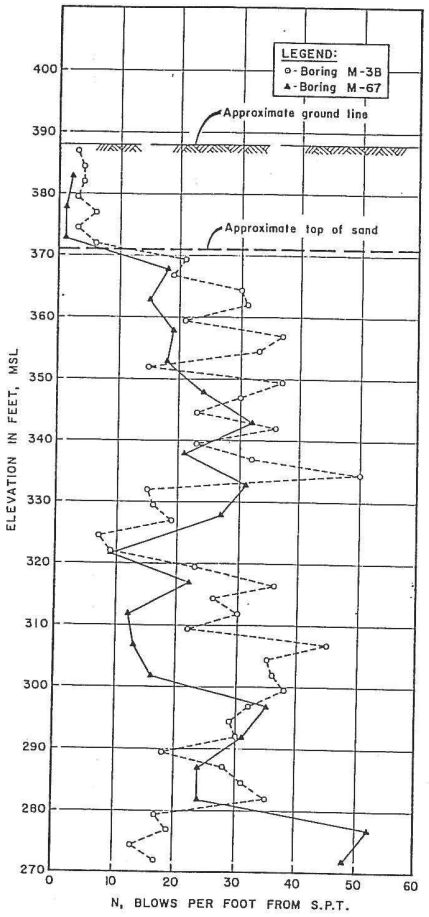
Data concerning subsurface conditions have been obtained at boring locations only. Actual conditions at locations between borings may differ from the generalized profile shown here.

NOTES:
1. See Plate 2 for location of profile.
2. See Plate 3 for legend.

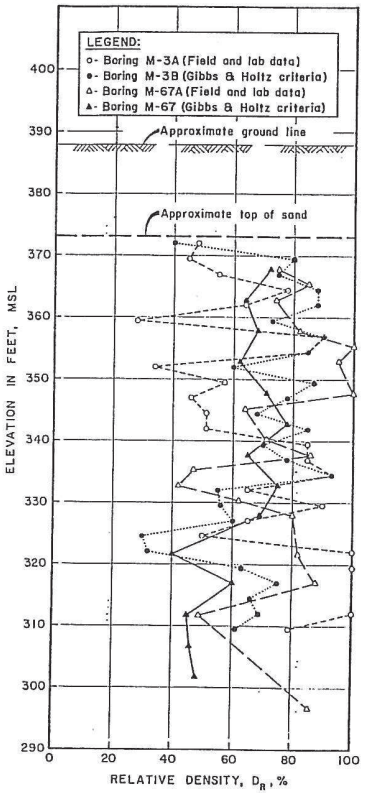
SOIL PROFILES L-L, M-M, AND N-N



LOGS OF BORINGS



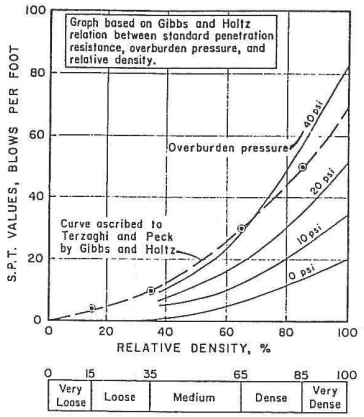
STANDARD PENETRATION RESISTANCES VS DEPTH

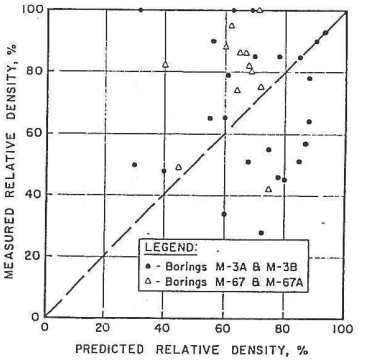


RELATIVE DENSITY VS DEPTH

NOTES:

1. Borings M-3A and M-67A were made 10 feet from borings M-3B and M-67, respectively.
2. Standard penetration tests were made in borings M-3B and M-67. Undisturbed samples of sands were taken in borings M-3A and M-67A.
3. The measured relative densities were computed from field and lab data. The in place densities were computed using the diameter of the tube at the cutting edge and the sample length, corrected for settlement in the tube.





MEASURED RELATIVE DENSITIES VS VALUES PREDICTED FROM S.P.T. USING GIBBS AND HOLTZ CRITERIA

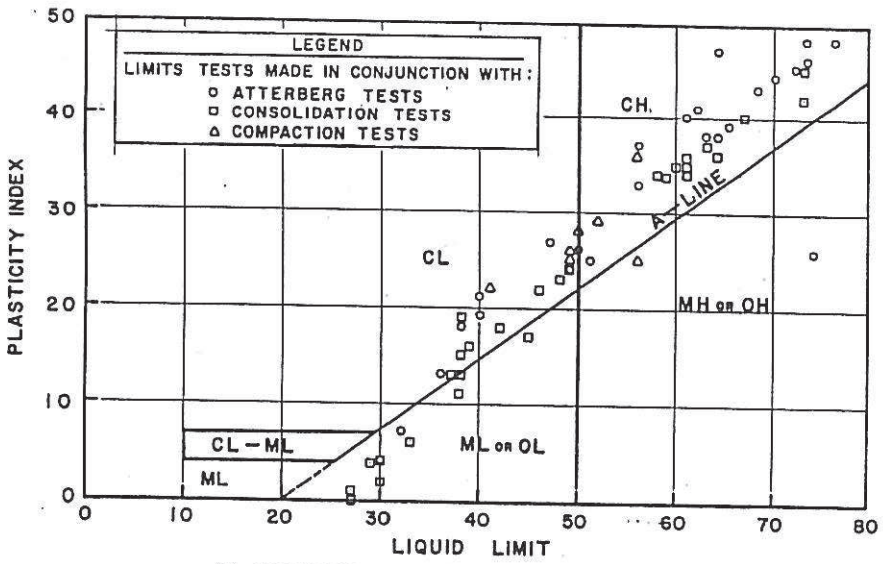
COMPARISON OF STANDARD PENETRATION TEST RESULTS AND RELATIVE DENSITIES

BORINGS M-3A, M-3B, M-67, AND M-67A

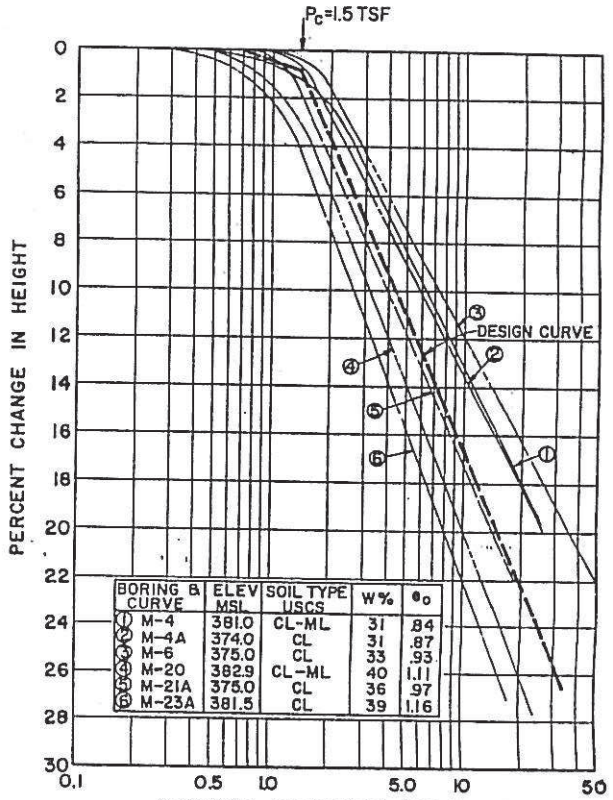
McCLELLAND ENGINEERS

PLATE 15

McCLELLAND ENGINEERS

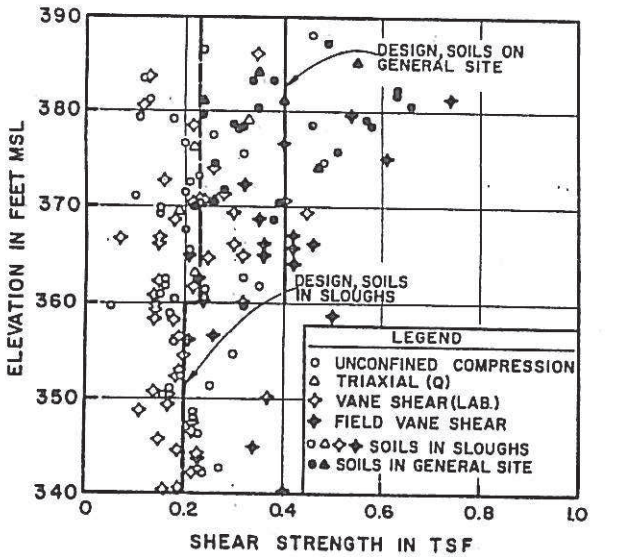


PLASTICITY OF TOP STRATUM SOILS

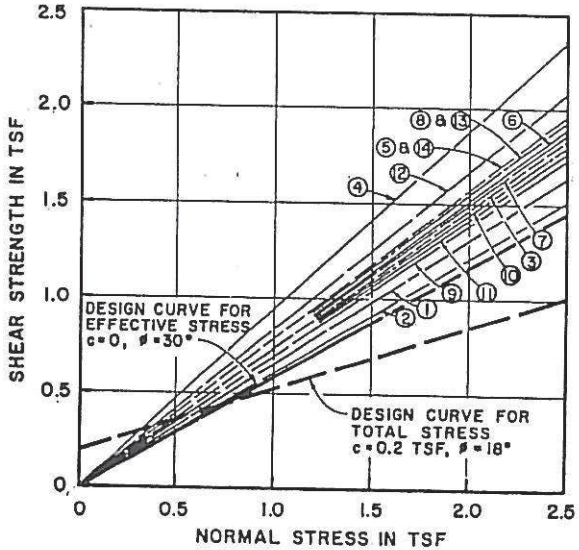


BORING & CURVE	ELEV MSL	SOIL TYPE USCS	W%	e_o
① M-4	381.0	CL-ML	31	.84
② M-4A	374.0	CL	31	.87
③ M-6	375.0	CL	33	.93
④ M-20	382.9	CL-ML	40	1.11
⑤ M-21A	375.0	CL	36	.97
⑥ M-23A	381.5	CL	39	1.16

CONSOLIDATION TEST RESULTS



(Q) AND (UC) SHEAR STRENGTH VS DEPTH



(R_e) SHEAR DATA

BORING & CURVE	ELEV MSL	ϕ	SOIL TYPE USCS
① M-4B	383.0	33.0	CL
② M-4B	376.2	31.0	CL
③ M-4B	370.8	36.0	ML
④ M-11	383.9	43.0	ML-CL
⑤ M-12	378.9	38.0	ML
⑥ M-18	377.2	37.0	ML
⑦ M-21A	378.0	36.5	ML-CL
⑧ M-21A	373.0	37.5	ML
⑨ M-26	380.5	34.5	ML
⑩ M-34	378.4	35.5	ML
⑪ M-39A	382.0	35.0	ML
⑫ M-45A	384.0	39.5	ML
⑬ M-47	373.0	37.5	ML
⑭ M-52	372.7	38.0	ML

TOP STRATUM SOILS DATA

PLATE 16

MISSOURI DEPARTMENT OF NATURAL RESOURCES
DAM AND RESERVOIR SAFETY

APPLICATION FOR REGISTRATION PERMIT

DATE: April 15, 2010

GENERAL INFORMATION

* OWNER(S) NAME: AmerenUE

* ADDRESS: 1901 Chouteau Ave.

* CITY: St. Louis | * STATE: MO | * ZIP CODE: 63103

* TELEPHONE NUMBER (REQUIRED): (314) 342-1000

NAME OF DAM: Rush Island Flyash Pond | ID NUMBER: MO 40179

COUNTY: Jefferson

LOCATION OF DAM AT CENTERLINE AT MAXIMUM SECTION
SECTION 3, SW quarter , TOWNSHIP 39N NORTH, RANGE 7E E/W

APPROXIMATE UTM COORDINATES
N E

DAM HEIGHT: 46 feet | RESERVOIR AREA: 29 Acres Active Water Storage

PURPOSE OF DAM AND RESERVOIR: Flyash Settling Pond

* NAME OF PERSON FILLING OUT THIS APPLICATION (TYPE OR PRINT): Thomas L. Hollenkamp, PE, SE

* SIGNATURE

* IN CASE OF EMERGENCY (TYPE OR PRINT)
NAME: Thomas L. Hollenkamp TELEPHONE NUMBER (REQUIRED): (314) 210-4356

CHECK ONE:

☐ **YES, I DO HAVE AN EMERGENCY ACTION PLAN FOR THE DAM.**

☒ **NO, I DO NOT HAVE AN EMERGENCY ACTION PLAN FOR THE DAM.**

IT IS MANDATORY THAT YOU COMPLETE ALL ITEMS MARKED WITH AN ASTERISK (*).

SUBMIT TO: Department of Natural Resources
Geological Survey and Resource Assessment Division
Dam and Reservoir Safety
P.O. Box 250
Rolla, Missouri 65402
(573) 368-2175

Note: located at 38 degrees, 07', 13.94" N
90 degrees, 15', 13.97" E

MO 780-1758 (3-04)

MISSOURI DEPARTMENT OF NATURAL RESOURCES
DAM AND RESERVOIR SAFETY

ATTACHMENT - REGISTRATION PERMIT APPLICATION

NAME OF DAM	ID NUMBER
Rush Island Flyash Pond	MO 40179
COUNTY	**DATE**
Jefferson	April 6. 2010

[X] **ENGINEER CERTIFICATION**

I hereby certify that I have inspected the Rush Island Flyash Pond
(NAME OF DAM)

on March 19, 2010 (DATE) in accordance with the law.

[ ] **ENGINEER CERTIFICATION**

I hereby certify that the owner of the _____
(NAME OF DAM)

has complied with my recommendations to correct observed defects as required by law.

[X] **JUDGEMENT OF STABILITY**

At the time of my inspection, there were no observable indications that the dam was unsafe.

Engineers Certification

I hereby certify that I have reviewed and approved preliminary plans for repair of the slopes as recommended in the attached report.

The owner has stated that plans will be completed and the work will be implemented during summer 2010.

It is my opinion that the proposed plans will correct the observed defects as required by law.

STATE OF MISSOURI
DONALD S. ESKRIDGE
NUMBER E-13802
REGISTERED PROFESSIONAL ENGINEER

NAME OF FIRM	DATE OF ENGINEER'S SEAL
Reitz & Jens, Incorporated	4/6/2010
REGISTERED ENGINEER	**P.E. NUMBER**
Donald S. Eskridge	E-13802

MO 780-1756 (3-04)

Rush Island Permit Report
Flyash Pond Levee System
Dam Safety Registration Analysis
MO 40179

Prepared for



St. Louis, Missouri

Prepared by



April 6, 2010

The Professional whose signature and personal seal appear hereon assumes responsibility only for what appears in the attached report and disclaims (pursuant to Section 327.411 RSMo) any responsibility for all other plans, estimates, specifications, reports, or other documents or instruments not sealed by the undersigned Professional relating to or intended to be used for any part or parts of the project to which this report refers.

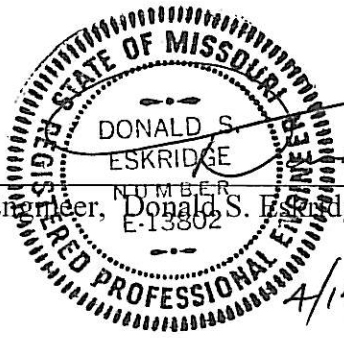
Certification by Experienced Professional Engineer

I hereby certify that the attached report has been prepared by the undersigned in accordance with the Dam Safety Regulations of the Missouri Dam and Reservoir Safety Council.

It is our opinion that when the recommended repairs are completed that this system will comply with the requirements for registration of this system as an industrial dam.

REITZ & JENS, INC.

Firm Name



Registered Engineer, Donald S. Eskridge, PE MO E-13802

4/14/2010

REITZ & JENS, INC.

Table of Contents

History 1
Site Classification 2
Site Survey 2
Dam Qualification 2
Slope Stability Analysis 2
Hydrology 3
River Floodplain 3
Rainfall Events 3
Operation & Maintenance Plan 4
Site Inspection 5
Seepage 5
External slope erosion 5
Polish pond Internal Slope 6
Woody Vegetation 6

Analysis of the Existing Fly Ash Pond for Missouri Dam Safety Permit Application

The Rush Island Power Plant, a coal fired power plant located on the west bank of the Mississippi River, deposits the flyash by-product of combustion in a settling pond. The pond was created by construction of a ring levee in the floodplain on the right bank of the Mississippi river. The downstream end of the pond is located at approximately river mile 139 above the mouth of the Ohio River.

It has been determined that the configuration of the levees fit into the regulated category for an industrial water retention dam as codified in the "Regulations of the Missouri Dam and Reservoir Safety Council" of the Missouri Department of Natural Resources. This document is the technical analysis of the existing system and engineering recommendations to accompany the Ameren Company's dam registration application.

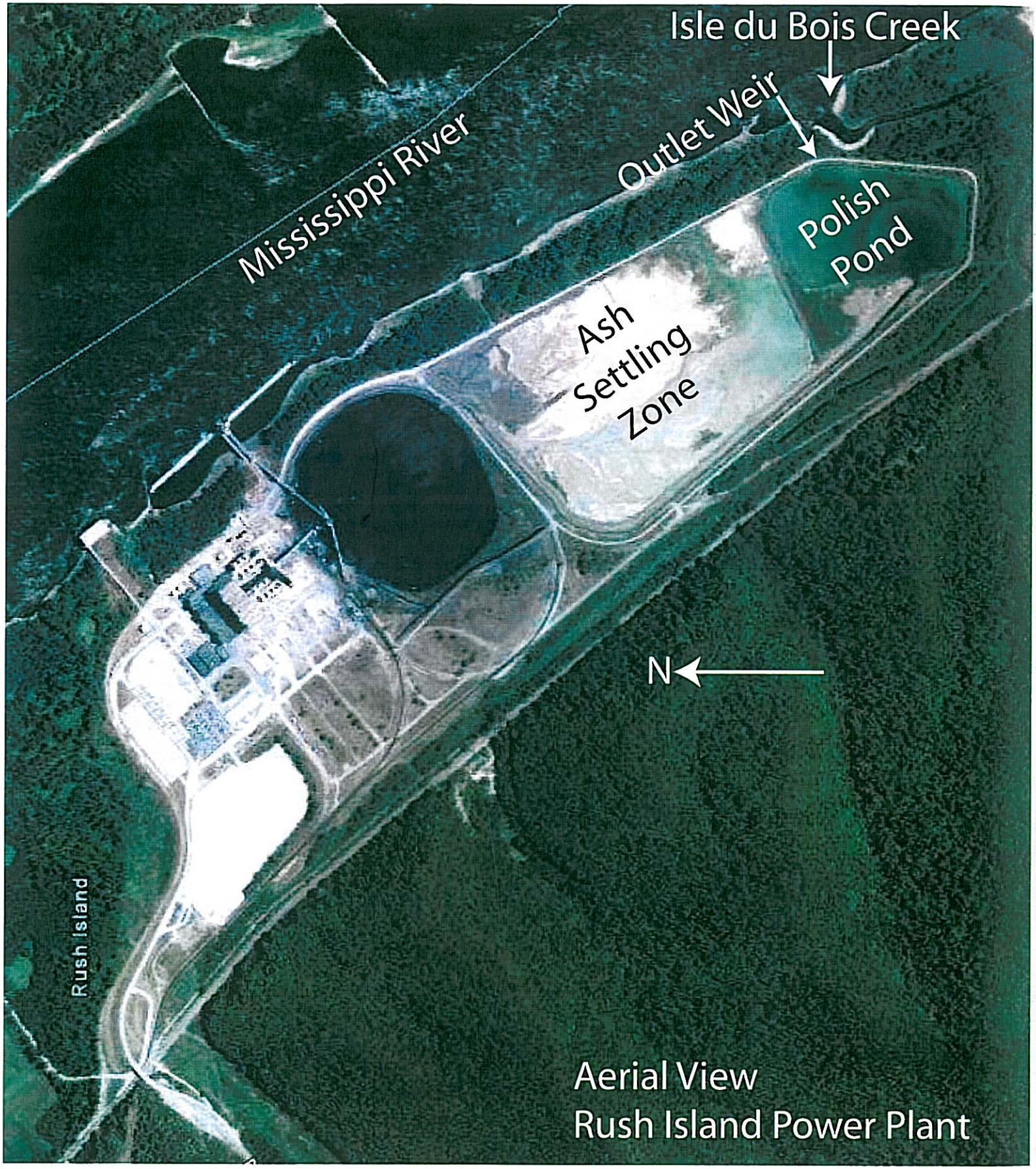
History

The Rush Island Power plant was built starting in the early 1970's. The available site plan, prepared by Bechtel Corporation has an "issued for bidding" date in early 1972. The plans show the initial plant layout with a south ash pond extending over the approximate limits of existing ash storage pond and the present "polish pond". The present pond configuration has an internal divider dike; the date of construction of the internal divider dike to separate the polish pond from the active ash accumulation portion is unknown. It is known that initial discussion of the design needs for the internal dike was started in 1994.

An annotated aerial photo on the following page shows the plant with its relationship to the Mississippi River on the east, the Isle du Bois creek on the south, and the vegetated hillside west of the plant.

The Bechtel site plan shows that the bottom of the ash pond was planned to be excavated to elevation 330, which is approximately 57 feet below the general original site grade of about 387. It is likely that some of the less permeable excavated materials were used to construct the containment dikes that are shown on the plans to be built up to elevation 410. The plans indicate that the containment dikes are supposed to have both internal and external slope surface inclinations of 3 horizontal to 1 vertical. The design top width of the dike is shown to be 14 feet.

The present use for flyash sedimentation is different from the original concept of "just a settling pond". The ash "pond" north of the internal dike is full, and the present ash disposal is into excavated pits within this area using a wetted dry ash nozzle to minimize the amount of water mixed with the ash in the smaller cell ponds. The "polish pond" is a final settlement pond that receives some ash, the plant process water, and the entire plant stormwater runoff.



Aerial View
Rush Island Power Plant

Site Classification

The flyash pond is located along the upstream side of the Isle du Bois Creek that empties into the Mississippi river. In this area the creek forms the south boundary line of Jefferson County. There are no residences or highways downstream of the dam and other public infrastructure. If the ring levee dam were to fail the discharge would flow immediately into the Mississippi river. Because there is no threat to life downstream of this dam in a potential inundation zone, it is our opinion that the Environmental Site Classification for this dam is class III, which is the lowest possible classification in Missouri. It is our understanding that in a site visit, the Chief Engineer for the Dam Safety Council also opined that this is a Class III downstream environment.

There are no dams upstream of this ring levee within the tributary watershed.

Site Survey

The entire top of levee was surveyed to obtain a profile around the ash pond. Five external slope cross sections were also obtained by the survey team. These cross section locations were chosen by Reitz & Jens as the probable locations of critical stability for analysis, the decision was based on both the geometry of the existing surface, and previous history of slope performance.

The top of levee profile is shown in the Appendix. The low point (approximately elevation 408.2) occurs between stations 84+50 and 85+50.

Dam Qualification

The surveyed cross sections show that the maximum "dam height" is 46 feet measured from the top of levee to the discharge channel flowline at the controlled outlet. Since this height is greater than 35 feet, the dam is a regulated dam in accord with the Missouri Dam Safety Council regulations, and the dam will need a registration permit.

The dam (levee) was constructed as a single stage containment levee using soils from the river floodplain. This is an industrial dam.

Slope Stability Analysis

The soil strength of the levee embankments and underlying foundation soils was analyzed using a combination of drilled test holes with both Standard Penetration Test sampling and 3 inch undisturbed thin-walled Shelby tube sampling, and Cone penetration testing. Six drilled test holes and 5 cone penetration test holes were originally proposed. One of the Test holes (TH # 5) was not drilled because of the presence of overhead power lines. The results of the test drilling, laboratory testing, and CPT testing are included in the appendix.

In late 2006 the left descending bank of the Isle du Bois creek where it is closest to the ash pond levee began to show some continued erosion towards the ash pond levee. The entire length of the adjoining creek bank was armored with rip-rap by the Corps of Engineers. There does not seem to be any

movement along that area since the creek bank was stabilized.. There was no obvious movement prior to the bank stabilization, however the bank stabilization was recommended because of the proximity to the ash pond. Levee stability study section # 4 was located through that bank stabilization area. The table on the following page shows the results of slope stability computations for three of the surveyed cross sections. The cross section number 7 was judged the most critical based on the initial total stress analysis of each cross section, therefore the greatest computational effort was on cross section # 7. The other cross sections were checked to assure that the calculated factors of safety meet the Dam Safety regulations.

The steady seepage surface used in the analysis was calculated using the procedures developed by Huang as referenced in the MO DNR 1989 Publication "Engineering Analysis of Dams". The steady seepage surface is shown on the stability computation program outputs appended to this report.

The slope stability summary (shown on the following page) indicates that the steady seepage condition is the controlling limit to maintain the factors of safety within the limits stated by Mo DNR.. This computation of the seepage surface assumes that the embankment is homogeneous, which will require any fills on the inside of the embankment to restore the grades will have to be built with fills having permeability similar to the remainder of the levee embankment. That will rule out using a rock fill to restore the inside inclinations.

The slope stability computations show that the permanent pool cannot be above elevation 403. Short term pool rises, such as a response to a major rainfall can rise above elevation 403 but the pool will have to be returned to no higher than elevation 403 after the rainfall event.

The computations show that the seismic stability is adequate.

There has been a transmission line recently constructed to serve the new Holcim cement plant just south of Rush Island, some of the transmission line towers are along the top of the west boundary levee. These are monopole towers on deep monopole drilled pier foundations. The bottoms of the tower foundations are at lease 45 feet below the top of the levee, and these are judged to have no effect on the stability of the levee.

Hydrology

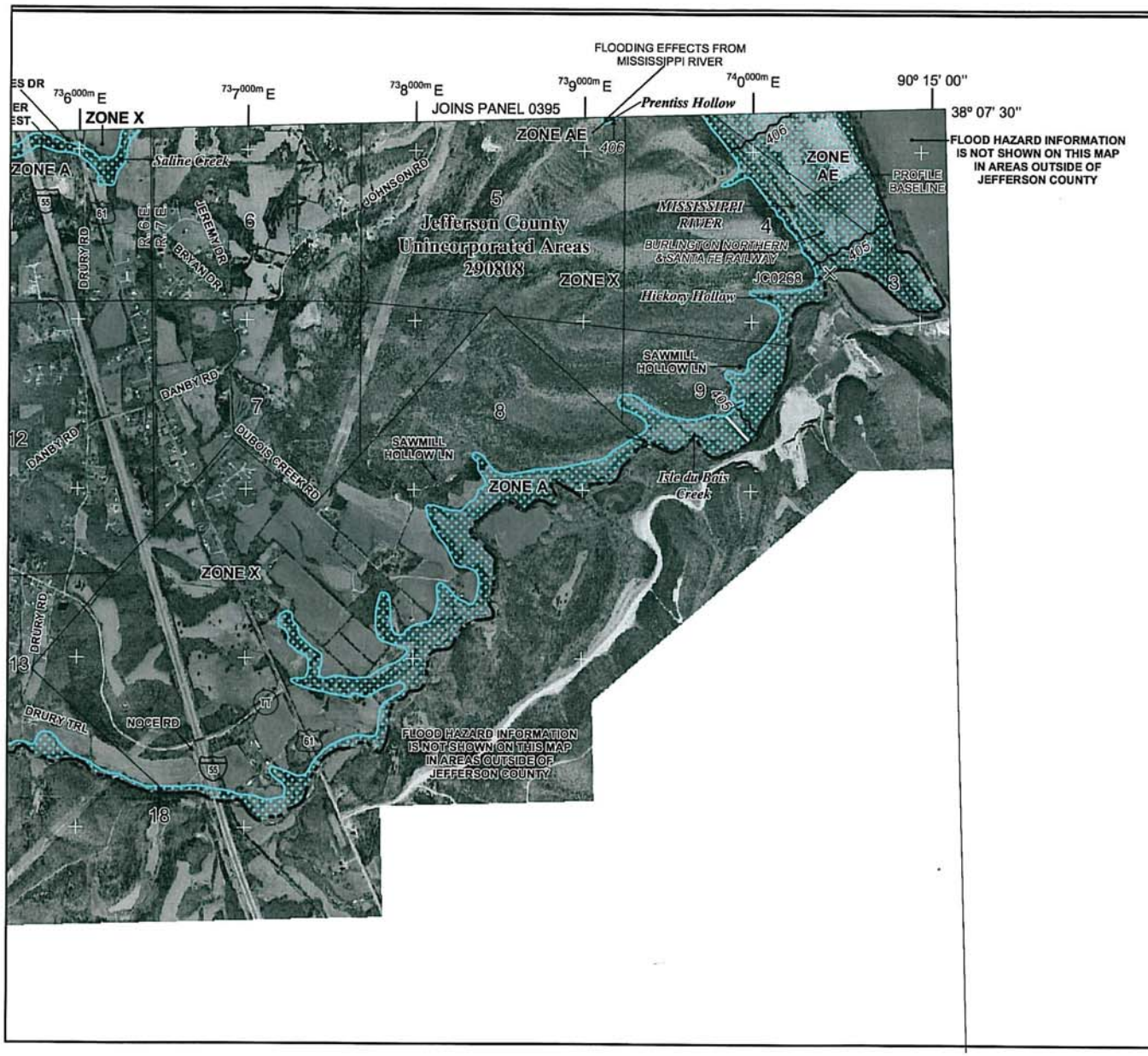
River Floodplain

The ash pond is on the floodplain of the Mississippi river, the south end of the pond is opposite mile marker 139 on the Mississippi river. The FEMA FIRM maps show the 100 year Mississippi river flood at Isle du Bois creek to be at elevation 405 on a Jefferson County FIRM with effective date of July, 2006. The US Corps of Engineers has recently completed a Flood Flow Frequency study (FFF) for the Mississippi, Missouri and Illinois rivers, that modeled all the development along the river. The FFF 100 year flood elevation at Mississippi river mile is 403.7. The Fema FIRM maps have not yet recognized the FFF study. Both of the Mississippi river 100 year flood calculated water surfaces are below the top of the ash pond levee as recently surveyed. A firmette of the area is on the following page.

Rainfall Events

Rush Island Slope Stability Summary Sheet

Section	Stress Phase	Seismic Force	Pool Elevation	Stored Ash	Toe Setback	Factor Safety	Req"d FS	File	
3	total	none	none	395		2.9		3001	
3	total	none	407	395		1.95		3002	
4	total	none	407	407		2.26	1.5	4001	
4	stdy seep	none	403	403		1.51	1.5	4012	normal pool
4	stdy seep	0.046	398	398		1.375	1.0	4011	
4	stdy seep	none	398	398		1.65	1.5	4010	
4	stdy seep	none	407	407		1.404	1.3	4013	max pool @ 407
4	stdy seep	0.046	403	403		1.31	1.0	4014	normal pool
7	total	none	407	407		1.731	1.5	7001	
7	stdy seep	none	398	398		1.711	1.5	7004	
7	stdy seep	0.046	398	398		1.49	1.0	7005	
7	stdy seep	none	407	407		1.41	1.5	7006	1.3 FS for max pool
7	stdy seep	none	403	403		1.54	1.5	7007	normal pool
7	stdy seep	0.046	403	403		1.34	1.0	7008	normal pool



MAP SCALE 1" = 2000'

1000 0 2000 4000 FEET

METER

NFIP

PANEL 0500E

FIRM

FLOOD INSURANCE RATE MAP

JEFFERSON COUNTY, MISSOURI AND INCORPORATED AREAS

PANEL 500 OF 500

(SEE MAP INDEX FOR FIRM PANEL LAYOUT)

CONTAINS:

COMMUNITY	NUMBER	PANEL	SUFFIX
JEFFERSON COUNTY	290808	0500	E

Notice to User: The **Map Number** shown below should be used when placing map orders; the **Community Number** shown above should be used on insurance applications for the subject community.

NATIONAL FLOOD INSURANCE PROGRAM

MAP NUMBER
29099C0500E

EFFECTIVE DATE
APRIL 5, 2006

Federal Emergency Management Agency

This is an official copy of a portion of the above referenced flood map. It was extracted using F-MIT On-Line. This map does not reflect changes or amendments which may have been made subsequent to the date on the title block. For the latest product information about National Flood Insurance Program flood maps check the FEMA Flood Map Store at www.msc.fema.gov

A completed existing industrial dam in a Class III environment is required to be able to handle the 100 year storm event without any uncontrolled overtopping or uncontrolled discharge.

The Rush Island power plant, coal stockpile, and ash pond create a stand-alone hydrologic unit that has no additional tributary area. Stormwater collected within the plant confines is pumped into the discharge channel that leads to the present polish pond. The runoff from the coal pile flows into the same discharge channel.

The total tributary area of the plant, coal pile and ash ponds is 261 acres. All the collected stormwater accumulates in the polish pond and is discharged through a 24 inch diameter vertical riser pipe spillway that has several control valves on it. The control valves are necessary to maintain the discharge water within EPA guidelines.

For purposes of storm routing the total plant tributary area was broken up into 4 separate hydrologic units as shown on the following drawing entitled "Storm Drainage Assumptions". Two outflow condtions were analyzed, the first assumes that the 24 inch discharge pipe is fully opened throughout the period of storm runoff storage, and the second condition is that the 24 inch pond discharge pipes are closed to flow. None of the analyses assume any flow over any other spillway on the system.

The hydrologic computations are shown in the appendix. All runoff and routing computations were performed using the computer program "Hydraflow Hydrographs" by Intellisolve. All of the computations include a steady plant process outflow of 20 cfs in addition to the stormwater runoff. A summary table of the computation results is shown on the following page.

The present operating elevation of the polish pond water surface ranges between elevation 396 and 398, the plant operations personnel stated that they would like to operate the pond at an elevation of 398. The hydrology computations show that for both the 100 year 24 hour storm and the 100 year 6 hour storm, the maximum routed pool elevation is 402.55 for a fully functioning pond outlet, and elevation 404.05 for a closed pond outlet. There remains at least 4.15 feet of freeboard below the lowest elevation of the ash pond levee. The system can safely store the 100 year storm for a beginning pool elevation of 398.

Since the slope stability analysis shows that a maximum permanent pool of 403 is possible, the system response was also modeled with a 403 starting pool elevation. A fully functioning pond outlet would pond water to an elevation of 407.44, and a closed outlet would pond water to an elevation of 408.88 which is above the lowest present elevation of the ash pond levee.

The low point of the perimeter levee is at elevation 408.2 between survey stations 84+50 and 85+50, in the north west corner of the ash pond. It is our opinion that as long as the operating water surface is at elevation 398 and the polish pond has a full 27 acres of water surface available (no ash delta above elevation 398) that there is no emergency spillway needed on this system.

Operation & Maintenance Plan

There is no documented operation and maintenance plan available. A plan should be prepared, to integrate the requirements of the regulated outfall and the pool elevation requirements needed to satisfy

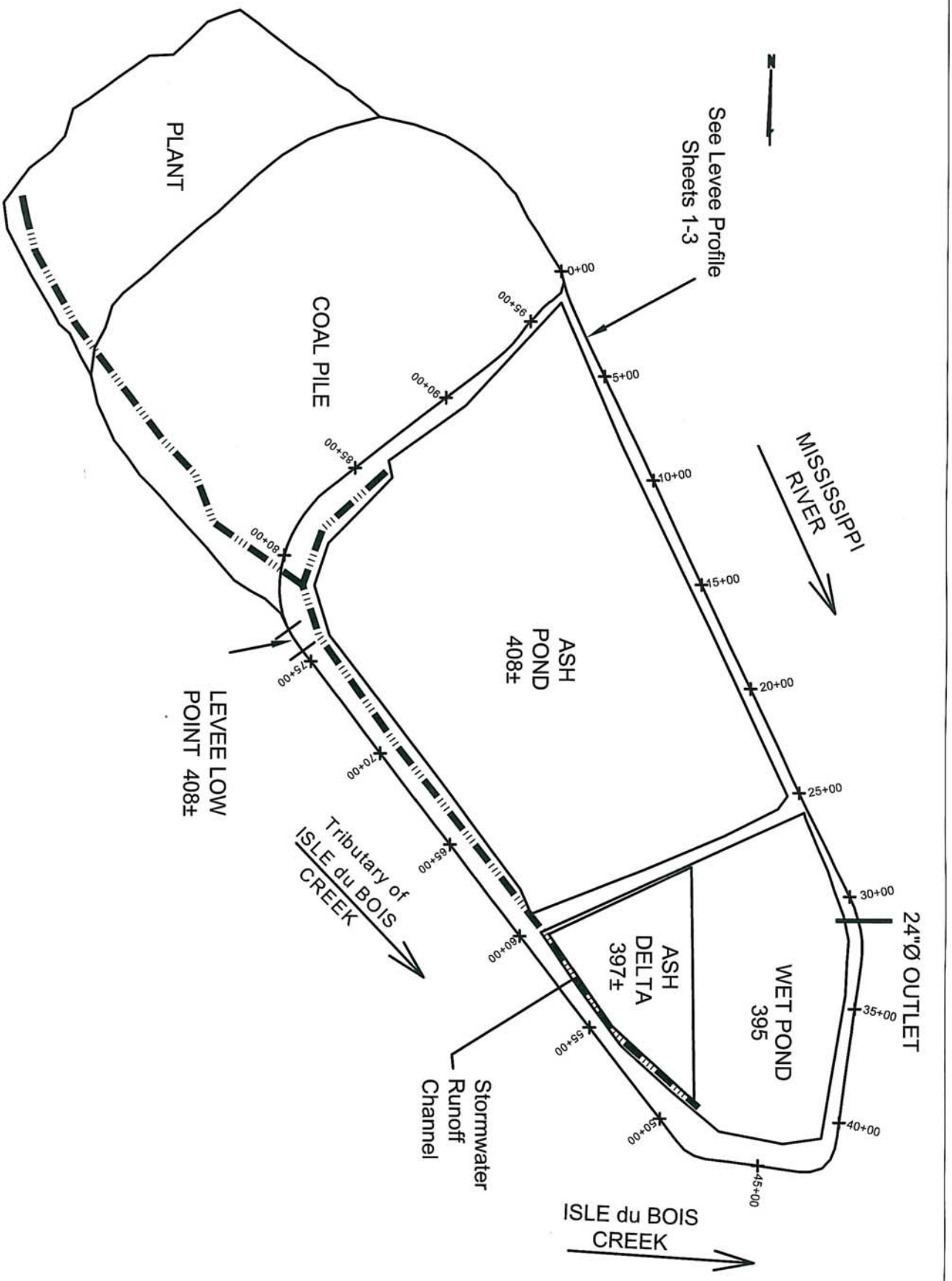
Table of Results
Hydrologic computations

Rush Island Ash Pond Storm Routing

File	Rainfall duration	frequency	Pond Start Elevtion	Base Flow from Plant	Maximum Stage	Max. Outflow cfs	Total Storage ac-ft	Remarks
Trial 03	24 hr	100 yr	395	15 cfs	399.55	27.97	116	8.1 ac Ash delta at 395
Trial 04	24 hr	100 yr	395	20 cfs	399.87	28.95	124	8.1 ac Ash delta at 395
Trial 05	24 hr	100 yr	403	20 cfs	407.44	27.93	126	No Ash Delta @ 403
Trial 09	24 hr	100 yr	398	20 cfs	402.55	28.27	125.2	Ash Delta Submerged @ 397
From Hand computations (sheet 4) - for a blocked outlet pipe								
	24 hr	100 yr	395	20 cfs	401.43	0	167.188	8.1 ac Ash delta at 395
	24 hr	100 yr	398	20 cfs	404.05	0	167.188	Ash Delta Submerged @ 397
	24 hr	100 yr	403	20 cfs	408.88	0	167.188	Stage is higher than 408.2 lowpoint
Trial 06	6 hr	100 yr	395	20 cfs	398.25	23.51	79.8	8.1 ac Ash delta at 395
Trial 07	6 hr	100 yr	403	20 cfs	405.88	22.38	80.3	No Ash Delta @ 403
Trial 08	6 hr	100 yr	398	20 cfs	400.93	22.68	80.21	Ash Delta Submerged @ 397

Note: 100 yr - 24 hour storm - 7.10 inches
100 yr - 6 hour storm - 5.20 inches
Souirce - Bulletin 71, Huff & Angel

rl levee.dwg 01/08/2010



SHEET 1	Dam Safety Permit Storm Drainage Assumptions 2009012469	AmerenUE Rush Island Plant Festus MO, 63028	Designed D.S.E. Checked D.S.E. Drawn D.L.B. Issued 01/08/2010	REITZ & JENS, INC. CONSULTING ENGINEERS 1055 CORPORATE SQUARE DRIVE ST. LOUIS MISSOURI 63132 (314) 993-4132 PROFESSIONAL ENGINEERING CORP., LICENSE #000215

both the geotechnical stability and the hydrologic requirements. This plan should be prepared within 6 months.

The operating pool water level needs to be monitored and recorded on at least a daily basis. When a significant rainfall event is predicted the operating staff needs to know what to expect as a response to the storm.

Since there is no emergency spillway recommended, it is our opinion that the maximum operating water surface elevation in the pond should be 400.2, provided that the full pond volume is available for storage. There should be no ash delta robbing the available storage for storm runoff. The recommended starting elevation would allow a 100 year 24 hour storm to be stored no higher than elevation 406.2 even if the outlet is blocked. This still provides a freeboard of 2 feet below the overflow elevation of the perimeter levee.

The plant personnel should develop an operating plan for pond management that reflects this storage need as well as the environmental constraints on the pond outlets.

Site Inspection

As a part of this application a visual site inspection was made by Donald Eskridge, PE on March 19, 2010. The following is a discussion of several observed deficiencies that need to be corrected. The discussion will refer to the stationing used in the 2010 levee survey plan sheets included in the appendix.

Seepage
There are two locations of slight seepage through the face of the slope in the vicinity of stations 14+00 to 15+00. These seeps have always been there and the embankment is not showing any distress except that from mowing disturbance. Since this is opposite the filled ash pond it is our opinion that these seeps do not pose an immediate threat to the stability of the embankment. We recommend that they be monitored and if the seepage increases then localized excavation and repairs may be needed.

External slope erosion
In the vicinity of station 30+00 the toe of the levee embankment slope has been eroded away to form a steep slope about 5 feet high. The surface has no erosion protection. This is shown in the photo to the right. In the event of a Mississippi river flood continued erosion could occur that would not be able to be observed through the flood waters, and the slope could fail. This eroded area needs to be rebuilt and rip-rapped. A similar section occurs about 80 feet south of the discharge platform bridge that also needs to be re-shaped and rip-rapped. The rock rip-rap should be placed on either a bedding layer, or a separation layer of non-woven filter fabric. The finish face of the entire slope should be built to



the original design slope.

In the vicinity of station 57+00 the external slope has experienced severe surface erosion from runoff from the road on the top of the levee. It could also be erosion started at a in-completely filled root ball hole from the slope clearing. This erosion should be filled in and re-seeded.

Polish pond Internal Slope

Wave action style erosion has steepened the internal slopes of the east and south sides of the polish pond from approximately stations 33+00 to 50+00. In many cases the erosion has created slopes as steep as 1H:1V, and along the east shore the erosion is within 10 feet of the edge of the roadway. A photo is shown on the left of this discussion.



The slope stability study has shown that the steady seepage condition is the most critical for the existing external slopes. The internal slopes have to be re-built with soils to a minimum 2H:1V slope to meet the seepage analysis assumptions. These slopes should also be rip-rapped after rebuilding to protect against recurrence of the wave erosion.

Reitz & Jens has been informed that plans are under way to perform this slope repair during the summer of 2010.

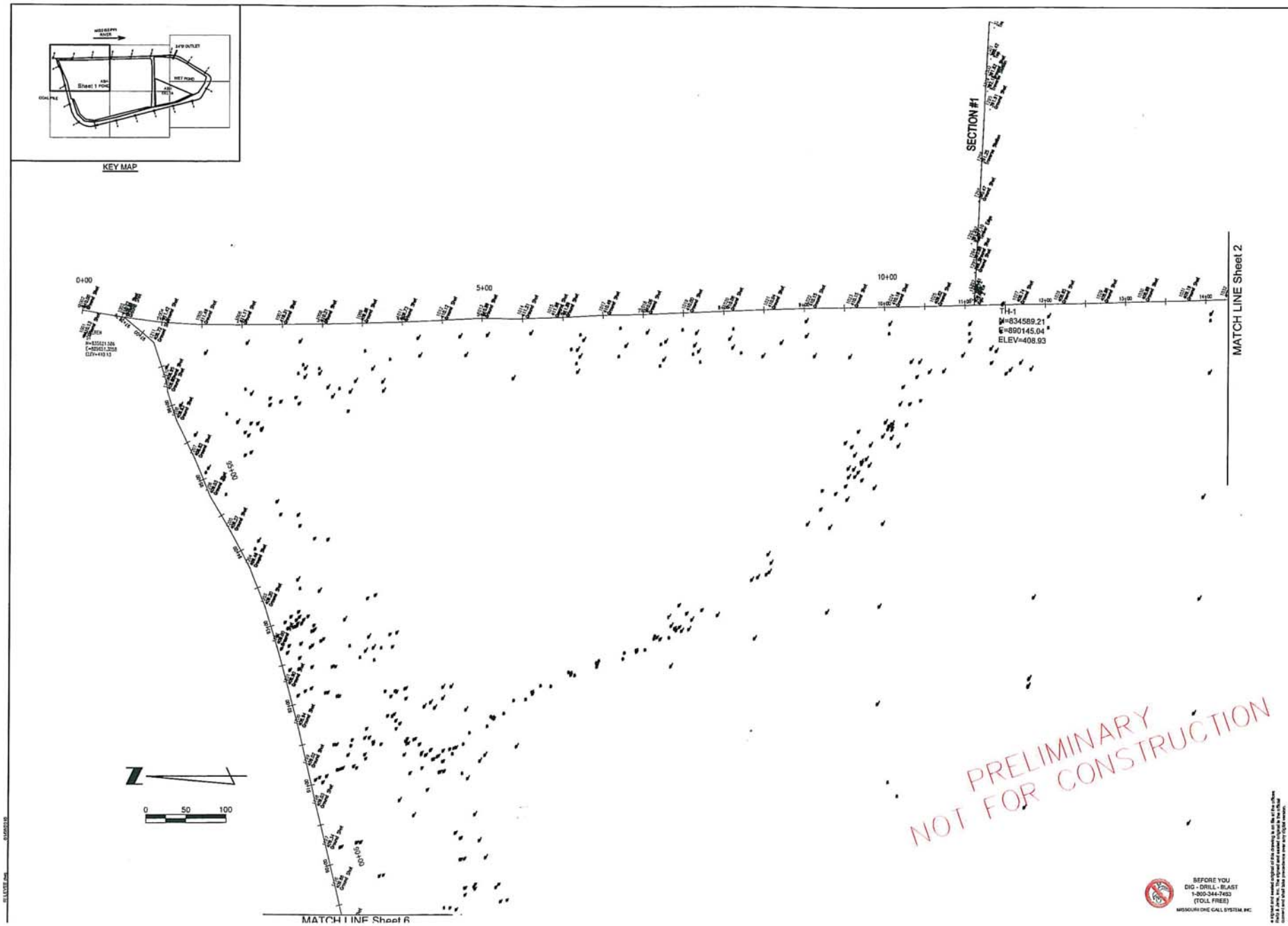
Woody Vegetation

Woody Vegetation is establishing along the interior slope from approximately Stations 48+00 to about 55+00. This needs to be cleared.

APPENDICES

Top of Levee Elevation Survey
Top of Levee Profile
Cross Section Plots
Test Holes Location Plan
Boring Logs Lab Testing Results
CPT Logs
Slope Stability Analysis
Hydrology Analysis

Top of Levee Elevation Survey



Engineer Seal

THIS MEDIA SHOULD NOT BE CONSIDERED A CERTIFIED DOCUMENT

Date:

THE ENGINEER WHOSE SIGNATURE AND PERSONAL SEAL APPEAR HEREON ASSUMES RESPONSIBILITY ONLY FOR WHAT APPEARS ON THIS PAGE AND DISCLAIMS ENTIRELY ANY RESPONSIBILITY FOR ALL OTHER PLANS, SPECIFICATIONS, ESTIMATES, REPORTS OR OTHER DOCUMENTS OR INSTRUMENTS NOT BEARING BY THE UNDERSIGNED ENGINEER RELATING TO OR INTENDED TO BE USED FOR ANY PART OR PARTS OF THE PROJECT TO WHICH THIS PAGE REFERS.

REITZ & JENS, INC.
CONSULTING ENGINEERS
1055 CORPORATE SQUARE DRIVE
ST. LOUIS, MISSOURI 63132
(314) 993-4422
PROFESSIONAL ENGINEERING CORPORATION LICENSE #000218

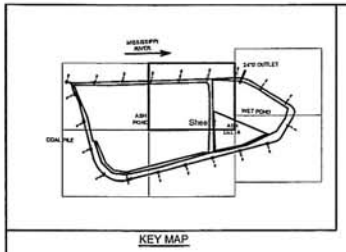
Designed: D.S.E. Checked: P.H.R.
Drawn: D.L.B. Issued: 01/05/2010

AmerenUE

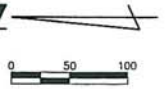
Rush Island Plant
Festus, MO 63028

Dam Safety Permit
Ash Pond Levee
Ash Pond Plan
2009012469

REVISIONS



KEY MAP



MATCH LINE Sheet 1

15+00

20+00

CPT-1
N=833791.77
E=890517.52
ELEV=410.60

25+00

TH-2
N=832
E=890
ELEV=

MATCH LINE Sheet 3

MATCH LINE Sheet 5

NOT FOR PRELIMINARY
NOT FOR CONSTRUCTION

BEFORE YOU
DIG - DRILL - BLAST
1-800-344-7483
(TOLL FREE)
MISSOURI ONE CALL SYSTEM, INC

Engineer Seal

THIS MEDIA SHOULD NOT BE CONSIDERED A CERTIFIED DOCUMENT

Date:

THE ENGINEER WHOSE SIGNATURE AND SEAL APPEAR ON THIS DOCUMENT ASSUMES RESPONSIBILITY ONLY FOR WHAT APPEARS ON THIS PAGE. ANY USE OF THIS DOCUMENT PURSUANT TO SECTION 327.411 RSMO) ANY RESPONSIBILITY ESTIMATES, REPORTS OR OTHER DOCUMENTS OR INSTRUMENTS NOT SEALED BY THE ENGINEER WHOSE SIGNATURE APPEARS TO OR REFERRED TO SHALL BE VOIDED FOR ANY PART OR PARTS OF THE PROJECT TO WHICH THEY ARE REFERS.

REITZ & JENS, INC.
CONSULTING ENGINEERS
ST. LOUIS MISSOURI 63102
PROFESSIONAL ENGINEERING CORPORATION, LICENSE #00018

Designed: D.S.E.
Drawn: D.L.R.
Checked: P.H.R.
Issued: 01/08/2010

AmerenUE

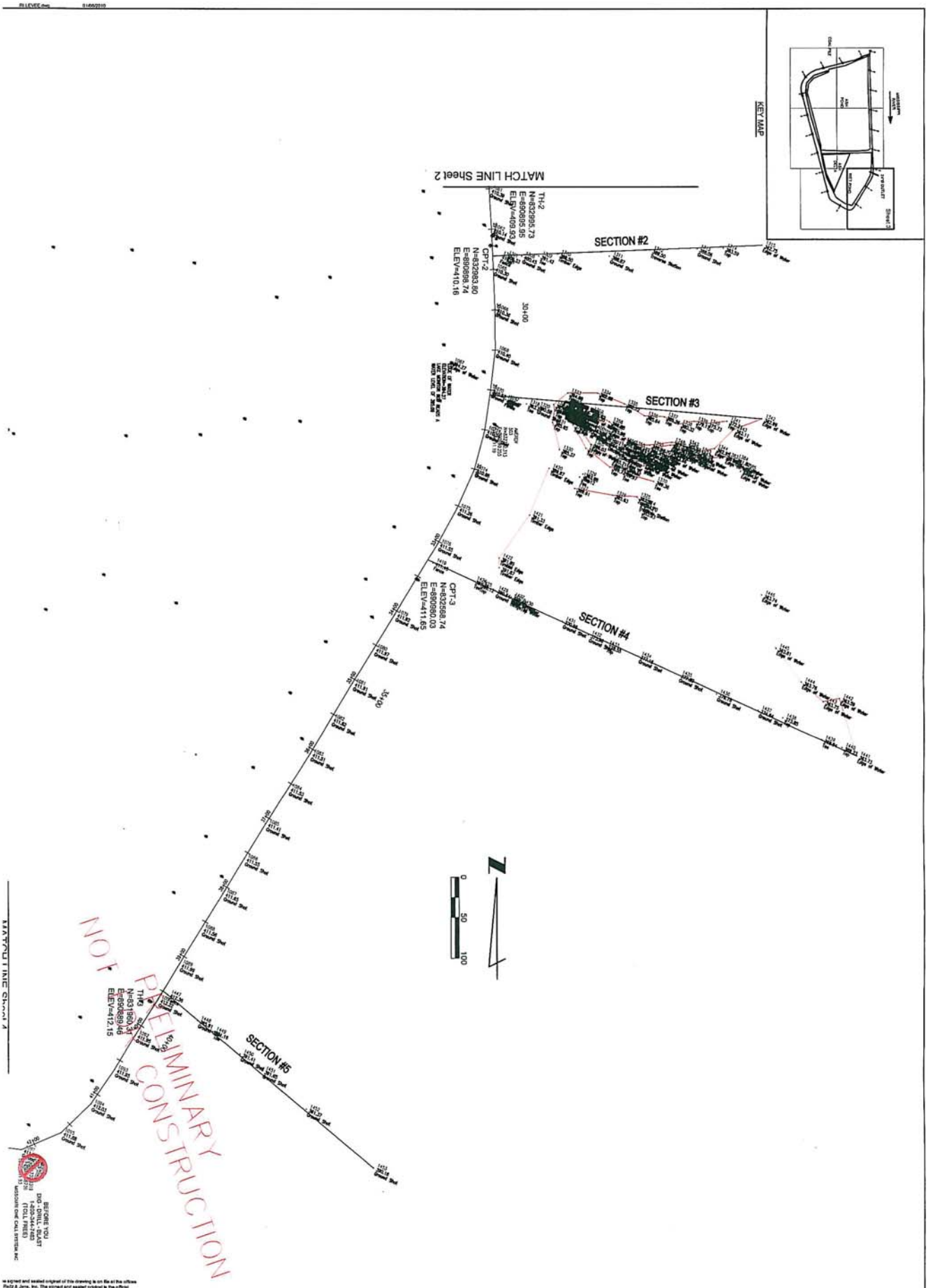
Rush Island Plant
Festus, MO 63028

Dam Safety Permit
Ash Pond Levee
Ash Pond Plan
2009012469

REVISIONS

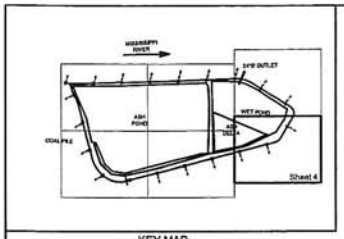
All signed and sealed original of this drawing is on file at the office of Reitz & Jens, Inc. Any alterations to this drawing will be the responsibility of the party making the alteration.

RI LOCS.dwg 01/08/2010

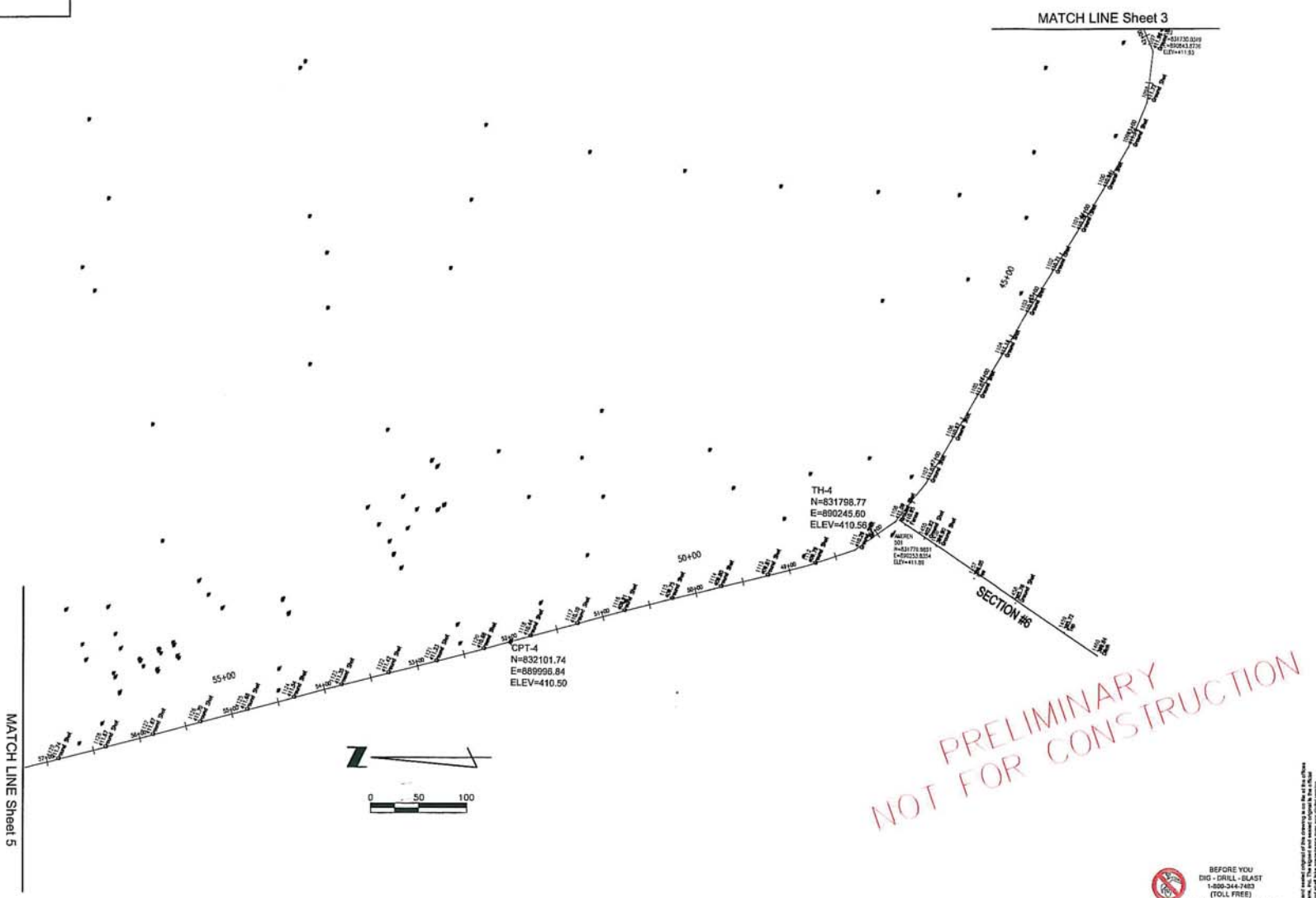


REVISIONS	Dam Safety Permit Ash Pond Levee Ash Pond Plan 2009012469	AmerenUE Rush Island Plant Festus, MO 63028	REITZ & JENS, INC. CONSULTING ENGINEERS 1018 CORPORATE SQUARE DRIVE ST. LOUIS, MISSOURI 63132 (314) 965-4132 PROFESSIONAL ENGINEERING CORPORATION LICENSE #A0215 Designed D.S.E. Checked P.H.R. Drawn D.L.B. Issued 01/08/2010	THE ENGINEER WHOSE SIGNATURE AND PERSONAL SEAL APPEAR HEREON ASSUMES RESPONSIBILITY ONLY FOR WHAT APPEARS ON THIS PAGE AND DISCLAIMS (PURSUANT TO SECTION 327.411 RSMO) ANY RESPONSIBILITY FOR ALL OTHER PLANS, SPECIFICATIONS, ESTIMATES, REPORTS OR OTHER DOCUMENTS OR INSTRUMENTS NOT SEALED BY THE UNDERSIGNED ENGINEER RELATING TO OR INTENDED TO BE USED FOR ANY PART OR PARTS OF THE PROJECT TO WHICH THIS PAGE REFERS.	Date	THIS MEDIA SHOULD NOT BE CONSIDERED A CERTIFIED DOCUMENT	Engineer Seal

e signed and sealed original of this drawing is on file at the offices Reitz & Jens, Inc. The signed and sealed original is the official ument and shall take precedence over any digital version.



KEY MAP



PRELIMINARY
NOT FOR CONSTRUCTION

BEFORE YOU
DIG - DRILL - BLAST
1-800-344-7483
(TOLL FREE)
MISSOURI ONE CALL SYSTEM, INC.

Engineer Seal

THIS MEDIA SHOULD NOT BE CONSIDERED A CERTIFIED DOCUMENT

Date:

THE ENGINEER WHOSE SIGNATURE AND PERSONAL SEAL APPEAR HEREON ASSUMES RESPONSIBILITY ONLY FOR WHAT APPEARS ON THIS PAGE AND DISCLAIMS ANY RESPONSIBILITY SECTION 327.411 (RSMO) ANY RESPONSIBILITY FOR ALL OTHER PLANS, SPECIFICATIONS, ESTIMATES, REPORTS OR OTHER DOCUMENTS OR INSTRUMENTS NOT SEALED BY THE UNDERSIGNED ENGINEER RELATING TO OR INTENDED TO BE USED FOR ANY PART OR PARTS OF THE PROJECT TO WHICH THIS PAGE REFERS.

REITZ & JENS, INC.
CONSULTING ENGINEERS
1055 CORPORATE SQUARE DRIVE
ST. LOUIS, MISSOURI 63132
(314) 993-9100
PROFESSIONAL ENGINEERING CORPORATION, LICENSE #00219

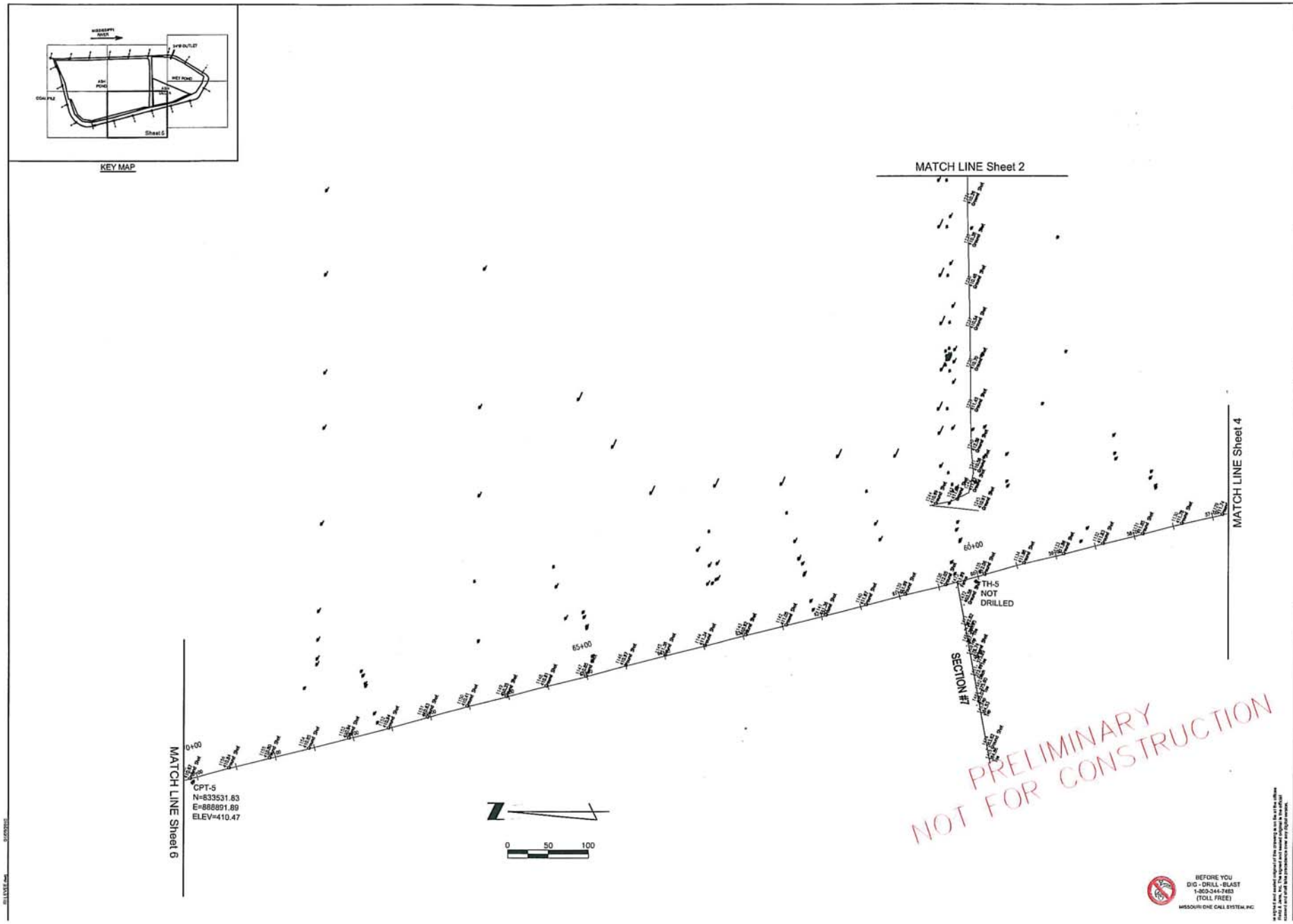
Designed: D.S.E.
Drawn: D.L.B.
Checked: P.H.R.
Issued: 01/08/2019

AmerenUE

Rush Island Plant
Festus, MO 63028

Dam Safety Permit
Ash Pond Levee
Ash Pond Plan
2009012469

REVISIONS



Engineer Seal

THIS MEDIA SHOULD NOT BE CONSIDERED A CERTIFIED DOCUMENT

Date

THE ENGINEER WHOSE SIGNATURE AND PERSONAL SEAL APPEAR HEREON ASSUMES RESPONSIBILITY ONLY FOR WHAT APPEARS ON THIS PAGE AND DISCLAIMS SPECIFICALLY TO SECTION 327 (ISSUED) ANY RESPONSIBILITY FOR ALL OTHER PLANS, SPECIFICATIONS, ESTIMATES, REPORTS OR OTHER DOCUMENTS OR INSTRUMENTS NOT SEALED BY THE UNDERSIGNED ENGINEER RELATING TO OR INTENDED TO BE USED FOR ANY PART OR PARTS OF THE PROJECT TO WHICH THIS PAGE REFERS.

REITZ & JENS, INC.
CONSULTING ENGINEERS
1055 CORPORATE BOUNDARY DRIVE
ST. LOUIS, MISSOURI 63132
(314) 993-1110
PROFESSIONAL ENGINEERING CORPORATION LICENSE #2019A

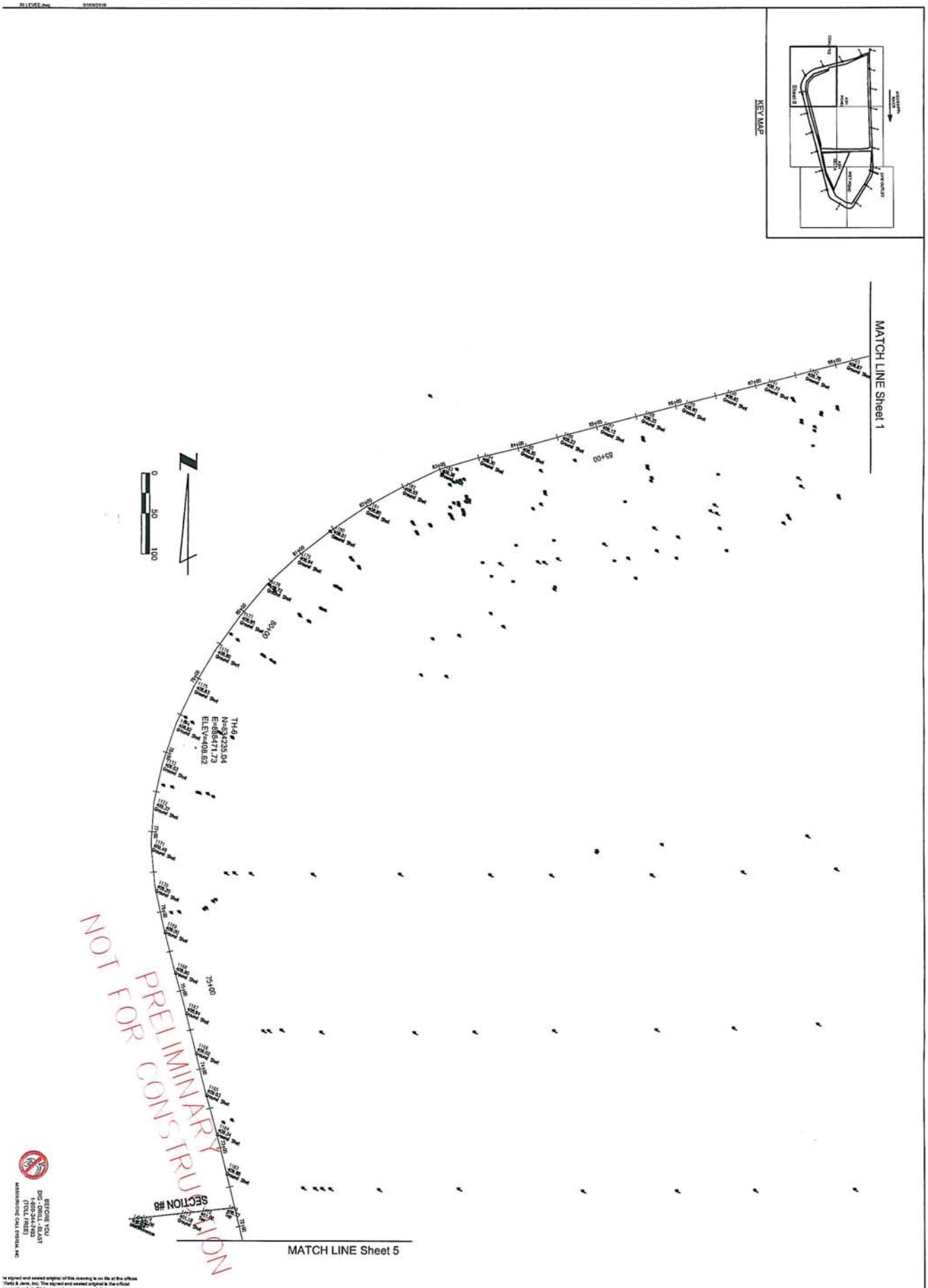
Designed D.S.E. Checked P.H.R.
Drawn D.L.B. Issued 01/09/2013

AmerenUE

Rush Island Plant
Festus, MO 63028

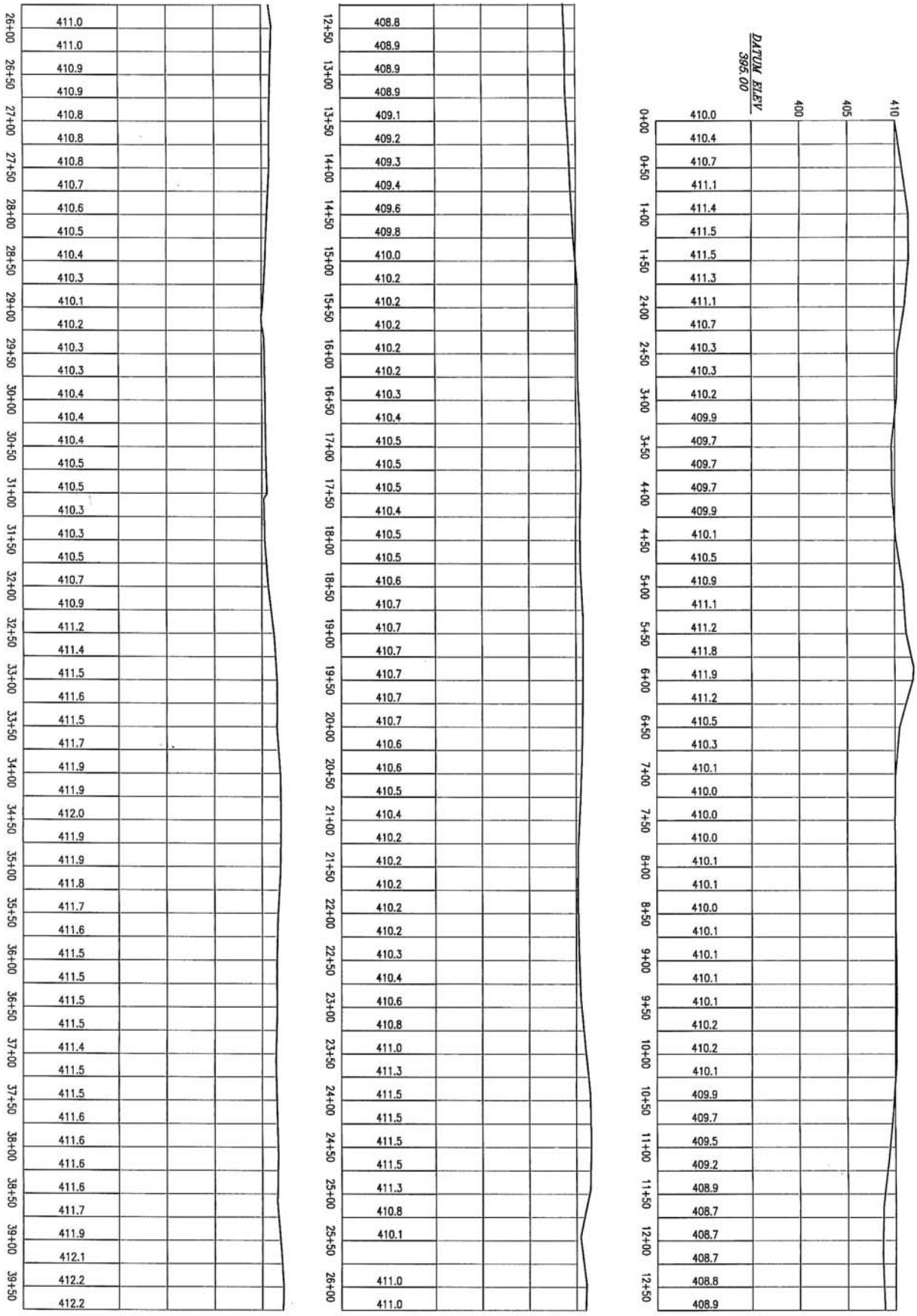
Dam Safety Permit
Ash Pond Levee
Ash Pond Plan
2009012469

REVISIONS



REVISIONS	Dam Safety Permit Ash Pond Levee Ash Pond Plan 2009012469	AmerenUE Rush Island Plant Festus, MO 63028	REITZ & JENS, INC. CONSULTING ENGINEERS 1050 CORPORATE SQUARE DRIVE ST. LOUIS MISSOURI 63132 (314) 993-4133 PROFESSIONAL ENGINEERING CORPORATION LICENSE #000215 Designed D.S.E. Checked P.H.R. Drawn D.L.B. Issued 01/08/2010	THE ENGINEER WHOSE SIGNATURE AND PERSONAL SEAL APPEAR HEREON ASSUMES RESPONSIBILITY ONLY FOR WHAT APPEARS ON THIS PAGE AND DISCLAIMS (PURSUANT TO SECTION 327.411 RSMO) ANY RESPONSIBILITY FOR ALL OTHER PLANS, SPECIFICATIONS, ESTIMATES, REPORTS OR OTHER DOCUMENTS OR INSTRUMENTS NOT SEALED BY THE UNDERSIGNED ENGINEER RELATING TO OR INTENDED TO BE USED FOR ANY PART OR PARTS OF THE PROJECT TO WHICH THIS PAGE REFERS.	Date THIS MEDIUM SHOULD NOT BE CONSIDERED A CERTIFIED DOCUMENT	Engineer Seal

Top of Levee Profile



SHEET 1 OF 3	Dam Safety Permit Top of Levee Profile 2009012469	AmerenUE Rush Island Plant Festus, MO 63028	Designed DSE Drawn DSE	Checked DSE Issued 01/11/2010	REITZ & JENS, INC. CONSULTING ENGINEERS 1055 CORPORATE SQUARE DRIVE ST. LOUIS MISSOURI 63132 (314) 993-4132 PROFESSIONAL ENGINEERING CORP., LICENSE #000215

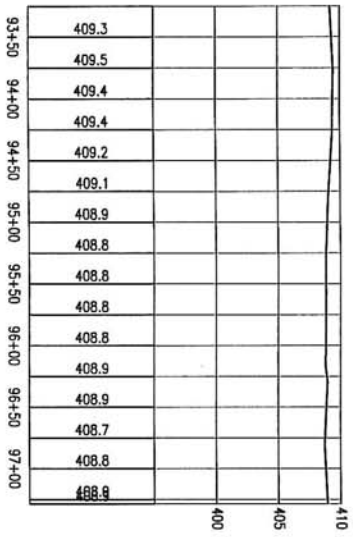
66+50	410.4
	410.5
67+00	410.6
	410.7
67+50	410.9
	410.9
68+00	410.9
	410.9
68+50	410.9
	410.8
69+00	410.8
	410.8
69+50	410.8
	410.8
70+00	410.7
	410.6
70+50	410.4
	410.2
71+00	409.9
	409.7
71+50	409.6
	409.5
72+00	409.6
	409.7
72+50	409.7
	409.7
73+00	409.5
	409.3
73+50	409.2
	409.0
74+00	409.0
	409.0
74+50	409.0
	408.9
75+00	408.9
	408.9
75+50	408.9
	409.0
76+00	409.1
	409.2
76+50	409.3
	409.4
77+00	409.4
	409.4
77+50	409.3
	409.1
78+00	409.0
	408.9
78+50	408.8
	408.8
79+00	408.8
	408.8
79+50	408.8
	408.9
80+00	408.9
	408.8

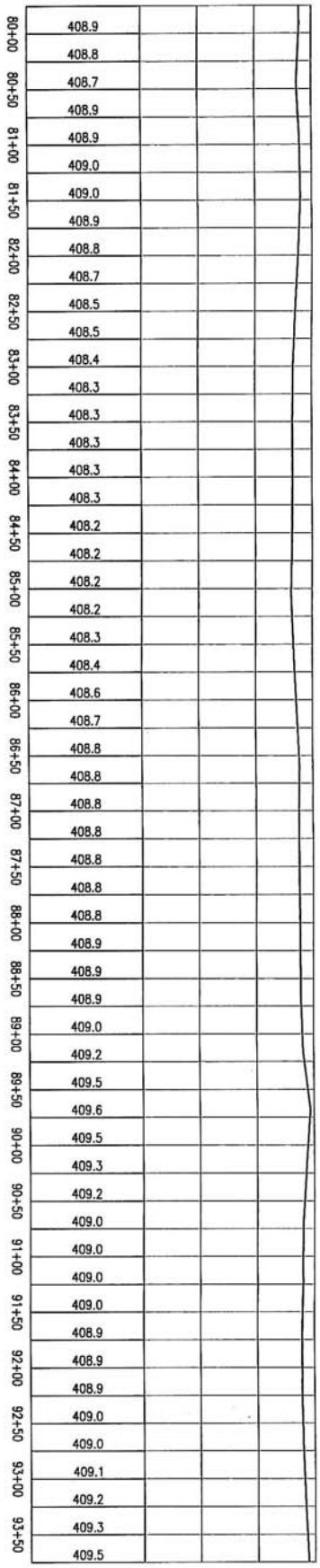
53+00	411.3
	411.4
53+50	411.4
	411.4
54+00	411.4
	411.5
54+50	411.6
	411.6
55+00	411.7
	411.7
55+50	411.7
	411.7
56+00	411.7
	411.7
56+50	411.7
	411.7
57+00	411.8
	411.8
57+50	411.8
	411.8
58+00	411.8
	411.8
58+50	411.8
	411.8
59+00	411.9
	411.9
59+50	412.0
	412.0
60+00	412.1
	412.1
60+50	412.0
	412.0
61+00	412.0
	411.8
61+50	411.7
	411.5
62+00	411.4
	411.2
62+50	411.1
	411.0
63+00	410.9
	411.1
63+50	411.3
	411.4
64+00	411.4
	411.2
64+50	411.0
	410.9
65+00	410.9
	410.8
65+50	410.7
	410.5
66+00	410.4
	410.4
66+50	410.4
	410.5

39+50	412.2
	412.2
40+00	412.0
	411.9
40+50	411.9
	412.0
41+00	412.0
	412.0
41+50	411.9
	411.9
42+00	411.9
	411.9
42+50	411.8
	411.7
43+00	411.5
	411.3
43+50	411.1
	410.9
44+00	410.8
	410.8
44+50	410.7
	410.7
45+00	410.8
	410.9
45+50	411.0
	411.1
46+00	411.1
	411.0
46+50	411.0
	411.0
47+00	411.0
	411.0
47+50	411.1
	411.1
48+00	410.8
	410.3
48+50	410.1
	409.8
49+00	409.8
	409.8
49+50	409.8
	409.8
50+00	409.8
	409.8
50+50	409.8
	409.9
51+00	410.0
	410.1
51+50	410.2
	410.4
52+00	410.5
	410.6
52+50	410.6
	411.1
53+00	411.3
	411.4

SHEET 2 OF 3	Dam Safety Permit Top of Levee Profile 2009012469	AmerenUE Rush Island Plant Festus, MO 63028	Designed DSE Checked DSE Drawn DSE Issued 01/11/2010

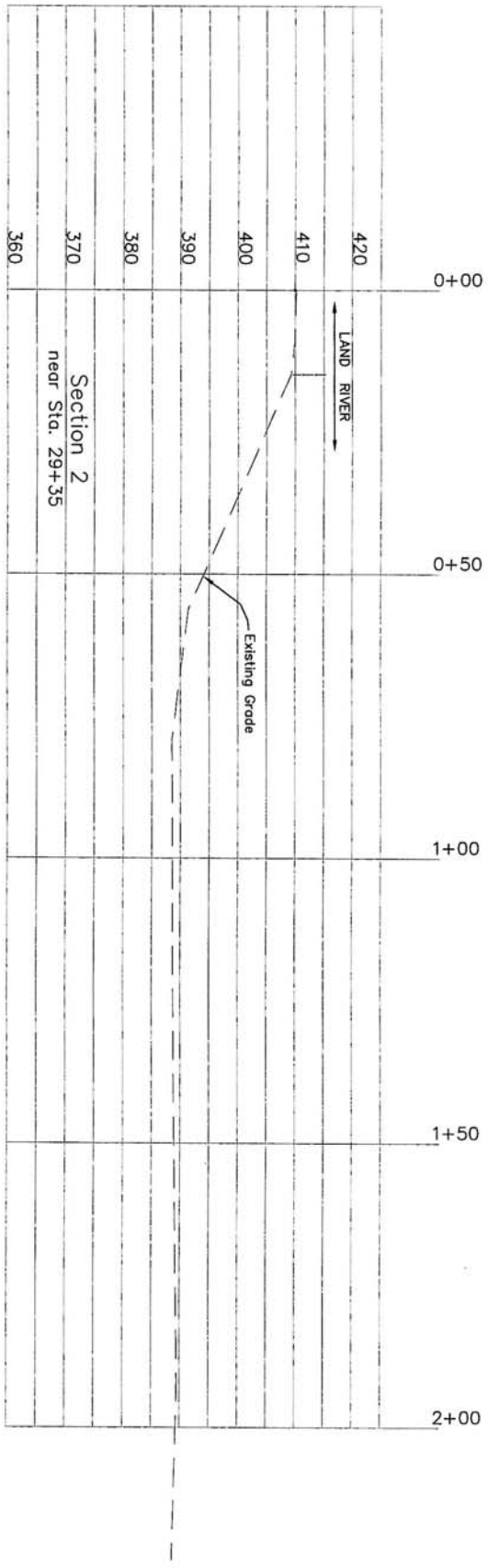
REITZ & JENS, INC.
CONSULTING ENGINEERS
1055 CORPORATE SQUARE DRIVE
ST. LOUIS MISSOURI 63132
(314) 993-4132
PROFESSIONAL ENGINEERING CORP., LICENSE #000215



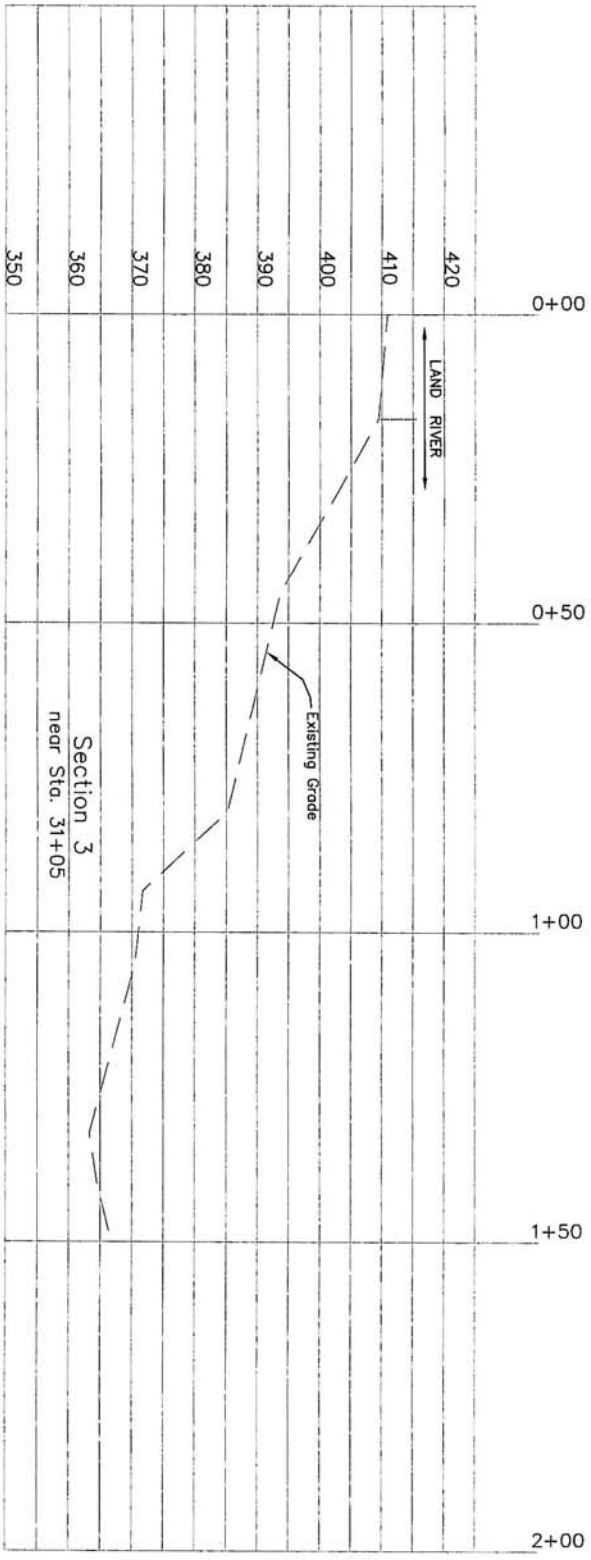


SHEET	Dam Safety Permit	AmerenUE	Designed DSE	Checked DSE	REITZ & JENS, INC.
3 OF 3	Top of Levee Profile	Rush Island Plant	Drawn DSE	Issued 01/11/2010	CONSULTING ENGINEERS
	2009012469	Festus, MO 63028			1055 CORPORATE SQUARE DRIVE ST. LOUIS MISSOURI 63132 (314) 993-4132
					PROFESSIONAL ENGINEERING CORP., LICENSE #000215

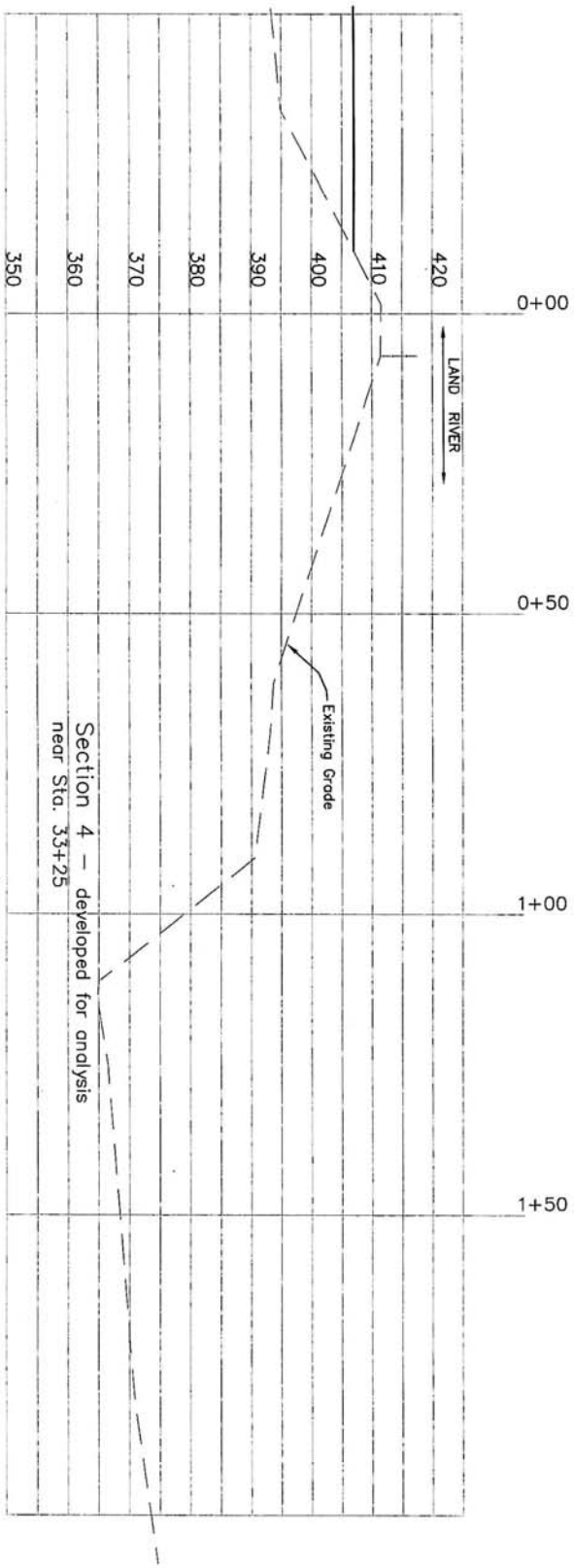
Cross Section Plots



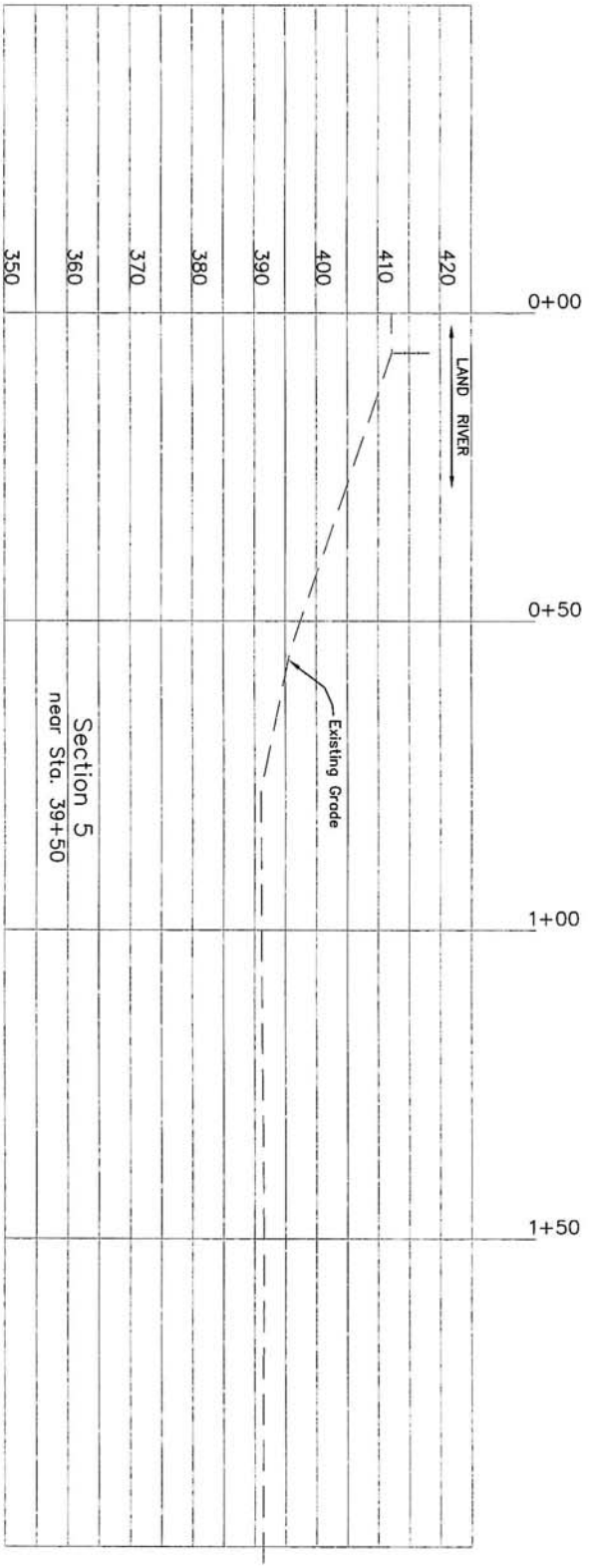
SHEET 2 OF 5	Dam Safety Permit Survey Sections 2009012469	AmerenUE Rush Island Plant Festus MO, 63028	Designed D.S.E. Checked D.S.E. Drawn D.S.E. Issued 01/08/10	REITZ & JENS, INC. CONSULTING ENGINEERS 1055 CORPORATE SQUARE DRIVE ST. LOUIS MISSOURI 63132 (314) 993-4132 PROFESSIONAL ENGINEERING CORP., LICENSE #000215



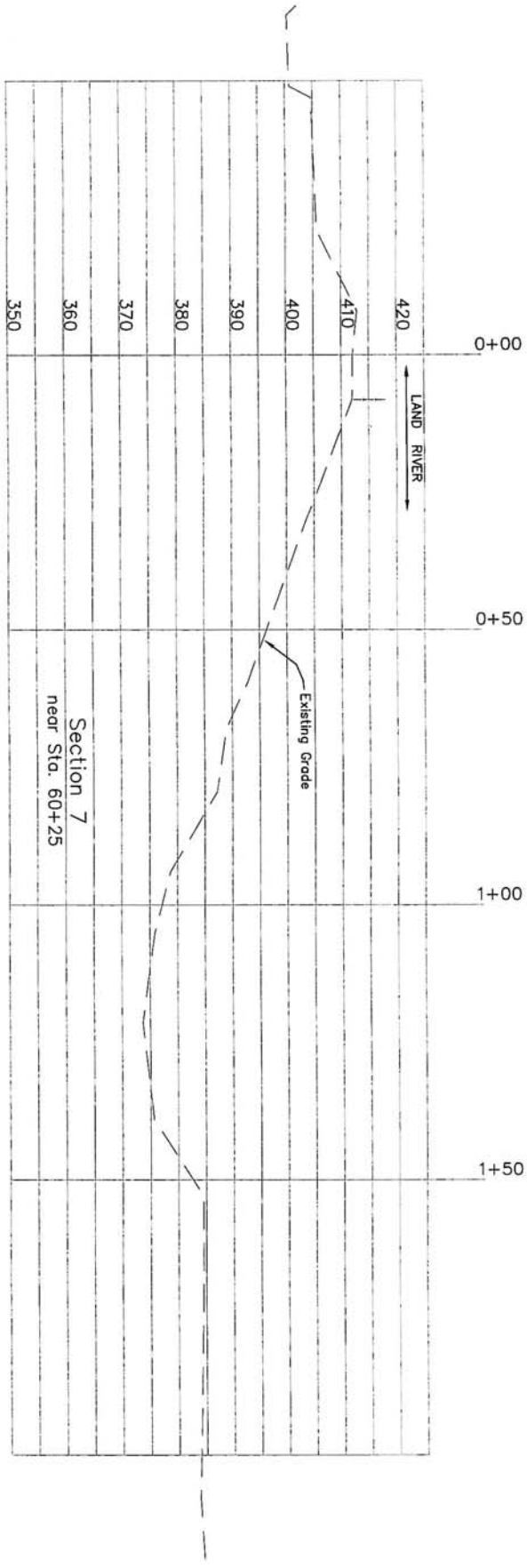
SHEET 3 OF 5	Dam Safety Permit Survey Sections 2009012469	AmerenUE Rush Island Plant Festus MO, 63028	Designed D.S.E. Checked D.S.E. Drawn D.S.E. Issued 01/08/2010	REITZ & JENS, INC. CONSULTING ENGINEERS 1055 CORPORATE SQUARE DRIVE ST. LOUIS MISSOURI 63132 (314) 993-4132 PROFESSIONAL ENGINEERING CORP., LICENSE #000215



SHEET 4 OF 5	Dam Safety Permit Survey Sections 2009012469	AmerenUE Rush Island Plant Festus MO, 63028	Designed D.S.E. Checked D.S.E. Drawn D.S.E. Issued 01/08/2010	REITZ & JENS, INC. CONSULTING ENGINEERS 1055 CORPORATE SQUARE DRIVE ST. LOUIS MISSOURI 63132 (314) 993-4132 PROFESSIONAL ENGINEERING CORP., LICENSE #000215

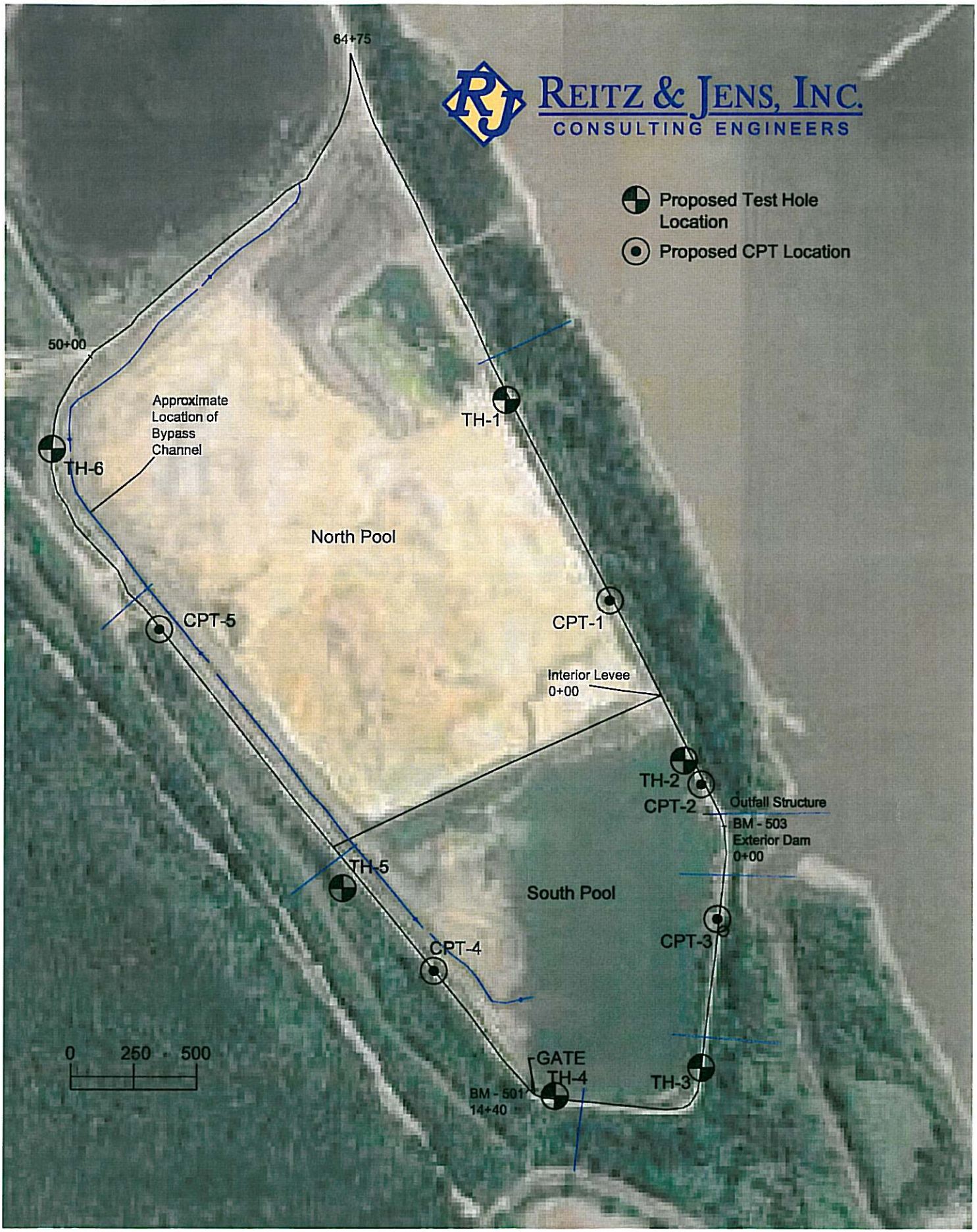


SHEET 5 OF 5	Dam Safety Permit Survey Sections 2009012469	AmerenUE Rush Island Plant Festus MO, 63028	Designed D.S.E. Checked D.S.E. Drawn D.S.E. Issued 01/08/2010	REITZ & JENS, INC. CONSULTING ENGINEERS 1055 CORPORATE SQUARE DRIVE ST. LOUIS MISSOURI 63132 (314) 993-4132 PROFESSIONAL ENGINEERING CORP., LICENSE #000215



SHEET 7 OF 5	Dam Safety Permit Survey Sections 2009012469	AmerenUE Rush Island Plant Festus MO, 63028	Designed D.S.E. Checked D.S.E. Drawn D.S.E. Issued 01/08/2010	REITZ & JENS, INC. CONSULTING ENGINEERS 1055 CORPORATE SQUARE DRIVE ST. LOUIS MISSOURI 63132 (314) 993-4132 PROFESSIONAL ENGINEERING CORP., LICENSE #000215

Test Hole Location Plan



2009012469/dwg/RushIslandAerial

Ameren UE Dam Inventory and Inspection Program
Rush Island Plant Proposed Testing Layout
Rev. 9/8/09

Figure 1

Boring Logs – Lab Testing Results

REITZ & JENS, INC.
CONSULTING ENGINEERS

BORING LOG B-1

Rush Island Ash Pond Dam Safety

CLIENT: **Ameren**

LOCATION: N 834589.2 E 890145.1
ELEVATION: 408.9 DATUM:
DATE DRILLED: 09-14-09

DEPTH (FEET)	ELEVATION	WATER TABLE	GRAPHIC LOG	SAMPLE TYPE	PERCENT RECOVERY	MATERIAL DESCRIPTION	DRY UNIT WEIGHT (PCF) BLOWS PER 6 INCHES RQD= ROCK QUALITY DES.	MOISTURE CONTENT PERCENT BY WEIGHT
0						Top 10 feet vacuum extracted no sampling		
	405							
5					0			
	400							
10								
	395							
15					100	Clay FILL? (CH), grey to dark grey, high plastic, slightly silty, with fine roots, and 3" layer of silty fine sand at 15'-7"	94.0	27.6
	390							
20					88	SILT (ML), grey and brown, with fine sand and pockets of high plastic clay	95.2	23.8
	385							
25					96	SAND (SP), golden tan, fine grain, becoming silty and greyish near bottom of sample	87.3 99.7	21.7 14.3
	380	▽						
30					100	Sandy SILT (ML), tan, fine grain, loose, saturated	2-2-4	31.8

SHEAR STRENGTH, tsf
△ QU/2 ■ PP □ SV ◇ TV
1 2 3

STANDARD PENETRATION TEST
▲ N-VALUE (BLOWS PER LAST FOOT)

● MOISTURE CONTENT, %
○ % FINES (PASSING #200 SIEVE)

PL ⊢——⊣ LL
20 40 60

DRILLER: Jet Drilling
METHOD: 4.25" HSA/Rotary
TYPE OF SPT HAMMER: Automatic
HAMMER EFFICIENCY (%): 78.2
LOGGED BY: J. Pruett

STRATIFICATION LINES ARE APPROXIMATE SOIL BOUNDARIES ONLY; ACTUAL CHANGES MAY BE GRADUAL OR MAY OCCUR BETWEEN SAMPLES.

WATER LEVELS: DURING DRILLING 29.5 FEET
N BORING DRY AT COMPLETION OF DRILLING
AT ____ FEET AFTER ____ HOURS
AT ____ FEET AFTER ____ HOURS

PIEZOMETER: INSTALLED AT ___ FEET

File: 2009012469

Figure

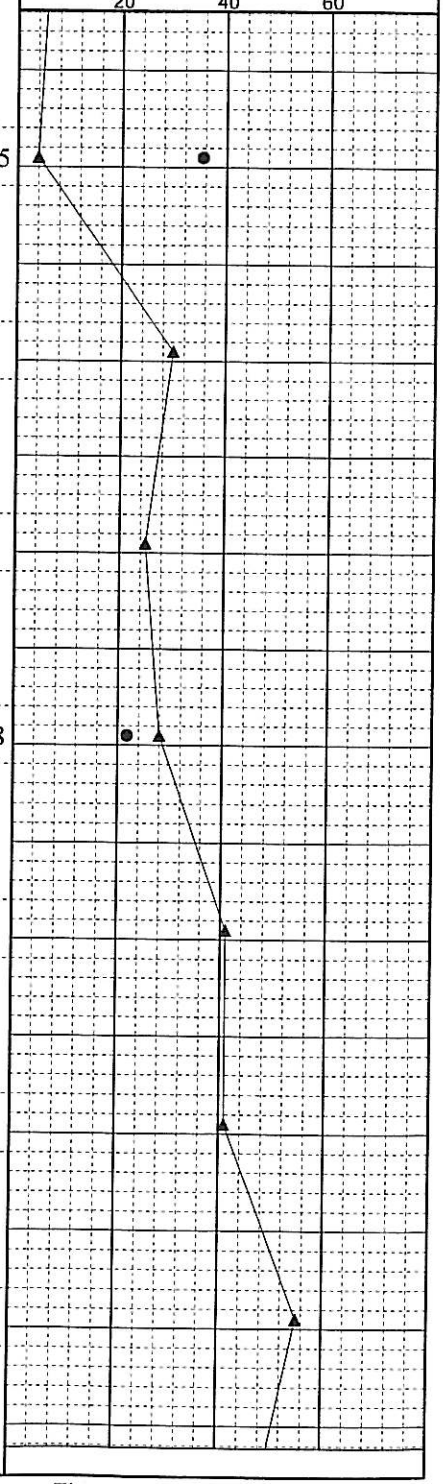
REITZ & JENS, INC.
CONSULTING ENGINEERS

BORING LOG B-1

Rush Island Ash Pond Dam Safety

DEPTH (FEET)	ELEVATION	WATER TABLE	GRAPHIC LOG	SAMPLE TYPE	PERCENT RECOVERY	MATERIAL DESCRIPTION	DRY UNIT WEIGHT (PCF) BLOWS PER 6 INCHES RQD= ROCK QUALITY DES.	MOISTURE CONTENT PERCENT BY WEIGHT
35	375				100	With layers of silty clay and fine grain sand	2-1-3	35.5
40	370				67	SAND (SP), tan, fine to coarse grain, dense	9-12-18	
45	365				89	With assorted gravel up to 3/4"	9-12-13	
50	360				78	Becoming grey, with thick layers of silt and silty clay, without gravel	3-10-18	21.8
55	355				56	In and out of gravelly drilling from 52'-6" to 55'-0" Without silt and clay content, with gravel up to 3/4", very dense	12-21-20	
60	350				89	Without gravel	12-20-21	
65	345				94	Becoming fine to medium grain sand	17-24-31	

SHEAR STRENGTH, tsf
△ QU/2 ■ PP □ SV ◇ TV
1 2 3
STANDARD PENETRATION TEST
▲ N-VALUE (BLOWS PER LAST FOOT)
● MOISTURE CONTENT, %
○ % FINES (PASSING #200 SIEVE)
PL LL
20 40 60



File: 2009012469

Figure

REITZ & JENS, INC.
CONSULTING ENGINEERS

BORING LOG B-1

Rush Island Ash Pond Dam Safety

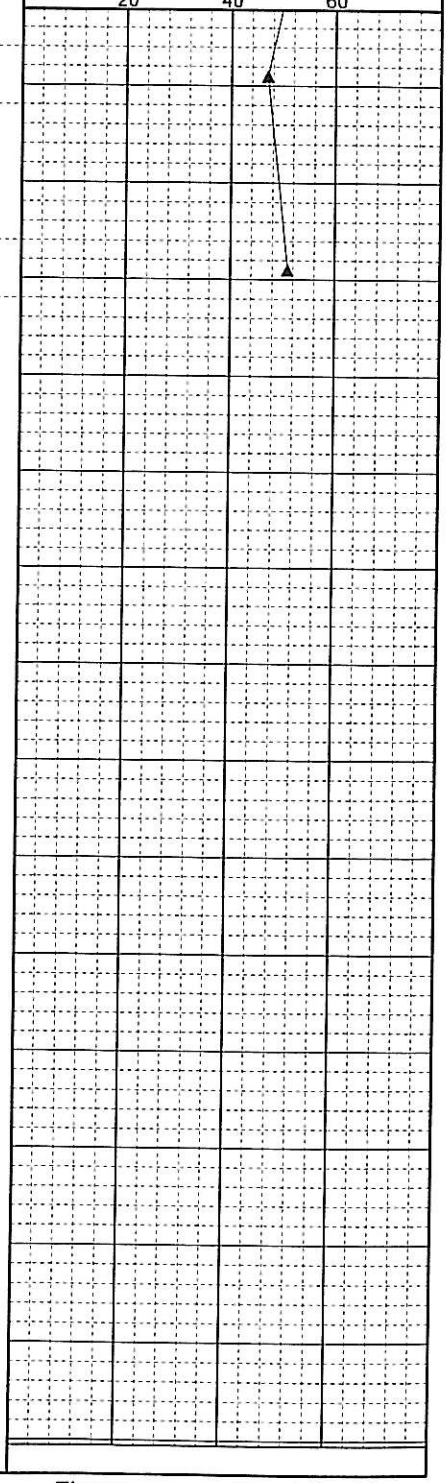
DEPTH (FEET)	ELEVATION	WATER TABLE	GRAPHIC LOG	SAMPLE TYPE	PERCENT RECOVERY	MATERIAL DESCRIPTION	DRY UNIT WEIGHT (PCF) BLOWS PER 6 INCHES RQD= ROCK QUALITY DES.	MOISTURE CONTENT PERCENT BY WEIGHT
70	340				94	Becoming fine to coarse sand	14-20-27	
75	335				78		18-23-28	
						Boring terminated in sand at 75'-6"		
80	330							
85	325							
90	320							
95	315							
100	310							
105	305							

SHEAR STRENGTH, tsf
△ QU/2 ■ PP □ SV ◇ TV
1 2 3

STANDARD PENETRATION TEST
▲ N-VALUE (BLOWS PER LAST FOOT)

● MOISTURE CONTENT, %
○ % FINES (PASSING #200 SIEVE)

PL LL
20 40 60



File: 2009012469

Figure

REITZ & JENS, INC.
CONSULTING ENGINEERS

BORING LOG B-2

Rush Island Ash Pond Dam Safety

CLIENT: **Ameren**

LOCATION: N 832995.7 E 890896.0
ELEVATION: 409.9 DATUM:
DATE DRILLED: 09-15-09

DEPTH (FEET)	ELEVATION	WATER TABLE	GRAPHIC LOG	SAMPLE TYPE	PERCENT RECOVERY	MATERIAL DESCRIPTION	DRY UNIT WEIGHT (PCF) BLOWS PER 6 INCHES RQD= ROCK QUALITY DES.	MOISTURE CONTENT PERCENT BY WEIGHT
0						Top 10 feet vacuum extracted no sampling		
5	405				0			
10	400							
15	395	▽			96	Silt FILL (ML), grey, slightly silty, trace fine grain sand, with high plastic clay lenses Perched water at 14'-6"	89.2	30.1
						Clay FILL (CH), grey, high plastic, trace roots		
20	390				88	Sandy Silt FILL (SM), grey and brown, slightly clayey, with high plastic clay balls, limoninte and iron staining, trace clay seams and sand lenses	94.4	27.4
25	385				100	Clay FILL (CH), grey, silty, high plastic, stiff, moist	2-3-5	29.8
					88	Becoming dark grey, with trace fine roots, lignite, coal, cinders, iron staining	84.8	33.4
						Clayey SILT (ML), brown and grey, with trace fine sand, limonite, and iron staining, becoming sandy with depth, natural?	89.5	29.0
30	380				100	Silty CLAY (CL), grey, with traces of lignite	2-2-3	27.5

SHEAR STRENGTH, tsf
△ QU/2 ■ PP □ SV ◇ TV
1 2 3
STANDARD PENETRATION TEST
▲ N-VALUE (BLOWS PER LAST FOOT)
● MOISTURE CONTENT, %
○ % FINES (PASSING #200 SIEVE)
PL LL
20 40 60

DRILLER: Jet Drilling
METHOD: 4.25" HSA/Rotary
TYPE OF SPT HAMMER: Automatic
HAMMER EFFICIENCY (%): 78.2
LOGGED BY: J. Pruett

STRATIFICATION LINES ARE APPROXIMATE SOIL BOUNDARIES ONLY; ACTUAL CHANGES MAY BE GRADUAL OR MAY OCCUR BETWEEN SAMPLES.

WATER LEVELS: DURING DRILLING 14.5 FEET
N BORING DRY AT COMPLETION OF DRILLING
AT ____ FEET AFTER ____ HOURS
AT ____ FEET AFTER ____ HOURS
PIEZOMETER: INSTALLED AT ____ FEET

File: 2009012469

Figure

REITZ & JENS, INC.
CONSULTING ENGINEERS

BORING LOG B-2

Rush Island Ash Pond Dam Safety

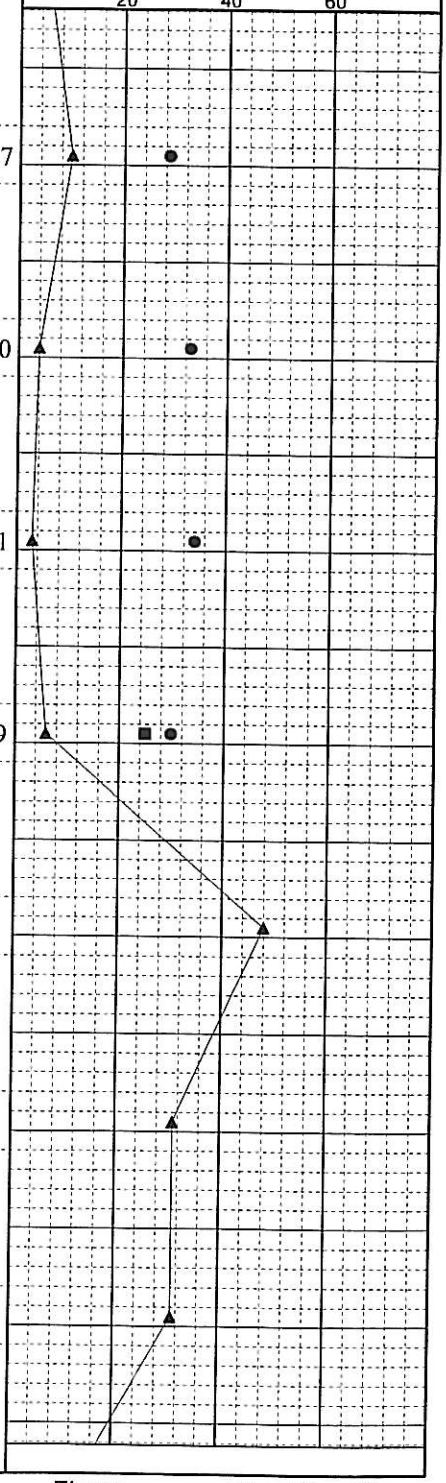
DEPTH (FEET)	ELEVATION	WATER TABLE	GRAPHIC LOG	SAMPLE TYPE	PERCENT RECOVERY	MATERIAL DESCRIPTION	DRY UNIT WEIGHT (PCF) BLOWS PER 6 INCHES RQD= ROCK QUALITY DES.	MOISTURE CONTENT PERCENT BY WEIGHT
						and limonite, trace fine grain sand, firm		
35	375				100	Sandy SILT (ML), tan and grey, highly laminated with silt and clay, traces of lignite, medium dense	0-2-8	28.7
40	370				100	Becoming loose, saturated	0-1-3	33.0
45	365				100	Without laminations of silt and clay, very loose	0-1-2	34.1
50	360				100	Becoming loose, with 2" clay seam near end of spoon	1-2-4	29.9
55	355				100	SAND (SP), grey, fine to coarse grain, with trace 1/4" gravel, very dense	15-22-26	
60	350				89	Becoming dense, with trace gravel up to 1"	6-11-20	
65	345				89	Becoming fine grain sand, without gravel	11-14-17	

SHEAR STRENGTH, tsf
△ QU/2 ■ PP □ SV ◇ TV
1 2 3

STANDARD PENETRATION TEST
▲ N-VALUE (BLOWS PER LAST FOOT)

● MOISTURE CONTENT, %
○ % FINES (PASSING #200 SIEVE)

PL ⊢——⊣ LL
20 40 60



File: 2009012469

Figure

REITZ & JENS, INC.
CONSULTING ENGINEERS

BORING LOG B-2

Rush Island Ash Pond Dam Safety

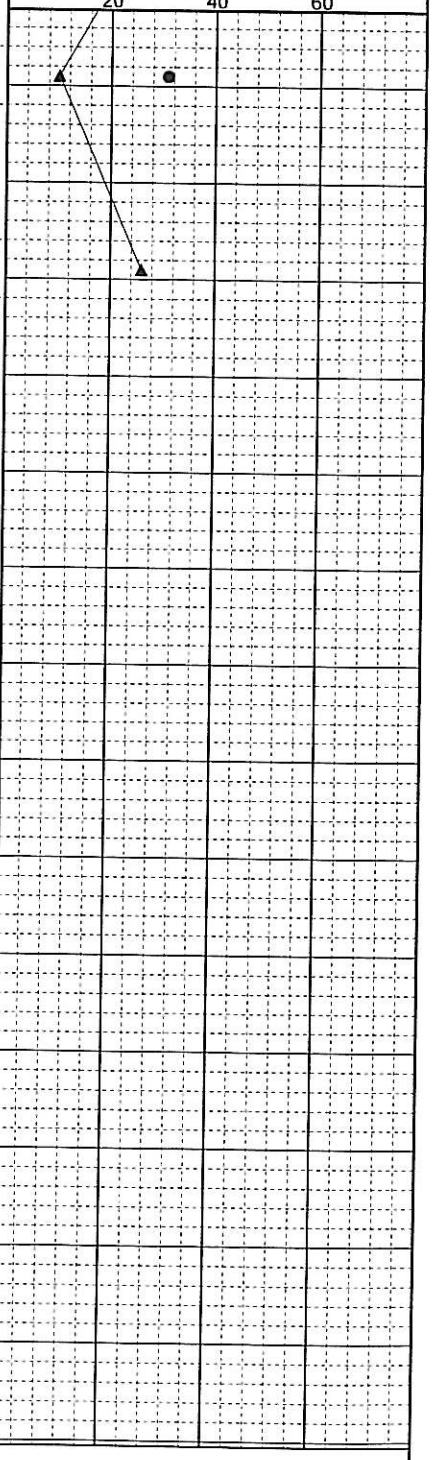
DEPTH (FEET)	ELEVATION	WATER TABLE	GRAPHIC LOG	SAMPLE TYPE	PERCENT RECOVERY	MATERIAL DESCRIPTION	DRY UNIT WEIGHT (PCF) BLOWS PER 6 INCHES RQD= ROCK QUALITY DES.	MOISTURE CONTENT PERCENT BY WEIGHT
70	340				94	Fine grain sandy SILT (ML), grey, medium dense	1-1-9	30.9
75	335				78	SAND (SP), grey, fine to coarse grain, with gravel up to 1/4", dense	9-14-12	
						Boring terminated in sand at 75'-6"		
80	330							
85	325							
90	320							
95	315							
100	310							
105	305							

SHEAR STRENGTH, tsf
△ QU/2 ■ PP □ SV ◇ TV
1 2 3

STANDARD PENETRATION TEST
▲ N-VALUE (BLOWS PER LAST FOOT)

● MOISTURE CONTENT, %
○ % FINES (PASSING #200 SIEVE)

PL 20 40 60 LL



File: 2009012469

Figure

REITZ & JENS, INC.
CONSULTING ENGINEERS

BORING LOG B-3

Rush Island Ash Pond Dam Safety

CLIENT: **Ameren**

LOCATION: N 831960.3 E 890889.5
ELEVATION: 412.2 DATUM:
DATE DRILLED: 09-15-09

DEPTH (FEET)	ELEVATION	SAMPLE TYPE	PERCENT RECOVERY	MATERIAL DESCRIPTION	DRY UNIT WEIGHT (PCF) BLOWS PER 6 INCHES RQD= ROCK QUALITY DES.	MOISTURE CONTENT PERCENT BY WEIGHT
0	410			6" crushed LIMESTONE Silty Clay FILL (CL), brown, with silt and high plastic clay inclusions and laminations		
5	405		83		88.9	32.0
10	400		100	Sandy Silt FILL (SM), tan, with dark grey high plastic balls, trace lignite, limonite, and small gravel	104.1	19.9
15	395		100	Becoming grey and tan, with fine to medium grain sand, without gravel	102.7 96.1	22.0 25.6
20	390		100	Silty Clay FILL (CL), grey and brown, with grey high plastic balls and tan fine to medium sand seams, becoming more clayey with depth	100.8 99.1	20.4 24.5
25	385		100	CLAY (CH), grey, high plastic, with traces fine sand lenses, trace limonite and iron staining, trace medium sand, some fine roots in top of sample, natural?	90.0	31.0
30			71	Becoming dark grey	95.6	25.0

SHEAR STRENGTH, tsf
△ QU/2 ■ PP □ SV ◇ TV
1 2 3

STANDARD PENETRATION TEST
▲ N-VALUE (BLOWS PER LAST FOOT)
● MOISTURE CONTENT, %
○ % FINES (PASSING #200 SIEVE)
PL LL
20 40 60

DRILLER: Jet Drilling
METHOD: 4.25" HSA/Rotary
TYPE OF SPT HAMMER: Automatic
HAMMER EFFICIENCY (%): 78.2
LOGGED BY: J. Pruett

STRATIFICATION LINES ARE APPROXIMATE SOIL BOUNDARIES ONLY; ACTUAL CHANGES MAY BE GRADUAL OR MAY OCCUR BETWEEN SAMPLES.

WATER LEVELS: DURING DRILLING 49.5 FEET
N BORING DRY AT COMPLETION OF DRILLING
AT ____ FEET AFTER ____ HOURS
AT ____ FEET AFTER ____ HOURS

PIEZOMETER: INSTALLED AT ____ FEET

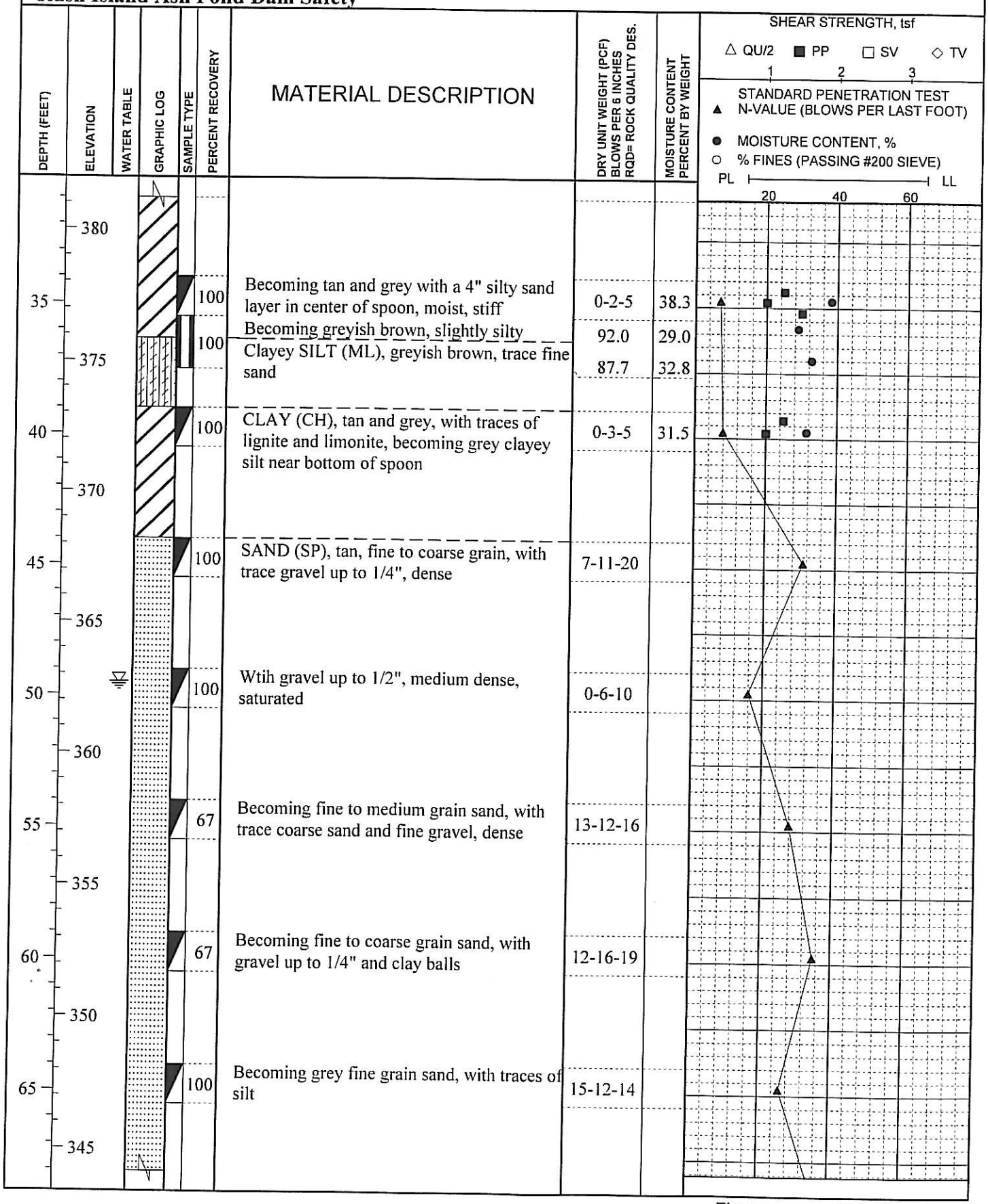
File: 2009012469

Figure

REITZ & JENS, INC.
CONSULTING ENGINEERS

BORING LOG B-3

Rush Island Ash Pond Dam Safety



File: 2009012469

Figure

REITZ & JENS, INC.
CONSULTING ENGINEERS

BORING LOG B-3

Rush Island Ash Pond Dam Safety

DEPTH (FEET)	ELEVATION	WATER TABLE	GRAPHIC LOG	SAMPLE TYPE	PERCENT RECOVERY	MATERIAL DESCRIPTION	DRY UNIT WEIGHT (PCF) BLOWS PER 6 INCHES RQD= ROCK QUALITY DES.	MOISTURE CONTENT PERCENT BY WEIGHT
70					94	Becoming fine to medium grain sand, with gravel up to 1/4"	10-15-23	
	340							
75					78	Becoming fine to coarse grain sand	12-15-22	
						Boring terminated in sand at 75'-6"		
	335							
80								
	330							
85								
	325							
90								
	320							
95								
	315							
100								
	310							
105								

SHEAR STRENGTH, tsf

△ QU/2 ■ PP □ SV ◇ TV

1 2 3

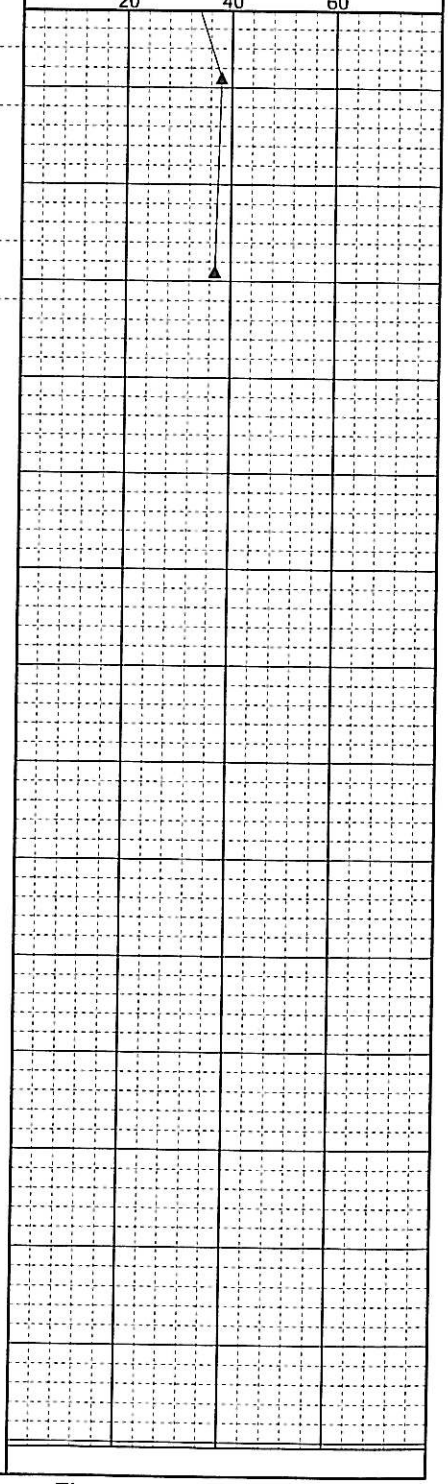
▲ STANDARD PENETRATION TEST N-VALUE (BLOWS PER LAST FOOT)

● MOISTURE CONTENT, %

○ % FINES (PASSING #200 SIEVE)

PL ├──┤ LL

20 40 60



File: 2009012469

Figure

REITZ & JENS, INC.
CONSULTING ENGINEERS

BORING LOG B-4

Rush Island Ash Pond Dam Safety

CLIENT: **Ameren**

LOCATION: N 831798.8 E 890245.6
ELEVATION: 410.6 DATUM:
DATE DRILLED: 09-16-09

SHEAR STRENGTH, tsf
△ QU/2 ■ PP □ SV ◇ TV
1 2 3
STANDARD PENETRATION TEST
▲ N-VALUE (BLOWS PER LAST FOOT)
● MOISTURE CONTENT, %
○ % FINES (PASSING #200 SIEVE)
PL LL
20 40 60

DEPTH (FEET)	ELEVATION	WATER TABLE	GRAPHIC LOG	SAMPLE TYPE	PERCENT RECOVERY	MATERIAL DESCRIPTION	DRY UNIT WEIGHT (PCF) BLOWS PER 6 INCHES RQD= ROCK QUALITY DES.	MOISTURE CONTENT PERCENT BY WEIGHT
0	410					6" crushed LIMESTONE Silty Clay FILL (CL), brown and grey, trace fine sand, with layers up to 6" of high plastic clay, firm, moist		
5	405				71		96.1 97.6	24.1 25.5
10	400				96		93.1	28.1
15	395				75	Silt FILL (ML), brown, slightly clayey, with trace fine sand, 1/2" high plastic clay seam	93.4	21.2
20	390				100	Becoming tan, very sandy Note: Shelby Tube was pushed with no recovery, Spilt Spoon pushed for sample		29.1
25	385				100	Clayey SILT (ML), grey, highly layered, with layers of clayey silt, sandy silt, and high plastic clay, loose, natural?	1-2-4	29.4
30	380				100	Becoming very loose	1-1-1	33.1

DRILLER: Jet Drilling
METHOD: 4.25" HSA/Rotary
TYPE OF SPT HAMMER: Automatic
HAMMER EFFICIENCY (%): 78.2
LOGGED BY: J. Pruett

STRATIFICATION LINES ARE APPROXIMATE SOIL BOUNDARIES ONLY; ACTUAL CHANGES MAY BE GRADUAL OR MAY OCCUR BETWEEN SAMPLES.

WATER LEVELS: DURING DRILLING 37 FEET
N BORING DRY AT COMPLETION OF DRILLING
AT ____ FEET AFTER ____ HOURS
AT ____ FEET AFTER ____ HOURS
PIEZOMETER: INSTALLED AT ____ FEET

File: 2009012469

Figure

REITZ & JENS, INC.
CONSULTING ENGINEERS

BORING LOG B-4

Rush Island Ash Pond Dam Safety

DEPTH (FEET)	ELEVATION	WATER TABLE	GRAPHIC LOG	SAMPLE TYPE	PERCENT RECOVERY	MATERIAL DESCRIPTION	DRY UNIT WEIGHT (PCF) BLOWS PER 6 INCHES RQD= ROCK QUALITY DES.	MOISTURE CONTENT PERCENT BY WEIGHT
35	375	▽			100	CLAY (CH), tannish brown and grey, high plastic, with lignite and limonite, traces of fine sand, stiff	1-3-4	29.7
					100	Becoming grey, less plastic, with layers of fine sandy silt	93.1	28.1
							90.7	30.5
40	370				100	SAND (SP), tan, fine to medium grain, with 2" grey high plastic clay seam, very loose	1-1-1	39.7
45	365				0	No recovery	1-1-2	
50	360				100	Fine grain sandy SILT (ML), grey, with 2" layer of grey high plastic clay near bottom of spoon	0-1-2	36.4
55	355				100	Becoming more clayey, with 5" grey high plastic clay seam in center of spoon, loose	0-2-3	37.6
60	350				100	Becoming less clayey, with thin layers of grey high plastic clay	1-1-3	35.0
65	345				100	Becoming medium dense	1-3-5	36.4

SHEAR STRENGTH, tsf
△ QU/2 ■ PP □ SV ◇ TV
1 2 3

STANDARD PENETRATION TEST
▲ N-VALUE (BLOWS PER LAST FOOT)

● MOISTURE CONTENT, %
○ % FINES (PASSING #200 SIEVE)

PL ⊢ LL
20 40 60

File: 2009012469

Figure

REITZ & JENS, INC.
CONSULTING ENGINEERS

BORING LOG B-4

Rush Island Ash Pond Dam Safety

DEPTH (FEET)	ELEVATION	WATER TABLE	GRAPHIC LOG	SAMPLE TYPE	PERCENT RECOVERY	MATERIAL DESCRIPTION	DRY UNIT WEIGHT (PCF) BLOWS PER 6 INCHES RQD= ROCK QUALITY DES.	MOISTURE CONTENT PERCENT BY WEIGHT
70	340				72	SAND (SP), grey, fine grain, slightly silty, with trace gravel up to 1/8", medium dense	5-6-9	
75	335				61	Becoming fine to medium grain, without gravel, very dense	15-22-26	
						Boring terminated in sand at 75'-6"		
80	330							
85	325							
90	320							
95	315							
100	310							
105								

SHEAR STRENGTH, tsf
△ QU/2 ■ PP □ SV ◇ TV
1 2 3
STANDARD PENETRATION TEST
▲ N-VALUE (BLOWS PER LAST FOOT)
● MOISTURE CONTENT, %
○ % FINES (PASSING #200 SIEVE)
PL LL
20 40 60

File: 2009012469

Figure

REITZ & JENS, INC.
CONSULTING ENGINEERS

BORING LOG B-6

Rush Island Ash Pond Dam Safety

CLIENT: **Ameren**

LOCATION: N 834235.0 E 888471.7
ELEVATION: 408.6 DATUM:
DATE DRILLED: 09-17-09

SHEAR STRENGTH, tsf
△ QU/2 ■ PP □ SV ◇ TV
1 2 3

STANDARD PENETRATION TEST
▲ N-VALUE (BLOWS PER LAST FOOT)
● MOISTURE CONTENT, %
○ % FINES (PASSING #200 SIEVE)
PL LL
20 40 60

DEPTH (FEET)	ELEVATION	WATER TABLE	GRAPHIC LOG	SAMPLE TYPE	PERCENT RECOVERY	MATERIAL DESCRIPTION	DRY UNIT WEIGHT (PCF) BLOWS PER 6 INCHES RQD= ROCK QUALITY DES.	MOISTURE CONTENT PERCENT BY WEIGHT
0						4" crushed LIMESTONE		
						Clayey Sandy Silt FILL (ML), grey and brown, with layers of fine to medium sand and silty clay		
	405							
5					92		97.6	24.5
	400							
10					96	Silty Clay FILL (CL), grey, with tan fine sand and silt seams both horzontal and vertical		
	395							
15					96	With high plastic clay and fine roots, without sand seams	88.8	29.4
						CLAY (CH), grey and light grey, with layers of silt and medium grain sand, traces of lignite and limonite, natural?	94.5	27.9
	390							
20					100	With traces of silt lenses, becoming clayey silt with high plastic clay lenses near bottom of tube		
	385							
25					100	Clayey SILT (ML), grey with lenses of high plastic clay, trace limonite, saturated, very soft	87.2 86.2	33.0 33.6
	380 ▽							
30					100	Becoming greyish tan, with fine grain sand and traces of limonite		32.1

DRILLER: Jet Drilling
METHOD: 4.25" HSA/Rotary
TYPE OF SPT HAMMER: Automatic
HAMMER EFFICIENCY (%): 78.2
LOGGED BY: J. Pruett

STRATIFICATION LINES ARE APPROXIMATE SOIL BOUNDARIES ONLY; ACTUAL CHANGES MAY BE GRADUAL OR MAY OCCUR BETWEEN SAMPLES.

WATER LEVELS: DURING DRILLING 29 FEET
N BORING DRY AT COMPLETION OF DRILLING
AT ____ FEET AFTER ____ HOURS
AT ____ FEET AFTER ____ HOURS

PIEZOMETER: INSTALLED AT ____ FEET

File: 2009012469

Figure

REITZ & JENS, INC.
CONSULTING ENGINEERS

BORING LOG B-6

Rush Island Ash Pond Dam Safety

DEPTH (FEET)	ELEVATION	SAMPLE TYPE	PERCENT RECOVERY	MATERIAL DESCRIPTION	DRY UNIT WEIGHT (PCF) BLOWS PER 6 INCHES RQD= ROCK QUALITY DES.	MOISTURE CONTENT PERCENT BY WEIGHT
				Note: Shelby Tube was pushed with no recovery, Spilt Spoon pushed for sample		
35	375		100	Fine grain sandy SILT (ML), greyish tan, slightly clayey, loose	3-2-3	34.6
40	370		100	SAND (SP), grey, fine to medium grain	2-6-12	
45	365		100	CLAY (CH-CL), grey, layers of high plastic clay and low plastic silty clay, stiff	0-1-5	42.4
50	360		100	SAND (SP), grey, fine to coarse grain, medium dense	0-3-13	55.7
55	355		89	With 3" layer of high plastic clay at bottom of spoon	13-10-5	44.5
60	350		61	Becoming fine to medium grain sand, with gravel up to 1/4", dense	13-17-15	
65	345		78	Becoming fine to coarse grain sand, very dense	13-16-24	

SHEAR STRENGTH, tsf
△ QU/2 ■ PP □ SV ◇ TV
1 2 3
STANDARD PENETRATION TEST
▲ N-VALUE (BLOWS PER LAST FOOT)
● MOISTURE CONTENT, %
○ % FINES (PASSING #200 SIEVE)
PL LL
20 40 60

File: 2009012469

Figure

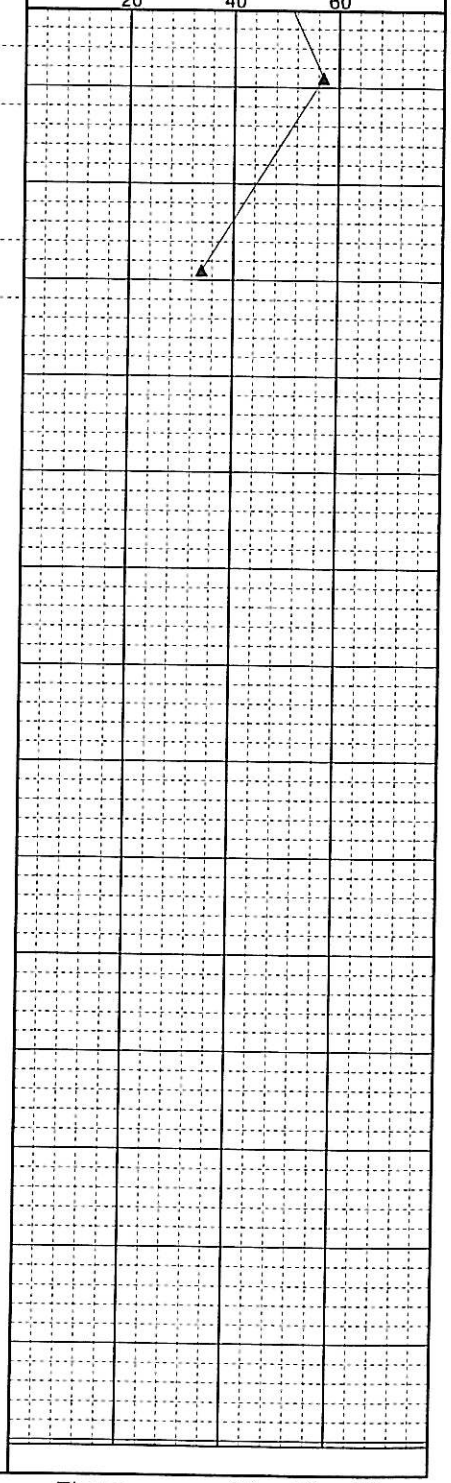
REITZ & JENS, INC.
CONSULTING ENGINEERS

BORING LOG B-6

Rush Island Ash Pond Dam Safety

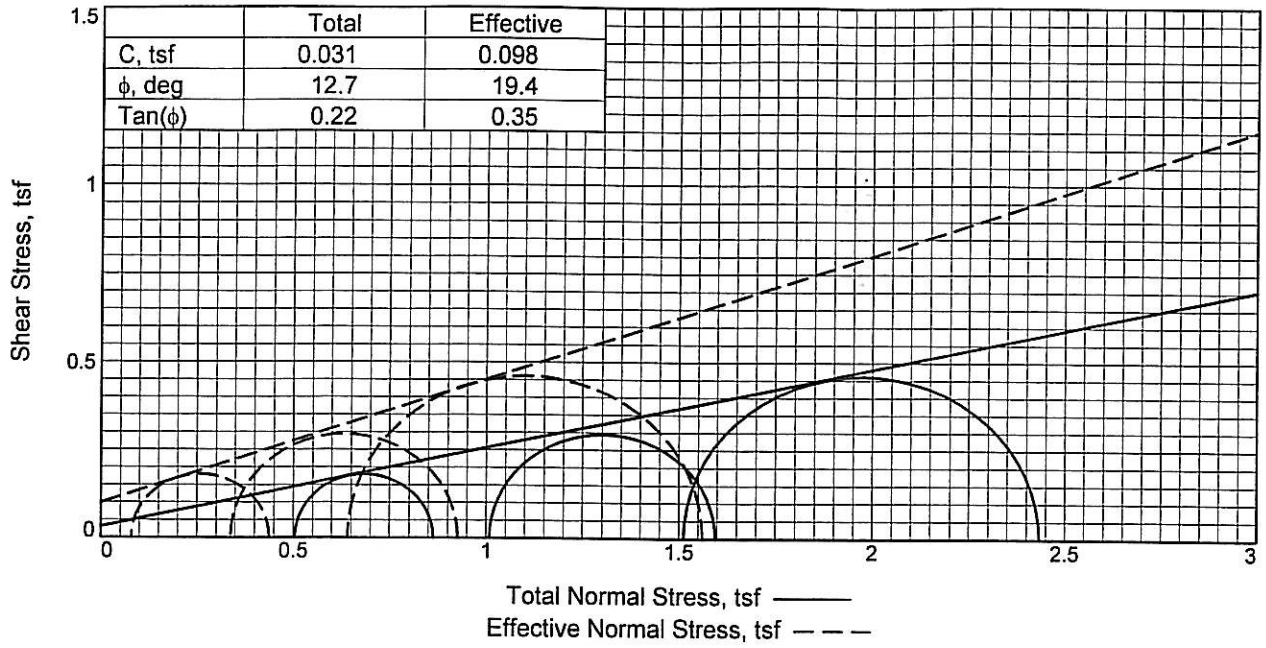
DEPTH (FEET)	ELEVATION	WATER TABLE	GRAPHIC LOG	SAMPLE TYPE	PERCENT RECOVERY	MATERIAL DESCRIPTION	DRY UNIT WEIGHT (PCF) BLOWS PER 6 INCHES RQD= ROCK QUALITY DES.	MOISTURE CONTENT PERCENT BY WEIGHT
70	340				83		16-23-34	
75	335				61	Without gravel, dense	10-15-19	
						Boring terminated in sand at 75'-6"		
80	330							
85	325							
90	320							
95	315							
100	310							
105	305							

SHEAR STRENGTH, tsf
△ QU/2 ■ PP □ SV ◇ TV
1 2 3
STANDARD PENETRATION TEST
▲ N-VALUE (BLOWS PER LAST FOOT)
● MOISTURE CONTENT, %
○ % FINES (PASSING #200 SIEVE)
PL LL
20 40 60

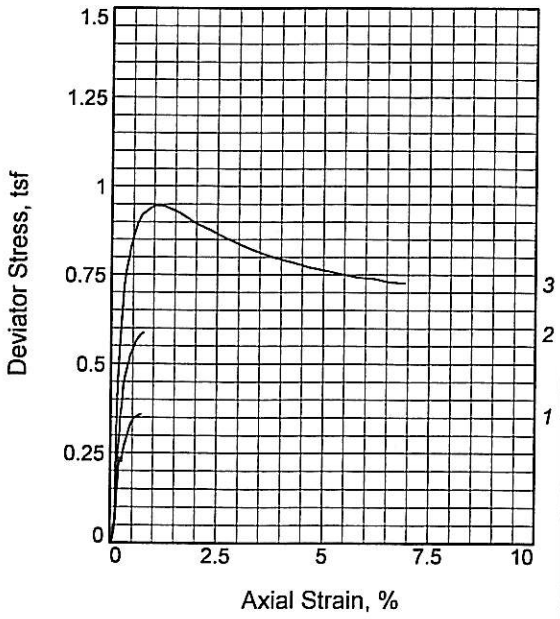


File: 2009012469

Figure



	Total	Effective
C, tsf	0.031	0.098
ϕ, deg	12.7	19.4
Tan(ϕ)	0.22	0.35



Sample No.		1	2	3
Initial	Water Content,	34.5	34.5	34.5
	Dry Density, pcf	64.1	64.1	64.1
	Saturation,	59.7	59.7	59.7
	Void Ratio	1.4555	1.4555	1.4555
	Diameter, in.	2.86	2.86	2.86
	Height, in.	6.00	6.00	6.00
At Test	Water Content,	50.5	49.0	48.2
	Dry Density, pcf	69.2	70.4	71.1
	Saturation,	100.0	100.0	100.0
	Void Ratio	1.2721	1.2346	1.2135
	Diameter, in.	2.79	2.78	2.79
	Height, in.	5.85	5.78	5.72
Strain rate, %/min.		0.30	0.30	0.10
Back Pressure, tsf		4.68	5.11	5.83
Cell Pressure, tsf		5.18	6.12	7.34
Fail. Stress, tsf		0.36	0.59	0.92
Total Pore Pr., tsf		5.10	5.78	6.70
Ult. Stress, tsf		0.36	0.59	0.92
Total Pore Pr., tsf		5.10	5.78	6.70
$\bar{\sigma}_1$ Failure, tsf		0.44	0.93	1.56
$\bar{\sigma}_3$ Failure, tsf		0.08	0.34	0.64

Type of Test:
CU with Pore Pressures

Sample Type: Compacted

Description: Fly Ash, at approximately 81% of standard proctor maximum dry density

Assumed Specific Gravity= 2.52

Remarks:

Client: Ameren UE

Project: UWL Dry Cell Design

Source of Sample: Sioux Fly Ash

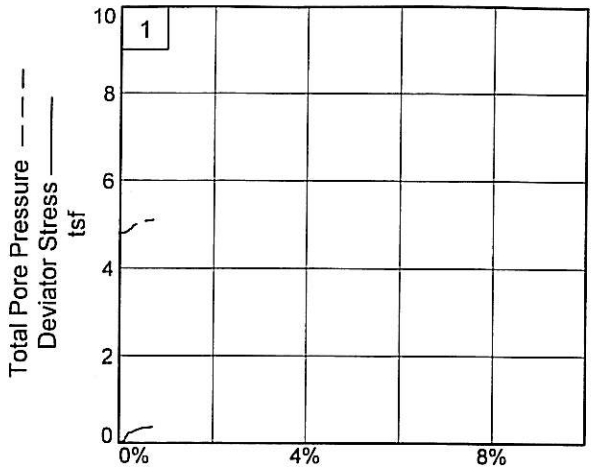
Sample Number: Grab-1

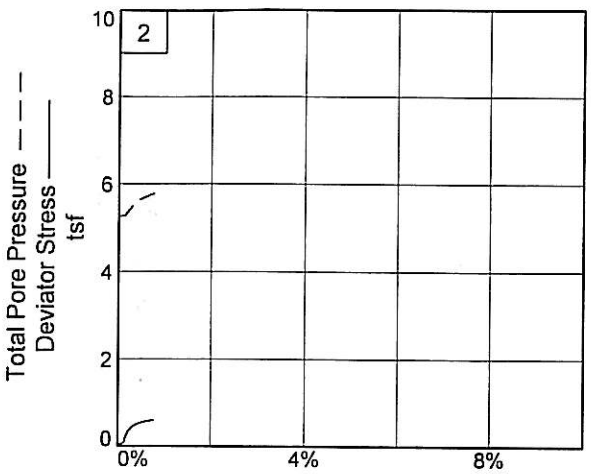
Proj. No.: 2009012470 **Date:**

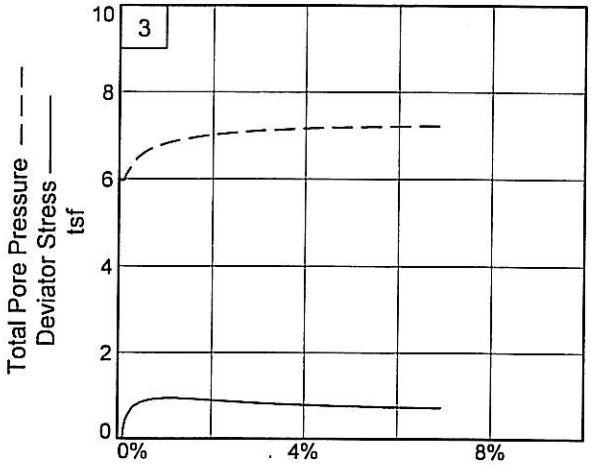
REITZ & JENS, INC.
CONSULTING ENGINEERS

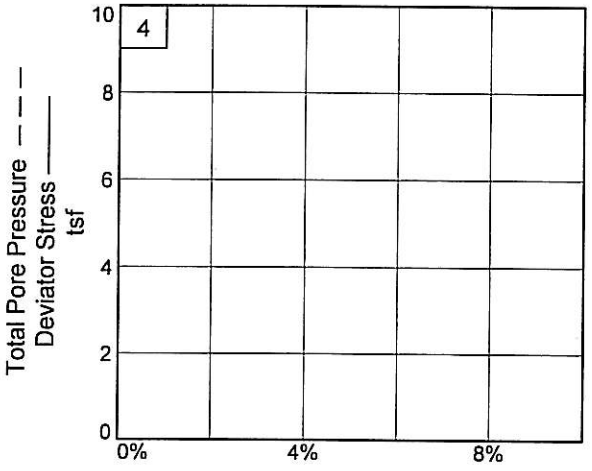
Figure 1

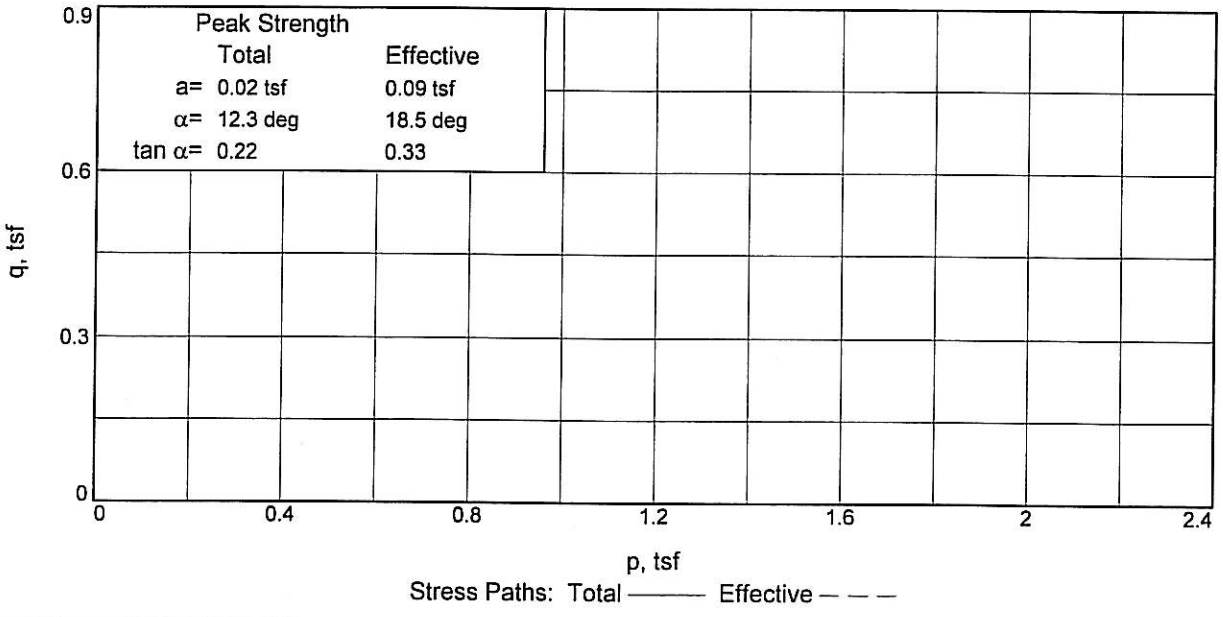
Tested By: K. Kocher **Checked By:** J. Fouse







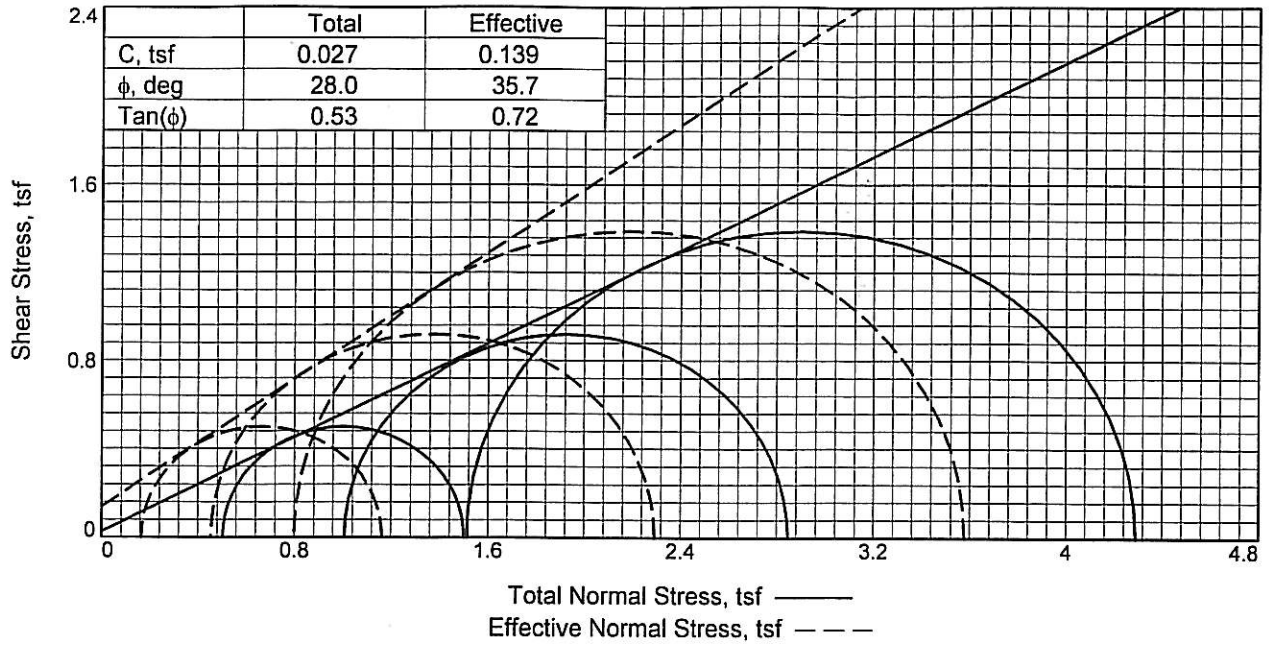




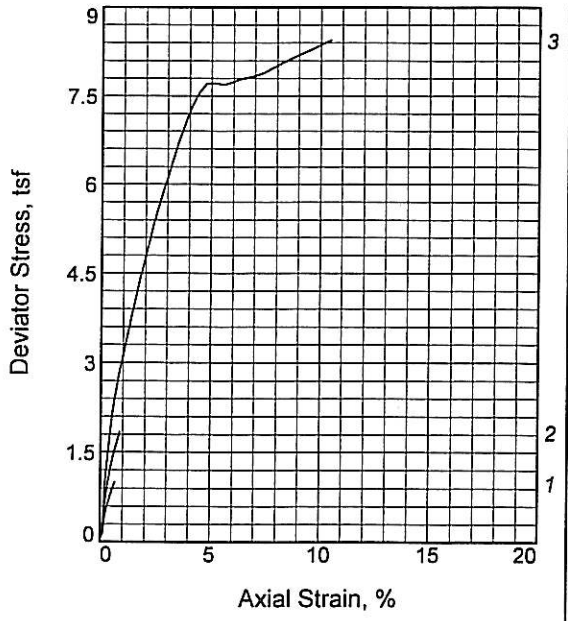
Client: Ameren UE
Project: UWL Dry Cell Design
Source of Sample: Sioux Fly Ash
Sample Number: Grab-1
Project No.: 2009012470
Figure _____

REITZ & JENS, INC.

Tested By: K. Kocher **Checked By:** J. Fouse



	Total	Effective
C, tsf	0.027	0.139
ϕ, deg	28.0	35.7
Tan(ϕ)	0.53	0.72



Sample No.		1	2	3
Initial	Water Content,	35.2	35.2	35.2
	Dry Density, pcf	78.9	78.9	78.9
	Saturation,	89.3	89.3	89.3
	Void Ratio	0.9944	0.9944	0.9944
	Diameter, in.	2.86	2.86	2.86
	Height, in.	6.00	6.00	6.00
At Test	Water Content,	37.2	36.9	36.7
	Dry Density, pcf	81.2	81.5	81.8
	Saturation,	100.0	100.0	100.0
	Void Ratio	0.9370	0.9311	0.9242
	Diameter, in.	2.84	2.84	2.85
	Height, in.	5.95	5.90	5.84
Strain rate, %/min.		0.30	0.30	0.30
Back Pressure, tsf		3.96	4.32	4.90
Cell Pressure, tsf		4.46	5.33	6.41
Fail. Stress, tsf		1.00	1.84	2.78
Total Pore Pr., tsf		4.30	4.87	5.61
Ult. Stress, tsf		1.00	1.84	2.78
Total Pore Pr., tsf		4.30	4.87	5.61
$\bar{\sigma}_1$ Failure, tsf		1.16	2.29	3.58
$\bar{\sigma}_3$ Failure, tsf		0.17	0.45	0.80

Type of Test:
CU with Pore Pressures

Sample Type: Compacted

Description: Fly Ash, at approximately 100% of standard proctor maximum dry density

Assumed Specific Gravity= 2.52

Remarks:

Client: Ameren UE

Project: UWL Dry Cell Design

Source of Sample: Sioux Fly Ash

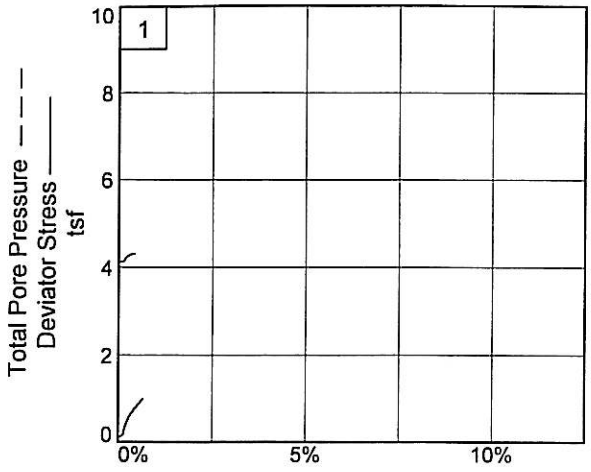
Sample Number: Grab-1

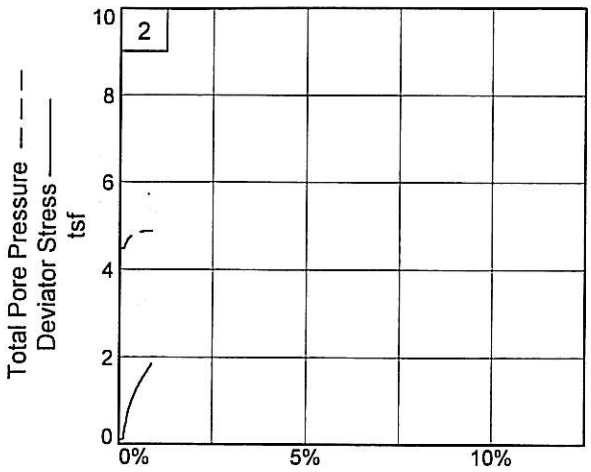
Proj. No.: 2009012470 **Date:**

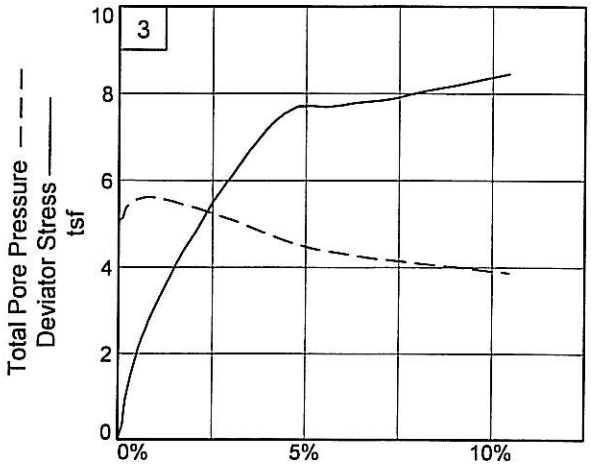
REITZ & JENS, INC.
CONSULTING ENGINEERS

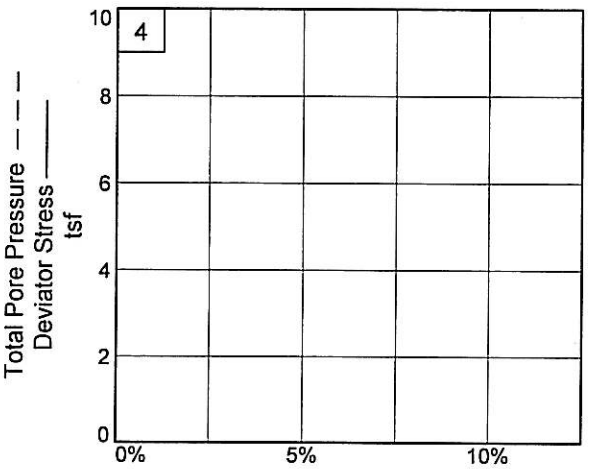
Figure 2

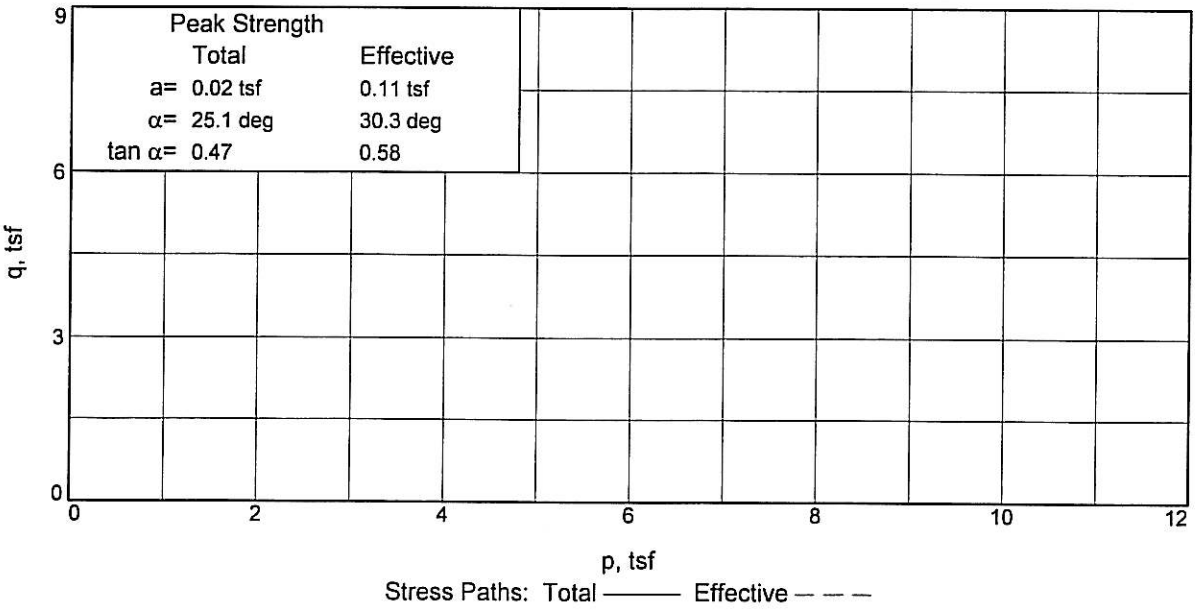
Tested By: K. Kocher **Checked By:** J. Fouse











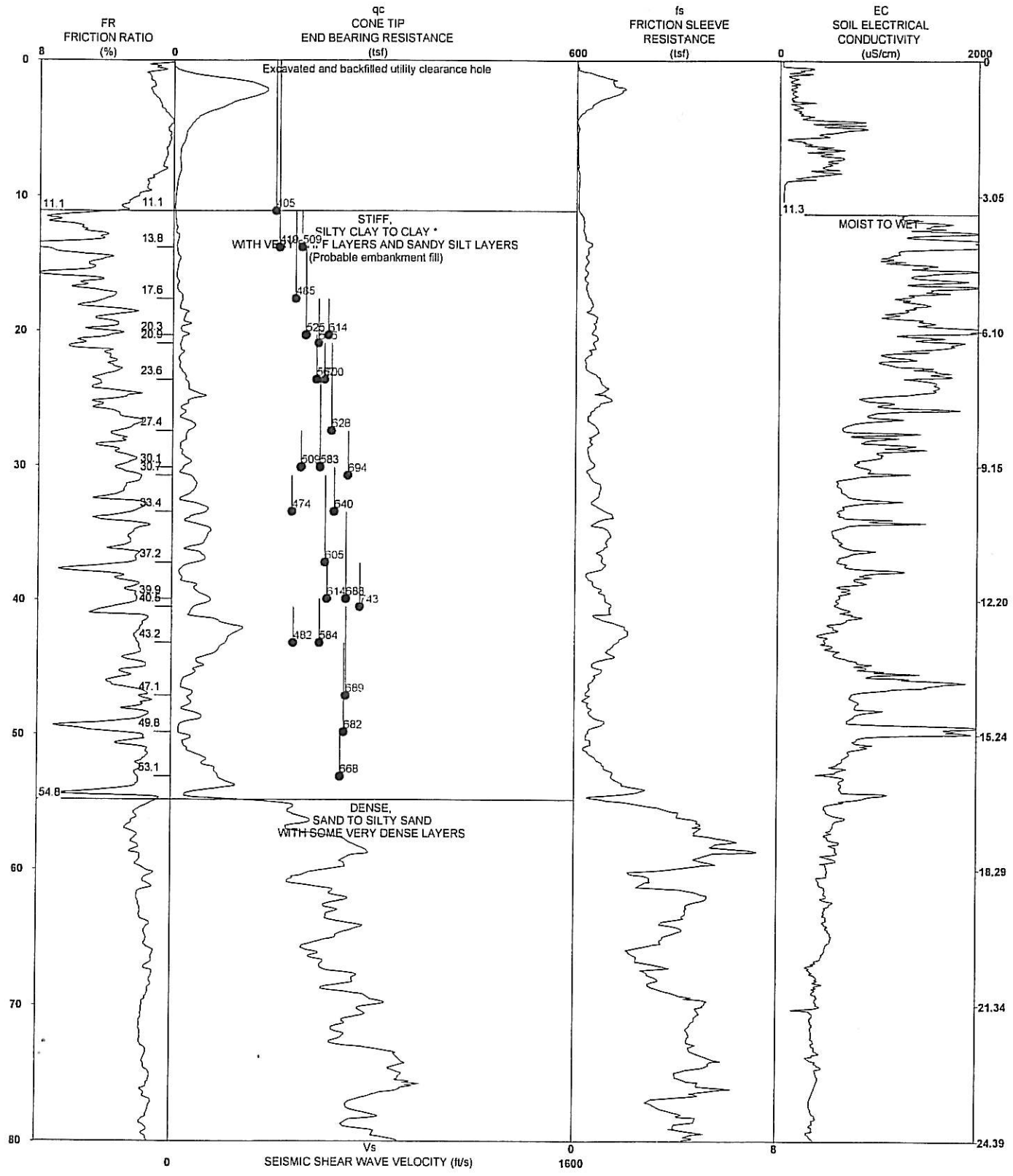
Client: Ameren UE
Project: UWL Dry Cell Design
Source of Sample: Sioux Fly Ash
Sample Number: Grab-1
Project No.: 2009012470
Figure _____

REITZ & JENS, INC.

Tested By: K. Kocher **Checked By:** J. Fouse

CPT Logs

CPTU-EC-S LOG WITH LITHOLOGIC EVALUATION CP01



- 0 - 1600 ft/sec True Shear Wave Velocity
- 0 - 1600 ft/sec Pseudo Interval Receiver 1
- 0 - 1600 ft/sec Pseudo Interval Receiver 2

Latitude: 38.12324 Longitude: -90.25558

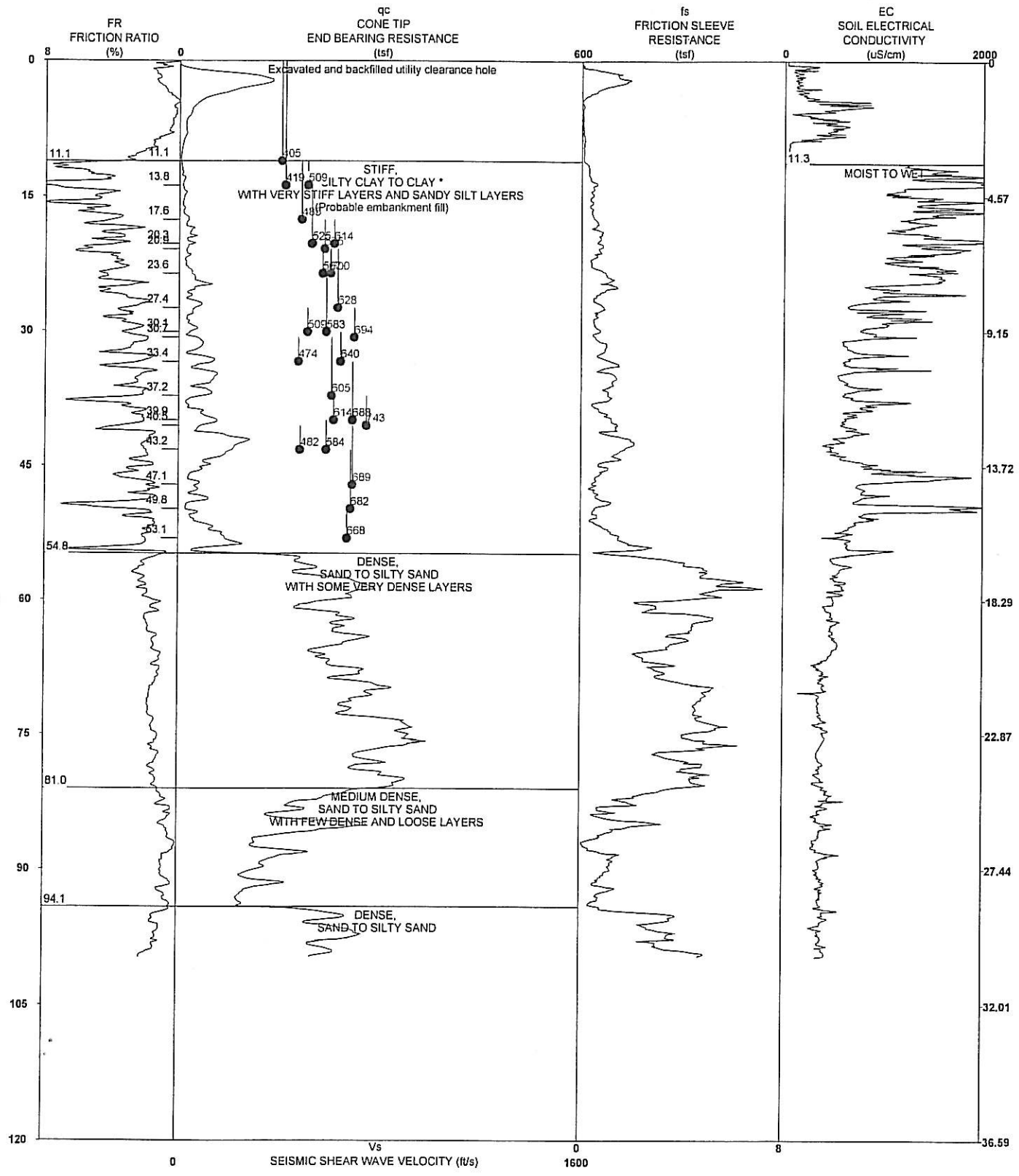
PROJECT NAME:Ameren UE Rush Island Levee Inventory
PROJECT NUMBER:09-110-090

STRATIGRAPHICS

R1 DATE:8/28/2009 TIME:9:35 AM
SOUNDING NUMBER:CP-01

CP01

CPTU-EC-S LOG WITH LITHOLOGIC EVALUATION CP01



0 - 1600 ft/sec True Shear Wave Velocity
0 - 1600 ft/sec Pseudo Interval Receiver 1
0 - 1600 ft/sec Pseudo Interval Receiver 2

Latitude: 38.12324 Longitude: -90.25558

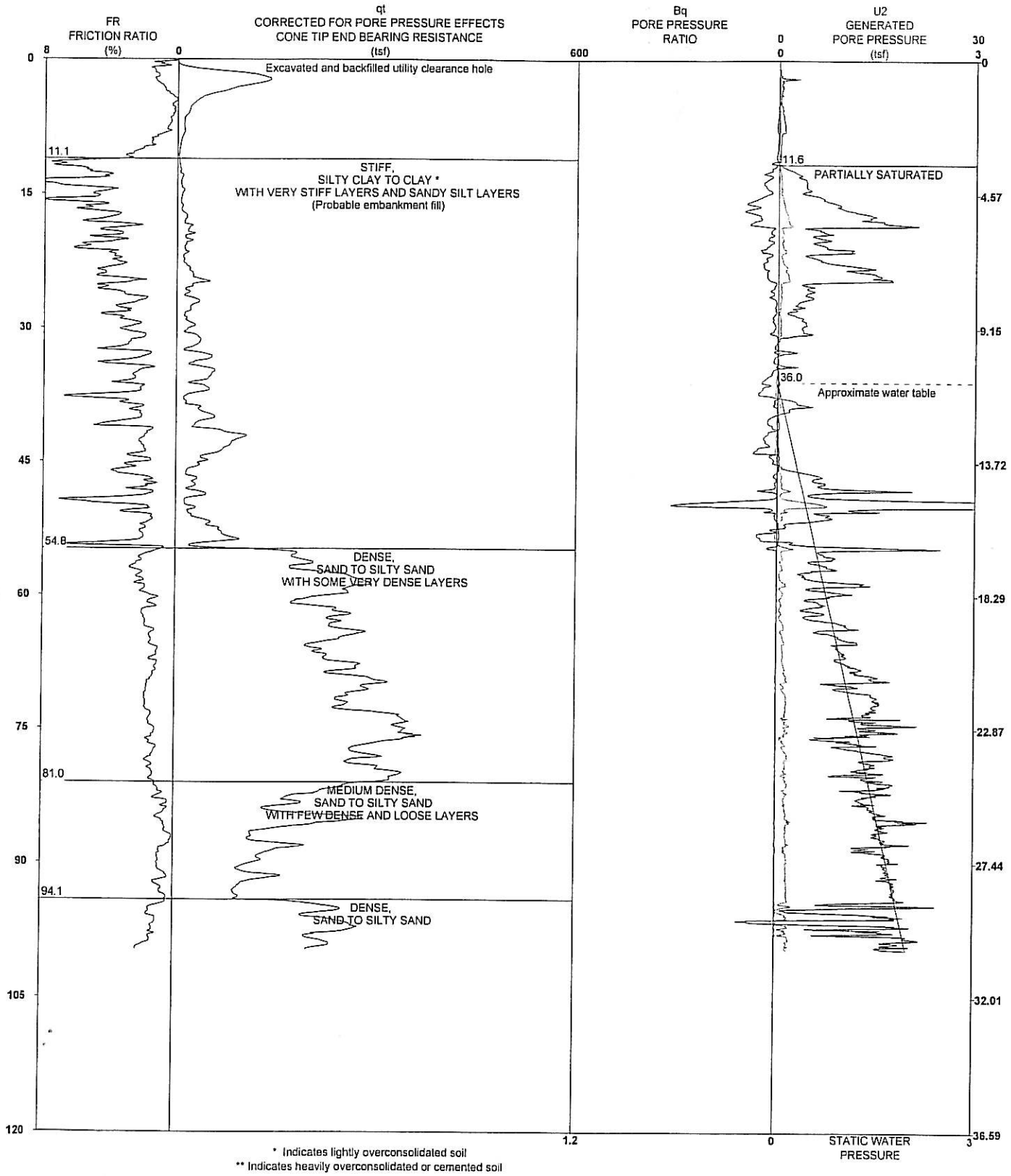
PROJECT NAME:Ameren UE Rush Island Levee Inventory
PROJECT NUMBER:09-110-090

STRATIGRAPHICS

R1 DATE:8/28/2009 TIME:9:35 AM
SOUNDING NUMBER:CP-01

CP01

CPTU-EC-S LOG WITH LITHOLOGIC EVALUATION CP01



* Indicates lightly overconsolidated soil
** Indicates heavily overconsolidated or cemented soil

Latitude: 38.12324 Longitude: -90.25558

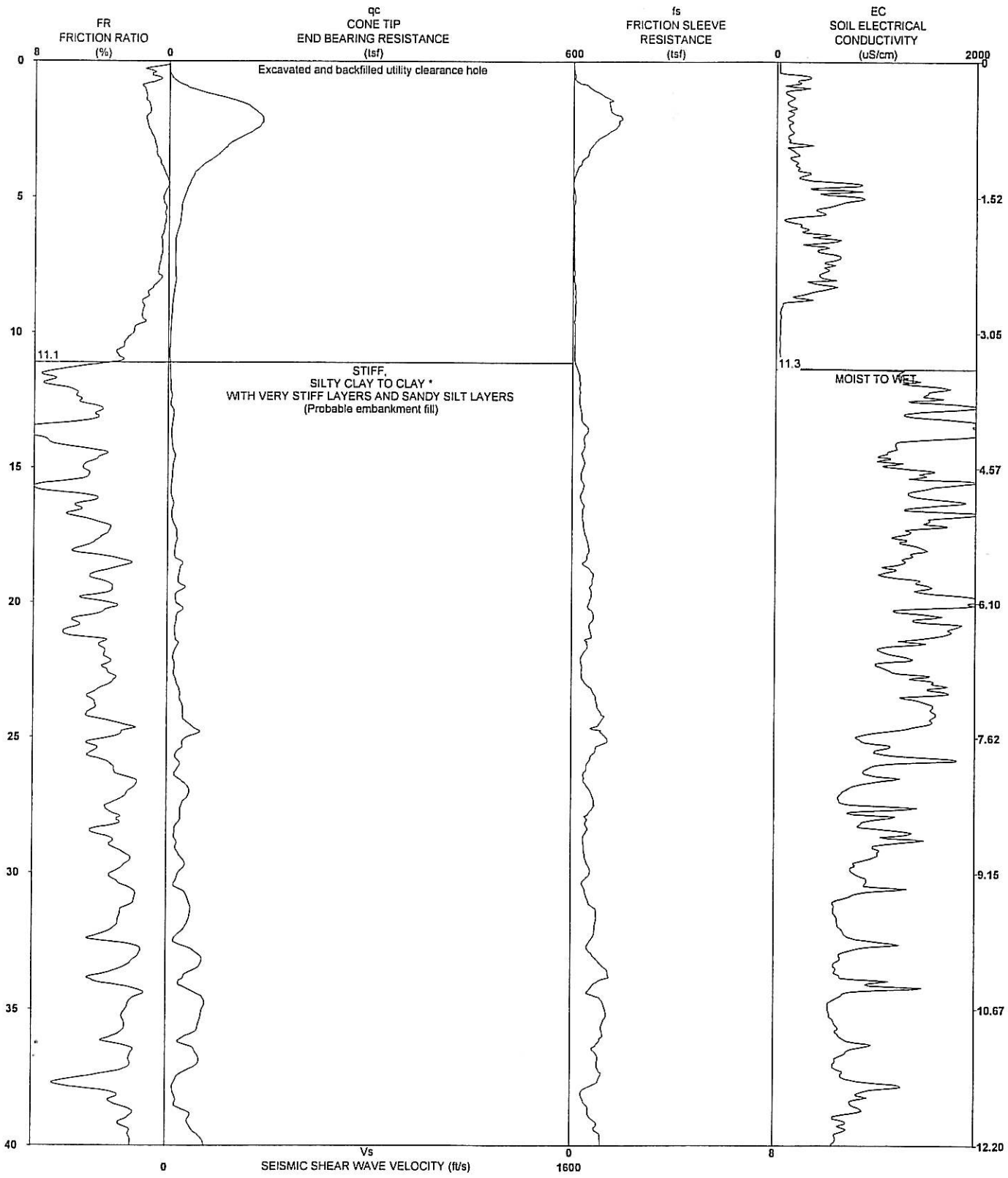
PROJECT NAME:Ameren UE Rush Island Levee Investigation
PROJECT NUMBER:09-110-090

STRATIGRAPHICS

R1 DATE:8/28/2009 TIME:9:35 AM
SOUNDING NUMBER:CP-01

CP01

CPTU-EC-S LOG WITH LITHOLOGIC EVALUATION CP01



Latitude: 38.12324 Longitude: -90.25558

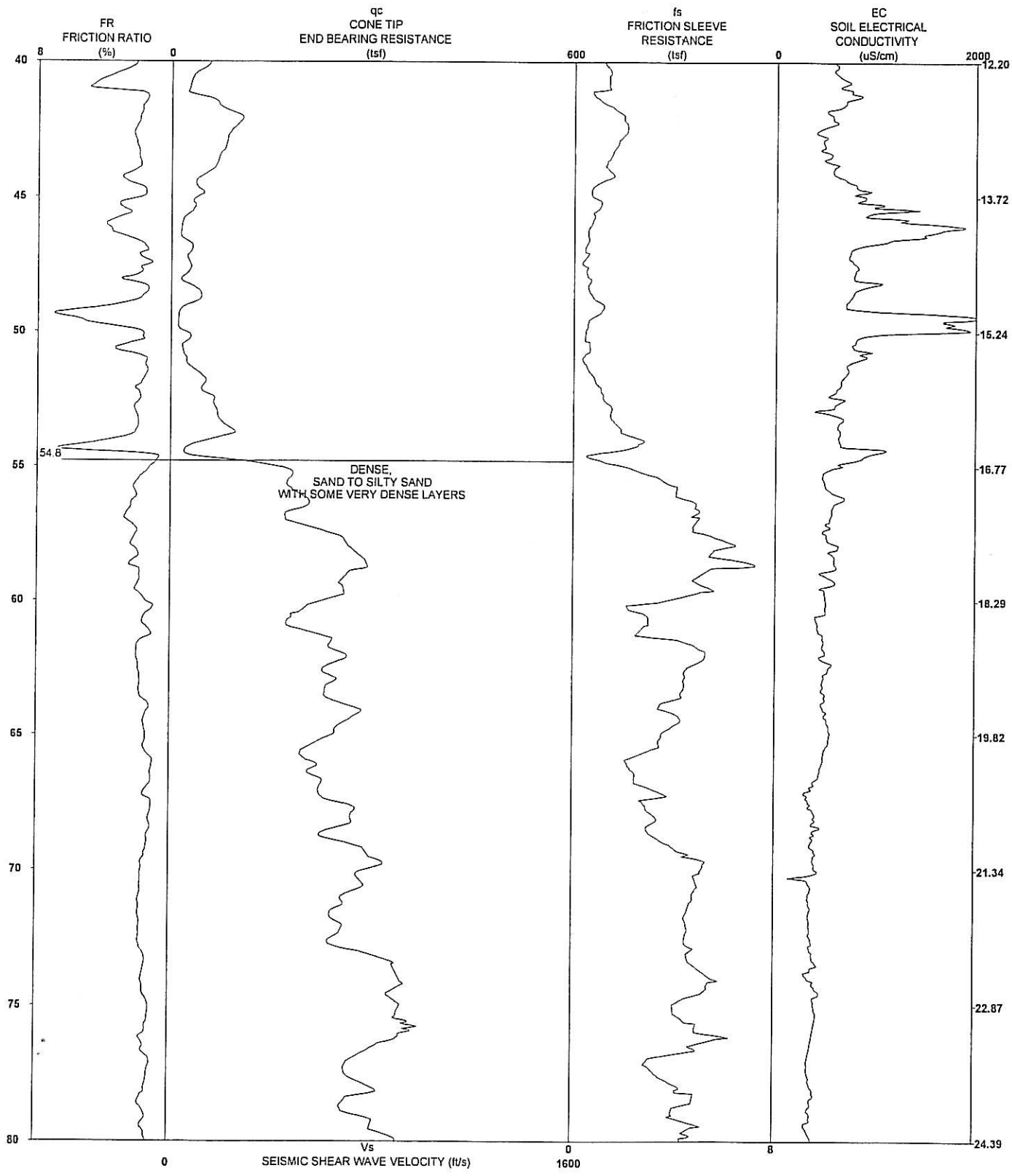
PROJECT NAME:Ameren UE Rush Island Levee Inventory
PROJECT NUMBER:09-110-090

STRATIGRAPHICS

R1 DATE:8/28/2009 TIME:9:35 AM
SOUNDING NUMBER:CP-01

CP01

CPTU-EC-S LOG WITH LITHOLOGIC EVALUATION CP01



Latitude: 38.12324 Longitude: -90.25558

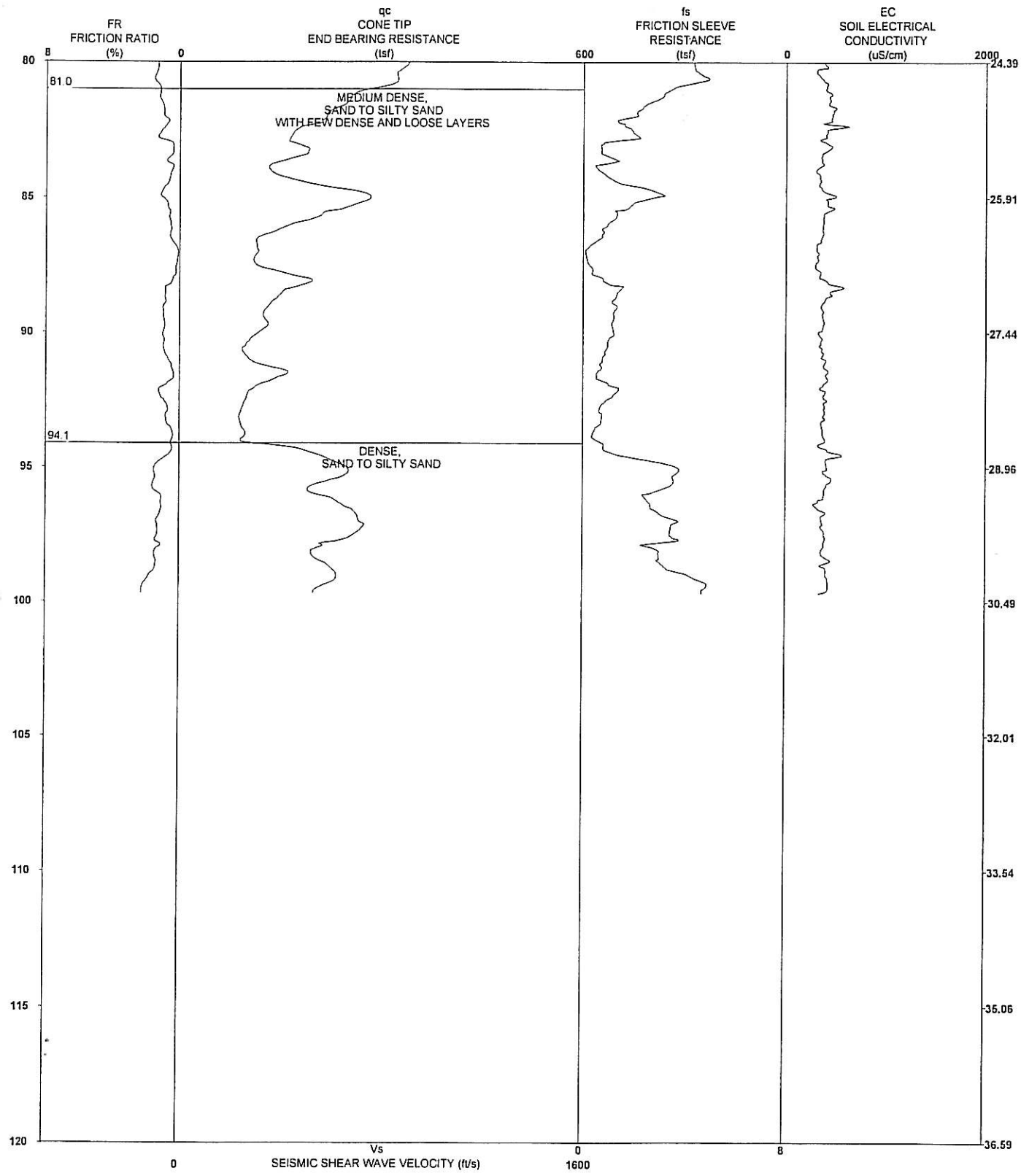
PROJECT NAME:Ameren UE Rush Island Levee Inventory
PROJECT NUMBER:09-110-090

STRATIGRAPHICS

R1 DATE:8/28/2009 TIME:9:35 AM
SOUNDING NUMBER:CP-01

CP01

CPTU-EC-S LOG WITH LITHOLOGIC EVALUATION CP01



Latitude: 38.12324 Longitude: -90.25558

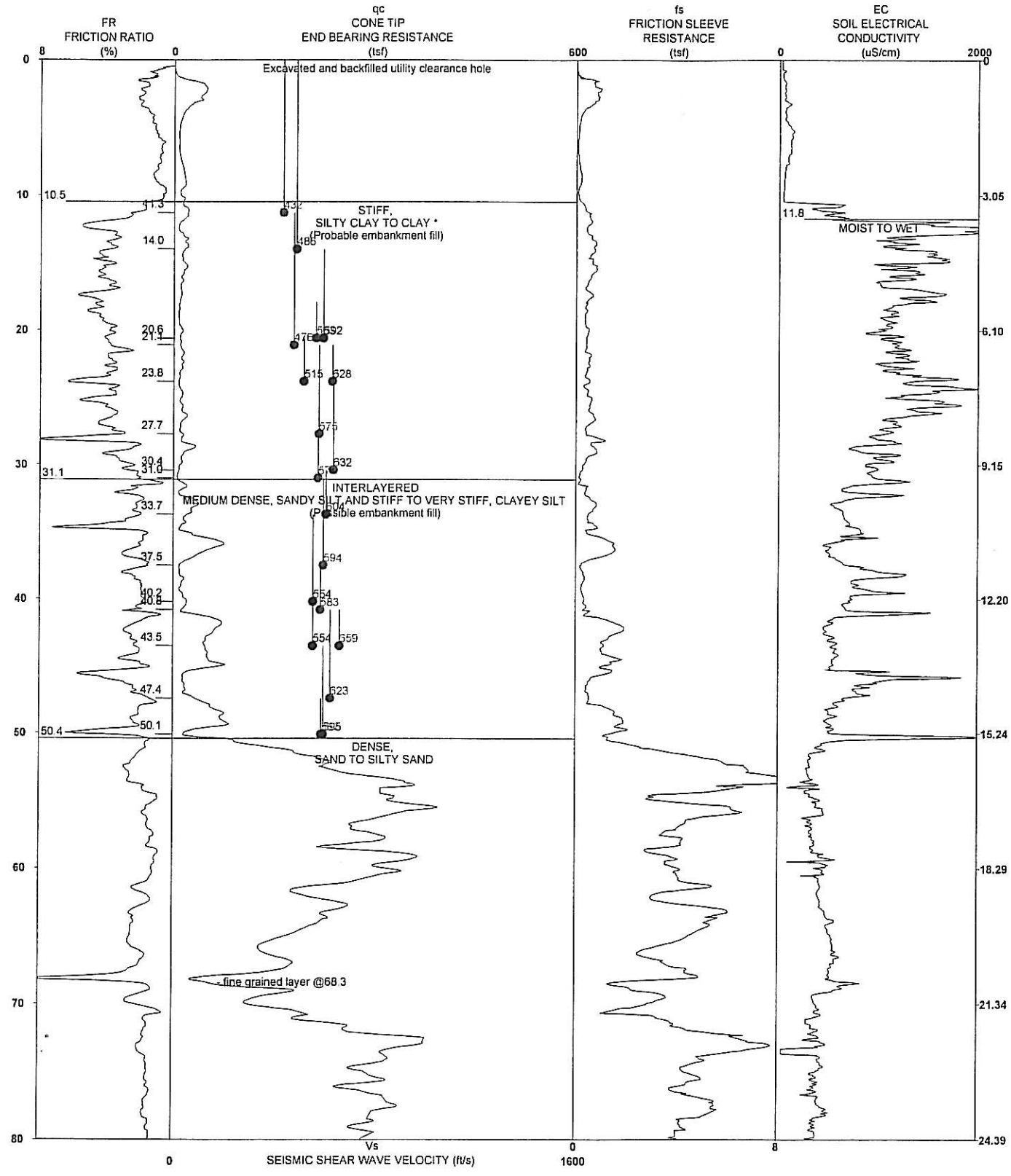
PROJECT NAME:Ameren UE Rush Island Levee Inventory
PROJECT NUMBER:09-110-090

STRATIGRAPHICS

R1 DATE:8/28/2009 TIME:9:35 AM
SOUNDING NUMBER:CP-01

CP01

CPTU-EC-S LOG WITH LITHOLOGIC EVALUATION CP02



- 0 - 1600 ft/sec True Shear Wave Velocity
- 0 - 1600 ft/sec Pseudo Interval Receiver 1
- 0 - 1600 ft/sec Pseudo Interval Receiver 2

Latitude: 0.00000 Longitude: 0.00000

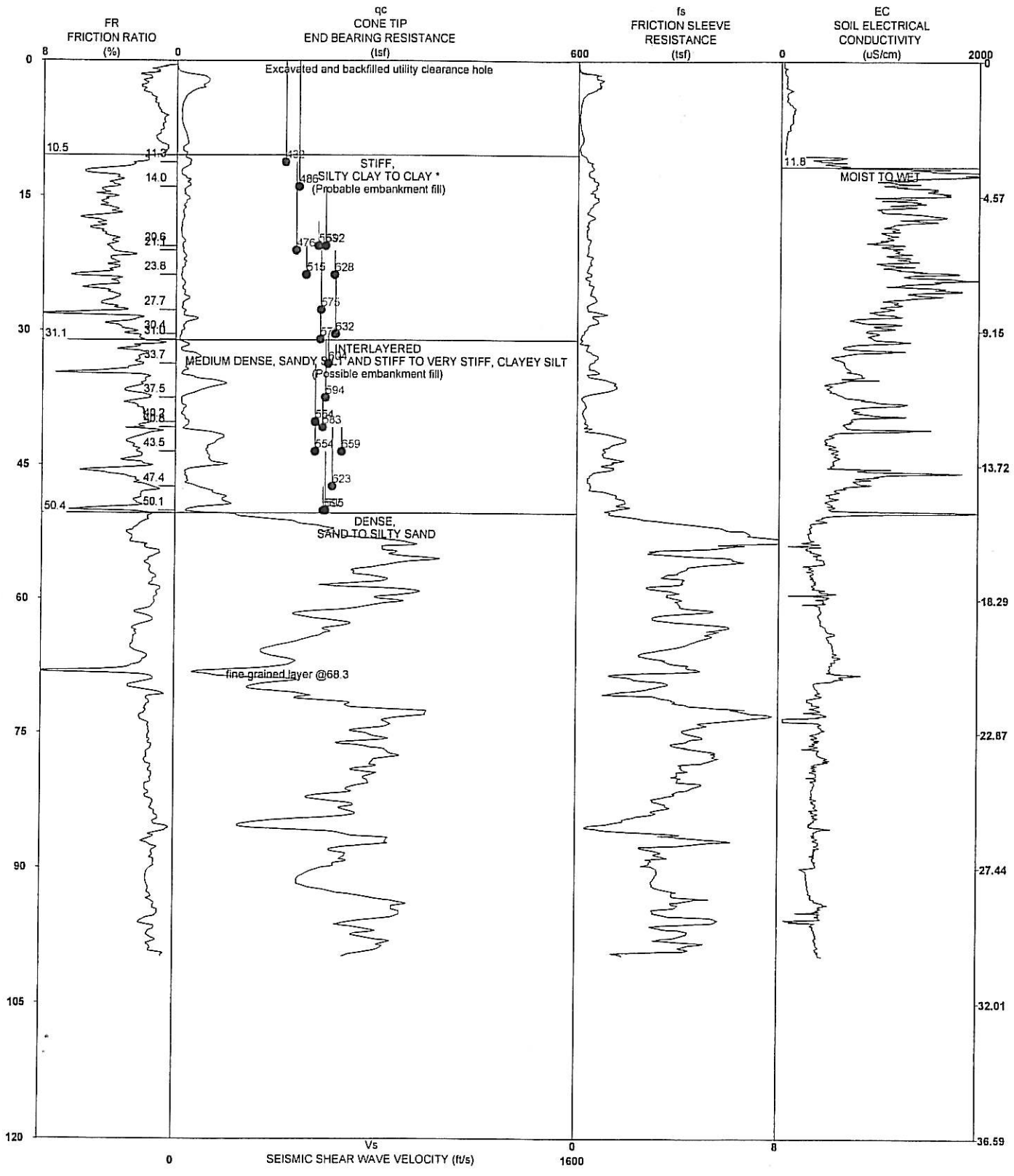
PROJECT NAME:Ameren UE Rush Island Levee Inventory
PROJECT NUMBER:09-110-090

STRATIGRAPHICS

R1 DATE:8/27/2009 TIME:5:25 PM
SOUNDING NUMBER:CP-02

CP02

CPTU-EC-S LOG WITH LITHOLOGIC EVALUATION CP02



0 - 1600 ft/sec True Shear Wave Velocity
0 - 1600 ft/sec Pseudo Interval Receiver 1
0 - 1600 ft/sec Pseudo Interval Receiver 2

Latitude: 0.00000 Longitude: 0.00000

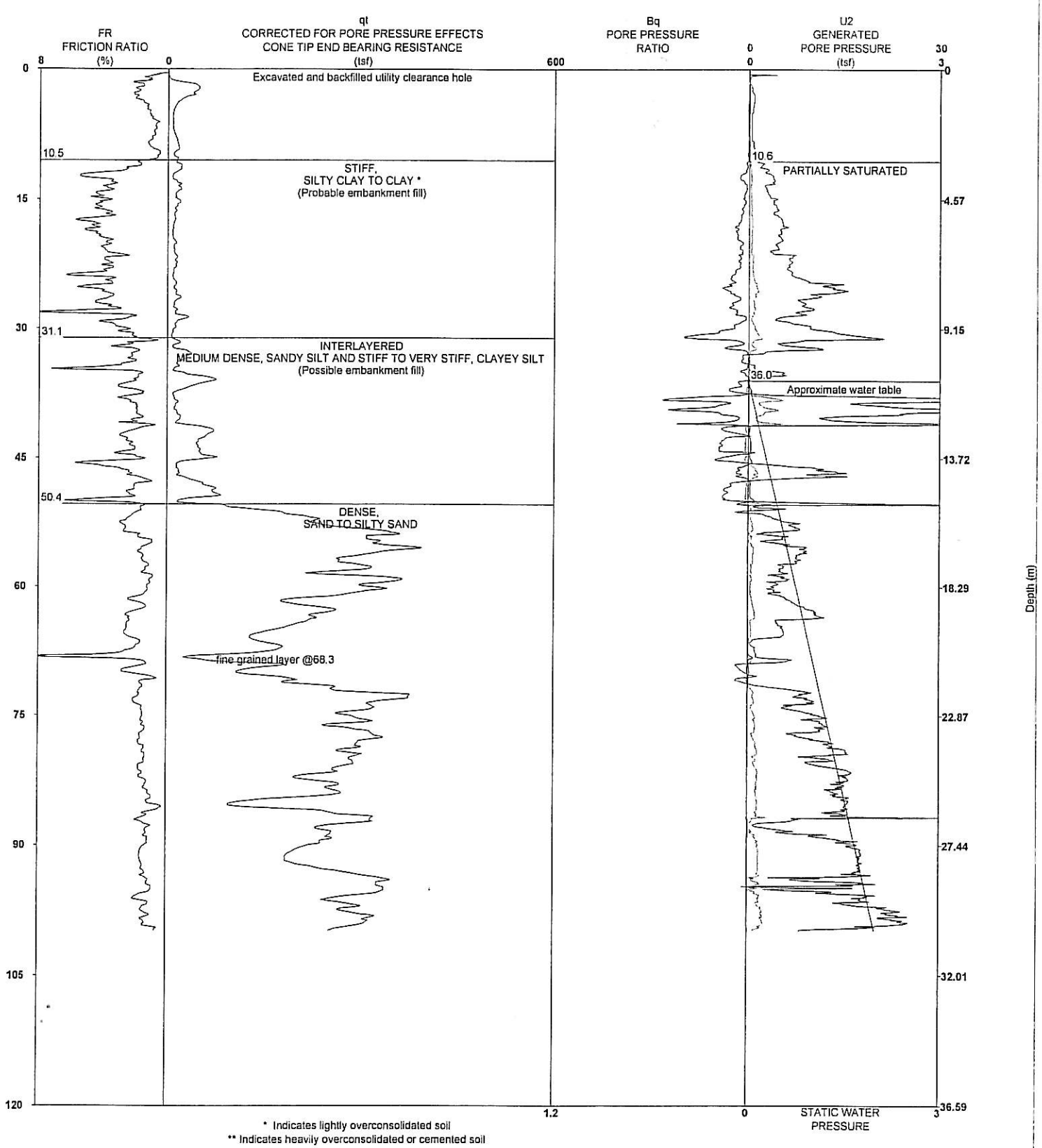
PROJECT NAME:Ameren UE Rush Island Levee Investigation
PROJECT NUMBER:09-110-090

STRATIGRAPHICS

R1 DATE:8/27/2009 TIME:5:25 PM
SOUNDING NUMBER:CP-02

CP02

CPTU-EC-S LOG WITH LITHOLOGIC EVALUATION CP02



* Indicates lightly overconsolidated soil
** Indicates heavily overconsolidated or cemented soil

Latitude: 0.00000 Longitude: 0.00000

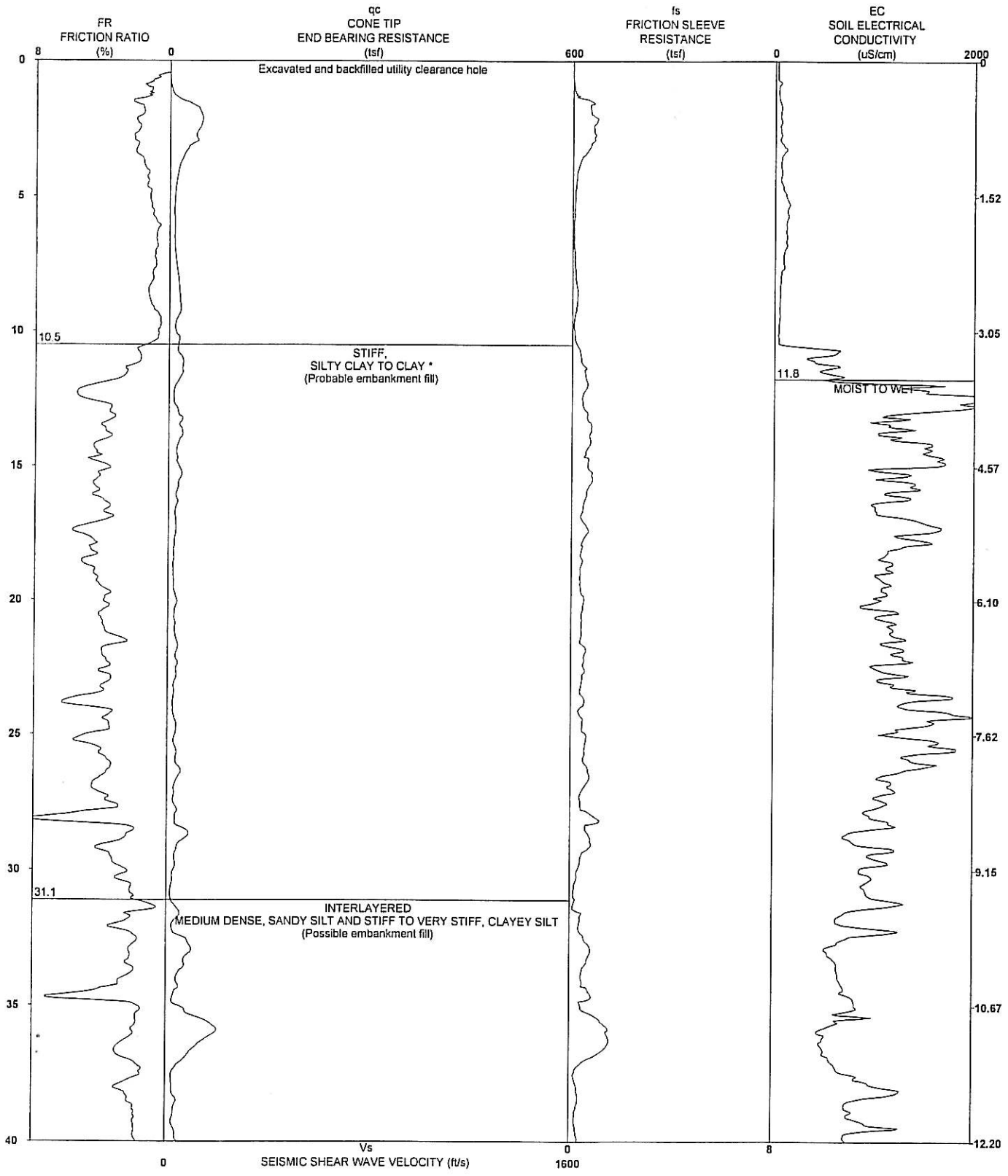
PROJECT NAME:Ameren UE Rush Island Levee Inventory
PROJECT NUMBER:09-110-090

STRATIGRAPHICS

R1 DATE:8/27/2009 TIME:5:25 PM
SOUNDING NUMBER:CP-02

CP02

CPTU-EC-S LOG WITH LITHOLOGIC EVALUATION CP02



Latitude: 0.00000 Longitude: 0.00000

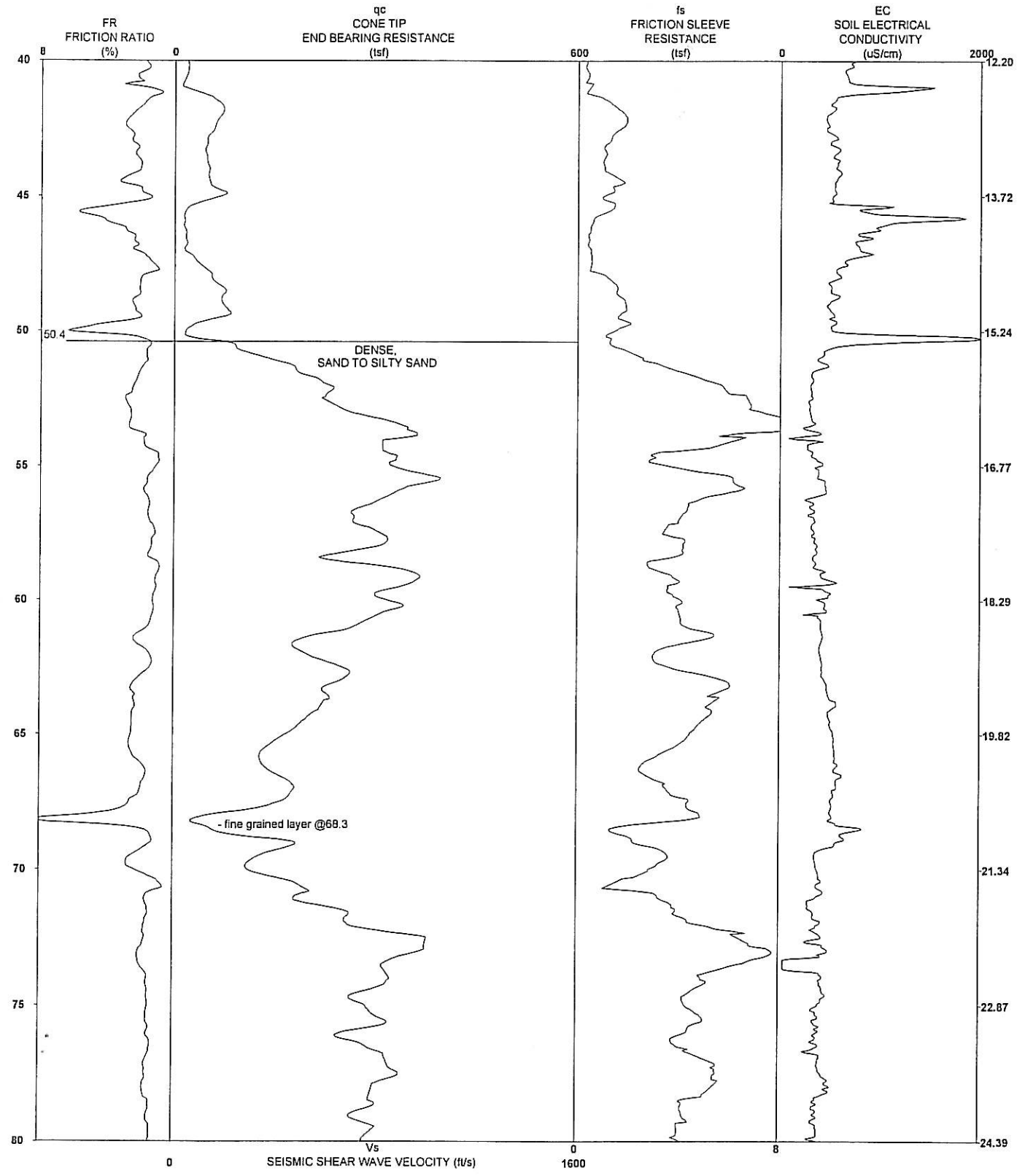
PROJECT NAME:Ameren UE Rush Island Levee Inventory
PROJECT NUMBER:09-110-090

STRATIGRAPHICS

R1 DATE:8/27/2009 TIME:5:25 PM
SOUNDING NUMBER:CP-02

CP02

CPTU-EC-S LOG WITH LITHOLOGIC EVALUATION CP02



Latitude: 0.00000 Longitude: 0.00000

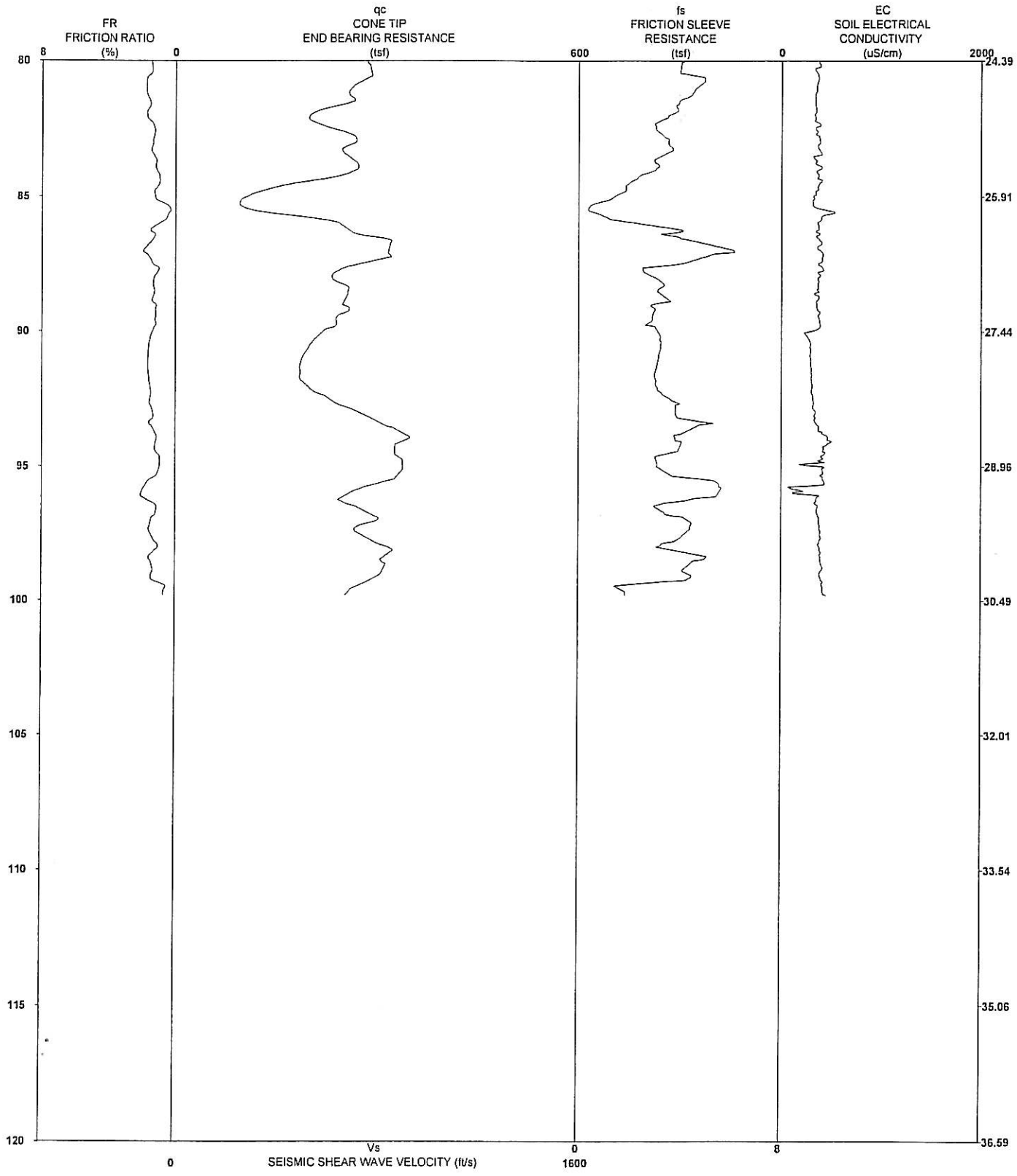
PROJECT NAME:Ameren UE Rush Island Levee Inventory
PROJECT NUMBER:09-110-090

STRATIGRAPHICS

R1 DATE:8/27/2009 TIME:5:25 PM
SOUNDING NUMBER:CP-02

CP02

CPTU-EC-S LOG WITH LITHOLOGIC EVALUATION CP02



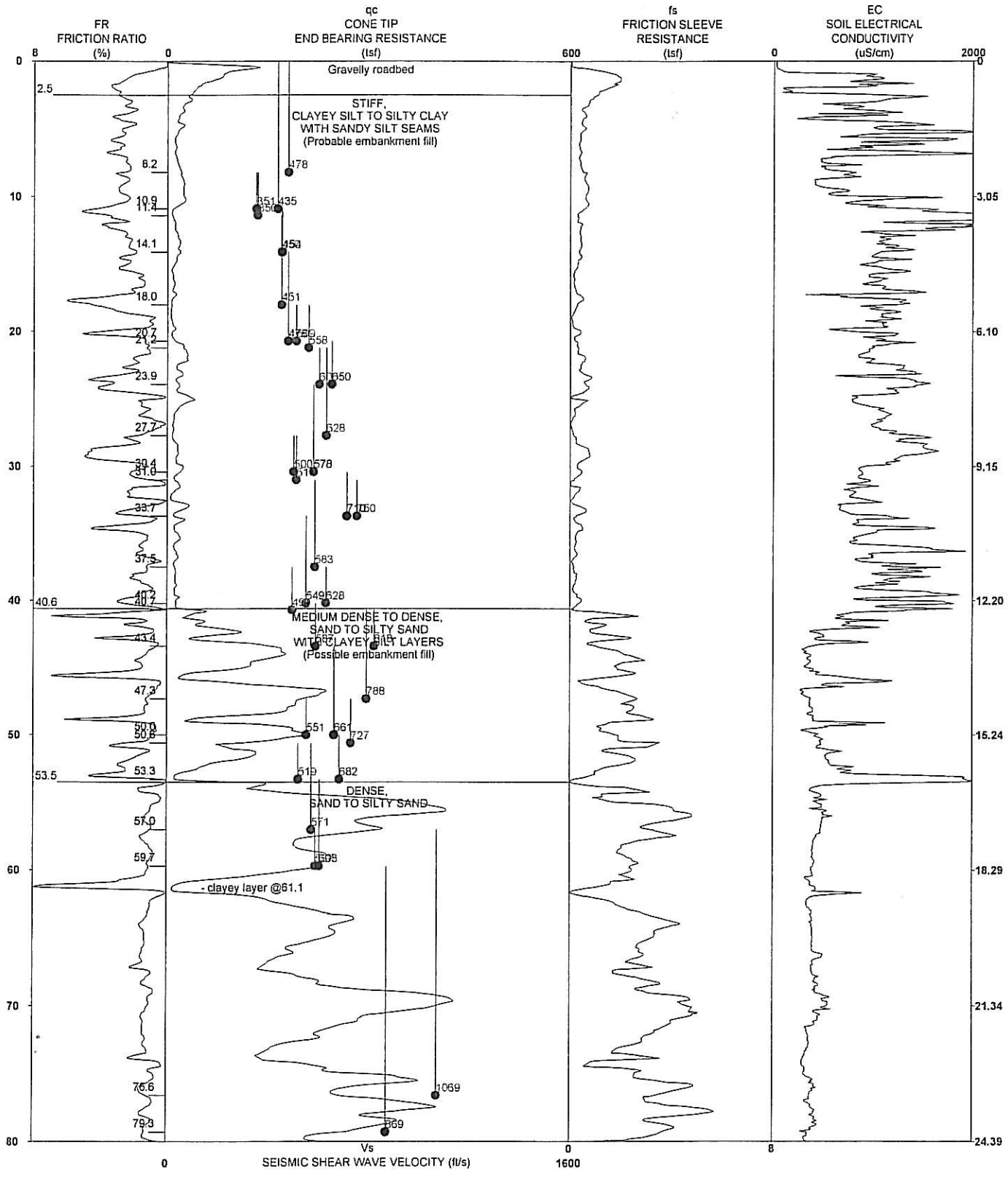
Latitude: 0.00000 Longitude: 0.00000

PROJECT NAME:Ameren UE Rush Island Levee Inventory
PROJECT NUMBER:09-110-090

STRATIGRAPHICS

R1 DATE:8/27/2009 TIME:5:25 PM
SOUNDING NUMBER:CP-02

CPTU-EC-S LOG WITH LITHOLOGIC EVALUATION CP03



- 0 - 1600 ft/sec True Shear Wave Velocity
- 0 - 1600 ft/sec Pseudo Interval Receiver 1
- 0 - 1600 ft/sec Pseudo Interval Receiver 2

Latitude: 0.00000 Longitude: 0.00000

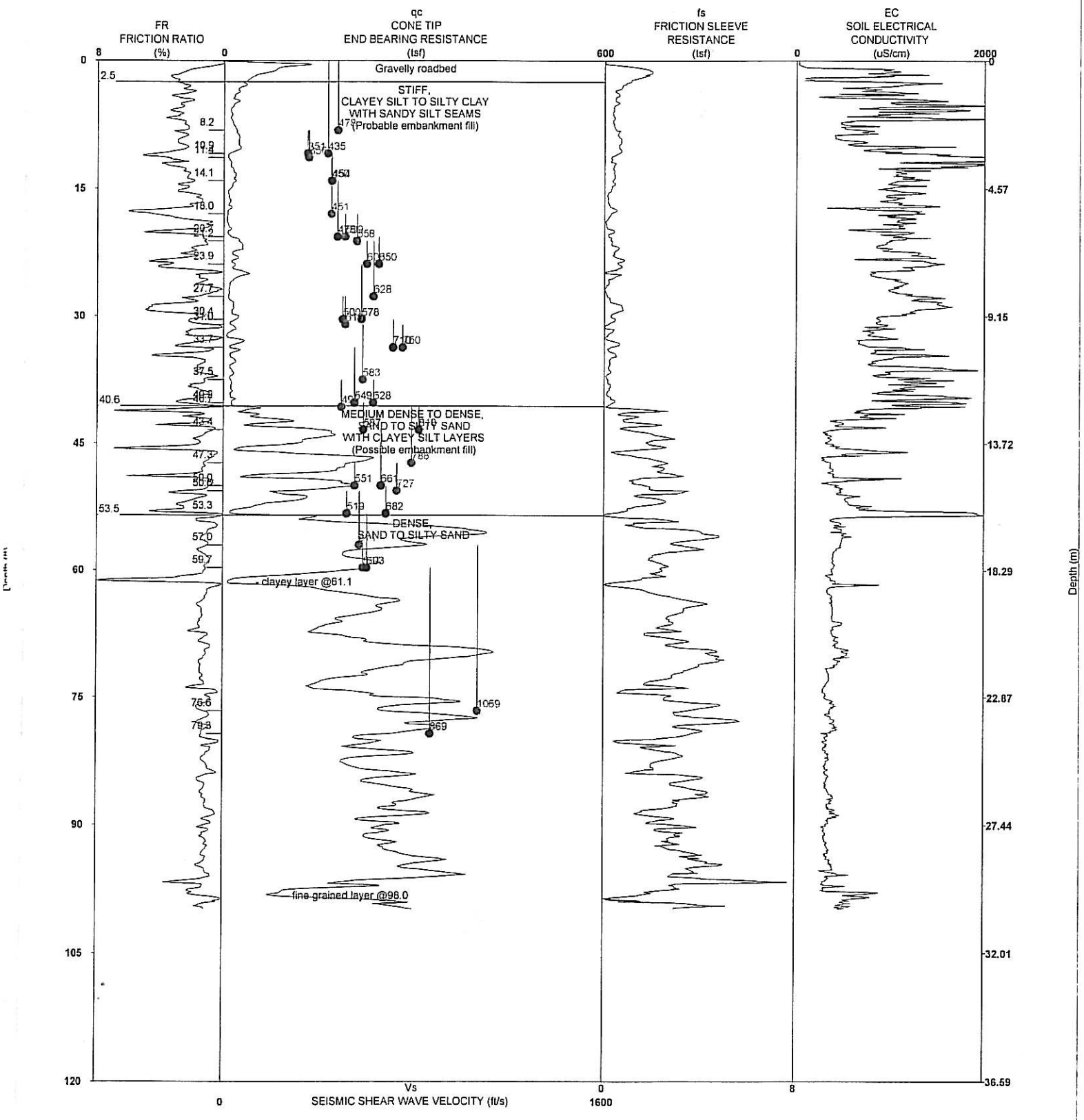
PROJECT NAME:Ameren UE Rush Island Levee Inventory
PROJECT NUMBER:09-110-090

STRATIGRAPHICS

R1 DATE:8/27/2009 TIME:3:19 PM
SOUNDING NUMBER:CP-03

CP03

CPTU-EC-S LOG WITH LITHOLOGIC EVALUATION CP03



Latitude: 0.00000 Longitude: 0.00000

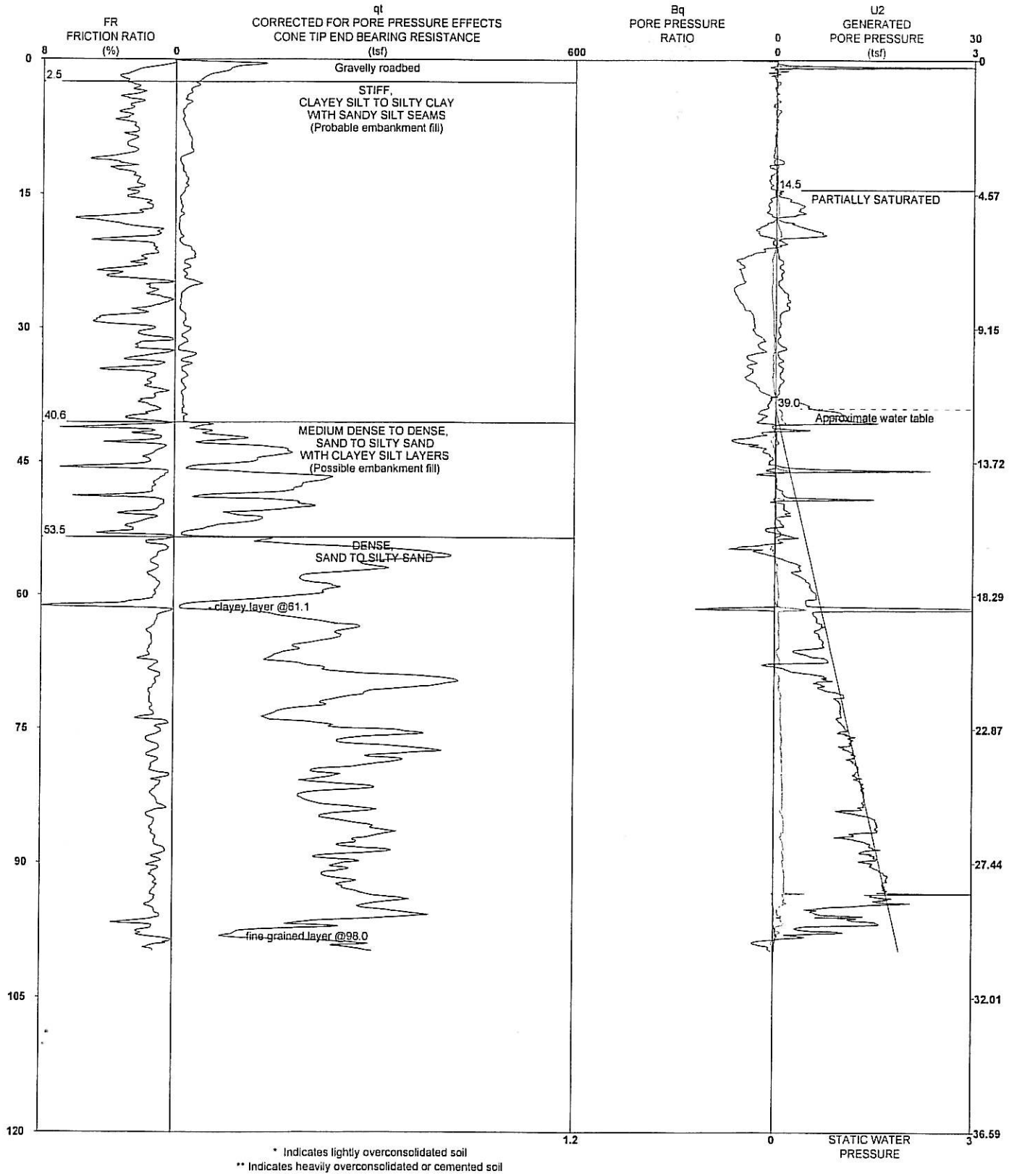
PROJECT NAME:Ameren UE Rush Island Levee Inventory
PROJECT NUMBER:09-110-090

STRATIGRAPHICS

R1 DATE:8/27/2009 TIME:3:19 PM
SOUNDING NUMBER:CP-03

CP03

CPTU-EC-S LOG WITH LITHOLOGIC EVALUATION CP03



* Indicates lightly overconsolidated soil
** Indicates heavily overconsolidated or cemented soil

Latitude: 0.00000 Longitude: 0.00000

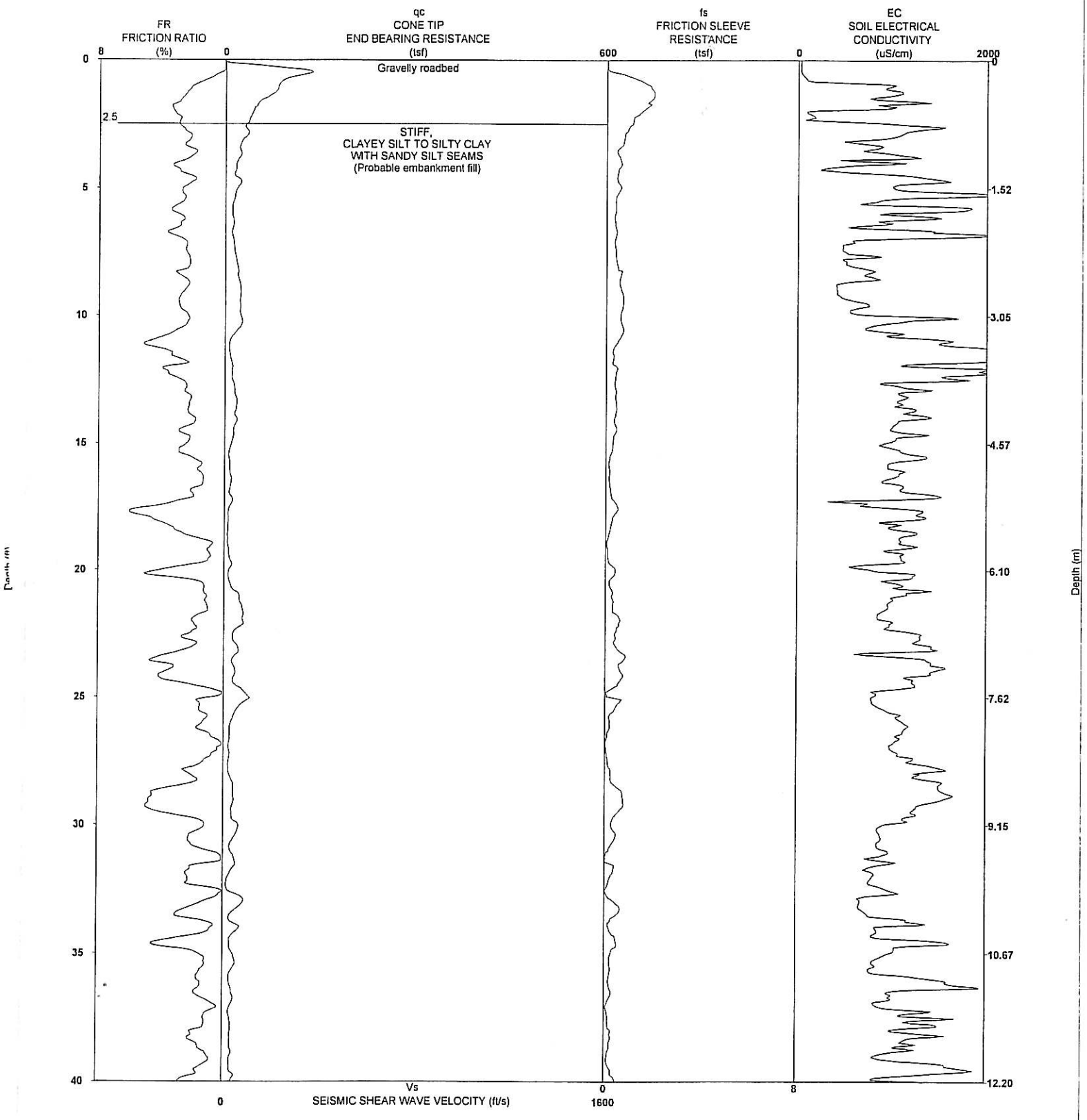
PROJECT NAME:Ameren UE Rush Island Levee Inventory
PROJECT NUMBER:09-110-090

STRATIGRAPHICS

R1 DATE:8/27/2009 TIME:3:19 PM
SOUNDING NUMBER:CP-03

CP03

CPTU-EC-S LOG WITH LITHOLOGIC EVALUATION CP03



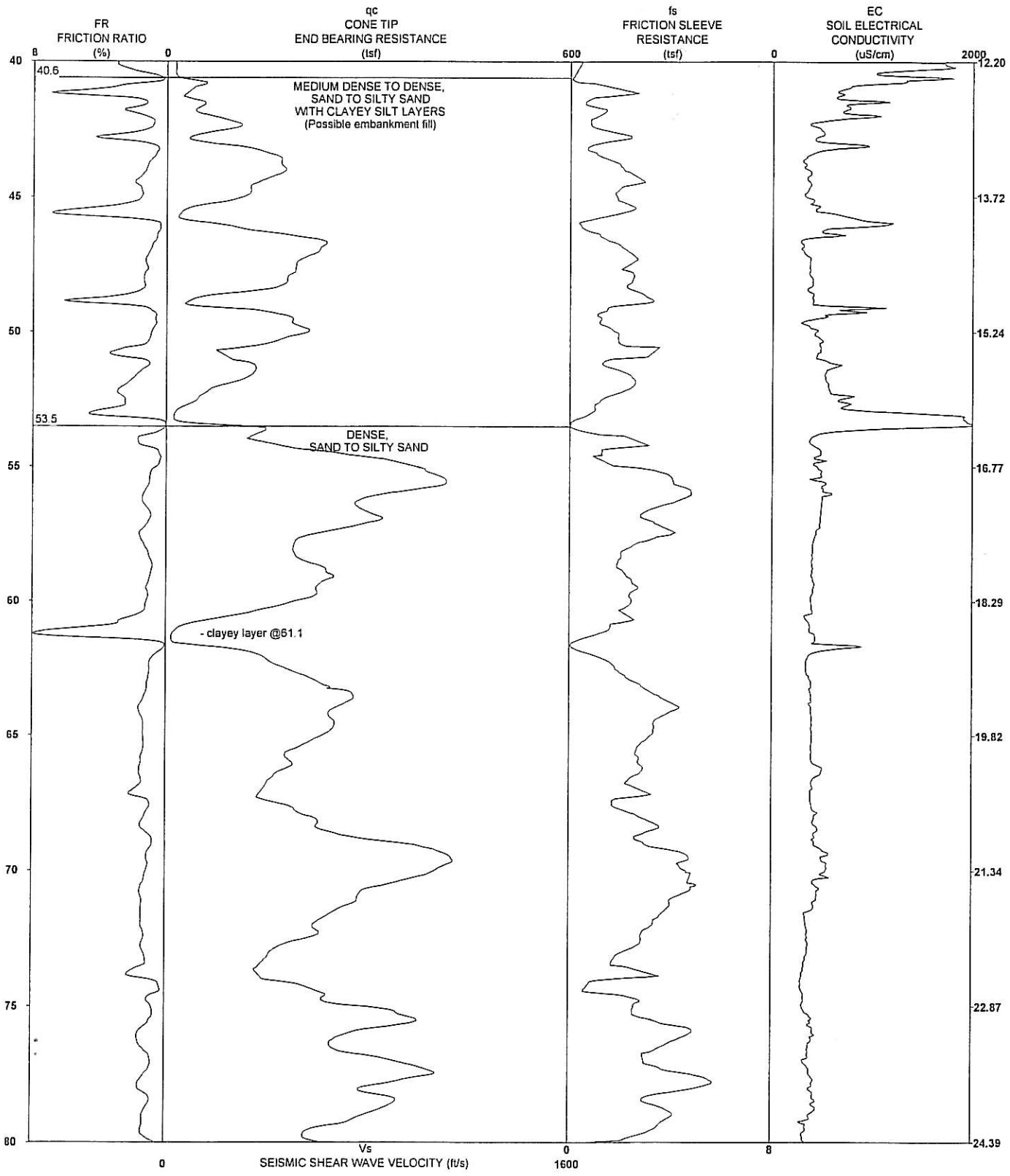
Latitude: 0.00000 Longitude: 0.00000

PROJECT NAME:Ameren UE Rush Island Levee Inventory
PROJECT NUMBER:09-110-090

STRATIGRAPHICS

R1 DATE:8/27/2009 TIME:3:19 PM
SOUNDING NUMBER:CP-03

CPTU-EC-S LOG WITH LITHOLOGIC EVALUATION CP03



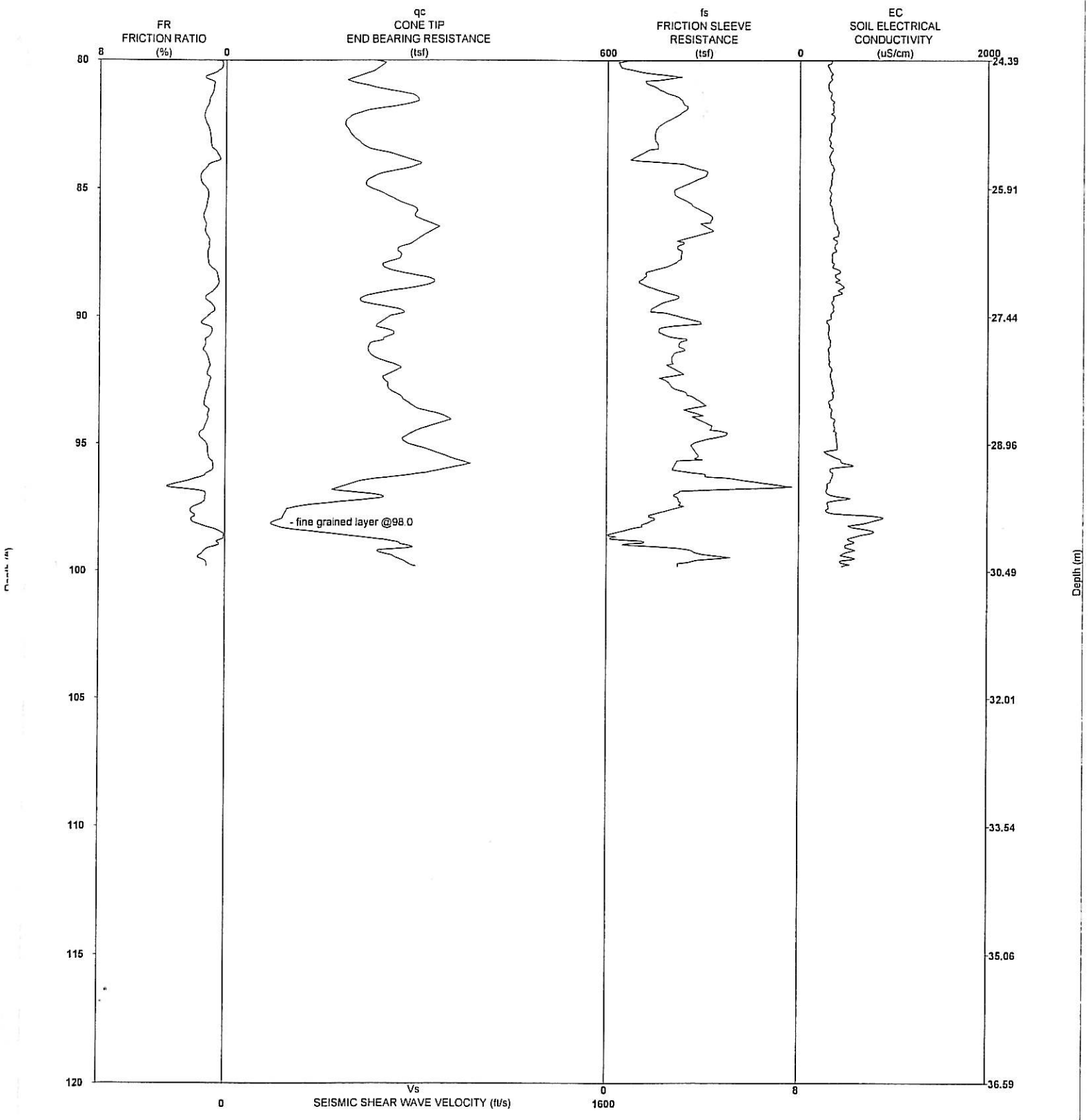
Latitude: 0.00000 Longitude: 0.00000

PROJECT NAME:Ameren UE Rush Island Levee Inventory
PROJECT NUMBER:09-110-090

STRATIGRAPHICS

R1 DATE:8/27/2009 TIME:3:19 PM
SOUNDING NUMBER:CP-03

CPTU-EC-S LOG WITH LITHOLOGIC EVALUATION CP03



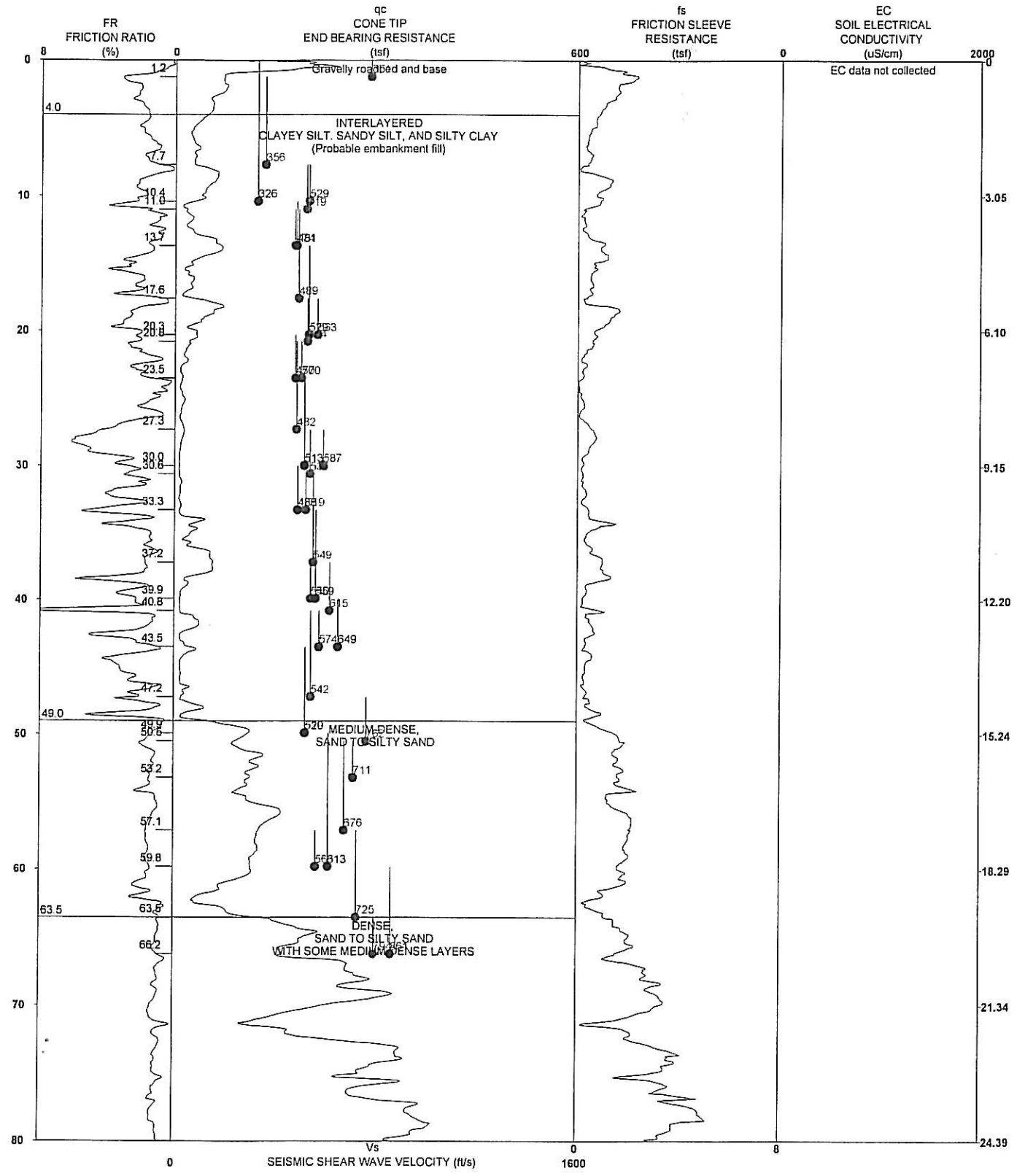
Latitude: 0.00000 Longitude: 0.00000

PROJECT NAME:Ameren UE Rush Island Levee Inventory
PROJECT NUMBER:09-110-090

STRATIGRAPHICS

R1 DATE:8/27/2009 TIME:3:19 PM
SOUNDING NUMBER:CP-03

CPTU-S LOG WITH LITHOLOGIC EVALUATION CP04



0 - 1600 ft/sec True Shear Wave Velocity
0 - 1600 ft/sec Pseudo Interval Receiver 1
0 - 1600 ft/sec Pseudo Interval Receiver 2

Latitude: 38.11862 Longitude: -90.25739

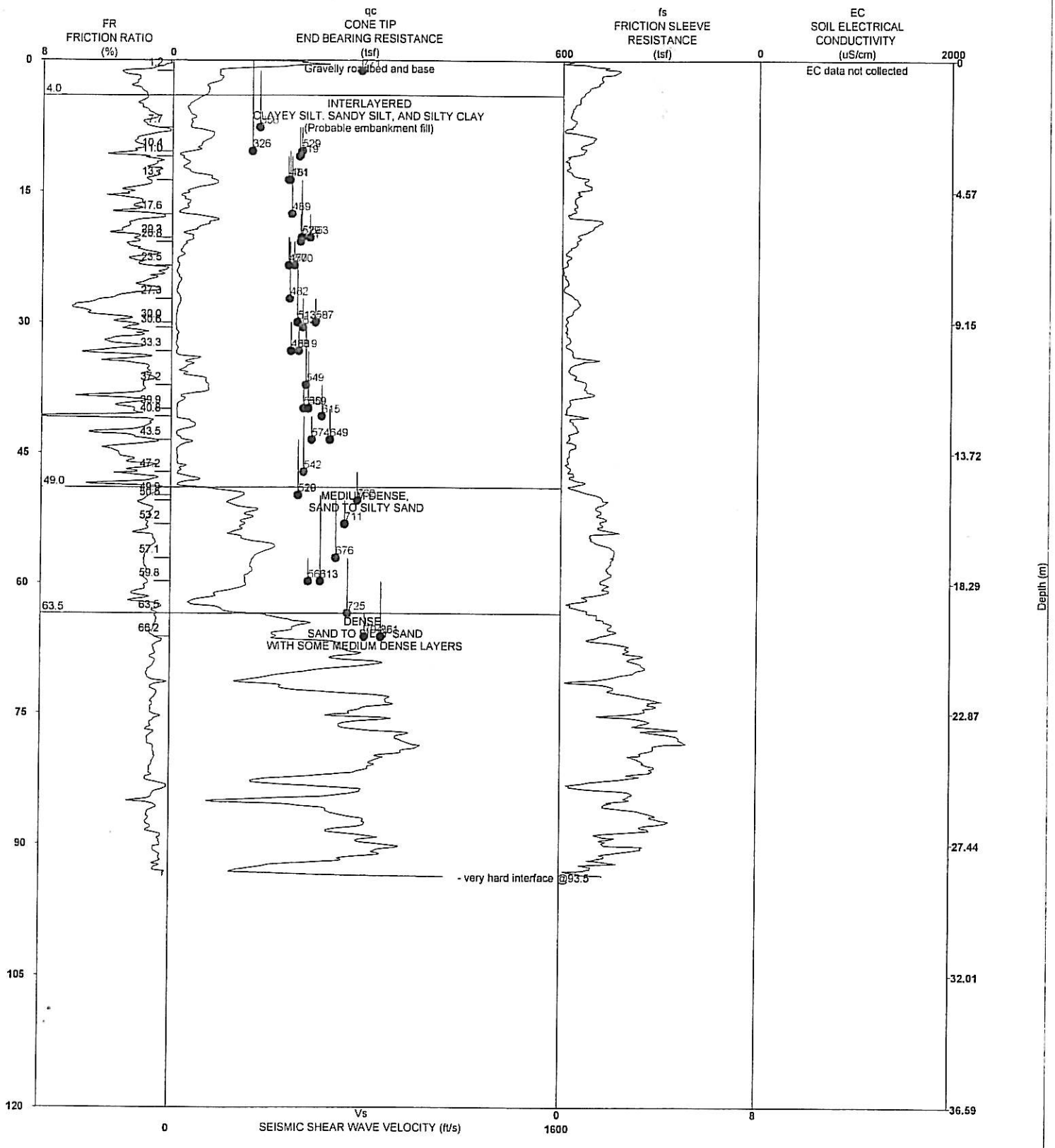
PROJECT NAME:Ameren UE Rush Island Levee Inventory
PROJECT NUMBER:09-110-090

STRATIGRAPHICS

R1 DATE:8/27/2009 TIME:11:42 AM
SOUNDING NUMBER:CP-04

CP04

CPTU-S LOG WITH LITHOLOGIC EVALUATION CP04



Latitude: 38.11862 Longitude: -90.25739

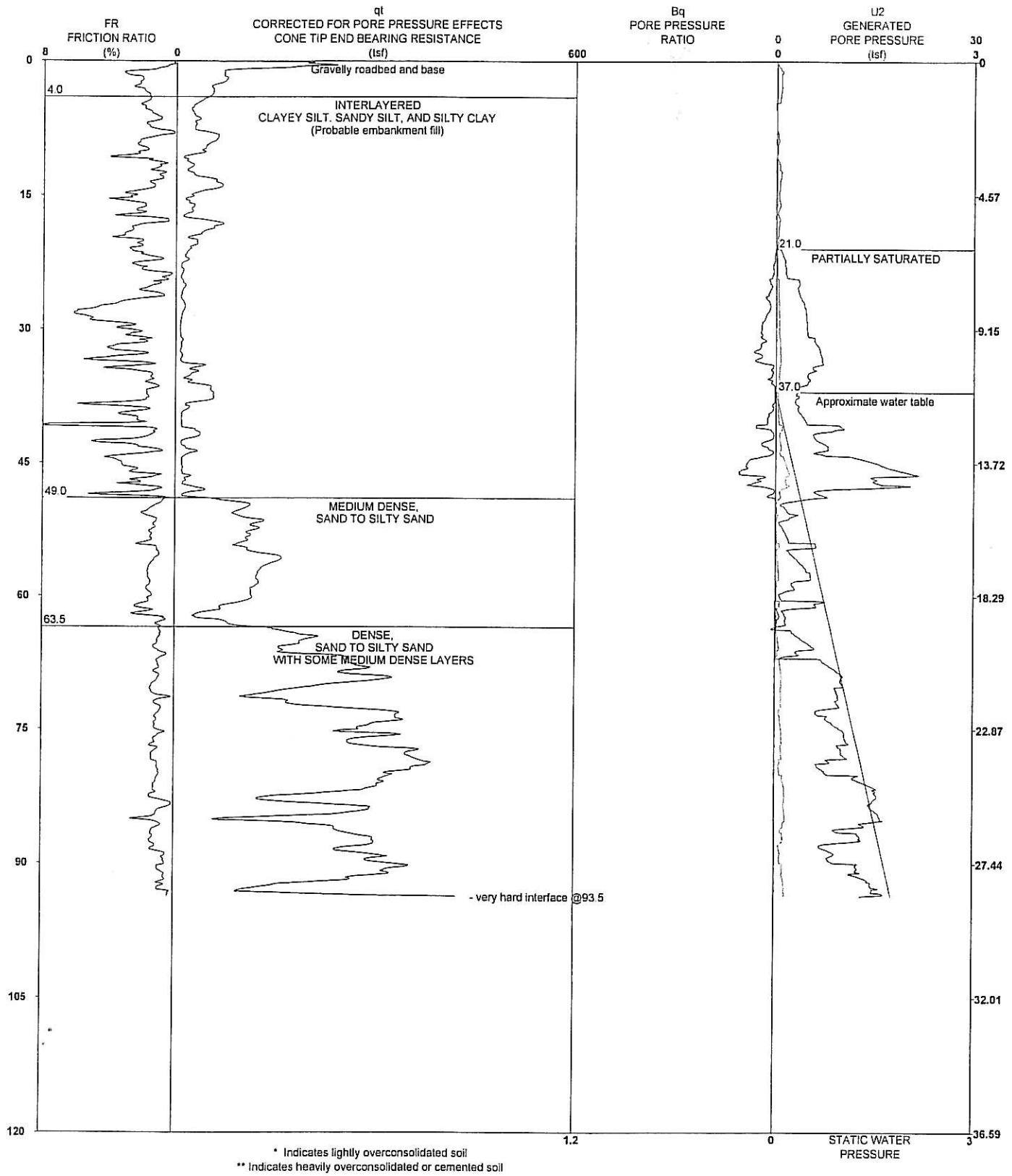
PROJECT NAME:Ameren UE Rush Island Levee Inventory
PROJECT NUMBER:09-110-090

STRATIGRAPHICS

R1 DATE:8/27/2009 TIME:11:42 AM
SOUNDING NUMBER:CP-04

CP04

CPTU-S LOG WITH LITHOLOGIC EVALUATION CP04



* Indicates lightly overconsolidated soil
** Indicates heavily overconsolidated or cemented soil

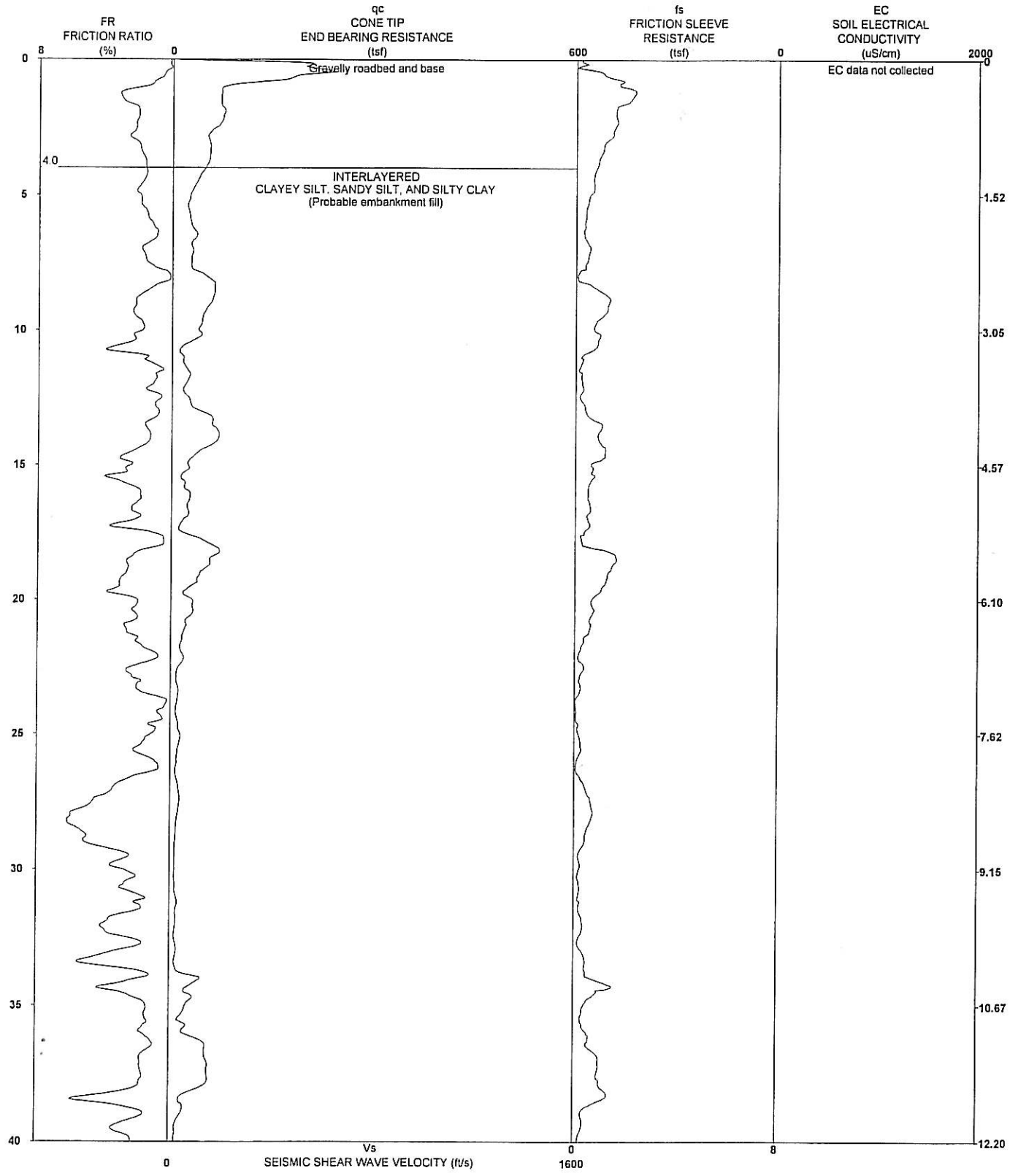
Latitude: 38.11862 Longitude: -90.25739

PROJECT NAME:Ameren UE Rush Island Levee Inventory
PROJECT NUMBER:09-110-090

STRATIGRAPHICS

R1 DATE:8/27/2009 TIME:11:42 AM
SOUNDING NUMBER:CP-04

CPTU-S LOG WITH LITHOLOGIC EVALUATION CP04



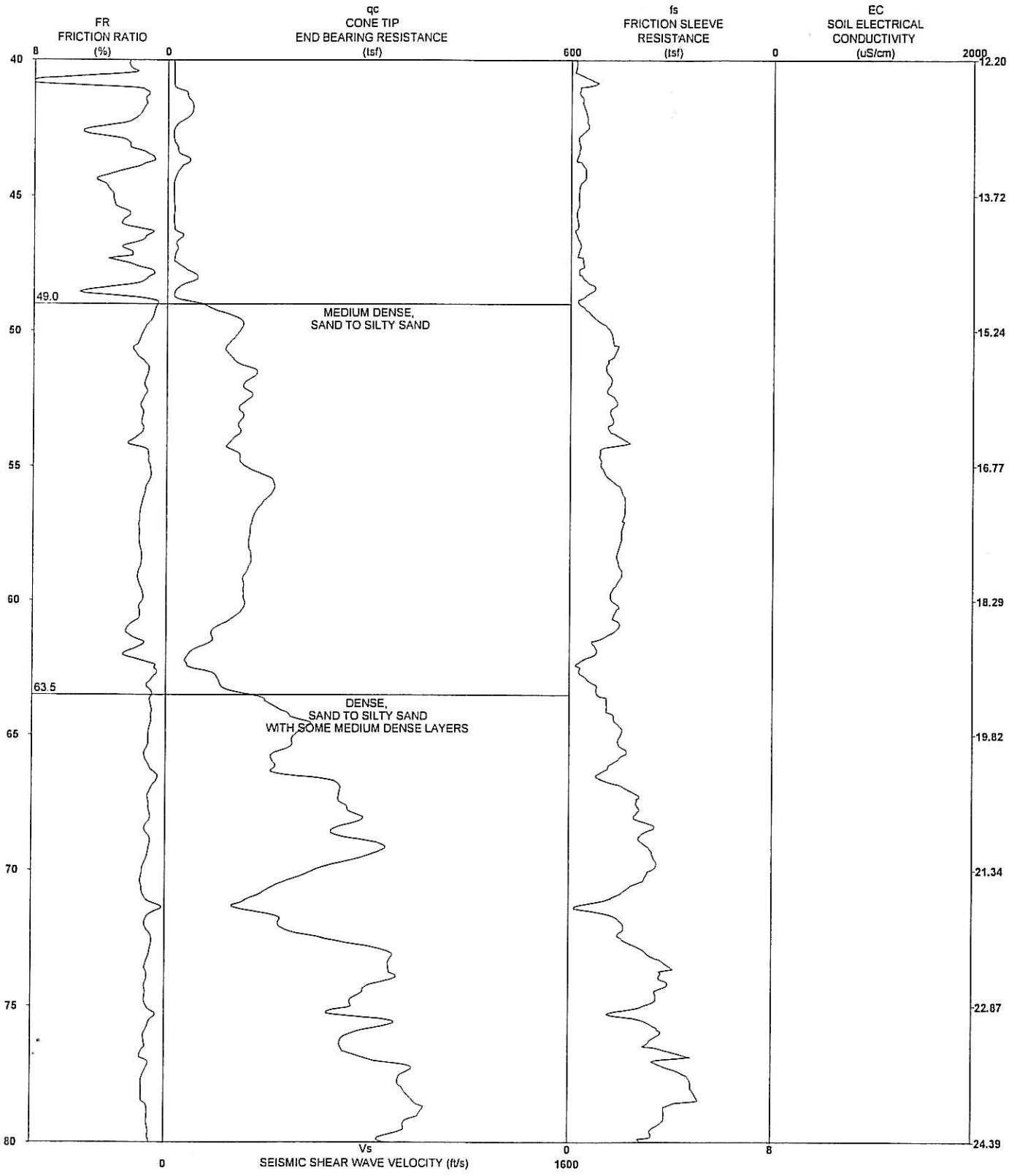
Latitude: 38.11862 Longitude: -90.25739

PROJECT NAME:Ameren UE Rush Island Levee Inventory
PROJECT NUMBER:09-110-090

STRATIGRAPHICS

R1 DATE:8/27/2009 TIME:11:42 AM
SOUNDING NUMBER:CP-04

CPTU-S LOG WITH LITHOLOGIC EVALUATION CP04



Latitude: 38.11862 Longitude: -90.25739

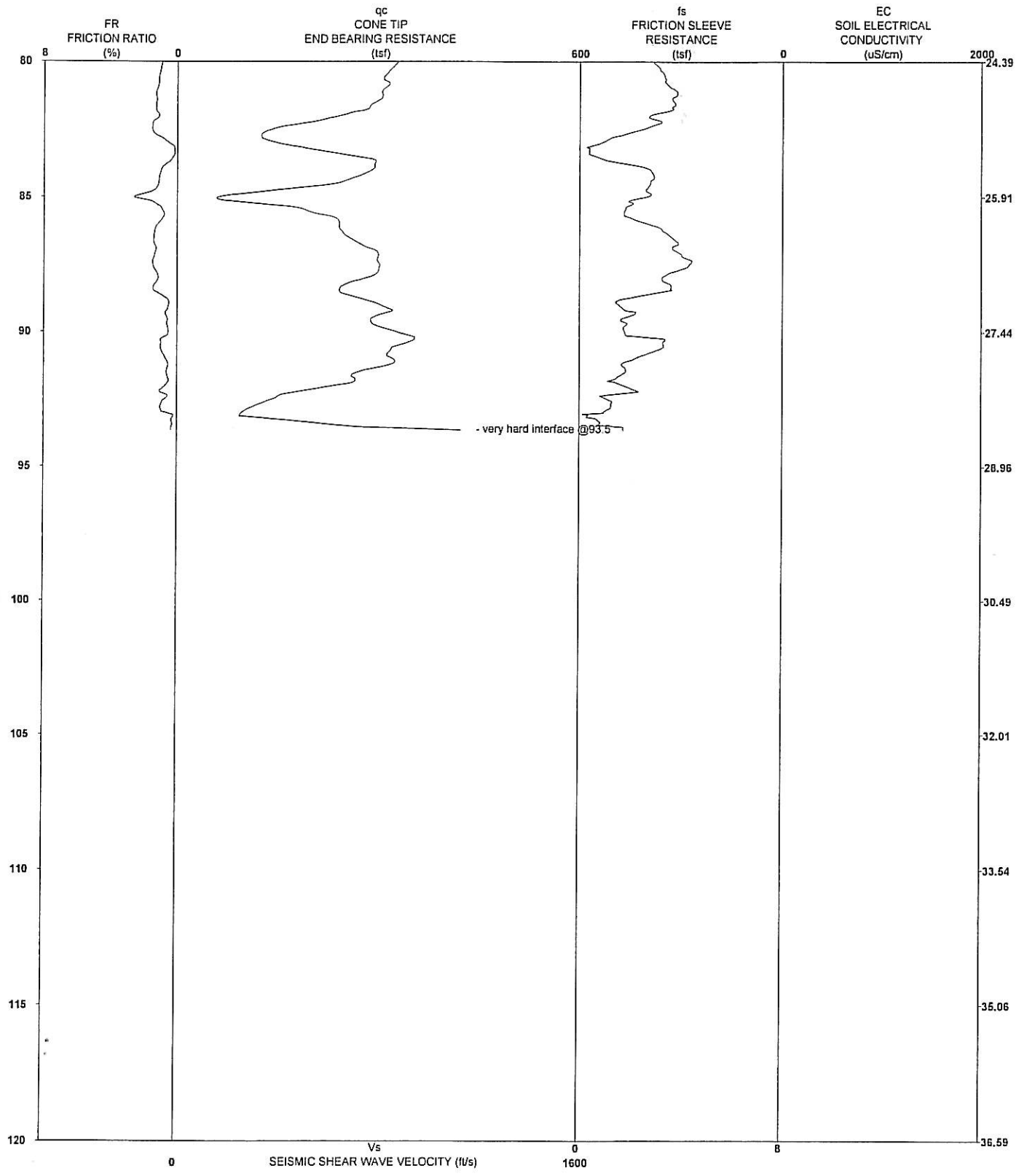
PROJECT NAME:Ameren UE Rush Island Levee Inventory
PROJECT NUMBER:09-110-090

STRATIGRAPHICS

R1 DATE:8/27/2009 TIME:11:42 AM
SOUNDING NUMBER:CP-04

CP04

CPTU-S LOG WITH LITHOLOGIC EVALUATION CP04



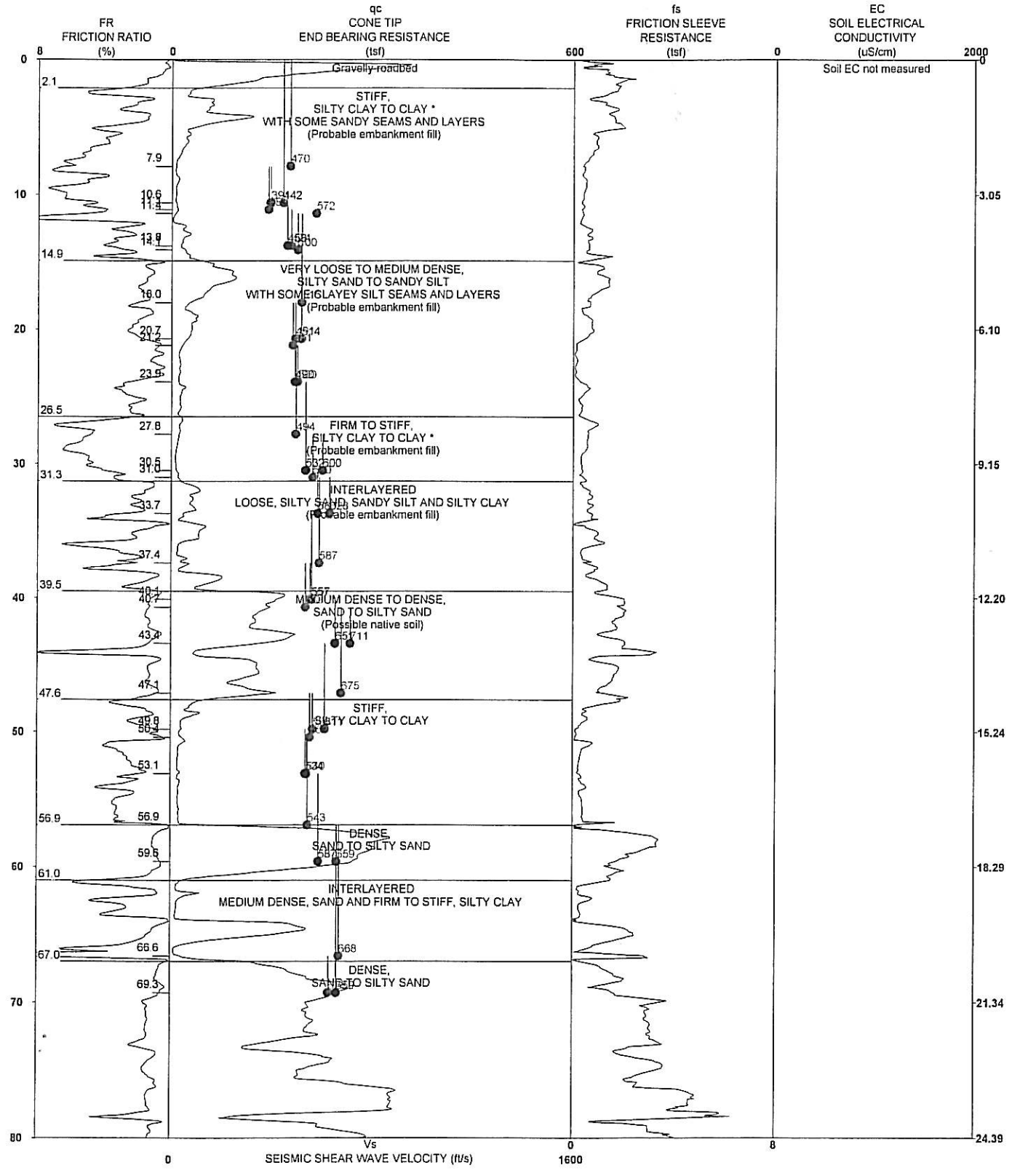
Latitude: 38.11862 Longitude: -90.25739

PROJECT NAME:Ameren UE Rush Island Levee Inventory
PROJECT NUMBER:09-110-090

STRATIGRAPHICS

R1 DATE:8/27/2009 TIME:11:42 AM
SOUNDING NUMBER:CP-04

CPTU-S LOG WITH LITHOLOGIC EVALUATION CP05



- 0 - 1600 ft/sec True Shear Wave Velocity
- 0 - 1600 ft/sec Pseudo Interval Receiver 1
- 0 - 1600 ft/sec Pseudo Interval Receiver 2

Latitude: 38.12255 Longitude: -90.26122

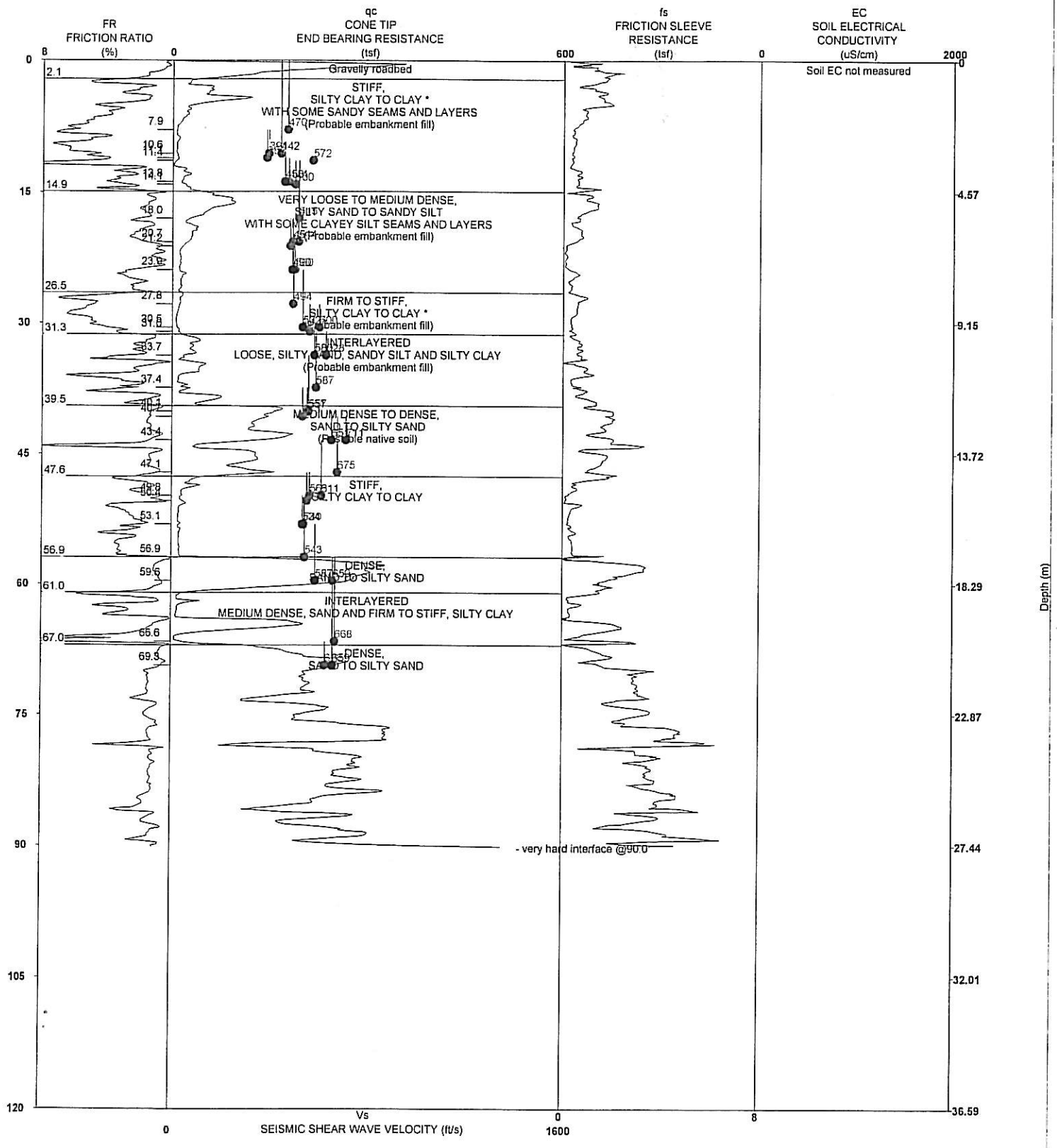
PROJECT NAME:Ameren UE Rush Island Levee Inventory
PROJECT NUMBER:09-110-090

STRATIGRAPHICS

R1 DATE:8/27/2009 TIME:9:12 AM
SOUNDING NUMBER:CP-05

CP05

CPTU-S LOG WITH LITHOLOGIC EVALUATION CP05



- 0 - 1600 ft/sec True Shear Wave Velocity
- 0 - 1600 ft/sec Pseudo Interval Receiver 1
- 0 - 1600 ft/sec Pseudo Interval Receiver 2

Latitude: 38.12255 Longitude: -90.26122

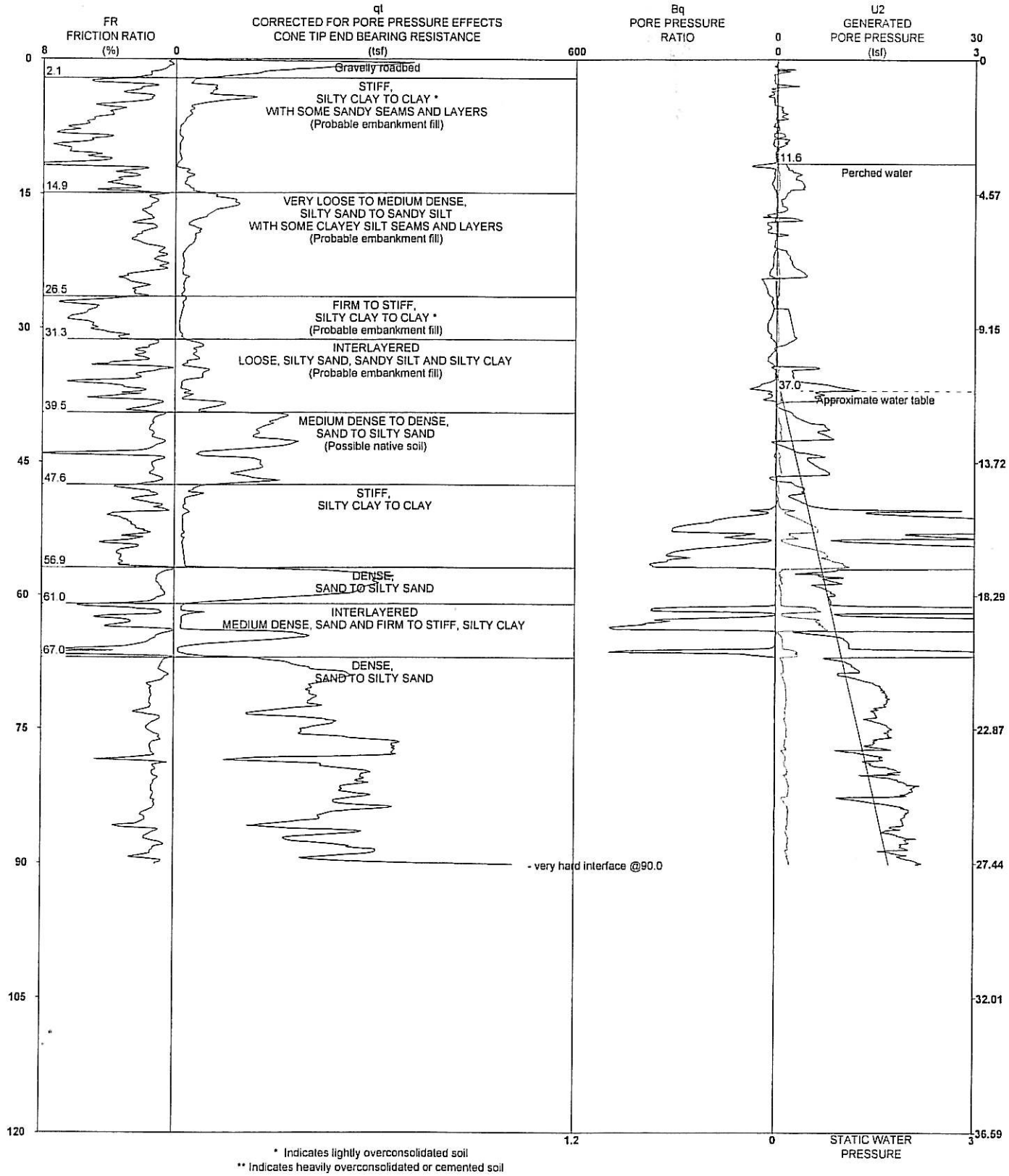
PROJECT NAME:Ameren UE Rush Island Levee Inventory
PROJECT NUMBER:09-110-090

STRATIGRAPHICS

R1 DATE:8/27/2009 TIME:9:12 AM
SOUNDING NUMBER:CP-05

CP05

CPTU-S LOG WITH LITHOLOGIC EVALUATION CP05



* Indicates lightly overconsolidated soil
** Indicates heavily overconsolidated or cemented soil

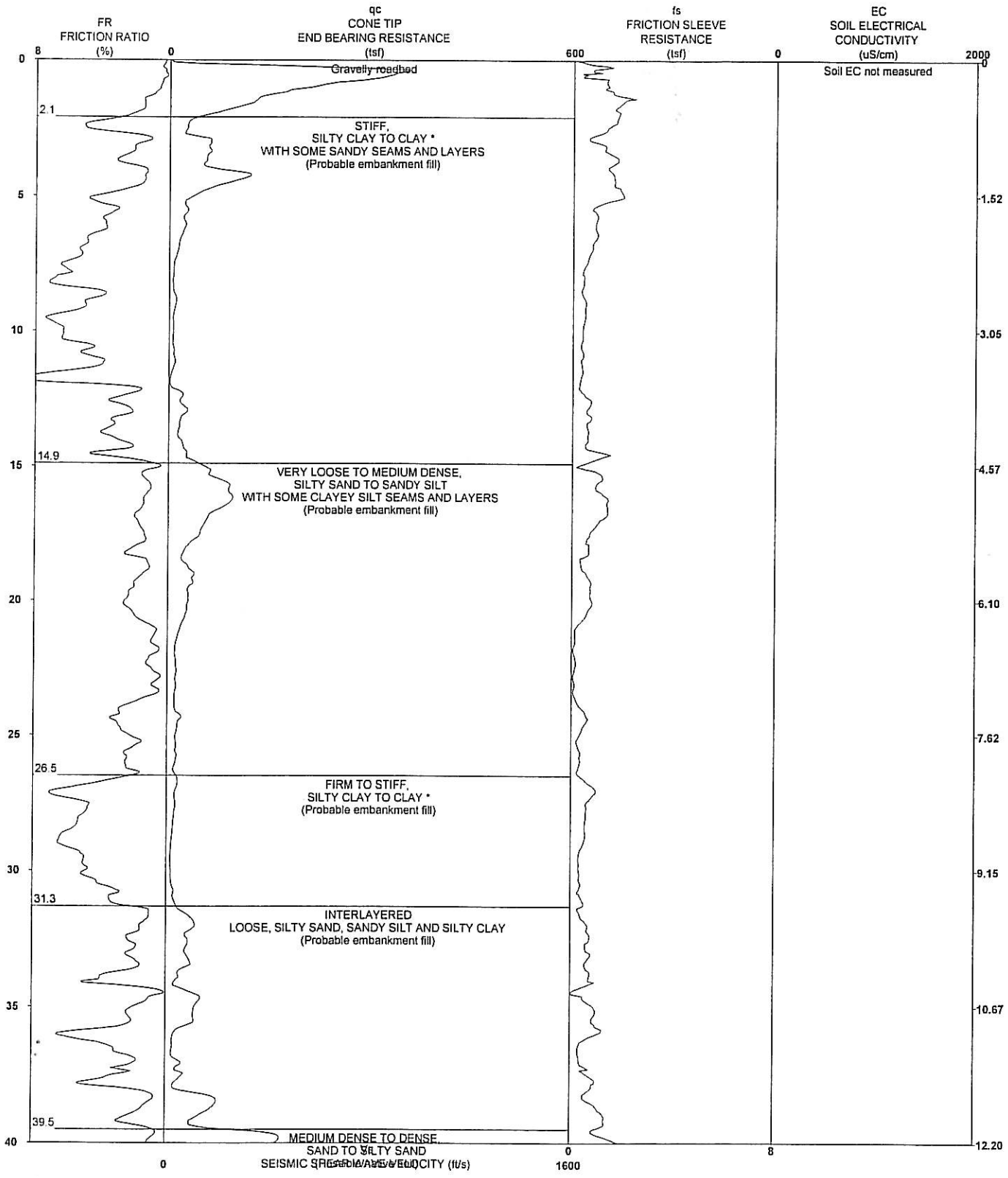
Latitude: 38.12255 Longitude: -90.26122

PROJECT NAME:Ameren UE Rush Island Levee Inventory
PROJECT NUMBER:09-110-090

STRATIGRAPHICS

R1 DATE:8/27/2009 TIME:9:12 AM
SOUNDING NUMBER:CP-05

CPTU-S LOG WITH LITHOLOGIC EVALUATION CP05



Latitude: 38.12255 Longitude: -90.26122

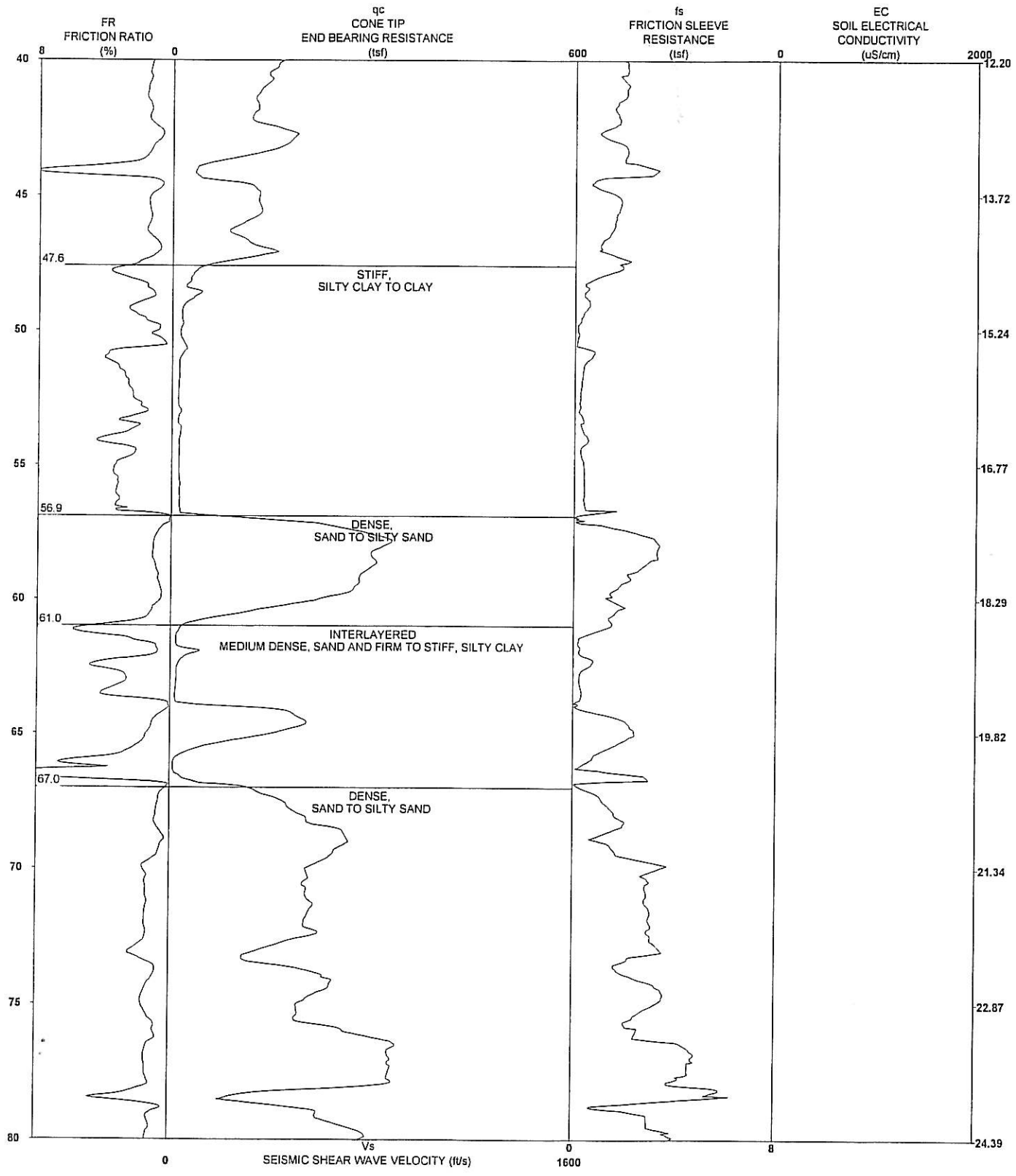
PROJECT NAME:Ameren UE Rush Island Levee Inventory
PROJECT NUMBER:09-110-090

STRATIGRAPHICS

R1 DATE:8/27/2009 TIME:9:12 AM
SOUNDING NUMBER:CP-05

CP05

CPTU-S LOG WITH LITHOLOGIC EVALUATION CP05



Latitude: 38.12255 Longitude: -90.26122

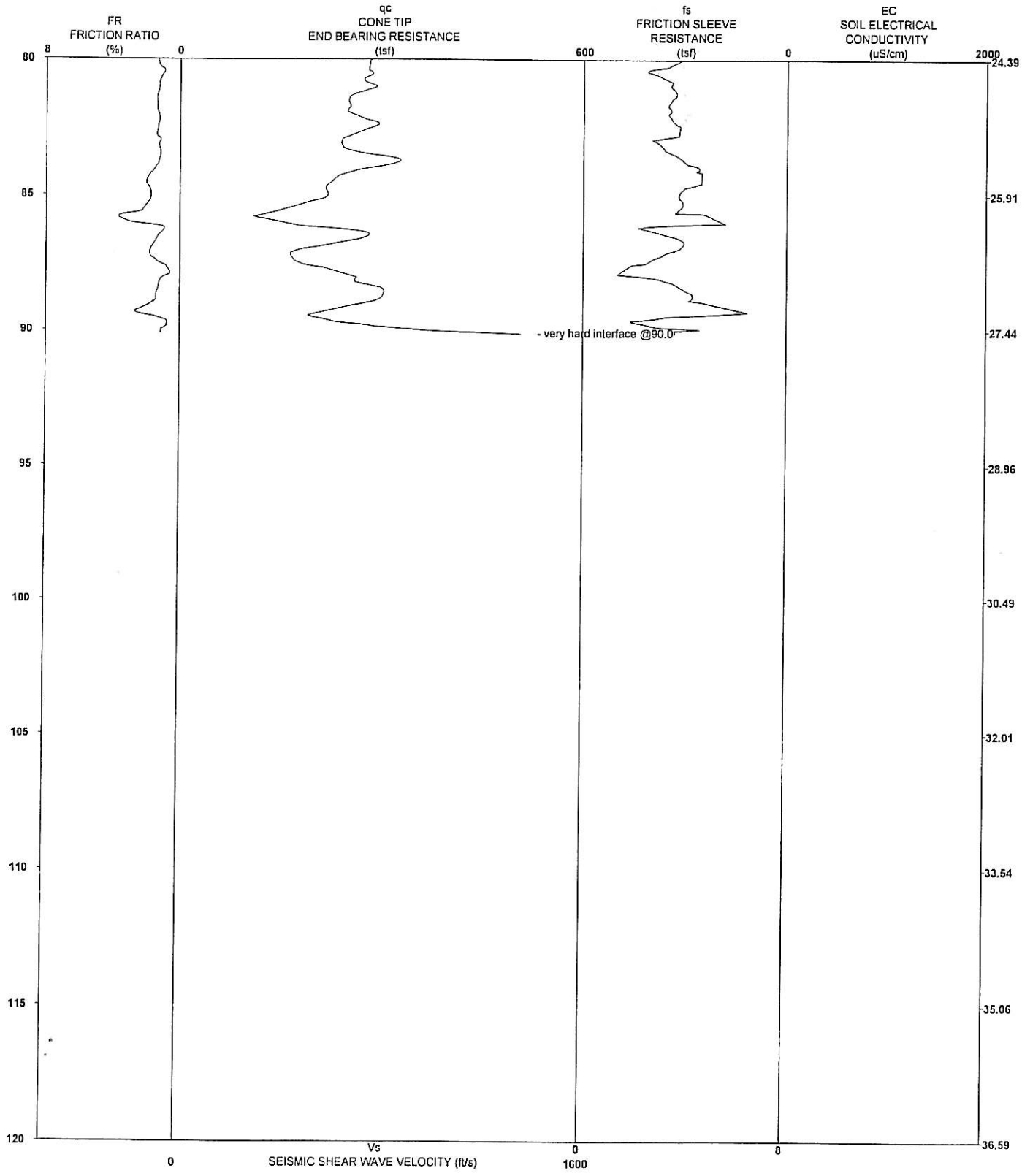
PROJECT NAME:Ameren UE Rush Island Levee Inventory
PROJECT NUMBER:09-110-090

STRATIGRAPHICS

R1 DATE:8/27/2009 TIME:9:12 AM
SOUNDING NUMBER:CP-05

CP05

CPTU-S LOG WITH LITHOLOGIC EVALUATION CP05



Latitude: 38.12255 Longitude: -90.26122

PROJECT NAME:Ameren UE Rush Island Levee Inventory
PROJECT NUMBER:09-110-090

STRATIGRAPHICS

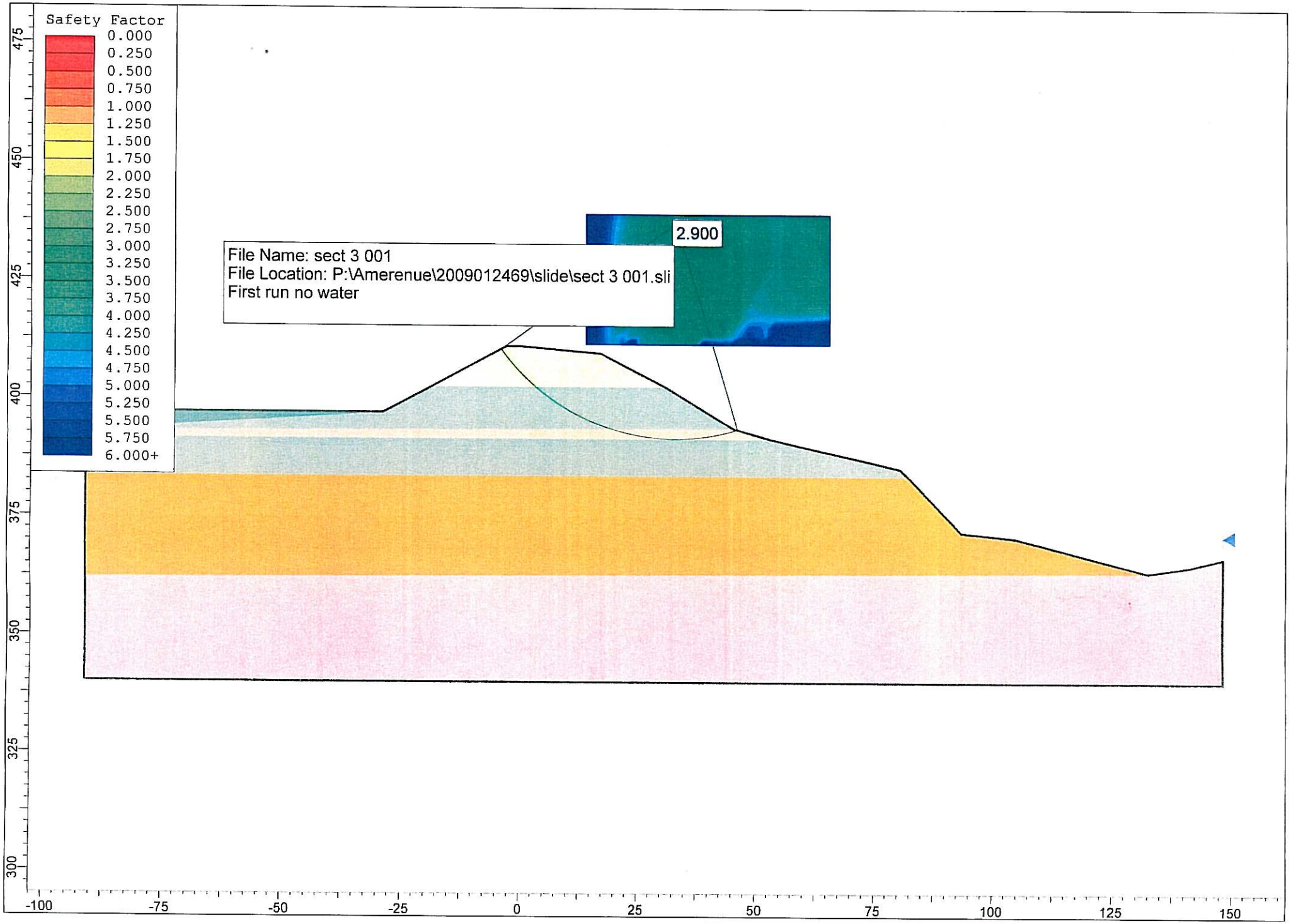
R1 DATE:8/27/2009 TIME:9:12 AM
SOUNDING NUMBER:CP-05

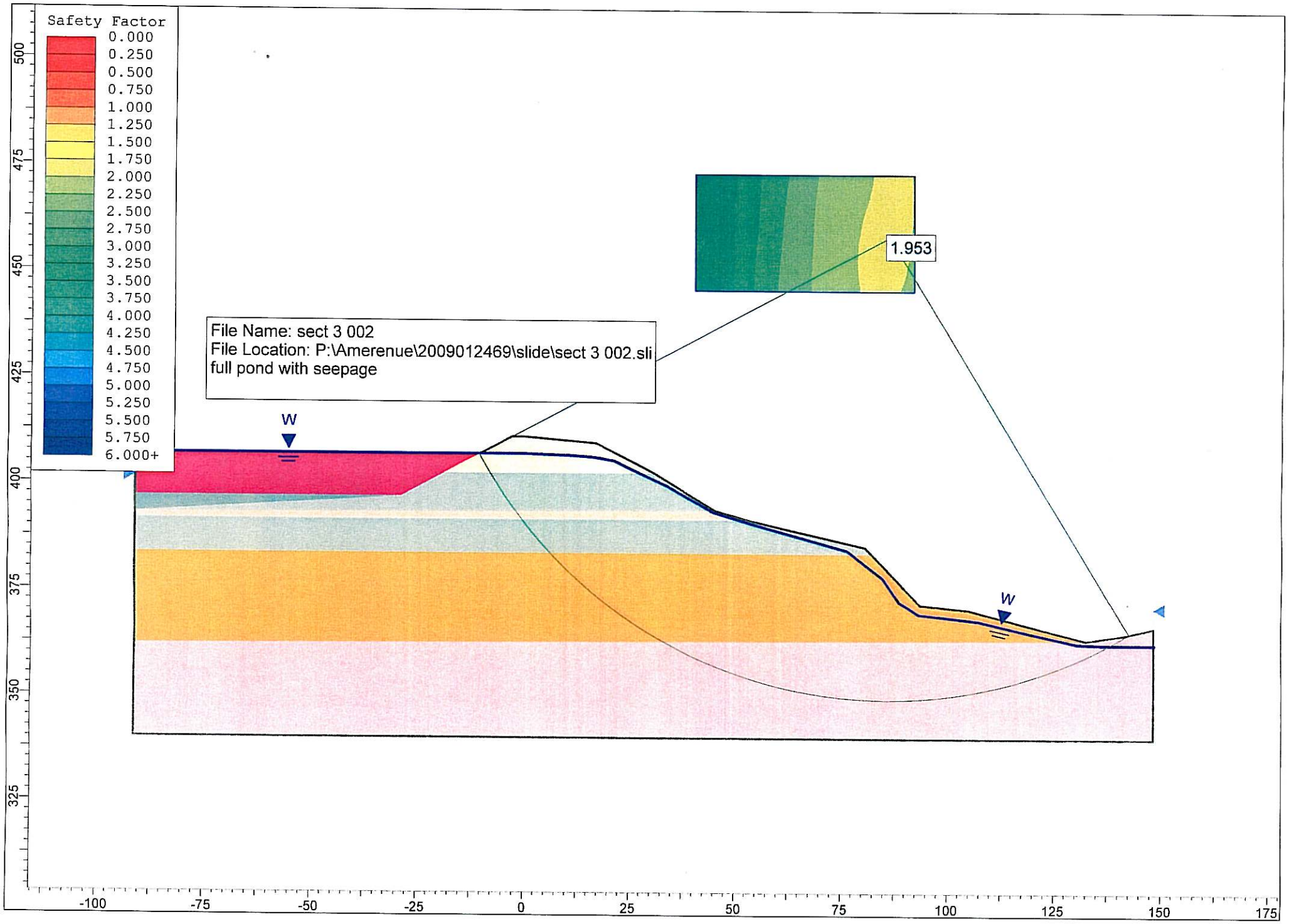
CP05

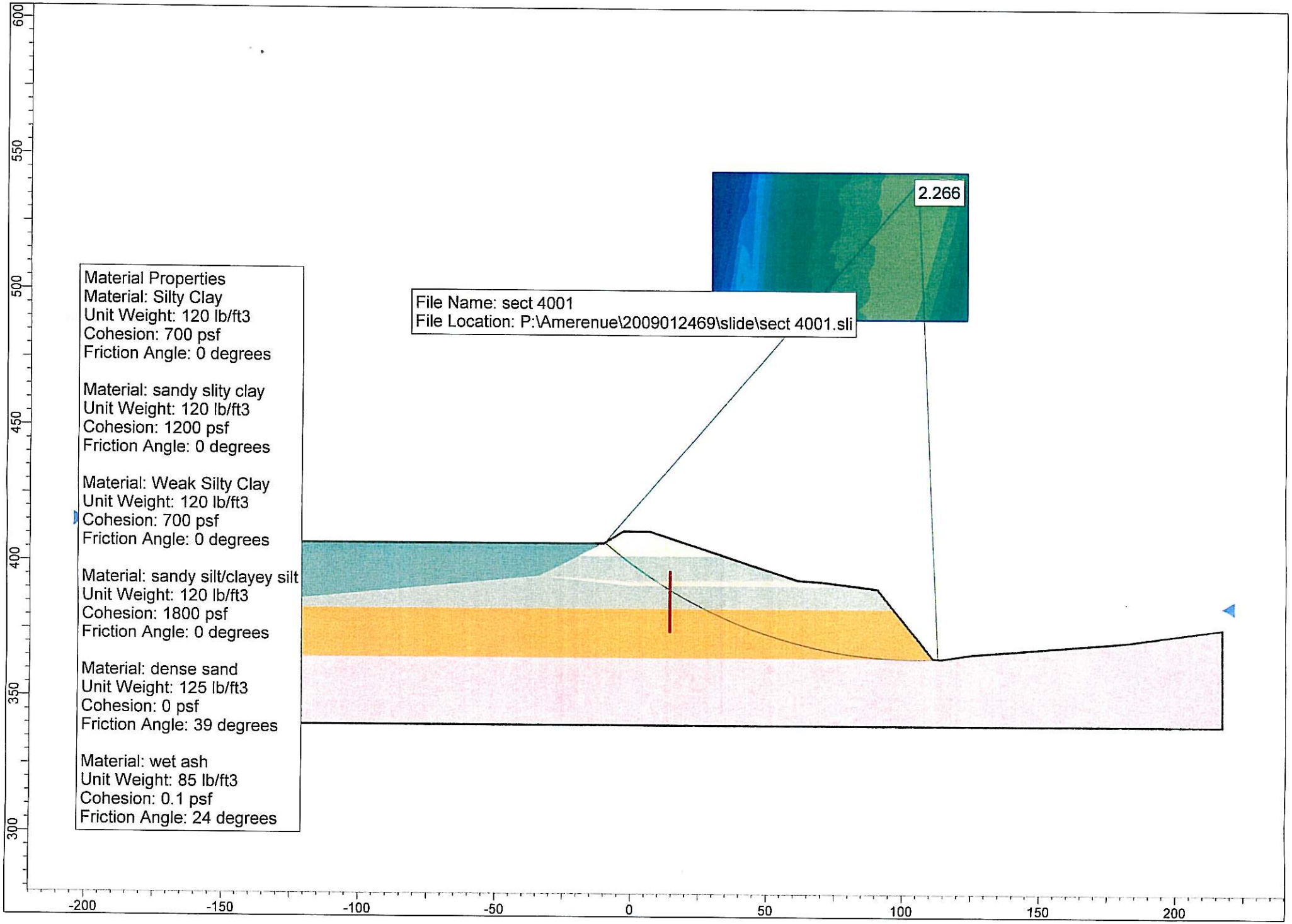
Slope Stability Analysis

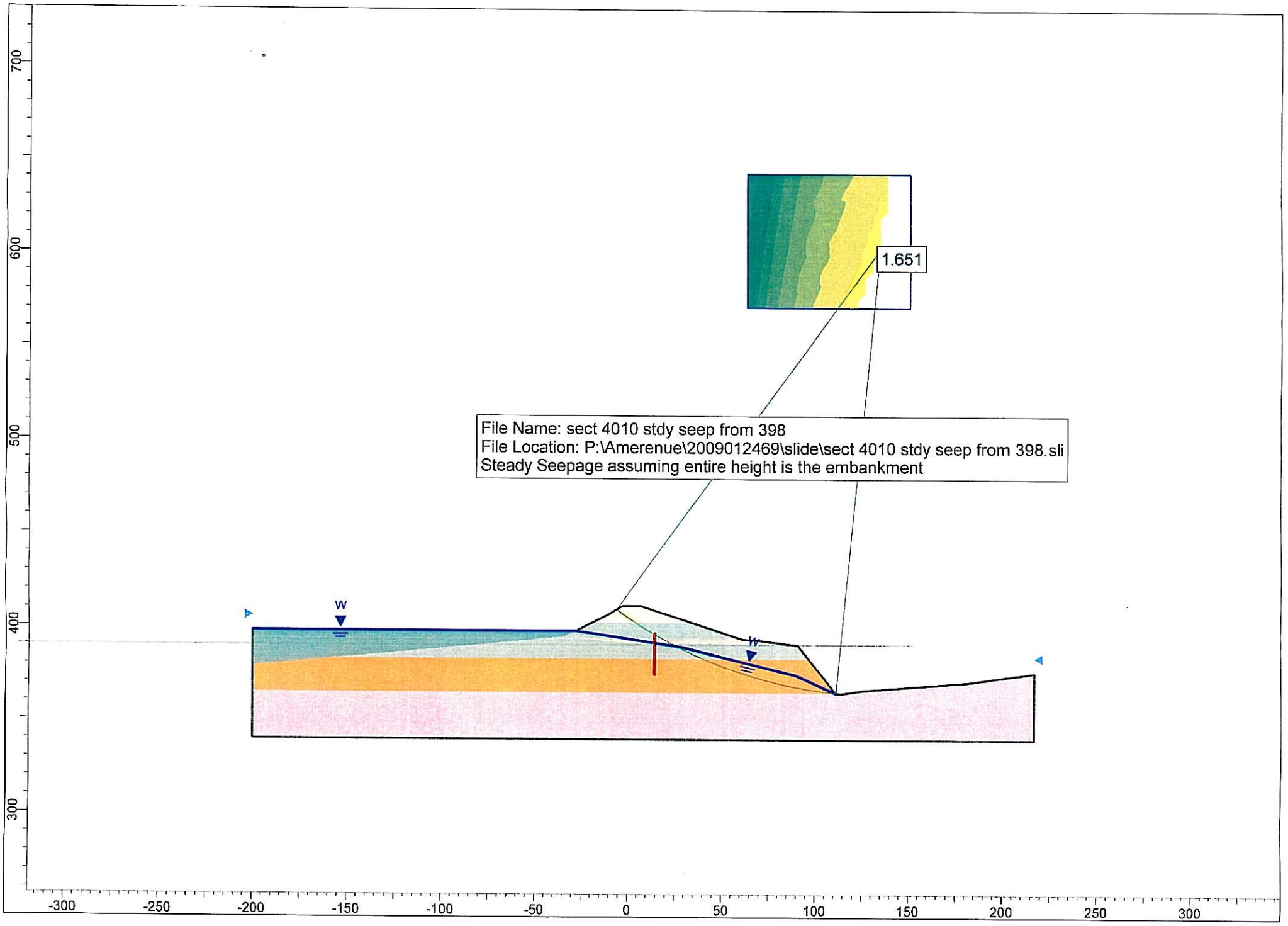
Rush Island Slope Stability Summary Sheet

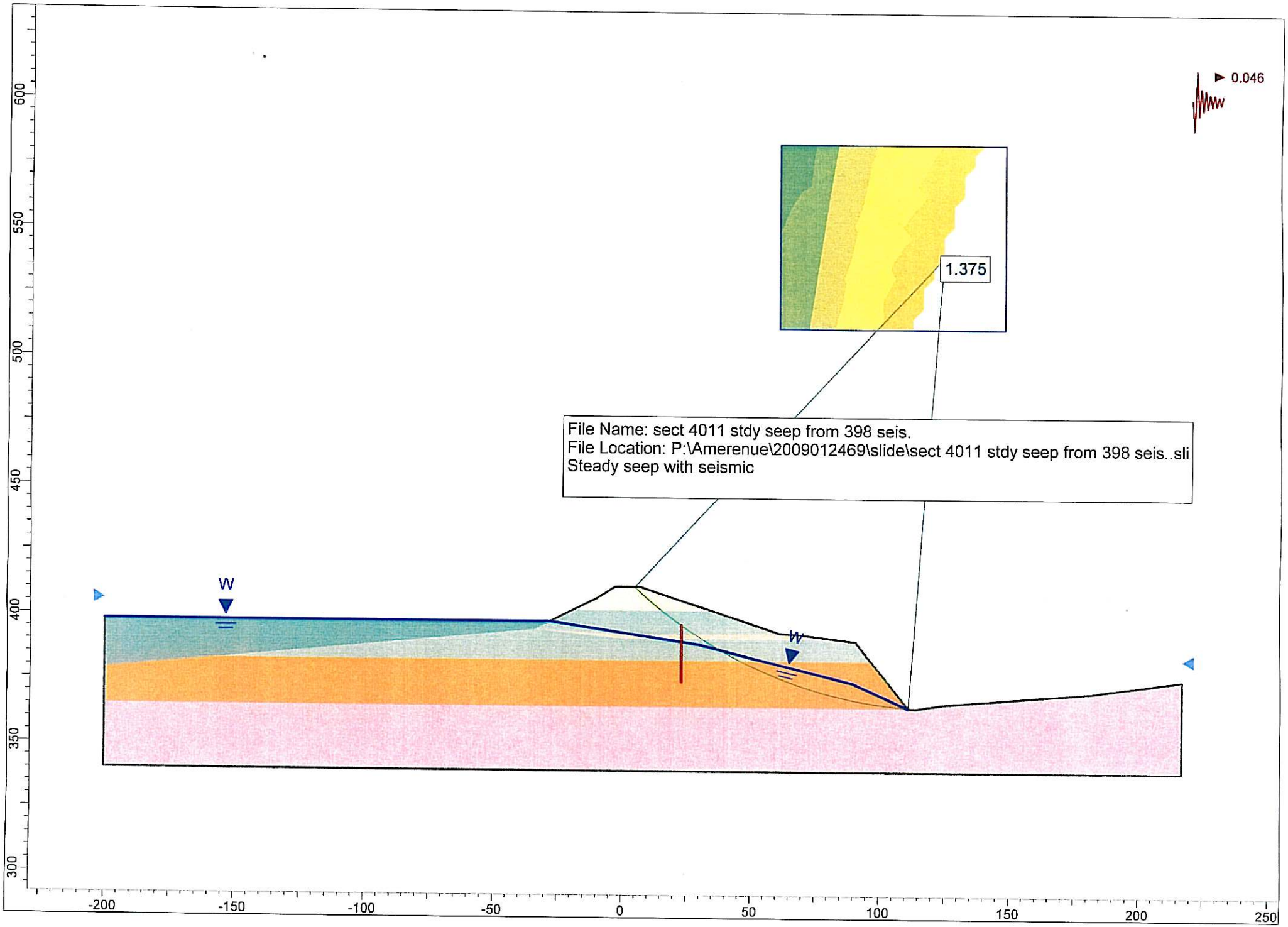
Section	Stress Phase	Seismic Force	Pool Elevation	Stored Ash	Toe Setback	Factor Safety	Req"d FS	File	
3	total	none	none	395		2.9		3001	
3	total	none	407	395		1.95		3002	
4	total	none	407	407		2.26	1.5	4001	
4	stdy seep	none	403	403		1.51	1.5	4012	normal pool
4	stdy seep	0.046	398	398		1.375	1.0	4011	
4	stdy seep	none	398	398		1.65	1.5	4010	
4	stdy seep	none	407	407		1.404	1.3	4013	max pool @ 407
4	stdy seep	0.046	403	403		1.31	1.0	4014	normal pool
7	total	none	407	407		1.731	1.5	7001	
7	stdy seep	none	398	398		1.711	1.5	7004	
7	stdy seep	0.046	398	398		1.49	1.0	7005	
7	stdy seep	none	407	407		1.41	1.5	7006	1.3 FS for max pool
7	stdy seep	none	403	403		1.54	1.5	7007	normal pool
7	stdy seep	0.046	403	403		1.34	1.0	7008	normal pool

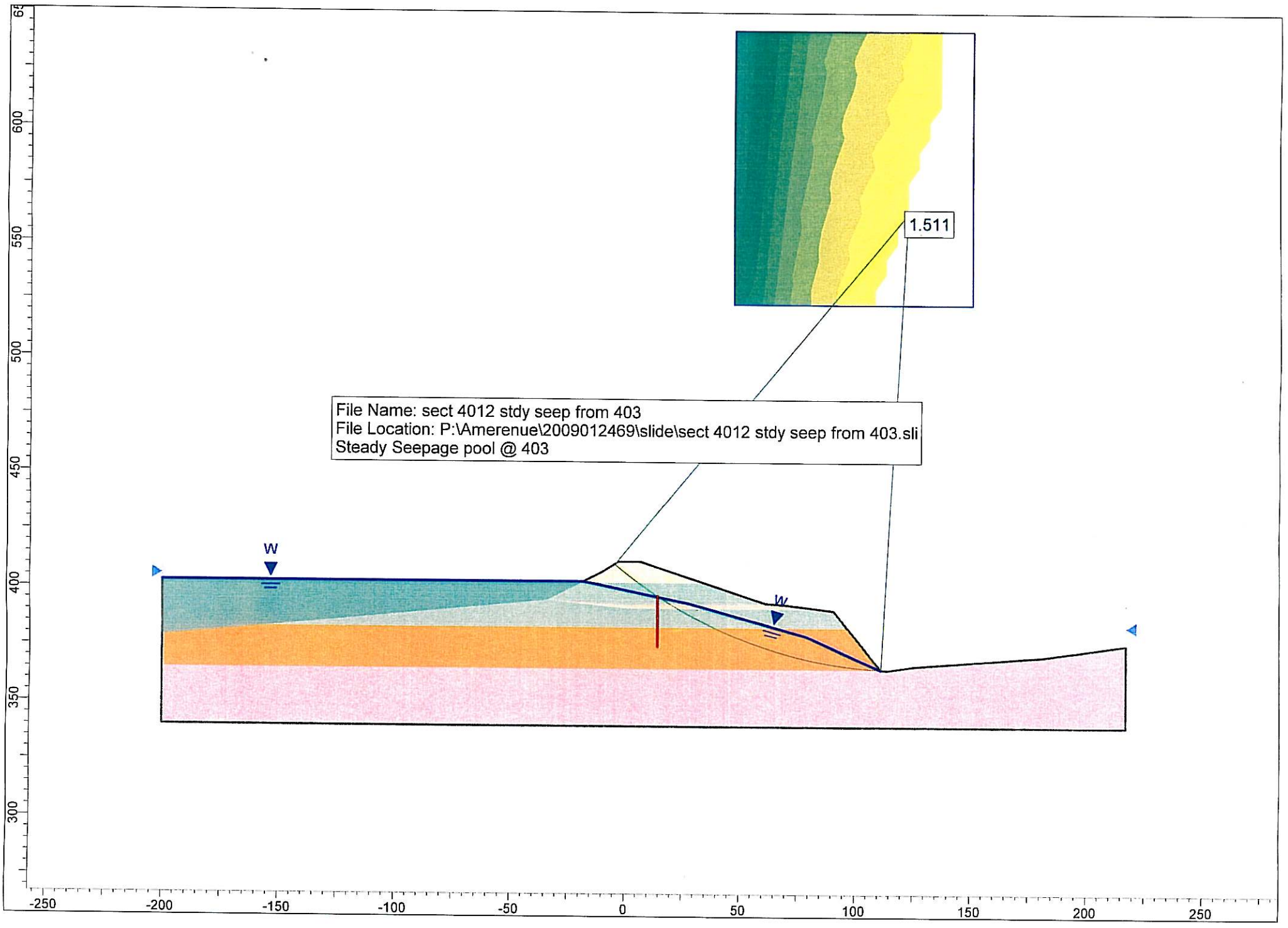

Safety Factor
0.000
0.250
0.500
0.750
1.000
1.250
1.500
1.750
2.000
2.250
2.500
2.750
3.000
3.250
3.500
3.750
4.000
4.250
4.500
4.750
5.000
5.250
5.500
5.750
6.000+
2.900
File Name: sect 3 001
File Location: P:\Amerenue\2009012469\slide\sect 3 001.sli
First run no water
475
450
425
400
375
350
325
300
-100
-75
-50
-25
0
25
50
75
100
125
150

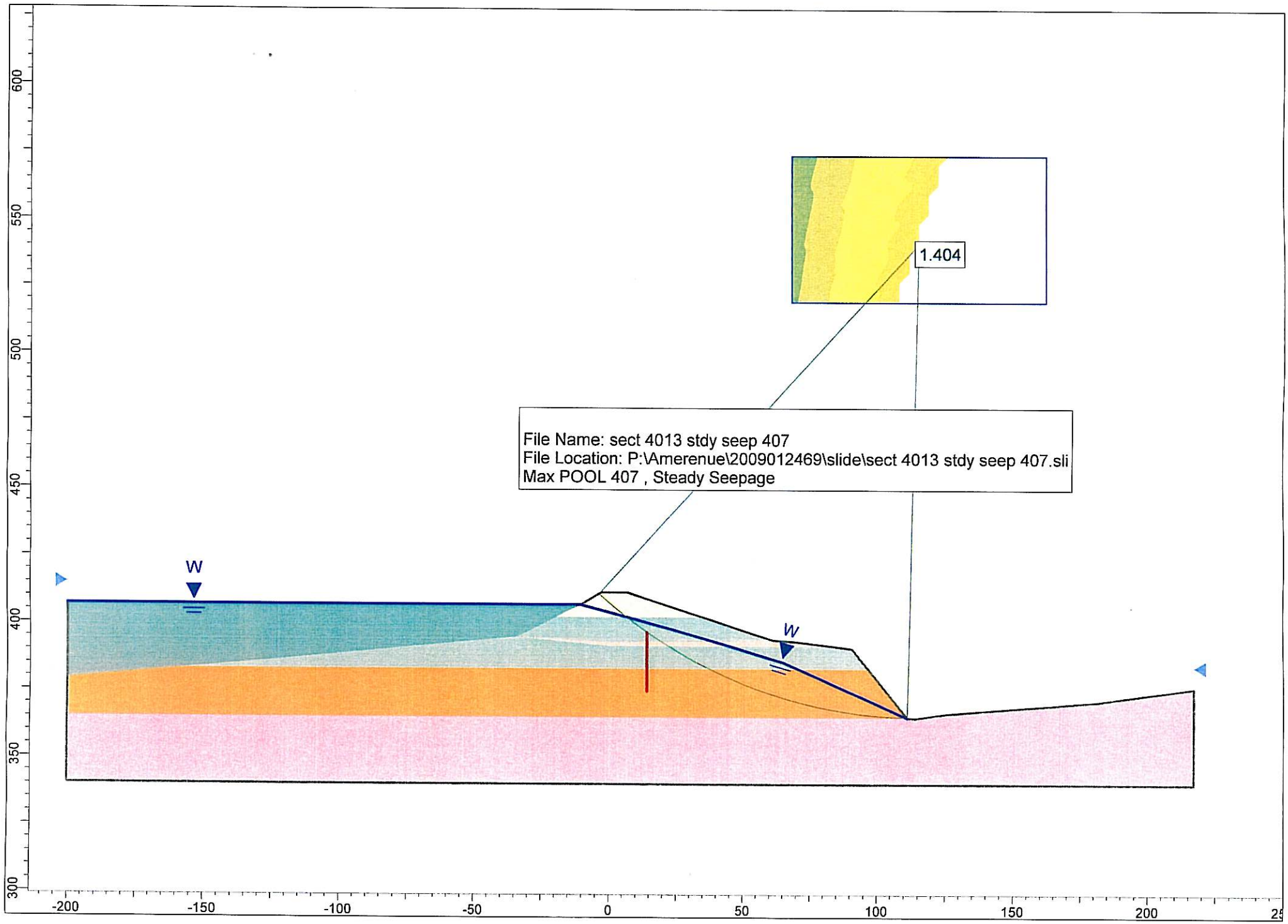

Safety Factor
0.000
0.250
0.500
0.750
1.000
1.250
1.500
1.750
2.000
2.250
2.500
2.750
3.000
3.250
3.500
3.750
4.000
4.250
4.500
4.750
5.000
5.250
5.500
5.750
6.000+
1.953
File Name: sect 3 002
File Location: P:\Amerenue\2009012469\slide\sect 3 002.sli
full pond with seepage
W
W
500
475
450
425
400
375
350
325
-100
-75
-50
-25
0
25
50
75
100
125
150
175

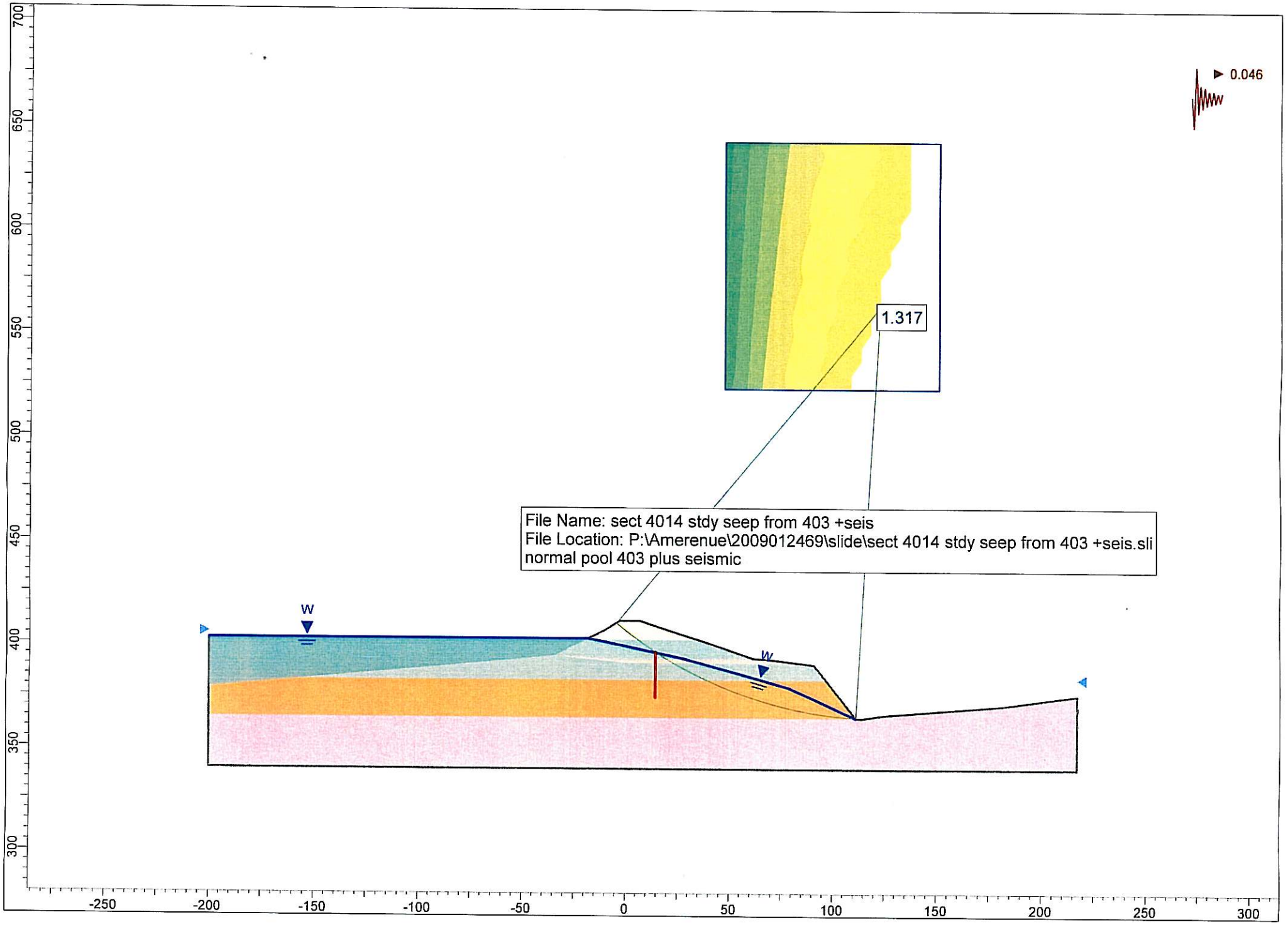

2.266
File Name: sect 4001
File Location: P:\Amerenue\2009012469\slide\sect 4001.sli
Material Properties
Material: Silty Clay
Unit Weight: 120 lb/ft3
Cohesion: 700 psf
Friction Angle: 0 degrees
Material: sandy slity clay
Unit Weight: 120 lb/ft3
Cohesion: 1200 psf
Friction Angle: 0 degrees
Material: Weak Silty Clay
Unit Weight: 120 lb/ft3
Cohesion: 700 psf
Friction Angle: 0 degrees
Material: sandy silt/clayey silt
Unit Weight: 120 lb/ft3
Cohesion: 1800 psf
Friction Angle: 0 degrees
Material: dense sand
Unit Weight: 125 lb/ft3
Cohesion: 0 psf
Friction Angle: 39 degrees
Material: wet ash
Unit Weight: 85 lb/ft3
Cohesion: 0.1 psf
Friction Angle: 24 degrees
600
550
500
450
400
350
300
-200
-150
-100
-50
0
50
100
150
200

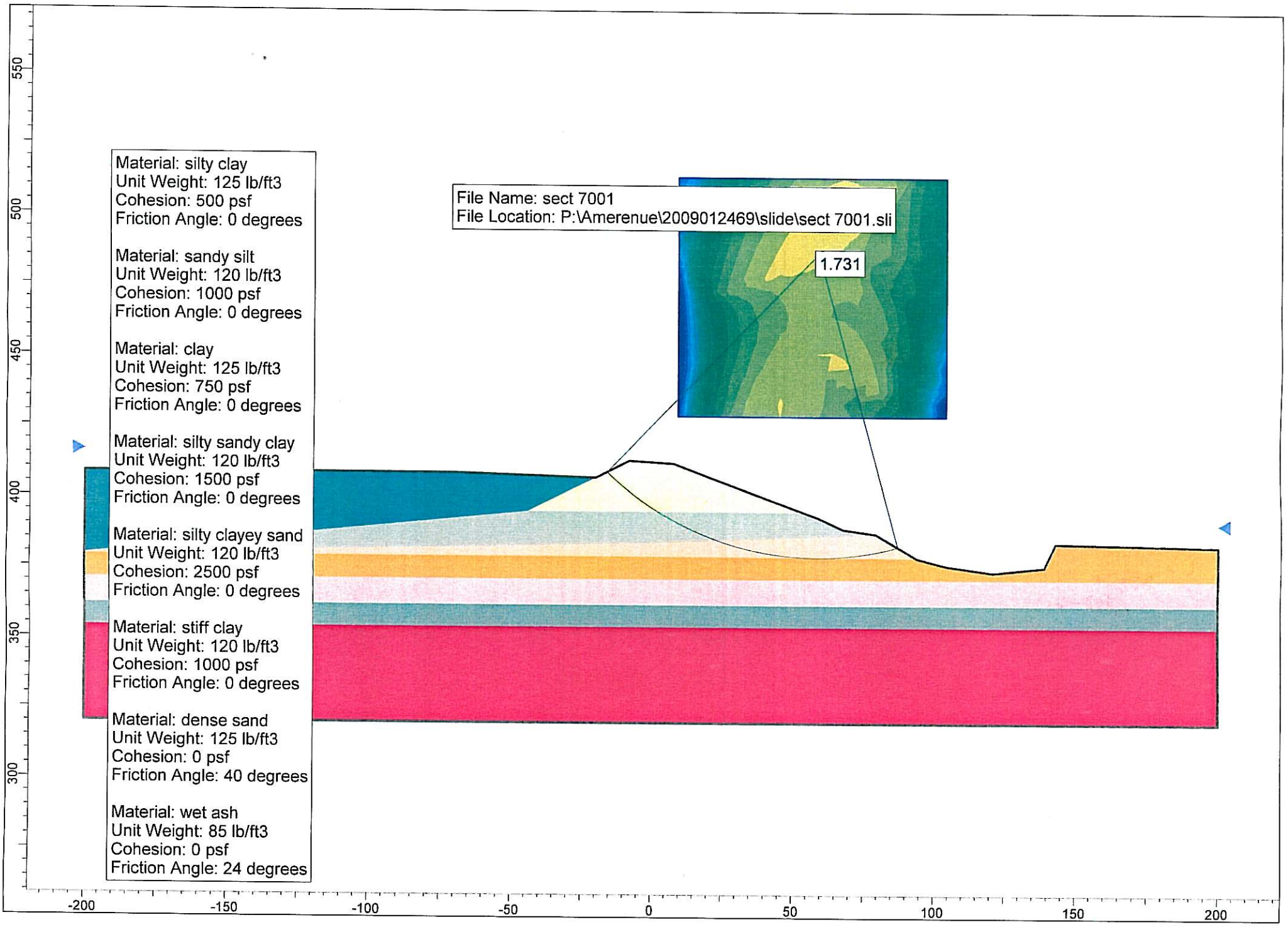

1.651
File Name: sect 4010 stdy seep from 398
File Location: P:\Amerenue\2009012469\slide\sect 4010 stdy seep from 398.sli
Steady Seepage assuming entire height is the embankment
W
W
700
600
500
400
300
-300
-250
-200
-150
-100
-50
0
50
100
150
200
250
300

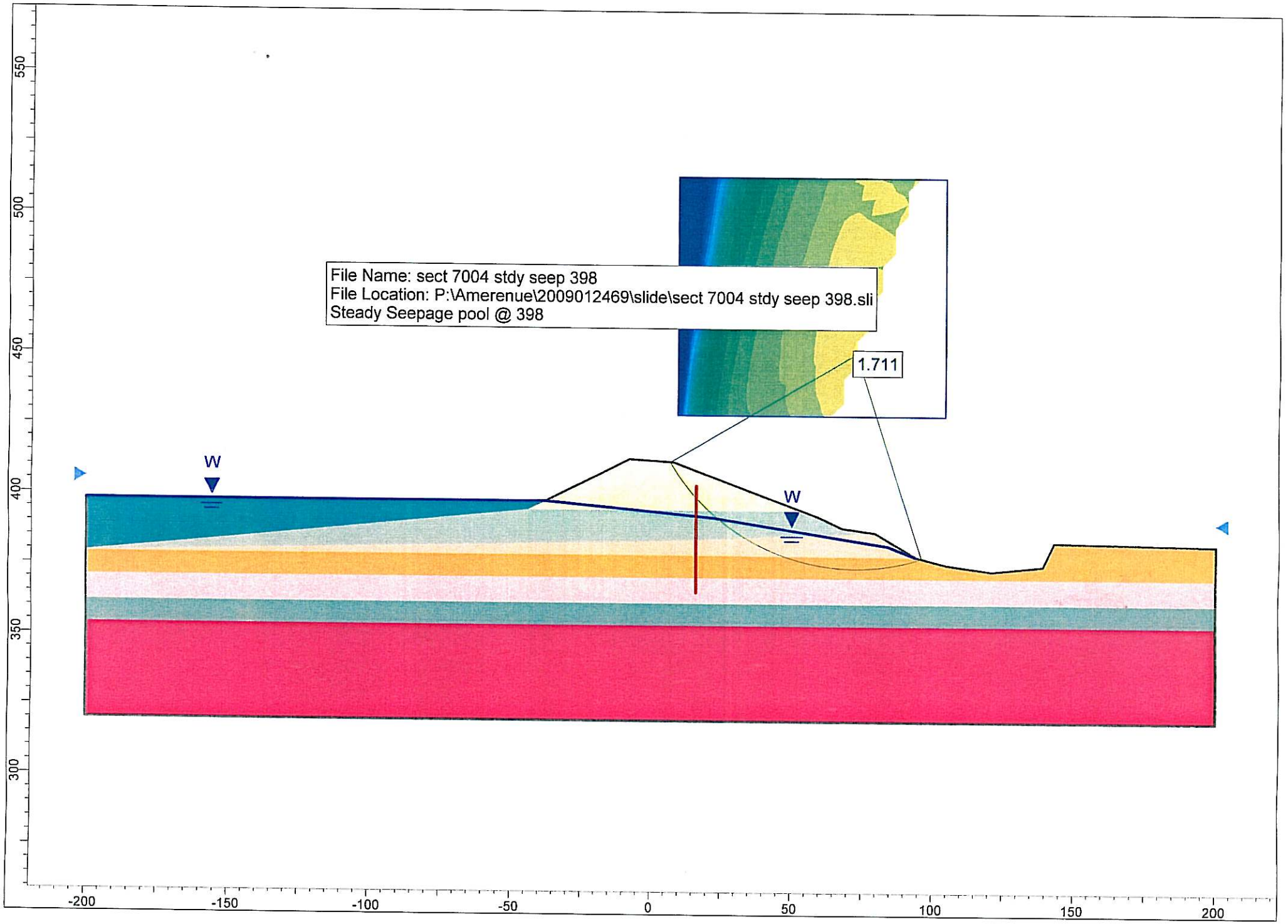

0.046
1.375
File Name: sect 4011 stdy seep from 398 seis.
File Location: P:\Amerenue\2009012469\slide\sect 4011 stdy seep from 398 seis..sli
Steady seep with seismic
W
W
600
550
500
450
400
350
300
-200
-150
-100
-50
0
50
100
150
200
250

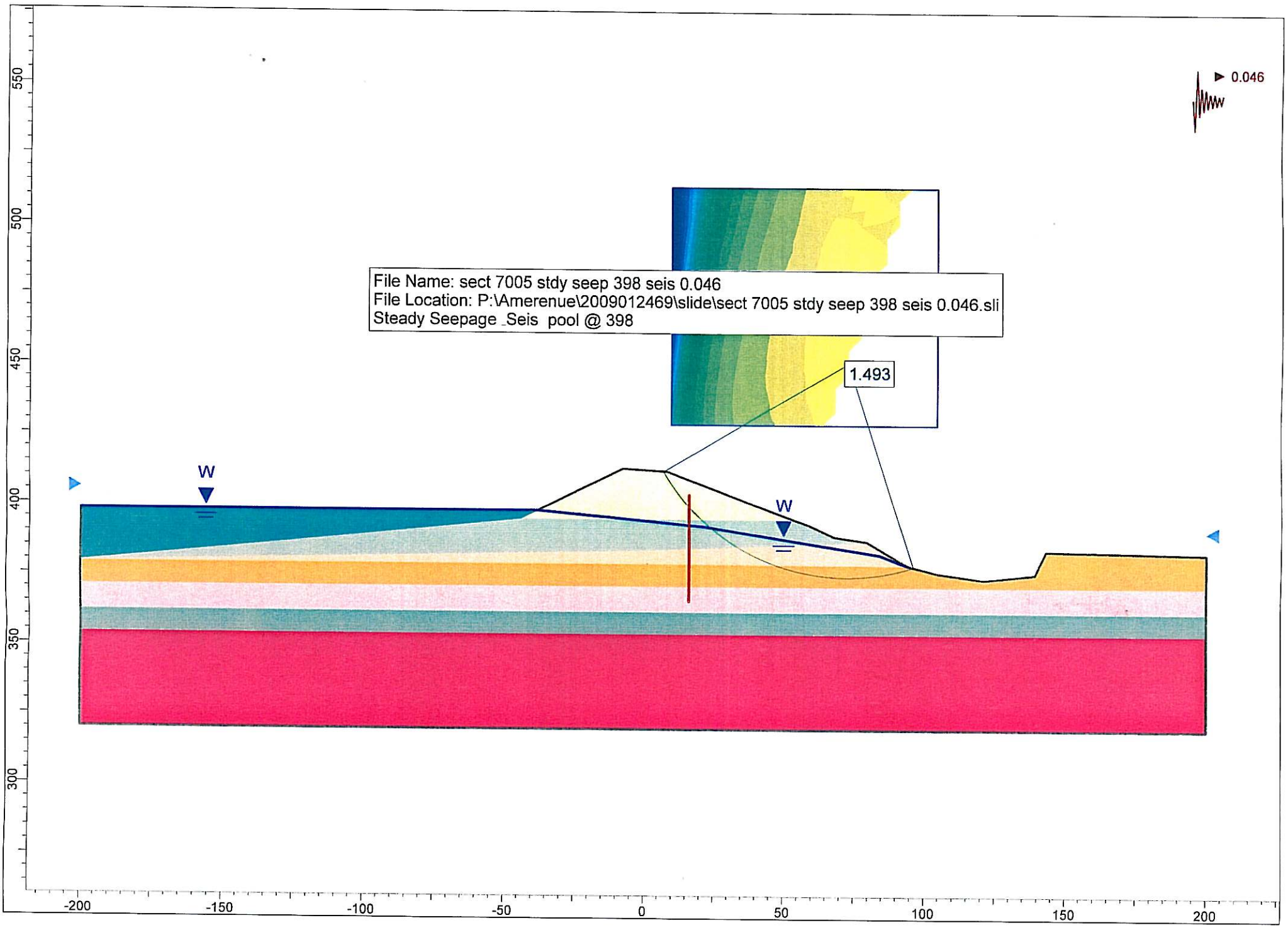

1.511
File Name: sect 4012 stdy seep from 403
File Location: P:\Amerenue\2009012469\slide\sect 4012 stdy seep from 403.sli
Steady Seepage pool @ 403
W
W
600
550
500
450
400
350
300
-250
-200
-150
-100
-50
0
50
100
150
200
250

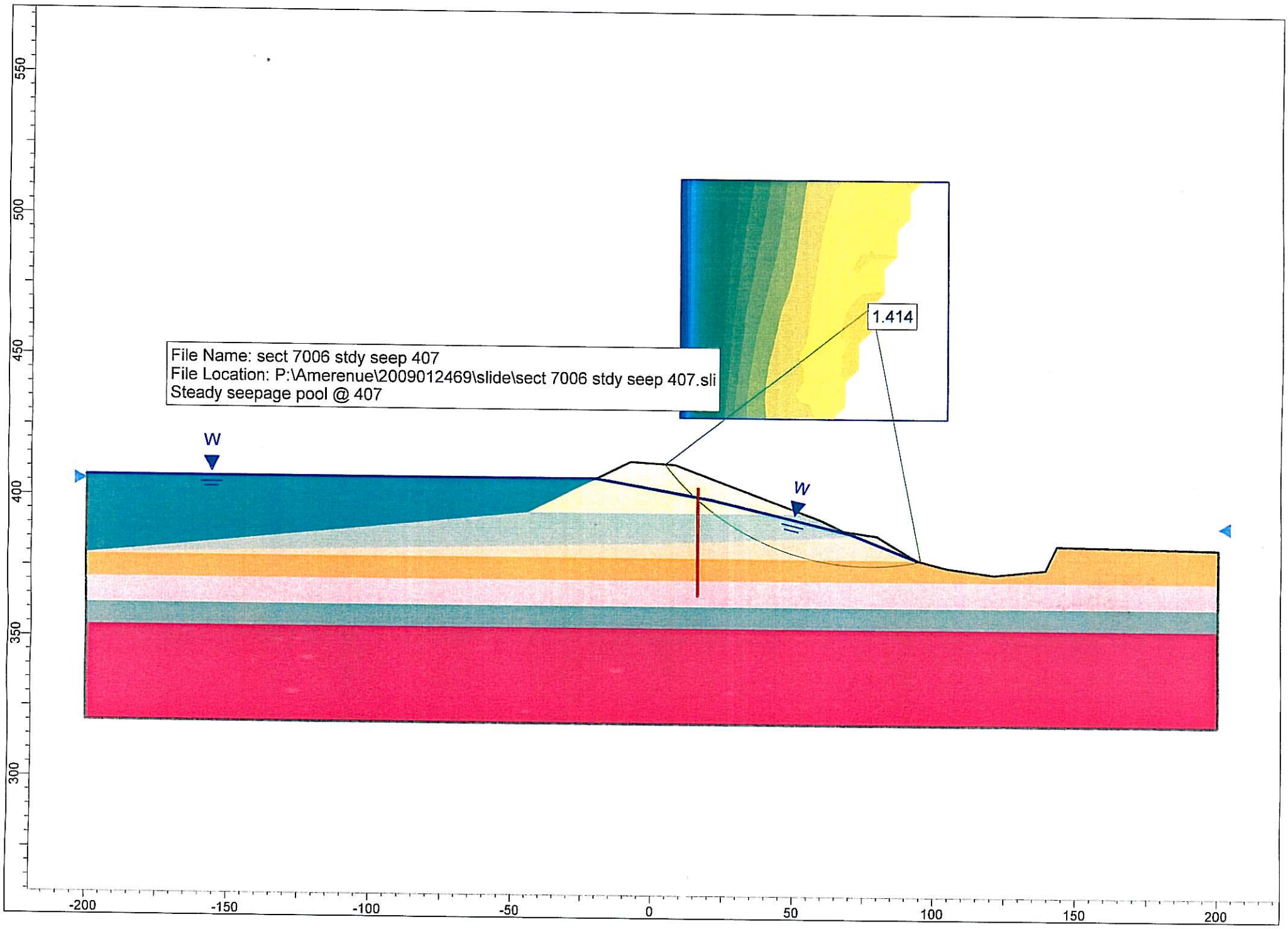

1.404
File Name: sect 4013 stdy seep 407
File Location: P:\Amerenue\2009012469\slide\sect 4013 stdy seep 407.sli
Max POOL 407 , Steady Seepage
W
W
600
550
500
450
400
350
300
-200
-150
-100
-50
0
50
100
150
200

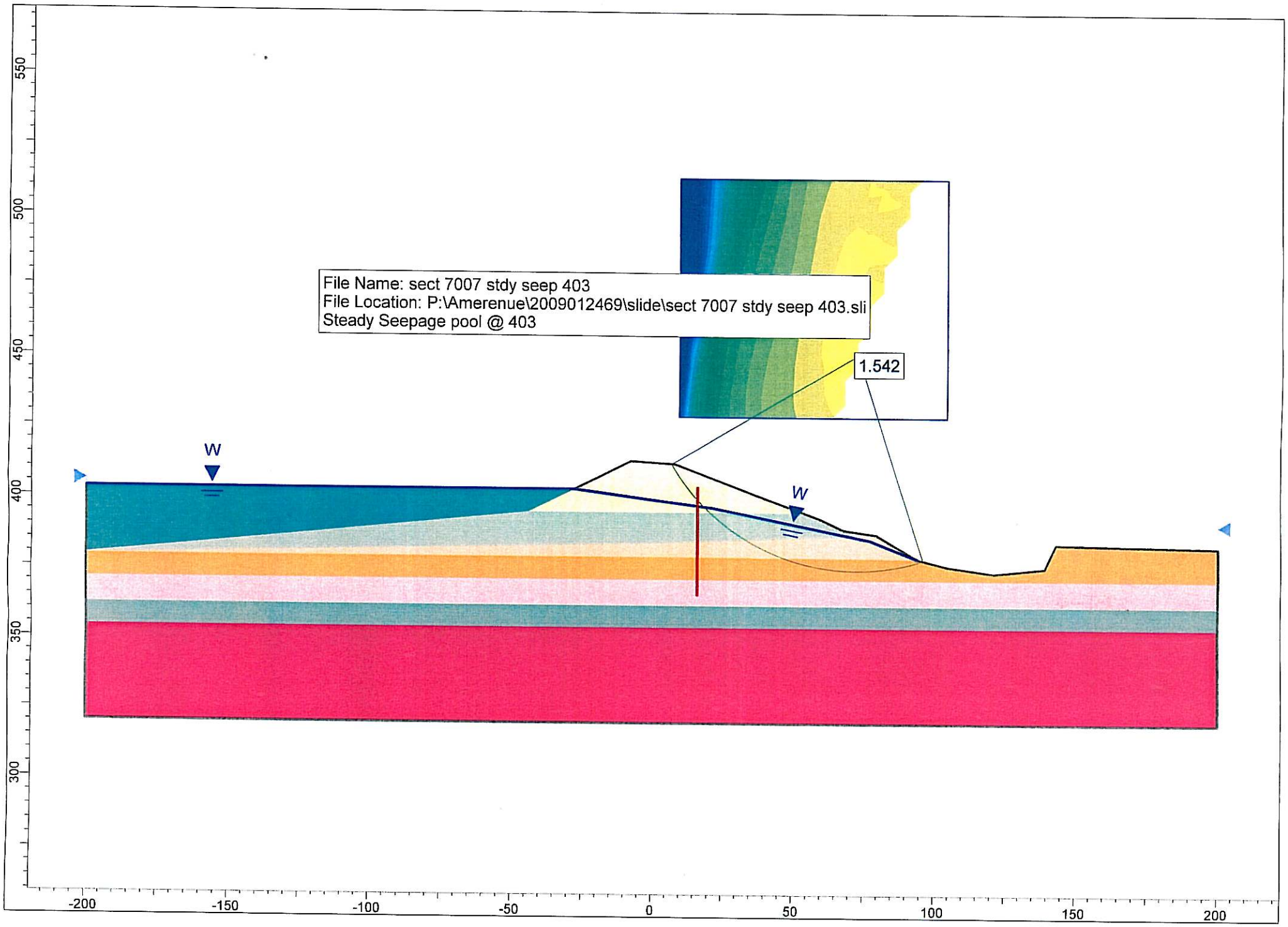

0.046
1.317
File Name: sect 4014 stdy seep from 403 +seis
File Location: P:\Amerenue\2009012469\slide\sect 4014 stdy seep from 403 +seis.sli
normal pool 403 plus seismic
W
W
700
650
600
550
500
450
400
350
300
-250
-200
-150
-100
-50
0
50
100
150
200
250
300

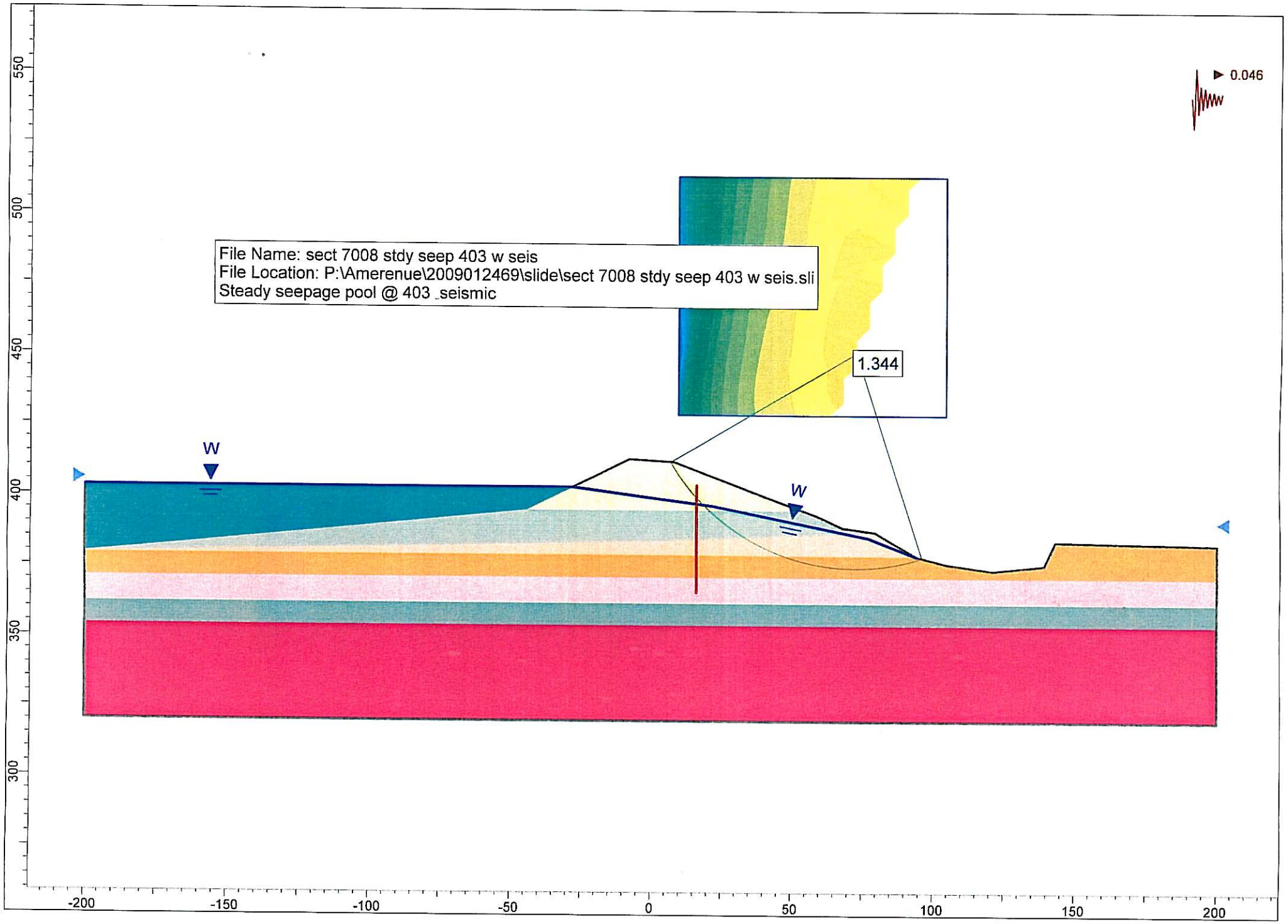

Material: silty clay
Unit Weight: 125 lb/ft3
Cohesion: 500 psf
Friction Angle: 0 degrees
Material: sandy silt
Unit Weight: 120 lb/ft3
Cohesion: 1000 psf
Friction Angle: 0 degrees
Material: clay
Unit Weight: 125 lb/ft3
Cohesion: 750 psf
Friction Angle: 0 degrees
Material: silty sandy clay
Unit Weight: 120 lb/ft3
Cohesion: 1500 psf
Friction Angle: 0 degrees
Material: silty clayey sand
Unit Weight: 120 lb/ft3
Cohesion: 2500 psf
Friction Angle: 0 degrees
Material: stiff clay
Unit Weight: 120 lb/ft3
Cohesion: 1000 psf
Friction Angle: 0 degrees
Material: dense sand
Unit Weight: 125 lb/ft3
Cohesion: 0 psf
Friction Angle: 40 degrees
Material: wet ash
Unit Weight: 85 lb/ft3
Cohesion: 0 psf
Friction Angle: 24 degrees
File Name: sect 7001
File Location: P:\Amerenue\2009012469\slide\sect 7001.sli
1.731
550
500
450
400
350
300
-200
-150
-100
-50
0
50
100
150
200


File Name: sect 7004 stdy seep 398
File Location: P:\Amerenue\2009012469\slide\sect 7004 stdy seep 398.sli
Steady Seepage pool @ 398
1.711
W
W
550
500
450
400
350
300
-200
-150
-100
-50
0
50
100
150
200


0.046
File Name: sect 7005 stdy seep 398 seis 0.046
File Location: P:\Amerenue\2009012469\slide\sect 7005 stdy seep 398 seis 0.046.sli
Steady Seepage _Seis pool @ 398
1.493
W
W
550
500
450
400
350
300
-200
-150
-100
-50
0
50
100
150
200


1.414
File Name: sect 7006 stdy seep 407
File Location: P:\Amerenue\2009012469\slide\sect 7006 stdy seep 407.sli
Steady seepage pool @ 407
W
W
550
500
450
400
350
300
-200
-150
-100
-50
0
50
100
150
200


File Name: sect 7007 stdy seep 403
File Location: P:\Amerenue\2009012469\slide\sect 7007 stdy seep 403.sli
Steady Seepage pool @ 403
1.542
W
W
550
500
450
400
350
300
-200
-150
-100
-50
0
50
100
150
200


0.046
File Name: sect 7008 stdy seep 403 w seis
File Location: P:\Amerenue\2009012469\slide\sect 7008 stdy seep 403 w seis.sli
Steady seepage pool @ 403 _seismic
1.344
W
W
550
500
450
400
350
300
-200
-150
-100
-50
0
50
100
150
200

Hydrology Analysis

REITZ & JENS, INC.
CONSULTING ENGINEERS

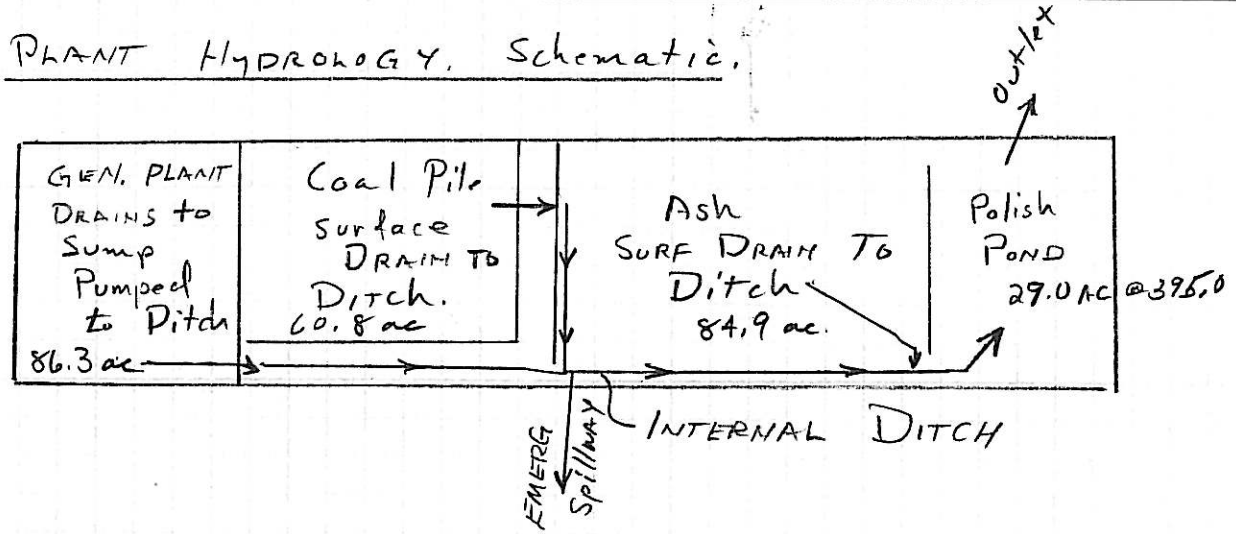
DATE 1/2/10

PROJECT Rush Island

SUBJECT F.A. Pond. Hyd

BY DSE CHK'D _____ SHEET 1 OF _____

PLANT HYDROLOGY. Schematic.



GEN PLANT.

PLANT PROCESS H_2O assume 15 cfs - & 20 cfs.

MAX. SUMP FLOW ≈ 38 cfs. ∴ STORM MAX CAP ≈ 23 cfs.

COAL Pile

MAX TRAVEL PATH 0.3 miles to ditch

AVG Slope = $20'/.3 \times 5280 = 0.0126$ 1/1

CN - COMPOSIT.

	CN	WT. CN
60% PACKED COAL	90	54
40% FLAT Weedy	80	32
	COMP CN =	86

using SCS LAG Eq'n

$$T_c = \frac{.000879 \times 1584^{.8}\left(\frac{1000}{86} - 9\right)^{.7}}{(.0126)^{1/2}} = \frac{.319 \times 1.966}{.1122} = 5.58 \text{ hr.}$$

too long - DO NOT USE.

USING KIRPICH

$T_c = 0.00013 \times 1584^{.77}(.0126)^{-.385} = 0.20$ hr. $v = 2.2$ fps. reasonable - use.

REITZ & JENS, INC.
CONSULTING ENGINEERS

DATE 1/2/2010

PROJECT Rush Island

SUBJECT F. A. Ponds Hyd.

BY DSE CHK'D _____ SHEET 2 OF _____

Ash Storage. Min. Elev. = 404.0

Slope of Surf = 5'/.46x5280 = 0.0021 1/1

Max Drain L = .46x5280 = 2428'

Ash C_N = 80 ≈ a gravel area.

$$T_c = \frac{.00013 \times 2428^{.77}}{(.0021)^{.385}} = \frac{.0526}{.0931} = 0.56 \text{ hr.}$$

Polish Pond.

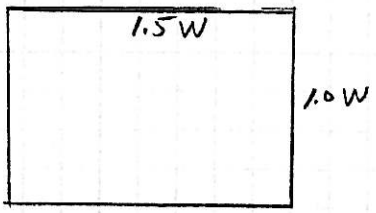
Ash Delta @ 395

@ 395 Wet Surf = 27 - 8.1 = 18.9 ac.

@ 397 = 27.0 AC

assume 2.5:1 Side Slopes. - do not have contours so have to synthesize Pond Area

Gen. Pond Shape
1.5:1 Rectangle.



$A_0 = 1.5W \times 1.0W = 1.5W^2$

for Δh rise. (w 2.5 ss)

$W_D = W + 5\Delta h$

$L = 1.5W + 5\Delta h$

$A = (W + 5\Delta h)(1.5W + 5\Delta h)$

$A = 1.5W^2 + 12.5W\Delta h + 25\Delta h^2$

W = 0.21 mi = 1108. Meas.

For Theo A = 27 ac @ 397

$A = 27 \times 43560 = 1.5W^2$

$W = 885'$

See Sheet 3 for Area vs Depth.

Polish Pond Area

assume rectangular shape (page 2 of computations)

Elev	delta H	Width	Length	Equation parts			Area sum	Acres	Ditch Area	Total Area
				1.5 W^2	5*dH*(PW +W)	25 dH^2	(sq ft)			
397	0	885.5	1328.25	1176165	0	0	1176165	27.00	1.01	28.01
398	1			1176165	11068.75	25	1187259	27.26	1.01	28.27
399	2			1176165	13282.5	100	1189548	27.31	1.01	28.32
400	3			1176165	19923.75	225	1196314	27.46	1.01	28.47
401	4			1176165	26565	400	1203130	27.62	1.01	28.63
402	5			1176165	33206.25	625	1209997	27.78	1.01	28.79
403	6			1176165	39847.5	900	1216913	27.94	1.01	28.95
404	7			1176165	46488.75	1225	1223879	28.10	1.01	29.11
405	8			1176165	53130	1600	1230895	28.26	1.01	29.27
406	9			1176165	59771.25	2025	1237962	28.42	1.01	29.43
407	10			1176165	66412.5	2500	1245078	28.58	1.01	29.59
408	11			1176165	73053.75	3025	1252244	28.75	1.01	29.76
409	12			1176165	79695	3600	1259460	28.91	1.01	29.92
410	13			1176165	86336.25	4225	1266727	29.08	1.01	30.09

pond only storage volumes - starting @ 397

Elev	Area (ac.)	delta Volume	Storage
397	27.00		0.00
398	27.26	27.13	27.13
399	27.31	27.28	54.41
400	27.46	27.39	81.80
401	27.62	27.54	109.34
402	27.78	27.70	137.04
403	27.94	27.86	164.89
404	28.10	28.02	192.91
405	28.26	28.18	221.09
406	28.42	28.34	249.43
407	28.58	28.50	277.93
408	28.75	28.67	306.59
409	28.91	28.83	335.42
410	29.08	29.00	364.42

sheet 3 of

REITZ & JENS, INC.
CONSULTING ENGINEERS

DATE 3/15/10

PROJECT RUSH ISLAND
SUBJECT F.A. POND HYD.
BY DSE CHK'D _____ SHEET 4 OF _____

DISCUSSION W/ PLANT MANAGERS

1) Would like to operate polish Pond as high as 398.

2) COMPUTATIONS STARTED @ 398

WERE ADDED.

SEE SHEET 5 FOR COMP SUMMARY

Check POND RISE ASSUMING That Outlet is Closed

100 yr Storm - 24 hr Volume = 167.188 ac ft.

USING STAGE STORAGE TABLE - TRIAL 04

START ELEV	START STOR.	+167.188	RQD STORAGE	INTERPOLATED STAGE	
395	0	167.188	167.188	401 155.239 402 182.938	401.43
398	73.029		240.217	404 238.812 405 216.989	404.05

USING TRIAL 05

403	0		167.188	408 141.699 409 170.529	408.884

using storage values on sheet 3
for 2' F.B = 408.2 - 2.0 = 406.2

START STOR = 249.43 + 0.2(28.5) = 255.13
MAX POSS. START ELEV W/ BLOCKED Outlet
255.13 - 167.88 = 87.94 Start Stor.
= 400.2 MAX POSS. POND ELEV.

Table of Results
Hydrologic computations

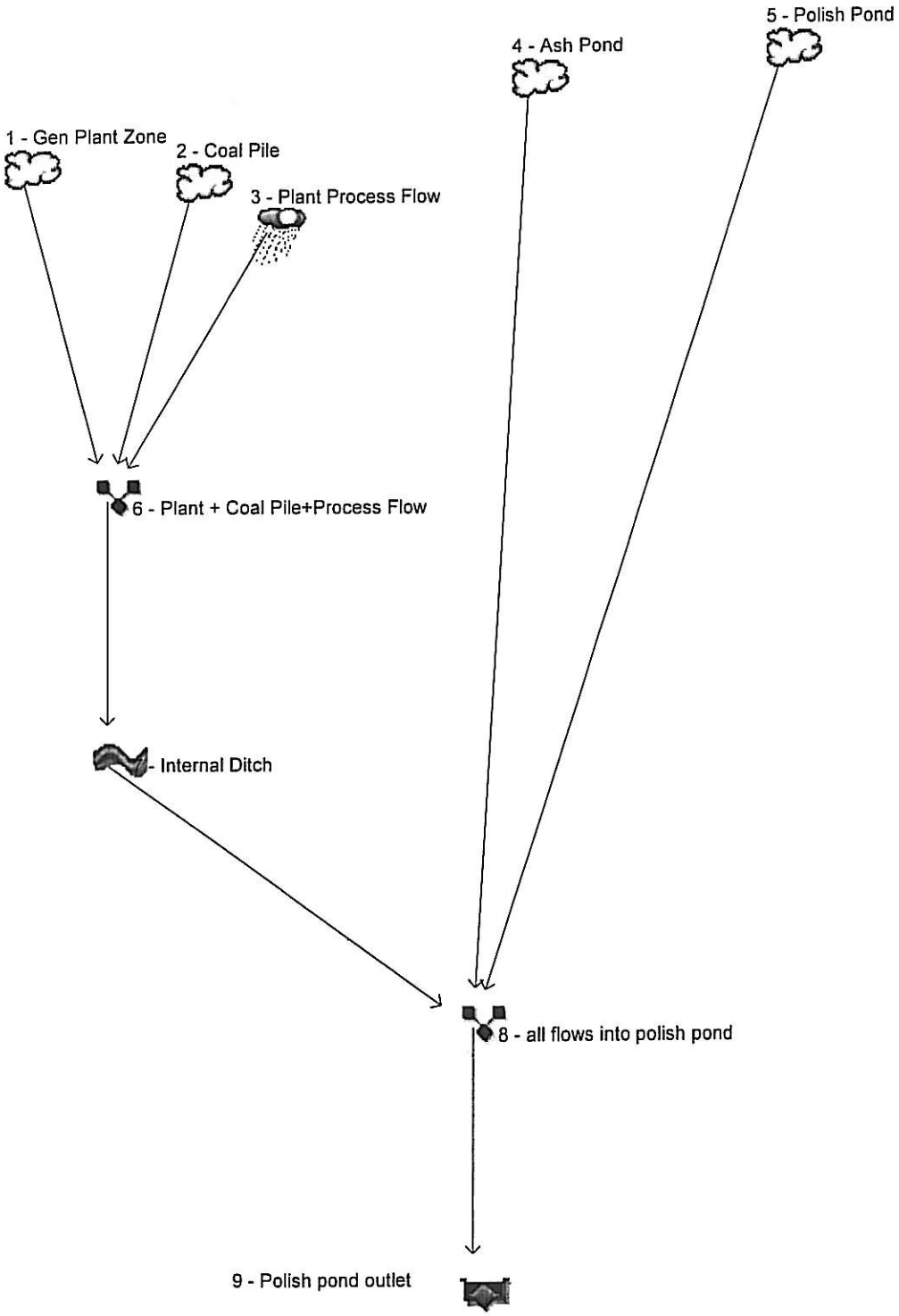
Rush Island Ash Pond Storm Routing

File	Rainfall duration	frequency	Pond Start Elevtion	Base Flow from Plant	Maximum Stage	Max. Outflow cfs	Total Storage ac-ft	Remarks
Trial 03	24 hr	100 yr	395	15 cfs	399.55	27.97	116	8.1 ac Ash delta at 395
Trial 04	24 hr	100 yr	395	20 cfs	399.87	28.95	124	8.1 ac Ash delta at 395
Trial 05	24 hr	100 yr	403	20 cfs	407.44	27.93	126	No Ash Delta @ 403
Trial 09	24 hr	100 yr	398	20 cfs	402.55	28.27	125.2	Ash Delta Submerged @ 397
Trial 06	6 hr	100 yr	395	20 cfs	398.25	23.51	79.8	8.1 ac Ash delta at 395
Trial 07	6 hr	100 yr	403	20 cfs	405.88	22.38	80.3	No Ash Delta @ 403
Trial 08	6 hr	100 yr	398	20 cfs	400.93	22.68	80.21	Ash Delta Submerged @ 397

Note: 100 yr - 24 hour storm - 7.10 inches
100 yr - 6 hour storm - 5.20 inches
Souirce - Bulletin 71, Huff & Angel

Sheet 5 of

Watershed Model Schematic



Hydrograph Summary Report

Hydraflow Hydrographs by Intelisolve v9.23

d. No.	Hydrograph type (origin)	Peak flow (cfs)	Time interval (min)	Time to peak (min)	Hyd. volume (acft)	Inflow hyd(s)	Maximum elevation (ft)	Total strge used (acft)	Hydrograph description
1	SCS Runoff	63.88	5	935	40.508	----	------	------	Gen Plant Zone
2	SCS Runoff	41.10	5	935	25.944	----	------	------	Coal Pile
3	Manual	20.00	5	5	49.587	----	------	------	Plant Process Flow
4	SCS Runoff	58.35	5	935	34.925	----	------	------	Ash Pond
5	SCS Runoff	21.09	5	925	16.086	----	------	------	Polish Pond
6	Combine	124.99	5	935	116.039	1, 2, 3,	------	------	Plant + Coal Pile+Process Flow
7	Reach	124.99	5	940	116.177	6	------	------	Internal Ditch
8	Combine	204.24	5	935	167.188	4, 5, 7	------	------	all flows into polish pond
9	Reservoir	28.95	5	1470	165.227	8	399.87	124	Polish pond outlet

Hydrograph Report

Hydraflow Hydrographs by Intelisolve v9.23

Tuesday, Jan 5, 2010

Hyd. No. 1

Gen Plant Zone

Hydrograph type	= SCS Runoff	Peak discharge	= 63.88 cfs
Storm frequency	= 100 yrs	Time to peak	= 15.58 hrs
Time interval	= 5 min	Hyd. volume	= 40.508 acft
Drainage area	= 86.300 ac	Curve number	= 86
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= USER	Time of conc. (Tc)	= 30.00 min
Total precip.	= 7.10 in	Distribution	= Huff-3rd
Storm duration	= 24.00 hrs	Shape factor	= 484



Hydrograph Report

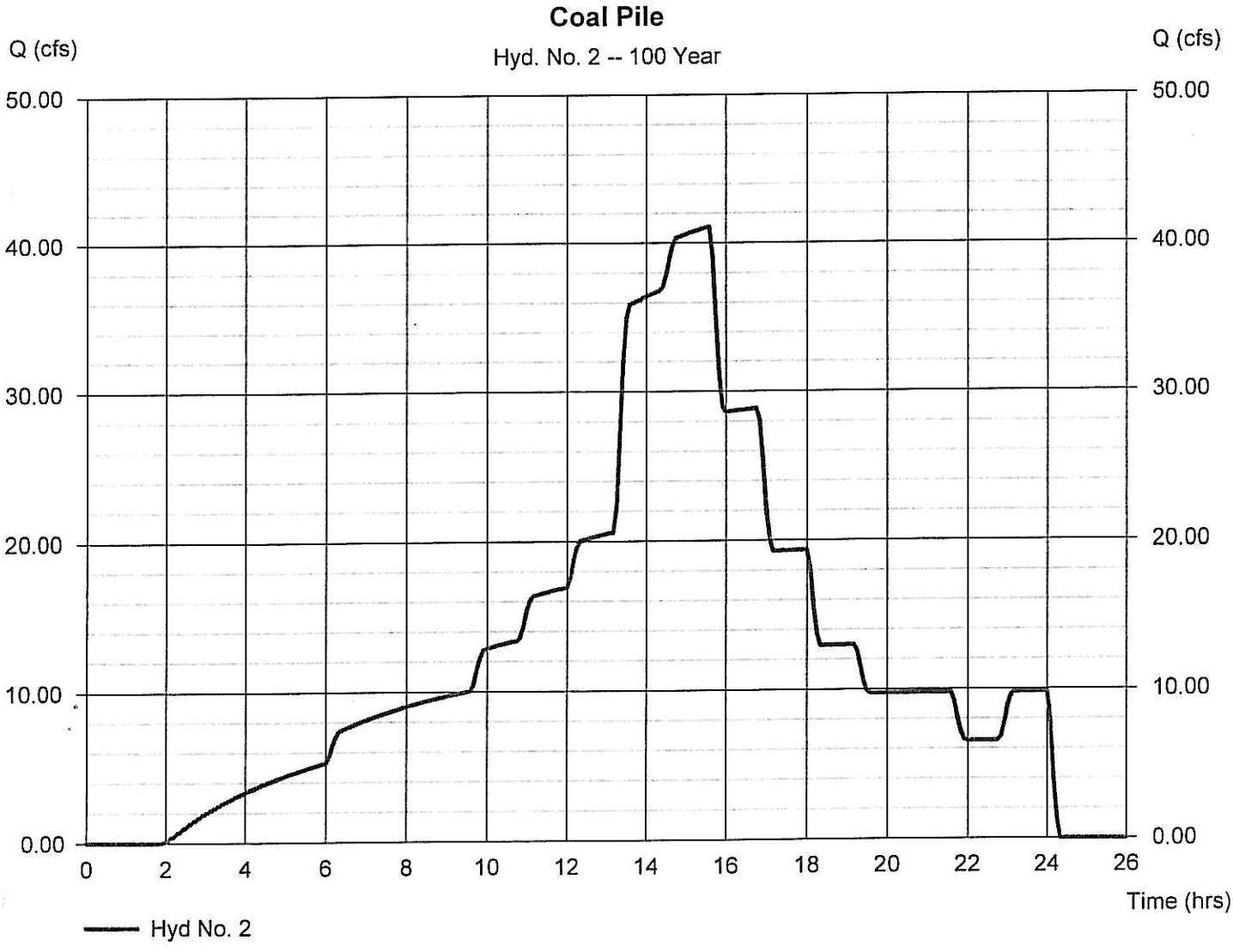
Hydraflow Hydrographs by Intelisolve v9.23

Tuesday, Jan 5, 2010

Hyd. No. 2

Coal Pile

Hydrograph type	= SCS Runoff	Peak discharge	= 41.10 cfs
Storm frequency	= 100 yrs	Time to peak	= 15.58 hrs
Time interval	= 5 min	Hyd. volume	= 25.944 acft
Drainage area	= 60.800 ac	Curve number	= 86
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= USER	Time of conc. (Tc)	= 12.00 min
Total precip.	= 7.10 in	Distribution	= Huff-3rd
Storm duration	= 24.00 hrs	Shape factor	= 484



Hydrograph Report

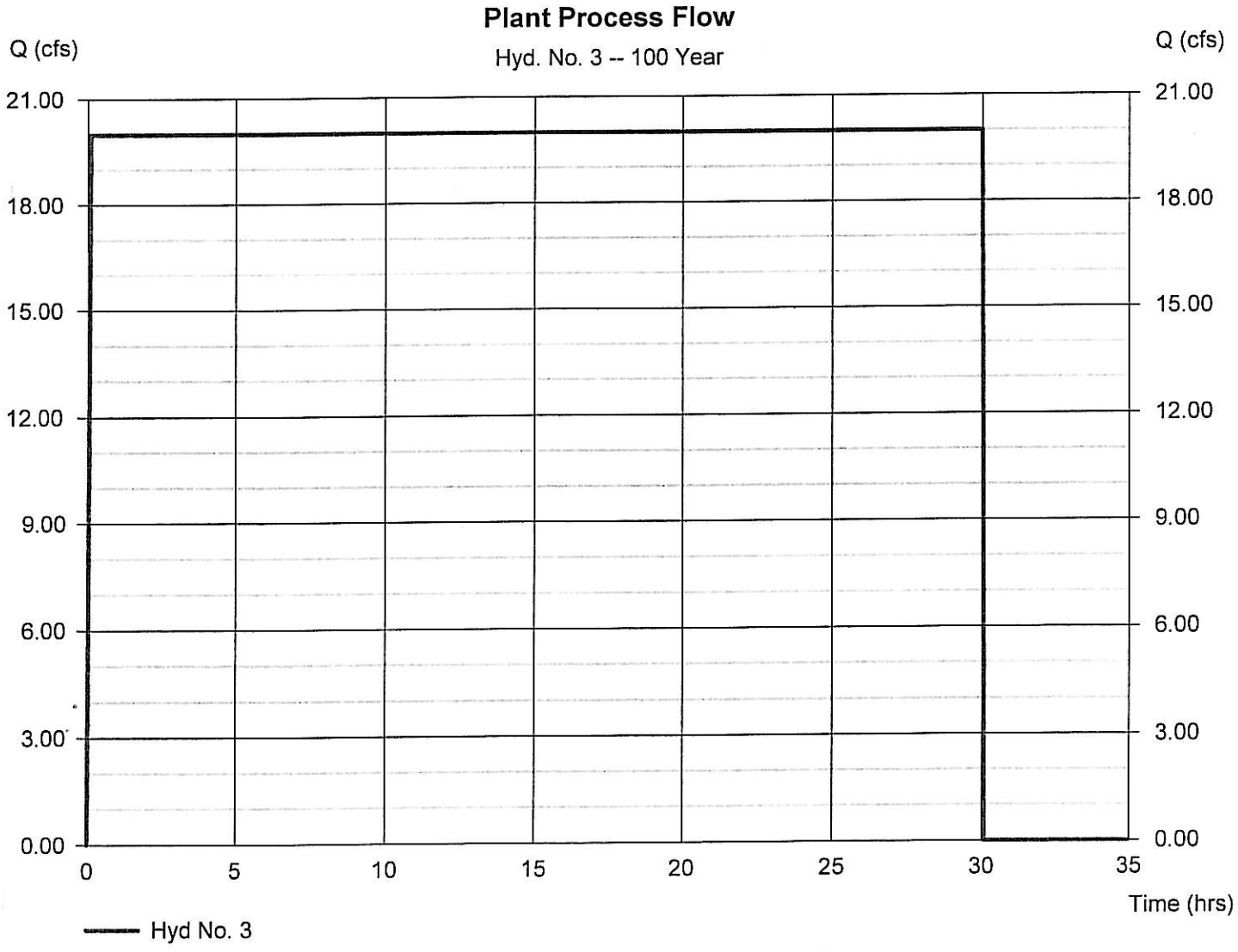
Hydraflow Hydrographs by Intelisolve v9.23

Tuesday, Jan 5, 2010

Hyd. No. 3

Plant Process Flow

Hydrograph type	= Manual	Peak discharge	= 20.00 cfs
Storm frequency	= 100 yrs	Time to peak	= 0.08 hrs
Time interval	= 5 min	Hyd. volume	= 49.587 acft

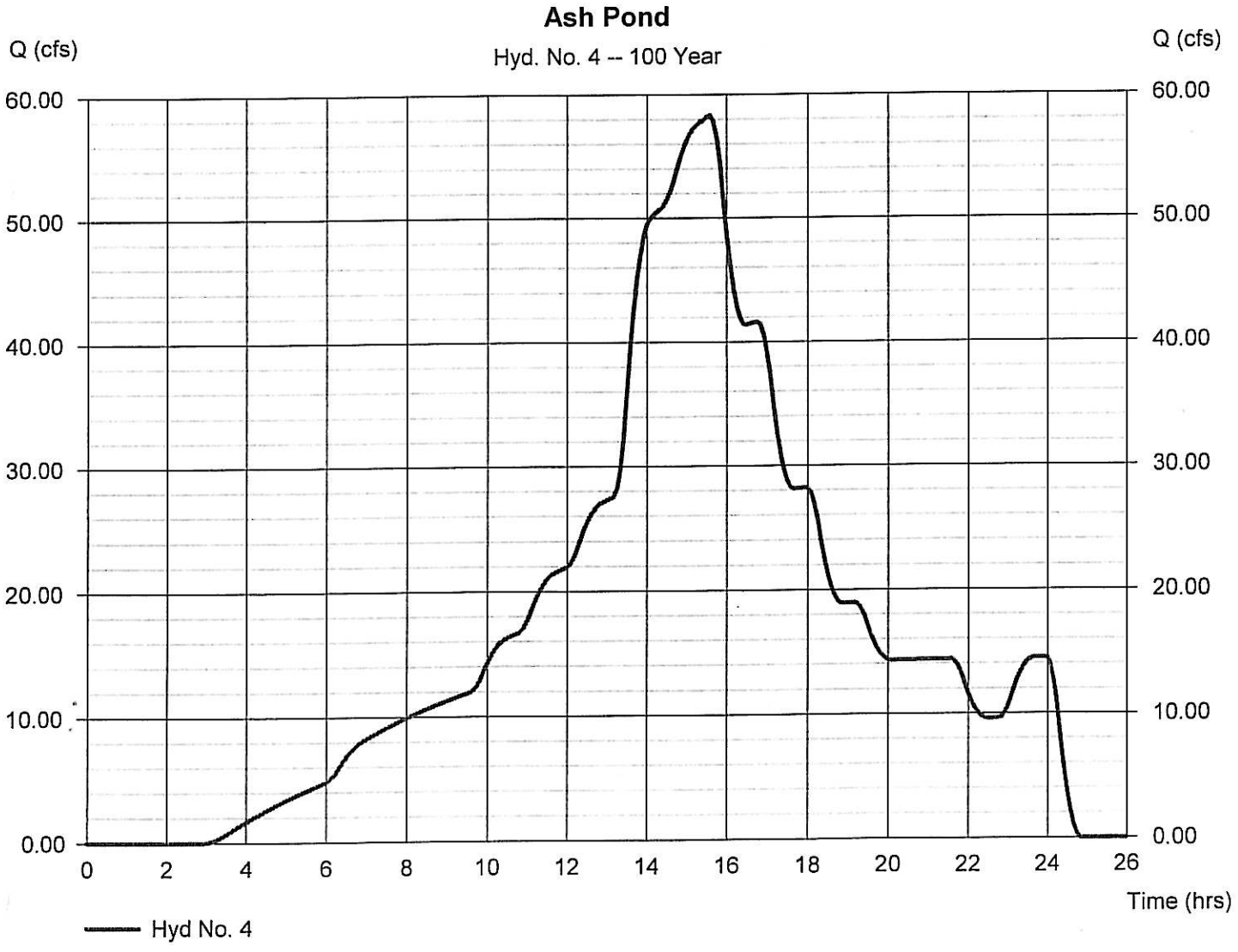


Hydrograph Report

Hyd. No. 4

Ash Pond

Hydrograph type	= SCS Runoff	Peak discharge	= 58.35 cfs
Storm frequency	= 100 yrs	Time to peak	= 15.58 hrs
Time interval	= 5 min	Hyd. volume	= 34.925 acft
Drainage area	= 84.900 ac	Curve number	= 80
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= USER	Time of conc. (Tc)	= 33.00 min
Total precip.	= 7.10 in	Distribution	= Huff-3rd
Storm duration	= 24.00 hrs	Shape factor	= 484



Hydrograph Report

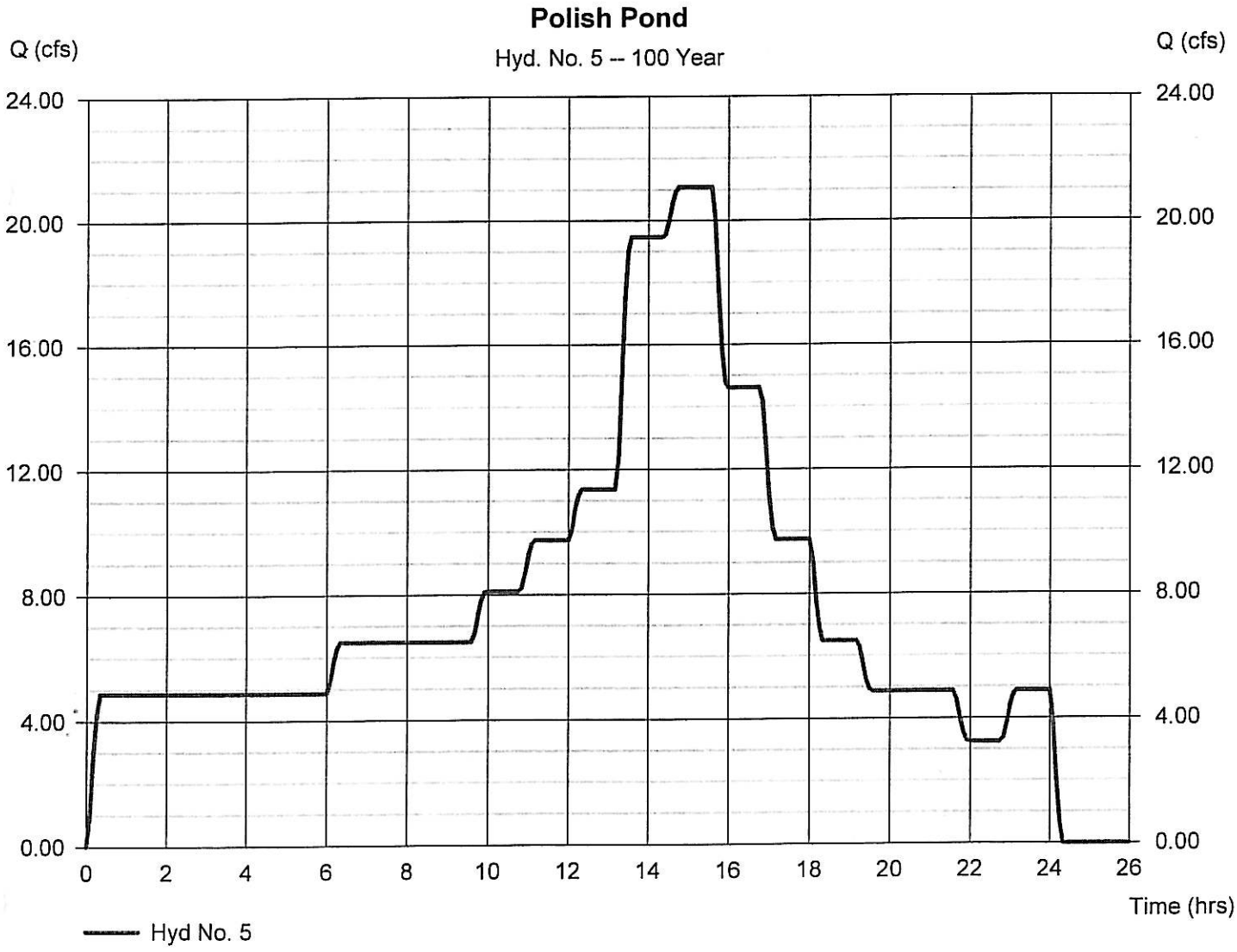
Hydraflow Hydrographs by Intelisolve v9.23

Tuesday, Jan 5, 2010

Hyd. No. 5

Polish Pond

Hydrograph type	= SCS Runoff	Peak discharge	= 21.09 cfs
Storm frequency	= 100 yrs	Time to peak	= 15.42 hrs
Time interval	= 5 min	Hyd. volume	= 16.086 acft
Drainage area	= 29.000 ac	Curve number	= 100
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= USER	Time of conc. (Tc)	= 10.00 min
Total precip.	= 7.10 in	Distribution	= Huff-3rd
Storm duration	= 24.00 hrs	Shape factor	= 484



Hydrograph Report

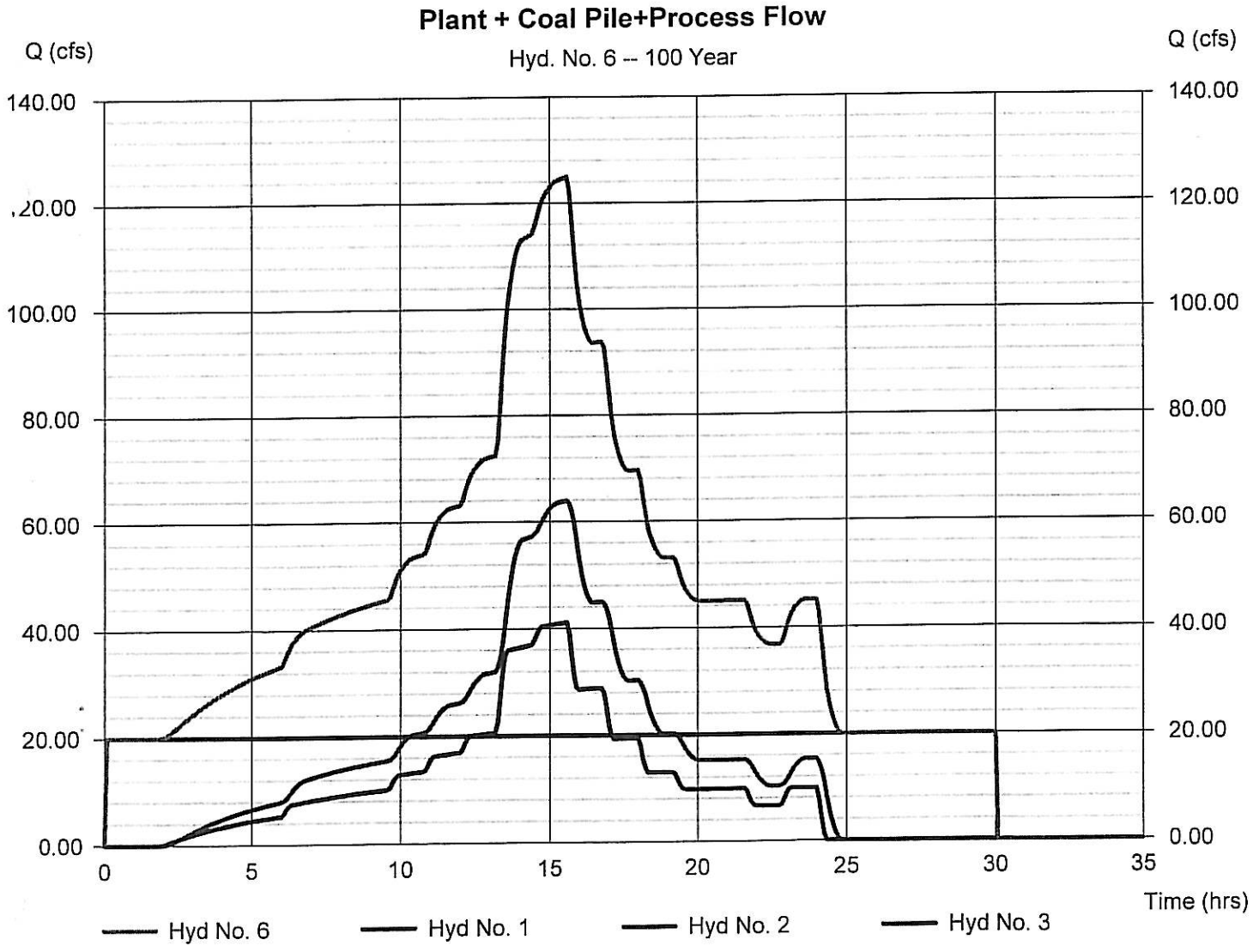
Hydraflow Hydrographs by Intelisolve v9.23

Tuesday, Jan 5, 2010

Hyd. No. 6

Plant + Coal Pile+Process Flow

Hydrograph type	= Combine	Peak discharge	= 124.99 cfs
Storm frequency	= 100 yrs	Time to peak	= 15.58 hrs
Time interval	= 5 min	Hyd. volume	= 116.039 acft
Inflow hyds.	= 1, 2, 3	Contrib. drain. area	= 147.100 ac



Hydrograph Report

Hydraflow Hydrographs by Intelisolve v9.23

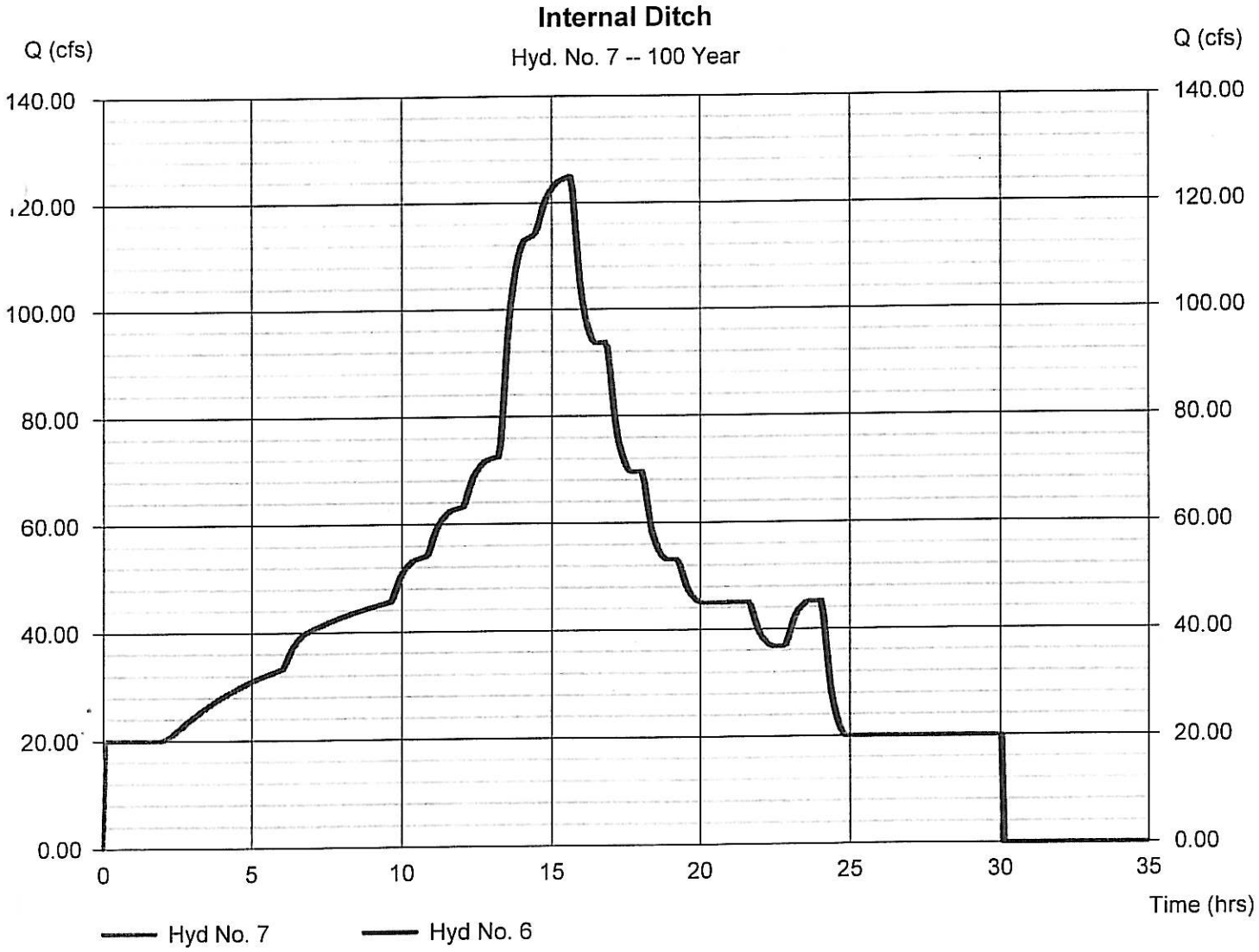
Tuesday, Jan 5, 2010

Hyd. No. 7

Internal Ditch

Hydrograph type	= Reach	Peak discharge	= 124.99 cfs
Storm frequency	= 100 yrs	Time to peak	= 15.67 hrs
Time interval	= 5 min	Hyd. volume	= 116.177 acft
Inflow hyd. No.	= 6 - Plant + Coal Pile+Process Flow	Section type	= Trapezoidal
Reach length	= 1800.0 ft	Channel slope	= 0.3 %
Manning's n	= 0.009	Bottom width	= 10.0 ft
Side slope	= 0.5:1	Max. depth	= 8.0 ft
Rating curve x	= 1.886	Rating curve m	= 1.516
Ave. velocity	= 7.86 ft/s	Routing coeff.	= 0.9967

Modified Att-Kin routing method used.



Hydrograph Report

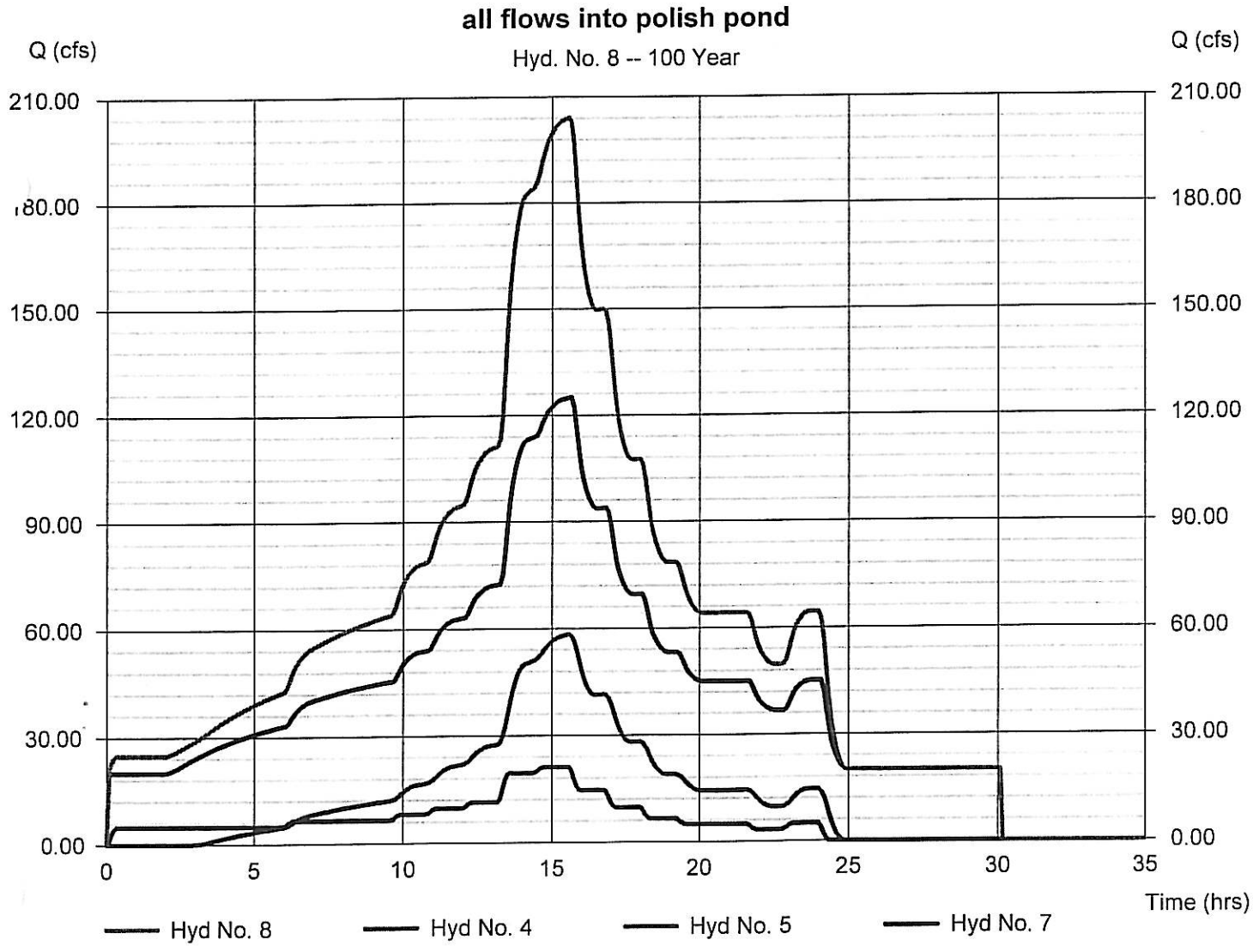
Hydraflow Hydrographs by Intelisolve v9.23

Tuesday, Jan 5, 2010

Hyd. No. 8

all flows into polish pond

Hydrograph type	= Combine	Peak discharge	= 204.24 cfs
Storm frequency	= 100 yrs	Time to peak	= 15.58 hrs
Time interval	= 5 min	Hyd. volume	= 167.188 acft
Inflow hyds.	= 4, 5, 7	Contrib. drain. area	= 113.900 ac



Hydrograph Report

Hydraflow Hydrographs by Intelisolve v9.23

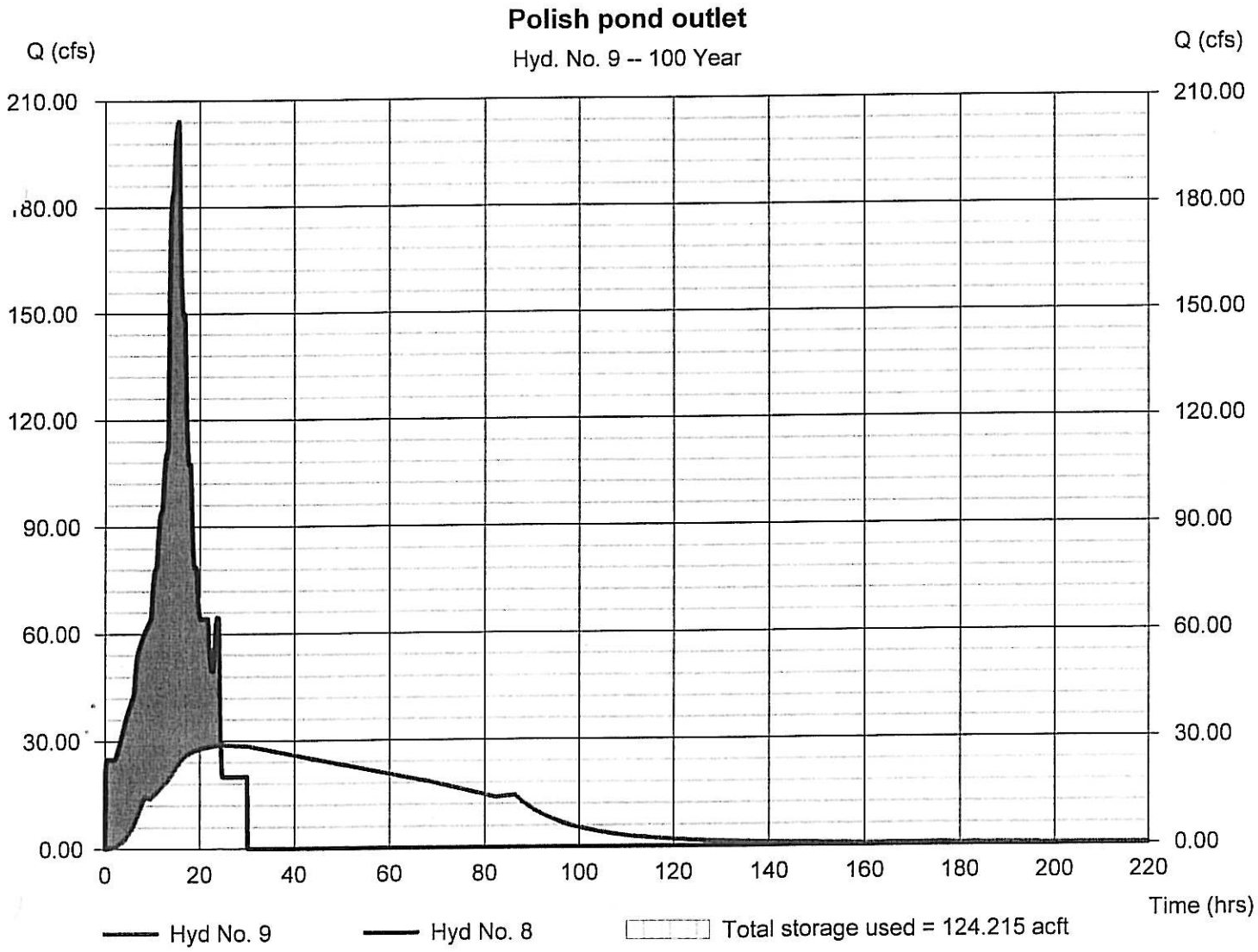
Tuesday, Jan 5, 2010

Hyd. No. 9

Polish pond outlet

Hydrograph type	= Reservoir	Peak discharge	= 28.95 cfs
Storm frequency	= 100 yrs	Time to peak	= 24.50 hrs
Time interval	= 5 min	Hyd. volume	= 165.227 acft
Inflow hyd. No.	= 8 - all flows into polish pond	Max. Elevation	= 399.87 ft
Reservoir name	= Polish pond	Max. Storage	= 124.215 acft

Storage Indication method used.



Pond Report

Hydraflow Hydrographs by Intelisolve v9.23

Tuesday, Jan 5, 2010

Pond No. 2 - Polish pond

Pond Data

Contours - User-defined contour areas. Average end area method used for volume calculation. Begining Elevation = 395.00 ft

Stage / Storage Table

Stage (ft)	Elevation (ft)	Contour area (sqft)	Incr. Storage (acft)	Total storage (acft)
0.00	395.00	823,284	0.000	0.000
2.00	397.00	1,176,165	45.901	45.901
3.00	398.00	1,187,259	27.128	73.029
4.00	399.00	1,189,548	27.282	100.311
5.00	400.00	1,196,314	27.386	127.697
6.00	401.00	1,203,130	27.542	155.239
7.00	402.00	1,209,997	27.699	182.938
8.00	403.00	1,216,913	27.857	210.795
9.00	404.00	1,223,879	28.016	238.812
10.00	405.00	1,230,895	28.177	266.989

Culvert / Orifice Structures

	[A]	[B]	[C]	[PrfRsr]
Rise (in)	= 24.00	Inactive	Inactive	Inactive
Span (in)	= 24.00	0.00	0.00	0.00
No. Barrels	= 1	0	0	0
Invert El. (ft)	= 385.00	0.00	0.00	0.00
Length (ft)	= 100.00	0.00	0.00	0.00
Slope (%)	= 5.00	0.00	0.00	n/a
N-Value	= .013	.013	.013	n/a
Orifice Coeff.	= 0.67	0.60	0.60	0.60
Multi-Stage	= n/a	No	No	No

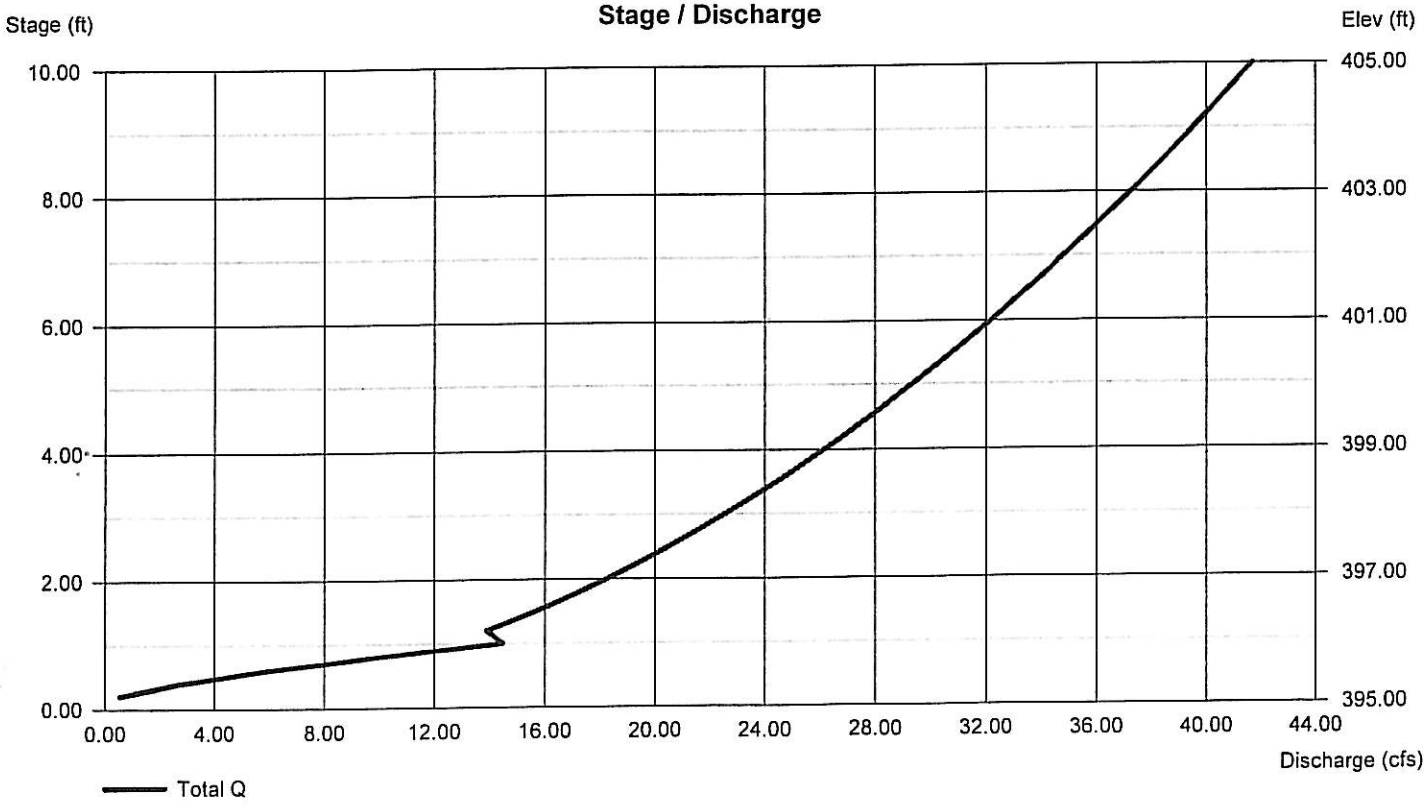
Weir Structures

	[A]	[B]	[C]	[D]
Crest Len (ft)	= 6.28	Inactive	Inactive	Inactive
Crest El. (ft)	= 395.10	0.00	0.00	0.00
Weir Coeff.	= 2.70	3.33	3.33	3.33
Weir Type	= Riser	---	---	---
Multi-Stage	= Yes	No	No	No

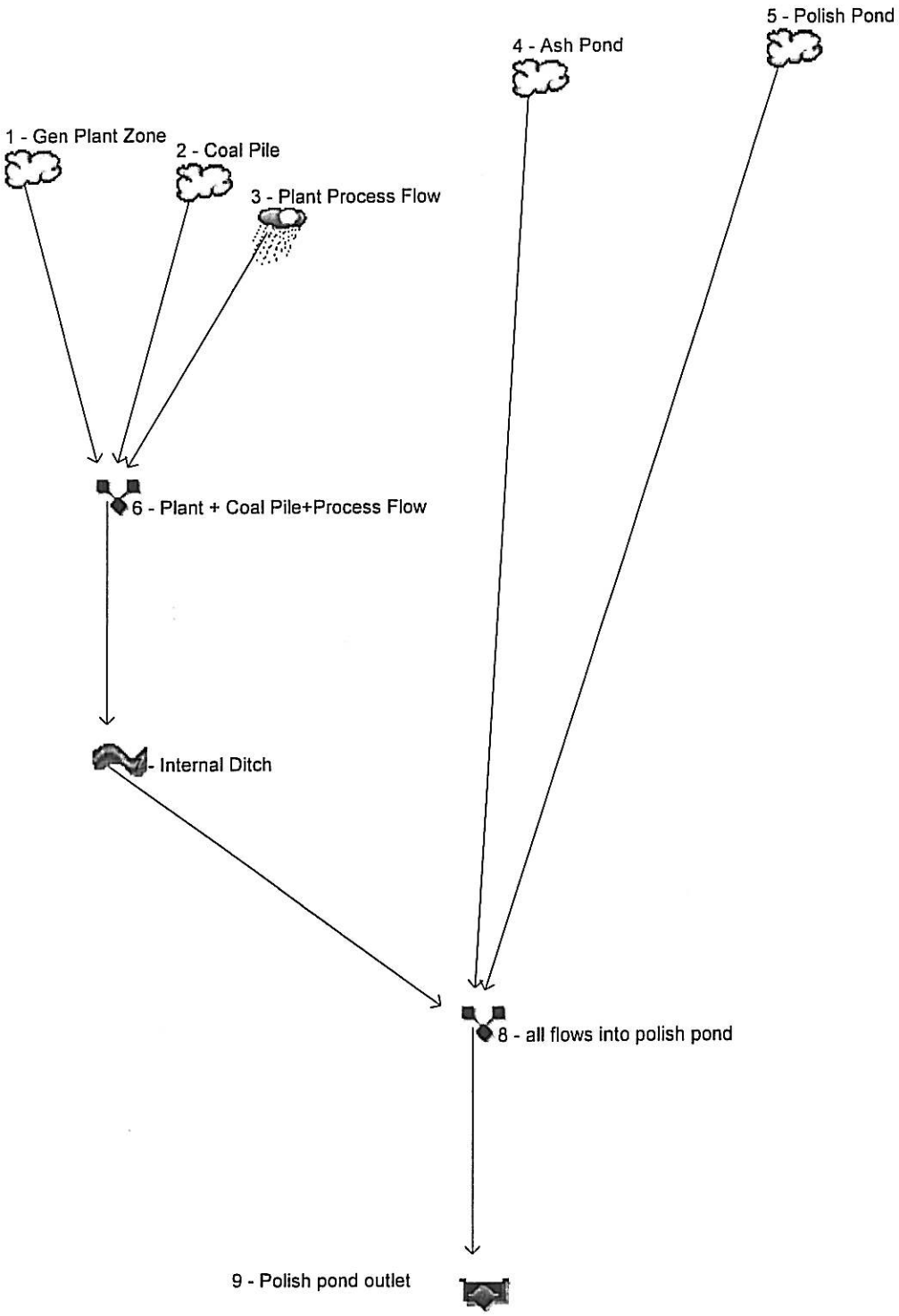
Exfil.(in/hr) = 0.000 (by Wet area)

TW Elev. (ft) = 360.00

Note: Culvert/Orifice outflows are analyzed under inlet (ic) and outlet (oc) control. Weir risers checked for orifice conditions (ic) and submergence (s).



Watershed Model Schematic



Hydrograph Summary Report

Hydraflow Hydrographs by Intelisolve v9.23

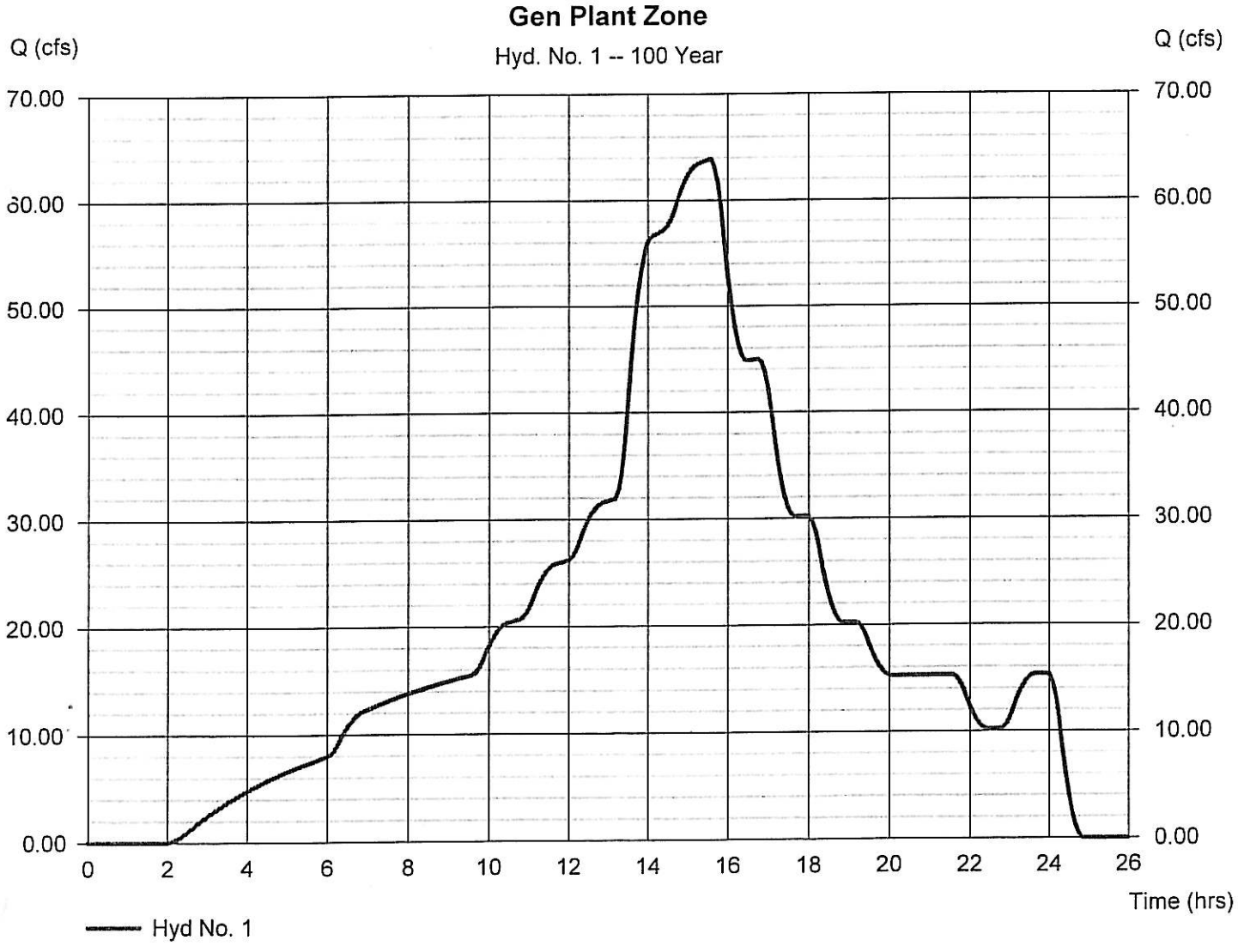
Hyd. No.	Hydrograph type (origin)	Peak flow (cfs)	Time interval (min)	Time to peak (min)	Hyd. volume (acft)	Inflow hyd(s)	Maximum elevation (ft)	Total strge used (acft)	Hydrograph description
1	SCS Runoff	63.88	5	935	40.508	----	------	------	Gen Plant Zone
2	SCS Runoff	41.10	5	935	25.944	----	------	------	Coal Pile
3	Manual	20.00	5	5	49.587	----	------	------	Plant Process Flow
4	SCS Runoff	58.35	5	935	34.925	----	------	------	Ash Pond
5	SCS Runoff	21.09	5	925	16.086	----	------	------	Polish Pond
6	Combine	124.99	5	935	116.039	1, 2, 3,	------	------	Plant + Coal Pile+Process Flow
7	Reach	124.99	5	940	116.177	6	------	------	Internal Ditch
8	Combine	204.24	5	935	167.188	4, 5, 7	------	------	all flows into polish pond
9	Reservoir	27.93	5	1475	166.243	8	407.44	126	Polish pond outlet

Hydrograph Report

Hyd. No. 1

Gen Plant Zone

Hydrograph type	= SCS Runoff	Peak discharge	= 63.88 cfs
Storm frequency	= 100 yrs	Time to peak	= 15.58 hrs
Time interval	= 5 min	Hyd. volume	= 40.508 acft
Drainage area	= 86.300 ac	Curve number	= 86
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= USER	Time of conc. (Tc)	= 30.00 min
Total precip.	= 7.10 in	Distribution	= Huff-3rd
Storm duration	= 24.00 hrs	Shape factor	= 484

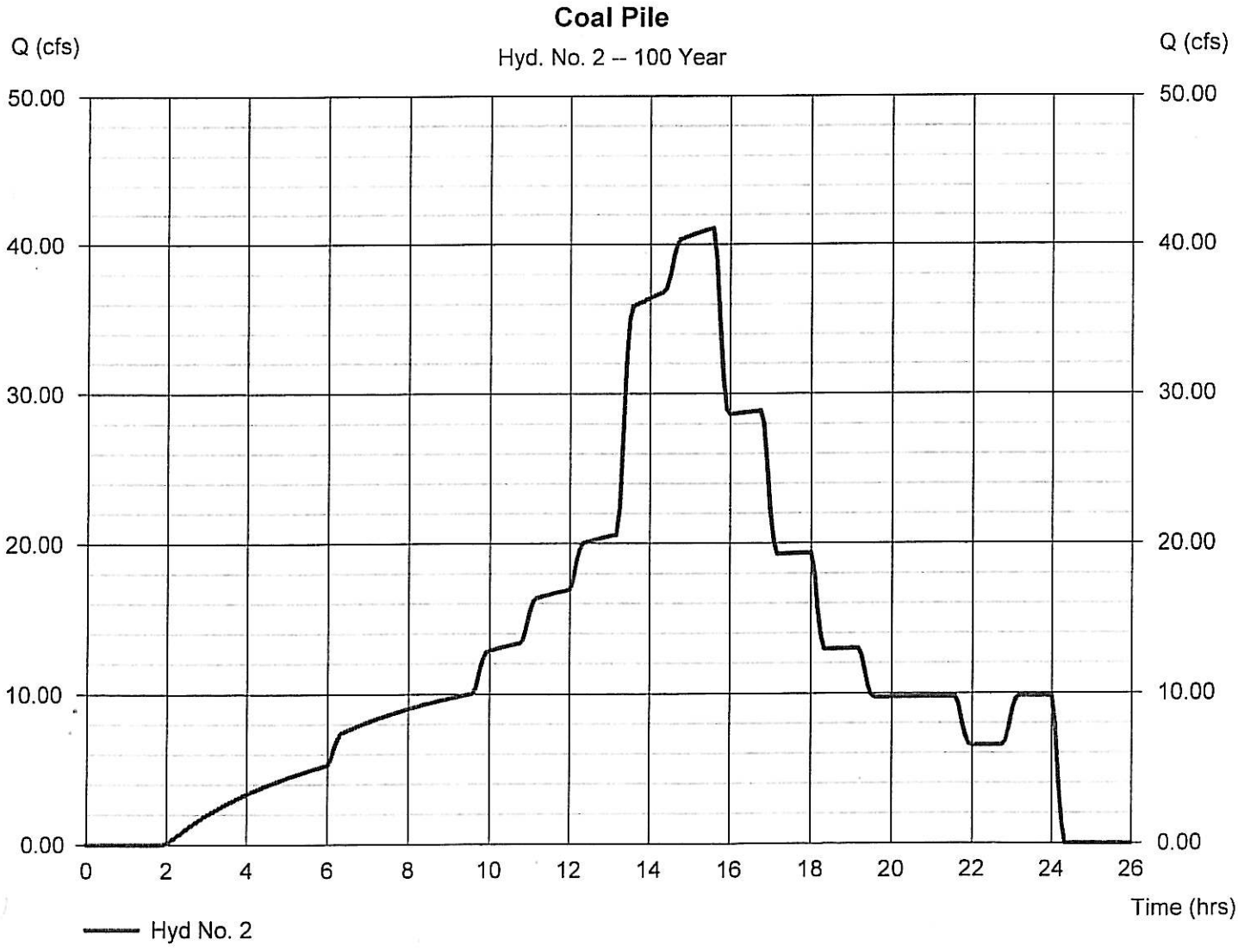


Hydrograph Report

Hyd. No. 2

Coal Pile

Hydrograph type	= SCS Runoff	Peak discharge	= 41.10 cfs
Storm frequency	= 100 yrs	Time to peak	= 15.58 hrs
Time interval	= 5 min	Hyd. volume	= 25.944 acft
Drainage area	= 60.800 ac	Curve number	= 86
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= USER	Time of conc. (Tc)	= 12.00 min
Total precip.	= 7.10 in	Distribution	= Huff-3rd
Storm duration	= 24.00 hrs	Shape factor	= 484

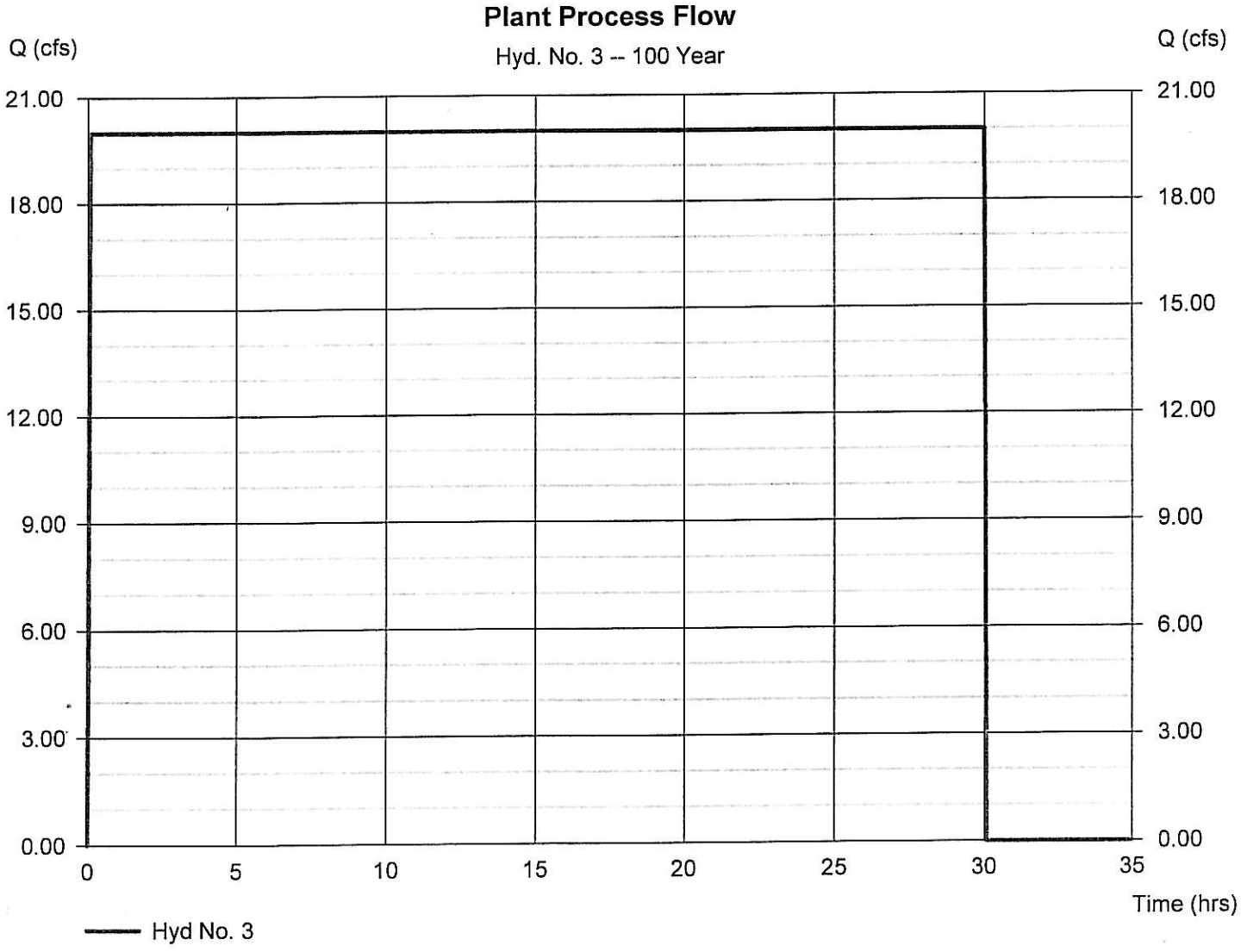


Hydrograph Report

Hyd. No. 3

Plant Process Flow

Hydrograph type	= Manual	Peak discharge	= 20.00 cfs
Storm frequency	= 100 yrs	Time to peak	= 0.08 hrs
Time interval	= 5 min	Hyd. volume	= 49.587 acft

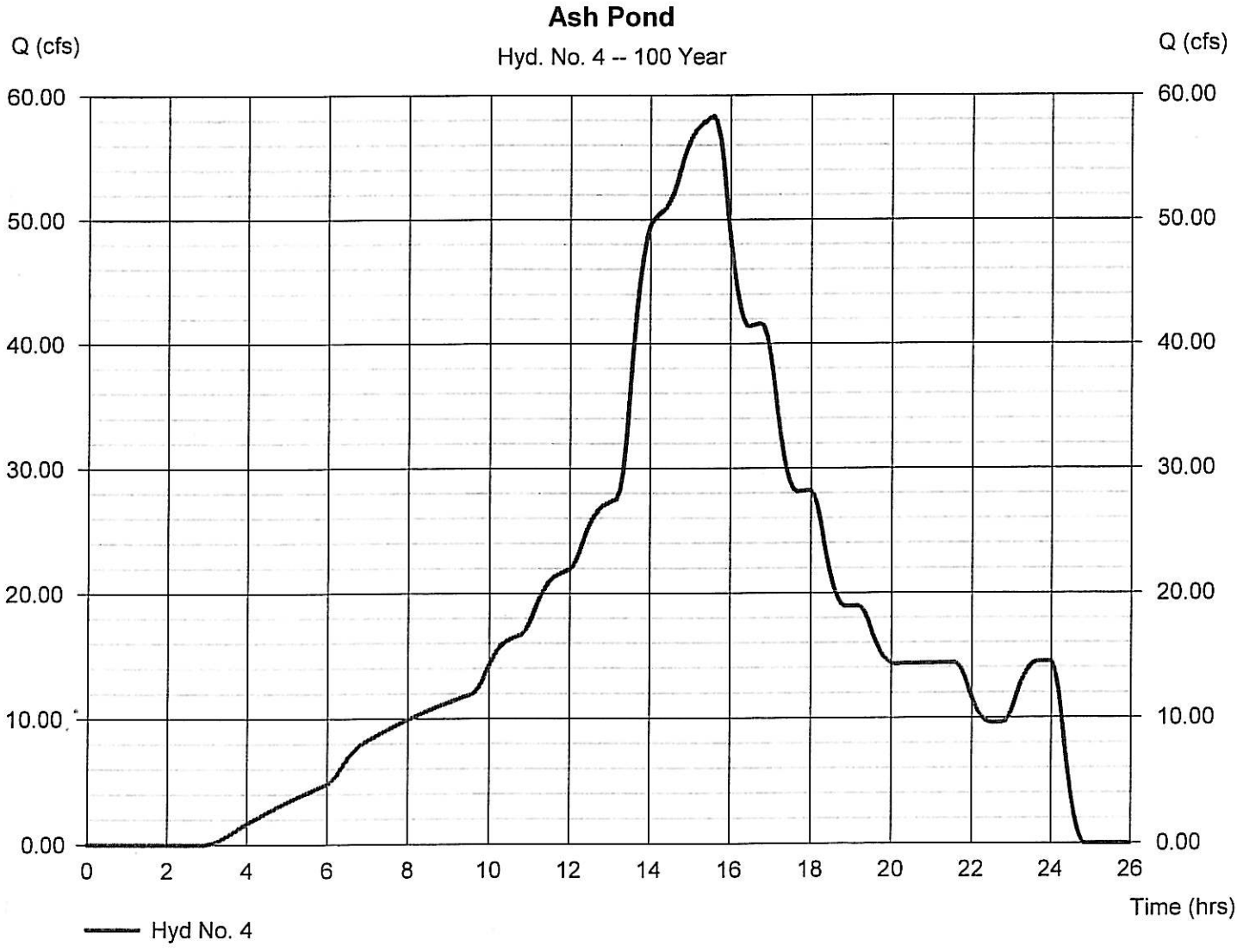


Hydrograph Report

Hyd. No. 4

Ash Pond

Hydrograph type	= SCS Runoff	Peak discharge	= 58.35 cfs
Storm frequency	= 100 yrs	Time to peak	= 15.58 hrs
Time interval	= 5 min	Hyd. volume	= 34.925 acft
Drainage area	= 84.900 ac	Curve number	= 80
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= USER	Time of conc. (Tc)	= 33.00 min
Total precip.	= 7.10 in	Distribution	= Huff-3rd
Storm duration	= 24.00 hrs	Shape factor	= 484



Hydrograph Report

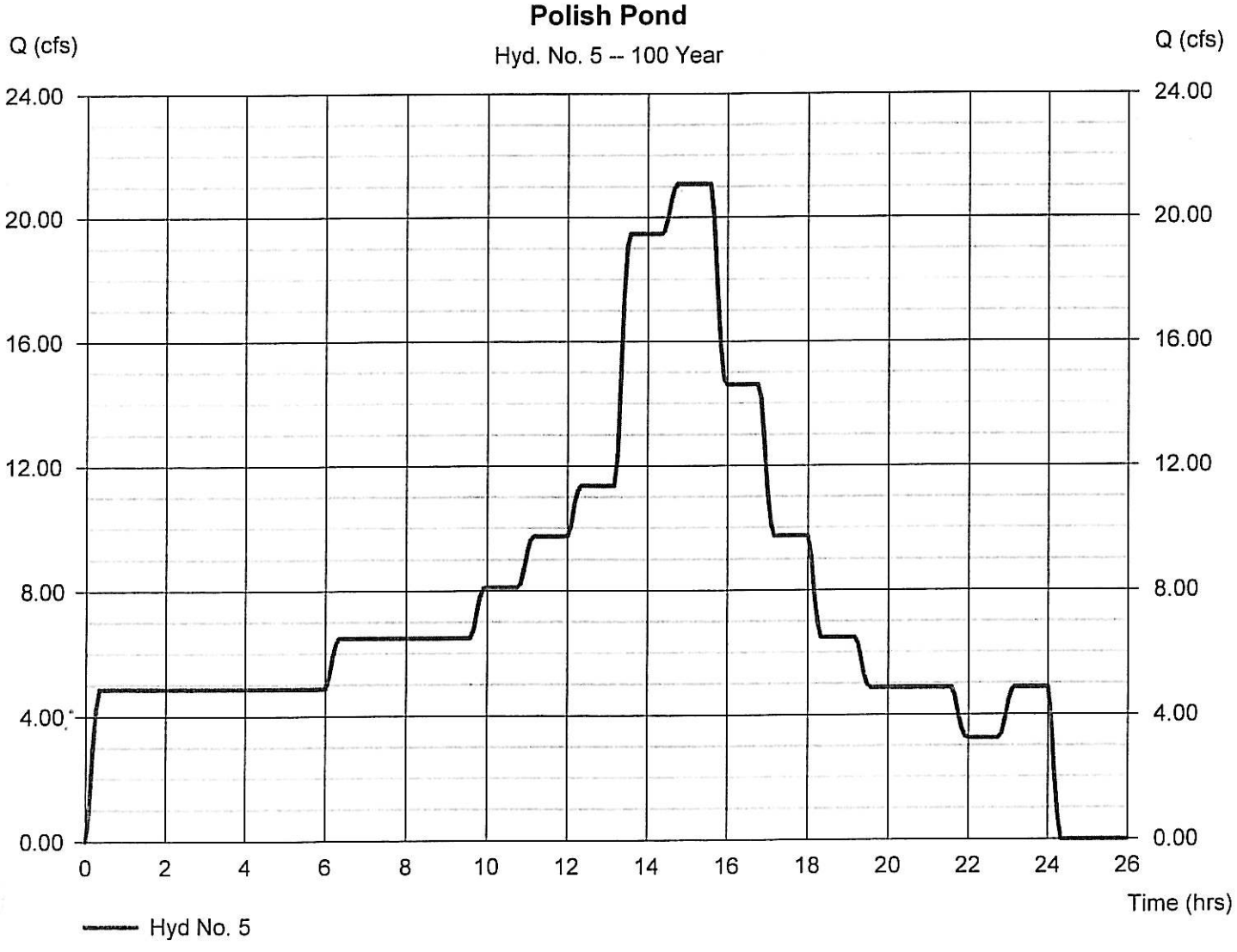
Hydraflow Hydrographs by Intelisolve v9.23

Tuesday, Jan 5, 2010

Hyd. No. 5

Polish Pond

Hydrograph type	= SCS Runoff	Peak discharge	= 21.09 cfs
Storm frequency	= 100 yrs	Time to peak	= 15.42 hrs
Time interval	= 5 min	Hyd. volume	= 16.086 acft
Drainage area	= 29.000 ac	Curve number	= 100
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= USER	Time of conc. (Tc)	= 10.00 min
Total precip.	= 7.10 in	Distribution	= Huff-3rd
Storm duration	= 24.00 hrs	Shape factor	= 484



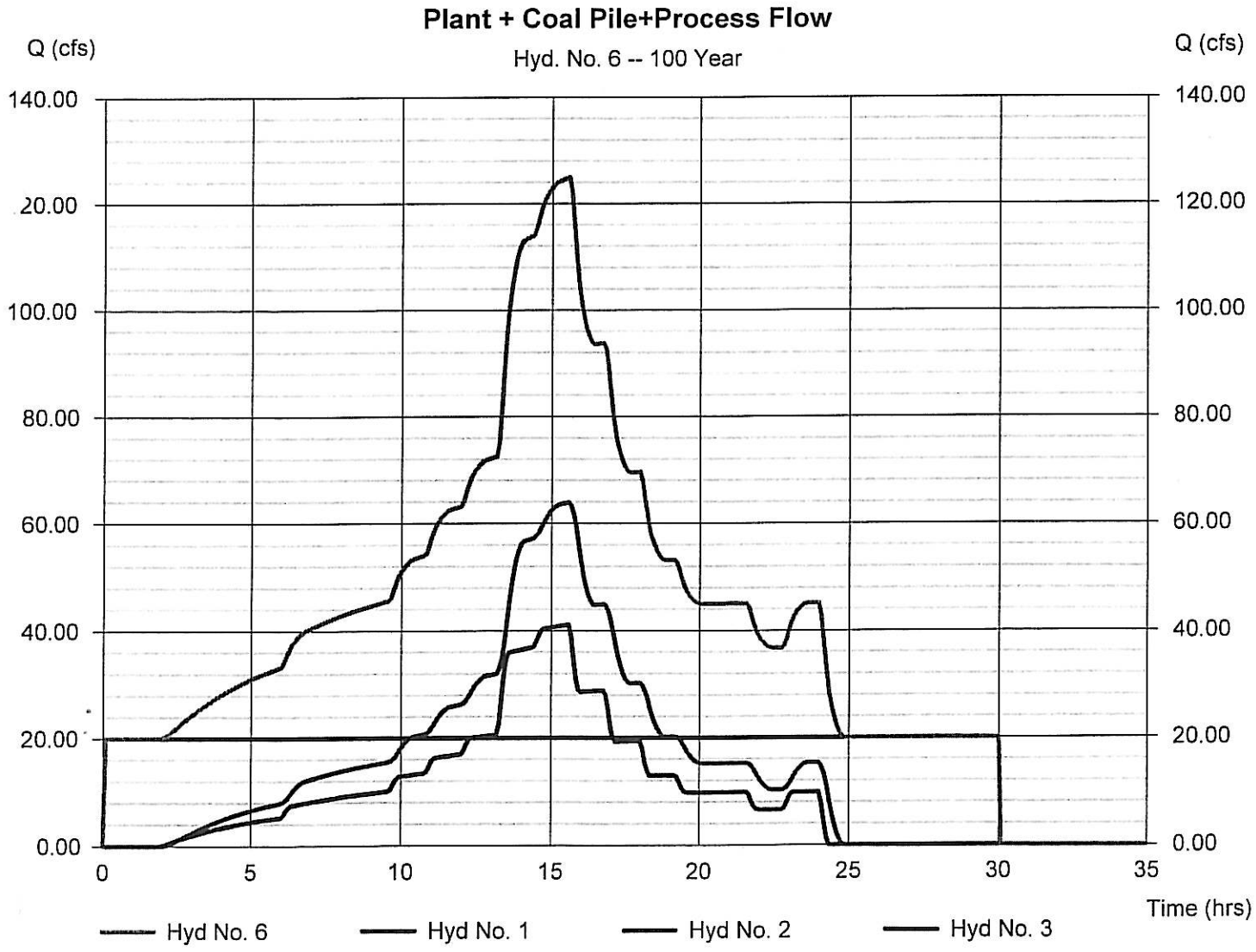
Hydrograph Report

Hydraflow Hydrographs by Intelisolve v9.23 — Tuesday, Jan 5, 2010

Hyd. No. 6

Plant + Coal Pile+Process Flow

Hydrograph type	= Combine	Peak discharge	= 124.99 cfs
Storm frequency	= 100 yrs	Time to peak	= 15.58 hrs
Time interval	= 5 min	Hyd. volume	= 116.039 acft
Inflow hyds.	= 1, 2, 3	Contrib. drain. area	= 147.100 ac



Hydrograph Report

Hydraflow Hydrographs by Intelisolve v9.23

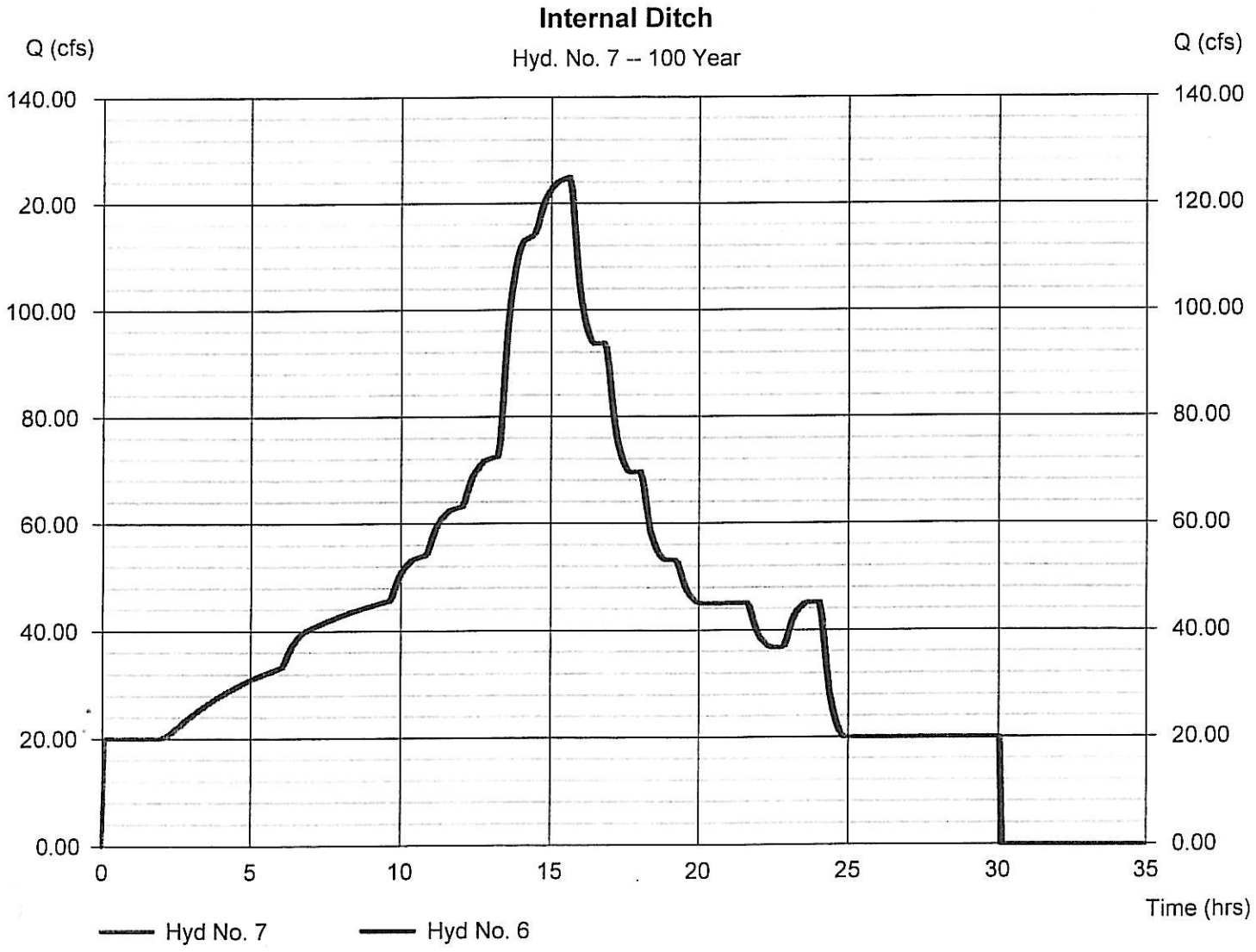
Tuesday, Jan 5, 2010

Hyd. No. 7

Internal Ditch

Hydrograph type	= Reach	Peak discharge	= 124.99 cfs
Storm frequency	= 100 yrs	Time to peak	= 15.67 hrs
Time interval	= 5 min	Hyd. volume	= 116.177 acft
Inflow hyd. No.	= 6 - Plant + Coal Pile+Process Flow	Section type	= Trapezoidal
Reach length	= 1800.0 ft	Channel slope	= 0.3 %
Manning's n	= 0.009	Bottom width	= 10.0 ft
Side slope	= 0.5:1	Max. depth	= 8.0 ft
Rating curve x	= 1.886	Rating curve m	= 1.516
Ave. velocity	= 7.86 ft/s	Routing coeff.	= 0.9967

Modified Att-Kin routing method used.



Hydrograph Report

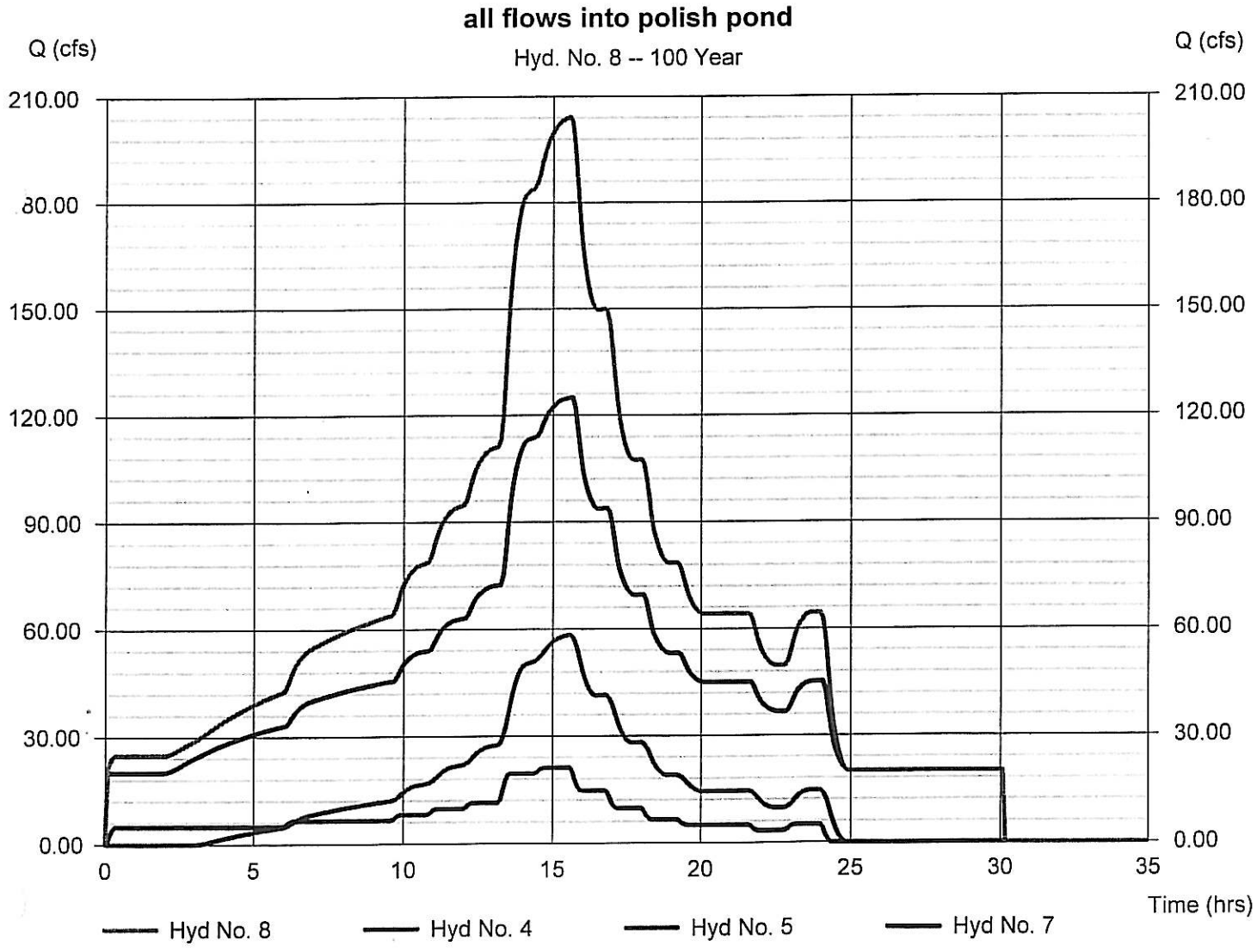
Hydraflow Hydrographs by Intelisolve v9.23

Tuesday, Jan 5, 2010

Hyd. No. 8

all flows into polish pond

Hydrograph type	= Combine	Peak discharge	= 204.24 cfs
Storm frequency	= 100 yrs	Time to peak	= 15.58 hrs
Time interval	= 5 min	Hyd. volume	= 167.188 acft
Inflow hyds.	= 4, 5, 7	Contrib. drain. area	= 113.900 ac



Hydrograph Report

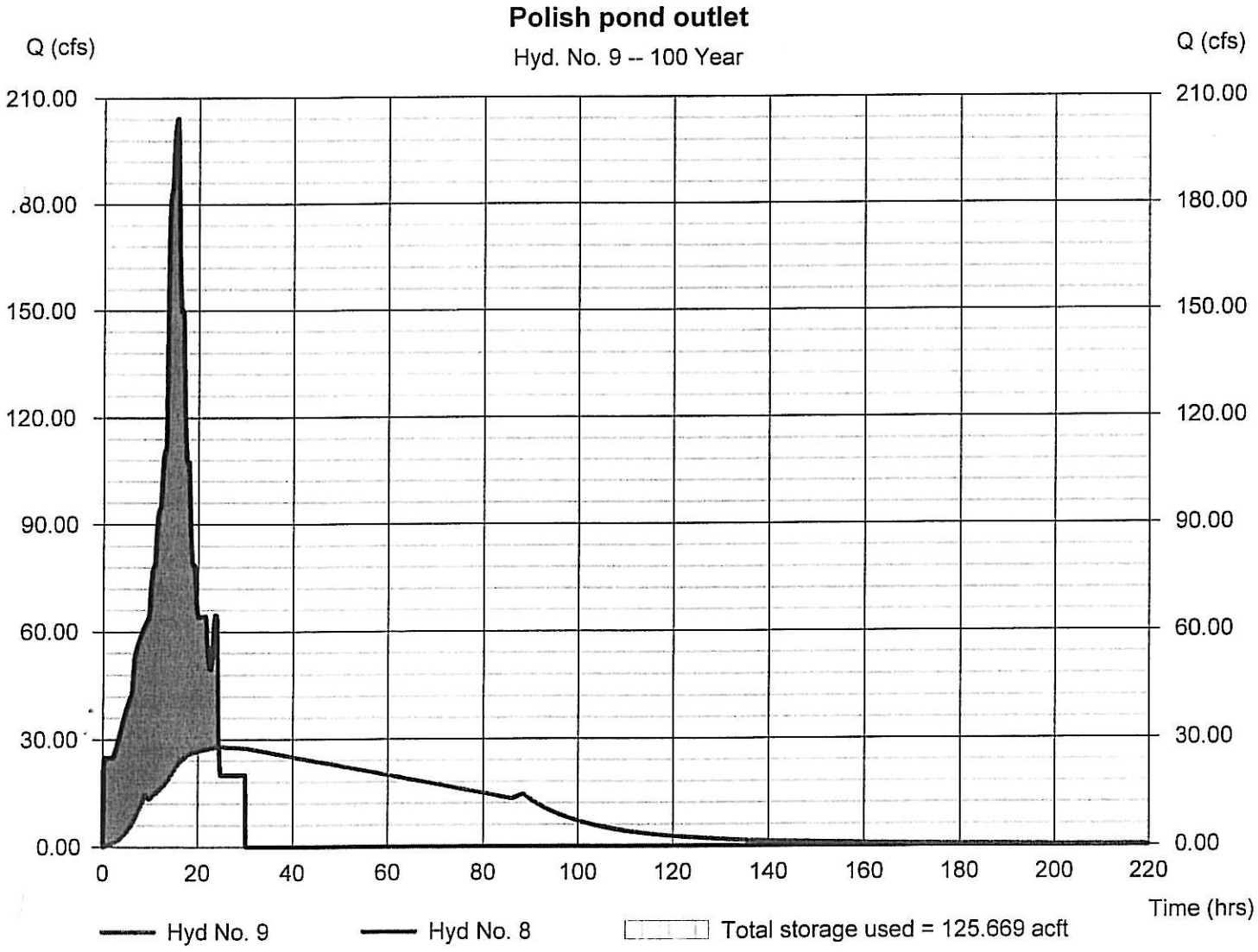
Hydraflow Hydrographs by Intelisolve v9.23 — Tuesday, Jan 5, 2010

Hyd. No. 9

Polish pond outlet

Hydrograph type	= Reservoir	Peak discharge	= 27.93 cfs
Storm frequency	= 100 yrs	Time to peak	= 24.58 hrs
Time interval	= 5 min	Hyd. volume	= 166.243 acft
Inflow hyd. No.	= 8 - all flows into polish pond	Max. Elevation	= 407.44 ft
Reservoir name	= Polish pond	Max. Storage	= 125.669 acft

Storage Indication method used.



Pond Report

Hydraflow Hydrographs by Intelisolve v9.23 — Tuesday, Jan 5, 2010

Pond No. 2 - Polish pond

Pond Data

Contours - User-defined contour areas. Average end area method used for volume calculation. Begining Elevation = 403.00 ft

Stage / Storage Table

Stage (ft)	Elevation (ft)	Contour area (sqft)	Incr. Storage (acft)	Total storage (acft)
0.00	403.00	1,216,913	0.000	0.000
1.00	404.00	1,223,879	28.016	28.016
2.00	405.00	1,230,895	28.177	56.193
3.00	406.00	1,237,962	28.339	84.532
4.00	407.00	1,245,078	28.501	113.033
5.00	408.00	1,252,244	28.665	141.699
6.00	409.00	1,259,460	28.830	170.529
7.00	410.00	1,266,727	28.997	199.526

Culvert / Orifice Structures

	[A]	[B]	[C]	[PrfRsr]
Rise (in)	= 24.00	Inactive	Inactive	Inactive
Span (in)	= 24.00	0.00	0.00	0.00
No. Barrels	= 1	0	0	0
Invert El. (ft)	= 385.00	0.00	0.00	0.00
Length (ft)	= 100.00	0.00	0.00	0.00
Slope (%)	= 5.00	0.00	0.00	n/a
N-Value	= .013	.013	.013	n/a
Orifice Coeff.	= 0.67	0.60	0.60	0.60
Multi-Stage	= n/a	No	No	No

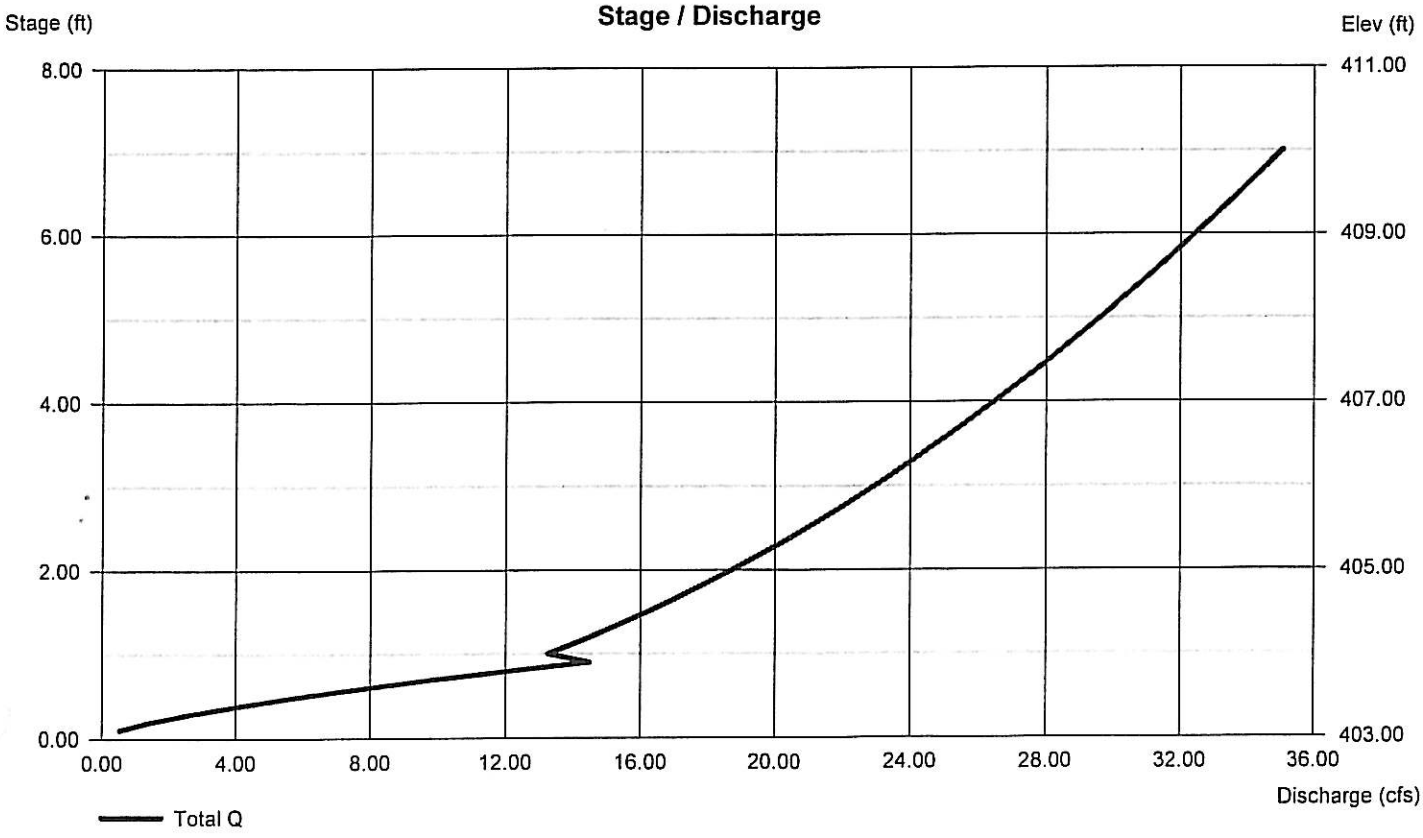
Weir Structures

	[A]	[B]	[C]	[D]
Crest Len (ft)	= 6.28	Inactive	Inactive	Inactive
Crest El. (ft)	= 403.00	0.00	0.00	0.00
Weir Coeff.	= 2.70	3.33	3.33	3.33
Weir Type	= Riser	---	---	---
Multi-Stage	= Yes	No	No	No

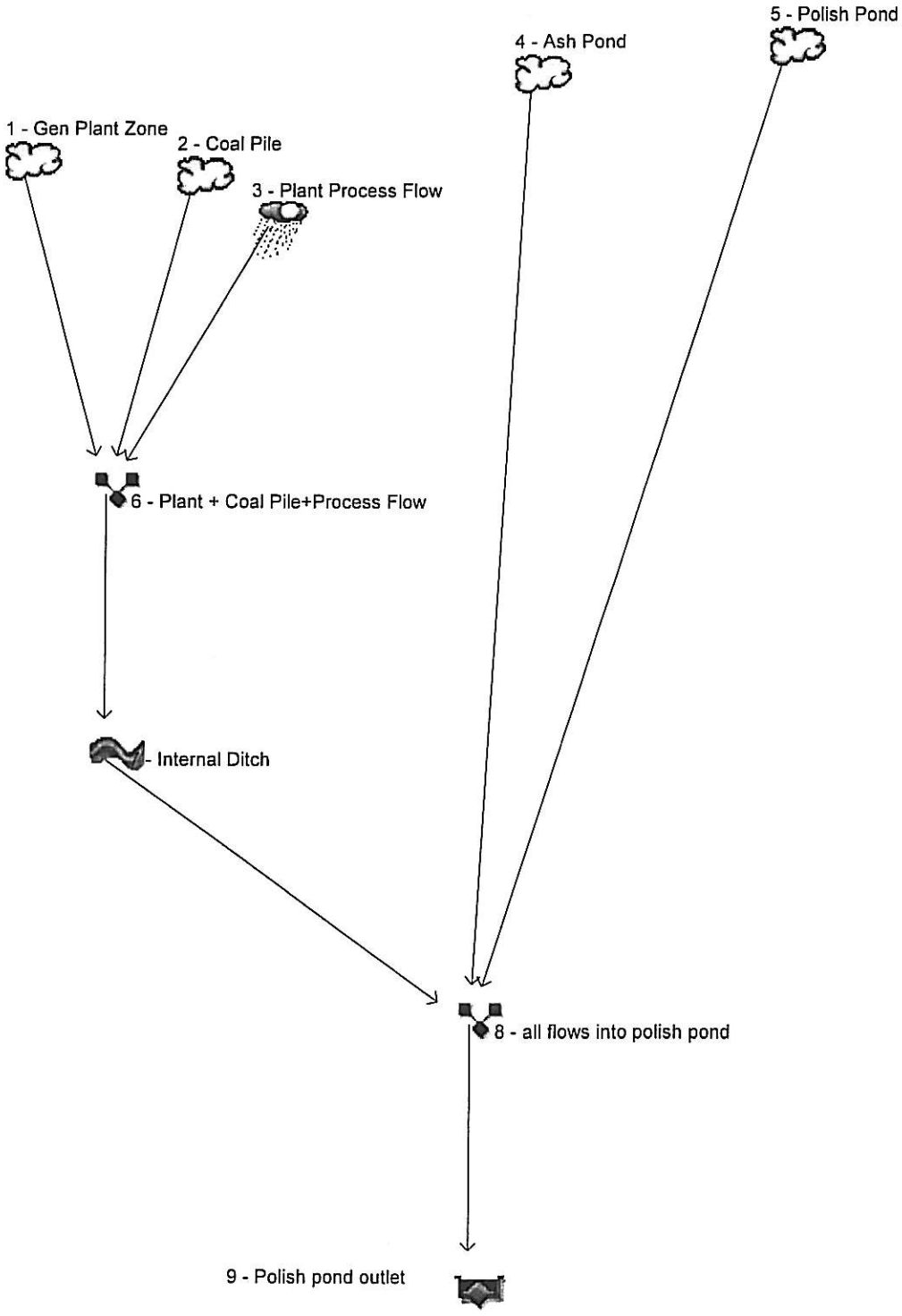
Exfil.(in/hr) = 0.000 (by Wet area)

TW Elev. (ft) = 0.00

Note: Culvert/Orifice outflows are analyzed under inlet (ic) and outlet (oc) control. Weir risers checked for orifice conditions (ic) and submergence (s).



Watershed Model Schematic



Hydrograph Summary Report

Hydraflow Hydrographs by Intelisolve v9.23

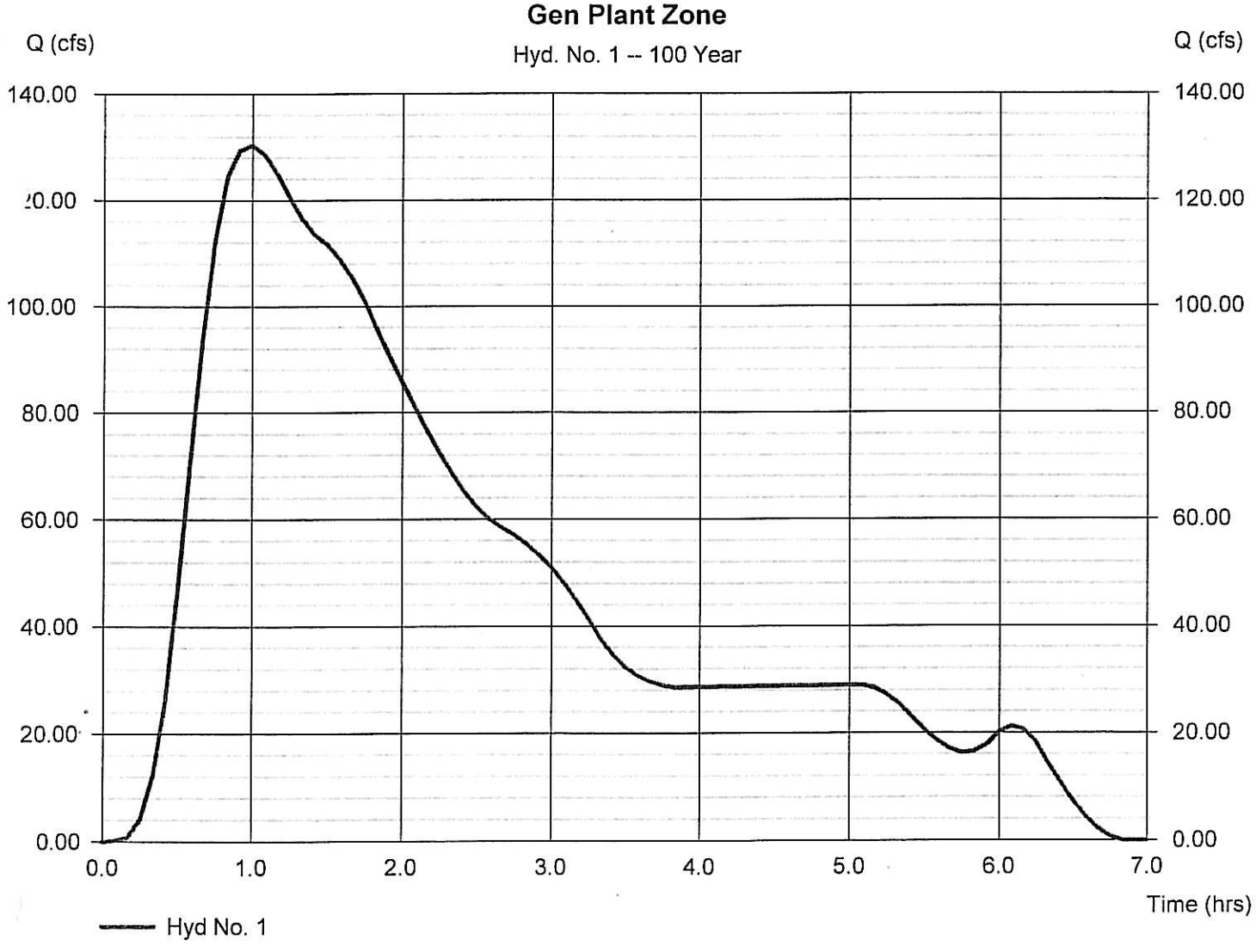
Hyd. No.	Hydrograph type (origin)	Peak flow (cfs)	Time interval (min)	Time to peak (min)	Hyd. volume (acft)	Inflow hyd(s)	Maximum elevation (ft)	Total strge used (acft)	Hydrograph description
1	SCS Runoff	130.36	5	60	27.092	----	------	------	Gen Plant Zone
2	SCS Runoff	100.99	5	40	17.352	----	------	------	Coal Pile
3	Manual	20.00	5	5	49.587	----	------	------	Plant Process Flow
4	SCS Runoff	97.72	5	70	22.381	----	------	------	Ash Pond
5	SCS Runoff	80.40	5	35	11.781	----	------	------	Polish Pond
6	Combine	226.00	5	50	94.031	1, 2, 3,	------	------	Plant + Coal Pile+Process Flow
7	Reach	226.18	5	55	94.174	6	------	------	Internal Ditch
8	Combine	367.43	5	65	128.336	4, 5, 7	------	------	all flows into polish pond
9	Reservoir	23.51	5	405	126.749	8	398.25	79.8	Polish pond outlet

Hydrograph Report

Hyd. No. 1

Gen Plant Zone

Hydrograph type	= SCS Runoff	Peak discharge	= 130.36 cfs
Storm frequency	= 100 yrs	Time to peak	= 1.00 hrs
Time interval	= 5 min	Hyd. volume	= 27.092 acft
Drainage area	= 86.300 ac	Curve number	= 86
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= USER	Time of conc. (Tc)	= 30.00 min
Total precip.	= 5.20 in	Distribution	= Huff-1st
Storm duration	= 6.00 hrs	Shape factor	= 484

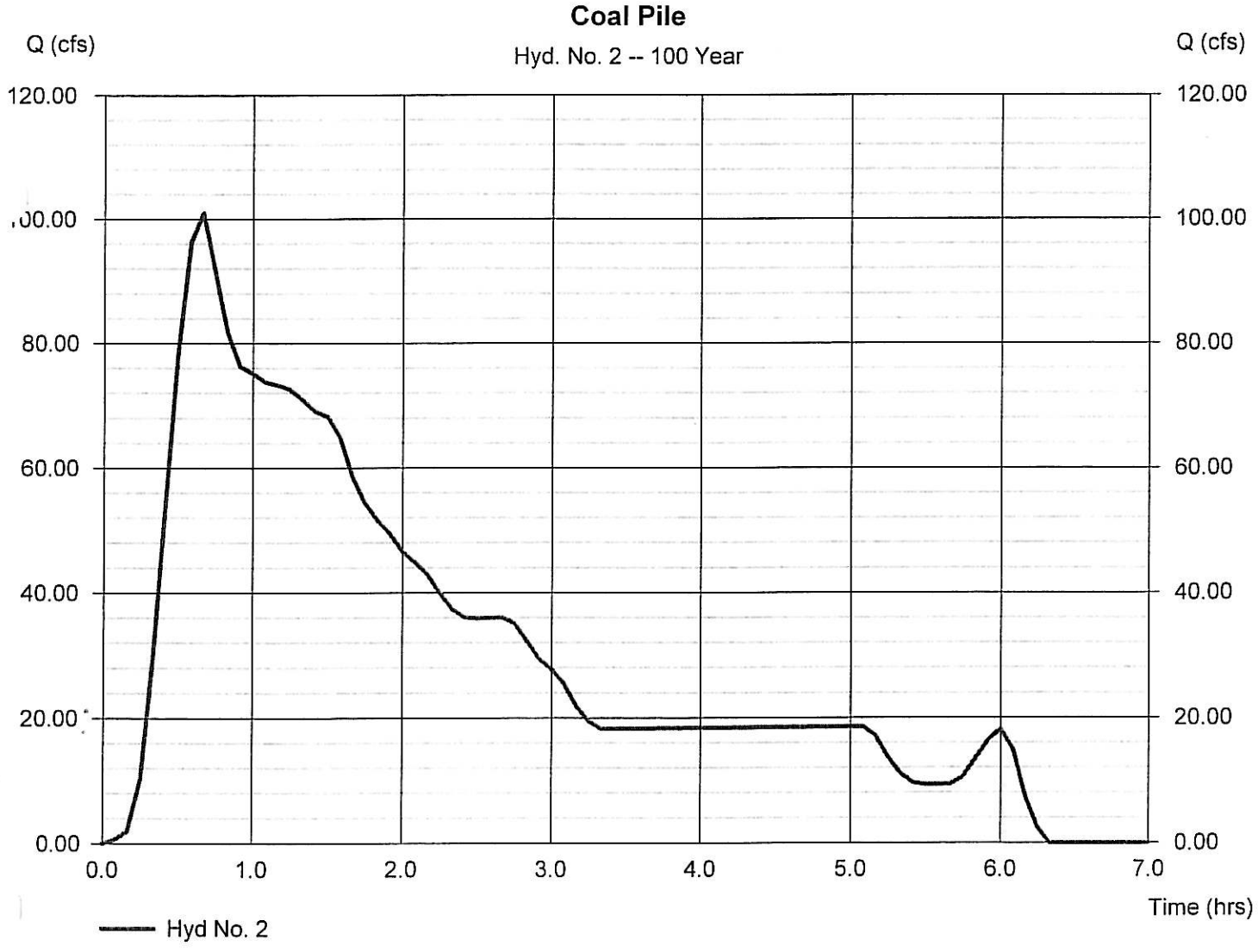


Hydrograph Report

Hyd. No. 2

Coal Pile

Hydrograph type	= SCS Runoff	Peak discharge	= 100.99 cfs
Storm frequency	= 100 yrs	Time to peak	= 0.67 hrs
Time interval	= 5 min	Hyd. volume	= 17.352 acft
Drainage area	= 60.800 ac	Curve number	= 86
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= USER	Time of conc. (Tc)	= 12.00 min
Total precip.	= 5.20 in	Distribution	= Huff-1st
Storm duration	= 6.00 hrs	Shape factor	= 484

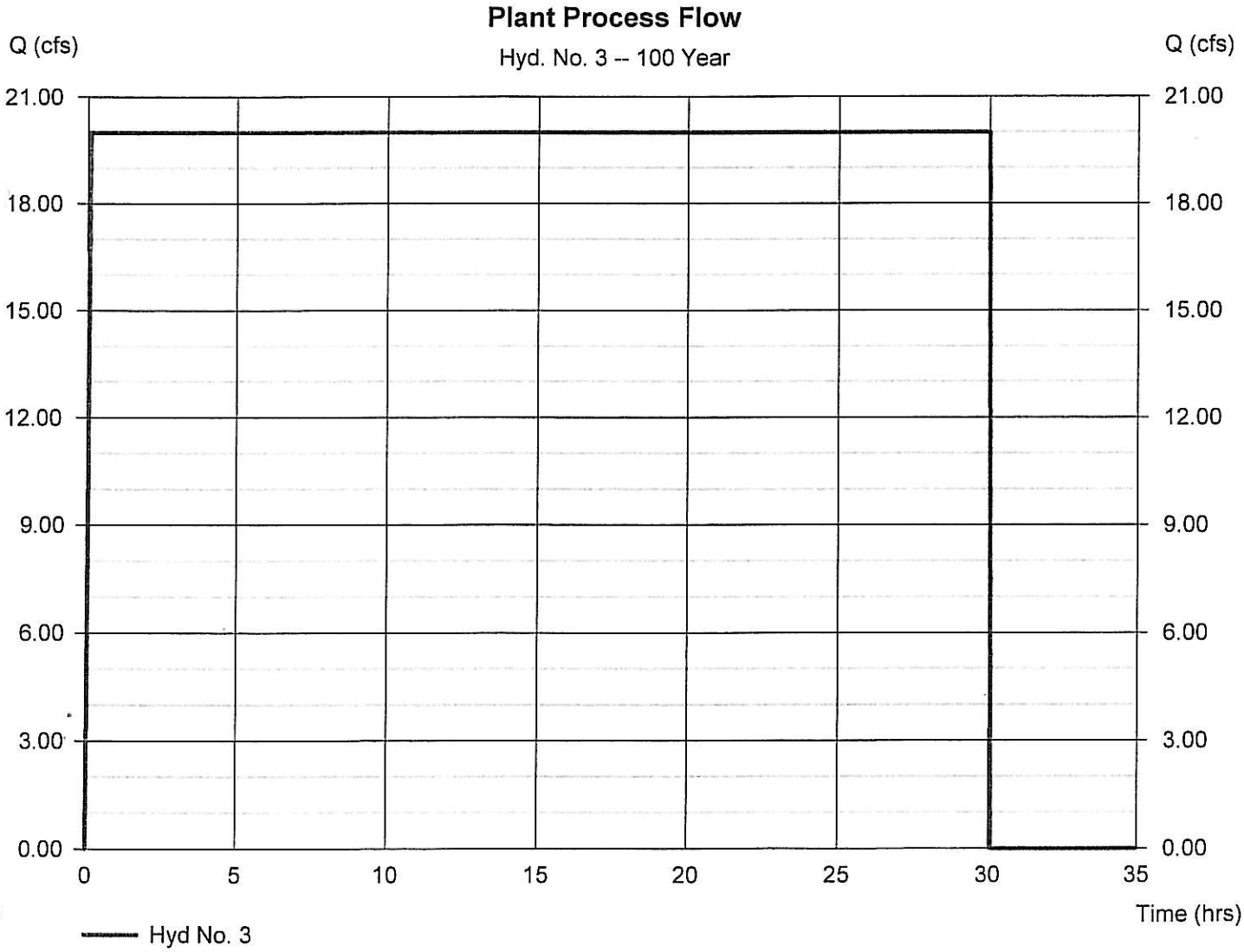


Hydrograph Report

Hyd. No. 3

Plant Process Flow

Hydrograph type	= Manual	Peak discharge	= 20.00 cfs
Storm frequency	= 100 yrs	Time to peak	= 0.08 hrs
Time interval	= 5 min	Hyd. volume	= 49.587 acft

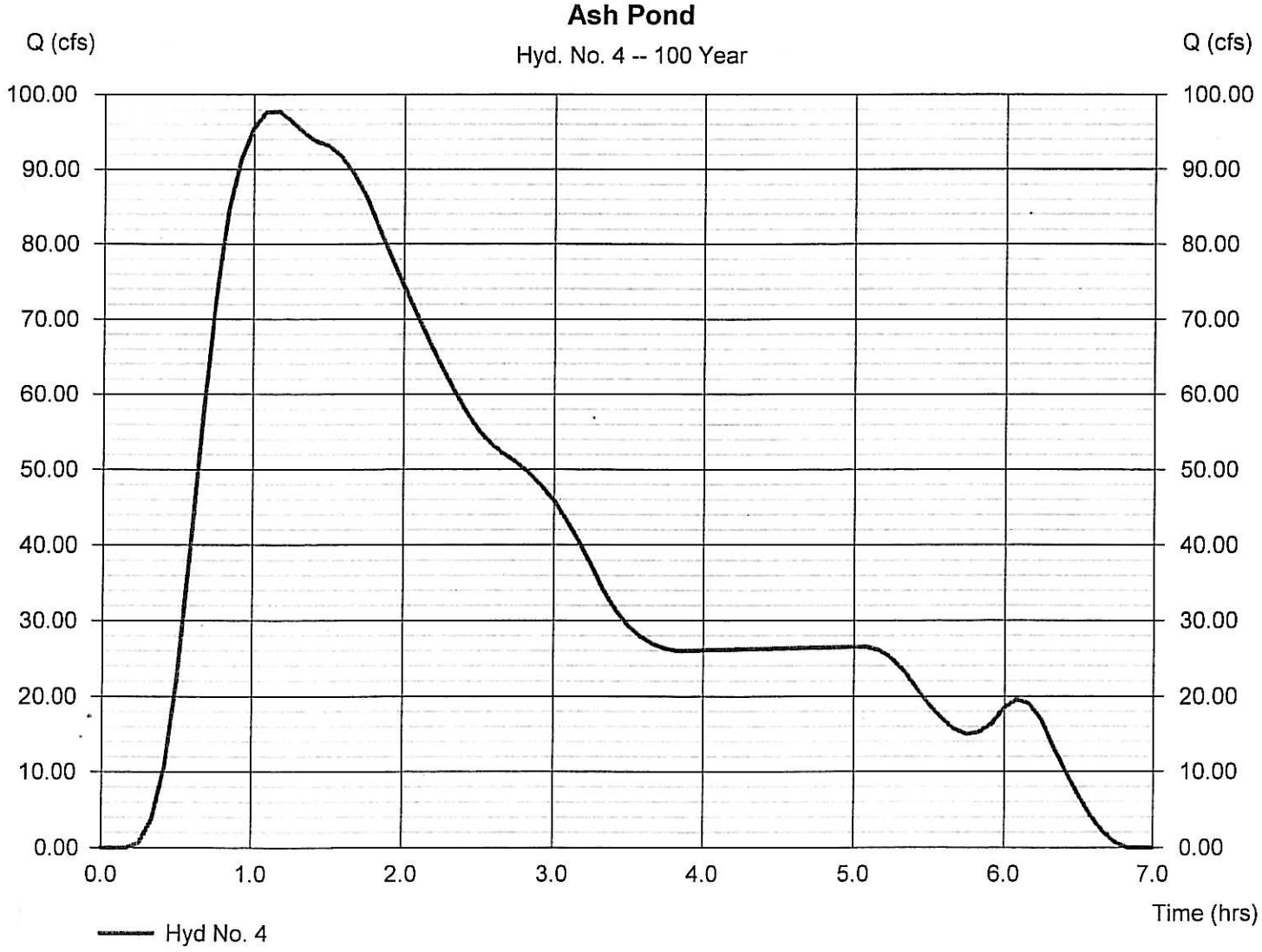


Hydrograph Report

Hyd. No. 4

Ash Pond

Hydrograph type	= SCS Runoff	Peak discharge	= 97.72 cfs
Storm frequency	= 100 yrs	Time to peak	= 1.17 hrs
Time interval	= 5 min	Hyd. volume	= 22.381 acft
Drainage area	= 84.900 ac	Curve number	= 80
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= USER	Time of conc. (Tc)	= 33.00 min
Total precip.	= 5.20 in	Distribution	= Huff-1st
Storm duration	= 6.00 hrs	Shape factor	= 484

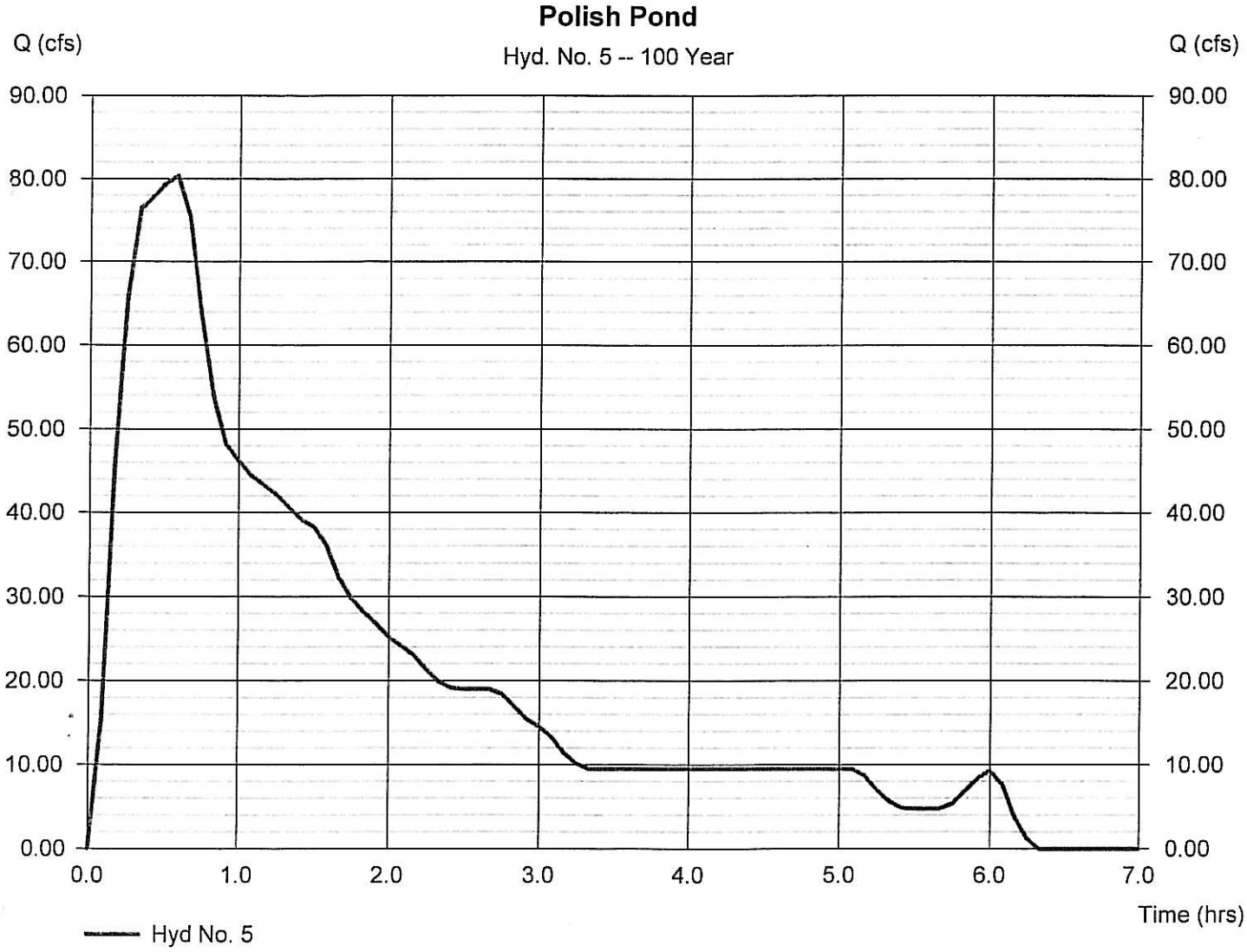


Hydrograph Report

Hyd. No. 5

Polish Pond

Hydrograph type	= SCS Runoff	Peak discharge	= 80.40 cfs
Storm frequency	= 100 yrs	Time to peak	= 0.58 hrs
Time interval	= 5 min	Hyd. volume	= 11.781 acft
Drainage area	= 29.000 ac	Curve number	= 100
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= USER	Time of conc. (Tc)	= 10.00 min
Total precip.	= 5.20 in	Distribution	= Huff-1st
Storm duration	= 6.00 hrs	Shape factor	= 484

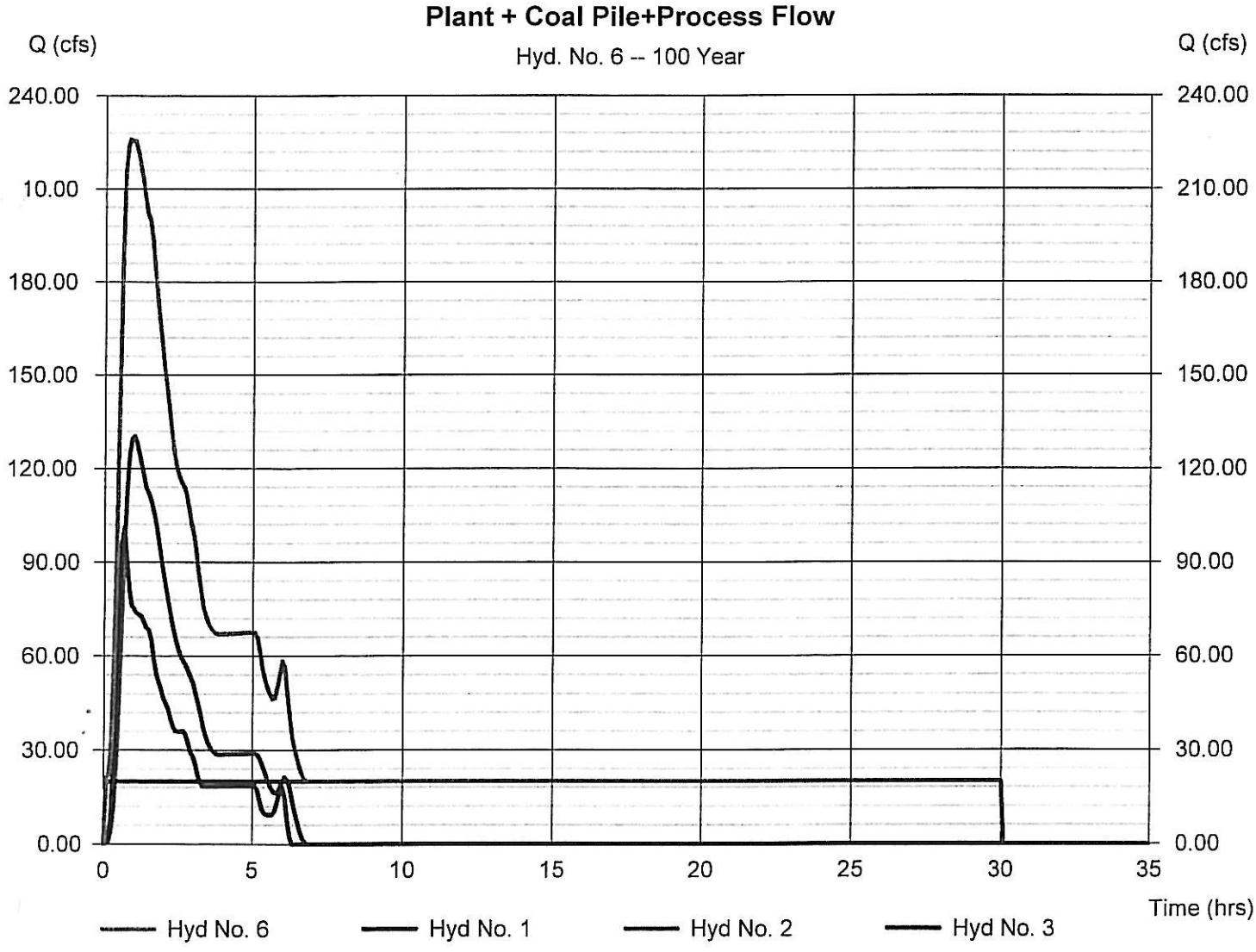


Hydrograph Report

Hyd. No. 6

Plant + Coal Pile+Process Flow

Hydrograph type	= Combine	Peak discharge	= 226.00 cfs
Storm frequency	= 100 yrs	Time to peak	= 0.83 hrs
Time interval	= 5 min	Hyd. volume	= 94.031 acft
Inflow hyds.	= 1, 2, 3	Contrib. drain. area	= 147.100 ac



Hydrograph Report

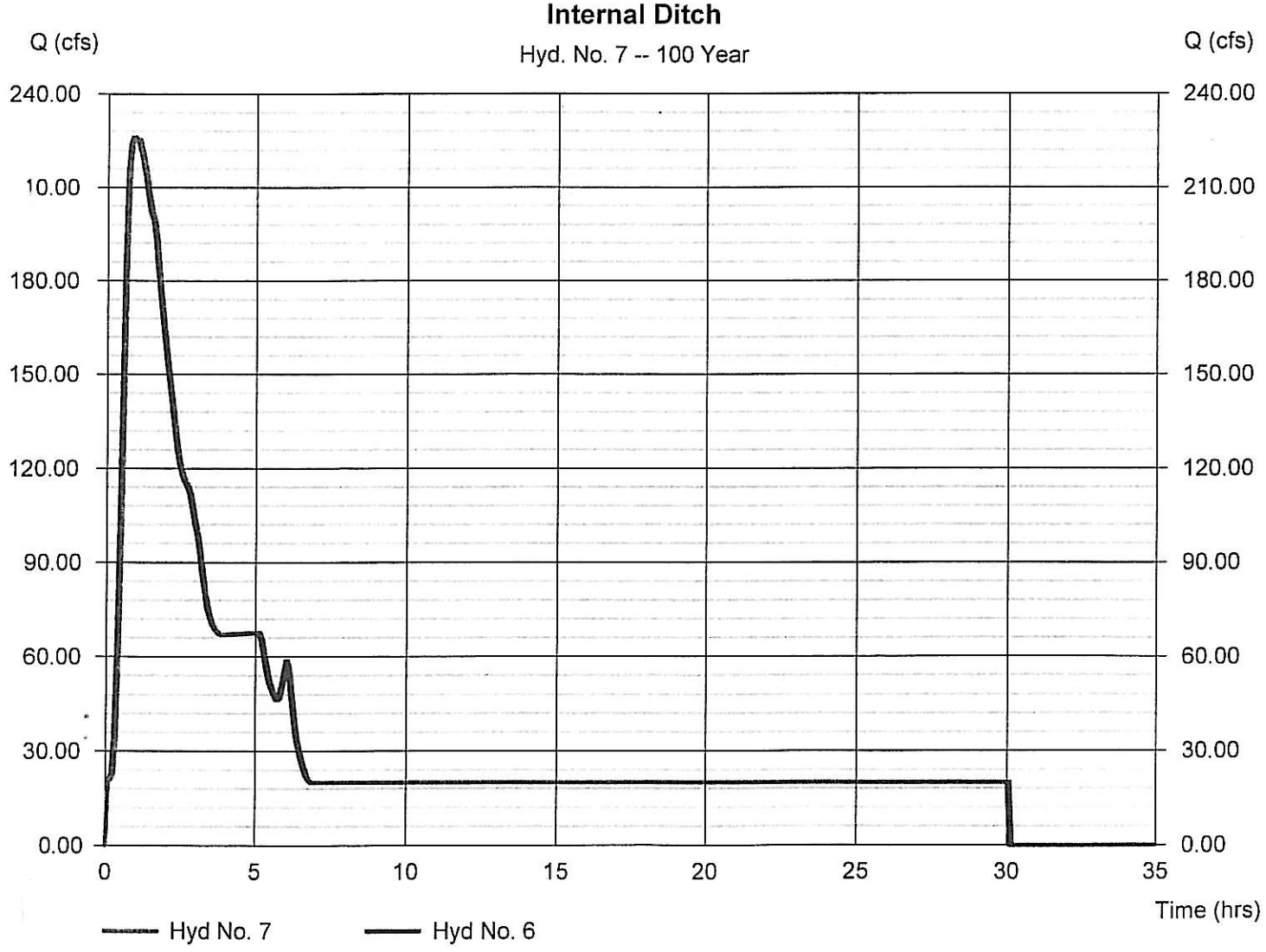
Hydraflow Hydrographs by Intelisolve v9.23 — Friday, Jan 8, 2010

Hyd. No. 7

Internal Ditch

Hydrograph type	= Reach	Peak discharge	= 226.18 cfs
Storm frequency	= 100 yrs	Time to peak	= 0.92 hrs
Time interval	= 5 min	Hyd. volume	= 94.174 acft
Inflow hyd. No.	= 6 - Plant + Coal Pile+Process Flow	Section type	= Trapezoidal
Reach length	= 1800.0 ft	Channel slope	= 0.3 %
Manning's n	= 0.009	Bottom width	= 10.0 ft
Side slope	= 0.5:1	Max. depth	= 8.0 ft
Rating curve x	= 1.886	Rating curve m	= 1.516
Ave. velocity	= 9.62 ft/s	Routing coeff.	= 1.0972

Modified Att-Kin routing method used.

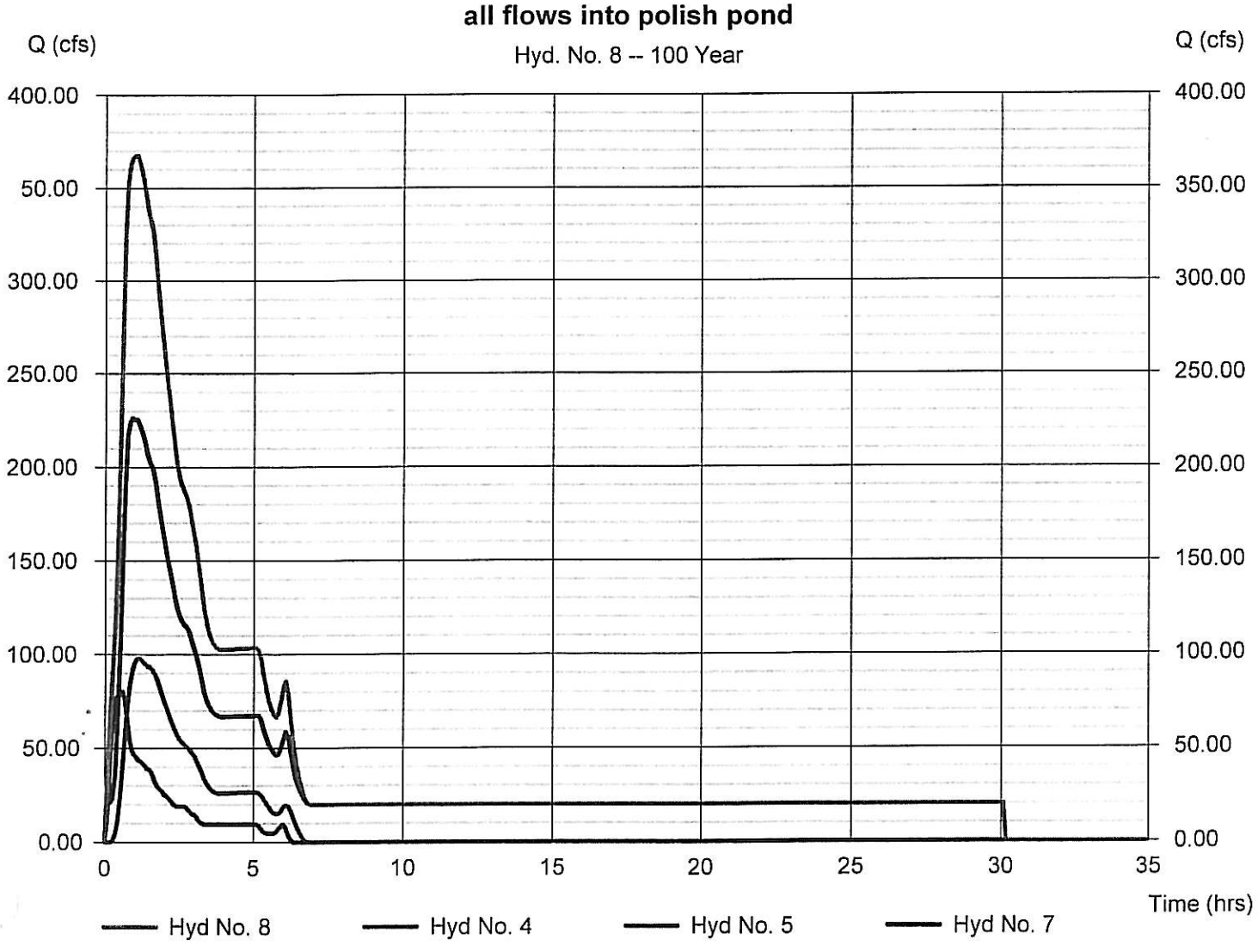


Hydrograph Report

Hyd. No. 8

all flows into polish pond

Hydrograph type	= Combine	Peak discharge	= 367.43 cfs
Storm frequency	= 100 yrs	Time to peak	= 1.08 hrs
Time interval	= 5 min	Hyd. volume	= 128.336 acft
Inflow hyds.	= 4, 5, 7	Contrib. drain. area	= 113.900 ac



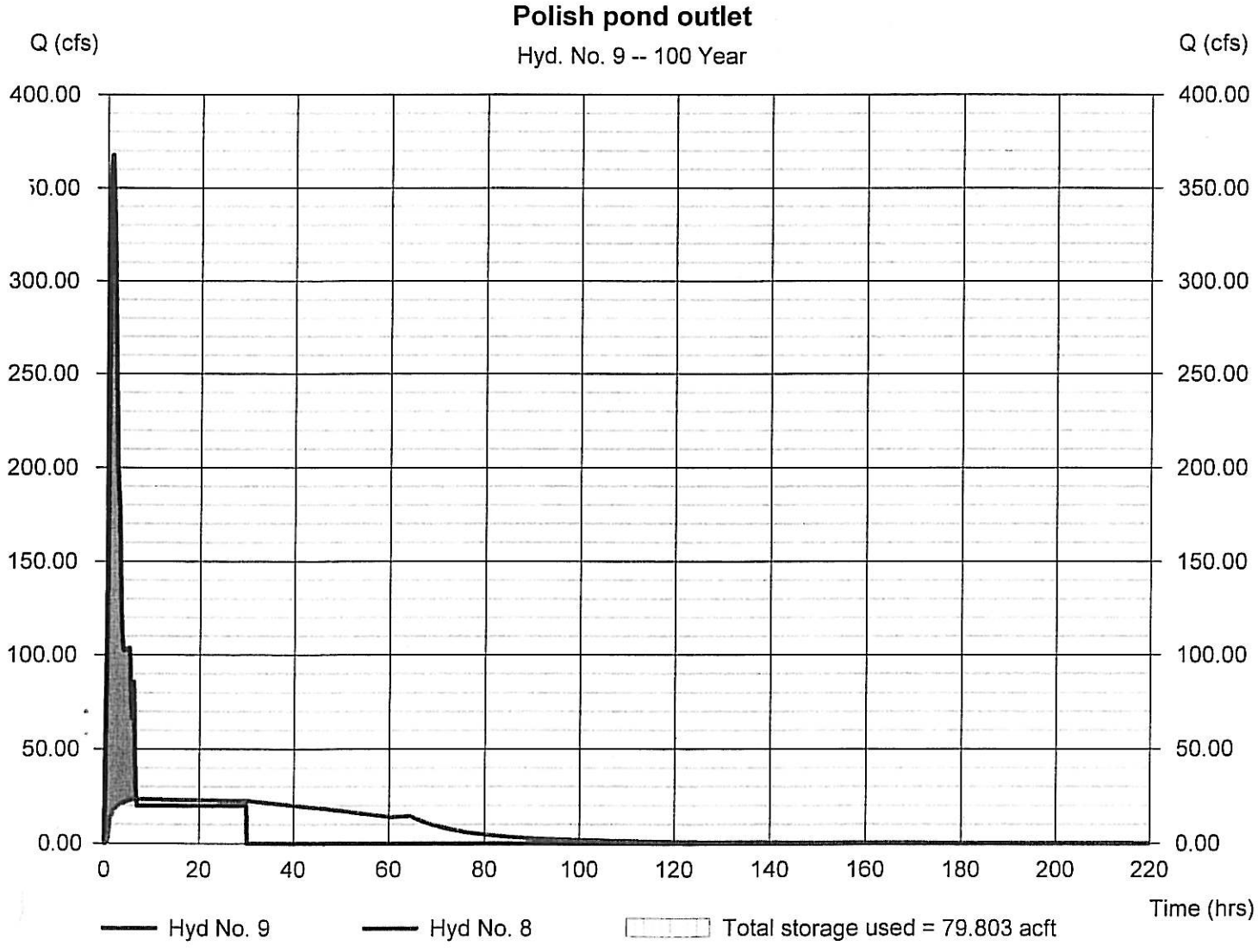
Hydrograph Report

Hyd. No. 9

Polish pond outlet

Hydrograph type	= Reservoir	Peak discharge	= 23.51 cfs
Storm frequency	= 100 yrs	Time to peak	= 6.75 hrs
Time interval	= 5 min	Hyd. volume	= 126.749 acft
Inflow hyd. No.	= 8 - all flows into polish pond	Max. Elevation	= 398.25 ft
Reservoir name	= Polish pond	Max. Storage	= 79.803 acft

Storage Indication method used.



Pond No. 2 - Polish pond

Pond Data

Contours - User-defined contour areas. Average end area method used for volume calculation. Begining Elevation = 395.00 ft

Stage / Storage Table

Stage (ft)	Elevation (ft)	Contour area (sqft)	Incr. Storage (acft)	Total storage (acft)
0.00	395.00	823,284	0.000	0.000
2.00	397.00	1,176,165	45.901	45.901
3.00	398.00	1,187,259	27.128	73.029
4.00	399.00	1,189,548	27.282	100.311
5.00	400.00	1,196,314	27.386	127.697
6.00	401.00	1,203,130	27.542	155.239
7.00	402.00	1,209,997	27.699	182.938
8.00	403.00	1,216,913	27.857	210.795
9.00	404.00	1,223,879	28.016	238.812
10.00	405.00	1,230,895	28.177	266.989

Culvert / Orifice Structures

	[A]	[B]	[C]	[PrfRsr]
Rise (in)	= 24.00	Inactive	Inactive	Inactive
Span (in)	= 24.00	0.00	0.00	0.00
No. Barrels	= 1	0	0	0
Invert El. (ft)	= 385.00	0.00	0.00	0.00
Length (ft)	= 100.00	0.00	0.00	0.00
Slope (%)	= 5.00	0.00	0.00	n/a
N-Value	= .013	.013	.013	n/a
Orifice Coeff.	= 0.67	0.60	0.60	0.60
Multi-Stage	= n/a	No	No	No

Weir Structures

	[A]	[B]	[C]	[D]
Crest Len (ft)	= 6.28	Inactive	Inactive	Inactive
Crest El. (ft)	= 395.10	0.00	0.00	0.00
Weir Coeff.	= 2.70	3.33	3.33	3.33
Weir Type	= Riser	---	---	---
Multi-Stage	= Yes	No	No	No

Exfil.(in/hr) = 0.000 (by Wet area)

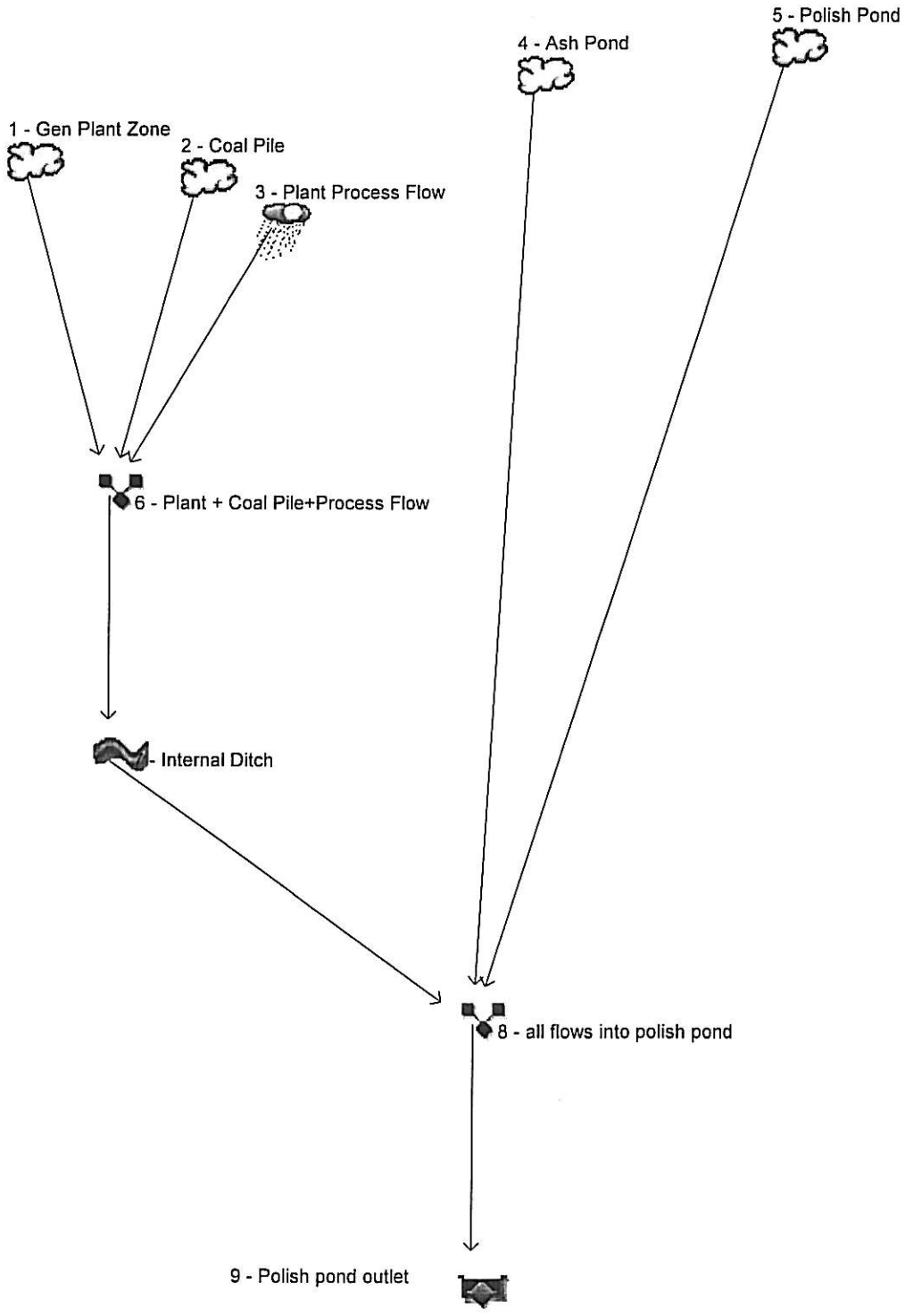
TW Elev. (ft) = 360.00

Note: Culvert/Orifice outflows are analyzed under inlet (ic) and outlet (oc) control. Weir risers checked for orifice conditions (ic) and submergence (s).

Stage / Storage / Discharge Table

Stage ft	Storage acft	Elevation ft	Clv A cfs	Clv B cfs	Clv C cfs	PrfRsr cfs	Wr A cfs	Wr B cfs	Wr C cfs	Wr D cfs	Exfil cfs	User cfs	Total cfs
0.00	0.000	395.00	0.00	---	---	---	0.00	---	---	---	---	---	0.000
2.00	45.901	397.00	50.67 ic	---	---	---	18.27 ic	---	---	---	---	---	18.27
3.00	73.029	398.00	50.67 ic	---	---	---	22.57 ic	---	---	---	---	---	22.57
4.00	100.311	399.00	50.67 ic	---	---	---	26.17 ic	---	---	---	---	---	26.17
5.00	127.697	400.00	50.67 ic	---	---	---	29.34 ic	---	---	---	---	---	29.34
6.00	155.239	401.00	50.67 ic	---	---	---	32.19 ic	---	---	---	---	---	32.19
7.00	182.938	402.00	50.67 ic	---	---	---	34.81 ic	---	---	---	---	---	34.81
8.00	210.795	403.00	50.67 ic	---	---	---	37.25 ic	---	---	---	---	---	37.25
9.00	238.812	404.00	50.67 ic	---	---	---	39.54 ic	---	---	---	---	---	39.54
10.00	266.989	405.00	50.67 ic	---	---	---	41.70 ic	---	---	---	---	---	41.70

Watershed Model Schematic



Hydrograph Summary Report

Hydraflow Hydrographs by Intelisolve v9.23

Hyd. No.	Hydrograph type (origin)	Peak flow (cfs)	Time interval (min)	Time to peak (min)	Hyd. volume (acft)	Inflow hyd(s)	Maximum elevation (ft)	Total strge used (acft)	Hydrograph description
1	SCS Runoff	130.36	5	60	27.092	----	------	------	Gen Plant Zone
2	SCS Runoff	100.99	5	40	17.352	----	------	------	Coal Pile
3	Manual	20.00	5	5	49.587	----	------	------	Plant Process Flow
4	SCS Runoff	97.72	5	70	22.381	----	------	------	Ash Pond
5	SCS Runoff	80.40	5	35	11.781	----	------	------	Polish Pond
6	Combine	226.00	5	50	94.031	1, 2, 3,	------	------	Plant + Coal Pile+Process Flow
7	Reach	226.18	5	55	94.174	6	------	------	Internal Ditch
8	Combine	367.43	5	65	128.336	4, 5, 7	------	------	all flows into polish pond
9	Reservoir	22.38	5	405	127.674	8	405.85	80.3	Polish pond outlet

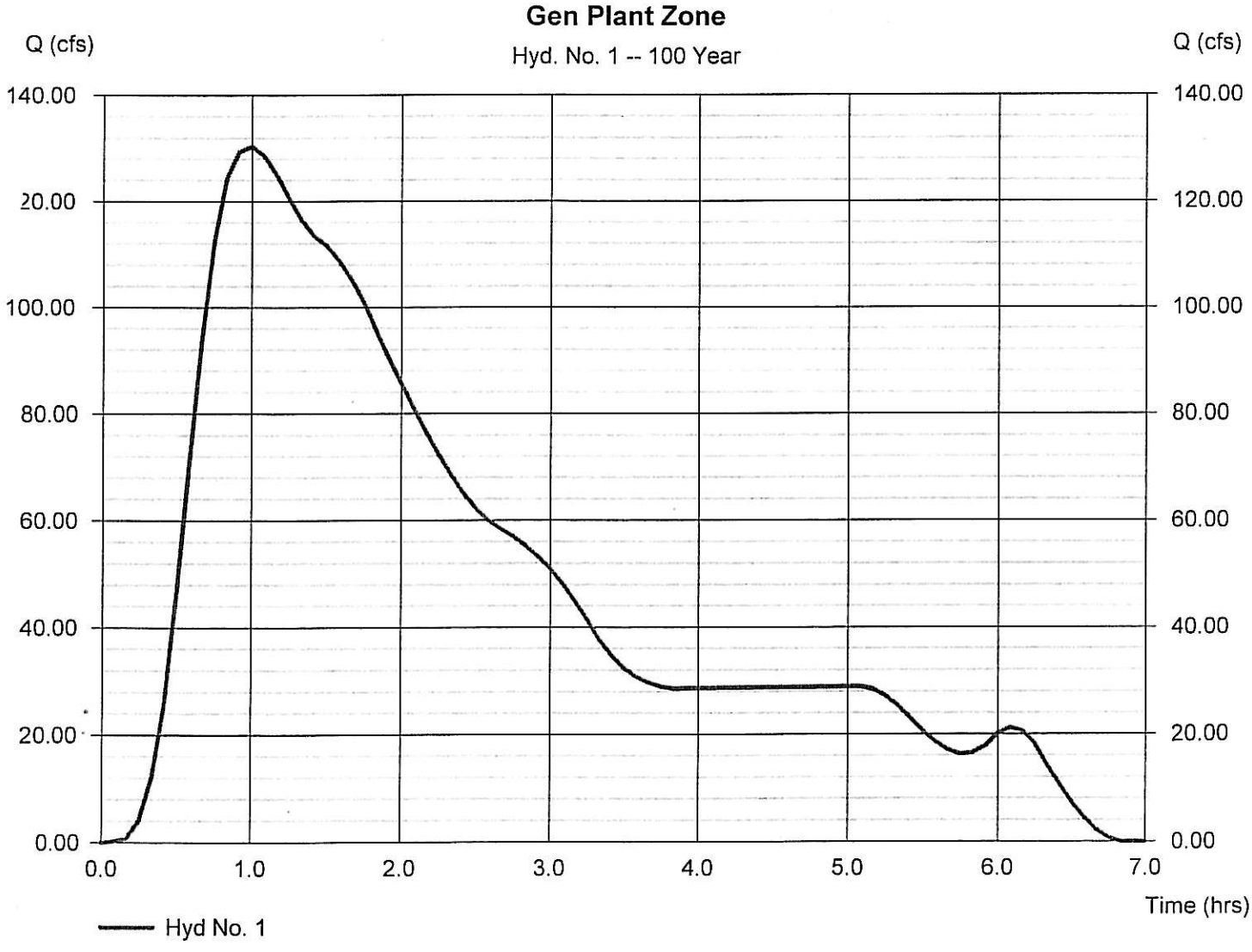
Hydrograph Report

Hydraflow Hydrographs by Intelisolve v9.23 — Friday, Jan 8, 2010

Hyd. No. 1

Gen Plant Zone

Hydrograph type	= SCS Runoff	Peak discharge	= 130.36 cfs
Storm frequency	= 100 yrs	Time to peak	= 1.00 hrs
Time interval	= 5 min	Hyd. volume	= 27.092 acft
Drainage area	= 86.300 ac	Curve number	= 86
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= USER	Time of conc. (Tc)	= 30.00 min
Total precip.	= 5.20 in	Distribution	= Huff-1st
Storm duration	= 6.00 hrs	Shape factor	= 484

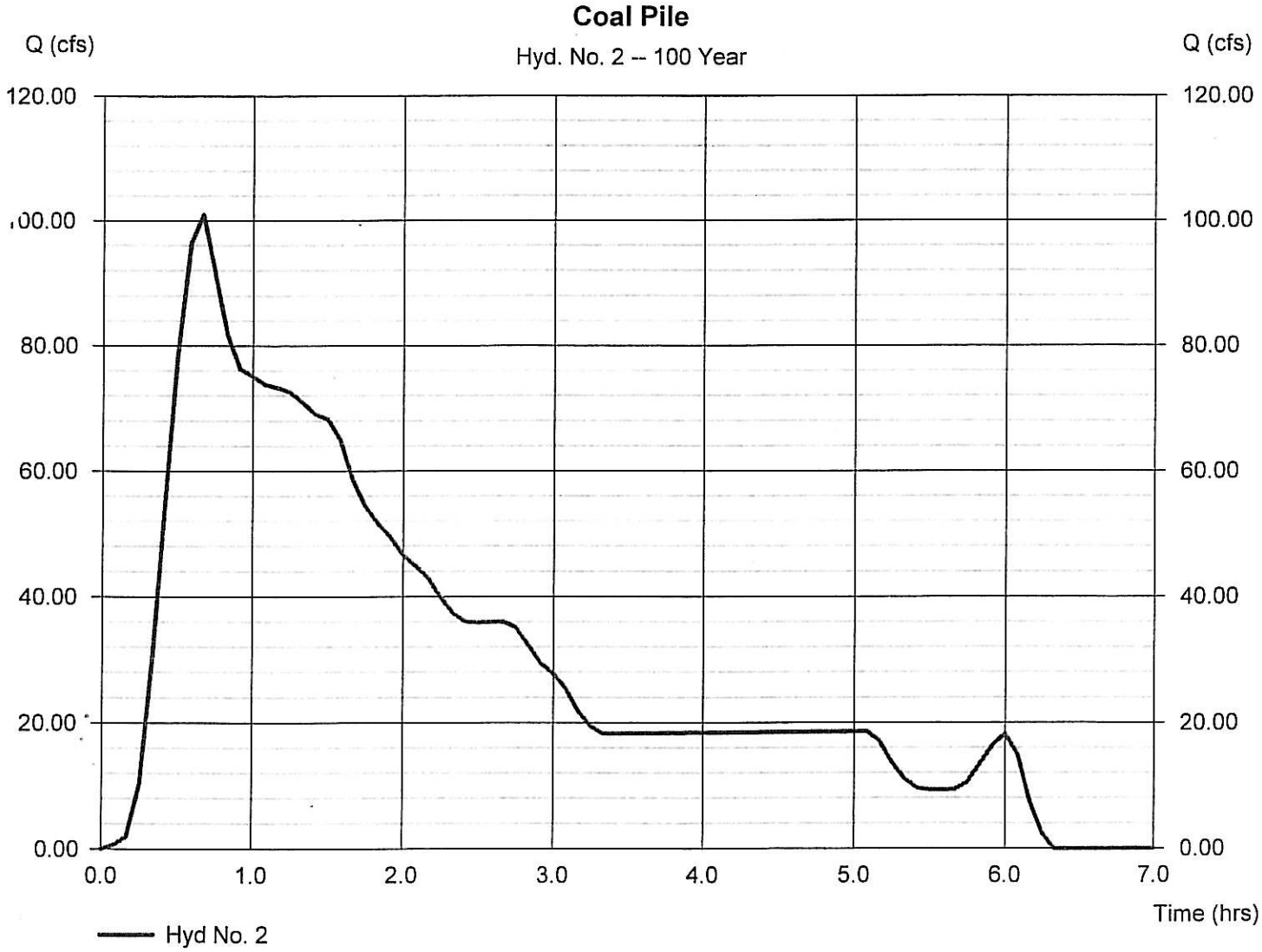


Hydrograph Report

Hyd. No. 2

Coal Pile

Hydrograph type	= SCS Runoff	Peak discharge	= 100.99 cfs
Storm frequency	= 100 yrs	Time to peak	= 0.67 hrs
Time interval	= 5 min	Hyd. volume	= 17.352 acft
Drainage area	= 60.800 ac	Curve number	= 86
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= USER	Time of conc. (Tc)	= 12.00 min
Total precip.	= 5.20 in	Distribution	= Huff-1st
Storm duration	= 6.00 hrs	Shape factor	= 484

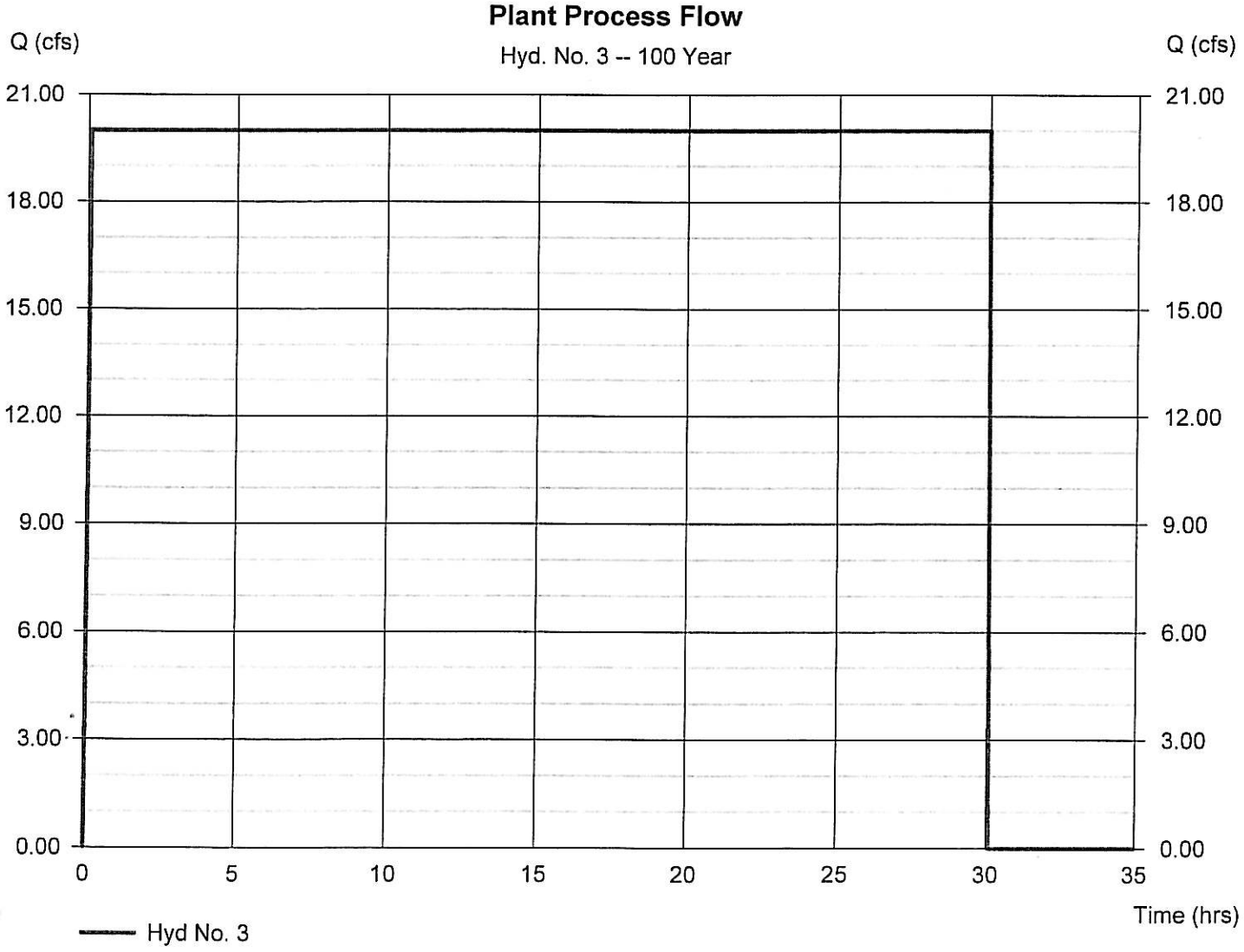


Hydrograph Report

Hyd. No. 3

Plant Process Flow

Hydrograph type	= Manual	Peak discharge	= 20.00 cfs
Storm frequency	= 100 yrs	Time to peak	= 0.08 hrs
Time interval	= 5 min	Hyd. volume	= 49.587 acft

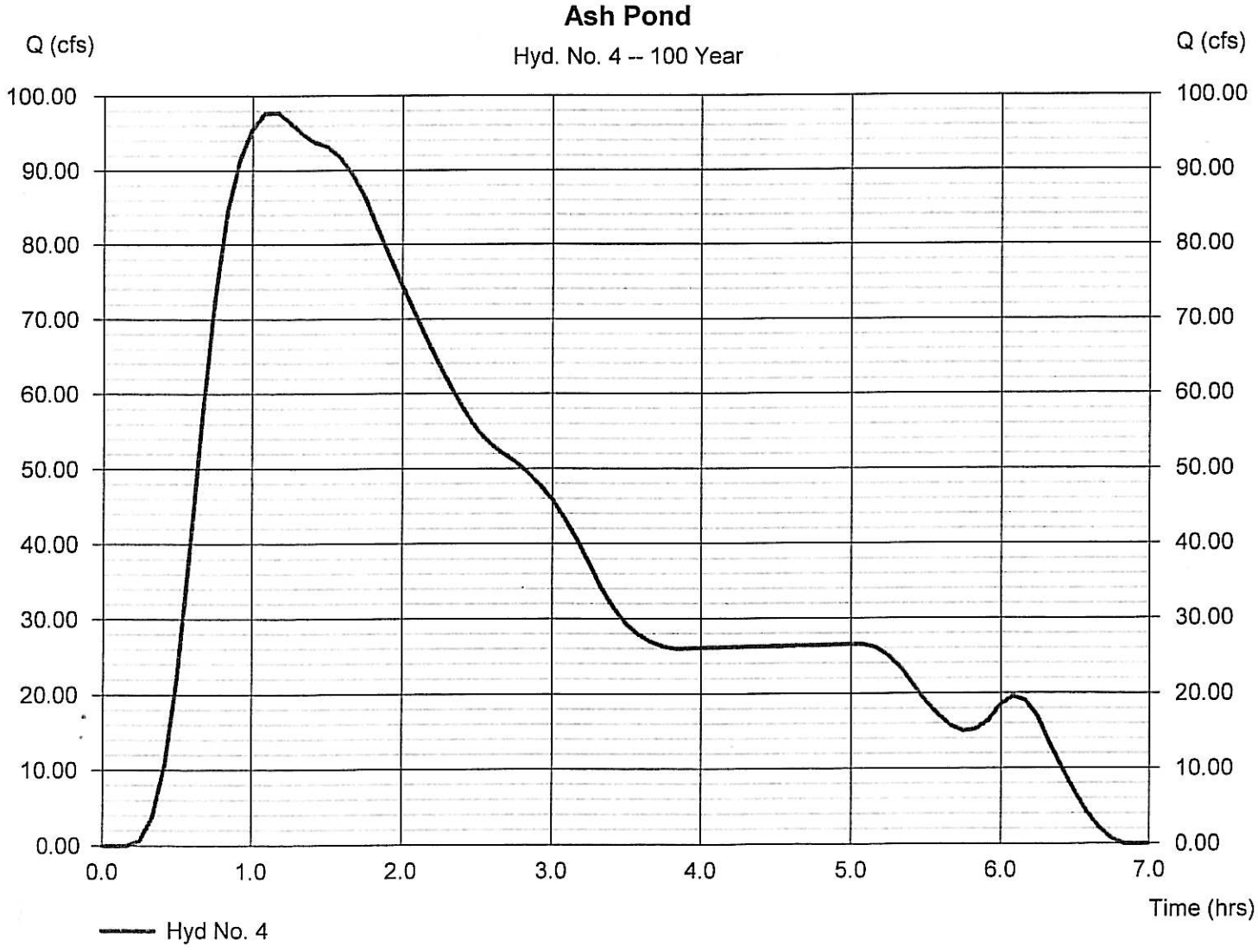


Hydrograph Report

Hyd. No. 4

Ash Pond

Hydrograph type	= SCS Runoff	Peak discharge	= 97.72 cfs
Storm frequency	= 100 yrs	Time to peak	= 1.17 hrs
Time interval	= 5 min	Hyd. volume	= 22.381 acft
Drainage area	= 84.900 ac	Curve number	= 80
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= USER	Time of conc. (Tc)	= 33.00 min
Total precip.	= 5.20 in	Distribution	= Huff-1st
Storm duration	= 6.00 hrs	Shape factor	= 484

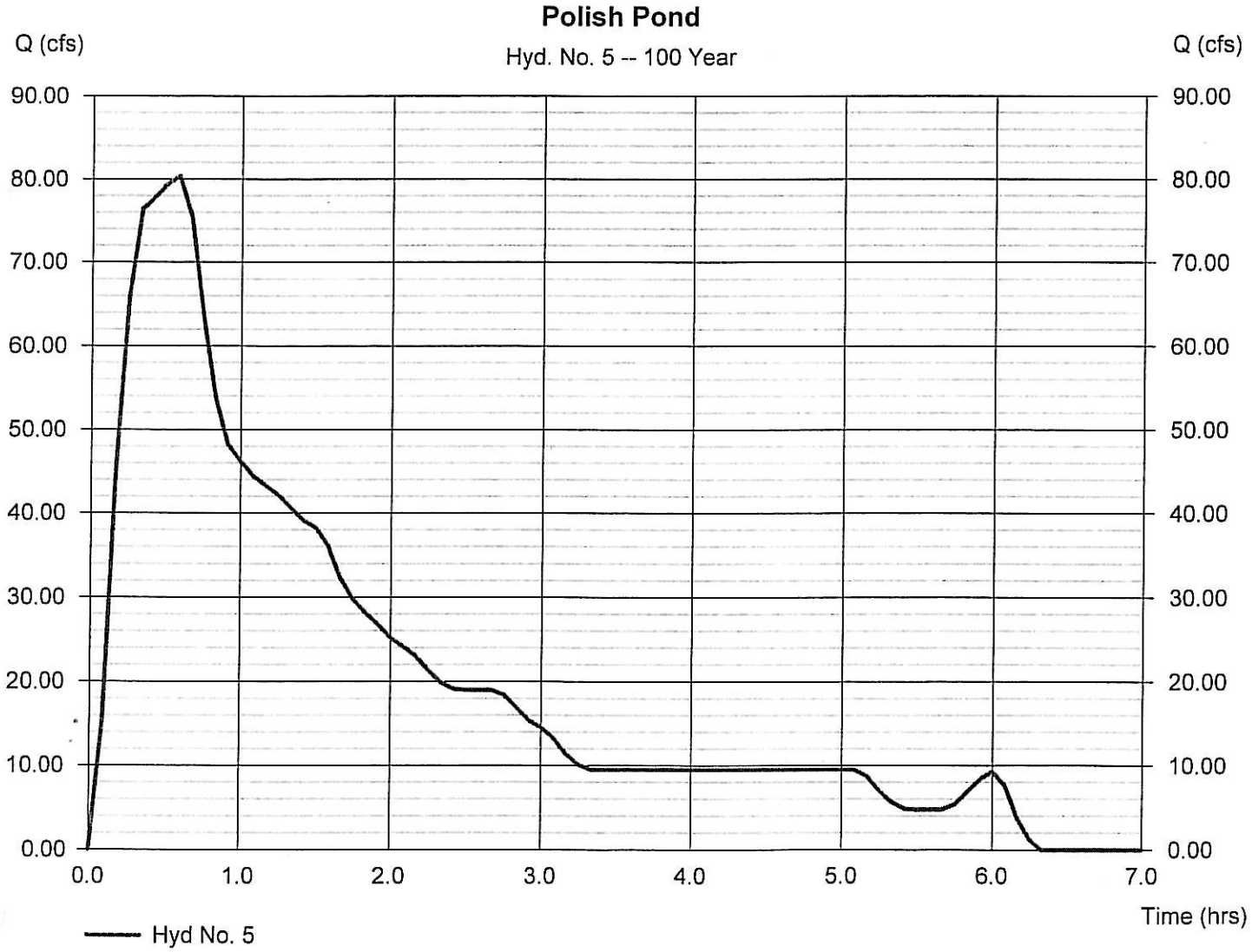


Hydrograph Report

Hyd. No. 5

Polish Pond

Hydrograph type	= SCS Runoff	Peak discharge	= 80.40 cfs
Storm frequency	= 100 yrs	Time to peak	= 0.58 hrs
Time interval	= 5 min	Hyd. volume	= 11.781 acft
Drainage area	= 29.000 ac	Curve number	= 100
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= USER	Time of conc. (Tc)	= 10.00 min
Total precip.	= 5.20 in	Distribution	= Huff-1st
Storm duration	= 6.00 hrs	Shape factor	= 484

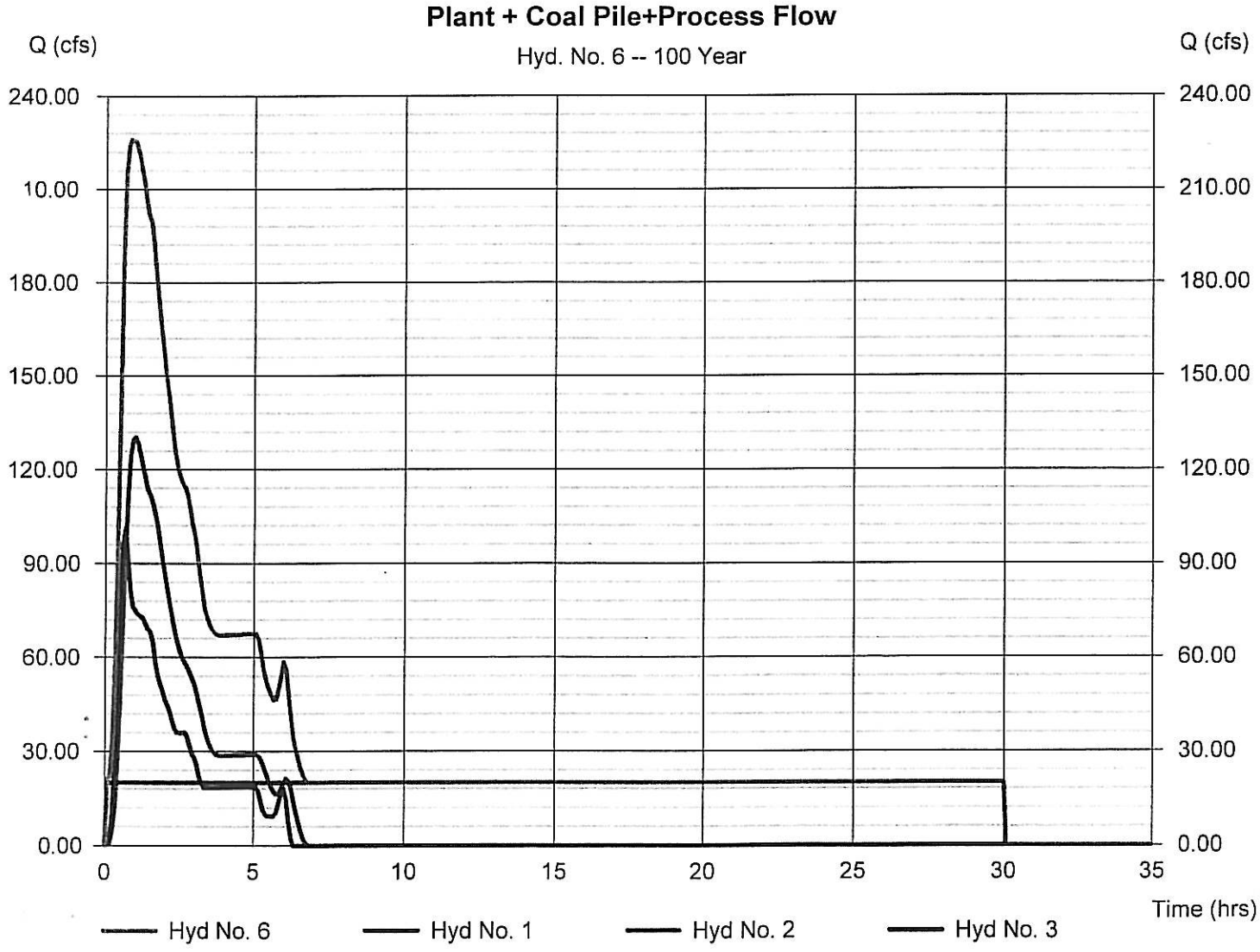


Hydrograph Report

Hyd. No. 6

Plant + Coal Pile+Process Flow

Hydrograph type	= Combine	Peak discharge	= 226.00 cfs
Storm frequency	= 100 yrs	Time to peak	= 0.83 hrs
Time interval	= 5 min	Hyd. volume	= 94.031 acft
Inflow hyds.	= 1, 2, 3	Contrib. drain. area	= 147.100 ac



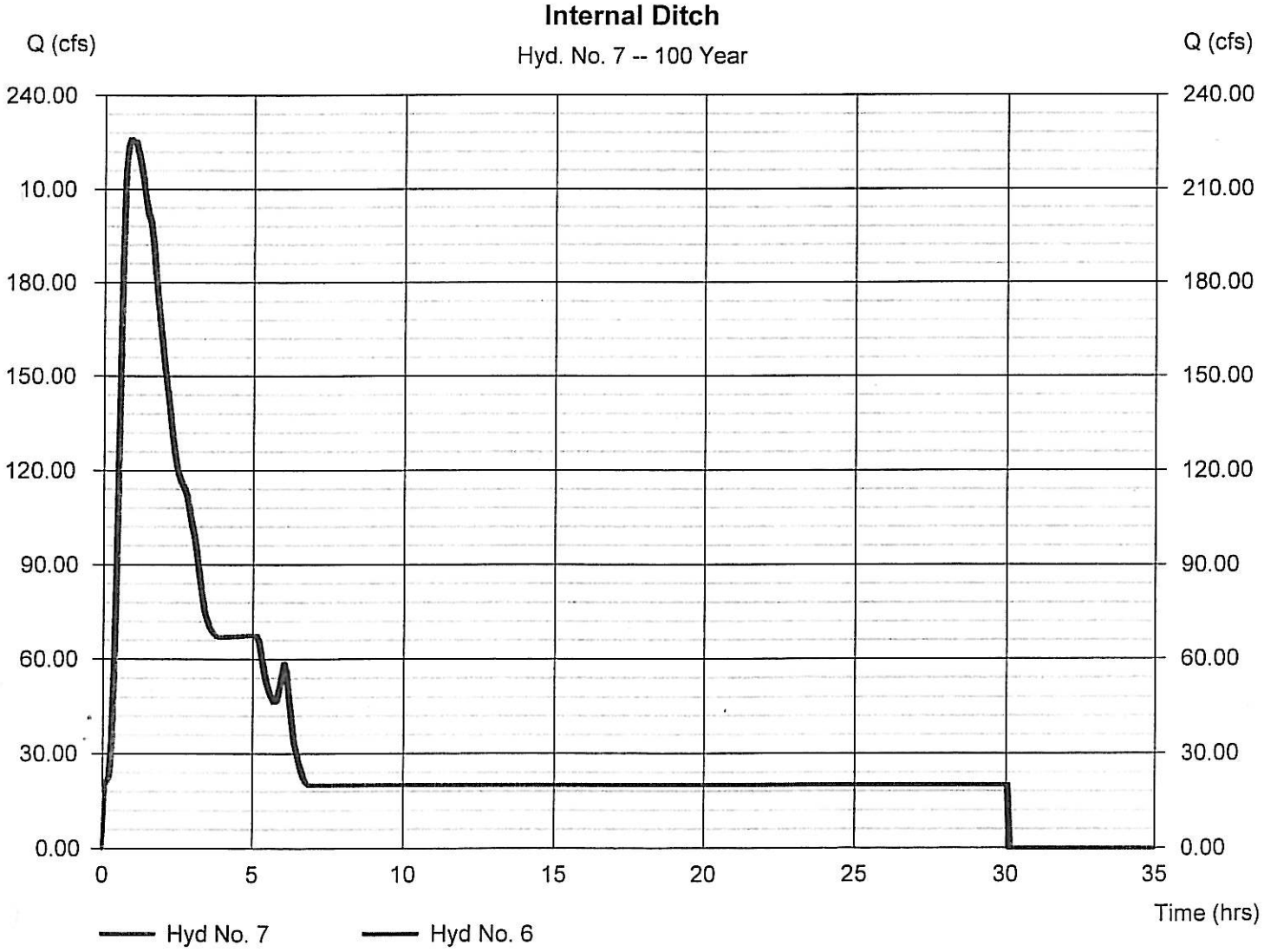
Hydrograph Report

Hyd. No. 7

Internal Ditch

Hydrograph type	= Reach	Peak discharge	= 226.18 cfs
Storm frequency	= 100 yrs	Time to peak	= 0.92 hrs
Time interval	= 5 min	Hyd. volume	= 94.174 acft
Inflow hyd. No.	= 6 - Plant + Coal Pile+Process Flow	Section type	= Trapezoidal
Reach length	= 1800.0 ft	Channel slope	= 0.3 %
Manning's n	= 0.009	Bottom width	= 10.0 ft
Side slope	= 0.5:1	Max. depth	= 8.0 ft
Rating curve x	= 1.886	Rating curve m	= 1.516
Ave. velocity	= 9.62 ft/s	Routing coeff.	= 1.0972

Modified Att-Kin routing method used.



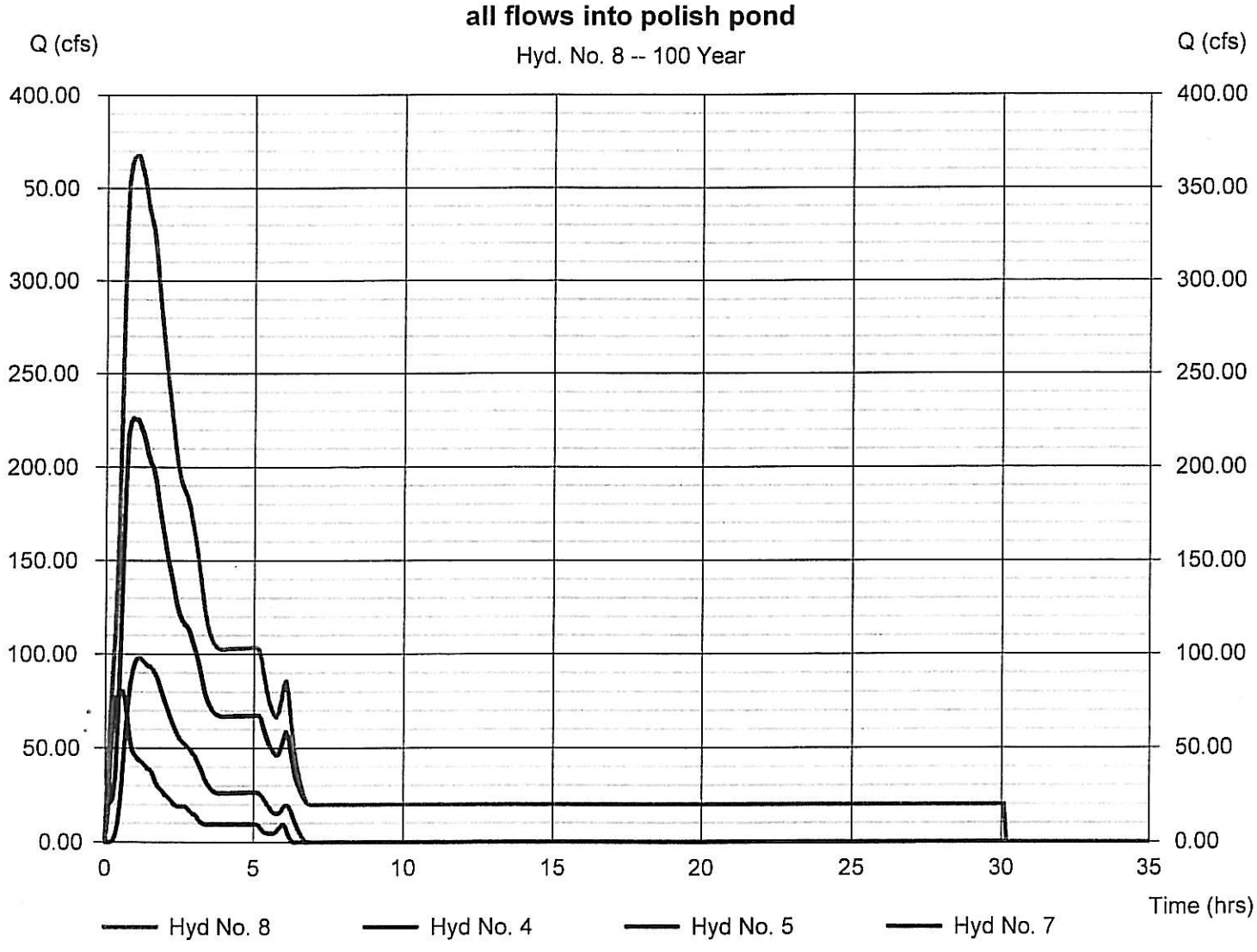
Hydrograph Report

Hydraflow Hydrographs by Intelisolve v9.23 — Friday, Jan 8, 2010

Hyd. No. 8

all flows into polish pond

Hydrograph type	= Combine	Peak discharge	= 367.43 cfs
Storm frequency	= 100 yrs	Time to peak	= 1.08 hrs
Time interval	= 5 min	Hyd. volume	= 128.336 acft
Inflow hyds.	= 4, 5, 7	Contrib. drain. area	= 113.900 ac



Hydrograph Report

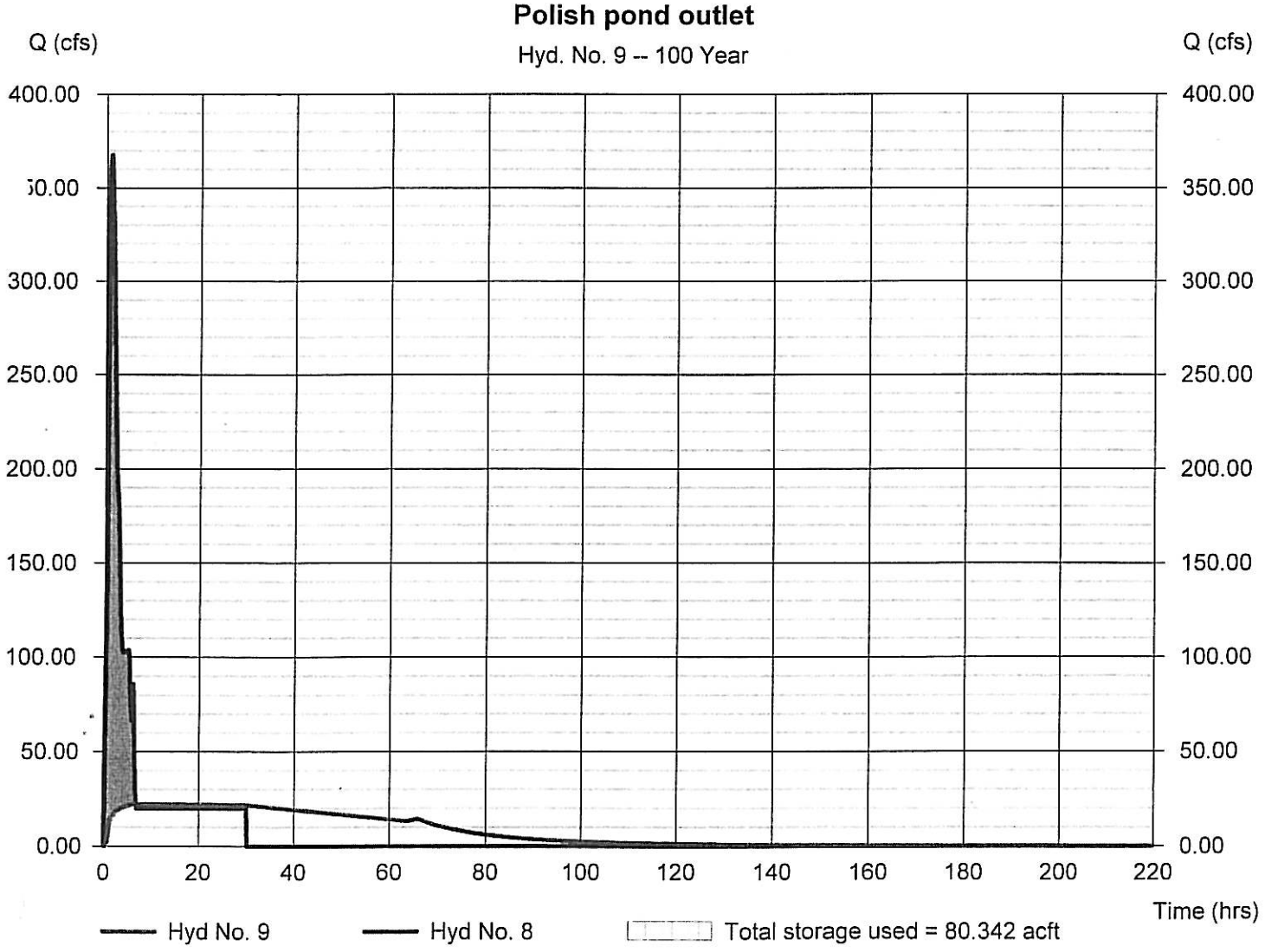
Hydraflow Hydrographs by Intelisolve v9.23 — Friday, Jan 8, 2010

Hyd. No. 9

Polish pond outlet

Hydrograph type	= Reservoir	Peak discharge	= 22.38 cfs
Storm frequency	= 100 yrs	Time to peak	= 6.75 hrs
Time interval	= 5 min	Hyd. volume	= 127.674 acft
Inflow hyd. No.	= 8 - all flows into polish pond	Max. Elevation	= 405.85 ft
Reservoir name	= Polish pond	Max. Storage	= 80.342 acft

Storage Indication method used.



Pond Report

Pond No. 2 - Polish pond

Pond Data

Contours - User-defined contour areas. Average end area method used for volume calculation. Begining Elevation = 403.00 ft

Stage / Storage Table

Stage (ft)	Elevation (ft)	Contour area (sqft)	Incr. Storage (acft)	Total storage (acft)
0.00	403.00	1,216,913	0.000	0.000
1.00	404.00	1,223,879	28.016	28.016
2.00	405.00	1,230,895	28.177	56.193
3.00	406.00	1,237,962	28.339	84.532
4.00	407.00	1,245,078	28.501	113.033
5.00	408.00	1,252,244	28.665	141.699
6.00	409.00	1,259,460	28.830	170.529
7.00	410.00	1,266,727	28.997	199.526

Culvert / Orifice Structures

	[A]	[B]	[C]	[PrfRsr]
Rise (in)	= 24.00	Inactive	Inactive	Inactive
Span (in)	= 24.00	0.00	0.00	0.00
No. Barrels	= 1	0	0	0
Invert El. (ft)	= 385.00	0.00	0.00	0.00
Length (ft)	= 100.00	0.00	0.00	0.00
Slope (%)	= 5.00	0.00	0.00	n/a
N-Value	= .013	.013	.013	n/a
Orifice Coeff.	= 0.67	0.60	0.60	0.60
Multi-Stage	= n/a	No	No	No

Weir Structures

	[A]	[B]	[C]	[D]
Crest Len (ft)	= 6.28	Inactive	Inactive	Inactive
Crest El. (ft)	= 403.00	0.00	0.00	0.00
Weir Coeff.	= 2.70	3.33	3.33	3.33
Weir Type	= Riser	---	---	---
Multi-Stage	= Yes	No	No	No

Exfil.(in/hr) = 0.000 (by Wet area)

TW Elev. (ft) = 0.00

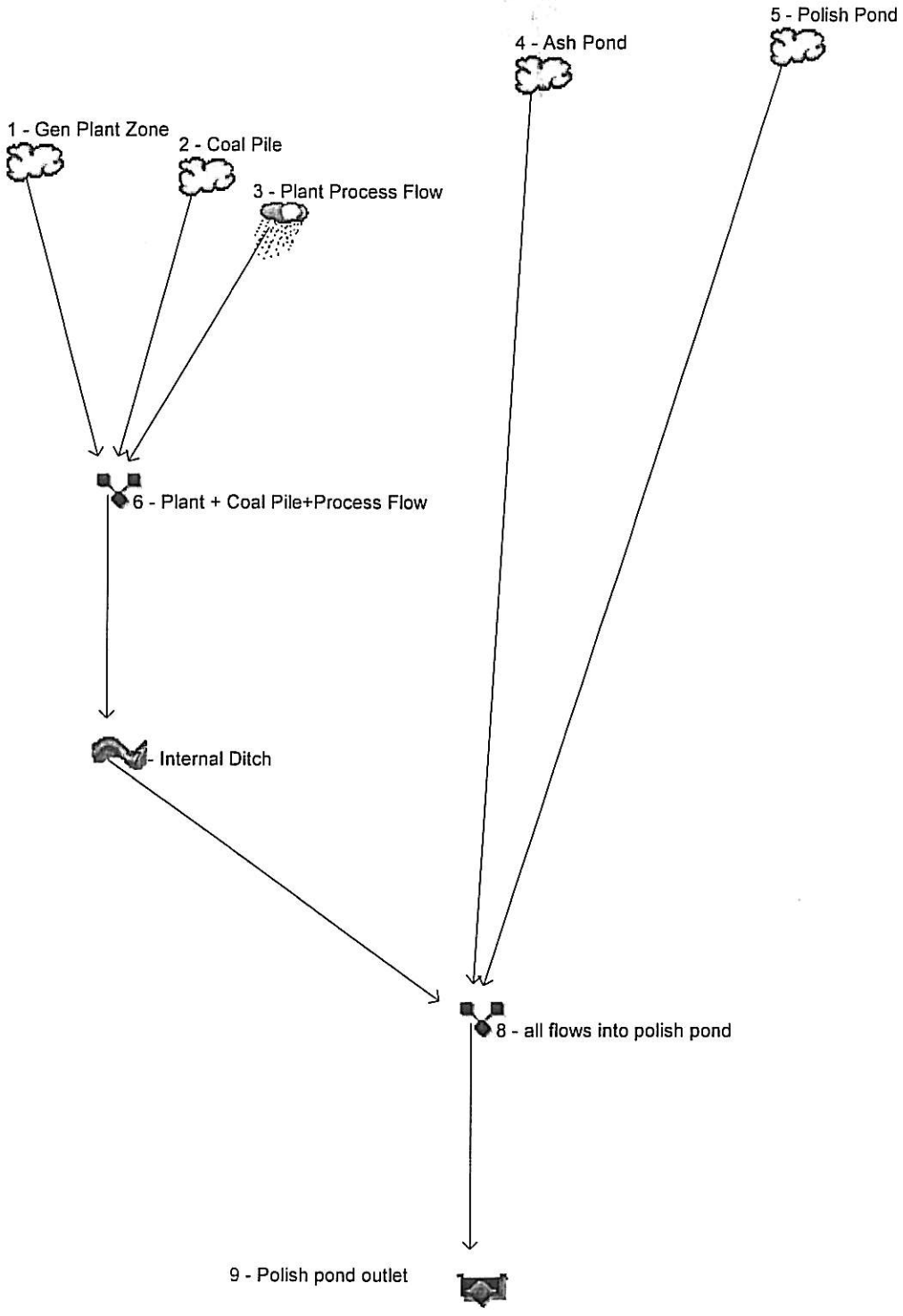
Note: Culvert/Orifice outflows are analyzed under inlet (ic) and outlet (oc) control. Weir risers checked for orifice conditions (ic) and submergence (s).

Stage / Storage / Discharge Table

Stage ft	Storage acft	Elevation ft	Clv A cfs	Clv B cfs	Clv C cfs	PrfRsr cfs	Wr A cfs	Wr B cfs	Wr C cfs	Wr D cfs	Exfil cfs	User cfs	Total cfs
0.00	0.000	403.00	0.00	---	---	---	0.00	---	---	---	---	---	0.000
1.00	28.016	404.00	69.64 ic	---	---	---	13.25 ic	---	---	---	---	---	13.25
2.00	56.193	405.00	69.64 ic	---	---	---	18.74 ic	---	---	---	---	---	18.74
3.00	84.532	406.00	69.64 ic	---	---	---	22.96 ic	---	---	---	---	---	22.96
4.00	113.033	407.00	69.64 ic	---	---	---	26.51 ic	---	---	---	---	---	26.51
5.00	141.699	408.00	69.64 ic	---	---	---	29.63 ic	---	---	---	---	---	29.63
6.00	170.529	409.00	69.64 ic	---	---	---	32.46 ic	---	---	---	---	---	32.46
7.00	199.526	410.00	69.64 ic	---	---	---	35.06 ic	---	---	---	---	---	35.06

Watershed Model Schematic

Hydraflow Hydrographs by Intelisolve v9.23



Hydrograph Return Period Recap

Hydraflow Hydrographs by Intelisolve v9.23

Hyd. No.	Hydrograph type (origin)	Inflow Hyd(s)	Peak Outflow (cfs)								Hydrograph description
			1-Yr	2-Yr	3-Yr	5-Yr	10-Yr	25-Yr	50-Yr	100-Yr	
1	SCS Runoff	-------	-------	-------	-------	-------	-------	-------	-------	130.36	Gen Plant Zone
2	SCS Runoff	-------	-------	-------	-------	-------	-------	-------	-------	100.99	Coal Pile
3	Manual	-------	-------	-------	-------	-------	-------	-------	-------	20.00	Plant Process Flow
4	SCS Runoff	-------	-------	-------	-------	-------	-------	-------	-------	97.72	Ash Pond
5	SCS Runoff	-------	-------	-------	-------	-------	-------	-------	-------	80.40	Polish Pond
6	Combine	1, 2, 3,	-------	-------	-------	-------	-------	-------	-------	226.00	Plant + Coal Pile+Process Flow
7	Reach	6	-------	-------	-------	-------	-------	-------	-------	226.18	Internal Ditch
8	Combine	4, 5, 7	-------	-------	-------	-------	-------	-------	-------	367.43	all flows into polish pond
9	Reservoir	8	-------	-------	-------	-------	-------	-------	-------	22.68	Polish pond outlet

Hydrograph Summary Report

Hydraflow Hydrographs by Intelisolve v9.23

Hyd. No.	Hydrograph type (origin)	Peak flow (cfs)	Time interval (min)	Time to peak (min)	Hyd. volume (acft)	Inflow hyd(s)	Maximum elevation (ft)	Total strge used (acft)	Hydrograph description
1	SCS Runoff	130.36	5	60	27.092	----	------	------	Gen Plant Zone
2	SCS Runoff	100.99	5	40	17.352	----	------	------	Coal Pile
3	Manual	20.00	5	5	49.587	----	------	------	Plant Process Flow
4	SCS Runoff	97.72	5	70	22.381	----	------	------	Ash Pond
5	SCS Runoff	80.40	5	35	11.781	----	------	------	Polish Pond
6	Combine	226.00	5	50	94.031	1, 2, 3,	------	------	Plant + Coal Pile+Process Flow
7	Reach	226.18	5	55	94.174	6	------	------	Internal Ditch
8	Combine	367.43	5	65	128.336	4, 5, 7	------	------	all flows into polish pond
9	Reservoir	22.68	5	405	127.740	8	400.93	80.2	Polish pond outlet

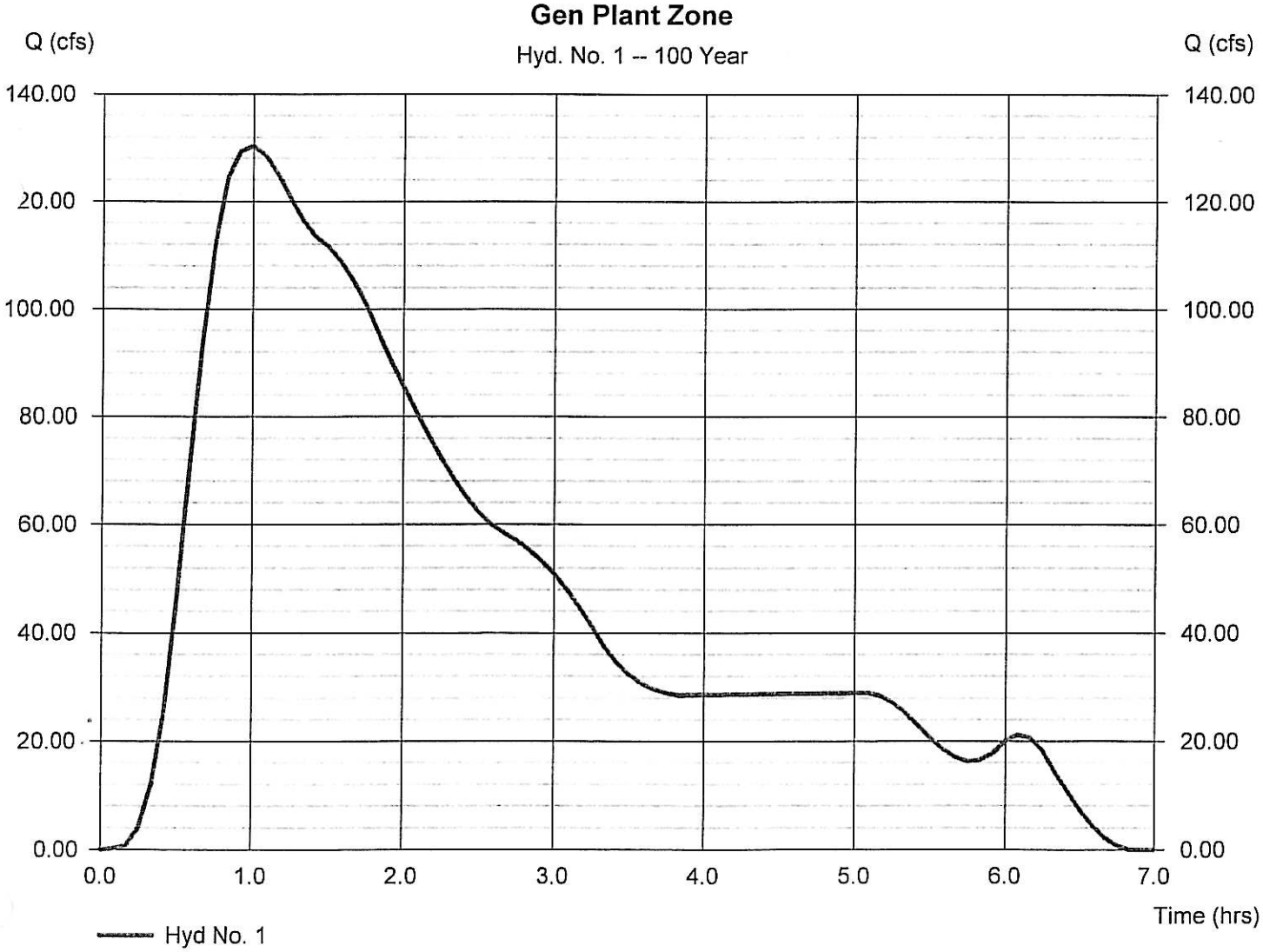
Hydrograph Report

Hydraflow Hydrographs by Intelisolve v9.23 — Monday, Mar 15, 2010

Hyd. No. 1

Gen Plant Zone

Hydrograph type	= SCS Runoff	Peak discharge	= 130.36 cfs
Storm frequency	= 100 yrs	Time to peak	= 1.00 hrs
Time interval	= 5 min	Hyd. volume	= 27.092 acft
Drainage area	= 86.300 ac	Curve number	= 86
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= USER	Time of conc. (Tc)	= 30.00 min
Total precip.	= 5.20 in	Distribution	= Huff-1st
Storm duration	= 6.00 hrs	Shape factor	= 484



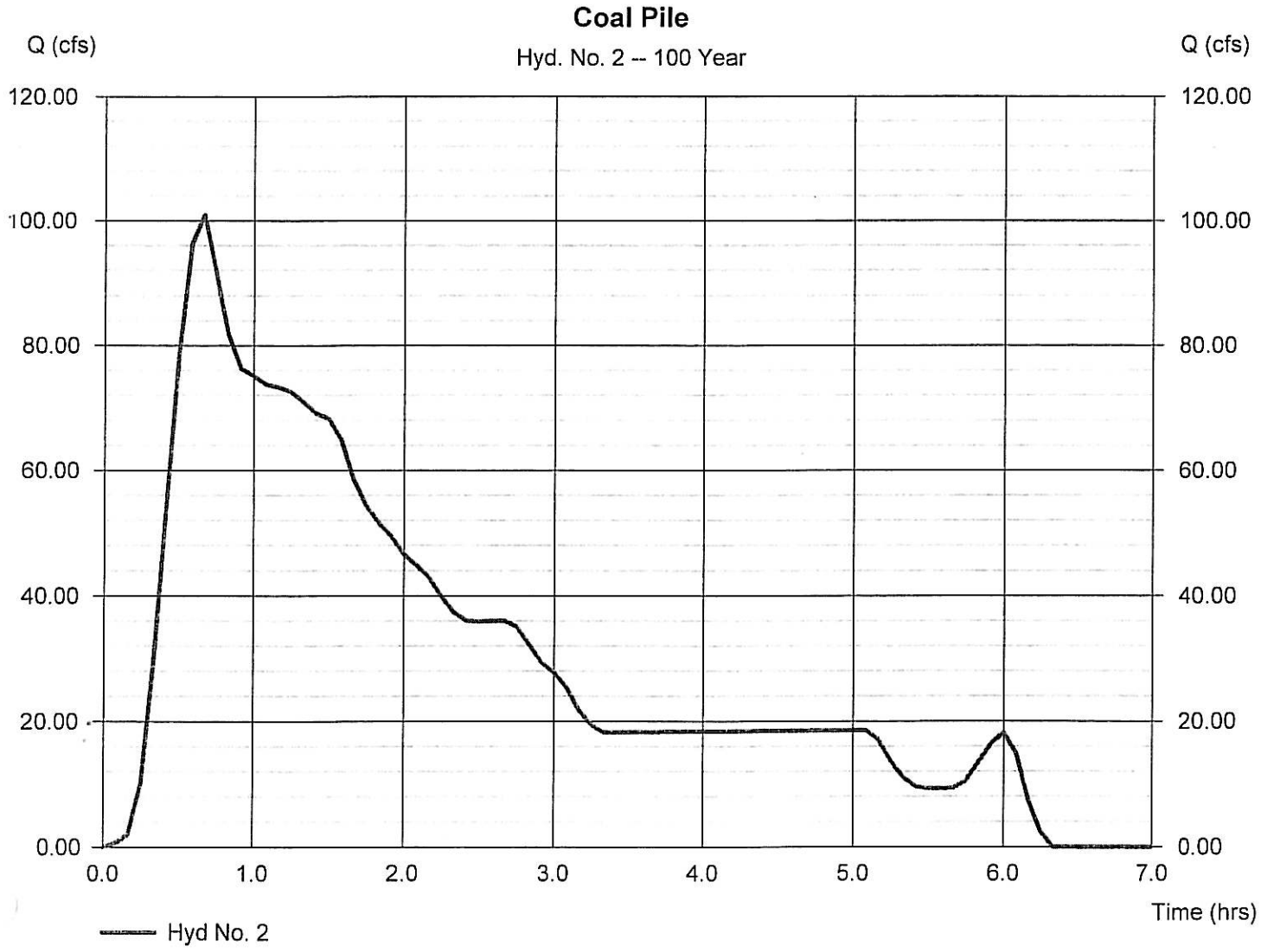
Hydrograph Report

Hydraflow Hydrographs by Intelisolve v9.23 — Monday, Mar 15, 2010

Hyd. No. 2

Coal Pile

Hydrograph type	= SCS Runoff	Peak discharge	= 100.99 cfs
Storm frequency	= 100 yrs	Time to peak	= 0.67 hrs
Time interval	= 5 min	Hyd. volume	= 17.352 acft
Drainage area	= 60.800 ac	Curve number	= 86
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= USER	Time of conc. (Tc)	= 12.00 min
Total precip.	= 5.20 in	Distribution	= Huff-1st
Storm duration	= 6.00 hrs	Shape factor	= 484

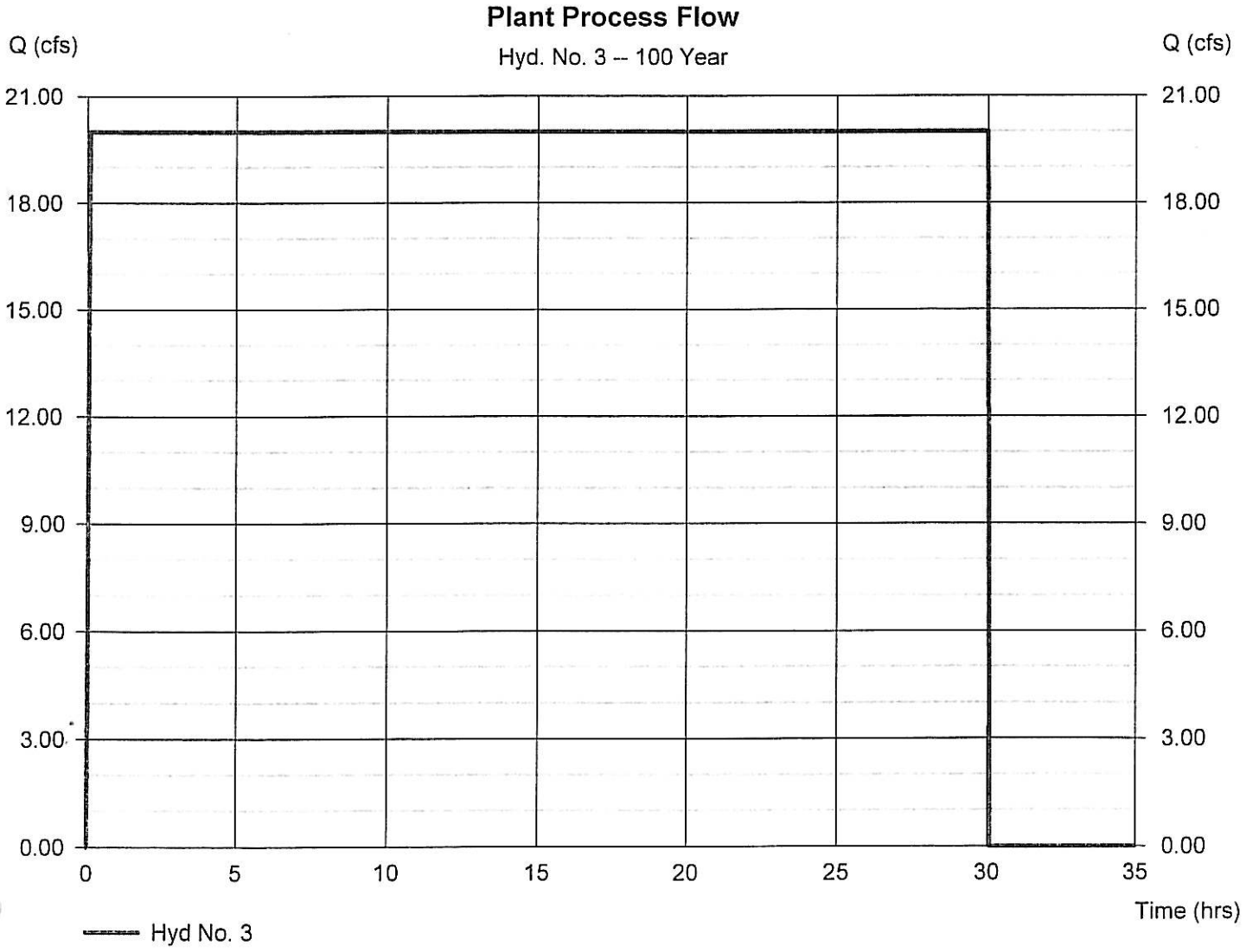


Hydrograph Report

Hyd. No. 3

Plant Process Flow

Hydrograph type	= Manual	Peak discharge	= 20.00 cfs
Storm frequency	= 100 yrs	Time to peak	= 0.08 hrs
Time interval	= 5 min	Hyd. volume	= 49.587 acft

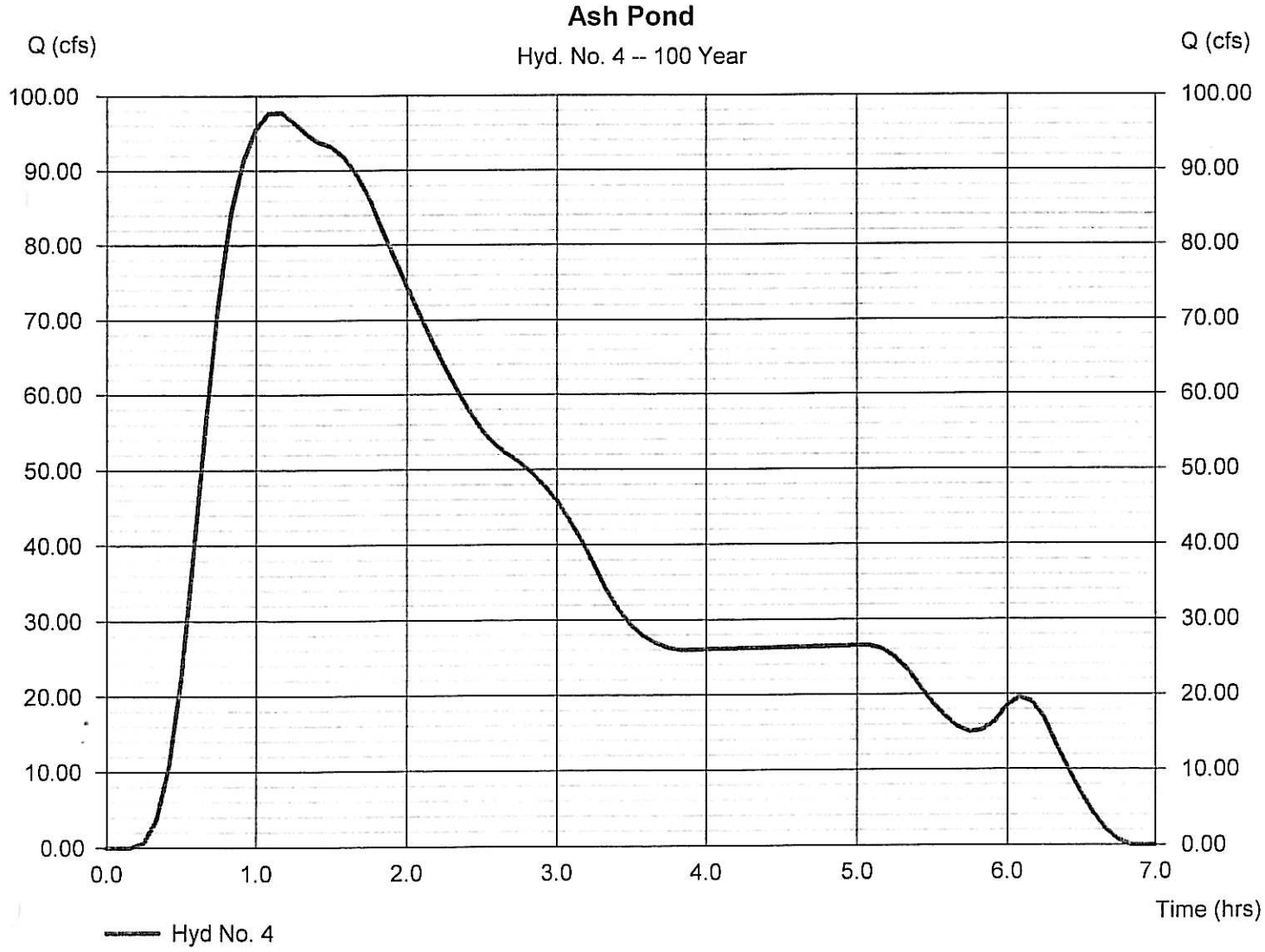


Hydrograph Report

Hyd. No. 4

Ash Pond

Hydrograph type	= SCS Runoff	Peak discharge	= 97.72 cfs
Storm frequency	= 100 yrs	Time to peak	= 1.17 hrs
Time interval	= 5 min	Hyd. volume	= 22.381 acft
Drainage area	= 84.900 ac	Curve number	= 80
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= USER	Time of conc. (Tc)	= 33.00 min
Total precip.	= 5.20 in	Distribution	= Huff-1st
Storm duration	= 6.00 hrs	Shape factor	= 484

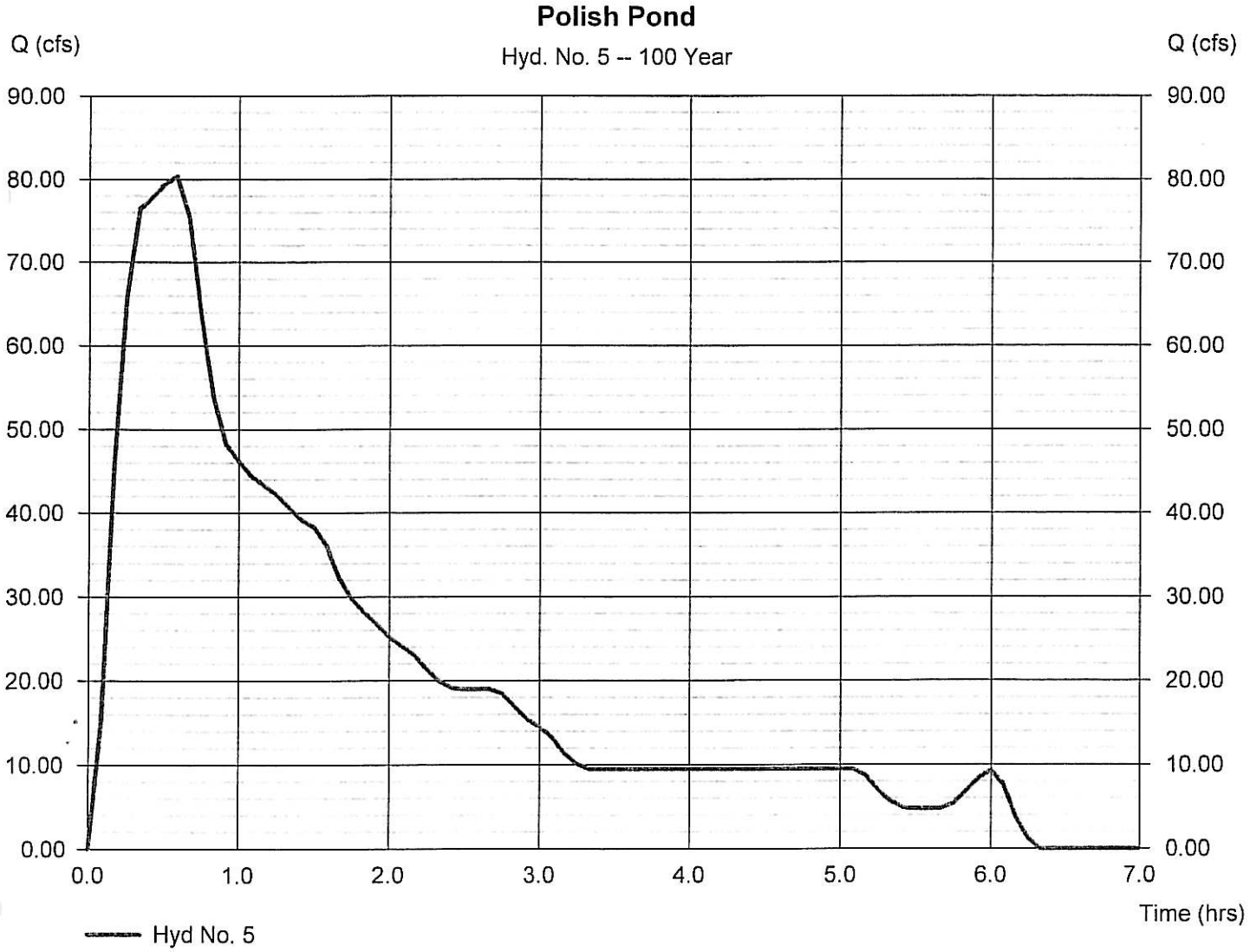


Hydrograph Report

Hyd. No. 5

Polish Pond

Hydrograph type	= SCS Runoff	Peak discharge	= 80.40 cfs
Storm frequency	= 100 yrs	Time to peak	= 0.58 hrs
Time interval	= 5 min	Hyd. volume	= 11.781 acft
Drainage area	= 29.000 ac	Curve number	= 100
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= USER	Time of conc. (Tc)	= 10.00 min
Total precip.	= 5.20 in	Distribution	= Huff-1st
Storm duration	= 6.00 hrs	Shape factor	= 484



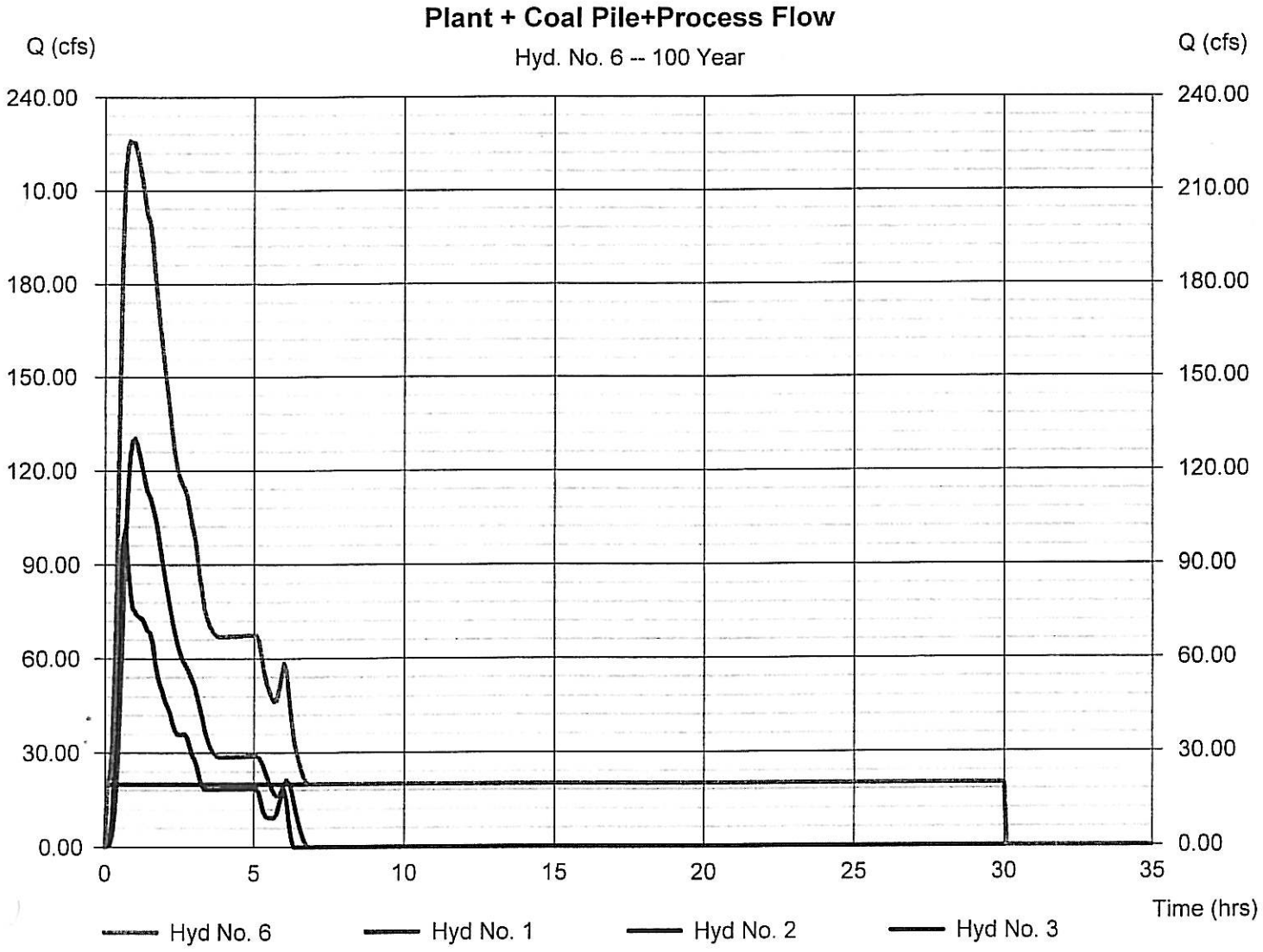
Hydrograph Report

Hydraflow Hydrographs by Intelisolve v9.23 — Monday, Mar 15, 2010

Hyd. No. 6

Plant + Coal Pile+Process Flow

Hydrograph type	= Combine	Peak discharge	= 226.00 cfs
Storm frequency	= 100 yrs	Time to peak	= 0.83 hrs
Time interval	= 5 min	Hyd. volume	= 94.031 acft
Inflow hyds.	= 1, 2, 3	Contrib. drain. area	= 147.100 ac



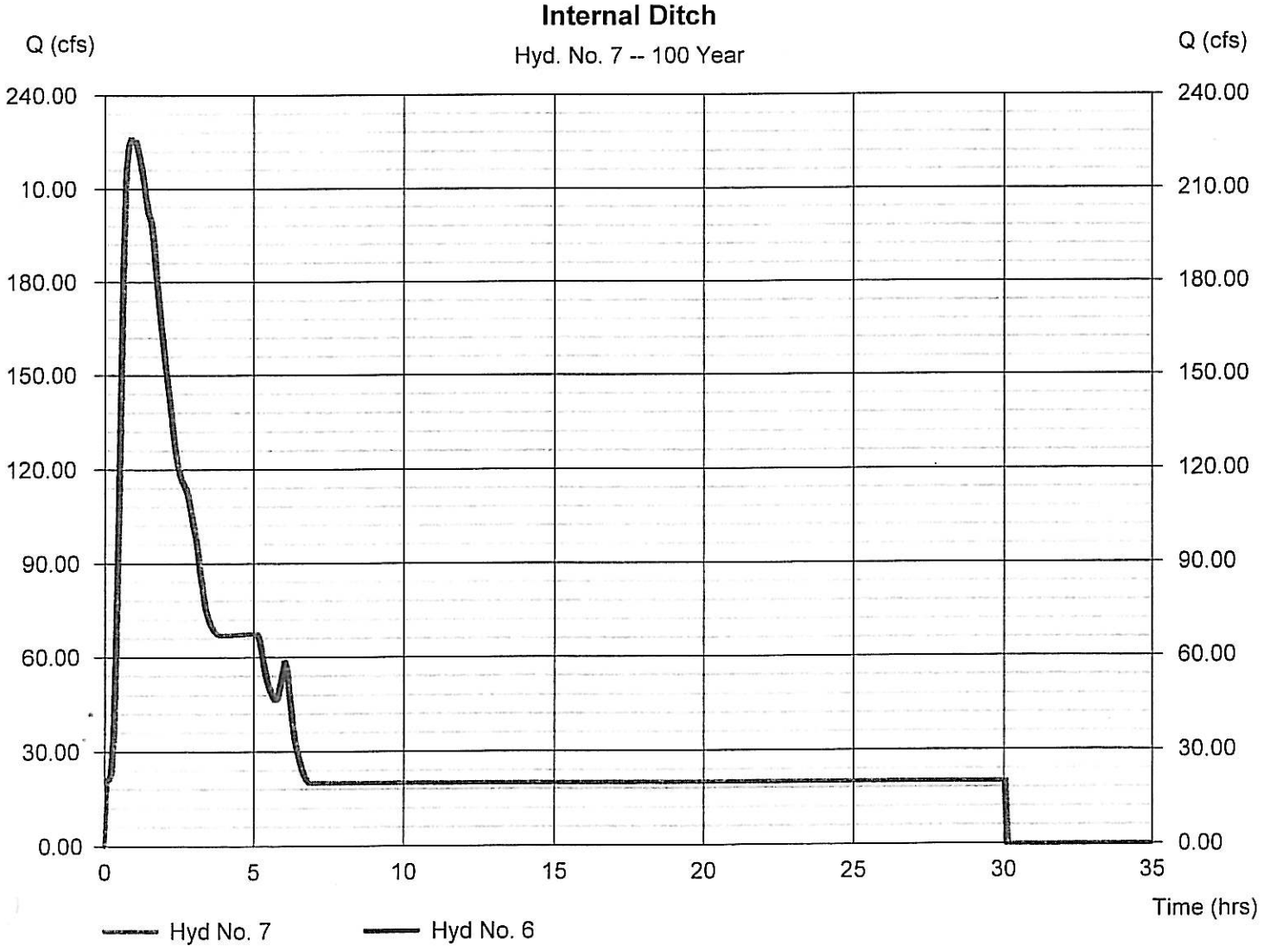
Hydrograph Report

Hyd. No. 7

Internal Ditch

Hydrograph type	= Reach	Peak discharge	= 226.18 cfs
Storm frequency	= 100 yrs	Time to peak	= 0.92 hrs
Time interval	= 5 min	Hyd. volume	= 94.174 acft
Inflow hyd. No.	= 6 - Plant + Coal Pile+Process Flow	Section type	= Trapezoidal
Reach length	= 1800.0 ft	Channel slope	= 0.3 %
Manning's n	= 0.009	Bottom width	= 10.0 ft
Side slope	= 0.5:1	Max. depth	= 8.0 ft
Rating curve x	= 1.886	Rating curve m	= 1.516
Ave. velocity	= 0.00 ft/s	Routing coeff.	= 1.0972

Modified Att-Kin routing method used.

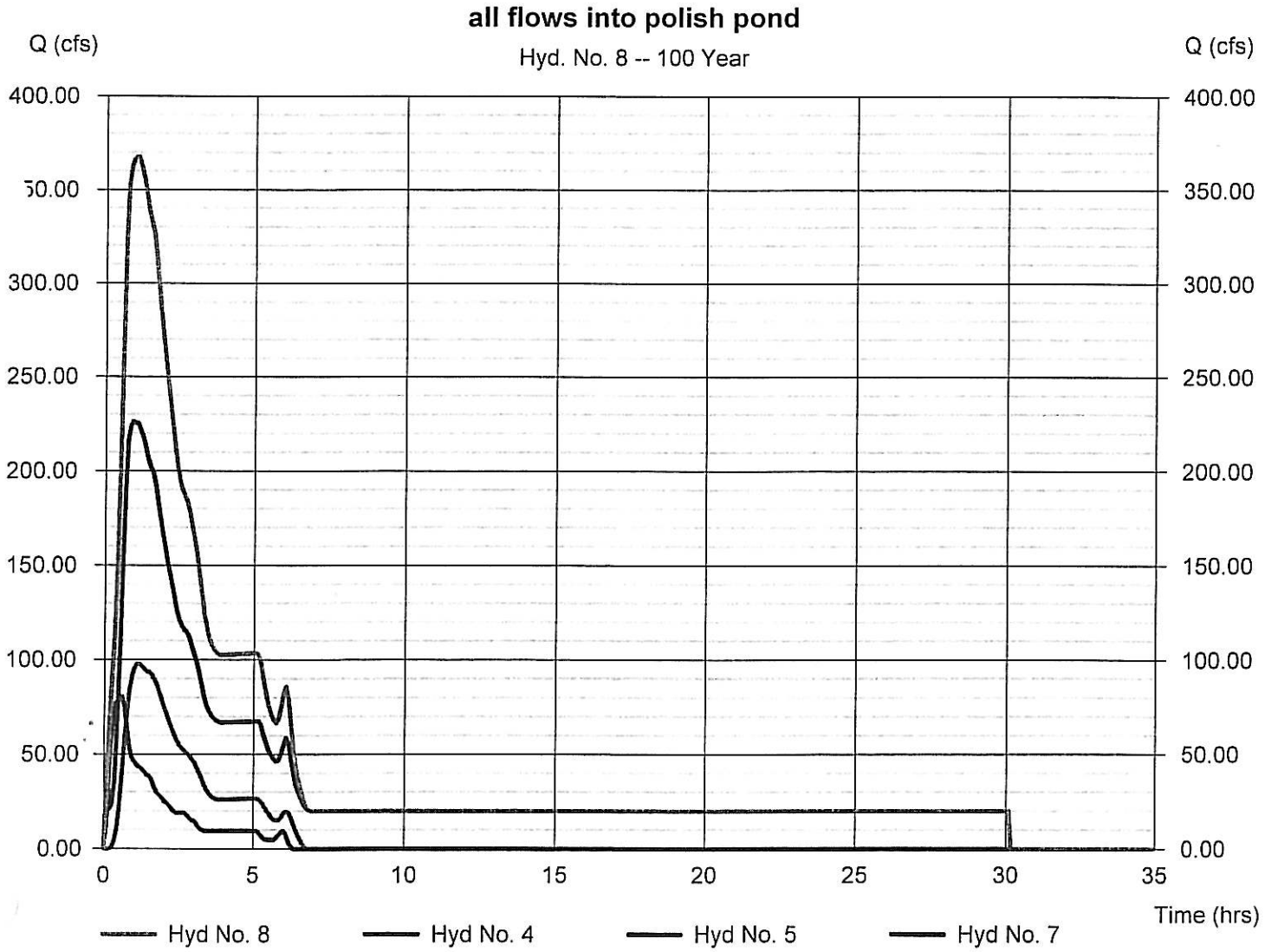


Hydrograph Report

Hyd. No. 8

all flows into polish pond

Hydrograph type	= Combine	Peak discharge	= 367.43 cfs
Storm frequency	= 100 yrs	Time to peak	= 1.08 hrs
Time interval	= 5 min	Hyd. volume	= 128.336 acft
Inflow hyds.	= 4, 5, 7	Contrib. drain. area	= 113.900 ac



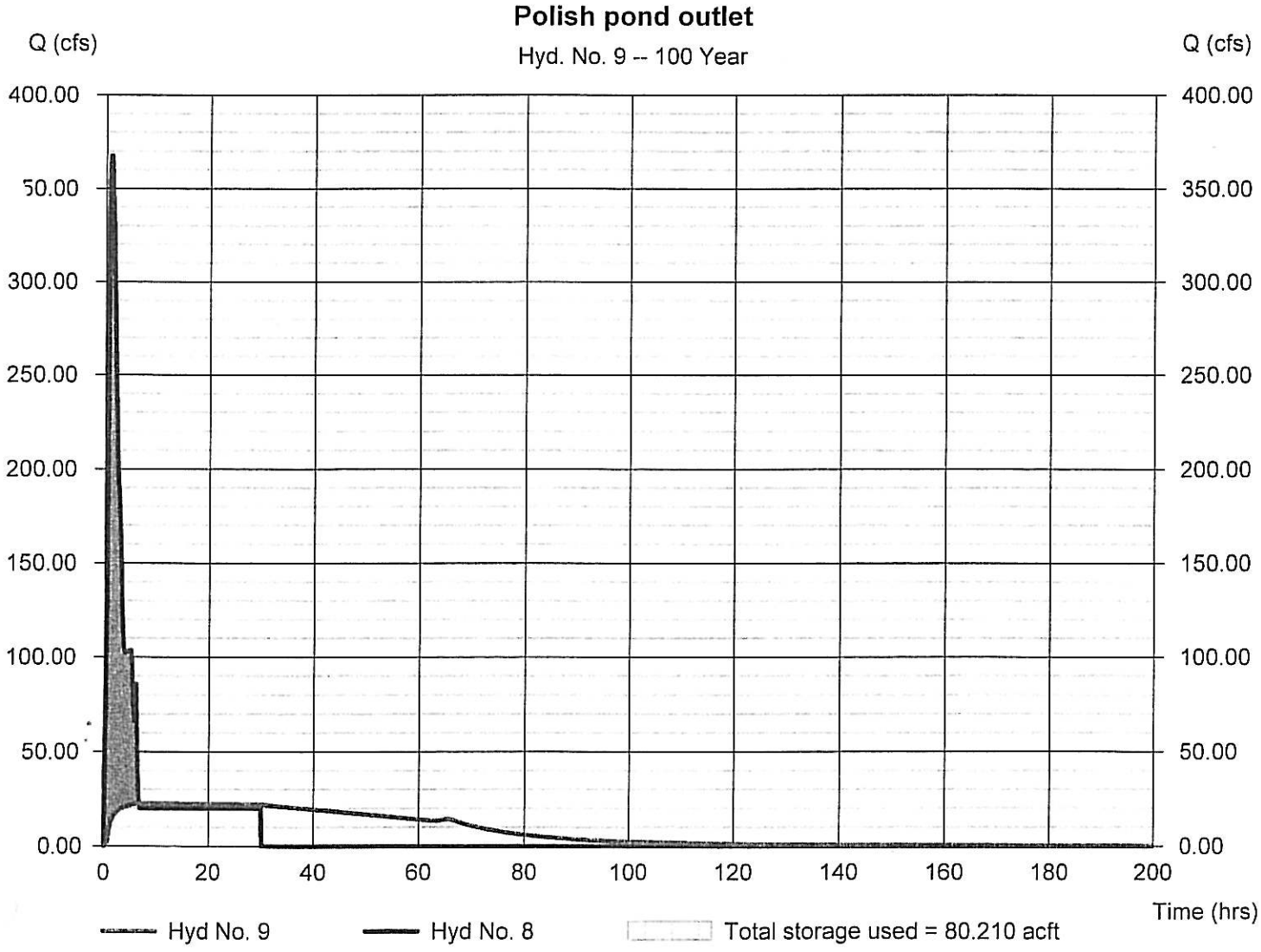
Hydrograph Report

Hyd. No. 9

Polish pond outlet

Hydrograph type	= Reservoir	Peak discharge	= 22.68 cfs
Storm frequency	= 100 yrs	Time to peak	= 6.75 hrs
Time interval	= 5 min	Hyd. volume	= 127.740 acft
Inflow hyd. No.	= 8 - all flows into polish pond	Max. Elevation	= 400.93 ft
Reservoir name	= Polish pond	Max. Storage	= 80.210 acft

Storage Indication method used.



Hydraflow Rainfall Report

Return Period (Yrs)	Intensity-Duration-Frequency Equation Coefficients (FHA)			
	B	D	E	(N/A)
1	0.0000	0.0000	0.0000	--------
2	69.8703	13.1000	0.8658	--------
3	0.0000	0.0000	0.0000	--------
5	79.2597	14.6000	0.8369	--------
10	88.2351	15.5000	0.8279	--------
25	102.6072	16.5000	0.8217	--------
50	114.8193	17.2000	0.8199	--------
100	127.1596	17.8000	0.8186	--------

File name: SampleFHA.idf

Intensity = B / (Tc + D)^E

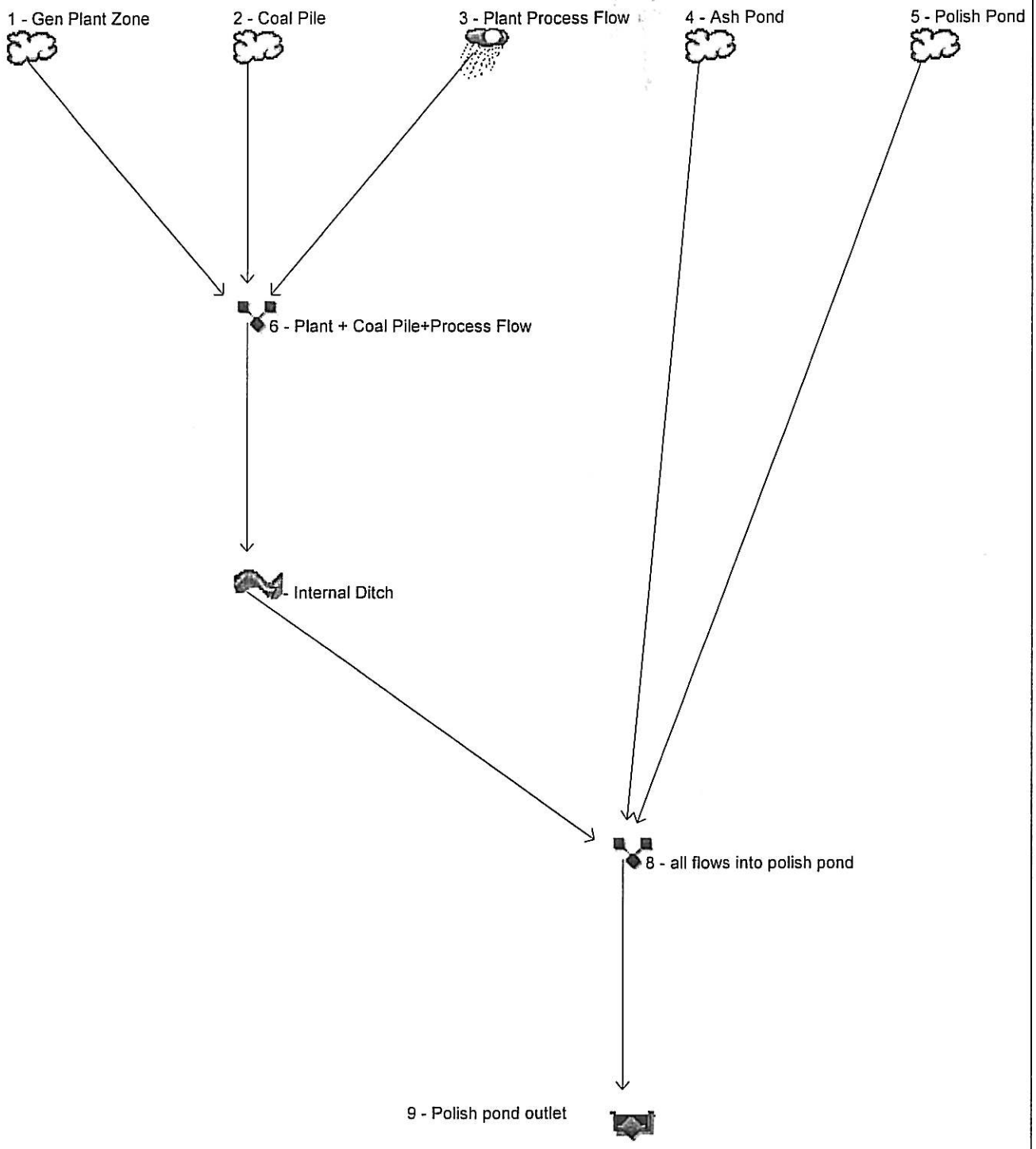
Return Period (Yrs)	Intensity Values (in/hr)											
	5 min	10	15	20	25	30	35	40	45	50	55	60
1	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2	5.69	4.61	3.89	3.38	2.99	2.69	2.44	2.24	2.07	1.93	1.81	1.70
3	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
5	6.57	5.43	4.65	4.08	3.65	3.30	3.02	2.79	2.59	2.42	2.27	2.15
10	7.24	6.04	5.21	4.59	4.12	3.74	3.43	3.17	2.95	2.77	2.60	2.46
25	8.25	6.95	6.03	5.34	4.80	4.38	4.02	3.73	3.48	3.26	3.07	2.91
50	9.04	7.65	6.66	5.92	5.34	4.87	4.49	4.16	3.88	3.65	3.44	3.25
100	9.83	8.36	7.30	6.50	5.87	5.36	4.94	4.59	4.29	4.03	3.80	3.60

Tc = time in minutes. Values may exceed 60.

Precip. file name: Sample.pcp

Storm Distribution	Rainfall Precipitation Table (in)							
	1-yr	2-yr	3-yr	5-yr	10-yr	25-yr	50-yr	100-yr
SCS 24-hour	0.00	2.20	0.00	3.30	4.25	5.77	6.80	0.00
SCS 6-Hr	0.00	1.80	0.00	0.00	2.60	0.00	0.00	0.00
Huff-1st	0.00	1.55	0.00	2.75	4.00	5.38	6.50	5.20
Huff-2nd	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Huff-3rd	0.00	0.00	0.00	0.00	0.00	0.00	0.00	7.10
Huff-4th	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Huff-Indy	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Custom	0.00	1.75	0.00	2.80	3.90	5.25	6.00	0.00

Watershed Model Schematic



Hydrograph Return Period Recap

Hydraflow Hydrographs by Intelisolve v9.23

'yd. .o.	Hydrograph type (origin)	Inflow Hyd(s)	Peak Outflow (cfs)								Hydrograph description
			1-Yr	2-Yr	3-Yr	5-Yr	10-Yr	25-Yr	50-Yr	100-Yr	
1	SCS Runoff	-------	-------	-------	-------	-------	-------	-------	-------	63.88	Gen Plant Zone
2	SCS Runoff	-------	-------	-------	-------	-------	-------	-------	-------	41.10	Coal Pile
3	Manual	-------	-------	-------	-------	-------	-------	-------	-------	20.00	Plant Process Flow
4	SCS Runoff	-------	-------	-------	-------	-------	-------	-------	-------	58.35	Ash Pond
5	SCS Runoff	-------	-------	-------	-------	-------	-------	-------	-------	21.09	Polish Pond
6	Combine	1, 2, 3,	-------	-------	-------	-------	-------	-------	-------	124.99	Plant + Coal Pile+Process Flow
7	Reach	6	-------	-------	-------	-------	-------	-------	-------	124.99	Internal Ditch
8	Combine	4, 5, 7	-------	-------	-------	-------	-------	-------	-------	204.24	all flows into polish pond
9	Reservoir	8	-------	-------	-------	-------	-------	-------	-------	28.27	Polish pond outlet

Hydrograph Summary Report

Hydraflow Hydrographs by Intelisolve v9.23

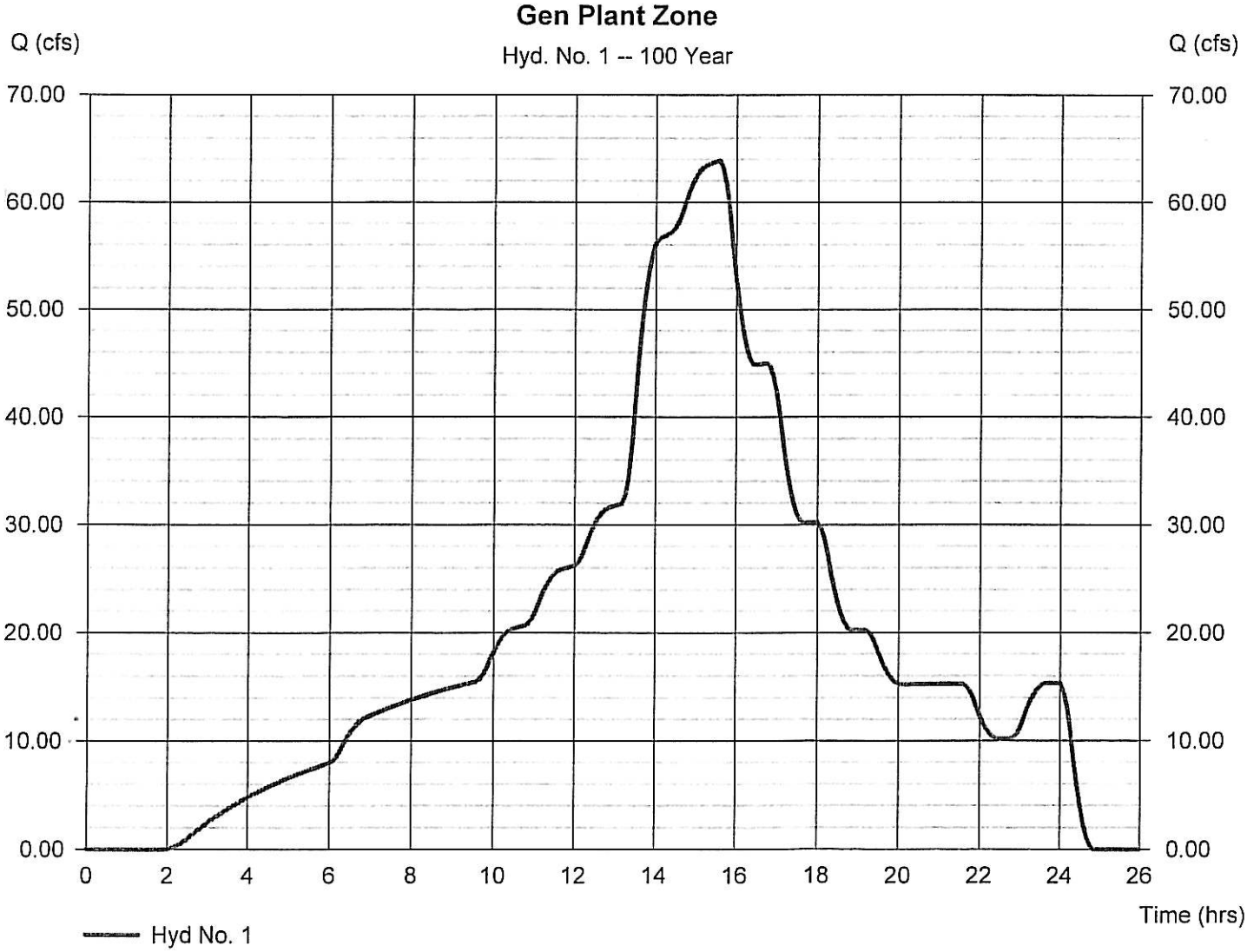
'yd. .o.	Hydrograph type (origin)	Peak flow (cfs)	Time interval (min)	Time to peak (min)	Hyd. volume (acft)	Inflow hyd(s)	Maximum elevation (ft)	Total strge used (acft)	Hydrograph description
1	SCS Runoff	63.88	5	935	40.508	----	------	------	Gen Plant Zone
2	SCS Runoff	41.10	5	935	25.944	----	------	------	Coal Pile
3	Manual	20.00	5	5	49.587	----	------	------	Plant Process Flow
4	SCS Runoff	58.35	5	935	34.925	----	------	------	Ash Pond
5	SCS Runoff	21.09	5	925	16.086	----	------	------	Polish Pond
6	Combine	124.99	5	935	116.039	1, 2, 3,	------	------	Plant + Coal Pile+Process Flow
7	Reach	124.99	5	940	116.177	6	------	------	Internal Ditch
8	Combine	204.24	5	935	167.188	4, 5, 7	------	------	all flows into polish pond
9	Reservoir	28.27	5	1470	166.331	8	402.55	125	Polish pond outlet

Hydrograph Report

Hyd. No. 1

Gen Plant Zone

Hydrograph type	= SCS Runoff	Peak discharge	= 63.88 cfs
Storm frequency	= 100 yrs	Time to peak	= 15.58 hrs
Time interval	= 5 min	Hyd. volume	= 40.508 acft
Drainage area	= 86.300 ac	Curve number	= 86
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= USER	Time of conc. (Tc)	= 30.00 min
Total precip.	= 7.10 in	Distribution	= Huff-3rd
Storm duration	= 24.00 hrs	Shape factor	= 484

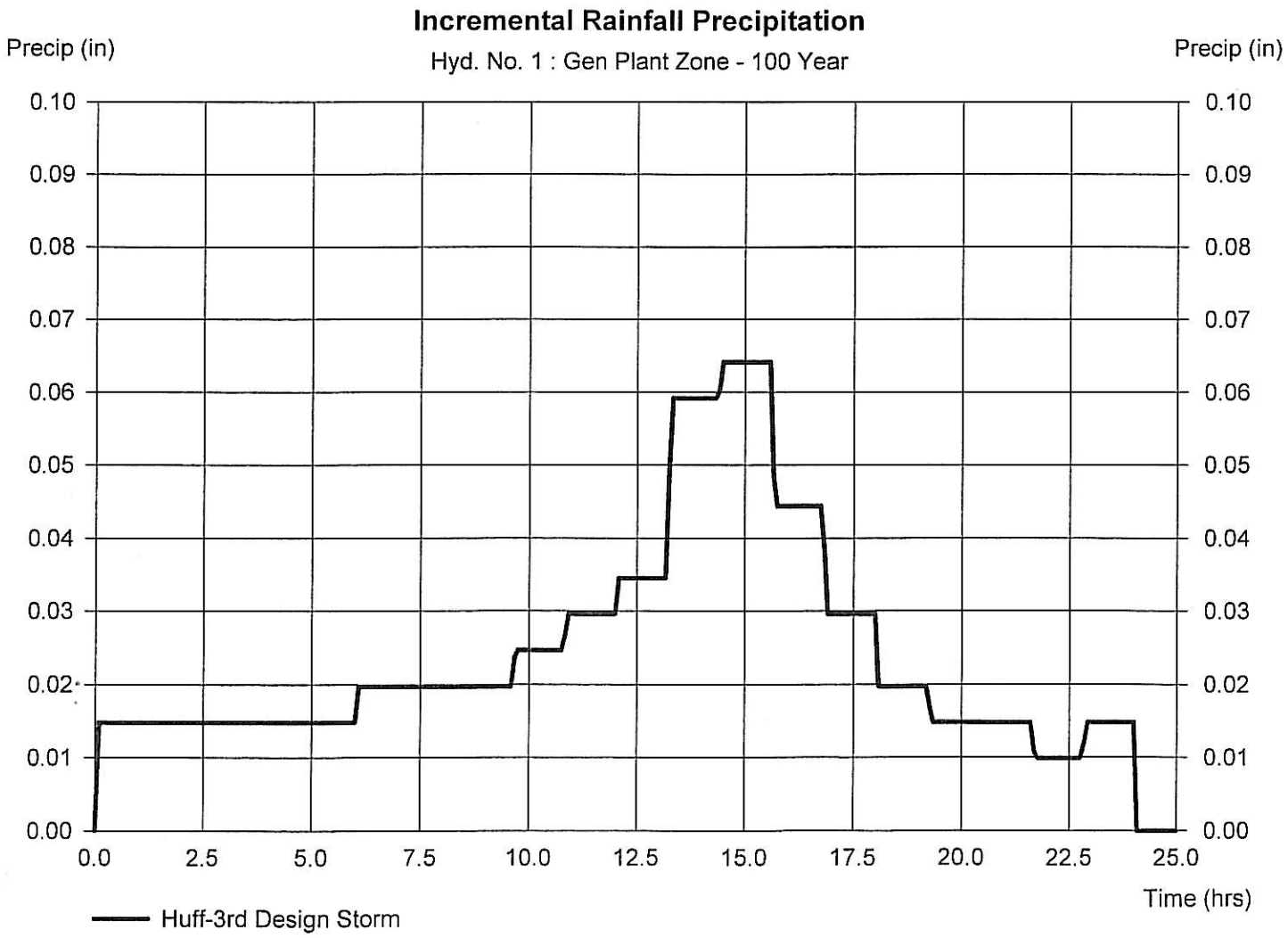


Precipitation Report

Hyd. No. 1

Gen Plant Zone

Storm Frequency	= 100 yrs	Time interval	= 5 min
Total precip.	= 7.1000 in	Distribution	= Huff-3rd
Storm duration	= 24.00 hrs		

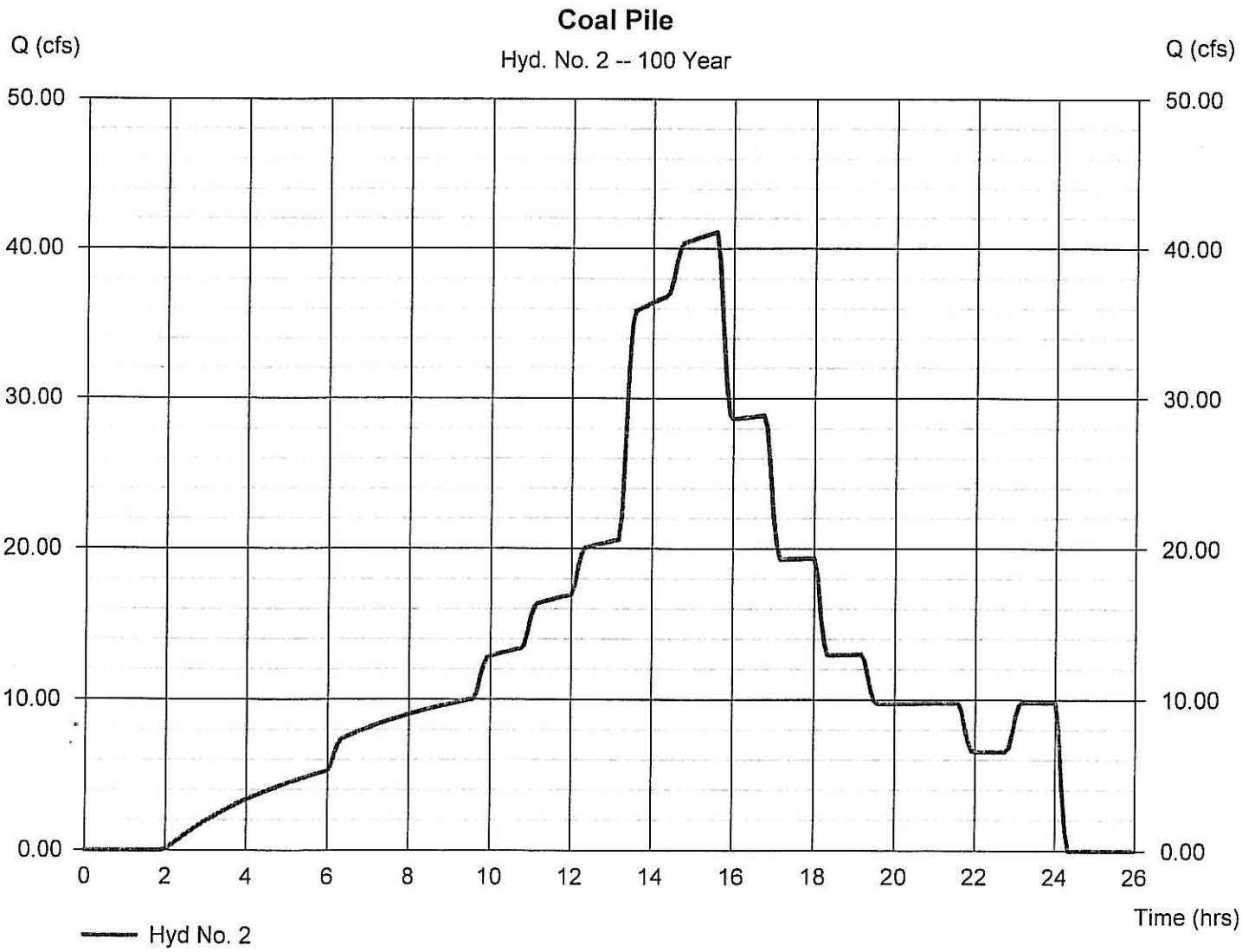


Hydrograph Report

Hyd. No. 2

Coal Pile

Hydrograph type	= SCS Runoff	Peak discharge	= 41.10 cfs
Storm frequency	= 100 yrs	Time to peak	= 15.58 hrs
Time interval	= 5 min	Hyd. volume	= 25.944 acft
Drainage area	= 60.800 ac	Curve number	= 86
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= USER	Time of conc. (Tc)	= 12.00 min
Total precip.	= 7.10 in	Distribution	= Huff-3rd
Storm duration	= 24.00 hrs	Shape factor	= 484

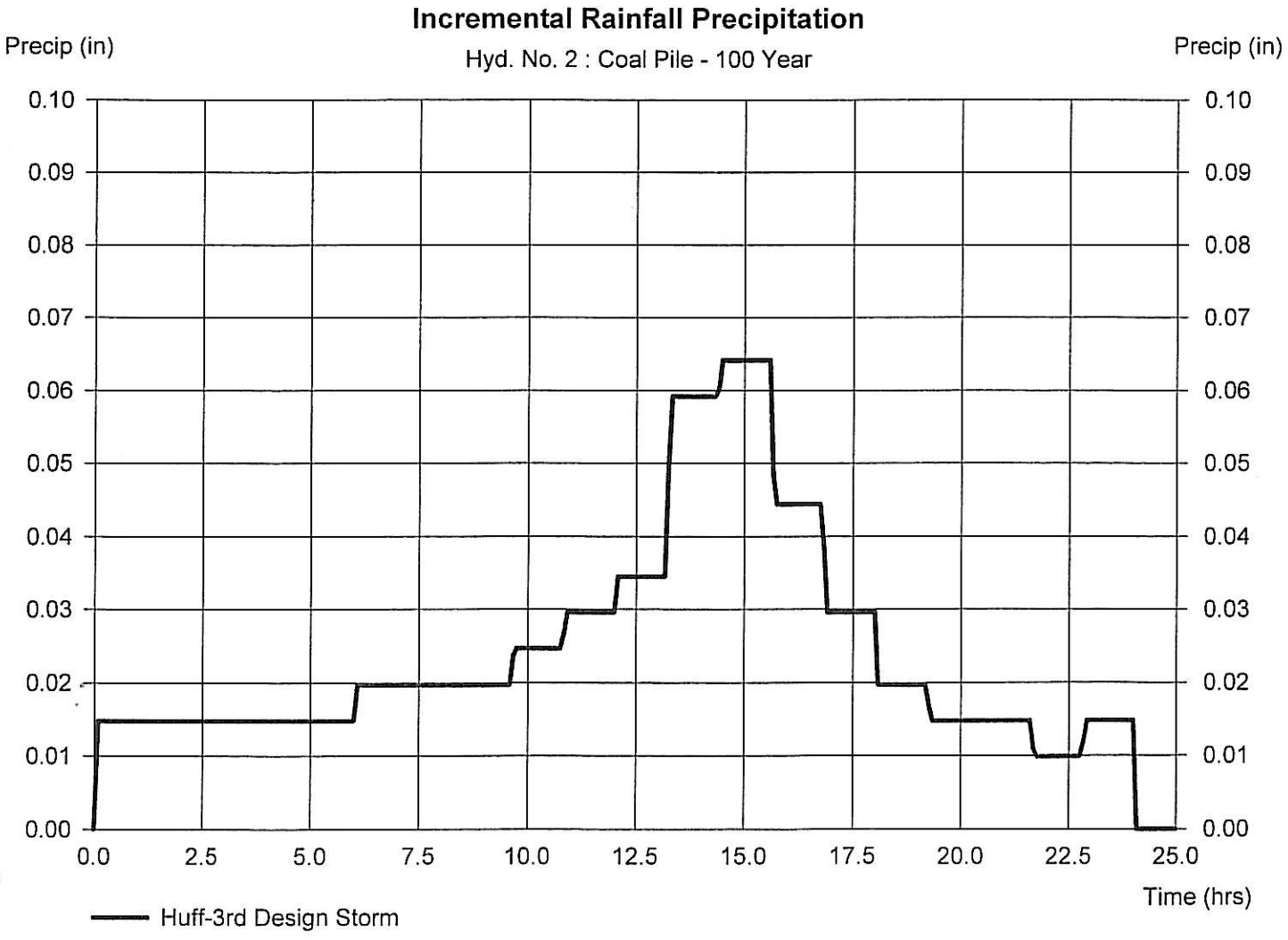


Precipitation Report

Hyd. No. 2

Coal Pile

Storm Frequency	= 100 yrs	Time interval	= 5 min
Total precip.	= 7.1000 in	Distribution	= Huff-3rd
Storm duration	= 24.00 hrs		

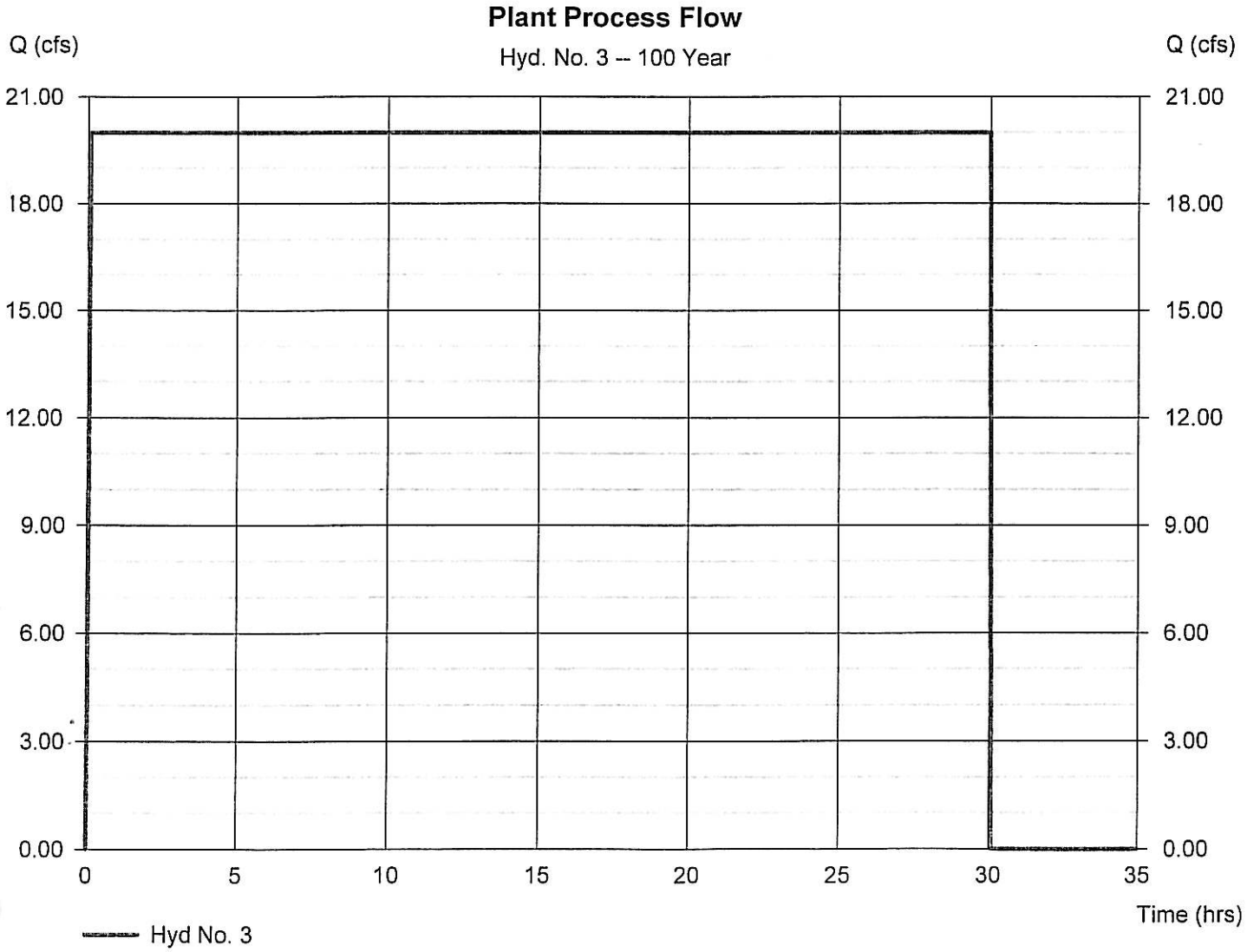


Hydrograph Report

Hyd. No. 3

Plant Process Flow

Hydrograph type	= Manual	Peak discharge	= 20.00 cfs
Storm frequency	= 100 yrs	Time to peak	= 0.08 hrs
Time interval	= 5 min	Hyd. volume	= 49.587 acft

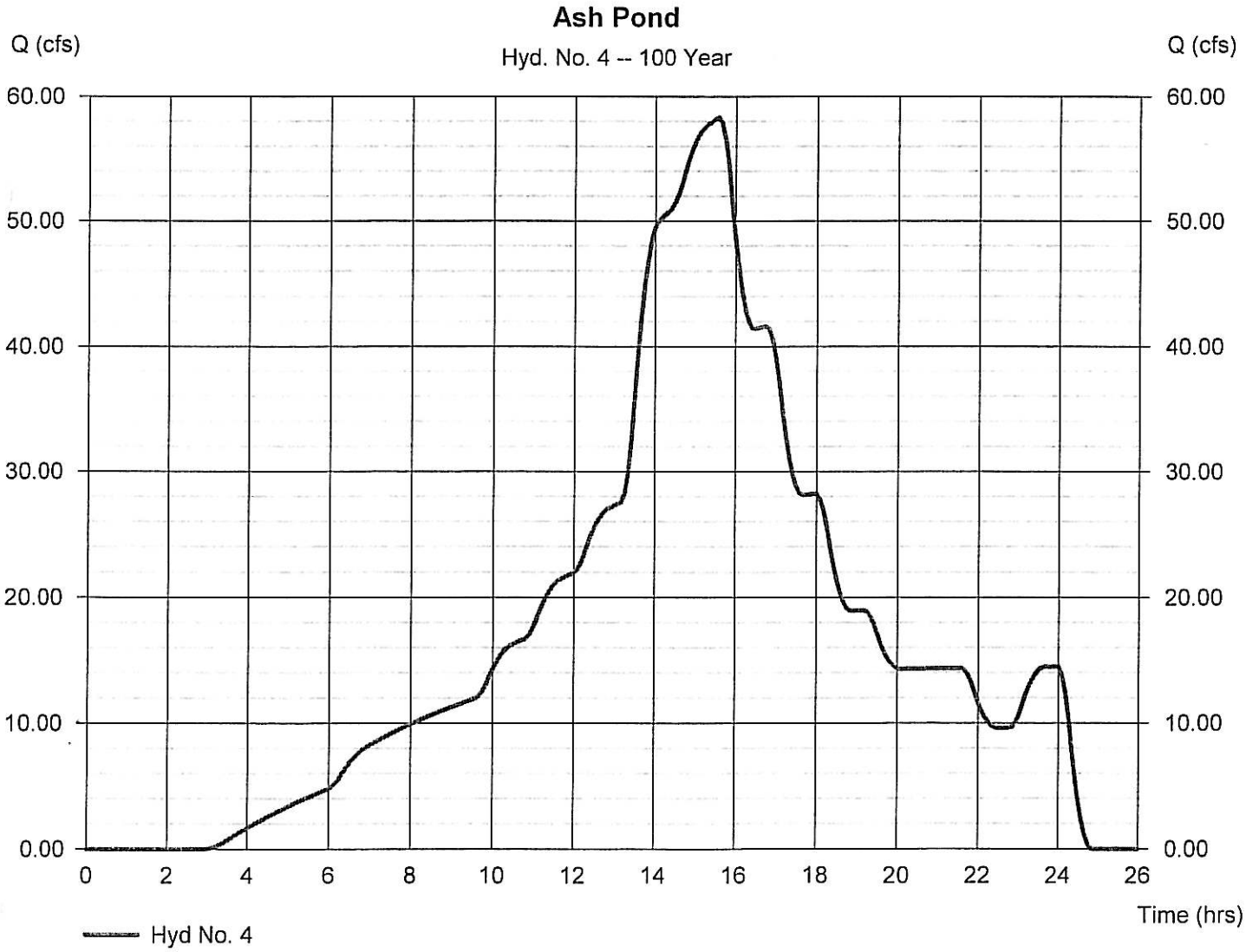


Hydrograph Report

Hyd. No. 4

Ash Pond

Hydrograph type	= SCS Runoff	Peak discharge	= 58.35 cfs
Storm frequency	= 100 yrs	Time to peak	= 15.58 hrs
Time interval	= 5 min	Hyd. volume	= 34.925 acft
Drainage area	= 84.900 ac	Curve number	= 80
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= USER	Time of conc. (Tc)	= 33.00 min
Total precip.	= 7.10 in	Distribution	= Huff-3rd
Storm duration	= 24.00 hrs	Shape factor	= 484

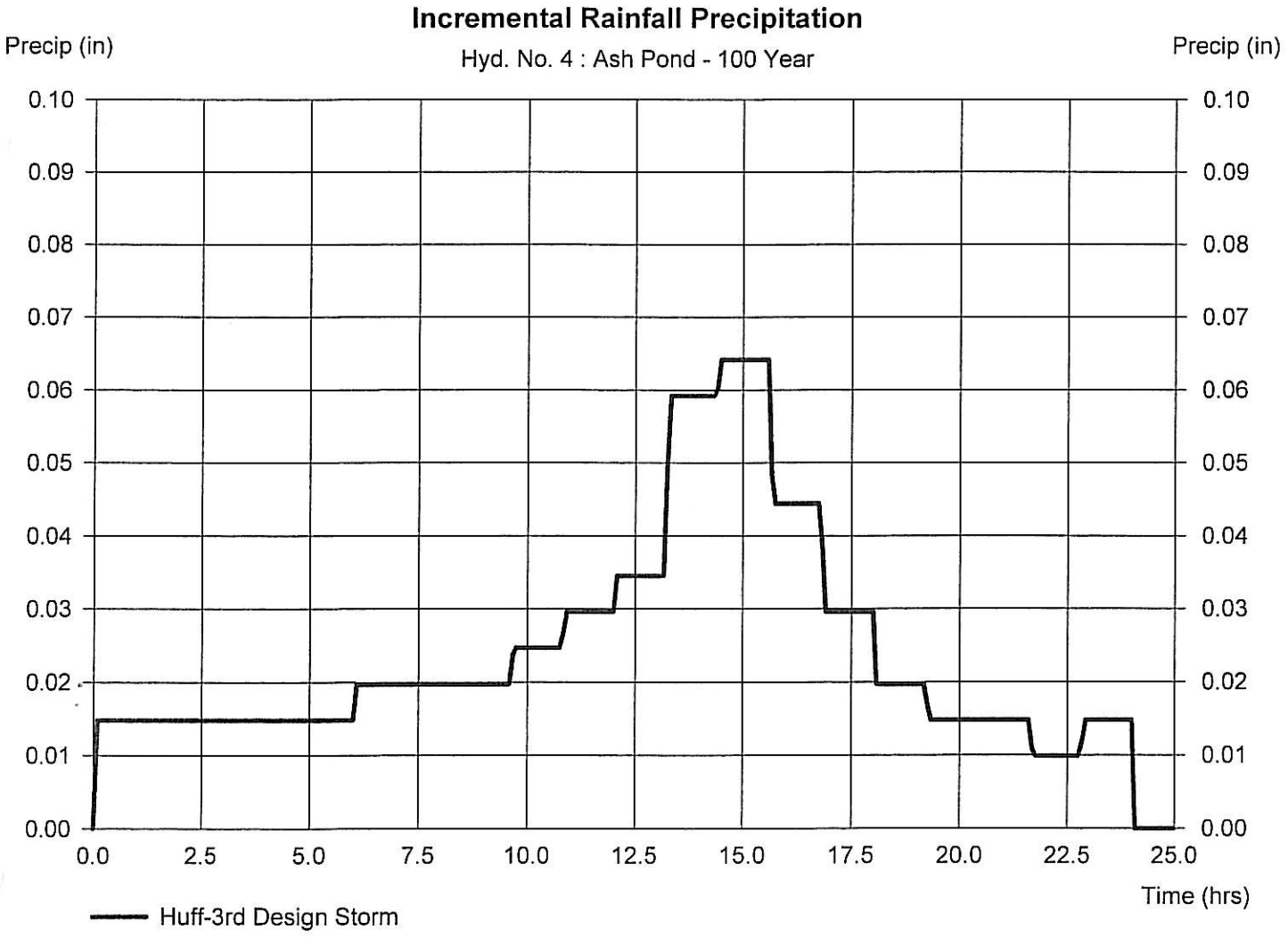


Precipitation Report

Hyd. No. 4

Ash Pond

Storm Frequency	= 100 yrs	Time interval	= 5 min
Total precip.	= 7.1000 in	Distribution	= Huff-3rd
Storm duration	= 24.00 hrs		



Hydrograph Report

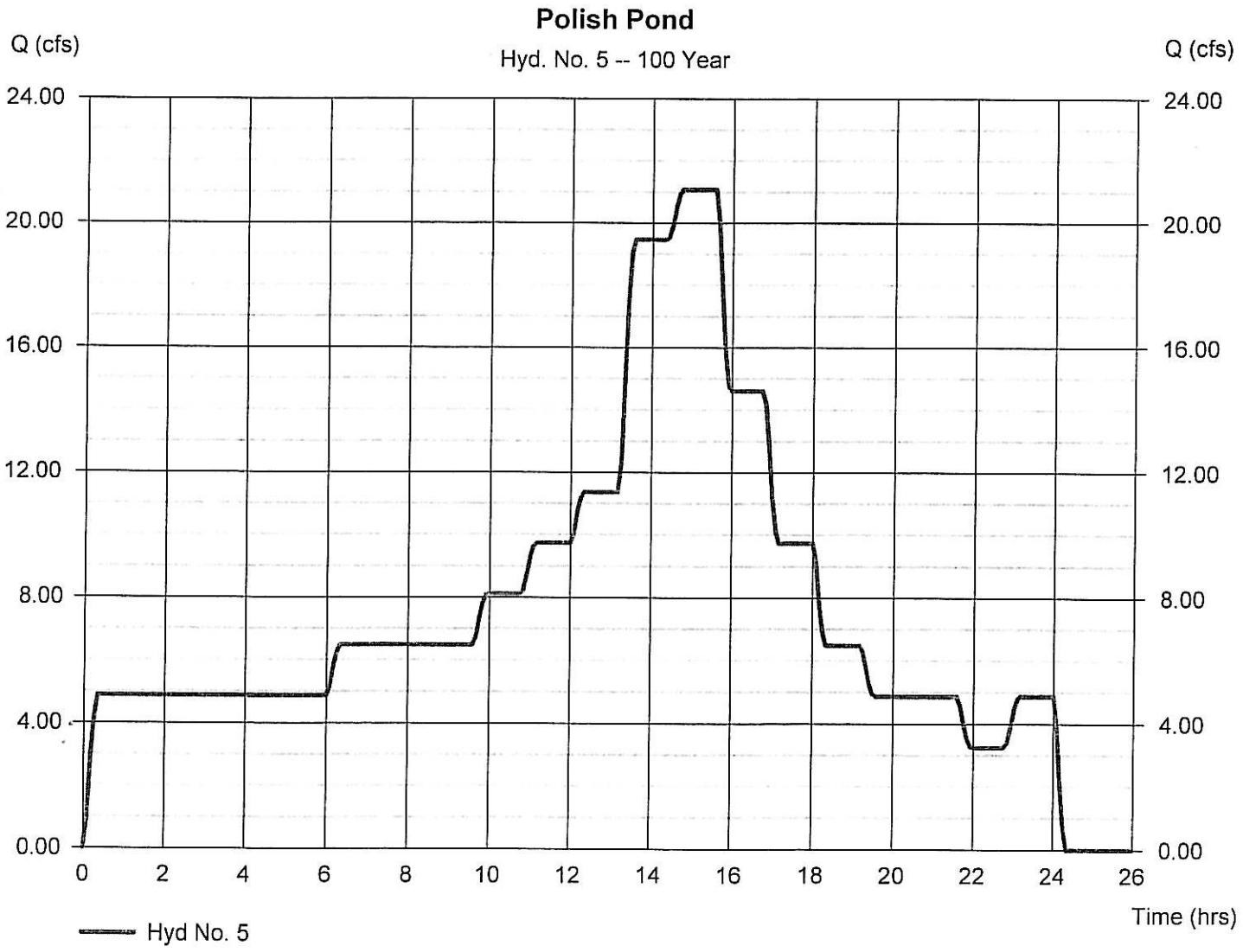
Hydraflow Hydrographs by Intelisolve v9.23

Monday, Mar 15, 2010

Hyd. No. 5

Polish Pond

Hydrograph type	= SCS Runoff	Peak discharge	= 21.09 cfs
Storm frequency	= 100 yrs	Time to peak	= 15.42 hrs
Time interval	= 5 min	Hyd. volume	= 16.086 acft
Drainage area	= 29.000 ac	Curve number	= 100
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= USER	Time of conc. (Tc)	= 10.00 min
Total precip.	= 7.10 in	Distribution	= Huff-3rd
Storm duration	= 24.00 hrs	Shape factor	= 484

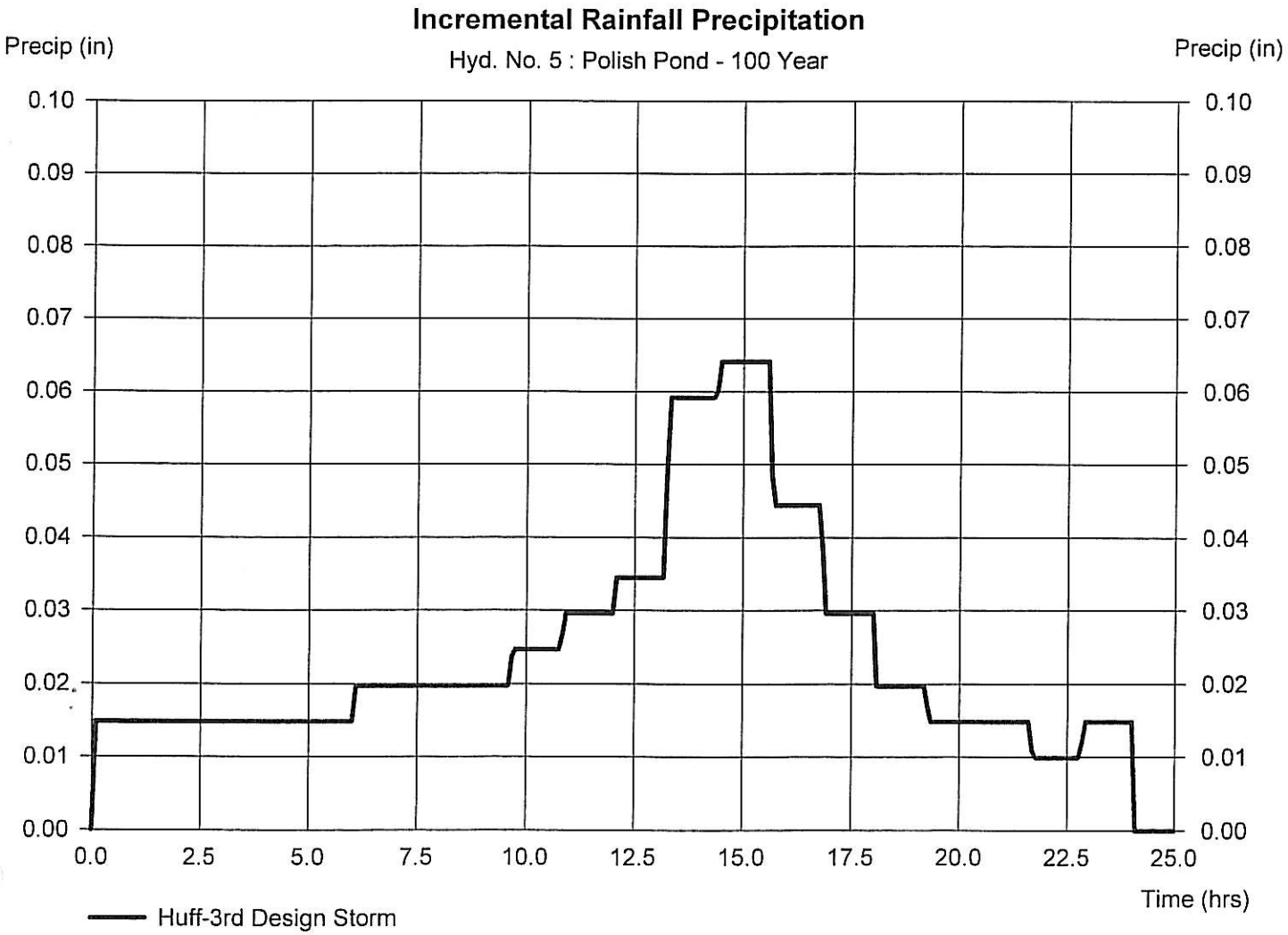


Precipitation Report

Hyd. No. 5

Polish Pond

Storm Frequency	= 100 yrs	Time interval	= 5 min
Total precip.	= 7.1000 in	Distribution	= Huff-3rd
Storm duration	= 24.00 hrs		

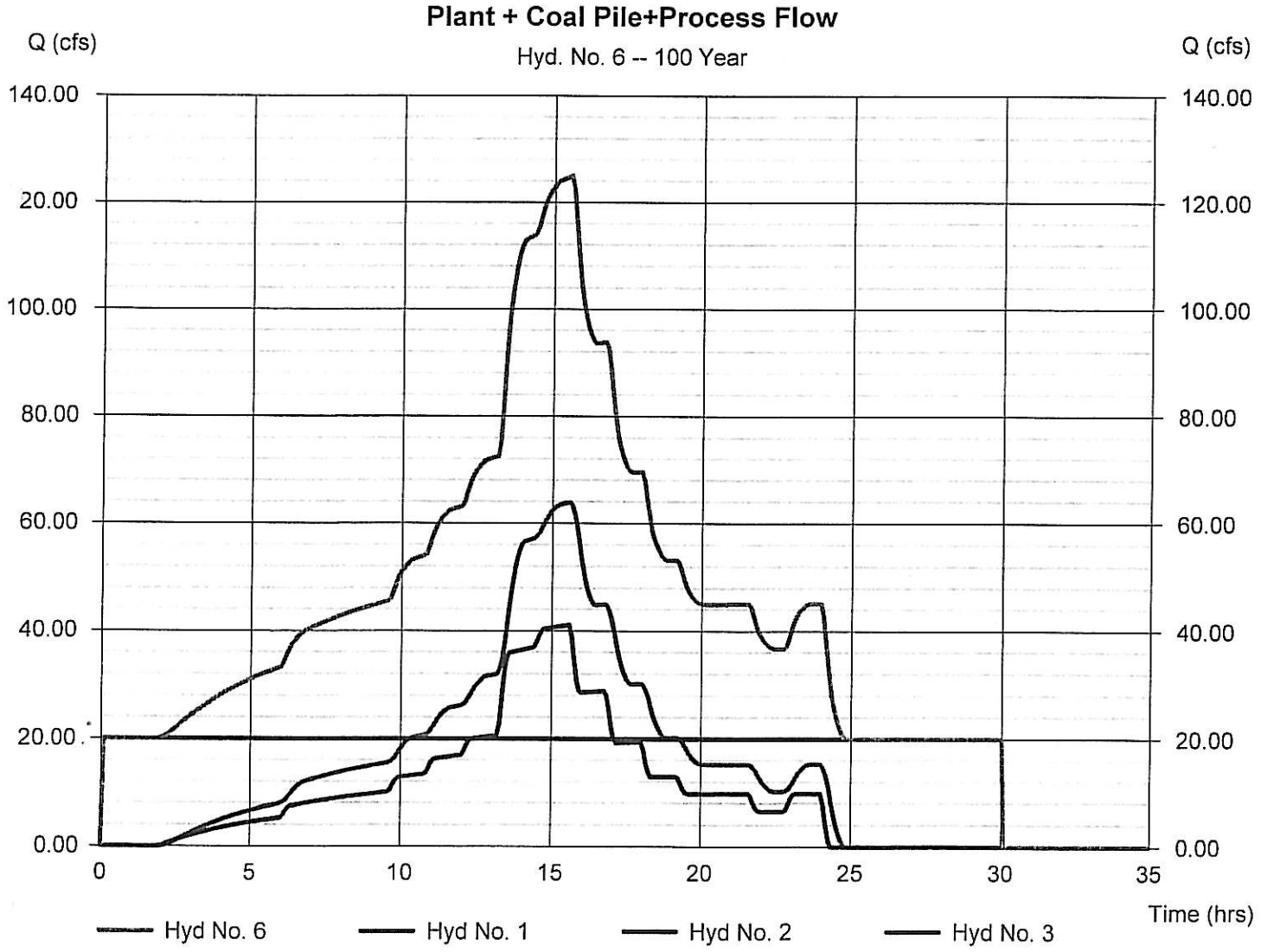


Hydrograph Report

Hyd. No. 6

Plant + Coal Pile+Process Flow

Hydrograph type	= Combine	Peak discharge	= 124.99 cfs
Storm frequency	= 100 yrs	Time to peak	= 15.58 hrs
Time interval	= 5 min	Hyd. volume	= 116.039 acft
Inflow hyds.	= 1, 2, 3	Contrib. drain. area	= 147.100 ac



Hydrograph Report

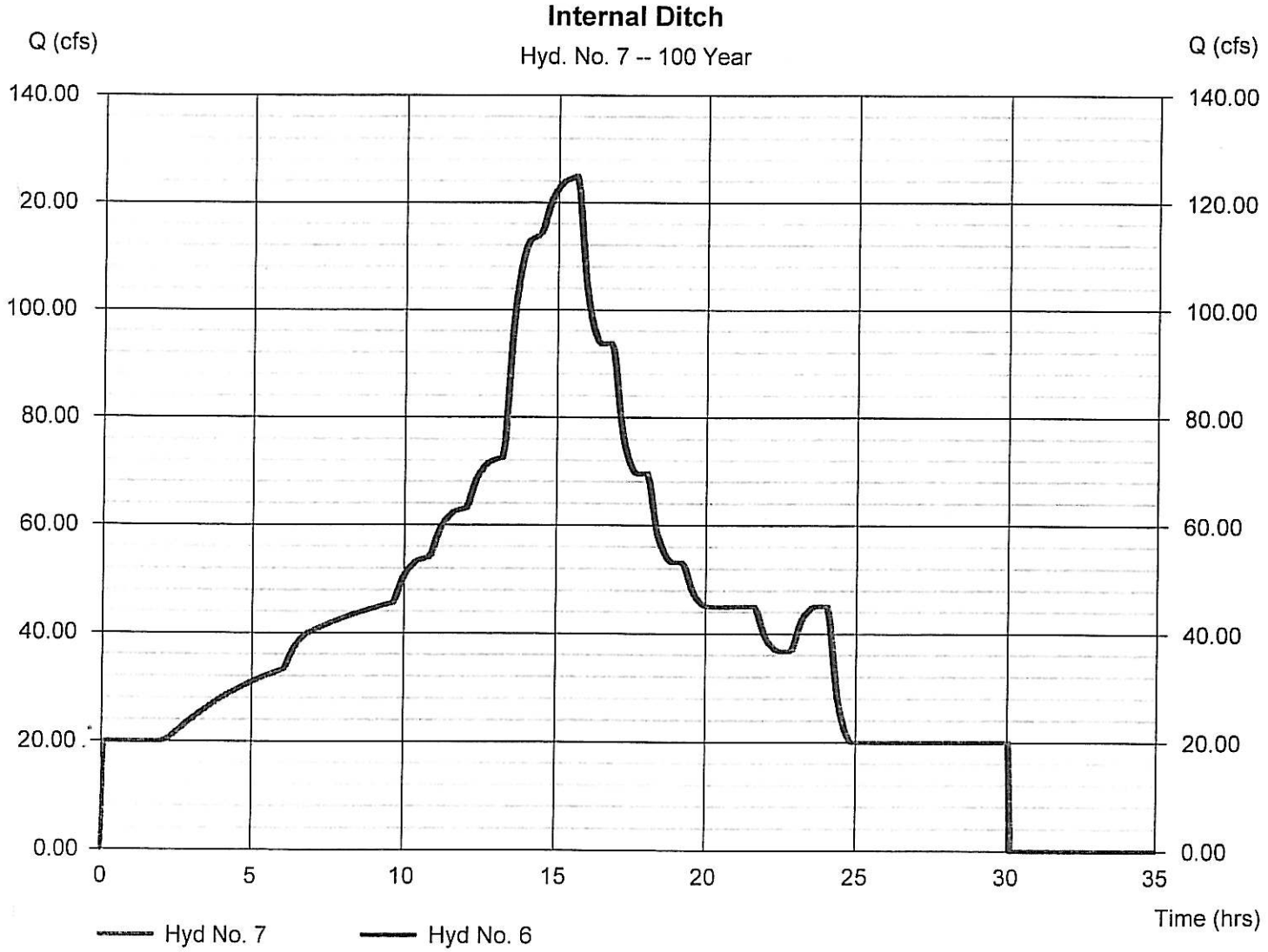
Hydraflow Hydrographs by Intelisolve v9.23 — Monday, Mar 15, 2010

Hyd. No. 7

Internal Ditch

Hydrograph type	= Reach	Peak discharge	= 124.99 cfs
Storm frequency	= 100 yrs	Time to peak	= 15.67 hrs
Time interval	= 5 min	Hyd. volume	= 116.177 acft
Inflow hyd. No.	= 6 - Plant + Coal Pile+Process Flow	Section type	= Trapezoidal
Reach length	= 1800.0 ft	Channel slope	= 0.3 %
Manning's n	= 0.009	Bottom width	= 10.0 ft
Side slope	= 0.5:1	Max. depth	= 8.0 ft
Rating curve x	= 1.886	Rating curve m	= 1.516
Ave. velocity	= 7.86 ft/s	Routing coeff.	= 0.9967

Modified Att-Kin routing method used.



Hydrograph Report

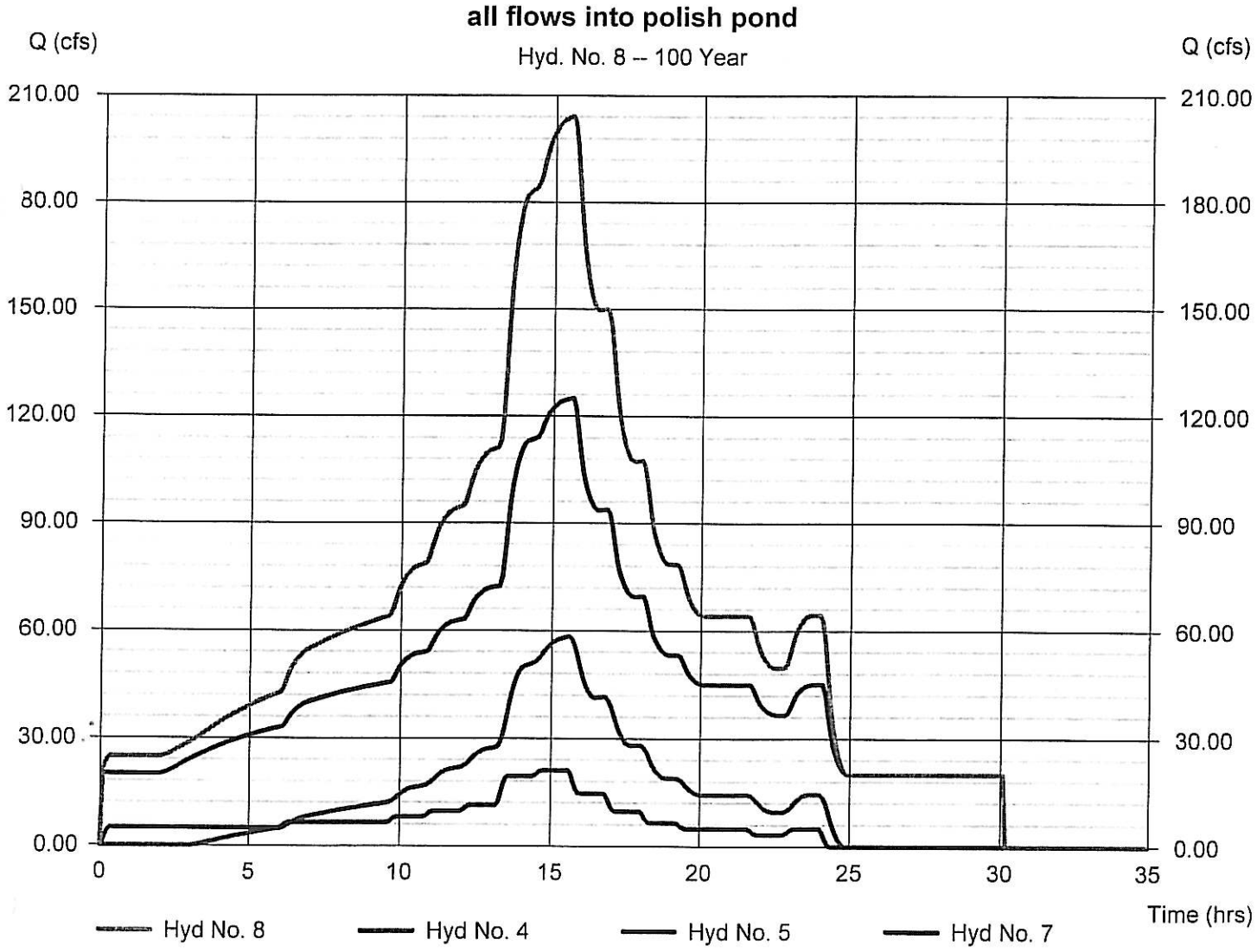
Hydraflow Hydrographs by Intelisolve v9.23

Monday, Mar 15, 2010

Hyd. No. 8

all flows into polish pond

Hydrograph type	= Combine	Peak discharge	= 204.24 cfs
Storm frequency	= 100 yrs	Time to peak	= 15.58 hrs
Time interval	= 5 min	Hyd. volume	= 167.188 acft
Inflow hyds.	= 4, 5, 7	Contrib. drain. area	= 113.900 ac



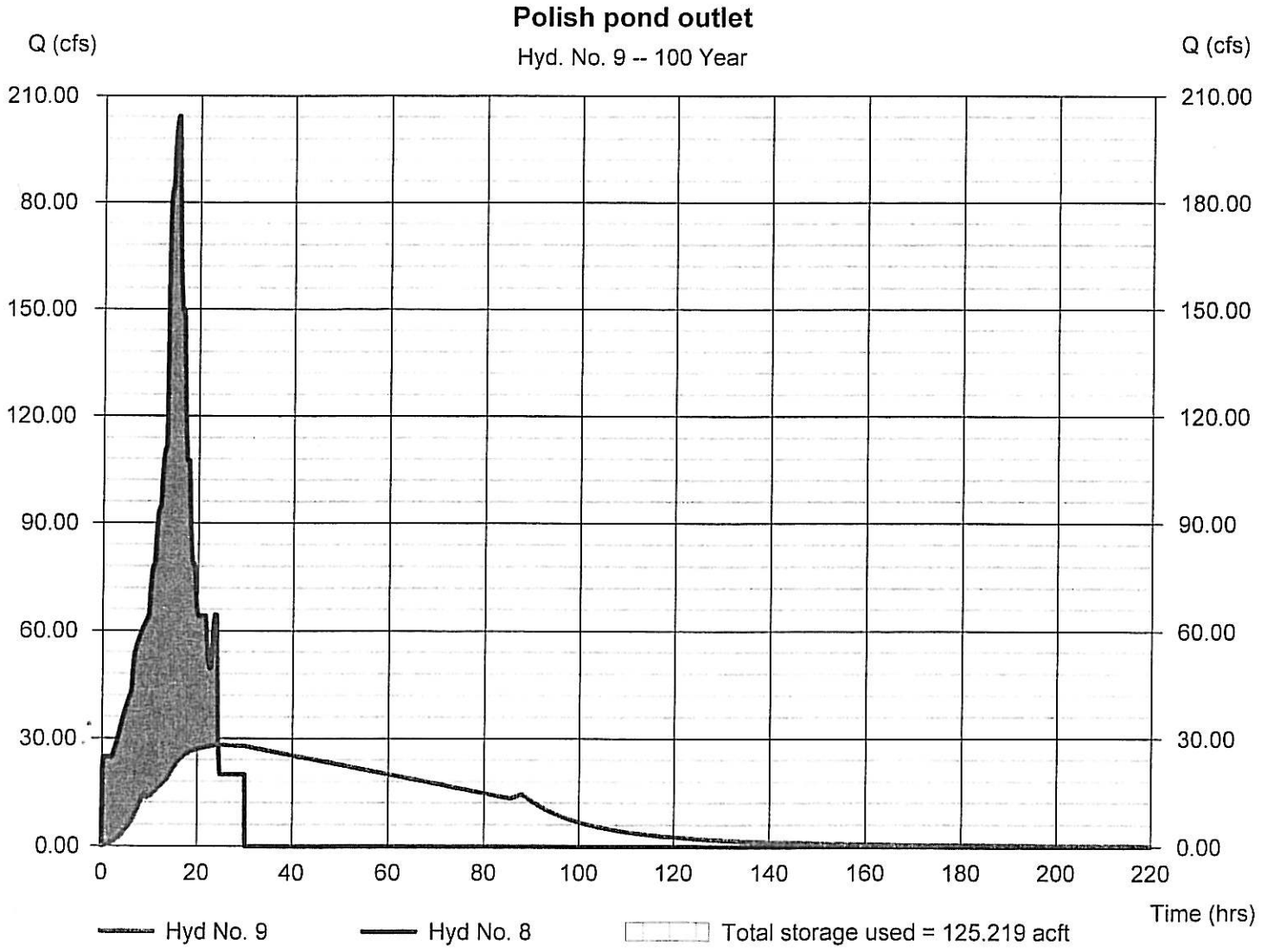
Hydrograph Report

Hyd. No. 9

Polish pond outlet

Hydrograph type	= Reservoir	Peak discharge	= 28.27 cfs
Storm frequency	= 100 yrs	Time to peak	= 24.50 hrs
Time interval	= 5 min	Hyd. volume	= 166.331 acft
Inflow hyd. No.	= 8 - all flows into polish pond	Max. Elevation	= 402.55 ft
Reservoir name	= Polish pond	Max. Storage	= 125.219 acft

Storage Indication method used.



Hydraflow Rainfall Report

Return Period (Yrs)	Intensity-Duration-Frequency Equation Coefficients (FHA)			
	B	D	E	(N/A)
1	0.0000	0.0000	0.0000	--------
2	69.8703	13.1000	0.8658	--------
3	0.0000	0.0000	0.0000	--------
5	79.2597	14.6000	0.8369	--------
10	88.2351	15.5000	0.8279	--------
25	102.6072	16.5000	0.8217	--------
50	114.8193	17.2000	0.8199	--------
100	127.1596	17.8000	0.8186	--------

File name: SampleFHA.idf

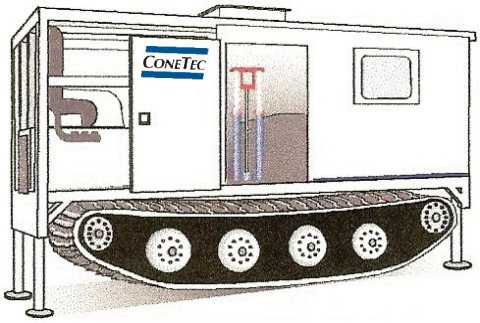
Intensity = B / (Tc + D)^E

Return Period (Yrs)	Intensity Values (in/hr)											
	5 min	10	15	20	25	30	35	40	45	50	55	60
1	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2	5.69	4.61	3.89	3.38	2.99	2.69	2.44	2.24	2.07	1.93	1.81	1.70
3	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
5	6.57	5.43	4.65	4.08	3.65	3.30	3.02	2.79	2.59	2.42	2.27	2.15
10	7.24	6.04	5.21	4.59	4.12	3.74	3.43	3.17	2.95	2.77	2.60	2.46
25	8.25	6.95	6.03	5.34	4.80	4.38	4.02	3.73	3.48	3.26	3.07	2.91
50	9.04	7.65	6.66	5.92	5.34	4.87	4.49	4.16	3.88	3.65	3.44	3.25
100	9.83	8.36	7.30	6.50	5.87	5.36	4.94	4.59	4.29	4.03	3.80	3.60

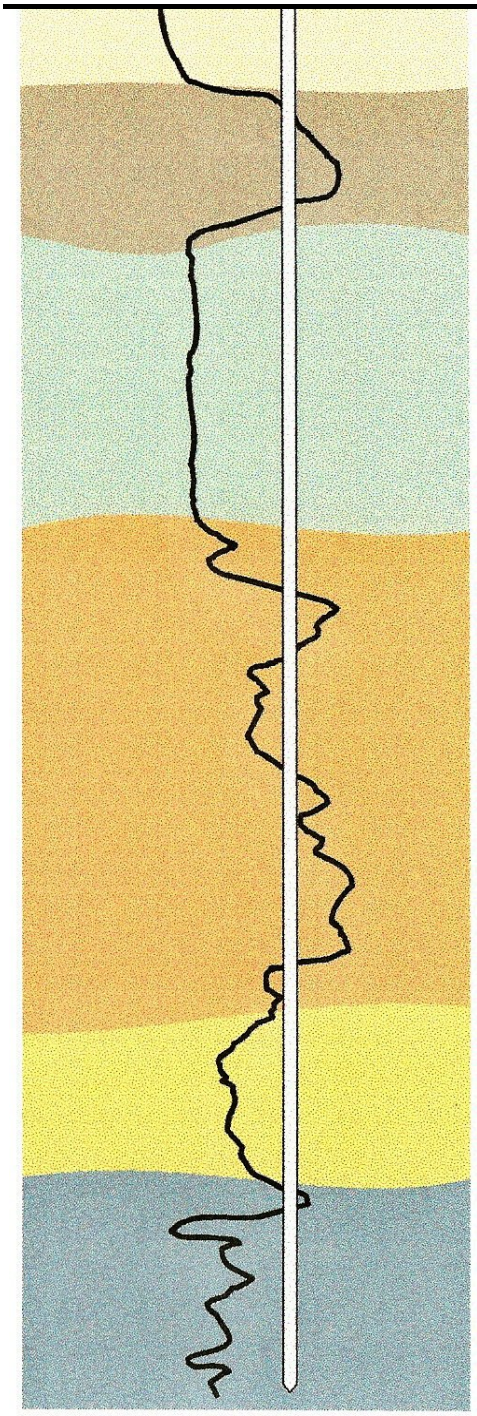
Tc = time in minutes. Values may exceed 60.

Precip. file name: Sample.pcp

Storm Distribution	Rainfall Precipitation Table (in)							
	1-yr	2-yr	3-yr	5-yr	10-yr	25-yr	50-yr	100-yr
SCS 24-hour	0.00	2.20	0.00	3.30	4.25	5.77	6.80	0.00
SCS 6-Hr	0.00	1.80	0.00	0.00	2.60	0.00	0.00	0.00
Huff-1st	0.00	1.55	0.00	2.75	4.00	5.38	6.50	0.00
Huff-2nd	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Huff-3rd	0.00	0.00	0.00	0.00	0.00	0.00	0.00	7.10
Huff-4th	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Huff-Indy	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Custom	0.00	1.75	0.00	2.80	3.90	5.25	6.00	0.00



ConeTec



Geotechnical and Environmental In Situ Testing Contractors

ConeTec Field Report

Presentation of In Situ Test Results for:

Rush Island
Festus, Missouri

Presented to: Haley & Aldrich

Date: October 2nd, 2014

Presented by: ConeTec, Inc.
436 Commerce Lane
Unit C
West Berlin, NJ 08091
(856) 767-8600

PRESENTATION OF IN-SITU PROGRAM TESTING RESULTS

Rush Island
Festus, Missouri

Project performed on:

September 23rd through October 1st, 2014

Prepared for:

Haley & Aldrich
McLean, Virginia

Prepared by:

ConeTec, Inc.
West Berlin, NJ

October 2nd, 2014

TABLE OF CONTENTS

1.0 INTRODUCTION **1**

2.0 FIELD EQUIPMENT AND PROCEDURES **1**
2.1 Cone Penetration Test 1
2.2 Seismic Cone Penetration Test 3

3.0 TEST RESULTS **4**
3.1 Cone Penetration Test Results 4
3.2 Pore Pressure Dissipation Test Results 6
3.3 Seismic Cone Penetration Test Results 7

4.0 FLAT PLATE DILATOMETER TESTING **7**

5.0 CLOSING **7**

6.0 BIBLIOGRAPHY **8**

FIGURES

Figure 1 - Cone Penetrometer

Figure 2 - Pore Pressure Filter Locations

Figure 3 - Seismic CPT System

Figure 4 - Soil Behavior Type Chart, Robertson (1990)

APPENDICES

APPENDIX A - CPT Sounding Summary and Plots

APPENDIX B - CPT Interpretation Methods

APPENDIX C - Pore Pressure Dissipation Summary and Plots

APPENDIX D - Seismic Results and Vs Plots

APPENDIX E - Flat Plate Dilatometer Data

APPENDIX F - Release Folder Contents and File Formats

1.0 INTRODUCTION

This report presents the results of a geotechnical site investigation program conducted by ConeTec, Inc. (ConeTec) of West Berlin, New Jersey for Haley & Aldrich from September 23rd through October 1st, 2014. The work took place at the Rush Island Site located in Festus, Missouri. The program consisted of twelve seismic cone penetration tests (SCPTu's). SCPT-D107 had a shallow refusal. The location was offset and pushed to depth. Also performed were five flat plate dilatometer test (DMT).

2.0 FIELD EQUIPMENT AND PROCEDURES

2.1 Cone Penetration Test

Cone penetration testing (CPT) was conducted by ConeTec using an integrated electronic cone penetration testing and data acquisition system. A ConeTec cone penetrometer (Figure 1) was used during this investigation. The CPT soundings were completed in accordance with ASTM D5778. The cone was deployed using ConeTec's, unitized, 20 ton CPT track rig. The cone and rods were pushed into the ground using the hydraulic ramset, located inside the cone rig, at a steady rate of .6 centimeters per second at 6 locations and 2 centimeters per second at 6 locations.

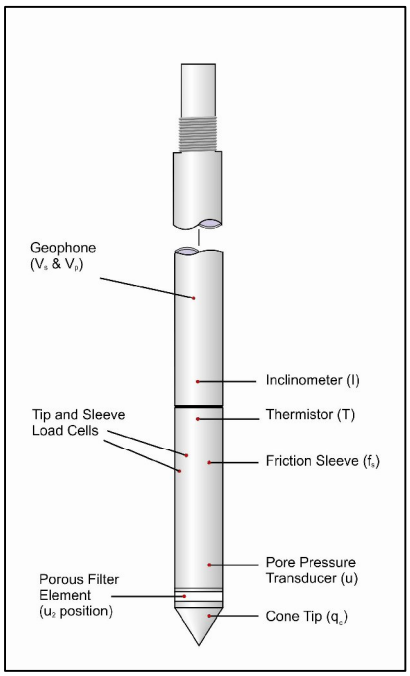


Figure 1 – Cone Penetrometer

The cone that was used had a maximum tip capacity of 1,500 bar, a tip area (A_c) of 15 cm^2, a friction sleeve area (A_s) of 225 cm^2, and a pore pressure transducer capacity of 500 psi. A pore pressure filter located directly behind the cone tip in the "u_2" position was also used (Figure 2). The six millimeter thick pore pressure filter, which is composed of porous plastic, enables the cone penetrometer to measure dynamic pore pressures during penetration, and record pore pressure dissipations at selected depths. The function of the filter is to allow rapid movements of the extremely small volumes of water needed to activate the pressure transducer while preventing soil ingress or blockage. Each pore pressure filter was saturated in silicone fluid under vacuum pressure prior to testing and the pore pressure cavity within the cone was filled with silicone fluid to maintain a compliant pore pressure measuring system. A viscous fluid is used to try to maintain saturation of the system. The data acquisition system automatically records and displays the pore pressure dissipation traces in real time (at five second intervals) during pauses in penetration.

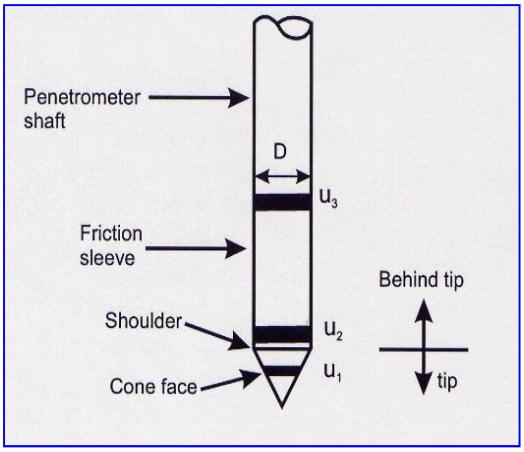


Figure 2 – Pore Pressure Filter Locations

ConeTec compression cones are designed with an equal end area friction sleeve; hence no corrections are required for friction sleeve data. ConeTec compression cones experience unequal area effects on the tip resistance due to the tip and load cell geometry. The unequal area is represented by the cone net area ratio (a) of 0.80. The net area ratio of ConeTec's compression cone has been verified through laboratory testing by subjecting the cone to a known pressure then measuring the load recorded on the tip. Refer to section 3.1 Cone

Penetration Test Results for a detailed explanation of the use of the net end area ratio in correcting CPT data.

The cone system used during the program recorded the following parameters in units selected by the client at one and five centimeter depth increments:

- Tip resistance (q_c)
- Sleeve friction (f_s)
- Dynamic pore pressure (u_2)

A complete set of baseline readings were taken before and after each sounding to determine if a zero load offset had occurred due to a temperature change in the probe. Establishing the presence of temperature shifts and load offsets enables the operator to make corrections to the cone data as necessary. Since the probes are temperature compensated, load shifts due to changes in probe temperature are only a problem when extreme temperature changes occur.

2.2 Seismic Cone Penetration Test

The seismic cone penetration test (SCPT) equipment and procedures used for determining seismic wave velocities were generally the same as those reported by Robertson et al. (1986). The procedure was incorporated with CPT testing and conducted when penetration was stopped at the end of each one meter stroke. Within the first few meters (depending on the ground conditions), initial shear wave velocity measurement was made and subsequent measurements were typically made at one meter intervals until refusal. Before taking any seismic wave measurements, the rods were decoupled from the CPT rig, serving to minimize any rig induced background noise.

The shear waves were generated using a sledge hammer, struck against a steel I-beam. The beam was held to the ground by the weight of the track rig and located under the tracks. The hammer striking the source acted as an electrical contact trigger, initiating the recording of the seismic wave traces. The offset and depth of the source from the cone was taken into account during calculation of the seismic wave velocities.

Multiple hits were recorded to enable the operator to check the consistency of the waveforms. The wave receiver used was a horizontally active geophone located in the body of the cone

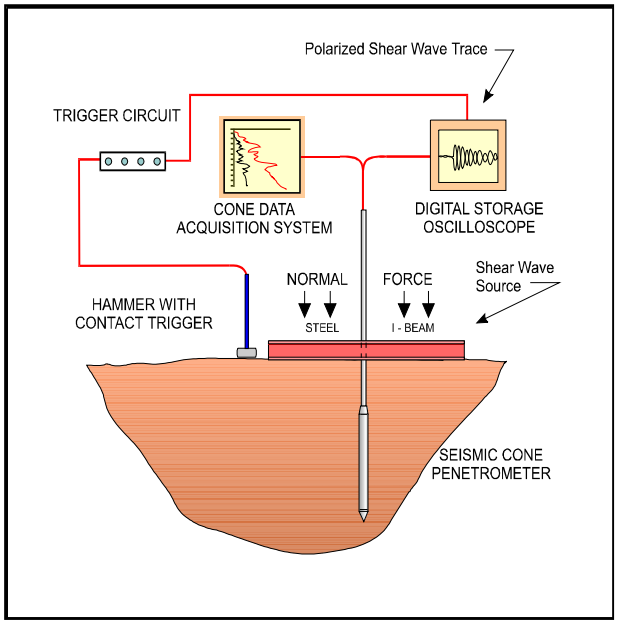


Figure 3 - Seismic CPT

penetrometer. The geophone is located 0.2 meters behind the cone tip. This offset was accounted for in all calculations. Shear wave data was sampled at a frequency of 20 kHz (i.e. 20,000 samples per second). Because the shear wave signals experienced attenuation in the soils, input sensitivity (gain) of the receiver was increased with depth to maintain the desired signal resolution.

3.0 TEST RESULTS

3.1 Cone Penetration Test Results

A summary of the cone penetration testing work is provided in Appendix A. The penetration depths are referenced to the existing ground surface at the time of the investigation.

All of the CPT data are presented in graphical form in the attached appendices and stored in Excel™ format in the release folder. A detailed set of CPT interpretations were generated and are provided in Excel™ format files in the release folder. The CPT interpretations are based on values of corrected tip (q_t), sleeve friction (f_s) and pore pressure averaged over a user specified interval (this interval is specified in the header of each file). Data from equilibrium and dynamic pore pressure profiles were used to interpret phreatic surface depths that are used in the interpretation tables. Further details on the description of parameters and methods used for the interpretations are provided in Appendix B. The contents of the release folder and file formats are detailed in Appendix F.

The CPT plots presented in Appendix A consist of corrected tip resistance (q_t), sleeve friction (f_s), friction ratio (R_f), dynamic pore pressure (u_2) and Soil Behavior Type (SBT) are plotted versus depth. The measured readings may or may not be averaged in these plots. The averaging interval is specified in the plot footnotes.

The cone tip (q_t) reading is the total force acting on the cone tip divided by the projected plan area of the tip. It indicates the relative density, or stiffness, of the soil. The sleeve friction (f_s) is the frictional force the soil is imposing on the friction sleeve divided by the surface area of the friction sleeve. The friction ratio (R_f), expressed as a percentage, is a ratio of the sleeve friction readings divided by the cone tip readings. The friction ratio gives an indication of the grain size characteristics of the material. Generally, fine-grained soils have a higher friction ratio than coarse-grained soils. The dynamic pore pressures generated behind the cone tip, during cone penetration, are recorded by a pore pressure transducer. In freely draining soils the dynamic pore pressure will often be similar to the equilibrium pore pressure, while in fine grained soils penetration is undrained and the dynamic pore pressure will deviate from the equilibrium pore pressure profile. To record equilibrium or static water pressures, the penetration must be stopped to allow the dynamic pore pressures to stabilize. The rate at which this will occur is a function of the permeability of the soil.

Due to the inner geometry of the cone penetrometer, the ambient pore water pressure will act on the shoulder area behind the cone tip and on the ends of the friction sleeve. This results in an imbalance of stresses and is known as the “unequal area effect”. This effect influences the total stress determined from the cone and friction sleeve. For the cone resistance, the unequal

area is represented by the cone net area ratio 'a', which is approximately equal to the ratio of the cross-sectional area of the load cell or shaft divided by the projected area of the cone. The corrected total cone resistance, q_t, is given by the equation:

$$q_t = q_c + u_2 (1-a)$$

As stated earlier in the report, the net area ratio for ConeTec's compression cone penetrometers is 0.80. All of the calculations and plots use the corrected cone resistance, q_t.

The stratigraphic interpretations included on the plots are based on a soil behavior chart described in Robertson (1990) as illustrated in Figure 4. The chart relates cone tip resistance to friction ratio in order to determine Soil Behavior Type (SBT). It should be noted that it is not always possible to clearly identify a soil type based on these parameters. In these situations, experience, judgment, the use of auxiliary modules and an assessment of pore pressure dissipation data should be used to infer Soil Behavior Type.

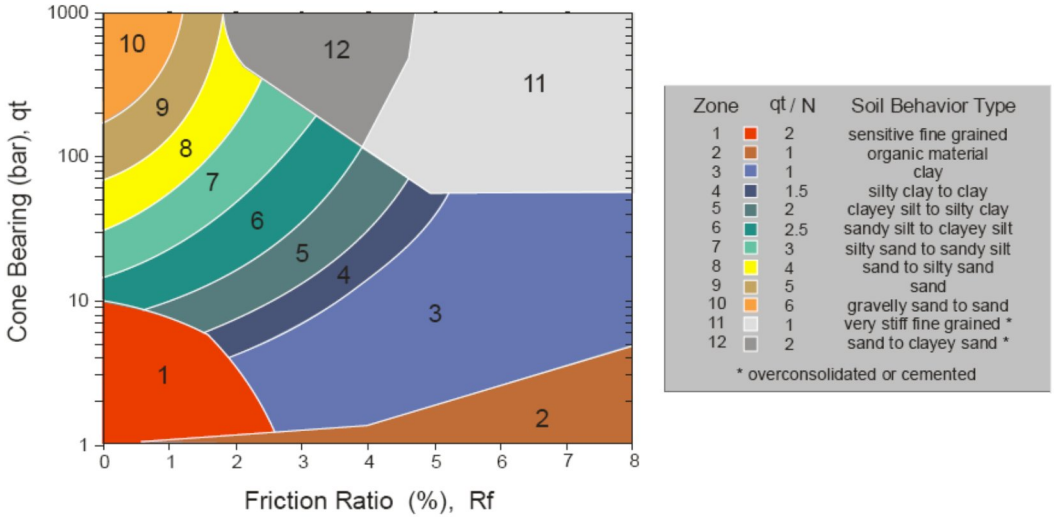


Figure 4 - Soil Behavior Type Chart, Robertson (1990)

3.2 Pore Pressure Dissipation Test Results

The penetration of the piezocone was halted at specific depths to carry out pore pressure dissipation tests. The variation of the pore pressure (u) with time was measured and recorded. All pore pressure data was recorded immediately behind the cone tip at the u_2 location. A tabular summary of these results is provided along with the individual pore pressure dissipation

plots in Appendix C. All of the dissipation data is provided in the release folder along with a summary of the results in both Excel™ and PDF format.

3.3 Seismic Cone Penetration Test Results

Tabular shear wave velocity results are presented in Appendix D and the seismic CPT (SCPT) plots are presented in Appendix A. The calculated shear wave velocities (Vs) are plotted against depth together with tip (q_t), friction sleeve (f_s), dynamic pore pressure (u_2) and SBT.

The shear wave velocity is directly related to the small strain shear modulus and can be used with Poisson's Ratio to calculate the small strain Elastic Modulus. These parameters are used as input variables to analyze soil deformation under both static and dynamic loads.

4.0 Flat Plate Dilatometer Testing

The flat plate dilatometer test (DMT) consists of pushing the dilatometer blade vertically into the soil to the first desired test depth and then using nitrogen gas pressure to expand a circular steel membrane located on one side of the blade. The operator measures and records the pressure required to produce expansion of the membrane into the soil at two preset deflections. The operator then deflates the membrane and advances the blade to the next depth increment (for this test, one foot increments were used) and repeats the test. Each test sequence typically requires about 2 minutes. A dilatometer sounding consists of the results from all tests at one location presented in a fashion indicating variation with depth. Dilatometer test results can be found in Appendix E.

5.0 CLOSING

Thank you very much for the opportunity to perform this work. We trust that the information presented in this report is sufficient for your purposes. If you have any questions regarding the contents of this report, please contact our office.

Sincerely,

ConeTec, Inc.

6.0 BIBLIOGRAPHY

ASTM D5778-12 2012. "Standard Test Method for Performing Electronic Friction Cone and Piezocone Penetration Testing of Soils". ASTM, West Conshohocken, US.

Lunne, T., Robertson, P.K. and Powell, J.J.M., 1997, “Cone Penetration Testing in Geotechnical Practice”, E & FN Spon, ISBN 0 419 23750, www.sponpress.com, 312 pages, 3rd printing.

Robertson, P.K., “Soil Classification using the Cone Penetration Test”, Canadian Geotechnical Journal, Vol 27, 1990 pp 151-158.

Robertson, P.K., Campanella, R.G., Gillespie, D. and Rice, A., “Seismic CPT to Measure In-Situ Shear Wave Velocity”, Journal of Geotechnical Engineering ASCE, Vol. 112, No. 8, 1986 pp 791-803.

Appendix A

Job No: 14-53069
Client: Haley & Aldrich
Project: Rush Island - Festus, Missouri
Date: September 23 through October 1, 2014

TABLE 1 Summary of CPT Soundings

CPT Sounding	File Name	Date	Cone	Assumed Phreatic Surface (ft)	Final Depth (ft)	Shear Wave Velocity Tests	Northing UTM Zone 15	Easting UTM Zone 15
SCPT-C100	14-53069_SP100	9/23/2014	268:T1500F15U500	19.84	85.24	25	4222988	740455
SCPT-C101	14-53069_SP101	9/27/2014	268:T1500F15U500	18.47	66.47	19	4223335	740286
SCPT-C102	14-53069_SP102	9/25/2014	268:T1500F15U500	34.68	109.68	33	4222843	740380
SCPT-C103	14-53069_SP103	9/26/2014	268:T1500F15U500	11.65	80.02	23	4222687	740408
SCPT-C104	14-53069_SP104	9/28/2014	268:T1500F15U500	27.00	52.33	5	4223441	740165
SCPT-C105	14-53069_SP105	9/27/2014	268:T1500F15U500	29.00	61.35	6	4223336	740433
SCPT-C106	14-53069_SP106	9/27/2014	268:T1500F15U500	18.00	57.58	5	4223183	740525
SCPT-C107	14-53069_SP107	9/26/2014	268:T1500F15U500	19.93	5.38		4222854	740546
SCPT-C107A	14-53069_SP107A	9/26/2014	268:T1500F15U500	19.93	65.16	19	4222862	740559
SCPT-C108	14-53069_SP108	9/28/2014	268:T1500F15U500	31.00	62.01	6	4222696	740725
SCPT-C109	14-53069_SP109	9/28/2014	268:T1500F15U500	36.00	62.01	6	4222429	740692
SCPT-C110	14-53069_SP110	9/28/2014	268:T1500F15U500	34.00	62.01	6	4222892	740137
	12				769.22	153		

Note: The hydrostatic water table is assumed for the interpretation tables and based on pore pressure dissipations.

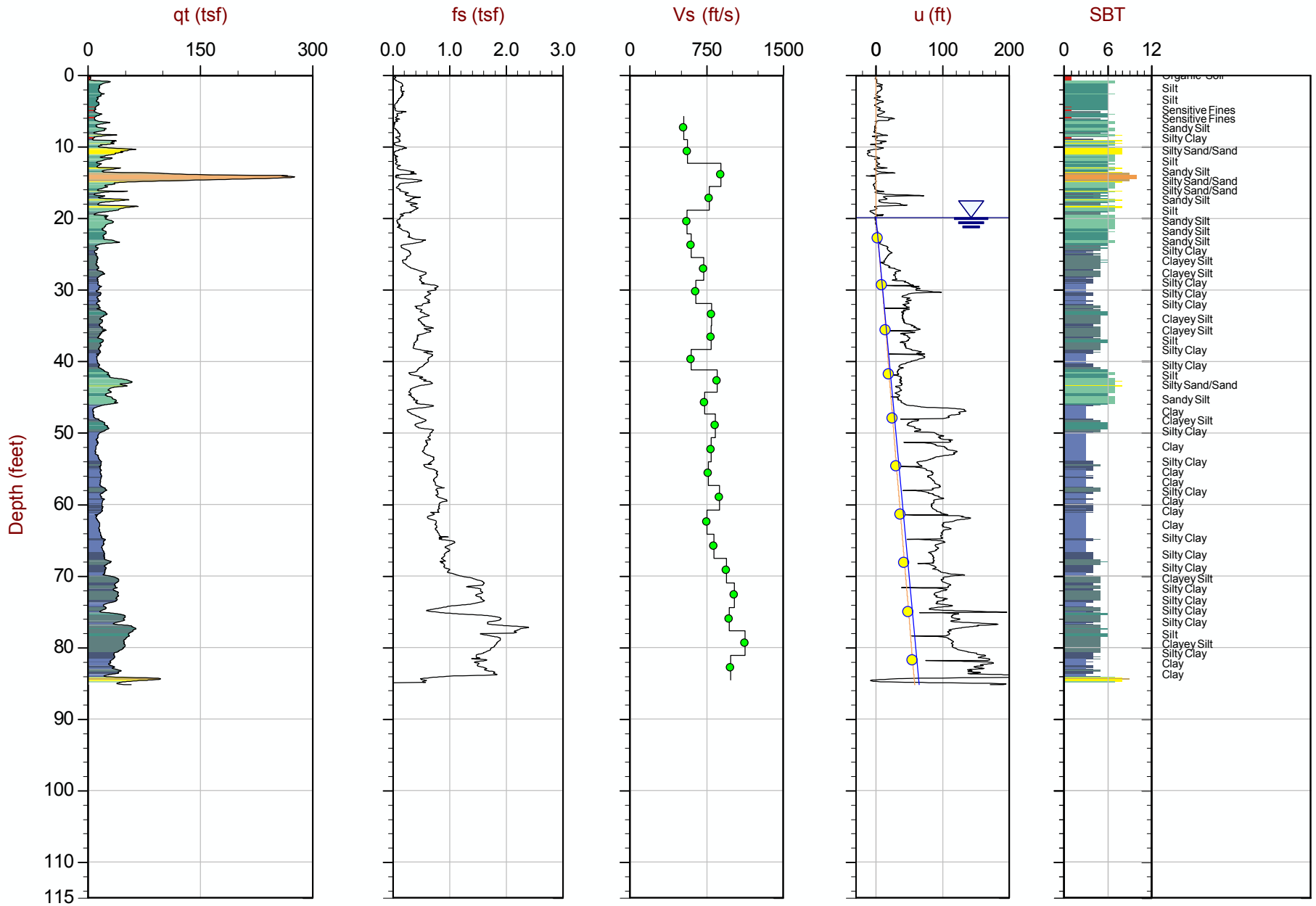
Shear Wave Velocity CPT Plots

CONETEC

Haley & Aldrich

Job No: 14-53069
Date: 09:23:14 14:48
Site: Rush Island

Sounding: SCPT-C100
Cone: 268:T1500F15U500



Max Depth: 25.980 m / 85.24 ft
Depth Inc: 0.010 m / 0.033 ft

File: 14-53069_SP100.COR

SBT: Lunne, Robertson and Powell, 1997
Coords: UTM Zone 15 N: 4222988 E: 740455

Overplot Item: Dynamic Pore Pressure
Overplot Item: Equilibrium Pore Pressure

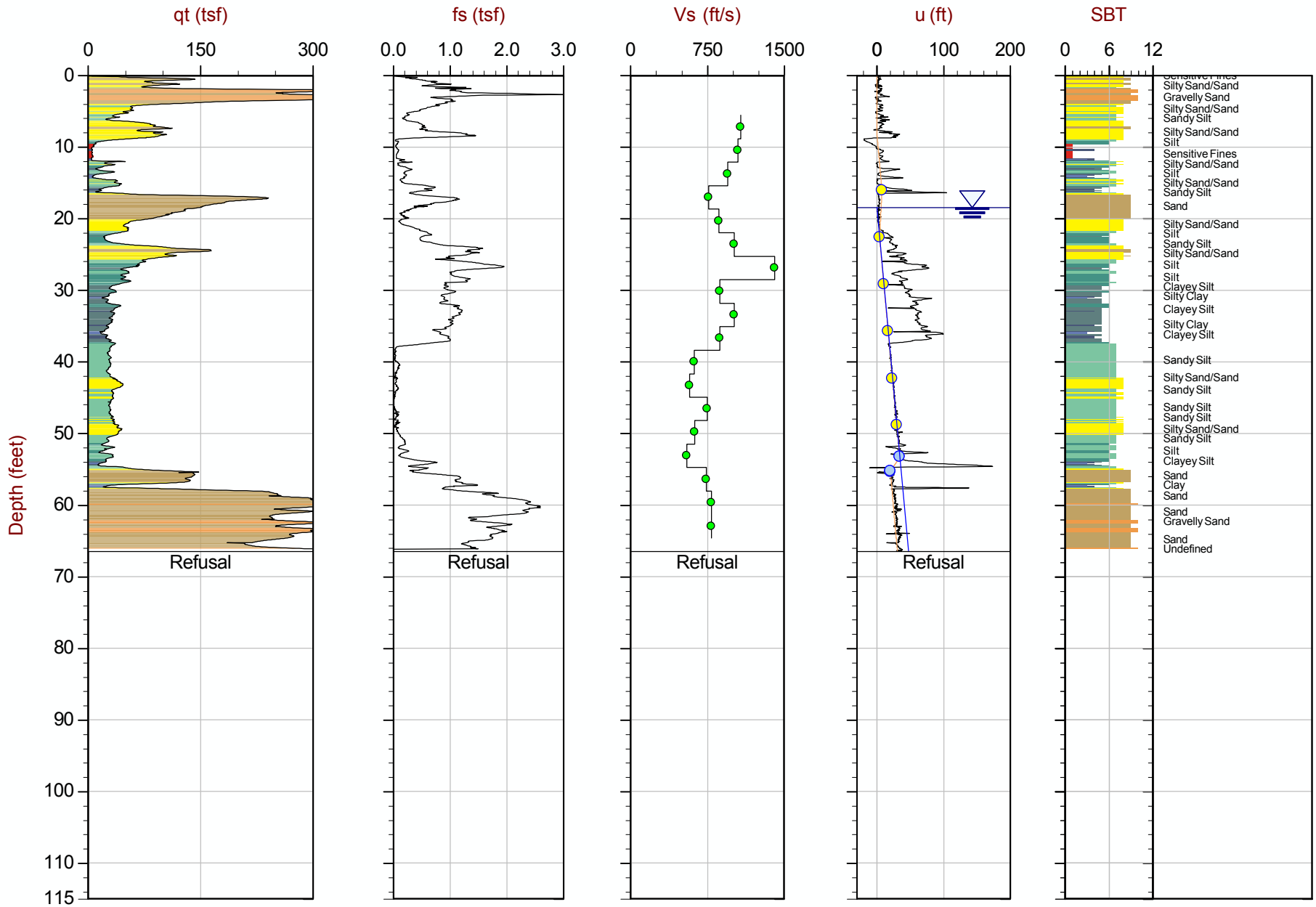
Equilibrium Pore Pressure Line
Assumed Equilibrium Pore Pressure

CONETEC

Haley & Aldrich

Job No: 14-53069
Date: 09:27:14 07:58
Site: Rush Island

Sounding: SCPT-C101
Cone: 268:T1500F15U500



Max Depth: 20.260 m / 66.47 ft
Depth Inc: 0.010 m / 0.033 ft

File: 14-53069_SP101.COR

SBT: Lunne, Robertson and Powell, 1997
Coords: UTM Zone 15 N: 4223335 E: 740286

Overplot Item: Dynamic Pore Pressure
Overplot Item: Equilibrium Pore Pressure

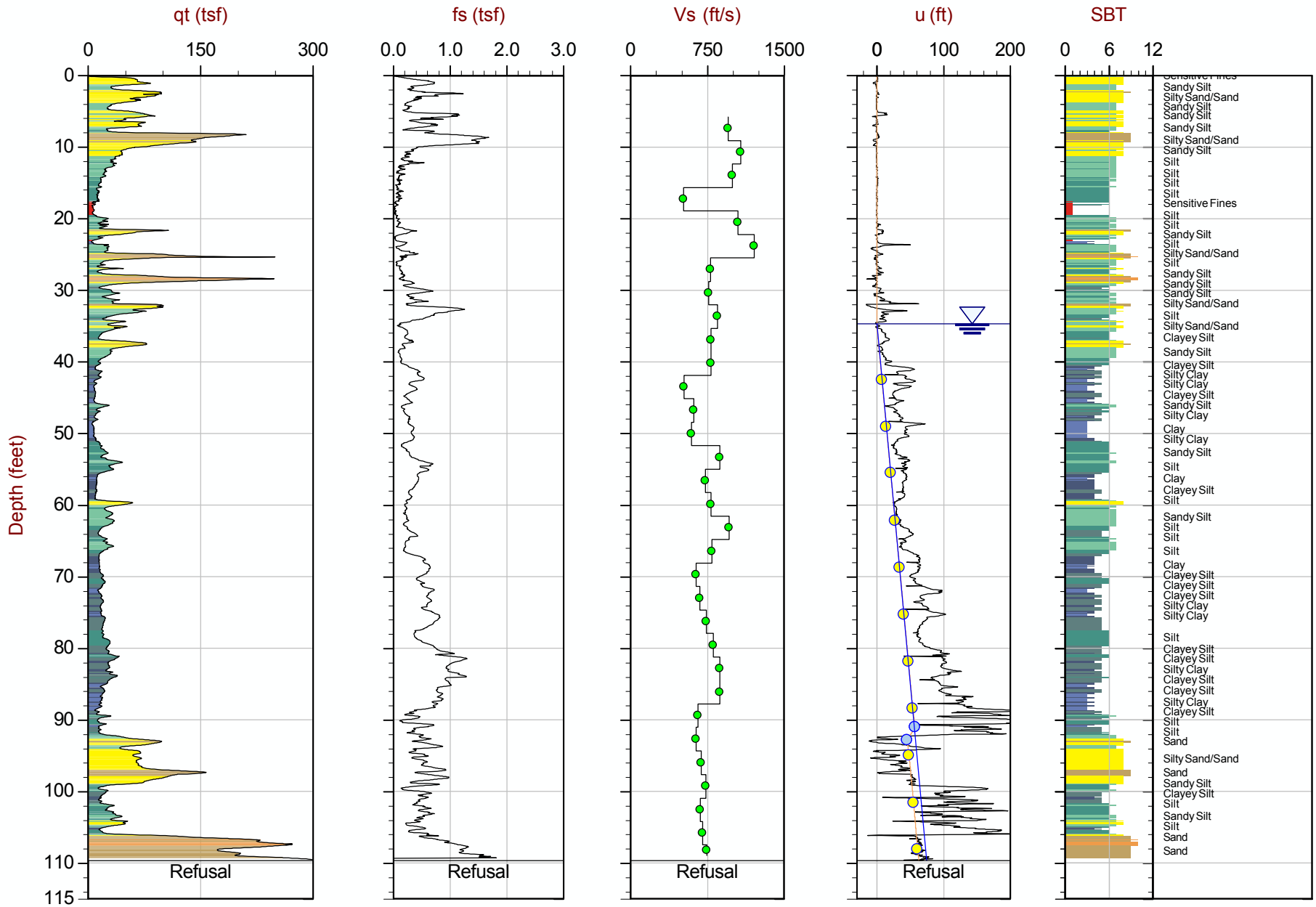
Equilibrium Pore Pressure Line
Assumed Equilibrium Pore Pressure

CONETEC

Haley & Aldrich

Job No: 14-53069
Date: 09:25:14 10:55
Site: Rush Island

Sounding: SCPT-C102
Cone: 268:T1500F15U500



Max Depth: 33.430 m / 109.68 ft
Depth Inc: 0.010 m / 0.033 ft

File: 14-53069_SP102.COR

SBT: Lunne, Robertson and Powell, 1997
Coords: UTM Zone 15 N: 4222843 E: 740380

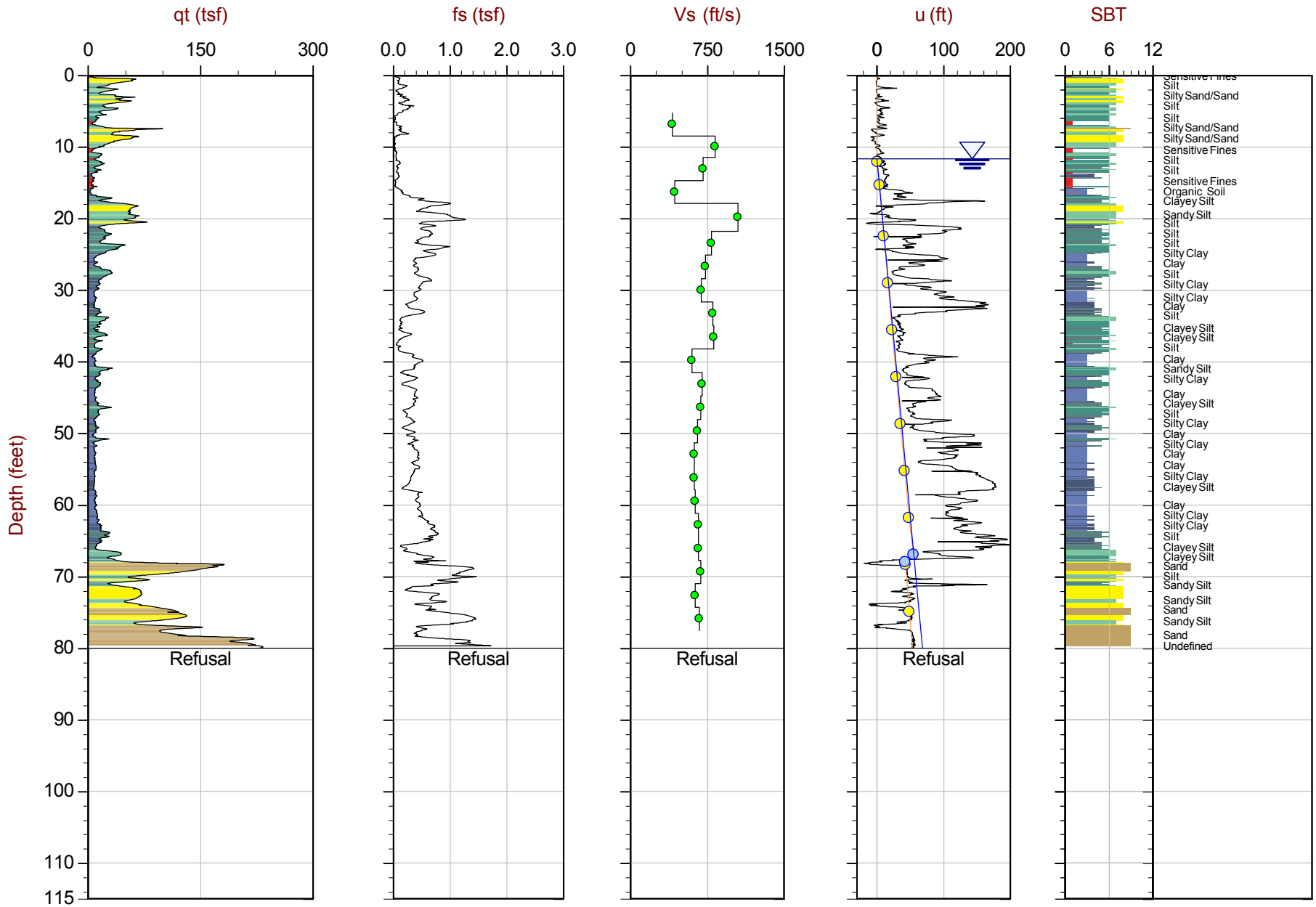
Overplot Item: Dynamic Pore Pressure
Overplot Item: Equilibrium Pore Pressure
Equilibrium Pore Pressure Line
Assumed Equilibrium Pore Pressure

CONETEC

Haley & Aldrich

Job No: 14-53069
Date: 09:26:14 08:52
Site: Rush Island

Sounding: SCPT-C103
Cone: 268:T1500F15U500



Max Depth: 24.390 m / 80.02 ft
Depth Inc: 0.010 m / 0.033 ft

File: 14-53069_SP103.COR

SBT: Lunne, Robertson and Powell, 1997
Coords: UTM Zone 15 N: 4222687 E: 740408

Overplot Item: Dynamic Pore Pressure
Overplot Item: Equilibrium Pore Pressure

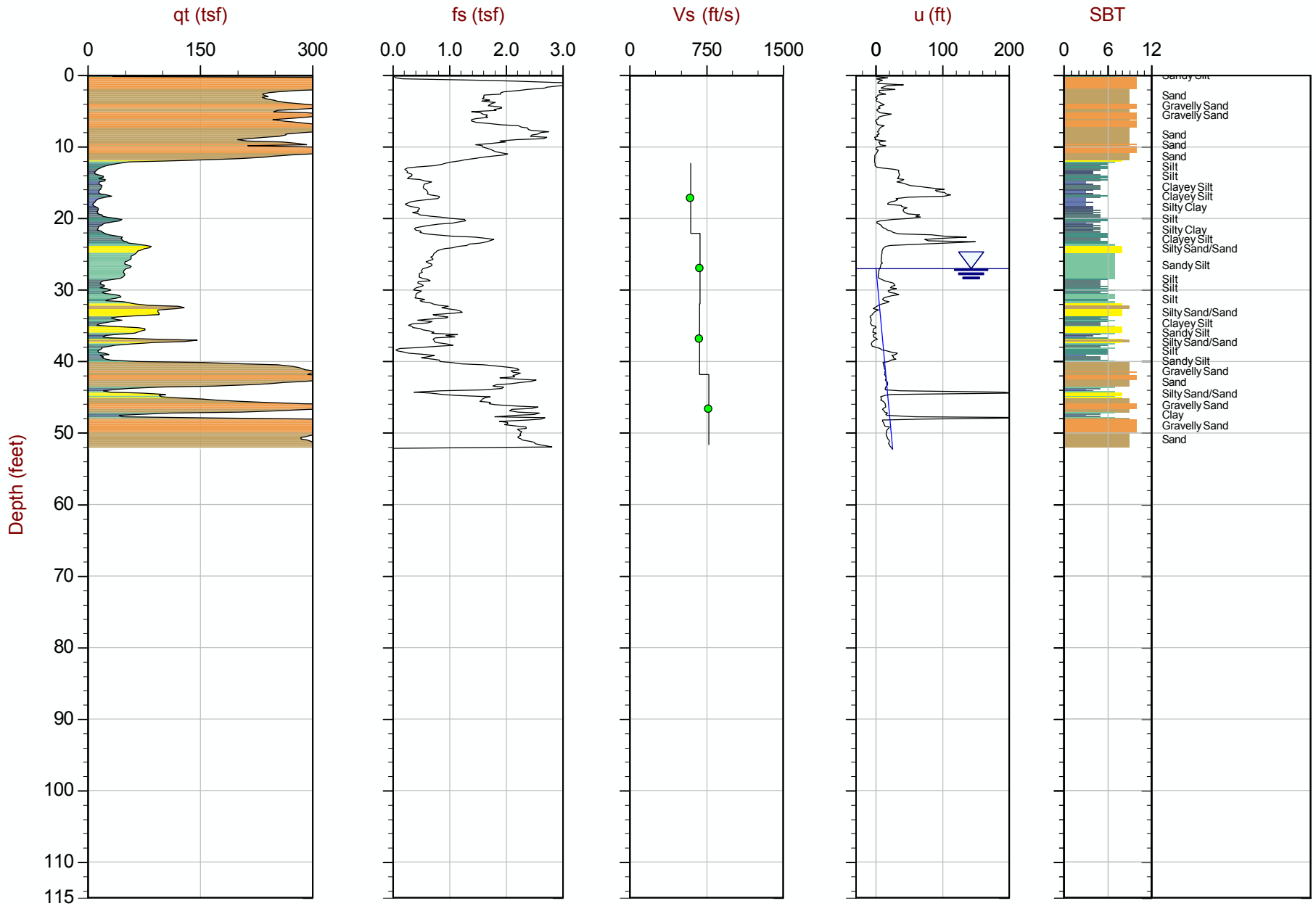
Equilibrium Pore Pressure Line
Assumed Equilibrium Pore Pressure

CONETEC

Haley & Aldrich

Job No: 14-53069
Date: 09:28:14 14:41
Site: Rush Island

Sounding: SCPT-C104
Cone: 268:T1500F15U500



Max Depth: 15.950 m / 52.33 ft
Depth Inc: 0.050 m / 0.164 ft

File: 14-53069_SP104.COR

SBT: Lunne, Robertson and Powell, 1997
Coords: UTM Zone 15 N: 4223441 E: 740165

Overplot Item: Dynamic Pore Pressure
Overplot Item: Equilibrium Pore Pressure

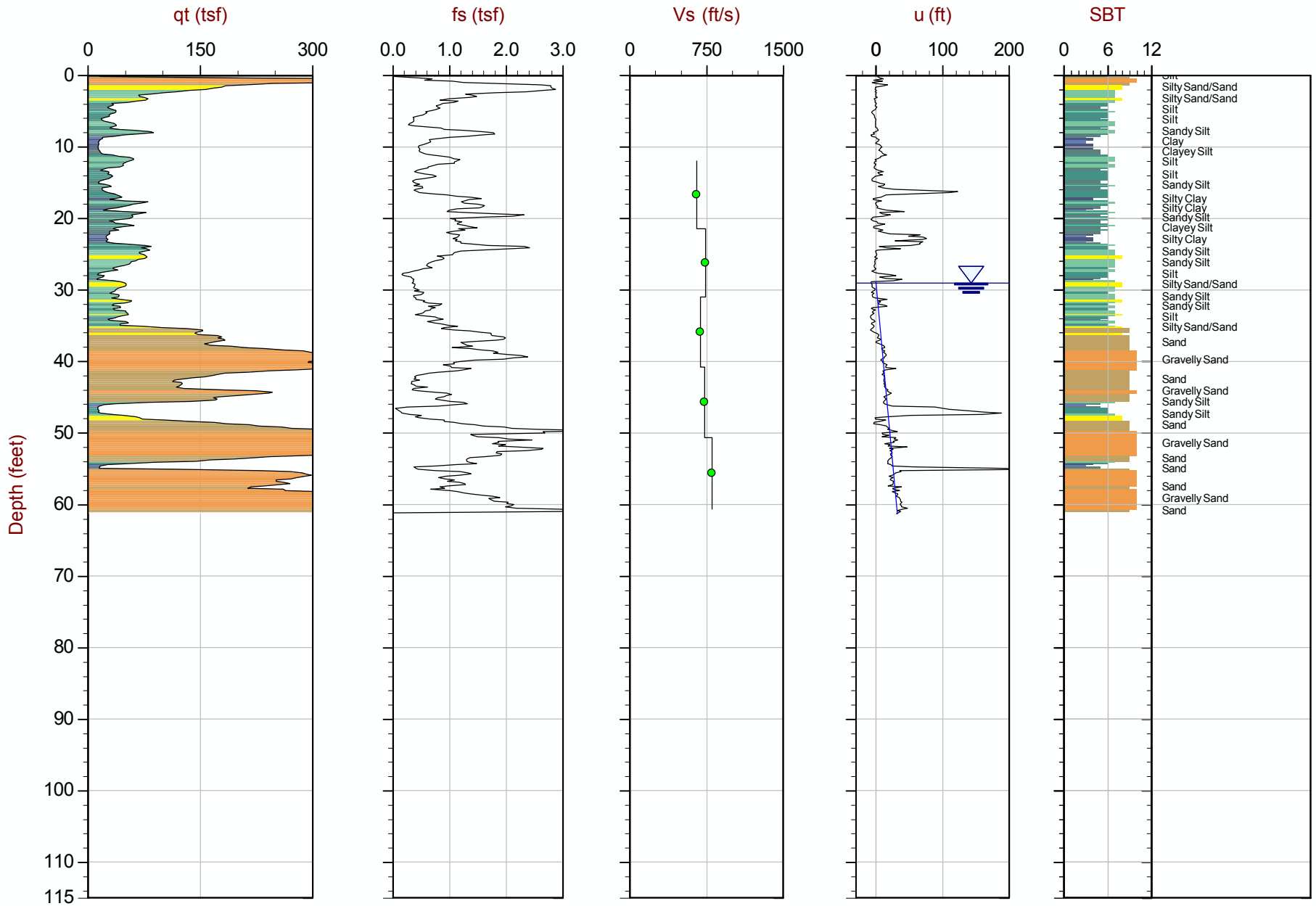
Equilibrium Pore Pressure Line
Assumed Equilibrium Pore Pressure

CONETEC

Haley & Aldrich

Job No: 14-53069
Date: 09:27:14 14:25
Site: Rush Island

Sounding: SCPT-C105
Cone: 268:T1500F15U500



Max Depth: 18.700 m / 61.35 ft
Depth Inc: 0.050 m / 0.164 ft

File: 14-53069_SP105.COR

SBT: Lunne, Robertson and Powell, 1997
Coords: UTM Zone 15 N: 4223336 E: 740433

Overplot Item: Dynamic Pore Pressure
Overplot Item: Equilibrium Pore Pressure

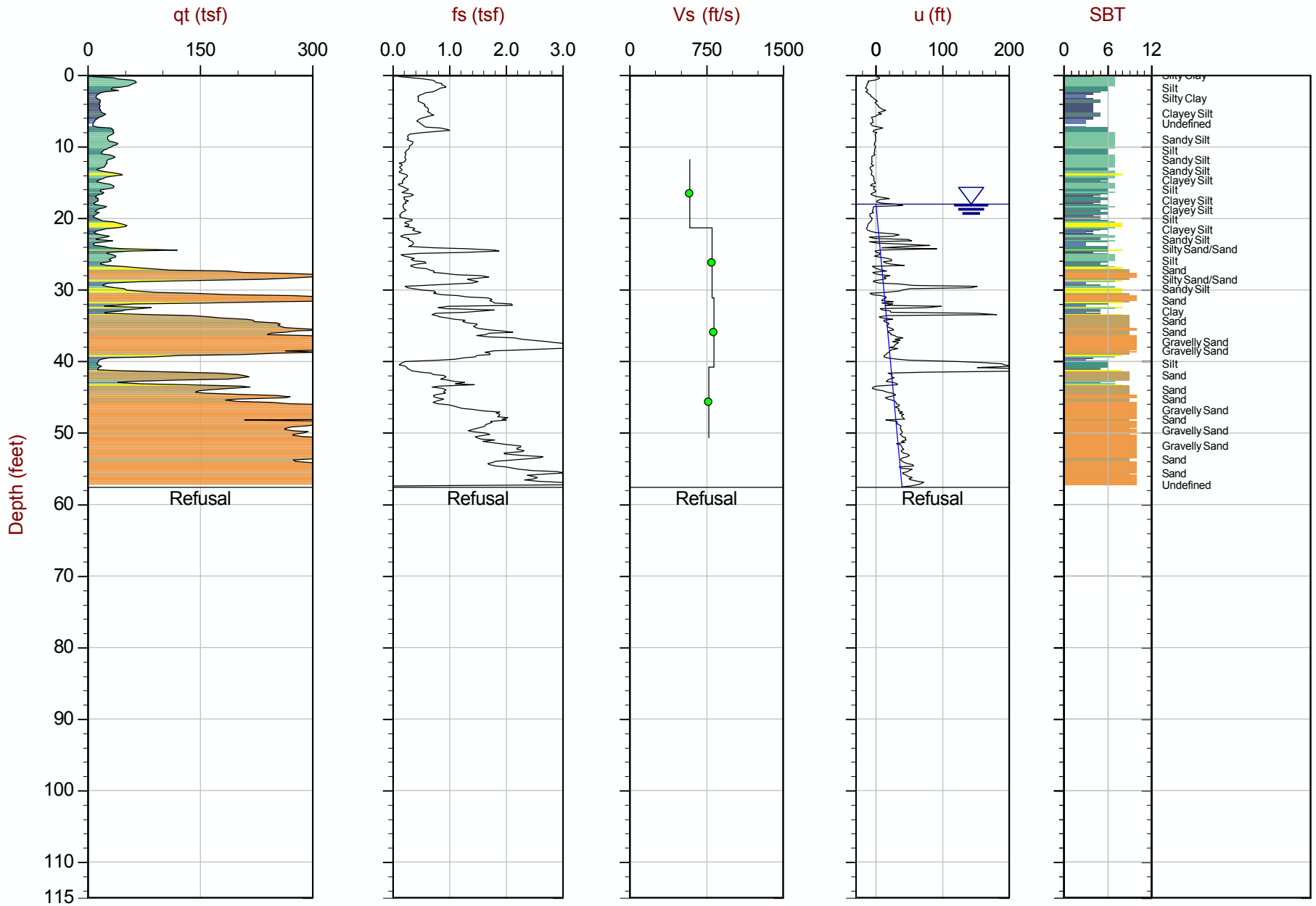
Equilibrium Pore Pressure Line
Assumed Equilibrium Pore Pressure

CONETEC

Haley & Aldrich

Job No: 14-53069
Date: 09:27:14 12:40
Site: Rush Island

Sounding: SCPT-C106
Cone: 268:T1500F15U500



Max Depth: 17.550 m / 57.58 ft
Depth Inc: 0.050 m / 0.164 ft

File: 14-53069_SP106.COR

SBT: Lunne, Robertson and Powell, 1997
Coords: UTM Zone 15 N: 4223183 E: 740525

Overplot Item: Dynamic Pore Pressure
Overplot Item: Equilibrium Pore Pressure

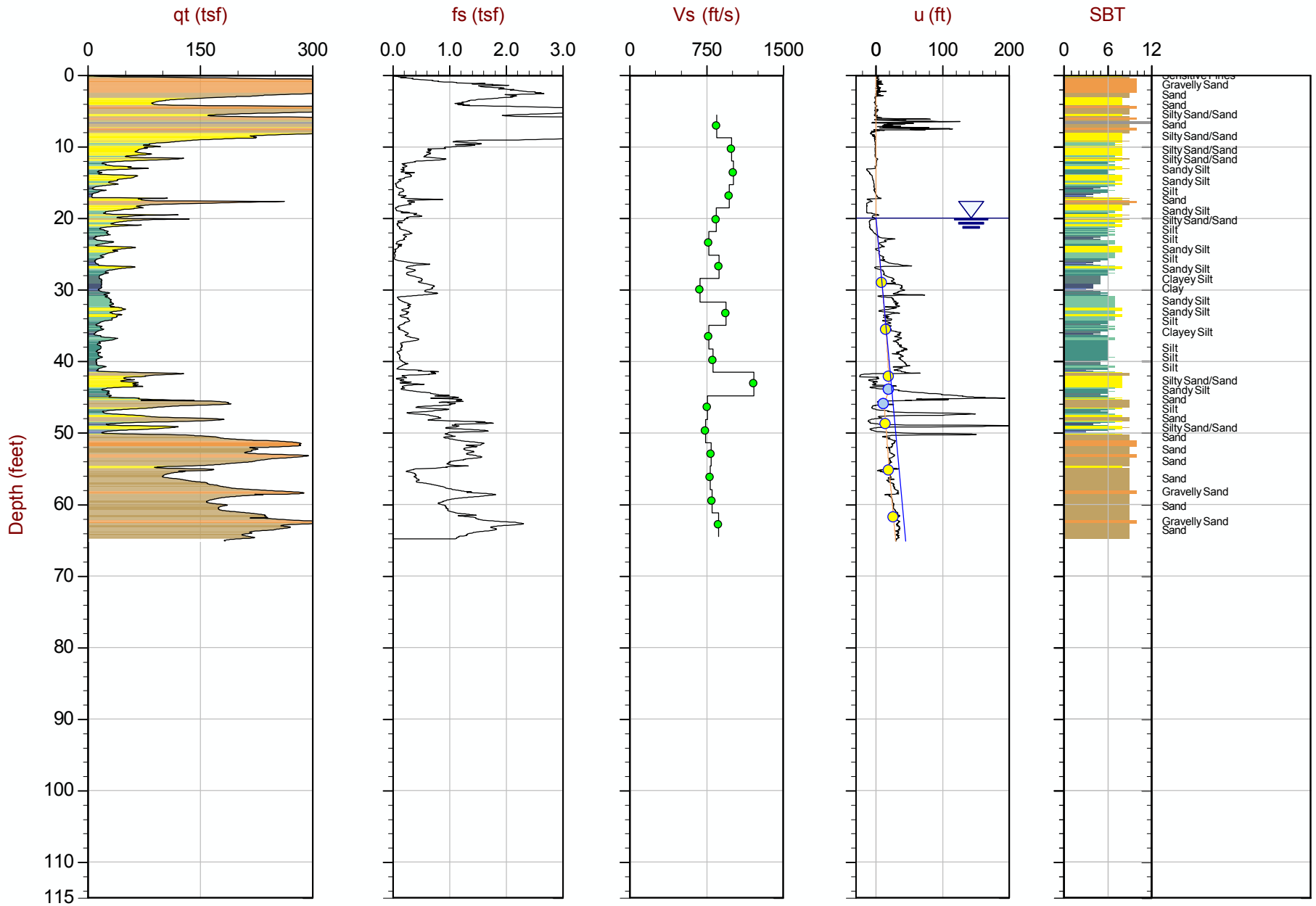
Equilibrium Pore Pressure Line
Assumed Equilibrium Pore Pressure

CONETEC

Haley & Aldrich

Job No: 14-53069
Date: 09:26:14 13:47
Site: Rush Island

Sounding: SCPT-C107A
Cone: 268:T1500F15U500



Max Depth: 19.860 m / 65.16 ft
Depth Inc: 0.010 m / 0.033 ft

File: 14-53069_SP107A.COR

SBT: Lunne, Robertson and Powell, 1997
Coords: UTM Zone 15 N: 4222862 E: 740559

Overplot Item: Dynamic Pore Pressure
Overplot Item: Equilibrium Pore Pressure

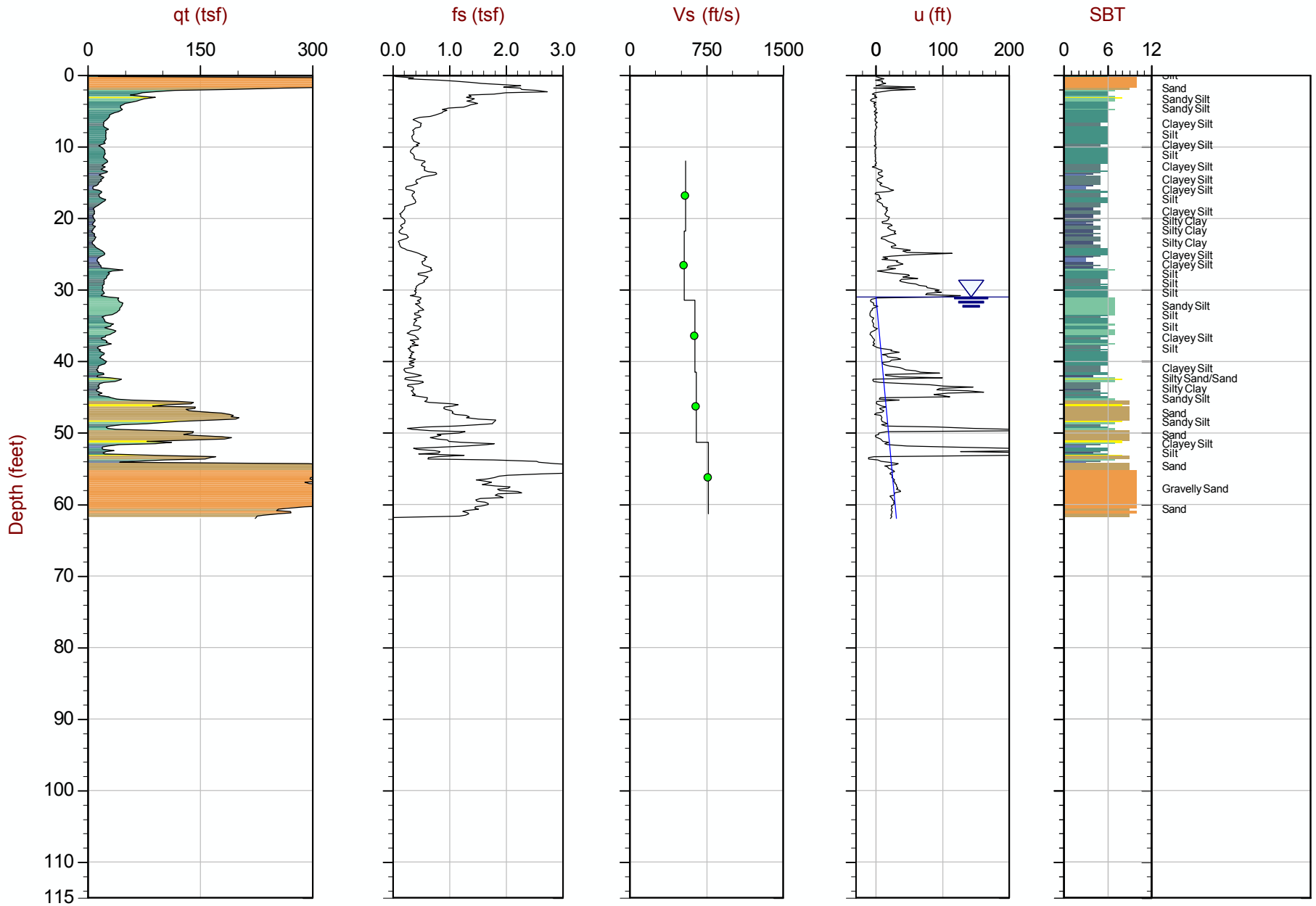
Equilibrium Pore Pressure Line
Assumed Equilibrium Pore Pressure

CONETEC

Haley & Aldrich

Job No: 14-53069
Date: 09:28:14 08:30
Site: Rush Island

Sounding: SCPT-C108
Cone: 268:T1500F15U500



Max Depth: 18.900 m / 62.01 ft
Depth Inc: 0.050 m / 0.164 ft

File: 14-53069_SP108.COR

SBT: Lunne, Robertson and Powell, 1997
Coords: UTM Zone 15 N: 4222696 E: 740725

Overplot Item: Dynamic Pore Pressure
Overplot Item: Equilibrium Pore Pressure

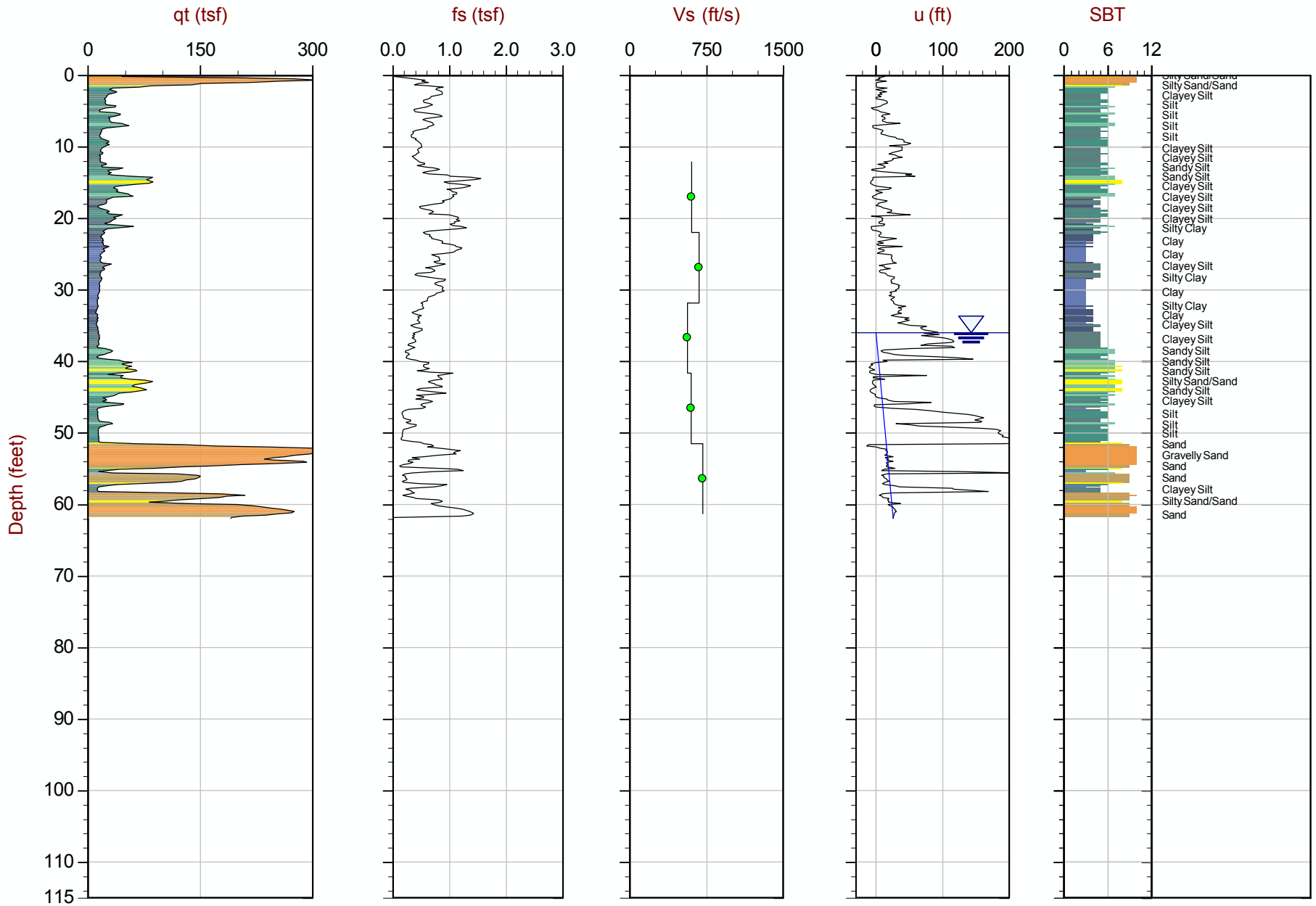
Equilibrium Pore Pressure Line
Assumed Equilibrium Pore Pressure

CONETEC

Haley & Aldrich

Job No: 14-53069
Date: 09:28:14 10:02
Site: Rush Island

Sounding: SCPT-C109
Cone: 268:T1500F15U500



Max Depth: 18.900 m / 62.01 ft
Depth Inc: 0.050 m / 0.164 ft

File: 14-53069_SP109.COR

SBT: Lunne, Robertson and Powell, 1997
Coords: UTM Zone 15 N: 4222429 E: 740692

Overplot Item: Dynamic Pore Pressure
Overplot Item: Equilibrium Pore Pressure

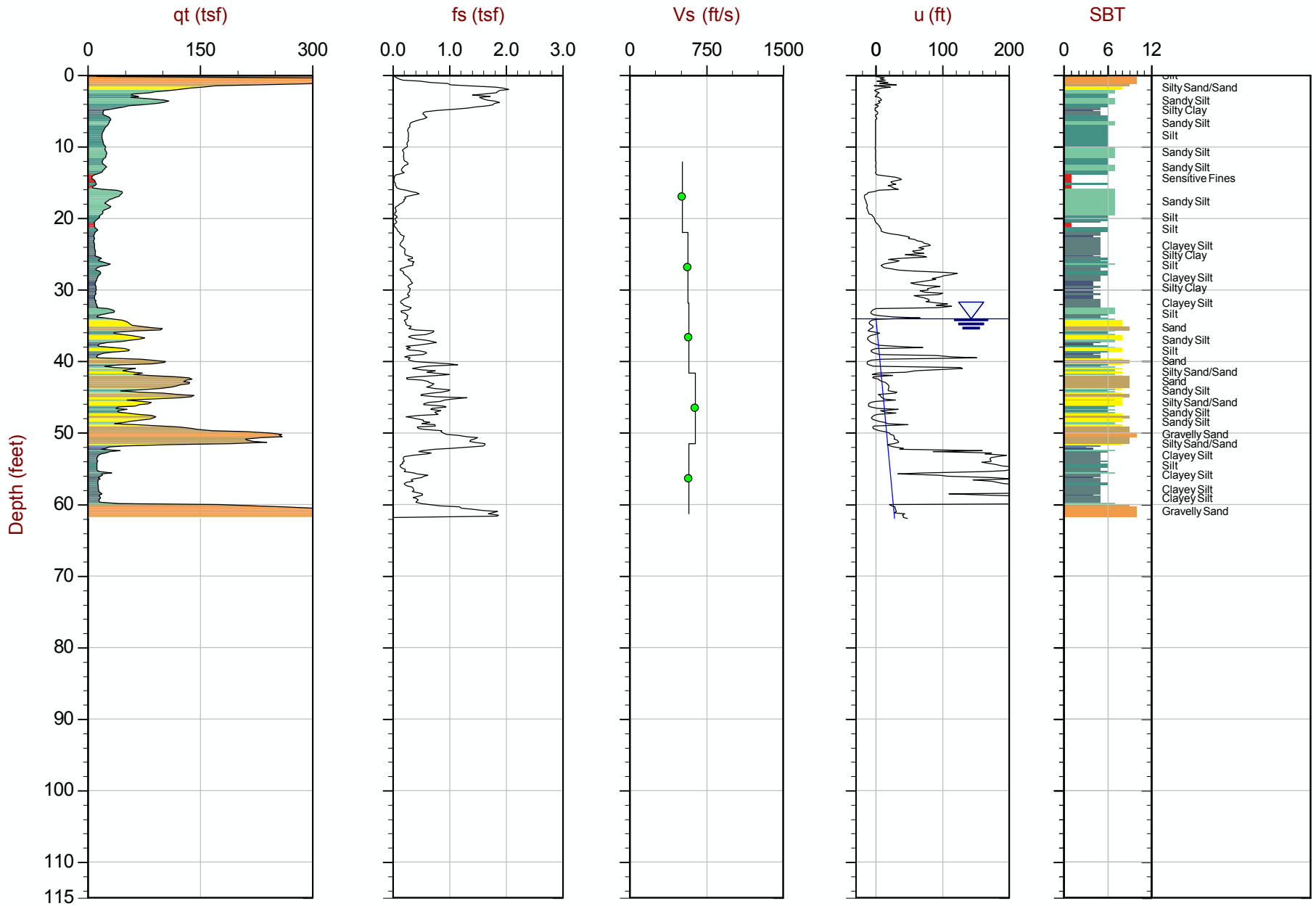
Equilibrium Pore Pressure Line
Assumed Equilibrium Pore Pressure

CONETEC

Haley & Aldrich

Job No: 14-53069
Date: 09:28:14 12:53
Site: Rush Island

Sounding: SCPT-C110
Cone: 268:T1500F15U500



Max Depth: 18.900 m / 62.01 ft
Depth Inc: 0.050 m / 0.164 ft

File: 14-53069_SP110.COR

SBT: Lunne, Robertson and Powell, 1997
Coords: UTM Zone 15 N: 4222892 E: 740137

Overplot Item: Dynamic Pore Pressure
Overplot Item: Equilibrium Pore Pressure

Equilibrium Pore Pressure Line
Assumed Equilibrium Pore Pressure

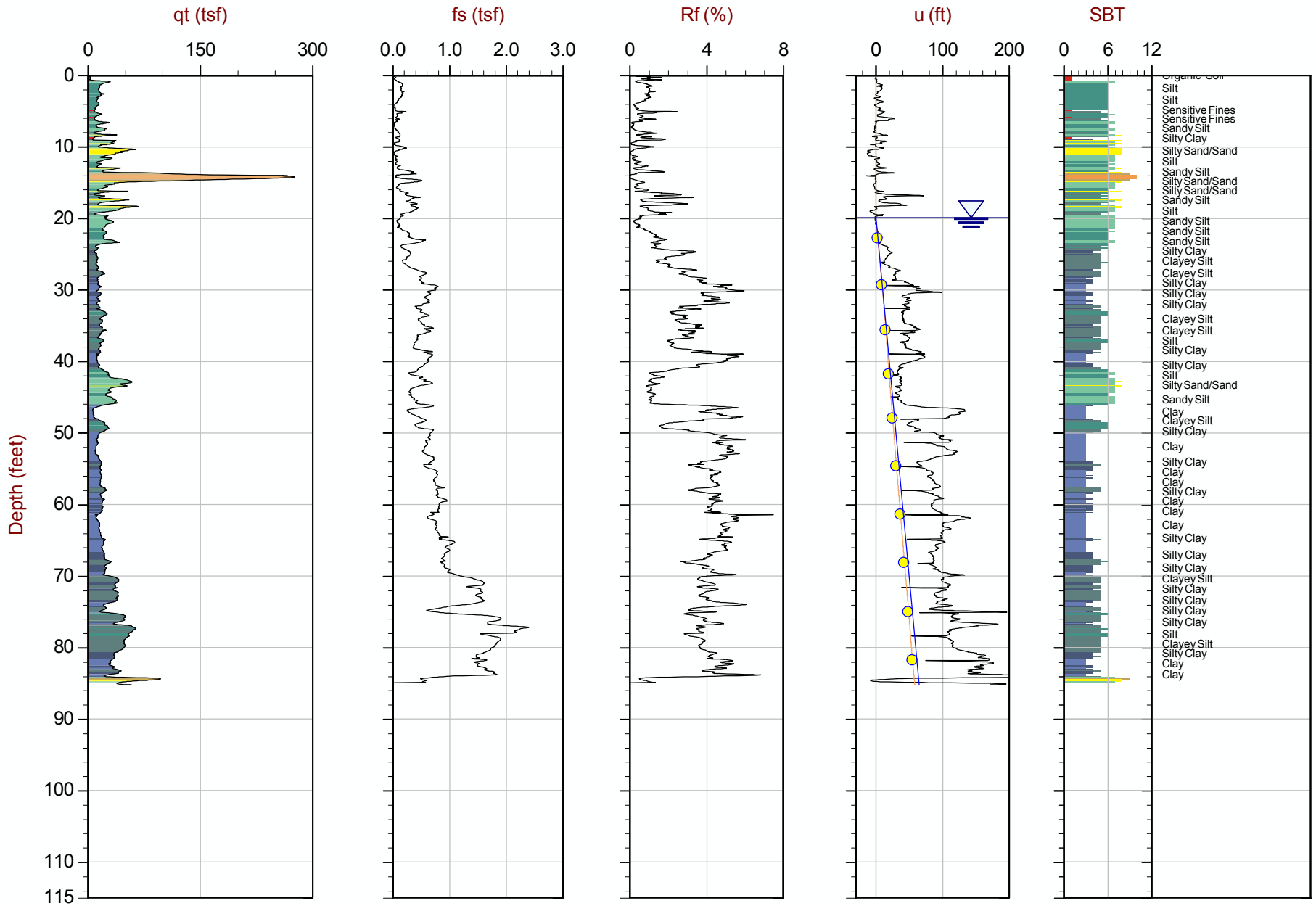
Non-Normalized CPT Plots

CONETEC

Haley & Aldrich

Job No: 14-53069
Date: 09:23:14 14:48
Site: Rush Island

Sounding: SCPT-C100
Cone: 268:T1500F15U500



Max Depth: 25.980 m / 85.24 ft
Depth Inc: 0.010 m / 0.033 ft

File: 14-53069_SP100.COR

SBT: Lunne, Robertson and Powell, 1997
Coords: UTM Zone 15 N: 4222988 E: 740455

Overplot Item: Dynamic Pore Pressure
Overplot Item: Equilibrium Pore Pressure

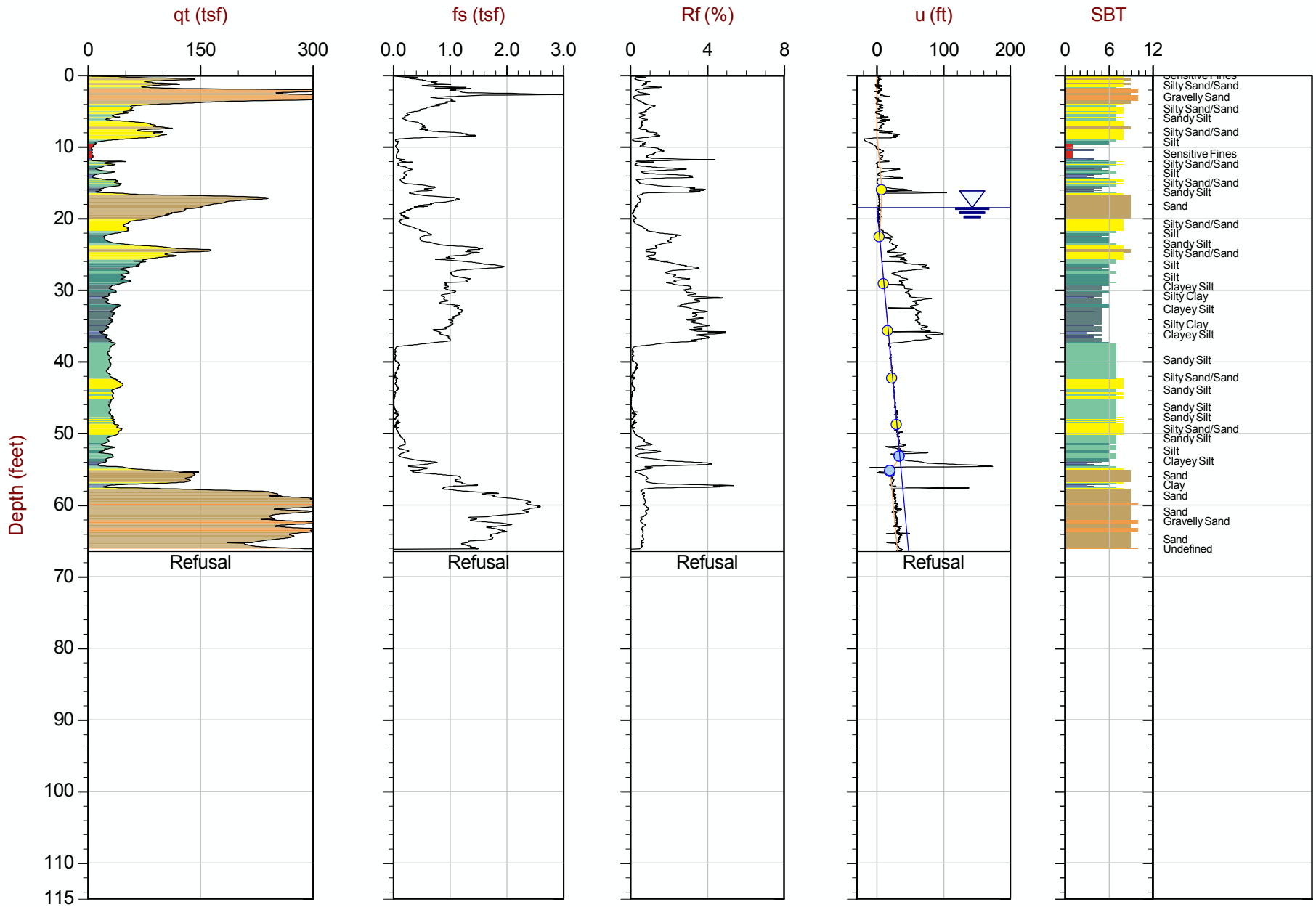
Equilibrium Pore Pressure Line
Assumed Equilibrium Pore Pressure

CONETEC

Haley & Aldrich

Job No: 14-53069
Date: 09:27:14 07:58
Site: Rush Island

Sounding: SCPT-C101
Cone: 268:T1500F15U500



Max Depth: 20.260 m / 66.47 ft
Depth Inc: 0.010 m / 0.033 ft

File: 14-53069_SP101.COR

SBT: Lunne, Robertson and Powell, 1997
Coords: UTM Zone 15 N: 4223335 E: 740286

Overplot Item: Dynamic Pore Pressure
Overplot Item: Equilibrium Pore Pressure

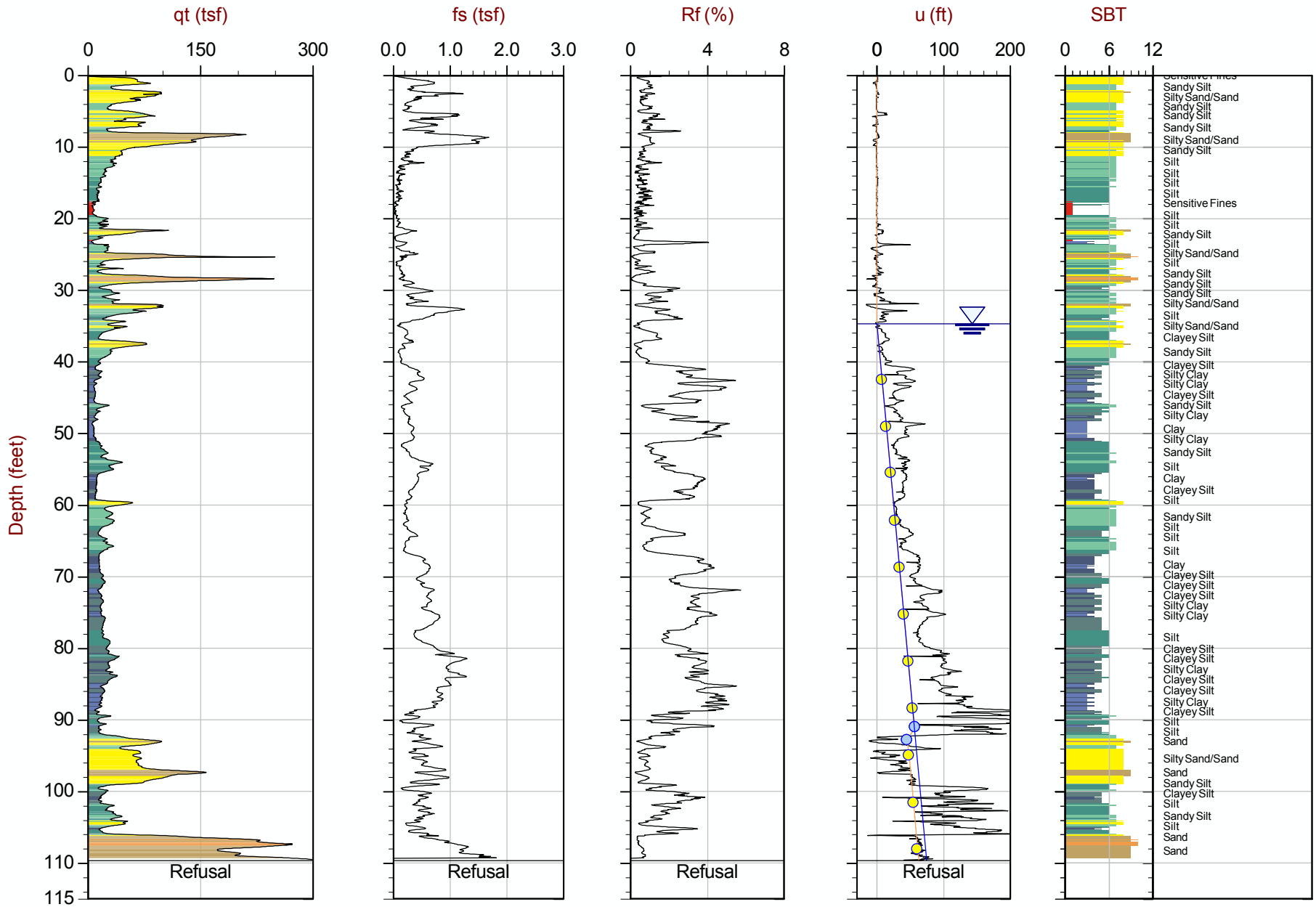
Equilibrium Pore Pressure Line
Assumed Equilibrium Pore Pressure

CONETEC

Haley & Aldrich

Job No: 14-53069
Date: 09:25:14 10:55
Site: Rush Island

Sounding: SCPT-C102
Cone: 268:T1500F15U500



Max Depth: 33.430 m / 109.68 ft
Depth Inc: 0.010 m / 0.033 ft

File: 14-53069_SP102.COR

SBT: Lunne, Robertson and Powell, 1997
Coords: UTM Zone 15 N: 4222843 E: 740380

Overplot Item: Dynamic Pore Pressure
Overplot Item: Equilibrium Pore Pressure

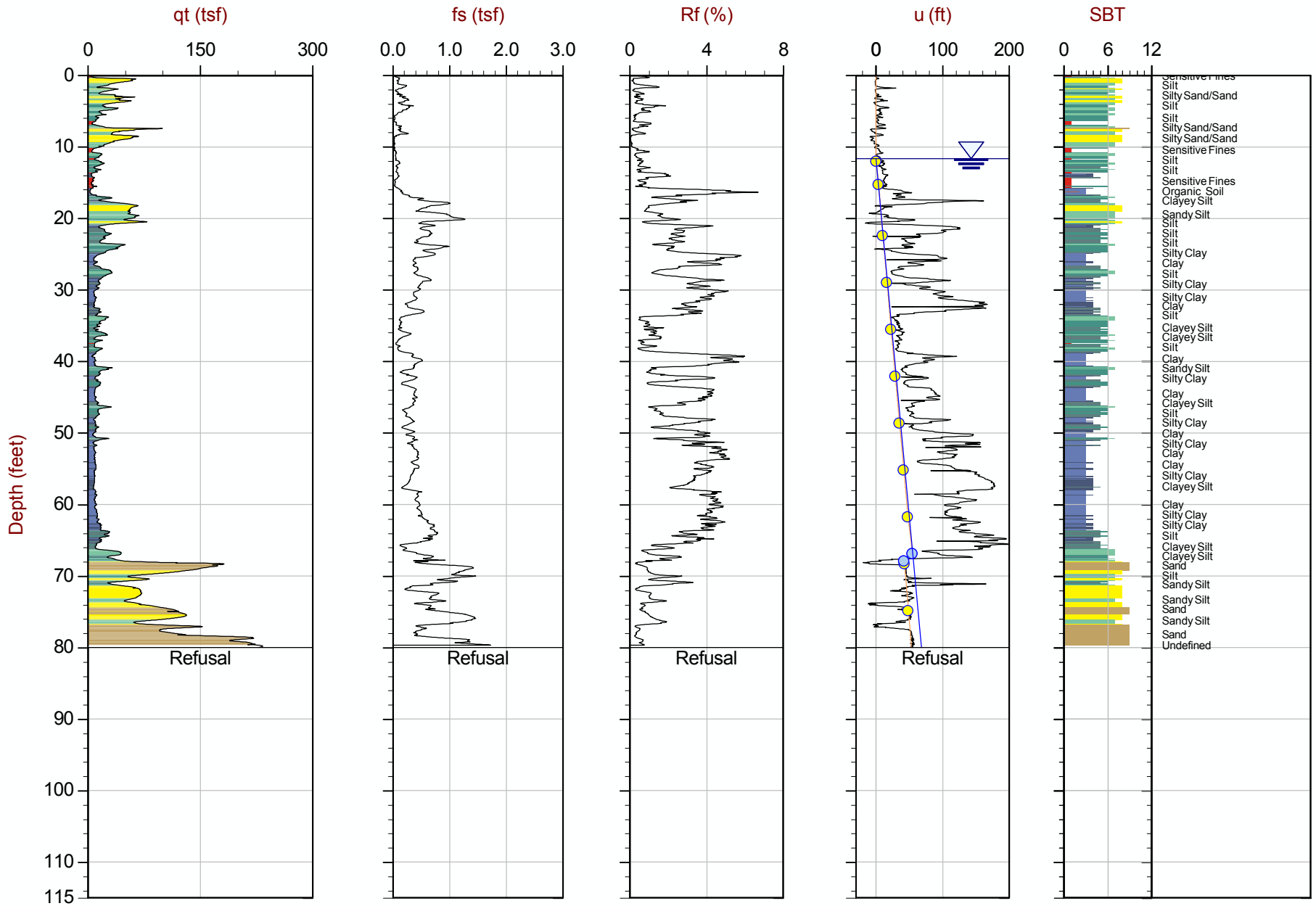
Equilibrium Pore Pressure Line
Assumed Equilibrium Pore Pressure

CONETEC

Haley & Aldrich

Job No: 14-53069
Date: 09:26:14 08:52
Site: Rush Island

Sounding: SCPT-C103
Cone: 268:T1500F15U500



Max Depth: 24.390 m / 80.02 ft
Depth Inc: 0.010 m / 0.033 ft

File: 14-53069_SP103.COR

SBT: Lunne, Robertson and Powell, 1997
Coords: UTM Zone 15 N: 4222687 E: 740408

Overplot Item: Dynamic Pore Pressure
Overplot Item: Equilibrium Pore Pressure

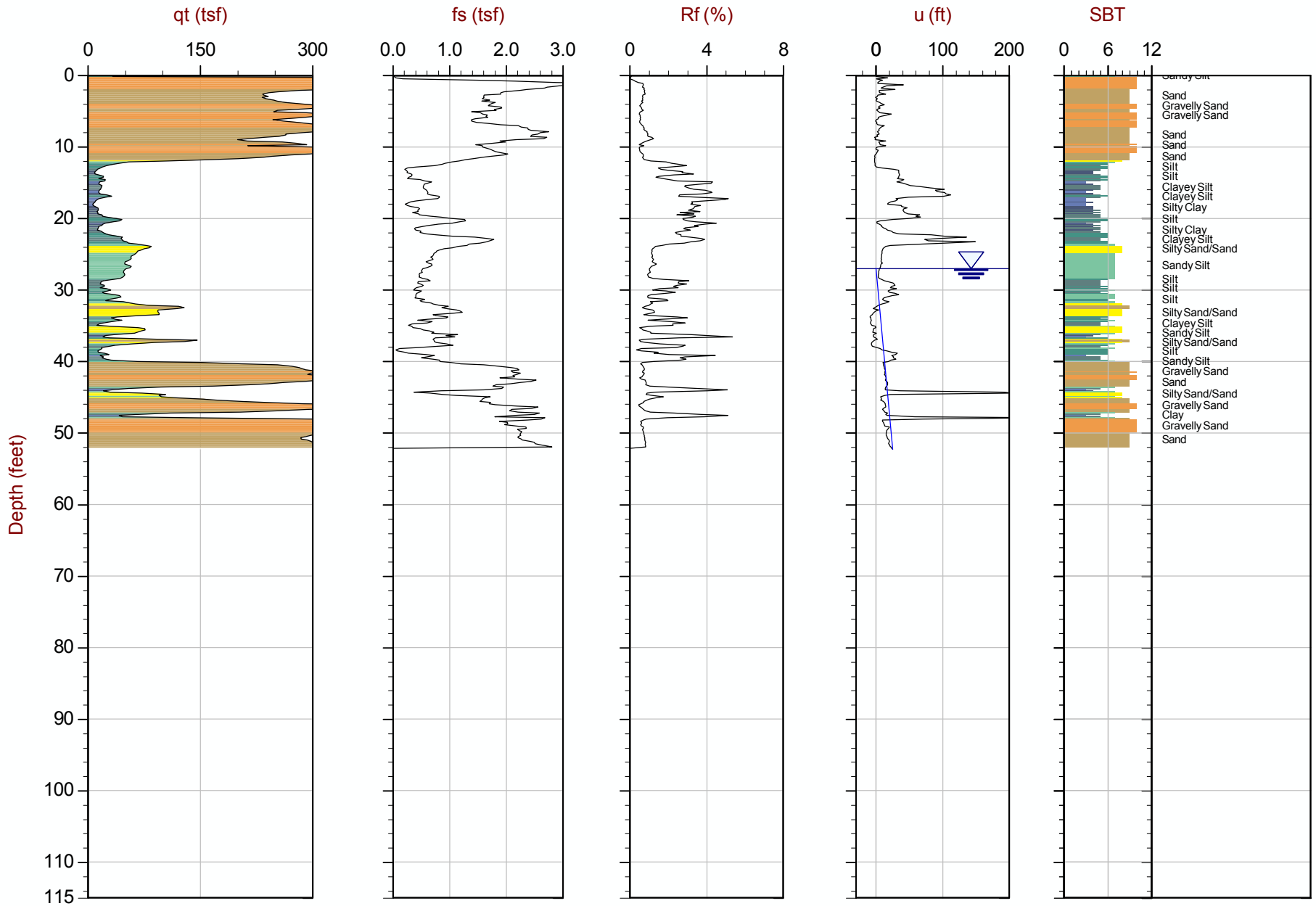
Equilibrium Pore Pressure Line
Assumed Equilibrium Pore Pressure

CONETEC

Haley & Aldrich

Job No: 14-53069
Date: 09:28:14 14:41
Site: Rush Island

Sounding: SCPT-C104
Cone: 268:T1500F15U500



Max Depth: 15.950 m / 52.33 ft
Depth Inc: 0.050 m / 0.164 ft

File: 14-53069_SP104.COR

SBT: Lunne, Robertson and Powell, 1997
Coords: UTM Zone 15 N: 4223441 E: 740165

Overplot Item: Dynamic Pore Pressure
Overplot Item: Equilibrium Pore Pressure

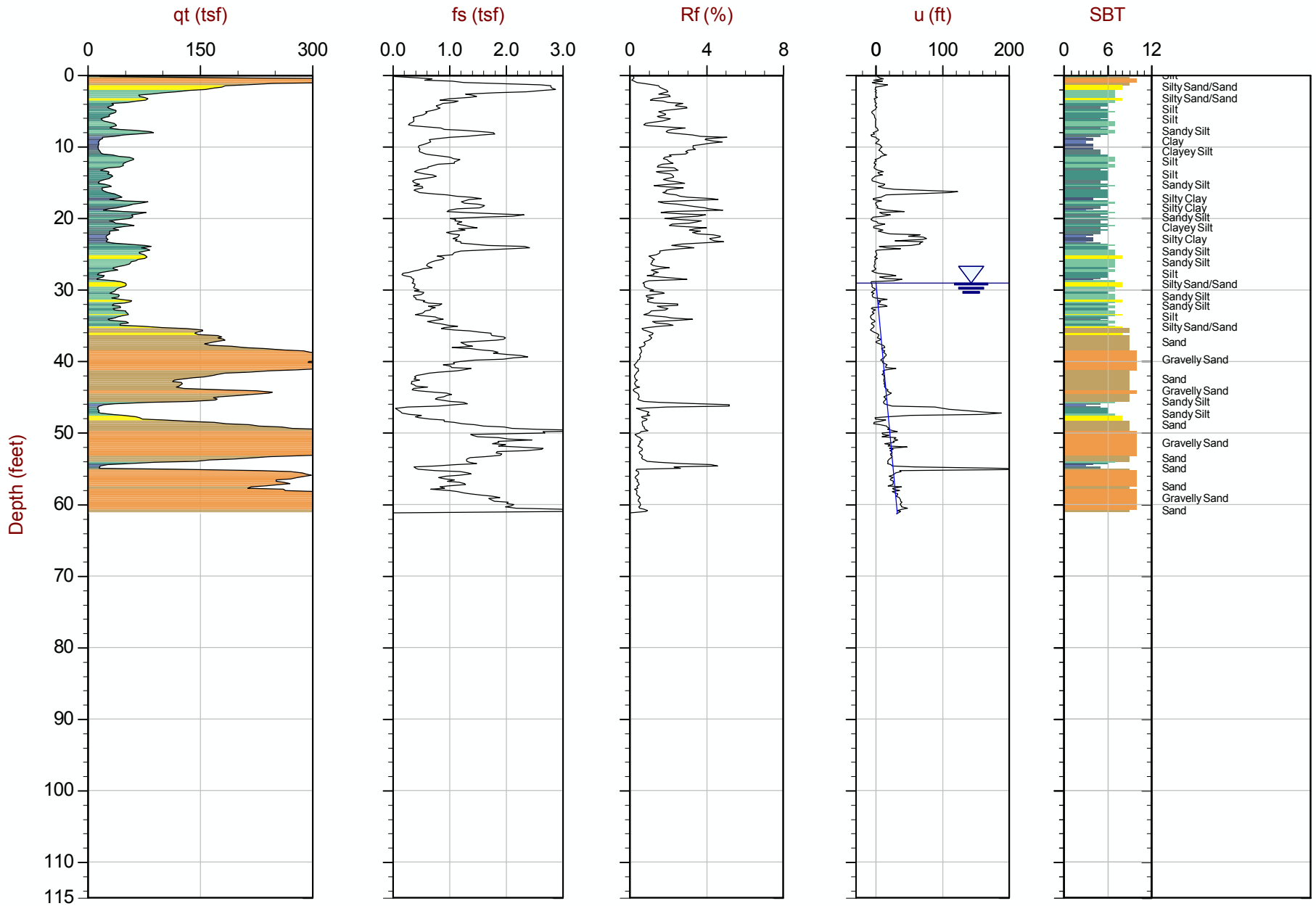
Equilibrium Pore Pressure Line
Assumed Equilibrium Pore Pressure

CONETEC

Haley & Aldrich

Job No: 14-53069
Date: 09:27:14 14:25
Site: Rush Island

Sounding: SCPT-C105
Cone: 268:T1500F15U500



Max Depth: 18.700 m / 61.35 ft
Depth Inc: 0.050 m / 0.164 ft

File: 14-53069_SP105.COR

SBT: Lunne, Robertson and Powell, 1997
Coords: UTM Zone 15 N: 4223336 E: 740433

Overplot Item: Dynamic Pore Pressure
Overplot Item: Equilibrium Pore Pressure

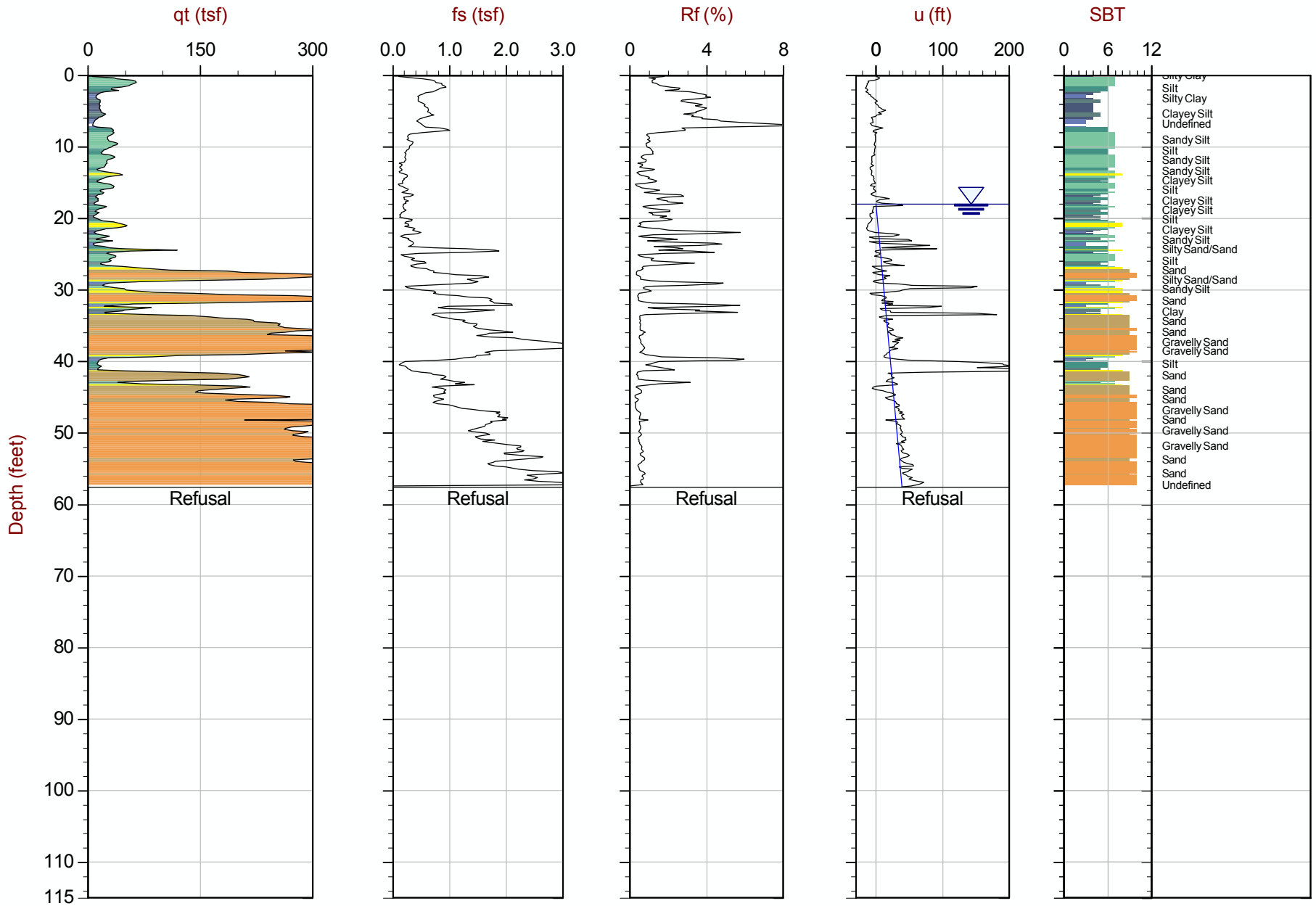
Equilibrium Pore Pressure Line
Assumed Equilibrium Pore Pressure

CONETEC

Haley & Aldrich

Job No: 14-53069
Date: 09:27:14 12:40
Site: Rush Island

Sounding: SCPT-C106
Cone: 268:T1500F15U500



Max Depth: 17.550 m / 57.58 ft
Depth Inc: 0.050 m / 0.164 ft

File: 14-53069_SP106.COR

SBT: Lunne, Robertson and Powell, 1997
Coords: UTM Zone 15 N: 4223183 E: 740525

Overplot Item: Dynamic Pore Pressure
Overplot Item: Equilibrium Pore Pressure

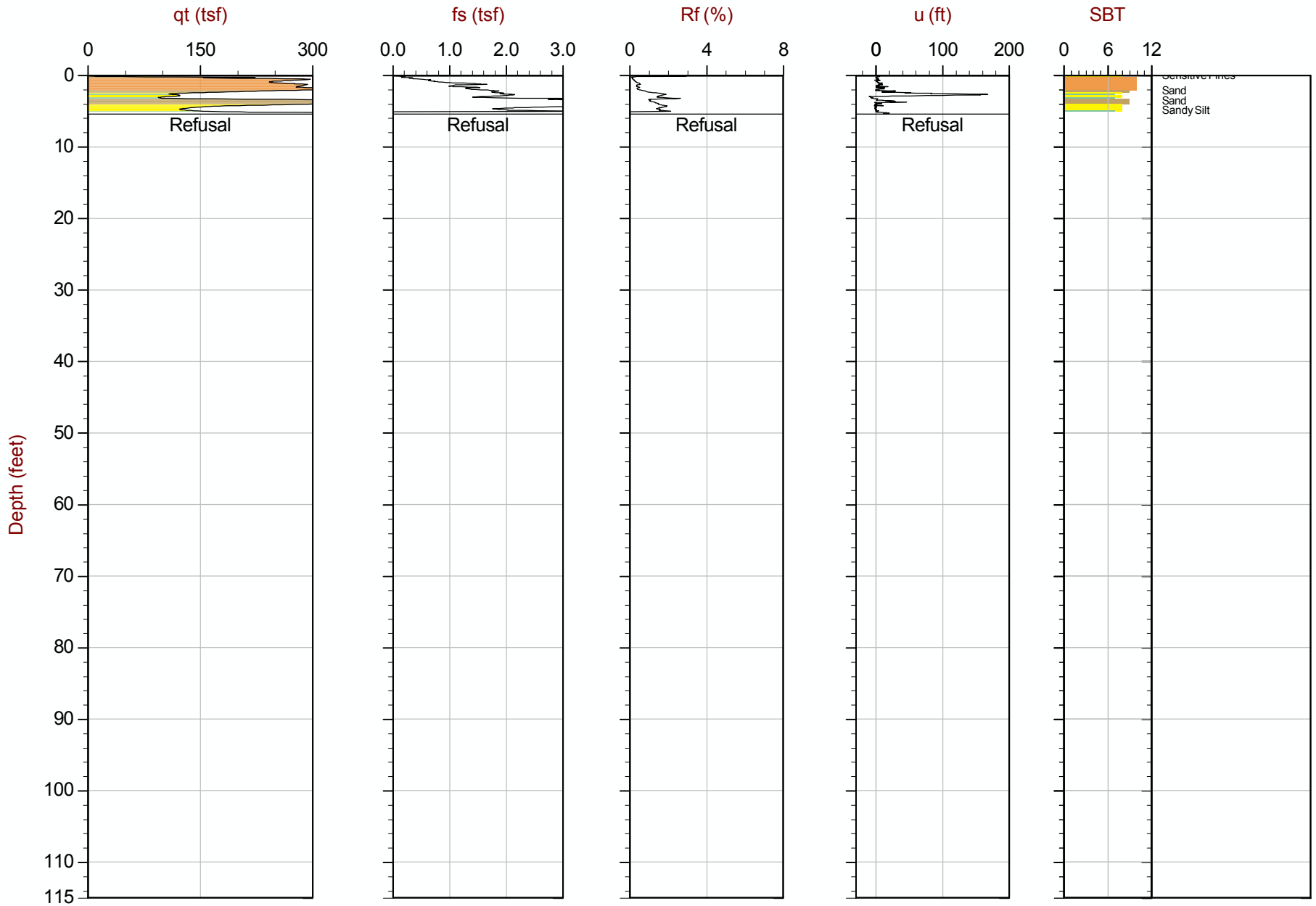
Equilibrium Pore Pressure Line
Assumed Equilibrium Pore Pressure

CONETEC

Haley & Aldrich

Job No: 14-53069
Date: 09:26:14 12:43
Site: Rush Island

Sounding: SCPT-C107
Cone: 268:T1500F15U500



Max Depth: 1.640 m / 5.38 ft
Depth Inc: 0.010 m / 0.033 ft

File: 14-53069_SP107.COR

SBT: Lunne, Robertson and Powell, 1997
Coords: UTM Zone 15 N: 4222854 E: 740546

Overplot Item: Dynamic Pore Pressure
Overplot Item: Equilibrium Pore Pressure

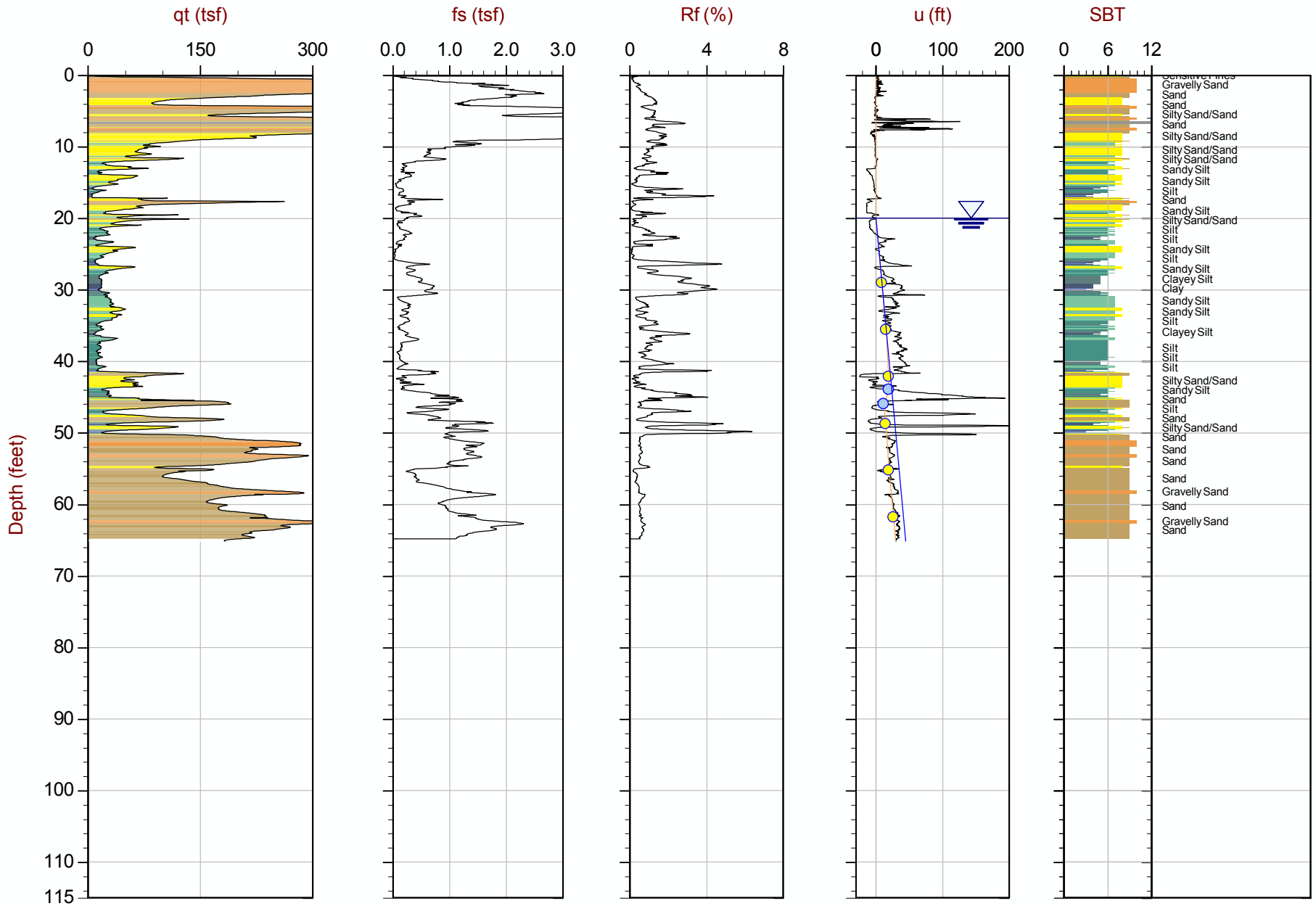
Equilibrium Pore Pressure Line
Assumed Equilibrium Pore Pressure

CONETEC

Haley & Aldrich

Job No: 14-53069
Date: 09:26:14 13:47
Site: Rush Island

Sounding: SCPT-C107A
Cone: 268:T1500F15U500



Max Depth: 19.860 m / 65.16 ft
Depth Inc: 0.010 m / 0.033 ft

File: 14-53069_SP107A.COR

SBT: Lunne, Robertson and Powell, 1997
Coords: UTM Zone 15 N: 4222862 E: 740559

Overplot Item: Dynamic Pore Pressure
Overplot Item: Equilibrium Pore Pressure

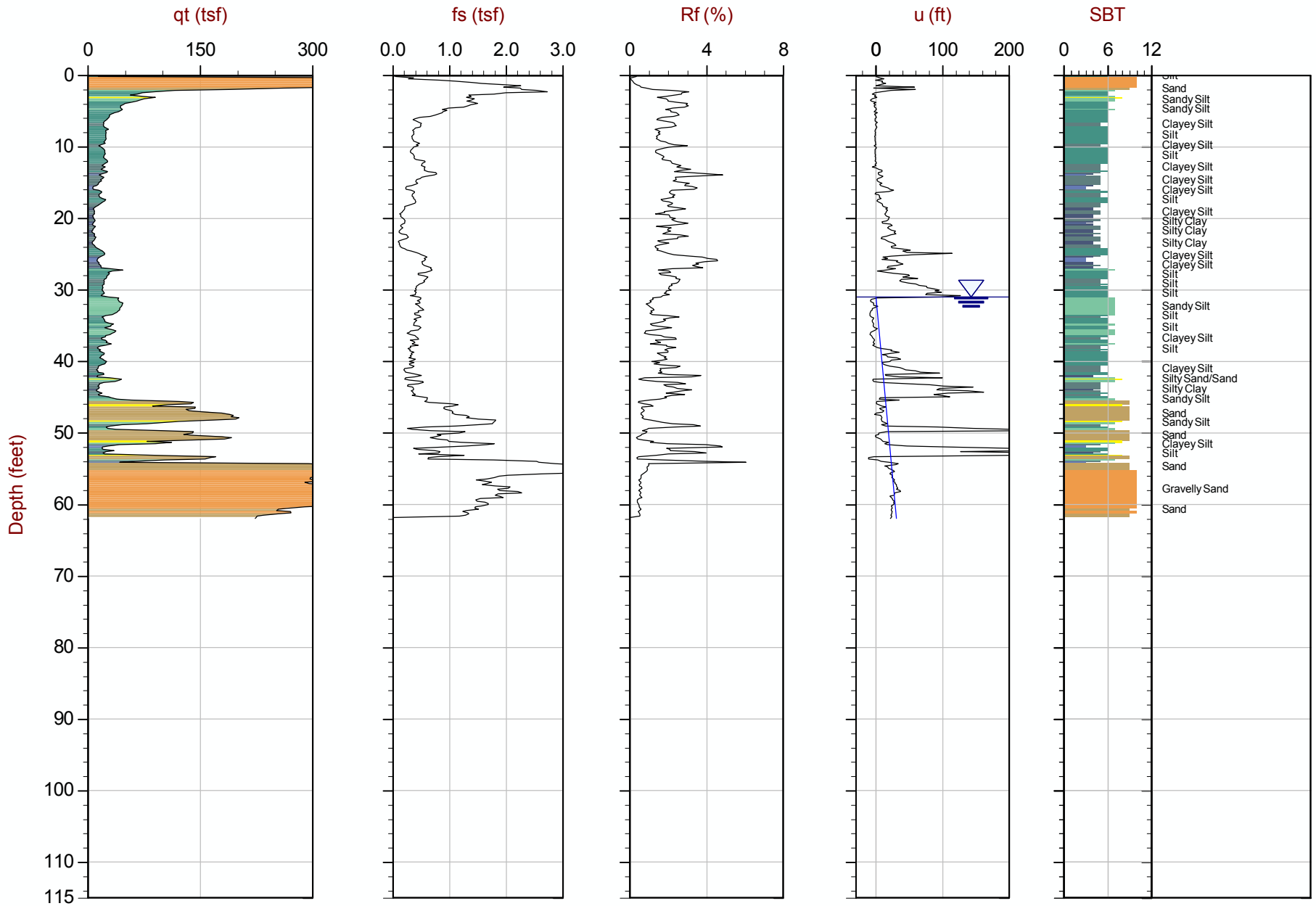
Equilibrium Pore Pressure Line
Assumed Equilibrium Pore Pressure

CONETEC

Haley & Aldrich

Job No: 14-53069
Date: 09:28:14 08:30
Site: Rush Island

Sounding: SCPT-C108
Cone: 268:T1500F15U500



Max Depth: 18.900 m / 62.01 ft
Depth Inc: 0.050 m / 0.164 ft

File: 14-53069_SP108.COR

SBT: Lunne, Robertson and Powell, 1997
Coords: UTM Zone 15 N: 4222696 E: 740725

Overplot Item: Dynamic Pore Pressure
Overplot Item: Equilibrium Pore Pressure

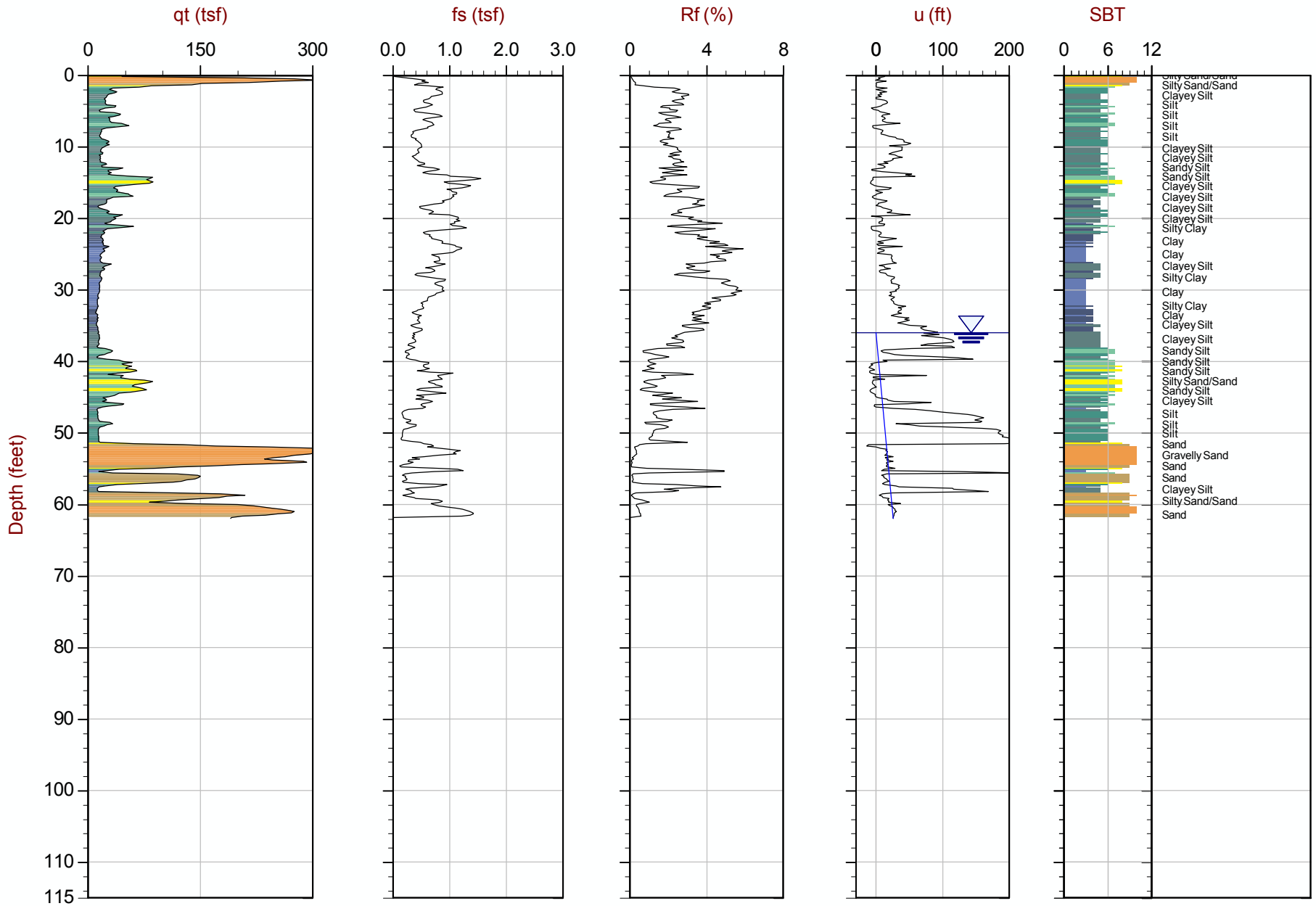
Equilibrium Pore Pressure Line
Assumed Equilibrium Pore Pressure

CONETEC

Haley & Aldrich

Job No: 14-53069
Date: 09:28:14 10:02
Site: Rush Island

Sounding: SCPT-C109
Cone: 268:T1500F15U500



Max Depth: 18.900 m / 62.01 ft
Depth Inc: 0.050 m / 0.164 ft

File: 14-53069_SP109.COR

SBT: Lunne, Robertson and Powell, 1997
Coords: UTM Zone 15 N: 4222429 E: 740692

Overplot Item: Dynamic Pore Pressure
Overplot Item: Equilibrium Pore Pressure

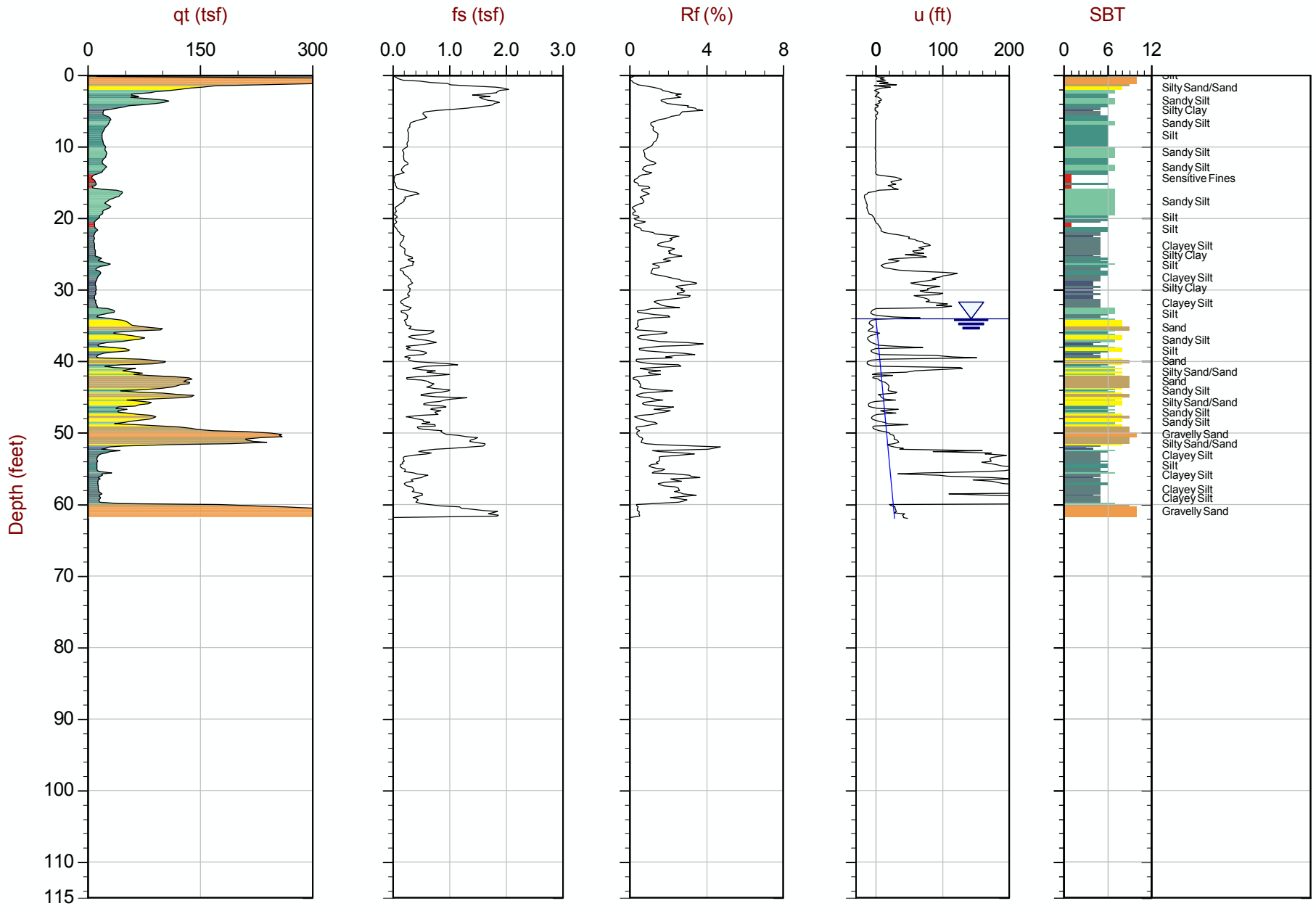
Equilibrium Pore Pressure Line
Assumed Equilibrium Pore Pressure

CONETEC

Haley & Aldrich

Job No: 14-53069
Date: 09:28:14 12:53
Site: Rush Island

Sounding: SCPT-C110
Cone: 268:T1500F15U500



Max Depth: 18.900 m / 62.01 ft
Depth Inc: 0.050 m / 0.164 ft

File: 14-53069_SP110.COR

SBT: Lunne, Robertson and Powell, 1997
Coords: UTM Zone 15 N: 4222892 E: 740137

Overplot Item: Dynamic Pore Pressure
Overplot Item: Equilibrium Pore Pressure

Equilibrium Pore Pressure Line
Assumed Equilibrium Pore Pressure

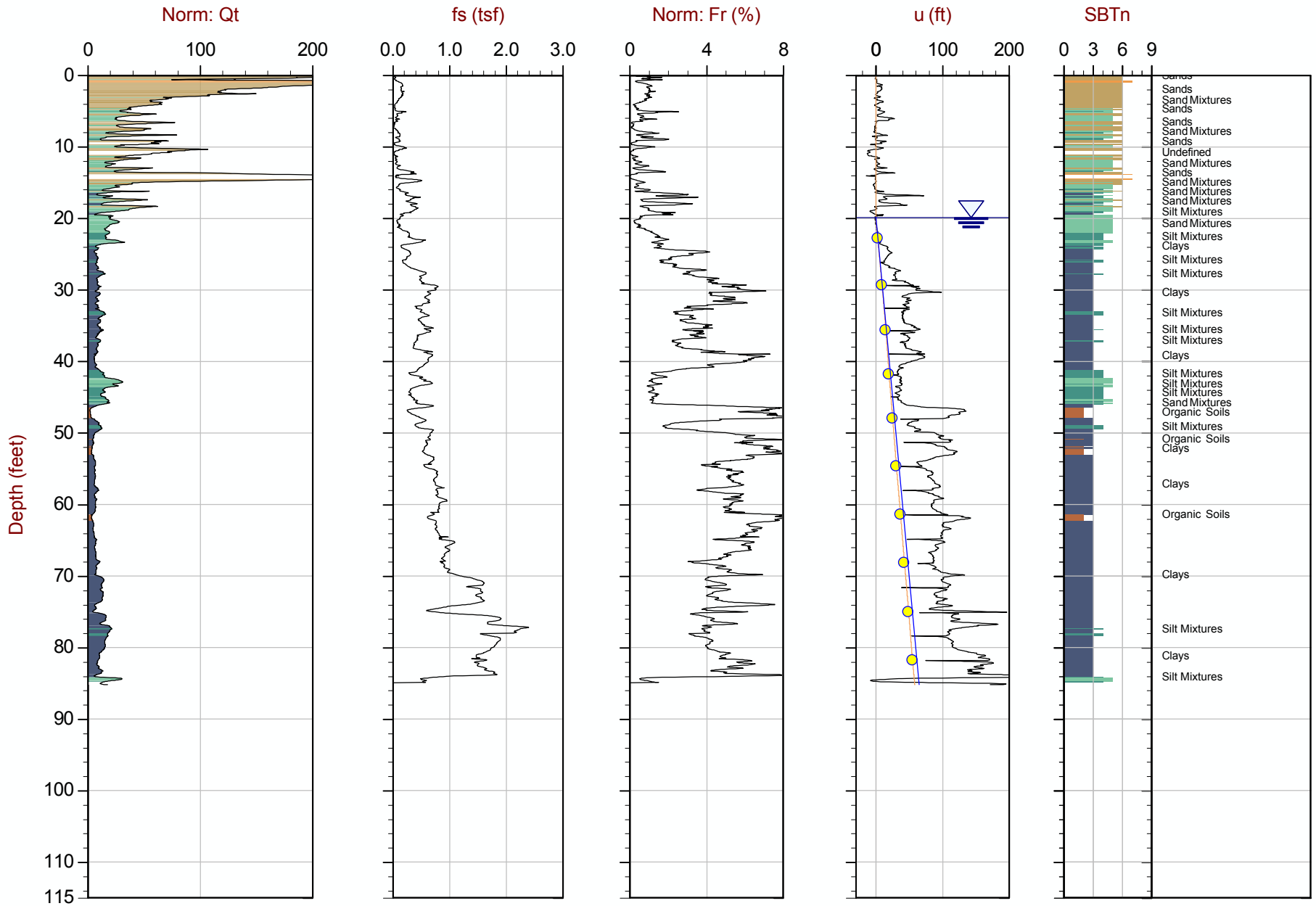
Normalized CPT Plots

CONETEC

Haley & Aldrich

Job No: 14-53069
Date: 09:23:14 14:48
Site: Rush Island

Sounding: SCPT-C100
Cone: 268:T1500F15U500



Max Depth: 25.980 m / 85.24 ft
Depth Inc: 0.010 m / 0.033 ft

File: 14-53069_SP100.COR

SBT: Lunne, Robertson and Powell, 1997
Coords: UTM Zone 15 N: 4222988 E: 740455

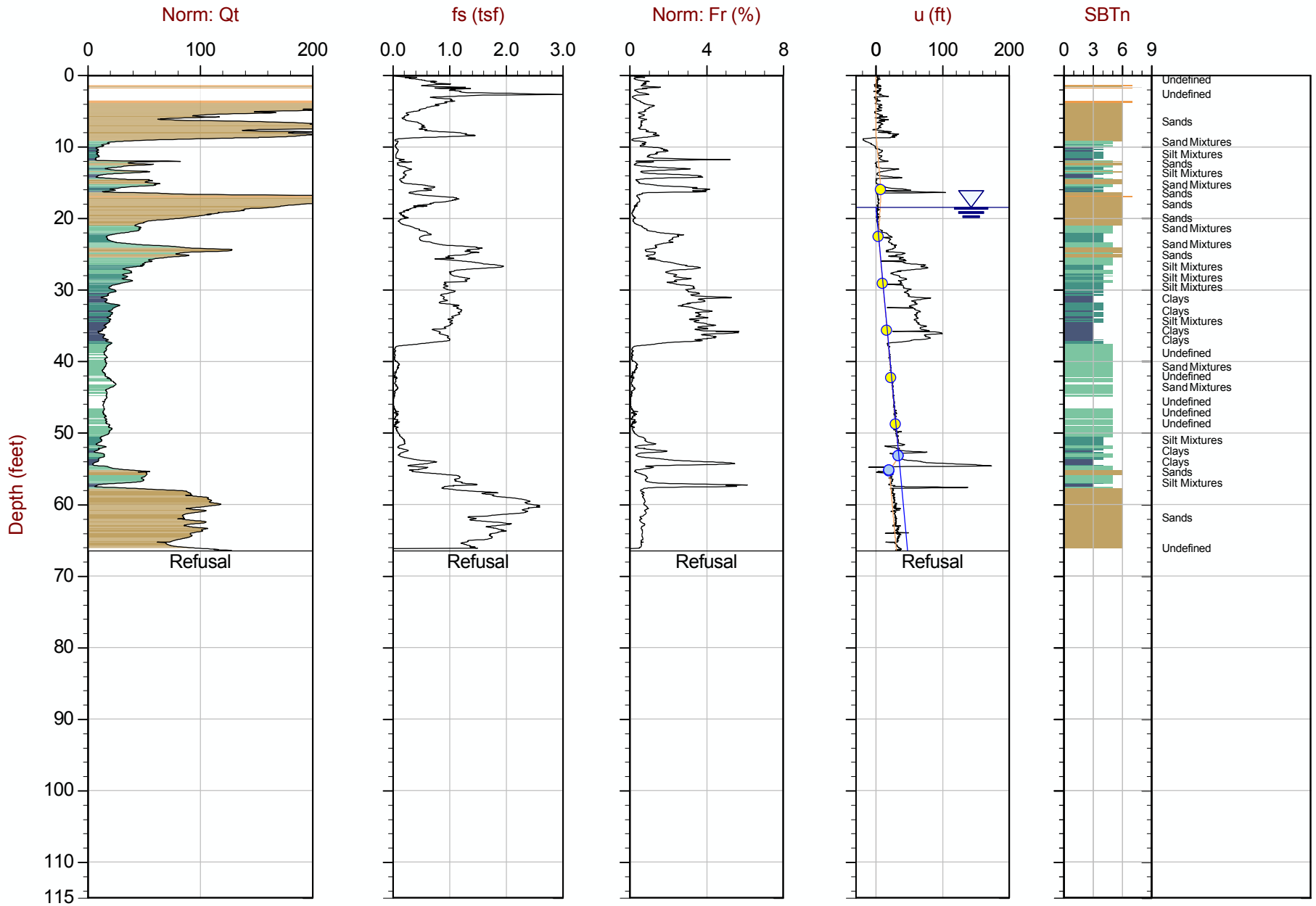
Overplot Item: Dynamic Pore Pressure
Overplot Item: Equilibrium Pore Pressure
Equilibrium Pore Pressure Line
Assumed Equilibrium Pore Pressure

CONETEC

Haley & Aldrich

Job No: 14-53069
Date: 09:27:14 07:58
Site: Rush Island

Sounding: SCPT-C101
Cone: 268:T1500F15U500



Max Depth: 20.260 m / 66.47 ft
Depth Inc: 0.010 m / 0.033 ft

File: 14-53069_SP101.COR

SBT: Lunne, Robertson and Powell, 1997
Coords: UTM Zone 15 N: 4223335 E: 740286

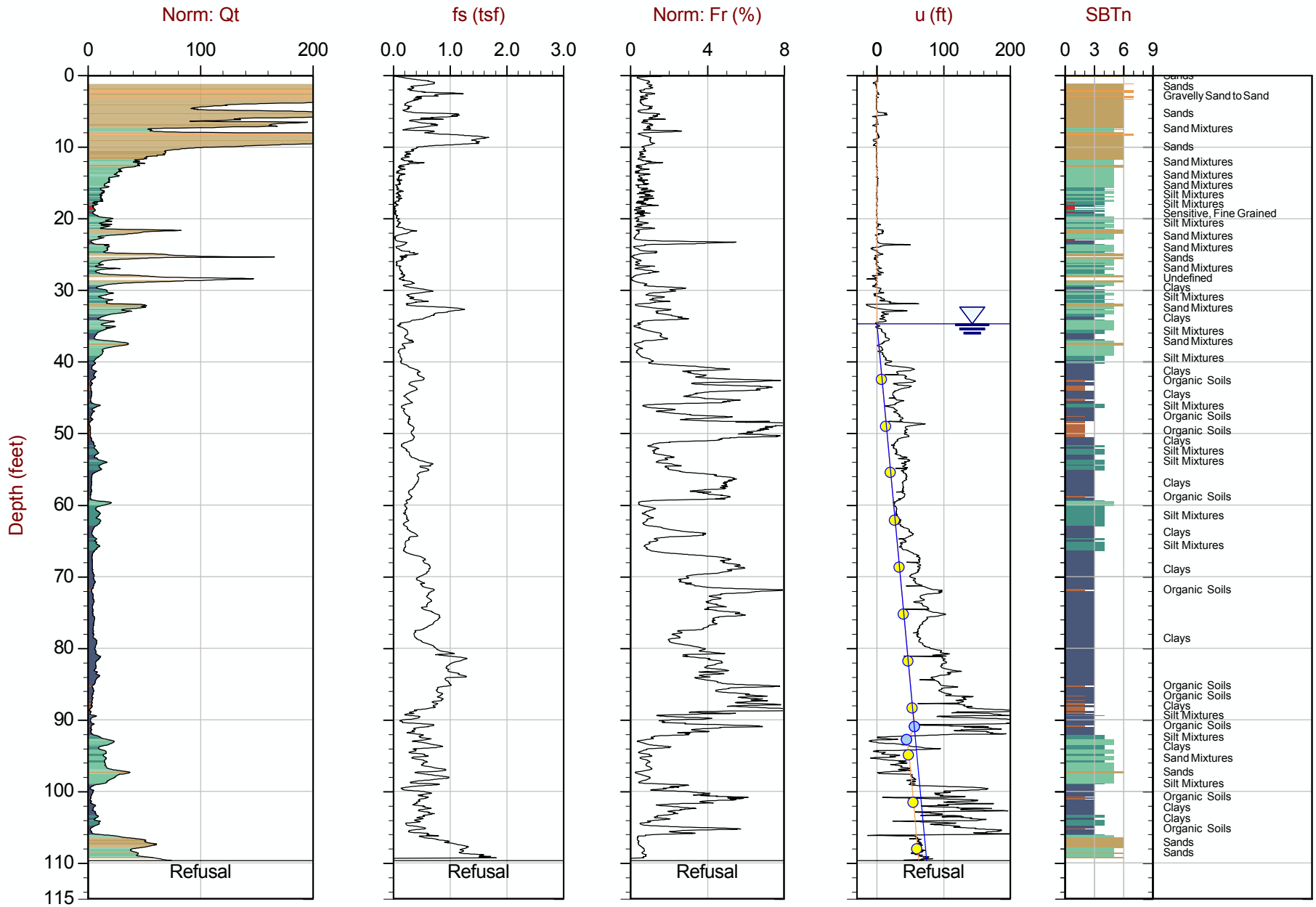
Overplot Item: Dynamic Pore Pressure
Overplot Item: Equilibrium Pore Pressure
Equilibrium Pore Pressure Line
Assumed Equilibrium Pore Pressure

CONETEC

Haley & Aldrich

Job No: 14-53069
Date: 09:25:14 10:55
Site: Rush Island

Sounding: SCPT-C102
Cone: 268:T1500F15U500



Max Depth: 33.430 m / 109.68 ft
Depth Inc: 0.010 m / 0.033 ft

File: 14-53069_SP102.COR

SBT: Lunne, Robertson and Powell, 1997
Coords: UTM Zone 15 N: 4222843 E: 740380

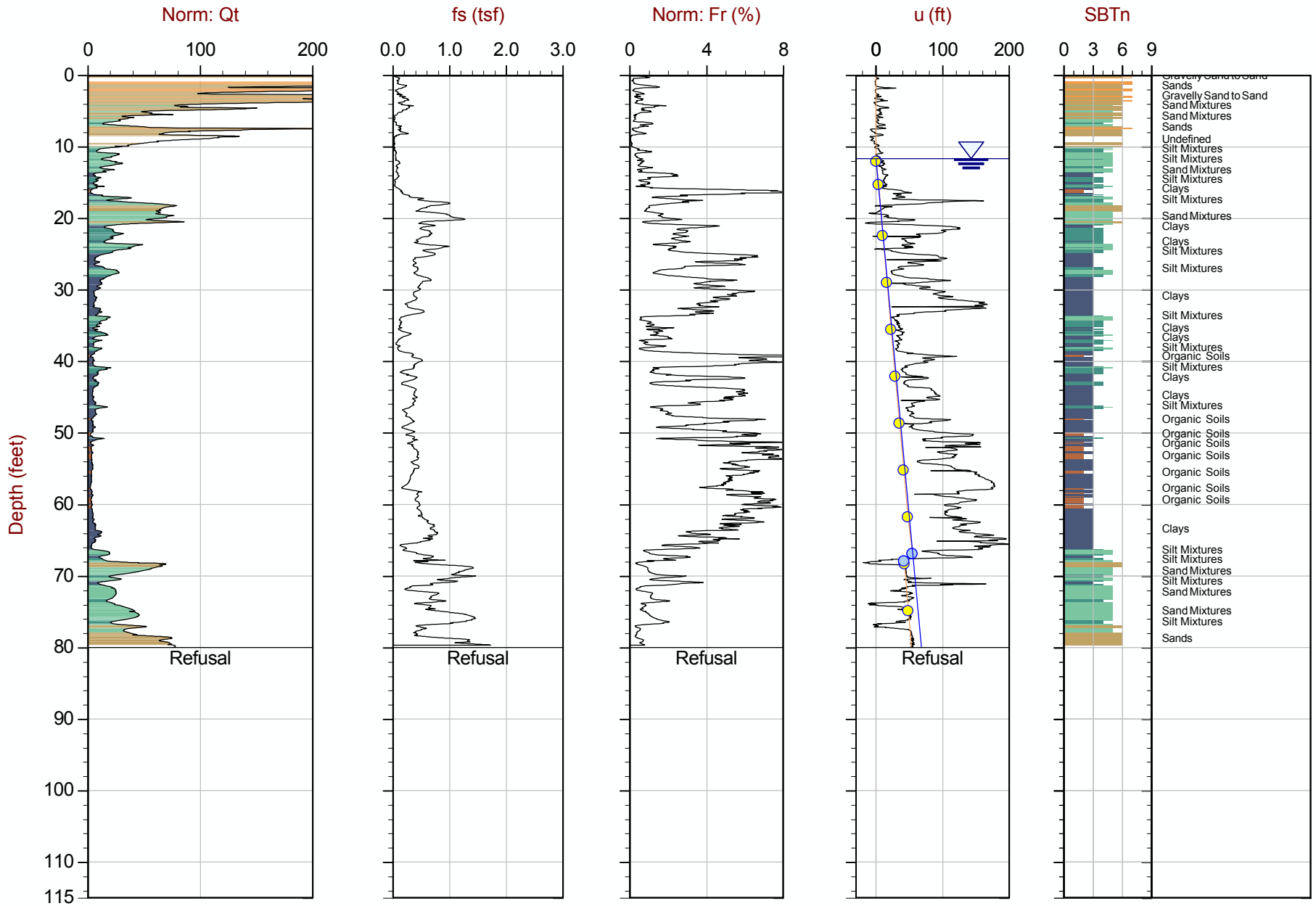
Overplot Item: Dynamic Pore Pressure
Overplot Item: Equilibrium Pore Pressure
Equilibrium Pore Pressure Line
Assumed Equilibrium Pore Pressure

CONETEC

Haley & Aldrich

Job No: 14-53069
Date: 09:26:14 08:52
Site: Rush Island

Sounding: SCPT-C103
Cone: 268:T1500F15U500



Max Depth: 24.390 m / 80.02 ft
Depth Inc: 0.010 m / 0.033 ft

File: 14-53069_SP103.COR

SBT: Lunne, Robertson and Powell, 1997
Coords: UTM Zone 15 N: 4222687 E: 740408

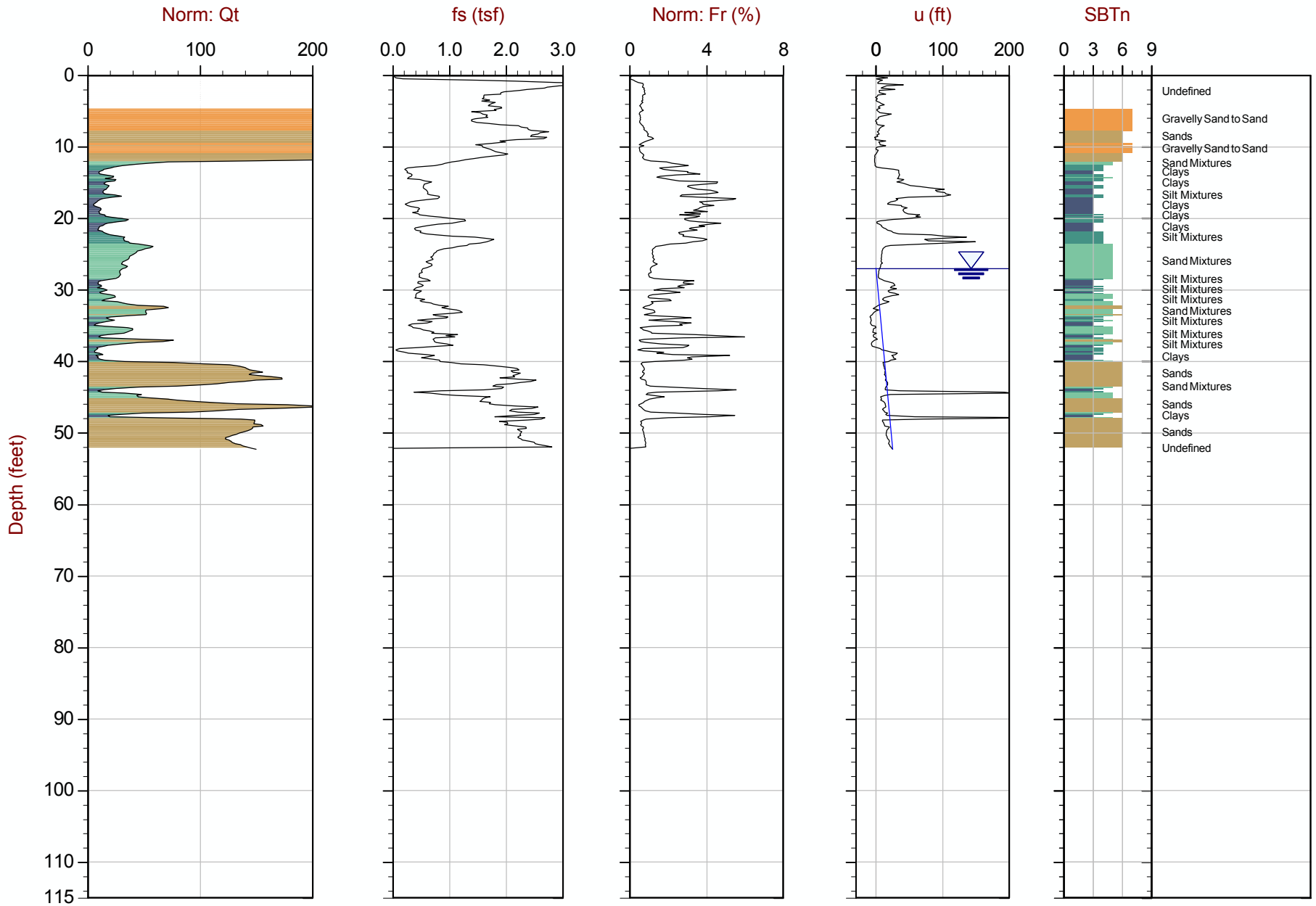
Overplot Item: Dynamic Pore Pressure
Overplot Item: Equilibrium Pore Pressure
Equilibrium Pore Pressure Line
Assumed Equilibrium Pore Pressure

CONETEC

Haley & Aldrich

Job No: 14-53069
Date: 09:28:14 14:41
Site: Rush Island

Sounding: SCPT-C104
Cone: 268:T1500F15U500



Max Depth: 15.950 m / 52.33 ft
Depth Inc: 0.050 m / 0.164 ft

File: 14-53069_SP104.COR

SBT: Lunne, Robertson and Powell, 1997
Coords: UTM Zone 15 N: 4223441 E: 740165

Overplot Item: Dynamic Pore Pressure
Overplot Item: Equilibrium Pore Pressure

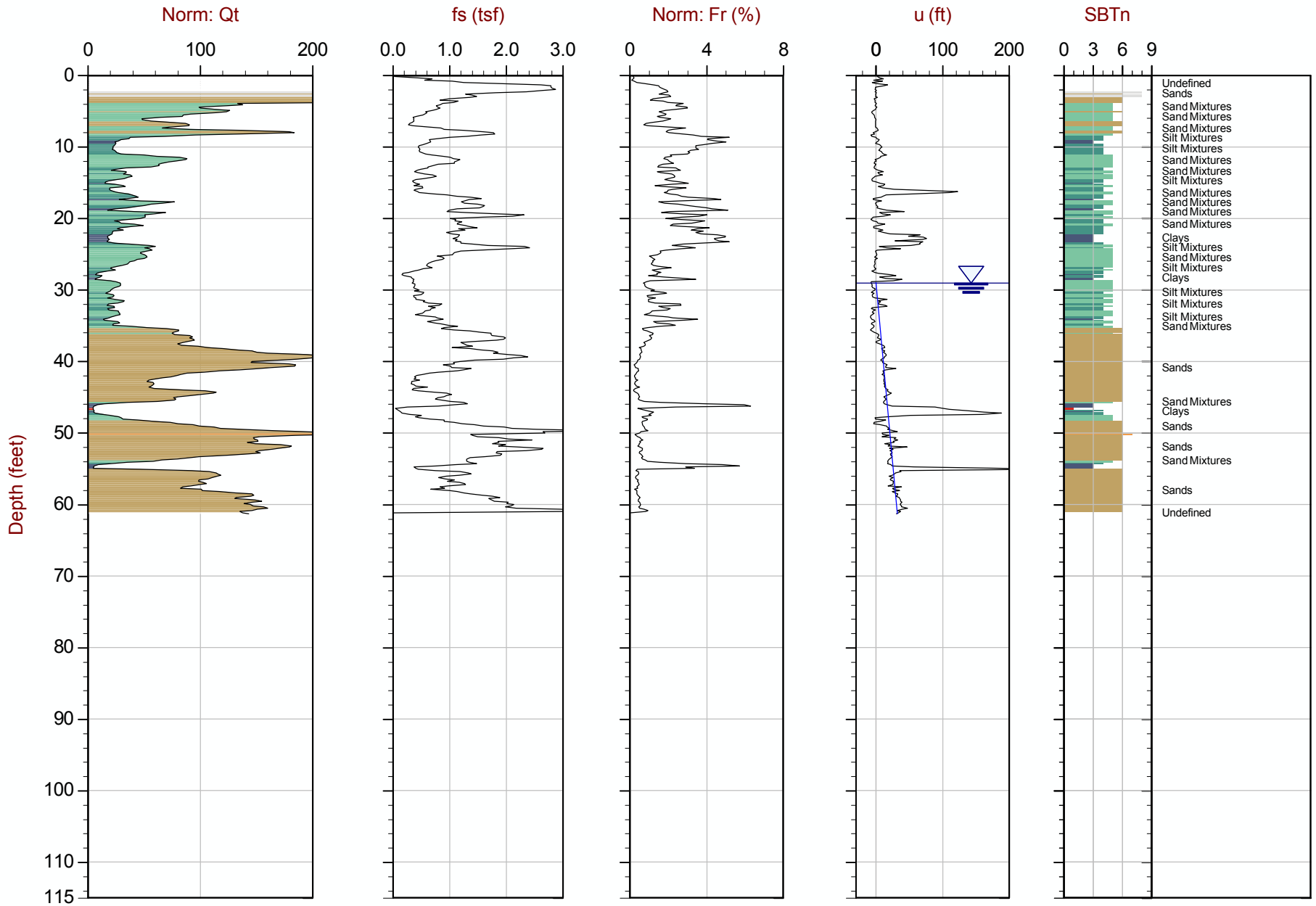
Equilibrium Pore Pressure Line
Assumed Equilibrium Pore Pressure

CONETEC

Haley & Aldrich

Job No: 14-53069
Date: 09:27:14 14:25
Site: Rush Island

Sounding: SCPT-C105
Cone: 268:T1500F15U500



Max Depth: 18.700 m / 61.35 ft
Depth Inc: 0.050 m / 0.164 ft

File: 14-53069_SP105.COR

SBT: Lunne, Robertson and Powell, 1997
Coords: UTM Zone 15 N: 4223336 E: 740433

Overplot Item: Dynamic Pore Pressure
Overplot Item: Equilibrium Pore Pressure

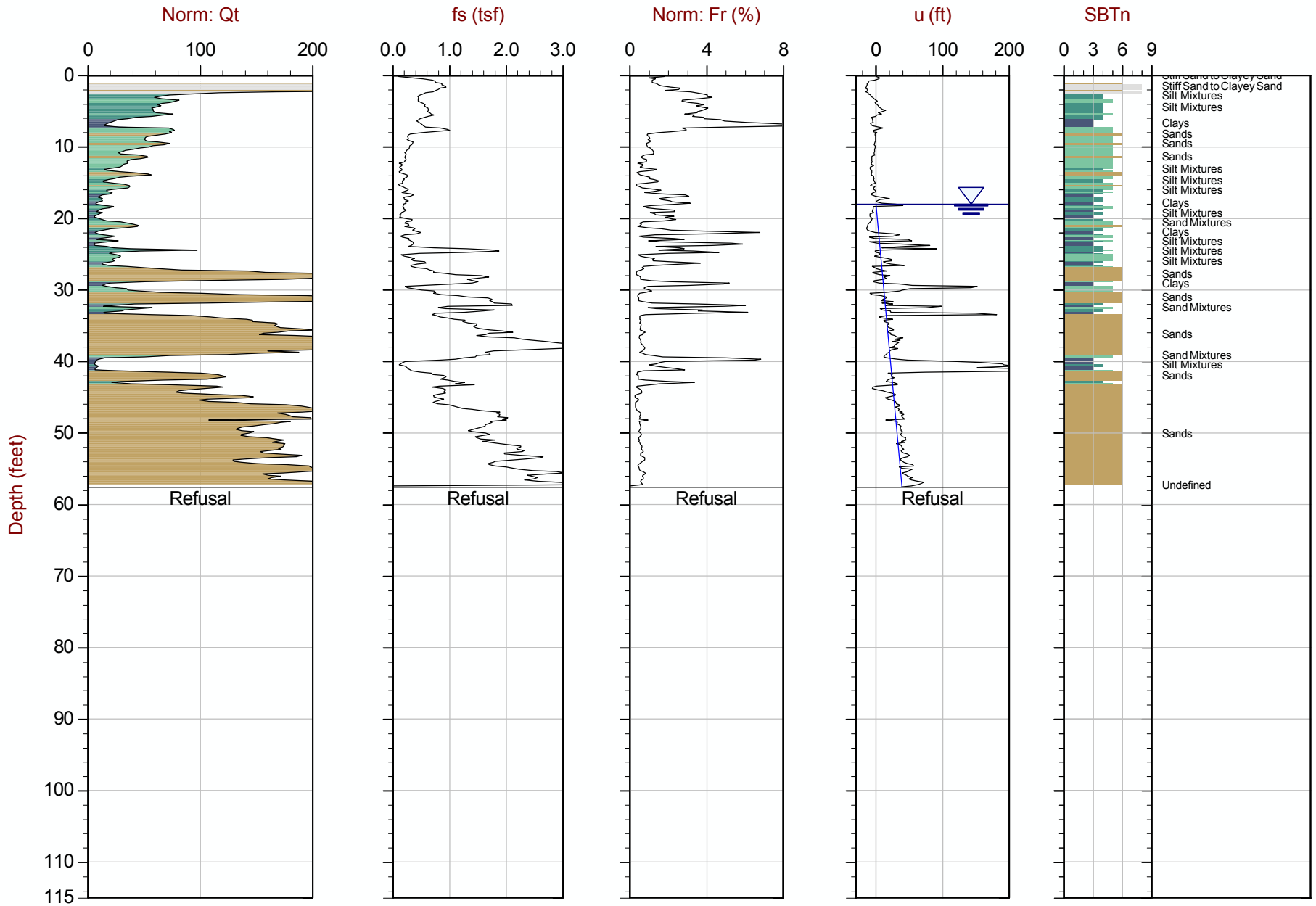
Equilibrium Pore Pressure Line
Assumed Equilibrium Pore Pressure

CONETEC

Haley & Aldrich

Job No: 14-53069
Date: 09:27:14 12:40
Site: Rush Island

Sounding: SCPT-C106
Cone: 268:T1500F15U500



Max Depth: 17.550 m / 57.58 ft
Depth Inc: 0.050 m / 0.164 ft

File: 14-53069_SP106.COR

SBT: Lunne, Robertson and Powell, 1997
Coords: UTM Zone 15 N: 4223183 E: 740525

Overplot Item: Dynamic Pore Pressure
Overplot Item: Equilibrium Pore Pressure

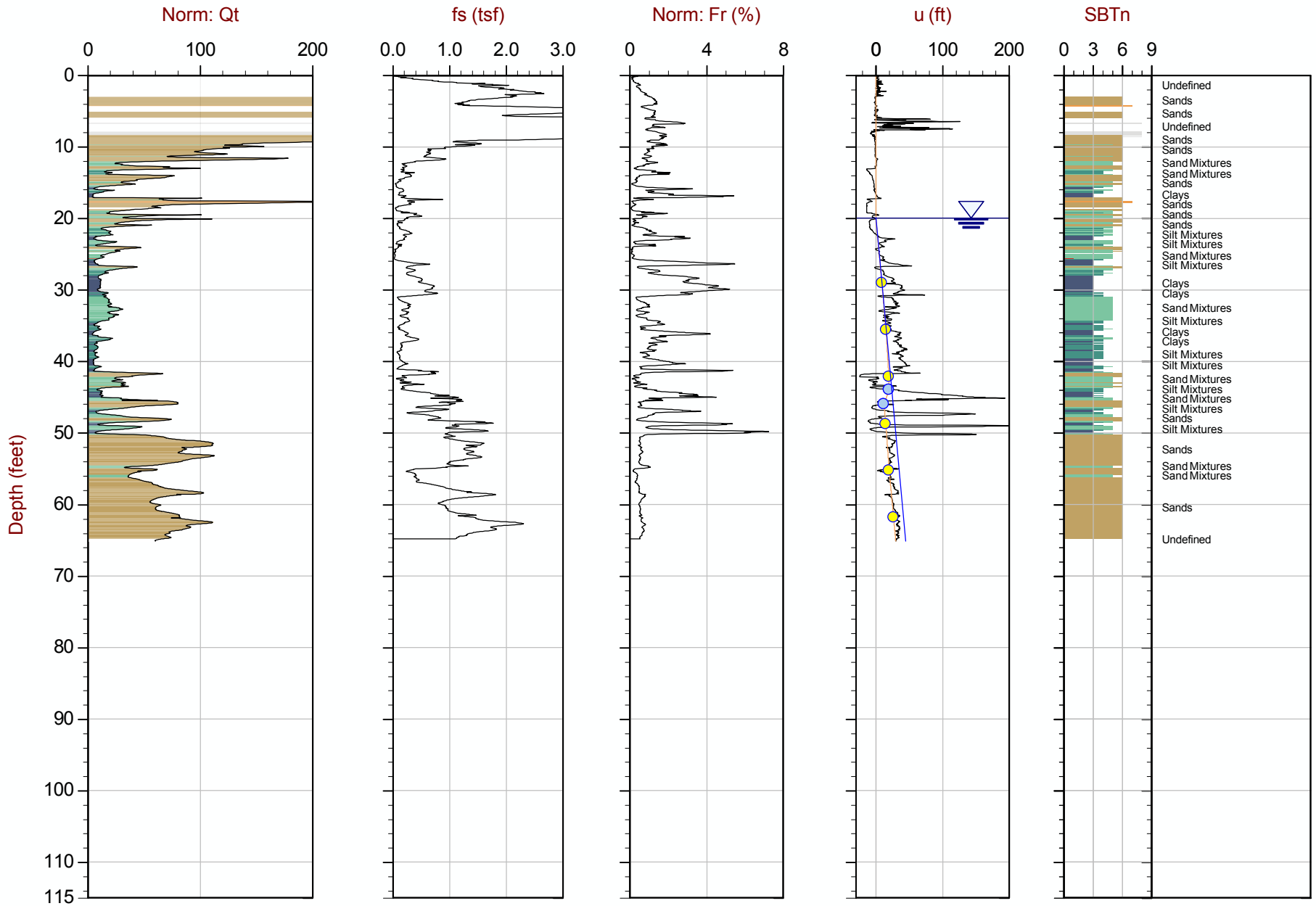
Equilibrium Pore Pressure Line
Assumed Equilibrium Pore Pressure

CONETEC

Haley & Aldrich

Job No: 14-53069
Date: 09:26:14 13:47
Site: Rush Island

Sounding: SCPT-C107A
Cone: 268:T1500F15U500



Max Depth: 19.860 m / 65.16 ft
Depth Inc: 0.010 m / 0.033 ft

File: 14-53069_SP107A.COR

SBT: Lunne, Robertson and Powell, 1997
Coords: UTM Zone 15 N: 4222862 E: 740559

Overplot Item: Dynamic Pore Pressure
Overplot Item: Equilibrium Pore Pressure

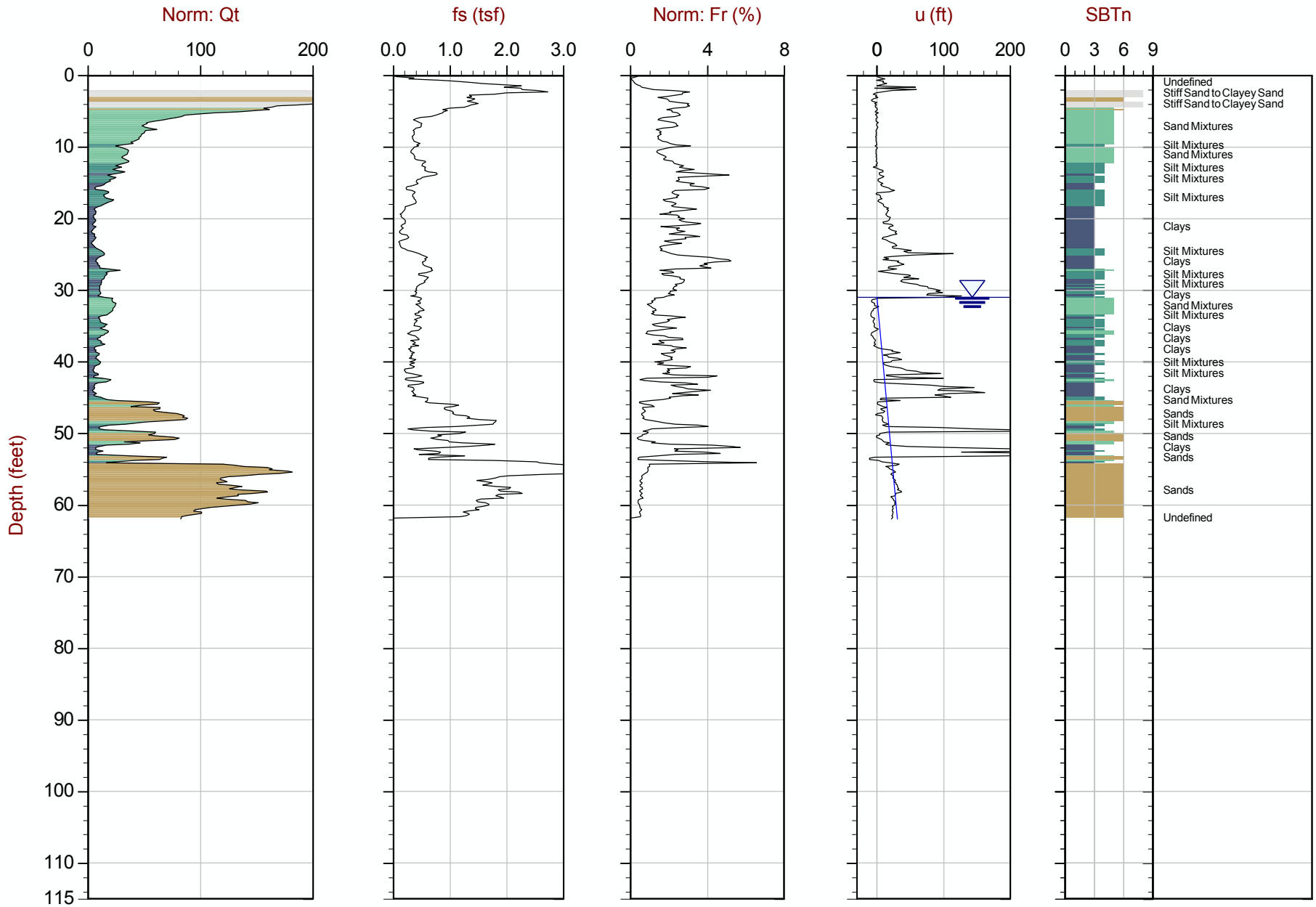
Equilibrium Pore Pressure Line
Assumed Equilibrium Pore Pressure

CONETEC

Haley & Aldrich

Job No: 14-53069
Date: 09:28:14 08:30
Site: Rush Island

Sounding: SCPT-C108
Cone: 268:T1500F15U500



Max Depth: 18.900 m / 62.01 ft
Depth Inc: 0.050 m / 0.164 ft

File: 14-53069_SP108.COR

SBT: Lunne, Robertson and Powell, 1997
Coords: UTM Zone 15 N: 4222696 E: 740725

Overplot Item: Dynamic Pore Pressure
Overplot Item: Equilibrium Pore Pressure

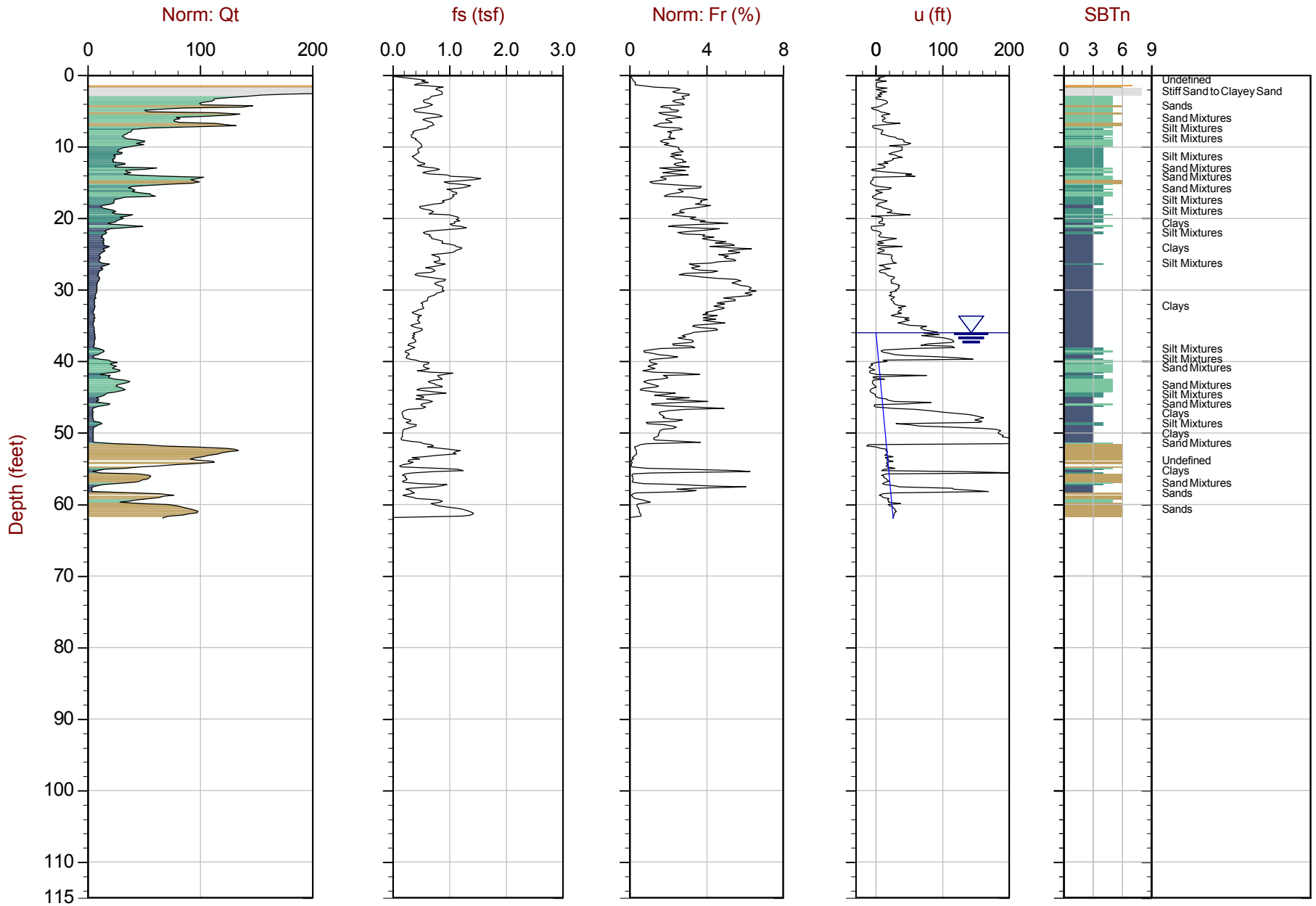
Equilibrium Pore Pressure Line
Assumed Equilibrium Pore Pressure

CONETEC

Haley & Aldrich

Job No: 14-53069
Date: 09:28:14 10:02
Site: Rush Island

Sounding: SCPT-C109
Cone: 268:T1500F15U500



Max Depth: 18.900 m / 62.01 ft
Depth Inc: 0.050 m / 0.164 ft

File: 14-53069_SP109.COR

SBT: Lunne, Robertson and Powell, 1997
Coords: UTM Zone 15 N: 4222429 E: 740692

Overplot Item: Dynamic Pore Pressure
Overplot Item: Equilibrium Pore Pressure

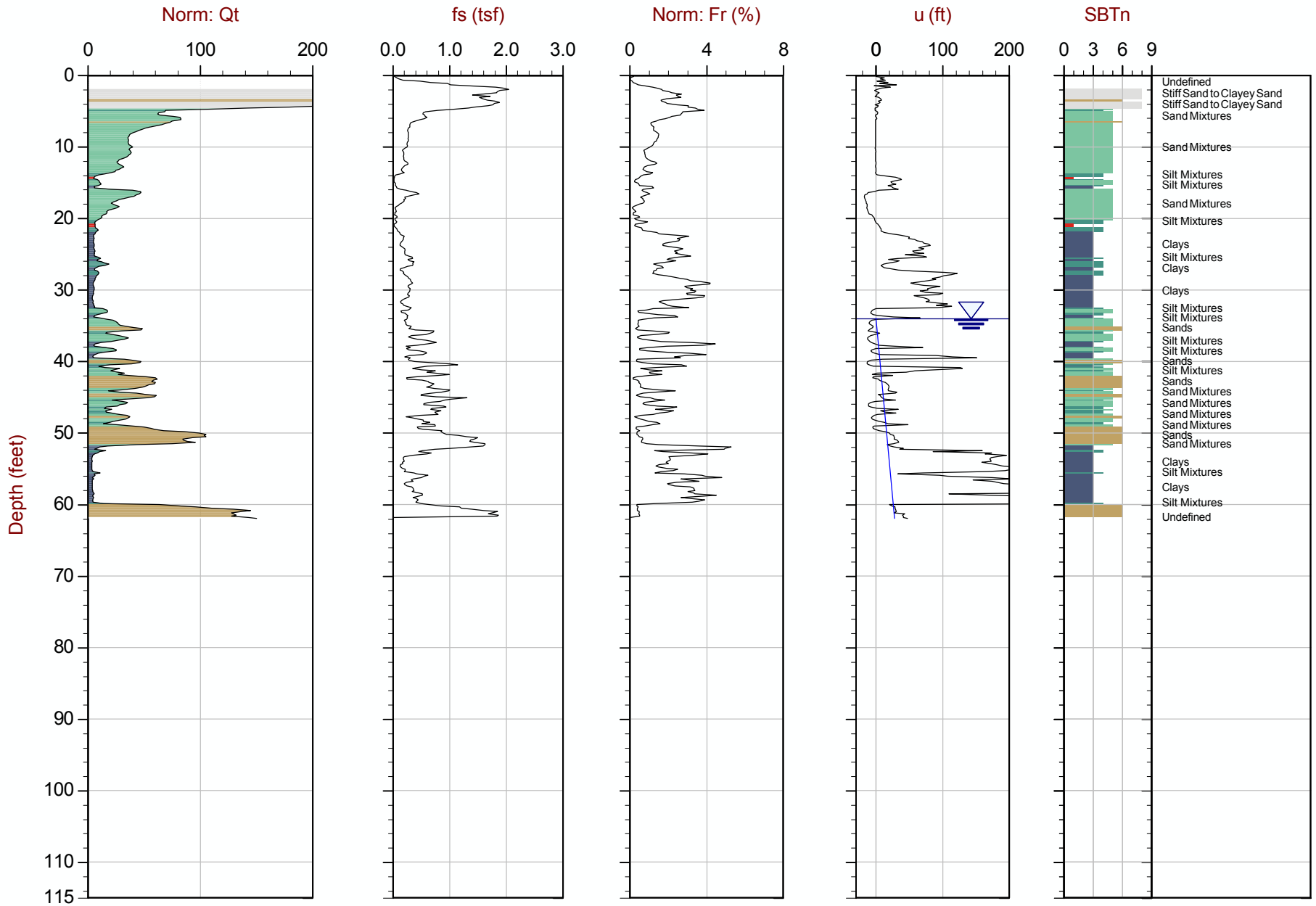
Equilibrium Pore Pressure Line
Assumed Equilibrium Pore Pressure

CONETEC

Haley & Aldrich

Job No: 14-53069
Date: 09:28:14 12:53
Site: Rush Island

Sounding: SCPT-C110
Cone: 268:T1500F15U500



Max Depth: 18.900 m / 62.01 ft
Depth Inc: 0.050 m / 0.164 ft

File: 14-53069_SP110.COR

SBT: Lunne, Robertson and Powell, 1997
Coords: UTM Zone 15 N: 4222892 E: 740137

Overplot Item: Dynamic Pore Pressure
Overplot Item: Equilibrium Pore Pressure

Equilibrium Pore Pressure Line
Assumed Equilibrium Pore Pressure

Appendix B

CONETEC INTERPRETATION METHODS

A Detailed Description of the Methods Used in ConeTec's CPT Interpretation and Plotting Software



Revision SZW-Rev 05A
April 8, 2011

Prepared by Jim Greig

CONETEC

ConeTec Interpretations as of April 8, 2011

ConeTec's interpretation routine provides a tabular output of geotechnical parameters based on current published CPT correlations and is subject to change to reflect the current state of practice. The interpreted values are not considered valid for all soil types. The interpretations are presented only as a guide for geotechnical use and should be carefully scrutinized for consideration in any geotechnical design. Reference to current literature is strongly recommended. ConeTec does not warranty the correctness or the applicability of any of the geotechnical parameters interpreted by the program and does not assume liability for any use of the results in any design or review. Representative hand calculations should be made for any parameter that is critical for design purposes. The end user of the interpreted output should also be fully aware of the techniques and the limitations of any method used in this program. The purpose of this document is to inform the user as to which methods were used and what the appropriate papers and/or publications are for further reference.

The CPT interpretations are based on values of tip, sleeve friction and pore pressure averaged over a user specified interval (e.g. 0.20m). Note that q_t is the tip resistance corrected for pore pressure effects and q_c is the recorded tip resistance. Since all ConeTec cones have equal end area friction sleeves, pore pressure corrections to sleeve friction, f_s, are not required.

The tip correction is: $q_t = q_c + (1\text{-}a) \cdot u_2$

where: q_t is the corrected tip resistance
q_c is the recorded tip resistance
u_2 is the recorded dynamic pore pressure behind the tip (u_2 position)
a is the Net Area Ratio for the cone (typically 0.80 for ConeTec cones)

The total stress calculations are based on soil unit weights that have been assigned to the Soil Behavior Type zones, from a user defined unit weight profile or by using a single value throughout the profile.

Effective vertical overburden stresses are calculated based on a hydrostatic distribution of equilibrium pore pressures below the water table or from a user defined equilibrium pore pressure profile (this can be obtained from CPT dissipation tests). For over water projects the effects of the column of water have been taken into account as has the appropriate unit weight of water. How this is done depends on where the instruments were zeroed (i.e. on deck or at mud line).

Details regarding the interpretation methods for all of the interpreted parameters are provided in Table 1. The appropriate references cited in Table 1 are listed in Table 2. Where methods are based on charts or techniques that are too complex to describe in this summary the user should refer to the cited material.

The Soil Behavior Type classification charts (normalized and non-normalized) shown in Figures 1 and 2 are based on the charts developed by Dr. Robertson and Dr. Campanella at the University of British Columbia. These charts appear in many publications, most notably: Robertson, Campanella, Gillespie and Greig (1986); Robertson (1990) and Lunne, Robertson and Powell (1997). The Bq classification charts shown in Figures 3a and 3b are based on those described in Robertson (1990) and Lunne, Robertson and Powell (1997). The Jefferies and Davies SBT chart shown in Figure 3c is based on that discussed in Jefferies and Davies, 1993.

Where the results of a calculation/interpretation are declared *'invalid'* the value will be represented by the text strings "-9999" or "-9999.0". In some cases the value 0 will be used. Invalid results will occur because of (and not limited to) one or a combination of:

1. Invalid or undefined CPT data (e.g. drilled out section or data gap).

2. Where the interpretation method is inappropriate, for example, drained parameters in an undrained material (and vice versa).

3. Where interpretation input values are beyond the range of the referenced charts or specified limitations of the interpretation method.

4. Where pre-requisite or intermediate interpretation calculations are invalid.

The parameters selected for output from the program are often specific to a particular project. As such, not all of the interpreted parameters listed in Table 1 may be included in the output files delivered with this report.

The output files are provided in Microsoft Excel XLS format. The ConeTec software has several options for output depending on the number or types of interpreted parameters desired. Each output file will be named using the original COR file basename followed by a three or four letter indicator of the interpretation set selected (e.g. BSC, TBL, NLI or IFI) and possibly followed by an operator selected suffix identifying the characteristics of the particular interpretation run.

Table 1
CPT Interpretation Methods

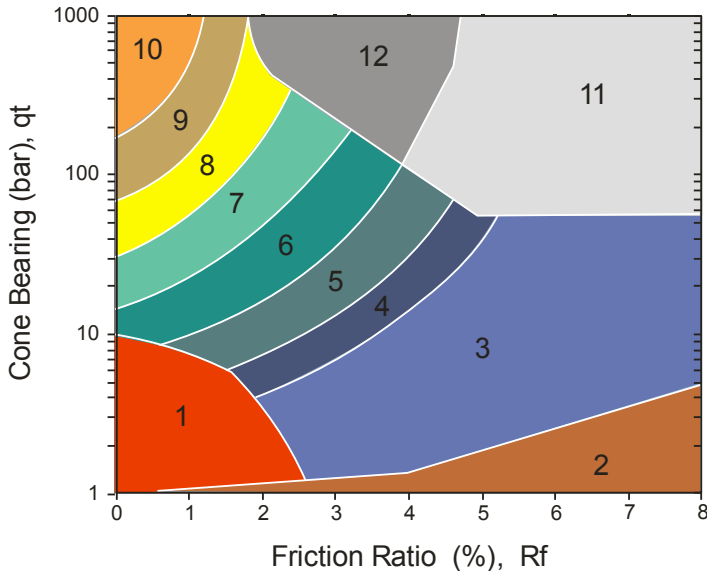
Interpreted Parameter	Description	Equation	Ref
Depth	Mid Layer Depth *(where interpretations are done at each point then Mid Layer Depth = Recorded Depth)*	*Depth (Layer Top) + Depth (Layer Bottom) / 2.0*	
Elevation	Elevation of Mid Layer based on sounding collar elevation supplied by client	Elevation = Collar Elevation - Depth	
Avgqc	Averaged recorded tip value (q_c)	$Avgqc = \frac{1}{n}\sum_{i=1}^{n} q_c$ *n=1 when interpretations are done at each point*	
Avgqt	Averaged corrected tip (q_t) where: $q_t = q_c + (1-a) \bullet u$	$Avgqt = \frac{1}{n}\sum_{i=1}^{n} q_t$ *n=1 when interpretations are done at each point*	
Avgfs	Averaged sleeve friction (f_s)	$Avgfs = \frac{1}{n}\sum_{i=1}^{n} fs$ *n=1 when interpretations are done at each point*	
AvgRf	Averaged friction ratio (Rf) where friction ratio is defined as: $Rf = 100\% \bullet \frac{fs}{qt}$	$AvgRf = 100\% \cdot \frac{Avgfs}{Avgqt}$ *n=1 when interpretations are done at each point*	
Avgu	Averaged dynamic pore pressure *(u)*	$Avgu = \frac{1}{n}\sum_{i=1}^{n} u_i$ *n=1 when interpretations are done at each point*	
AvgRes	Averaged Resistivity (this data is not always available since it is a specialized test requiring an additional module)	$Avgu = \frac{1}{n}\sum_{i=1}^{n} RESISTIVITY_i$ *n=1 when interpretations are done at each point*	
AvgUVIF	Averaged UVIF ultra-violet induced fluorescence (this data is not always available since it is a specialized test requiring an additional module)	$Avgu = \frac{1}{n}\sum_{i=1}^{n} UVIF_i$ *n=1 when interpretations are done at each point*	
AvgTemp	Averaged Temperature (this data is not always available since it is a specialized test)	$Avgu = \frac{1}{n}\sum_{i=1}^{n} TEMPERATUR\,E_i$ *n=1 when interpretations are done at each point*	

Interpreted Parameter	Description	Equation	Ref
AvgGamma	Averaged Gamma Counts (this data is not always available since it is a specialized test requiring an additional module)	$Avgu = \frac{1}{n}\sum_{i=1}^{n} GAMMA_i$ *n=1 when interpretations are done at each point*	
SBT	Soil Behavior Type as defined by Robertson and Campanella	See Figure 1	2, 5
U.Wt.	Unit Weight of soil determined from one of the following user selectable options: 1) uniform value 2) value assigned to each SBT zone 3) user supplied unit weight profile	See references	5
T. Stress σ_v	Total vertical overburden stress at Mid Layer Depth. *A layer is defined as the averaging interval specified by the user. For data interpreted at each point the Mid Layer Depth is the same as the recorded depth.*	$TStress = \sum_{i=1}^{n} \gamma_i h_i$ *where* γ_i is layer unit weight h_i is layer thickness	
E. Stress σ_v'	Effective vertical overburden stress at Mid Layer Depth	*Estress = Tstress - u_{eq}*	
Ueq	Equilibrium pore pressure determined from one of the following user selectable options: 1) hydrostatic from water table depth 2) user supplied profile	For hydrostatic option: $u_{eq} = \gamma_w \cdot (D - D_{wt})$ where u_{eq} is equilibrium pore pressure γ_w is unit weight of water D is the current depth D_{wt} is the depth to the water table	
Cn	SPT N_{60} overburden correction factor	*$Cn=(\sigma_v')^{-0.5}$* where *σ_v' is in tsf* *$0.5 < C_n < 2.0$*	
N_{60}	SPT N value at 60% energy calculated from qt/N ratios assigned to each SBT zone. This method has abrupt N value changes at zone boundaries.	*See Figure 1*	4, 5
$(N_1)_{60}$	SPT N_{60} value corrected for overburden pressure	*$(N_1)_{60} = Cn \cdot N_{60}$*	4
$N_{60}I_c$	SPT N_{60} values based on the Ic parameter	(qt/pa)/ N_{60} = 8.5 (1 – Ic/4.6)	5
$(N_1)_{60}$Ic	SPT N_{60} value corrected for overburden pressure (using N_{60} I_c). User has 2 options.	*1) $(N_1)_{60}Ic = Cn \cdot (N_{60}\,Ic)$* 2) q_{c1n}/ *$(N_1)_{60}Ic$* = 8.5 (1 – Ic/4.6)	4 5
$(N_1)_{60cs}$Ic	Clean sand equivalent SPT $(N_1)_{60}$Ic. User has 3 options.	1) $(N_1)_{60cs}Ic = \alpha + \beta((N_1)_{60}Ic)$ 2) $(N_1)_{60cs}Ic = K_{SPT} * ((N_1)_{60}Ic)$ 3) q_{c1ncs})/ $(N_1)_{60cs}Ic = 8.5 (1 – Ic/4.6)$ FC ≤ 5%: α = 0, β=1.0 FC ≥ 35% α = 5.0, β=1.2 5% < FC < 35% $\alpha = \exp[1.76 – (190/FC^2)]$ $\beta = [0.99 + (FC^{1.5}/1000)]$	10 10 5
Su	Undrained shear strength based on q_t Su factor N_{kt} is user selectable	$Su = \frac{qt - \sigma_v}{N_{kt}}$	1, 5
Su	Undrained shear strength based on pore pressure Su factor $N_{\Delta u}$ is user selectable	$Su = \frac{u_2 - u_{eq}}{N_{\Delta u}}$	1, 5
k	Coefficient of permeability (assigned to each SBT zone)		5

Interpreted Parameter	Description	Equation	Ref
Bq	Pore pressure parameter	$Bq = \frac{\Delta u}{qt - \sigma_v}$ *where:* $\Delta u = u - u_{eq}$ *and* u = *dynamic pore pressure* u_{eq} = *equilibrium pore pressure*	1, 5
Q_t	Normalized q_t for Soil Behavior Type classification as defined by Robertson, 1990	$Qt = \frac{qt - \sigma_v}{\sigma'_v}$	2, 5
F_r	Normalized Friction Ratio for Soil Behavior Type classification as defined by Robertson, 1990	$Fr = 100\% \cdot \frac{fs}{qt - \sigma_v}$	2, 5
Net qt	Net tip resistance	$qt - \sigma_v$	
qe	Effective tip resistance	$qt - u_2$	
qeNorm	Normalized effective tip resistance	$\frac{qt - u_2}{\sigma'_v}$	
SBTn	Normalized Soil Behavior Type as defined by Robertson and Campanella	See Figure 2	2, 5
SBT-BQ	Non-normalized Soil Behavior type based on the Bq parameter	See Figure 3	2, 5
SBT-BQn	Normalized Soil Behavior based on the Bq parameter	See Figure 3	2, 5
SBT-JandD	Soil Behaviour Type as defined by Jeffries and Davies	See Figure 3	7
SBT-BQn	Normalized Soil Behavior base on the Bq parameter	See Figure 3	2, 5
I_c	Soil index for estimating grain characteristics	$Ic = [(3.47 - \log_{10}Q)^2 + (\log_{10} Fr + 1.22)^2]^{0.5}$ *Where:* $Q = \left(\frac{qt - \sigma_v}{P_{a2}}\right)\left(\frac{P_a}{\sigma'_v}\right)^n$ *And* *Fr is in percent* P_a = *atmospheric pressure* P_{a2} = *atmospheric pressure* *n varies from 0.5 to 1.0 and is selected in an iterative manner based on the resulting* I_c	3, 8
FC	Apparent fines content (%)	*FC=1.75(Ic$^{3.25}$) - 3.7* *FC=100 for Ic > 3.5* *FC=0 for Ic < 1.26* *FC = 5% if 1.64 < Ic < 2.6 AND F_r<0.5*	3
Ic Zone	This parameter is the Soil Behavior Type zone based on the Ic parameter (valid for zones 2 through 7 on SBTn chart)	Ic < 1.31 Zone = 7 1.31 < Ic < 2.05 Zone = 6 2.05 < Ic < 2.60 Zone = 5 2.60 < Ic < 2.95 Zone = 4 2.95 < Ic < 3.60 Zone = 3 Ic > 3.60 Zone = 2	3
PHI ϕ	Friction Angle determined from one of the following user selectable options: a) Campanella and Robertson b) Durgunoglu and Mitchel c) Janbu d) Kulhawy and Mayne	See reference	5 5 5 11

Interpreted Parameter	Description	Equation	Ref
Dr	Relative Density determined from one of the following user selectable options: a) Ticino Sand b) Hokksund Sand c) Schmertmann 1976 d) Jamiolkowski - All Sands	See reference	5
OCR	Over Consolidation Ratio	a) Based on Schmertmann's method involving a plot of S_u/σ_v' /($S_u/\sigma_v')_{NC}$ and OCR where the Su/p' ratio for NC clay is user selectable	9
State Parameter	The state parameter is used to describe whether a soil is contractive (SP is positive) or dilative (SP is negative) at large strains based on the work by Been and Jefferies	See reference	8, 6, 5
Es/qt	Intermediate parameter for calculating Young's Modulus, E, in sands. It is the Y axis of the reference chart.	Based on Figure 5.59 in the reference	5
Young's Modulus E	Young's Modulus based on the work done in Italy. There are three types of sands considered in this technique. The user selects the appropriate type for the site from: a) OC Sands b) Aged NC Sands c) Recent NC Sands Each sand type has a family of curves that depend on mean normal stress. The program calculates mean normal stress and linearly interpolates between the two extremes provided in the Es/qt chart.	Mean normal stress is evaluated from: $\sigma_m' = \frac{1}{3}(\sigma_v' + \sigma_h' + \sigma_h')$ where σ_v'= vertical effective stress σ_h'= horizontal effective stress and $\sigma_h = K_o \cdot \sigma_v'$ with Ko assumed to be 0.5	5
q_{c1}	q_t normalized for overburden stress used for seismic analysis	$q_{c1} = q_t \cdot (Pa/\sigma_v')^{0.5}$ where: Pa = atm. Pressure q_t is in MPa	3
q_{c1n}	q_{c1} in dimensionless form used for seismic analysis	$q_{c1n} = (q_{c1} / Pa)(Pa/\sigma_v')^n$ where: Pa = atm. Pressure and n ranges from 0.5 to 0.75 based on Ic.	3
K_{SPT}	Equivalent clean sand factor for $(N_1)60$	$K_{SPT} = 1 + ((0.75/30) \cdot (FC - 5))$	10
K_{CPT}	Equivalent clean sand correction for q_{c1N}	$K_{cpt} = 1.0$ for $I_c \leq 1.64$ $K_{cpt} = f(I_c)$ for $I_c > 1.64$ (see reference)	10
q_{c1ncs}	Clean sand equivalent q_{c1n}	$q_{c1ncs} = q_{c1n} \cdot K_{cpt}$	3
CRR	Cyclic Resistance Ratio (for Magnitude 7.5)	$q_{c1ncs} < 50$: $CRR_{7.5} = 0.833\ [(q_{c1ncs}/1000] + 0.05$ $50 \leq q_{c1ncs} < 160$: $CRR_{7.5} = 93\ [(q_{c1ncs}/1000]^3 + 0.08$	10

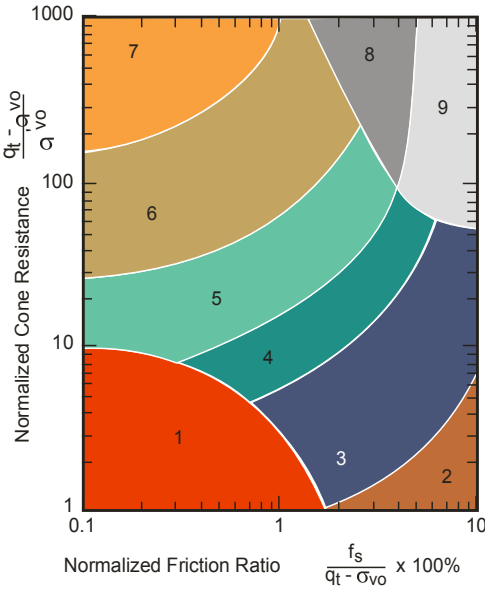
Interpreted Parameter	Description	Equation	Ref
CSR	Cyclic Stress Ratio	$CSR = (\tau_{av}/\sigma_v') = 0.65\ (a_{max} / g)\ (\sigma_v/ \sigma_v')\ r_d$ $r_d = 1.0 - 0.00765\ z$ $\quad z \leq 9.15m$ $r_d = 1.174 - 0.0267\ z$ $\quad 9.15 < z \leq 23m$ $r_d = 0.744 - 0.008\ z$ $\quad 23 < z \leq 30m$ $r_d = 0.50$ $\quad z > 30m$	10
MSF	Magnitude Scaling Factor	See Reference	10
FofS	Factor of Safety against Liquefaction	$FS = (CRR_{7.5} / CSR)\ MSF$	10
Liquefaction Status	Statement indicating possible liquefaction	Takes into account FofS and limitations based on I_c and q_{c1ncs}.	10
Cont/Dilat Tip	Contractive / Dilative qc1 Boundary based on $(N_1)_{60}$	$(\sigma_v')_{boundary} = 9.58 \times 10^{-4}\ [(N_1)_{60}]^{4.79}$ qc1 is calculated from specified qt(MPa)/N ratio	13
Cq	Normalizing Factor	$Cq = 1.8 / (0.8 + ((\sigma_v'/Pa))$	12
qc1 (Cq)	Normalized tip resistance based on Cq	$q_{c1} = C_q * q_t$ (some papers use q_c)	12
Su(Liq)/s'v	Liquefied Shear Strength Ratio	$\frac{Su(Liq)}{\sigma_v'} = 0.03 + 0.0143(q_{c1})$	13



Zone	qt / N	Soil Behavior Type
1	2	sensitive fine grained
2	1	organic material
3	1	clay
4	1.5	silty clay to clay
5	2	clayey silt to silty clay
6	2.5	sandy silt to clayey silt
7	3	silty sand to sandy silt
8	4	sand to silty sand
9	5	sand
10	6	gravelly sand to sand
11	1	very stiff fine grained *
12	2	sand to clayey sand *

* overconsolidated or cemented

Figure 1 Non-Normalized Behavior Type Classification Chart



Zone	Normalized Soil Behavior Type
1	sensitive fine grained
2	organic material
3	clay to silty clay
4	clayey silt to silty clay
5	silty sand to sandy silt
6	clean sands to silty sands
7	gravelly sand to sand
8	very stiff sand to clayey sand
9	very stiff fine grained

Figure 2 Normalized Behavior Type Classification Chart

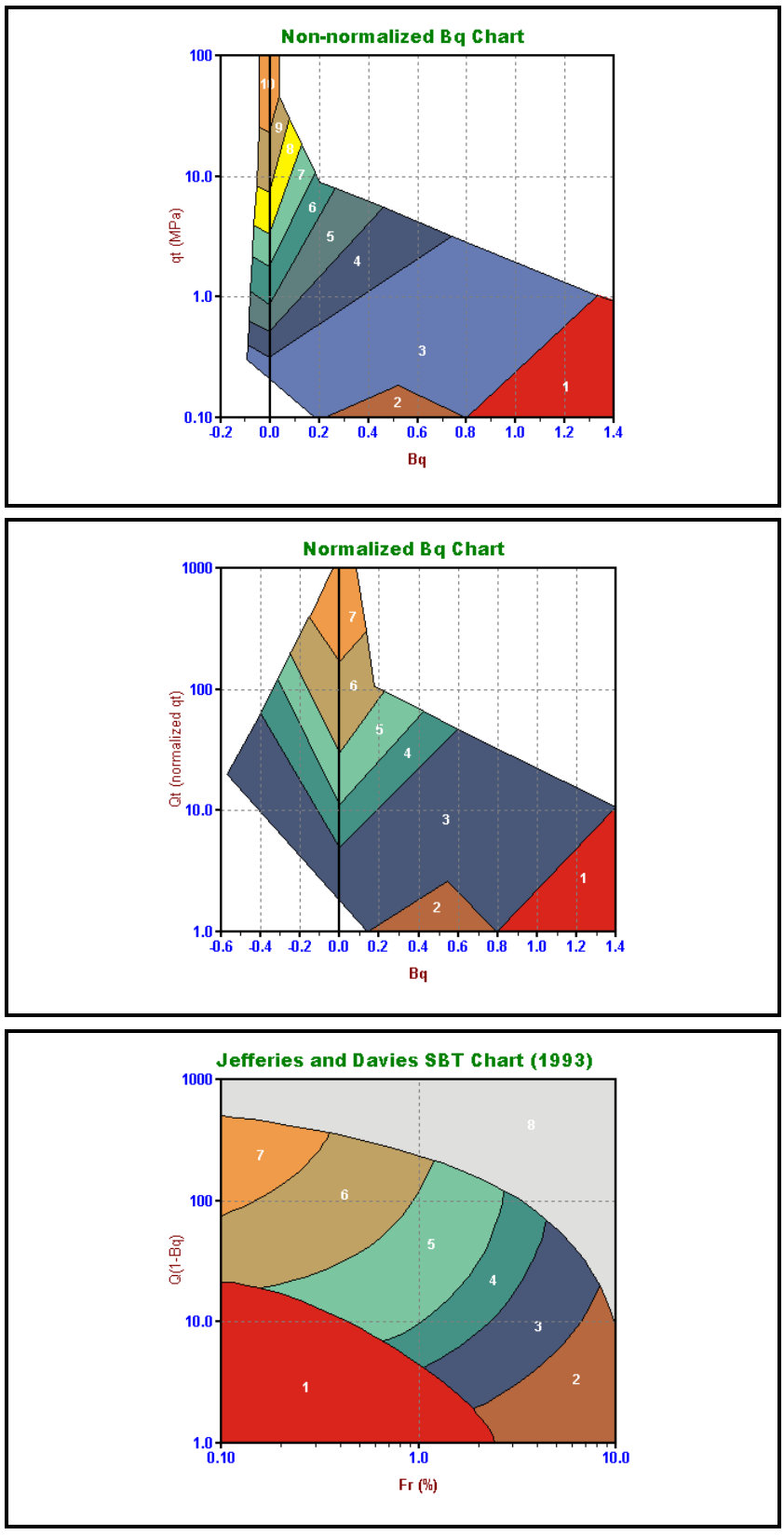


Figure 3 – Alternate Soil Behaviour Type Charts

Table 2 References

No.	References
1	Robertson, P.K., Campanella, R.G., Gillespie, D. and Greig, J., 1986, "Use of Piezometer Cone Data", Proceedings of InSitu 86, ASCE Specialty Conference, Blacksburg, Virginia.
2	Robertson, P.K., 1990, "Soil Classification Using the Cone Penetration Test", Canadian Geotechnical Journal, Volume 27.
3	Robertson, P.K. and Fear, C.E., 1998, "Evaluating cyclic liquefaction potential using the cone penetration test", Canadian Geotechnical Journal, 35: 442-459.
4	Robertson, P.K. and Wride, C.E., 1998, "Cyclic Liquefaction and its Evaluation Based on SPT and CPT", NCEER Workshop Paper, January 22, 1997
5	Lunne, T., Robertson, P.K. and Powell, J. J. M., 1997, " Cone Penetration Testing in Geotechnical Practice," Blackie Academic and Professional.
6	Plewes, H.D., Davies, M.P. and Jefferies, M.G., 1992, "CPT Based Screening Procedure for Evaluating Liquefaction Susceptibility", 45th Canadian Geotechnical Conference, Toronto, Ontario, October 1992.
7	Jefferies, M.G. and Davies, M.P., 1993. "Use of CPTu to Estimate equivalent N_{60}", Geotechnical Testing Journal, 16(4): 458-467.
8	Been, K. and Jefferies, M.P., 1985, "A state parameter for sands", Geotechnique, 35(2), 99-112.
9	Schmertmann, 1977, "Guidelines for Cone Penetration Test Performance and Design", Federal Highway Administration Report FHWA-TS-78-209, U.S. Department of Transportation
10	Proceedings of theNCEER Workshop on Evaluation of Liquefaction Resistance of Soils, Salt LakeCity, 1996. Chaired by Leslie Youd. 11
11	Kulhawy, F.H. and Mayne, P.W. ,1990, "Manual on Estimating Soil Properties for Foundation Design, *Report No. EL-6800"*, Electric Power Research Institute, Palo Alto, CA, August 1990, 306 p.
12	Olson, S.M. and Stark, T.D., 2002, "Liquefied strength ratio from liquefied flow filaure case histories", Canadian Geotechnical Journal, 39: 951-966.
13	Oslon, Scott M. and Stark, Timothy D., 2003, "Yield Strength Ratio and Liquefaction Analysis of Slopes and Embankments", Journal of Geotechnical and Geoenvironmental Engineering, ASCE, August 2003.

Appendix C

Job No: 14-53069
Client: Haley & Aldrich
Project: Rush Island - Festus, Missouri
Date: September 23 through October 1, 2014

Table 2 - DISSIPATION TRACE SUMMARY

Sounding ID	Duration sec.	Depth ft	Min. U ft	Max. U ft	Calc. Phrea. Surface ft	Est. Phrea. Surface ft	T50 sec.	Ch cm^2/min.
SCPT-C100	200	9.68	-9.50	-1.15				
SCPT-C100	250	16.24	-1.27	12.60				
SCPT-C100	200	22.83	2.84	4.73	19.9			
SCPT-C100	250	29.36	9.43	57.83	19.8		4	175.29
SCPT-C100	250	35.70	15.03	56.42	20.4		4.2	168.6
SCPT-C100	140	41.86	19.98	33.26	21.9			
SCPT-C100	350	48.03	25.53	92.29	22.6		3.7	188.42
SCPT-C100	250	54.69	31.12	70.38	23.7		3.2	219.27
SCPT-C100	250	61.45	37.32	113.78	24.3		4.9	143.18
SCPT-C100	250	68.24	43.09	88.11	25.1		3	234.58
SCPT-C100	250	75.10	49.15	199.40	25.7		3.4	204.87
SCPT-C100	300	81.82	55.18	167.20	26.7		4.3	164.99
SCPT-C101	205	9.51	-7.45	-4.93				
SCPT-C101	200	16.08	7.97	52.29	8.2		4.5	156.75
SCPT-C101	150	22.64	4.23	24.43	18.4		3.5	201.89
SCPT-C101	150	29.20	10.62	40.23	18.7		3.3	215.74
SCPT-C101	200	35.76	17.15	80.82	18.5		3.1	227.52
SCPT-C101	150	42.36	23.04	23.96	18.8			
SCPT-C101	100	48.88	29.79	30.48	18.7			
SCPT-C101	685	55.45	1.76	24.40	34.8			
SCPT-C101	570	62.01	24.34	31.34	35.4			
SCPT-C102	200	9.78	-5.16	2.28	10.3			
SCPT-C102	710	16.34	-0.25	0.21				
SCPT-C102	200	22.87	5.00	7.76				
SCPT-C102	150	29.43	-1.25	-0.02				
SCPT-C102	200	35.99	1.16	4.47	34.7			
SCPT-C102	200	42.55	7.82	32.75	34.8		4.1	169.82
SCPT-C102	200	49.11	14.43	39.46	34.6		3.1	225.83

SCPT-C102	200	55.68	20.95	45.08	34.7		2.9	241.28
SCPT-C102	250	62.24	27.52	28.39	34.7			
SCPT-C102	275	68.80	34.27	64.89	34.4		3.1	229.07
SCPT-C102	300	75.36	40.91	78.53	34.5		3.4	206.98
SCPT-C102	275	81.92	47.68	104.45	34.3		4.5	155.04
SCPT-C102	300	88.48	55.03	125.36	34.4		7.3	96.58
SCPT-C102	250	95.05	42.61	66.86	46.5			
SCPT-C102	500	101.64	57.73	147.99		46.3	77.5	9.06
SCPT-C102	175	108.17	54.60	65.51	47.0			
SCPT-C102	540	109.68	61.74	146.33	46.3			
SCPT-C103	145	5.91	-0.23	11.15				
SCPT-C103	150	9.15	-6.44	-0.97				
SCPT-C103	125	12.14	1.05	10.21	11.1			
SCPT-C103	150	15.35	4.34	14.94	10.9			
SCPT-C103	300	22.47	10.86	68.17	11.7		6.8	102.92
SCPT-C103	200	29.04	17.16	60.28	11.9			
SCPT-C103	150	35.60	23.05	35.02	12.6			
SCPT-C103	150	42.16	29.38	73.45	12.7			
SCPT-C103	150	48.72	35.78	67.84	12.9			
SCPT-C103	250	55.28	42.08	146.35	13.0			
SCPT-C103	250	61.84	48.67	131.42	13.4		3.2	219.45
SCPT-C103	350	68.44	16.40	43.43	25.0			
SCPT-C103	200	74.97	38.61	49.43	25.8			
SCPT-C103	80	80.02	37.16	53.98	26.6			
SCPT-C107A	200	29.07	8.98	29.37	19.9		5.3	133.16
SCPT-C107A	150	35.63	15.48	24.67	20.2		3.5	202.14
SCPT-C107A	200	42.19	-23.75	20.01	22.6			
SCPT-C107A	200	48.79	4.82	15.09	33.7			
SCPT-C107A	2480	55.31	2.02	20.33	35.1			
SCPT-C107A	200	61.88	21.98	37.95				

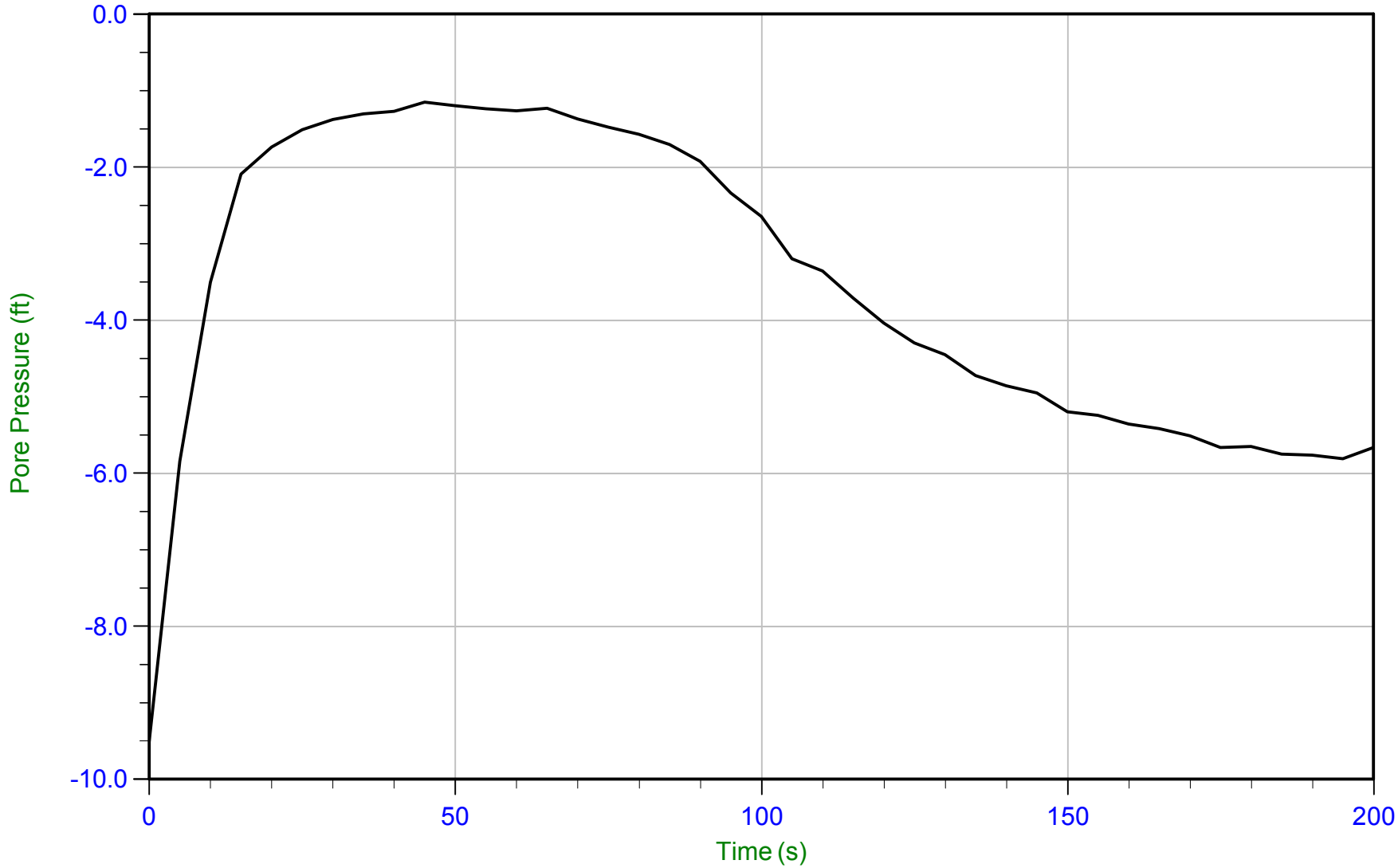
16,355	sec.
4.54	hr.

CONETEC

Haley & Aldrich

Job No: 14-53069
Date: 09/23/2014 14:48
Site: Rush Island

Sounding: SCPT-C100
Cone: 268:T1500F15U500
Cone Area: 15 sq cm



Trace Summary:

Filename: 14-53069_SP100.PPD
Depth: 2.950 m / 9.678 ft
Duration: 200.0 s

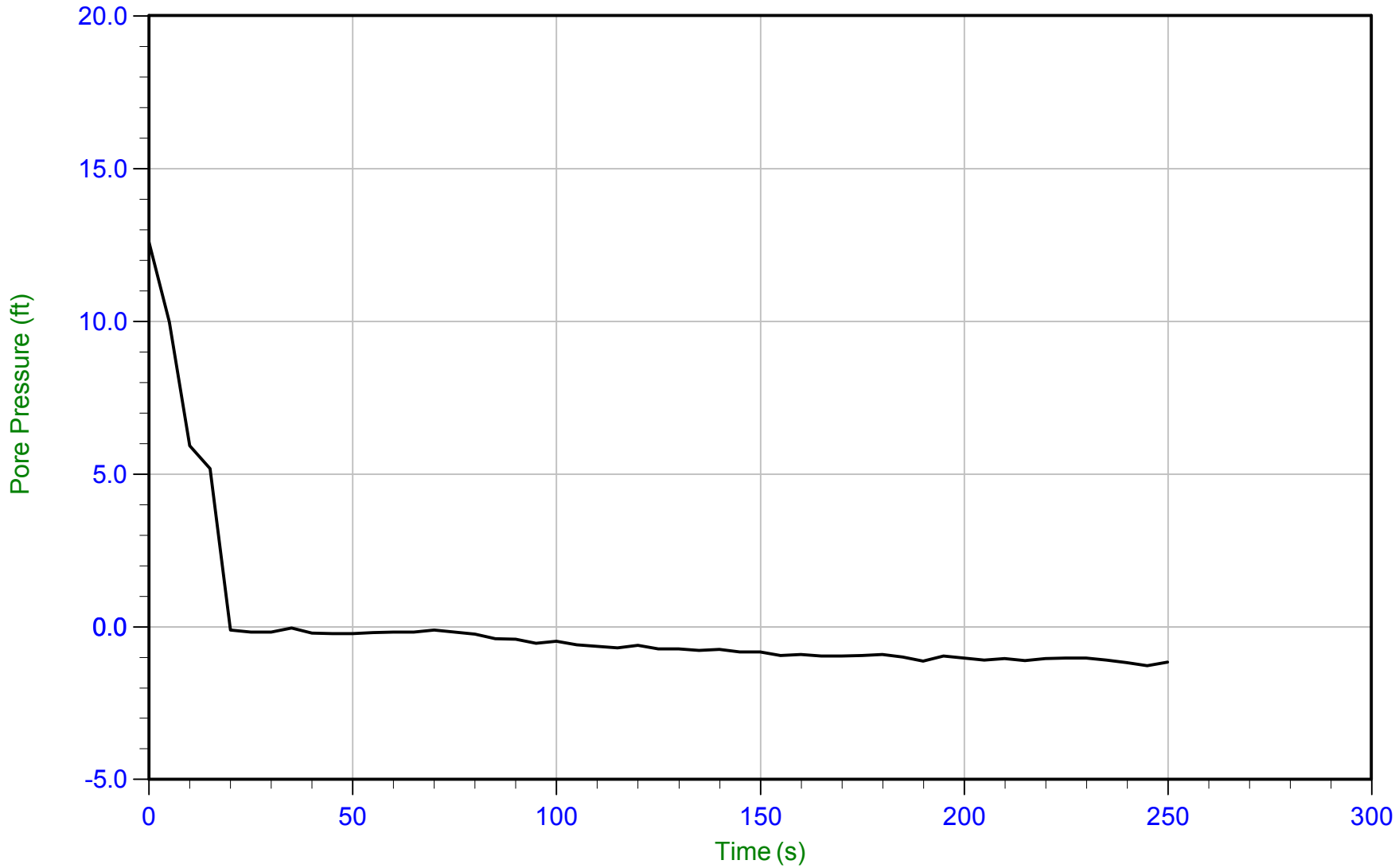
U Min: -9.5 ft
U Max: -1.1 ft

CONETEC

Haley & Aldrich

Job No: 14-53069
Date: 09/23/2014 14:48
Site: Rush Island

Sounding: SCPT-C100
Cone: 268:T1500F15U500
Cone Area: 15 sq cm



Trace Summary:

Filename: 14-53069_SP100.PPD
Depth: 4.950 m / 16.240 ft
Duration: 250.0 s

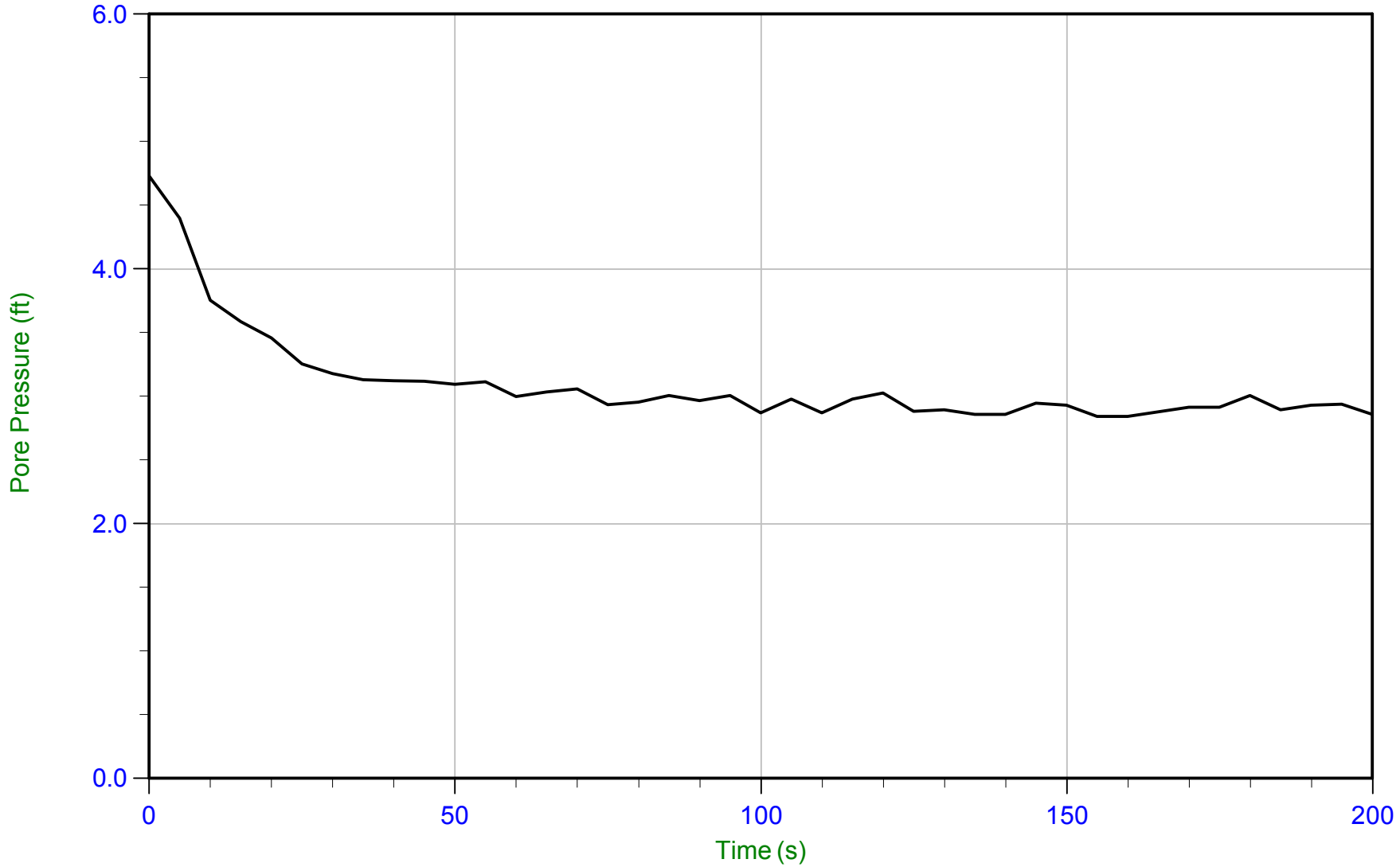
U Min: -1.3 ft
U Max: 12.6 ft

CONETEC

Haley & Aldrich

Job No: 14-53069
Date: 09/23/2014 14:48
Site: Rush Island

Sounding: SCPT-C100
Cone: 268:T1500F15U500
Cone Area: 15 sq cm



Trace Summary:

Filename: 14-53069_SP100.PPD
Depth: 6.960 m / 22.834 ft
Duration: 200.0 s

U Min: 2.8 ft
U Max: 4.7 ft

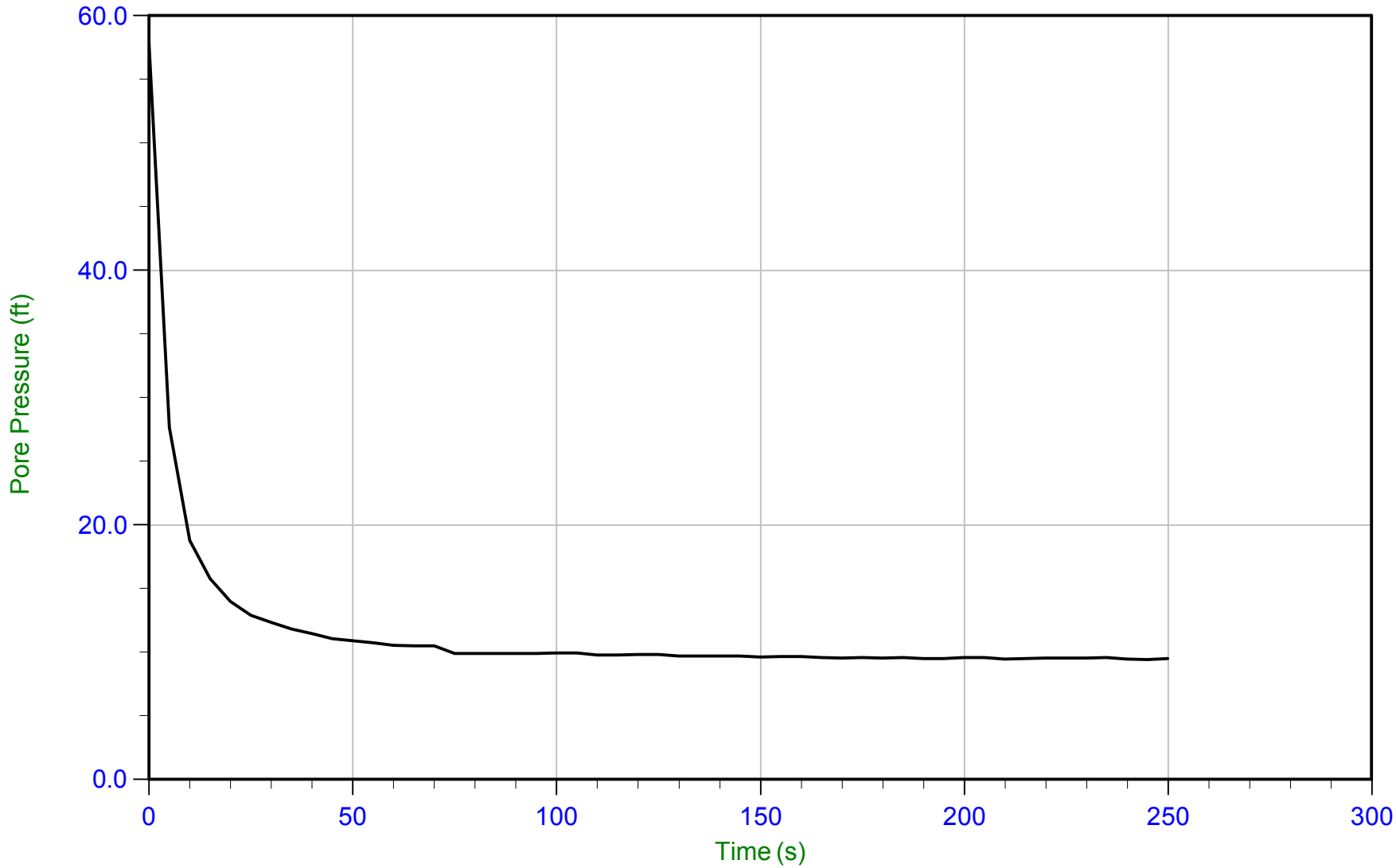
WT: 6.069 m / 19.911 ft
Ueq: 2.9 ft

CONETEC

Haley & Aldrich

Job No: 14-53069
Date: 09/23/2014 14:48
Site: Rush Island

Sounding: SCPT-C100
Cone: 268:T1500F15U500
Cone Area: 15 sq cm



Trace Summary:

Filename: 14-53069_SP100.PPD
Depth: 8.950 m / 29.363 ft
Duration: 250.0 s

U Min: 9.4 ft
U Max: 57.8 ft

WT: 6.048 m / 19.842 ft
Ueq: 9.5 ft
U(50): 33.67 ft

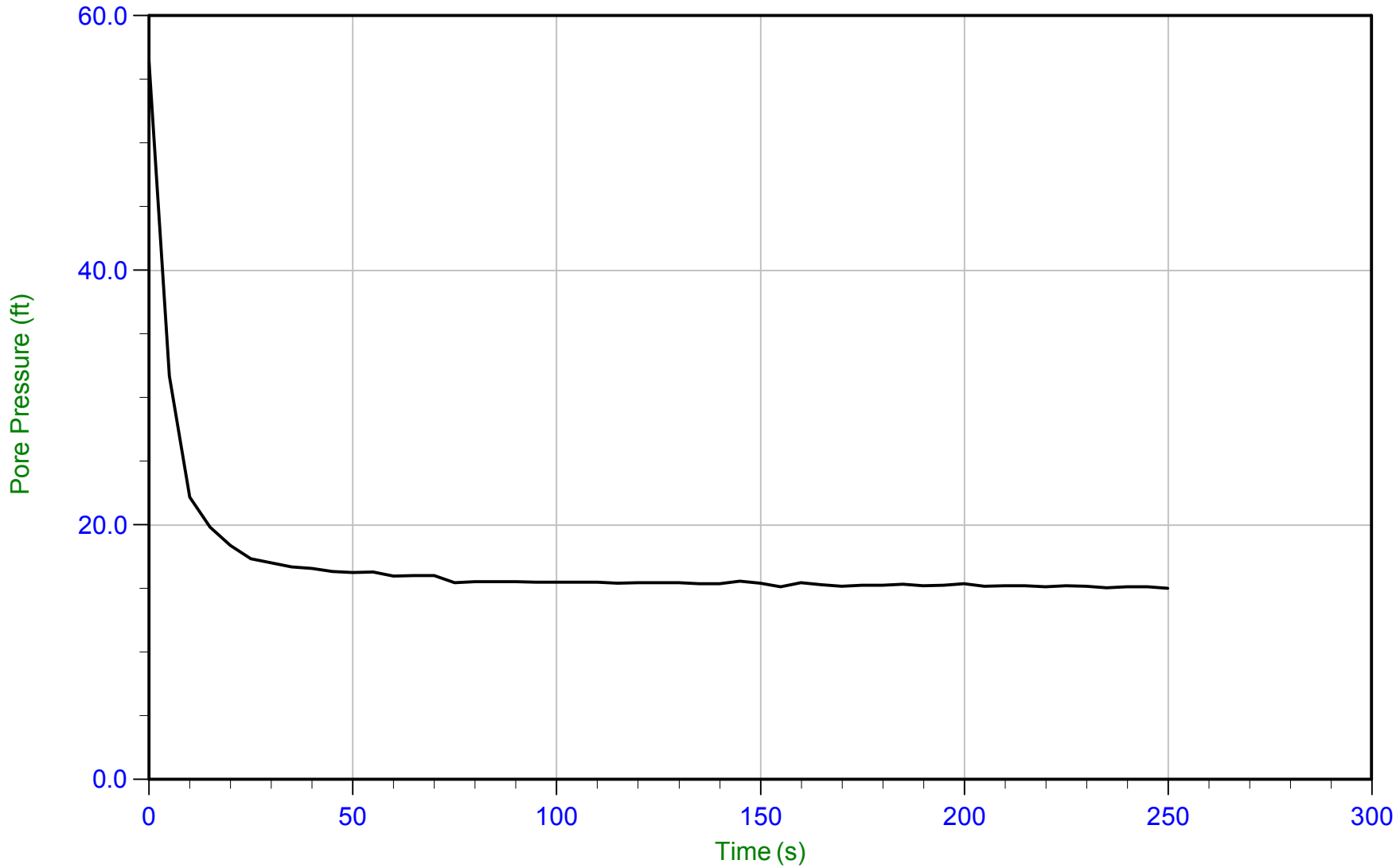
T(50): 4.0 s
Ir: 100
Ch: 175.3 sq cm/min

CONETEC

Haley & Aldrich

Job No: 14-53069
Date: 09/23/2014 14:48
Site: Rush Island

Sounding: SCPT-C100
Cone: 268:T1500F15U500
Cone Area: 15 sq cm



Trace Summary:

Filename: 14-53069_SP100.PPD
Depth: 10.880 m / 35.695 ft
Duration: 250.0 s

U Min: 15.0 ft
U Max: 56.4 ft

WT: 6.224 m / 20.420 ft
Ueq: 15.3 ft
U(50): 35.85 ft

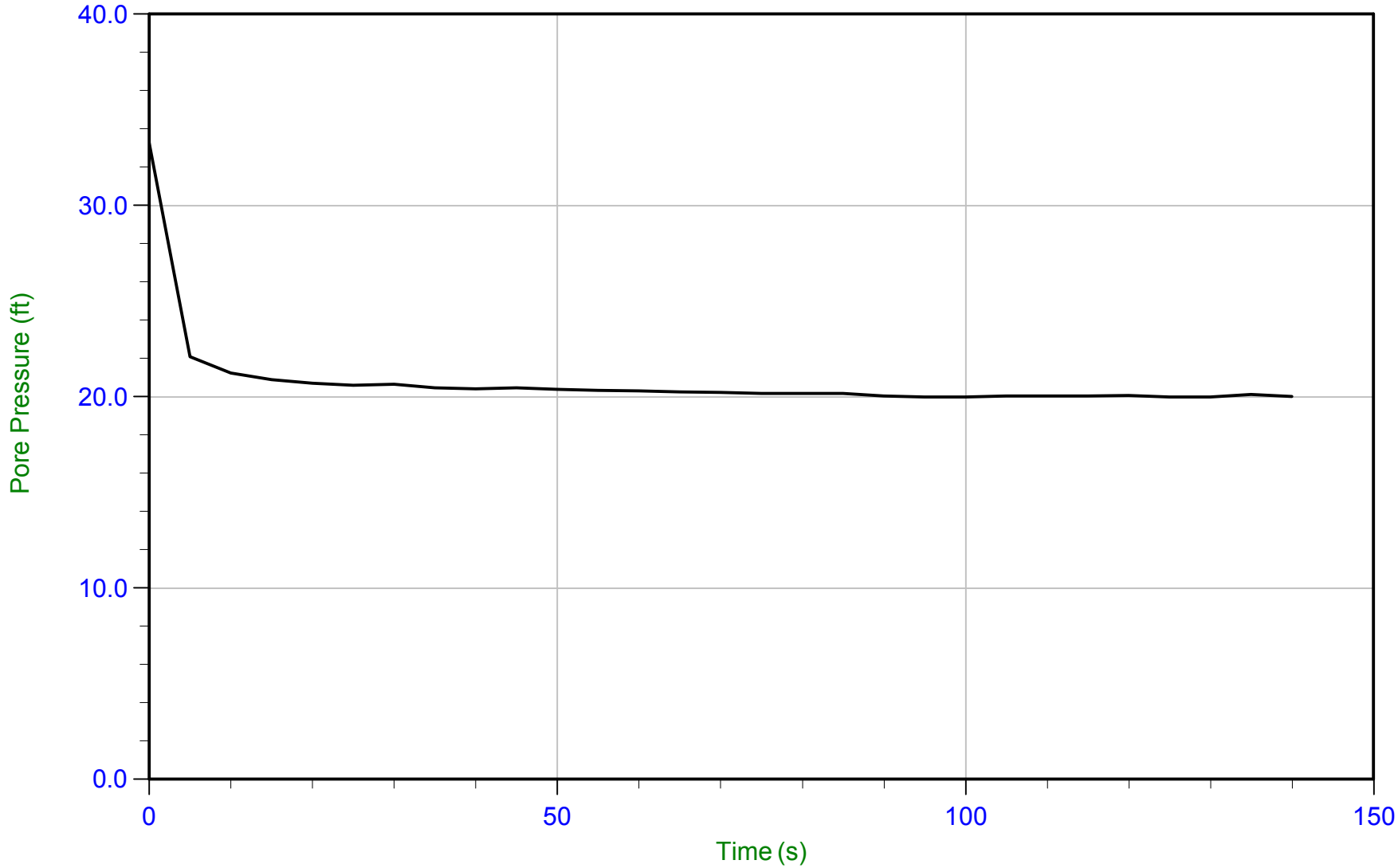
T(50): 4.2 s
Ir: 100
Ch: 168.6 sq cm/min

CONETEC

Haley & Aldrich

Job No: 14-53069
Date: 09/23/2014 14:48
Site: Rush Island

Sounding: SCPT-C100
Cone: 268:T1500F15U500
Cone Area: 15 sq cm



Trace Summary:

Filename: 14-53069_SP100.PPD
Depth: 12.760 m / 41.863 ft
Duration: 140.0 s

U Min: 20.0 ft
U Max: 33.3 ft

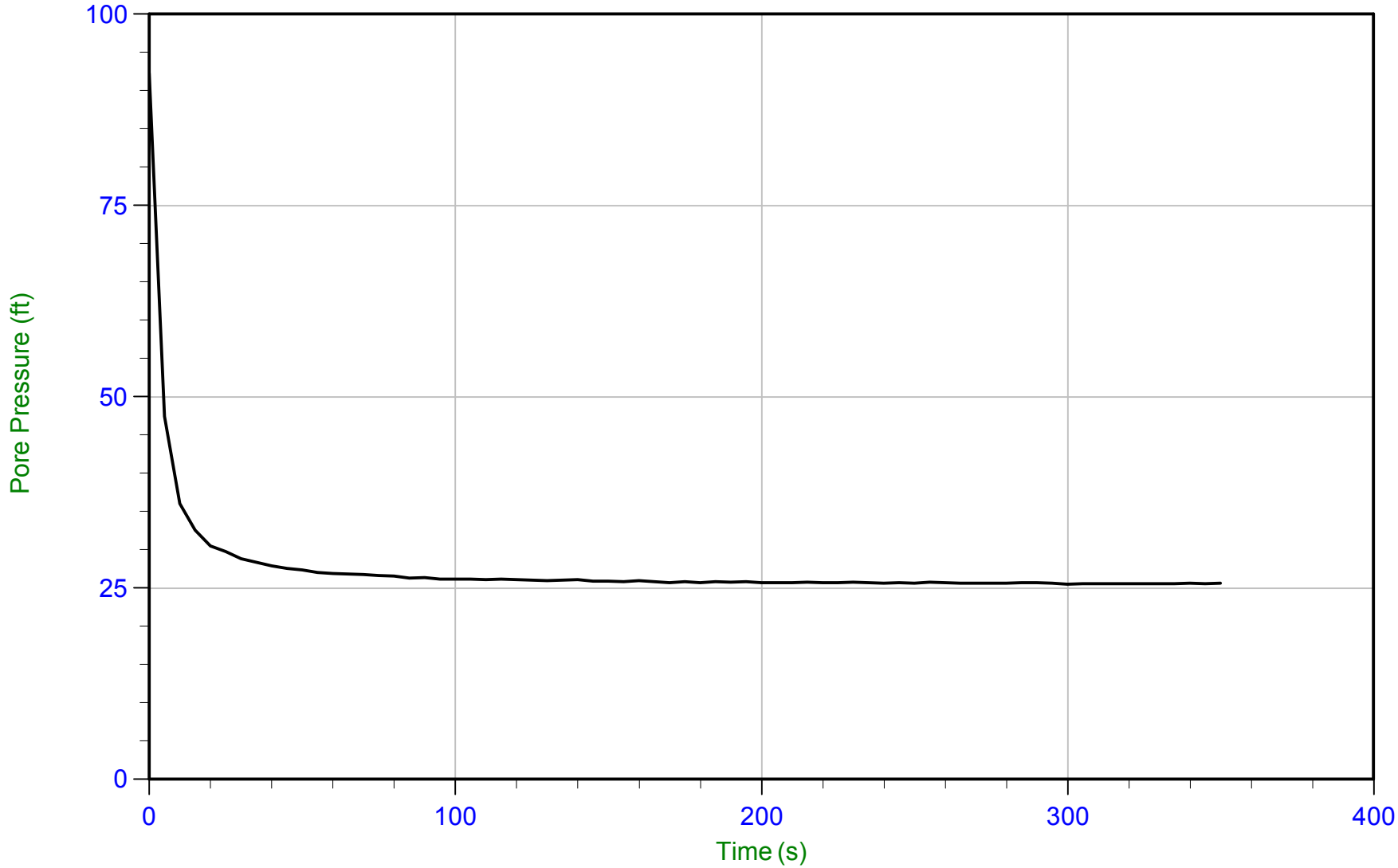
WT: 6.686 m / 21.935 ft
Ueq: 19.9 ft

CONETEC

Haley & Aldrich

Job No: 14-53069
Date: 09/23/2014 14:48
Site: Rush Island

Sounding: SCPT-C100
Cone: 268:T1500F15U500
Cone Area: 15 sq cm



Trace Summary:

Filename: 14-53069_SP100.PPD
Depth: 14.640 m / 48.031 ft
Duration: 350.0 s

U Min: 25.5 ft
U Max: 92.3 ft

WT: 6.879 m / 22.569 ft
Ueq: 25.5 ft
U(50): 58.87 ft

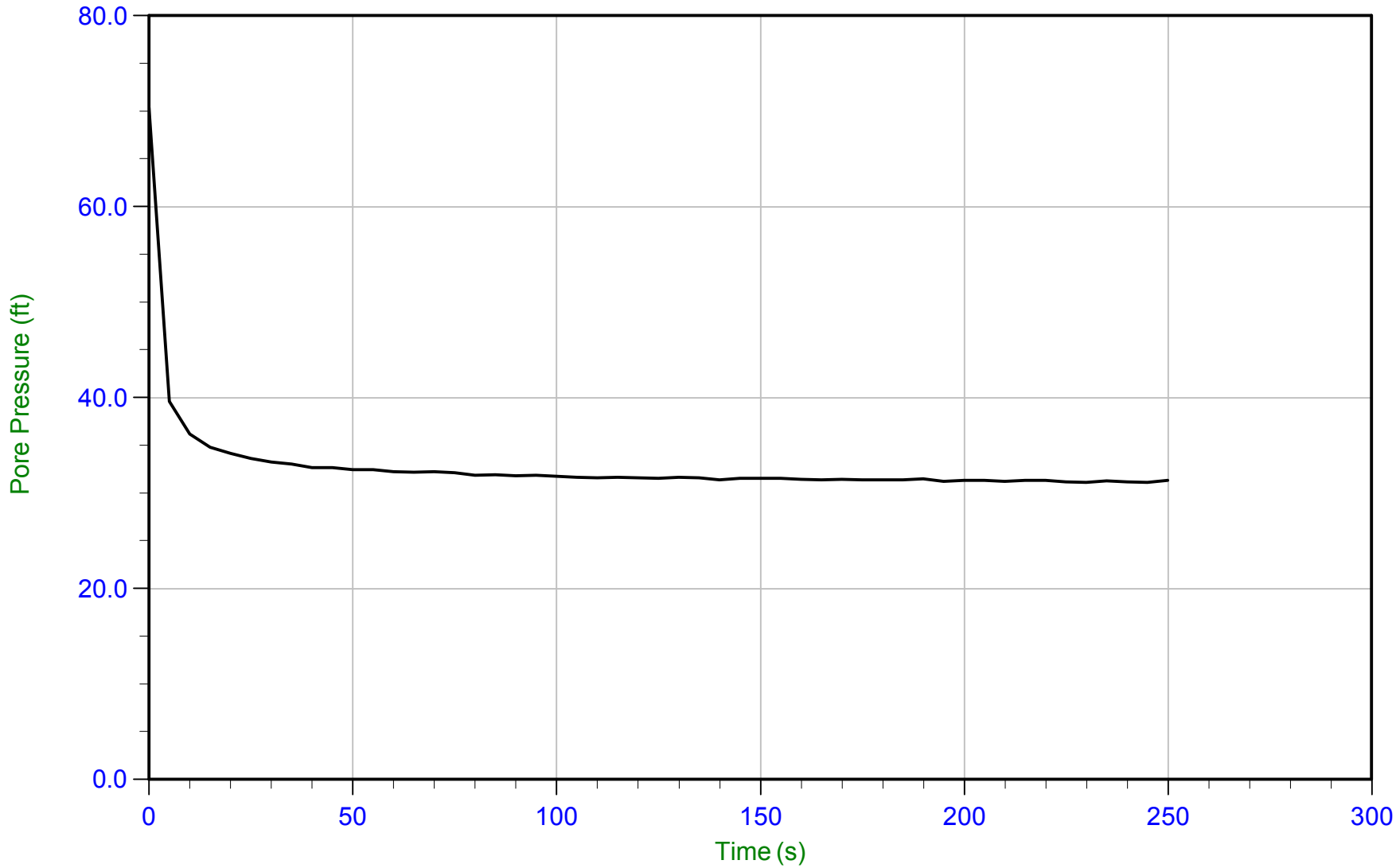
T(50): 3.7 s
Ir: 100
Ch: 188.4 sq cm/min

CONETEC

Haley & Aldrich

Job No: 14-53069
Date: 09/23/2014 14:48
Site: Rush Island

Sounding: SCPT-C100
Cone: 268:T1500F15U500
Cone Area: 15 sq cm



Trace Summary:

Filename: 14-53069_SP100.PPD
Depth: 16.670 m / 54.691 ft
Duration: 250.0 s

U Min: 31.1 ft
U Max: 70.4 ft

WT: 7.222 m / 23.694 ft
Ueq: 31.0 ft
U(50): 50.69 ft

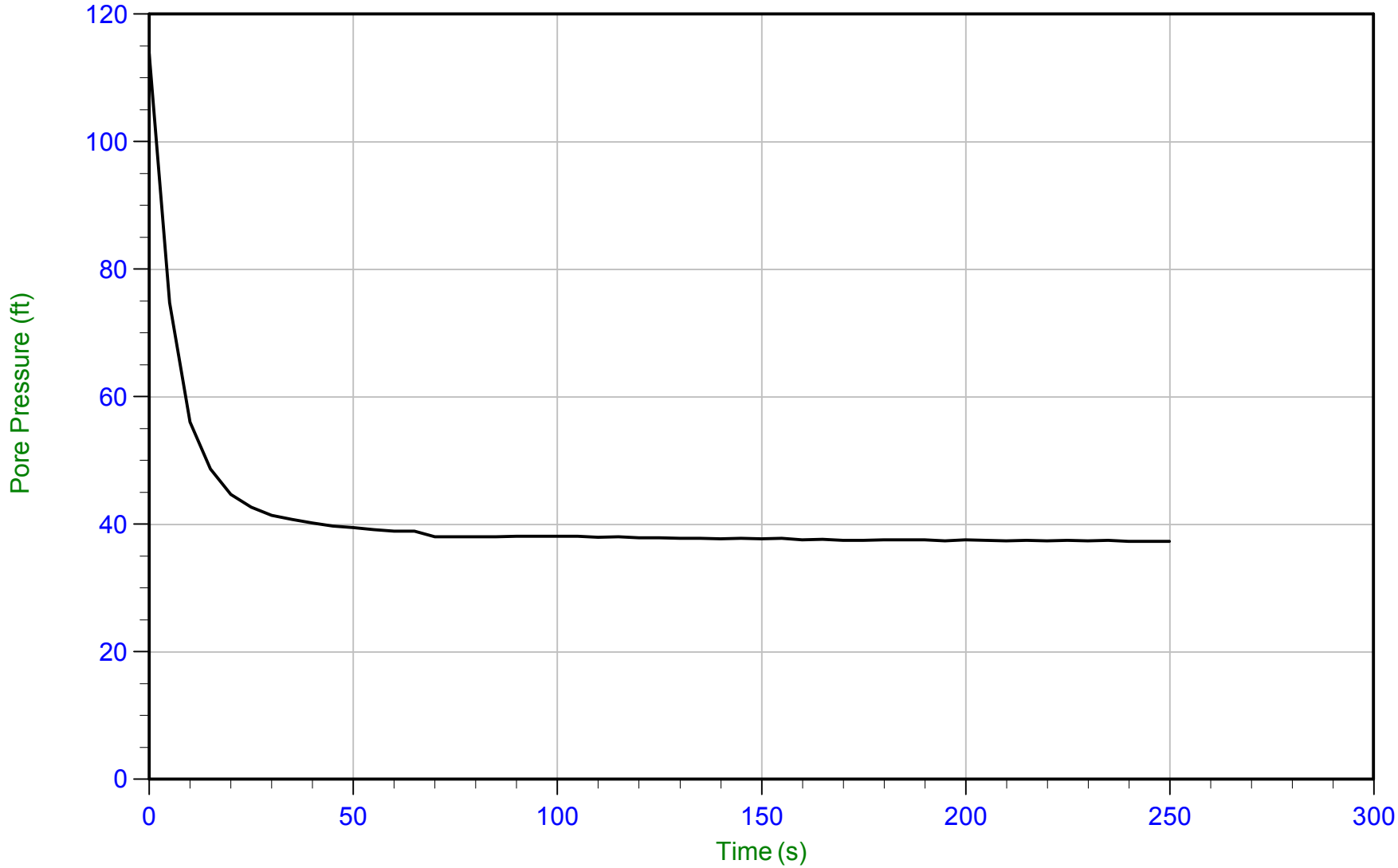
T(50): 3.2 s
Ir: 100
Ch: 219.3 sq cm/min

CONETEC

Haley & Aldrich

Job No: 14-53069
Date: 09/23/2014 14:48
Site: Rush Island

Sounding: SCPT-C100
Cone: 268:T1500F15U500
Cone Area: 15 sq cm



Trace Summary:

Filename: 14-53069_SP100.PPD
Depth: 18.730 m / 61.449 ft
Duration: 250.0 s

U Min: 37.3 ft
U Max: 113.8 ft

WT: 7.393 m / 24.255 ft
Ueq: 37.2 ft
U(50): 75.49 ft

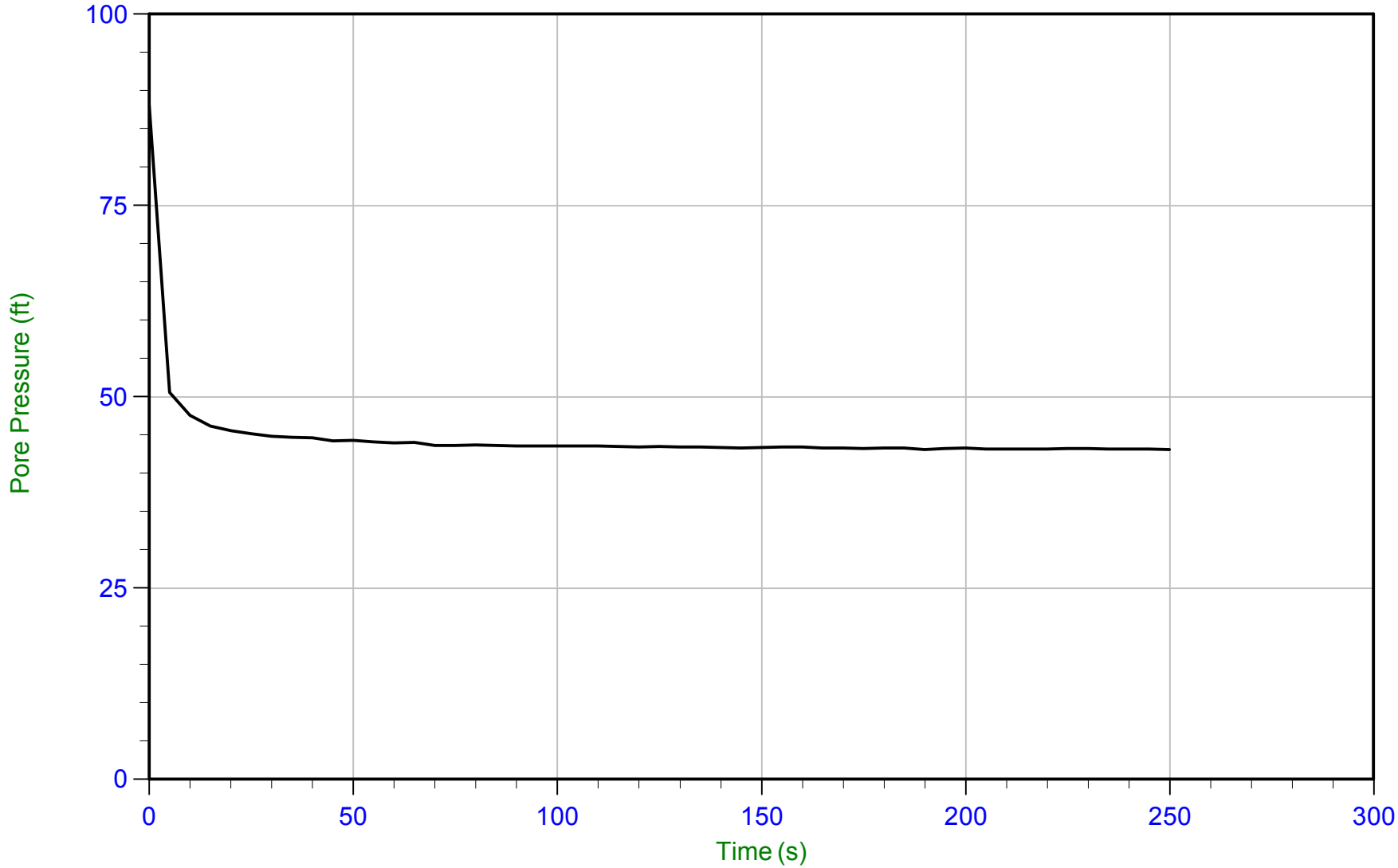
T(50): 4.9 s
Ir: 100
Ch: 143.2 sq cm/min

CONETEC

Haley & Aldrich

Job No: 14-53069
Date: 09/23/2014 14:48
Site: Rush Island

Sounding: SCPT-C100
Cone: 268:T1500F15U500
Cone Area: 15 sq cm



Trace Summary:

Filename: 14-53069_SP100.PPD
Depth: 20.800 m / 68.241 ft
Duration: 250.0 s

U Min: 43.1 ft
U Max: 88.1 ft

WT: 7.641 m / 25.069 ft
Ueq: 43.2 ft
U(50): 65.64 ft

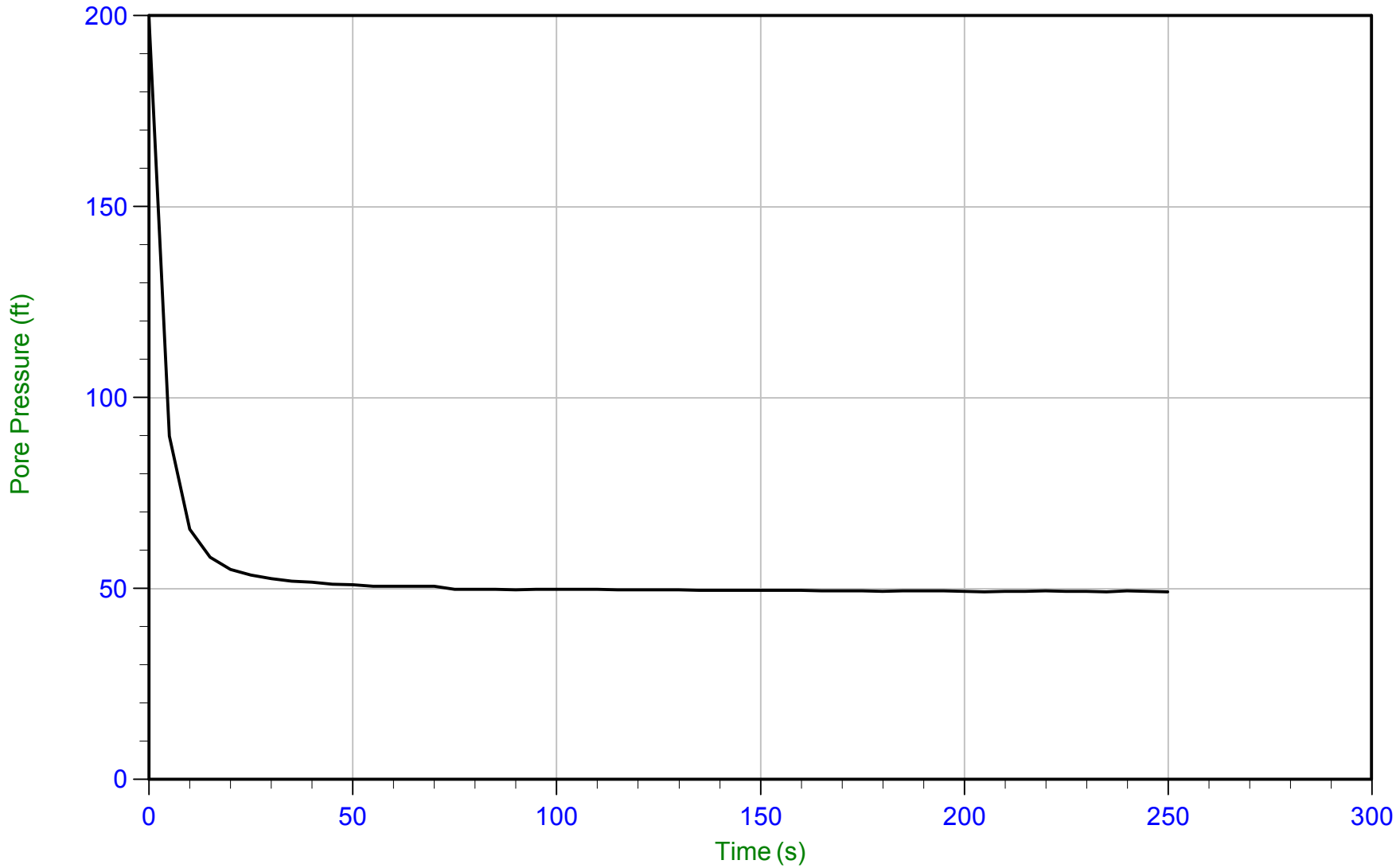
T(50): 3.0 s
Ir: 100
Ch: 234.6 sq cm/min

CONETEC

Haley & Aldrich

Job No: 14-53069
Date: 09/23/2014 14:48
Site: Rush Island

Sounding: SCPT-C100
Cone: 268:T1500F15U500
Cone Area: 15 sq cm



Trace Summary:

Filename: 14-53069_SP100.PPD
Depth: 22.890 m / 75.098 ft
Duration: 250.0 s

U Min: 49.2 ft
U Max: 199.4 ft

WT: 7.819 m / 25.653 ft
Ueq: 49.4 ft
U(50): 124.42 ft

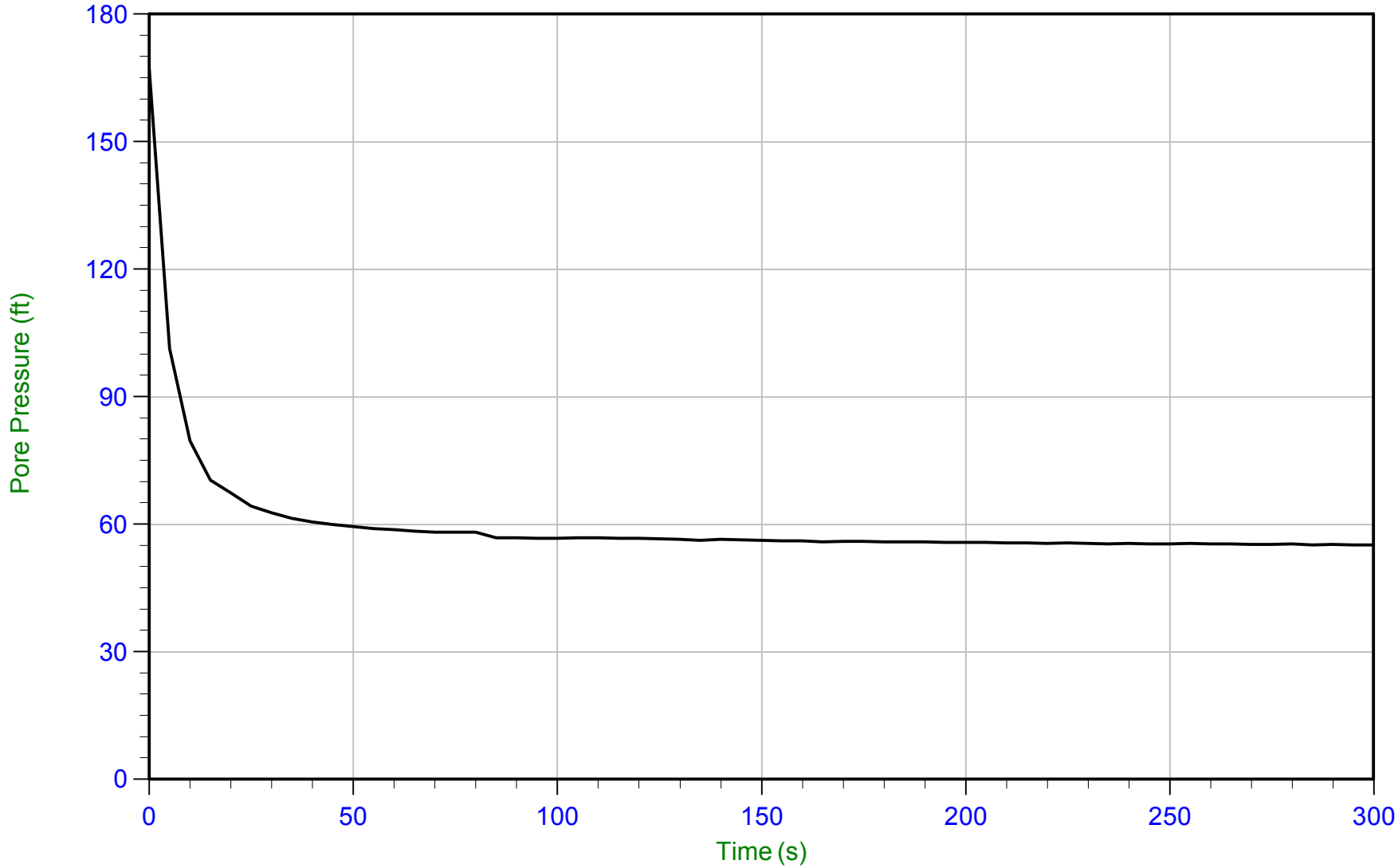
T(50): 3.4 s
Ir: 100
Ch: 204.9 sq cm/min

CONETEC

Haley & Aldrich

Job No: 14-53069
Date: 09/23/2014 14:48
Site: Rush Island

Sounding: SCPT-C100
Cone: 268:T1500F15U500
Cone Area: 15 sq cm



Trace Summary:

Filename: 14-53069_SP100.PPD
Depth: 24.940 m / 81.823 ft
Duration: 300.0 s

U Min: 55.2 ft
U Max: 167.2 ft

WT: 8.137 m / 26.696 ft
Ueq: 55.1 ft
U(50): 111.16 ft

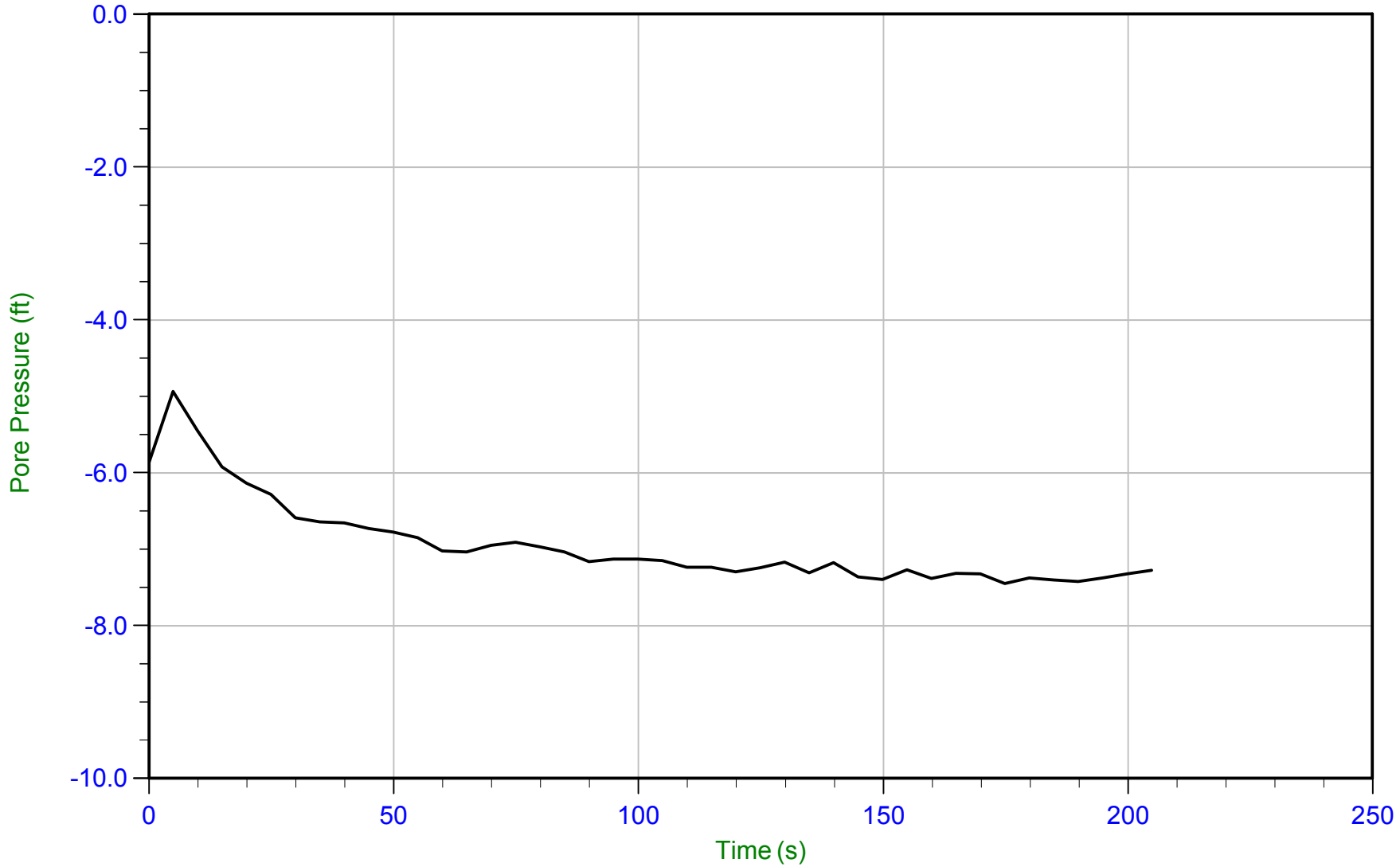
T(50): 4.3 s
Ir: 100
Ch: 165.0 sq cm/min

CONETEC

Haley & Aldrich

Job No: 14-53069
Date: 09/27/2014 07:58
Site: Rush Island

Sounding: SCPT-C101
Cone: 268:T1500F15U500
Cone Area: 15 sq cm



Trace Summary:

Filename: 14-53069_SP101.PPD
Depth: 2.900 m / 9.514 ft
Duration: 205.0 s

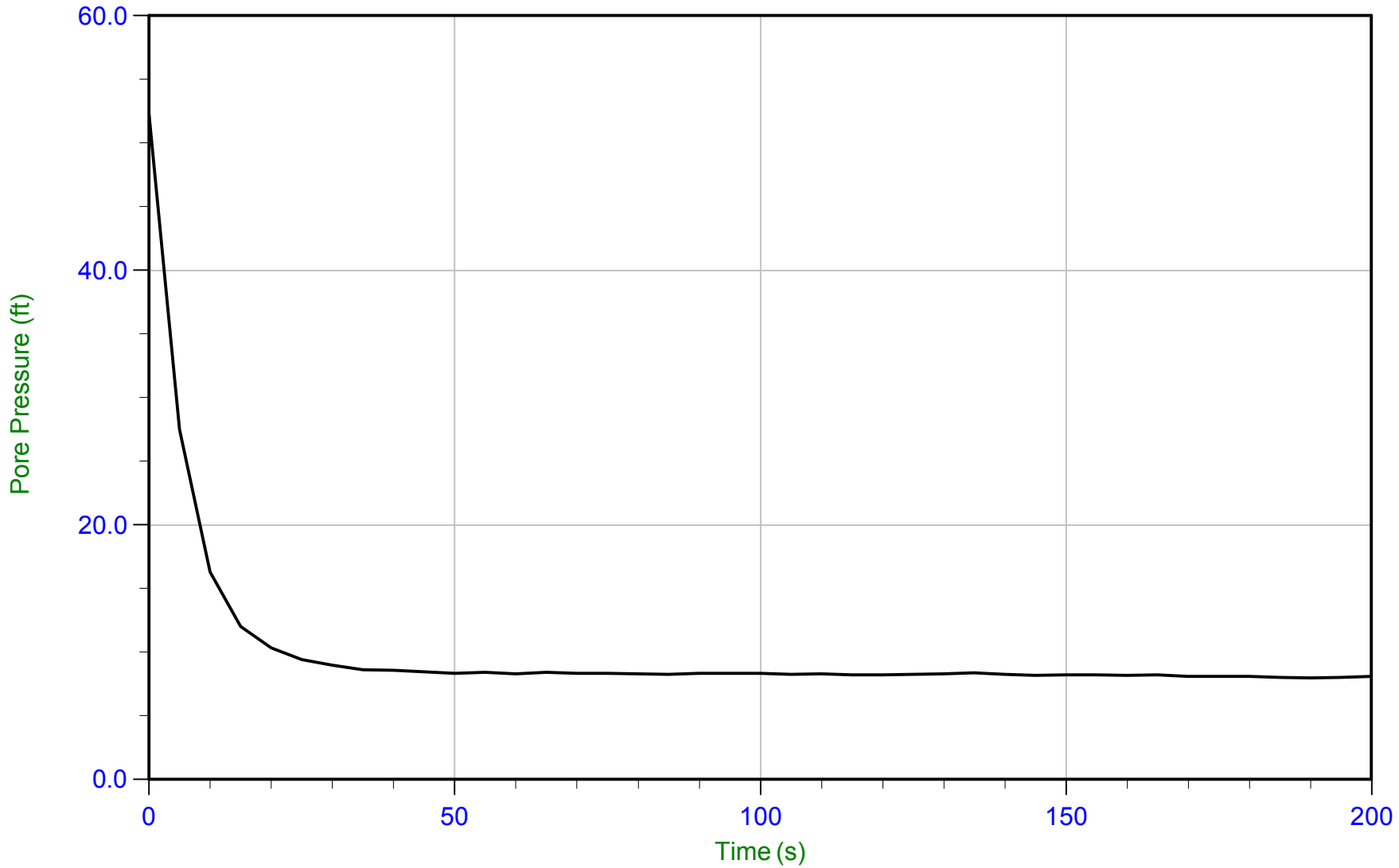
U Min: -7.4 ft
U Max: -4.9 ft

CONETEC

Haley & Aldrich

Job No: 14-53069
Date: 09/27/2014 07:58
Site: Rush Island

Sounding: SCPT-C101
Cone: 268:T1500F15U500
Cone Area: 15 sq cm



Trace Summary:

Filename: 14-53069_SP101.PPD
Depth: 4.900 m / 16.076 ft
Duration: 200.0 s

U Min: 8.0 ft
U Max: 52.3 ft

WT: 2.494 m / 8.181 ft
Ueq: 7.9 ft
U(50): 30.09 ft

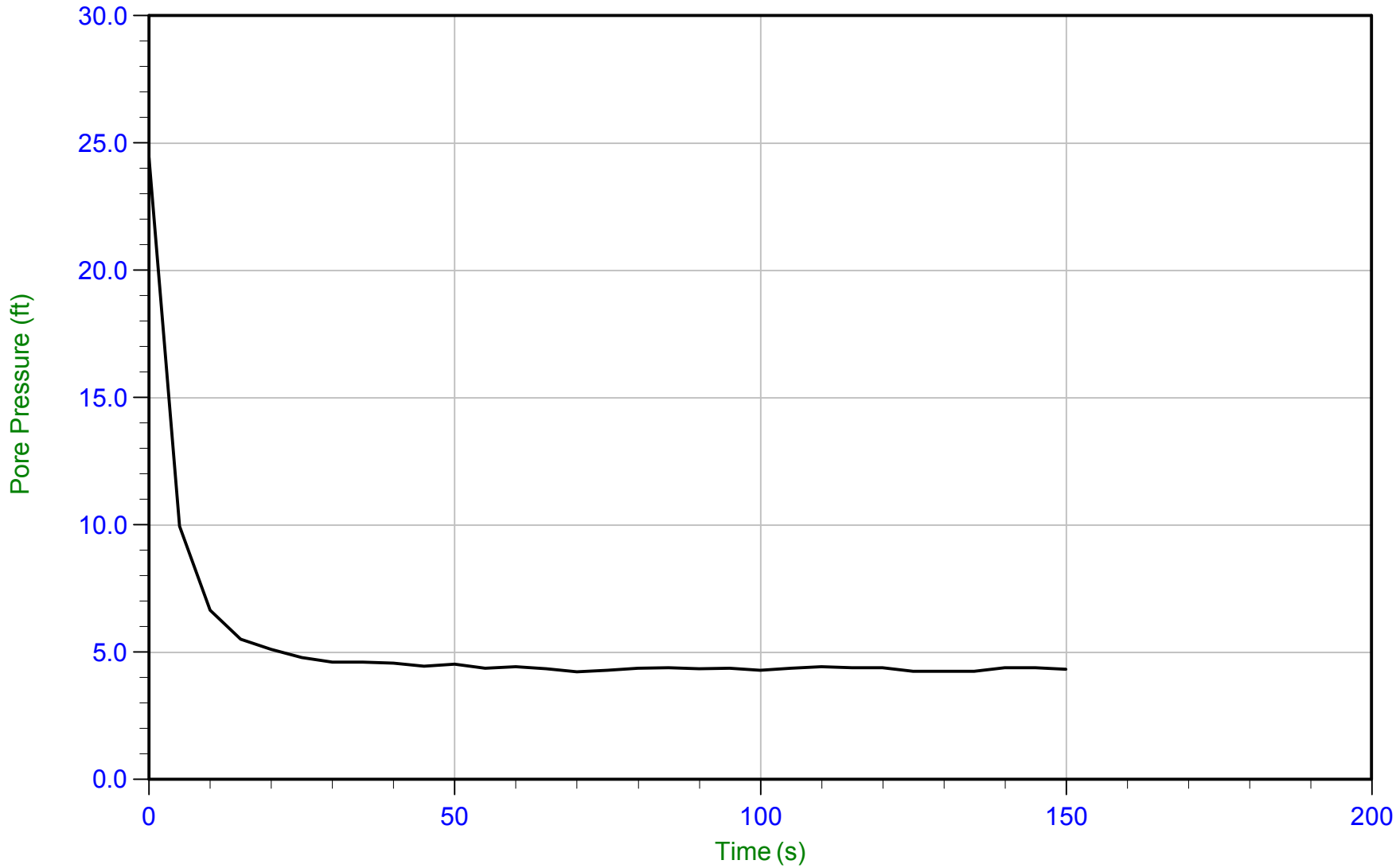
T(50): 4.5 s
Ir: 100
Ch: 156.7 sq cm/min

CONETEC

Haley & Aldrich

Job No: 14-53069
Date: 09/27/2014 07:58
Site: Rush Island

Sounding: SCPT-C101
Cone: 268:T1500F15U500
Cone Area: 15 sq cm



Trace Summary:

Filename: 14-53069_SP101.PPD
Depth: 6.900 m / 22.638 ft
Duration: 150.0 s

U Min: 4.2 ft
U Max: 24.4 ft

WT: 5.594 m / 18.352 ft
Ueq: 4.3 ft
U(50): 14.36 ft

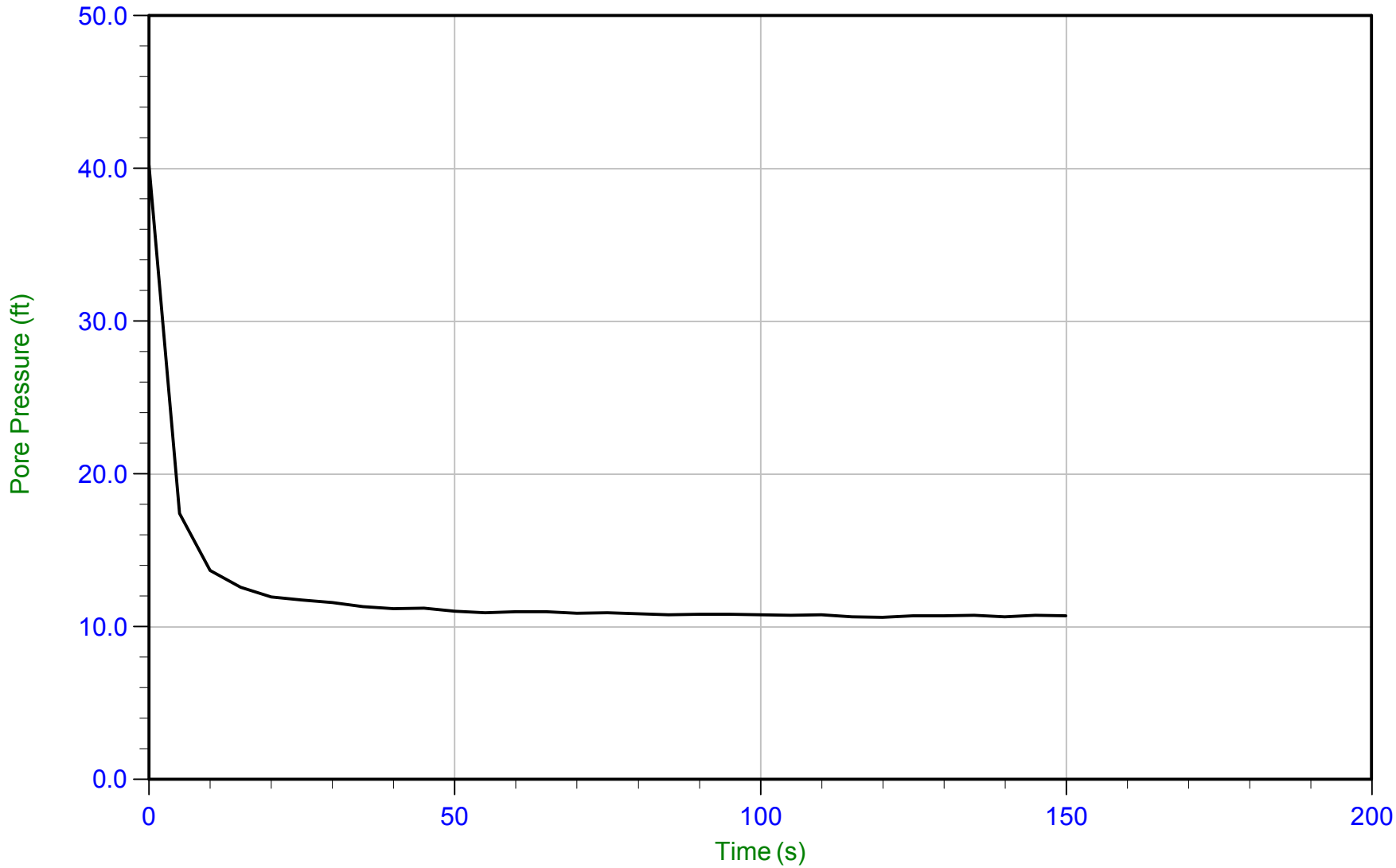
T(50): 3.5 s
Ir: 100
Ch: 201.9 sq cm/min

CONETEC

Haley & Aldrich

Job No: 14-53069
Date: 09/27/2014 07:58
Site: Rush Island

Sounding: SCPT-C101
Cone: 268:T1500F15U500
Cone Area: 15 sq cm



Trace Summary:

Filename: 14-53069_SP101.PPD
Depth: 8.900 m / 29.199 ft
Duration: 150.0 s

U Min: 10.6 ft
U Max: 40.2 ft

WT: 5.692 m / 18.673 ft
Ueq: 10.5 ft
U(50): 25.38 ft

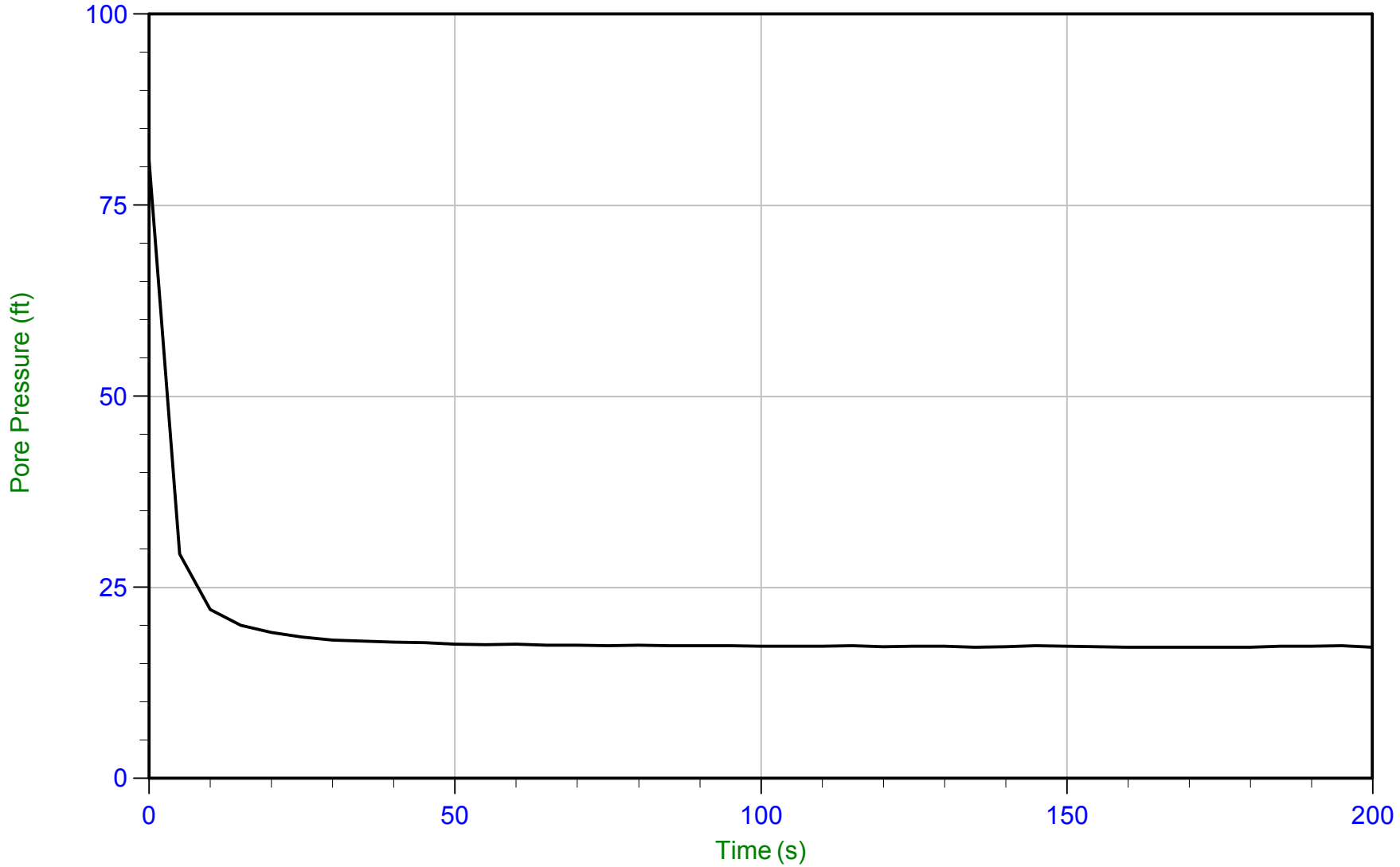
T(50): 3.3 s
Ir: 100
Ch: 215.7 sq cm/min

CONETEC

Haley & Aldrich

Job No: 14-53069
Date: 09/27/2014 07:58
Site: Rush Island

Sounding: SCPT-C101
Cone: 268:T1500F15U500
Cone Area: 15 sq cm



Trace Summary:

Filename: 14-53069_SP101.PPD
Depth: 10.900 m / 35.761 ft
Duration: 200.0 s

U Min: 17.2 ft
U Max: 80.8 ft

WT: 5.629 m / 18.468 ft
Ueq: 17.3 ft
U(50): 49.06 ft

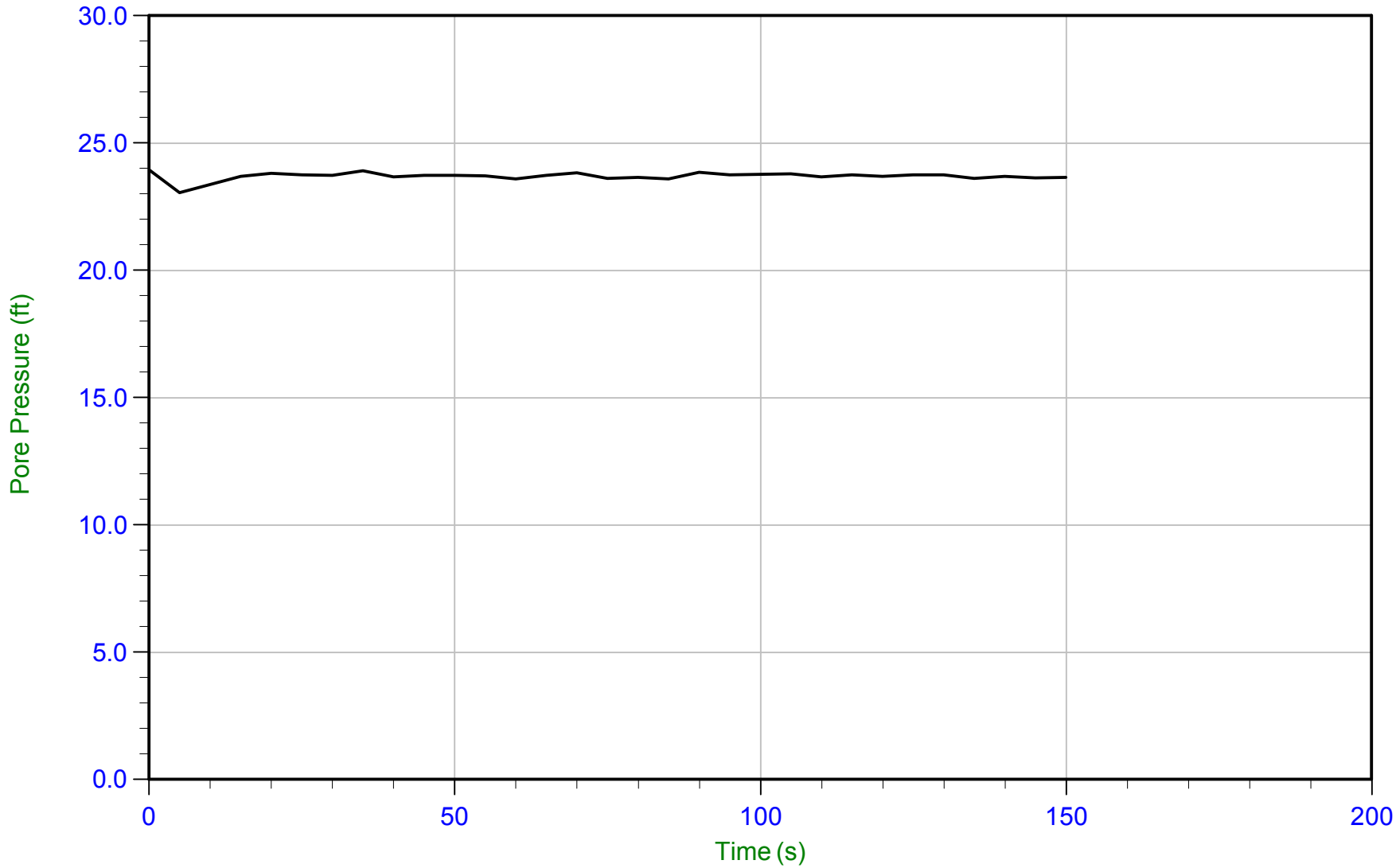
T(50): 3.1 s
Ir: 100
Ch: 227.5 sq cm/min

CONETEC

Haley & Aldrich

Job No: 14-53069
Date: 09/27/2014 07:58
Site: Rush Island

Sounding: SCPT-C101
Cone: 268:T1500F15U500
Cone Area: 15 sq cm



Trace Summary:

Filename: 14-53069_SP101.PPD
Depth: 12.910 m / 42.355 ft
Duration: 150.0 s

U Min: 23.0 ft
U Max: 24.0 ft

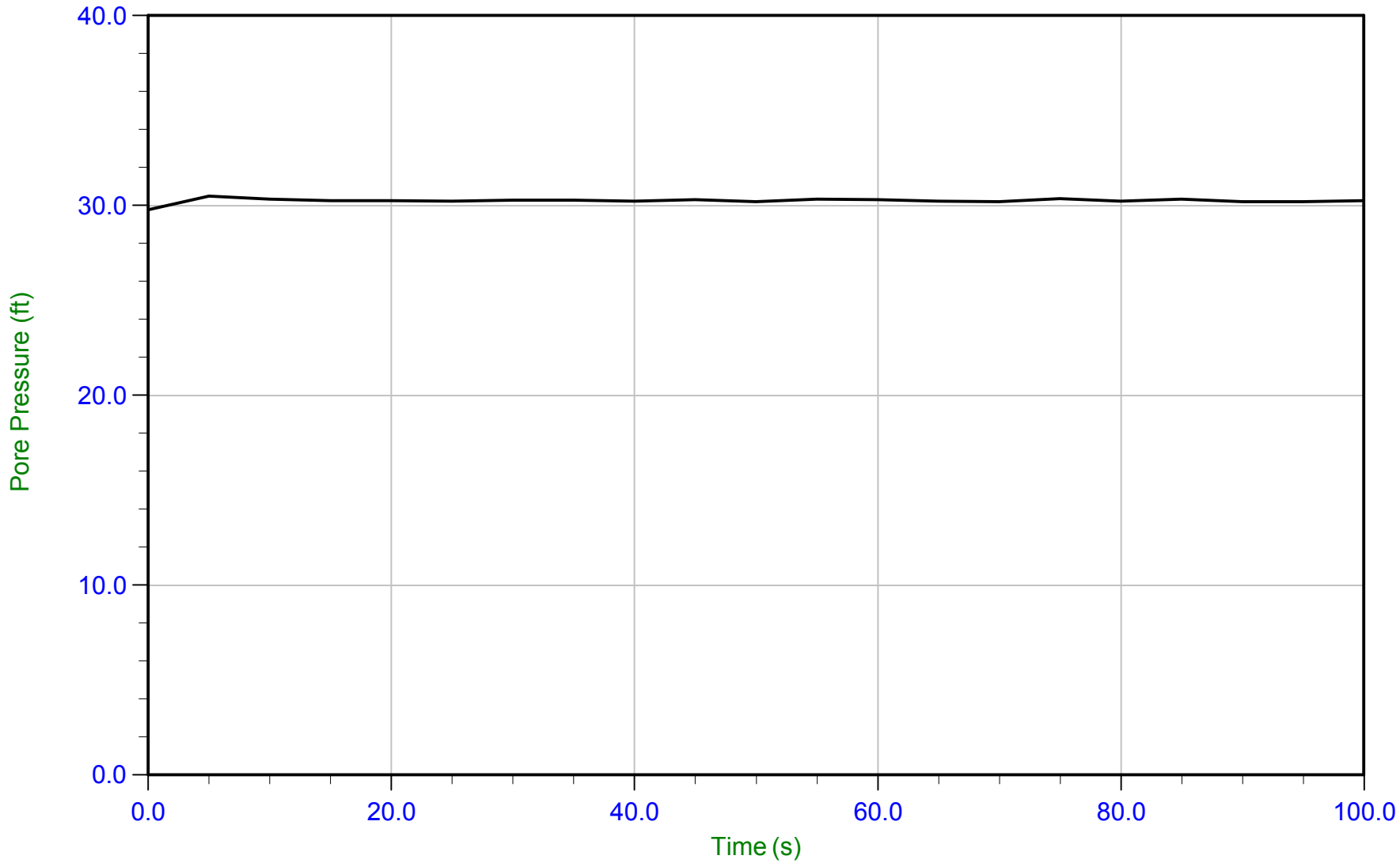
WT: 5.725 m / 18.784 ft
Ueq: 23.6 ft

CONETEC

Haley & Aldrich

Job No: 14-53069
Date: 09/27/2014 07:58
Site: Rush Island

Sounding: SCPT-C101
Cone: 268:T1500F15U500
Cone Area: 15 sq cm



Trace Summary:

Filename: 14-53069_SP101.PPD
Depth: 14.900 m / 48.884 ft
Duration: 100.0 s

U Min: 29.8 ft
U Max: 30.5 ft

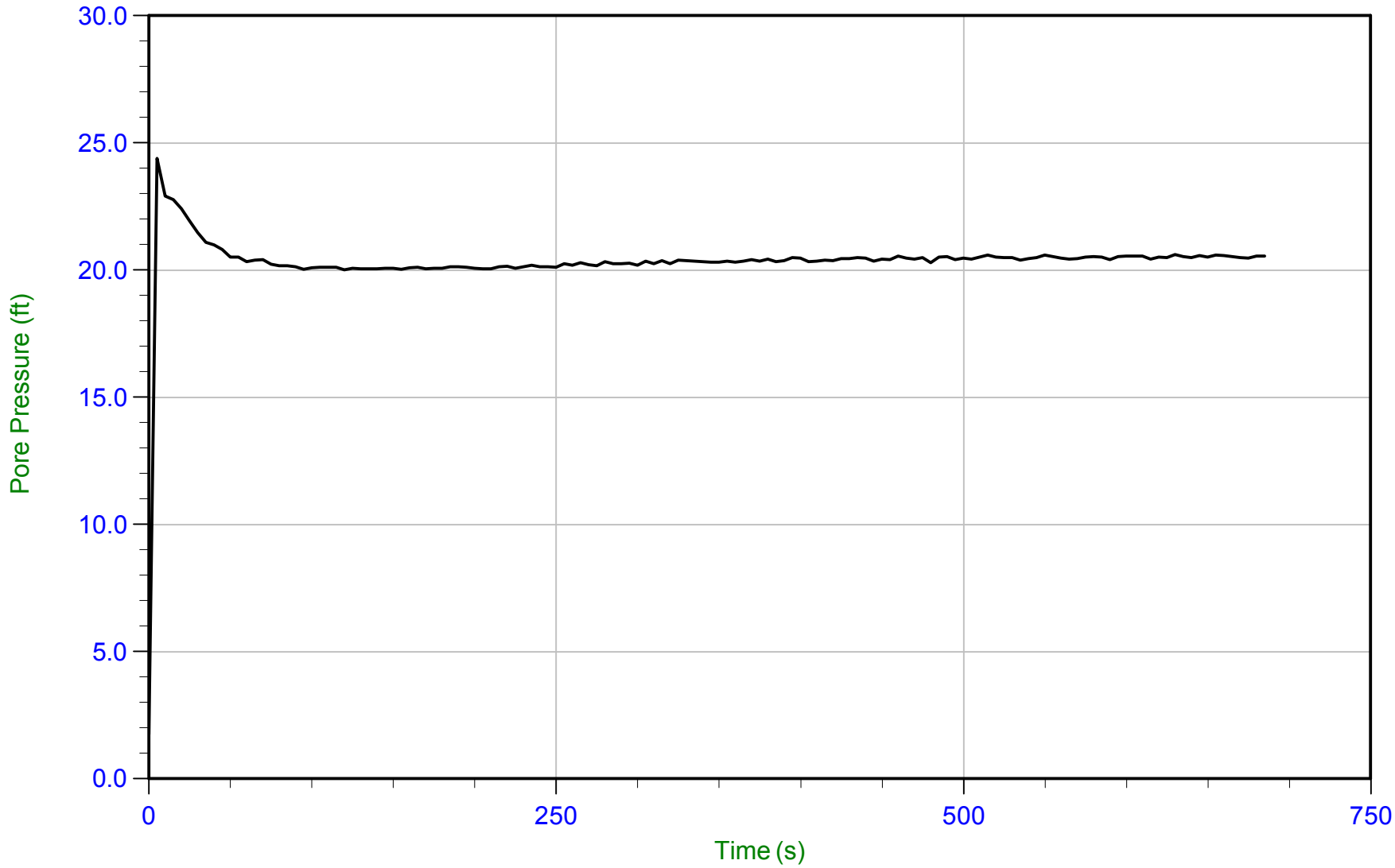
WT: 5.687 m / 18.659 ft
Ueq: 30.2 ft

CONETEC

Haley & Aldrich

Job No: 14-53069
Date: 09/27/2014 07:58
Site: Rush Island

Sounding: SCPT-C101
Cone: 268:T1500F15U500
Cone Area: 15 sq cm



Trace Summary:

Filename: 14-53069_SP101.PPD
Depth: 16.900 m / 55.446 ft
Duration: 685.0 s

U Min: 1.8 ft
U Max: 24.4 ft

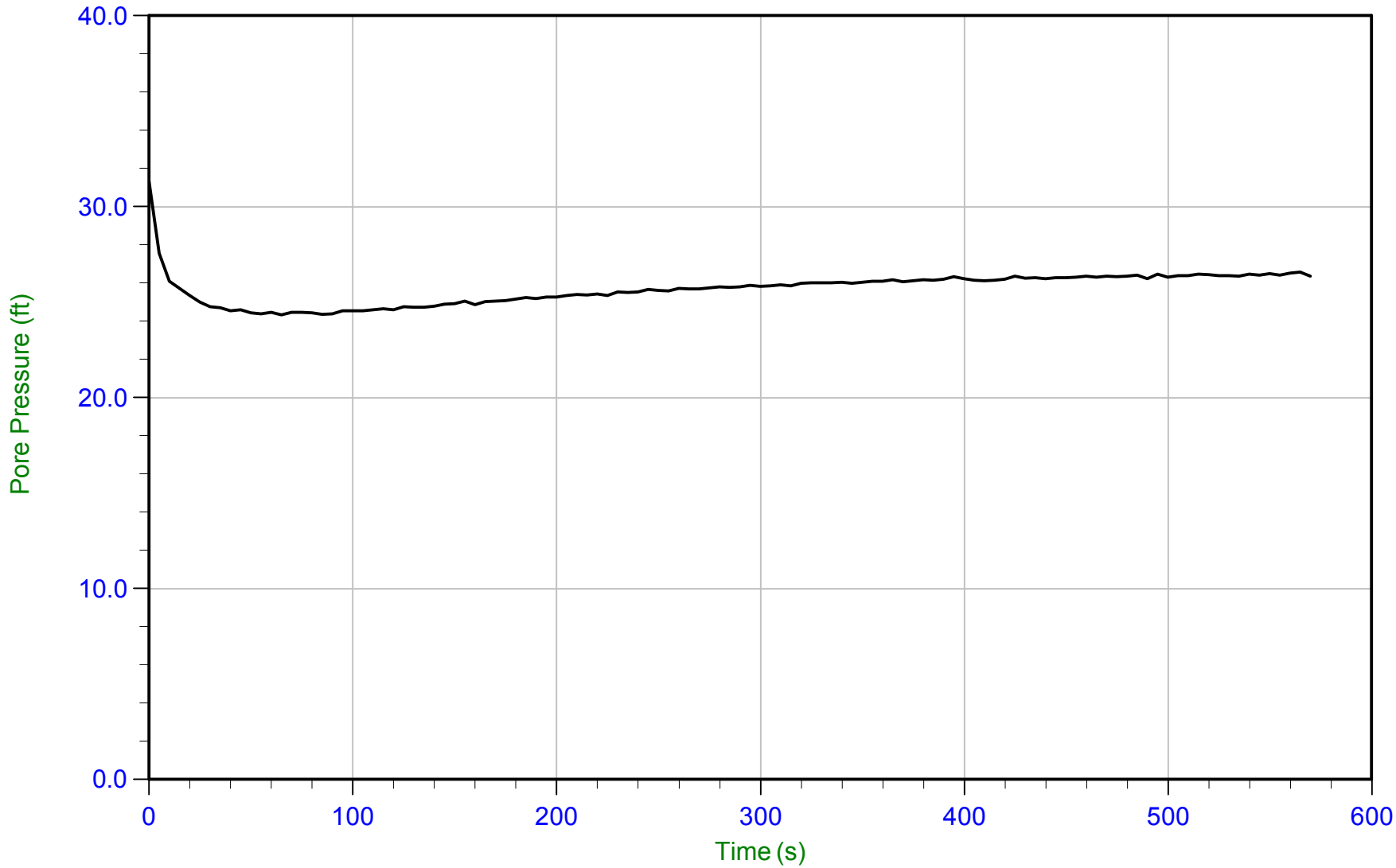
WT: 10.609 m / 34.807 ft
Ueq: 20.6 ft

CONETEC

Haley & Aldrich

Job No: 14-53069
Date: 09/27/2014 07:58
Site: Rush Island

Sounding: SCPT-C101
Cone: 268:T1500F15U500
Cone Area: 15 sq cm



Trace Summary:

Filename: 14-53069_SP101.PPD
Depth: 18.900 m / 62.007 ft
Duration: 570.0 s

U Min: 24.3 ft
U Max: 31.3 ft

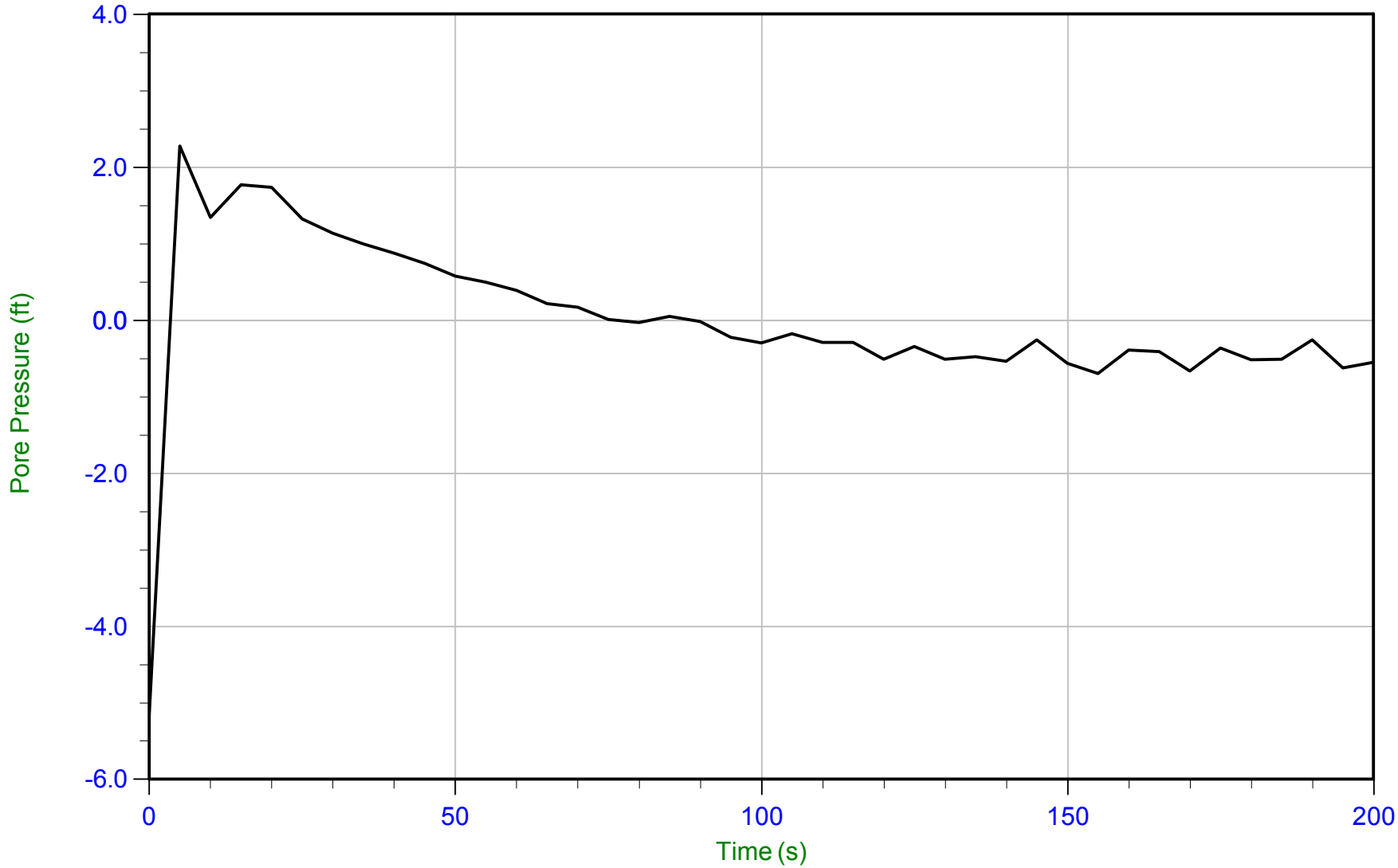
WT: 10.787 m / 35.391 ft
Ueq: 26.6 ft

CONETEC

Haley & Aldrich

Job No: 14-53069
Date: 09/25/2014 10:55
Site: Rush Island

Sounding: SCPT-C102
Cone: 268:T1500F15U500
Cone Area: 15 sq cm



Trace Summary:

Filename: 14-53069_SP102.PPD
Depth: 2.980 m / 9.777 ft
Duration: 200.0 s

U Min: -5.2 ft
U Max: 2.3 ft

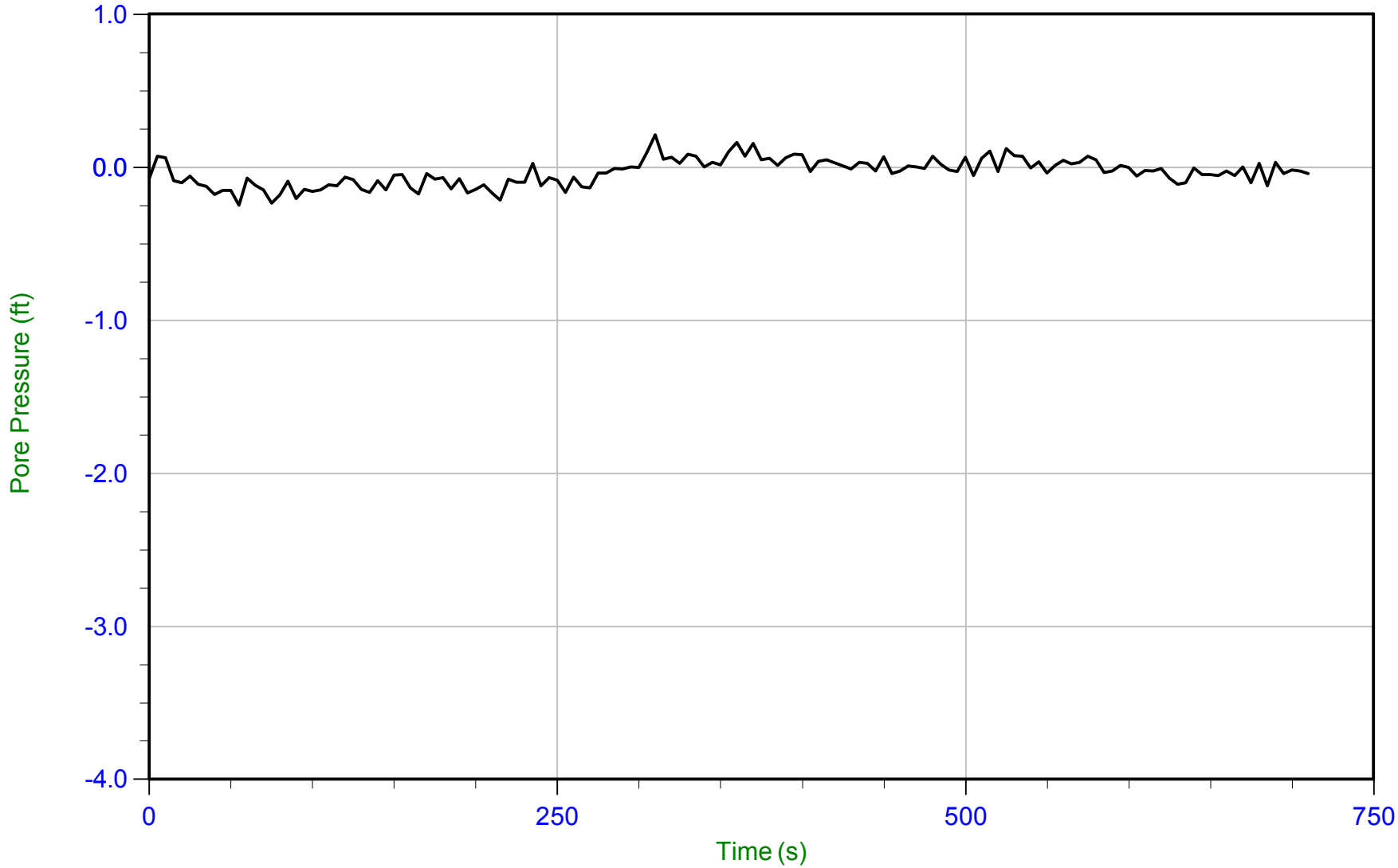
WT: 3.136 m / 10.288 ft
Ueq: -0.5 ft

CONETEC

Haley & Aldrich

Job No: 14-53069
Date: 09/25/2014 10:55
Site: Rush Island

Sounding: SCPT-C102
Cone: 268:T1500F15U500
Cone Area: 15 sq cm



Trace Summary:

Filename: 14-53069_SP102.PPD
Depth: 4.980 m / 16.338 ft
Duration: 710.0 s

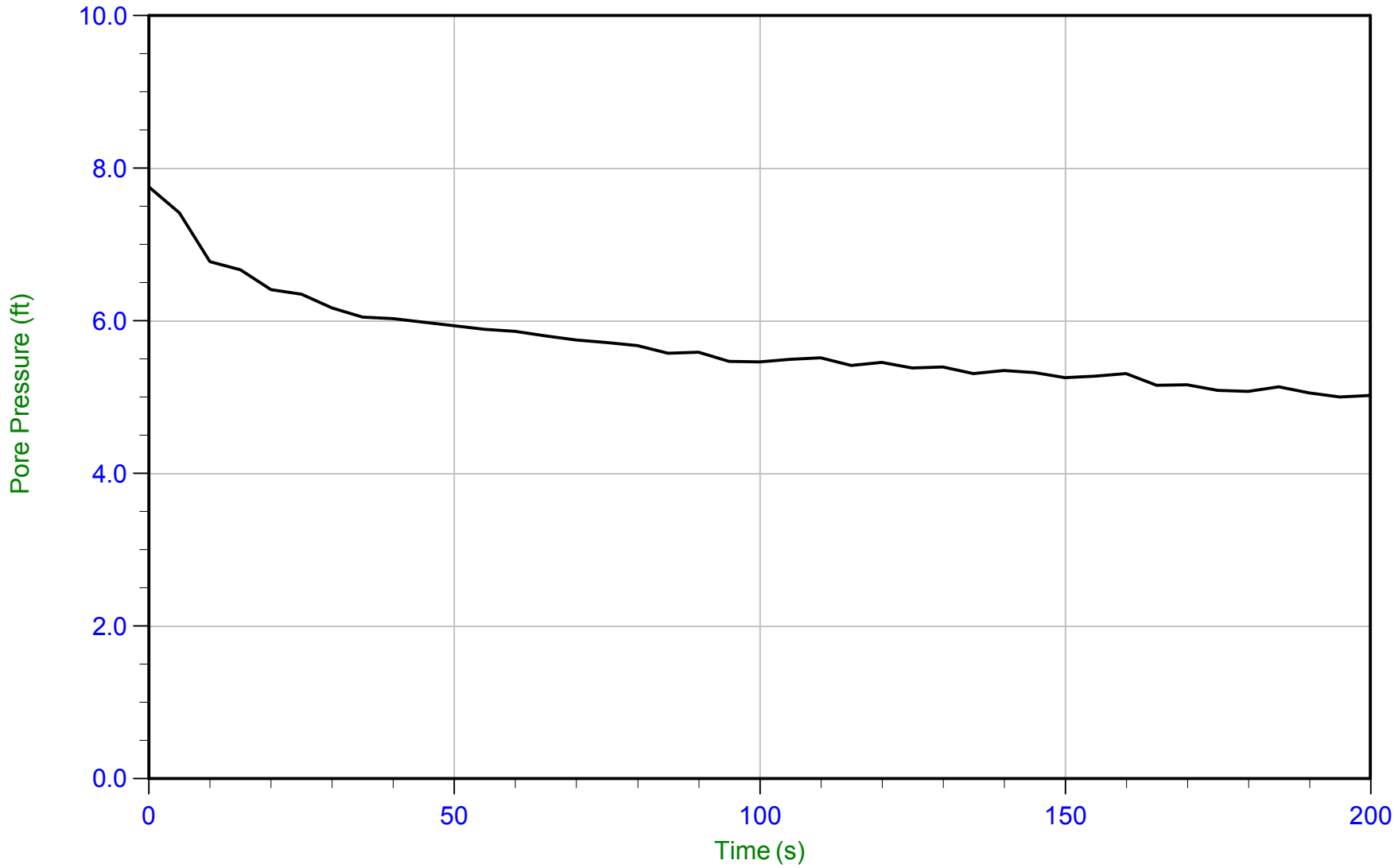
U Min: -0.2 ft
U Max: 0.2 ft

CONETEC

Haley & Aldrich

Job No: 14-53069
Date: 09/25/2014 10:55
Site: Rush Island

Sounding: SCPT-C102
Cone: 268:T1500F15U500
Cone Area: 15 sq cm



Trace Summary:

Filename: 14-53069_SP102.PPD
Depth: 6.970 m / 22.867 ft
Duration: 200.0 s

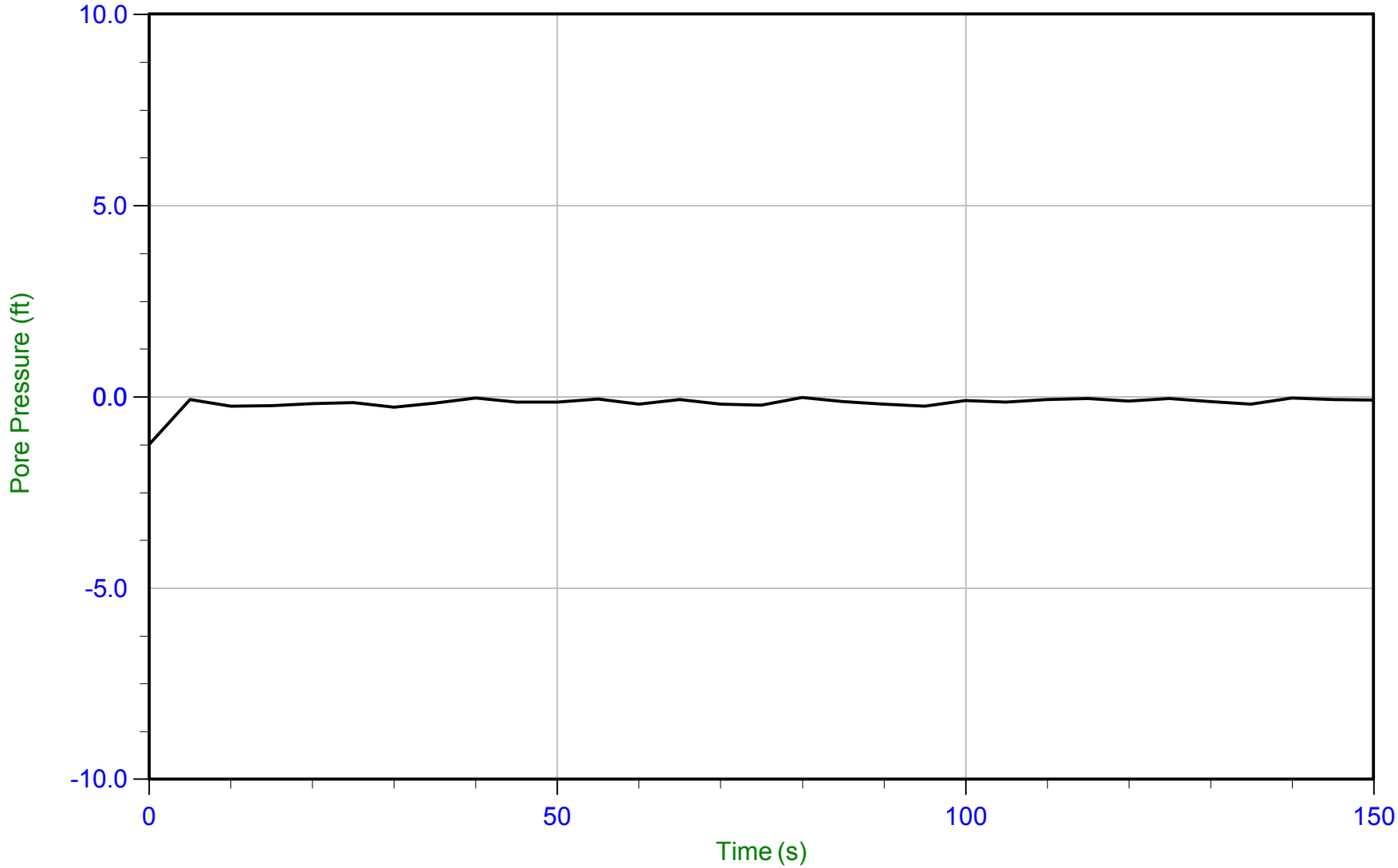
U Min: 5.0 ft
U Max: 7.8 ft

CONETEC

Haley & Aldrich

Job No: 14-53069
Date: 09/25/2014 10:55
Site: Rush Island

Sounding: SCPT-C102
Cone: 268:T1500F15U500
Cone Area: 15 sq cm



Trace Summary:

Filename: 14-53069_SP102.PPD
Depth: 8.970 m / 29.429 ft
Duration: 150.0 s

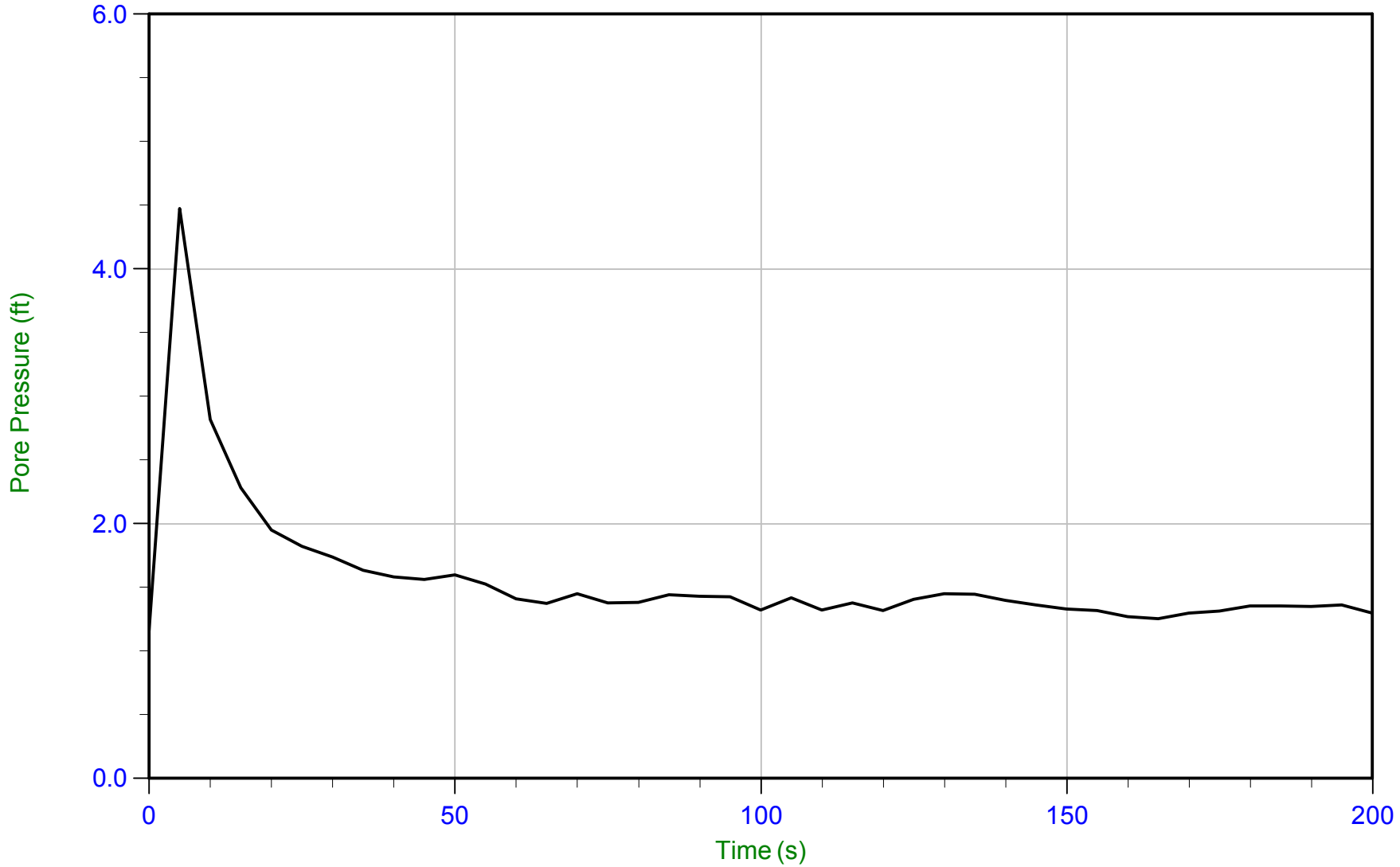
U Min: -1.2 ft
U Max: -0.0 ft

CONETEC

Haley & Aldrich

Job No: 14-53069
Date: 09/25/2014 10:55
Site: Rush Island

Sounding: SCPT-C102
Cone: 268:T1500F15U500
Cone Area: 15 sq cm



Trace Summary:

Filename: 14-53069_SP102.PPD
Depth: 10.970 m / 35.990 ft
Duration: 200.0 s

U Min: 1.2 ft
U Max: 4.5 ft

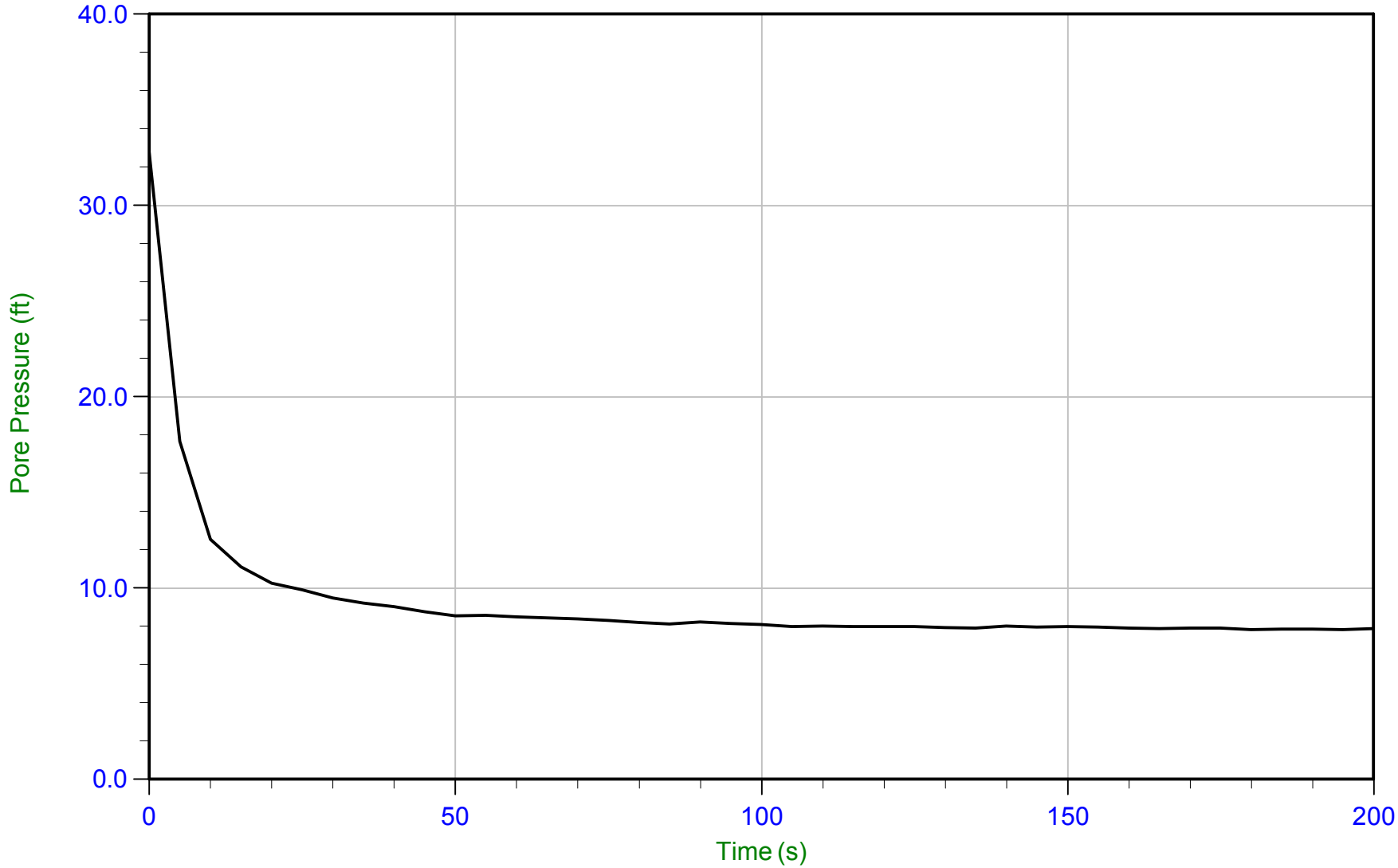
WT: 10.571 m / 34.682 ft
Ueq: 1.3 ft

CONETEC

Haley & Aldrich

Job No: 14-53069
Date: 09/25/2014 10:55
Site: Rush Island

Sounding: SCPT-C102
Cone: 268:T1500F15U500
Cone Area: 15 sq cm



Trace Summary:

Filename: 14-53069_SP102.PPD
Depth: 12.970 m / 42.552 ft
Duration: 200.0 s

U Min: 7.8 ft
U Max: 32.7 ft

WT: 10.594 m / 34.757 ft
Ueq: 7.8 ft
U(50): 20.27 ft

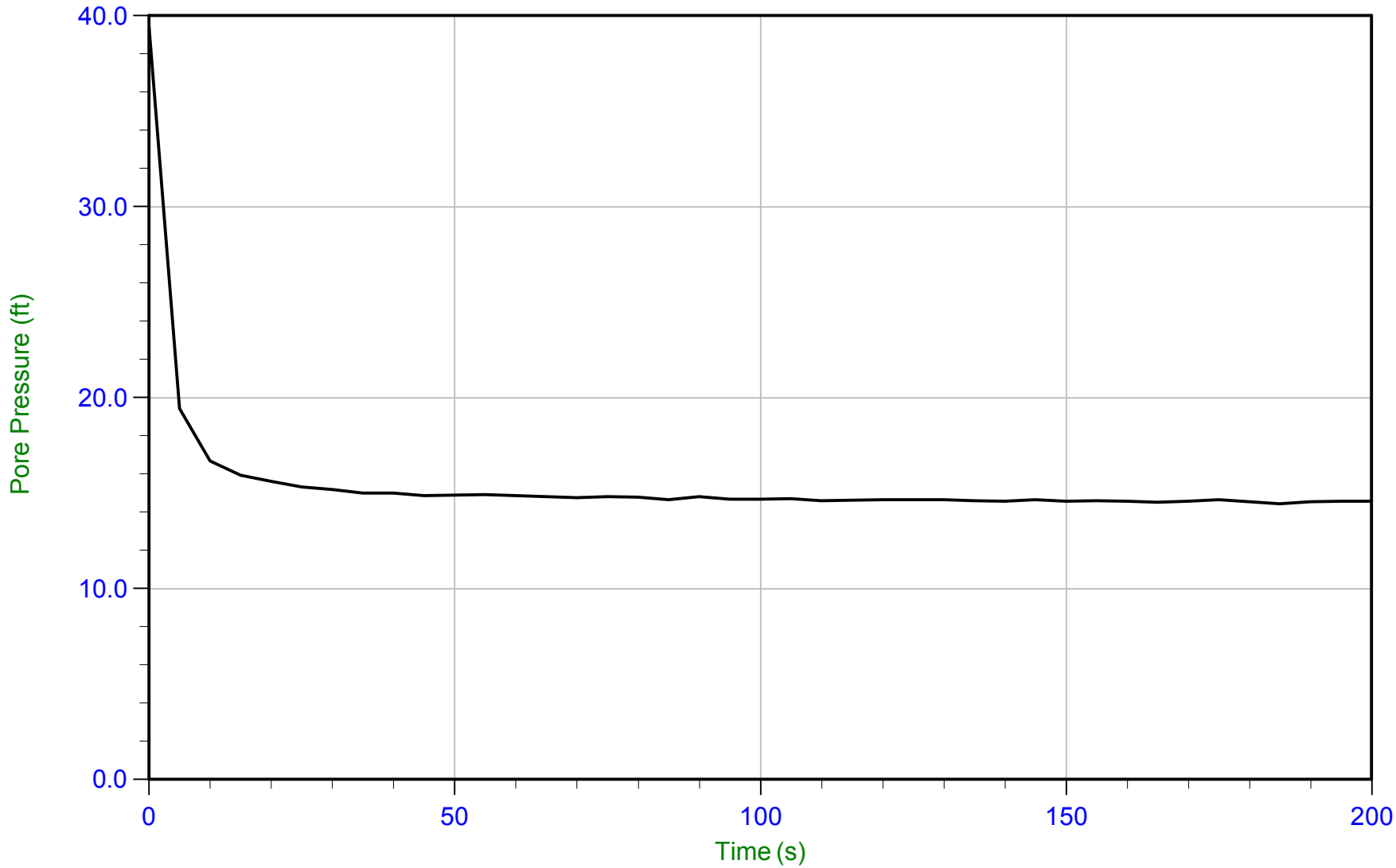
T(50): 4.1 s
Ir: 100
Ch: 169.8 sq cm/min

CONETEC

Haley & Aldrich

Job No: 14-53069
Date: 09/25/2014 10:55
Site: Rush Island

Sounding: SCPT-C102
Cone: 268:T1500F15U500
Cone Area: 15 sq cm



Trace Summary:

Filename: 14-53069_SP102.PPD
Depth: 14.970 m / 49.114 ft
Duration: 200.0 s

U Min: 14.4 ft
U Max: 39.5 ft

WT: 10.532 m / 34.553 ft
Ueq: 14.6 ft
U(50): 27.01 ft

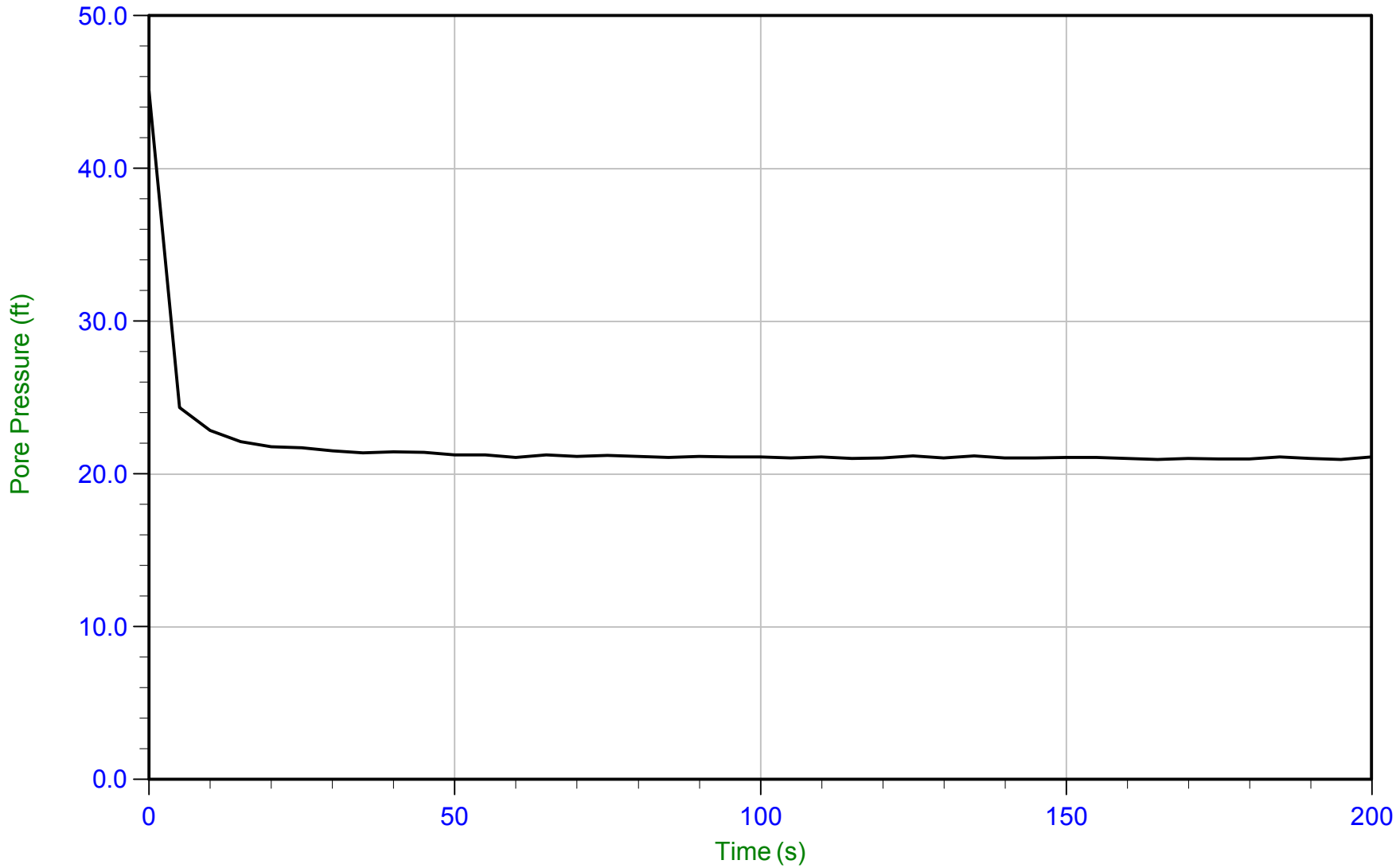
T(50): 3.1 s
Ir: 100
Ch: 225.8 sq cm/min

CONETEC

Haley & Aldrich

Job No: 14-53069
Date: 09/25/2014 10:55
Site: Rush Island

Sounding: SCPT-C102
Cone: 268:T1500F15U500
Cone Area: 15 sq cm



Trace Summary:

Filename: 14-53069_SP102.PPD
Depth: 16.970 m / 55.675 ft
Duration: 200.0 s

U Min: 21.0 ft
U Max: 45.1 ft

WT: 10.583 m / 34.721 ft
Ueq: 21.0 ft
U(50): 33.02 ft

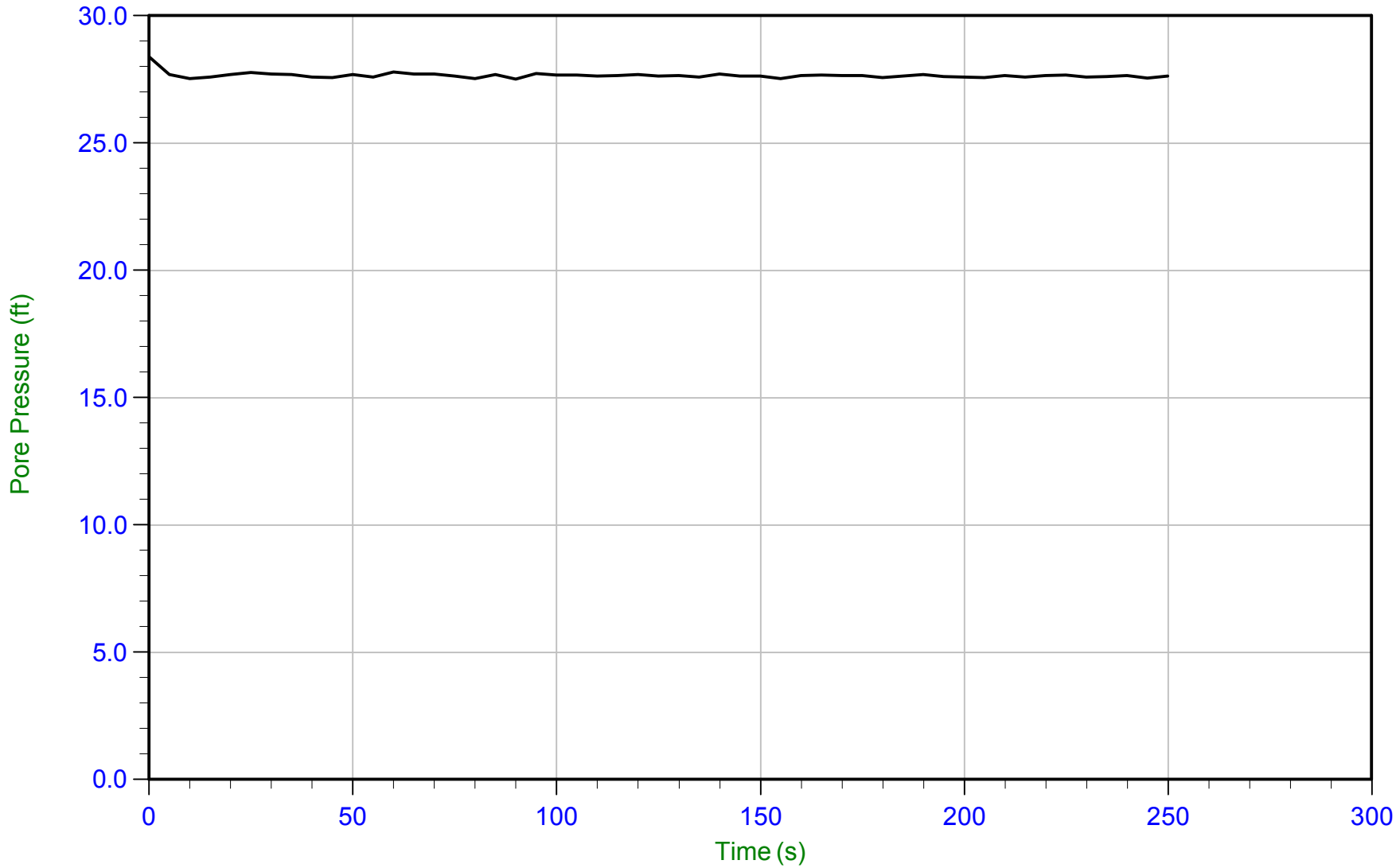
T(50): 2.9 s
Ir: 100
Ch: 241.3 sq cm/min

CONETEC

Haley & Aldrich

Job No: 14-53069
Date: 09/25/2014 10:55
Site: Rush Island

Sounding: SCPT-C102
Cone: 268:T1500F15U500
Cone Area: 15 sq cm



Trace Summary:

Filename: 14-53069_SP102.PPD
Depth: 18.970 m / 62.237 ft
Duration: 250.0 s

U Min: 27.5 ft
U Max: 28.4 ft

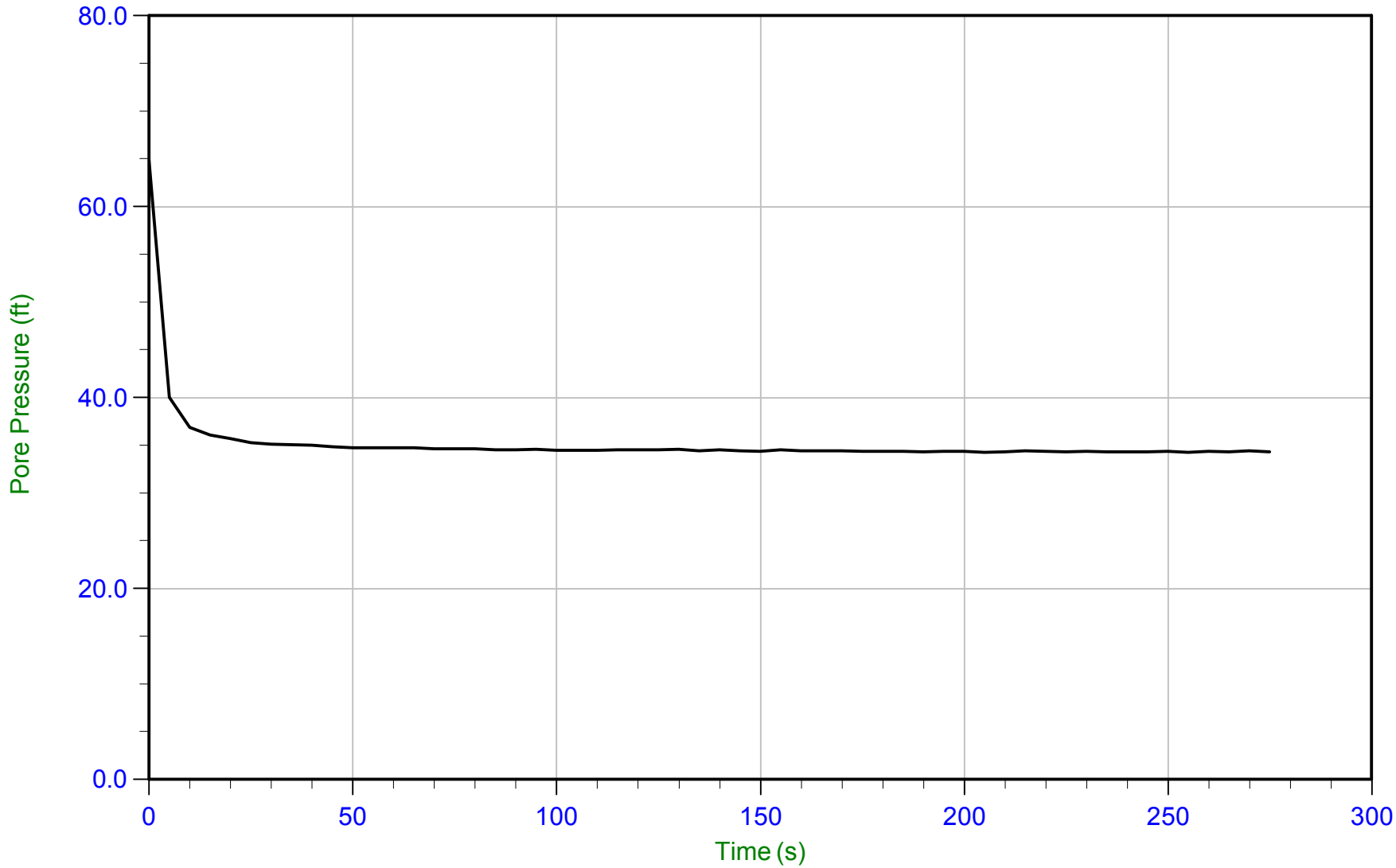
WT: 10.566 m / 34.665 ft
Ueq: 27.6 ft

CONETEC

Haley & Aldrich

Job No: 14-53069
Date: 09/25/2014 10:55
Site: Rush Island

Sounding: SCPT-C102
Cone: 268:T1500F15U500
Cone Area: 15 sq cm



Trace Summary:

Filename: 14-53069_SP102.PPD
Depth: 20.970 m / 68.798 ft
Duration: 275.0 s

U Min: 34.3 ft
U Max: 64.9 ft

WT: 10.481 m / 34.386 ft
Ueq: 34.4 ft
U(50): 49.65 ft

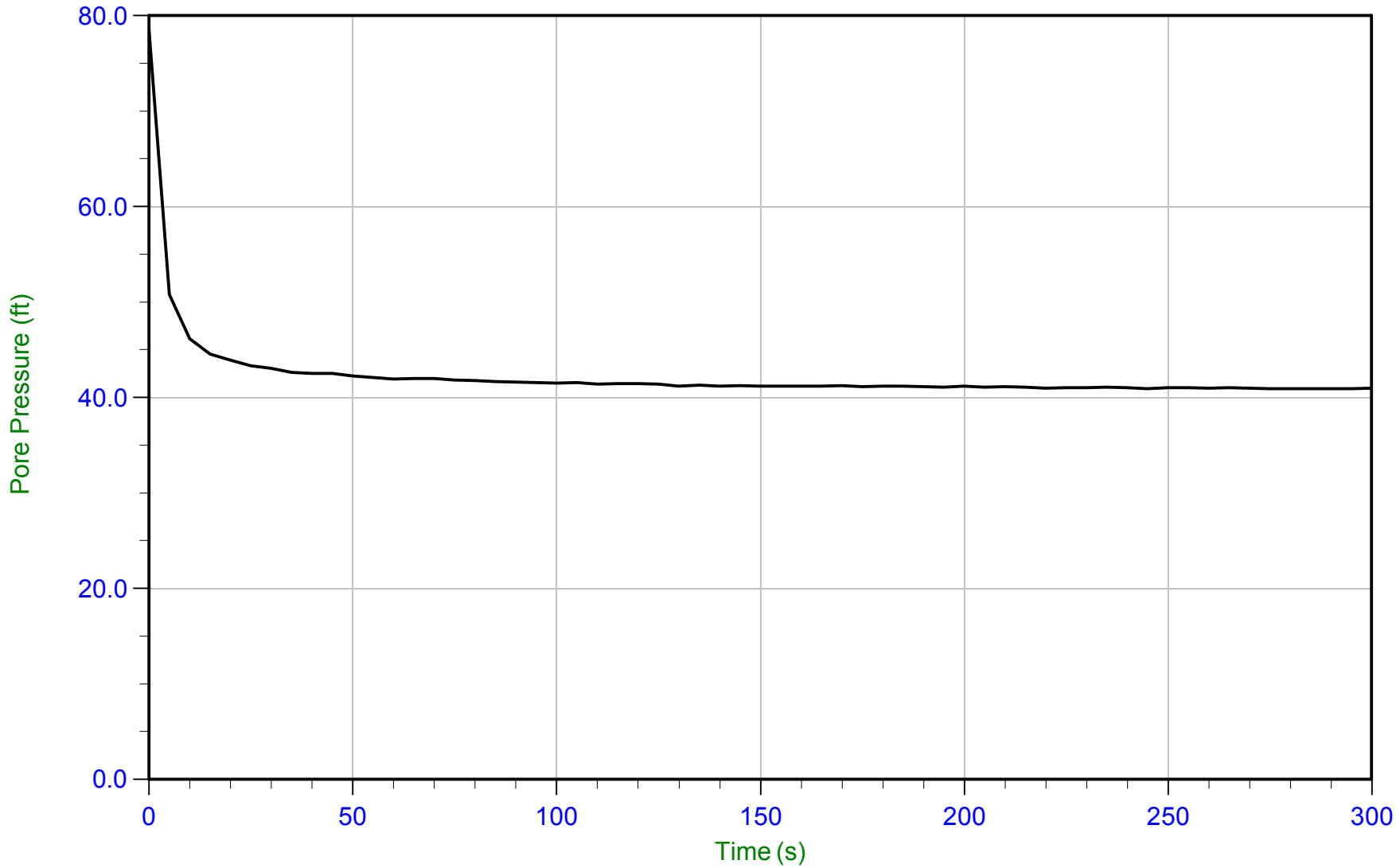
T(50): 3.1 s
Ir: 100
Ch: 229.1 sq cm/min

CONETEC

Haley & Aldrich

Job No: 14-53069
Date: 09/25/2014 10:55
Site: Rush Island

Sounding: SCPT-C102
Cone: 268:T1500F15U500
Cone Area: 15 sq cm



Trace Summary:

Filename: 14-53069_SP102.PPD
Depth: 22.970 m / 75.360 ft
Duration: 300.0 s

U Min: 40.9 ft
U Max: 78.5 ft

WT: 10.509 m / 34.478 ft
Ueq: 40.9 ft
U(50): 59.71 ft

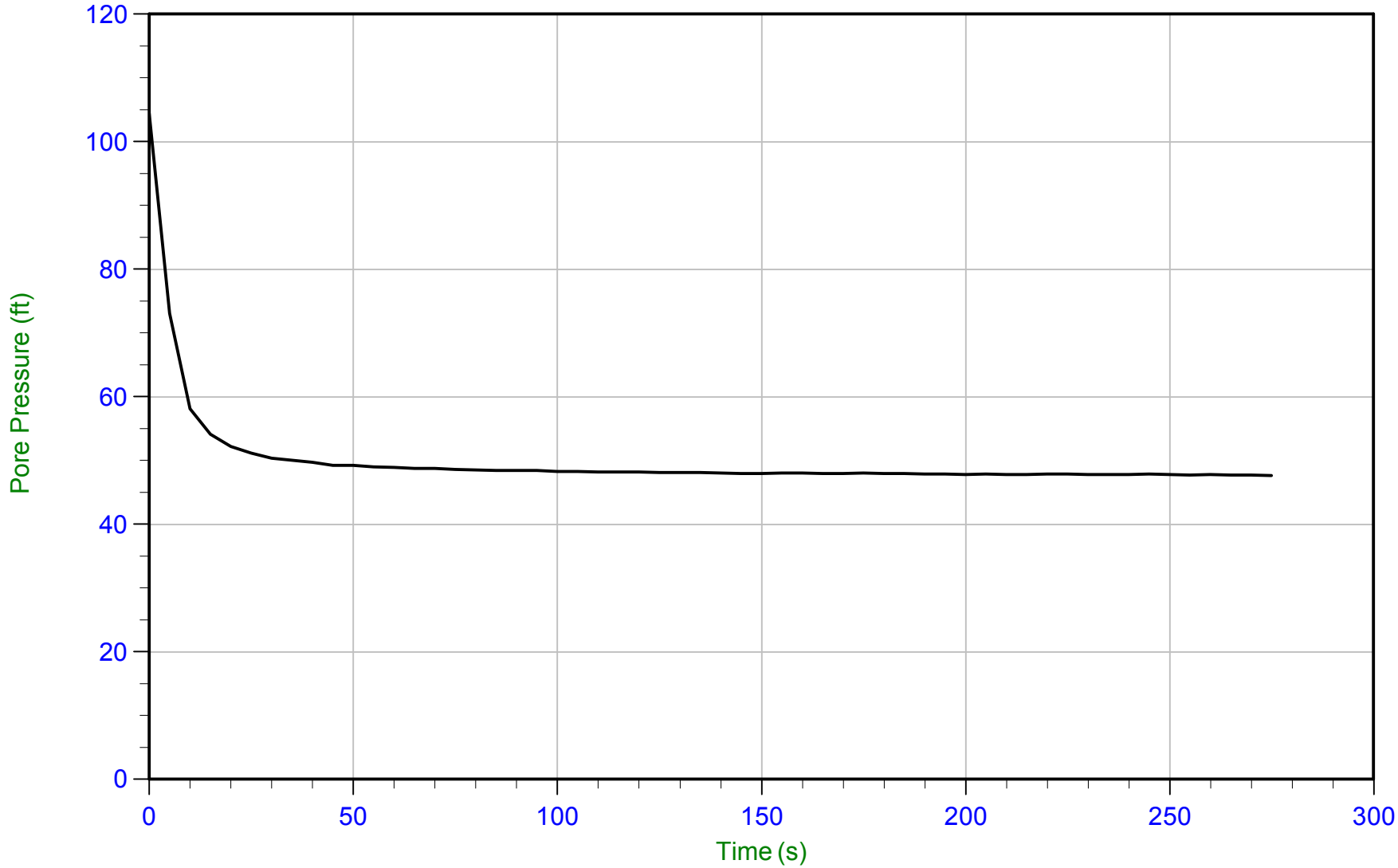
T(50): 3.4 s
Ir: 100
Ch: 207.0 sq cm/min

CONETEC

Haley & Aldrich

Job No: 14-53069
Date: 09/25/2014 10:55
Site: Rush Island

Sounding: SCPT-C102
Cone: 268:T1500F15U500
Cone Area: 15 sq cm



Trace Summary:

Filename: 14-53069_SP102.PPD
Depth: 24.970 m / 81.922 ft
Duration: 275.0 s

U Min: 47.7 ft
U Max: 104.4 ft

WT: 10.447 m / 34.275 ft
Ueq: 47.6 ft
U(50): 76.05 ft

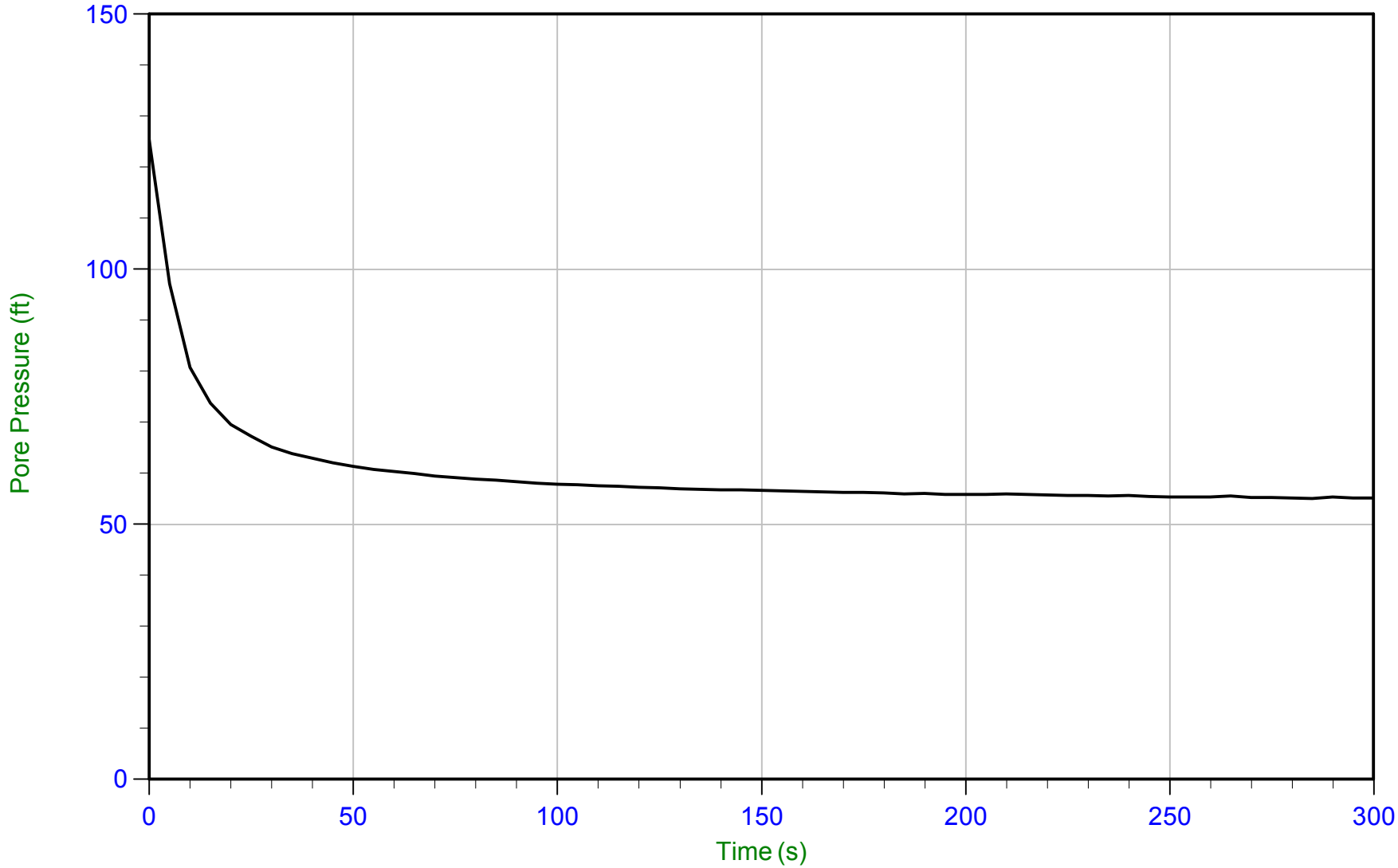
T(50): 4.5 s
Ir: 100
Ch: 155.0 sq cm/min

CONETEC

Haley & Aldrich

Job No: 14-53069
Date: 09/25/2014 10:55
Site: Rush Island

Sounding: SCPT-C102
Cone: 268:T1500F15U500
Cone Area: 15 sq cm



Trace Summary:

Filename: 14-53069_SP102.PPD
Depth: 26.970 m / 88.483 ft
Duration: 300.0 s

U Min: 55.0 ft
U Max: 125.4 ft

WT: 10.497 m / 34.439 ft
Ueq: 54.0 ft
U(50): 89.70 ft

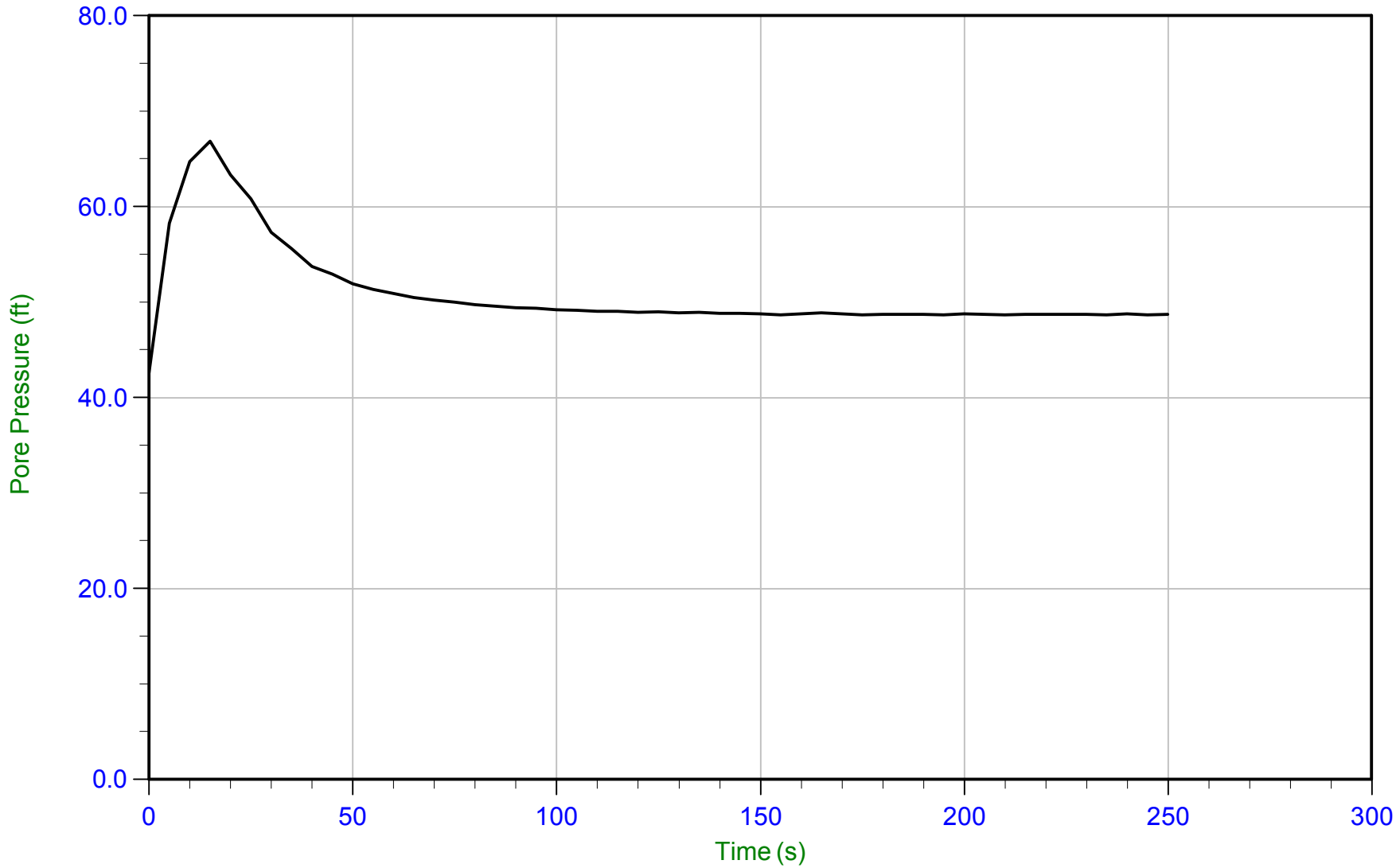
T(50): 7.3 s
Ir: 100
Ch: 96.6 sq cm/min

CONETEC

Haley & Aldrich

Job No: 14-53069
Date: 09/25/2014 10:55
Site: Rush Island

Sounding: SCPT-C102
Cone: 268:T1500F15U500
Cone Area: 15 sq cm



Trace Summary:

Filename: 14-53069_SP102.PPD
Depth: 28.970 m / 95.045 ft
Duration: 250.0 s

U Min: 42.6 ft
U Max: 66.9 ft

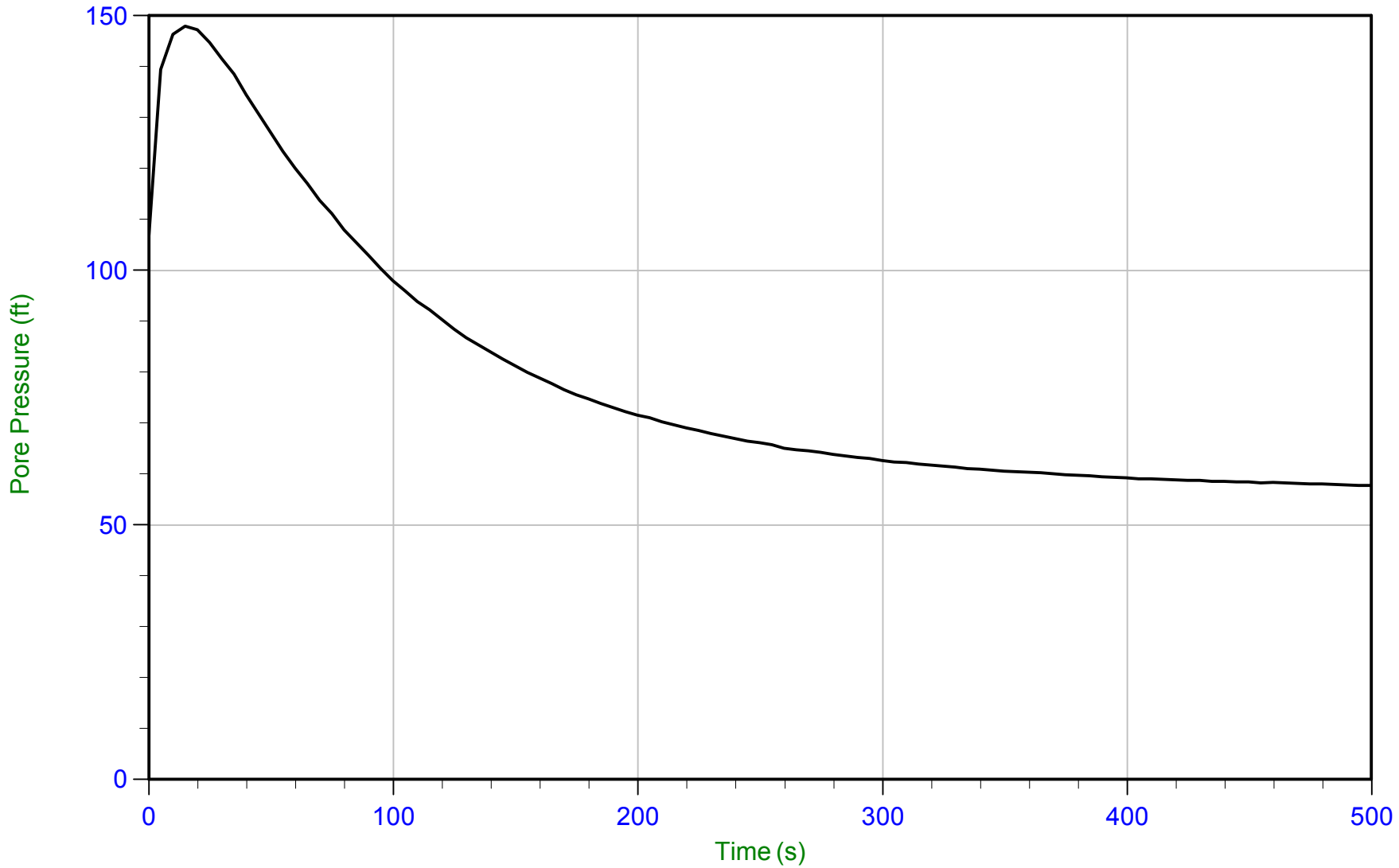
WT: 14.178 m / 46.515 ft
Ueq: 48.5 ft

CONETEC

Haley & Aldrich

Job No: 14-53069
Date: 09/25/2014 10:55
Site: Rush Island

Sounding: SCPT-C102
Cone: 268:T1500F15U500
Cone Area: 15 sq cm



Trace Summary:

Filename: 14-53069_SP102.PPD
Depth: 30.980 m / 101.639 ft
Duration: 500.0 s

U Min: 57.7 ft
U Max: 148.0 ft

WT: 14.097 m / 46.249 ft
Ueq: 55.4 ft
U(50): 101.69 ft

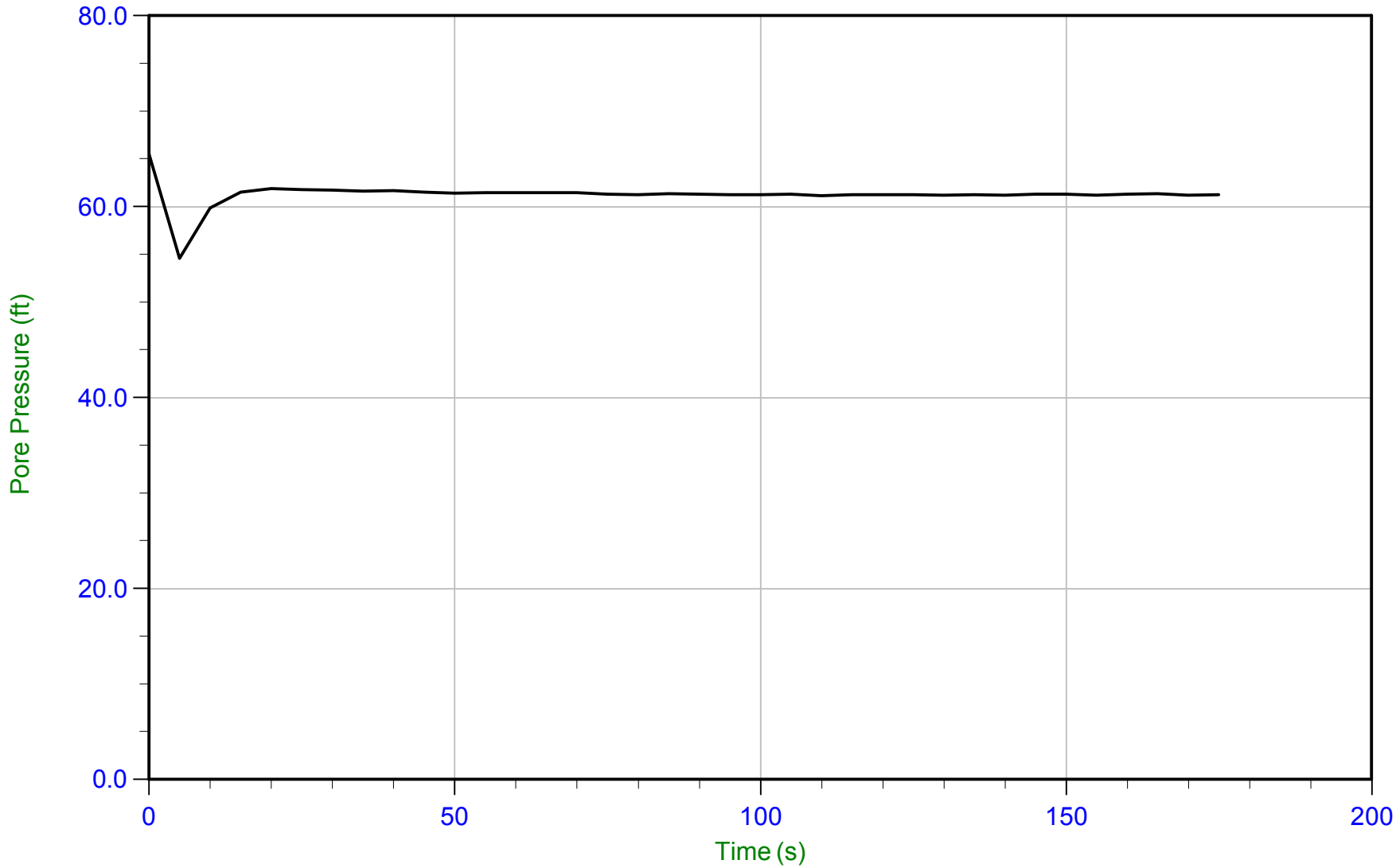
T(50): 77.5 s
Ir: 100
Ch: 9.1 sq cm/min

CONETEC

Haley & Aldrich

Job No: 14-53069
Date: 09/25/2014 10:55
Site: Rush Island

Sounding: SCPT-C102
Cone: 268:T1500F15U500
Cone Area: 15 sq cm



Trace Summary:

Filename: 14-53069_SP102.PPD
Depth: 32.970 m / 108.168 ft
Duration: 175.0 s

U Min: 54.6 ft
U Max: 65.5 ft

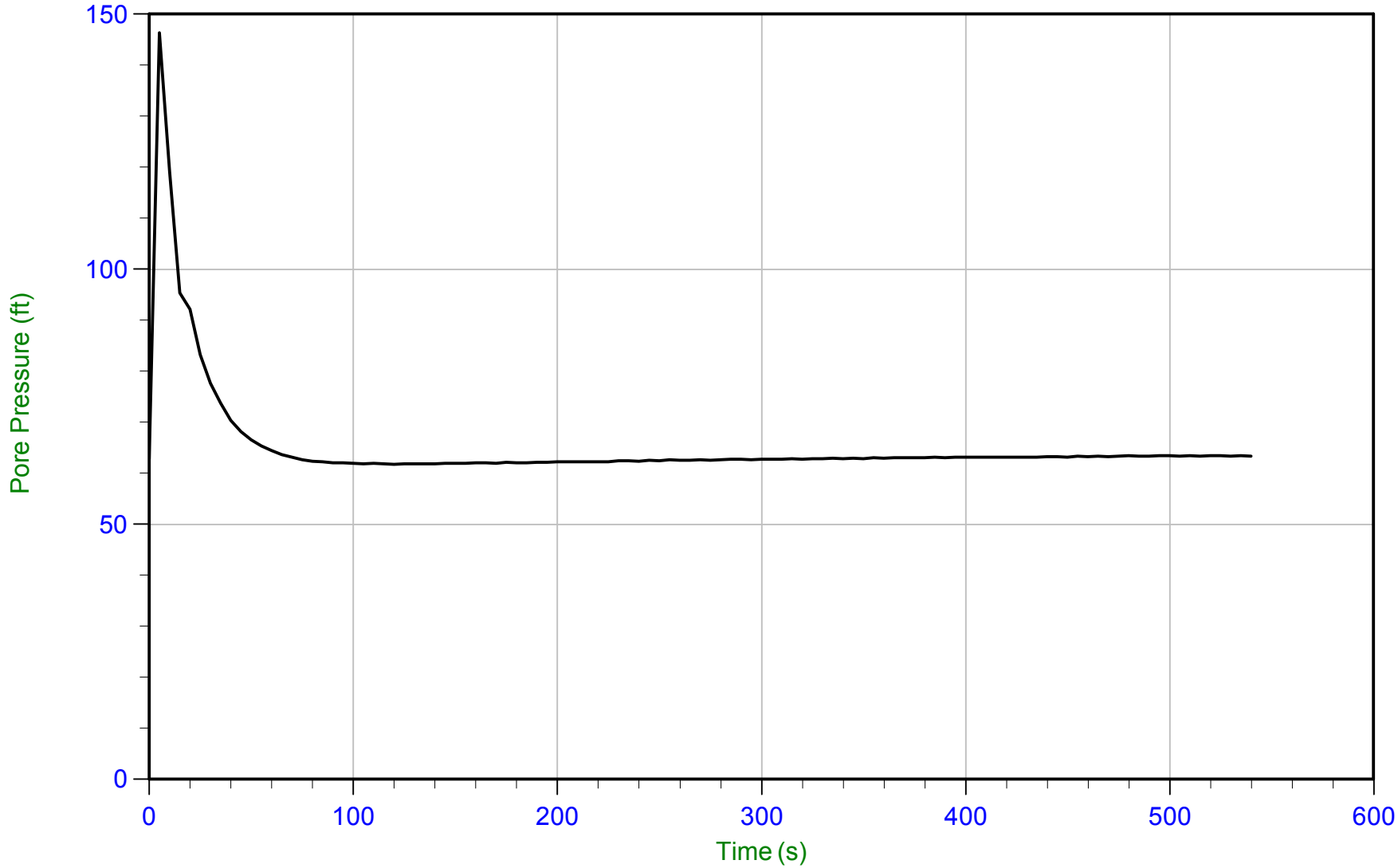
WT: 14.323 m / 46.991 ft
Ueq: 61.2 ft

CONETEC

Haley & Aldrich

Job No: 14-53069
Date: 09/25/2014 10:55
Site: Rush Island

Sounding: SCPT-C102
Cone: 268:T1500F15U500
Cone Area: 15 sq cm



Trace Summary:

Filename: 14-53069_SP102.PPD
Depth: 33.430 m / 109.677 ft
Duration: 540.0 s

U Min: 61.7 ft
U Max: 146.3 ft

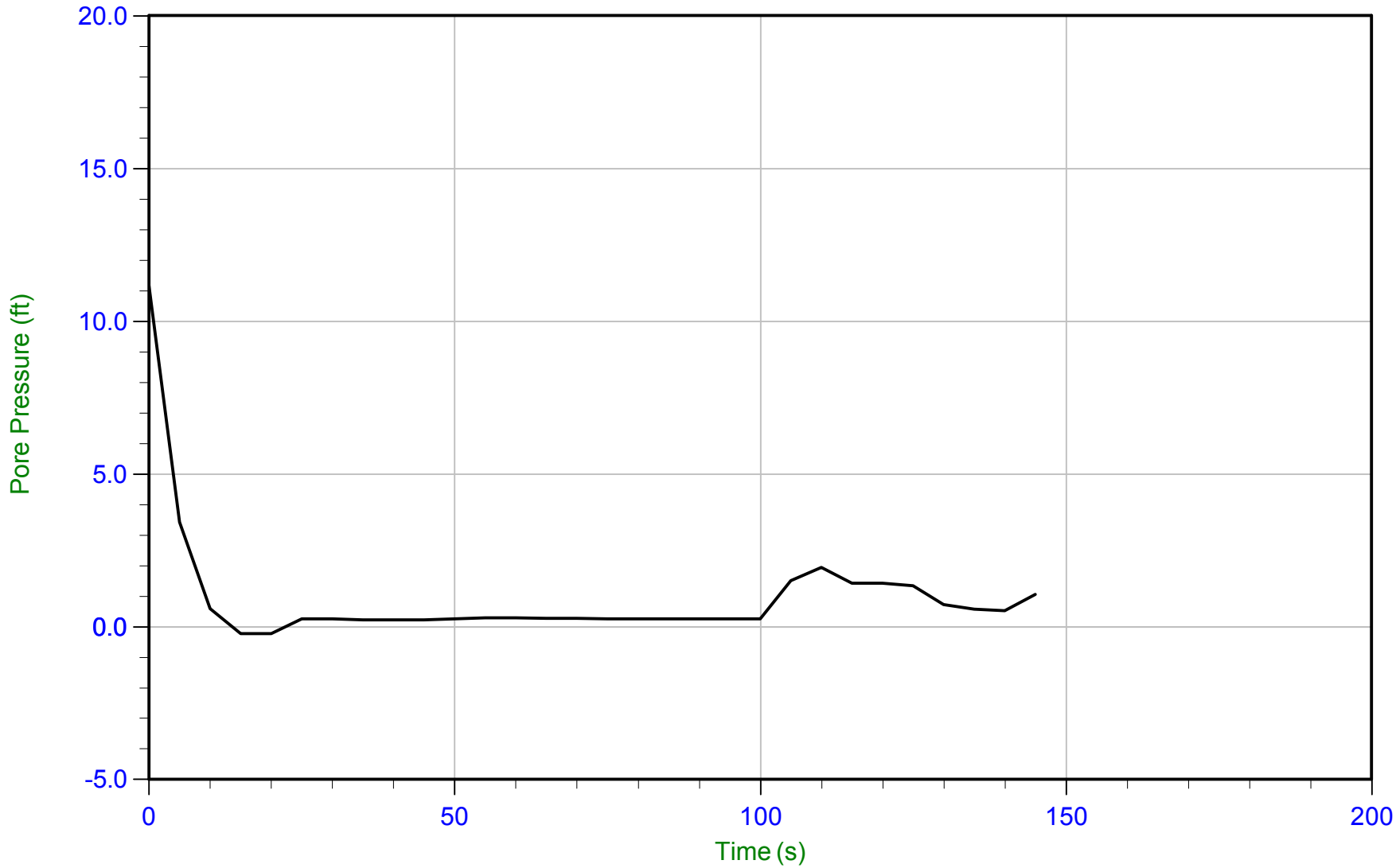
WT: 14.100 m / 46.259 ft
Ueq: 63.4 ft

CONETEC

Haley & Aldrich

Job No: 14-53069
Date: 09/26/2014 08:52
Site: Rush Island

Sounding: SCPT-C103
Cone: 268:T1500F15U500
Cone Area: 15 sq cm



Trace Summary:

Filename: 14-53069_SP103.PPD
Depth: 1.800 m / 5.905 ft
Duration: 145.0 s

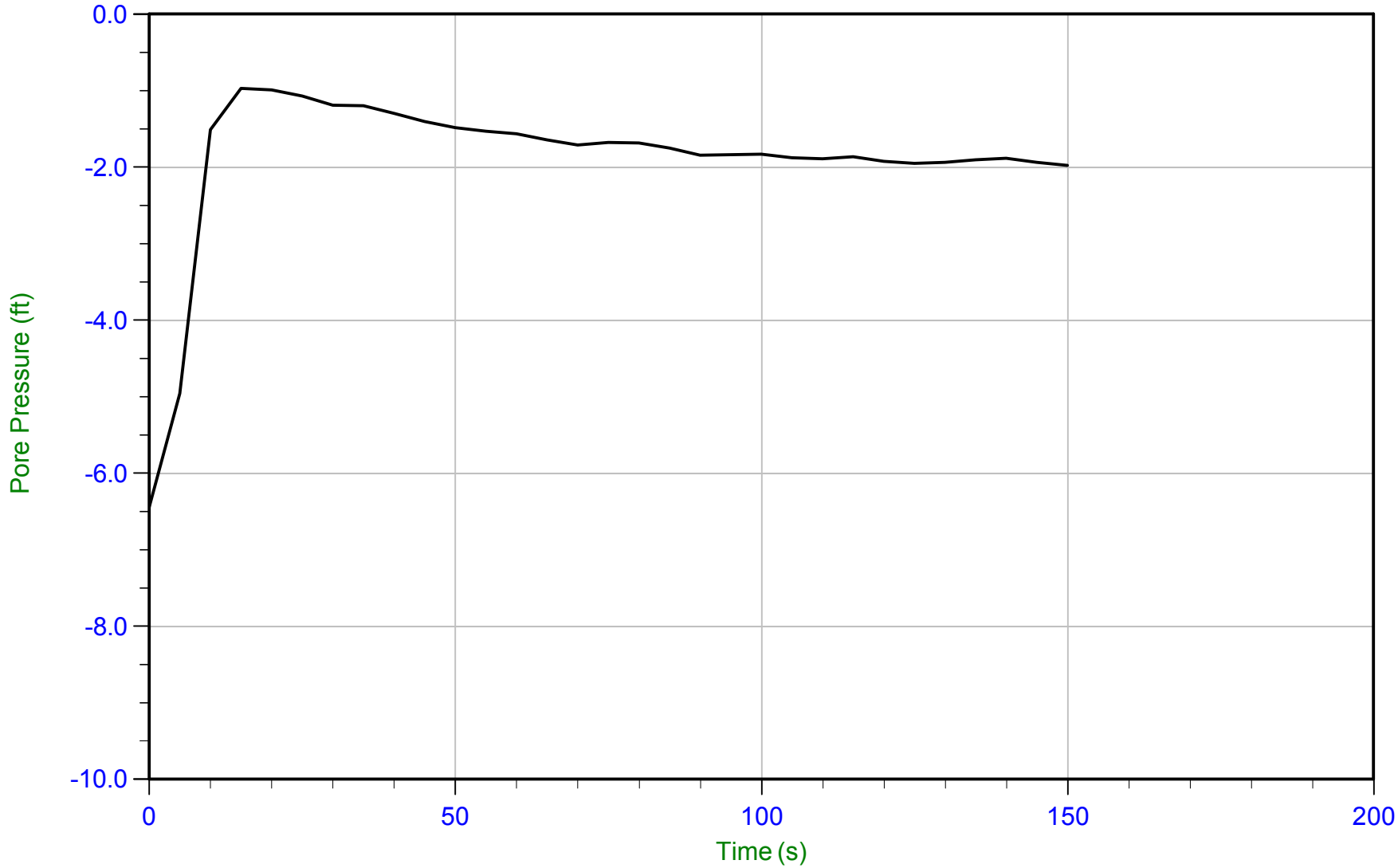
U Min: -0.2 ft
U Max: 11.2 ft

CONETEC

Haley & Aldrich

Job No: 14-53069
Date: 09/26/2014 08:52
Site: Rush Island

Sounding: SCPT-C103
Cone: 268:T1500F15U500
Cone Area: 15 sq cm



Trace Summary:

Filename: 14-53069_SP103.PPD
Depth: 2.790 m / 9.153 ft
Duration: 150.0 s

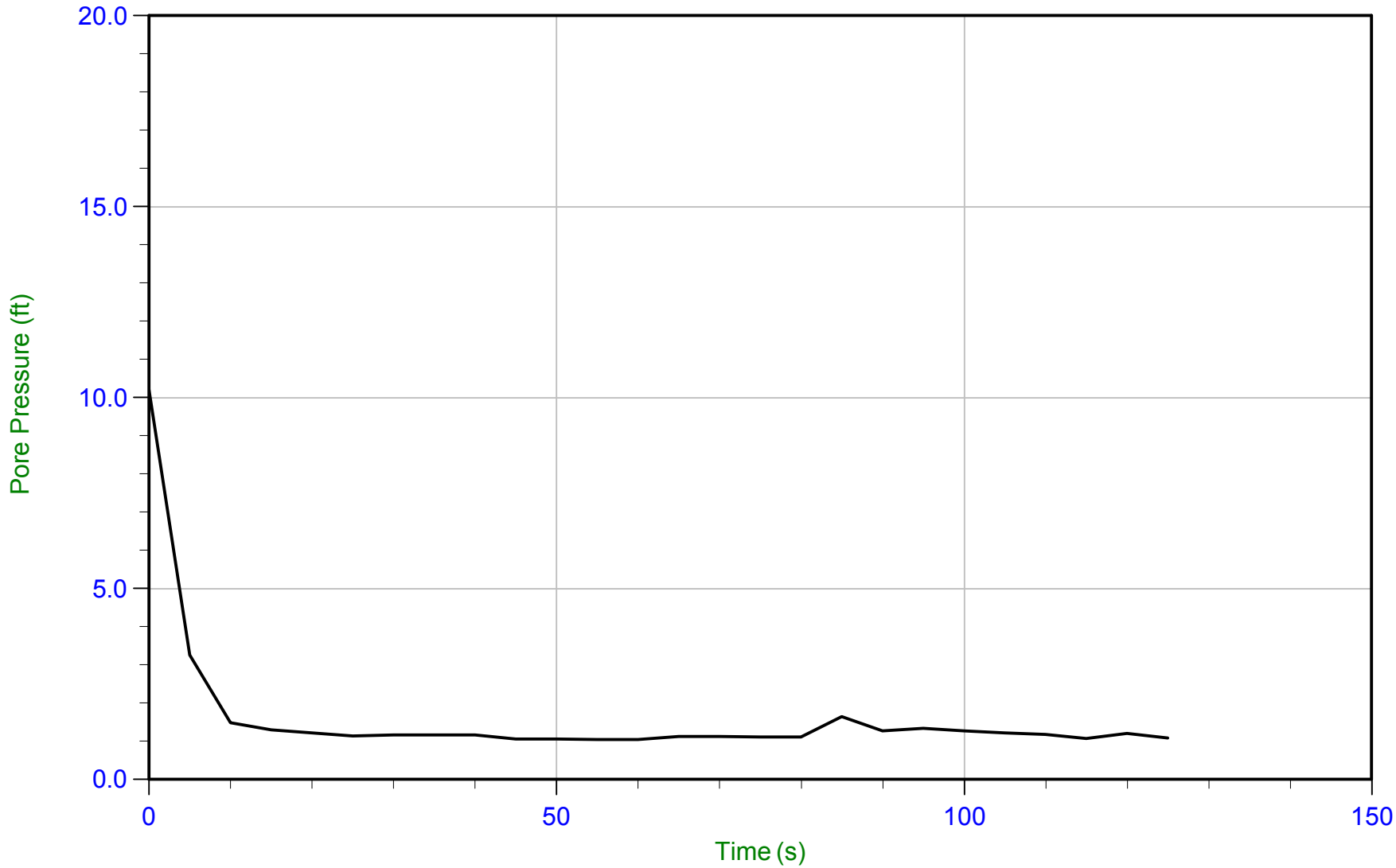
U Min: -6.4 ft
U Max: -1.0 ft

CONETEC

Haley & Aldrich

Job No: 14-53069
Date: 09/26/2014 08:52
Site: Rush Island

Sounding: SCPT-C103
Cone: 268:T1500F15U500
Cone Area: 15 sq cm



Trace Summary:

Filename: 14-53069_SP103.PPD
Depth: 3.700 m / 12.139 ft
Duration: 125.0 s

U Min: 1.0 ft
U Max: 10.2 ft

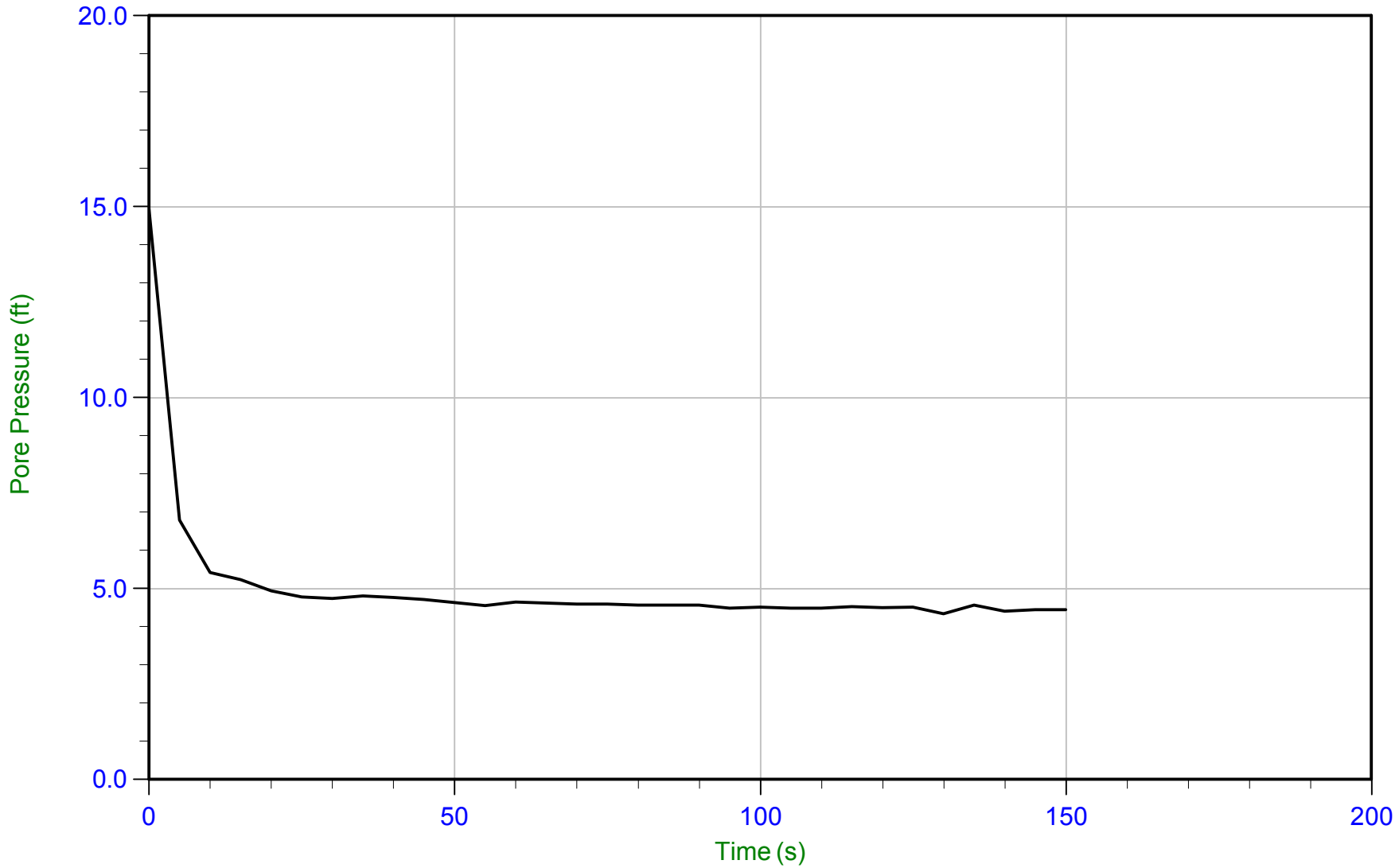
WT: 3.379 m / 11.086 ft
Ueq: 1.1 ft

CONETEC

Haley & Aldrich

Job No: 14-53069
Date: 09/26/2014 08:52
Site: Rush Island

Sounding: SCPT-C103
Cone: 268:T1500F15U500
Cone Area: 15 sq cm



Trace Summary:

Filename: 14-53069_SP103.PPD
Depth: 4.680 m / 15.354 ft
Duration: 150.0 s

U Min: 4.3 ft
U Max: 14.9 ft

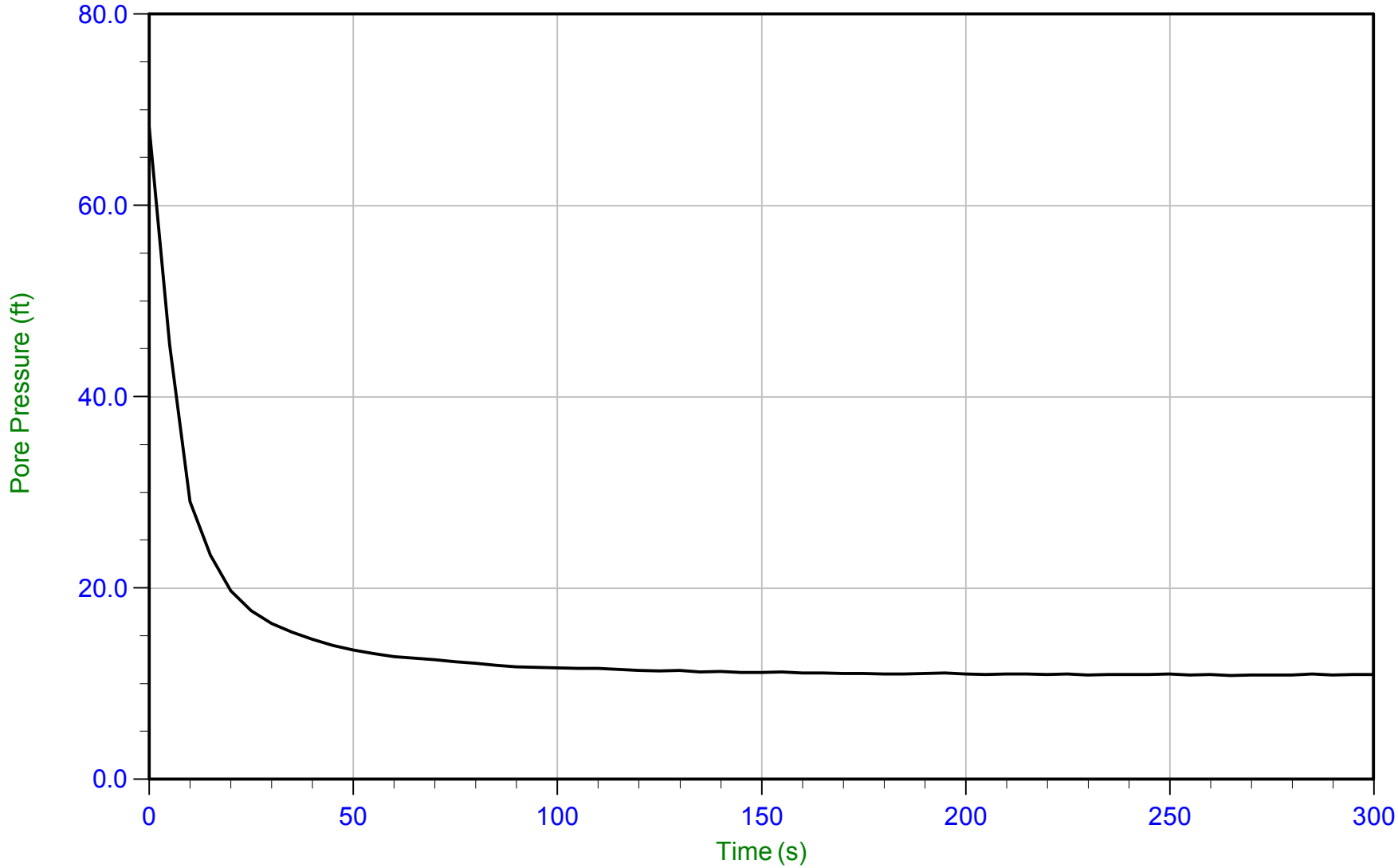
WT: 3.328 m / 10.918 ft
Ueq: 4.4 ft

CONETEC

Haley & Aldrich

Job No: 14-53069
Date: 09/26/2014 08:52
Site: Rush Island

Sounding: SCPT-C103
Cone: 268:T1500F15U500
Cone Area: 15 sq cm



Trace Summary:

Filename: 14-53069_SP103.PPD
Depth: 6.850 m / 22.473 ft
Duration: 300.0 s

U Min: 10.9 ft
U Max: 68.2 ft

WT: 3.550 m / 11.647 ft
Ueq: 10.8 ft
U(50): 39.50 ft

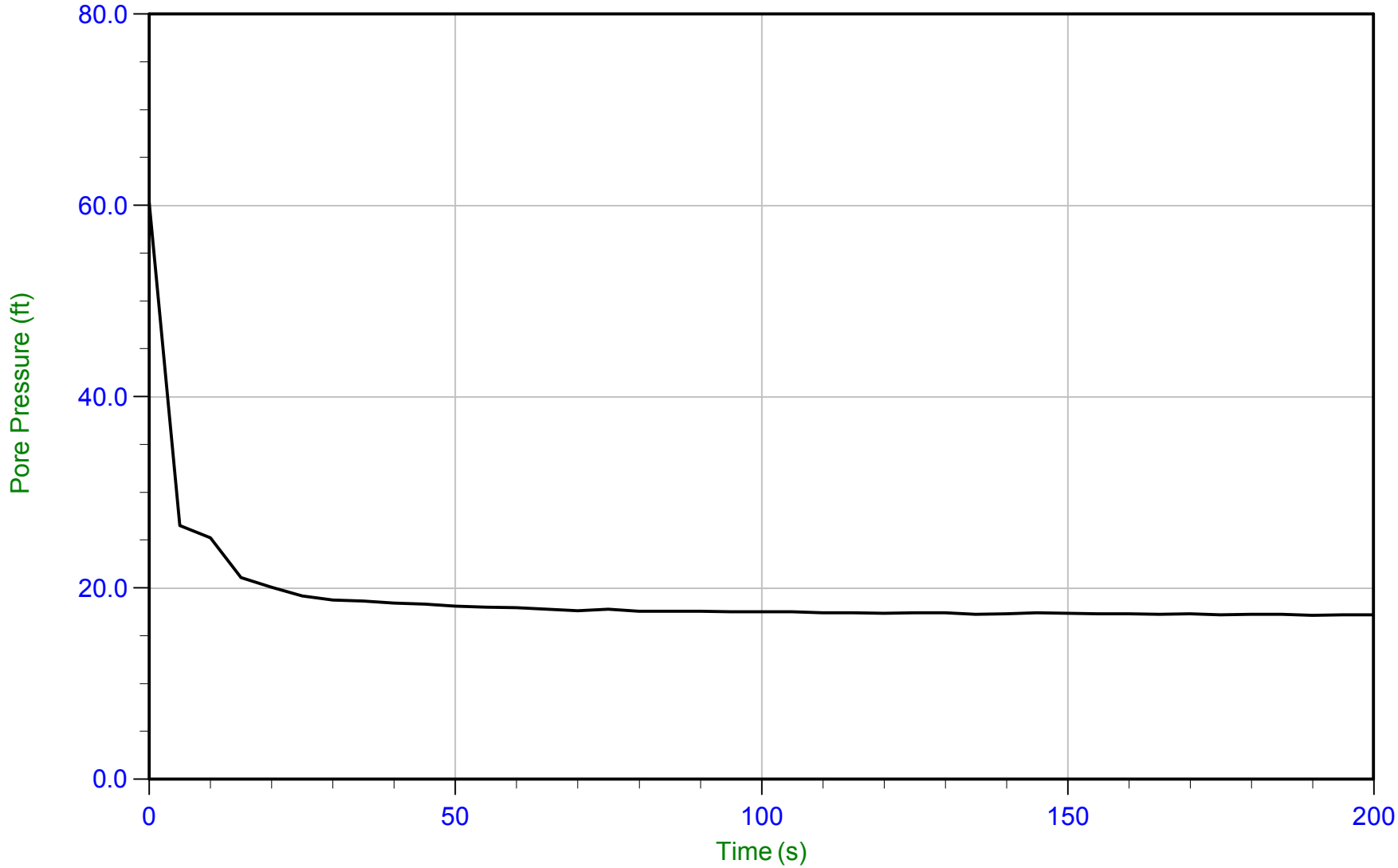
T(50): 6.8 s
Ir: 100
Ch: 102.9 sq cm/min

CONETEC

Haley & Aldrich

Job No: 14-53069
Date: 09/26/2014 08:52
Site: Rush Island

Sounding: SCPT-C103
Cone: 268:T1500F15U500
Cone Area: 15 sq cm



Trace Summary:

Filename: 14-53069_SP103.PPD
Depth: 8.850 m / 29.035 ft
Duration: 200.0 s

U Min: 17.2 ft
U Max: 60.3 ft

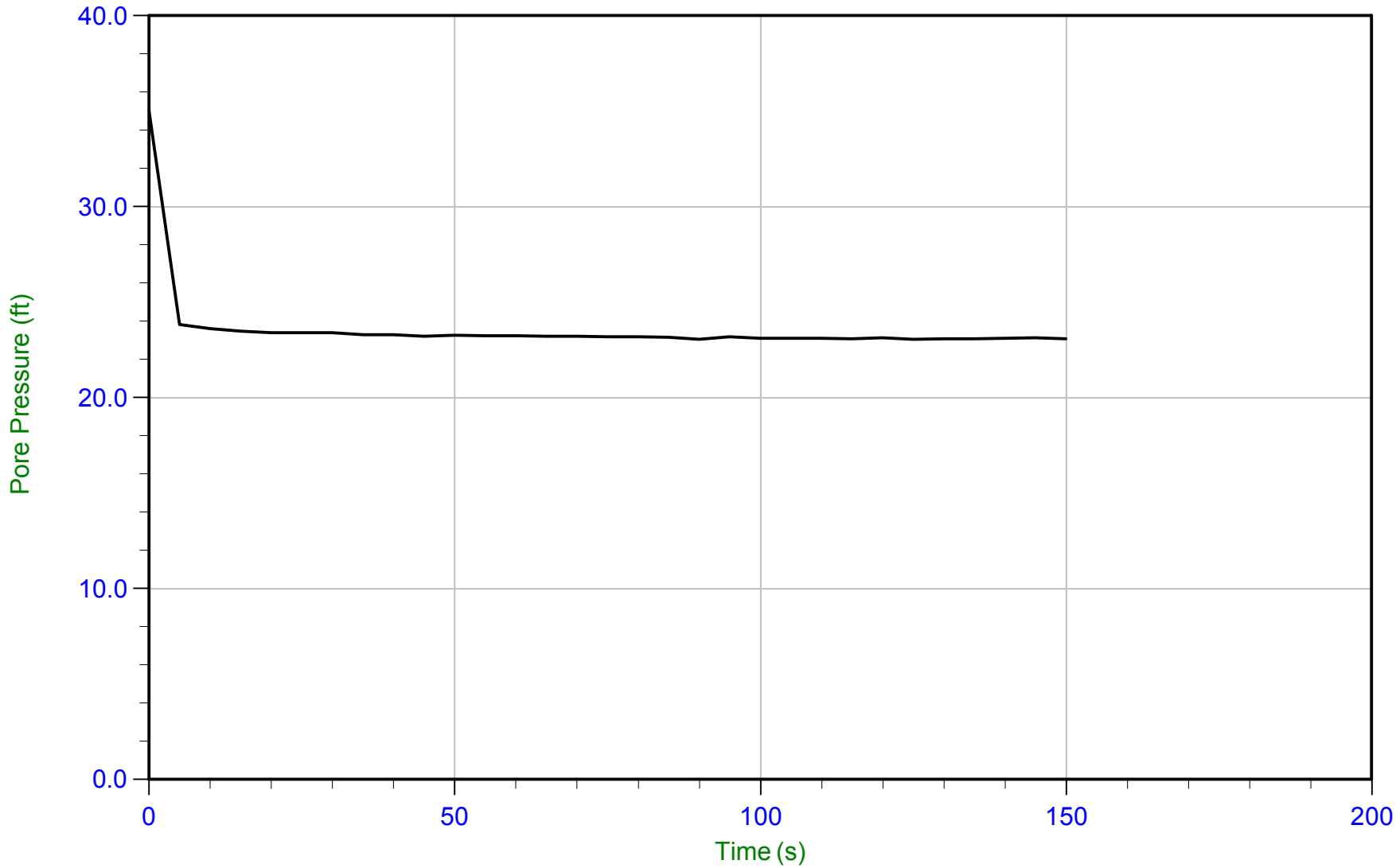
WT: 3.625 m / 11.892 ft
Ueq: 17.1 ft

CONETEC

Haley & Aldrich

Job No: 14-53069
Date: 09/26/2014 08:52
Site: Rush Island

Sounding: SCPT-C103
Cone: 268:T1500F15U500
Cone Area: 15 sq cm



Trace Summary:

Filename: 14-53069_SP103.PPD
Depth: 10.850 m / 35.597 ft
Duration: 150.0 s

U Min: 23.1 ft
U Max: 35.0 ft

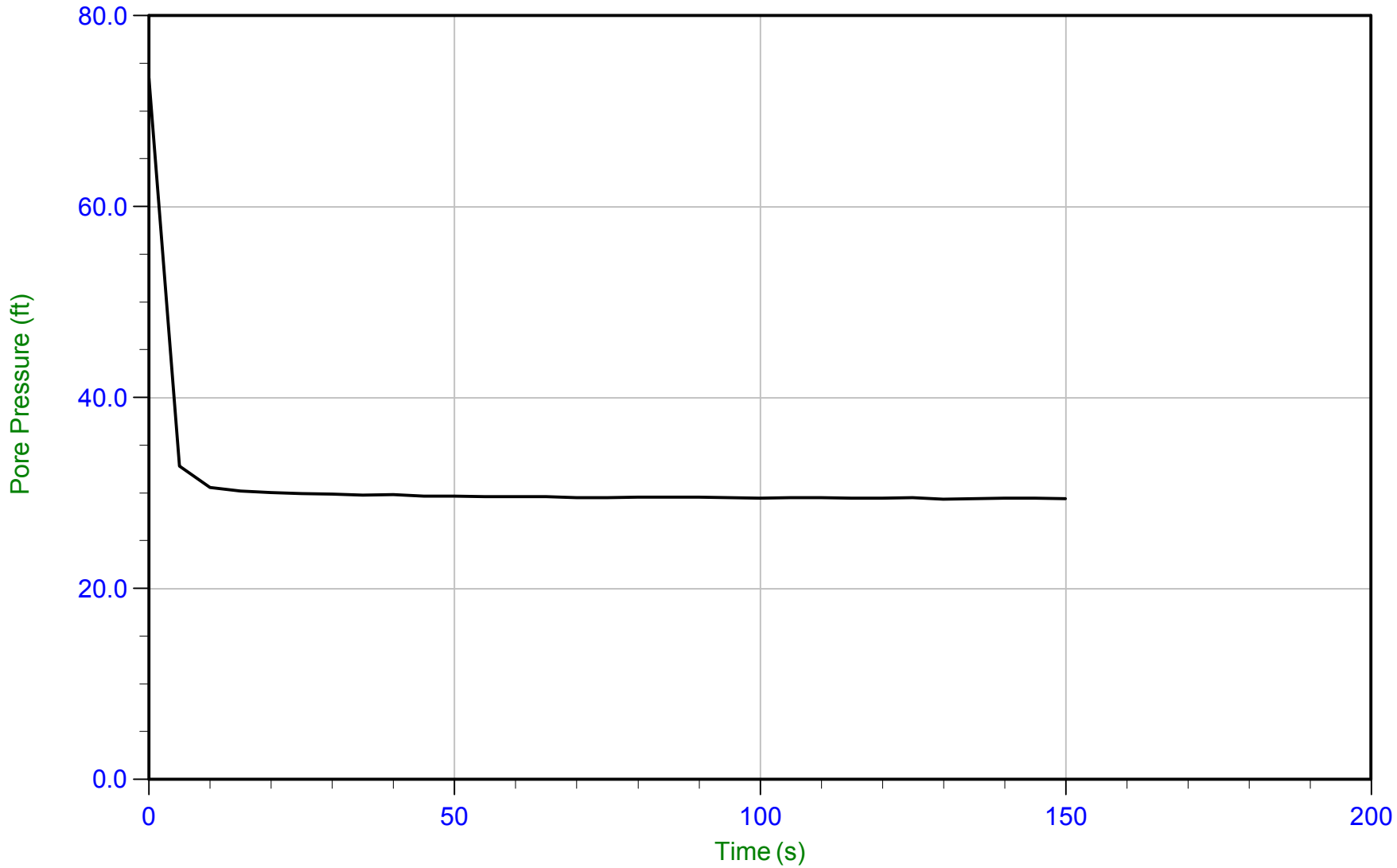
WT: 3.837 m / 12.589 ft
Ueq: 23.0 ft

CONETEC

Haley & Aldrich

Job No: 14-53069
Date: 09/26/2014 08:52
Site: Rush Island

Sounding: SCPT-C103
Cone: 268:T1500F15U500
Cone Area: 15 sq cm



Trace Summary:

Filename: 14-53069_SP103.PPD
Depth: 12.850 m / 42.158 ft
Duration: 150.0 s

U Min: 29.4 ft
U Max: 73.4 ft

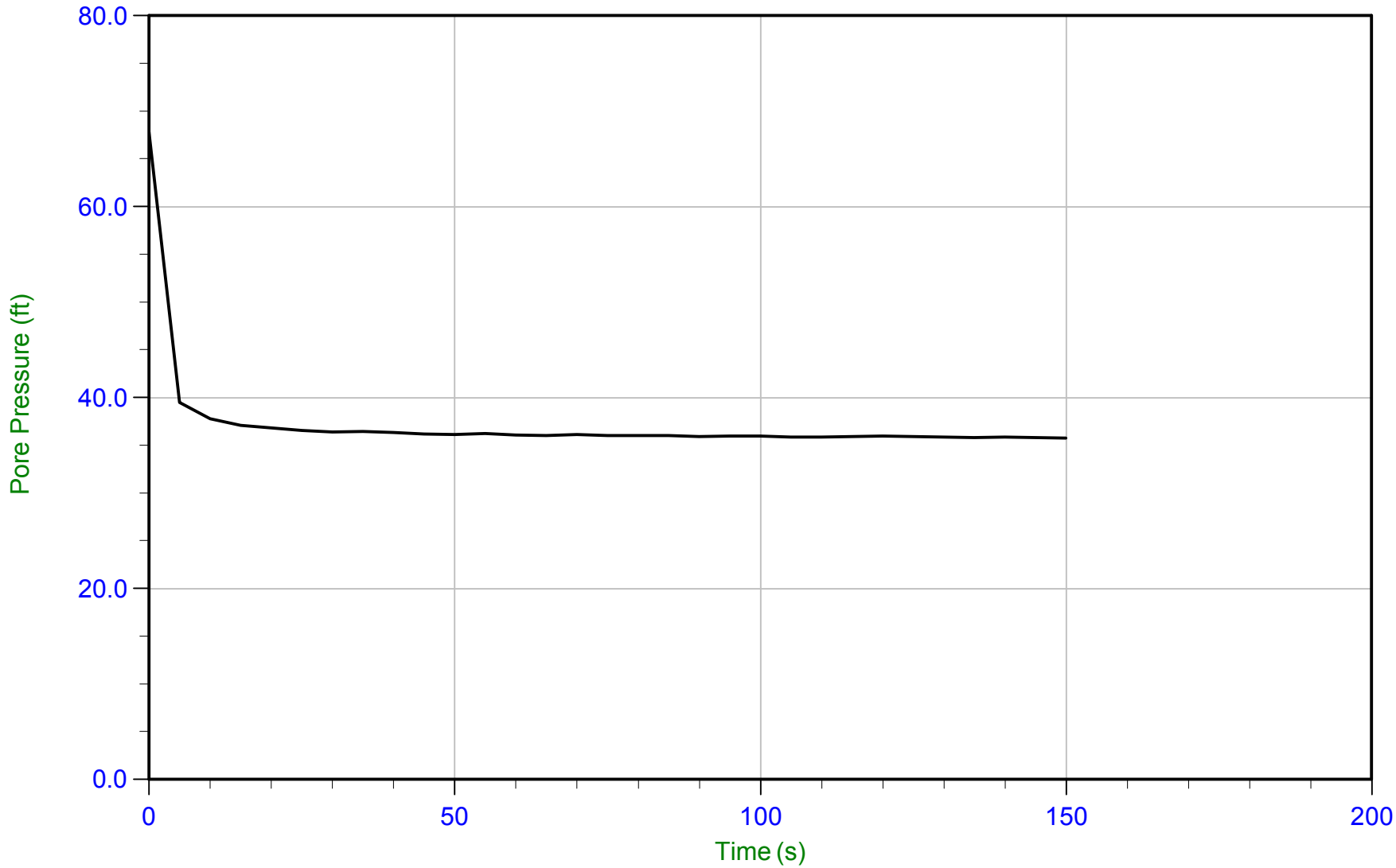
WT: 3.866 m / 12.685 ft
Ueq: 29.5 ft

CONETEC

Haley & Aldrich

Job No: 14-53069
Date: 09/26/2014 08:52
Site: Rush Island

Sounding: SCPT-C103
Cone: 268:T1500F15U500
Cone Area: 15 sq cm



Trace Summary:

Filename: 14-53069_SP103.PPD
Depth: 14.850 m / 48.720 ft
Duration: 150.0 s

U Min: 35.8 ft
U Max: 67.8 ft

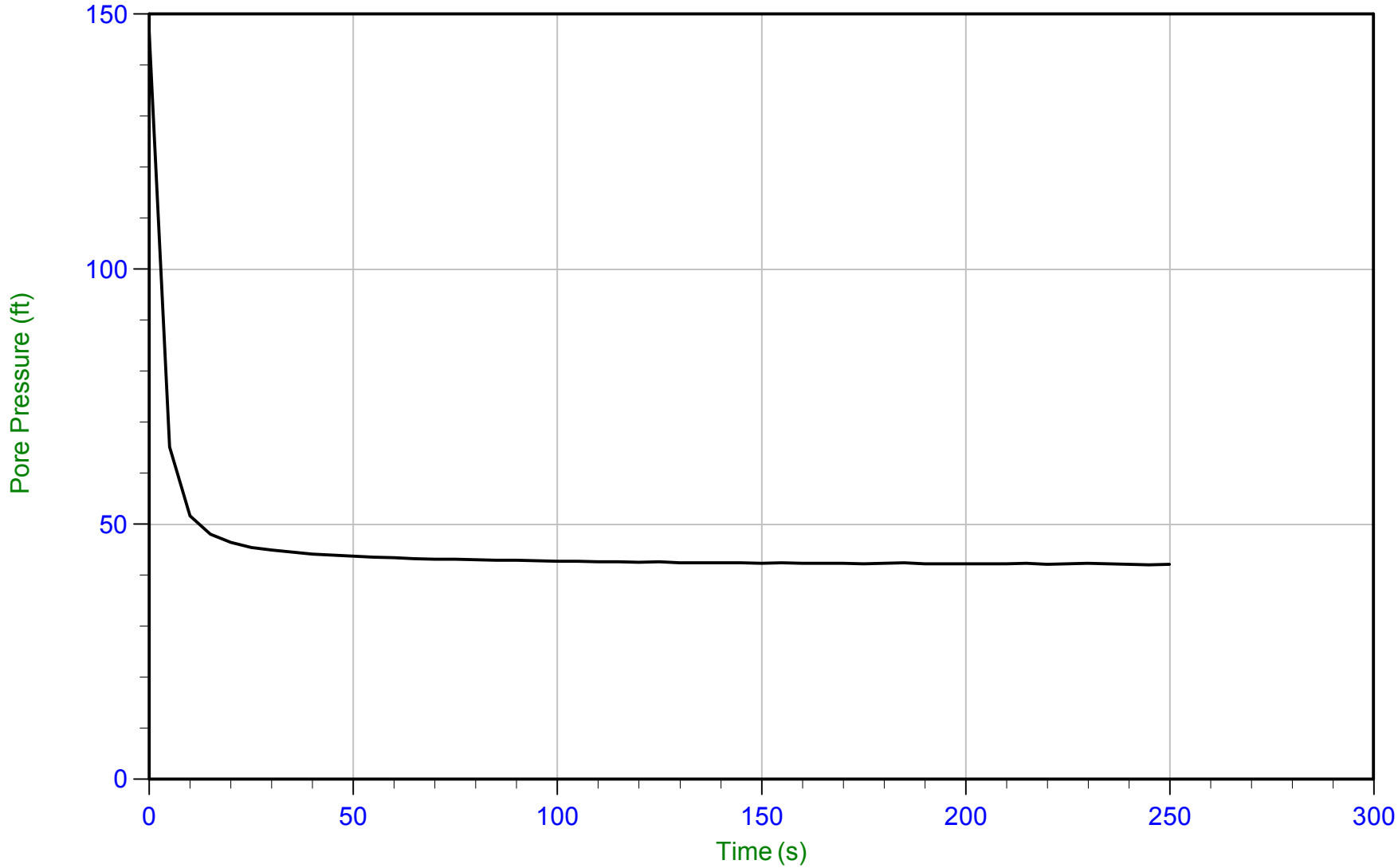
WT: 3.941 m / 12.931 ft
Ueq: 35.8 ft

CONETEC

Haley & Aldrich

Job No: 14-53069
Date: 09/26/2014 08:52
Site: Rush Island

Sounding: SCPT-C103
Cone: 268:T1500F15U500
Cone Area: 15 sq cm



Trace Summary:

Filename: 14-53069_SP103.PPD
Depth: 16.850 m / 55.281 ft
Duration: 250.0 s

U Min: 42.1 ft
U Max: 146.4 ft

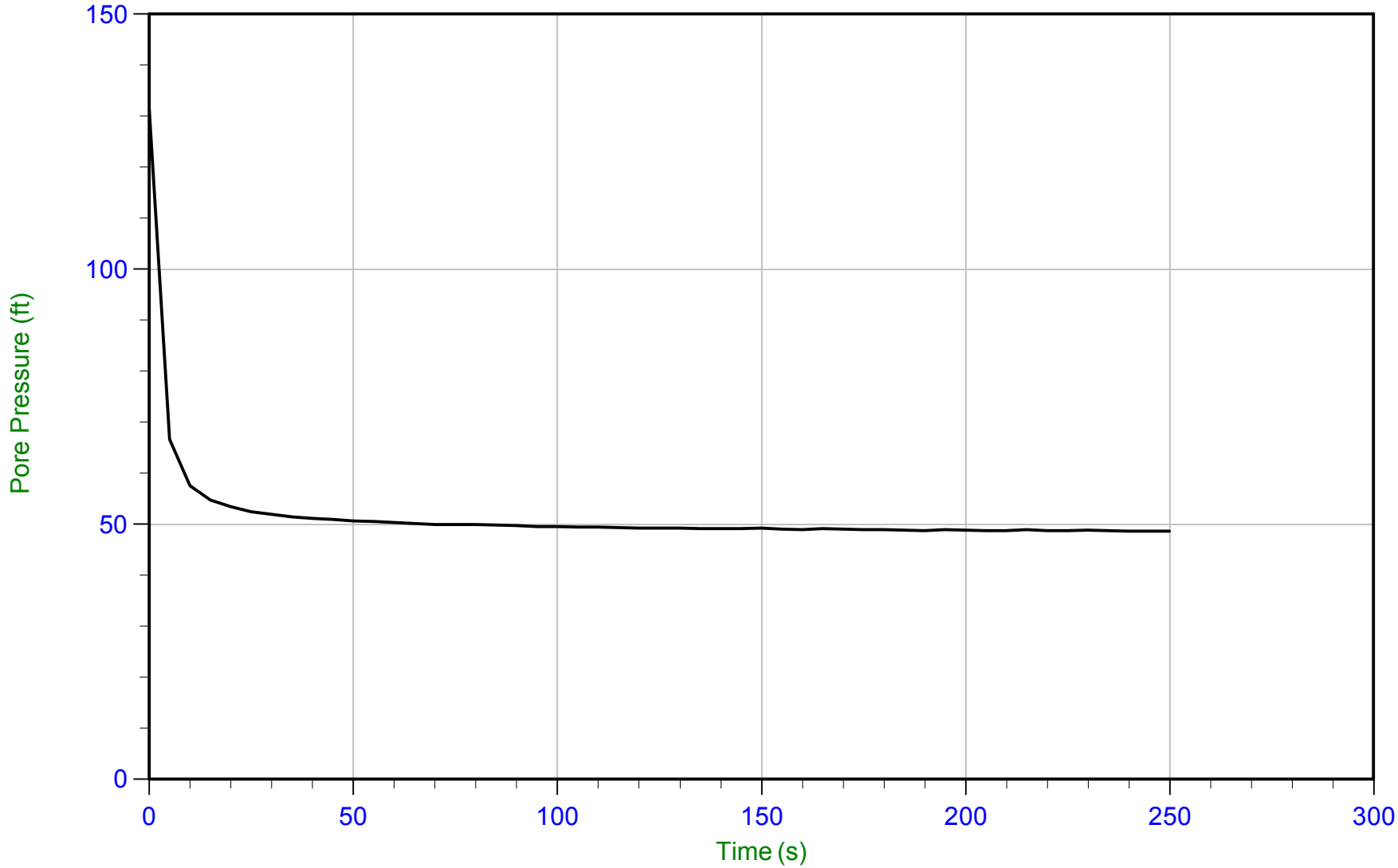
WT: 3.959 m / 12.989 ft
Ueq: 42.3 ft

CONETEC

Haley & Aldrich

Job No: 14-53069
Date: 09/26/2014 08:52
Site: Rush Island

Sounding: SCPT-C103
Cone: 268:T1500F15U500
Cone Area: 15 sq cm



Trace Summary:

Filename: 14-53069_SP103.PPD
Depth: 18.850 m / 61.843 ft
Duration: 250.0 s

U Min: 48.7 ft
U Max: 131.4 ft

WT: 4.068 m / 13.347 ft
Ueq: 48.5 ft
U(50): 89.96 ft

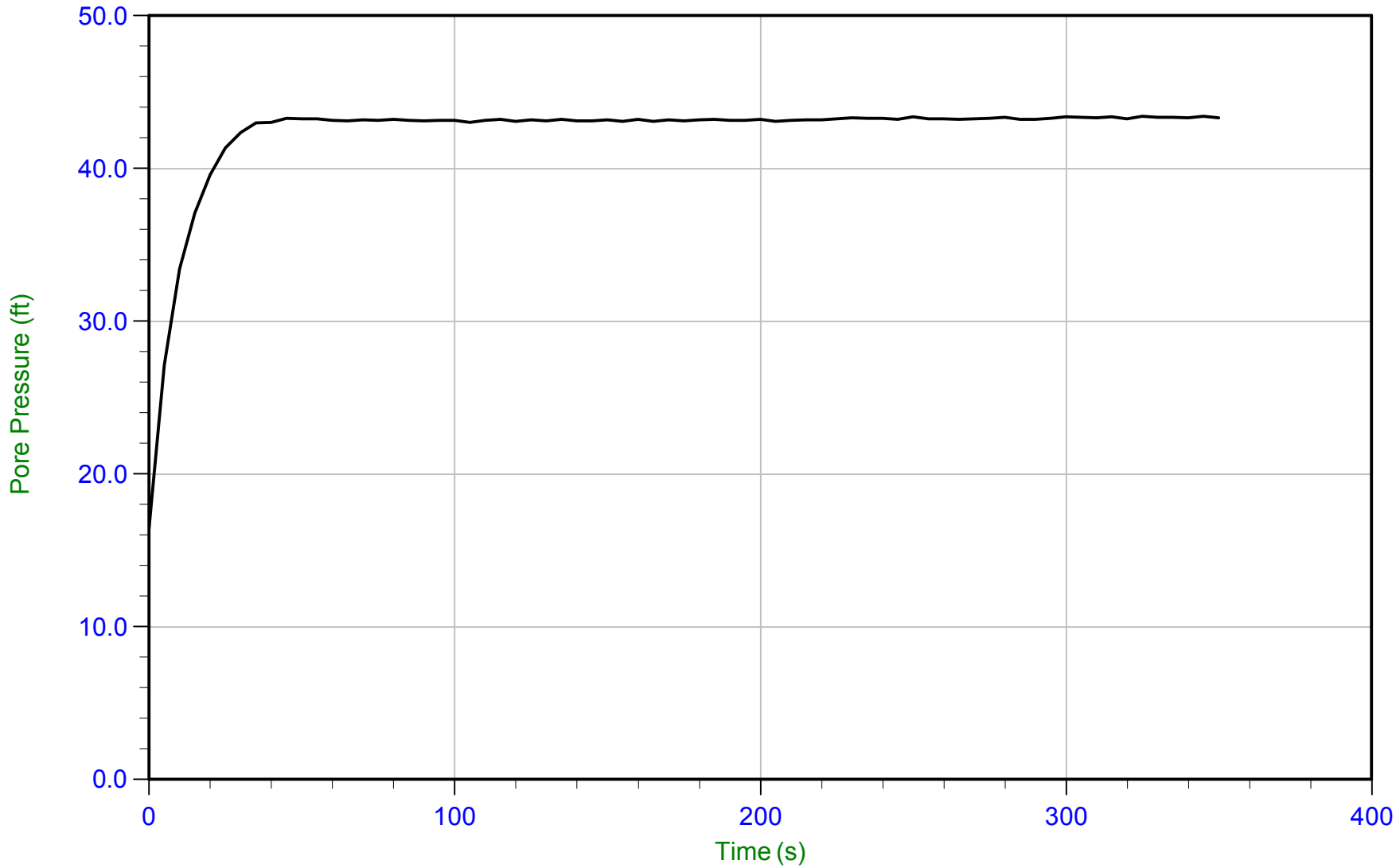
T(50): 3.2 s
Ir: 100
Ch: 219.4 sq cm/min

CONETEC

Haley & Aldrich

Job No: 14-53069
Date: 09/26/2014 08:52
Site: Rush Island

Sounding: SCPT-C103
Cone: 268:T1500F15U500
Cone Area: 15 sq cm



Trace Summary:

Filename: 14-53069_SP103.PPD
Depth: 20.860 m / 68.437 ft
Duration: 350.0 s

U Min: 16.4 ft
U Max: 43.4 ft

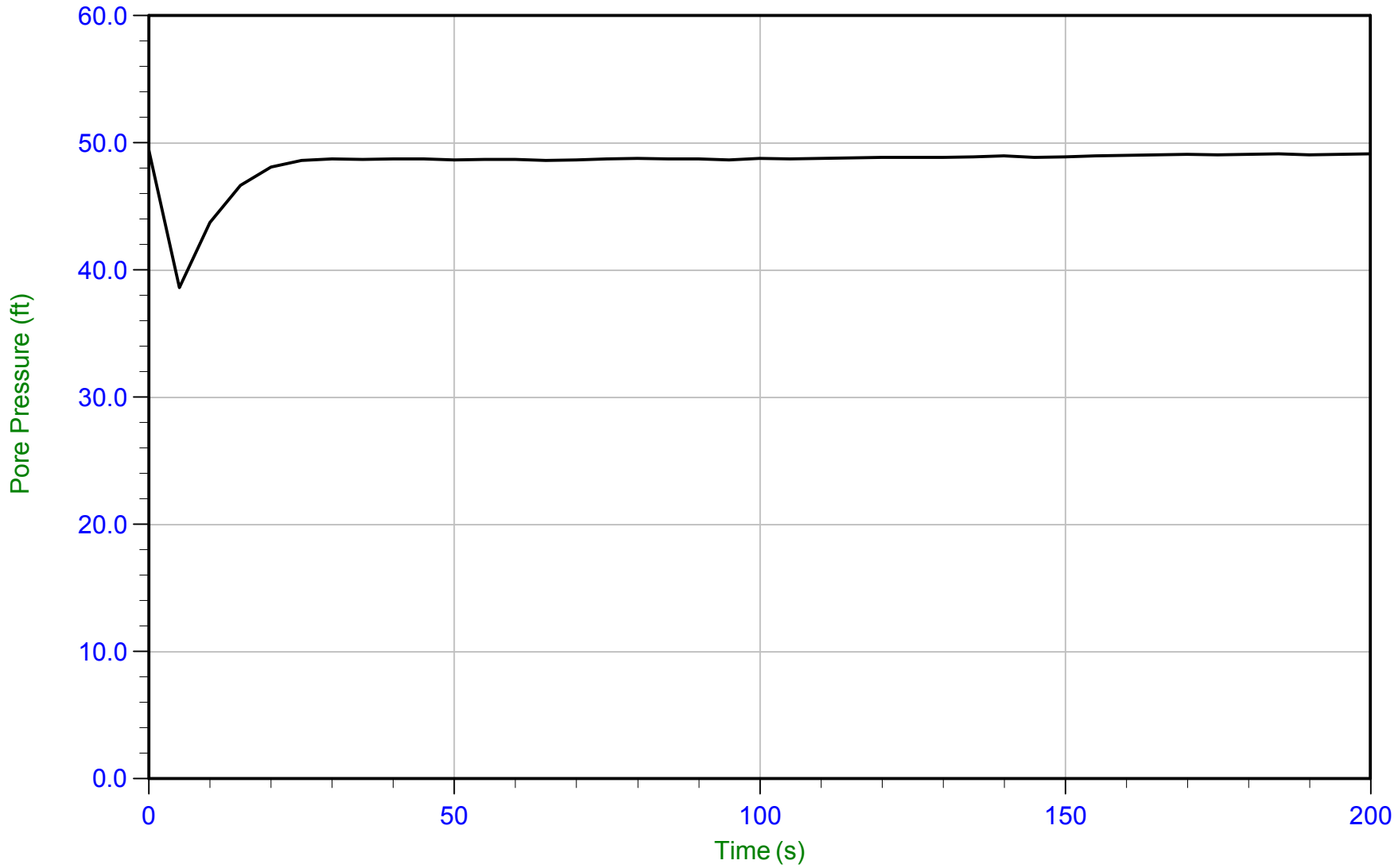
WT: 7.625 m / 25.017 ft
Ueq: 43.4 ft

CONETEC

Haley & Aldrich

Job No: 14-53069
Date: 09/26/2014 08:52
Site: Rush Island

Sounding: SCPT-C103
Cone: 268:T1500F15U500
Cone Area: 15 sq cm



Trace Summary:

Filename: 14-53069_SP103.PPD
Depth: 22.850 m / 74.966 ft
Duration: 200.0 s

U Min: 38.6 ft
U Max: 49.4 ft

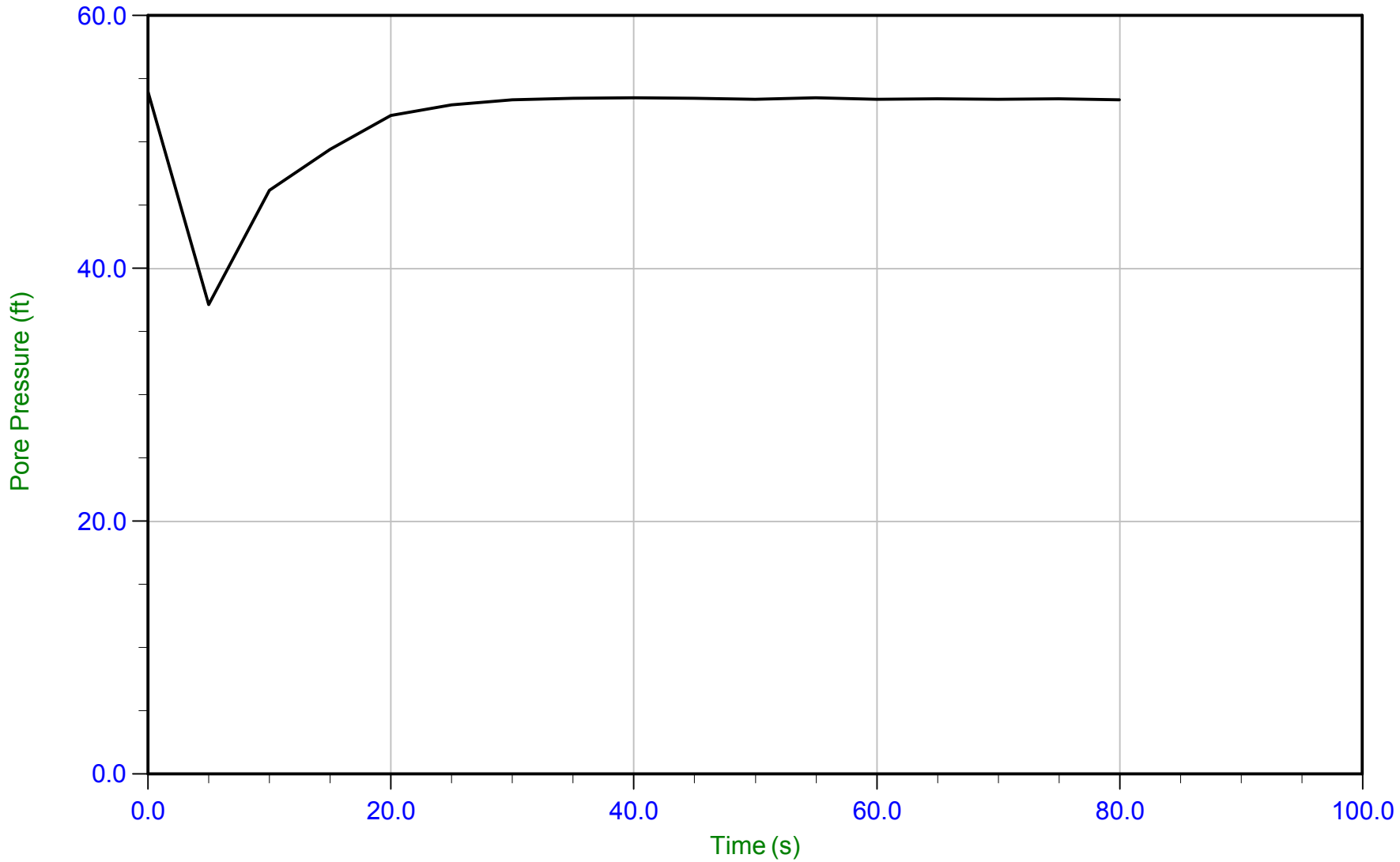
WT: 7.862 m / 25.794 ft
Ueq: 49.2 ft

CONETEC

Haley & Aldrich

Job No: 14-53069
Date: 09/26/2014 08:52
Site: Rush Island

Sounding: SCPT-C103
Cone: 268:T1500F15U500
Cone Area: 15 sq cm



Trace Summary:

Filename: 14-53069_SP103.PPD
Depth: 24.390 m / 80.019 ft
Duration: 80.0 s

U Min: 37.2 ft
U Max: 54.0 ft

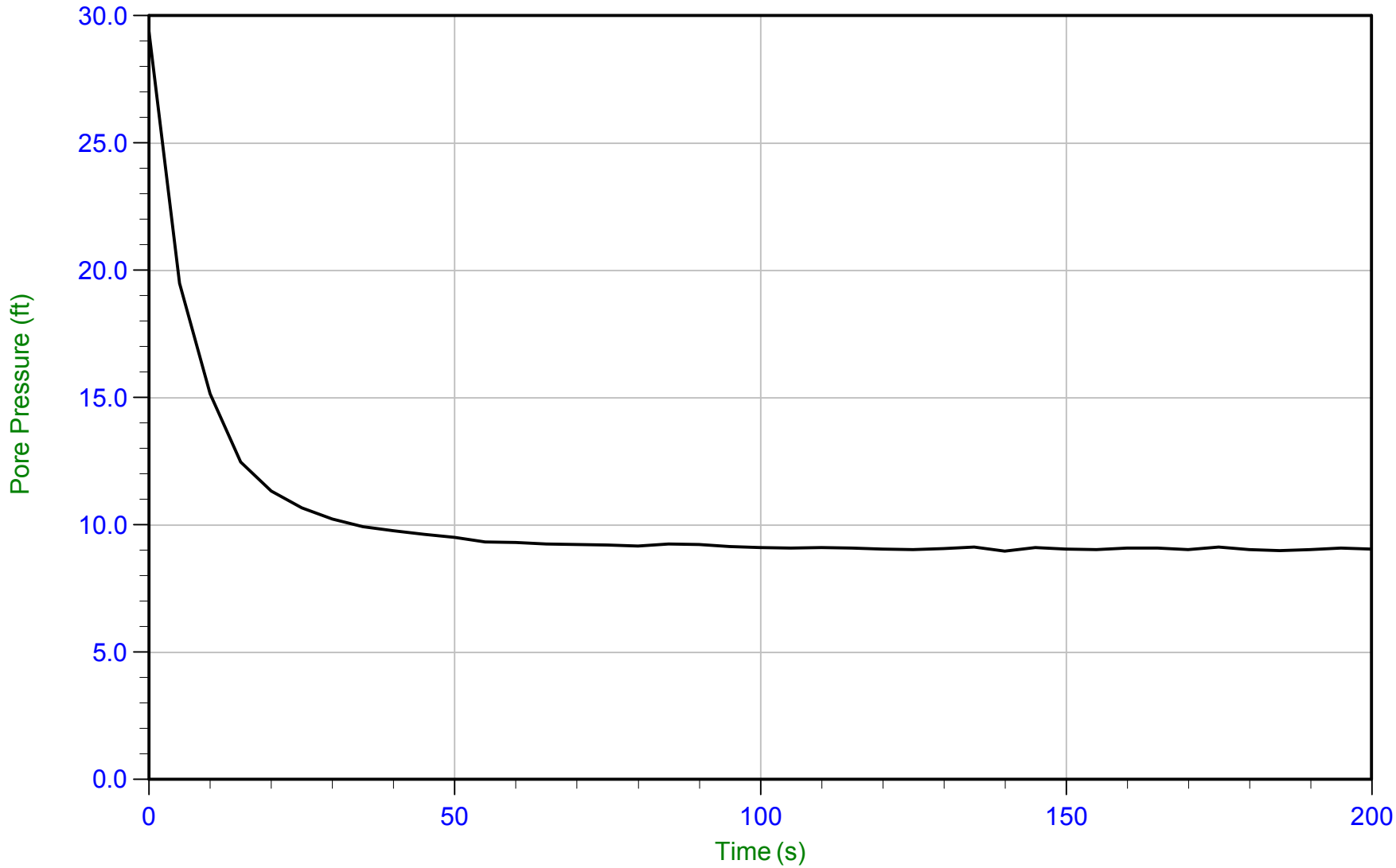
WT: 8.096 m / 26.561 ft
Ueq: 53.5 ft

CONETEC

Haley & Aldrich

Job No: 14-53069
Date: 09/26/2014 13:47
Site: Rush Island

Sounding: SCPT-C107A
Cone: 268:T1500F15U500
Cone Area: 15 sq cm



Trace Summary:

Filename: 14-53069_SP107A.PPD
Depth: 8.860 m / 29.068 ft
Duration: 200.0 s

U Min: 9.0 ft
U Max: 29.4 ft

WT: 6.076 m / 19.933 ft
Ueq: 9.1 ft
U(50): 19.25 ft

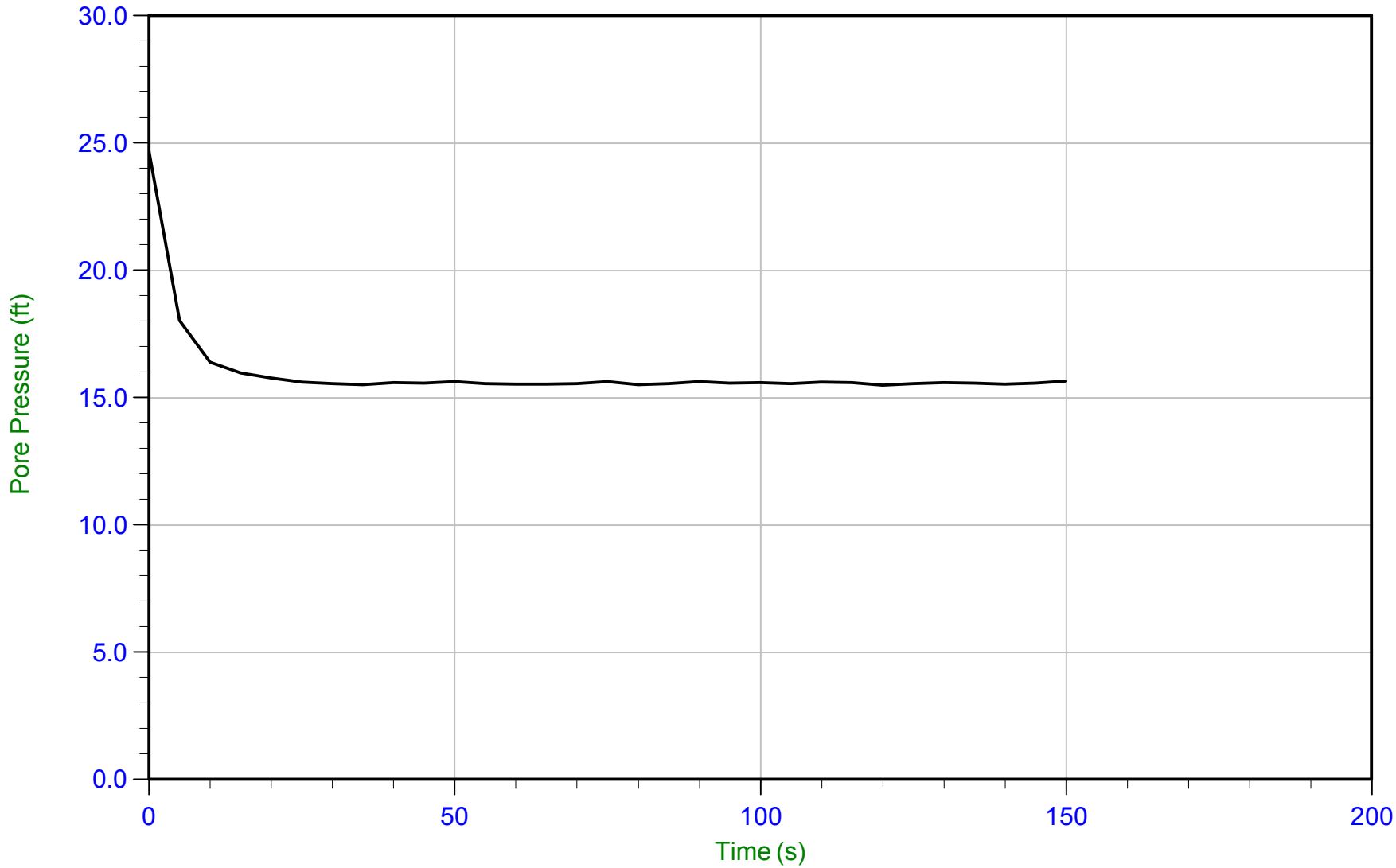
T(50): 5.3 s
Ir: 100
Ch: 133.2 sq cm/min

CONETEC

Haley & Aldrich

Job No: 14-53069
Date: 09/26/2014 13:47
Site: Rush Island

Sounding: SCPT-C107A
Cone: 268:T1500F15U500
Cone Area: 15 sq cm



Trace Summary:

Filename: 14-53069_SP107A.PPD
Depth: 10.860 m / 35.629 ft
Duration: 150.0 s

U Min: 15.5 ft
U Max: 24.7 ft

WT: 6.150 m / 20.179 ft
Ueq: 15.5 ft
U(50): 20.06 ft

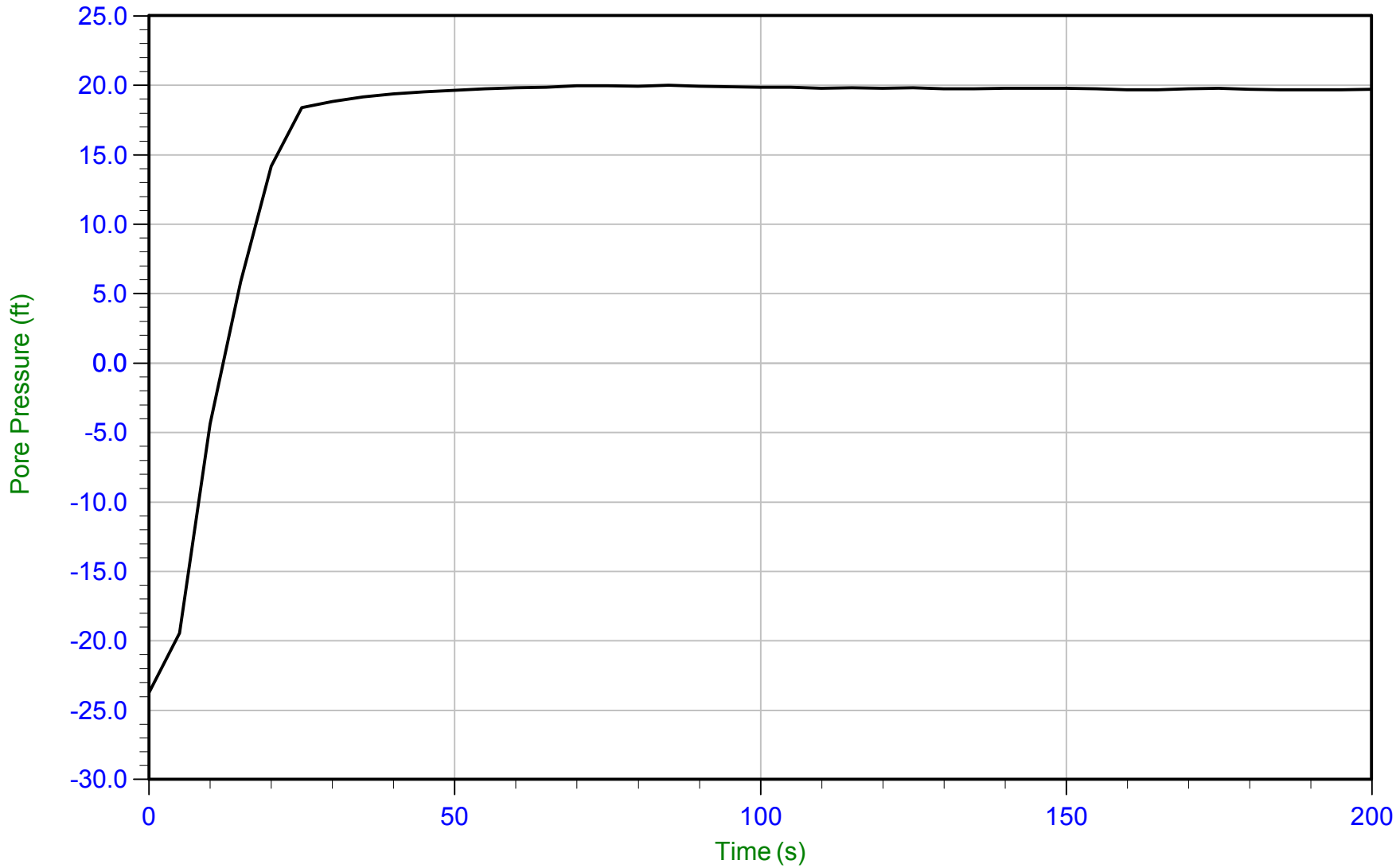
T(50): 3.5 s
Ir: 100
Ch: 202.1 sq cm/min

CONETEC

Haley & Aldrich

Job No: 14-53069
Date: 09/26/2014 13:47
Site: Rush Island

Sounding: SCPT-C107A
Cone: 268:T1500F15U500
Cone Area: 15 sq cm



Trace Summary:

Filename: 14-53069_SP107A.PPD
Depth: 12.860 m / 42.191 ft
Duration: 200.0 s

U Min: -23.7 ft
U Max: 20.0 ft

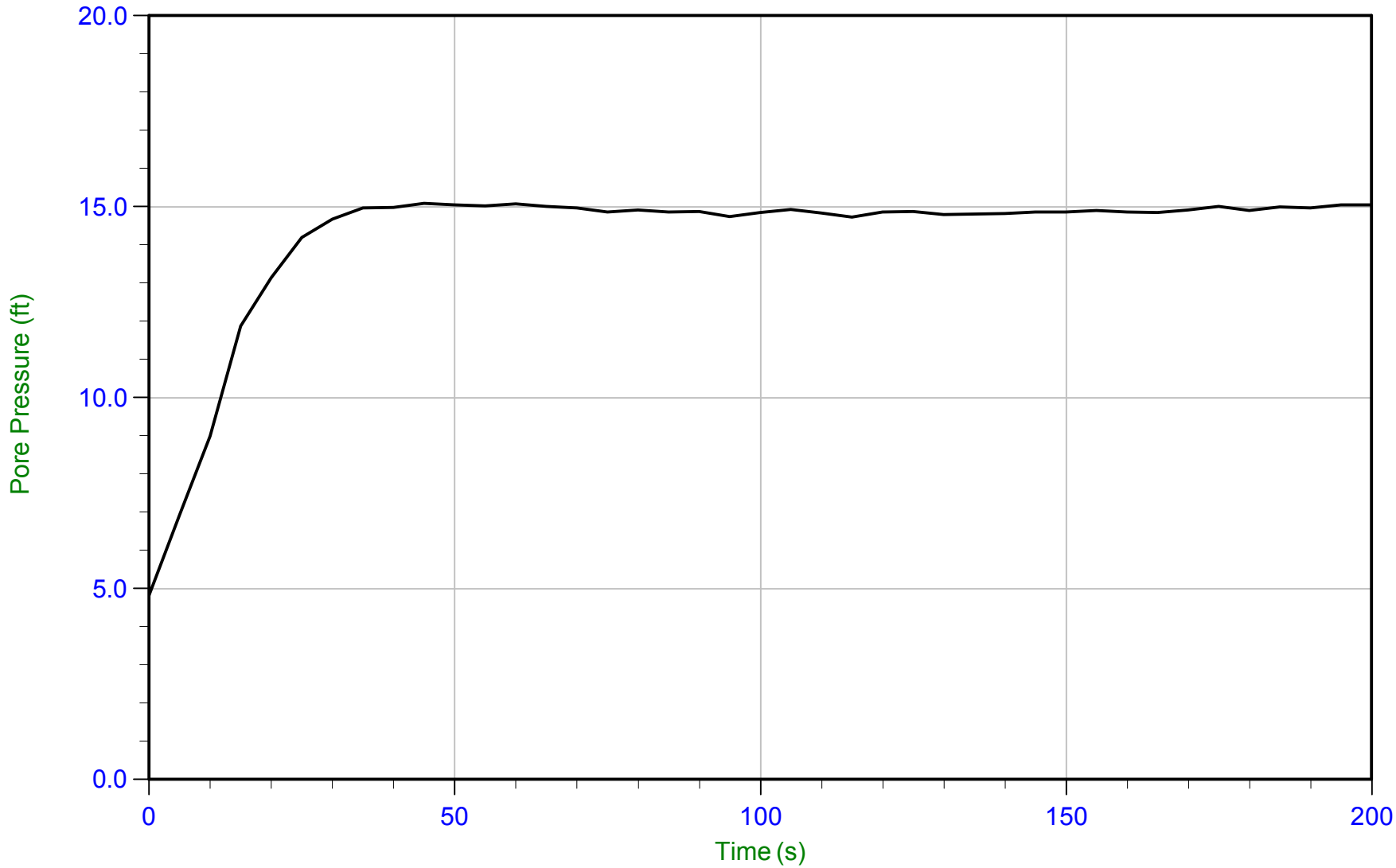
WT: 6.879 m / 22.567 ft
Ueq: 19.6 ft

CONETEC

Haley & Aldrich

Job No: 14-53069
Date: 09/26/2014 13:47
Site: Rush Island

Sounding: SCPT-C107A
Cone: 268:T1500F15U500
Cone Area: 15 sq cm



Trace Summary:

Filename: 14-53069_SP107A.PPD
Depth: 14.870 m / 48.785 ft
Duration: 200.0 s

U Min: 4.8 ft
U Max: 15.1 ft

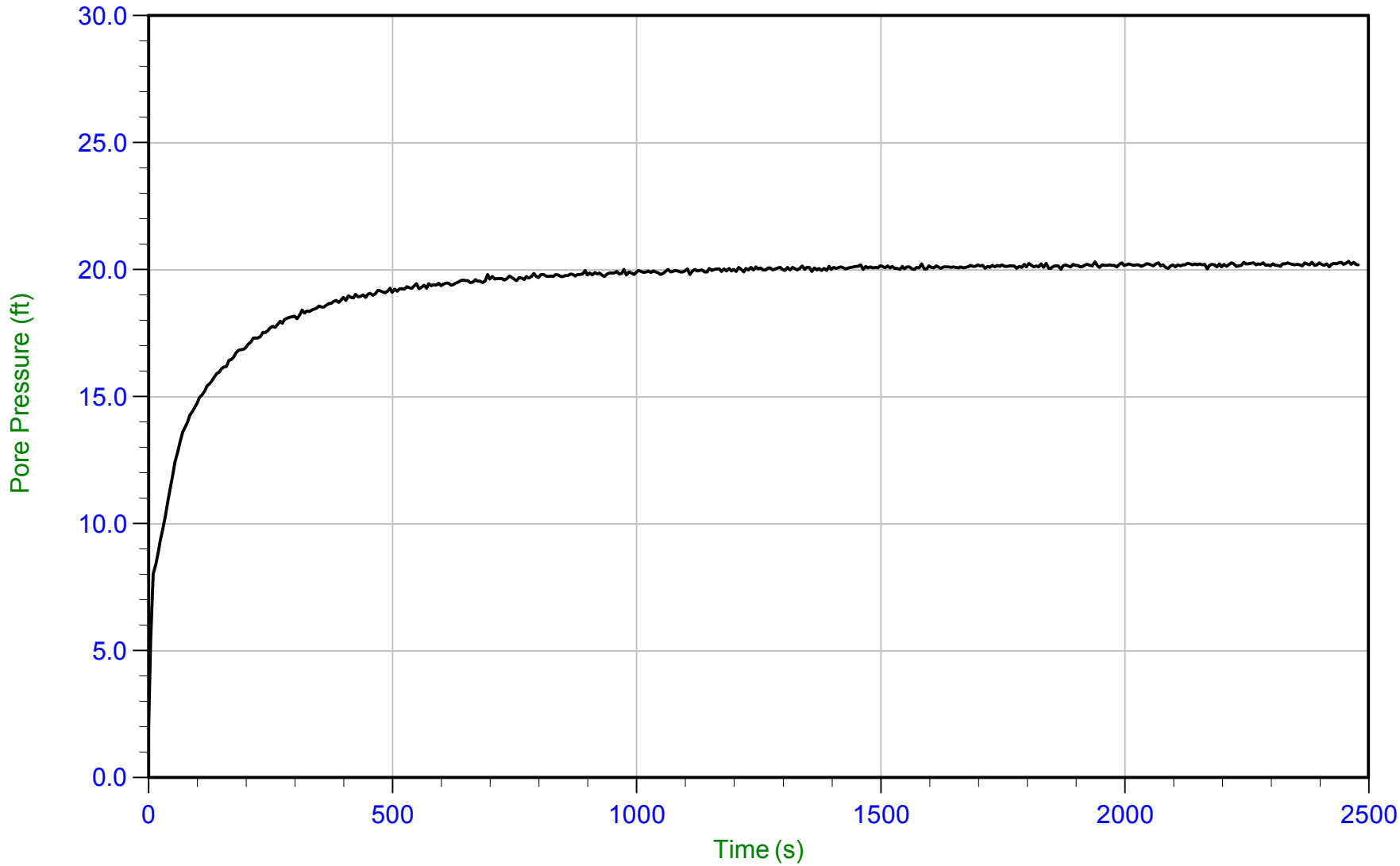
WT: 10.264 m / 33.673 ft
Ueq: 15.1 ft

CONETEC

Haley & Aldrich

Job No: 14-53069
Date: 09/26/2014 13:47
Site: Rush Island

Sounding: SCPT-C107A
Cone: 268:T1500F15U500
Cone Area: 15 sq cm



Trace Summary:

Filename: 14-53069_SP107A.PPD
Depth: 16.860 m / 55.314 ft
Duration: 2480.0 s

U Min: 2.0 ft
U Max: 20.3 ft

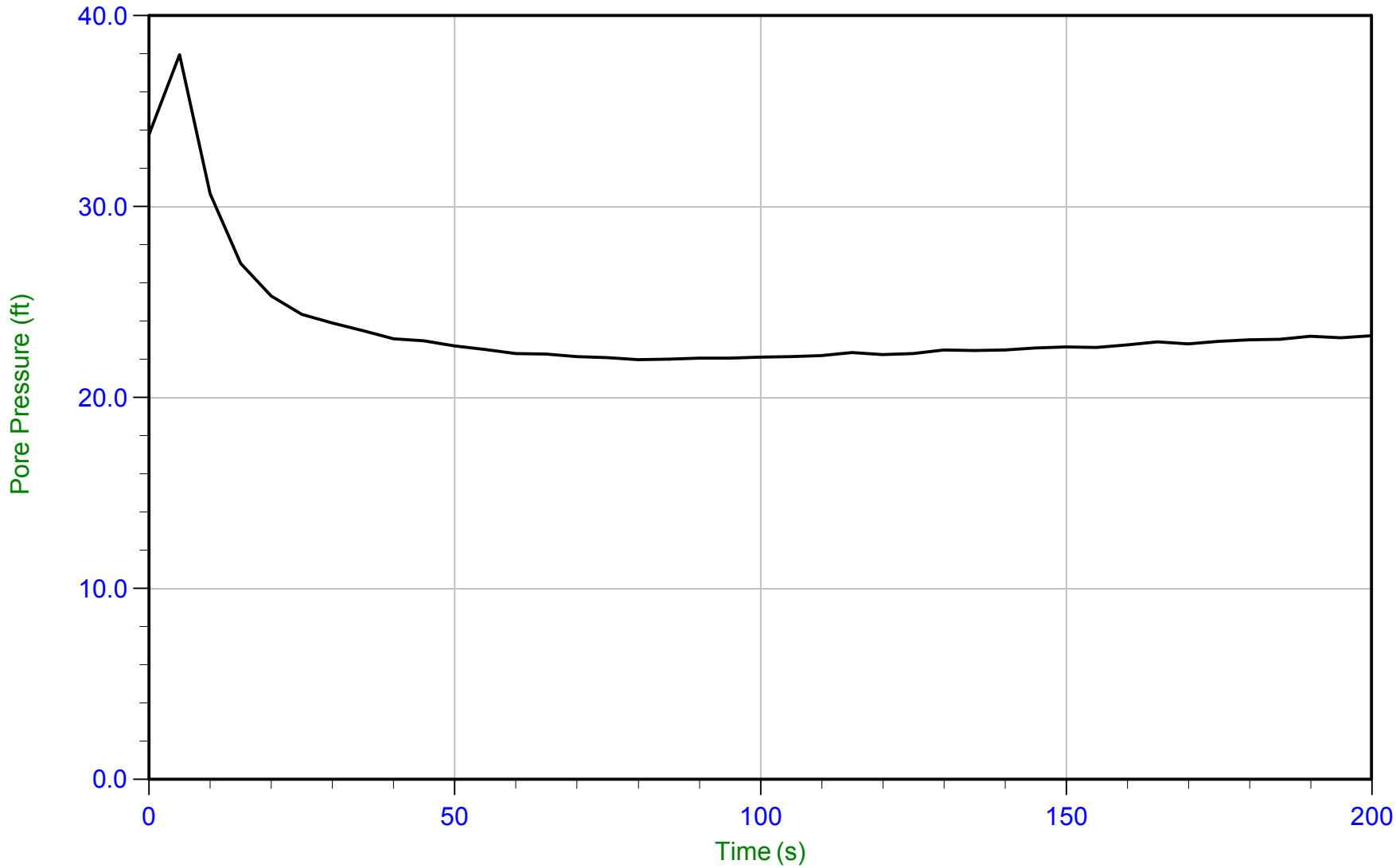
WT: 10.707 m / 35.127 ft
Ueq: 20.2 ft

CONETEC

Haley & Aldrich

Job No: 14-53069
Date: 09/26/2014 13:47
Site: Rush Island

Sounding: SCPT-C107A
Cone: 268:T1500F15U500
Cone Area: 15 sq cm



Trace Summary:

Filename: 14-53069_SP107A.PPD
Depth: 18.860 m / 61.876 ft
Duration: 200.0 s

U Min: 22.0 ft
U Max: 37.9 ft

Appendix D

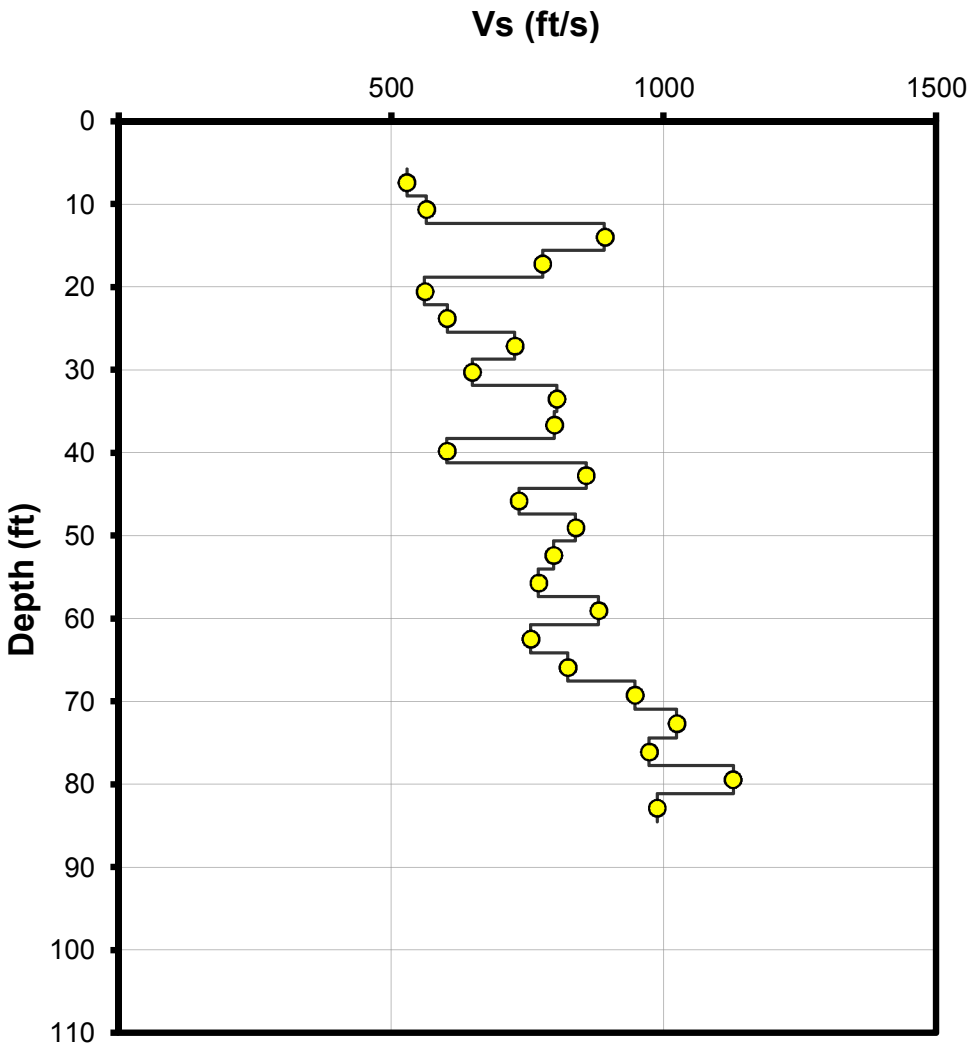
Client:	Haley & Aldrich
Project:	Rush Island - Fastus, Missouri
Sounding:	SCPT-C100
Date:	September 23, 2014

Seismic Source:	Beam	
Source Offset:	1.97	(ft)
Source Depth:	0.00	(ft)
Geophone Offset:	0.66	(ft)

SEISMIC - Vs

Tip Depth (ft)	Geophone Depth (ft)	Ray Path (ft)	Depth Interval (ft)	Time Interval (ms)	Mid-layer Depth (ft)	Vs Interval Velocity (ft/s)
6.43	5.77	6.10				
9.68	9.02	9.24	3.14	5.93	7.40	529
12.99	12.33	12.49	3.25	5.77	10.68	564
16.24	15.58	15.71	3.22	3.61	13.96	891
19.52	18.86	18.97	3.26	4.19	17.22	778
22.83	22.17	22.26	3.29	5.87	20.52	561
26.12	25.46	25.54	3.28	5.44	23.82	603
29.36	28.70	28.77	3.23	4.45	27.08	726
32.55	31.89	31.95	3.18	4.91	30.30	648
35.70	35.04	35.10	3.14	3.91	33.47	804
38.98	38.32	38.37	3.28	4.10	36.68	799
41.86	41.20	41.25	2.88	4.78	39.76	602
44.95	44.29	44.34	3.09	3.60	42.75	857
48.03	47.37	47.41	3.08	4.19	45.83	734
51.31	50.65	50.69	3.28	3.91	49.01	838
54.69	54.03	54.07	3.38	4.23	52.34	798
58.04	57.38	57.42	3.35	4.35	55.71	770
61.45	60.79	60.83	3.41	3.87	59.09	881
64.86	64.20	64.23	3.41	4.51	62.50	756
68.24	67.58	67.61	3.38	4.10	65.89	824
71.65	70.99	71.02	3.41	3.60	69.29	947
75.10	74.44	74.47	3.45	3.37	72.72	1023
78.38	77.72	77.75	3.28	3.37	76.08	973
81.82	81.16	81.19	3.44	3.05	79.44	1128
85.24	84.58	84.61	3.42	3.46	82.87	988

Client:	Haley & Aldrich
Location:	Rush Island - Festus, Missouri
CPT Sounding:	SCPT-C100
Date:	September 23, 2014



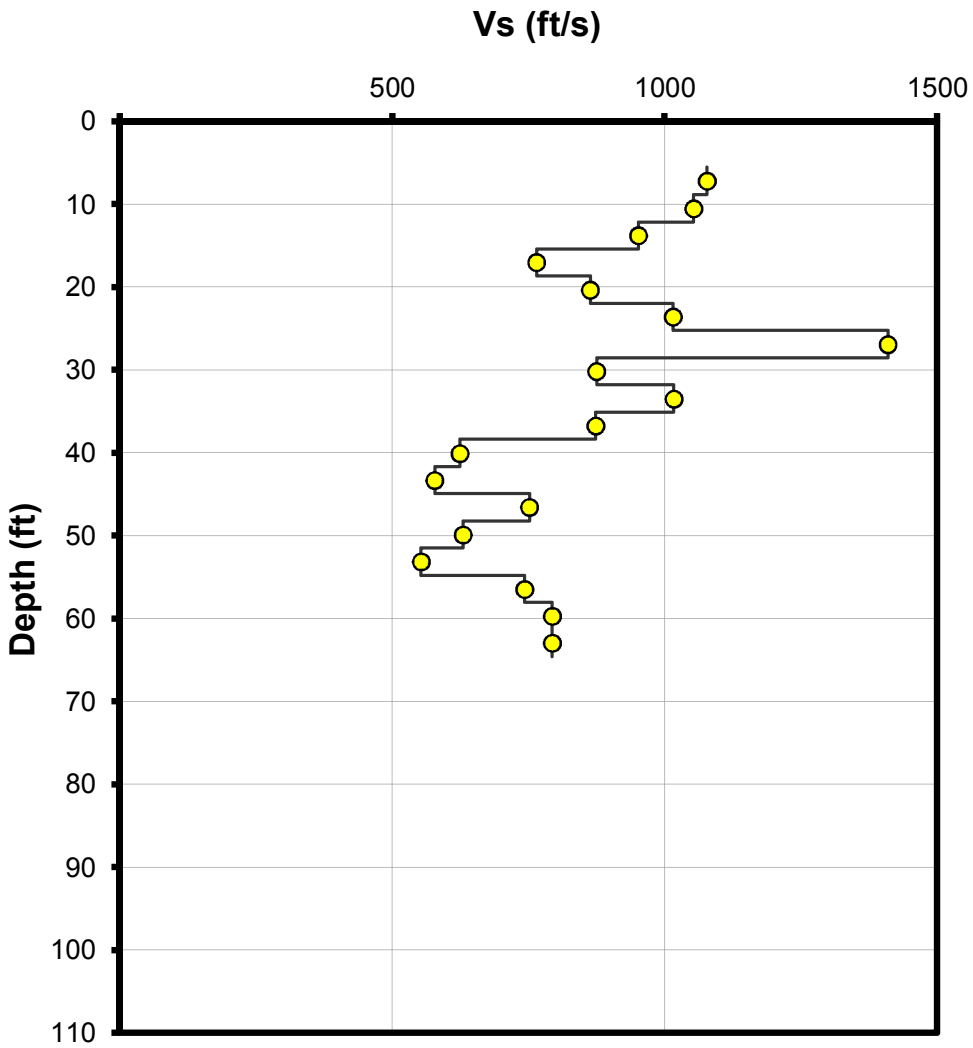
Client:	Haley & Aldrich
Project:	Rush Island - Fastus, Missouri
Sounding:	SCPT-C101
Date:	September 27, 2014

Seismic Source:	Beam	
Source Offset:	1.97	(ft)
Source Depth:	0.00	(ft)
Geophone Offset:	0.66	(ft)

SEISMIC - Vs

Tip Depth (ft)	Geophone Depth (ft)	Ray Path (ft)	Depth Interval (ft)	Time Interval (ms)	Mid-layer Depth (ft)	Vs Interval Velocity (ft/s)
6.23	5.57	5.91				
9.51	8.85	9.07	3.16	2.93	7.21	1078
12.80	12.14	12.30	3.23	3.07	10.50	1053
16.08	15.42	15.55	3.25	3.41	13.78	952
19.36	18.70	18.81	3.26	4.26	17.06	765
22.64	21.98	22.07	3.26	3.78	20.34	864
25.92	25.26	25.34	3.27	3.22	23.62	1015
29.20	28.54	28.61	3.27	2.32	26.90	1410
32.48	31.82	31.88	3.27	3.74	30.18	875
35.76	35.10	35.16	3.27	3.22	33.46	1017
39.04	38.38	38.43	3.28	3.75	36.74	873
42.36	41.70	41.75	3.32	5.31	40.04	624
45.60	44.94	44.99	3.24	5.60	43.32	578
48.88	48.22	48.26	3.28	4.36	46.58	752
52.17	51.51	51.55	3.29	5.22	49.87	630
55.45	54.79	54.83	3.28	5.93	53.15	553
58.73	58.07	58.11	3.28	4.41	56.43	743
62.01	61.35	61.39	3.28	4.13	59.71	794
65.29	64.63	64.66	3.28	4.13	62.99	794

Client:	Haley & Aldrich
Location:	Rush Island - Festus, Missouri
CPT Sounding:	SCPT-C101
Date:	September 27, 2014



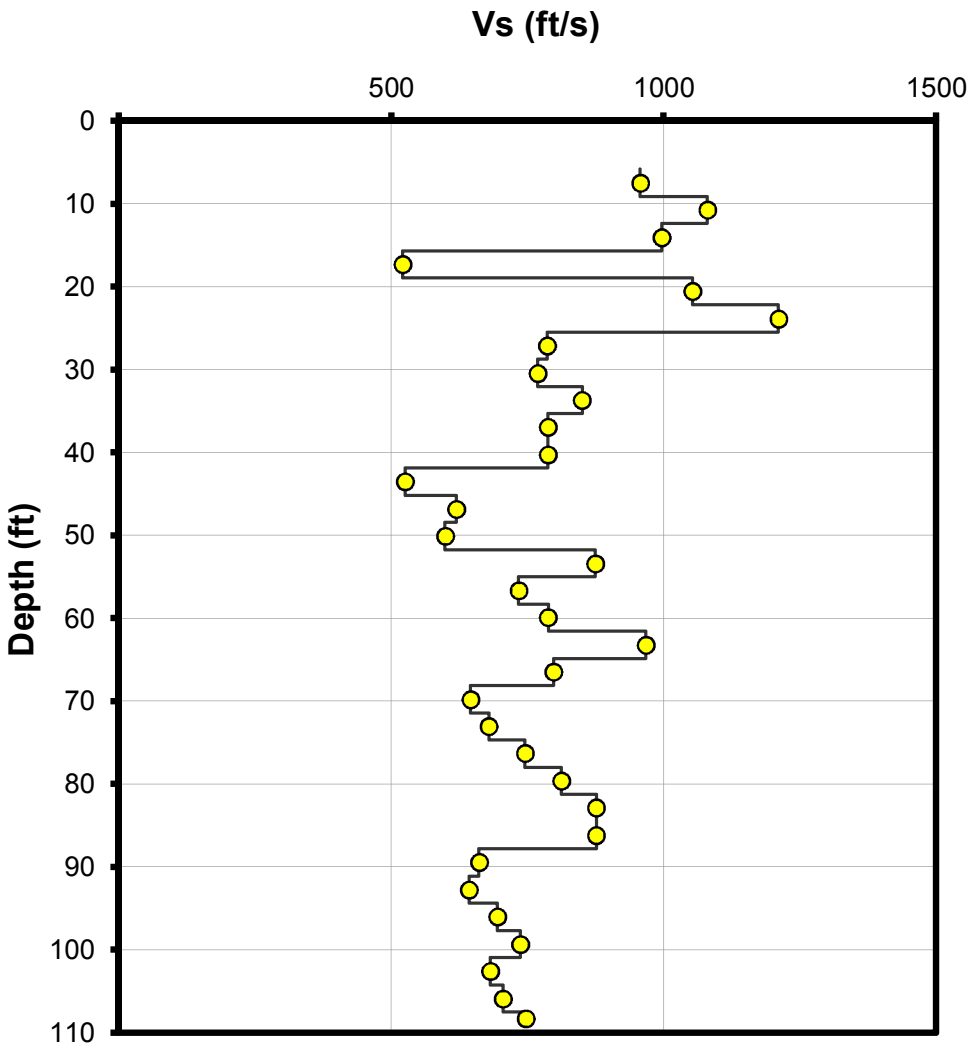
Client:	Haley & Aldrich
Project:	Rush Island - Fastus, Missouri
Sounding:	SCPT-C102
Date:	September 25, 2014

Seismic Source:	Beam	
Source Offset:	1.97	(ft)
Source Depth:	0.00	(ft)
Geophone Offset:	0.66	(ft)

SEISMIC - Vs

Tip Depth (ft)	Geophone Depth (ft)	Ray Path (ft)	Depth Interval (ft)	Time Interval (ms)	Mid-layer Depth (ft)	Vs Interval Velocity (ft/s)
6.46	5.80	6.13				
9.78	9.12	9.33	3.21	3.35	7.46	957
13.02	12.36	12.52	3.19	2.95	10.74	1080
16.34	15.68	15.81	3.29	3.30	14.02	996
19.59	18.93	19.04	3.23	6.20	17.31	521
22.87	22.21	22.30	3.26	3.10	20.57	1053
26.15	25.49	25.57	3.27	2.70	23.85	1211
29.43	28.77	28.84	3.27	4.16	27.13	786
32.71	32.05	32.11	3.27	4.26	30.41	768
35.99	35.33	35.39	3.27	3.85	33.69	850
39.27	38.61	38.66	3.28	4.16	36.97	787
42.55	41.89	41.94	3.28	4.16	40.25	788
45.83	45.17	45.22	3.28	6.24	43.53	525
49.11	48.45	48.49	3.28	5.29	46.81	619
52.40	51.74	51.78	3.29	5.49	50.10	599
55.68	55.02	55.06	3.28	3.75	53.38	874
58.96	58.30	58.34	3.28	4.47	56.66	733
62.24	61.58	61.62	3.28	4.16	59.94	788
65.52	64.86	64.89	3.28	3.39	63.22	967
68.80	68.14	68.17	3.28	4.11	66.50	798
72.08	71.42	71.45	3.28	5.08	69.78	645
75.36	74.70	74.73	3.28	4.83	73.06	679
78.64	77.98	78.01	3.28	4.40	76.34	745
81.92	81.26	81.29	3.28	4.04	79.62	812
85.20	84.54	84.57	3.28	3.74	82.90	877
88.48	87.82	87.85	3.28	3.74	86.18	877
91.76	91.10	91.13	3.28	4.96	89.46	661
95.05	94.39	94.41	3.29	5.12	92.75	642
98.36	97.70	97.72	3.31	4.76	96.05	695
101.64	100.98	101.00	3.28	4.45	99.34	737
104.92	104.26	104.28	3.28	4.81	102.62	682
108.17	107.51	107.53	3.25	4.61	105.89	705
109.68	109.02	109.04	1.51	2.02	108.27	747

Client:	Haley & Aldrich
Location:	Rush Island - Festus, Missouri
CPT Sounding:	SCPT-C102
Date:	September 25, 2014



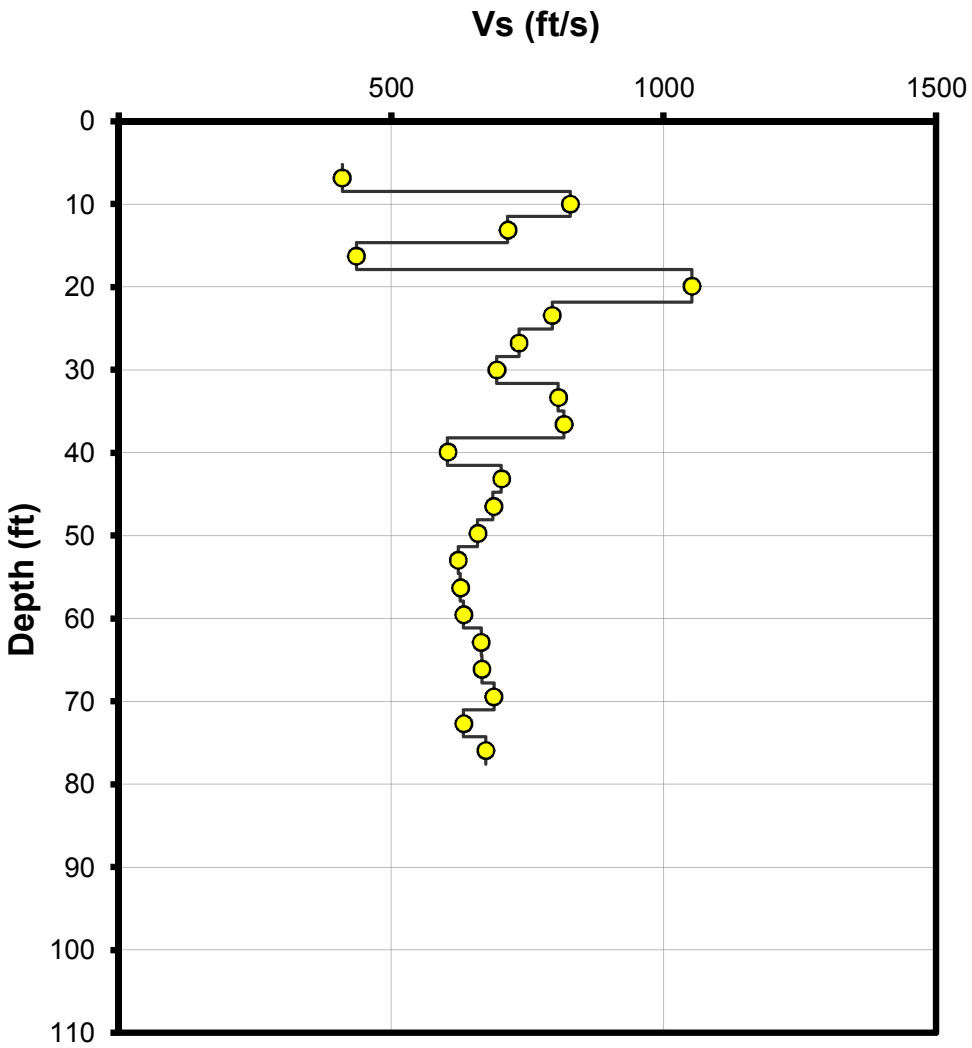
Client:	Haley & Aldrich
Project:	Rush Island - Fastus, Missouri
Sounding:	SCPT-C103
Date:	September 26, 2014

Seismic Source:	Beam	
Source Offset:	1.97	(ft)
Source Depth:	0.00	(ft)
Geophone Offset:	0.66	(ft)

SEISMIC - Vs

Tip Depth (ft)	Geophone Depth (ft)	Ray Path (ft)	Depth Interval (ft)	Time Interval (ms)	Mid-layer Depth (ft)	Vs Interval Velocity (ft/s)
5.91	5.25	5.61				
9.15	8.49	8.72	3.11	7.58	6.87	410
12.14	11.48	11.65	2.93	3.54	9.99	828
15.35	14.69	14.83	3.17	4.45	13.09	713
18.57	17.91	18.02	3.20	7.33	16.30	436
22.47	21.81	21.90	3.88	3.69	19.86	1052
25.75	25.09	25.17	3.27	4.11	23.45	795
29.04	28.38	28.45	3.28	4.47	26.74	734
32.32	31.66	31.73	3.27	4.72	30.02	693
35.60	34.94	35.00	3.27	4.06	33.30	806
38.88	38.22	38.27	3.28	4.01	36.58	817
42.16	41.50	41.55	3.28	5.43	39.86	603
45.44	44.78	44.83	3.28	4.67	43.14	702
48.72	48.06	48.10	3.28	4.77	46.42	687
52.00	51.34	51.38	3.28	4.98	49.70	658
55.28	54.62	54.66	3.28	5.26	52.98	623
58.56	57.90	57.94	3.28	5.23	56.26	627
61.84	61.18	61.22	3.28	5.18	59.54	633
65.12	64.46	64.49	3.28	4.93	62.82	665
68.44	67.78	67.81	3.32	4.98	66.12	666
71.69	71.03	71.06	3.25	4.72	69.41	688
74.97	74.31	74.34	3.28	5.18	72.67	633
78.25	77.59	77.62	3.28	4.87	75.95	673

Client:	Haley & Aldrich
Location:	Rush Island - Festus, Missouri
CPT Sounding:	SCPT-C103
Date:	September 26, 2014



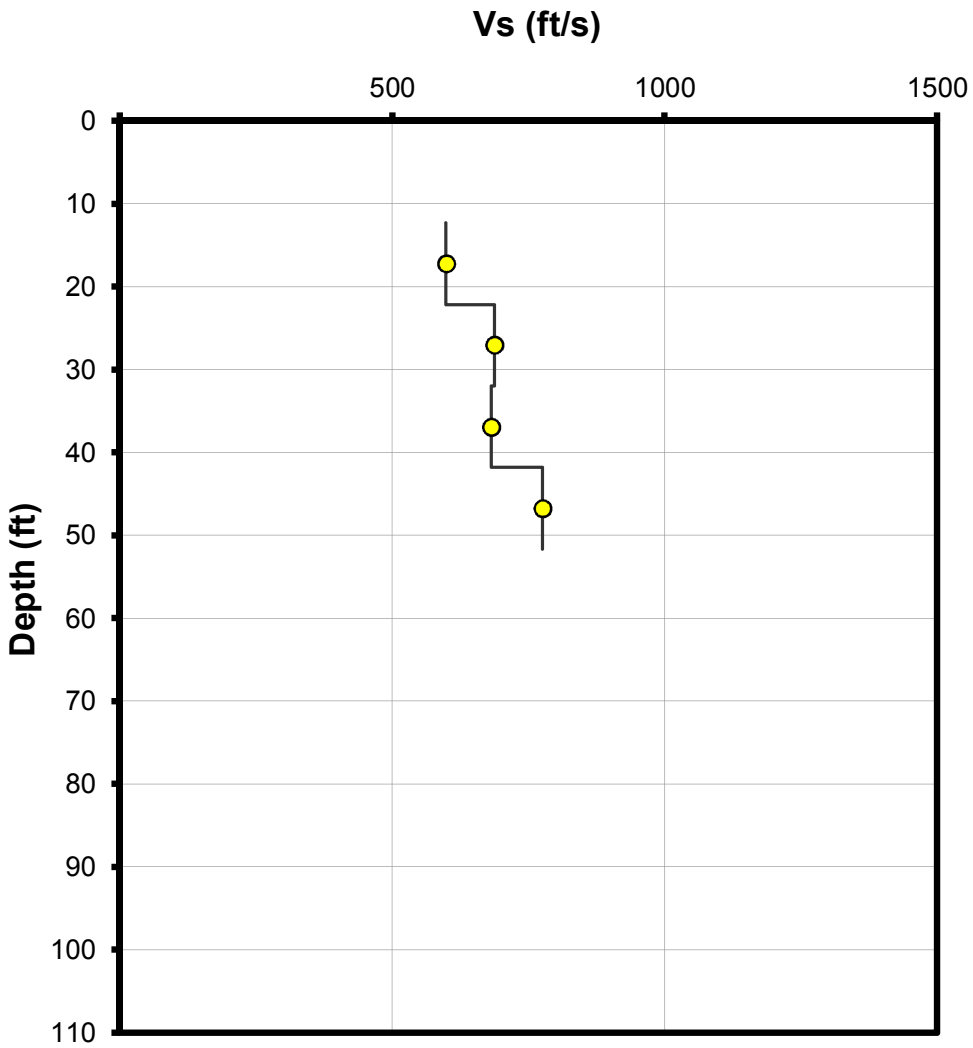
Client:	Haley & Aldrich
Project:	Rush Island - Fastus, Missouri
Sounding:	SCPT-C104
Date:	September 28, 2014

Seismic Source:	Beam	
Source Offset:	1.97	(ft)
Source Depth:	0.00	(ft)
Geophone Offset:	0.66	(ft)

SEISMIC - Vs

Tip Depth (ft)	Geophone Depth (ft)	Ray Path (ft)	Depth Interval (ft)	Time Interval (ms)	Mid-layer Depth (ft)	Vs Interval Velocity (ft/s)
12.96	12.30	12.46				
22.80	22.14	22.23	9.77	16.32	17.22	599
32.64	31.98	32.04	9.81	14.27	27.06	688
42.49	41.83	41.88	9.84	14.42	36.91	682
52.33	51.67	51.71	9.83	12.67	46.75	776

Client:	Haley & Aldrich
Location:	Rush Island - Festus, Missouri
CPT Sounding:	SCPT-C104
Date:	September 28, 2014



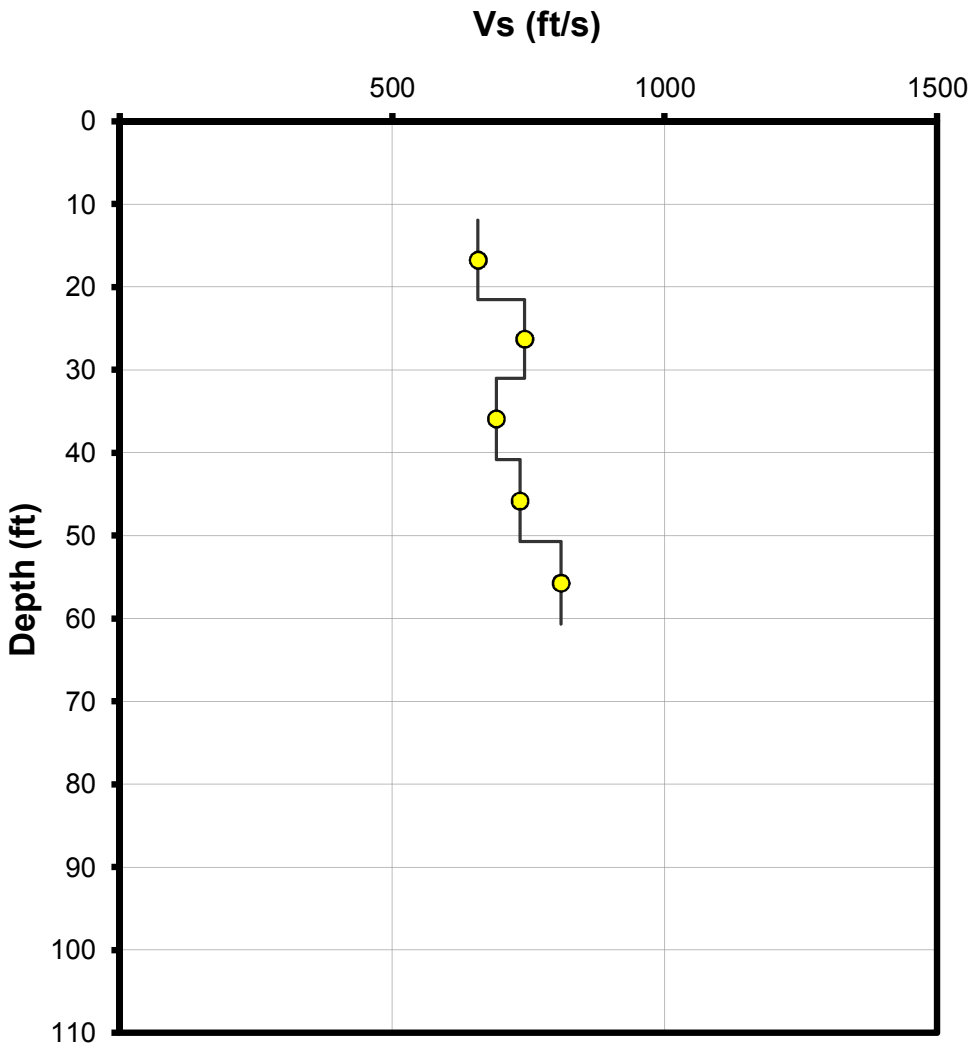
Client:	Haley & Aldrich
Project:	Rush Island - Fastus, Missouri
Sounding:	SCPT-C105
Date:	September 27, 2014

Seismic Source:	Beam	
Source Offset:	1.97	(ft)
Source Depth:	0.00	(ft)
Geophone Offset:	0.66	(ft)

SEISMIC - Vs

Tip Depth (ft)	Geophone Depth (ft)	Ray Path (ft)	Depth Interval (ft)	Time Interval (ms)	Mid-layer Depth (ft)	Vs Interval Velocity (ft/s)
12.63	11.97	12.13				
22.15	21.49	21.58	9.45	14.38	16.73	657
31.66	31.00	31.07	9.48	12.76	26.25	743
41.50	40.84	40.89	9.82	14.22	35.92	691
51.34	50.68	50.72	9.83	13.39	45.76	734
61.35	60.69	60.73	10.00	12.36	55.69	809

Client:	Haley & Aldrich
Location:	Rush Island - Festus, Missouri
CPT Sounding:	SCPT-C105
Date:	September 27, 2014



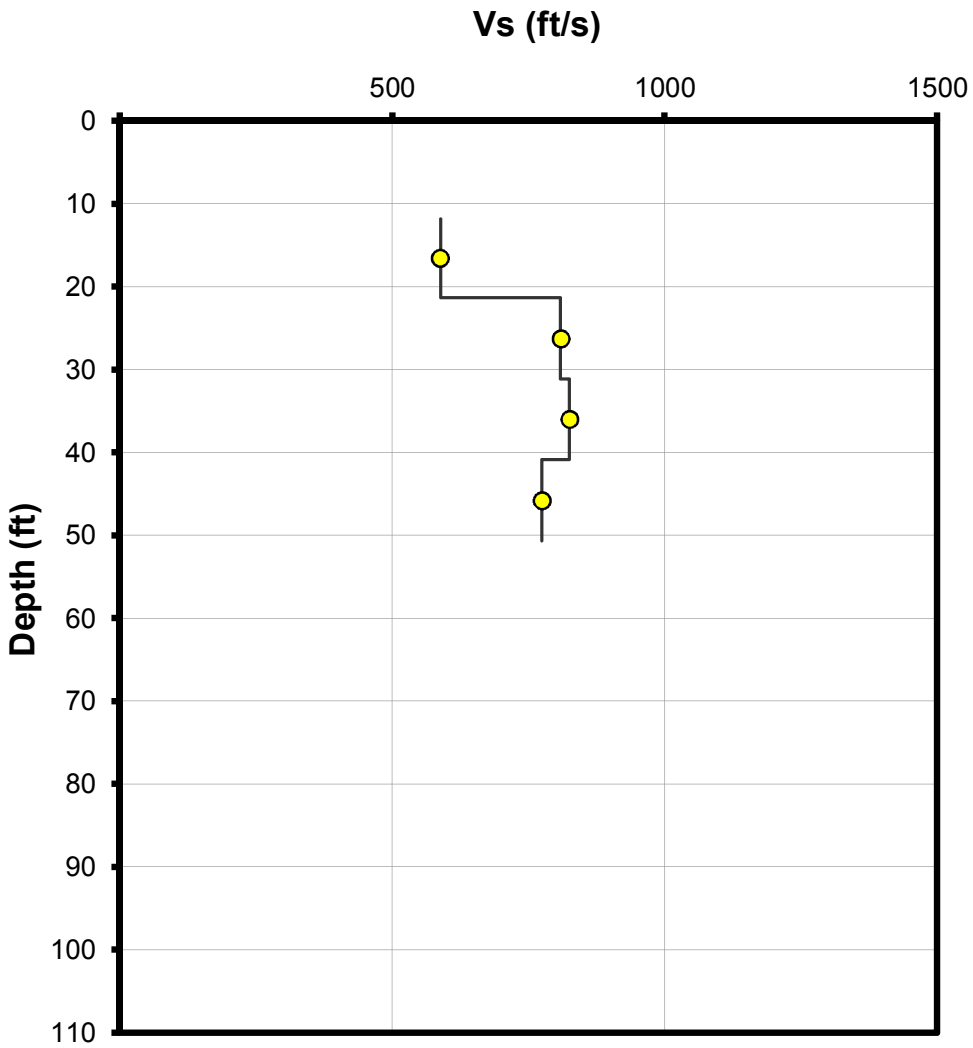
Client:	Haley & Aldrich
Project:	Rush Island - Fastus, Missouri
Sounding:	SCPT-C106
Date:	September 27, 2014

Seismic Source:	Beam	
Source Offset:	1.97	(ft)
Source Depth:	0.00	(ft)
Geophone Offset:	0.66	(ft)

SEISMIC - Vs

Tip Depth (ft)	Geophone Depth (ft)	Ray Path (ft)	Depth Interval (ft)	Time Interval (ms)	Mid-layer Depth (ft)	Vs Interval Velocity (ft/s)
12.47	11.81	11.98				
21.98	21.32	21.41	9.44	16.04	16.57	588
31.82	31.16	31.23	9.81	12.13	26.24	809
41.50	40.84	40.89	9.67	11.72	36.00	825
51.34	50.68	50.72	9.83	12.70	45.76	774

Client:	Haley & Aldrich
Location:	Rush Island - Festus, Missouri
CPT Sounding:	SCPT-C106
Date:	September 27, 2014



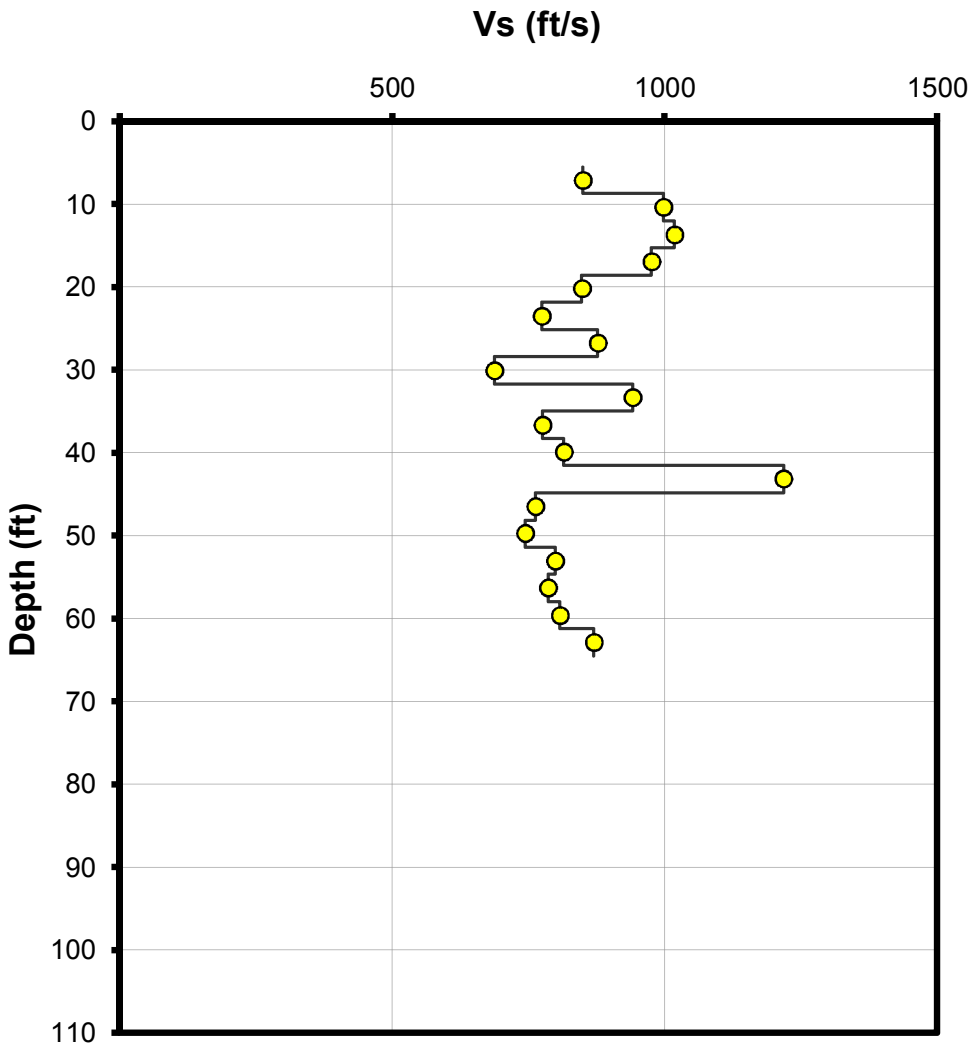
Client:	Haley & Aldrich
Project:	Rush Island - Fastus, Missouri
Sounding:	SCPT-C107A
Date:	September 27, 2014

Seismic Source:	Beam	
Source Offset:	1.97	(ft)
Source Depth:	0.00	(ft)
Geophone Offset:	0.66	(ft)

SEISMIC - Vs

Tip Depth (ft)	Geophone Depth (ft)	Ray Path (ft)	Depth Interval (ft)	Time Interval (ms)	Mid-layer Depth (ft)	Vs Interval Velocity (ft/s)
6.20	5.54	5.88				
9.38	8.72	8.94	3.06	3.60	7.13	850
12.66	12.00	12.16	3.22	3.23	10.36	997
15.94	15.28	15.41	3.25	3.19	13.64	1018
19.23	18.57	18.68	3.27	3.35	16.93	975
22.51	21.85	21.94	3.26	3.85	20.21	848
25.79	25.13	25.21	3.27	4.22	23.49	775
29.07	28.41	28.48	3.27	3.73	26.77	877
32.35	31.69	31.75	3.27	4.76	30.05	688
35.63	34.97	35.03	3.27	3.48	33.33	941
38.91	38.25	38.30	3.28	4.22	36.61	776
42.19	41.53	41.58	3.28	4.02	39.89	815
45.47	44.81	44.86	3.28	2.69	43.17	1218
48.79	48.13	48.17	3.32	4.35	46.47	763
52.03	51.37	51.41	3.24	4.35	49.75	744
55.31	54.65	54.69	3.28	4.10	53.01	799
58.60	57.94	57.98	3.29	4.18	56.30	787
61.88	61.22	61.26	3.28	4.06	59.58	807
65.16	64.50	64.53	3.28	3.77	62.86	870

Client:	Haley & Aldrich
Location:	Rush Island - Festus, Missouri
CPT Sounding:	SCPT-C107A
Date:	September 27, 2014



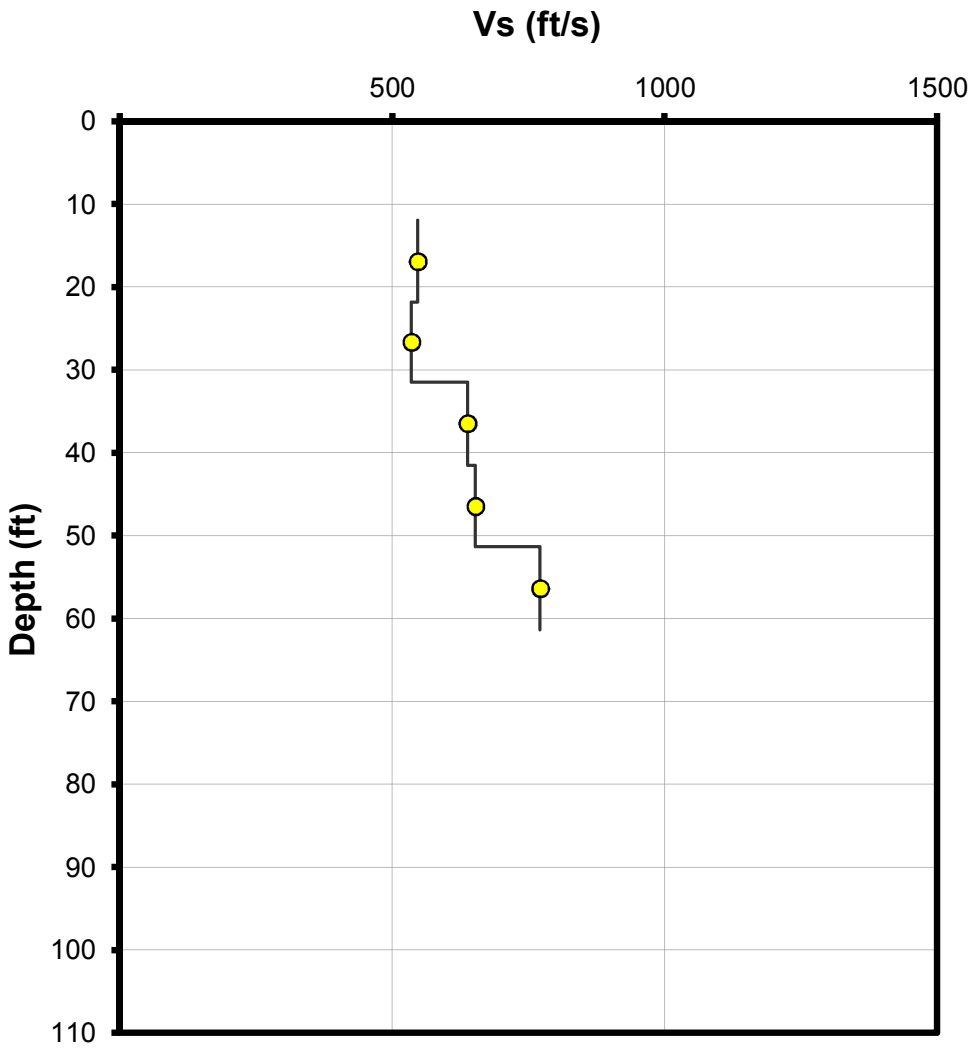
Client:	Haley & Aldrich
Project:	Rush Island - Fastus, Missouri
Sounding:	SCPT-C108
Date:	September 28, 2014

Seismic Source:	Beam	
Source Offset:	1.97	(ft)
Source Depth:	0.00	(ft)
Geophone Offset:	0.66	(ft)

SEISMIC - Vs

Tip Depth (ft)	Geophone Depth (ft)	Ray Path (ft)	Depth Interval (ft)	Time Interval (ms)	Mid-layer Depth (ft)	Vs Interval Velocity (ft/s)
12.63	11.97	12.13				
22.47	21.81	21.90	9.77	17.85	16.89	547
32.15	31.49	31.56	9.65	18.03	26.65	535
42.16	41.50	41.55	10.00	15.67	36.50	638
52.00	51.34	51.38	9.83	15.06	46.42	653
62.01	61.35	61.39	10.00	12.97	56.35	771

Client:	Haley & Aldrich
Location:	Rush Island - Festus, Missouri
CPT Sounding:	SCPT-C108
Date:	September 28, 2014



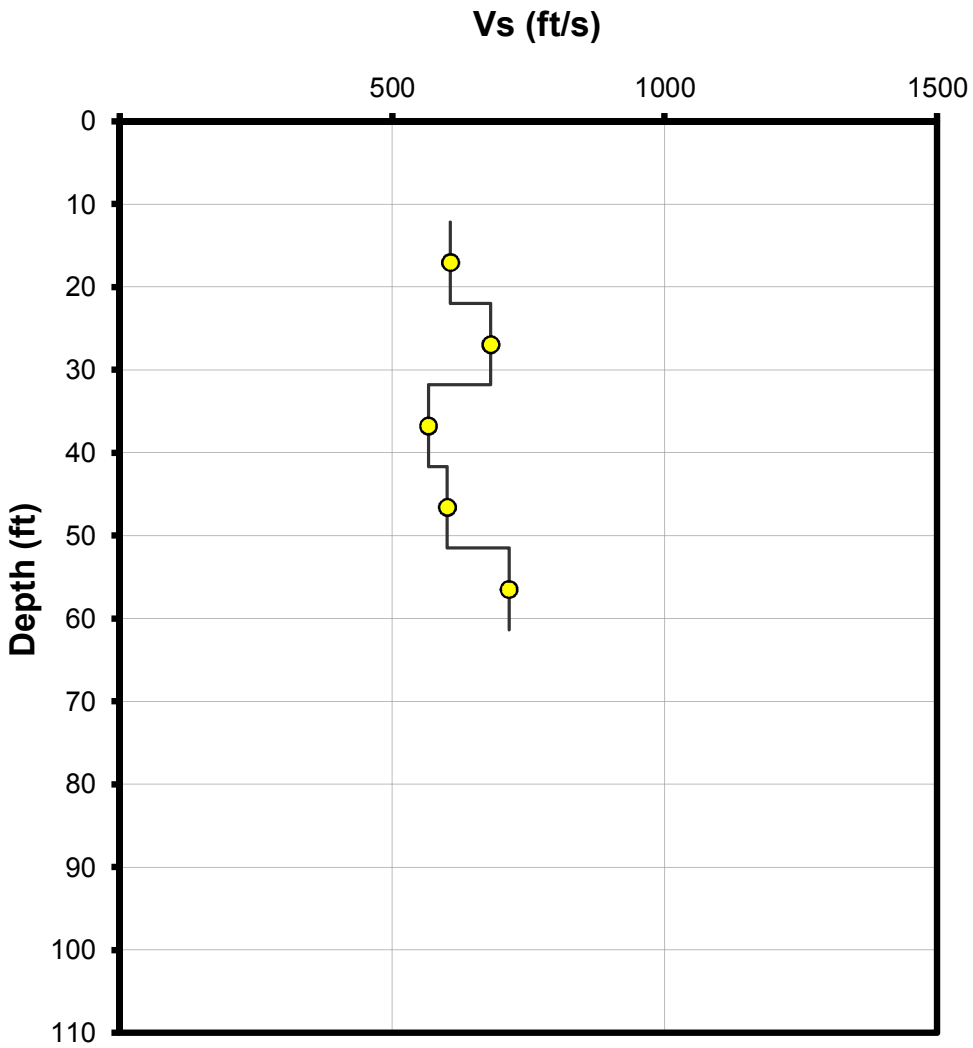
Client:	Haley & Aldrich
Project:	Rush Island - Fastus, Missouri
Sounding:	SCPT-C109
Date:	September 28, 2014

Seismic Source:	Beam	
Source Offset:	1.97	(ft)
Source Depth:	0.00	(ft)
Geophone Offset:	0.66	(ft)

SEISMIC - Vs

Tip Depth (ft)	Geophone Depth (ft)	Ray Path (ft)	Depth Interval (ft)	Time Interval (ms)	Mid-layer Depth (ft)	Vs Interval Velocity (ft/s)
12.80	12.14	12.30				
22.64	21.98	22.07	9.77	16.11	17.06	606
32.48	31.82	31.88	9.81	14.43	26.90	680
42.32	41.66	41.71	9.83	17.34	36.74	567
52.17	51.51	51.55	9.84	16.37	46.59	601
62.01	61.35	61.39	9.83	13.77	56.43	714

Client:	Haley & Aldrich
Location:	Rush Island - Festus, Missouri
CPT Sounding:	SCPT-C109
Date:	September 28, 2014



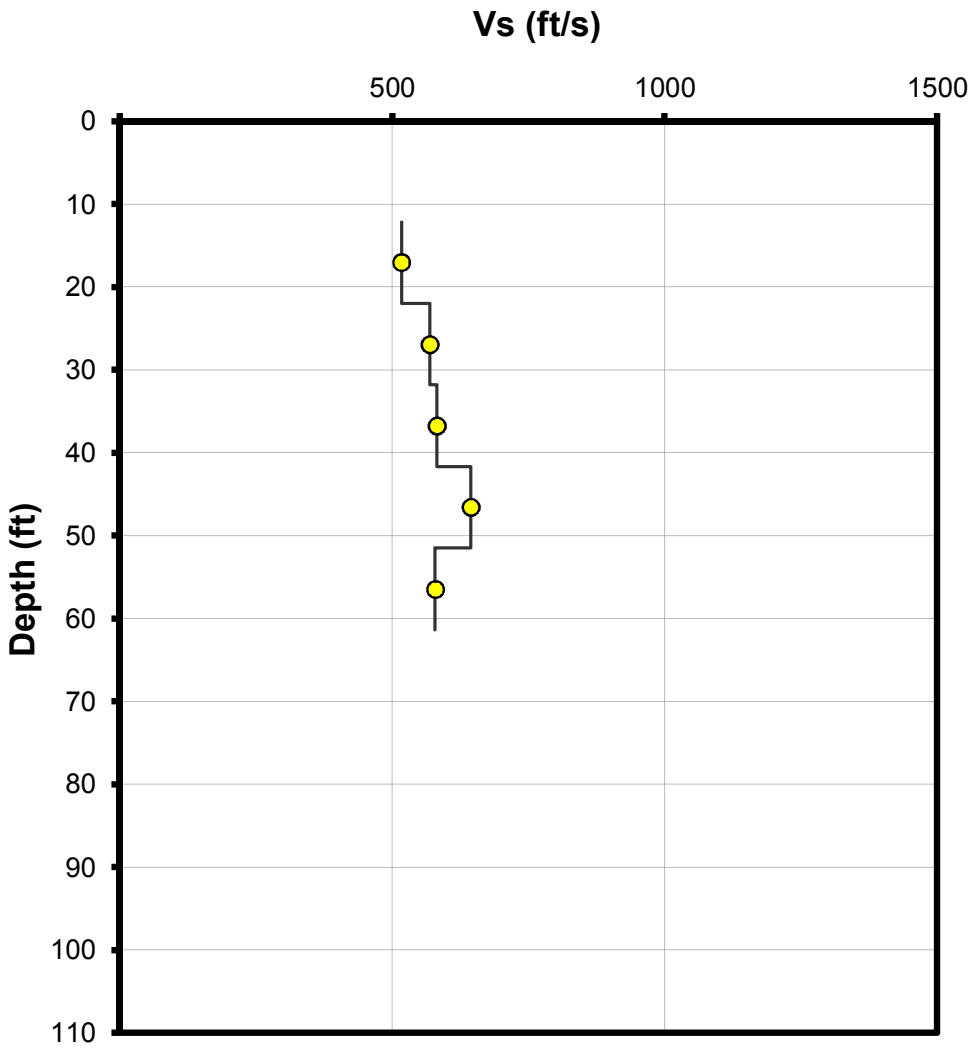
Client:	Haley & Aldrich
Project:	Rush Island - Fastus, Missouri
Sounding:	SCPT-C110
Date:	September 28, 2014

Seismic Source:	Beam	
Source Offset:	1.97	(ft)
Source Depth:	0.00	(ft)
Geophone Offset:	0.66	(ft)

SEISMIC - Vs

Tip Depth (ft)	Geophone Depth (ft)	Ray Path (ft)	Depth Interval (ft)	Time Interval (ms)	Mid-layer Depth (ft)	Vs Interval Velocity (ft/s)
12.80	12.14	12.30				
22.64	21.98	22.07	9.77	18.89	17.06	517
32.48	31.82	31.88	9.81	17.26	26.90	569
42.32	41.66	41.71	9.83	16.90	36.74	581
52.17	51.51	51.55	9.84	15.28	46.59	644
62.01	61.35	61.39	9.83	16.99	56.43	579

Client:	Haley & Aldrich
Location:	Rush Island - Festus, Missouri
CPT Sounding:	SCPT-C110
Date:	September 28, 2014



Appendix E

Job No: 14-53069
Job Name: Rush Island
Job Location: Festus, Missouri
Date: 10/1/14
Sounding No: D100
Ground Water Depth (ft): 19.842

	Membrane 1	Membrane 2	Membrane 3
ΔA =	0.15	0	0
ΔB =	0.15	0	0
Zm=	0.05	bar	

Latitude:
Longitude:

[1] Depth Below Existing Ground Surface
[2] Mayne, 1995
[3] Marchetti,2001
[4] Schmertman, 1981
[5] Mayne, 2002

CONETEC

Depth[1] (ft)	A (bar)	B (bar)	C (bar)	po (bar)	p1 (bar)	p2 (bar)	u_o (psf)	γ_T[5] (pcf)	σ_{vo} (psf)	σ_{vo}' (psf)	Id	K_D	E_D (bar)	K_o	OCR[2]	OCR[3]	ϕ[3] (deg)	R_M	E_D (ksf)	s_u[3] (psf)	s_u[4] (psf)	M (ksf)
0.7	1.05	4.5		1.0	4.3		0	106	71	71	3.33	29.3	115				44.9	3.52	240			843
1.3	0.7	3.7		0.7	3.5		0	103	139	139	4.26	10.0	98				40.5	2.50	205			514
2.0							0	130	226	226												
2.7							0	130	313	313												
3.3	0.55	3.55		0.5	3.35		0	101	380	380	5.50	2.8	98				34.2	1.40	205			289
4.0	0.2	2.2		0.2	2		0	95	443	443	8.30	1.0	62				28.1	0.85	129			110
4.7							0	130	530	530												
5.3							0	130	616	616												
6.0	0.25	2		0.3	1.8		0	95	680	680	5.49	0.9	53				27.0	0.85	110			94
6.7	1.85	7.75		1.7	7.55		0	112	755	755	3.52	4.6	204				36.8	1.83	426			780
7.3	0.35	5.2		0.2	5		0	100	821	821	21.47	0.6	166				24.3	0.85	346			294
8.0	1.65	5.95		1.6	5.75		0	109	894	894	2.71	3.6	146				35.5	1.60	304			487
8.7	0.45	2.1		0.5	1.9		0	98	959	959	2.94	1.1	49				28.3	0.85	103			87
9.3	0.65	2.95		0.7	2.75		0	101	1026	1026	3.23	1.3	73				29.7	0.85	152			129
10.0	0.7	7.05		0.5	6.85		0	105	1097	1097	12.77	0.9	220				27.7	0.85	460			391
10.7	1.85	7.3		1.7	7.1		0	111	1171	1171	3.19	3.0	188				34.5	1.46	392			572
11.3	0.45	5.5		0.3	5.3		0	102	1238	1238	15.96	0.5	173				23.8	0.85	361			307
12.0	0.5	3.15		0.5	2.95		0	100	1305	1305	5.11	0.8	86				26.3	0.85	179			152
12.7	1	4.7		0.9	4.5		0	106	1376	1376	3.84	1.4	124				30.1	0.85	259			220
13.3	0.55	3.2		0.5	3		0	101	1443	1443	4.63	0.8	86				26.3	0.85	179			152
14.0							0	130	1530	1530												
14.7	0.85	4.4		0.8	4.2		0	105	1600	1600	4.33	1.0	118				28.2	0.85	247			210
15.3	1.25	3.55		1.3	3.35		0	104	1669	1669	1.68	1.6	73					0.85	152			129
16.0	1.25	2.5		1.3	2.3		0	101	1736	1736	0.77	1.6	35	0.4	0.8	0.7		0.85	72	282	272	61
16.7	0.8	2.85		0.8	2.65		0	102	1804	1804	2.26	0.9	64				27.6	0.85	133			113
17.3	2	8.25		1.8	8.05		0	112	1879	1879	3.47	2.0	217				32.2	1.10	453			500
18.0	3	16.2		2.5	16		0	119	1958	1958	5.52	2.6	470				33.7	1.34	982			1312
18.7	2.95	9.45		2.7	9.25		0	115	2035	2035	2.38	2.8	226				34.1	1.35	472			635
19.3	1.55	4.35		1.5	4.15		0	107	2105	2105	1.72	1.5	91					0.85	190			162
20.0	1.5	4.55		1.5	4.35		10	107	2177	2167	1.98	1.4	100				30.1	0.85	209			178
20.7	1.35	3.8		1.3	3.6		52	105	2248	2196	1.71	1.3	78					0.85	164			139
21.3	1.7	4.45		1.7	4.25		93	107	2318	2225	1.58	1.5	89					0.85	186			158
22.0	1.6	5.8		1.5	5.6		135	109	2391	2256	2.84	1.3	142				29.8	0.85	297			252
22.7	2.05	5.3		2.0	5.1		176	109	2464	2287	1.61	1.8	107					0.85	224			191
23.3	2	5.25		2.0	5.05		218	109	2535	2318	1.68	1.7	107					0.85	224			191
24.0	2.4	7.7		2.3	7.5		259	112	2611	2351	2.47	1.9	182				31.9	0.99	380			378
24.7	3.15	8.8		3.0	8.6		301	114	2687	2386	1.98	2.5	195				33.4	1.20	407			488
25.3	3.4	12.2		3.1	12		342	117	2765	2422	3.07	2.5	310				33.5	1.30	647			840
26.0	5.25	13.4		5.0	13.2		384	120	2845	2460	1.73	4.1	286					1.64	597			980
26.7	4.45	10.8		4.2	10.6		426	117	2923	2497	1.57	3.4	220					1.46	460			671
27.3	3.6	8.15		3.5	7.95		467	114	2998	2531	1.37	2.7	155					1.22	323			395
28.0	2.35	5.25		2.3	5.05		509	109	3071	2562	1.31	1.7	95					0.85	198			168
28.7	2	4.15		2.0	3.95		551	106	3142	2591	1.11	1.4	67	0.4	0.7	0.6		0.85	141	367	364	120
29.3	2.5	4.35		2.5	4.15		592	106	3212	2620	0.73	1.8	56	0.5	0.9	0.8		0.85	118	500	468	100
30.0	2.7	5		2.7	4.8		634	108	3284	2650	0.88	1.9	73	0.5	1.0	0.9		0.85	152	543	501	129
30.7	2.35	5.55		2.3	5.35		676	109	3357	2681	1.54	1.5	106					0.85	221			188
31.3	2.15	4.4		2.2	4.2		717	106	3427	2710	1.13	1.4	71	0.4	0.7	0.6		0.85	148	380	378	126
32.0	3.15	6.85		3.1	6.65		759	111	3502	2743	1.31	2.1	124					0.96	259			248
32.7	4.35	9.45		4.2	9.25		800	115	3579	2779	1.32	2.9	175					1.28	365			468
33.3	3.05	6.25		3.0	6.05		842	110	3652	2810	1.17	1.9	106	0.5	1.0	0.9		0.88	221	593	543	194
34.0	2.75	5.55		2.7	5.35		883	109	3725	2842	1.14	1.7	91	0.5	0.9	0.8		0.85	190	507	481	162
34.7	2.8	6.15		2.7	5.95		925	110	3799	2873	1.39	1.7	111					0.85	232			197
35.3	2.25	4.2		2.3	4		966	105	3868	2902	0.96	1.3	60	0.3	0.7	0.5		0.85	126	372	377	107
36.0	3.05	5.5		3.0	5.3		1008	109	3941	2933	0.88	1.8	78	0.5	0.9	0.9		0.85	164	575	535	139
36.7	2.7	4.85		2.7	4.65		1050	107	4013	2963	0.88	1.6	67	0.4	0.8	0.7		0.85	141	476	460	120
37.3	2.4	4.65		2.4	4.45		1091	106	4083	2992	1.09	1.3	71	0.3	0.7	0.5		0.85	148	389	393	126
38.0	2.45	5.15		2.4	4.95		1133	108	4155	3022	1.34	1.3	87					0.85	183			155
38.7	2.65	6.15		2.6	5.95		1175	110	4228	3054	1.66	1.4	117					0.85	244			207

Job No: 14-53069
Job Name: Rush Island
Job Location: Festus, Missouri
Date: 10/1/14
Sounding No: D100
Ground Water Depth (ft): 19.842

	Membrane 1	Membrane 2	Membrane 3
ΔA =	0.15	0	0
ΔB =	0.15	0	0
Zm=	0.05	bar	

Latitude:
Longitude:

[1] Depth Below Existing Ground Surface
[2] Mayne, 1995
[3] Marchetti,2001
[4] Schmertman, 1981
[5] Mayne, 2002

CONETEC

Depth[1] (ft)	A (bar)	B (bar)	C (bar)	po (bar)	p1 (bar)	p2 (bar)	u_o (psf)	γ_T[5] (pcf)	σ_{vo} (psf)	σ_{vo}' (psf)	Id	K_D	E_D (bar)	K_o	OCR[2]	OCR[3]	ϕ[3] (deg)	R_M	E_D (ksf)	s_u[3] (psf)	s_u[4] (psf)	M (ksf)
39.3	3.55	7.6		3.5	7.4		1216	112	4303	3087	1.37	1.9	137					0.91	285			258
40.0	3.55	6.25		3.5	6.05		1258	110	4376	3118	0.86	2.0	87	0.5	1.0	1.0		0.86	183	669	611	157
40.7	3.1	5.4		3.1	5.2		1300	108	4449	3149	0.85	1.6	73	0.4	0.8	0.7		0.85	152	542	517	129
41.3	3	8.75		2.8	8.55		1341	113	4523	3182	2.62	1.4	199				30.2	0.85	415			353
42.0	2.45	3.6		2.5	3.4		1383	102	4592	3209	0.48	1.2	31	0.3	0.6	0.5		0.85	65	373	385	55
42.7	2.35	3.45		2.4	3.25		1424	101	4659	3235	0.49	1.1	29	0.3	0.6	0.4		0.85	61	343	361	52
43.3	2.45	4.15		2.5	3.95		1466	104	4728	3263	0.83	1.1	51	0.3	0.6	0.4		0.85	107	355	371	91
44.0	2.5	5.05		2.5	4.85		1507	107	4800	3293	1.34	1.1	82					0.85	171			146
44.7	2.6	7.6		2.5	7.4		1549	111	4874	3325	2.86	1.1	171				28.5	0.85	358			304
45.3	2.55	4.75		2.6	4.55		1590	106	4944	3354	1.11	1.1	69	0.3	0.6	0.4		0.85	145	356	375	123
46.0	2.95	5.75		2.9	5.55		1632	108	5017	3385	1.22	1.3	91					0.85	190			162
46.7	4.15	8.8		4.0	8.6		1674	114	5093	3419	1.41	2.0	158					0.92	331			305
47.3	3	6.3		3.0	6.1		1715	109	5165	3450	1.48	1.3	109					0.85	228			194
48.0	3.05	7.7		2.9	7.5		1757	111	5240	3483	2.18	1.3	158				29.4	0.85	331			281
48.7	3.5	5.8		3.5	5.6		1799	108	5313	3514	0.80	1.6	73	0.4	0.8	0.7		0.85	152	570	551	129
49.3	2.85	3.75		2.9	3.55		1840	101	5379	3539	0.31	1.2	22	0.3	0.6	0.5		0.85	46	413	426	39
50.0	2.65	4.15		2.7	3.95		1882	104	5449	3567	0.70	1.0	44	0.2	0.5	0.4		0.85	91	350	374	78
50.7	2.8	4.35		2.8	4.15		1924	104	5518	3595	0.68	1.1	46	0.3	0.6	0.4		0.85	95	380	400	81
51.3	2.7	4.05		2.7	3.85		1965	103	5586	3622	0.61	1.0	38	0.2	0.5	0.4		0.85	80	353	377	68
52.0	2.5	4.15		2.5	3.95		2007	104	5656	3649	0.90	0.9	49	0.2	0.5	0.3		0.85	103	296	328	87
52.7	2.6	3.55		2.7	3.35		2048	100	5723	3674	0.40	1.0	24	0.2	0.5	0.3		0.85	49	322	352	42
53.3	2.55	3.7		2.6	3.5		2090	101	5790	3700	0.56	0.9	31	0.2	0.5	0.3		0.85	65	303	336	55
54.0	2.6	3.95		2.6	3.75		2131	102	5858	3727	0.68	0.9	38	0.2	0.5	0.3		0.85	80	307	340	68
54.7	2.5	4.15		2.5	3.95		2173	103	5928	3754	0.95	0.8	49	0.2	0.4	0.3		0.85	103	275	312	87
55.3	2.65	3.8		2.7	3.6		2214	101	5995	3780	0.54	0.9	31	0.2	0.5	0.3		0.85	65	311	344	55
56.0	2.8	4.35		2.8	4.15		2256	104	6064	3808	0.75	1.0	46	0.2	0.5	0.3		0.85	95	336	367	81
56.7	2.65	4.05		2.7	3.85		2298	103	6133	3835	0.72	0.9	40	0.2	0.4	0.3		0.85	84	297	333	71
57.3	2.45	5.75		2.4	5.55		2339	107	6203	3864	2.46	0.7	109				25.6	0.85	228			194
58.0	2.3	4.35		2.3	4.15		2381	103	6273	3892	1.57	0.6	64					0.85	133			113
58.7	2.85	4.9		2.9	4.7		2423	105	6343	3920	1.08	0.9	64	0.2	0.5	0.3		0.85	133	321	356	113
59.3	3.05	5.95		3.0	5.75		2464	108	6414	3950	1.48	1.0	95					0.85	198			168
60.0	2.85	5.15		2.9	4.95		2506	106	6485	3979	1.27	0.9	73					0.85	152			129
60.7	3	5.95		3.0	5.75		2548	108	6557	4010	1.59	0.9	97					0.85	202			171
61.3	3	5.7		3.0	5.5		2589	107	6628	4039	1.45	0.9	87					0.85	183			155
62.0	3.2	7.9		3.1	7.7		2631	111	6702	4072	2.54	0.9	160				27.6	0.85	335			285
62.7	3.25	5.4		3.3	5.2		2672	106	6774	4101	0.98	1.0	67	0.2	0.5	0.3		0.85	141	383	413	120
63.3	2.85	4.65		2.9	4.45		2714	104	6842	4129	1.00	0.8	55	0.1	0.4	0.2		0.85	114	288	329	97
64.0	3.05	4.8		3.1	4.6		2755	105	6912	4157	0.87	0.9	53	0.2	0.4	0.3		0.85	110	329	367	94
64.7	3.25	4.6		3.3	4.4		2797	103	6982	4184	0.56	1.0	38	0.2	0.5	0.3		0.85	80	376	409	68
65.3	3.2	4.15		3.3	3.95		2838	101	7048	4210	0.36	0.9	24	0.2	0.5	0.3		0.85	49	364	399	42
66.0	3	4.35		3.0	4.15		2880	103	7117	4237	0.66	0.8	38	0.2	0.4	0.3		0.85	80	307	348	68
66.7	3.15	4.6		3.2	4.4		2922	103	7186	4264	0.67	0.9	42	0.2	0.4	0.3		0.85	88	335	375	74
67.3	3.05	4.5		3.1	4.3		2963	103	7254	4291	0.72	0.8	42	0.2	0.4	0.2		0.85	88	307	350	74
68.0	2.8	4.55		2.8	4.35		3005	103	7324	4318	1.10	0.7	53	0.1	0.3	0.2		0.85	110	243	290	94
68.7	2.85	4.6		2.9	4.4		3047	103	7393	4346	1.07	0.7	53	0.1	0.3	0.2		0.85	110	249	296	94
69.3	2.8	4.85		2.8	4.65		3088	104	7462	4373	1.38	0.6	64					0.85	133			113
70.0	3.25	4.9		3.3	4.7		3130	104	7531	4402	0.79	0.8	49	0.2	0.4	0.3		0.85	103	331	373	87
70.7	3.05	5.45		3.0	5.25		3172	106	7602	4431	1.44	0.7	77					0.85	160			136
71.3	3.7	6.75		3.7	6.55		3213	109	7674	4461	1.36	1.0	100					0.85	209			178
72.0	4.5	9		4.4	8.8		3255	113	7750	4495	1.56	1.3	153					0.85	320			272
72.7	3.25	6.8		3.2	6.6		3296	108	7822	4526	2.12	0.7	118				26.1	0.85	247			210
73.3	3.3	5.25		3.3	5.05		3338	105	7892	4554	1.01	0.8	60	0.1	0.4	0.2		0.85	126	313	359	107
74.0	3.45	5.5		3.5	5.3		3379	106	7963	4583	1.00	0.8	64	0.2	0.4	0.3		0.85	133	341	385	113
74.7	3.75	7.9		3.7	7.7		3421	111	8037	4615	2.00	0.9	140				27.4	0.85	293			249
75.3	3.9	8.3		3.8	8.1		3462	111	8110	4648	2.01	1.0	149				27.7	0.85	312			265
76.0	3.85	7.75		3.8	7.55		3504	110	8184	4680	1.81	0.9	131				27.6	0.85	274			233
76.7	4.4	8.95		4.3	8.75		3546	112	8259	4713	1.72	1.1	155					0.85	323			275
77.3	4.5	10.8		4.3	10.6		3587	114	8335	4748	2.44	1.1	219				28.8	0.85	457			388

Job No: 14-53069
Job Name: Rush Island
Job Location: Festus, Missouri
Date: 10/1/14
Sounding No: D100
Ground Water Depth (ft): 19.842

	Membrane 1	Membrane 2	Membrane 3
ΔA =	0.15	0	0
ΔB =	0.15	0	0
Zm=	0.05	bar	

Latitude:
Longitude:

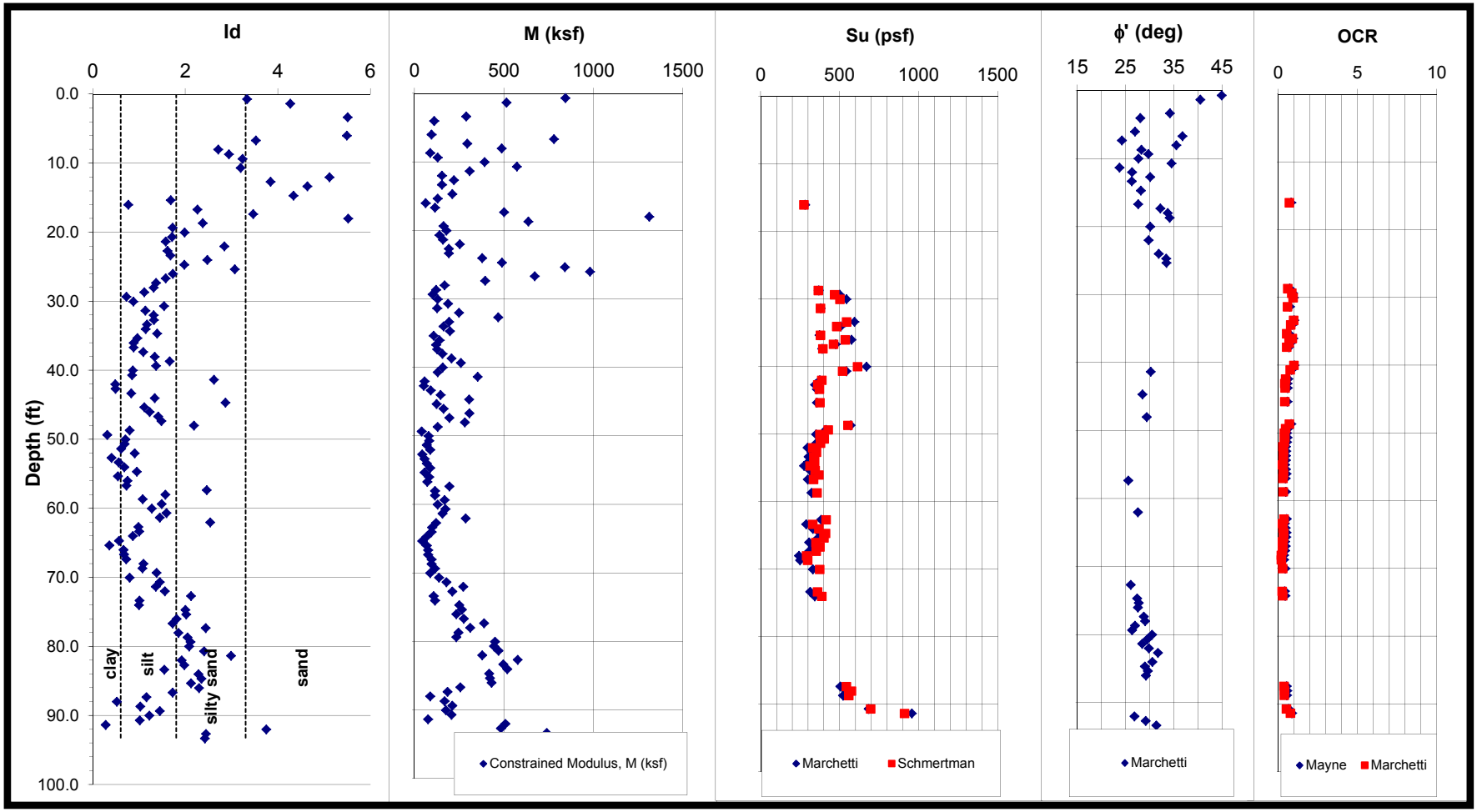
[1] Depth Below Existing Ground Surface
[2] Mayne, 1995
[3] Marchetti,2001
[4] Schmertman, 1981
[5] Mayne, 2002

CONETEC

Depth[1] (ft)	A (bar)	B (bar)	C (bar)	po (bar)	p1 (bar)	p2 (bar)	u_o (psf)	γ_T[5] (pcf)	σ_{vo} (psf)	σ_{vo}' (psf)	Id	K_D	E_D (bar)	K_o	OCR[2]	OCR[3]	ϕ[3] (deg)	R_M	E_D (ksf)	s_u[3] (psf)	s_u[4] (psf)	M (ksf)
78.0	4.6	9.7		4.5	9.5		3629	113	8411	4782	1.85	1.2	175				29.1	0.85	365			310
78.7	3.8	7.9		3.7	7.7		3671	110	8485	4814	2.04	0.8	138				26.9	0.85	289			246
79.3	3.65	7.55		3.6	7.35		3712	110	8557	4845	2.11	0.8	131				26.3	0.85	274			233
80.0	5.55	12.8		5.3	12.6		3754	117	8635	4882	2.08	1.5	253				30.5	0.85	529			450
80.7	5.05	12.2		4.8	12		3796	116	8713	4917	2.41	1.3	250				29.5	0.85	521			443
81.3	4.65	12.2		4.4	12		3837	115	8789	4952	2.98	1.1	264				28.5	0.85	552			469
82.0	5.25	11.4		5.1	11.2		3879	115	8867	4988	1.92	1.3	213				29.8	0.85	445			378
82.7	6.6	15.2		6.3	15		3920	119	8947	5026	1.98	1.8	302				31.7	0.91	632			576
83.3	6.9	14.2		6.7	14		3962	119	9025	5063	1.55	2.0	255					0.93	533			496
84.0	5.9	14.2		5.6	14		4003	118	9104	5101	2.28	1.5	291				30.5	0.85	609			517
84.7	5.05	11.8		4.8	11.6		4045	115	9182	5136	2.34	1.2	235				29.0	0.85	491			417
85.3	5.4	12.2		5.2	12		4086	116	9258	5172	2.12	1.3	237				29.6	0.85	495			420
86.0	5.25	12.2		5.0	12		4128	116	9336	5208	2.30	1.2	242				29.2	0.85	506			430
86.7	4.5	8.75		4.4	8.55		4170	112	9411	5241	1.72	1.0	144					0.85	301			255
87.3	4.65	7.8		4.6	7.6		4211	110	9484	5272	1.15	1.0	104	0.2	0.5	0.4		0.85	217	504	541	184
88.0	4.75	6.4		4.8	6.2		4253	107	9555	5302	0.52	1.1	49	0.3	0.6	0.4		0.85	103	541	574	87
88.7	4.75	7.65		4.7	7.45		4295	110	9629	5334	1.02	1.0	95	0.2	0.5	0.4		0.85	198	520	556	168
89.3	4.5	8.05		4.4	7.85		4336	110	9701	5365	1.45	0.9	118					0.85	247			210
90.0	4.45	7.45		4.4	7.25		4378	109	9775	5397	1.22	0.9	98					0.85	205			175
90.7	5.5	9		5.4	8.8		4420	112	9850	5430	1.01	1.3	117	0.3	0.7	0.5		0.85	244	683	694	207
91.3	6.45	7.9		6.5	7.7		4461	108	9921	5460	0.28	1.7	42	0.5	0.8	0.8		0.85	88	956	910	74
92.0	4.65	12.8		4.4	12.6		4503	115	9998	5496	3.74	0.8	286				26.9	0.85	597			508
92.7	5.65	13.4		5.4	13.2		4544	117	10077	5532	2.44	1.2	271				29.2	0.85	567			482
93.3	7.25	18.2		6.8	18		4586	121	10157	5571	2.42	1.7	388				31.4	0.91	810			738

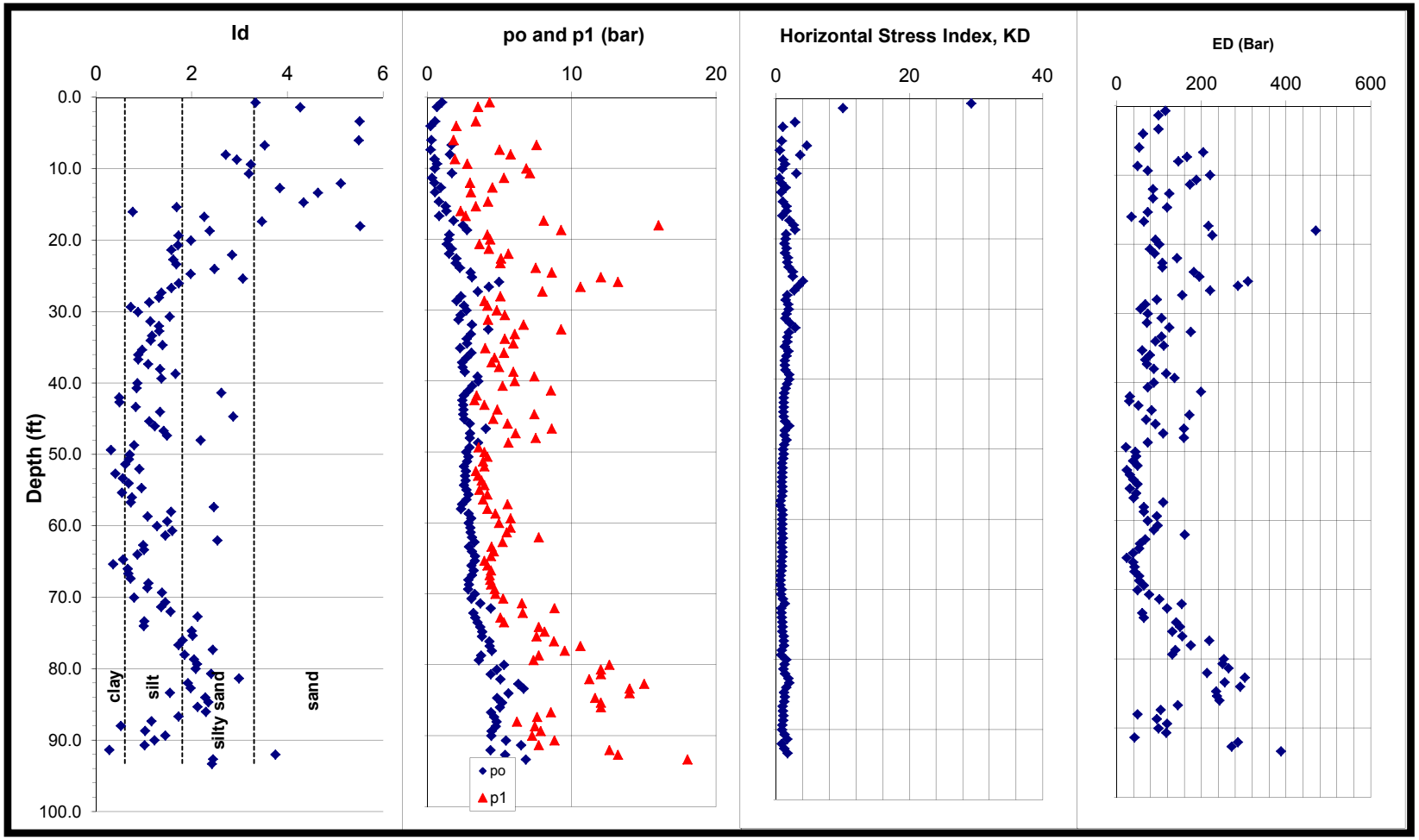
DILATOMETER TEST RESULTS

Test ID: D100
Site: Rush Island
Location: Festus, Missouri
Project No.: 14-53069



DILATOMETER TEST RESULTS

Test ID: D100
Site: Rush Island
Location: Festus, Missouri
Project No.: 14-53069



Job No: 14-53069
Job Name: Rush Island
Job Location: Festus, Missouri
Date: 9/29/14
Sounding No: D101
Ground Water Depth (ft): 18

	Membrane 1	Membrane 2	Membrane 3
ΔA =	0.15	0	0
ΔB =	0.2	0	0
Zm=	0.05	bar	

Latitude:
Longitude:

[1] Depth Below Existing Ground Surface
[2] Mayne, 1995
[3] Marchetti,2001
[4] Schmertman, 1981
[5] Mayne, 2002

CONETEC

Depth[1] (ft)	A (bar)	B (bar)	C (bar)	po (bar)	p1 (bar)	p2 (bar)	u_o (psf)	γ_T[5] (pcf)	σ_{vo} (psf)	σ_{vo}' (psf)	Id	K_D	E_D (bar)	K_o	OCR[2]	OCR[3]	ϕ[3] (deg)	R_M	E_D (ksf)	s_u[3] (psf)	s_u[4] (psf)	M (ksf)
0.7	3.8	15.8		3.3	15.55		0	120	80	80	3.69	86.4	424				48.4	4.54	887			4026
1.3	14.6	29.5		14.0	29.25		0	130	166	166	1.09	175.7	530	8.8	89.4	1076.8		5.21	1107	9827	2918	5772
2.0	8.15	18.55		7.7	18.3		0	124	249	249	1.36	64.9	366					4.27	765			3266
2.7	14.6	30.4		13.9	30.15		0	130	337	337	1.16	86.4	563	6.1	44.0	356.0		4.54	1176	8203	2909	5340
3.3	12.2	27.2		11.6	26.95		0	129	422	422	1.33	57.3	534					4.15	1115			4629
4.0	0.95	9.5		0.6	9.25		0	108	494	494	13.45	2.7	299				33.9	1.36	624			851
4.7	3.9	15.8		3.4	15.55		0	120	575	575	3.54	12.4	421				41.5	2.71	879			2379
5.3	9	26.2		8.3	25.95		0	128	659	659	2.14	26.2	614				44.5	3.41	1282			4374
6.0	2.45	17.8		1.8	17.55		0	118	738	738	8.75	5.1	547				37.3	1.91	1141			2185
6.7	2.75	15		2.3	14.75		0	118	817	817	5.54	5.8	434				37.9	2.02	906			1831
7.3	5.25	22.2		4.5	21.95		0	124	898	898	3.86	10.5	605				40.7	2.55	1263			3217
8.0	3	15.2		2.5	14.95		0	118	977	977	4.96	5.4	432				37.5	1.96	902			1766
8.7	6	12.8		5.8	12.55		0	120	1058	1058	1.17	11.4	235	2.0	5.8	15.1		2.62	491	2051	1207	1288
9.3	3.2	9.9		3.0	9.65		0	116	1134	1134	2.24	5.5	231				37.7	1.95	483			942
10.0	2	7.35		1.9	7.1		0	111	1208	1208	2.84	3.2	182				34.8	1.50	380			570
10.7							0	130	1296	1296												
11.3	1.65	2.7		1.7	2.45		0	101	1362	1362	0.43	2.6	26	0.7	1.3	1.5		1.13	53	422	358	60
12.0	4.3	27		3.3	26.75		0	124	1445	1445	7.15	4.7	814				36.9	1.85	1701			3151
12.7	1.5	5.25		1.4	5		0	108	1517	1517	2.50	2.0	124				32.1	1.03	259			268
13.3	1.15	4.25		1.1	4		0	105	1587	1587	2.60	1.5	100				30.4	0.85	209			178
14.0	1.45	3.35		1.5	3.1		0	104	1656	1656	1.11	1.9	56	0.5	0.9	0.9		0.85	118	332	308	100
14.7	1.35	3.45		1.4	3.2		0	104	1726	1726	1.35	1.6	64					0.85	133			113
15.3	0.85	1.75		0.9	1.5		0	96	1790	1790	0.63	1.1	20	0.3	0.5	0.4		0.85	42	182	193	36
16.0	3.7	9.9		3.5	9.65		0	116	1868	1868	1.75	3.9	213					1.61	445			717
16.7	2.5	6.2		2.4	5.95		0	111	1942	1942	1.45	2.6	122					1.20	255			306
17.3	1.45	3.3		1.5	3.05		0	104	2010	2010	1.07	1.5	55	0.4	0.8	0.7		0.85	114	317	308	97
18.0	3.8	22.8		3.0	22.55		0	122	2092	2092	6.60	3.0	680				34.4	1.44	1419			2048
18.7	20.1						42	130	2179	2137												
19.3	6.9	20		6.4	19.75		83	124	2261	2178	2.12	6.1	465				38.1	2.04	970			1976
20.0	5.35	13		5.1	12.75		125	119	2341	2216	1.53	4.7	266					1.78	556			988
20.7	4.35	13.2		4.0	12.95		167	119	2421	2254	2.26	3.7	310				35.6	1.58	647			1020
21.3	4.4	10.8		4.2	10.55		208	117	2498	2290	1.55	3.7	220					1.55	460			715
22.0	3	8.15		2.9	7.9		250	113	2574	2325	1.84	2.5	175				33.4	1.18	365			430
22.7	4.55	11.6		4.3	11.35		291	118	2653	2362	1.68	3.7	244					1.55	510			790
23.3	5.4	14.6		5.1	14.35		333	120	2733	2400	1.90	4.3	322				36.4	1.70	673			1144
24.0	3.5	8.25		3.4	8		374	114	2809	2435	1.44	2.7	160					1.25	335			417
24.7	2.8	8.35		2.6	8.1		416	113	2885	2469	2.24	2.1	189				32.4	1.05	396			416
25.3	2.15	5		2.1	4.75		457	108	2956	2499	1.38	1.6	91					0.85	190			162
26.0	0.45	2.55		0.5	2.3		499	95	3020	2521	8.22	0.2	64				16.2	0.85	133			113
26.7	2.05	4.65		2.0	4.4		541	107	3091	2550	1.33	1.5	82					0.85	171			146
27.3	1.65	4.25		1.6	4		582	105	3161	2579	1.74	1.1	82					0.85	171			146
28.0	1.6	4.2		1.6	3.95		624	105	3232	2608	1.83	1.0	82				28.2	0.85	171			146
28.7	0.95	4.45		0.9	4.2		666	103	3300	2635	5.77	0.5	115				22.8	0.85	240			204
29.3	2.5	4.95		2.5	4.7		707	108	3371	2664	1.02	1.7	77	0.5	0.9	0.8		0.85	160	475	450	136
30.0	2	4.7		2.0	4.45		749	107	3443	2694	1.52	1.3	86					0.85	179			152
30.7	2.45	5.3		2.4	5.05		791	108	3515	2725	1.28	1.6	91					0.85	190			162
31.3	2.35	5.3		2.3	5.05		832	108	3587	2755	1.42	1.5	95					0.85	198			168
32.0	1.75	5.15		1.7	4.9		874	107	3658	2785	2.50	1.0	111				27.7	0.85	232			197
32.7	2.5	5.75		2.5	5.5		915	109	3731	2816	1.51	1.5	106					0.85	221			188
33.3	2.2	5.1		2.2	4.85		957	107	3802	2846	1.56	1.3	93					0.85	194			165
34.0	1.2	4.4		1.2	4.15		998	103	3871	2873	4.40	0.5	104				23.3	0.85	217			184
34.7	1.7	4.45		1.7	4.2		1040	105	3942	2901	2.13	0.9	87				27.0	0.85	183			155
35.3	2.25	5.5		2.2	5.25		1081	108	4013	2932	1.80	1.2	106				29.2	0.85	221			188
36.0	2.15	5.95		2.1	5.7		1123	108	4086	2962	2.35	1.1	126				28.5	0.85	263			223
36.7	0.95	2.25		1.0	2		1165	96	4150	2985	2.24	0.3	35				20.1	0.85	72			61
37.3	1.35	2.95		1.4	2.7		1206	100	4215	3009	1.62	0.6	46					0.85	95			81
38.0	1.85	6.05		1.8	5.8		1248	108	4287	3039	3.49	0.8	140				26.5	0.85	293			249
38.7	2.05	5.45		2.0	5.2		1290	107	4359	3069	2.32	0.9	111				27.6	0.85	232			197

Job No: 14-53069
Job Name: Rush Island
Job Location: Festus, Missouri
Date: 9/29/14
Sounding No: D101
Ground Water Depth (ft): 18

	Membrane 1	Membrane 2	Membrane 3
ΔA =	0.15	0	0
ΔB =	0.2	0	0
Zm=	0.05	bar	

Latitude:
Longitude:

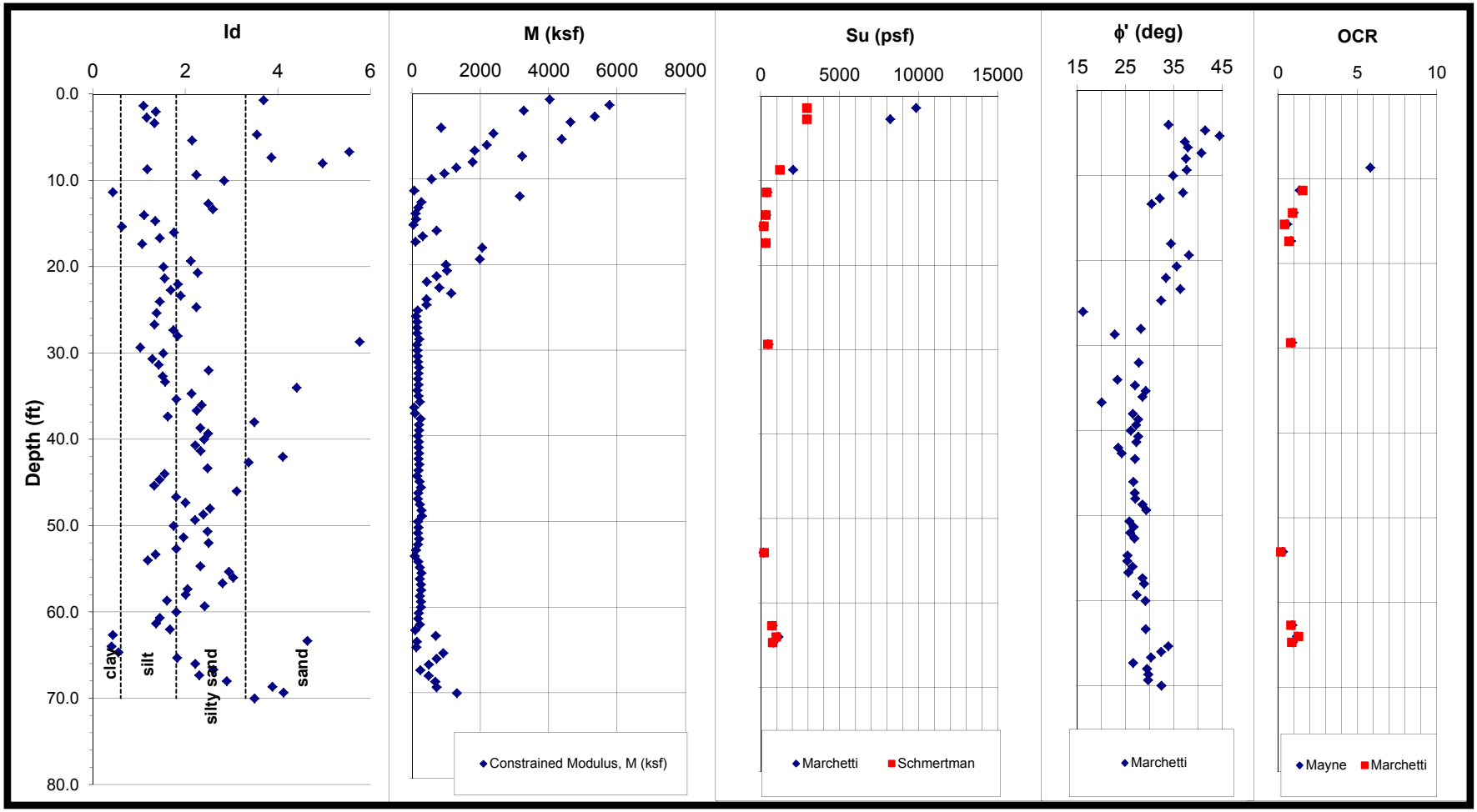
[1] Depth Below Existing Ground Surface
[2] Mayne, 1995
[3] Marchetti,2001
[4] Schmertman, 1981
[5] Mayne, 2002

CONETEC

Depth[1] (ft)	A (bar)	B (bar)	C (bar)	po (bar)	p1 (bar)	p2 (bar)	u_o (psf)	γ_T[5] (pcf)	σ_{vo} (psf)	σ_{vo}' (psf)	Id	K_D	E_D (bar)	K_o	OCR[2]	OCR[3]	ϕ[3] (deg)	R_M	E_D (ksf)	s_u[3] (psf)	s_u[4] (psf)	M (ksf)
39.3	2	5.45		1.9	5.2		1331	107	4430	3099	2.49	0.9	113				27.2	0.85	236			201
40.0	1.8	4.7		1.8	4.45		1373	105	4500	3128	2.40	0.7	93				26.1	0.85	194			165
40.7	2.15	5.5		2.1	5.25		1415	107	4572	3158	2.21	0.9	109				27.6	0.85	228			194
41.3	2.1	5.45		2.1	5.2		1456	107	4643	3187	2.33	0.9	109				27.2	0.85	228			194
42.0	1.55	4.95		1.5	4.7		1498	104	4713	3215	4.10	0.5	111				23.5	0.85	232			197
42.7	1.65	4.8		1.6	4.55		1539	104	4783	3243	3.37	0.6	102				24.2	0.85	213			181
43.3	2.15	5.65		2.1	5.4		1581	107	4853	3273	2.48	0.9	115				27.0	0.85	240			204
44.0	2.75	5.95		2.7	5.7		1622	109	4926	3304	1.55	1.2	104					0.85	217			184
44.7	2.45	5.05		2.4	4.8		1664	106	4997	3333	1.44	1.0	82					0.85	171			146
45.3	3.5	7.15		3.4	6.9		1705	111	5071	3365	1.32	1.6	120					0.85	251			213
46.0	2.25	6.5		2.2	6.25		1747	108	5143	3396	3.11	0.8	142				26.7	0.85	297			252
46.7	2.5	5.6		2.5	5.35		1789	107	5215	3426	1.80	1.0	100					0.85	209			178
47.3	2.3	5.3		2.3	5.05		1830	106	5286	3455	2.00	0.8	97				26.9	0.85	202			171
48.0	2.4	6.2		2.3	5.95		1872	108	5358	3486	2.53	0.9	126				27.0	0.85	263			223
48.7	2.85	7.35		2.7	7.1		1914	110	5432	3518	2.39	1.1	151				28.5	0.85	316			268
49.3	3.15	7.9		3.0	7.65		1955	111	5505	3550	2.21	1.2	160				29.3	0.85	335			285
50.0	2.55	5.5		2.5	5.25		1997	107	5577	3580	1.75	0.9	95					0.85	198			168
50.7	2.25	5.5		2.2	5.25		2039	106	5648	3610	2.48	0.7	106				25.8	0.85	221			188
51.3	2.45	5.45		2.4	5.2		2080	107	5719	3639	1.96	0.8	97				26.7	0.85	202			171
52.0	2.35	5.75		2.3	5.5		2122	107	5790	3669	2.50	0.7	111				26.0	0.85	232			197
52.7	2.55	5.45		2.5	5.2		2163	107	5862	3698	1.80	0.8	93				26.9	0.85	194			165
53.3	2.4	4.5		2.4	4.25		2205	104	5930	3726	1.35	0.8	64					0.85	133			113
54.0	2.05	3.55		2.1	3.3		2246	101	5998	3751	1.19	0.6	42	0.0	0.3	0.1		0.85	88	170	212	74
54.7	2.35	5.4		2.3	5.15		2288	106	6069	3781	2.32	0.7	98				25.4	0.85	205			175
55.3	2.4	6.15		2.3	5.9		2329	107	6139	3810	2.94	0.7	124				25.4	0.85	259			220
56.0	2.7	7.25		2.6	7		2371	109	6213	3841	3.03	0.8	153				26.5	0.85	320			272
56.7	2.5	6.25		2.4	6		2413	107	6284	3871	2.80	0.7	124				25.6	0.85	259			220
57.3	3.3	7.6		3.2	7.35		2454	111	6358	3903	2.05	1.1	144				28.5	0.85	301			255
58.0	3.45	7.9		3.3	7.65		2496	111	6432	3936	2.00	1.1	149				28.8	0.85	312			265
58.7	3.55	7.35		3.5	7.1		2538	111	6506	3968	1.60	1.2	126					0.85	263			223
59.3	3.05	7.35		3.0	7.1		2579	110	6579	4000	2.41	0.9	144				27.3	0.85	301			255
60.0	3.65	7.95		3.6	7.7		2621	111	6653	4032	1.81	1.2	144				29.1	0.85	301			255
60.7	3.5	6.85		3.5	6.6		2663	110	6727	4064	1.45	1.1	109					0.85	228			194
61.3	3.45	6.55		3.4	6.3		2704	109	6799	4095	1.36	1.1	100					0.85	209			178
62.0	3.6	7.45		3.5	7.2		2746	110	6873	4127	1.66	1.1	128					0.85	266			226
62.7	4.7	6.45		4.7	6.2		2787	108	6945	4157	0.43	1.7	51	0.5	0.9	0.8		0.85	107	750	709	91
63.3	4.2	15.2		3.8	14.95		2829	117	7022	4194	4.63	1.2	388				29.2	0.85	810			689
64.0	6.05	8.2		6.1	7.95		2870	111	7097	4226	0.40	2.3	66	0.6	1.2	1.3		1.00	137	1117	979	137
64.7	5	7.25		5.0	7		2912	110	7170	4258	0.55	1.8	69	0.5	0.9	0.8		0.85	145	805	754	123
65.3	7.3	17.2		6.9	16.95		2953	122	7250	4297	1.82	2.7	348				33.9	1.25	727			911
66.0	6.05	15.4		5.7	15.15		2995	120	7331	4335	2.22	2.1	328				32.4	1.04	685			716
66.7	4.75	12.6		4.5	12.35		3037	117	7409	4372	2.61	1.4	273				30.3	0.85	571			485
67.3	3.25	7.3		3.2	7.05		3078	109	7481	4403	2.30	0.8	135				26.6	0.85	282			239
68.0	4.45	12.2		4.2	11.95		3120	116	7559	4439	2.89	1.3	270				29.5	0.85	563			479
68.7	4.75	15.5		4.3	15.25		3162	118	7638	4476	3.88	1.3	379				29.7	0.85	791			673
69.3	4.8	16.2		4.3	15.95		3203	118	7716	4513	4.12	1.3	403				29.6	0.85	841			715
70.0	6.75	22.2		6.1	21.95		3245	123	7798	4554	3.49	2.1	550				32.4	1.14	1149			1307

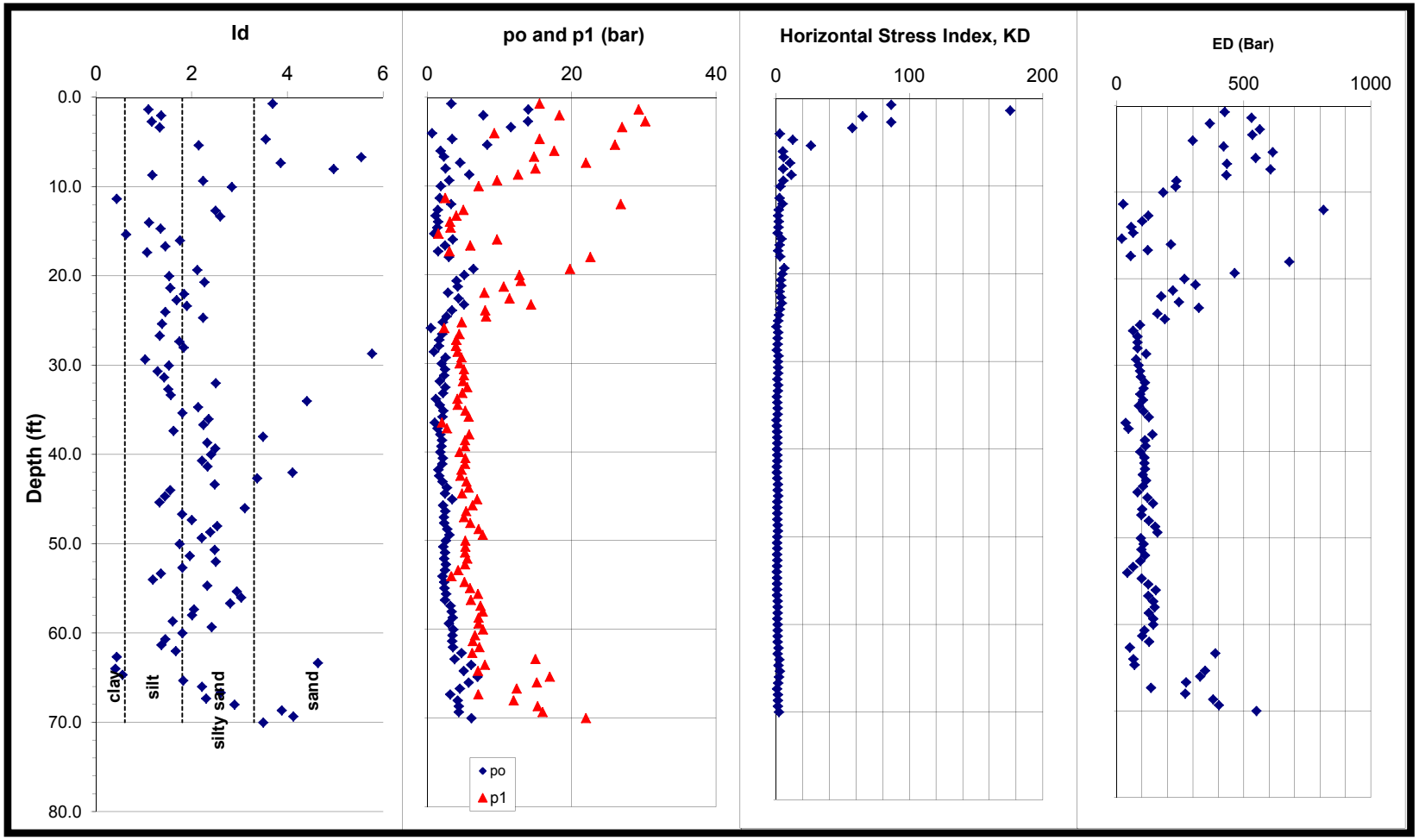
DILATOMETER TEST RESULTS

Test ID: D101
Site: Rush Island
Location: Festus, Missouri
Project No.: 14-53069



DILATOMETER TEST RESULTS

Test ID: D101
Site: Rush Island
Location: Festus, Missouri
Project No.: 14-53069



Job No: 14-53069
Job Name: Rush Island
Job Location: Festus, Missouri
Date: 9/30/14
Sounding No: D102
Ground Water Depth (ft): 18

	Membrane 1	Membrane 2	Membrane 3
ΔA =	0.15	0	0
ΔB =	0.2	0	0
Zm=	0.05	bar	

Latitude:
Longitude:

[1] Depth Below Existing Ground Surface
[2] Mayne, 1995
[3] Marchetti,2001
[4] Schmertman, 1981
[5] Mayne, 2002

CONETEC

Depth[1] (ft)	A (bar)	B (bar)	C (bar)	po (bar)	p1 (bar)	p2 (bar)	u_o (psf)	γ_T[5] (pcf)	σ_{vo} (psf)	σ_{vo}' (psf)	Id	K_D	E_D (bar)	K_o	OCR[2]	OCR[3]	ϕ[3] (deg)	R_M	E_D (ksf)	s_u[3] (psf)	s_u[4] (psf)	M (ksf)
0.7	0.75	5.75		0.6	5.5		0	105	70	70	7.91	18.3	169				43.1	3.07	354			1087
1.3	0.8	6.95		0.6	6.7		0	106	141	141	9.98	9.1	211				40.1	2.41	441			1066
2.0	1.05	6.6		0.9	6.35		0	108	213	213	6.13	8.7	189				39.9	2.38	396			943
2.7	1.35	6.25		1.2	6		0	109	286	286	3.91	8.9	166				40.0	2.40	346			832
3.3							0	130	371	371												
4.0	0.65	8.65		0.4	8.4		0	105	442	442	21.86	1.7	279				31.4	0.98	582			570
4.7							0	130	529	529												
5.3							0	130	615	615												
6.0							0	130	702	702												
6.7							0	130	789	789												
7.3	13.4	31.6		12.6	31.35		0	131	875	875	1.49	30.1	650					3.54	1358			4812
8.0	11.6	28.8		10.9	28.55		0	129	962	962	1.63	23.6	614					3.31	1282			4247
8.7	2.7	8.4		2.5	8.15		0	114	1038	1038	2.22	5.1	195				37.3	1.88	407			765
9.3	3.15	13.6		2.7	13.35		0	118	1116	1116	3.86	5.1	368				37.3	1.92	769			1477
10.0	0.7	6.25		0.5	6		0	105	1186	1186	10.11	1.0	189				27.7	0.85	396			336
10.7	0.4	4.75		0.3	4.5		0	101	1254	1254	14.00	0.5	146				23.4	0.85	304			259
11.3							0	130	1339	1339												
12.0							0	130	1426	1426												
12.7							0	130	1514	1514												
13.3	0.35	4.05		0.3	3.8		0	99	1579	1579	12.45	0.4	122				21.4	0.85	255			217
14.0							0	130	1666	1666												
14.7							0	130	1753	1753												
15.3							0	130	1839	1839												
16.0							0	130	1926	1926												
16.7							0	130	2013	2013												
17.3							0	130	2099	2099												
18.0							0	130	2186	2186												
18.7	1.05	2.85		1.1	2.6		42	102	2255	2213	1.44	1.0	53					0.85	110			94
19.3	1.2	5.5		1.1	5.25		83	107	2325	2242	3.90	1.0	144				27.9	0.85	301			255
20.0	0.35	3.15		0.3	2.9		125	98	2391	2266	9.61	0.2	89				18.4	0.85	186			158
20.7	1.15	13.8		0.6	13.55		167	110	2464	2298	23.26	0.5	448				23.5	0.85	936			796
21.3	1.5	16.2		0.9	15.95		208	113	2539	2331	19.24	0.7	523				25.7	0.85	1092			928
22.0	0.7	6.1		0.5	5.85		250	104	2608	2359	12.39	0.4	184				21.5	0.85	384			327
22.7	0.5	2.75		0.5	2.5		291	98	2674	2382	5.46	0.3	69				20.3	0.85	145			123
23.3	2.15	10.2		1.9	9.95		333	113	2749	2416	4.74	1.5	281				30.4	0.85	586			498
24.0	1.2	8.5		1.0	8.25		374	109	2821	2447	9.44	0.7	253				25.3	0.85	529			450
24.7	0.6	2.25		0.6	2		416	97	2886	2470	3.13	0.4	47				21.3	0.85	99			84
25.3	1.7	7.65		1.5	7.4		457	110	2959	2502	4.52	1.1	204				28.5	0.85	426			362
26.0	1.8	5.1		1.8	4.85		499	108	3031	2532	2.05	1.2	107				29.4	0.85	224			191
26.7	1.45	7.2		1.3	6.95		541	109	3104	2563	5.55	0.8	197				26.8	0.85	411			349
27.3	7.3	15		7.0	14.75		582	121	3184	2602	1.14	5.4	268	1.2	2.8	4.7		1.89	559	1991	1411	1059
28.0	1.45	2.95		1.5	2.7		624	101	3252	2628	1.01	0.9	42	0.2	0.5	0.3		0.85	88	228	249	74
28.7	2.45	8.9		2.2	8.65		666	113	3327	2662	3.33	1.5	222				30.6	0.86	464			399
29.3	2.4	7.8		2.2	7.55		707	112	3401	2694	2.78	1.5	184				30.4	0.85	384			327
30.0	1.85	5.5		1.8	5.25		749	108	3473	2725	2.43	1.1	120				28.6	0.85	251			213
30.7	1.25	3.85		1.2	3.6		791	103	3542	2752	2.75	0.7	82				25.2	0.85	171			146
31.3	3.5	13.2		3.1	12.95		832	117	3620	2788	3.59	2.0	341				32.3	1.12	711			799
32.0	4.25	14.4		3.9	14.15		874	119	3700	2826	2.99	2.5	357				33.6	1.31	746			977
32.7	3.8	11.8		3.5	11.55		915	117	3778	2862	2.61	2.2	279				32.9	1.17	582			678
33.3	1.65	6.4		1.5	6.15		957	108	3849	2892	4.31	0.8	160				26.4	0.85	335			285
34.0	1.65	10.4		1.3	10.15		998	110	3923	2924	10.35	0.6	306				24.8	0.85	639			543
34.7	0.95	3.05		1.0	2.8		1040	99	3989	2949	3.96	0.3	64				20.5	0.85	133			113
35.3	1.45	3.65		1.5	3.4		1081	103	4057	2975	2.07	0.7	67				25.3	0.85	141			120
36.0	1	2.25		1.1	2		1123	96	4121	2998	1.83	0.4	33				21.1	0.85	68			58
36.7	1.35	5.7		1.3	5.45		1165	105	4191	3026	6.07	0.5	146				23.1	0.85	304			259
37.3	1.05	11		0.7	10.75		1206	99	4257	3050	109.01	0.1	350				7.5	0.85	731			621
38.0	1.5	6.5		1.4	6.25		1248	106	4328	3080	6.34	0.5	169				23.7	0.85	354			301
38.7	2.65	5.2		2.6	4.95		1290	107	4400	3110	1.14	1.4	80	0.4	0.7	0.5		0.85	167	422	422	142

Job No: 14-53069
Job Name: Rush Island
Job Location: Festus, Missouri
Date: 9/30/14
Sounding No: D102
Ground Water Depth (ft): 18

	Membrane 1	Membrane 2	Membrane 3
ΔA =	0.15	0	0
ΔB =	0.2	0	0
Zm=	0.05	bar	

Latitude:
Longitude:

[1] Depth Below Existing Ground Surface
[2] Mayne, 1995
[3] Marchetti,2001
[4] Schmertman, 1981
[5] Mayne, 2002

CONETEC

Depth[1] (ft)	A (bar)	B (bar)	C (bar)	po (bar)	p1 (bar)	p2 (bar)	u_o (psf)	γ_T[5] (pcf)	σ_{vo} (psf)	σ_{vo}' (psf)	Id	K_D	E_D (bar)	K_o	OCR[2]	OCR[3]	ϕ[3] (deg)	R_M	E_D (ksf)	s_u[3] (psf)	s_u[4] (psf)	M (ksf)
39.3	3.2	11.6		2.9	11.35		1331	115	4476	3145	3.74	1.5	293				30.5	0.85	613			522
40.0	1.4	4.5		1.4	4.25		1373	103	4545	3172	4.09	0.5	100				22.9	0.85	209			178
40.7	2.75	6.05		2.7	5.8		1415	109	4618	3204	1.53	1.3	107					0.85	224			191
41.3	2	4.95		2.0	4.7		1456	106	4688	3232	2.14	0.8	95				26.7	0.85	198			168
42.0	3.6	11.2		3.3	10.95		1498	116	4765	3268	2.91	1.7	264				31.2	0.94	552			517
42.7	3.2	8.65		3.0	8.4		1539	113	4841	3302	2.32	1.5	186				30.3	0.85	388			330
43.3	2.45	6.75		2.4	6.5		1581	109	4913	3333	2.60	1.0	144				28.0	0.85	301			255
44.0	1.75	8.4		1.5	8.15		1622	108	4986	3363	8.72	0.5	230				23.0	0.85	479			407
44.7	1.75	3.15		1.8	2.9		1664	100	5053	3388	1.10	0.6	38	0.1	0.3	0.2		0.85	80	171	209	68
45.3	1.9	3.65		1.9	3.4		1705	102	5120	3414	1.32	0.7	51					0.85	107			91
46.0	1.55	2.55		1.6	2.3		1747	96	5184	3437	0.87	0.5	24	0.0	0.2	0.1		0.85	49	125	163	42
46.7	1.7	3.65		1.7	3.4		1789	101	5252	3463	1.95	0.5	58				23.7	0.85	122			103
47.3	3.25	9.3		3.1	9.05		1830	113	5327	3497	2.73	1.3	208				29.7	0.85	434			369
48.0	5.4	15.4		5.0	15.15		1872	120	5407	3535	2.46	2.4	352				33.3	1.22	734			898
48.7	4.85	13.2		4.6	12.95		1914	118	5487	3573	2.31	2.1	291				32.6	1.08	609			660
49.3	4.4	10.4		4.2	10.15		1955	115	5563	3608	1.81	1.9	206				31.9	0.93	430			399
50.0	2.75	6.75		2.7	6.5		1997	109	5636	3639	2.24	1.0	133				27.9	0.85	278			236
50.7	1.55	2.45		1.6	2.2		2039	95	5699	3661	0.89	0.4	20	-0.1	0.2	0.1		0.85	42	97	135	36
51.3	1.45	2		1.5	1.75		2080	89	5758	3679	0.39	0.3	7	-0.1	0.2	0.1		0.85	15	78	114	13
52.0	1.85	2.35		1.9	2.1		2122	90	5819	3697	0.17	0.5	5	0.0	0.3	0.1		0.85	11	152	194	10
52.7	1.95	3.7		2.0	3.45		2163	101	5887	3723	1.56	0.5	51					0.85	107			91
53.3	2.55	5.35		2.5	5.1		2205	106	5957	3752	1.75	0.8	89					0.85	186			158
54.0	1.95	3.15		2.0	2.9		2246	99	6023	3777	0.96	0.5	31	0.0	0.3	0.1		0.85	65	153	195	55
54.7	2.2	3.35		2.3	3.1		2288	99	6090	3801	0.72	0.6	29	0.1	0.3	0.2		0.85	61	201	243	52
55.3	1.9	2.7		2.0	2.45		2329	95	6152	3823	0.55	0.5	16	0.0	0.2	0.1		0.85	34	138	180	29
56.0	2	2.85		2.1	2.6		2371	96	6217	3846	0.56	0.5	18	0.0	0.3	0.1		0.85	38	153	196	32
56.7	2	2.95		2.1	2.7		2413	97	6282	3869	0.69	0.5	22	0.0	0.3	0.1		0.85	46	148	191	39
57.3	2.3	3.65		2.4	3.4		2454	101	6348	3894	0.89	0.6	36	0.1	0.3	0.2		0.85	76	202	245	65
58.0	2.2	3.55		2.3	3.3		2496	100	6415	3919	1.00	0.6	36	0.0	0.3	0.1		0.85	76	176	220	65
58.7	2.25	3.55		2.3	3.3		2538	100	6482	3944	0.92	0.6	35	0.0	0.3	0.1		0.85	72	183	227	61
59.3	2.3	3.4		2.4	3.15		2579	99	6547	3968	0.70	0.6	27	0.0	0.3	0.2		0.85	57	191	236	49
60.0	2.5	5.05		2.5	4.8		2621	105	6617	3997	1.87	0.6	80				25.1	0.85	167			142
60.7	2	2.85		2.1	2.6		2663	95	6681	4019	0.66	0.4	18	-0.1	0.2	0.1		0.85	38	124	167	32
61.3	2.1	3.45		2.2	3.2		2704	99	6747	4043	1.23	0.4	36					0.85	76			65
62.0	4.4	10.4		4.2	10.15		2746	115	6823	4078	2.04	1.5	206				30.5	0.85	430			365
62.7	3.7	9.8		3.5	9.55		2787	113	6899	4112	2.77	1.1	210				28.6	0.85	438			372
63.3	4.8	11.4		4.6	11.15		2829	116	6976	4147	2.03	1.6	228				31.0	0.85	476			404
64.0	4	12.4		3.7	12.15		2870	115	7053	4183	3.64	1.2	293				28.9	0.85	613			521
64.7	2.55	4.45		2.6	4.2		2912	103	7122	4210	1.38	0.6	56					0.85	118			100
65.3	2.65	4.2		2.7	3.95		2953	102	7189	4236	0.99	0.6	44	0.1	0.3	0.2		0.85	91	220	266	78
66.0	2.65	5.7		2.6	5.45		2995	106	7260	4265	2.40	0.6	98				24.4	0.85	205			175
66.7	2.9	8.15		2.8	7.9		3037	109	7334	4297	3.96	0.6	179				25.0	0.85	373			317
67.3	3.55	9.85		3.4	9.6		3078	113	7408	4330	3.33	0.9	217				27.4	0.85	453			385
68.0	2.75	5.35		2.7	5.1		3120	105	7478	4358	1.90	0.6	82				24.6	0.85	171			146
68.7	2.8	5.4		2.8	5.15		3162	105	7549	4387	1.85	0.6	82				24.7	0.85	171			146
69.3	2.6	4.55		2.6	4.3		3203	103	7616	4413	1.55	0.5	58					0.85	122			103
70.0	2.65	5.15		2.6	4.9		3245	104	7686	4441	2.07	0.5	78				23.6	0.85	164			139
70.7	2.45	6.05		2.4	5.8		3287	105	7756	4470	4.19	0.4	118				21.5	0.85	247			210
71.3	2.6	4		2.6	3.75		3328	100	7822	4495	1.05	0.5	38	0.0	0.2	0.1		0.85	80	170	220	68
72.0	2.5	4.2		2.5	3.95		3370	101	7890	4520	1.54	0.4	49					0.85	103			87
72.7	2.65	4.25		2.7	4		3411	101	7958	4546	1.25	0.5	46					0.85	95			81
73.3	2.85	4.25		2.9	4		3453	101	8024	4572	0.89	0.6	38	0.0	0.3	0.1		0.85	80	209	260	68
74.0	2.65	4		2.7	3.75		3494	100	8091	4597	1.02	0.5	36	0.0	0.2	0.1		0.85	76	164	214	65
74.7	3.05	4.7		3.1	4.45		3536	103	8160	4624	0.98	0.6	47	0.1	0.3	0.2		0.85	99	239	291	84
75.3	3	5.15		3.0	4.9		3577	104	8229	4651	1.46	0.6	66					0.85	137			116
76.0	2.95	5.35		2.9	5.1		3619	104	8299	4680	1.77	0.5	75					0.85	156			133
76.7	3.05	5.45		3.0	5.2		3661	105	8369	4708	1.66	0.6	75					0.85	156			133
77.3	2.8	4.25		2.8	4		3702	101	8435	4733	1.08	0.5	40	0.0	0.2	0.1		0.85	84	172	224	71

Job No: 14-53069
Job Name: Rush Island
Job Location: Festus, Missouri
Date: 9/30/14
Sounding No: D102
Ground Water Depth (ft): 18

	Membrane 1	Membrane 2	Membrane 3
ΔA =	0.15	0	0
ΔB =	0.2	0	0
Zm=	0.05	bar	

Latitude:
Longitude:

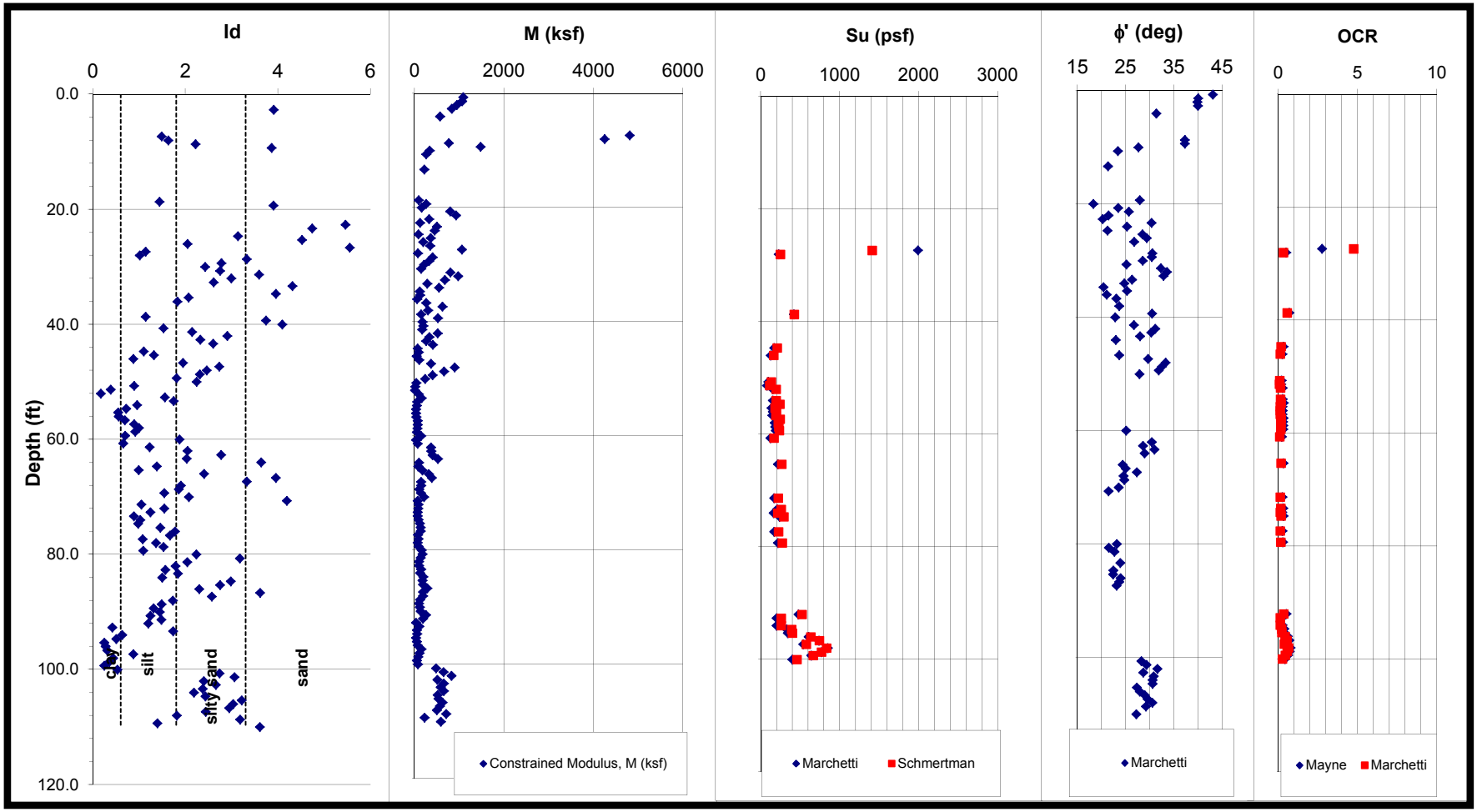
[1] Depth Below Existing Ground Surface
[2] Mayne, 1995
[3] Marchetti,2001
[4] Schmertman, 1981
[5] Mayne, 2002

CONETEC

Depth[1] (ft)	A (bar)	B (bar)	C (bar)	po (bar)	p1 (bar)	p2 (bar)	u_o (psf)	γ_T[5] (pcf)	σ_{vo} (psf)	σ_{vo}' (psf)	Id	K_D	E_D (bar)	K_o	OCR[2]	OCR[3]	ϕ[3] (deg)	R_M	E_D (ksf)	s_u[3] (psf)	s_u[4] (psf)	M (ksf)
78.0	2.8	4.5		2.8	4.25		3744	101	8503	4759	1.36	0.5	49					0.85	103			87
78.7	2.45	3.8		2.5	3.55		3786	98	8569	4783	1.53	0.3	36					0.85	76			65
79.3	3.1	4.8		3.1	4.55		3827	103	8637	4810	1.09	0.6	49	0.0	0.3	0.1		0.85	103	218	272	87
80.0	3	5.75		3.0	5.5		3869	105	8707	4838	2.23	0.5	87				23.2	0.85	183			155
80.7	2.8	5.85		2.8	5.6		3911	104	8777	4866	3.18	0.4	98				21.6	0.85	205			175
81.3	2.95	5.35		2.9	5.1		3952	104	8845	4893	2.04	0.5	75				22.7	0.85	156			133
82.0	2.8	4.7		2.8	4.45		3994	101	8913	4920	1.79	0.4	56					0.85	118			100
82.7	2.95	4.85		3.0	4.6		4035	102	8982	4946	1.56	0.4	56					0.85	118			100
83.3	3.25	5.85		3.2	5.6		4077	105	9051	4974	1.84	0.5	82				23.9	0.85	171			146
84.0	3.3	5.55		3.3	5.3		4118	104	9121	5003	1.50	0.6	69					0.85	145			123
84.7	3.1	6.45		3.1	6.2		4160	106	9192	5032	2.98	0.4	109				22.5	0.85	228			194
85.3	3.1	6.2		3.1	5.95		4201	105	9261	5060	2.75	0.4	100				22.4	0.85	209			178
86.0	3.4	6.65		3.4	6.4		4243	107	9333	5090	2.30	0.5	106				24.0	0.85	221			188
86.7	3.45	8.2		3.3	7.95		4285	109	9406	5121	3.61	0.5	160				23.7	0.85	335			285
87.3	3.3	6.55		3.3	6.3		4326	106	9476	5150	2.57	0.5	106				23.1	0.85	221			188
88.0	3.9	7.15		3.9	6.9		4368	108	9548	5180	1.73	0.7	106					0.85	221			188
88.7	3.45	5.7		3.5	5.45		4410	105	9618	5208	1.48	0.5	69					0.85	145			123
89.3	3.35	5.25		3.4	5		4451	103	9686	5235	1.31	0.5	56					0.85	118			100
90.0	3.45	5.6		3.5	5.35		4493	104	9756	5263	1.44	0.5	66					0.85	137			116
90.7	3.95	6.4		3.9	6.15		4535	107	9827	5293	1.24	0.7	77					0.85	160			136
91.3	5.05	9.3		5.0	9.05		4576	112	9902	5326	1.48	1.1	142					0.85	297			252
92.0	4.75	7.95		4.7	7.7		4618	110	9975	5358	1.20	1.0	104	0.2	0.5	0.3		0.85	217	479	521	184
92.7	3.4	4.25		3.5	4		4659	97	10041	5381	0.42	0.5	18	0.0	0.2	0.1		0.85	38	200	260	32
93.3	3.2	5.15		3.2	4.9		4701	102	10108	5407	1.73	0.4	58					0.85	122			103
94.0	3.45	4.55		3.5	4.3		4742	99	10174	5432	0.63	0.5	27	0.0	0.2	0.1		0.85	57	199	259	49
94.7	4.1	5.35		4.2	5.1		4784	102	10243	5459	0.51	0.7	33	0.1	0.4	0.2		0.85	68	331	389	58
95.3	4.15	4.95		4.2	4.7		4825	99	10308	5483	0.25	0.7	16	0.1	0.4	0.2		0.85	34	342	400	29
96.0	5.3	6.45		5.4	6.2		4867	104	10378	5511	0.28	1.1	29	0.3	0.6	0.4		0.85	61	606	633	52
96.7	5.85	7.25		5.9	7		4909	107	10450	5541	0.31	1.3	38	0.3	0.7	0.5		0.85	80	737	741	68
97.3	5.15	7.8		5.1	7.55		4950	109	10522	5572	0.87	1.0	84	0.2	0.5	0.4		0.85	175	539	577	149
98.0	6.35	8.35		6.4	8.1		4992	110	10595	5603	0.44	1.5	60	0.4	0.8	0.6		0.85	126	848	831	107
98.7	6.05	7.65		6.1	7.4		5034	108	10667	5634	0.36	1.4	46	0.4	0.7	0.5		0.85	95	768	768	81
99.3	5.55	6.65		5.6	6.4		5075	104	10736	5661	0.25	1.2	27	0.3	0.6	0.4		0.85	57	640	665	49
100.0	4.6	6.05		4.6	5.8		5117	104	10806	5689	0.53	0.8	40	0.1	0.4	0.2		0.85	84	402	458	71
100.7	5.6	13.4		5.3	13.15		5159	116	10884	5725	2.74	1.0	271				28.3	0.85	567			482
101.3	6.3	16.6		5.9	16.35		5200	119	10962	5763	3.06	1.2	363				29.3	0.85	757			644
102.0	8	19.8		7.5	19.55		5242	122	11044	5803	2.40	1.8	417				31.6	0.95	871			824
102.7	5.95	14.2		5.7	13.95		5283	117	11123	5839	2.65	1.1	288				28.7	0.85	601			511
103.3	7.4	17.8		7.0	17.55		5325	121	11202	5878	2.37	1.6	366				30.8	0.85	765			650
104.0	7.25	16.6		6.9	16.35		5366	120	11283	5916	2.18	1.5	328				30.6	0.85	685			582
104.7	7.35	17.8		6.9	17.55		5408	121	11363	5955	2.43	1.5	368				30.6	0.85	769			653
105.3	5.5	13.8		5.2	13.55		5449	116	11440	5991	3.22	0.9	290				27.4	0.85	605			514
106.0	5.8	14.4		5.5	14.15		5491	117	11518	6027	3.03	1.0	301				27.9	0.85	628			534
106.7	6.45	16.4		6.1	16.15		5533	119	11598	6065	2.95	1.2	350				29.0	0.85	731			621
107.3	6.75	15.8		6.4	15.55		5574	119	11676	6102	2.44	1.3	317				29.6	0.85	662			563
108.0	7.4	15.4		7.1	15.15		5616	119	11756	6140	1.81	1.5	279				30.5	0.85	582			495
108.7	6.75	18		6.3	17.75		5658	120	11836	6178	3.18	1.2	397				29.2	0.85	829			705
109.3	5.4	9.2		5.3	8.95		5699	111	11910	6211	1.39	0.9	126					0.85	263			223
110.0	5.75	15.2		5.4	14.95		5741	117	11988	6247	3.61	0.9	332				27.2	0.85	692			589

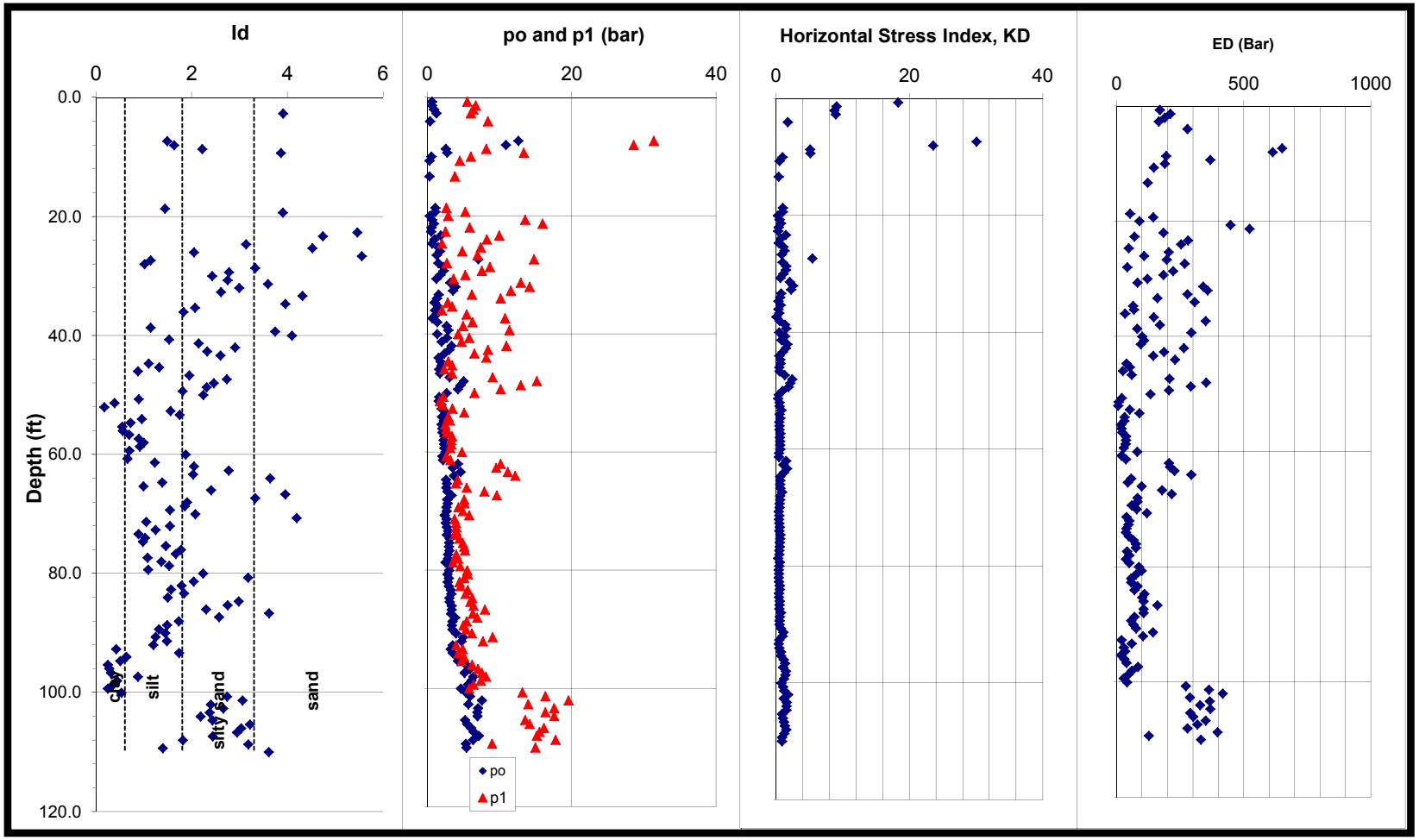
DILATOMETER TEST RESULTS

Test ID: D102
Site: Rush Island
Location: Festus, Missouri
Project No.: 14-53069



DILATOMETER TEST RESULTS

Test ID: D102
Site: Rush Island
Location: Festus, Missouri
Project No.: 14-53069



Job No: 14-53069
Job Name: Rush Island
Job Location: Festus, Missouri
Date: 9/30/14
Sounding No: D102
Ground Water Depth (ft): 11.647

	Membrane 1	Membrane 2	Membrane 3
ΔA =	0.15	0	0
ΔB =	0.2	0	0
Zm=	0.05	bar	

Latitude:
Longitude:

[1] Depth Below Existing Ground Surface
[2] Mayne, 1995
[3] Marchetti,2001
[4] Schmertman, 1981
[5] Mayne, 2002

CONETEC

Depth[1] (ft)	A (bar)	B (bar)	C (bar)	po (bar)	p1 (bar)	p2 (bar)	u_o (psf)	γ_T[5] (pcf)	σ_{vo} (psf)	σ_{vo}' (psf)	Id	K_D	E_D (bar)	K_o	OCR[2]	OCR[3]	ϕ[3] (deg)	R_M	E_D (ksf)	s_u[3] (psf)	s_u[4] (psf)	M (ksf)
0.7	0.95	2.75		1.0	2.5		0	102	68	68	1.56	30.0	53					3.54	110			391
1.3	1.95	7.5		1.8	7.25		0	112	142	142	3.05	26.4	189				44.5	3.42	396			1353
2.0	1.6	4.25		1.6	4		0	106	213	213	1.52	15.5	84					2.92	175			511
2.7	0.8	8.05		0.6	7.8		0	107	284	284	13.05	4.1	251				36.1	1.72	525			903
3.3							0	130	370	370												
4.0	1.75	3.75		1.8	3.5		0	105	441	441	0.98	8.4	60	1.6	4.3	9.3		2.32	126	581	369	292
4.7	1.7	5.4		1.6	5.15		0	109	513	513	2.15	6.6	122				38.6	2.12	255			541
5.3	0.8	2.75		0.8	2.5		0	101	580	580	2.05	3.0	58				34.4	1.36	122			166
6.0	0.75	3		0.8	2.75		0	102	648	648	2.64	2.4	69				33.3	1.24	145			179
6.7	0.65	2.7		0.7	2.45		0	100	716	716	2.68	1.9	62				32.0	1.04	129			135
7.3	1.4	5.05		1.3	4.8		0	107	786	786	2.60	3.5	120				35.4	1.57	251			395
8.0	1.75	6.2		1.6	5.95		0	110	860	860	2.62	4.0	149				36.0	1.68	312			524
8.7	1.3	7.15		1.1	6.9		0	109	933	933	5.13	2.5	200				33.5	1.30	419			545
9.3	1.35	5.95		1.2	5.7		0	108	1005	1005	3.61	2.6	155				33.6	1.32	323			427
10.0	1.75	9.4		1.5	9.15		0	112	1080	1080	5.16	2.9	266				34.2	1.42	556			787
10.7	2.2	8.25		2.0	8		0	113	1155	1155	2.97	3.6	208				35.5	1.62	434			703
11.3	2.55	9.15		2.3	8.9		0	114	1231	1231	2.81	4.0	228				36.0	1.69	476			801
12.0	0.75	3.15		0.7	2.9		22	102	1299	1277	2.92	1.2	75				29.2	0.85	156			133
12.7	0.75	3.05		0.8	2.8		64	101	1367	1303	2.84	1.2	71				28.9	0.85	148			126
13.3	0.75	2.4		0.8	2.15		105	100	1433	1328	1.86	1.2	47				28.9	0.85	99			84
14.0	0.9	4		0.9	3.75		147	104	1502	1355	3.64	1.2	100				29.2	0.85	209			178
14.7	5.2	18		4.7	17.75		189	122	1584	1395	2.85	6.9	454				38.7	2.17	947			2056
15.3	3.15	9.45		3.0	9.2		230	115	1660	1430	2.20	4.2	217				36.2	1.69	453			765
16.0	2.75	8.05		2.6	7.8		272	113	1736	1464	2.10	3.5	180				35.4	1.53	377			578
16.7	1.1	4.25		1.1	4		313	105	1806	1492	3.23	1.3	102				29.5	0.85	213			181
17.3	1.05	2.15		1.1	1.9		355	98	1870	1516	0.84	1.3	27	0.3	0.7	0.5		0.85	57	194	197	49
18.0	0.65	2.1		0.7	1.85		396	97	1935	1539	2.29	0.7	40				25.6	0.85	84			71
18.7	1.05	1.6		1.1	1.35		438	92	1997	1558	0.23	1.2	7	0.3	0.6	0.5		0.85	15	190	194	13
19.3	1.55	3.95		1.5	3.7		479	105	2066	1586	1.63	1.7	75					0.85	156			133
20.0	2.35	7.75		2.2	7.5		521	112	2141	1620	2.72	2.5	184				33.5	1.28	384			490
20.7	1.15	3.95		1.1	3.7		563	104	2210	1647	3.00	1.1	89				28.5	0.85	186			158
21.3	1.55	3.75		1.6	3.5		604	104	2279	1675	1.53	1.6	67					0.85	141			120
22.0	1.7	4.35		1.7	4.1		646	106	2350	1704	1.76	1.7	84					0.85	175			149
22.7	2	4.75		2.0	4.5		688	107	2421	1733	1.53	2.0	87					0.94	183			172
23.3	1.65	6.05		1.5	5.8		729	108	2493	1763	3.55	1.4	148				30.2	0.85	308			262
24.0	1.75	4.35		1.7	4.1		771	106	2563	1792	1.73	1.6	82					0.85	171			146
24.7	1.35	4.95		1.3	4.7		813	105	2634	1821	3.80	1.0	118				28.2	0.85	247			210
25.3	1.4	3.8		1.4	3.55		854	103	2702	1848	2.18	1.1	75				28.7	0.85	156			133
26.0	2.05	4.75		2.0	4.5		896	107	2773	1878	1.54	1.8	86					0.85	179			152
26.7	5.55	19.8		5.0	19.55		937	123	2856	1918	3.24	4.9	506				37.1	1.88	1058			1990
27.3	6.75	17.2		6.3	16.95		979	122	2936	1958	1.80	6.3	368				38.3	2.06	769			1582
28.0	3.5	9.35		3.3	9.1		1020	114	3013	1993	2.04	3.0	200				34.4	1.37	419			573
28.7	2.8	6.95		2.7	6.7		1062	111	3087	2025	1.81	2.3	138				32.9	1.10	289			317
29.3	2.5	6.35		2.4	6.1		1103	110	3160	2056	1.94	1.9	128				32.0	0.96	266			254
30.0	3.5	8.75		3.4	8.5		1145	114	3236	2091	1.83	2.8	179				34.1	1.30	373			484
30.7	4.4	12.2		4.1	11.95		1187	118	3315	2128	2.20	3.5	271				35.3	1.53	567			868
31.3	2.8	4.25		2.8	4		1228	104	3384	2155	0.51	2.2	40	0.6	1.1	1.1		0.94	84	530	471	79
32.0	3.55	12.6		3.2	12.35		1270	117	3462	2192	3.50	2.5	317				33.4	1.29	662			854
32.7	2.9	3.7		3.0	3.45		1312	100	3529	2217	0.20	2.2	16	0.6	1.1	1.2		0.95	34	554	491	33
33.3	2.6	3.4		2.7	3.15		1353	99	3594	2241	0.23	1.9	16	0.5	1.0	0.9		0.85	34	460	424	29
34.0	2.35	3.5		2.4	3.25		1395	101	3662	2267	0.48	1.6	29	0.4	0.8	0.7		0.85	61	379	364	52
34.7	2	4.2		2.0	3.95		1437	104	3732	2295	1.47	1.2	67					0.85	141			120
35.3	1.8	4.05		1.8	3.8		1478	103	3800	2323	1.82	1.0	69				27.9	0.85	145			123
36.0	1.85	5.95		1.8	5.7		1520	107	3872	2352	3.80	0.9	137				27.5	0.85	285			243
36.7	2	8.55		1.8	8.3		1561	110	3945	2384	6.25	0.9	226				27.4	0.85	472			401
37.3	2.4	3.85		2.4	3.6		1603	103	4013	2411	0.69	1.5	40	0.4	0.7	0.6		0.85	84	356	350	71
38.0	2.4	4.25		2.4	4		1644	104	4083	2439	0.96	1.4	55	0.4	0.7	0.6		0.85	114	344	342	97
38.7	2.2	4.05		2.2	3.8		1686	104	4152	2466	1.11	1.2	55	0.3	0.6	0.5		0.85	114	287	296	97

Job No: 14-53069
Job Name: Rush Island
Job Location: Festus, Missouri
Date: 9/30/14
Sounding No: D102
Ground Water Depth (ft): 11.647

	Membrane 1	Membrane 2	Membrane 3
ΔA =	0.15	0	0
ΔB =	0.2	0	0
Zm=	0.05	bar	

Latitude:
Longitude:

[1] Depth Below Existing Ground Surface
[2] Mayne, 1995
[3] Marchetti,2001
[4] Schmertman, 1981
[5] Mayne, 2002

CONETEC

Depth[1] (ft)	A (bar)	B (bar)	C (bar)	po (bar)	p1 (bar)	p2 (bar)	u_o (psf)	γ_T[5] (pcf)	σ_{vo} (psf)	σ_{vo}' (psf)	Id	K_D	E_D (bar)	K_o	OCR[2]	OCR[3]	ϕ[3] (deg)	R_M	E_D (ksf)	s_u[3] (psf)	s_u[4] (psf)	M (ksf)
39.3	2.1	4		2.1	3.75		1727	103	4221	2493	1.26	1.1	56					0.85	118			100
40.0	2.35	3.5		2.4	3.25		1769	101	4288	2519	0.54	1.3	29	0.3	0.7	0.5		0.85	61	322	326	52
40.7	1.65	2.9		1.7	2.65		1811	98	4354	2543	1.13	0.7	33	0.1	0.4	0.2		0.85	68	147	175	58
41.3	1.8	2.5		1.9	2.25		1852	95	4417	2564	0.37	0.8	13	0.1	0.4	0.2		0.85	27	183	208	23
42.0	1.9	3.1		2.0	2.85		1894	99	4483	2589	0.85	0.8	31	0.2	0.4	0.3		0.85	65	195	219	55
42.7	2.1	2.9		2.2	2.65		1936	97	4548	2612	0.38	1.0	16	0.2	0.5	0.3		0.85	34	242	261	29
43.3	2.3	3.15		2.4	2.9		1977	98	4613	2636	0.37	1.1	18	0.3	0.6	0.4		0.85	38	285	298	32
44.0	2.15	3.25		2.2	3		2019	99	4679	2660	0.63	1.0	27	0.2	0.5	0.3		0.85	57	239	260	49
44.7	2.45	4.15		2.5	3.9		2061	103	4749	2688	0.95	1.2	49	0.3	0.6	0.4		0.85	103	300	312	87
45.3	2.5	3.75		2.6	3.5		2102	101	4815	2714	0.61	1.2	33	0.3	0.6	0.4		0.85	68	313	323	58
46.0	3.7	6.65		3.7	6.4		2144	110	4889	2745	1.03	2.0	95	0.5	1.0	1.0		0.90	198	608	552	178
46.7	2.45	4.25		2.5	4		2185	103	4958	2773	1.06	1.1	53	0.3	0.5	0.4		0.85	110	282	299	94
47.3	2.5	3.8		2.6	3.55		2227	101	5025	2799	0.67	1.1	35	0.3	0.6	0.4		0.85	72	295	310	61
48.0	2.35	3.1		2.4	2.85		2268	97	5090	2822	0.31	1.0	15	0.2	0.5	0.3		0.85	30	259	281	26
48.7	2.5	3.25		2.6	3		2310	97	5155	2845	0.28	1.1	15	0.3	0.6	0.4		0.85	30	290	308	26
49.3	2.7	4.75		2.7	4.5		2351	105	5224	2873	1.12	1.2	62	0.3	0.6	0.4		0.85	129	318	332	110
50.0	2.5	3.2		2.6	2.95		2393	96	5289	2896	0.26	1.0	13	0.2	0.5	0.4		0.85	27	280	300	23
50.7	2.5	4		2.5	3.75		2435	102	5357	2922	0.88	1.0	42	0.2	0.5	0.3		0.85	88	265	288	74
51.3	2.5	3.55		2.6	3.3		2476	100	5423	2947	0.53	1.0	26	0.2	0.5	0.3		0.85	53	265	288	45
52.0	2.8	3.7		2.9	3.45		2518	99	5490	2972	0.35	1.2	20	0.3	0.6	0.4		0.85	42	335	348	36
52.7	2.85	3.95		2.9	3.7		2560	101	5557	2997	0.47	1.2	27	0.3	0.6	0.4		0.85	57	339	352	49
53.3	3.15	4.55		3.2	4.3		2601	103	5626	3025	0.56	1.3	38	0.4	0.7	0.5		0.85	80	406	408	68
54.0	3.2	4.05		3.3	3.8		2643	100	5692	3050	0.26	1.4	18	0.4	0.7	0.6		0.85	38	421	420	32
54.7	2.85	4		2.9	3.75		2685	101	5760	3075	0.52	1.1	29	0.3	0.6	0.4		0.85	61	322	339	52
55.3	2.8	4.15		2.9	3.9		2726	102	5827	3102	0.68	1.0	36	0.2	0.5	0.4		0.85	76	301	323	65
56.0	3.1	4.1		3.2	3.85		2768	101	5895	3127	0.37	1.2	24	0.3	0.6	0.5		0.85	49	375	385	42
56.7	3	4.2		3.1	3.95		2809	102	5963	3154	0.52	1.1	31	0.3	0.6	0.4		0.85	65	341	358	55
57.3	3.35	4.25		3.4	4		2851	100	6029	3179	0.28	1.4	20	0.4	0.7	0.5		0.85	42	429	430	36
58.0	3.1	3.75		3.2	3.5		2892	97	6094	3202	0.17	1.2	11	0.3	0.6	0.4		0.85	23	362	376	19
58.7	3.5	4.45		3.6	4.2		2934	101	6162	3227	0.29	1.4	22	0.4	0.7	0.6		0.85	46	455	452	39
59.3	3.55	4.55		3.6	4.3		2975	102	6229	3253	0.31	1.4	24	0.4	0.7	0.6		0.85	49	461	458	42
60.0	3.65	4.25		3.7	4		3017	97	6294	3277	0.11	1.5	9	0.4	0.7	0.6		0.85	19	487	479	16
60.7	3.65	4.35		3.7	4.1		3059	99	6360	3301	0.16	1.4	13	0.4	0.7	0.6		0.85	27	480	474	23
61.3	3.45	4.25		3.5	4		3100	99	6425	3325	0.23	1.3	16	0.3	0.7	0.5		0.85	34	420	427	29
62.0	3.25	3.8		3.3	3.55		3142	95	6489	3347	0.11	1.1	7	0.3	0.6	0.4		0.85	15	367	383	13
62.7	3.35	4.35		3.4	4.1		3184	101	6556	3373	0.36	1.2	24	0.3	0.6	0.4		0.85	49	381	395	42
63.3	3.4	4.55		3.5	4.3		3225	102	6624	3399	0.44	1.2	29	0.3	0.6	0.4		0.85	61	386	400	52
64.0	3.05	4.25		3.1	4		3267	101	6691	3425	0.58	0.9	31	0.2	0.5	0.3		0.85	65	294	322	55
64.7	3.3	4.45		3.4	4.2		3309	102	6759	3451	0.47	1.1	29	0.3	0.5	0.4		0.85	61	349	371	52
65.3	3.15	3.65		3.2	3.4		3350	93	6821	3471	0.10	1.0	5	0.2	0.5	0.3		0.85	11	315	342	10
66.0	3.35	4.75		3.4	4.5		3392	103	6890	3498	0.62	1.1	38	0.2	0.5	0.4		0.85	80	348	370	68
66.7	3.6	4.8		3.7	4.55		3433	102	6958	3525	0.44	1.2	31	0.3	0.6	0.4		0.85	65	407	421	55
67.3	3.75	5.15		3.8	4.9		3475	104	7027	3552	0.52	1.3	38	0.3	0.6	0.5		0.85	80	436	446	68
68.0	3.9	5.85		3.9	5.6		3516	106	7098	3582	0.75	1.3	58	0.3	0.7	0.5		0.85	122	462	467	103
68.7	3.8	5.15		3.9	4.9		3558	104	7168	3609	0.49	1.2	36	0.3	0.6	0.5		0.85	76	438	448	65
69.3	3.55	4.5		3.6	4.25		3599	100	7234	3635	0.33	1.1	22	0.3	0.6	0.4		0.85	46	374	396	39
70.0	3.65	4.75		3.7	4.5		3641	102	7302	3661	0.40	1.1	27	0.3	0.6	0.4		0.85	57	392	411	49
70.7	3.95	4.45		4.0	4.2		3683	95	7365	3682	0.07	1.3	5	0.3	0.7	0.5		0.85	11	469	476	10
71.3	4.05	4.65		4.1	4.4		3724	97	7430	3705	0.11	1.3	9	0.3	0.7	0.5		0.85	19	488	492	16
72.0	4.1	5.45		4.2	5.2		3766	104	7499	3733	0.45	1.3	36	0.3	0.7	0.5		0.85	76	485	490	65
72.7	5.75	6.8		5.8	6.55		3808	105	7570	3762	0.18	2.2	26	0.6	1.1	1.2		0.96	53	941	834	51
73.3	6.1	7.3		6.2	7.05		3849	106	7640	3791	0.21	2.4	31	0.6	1.2	1.3		1.03	65	1035	901	66
74.0	5.75	7.4		5.8	7.15		3891	108	7712	3822	0.35	2.1	47	0.6	1.1	1.1		0.92	99	917	819	91
74.7	4.8	13.8		4.5	13.55		3933	117	7791	3858	3.51	1.4	315				30.1	0.85	658			559
75.3	4.9	7.05		4.9	6.8		3974	109	7862	3888	0.63	1.6	66	0.4	0.8	0.7		0.85	137	655	628	116
76.0	5.55	9.95		5.4	9.7		4016	114	7938	3923	1.21	1.9	148					0.85	308			262
76.7	9.45	25.8		8.8	25.55		4057	126	8023	3966	2.47	3.6	583				35.5	1.57	1218			1916
77.3	7.75	20.2		7.2	19.95		4099	123	8104	4005	2.41	2.8	441				34.0	1.33	921			1225

Job No: 14-53069
Job Name: Rush Island
Job Location: Festus, Missouri
Date: 9/30/14
Sounding No: D102
Ground Water Depth (ft): 11.647

	Membrane 1	Membrane 2	Membrane 3
ΔA =	0.15	0	0
ΔB =	0.2	0	0
Zm=	0.05	bar	

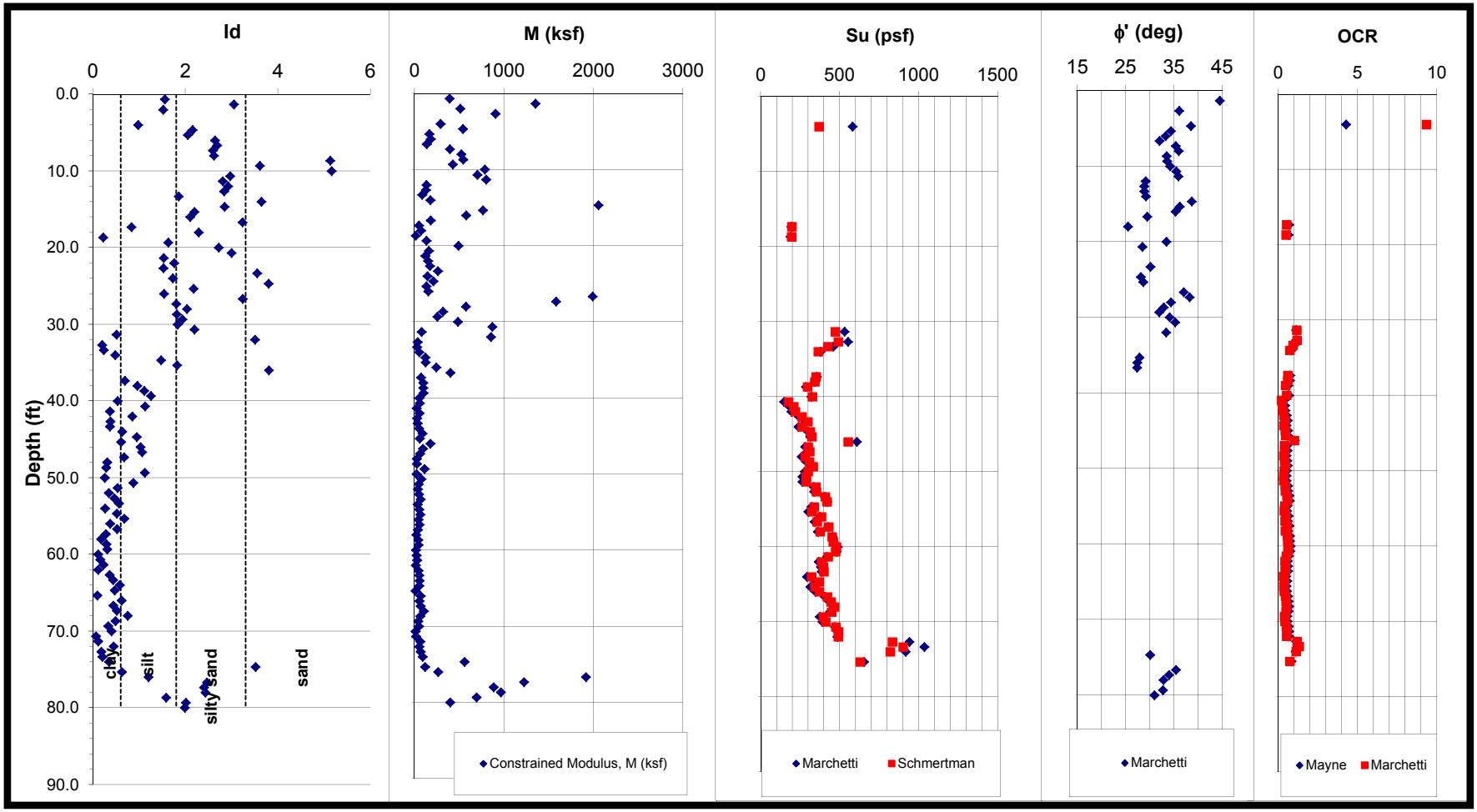
Latitude:
Longitude:

[1] Depth Below Existing Ground Surface
[2] Mayne, 1995
[3] Marchetti,2001
[4] Schmertman, 1981
[5] Mayne, 2002

Depth[1] (ft)	A (bar)	B (bar)	C (bar)	po (bar)	p1 (bar)	p2 (bar)	u_o (psf)	γ_T[5] (pcf)	σ_{vo} (psf)	σ_{vo}' (psf)	Id	K_D	E_D (bar)	K_o	OCR[2]	OCR[3]	ϕ[3] (deg)	R_M	E_D (ksf)	s_u[3] (psf)	s_u[4] (psf)	M (ksf)
78.0	6.75	17.2		6.3	16.95		4140	121	8185	4044	2.43	2.3	368				32.9	1.15	769			884
78.7	8.45	18		8.1	17.75		4182	122	8267	4084	1.59	3.1	335					1.38	700			965
79.3	6.7	15.4		6.4	15.15		4223	119	8345	4122	2.01	2.2	304				32.8	1.09	635			693
80.0	5.5	12		5.3	11.75		4265	116	8423	4158	1.99	1.6	224				31.0	0.85	468			398

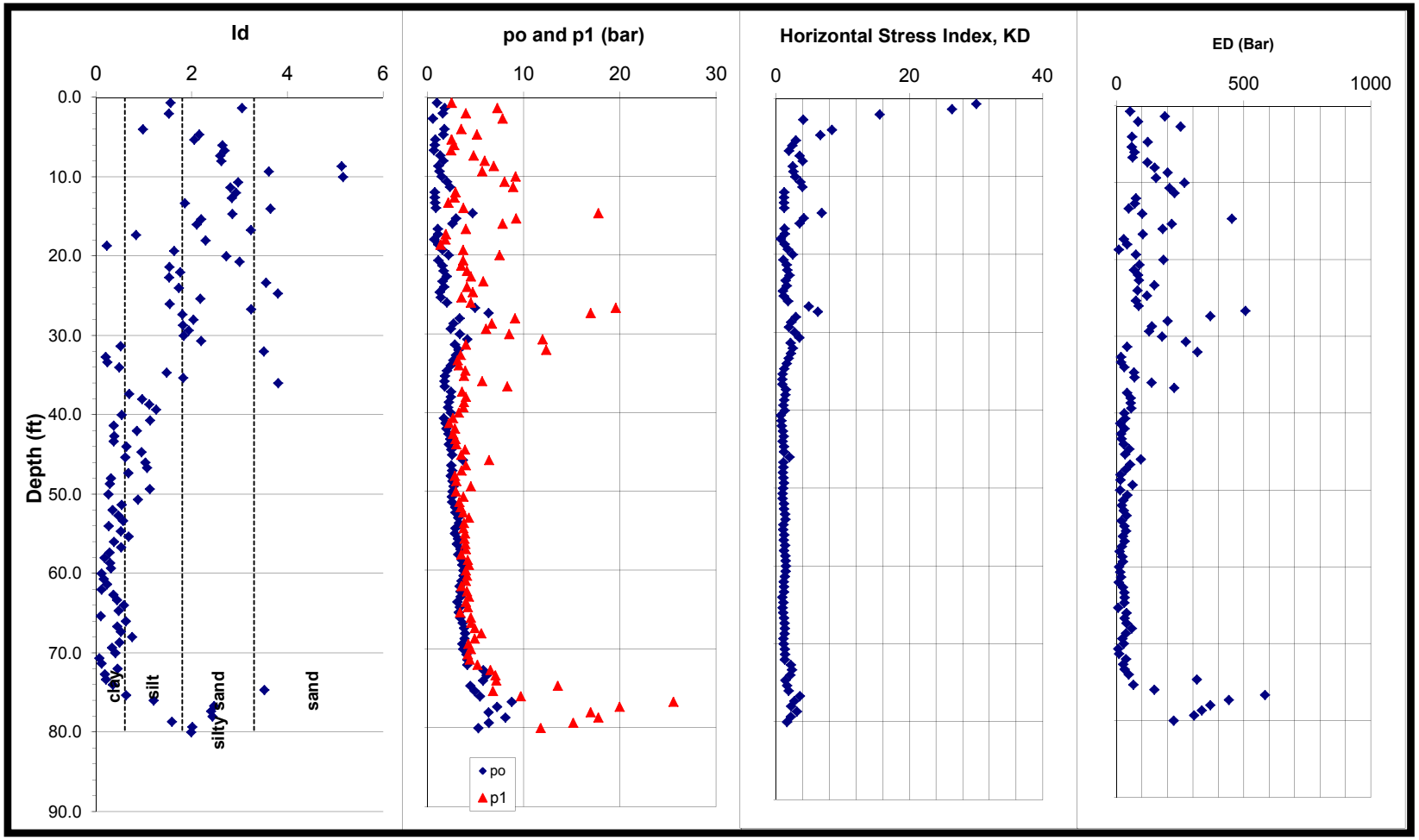
DILATOMETER TEST RESULTS

Test ID: D102
Site: Rush Island
Location: Festus, Missouri
Project No.: 14-53069



DILATOMETER TEST RESULTS

Test ID: D102
Site: Rush Island
Location: Festus, Missouri
Project No.: 14-53069



Job No: 14-53069
Job Name: Rush Island
Job Location: Festus, Missouri
Date: 9/29/14
Sounding No: D104
Ground Water Depth (ft): 18

	Membrane 1	Membrane 2	Membrane 3
ΔA =	0.15	0	0
ΔB =	0.2	0	0
Zm=	0.05	bar	

Latitude:
Longitude:

[1] Depth Below Existing Ground Surface
[2] Mayne, 1995
[3] Marchetti,2001
[4] Schmertman, 1981
[5] Mayne, 2002

CONETEC

Depth[1] (ft)	A (bar)	B (bar)	C (bar)	po (bar)	p1 (bar)	p2 (bar)	u_o (psf)	γ_T[5] (pcf)	σ_{vo} (psf)	σ_{vo}' (psf)	Id	K_D	E_D (bar)	K_o	OCR[2]	OCR[3]	ϕ[3] (deg)	R_M	E_D (ksf)	s_u[3] (psf)	s_u[4] (psf)	M (ksf)
0.7	5.35	19.2		4.8	18.95		0	123	82	82	2.97	121.2	492				49.3	4.86	1027			4994
1.3	5.9	20.2		5.3	19.95		0	124	164	164	2.76	67.5	508				47.7	4.31	1062			4574
2.0	3.75	12.2		3.4	11.95		0	118	243	243	2.47	29.6	295				44.9	3.53	616			2175
2.7	1.05	5.75		0.9	5.5		0	107	315	315	4.90	6.2	158				38.2	2.08	331			690
3.3	0.95	7.45		0.7	7.2		0	108	386	386	8.70	4.0	224				36.1	1.71	468			800
4.0							0	130	473	473												
4.7	0.65	10.6		0.3	10.35		0	105	543	543	37.33	1.0	350				28.2	0.85	731			621
5.3	3.15	10.6		2.9	10.35		0	116	619	619	2.58	9.8	259				40.4	2.48	540			1339
6.0	2.35	7.15		2.2	6.9		0	112	694	694	2.10	6.7	162				38.6	2.13	339			721
6.7	2.6	14		2.1	13.75		0	117	773	773	5.40	5.8	403				37.9	2.03	841			1705
7.3	1.5	6.85		1.4	6.6		0	110	845	845	3.89	3.3	182				35.1	1.55	380			588
8.0	1.5	9.1		1.2	8.85		0	111	920	920	6.15	2.8	264				34.1	1.40	552			771
8.7							0	130	1007	1007												
9.3							0	130	1093	1093												
10.0	2.75	7.15		2.6	6.9		0	112	1168	1168	1.61	4.7	148					1.78	308			549
10.7	1.85	4.85		1.8	4.6		0	108	1240	1240	1.53	3.1	97					1.36	202			274
11.3	3.45	12.8		3.1	12.55		0	118	1318	1318	3.05	4.9	328				37.1	1.88	685			1289
12.0							0	130	1405	1405												
12.7	0.95	3.65		0.9	3.4		0	104	1474	1474	2.65	1.3	86				29.7	0.85	179			152
13.3	1	5.65		0.9	5.4		0	107	1545	1545	5.10	1.2	157				29.1	0.85	327			278
14.0	1.4	4.8		1.3	4.55		0	107	1617	1617	2.38	1.7	111				31.4	0.91	232			211
14.7	1.4	2.55		1.5	2.3		0	101	1684	1684	0.58	1.8	29	0.5	0.9	0.9		0.85	61	327	305	52
15.3	1.1	4.65		1.0	4.4		0	106	1754	1754	3.23	1.2	117				29.3	0.85	244			207
16.0	1.4	2.55		1.5	2.3		0	101	1821	1821	0.58	1.7	29	0.5	0.9	0.8		0.85	61	321	305	52
16.7							0	130	1908	1908												
17.3	1.85	5.1		1.8	4.85		0	108	1980	1980	1.69	1.9	106					0.92	221			202
18.0	2.2	6.45		2.1	6.2		0	111	2054	2054	1.95	2.1	142				32.6	1.06	297			313
18.7	1.7	4.35		1.7	4.1		42	107	2126	2084	1.45	1.7	84					0.85	175			149
19.3	2.7	4.8		2.7	4.55		83	108	2197	2114	0.69	2.6	64	0.7	1.3	1.5		1.14	133	658	558	152
20.0	4.35	17.2		3.8	16.95		125	121	2278	2153	3.49	3.7	455				35.5	1.63	951			1546
20.7	2.7	7.75		2.6	7.5		167	113	2353	2187	1.99	2.4	171				33.2	1.16	358			413
21.3	3.95	9.3		3.8	9.05		208	115	2429	2222	1.42	3.5	182					1.47	380			561
22.0	2.1	6.75		2.0	6.5		250	111	2504	2254	2.42	1.7	157				31.4	0.91	327			297
22.7	1.96	3.9		2.0	3.65		291	105	2574	2283	0.91	1.7	58	0.5	0.9	0.8		0.85	121	405	384	103
23.3	1.7	3.5		1.7	3.25		333	104	2643	2310	0.97	1.4	53	0.4	0.7	0.6		0.85	110	331	328	94
24.0	1.4	2		1.5	1.75		374	94	2706	2332	0.20	1.2	9	0.3	0.6	0.4		0.85	19	263	273	16
24.7	1.4	2.05		1.5	1.8		416	95	2770	2354	0.24	1.1	11	0.3	0.6	0.4		0.85	23	257	269	19
25.3	1.55	2.05		1.6	1.8		457	92	2831	2373	0.11	1.3	5	0.3	0.6	0.5		0.85	11	291	297	10
26.0	1.4	1.95		1.5	1.7		499	93	2893	2394	0.17	1.1	7	0.3	0.6	0.4		0.85	15	247	261	13
26.7	1.1	2.1		1.2	1.85		541	97	2958	2417	0.75	0.8	24	0.1	0.4	0.2		0.85	49	165	190	42
27.3	1.3	2.1		1.4	1.85		582	96	3022	2439	0.43	0.9	16	0.2	0.5	0.3		0.85	34	209	229	29
28.0	1.75	3.95		1.8	3.7		624	105	3092	2468	1.33	1.2	67					0.85	141			120
28.7	2.7	6		2.7	5.75		666	110	3166	2500	1.33	1.9	107					0.90	224			202
29.3	3.9	11.2		3.7	10.95		707	117	3243	2536	2.20	2.7	253				34.0	1.30	529			690
30.0	2	4.95		2.0	4.7		749	107	3314	2566	1.69	1.3	95					0.85	198			168
30.7	1.9	3.1		2.0	2.85		791	101	3382	2592	0.57	1.3	31	0.3	0.6	0.5		0.85	65	324	330	55
31.3	1.85	2.7		1.9	2.45		832	98	3447	2615	0.34	1.2	18	0.3	0.6	0.5		0.85	38	310	319	32
32.0	2.1	3.65		2.1	3.4		874	103	3516	2643	0.73	1.4	44	0.4	0.7	0.5		0.85	91	359	360	78
32.7	3.35	7.55		3.3	7.3		915	112	3592	2676	1.43	2.2	140					1.03	293			302
33.3	4.35	10.4		4.2	10.15		957	116	3668	2712	1.61	2.9	208					1.30	434			563
34.0	7.55	19.8		7.1	19.55		998	124	3752	2753	1.90	5.0	434				37.2	1.85	906			1672
34.7	7.5	18.2		7.1	17.95		1040	123	3834	2794	1.65	4.9	377					1.82	788			1435
35.3	8.1	18.6		7.7	18.35		1081	124	3916	2834	1.49	5.3	370					1.88	772			1455
36.0	5.65	12.8		5.4	12.55		1123	119	3995	2872	1.47	3.5	248					1.50	517			774
36.7	4.45	11.2		4.2	10.95		1165	117	4074	2909	1.83	2.6	233				33.8	1.24	487			604
37.3	4.45	9		4.3	8.75		1206	115	4149	2943	1.17	2.7	153	0.7	1.4	1.6		1.20	320	929	786	382
38.0	3.55	8.1		3.4	7.85		1248	113	4225	2977	1.55	2.0	153					0.95	320			303
38.7	2.05	3.65		2.1	3.4		1290	103	4294	3004	0.89	1.0	46	0.2	0.5	0.4		0.85	95	286	307	81

Job No: 14-53069
Job Name: Rush Island
Job Location: Festus, Missouri
Date: 9/29/14
Sounding No: D104
Ground Water Depth (ft): 18

	Membrane 1	Membrane 2	Membrane 3
ΔA =	0.15	0	0
ΔB =	0.2	0	0
Zm=	0.05	bar	

Latitude:
Longitude:

[1] Depth Below Existing Ground Surface
[2] Mayne, 1995
[3] Marchetti,2001
[4] Schmertman, 1981
[5] Mayne, 2002

CONETEC

Depth[1] (ft)	A (bar)	B (bar)	C (bar)	po (bar)	p1 (bar)	p2 (bar)	u_o (psf)	γ_T[5] (pcf)	σ_{vo} (psf)	σ_{vo}' (psf)	Id	K_D	E_D (bar)	K_o	OCR[2]	OCR[3]	ϕ[3] (deg)	R_M	E_D (ksf)	s_u[3] (psf)	s_u[4] (psf)	M (ksf)
39.3	2.15	3.7		2.2	3.45		1331	103	4362	3031	0.81	1.1	44	0.3	0.5	0.4		0.85	91	305	324	78
40.0	2.3	3.9		2.3	3.65		1373	104	4431	3058	0.78	1.1	46	0.3	0.6	0.4		0.85	95	336	351	81
40.7	3	7.6		2.9	7.35		1415	112	4506	3091	2.02	1.5	155				30.5	0.85	323			275
41.3	2.5	5.35		2.5	5.1		1456	107	4577	3121	1.48	1.2	91					0.85	190			162
42.0	3.45	8.45		3.3	8.2		1498	113	4652	3155	1.88	1.7	169				31.3	0.85	354			301
42.7	4.45	11.2		4.2	10.95		1539	117	4730	3191	1.92	2.3	233				33.0	1.11	487			543
43.3	3	7.35		2.9	7.1		1581	111	4804	3223	1.96	1.4	146				30.0	0.85	304			259
44.0	3.35	7.45		3.3	7.2		1622	112	4878	3256	1.58	1.6	137					0.85	285			243
44.7	2.85	6.4		2.8	6.15		1664	109	4952	3288	1.69	1.3	117					0.85	244			207
45.3	2.85	7.1		2.8	6.85		1705	110	5025	3319	2.11	1.2	142				29.2	0.85	297			252
46.0	4	9.45		3.8	9.2		1747	114	5101	3354	1.78	1.9	186					0.91	388			354
46.7	3.2	7.55		3.1	7.3		1789	111	5176	3387	1.87	1.4	146				30.0	0.85	304			259
47.3	2.8	6.1		2.8	5.85		1830	109	5248	3417	1.65	1.1	107					0.85	224			191
48.0	3.3	7.65		3.2	7.4		1872	111	5322	3450	1.82	1.4	146				30.1	0.85	304			259
48.7	3.2	7.9		3.1	7.65		1914	112	5397	3483	2.11	1.3	158				29.6	0.85	331			281
49.3	3.8	9.35		3.6	9.1		1955	114	5472	3517	2.02	1.6	189				30.9	0.85	396			336
50.0	4.1	9.9		3.9	9.65		1997	115	5549	3552	1.93	1.7	199				31.4	0.86	415			358
50.7	4.35	11		4.1	10.75		2039	116	5627	3588	2.09	1.8	230				31.7	0.93	479			445
51.3	5.8	16		5.4	15.75		2080	120	5706	3626	2.34	2.5	359				33.6	1.25	750			938
52.0	3.95	9.75		3.8	9.5		2122	114	5783	3661	2.07	1.6	199				30.8	0.85	415			353
52.7	3.65	10.2		3.4	9.95		2163	114	5859	3696	2.71	1.4	226				29.9	0.85	472			401
53.3	2.35	4.1		2.4	3.85		2205	103	5927	3722	1.11	0.7	51	0.1	0.4	0.2		0.85	107	238	277	91
54.0	2.5	4		2.5	3.75		2246	102	5996	3749	0.82	0.8	42	0.2	0.4	0.2		0.85	88	269	306	74
54.7	2.8	5.15		2.8	4.9		2288	106	6067	3778	1.23	0.9	73					0.85	152			129
55.3	2.7	6.25		2.6	6		2329	108	6138	3809	2.20	0.8	117				26.9	0.85	244			207
56.0	2.85	6		2.8	5.75		2371	108	6210	3839	1.76	0.9	102					0.85	213			181
56.7	2.75	5.9		2.7	5.65		2413	107	6282	3869	1.89	0.8	102				26.9	0.85	213			181
57.3	2.65	6.25		2.6	6		2454	108	6353	3899	2.42	0.8	118				26.2	0.85	247			210
58.0	2.5	4.45		2.5	4.2		2496	104	6423	3927	1.27	0.7	58					0.85	122			103
58.7	2.45	4.35		2.5	4.1		2538	103	6492	3954	1.29	0.7	56					0.85	118			100
59.3	2.55	3.7		2.6	3.45		2579	100	6558	3979	0.61	0.7	29	0.1	0.4	0.2		0.85	61	245	287	52
60.0	3.05	6.05		3.0	5.8		2621	108	6630	4009	1.58	0.9	97					0.85	202			171
60.7	3.5	7.55		3.4	7.3		2663	111	6704	4042	1.82	1.1	135				28.6	0.85	282			239
61.3	2.65	4.75		2.7	4.5		2704	104	6773	4069	1.34	0.7	64					0.85	133			113
62.0	2.95	4.5		3.0	4.25		2746	103	6842	4097	0.75	0.9	44	0.2	0.4	0.3		0.85	91	311	350	78
62.7	3.65	5.7		3.7	5.45		2787	107	6914	4126	0.77	1.2	62	0.3	0.6	0.4		0.85	129	469	487	110
63.3	3.65	6		3.7	5.75		2829	108	6985	4156	0.91	1.2	73	0.3	0.6	0.4		0.85	152	460	479	129
64.0	3.15	5.45		3.2	5.2		2870	106	7056	4185	1.15	0.9	71	0.2	0.5	0.3		0.85	148	333	371	126
64.7	3.15	4.9		3.2	4.65		2912	104	7126	4214	0.82	0.9	51	0.2	0.5	0.3		0.85	107	335	373	91
65.3	2.75	3.6		2.8	3.35		2953	98	7191	4237	0.37	0.7	18	0.1	0.4	0.2		0.85	38	249	295	32
66.0	3.35	4.5		3.4	4.25		2995	102	7259	4264	0.43	1.0	29	0.2	0.5	0.3		0.85	61	379	413	52
66.7	2.8	4.15		2.9	3.9		3037	101	7327	4290	0.75	0.7	36	0.1	0.3	0.2		0.85	76	245	292	65
67.3	3.05	4.25		3.1	4		3078	101	7394	4316	0.55	0.8	31	0.1	0.4	0.2		0.85	65	298	341	55
68.0	3.2	4.8		3.2	4.55		3120	104	7463	4343	0.75	0.8	46	0.2	0.4	0.3		0.85	95	322	364	81
68.7	3.3	5.25		3.3	5		3162	105	7534	4372	0.93	0.9	58	0.2	0.4	0.3		0.85	122	336	377	103
69.3	3.3	4.95		3.3	4.7		3203	104	7602	4399	0.76	0.9	47	0.2	0.4	0.3		0.85	99	335	376	84
70.0	3.2	4.25		3.3	4		3245	101	7670	4425	0.43	0.8	26	0.1	0.4	0.2		0.85	53	313	357	45
70.7	3.05	4.15		3.1	3.9		3287	100	7737	4451	0.51	0.7	27	0.1	0.4	0.2		0.85	57	274	321	49
71.3	2.95	4.35		3.0	4.1		3328	102	7804	4477	0.79	0.7	38	0.1	0.3	0.2		0.85	80	244	293	68
72.0	3.15	4.45		3.2	4.2		3370	102	7873	4503	0.63	0.7	35	0.1	0.4	0.2		0.85	72	284	332	61
72.7	3.3	4.65		3.4	4.4		3411	102	7941	4530	0.61	0.8	36	0.1	0.4	0.2		0.85	76	313	359	65
73.3	3.6	4.45		3.7	4.2		3453	100	8007	4555	0.26	0.9	18	0.2	0.5	0.3		0.85	38	383	422	32
74.0	3.1	4.75		3.1	4.5		3494	103	8076	4582	0.93	0.7	47	0.1	0.3	0.2		0.85	99	255	305	84
74.7	3	5.05		3.0	4.8		3536	104	8146	4610	1.35	0.6	62					0.85	129			110
75.3	3.25	6.55		3.2	6.3		3577	107	8217	4639	2.08	0.7	107				25.4	0.85	224			191
76.0	4.55	9.05		4.4	8.8		3619	113	8292	4673	1.61	1.2	151					0.85	316			268
76.7	4.95	10.6		4.8	10.35		3661	115	8369	4708	1.84	1.3	193				29.8	0.85	403			343
77.3	5.45	11.4		5.3	11.15		3702	116	8445	4743	1.68	1.5	204					0.85	426			362

Job No: 14-53069
Job Name: Rush Island
Job Location: Festus, Missouri
Date: 9/29/14
Sounding No: D104
Ground Water Depth (ft): 18

	Membrane 1	Membrane 2	Membrane 3
ΔA =	0.15	0	0
ΔB =	0.2	0	0
Zm=	0.05	bar	

Latitude:
Longitude:

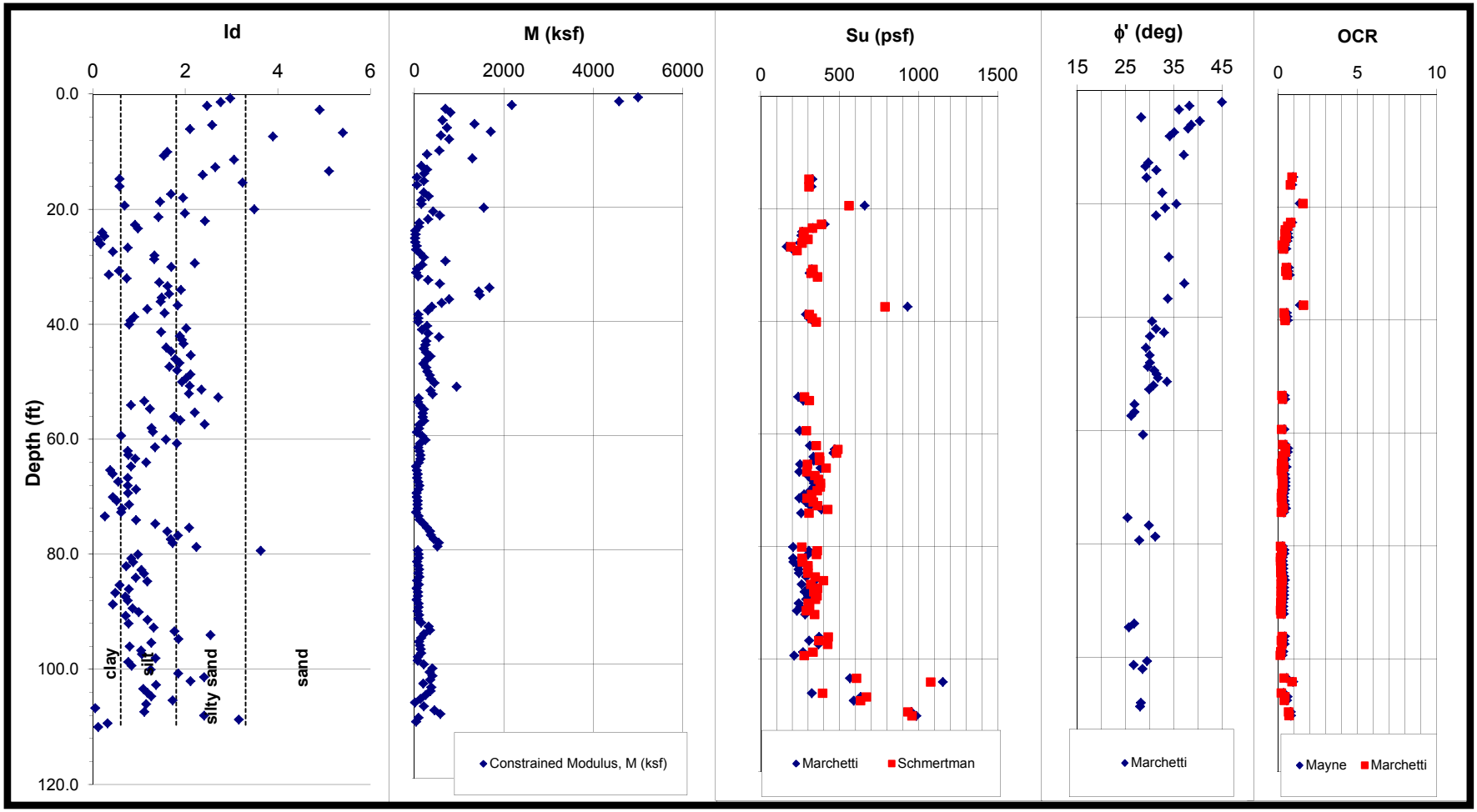
[1] Depth Below Existing Ground Surface
[2] Mayne, 1995
[3] Marchetti,2001
[4] Schmertman, 1981
[5] Mayne, 2002

CONETEC

Depth[1] (ft)	A (bar)	B (bar)	C (bar)	po (bar)	p1 (bar)	p2 (bar)	u_o (psf)	γ_T[5] (pcf)	σ_{vo} (psf)	σ_{vo}' (psf)	Id	K_D	E_D (bar)	K_o	OCR[2]	OCR[3]	ϕ[3] (deg)	R_M	E_D (ksf)	s_u[3] (psf)	s_u[4] (psf)	M (ksf)
78.0	6.05	13		5.8	12.75		3744	118	8524	4780	1.72	1.8	240					0.85	502			427
78.7	6	14.6		5.7	14.35		3786	119	8603	4818	2.24	1.7	301				31.2	0.86	628			541
79.3	4.4	12.6		4.1	12.35		3827	115	8680	4853	3.62	1.0	286				27.9	0.85	597			508
80.0	3.05	4.55		3.1	4.3		3869	102	8748	4879	0.97	0.5	42	0.0	0.3	0.1		0.85	88	204	259	74
80.7	3.55	5.25		3.6	5		3911	104	8817	4907	0.83	0.7	49	0.1	0.4	0.2		0.85	103	305	357	87
81.3	3.55	5.3		3.6	5.05		3952	104	8886	4934	0.87	0.7	51	0.1	0.4	0.2		0.85	107	300	353	91
82.0	3.1	4.3		3.2	4.05		3994	100	8953	4959	0.72	0.5	31	0.0	0.3	0.1		0.85	65	205	260	55
82.7	3.15	4.75		3.2	4.5		4035	102	9021	4986	1.05	0.5	46	0.0	0.3	0.1		0.85	95	207	262	81
83.3	3.35	5.2		3.4	4.95		4077	104	9090	5013	1.11	0.6	55	0.0	0.3	0.2		0.85	114	241	297	97
84.0	3.35	4.95		3.4	4.7		4118	103	9159	5040	0.93	0.6	46	0.0	0.3	0.1		0.85	95	239	296	81
84.7	3.4	5.35		3.4	5.1		4160	104	9228	5068	1.18	0.6	58	0.0	0.3	0.1		0.85	122	242	298	103
85.3	3.6	4.85		3.7	4.6		4201	102	9295	5094	0.58	0.7	33	0.1	0.3	0.2		0.85	68	288	343	58
86.0	3.9	5.65		3.9	5.4		4243	105	9366	5122	0.77	0.8	51	0.1	0.4	0.2		0.85	107	344	396	91
86.7	3.5	4.55		3.6	4.3		4285	100	9433	5148	0.49	0.6	26	0.1	0.3	0.2		0.85	53	259	316	45
87.3	3.75	5.25		3.8	5		4326	103	9501	5174	0.70	0.7	42	0.1	0.4	0.2		0.85	88	304	359	74
88.0	3.65	5.15		3.7	4.9		4368	103	9570	5202	0.75	0.6	42	0.1	0.3	0.2		0.85	88	277	334	74
88.7	3.75	4.8		3.8	4.55		4410	101	9637	5227	0.43	0.7	26	0.1	0.3	0.2		0.85	53	299	356	45
89.3	3.75	5.45		3.8	5.2		4451	104	9706	5255	0.86	0.7	49	0.1	0.3	0.2		0.85	103	287	345	87
90.0	3.55	5.25		3.6	5		4493	103	9775	5282	0.99	0.6	49	0.0	0.3	0.1		0.85	103	240	299	87
90.7	3.6	4.95		3.7	4.7		4535	102	9843	5308	0.71	0.6	36	0.0	0.3	0.1		0.85	76	250	309	65
91.3	3.55	5.45		3.6	5.2		4576	104	9911	5335	1.18	0.5	56	0.0	0.3	0.1		0.85	118	229	289	100
92.0	3.8	5.35		3.8	5.1		4618	103	9980	5363	0.77	0.6	44	0.1	0.3	0.2		0.85	91	281	340	78
92.7	4	6.55		4.0	6.3		4659	107	10052	5392	1.31	0.7	80					0.85	167			142
93.3	5.25	10.4		5.1	10.15		4701	114	10127	5426	1.76	1.1	175					0.85	365			310
94.0	4.6	10.2		4.4	9.95		4742	113	10202	5460	2.54	0.8	191				26.8	0.85	400			340
94.7	4.2	7.8		4.1	7.55		4784	109	10275	5491	1.85	0.7	118				25.7	0.85	247			210
95.3	4.2	6.8		4.2	6.55		4825	107	10346	5521	1.26	0.7	82					0.85	171			146
96.0	4.35	6.25		4.4	6		4867	106	10417	5550	0.80	0.8	56	0.1	0.4	0.2		0.85	118	369	426	100
96.7	4.1	6.2		4.1	5.95		4909	106	10488	5579	1.04	0.7	64	0.1	0.3	0.2		0.85	133	307	368	113
97.3	4.4	6.8		4.4	6.55		4950	107	10558	5608	1.06	0.8	75	0.1	0.4	0.2		0.85	156	365	423	133
98.0	4.15	6.75		4.1	6.5		4992	107	10630	5638	1.35	0.6	82					0.85	171			146
98.7	3.95	5.45		4.0	5.2		5034	103	10699	5665	0.76	0.6	42	0.0	0.3	0.1		0.85	88	267	330	74
99.3	3.7	5.1		3.7	4.85		5075	101	10766	5691	0.84	0.5	38	0.0	0.2	0.1		0.85	80	212	275	68
100.0	5.2	8.75		5.1	8.5		5117	111	10840	5723	1.25	1.0	117					0.85	244			207
100.7	6.15	12.6		5.9	12.35		5159	116	10918	5759	1.84	1.3	222				29.4	0.85	464			395
101.3	4.9	10.4		4.7	10.15		5200	113	10992	5793	2.40	0.8	188				26.7	0.85	392			333
102.0	5.75	12.2		5.5	11.95		5242	115	11070	5828	2.11	1.1	222				28.5	0.85	464			395
102.7	6.85	12.6		6.7	12.35		5283	117	11148	5864	1.37	1.5	197					0.85	411			349
103.3	5.5	8.85		5.5	8.6		5325	111	11221	5897	1.09	1.0	109	0.2	0.5	0.4		0.85	228	564	606	194
104.0	7.9	14		7.7	13.75		5366	118	11300	5934	1.17	1.8	210	0.5	0.9	0.9		0.85	438	1152	1074	372
104.7	7.35	13.2		7.2	12.95		5408	117	11379	5971	1.26	1.6	200					0.85	419			356
105.3	5.05	9.25		5.0	9		5449	111	11452	6003	1.72	0.8	140					0.85	293			249
106.0	4.5	6.9		4.5	6.65		5491	107	11524	6033	1.15	0.6	75	0.1	0.3	0.2		0.85	156	324	390	133
106.7	5.75	6.25		5.8	6		5533	96	11588	6055	0.05	1.1	5	0.3	0.6	0.4		0.85	11	632	667	10
107.3	5.75	9.3		5.7	9.05		5574	112	11662	6088	1.11	1.0	117	0.2	0.5	0.4		0.85	244	589	631	207
108.0	5.95	13.2		5.7	12.95		5616	116	11740	6124	2.40	1.0	251				28.2	0.85	525			446
108.7	6	15.2		5.7	14.95		5658	117	11819	6161	3.15	1.0	322				28.0	0.85	673			572
109.3	7.15	8.85		7.2	8.6		5699	109	11891	6192	0.32	1.5	49	0.4	0.8	0.6		0.85	103	953	930	87
110.0	7.25	8.1		7.3	7.85		5741	104	11960	6219	0.11	1.5	18	0.4	0.8	0.7		0.85	38	984	956	32

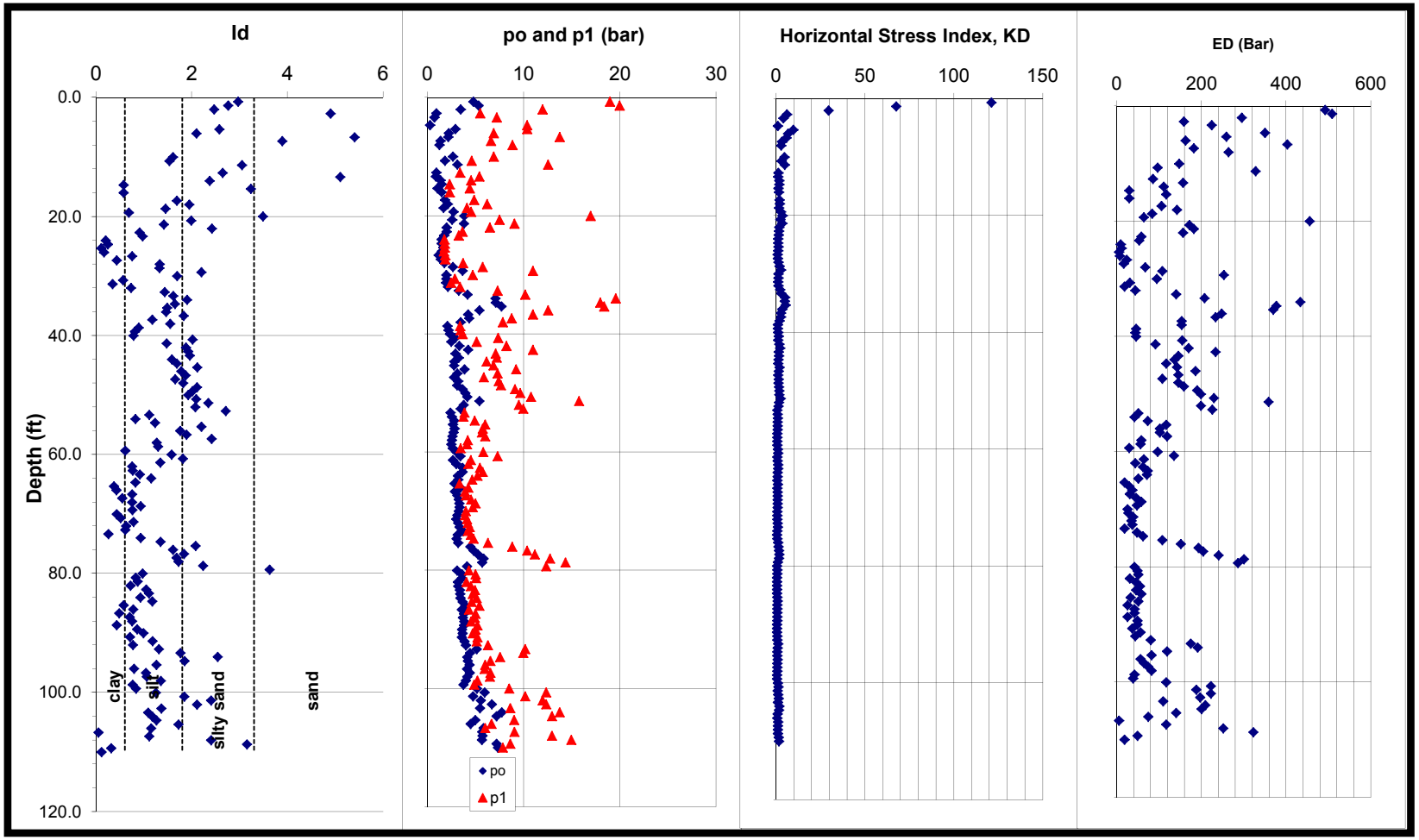
DILATOMETER TEST RESULTS

Test ID: D104
Site: Rush Island
Location: Festus, Missouri
Project No.: 14-53069



DILATOMETER TEST RESULTS

Test ID: D104
Site: Rush Island
Location: Festus, Missouri
Project No.: 14-53069



Appendix F

Electronic Data Files

The released data contains the following folders:

1. CPT Data - .cor files in ASCII format, and or .xls files.
2. Pore Pressure Dissipation Data - .ppd files in Excel format
3. CPT Plots - .pdf files
4. Data Interpretation - .xls files contain common engineering values
5. Shear Wave Velocity Data - .pdf files of tabular and graphical seismic data.

CPT Data Files (COR Extension)

ConeTec CPT data files are stored in ASCII text files that are readable by almost any text editor. ConeTec file names start with the job number (which includes the two digit year number) an underscore as a separating character, followed by two letters based on the type of test and the sounding ID. The last character position is reserved for an identifier letter (such as b, c, d etc.) used to uniquely distinguish multiple soundings at the same location. The CPT sounding file has the extension COR. As an example, for job number 14-02001 the first CPT sounding will have file name 14-02001_CP01.COR

The sounding (COR) file consists of the following components:

1. Two lines of header information
2. Data records
3. End of data marker
4. Units information

Header Lines

Line 1: Columns 1-6 may be blank or may indicate the version number of the recording software
Columns 7-21 contain the sounding Date and Time
Columns 23-38 contain the sounding Operator
Columns 51-100 contain extended Job Location information

Line 2: Columns 1-16 contain the Job Location
Columns 17-32 contain the Cone ID
Columns 33-47 contain the sounding number
Columns 51-100 may contain extended sounding ID information

Data Records

The data records contain 4 or more columns of data in floating point format. A comma and spaces separate each data item:

Column 1: Sounding Depth (meters)
Column 2: Tip (q_c), recorded in units selected by the operator
Column 3: Sleeve (f_s), recorded in units selected by the operator
Column 4: Dynamic pore pressure (u), recorded in units selected by the operator
Column 5: Empty or may contain other requested data such as Gamma, Resistivity or UVIF data

End of Data Marker

After the last line of data there is a line containing an ASCII 26 (CTL-Z) character (small rectangular shaped character) followed by a newline (carriage return / line feed). This is used to mark the end of data.

Units Information

The last section of the file contains information about the units that were selected for the sounding. A separator bar makes up the first line. The second line contains the type of units used for depth, q_c, f_s and u. The third line contains the conversion values required for ConeTec's software to convert the recorded data to an internal set of base units (bar for q_c, bar for f_s and meters for u). Additional lines used for internal ConeTec use may appear following the conversion values.

CPT Data Files (XLS Extension)

Excel format files of ConeTec CPT data are also generated from corresponding COR files. The XLS files have the same base file name as the COR file with a -BSC suffix. The information in the file is presented in table format and contains additional information about the sounding such as coordinate information, tip net area ratio and averaging interval.

The BSCI suffix are given to xls files which are enhanced versions of the BSC files and include the same data records in addition to inclination data collected for each sounding.

CPT Standard Interpretations (TBL XLS Extension)

ConeTec's standard CPT interpretation output files are generally delivered in XLS files with a TBL suffix. The root file name is the same as the COR files. A number of calculated geotechnical parameters are presented in these files and are presented in a table. These files are not distributed if the enhanced interpretation files are provided.

A more enhanced version of the TBL files are the ETBL files which contain all of the parameters available in the TBL as well as additional geotechnical interpretation data involving the normalized soil behavior type (SBTn).

CPT Enhanced Interpretations (XLS Extension)

ConeTec's enhanced CPT interpretation output files are delivered in XLS format. The base file names are the same as COR files with additional suffixes. The files typically have any of the following suffixes:

1. IFI — A file containing approximately 46 data columns of geotechnical interpretation. The file contains two tables. One table contains information about the project and the sounding and the interpretation options used. The geotechnical parameters are reported in a separate table below the one previously described. A companion document describes the techniques used for the interpretations

2. NLI A file containing approximately 37 columns of geotechnical interpretation. The file is similar in format to the IFI file and contains most of the same parameters except those pertaining to liquefaction.

In each case root file name is the same as the COR files.

CPT Dissipation Files (XLS Extension)

Pore pressure dissipation files are provided in Excel format and contain each dissipation trace that exceeds a minimum duration (selected during post-processing) formatted column wise within the spreadsheet. The first column (Column A) contains the time in seconds and the second column (Column B) contains the time in minutes. Subsequent columns contain the dissipation trace data. The columns extend to the longest trace of the data set.

Detailed header information is provided at the top of the worksheet. The test depth in meters and feet, the number of points in the trace and the particular units are all presented at the top of each trace column.

CPT Dissipation files have the same naming convention as the CPT sounding files with a "–PPD" suffix.

Data Records

Each file will contain dissipation traces that exceed a minimum duration (selected by the engineer during post-processing) in a particular column. The dissipation pore pressure values are typically stored at 5 second intervals. The test depth in meters and feet, the number of points in the trace and the trace number are identified at the top of each trace column.

DRAFT

2014 Alluvial Piezometer Water Level Data
Detailed Site Investigation
Ameren Rush Island Energy Center
Festus, Missouri

State Certification Number	Installation Date	Piezometer Designation	Piezometer Casing Elevation [2]	January 13, 2014		February 24, 2014		March 25, 2014		April 9, 2014		May 15, 2014		June 13, 2014		July 28, 2014		August 14, 2014		September 16, 2014		October 22, 2014		November 20, 2014		December 11, 2014		January 20, 2015		February 19, 2015		March 17, 2015		April	
				Depth to Water [3]	Groundwater Elevation [2]	Depth to Water [3]	Groundwater Elevation [2]	Depth to Water [3]	Groundwater Elevation [2]	Depth to Water [3]	Groundwater Elevation [2]	Depth to Water [3]	Groundwater Elevation [2]	Depth to Water [6]	Groundwater Elevation [2]	Depth to Water [3]	Groundwater Elevation [2]	Depth to Water [2]	Groundwater Elevation [1]	Depth to Water [2]	Groundwater Elevation [1]	Depth to Water [2]	Groundwater Elevation [1]	Depth to Water [2]	Groundwater Elevation [1]	Depth to Water [2]	Groundwater Elevation [1]	Depth to Water [2]	Groundwater Elevation [1]	Depth to Water [2]	Groundwater Elevation [1]	Depth to Water [2]	Groundwater Elevation [1]	Depth to Water [2]	Groundwater Elevation [1]
A188840	12/3/2012	P01S	387.62	27.35	360.27	20.61	367.01	17.60	370.02	20.56	367.06	9.85	377.77	NM [6]	> 385.69	10.40	377.22	18.89	368.73	2.37	385.25	10.57	377.05	20.48	367.14	18.92	368.70	23.74	363.88	22.67	364.95	16.98	370.64		
A189897	11/30/2012	P02S	394.39	34.17	360.22	24.78	369.61	23.95	370.44	18.07	376.32	16.49	377.90	10.08	384.31	17.43	376.96	26.11	368.28	9.44	384.95	17.52	376.87	26.66	367.73	24.47	369.92	23.31	371.08	29.79	364.60	23.12	371.27		
A189898	11/30/2012	P03S	391.68	30.56	361.12	21.95	369.73	20.91	370.77	14.62	377.06	13.44	378.24	6.99	384.69	14.36	377.32	22.89	368.79	6.40	385.28	14.37	377.31	24.40	367.28	22.57	369.11	27.44	364.24	26.47	365.21	19.77	371.91		
A195402	12/11/2013	P03D	391.65	30.57	361.08	21.02	370.63	20.92	370.73	14.76	376.89	13.40	378.25	6.92	384.73	14.44	377.21	23.05	368.60	6.27	385.38	14.47	377.18	24.51	367.14	22.66	368.99	27.45	364.20	26.50	365.15	19.61	372.04		
A189899	12/2/2012	P04S	391.71	28.93	362.78	20.19	371.52	17.60	374.11	11.49	380.22	11.86	379.85	6.86	384.85	12.38	379.33	18.91	372.80	6.31	385.40	11.85	379.86	20.37	371.34	16.88	374.83	22.24	369.47	22.82	368.89	14.68	377.03		
A189900	12/5/2012	P05S	392.50	29.81	362.69	21.57	370.93	20.96	371.54	14.56	377.94	13.80	378.70	7.53	384.97	14.80	377.70	22.96	369.54	6.96	385.54	14.87	377.63	24.57	367.93	22.71	369.79	27.40	365.10	26.80	365.70	19.76	372.74		
A195403	12/11/2013	P05I	390.07	28.23	361.84	19.02	371.05	18.90	371.17	12.60	377.47	11.50	378.57	5.11	384.96	12.50	377.57	20.88	369.19	4.51	385.56	12.53	377.54	22.36	367.71	20.52	369.55	25.20	364.87	24.34	365.73	17.49	372.58		
A189901	12/18/2012	P06S	412.65	44.26	368.39	37.89	374.76	36.39	376.26	31.00	381.65	30.55	382.10	25.72	386.93	30.88	381.77	36.48	376.17	25.90	386.75	31.72	380.93	38.54	374.11	35.79	376.86	38.09	374.56	39.02	373.63	33.48	379.17		
A189902	12/5/2012	P07S	388.92	11.18	377.74	10.04	378.88	8.82	380.10	5.15	383.77	5.64	383.28	1.06	387.86	5.56	383.36	8.40	380.52	0.71	388.21	5.48	383.44	9.88	379.04	8.87	380.05	10.88	378.04	11.15	377.77	7.55	381.37		
A189903	11/30/2012	P08S	404.79	43.02	361.77	37.20	367.59	33.69	371.10	26.92	377.87	26.04	378.75	19.95	384.84	26.29	378.50	34.86	369.93	19.38	385.41	26.41	378.38	36.34	368.45	34.85	369.94	39.46	365.33	38.85	365.94	33.83	370.96		
A195404	12/11/2013	P08D	404.61	42.96	361.65	36.99	367.62	33.52	371.09	26.74	377.87	25.86	378.75	19.77	384.84	26.13	378.48	34.71	369.90	19.22	385.39	26.24	378.37	36.20	368.41	34.72	369.89	39.30	365.31	38.70	365.91	33.48	371.13		
A189904	12/4/2012	P09S	406.73	25.53	381.20	25.77	380.96	24.43	382.30	21.60	385.13	22.53	384.20	18.70	388.03	21.78	384.95	24.12	382.61	17.98	388.75	21.74	384.99	24.89	381.84	24.07	382.66	26.42	380.31	26.75	379.98	24.82	381.91		
A189905	12/4/2012	P10S	407.23	30.90	376.33	30.79	376.44	29.02	378.21	26.28	380.95	26.07	381.16	21.97	385.26	25.64	381.59	28.37	378.86	21.52	385.71	25.67	381.56	29.16	378.07	28.69	378.54	30.31	376.92	30.58	376.65	29.37	377.86		
A189906	12/5/2012	P11S	407.00	46.56	360.44	43.76	363.24	35.49	371.51	29.76	377.24	28.68	378.32	22.45	384.55	28.27	378.73	36.98	370.02	22.25	384.75	28.35	378.65	38.53	368.47	37.48	369.52	41.84	365.16	41.31	365.69	39.00	368.00		
A189907	12/11/2012	P12S	409.89	49.34	360.55	49.90	359.99	39.34	370.55	32.42	377.47	31.28	378.61	25.04	384.85	31.12	378.77	39.84	370.05	24.88	385.01	31.21	378.68	41.47	368.42	40.37	369.52	44.72	365.17	44.13	365.76	40.80	369.09		
A189908	12/11/2012	P13S	411.62	51.28	360.34	43.49	368.13	41.11	370.51	34.57	377.05	33.15	378.47	26.84	384.78	33.40	378.22	42.27	369.35	26.48	385.14	33.53	378.09	43.82	367.80	42.49	369.13	47.26	364.36	46.45	365.17	41.69	369.93		
A195406	12/7/2013	P13I	410.52	50.14	360.38	44.21	366.31	40.09	370.43	33.45	377.07	32.08	378.44	25.70	384.82	32.33	378.19	41.21	369.31	25.34	385.18	32.42	378.10	42.77	367.75	41.40	369.12	46.13	364.39	45.36	365.16	40.61	369.91		
A195405	12/6/2013	P13D	410.40	49.98	360.42	43.46	366.94	39.98	370.42	33.44	376.96	32.01	378.39	25.59	384.81	32.34	378.06	41.24	369.16	25.22	385.18	32.48	377.92	42.81	367.59	41.40	369.00	46.08	364.32	45.35	365.05	40.39	370.01		
A189909	1/8/2012	P14SR	411.95	50.05	361.90	44.64	367.31	39.65	372.30	33.17	378.78	31.95	380.00	25.69	386.26	29.89	382.06	37.47	374.48	25.73	386.22	30.66	381.29	37.77	374.18	36.42	375.53	39.84	372.11	39.67	372.28	37.57	374.38		
A189910	11/26/2012	P15SR	395.49	35.43	360.06	28.88	366.61	25.12	370.37	18.85	376.64	17.39	378.10	11.26	384.23	17.85	377.64	26.37	369.12	10.80	384.69	18.02	377.47	28.04	367.45	26.70	368.79	31.67	363.82	30.53	364.96	25.80	369.69		
A189911	12/6/2012	P16S	393.39	33.64	359.75	25.78	367.61	23.25	370.14	16.47	376.92	15.34	378.05	9.62	383.77	15.56	377.83	23.42	369.97	9.10	384.29	15.71	377.68	25.25	368.14	24.61	368.78	29.43	363.96	28.30	365.09	24.08	369.31		
A189912	11/27/2012	P17S	394.65	31.46	363.19	22.97	371.68	19.30	375.35	16.97	377.68	14.05	380.60	10.36	384.29	13.46	381.19	18.25	376.40	11.04	383.61	14.43	380.22	17.07	377.58	16.23	378.42	19.03	375.62	19.08	375.57	16.71	377.94		
A195407	12/10/2013	P17I	394.86	34.27	360.59	22.39	372.47	24.25	370.61	18.35	376.51	16.48	378.38	9.87	384.99	17.91	376.95	26.99	367.87	9.05	385.81	18.00	376.86	28.46	366.40	26.58	368.28	31.31	363.55	30.40	364.46	22.90	371.96		
A195400	9/6/2013	P17D	395.56	34.98	360.58	22.96	372.60	24.97	370.59	19.06	376.50	17.19	378.37	10.55	385.01	18.63	376.93	27.74	367.82	9.73	385.83	18.73	376.83	29.21	366.35	27.31	368.25	32.04	363.52	31.15	364.41	23.58	371.98		
A189913	12/6/2012	P18S	394.47	30.84	363.63	23.95	370.52	21.31	373.16	17.39	377.08	15.30	379.17	11.02	383.45	14.22	380.25	20.77	373.70	11.45	383.02	15.40	379.07	21.88	372.59	20.38	374.09	24.11	370.36	23.41	371.06	18.97	375.50		
A189914	11/27/2012	P19S	393.31	33.67	359.64	26.10	367.21	22.87	370.44	17.02	376.29	15.31	378.00	9.02	384.29	16.06	377.25	25.03	368.28	8.49	384.82	16.33	376.98	26.54	366.77	24.84	368.47	29.80	363.51	28.60	364.71	21.92	371.39		
A195409	12/10/2013	P19I	392.75	31.66	361.09	19.41	373.34	21.63	371.12	15.81	376.94	13.91	378.84	7.27	385.48	15.44	377.31	24.53	368.22	6.44	386.31	15.51	377.24	26.03	366.72	24.06	368.69	28.78	363.97	27.88	364.87	20.08	372.67		
A195408	12/10/2013	P19D	392.08	32.00	360.08	19.64	372.44	21.99	370.09	16.17	375.91	14.29	377.79	7.60	384.48	15.81	376.27	24.95	367.13	6.78	385.30	15.92	376.16	26.41	365.67	24.44	367.64	29.20	362.88	28.28	363.80	20.45	371.63		
A189915	12/6/2012	P20S	394.04	33.88	360.16	21.93	372.11	23.64	370.40	17.79	376.25	15.98	378.06	9.31	384.73	17.40	376.64	26.55	367.49	8.49	385.55	17.53	376.51	28.07	365.97	26.11	367.93	30.98	363.06	29.93	364.11	22.21	371.83		
A189916	11/28/2012	P21S	393.87	32.71	361.16	23.21	370.66	23.36	370.51	17.80	376.07	16.05	377.82	9.28	384.59	16.91	376.96	26.31	367.56	8.67	385.20	17.30	376.57	27.79	366.08	25.92	367.95	30.77	363.10	29.70	364.17	22.23	371.64		
A195411	12/9/2013	P21I	393.53	33.13	360.40	20.19	373.34	23.09	370.44	17.28	376.25	15.40	378.13	8.62	384.91	16.96	376.57	26.17	367.36	7.77	385.76	17.03	376.50	27.67	365.86	25.66	367.87	30.44	363.09	29.45	364.08	21.51	372.02		
A195410	12/9/2013	P21D	393.39	33.05	360.34	20.11	373.28	23.13	370.26	17.25	376.14	15.36	378.03	8.59	384.80	16.91	376.48	26.15	367.24	7.74	385.65	17.00	376.39	27.63	365.76	25.62	367.77	30.40	362.99	29.43	363.96	21.45	371.94		
A189917	11/29/2012	P22S	394.30	33.99	360.31	26.81	367.49	24.04	370.26	18.16	376.14	16.54	377.76	10.17	384.13	17.26	377.04	25.81	368.49	9.66	384.64	17.29	377.01	27.31	366.99	25.78	368.52	30.46	363.84	29.37	364.93	24.00	370.30		
A195413	12/8/2013	P22I	393.52	33.31	360.21	21.75	371.77	23.25	370.27	17.40	376.12	15.58	377.94	8.90	384.62	16.95	376.57	25.99	367.53	8.14	385.38	17.01	376.51	27.50	366.02	25.56	367.96	30.50	363.02	29.38	364.14	22.07	371.45		
A195412	12/7/2013	P22D	393.76	33.50	360.26	21.79	371.97	23.43	370.33	17.56	376.20	15.75	378.01	9.08	384.68	17.13	376.63	26.20	367.56	8.30	385.46	17.19	376.57	27.70	366.06	25.76	368.00	30.64	363.12	29.56	364.20	22.17	371.59		
A189918	12/19/2012	P23S	412.42	20.47	391.95	16.89	395.53	18.60	393.82	15.01	397.41	17.54	394.88	16.67	395.75	15.81	396.61	16.54	395.88	15.78	396.64	18.13	394.29	18.36	394.06	15.86	396.56	18.32	394.10	20.99	391.43	19.55	392.87		
A190014	1/10/2013	P23D	412.27	50.98	361.29	42.58	369.69	41.23	371.04	35.03	377.24	33.58	378.69	27.23	385.04	34.29	377.98	42.96	369.31	26.73	385.54	34.42	377.85	44.66	367.61	42.96	369.31	47.50	364.77	46.82	365.45	40.73	371.54		
A189919	12/12/2012	P24S	409.16	16.02	393.14	19.15	390.01	19.59	389.57	10.15	399.01	13.65	395.51	13.28	395.88	18.22	390.94	19.56	389.60	19.35	389.81	19.19	389.97	12.99	396.17	0.49	(see note 7)	12.10	397.06	12.59	396.57	11.33	397.83		
A190013	1/15/2013	P24D	408.50	47.39	361.11	36.26	372.24	37.50	371.00	31.65	376.85	29.93	378.57	23.33	385.17	31.20	377.30	40.05	368.45	22.66	385.84	31.25	377.25	41.78	366.72	39.77	368.73	44.43	364.07	43.62	364.88	36.12	372.38		
A189920	12/2/2012	P25S	410.37	20.04	390.33	19.51	390.86	18.72	391.65	16.78	393.59	9.51	400.86	13.65	396.72	17.13	393.24	18.20	392.17	19.38	390.99	20.78	389.59	13.47	396.90	10.70	399.67	12.58	397.79	16.65	393.72	14.25	396.12		
A190016	1/17/2013	P25D	410.43	49.62	360.81	38.05	372.38	39.61	370.82	33.84	376.59	31.98	378.45	25.35	385.08	33.32	377.11	42.32	368.11	24.62	385.81	33.43	377.00	44.01	366.42	41.99	368.44	46.69	363.74	45.83	364.60	38.20	372.23		
A189921	12/10/2012	P26S	411.46	18.93	392.53	16.40	395.06	15.88	395.58	13.19	398.27	11.65	399.81	14.55	396.91	16.37	395.09	17.11	394.35	18.93	392.53	20.18	391.28	10.11	401.35	8.25	403.21	9.65	401.81	12.67	398.79	11.49	399.97		
A190015	1/15/2013	P26D	411.07	49.94	361.13	38.92	372.15	40.03	371.04	34.18	376.89	32.46	378.61	25.92	385.15	33.62	377.45	42.51	368.56	25.25	385.82	33.75	377.32	44.20	366.87	42.26	368.81	46.90	364.17	46.13	364.94	38.90	372.17		
A189922	12/13/2012	P27S	413.23	22.77	390.46	14.85	398.38	13.94	399.29	12.45	400.78	12.75	400.48	11.77	401.46	14.03	399.20	16.45	396.78	14.72	398.51	16.00	397.23	18.88	394.35	19.87	393.36	23.35	389.88	24.37	388.86	23.20	390.03		
A189923	12/12/2012	P28S	413.34	30.06	383.28	23.89	389.45	21.27	392.07	18.94	394.40	19.14	394.20	18.40	394.94	17.20	396.14	20.72	392.62	20.82	392.52	23.65	389.69	18.58	394.76	16.81	396.53	19.01	394.33	22.00	391.34	22.91	390.43		
A190017	1/9/2013	P28D	413.46	52.53	360.93	42.32	371.14	42.52	370.94	36.48	376.98	34.79	378.67	28.31	385.15	35.75	377.71	44.64	368.82	27.69	385.77	35.92	377.54	46.35	367.11	44.56	368.90	49.18	364.28	48.44	365.02	41.79	371.67		
A190018	1/17/2013	P29S	399.11	36.56	362.55	36.67	362.44	31.34	367.77	24.70	374.41	21.15	377.96	16.88	382.23	17.28	381.83	24.16	374.95	16.07	383.04	18.81	380.30	27.81	371.30	27.10	372.01	30.72	368.39	30.83	368.28	30.11	369.00		
A195414	12/11/2013	P29D	398.27	37.76	360.51	37.09	361.18	29.55	368.72	21.72	376.55	20.15	378.12	14.34	383.93	17.80	380.47	26.28	371.99	14.00	384.27	18.66	379.61	29.03	369.24	28.26	370.01	32.60	365.67	31.90	366.37	30.46	367.81		
A190019	1/16/2013	P30S	407.75	47.70	360.05	40.46	367.29	37.77	369.98	31.21	376.54	29.75	378.00	23.19	384.56	30.03	377.72	38.95	368.80	22.78	384.97	30.05	377.70	40.59	367.16	39.29	368.46	44.08	363.67	42.98	364.77	38.10	369.65		
A189924	12/10/2012	P31S	408.68	34.94	373.74	34.54	374.14	33.51	375.17	28.28	380.40	27.65	381.03	23.60	385.08	27.54	381.14	33.57	375.11	24.30	384.38	27.69	380.99	34.62	374.06	34.11	374.57	35.13	373.55	35.09	373.59	33.94	374.74		
A197227	8/5/2014	P64S	393.85															24.45	369.40	9.67	384.18	16.23	377.62	25.99	367.86	24.98	368.87	29.98	363.87	29.11	364.74	23.55	370.30		
A197228	8/5/2014	P65S	393.67															25.72	367.95	7.91	385.76	16.72	376.95	27.22	366.45	25.37	368.30	30.10	363.57	29.21	364.46	21.82	371.85		
A197229	8/4/2014	P66S	393.57															15.40	378.17	12.22	381.35	12.61	380.96	15.35	378.22	14.78	378.79	17.53	376.04	17.68	375.89	15.87	377.70		
A197230	8/4/2014	P67S	393.08															23.42	369.66	8.83	384.25	15.92	377.16	25.08	368.00	22.18	370.90	25.95	367.13	22.97	370.11	19.22	373.86		
A197231	8/4/2014	P68S	391.84															24.08	367.76	7.41	384.43	15.25	376.59	25.57	366.27	23.88	367.96	28.81	363.03	27.73	364.11	20.91	370.93		
A197232	8/4/2014	P69S	391.54															24.19	367.35	6.14	385.40	15.11	376.43	25.62	365.92	23.59	367.95	28.44	363.10	27.38	364.16	19.84	371.70		
A197233	8/4/2014	P70S	394.16															27.07	367.09	8.65	385.51	17.94	376.22	28.44	365.72	26.62	367.54	31.32	362.84	31.32	362.84	22.50	371.66		
A197234	8/4/2014	P71S	393.93															25.89	368.04	8.90	385.03	17.08	376.85	27.44	366.49	25.58	368.35	30.31	363.62	29.55	364.38	22.86	371.07		
		Mississippi River Elevation [5]		360.0		375.3		370.9		376.6		378.7		385.5		377.0		367.5		386.5		376.8		365.7		368.1		363.4							

Notes:
1) SPC NAD83 Missouri East coordinates
2) NGVD29 vertical datum, feet above mean sea level
3) Feet below ground surface
4) Piezometers P64S through P71S were installed in August 2014 for future landfill monitoring; water levels from these piezometers are included as supplemental information to the DSI.
5) River elevation recorded by Rush Island Energy Center operations
6) NM = not measured; water level at P01S was not measured on 6/13/14 due to flooding which prevented access to the piezometer location
7) The water level recorded at piezometer P24S on December 11, 2014 is a potentially spurious result as the water level is anomalous to water levels at surrounding shallow piezometers.

Natural Resource Technology

2014 Bedrock Piezometer Water Level Data

Detailed Site Investigation
Ameren Rush Island Energy Center
Festus, Missouri

State Certification Number	Installation Date	Piezometer Designation	Piezometer Casing Elevation [2]	January 13, 2014		February 24, 2014		March 25, 2014		April 9, 2014		May 15, 2014		June 13, 2014		July 28, 2014		August 14, 2014		September 16, 2014		October 22, 2014		November 20, 2014		December 11, 2014		January 20, 2015		February 19, 2015		March 17, 2015		April	
				Depth to Water [3]	Groundwater Elevation [2]	Depth to Water [3]	Groundwater Elevation [2]	Depth to Water [3]	Groundwater Elevation [2]	Depth to Water [3]	Groundwater Elevation [2]	Depth to Water [3]	Groundwater Elevation [2]	Depth to Water [3]	Groundwater Elevation [2]	Depth to Water [3]	Groundwater Elevation [2]	Depth to Water [3]	Groundwater Elevation [2]	Depth to Water [3]	Groundwater Elevation [2]	Depth to Water [3]	Groundwater Elevation [2]	Depth to Water [3]	Groundwater Elevation [2]	Depth to Water [3]	Groundwater Elevation [2]	Depth to Water [3]	Groundwater Elevation [2]	Depth to Water [3]	Groundwater Elevation [2]	Depth to Water [3]	Groundwater Elevation [2]	Depth to Water [3]	Groundwater Elevation [2]
A196980	4/14/2014	P02SBR	390.66									94.42	296.24	76.12	314.54	46.18	344.48	43.11	347.55	37.93	352.73	33.61	357.05	31.88	358.78	31.28	359.38	30.57	360.09	30.07	360.59	30.01	360.65		
A196797	4/14/2014	P03SBR	391.65									87.92	303.73	87.74	303.91	87.12	304.53	87.03	304.62	86.62	305.03	86.14	305.51	85.72	305.93	85.41	306.24	84.75	306.90	84.40	307.25	83.89	307.76		
A196978	4/15/2014	P04SBR	391.03									12.61	378.42	6.16	384.87	13.60	377.43	22.10	368.93	5.54	385.49	13.64	377.39	23.53	367.5	21.67	369.36	26.39	364.64	25.50	365.53	18.60	372.43		
A196977	4/15/2014	P05SBR	390.09									11.59	378.5	5.19	384.9	12.56	377.53	20.95	369.14	4.57	385.52	12.61	377.48	22.45	367.64	20.61	369.48	25.31	364.78	24.45	365.64	17.56	372.53		
A196976	4/24/2014	P07SBR	403.41									24.58	378.83	18.55	384.86	25.26	378.15	33.45	369.96	17.97	385.44	25.31	378.10	34.87	368.54	32.80	370.61	37.09	366.32	36.74	366.67	28.93	374.48		
A196975	4/8/2014	P08SBR	403.62									24.87	378.75	18.63	384.99	25.15	378.47	33.20	370.42	18.18	385.44	25.26	378.36	35.21	368.41	33.70	369.92	38.14	365.48	37.55	366.07	32.27	371.35		
A196974	4/14/2014	P12SBR	410.01									87.07	322.94	47.56	362.45	32.11	377.9	37.95	372.06	34.35	375.66	34.01	376.00	36.57	373.44	38.67	371.34	41.17	368.84	42.18	367.83	42.89	367.12		
A196973	4/22/2014	P14SBR	412.25									33.81	378.44	27.24	385.01	34.80	377.45	43.87	368.38	26.62	385.63	34.91	377.34	45.42	366.83	43.62	368.63	48.37	363.88	47.51	364.74	40.78	371.47		
A196972	4/8/2014	P15SBR	394.14									150.98	243.16	150.26	243.88	148.2	245.94	147.24	246.90	145.23	248.91	142.92	251.22	141.09	253.05	139.77	254.37	137.28	256.86	135.61	258.53	133.97	260.17		
A196971	4/9/2014	P16SBR	393.04									14.89	378.15	8.28	384.76	16.25	376.79	25.32	367.72	7.49	385.55	16.35	376.69	26.83	366.21	25.01	368.03	29.31	363.73	28.82	364.22	21.49	371.55		
A196970	4/13/2014	P17SBR	394.23									16.17	378.06	9.54	384.69	17.57	376.66	26.63	367.60	8.72	385.51	17.65	376.58	28.09	366.14	26.22	368.01	30.94	363.29	30.03	364.20	22.56	371.67		
A195416	9/19/2013	P17BR [4]	395.28	32.62	362.66	28.86	366.42	25.35	369.93	20.93	374.35	164.06	231.22	143.26	252.02	116.12	279.16	108.01	287.27	94.31	300.97	83.00	312.28	74.34	320.94	69.13	326.15	60.99	334.29	56.07	339.21	52.36	342.92		
A196969	4/12/2014	P18SBR	393.85									15.77	378.08	9.12	384.73	17.11	376.74	26.17	367.68	8.28	385.57	17.21	376.64	27.61	366.24	25.77	368.08	30.54	363.31	29.58	364.27	22.03	371.82		
A196968	4/10/2014	P19SBR	392.53									16.47	376.06	10.78	381.75	15.74	376.79	24.80	367.73	7.21	385.32	15.83	376.7	26.26	366.27	24.39	368.14	29.11	363.42	28.20	364.33	20.65	371.88		
A196966	5/6/2014	P21SBR	393.34									15.39	377.95	8.79	384.55	16.58	376.76	25.75	367.59	7.98	385.36	16.71	376.63	27.26	366.08	25.39	367.95	30.01	363.33	29.12	364.22	21.68	371.66		
A196967	4/30/2014	P21BR	393.59									164.55	229.04	18.11	375.48	16.67	376.92	25.42	368.17	8.59	385	16.40	377.19	27.10	366.49	25.37	368.22	30.41	363.18	29.33	364.26	22.20	371.39		
A196965	4/13/2014	P22SBR	393.96									117.89	276.07	116.74	277.22	114.54	279.42	113.94	280.02	112.8	281.16	111.84	282.12	110.9	283.06	110.24	283.72	109.05	284.91	108.20	285.76	107.39	286.57		
A196964	4/12/2014	P23SBR	411.74									33.10	378.64	26.72	385.02	33.83	377.91	42.52	369.22	26.21	385.53	33.95	377.79	44.24	367.5	42.51	369.23	47.07	364.67	46.35	365.39	50.19	361.55		
A196963	4/13/2014	P25SBR	411.22									33.00	378.22	26.36	384.86	34.35	376.87	43.30	367.92	25.62	385.6	34.36	376.86	45.04	366.18	43.01	368.21	47.69	363.53	46.83	364.39	39.27	371.95		
A195401	10/14/2013	P25BR	411.08	50.39	360.69	38.95	372.13	40.76	370.32	34.92	376.16	33.09	377.99	26.50	384.58	34.24	376.84	43.21	367.87	25.7	385.38	34.33	376.75	45.03	366.05	43.07	368.01	47.55	363.53	46.85	364.23	39.42	371.66		
A195415	6/19/2013	P26BR [4]	410.88	70.68	340.2	59.7	351.18	54.26	356.62	24.9	385.98	48.15	362.73	45.16	365.72	40.32	370.56	41.77	369.11	40.55	370.33	39.13	371.75	43.24	367.64	43.32	367.56	46.99	363.89	45.25	365.63	42.85	368.03		
A196962	4/22/2014	P34SBR	412.20									34.05	378.15	27.43	384.77	35.19	377.01	44.23	367.97	26.67	385.53	35.25	376.95	46.09	366.11	44.05	368.15	48.70	363.5	47.85	364.35	40.39	371.81		
A196961	4/23/2014	P36SBR	411.43									32.84	378.59	26.46	384.97	33.72	377.71	42.12	369.31	25.91	385.52	33.72	377.71	43.78	367.65	41.85	369.58	46.48	364.95	45.69	365.74	38.82	372.61		
A196960	4/13/2014	P54SBR	409.61									34.70	374.91	27.44	382.17	29.10	380.51	39.64	369.97	28.76	380.85	30.63	378.98	41.55	368.06	40.51	369.1	45.47	364.14	43.78	365.83	41.58	368.03		
A196959	4/11/2014	P55SBR	410.86									32.61	378.25	26.02	384.84	33.74	377.12	42.71	368.15	25.33	385.53	33.83	377.03	44.53	366.33	42.56	368.3	47.15	363.71	46.39	364.47	39.08	371.78		
A196957	4/10/2014	P56SBR	411.60									33.31	378.29	26.76	384.84	34.35	377.25	43.30	368.30	26.07	385.53	34.46	377.14	45.14	366.46	43.21	368.39	47.84	363.76	47.09	364.51	40.03	371.57		
A196796	4/17/2014	P56BR	411.24									33.90	377.34	27.35	383.89	34.92	376.32	43.85	367.39	26.61	384.63	35.04	376.20	45.70	365.54	43.79	367.45	48.40	362.84	47.60	363.64	40.81	370.43		
A196955	4/9/2014	P57SBR	391.19									12.99	378.2	6.43	384.76	14.28	376.91	23.38	367.81	5.60	385.59	14.40	376.79	24.97	366.22	23.04	368.15	27.67	363.52	26.77	364.42	19.35	371.84		
A196956	4/13/2014	P58SBR	391.95									13.89	378.06	7.25	384.7	15.23	376.72	24.29	367.66	6.41	385.54	15.30	376.65	25.82	366.13	23.93	368.02	28.60	363.35	27.68	364.27	20.13	371.82		
A196954	4/15/2014	P59SBR	408.76									30.25	378.51	24.03	384.73	29.91	378.85	38.63	370.13	23.80	384.96	30.08	378.68	40.24	368.52	39.12	369.64	43.54	365.22	42.96	365.80	39.45	369.31		
A196953	4/9/2014	P60SBR	405.65									26.98	378.67	20.76	384.89	26.98	378.67	35.56	370.09	20.44	385.21	27.09	378.56	37.15	368.5	35.86	369.79	40.27	365.38	39.72	365.93	35.42	370.23		
A196952	4/16/2014	P61SBR	388.37									9.65	378.72	3.35	385.02	10.59	377.78	18.92	369.45	2.74	385.63	10.65	377.72	20.42	367.95	18.57	369.8	23.19	365.18	22.41	365.96	15.45	372.92		
		Mississippi River Elevation [5]		360.0		375.3		370.9		376.6		378.7		385.5		377.0		367.5		386.5		376.8		365.7		368.1		363.4							

Notes:
1) SPC NAD83 Missouri East coordinates
2) NGVD29 vertical datum, feet above mean sea level
3) Feet below ground surface
4) Piezometers P17BR and P26BR were purged dry (re-developed) between April and May 2014.
5) River elevation recorded by Rush Island Energy Center operations

Natural Resource Technology

APPENDIX B

PERIODIC HAZARD CLASSIFICATION

AMEREN MISSOURI RUSH ISLAND ENERGY CENTER
EVALUATION OF CCR UNITS
40 CFR PART 257
JEFFERSON COUNTY, MISSOURI

APPENDIX B: PERIODIC HAZARD POTENTIAL CLASSIFICATION 257.73(a)(2)

TABLE OF CONTENTS

Section — Page

1.0 INTRODUCTION 1
1.1 Purpose 1
2.0 RUSH ISLAND ENEREGY CENTER CCR UNIT 2
2.1 RCPA 3
3.0 CONCLUSION 3
4.0 REFERENCES 4

LIST OF FIGURES

Figure 1 ..... Site Map

LIST OF TABLES

Table 1 ..... Active surface impoundments at the Rush Island Energy Center
Table 2 ..... Methodology used in the FEMA hazard classification of dams

AMEREN MISSOURI RUSH ISLAND ENERGY CENTER
EVALUATION OF CCR UNITS
JEFFERSON COUNTY, MISSOURI

APPENDIX B: PERIODIC HAZARD POTENTIAL CLASSIFICATION §257.73(a)(2)

1.0 INTRODUCTION

The Rush Island Energy Center (REC) is located in southern Jefferson County, Missouri, in the Mississippi River floodplain. The plant is south of the City of Festus and north of the City of Bloomsdale. The REC has one active surface impoundment. The surface impoundment is located just west of the Mississippi River and north of Isle du Bois Creek. The Rush Island Dam is in Sections 3 and 4, Township 39 North, Range 7 East of the 5th Principal Meridian. An aerial showing the surface impoundment is attached as Figure 1.

The Rush Island Dam is a single stage industrial dam. The perimeter of the dam has a length of approximately 9,750-lineal feet and a maximum height of 46 feet. The upstream and downstream slopes of the dam are sloped at 3 horizontal (H) to 1 vertical (V). The Rush Island Dam is permitted by the Missouri Department of Natural Resources (MDNR) under registration permit ID No. MO-40179. The RCPA no longer receives CCRs, has been dewatered and is currently being closed. The impoundment is no longer used for CCR disposal and water treatment.

1.1 Purpose

40 CFR Part §257.73(a)(2) requires the owner or operator of an existing surface impoundment to conduct periodic hazard potential classification assessment of the CCR unit. The owner or operator must document the hazard classification of each CCR unit as either a high hazard potential CCR surface impoundment, a significant hazard potential CCR surface impoundment, or a low hazard potential CCR surface impoundment. The owner or operator must obtain a certification from a qualified professional engineer stating that the initial and each subsequent periodic classification was conducted in accordance with the requirements of §257.73(a)(2). The following documents Reitz & Jens, Inc.'s periodic hazard potential classification evaluation for RCPA at the Ameren Missouri Rush Island Energy Center.

2.0 RUSH ISLAND ENEREGY CENTER CCR UNIT

There is one active surface impoundment at the REC, which is called RCPA. The surface impoundment historically was used to store CCR, water retention, water clarification and alkalinity adjustment prior to discharge through Outfall #002 of NPDES permit number MO-0000043. The CCR stored within the surface impoundment is bottom and fly ash. The RCPA no longer receives CCRs, has been dewatered and is currently being closed. RCPA is regulated by the MDNR because the height of the perimeter impoundment is greater than 35 feet. The State of Missouri operating permit ID numbers for the dam is MO-40179. The surface impoundment location and the centerline of the embankments are shown in Figure 1.

The initial hazard potential classifications were determined for the active surface impoundments at the Rush Island Energy Center based on the Federal Emergency Management Agency (FEMA) hazard potential classification criteria. Pertinent data regarding each surface impoundment are shown in Table 1.

Table 1 – Active Surface Impoundments at the Rush Island Energy Center

CCR Unit	Maximum Surface Area (acres)	Dam Height (feet)	Crest Length (feet)	Normal Pool Elevation (feet)
RCPA	114	46	9,750	398.0

The FEMA classification system has three levels of Hazard Potential Classification: Low, Significant, and High. The hazard potential classification system categorizes dams based on the probable loss of human life and the impacts on economic, environmental, and lifeline interests should the dam fail. The classification system relies heavily on judgement and common sense, because all possibilities cannot be defined. Allowances for evacuation or emergency actions by the population were not considered because emergency procedures should not be a substitute for appropriate design, construction, and maintenance of dam structures. A summary for the FEMA hazard classification system of dams is shown in Table 2.

Table 2 - FEMA Hazard Classification System of Dams

Hazard Potential Classification	Loss of Human Life	Economic, Environmental, Lifeline Losses
Low	None expected	Low and generally limited to owner
Significant	None expected	Yes
High	Probable. One or more expected	Yes (but not necessary for this classification)

2.1 RCPA

RCPA was brought online in 1976. The location of the pond is shown in Figure 1. As-built drawings for the pond are presented in the O&M manual in Appendix A. RCPA consists of a ring dam impounding an area of approximately 114 acres. The impounded area was divided by an internal berm constructed of CCR prior to closure. The area to the north of the berm was used for CCR sedimentation and disposal, and an area to the south of the berm known as the "polish pond" was used for final sedimentation and detention. The portion formerly used for disposal had an area of approximately 85 acres, and the polish pond had an area of approximately 29 acres. The disposal area received process water for bottom ash and fly ash deposition.

Failure of RCPA would result in the release of water and CCR into the Mississippi River and potentially Isle du Bois Creek. The failure should not cause loss of life or significant environmental impacts. Economic and lifeline losses of the impoundment would generally be limited to the owner. Therefore, according to the FEMA Hazard Potential Classification of Dams, RCPA should have a Low Hazard Potential Classification.

3.0 CONCLUSION

The initial hazard potential classifications for the active CCR surface impoundments at the Rush Island Energy Center is Low Hazard Potential for RCPA. The hazard potential classification should be re-evaluated within 5 years of the initial hazard potential classification.

4.0 REFERENCES

Environmental Protection Agency. (2015). "Hazardous and Solid Waste Management System; Disposal of Coal Combustion Residuals From Electric Utilities; Final Rule." 40 CFR Parts 257 and 261., Vol. 80, No. 74.

Federal Emergency Management Agency. (2004). "Federal Guidelines for Dam Safety, Hazard Potential Classification System for Dams." Interagency Committee on Dam Safety.



Legend

Embankment

Spillway

N

0 250 500 Feet

AMEREN MISSOURI
RUSH ISLAND ENERGY CENTER
ACTIVE CCR SURFACE IMPOUNDMENTS
FIGURE 1

Ameren MISSOURI

REITZ & JENS, INC. CONSULTING ENGINEERS

APPENDIX C

PERIODIC STRUCTURAL STABILITY ASSESSMENT

AMEREN MISSOURI RUSH ISLAND ENERGY CENTER
EVALUATION OF CCR UNITS
40 CFR PART 257
JEFFERSON COUNTY, MISSOURI

APPENDIX C: PERIODIC STRUCTURAL STABILITY ASSESSMENT
257.73(d)(1)

TABLE OF CONTENTS

Section — Page

1.0 INTRODUCTION 1
1.1 Purpose 1
2.0 FIELD INSPECTION 2
2.1 Embankment and Foundation Stability 2
2.2 Slope Protection 3
2.3 Hydraulic Structures 3
2.4 RCPA Investigation Conclusions 3
3.0 OPERATIONS AND MAINTENANCE REVIEW 4
3.1 Operations 4
3.2 Maintenance 4
4.0 DESIGN AND CONSTRUCTION DOCUMENT REVIEW 6
4.1 Embankment and Foundation Stability 6
4.2 Slope Protection 6
4.3 Spillways 6
5.0 PERIODIC STRUCTURAL STABILITY ASSESSMENT SUMMARY 7
6.0 REFERENCES 8

LIST OF FIGURES

Figure 1 ..... Site Map

LIST OF TABLES

Table 1 ..... Volume and depth of impounded CCR in RCPA

LIST OF APPENDICES

APPENDIX I	2020 PERIODIC INSPECTION CHECK SHEETS
	2020 PERIODIC INSPECTION PHOTOGRAPH LOG
APPENDIX II	DVD CONTAINING 2020 PERIODIC INSPECTION PHOTOGRAPHS
APPENDIX III	2019 RUSH ISLAND ENERGY CENTER ANNUAL INSPECTION CHECK SHEET

AMEREN MISSOURI RUSH ISLAND ENERGY CENTER
EVALUATION OF CCR UNITS
JEFFERSON COUNTY, MISSOURI

APPENDIX C: PERIODIC STRUCTURAL STABILITY ASSESSMENT 257.73(d)(1)

1.0 INTRODUCTION

The Rush Island Energy Center (REC) is located in southern Jefferson County, Missouri, in the Mississippi River floodplain. The plant is south of the City of Festus and north of the City of Bloomsdale. The REC has one active surface impoundment. The surface impoundment is located just west of the Mississippi River and north of Isle du Bois Creek. The Rush Island Dam is in Sections 3 and 4, Township 39 North, Range 7 East of the 5th Principal Meridian. An aerial showing the surface impoundment is attached as Figure 1.

The Rush Island Dam is a single stage industrial dam. The perimeter of the dam has a length of approximately 9,750-lineal feet and a maximum height of 46 feet. The upstream and downstream slopes of the dam are sloped at 3 horizontal (H) to 1 vertical (V). The Rush Island Dam is permitted by the Missouri Department of Natural Resources (MDNR) under registration permit ID No. MO-40179. The RCPA no longer receives CCRs, has been dewatered and is currently being closed. The impoundment is no longer used for CCR disposal and water treatment.

1.1 Purpose

40 CFR Part 257.73(d)(1) specifies that the owner or operator of all existing CCR surface impoundments, except for incised CCR units, shall conduct initial and periodic structural stability assessments and document whether the design, construction, operation and maintenance of the CCR unit is consistent with recognized and generally accepted good engineering practices for the maximum volume of CCR and CCR wastewater which can be impounded therein.

The purpose of this periodic structural stability assessment for RCPA at the Rush Island Energy Center is to provide the information required by 40 CFR Part 257.73(d)(1). The periodic structural stability assessment consisted of field inspections, design and construction document review, and review of operation and maintenance records. Additional information for RCPA is included in the History of Construction Report.

2.0 FIELD INSPECTION

A field inspection of the existing surface impoundment at the Rush Island Energy Center was conducted on October 30, 2020 by Reitz & Jens, Inc. personnel Jeff Bertel, P.E., Laura Sutton, P.E. and Ashley Martinez, E.I.; who were accompanied by Ameren Missouri personnel Marc Lueckenhoff, P.E. The weather was sunny with temperatures near 50 degrees (F). The Mississippi River elevation at the REC was el. 369.0 feet. The RCPA was being closed and had been dewatered. The closure cap was nearly complete during the inspection. The field inspection consisted of walking the crest and toe of the RCPA perimeter berm, and visually reviewing the hydraulic outlet structures.

Observations made during the inspection were recorded on the Ameren Annual Inspection Check Sheet which is included in Appendix I. A photograph log of the typical conditions and main inspection findings is also included in Appendix I. Photographs taken during the inspection are included on a DVD contained in Appendix II. Observations from the field inspection are summarized below for each CCR unit.

2.1 Embankment and Foundation Stability

Field inspection of the RCPA perimeter berm found no signs of instability. There was no visible vertical or horizontal misalignment of the crest. No sloughs, slides or cracks were observed.

Ponding was observed on the east side of the impoundment near the downstream toe. The ponding begins approximately 200 feet north of the abandoned primary spillway and continues for approximately 500 feet north. The new outfalls constructed for closure may be contributing to the ponding. Positive drainage should be created to prevent ponding near the embankment. Verify that drainage features necessary to create positive drainage are properly armored to prevent head cut erosion.

No seepage was observed, but the ground was soft and saturated approximately 50 feet north of P20S and 100 feet south of P19S. Monitor these areas for seepage.

The west embankment slope has ruts, the sod cover has been highly disturbed and there is erosion at a newly installed outfall for closure. The disturbance appears to be caused by ongoing work for closure and to line the slope with riprap. We recommend inspecting the slope after construction to verify that the embankment is adequately protected. The outfall riprap should be extended down the slope to the flowline of the receiving channel at the toe. The riprap being installed on the west embankment downstream slope should be extended to the bottom of the channel at the toe.

The riprap below the newly installed Outlet 6 should be extended to the toe. Soil and geotextile fabric are exposed at Outlets 3 and 4. Verify that the riprap has been properly placed and add additional riprap as necessary. Monitor outlet discharge flow paths and armor as needed to prevent head cut erosion.

There is good access at the crown of the embankment for visually reviewing the crest and slopes. No operational activities or adjacent developments were observed that might threaten the integrity of the embankment.

2.2 Slope Protection

The RCPA has been dewatered and is currently being closed. The upstream slopes are lined with closure turf. Most of the downstream slopes have been armored with riprap or are being prepped for riprap placement. Only a small area near the southwest corner of the impoundment has vegetated slopes. No excess vegetation was observed, but the vegetation was intermittently sparse. Some of the sparse areas may have been disturbed by closure construction. We recommend inspecting the area next spring and seedings areas with sparse vegetation growth.

2.3 Hydraulic Structures

The RCPA has been dewatered and currently is being closed. The principal spillway has been grouted closed and the emergency spillway has been removed. Rainfall within the footprint of the impoundment is routed to 9 stormwater outlets through the perimeter embankment. The outlets have been installed and were functional during the inspection.

2.4 RCPA Investigation Conclusions

There were no significant deficiencies or signs of instability observed during the field inspection of RCPA, however there are maintenance items and additional monitoring that should occur. The following remedial items should be addressed as soon as feasible. Ameren should prepare documentation detailing the corrective measures taken as these items are addressed.

- Positive drainage should be created to prevent ponding near the embankment along the east side of the embankment.
- Several items were noted regarding erosion, rutting or sparse vegetation related to ongoing closure construction. We recommend a thorough inspection after completion of closure to verify that these items have been addressed.

3.0 OPERATIONS AND MAINTENANCE REVIEW

The available operations and maintenance records were reviewed as part of the periodic structural stability assessment. The review included the O&M Manual, the preceding weekly and annual inspections for a period of 1-year, on-site meetings to discuss ongoing maintenance, and the most recent survey data provided by Ameren Missouri.

The O&M Manual specifies minimum requirements for maintenance and establishes operational requirements for CCR placement. The manual states that no alterations or repairs to structural elements should be made without the approval of the Chief Dam Safety Engineer. The O&M Manual is attached in Appendix A of the *Ameren Missouri Rush Island Energy Center: Evaluation of CCR Units* report.

3.1 Operations

RCPA historically received flow from stormwater, and bottom and fly ash sluice flow. The RCPA no longer receives CCRs, has been dewatered and is currently being closed.

Table 1 includes pertinent data regarding the volume and depth of impounded CCR in RCPA.

Table 1 – Volume and depth of impounded CCR in RCPA

CCR Unit	Est. Volume of Water and CCR (CY)	Est. Bottom Elev. of CCR Unit (feet)	Est. Minimum CCR Elev. (feet)	Est. Minimum Depth of CCR (feet)	Est. Maximum CCR Elev. (feet)	Est. Maximum Depth of CCR (feet)
RCPA	12,964,032	320	400	70	414	84

There was a staff gage installed in the polish pond and pool levels are recorded during weekly inspections. The staff gage was removed as part of closure construction.

3.2 Maintenance

Weekly inspection check sheets from March 2018 through June 2020, and the 2019 annual inspection check sheet were reviewed. Deficiencies noted during the weekly inspection reports were generally minor in nature and included minor sloughs, animal burrows, ruts, erosion, vegetation and visual seepage monitoring on the east side of the impoundment.

The 2019 annual inspection was conducted on August 21, 2019 and did not note any immediate maintenance items; however the report does recommend some minor maintenance and monitoring. Wet areas were observed along the downstream toe along the east embankment. This condition was generally unchanged during the current inspection. Small minor slides were also observed along the east embankment. These areas have been armored with riprap during the current inspection. Multiple animal burrows were observed on the downstream slopes on the east and west sides of the impoundment. Several areas of ruts were also observed along the downstream slope on the west side of the impoundment. The east side of the impoundment has been armored with riprap. The west side of the

impoundment was also disturbed during the current inspection, in preparation for riprap installation. The 2019 Rush Island Annual Levee Inspection is included in Appendix A of the *Ameren Missouri Rush Island Energy Center: Evaluation of CCR Units* report .

The O&M Manual states that all maintenance activities should be documented. Most maintenance activities are documented in the weekly and annual inspection reports; however maintenance records are not complete and comprehensive. The O&M Manual should be updated so that the responsibility and procedures for maintaining maintenance records are clearly defined.

4.0 DESIGN AND CONSTRUCTION DOCUMENT REVIEW

4.1 Embankment and Foundation Stability

There are no construction documents or records for the RCPA ring dam. The embankment fill was constructed of the less permeable material excavated from the interior of the impoundment. Borings through the embankment were conducted in 2010 and are presented in Appendix A. The embankment fill generally consists of clays and silts with varying amounts of sand. The dry density of the embankment fill ranged from 88.8 to 104.1 pcf, with an average dry density of about 95.2 pcf. The undrained shear strength (su) of the fill typically ranges from about 800 to 1600 psf.

The initial periodic safety factor assessment for RCPA were completed in October 2016. RCPA has been dewatered and is currently being closed. Haley & Aldrich, Inc. completed analyses of RCPA for the closed condition. Haley & Aldrich's report is included in Appendix D. The initial periodic safety factor assessment was completed by Reitz & Jens, and is also included in Appendix D.

4.2 Slope Protection

The perimeter berm for RCPA was originally designed with vegetated downstream and upstream slopes. Presently the east and south downstream slopes are armored with riprap. The downstream slope along the west side of the impoundment is currently being prepared for additional riprap installation. Only a small area on the southwest side of the impoundment will be vegetated. The upstream slopes are now lined with closure turf. There is also evidence of erosion on the upstream or downstream slopes.

4.3 Spillways

The RCPA has been dewatered and currently is being closed. The principal spillway has been grouted closed and the emergency spillway has been removed. Rainfall within the footprint of the impoundment is routed to 9 stormwater outlets through the perimeter embankment. The outlets have been installed and were functional during the inspection.

5.0 PERIODIC STRUCTURAL STABILITY ASSESSMENT SUMMARY

The initial periodic structural stability assessment found no structural stability deficiencies, no significant issues with the current operations and maintenance, and that the design and construction of the embankments and spillways were adequate for the range of loading conditions under which the CCR unit should be subjected. However, the deficiencies listed below do need to be addressed.

- Positive drainage should be created to prevent ponding near the embankment along the east side of the embankment.
- Several items were noted regarding erosion, rutting or sparse vegetation related to ongoing closure construction. We recommend a thorough inspection after completion of closure to verify that these items have been addressed.
- Continue monitoring the intermittently wet area just south of the outfall structure near the downstream toe.

6.0 REFERENCES

Environmental Protection Agency. (2015). "Hazardous and Solid Waste Management System; Disposal of Coal Combustion Residuals From Electric Utilities; Final Rule." 40 CFR Parts 257 and 261., Vol. 80, No. 74.



Legend

Embankment

Spillway

N

0 250 500 Feet

AMEREN MISSOURI
RUSH ISLAND ENERGY CENTER
ACTIVE CCR SURFACE IMPOUNDMENTS
FIGURE 1

Ameren MISSOURI

REITZ & JENS, INC. CONSULTING ENGINEERS

APPENDIX I

2020 PERIODIC INSPECTION CHECK SHEETS

2020 PERIODIC INSPECTION PHOTOGRAPH LOG

REITZ & JENS, INC.
CONSULTING ENGINEERS

1055 corporate square drive
st. louis, mo 63132
phone: 314.993.4132
fax: 314.993.4177
www.reitzjens.com

December 14, 2020

Jeffrey Greer, P.E.
Manager of Dam Safety & Hydro Licensing
Ameren Missouri
11149 Lindbergh Business Ct.
St. Louis, MO 63123

RE: Ameren Missouri – Rush Island Energy Center
2020 Annual Surface Impoundment Inspection
Fly Ash/Bottom Ash Pond (RCPA)

Dear Matt,

Enclosed herewith is an Annual Inspection Check Sheet for the 2020 Annual Inspection of the active surface impoundment Fly Ash/ Bottom Ash Pond (RCPA) at Ameren Missouri's Rush Island Energy Center conducted on October 30, 2020 by Reitz & Jens and Ameren Personnel. The Annual Inspection was in general accordance with 40 CFR Part 257.83(b), and included a review of available information regarding the status and condition of the CCR unit, including files available in the operating record.

No signs of structural weakness which would impact the operation and safety of the unit were observed. Minor maintenance items observed in the 2020 Annual Inspection associated with routine upkeep, presently do not impact the structural integrity of the embankment. Nonetheless, Ameren should address these minor maintenance items in a timely manner.

The following documents were reviewed as part of the inspection:

1. *Ameren Missouri. (2010). "Operation and Maintenance Manual; Rush Island Fly Ash Pond Dam, Festus, Missouri, Jefferson County, ID No. MO 40179" Dam Safety and Hydro Engineering, St. Louis, Missouri.*
2. *Ameren Missouri. (2016). "Rush Island 2016 Annual Inspection Checklist." October 6, 2016*
3. *Ameren Missouri. (2017). "Rush Island 2017 Annual Inspection Checklist." October 6, 2017*
4. *Ameren Missouri. (2018). "Rush Island 2018 Annual Inspection Checklist." October 5, 2018*
5. *Ameren Missouri. (2019). "Rush Island 2019 Annual Inspection Checklist." August 21, 2019*

6. *Ameren Missouri (2019). "Meramec Ash Impoundment, Weekly Inspection Checksheet." January 2 to December 30, 2019*
7. *Ameren Missouri (2020). "Meramec Ash Impoundment, Weekly Inspection Checksheet." January 6 to June 17, 2020*
8. *Ameren Ash Volumes Inventory, Excel Spreadsheet*
9. *Ameren CCR Unit Inventory, Excel Spreadsheet*
10. *Ameren Missouri. (2020). "Rush Island Energy Center 100 Big Hollow Road Festus, Jefferson County, Missouri Ash Pond Closure (Phase 3) Issued for Construction" Dam Safety and Hydro Engineering, St. Louis, Missouri.*
11. *Dewberry & Davis, LLC. (2011). "Coal Combustion Waste Impoundment Round 7 – Dam Assessment Report, Rush Island Power Station, Ameren Missouri, St. Louis, Missouri." USEPA Contract Number; EP-09W001727*
12. *Environmental Protection Agency (EPA). (2015). "Hazardous and Solid Waste Management System; Disposal of Coal Combustion Residuals from Electric Utilities." 40 CFR Parts 257 to 261. Vol. 80. No. 74. Federal Register*

The subsequent annual inspection must be conducted no later than October 30, 2021.

Sincerely,

Jeff Bertel, P.E.
Project Manager
Reitz & Jens, Inc.

P:\Amerenue\2020012463\Rush Island\2020 Inspection\Rush Island Annual Inspection Cover Letter.docx

RUSH ISLAND ENERGY CENTER
Fly Ash/Bottom Ash Pond (RCPA)

Annual Inspection Check Sheet

Date	10/30/2020
Inspector	J. Bertel, L. Sutton, A. Martinez, M. Lueckenhoff
Pool Level	NA
River Level	369
Temperature	50°F
Weather	Sunny

Date of Previous Annual Inspection: 8/21/2019

Date of Previous Periodic Inspection: 10/07/2015

Description of Emergency (EC) or Immediate Maintenance (IM) conditions observed since the last annual inspection:
None

Describe any action taken to restore or improve safety and integrity of impounding structure:
The impoundment is currently being closed and closure was nearly complete. There was no free water within the impoundment. There was active construction on the west side lining the downstream slope with riprap. The remaining downstream slopes have been lined with riprap at an approximate steepness of 3H to 1V and thickness of 2 feet. The outlet has been removed and the outlet channel has been filled.

Describe any modifications to the geometry of the impounding structure since the previous annual inspection:
Closure of the surface impoundment is nearly complete.

Describe any modifications to the operation of the impounding structure since the previous annual inspection:
There is no water being discharged into the impoundment.

List the approximate remaining storage capacity of the impounding structure:
NA

List the approximate maximum, minimum and present depth and elevation of the impounded water since the previous annual inspection:
Max – el. <388 feet, depth 20 feet; Min – el. <386 feet, depth 18 feet; Present – Pond is being closed, no impounded water.

List the approximate maximum, minimum and present depth and elevation of the impounded CCR since the previous annual inspection:
Max – el. 414 feet, depth 84 feet; Min – el. 400 feet, depth 70 feet; Present – el. 414 feet, depth 84 feet

Approximate volume of impounded water and CCR at the time of the inspection:
12,964,032 CY of CCR, no impounded free water

Describe any changes to the downstream watershed:
None

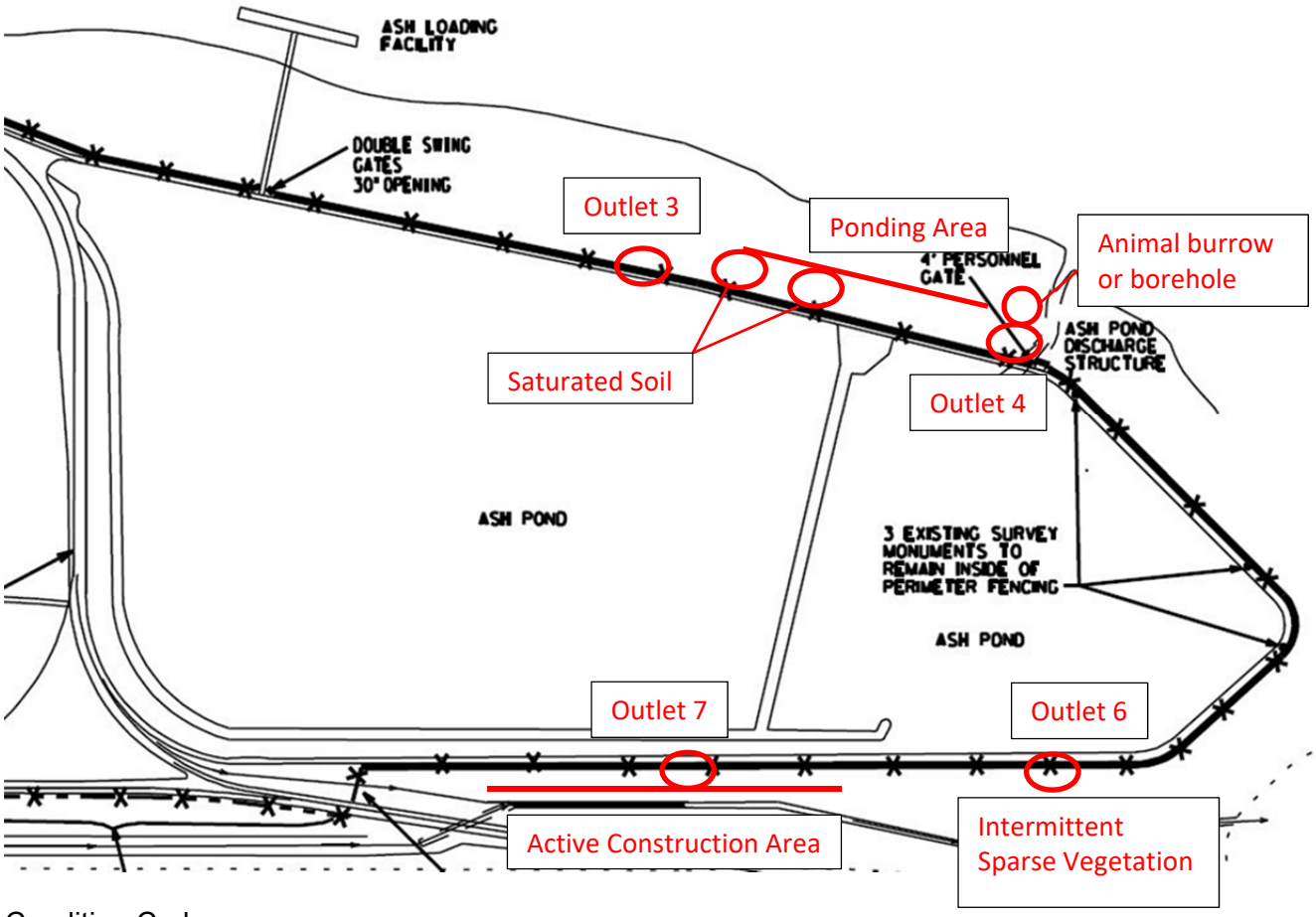
Inlet and Outlet Works		
Item	**Condition Code**	**Comments**
Outlet Condition	NO	The primary spillway has been removed. (IMG_4036)
Gate Condition/ Operability	NO	
Leakage	NO	
Outfall Condition	NO	
Outlet Channel	NO	The outlet channel has been filled with riprap. (IMG_4043)
Discharge (color and/or sediment)	NO	
Obstructions	NO	
Instrumentation	NO	
Inlet Piping Condition	NO	The inlet piping has been removed.
Emergency Spillway	NO	The emergency spillway has been removed. (IMG_3956)
Other		

Earth Embankment		
Item	**Condition Code**	**Comments**
Vertical & Horizontal Alignment of Crest	GC	There was no visible vertical or horizontal misalignment of the crest. (IMG_3962 and IMG_4041).
Seepage/Wetness/ Ponding Areas	MM	Ponding was observed along the east side of the impoundment near the downstream toe. The ponding begins approximately 200 feet north of the primary spillway and continues for approximately 500 feet to the north. The new outfalls may be contributing to the ponding. Create positive drainage to remove ponding near the embankment. Verify that drainage features necessary to create positive drainage are properly armored to prevent head cut erosion as the water flows down the Mississippi River bank. (IMG_4045) No seepage was observed but the ground soil was soft and saturated approximately 50 feet north of P20S

Earth Embankment		
Item	**Condition Code**	**Comments**
		and 100 feet south of P19S. Monitor these areas for seepage and wetness. (IMG_20201030_094232)
Erosion/Rutting	MM	The west embankment downstream slope has ruts, the sod cover that has been highly disturbed and erosion at a newly installed outfall (Outfall 7). The disturbance appears to be caused by ongoing work to line the slope with riprap. We recommend inspecting the slope after construction to verify the embankment is adequately protected. The outfall riprap should be extended down the slope to the flowline of the receiving channel at the toe. (IMG_20201030_084627, IMG_20201030_084300, IMG_20201030_084134, IMG_ 20201030_085350 and IMG_ 20201030_084900) Similarly, the riprap below Outlet 6 should be extended to at least the toe of the slope. (IMG_20201030_090038) We also recommend that the slope protection along the west embankment downstream slope be extended to the bottom of the channel at the toe. (IMG_ 20201030_085403) Soil and geotextile fabric is exposed at Outlets 3 and 4, there does not appear to be a uniform coverage of riprap around the outfall. Verify that the riprap has been properly placed and add additional riprap as necessary. (IMG_20201030_093326) Monitor outlet discharge flow paths over the Mississippi River bank and armor as needed to prevent head cut erosion.
Fencing	GC	The perimeter fence has been removed for closure construction. Fence added to make a closed perimeter around the plant is in good condition. (IMG_3951)
Vegetation	GC	After completion of the riprap lining on the west side of the impoundment, only a small section of the embankment on the southwest side will have vegetated slopes. No excess vegetation was observed in this area, but the vegetation is intermittently sparse. Some of the sparse areas appear to have been recently disturbed and may have been seeded as part of closure. We recommend inspecting the area next spring and seed areas with sparse vegetation growth. (IMG_ 20201030_090122 and IMG_ 20201030_090346)
Sloughs/Slides/ Cracks	GC	No sloughs, slides or cracks were observed.
Animal Control	MM	One large animal burrow or possibly a borehole that has settled was observed by the piezometer closest to the old primary spillway (P-21). Fill burrow or borehole with fine grain

Earth Embankment		
Item	**Condition Code**	**Comments**
		fill. (IMG_20201030_093202)
Other		

Note location of observation on attached plan sheet.



Condition Code

EC = Emergency Condition. A serious dam safety condition exists that need immediate action. Emergency measures implemented as instructed by Chief Dam Safety Engineer; pool draw down, work stoppage, plant stoppage.
IM = Item needing immediate maintenance to restore or ensure its safety and integrity. Remediation should be complete within 1 month or as required.
MM = Minor Maintenance. Item needing minor maintenance and/or repairs within the year. The safety or integrity of the item is not yet imperiled.
OB = Condition requires regular observation and potential future minor maintenance.
GC = Good Condition
NO = No observation possible.
NI = Not Inspected. State reason in comment column.



Figure 1 –The primary spillway has been removed.



Figure 2 – The primary spillway outlet channel has been filled with riprap.



Figure 3 – The emergency spillway has been removed.



Figure 4 – Embankment crest on the west side of the impoundment.



Figure 5 – Embankment crest on the east side of the impoundment.



Figure 6 – Ponding near downstream toe on the east side of the impoundment.



Figure 7 – Wet saturated area approximately 100 feet south of P19S.



Figure 8 – Erosion at partially constructed stormwater Outlet 7.



Figure 9 - Area disturbed on west side of the impoundment.



Figure 10 - Area cleared and disturbed on west side of impoundment.



Figure 11 - Area on west side of impoundment being prepared for riprap installation.



Figure 12 - Area on west side of impoundment being prepared for riprap installation.

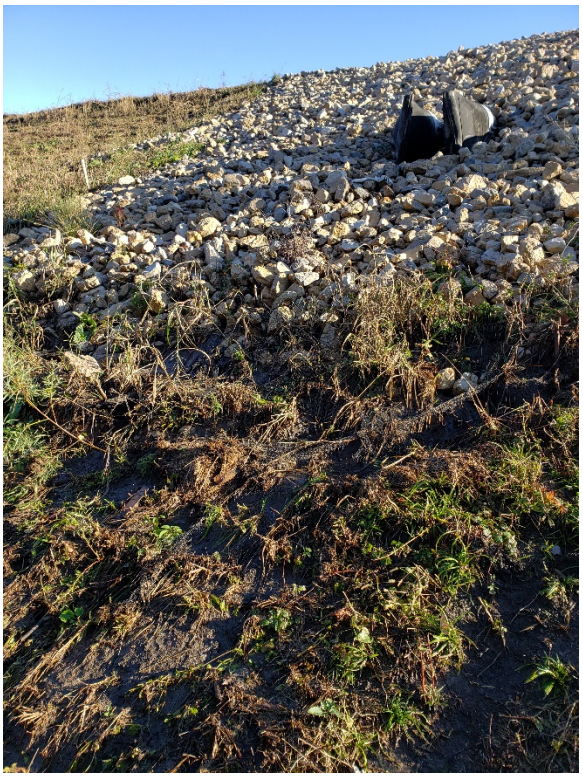


Figure 13 - The riprap below Outlet 6 should be extended to at least the toe of the slope.



Figure 14 - We recommend that the planned slope protection along the west embankment downstream slope be extended to the channel at the toe.



Figure 15 - Verify riprap has been properly placed around Outlets 3 and 4.



Figure 16 - Fenced placed for closure construction is in good condition.



Figure 17 - Area of sparse vegetation on downstream slope on southwest side of impoundment.



Figure 18 - Animal burrow or old borehole that should be filled.

APPENDIX II

DVD CONTAINING 2020 PERIODIC INSPECTION PHOTOGRAPHS

APPENDIX III

2019 RUSH ISLAND ENERGY CENTER ANNUAL INSPECTION CHECK SHEET

Guhse, Lora G

From: Lueckenhoff, Marc J
Sent: Thursday, January 9, 2020 9:11 AM
To: Guhse, Lora G
Subject: 2019 Annual Ash Pond Inspection
Attachments: RI Ash Pond Annual Inspection 8-21-2019.pdf; RI Ash Pond Annual Inspection 11-26-2019.pdf; Inspection Report Checklist - RCPA - 8-21-2019.pdf; Inspection Report Checklist - RCPA - 11-26-2019.pdf

Lora,
Please file the email below and the attachments in eB versus commitment 1190.

Thanks,

Marc Lueckenhoff, P.E. : : Engineer of Dam Safety, Hydro, Licensing & Civil Engineering : : T 314.957-3391 : : C 573.690.0576
Ameren Missouri : : 11149 Lindbergh Business Ct. : : St. Louis, MO 63123

From: Lueckenhoff, Marc J
Sent: Monday, December 30, 2019 1:30 PM
To: Eye, David M <DEye2@ameren.com>
Cc: Sievers, Michael J <MSievers@ameren.com>; Kuhlenberg, Jacob P <JKuhlenberg@ameren.com>; Schaeffer, Steven M <SSchaeffer@ameren.com>; Greer, Jeff W <JGreer@ameren.com>; Frerking, Matthew K <MFrerking@ameren.com>
Subject: 2019 Annual Ash Pond Inspection

Please find attached documents which serve as records of the 2019 Annual Ash Pond Inspection for Rush Island:

1. Per the CCR ruling, the Inspection Report Checklist – RCPA 11-26-2019.pdf is sealed and will be filed on a public accessible website, which Ameren Environmental manages.

2. The RI Ash Pond Annual Inspection 11-26-2019.pdf and the RI Ash Pond Annual Inspection 8-21-2019 will be saved on an internal SharePoint site and in eB, to be considered part of the Operating Record, not accessible by the public.

I performed two annual inspections this year to move the required inspection date for next year to November.
Please let me know if you have questions or concerns. Thank you for your efforts and support.

Thank you,

::::::::::::::::::::::::

MARC LUECKENHOFF, P.E.
Engineer
Dam Safety, Hydro, Licensing & Civil Engineering
T 314.957.3391
C 573.690.0576
E mlueckenhoff2@ameren.com

.....

Ameren Missouri
11149 Lindbergh Business Ct.

St. Louis, Missouri 63123
AmerenMissouri.com

40 CFR Parts 257

Checklist for Inspection Requirements for CCR Surface Impoundments
257.83 (b)

Rush Island Power Station – RCPA (Ash Pond)

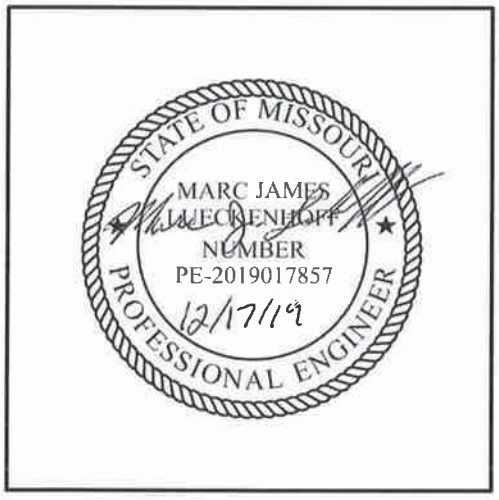
1. Annual Inspection

Requirements	Signs of actual or potential structural weakness	Disruptions or potential disruption to the operation and safety of the unit
CCR Unit and appurtenant structures 257.83(b)(ii)	None Observed	None Observed
Hydraulic structures underlying the base of the CCR unit 257.83(b)(iii)	None Observed	None Observed

The 2019 Annual Inspection included a review of available information regarding the status and condition of the CCR unit, including, but not limited to, files available in the operating record in general accordance with 257.83(b)(i).

Minor maintenance items (e.g. animal burrows, ruts, etc.) associated with routine upkeep observed during the 2019 Annual Inspection, presently do not impact the structural integrity of the embankment. Ameren plans to address these items in a timely manner through Ameren's work control process.

Engineer's Seal



Marc Lueckenhoff, P.E.
License: PE-2019017857
Date: 12/17/2019

RUSH ISLAND ENERGY CENTER
Fly Ash/Bottom Ash Pond (RCPA)
Annual Inspection Check Sheet

Date	8/21/2019
Inspector	M. Lueckenhoff
Pool Level	NA - Drained
River Level	382 Feet
Temperature	83 F
Weather	Clear

Date of Previous Annual Inspection: 10/5/2018

Date of Previous Periodic Inspection: 7/24/2019

Description of Emergency (EC) or Immediate Maintenance (IM) conditions observed since the last annual inspection:
None

Describe any action taken to restore or improve safety and integrity of impounding structure:
None

Describe any modifications to the geometry of the impounding structure since the previous annual inspection:
Pond RCPA is currently being closed. The pond is drained. The pond is no longer receiving processed water or CCR material.

Describe any modifications to the operation of the impounding structure since the previous annual inspection:
Pond RCPA is currently being closed. The pond is drained.

List the approximate remaining storage capacity of the impounding structure:
269,084 CY

List the approximate maximum, minimum and present depth and elevation of the impounded water since the previous annual inspection:
Max: 402 EL, Min: Pond is being closed, no impounded water, Present: Pond is being closed, no impounded water.

List the approximate maximum, minimum and present depth and elevation of the impounded CCR since the previous annual inspection:
Max 425 feet, Min 370 feet and current is 425 feet with estimated depth of 95 feet.

Approximate volume of impounded water and CCR at the time of the inspection:
12,955,424 CY

Describe any changes to the downstream watershed:
None

RUSH ISLAND ENERGY CENTER
Fly Ash/Bottom Ash Pond (RCPA)
Annual Inspection Check Sheet

Date	8/21/19
Inspector	M. Lueckenhoff / J. Greer
Pool Level	NA - Drained
River Level	382 Feet
Temperature	83 F
Weather	Clear

Date of Previous Annual Inspection: 10/5/2018

Date of Previous Periodic Inspection: 7/24/19 Inspection

Description of Emergency (EC) or Immediate Maintenance (IM) conditions observed since the last annual inspection:
None

Describe any action taken to restore or improve safety and integrity of impounding structure:
None

Describe any modifications to the geometry of the impounding structure since the previous annual inspection:
Pond RCPA is currently being closed. The pond is drained. The pond is no longer receiving processed water or CCR material.

Describe any modifications to the operation of the impounding structure since the previous annual inspection:
Pond RCPA is currently being closed. The pond is drained.

List the approximate remaining storage capacity of the impounding structure:
269,084 CY

List the approximate maximum, minimum and present depth and elevation of the impounded water since the previous annual inspection:
Max: 402 EL, Min: Pond is being closed, no impounded water, Present: Pond is being closed, no impounded water.

List the approximate maximum, minimum and present depth and elevation of the impounded CCR since the previous annual inspection:
Max 425 feet, Min 370 feet and current is 425 feet with estimated depth of 95 feet.

Approximate volume of impounded water and CCR at the time of the inspection:
12,955,424 CY

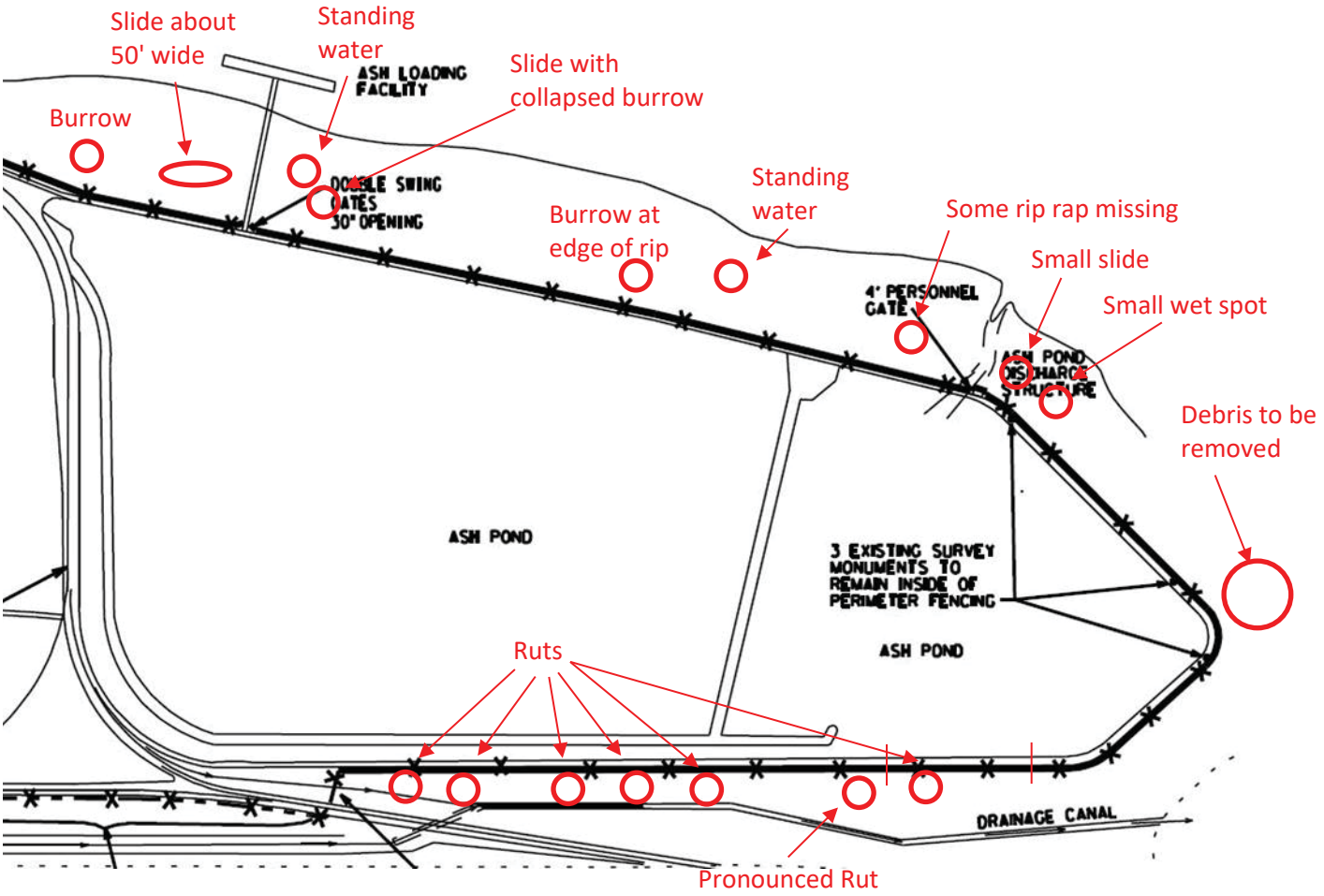
Describe any changes to the downstream watershed:
None

Inlet and Outlet Works		
Item	**Condition Code**	**Comments**
Outlet Condition	GC	
Gate Condition/ Operability	GC	No reported issues with MOVs.
Leakage	GC	None observed.
Outfall Condition	GC	
Outlet Channel	OB	Water over discharge
Discharge (color and/or sediment)	NO	Water over discharge
Obstructions	GC	None observed. Some debris in channel but not obstructing.
Instrumentation	GC	Staff gauge is the only instrumentation utilized.
Inlet Piping Condition	GC	
Emergency Spillway	GC	
Other		

Earth Embankment		
Item	**Condition Code**	**Comments**
Vertical & Horizontal Alignment of Crest	GC	
Seepage/Wetness/ Ponding Areas	OB	Some wet spots observed along the toe.
Erosion/Rutting	MM	Some rutting noted from mowing or well crew on the West embankment. Areas needing repair are noted on the attached plan view. The Pond Closure Project plans to add rip rap to the East embankment within a year.
Fencing	GC	Area along the west to south west has listed for some time, but no worse than previous years.

Earth Embankment		
Item	**Condition Code**	**Comments**
Vegetation	OB	Some minor vegetation removal needed by the emergency spillway.
Sloughs/Slides/ Cracks	OB	Small, minor slides along the exterior bank along the east side.
Animal Control	OB	Some minor surface activity but not significant.
Other		

Note location of observation on attached plan sheet.



Condition Code

EC = Emergency Condition. A serious dam safety condition exists that need immediate action. Emergency measures implemented as instructed by Chief Dam Safety Engineer; pool draw down, work stoppage, plant stoppage.
IM = Item needing immediate maintenance to restore or ensure its safety and integrity. Remediation should be complete within 1 month or as required.
MM = Minor Maintenance. Item needing minor maintenance and/or repairs within the year. The safety or integrity of the item is not yet imperiled.
OB = Condition requires regular observation and potential future minor maintenance.
GC = Good Condition
NO = No observation possible.
NI = Not Inspected. State reason in comment column.

APPENDIX D

PERIODIC SAFETY FACTOR ASSESSMENT

AMEREN MISSOURI RUSH ISLAND ENERGY CENTER
EVALUATION OF CCR UNITS
40 CFR PART 257
JEFFERSON COUNTY, MISSOURI

APPENDIX D: SAFETY FACTOR ASSESSMENT §257.73(e)

TABLE OF CONTENTS

Section Page

1.0 INTRODUCTION 1
1.1 Purpose 1
2.0 REVIEW OF PREVIOUS SAFETY FACTOR ASSESSMENT 2
3.0 CONCLUSIONS 2
4.0 REFERENCES 3

LIST OF FIGURES

Figure 1 ..... Site Map

LIST OF TABLES

Table 1 ..... Minimum safety factors

LIST OF APPENDICES

APPENDIX I INITIAL SAFETY FACTOR ASSESSMENT FOR RCPA
APPENDIX II AMEREN RUSH ISLAND ASH POND MDNR CLOSURE DESIGN REPORT

AMEREN MISSOURI RUSH ISLAND ENERGY CENTER
EVALUATION OF CCR UNITS
JEFFERSON COUNTY, MISSOURI

APPENDIX D: SAFETY FACTOR ASSESSMENT §257.73(e)

1.0 INTRODUCTION

The Rush Island Energy Center (REC) is in southern Jefferson County, Missouri, in the Mississippi River floodplain. The plant is south of the City of Festus and north of the City of Bloomsdale. The REC has one active surface impoundment. The surface impoundment is located just west of the Mississippi River and north of Isle du Bois Creek. The Rush Island Dam is in Sections 3 and 4, Township 39 North, Range 7 East of the 5th Principal Meridian. An aerial showing the surface impoundment is attached as Figure 1.

The Rush Island Dam is a single stage industrial dam. The perimeter of the dam has a length of approximately 9,750-lineal feet and a maximum height of 46 feet. The upstream and downstream slopes of the dam are sloped at 3 horizontal (H) to 1 vertical (V). The Rush Island Dam is permitted by the Missouri Department of Natural Resources (MDNR) under registration permit ID No. MO-40179. The RCPA no longer receives CCRs, has been dewatered and is currently being closed. The impoundment is no longer used for CCR disposal and water treatment.

1.1 Purpose

40 CFR §257.73(e) requires that the owner or operator of an existing CCR surface impoundment to conduct initial and periodic safety factor assessments for each CCR unit and document whether the calculated factors of safety for each CCR unit achieve the minimum factors of safety for the critical cross section of the embankment. The critical cross section is the cross section anticipated to be the most susceptible of all cross sections to structural failure based on appropriate engineering considerations, including loading conditions. The safety factor assessments should be supported by appropriate engineering calculations. The specified minimum safety factors are shown in Table 1.

Table 1 - Minimum Safety Factors

Loading Condition	Minimum Factor of Safety
Static, long-term, maximum storage pool	1.50
Static, maximum surcharge pool	1.40
Seismic	1.00
Liquefaction	1.20

2.0 REVIEW OF PREVIOUS SAFETY FACTOR ASSESSMENT

The initial periodic safety factor assessment for RCPA was completed in October 2016. The Initial Periodic Safety Factor Assessment report documents the analyses performed and includes graphical outputs of the results of the stability analyses is included in Appendix I. The RCPA no longer receives CCRs, has been dewatered and is currently being closed. The current conditions are no longer representative of those used in the 2016 assessment. Haley & Aldrich, Inc. completed analyses of RCPA for the closed condition. Haley & Aldrich's Ameren Rush Island Ash Pond MDNR Closure Design Report is included in Appendix II.

3.0 CONCLUSIONS

The initial periodic safety factor assessment for the Rush Island Energy Center Ash Pond found that the calculated factors of safety for the critical cross-sections the CCR unit exceed the minimum factors of safety for each loading condition required by 40 CFR §257.73(e). The RCPA has been dewatered and is currently being closed. A safety factor assessment for the closed condition has been performed by Haley & Aldrich. They found that the static and seismic analyses meets or exceeds the minimum requirements.

4.0 REFERENCES

Haley & Aldrich (2018), Rush Island Ash Pond Closure, MDNR Permit Application (MO40179)



Legend

Embankment

Spillway

N

0 250 500 Feet

AMEREN MISSOURI
RUSH ISLAND ENERGY CENTER
ACTIVE CCR SURFACE IMPOUNDMENTS
FIGURE 1

Ameren MISSOURI

REITZ & JENS, INC. CONSULTING ENGINEERS

APPENDIX I

INITIAL SAFETY FACTOR ASSESSMENT FOR RCPA

AMEREN MISSOURI RUSH ISLAND ENERGY CENTER
EVALUATION OF CCR UNITS
40 CFR PART 257
JEFFERSON COUNTY, MISSOURI

APPENDIX D: SAFETY FACTOR ASSESSMENT §257.73(e)

TABLE OF CONTENTS

Section — Page

1.0 INTRODUCTION 1
1.1 Purpose 1
2.0 PERIODIC SAFETY FACTOR ASSESSMENT 2
2.1 Static Stability Analyses 2
2.2 Seismic Stability Analyses 2
2.3 Liquefaction Stability Analyses 2
3.0 RCPA 3
3.1 Critical Section and Assumptions 3
3.2 Stability Analysis Results 4
4.0 CONCLUSIONS 4
5.0 REFERENCES 5

LIST OF FIGURES

Figure 1 ..... Site Map
Figure 2 ..... 2014 USGS Hazard Map
Figure 3 ..... Section 3 Location Map
Figure 4 ..... Section 3 Cross Section

LIST OF TABLES

Table 1 ..... Minimum safety factors
Table 2 ..... Soil Properties Assumed in the Ash Pond Critical Section Stability Analyses
Table 3 ..... Ash Pond Stability Analyses Results

LIST OF APPENDICES

APPENDIX I GEOTECHNICAL BORINGS AND CPT(s)
APPENDIX II GRAPHICAL DEPICTIONS OF STABILITY ANALYSES

AMEREN MISSOURI RUSH ISLAND ENERGY CENTER
EVALUATION OF CCR UNITS
JEFFERSON COUNTY, MISSOURI

APPENDIX D: SAFETY FACTOR ASSESSMENT §257.73(e)

1.0 INTRODUCTION

The Rush Island Energy Center (REC) is located in southern Jefferson County, Missouri, in the Mississippi River floodplain. The plant is south of the City of Festus and north of the City of Bloomsdale. The REC has one active surface impoundment. The surface impoundment is located just west of the Mississippi River and north of Isle du Bois Creek. The Rush Island Dam is in Sections 3 and 4, Township 39 North, Range 7 East of the 5th Principal Meridian. An aerial showing the surface impoundment is attached as Figure 1.

The Rush Island Dam is a single stage industrial dam. The perimeter of the dam has a length of approximately 9,750-lineal feet and a maximum height of 46 feet. The upstream and downstream slopes of the dam are sloped at 3 horizontal (H) to 1 vertical (V). The Rush Island Dam is permitted by the Missouri Department of Natural Resources (MDNR) under registration permit ID No. MO-40179. The impoundment formed by the dam is used for CCR disposal and water treatment. Discharge from the pond is through a NPDES permitted outfall.

1.1 Purpose

40 CFR §257.73(e) requires that the owner or operator of an existing CCR surface impoundment to conduct initial and periodic safety factor assessments for each CCR unit and document whether the calculated factors of safety for each CCR unit achieve the minimum factors of safety for the critical cross section of the embankment. The critical cross section is the cross section anticipated to be the most susceptible of all cross sections to structural failure based on appropriate engineering considerations, including loading conditions. The safety factor assessments should be supported by appropriate engineering calculations. The specified minimum safety factors are shown in Table 1.

Table 1 - Minimum Safety Factors

Loading Condition	Minimum Factor of Safety
Static, long-term, maximum storage pool	1.50
Static, maximum surcharge pool	1.40
Seismic	1.00
Liquefaction	1.20

A periodic safety factor assessment has been conducted for the active Ash Pond surface impoundment at the REC.

2.0 PERIODIC SAFETY FACTOR ASSESSMENT

2.1 Static Stability Analyses

Slope stability analyses were performed in general accordance with United States Army Corps of Engineers (USACE) EM1110-2-1902 *Slope Stability* and MSHA's 2009 *Engineering and Design Manual for Coal Refuse Disposal Facilities*, and using the computer program SLIDE 6.0. This program uses the Spencer method in a limit-equilibrium analysis, which resolves the static forces on each vertical slice of soil profile along a given circular or irregular assumed failure surface. The program searches for the minimum Factor of Safety (FS) against slope failure for each center point in the grid by incrementally varying the radius of the failure surface. The plotted results from the program show the minimum FS, and the center and radius of the failure surface with the minimum FS. The output of the program also plots contours of equal FS within the grid of possible center points.

2.2 Seismic Stability Analyses

The critical cross-section was analyzed using a pseudo-static acceleration as a horizontal body force on the soil mass to calculate the minimum factor of safety for a seismic event. The seismic acceleration was based upon the USGS 2014 seismic hazard maps for a Peak Horizontal Ground Acceleration (PHGA) for seismic loading event with a 2% probability of exceedance in 50 years. The PHGA was factored for the seismic site class in accordance with ASCE 7 *Minimum Design Loads for Buildings and Other Structures, International Building Code*. A seismic coefficient of 0.5 was applied to the PHGA, which is consistent with MSHA's 2009 *Engineering and Design Manual for Coal Refuse Disposal Facilities*, in particular Chapter 7, "Seismic Design: Stability and Deformation Analyses." The manual cites research by Hynes-Griffen and Franklin (1984) which found that for seismic coefficient of 0.5 would result in deformations of less than 3 feet for a safety factor of 1.0.

The published 2014 USGS hazard map for the Rush Island Energy Center is reproduced in Figure 2. This is the latest map available from the USGS website. The probabilistic PHGA for the design earthquake at the Rush Island site is 0.310g (that is, 31.0% of standard gravity acceleration of 32.2 feet/sec^2). This value takes into account attenuation of bedrock shaking with distance from the probable sources and general soil interactions such as damping for a hypothetical soil profile. This value is meant to be a conservative estimate. Based upon the data, the most probable earthquake magnitudes (M_w) for these accelerations are between 7.0 and 8.0. We applied a multiplier of 1.200 to the base PHGA to account for the soil profile at the REC to obtain a site specific PHGA of 0.372g. Therefore, the pseudo-static seismic load was 0.190g.

2.3 Liquefaction Stability Analyses

The liquefaction slope stability analysis is a post-earthquake, static analysis which includes the effects of potential liquefaction or softening of the soils. Liquefaction occurs when ground shaking is sufficient to produce cyclic particle movements that cause excess pore water pressures to build to the point that most of the shear strength of the soil is lost. Liquefaction occurs in loose sandy soils with less than about 35% fines (soils which are finer than standard U.S. #200 or 0.075mm). Liquefaction can occur in very loose soils with up to 50 percent fines, and soils up to the size of fine gravel. Liquefaction only occurs below the ground water table (phreatic surface). The presence of soil susceptible to liquefaction in the top 50

feet of the soil profile at the REC typically included the sandy silts and sands. Based on the liquefaction analysis we identified liquefiable soil at depths of 40 to 46.5 feet, 48 to 51 feet and 51.5 to 52.5 feet. Conservative estimates of post-earthquake or residual shear strengths in the liquefied strata were assumed using a correlation between the normalized residual shear strength ratio for liquefied soils and overburden-correction CPT penetration resistance recommended by Idriss and Boulanger (2008).

3.0 RCPA

3.1 Critical Section and Assumptions

The critical section for the Ash Pond is at the outfall location along the eastern berm adjacent to the Mississippi River. A plan view showing the location of the section is shown in Figure 3, and a cross section through the perimeter berm at this location is shown as Section 3 in Figure 4. The height of the section at this location is about 46 feet.

The groundwater table for stability analysis was assumed to be at el. 371, and the Mississippi River level was below the bottom of the outlet channel. The elevation of the water surface in the Ash Pond was assumed at the normal pool of el. 398. The interior water elevation was increased to el. 407 for the maximum surcharge pool.

Soil parameters used for stability analysis of the Ash Pond critical section were derived from borings and CPT soundings completed in 2009 for the Ash Pond Stability Analyses Project. The boring and CPT sounding logs are included in Appendix I.

The perimeter berm was constructed of primarily fine-grained soil excavated from the incised portion of the pond. A CPT sounding and boring through the crest of the embankment and about 100 feet north of the critical section location indicated the embankment fill was primarily firm to very stiff silts and clays with some sand. A thin layer of clay with a firm consistency was assumed at the base of the embankment fill for stability analysis. The embankment fill was underlain by silty clay, clayey silt and intermittently sandy silt to a depth of about 42 feet. The CPT sounding through these strata indicated they are stiff to very stiff, with an average undrained shear strength varying from about 1550 to 2050 psf. Sandy and clayey silt were encountered at depths of 42 to 51 feet, however the soil was intermittently sandy and silty clay, and silty sand. The stratum was loose to dense and stiff to very stiff, and the average drained friction angle based on correlations for tip resistance and sleeve friction from the CPT sounding averaged about 34 degrees. At a depth of 51 feet and to the termination depth of the boring and CPT, dense sand was encountered. The sand was intermittently silty and gravelly. Based on correlations for tip resistance and sleeve friction the friction angle of the sand ranged from 36 to 46 degrees, and a friction angle of 37 degrees was assumed. Table 2 summarizes the soil parameters developed from CPT data correlations and boring information.

Table 2 – Soil Properties Assumed in the Ash Pond Critical Section Stability Analyses

Material	Unit Weight		Normal/Max Pool		Seismic		Liquefaction	
	γ (pcf)	γ′ (pcf)	c′ (psf)	ϕ′ (°)	c (psf)	ϕ (°)	c (psf)	ϕ (°)
Fill	123	61	100	28	800	0	800	0
Silty Clay Fill	123	61	100	29	1280	0	1600	0
Soft Layer	120	58	700	0	700	0	700	0
Sandy Silt & Silty Clay	120	58	100	29	1240	0	1550	0
Silty Clay	118	56	225	28	400	15.1	1580	0
Clayey Silt	116	54	200	33	1640	0	2050	0
Sandy Silt	118	56	0	34	0	34	0	34
Sand	120	58	0	37	0	37	0	37
Liq 1	118	56	-	-	-	-	350	0
Liq 2	118	56	-	-	-	-	300	0
Liq 3	120	58	-	-	-	-	600	0

3.2 Stability Analysis Results

The Ash Pond stability analysis results for each load case are presented in Table 3. The search for critical failure surfaces was limited to those that significantly impact the dike. The analyses show that the calculated factors of safety exceeds the minimum presented in §257.73(e) for each loading condition. Graphical outputs of the results of the stability analyses are shown in Appendix II.

Table 3 – Ash Pond Stability Analyses Results

Loading Condition	Minimum Factor of Safety	Calculated Factor of Safety
Static, long-term, maximum storage pool	1.50	1.51
Static, maximum surcharge pool	1.40	1.42
Seismic	1.00	1.07
Liquefaction	1.20	1.29

4.0 CONCLUSIONS

The initial periodic safety factor assessment for the Rush Island Energy Center Ash Pond found that the calculated factors of safety for the critical cross-sections at each CCR unit exceed the minimum factors of safety for each loading condition required by 40 CFR §257.73(e). The subsequent periodic safety factor assessment should be conducted within 5 years of the date of this report.

5.0 REFERENCES

Ameren Missouri (2010), "Operation and Maintenance Manual; Rush Island Fly Ash Pond Dam, Festus, Missouri, Jefferson County." Dam Safety and Hydro Engineering, St. Louis, Missouri.

American Society of Civil Engineers (2013), *Minimum Design Loads for Buildings and Other Structures*, Standards ASCE/SEI 7-10, 3rd Printing.

EM1110-2-1902 (2003), *Slope Stability*. U.S. Army Corps of Engineers, Washington, D.C.

Hynes-Griffen, M.E. and A.G. Franklin (1984), "Rationalizing the Seismic Coefficient Method," Miscellaneous Paper GL-84-13, U.S. Department of the Army, Corps of Engineers, Waterways Experiment Station, Vicksburg, MS.

Idriss, I.M. and R.W. Boulanger (2008), "Soil Liquefaction During Earthquakes," Earthquake Engineering Research Institute, Oakland, California, EERI Publication No. MNO-12.

Mine Safety and Health Administration (2010), *Engineering and Design Manual, Coal Refuse Disposal Facilities*. Second Edition.

Naval Facilities Engineering Command (1986). *Soil Mechanics, Design Manual 7.01*. Alexandria, Virginia.



Legend

Embankment

Spillway

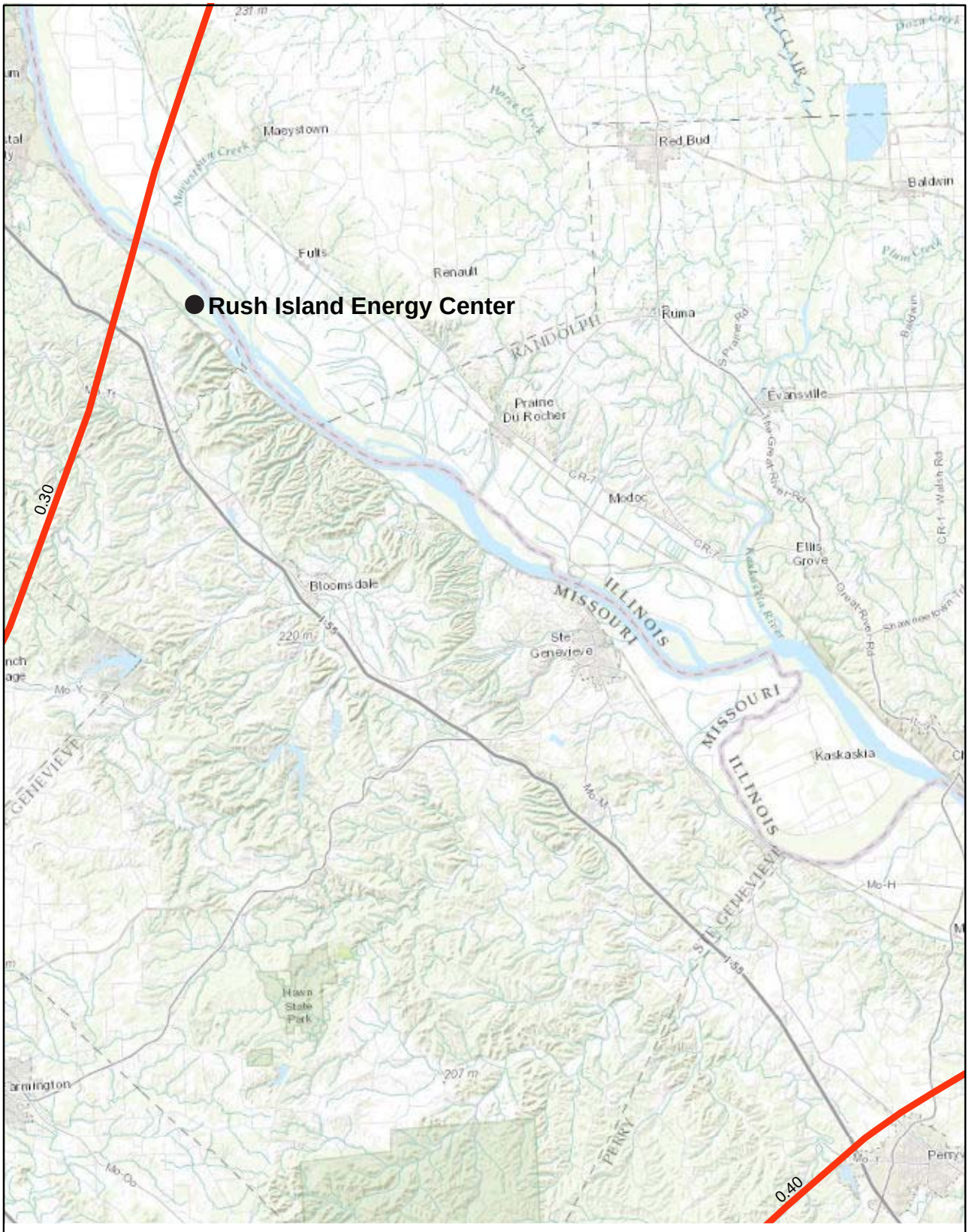
N

0 250 500 Feet

AMEREN MISSOURI
RUSH ISLAND ENERGY CENTER
ACTIVE CCR SURFACE IMPOUNDMENTS
FIGURE 1

Ameren MISSOURI

REITZ & JENS, INC. CONSULTING ENGINEERS



2% Probability of Exceedance in 50 Years Map of Peak Ground Acceleration

Ameren Missouri: Rush Island Energy Center
2014 USGS Seismic Hazard Map

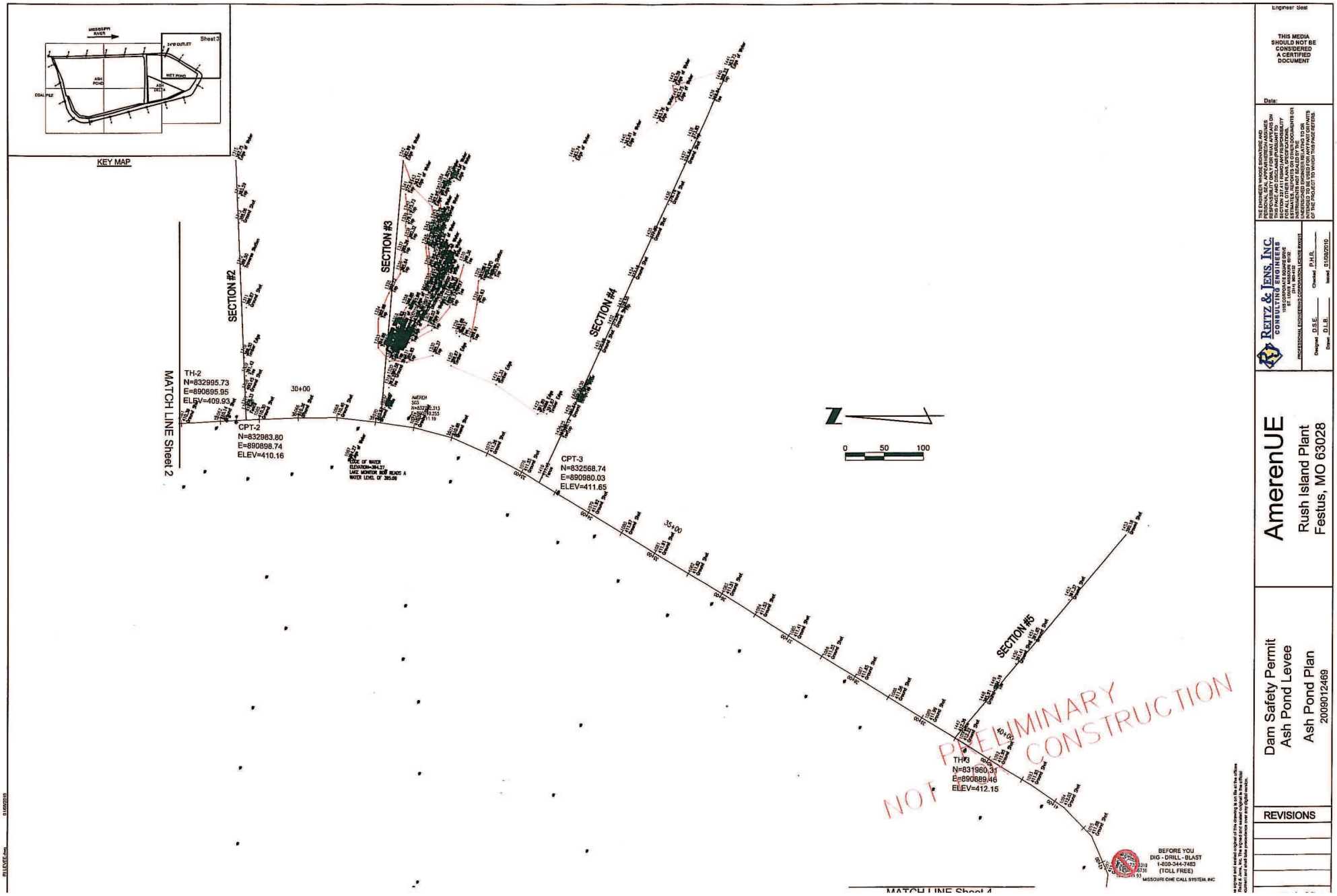
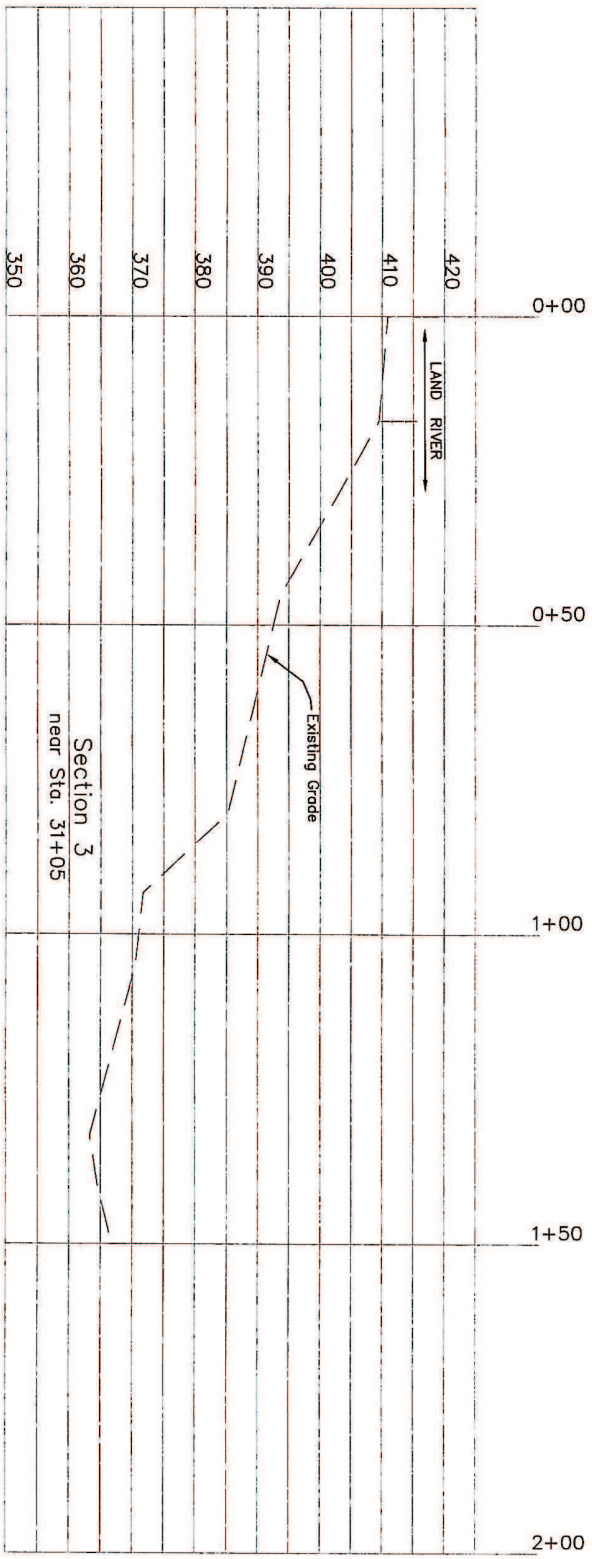

KEY MAP
SECTION #2
SECTION #3
SECTION #4
SECTION #5
TH-2
N=832995.73
E=890895.95
ELEV=409.93
CPT-2
N=832983.80
E=890898.74
ELEV=410.16
CPT-3
N=832568.74
E=890980.03
ELEV=411.65
TH-3
N=831960.31
E=890889.46
ELEV=412.15
30+00
35+00
40+00
MATCH LINE Sheet 2
MATCH LINE Sheet 4
0 50 100
PRELIMINARY NOT FOR CONSTRUCTION
BEFORE YOU DIG - DRILL - BLAST 1-800-344-7483 (TOLL FREE)
MISSOURI ONE CALL SYSTEM, INC
Engineer Seal
THIS MEDIA SHOULD NOT BE CONSIDERED A CERTIFIED DOCUMENT
Date:
REITZ & JENS, INC.
CONSULTING ENGINEERS
1055 CORPORATE SQUARE DRIVE
ST. LOUIS, MISSOURI 63132
PROFESSIONAL ENGINEERING CORPORATION, LICENSE #00712
Designed D.S.E.
Drawn D.L.B.
Checked P.H.R.
Issued 01/06/2010
AmerenUE
Rush Island Plant
Festus, MO 63028
Dam Safety Permit
Ash Pond Levee
Ash Pond Plan
2009012469
REVISIONS

Figure 3



SHEET 3 OF 5	Dam Safety Permit Survey Sections 2009012469	AmerenUE Rush Island Plant Festus MO, 63028	Designed D.S.E. Checked D.S.E. Drawn D.S.E. Issued 01/08/2010	REITZ & JENS, INC. CONSULTING ENGINEERS 1055 CORPORATE SQUARE DRIVE ST. LOUIS MISSOURI 63132 (314) 993-4132 PROFESSIONAL ENGINEERING CORP., LICENSE #000215

Figure 4

APPENDIX I

GEOTECHNICAL BORINGS AND CPT's

REITZ & JENS, INC.
CONSULTING ENGINEERS

BORING LOG B-1

Rush Island Ash Pond Dam Safety

CLIENT: **Ameren**

LOCATION: N 834589.2 E 890145.1
ELEVATION: 408.9 DATUM:
DATE DRILLED: 09-14-09

SHEAR STRENGTH, tsf
△ QU/2 ■ PP □ SV ◇ TV
1 2 3

STANDARD PENETRATION TEST
▲ N-VALUE (BLOWS PER LAST FOOT)
● MOISTURE CONTENT, %
○ % FINES (PASSING #200 SIEVE)
PL LL
20 40 60

DEPTH (FEET)	ELEVATION	WATER TABLE	GRAPHIC LOG	SAMPLE TYPE	PERCENT RECOVERY	MATERIAL DESCRIPTION	DRY UNIT WEIGHT (PCF) BLOWS PER 6 INCHES RQD= ROCK QUALITY DES.	MOISTURE CONTENT PERCENT BY WEIGHT
0						Top 10 feet vacuum extracted no sampling		
	405							
5					0			
	400							
10								
	395							
15					100	Clay FILL? (CH), grey to dark grey, high plastic, slightly silty, with fine roots, and 3" layer of silty fine sand at 15'-7"	94.0	27.6
	390							
20					88	SILT (ML), grey and brown, with fine sand and pockets of high plastic clay	95.2	23.8
	385							
25					96	SAND (SP), golden tan, fine grain, becoming silty and greyish near bottom of sample	87.3 99.7	21.7 14.3
	380	▽						
30					100	Sandy SILT (ML), tan, fine grain, loose, saturated	2-2-4	31.8

DRILLER: Jet Drilling
METHOD: 4.25" HSA/Rotary
TYPE OF SPT HAMMER: Automatic
HAMMER EFFICIENCY (%): 78.2
LOGGED BY: J. Pruett

STRATIFICATION LINES ARE APPROXIMATE SOIL BOUNDARIES ONLY; ACTUAL CHANGES MAY BE GRADUAL OR MAY OCCUR BETWEEN SAMPLES.

WATER LEVELS: DURING DRILLING 29.5 FEET
N BORING DRY AT COMPLETION OF DRILLING
AT ____ FEET AFTER ____ HOURS
AT ____ FEET AFTER ____ HOURS

PIEZOMETER: INSTALLED AT ____ FEET

File: 2009012469

Figure

REITZ & JENS, INC.
CONSULTING ENGINEERS

BORING LOG B-1

Rush Island Ash Pond Dam Safety

DEPTH (FEET)	ELEVATION	WATER TABLE	GRAPHIC LOG	SAMPLE TYPE	PERCENT RECOVERY	MATERIAL DESCRIPTION	DRY UNIT WEIGHT (PCF) BLOWS PER 6 INCHES RQD= ROCK QUALITY DES.	MOISTURE CONTENT PERCENT BY WEIGHT
35	375				100	With layers of silty clay and fine grain sand	2-1-3	35.5
40	370				67	SAND (SP), tan, fine to coarse grain, dense	9-12-18	
45	365				89	With assorted gravel up to 3/4"	9-12-13	
50	360				78	Becoming grey, with thick layers of silt and silty clay, without gravel	3-10-18	21.8
55	355				56	In and out of gravelly drilling from 52'-6" to 55'-0" Without silt and clay content, with gravel up to 3/4", very dense	12-21-20	
60	350				89	Without gravel	12-20-21	
65	345				94	Becoming fine to medium grain sand	17-24-31	

SHEAR STRENGTH, tsf

△ QU/2 ■ PP □ SV ◇ TV

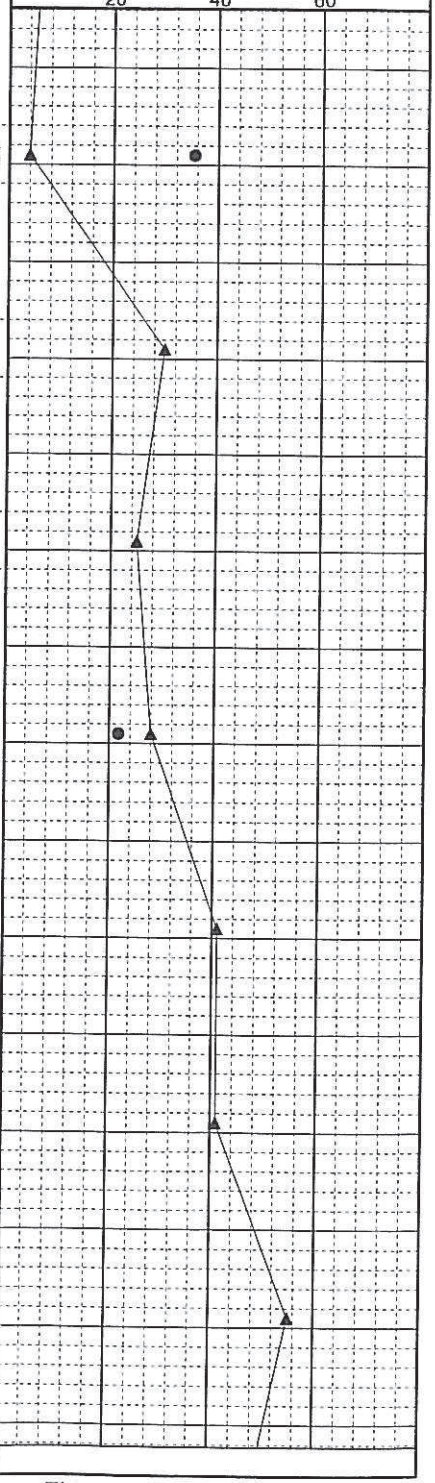
1 2 3

STANDARD PENETRATION TEST
▲ N-VALUE (BLOWS PER LAST FOOT)

● MOISTURE CONTENT, %
○ % FINES (PASSING #200 SIEVE)

PL LL

20 40 60



File: 2009012469

Figure

REITZ & JENS, INC.
CONSULTING ENGINEERS

BORING LOG B-1

Rush Island Ash Pond Dam Safety

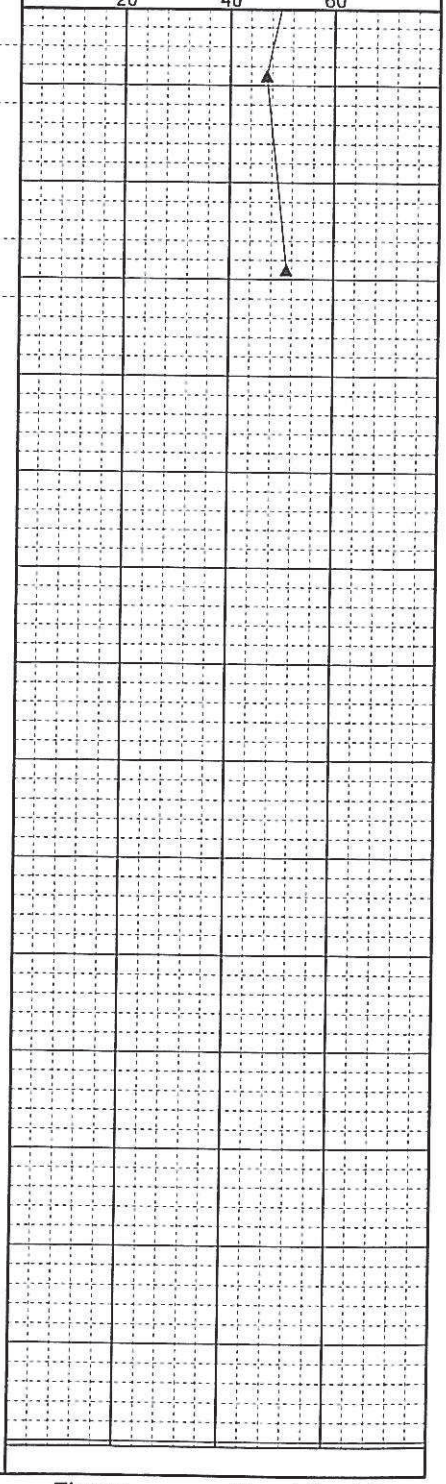
DEPTH (FEET)	ELEVATION	WATER TABLE	GRAPHIC LOG	SAMPLE TYPE	PERCENT RECOVERY	MATERIAL DESCRIPTION	DRY UNIT WEIGHT (PCF) BLOWS PER 6 INCHES RQD= ROCK QUALITY DES.	MOISTURE CONTENT PERCENT BY WEIGHT
70	340				94	Becoming fine to coarse sand	14-20-27	
75	335				78		18-23-28	
						Boring terminated in sand at 75'-6"		
80	330							
85	325							
90	320							
95	315							
100	310							
105	305							

SHEAR STRENGTH, tsf
△ QU/2 ■ PP □ SV ◇ TV
1 2 3

STANDARD PENETRATION TEST
▲ N-VALUE (BLOWS PER LAST FOOT)

● MOISTURE CONTENT, %
○ % FINES (PASSING #200 SIEVE)

PL LL
20 40 60



File: 2009012469

Figure

REITZ & JENS, INC.
CONSULTING ENGINEERS

BORING LOG B-2

Rush Island Ash Pond Dam Safety

CLIENT: **Ameren**

LOCATION: N 832995.7 E 890896.0
ELEVATION: 409.9 DATUM:
DATE DRILLED: 09-15-09

DEPTH (FEET)	ELEVATION	WATER TABLE	GRAPHIC LOG	SAMPLE TYPE	PERCENT RECOVERY	MATERIAL DESCRIPTION	DRY UNIT WEIGHT (PCF) BLOWS PER 6 INCHES RQD= ROCK QUALITY DES.	MOISTURE CONTENT PERCENT BY WEIGHT
0						Top 10 feet vacuum extracted no sampling		
5	405				0			
10	400							
15	395	▽			96	Silt FILL (ML), grey, slightly silty, trace fine grain sand, with high plastic clay lenses Perched water at 14'-6"	89.2	30.1
						Clay FILL (CH), grey, high plastic, trace roots		
20	390				88	Sandy Silt FILL (SM), grey and brown, slightly clayey, with high plastic clay balls, limoninte and iron staining, trace clay seams and sand lenses	94.4	27.4
25	385				100	Clay FILL (CH), grey, silty, high plastic, stiff, moist	2-3-5	29.8
					88	Becoming dark grey, with trace fine roots, lignite, coal, cinders, iron staining	84.8	33.4
						Clayey SILT (ML), brown and grey, with trace fine sand, limonite, and iron staining, becoming sandy with depth, natural?	89.5	29.0
30	380				100	Silty CLAY (CL), grey, with traces of lignite	2-2-3	27.5

SHEAR STRENGTH, tsf
△ QU/2 ■ PP □ SV ◇ TV
1 2 3

STANDARD PENETRATION TEST
▲ N-VALUE (BLOWS PER LAST FOOT)

● MOISTURE CONTENT, %
○ % FINES (PASSING #200 SIEVE)

PL ⊢——⊣ LL
20 40 60

DRILLER: Jet Drilling
METHOD: 4.25" HSA/Rotary
TYPE OF SPT HAMMER: Automatic
HAMMER EFFICIENCY (%): 78.2
LOGGED BY: J. Pruett

STRATIFICATION LINES ARE APPROXIMATE SOIL BOUNDARIES ONLY; ACTUAL CHANGES MAY BE GRADUAL OR MAY OCCUR BETWEEN SAMPLES.

WATER LEVELS: DURING DRILLING 14.5 FEET
N BORING DRY AT COMPLETION OF DRILLING
AT ____ FEET AFTER ____ HOURS
AT ____ FEET AFTER ____ HOURS

PIEZOMETER: INSTALLED AT ___ FEET

File: 2009012469

Figure

REITZ & JENS, INC.
CONSULTING ENGINEERS

BORING LOG B-2

Rush Island Ash Pond Dam Safety

DEPTH (FEET)	ELEVATION	SAMPLE TYPE	PERCENT RECOVERY	MATERIAL DESCRIPTION	DRY UNIT WEIGHT (PCF) BLOWS PER 6 INCHES RQD= ROCK QUALITY DES.	MOISTURE CONTENT PERCENT BY WEIGHT
				and limonite, trace fine grain sand, firm		
35	375		100	Sandy SILT (ML), tan and grey, highly laminated with silt and clay, traces of lignite, medium dense	0-2-8	28.7
40	370		100	Becoming loose, saturated	0-1-3	33.0
45	365		100	Without laminations of silt and clay, very loose	0-1-2	34.1
50	360		100	Becoming loose, with 2" clay seam near end of spoon	1-2-4	29.9
55	355		100	SAND (SP), grey, fine to coarse grain, with trace 1/4" gravel, very dense	15-22-26	
60	350		89	Becoming dense, with trace gravel up to 1"	6-11-20	
65	345		89	Becoming fine grain sand, without gravel	11-14-17	

SHEAR STRENGTH, tsf
△ QU/2 ■ PP □ SV ◇ TV
1 2 3

STANDARD PENETRATION TEST
▲ N-VALUE (BLOWS PER LAST FOOT)
● MOISTURE CONTENT, %
○ % FINES (PASSING #200 SIEVE)
PL LL
20 40 60

File: 2009012469

Figure

REITZ & JENS, INC.
CONSULTING ENGINEERS

BORING LOG B-2

Rush Island Ash Pond Dam Safety

DEPTH (FEET)	ELEVATION	WATER TABLE	GRAPHIC LOG	SAMPLE TYPE	PERCENT RECOVERY	MATERIAL DESCRIPTION	DRY UNIT WEIGHT (PCF) BLOWS PER 6 INCHES RQD= ROCK QUALITY DES.	MOISTURE CONTENT PERCENT BY WEIGHT
70	340				94	Fine grain sandy SILT (ML), grey, medium dense	1-1-9	30.9
75	335				78	SAND (SP), grey, fine to coarse grain, with gravel up to 1/4", dense	9-14-12	
						Boring terminated in sand at 75'-6"		
80	330							
85	325							
90	320							
95	315							
100	310							
105	305							

SHEAR STRENGTH, tsf

△ QU/2 ■ PP □ SV ◇ TV

1 2 3

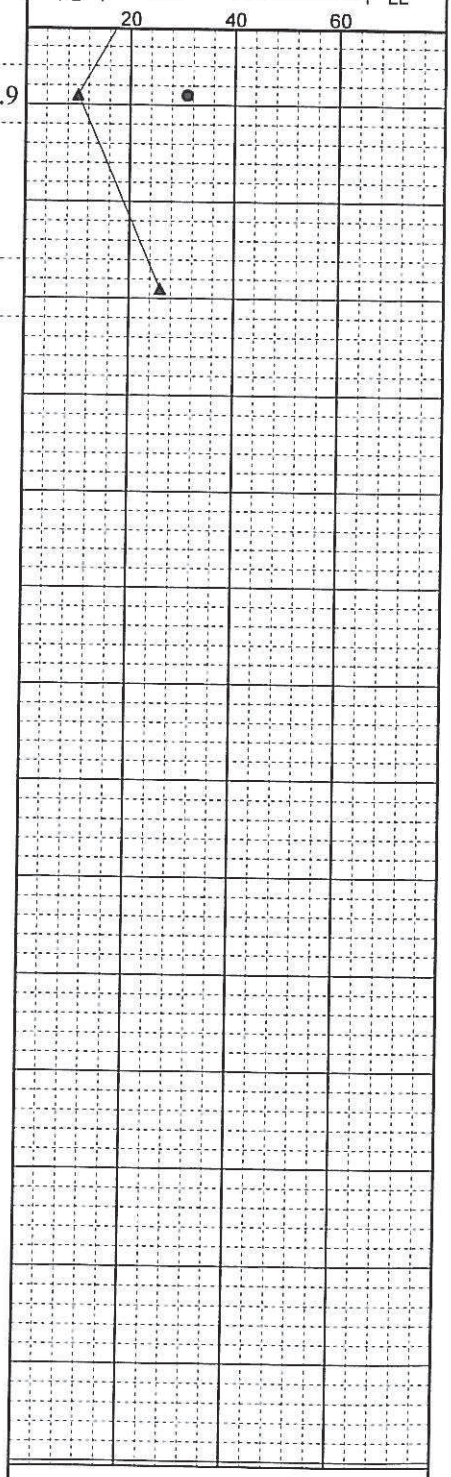
▲ STANDARD PENETRATION TEST N-VALUE (BLOWS PER LAST FOOT)

● MOISTURE CONTENT, %

○ % FINES (PASSING #200 SIEVE)

PL ├──┤ LL

20 40 60



File: 2009012469

Figure

REITZ & JENS, INC.
CONSULTING ENGINEERS

BORING LOG B-3

Rush Island Ash Pond Dam Safety

CLIENT: **Ameren**

LOCATION: N 831960.3 E 890889.5
ELEVATION: 412.2 DATUM:
DATE DRILLED: 09-15-09

DEPTH (FEET)	ELEVATION	SAMPLE TYPE	PERCENT RECOVERY	MATERIAL DESCRIPTION	DRY UNIT WEIGHT (PCF) BLOWS PER 6 INCHES RQD= ROCK QUALITY DES.	MOISTURE CONTENT PERCENT BY WEIGHT
0	412.2			6" crushed LIMESTONE		
				Silty Clay FILL (CL), brown, with silt and high plastic clay inclusions and laminations		
5	410		83		88.9	32.0
	405					
10			100	Sandy Silt FILL (SM), tan, with dark grey high plastic balls, trace lignite, limonite, and small gravel	104.1	19.9
	400					
15			100	Becoming grey and tan, with fine to medium grain sand, without gravel	102.7	22.0
					96.1	25.6
	395					
20			100	Silty Clay FILL (CL), grey and brown, with grey high plastic balls and tan fine to medium sand seams, becoming more clayey with depth	100.8	20.4
					99.1	24.5
	390					
25			100	CLAY (CH), grey, high plastic, with traces fine sand lenses, trace limonite and iron staining, trace medium sand, some fine roots in top of sample, natural?	90.0	31.0
	385					
30			71	Becoming dark grey	95.6	25.0

SHEAR STRENGTH, tsf
△ QU/2 ■ PP □ SV ◇ TV
1 2 3

STANDARD PENETRATION TEST
▲ N-VALUE (BLOWS PER LAST FOOT)
● MOISTURE CONTENT, %
○ % FINES (PASSING #200 SIEVE)
PL LL
20 40 60

DRILLER: Jet Drilling
METHOD: 4.25" HSA/Rotary
TYPE OF SPT HAMMER: Automatic
HAMMER EFFICIENCY (%): 78.2
LOGGED BY: J. Pruett

STRATIFICATION LINES ARE APPROXIMATE SOIL BOUNDARIES ONLY; ACTUAL CHANGES MAY BE GRADUAL OR MAY OCCUR BETWEEN SAMPLES.

WATER LEVELS: DURING DRILLING 49.5 FEET
N BORING DRY AT COMPLETION OF DRILLING
AT ____ FEET AFTER ____ HOURS
AT ____ FEET AFTER ____ HOURS
PIEZOMETER: INSTALLED AT ____ FEET

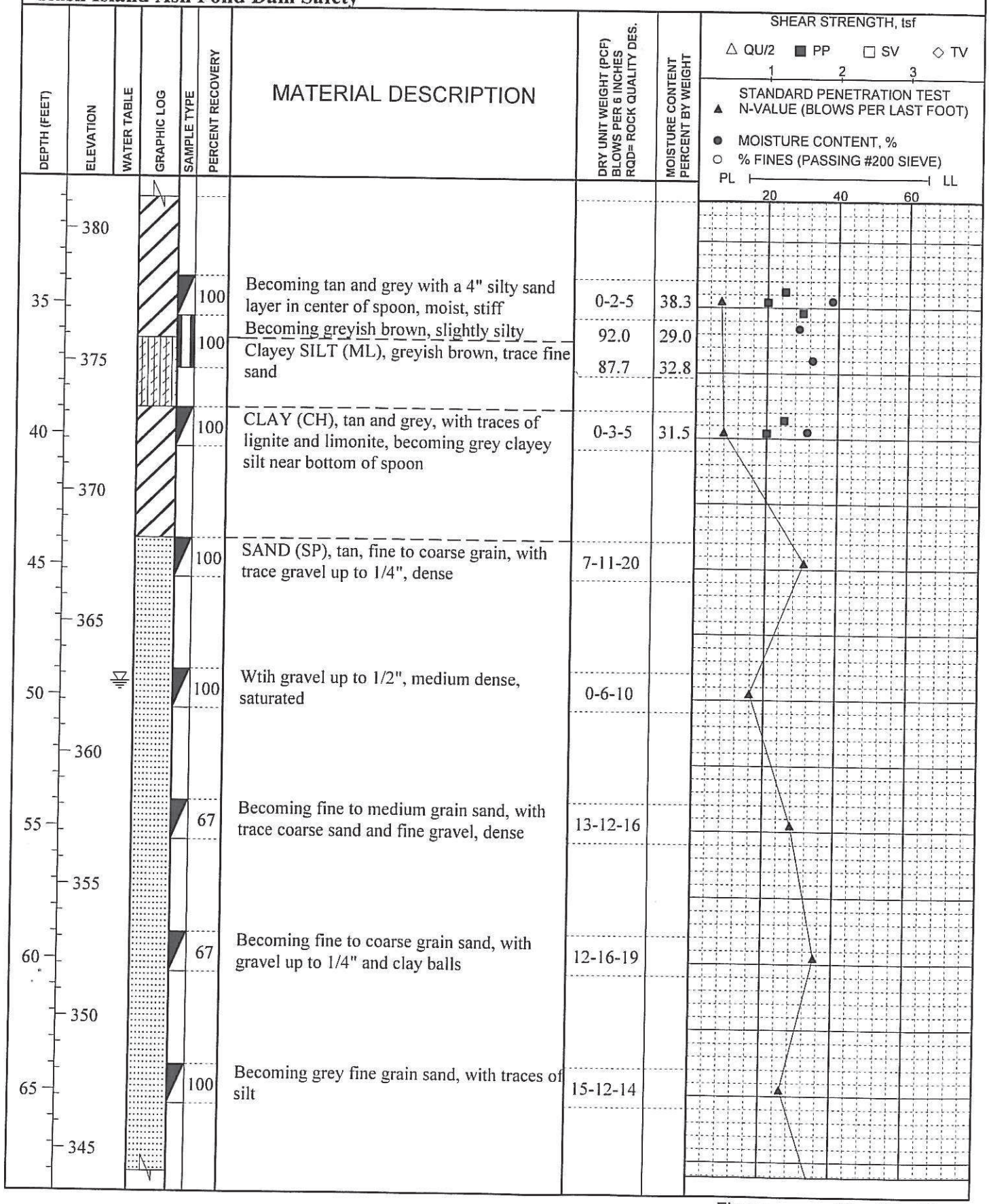
File: 2009012469

Figure

REITZ & JENS, INC.
CONSULTING ENGINEERS

BORING LOG B-3

Rush Island Ash Pond Dam Safety



File: 2009012469

Figure

REITZ & JENS, INC.
CONSULTING ENGINEERS

BORING LOG B-3

Rush Island Ash Pond Dam Safety

DEPTH (FEET)	ELEVATION	WATER TABLE	GRAPHIC LOG	SAMPLE TYPE	PERCENT RECOVERY	MATERIAL DESCRIPTION	DRY UNIT WEIGHT (PCF) BLOWS PER 6 INCHES RQD= ROCK QUALITY DES.	MOISTURE CONTENT PERCENT BY WEIGHT
70	340				94	Becoming fine to medium grain sand, with gravel up to 1/4"	10-15-23	
75	335				78	Becoming fine to coarse grain sand	12-15-22	
80	330					Boring terminated in sand at 75'-6"		
85	325							
90	320							
95	315							
100	310							
105								

SHEAR STRENGTH, tsf

△ QU/2 ■ PP □ SV ◇ TV

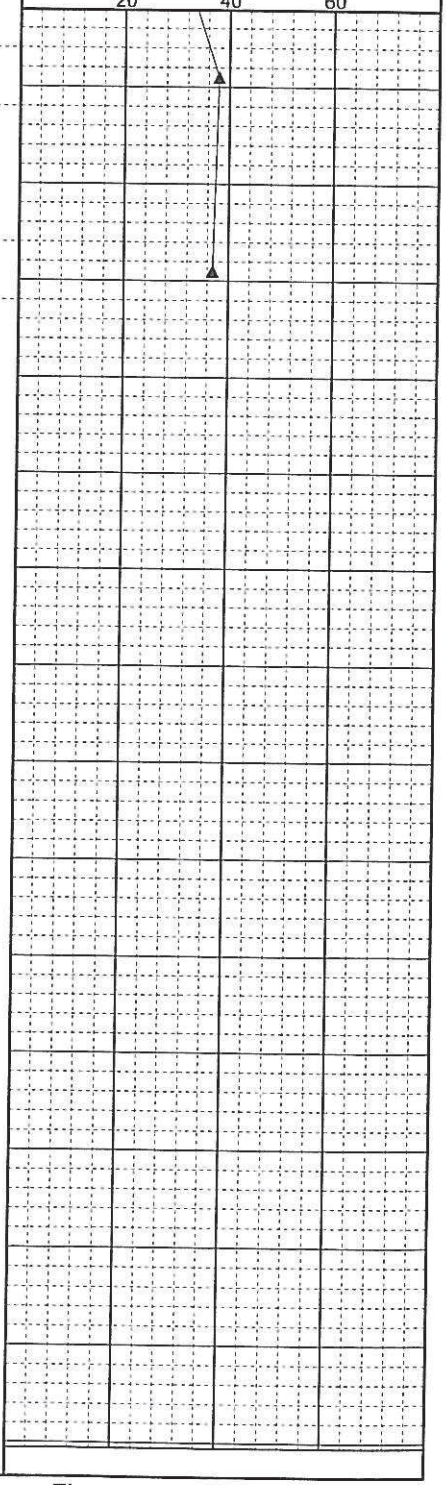
1 2 3

STANDARD PENETRATION TEST
▲ N-VALUE (BLOWS PER LAST FOOT)

● MOISTURE CONTENT, %
○ % FINES (PASSING #200 SIEVE)

PL LL

20 40 60



File: 2009012469

Figure

REITZ & JENS, INC.
CONSULTING ENGINEERS

BORING LOG B-4

Rush Island Ash Pond Dam Safety

CLIENT: **Ameren**

LOCATION: N 831798.8 E 890245.6
ELEVATION: 410.6 DATUM:
DATE DRILLED: 09-16-09

SHEAR STRENGTH, tsf
△ QU/2 ■ PP □ SV ◇ TV
1 2 3
STANDARD PENETRATION TEST
▲ N-VALUE (BLOWS PER LAST FOOT)
● MOISTURE CONTENT, %
○ % FINES (PASSING #200 SIEVE)
PL LL
20 40 60

DEPTH (FEET)	ELEVATION	WATER TABLE	GRAPHIC LOG	SAMPLE TYPE	PERCENT RECOVERY	MATERIAL DESCRIPTION	DRY UNIT WEIGHT (PCF) BLOWS PER 6 INCHES RQD= ROCK QUALITY DES.	MOISTURE CONTENT PERCENT BY WEIGHT
0	410					6" crushed LIMESTONE Silty Clay FILL (CL), brown and grey, trace fine sand, with layers up to 6" of high plastic clay, firm, moist		
5	405				71		96.1 97.6	24.1 25.5
10	400				96		93.1	28.1
15	395				75	Silt FILL (ML), brown, slightly clayey, with trace fine sand, 1/2" high plastic clay seam	93.4	21.2
20	390				100	Becoming tan, very sandy Note: Shelby Tube was pushed with no recovery, Spilt Spoon pushed for sample		29.1
25	385				100	Clayey SILT (ML), grey, highly layered, with layers of clayey silt, sandy silt, and high plastic clay, loose, natural?	1-2-4	29.4
30	380				100	Becoming very loose	1-1-1	33.1

DRILLER: Jet Drilling
METHOD: 4.25" HSA/Rotary
TYPE OF SPT HAMMER: Automatic
HAMMER EFFICIENCY (%): 78.2
LOGGED BY: J. Pruett

STRATIFICATION LINES ARE APPROXIMATE SOIL BOUNDARIES ONLY; ACTUAL CHANGES MAY BE GRADUAL OR MAY OCCUR BETWEEN SAMPLES.

WATER LEVELS: DURING DRILLING 37 FEET
N BORING DRY AT COMPLETION OF DRILLING
AT ____ FEET AFTER ____ HOURS
AT ____ FEET AFTER ____ HOURS
PIEZOMETER: INSTALLED AT ____ FEET

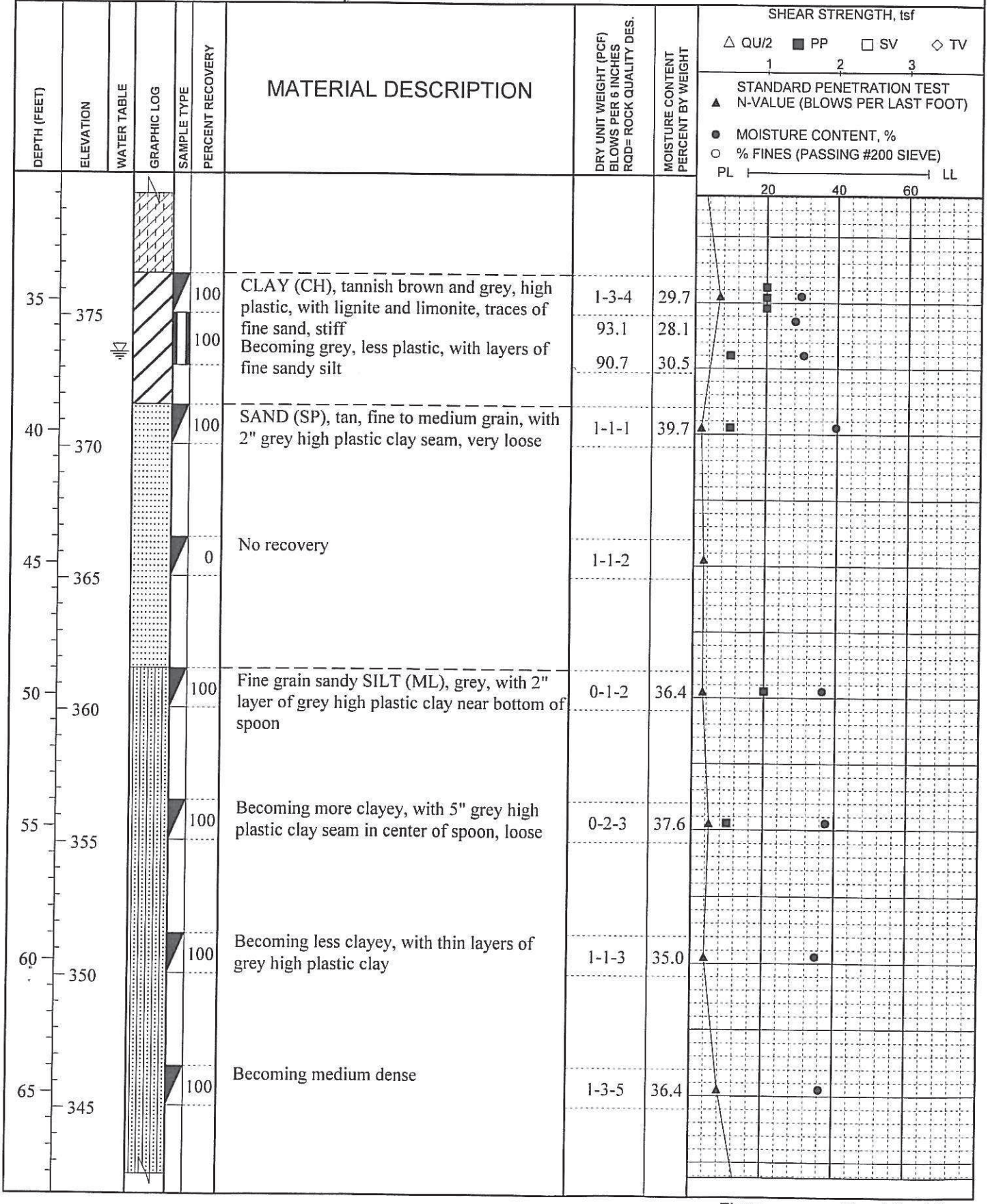
File: 2009012469

Figure

REITZ & JENS, INC.
CONSULTING ENGINEERS

BORING LOG B-4

Rush Island Ash Pond Dam Safety



File: 2009012469

Figure

REITZ & JENS, INC.
CONSULTING ENGINEERS

BORING LOG B-4

Rush Island Ash Pond Dam Safety

DEPTH (FEET)	ELEVATION	WATER TABLE	GRAPHIC LOG	SAMPLE TYPE	PERCENT RECOVERY	MATERIAL DESCRIPTION	DRY UNIT WEIGHT (PCF) BLOWS PER 6 INCHES RQD= ROCK QUALITY DES.	MOISTURE CONTENT PERCENT BY WEIGHT
70	340				72	SAND (SP), grey, fine grain, slightly silty, with trace gravel up to 1/8", medium dense	5-6-9	
75	335				61	Becoming fine to medium grain, without gravel, very dense	15-22-26	
						Boring terminated in sand at 75'-6"		
80	330							
85	325							
90	320							
95	315							
100	310							
105								

SHEAR STRENGTH, tsf

△ QU/2 ■ PP □ SV ◇ TV

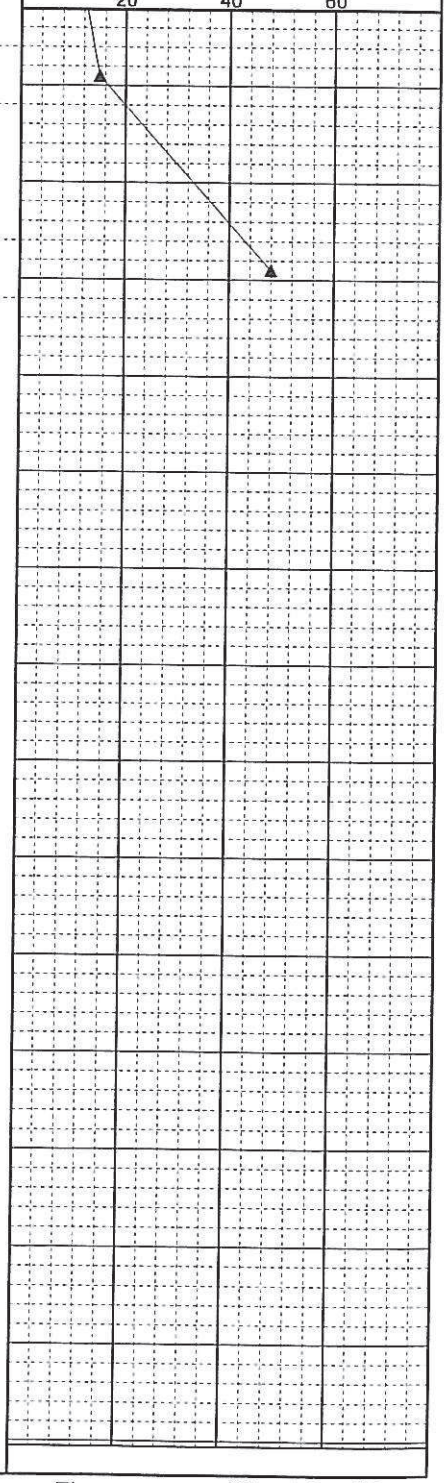
1 2 3

STANDARD PENETRATION TEST
▲ N-VALUE (BLOWS PER LAST FOOT)

● MOISTURE CONTENT, %
○ % FINES (PASSING #200 SIEVE)

PL LL

20 40 60



File: 2009012469

Figure

REITZ & JENS, INC.
CONSULTING ENGINEERS

BORING LOG B-6

Rush Island Ash Pond Dam Safety

CLIENT: **Ameren**

LOCATION: N 834235.0 E 888471.7
ELEVATION: 408.6 DATUM:
DATE DRILLED: 09-17-09

DEPTH (FEET)	ELEVATION	WATER TABLE	GRAPHIC LOG	SAMPLE TYPE	PERCENT RECOVERY	MATERIAL DESCRIPTION	DRY UNIT WEIGHT (PCF) BLOWS PER 6 INCHES RQD= ROCK QUALITY DES.	MOISTURE CONTENT PERCENT BY WEIGHT
0						4" crushed LIMESTONE		
						Clayey Sandy Silt FILL (ML), grey and brown, with layers of fine to medium sand and silty clay		
	405							
5					92		97.6	24.5
	400							
10					96	Silty Clay FILL (CL), grey, with tan fine sand and silt seams both horzontal and vertical		
	395							
15					96	With high plastic clay and fine roots, without sand seams	88.8	29.4
						CLAY (CH), grey and light grey, with layers of silt and medium grain sand, traces of lignite and limonite, natural?	94.5	27.9
	390							
20					100	With traces of silt lenses, becoming clayey silt with high plastic clay lenses near bottom of tube		
	385							
25					100	Clayey SILT (ML), grey with lenses of high plastic clay, trace limonite, saturated, very soft	87.2 86.2	33.0 33.6
	380 ▽							
30					100	Becoming greyish tan, with fine grain sand and traces of limonite		32.1

SHEAR STRENGTH, tsf
△ QU/2 ■ PP □ SV ◇ TV
1 2 3

STANDARD PENETRATION TEST
▲ N-VALUE (BLOWS PER LAST FOOT)
● MOISTURE CONTENT, %
○ % FINES (PASSING #200 SIEVE)
PL LL
20 40 60

DRILLER: Jet Drilling
METHOD: 4.25" HSA/Rotary
TYPE OF SPT HAMMER: Automatic
HAMMER EFFICIENCY (%): 78.2
LOGGED BY: J. Pruett

STRATIFICATION LINES ARE APPROXIMATE SOIL BOUNDARIES ONLY; ACTUAL CHANGES MAY BE GRADUAL OR MAY OCCUR BETWEEN SAMPLES.

WATER LEVELS: DURING DRILLING 29 FEET
N BORING DRY AT COMPLETION OF DRILLING
AT ____ FEET AFTER ____ HOURS
AT ____ FEET AFTER ____ HOURS
PIEZOMETER: INSTALLED AT ____ FEET

File: 2009012469

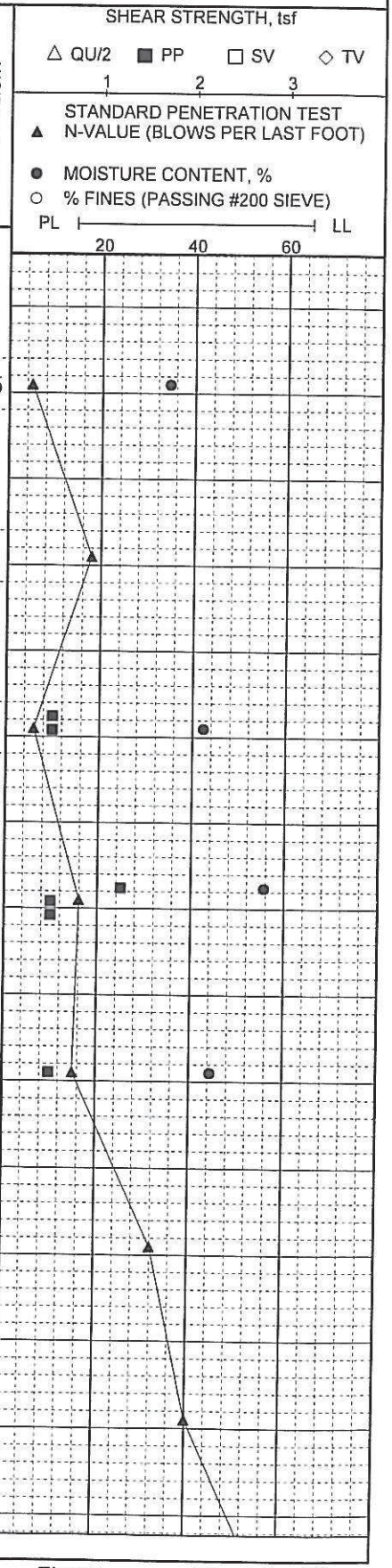
Figure

REITZ & JENS, INC.
CONSULTING ENGINEERS

BORING LOG B-6

Rush Island Ash Pond Dam Safety

DEPTH (FEET)	ELEVATION	SAMPLE TYPE	PERCENT RECOVERY	MATERIAL DESCRIPTION	DRY UNIT WEIGHT (PCF) BLOWS PER 6 INCHES RQD= ROCK QUALITY DES.	MOISTURE CONTENT PERCENT BY WEIGHT
	375			Note: Shelby Tube was pushed with no recovery, Spilt Spoon pushed for sample		
35			100	Fine grain sandy SILT (ML), greyish tan, slightly clayey, loose	3-2-3	34.6
	370					
40			100	SAND (SP), grey, fine to medium grain	2-6-12	
	365					
45			100	CLAY (CH-CL), grey, layers of high plastic clay and low plastic silty clay, stiff	0-1-5	42.4
	360					
50			100	SAND (SP), grey, fine to coarse grain, medium dense	0-3-13	55.7
	355					
55			89	With 3" layer of high plastic clay at bottom of spoon	13-10-5	44.5
	350					
60			61	Becoming fine to medium grain sand, with gravel up to 1/4", dense	13-17-15	
	345					
65			78	Becoming fine to coarse grain sand, very dense	13-16-24	



File: 2009012469

Figure

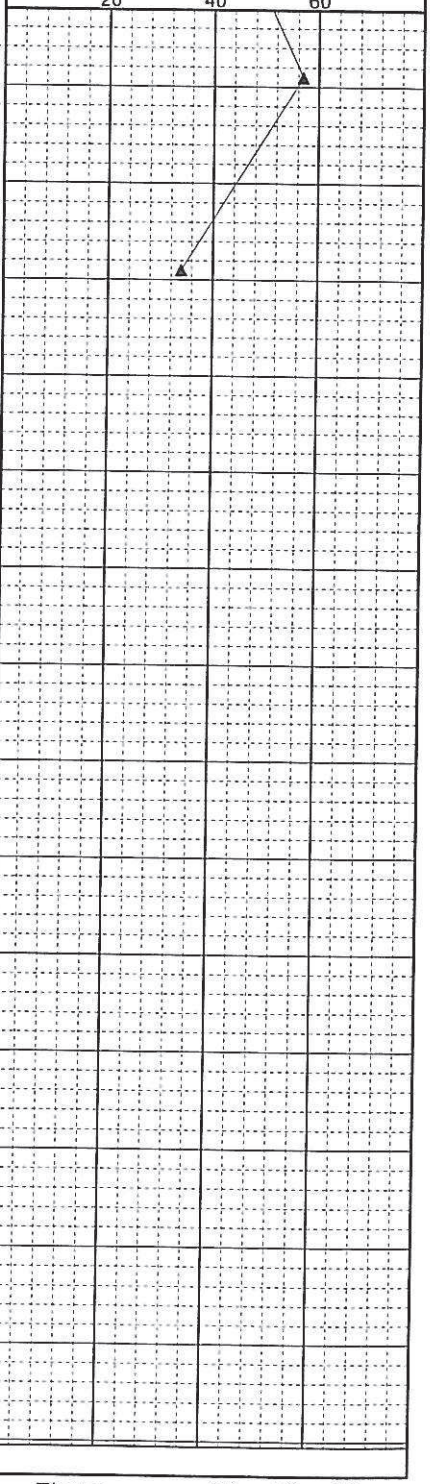
REITZ & JENS, INC.
CONSULTING ENGINEERS

BORING LOG B-6

Rush Island Ash Pond Dam Safety

DEPTH (FEET)	ELEVATION	WATER TABLE	GRAPHIC LOG	SAMPLE TYPE	PERCENT RECOVERY	MATERIAL DESCRIPTION	DRY UNIT WEIGHT (PCF) BLOWS PER 6 INCHES RQD= ROCK QUALITY DES.	MOISTURE CONTENT PERCENT BY WEIGHT
70	340				83		16-23-34	
75	335				61	Without gravel, dense	10-15-19	
						Boring terminated in sand at 75'-6"		
80	330							
85	325							
90	320							
95	315							
100	310							
105	305							

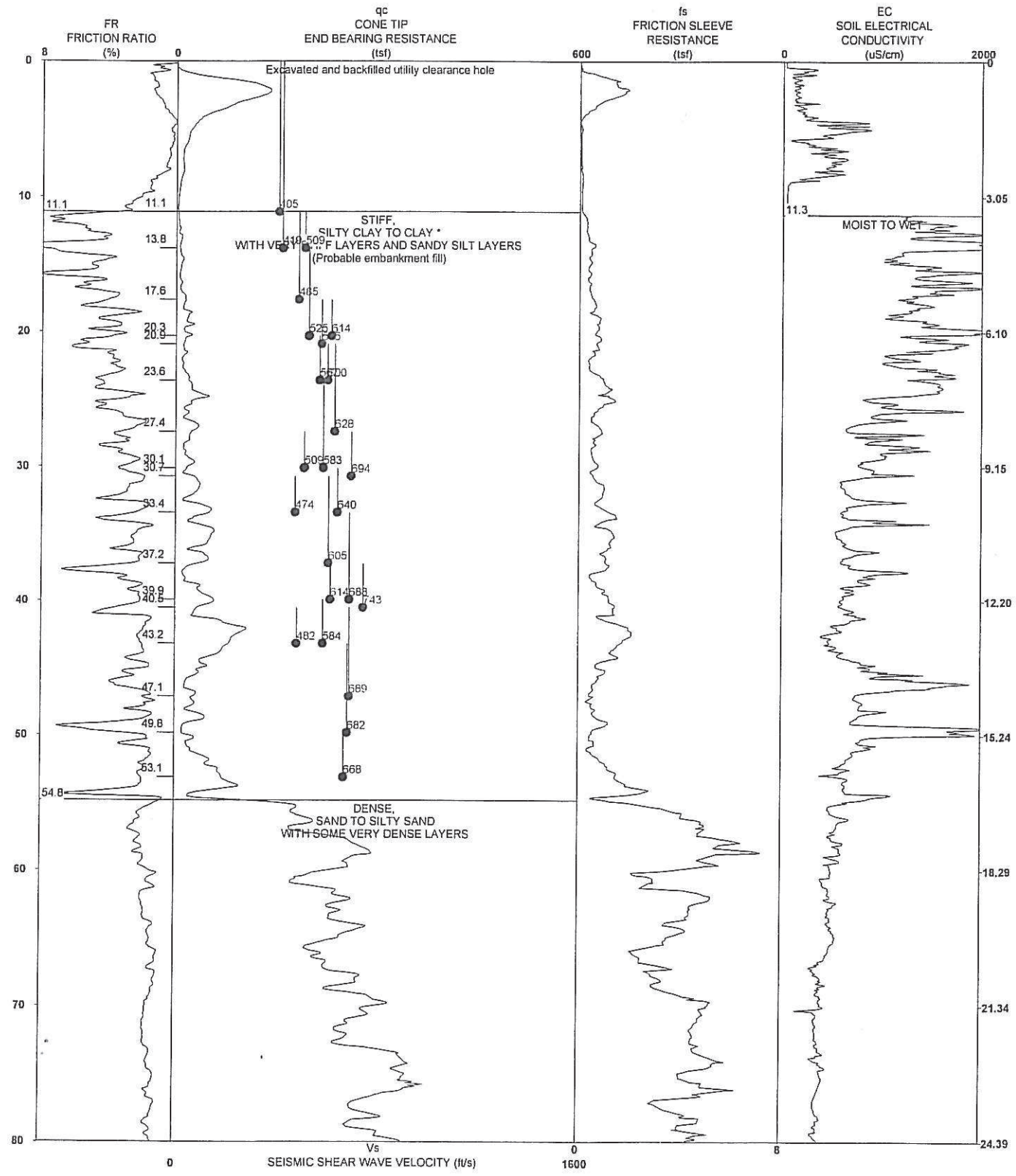
SHEAR STRENGTH, tsf
△ QU/2 ■ PP □ SV ◇ TV
1 2 3
STANDARD PENETRATION TEST
▲ N-VALUE (BLOWS PER LAST FOOT)
● MOISTURE CONTENT, %
○ % FINES (PASSING #200 SIEVE)
PL LL
20 40 60



File: 2009012469

Figure

CPTU-EC-S LOG WITH LITHOLOGIC EVALUATION CP01



Latitude: 38.12324 Longitude: -90.25558

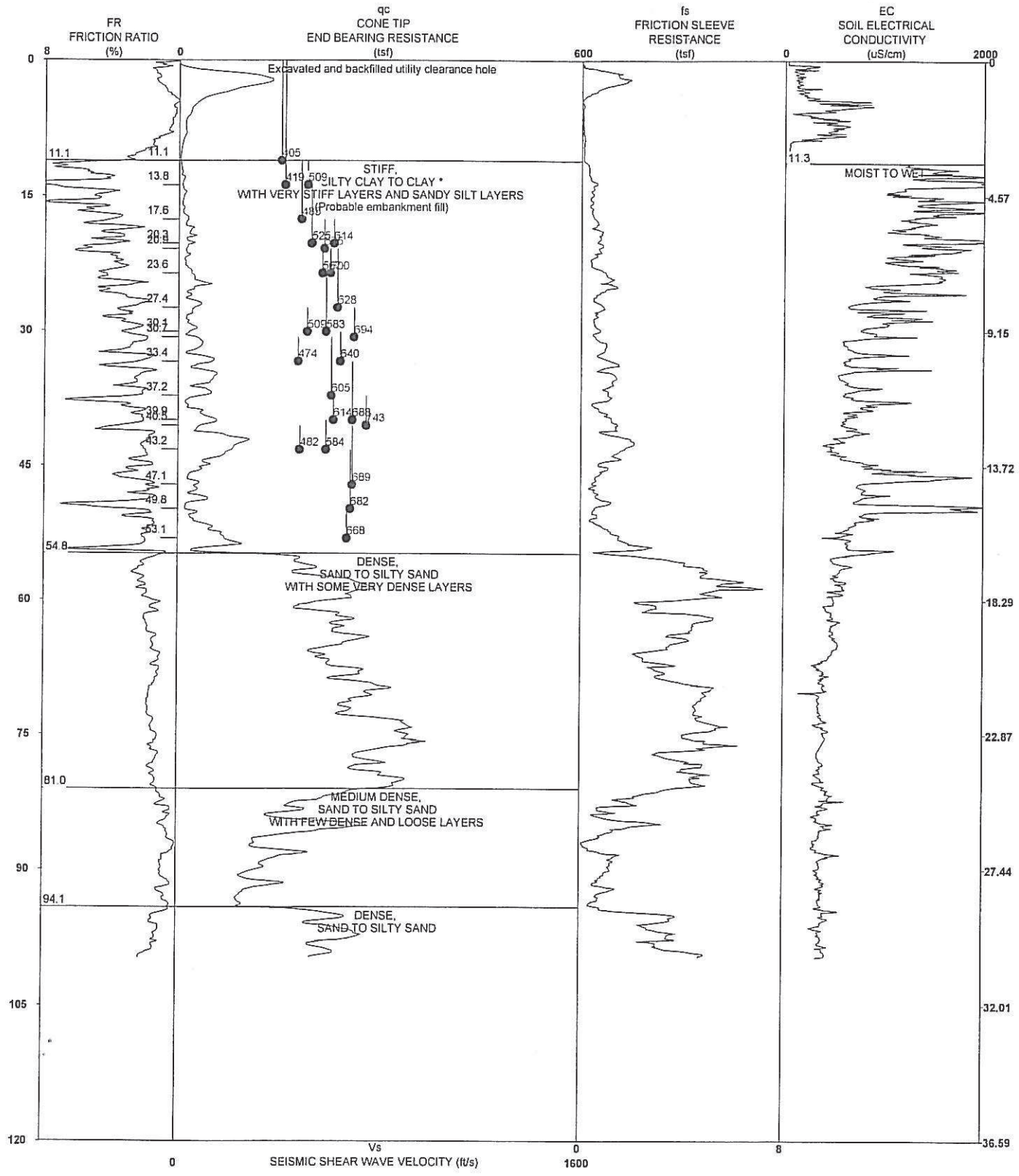
PROJECT NAME:Ameren UE Rush Island Levee Inventory
PROJECT NUMBER:09-110-090

STRATIGRAPHICS

R1 DATE:8/28/2009 TIME:9:35 AM
SOUNDING NUMBER:CP-01

CP01

CPTU-EC-S LOG WITH LITHOLOGIC EVALUATION CP01



- 0 - 1600 ft/sec True Shear Wave Velocity
- 0 - 1600 ft/sec Pseudo Interval Receiver 1
- 0 - 1600 ft/sec Pseudo Interval Receiver 2

Latitude: 38.12324 Longitude: -90.25558

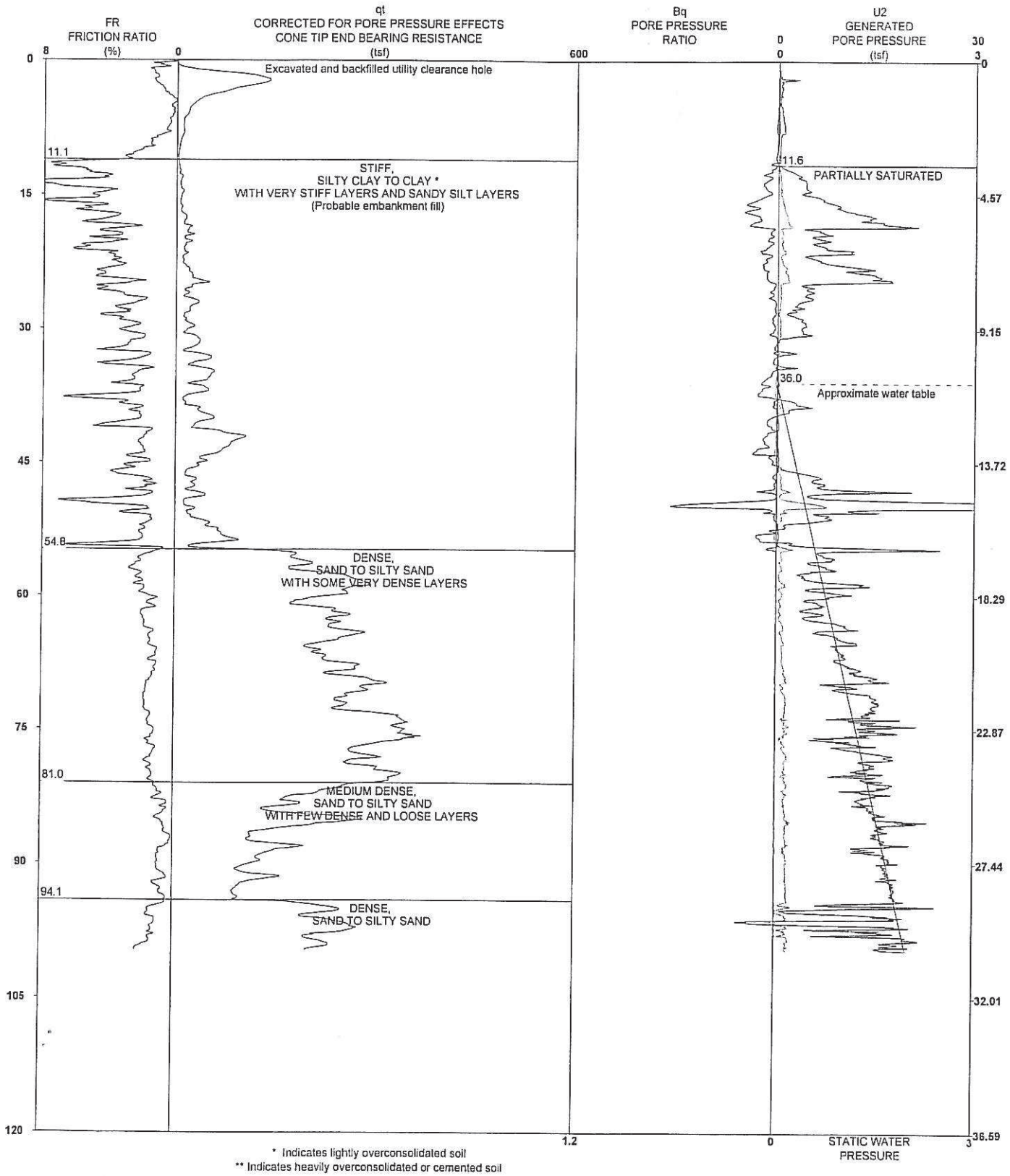
PROJECT NAME:Ameren UE Rush Island Levee Inventory
PROJECT NUMBER:09-110-090

STRATIGRAPHICS

R1 DATE:8/28/2009 TIME:9:35 AM
SOUNDING NUMBER:CP-01

CP01

CPTU-EC-S LOG WITH LITHOLOGIC EVALUATION CP01



Latitude: 38.12324 Longitude: -90.25558

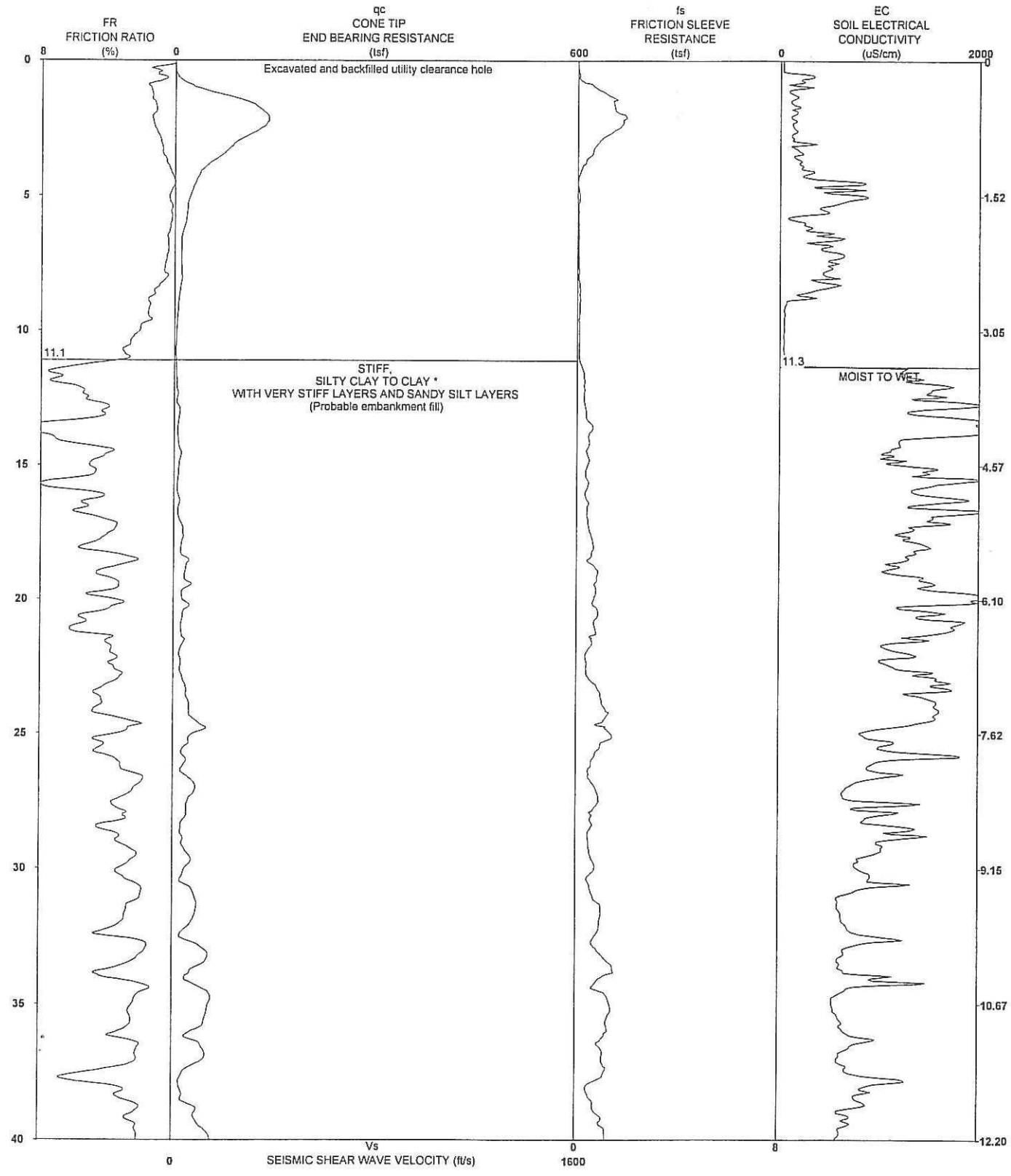
PROJECT NAME:Ameren UE Rush Island Levee Inventory
PROJECT NUMBER:09-110-090

STRATIGRAPHICS

R1 DATE:8/28/2009 TIME:9:35 AM
SOUNDING NUMBER:CP-01

CP01

CPTU-EC-S LOG WITH LITHOLOGIC EVALUATION CP01



Latitude: 38.12324 Longitude: -90.25558

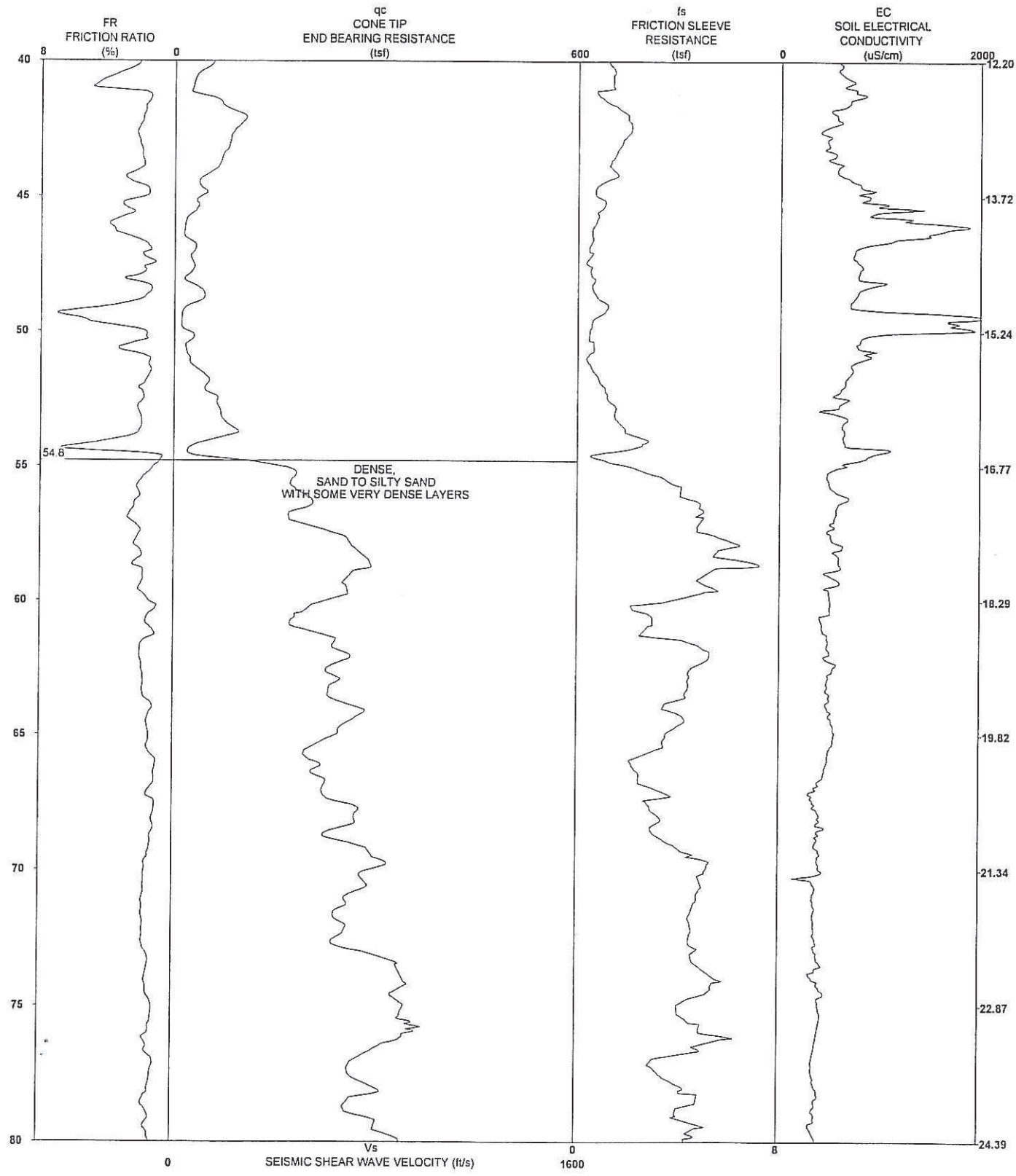
PROJECT NAME:Ameren UE Rush Island Levee Inventory
PROJECT NUMBER:09-110-090

STRATIGRAPHICS

R1 DATE:8/28/2009 TIME:9:35 AM
SOUNDING NUMBER:CP-01

CP01

CPTU-EC-S LOG WITH LITHOLOGIC EVALUATION CP01



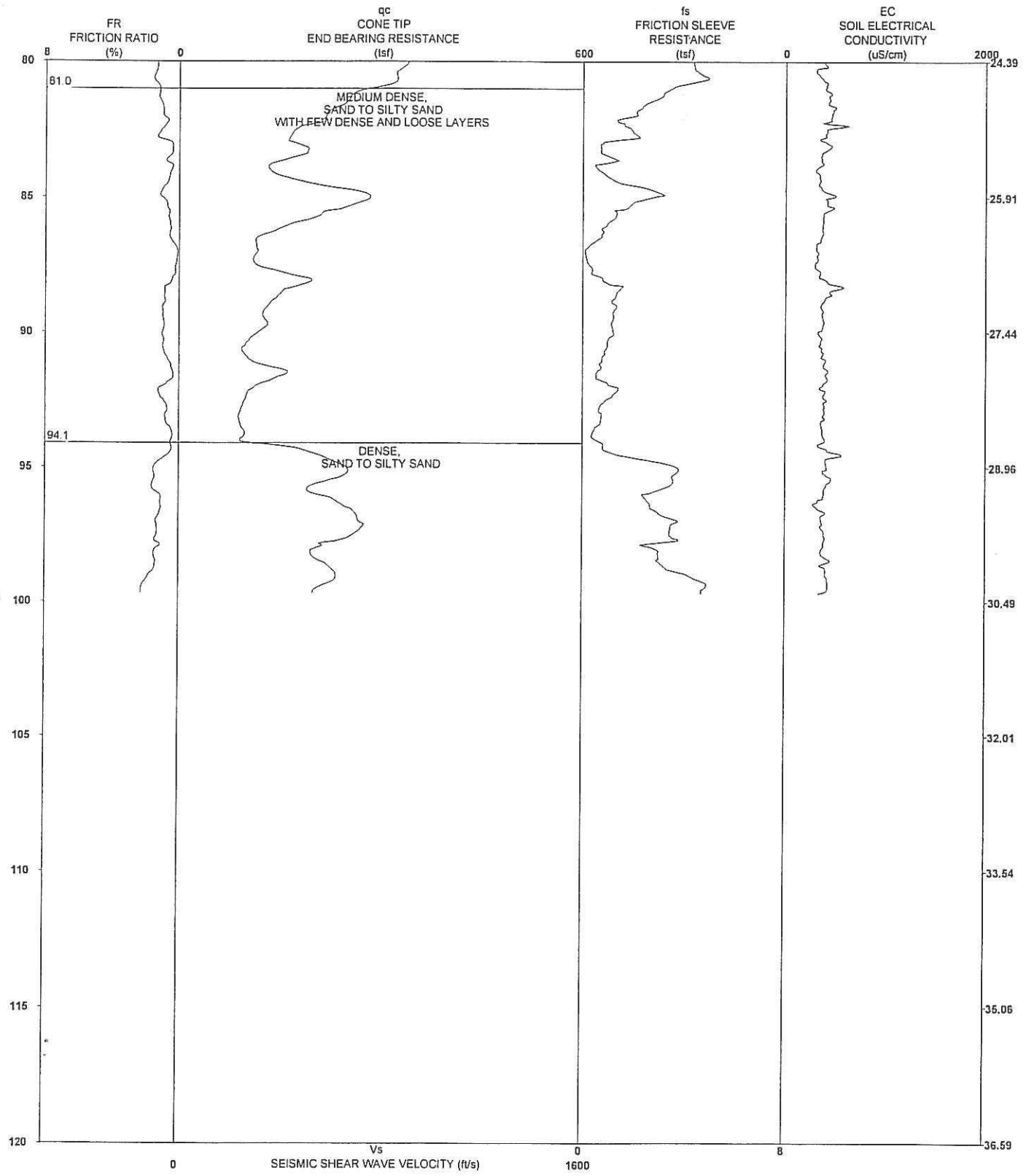
Latitude: 38.12324 Longitude: -90.25558

PROJECT NAME:Ameren UE Rush Island Levee Inventory
PROJECT NUMBER:09-110-090

STRATIGRAPHICS

R1 DATE:8/28/2009 TIME:9:35 AM
SOUNDING NUMBER:CP-01

CPTU-EC-S LOG WITH LITHOLOGIC EVALUATION CP01



Latitude: 38.12324 Longitude: -90.25558

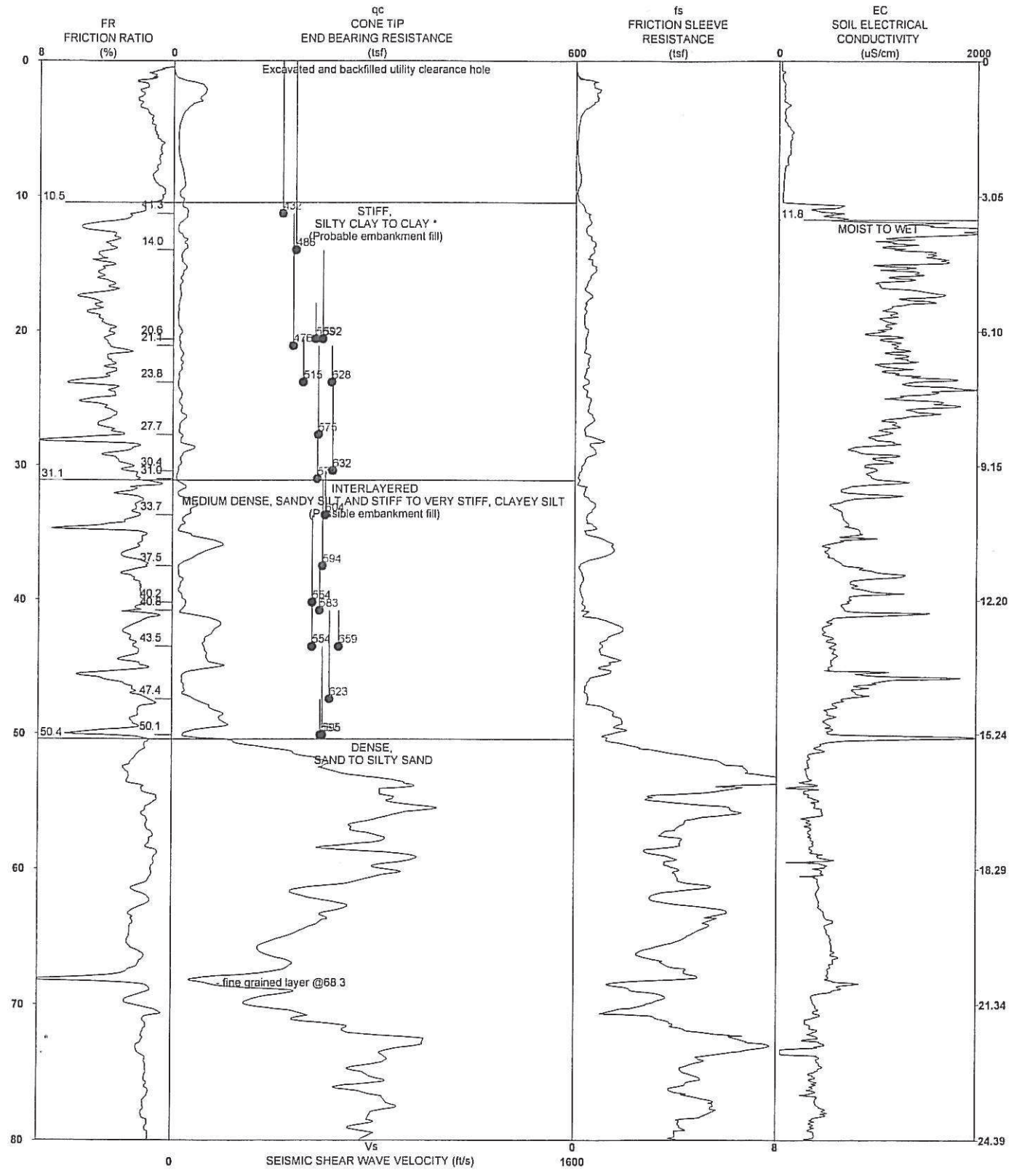
PROJECT NAME:Ameren UE Rush Island Levee Inventory
PROJECT NUMBER:09-110-090

STRATIGRAPHICS

R1 DATE:8/28/2009 TIME:9:35 AM
SOUNDING NUMBER:CP-01

CP01

CPTU-EC-S LOG WITH LITHOLOGIC EVALUATION CP02



- 0 - 1600 ft/sec True Shear Wave Velocity
- 0 - 1600 ft/sec Pseudo Interval Receiver 1
- 0 - 1600 ft/sec Pseudo Interval Receiver 2

Latitude: 0.00000 Longitude: 0.00000

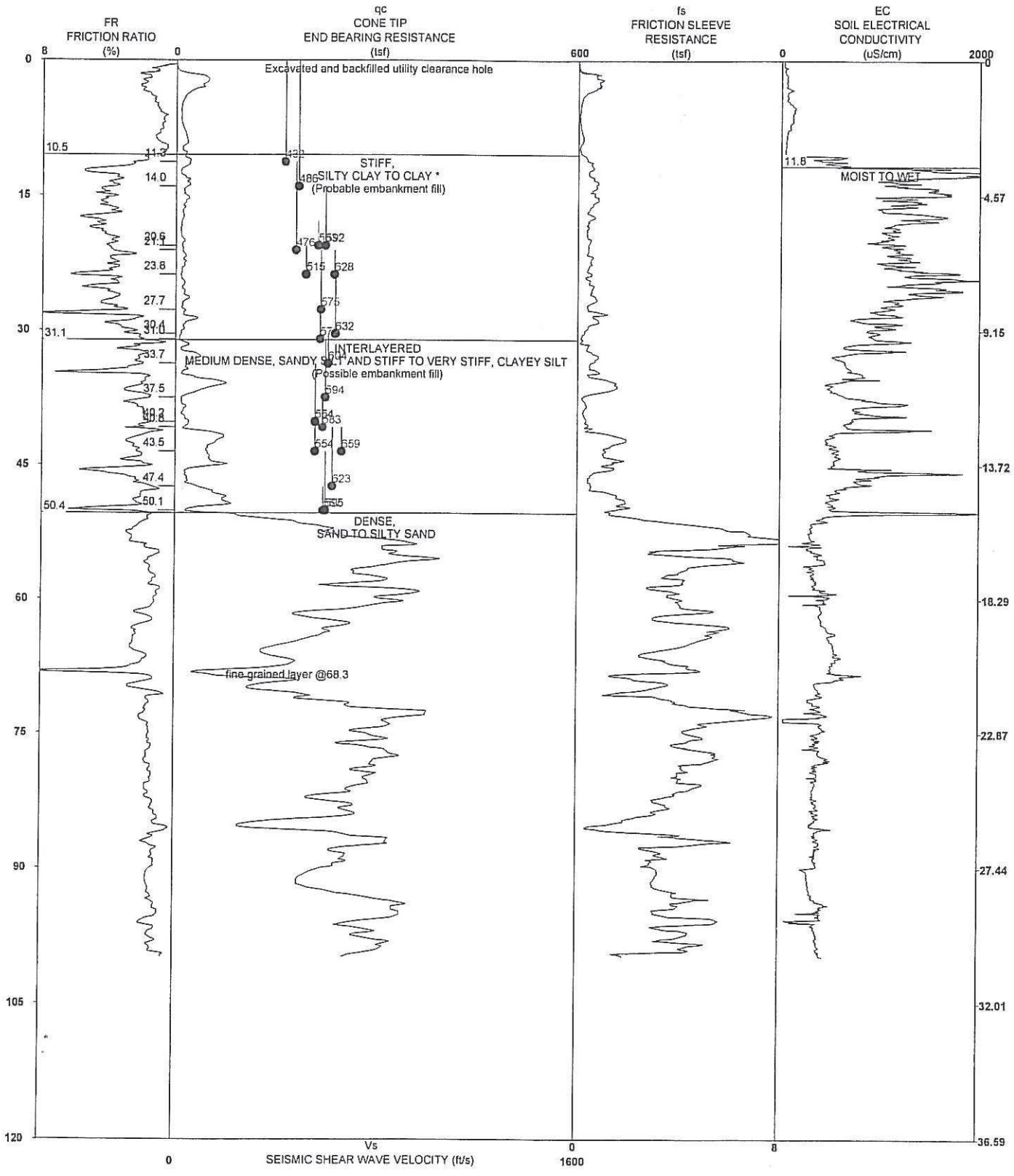
PROJECT NAME:Ameren UE Rush Island Levee Inventory
PROJECT NUMBER:09-110-090

STRATIGRAPHICS

R1 DATE:8/27/2009 TIME:5:25 PM
SOUNDING NUMBER:CP-02

CP02

CPTU-EC-S LOG WITH LITHOLOGIC EVALUATION CP02



0 - 1600 ft/sec True Shear Wave Velocity
0 - 1600 ft/sec Pseudo Interval Receiver 1
0 - 1600 ft/sec Pseudo Interval Receiver 2

Latitude: 0.00000 Longitude: 0.00000

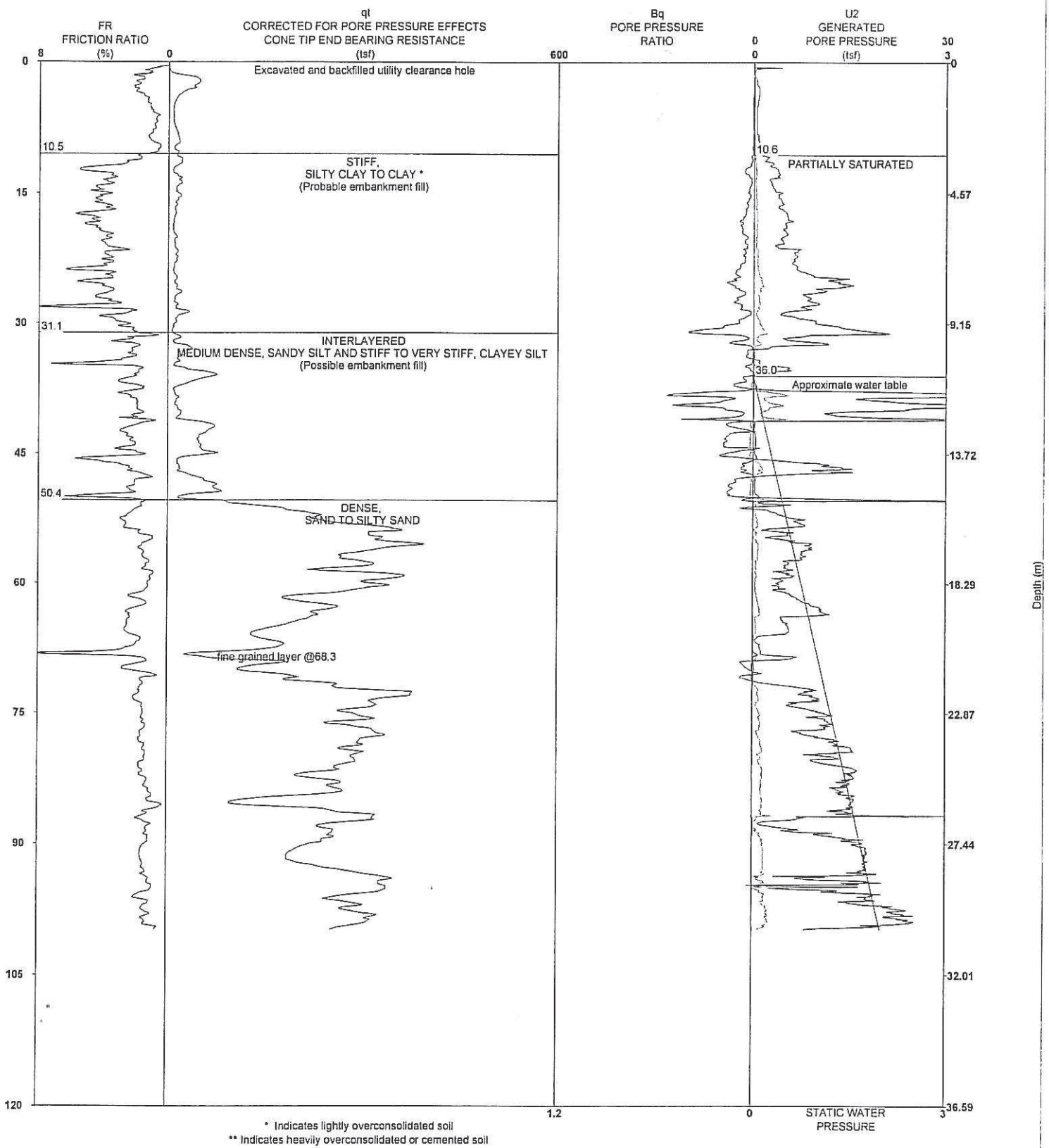
PROJECT NAME:Ameren UE Rush Island Levee Inventory
PROJECT NUMBER:09-110-090

STRATIGRAPHICS

R1 DATE:8/27/2009 TIME:5:25 PM
SOUNDING NUMBER:CP-02

CP02

CPTU-EC-S LOG WITH LITHOLOGIC EVALUATION CP02



* Indicates lightly overconsolidated soil
** Indicates heavily overconsolidated or cemented soil

Latitude: 0.00000 Longitude: 0.00000

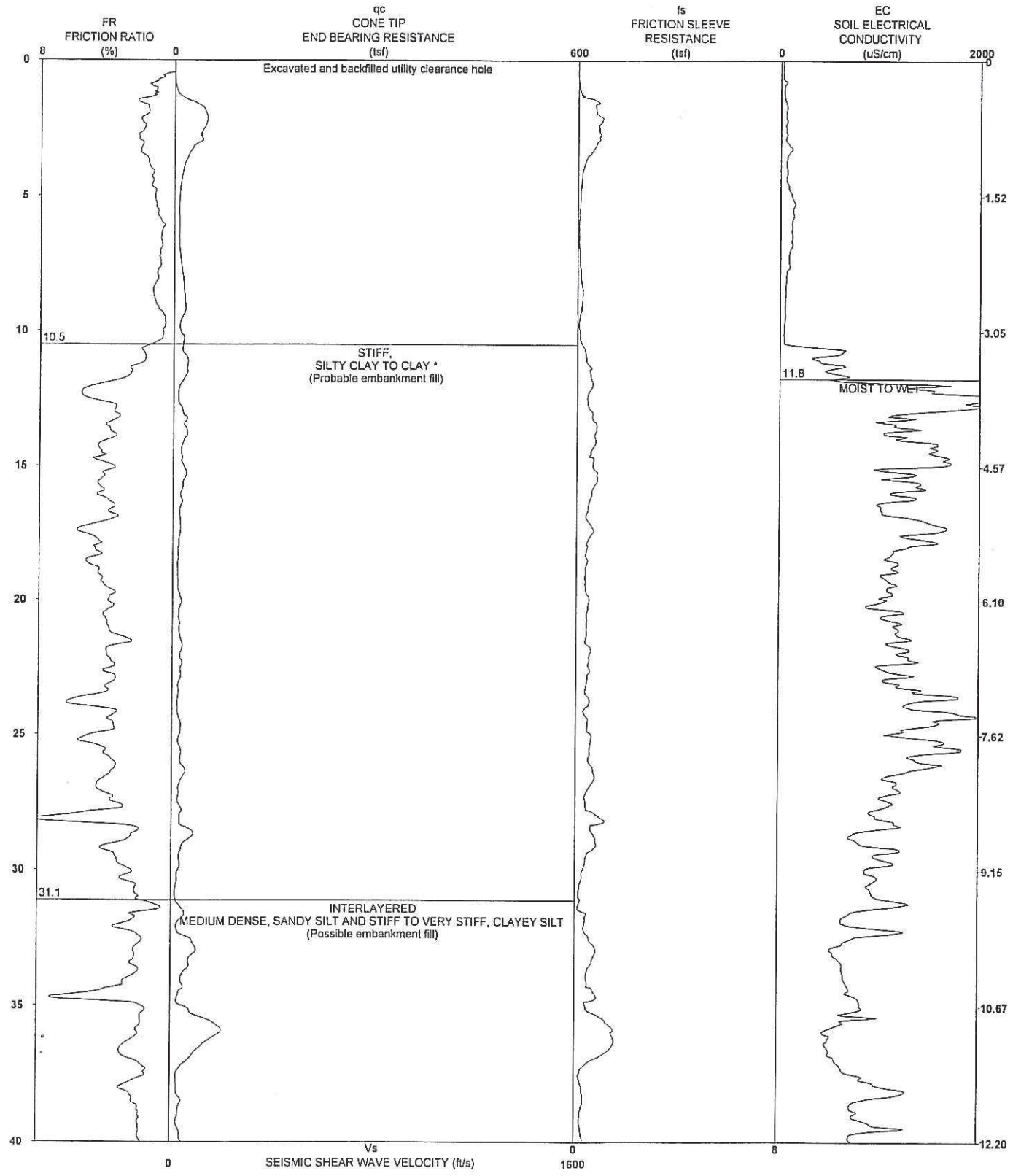
PROJECT NAME:Ameren UE Rush Island Levee Inventory
PROJECT NUMBER:09-110-090

STRATIGRAPHICS

R1 DATE:8/27/2009 TIME:5:25 PM
SOUNDING NUMBER:CP-02

CP02

CPTU-EC-S LOG WITH LITHOLOGIC EVALUATION CP02



Latitude: 0.00000 Longitude: 0.00000

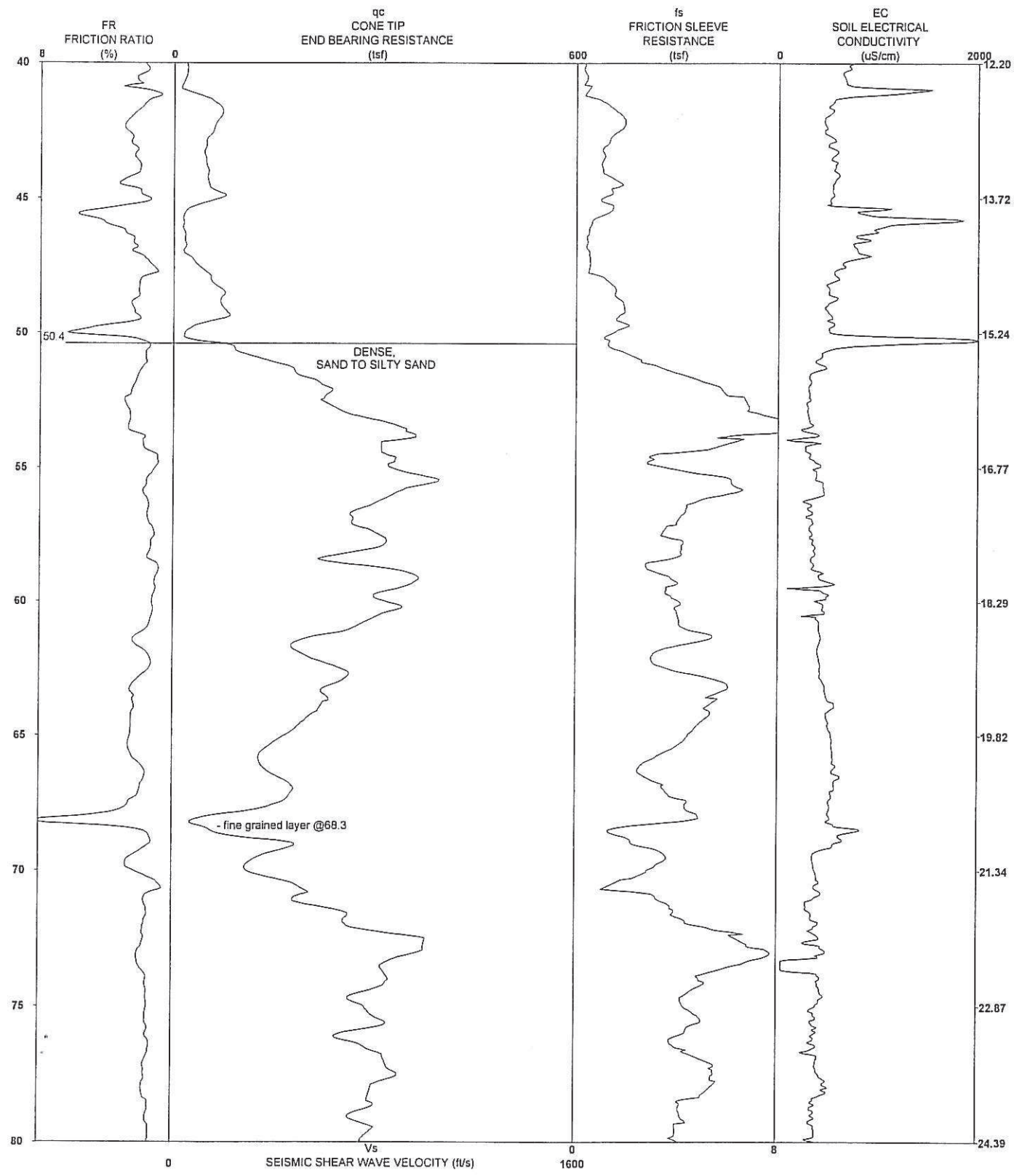
PROJECT NAME:Ameren UE Rush Island Levee Inventory
PROJECT NUMBER:09-110-090

STRATIGRAPHICS

R1 DATE:8/27/2009 TIME:5:25 PM
SOUNDING NUMBER:CP-02

CP02

CPTU-EC-S LOG WITH LITHOLOGIC EVALUATION CP02



Latitude: 0.00000 Longitude: 0.00000

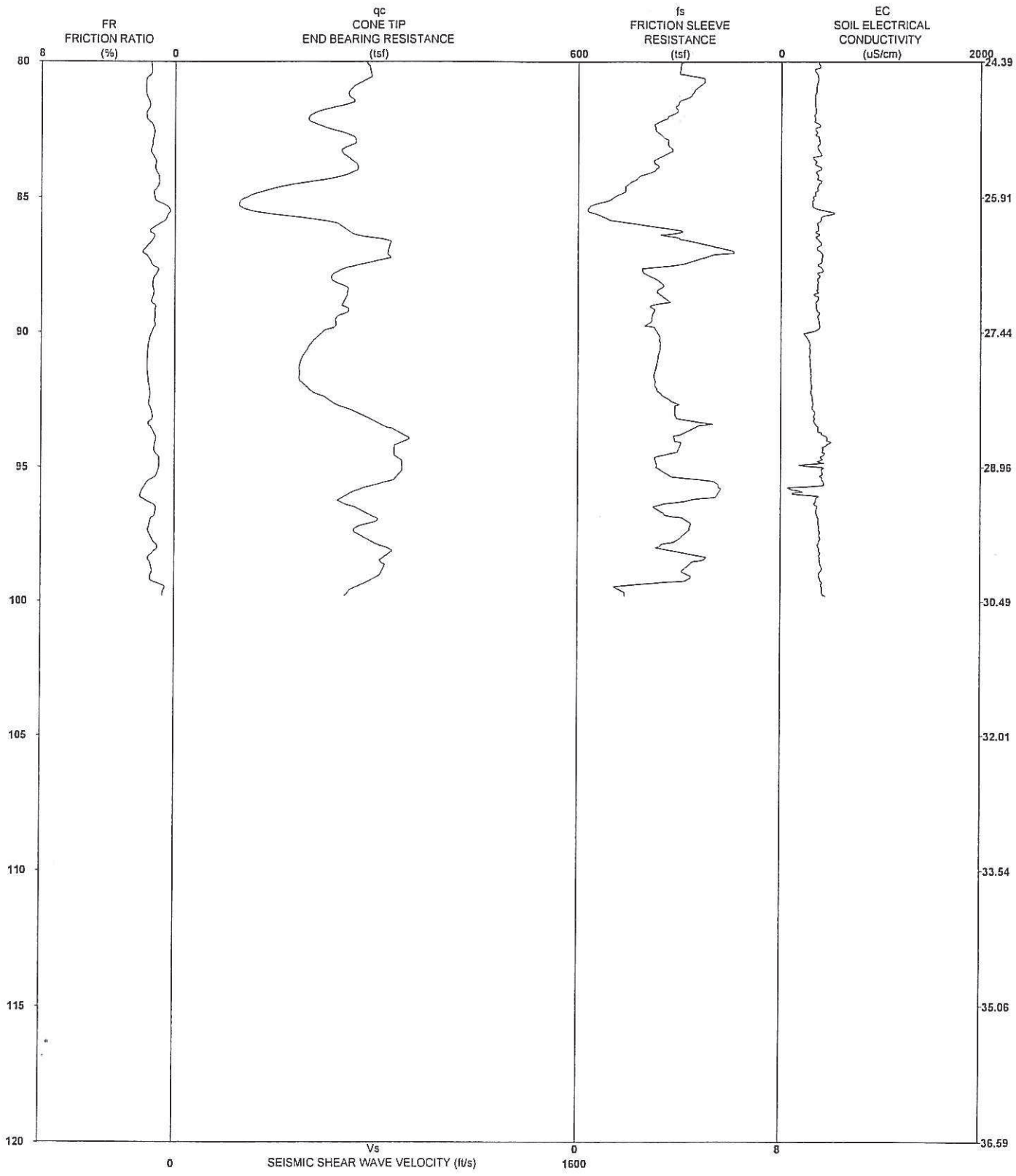
PROJECT NAME:Ameren UE Rush Island Levee Inventory
PROJECT NUMBER:09-110-090

STRATIGRAPHICS

R1 DATE:8/27/2009 TIME:5:25 PM
SOUNDING NUMBER:CP-02

CP02

CPTU-EC-S LOG WITH LITHOLOGIC EVALUATION CP02



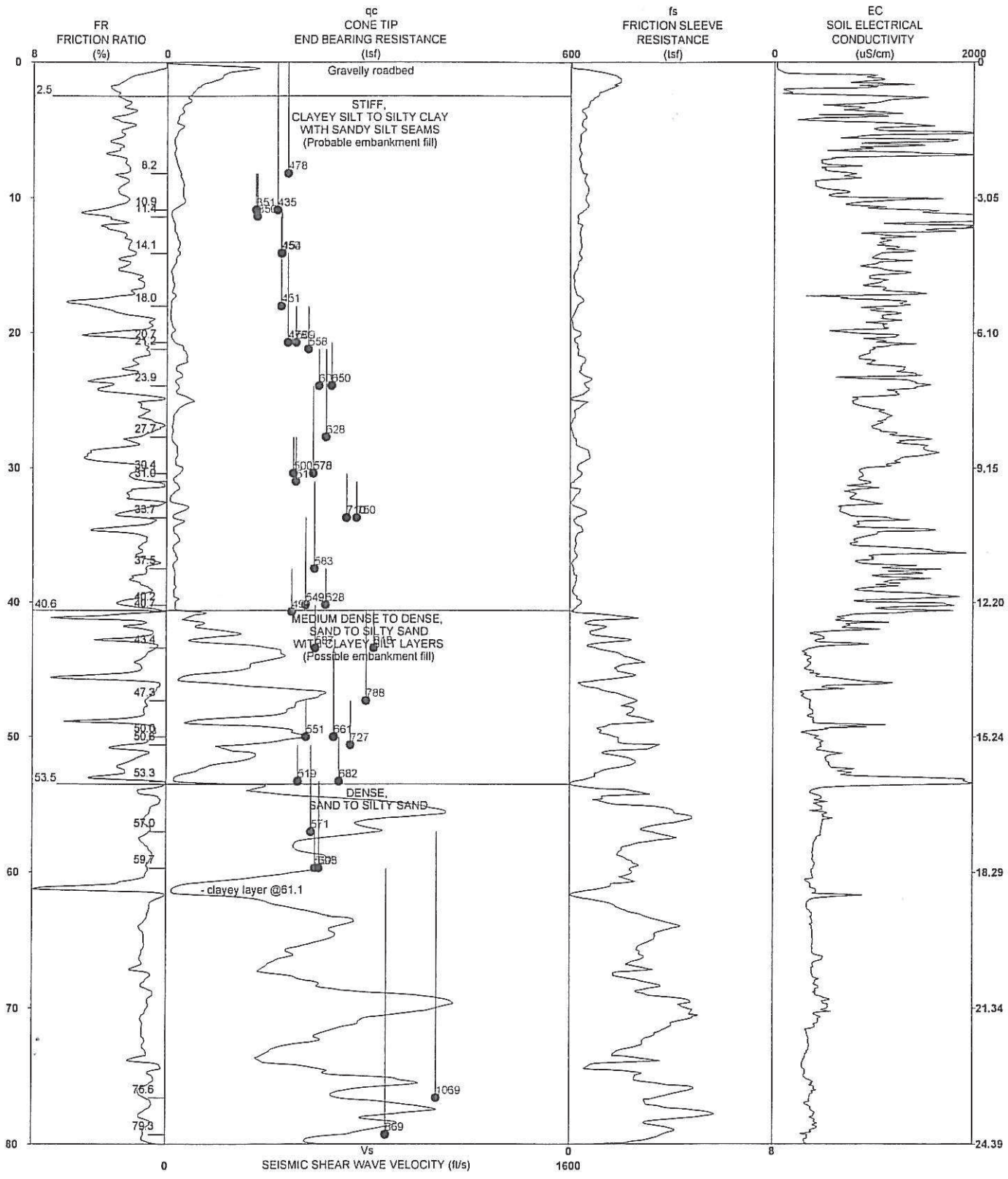
Latitude: 0.00000 Longitude: 0.00000

PROJECT NAME:Ameren UE Rush Island Levee Inventory
PROJECT NUMBER:09-110-090

STRATIGRAPHICS

R1 DATE:8/27/2009 TIME:5:25 PM
SOUNDING NUMBER:CP-02

CPTU-EC-S LOG WITH LITHOLOGIC EVALUATION CP03



0 - 1600 ft/sec True Shear Wave Velocity
0 - 1600 ft/sec Pseudo Interval Receiver 1
0 - 1600 ft/sec Pseudo Interval Receiver 2

Latitude: 0.00000 Longitude: 0.00000

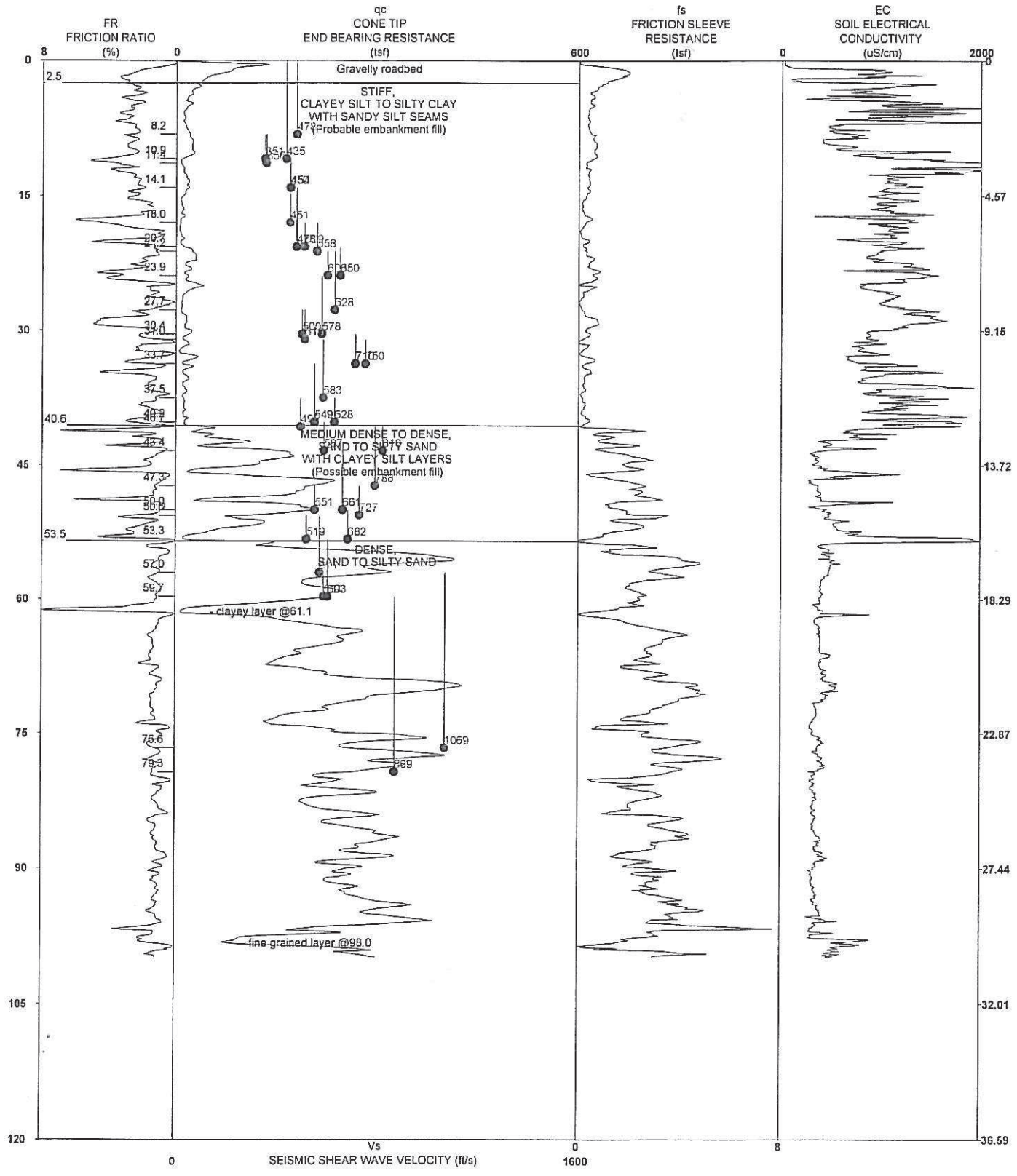
PROJECT NAME:Ameren UE Rush Island Levee Inventory
PROJECT NUMBER:09-110-090

STRATIGRAPHICS

R1 DATE:8/27/2009 TIME:3:19 PM
SOUNDING NUMBER:CP-03

CP03

CPTU-EC-S LOG WITH LITHOLOGIC EVALUATION CP03



Latitude: 0.00000 Longitude: 0.00000

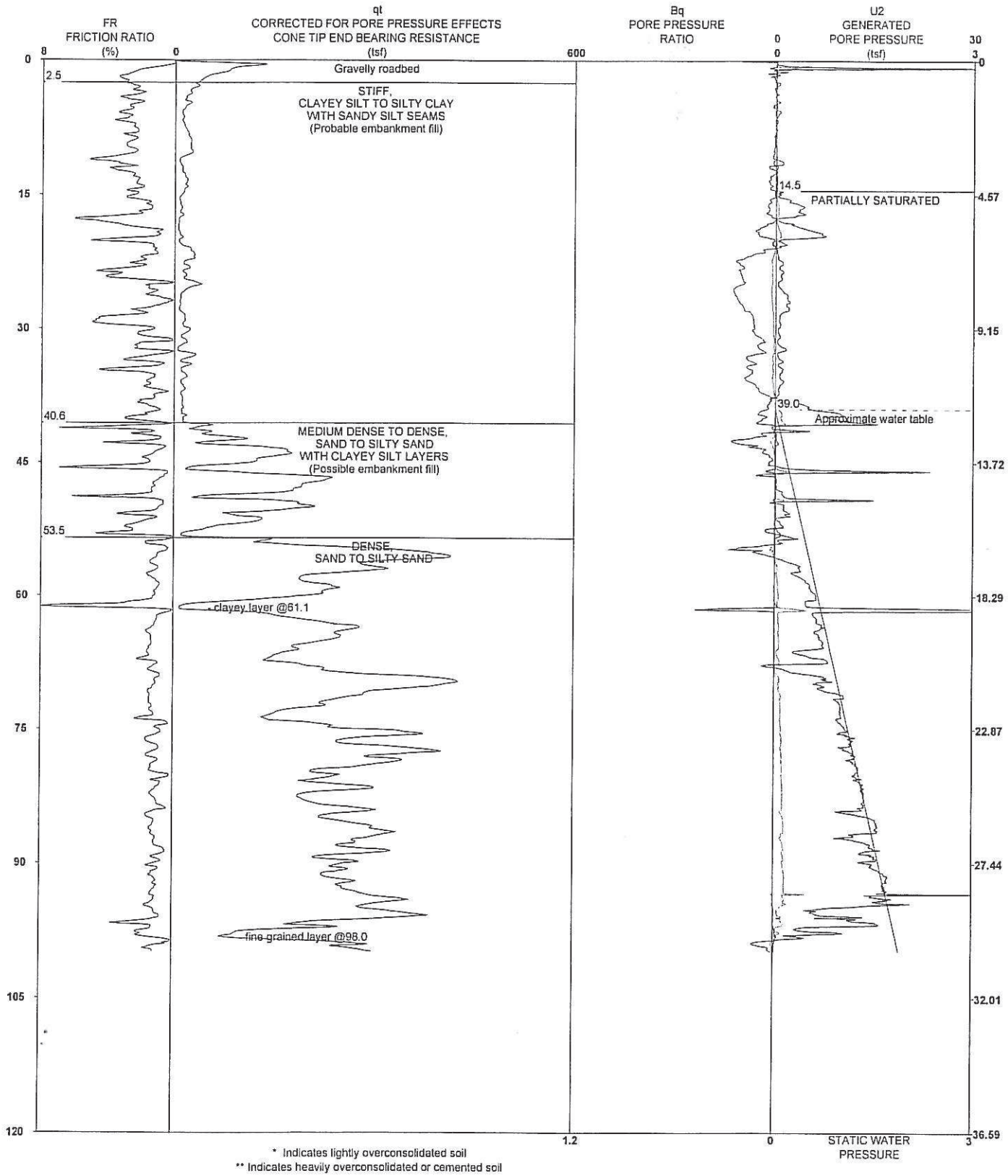
PROJECT NAME:Ameren UE Rush Island Levee Inventory
PROJECT NUMBER:09-110-090

STRATIGRAPHICS

R1 DATE:8/27/2009 TIME:3:19 PM
SOUNDING NUMBER:CP-03

CP03

CPTU-EC-S LOG WITH LITHOLOGIC EVALUATION CP03



* Indicates lightly overconsolidated soil
** Indicates heavily overconsolidated or cemented soil

Latitude: 0.00000 Longitude: 0.00000

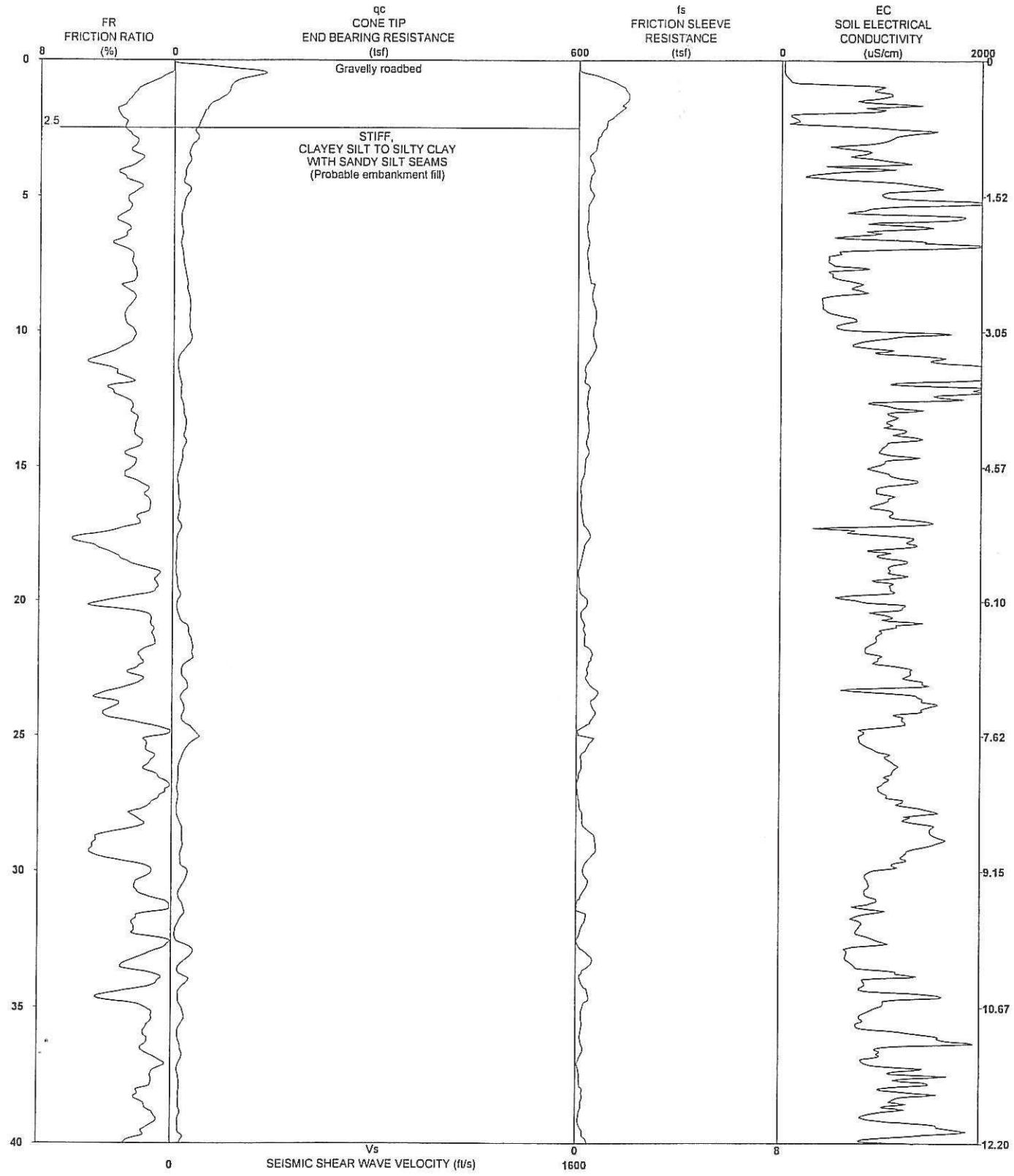
PROJECT NAME:Ameren UE Rush Island Levee Inventory
PROJECT NUMBER:09-110-090

STRATIGRAPHICS

R1 DATE:8/27/2009 TIME:3:19 PM
SOUNDING NUMBER:CP-03

CP03

CPTU-EC-S LOG WITH LITHOLOGIC EVALUATION CP03



Latitude: 0.00000 Longitude: 0.00000

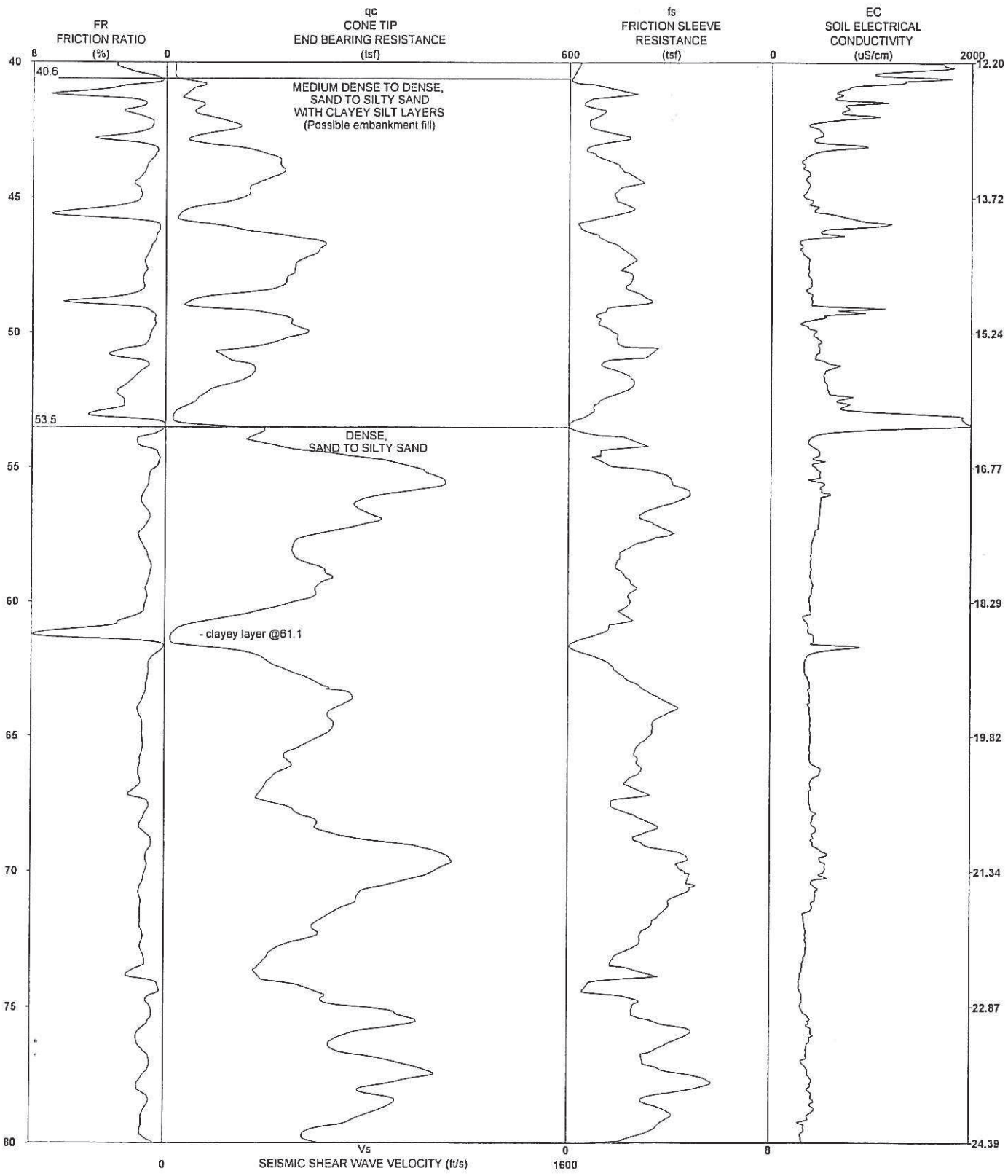
PROJECT NAME:Ameren UE Rush Island Levee Inventory
PROJECT NUMBER:09-110-090

STRATIGRAPHICS

R1 DATE:8/27/2009 TIME:3:19 PM
SOUNDING NUMBER:CP-03

CP03

CPTU-EC-S LOG WITH LITHOLOGIC EVALUATION CP03



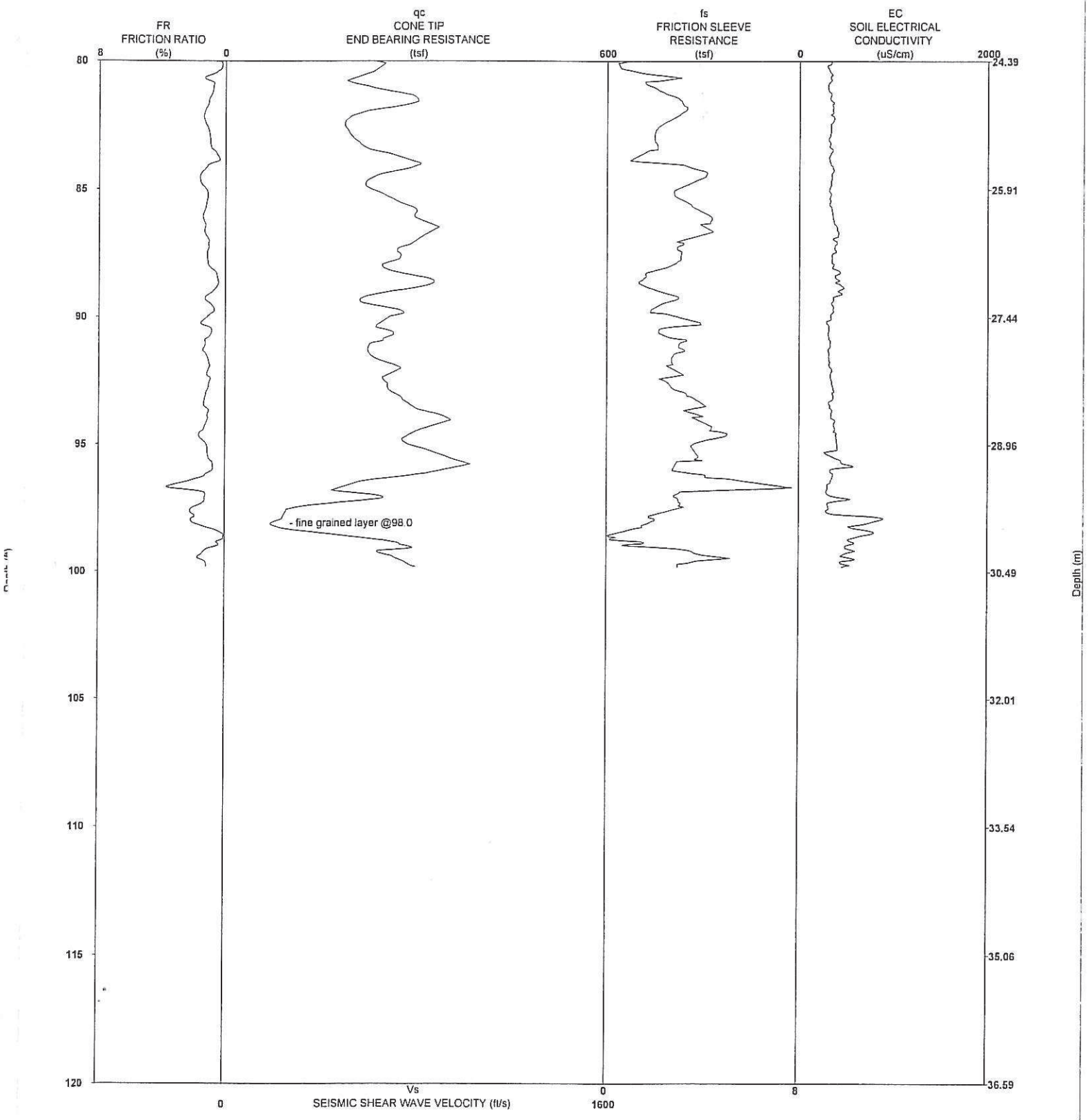
Latitude: 0.00000 Longitude: 0.00000

PROJECT NAME:Ameren UE Rush Island Levee Inventory
PROJECT NUMBER:09-110-090

STRATIGRAPHICS

R1 DATE:8/27/2009 TIME:3:19 PM
SOUNDING NUMBER:CP-03

CPTU-EC-S LOG WITH LITHOLOGIC EVALUATION CP03



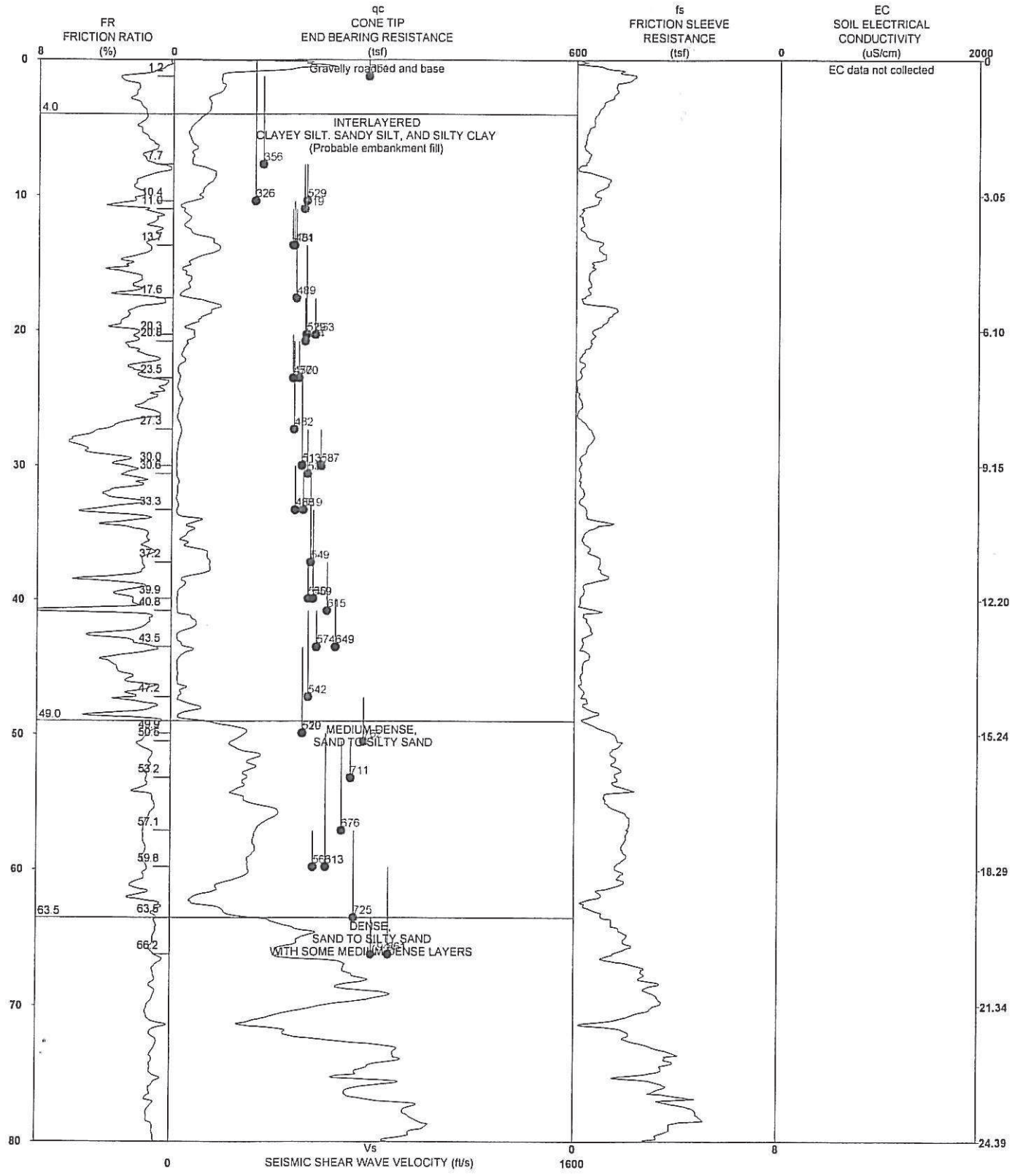
Latitude: 0.00000 Longitude: 0.00000

PROJECT NAME:Ameren UE Rush Island Levee Inventory
PROJECT NUMBER:09-110-090

STRATIGRAPHICS

R1 DATE:8/27/2009 TIME:3:19 PM
SOUNDING NUMBER:CP-03

CPTU-S LOG WITH LITHOLOGIC EVALUATION CP04



0 - 1600 ft/sec True Shear Wave Velocity
0 - 1600 ft/sec Pseudo Interval Receiver 1
0 - 1600 ft/sec Pseudo Interval Receiver 2

Latitude: 38.11862 Longitude: -90.25739

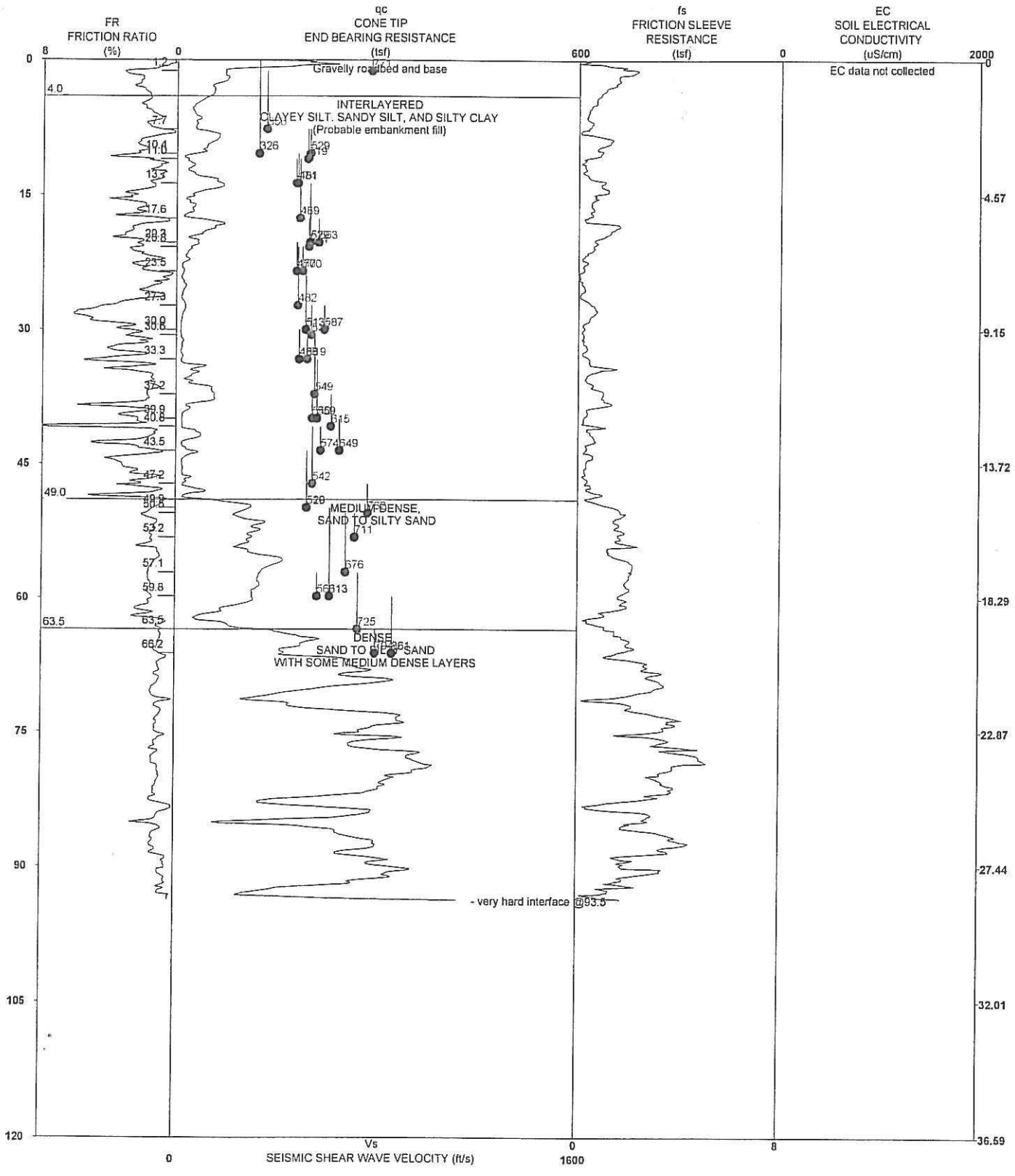
PROJECT NAME:Ameren UE Rush Island Levee Inventory
PROJECT NUMBER:09-110-090

STRATIGRAPHICS

R1 DATE:8/27/2009 TIME:11:42 AM
SOUNDING NUMBER:CP-04

CP04

CPTU-S LOG WITH LITHOLOGIC EVALUATION CP04



0 - 1600 ft/sec True Shear Wave Velocity
0 - 1600 ft/sec Pseudo Interval Receiver 1
0 - 1600 ft/sec Pseudo Interval Receiver 2

Latitude: 38.11862 Longitude: -90.25739

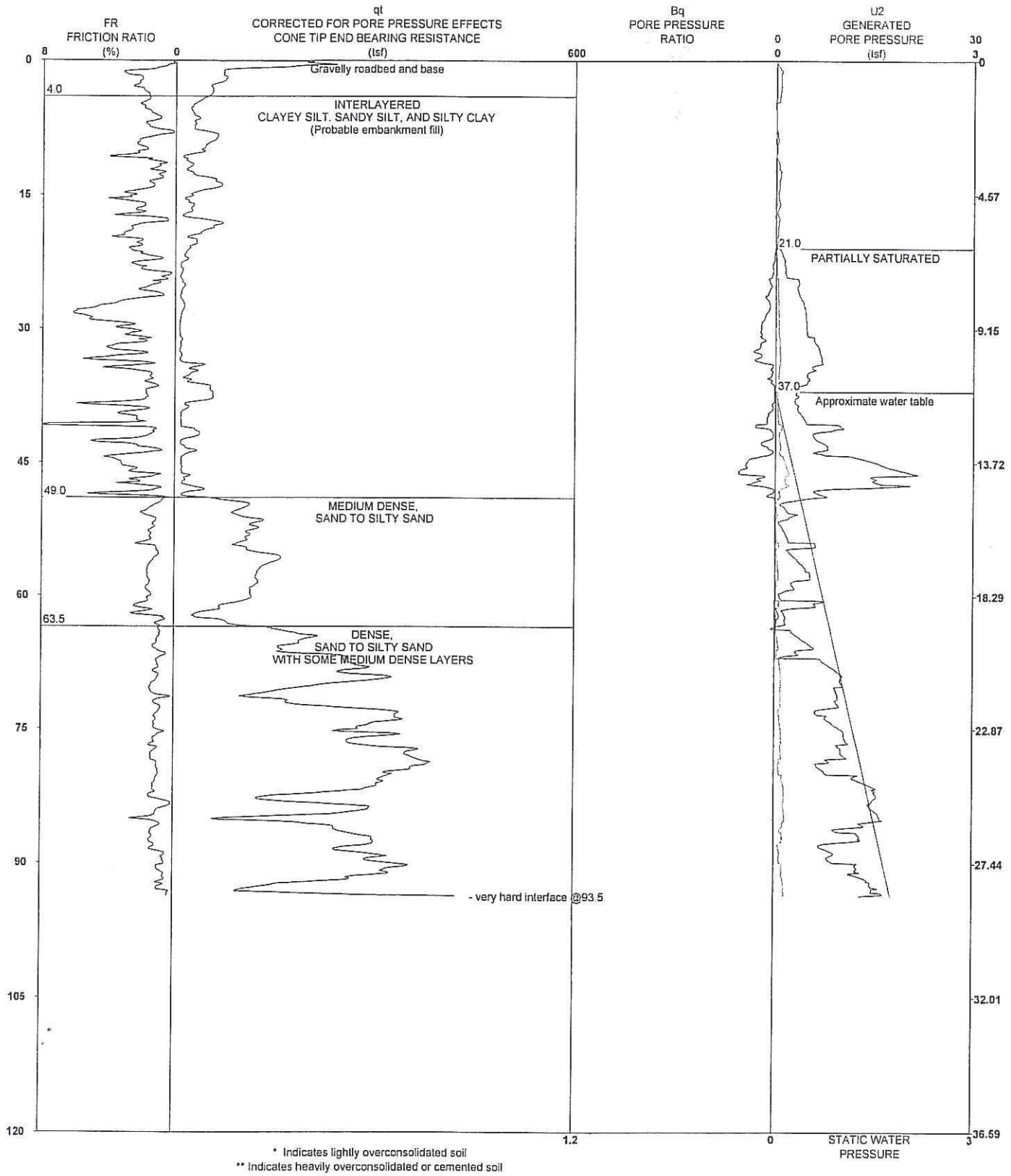
PROJECT NAME:Ameren UE Rush Island Levee Inventory
PROJECT NUMBER:09-110-090

STRATIGRAPHICS

R1 DATE:8/27/2009 TIME:11:42 AM
SOUNDING NUMBER:CP-04

CP04

CPTU-S LOG WITH LITHOLOGIC EVALUATION CP04



* Indicates lightly overconsolidated soil
** Indicates heavily overconsolidated or cemented soil

Latitude: 38.11862 Longitude: -90.25739

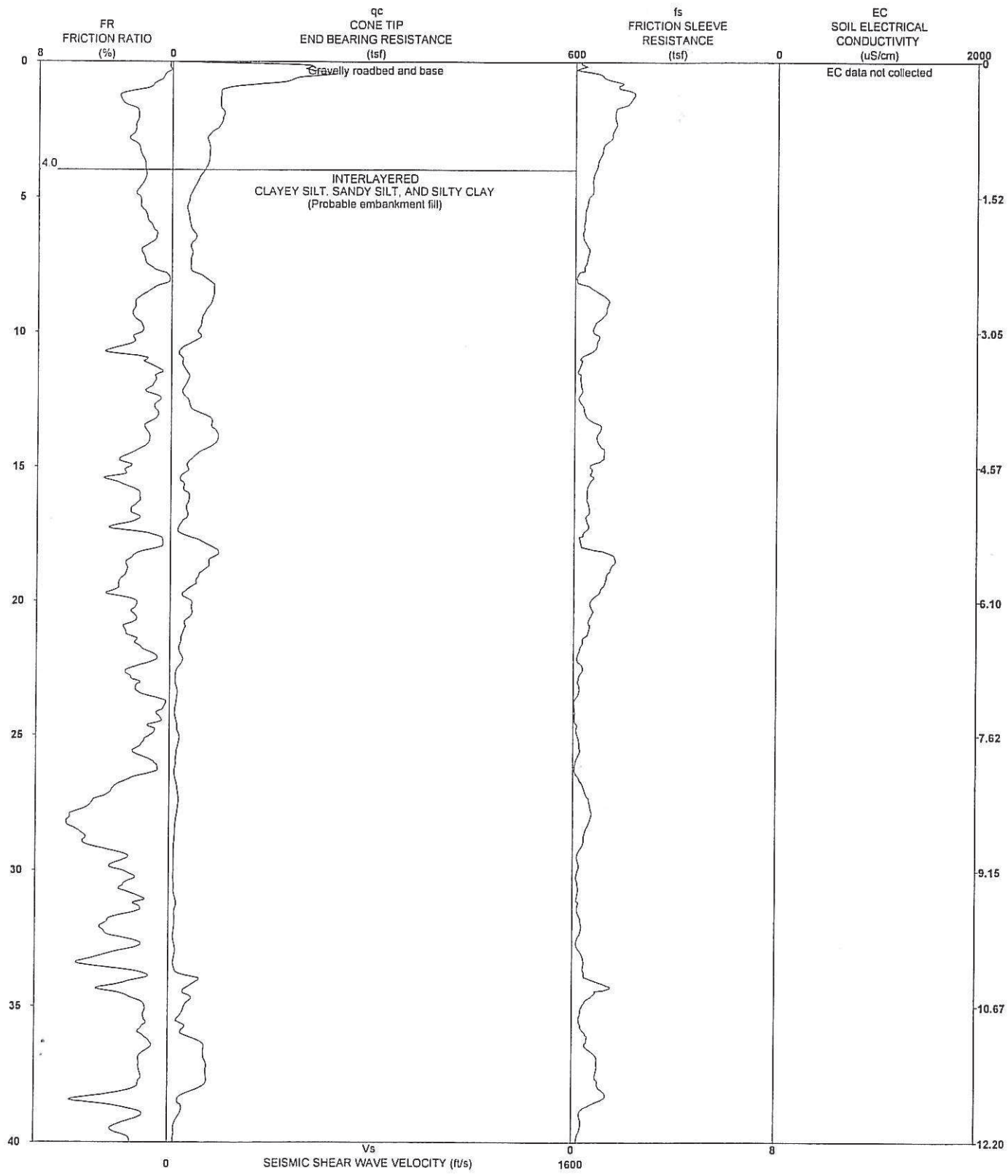
PROJECT NAME:Ameren UE Rush Island Levee Inventory
PROJECT NUMBER:09-110-090

STRATIGRAPHICS

R1 DATE:8/27/2009 TIME:11:42 AM
SOUNDING NUMBER:CP-04

CP04

CPTU-S LOG WITH LITHOLOGIC EVALUATION CP04



Latitude: 38.11862 Longitude: -90.25739

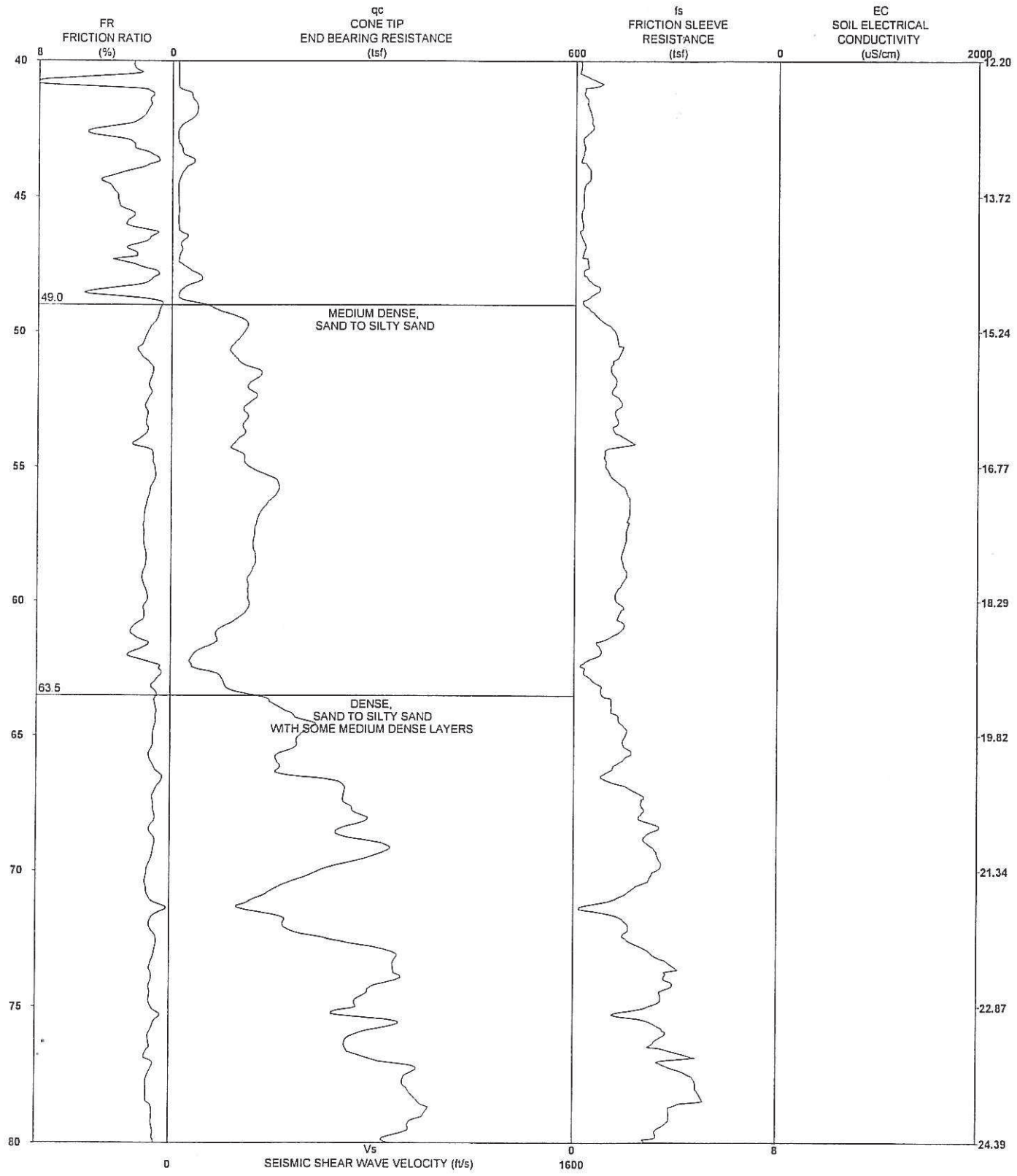
PROJECT NAME:Ameren UE Rush Island Levee Inventory
PROJECT NUMBER:09-110-090

STRATIGRAPHICS

R1 DATE:8/27/2009 TIME:11:42 AM
SOUNDING NUMBER:CP-04

CP04

CPTU-S LOG WITH LITHOLOGIC EVALUATION CP04



Latitude: 38.11862 Longitude: -90.25739

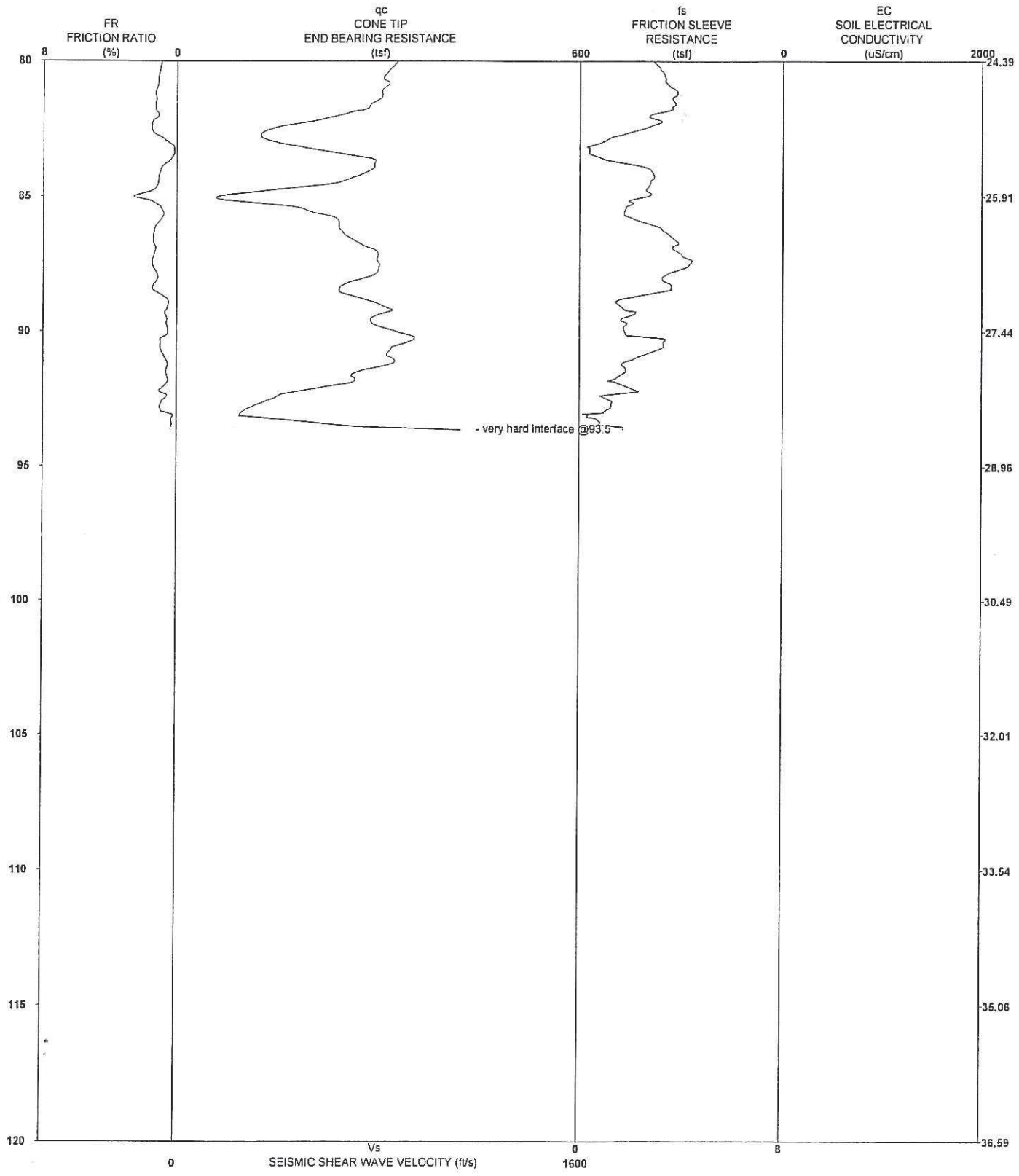
PROJECT NAME:Ameren UE Rush Island Levee Inventory
PROJECT NUMBER:09-110-090

STRATIGRAPHICS

R1 DATE:8/27/2009 TIME:11:42 AM
SOUNDING NUMBER:CP-04

CP04

CPTU-S LOG WITH LITHOLOGIC EVALUATION CP04



Latitude: 38.11862 Longitude: -90.25739

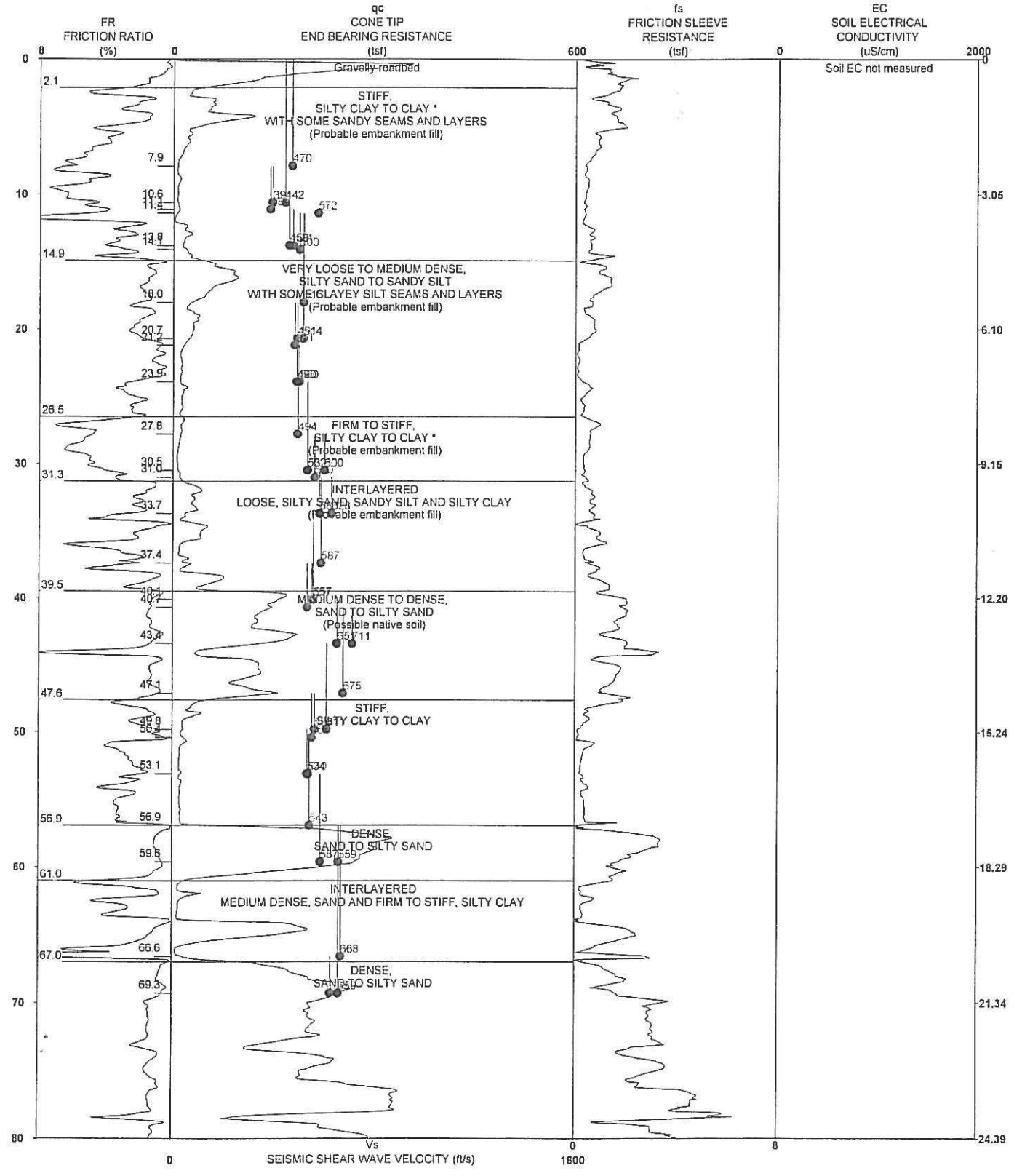
PROJECT NAME:Ameren UE Rush Island Levee Inventory
PROJECT NUMBER:09-110-090

STRATIGRAPHICS

R1 DATE:8/27/2009 TIME:11:42 AM
SOUNDING NUMBER:CP-04

CP04

CPTU-S LOG WITH LITHOLOGIC EVALUATION CP05



Latitude: 38.12255 Longitude: -90.26122

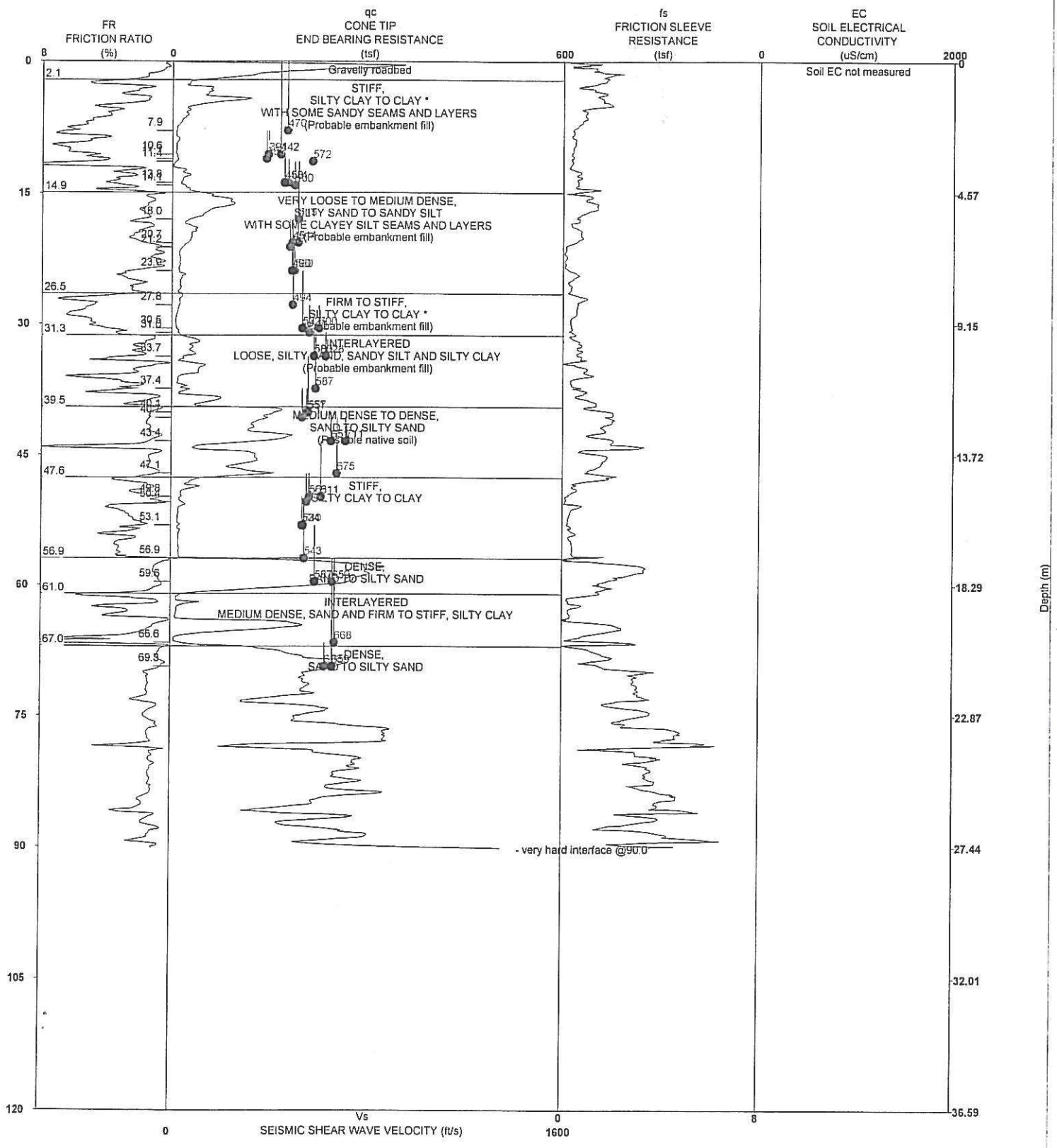
PROJECT NAME:Ameren UE Rush Island Levee Inventory
PROJECT NUMBER:09-110-090

STRATIGRAPHICS

R1 DATE:8/27/2009 TIME:9:12 AM
SOUNDING NUMBER:CP-05

CP05

CPTU-S LOG WITH LITHOLOGIC EVALUATION CP05



Latitude: 38.12255 Longitude: -90.26122

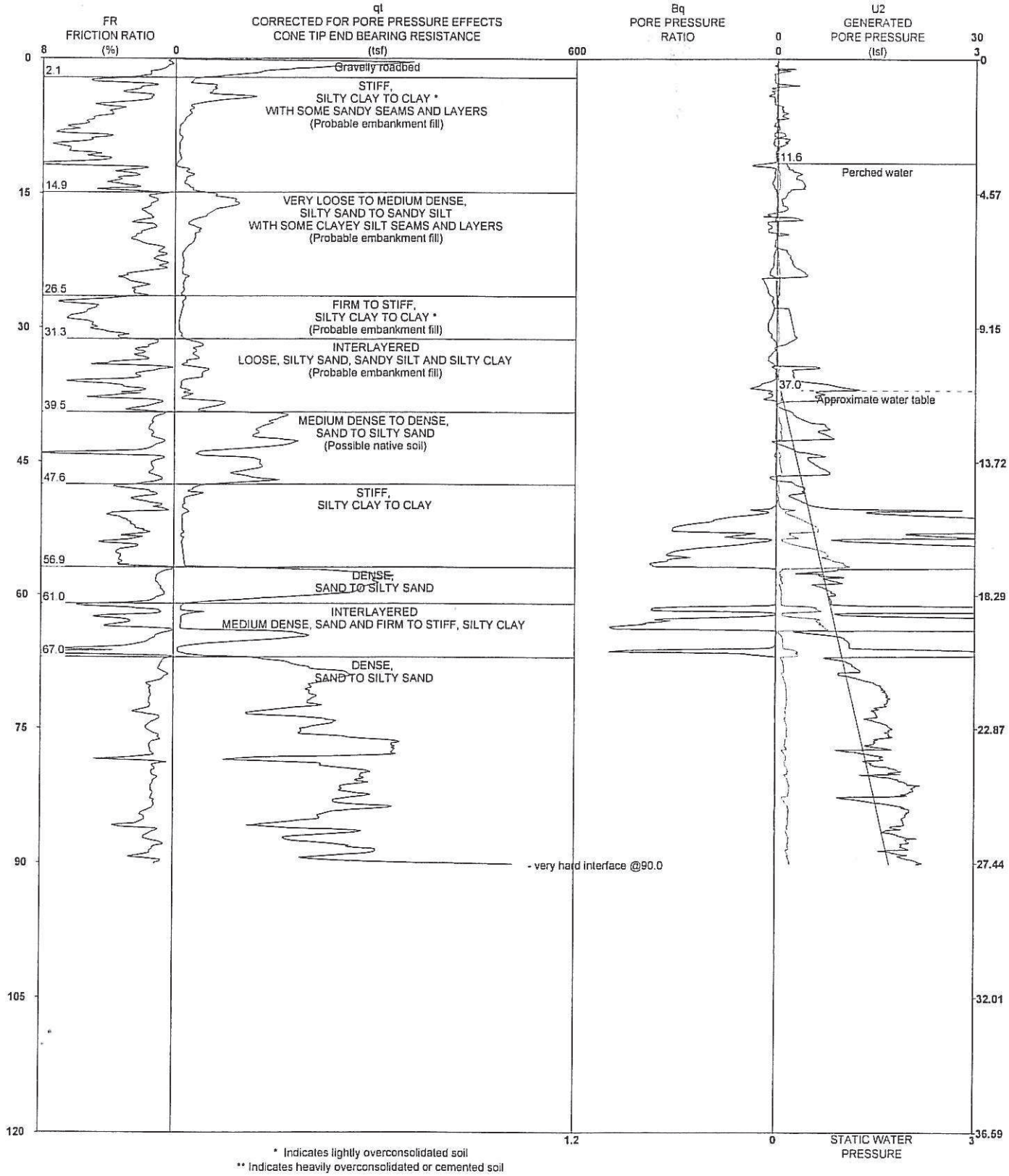
PROJECT NAME:Ameren UE Rush Island Levee Inventory
PROJECT NUMBER:09-110-090

STRATIGRAPHICS

R1 DATE:8/27/2009 TIME:9:12 AM
SOUNDING NUMBER:CP-05

CP05

CPTU-S LOG WITH LITHOLOGIC EVALUATION CP05



* Indicates lightly overconsolidated soil
** Indicates heavily overconsolidated or cemented soil

Latitude: 38.12255 Longitude: -90.26122

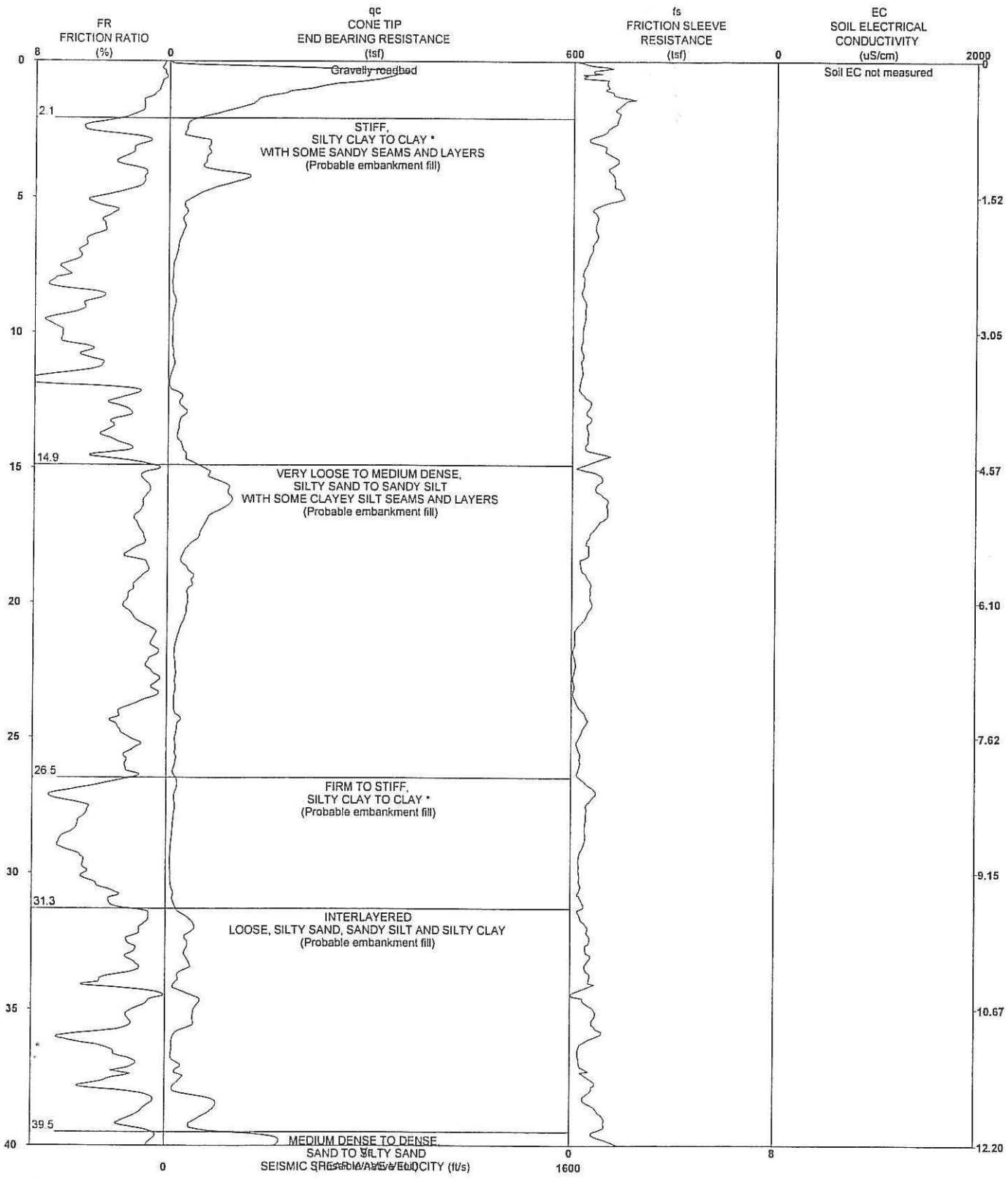
PROJECT NAME:Ameren UE Rush Island Levee Inventory
PROJECT NUMBER:09-110-090

STRATIGRAPHICS

R1 DATE:8/27/2009 TIME:9:12 AM
SOUNDING NUMBER:CP-05

CP05

CPTU-S LOG WITH LITHOLOGIC EVALUATION CP05



Latitude: 38.12255 Longitude: -90.26122

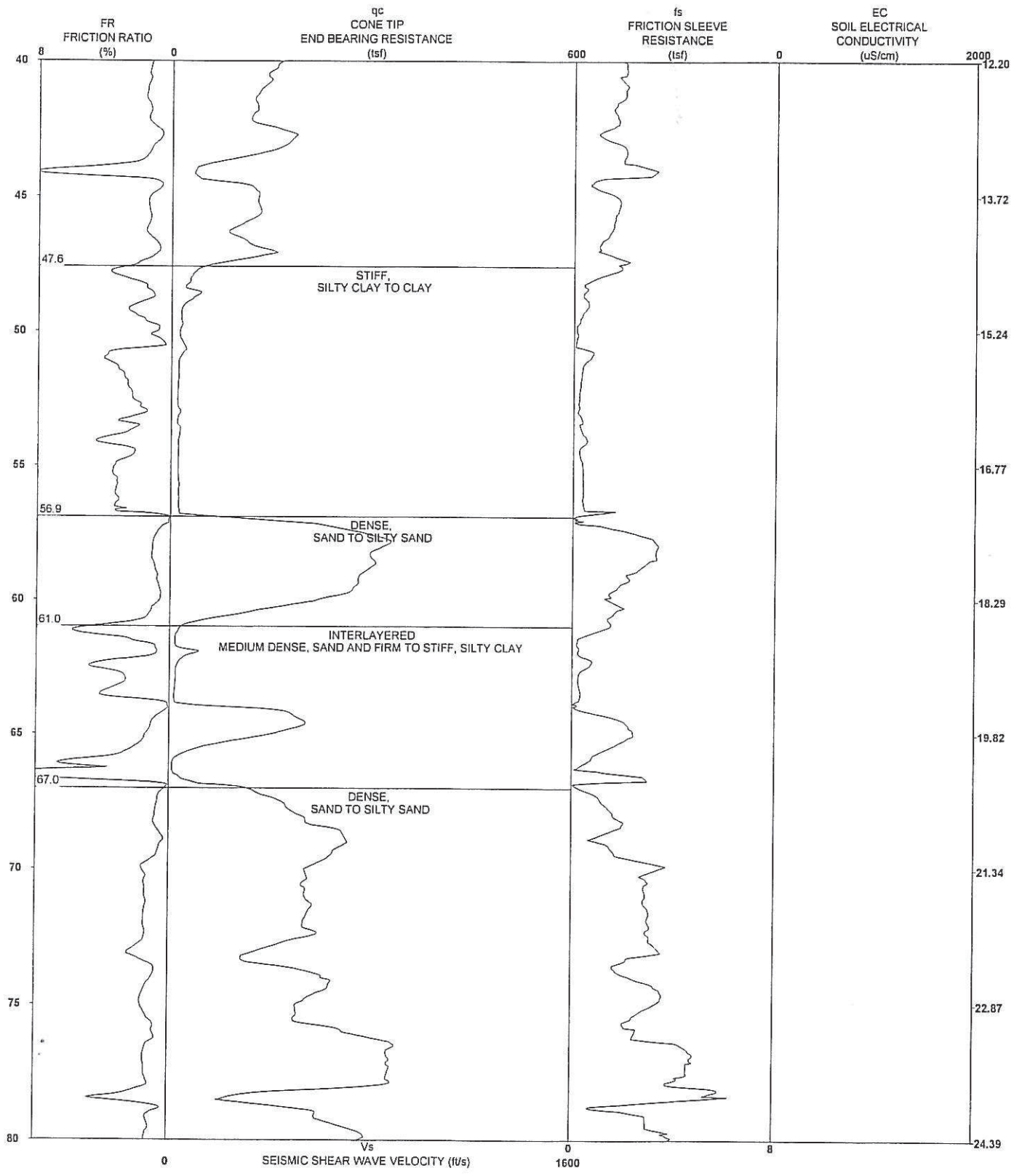
PROJECT NAME:Ameren UE Rush Island Levee Inventory
PROJECT NUMBER:09-110-090

STRATIGRAPHICS

R1 DATE:8/27/2009 TIME:9:12 AM
SOUNDING NUMBER:CP-05

CP05

CPTU-S LOG WITH LITHOLOGIC EVALUATION CP05



Latitude: 38.12255 Longitude: -90.26122

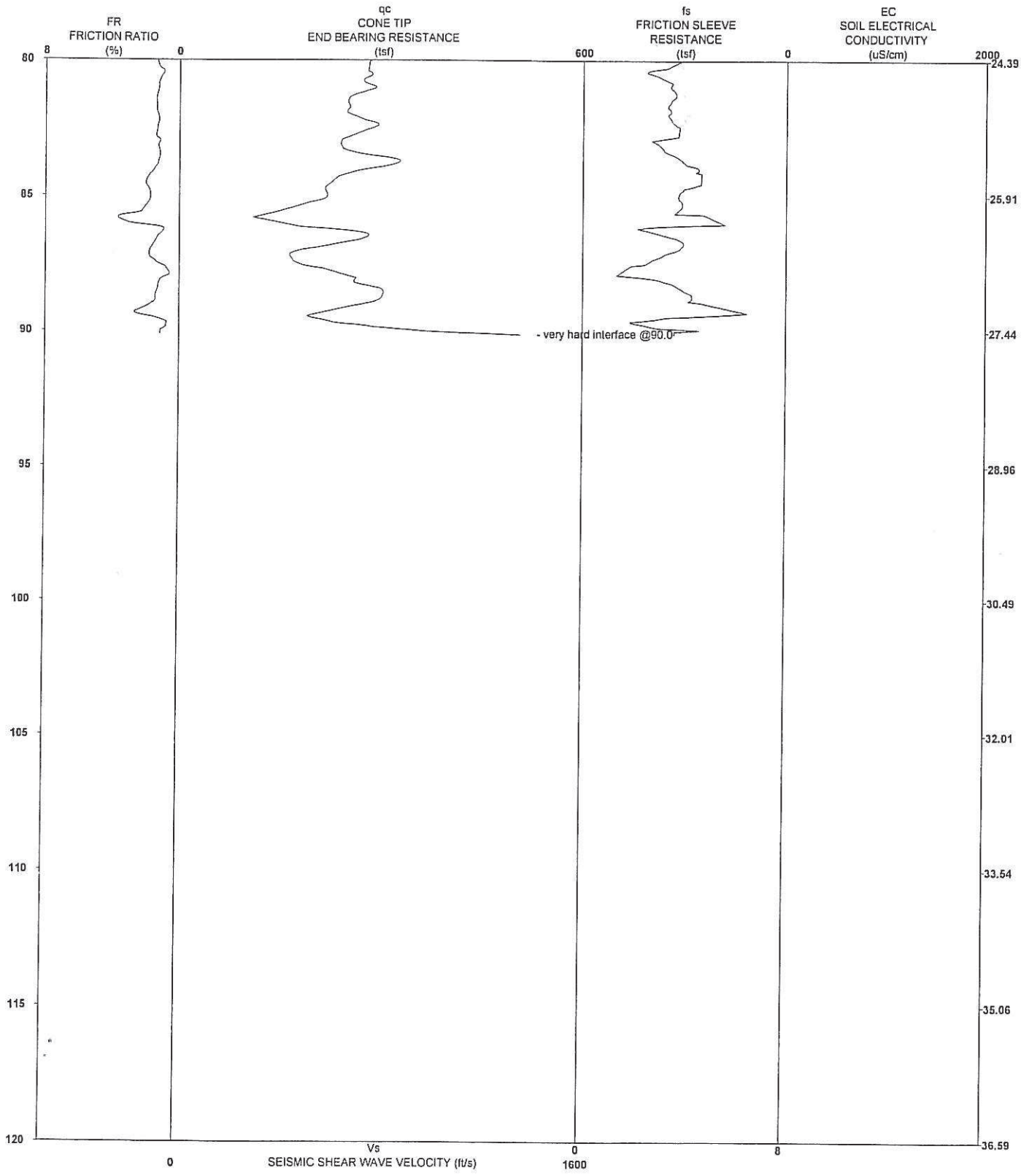
PROJECT NAME:Ameren UE Rush Island Levee Inventory
PROJECT NUMBER:09-110-090

STRATIGRAPHICS

R1 DATE:8/27/2009 TIME:9:12 AM
SOUNDING NUMBER:CP-05

CP05

CPTU-S LOG WITH LITHOLOGIC EVALUATION CP05



Latitude: 38.12255 Longitude: -90.26122

PROJECT NAME:Ameren UE Rush Island Levee Inventory
PROJECT NUMBER:09-110-090

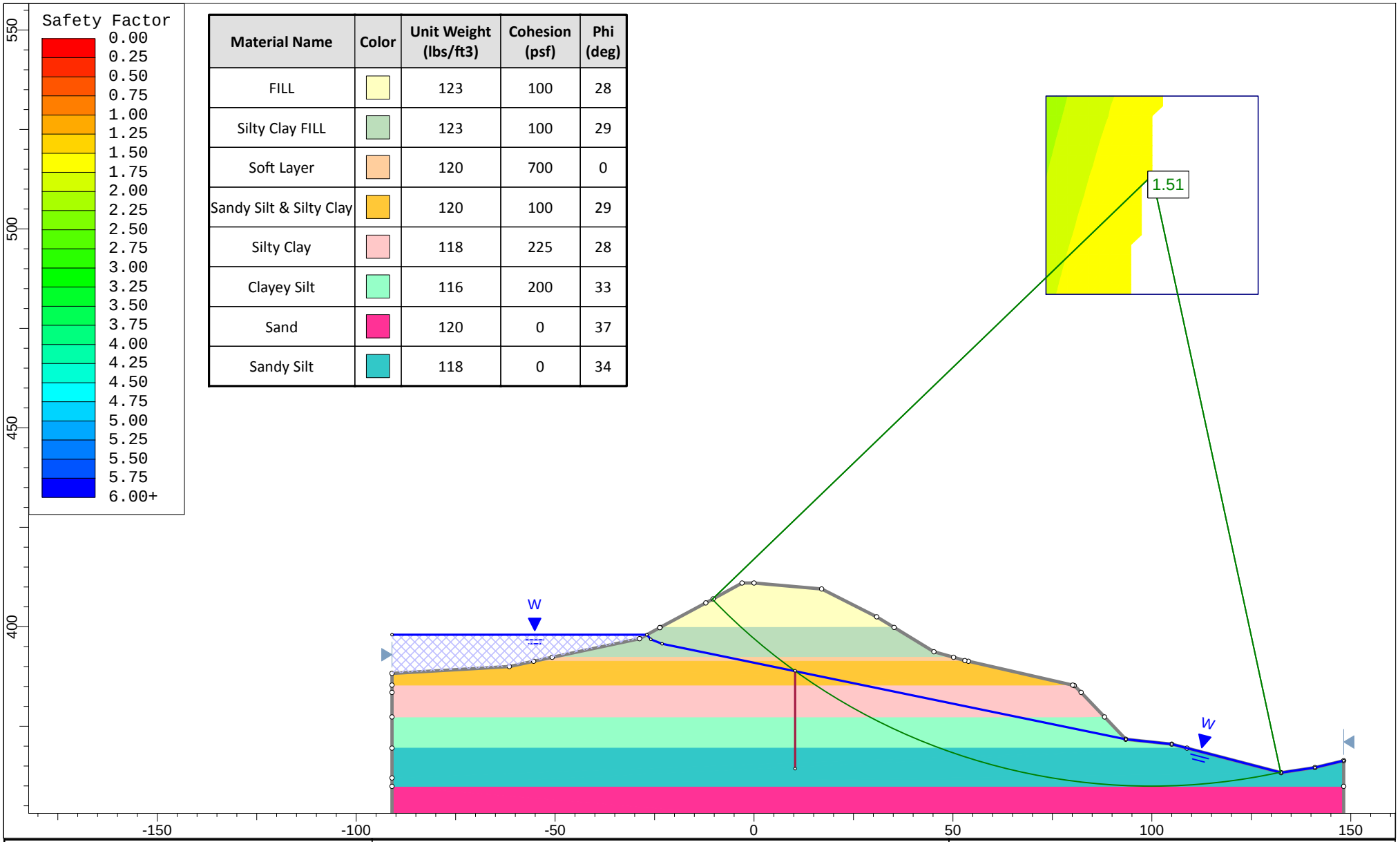
STRATIGRAPHICS

R1 DATE:8/27/2009 TIME:9:12 AM
SOUNDING NUMBER:CP-05

CP05

APPENDIX II

GRAPHICAL RESULTS OF SLOPE STABILITY ANALYSES



Material Name	Color	Unit Weight (lbs/ft3)	Cohesion (psf)	Phi (deg)
FILL		123	100	28
Silty Clay FILL		123	100	29
Soft Layer		120	700	0
Sandy Silt & Silty Clay		120	100	29
Silty Clay		118	225	28
Clayey Silt		116	200	33
Sand		120	0	37
Sandy Silt		118	0	34

REITZ & JENS, INC.
CONSULTING ENGINEERS

Project Name: Periodic Safety Factor Assessment			Client: Ameren - Rush Island Energy Center
Section Location: Section 3			Load Case: Static, Maximum Storage Pool
File Path/Name: P:\Amerenue\2015012432\Rush Island\calc\Section 3\New Sect 3 SS.sli			
Project Number: 2015012432	Analysis By: J. Bertel	Checked By: J. Fouse	Figure: 1

Slide Analysis Information

Periodic Safety Factor Assessment

Project Summary

File Name:	New Sect 3 SS
Slide Modeler Version:	6.038
Project Title:	Periodic Safety Factor Assessment
Analysis:	Static, Maximum Storage Pool
Author:	J. Bertel
Company:	Ameren - Rush Island Energy Center
	Comments
	2015012432
	Section 3
	J. Fouse

General Settings

Units of Measurement:	Imperial Units
Time Units:	seconds
Permeability Units:	feet/second
Failure Direction:	Left to Right
Data Output:	Standard
Maximum Material Properties:	20
Maximum Support Properties:	20

Analysis Options

Slices Type:	Vertical
Analysis Methods Used	
GLE/Morgenstern-Price with interslice force function:	Half Sine Spencer
Number of slices:	25
Tolerance:	0.005
Maximum number of iterations:	50
Check malpha < 0.2:	Yes
Initial trial value of FS:	1
Steffensen Iteration:	Yes

Groundwater Analysis

Groundwater Method:	Water Surfaces
Pore Fluid Unit Weight [lbs/ft3]:	62.4
Use negative pore pressure cutoff:	Yes
Maximum negative pore pressure [psf]:	0
Advanced Groundwater Method:	None

Random Numbers

Pseudo-random Seed:	10116
Random Number Generation Method:	Park and Miller v.3

Surface Options

Surface Type:	Circular
Search Method:	Grid Search
Radius Increment:	10
Composite Surfaces:	Disabled
Reverse Curvature:	Create Tension Crack
Minimum Elevation:	Not Defined
Minimum Depth:	Not Defined
Minimum Area:	Not Defined
Minimum Weight:	Not Defined

Seismic

Advanced seismic analysis:	No
Staged pseudostatic analysis:	No

Material Properties

Property	FILL	Silty Clay FILL	Soft Layer	Sandy Silt & Silty Clay	Silty Clay	Clayey Silt	Sand	Sandy Silt
Color								
Strength Type	Mohr-Coulomb	Mohr-Coulomb	Mohr-Coulomb	Mohr-Coulomb	Mohr-Coulomb	Mohr-Coulomb	Mohr-Coulomb	Mohr-Coulomb
Unit Weight [lbs/ft3]	123	123	120	120	118	116	120	118
Cohesion [psf]	100	100	700	100	225	200	0	0
Friction Angle [deg]	28	29	0	29	28	33	37	34
Water Surface	Water Table	Water Table	Water Table	Water Table	Water Table	Water Table	Water Table	Water Table
Hu Value	1	1	1	1	1	1	1	1

Global Minimums

Method: spencer

FS	1.514540
Center:	94.694, 498.486
Radius:	138.569
Left Slip Surface Endpoint:	-9.679, 407.340
Right Slip Surface Endpoint:	128.971, 364.224
Resisting Moment:	2.01859e+007 lb-ft
Driving Moment:	1.33281e+007 lb-ft
Resisting Horizontal Force:	132899 lb
Driving Horizontal Force:	87748.8 lb
Total Slice Area:	2537.42 ft2
Surface Horizontal Width:	138.651 ft
Surface Average Height:	18.3008 ft

Method: gle/morgenstern-price

FS	1.513810
Center:	97.361, 505.966
Radius:	145.997
Left Slip Surface Endpoint:	-10.084, 407.119
Right Slip Surface Endpoint:	130.589, 363.800
Resisting Moment:	2.11321e+007 lb-ft
Driving Moment:	1.39595e+007 lb-ft
Resisting Horizontal Force:	132322 lb
Driving Horizontal Force:	87410 lb
Total Slice Area:	2518.58 ft2
Surface Horizontal Width:	140.672 ft
Surface Average Height:	17.9039 ft

Valid / Invalid Surfaces

Method: spencer

Number of Valid Surfaces: 2365
Number of Invalid Surfaces: 2486

Error Codes:

Error Code -1000 reported for 2486 surfaces

Method: gle/morgenstern-price

Number of Valid Surfaces: 2365
Number of Invalid Surfaces: 2486

Error Codes:

Error Code -1000 reported for 2486 surfaces

Error Codes

The following errors were encountered during the computation:

-1000 = No valid slip surfaces are generated at a grid center. Unable to draw a surface.

Slice Data

Global Minimum Query (spencer) - Safety Factor: 1.51454

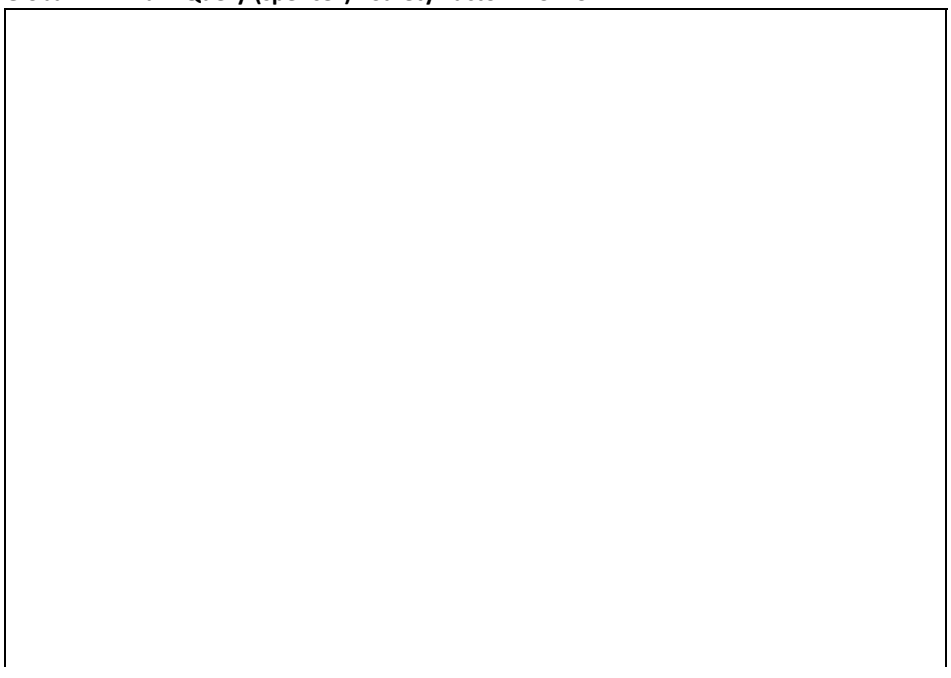
Slice Number	Width [ft]	Weight [lbs]	Angle of Slice Base [degrees]	Base Material	Base Cohesion [psf]	Base Friction Angle [degrees]	Shear Stress [psf]	Shear Strength [psf]	Base Normal Stress [psf]	Pore Pressure [psf]	Effective Normal Stress [psf]
1	7.09838	4983.73	-46.7288	FILL	100	28	209.566	317.396	408.861	0	408.861
2	8.24759	14991.8	-42.282	Silty Clay FILL	100	29	498.702	755.304	1182.2	0	1182.2
3	1.20653	2765.43	-39.6527	Soft Layer	700	0	462.187	700	1642.71	0	1642.71
4	7.88172	20986.9	-37.2804	Sandy Silt & Silty Clay	100	29	744.338	1127.33	1878.28	24.9292	1853.35
5	6.37165	19922.5	-33.6494	Silty Clay	225	28	877.237	1328.61	2328.51	252.918	2075.6
6	6.37165	20526.9	-30.5372	Silty Clay	225	28	882.149	1336.05	2510.26	420.677	2089.58
7	5.5202	17857.4	-27.7183	Clayey Silt	200	33	1006.89	1524.98	2592.36	552.071	2040.29
8	5.5202	17395.6	-25.1679	Clayey Silt	200	33	972.579	1473.01	2612.86	652.588	1960.27
9	5.5202	16673.8	-22.6699	Clayey Silt	200	33	925.456	1401.64	2584.92	734.551	1850.37
10	5.30703	15544.8	-20.2634	Sandy Silt	0	34	795.912	1205.44	2585.21	798.085	1787.12
11	5.30703	15710.3	-17.9404	Sandy Silt	0	34	817.45	1238.06	2680.16	844.658	1835.5
12	5.30703	15897.3	-15.6476	Sandy Silt	0	34	848.02	1284.36	2780.62	876.481	1904.14
13	5.30703	15983.7	-13.3802	Sandy Silt	0	34	878.22	1330.1	2866.03	894.08	1971.95
14	5.30703	15931.7	-11.1341	Sandy Silt	0	34	904.499	1369.9	2928.84	897.888	2030.95
15	5.30703	15744.9	-8.90512	Sandy Silt	0	34	926.466	1403.17	2968.55	888.253	2080.3
16	5.30703	15403.4	-6.68971	Sandy Silt	0	34	941.725	1426.28	2979.99	865.453	2114.54
17	5.30703	13304.3	-4.48432	Sandy Silt	0	34	803.016	1216.2	2632.79	829.694	1803.1
18	5.30703	10017.3	-2.28557	Sandy Silt	0	34	548.848	831.253	2013.5	781.122	1232.38
19	5.30703	7409.21	-0.0901973	Sandy Silt	0	34	345.821	523.76	1503.57	727.067	776.506
20	5.30703	6875.31	2.10505	Sandy Silt	0	34	329.812	499.514	1427.36	686.798	740.56
21	5.30703	6281.23	4.30339	Sandy Silt	0	34	313.188	474.335	1336.16	632.924	703.231
22	5.30703	5166.81	6.50811	Sandy Silt	0	34	273.882	414.806	1129.85	514.872	614.975
23	5.30703	3852.47	8.72257	Sandy Silt	0	34	214.84	325.384	866.277	383.876	482.401
24	5.30703	2405.89	10.9503	Sandy Silt	0	34	141.401	214.157	557.234	239.732	317.502
25	5.30703	824.658	13.1949	Sandy Silt	0	34	51.5261	78.0384	197.869	82.1723	115.697

Global Minimum Query (gle/morgenstern-price) - Safety Factor: 1.51381

Slice Number	Width [ft]	Weight [lbs]	Angle of Slice Base [degrees]	Base Material	Base Cohesion [psf]	Base Friction Angle [degrees]	Shear Stress [psf]	Shear Strength [psf]	Base Normal Stress [psf]	Pore Pressure [psf]	Effective Normal Stress [psf]
1	7.22512	5010.43	-45.368	FILL	100	28	224.446	339.769	450.94	0	450.94
2	4.29706	6938.49	-42.2112	Silty Clay FILL	100	29	474.582	718.427	1115.67	0	1115.67
3	4.29706	8764.46	-39.9724	Silty Clay FILL	100	29	589.489	892.375	1429.48	0	1429.48
4	1.2546	2874.34	-38.5572	Soft Layer	700	0	462.409	700	1737.04	0	1737.04
5	8.18267	21764.5	-36.251	Sandy Silt & Silty Clay	100	29	757.605	1146.87	1910.09	21.4963	1888.6
6	6.59685	20455.8	-32.7208	Silty Clay	225	28	869.092	1315.64	2297.22	246.02	2051.2
7	6.59685	20940.3	-29.6917	Silty Clay	225	28	856.468	1296.53	2426.15	410.887	2015.27
8	5.70268	18070	-26.9461	Clayey Silt	200	33	962.505	1457.05	2475.39	539.701	1935.69
9	5.70268	17480.3	-24.4613	Clayey Silt	200	33	921.523	1395.01	2477.98	637.839	1840.14
10	5.70268	16658.4	-22.0247	Clayey Silt	200	33	874.053	1323.15	2447	717.505	1729.5
11	5.67427	16299.7	-19.6352	Sandy Silt	0	34	765.314	1158.54	2497.18	779.577	1717.6
12	5.67427	16516	-17.2868	Sandy Silt	0	34	802.366	1214.63	2625.71	824.953	1800.75
13	5.67427	16719.1	-14.968	Sandy Silt	0	34	848.957	1285.16	2759.83	854.498	1905.33
14	5.67427	16769	-12.6741	Sandy Silt	0	34	892.562	1351.17	2871.95	868.759	2003.19
15	5.67427	16659.7	-10.4007	Sandy Silt	0	34	929.456	1407.02	2954.17	868.184	2085.99
16	5.67427	16395.1	-8.1438	Sandy Silt	0	34	956.434	1447.86	2999.67	853.13	2146.54
17	5.67427	14953.4	-5.89955	Sandy Silt	0	34	884.232	1338.56	2808.37	823.875	1984.5
18	5.67427	11343	-3.66436	Sandy Silt	0	34	620.196	938.859	2172.54	780.624	1391.91
19	5.67427	8113.97	-1.43474	Sandy Silt	0	34	379.082	573.858	1576.64	725.862	850.779
20	5.67427	7395.83	0.792695	Sandy Silt	0	34	339.322	513.669	1452.56	691.02	761.545
21	5.67427	6805.14	3.02133	Sandy Silt	0	34	311.998	472.306	1342.09	641.864	700.223
22	5.67427	5617.4	5.25457	Sandy Silt	0	34	260.642	394.563	1108.5	523.535	584.963
23	5.67427	4198.25	7.49585	Sandy Silt	0	34	192.354	291.188	822.959	391.256	431.703
24	5.67427	2627.2	9.74874	Sandy Silt	0	34	117.591	178.01	508.752	244.842	263.91
25	5.67427	901.731	12.017	Sandy Silt	0	34	39.7734	60.2093	173.301	84.0368	89.2645

Interslice Data

Global Minimum Query (spencer) - Safety Factor: 1.51454



Slice Number	X coordinate [ft]	Y coordinate - Bottom [ft]	Interslice Normal Force [lbs]	Interslice Shear Force [lbs]	Interslice Force Angle [degrees]
1	-9.67912	407.34	0	0	0
2	-2.58074	399.8	1593.17	505.649	17.6087
3	5.66685	392.3	6340.6	2012.42	17.6087
4	6.87338	391.3	7424.86	2356.55	17.6087
5	14.7551	385.3	12819.3	4068.68	17.6088
6	21.1267	381.059	17097.5	5426.52	17.6087
7	27.4984	377.3	20904.1	6634.67	17.6087
8	33.0186	374.4	22856.7	7254.4	17.6087
9	38.5388	371.806	24257.4	7698.96	17.6087
10	44.059	369.5	25101.4	7966.84	17.6087
11	49.366	367.541	25936.5	8231.89	17.6087
12	54.673	365.822	26197.2	8314.63	17.6087
13	59.9801	364.336	25823.6	8196.05	17.6087
14	65.2871	363.074	24774.1	7862.95	17.6087
15	70.5941	362.029	23026	7308.14	17.6087
16	75.9011	361.198	20570.6	6528.81	17.6087
17	81.2082	360.575	17420.5	5529.03	17.6087
18	86.5152	360.159	14248.5	4522.27	17.6087
19	91.8222	359.947	11758	3731.82	17.6087
20	97.1293	359.939	9932.6	3152.47	17.6087
21	102.436	360.134	7901.31	2507.76	17.6087
22	107.743	360.533	5703.2	1810.12	17.6087
23	113.05	361.139	3563.55	1131.02	17.6087
24	118.357	361.953	1716.39	544.758	17.6087
25	123.664	362.98	392.711	124.641	17.6087
26	128.971	364.224	0	0	0

Global Minimum Query (gle/morgenstern-price) - Safety Factor: 1.51381

Slice Number	X coordinate [ft]	Y coordinate - Bottom [ft]	Interslice Normal Force [lbs]	Interslice Shear Force [lbs]	Interslice Force Angle [degrees]
1	-10.0837	407.119	0	0	0
2	-2.85855	399.8	1673.42	103.894	3.55264
3	1.43851	395.902	3976.38	391.061	5.61675
4	5.73558	392.3	6584.46	880.358	7.61542
5	6.99017	391.3	7739.53	1113	8.18344
6	15.1728	385.3	12981.2	2681.86	11.6728
7	21.7697	381.062	16966.5	4280.6	14.1601
8	28.3665	377.3	20424.5	5974.86	16.306
9	34.0692	374.401	22094.2	7119.54	17.8608
10	39.7719	371.807	23250.8	8061.5	19.1224
11	45.4746	369.5	23895.5	8735.87	20.0817
12	51.1489	367.476	24594.6	9308.61	20.7307
13	56.8231	365.71	24664	9503.27	21.0721
14	62.4974	364.193	24018.3	9270	21.1044
15	68.1717	362.917	22602.3	8598.24	20.8275
16	73.8459	361.875	20388.4	7518.65	20.2425
17	79.5202	361.063	17379.8	6104.04	19.352
18	85.1945	360.477	13993.2	4590.11	18.1607
19	90.8687	360.113	11252.4	3370.92	16.6768
20	96.543	359.971	9318.6	2481.73	14.9129
21	102.217	360.05	7273.05	1664.04	12.8872
22	107.892	360.349	5095.12	955.851	10.6253
23	113.566	360.871	3033.01	434.929	8.1605
24	119.24	361.618	1323.65	128.256	5.53444
25	124.914	362.593	158.313	7.73194	2.79608
26	130.589	363.8	0	0	0

List Of Coordinates

Water Table

X	Y
-91	398
-26.95	398
-25.9406	396.824
-23.1423	395.689
93.4	371.7
93.4625	371.7
105	370.5
132.5	363.3
141	364.6
148.2	366.3

Focus Search Line

X	Y
10.3065	364.318
10.3065	388.939

External Boundary

X	Y
-91	388.265
-91	385.3
-91	383.5
-91	377.3
-91	369.5
-91	362
-91	359.9
-91	340
148.2	340
148.2	359.9
148.2	366.3
141	364.6
132.5	363.3
108.819	369.5
105	370.5
93.4	371.7
88.0847	377.3
82.2	383.5
80.5	385.2
80.0635	385.3
53.873	391.3
53	391.5
50.1636	392.3
45.2	393.7
35.2182	399.8
30.8	402.5
17	409.5
0	411
-3	411
-10.3	407
-12.15	406
-23.62	399.8
-23.7125	399.75
-28.8	397
-50.7557	392.3
-55.4271	391.3
-61.5	390

Material Boundary

X	Y
-23.62	399.8
35.2182	399.8

Material Boundary

X	Y
-50.7557	392.3
50.1636	392.3

Material Boundary

X	Y
-55.4271	391.3
53.873	391.3

Material Boundary

X	Y
-91	385.3
80.0635	385.3

Material Boundary

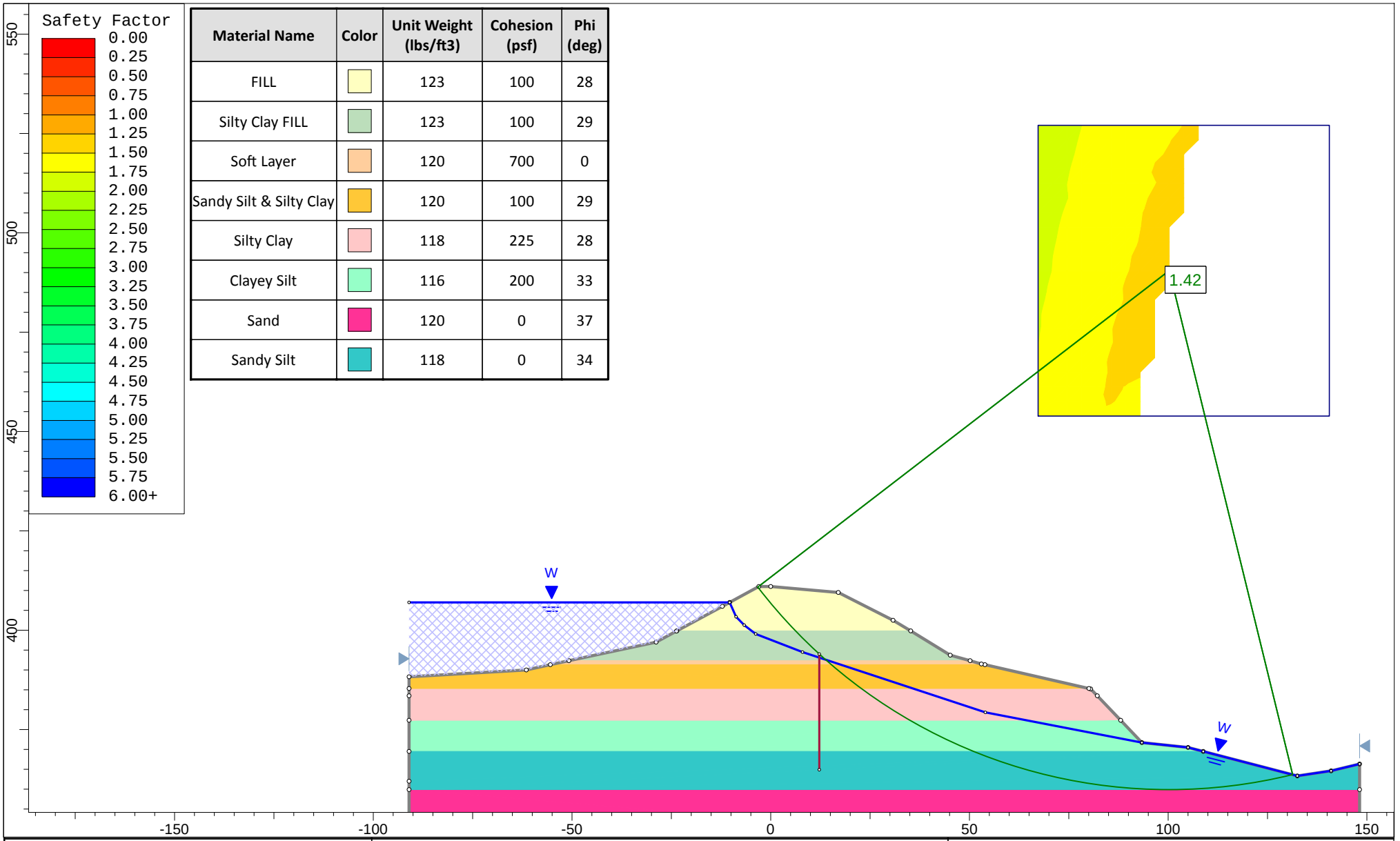
X	Y
-91	377.3
88.0847	377.3

Material Boundary

X	Y
-91	359.9
148.2	359.9

Material Boundary

X	Y
-91	369.5
108.819	369.5



Material Name	Color	Unit Weight (lbs/ft3)	Cohesion (psf)	Phi (deg)
FILL		123	100	28
Silty Clay FILL		123	100	29
Soft Layer		120	700	0
Sandy Silt & Silty Clay		120	100	29
Silty Clay		118	225	28
Clayey Silt		116	200	33
Sand		120	0	37
Sandy Silt		118	0	34

REITZ & JENS, INC.
CONSULTING ENGINEERS

Project Name: Periodic Safety Factor Assessment			Client: Ameren - Rush Island Energy Center
Section Location: Section 3			Load Case: Static, Maximum Surcharge Pool
File Path/Name: P:\Amerenue\2015012432\Rush Island\calc\Section 3\New Sect 3 SS MAX.sli			
Project Number: 2015012432	Analysis By: J. Bertel	Checked By: J. Fouse	Figure: 2

Slide Analysis Information

Periodic Safety Factor Assessment

Project Summary

File Name:	New Sect 3 SS MAX
Slide Modeler Version:	6.038
Project Title:	Periodic Safety Factor Assessment
Analysis:	Static, Maximum Surcharge Pool
Author:	J. Bertel
Company:	Ameren - Rush Island Energy Center
	Comments
	2015012432
	Section 3
	J. Fouse

General Settings

Units of Measurement:	Imperial Units
Time Units:	seconds
Permeability Units:	feet/second
Failure Direction:	Left to Right
Data Output:	Standard
Maximum Material Properties:	20
Maximum Support Properties:	20

Analysis Options

Slices Type:	Vertical
Analysis Methods Used	
GLE/Morgenstern-Price with interslice force function:	Half Sine Spencer
Number of slices:	25
Tolerance:	0.005
Maximum number of iterations:	50
Check malpha < 0.2:	Yes
Initial trial value of FS:	1
Steffensen Iteration:	Yes

Groundwater Analysis

Groundwater Method:	Water Surfaces
Pore Fluid Unit Weight [lbs/ft3]:	62.4
Use negative pore pressure cutoff:	Yes
Maximum negative pore pressure [psf]:	0
Advanced Groundwater Method:	None

Random Numbers

Pseudo-random Seed:	10116
Random Number Generation Method:	Park and Miller v.3

Surface Options

Surface Type:	Circular
Search Method:	Grid Search
Radius Increment:	10
Composite Surfaces:	Disabled
Reverse Curvature:	Create Tension Crack
Minimum Elevation:	Not Defined
Minimum Depth:	Not Defined
Minimum Area:	Not Defined
Minimum Weight:	Not Defined

Seismic

Advanced seismic analysis:	No
Staged pseudostatic analysis:	No

Material Properties

Property	FILL	Silty Clay FILL	Soft Layer	Sandy Silt & Silty Clay	Silty Clay	Clayey Silt	Sand	Sandy Silt
Color								
Strength Type	Mohr-Coulomb	Mohr-Coulomb	Mohr-Coulomb	Mohr-Coulomb	Mohr-Coulomb	Mohr-Coulomb	Mohr-Coulomb	Mohr-Coulomb
Unit Weight [lbs/ft3]	123	123	120	120	118	116	120	118
Cohesion [psf]	100	100	700	100	225	200	0	0
Friction Angle [deg]	28	29	0	29	28	33	37	34
Water Surface	Water Table	Water Table	Water Table	Water Table	Water Table	Water Table	Water Table	Water Table
Hu Value	1	1	1	1	1	1	1	1

Global Minimums

Method: spencer

FS	1.423990
Center:	100.267, 490.477
Radius:	130.630
Left Slip Surface Endpoint:	-3.283, 410.845
Right Slip Surface Endpoint:	131.353, 363.600
Resisting Moment:	1.61437e+007 lb-ft
Driving Moment:	1.1337e+007 lb-ft
Resisting Horizontal Force:	111454 lb
Driving Horizontal Force:	78268.8 lb
Total Slice Area:	2174.57 ft2

Method: gle/morgenstern-price

FS	1.425450
Center:	100.267, 494.135
Radius:	134.292
Left Slip Surface Endpoint:	-4.531, 410.161
Right Slip Surface Endpoint:	131.572, 363.543
Resisting Moment:	1.69717e+007 lb-ft
Driving Moment:	1.19062e+007 lb-ft
Resisting Horizontal Force:	114422 lb
Driving Horizontal Force:	80270.8 lb
Total Slice Area:	2233.86 ft2

Valid / Invalid Surfaces

Method: spencer

Number of Valid Surfaces: 2266
Number of Invalid Surfaces: 2585

Error Codes:

Error Code -1000 reported for 2585 surfaces

Method: gle/morgenstern-price

Number of Valid Surfaces: 2266
Number of Invalid Surfaces: 2585

Error Codes:

Error Code -1000 reported for 2585 surfaces

Error Codes

The following errors were encountered during the computation:

-1000 = No valid slip surfaces are generated at a grid center. Unable to draw a surface.

Slice Data

Global Minimum Query (spencer) - Safety Factor: 1.42399

Slice Number	Width [ft]	Weight [lbs]	Angle of Slice Base [degrees]	Base Material	Base Cohesion [psf]	Base Friction Angle [degrees]	Shear Stress [psf]	Shear Strength [psf]	Base Normal Stress [psf]	Pore Pressure [psf]	Effective Normal Stress [psf]
1	4.76012	1784.26	-50.7874	FILL	100	28	136.715	194.681	178.069	0	178.069
2	4.76012	4832.85	-47.5879	FILL	100	28	286.652	408.189	579.618	0	579.618
3	7.86019	13586.4	-43.6567	Silty Clay FILL	100	29	488.015	694.928	1073.28	0	1073.28
4	1.15286	2537.27	-40.9387	Soft Layer	700	0	491.576	700	1509.8	30.8811	1478.92
5	7.54593	18555	-38.4893	Sandy Silt & Silty Clay	100	29	665.515	947.687	1688.87	159.6	1529.27
6	6.1206	16241	-34.7408	Silty Clay	225	28	750.267	1068.37	1924.49	338.335	1586.16
7	6.1206	16677.9	-31.5321	Silty Clay	225	28	760.366	1082.75	2074.94	461.733	1613.21
8	5.31656	14294.3	-28.6287	Clayey Silt	200	33	853.426	1215.27	2114.91	551.537	1563.38
9	5.31656	13868.7	-26.0028	Clayey Silt	200	33	831.639	1184.24	2128.98	613.374	1515.61
10	5.31656	13923.4	-23.4345	Clayey Silt	200	33	849.718	1209.99	2211.81	656.565	1555.25
11	5.06529	13654.2	-20.9739	Sandy Silt	0	34	791.684	1127.35	2353.38	682.015	1671.36
12	5.06529	14026	-18.6119	Sandy Silt	0	34	832.204	1185.05	2487.64	730.724	1756.92
13	5.06529	14272.6	-16.2823	Sandy Silt	0	34	868.918	1237.33	2603.55	769.138	1834.42
14	5.06529	14386.3	-13.9801	Sandy Silt	0	34	902.324	1284.9	2698.61	793.674	1904.94
15	5.06529	14371.3	-11.7008	Sandy Silt	0	34	932.029	1327.2	2772.43	804.781	1967.65
16	5.06529	14196.5	-9.44013	Sandy Silt	0	34	954.248	1358.84	2817.39	802.819	2014.57
17	5.06529	12348.9	-7.19422	Sandy Silt	0	34	816.825	1163.15	2512.51	788.076	1724.44
18	5.06529	9496.12	-4.95939	Sandy Silt	0	34	571.43	813.71	1967.14	760.769	1206.37
19	5.06529	7116.46	-2.73211	Sandy Silt	0	34	362.797	516.62	1490.56	724.637	765.92
20	7.38561	9642.62	0	Sandy Silt	0	34	348.54	496.318	1427.82	691.992	735.825
21	5.47857	6461.56	2.82296	Sandy Silt	0	34	336.794	479.592	1336.28	625.252	711.025
22	5.47857	5300.89	5.23259	Sandy Silt	0	34	293.873	418.472	1132.07	511.663	620.411
23	5.47857	3973.51	7.65156	Sandy Silt	0	34	234.085	333.335	877.729	383.54	494.189
24	5.47857	2493.38	10.0844	Sandy Silt	0	34	156.443	222.773	570.946	240.671	330.275
25	5.47857	857.395	12.5357	Sandy Silt	0	34	57.7509	82.2367	204.68	82.7593	121.921

Global Minimum Query (gle/morgenstern-price) - Safety Factor: 1.42545

Slice Number	Width [ft]	Weight [lbs]	Angle of Slice Base [degrees]	Base Material	Base Cohesion [psf]	Base Friction Angle [degrees]	Shear Stress [psf]	Shear Strength [psf]	Base Normal Stress [psf]	Pore Pressure [psf]	Effective Normal Stress [psf]
1	4.60998	1941.78	-49.7722	FILL	100	28	156.233	222.702	230.768	0	230.768
2	4.60998	4839.04	-46.8122	FILL	100	28	319.482	455.406	668.421	0	668.421
3	8.03439	14014.9	-43.0298	Silty Clay FILL	100	29	516.839	736.728	1148.69	0	1148.69
4	1.17687	2607.5	-40.355	Soft Layer	700	0	491.073	700	1591.45	58.9586	1532.49
5	7.69529	19367.3	-37.9435	Sandy Silt & Silty Clay	100	29	680.698	970.301	1755.95	185.891	1570.06
6	6.23043	16976.9	-34.2532	Silty Clay	225	28	750.269	1069.47	1950.11	361.893	1588.21
7	6.23043	17428.1	-31.0927	Silty Clay	225	28	750.371	1069.62	2071.52	483.027	1588.5
8	5.40225	14905	-28.2322	Clayey Silt	200	33	835.115	1190.42	2095.93	570.827	1525.1
9	5.40225	14432.8	-25.6456	Clayey Silt	200	33	813.128	1159.07	2107.7	630.856	1476.85
10	5.40225	14293	-23.114	Clayey Silt	200	33	824.768	1175.67	2174.72	672.328	1502.39
11	5.12201	13913.6	-20.6928	Sandy Silt	0	34	771.96	1100.39	2327.52	696.132	1631.39
12	5.12201	14267.3	-18.3733	Sandy Silt	0	34	826.237	1177.76	2483.93	737.828	1746.1
13	5.12201	14506.5	-16.0846	Sandy Silt	0	34	876.825	1249.87	2628.33	775.333	1853
14	5.12201	14612.5	-13.822	Sandy Silt	0	34	924.319	1317.57	2752.45	799.079	1953.37
15	5.12201	14589.3	-11.5813	Sandy Silt	0	34	965.927	1376.88	2850.8	809.494	2041.31
16	5.12201	14429.4	-9.35839	Sandy Silt	0	34	997.489	1421.87	2914.93	806.929	2108
17	5.12201	12704.2	-7.14964	Sandy Silt	0	34	874.103	1245.99	2638.92	791.66	1847.26
18	5.12201	9785.92	-4.95154	Sandy Silt	0	34	621.658	886.143	2077.67	763.899	1313.77
19	5.12201	7267.46	-2.76073	Sandy Silt	0	34	399.146	568.963	1569.55	726.032	843.522
20	7.81203	10199.3	0	Sandy Silt	0	34	367.603	524	1468.85	691.992	776.858
21	5.47981	6430.55	2.83724	Sandy Silt	0	34	335.549	478.309	1330.84	621.714	709.121
22	5.47981	5266.31	5.1816	Sandy Silt	0	34	275.044	392.062	1089.47	508.21	581.256
23	5.47981	3943.6	7.53471	Sandy Silt	0	34	202.608	288.808	808.742	380.566	428.176
24	5.47981	2472.32	9.9007	Sandy Silt	0	34	123.127	175.512	498.791	238.585	260.206
25	5.47981	849.62	12.2839	Sandy Silt	0	34	40.7234	58.0491	168.052	81.9902	86.0614

Interslice Data

Global Minimum Query (spencer) - Safety Factor: 1.42399

Slice Number	X coordinate [ft]	Y coordinate - Bottom [ft]	Interslice Normal Force [lbs]	Interslice Shear Force [lbs]	Interslice Force Angle [degrees]
1	-3.2835	410.845	0	0	0
2	1.47662	405.011	386.9	137.567	19.5735
3	6.23674	399.8	2040.27	725.441	19.5734
4	14.0969	392.3	6247.2	2221.26	19.5734
5	15.2498	391.3	7189.29	2556.23	19.5734
6	22.7957	385.3	12291.7	4370.45	19.5734
7	28.9163	381.055	15860.1	5639.24	19.5734
8	35.0369	377.3	18990.3	6752.21	19.5734
9	40.3535	374.398	20582.8	7318.43	19.5734
10	45.67	371.804	21674.7	7706.7	19.5735
11	50.9866	369.5	22246.3	7909.92	19.5734
12	56.0519	367.558	22798.7	8106.35	19.5735
13	61.1172	365.852	22819.4	8113.7	19.5734
14	66.1825	364.373	22262.3	7915.61	19.5734
15	71.2478	363.112	21086.8	7497.65	19.5734
16	76.3131	362.063	19265.9	6850.2	19.5734
17	81.3784	361.221	16796.6	5972.22	19.5734
18	86.4437	360.581	14258.3	5069.7	19.5734
19	91.509	360.142	12223.4	4346.16	19.5734
20	96.5742	359.9	10742.8	3819.7	19.5733
21	103.96	359.9	8164.02	2902.81	19.5734
22	109.438	360.17	5954.62	2117.23	19.5734
23	114.917	360.672	3773.78	1341.81	19.5734
24	120.396	361.408	1843.04	655.315	19.5735
25	125.874	362.382	428.152	152.234	19.5734
26	131.353	363.6	0	0	0

Global Minimum Query (gle/morgenstern-price) - Safety Factor: 1.42545

Slice Number	X coordinate [ft]	Y coordinate - Bottom [ft]	Interslice Normal Force [lbs]	Interslice Shear Force [lbs]	Interslice Force Angle [degrees]
1	-4.53114	410.161	0	0	0
2	0.0788344	404.711	535.192	23.8155	2.54792
3	4.68881	399.8	2340.61	207.131	5.05718
4	12.7232	392.3	6790.49	1103.39	9.22935
5	13.9001	391.3	7802.24	1349.16	9.81055
6	21.5954	385.3	13083.7	3109.06	13.3672
7	27.8258	381.057	16668.4	4744.35	15.888
8	34.0562	377.3	19762.3	6437.69	18.0433
9	39.4585	374.399	21316.3	7588.54	19.5956
10	44.8607	371.806	22376.6	8519	20.8423
11	50.263	369.5	22921.8	9157.49	21.7772
12	55.385	367.565	23458.7	9655.83	22.3725
13	60.507	365.864	23439.4	9796.77	22.6831
14	65.629	364.387	22816.2	9548.12	22.7083
15	70.751	363.127	21535.9	8897.62	22.4481
16	75.873	362.077	19565.5	7866.5	21.9031
17	80.995	361.233	16901.2	6512.91	21.0743
18	86.117	360.591	14105.7	5124.11	19.9643
19	91.239	360.147	11833.7	3977.38	18.5778
20	96.361	359.9	10170.7	3094.46	16.9225
21	104.173	359.9	7290.08	1805.47	13.9101
22	109.653	360.172	5084.25	1032.36	11.4779
23	115.133	360.669	3031.03	470.407	8.82176
24	120.612	361.393	1331.17	139.591	5.98635
25	126.092	362.35	177.314	9.37173	3.02549
26	131.572	363.543	0	0	0

List Of Coordinates

Water Table

X	Y
-91	407
-10.3	407
-8.68846	403.36
-6.66741	401.247
-3.76271	399.06
8	394.5
54	379.3
93.4	371.7
105	370.5
108.819	369.5
132.5	363.3
141	364.6
148.2	366.3

Focus Search Line

X	Y
12.2078	364.862
12.2078	393.991

External Boundary

X	Y
-91	388.265
-91	385.3
-91	383.5
-91	377.3
-91	369.5
-91	362
-91	359.9
-91	340
148.2	340
148.2	359.9
148.2	366.3
141	364.6
132.5	363.3
108.819	369.5
105	370.5
93.4	371.7
88.0847	377.3
82.2	383.5
80.5	385.2
80.0635	385.3
53.873	391.3
53	391.5
50.1636	392.3
45.2	393.7
35.2182	399.8
30.8	402.5
17	409.5
0	411
-3	411
-10.3	407
-12.15	406
-23.62	399.8
-23.7125	399.75
-28.8	397
-50.7557	392.3
-55.4271	391.3
-61.5	390

Material Boundary

X	Y
-23.62	399.8
35.2182	399.8

Material Boundary

X	Y
-50.7557	392.3
50.1636	392.3

Material Boundary

X	Y
-55.4271	391.3
53.873	391.3

Material Boundary

X	Y
-91	385.3
80.0635	385.3

Material Boundary

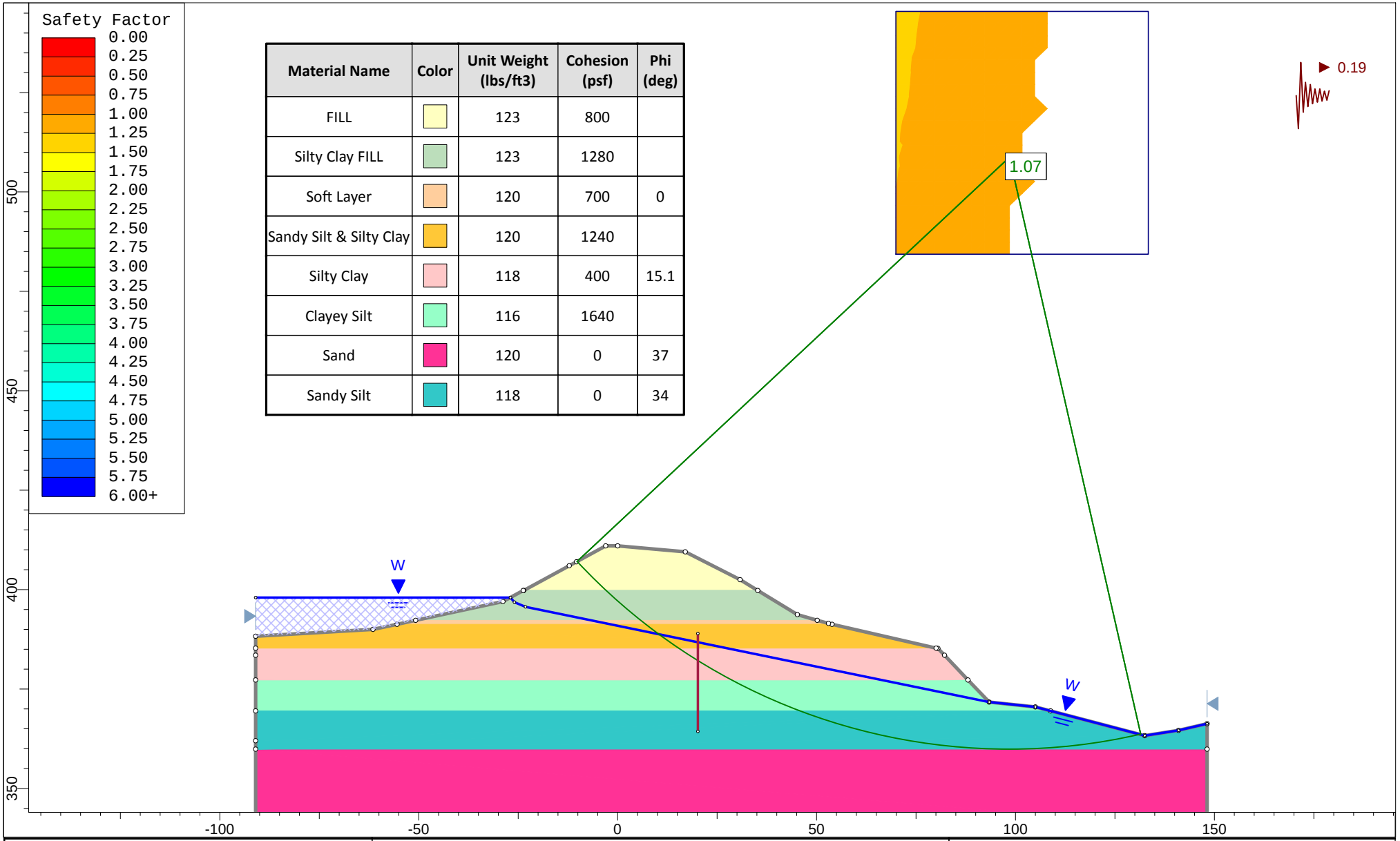
X	Y
-91	377.3
88.0847	377.3

Material Boundary

X	Y
-91	359.9
148.2	359.9

Material Boundary

X	Y
-91	369.5
108.819	369.5



Material Name	Color	Unit Weight (lbs/ft3)	Cohesion (psf)	Phi (deg)
FILL		123	800	
Silty Clay FILL		123	1280	
Soft Layer		120	700	0
Sandy Silt & Silty Clay		120	1240	
Silty Clay		118	400	15.1
Clayey Silt		116	1640	
Sand		120	0	37
Sandy Silt		118	0	34

REITZ & JENS, INC.
CONSULTING ENGINEERS

Project Name: Periodic Safety Factor Assessment			Client: Ameren - Rush Island Energy Center
Section Location: Section 3			Load Case: Seismic
File Path/Name: P:\Amerenue\2015012432\Rush Island\calc\Section 3\New Sect 3 SS seismic UD.sli			
Project Number: 2015012432	Analysis By: J. Bertel	Checked By: J. Fouse	Figure: 3

Slide Analysis Information

Periodic Safety Factor Assessment

Project Summary

File Name:	New Sect 3 SS seismic UD
Slide Modeler Version:	6.038
Project Title:	Periodic Safety Factor Assessment
Analysis:	Seismic
Author:	J. Bertel
Company:	Ameren - Rush Island Energy Center
	Comments
	2015012432
	Section 3
	J. Fouse

General Settings

Units of Measurement:	Imperial Units
Time Units:	seconds
Permeability Units:	feet/second
Failure Direction:	Left to Right
Data Output:	Standard
Maximum Material Properties:	20
Maximum Support Properties:	20

Analysis Options

Slices Type:	Vertical
Analysis Methods Used	
GLE/Morgenstern-Price with interslice force function:	Half Sine Spencer
Number of slices:	25
Tolerance:	0.005
Maximum number of iterations:	50
Check malpha < 0.2:	Yes
Initial trial value of FS:	1
Steffensen Iteration:	Yes

Groundwater Analysis

Groundwater Method:	Water Surfaces
Pore Fluid Unit Weight [lbs/ft3]:	62.4
Use negative pore pressure cutoff:	Yes
Maximum negative pore pressure [psf]:	0
Advanced Groundwater Method:	None

Random Numbers

Pseudo-random Seed:	10116
Random Number Generation Method:	Park and Miller v.3

Surface Options

Surface Type:	Circular
Search Method:	Grid Search
Radius Increment:	10
Composite Surfaces:	Disabled
Reverse Curvature:	Create Tension Crack
Minimum Elevation:	Not Defined
Minimum Depth:	Not Defined
Minimum Area:	Not Defined
Minimum Weight:	Not Defined

Seismic

Advanced seismic analysis:	No
Staged pseudostatic analysis:	No

Loading

Seismic Load Coefficient (Horizontal):	0.19

Material Properties

Property	FILL	Silty Clay FILL	Soft Layer	Sandy Silt & Silty Clay	Silty Clay	Clayey Silt	Sand	Sandy Silt
Color								
Strength Type	Undrained	Undrained	Mohr-Coulomb	Undrained	Mohr-Coulomb	Undrained	Mohr-Coulomb	Mohr-Coulomb
Unit Weight [lbs/ft3]	123	123	120	120	118	116	120	118
Cohesion [psf]			700		400		0	0
Friction Angle [deg]			0		15.1		37	34
Cohesion Type	800	1280		1240		1640		
Water Surface	None	None	Water Table	None	None	None	Water Table	Water Table
Hu Value			1				1	1
Ru Value	0	0		0	0	0		

Global Minimums

Method: spencer

FS	1.071940
Center:	98.520, 508.737
Radius:	148.892
Left Slip Surface Endpoint:	-10.230, 407.039
Right Slip Surface Endpoint:	131.539, 363.552
Resisting Moment:	2.30282e+007 lb-ft
Driving Moment:	2.14828e+007 lb-ft
Resisting Horizontal Force:	139980 lb
Driving Horizontal Force:	130586 lb
Total Slice Area:	2524.98 ft2

Method: gle/morgenstern-price

FS	1.073540
Center:	98.520, 517.893
Radius:	158.218
Left Slip Surface Endpoint:	-12.922, 405.583
Right Slip Surface Endpoint:	132.361, 363.336
Resisting Moment:	2.55187e+007 lb-ft
Driving Moment:	2.37706e+007 lb-ft
Resisting Horizontal Force:	147632 lb
Driving Horizontal Force:	137518 lb
Total Slice Area:	2670.34 ft2

Valid / Invalid Surfaces

Method: spencer

Number of Valid Surfaces: 2546
Number of Invalid Surfaces: 2305

Error Codes:

Error Code -108 reported for 205 surfaces
Error Code -111 reported for 87 surfaces
Error Code -1000 reported for 2013 surfaces

Method: gle/morgenstern-price

Number of Valid Surfaces: 2811
Number of Invalid Surfaces: 2040

Error Codes:

Error Code -108 reported for 23 surfaces
Error Code -111 reported for 4 surfaces
Error Code -1000 reported for 2013 surfaces

Error Codes

The following errors were encountered during the computation:

-108 = Total driving moment or total driving force < 0.1. This is to limit the calculation of extremely high safety factors if the driving force is very small (0.1 is an arbitrary number).
-111 = safety factor equation did not converge
-1000 = No valid slip surfaces are generated at a grid center. Unable to draw a surface.

Slice Data

Global Minimum Query (spencer) - Safety Factor: 1.07194

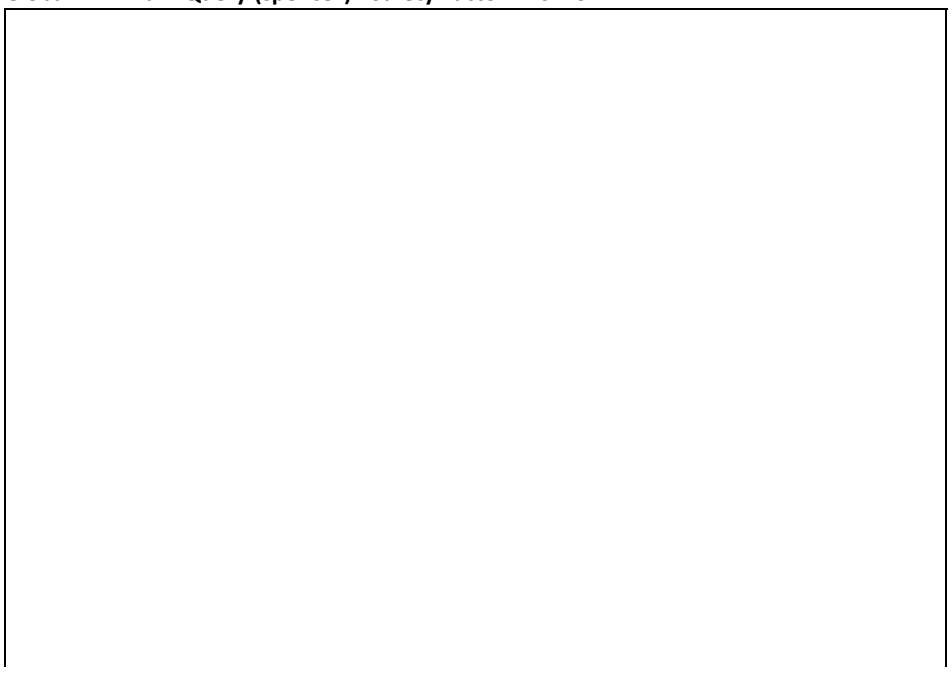
Slice Number	Width [ft]	Weight [lbs]	Angle of Slice Base [degrees]	Base Material	Base Cohesion [psf]	Base Friction Angle [degrees]	Shear Stress [psf]	Shear Strength [psf]	Base Normal Stress [psf]	Pore Pressure [psf]	Effective Normal Stress [psf]
1	7.25187	5000.49	-44.9472	FILL	800	0	746.31	800	349.076	0	349.076
2	4.34982	7024.41	-41.8517	Silty Clay FILL	1280	0	1194.1	1280	778.196	0	778.196
3	4.34982	8873.54	-39.6411	Silty Clay FILL	1280	0	1194.1	1280	1017.28	0	1017.28
4	1.2688	2906.96	-38.2433	Soft Layer	700	0	653.022	700	1122.26	0	1122.26
5	8.26846	21988.8	-35.9665	Sandy Silt & Silty Clay	1240	0	1156.78	1240	1449.36	0	1449.36
6	6.6541	20593.4	-32.4825	Silty Clay	400	15.1	841.037	901.541	1858.8	0	1858.8
7	6.6541	21049.7	-29.4936	Silty Clay	400	15.1	881.649	945.075	2020.14	0	2020.14
8	5.73565	18085.9	-26.7862	Clayey Silt	1640	0	1529.94	1640	2218.43	0	2218.43
9	5.73565	17471.3	-24.3385	Clayey Silt	1640	0	1529.94	1640	2278.59	0	2278.59
10	5.73565	16636.7	-21.9374	Clayey Silt	1640	0	1529.94	1640	2307.59	0	2307.59
11	5.40825	15474.3	-19.6427	Sandy Silt	0	34	913.82	979.56	2226.77	774.501	1452.26
12	5.40825	15675.4	-17.4469	Sandy Silt	0	34	970.959	1040.81	2361.37	818.292	1543.07
13	5.40825	15874.6	-15.2773	Sandy Silt	0	34	1045.63	1120.85	2509.67	847.946	1661.72
14	5.40825	15944.4	-13.1299	Sandy Silt	0	34	1124.77	1205.69	2651.43	863.929	1787.5
15	5.40825	15878.3	-11.0012	Sandy Silt	0	34	1206.93	1293.76	2784.7	866.625	1918.08
16	5.40825	15679.5	-8.88783	Sandy Silt	0	34	1291.67	1384.59	2909.09	856.349	2052.74
17	5.40825	14901	-6.78656	Sandy Silt	0	34	1314.5	1409.07	2922.39	833.35	2089.04
18	5.40825	11897.6	-4.69444	Sandy Silt	0	34	1009.92	1082.57	2402.81	797.821	1604.98
19	5.40825	8583.36	-2.60857	Sandy Silt	0	34	616.155	660.481	1729.1	749.899	979.203
20	8.14244	10803.3	0	Sandy Silt	0	34	505.109	541.447	1506.23	703.499	802.733
21	5.78956	6998.76	2.6821	Sandy Silt	0	34	533.929	572.34	1493.57	645.044	848.529
22	5.78956	5763.75	4.91547	Sandy Silt	0	34	509.4	546.046	1336.01	526.461	809.545
23	5.78956	4309.86	7.15637	Sandy Silt	0	34	437.364	468.828	1088.73	393.659	695.067
24	5.78956	2698.32	9.40835	Sandy Silt	0	34	316.023	338.758	748.691	246.462	502.229
25	5.78956	926.427	11.6751	Sandy Silt	0	34	127.896	137.097	287.873	84.6191	203.254

Global Minimum Query (gle/morgenstern-price) - Safety Factor: 1.07354

Slice Number	Width [ft]	Weight [lbs]	Angle of Slice Base [degrees]	Base Material	Base Cohesion [psf]	Base Friction Angle [degrees]	Shear Stress [psf]	Shear Strength [psf]	Base Normal Stress [psf]	Pore Pressure [psf]	Effective Normal Stress [psf]
1	6.14713	3447.9	-43.2494	FILL	800	0	745.198	800	-70.682	0	-70.682
2	4.53464	6852.03	-40.639	Silty Clay FILL	1280	0	1192.32	1280	619.915	0	619.915
3	4.53464	9395.36	-38.5076	Silty Clay FILL	1280	0	1192.32	1280	1184.23	0	1184.23
4	1.31943	3071.7	-37.1585	Soft Layer	700	0	652.048	700	1648.67	0	1648.67
5	8.58082	23119.5	-34.9625	Sandy Silt & Silty Clay	1240	0	1155.06	1240	1731.14	0	1731.14
6	6.87707	22034.3	-31.6042	Silty Clay	400	15.1	913.705	980.899	2152.9	0	2152.9
7	6.87707	22924.6	-28.7219	Silty Clay	400	15.1	932.361	1000.93	2227.13	0	2227.13
8	5.89502	19593.9	-26.1131	Clayey Silt	1640	0	1527.66	1640	2293.02	0	2293.02
9	5.89502	19007.3	-23.7579	Clayey Silt	1640	0	1527.66	1640	2345.36	0	2345.36
10	5.89502	18074.1	-21.4448	Clayey Silt	1640	0	1527.66	1640	2371.85	0	2371.85
11	5.80614	17083.8	-19.1848	Sandy Silt	0	34	909.072	975.925	2249.11	802.245	1446.86
12	5.80614	17190.7	-16.9723	Sandy Silt	0	34	969.466	1040.76	2388.96	845.986	1542.98
13	5.80614	17355.4	-14.7857	Sandy Silt	0	34	1066.12	1144.52	2571.33	874.511	1696.82
14	5.80614	17399	-12.621	Sandy Silt	0	34	1177.54	1264.14	2762.48	888.31	1874.17
15	5.80614	17285.3	-10.4744	Sandy Silt	0	34	1290.99	1385.93	2942.52	887.786	2054.73
16	5.80614	17018	-8.34266	Sandy Silt	0	34	1394.59	1497.15	3092.87	873.265	2219.61
17	5.80614	15941.5	-6.22247	Sandy Silt	0	34	1390.08	1492.31	3057.45	845.005	2212.45
18	5.80614	12345.2	-4.11082	Sandy Silt	0	34	1028.94	1104.61	2440.85	803.199	1637.66
19	5.62467	8515.95	-2.03762	Sand	0	37	749.035	804.119	1816.15	749.051	1067.1
20	5.62467	7597.83	0	Sand	0	37	654.243	702.356	1648.04	715.986	932.058
21	5.62467	7114.45	2.03762	Sand	0	37	620.698	666.344	1557.5	673.237	884.268
22	6.35107	6760.83	4.20991	Sandy Silt	0	34	451.623	484.835	1281.81	563.008	718.797
23	6.35107	5068.39	6.52059	Sandy Silt	0	34	332.539	356.994	951.278	422.012	529.266
24	6.35107	3180	8.84199	Sandy Silt	0	34	200.337	215.07	583.632	264.779	318.853
25	6.35107	1093.36	11.1781	Sandy Silt	0	34	67.9336	72.9294	199.16	91.0371	108.123

Interslice Data

Global Minimum Query (spencer) - Safety Factor: 1.07194



Slice Number	X coordinate [ft]	Y coordinate - Bottom [ft]	Interslice Normal Force [lbs]	Interslice Shear Force [lbs]	Interslice Force Angle [degrees]
1	-10.2297	407.039	0	0	0
2	-2.97784	399.8	-1940.69	-1420.4	36.2006
3	1.37198	395.904	-2773.32	-2029.81	36.2006
4	5.72181	392.3	-2620.63	-1918.06	36.2007
5	6.9906	391.3	-1775.43	-1299.45	36.2007
6	15.2591	385.3	1524.2	1115.57	36.2006
7	21.9132	381.064	7709.37	5642.54	36.2006
8	28.5673	377.3	13439.6	9836.52	36.2006
9	34.3029	374.404	14515.5	10624	36.2007
10	40.0386	371.81	14962.7	10951.3	36.2006
11	45.7742	369.5	14670.4	10737.3	36.2005
12	51.1824	367.57	16961.7	12414.4	36.2007
13	56.5907	365.87	18697.2	13684.6	36.2006
14	61.9989	364.393	19760	14462.5	36.2007
15	67.4072	363.131	20045.2	14671.2	36.2006
16	72.8154	362.08	19455.9	14239.9	36.2006
17	78.2237	361.234	17902.6	13103	36.2006
18	83.6319	360.591	15498.4	11343.4	36.2007
19	89.0402	360.146	13358.7	9777.29	36.2006
20	94.4484	359.9	12079.8	8841.3	36.2007
21	102.591	359.9	10015.1	7330.15	36.2008
22	108.38	360.171	7845.5	5742.17	36.2006
23	114.17	360.669	5323.24	3896.11	36.2006
24	119.96	361.396	2816.02	2061.07	36.2007
25	125.749	362.355	779	570.156	36.2007
26	131.539	363.552	0	0	0

Global Minimum Query (gle/morgenstern-price) - Safety Factor: 1.07354

Slice Number	X coordinate [ft]	Y coordinate - Bottom [ft]	Interslice Normal Force [lbs]	Interslice Shear Force [lbs]	Interslice Force Angle [degrees]
1	-12.9224	405.583	0	0	0
2	-6.77522	399.8	-4330.93	-422.489	5.57166
3	-2.24059	395.908	-6018.89	-1014.22	9.56484
4	2.29405	392.3	-5363.64	-1275.7	13.3788
5	3.61348	391.3	-3991.02	-1028.15	14.4462
6	12.1943	385.3	884.779	336.568	20.8267
7	19.0714	381.069	7902.52	3710.71	25.1529
8	25.9484	377.3	14244.2	7810.93	28.7385
9	31.8435	374.41	15594.3	9455.28	31.2297
10	37.7385	371.816	16292.9	10663.1	33.2033
11	43.6335	369.5	16220.6	11224.1	34.6819
12	49.4396	367.48	18736	13451.3	35.676
13	55.2458	365.708	20611.1	15099.8	36.2267
14	61.0519	364.175	21663.9	15939.1	36.3436
15	66.8581	362.875	21729.4	15803.7	36.0282
16	72.6642	361.802	20682.2	14630.6	35.2756
17	78.4703	360.95	18458.1	12484.5	34.0732
18	84.2765	360.317	15357.7	9747.33	32.4028
19	90.0826	359.9	12752.2	7434.74	30.2429
20	95.7073	359.7	10523.7	5516.49	27.6634
21	101.332	359.7	8289.95	3793.77	24.5905
22	106.957	359.9	5841.44	2244.92	21.0222
23	113.308	360.367	3660.67	1078.98	16.4228
24	119.659	361.093	1822.75	363.892	11.29
25	126.01	362.081	578.971	58.3417	5.75415
26	132.361	363.336	0	0	0

List Of Coordinates

Water Table

X	Y
-91	398
-26.95	398
-25.9406	396.824
-23.1423	395.689
93.4	371.7
93.4625	371.7
105	370.5
132.5	363.3
141	364.6
148.2	366.3

Focus Search Line

X	Y
20.1771	364.318
20.1771	388.939

External Boundary

X	Y
-91	388.265
-91	385.3
-91	383.5
-91	377.3
-91	369.5
-91	362
-91	359.9
-91	340
148.2	340
148.2	359.9
148.2	366.3
141	364.6
132.5	363.3
108.819	369.5
105	370.5
93.4	371.7
88.0847	377.3
82.2	383.5
80.5	385.2
80.0635	385.3
53.873	391.3
53	391.5
50.1636	392.3
45.2	393.7
35.2182	399.8
30.8	402.5
17	409.5
0	411
-3	411
-10.3	407
-12.15	406
-23.62	399.8
-23.7125	399.75
-28.8	397
-50.7557	392.3
-55.4271	391.3
-61.5	390

Material Boundary

X	Y
-23.62	399.8
35.2182	399.8

Material Boundary

X	Y
-50.7557	392.3
50.1636	392.3

Material Boundary

X	Y
-55.4271	391.3
53.873	391.3

Material Boundary

X	Y
-91	385.3
80.0635	385.3

Material Boundary

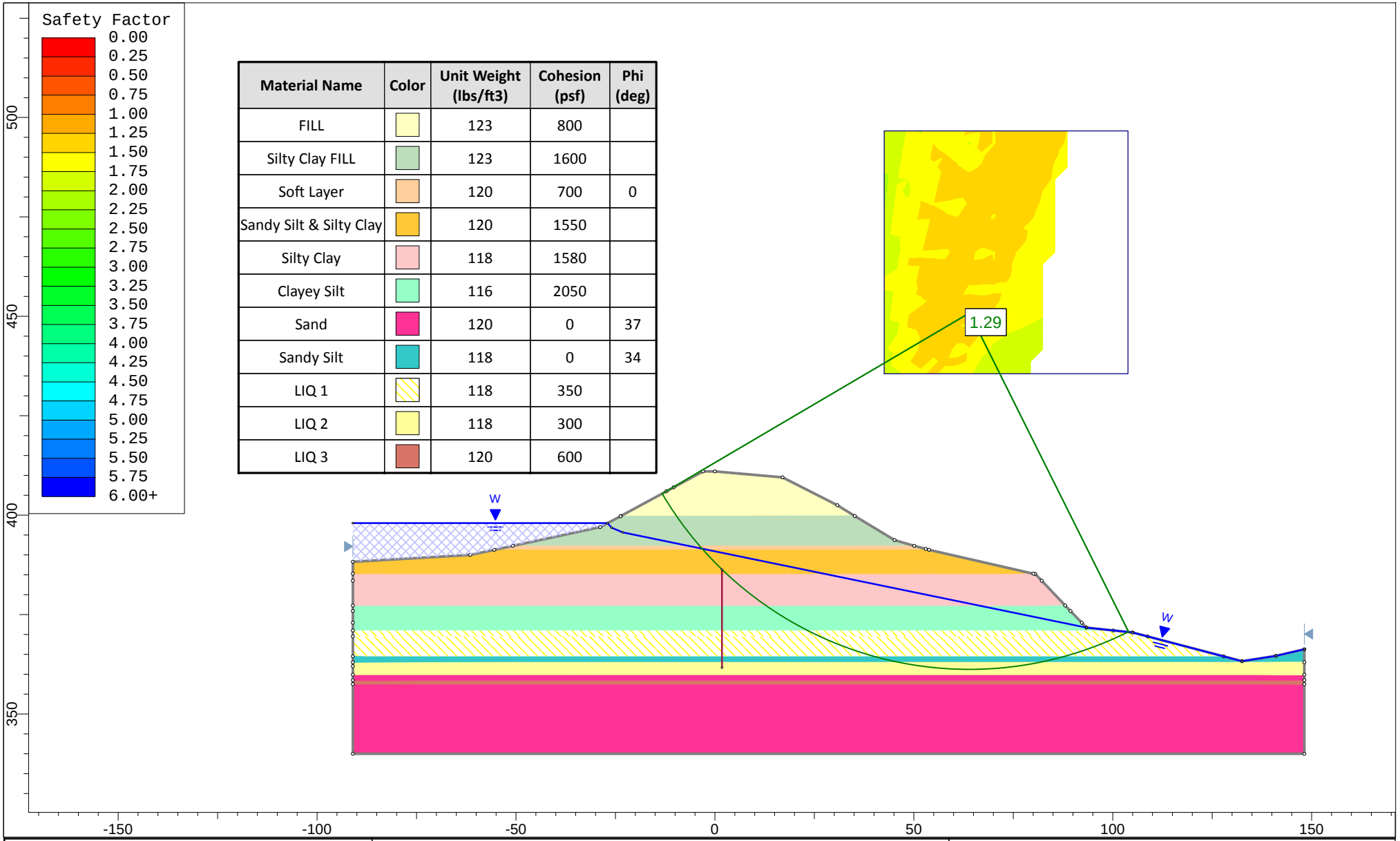
X	Y
-91	377.3
88.0847	377.3

Material Boundary

X	Y
-91	359.9
148.2	359.9

Material Boundary

X	Y
-91	369.5
108.819	369.5



Material Name	Color	Unit Weight (lbs/ft3)	Cohesion (psf)	Phi (deg)
FILL		123	800	
Silty Clay FILL		123	1600	
Soft Layer		120	700	0
Sandy Silt & Silty Clay		120	1550	
Silty Clay		118	1580	
Clayey Silt		116	2050	
Sand		120	0	37
Sandy Silt		118	0	34
LIQ 1		118	350	
LIQ 2		118	300	
LIQ 3		120	600	

REITZ & JENS, INC.
CONSULTING ENGINEERS

Project Name: Periodic Safety Factor Assessment			Client: Ameren - Rush Island Energy Center
Section Location: Section 3			Load Case: Liquefaction
File Path/Name: P:\Amerenue\2015012432\Rush Island\calc\Section 3\New Sect 3 SS Post EQ UD.sli			
Project Number: 2015012432	Analysis By: J. Bertel	Checked By: J. Fouse	Figure: 4

Slide Analysis Information

Periodic Safety Factor Assessment

Project Summary

File Name:	New Sect 3 SS Post EQ UD
Slide Modeler Version:	6.038
Project Title:	Periodic Safety Factor Assessment
Analysis:	Liquefaction
Author:	J. Bertel
Company:	Ameren - REC
Comments	
	2015012432
	Section 3
	J. Fouse

General Settings

Units of Measurement:	Imperial Units
Time Units:	seconds
Permeability Units:	feet/second
Failure Direction:	Left to Right
Data Output:	Standard
Maximum Material Properties:	20
Maximum Support Properties:	20

Analysis Options

Slices Type:	Vertical
Analysis Methods Used	
GLE/Morgenstern-Price with interslice force function:	Half Sine Spencer
Number of slices:	25
Tolerance:	0.005
Maximum number of iterations:	50
Check malpha < 0.2:	Yes
Initial trial value of FS:	1
Steffensen Iteration:	Yes

Groundwater Analysis

Groundwater Method:	Water Surfaces
Pore Fluid Unit Weight [lbs/ft3]:	62.4
Use negative pore pressure cutoff:	Yes
Maximum negative pore pressure [psf]:	0
Advanced Groundwater Method:	None

Random Numbers

Pseudo-random Seed:	10116
Random Number Generation Method:	Park and Miller v.3

Surface Options

Surface Type:	Circular
Search Method:	Grid Search
Radius Increment:	10
Composite Surfaces:	Disabled
Reverse Curvature:	Create Tension Crack
Minimum Elevation:	Not Defined
Minimum Depth:	Not Defined
Minimum Area:	Not Defined
Minimum Weight:	Not Defined

Seismic

Advanced seismic analysis:	No
Staged pseudostatic analysis:	No

Material Properties

Property	FILL	Silty Clay FILL	Soft Layer	Sandy Silt & Silty Clay	Silty Clay	Clayey Silt	Sand	Sandy Silt
Color								
Strength Type	Undrained	Undrained	Mohr-Coulomb	Undrained	Undrained	Undrained	Mohr-Coulomb	Mohr-Coulomb
Unit Weight [lbs/ft3]	123	123	120	120	118	116	120	118
Cohesion [psf]			700				0	0
Friction Angle [deg]			0				37	34
Cohesion Type	800	1600		1550	1580	2050		
Water Surface	None	None	Water Table	None	None	None	Water Table	Water Table
Hu Value			1				1	1
Ru Value	0	0		0	0	0		

Property	LIQ 1	LIQ 2	LIQ 3
Color			
Strength Type	Undrained	Undrained	Undrained
Unit Weight [lbs/ft3]	118	118	120
Cohesion Type	350	300	600
Water Surface	None	None	None
Ru Value	0	0	0

Global Minimums

Method: spencer

FS	1.293770
Center:	64.038, 450.820
Radius:	89.645
Left Slip Surface Endpoint:	-13.252, 405.405
Right Slip Surface Endpoint:	104.049, 370.598
Resisting Moment:	1.06503e+007 lb-ft
Driving Moment:	8.23195e+006 lb-ft
Resisting Horizontal Force:	96457.9 lb
Driving Horizontal Force:	74555.5 lb
Total Slice Area:	2814.18 ft2

Method: gle/morgenstern-price

FS	1.265640
Center:	60.974, 447.765
Radius:	87.234
Left Slip Surface Endpoint:	-14.810, 404.562
Right Slip Surface Endpoint:	102.047, 370.806
Left Slope Intercept:	-14.810 404.562
Right Slope Intercept:	102.047 370.807
Resisting Moment:	1.01862e+007 lb-ft
Driving Moment:	8.04824e+006 lb-ft
Resisting Horizontal Force:	93843.5 lb
Driving Horizontal Force:	74146.8 lb
Total Slice Area:	2952.27 ft2

Valid / Invalid Surfaces

Method: spencer

Number of Valid Surfaces: 3262
Number of Invalid Surfaces: 1589

Error Codes:

Error Code -103 reported for 41 surfaces
Error Code -111 reported for 74 surfaces
Error Code -1000 reported for 1474 surfaces

Method: gle/morgenstern-price

Number of Valid Surfaces: 3281
Number of Invalid Surfaces: 1570

Error Codes:

Error Code -103 reported for 41 surfaces
Error Code -111 reported for 55 surfaces
Error Code -1000 reported for 1474 surfaces

Error Codes

The following errors were encountered during the computation:

-103 = Two surface / slope intersections, but one or more surface / nonslope external polygon intersections lie between them. This usually occurs when the slip surface extends past the bottom of the soil region, but may also occur on a benched slope model with two sets of Slope Limits.
-111 = safety factor equation did not converge
-1000 = No valid slip surfaces are generated at a grid center. Unable to draw a surface.

Slice Data

Global Minimum Query (spencer) - Safety Factor: 1.29377

Slice Number	Width [ft]	Weight [lbs]	Angle of Slice Base [degrees]	Base Material	Base Cohesion [psf]	Base Friction Angle [degrees]	Shear Stress [psf]	Shear Strength [psf]	Base Normal Stress [psf]	Pore Pressure [psf]	Effective Normal Stress [psf]
1	3.57926	1659.75	-57.4361	FILL	800	0	618.348	800	-649.111	0	-649.111
2	5.80103	9192.53	-52.2791	Silty Clay FILL	1600	0	1236.7	1600	-142.923	0	-142.923
3	0.874723	2038.85	-48.823	Soft Layer	700	0	541.054	700	1847.81	0	1847.81
4	5.85122	16222.7	-45.7193	Sandy Silt & Silty Clay	1550	0	1198.05	1550	1576.96	0	1576.96
5	4.94457	16492.2	-40.9476	Silty Clay	1580	0	1221.24	1580	2343.74	0	2343.74
6	4.94457	18560.7	-36.8793	Silty Clay	1580	0	1221.24	1580	2919.74	0	2919.74
7	5.24448	21551.5	-32.9068	Clayey Silt	2050	0	1584.52	2050	3118.83	0	3118.83
8	5.24448	22218.6	-28.9937	Clayey Silt	2050	0	1584.52	2050	3381.01	0	3381.01
9	4.15369	17567.6	-25.6051	LIQ 1	350	0	270.527	350	4255.08	0	4255.08
10	4.15369	17401.2	-22.6941	LIQ 1	350	0	270.527	350	4206.97	0	4206.97
11	4.15369	16971.8	-19.8438	LIQ 1	350	0	270.527	350	4094.36	0	4094.36
12	4.15369	16354.4	-17.044	LIQ 1	350	0	270.527	350	3936.61	0	3936.61
13	6.19112	22996.6	-13.6193	Sandy Silt	0	34	1174.84	1519.97	3397.61	1144.17	2253.44
14	4.49998	16070.6	-10.1222	LIQ 2	300	0	231.88	300	3565.38	0	3565.38
15	4.49998	15755.7	-7.2116	LIQ 2	300	0	231.88	300	3490.29	0	3490.29
16	4.49998	15421.2	-4.31962	LIQ 2	300	0	231.88	300	3411.61	0	3411.61
17	4.49998	14984.8	-1.43866	LIQ 2	300	0	231.88	300	3310.95	0	3310.95
18	4.49998	14428.1	1.43866	LIQ 2	300	0	231.88	300	3184.52	0	3184.52
19	4.49998	13751.1	4.31962	LIQ 2	300	0	231.88	300	3032.66	0	3032.66
20	4.49998	12953	7.2116	LIQ 2	300	0	231.88	300	2855.51	0	2855.51
21	4.49998	11925.1	10.1222	LIQ 2	300	0	231.88	300	2629.63	0	2629.63
22	6.19112	12092.1	13.6193	Sandy Silt	0	34	741.798	959.716	2025.09	602.253	1422.84
23	5.27314	5591.46	17.4219	LIQ 1	350	0	270.527	350	1091.4	0	1091.4
24	5.27314	2641.82	20.9936	LIQ 1	350	0	270.527	350	562.19	0	562.19
25	5.27314	923.127	24.6533	LIQ 1	350	0	270.527	350	264.898	0	264.898

Global Minimum Query (gle/morgenstern-price) - Safety Factor: 1.26564

Slice Number	Width [ft]	Weight [lbs]	Angle of Slice Base [degrees]	Base Material	Base Cohesion [psf]	Base Friction Angle [degrees]	Shear Stress [psf]	Shear Strength [psf]	Base Normal Stress [psf]	Pore Pressure [psf]	Effective Normal Stress [psf]
1	2.92063	1138.91	-58.4784	FILL	800	0	632.091	800	-655.512	0	-655.512
2	5.53327	7892.54	-53.5813	Silty Clay FILL	1600	0	1264.18	1600	-341.707	0	-341.707
3	0.836401	1808.36	-50.0909	Soft Layer	700	0	553.08	700	1492.44	21.7055	1470.73
4	5.60174	15359.4	-46.9661	Sandy Silt & Silty Clay	1550	0	1224.68	1550	1404.97	0	1404.97
5	4.73416	15937.7	-42.1712	Silty Clay	1580	0	1248.38	1580	2245.14	0	2245.14
6	4.73416	17929	-38.097	Silty Clay	1580	0	1248.38	1580	2848.79	0	2848.79
7	4.99442	20725.7	-34.139	Clayey Silt	2050	0	1619.73	2050	3075.96	0	3075.96
8	4.99442	22113.8	-30.2577	Clayey Silt	2050	0	1619.73	2050	3513.67	0	3513.67
9	5.14076	22941.5	-26.4722	LIQ 1	350	0	276.54	350	4497.37	0	4497.37
10	5.14076	22723.1	-22.7548	LIQ 1	350	0	276.54	350	4465.24	0	4465.24
11	5.14076	22158.7	-19.1365	LIQ 1	350	0	276.54	350	4349.46	0	4349.46
12	5.4065	22214.9	-15.5064	Sandy Silt	0	34	1335.69	1690.5	3718.24	1211.97	2506.27
13	4.57918	17768	-12.1252	LIQ 2	300	0	237.034	300	3890.62	0	3890.62
14	4.57918	17033.7	-9.06383	LIQ 2	300	0	237.034	300	3710	0	3710
15	4.57918	16643.5	-6.02847	LIQ 2	300	0	237.034	300	3606.7	0	3606.7
16	4.57918	16224.2	-3.01005	LIQ 2	300	0	237.034	300	3499.46	0	3499.46
17	4.57918	15712.8	0	LIQ 2	300	0	237.034	300	3376.15	0	3376.15
18	4.57918	15071.3	3.01005	LIQ 2	300	0	237.034	300	3230.09	0	3230.09
19	4.57918	14299.1	6.02847	LIQ 2	300	0	237.034	300	3062.38	0	3062.38
20	4.57918	13394.7	9.06383	LIQ 2	300	0	237.034	300	2873.4	0	2873.4
21	4.57918	12302.5	12.1252	LIQ 2	300	0	237.034	300	2651.45	0	2651.45
22	5.4065	11130.1	15.5064	Sandy Silt	0	34	844.158	1068.4	2197.15	613.176	1583.97
23	5.01997	6139.2	19.0941	LIQ 1	350	0	276.54	350	1278.19	0	1278.19
24	5.01997	2649.84	22.6252	LIQ 1	350	0	276.54	350	623.288	0	623.288
25	5.01997	886.957	26.25	LIQ 1	350	0	276.54	350	307.468	0	307.468

Interslice Data

Global Minimum Query (spencer) - Safety Factor: 1.29377

Slice Number	X coordinate [ft]	Y coordinate - Bottom [ft]	Interslice Normal Force [lbs]	Interslice Shear Force [lbs]	Interslice Force Angle [degrees]
1	-13.2516	405.405	0	0	0
2	-9.67238	399.8	-5857.83	516.772	-5.04153
3	-3.87135	392.3	-14125.4	1246.13	-5.04153
4	-2.99662	391.3	-12752.3	1125	-5.04155
5	2.85459	385.3	-10321.6	910.561	-5.04152
6	7.79916	381.01	-6322.86	557.797	-5.04153
7	12.7437	377.3	-1548.11	136.572	-5.0415
8	17.9882	373.906	701.328	-61.8705	-5.04153
9	23.2327	371	2192.66	-193.434	-5.04152
10	27.3864	369.009	9535.62	-841.224	-5.04153
11	31.5401	367.272	15716.2	-1386.47	-5.04153
12	35.6937	365.773	20726.6	-1828.48	-5.04152
13	39.8474	364.5	24612.4	-2171.28	-5.04152
14	46.0386	363	22413.4	-1977.29	-5.04153
15	50.5385	362.197	24231.2	-2137.65	-5.04152
16	55.0385	361.627	25172	-2220.65	-5.04153
17	59.5385	361.287	25285	-2230.62	-5.04153
18	64.0385	361.174	24612.6	-2171.3	-5.04153
19	68.5385	361.287	23206.1	-2047.22	-5.04153
20	73.0384	361.627	21128.7	-1863.95	-5.04152
21	77.5384	362.197	18456.2	-1628.19	-5.04153
22	82.0384	363	15297	-1349.49	-5.04154
23	88.2295	364.5	7653.01	-675.141	-5.04153
24	93.5027	366.155	4416.24	-389.597	-5.04153
25	98.7758	368.178	1847.84	-163.015	-5.04154
26	104.049	370.598	8.86209e-006	0	0

Global Minimum Query (gle/morgenstern-price) - Safety Factor: 1.26564

Slice Number	X coordinate [ft]	Y coordinate - Bottom [ft]	Interslice Normal Force [lbs]	Interslice Shear Force [lbs]	Interslice Force Angle [degrees]
1	-14.8103	404.562	0	0	0
2	-11.8897	399.8	-4970.36	38.9864	-0.449406
3	-6.35642	392.3	-14538.5	327.587	-1.29079
4	-5.52002	391.3	-13509.4	333.914	-1.4159
5	0.0817184	385.3	-11950	465.75	-2.23197
6	4.81588	381.012	-8240.85	414.918	-2.88235
7	9.55004	377.3	-3585.82	218.406	-3.48548
8	14.5445	373.914	-1270.83	90.2	-4.05989
9	19.5389	371	864.9	-68.9918	-4.56074
10	24.6796	368.44	10954.3	-956.488	-4.99019
11	29.8204	366.284	19158.6	-1785.56	-5.32452
12	34.9612	364.5	25493.5	-2480.62	-5.55761
13	40.3677	363	23838.9	-2374.79	-5.68894
14	44.9468	362.016	26579.4	-2656.25	-5.70699
15	49.526	361.286	28202.6	-2784.76	-5.63918
16	54.1052	360.802	28859.7	-2772.03	-5.48654
17	58.6844	360.561	28615.3	-2629.99	-5.25122
18	63.2636	360.561	27528.3	-2377.73	-4.93661
19	67.8428	360.802	25663.5	-2041.08	-4.5473
20	72.4219	361.286	23095.5	-1651.02	-4.08893
21	77.0011	362.016	19909.5	-1241.54	-3.5683
22	81.5803	363	16214	-847.788	-2.99312
23	86.9868	364.5	8347.6	-328.813	-2.25572
24	92.0068	366.238	4736.18	-126.29	-1.52743
25	97.0267	368.33	2041.86	-27.4729	-0.770859
26	102.047	370.806	8.54573e-005	0	0

List Of Coordinates

Water Table

X	Y
-91	398
-26.95	398
-25.9406	396.824
-23.1423	395.689
93.4	371.7
93.4625	371.7
105	370.5
132.5	363.3
141	364.6
148.2	366.3

Focus Search Line

X	Y
1.81155	361.669
1.81155	386.29

External Boundary

X	Y
-91	388.265
-91	385.3
-91	383.5
-91	377.3
-91	375.912
-91	372.93
-91	371
-91	369.5
-91	364.5
-91	363
-91	362
-91	359.9
-91	358.5
-91	357.5
-91	340
148.2	340
148.2	357.5
148.2	358.5
148.2	359.9
148.2	363
148.2	366.3
141	364.6
132.5	363.3
127.917	364.5
108.819	369.5
105	370.5
100.167	371
93.4	371.7
92.2326	372.93
89.4018	375.912
88.0847	377.3
82.2	383.5
80.5	385.2
80.0635	385.3
53.873	391.3
53	391.5
50.1636	392.3
45.2	393.7
35.2182	399.8
30.8	402.5
17	409.5
0	411
-3	411
-10.3	407
-12.15	406
-23.62	399.8
-23.7125	399.75
-28.8	397
-50.7557	392.3
-55.4271	391.3
-61.5	390

Material Boundary

X	Y
-23.62	399.8
35.2182	399.8

Material Boundary

X	Y
-50.7557	392.3
50.1636	392.3

Material Boundary

X	Y
-55.4271	391.3
53.873	391.3

Material Boundary

X	Y
-91	385.3
80.0635	385.3

Material Boundary

X	Y
-91	377.3
88.0847	377.3

Material Boundary

X	Y
-91	359.9
148.2	359.9

Material Boundary

X	Y
-91	369.5
108.819	369.5

Material Boundary

X	Y
-91	363
148.2	363

Material Boundary

X	Y
-91	364.5
127.917	364.5

Material Boundary

X	Y
-91	371
100.167	371

Material Boundary

X	Y
-91	358.5
148.2	358.5

Material Boundary

X	Y
-91	357.5
148.2	357.5

APPENDIX II

AMEREN RUSH ISLAND ASH POND MDNR CLOSURE DESIGN REPORT

HALEY & ALDRICH, INC.
6500 Rockside Road
Suite 200
Cleveland, OH 44131
216.739.0555

29 June 2018
File No. 129530

Ameren Missouri

Attention: Michael Wagstaff, P.E.

Subject: Rush Island Ash Pond Closure
MDNR Permit Application (MO40179)

Mr. Wagstaff:

The attached Rush Island Ash Pond Closure Design Report (Report) is provided for your review and use in making your resubmittal to MDNR in response to their 2 March 2018 comment letter to Mr. Frerking requesting additional information. The Report has been assembled to efficiently address information requirements as referenced in the MDNR Dam and Reservoir Safety Staff Checklist for Evaluating Construction Permit Applications for Industrial Water Retention Dams based on guidance you provided regarding which specific sections you decided we should address in the Report. As we've discussed, upon receipt/review of the Report, MDNR may require additional information be submitted, which we can assist Ameren with, as needed, at that time.

Sincerely yours,
HALEY & ALDRICH, INC.

Neal Kochis
Project Manager

Steve Putrich, P. E.
Program Manager

Enclosures

HALEY ALDRICH

www.haleyaldrich.com

AMEREN RUSH ISLAND ASH POND
MDNR CLOSURE DESIGN REPORT

by Haley & Aldrich, Inc.
Cleveland, Ohio

for Ameren Missouri
11149 Lindbergh Business Ct.
St. Louis, MO 63123

File No. 129530
June 2018



TABLE OF CONTENTS

Page

1. Introduction 3

2. General Information 3

2.1 SITE BACKGROUND 3
2.2 TOPOGRAPHIC MAPS 3
2.3 SUMMARY OF DESIGN 3
2.4 GEOLOGIC EXPLORATION 3
2.5 GEOTECHNICAL INVESTIGATIONS AND DESIGN 4
2.5.1 Ash Settlement Analysis 4
2.5.2 Berm Stability Evaluation - Static 4
2.5.3 Berm Stability Evaluation - Seismic 4
2.6 DESIGN OF STRUCTURES 5
2.7 HYDROLOGIC/HYDRAULIC INVESTIGATIONS 5
2.7.1 Environmental Class Determination 5
2.7.2 Evaluation of Spillway Capacity 5
2.8 DISCUSSION OF DIVERSION CHANNELS 6
2.9 DISCUSSION OF UPSTREAM SLOPE PROTECTION 6
2.10 OPERATION OF THE DAM AFTER UNIT CLOSURE 6

3. Phase 2 Field Documentation Summary 7

3.1 DRAWINGS 7
3.2 SPECIFICATIONS 7
REFERENCES 7

Attachment 1 - Rush Island Permit Report Fly Ash Pond Levee System
Attachment 2 - Ash Pond Closure Issued for Bid Design Drawings
Attachment 3 - Report on Ash Pond Geotechnical Closure Design
Attachment 4 - Stormwater Management Evaluation
Attachment 5 - Rush Island Low Volume Waste Grading and Drainage Drawings
Attachment 6 - Ash Pond Closure Construction Specification RI-SPEC-001059

1. Introduction

The Rush Island Energy Center (Plant), located on the west bank of the Mississippi River, currently deposits coal combustion products (CCP's) in a 111-acre CCR impoundment (Ash Pond) constructed using a ring levee in the floodplain of the Mississippi River. The Ash Pond is situated immediately south of the facility on the east bank of the Mississippi River south of Festus, Missouri.

Per USEPA CCR Rule 40 CFR Part 257, Ameren is in the process of closing the Rush Island Energy Center Ash Pond. The proposed closure plan includes stabilization of the pond wet ash materials, construction of a low permeability cap with protective soil cover over the compacted ash materials, stormwater drainage from the cap thru multiple drainage structures, armoring of several pond berms with rip-rap, and removal of the existing outlet piping and outlet structure. Construction of the ash pond closure cap is scheduled to start in Fall 2018 and be completed by December 2020.

2. General Information

An MDNR Dam and Reservoir Safety Application for Registration Permit and "Rush Island Permit Report" was prepared by Reitz & Jens, Inc. dated 6 April 2010 (R&J Permit Report) (**Attachment 1**) which includes project information that has not changed since that time and is appropriate to this Design Report.

2.1 SITE BACKGROUND

Refer to History section of R&J Permit Report (**Attachment 1**).

2.2 TOPOGRAPHIC MAPS

Updated topographic survey information for the Ash Pond was provided in July 2017 and was incorporated into the Ash Pond Closure Issued for Bid design drawings dated January 2018 (herein referred to as Closure Design Drawings) and as detailed on sheet G-101 (see **Attachment 2**).

2.3 SUMMARY OF DESIGN

The R&J Permit Report (**Attachment 1**) includes information describing the dam height, top and toe of dam and emergency spillway elevation as well as crest elevation, dam configuration, spillway elevation and a top of levee profile. The dike elevations have not changed since that time and will not be raised or lowered as part of the ash pond closure construction. The emergency spillway will therefore remain as it currently exists on the north end of the west Ash Pond dike. Similarly, the closure design was developed so as to not permanently impound water but to allow collected stormwater to discharge from the cap via single or dual gravity outlet pipes at nine (9) locations around the perimeter of the unit. The Closure Design Drawings (**Attachment 2**) provide detail of the proposed topographic elevations and stormwater management features of the unit upon closure.

2.4 GEOLOGIC EXPLORATION

Geologic exploration information relative to borings and CPTs completed along the south pool of the perimeter dike is included in the R&J Permit Report provided in Attachment 1. Geologic information

associated with initial dam construction has not been provided as that information is not applicable to the closure operation.

2.5 GEOTECHNICAL INVESTIGATIONS AND DESIGN

2.5.1 Ash Settlement Analysis

An ash consolidation analysis was performed as part of the closure design. Dewatering the wet end of the ash pond and redistributing the overburden will cause additional consolidation of the material. Results of the analyses are presented in the Ash Pond Geotechnical Closure Design report included as **Attachment 3**. Dilatometer (DMT) data was used to establish the lower bound of maximum settlement depth and the laboratory derived oedometer data was used to evaluate the upper bound of maximum settlement. Maximum localized settlement across the closed unit will vary depending on location. As much as 38-inches is anticipated with a majority of the settlement expected to occur during ash regrading and final cover construction. Settlement calculations along the drainage channels demonstrate relatively low values of angular distortion that are not expected to negatively impact long-term drainage characteristics.

2.5.2 Berm Stability Evaluation - Static

A static stability evaluation of the critical cross section of the berm under proposed closed conditions was performed as part of the closure design. To identify the critical berm cross-sections at the unit, the following conditions were examined at several locations:

a. The geometry of the upstream and downstream embankment slopes;
b. Phreatic surface levels within and below the cross sections;
c. Subsurface soil conditions;
d. Presence of lack of surcharge loads behind the crest of the embankments; and
e. Presence of lack of reinforcing measures in front of the embankments.

The material properties, design water levels, and methods used in the analysis, as well as a summary of the results with corresponding graphical presentations of the analysis are presented in the Ash Pond Geotechnical Closure Design Report included as **Attachment 3**. The static safety factor was determined to be above the minimum required value for the critical cross section including installed rip-rap on the exterior downstream slope of the Ash Pond berm.

2.5.3 Berm Stability Evaluation - Seismic

A seismic stability evaluation of the critical berm cross-section under proposed closed conditions was performed as part of the closure design. The material properties, design water levels, design seismic event, and methods used in the analysis, as well as a summary of results with corresponding graphical presentations are presented in the Ash Pond Geotechnical Closure Design Report included as **Attachment 3**. Deformations were evaluated using the simplified approach described in the MDNR Draft Technical Guidance Document. MSHA guidelines indicate that the maximum acceptable deformation of the impoundment embankments is approximately 25 percent of the available freeboard, which corresponds to approximately 34 inches for the Ash Pond. Based on the results of the analyses, the calculated average displacement is below the maximum recommended value.

2.6 DESIGN OF STRUCTURES

No concrete structures have been incorporated into the Ash Pond closure design. However, the existing Ash Pond stormwater outfall discharge riser structure will be removed, and the 24-inch diameter HDPE discharge pipe (slip-lined and grouted within an original 36-inch diameter pipe) will be grouted (plugged) and abandoned in place as shown on Demolition Plan, Sheet C-101 (**Attachment 2**). Also, a second 36-inch diameter outlet pipe located immediately south of and adjacent to the 24-inch outlet pipe was previously grouted (plugged) and abandoned in-place.

Upon contract award, the contractor performing the riser structure removal and pipe grouting will be required to provide both a construction sequence and grouting plan specific to the outlet abandonment and new outlet construction work. Sheet G-101 of the design drawings (**Attachment 2**) includes a General Construction Sequence from which the contractor will use as the framework from which they will develop their detailed sequence plan.

2.7 HYDROLOGIC/HYDRAULIC INVESTIGATIONS

2.7.1 Environmental Class Determination

The environmental class of the Ash Pond dike/dam was previously determined to be Class III by Reitz and Jens (R&J Permit Report – **Attachment 1**) and is reported as such in the MDNR published list of Dams in Missouri as of 7/20/2017 (Dnr.mo.gov, 2018). Downstream conditions at the facility have not changed since issuance of the R&J Permit Report. Therefore, no further evaluation/determination has been performed for this report.

2.7.2 Evaluation of Spillway Capacity

The Ash Pond Closure design includes a mass balance grading of the existing CCR material and the installation of nine (9) culvert outlet discharge locations with check valves around the perimeter of the unit to collect and drain stormwater and prevent the backflow of water during Mississippi River flood events. A separate Stormwater Management and Erosion Control Evaluation memorandum (Stormwater Memo) was prepared as part of the closure design and is included as **Attachment 4.** This Stormwater Memo details the hydrologic and hydraulic modeling for the site as well as the erosion control design for the proposed outlets.

Highlights from the Stormwater Memo include the following:

- the design accommodates stormwater drainage of the closed ash pond and provides temporary stormwater detention within the interior of the unit without encroaching on the perimeter dike at any of the nine outlet locations during the 100-year design storm event
- outfall culverts will fully drain collected stormwater runoff within 48-hours of a 100-year storm event to prevent ponding of water on the final cover
- the outlets will each include rip-rap lined outlet protection channels that will prevent channel/bank erosion during the 25-Year rainfall event as a minimum
- Tideflex Check Valves will be included at the downstream end of the outlet pipes to prevent the possibility of backwater on the cap during extreme flooding events since culvert inlet elevations range between elevation 399.0 and 403.0 while the FEMA base flood elevation for the 100-Year storm is as much as elevation 406.0.

2.8 DISCUSSION OF DIVERSION CHANNELS

The Ash Pond consists of an elevated dike on all but the north side of the unit prohibiting run-on from the south, east and west sides of the unit. Site conditions prior to closure do include stormwater runoff from the coal pile area north of the Ash Pond. Prior to or during Ash Pond closure construction, site drainage conditions north of the impoundment will be modified to eliminate run-on to the Ash Pond by collecting coal pile area stormwater runoff in ditches and pipes to discharge it away from the north end of the Unit in conjunction with site wide stormwater management improvements being completed to satisfy separate regulatory requirements as detailed in the Black & Veatch Low Volume Waste Grading and Drainage Drawings included as **Attachment 5**.

2.9 DISCUSSION OF UPSTREAM SLOPE PROTECTION

Portions of the exterior face of the easterly facing Ash Pond berm slope along the Mississippi River currently includes rip-rap slope protection. Closure construction will include installation of rip-rap on the remainder of the dike along the river and south facing sides of the Ash Pond to ensure long-term erosion protection is maintained. Existing and proposed rip-rap will consist of a 12-inch+ thick layer of D50=6" stone which will provide adequate long-term erosion protection against peak flood river velocities expected to range up to 6 ft per second during a 100-Year flood according to the Jefferson County FIS Floodway Data table (Federal Emergency Management Agency, 2006).

2.10 OPERATION OF THE DAM AFTER UNIT CLOSURE

In accordance with 40 CFR §257.104(c) of the CCR Rule and 10 CSR 80-2.030(B) of the MDNR, Ameren will conduct post-closure care activities for 30 years following completion of closure activities of the Ash Pond. This assumes that the site is not under groundwater monitoring assessment monitoring. If the unit is under assessment monitoring, post-closure care activities continue to be implemented beyond the 30-year timeframe until the groundwater monitoring program returns to detection monitoring in accordance with 40 CFR §257.95.

The final cover system, perimeter berms/dikes (including dam crest, exterior slopes, downstream toe area) and associated stormwater management controls (including inlet/outlet culverts, structures and rip-rap outlet protection) will undergo annual detailed visual inspections and an annual report will be generated by appropriate personnel. The annual report will include completion of a detailed inspection checklist, description of observations made and photographs of the facilities during visual inspection along with a written evaluation of the results. The report will evaluate settlement, seepage, erosion, scarps, sloughs, stormwater ponding, wind erosion, storm water erosion, animal burrows, and overall integrity. As determined necessary to maintain the structural integrity of the berms/dikes, final cover system and storm water controls, the berms/dikes and final cover system and its components will be repaired for any noted deficiencies.

Ameren currently has no planned uses for the Ash Pond during the post-closure period so there are currently no post-closure operating procedures associated with the closed unit.

During the post-closure care period, Ameren will routinely inspect and maintain the monitoring wells, bollards, well surface completion, and sampling equipment in secure and proper working condition for the required sampling intervals in accordance with the Groundwater Monitoring Plan/Post-Closure Care Plan.

3. Phase 2 Field Documentation Summary

3.1 DRAWINGS

Ash Pond Closure design drawings were prepared and previously submitted (see **Attachment 2**).

3.2 SPECIFICATIONS

Ash Pond Closure Construction Specifications dated 29 January 2018 were prepared (see **Attachment 6**) and submitted previously as part of the initial Ameren construction permit request to MDNR dated 26 February 2018.

REFERENCES

1. Dnr.mo.gov. (2018). *Water Resources Center - DNR*. [online] Available at: https://dnr.mo.gov/geology/wrc/dam-safety/damsinmissouri.htm [Accessed 23 May 2018].

2. Federal Emergency Management Agency (2006). Flood Insurance Study. Jefferson County, Missouri: U.S. Department of Homeland Security, Table 3 - Floodway Data, Mississippi River.

ATTACHMENT 1

Rush Island Permit Report
Fly Ash Pond Levee System

By Reitz & Jens, Inc.
6 April 2010

Rush Island Permit Report
Flyash Pond Levee System
Dam Safety Registration Analysis
MO 40179

Prepared for



St. Louis, Missouri

Prepared by



April 6, 2010

The Professional whose signature and personal seal appear hereon assumes responsibility only for what appears in the attached report and disclaims (pursuant to Section 327.411 RSMo) any responsibility for all other plans, estimates, specifications, reports, or other documents or instruments not sealed by the undersigned Professional relating to or intended to be used for any part or parts of the project to which this report refers.

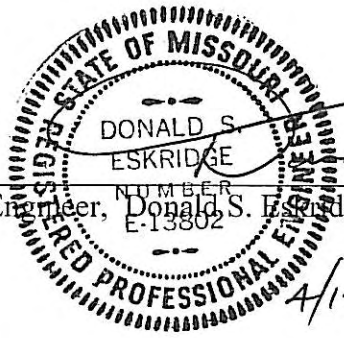
Certification by Experienced Professional Engineer

I hereby certify that the attached report has been prepared by the undersigned in accordance with the Dam Safety Regulations of the Missouri Dam and Reservoir Safety Council.

It is our opinion that when the recommended repairs are completed that this system will comply with the requirements for registration of this system as an industrial dam.

REITZ & JENS, INC.

Firm Name



Registered Engineer, Donald S. Eskridge, PE MO E-13802

4/14/2010

Table of Contents

History 1
Site Classification 2
Site Survey 2
Dam Qualification 2
Slope Stability Analysis 2
Hydrology 3
River Floodplain 3
Rainfall Events 3
Operation & Maintenance Plan 4
Site Inspection 5
Seepage 5
External slope erosion 5
Polish pond Internal Slope 6
Woody Vegetation 6

Analysis of the Existing Fly Ash Pond for Missouri Dam Safety Permit Application

The Rush Island Power Plant, a coal fired power plant located on the west bank of the Mississippi River, deposits the flyash by-product of combustion in a settling pond. The pond was created by construction of a ring levee in the floodplain on the right bank of the Mississippi river. The downstream end of the pond is located at approximately river mile 139 above the mouth of the Ohio River.

It has been determined that the configuration of the levees fit into the regulated category for an industrial water retention dam as codified in the "Regulations of the Missouri Dam and Reservoir Safety Council" of the Missouri Department of Natural Resources. This document is the technical analysis of the existing system and engineering recommendations to accompany the Ameren Company's dam registration application.

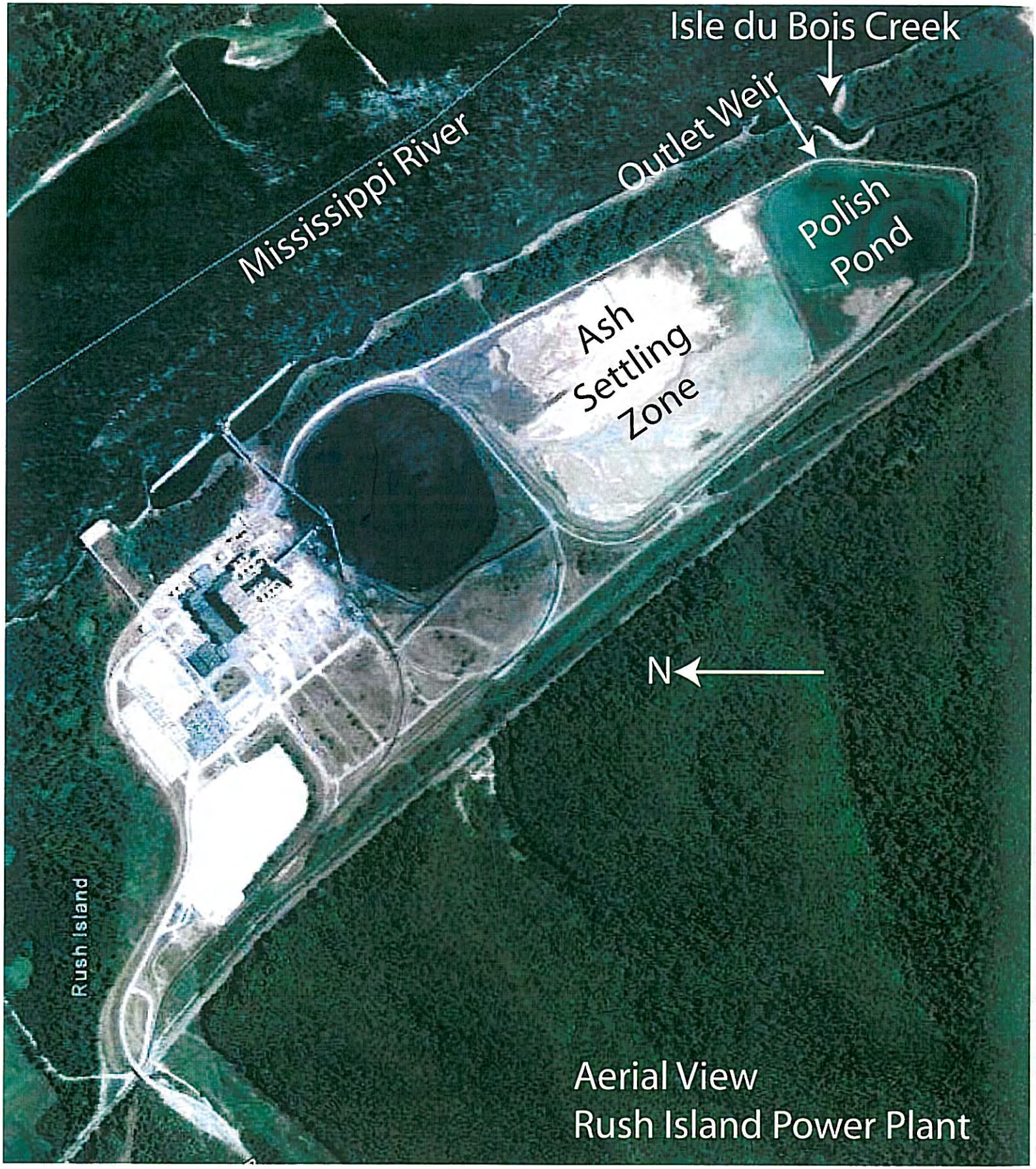
History

The Rush Island Power plant was built starting in the early 1970's. The available site plan, prepared by Bechtel Corporation has an "issued for bidding" date in early 1972. The plans show the initial plant layout with a south ash pond extending over the approximate limits of existing ash storage pond and the present "polish pond". The present pond configuration has an internal divider dike; the date of construction of the internal divider dike to separate the polish pond from the active ash accumulation portion is unknown. It is known that initial discussion of the design needs for the internal dike was started in 1994.

An annotated aerial photo on the following page shows the plant with its relationship to the Mississippi River on the east, the Isle du Bois creek on the south, and the vegetated hillside west of the plant.

The Bechtel site plan shows that the bottom of the ash pond was planned to be excavated to elevation 330, which is approximately 57 feet below the general original site grade of about 387. It is likely that some of the less permeable excavated materials were used to construct the containment dikes that are shown on the plans to be built up to elevation 410. The plans indicate that the containment dikes are supposed to have both internal and external slope surface inclinations of 3 horizontal to 1 vertical. The design top width of the dike is shown to be 14 feet.

The present use for flyash sedimentation is different from the original concept of "just a settling pond". The ash "pond" north of the internal dike is full, and the present ash disposal is into excavated pits within this area using a wetted dry ash nozzle to minimize the amount of water mixed with the ash in the smaller cell ponds. The "polish pond" is a final settlement pond that receives some ash, the plant process water, and the entire plant stormwater runoff.



Aerial View
Rush Island Power Plant

Site Classification

The flyash pond is located along the upstream side of the Isle du Bois Creek that empties into the Mississippi river. In this area the creek forms the south boundary line of Jefferson County. There are no residences or highways downstream of the dam and other public infrastructure. If the ring levee dam were to fail the discharge would flow immediately into the Mississippi river. Because there is no threat to life downstream of this dam in a potential inundation zone, it is our opinion that the Environmental Site Classification for this dam is class III, which is the lowest possible classification in Missouri. It is our understanding that in a site visit, the Chief Engineer for the Dam Safety Council also opined that this is a Class III downstream environment.

There are no dams upstream of this ring levee within the tributary watershed.

Site Survey

The entire top of levee was surveyed to obtain a profile around the ash pond. Five external slope cross sections were also obtained by the survey team. These cross section locations were chosen by Reitz & Jens as the probable locations of critical stability for analysis, the decision was based on both the geometry of the existing surface, and previous history of slope performance.

The top of levee profile is shown in the Appendix. The low point (approximately elevation 408.2) occurs between stations 84+50 and 85+50.

Dam Qualification

The surveyed cross sections show that the maximum "dam height" is 46 feet measured from the top of levee to the discharge channel flowline at the controlled outlet. Since this height is greater than 35 feet, the dam is a regulated dam in accord with the Missouri Dam Safety Council regulations, and the dam will need a registration permit.

The dam (levee) was constructed as a single stage containment levee using soils from the river floodplain. This is an industrial dam.

Slope Stability Analysis

The soil strength of the levee embankments and underlying foundation soils was analyzed using a combination of drilled test holes with both Standard Penetration Test sampling and 3 inch undisturbed thin-walled Shelby tube sampling, and Cone penetration testing. Six drilled test holes and 5 cone penetration test holes were originally proposed. One of the Test holes (TH # 5) was not drilled because of the presence of overhead power lines. The results of the test drilling, laboratory testing, and CPT testing are included in the appendix.

In late 2006 the left descending bank of the Isle du Bois creek where it is closest to the ash pond levee began to show some continued erosion towards the ash pond levee. The entire length of the adjoining creek bank was armored with rip-rap by the Corps of Engineers. There does not seem to be any

movement along that area since the creek bank was stabilized.. There was no obvious movement prior to the bank stabilization, however the bank stabilization was recommended because of the proximity to the ash pond. Levee stability study section # 4 was located through that bank stabilization area. The table on the following page shows the results of slope stability computations for three of the surveyed cross sections. The cross section number 7 was judged the most critical based on the initial total stress analysis of each cross section, therefore the greatest computational effort was on cross section # 7. The other cross sections were checked to assure that the calculated factors of safety meet the Dam Safety regulations.

The steady seepage surface used in the analysis was calculated using the procedures developed by Huang as referenced in the MO DNR 1989 Publication "Engineering Analysis of Dams". The steady seepage surface is shown on the stability computation program outputs appended to this report.

The slope stability summary (shown on the following page) indicates that the steady seepage condition is the controlling limit to maintain the factors of safety within the limits stated by Mo DNR.. This computation of the seepage surface assumes that the embankment is homogeneous, which will require any fills on the inside of the embankment to restore the grades will have to be built with fills having permeability similar to the remainder of the levee embankment. That will rule out using a rock fill to restore the inside inclinations.

The slope stability computations show that the permanent pool cannot be above elevation 403. Short term pool rises, such as a response to a major rainfall can rise above elevation 403 but the pool will have to be returned to no higher than elevation 403 after the rainfall event.

The computations show that the seismic stability is adequate.

There has been a transmission line recently constructed to serve the new Holcim cement plant just south of Rush Island, some of the transmission line towers are along the top of the west boundary levee. These are monopole towers on deep monopole drilled pier foundations. The bottoms of the tower foundations are at lease 45 feet below the top of the levee, and these are judged to have no effect on the stability of the levee.

Hydrology

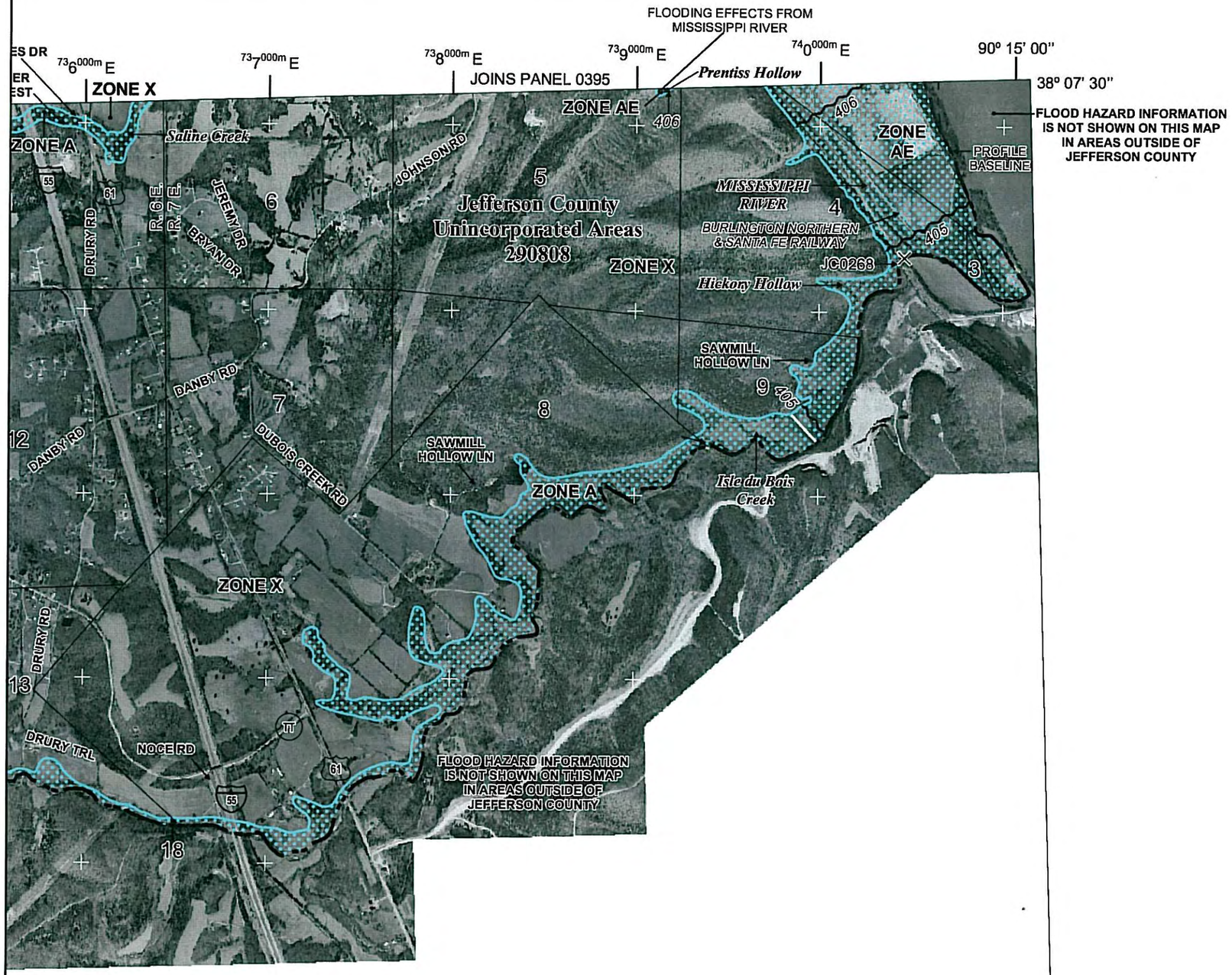
River Floodplain

The ash pond is on the floodplain of the Mississippi river, the south end of the pond is opposite mile marker 139 on the Mississippi river. The FEMA FIRM maps show the 100 year Mississippi river flood at Isle du Bois creek to be at elevation 405 on a Jefferson County FIRM with effective date of July, 2006. The US Corps of Engineers has recently completed a Flood Flow Frequency study (FFF) for the Mississippi, Missouri and Illinois rivers, that modeled all the development along the river. The FFF 100 year flood elevation at Mississippi river mile is 403.7. The Fema FIRM maps have not yet recognized the FFF study. Both of the Mississippi river 100 year flood calculated water surfaces are below the top of the ash pond levee as recently surveyed. A firmette of the area is on the following page.

Rainfall Events

Rush Island Slope Stability Summary Sheet

Section	Stress Phase	Seismic Force	Pool Elevation	Stored Ash	Toe Setback	Factor Safety	Req"d FS	File	
3	total	none	none	395		2.9		3001	
3	total	none	407	395		1.95		3002	
4	total	none	407	407		2.26	1.5	4001	
4	stdy seep	none	403	403		1.51	1.5	4012	normal pool
4	stdy seep	0.046	398	398		1.375	1.0	4011	
4	stdy seep	none	398	398		1.65	1.5	4010	
4	stdy seep	none	407	407		1.404	1.3	4013	max pool @ 407
4	stdy seep	0.046	403	403		1.31	1.0	4014	normal pool
7	total	none	407	407		1.731	1.5	7001	
7	stdy seep	none	398	398		1.711	1.5	7004	
7	stdy seep	0.046	398	398		1.49	1.0	7005	
7	stdy seep	none	407	407		1.41	1.5	7006	1.3 FS for max pool
7	stdy seep	none	403	403		1.54	1.5	7007	normal pool
7	stdy seep	0.046	403	403		1.34	1.0	7008	normal pool



MAP SCALE 1" = 2000'

1000 0 2000 4000 FEET

METER

PANEL 0500E

NATIONAL FLOOD INSURANCE PROGRAM

FIRM

FLOOD INSURANCE RATE MAP

JEFFERSON COUNTY, MISSOURI AND INCORPORATED AREAS

PANEL 500 OF 500

(SEE MAP INDEX FOR FIRM PANEL LAYOUT)

CONTAINS:

COMMUNITY	NUMBER	PANEL	SUFFIX
JEFFERSON COUNTY	290808	0500	E

Notice to User: The **Map Number** shown below should be used when placing map orders; the **Community Number** shown above should be used on insurance applications for the subject community.

MAP NUMBER
29099C0500E

EFFECTIVE DATE
APRIL 5, 2006

Federal Emergency Management Agency

This is an official copy of a portion of the above referenced flood map. It was extracted using F-MIT On-Line. This map does not reflect changes or amendments which may have been made subsequent to the date on the title block. For the latest product information about National Flood Insurance Program flood maps check the FEMA Flood Map Store at www.msc.fema.gov

A completed existing industrial dam in a Class III environment is required to be able to handle the 100 year storm event without any uncontrolled overtopping or uncontrolled discharge.

The Rush Island power plant, coal stockpile, and ash pond create a stand-alone hydrologic unit that has no additional tributary area. Stormwater collected within the plant confines is pumped into the discharge channel that leads to the present polish pond. The runoff from the coal pile flows into the same discharge channel.

The total tributary area of the plant, coal pile and ash ponds is 261 acres. All the collected stormwater accumulates in the polish pond and is discharged through a 24 inch diameter vertical riser pipe spillway that has several control valves on it. The control valves are necessary to maintain the discharge water within EPA guidelines.

For purposes of storm routing the total plant tributary area was broken up into 4 separate hydrologic units as shown on the following drawing entitled "Storm Drainage Assumptions". Two outflow condtions were analyzed, the first assumes that the 24 inch discharge pipe is fully opened throughout the period of storm runoff storage, and the second condition is that the 24 inch pond discharge pipes are closed to flow. None of the analyses assume any flow over any other spillway on the system.

The hydrologic computations are shown in the appendix. All runoff and routing computations were performed using the computer program "Hydraflow Hydrographs" by Intellisolve. All of the computations include a steady plant process outflow of 20 cfs in addition to the stormwater runoff. A summary table of the computation results is shown on the following page.

The present operating elevation of the polish pond water surface ranges between elevation 396 and 398, the plant operations personnel stated that they would like to operate the pond at an elevation of 398. The hydrology computations show that for both the 100 year 24 hour storm and the 100 year 6 hour storm, the maximum routed pool elevation is 402.55 for a fully functioning pond outlet, and elevation 404.05 for a closed pond outlet. There remains at least 4.15 feet of freeboard below the lowest elevation of the ash pond levee. The system can safely store the 100 year storm for a beginning pool elevation of 398.

Since the slope stability analysis shows that a maximum permanent pool of 403 is possible, the system response was also modeled with a 403 starting pool elevation. A fully functioning pond outlet would pond water to an elevation of 407.44, and a closed outlet would pond water to an elevation of 408.88 which is above the lowest present elevation of the ash pond levee.

The low point of the perimeter levee is at elevation 408.2 between survey stations 84+50 and 85+50, in the north west corner of the ash pond. It is our opinion that as long as the operating water surface is at elevation 398 and the polish pond has a full 27 acres of water surface available (no ash delta above elevation 398) that there is no emergency spillway needed on this system.

Operation & Maintenance Plan

There is no documented operation and maintenance plan available. A plan should be prepared, to integrate the requirements of the regulated outfall and the pool elevation requirements needed to satisfy

Table of Results
Hydrologic computations

Rush Island Ash Pond Storm Routing

File	Rainfall duration	frequency	Pond Start Elevtion	Base Flow from Plant	Maximum Stage	Max. Outflow cfs	Total Storage ac-ft	Remarks
Trial 03	24 hr	100 yr	395	15 cfs	399.55	27.97	116	8.1 ac Ash delta at 395
Trial 04	24 hr	100 yr	395	20 cfs	399.87	28.95	124	8.1 ac Ash delta at 395
Trial 05	24 hr	100 yr	403	20 cfs	407.44	27.93	126	No Ash Delta @ 403
Trial 09	24 hr	100 yr	398	20 cfs	402.55	28.27	125.2	Ash Delta Submerged @ 397
From Hand computations (sheet 4) - for a blocked outlet pipe								
	24 hr	100 yr	395	20 cfs	401.43	0	167.188	8.1 ac Ash delta at 395
	24 hr	100 yr	398	20 cfs	404.05	0	167.188	Ash Delta Submerged @ 397
	24 hr	100 yr	403	20 cfs	408.88	0	167.188	Stage is higher than 408.2 lowpoint
Trial 06	6 hr	100 yr	395	20 cfs	398.25	23.51	79.8	8.1 ac Ash delta at 395
Trial 07	6 hr	100 yr	403	20 cfs	405.88	22.38	80.3	No Ash Delta @ 403
Trial 08	6 hr	100 yr	398	20 cfs	400.93	22.68	80.21	Ash Delta Submerged @ 397

Note: 100 yr - 24 hour storm - 7.10 inches
100 yr - 6 hour storm - 5.20 inches
Souirce - Bulletin 71, Huff & Angel

24"Ø OUTLET

MISSISSIPPI RIVER

N

See Levee Profile Sheets 1-3

WET POND 395

ASH DELTA 397±

ASH POND 408±

ISLE du BOIS CREEK

Stormwater Runoff Channel

COAL PILE

PLANT

Tributary of ISLE du BOIS CREEK

LEVEE LOW POINT 408±

0+00
5+00
10+00
15+00
20+00
25+00
30+00
35+00
40+00
45+00
50+00
55+00
60+00
65+00
70+00
75+00
80+00
85+00
90+00
95+00

REITZ & JENS, INC.
CONSULTING ENGINEERS
1055 CORPORATE SQUARE DRIVE
ST. LOUIS MISSOURI 63132
(314) 993-4132
PROFESSIONAL ENGINEERING CORP., LICENSE #000215

Designed D.S.E. Checked D.S.E.

Drawn D.L.B. Issued 01/08/2010

AmerenUE
Rush Island Plant
Festus MO, 63028

Dam Safety Permit
Storm Drainage Assumptions
2009012469

SHEET 1

01/08/2010

ri levee.dwg

both the geotechnical stability and the hydrologic requirements. This plan should be prepared within 6 months.

The operating pool water level needs to be monitored and recorded on at least a daily basis. When a significant rainfall event is predicted the operating staff needs to know what to expect as a response to the storm.

Since there is no emergency spillway recommended, it is our opinion that the maximum operating water surface elevation in the pond should be 400.2, provided that the full pond volume is available for storage. There should be no ash delta robbing the available storage for storm runoff. The recommended starting elevation would allow a 100 year 24 hour storm to be stored no higher than elevation 406.2 even if the outlet is blocked. This still provides a freeboard of 2 feet below the overflow elevation of the perimeter levee.

The plant personnel should develop an operating plan for pond management that reflects this storage need as well as the environmental constraints on the pond outlets.

Site Inspection

As a part of this application a visual site inspection was made by Donald Eskridge, PE on March 19, 2010. The following is a discussion of several observed deficiencies that need to be corrected. The discussion will refer to the stationing used in the 2010 levee survey plan sheets included in the appendix.

Seepage
There are two locations of slight seepage through the face of the slope in the vicinity of stations 14+00 to 15+00. These seeps have always been there and the embankment is not showing any distress except that from mowing disturbance. Since this is opposite the filled ash pond it is our opinion that these seeps do not pose an immediate threat to the stability of the embankment. We recommend that they be monitored and if the seepage increases then localized excavation and repairs may be needed.

External slope erosion
In the vicinity of station 30+00 the toe of the levee embankment slope has been eroded away to form a steep slope about 5 feet high. The surface has no erosion protection. This is shown in the photo to the right. In the event of a Mississippi river flood continued erosion could occur that would not be able to be observed through the flood waters, and the slope could fail. This eroded area needs to be rebuilt and rip-rapped. A similar section occurs about 80 feet south of the discharge platform bridge that also needs to be re-shaped and rip-rapped. The rock rip-rap should be placed on either a bedding layer, or a separation layer of non-woven filter fabric. The finish face of the entire slope should be built to



the original design slope.

In the vicinity of station 57+00 the external slope has experienced severe surface erosion from runoff from the road on the top of the levee. It could also be erosion started at a in-completely filled root ball hole from the slope clearing. This erosion should be filled in and re-seeded.

Polish pond Internal Slope
Wave action style erosion has steepened the internal slopes of the east and south sides of the polish pond from approximately stations 33+00 to 50+00. In many cases the erosion has created slopes as steep as 1H:1V, and along the east shore the erosion is within 10 feet of the edge of the roadway. A photo is shown on the left of this discussion.



The slope stability study has shown that the steady seepage condition is the most critical for the existing external slopes. The internal slopes have to be re-built with soils to a minimum 2H:1V slope to meet the seepage analysis assumptions. These slopes should also be rip-rapped after rebuilding to protect against recurrence of the wave erosion.

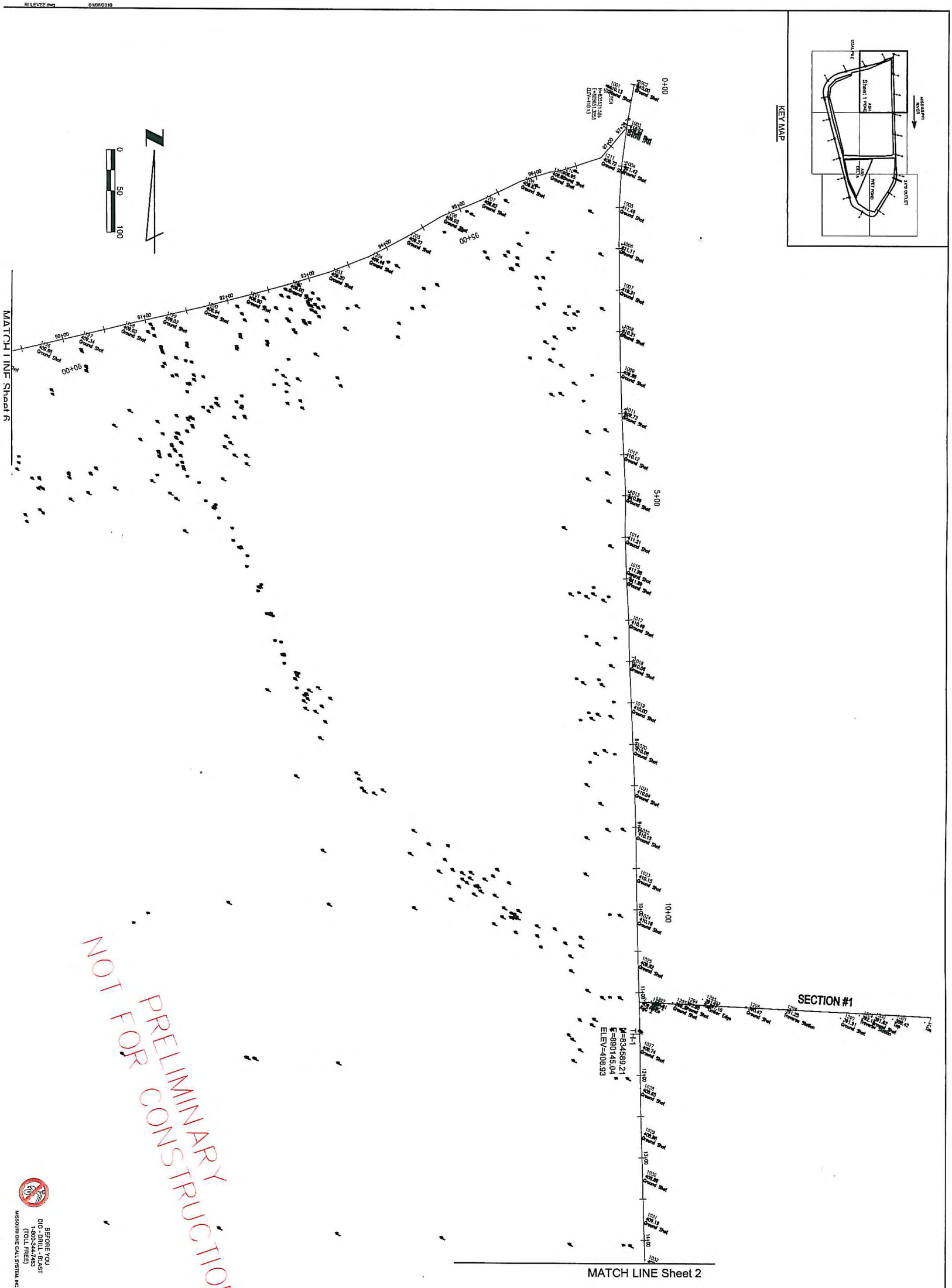
Reitz & Jens has been informed that plans are under way to perform this slope repair during the summer of 2010.

Woody Vegetation
Woody Vegetation is establishing along the interior slope from approximately Stations 48+00 to about 55+00. This needs to be cleared.

APPENDICES

Top of Levee Elevation Survey
Top of Levee Profile
Cross Section Plots
Test Holes Location Plan
Boring Logs Lab Testing Results
CPT Logs
Slope Stability Analysis
Hydrology Analysis

Top of Levee Elevation Survey

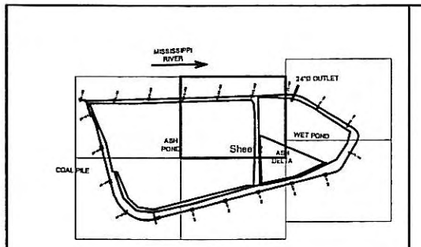


PRELIMINARY
NOT FOR CONSTRUCTION

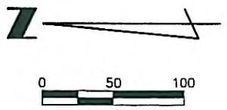
BEFORE YOU DIG - DRILL - BLAST
1-800-344-7483
(TOLL FREE)
MISSOURI ONE CALL SYSTEM, INC.

A signed and sealed original of this drawing is on file at the offices Reitz & Jens, Inc. The signed and sealed original is the official current and shall take precedence over any digital version.

REVISIONS	Dam Safety Permit Ash Pond Levee Ash Pond Plan 2009012469	AmerenUE Rush Island Plant Festus, MO 63028	REITZ & JENS, INC. CONSULTING ENGINEERS 1055 CORPORATE SQUARE DRIVE ST. LOUIS MISSOURI 63132 (314) 993-4132 PROFESSIONAL ENGINEERING CORPORATION, LICENSE #000218 Designed D.S.E. Checked P.H.R. Drawn D.L.B. Issued 01/08/2010	THE ENGINEER WHOSE SIGNATURE AND PERSONAL SEAL APPEAR HEREON ASSUMES RESPONSIBILITY ONLY FOR WHAT APPEARS ON THIS PAGE AND DISCLAIMS (PURSUANT TO SECTION 327.411 RSMO) ANY RESPONSIBILITY FOR ALL OTHER PLANS, SPECIFICATIONS, ESTIMATES, REPORTS OR OTHER DOCUMENTS OR INSTRUMENTS NOT SEALED BY THE UNDERSIGNED ENGINEER RELATING TO OR INTENDED TO BE USED FOR ANY PART OR PARTS OF THE PROJECT TO WHICH THIS PAGE REFERS.	Date:	THIS MEDIA SHOULD NOT BE CONSIDERED A CERTIFIED DOCUMENT	Engineer Seal



KEY MAP



MATCH LINE Sheet 1

15+00

20+00

25+00

CPT-1
N=833791.77
E=890517.52
ELEV=410.60

TH-2
N=832
E=890
ELEV=

MATCH LINE Sheet 3

MATCH LINE Sheet 5

NOT FOR PRELIMINARY CONSTRUCTION

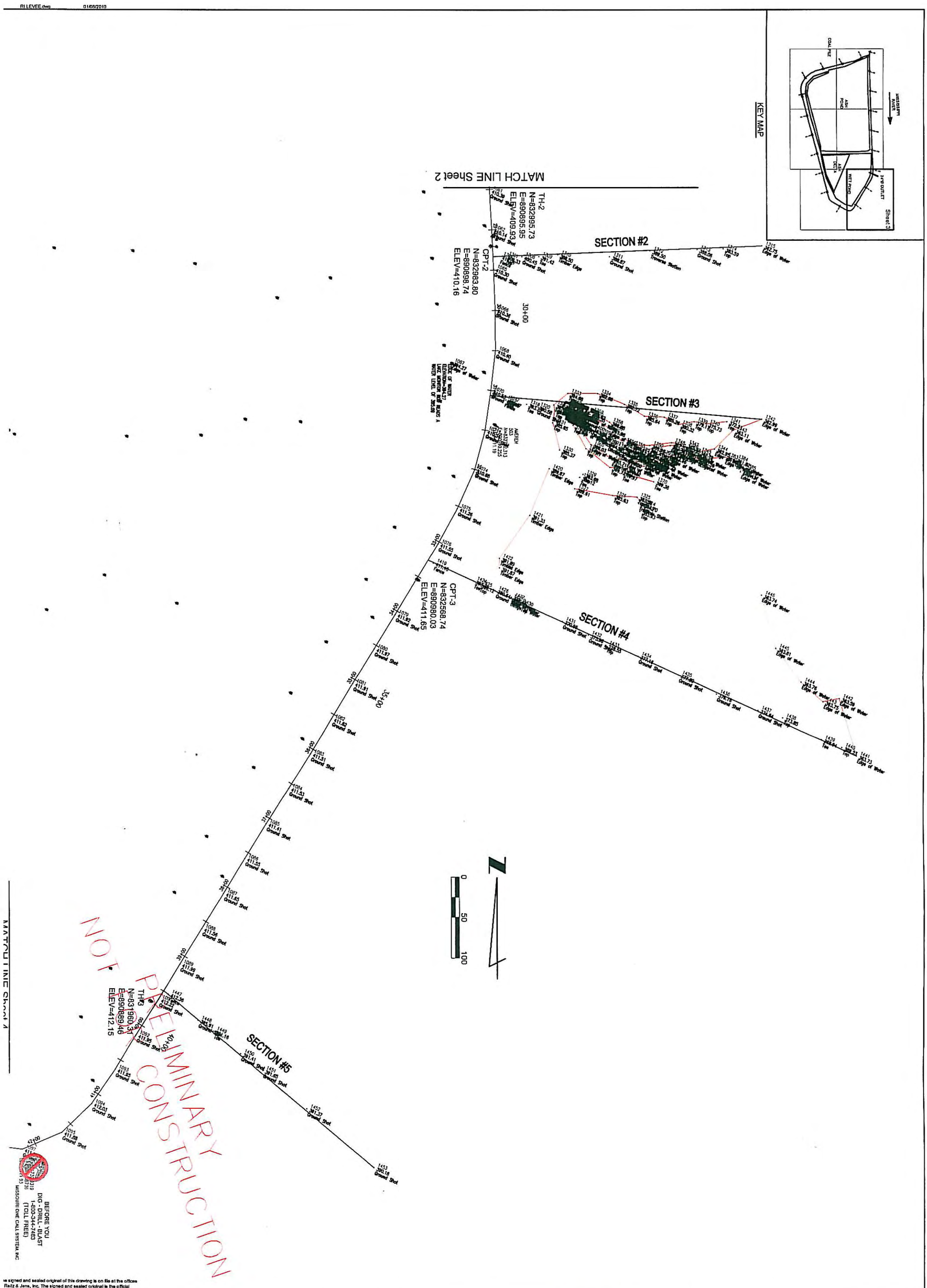
BEFORE YOU DIG - DRILL - BLAST
1-800-344-7483
(TOLL FREE)
MISSOURI ONE CALL SYSTEM, INC

Engineer Seal

THIS MEDIA SHOULD NOT BE CONSIDERED A CERTIFIED DOCUMENT

Date:

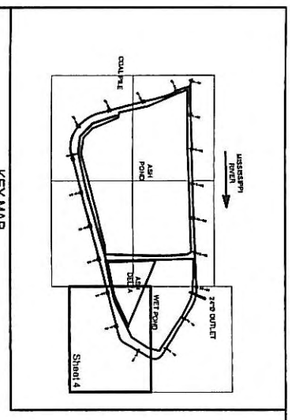
THE ENGINEER WHOSE SIGNATURE AND PERSONAL SEAL APPEAR HEREON ASSUMES RESPONSIBILITY ONLY FOR WHAT APPEARS ON THIS PAGE AND ONLY TO THE EXTENT REQUIRED BY SECTION 327.411 RSMO. ANY RESPONSIBILITY FOR ALL OTHER PLANS, SPECIFICATIONS, ESTIMATES, REPORTS OR OTHER DOCUMENTS OR ESTIMATES, REPORTS OR OTHER DOCUMENTS OR ESTIMATES, REPORTS OR OTHER DOCUMENTS OR



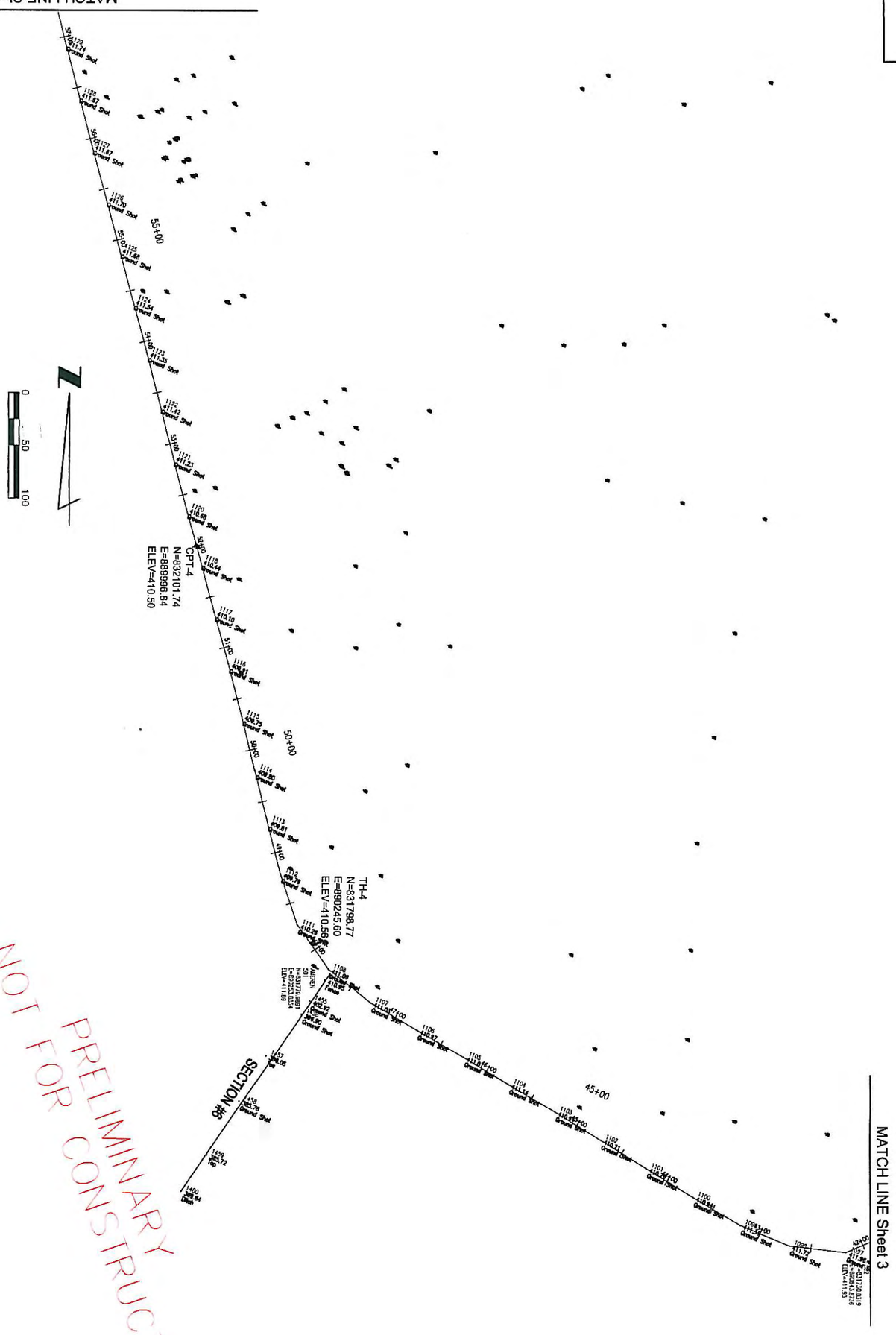
...e signed and sealed original of this drawing is on file at the offices ... Reitz & Jens, Inc. The signed and sealed original is the official ...cument and shall take precedence over any digital version.

REVISIONS	Dam Safety Permit Ash Pond Levee Ash Pond Plan 2009012469	AmerenUE Rush Island Plant Festus, MO 63028	REITZ & JENS, INC. CONSULTING ENGINEERS 1055 CORPORATE SQUARE DRIVE ST. LOUIS MISSOURI 63132 (314) 993-4132 PROFESSIONAL ENGINEERING CORPORATION LICENSE #000215 Designed D.S.E. Checked P.H.R. Drawn D.L.B. Issued 01/08/2010	THE ENGINEER WHOSE SIGNATURE AND PERSONAL SEAL APPEAR HEREON ASSUMES RESPONSIBILITY ONLY FOR WHAT APPEARS ON THIS PAGE AND DISCLAIMS (PURSUANT TO SECTION 327.411 RSMO) ANY RESPONSIBILITY FOR ALL OTHER PLANS, SPECIFICATIONS, ESTIMATES, REPORTS OR OTHER DOCUMENTS OR INSTRUMENTS NOT SEALED BY THE UNDERSIGNED ENGINEER RELATING TO OR INTENDED TO BE USED FOR ANY PART OR PARTS OF THE PROJECT TO WHICH THIS PAGE REFERS.	Date:	THIS MEDIA SHOULD NOT BE CONSIDERED A CERTIFIED DOCUMENT	Engineer Seal

RI LEVEE.dwg 01/08/2010



MATCH LINE Sheet 5



MATCH LINE Sheet 3

PRELIMINARY
NOT FOR CONSTRUCTION

BEFORE YOU DIG - DRILL - BLAST
1-800-344-7483
(TOLL FREE)
MISSOURI ONE CALL SYSTEM, INC.

The signed and sealed original of this drawing is on file at the offices of Reitz & Jens, Inc. The signed and sealed original is the official document and shall take precedence over any digital version.

REVISIONS	Dam Safety Permit Ash Pond Levee Ash Pond Plan 2009012469	AmerenUE Rush Island Plant Festus, MO 63028	REITZ & JENS, INC. CONSULTING ENGINEERS 1055 CORPORATE SQUARE DRIVE ST. LOUIS, MISSOURI 63132 (314) 993-1122 PROFESSIONAL ENGINEERING CORPORATION, LICENSE #000215 Designed D.S.E. Checked P.H.R. Drawn D.L.B. Issued 01/08/2010	THE ENGINEER WHOSE SIGNATURE AND PERSONAL SEAL APPEAR HEREON ASSUMES RESPONSIBILITY ONLY FOR WHAT APPEARS ON THIS PAGE AND DISCLAIMS (PURSUANT TO SECTION 327.411 RSMO) ANY RESPONSIBILITY FOR ALL OTHER PLANS, SPECIFICATIONS, ESTIMATES, REPORTS OR OTHER DOCUMENTS OR INSTRUMENTS NOT SEALED BY THE UNDERSIGNED ENGINEER RELATING TO OR INTENDED TO BE USED FOR ANY PART OR PARTS OF THE PROJECT TO WHICH THIS PAGE REFERS.	Date:	THIS MEDIA SHOULD NOT BE CONSIDERED A CERTIFIED DOCUMENT	Engineer Seal

KEY MAP

MATCH LINE Sheet 2

MATCH LINE Sheet 4

MATCH LINE Sheet 6

0+00

60+00

65+00

CPT-5
N=833531.83
E=888891.89
ELEV=410.47

TH-5
NOT
DRILLED

SECTION #7

0 50 100

PRELIMINARY
NOT FOR CONSTRUCTION

BEFORE YOU
DIG - DRILL - BLAST
1-800-344-7483
(TOLL FREE)
MISSOURI ONE CALL SYSTEM, INC.

Engineer Seal

THIS MEDIA SHOULD NOT BE CONSIDERED A CERTIFIED DOCUMENT

Date:

THE ENGINEER WHOSE SIGNATURE AND PERSONAL SEAL APPEARS HEREON AND/OR WHOSE IDENTITY APPEARS ON THIS PAGE AND DISCLAIMS (PURSUANT TO SECTION 327.411 RSMO) ANY RESPONSIBILITY FOR ALL OTHER DOCUMENTS OR ESTIMATES, REPORTS OR OTHER DOCUMENTS OR INSTRUMENTS NOT SEALED BY THE UNDERSIGNED AND NOT PREPARED BY HIM/HER OR UNDER HIS/HER DIRECT SUPERVISION AND NOT INTENDED TO BE USED FOR ANY PART OR PARTS OF THE PROJECT TO WHICH THIS PAGE REFERS.

REITZ & JENS, INC.
CONSULTING ENGINEERS
1058 CORPORATE SQUARE DRIVE
ST. LOUIS (HAZELWOOD), MO 63132
(314) 993-4100
PROFESSIONAL ENGINEERING CORPORATION, LIC/REG #000315

Designed D.S.E. Checked P.H.R.
Drawn D.L.B. Issued 01/09/2019

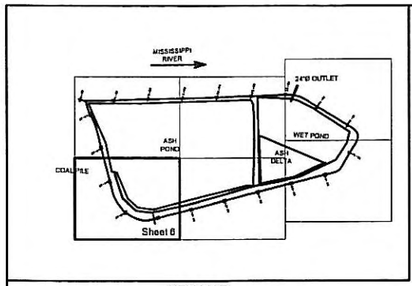
AmerenUE
Rush Island Plant
Festus, MO 63028

Dam Safety Permit
Ash Pond Levee
Ash Pond Plan
2009012469

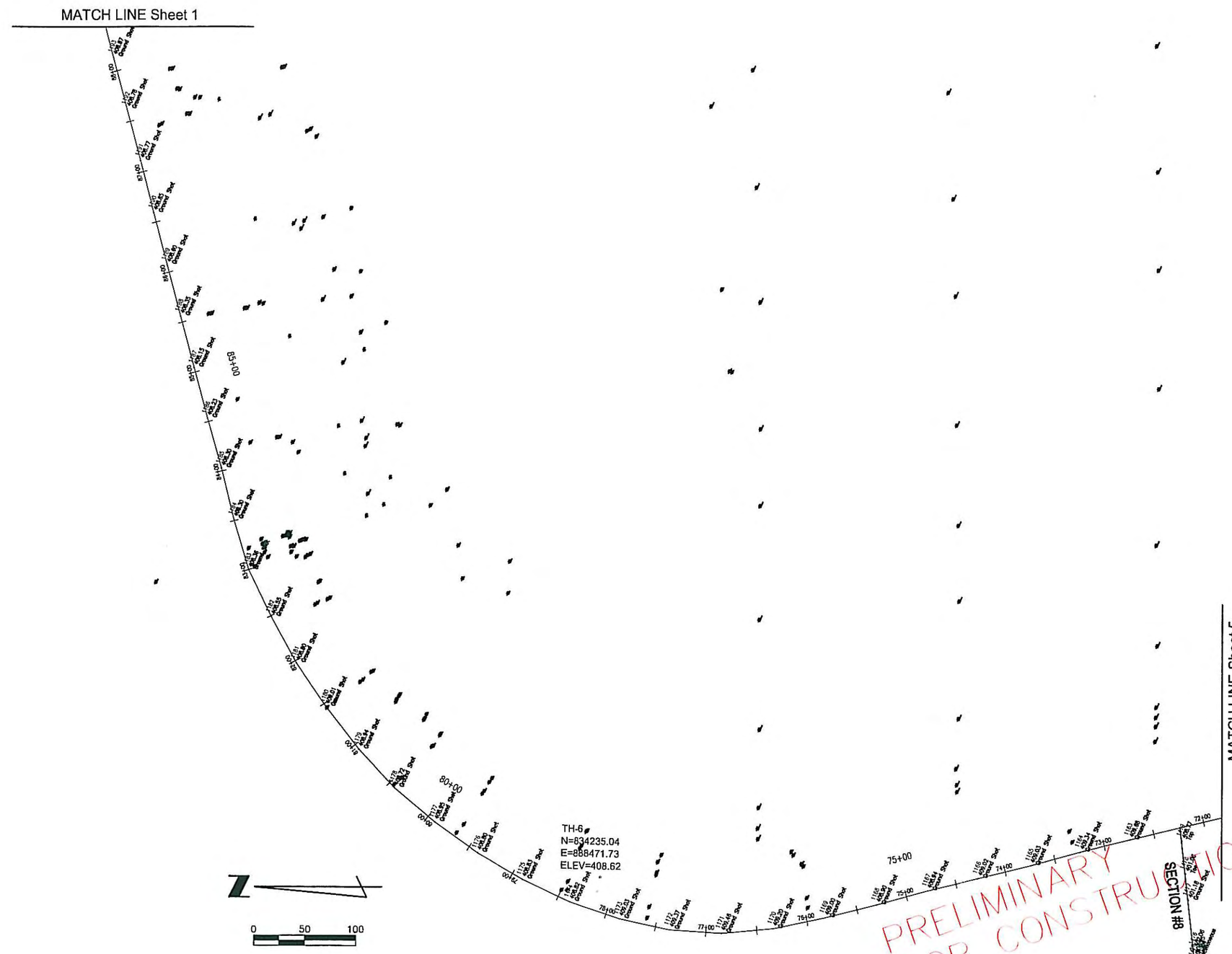
REVISIONS

This drawing is the property of Reitz & Jens, Inc. The ideas and design incorporated herein, as an instrument of service, is and shall remain the property of Reitz & Jens, Inc. The reproduction or unauthorized use of this drawing without the written permission of Reitz & Jens, Inc. is prohibited and will be subject to legal action. Visual contact with this drawing shall constitute prima facie evidence of the acceptance of these restrictions. Reitz & Jens, Inc. retains all common law, statutory and other reserved rights, including the copyright thereto. Reitz & Jens, Inc. shall retain all ownership and property rights in the drawing as an instrument of service. The drawing is not to be changed or copied in any form or manner whatsoever nor are they to be assigned to any third party without first obtaining the expressed written permission and consent of Reitz & Jens, Inc. In the event of unauthorized reuse of these documents, the user shall indemnify and hold harmless Reitz & Jens, Inc. from any claims arising out of the unauthorized reuse of these documents. Any unauthorized use of these documents shall be at the user's sole risk and without liability to Reitz & Jens, Inc. Submission or distribution of these documents to meet official regulatory requirements or for other purposes in connection with this project is not to be construed as publication in derogation of Reitz & Jens, Inc. reserved rights. Only the signed and sealed original of this drawing is on file at the offices of Reitz & Jens, Inc. The signed and sealed original shall govern in the event of any discrepancy between it and any digital version.

FILE EVSE.dwg 01/09/2019



KEY MAP



PRELIMINARY
NOT FOR CONSTRUCTION

BEFORE YOU
DIG - DRILL - BLAST
1-800-344-7483
(TOLL FREE)
MISSOURI ONE CALL SYSTEM, INC.

Engineer Seal

THIS MEDIA SHOULD NOT BE CONSIDERED A CERTIFIED DOCUMENT

Date:

THE ENGINEER WHOSE SIGNATURE AND PERSONAL SEAL APPEAR HEREON ASSUMES RESPONSIBILITY ONLY FOR WHAT APPEARS ON THIS PAGE AND DISCLAIMS (PURSUANT TO SECTION 327.411 RSMO) ANY RESPONSIBILITY FOR ALL OTHER PLANS, SPECIFICATIONS, ESTIMATES, REPORTS OR OTHER DOCUMENTS OR INSTRUMENTS NOT SEALED BY THE UNDERSIGNED ENGINEER RELATING TO OR INTENDED TO BE USED FOR ANY PART OR PARTS OF THE PROJECT TO WHICH THIS PAGE REFERS.

REITZ & JENS, INC.
CONSULTING ENGINEERS
1055 CORPORATE SQUARE DRIVE
ST. LOUIS, MISSOURI 63132
(314) 993-4132
PROFESSIONAL ENGINEERING CORPORATION, LICENSE #000215

Designed D.S.E. Checked P.H.R.
Drawn D.L.B. Issued 01/08/2010

AmerenUE

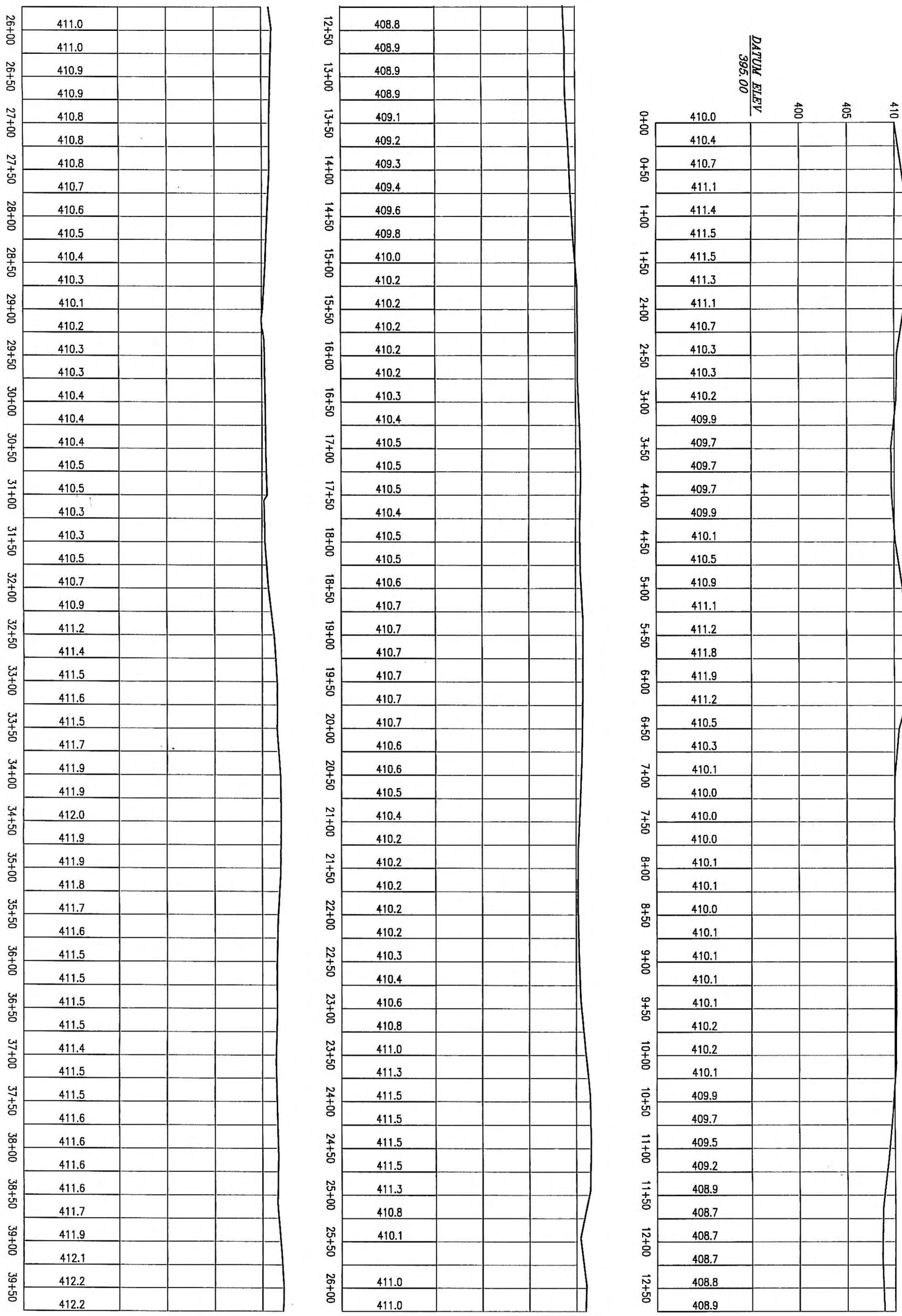
Rush Island Plant
Festus, MO 63028

Dam Safety Permit
Ash Pond Levee
Ash Pond Plan
2009012469

REVISIONS

01/08/2010
RI LEVEE.dwg

Top of Levee Profile



SHEET 1 OF 3	Dam Safety Permit Top of Levee Profile 2009012469	AmerenUE Rush Island Plant Festus, MO 63028	Designed DSE Drawn DSE	Checked DSE Issued 01/11/2010	REITZ & JENS, INC. CONSULTING ENGINEERS 1055 CORPORATE SQUARE DRIVE ST. LOUIS MISSOURI 63132 (314) 993-4132 PROFESSIONAL ENGINEERING CORP., LICENSE #000215

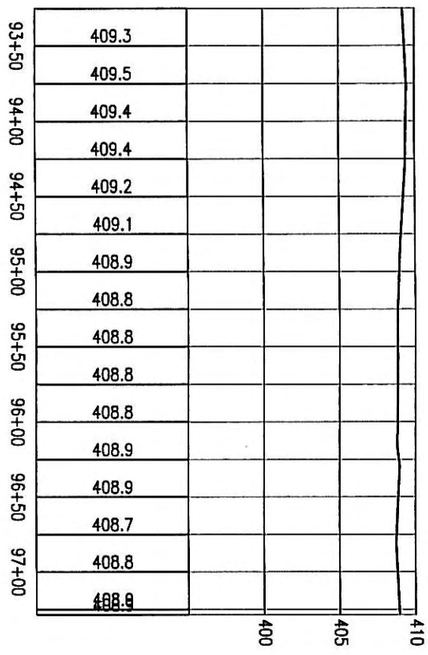
66+50	410.4
	410.5
67+00	410.6
	410.7
67+50	410.9
	410.9
68+00	410.9
	410.9
68+50	410.9
	410.8
69+00	410.8
	410.8
69+50	410.8
	410.8
70+00	410.7
	410.6
70+50	410.4
	410.2
71+00	409.9
	409.7
71+50	409.6
	409.5
72+00	409.6
	409.7
72+50	409.7
	409.7
73+00	409.5
	409.3
73+50	409.2
	409.0
74+00	409.0
	409.0
74+50	409.0
	408.9
75+00	408.9
	408.9
75+50	408.9
	409.0
76+00	409.1
	409.2
76+50	409.3
	409.4
77+00	409.4
	409.4
77+50	409.3
	409.1
78+00	409.0
	408.9
78+50	408.8
	408.8
79+00	408.8
	408.8
79+50	408.8
	408.9
80+00	408.9
	408.8

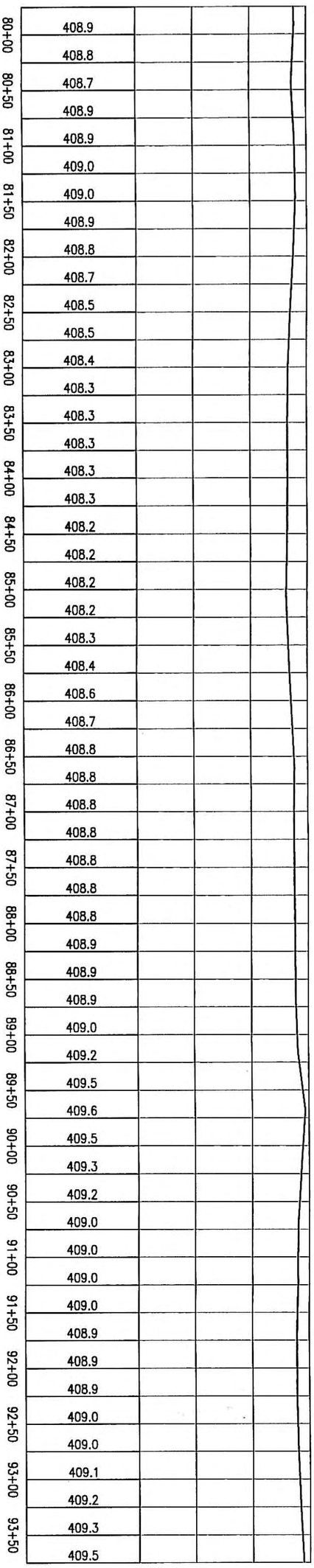
53+00	411.3
	411.4
53+50	411.4
	411.4
54+00	411.4
	411.5
54+50	411.6
	411.6
55+00	411.7
	411.7
55+50	411.7
	411.7
56+00	411.7
	411.7
56+50	411.7
	411.7
57+00	411.7
	411.8
57+50	411.8
	411.8
58+00	411.8
	411.8
58+50	411.8
	411.8
59+00	411.9
	411.9
59+50	412.0
	412.0
60+00	412.1
	412.1
60+50	412.0
	412.0
61+00	412.0
	411.8
61+50	411.7
	411.5
62+00	411.4
	411.2
62+50	411.1
	411.0
63+00	410.9
	411.1
63+50	411.3
	411.4
64+00	411.4
	411.2
64+50	411.0
	410.9
65+00	410.9
	410.8
65+50	410.7
	410.5
66+00	410.4
	410.4
66+50	410.4
	410.5

39+50	412.2
	412.2
40+00	412.0
	411.9
40+50	411.9
	412.0
41+00	412.0
	412.0
41+50	411.9
	411.9
42+00	411.9
	411.9
42+50	411.8
	411.7
43+00	411.5
	411.3
43+50	411.1
	410.9
44+00	410.8
	410.8
44+50	410.7
	410.7
45+00	410.8
	410.9
45+50	411.0
	411.1
46+00	411.1
	411.0
46+50	411.0
	411.0
47+00	411.0
	411.0
47+50	411.1
	411.1
48+00	410.8
	410.3
48+50	410.1
	409.8
49+00	409.8
	409.8
49+50	409.8
	409.8
50+00	409.8
	409.8
50+50	409.8
	409.9
51+00	410.0
	410.1
51+50	410.2
	410.4
52+00	410.5
	410.6
52+50	410.8
	411.1
53+00	411.3
	411.4

SHEET 2 OF 3	Dam Safety Permit Top of Levee Profile 2009012469	AmerenUE Rush Island Plant Festus, MO 63028	Designed DSE Checked DSE Drawn DSE Issued 01/11/2010

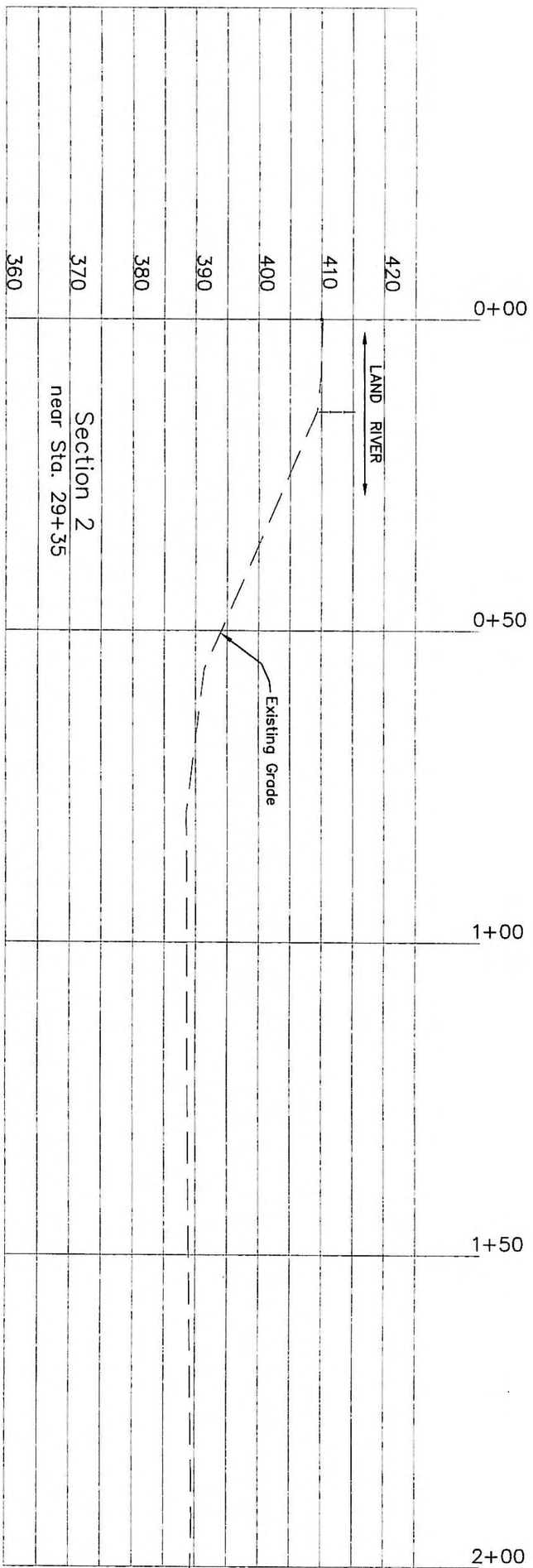
REITZ & JENS, INC.
CONSULTING ENGINEERS
1055 CORPORATE SQUARE DRIVE
ST. LOUIS MISSOURI 63132
(314) 993-4132
PROFESSIONAL ENGINEERING CORP., LICENSE #000215



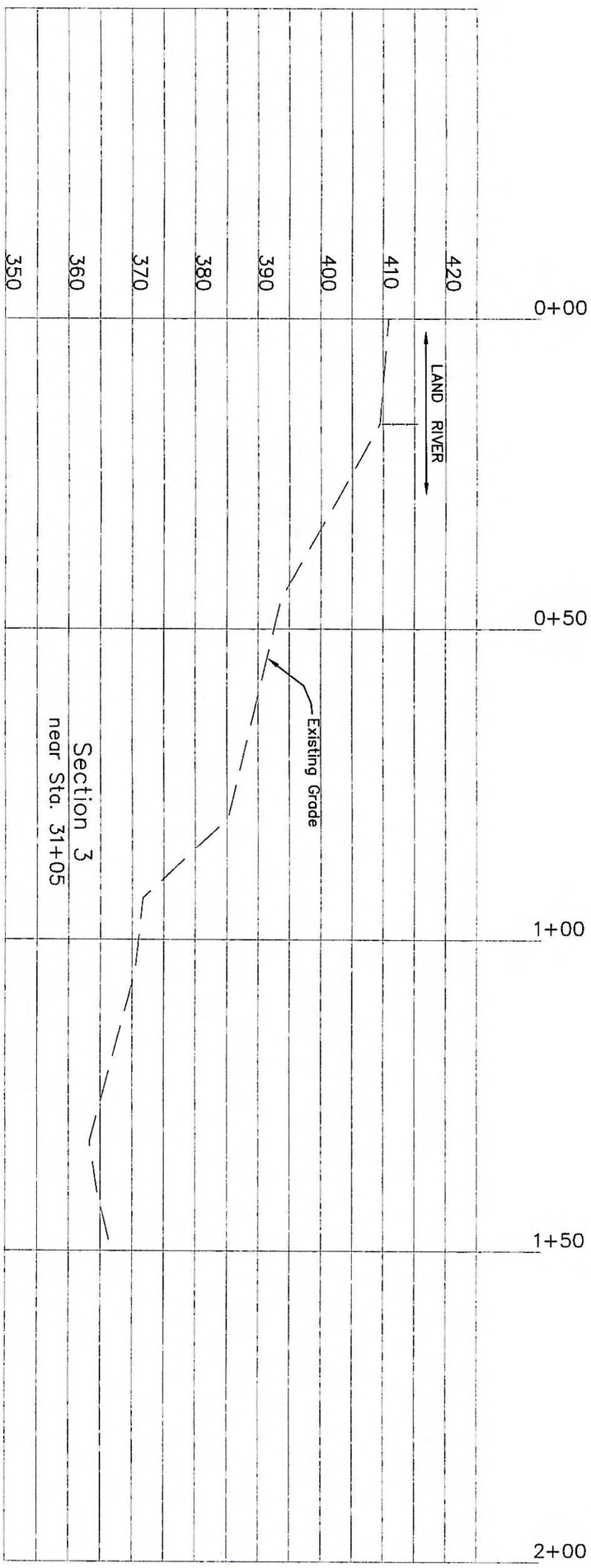


SHEET	Dam Safety Permit	AmerenUE			
3 OF 3	Top of Levee Profile	Rush Island Plant	Designed DSE	Checked DSE	REITZ & JENS, INC. CONSULTING ENGINEERS
	2009012469	Festus, MO 63028	Drawn DSE	Issued 01/11/2010	1055 CORPORATE SQUARE DRIVE ST. LOUIS MISSOURI 63132 (314) 993-4132 PROFESSIONAL ENGINEERING CORP., LICENSE #000215

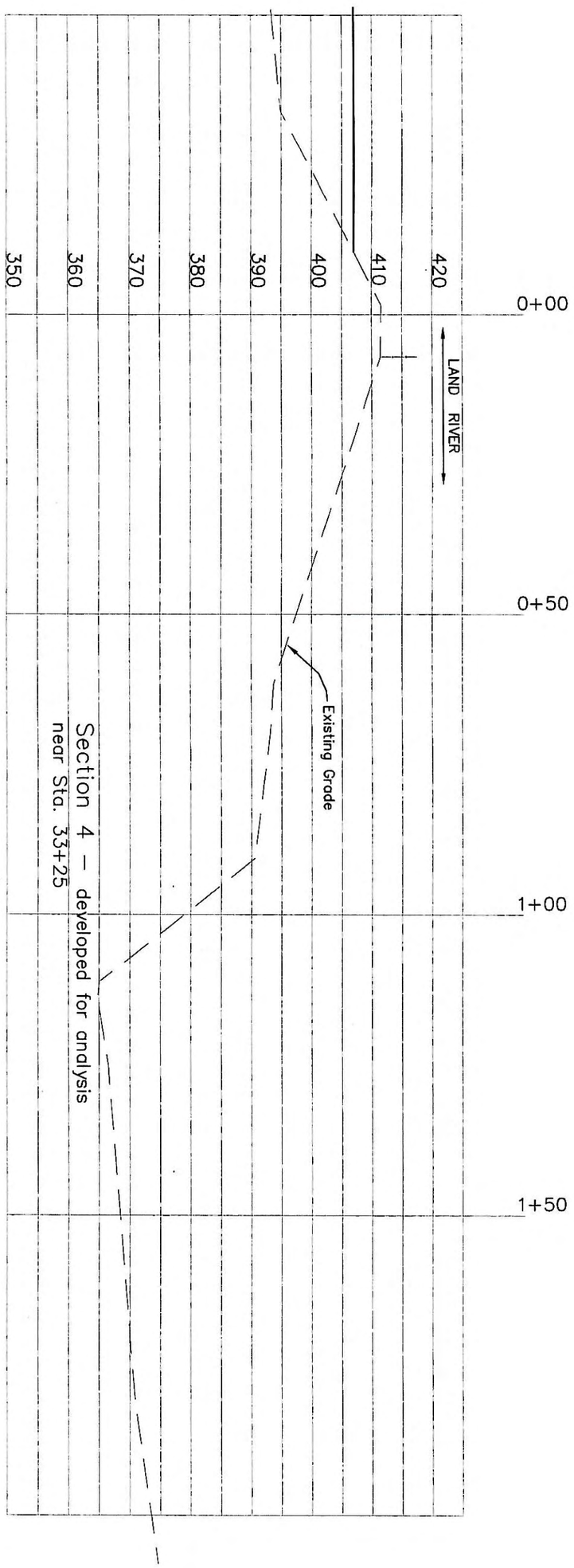
Cross Section Plots



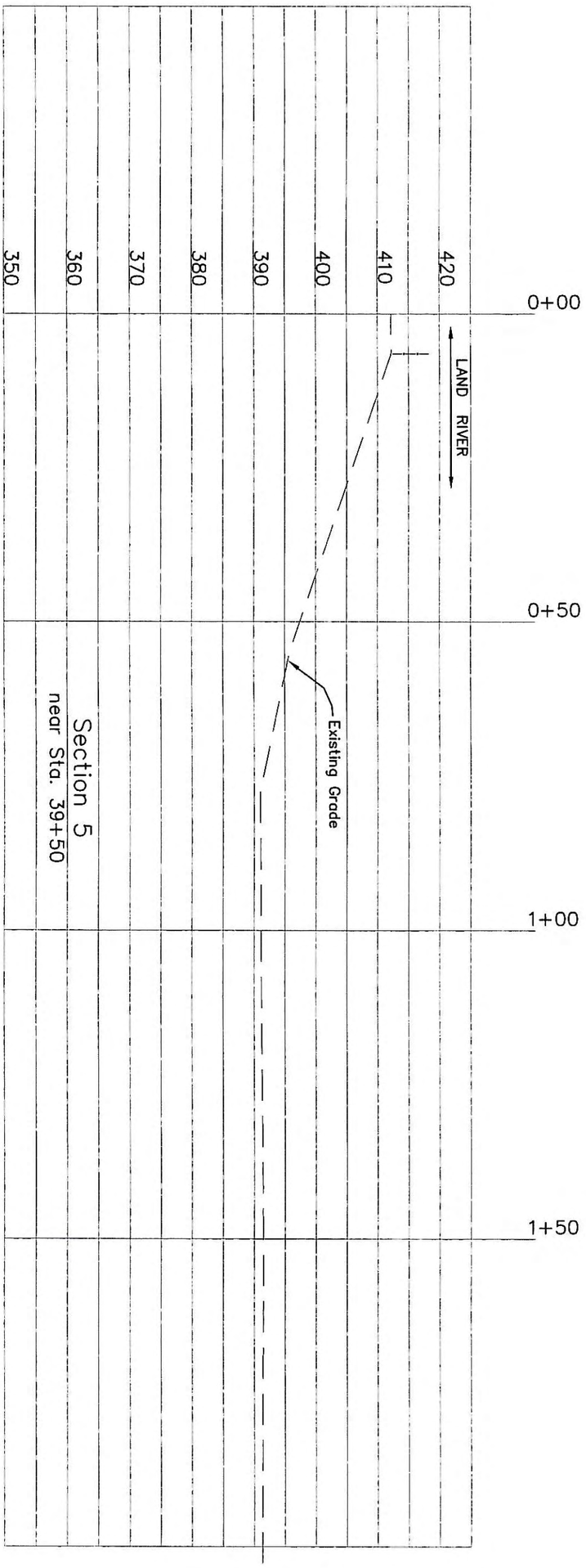
SHEET 2 OF 5	Dam Safety Permit Survey Sections 2009012469	AmerenUE Rush Island Plant Festus MO, 63028	Designed D.S.E. Checked D.S.E. Drawn D.S.E. Issued 01/08/10	REITZ & JENS, INC. CONSULTING ENGINEERS 1055 CORPORATE SQUARE DRIVE ST. LOUIS MISSOURI 63132 (314) 993-4132 PROFESSIONAL ENGINEERING CORP., LICENSE #000215



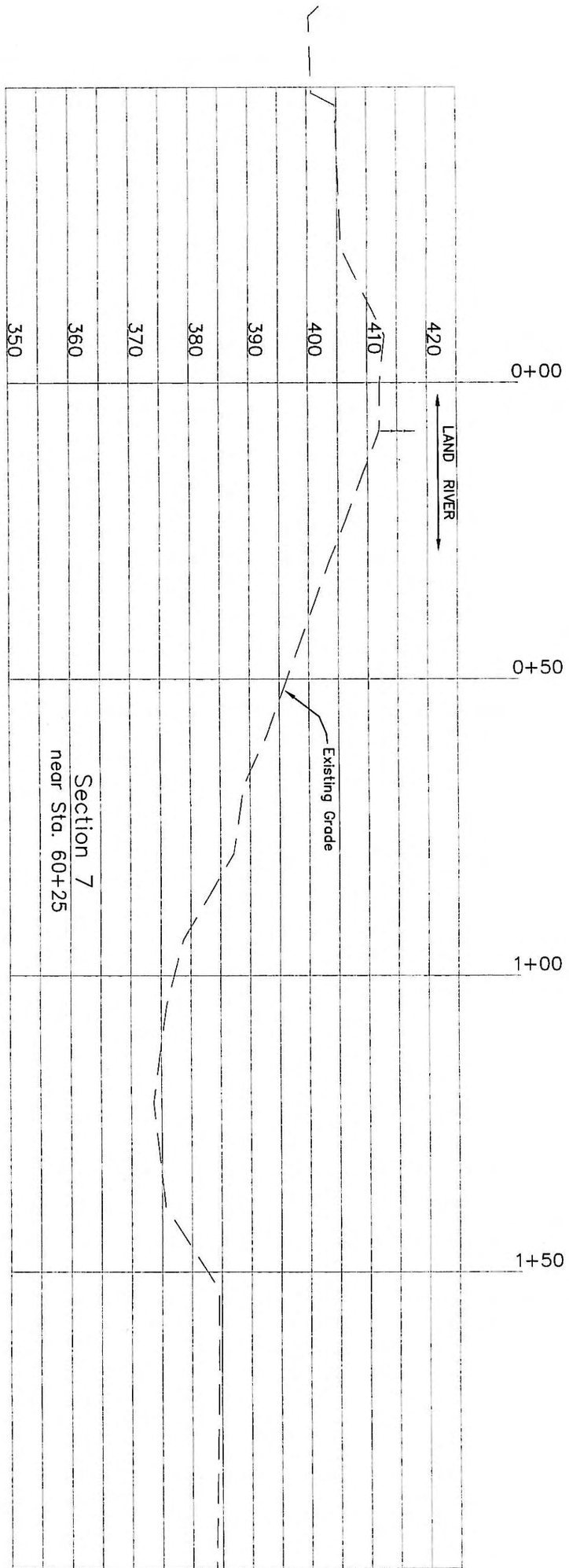
SHEET 3 OF 5	Dam Safety Permit Survey Sections 2009012469	AmerenUE Rush Island Plant Festus MO, 63028	Designed D.S.E. Checked D.S.E. Drawn D.S.E. Issued 01/08/2010	REITZ & JENS, INC. CONSULTING ENGINEERS 1055 CORPORATE SQUARE DRIVE ST. LOUIS MISSOURI 63132 (314) 993-4132 PROFESSIONAL ENGINEERING CORP., LICENSE #000215



SHEET 4 OF 5	Dam Safety Permit Survey Sections 2009012469	AmerenUE Rush Island Plant Festus MO, 63028	Designed D.S.E. Checked D.S.E. Drawn D.S.E. Issued 01/08/2010	REITZ & JENS, INC. CONSULTING ENGINEERS 1055 CORPORATE SQUARE DRIVE ST. LOUIS MISSOURI 63132 (314) 993-4132 PROFESSIONAL ENGINEERING CORP., LICENSE #000215

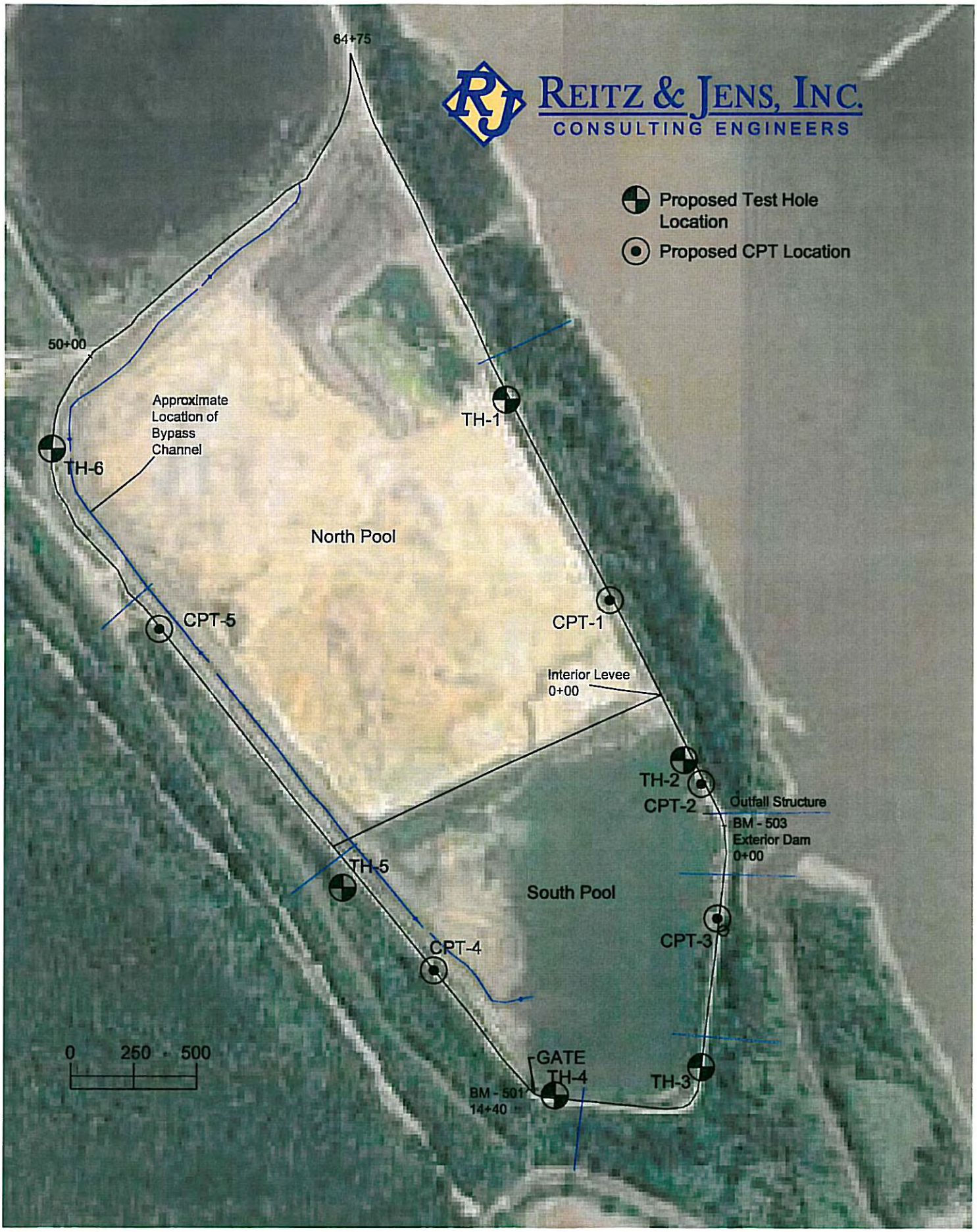


SHEET 5 OF 5	Dam Safety Permit Survey Sections 2009012469	AmerenUE Rush Island Plant Festus MO, 63028	Designed D.S.E. Checked D.S.E. Drawn D.S.E. Issued 01/08/2010	REITZ & JENS, INC. CONSULTING ENGINEERS 1055 CORPORATE SQUARE DRIVE ST. LOUIS MISSOURI 63132 (314) 993-4132 PROFESSIONAL ENGINEERING CORP., LICENSE #000215



SHEET 7 OF 5	Dam Safety Permit Survey Sections 2009012469	AmerenUE Rush Island Plant Festus MO, 63028	Designed D.S.E. Checked D.S.E. Drawn D.S.E. Issued 01/08/2010	REITZ & JENS, INC. CONSULTING ENGINEERS 1055 CORPORATE SQUARE DRIVE ST. LOUIS MISSOURI 63132 (314) 993-4132 PROFESSIONAL ENGINEERING CORP., LICENSE #000215

Test Hole Location Plan



2009012469/dwg/RushIslandAerial

Ameren UE Dam Inventory and Inspection Program
Rush Island Plant Proposed Testing Layout
Rev. 9/8/09

Figure 1

Boring Logs – Lab Testing Results

REITZ & JENS, INC.
CONSULTING ENGINEERS

BORING LOG B-1

Rush Island Ash Pond Dam Safety

CLIENT: **Ameren**

LOCATION: N 834589.2 E 890145.1
ELEVATION: 408.9 DATUM:
DATE DRILLED: 09-14-09

SHEAR STRENGTH, tsf
△ QU/2 ■ PP □ SV ◇ TV
1 2 3

STANDARD PENETRATION TEST
▲ N-VALUE (BLOWS PER LAST FOOT)
● MOISTURE CONTENT, %
○ % FINES (PASSING #200 SIEVE)
PL LL
20 40 60

DEPTH (FEET)	ELEVATION	WATER TABLE	GRAPHIC LOG	SAMPLE TYPE	PERCENT RECOVERY	MATERIAL DESCRIPTION	DRY UNIT WEIGHT (PCF) BLOWS PER 6 INCHES RQD= ROCK QUALITY DES.	MOISTURE CONTENT PERCENT BY WEIGHT
0						Top 10 feet vacuum extracted no sampling		
	405							
5					0			
	400							
10								
	395							
15					100	Clay FILL? (CH), grey to dark grey, high plastic, slightly silty, with fine roots, and 3" layer of silty fine sand at 15'-7"	94.0	27.6
	390							
20					88	SILT (ML), grey and brown, with fine sand and pockets of high plastic clay	95.2	23.8
	385							
25					96	SAND (SP), golden tan, fine grain, becoming silty and greyish near bottom of sample	87.3 99.7	21.7 14.3
	380	▽						
30					100	Sandy SILT (ML), tan, fine grain, loose, saturated	2-2-4	31.8

DRILLER: Jet Drilling
METHOD: 4.25" HSA/Rotary
TYPE OF SPT HAMMER: Automatic
HAMMER EFFICIENCY (%): 78.2
LOGGED BY: J. Pruett

STRATIFICATION LINES ARE APPROXIMATE SOIL BOUNDARIES ONLY; ACTUAL CHANGES MAY BE GRADUAL OR MAY OCCUR BETWEEN SAMPLES.

WATER LEVELS: DURING DRILLING 29.5 FEET
N BORING DRY AT COMPLETION OF DRILLING
AT ____ FEET AFTER ____ HOURS
AT ____ FEET AFTER ____ HOURS

PIEZOMETER: INSTALLED AT ____ FEET

File: 2009012469

Figure

REITZ & JENS, INC.
CONSULTING ENGINEERS

BORING LOG B-1

Rush Island Ash Pond Dam Safety

DEPTH (FEET)	ELEVATION	PERCENT RECOVERY	MATERIAL DESCRIPTION	DRY UNIT WEIGHT (PCF) BLOWS PER 6 INCHES RQD= ROCK QUALITY DES.	MOISTURE CONTENT PERCENT BY WEIGHT
35	375	100	With layers of silty clay and fine grain sand	2-1-3	35.5
40	370	67	SAND (SP), tan, fine to coarse grain, dense	9-12-18	
45	365	89	With assorted gravel up to 3/4"	9-12-13	
50	360	78	Becoming grey, with thick layers of silt and silty clay, without gravel	3-10-18	21.8
55	355	56	In and out of gravelly drilling from 52'-6" to 55'-0" Without silt and clay content, with gravel up to 3/4", very dense	12-21-20	
60	350	89	Without gravel	12-20-21	
65	345	94	Becoming fine to medium grain sand	17-24-31	

SHEAR STRENGTH, tsf
△ QU/2 ■ PP □ SV ◇ TV
1 2 3
STANDARD PENETRATION TEST
▲ N-VALUE (BLOWS PER LAST FOOT)
● MOISTURE CONTENT, %
○ % FINES (PASSING #200 SIEVE)
PL LL
20 40 60

File: 2009012469

Figure

REITZ & JENS, INC.
CONSULTING ENGINEERS

BORING LOG B-1

Rush Island Ash Pond Dam Safety

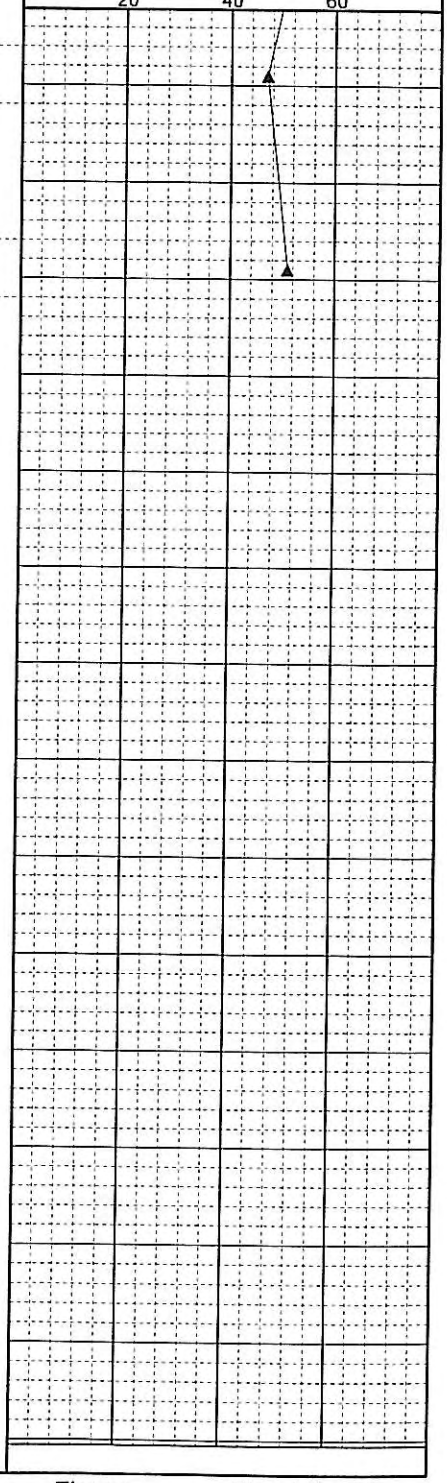
DEPTH (FEET)	ELEVATION	WATER TABLE	GRAPHIC LOG	SAMPLE TYPE	PERCENT RECOVERY	MATERIAL DESCRIPTION	DRY UNIT WEIGHT (PCF) BLOWS PER 6 INCHES RQD= ROCK QUALITY DES.	MOISTURE CONTENT PERCENT BY WEIGHT
70	340				94	Becoming fine to coarse sand	14-20-27	
75	335				78		18-23-28	
						Boring terminated in sand at 75'-6"		
80	330							
85	325							
90	320							
95	315							
100	310							
105	305							

SHEAR STRENGTH, tsf
△ QU/2 ■ PP □ SV ◇ TV
1 2 3

STANDARD PENETRATION TEST
▲ N-VALUE (BLOWS PER LAST FOOT)

● MOISTURE CONTENT, %
○ % FINES (PASSING #200 SIEVE)

PL LL
20 40 60



File: 2009012469

Figure

REITZ & JENS, INC.
CONSULTING ENGINEERS

BORING LOG B-2

Rush Island Ash Pond Dam Safety

CLIENT: **Ameren**

LOCATION: N 832995.7 E 890896.0
ELEVATION: 409.9 DATUM:
DATE DRILLED: 09-15-09

SHEAR STRENGTH, tsf
△ QU/2 ■ PP □ SV ◇ TV
1 2 3
STANDARD PENETRATION TEST
▲ N-VALUE (BLOWS PER LAST FOOT)
● MOISTURE CONTENT, %
○ % FINES (PASSING #200 SIEVE)
PL LL
20 40 60

DEPTH (FEET)	ELEVATION	WATER TABLE	GRAPHIC LOG	SAMPLE TYPE	PERCENT RECOVERY	MATERIAL DESCRIPTION	DRY UNIT WEIGHT (PCF) BLOWS PER 6 INCHES RQD= ROCK QUALITY DES.	MOISTURE CONTENT PERCENT BY WEIGHT
0						Top 10 feet vacuum extracted no sampling		
5	405				0			
10	400							
15	395	▽			96	Silt FILL (ML), grey, slightly silty, trace fine grain sand, with high plastic clay lenses Perched water at 14'-6"	89.2	30.1
						Clay FILL (CH), grey, high plastic, trace roots		
20	390				88	Sandy Silt FILL (SM), grey and brown, slightly clayey, with high plastic clay balls, limoninte and iron staining, trace clay seams and sand lenses	94.4	27.4
25	385				100	Clay FILL (CH), grey, silty, high plastic, stiff, moist	2-3-5	29.8
					88	Becoming dark grey, with trace fine roots, lignite, coal, cinders, iron staining	84.8	33.4
						Clayey SILT (ML), brown and grey, with trace fine sand, limonite, and iron staining, becoming sandy with depth, natural?	89.5	29.0
30	380				100	Silty CLAY (CL), grey, with traces of lignite	2-2-3	27.5

DRILLER: Jet Drilling
METHOD: 4.25" HSA/Rotary
TYPE OF SPT HAMMER: Automatic
HAMMER EFFICIENCY (%): 78.2
LOGGED BY: J. Pruett

STRATIFICATION LINES ARE APPROXIMATE SOIL BOUNDARIES ONLY; ACTUAL CHANGES MAY BE GRADUAL OR MAY OCCUR BETWEEN SAMPLES.

WATER LEVELS: DURING DRILLING 14.5 FEET
N BORING DRY AT COMPLETION OF DRILLING
AT ____ FEET AFTER ____ HOURS
AT ____ FEET AFTER ____ HOURS
PIEZOMETER: INSTALLED AT ____ FEET

File: 2009012469

Figure

REITZ & JENS, INC.
CONSULTING ENGINEERS

BORING LOG B-2

Rush Island Ash Pond Dam Safety

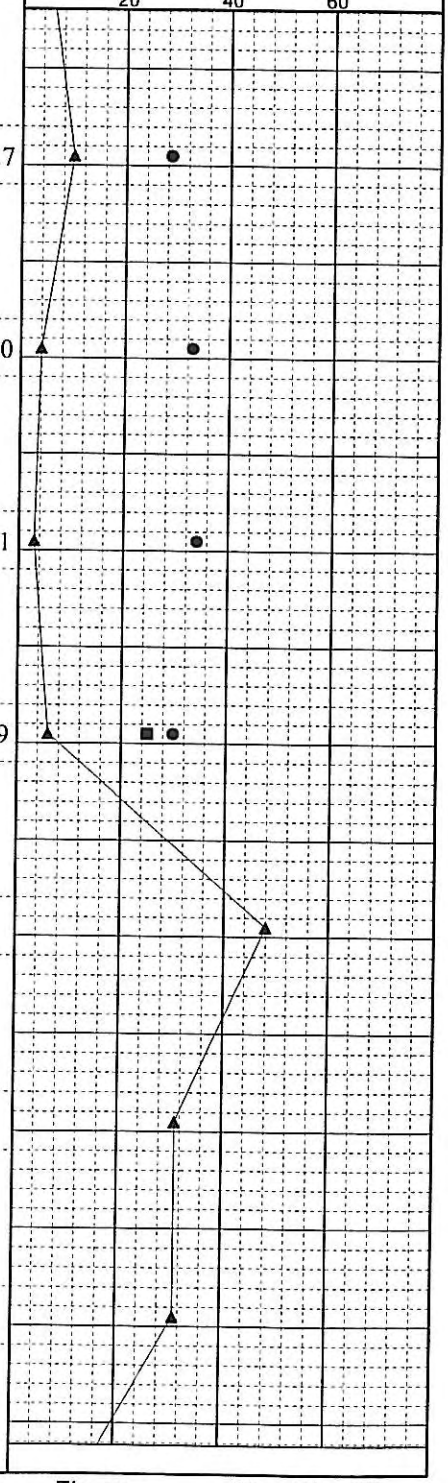
DEPTH (FEET)	ELEVATION	WATER TABLE	GRAPHIC LOG	SAMPLE TYPE	PERCENT RECOVERY	MATERIAL DESCRIPTION	DRY UNIT WEIGHT (PCF) BLOWS PER 6 INCHES RQD= ROCK QUALITY DES.	MOISTURE CONTENT PERCENT BY WEIGHT
						and limonite, trace fine grain sand, firm		
35	375				100	Sandy SILT (ML), tan and grey, highly laminated with silt and clay, traces of lignite, medium dense	0-2-8	28.7
40	370				100	Becoming loose, saturated	0-1-3	33.0
45	365				100	Without laminations of silt and clay, very loose	0-1-2	34.1
50	360				100	Becoming loose, with 2" clay seam near end of spoon	1-2-4	29.9
55	355				100	SAND (SP), grey, fine to coarse grain, with trace 1/4" gravel, very dense	15-22-26	
60	350				89	Becoming dense, with trace gravel up to 1"	6-11-20	
65	345				89	Becoming fine grain sand, without gravel	11-14-17	

SHEAR STRENGTH, tsf
△ QU/2 ■ PP □ SV ◇ TV
1 2 3

STANDARD PENETRATION TEST
▲ N-VALUE (BLOWS PER LAST FOOT)

● MOISTURE CONTENT, %
○ % FINES (PASSING #200 SIEVE)

PL LL
20 40 60



File: 2009012469

Figure

REITZ & JENS, INC.
CONSULTING ENGINEERS

BORING LOG B-2

Rush Island Ash Pond Dam Safety

DEPTH (FEET)	ELEVATION	WATER TABLE	GRAPHIC LOG	SAMPLE TYPE	PERCENT RECOVERY	MATERIAL DESCRIPTION	DRY UNIT WEIGHT (PCF) BLOWS PER 6 INCHES RQD= ROCK QUALITY DES.	MOISTURE CONTENT PERCENT BY WEIGHT
70	340				94	Fine grain sandy SILT (ML), grey, medium dense	1-1-9	30.9
75	335				78	SAND (SP), grey, fine to coarse grain, with gravel up to 1/4", dense	9-14-12	
						Boring terminated in sand at 75'-6"		
80	330							
85	325							
90	320							
95	315							
100	310							
105	305							

SHEAR STRENGTH, tsf

△ QU/2 ■ PP □ SV ◇ TV

1 2 3

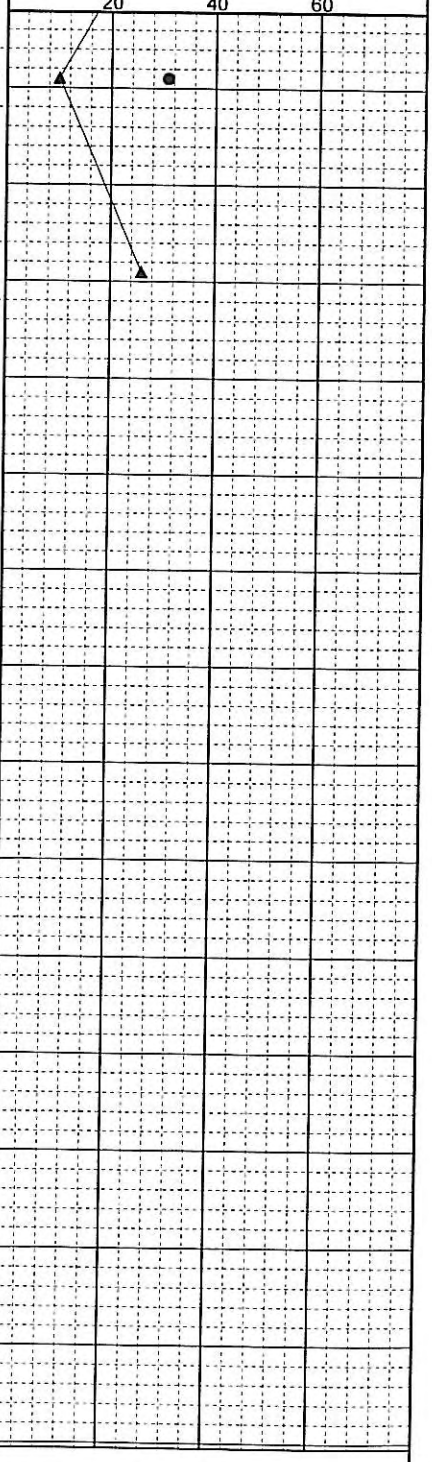
▲ STANDARD PENETRATION TEST N-VALUE (BLOWS PER LAST FOOT)

● MOISTURE CONTENT, %

○ % FINES (PASSING #200 SIEVE)

PL ├──┤ LL

20 40 60



File: 2009012469

Figure

REITZ & JENS, INC.
CONSULTING ENGINEERS

BORING LOG B-3

Rush Island Ash Pond Dam Safety

CLIENT: **Ameren**

LOCATION: N 831960.3 E 890889.5
ELEVATION: 412.2 DATUM:
DATE DRILLED: 09-15-09

DEPTH (FEET)	ELEVATION	WATER TABLE	GRAPHIC LOG	SAMPLE TYPE	PERCENT RECOVERY	MATERIAL DESCRIPTION	DRY UNIT WEIGHT (PCF) BLOWS PER 6 INCHES RQD= ROCK QUALITY DES.	MOISTURE CONTENT PERCENT BY WEIGHT
0	410					6" crushed LIMESTONE Silty Clay FILL (CL), brown, with silt and high plastic clay inclusions and laminations		
5	405				83		88.9	32.0
10	400				100	Sandy Silt FILL (SM), tan, with dark grey high plastic balls, trace lignite, limonite, and small gravel	104.1	19.9
15	395				100	Becoming grey and tan, with fine to medium grain sand, without gravel	102.7 96.1	22.0 25.6
20	390				100	Silty Clay FILL (CL), grey and brown, with grey high plastic balls and tan fine to medium sand seams, becoming more clayey with depth	100.8 99.1	20.4 24.5
25	385				100	CLAY (CH), grey, high plastic, with traces fine sand lenses, trace limonite and iron staining, trace medium sand, some fine roots in top of sample, natural?	90.0	31.0
30					71	Becoming dark grey	95.6	25.0

SHEAR STRENGTH, tsf
△ QU/2 ■ PP □ SV ◇ TV
1 2 3

STANDARD PENETRATION TEST
▲ N-VALUE (BLOWS PER LAST FOOT)

● MOISTURE CONTENT, %
○ % FINES (PASSING #200 SIEVE)

PL ⊢——⊣ LL
20 40 60

DRILLER: Jet Drilling
METHOD: 4.25" HSA/Rotary
TYPE OF SPT HAMMER: Automatic
HAMMER EFFICIENCY (%): 78.2
LOGGED BY: J. Pruett

STRATIFICATION LINES ARE APPROXIMATE SOIL BOUNDARIES ONLY; ACTUAL CHANGES MAY BE GRADUAL OR MAY OCCUR BETWEEN SAMPLES.

WATER LEVELS: DURING DRILLING 49.5 FEET
N BORING DRY AT COMPLETION OF DRILLING
AT ____ FEET AFTER ____ HOURS
AT ____ FEET AFTER ____ HOURS

PIEZOMETER: INSTALLED AT ____ FEET

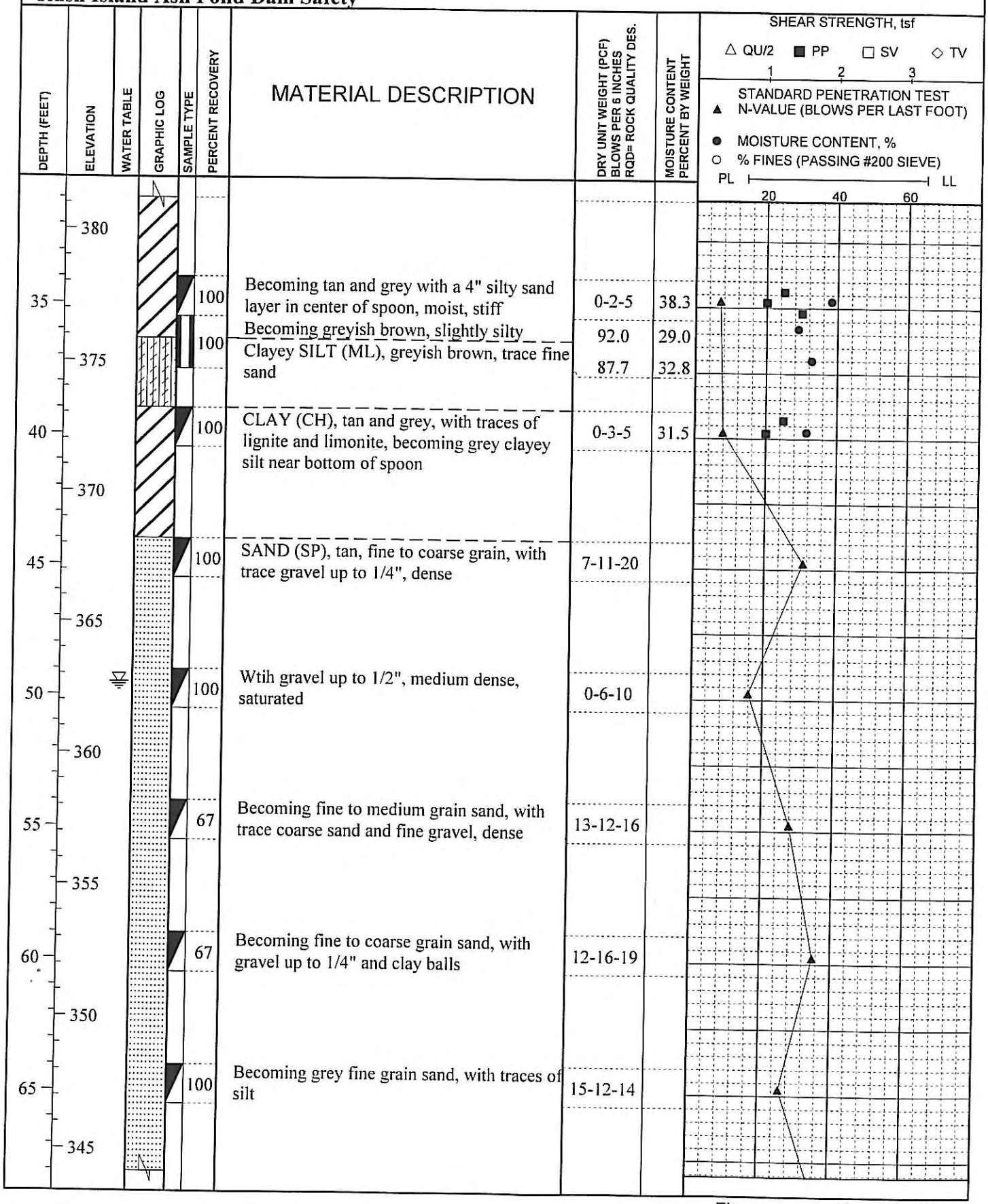
File: 2009012469

Figure

REITZ & JENS, INC.
CONSULTING ENGINEERS

BORING LOG B-3

Rush Island Ash Pond Dam Safety



File: 2009012469

Figure

REITZ & JENS, INC.
CONSULTING ENGINEERS

BORING LOG B-3

Rush Island Ash Pond Dam Safety

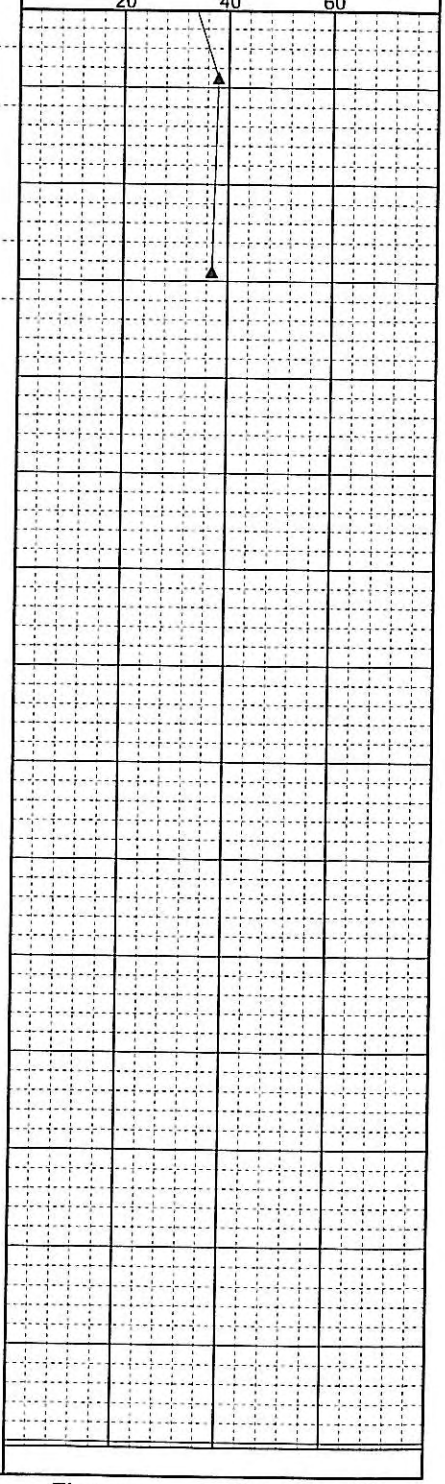
DEPTH (FEET)	ELEVATION	WATER TABLE	GRAPHIC LOG	SAMPLE TYPE	PERCENT RECOVERY	MATERIAL DESCRIPTION	DRY UNIT WEIGHT (PCF) BLOWS PER 6 INCHES RQD= ROCK QUALITY DES.	MOISTURE CONTENT PERCENT BY WEIGHT
70	340				94	Becoming fine to medium grain sand, with gravel up to 1/4"	10-15-23	
75	335				78	Becoming fine to coarse grain sand	12-15-22	
80	330					Boring terminated in sand at 75'-6"		
85	325							
90	320							
95	315							
100	310							
105								

SHEAR STRENGTH, tsf
△ QU/2 ■ PP □ SV ◇ TV
1 2 3

STANDARD PENETRATION TEST
▲ N-VALUE (BLOWS PER LAST FOOT)

● MOISTURE CONTENT, %
○ % FINES (PASSING #200 SIEVE)

PL LL
20 40 60



File: 2009012469

Figure

REITZ & JENS, INC.
CONSULTING ENGINEERS

BORING LOG B-4

Rush Island Ash Pond Dam Safety

CLIENT: **Ameren**

LOCATION: N 831798.8 E 890245.6
ELEVATION: 410.6 DATUM:
DATE DRILLED: 09-16-09

SHEAR STRENGTH, tsf
△ QU/2 ■ PP □ SV ◇ TV
1 2 3
STANDARD PENETRATION TEST N-VALUE (BLOWS PER LAST FOOT)
● MOISTURE CONTENT, %
○ % FINES (PASSING #200 SIEVE)
PL LL
20 40 60

DEPTH (FEET)	ELEVATION	WATER TABLE	GRAPHIC LOG	SAMPLE TYPE	PERCENT RECOVERY	MATERIAL DESCRIPTION	DRY UNIT WEIGHT (PCF) BLOWS PER 6 INCHES RQD= ROCK QUALITY DES.	MOISTURE CONTENT PERCENT BY WEIGHT
0	410					6" crushed LIMESTONE Silty Clay FILL (CL), brown and grey, trace fine sand, with layers up to 6" of high plastic clay, firm, moist		
5	405				71		96.1 97.6	24.1 25.5
10	400				96		93.1	28.1
15	395				75	Silt FILL (ML), brown, slightly clayey, with trace fine sand, 1/2" high plastic clay seam	93.4	21.2
20	390				100	Becoming tan, very sandy Note: Shelby Tube was pushed with no recovery, Spilt Spoon pushed for sample		29.1
25	385				100	Clayey SILT (ML), grey, highly layered, with layers of clayey silt, sandy silt, and high plastic clay, loose, natural?	1-2-4	29.4
30	380				100	Becoming very loose	1-1-1	33.1

DRILLER: Jet Drilling
METHOD: 4.25" HSA/Rotary
TYPE OF SPT HAMMER: Automatic
HAMMER EFFICIENCY (%): 78.2
LOGGED BY: J. Pruett

STRATIFICATION LINES ARE APPROXIMATE SOIL BOUNDARIES ONLY; ACTUAL CHANGES MAY BE GRADUAL OR MAY OCCUR BETWEEN SAMPLES.

WATER LEVELS: DURING DRILLING 37 FEET
N BORING DRY AT COMPLETION OF DRILLING
AT ____ FEET AFTER ____ HOURS
AT ____ FEET AFTER ____ HOURS
PIEZOMETER: INSTALLED AT ____ FEET

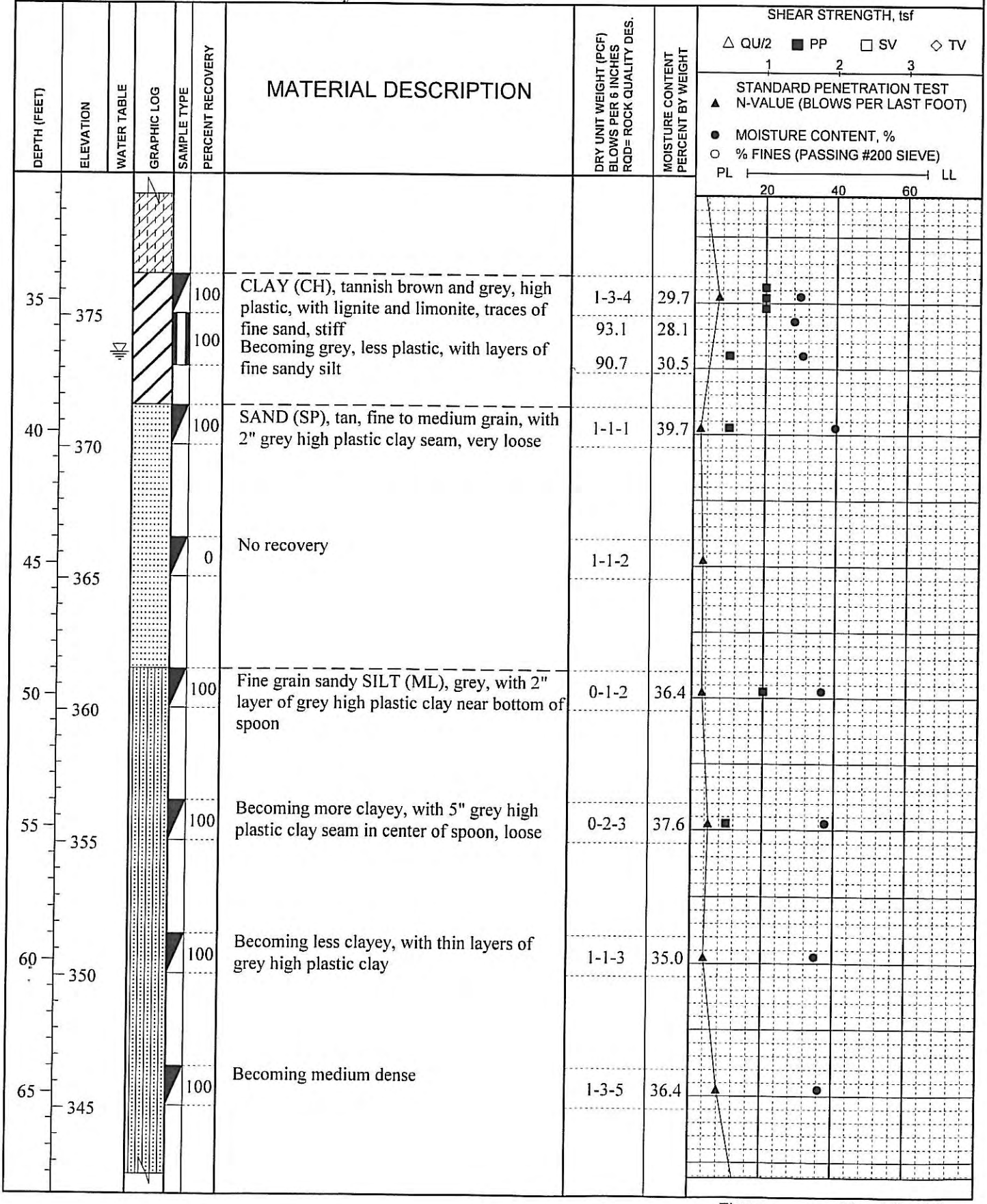
File: 2009012469

Figure

REITZ & JENS, INC.
CONSULTING ENGINEERS

BORING LOG B-4

Rush Island Ash Pond Dam Safety



File: 2009012469

Figure

REITZ & JENS, INC.
CONSULTING ENGINEERS

BORING LOG B-4

Rush Island Ash Pond Dam Safety

DEPTH (FEET)	ELEVATION	WATER TABLE	GRAPHIC LOG	SAMPLE TYPE	PERCENT RECOVERY	MATERIAL DESCRIPTION	DRY UNIT WEIGHT (PCF) BLOWS PER 6 INCHES RQD= ROCK QUALITY DES.	MOISTURE CONTENT PERCENT BY WEIGHT
70	340				72	SAND (SP), grey, fine grain, slightly silty, with trace gravel up to 1/8", medium dense	5-6-9	
75	335				61	Becoming fine to medium grain, without gravel, very dense	15-22-26	
						Boring terminated in sand at 75'-6"		
80	330							
85	325							
90	320							
95	315							
100	310							
105								

SHEAR STRENGTH, tsf

△ QU/2 ■ PP □ SV ◇ TV

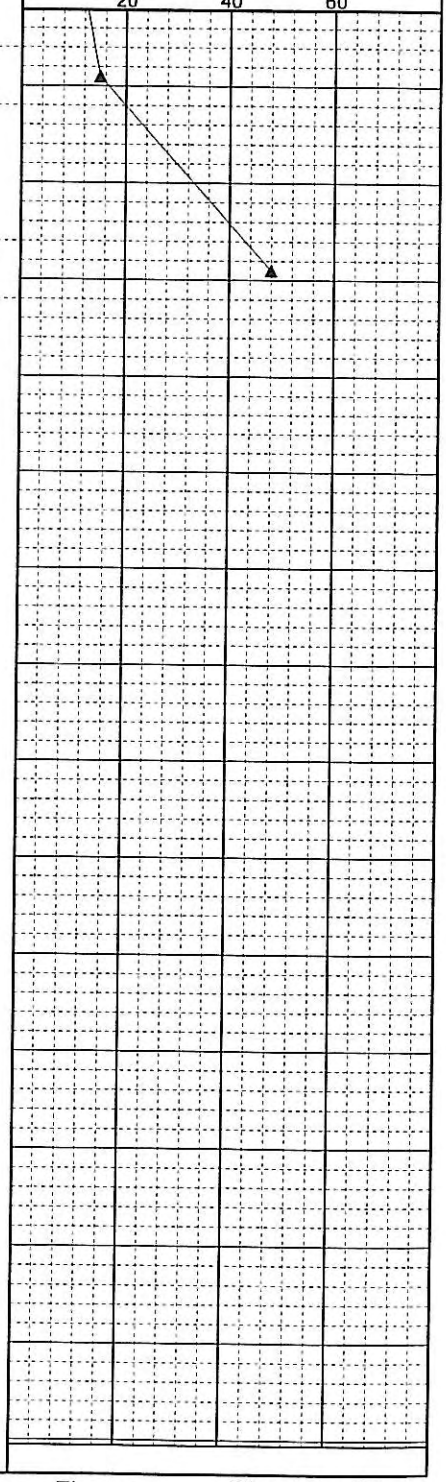
1 2 3

STANDARD PENETRATION TEST
▲ N-VALUE (BLOWS PER LAST FOOT)

● MOISTURE CONTENT, %
○ % FINES (PASSING #200 SIEVE)

PL LL

20 40 60



File: 2009012469

Figure

REITZ & JENS, INC.
CONSULTING ENGINEERS

BORING LOG B-6

Rush Island Ash Pond Dam Safety

CLIENT: **Ameren**

LOCATION: N 834235.0 E 888471.7
ELEVATION: 408.6 DATUM:
DATE DRILLED: 09-17-09

SHEAR STRENGTH, tsf
△ QU/2 ■ PP □ SV ◇ TV
1 2 3

STANDARD PENETRATION TEST
▲ N-VALUE (BLOWS PER LAST FOOT)
● MOISTURE CONTENT, %
○ % FINES (PASSING #200 SIEVE)
PL ⊢ LL
20 40 60

DEPTH (FEET)	ELEVATION	WATER TABLE	GRAPHIC LOG	SAMPLE TYPE	PERCENT RECOVERY	MATERIAL DESCRIPTION	DRY UNIT WEIGHT (PCF) BLOWS PER 6 INCHES RQD= ROCK QUALITY DES.	MOISTURE CONTENT PERCENT BY WEIGHT
0						4" crushed LIMESTONE		
						Clayey Sandy Silt FILL (ML), grey and brown, with layers of fine to medium sand and silty clay		
	405							
5					92		97.6	24.5
	400							
10					96	Silty Clay FILL (CL), grey, with tan fine sand and silt seams both horzontal and vertical		
	395							
15					96	With high plastic clay and fine roots, without sand seams	88.8	29.4
						CLAY (CH), grey and light grey, with layers of silt and medium grain sand, traces of lignite and limonite, natural?	94.5	27.9
	390							
20					100	With traces of silt lenses, becoming clayey silt with high plastic clay lenses near bottom of tube		
	385							
25					100	Clayey SILT (ML), grey with lenses of high plastic clay, trace limonite, saturated, very soft	87.2 86.2	33.0 33.6
	380 ▽							
30					100	Becoming greyish tan, with fine grain sand and traces of limonite		32.1

DRILLER: Jet Drilling
METHOD: 4.25" HSA/Rotary
TYPE OF SPT HAMMER: Automatic
HAMMER EFFICIENCY (%): 78.2
LOGGED BY: J. Pruett

STRATIFICATION LINES ARE APPROXIMATE SOIL BOUNDARIES ONLY; ACTUAL CHANGES MAY BE GRADUAL OR MAY OCCUR BETWEEN SAMPLES.

WATER LEVELS: DURING DRILLING 29 FEET
N BORING DRY AT COMPLETION OF DRILLING
AT ____ FEET AFTER ____ HOURS
AT ____ FEET AFTER ____ HOURS

PIEZOMETER: INSTALLED AT ___ FEET

File: 2009012469

Figure

REITZ & JENS, INC.
CONSULTING ENGINEERS

BORING LOG B-6

Rush Island Ash Pond Dam Safety

DEPTH (FEET)	ELEVATION	SAMPLE TYPE	PERCENT RECOVERY	MATERIAL DESCRIPTION	DRY UNIT WEIGHT (PCF) BLOWS PER 6 INCHES RQD= ROCK QUALITY DES.	MOISTURE CONTENT PERCENT BY WEIGHT
	375			Note: Shelby Tube was pushed with no recovery, Spilt Spoon pushed for sample		
35			100	Fine grain sandy SILT (ML), greyish tan, slightly clayey, loose	3-2-3	34.6
	370					
40			100	SAND (SP), grey, fine to medium grain	2-6-12	
	365					
45			100	CLAY (CH-CL), grey, layers of high plastic clay and low plastic silty clay, stiff	0-1-5	42.4
	360					
50			100	SAND (SP), grey, fine to coarse grain, medium dense	0-3-13	55.7
	355					
55			89	With 3" layer of high plastic clay at bottom of spoon	13-10-5	44.5
	350					
60			61	Becoming fine to medium grain sand, with gravel up to 1/4", dense	13-17-15	
	345					
65			78	Becoming fine to coarse grain sand, very dense	13-16-24	

SHEAR STRENGTH, tsf
△ QU/2 ■ PP □ SV ◇ TV
1 2 3
STANDARD PENETRATION TEST
▲ N-VALUE (BLOWS PER LAST FOOT)
● MOISTURE CONTENT, %
○ % FINES (PASSING #200 SIEVE)
PL LL
20 40 60

File: 2009012469

Figure

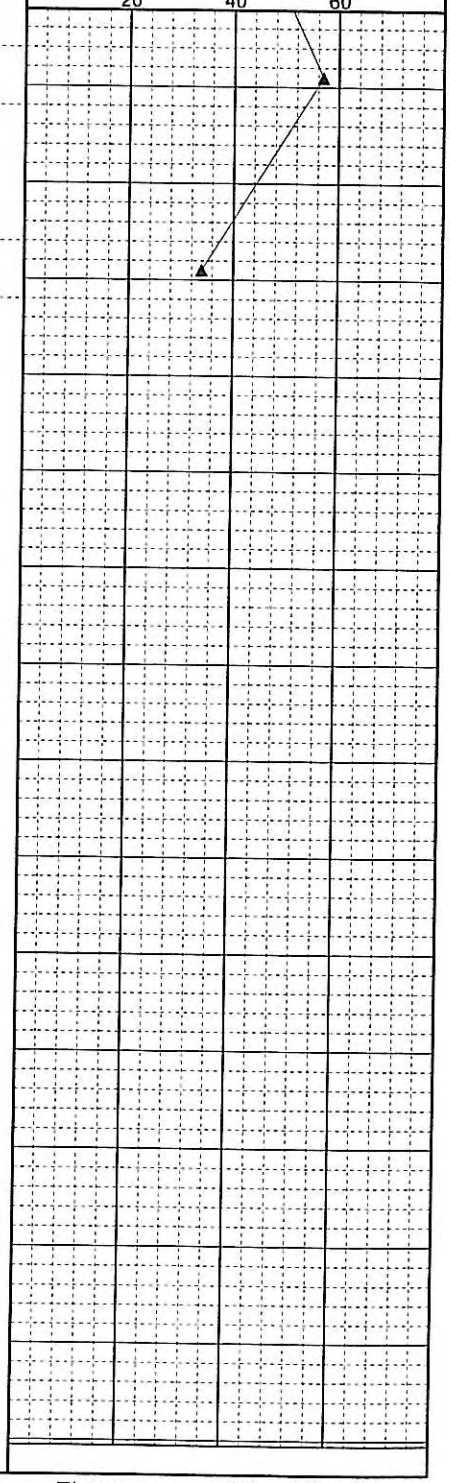
REITZ & JENS, INC.
CONSULTING ENGINEERS

BORING LOG B-6

Rush Island Ash Pond Dam Safety

DEPTH (FEET)	ELEVATION	WATER TABLE	GRAPHIC LOG	SAMPLE TYPE	PERCENT RECOVERY	MATERIAL DESCRIPTION	DRY UNIT WEIGHT (PCF) BLOWS PER 6 INCHES RQD= ROCK QUALITY DES.	MOISTURE CONTENT PERCENT BY WEIGHT
70	340				83		16-23-34	
75	335				61	Without gravel, dense	10-15-19	
						Boring terminated in sand at 75'-6"		
80	330							
85	325							
90	320							
95	315							
100	310							
105	305							

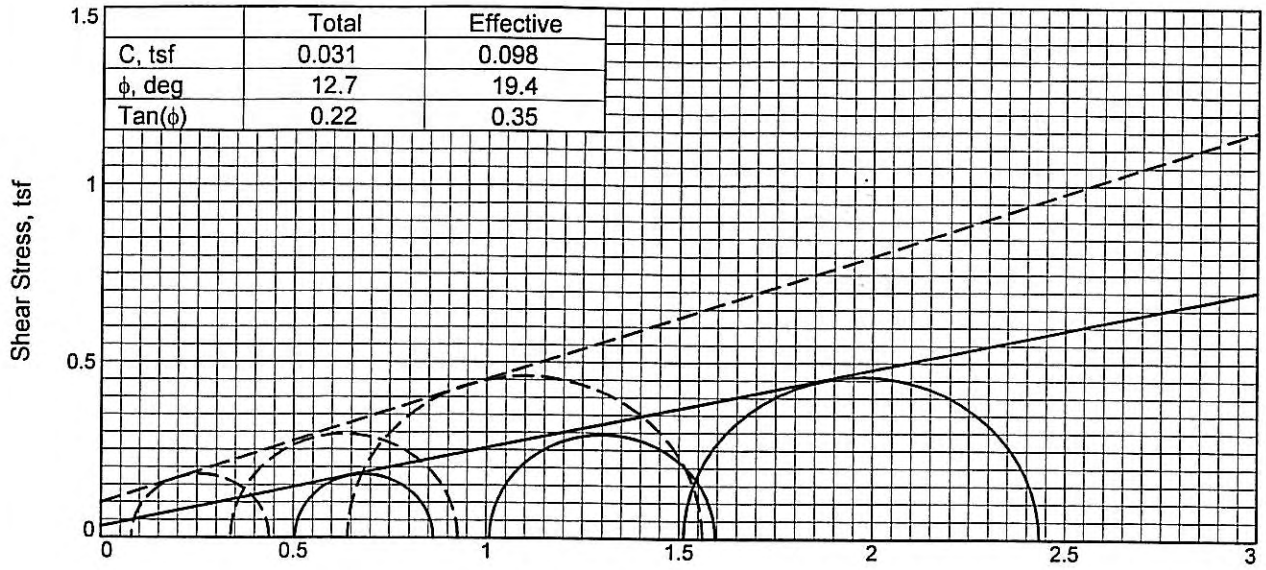
SHEAR STRENGTH, tsf
△ QU/2 ■ PP □ SV ◇ TV
1 2 3
STANDARD PENETRATION TEST
▲ N-VALUE (BLOWS PER LAST FOOT)
● MOISTURE CONTENT, %
○ % FINES (PASSING #200 SIEVE)
PL LL
20 40 60

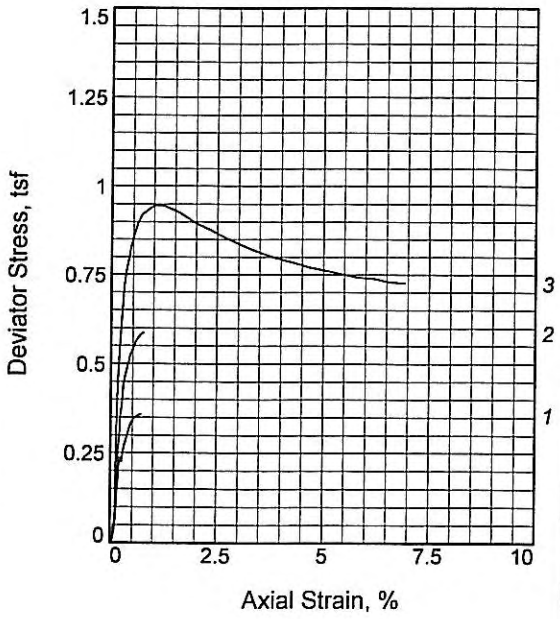


File: 2009012469

Figure

	Total	Effective
C, tsf	0.031	0.098
ϕ, deg	12.7	19.4
Tan(ϕ)	0.22	0.35





Sample No.		1	2	3
Initial	Water Content,	34.5	34.5	34.5
	Dry Density, pcf	64.1	64.1	64.1
	Saturation,	59.7	59.7	59.7
	Void Ratio	1.4555	1.4555	1.4555
	Diameter, in.	2.86	2.86	2.86
	Height, in.	6.00	6.00	6.00
At Test	Water Content,	50.5	49.0	48.2
	Dry Density, pcf	69.2	70.4	71.1
	Saturation,	100.0	100.0	100.0
	Void Ratio	1.2721	1.2346	1.2135
	Diameter, in.	2.79	2.78	2.79
	Height, in.	5.85	5.78	5.72
Strain rate, %/min.		0.30	0.30	0.10
Back Pressure, tsf		4.68	5.11	5.83
Cell Pressure, tsf		5.18	6.12	7.34
Fail. Stress, tsf		0.36	0.59	0.92
Total Pore Pr., tsf		5.10	5.78	6.70
Ult. Stress, tsf		0.36	0.59	0.92
Total Pore Pr., tsf		5.10	5.78	6.70
$\bar{\sigma}_1$ Failure, tsf		0.44	0.93	1.56
$\bar{\sigma}_3$ Failure, tsf		0.08	0.34	0.64

Type of Test:
CU with Pore Pressures

Sample Type: Compacted

Description: Fly Ash, at approximately 81% of standard proctor maximum dry density

Assumed Specific Gravity= 2.52

Remarks:

Client: Ameren UE

Project: UWL Dry Cell Design

Source of Sample: Sioux Fly Ash

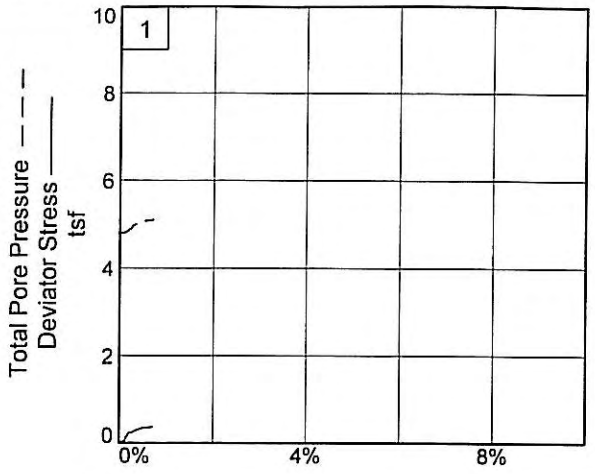
Sample Number: Grab-1

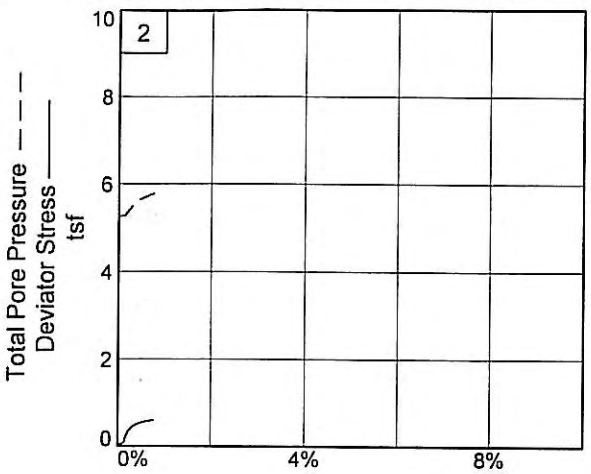
Proj. No.: 2009012470 **Date:**

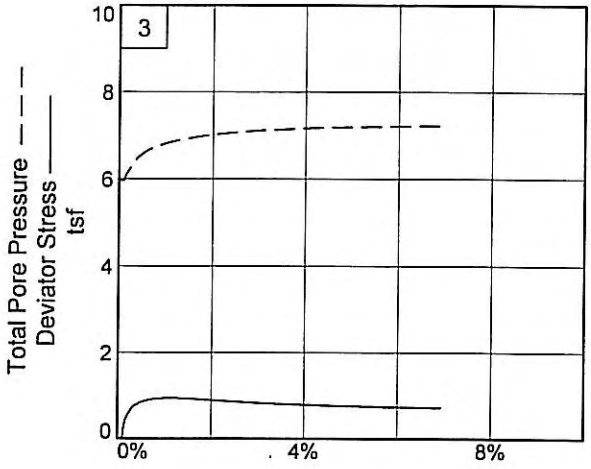
REITZ & JENS, INC.
CONSULTING ENGINEERS

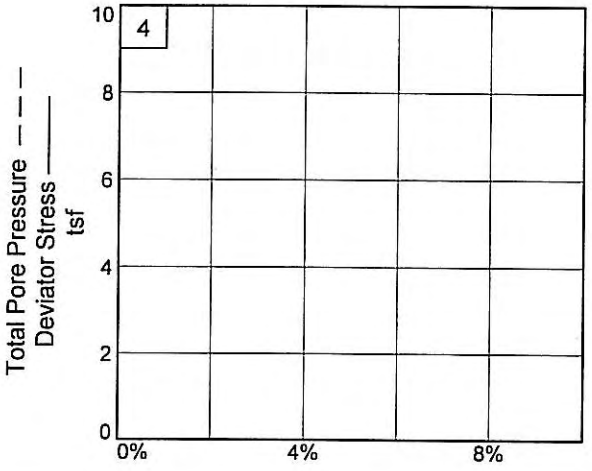
Figure 1

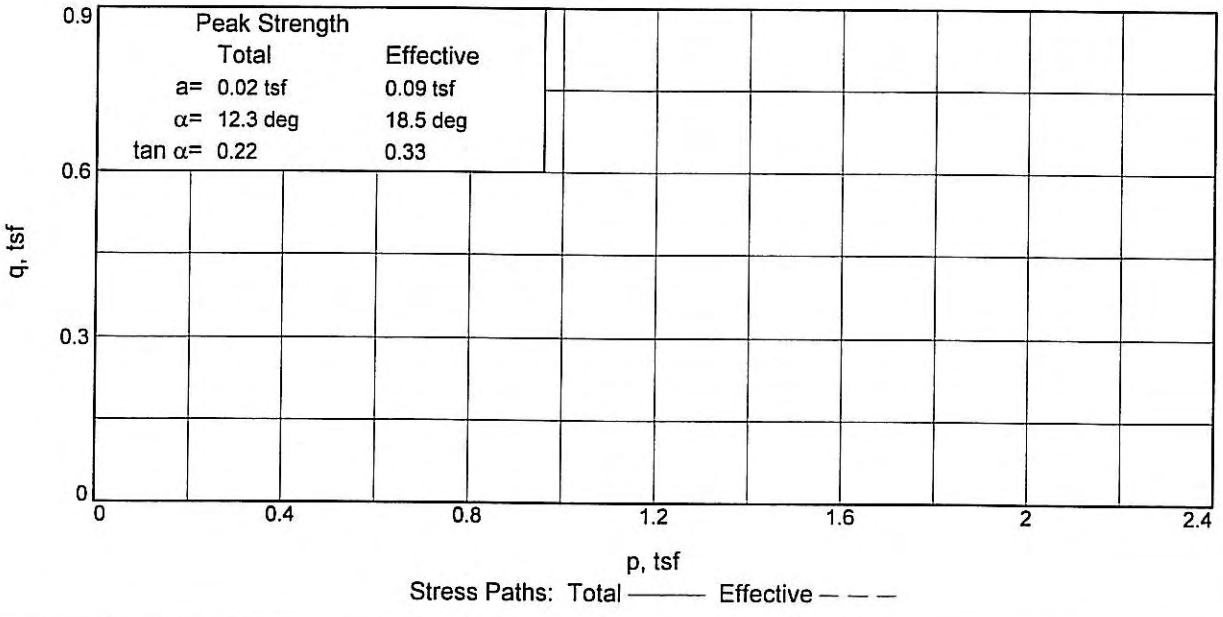
Tested By: K. Kocher **Checked By:** J. Fouse







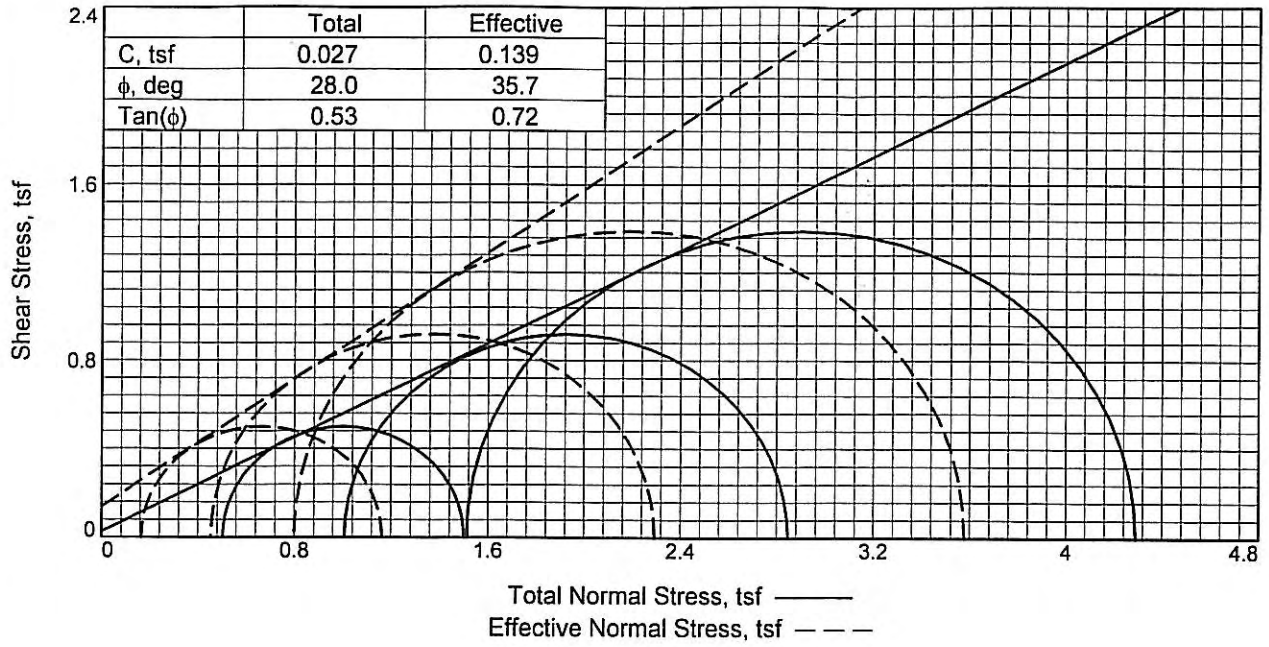


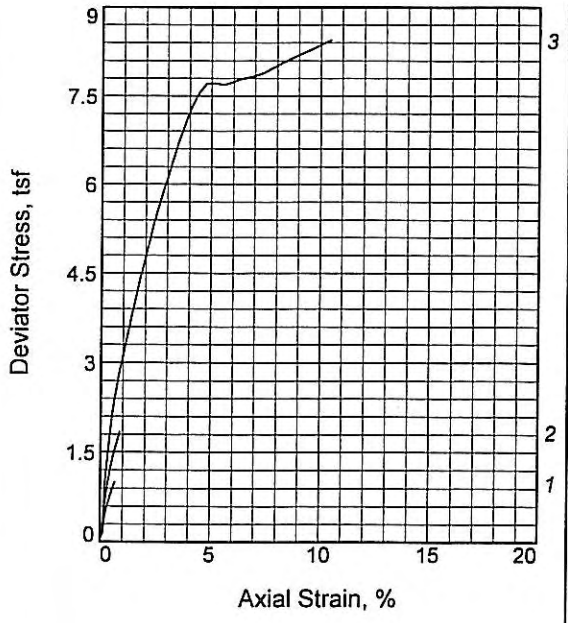


Client: Ameren UE
Project: UWL Dry Cell Design
Source of Sample: Sioux Fly Ash **Sample Number:** Grab-1
Project No.: 2009012470 **Figure** _____

REITZ & JENS, INC.

Tested By: K. Kocher **Checked By:** J. Fouse





Sample No.		1	2	3
Initial	Water Content,	35.2	35.2	35.2
	Dry Density, pcf	78.9	78.9	78.9
	Saturation,	89.3	89.3	89.3
	Void Ratio	0.9944	0.9944	0.9944
	Diameter, in.	2.86	2.86	2.86
	Height, in.	6.00	6.00	6.00
At Test	Water Content,	37.2	36.9	36.7
	Dry Density, pcf	81.2	81.5	81.8
	Saturation,	100.0	100.0	100.0
	Void Ratio	0.9370	0.9311	0.9242
	Diameter, in.	2.84	2.84	2.85
	Height, in.	5.95	5.90	5.84
Strain rate, %/min.		0.30	0.30	0.30
Back Pressure, tsf		3.96	4.32	4.90
Cell Pressure, tsf		4.46	5.33	6.41
Fail. Stress, tsf		1.00	1.84	2.78
Total Pore Pr., tsf		4.30	4.87	5.61
Ult. Stress, tsf		1.00	1.84	2.78
Total Pore Pr., tsf		4.30	4.87	5.61
$\bar{\sigma}_1$ Failure, tsf		1.16	2.29	3.58
$\bar{\sigma}_3$ Failure, tsf		0.17	0.45	0.80

Type of Test:
CU with Pore Pressures

Sample Type: Compacted

Description: Fly Ash, at approximately 100% of standard proctor maximum dry density

Assumed Specific Gravity= 2.52

Remarks:

Client: Ameren UE

Project: UWL Dry Cell Design

Source of Sample: Sioux Fly Ash

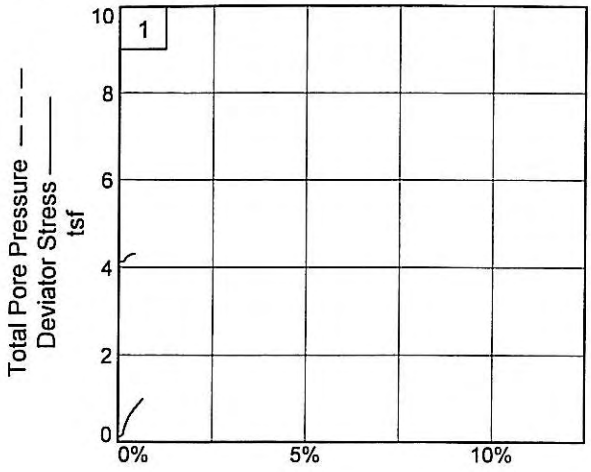
Sample Number: Grab-1

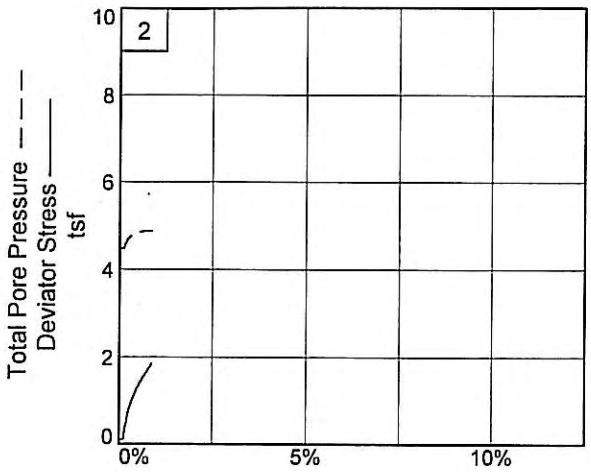
Proj. No.: 2009012470 **Date:**

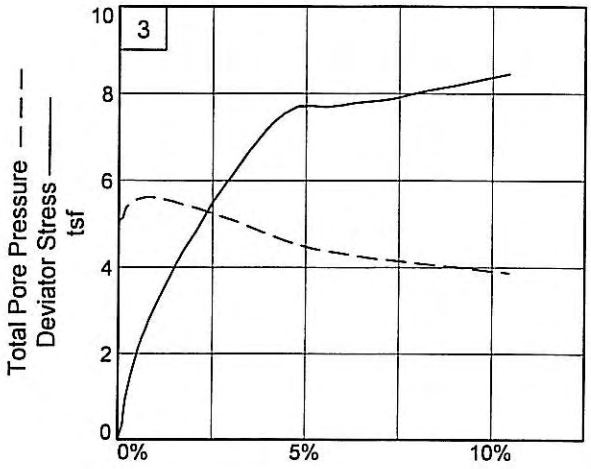
REITZ & JENS, INC.
CONSULTING ENGINEERS

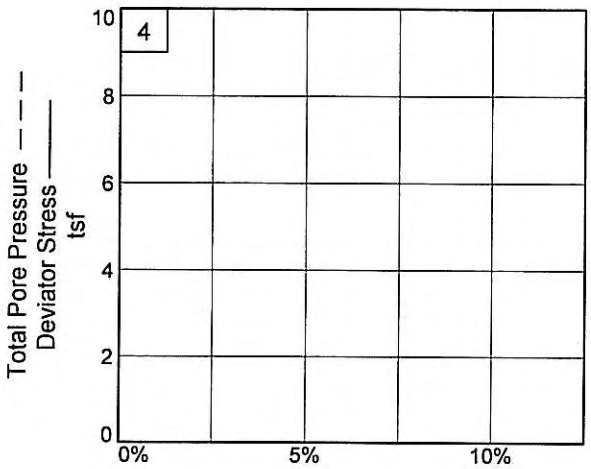
Figure 2

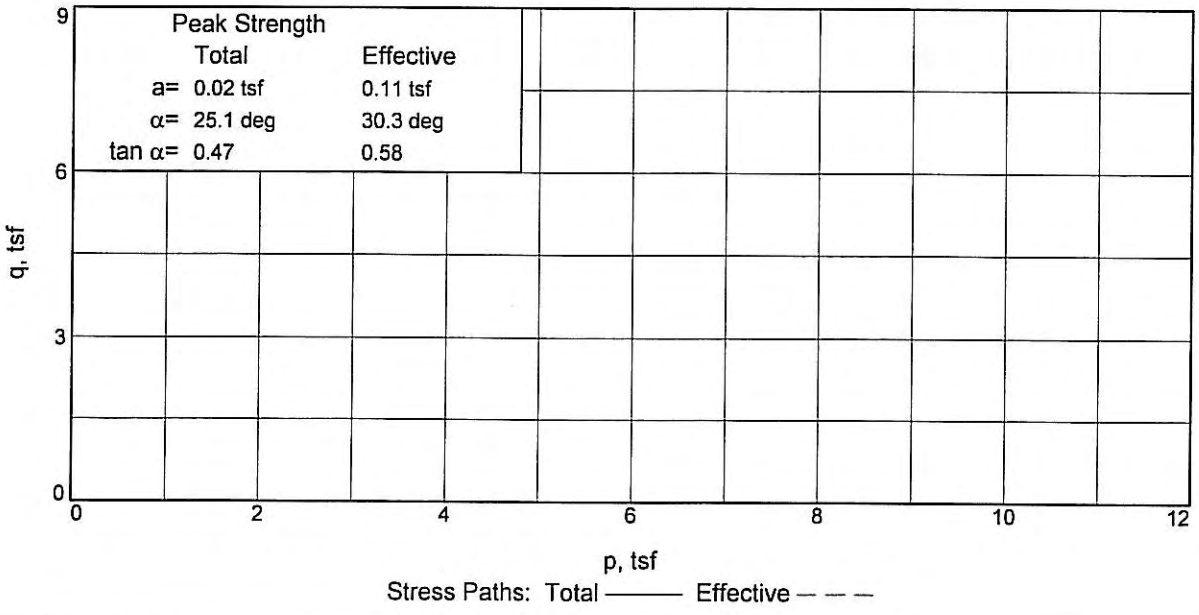
Tested By: K. Kocher **Checked By:** J. Fouse











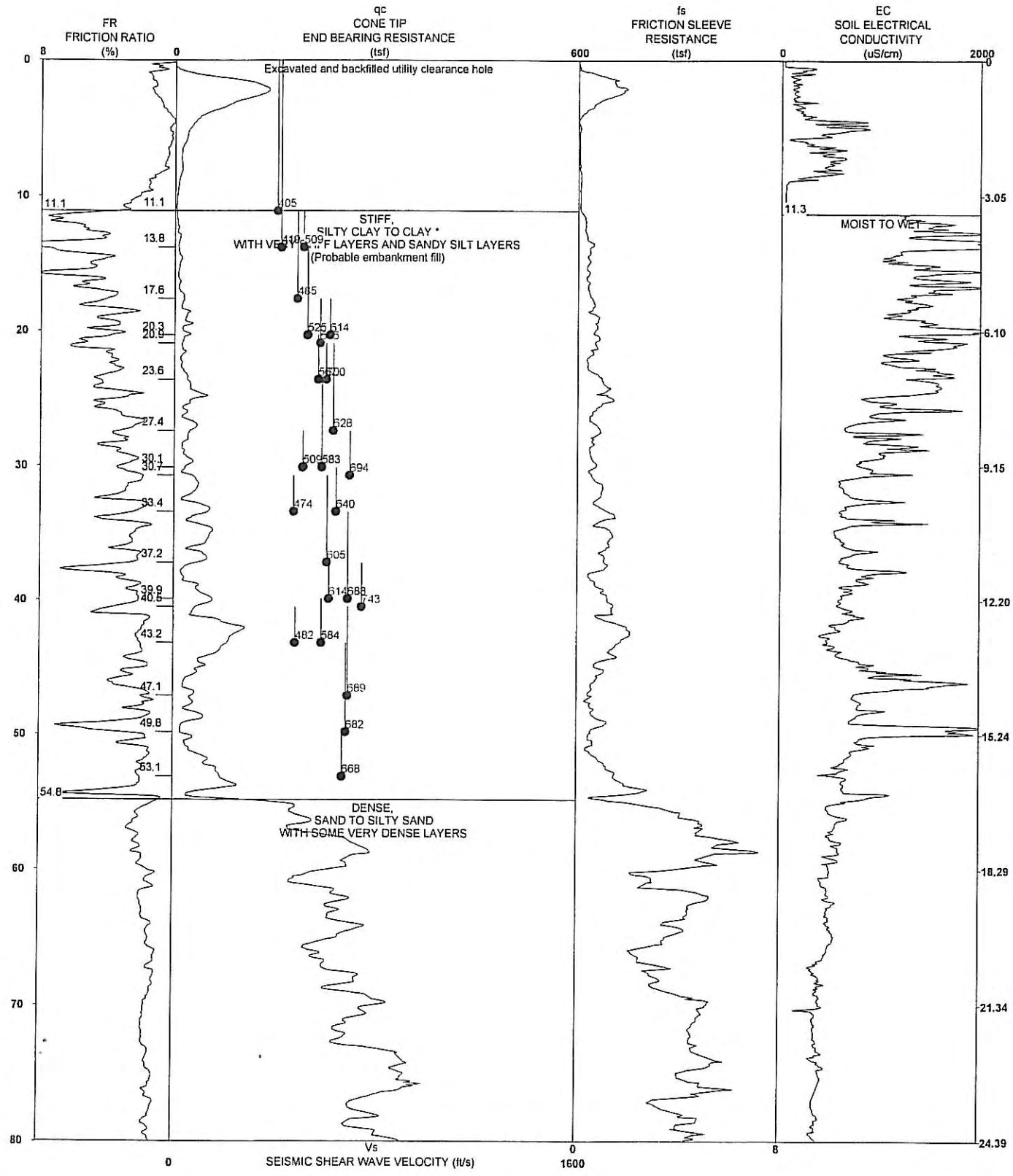
Client: Ameren UE
Project: UWL Dry Cell Design
Source of Sample: Sioux Fly Ash **Sample Number:** Grab-1
Project No.: 2009012470 **Figure** _____

REITZ & JENS, INC.

Tested By: K. Kocher **Checked By:** J. Fouse

CPT Logs

CPTU-EC-S LOG WITH LITHOLOGIC EVALUATION CP01



- 0 - 1600 ft/sec True Shear Wave Velocity
- 0 - 1600 ft/sec Pseudo Interval Receiver 1
- 0 - 1600 ft/sec Pseudo Interval Receiver 2

Latitude: 38.12324 Longitude: -90.25558

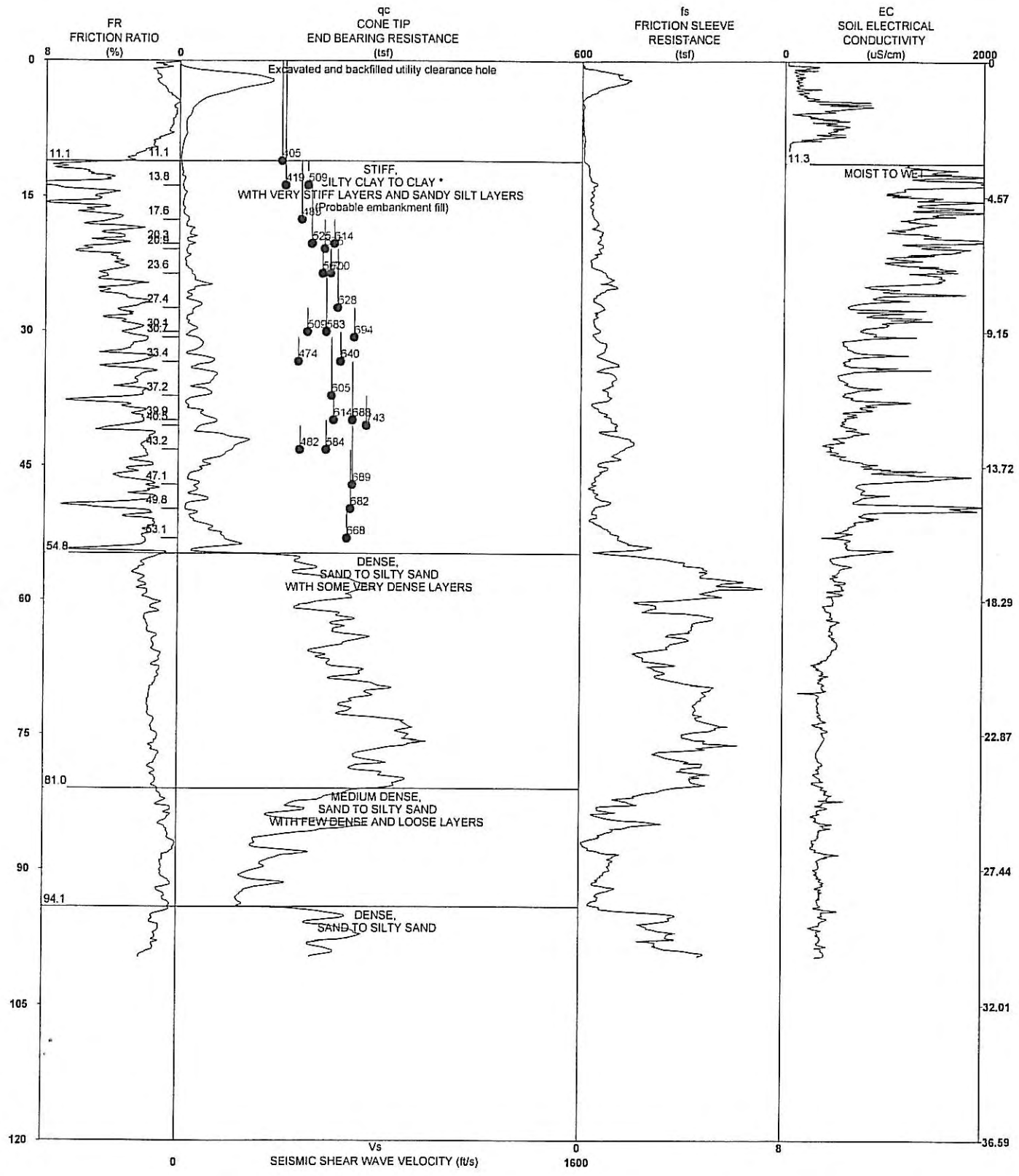
PROJECT NAME:Ameren UE Rush Island Levee Inventory
PROJECT NUMBER:09-110-090

STRATIGRAPHICS

R1 DATE:8/28/2009 TIME:9:35 AM
SOUNDING NUMBER:CP-01

CP01

CPTU-EC-S LOG WITH LITHOLOGIC EVALUATION CP01



0 - 1600 ft/sec True Shear Wave Velocity
0 - 1600 ft/sec Pseudo Interval Receiver 1
0 - 1600 ft/sec Pseudo Interval Receiver 2

Latitude: 38.12324 Longitude: -90.25558

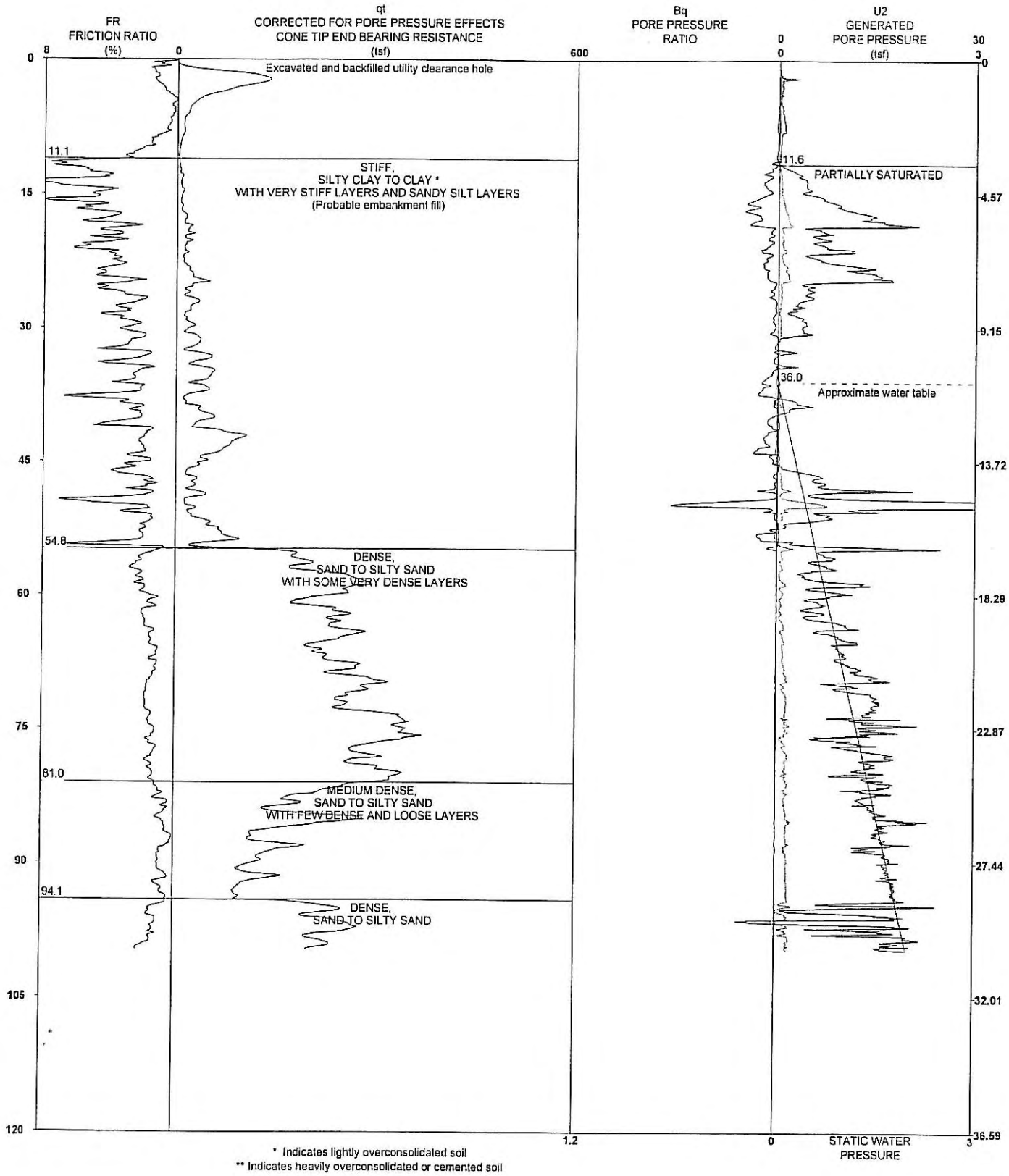
PROJECT NAME:Ameren UE Rush Island Levee Inventory
PROJECT NUMBER:09-110-090

STRATIGRAPHICS

R1 DATE:8/28/2009 TIME:9:35 AM
SOUNDING NUMBER:CP-01

CP01

CPTU-EC-S LOG WITH LITHOLOGIC EVALUATION CP01



* Indicates lightly overconsolidated soil
** Indicates heavily overconsolidated or cemented soil

Latitude: 38.12324 Longitude: -90.25558

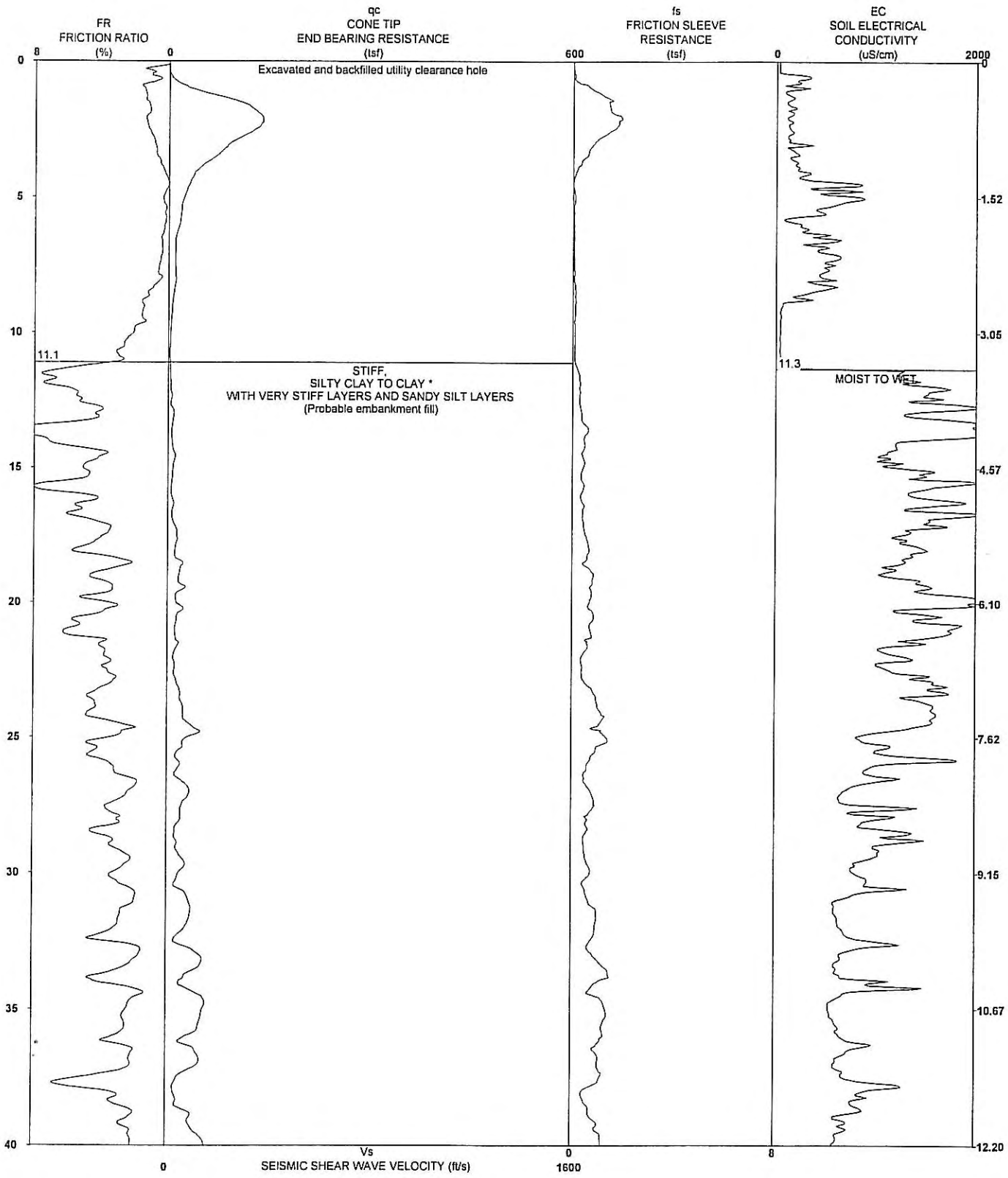
PROJECT NAME:Ameren UE Rush Island Levee Investigation
PROJECT NUMBER:09-110-090

STRATIGRAPHICS

R1 DATE:8/28/2009 TIME:9:35 AM
SOUNDING NUMBER:CP-01

CP01

CPTU-EC-S LOG WITH LITHOLOGIC EVALUATION CP01



Latitude: 38.12324 Longitude: -90.25558

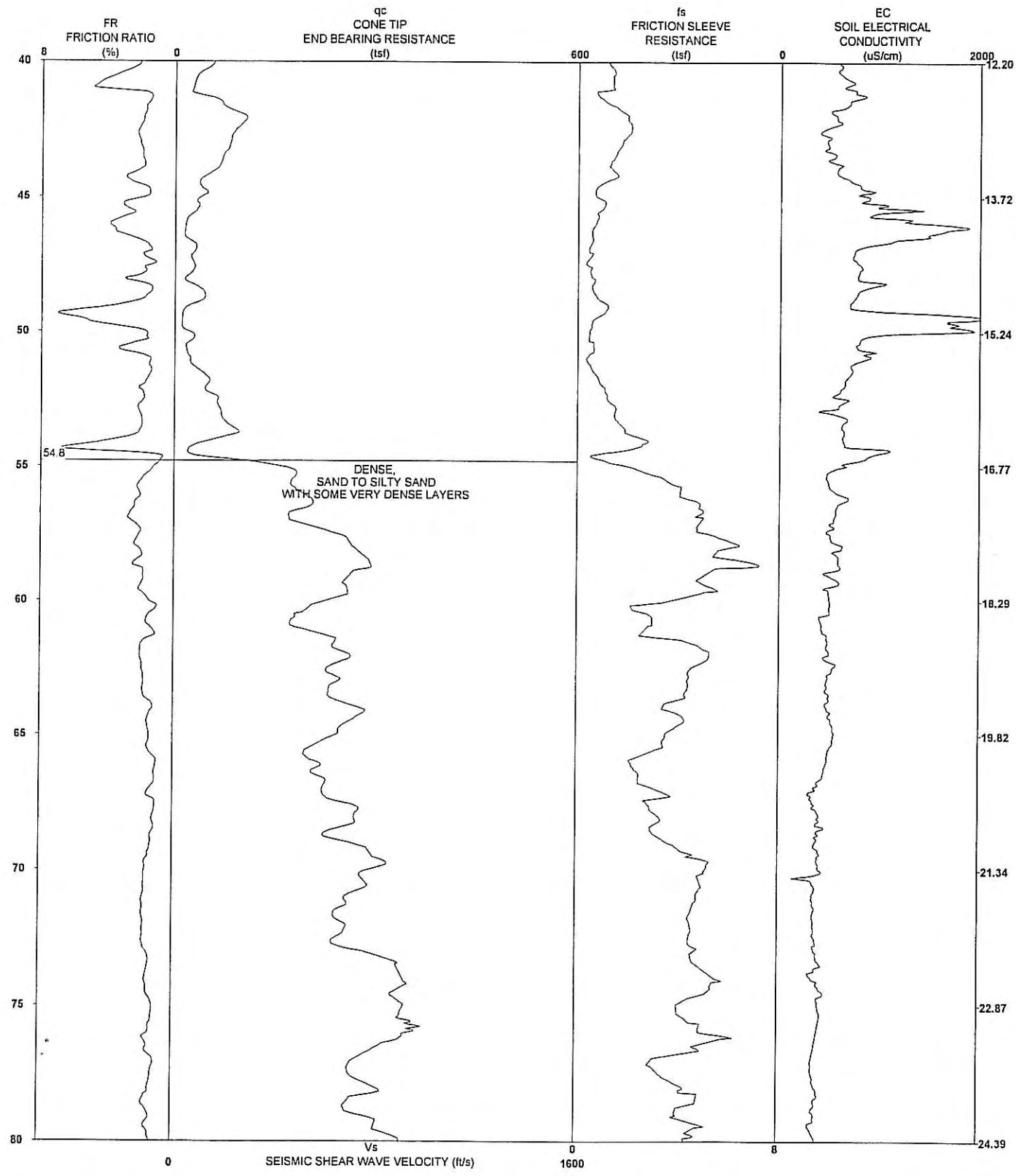
PROJECT NAME:Ameren UE Rush Island Levee Inventory
PROJECT NUMBER:09-110-090

STRATIGRAPHICS

R1 DATE:8/28/2009 TIME:9:35 AM
SOUNDING NUMBER:CP-01

CP01

CPTU-EC-S LOG WITH LITHOLOGIC EVALUATION CP01



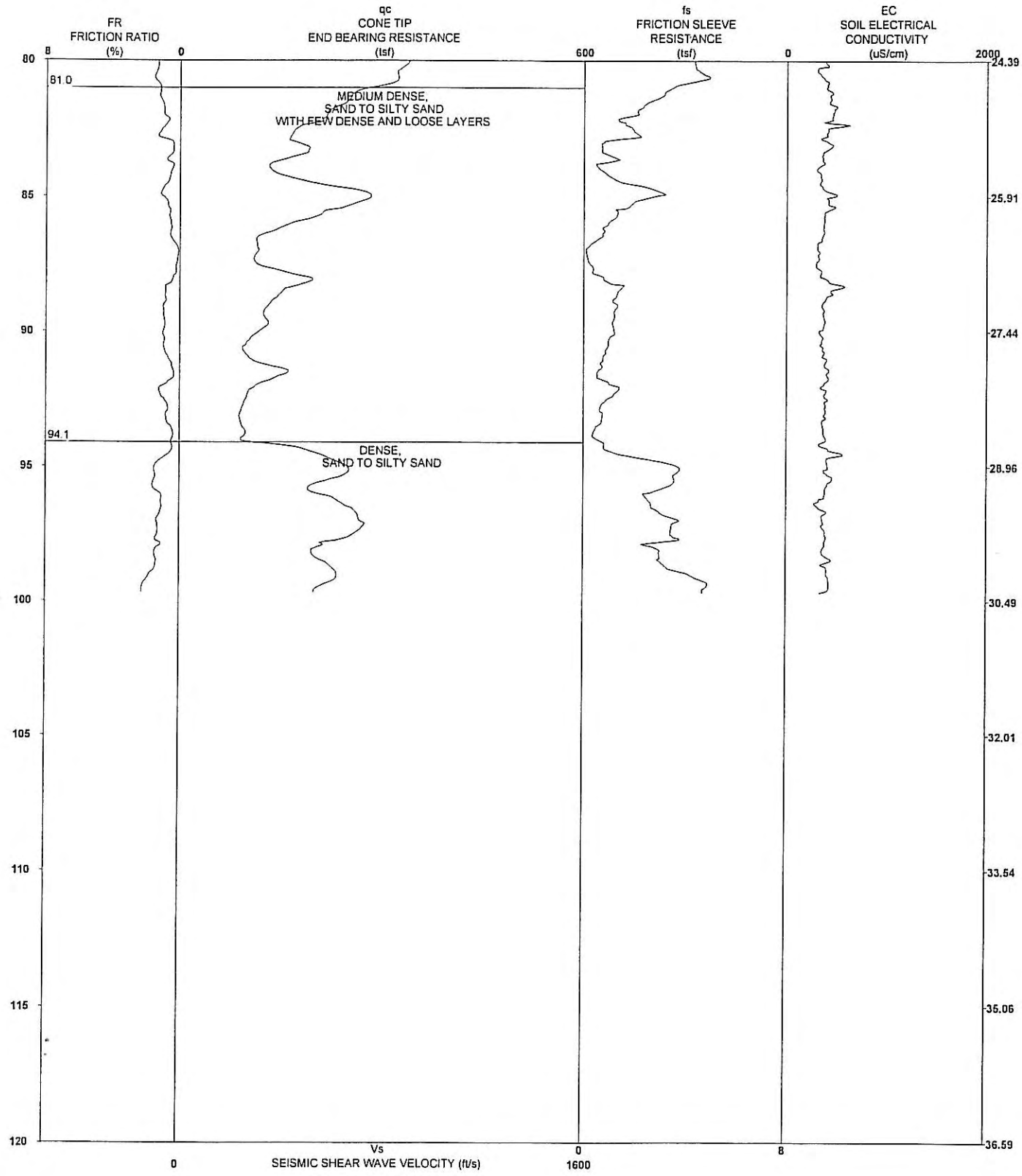
Latitude: 38.12324 Longitude: -90.25558

PROJECT NAME:Ameren UE Rush Island Levee Inventory
PROJECT NUMBER:09-110-090

STRATIGRAPHICS

R1 DATE:8/28/2009 TIME:9:35 AM
SOUNDING NUMBER:CP-01

CPTU-EC-S LOG WITH LITHOLOGIC EVALUATION CP01



Latitude: 38.12324 Longitude: -90.25558

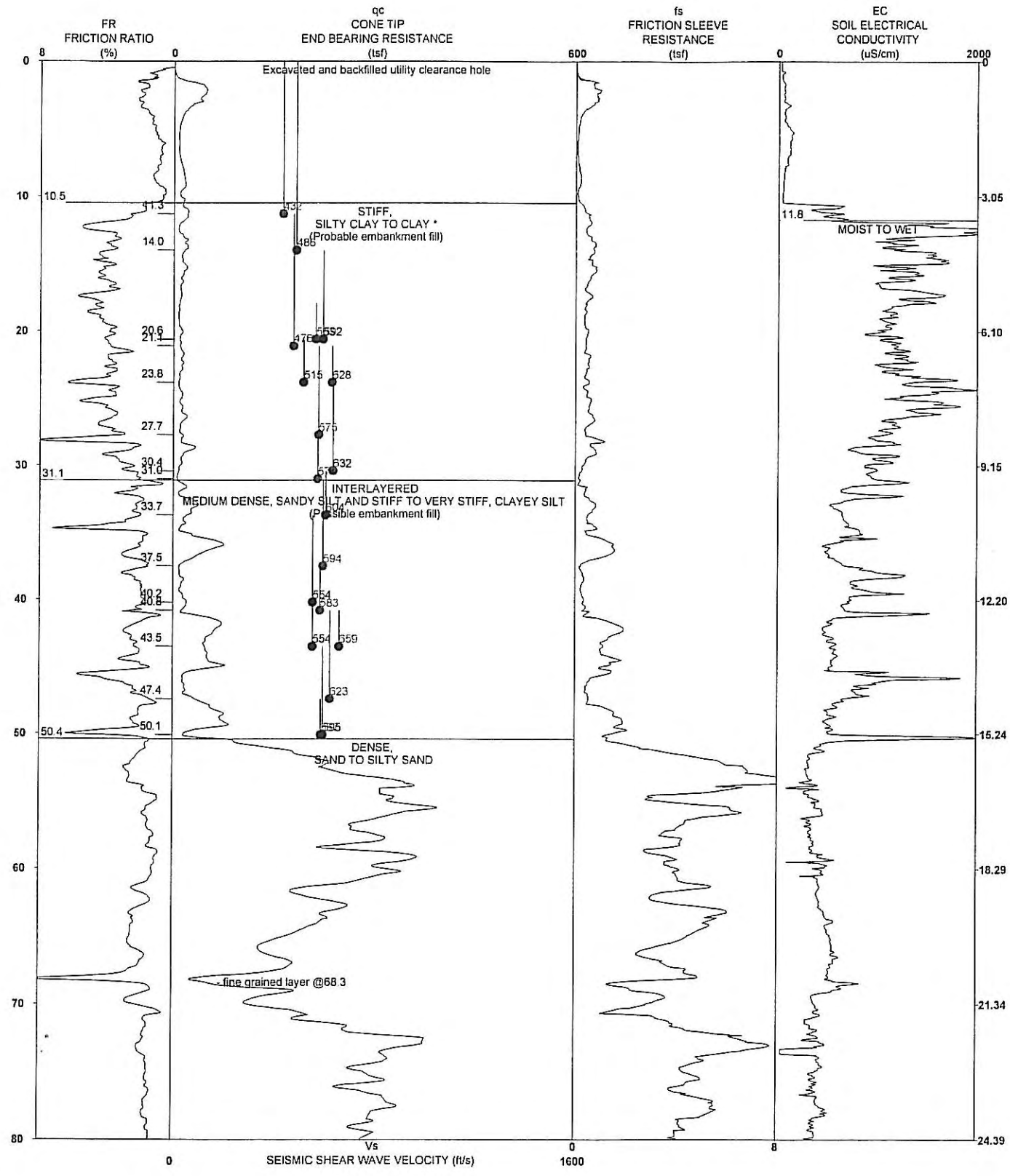
PROJECT NAME:Ameren UE Rush Island Levee Inventory
PROJECT NUMBER:09-110-090

STRATIGRAPHICS

R1 DATE:8/28/2009 TIME:9:35 AM
SOUNDING NUMBER:CP-01

CP01

CPTU-EC-S LOG WITH LITHOLOGIC EVALUATION CP02



- 0 - 1600 ft/sec True Shear Wave Velocity
- 0 - 1600 ft/sec Pseudo Interval Receiver 1
- 0 - 1600 ft/sec Pseudo Interval Receiver 2

Latitude: 0.00000 Longitude: 0.00000

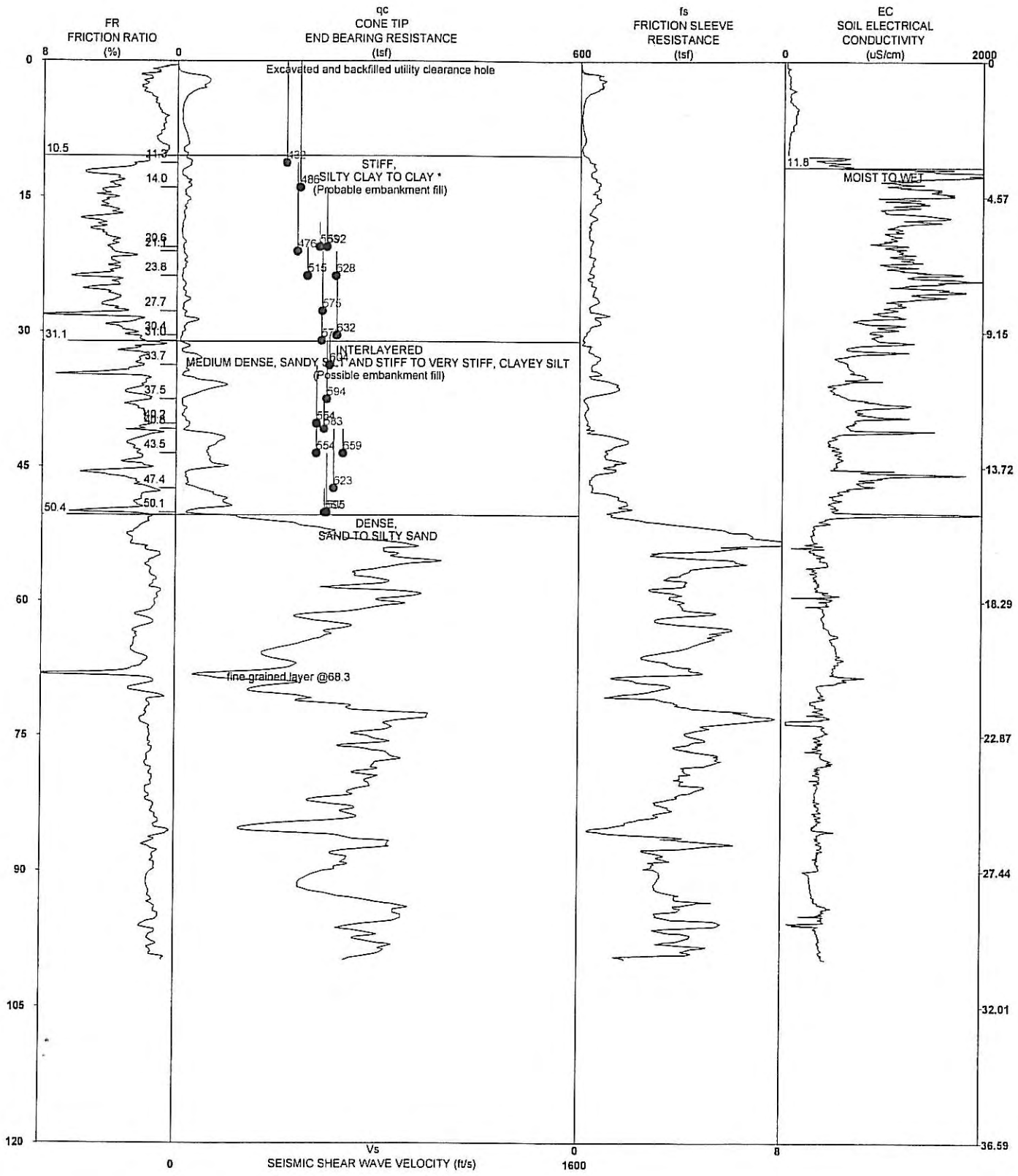
PROJECT NAME:Ameren UE Rush Island Levee Inventory
PROJECT NUMBER:09-110-090

STRATIGRAPHICS

R1 DATE:8/27/2009 TIME:5:25 PM
SOUNDING NUMBER:CP-02

CP02

CPTU-EC-S LOG WITH LITHOLOGIC EVALUATION CP02



0 - 1600 ft/sec True Shear Wave Velocity
0 - 1600 ft/sec Pseudo Interval Receiver 1
0 - 1600 ft/sec Pseudo Interval Receiver 2

Latitude: 0.00000 Longitude: 0.00000

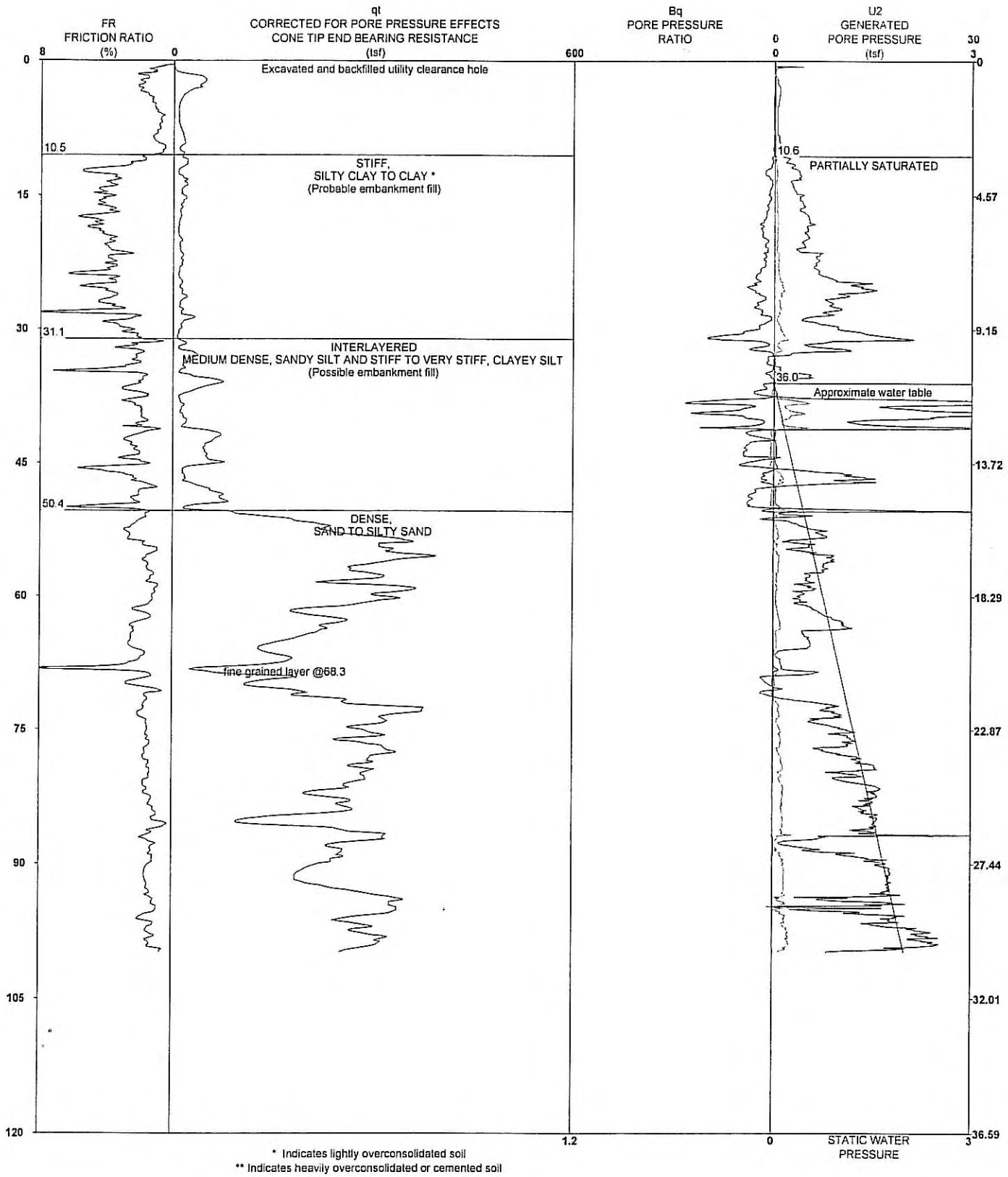
PROJECT NAME:Ameren UE Rush Island Levee Investigation
PROJECT NUMBER:09-110-090

STRATIGRAPHICS

R1 DATE:8/27/2009 TIME:5:25 PM
SOUNDING NUMBER:CP-02

CP02

CPTU-EC-S LOG WITH LITHOLOGIC EVALUATION CP02



* Indicates lightly overconsolidated soil
** Indicates heavily overconsolidated or cemented soil

Latitude: 0.00000 Longitude: 0.00000

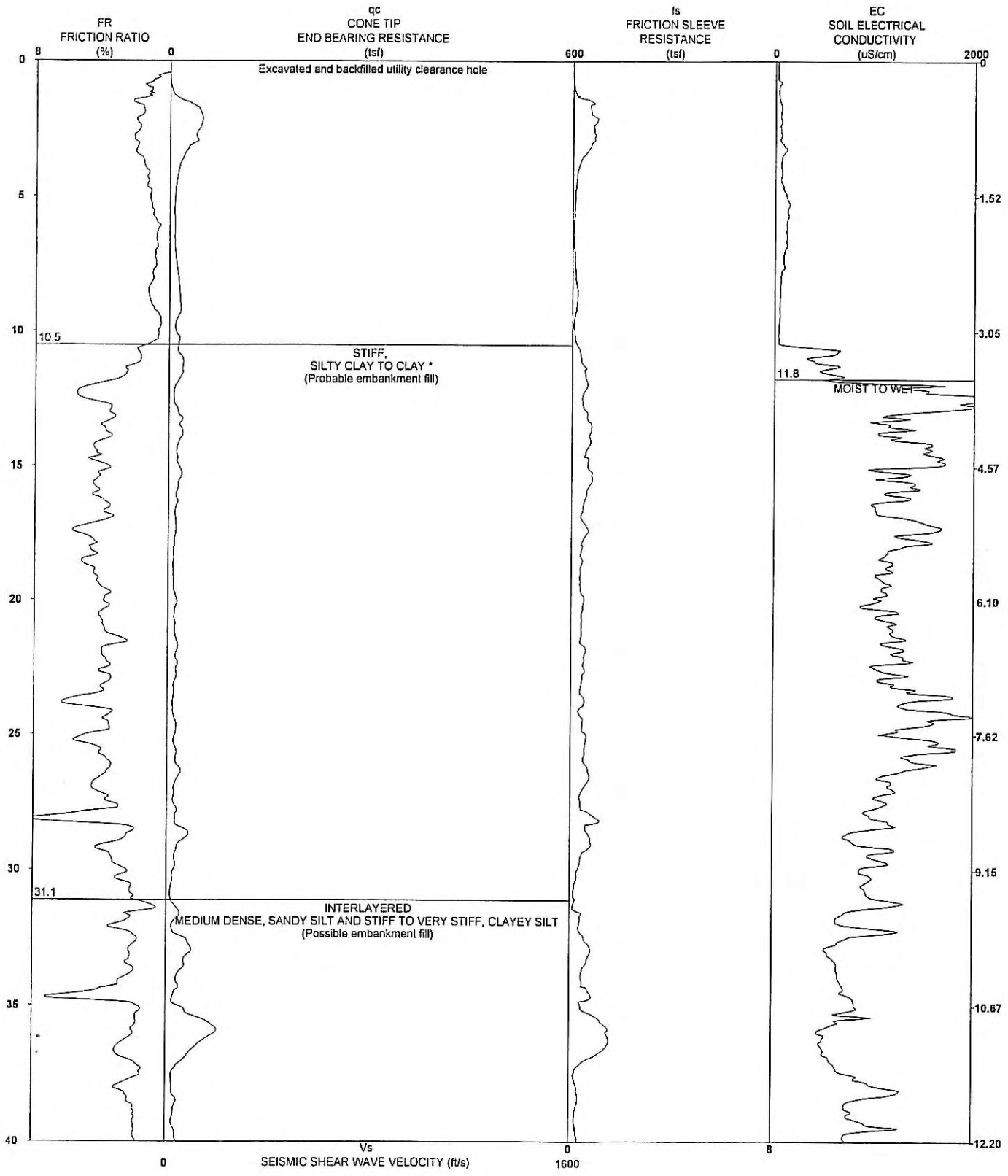
PROJECT NAME:Ameren UE Rush Island Levee Inventory
PROJECT NUMBER:09-110-090

STRATIGRAPHICS

R1 DATE:8/27/2009 TIME:5:25 PM
SOUNDING NUMBER:CP-02

CP02

CPTU-EC-S LOG WITH LITHOLOGIC EVALUATION CP02



Latitude: 0.00000 Longitude: 0.00000

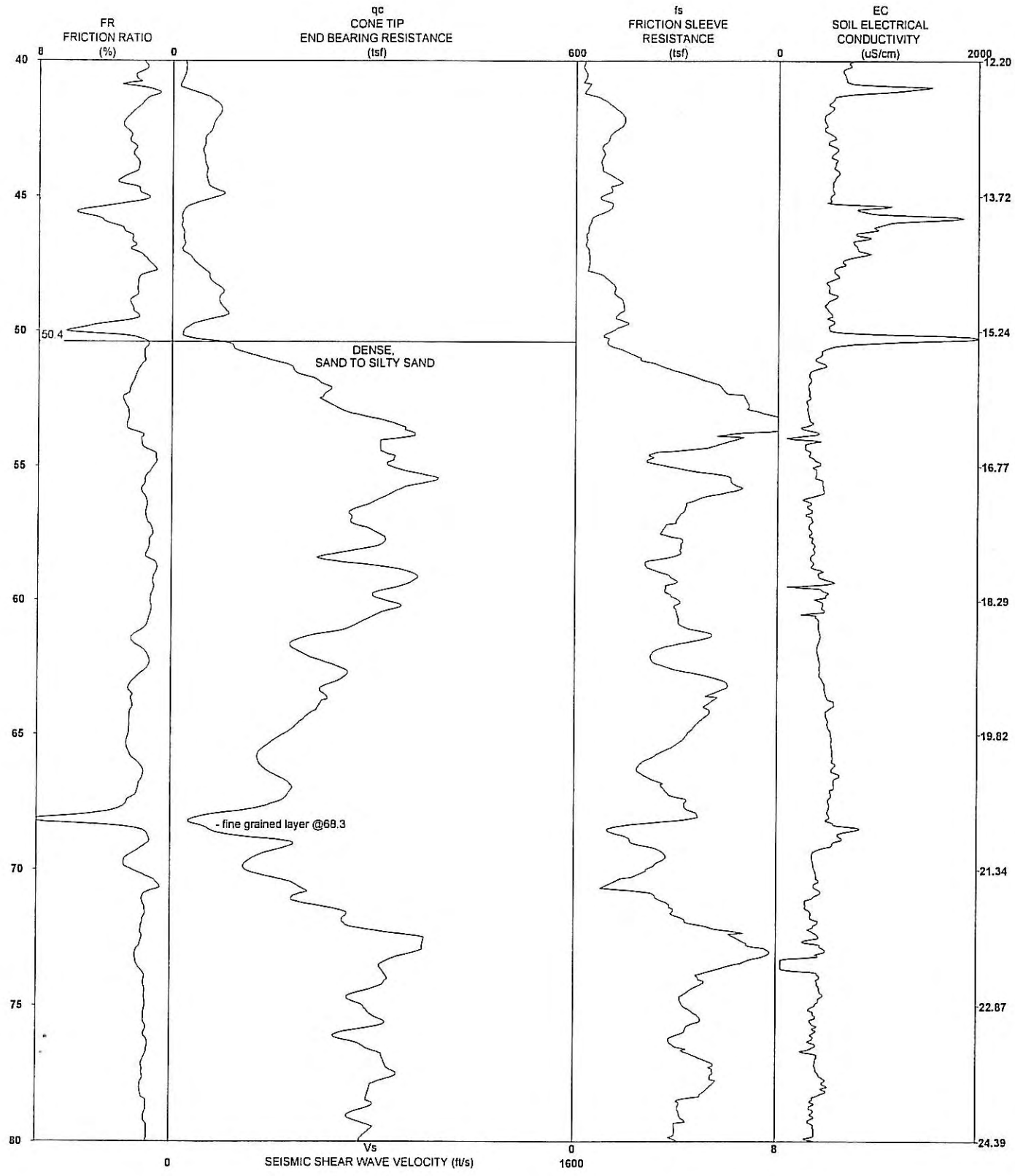
PROJECT NAME:Ameren UE Rush Island Levee Inventory
PROJECT NUMBER:09-110-090

STRATIGRAPHICS

R1 DATE:8/27/2009 TIME:5:25 PM
SOUNDING NUMBER:CP-02

CP02

CPTU-EC-S LOG WITH LITHOLOGIC EVALUATION CP02



Latitude: 0.00000 Longitude: 0.00000

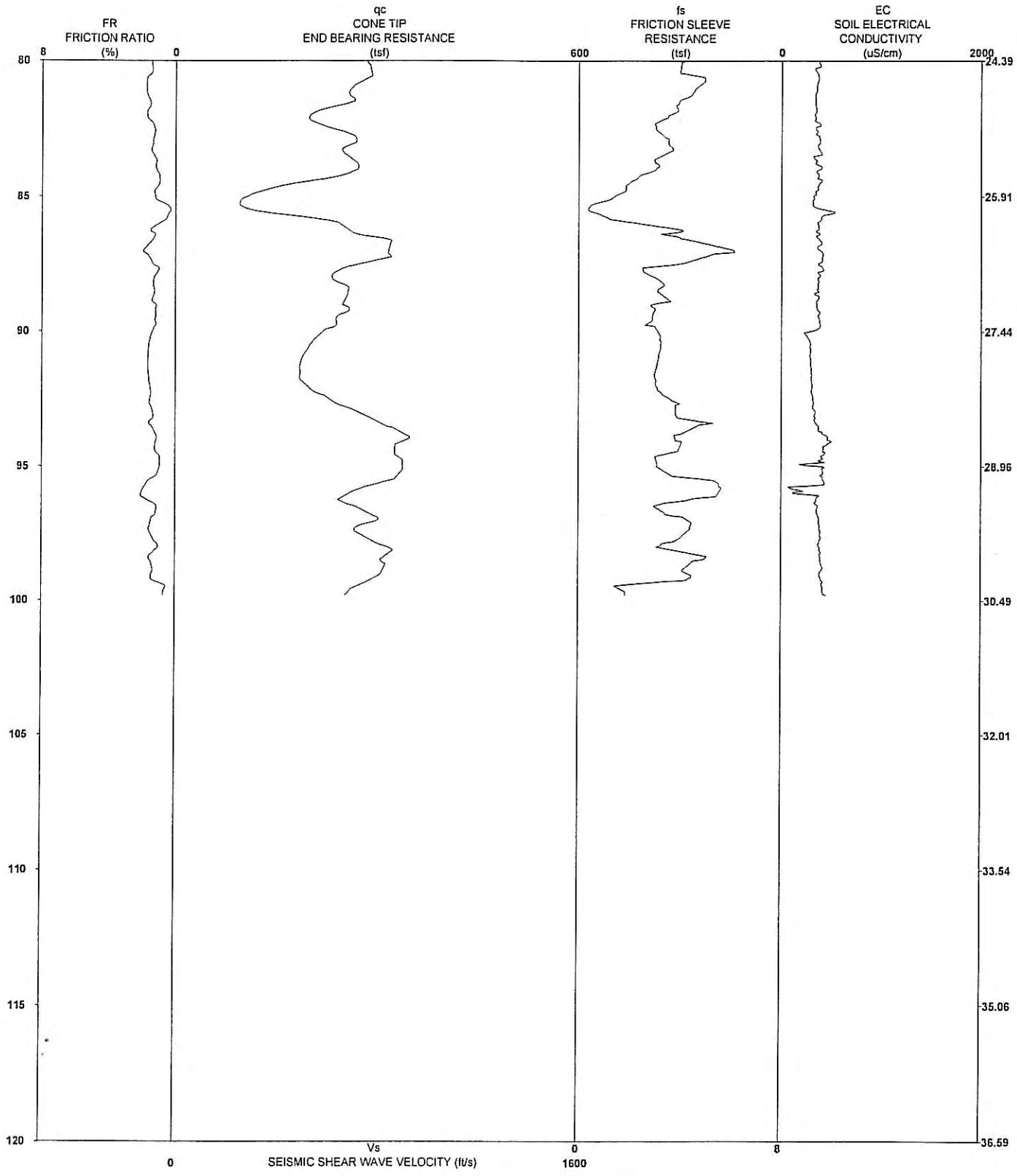
PROJECT NAME:Ameren UE Rush Island Levee Inventory
PROJECT NUMBER:09-110-090

STRATIGRAPHICS

R1 DATE:8/27/2009 TIME:5:25 PM
SOUNDING NUMBER:CP-02

CP02

CPTU-EC-S LOG WITH LITHOLOGIC EVALUATION CP02



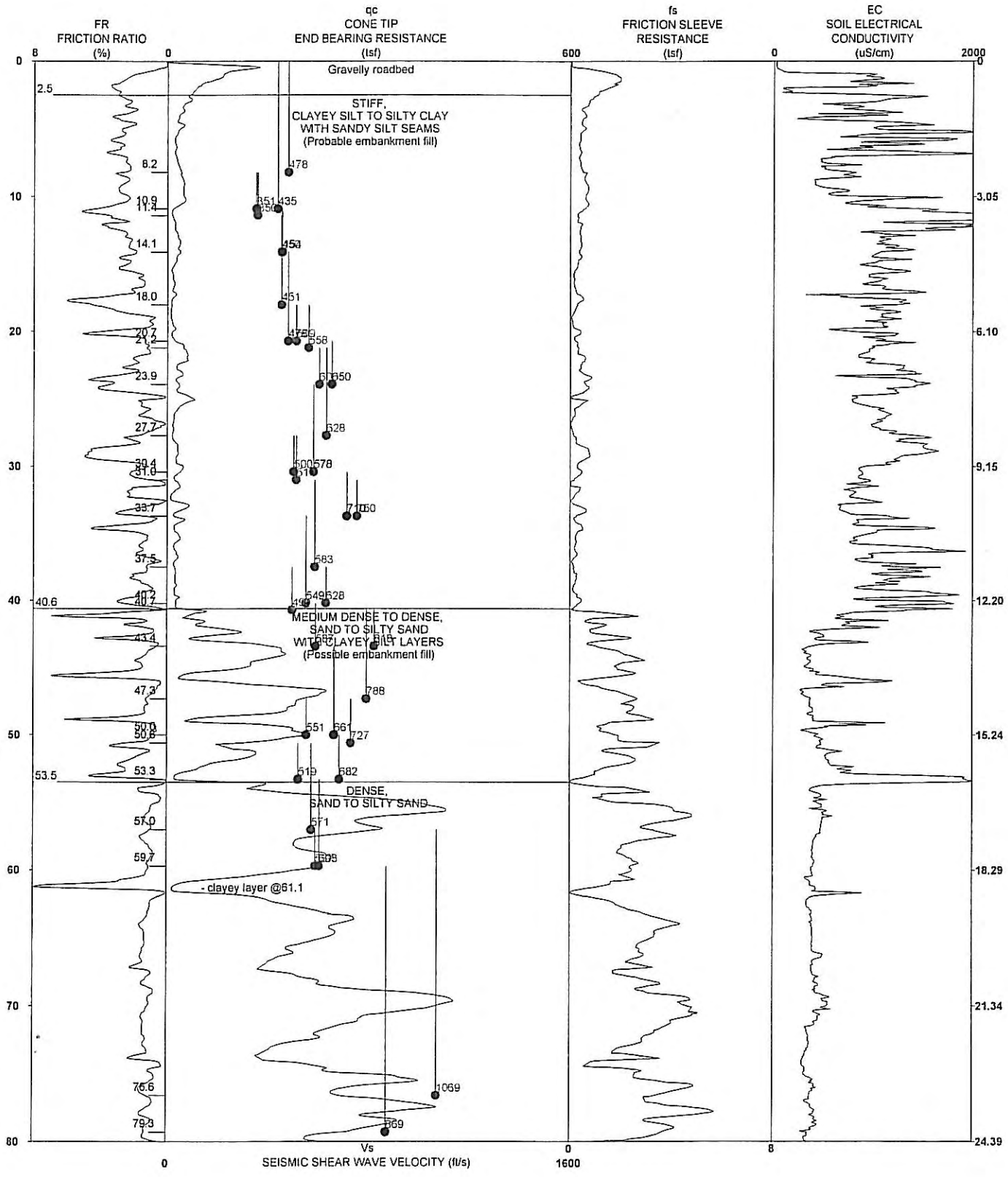
Latitude: 0.00000 Longitude: 0.00000

PROJECT NAME:Ameren UE Rush Island Levee Inventory
PROJECT NUMBER:09-110-090

STRATIGRAPHICS

R1 DATE:8/27/2009 TIME:5:25 PM
SOUNDING NUMBER:CP-02

CPTU-EC-S LOG WITH LITHOLOGIC EVALUATION CP03



0 - 1600 ft/sec True Shear Wave Velocity
0 - 1600 ft/sec Pseudo Interval Receiver 1
0 - 1600 ft/sec Pseudo Interval Receiver 2

Latitude: 0.00000 Longitude: 0.00000

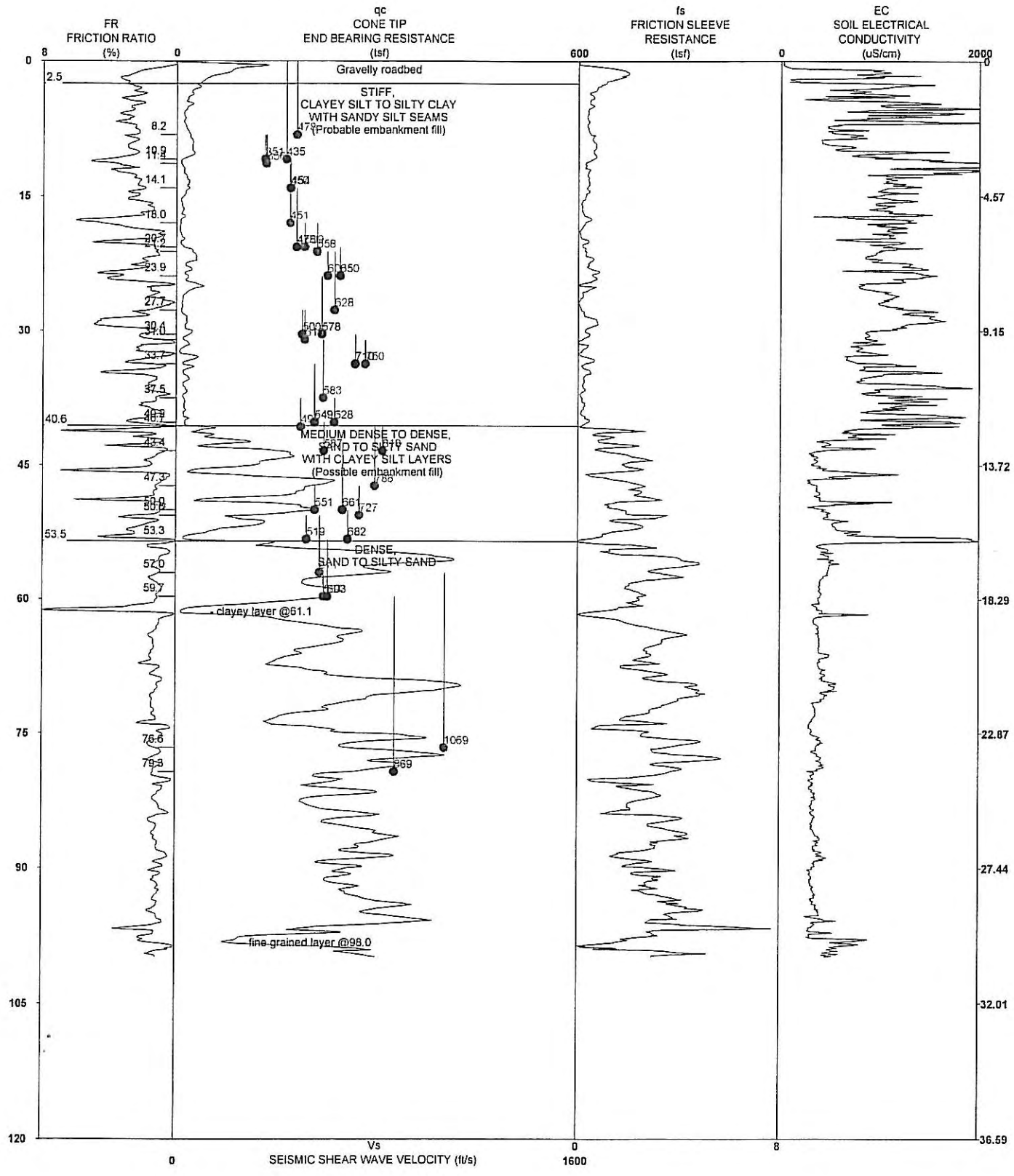
PROJECT NAME:Ameren UE Rush Island Levee Inventory
PROJECT NUMBER:09-110-090

STRATIGRAPHICS

R1 DATE:8/27/2009 TIME:3:19 PM
SOUNDING NUMBER:CP-03

CP03

CPTU-EC-S LOG WITH LITHOLOGIC EVALUATION CP03



Latitude: 0.00000 Longitude: 0.00000

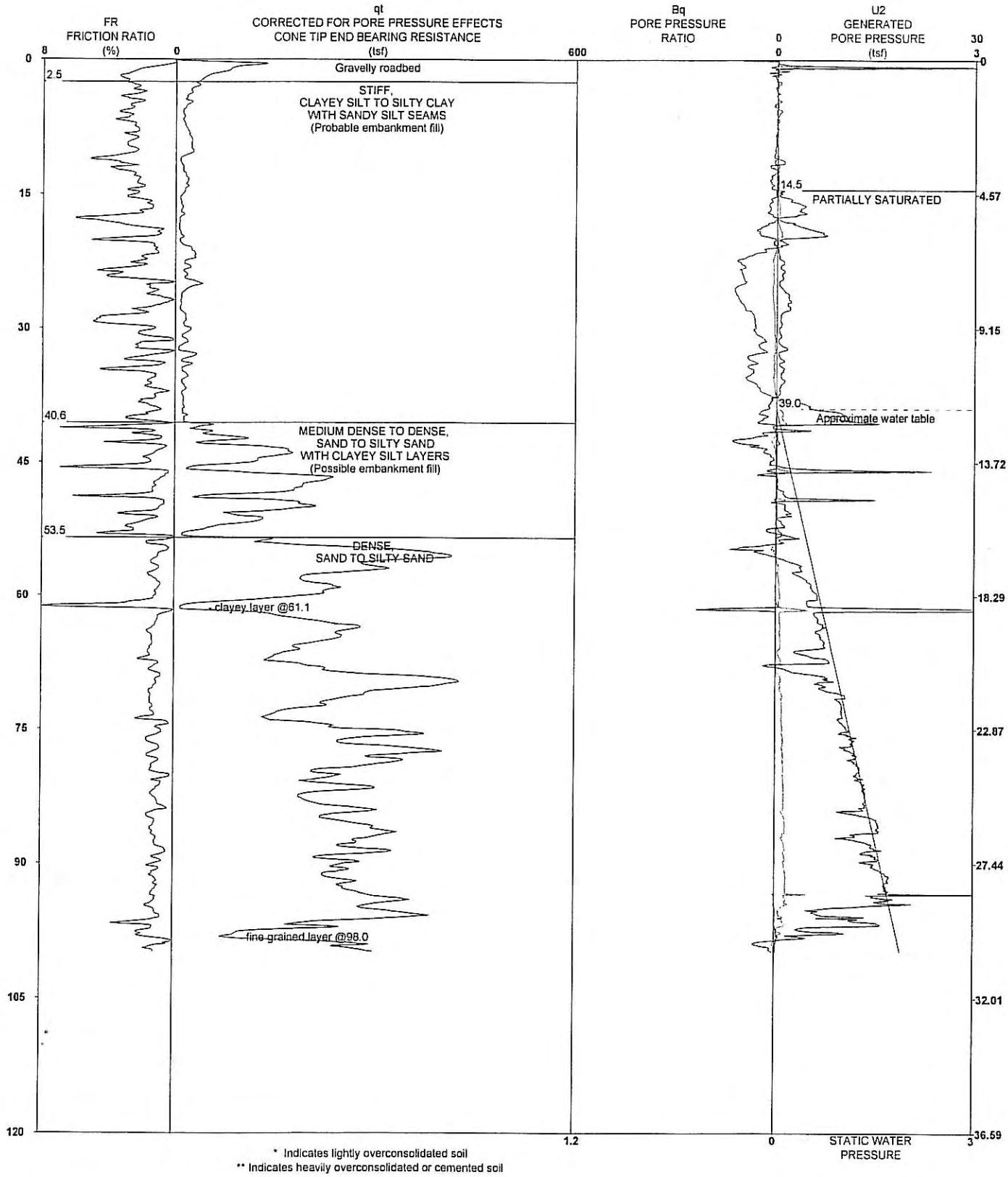
PROJECT NAME:Ameren UE Rush Island Levee Inventory
PROJECT NUMBER:09-110-090

STRATIGRAPHICS

R1 DATE:8/27/2009 TIME:3:19 PM
SOUNDING NUMBER:CP-03

CP03

CPTU-EC-S LOG WITH LITHOLOGIC EVALUATION CP03



* Indicates lightly overconsolidated soil
** Indicates heavily overconsolidated or cemented soil

Latitude: 0.00000 Longitude: 0.00000

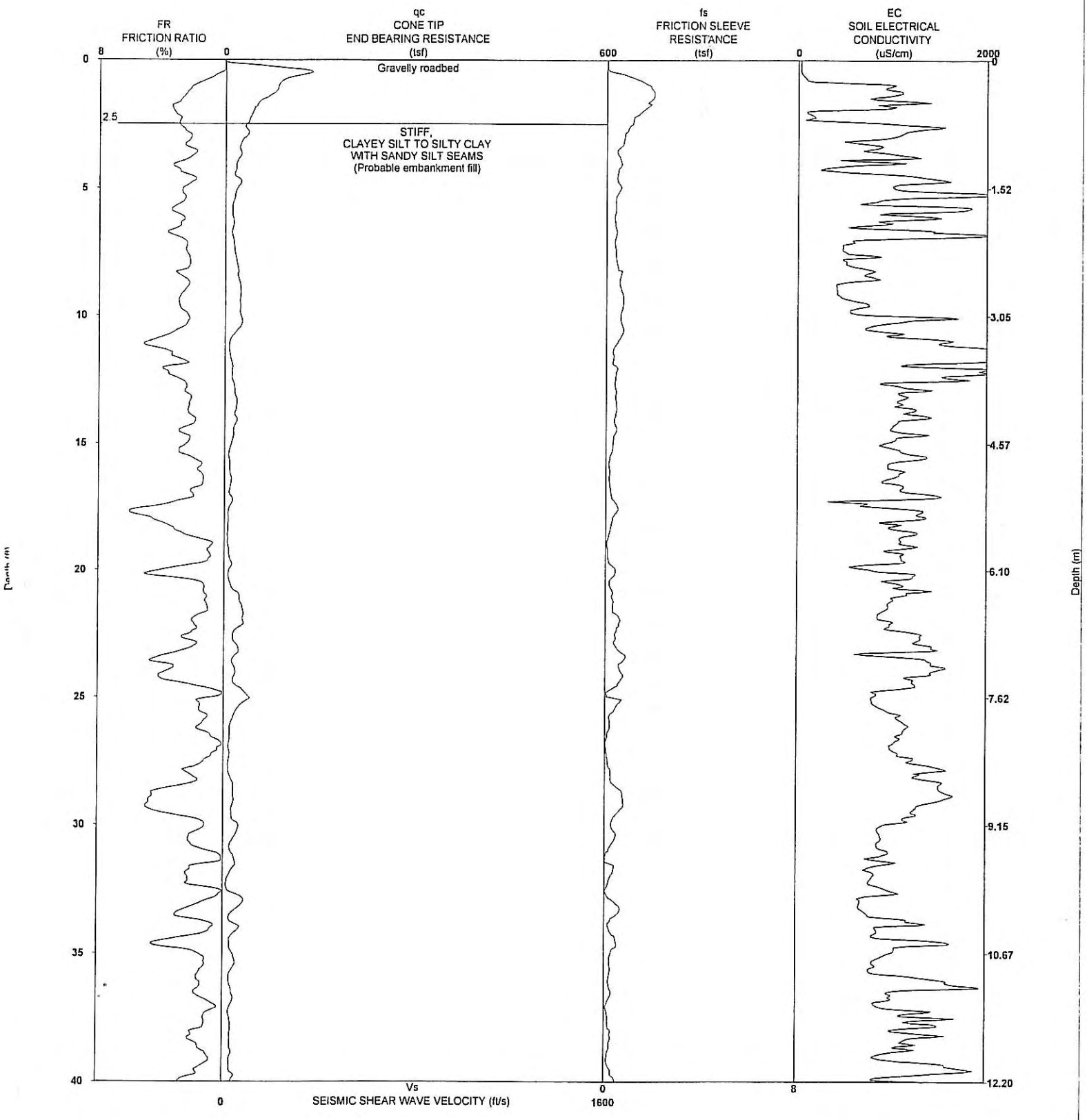
PROJECT NAME:Ameren UE Rush Island Levee Inventory
PROJECT NUMBER:09-110-090

STRATIGRAPHICS

R1 DATE:8/27/2009 TIME:3:19 PM
SOUNDING NUMBER:CP-03

CP03

CPTU-EC-S LOG WITH LITHOLOGIC EVALUATION CP03



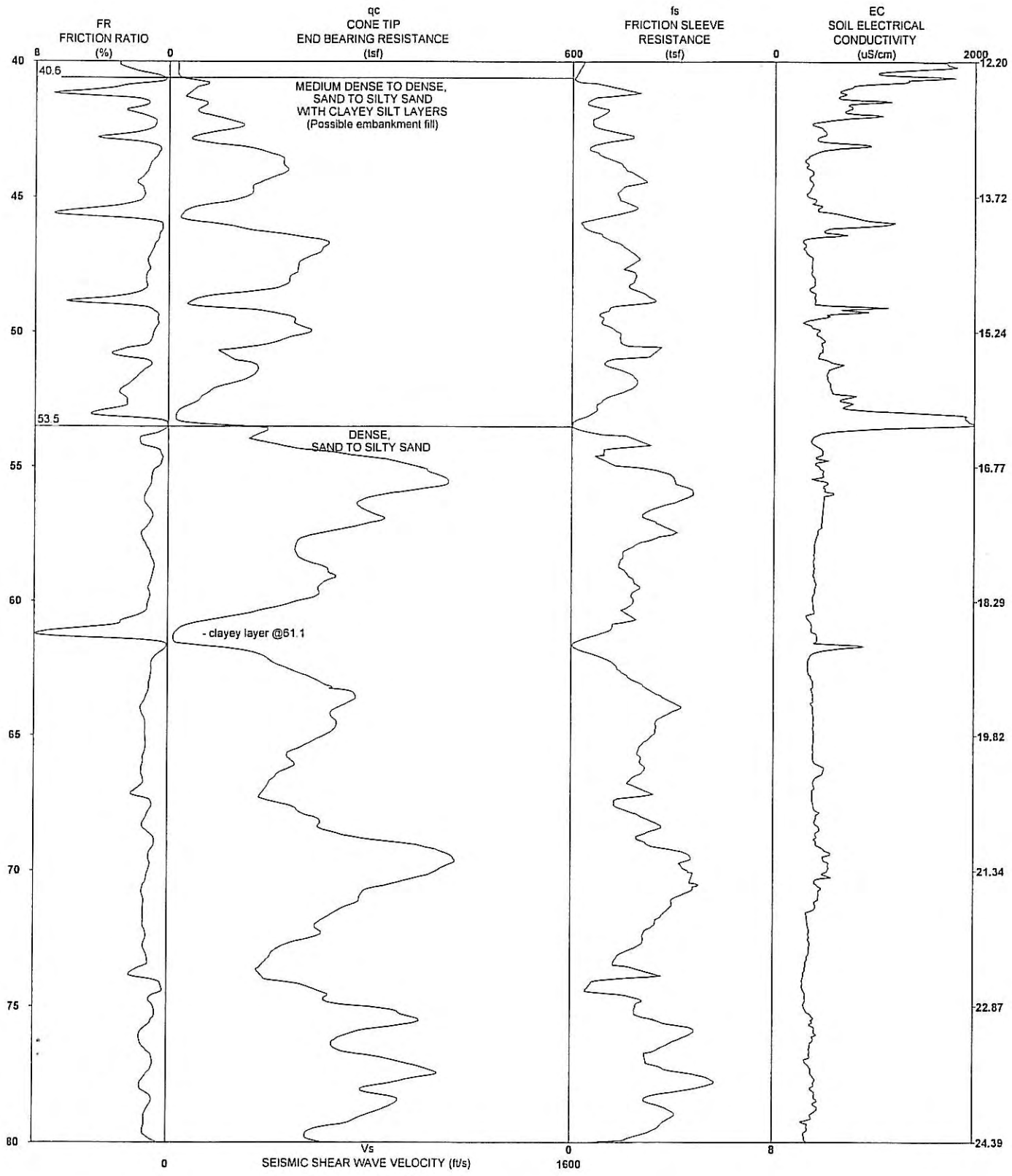
Latitude: 0.00000 Longitude: 0.00000

PROJECT NAME:Ameren UE Rush Island Levee Inventory
PROJECT NUMBER:09-110-090

STRATIGRAPHICS

R1 DATE:8/27/2009 TIME:3:19 PM
SOUNDING NUMBER:CP-03

CPTU-EC-S LOG WITH LITHOLOGIC EVALUATION CP03



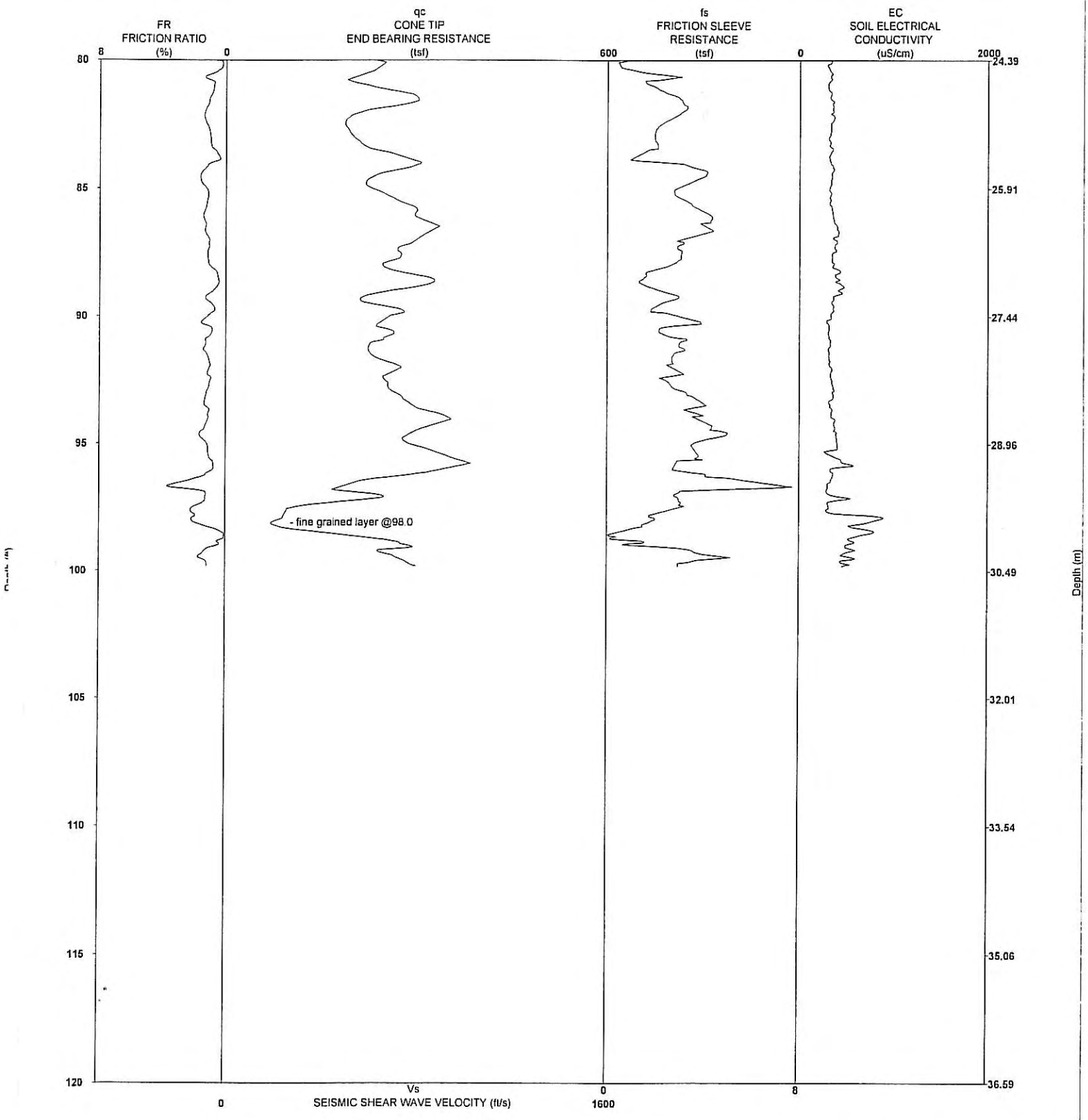
Latitude: 0.00000 Longitude: 0.00000

PROJECT NAME:Ameren UE Rush Island Levee Inventory
PROJECT NUMBER:09-110-090

STRATIGRAPHICS

R1 DATE:8/27/2009 TIME:3:19 PM
SOUNDING NUMBER:CP-03

CPTU-EC-S LOG WITH LITHOLOGIC EVALUATION CP03



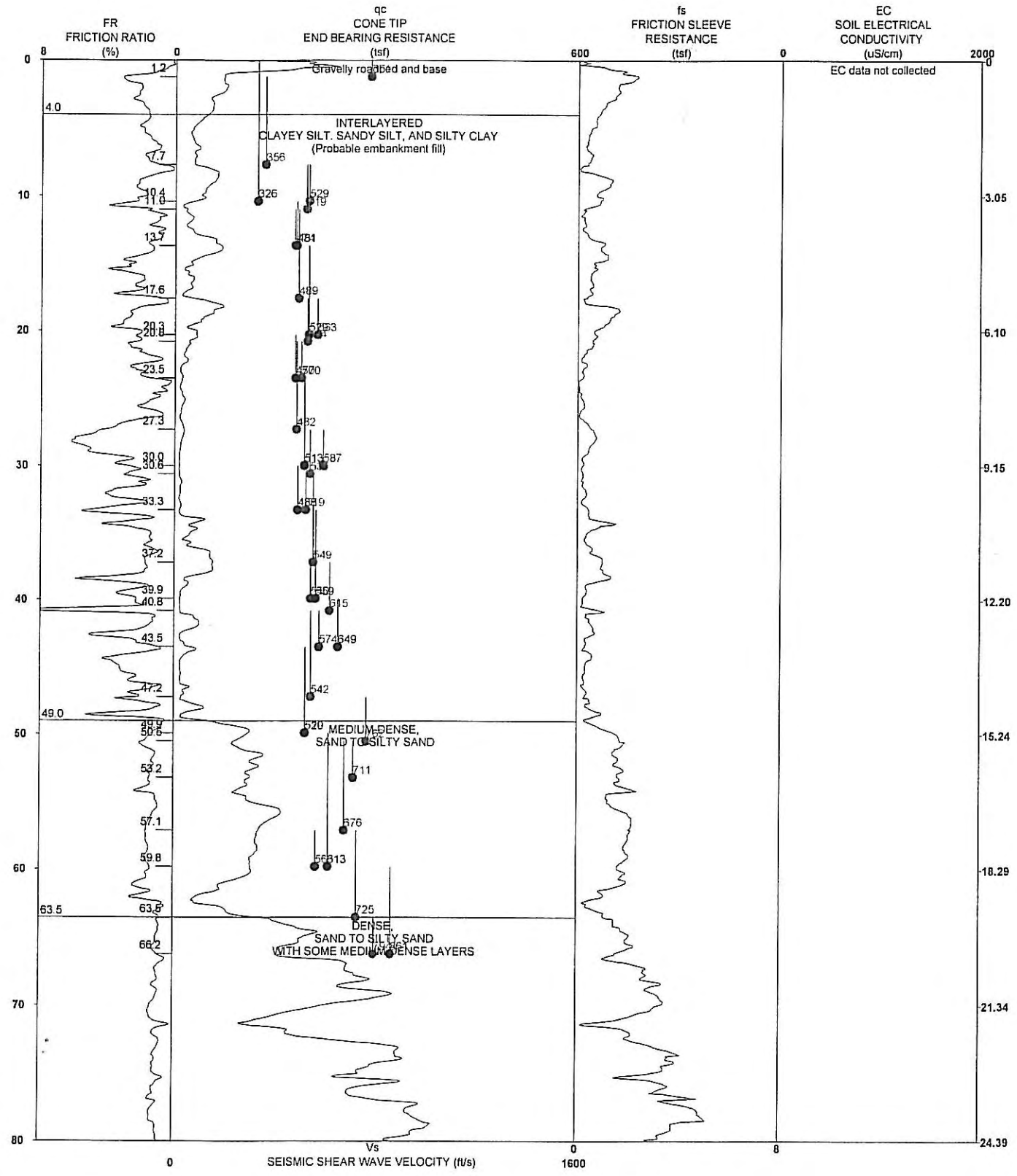
Latitude: 0.00000 Longitude: 0.00000

PROJECT NAME:Ameren UE Rush Island Levee Inventory
PROJECT NUMBER:09-110-090

STRATIGRAPHICS

R1 DATE:8/27/2009 TIME:3:19 PM
SOUNDING NUMBER:CP-03

CPTU-S LOG WITH LITHOLOGIC EVALUATION CP04



0 - 1600 ft/sec True Shear Wave Velocity
0 - 1600 ft/sec Pseudo Interval Receiver 1
0 - 1600 ft/sec Pseudo Interval Receiver 2

Latitude: 38.11862 Longitude: -90.25739

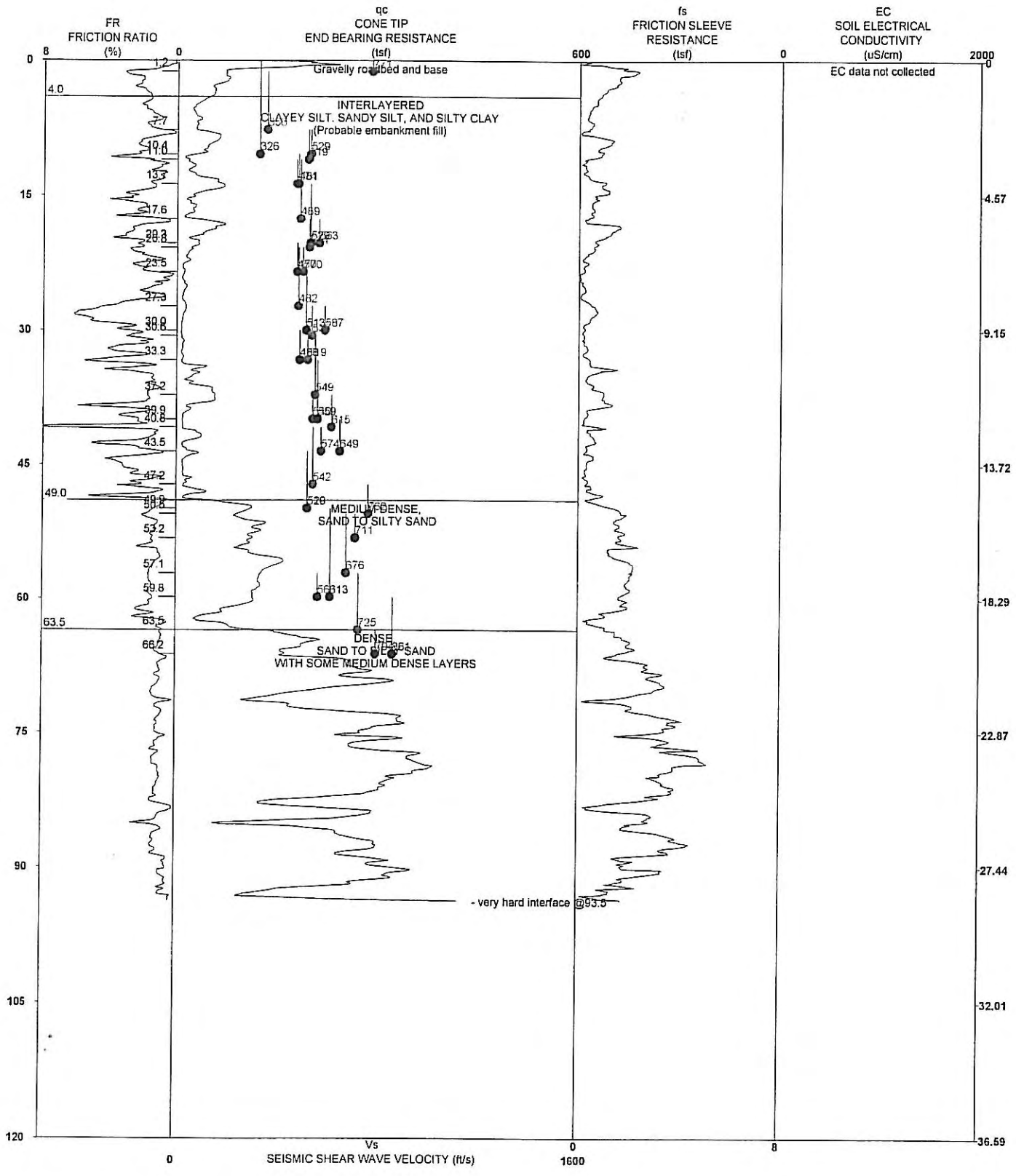
PROJECT NAME:Ameren UE Rush Island Levee Inventory
PROJECT NUMBER:09-110-090

STRATIGRAPHICS

R1 DATE:8/27/2009 TIME:11:42 AM
SOUNDING NUMBER:CP-04

CP04

CPTU-S LOG WITH LITHOLOGIC EVALUATION CP04



Latitude: 38.11862 Longitude: -90.25739

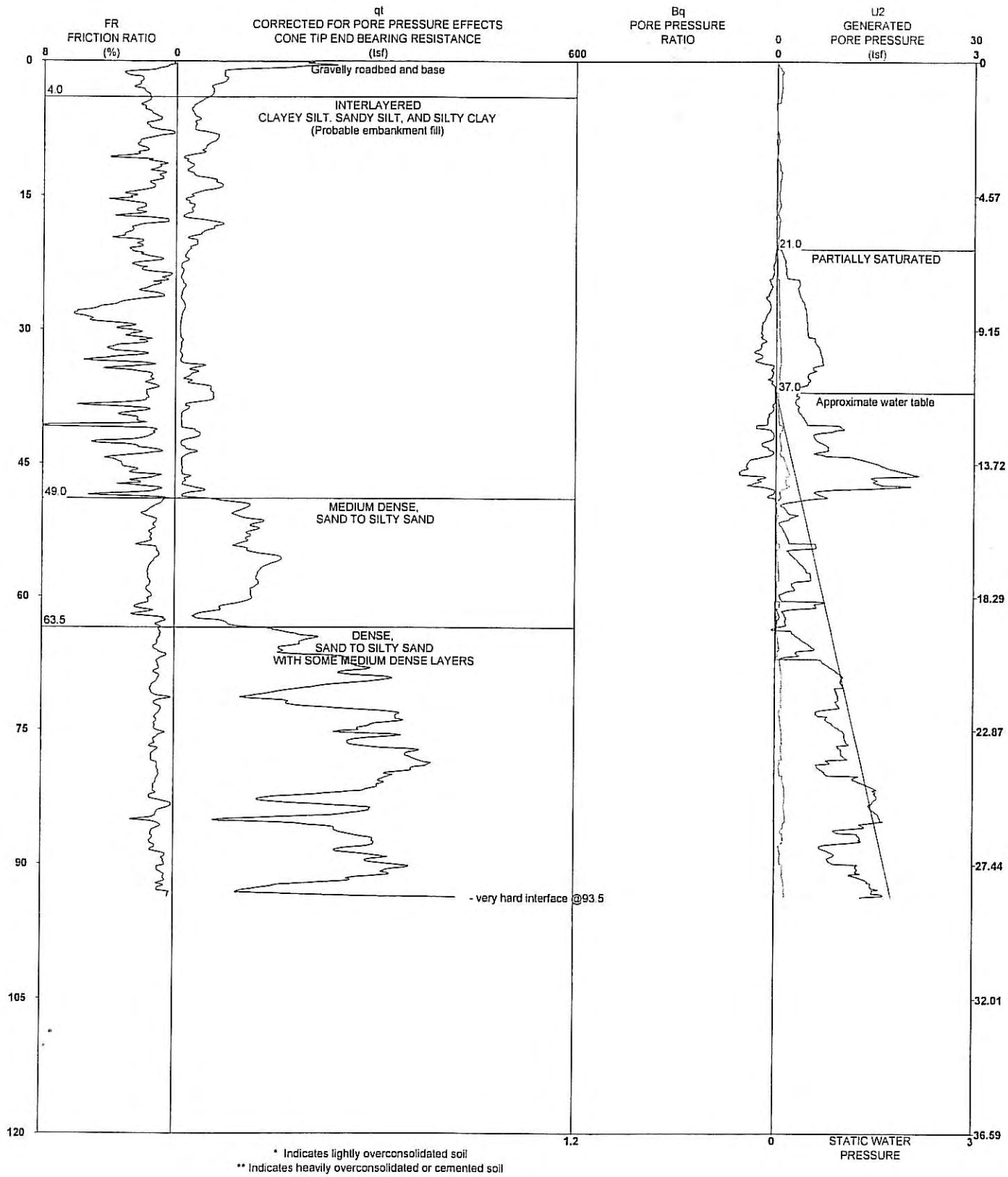
PROJECT NAME:Ameren UE Rush Island Levee Inventory
PROJECT NUMBER:09-110-090

STRATIGRAPHICS

R1 DATE:8/27/2009 TIME:11:42 AM
SOUNDING NUMBER:CP-04

CP04

CPTU-S LOG WITH LITHOLOGIC EVALUATION CP04



* Indicates lightly overconsolidated soil
** Indicates heavily overconsolidated or cemented soil

Latitude: 38.11862 Longitude: -90.25739

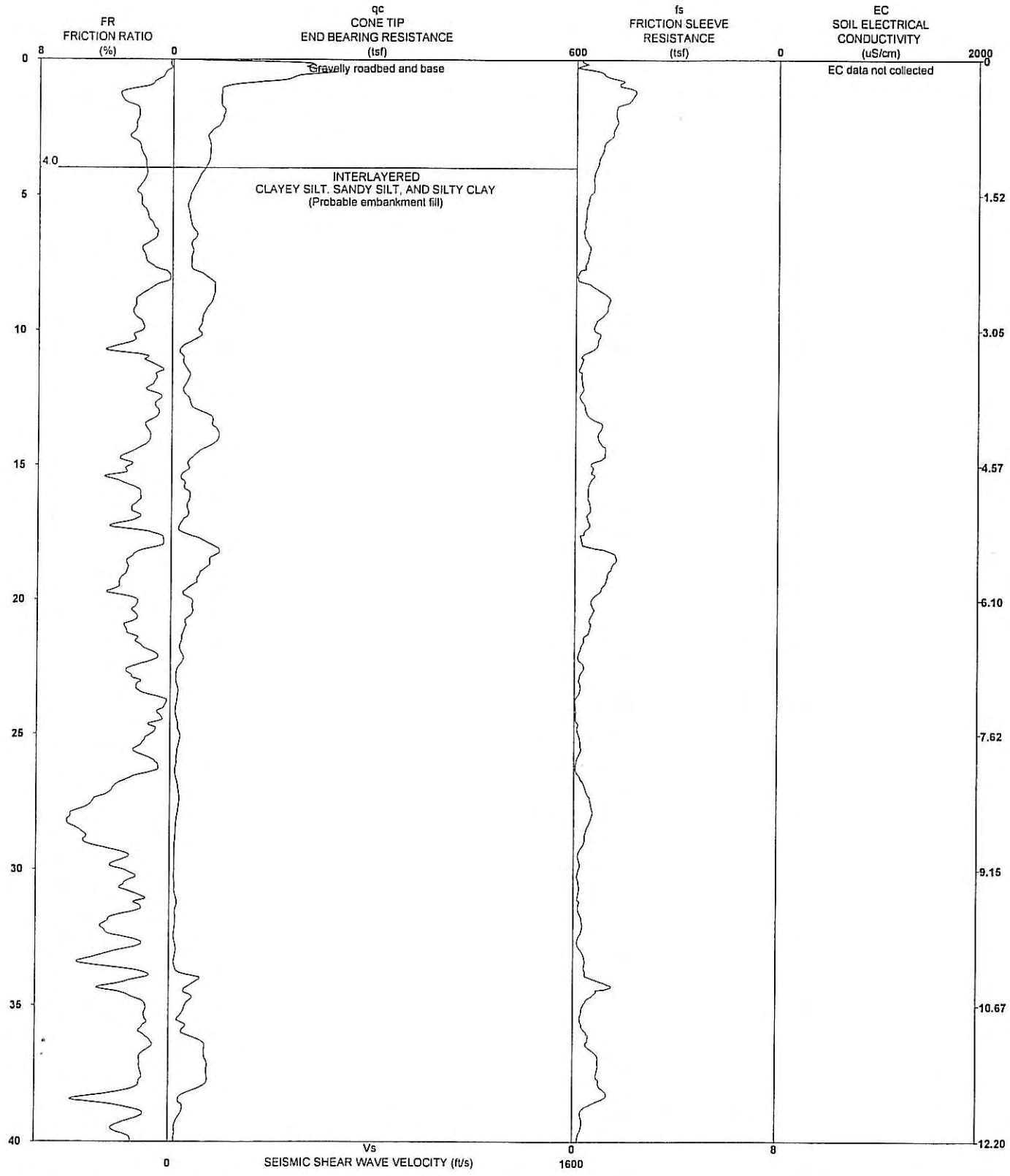
PROJECT NAME:Ameren UE Rush Island Levee Inventory
PROJECT NUMBER:09-110-090

STRATIGRAPHICS

R1 DATE:8/27/2009 TIME:11:42 AM
SOUNDING NUMBER:CP-04

CP04

CPTU-S LOG WITH LITHOLOGIC EVALUATION CP04



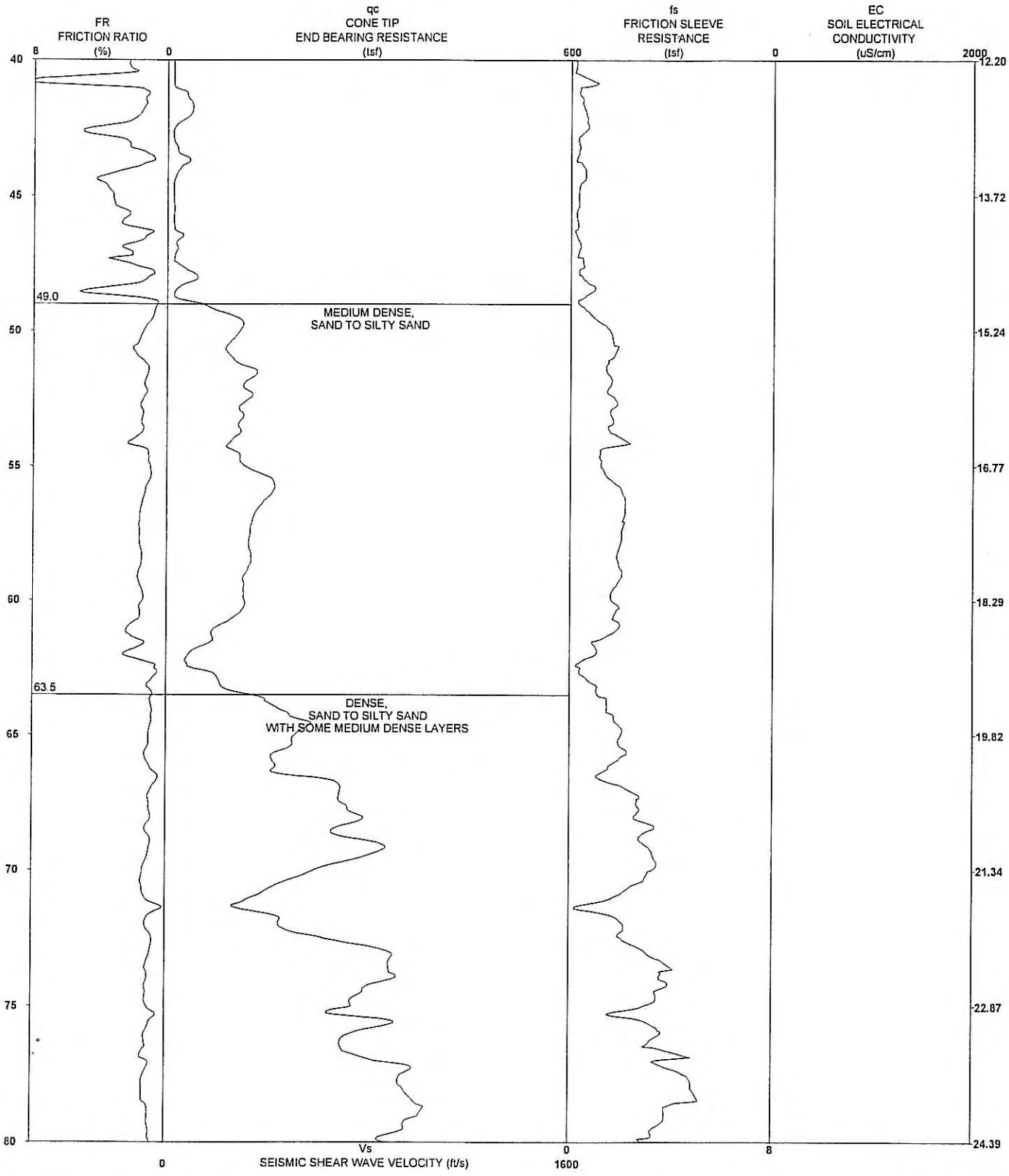
Latitude: 38.11862 Longitude: -90.25739

PROJECT NAME:Ameren UE Rush Island Levee Inventory
PROJECT NUMBER:09-110-090

STRATIGRAPHICS

R1 DATE:8/27/2009 TIME:11:42 AM
SOUNDING NUMBER:CP-04

CPTU-S LOG WITH LITHOLOGIC EVALUATION CP04



Latitude: 38.11862 Longitude: -90.25739

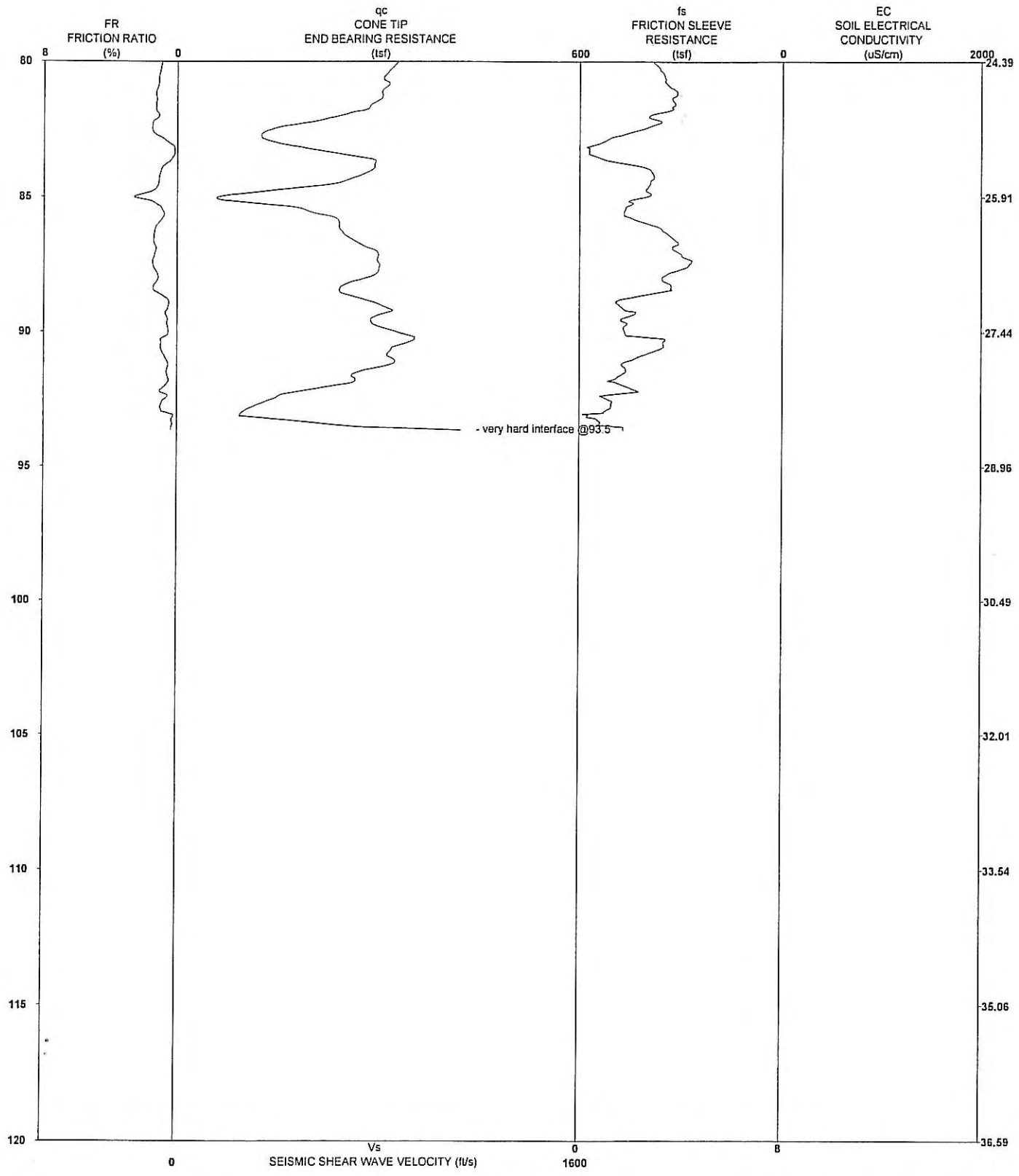
PROJECT NAME:Ameren UE Rush Island Levee Inventory
PROJECT NUMBER:09-110-090

STRATIGRAPHICS

R1 DATE:8/27/2009 TIME:11:42 AM
SOUNDING NUMBER:CP-04

CP04

CPTU-S LOG WITH LITHOLOGIC EVALUATION CP04



Latitude: 38.11862 Longitude: -90.25739

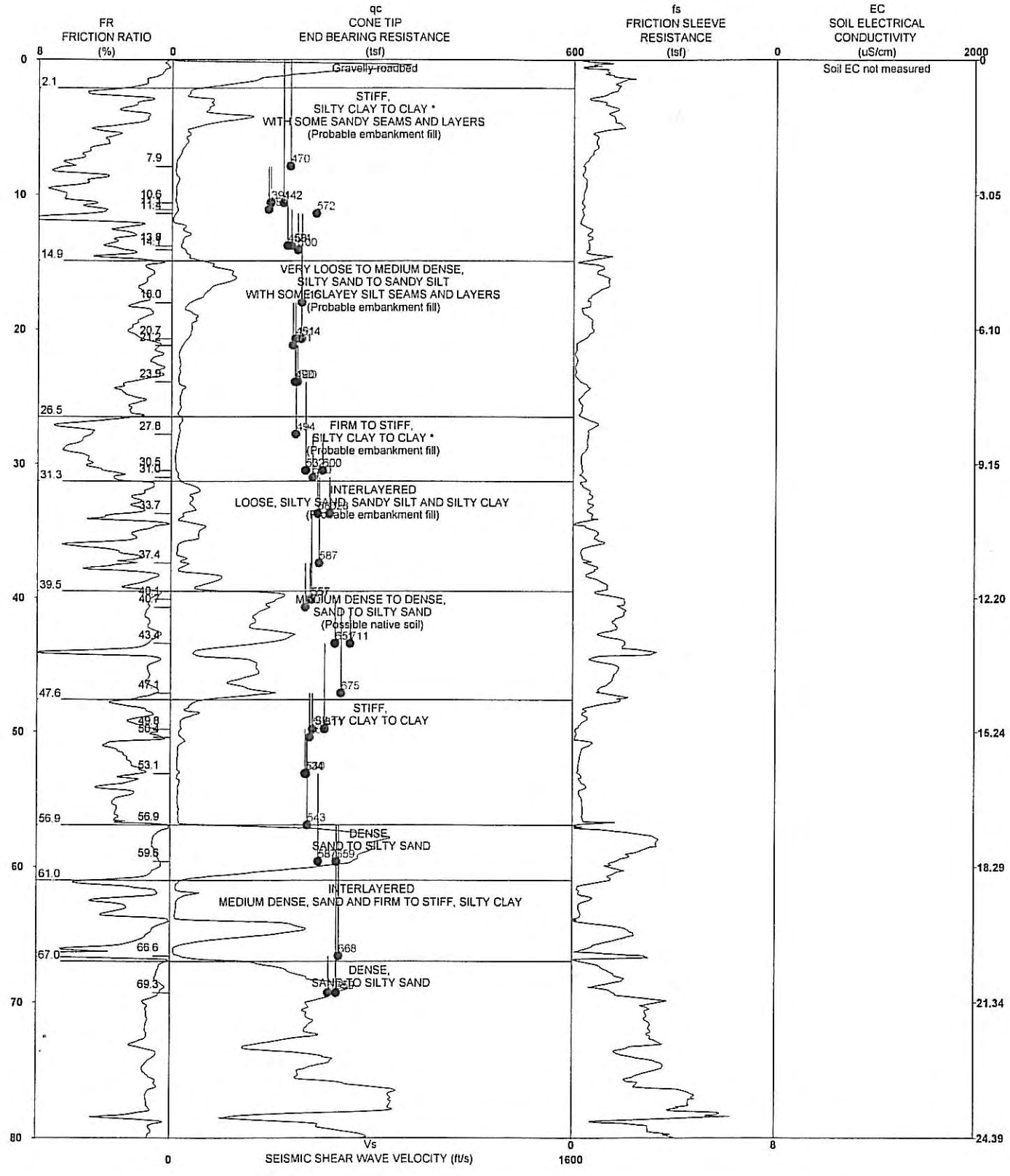
PROJECT NAME:Ameren UE Rush Island Levee Inventory
PROJECT NUMBER:09-110-090

STRATIGRAPHICS

R1 DATE:8/27/2009 TIME:11:42 AM
SOUNDING NUMBER:CP-04

CP04

CPTU-S LOG WITH LITHOLOGIC EVALUATION CP05



Latitude: 38.12255 Longitude: -90.26122

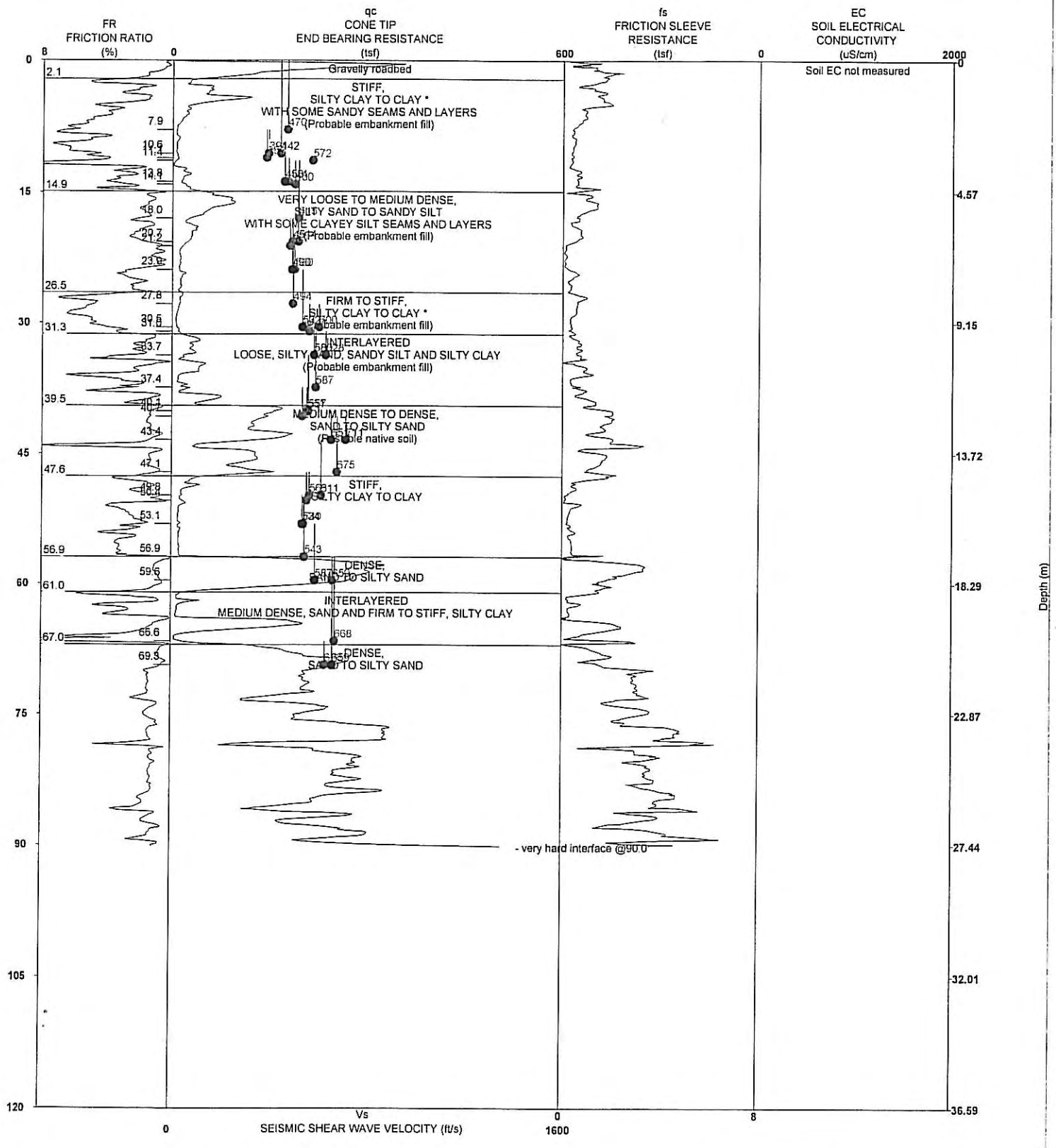
PROJECT NAME:Ameren UE Rush Island Levee Inventory
PROJECT NUMBER:09-110-090

STRATIGRAPHICS

R1 DATE:8/27/2009 TIME:9:12 AM
SOUNDING NUMBER:CP-05

CP05

CPTU-S LOG WITH LITHOLOGIC EVALUATION CP05



- 0 - 1600 ft/sec True Shear Wave Velocity
- 0 - 1600 ft/sec Pseudo Interval Receiver 1
- 0 - 1600 ft/sec Pseudo Interval Receiver 2

Latitude: 38.12255 Longitude: -90.26122

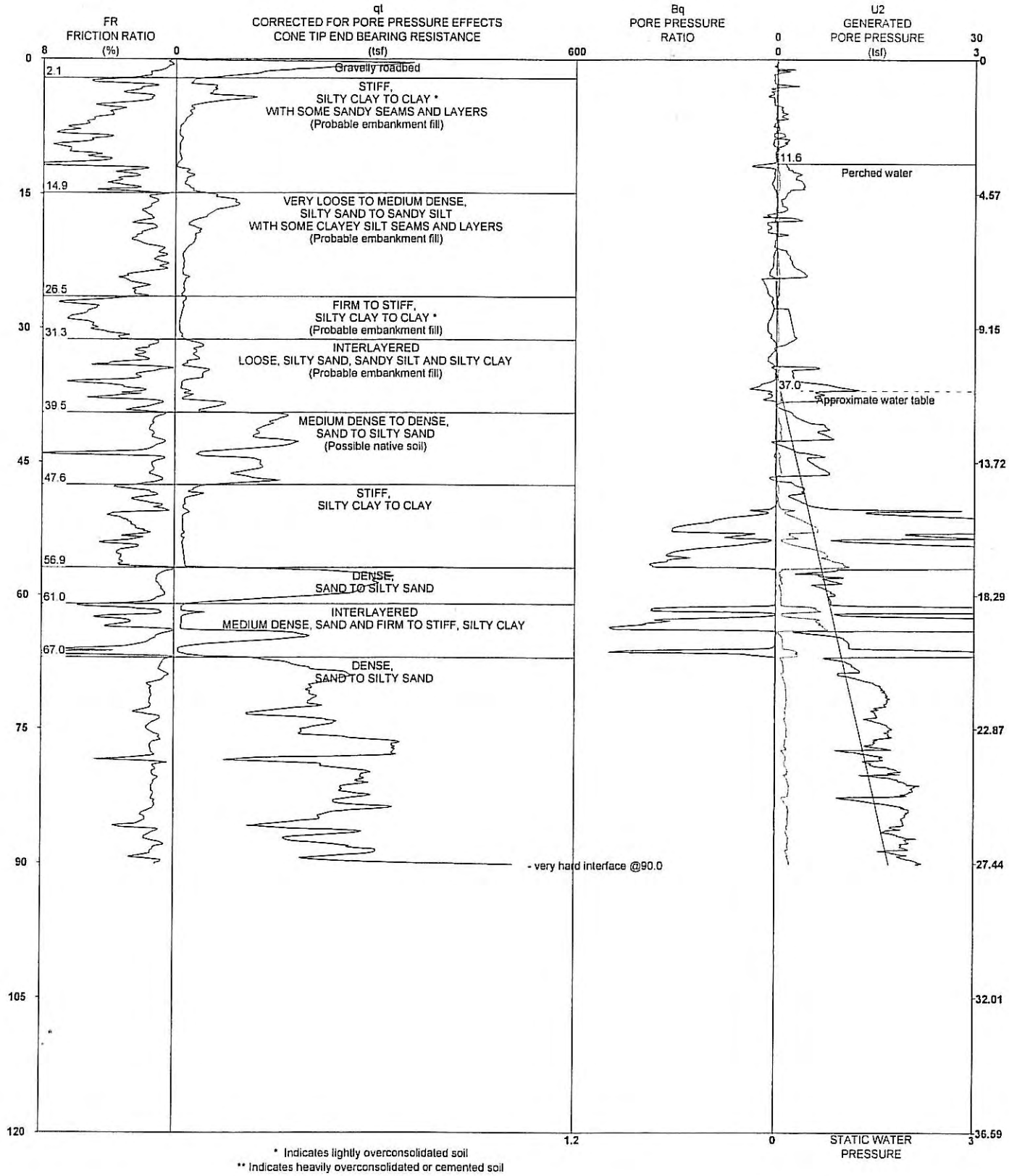
PROJECT NAME:Ameren UE Rush Island Levee Inventory
PROJECT NUMBER:09-110-090

STRATIGRAPHICS

R1 DATE:8/27/2009 TIME:9:12 AM
SOUNDING NUMBER:CP-05

CP05

CPTU-S LOG WITH LITHOLOGIC EVALUATION CP05



* Indicates lightly overconsolidated soil
** Indicates heavily overconsolidated or cemented soil

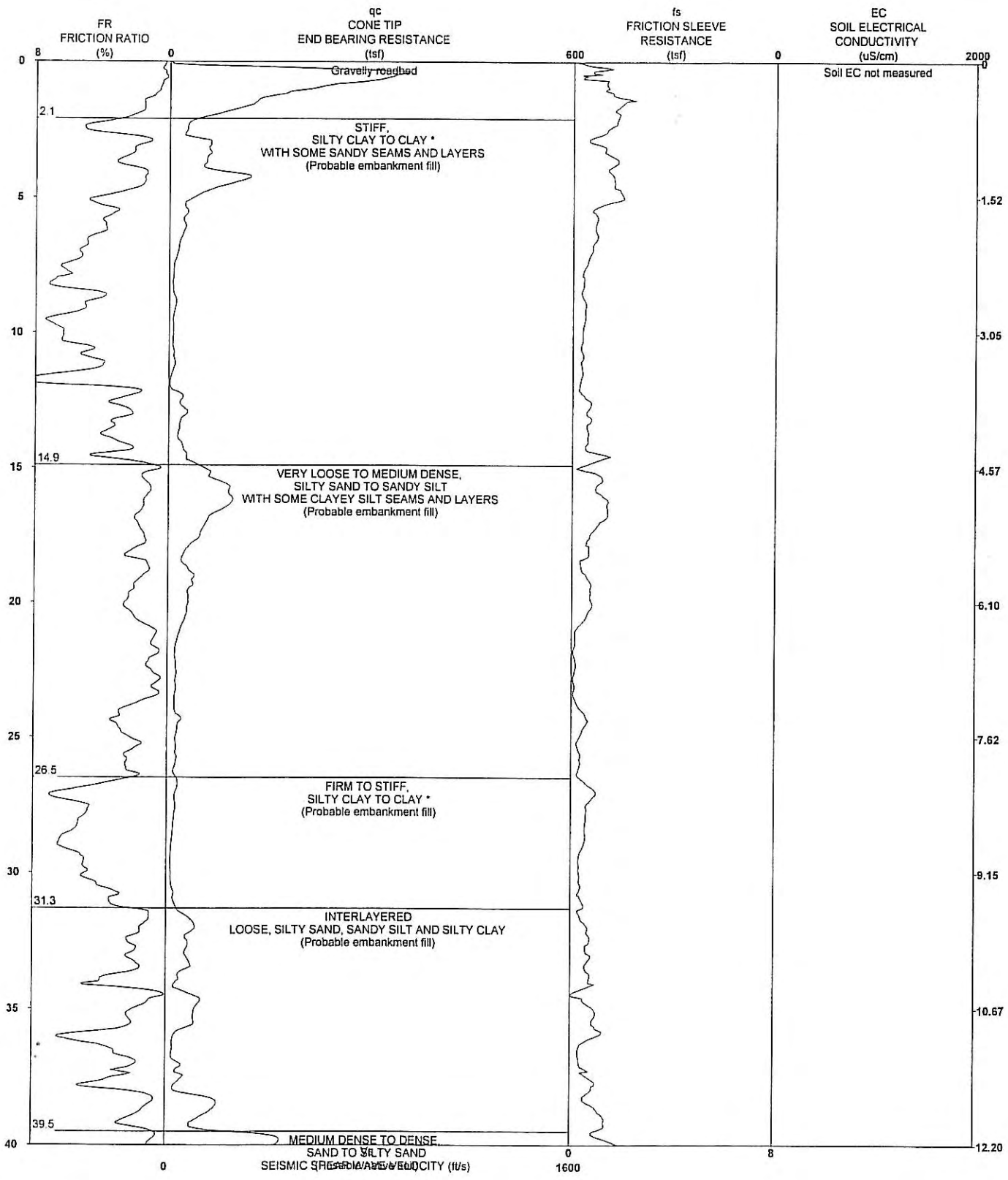
Latitude: 38.12255 Longitude: -90.26122

PROJECT NAME:Ameren UE Rush Island Levee Inventory
PROJECT NUMBER:09-110-090

STRATIGRAPHICS

R1 DATE:8/27/2009 TIME:9:12 AM
SOUNDING NUMBER:CP-05

CPTU-S LOG WITH LITHOLOGIC EVALUATION CP05



Latitude: 38.12255 Longitude: -90.26122

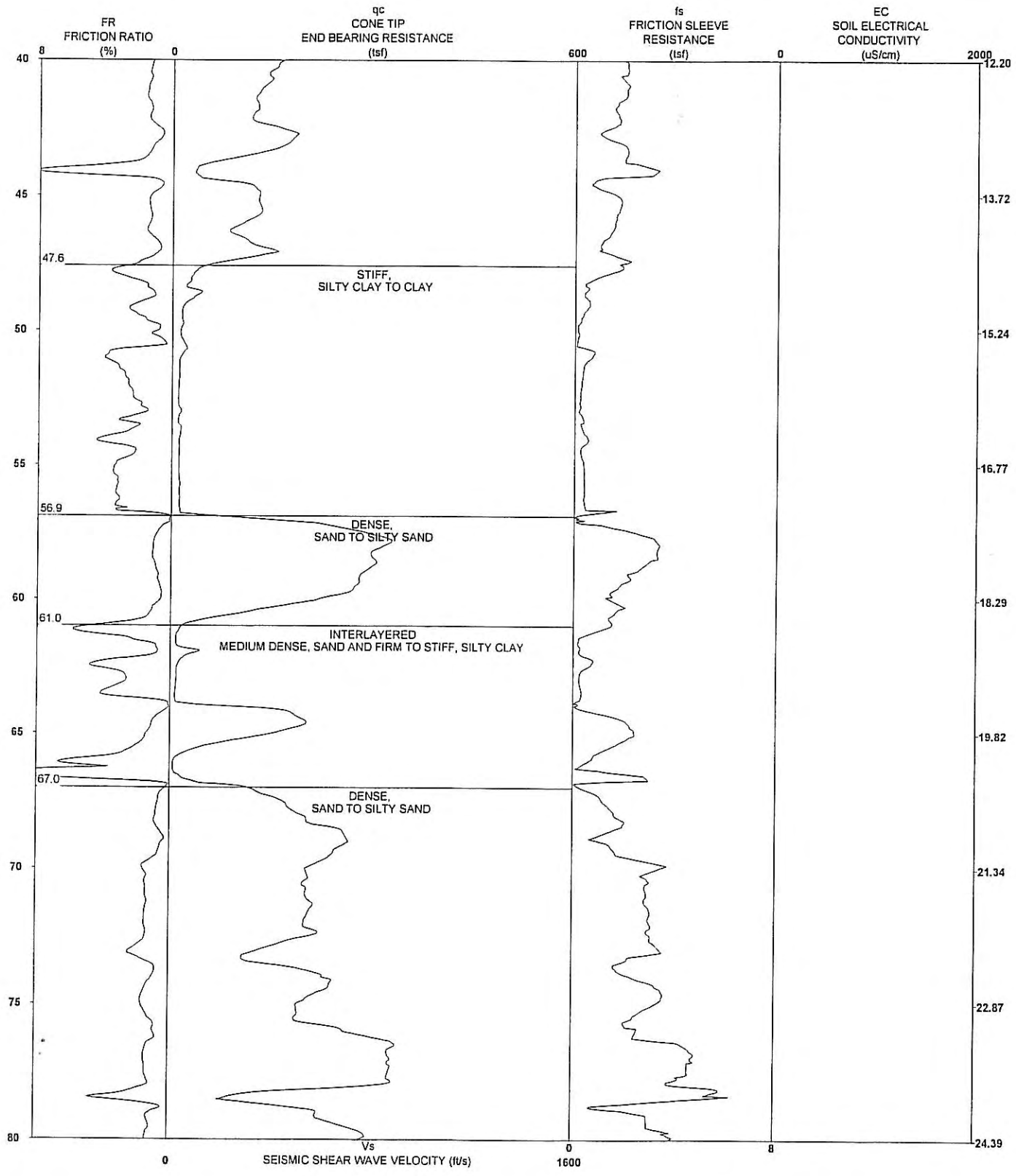
PROJECT NAME:Ameren UE Rush Island Levee Inventory
PROJECT NUMBER:09-110-090

STRATIGRAPHICS

R1 DATE:8/27/2009 TIME:9:12 AM
SOUNDING NUMBER:CP-05

CP05

CPTU-S LOG WITH LITHOLOGIC EVALUATION CP05



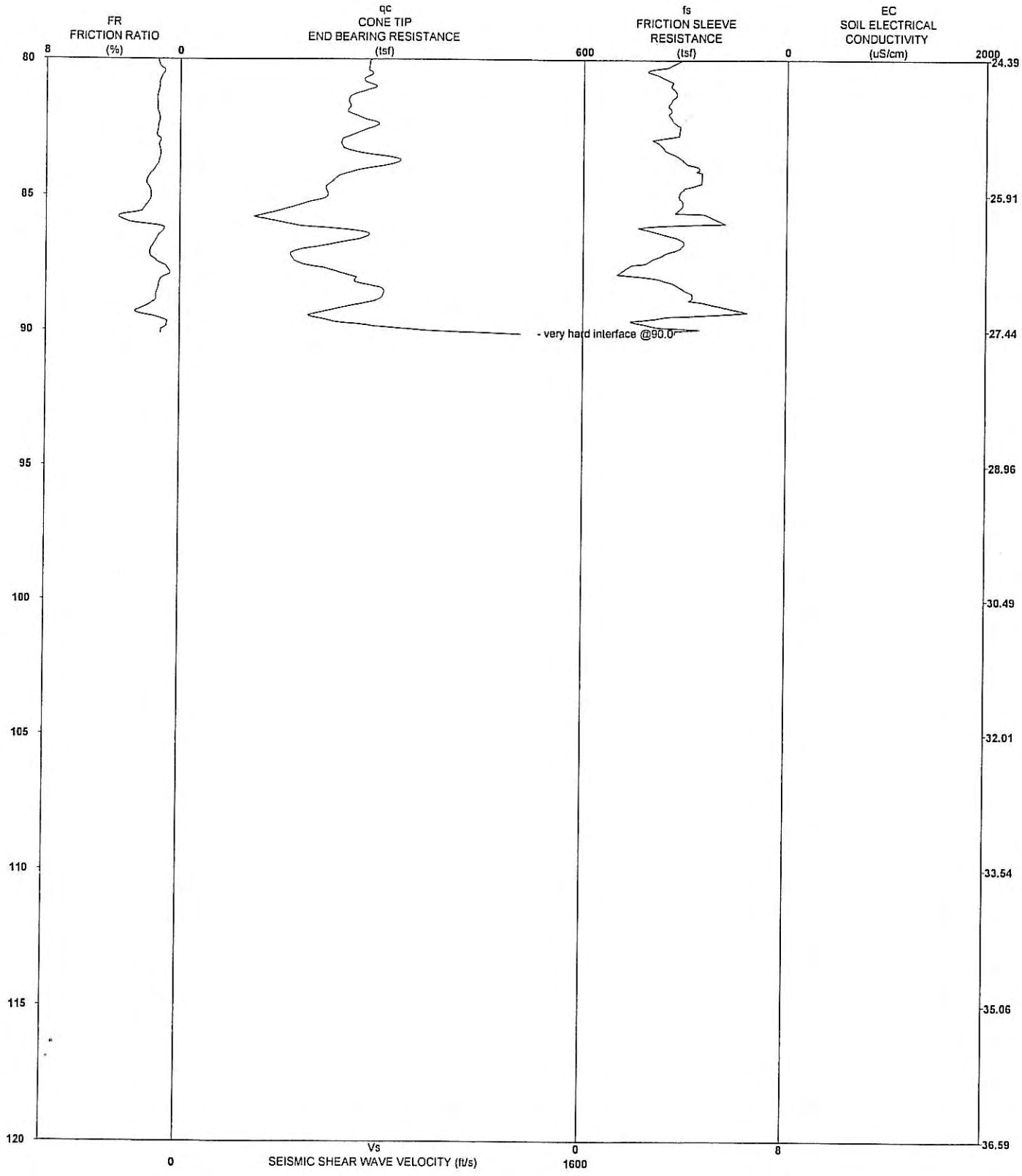
Latitude: 38.12255 Longitude: -90.26122

PROJECT NAME:Ameren UE Rush Island Levee Inventory
PROJECT NUMBER:09-110-090

STRATIGRAPHICS

R1 DATE:8/27/2009 TIME:9:12 AM
SOUNDING NUMBER:CP-05

CPTU-S LOG WITH LITHOLOGIC EVALUATION CP05



Latitude: 38.12255 Longitude: -90.26122

PROJECT NAME:Ameren UE Rush Island Levee Investigation
PROJECT NUMBER:09-110-090

STRATIGRAPHICS

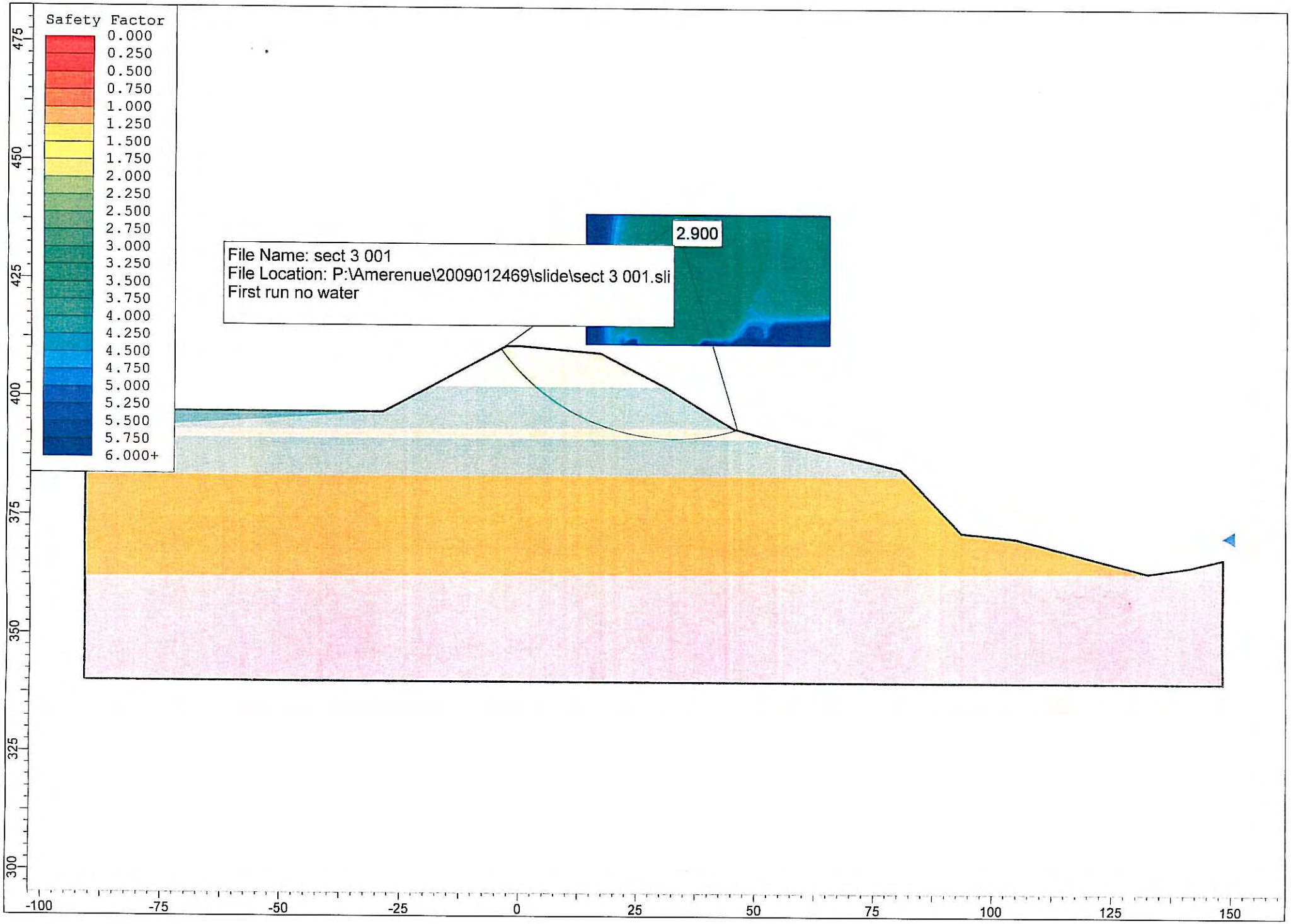
R1 DATE:8/27/2009 TIME:9:12 AM
SOUNDING NUMBER:CP-05

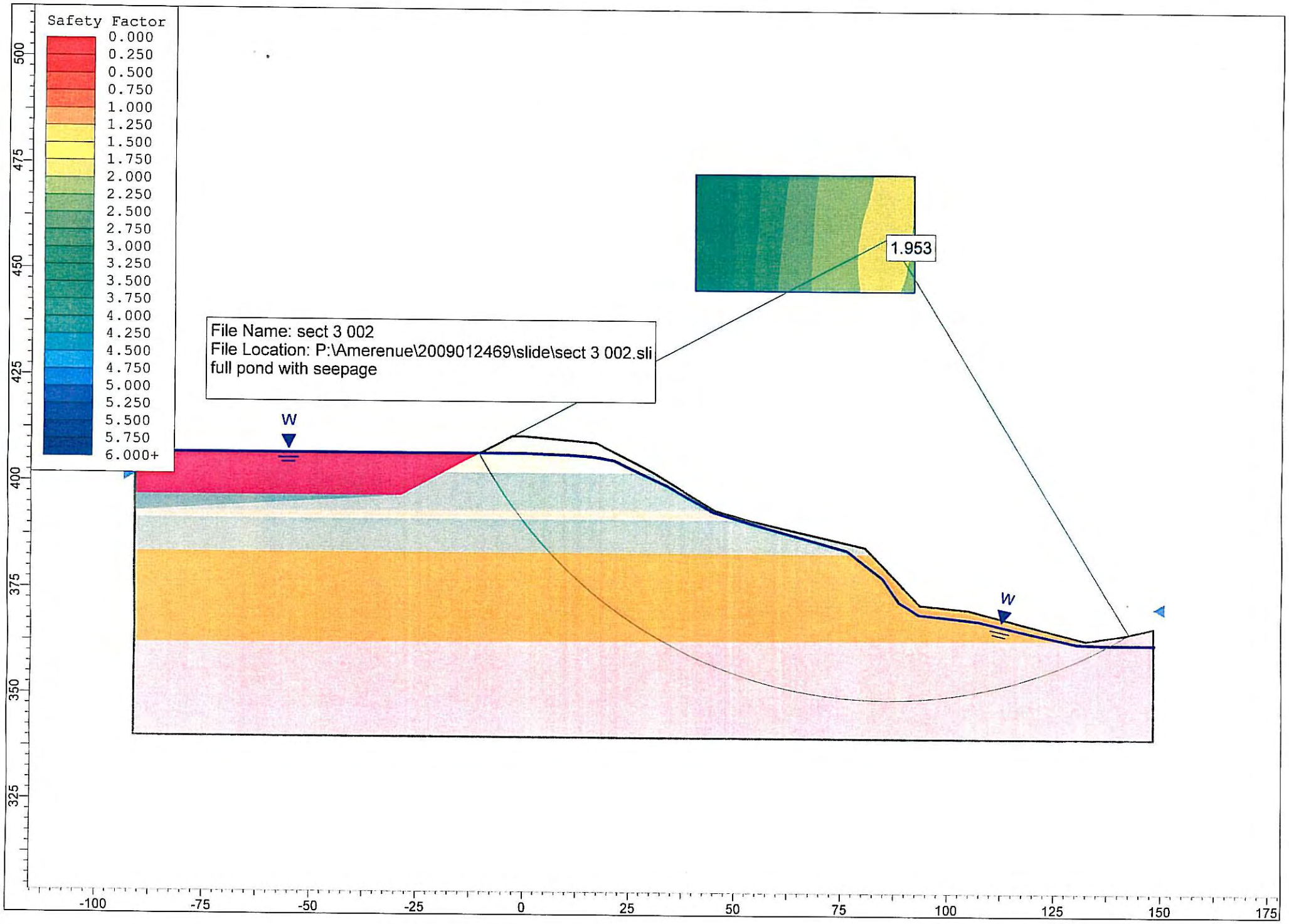
CP05

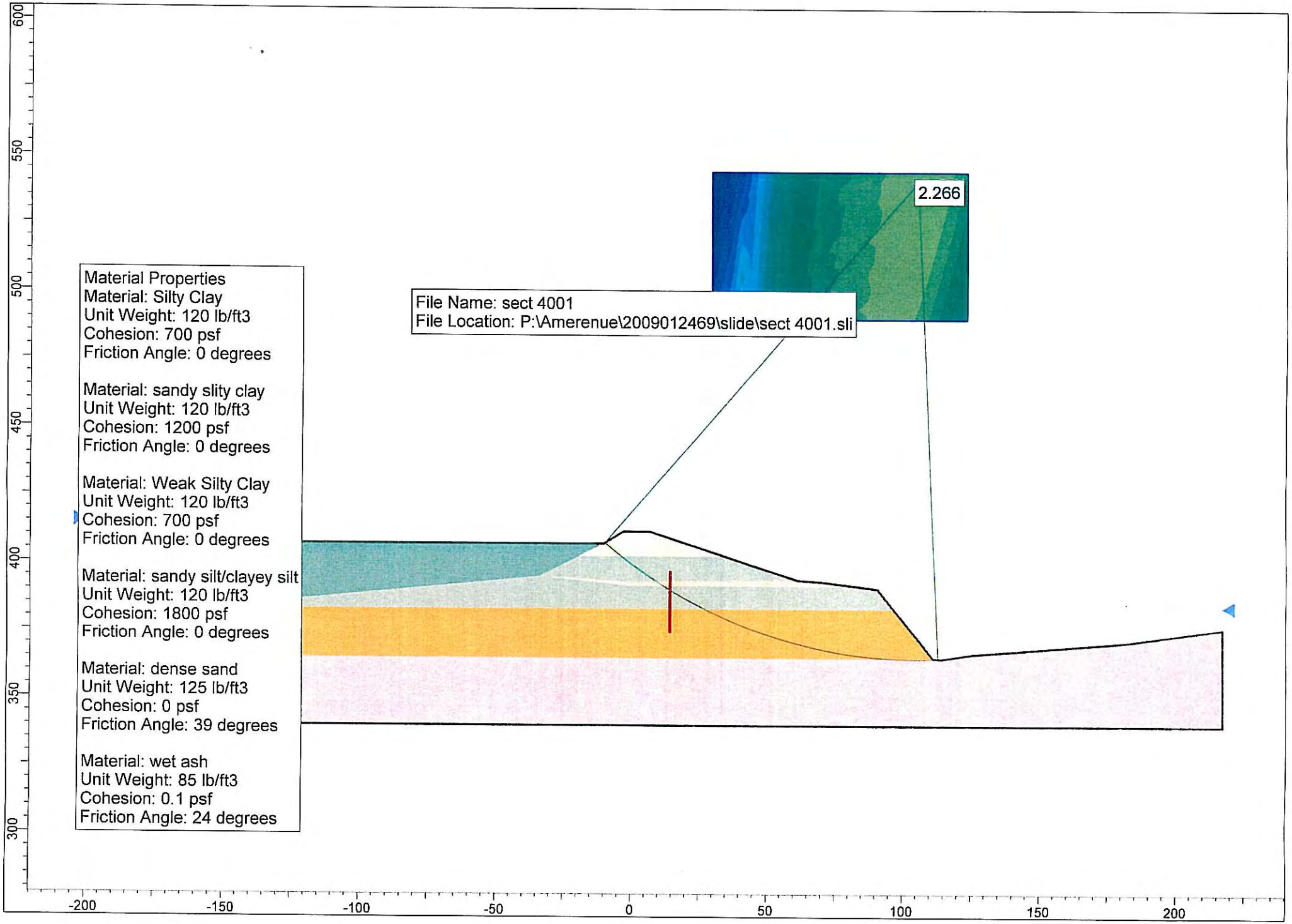
Slope Stability Analysis

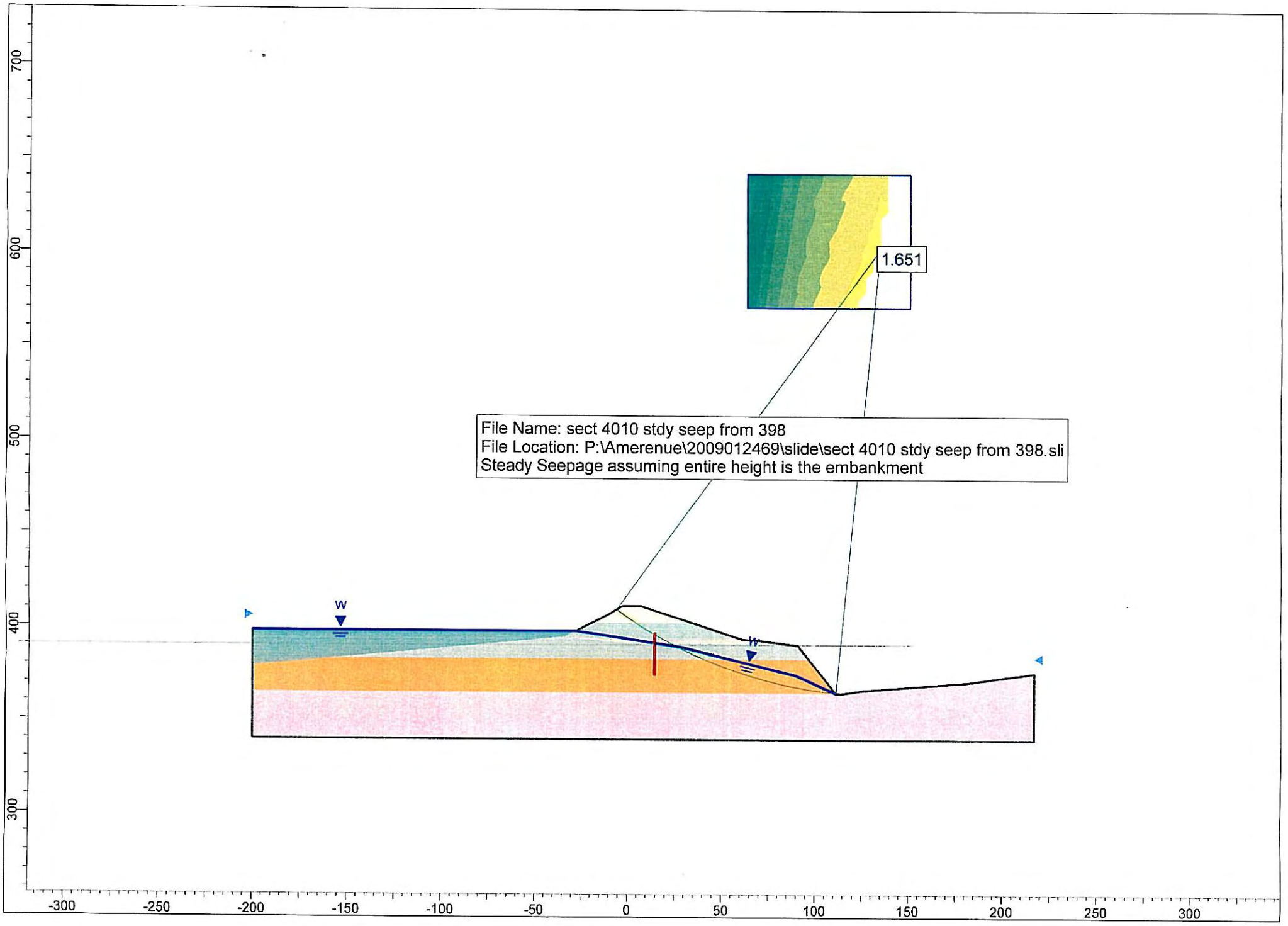
Rush Island Slope Stability Summary Sheet

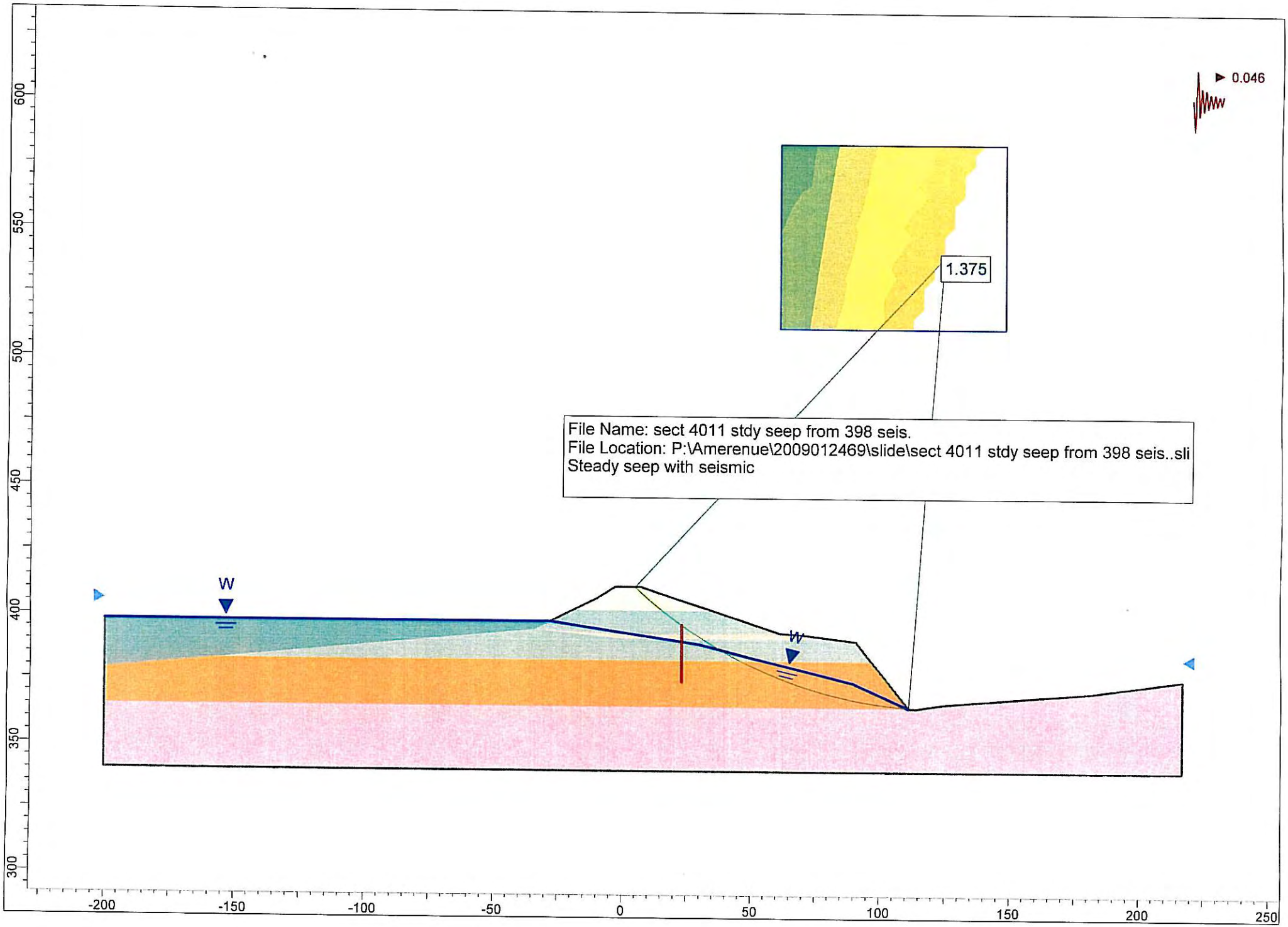
Section	Stress Phase	Seismic Force	Pool Elevation	Stored Ash	Toe Setback	Factor Safety	Req"d FS	File	
3	total	none	none	395		2.9		3001	
3	total	none	407	395		1.95		3002	
4	total	none	407	407		2.26	1.5	4001	
4	stdy seep	none	403	403		1.51	1.5	4012	normal pool
4	stdy seep	0.046	398	398		1.375	1.0	4011	
4	stdy seep	none	398	398		1.65	1.5	4010	
4	stdy seep	none	407	407		1.404	1.3	4013	max pool @ 407
4	stdy seep	0.046	403	403		1.31	1.0	4014	normal pool
7	total	none	407	407		1.731	1.5	7001	
7	stdy seep	none	398	398		1.711	1.5	7004	
7	stdy seep	0.046	398	398		1.49	1.0	7005	
7	stdy seep	none	407	407		1.41	1.5	7006	1.3 FS for max pool
7	stdy seep	none	403	403		1.54	1.5	7007	normal pool
7	stdy seep	0.046	403	403		1.34	1.0	7008	normal pool

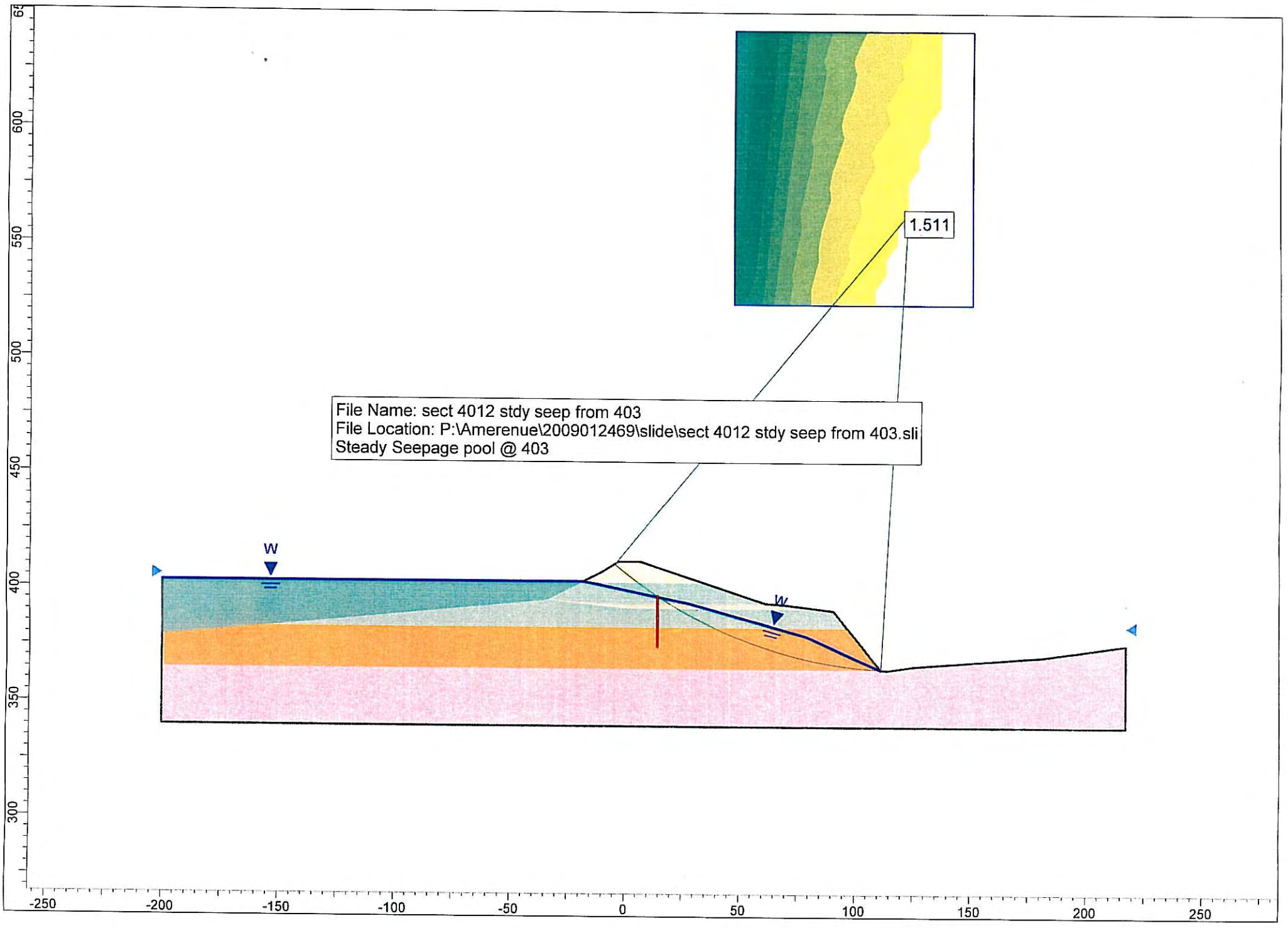

Safety Factor
0.000
0.250
0.500
0.750
1.000
1.250
1.500
1.750
2.000
2.250
2.500
2.750
3.000
3.250
3.500
3.750
4.000
4.250
4.500
4.750
5.000
5.250
5.500
5.750
6.000+
2.900
File Name: sect 3 001
File Location: P:\Amerenue\2009012469\slide\sect 3 001.sli
First run no water
475
450
425
400
375
350
325
300
-100
-75
-50
-25
0
25
50
75
100
125
150

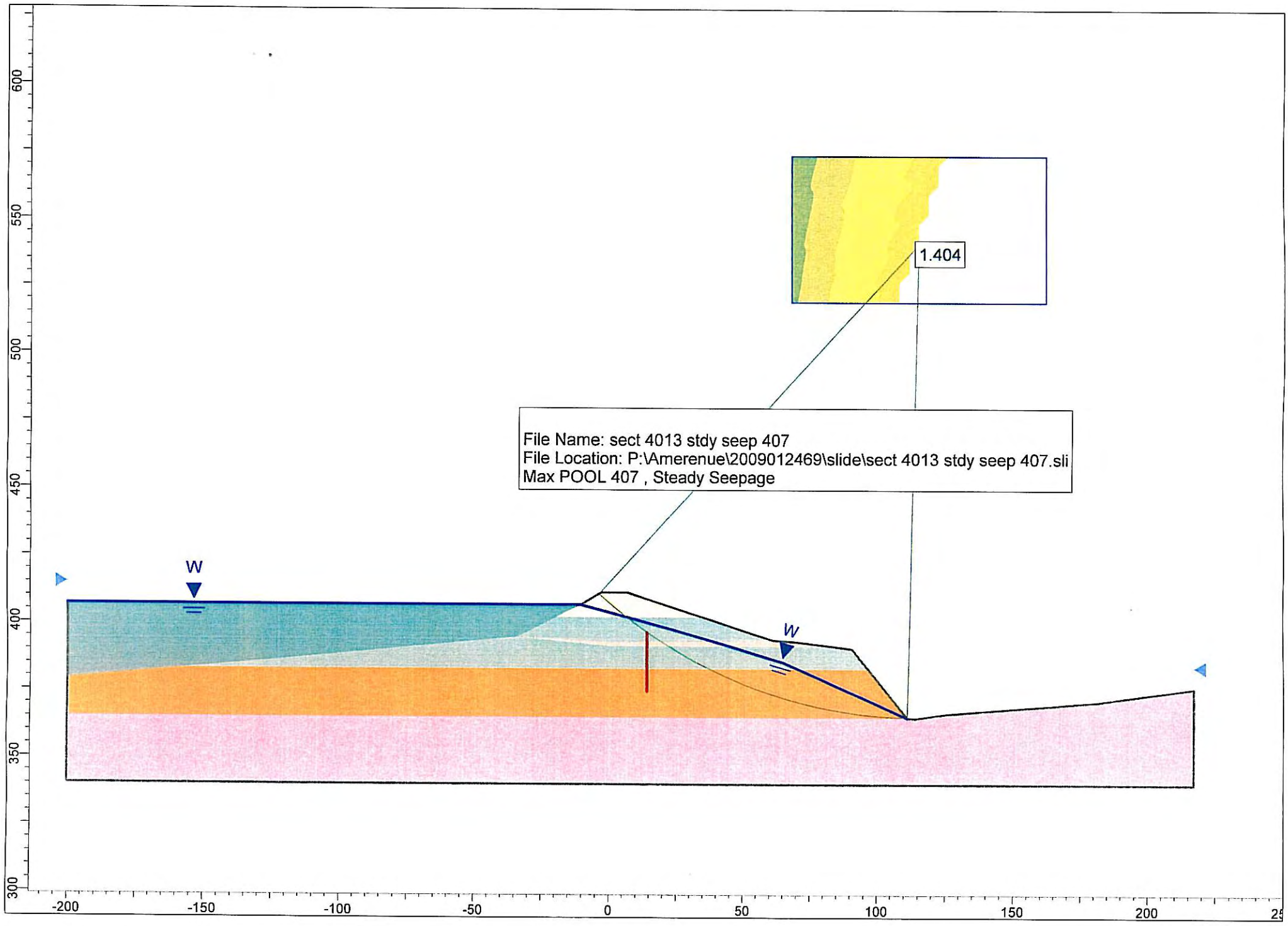

Safety Factor
0.000
0.250
0.500
0.750
1.000
1.250
1.500
1.750
2.000
2.250
2.500
2.750
3.000
3.250
3.500
3.750
4.000
4.250
4.500
4.750
5.000
5.250
5.500
5.750
6.000+
1.953
File Name: sect 3 002
File Location: P:\Amerenue\2009012469\slide\sect 3 002.sli
full pond with seepage
W
W
500
475
450
425
400
375
350
325
-100
-75
-50
-25
0
25
50
75
100
125
150
175

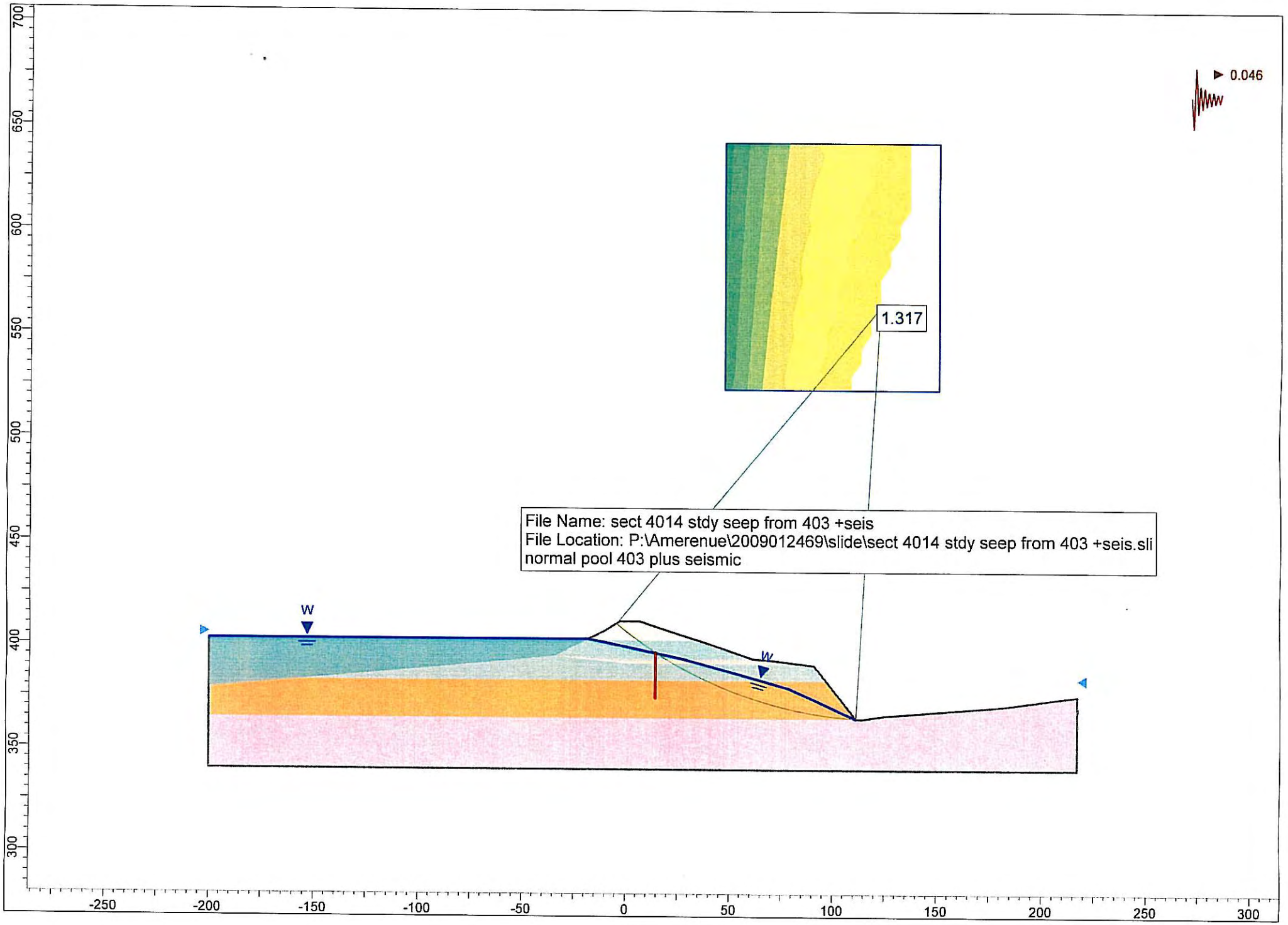

2.266
File Name: sect 4001
File Location: P:\Amerenue\2009012469\slide\sect 4001.sli
Material Properties
Material: Silty Clay
Unit Weight: 120 lb/ft3
Cohesion: 700 psf
Friction Angle: 0 degrees
Material: sandy slity clay
Unit Weight: 120 lb/ft3
Cohesion: 1200 psf
Friction Angle: 0 degrees
Material: Weak Silty Clay
Unit Weight: 120 lb/ft3
Cohesion: 700 psf
Friction Angle: 0 degrees
Material: sandy silt/clayey silt
Unit Weight: 120 lb/ft3
Cohesion: 1800 psf
Friction Angle: 0 degrees
Material: dense sand
Unit Weight: 125 lb/ft3
Cohesion: 0 psf
Friction Angle: 39 degrees
Material: wet ash
Unit Weight: 85 lb/ft3
Cohesion: 0.1 psf
Friction Angle: 24 degrees
600
550
500
450
400
350
300
-200
-150
-100
-50
0
50
100
150
200

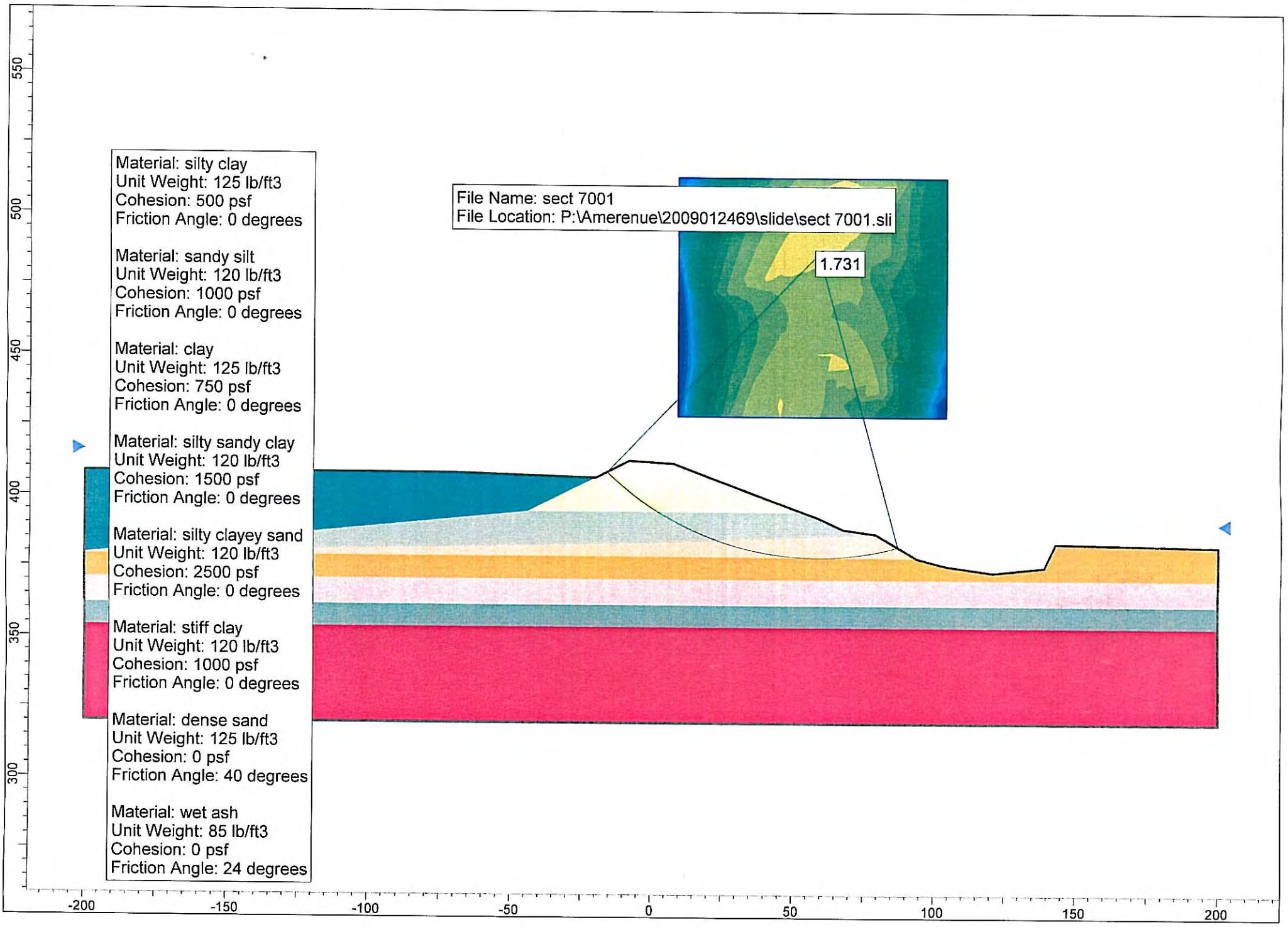

1.651
File Name: sect 4010 stdy seep from 398
File Location: P:\Amerenue\2009012469\slide\sect 4010 stdy seep from 398.sli
Steady Seepage assuming entire height is the embankment
W
W
700
600
500
400
300
-300
-250
-200
-150
-100
-50
0
50
100
150
200
250
300

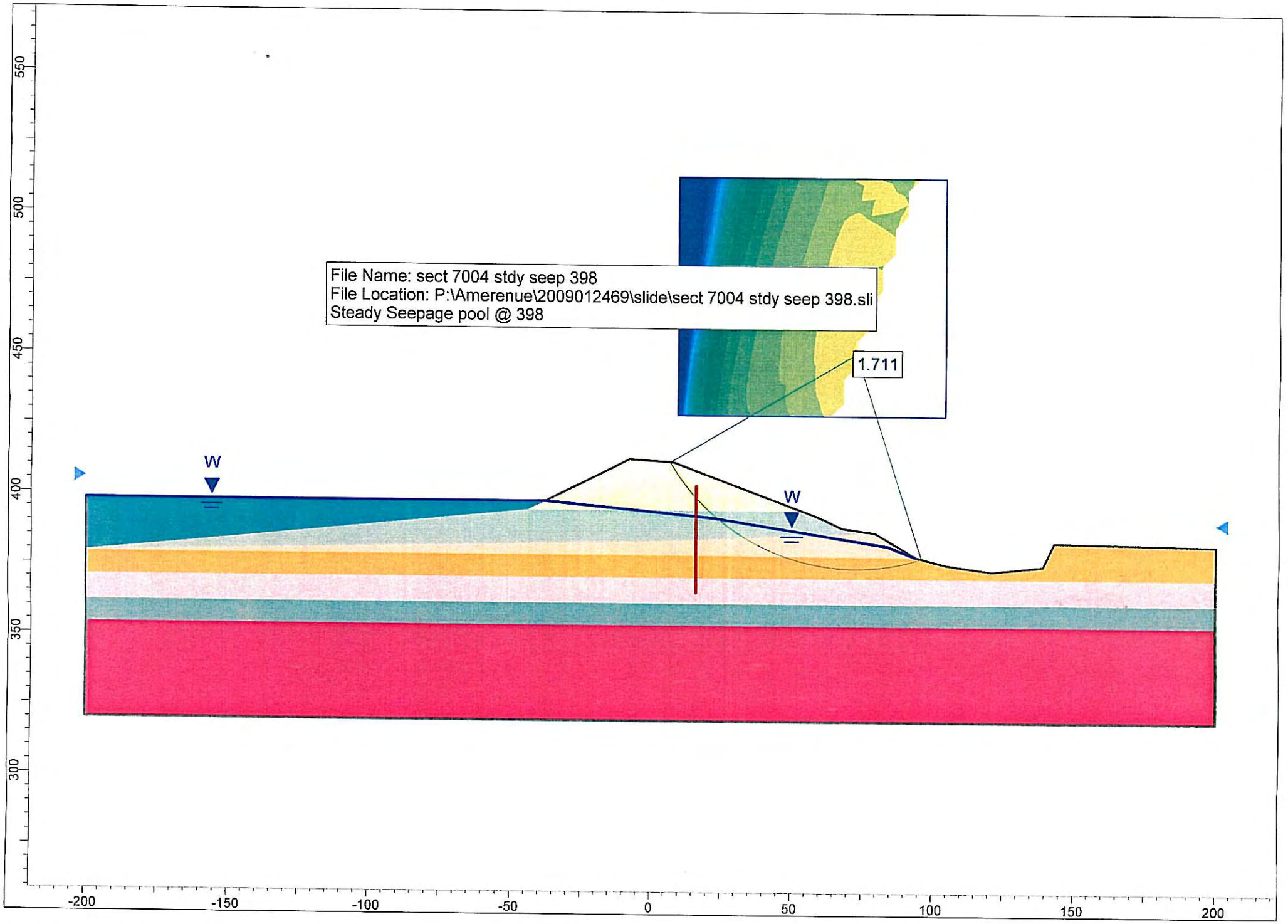

0.046
1.375
File Name: sect 4011 stdy seep from 398 seis.
File Location: P:\Amerenue\2009012469\slide\sect 4011 stdy seep from 398 seis..sli
Steady seep with seismic
W
W
600
550
500
450
400
350
300
-200
-150
-100
-50
0
50
100
150
200
250

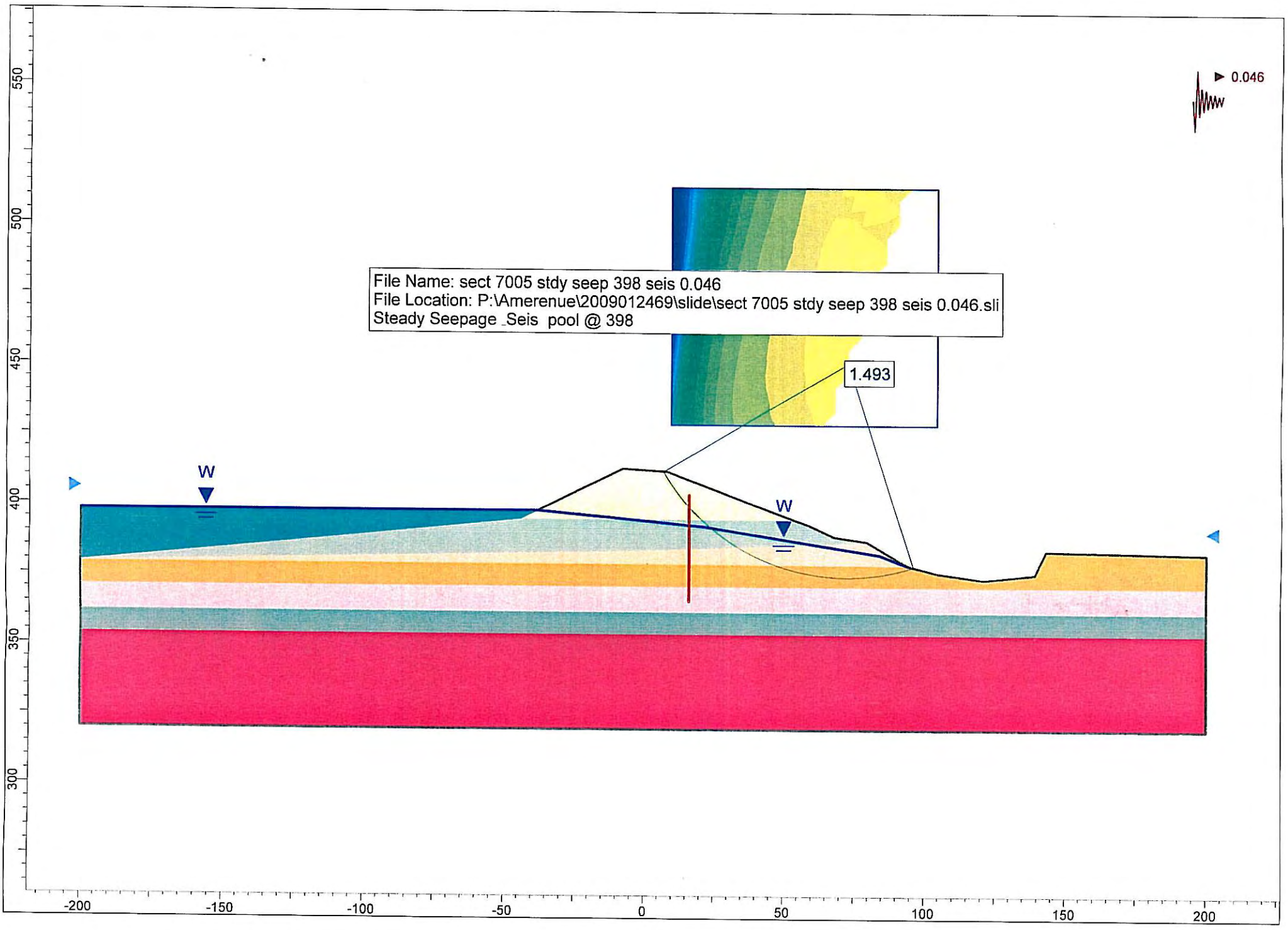

1.511
File Name: sect 4012 stdy seep from 403
File Location: P:\Amerenue\2009012469\slide\sect 4012 stdy seep from 403.sli
Steady Seepage pool @ 403
W
W
600
550
500
450
400
350
300
-250
-200
-150
-100
-50
0
50
100
150
200
250

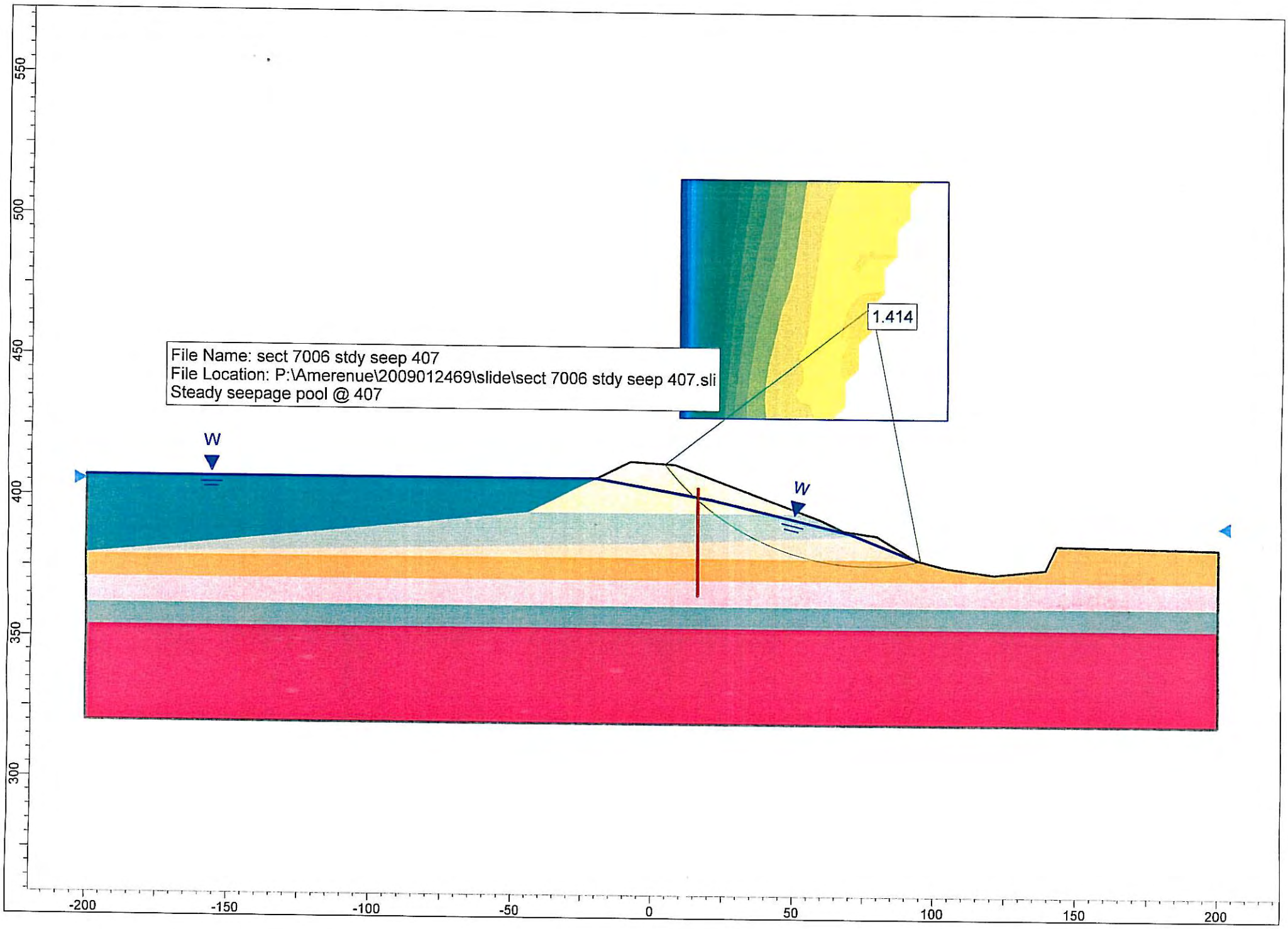

1.404
File Name: sect 4013 stdy seep 407
File Location: P:\Amerenue\2009012469\slide\sect 4013 stdy seep 407.sli
Max POOL 407 , Steady Seepage
W
W
600
550
500
450
400
350
300
-200
-150
-100
-50
0
50
100
150
200

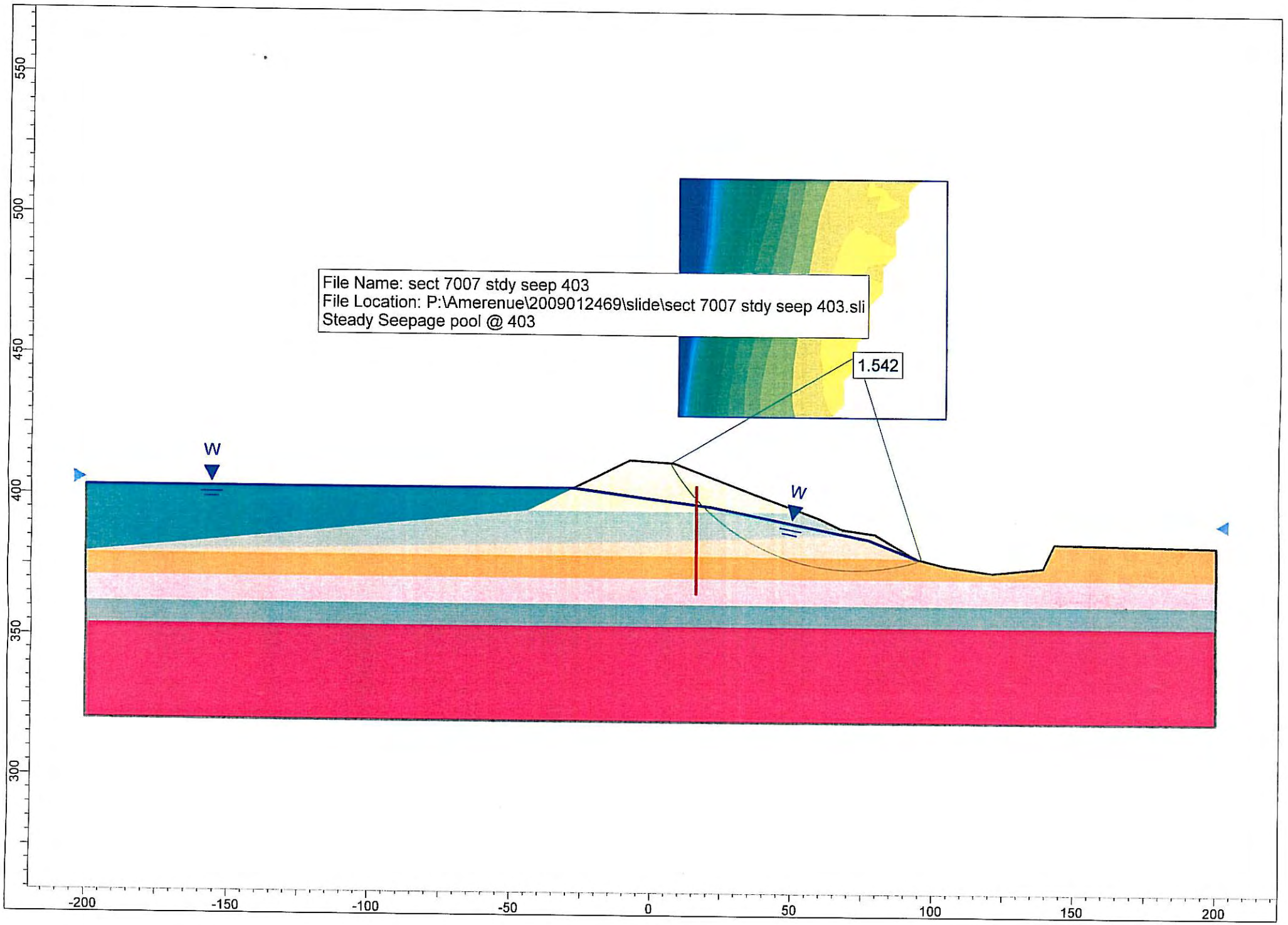

0.046
1.317
File Name: sect 4014 stdy seep from 403 +seis
File Location: P:\Amerenue\2009012469\slide\sect 4014 stdy seep from 403 +seis.sli
normal pool 403 plus seismic
W
W
700
650
600
550
500
450
400
350
300
-250
-200
-150
-100
-50
0
50
100
150
200
250
300

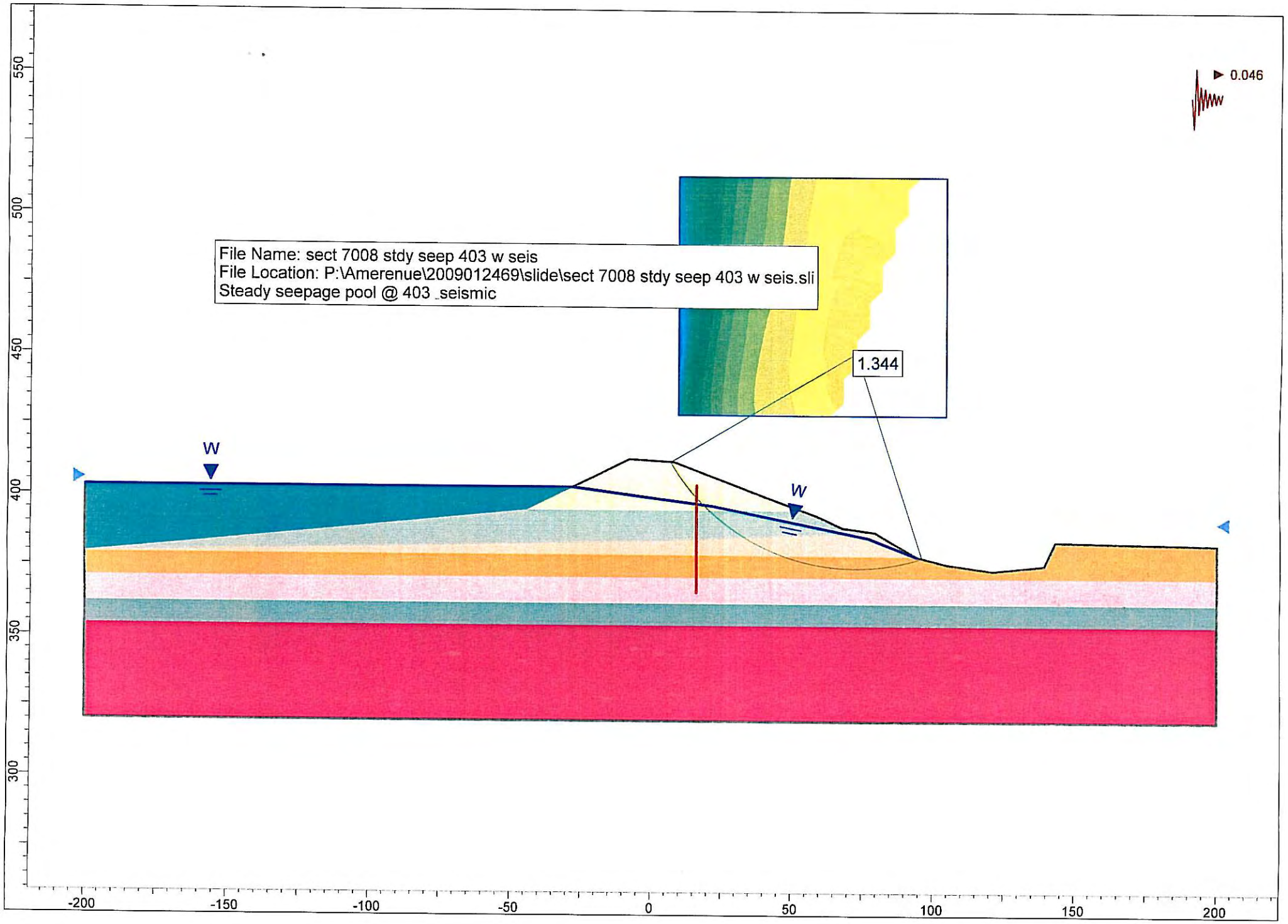

Material: silty clay
Unit Weight: 125 lb/ft3
Cohesion: 500 psf
Friction Angle: 0 degrees
Material: sandy silt
Unit Weight: 120 lb/ft3
Cohesion: 1000 psf
Friction Angle: 0 degrees
Material: clay
Unit Weight: 125 lb/ft3
Cohesion: 750 psf
Friction Angle: 0 degrees
Material: silty sandy clay
Unit Weight: 120 lb/ft3
Cohesion: 1500 psf
Friction Angle: 0 degrees
Material: silty clayey sand
Unit Weight: 120 lb/ft3
Cohesion: 2500 psf
Friction Angle: 0 degrees
Material: stiff clay
Unit Weight: 120 lb/ft3
Cohesion: 1000 psf
Friction Angle: 0 degrees
Material: dense sand
Unit Weight: 125 lb/ft3
Cohesion: 0 psf
Friction Angle: 40 degrees
Material: wet ash
Unit Weight: 85 lb/ft3
Cohesion: 0 psf
Friction Angle: 24 degrees
File Name: sect 7001
File Location: P:\Amerenue\2009012469\slide\sect 7001.sli
1.731
550
500
450
400
350
300
-200
-150
-100
-50
0
50
100
150
200


File Name: sect 7004 stdy seep 398
File Location: P:\Amerenue\2009012469\slide\sect 7004 stdy seep 398.sli
Steady Seepage pool @ 398
1.711
W
W
550
500
450
400
350
300
-200
-150
-100
-50
0
50
100
150
200


0.046
File Name: sect 7005 stdy seep 398 seis 0.046
File Location: P:\Amerenue\2009012469\slide\sect 7005 stdy seep 398 seis 0.046.sli
Steady Seepage _Seis pool @ 398
1.493
W
W
550
500
450
400
350
300
-200
-150
-100
-50
0
50
100
150
200


1.414
File Name: sect 7006 stdy seep 407
File Location: P:\Amerenue\2009012469\slide\sect 7006 stdy seep 407.sli
Steady seepage pool @ 407
W
W
550
500
450
400
350
300
-200
-150
-100
-50
0
50
100
150
200


File Name: sect 7007 stdy seep 403
File Location: P:\Amerenue\2009012469\slide\sect 7007 stdy seep 403.sli
Steady Seepage pool @ 403
1.542
W
W
550
500
450
400
350
300
-200
-150
-100
-50
0
50
100
150
200


0.046
File Name: sect 7008 stdy seep 403 w seis
File Location: P:\Amerenue\2009012469\slide\sect 7008 stdy seep 403 w seis.sli
Steady seepage pool @ 403 _seismic
1.344
W
W
550
500
450
400
350
300
-200
-150
-100
-50
0
50
100
150
200

Hydrology Analysis

REITZ & JENS, INC.
CONSULTING ENGINEERS

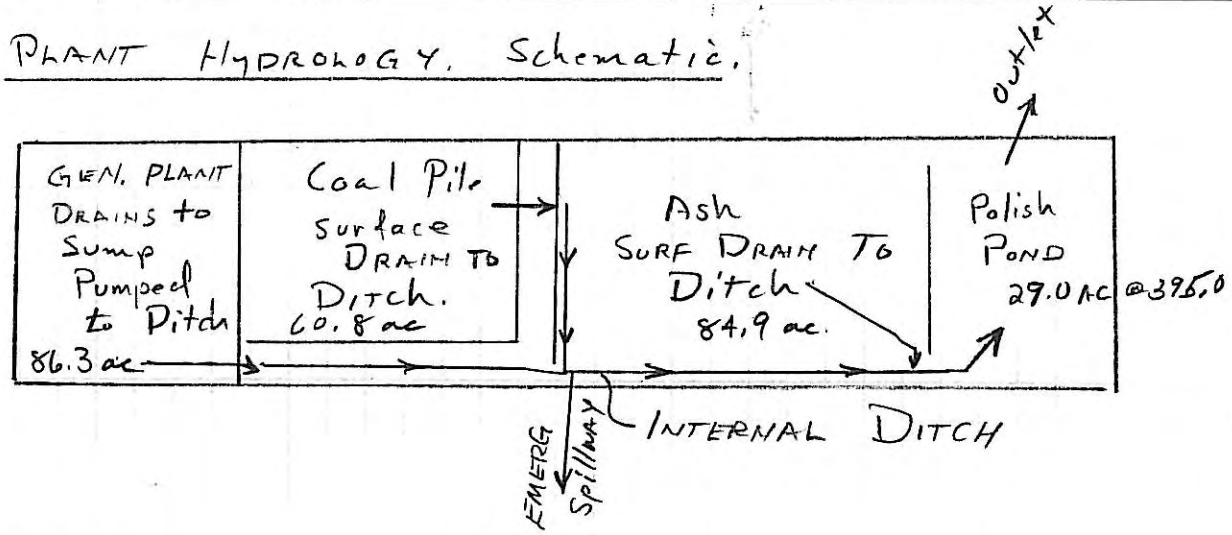
DATE 1/2/10

PROJECT Rush Island

SUBJECT F.A. Pond. Hyd

BY DSE CHK'D _____ SHEET 1 OF _____

PLANT HYDROLOGY. Schematic.



GEN PLANT.

PLANT PROCESS H_2O assume 15 cfs - & 20 cfs.

MAX. SUMP FLOW ≈ 38 cfs. ∴ STORM MAX CAP ≈ 23 cfs.

COAL Pile

MAX TRAVEL PATH 0.3 miles to ditch

AVG Slope = $20'/.3 \times 5280 = 0.0126$ 1/1

CN - COMPOSIT.

	CN	WT. CN
60% PACKED COAL	90	54
40% FLAT Weedy	80	32
	COMP CN =	86

using SCS LAG Eq'n

$$T_c = \frac{.000879 \times 1584^{.8}\left(\frac{1000}{86} - 9\right)^{.7}}{(.0126)^{1/2}} = \frac{.319 \times 1.966}{.1122} = 5.58 \text{ hr.}$$

too long - DO NOT USE.

USING KIRPICH

$T_c = 0.00013 \times 1584^{.77}(.0126)^{-.385} = 0.20$ hr. $v = 2.2$ fps. reasonable - use.

REITZ & JENS, INC.
CONSULTING ENGINEERS

DATE 1/2/2010

PROJECT RUSH ISLAND
SUBJECT F. A. PONDS HYD.
BY DSE CHK'D _____ SHEET 2 OF _____

ASH STORAGE. MIN. Elev. = 404.0

SLOPE OF SURF = $5'/_{.46 \times 5280}$ = 0.0021 1/1

MAX Drain L = .46 x 5280 = 2428'

Ash C_N = 80 ≈ a gravel area.

$$T_c = \frac{.00013 \times 2428^{.77}}{(.0021)^{.385}} = \frac{.0526}{.0931} = 0.56 \text{ hr.}$$

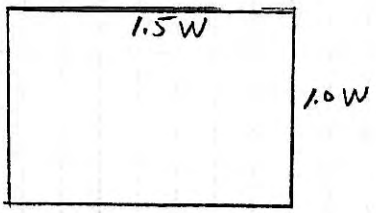
Polish Pond.

Ash Delta @ 395

@ 395 WET SURF = 27 - 8.1 = 18.9 ac.
@ 397 = 27.0 AC

assume 2.5:1 SIDE Slopes. - do not have CONTOURS so have to synthesize POND Area

Gen. POND Shape
1.5:1 Rectangle.



$A_0 = 1.5W \times 1.0W = 1.5W^2$

for Δh rise. (w 2.5 SS)
$W_0 = W + 5\Delta h$

$L = 1.5\ W + 5\Delta h$

$A = (W + 5\Delta h)(1.5W + 5\Delta h)$

$A = 1.5W^2 + 12.5W\Delta h + 25\Delta h^2$

W = 0.21 mi = 1108. Meas.

FOR Theo A = 27 ac @ 397

$A = 27 \times 43560 = 1.5W^2$
$W = 885'$

See Sheet 3 for Area vs Depth.

Polish Pond Area

assume rectangular shape (page 2 of computations)

Elev	delta H	Width	Length	Equation parts			Area sum	Acres	Ditch Area	Total Area
				1.5 W^2	5*dH*(PW +W)	25 dH^2	(sq ft)			
397	0	885.5	1328.25	1176165	0	0	1176165	27.00	1.01	28.01
398	1			1176165	11068.75	25	1187259	27.26	1.01	28.27
399	2			1176165	13282.5	100	1189548	27.31	1.01	28.32
400	3			1176165	19923.75	225	1196314	27.46	1.01	28.47
401	4			1176165	26565	400	1203130	27.62	1.01	28.63
402	5			1176165	33206.25	625	1209997	27.78	1.01	28.79
403	6			1176165	39847.5	900	1216913	27.94	1.01	28.95
404	7			1176165	46488.75	1225	1223879	28.10	1.01	29.11
405	8			1176165	53130	1600	1230895	28.26	1.01	29.27
406	9			1176165	59771.25	2025	1237962	28.42	1.01	29.43
407	10			1176165	66412.5	2500	1245078	28.58	1.01	29.59
408	11			1176165	73053.75	3025	1252244	28.75	1.01	29.76
409	12			1176165	79695	3600	1259460	28.91	1.01	29.92
410	13			1176165	86336.25	4225	1266727	29.08	1.01	30.09

pond only storage volumes - starting @ 397

Elev	Area (ac.)	delta Volume	Storage
397	27.00		0.00
398	27.26	27.13	27.13
399	27.31	27.28	54.41
400	27.46	27.39	81.80
401	27.62	27.54	109.34
402	27.78	27.70	137.04
403	27.94	27.86	164.89
404	28.10	28.02	192.91
405	28.26	28.18	221.09
406	28.42	28.34	249.43
407	28.58	28.50	277.93
408	28.75	28.67	306.59
409	28.91	28.83	335.42
410	29.08	29.00	364.42

sheet 3 of

REITZ & JENS, INC.
CONSULTING ENGINEERS

DATE 3/15/10

PROJECT RUSH ISLAND
SUBJECT F.A. POND HYD.
BY DSE CHK'D _____ SHEET 4 OF _____

DISCUSSION W/ PLANT MANAGERS

1) Would like to operate polish Pond as high as 398.

2) COMPUTATIONS STARTED @ 398 WERE ADDED.

SEE SHEET 5 FOR COMP SUMMARY

Check POND RISE ASSUMING That Outlet is Closed

100 yr Storm - 24 hr Volume = 167.188 ac ft.

USING STAGE STORAGE TABLE - TRIAL 04

START ELEV	START STOR.	+167.188	RAD STORAGE	INTERPOLATED STAGE
395	0	167.188	167.188	401 155.239 402 182.938 — 401.43
398	73.029		240.217	404 238.812 405 216.989 — 404.05

USING TRIAL 05

403	0		167.188	408 141.699 409 170.529 — 408.884

using storage values on sheet 3
for 2' F.B = 408.2 - 2.0 = 406.2

START STOR = 249.43 + 0.2(28.5) = 255.13
MAX POSS. START ELEV W/ BLOCKED Outlet
255.13 - 167.88 = 87.94 Start Stor.
= 400.2 MAX POSS. POND ELEV.

Table of Results
Hydrologic computations

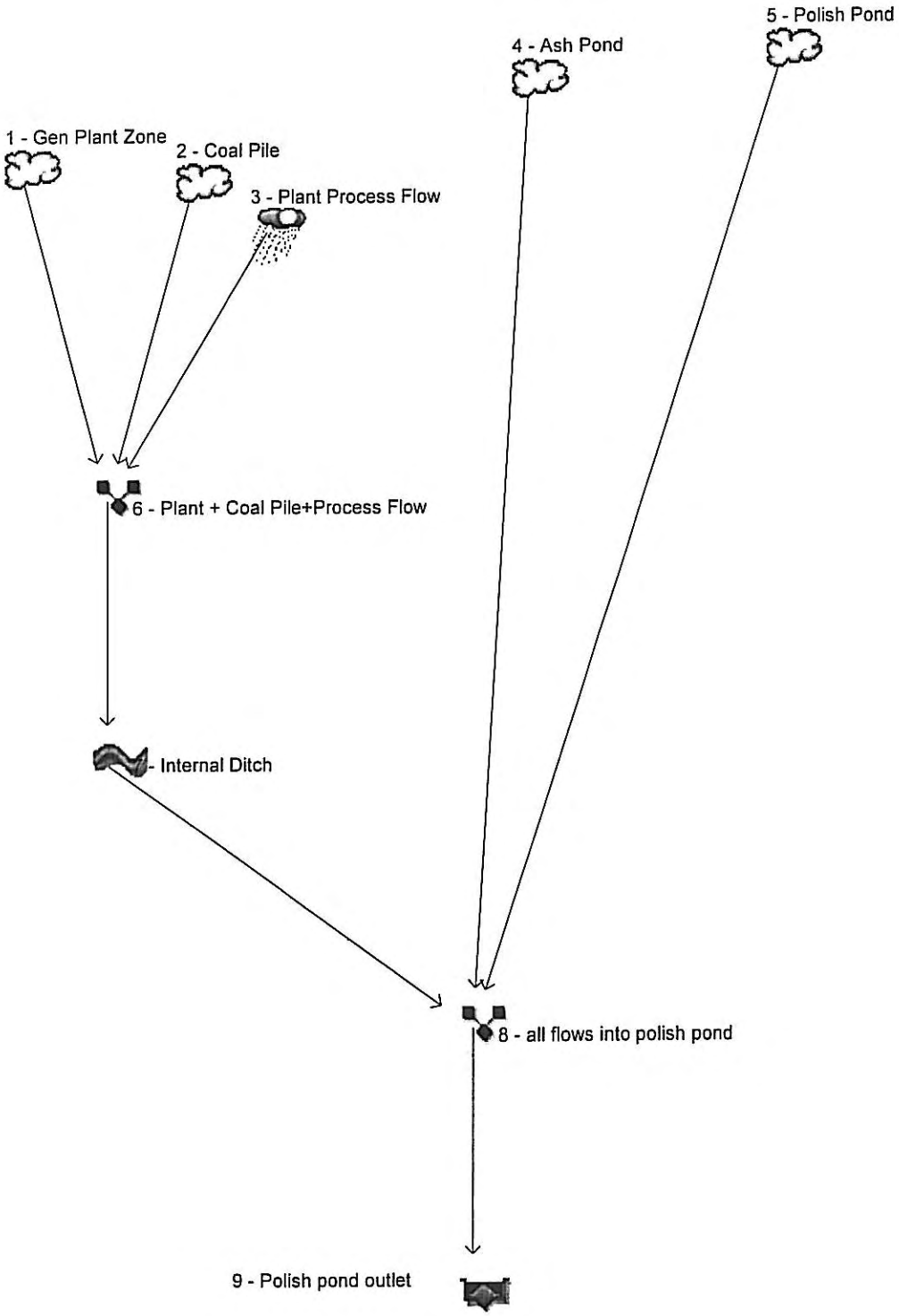
Rush Island Ash Pond Storm Routing

File	Rainfall duration	frequency	Pond Start Elevtion	Base Flow from Plant	Maximum Stage	Max. Outflow cfs	Total Storage ac-ft	Remarks
Trial 03	24 hr	100 yr	395	15 cfs	399.55	27.97	116	8.1 ac Ash delta at 395
Trial 04	24 hr	100 yr	395	20 cfs	399.87	28.95	124	8.1 ac Ash delta at 395
Trial 05	24 hr	100 yr	403	20 cfs	407.44	27.93	126	No Ash Delta @ 403
Trial 09	24 hr	100 yr	398	20 cfs	402.55	28.27	125.2	Ash Delta Submerged @ 397
Trial 06	6 hr	100 yr	395	20 cfs	398.25	23.51	79.8	8.1 ac Ash delta at 395
Trial 07	6 hr	100 yr	403	20 cfs	405.88	22.38	80.3	No Ash Delta @ 403
Trial 08	6 hr	100 yr	398	20 cfs	400.93	22.68	80.21	Ash Delta Submerged @ 397

Note: 100 yr - 24 hour storm - 7.10 inches
100 yr - 6 hour storm - 5.20 inches
Souirce - Bulletin 71, Huff & Angel

Sheet 5 of

Watershed Model Schematic



Hydrograph Summary Report

Hydraflow Hydrographs by Intelisolve v9.23

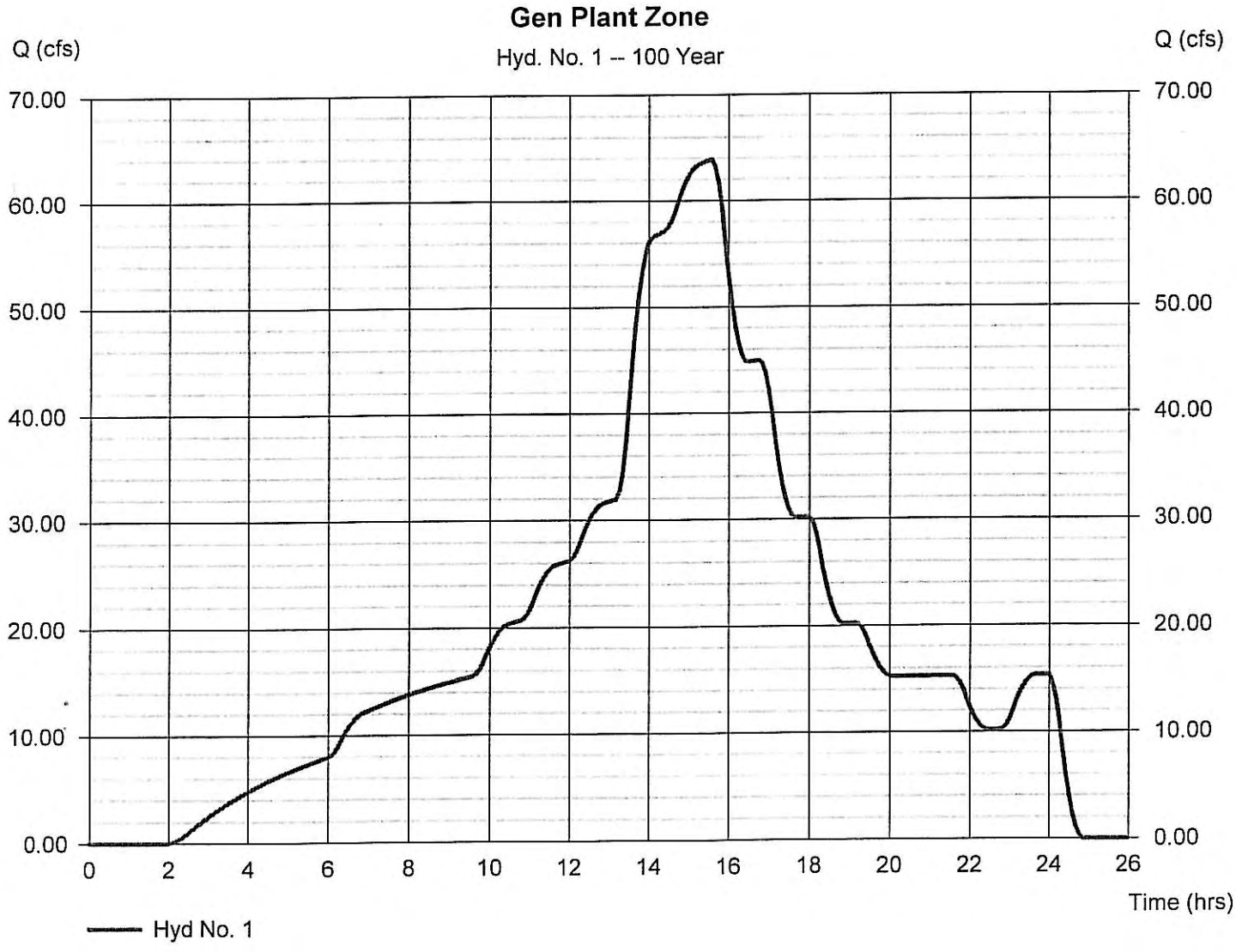
d. No.	Hydrograph type (origin)	Peak flow (cfs)	Time interval (min)	Time to peak (min)	Hyd. volume (acft)	Inflow hyd(s)	Maximum elevation (ft)	Total strge used (acft)	Hydrograph description
1	SCS Runoff	63.88	5	935	40.508	----	------	------	Gen Plant Zone
2	SCS Runoff	41.10	5	935	25.944	----	------	------	Coal Pile
3	Manual	20.00	5	5	49.587	----	------	------	Plant Process Flow
4	SCS Runoff	58.35	5	935	34.925	----	------	------	Ash Pond
5	SCS Runoff	21.09	5	925	16.086	----	------	------	Polish Pond
6	Combine	124.99	5	935	116.039	1, 2, 3,	------	------	Plant + Coal Pile+Process Flow
7	Reach	124.99	5	940	116.177	6	------	------	Internal Ditch
8	Combine	204.24	5	935	167.188	4, 5, 7	------	------	all flows into polish pond
9	Reservoir	28.95	5	1470	165.227	8	399.87	124	Polish pond outlet

Hydrograph Report

Hyd. No. 1

Gen Plant Zone

Hydrograph type	= SCS Runoff	Peak discharge	= 63.88 cfs
Storm frequency	= 100 yrs	Time to peak	= 15.58 hrs
Time interval	= 5 min	Hyd. volume	= 40.508 acft
Drainage area	= 86.300 ac	Curve number	= 86
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= USER	Time of conc. (Tc)	= 30.00 min
Total precip.	= 7.10 in	Distribution	= Huff-3rd
Storm duration	= 24.00 hrs	Shape factor	= 484

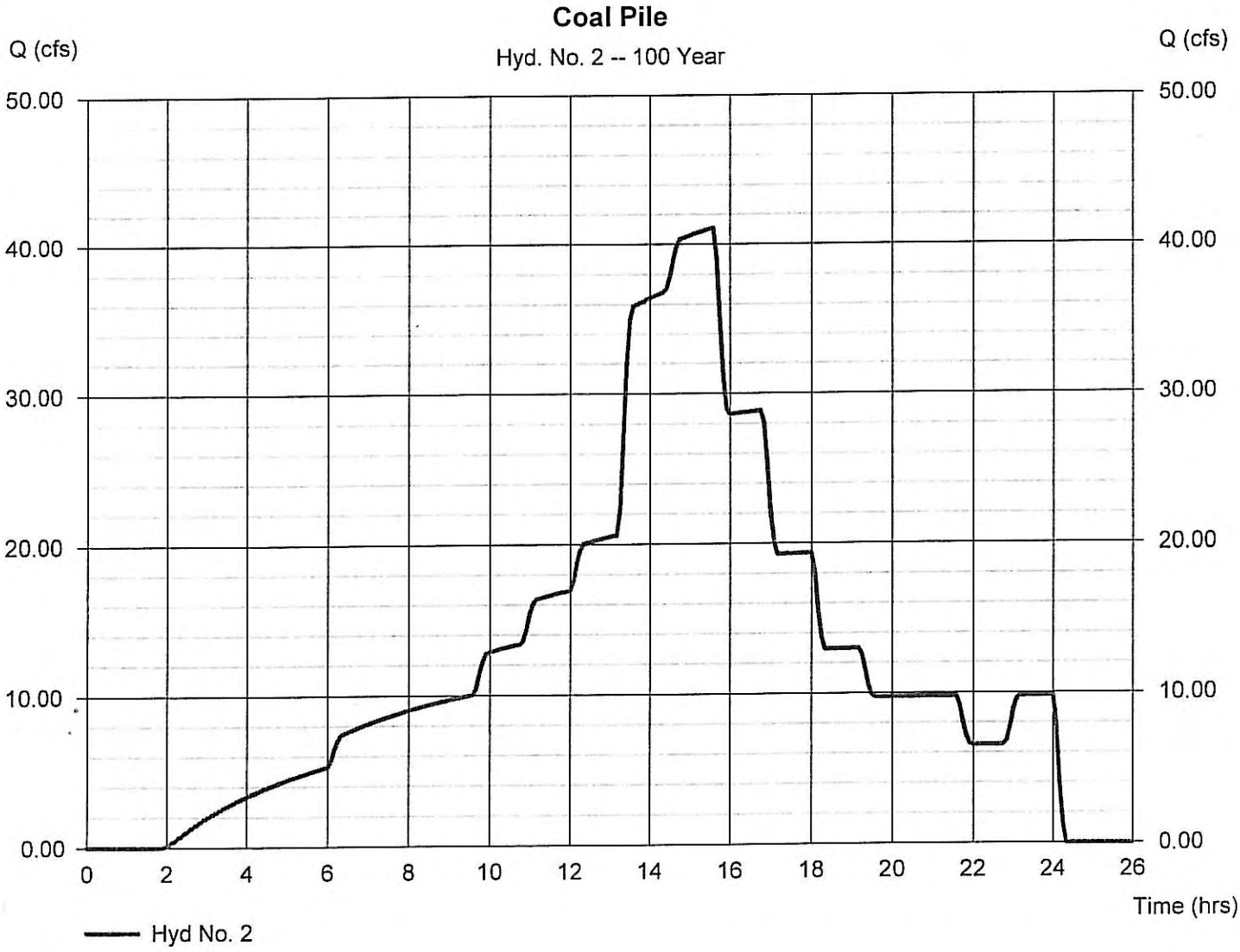


Hydrograph Report

Hyd. No. 2

Coal Pile

Hydrograph type	= SCS Runoff	Peak discharge	= 41.10 cfs
Storm frequency	= 100 yrs	Time to peak	= 15.58 hrs
Time interval	= 5 min	Hyd. volume	= 25.944 acft
Drainage area	= 60.800 ac	Curve number	= 86
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= USER	Time of conc. (Tc)	= 12.00 min
Total precip.	= 7.10 in	Distribution	= Huff-3rd
Storm duration	= 24.00 hrs	Shape factor	= 484



Hydrograph Report

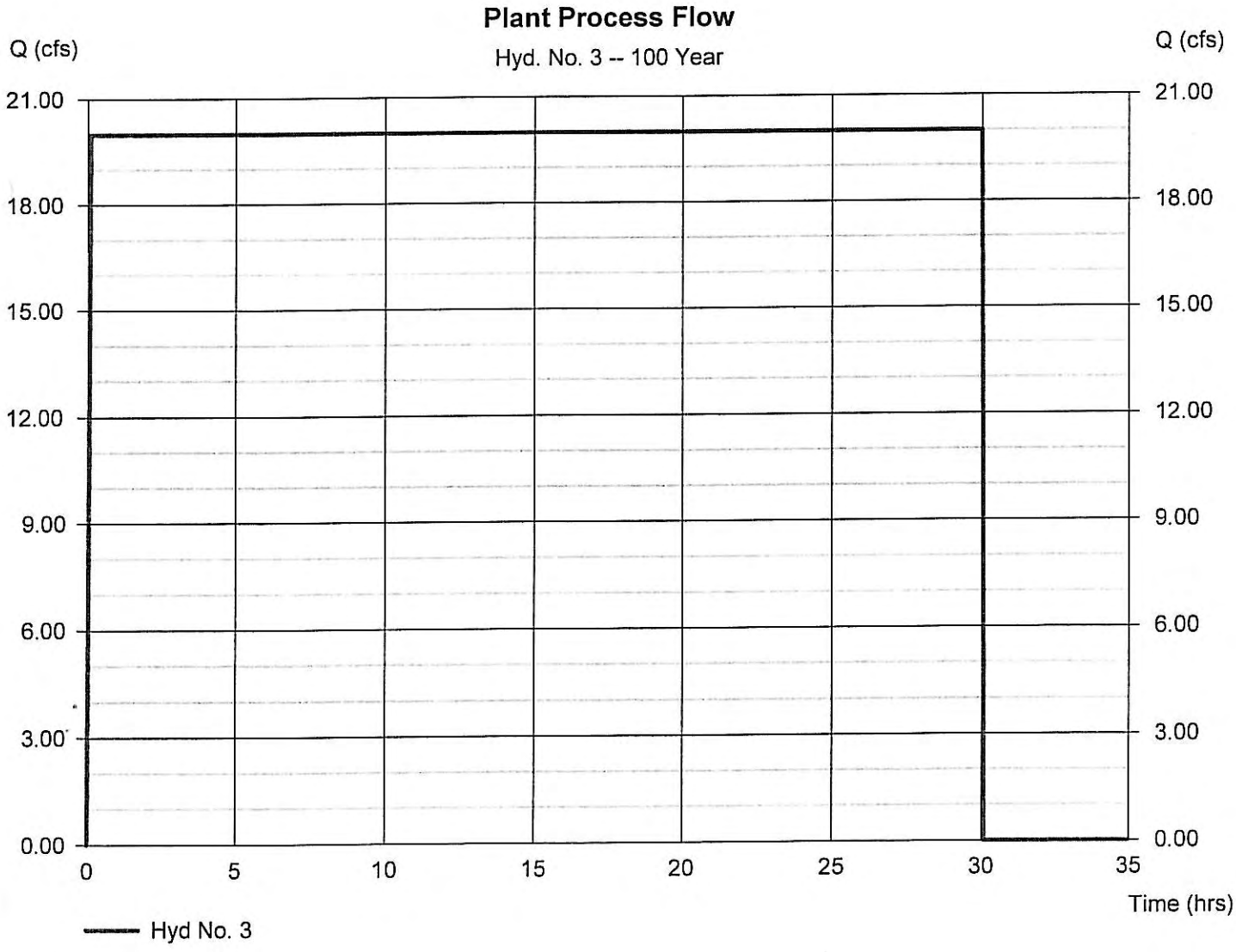
Hydraflow Hydrographs by Intelisolve v9.23

Tuesday, Jan 5, 2010

Hyd. No. 3

Plant Process Flow

Hydrograph type	= Manual	Peak discharge	= 20.00 cfs
Storm frequency	= 100 yrs	Time to peak	= 0.08 hrs
Time interval	= 5 min	Hyd. volume	= 49.587 acft



Hydrograph Report

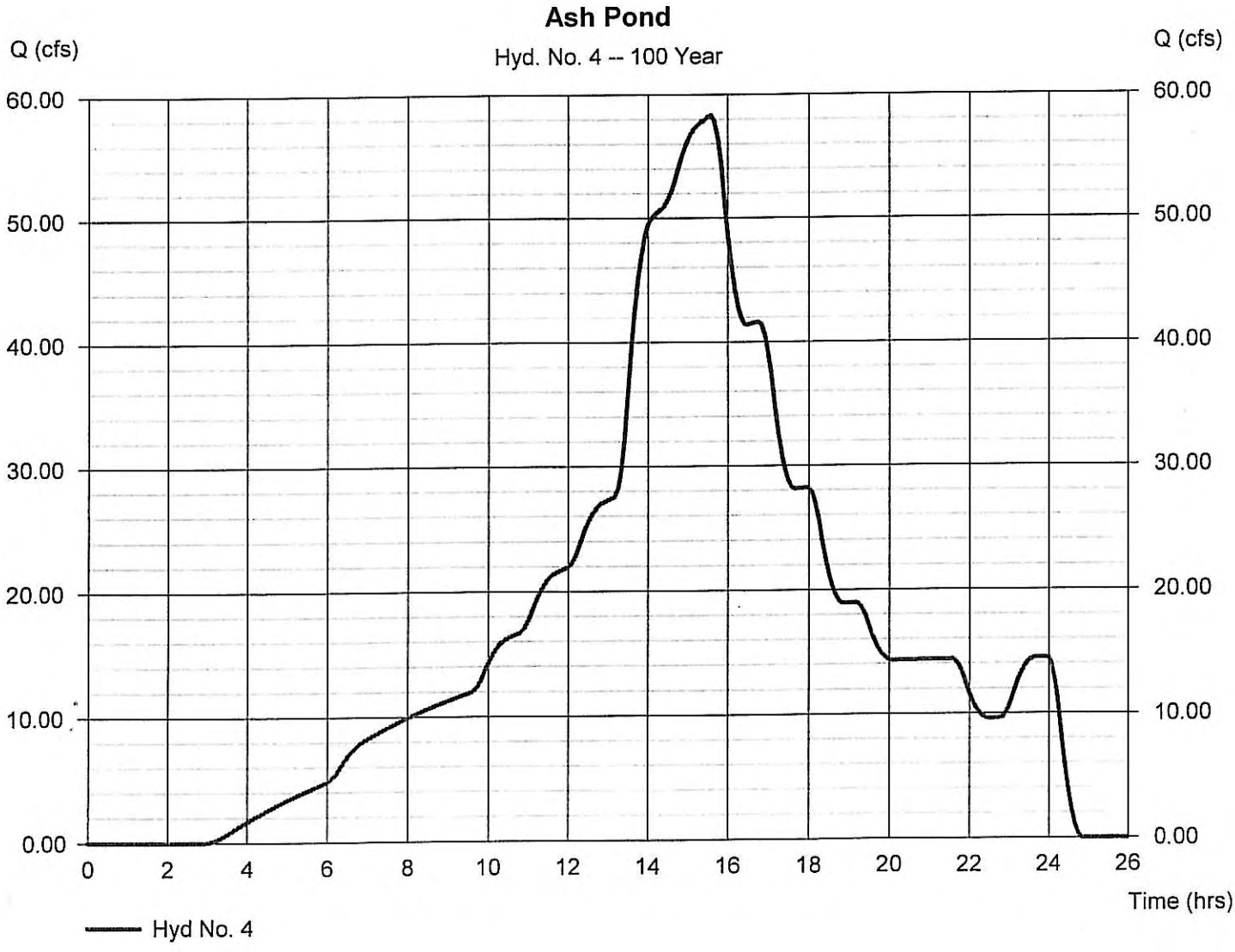
Hydraflow Hydrographs by Intelisolve v9.23

Tuesday, Jan 5, 2010

Hyd. No. 4

Ash Pond

Hydrograph type	= SCS Runoff	Peak discharge	= 58.35 cfs
Storm frequency	= 100 yrs	Time to peak	= 15.58 hrs
Time interval	= 5 min	Hyd. volume	= 34.925 acft
Drainage area	= 84.900 ac	Curve number	= 80
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= USER	Time of conc. (Tc)	= 33.00 min
Total precip.	= 7.10 in	Distribution	= Huff-3rd
Storm duration	= 24.00 hrs	Shape factor	= 484



Hydrograph Report

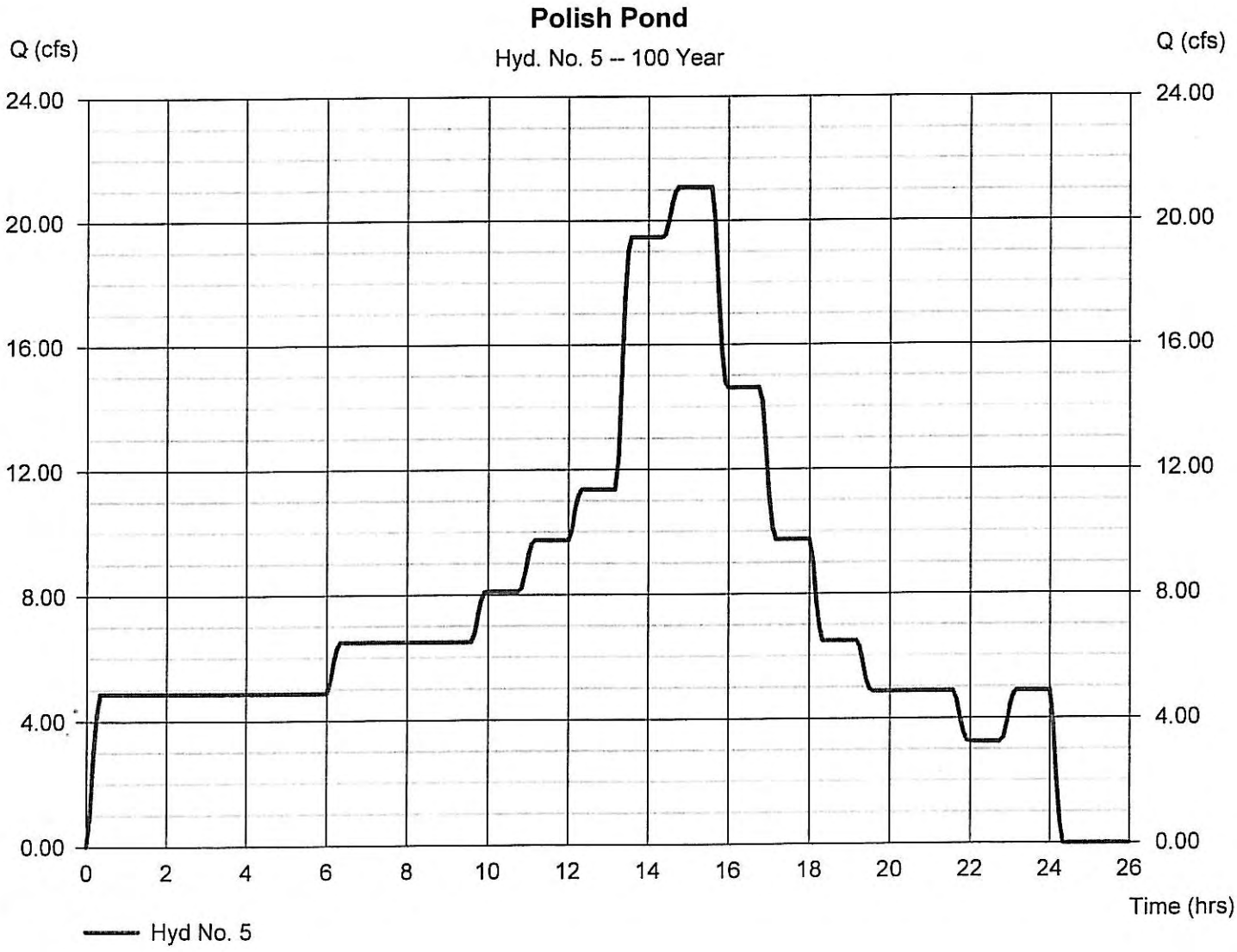
Hydraflow Hydrographs by Intelisolve v9.23

Tuesday, Jan 5, 2010

Hyd. No. 5

Polish Pond

Hydrograph type	= SCS Runoff	Peak discharge	= 21.09 cfs
Storm frequency	= 100 yrs	Time to peak	= 15.42 hrs
Time interval	= 5 min	Hyd. volume	= 16.086 acft
Drainage area	= 29.000 ac	Curve number	= 100
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= USER	Time of conc. (Tc)	= 10.00 min
Total precip.	= 7.10 in	Distribution	= Huff-3rd
Storm duration	= 24.00 hrs	Shape factor	= 484



Hydrograph Report

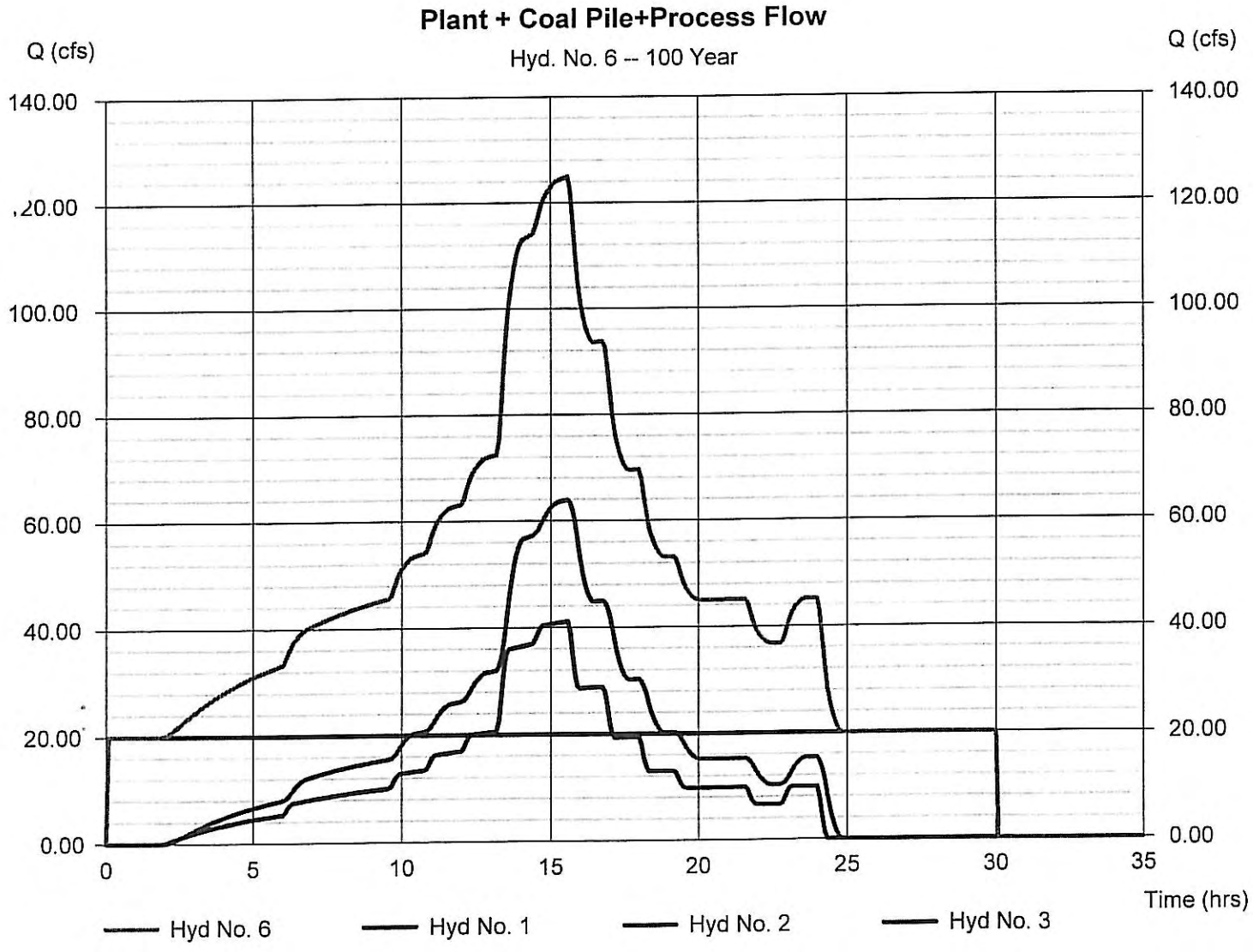
Hydraflow Hydrographs by Intelisolve v9.23

Tuesday, Jan 5, 2010

Hyd. No. 6

Plant + Coal Pile+Process Flow

Hydrograph type	= Combine	Peak discharge	= 124.99 cfs
Storm frequency	= 100 yrs	Time to peak	= 15.58 hrs
Time interval	= 5 min	Hyd. volume	= 116.039 acft
Inflow hyds.	= 1, 2, 3	Contrib. drain. area	= 147.100 ac



Hydrograph Report

Hydraflow Hydrographs by Intelisolve v9.23

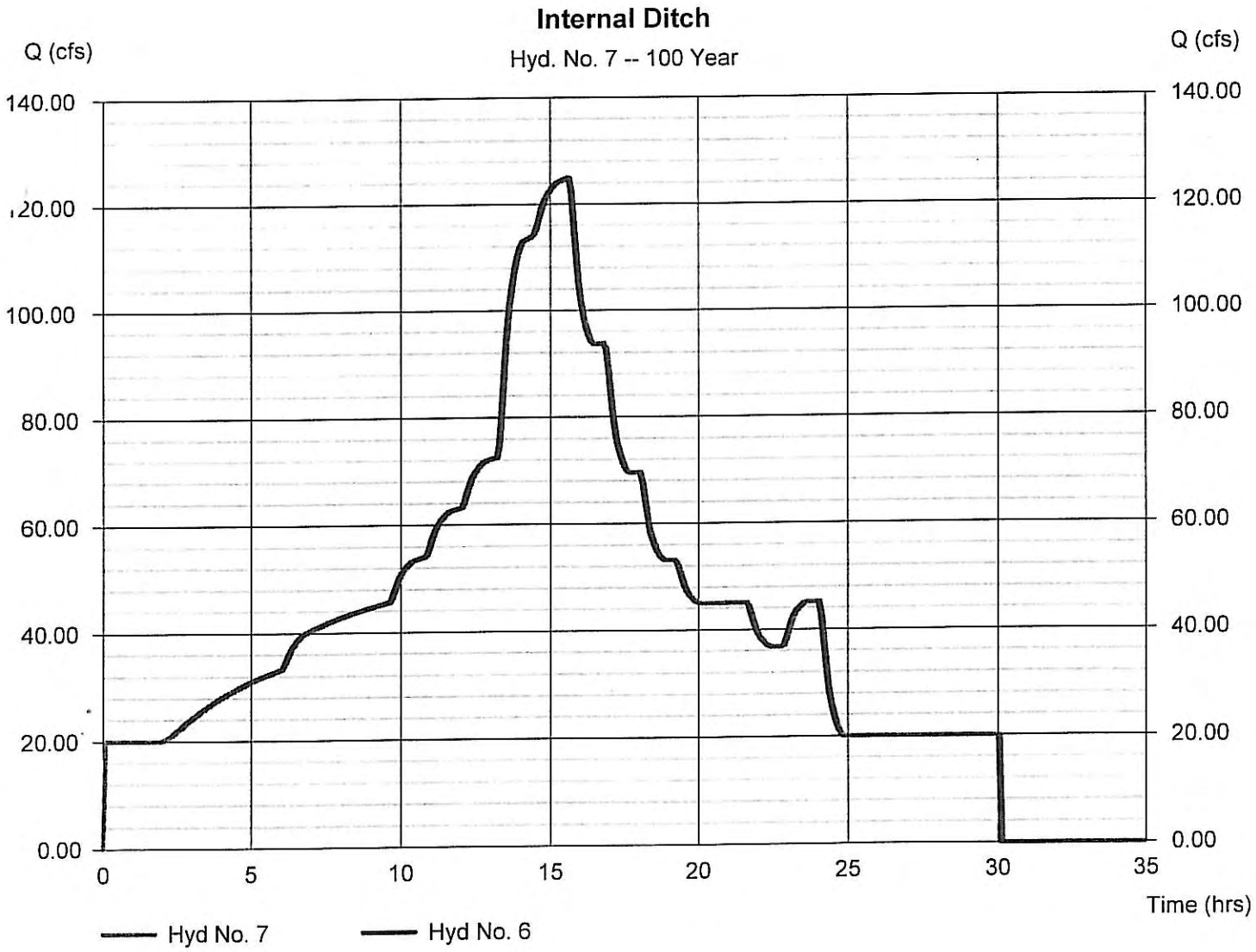
Tuesday, Jan 5, 2010

Hyd. No. 7

Internal Ditch

Hydrograph type	= Reach	Peak discharge	= 124.99 cfs
Storm frequency	= 100 yrs	Time to peak	= 15.67 hrs
Time interval	= 5 min	Hyd. volume	= 116.177 acft
Inflow hyd. No.	= 6 - Plant + Coal Pile+Process Flow	Section type	= Trapezoidal
Reach length	= 1800.0 ft	Channel slope	= 0.3 %
Manning's n	= 0.009	Bottom width	= 10.0 ft
Side slope	= 0.5:1	Max. depth	= 8.0 ft
Rating curve x	= 1.886	Rating curve m	= 1.516
Ave. velocity	= 7.86 ft/s	Routing coeff.	= 0.9967

Modified Att-Kin routing method used.



Hydrograph Report

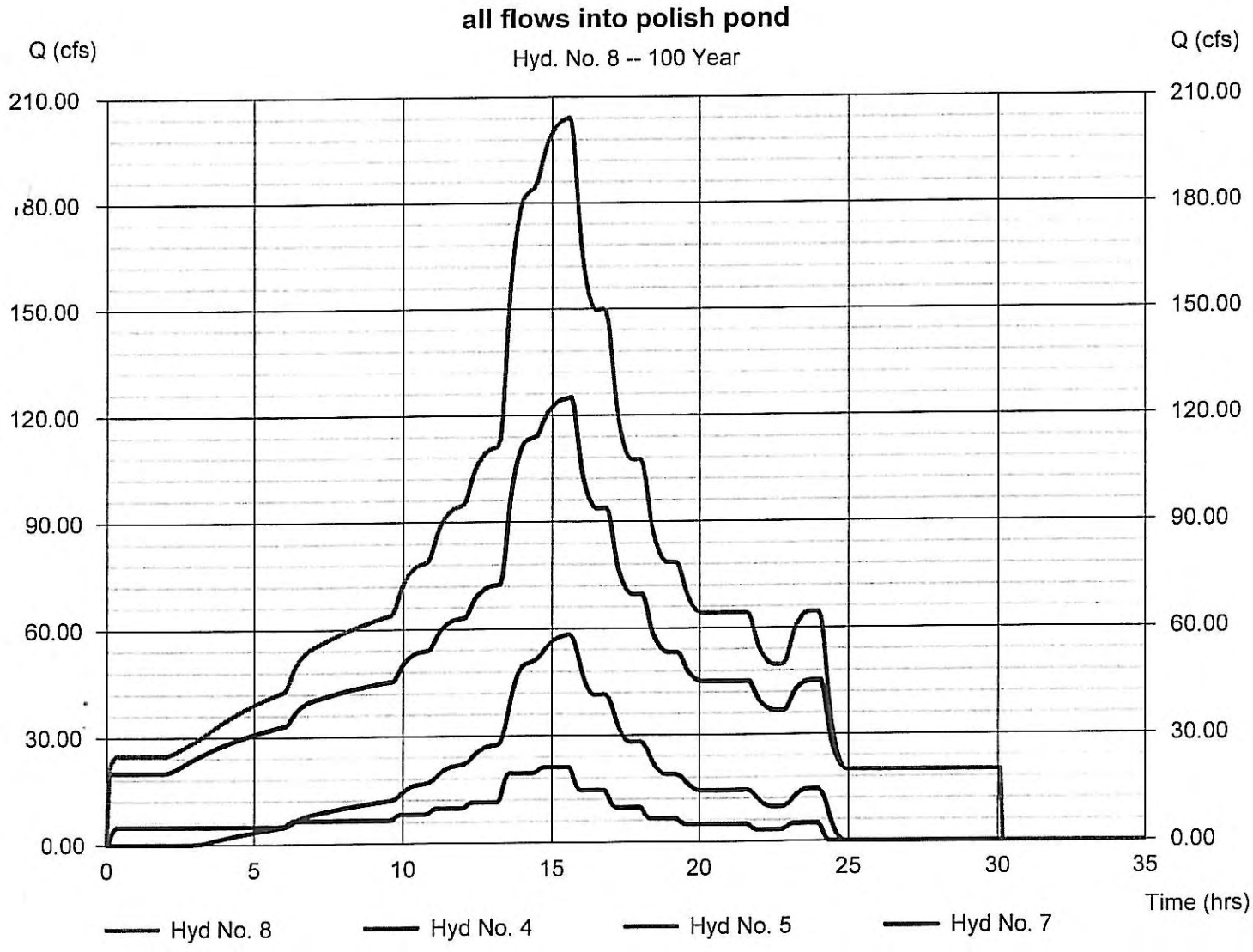
Hydraflow Hydrographs by Intelisolve v9.23

Tuesday, Jan 5, 2010

Hyd. No. 8

all flows into polish pond

Hydrograph type	= Combine	Peak discharge	= 204.24 cfs
Storm frequency	= 100 yrs	Time to peak	= 15.58 hrs
Time interval	= 5 min	Hyd. volume	= 167.188 acft
Inflow hyds.	= 4, 5, 7	Contrib. drain. area	= 113.900 ac



Hydrograph Report

Hydraflow Hydrographs by Intelisolve v9.23

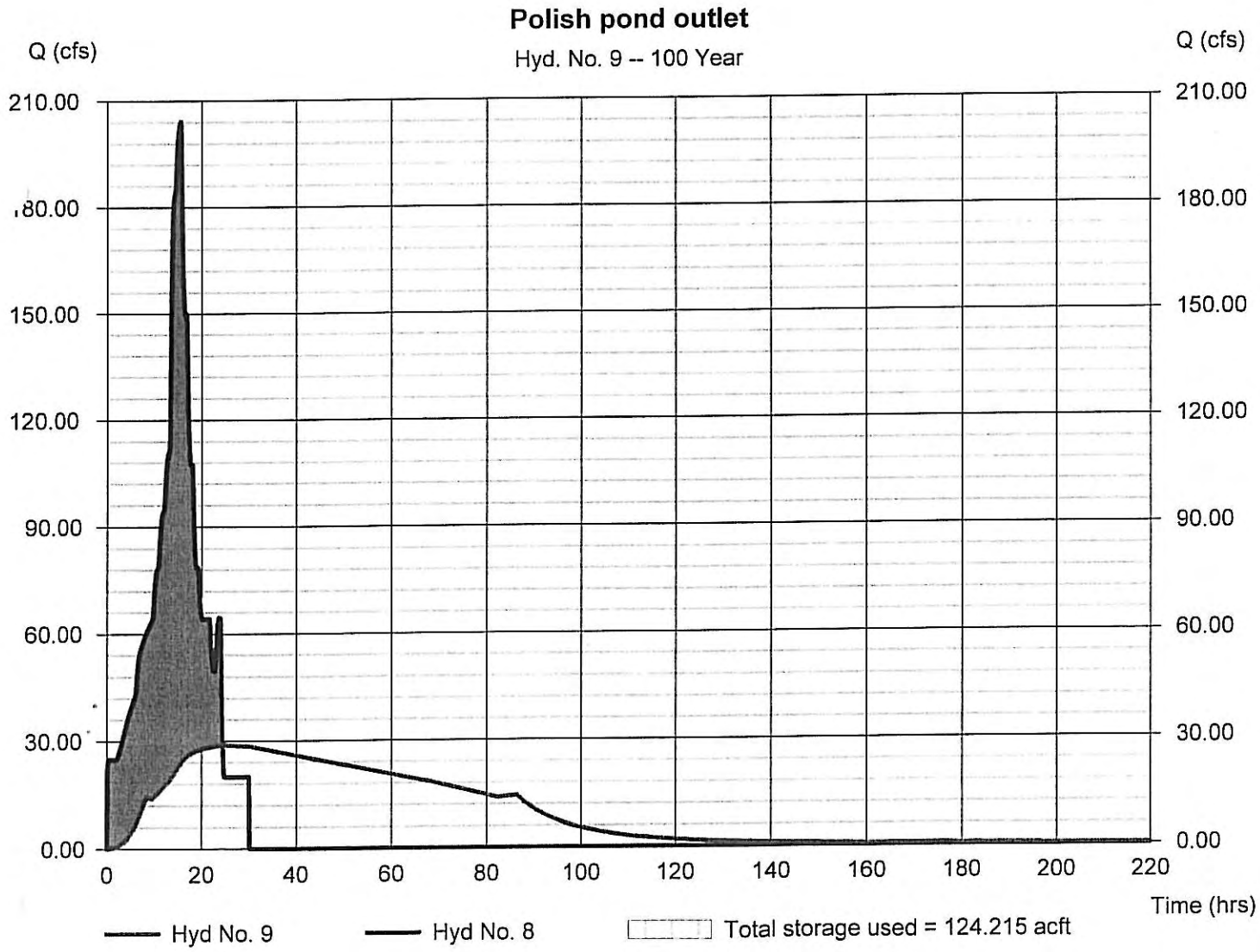
Tuesday, Jan 5, 2010

Hyd. No. 9

Polish pond outlet

Hydrograph type	= Reservoir	Peak discharge	= 28.95 cfs
Storm frequency	= 100 yrs	Time to peak	= 24.50 hrs
Time interval	= 5 min	Hyd. volume	= 165.227 acft
Inflow hyd. No.	= 8 - all flows into polish pond	Max. Elevation	= 399.87 ft
Reservoir name	= Polish pond	Max. Storage	= 124.215 acft

Storage Indication method used.



Pond Report

Hydraflow Hydrographs by Intelisolve v9.23

Tuesday, Jan 5, 2010

Pond No. 2 - Polish pond

Pond Data

Contours - User-defined contour areas. Average end area method used for volume calculation. Begining Elevation = 395.00 ft

Stage / Storage Table

Stage (ft)	Elevation (ft)	Contour area (sqft)	Incr. Storage (acft)	Total storage (acft)
0.00	395.00	823,284	0.000	0.000
2.00	397.00	1,176,165	45.901	45.901
3.00	398.00	1,187,259	27.128	73.029
4.00	399.00	1,189,548	27.282	100.311
5.00	400.00	1,196,314	27.386	127.697
6.00	401.00	1,203,130	27.542	155.239
7.00	402.00	1,209,997	27.699	182.938
8.00	403.00	1,216,913	27.857	210.795
9.00	404.00	1,223,879	28.016	238.812
10.00	405.00	1,230,895	28.177	266.989

Culvert / Orifice Structures

	[A]	[B]	[C]	[PrfRsr]
Rise (in)	= 24.00	Inactive	Inactive	Inactive
Span (in)	= 24.00	0.00	0.00	0.00
No. Barrels	= 1	0	0	0
Invert El. (ft)	= 385.00	0.00	0.00	0.00
Length (ft)	= 100.00	0.00	0.00	0.00
Slope (%)	= 5.00	0.00	0.00	n/a
N-Value	= .013	.013	.013	n/a
Orifice Coeff.	= 0.67	0.60	0.60	0.60
Multi-Stage	= n/a	No	No	No

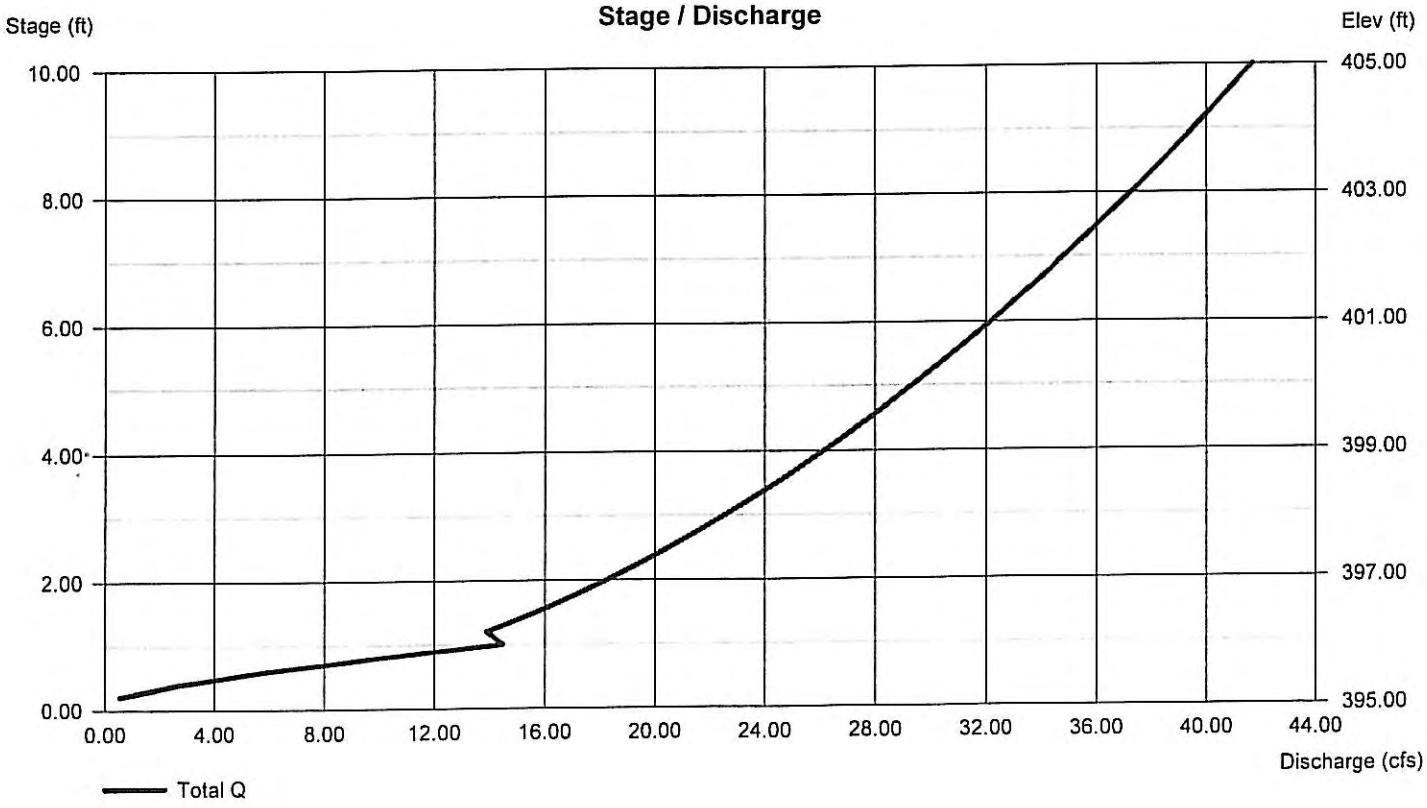
Weir Structures

	[A]	[B]	[C]	[D]
Crest Len (ft)	= 6.28	Inactive	Inactive	Inactive
Crest El. (ft)	= 395.10	0.00	0.00	0.00
Weir Coeff.	= 2.70	3.33	3.33	3.33
Weir Type	= Riser	---	---	---
Multi-Stage	= Yes	No	No	No

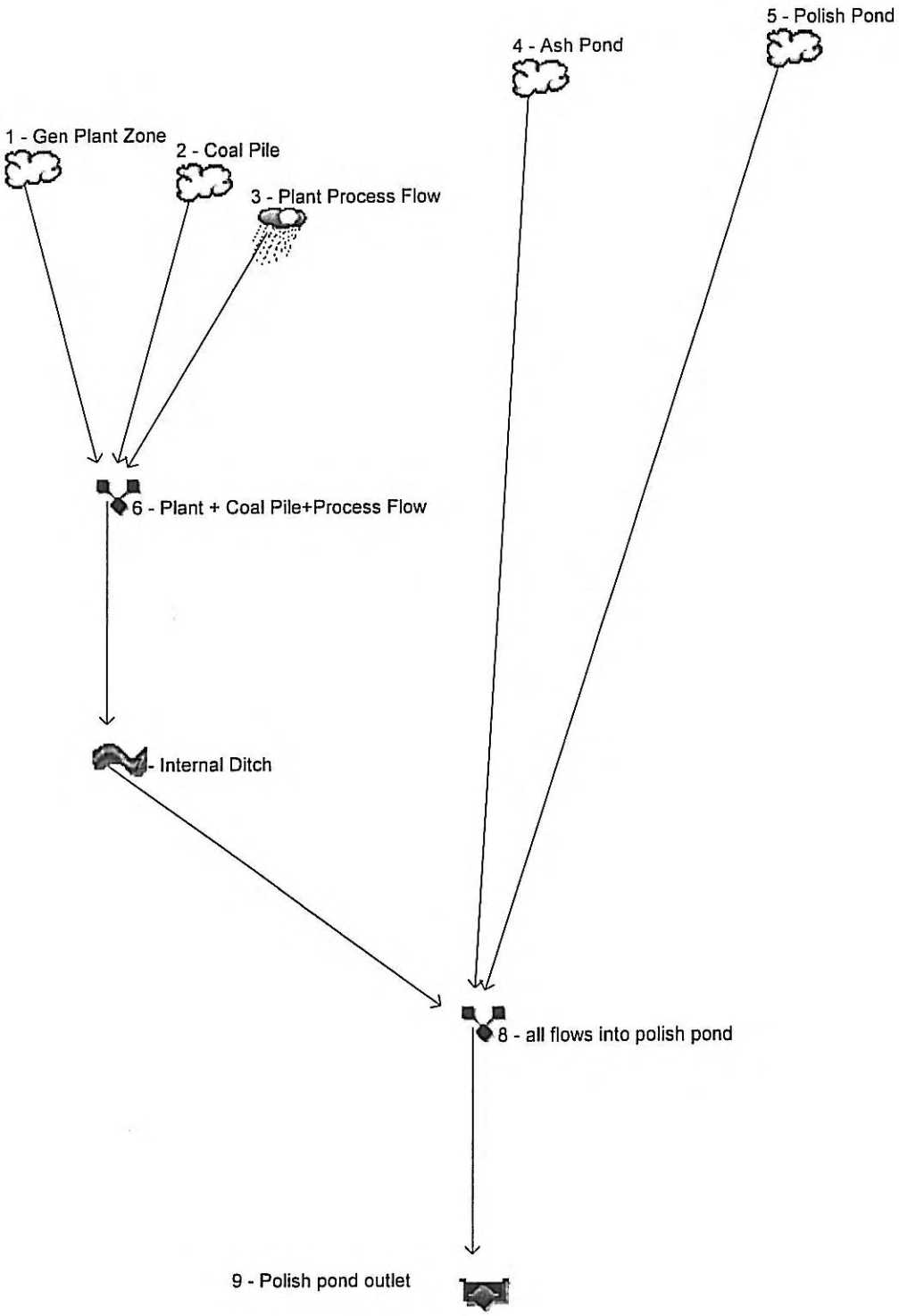
Exfil.(in/hr) = 0.000 (by Wet area)

TW Elev. (ft) = 360.00

Note: Culvert/Orifice outflows are analyzed under inlet (ic) and outlet (oc) control. Weir risers checked for orifice conditions (ic) and submergence (s).



Watershed Model Schematic



Hydrograph Summary Report

Hydraflow Hydrographs by Intelisolve v9.23

Hyd. No.	Hydrograph type (origin)	Peak flow (cfs)	Time interval (min)	Time to peak (min)	Hyd. volume (acft)	Inflow hyd(s)	Maximum elevation (ft)	Total strge used (acft)	Hydrograph description
1	SCS Runoff	63.88	5	935	40.508	----	------	------	Gen Plant Zone
2	SCS Runoff	41.10	5	935	25.944	----	------	------	Coal Pile
3	Manual	20.00	5	5	49.587	----	------	------	Plant Process Flow
4	SCS Runoff	58.35	5	935	34.925	----	------	------	Ash Pond
5	SCS Runoff	21.09	5	925	16.086	----	------	------	Polish Pond
6	Combine	124.99	5	935	116.039	1, 2, 3,	------	------	Plant + Coal Pile+Process Flow
7	Reach	124.99	5	940	116.177	6	------	------	Internal Ditch
8	Combine	204.24	5	935	167.188	4, 5, 7	------	------	all flows into polish pond
9	Reservoir	27.93	5	1475	166.243	8	407.44	126	Polish pond outlet

Hydrograph Report

Hyd. No. 1

Gen Plant Zone

Hydrograph type	= SCS Runoff	Peak discharge	= 63.88 cfs
Storm frequency	= 100 yrs	Time to peak	= 15.58 hrs
Time interval	= 5 min	Hyd. volume	= 40.508 acft
Drainage area	= 86.300 ac	Curve number	= 86
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= USER	Time of conc. (Tc)	= 30.00 min
Total precip.	= 7.10 in	Distribution	= Huff-3rd
Storm duration	= 24.00 hrs	Shape factor	= 484

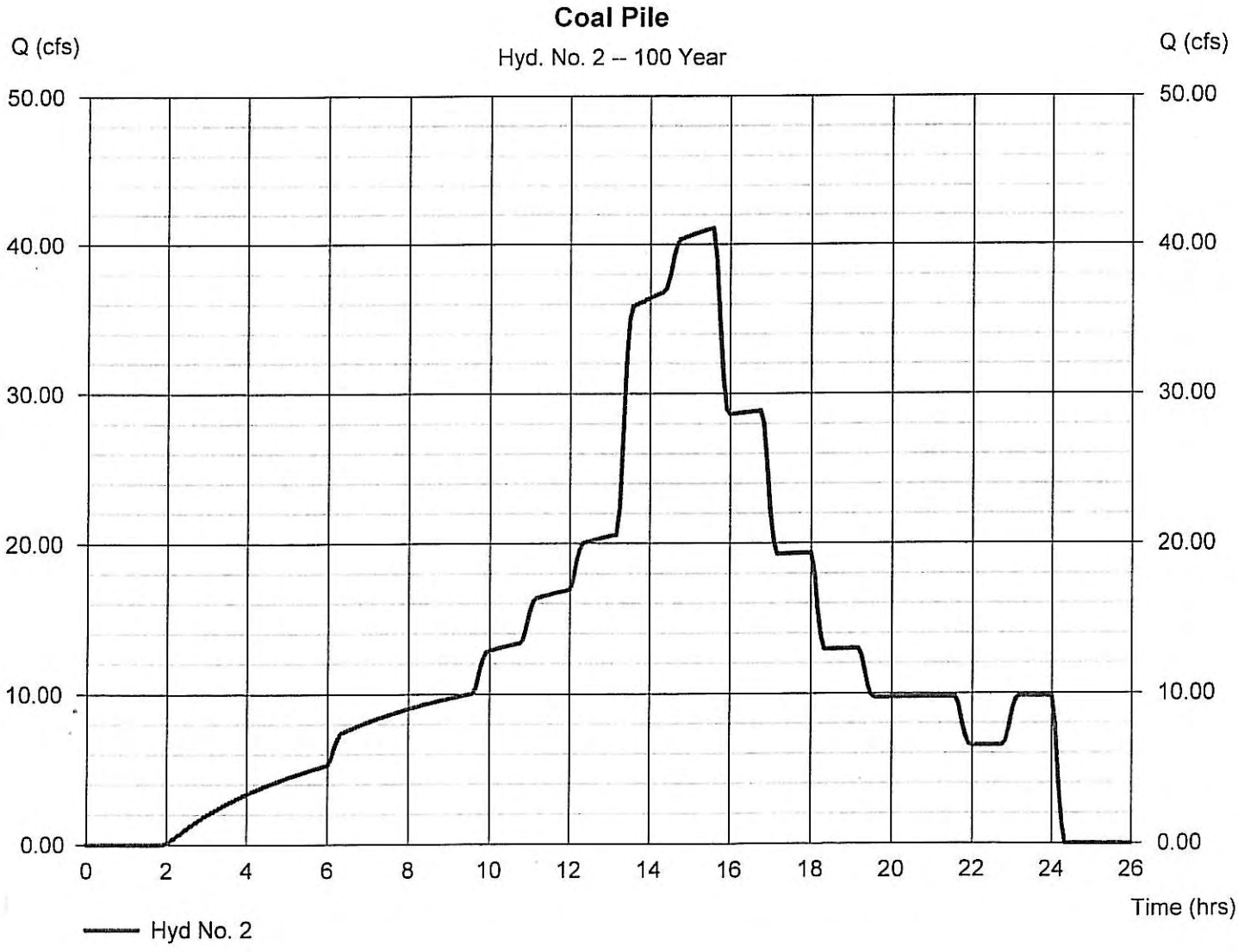


Hydrograph Report

Hyd. No. 2

Coal Pile

Hydrograph type	= SCS Runoff	Peak discharge	= 41.10 cfs
Storm frequency	= 100 yrs	Time to peak	= 15.58 hrs
Time interval	= 5 min	Hyd. volume	= 25.944 acft
Drainage area	= 60.800 ac	Curve number	= 86
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= USER	Time of conc. (Tc)	= 12.00 min
Total precip.	= 7.10 in	Distribution	= Huff-3rd
Storm duration	= 24.00 hrs	Shape factor	= 484

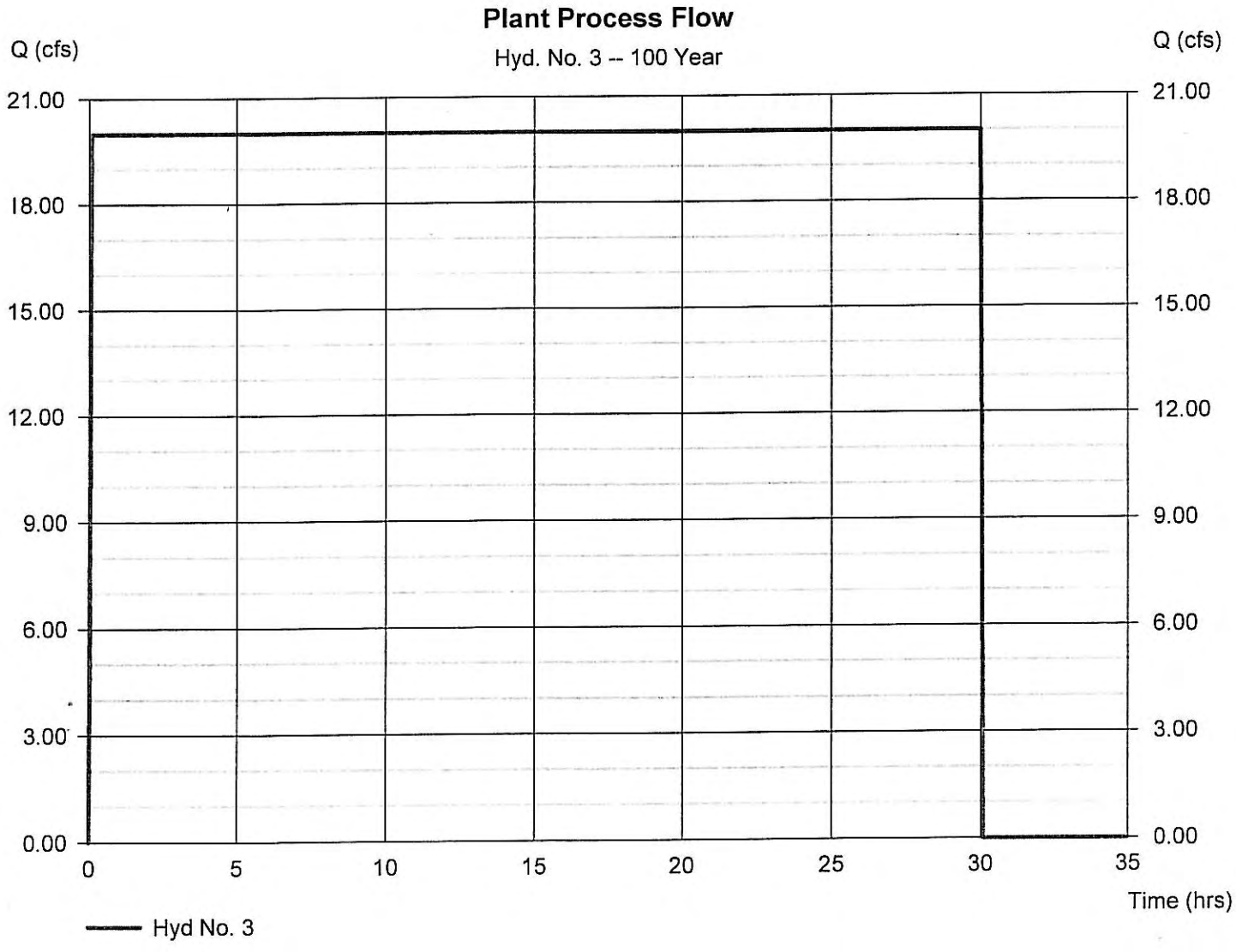


Hydrograph Report

Hyd. No. 3

Plant Process Flow

Hydrograph type	= Manual	Peak discharge	= 20.00 cfs
Storm frequency	= 100 yrs	Time to peak	= 0.08 hrs
Time interval	= 5 min	Hyd. volume	= 49.587 acft

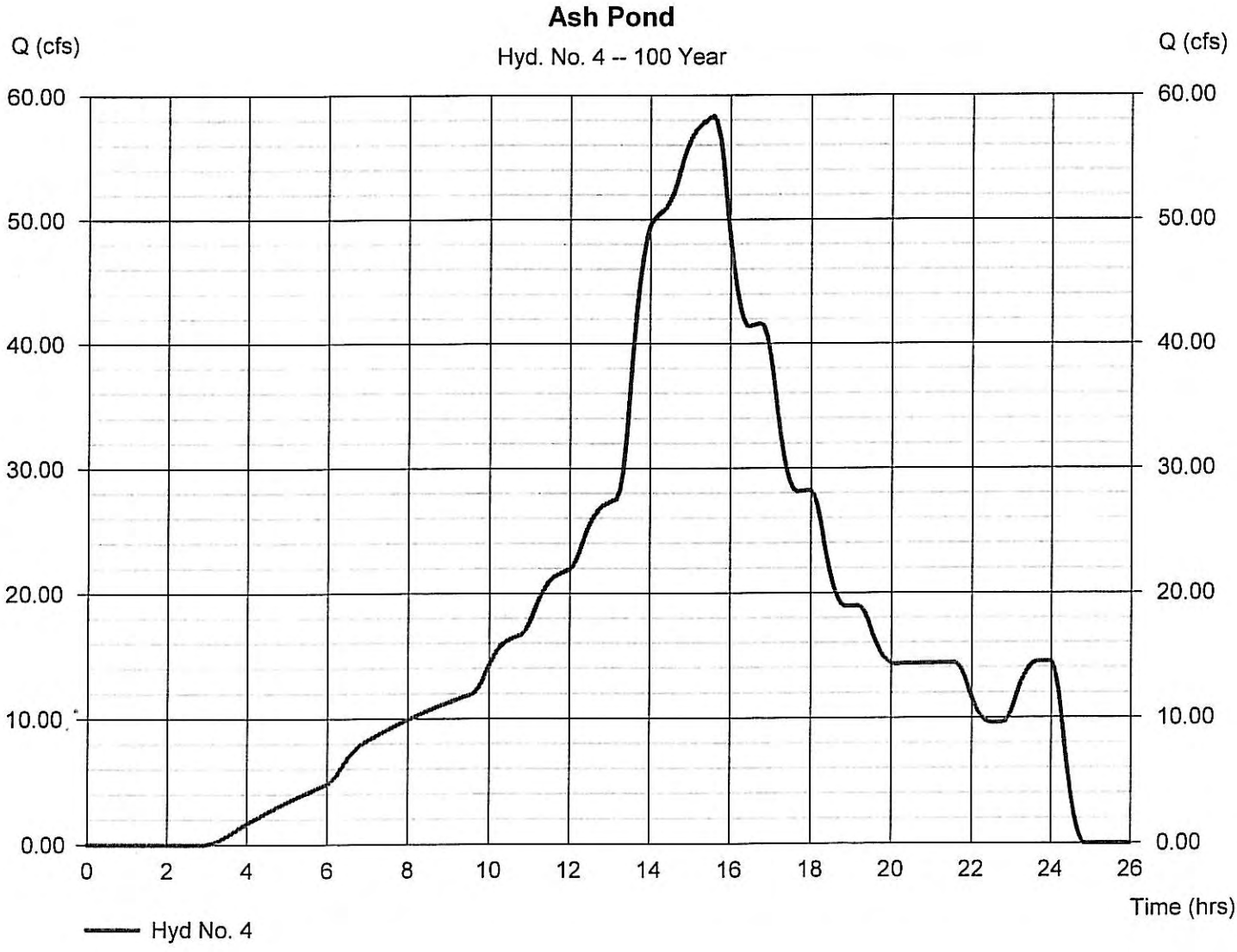


Hydrograph Report

Hyd. No. 4

Ash Pond

Hydrograph type	= SCS Runoff	Peak discharge	= 58.35 cfs
Storm frequency	= 100 yrs	Time to peak	= 15.58 hrs
Time interval	= 5 min	Hyd. volume	= 34.925 acft
Drainage area	= 84.900 ac	Curve number	= 80
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= USER	Time of conc. (Tc)	= 33.00 min
Total precip.	= 7.10 in	Distribution	= Huff-3rd
Storm duration	= 24.00 hrs	Shape factor	= 484

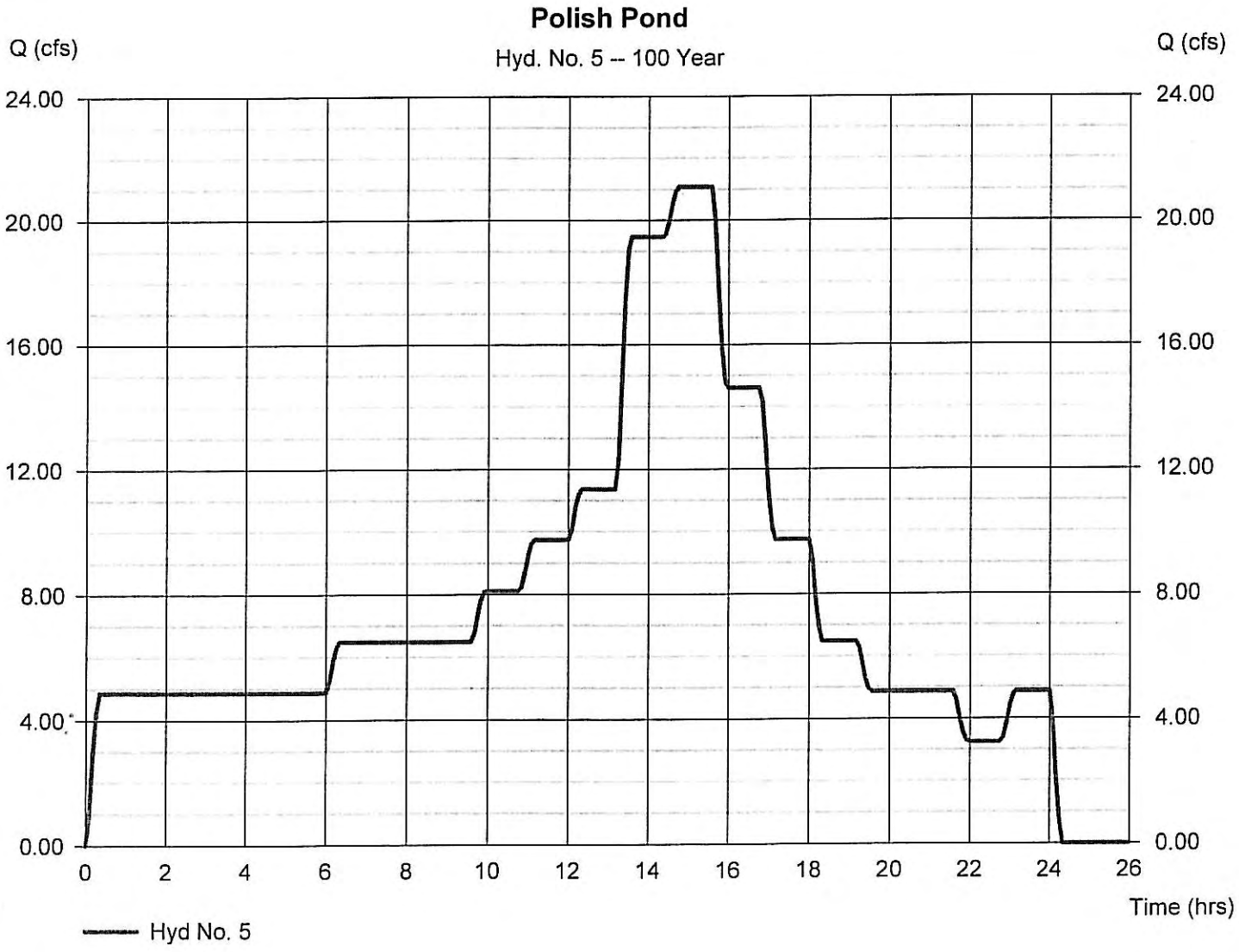


Hydrograph Report

Hyd. No. 5

Polish Pond

Hydrograph type	= SCS Runoff	Peak discharge	= 21.09 cfs
Storm frequency	= 100 yrs	Time to peak	= 15.42 hrs
Time interval	= 5 min	Hyd. volume	= 16.086 acft
Drainage area	= 29.000 ac	Curve number	= 100
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= USER	Time of conc. (Tc)	= 10.00 min
Total precip.	= 7.10 in	Distribution	= Huff-3rd
Storm duration	= 24.00 hrs	Shape factor	= 484

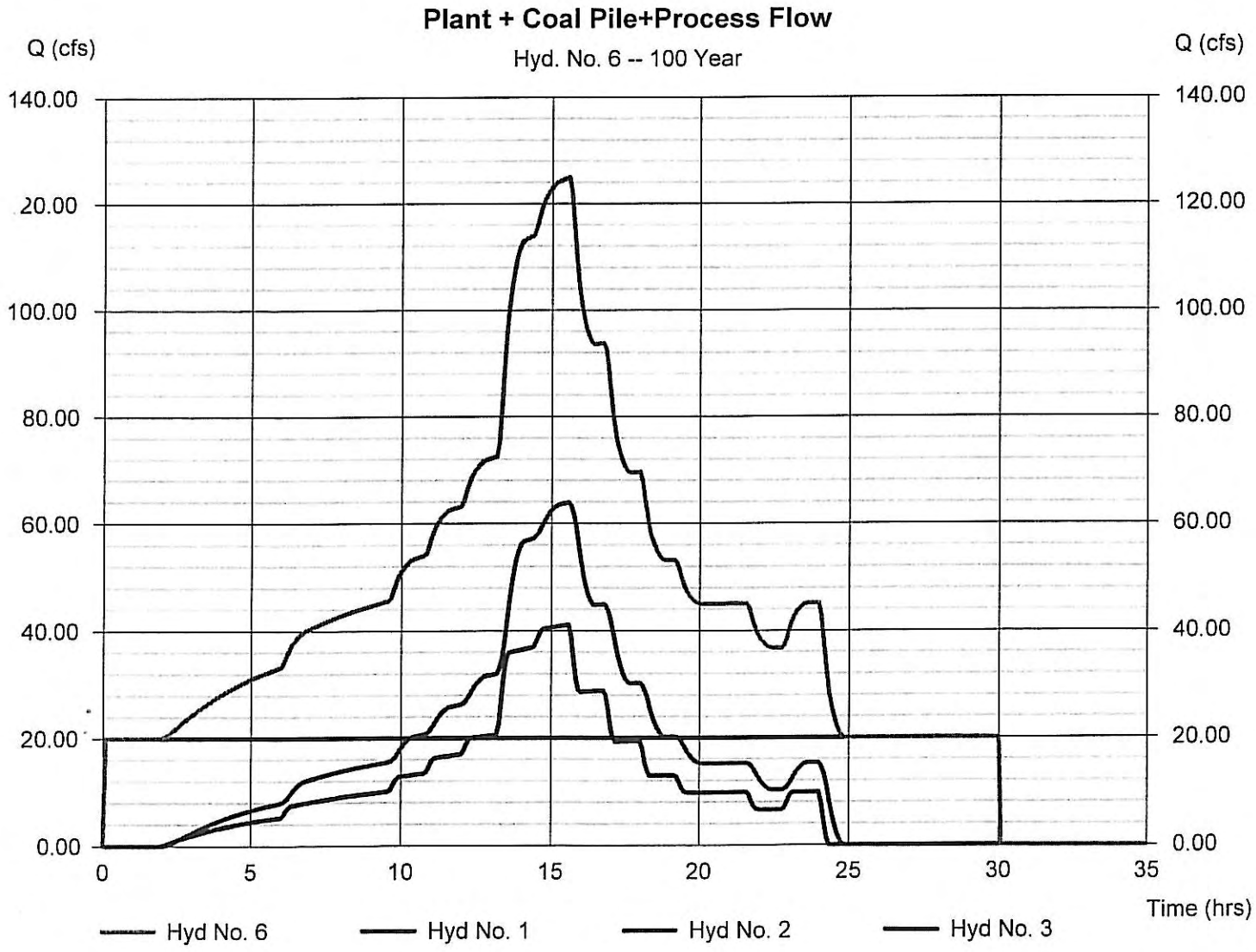


Hydrograph Report

Hyd. No. 6

Plant + Coal Pile+Process Flow

Hydrograph type	= Combine	Peak discharge	= 124.99 cfs
Storm frequency	= 100 yrs	Time to peak	= 15.58 hrs
Time interval	= 5 min	Hyd. volume	= 116.039 acft
Inflow hyds.	= 1, 2, 3	Contrib. drain. area	= 147.100 ac



Hydrograph Report

Hydraflow Hydrographs by Intelisolve v9.23

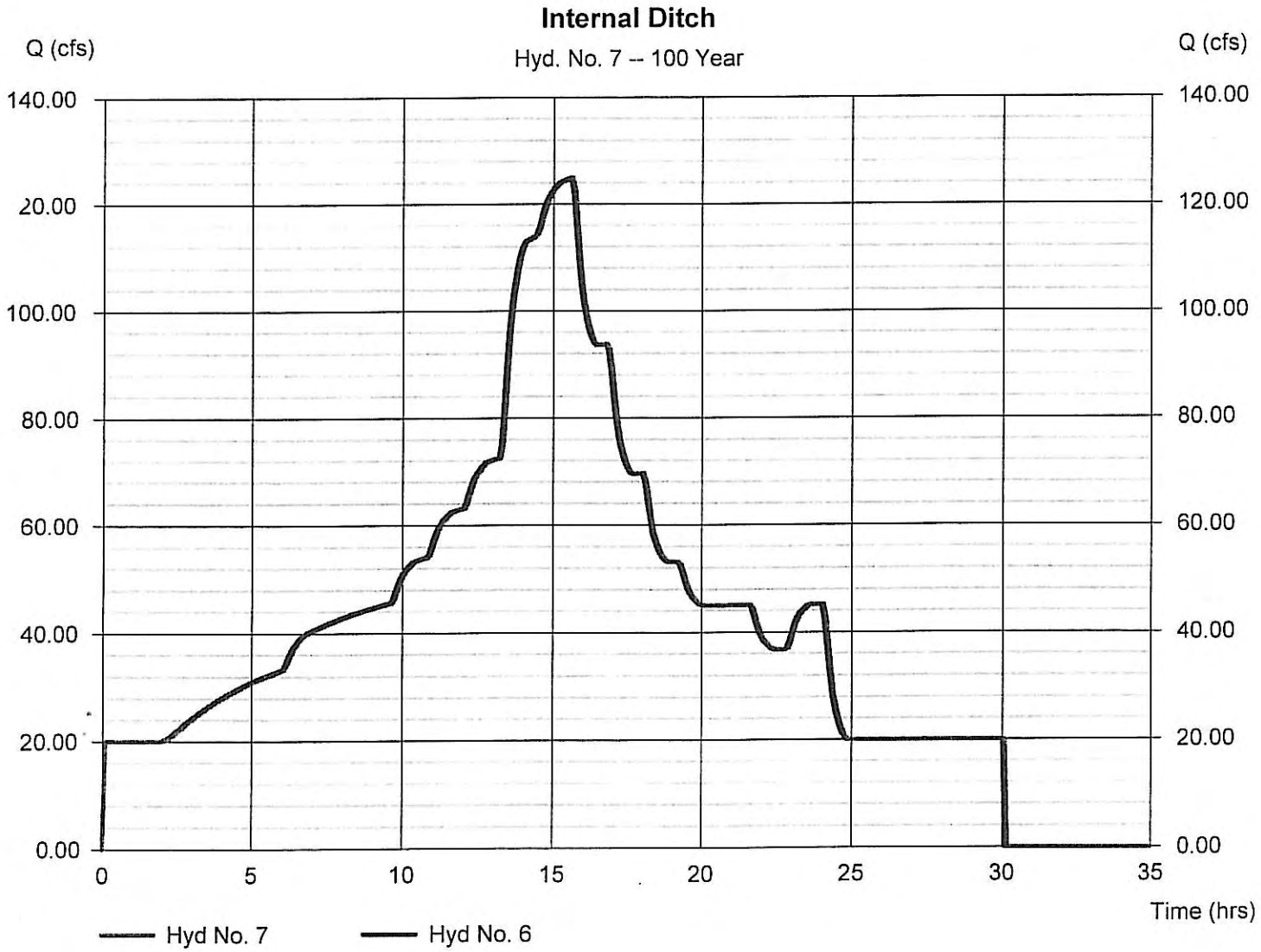
Tuesday, Jan 5, 2010

Hyd. No. 7

Internal Ditch

Hydrograph type	= Reach	Peak discharge	= 124.99 cfs
Storm frequency	= 100 yrs	Time to peak	= 15.67 hrs
Time interval	= 5 min	Hyd. volume	= 116.177 acft
Inflow hyd. No.	= 6 - Plant + Coal Pile+Process Flow	Section type	= Trapezoidal
Reach length	= 1800.0 ft	Channel slope	= 0.3 %
Manning's n	= 0.009	Bottom width	= 10.0 ft
Side slope	= 0.5:1	Max. depth	= 8.0 ft
Rating curve x	= 1.886	Rating curve m	= 1.516
Ave. velocity	= 7.86 ft/s	Routing coeff.	= 0.9967

Modified Att-Kin routing method used.



Hydrograph Report

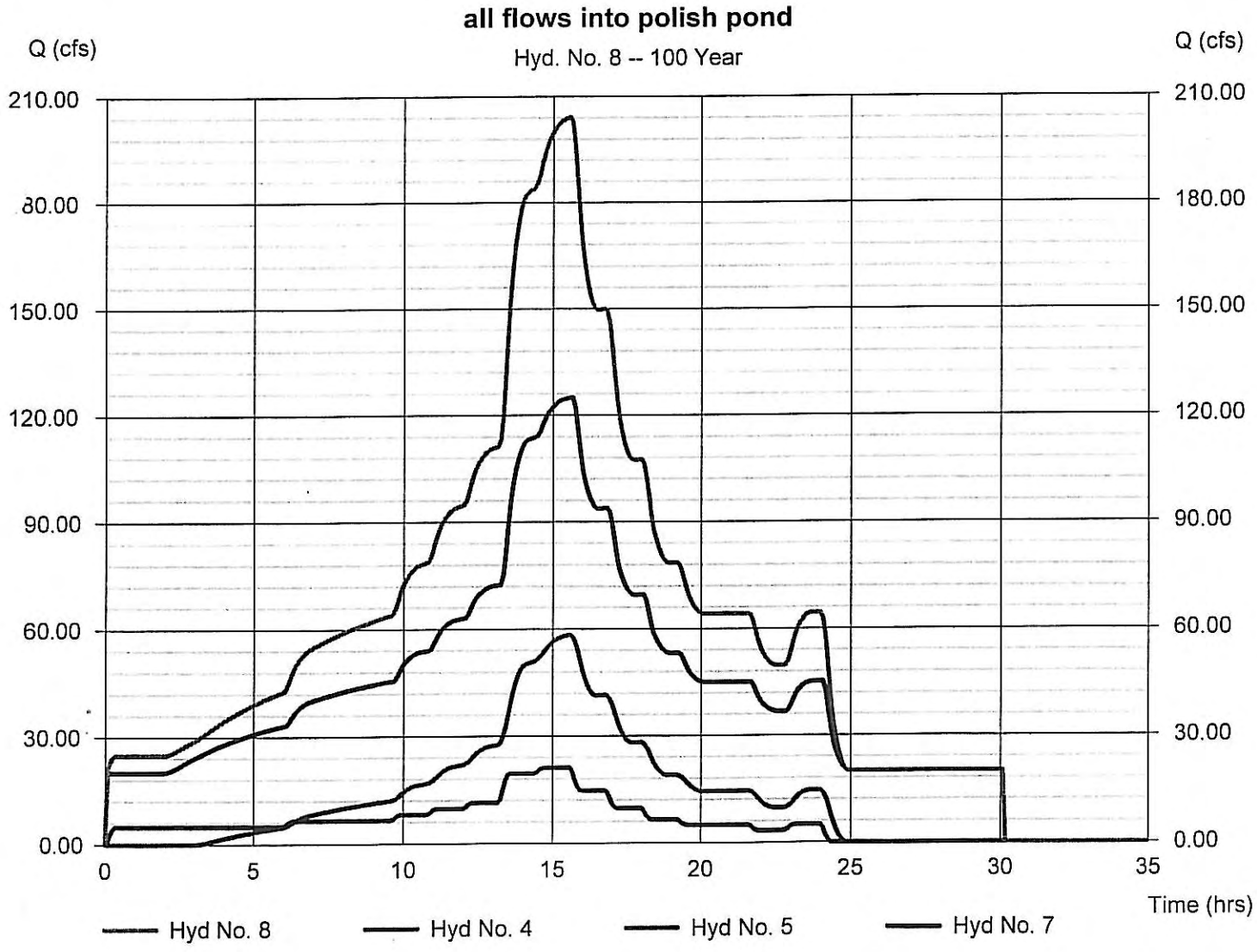
Hydraflow Hydrographs by Intelisolve v9.23

Tuesday, Jan 5, 2010

Hyd. No. 8

all flows into polish pond

Hydrograph type	= Combine	Peak discharge	= 204.24 cfs
Storm frequency	= 100 yrs	Time to peak	= 15.58 hrs
Time interval	= 5 min	Hyd. volume	= 167.188 acft
Inflow hyds.	= 4, 5, 7	Contrib. drain. area	= 113.900 ac



Hydrograph Report

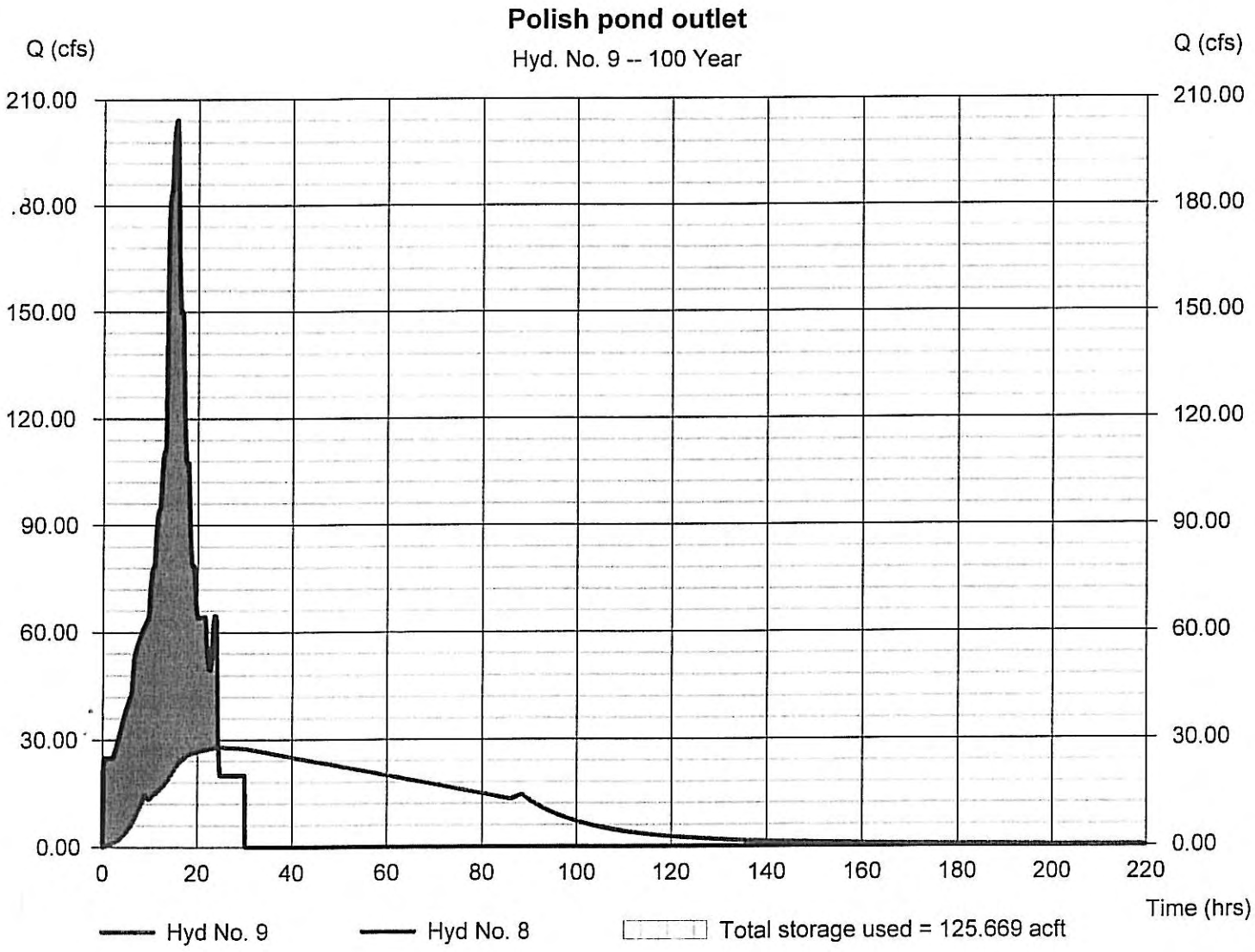
Hydraflow Hydrographs by Intelisolve v9.23 — Tuesday, Jan 5, 2010

Hyd. No. 9

Polish pond outlet

Hydrograph type	= Reservoir	Peak discharge	= 27.93 cfs
Storm frequency	= 100 yrs	Time to peak	= 24.58 hrs
Time interval	= 5 min	Hyd. volume	= 166.243 acft
Inflow hyd. No.	= 8 - all flows into polish pond	Max. Elevation	= 407.44 ft
Reservoir name	= Polish pond	Max. Storage	= 125.669 acft

Storage Indication method used.



Pond Report

Hydraflow Hydrographs by Intelisolve v9.23 — Tuesday, Jan 5, 2010

Pond No. 2 - Polish pond

Pond Data

Contours - User-defined contour areas. Average end area method used for volume calculation. Begining Elevation = 403.00 ft

Stage / Storage Table

Stage (ft)	Elevation (ft)	Contour area (sqft)	Incr. Storage (acft)	Total storage (acft)
0.00	403.00	1,216,913	0.000	0.000
1.00	404.00	1,223,879	28.016	28.016
2.00	405.00	1,230,895	28.177	56.193
3.00	406.00	1,237,962	28.339	84.532
4.00	407.00	1,245,078	28.501	113.033
5.00	408.00	1,252,244	28.665	141.699
6.00	409.00	1,259,460	28.830	170.529
7.00	410.00	1,266,727	28.997	199.526

Culvert / Orifice Structures

	[A]	[B]	[C]	[PrfRsr]
Rise (in)	= 24.00	Inactive	Inactive	Inactive
Span (in)	= 24.00	0.00	0.00	0.00
No. Barrels	= 1	0	0	0
Invert El. (ft)	= 385.00	0.00	0.00	0.00
Length (ft)	= 100.00	0.00	0.00	0.00
Slope (%)	= 5.00	0.00	0.00	n/a
N-Value	= .013	.013	.013	n/a
Orifice Coeff.	= 0.67	0.60	0.60	0.60
Multi-Stage	= n/a	No	No	No

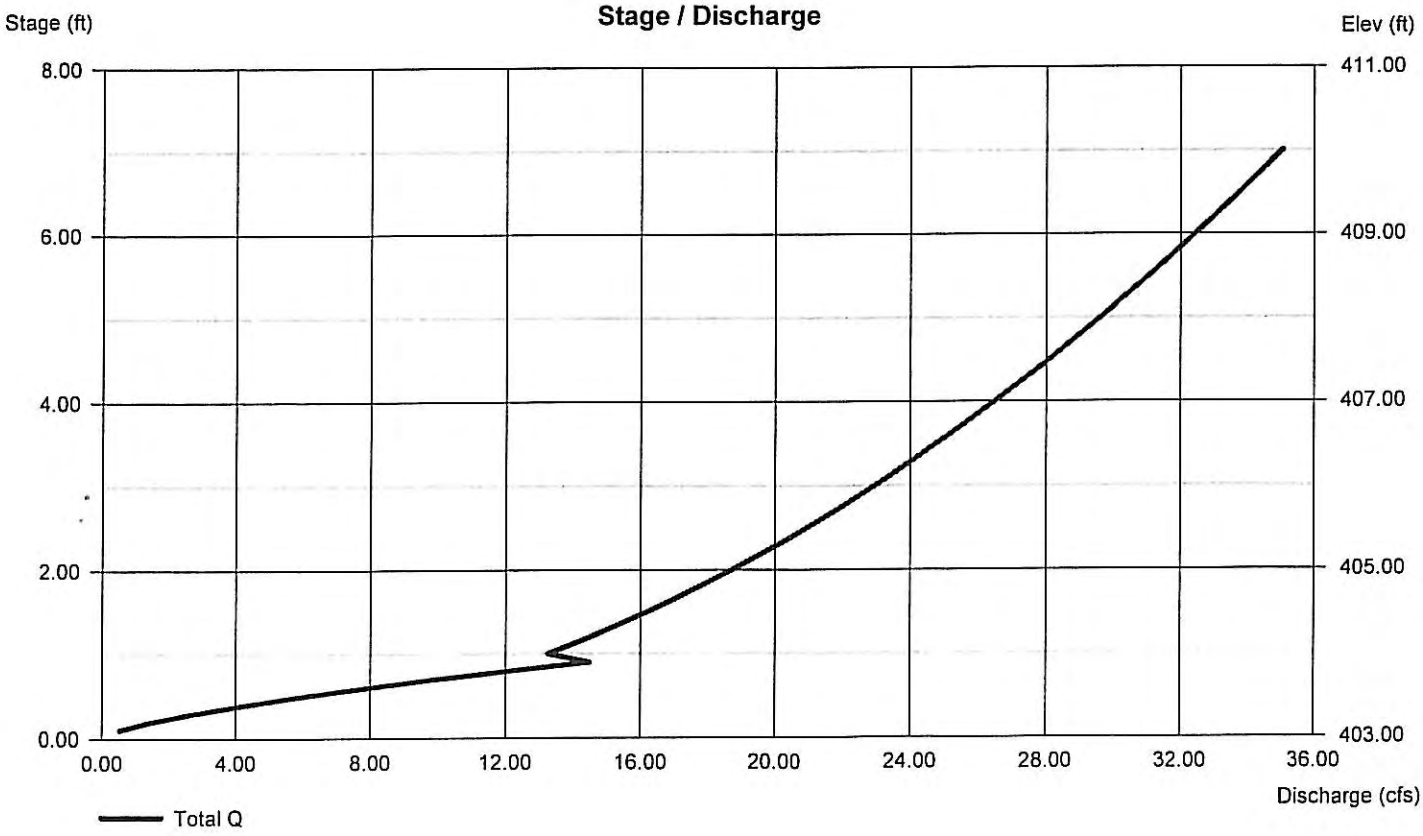
Weir Structures

	[A]	[B]	[C]	[D]
Crest Len (ft)	= 6.28	Inactive	Inactive	Inactive
Crest El. (ft)	= 403.00	0.00	0.00	0.00
Weir Coeff.	= 2.70	3.33	3.33	3.33
Weir Type	= Riser	---	---	---
Multi-Stage	= Yes	No	No	No

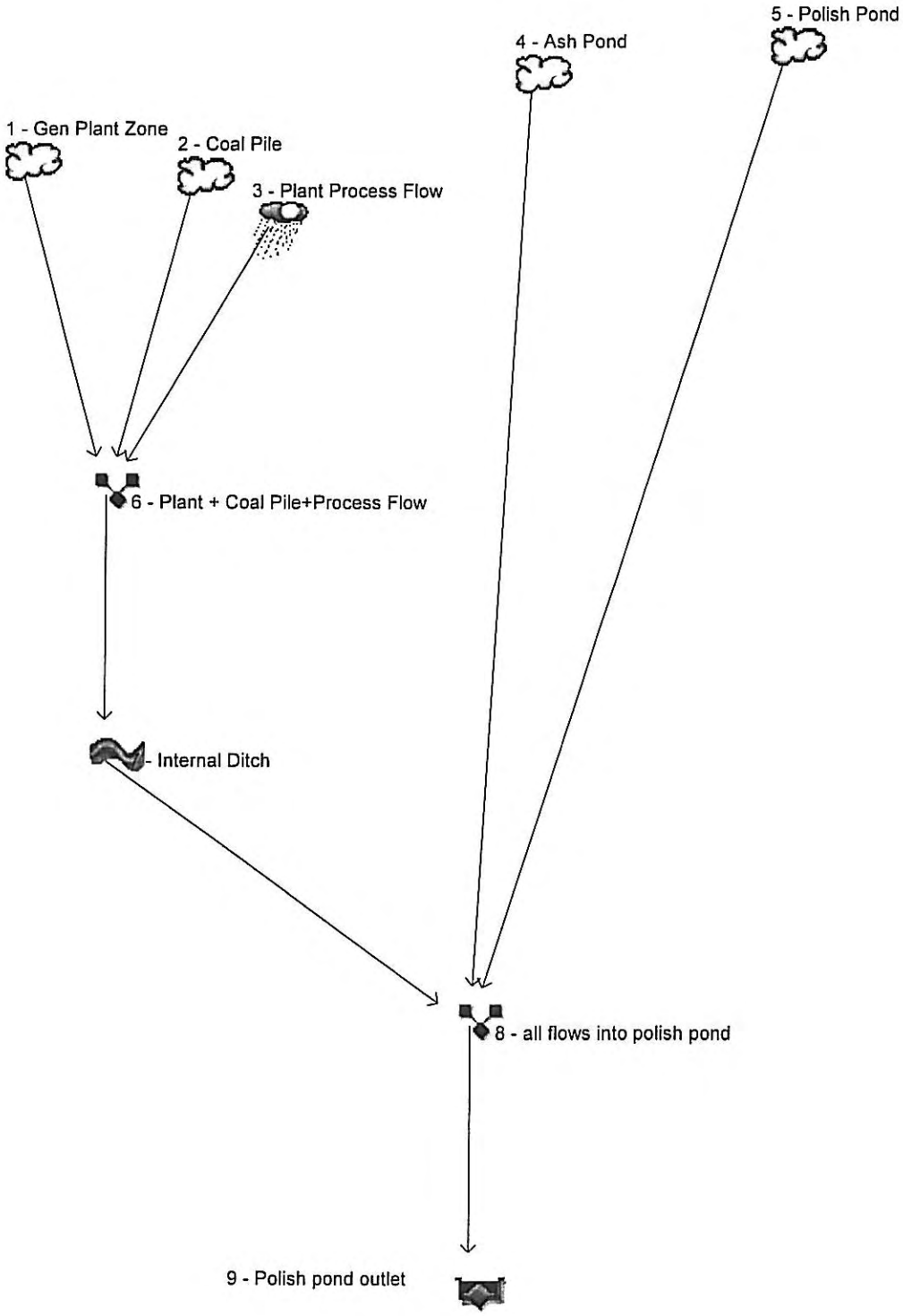
Exfil.(in/hr) = 0.000 (by Wet area)

TW Elev. (ft) = 0.00

Note: Culvert/Orifice outflows are analyzed under inlet (ic) and outlet (oc) control. Weir risers checked for orifice conditions (ic) and submergence (s).



Watershed Model Schematic



Hydrograph Summary Report

Hydraflow Hydrographs by Intelisolve v9.23

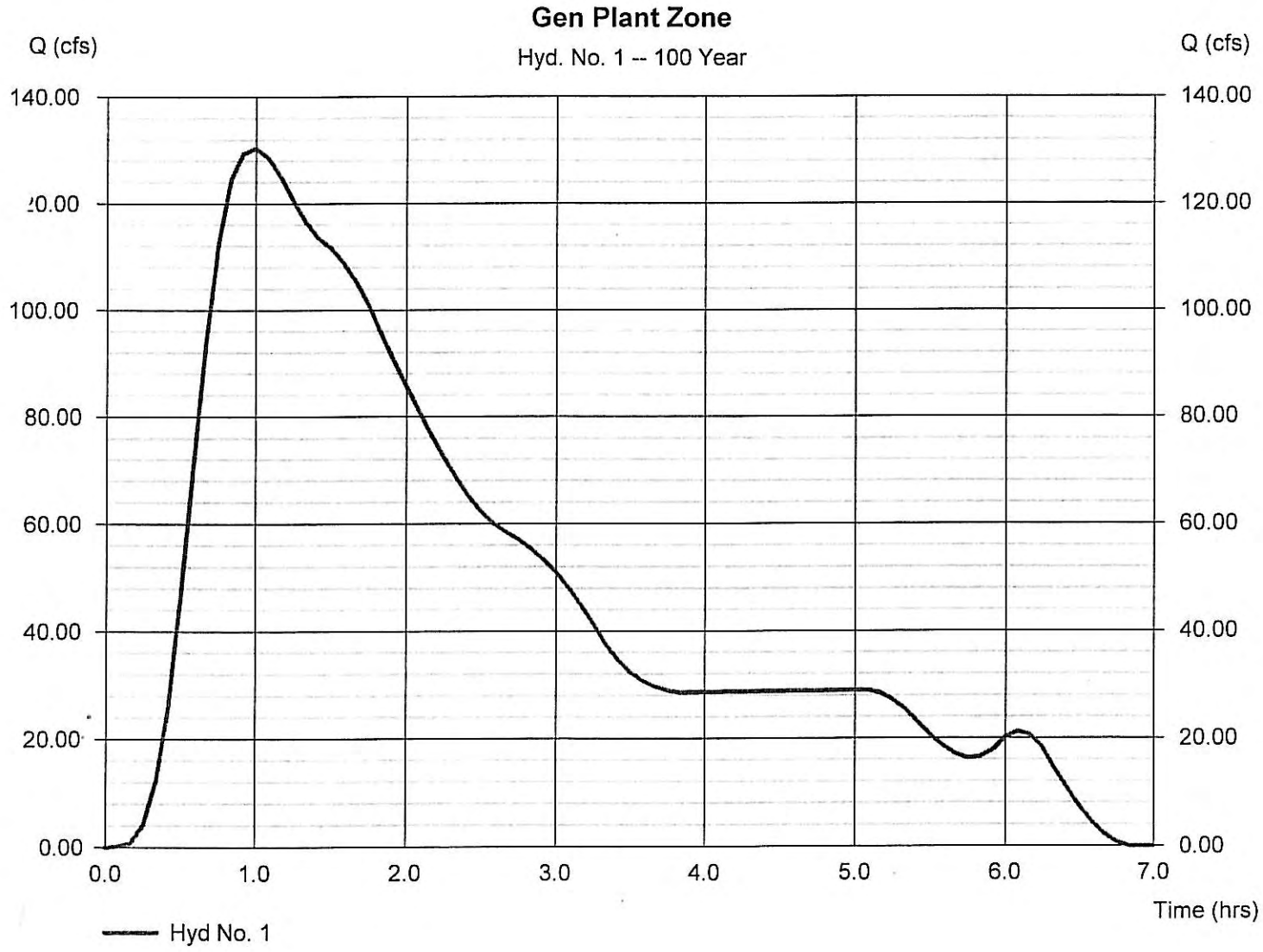
Hyd. No.	Hydrograph type (origin)	Peak flow (cfs)	Time interval (min)	Time to peak (min)	Hyd. volume (acft)	Inflow hyd(s)	Maximum elevation (ft)	Total strge used (acft)	Hydrograph description
1	SCS Runoff	130.36	5	60	27.092	----	------	------	Gen Plant Zone
2	SCS Runoff	100.99	5	40	17.352	----	------	------	Coal Pile
3	Manual	20.00	5	5	49.587	----	------	------	Plant Process Flow
4	SCS Runoff	97.72	5	70	22.381	----	------	------	Ash Pond
5	SCS Runoff	80.40	5	35	11.781	----	------	------	Polish Pond
6	Combine	226.00	5	50	94.031	1, 2, 3,	------	------	Plant + Coal Pile+Process Flow
7	Reach	226.18	5	55	94.174	6	------	------	Internal Ditch
8	Combine	367.43	5	65	128.336	4, 5, 7	------	------	all flows into polish pond
9	Reservoir	23.51	5	405	126.749	8	398.25	79.8	Polish pond outlet

Hydrograph Report

Hyd. No. 1

Gen Plant Zone

Hydrograph type	= SCS Runoff	Peak discharge	= 130.36 cfs
Storm frequency	= 100 yrs	Time to peak	= 1.00 hrs
Time interval	= 5 min	Hyd. volume	= 27.092 acft
Drainage area	= 86.300 ac	Curve number	= 86
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= USER	Time of conc. (Tc)	= 30.00 min
Total precip.	= 5.20 in	Distribution	= Huff-1st
Storm duration	= 6.00 hrs	Shape factor	= 484

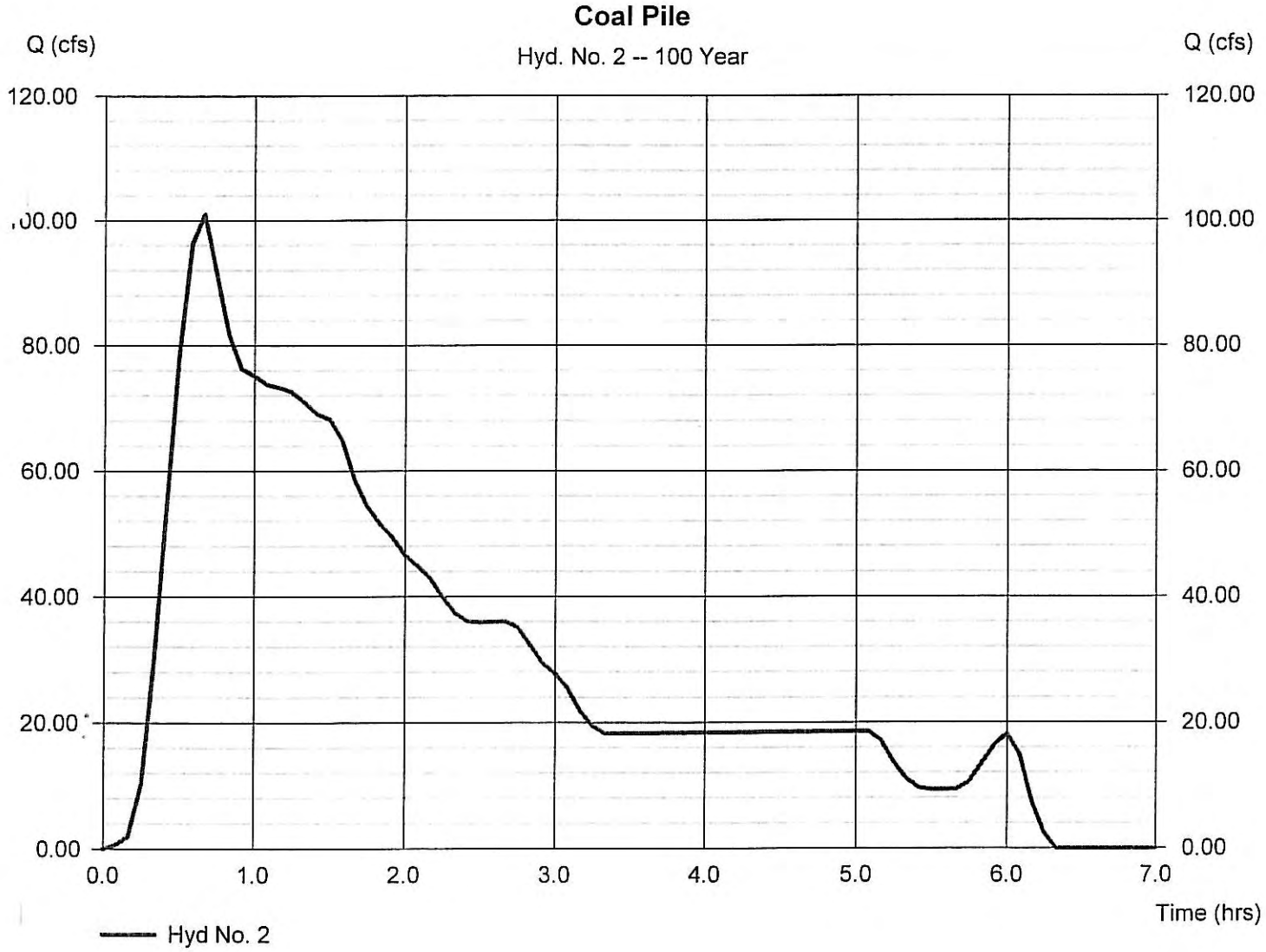


Hydrograph Report

Hyd. No. 2

Coal Pile

Hydrograph type	= SCS Runoff	Peak discharge	= 100.99 cfs
Storm frequency	= 100 yrs	Time to peak	= 0.67 hrs
Time interval	= 5 min	Hyd. volume	= 17.352 acft
Drainage area	= 60.800 ac	Curve number	= 86
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= USER	Time of conc. (Tc)	= 12.00 min
Total precip.	= 5.20 in	Distribution	= Huff-1st
Storm duration	= 6.00 hrs	Shape factor	= 484

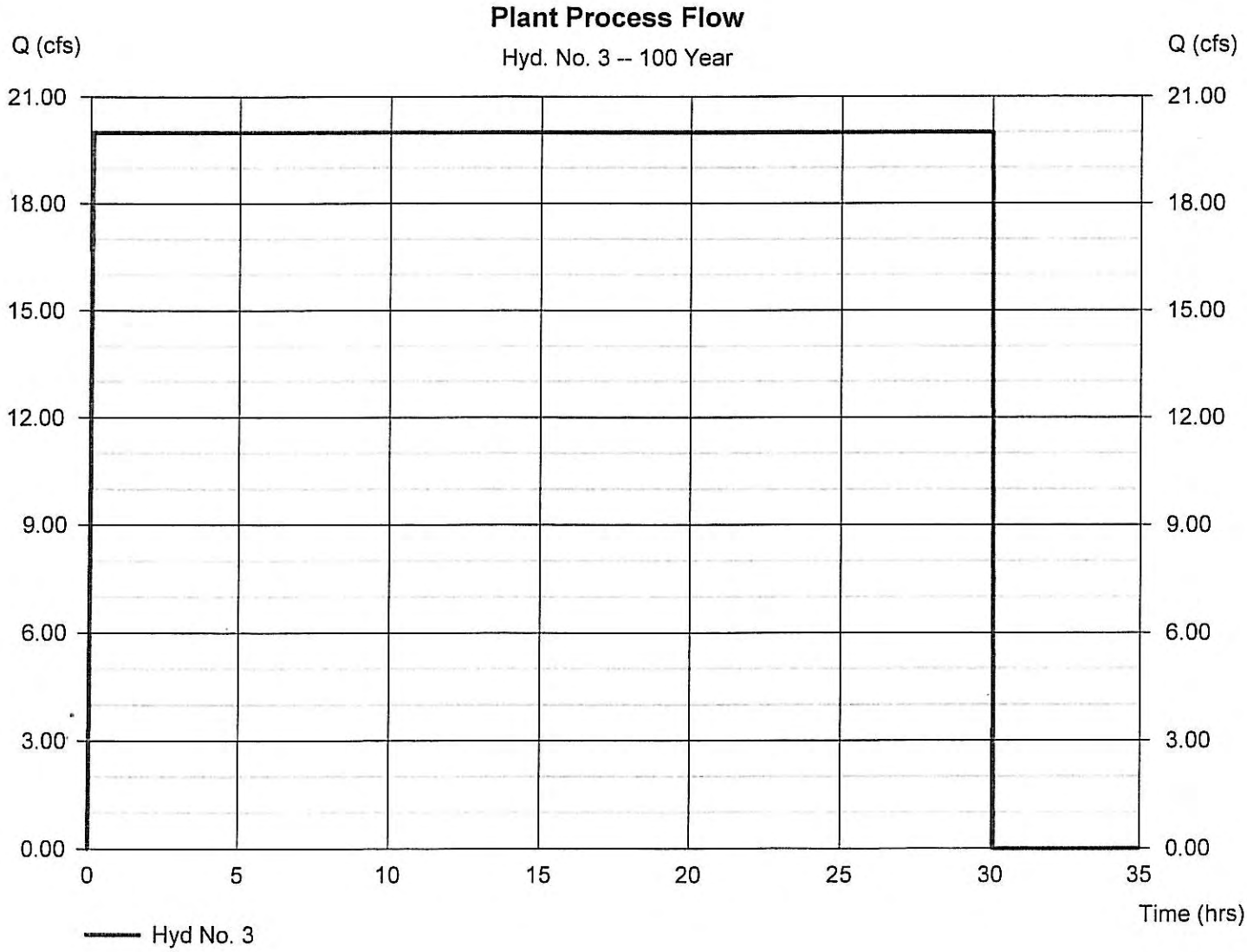


Hydrograph Report

Hyd. No. 3

Plant Process Flow

Hydrograph type	= Manual	Peak discharge	= 20.00 cfs
Storm frequency	= 100 yrs	Time to peak	= 0.08 hrs
Time interval	= 5 min	Hyd. volume	= 49.587 acft

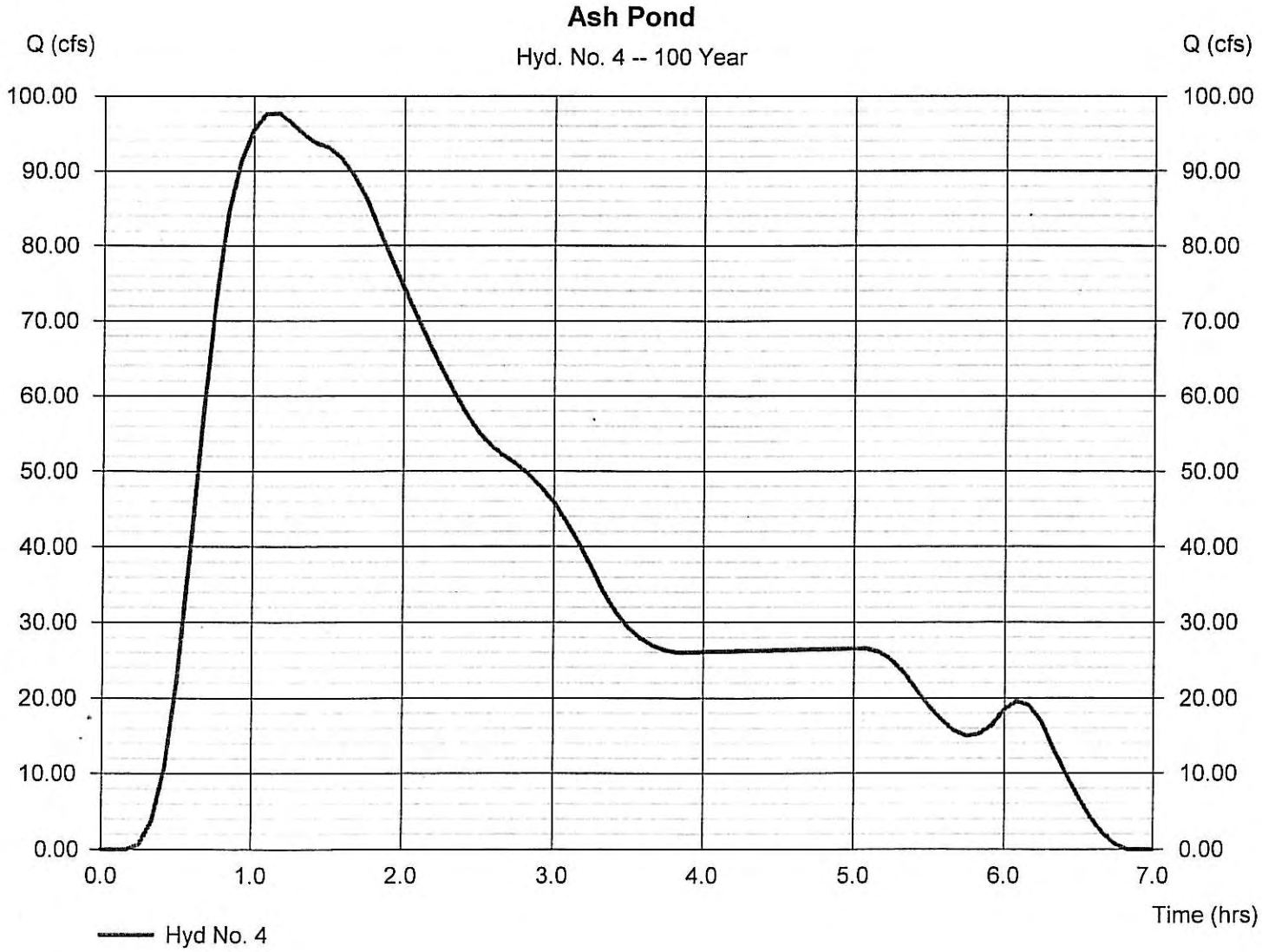


Hydrograph Report

Hyd. No. 4

Ash Pond

Hydrograph type	= SCS Runoff	Peak discharge	= 97.72 cfs
Storm frequency	= 100 yrs	Time to peak	= 1.17 hrs
Time interval	= 5 min	Hyd. volume	= 22.381 acft
Drainage area	= 84.900 ac	Curve number	= 80
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= USER	Time of conc. (Tc)	= 33.00 min
Total precip.	= 5.20 in	Distribution	= Huff-1st
Storm duration	= 6.00 hrs	Shape factor	= 484

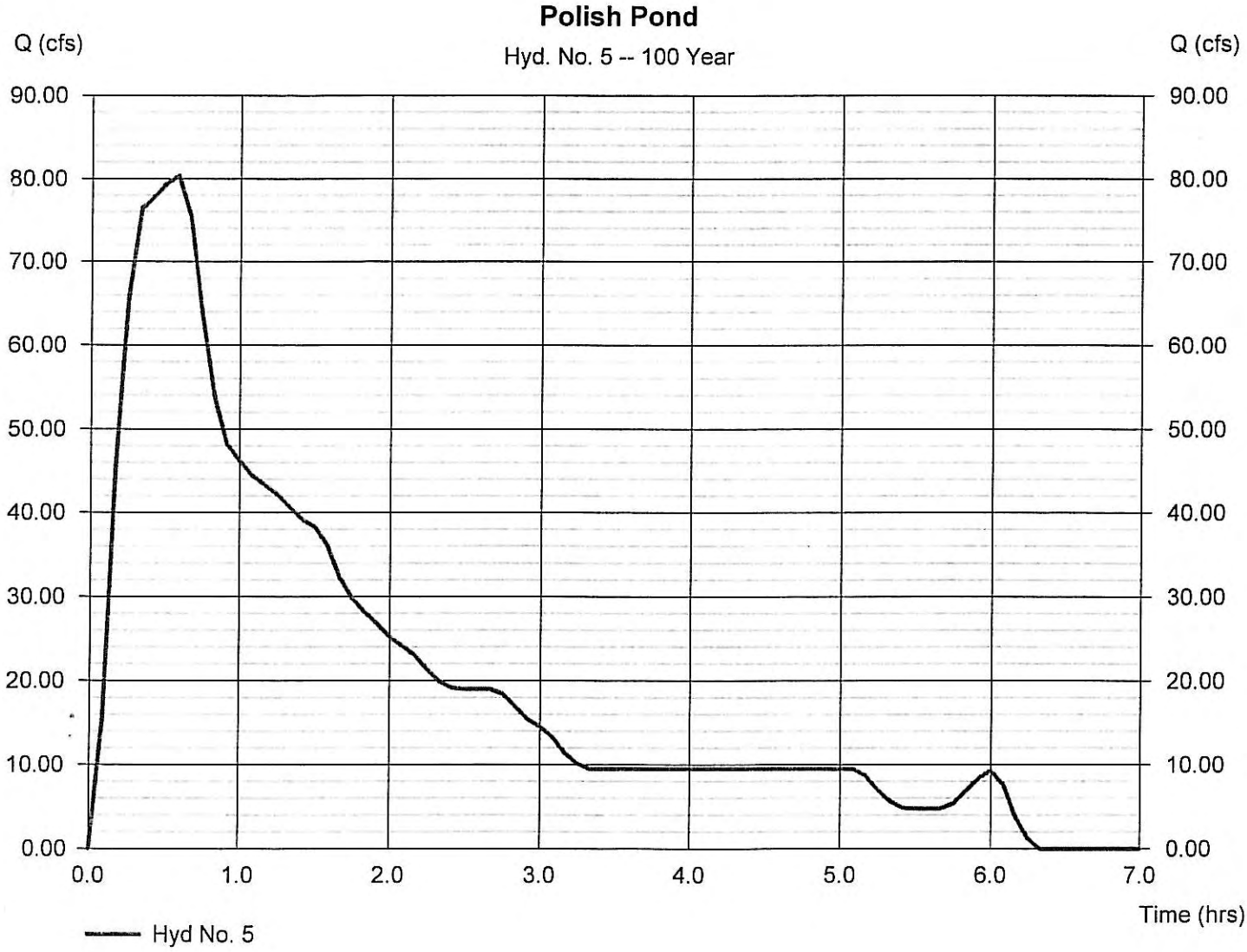


Hydrograph Report

Hyd. No. 5

Polish Pond

Hydrograph type	= SCS Runoff	Peak discharge	= 80.40 cfs
Storm frequency	= 100 yrs	Time to peak	= 0.58 hrs
Time interval	= 5 min	Hyd. volume	= 11.781 acft
Drainage area	= 29.000 ac	Curve number	= 100
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= USER	Time of conc. (Tc)	= 10.00 min
Total precip.	= 5.20 in	Distribution	= Huff-1st
Storm duration	= 6.00 hrs	Shape factor	= 484

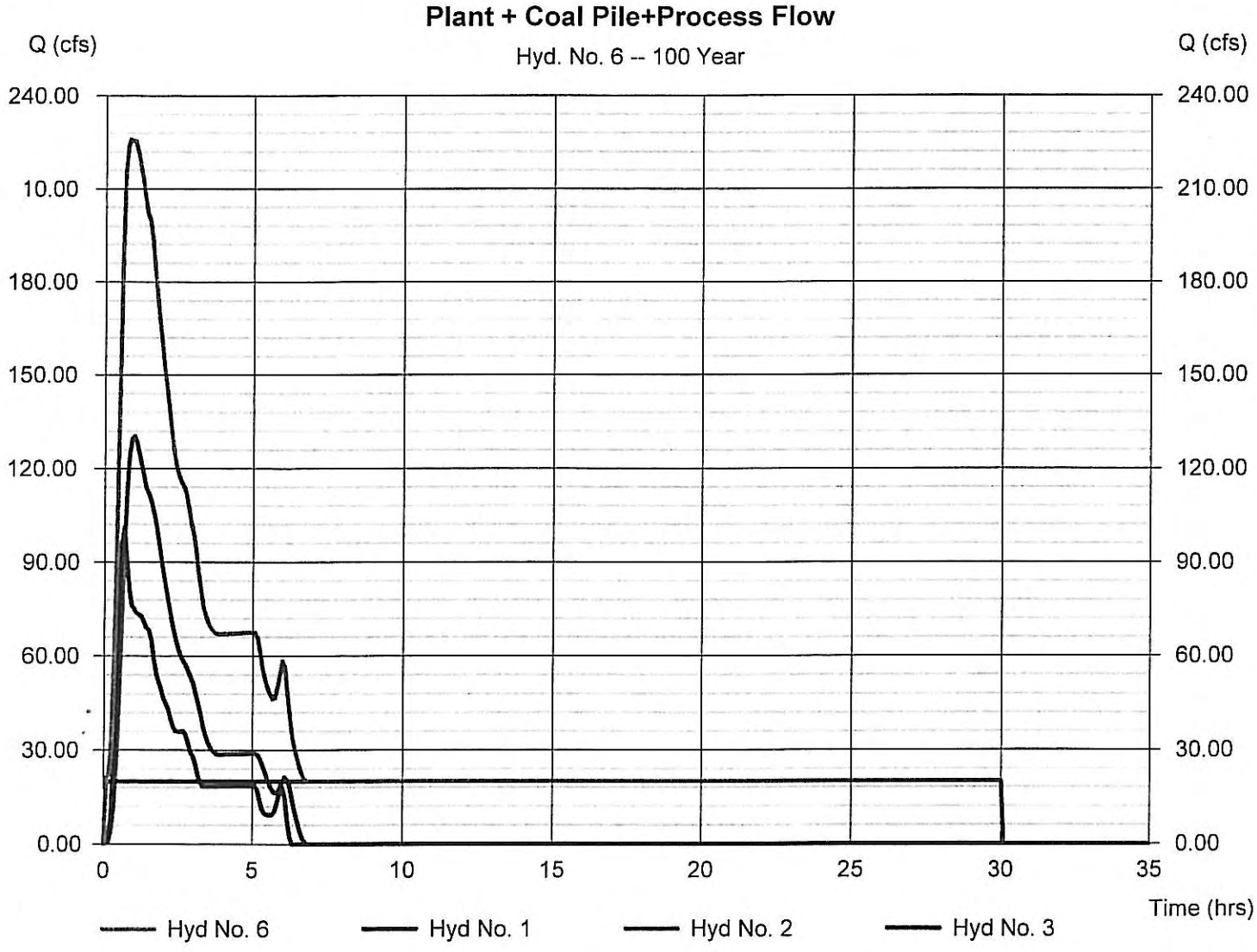


Hydrograph Report

Hyd. No. 6

Plant + Coal Pile+Process Flow

Hydrograph type	= Combine	Peak discharge	= 226.00 cfs
Storm frequency	= 100 yrs	Time to peak	= 0.83 hrs
Time interval	= 5 min	Hyd. volume	= 94.031 acft
Inflow hyds.	= 1, 2, 3	Contrib. drain. area	= 147.100 ac



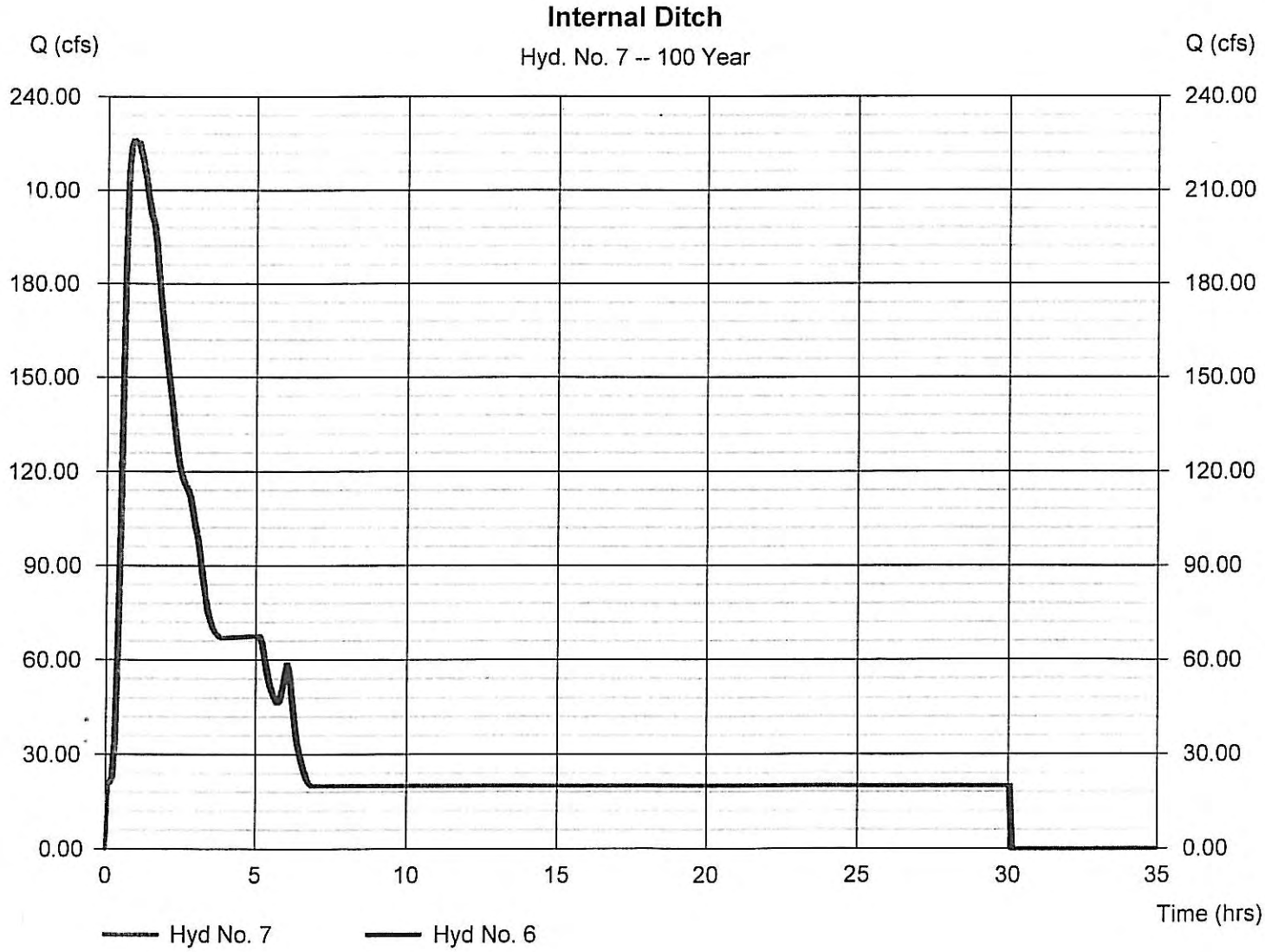
Hydrograph Report

Hyd. No. 7

Internal Ditch

Hydrograph type	= Reach	Peak discharge	= 226.18 cfs
Storm frequency	= 100 yrs	Time to peak	= 0.92 hrs
Time interval	= 5 min	Hyd. volume	= 94.174 acft
Inflow hyd. No.	= 6 - Plant + Coal Pile+Process Flow	Section type	= Trapezoidal
Reach length	= 1800.0 ft	Channel slope	= 0.3 %
Manning's n	= 0.009	Bottom width	= 10.0 ft
Side slope	= 0.5:1	Max. depth	= 8.0 ft
Rating curve x	= 1.886	Rating curve m	= 1.516
Ave. velocity	= 9.62 ft/s	Routing coeff.	= 1.0972

Modified Att-Kin routing method used.

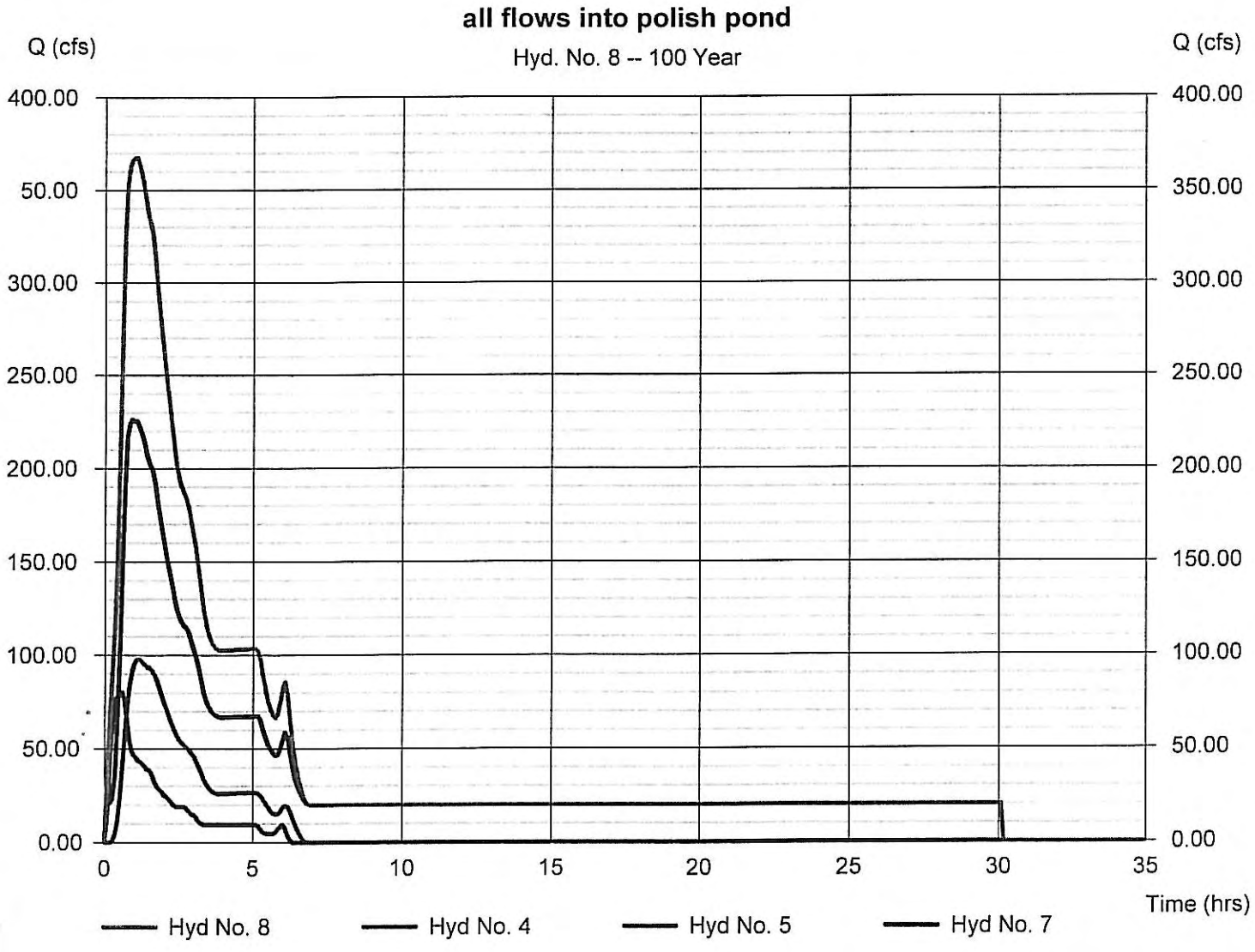


Hydrograph Report

Hyd. No. 8

all flows into polish pond

Hydrograph type	= Combine	Peak discharge	= 367.43 cfs
Storm frequency	= 100 yrs	Time to peak	= 1.08 hrs
Time interval	= 5 min	Hyd. volume	= 128.336 acft
Inflow hyds.	= 4, 5, 7	Contrib. drain. area	= 113.900 ac



Hydrograph Report

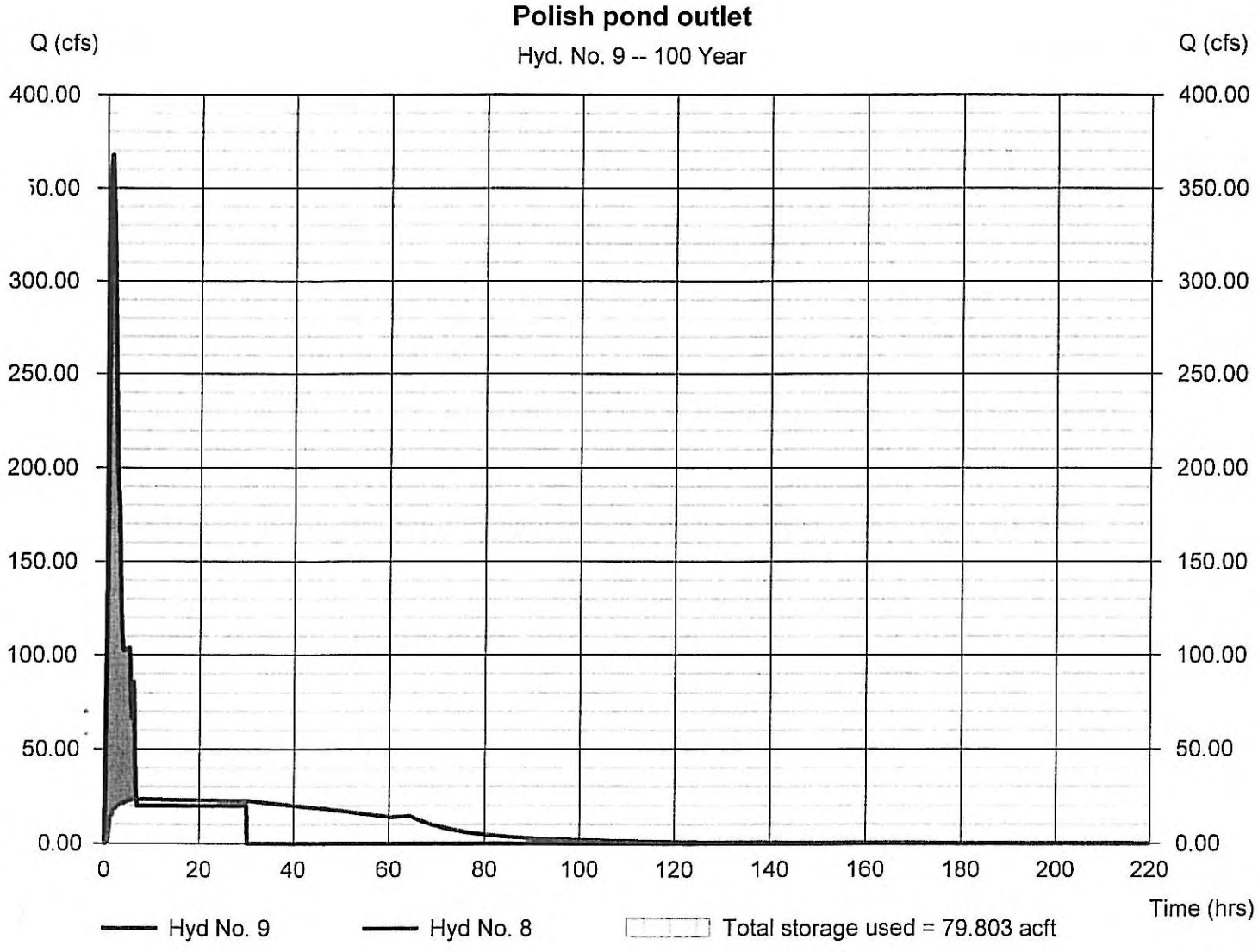
Hydraflow Hydrographs by Intelisolve v9.23 — Friday, Jan 8, 2010

Hyd. No. 9

Polish pond outlet

Hydrograph type	= Reservoir	Peak discharge	= 23.51 cfs
Storm frequency	= 100 yrs	Time to peak	= 6.75 hrs
Time interval	= 5 min	Hyd. volume	= 126.749 acft
Inflow hyd. No.	= 8 - all flows into polish pond	Max. Elevation	= 398.25 ft
Reservoir name	= Polish pond	Max. Storage	= 79.803 acft

Storage Indication method used.



Pond No. 2 - Polish pond

Pond Data

Contours - User-defined contour areas. Average end area method used for volume calculation. Begining Elevation = 395.00 ft

Stage / Storage Table

Stage (ft)	Elevation (ft)	Contour area (sqft)	Incr. Storage (acft)	Total storage (acft)
0.00	395.00	823,284	0.000	0.000
2.00	397.00	1,176,165	45.901	45.901
3.00	398.00	1,187,259	27.128	73.029
4.00	399.00	1,189,548	27.282	100.311
5.00	400.00	1,196,314	27.386	127.697
6.00	401.00	1,203,130	27.542	155.239
7.00	402.00	1,209,997	27.699	182.938
8.00	403.00	1,216,913	27.857	210.795
9.00	404.00	1,223,879	28.016	238.812
10.00	405.00	1,230,895	28.177	266.989

Culvert / Orifice Structures

	[A]	[B]	[C]	[PrfRsr]
Rise (in)	= 24.00	Inactive	Inactive	Inactive
Span (in)	= 24.00	0.00	0.00	0.00
No. Barrels	= 1	0	0	0
Invert El. (ft)	= 385.00	0.00	0.00	0.00
Length (ft)	= 100.00	0.00	0.00	0.00
Slope (%)	= 5.00	0.00	0.00	n/a
N-Value	= .013	.013	.013	n/a
Orifice Coeff.	= 0.67	0.60	0.60	0.60
Multi-Stage	= n/a	No	No	No

Weir Structures

	[A]	[B]	[C]	[D]
Crest Len (ft)	= 6.28	Inactive	Inactive	Inactive
Crest El. (ft)	= 395.10	0.00	0.00	0.00
Weir Coeff.	= 2.70	3.33	3.33	3.33
Weir Type	= Riser	---	---	---
Multi-Stage	= Yes	No	No	No

Exfil.(in/hr) = 0.000 (by Wet area)

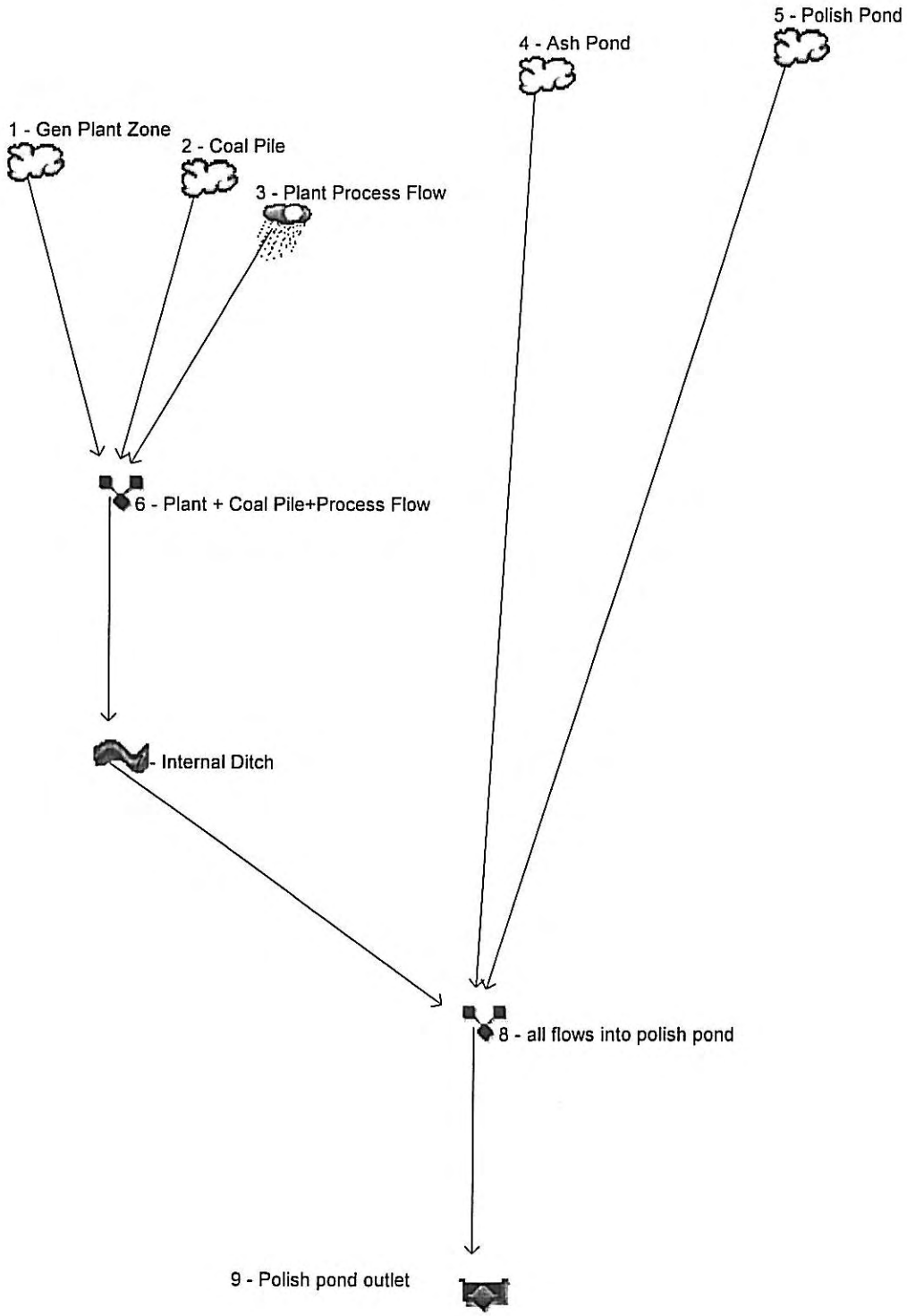
TW Elev. (ft) = 360.00

Note: Culvert/Orifice outflows are analyzed under inlet (ic) and outlet (oc) control. Weir risers checked for orifice conditions (ic) and submergence (s).

Stage / Storage / Discharge Table

Stage ft	Storage acft	Elevation ft	Clv A cfs	Clv B cfs	Clv C cfs	PrfRsr cfs	Wr A cfs	Wr B cfs	Wr C cfs	Wr D cfs	Exfil cfs	User cfs	Total cfs
0.00	0.000	395.00	0.00	---	---	---	0.00	---	---	---	---	---	0.000
2.00	45.901	397.00	50.67 ic	---	---	---	18.27 ic	---	---	---	---	---	18.27
3.00	73.029	398.00	50.67 ic	---	---	---	22.57 ic	---	---	---	---	---	22.57
4.00	100.311	399.00	50.67 ic	---	---	---	26.17 ic	---	---	---	---	---	26.17
5.00	127.697	400.00	50.67 ic	---	---	---	29.34 ic	---	---	---	---	---	29.34
6.00	155.239	401.00	50.67 ic	---	---	---	32.19 ic	---	---	---	---	---	32.19
7.00	182.938	402.00	50.67 ic	---	---	---	34.81 ic	---	---	---	---	---	34.81
8.00	210.795	403.00	50.67 ic	---	---	---	37.25 ic	---	---	---	---	---	37.25
9.00	238.812	404.00	50.67 ic	---	---	---	39.54 ic	---	---	---	---	---	39.54
10.00	266.989	405.00	50.67 ic	---	---	---	41.70 ic	---	---	---	---	---	41.70

Watershed Model Schematic



Hydrograph Summary Report

Hydraflow Hydrographs by Intelisolve v9.23

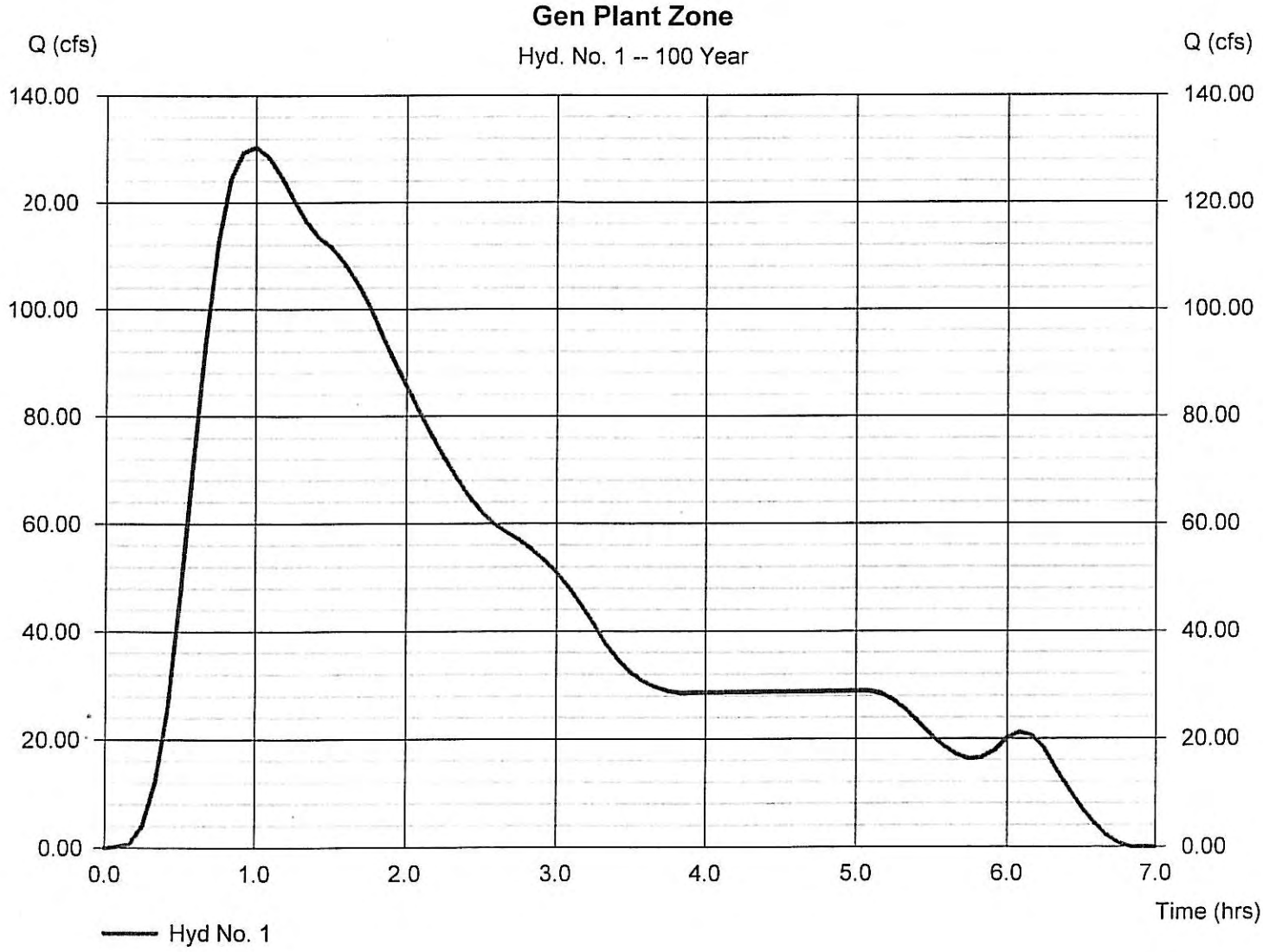
Hyd. No.	Hydrograph type (origin)	Peak flow (cfs)	Time interval (min)	Time to peak (min)	Hyd. volume (acft)	Inflow hyd(s)	Maximum elevation (ft)	Total strge used (acft)	Hydrograph description
1	SCS Runoff	130.36	5	60	27.092	----	------	------	Gen Plant Zone
2	SCS Runoff	100.99	5	40	17.352	----	------	------	Coal Pile
3	Manual	20.00	5	5	49.587	----	------	------	Plant Process Flow
4	SCS Runoff	97.72	5	70	22.381	----	------	------	Ash Pond
5	SCS Runoff	80.40	5	35	11.781	----	------	------	Polish Pond
6	Combine	226.00	5	50	94.031	1, 2, 3,	------	------	Plant + Coal Pile+Process Flow
7	Reach	226.18	5	55	94.174	6	------	------	Internal Ditch
8	Combine	367.43	5	65	128.336	4, 5, 7	------	------	all flows into polish pond
9	Reservoir	22.38	5	405	127.674	8	405.85	80.3	Polish pond outlet

Hydrograph Report

Hyd. No. 1

Gen Plant Zone

Hydrograph type	= SCS Runoff	Peak discharge	= 130.36 cfs
Storm frequency	= 100 yrs	Time to peak	= 1.00 hrs
Time interval	= 5 min	Hyd. volume	= 27.092 acft
Drainage area	= 86.300 ac	Curve number	= 86
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= USER	Time of conc. (Tc)	= 30.00 min
Total precip.	= 5.20 in	Distribution	= Huff-1st
Storm duration	= 6.00 hrs	Shape factor	= 484

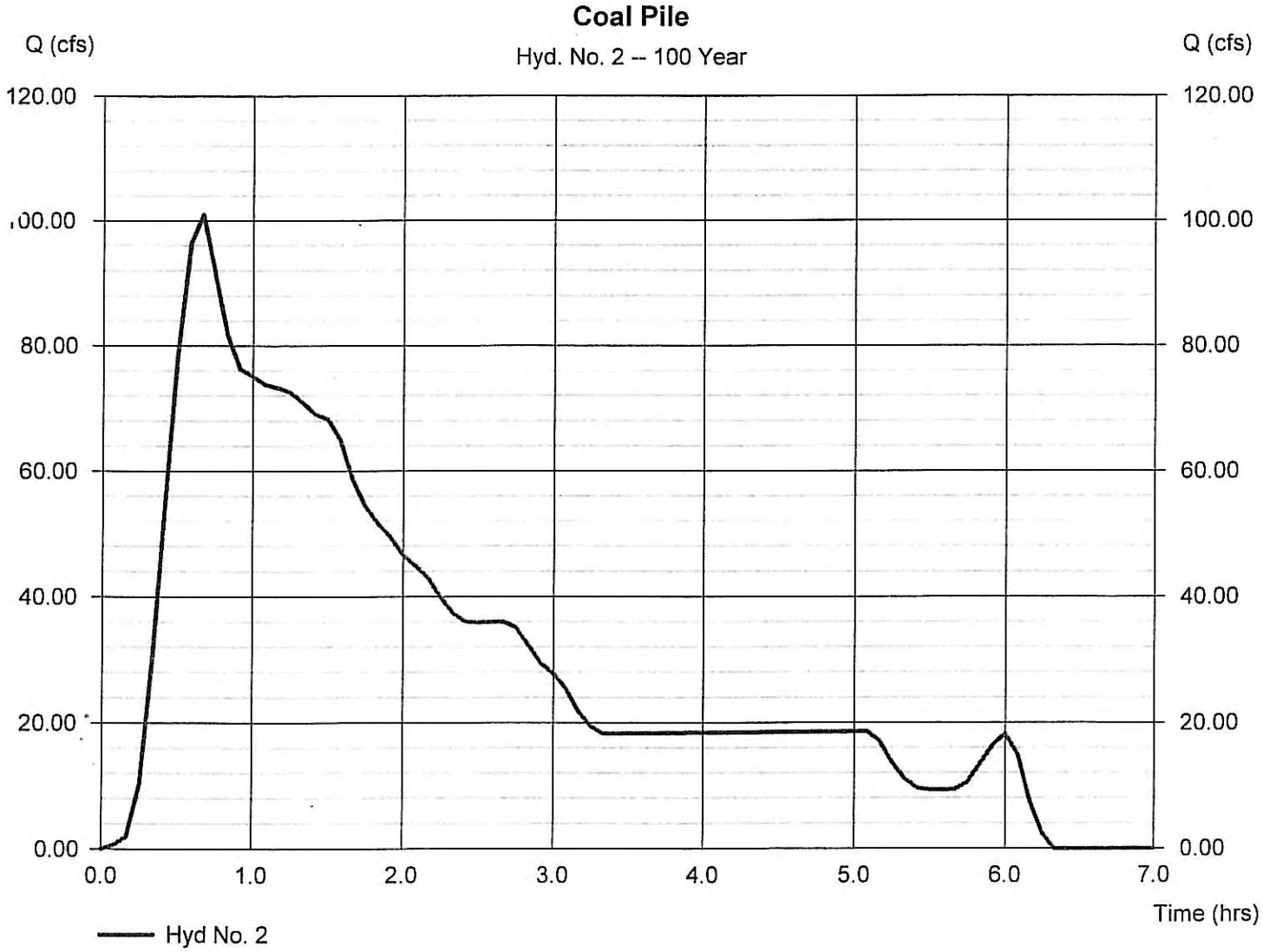


Hydrograph Report

Hyd. No. 2

Coal Pile

Hydrograph type	= SCS Runoff	Peak discharge	= 100.99 cfs
Storm frequency	= 100 yrs	Time to peak	= 0.67 hrs
Time interval	= 5 min	Hyd. volume	= 17.352 acft
Drainage area	= 60.800 ac	Curve number	= 86
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= USER	Time of conc. (Tc)	= 12.00 min
Total precip.	= 5.20 in	Distribution	= Huff-1st
Storm duration	= 6.00 hrs	Shape factor	= 484

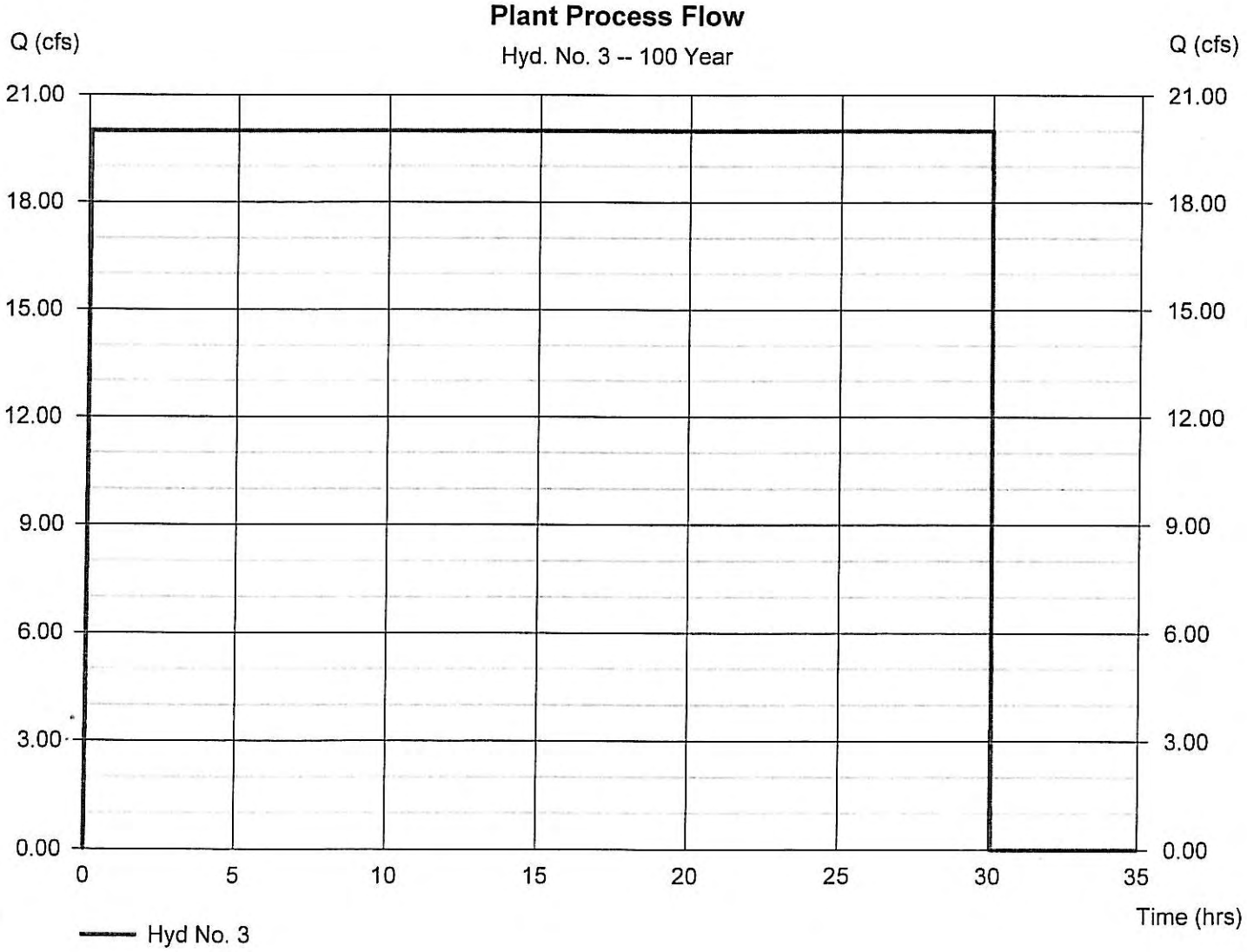


Hydrograph Report

Hyd. No. 3

Plant Process Flow

Hydrograph type	= Manual	Peak discharge	= 20.00 cfs
Storm frequency	= 100 yrs	Time to peak	= 0.08 hrs
Time interval	= 5 min	Hyd. volume	= 49.587 acft

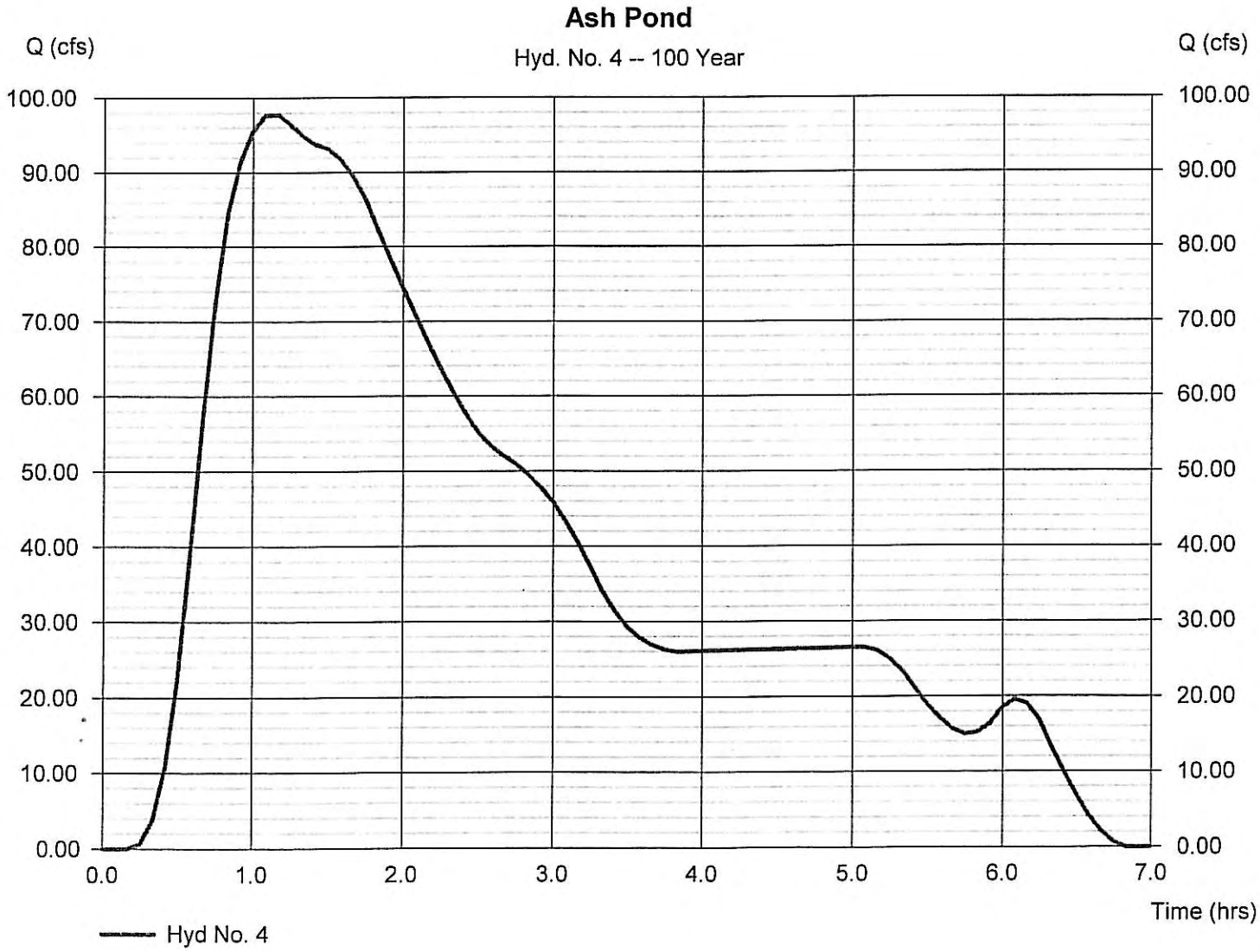


Hydrograph Report

Hyd. No. 4

Ash Pond

Hydrograph type	= SCS Runoff	Peak discharge	= 97.72 cfs
Storm frequency	= 100 yrs	Time to peak	= 1.17 hrs
Time interval	= 5 min	Hyd. volume	= 22.381 acft
Drainage area	= 84.900 ac	Curve number	= 80
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= USER	Time of conc. (Tc)	= 33.00 min
Total precip.	= 5.20 in	Distribution	= Huff-1st
Storm duration	= 6.00 hrs	Shape factor	= 484

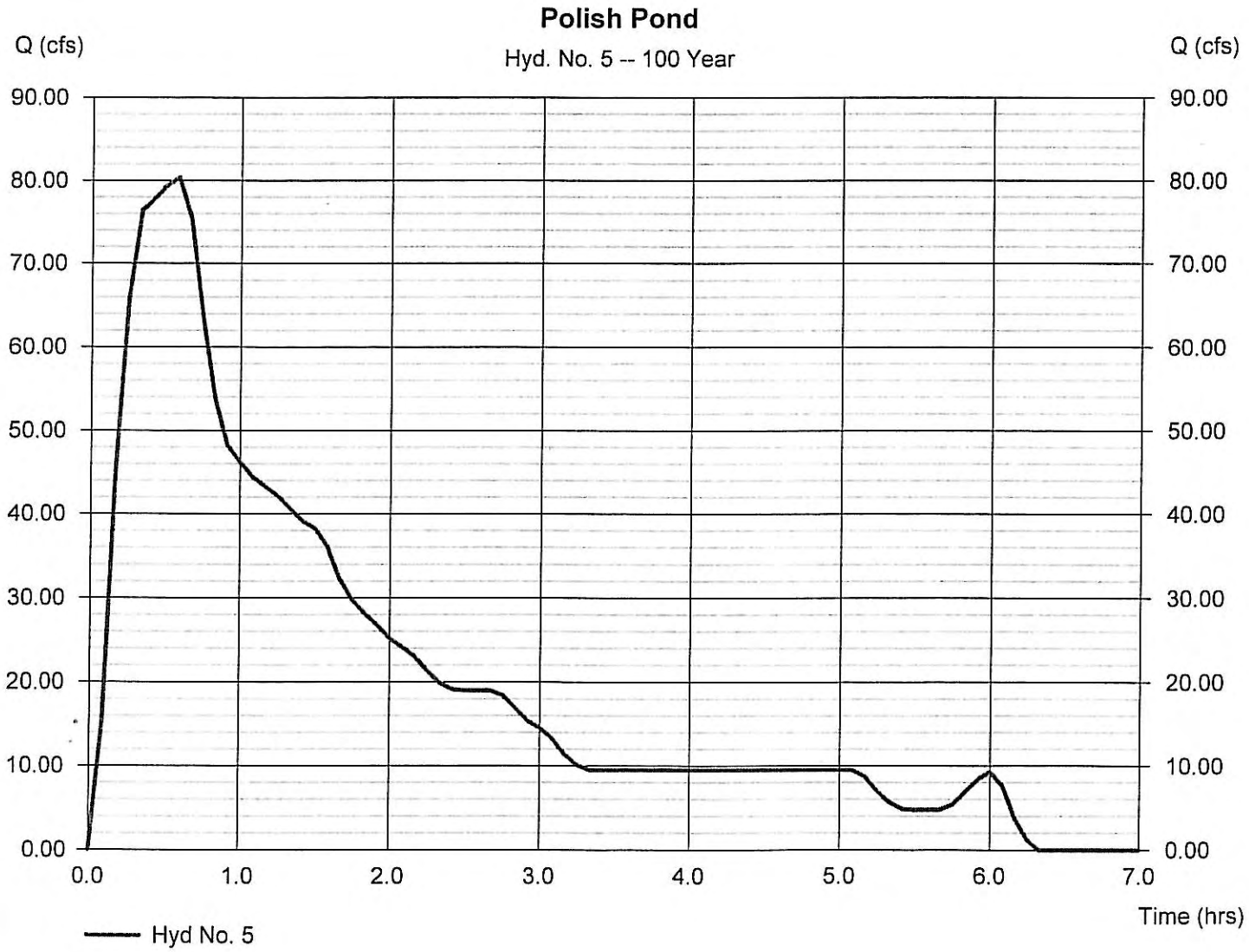


Hydrograph Report

Hyd. No. 5

Polish Pond

Hydrograph type	= SCS Runoff	Peak discharge	= 80.40 cfs
Storm frequency	= 100 yrs	Time to peak	= 0.58 hrs
Time interval	= 5 min	Hyd. volume	= 11.781 acft
Drainage area	= 29.000 ac	Curve number	= 100
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= USER	Time of conc. (Tc)	= 10.00 min
Total precip.	= 5.20 in	Distribution	= Huff-1st
Storm duration	= 6.00 hrs	Shape factor	= 484



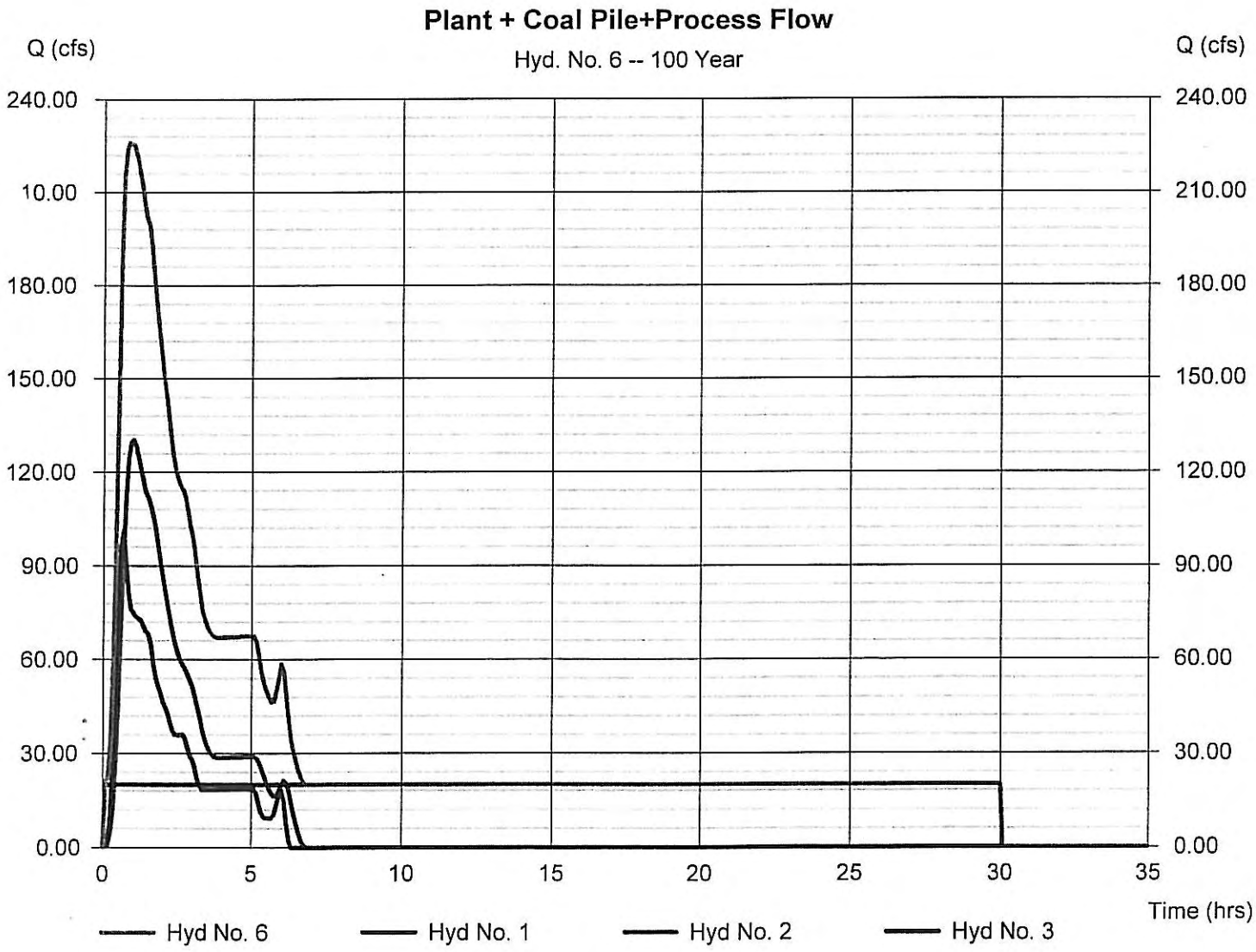
Hydrograph Report

Hydraflow Hydrographs by Intelisolve v9.23 — Friday, Jan 8, 2010

Hyd. No. 6

Plant + Coal Pile+Process Flow

Hydrograph type	= Combine	Peak discharge	= 226.00 cfs
Storm frequency	= 100 yrs	Time to peak	= 0.83 hrs
Time interval	= 5 min	Hyd. volume	= 94.031 acft
Inflow hyds.	= 1, 2, 3	Contrib. drain. area	= 147.100 ac



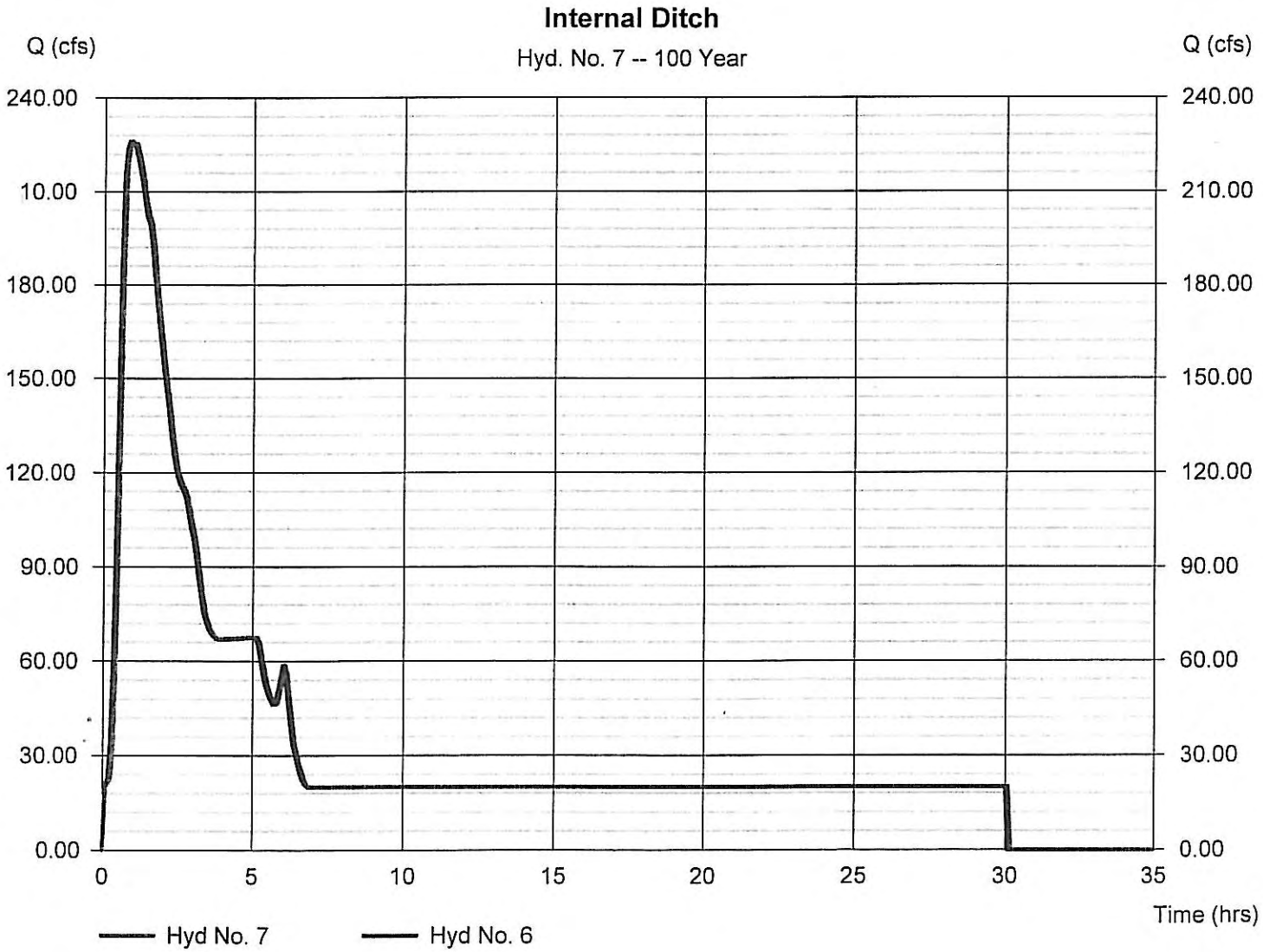
Hydrograph Report

Hyd. No. 7

Internal Ditch

Hydrograph type	= Reach	Peak discharge	= 226.18 cfs
Storm frequency	= 100 yrs	Time to peak	= 0.92 hrs
Time interval	= 5 min	Hyd. volume	= 94.174 acft
Inflow hyd. No.	= 6 - Plant + Coal Pile+Process Flow	Section type	= Trapezoidal
Reach length	= 1800.0 ft	Channel slope	= 0.3 %
Manning's n	= 0.009	Bottom width	= 10.0 ft
Side slope	= 0.5:1	Max. depth	= 8.0 ft
Rating curve x	= 1.886	Rating curve m	= 1.516
Ave. velocity	= 9.62 ft/s	Routing coeff.	= 1.0972

Modified Att-Kin routing method used.

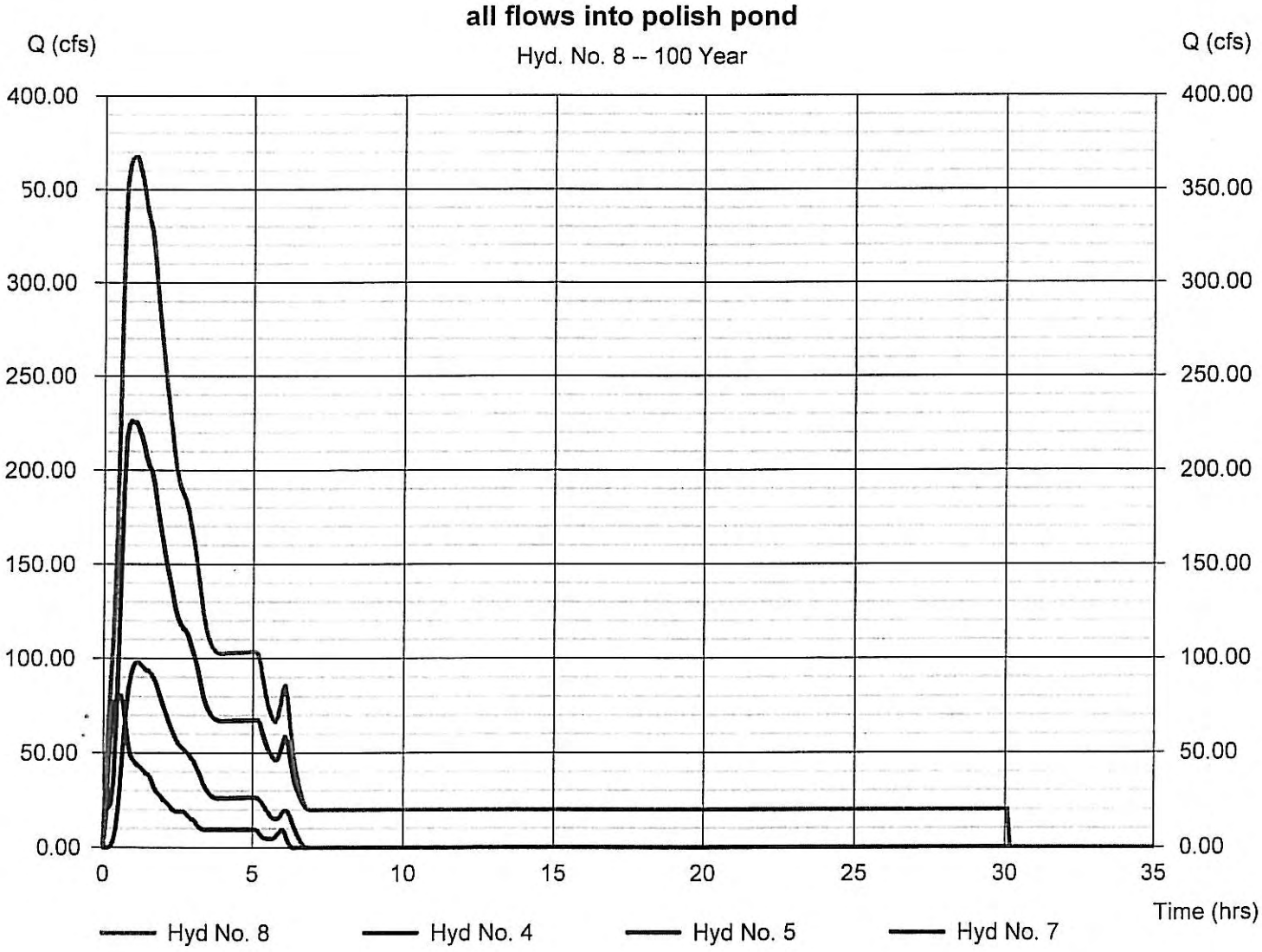


Hydrograph Report

Hyd. No. 8

all flows into polish pond

Hydrograph type	= Combine	Peak discharge	= 367.43 cfs
Storm frequency	= 100 yrs	Time to peak	= 1.08 hrs
Time interval	= 5 min	Hyd. volume	= 128.336 acft
Inflow hyds.	= 4, 5, 7	Contrib. drain. area	= 113.900 ac



Hydrograph Report

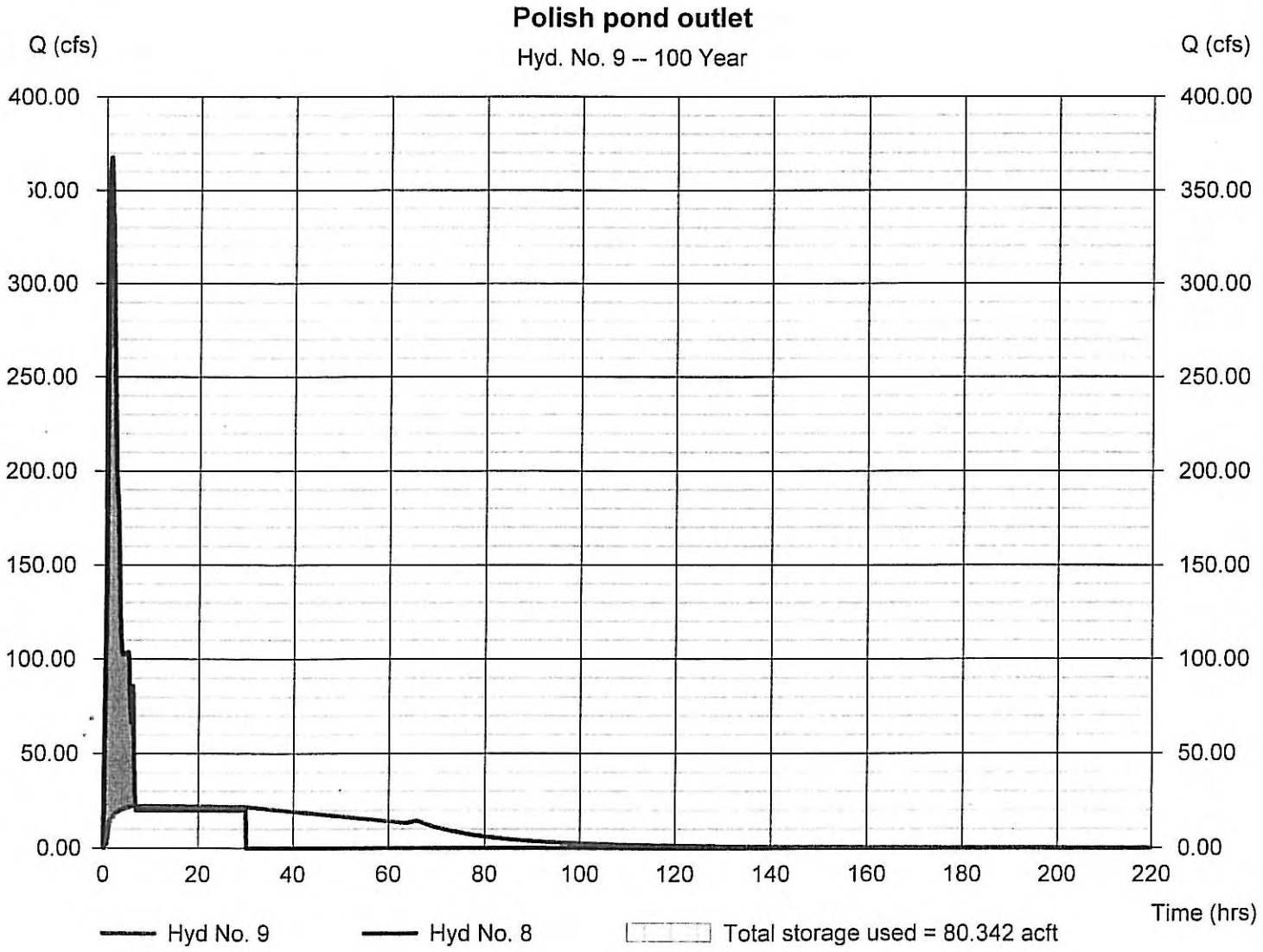
Hydraflow Hydrographs by Intelisolve v9.23 — Friday, Jan 8, 2010

Hyd. No. 9

Polish pond outlet

Hydrograph type	= Reservoir	Peak discharge	= 22.38 cfs
Storm frequency	= 100 yrs	Time to peak	= 6.75 hrs
Time interval	= 5 min	Hyd. volume	= 127.674 acft
Inflow hyd. No.	= 8 - all flows into polish pond	Max. Elevation	= 405.85 ft
Reservoir name	= Polish pond	Max. Storage	= 80.342 acft

Storage Indication method used.



Pond Report

Pond No. 2 - Polish pond

Pond Data

Contours - User-defined contour areas. Average end area method used for volume calculation. Begining Elevation = 403.00 ft

Stage / Storage Table

Stage (ft)	Elevation (ft)	Contour area (sqft)	Incr. Storage (acft)	Total storage (acft)
0.00	403.00	1,216,913	0.000	0.000
1.00	404.00	1,223,879	28.016	28.016
2.00	405.00	1,230,895	28.177	56.193
3.00	406.00	1,237,962	28.339	84.532
4.00	407.00	1,245,078	28.501	113.033
5.00	408.00	1,252,244	28.665	141.699
6.00	409.00	1,259,460	28.830	170.529
7.00	410.00	1,266,727	28.997	199.526

Culvert / Orifice Structures

	[A]	[B]	[C]	[PrfRsr]
Rise (in)	= 24.00	Inactive	Inactive	Inactive
Span (in)	= 24.00	0.00	0.00	0.00
No. Barrels	= 1	0	0	0
Invert El. (ft)	= 385.00	0.00	0.00	0.00
Length (ft)	= 100.00	0.00	0.00	0.00
Slope (%)	= 5.00	0.00	0.00	n/a
N-Value	= .013	.013	.013	n/a
Orifice Coeff.	= 0.67	0.60	0.60	0.60
Multi-Stage	= n/a	No	No	No

Weir Structures

	[A]	[B]	[C]	[D]
Crest Len (ft)	= 6.28	Inactive	Inactive	Inactive
Crest El. (ft)	= 403.00	0.00	0.00	0.00
Weir Coeff.	= 2.70	3.33	3.33	3.33
Weir Type	= Riser	---	---	---
Multi-Stage	= Yes	No	No	No

Exfil.(in/hr) = 0.000 (by Wet area)

TW Elev. (ft) = 0.00

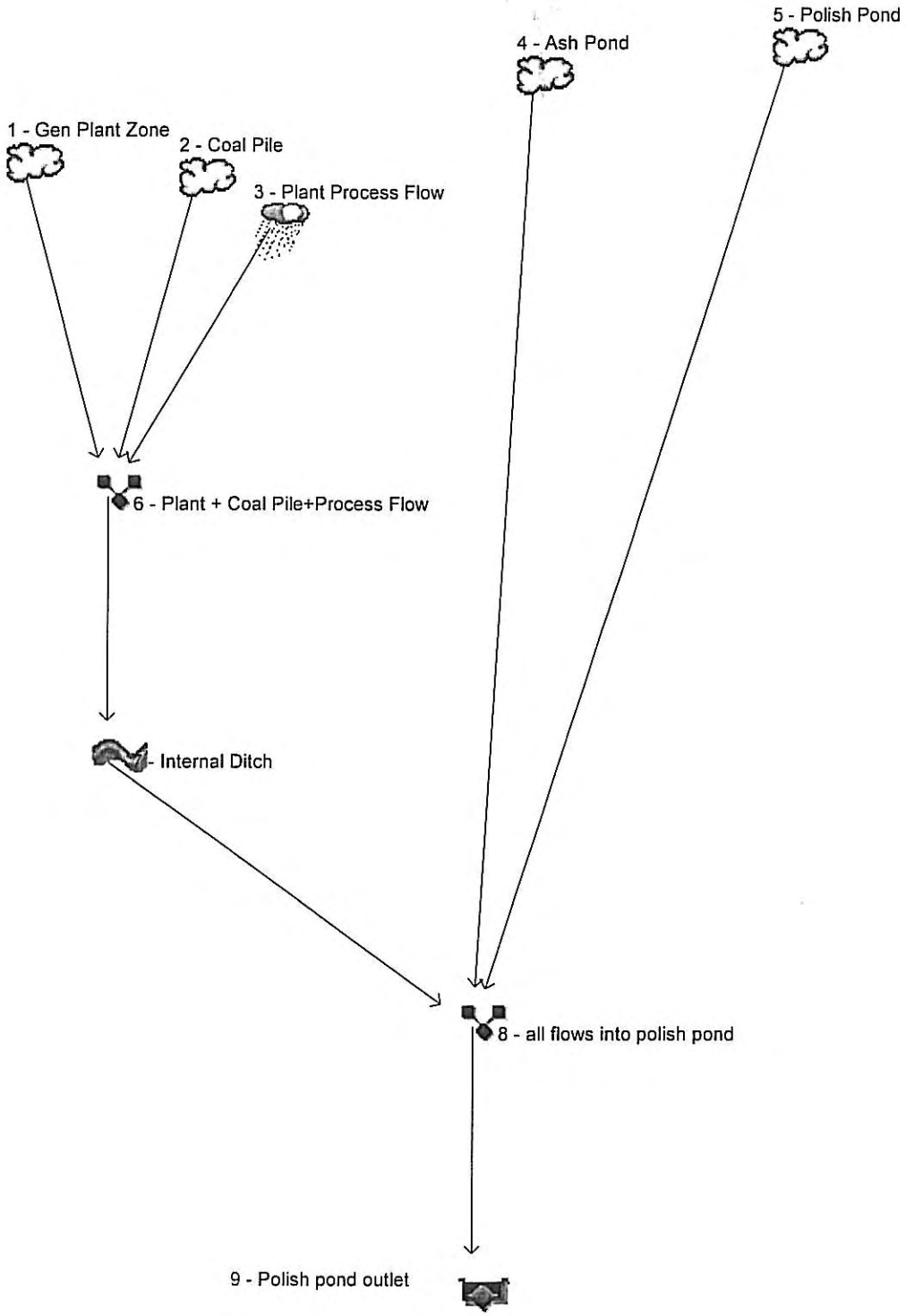
Note: Culvert/Orifice outflows are analyzed under inlet (ic) and outlet (oc) control. Weir risers checked for orifice conditions (ic) and submergence (s).

Stage / Storage / Discharge Table

Stage ft	Storage acft	Elevation ft	Clv A cfs	Clv B cfs	Clv C cfs	PrfRsr cfs	Wr A cfs	Wr B cfs	Wr C cfs	Wr D cfs	Exfil cfs	User cfs	Total cfs
0.00	0.000	403.00	0.00	---	---	---	0.00	---	---	---	---	---	0.000
1.00	28.016	404.00	69.64 ic	---	---	---	13.25 ic	---	---	---	---	---	13.25
2.00	56.193	405.00	69.64 ic	---	---	---	18.74 ic	---	---	---	---	---	18.74
3.00	84.532	406.00	69.64 ic	---	---	---	22.96 ic	---	---	---	---	---	22.96
4.00	113.033	407.00	69.64 ic	---	---	---	26.51 ic	---	---	---	---	---	26.51
5.00	141.699	408.00	69.64 ic	---	---	---	29.63 ic	---	---	---	---	---	29.63
6.00	170.529	409.00	69.64 ic	---	---	---	32.46 ic	---	---	---	---	---	32.46
7.00	199.526	410.00	69.64 ic	---	---	---	35.06 ic	---	---	---	---	---	35.06

Watershed Model Schematic

Hydraflow Hydrographs by Intelisolve v9.23



Hydrograph Return Period Recap

Hydraflow Hydrographs by Intelisolve v9.23

Hyd. No.	Hydrograph type (origin)	Inflow Hyd(s)	Peak Outflow (cfs)								Hydrograph description
			1-Yr	2-Yr	3-Yr	5-Yr	10-Yr	25-Yr	50-Yr	100-Yr	
1	SCS Runoff	-------	-------	-------	-------	-------	-------	-------	-------	130.36	Gen Plant Zone
2	SCS Runoff	-------	-------	-------	-------	-------	-------	-------	-------	100.99	Coal Pile
3	Manual	-------	-------	-------	-------	-------	-------	-------	-------	20.00	Plant Process Flow
4	SCS Runoff	-------	-------	-------	-------	-------	-------	-------	-------	97.72	Ash Pond
5	SCS Runoff	-------	-------	-------	-------	-------	-------	-------	-------	80.40	Polish Pond
6	Combine	1, 2, 3,	-------	-------	-------	-------	-------	-------	-------	226.00	Plant + Coal Pile+Process Flow
7	Reach	6	-------	-------	-------	-------	-------	-------	-------	226.18	Internal Ditch
8	Combine	4, 5, 7	-------	-------	-------	-------	-------	-------	-------	367.43	all flows into polish pond
9	Reservoir	8	-------	-------	-------	-------	-------	-------	-------	22.68	Polish pond outlet

Hydrograph Summary Report

Hydraflow Hydrographs by Intelisolve v9.23

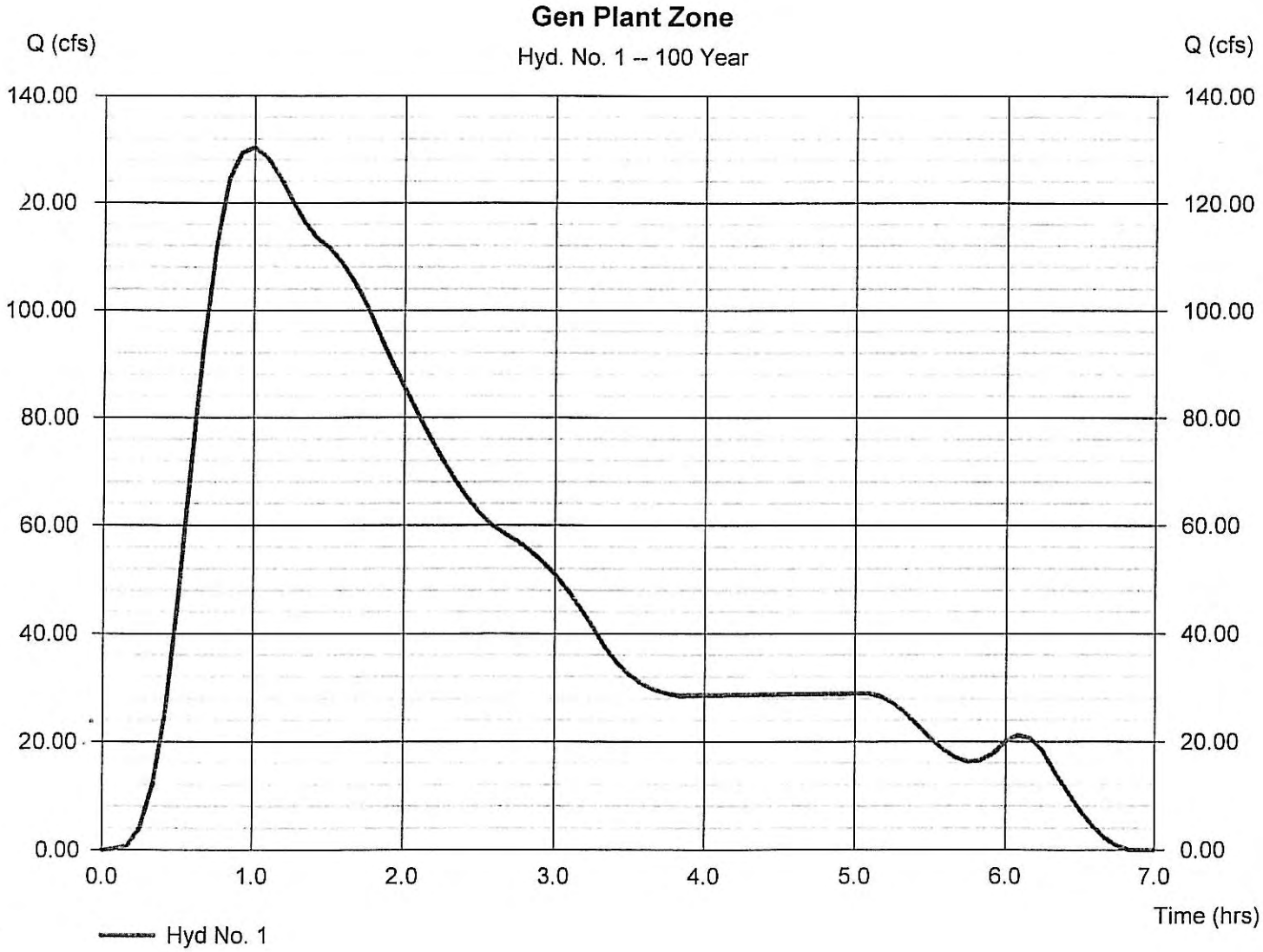
Hyd. No.	Hydrograph type (origin)	Peak flow (cfs)	Time interval (min)	Time to peak (min)	Hyd. volume (acft)	Inflow hyd(s)	Maximum elevation (ft)	Total strge used (acft)	Hydrograph description
1	SCS Runoff	130.36	5	60	27.092	----	------	------	Gen Plant Zone
2	SCS Runoff	100.99	5	40	17.352	----	------	------	Coal Pile
3	Manual	20.00	5	5	49.587	----	------	------	Plant Process Flow
4	SCS Runoff	97.72	5	70	22.381	----	------	------	Ash Pond
5	SCS Runoff	80.40	5	35	11.781	----	------	------	Polish Pond
6	Combine	226.00	5	50	94.031	1, 2, 3,	------	------	Plant + Coal Pile+Process Flow
7	Reach	226.18	5	55	94.174	6	------	------	Internal Ditch
8	Combine	367.43	5	65	128.336	4, 5, 7	------	------	all flows into polish pond
9	Reservoir	22.68	5	405	127.740	8	400.93	80.2	Polish pond outlet

Hydrograph Report

Hyd. No. 1

Gen Plant Zone

Hydrograph type	= SCS Runoff	Peak discharge	= 130.36 cfs
Storm frequency	= 100 yrs	Time to peak	= 1.00 hrs
Time interval	= 5 min	Hyd. volume	= 27.092 acft
Drainage area	= 86.300 ac	Curve number	= 86
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= USER	Time of conc. (Tc)	= 30.00 min
Total precip.	= 5.20 in	Distribution	= Huff-1st
Storm duration	= 6.00 hrs	Shape factor	= 484

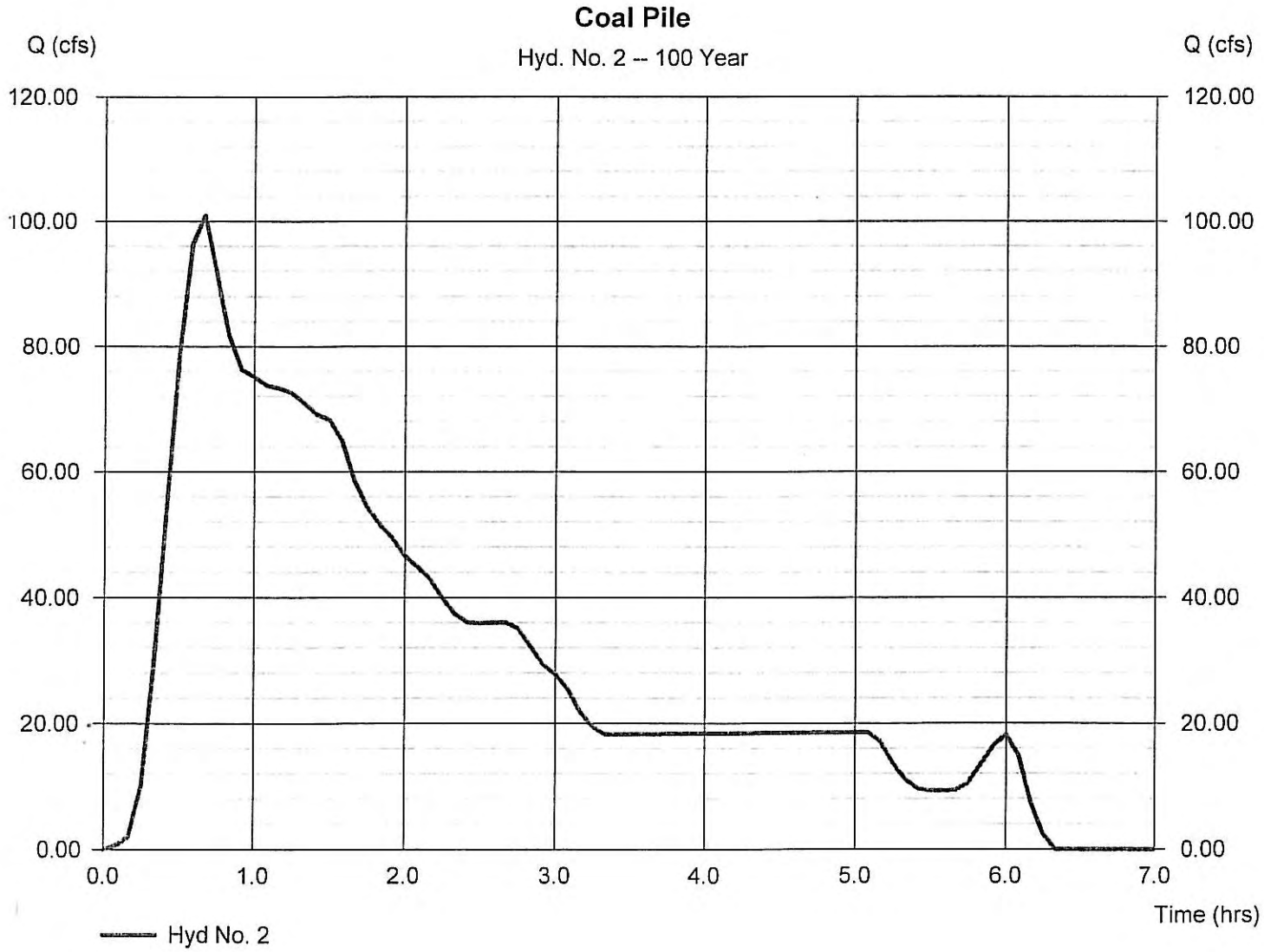


Hydrograph Report

Hyd. No. 2

Coal Pile

Hydrograph type	= SCS Runoff	Peak discharge	= 100.99 cfs
Storm frequency	= 100 yrs	Time to peak	= 0.67 hrs
Time interval	= 5 min	Hyd. volume	= 17.352 acft
Drainage area	= 60.800 ac	Curve number	= 86
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= USER	Time of conc. (Tc)	= 12.00 min
Total precip.	= 5.20 in	Distribution	= Huff-1st
Storm duration	= 6.00 hrs	Shape factor	= 484

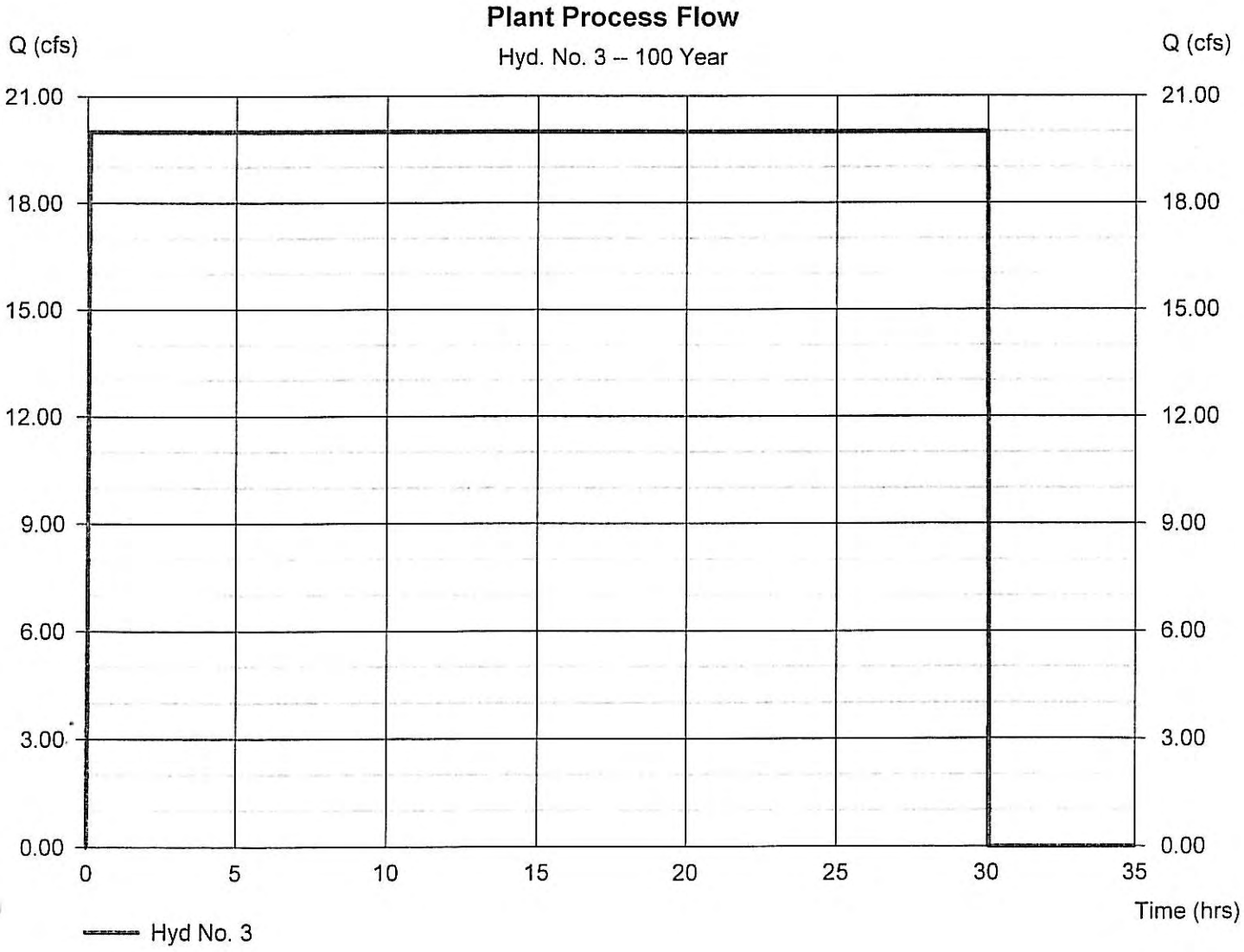


Hydrograph Report

Hyd. No. 3

Plant Process Flow

Hydrograph type	= Manual	Peak discharge	= 20.00 cfs
Storm frequency	= 100 yrs	Time to peak	= 0.08 hrs
Time interval	= 5 min	Hyd. volume	= 49.587 acft

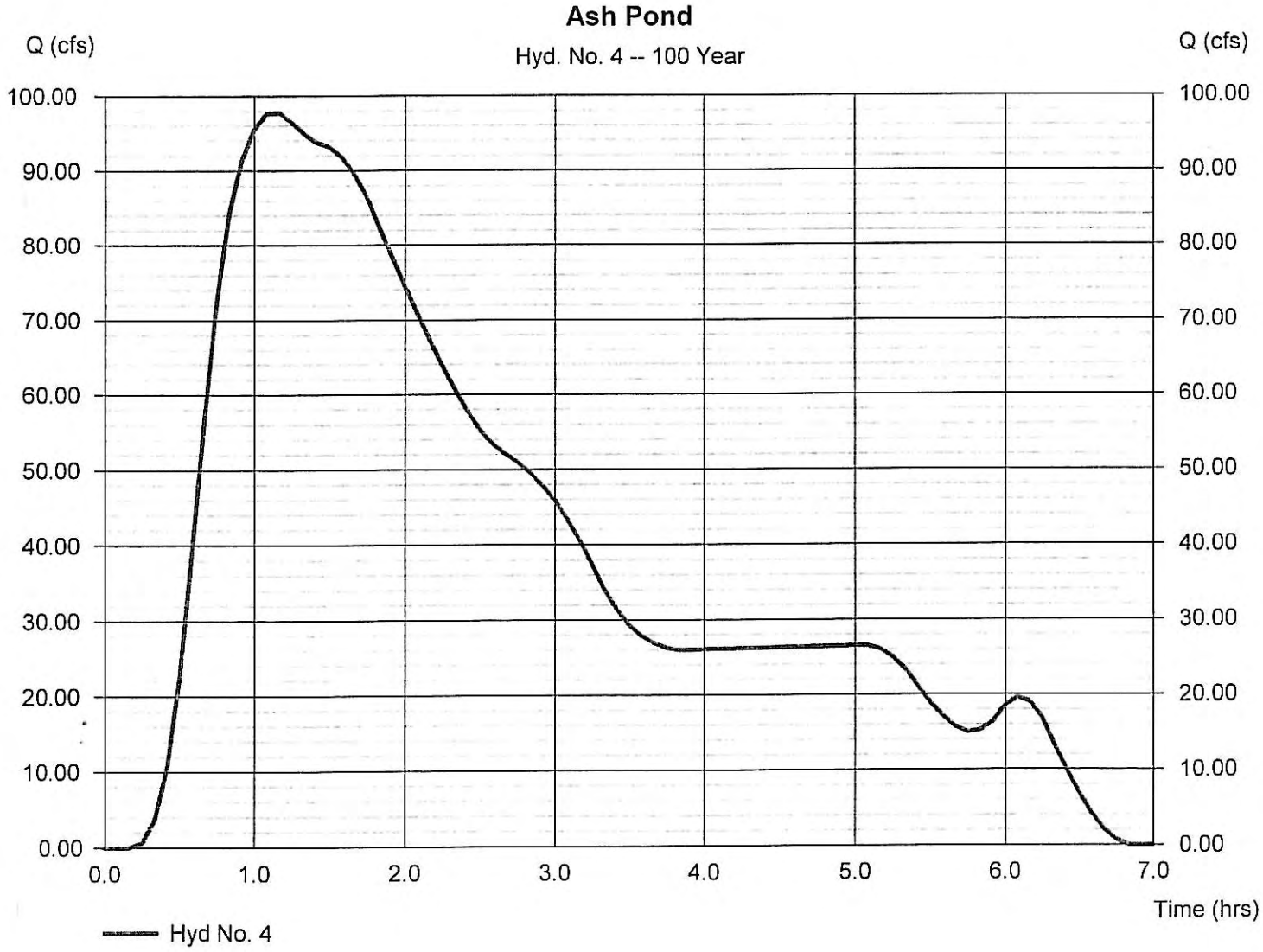


Hydrograph Report

Hyd. No. 4

Ash Pond

Hydrograph type	= SCS Runoff	Peak discharge	= 97.72 cfs
Storm frequency	= 100 yrs	Time to peak	= 1.17 hrs
Time interval	= 5 min	Hyd. volume	= 22.381 acft
Drainage area	= 84.900 ac	Curve number	= 80
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= USER	Time of conc. (Tc)	= 33.00 min
Total precip.	= 5.20 in	Distribution	= Huff-1st
Storm duration	= 6.00 hrs	Shape factor	= 484

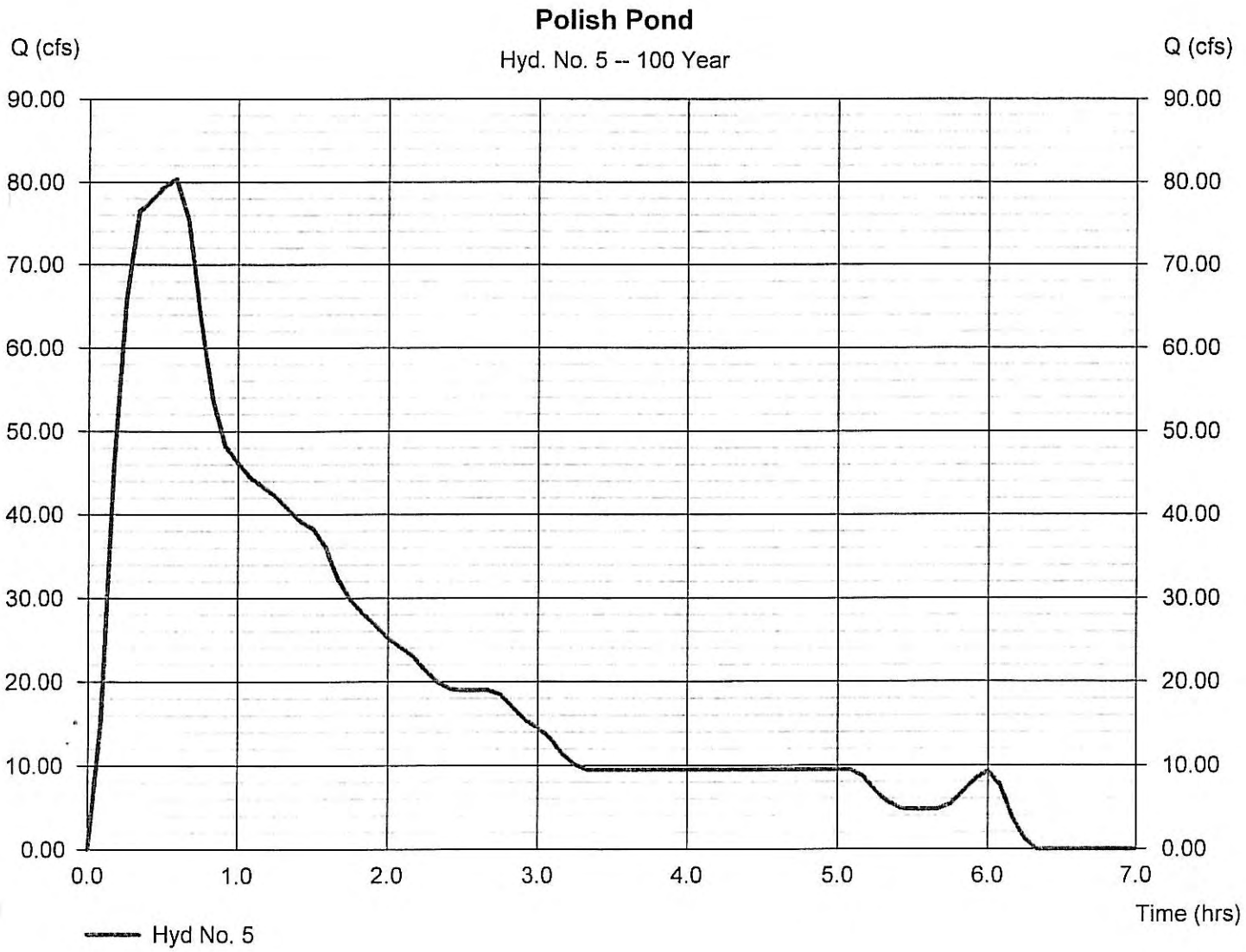


Hydrograph Report

Hyd. No. 5

Polish Pond

Hydrograph type	= SCS Runoff	Peak discharge	= 80.40 cfs
Storm frequency	= 100 yrs	Time to peak	= 0.58 hrs
Time interval	= 5 min	Hyd. volume	= 11.781 acft
Drainage area	= 29.000 ac	Curve number	= 100
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= USER	Time of conc. (Tc)	= 10.00 min
Total precip.	= 5.20 in	Distribution	= Huff-1st
Storm duration	= 6.00 hrs	Shape factor	= 484



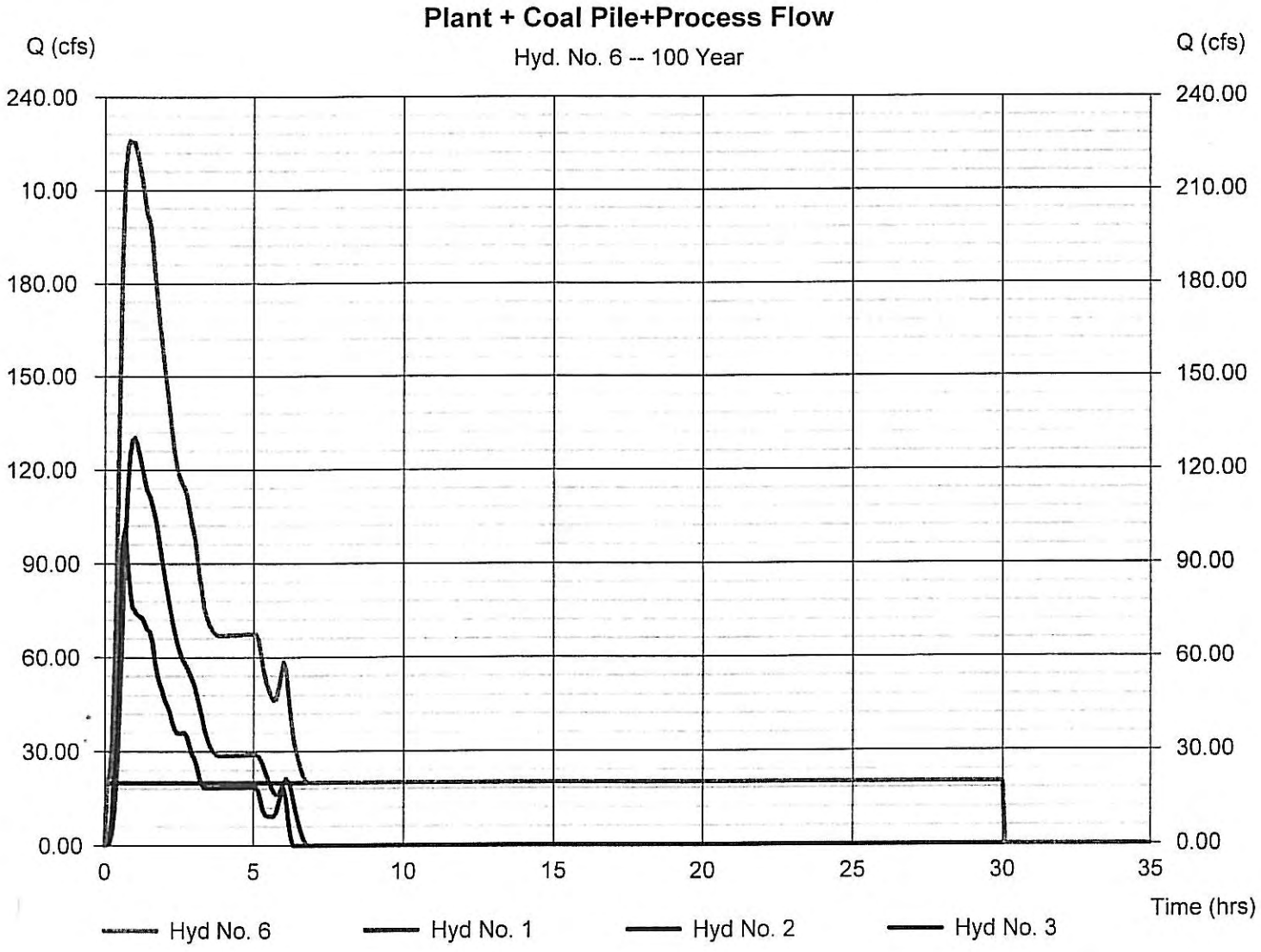
Hydrograph Report

Hydraflow Hydrographs by Intelisolve v9.23 — Monday, Mar 15, 2010

Hyd. No. 6

Plant + Coal Pile+Process Flow

Hydrograph type	= Combine	Peak discharge	= 226.00 cfs
Storm frequency	= 100 yrs	Time to peak	= 0.83 hrs
Time interval	= 5 min	Hyd. volume	= 94.031 acft
Inflow hyds.	= 1, 2, 3	Contrib. drain. area	= 147.100 ac



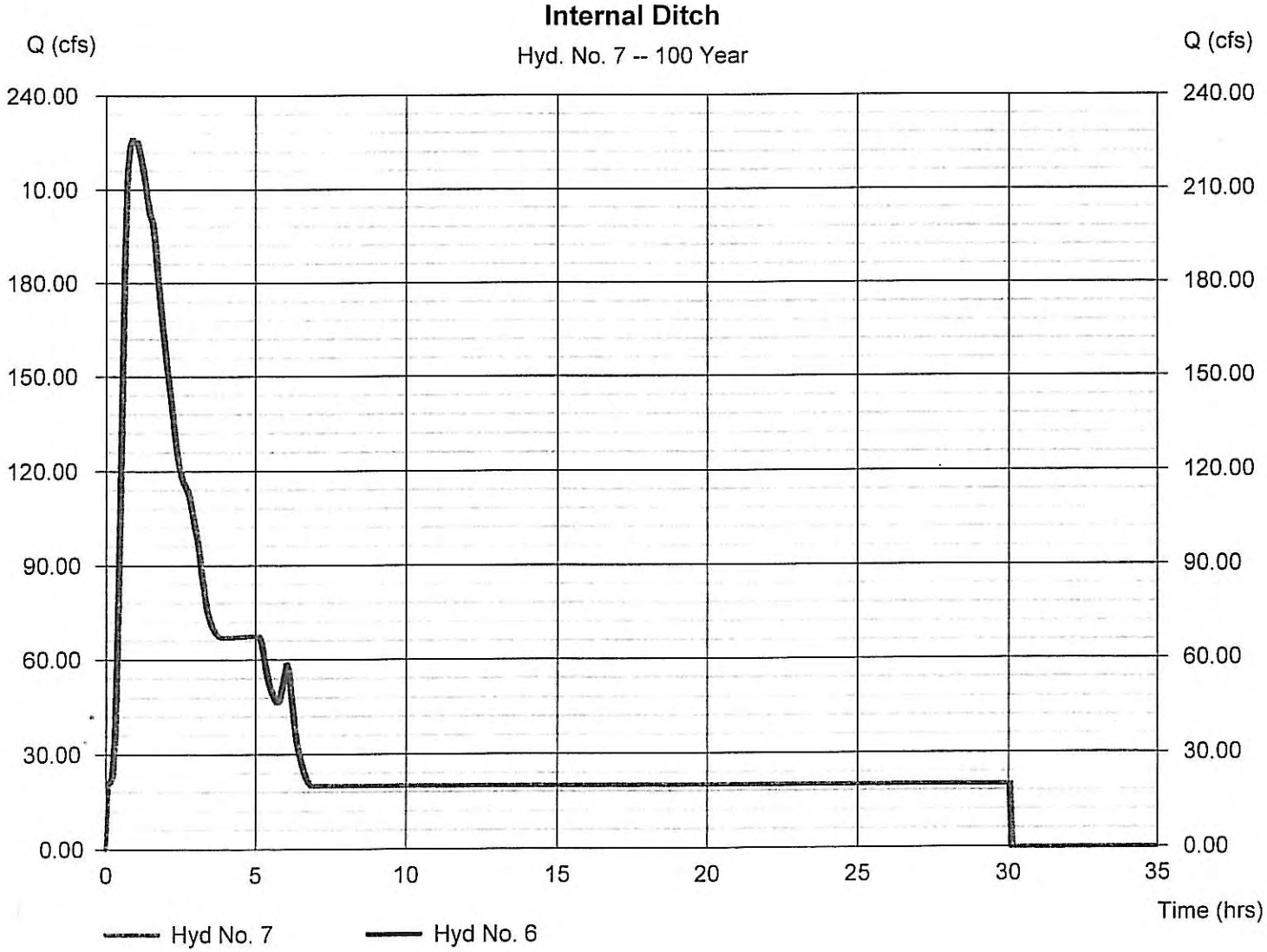
Hydrograph Report

Hyd. No. 7

Internal Ditch

Hydrograph type	= Reach	Peak discharge	= 226.18 cfs
Storm frequency	= 100 yrs	Time to peak	= 0.92 hrs
Time interval	= 5 min	Hyd. volume	= 94.174 acft
Inflow hyd. No.	= 6 - Plant + Coal Pile+Process Flow	Section type	= Trapezoidal
Reach length	= 1800.0 ft	Channel slope	= 0.3 %
Manning's n	= 0.009	Bottom width	= 10.0 ft
Side slope	= 0.5:1	Max. depth	= 8.0 ft
Rating curve x	= 1.886	Rating curve m	= 1.516
Ave. velocity	= 0.00 ft/s	Routing coeff.	= 1.0972

Modified Att-Kin routing method used.

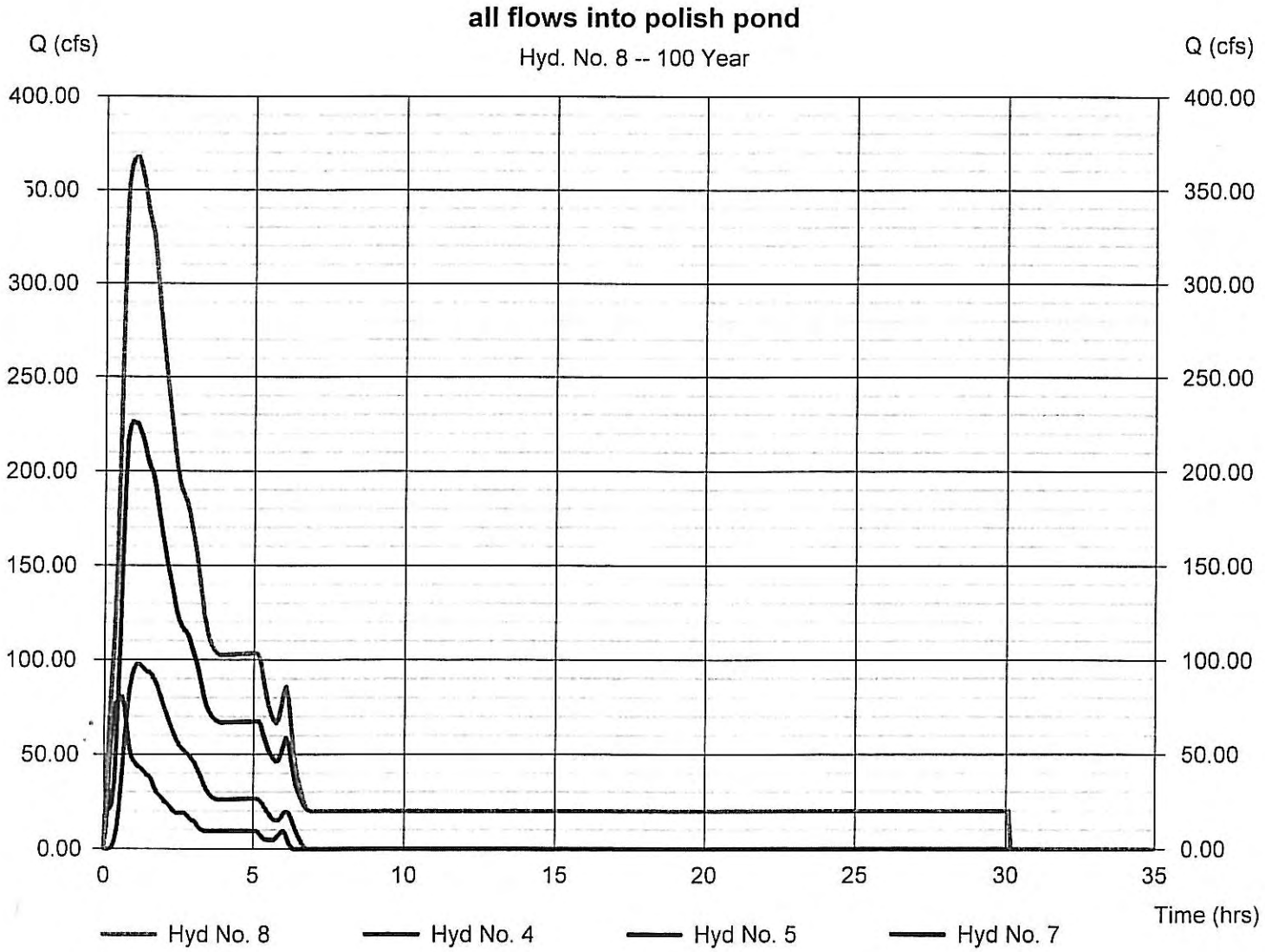


Hydrograph Report

Hyd. No. 8

all flows into polish pond

Hydrograph type	= Combine	Peak discharge	= 367.43 cfs
Storm frequency	= 100 yrs	Time to peak	= 1.08 hrs
Time interval	= 5 min	Hyd. volume	= 128.336 acft
Inflow hyds.	= 4, 5, 7	Contrib. drain. area	= 113.900 ac



Hydrograph Report

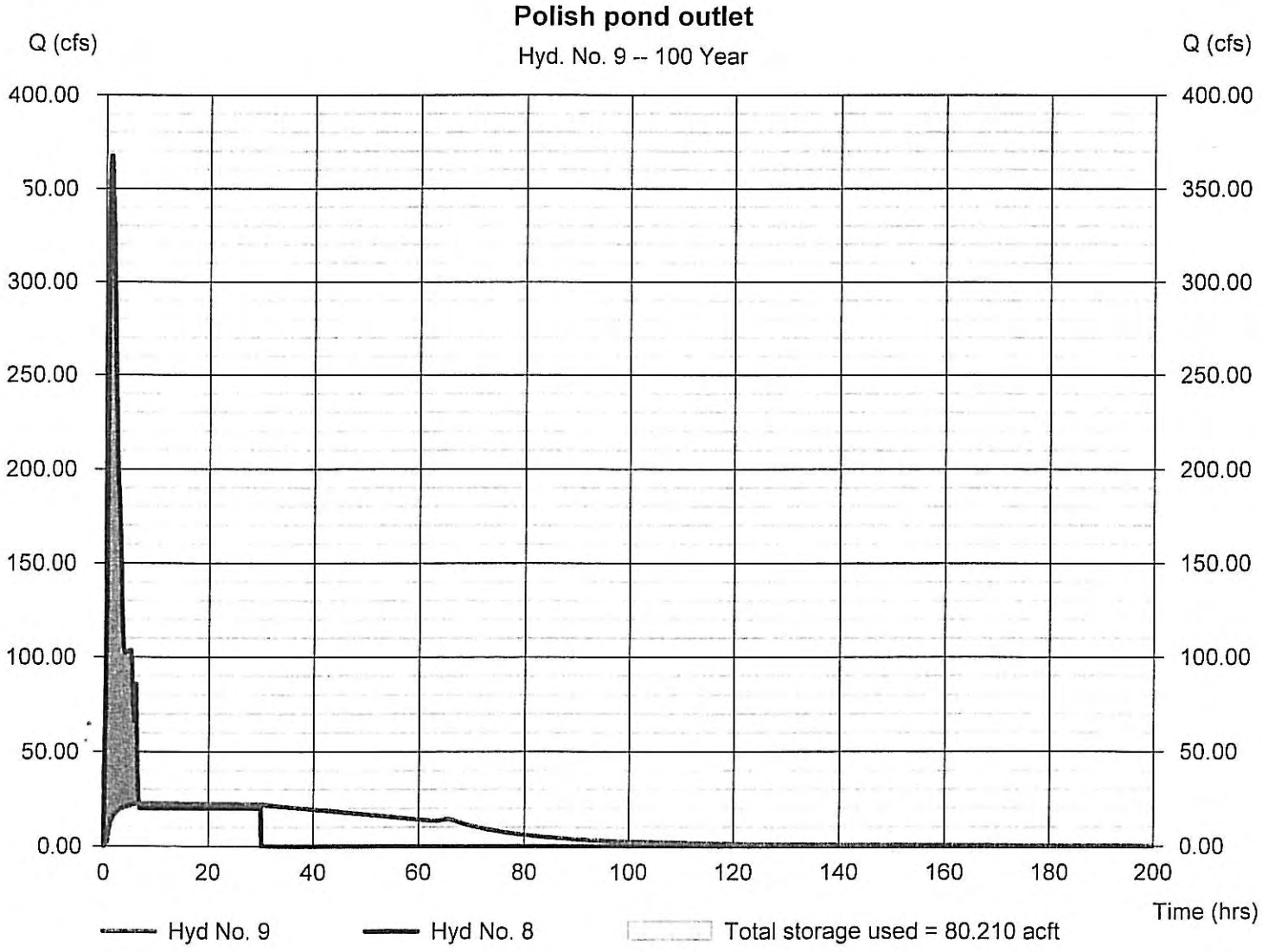
Hydraflow Hydrographs by Intelisolve v9.23 — Monday, Mar 15, 2010

Hyd. No. 9

Polish pond outlet

Hydrograph type	= Reservoir	Peak discharge	= 22.68 cfs
Storm frequency	= 100 yrs	Time to peak	= 6.75 hrs
Time interval	= 5 min	Hyd. volume	= 127.740 acft
Inflow hyd. No.	= 8 - all flows into polish pond	Max. Elevation	= 400.93 ft
Reservoir name	= Polish pond	Max. Storage	= 80.210 acft

Storage Indication method used.



Hydraflow Rainfall Report

Return Period (Yrs)	Intensity-Duration-Frequency Equation Coefficients (FHA)			
	B	D	E	(N/A)
1	0.0000	0.0000	0.0000	--------
2	69.8703	13.1000	0.8658	--------
3	0.0000	0.0000	0.0000	--------
5	79.2597	14.6000	0.8369	--------
10	88.2351	15.5000	0.8279	--------
25	102.6072	16.5000	0.8217	--------
50	114.8193	17.2000	0.8199	--------
100	127.1596	17.8000	0.8186	--------

File name: SampleFHA.idf

Intensity = B / (Tc + D)^E

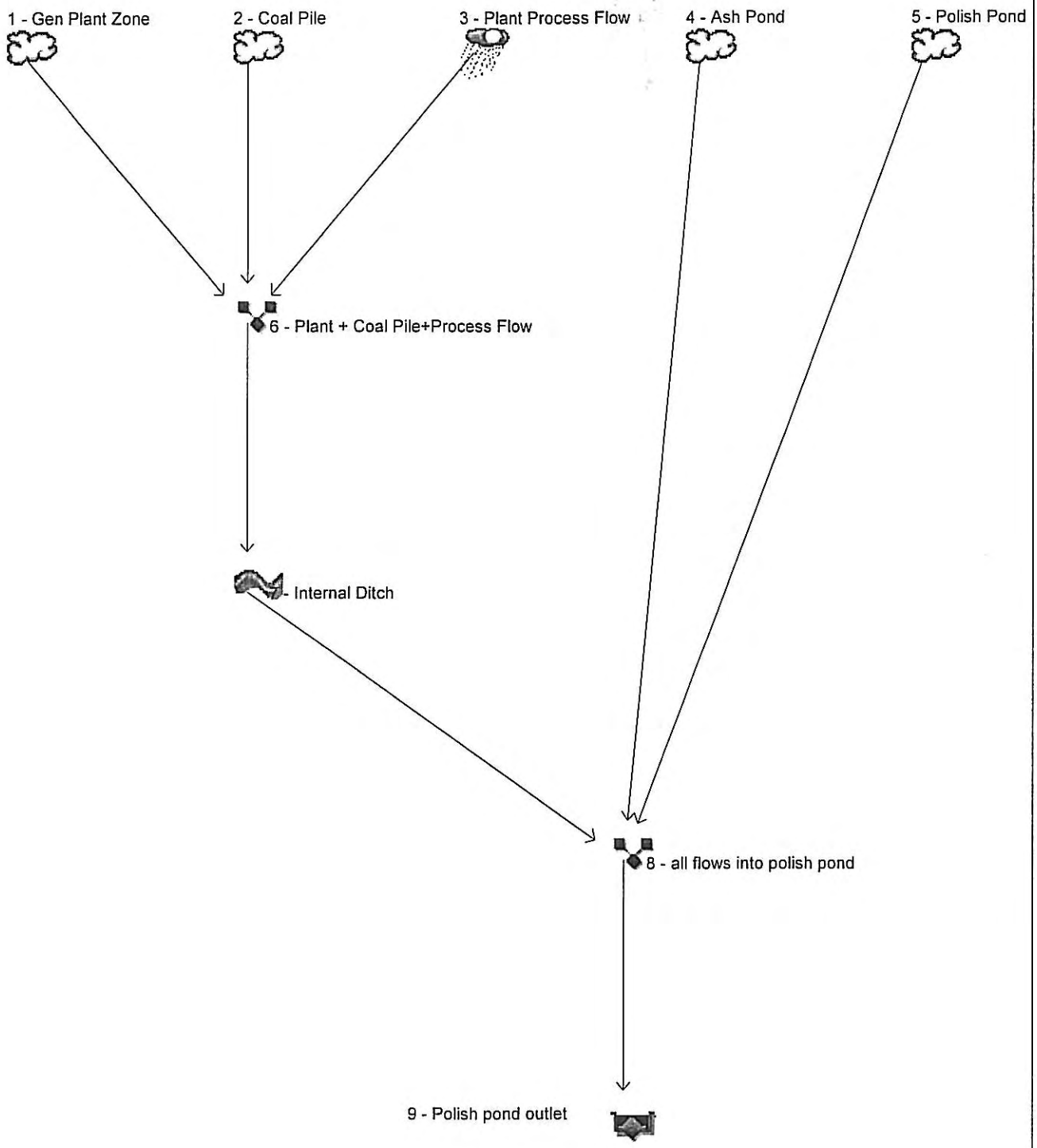
Return Period (Yrs)	Intensity Values (in/hr)											
	5 min	10	15	20	25	30	35	40	45	50	55	60
1	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2	5.69	4.61	3.89	3.38	2.99	2.69	2.44	2.24	2.07	1.93	1.81	1.70
3	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
5	6.57	5.43	4.65	4.08	3.65	3.30	3.02	2.79	2.59	2.42	2.27	2.15
10	7.24	6.04	5.21	4.59	4.12	3.74	3.43	3.17	2.95	2.77	2.60	2.46
25	8.25	6.95	6.03	5.34	4.80	4.38	4.02	3.73	3.48	3.26	3.07	2.91
50	9.04	7.65	6.66	5.92	5.34	4.87	4.49	4.16	3.88	3.65	3.44	3.25
100	9.83	8.36	7.30	6.50	5.87	5.36	4.94	4.59	4.29	4.03	3.80	3.60

Tc = time in minutes. Values may exceed 60.

Precip. file name: Sample.pcp

Storm Distribution	Rainfall Precipitation Table (in)							
	1-yr	2-yr	3-yr	5-yr	10-yr	25-yr	50-yr	100-yr
SCS 24-hour	0.00	2.20	0.00	3.30	4.25	5.77	6.80	0.00
SCS 6-Hr	0.00	1.80	0.00	0.00	2.60	0.00	0.00	0.00
Huff-1st	0.00	1.55	0.00	2.75	4.00	5.38	6.50	5.20
Huff-2nd	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Huff-3rd	0.00	0.00	0.00	0.00	0.00	0.00	0.00	7.10
Huff-4th	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Huff-Indy	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Custom	0.00	1.75	0.00	2.80	3.90	5.25	6.00	0.00

Watershed Model Schematic



Hydrograph Return Period Recap

Hydraflow Hydrographs by Intelisolve v9.23

'yd. .o.	Hydrograph type (origin)	Inflow Hyd(s)	Peak Outflow (cfs)								Hydrograph description
			1-Yr	2-Yr	3-Yr	5-Yr	10-Yr	25-Yr	50-Yr	100-Yr	
1	SCS Runoff	-------	-------	-------	-------	-------	-------	-------	-------	63.88	Gen Plant Zone
2	SCS Runoff	-------	-------	-------	-------	-------	-------	-------	-------	41.10	Coal Pile
3	Manual	-------	-------	-------	-------	-------	-------	-------	-------	20.00	Plant Process Flow
4	SCS Runoff	-------	-------	-------	-------	-------	-------	-------	-------	58.35	Ash Pond
5	SCS Runoff	-------	-------	-------	-------	-------	-------	-------	-------	21.09	Polish Pond
6	Combine	1, 2, 3,	-------	-------	-------	-------	-------	-------	-------	124.99	Plant + Coal Pile+Process Flow
7	Reach	6	-------	-------	-------	-------	-------	-------	-------	124.99	Internal Ditch
8	Combine	4, 5, 7	-------	-------	-------	-------	-------	-------	-------	204.24	all flows into polish pond
9	Reservoir	8	-------	-------	-------	-------	-------	-------	-------	28.27	Polish pond outlet

Hydrograph Summary Report

Hydraflow Hydrographs by Intelisolve v9.23

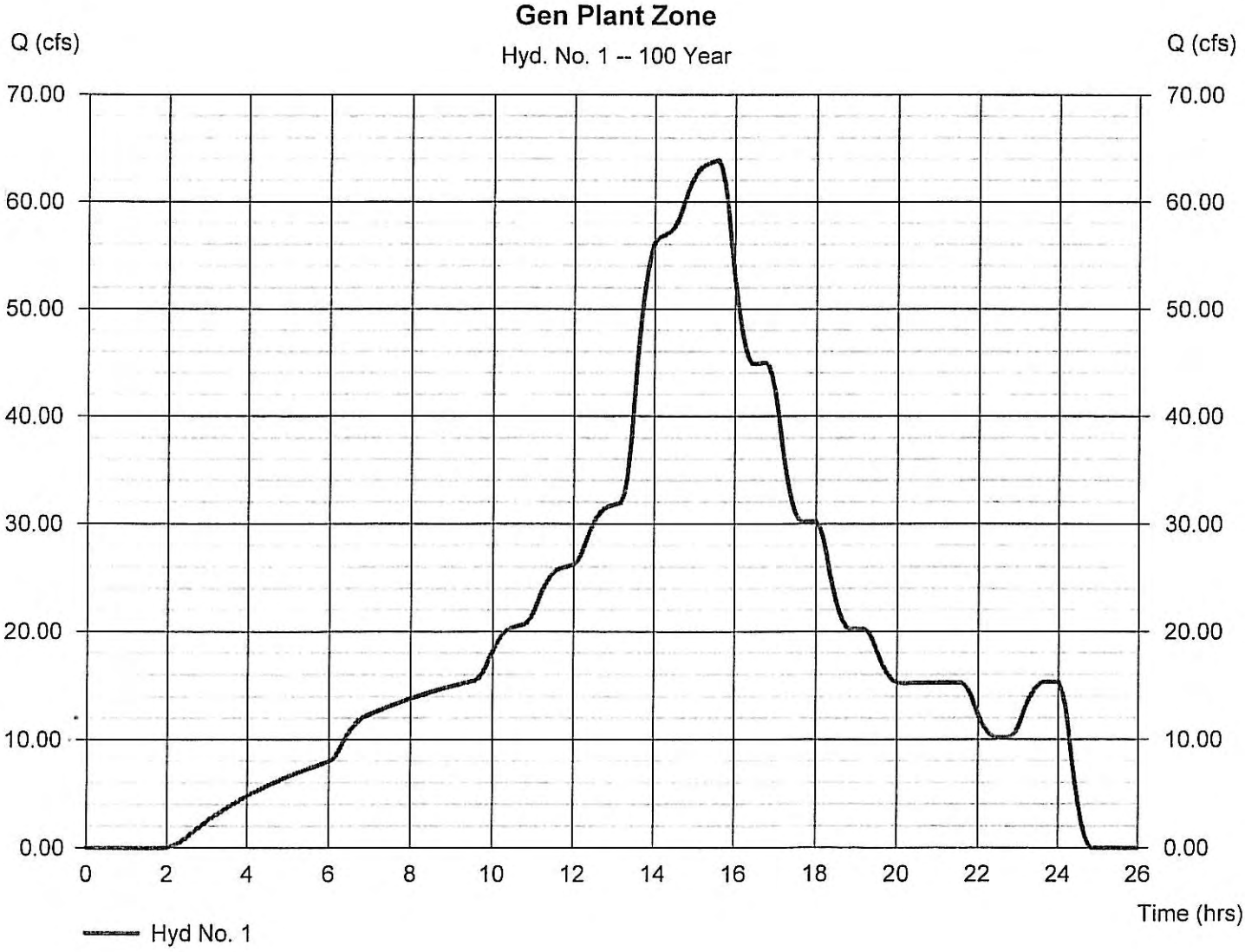
Hyd. No.	Hydrograph type (origin)	Peak flow (cfs)	Time interval (min)	Time to peak (min)	Hyd. volume (acft)	Inflow hyd(s)	Maximum elevation (ft)	Total strge used (acft)	Hydrograph description
1	SCS Runoff	63.88	5	935	40.508	----	------	------	Gen Plant Zone
2	SCS Runoff	41.10	5	935	25.944	----	------	------	Coal Pile
3	Manual	20.00	5	5	49.587	----	------	------	Plant Process Flow
4	SCS Runoff	58.35	5	935	34.925	----	------	------	Ash Pond
5	SCS Runoff	21.09	5	925	16.086	----	------	------	Polish Pond
6	Combine	124.99	5	935	116.039	1, 2, 3,	------	------	Plant + Coal Pile+Process Flow
7	Reach	124.99	5	940	116.177	6	------	------	Internal Ditch
8	Combine	204.24	5	935	167.188	4, 5, 7	------	------	all flows into polish pond
9	Reservoir	28.27	5	1470	166.331	8	402.55	125	Polish pond outlet

Hydrograph Report

Hyd. No. 1

Gen Plant Zone

Hydrograph type	= SCS Runoff	Peak discharge	= 63.88 cfs
Storm frequency	= 100 yrs	Time to peak	= 15.58 hrs
Time interval	= 5 min	Hyd. volume	= 40.508 acft
Drainage area	= 86.300 ac	Curve number	= 86
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= USER	Time of conc. (Tc)	= 30.00 min
Total precip.	= 7.10 in	Distribution	= Huff-3rd
Storm duration	= 24.00 hrs	Shape factor	= 484

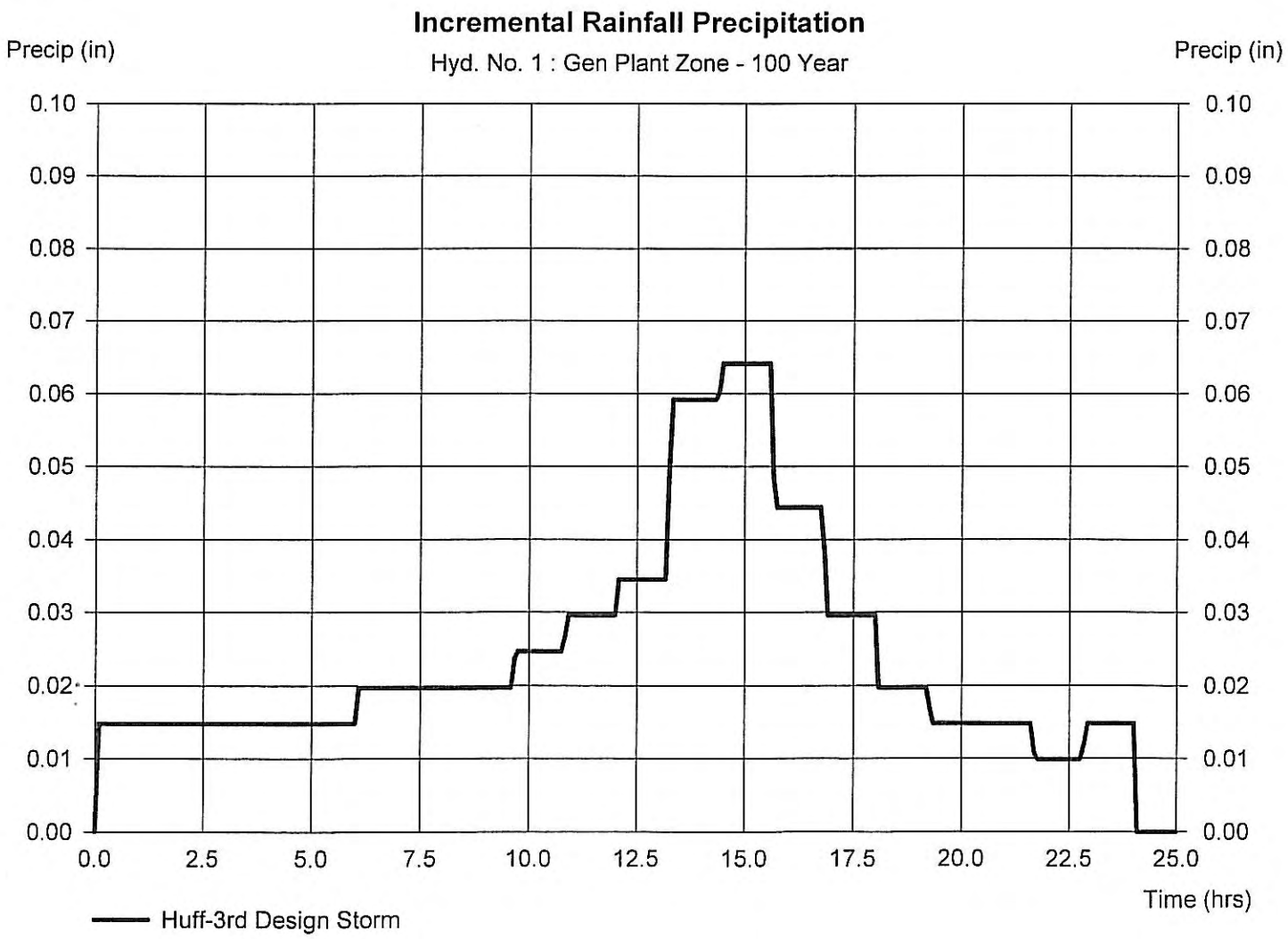


Precipitation Report

Hyd. No. 1

Gen Plant Zone

Storm Frequency	= 100 yrs	Time interval	= 5 min
Total precip.	= 7.1000 in	Distribution	= Huff-3rd
Storm duration	= 24.00 hrs		

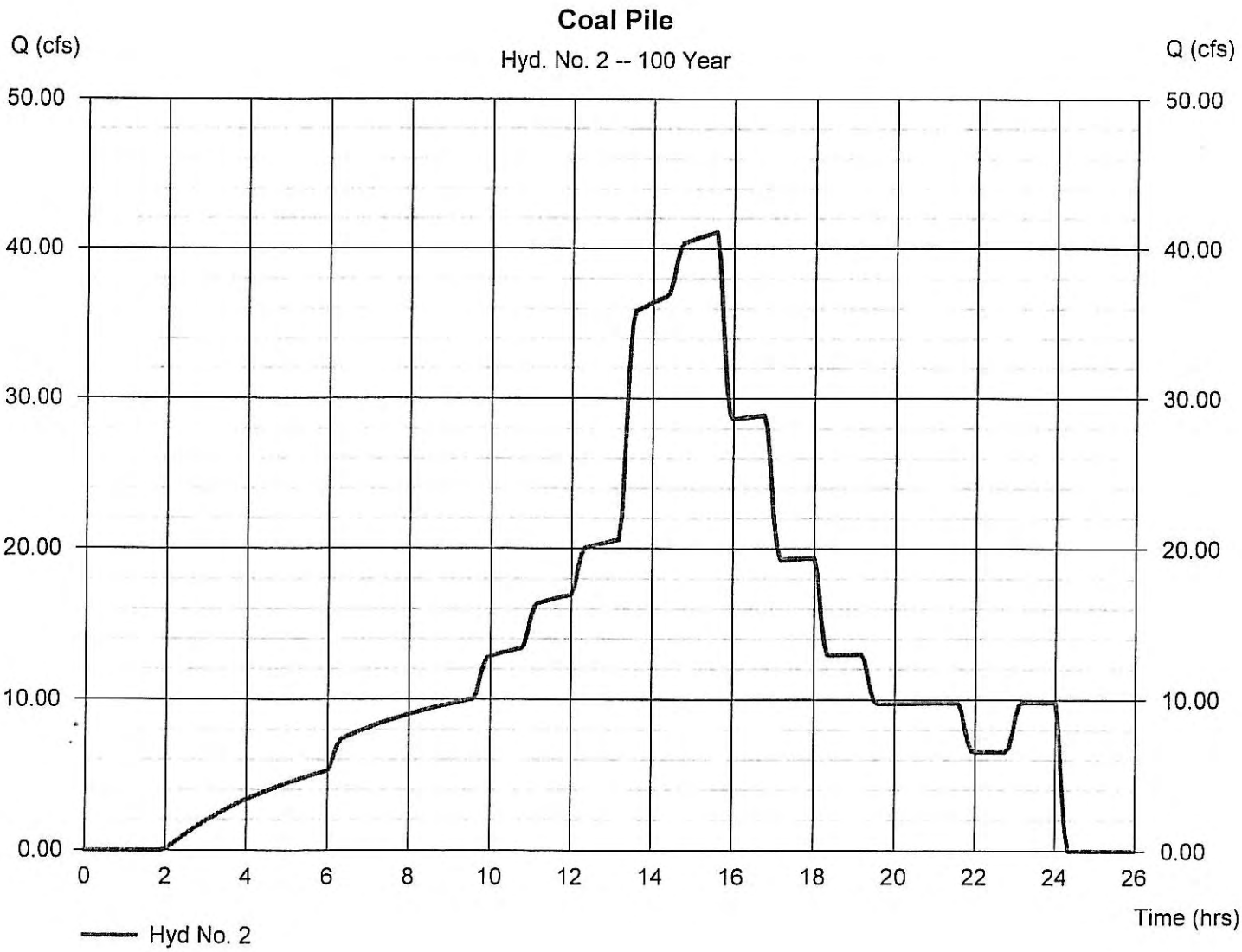


Hydrograph Report

Hyd. No. 2

Coal Pile

Hydrograph type	= SCS Runoff	Peak discharge	= 41.10 cfs
Storm frequency	= 100 yrs	Time to peak	= 15.58 hrs
Time interval	= 5 min	Hyd. volume	= 25.944 acft
Drainage area	= 60.800 ac	Curve number	= 86
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= USER	Time of conc. (Tc)	= 12.00 min
Total precip.	= 7.10 in	Distribution	= Huff-3rd
Storm duration	= 24.00 hrs	Shape factor	= 484

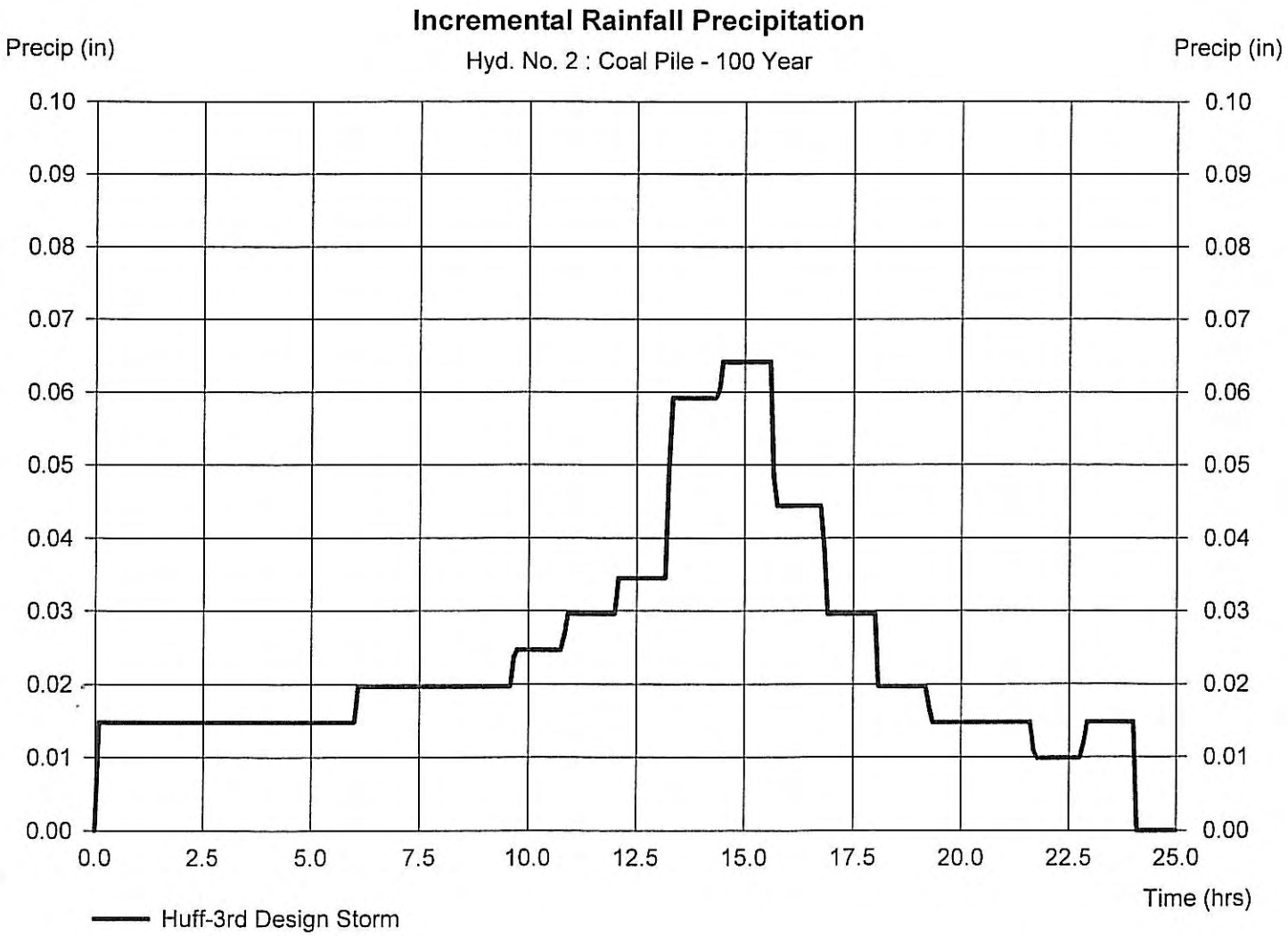


Precipitation Report

Hyd. No. 2

Coal Pile

Storm Frequency	= 100 yrs	Time interval	= 5 min
Total precip.	= 7.1000 in	Distribution	= Huff-3rd
Storm duration	= 24.00 hrs		

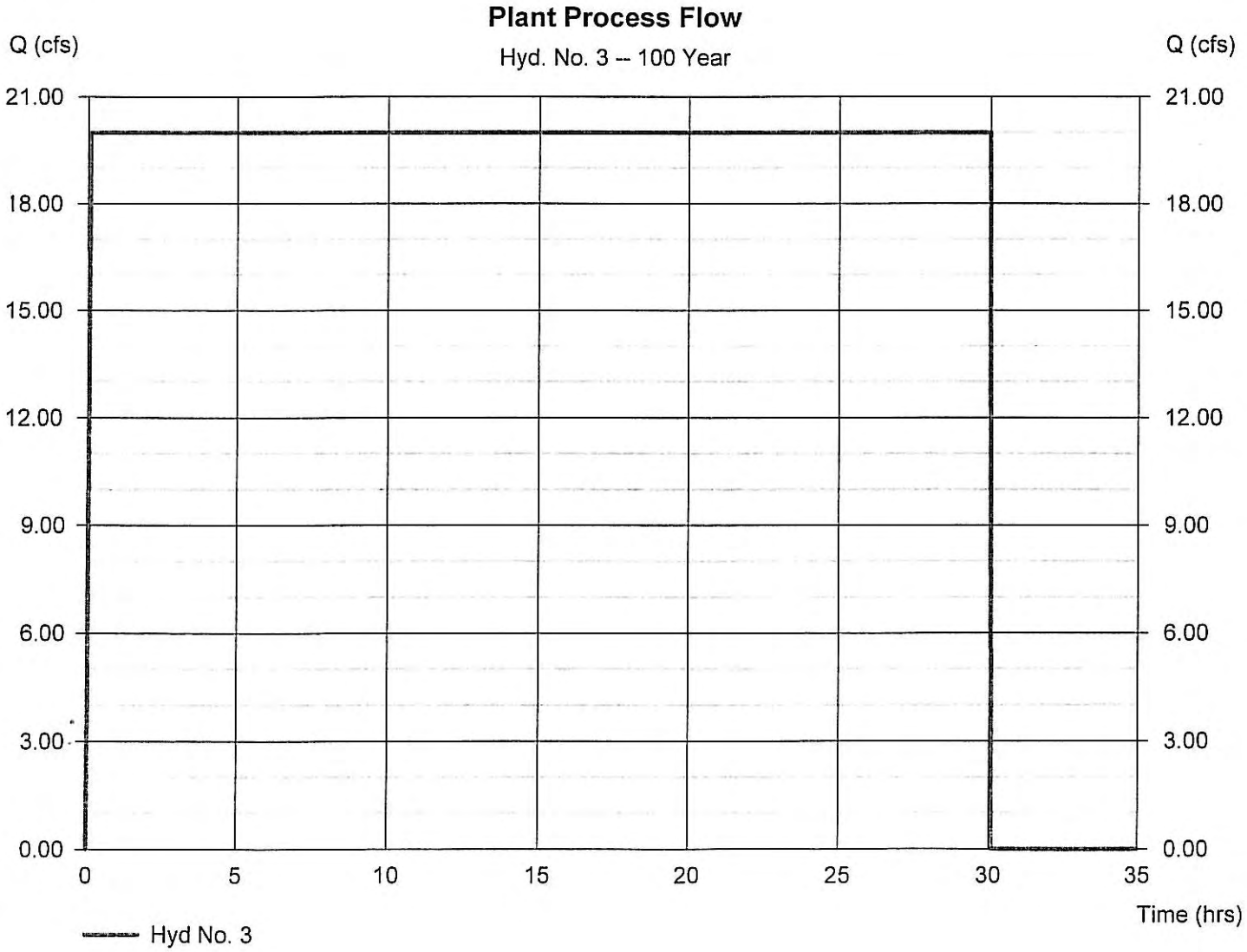


Hydrograph Report

Hyd. No. 3

Plant Process Flow

Hydrograph type	= Manual	Peak discharge	= 20.00 cfs
Storm frequency	= 100 yrs	Time to peak	= 0.08 hrs
Time interval	= 5 min	Hyd. volume	= 49.587 acft

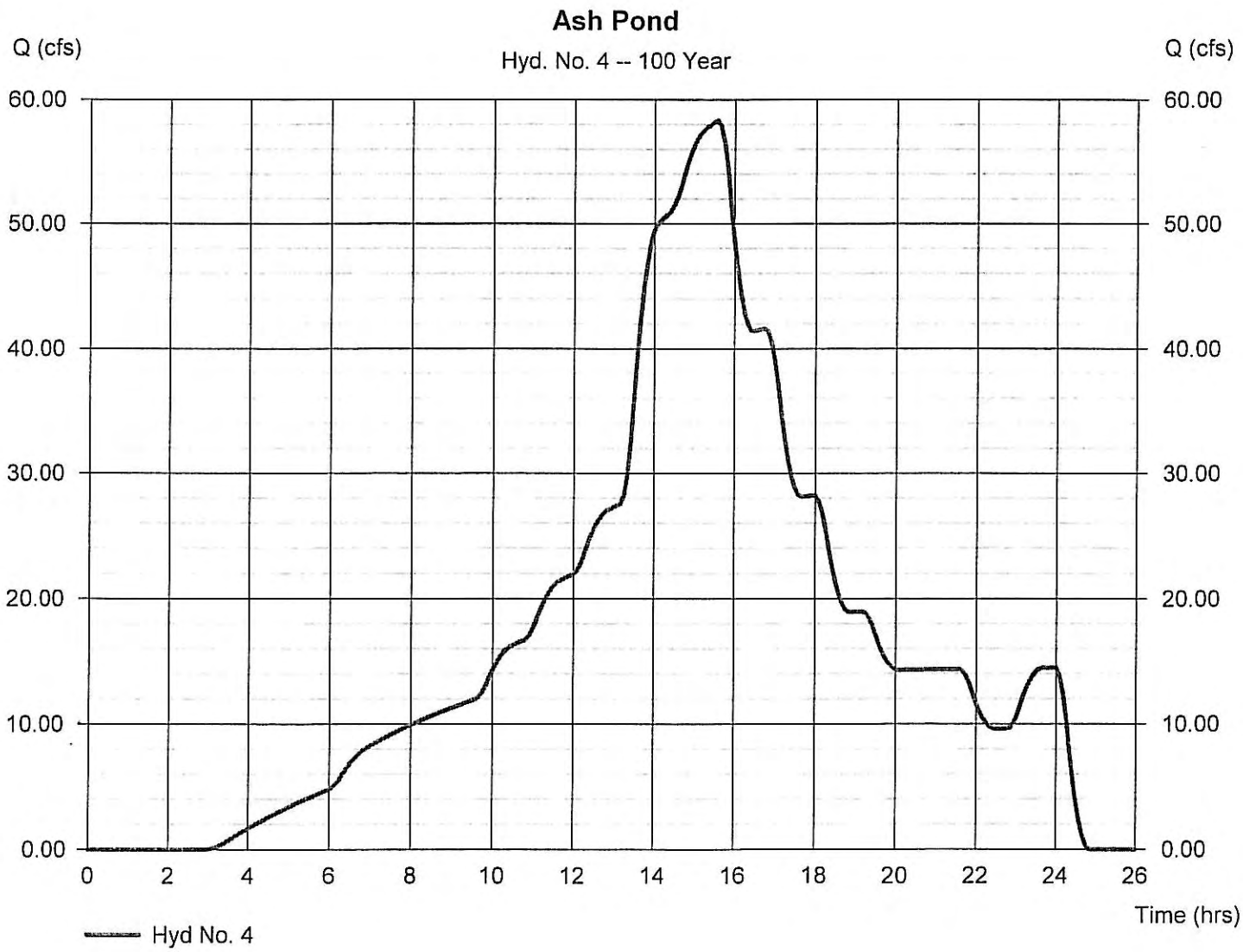


Hydrograph Report

Hyd. No. 4

Ash Pond

Hydrograph type	= SCS Runoff	Peak discharge	= 58.35 cfs
Storm frequency	= 100 yrs	Time to peak	= 15.58 hrs
Time interval	= 5 min	Hyd. volume	= 34.925 acft
Drainage area	= 84.900 ac	Curve number	= 80
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= USER	Time of conc. (Tc)	= 33.00 min
Total precip.	= 7.10 in	Distribution	= Huff-3rd
Storm duration	= 24.00 hrs	Shape factor	= 484

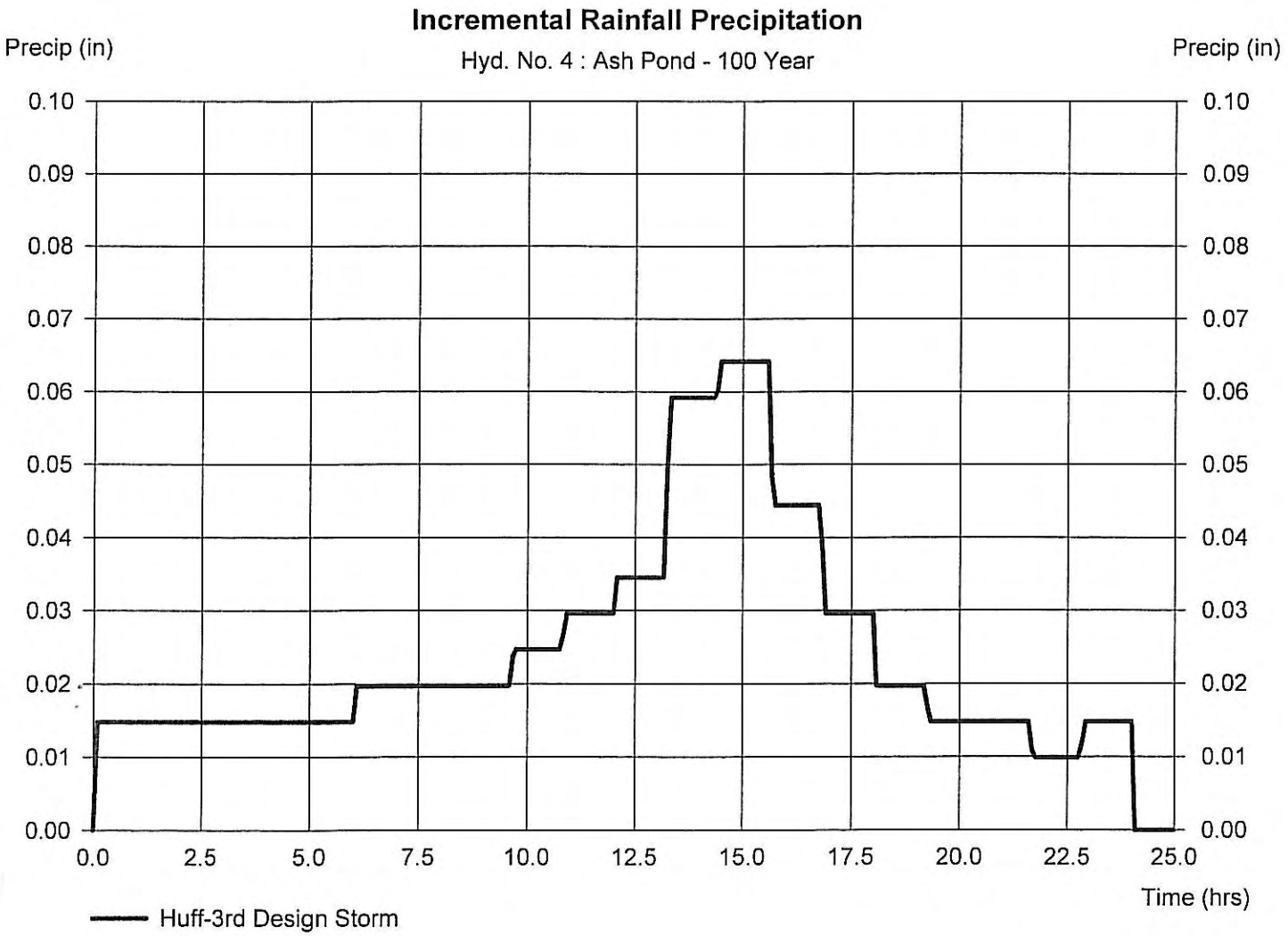


Precipitation Report

Hyd. No. 4

Ash Pond

Storm Frequency	= 100 yrs	Time interval	= 5 min
Total precip.	= 7.1000 in	Distribution	= Huff-3rd
Storm duration	= 24.00 hrs		



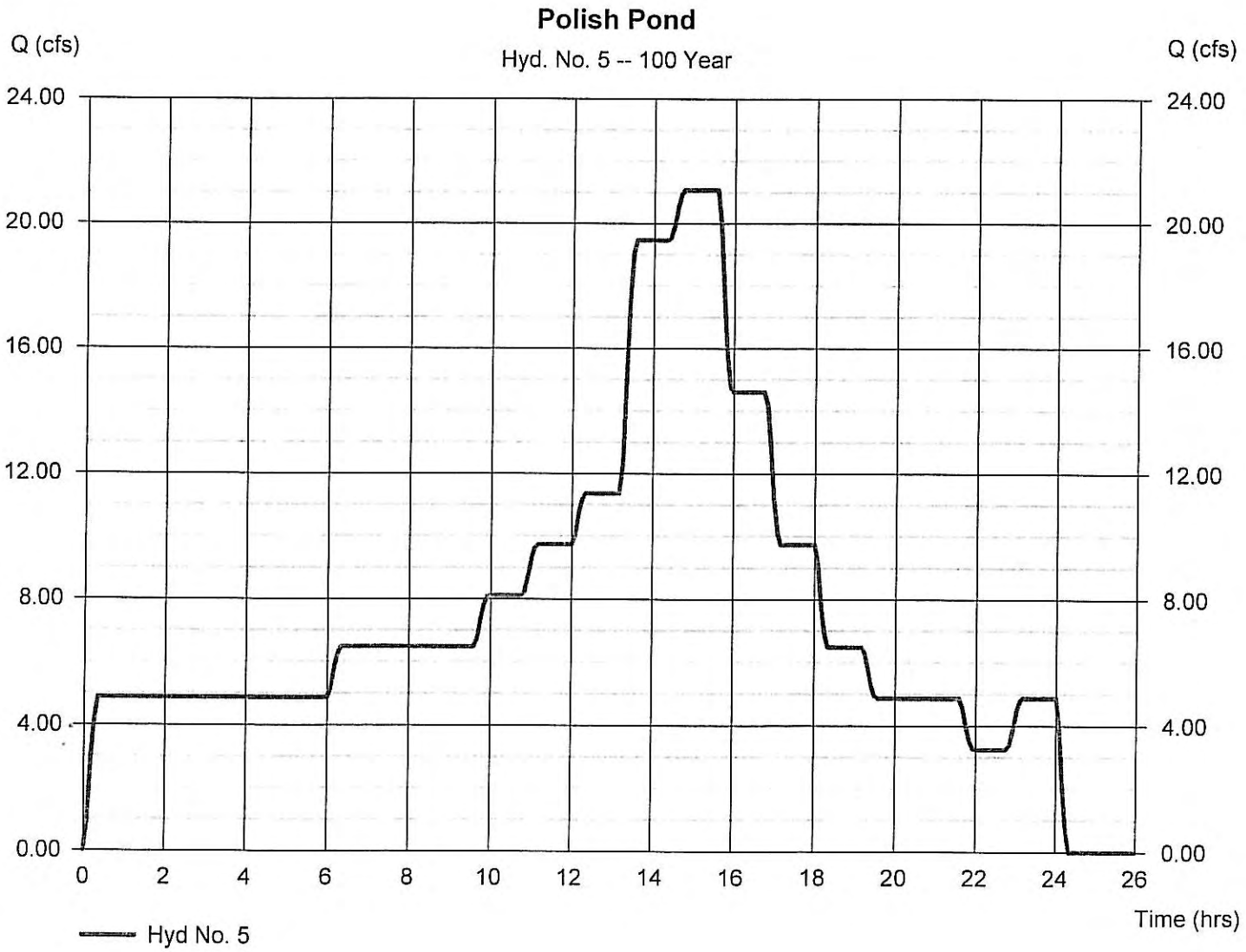
Hydrograph Report

Hydraflow Hydrographs by Intelisolve v9.23 — Monday, Mar 15, 2010

Hyd. No. 5

Polish Pond

Hydrograph type	= SCS Runoff	Peak discharge	= 21.09 cfs
Storm frequency	= 100 yrs	Time to peak	= 15.42 hrs
Time interval	= 5 min	Hyd. volume	= 16.086 acft
Drainage area	= 29.000 ac	Curve number	= 100
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= USER	Time of conc. (Tc)	= 10.00 min
Total precip.	= 7.10 in	Distribution	= Huff-3rd
Storm duration	= 24.00 hrs	Shape factor	= 484

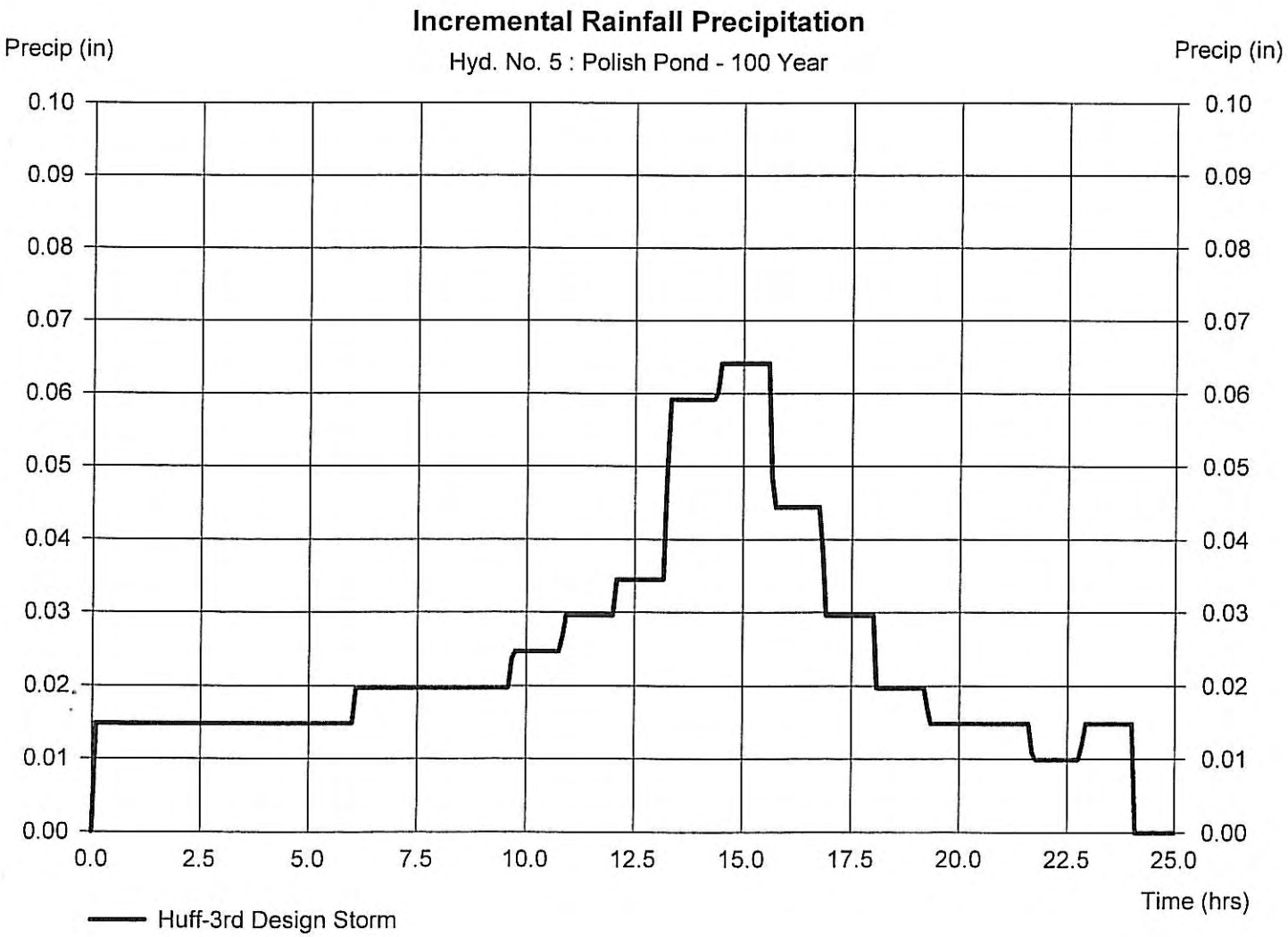


Precipitation Report

Hyd. No. 5

Polish Pond

Storm Frequency	= 100 yrs	Time interval	= 5 min
Total precip.	= 7.1000 in	Distribution	= Huff-3rd
Storm duration	= 24.00 hrs		



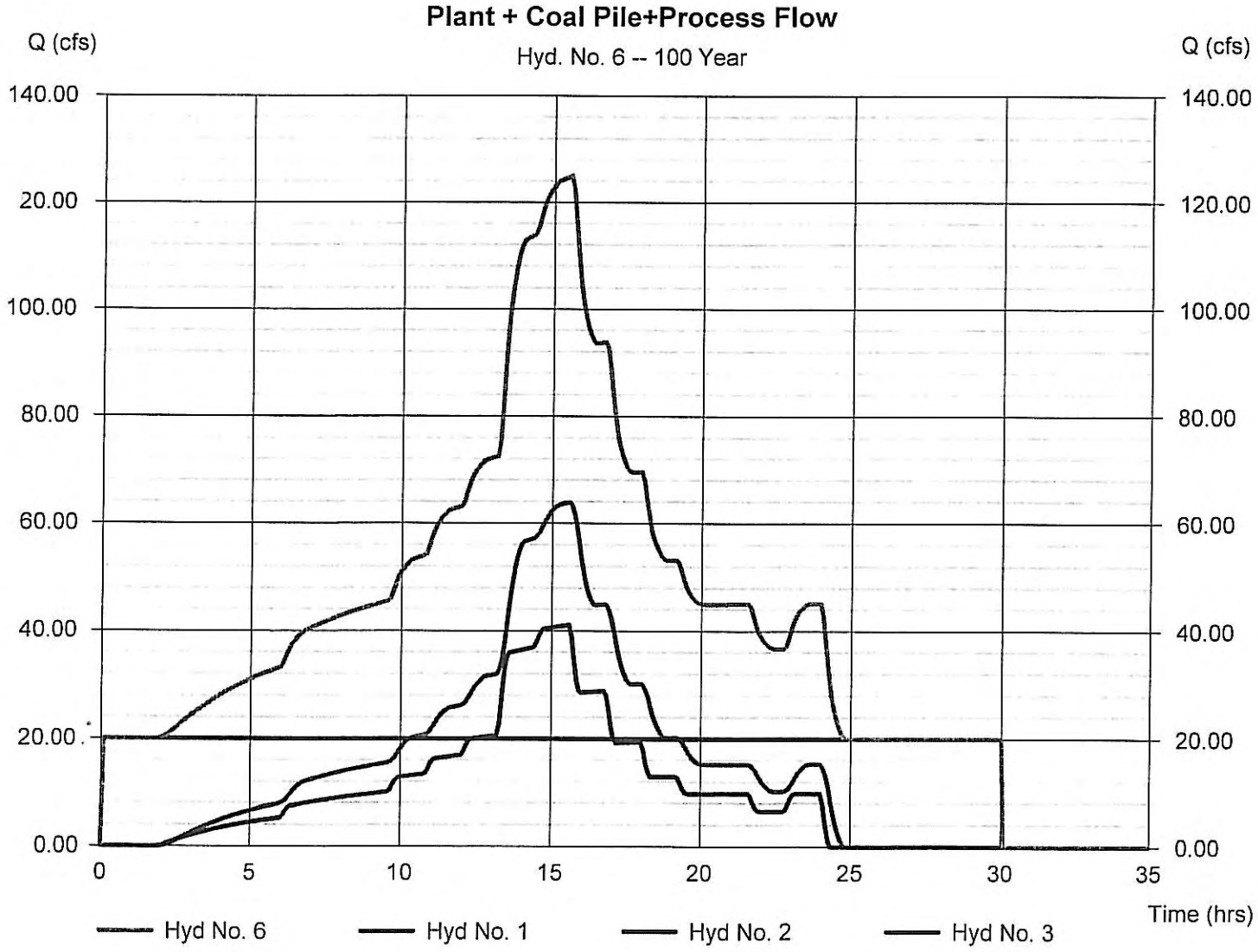
Hydrograph Report

Hydraflow Hydrographs by Intelisolve v9.23 — Monday, Mar 15, 2010

Hyd. No. 6

Plant + Coal Pile+Process Flow

Hydrograph type	= Combine	Peak discharge	= 124.99 cfs
Storm frequency	= 100 yrs	Time to peak	= 15.58 hrs
Time interval	= 5 min	Hyd. volume	= 116.039 acft
Inflow hyds.	= 1, 2, 3	Contrib. drain. area	= 147.100 ac



Hydrograph Report

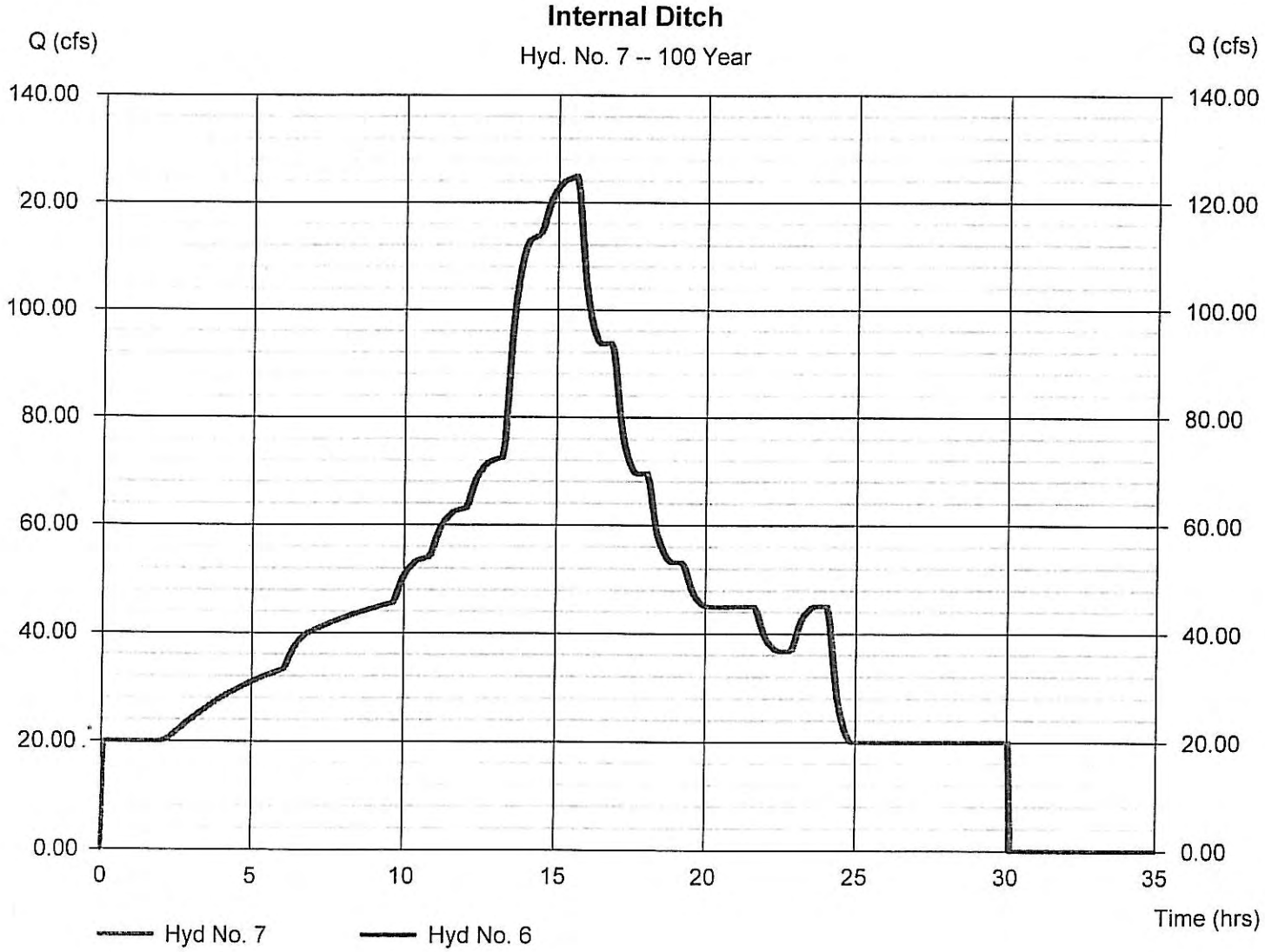
Hydraflow Hydrographs by Intelisolve v9.23 — Monday, Mar 15, 2010

Hyd. No. 7

Internal Ditch

Hydrograph type	= Reach	Peak discharge	= 124.99 cfs
Storm frequency	= 100 yrs	Time to peak	= 15.67 hrs
Time interval	= 5 min	Hyd. volume	= 116.177 acft
Inflow hyd. No.	= 6 - Plant + Coal Pile+Process Flow	Section type	= Trapezoidal
Reach length	= 1800.0 ft	Channel slope	= 0.3 %
Manning's n	= 0.009	Bottom width	= 10.0 ft
Side slope	= 0.5:1	Max. depth	= 8.0 ft
Rating curve x	= 1.886	Rating curve m	= 1.516
Ave. velocity	= 7.86 ft/s	Routing coeff.	= 0.9967

Modified Att-Kin routing method used.



Hydrograph Report

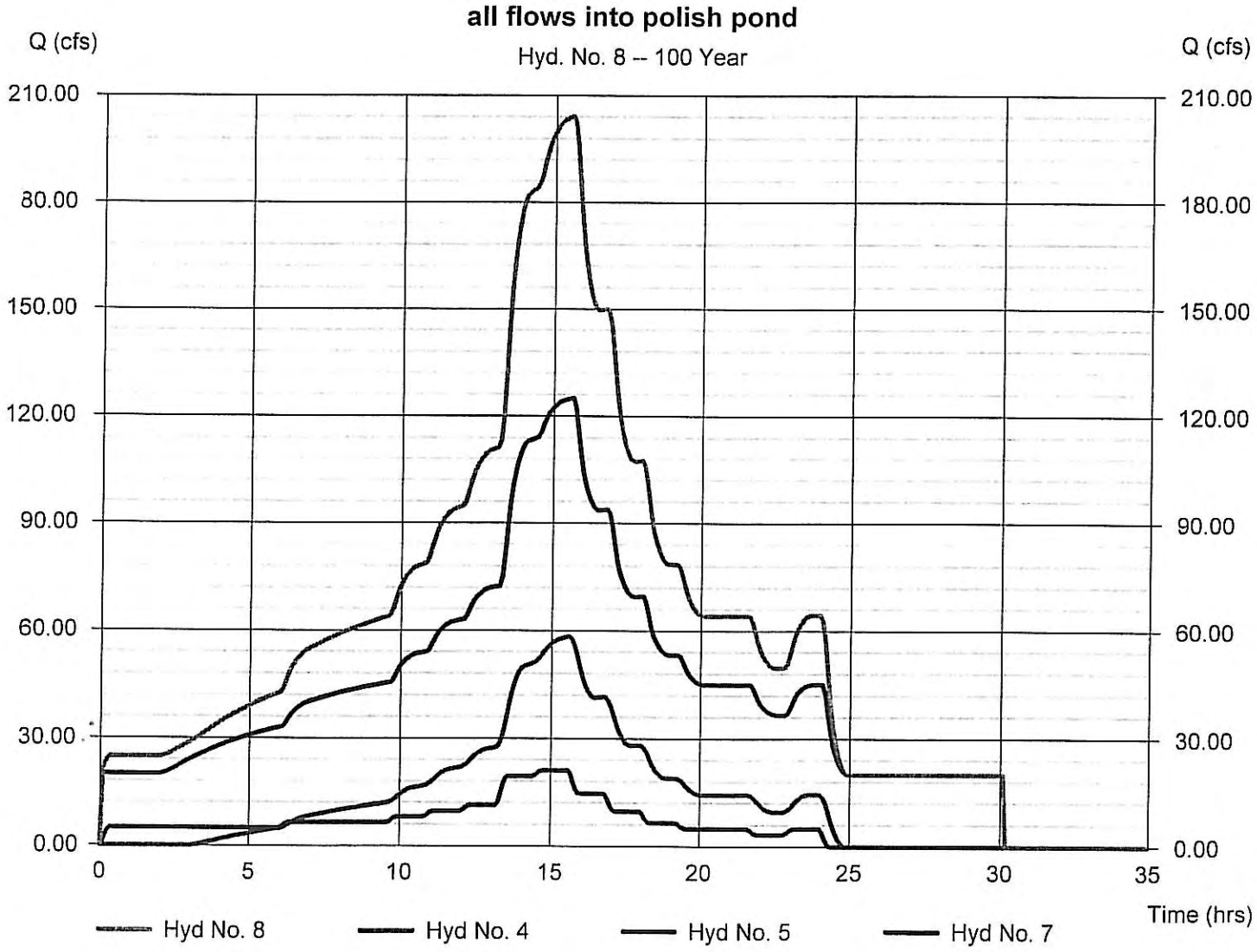
Hydraflow Hydrographs by Intelisolve v9.23

Monday, Mar 15, 2010

Hyd. No. 8

all flows into polish pond

Hydrograph type	= Combine	Peak discharge	= 204.24 cfs
Storm frequency	= 100 yrs	Time to peak	= 15.58 hrs
Time interval	= 5 min	Hyd. volume	= 167.188 acft
Inflow hyds.	= 4, 5, 7	Contrib. drain. area	= 113.900 ac



Hydrograph Report

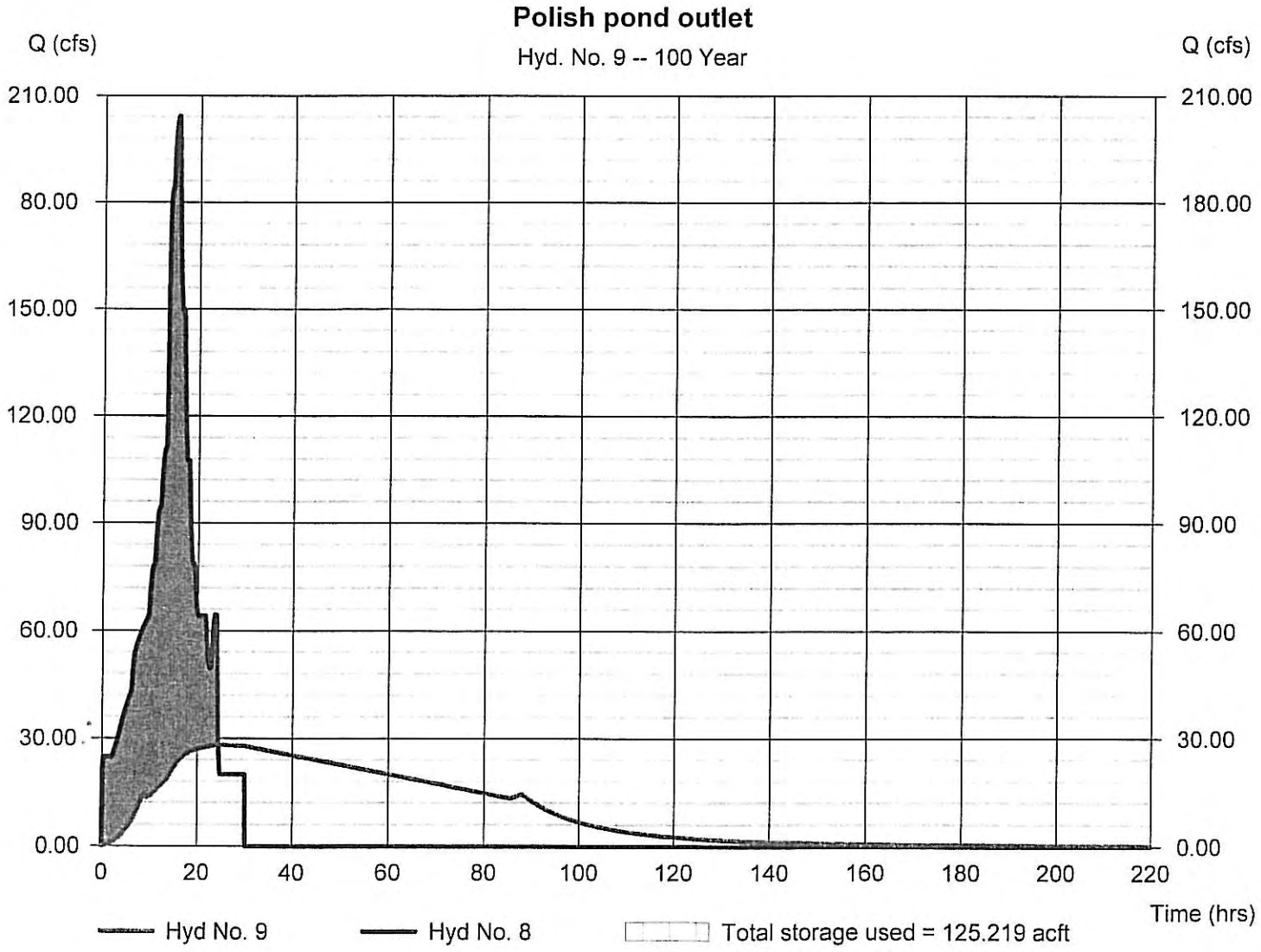
Hydraflow Hydrographs by Intelisolve v9.23 — Monday, Mar 15, 2010

Hyd. No. 9

Polish pond outlet

Hydrograph type	= Reservoir	Peak discharge	= 28.27 cfs
Storm frequency	= 100 yrs	Time to peak	= 24.50 hrs
Time interval	= 5 min	Hyd. volume	= 166.331 acft
Inflow hyd. No.	= 8 - all flows into polish pond	Max. Elevation	= 402.55 ft
Reservoir name	= Polish pond	Max. Storage	= 125.219 acft

Storage Indication method used.



Hydraflow Rainfall Report

Return Period (Yrs)	Intensity-Duration-Frequency Equation Coefficients (FHA)			
	B	D	E	(N/A)
1	0.0000	0.0000	0.0000	--------
2	69.8703	13.1000	0.8658	--------
3	0.0000	0.0000	0.0000	--------
5	79.2597	14.6000	0.8369	--------
10	88.2351	15.5000	0.8279	--------
25	102.6072	16.5000	0.8217	--------
50	114.8193	17.2000	0.8199	--------
100	127.1596	17.8000	0.8186	--------

File name: SampleFHA.idf

Intensity = B / (Tc + D)^E

Return Period (Yrs)	Intensity Values (in/hr)											
	5 min	10	15	20	25	30	35	40	45	50	55	60
1	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2	5.69	4.61	3.89	3.38	2.99	2.69	2.44	2.24	2.07	1.93	1.81	1.70
3	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
5	6.57	5.43	4.65	4.08	3.65	3.30	3.02	2.79	2.59	2.42	2.27	2.15
10	7.24	6.04	5.21	4.59	4.12	3.74	3.43	3.17	2.95	2.77	2.60	2.46
25	8.25	6.95	6.03	5.34	4.80	4.38	4.02	3.73	3.48	3.26	3.07	2.91
50	9.04	7.65	6.66	5.92	5.34	4.87	4.49	4.16	3.88	3.65	3.44	3.25
100	9.83	8.36	7.30	6.50	5.87	5.36	4.94	4.59	4.29	4.03	3.80	3.60

Tc = time in minutes. Values may exceed 60.

Precip. file name: Sample.pcp

Storm Distribution	Rainfall Precipitation Table (in)							
	1-yr	2-yr	3-yr	5-yr	10-yr	25-yr	50-yr	100-yr
SCS 24-hour	0.00	2.20	0.00	3.30	4.25	5.77	6.80	0.00
SCS 6-Hr	0.00	1.80	0.00	0.00	2.60	0.00	0.00	0.00
Huff-1st	0.00	1.55	0.00	2.75	4.00	5.38	6.50	0.00
Huff-2nd	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Huff-3rd	0.00	0.00	0.00	0.00	0.00	0.00	0.00	7.10
Huff-4th	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Huff-Indy	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Custom	0.00	1.75	0.00	2.80	3.90	5.25	6.00	0.00

ATTACHMENT 2

Ash Pond Closure Issued for Bid
Design Drawings

By Haley & Aldrich, Inc.
January 2018

(Drawings submitted previously as part of the initial Ameren construction permit request to MDNR dated 26 February 2018)

ATTACHMENT 3

Report on Ash Pond Geotechnical Closure Design

By Haley & Aldrich, Inc.
December 2017

HALEY ALDRICH

www.haleyaldrich.com

REPORT ON

ASH POND GEOTECHNICAL CLOSURE DESIGN
RUSH ISLAND ENERGY CENTER
FESTUS, MISSOURI

by Haley & Aldrich, Inc.
Cleveland, Ohio

for Ameren Missouri
St. Louis, Missouri

File No. 129530-003
December 2017



HALEY & ALDRICH, INC.
6500 ROCKSIDE ROAD
SUITE 200
CLEVELAND, OH 44131
216.739.0555

20 December 2017
File No. 129530-003

Ameren Missouri
3700 S. Lindbergh Boulevard
St. Louis Missouri 61501

Attention: Mr. Michael J. Wagstaff, P.E.
Consulting Engineer, Dam Safety & Hydro Engineering

Subject: Report on Ash Pond Geotechnical Closure Design
Rush Island Energy Center
Festus, Missouri

Dear Mr. Wagstaff:

We are pleased to submit herewith our report entitled, "Report on Ash Pond Geotechnical Closure Design, Rush Island Energy Center, Festus, Missouri." This report has been prepared in accordance with our proposal dated 15 February 2016 and your subsequent authorization.

The purpose of this study was to develop a summary of geotechnical characterizations and geotechnical recommendations for closure design at the subject site. This report includes background information regarding the project and summarizes our design recommendations and construction considerations.

Introduction

BACKGROUND

Ameren Missouri (Ameren) operates a coal-fired power plant at the Rush Island Energy Center (RIEC) in southeast Jefferson County, Missouri. Currently, this facility has an active surface impoundment (Ash Pond) containing fly ash and bottom ash coal combustion residual products. The Ash Pond is nearing capacity and Ameren plans to close the existing pond.

Ameren has retained Haley & Aldrich to perform the Ash Pond closure design and prepare construction bid documents; this ash pond geotechnical closure design report is an integral part of the construction bid documents. The proposed closure generally consists of regrading existing ash within the pond to achieve a mass balance. That regrading will include reshaping and excavation of ash fill in the north portion of the Ash Pond (north of the existing ash splitter dike), and unwatering and fill placement to raise the grade to within approximately 1 ft. of the existing impoundment embankment in the southern end of the pond (currently the lower settling pond). The closure will be designed in such a manner that long-term drainage of clean surface water/runoff will be accomplished via gravity drainage to a series of

nine culvert discharge pipes to be installed around the perimeter of the unit through the dike, eventually discharging to the Mississippi River.

The geotechnical data used as the basis of this design report can be found in the Haley & Aldrich report entitled "Data Report on Subsurface Investigation and Laboratory Testing, Ash Pond Closure, Rush Island Energy Center, Festus, Missouri", dated December 2017. The referenced geotechnical data report contains recent and historic exploration logs (i.e., dilatometer soundings, cone penetrometer soundings, and test borings) subsurface exploration location plans, and laboratory testing results.

The elevations used in this report are in feet and reference the North American Vertical Datum of 1988 (NAVD88) unless otherwise noted. The horizontal control is Missouri State Plane East, which is based on North American Datum 83 (NAD83).

DESCRIPTION OF POND

The Ash Pond is a surface impoundment that was constructed around 1976 as part of the original construction of RIEC and is currently active. The Ash Pond is bordered to the east by the Mississippi River, to the north by RIEC plant facilities, and to the west and south by undeveloped lands. The Ash Pond is approximately 112 acres in size and is surrounded by a ring dam (embankment) with approximate 3 horizontal to 1 vertical (3H:1V) exterior side slopes and a maximum embankment height of approximately 46 ft. The pond generally consists of bottom ash and fly ash coal combustion residuals (CCR) that have been sluiced to the pond over the life of the pond. Operations originally consisted of sluicing Class F Fly ash into the pond and eventually coal selections (a fuel change to PRB coal) resulted in sluicing Class C Fly Ash through present day operations. An internal ash berm located in the southern portion of the pond divides the pond into two separate areas. The area north of the ash berm (approximately 83 acres) is used for receipt of sluiced ash, the remaining footprint south of the berm (approximately 29 acres) is used for final sedimentation of ash fines.

The principal spillway for the Ash Pond is located in the south end of the Ash Pond and consists of a 24-in. diameter HDPE pipe (that was slip-lined within a 36-in. diameter corrugated outer pipe) that discharges to the Mississippi River. The invert elevation of the principal spillway is approximately El. 372.5 ft. The outlet channel includes limited erosion protection and has experienced some erosion. There is also an emergency spillway located on the west side of the unit with a crest at approximately El. 407 ft. Riprap was installed on portions of the exterior upstream and downstream slopes to enhance long-term performance in 2010, and subsequent inspections and upgrades/improvements as recently as 2015 included some localized slope regrading to 3H:1V and additional slope armoring with riprap. More improvements are planned as part of the final pond closure process which includes enhancements at the toe of the embankment proximate to the 24-in. diameter outfall pipe that discharges to the Mississippi River.

Design Recommendations

STABILITY ANALYSES

An evaluation of the existing impoundment embankment was performed for the closed condition. Our analyses have been performed in general conformance with the principles and methodologies described in the USACE Slope Stability Manual (U.S. Army Corps of Engineers, 2003). Conventional static analyses of the impoundment embankments were performed using limit equilibrium methods. Limit equilibrium methods compare forces, moments, and stresses which cause instability of the mass of the embankment to those which resist that instability. The principle of the limit equilibrium method is to assume that if the slope under consideration is at the theoretical structural limit of failure, then one must determine the resulting shear stresses along the expected failure surface. These determined shear stresses are then compared with the shear strength of the soils along the expected failure surface to determine the resultant safety factor. The details of the analyses performed for the impoundments are presented in the following sections of this report.

The minimum required safety factors used in our evaluation are defined as follows:

- The calculated static factor of safety under the long-term conditions must equal or exceed 1.5.

For the seismic condition, deformation analyses were performed to evaluate the amount of embankment displacement that would occur due to a seismic event. The deformation analyses were generally performed in accordance with MDNR Draft Technical Guidance Document[1]. It should be noted that pseudo-static analyses were not performed to evaluate seismic stability as the factor of safety predicted by pseudo-static analyses does not necessarily indicate that a slope failure will (or would not) occur. The fact that the calculated factor of safety does not provide an estimated magnitude of displacement is one of the primary limitations of the pseudo-static stability analyses. As a result, deformation analyses were performed to assess seismic stability.

Design Water Levels

The water levels (i.e., phreatic surface) within the Ash Pond used in our stability analyses were conservatively defined as follows:

Location	Crest	Anticipated Water Level after Closure	Available Freeboard after Closure
Ash Pond (southern settling pond)	El. 409.5	El. 398	11.5 ft.

The elevation of the phreatic surface within the embankments and at the toe of slope were estimated based on conditions encountered in nearby subsurface explorations, observation wells, and drainage structures. At the critical cross section, a simplified and conservative straight-line interpolation was used

1. Technical guidance documents and reports referenced in this report can be found in the references section.

to model the phreatic surface as moving laterally through the embankment and discharging at the downstream side of the embankment at El. 369.5.

Material Properties

The material properties used in our slope stability analyses have been evaluated using the results of the historic subsurface explorations and laboratory testing by others, Haley & Aldrich's recent subsurface explorations and laboratory testing, and analyses performed by Reitz & Jens, Inc. for the Safety Factor Assessment. Refer to **Table I** for a summary of material properties. The generalized stratigraphy used in our slope stability analysis are provided in our analysis output included in **Appendix A** of this report.

TABLE I
MATERIAL PROPERTIES USED IN STABILITY ANALYSIS INCLUDING PLANNED AS-BUILT FINAL COVER SYSTEM

Material	Material Strength	Unit Weight (pcf)	Cohesion (psf)	Friction Angle (degrees)
Cover System	Drained	130	50	28
	Undrained	130	800	0
Ponded Ash/Subgrade Fill	Drained	105	0	30
	Undrained	105	0	30
Embankment Fill	Drained	123	100	28
	Undrained	123	800	0
Silty Clay Fill	Drained	123	100	29
	Undrained	123	1280	0
Silty Clay Fill (below water table)	Drained	123	0	29
Soft Layer	Drained	120	100	28
	Undrained	120	700	0
Soft Layer (below water table)	Drained	120	0	28
Sandy Silt & Silty Clay	Drained	120	100	29
	Undrained	120	1240	0
Sandy Silt & Silty Clay (below water table)	Drained	120	0	29
Silty Clay	Drained	118	225	28
	Undrained	118	400	15.1
Silty Clay (below water table)	Drained	118	0	28
	Undrained	118	400	0
Clayey Silt	Drained	116	200	33
	Undrained	116	1640	0

TABLE I (CONTINUED)
MATERIAL PROPERTIES USED IN STABILITY ANALYSIS INCLUDING PLANNED AS-BUILT FINAL COVER SYSTEM

Material[1,2]	Material Strength	Unit Weight (pcf)	Cohesion (psf)	Friction Angle (degrees)
Clayey Silt (below water table)	Drained	116	0	33
Sandy Silt	Drained	118	0	34
	Undrained	118	0	34
Sand	Drained	120	0	37
	Undrained	120	0	37

1. All of the materials shown are those included in our stability models, but may or may not be associated with the critical failure surface.
2. Material properties above and below the water table are the same for the undrained condition.

Design Seismic Event

The earthquake conditions used in our analyses correspond to the peak ground acceleration for a seismic event with a 2 percent probability of exceedance in 50 years (2,500-year return period). The gridded hazard map data associated with the latest USGS National Seismic Hazard maps developed in 2014 indicates that the bedrock peak ground acceleration (PGA) at the site for the 2,500-year earthquake event is 0.309g, with the greatest contribution to the hazard coming from an earthquake with a modal magnitude of 7.5 as indicated on the de-aggregation chart included in **Appendix A**. The bedrock PGA value was adjusted by the USGS site coefficient, F_{PGA}, of 1.2 for Site Class D (IBC 2012/2015) to determine the peak free field ground acceleration of 0.371g. Note that the value of peak free field acceleration corresponds to the peak ground acceleration at the base of the impoundment embankment.

Methodology for Analyses

The computer software program Slide 7.0 was used to evaluate the static stability of the impoundment embankments. Analyses were performed to evaluate static drained (long-term) strength conditions for circular and translational (block) failures using Spencer's method of slices. Spencer's method of slices was selected as it fully satisfies the requirements of force and moment equilibrium (i.e., the limit equilibrium method). Translational (block) failures were analyzed where subsurface conditions included a relatively weak foundation layer underlain by a relatively strong foundation layer (soft clay overlying dense sand). The results of our evaluation of circular and translational failures indicated that circular failure surfaces represent the critical slope failure case. Accordingly, the results discussed below are limited to the critical case analyses performed for circular failure surfaces and takes stability of the final cover system into consideration.

Deformation Analyses

Using the design earthquake information discussed above, we evaluated deformations using the simplified approach described in the MDNR Draft Technical Guidance Document. Using the simplified approach, an estimate of deformation (due to ground shaking caused by the design horizontal ground accelerations) was calculated for the critical case circular failures.

Results of Stability Evaluation

The critical cross section is defined as that which is anticipated to be most susceptible to failure (i.e., result in the lowest calculated factor of safety) from all cross sections considered. To identify the critical cross section at our project site, we examined the following conditions at several cross-section locations:

a. the geometry of the upstream and downstream embankment slopes;
b. phreatic surface levels within and below the cross sections;
c. subsurface soil conditions;
d. presence or lack of surcharge loads behind the crest of the embankments; and
e. presence or lack of reinforcing measures in front of the embankments.

Examination of the conditions noted above resulted in the identification of the critical cross section at the location shown on **Figure 1** in **Appendix A**. The critical cross section is located at the principle spillway discharge pipe. The results of our analyses are summarized below in **Table II** and additional details are included in **Appendix A**.

As shown below, the static safety factor is above the minimum required values for the critical cross section (Section A-A') including installed rip-rap on the exterior downstream slope of the Ash Pond impoundment (which is part of the planned pond closure improvements). Similarly, MSHA guidelines indicate that the maximum acceptable deformation of impoundment embankments is approximately 25 percent of the available freeboard, which corresponds to approximately 34 inches for the Ash Pond (freeboard as previously defined is 11.5 feet (138 inches)). Based on the results of our analyses, the calculated average displacement is below the maximum recommended value. Therefore, for both the static and seismic analysis, the critical section passes (meets or exceeds minimum requirements).

TABLE II
SUMMARY OF STATIC AND SEISMIC STABILITY EVALUATIONS

Cross Section	Condition	Soil Strength[1]	Minimum Required Safety Factor	Calculated Safety Factor	Seismic Displacement		Outcome (Pass/Fail)
					Maximum Allowable	Average Calculated	
A-A'	Static Long-Term (w/Rip Rap Improvements)[3]	Drained	1.5	1.9		--	Pass
A-A'	Seismic (w/Rip Rap Improvements)[3]	Undrained[2]	--	--	34 in.	12 in.	Pass

1. Refer to **Table I** for material properties.
2. Includes 20 percent strength reduction to account for the threshold between large and small strains (elastic vs. non-elastic behavior) induced by cyclic loading.
3. Condition represents post-closure condition with rip rap installation.

BEARING CAPACITY ANALYSIS FOR CAP/COVER SUBGRADE FILL

Bearing capacity failure (i.e., subgrade instability) can be a potential issue during filling and grading associated with the pond subgrade construction. Subgrade instability is anticipated to be a more probable/prevalent issue within the southern end of the Ash Pond where ponded water and ash fines have been accumulated during the life of the pond. The minimum and maximum thickness of net new fill in the southern end of the Ash Pond is anticipated to range from less than 1 foot to approximately 37.5 ft., respectively.

Theoretical bearing capacity calculations were evaluated based on the available geotechnical laboratory strength testing, in-situ testing associated with previously completed borings and piezo-cone (CPT) testing, and several generalized/simplifying assumptions. The analysis performed for this evaluation assumed that subgrade fill would be placed over the ponded ash after sufficient unwatering/dewatering and adequate time for excess pore pressures to dissipate from previous or current subgrade placement activities. The properties assumed for the ponded ash/subgrade fill in our analyses are summarized above in **Table I**. Incremental strength gains of the ponded ash due to consolidation that will likely occur during cover (and associated subgrade) construction was conservatively ignored in our calculations. The results of our analyses indicate that for the initial undrained loading with an assumed fill thickness of 3 ft. (and associated equipment surcharge), the subgrade should remain stable[2].

The rate of loading and the construction methodology for the pond cover system (and associated subgrade) is largely a Contractor means and methods issue. There will likely be variability with respect to what is required in different areas of the Ash Pond due to the local variability in subsurface conditions and the amount of filling and excavation (if any) that will occur prior to the cover system installation. The bearing capacity evaluations demonstrate that capping is feasible with proper construction

2. Initial loadings were represented conservatively with a 3-feet push/placement of ponded ash with a total unit weight of 120 pcf and a 240 psf equipment surcharge load.

technique including sufficient and informed unwatering/dewatering and allowance of sufficient time in the schedule for excess pore pressure to dissipate and strength gain to occur between successive ash subgrade lifts.

Under special circumstances where the contractor is unable to achieve a stable subgrade using the approach defined previously, the Contractor may be required to employ "select ash stabilization techniques" to further stabilize/bridge the unstable material. Select ash stabilization techniques may include but are not limited to use of geosynthetic reinforcement fabrics, competent imported granular backfill, over-excavation and replacement, and use of stabilizing agents as proposed by the Contractor and approved by the Engineer.

SETTLEMENT ANALYSES

When the Ash Pond is unwatered/dewatered and capped for closure, areas with an increase in net load overlying compressible ponded ash will settle. The amount and timing of the settlement is important to the cover design because it is necessary to confirm that the slopes of the storm water management channels are sufficient to maintain long-term positive drainage after site closure. In addition, the magnitude of overall settlement will also have an impact on fill quantities required to achieve final cap/cover subgrade design grades. Given the size of the Ash Pond, the variation in thickness and composition of the ash, variation in loading conditions, and the limitations of subsurface explorations, the settlement analyses outcomes discussed herein should be considered "order of magnitude" estimates.

We have used a variety of methods to evaluate settlement. Our overall calculation approach is summarized below.

1. Perform settlement calculations at specific exploration locations using correlations with in-situ dilatometer (DMT) data, cone penetrometer (CPT) data, and laboratory odometer (i.e., consolidation) test data on field bulk and Shelby tube samples. Refer to the Haley& Aldrich Data Report for the associated field and laboratory data.
2. Compare the results of these different methods and determine the compressibility characteristics and most appropriate method for performing settlement analyses.
3. Evaluate the change in net loading along the drainage channels due to construction of the cap and final grading.
4. Calculate settlement at discrete points along the drainage channels where an increase in net load occurs.
5. Evaluate the final slope of the drainage channels once settlement is taken into consideration to confirm that the minimum slope requirements for drainage are met.

Using the approach described above, the DMT data was used to establish the lower bound of maximum settlement and the oedometer data was used to evaluate the upper bound of maximum settlement. The settlement calculations indicate that the majority of settlement will occur in the south end of the pond where fill thicknesses are greatest per the closure design. Maximum settlements are anticipated to

range from approximately 11 to 38 inches. Settlement calculations along the drainage channels result in relatively low values of angular distortion and will not negatively impact long-term drainage characteristics. The calculation details are included in **Appendix A**.

SITE FILL AND COMPACTION REQUIREMENTS

In consideration of the existing site grades and the proposed finished grades, we anticipate that subgrade excavation and fill placement will be required to achieve the proposed finished grades. Generalized recommendations/guidelines for preparation of subgrade, fill materials, and compaction are provided below. The recommendations presented below are written primarily for the engineer that will be preparing the quality assurance documents. In the event that there is a discrepancy between the recommendations presented below and the quality assurance documents, Haley & Aldrich should be consulted to resolve the discrepancy.

Preparation of Subgrade for Final Cover System

Material for subgrade fill will consist primarily of regraded, in-place ponded ash, placed in nominal 18-inch thick lifts, and tracked in-place with a minimum of three equipment passes per lift. The subgrade surface should be periodically proof-rolled as lifts are placed (particularly in the south end of the pond where a significant amount of subgrade fill will be placed) to ensure adequate subgrade stability and again following placement of the final subgrade lift in preparation of the final cover system. Proof rolling should be performed by truck or conventional compaction equipment having a minimum single axle weight of 10 tons and be visually inspected to verify a stable in-situ foundation exists to accommodate trafficability and to allow for successful installation of the final cover system.

Fill Materials and Compaction

As stated previously, existing ponded ash material will be regraded to achieve a mass balance condition for the cover system subgrade (generally resulting in ash material being cut from the north end of the Ash Pond and filled in the southern end). However, due to the lack of on-site borrow available for cover system construction, cover system soils will need to be imported to the site.

Material and compaction requirements for construction of the cover system and general site fill are provided below. To evaluate the suitability and the quality of fill sources, we recommend that laboratory testing of fill material be performed in accordance with the ASTM Test Methods indicated below in **Table III**. In addition, all materials proposed as fill must meet the shear strength requirements indicated earlier in **Table I**.

Table III ASTM TEST DESIGNATIONS	
Test	ASTM Designation
Sieve Analysis	D 422
Standard Proctor	D 698
Percent Passing No. 200	D1140
Moisture Content	D 2216
Unified Soil Classification	D 2487
Organic Matter Content	D 2974
Atterberg Limits	D 4318
Hydraulic Conductivity	D 5084
Sieve Analysis	D 6913

General Fill

General Fill may consist of in-organic soils, free of roots or other organic matter, refuse, frozen earth, or other unsuitable material including gravel, stones, shale particles or clods greater than half the depth of the layer or lift to be compacted. General Fill should be sufficiently friable for embankment to provide a dense mass free of voids and capable of satisfactory compaction. Material proposed as General Fill should be tested and approved by a qualified geotechnical engineer prior to its use.

General Fill in unconfined areas should be placed in horizontal lifts not exceeding 12-in. in loose thickness and compacted to a minimum 95 percent maximum dry density demonstrated by test method ASTM D 698 (Standard Proctor). General Fill should have sufficient water applied to the fill immediately ahead of the compactor to ensure adequate saturation of the material during compaction to achieve the required in-place density.

Protective Cover Soil

The Protective Cover Soil should consist of material suitable for use as General Fill material but with a maximum particle size of ¾-in. Material proposed as Protective Cover Soil should be tested and approved by a qualified geotechnical engineer prior to its use.

The Protective Cover Soil should be placed to include a first lift thickness of greater than or equal to 18-in. (loose) and be sufficiently compacted to avoid excessive rutting during subsequent placement of the Vegetative Cover Soil layer.

Vegetative Soil

The Vegetative Soil will consist of Contractor-supplied off-site borrow soils and/or topsoil capable of providing stormwater runoff, resisting erosion and facilitating vegetation growth. Vegetative Soil should consist of loam texture soils from the “A” horizon of local soil profiles, as defined in the USDA Soil Texture Triangle. The Vegetative Soil should have an organic content between one and ten percent

according to AASHTO T 194. It should be relatively free from large roots, sticks, weeds, brush, or stones larger than ¾-in. diameter, or other litter and waste products. At least 90 percent should pass the No. 10 sieve according to Illinois Modified AASHTO T 27, and the pH should be between 5.0 and 8.0 according to ASTM D 4972.

Cohesive Soil/Infiltration Soil

The Cohesive Soil/Infiltration Soil should consist of imported soils that do not contain degradable materials with a minimum of 50 percent passing the No. 200 sieve and a maximum of 10 percent greater than the ¾-in. sieve. The Cohesive Soil/Infiltration Soil should be free of CCR, roots or other organic matter, refused, ashes, cinders, frozen earth, gravel, stones, shale particles greater than 2-in. in any direction and have a vertical hydraulic conductivity less than 1×10^{-5} cm/sec. Material proposed as Cohesive Soil/Infiltration Soil should be tested and approved by a qualified geotechnical engineer prior to its use.

Cohesive Soil/Infiltration Soil material in unconfined areas should be placed in horizontal lifts not exceeding 8 in. in loose thickness and compacted to at least 90 percent of the laboratory maximum dry density, as determined by ASTM Test D 698 (Standard Proctor). Cohesive Soil/Infiltration Soil should be moisture conditioned to within ± 4 percentage points of the optimum moisture content. In confined areas, the material should be placed in thinner lifts and tamped in place by hand-guided equipment.

Outlet Pipe Trench Backfill

Outlet Pipe Trench Backfill should consist of material that meets the requirements of Cohesive Soil/Infiltration Soil material with the exception that there are no hydraulic conductivity requirements.

Outlet Pipe Trench Backfill in unconfined areas should be placed in horizontal lifts not exceeding a loose thickness of 12 in. and compacted to at least 95 percent of the laboratory maximum dry density, as determined by ASTM Test D 698 (Standard Proctor). Outlet Pipe Trench Backfill should have a maximum particle size of 2 in., a minimum of 50 percent passing the No. 200 sieve, a maximum of 10 percent retained on the ¾-inch sieve and should be moisture conditioned to within ± 2 percentage points of the optimum moisture content. In confined areas, material should be placed in shallower lifts and tamped in place by hand-guided equipment.

Construction Considerations

The following sections of the report include comments on items related to geotechnical engineering aspects of the proposed construction. This section is written primarily for the Contractor and the engineer responsible for preparation of plans and specifications. Since this section identifies potential construction problems related to foundations and earthwork, it will also aid personnel who monitor the construction activity.

Prospective Contractors for the project must evaluate potential construction problems on the basis of their own knowledge and experience in the state of Missouri, and on the basis of similar projects in other localities, considering their own proposed construction methods and procedures.

In addition to the construction guidelines and recommendations made herein, construction activities should conform to the requirements of OSHA, MDNR and other applicable state and regulatory agencies.

UNWATERING/DEWATERING

Water levels within the pond generally indicate static water levels ranging from El. 360 to El. 402 in the north portion of the pond and from El. 366 to El. 399 in the portion of the pond south of the existing splitter dike. Accordingly, there is significant potential for subsurface water to adversely affect the proposed construction, especially during excavation and construction of the stormwater outlet areas of the pond and lower elevations throughout the pond footprint. During construction, the Contractor should be prepared to unwater/dewater in areas where excavations are planned to extend below or to within close proximity of the static water levels. Localized or site-wide dewatering may also be required to create a stable subgrade to serve as a working platform in areas where filling is required. In general, the unwatering/dewatering system may consist of pumping from sumps within the excavation or pumps installed in wells in close proximity to the excavation. Means and methods to achieve a stable, safe, and constructible condition are the responsibility of the Contractor.

EXCAVATION

Excavation will be required for installation of storm water management outlet pipes and associated ash material in the vicinity of the outlet pipes. We anticipate that excavation of the existing ash should generally be achievable using conventional earth-moving equipment in proper working condition, although low contact pressure equipment may be required during the initial stages of construction or in excessively soft areas. In certain areas of the site, where the near surface Class C fly ash is present and displays a cemented behavior, excavations may be more difficult due to larger masses of cemented ash. All excavations should be performed in accordance with local, state, and federal regulations, including current OSHA excavation safety standards.

CONSTRUCTION MONITORING

A qualified and experienced engineer from our office should be present during construction to:

- Observe subgrades prior to placement of final cover;
- Observe and test placement and compaction of all fill materials in accordance with ASTM D 1556 (sand cone method), ASTM D 2922 and D3017 (nuclear method), or other field methods acceptable to the Engineer of Record to verify the proper placement and compaction of fill material; as an exception, the subgrade fill and final subgrade surface should only be tested via proof-rolling.

- Observe and record relevant data during construction;
- Collect samples and perform additional laboratory tests, as required during construction, to substantiate the suitability of proposed fill; and
- Prepare a field report for each day's work summarizing the test results and observations, including comments on the day's construction activities.

Limitations

This report has been prepared for specific application to the proposed construction as understood at this time. In the event that changes in the recommended design are planned, the conclusions and recommendations contained in this report should not be considered valid, unless the changes are reviewed by Haley & Aldrich and the conclusions of this report modified or verified in writing.

The geotechnical evaluations and recommendations are based, in part, upon the data obtained from the referenced subsurface explorations. The nature and extent of variations between explorations may not become evident until construction. If variations appear at that time, it may be necessary to re-evaluate the recommendations of this report.

This report is prepared for the exclusive use of Ameren Missouri (Ameren) and their subconsultants in connection with the closure of the Ash Pond at the Rush Island Energy Center in Festus, Missouri. There are no intended beneficiaries other than Ameren. Haley & Aldrich shall owe no duty whatsoever to any other person or entity on account of the Agreement or the report. Use of this report by any person or entity other than Ameren and their subconsultants for any purpose whatsoever is expressly forbidden unless such other person or entity obtains written authorization from Ameren and from Haley & Aldrich. Use of this report by such other person or entity without the written authorization of Ameren and Haley & Aldrich shall be at such other person's or entity's sole risk, and shall be without legal exposure or liability to Haley & Aldrich.

Closing

We appreciate the opportunity to provide engineering services on this project. Please do not hesitate to call if you have any questions or comments.

Sincerely yours,
HALEY & ALDRICH, INC.



Derrick A. Shelton, P.E. (VA, MD, DC, TN)
Geotechnical Program Manger | Senior Associate



Steven F. Putrich, P.E.
Principal, CCR/Industrial Waste Lead



Roger J. Wilcox
Staff Engineer

Cc: Neal Kochis, PE (Haley & Aldrich PM)
Enclosures:
Appendix A – Design Calculations

\\haleyaldrich.com\share\was_common\Projects\40328 Rush Island UWL\Deliverables\Design Report\2017-1220-HAI-Ash Pond Design Report_F.docx

References

1. DeHavilland, Annette et. Al. (2004). “Geotechnical and Stability Analyses for Ohio Waste Containment Facilities.” Ohio Environmental Protection Agency Geotechnical Resource Group. Columbus, Ohio.

2. Duncan, J.M., Wright, S.G., and Brandon, T.L. (2014). Soil Strength and Slope Stability. John Wiley & Sons, Upper Saddle River, 2nd Edition, pp. 182-184.

3. Haley & Aldrich, Inc. (November 2017). “Data Report on Subsurface Investigation and Laboratory Testing, Ash Pond Closure, Rush Island Energy Center, Festus Missouri.”

4. Mine Safety and Health Administration – U.S. Department of Labor (MSHA), (May 2009. Rev. August 2010). Engineering and Design Manual Coal Refuse Disposal Facilities - Second Edition.

5. Missouri Department of Natural Resources – The Solid Waste Management Program Division of Environmental Quality (October 1998). “Draft Technical Guidance Document on Static and Seismic Slope Stability for Solid Waste Containment Facilities.”

6. Reitz & Jens, Inc. (October 2016). “Ameren Missouri Rush Island Energy Center Evaluation of CCR Units – Periodic Safety Factor Assessment.”

7. U.S. Army Corps of Engineers (October 2003). “Engineering and Design: Slope Stability,” Engineer Manual EM-1110-2-1902, Department of the Army, U.S. Army Corps of Engineers, Washington, DC.

8. U.S. Geological Survey (2014). “Earthquake Hazards Program.” https://earthquake.usgs.gov/static/lfs/nshm/conterminous/2014/data/

APPENDIX A

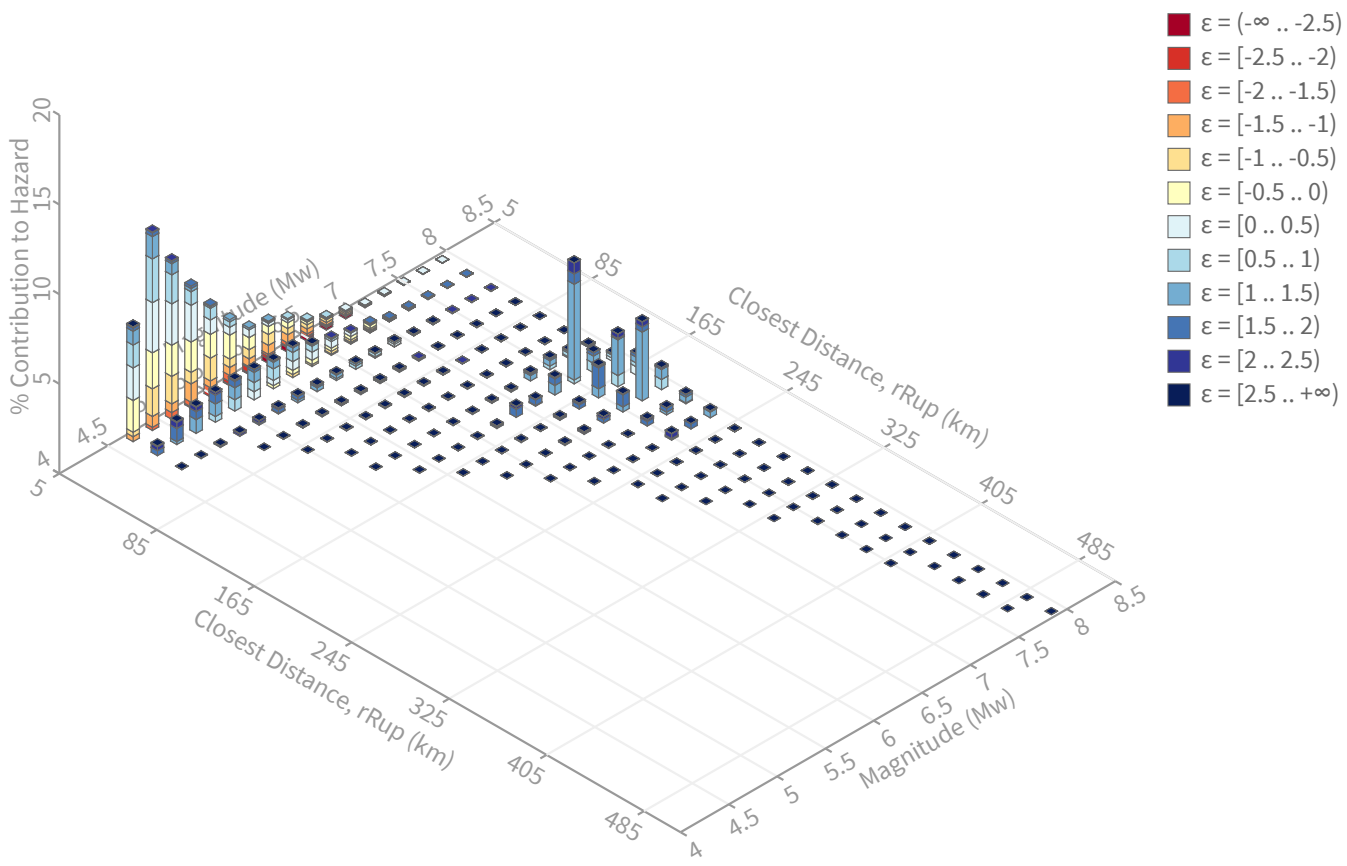
DESIGN CALCULATIONS

Seismic Documents

Deaggregation

Component

Total



Summary statistics for, Deaggregation: Total

Deaggregation targets

Return period: 2475 yrs
Exceedance rate: 0.0004040404 yr^{-1}
PGA ground motion: 0.31236523 g

Recovered targets

Return period: 2494.7762 yrs
Exceedance rate: 0.00040083756 yr^{-1}

Totals

Binned: 100 %
Residual: 0 %
Trace: 0.96 %

Mean (for all sources)

r: 60.86 km
m: 6.09
ε_0: 0.48 σ

Mode (largest r-m bin)

r: 10.52 km
m: 4.9
ε_0: 0.16 σ
Contribution: 11.06 %

Mode (largest ε_0 bin)

r: 149.95 km
m: 7.53
ε_0: 1.25 σ
Contribution: 5.34 %

Discretization

r: min = 0.0, max = 1000.0, Δ = 20.0 km
m: min = 4.4, max = 9.4, Δ = 0.2
ε: min = -3.0, max = 3.0, Δ = 0.5 σ

Epsilon keys

ε0: [-∞ .. -2.5)
ε1: [-2.5 .. -2.0)
ε2: [-2.0 .. -1.5)
ε3: [-1.5 .. -1.0)
ε4: [-1.0 .. -0.5)
ε5: [-0.5 .. 0.0)
ε6: [0.0 .. 0.5)
ε7: [0.5 .. 1.0)
ε8: [1.0 .. 1.5)
ε9: [1.5 .. 2.0)
ε10: [2.0 .. 2.5)
ε11: [2.5 .. +∞]

USGS Design Maps Detailed Report

ASCE 7-10 Standard (38.124°N, 90.258°W)

Site Class D – "Stiff Soil", Risk Category IV (e.g. essential facilities)

Section 11.4.1 — Mapped Acceleration Parameters

Note: Ground motion values provided below are for the direction of maximum horizontal spectral response acceleration. They have been converted from corresponding geometric mean ground motions computed by the USGS by applying factors of 1.1 (to obtain S_S) and 1.3 (to obtain S_1). Maps in the 2010 ASCE-7 Standard are provided for Site Class B. Adjustments for other Site Classes are made, as needed, in Section 11.4.3.

From Figure 22-1 [1]	S_S = 0.540 g
From Figure 22-2 [2]	S_1 = 0.201 g

Section 11.4.2 — Site Class

The authority having jurisdiction (not the USGS), site-specific geotechnical data, and/or the default has classified the site as Site Class D, based on the site soil properties in accordance with Chapter 20.

Table 20.3–1 Site Classification

Site Class	$\overline{v}_s$	$\overline{N}$ or $\overline{N}_{ch}$	$\overline{s}_u$
A. Hard Rock	>5,000 ft/s	N/A	N/A
B. Rock	2,500 to 5,000 ft/s	N/A	N/A
C. Very dense soil and soft rock	1,200 to 2,500 ft/s	>50	>2,000 psf
D. Stiff Soil	600 to 1,200 ft/s	15 to 50	1,000 to 2,000 psf
E. Soft clay soil	<600 ft/s	<15	<1,000 psf
	Any profile with more than 10 ft of soil having the characteristics: • Plasticity index *PI* > 20, • Moisture content *w* ≥ 40%, and • Undrained shear strength $\overline{s}_u$ < 500 psf		
F. Soils requiring site response analysis in accordance with Section 21.1	See Section 20.3.1		

For SI: 1ft/s = 0.3048 m/s 1lb/ft² = 0.0479 kN/m²

Section 11.8.3 — Additional Geotechnical Investigation Report Requirements for Seismic Design Categories D through F

From Figure 22-7 [4] PGA = 0.309

Equation (11.8–1): $PGA_M = F_{PGA}PGA =$ 1.2 x 0.309 = 0.371 g

Table 11.8–1: Site Coefficient F_{PGA}

Site Class	Mapped MCE Geometric Mean Peak Ground Acceleration, PGA				
	PGA ≤ 0.10	PGA = 0.20	PGA = 0.30	PGA = 0.40	PGA ≥ 0.50
A	0.8	0.8	0.8	0.8	0.8
B	1.0	1.0	1.0	1.0	1.0
C	1.2	1.2	1.1	1.0	1.0
D	1.6	1.4	1.2	1.1	1.0
E	2.5	1.7	1.2	0.9	0.9
F	See Section 11.4.7 of ASCE 7				

Note: Use straight–line interpolation for intermediate values of PGA

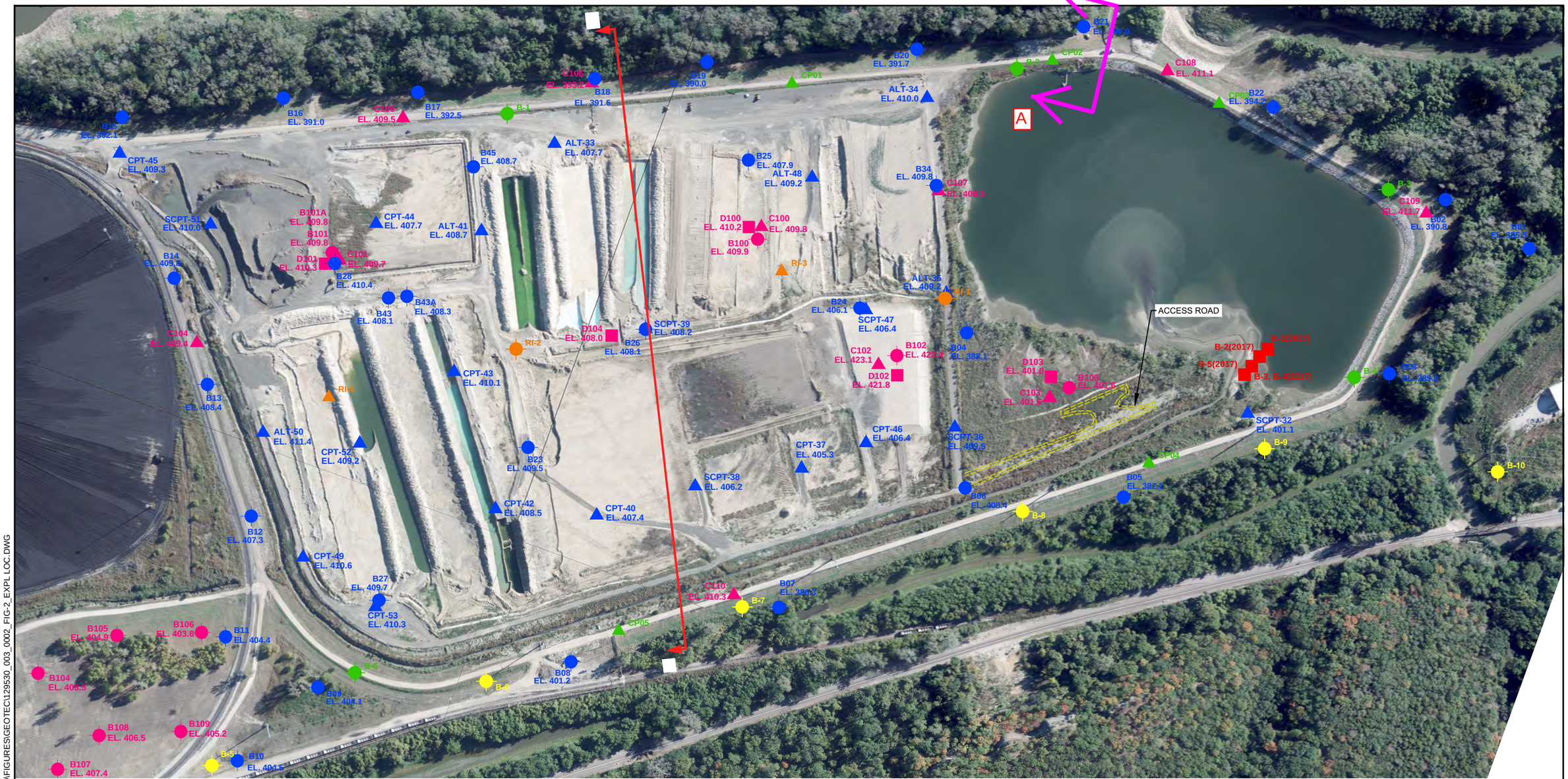
For Site Class = D and PGA = 0.287 g, F_{PGA} = 1.225

Section 21.2.1.1 — Method 1 (from Chapter 21 – Site-Specific Ground Motion Procedures for Seismic Design)

From Figure 22-17 [5] C_{RS} = 0.853

From Figure 22-18 [6] C_{R1} = 0.828

Slope Stability



LEGEND

- **B100 EL. 409.9** — DESIGNATION, LOCATION AND GROUND SURFACE ELEVATION OF TEST BORINGS PERFORMED BY BULLDOG DRILLING, INC. OF DUPO, ILLINOIS DURING THE PERIOD 06 OCTOBER 2014 TO 16 OCTOBER 2014. DESIGNATIONS THAT INCLUDE AN "A" CORRESPOND TO OFFSET BORINGS PERFORMED IMMEDIATELY ADJACENT TO THE ORIGINAL BORING.
- **C100 EL. 409.8** — DESIGNATION, LOCATION AND GROUND SURFACE ELEVATION OF CONE PENETROMETER (CPT) SOUNDINGS PERFORMED BY CONETEC, INC. OF WEST BERLIN, NEW JERSEY DURING THE PERIOD 23 SEPTEMBER 2014 TO 28 SEPTERMBER 2014.
- **D100 EL. 410.2** — DESIGNATION, LOCATION AND GROUND SURFACE ELEVATION OF DILATOMETER SOUNDINGS PERFORMED BY CONETEC, INC. OF WEST BERLIN, NEW JERSEY DURING THE PERIOD 29 SEPTEMBER 2014 TO 01 OCTOBER 2014.
- **B09 EL. 404.1** — DESIGNATION, LOCATION AND GROUND SURFACE ELEVATION OF TEST BORINGS PERFORMED BY NATURAL RESOURCE TECHNOLOGY DURING THE FALL OF 2013.
- **CPT-38 EL. 406.2** — DESIGNATION, LOCATION AND GROUND SURFACE ELEVATION OF CPT SOUNDINGS PERFORMED BY NATURAL RESOURCE TECHNOLOGY DURING THE PERIOD OF 22-26 APRIL 2013.
- **A A'** — LOCATION OF GEOLOGIC CROSS SECTION
- **RI-1** — DESIGNATION AND APPROXIMATE LOCATION OF TEST BORING PERFORMED BY HARRIS DRILLING SERVICES, INC. FOR CIVIL & ENVIRONMENTAL CONSULTANTS, INC. DURING THE PERIOD 1 NOVEMBER 2011 TO 2 NOVEMBER 2011.
- **RI-3** — DESIGNATION AND APPROXIMATE LOCATION OF CONE PENETROMETER SOUNDING PERFORMED BY STRATIGRAPHICS, INC. OF HILLPOINT, WISCONSIN FOR CIVIL ENVIRONMENTAL CONSULTANTS, INC. ON NOVEMBER 2011.
- **B-6** — DESIGNATION AND APPROXIMATE LOCATION OF TEST BORING PERFORMED BY REITZ & JENS, INC. OF SAINT LOUIS, MISSOURI DURING THE PERIOD 14 SEPTEMBER 2009 TO 17 SEPTEMBER 2009.
- **CP05** — DESIGNATION AND APPROXIMATE LOCATION OF CONE PENETROMETER SOUNDING PERFORMED BY STRATIGRAPHICS, INC. OF HILLPOINT, WISCONSIN FOR REITZ & JENS, INC. DURING THE PERIOD 27 AUGUST 2009 TO 28 AUGUST 2009.
- **B-6** — DESIGNATION AND APPROXIMATE LOCATION OF TEST BORINGS DRILLED BY PROFESSIONAL SERVICE INDUSTRIES, INC. OF SAINT LOUIS, MISSOURI DURING THE PERIOD 2 JANUARY 2007 TO 17 JANUARY 2007.
- **B-1(2017)** — DESIGNATION AND APPROXIMATE LOCATION OF SURFACE SAMPLE COLLECTED BY CIVIL & ENVIRONMENTAL CONSULTANTS, INC. ON 30 AUGUST 2017

NOTES:

1. EXPLORATION LOCATION PLAN WAS PREPARED FROM ORTHOIMAGERY BASED ON AERIAL SURVEY CONDUCTED BY KUCERA INTERNATIONAL, INC. ON OCTOBER 8, 2013 AND PROCESSED BY HENDERSON AERIAL SURVEYS.
2. ELEVATIONS INDICATED ON THIS DRAWING ARE IN FEET AND REFER TO NAVD 88 DATUM. HORIZONTAL CONTROL IS BASED ON MISSOURI STATE PLANE COORDINATE SYSTEM NAD83 (MO E).
3. TECHNICAL MONITORING OF TEST BORINGS, DILATOMETER SOUNDINGS, AND CONE PENETROMETER SOUNDINGS COMPLETED DURING THE PERIOD 23 SEPTEMEBER 2014 TO 16 OCTOBER 2014 WAS PERFORMED BY HALEY & ALDRICH, INC.
4. AS DRILLED LOCATIONS AND GROUND SURFACE ELEVATIONS OF TEST BORINGS, DILATOMETER SOUNDINGS, AND CONE PENETROMETER SOUNDINGS PERFORMED IN 2013 AND 2014 WERE DETERMINED IN THE FIELD BY ZAHNER & ASSOCIATES, INC. BY OPTICAL SURVEY.

A A' — LOCATION OF CRITICAL CROSS SECTION

0 300 600
SCALE IN FEET

HALEY ALDRICH

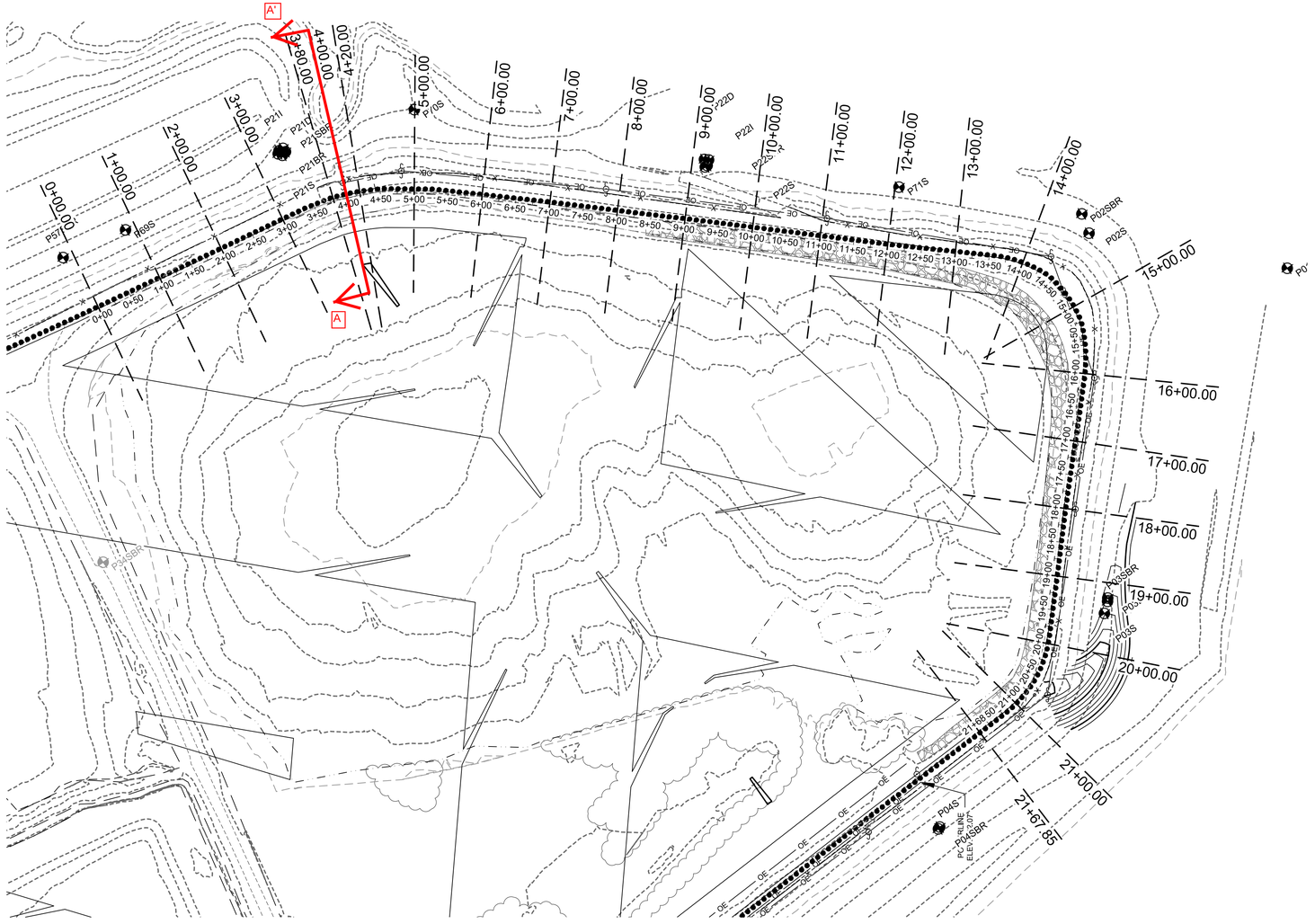
ASH POND CLOSURE
RUSH ISLAND ENERGY CENTER
FESTUS, MISSOURI

SUBSURFACE EXPLORATION LOCATION PLAN

SCALE: AS SHOWN
DECEMBER 2017

FIGURE 1

VARI, KATALIN Printed11/6/2017 12:11 PM Layout:L
G:\129530_AMEREN RUSH ISLAND POND CLOSURE\CAD\FIGURES\GEOTEC\129530_003_0002_FIG-2_EXPL LOC.DWG



HALEY ALDRICH

HALEY & ALDRICH, INC.
6500 Rockside Road, Suite 200
Cleveland, OH 44131-1463
Tel: 216.739.0555
Fax: 216.520.0712
www.Haleyaldrich.com

Project No.:	
Scale:	
Date:	
Drawn By:	
Designed By:	
Checked By:	
Approved By:	

Stamp:

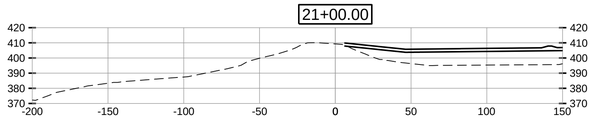
DRAFT

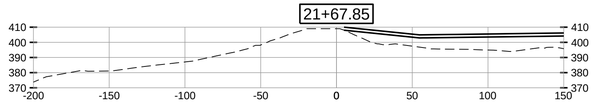
Rev.	Description	By	Date

FIGURE A-1

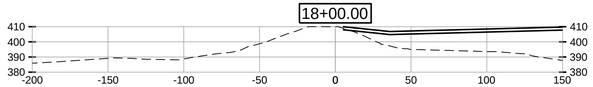
Sheet: of

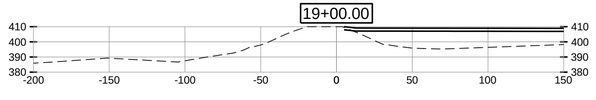
Operator Name: VARI, KATALIN Drawing Layout: PLAN Plot Date: October 30, 2017
Drawing Name: G:\129530_AMEREN RUSH ISLAND POND CLOSURE\CAD\XREFS\RI XS_GEOTECH.DWG

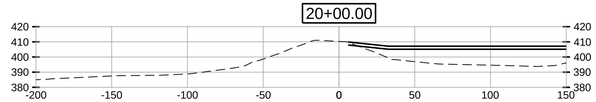


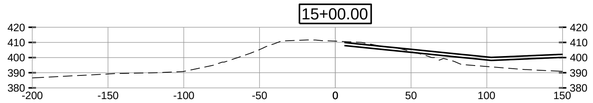


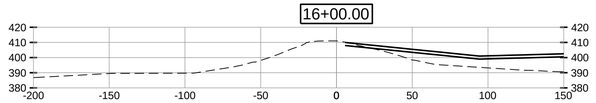


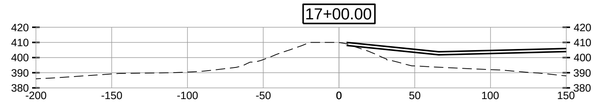


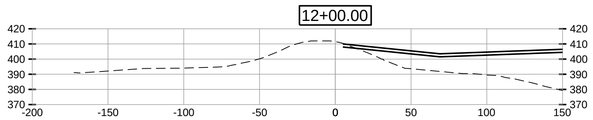


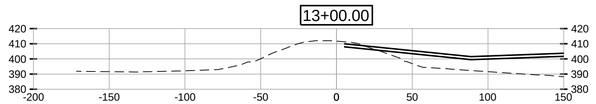


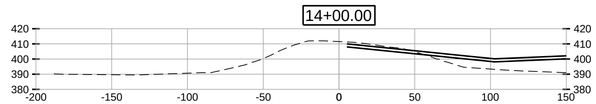


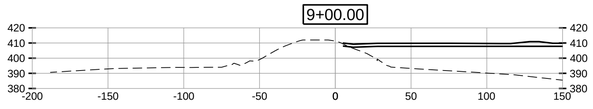


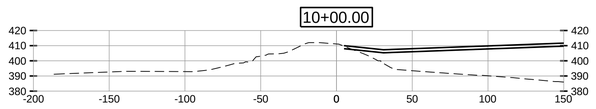


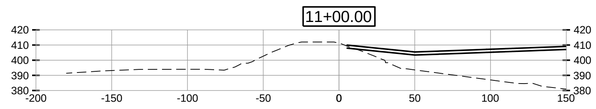


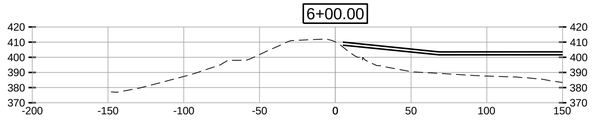


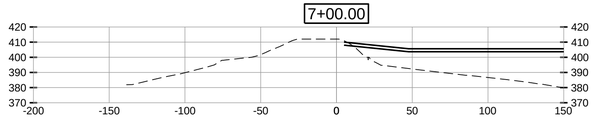


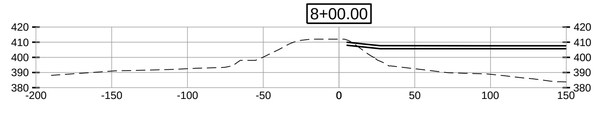


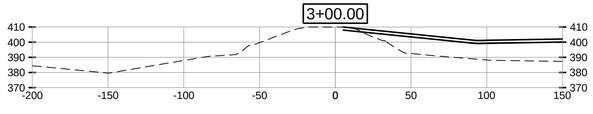


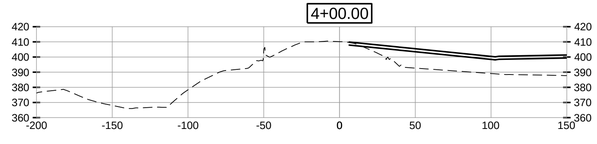


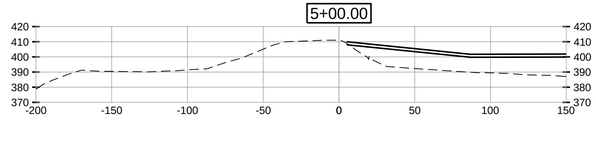


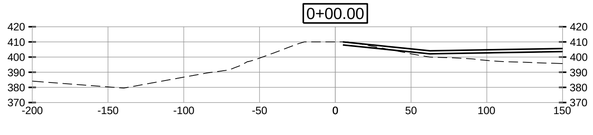


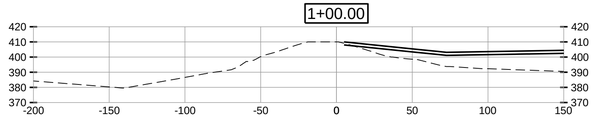


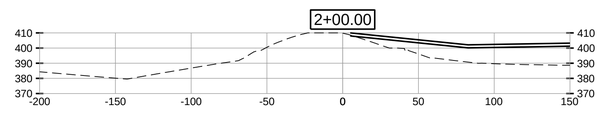












HALEY & ALDRICH, INC.
6500 Rockside Road, Suite 200
Cleveland, OH 44131-1463
Tel: 216.739.0555
Fax: 216.520.0712
www.Haleyaldrich.com

Project No.:
Scale:
Date:
Drawn By:
Designed By:
Checked By:
Approved By:
Stamp:

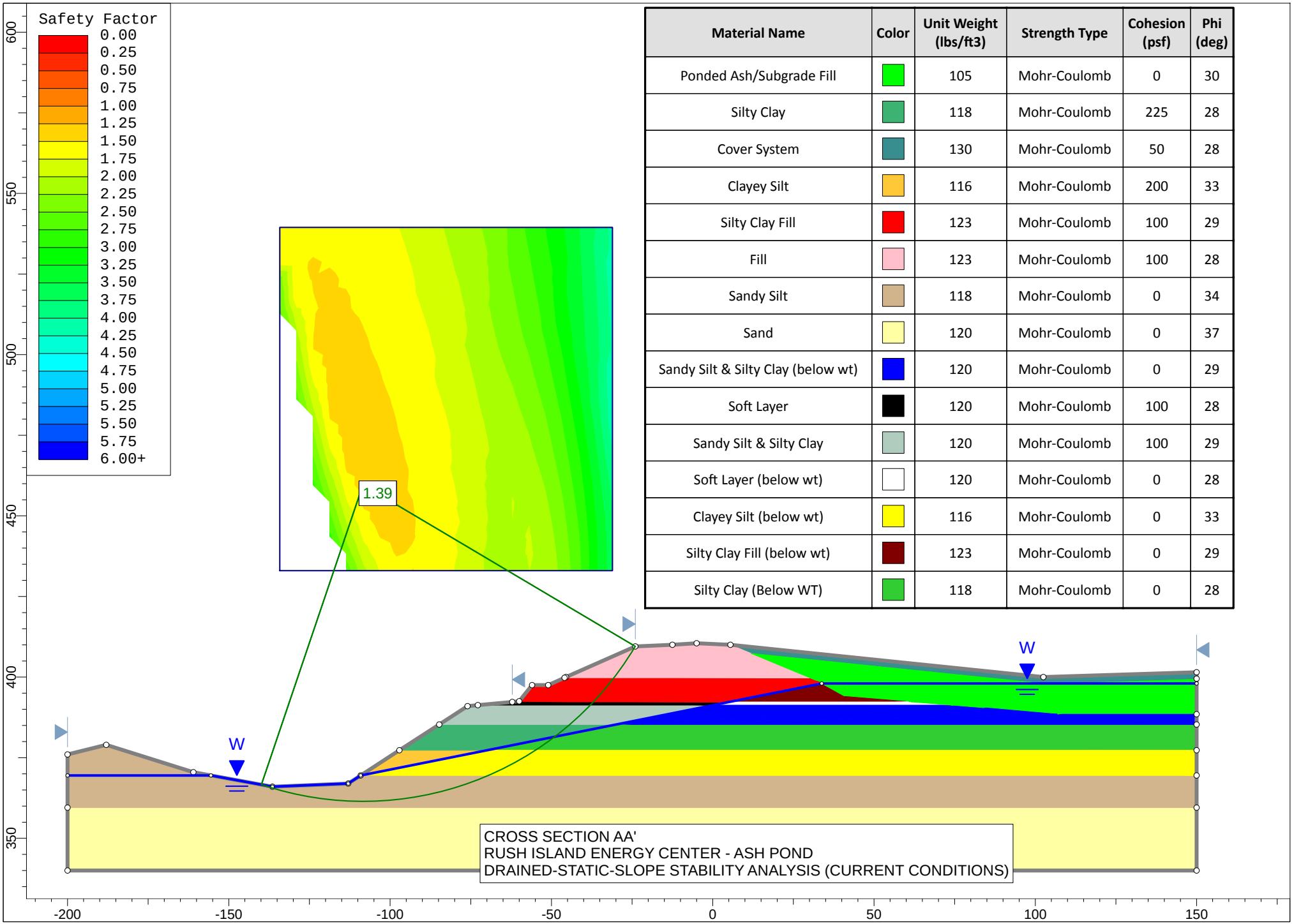
DRAFT

Rev.	Description	By	Date

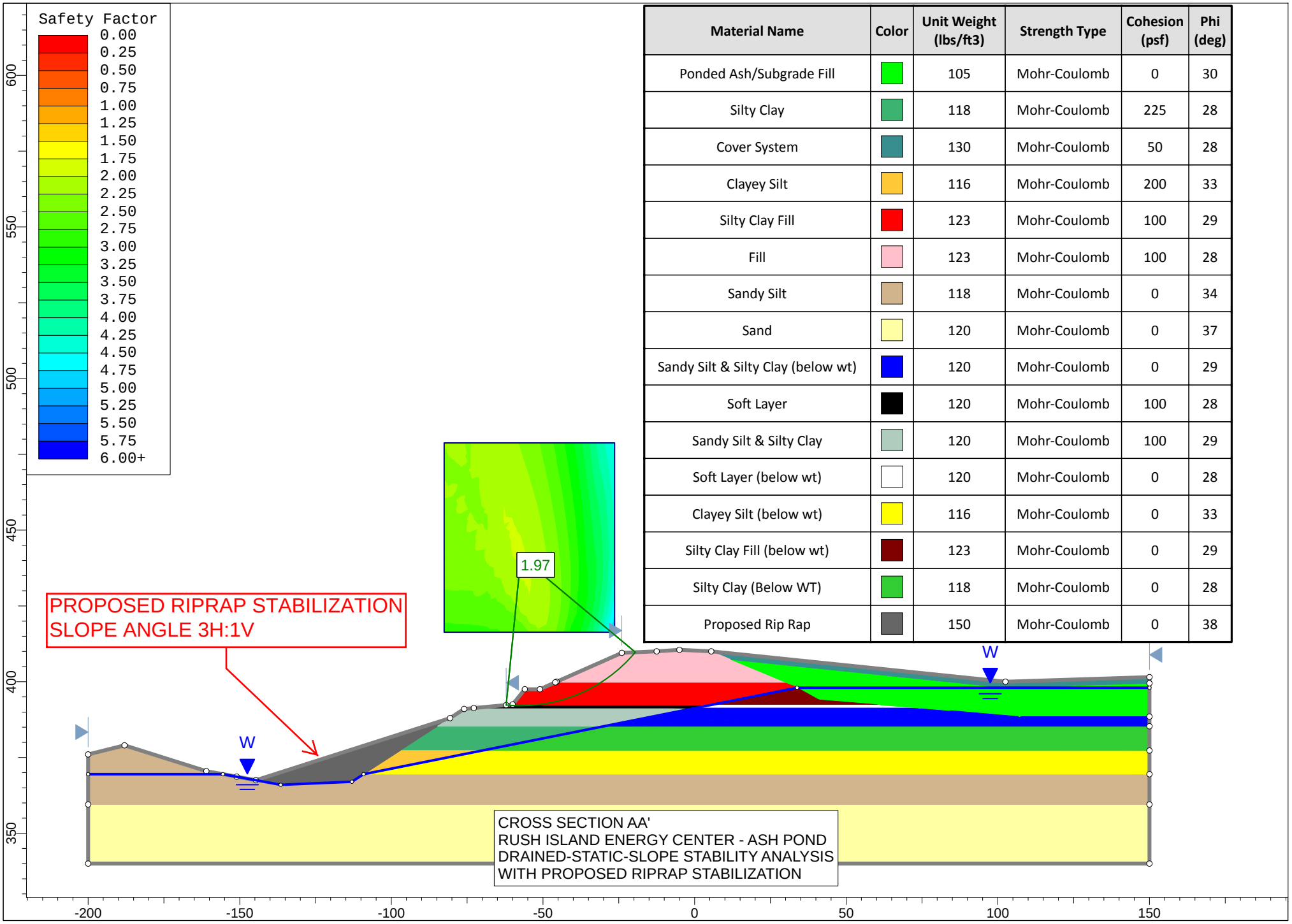
FIGURE A-2

Sheet: of

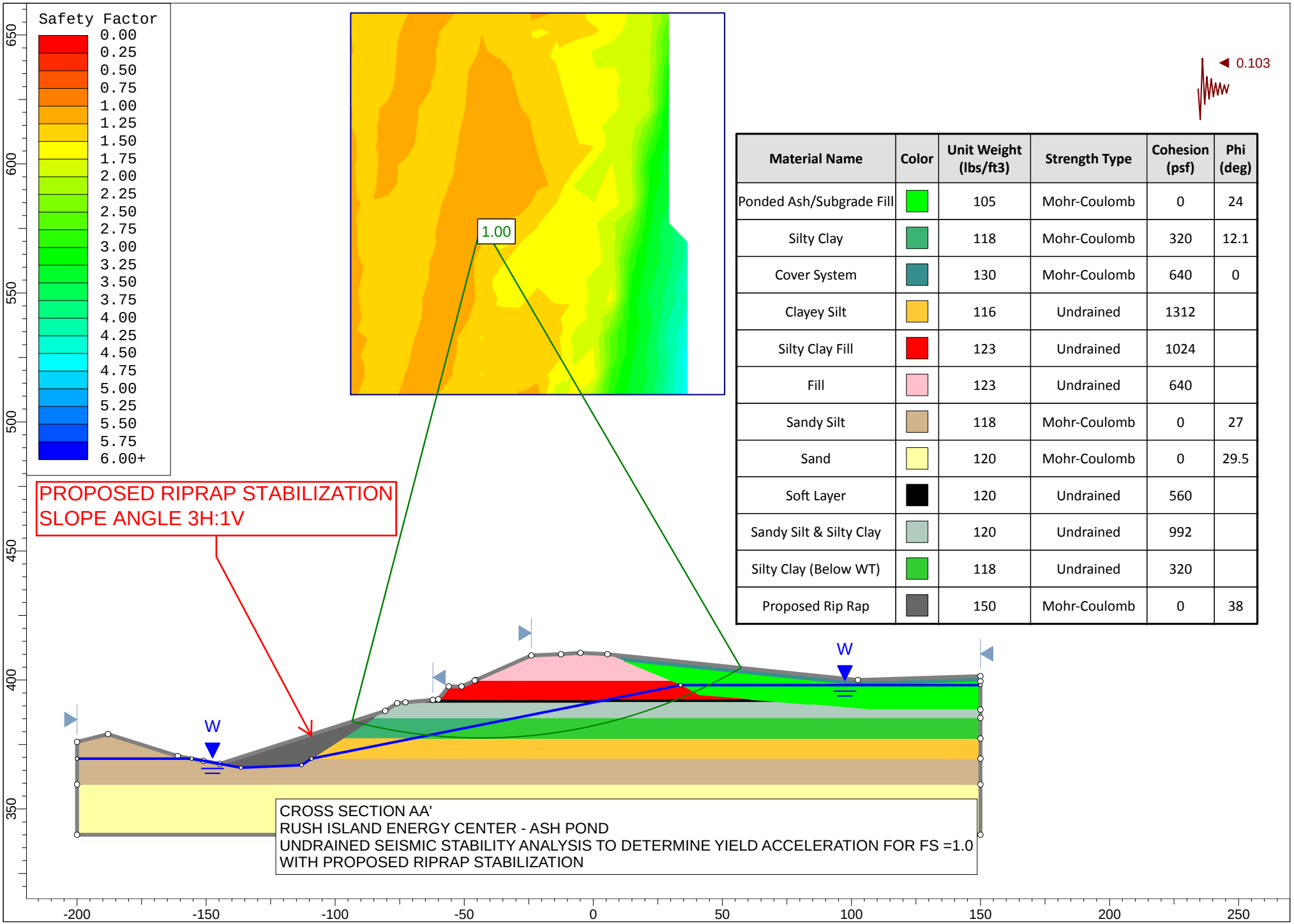
Operator Name: VARI KATALIN
Drawing Name: G:\129530_AMEREN RUSH ISLAND POND CLOSURE\CAD\XREFS\RI_XS_GEOTECH.DWG
Drawing Layout: XS
Plot Date: October 30, 2017



Material Name	Color	Unit Weight (lbs/ft3)	Strength Type	Cohesion (psf)	Phi (deg)
Ponded Ash/Subgrade Fill		105	Mohr-Coulomb	0	30
Silty Clay		118	Mohr-Coulomb	225	28
Cover System		130	Mohr-Coulomb	50	28
Clayey Silt		116	Mohr-Coulomb	200	33
Silty Clay Fill		123	Mohr-Coulomb	100	29
Fill		123	Mohr-Coulomb	100	28
Sandy Silt		118	Mohr-Coulomb	0	34
Sand		120	Mohr-Coulomb	0	37
Sandy Silt & Silty Clay (below wt)		120	Mohr-Coulomb	0	29
Soft Layer		120	Mohr-Coulomb	100	28
Sandy Silt & Silty Clay		120	Mohr-Coulomb	100	29
Soft Layer (below wt)		120	Mohr-Coulomb	0	28
Clayey Silt (below wt)		116	Mohr-Coulomb	0	33
Silty Clay Fill (below wt)		123	Mohr-Coulomb	0	29
Silty Clay (Below WT)		118	Mohr-Coulomb	0	28



Material Name	Color	Unit Weight (lbs/ft3)	Strength Type	Cohesion (psf)	Phi (deg)
Ponded Ash/Subgrade Fill		105	Mohr-Coulomb	0	30
Silty Clay		118	Mohr-Coulomb	225	28
Cover System		130	Mohr-Coulomb	50	28
Clayey Silt		116	Mohr-Coulomb	200	33
Silty Clay Fill		123	Mohr-Coulomb	100	29
Fill		123	Mohr-Coulomb	100	28
Sandy Silt		118	Mohr-Coulomb	0	34
Sand		120	Mohr-Coulomb	0	37
Sandy Silt & Silty Clay (below wt)		120	Mohr-Coulomb	0	29
Soft Layer		120	Mohr-Coulomb	100	28
Sandy Silt & Silty Clay		120	Mohr-Coulomb	100	29
Soft Layer (below wt)		120	Mohr-Coulomb	0	28
Clayey Silt (below wt)		116	Mohr-Coulomb	0	33
Silty Clay Fill (below wt)		123	Mohr-Coulomb	0	29
Silty Clay (Below WT)		118	Mohr-Coulomb	0	28
Proposed Rip Rap		150	Mohr-Coulomb	0	38



Material Name	Color	Unit Weight (lbs/ft3)	Strength Type	Cohesion (psf)	Phi (deg)
Ponded Ash/Subgrade Fill		105	Mohr-Coulomb	0	24
Silty Clay		118	Mohr-Coulomb	320	12.1
Cover System		130	Mohr-Coulomb	640	0
Clayey Silt		116	Undrained	1312	
Silty Clay Fill		123	Undrained	1024	
Fill		123	Undrained	640	
Sandy Silt		118	Mohr-Coulomb	0	27
Sand		120	Mohr-Coulomb	0	29.5
Soft Layer		120	Undrained	560	
Sandy Silt & Silty Clay		120	Undrained	992	
Silty Clay (Below WT)		118	Undrained	320	
Proposed Rip Rap		150	Mohr-Coulomb	0	38

Deformation Analysis

HALEY ALDRICH	CALCULATIONS	File No.	129530-003
		Sheet	1 of 3
Client	Ameren Missouri	Date	19-Dec-17
Project	Rush Island Energy Center Ash Pond Closure, Festus, Missouri	Computed by	RJW
Subject	Deformation Analysis	Checked by	DAS

Objective:

-Estimate the expected deformation during seismic event of the Ash Pond embankment at cross section AA'.

References:

-Slide version 7.0 by RocScience

-Missouri Department of Natural Resources - The Solid Waste Management Program Divison of Environmental Quality (October 1998). "Draft Technical Guidance Document on Static and Seismic Slope Stability for Solid Waste Containment Facilities."

Step 1

Estimate peak horizontal bedrock acceleration, Amax, for 2% in 50 year using 2014 USGS text file by computing the average of the four corners grid using latitude and longitude of the site.

http://earthquake.usgs.gov/hazards/products/conterminous/2014/data/

Site Coordinates:

Latitude	38.124
Longitude	-90.258

PGA for 2% in 50 yr event = 0.309

Step 2

Classify site stiffness. Site is classified based on site specific shear wave velocity (Vs) and uses the criteria presented by Borcherdt (1994).

Site Average Vs = 770 ft/sec

Site Class = D

Step 3

Using the site latitude and longitude, determined site class, and the USGS design application tool 2010 ASCE 7 (with March 2013) estimate peak free field (ground surface) acceleration using the empirical charts. The peak free field acceleration corresponds to the bedrock acceleration propogated upward through the existing soils at the site.

http://earthquake.usgs.gov/hazards/designmaps/usdesign.php

Using Table 11.8-1 from the ASCE-10 Summary Report

USGS Site Coefficient, F_{PGA} = 1.2

Peak Free Field Acceleration* = PGA x F_{PGA} = 0.371

*Corresponds to acceleration at top of natural ground surface, only pertaining to impoundment embankment, and not the Ash Pond.

Step 4

Estimate peak acceleration at the top of the embankment using an empirical chart (Figure 12). The empirical chart can be used to estimate whether the earthquake acceleration will amplify or attentuate through the embankment using Harder (1991) Upper Bound for Observed Motions at Earth Dams.

Height of embankment at critical cross section = 44 ft

Peak Free Field Acceleration = 0.371

HALEY ALDRICH	CALCULATIONS	File No.	129530-003
		Sheet	2 of 3
Client	Ameren Missouri	Date	19-Dec-17
Project	Rush Island Energy Center Ash Pond Closure, Festus, Missouri	Computed by	RJW
Subject	Deformation Analysis	Checked by	DAS

Step 4 (Continued)

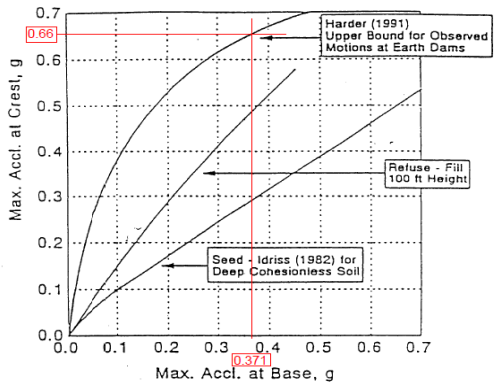


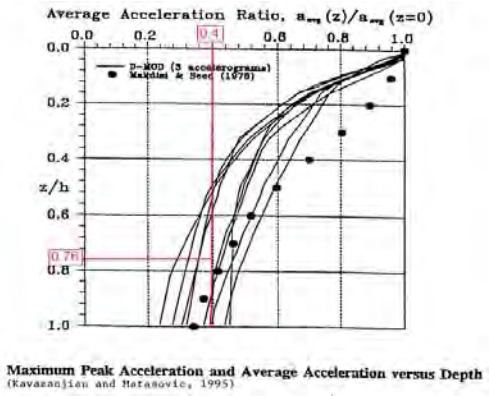
FIGURE 12

Using Figure 12, maximum acceleration at top of embankment $a_{avg}(z=0)$ = 0.66 g

Step 5

Determine the maximum average horizontal earthquake acceleration , $a_{avg}(z)$ in Figure 14 (Kavazanjian and Matasovic 1995) at the base of the slip surface using seismic slope stability analysis performed to determine yield acceleration for FS = 1.0. This is accomplished using an empirical correlation chart (Figure 14).

Height of Embankment (h) =	44 ft
Depth of slip surface (z) =	34 ft
Ratio of z/h =	0.76



Maximum Peak Acceleration and Average Acceleration versus Depth
(Kavazanjian and Matasovic, 1995)

FIGURE 14

Average Acceleration Ratio = $a_{avg}(z)/a_{avg}(z=0)$ = 0.4

$a_{avg}(z) = a_{avg}(z=0)$ x average acceleration ratio = 0.66 x 0.4 = 0.264 = K_{max}

Step 6

Determine Ky (yield acceleration) by inputting values of seismic coefficients into the slope stability software until a factor of safety of 1.00 is obtained.

Ky =	0.103	from SLIDE back analysis (undrained seismic model)
K_{max} =	0.264	
Ky/K_{max} =	0.390	

Step 7

Use the empirical deformation chart by Makdisi and Seed (1978) in Figure 8 using the ratio Ky/Kmax to determine an estimate of the associated cumulative permanent displacement along the critical slip surface for a selected maximum earthquake event. This chart uses the ratio of the coefficients (or accelerations in each coefficient is multiplied by gravity) as related to serveral earthquake magnitudes, each having a different range of cumulative earthquake deformation for various values of the ratio of Ky/Kmax.

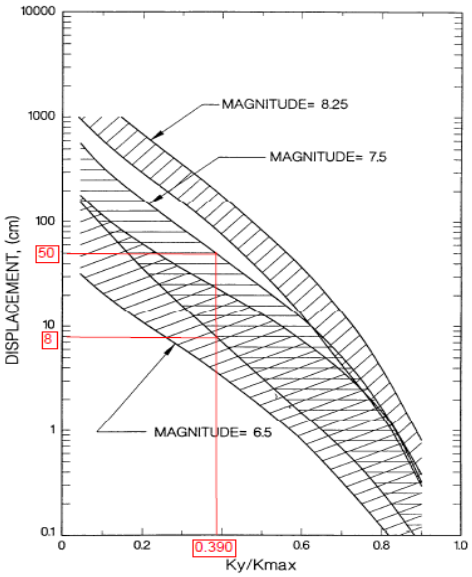
HALEY ALDRICH	CALCULATIONS	File No.	129530-003
		Sheet	3 of 3
Client	Ameren Missouri	Date	19-Dec-17
Project	Rush Island Energy Center Ash Pond Closure, Festus, Missouri	Computed by	RJW
Subject	Deformation Analysis	Checked by	DAS

Step 7 (continued)

Esimated EQ Magnitude (modal) from USGS Deaggreagation Plot 2014 = 7.5

https://earthquake.usgs.gov/hazards/interactive/

Use Figure 8, EQ Magnitude =	7.5
Ky/K_{max} =	0.390



Permanent Seismic Deformation Chart by Makdisi and Seed (1978)

FIGURE 8

From Figure 8

Maximum Displacement =	50.0 cm	19.7 in.
Minimum Displacment =	8.0 cm	3.1 in.
Average Displacement =	29.0 cm	11.4 in.

Settlement Analysis

SUMMARY OF ESTIMATED SETTLEMENT
RUSH ISLAND ENERGY CENTER ASH POND CLOSURE
FESTUS, MISSOURI

Location	Proposed Fill Thickness (ft)	Existing Ash Thickness (ft)	Change in Stress Due to Proposed Fill (psf)	Settlement Based on DMT Average Strain		Settlement Based on Oedometer Average Strain	
				(%)	(in.)	(%)	(in.)
1	15.0	39.0	1575	1.4	6.6	6.3	29.5
2	35.0	25.0	3675	3.3	9.9	10.9	32.7
3	30.0	29.0	3150	2.8	9.9	10.0	34.8
4	38.0	20.0	3990	3.6	8.6	11.5	27.6
5	35.0	20.5	3675	3.3	8.1	10.9	26.8
6	35.0	22.0	3675	3.3	8.7	10.9	28.8
7	35.0	27.0	3675	3.3	10.7	10.9	35.3
8	30.0	28.5	3150	2.8	9.7	10.0	34.2
9	15.0	43.0	1575	1.4	7.3	6.3	32.5
10	38.0	26.0	3990	3.6	11.2	11.5	35.9
11	20.0	38.0	2100	1.9	8.6	7.8	35.6
12	10.0	45.0	1050	0.9	5.1	4.7	25.4
13	35.0	27.0	3675	3.3	10.7	10.9	35.3
14	2.5	54.0	262.5	0.3	1.5	1.5	9.7
15	0.0	53.0	0	0	0.0	0.0	0.0
16	5.0	50.0	525	0.4	2.8	2.8	16.8
17	15.0	51.0	1575	1.4	8.7	6.3	38.6


Site-Wide Settlement Chart for Insitu CCR
DMT (Average Strain)
DMT (Average Strain + 1 Standard Deviation)
CPT (Average Strain)
CPT (Average Strain + 1 Standard Deviation)
Oedometer (Average Strain)
Strain (%)
12.0%
10.0%
8.0%
6.0%
4.0%
2.0%
0.0%
0
500
1,000
1,500
2,000
2,500
3,000
3,500
4,000
4,500
Change in Stress (psf)

ELEVATIONS TABLE				
MIN. ELEV.	MAX. ELEV.	AREA (AC)	AREA %	COLOR
-26.1	0.0	66.7	60.0	N/A
0.0	2.5	9.8	8.7	
2.5	5.0	6.7	6.0	
5.0	7.5	4.6	4.1	
7.5	10.0	4.4	3.9	
10.0	15.0	6.3	5.7	
15.0	20.0	3.0	2.7	
20.0	25.0	2.5	2.2	
25.0	30.0	2.9	2.6	
30.0	35.0	3.5	3.1	
35.0	37.3	1.0	0.9	

Est. Ave. Settlement = 6.6 in
Est. Max. Settlement = 29.5 in

Est. Ave. Settlement = 9.9 in
Est. Max. Settlement = 32.7 in

Est. Ave. Settlement = 9.9 in
Est. Max. Settlement = 34.8 in

Est. Ave. Settlement = 8.6 in
Est. Max. Settlement = 27.6 in

Est. Ave. Settlement = 8.1 in
Est. Max. Settlement = 26.8 in

Est. Ave. Settlement = 8.7 in
Est. Max. Settlement = 28.8 in

Est. Ave. Settlement = 10.7 in
Est. Max. Settlement = 35.3 in

Est. Ave. Settlement = 9.7 in
Est. Max. Settlement = 34.2 in

Est. Ave. Settlement = 7.3 in
Est. Max. Settlement = 32.5 in

Est. Ave. Settlement = 11.2 in
Est. Max. Settlement = 35.9 in

Est. Ave. Settlement = 8.6 in
Est. Max. Settlement = 35.6 in

Est. Ave. Settlement = 10.7 in
Est. Max. Settlement = 35.3 in

Est. Ave. Settlement = 5.1 in
Est. Max. Settlement = 25.4 in

Est. Ave. Settlement = 1.5 in
Est. Max. Settlement = 9.7 in

Est. Ave. Settlement = 2.8 in
Est. Max. Settlement = 16.8 in

Est. Ave. Settlement = 0.0 in
Est. Max. Settlement = 0.0 in

Est. Ave. Settlement = 8.7 in
Est. Max. Settlement = 38.6 in

-1.4%

LEGEND

- EXISTING 5-FT. CONTOUR
- EXISTING 25-FT. CONTOUR
- PROPOSED SUBGRADE 2-FT. CONTOUR
- PROPOSED SUBGRADE 10-FT. CONTOUR

NOTES

1. AERIAL IMAGERY OBTAINED FROM GOOGLE EARTH PRO DATED 12 OCTOBER 2015.
2. EXISTING TOPOGRAPHY AS PROVIDED BY LAMAC ENGINEERING, SURVEYED 2 MAY 2017 AND COMBINED WITH 2013 SURVEY.

0 300 600
SCALE IN FEET

HALEY ALDRICH

AMEREN MISSOURI
RUSH ISLAND ENERGY CENTER
FESTUS, MISSOURI

ISOPACH
EXISTING GRADE VS. PROPOSED SUBGRADE

SCALE: AS SHOWN
DECEMBER 2017

FIGURE

VARI, KATALIN Printed: 11/8/2017 11:22 AM Layout: PLAN
G:\129530_AMEREN RUSH ISLAND POND CLOSURE\CAD\FIGURES\PRELIMINARY\129530-FIG X_RUSH ISLAND ASH POND ISOPACH.DWG

ATTACHMENT 4

Stormwater Management Evaluation

By Haley & Aldrich, Inc.
May 2018

HALEY & ALDRICH, INC.
6500 Rockside Road Suite 200
Cleveland, OH 44131
(216) 739.0555

22 May 2018
File No. 129530

MEMORANDUM

Subject: Stormwater Management and Erosion Control Evaluation
Rush Island Energy Center – Ash Pond Closure
Festus, MO

1. Stormwater Design Overview

This memorandum has been prepared by Haley & Aldrich, Inc. to document the stormwater management Hydrology and Hydraulics evaluation and modeling/calculations performed to support the development of the Ash Pond Closure Design at the Rush Island Energy Center in Festus, Missouri. This memorandum is intended to document the modeling methodology, decisions, and assumptions for various aspects of the Hydrology and Hydraulic for the Ash Pond Closure design.

In general, stormwater within the closed Ash Pond will be collected in one of nine (9) sub-drainage areas ranging from 1.1 to 20.3 acres within the 111-acre overall Ash Pond drainage area. The sub-drainage areas will be graded to collection channels that will drain stormwater to one of nine (9) outfalls consisting of either one or two discharge culvert pipes installed through the Ash Pond dike that will discharge to an area drainage ditch to the west and south and to the Mississippi River to the east. Discharges through the individual outfall structures will be restricted and stormwater temporarily detained within the individual drainage areas to attenuate peak flows during extreme rainfall events.

2. Area Drainage Conditions

The Ash Pond is situated on the west side of the Mississippi River and was created by constructing a ring dike/levee in the Mississippi River floodplain at a berm height between 408.0+/- and 410.0+/- above the 100-Year FEMA Base Flood Elevation that ranges between 405.5 and 406.0 in the vicinity of the Ash Pond. The pond currently receives water inflow from three sources: wetting head water associated with the plant's CCR waste disposal operation, direct rainfall into the unit and surface runoff via culvert inflow from the Coal Pile Area to the north. All collected water is currently discharged through a single outfall riser situated at the south east end of the unit which discharges directly to the Mississippi River via an existing NPDES permitted outfall. When the Ash Pond is closed, the inflow from the plant will cease and prior to closure, the drainage from the Coal Pile Area will be rerouted away from the Ash Pond as part of a separate plant project.

3. Modeling Method

The HydroCAD software modeling program was used to design and calculate the stormwater management elements of the Ash Pond Closure design. HydroCAD is a Computer Aided Design tool used to model stormwater runoff. HydroCAD provides a wide range of commonly used drainage calculations

including Rational Method with automatic IDF curves, Hydrologic routing through ponds and reaches, SCS, NRCS, SBUH runoff hydrology, and more. Within HydroCAD, runoff was calculated using the SCS TR-20 method and routing was completed using Dynamic Storage-Indication method, where the stage-discharge and storage-indication curves are re-evaluated at each time step, based on the current elevation of any downstream nodes. This allows the routing to respond to ongoing tailwater changes, rather than assuming static tailwater conditions. This results in a more accurate representation of controls on the system throughout a flood event.

All drainage areas, stage storage areas, and other site geometry were calculated using AutoCAD 2016 Civil 3D or Bluebeam PDF viewer and the Ash Pond Closure Issued for Bid design drawings dated January 2018 (Design Drawings).

4. Design Criteria

The HydroCAD model was prepared based on the final grading and associated design elements included in the Design Drawings. Stormwater within the unit has been evaluated and appurtenances sized to accommodate peak discharges from the 25-year 24-hour storm and the 100-year 24-hour storm events. The stormwater management system was designed to drain both the 25-year and 100-year storm events within 36 hours.

Design slopes along primary drainage channels were kept to 1.0% min while secondary channel slopes were designed at a minimum of 1.5%. Overland drainage slopes were typically maintained at 2% to 3% with limited instances of steeper slopes including perimeter areas that were maintained at up to 20% to more closely match existing topography and minimize extensive cuts and fills. Maximum surface runoff overland flow distance will be minimized via cut-off swales/channels to reduce the likelihood for post-closure rill erosion.

Erosion Protection was considered as part of the design. Grass-lined slopes and channels will be utilized where possible (typically when peak velocities are < 3.0 fps), but when additional erosion protection is required, secondary channels will include erosion matting and primary channels will be rip-rap lined. Discharge channels at culvert outfall locations will include rip-rap lining sufficient to provide erosion protection during the 25-year rainfall event.

5. Data & Assumptions

The following basis of design standards, assumptions and goals were considered as part of this design:

- Design Storm: Stormwater management systems will be designed to adequately manage flow during peak discharge of the design flood event, 25-year/24-hour rainfall event
    - All pipe discharges through the berms will be designed to accommodate the 25-year/24-hour rainfall event
    - All stormwater will be managed within the ash pond footprint for the 100-year/24-hour rainfall event with a minimum one foot of freeboard below the perimeter berm elevation to avoid potential overtopping.
    - Channel capacity will be designed to accommodate the 25-year/24-hour rainfall event with a typical minimum 0.5 foot of freeboard within the channel.

    - Channel erosion protection will be designed for velocities resulting from the 100-year/24-hour rainfall event.
- Ameren is willing to permit new stormwater NPDES outfalls.
- Installation of pipes through the berm for stormwater discharge is the Stormwater management option of choice and will include tidal valves and/or gate valves to limit opportunity for flood water backflow onto cap.
- The use of "letdown outlets", where limited portions of the exterior berm will be excavated for stormwater discharge is preferred
- The use of pump stations for the management/discharge of stormwater within the cap system, in Ameren's opinion, is not a viable or preferred option (per H&A meeting with Ameren in April 2017). The intent is for gravity discharge of all stormwater and that portable pumps may be available and only be used in the event of an emergency (i.e. back-to-back extreme events). Discharge elevations (upstream invert elevations of pipes through perimeter berm, or upstream invert of "letdown outlet") will be maintained at a minimum of the 10 Year Mississippi River flood elevation (~El. 397) and be made higher, if possible, with a target minimum elevation of 400.0.
- Existing outlet structure is expected to be decommissioned/abandoned by grouting in place
- Design Slopes
    - Less than 5% max slopes where possible; do not exceed 5:1 on interior slopes
    - 1.5% min overland slopes with a target of 1.5% or greater
    - 1.0% min slopes in stormwater conveyance channels
- Stormwater swales - Erosion Protection
    - Grass-lined only where possible
    - More robust erosion protection alternatives will be implemented where necessary with consideration for limiting long-term maintenance requirements
- Sheet Flow
    - A maximum sheet flow distance along any slope will be 300'. Intermediate swales/channels shall be incorporated to convey stormwater beyond this length

➢ Mississippi River Flood Elevations
- FEMA Flood Profile at RI Plant

Event	***River Elevation Proximate to Ash Pond***
10 Yr	*397*
50 Yr	*403*
100 Yr	*406*
500 Yr	*408*

6. Hydrology

The analysis of the Ash Pond Closure hydrology consists of estimating the Ash Pond post-closure watershed hydrology (i.e., tributary drainage areas, time of concentration, runoff curve numbers, etc.).

Drainage areas were determined by the Design Drawings "Proposed Top of Final Cover Plan", sheet C-103. There are 9 drainage sub basins which feed to 9 outfalls. The areas for these drainage sub basins were determined using AutoCAD 2016 Civil 3D. These areas can be seen in **Figure 1**, Drainage Area Map.

The Times of Concentration (Tc) were calculated in HydroCAD based on manually calculated input distances. Watershed criteria included a maximum length of 100' for sheet flow during the calculation of the time of concertation. Overland flow distance beyond 100' was treated as shallow concentrated flow up to the point where flow paths intercept secondary or primary drainage channels. The remaining distance to the outfall was defined as channel flow. Flow paths are also shown on the Drainage Area Map.

Curve Numbers values were set at 61 for the respective drainage areas assuming a type B hydrologic soil group with a meadow or grassed surface (>75% Grass Cover).

The Times of Concentration (T_c) considered a maximum sheet flow distance of 100 feet for each of the nine drainage areas. Results are summarized in the table below for each drainage area.

TABLE 1 – T_C SUMMARY

Drainage Area	1	2	3	4	5	6	7	8	9
Time of Concentration (T_c) [min]	2.7	18.9	18.5	18.0	12.2	18.3	18.5	18.3	3.2

The rainfall information used in the HydroCAD modeling was based on the NOAA Atlas 14, Volume 8, Version 2 which provides rainfall data for storm events over a range of recurrence intervals and durations (see **Attachment 1**). We also determined that the SCS Type II storm, 24-hour rainfall distribution is appropriate to use for modeling the design storms at the project site. The following chart summarizes the rainfall information used in this analysis

Return Period	Rainfall Depth (inches)	Duration (hrs.)
25-Year	5.88	24
100-Year	7.57	24

7. Hydraulics

The stormwater management system is a gravity drainage system consisting of primary, secondary and perimeter channels which collect and direct stormwater runoff to culvert pipes within each respective drainage area. The culverts will discharge stormwater thru the perimeter dike to the east, west, and south sides of the Ash Pond to rip-rap outlets. Outlets 1, 2, 3, & 4 will discharge to the east toward the Mississippi River, drainage area 5 will discharge to the south, outlets 6 and 7 will discharge to the west into a tributary to Isle du Bois Creek, and Outlets 8 & 9 will also discharge west into the West Ditch which also leads to the Isle du Bois Creek tributary.

Each outfall location within the Ash Pond will have its own temporary stormwater detention area. The stage storage relationships within these detention areas were calculated using AutoCAD and manually entered into HydroCAD. The primary channels will be trapezoidal with 4-feet wide base and 1 (V):3(H)

side slopes. Secondary channels will consist of raised 1-foot high berms that will intercept stormwater flow to maintain a maximum sheet flow/overland flow path of no greater than 300-feet. The culvert pipes at the outfall locations will be either 12-inch or 18-inch diameter smooth interior HDPE pipe and will include Tideflex Check Valves at the outlet end as summarized in Table 2 (below).

TABLE 2

PIPE/CHECK VALVE INFORMATION									
OUTLET	TYPE	NO. OF PIPES	DIA.	LENGTH (SEE NOTE 4)	UPSTREAM INV.	DOWNSTREAM INV.	SLOPE	CHECK VALVE	
								TYPE	BILL CURVE
1	HDPE	1	12"	119'	399.0'	397.8'	1.0%	TF-2	RIGHT
2	HDPE	2	18"	160'	400.2'	398.6'	1.0%	TF-2	RIGHT
3	HDPE	2	18"	153'	400.2'	398.7'	1.0%	TF-2	RIGHT
4	HDPE	2	18"	192'	399.1'	397.1'	1.0%	TF-2	RIGHT
5	HDPE	1	12"	163'	400.1'	398.4'	1.0%	TF-2	LEFT
6	HDPE	2	18"	163'	399.5'	397.8'	1.0%	TF-2	LEFT
7	HDPE	2	18"	151'	400.2'	398.7'	1.0%	TF-2	LEFT
8	HDPE	2	18"	162'	400.2'	398.6'	1.0%	TF-2	LEFT
9	HDPE	1	12"	208'	403.0'	401	1.0%	TF-1	LEFT

The Tideflex Check Valves will prevent Mississippi River backwater from entering the closed unit during extreme flood events since the 100-year flood elevation along the river is at elevation 406+/- which is between three to seven feet above the inlet elevation of the culverts. Refer to Design Drawing “Details” sheet C-402 (**Attachment 2**) for typical culvert and check valve details. From a modeling standpoint, the culverts were assumed to be under a free discharge condition during the 25-Year and 100-Year events since the time for the Mississippi River to rise to flood stage is significantly longer than that of the Ash Pond stormwater management system.

8. Modeling Results

HydroCAD model inputs and outputs for both the 25-year and 100-Year storm events are included as **Attachment 3.** Peak flow and outfall discharge results are summarized below in Table 3 and Table 4.

The tables denote the peak discharges from individual outfall pipes for establishing peak storage depths and retention times within each appropriate channel erosion protection (and to size outfall rip rap protection) as well as the peak of the combined system that will occur within the downstream ditches, etc.

TABLE 3 – HYDROCAD MODELING RESULTS FOR 25-YEAR STORM EVENT

Outlet Number	Drainage Area (acres)	Peak Discharge (cfs)	Peak Velocity (ft/s)	Peak Storage Depth (ft) / Freeboard	Retention Time (hr.)	System Peak Discharge at 12.44 hours
O1	1.55	3.1	3.9	1.6/11.0	24.9	1.07
O2	18.21	20.0	5.7	2.9/10.0	26.4	19.92
O3	19.35	20.3	5.7	3.0/10.0	26.5	20.15
O4	14.68	18.7	5.3	2.6/10.0	26.1	18.66
O5	3.72	3.6	4.6	2.0/9.0	24.9	3.53
O6	13.97	18.5	5.2	2.6/9.0	24.9	18.44
O7	18.44	20.1	5.7	3.0/9.0	25.6	19.98
O8	20.30	20.6	5.8	3.0/10.0	25.2	20.48
O9	1.08	2.5	3.2	1.2/6.0	24.5	0.51

Combined Total = 190.3 CFS

TABLE 4 – HYDROCAD MODELING RESULTS FOR 100-YEAR STORM EVENT

Outlet Number	Drainage Area (acres)	Peak Discharge (cfs)	Peak Velocity (ft/s)	Peak Storage Depth (ft) / Freeboard	Retention Time (hr.)	System Peak Discharge at 12.80 hours
O1	1.55	4.0	5.05	2.3/11.0	25.0	0.71
O2	18.21	23.3	6.6	3.7/10.0	26.4	22.77
O3	19.35	23.6	6.7	3.8/10.0	26.5	23.25
O4	14.68	22.5	6.4	3.5/10.0	26.1	21.26
O5	3.72	4.3	5.4	2.6/10.0	24.9	4.06
O6	13.97	22.1	6.3	3.4/9.0	26.0	20.69
O7	18.44	23.4	6.6	3.8/9.0	26.5	22.94
O8	20.30	24.0	6.8	3.8/10.0	26.6	23.64
O9	1.08	3.3	4.2	1.7/6.0	24.5	0.44

Combined Total = 238.1 CFS

9. Erosion Control at Outlet Pipe Outfalls

At the point of discharge from the nine outfall pipes, stormwater will be conveyed to the Mississippi River and/or upland tributary Isle du Bois Creek via rip-rap lined outlet conveyance channels designed to provide a stable, non-erosive flow path to the various down-gradient water sources for the 25-year storm event. These outlet channels will include a transition length for water exiting the pipe, a trapezoidal channel section length to convey flow and an apron portion to transition flow from the channel to downstream areas. In each case the apron portion of the outlet channel will be extended beyond the toe of the perimeter dike with appropriately sized rip-rap to prevent slope erosion. The channel will include a non-woven geotextile base upon which an 18-inch to 24-inch thick layer of 6-inch and 9-inch diameter D_{50} rip-rap will be constructed for erosion protection (see Table 5). Peak outlet channel velocities will range from 1.9 f/s to 6.0 f/s in the nine channels. **Attachment 2** provides a detail

of the typical outfall channel cross-section. **Attachment 4** provides rip-rap sizing calculations to support the selected outlet erosion control design.

TABLE 5 – RIP-RAP OUTLET PROTECTION

OUTLET PROTECTION SIZING TABLE										
OUTLET	PIPE SIZE (INCHES)	D50 SIZE (INCHES)	T (FEET)	L (FEET)	IL (FEET)	TL (FEET)	CW (FEET)	D ((INCHES)	TW (FEET)	ANCHOR WIDTH (FEET)
1	1X12	6	1.5	115	3	10	3	9	6	1
2	2X18	9	2	105	9	10	5	14	10	1.5
3	2X18	9	2	87	9	10	6	15	11	1.5
4	2X18	9	2	108	9	10	5	14	10	1.5
5	1X12	6	1.5	25	3	10	3	9	6	1
6	2X18	9	2	167	9	10	5	14	10	1.5
7	2X18	9	2	60	9	10	7.5	16.5	13	1.5
8	2X18	REFER TO WEST DITCH RIPRAP CHANNEL LINING								
9	1X12	REFER TO WEST DITCH RIPRAP CHANNEL LINING								

10. Conclusions

Stormwater will be collected and directed to nine culverted outfall locations thru the east, west and south perimeter dike and into either the Mississippi River or Isle du Bois Creek tributary. The design accommodates stormwater drainage of the closed ash pond and provides temporary stormwater detention within the interior of the unit without encroaching on the perimeter dike at any of the nine outlet locations during the 100-year storm event. Outfall culverts will fully drain collected stormwater runoff within 48-hours of a 100-year storm event to prevent ponding of water on the final cover. The outlets will each include rip-rap lined outlet protection channels that will prevent channel/bank erosion during the 25-Year rainfall event as a minimum.

FIGURE 1

DRAINAGE AREA MAP

LUCAS, ANDY Printed: 12/26/2017 12:28 PM Layout: PLAN
G:\129530_AMEREN RUSH ISLAND POND CLOSURE\CALCULATIONS\STORMWATER\REFERENCE INFO\129530-RCPA-STORMWATER_100%.DWG

DETENTION BASIN

LEGEND

- SHEET FLOW
- SHALLOW CONCENTRATED FLOW
- CHANNEL FLOW
- SUBCATCHMENT

NOTES

1. EXISTING TOPOGRAPHY AS PROVIDED BY LAMAC ENGINEERING, SURVEYED 2 MAY 2017 AND COMBINED WITH 2013 SURVEY.

0 300 600
SCALE IN FEET

HALEY ALDRICH

AMEREN MISSOURI
RUSH ISLAND ENERGY CENTER FESTUS, MISSOURI

DRAINAGE AREA MAP

SCALE: AS SHOWN
MAY 2018

FIGURE 1

ATTACHMENT 1

NOAA PRECIPITATION FREQUENCY DATA

NOAA Atlas 14, Volume 8, Version 2
Location name: Festus, Missouri, USA*
Latitude: 38.1232°, Longitude: -90.2581°
Elevation: 402.58 ft**
* source: ESRI Maps
** source: USGS

POINT PRECIPITATION FREQUENCY ESTIMATES

Sanja Perica, Deborah Martin, Sandra Pavlovic, Ishani Roy, Michael St. Laurent, Carl Trypaluk, Dale Unruh, Michael Yekta, Geoffery Bonnin

NOAA, National Weather Service, Silver Spring, Maryland

PF_tabular | PF_graphical | Maps_&_aerials

PF tabular

PDS-based point precipitation frequency estimates with 90% confidence intervals (in inches)[1]

Duration	Average recurrence interval (years)									
	1	2	5	10	25	50	100	200	500	1000
5-min	**0.371** (0.304-0.456)	**0.433** (0.355-0.533)	**0.536** (0.438-0.661)	**0.621** (0.505-0.769)	**0.739** (0.582-0.937)	**0.831** (0.640-1.06)	**0.923** (0.688-1.21)	**1.02** (0.729-1.36)	**1.14** (0.789-1.56)	**1.24** (0.835-1.71)
10-min	**0.543** (0.446-0.668)	**0.634** (0.520-0.781)	**0.784** (0.641-0.968)	**0.909** (0.739-1.13)	**1.08** (0.852-1.37)	**1.22** (0.937-1.56)	**1.35** (1.01-1.77)	**1.49** (1.07-1.99)	**1.67** (1.16-2.28)	**1.81** (1.22-2.50)
15-min	**0.662** (0.543-0.815)	**0.774** (0.634-0.952)	**0.957** (0.781-1.18)	**1.11** (0.901-1.37)	**1.32** (1.04-1.67)	**1.48** (1.14-1.90)	**1.65** (1.23-2.15)	**1.82** (1.30-2.42)	**2.04** (1.41-2.78)	**2.21** (1.49-3.05)
30-min	**0.957** (0.785-1.18)	**1.12** (0.916-1.38)	**1.38** (1.13-1.70)	**1.60** (1.30-1.98)	**1.90** (1.49-2.41)	**2.13** (1.64-2.73)	**2.36** (1.76-3.08)	**2.60** (1.86-3.46)	**2.91** (2.01-3.96)	**3.14** (2.12-4.34)
60-min	**1.26** (1.03-1.55)	**1.46** (1.20-1.80)	**1.80** (1.47-2.22)	**2.08** (1.69-2.57)	**2.47** (1.95-3.14)	**2.78** (2.14-3.57)	**3.09** (2.31-4.05)	**3.42** (2.45-4.56)	**3.85** (2.66-5.25)	**4.18** (2.82-5.78)
2-hr	**1.56** (1.29-1.91)	**1.81** (1.49-2.20)	**2.21** (1.82-2.71)	**2.56** (2.10-3.14)	**3.05** (2.42-3.84)	**3.43** (2.67-4.37)	**3.83** (2.88-4.97)	**4.23** (3.06-5.62)	**4.79** (3.34-6.50)	**5.21** (3.55-7.17)
3-hr	**1.75** (1.46-2.12)	**2.02** (1.68-2.45)	**2.47** (2.04-3.00)	**2.86** (2.35-3.49)	**3.42** (2.73-4.29)	**3.86** (3.02-4.90)	**4.32** (3.27-5.60)	**4.80** (3.49-6.36)	**5.46** (3.83-7.40)	**5.98** (4.08-8.19)
6-hr	**2.08** (1.75-2.50)	**2.41** (2.02-2.90)	**2.97** (2.47-3.57)	**3.45** (2.86-4.17)	**4.16** (3.35-5.19)	**4.73** (3.73-5.96)	**5.32** (4.06-6.85)	**5.95** (4.36-7.83)	**6.81** (4.82-9.17)	**7.50** (5.16-10.2)
12-hr	**2.44** (2.06-2.90)	**2.85** (2.40-3.39)	**3.55** (2.98-4.24)	**4.16** (3.48-4.98)	**5.04** (4.10-6.25)	**5.76** (4.58-7.21)	**6.50** (5.00-8.31)	**7.29** (5.39-9.52)	**8.37** (5.96-11.2)	**9.23** (6.40-12.5)
24-hr	**2.87** (2.44-3.38)	**3.34** (2.84-3.93)	**4.14** (3.51-4.90)	**4.85** (4.09-5.75)	**5.88** (4.82-7.21)	**6.71** (5.37-8.32)	**7.57** (5.87-9.60)	**8.49** (6.32-11.0)	**9.76** (7.00-13.0)	**10.8** (7.51-14.4)
2-day	**3.36** (2.89-3.92)	**3.86** (3.31-4.50)	**4.71** (4.02-5.51)	**5.45** (4.63-6.40)	**6.54** (5.41-7.95)	**7.42** (5.99-9.13)	**8.34** (6.52-10.5)	**9.32** (7.00-12.0)	**10.7** (7.73-14.1)	**11.8** (8.28-15.7)
3-day	**3.65** (3.15-4.24)	**4.18** (3.60-4.86)	**5.09** (4.37-5.92)	**5.88** (5.02-6.86)	**7.00** (5.82-8.46)	**7.92** (6.42-9.67)	**8.86** (6.95-11.1)	**9.85** (7.43-12.6)	**11.2** (8.15-14.7)	**12.3** (8.69-16.3)
4-day	**3.89** (3.37-4.49)	**4.45** (3.85-5.15)	**5.41** (4.66-6.27)	**6.23** (5.34-7.24)	**7.40** (6.16-8.89)	**8.33** (6.77-10.1)	**9.29** (7.31-11.6)	**10.3** (7.79-13.1)	**11.7** (8.50-15.3)	**12.7** (9.04-16.9)
7-day	**4.53** (3.95-5.19)	**5.15** (4.49-5.91)	**6.20** (5.37-7.12)	**7.08** (6.11-8.18)	**8.34** (6.98-9.93)	**9.34** (7.64-11.3)	**10.4** (8.20-12.8)	**11.4** (8.68-14.4)	**12.9** (9.41-16.7)	**14.0** (9.97-18.4)
10-day	**5.14** (4.50-5.86)	**5.80** (5.07-6.62)	**6.91** (6.02-7.90)	**7.85** (6.80-9.01)	**9.18** (7.71-10.9)	**10.2** (8.40-12.3)	**11.3** (8.97-13.9)	**12.4** (9.46-15.6)	**13.9** (10.2-18.0)	**15.0** (10.8-19.7)
20-day	**6.92** (6.11-7.82)	**7.74** (6.82-8.74)	**9.06** (7.97-10.3)	**10.2** (8.89-11.6)	**11.7** (9.90-13.7)	**12.9** (10.7-15.3)	**14.1** (11.3-17.1)	**15.3** (11.8-19.1)	**16.9** (12.5-21.6)	**18.1** (13.1-23.6)
30-day	**8.41** (7.46-9.44)	**9.38** (8.32-10.5)	**10.9** (9.67-12.3)	**12.2** (10.7-13.8)	**14.0** (11.9-16.2)	**15.3** (12.7-18.0)	**16.6** (13.3-20.0)	**17.9** (13.8-22.2)	**19.6** (14.6-25.0)	**20.9** (15.1-27.1)
45-day	**10.3** (9.17-11.5)	**11.5** (10.2-12.8)	**13.4** (11.9-15.0)	**15.0** (13.2-16.8)	**17.0** (14.5-19.6)	**18.5** (15.5-21.7)	**20.0** (16.1-24.0)	**21.5** (16.6-26.4)	**23.3** (17.4-29.5)	**24.6** (17.9-31.8)
60-day	**11.9** (10.6-13.2)	**13.3** (11.9-14.8)	**15.6** (13.9-17.3)	**17.4** (15.4-19.4)	**19.7** (16.8-22.6)	**21.4** (17.9-24.9)	**23.1** (18.7-27.5)	**24.7** (19.1-30.2)	**26.6** (19.9-33.6)	**28.0** (20.5-36.1)

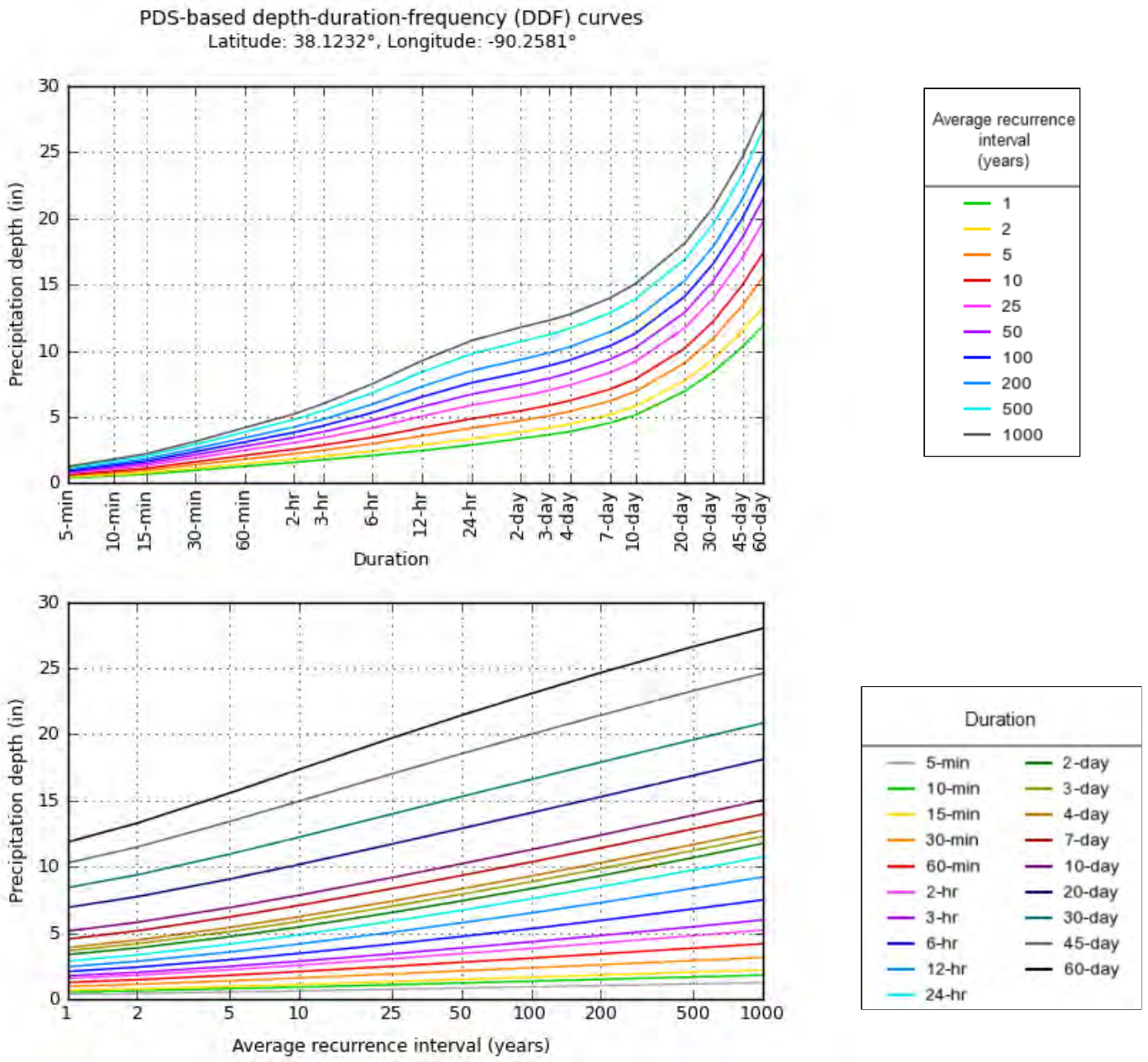
[1] Precipitation frequency (PF) estimates in this table are based on frequency analysis of partial duration series (PDS).

Numbers in parenthesis are PF estimates at lower and upper bounds of the 90% confidence interval. The probability that precipitation frequency estimates (for a given duration and average recurrence interval) will be greater than the upper bound (or less than the lower bound) is 5%. Estimates at upper bounds are not checked against probable maximum precipitation (PMP) estimates and may be higher than currently valid PMP values.

Please refer to NOAA Atlas 14 document for more information.

Back to Top

PF graphical



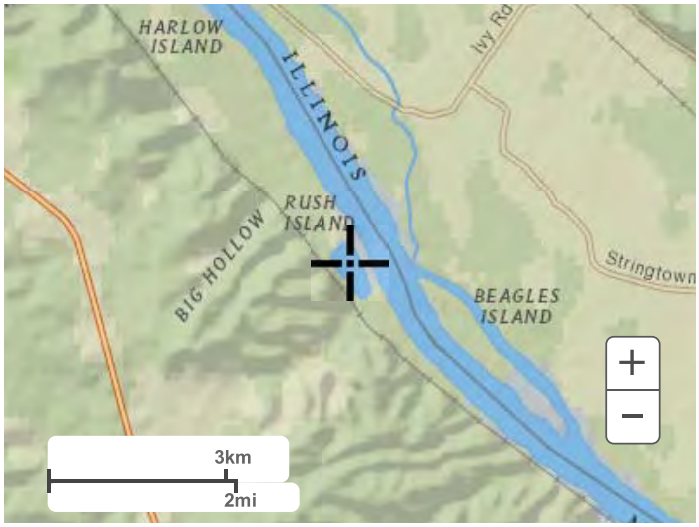
NOAA Atlas 14, Volume 8, Version 2

Created (GMT): Tue Apr 18 18:08:28 2017

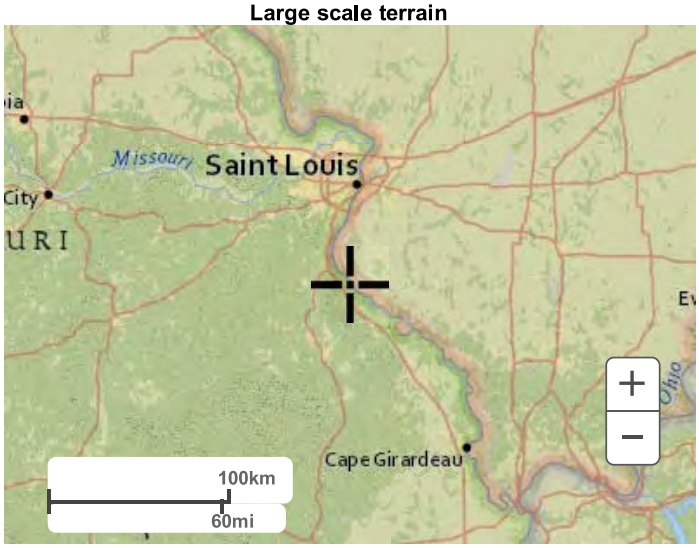
Back to Top

Maps & aerials

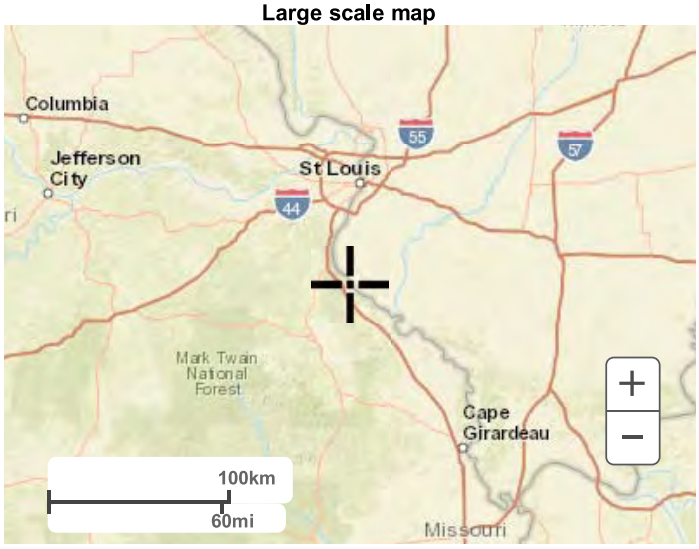
Small scale terrain



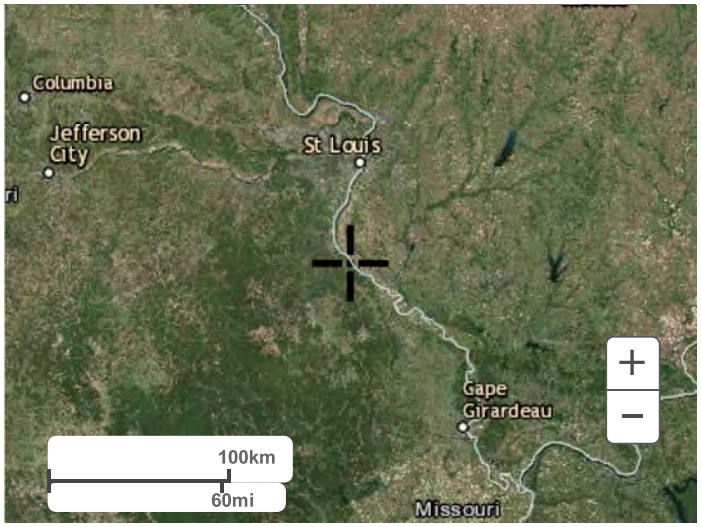
Large scale terrain



Large scale map



Large scale aerial



Back to Top

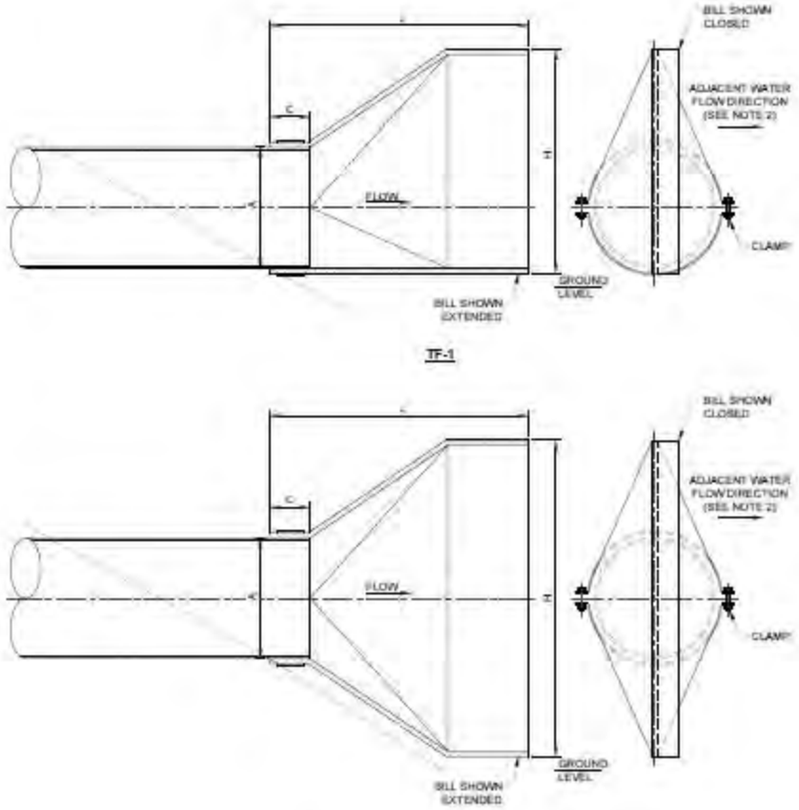
US Department of Commerce
National Oceanic and Atmospheric Administration
National Weather Service
National Water Center
1325 East West Highway
Silver Spring, MD 20910
Questions?: HDSC.Questions@noaa.gov

Disclaimer

ATTACHMENT 2

CULVERT/RIP-RAP DETAILS

Design Drawing Sheet C-402



TF-1

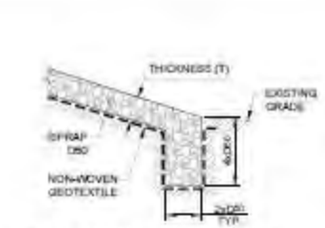
TF-2

CHECK VALVE INFORMATION				
CHECK VALVE TYPE	DIMENSIONS (IN.)			
	A (PIPE OUTER DIA.)	L (LENGTH)	H (SILL HEIGHT)	C (CUFF LENGTH)
TF-1	12"	27"	23"	4"
TF-2	18"	39"	33"	6"

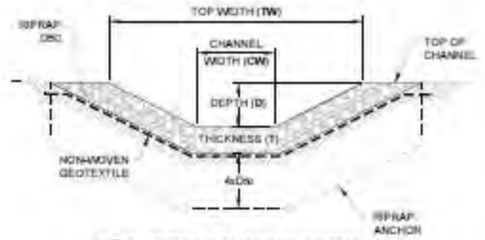
NOTES:

1. TIDEFLEX CHECK VALVE TO BE INSTALLED PER MANUFACTURER'S SPECIFICATIONS AND RECOMMENDATIONS.
2. SILL IN ITS CLOSED POSITION SHALL FACE IN THE DIRECTION OF ADJACENT WATER FLOW (I.E. RIVER FLOOD WATER, ETC.).

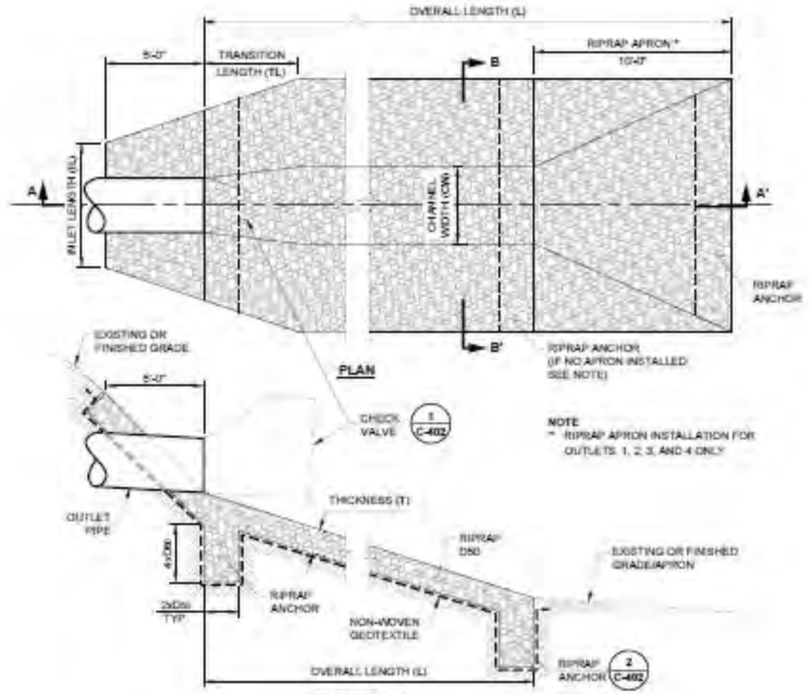
1 **TIDEFLEX CHECK VALVE**
NTS



2 **RIPRAP ANCHOR (TYP.)**
NTS

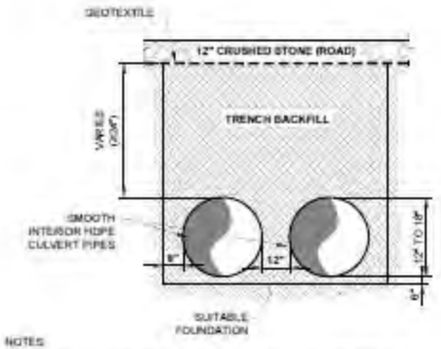


3 **RIPRAP CHANNEL LINING**
NTS



4 **RIPRAP OUTLET PROTECTION**
NTS

OUTLET PROTECTION SIZING TABLE										
OUTLET	PIPE SIZE (INCHES)	D50 SIZE (INCHES)	T (FEET)	L (FEET)	IL (FEET)	TL (FEET)	CW (FEET)	D (INCHES)	TW (FEET)	ANCHOR WIDTH (FEET)
1	18/12	6	1.5	115	7	10	3	9	6	1
2	24/18	9	3	105	8	10	5	14	10	1.5
3	24/18	9	3	87	8	10	6	15	11	1.5
4	24/18	9	3	108	8	10	5	14	10	1.5
5	18/12	6	1.5	35	3	10	3	9	6	1
6	24/18	9	3	107	8	10	5	14	10	1.5
7	24/18	9	3	60	8	10	7.5	18.5	13	1.5
8	24/18	REFER TO WEST DITCH RIPRAP CHANNEL LINING								
9	18/12	REFER TO WEST DITCH RIPRAP CHANNEL LINING								



NOTES:

1. ALL PIPE SYSTEMS SHALL BE INSTALLED IN ACCORDANCE WITH SPECIFICATIONS.
2. FOUNDATION: WHERE THE TRENCH BOTTOM IS UNSTABLE, THE CONTRACTOR SHALL EXCAVATE TO A DEPTH REQUIRED BY THE ENGINEER AND REPLACE WITH SUITABLE MATERIAL AS SPECIFIED BY THE ENGINEER. AS AN ALTERNATIVE AND AT THE DISCRETION OF THE DESIGN ENGINEER, THE TRENCH BOTTOM MAY BE STABILIZED USING A GEOTEXTILE MATERIAL.
3. BEDDING AND BACKFILL: SUITABLE MATERIAL SHALL BE COHESIVE SOIL IN ACCORDANCE WITH SPECIFICATION SECTION 02301, "SITE PREPARATION AND EARTHWORK".
4. THE SECTION SHOWN REPRESENTS A PIPE UNDERNEATH A PERIMETER ACCESS ROAD. FOR PIPES AND PORTIONS OF PIPE NOT IN FINAL COVER, THE FINAL COVER SECTION WOULD BE REPLACED WITH GENERAL BACKFILL.

5 **SINGLE/DUAL OUTLET PIPE SECTION**
NTS

HALEY ALDRICH

HALEY & ALDRICH, INC.
6500 Rockside Road, Suite 200
Cleveland, OH 44131-1463
Tel: 216.739.0555
Fax: 216.520.0712
www.haleyaldrich.com

ISSUED FOR BID

Project No:	129653-003
Scale:	AS SHOWN
Date:	JANUARY 2016
Drawn By:	TW
Designed By:	AKL
Checked By:	NPK
Approved By:	SPF
Stamp:	

NO.	DESCRIPTION	HALEY ALDRICH BY	DATE
0	ISSUED FOR BID	MK	1/29/16

AMEREN MISSOURI
RUSH ISLAND ENERGY CENTER

ASH POND CLOSURE

DETAILS

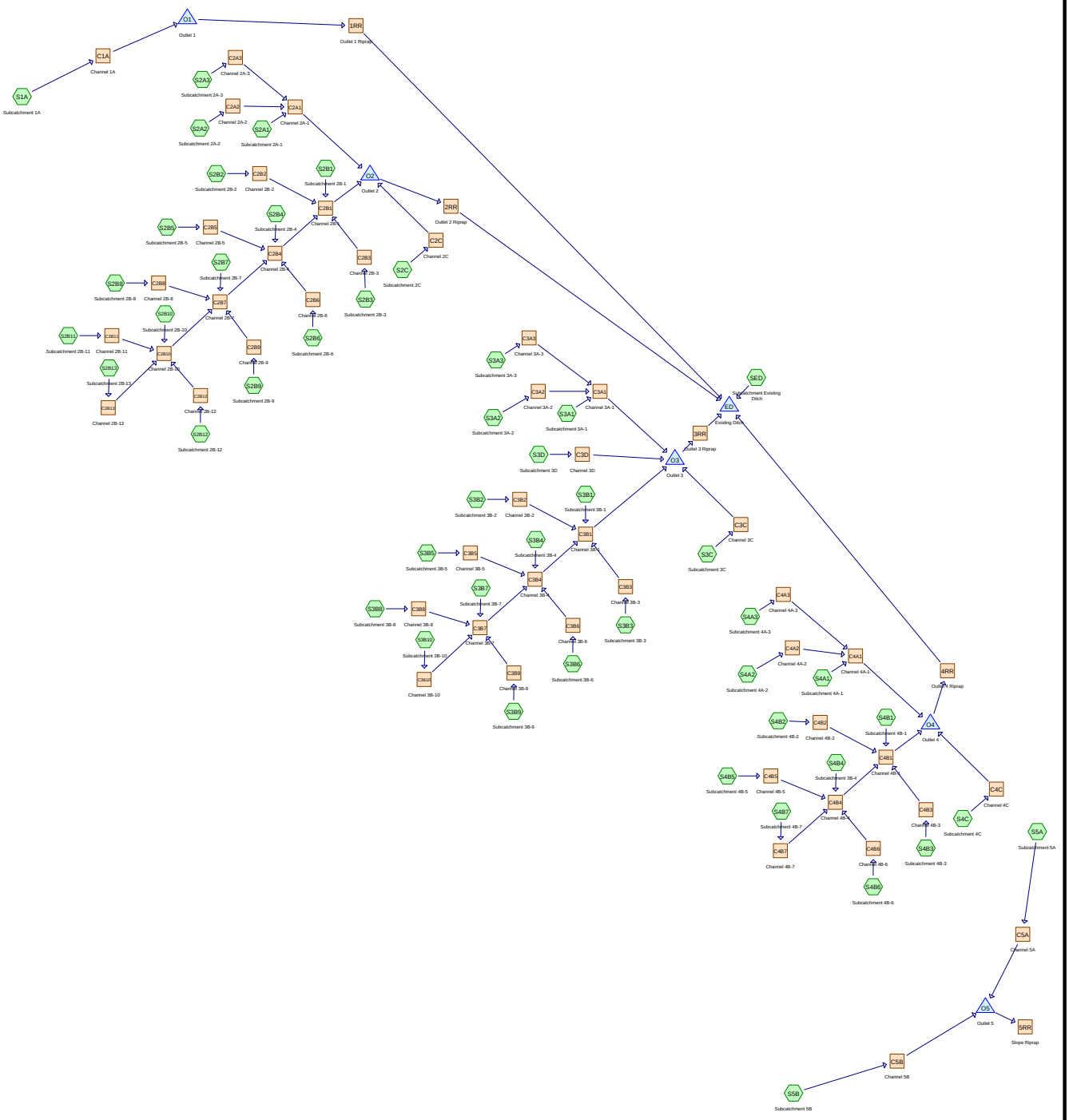
C-402

Sheet 15 of 19

Created Name: V:\AR\ATKLN...\Drawings\Issue...C-402
Date/Time: January 29, 2016
Drawing Name: C:\Users\...\AppData\Local\Temp\...\Acad.ctb

ATTACHMENT 3

HYDROCAD OUTPUT



Routing Diagram for 129530 - RCPA Closure_EAST_2017-12-18
Prepared by {enter your company name here}, Printed 5/29/2018
HydroCAD® 10.00 s/n 08262 © 2013 HydroCAD Software Solutions LLC

Area Listing (all nodes)

Area (acres)	CN	Description (subcatchment-numbers)
77.977	61	>75% Grass cover, Good, HSG B (S1A, S2A1, S2A2, S2A3, S2B1, S2B10, S2B11, S2B12, S2B13, S2B2, S2B3, S2B4, S2B5, S2B6, S2B7, S2B8, S2B9, S2C, S3A1, S3A2, S3A3, S3B1, S3B10, S3B2, S3B3, S3B4, S3B5, S3B6, S3B7, S3B8, S3B9, S3C, S3D, S4A1, S4A2, S4A3, S4B1, S4B2, S4B3, S4B4, S4B5, S4B6, S4B7, S4C, S5A, S5B, SED)
77.977	**61**	**TOTAL AREA**

Soil Listing (all nodes)

Area (acres)	Soil Group	Subcatchment Numbers
0.000	HSG A	
77.977	HSG B	S1A, S2A1, S2A2, S2A3, S2B1, S2B10, S2B11, S2B12, S2B13, S2B2, S2B3, S2B4, S2B5, S2B6, S2B7, S2B8, S2B9, S2C, S3A1, S3A2, S3A3, S3B1, S3B10, S3B2, S3B3, S3B4, S3B5, S3B6, S3B7, S3B8, S3B9, S3C, S3D, S4A1, S4A2, S4A3, S4B1, S4B2, S4B3, S4B4, S4B5, S4B6, S4B7, S4C, S5A, S5B, SED
0.000	HSG C	
0.000	HSG D	
0.000	Other	
77.977		**TOTAL AREA**

Ground Covers (all nodes)

HSG-A (acres)	HSG-B (acres)	HSG-C (acres)	HSG-D (acres)	Other (acres)	Total (acres)	Ground Cover	Subcatchment Numbers
0.000	77.977	0.000	0.000	0.000	77.977	>75% Grass cover, Good	S1A, S2A1, S2A2, S2A3, S2B1, S2B10, S2B11, S2B12, S2B13, S2B2, S2B3, S2B4, S2B5, S2B6, S2B7, S2B8, S2B9, S2C, S3A1, S3A2, S3A3, S3B1, S3B10, S3B2, S3B3, S3B4, S3B5, S3B6, S3B7, S3B8, S3B9, S3C, S3D, S4A1, S4A2, S4A3, S4B1, S4B2, S4B3, S4B4, S4B5, S4B6, S4B7, S4C, S5A, S5B, SED

Ground Covers (all nodes) (continued)

HSG-A (acres)	HSG-B (acres)	HSG-C (acres)	HSG-D (acres)	Other (acres)	Total (acres)	Ground Cover	Subcatchment Numbers
0.000	**77.977**	**0.000**	**0.000**	**0.000**	**77.977**	**TOTAL AREA**	

Pipe Listing (all nodes)

Line#	Node Number	In-Invert (feet)	Out-Invert (feet)	Length (feet)	Slope (ft/ft)	n	Diam/Width (inches)	Height (inches)	Inside-Fill (inches)
1	O1	399.00	397.79	118.5	0.0102	0.013	12.0	0.0	0.0
2	O2	400.22	398.63	159.4	0.0100	0.013	18.0	0.0	0.0
3	O3	400.22	398.70	152.2	0.0100	0.013	18.0	0.0	0.0
4	O4	399.07	397.15	192.0	0.0100	0.013	18.0	0.0	0.0
5	O5	400.06	398.43	162.6	0.0100	0.013	12.0	0.0	0.0

Time span=0.00-36.00 hrs, dt=0.01 hrs, 3601 points
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN
Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

Subcatchment S1A: Subcatchment 1A Runoff Area=67,665 sf 0.00% Impervious Runoff Depth=1.93"
Flow Length=38' Slope=0.2000 '/' Tc=2.7 min CN=61 Runoff=6.06 cfs 0.249 af

Subcatchment S2A1: Subcatchment 2A-1 Runoff Area=23,977 sf 0.00% Impervious Runoff Depth=1.93"
Flow Length=269' Tc=18.6 min CN=61 Runoff=1.17 cfs 0.088 af

Subcatchment S2A2: Subcatchment 2A-2 Runoff Area=25,906 sf 0.00% Impervious Runoff Depth=1.93"
Flow Length=287' Tc=18.9 min CN=61 Runoff=1.25 cfs 0.095 af

Subcatchment S2A3: Subcatchment 2A-3 Runoff Area=61,880 sf 0.00% Impervious Runoff Depth=1.93"
Flow Length=261' Tc=18.5 min CN=61 Runoff=3.03 cfs 0.228 af

Subcatchment S2B1: Subcatchment 2B-1 Runoff Area=28,853 sf 0.00% Impervious Runoff Depth=1.93"
Flow Length=212' Tc=17.6 min CN=61 Runoff=1.46 cfs 0.106 af

Subcatchment S2B10: Subcatchment 2B-10 Runoff Area=41,432 sf 0.00% Impervious Runoff Depth=1.93"
Flow Length=231' Slope=0.0180 '/' Tc=17.8 min CN=61 Runoff=2.08 cfs 0.153 af

Subcatchment S2B11: Subcatchment 2B-11 Runoff Area=58,052 sf 0.00% Impervious Runoff Depth=1.93"
Flow Length=267' Slope=0.0180 '/' Tc=18.5 min CN=61 Runoff=2.84 cfs 0.214 af

Subcatchment S2B12: Subcatchment 2B-12 Runoff Area=55,330 sf 0.00% Impervious Runoff Depth=1.93"
Flow Length=248' Slope=0.0190 '/' Tc=17.8 min CN=61 Runoff=2.78 cfs 0.204 af

Subcatchment S2B13: Subcatchment 2B-13 Runoff Area=45,118 sf 0.00% Impervious Runoff Depth=1.93"
Flow Length=246' Slope=0.0180 '/' Tc=18.1 min CN=61 Runoff=2.24 cfs 0.166 af

Subcatchment S2B2: Subcatchment 2B-2 Runoff Area=47,843 sf 0.00% Impervious Runoff Depth=1.93"
Flow Length=265' Tc=18.5 min CN=61 Runoff=2.34 cfs 0.176 af

Subcatchment S2B3: Subcatchment 2B-3 Runoff Area=52,998 sf 0.00% Impervious Runoff Depth=1.93"
Flow Length=232' Slope=0.0190 '/' Tc=17.5 min CN=61 Runoff=2.69 cfs 0.195 af

Subcatchment S2B4: Subcatchment 2B-4 Runoff Area=41,859 sf 0.00% Impervious Runoff Depth=1.93"
Flow Length=232' Tc=17.8 min CN=61 Runoff=2.10 cfs 0.154 af

Subcatchment S2B5: Subcatchment 2B-5 Runoff Area=50,647 sf 0.00% Impervious Runoff Depth=1.93"
Flow Length=253' Tc=18.2 min CN=61 Runoff=2.51 cfs 0.187 af

Subcatchment S2B6: Subcatchment 2B-6 Runoff Area=53,673 sf 0.00% Impervious Runoff Depth=1.93"
Flow Length=233' Tc=17.5 min CN=61 Runoff=2.72 cfs 0.198 af

Subcatchment S2B7: Subcatchment 2B-7 Runoff Area=41,873 sf 0.00% Impervious Runoff Depth=1.93"
Flow Length=233' Slope=0.0179 '/' Tc=17.9 min CN=61 Runoff=2.09 cfs 0.154 af

Subcatchment S2B8: Subcatchment 2B-8 Runoff Area=53,632 sf 0.00% Impervious Runoff Depth=1.93"
Flow Length=250' Slope=0.0180 '/' Tc=18.2 min CN=61 Runoff=2.65 cfs 0.198 af

Subcatchment S2B9: Subcatchment 2B-9 Runoff Area=53,565 sf 0.00% Impervious Runoff Depth=1.93"
Flow Length=233' Slope=0.0190 '/' Tc=17.5 min CN=61 Runoff=2.71 cfs 0.197 af

Subcatchment S2C: Subcatchment 2C Runoff Area=56,767 sf 0.00% Impervious Runoff Depth=1.93"
Flow Length=197' Slope=0.0190 '/' Tc=16.9 min CN=61 Runoff=2.94 cfs 0.209 af

Subcatchment S3A1: Subcatchment 3A-1 Runoff Area=74,883 sf 0.00% Impervious Runoff Depth=1.93"
Flow Length=276' Slope=0.0190 '/' Tc=18.2 min CN=61 Runoff=3.71 cfs 0.276 af

Subcatchment S3A2: Subcatchment 3A-2 Runoff Area=9,809 sf 0.00% Impervious Runoff Depth=1.93"
Flow Length=284' Slope=0.0190 '/' Tc=18.4 min CN=61 Runoff=0.48 cfs 0.036 af

Subcatchment S3A3: Subcatchment 3A-3 Runoff Area=36,274 sf 0.00% Impervious Runoff Depth=1.93"
Flow Length=239' Slope=0.0190 '/' Tc=17.6 min CN=61 Runoff=1.83 cfs 0.134 af

Subcatchment S3B1: Subcatchment 3B-1 Runoff Area=41,774 sf 0.00% Impervious Runoff Depth=1.93"
Flow Length=267' Tc=18.1 min CN=61 Runoff=2.07 cfs 0.154 af

Subcatchment S3B10: Subcatchment 3B-10 Runoff Area=45,256 sf 0.00% Impervious Runoff Depth=1.93"
Flow Length=268' Slope=0.0190 '/' Tc=18.1 min CN=61 Runoff=2.25 cfs 0.167 af

Subcatchment S3B2: Subcatchment 3B-2 Runoff Area=84,030 sf 0.00% Impervious Runoff Depth=1.93"
Flow Length=284' Slope=0.0190 '/' Tc=18.4 min CN=61 Runoff=4.14 cfs 0.310 af

Subcatchment S3B3: Subcatchment 3B-3 Runoff Area=49,143 sf 0.00% Impervious Runoff Depth=1.93"
Flow Length=232' Tc=17.9 min CN=61 Runoff=2.46 cfs 0.181 af

Subcatchment S3B4: Subcatchment 3B-4 Runoff Area=42,968 sf 0.00% Impervious Runoff Depth=1.93"
Flow Length=267' Slope=0.0188 '/' Tc=18.1 min CN=61 Runoff=2.13 cfs 0.158 af

Subcatchment S3B5: Subcatchment 3B-5 Runoff Area=84,295 sf 0.00% Impervious Runoff Depth=1.93"
Flow Length=284' Slope=0.0190 '/' Tc=18.4 min CN=61 Runoff=4.15 cfs 0.311 af

Subcatchment S3B6: Subcatchment 3B-6 Runoff Area=52,439 sf 0.00% Impervious Runoff Depth=1.93"
Flow Length=234' Slope=0.0180 '/' Tc=17.9 min CN=61 Runoff=2.62 cfs 0.193 af

Subcatchment S3B7: Subcatchment 3B-7 Runoff Area=41,749 sf 0.00% Impervious Runoff Depth=1.93"
Flow Length=254' Slope=0.0189 '/' Tc=17.9 min CN=61 Runoff=2.09 cfs 0.154 af

Subcatchment S3B8: Subcatchment 3B-8 Runoff Area=76,316 sf 0.00% Impervious Runoff Depth=1.93"
Flow Length=291' Slope=0.0190 '/' Tc=18.5 min CN=61 Runoff=3.73 cfs 0.281 af

Subcatchment S3B9: Subcatchment 3B-9 Runoff Area=57,859 sf 0.00% Impervious Runoff Depth=1.93"
Flow Length=232' Slope=0.0180 '/' Tc=17.8 min CN=61 Runoff=2.90 cfs 0.213 af

Subcatchment S3C: Subcatchment 3C Runoff Area=61,276 sf 0.00% Impervious Runoff Depth=1.93"
Flow Length=221' Slope=0.0180 '/' Tc=17.6 min CN=61 Runoff=3.09 cfs 0.226 af

Subcatchment S3D: Subcatchment 3D Runoff Area=84,589 sf 0.00% Impervious Runoff Depth=1.93"
Flow Length=284' Tc=18.4 min CN=61 Runoff=4.16 cfs 0.312 af

Subcatchment S4A1: Subcatchment 4A-1 Runoff Area=103,404 sf 0.00% Impervious Runoff Depth=1.93"
Flow Length=280' Tc=17.7 min CN=61 Runoff=5.20 cfs 0.381 af

Subcatchment S4A2: Subcatchment 4A-2 Runoff Area=29,841 sf 0.00% Impervious Runoff Depth=1.93"
Flow Length=285' Tc=17.8 min CN=61 Runoff=1.50 cfs 0.110 af

Subcatchment S4A3: Subcatchment 4A-3 Runoff Area=48,624 sf 0.00% Impervious Runoff Depth=1.93"
Flow Length=262' Tc=17.4 min CN=61 Runoff=2.47 cfs 0.179 af

Subcatchment S4B1: Subcatchment 4B-1 Runoff Area=7,017 sf 0.00% Impervious Runoff Depth=1.93"
Flow Length=68' Slope=0.0207 '/' Tc=10.8 min CN=61 Runoff=0.45 cfs 0.026 af

Subcatchment S4B2: Subcatchment 4B-2 Runoff Area=118,286 sf 0.00% Impervious Runoff Depth=1.93"
Flow Length=284' Slope=0.0207 '/' Tc=17.7 min CN=61 Runoff=5.94 cfs 0.436 af

Subcatchment S4B3: Subcatchment 4B-3 Runoff Area=27,625 sf 0.00% Impervious Runoff Depth=1.93"
Flow Length=285' Tc=17.8 min CN=61 Runoff=1.39 cfs 0.102 af

Subcatchment S4B4: Subcatchment 3B-4 Runoff Area=46,922 sf 0.00% Impervious Runoff Depth=1.93"
Flow Length=248' Slope=0.0204 '/' Tc=17.2 min CN=61 Runoff=2.40 cfs 0.173 af

Subcatchment S4B5: Subcatchment 4B-5 Runoff Area=108,239 sf 0.00% Impervious Runoff Depth=1.93"
Flow Length=297' Slope=0.0207 '/' Tc=18.0 min CN=61 Runoff=5.39 cfs 0.399 af

Subcatchment S4B6: Subcatchment 4B-6 Runoff Area=56,286 sf 0.00% Impervious Runoff Depth=1.93"
Flow Length=299' Tc=18.0 min CN=61 Runoff=2.80 cfs 0.207 af

Subcatchment S4B7: Subcatchment 4B-7 Runoff Area=50,996 sf 0.00% Impervious Runoff Depth=1.93"
Flow Length=260' Tc=17.4 min CN=61 Runoff=2.59 cfs 0.188 af

Subcatchment S4C: Subcatchment 4C Runoff Area=42,187 sf 0.00% Impervious Runoff Depth=1.93"
Flow Length=171' Tc=15.8 min CN=61 Runoff=2.26 cfs 0.155 af

Subcatchment S5A: Subcatchment 5A Runoff Area=103,005 sf 0.00% Impervious Runoff Depth=1.93"
Flow Length=234' Slope=0.0450 '/' Tc=12.2 min CN=61 Runoff=6.31 cfs 0.379 af

Subcatchment S5B: Subcatchment 5B Runoff Area=58,931 sf 0.00% Impervious Runoff Depth=1.93"
Flow Length=214' Slope=0.0450 '/' Tc=12.0 min CN=61 Runoff=3.63 cfs 0.217 af

Subcatchment SED: Subcatchment Runoff Area=891,570 sf 0.00% Impervious Runoff Depth=1.93"
Tc=0.0 min CN=61 Runoff=87.38 cfs 3.284 af

Reach 1RR: Outlet 1 Riprap Avg. Flow Depth=0.29' Max Vel=2.71 fps Inflow=3.08 cfs 0.249 af
n=0.070 L=107.4' S=0.1131 '/' Capacity=31.93 cfs Outflow=3.07 cfs 0.249 af

Reach 2RR: Outlet 2 Riprap Avg. Flow Depth=0.62' Max Vel=4.70 fps Inflow=19.96 cfs 2.923 af
n=0.070 L=108.3' S=0.1316 '/' Capacity=108.53 cfs Outflow=19.96 cfs 2.923 af

Reach 3RR: Outlet 3 Riprap Avg. Flow Depth=0.50' Max Vel=5.40 fps Inflow=20.27 cfs 3.104 af
n=0.070 L=88.2' S=0.2124 '/' Capacity=155.82 cfs Outflow=20.27 cfs 3.104 af

Reach 4RR: Outlet 4 Riprap Avg. Flow Depth=0.55' Max Vel=5.13 fps Inflow=18.67 cfs 2.356 af
n=0.070 L=90.7' S=0.1800 '/' Capacity=126.96 cfs Outflow=18.67 cfs 2.356 af

Reach 5RR: Slope Riprap Avg. Flow Depth=0.29' Max Vel=3.17 fps Inflow=3.59 cfs 0.597 af
n=0.070 L=49.9' S=0.1553 '/' Capacity=87.80 cfs Outflow=3.59 cfs 0.597 af

Reach C1A: Channel 1A Avg. Flow Depth=0.60' Max Vel=2.44 fps Inflow=6.06 cfs 0.249 af
n=0.027 L=901.9' S=0.0100 '/' Capacity=148.74 cfs Outflow=4.44 cfs 0.249 af

Reach C2A1: Channel 2A-1 Avg. Flow Depth=0.23' Max Vel=3.29 fps Inflow=4.72 cfs 0.412 af
n=0.027 L=78.4' S=0.0647 '/' Capacity=713.92 cfs Outflow=4.71 cfs 0.412 af

Reach C2A2: Channel 2A-2 Avg. Flow Depth=0.18' Max Vel=1.38 fps Inflow=1.25 cfs 0.095 af
n=0.027 L=158.7' S=0.0152 '/' Capacity=112.98 cfs Outflow=1.23 cfs 0.095 af

Reach C2A3: Channel 2A-3 Avg. Flow Depth=0.27' Max Vel=1.40 fps Inflow=3.03 cfs 0.228 af
n=0.027 L=425.8' S=0.0094 '/' Capacity=272.44 cfs Outflow=2.74 cfs 0.228 af

Reach C2B1: Channel 2B-1 Avg. Flow Depth=1.16' Max Vel=3.03 fps Inflow=26.40 cfs 2.302 af
n=0.045 L=117.5' S=0.0120 '/' Capacity=44.43 cfs Outflow=26.36 cfs 2.302 af

Reach C2B10: Channel 2B-10 Avg. Flow Depth=0.65' Max Vel=2.22 fps Inflow=8.66 cfs 0.737 af
n=0.045 L=157.6' S=0.0121 '/' Capacity=44.53 cfs Outflow=8.62 cfs 0.737 af

Reach C2B11: Channel 2B-11 Avg. Flow Depth=0.24' Max Vel=1.65 fps Inflow=2.84 cfs 0.214 af
n=0.027 L=456.9' S=0.0150 '/' Capacity=112.17 cfs Outflow=2.61 cfs 0.214 af

Reach C2B12: Channel 2B-12 Avg. Flow Depth=0.24' Max Vel=1.69 fps Inflow=2.78 cfs 0.204 af
n=0.027 L=469.6' S=0.0162 '/' Capacity=116.63 cfs Outflow=2.54 cfs 0.204 af

Reach C2B13: Channel 2B-13 Avg. Flow Depth=0.31' Max Vel=1.46 fps Inflow=2.24 cfs 0.166 af
n=0.045 L=141.6' S=0.0121 '/' Capacity=44.57 cfs Outflow=2.22 cfs 0.166 af

Reach C2B2: Channel 2B-2 Avg. Flow Depth=0.23' Max Vel=1.57 fps Inflow=2.34 cfs 0.176 af
n=0.027 L=415.6' S=0.0147 '/' Capacity=111.16 cfs Outflow=2.17 cfs 0.176 af

Reach C2B3: Channel 2B-3 Avg. Flow Depth=0.24' Max Vel=1.69 fps Inflow=2.69 cfs 0.195 af
n=0.027 L=416.3' S=0.0163 '/' Capacity=116.91 cfs Outflow=2.49 cfs 0.195 af

Reach C2B4: Channel 2B-4 Avg. Flow Depth=1.04' Max Vel=2.85 fps Inflow=21.07 cfs 1.824 af
n=0.045 L=157.6' S=0.0121 '/' Capacity=44.53 cfs Outflow=21.01 cfs 1.824 af

Reach C2B5: Channel 2B-5 Avg. Flow Depth=0.23' Max Vel=1.60 fps Inflow=2.51 cfs 0.187 af
n=0.027 L=420.8' S=0.0149 '/' Capacity=111.73 cfs Outflow=2.31 cfs 0.187 af

Reach C2B6: Channel 2B-6 Avg. Flow Depth=0.24' Max Vel=1.68 fps Inflow=2.72 cfs 0.198 af
n=0.027 L=475.0' S=0.0162 '/' Capacity=116.65 cfs Outflow=2.48 cfs 0.198 af

Reach C2B7: Channel 2B-7 Avg. Flow Depth=0.87' Max Vel=2.60 fps Inflow=15.00 cfs 1.286 af
n=0.045 L=157.6' S=0.0121 '/' Capacity=44.53 cfs Outflow=14.95 cfs 1.286 af

Reach C2B8: Channel 2B-8 Avg. Flow Depth=0.24' Max Vel=1.63 fps Inflow=2.65 cfs 0.198 af
n=0.027 L=437.8' S=0.0149 '/' Capacity=112.05 cfs Outflow=2.44 cfs 0.198 af

Reach C2B9: Channel 2B-9 Avg. Flow Depth=0.24' Max Vel=1.68 fps Inflow=2.71 cfs 0.197 af
n=0.027 L=472.3' S=0.0162 '/' Capacity=116.76 cfs Outflow=2.47 cfs 0.197 af

Reach C2C: Channel 2C Avg. Flow Depth=0.24' Max Vel=1.74 fps Inflow=2.94 cfs 0.209 af
n=0.027 L=481.7' S=0.0172 '/' Capacity=368.51 cfs Outflow=2.67 cfs 0.209 af

Reach C3A1: Channel 3A-1 Avg. Flow Depth=0.33' Max Vel=1.77 fps Inflow=5.54 cfs 0.446 af
n=0.027 L=415.3' S=0.0115 '/' Capacity=301.19 cfs Outflow=5.25 cfs 0.446 af

Reach C3A2: Channel 3A-2 Avg. Flow Depth=0.13' Max Vel=1.12 fps Inflow=0.48 cfs 0.036 af
n=0.027 L=57.4' S=0.0162 '/' Capacity=116.70 cfs Outflow=0.48 cfs 0.036 af

Reach C3A3: Channel 3A-3 Avg. Flow Depth=0.22' Max Vel=1.34 fps Inflow=1.83 cfs 0.134 af
n=0.027 L=308.4' S=0.0115 '/' Capacity=301.63 cfs Outflow=1.71 cfs 0.134 af

Reach C3B1: Channel 3B-1 Avg. Flow Depth=1.09' Max Vel=2.96 fps Inflow=23.42 cfs 2.121 af
n=0.045 L=149.2' S=0.0123 '/' Capacity=45.04 cfs Outflow=23.36 cfs 2.121 af

Reach C3B10: Channel 3B-10 Avg. Flow Depth=0.31' Max Vel=1.48 fps Inflow=2.25 cfs 0.167 af
n=0.045 L=141.8' S=0.0124 '/' Capacity=45.18 cfs Outflow=2.22 cfs 0.167 af

Reach C3B2: Channel 3B-2 Avg. Flow Depth=0.27' Max Vel=1.85 fps Inflow=4.14 cfs 0.310 af
n=0.027 L=668.9' S=0.0161 '/' Capacity=116.49 cfs Outflow=3.63 cfs 0.310 af

Reach C3B3: Channel 3B-3 Avg. Flow Depth=0.23' Max Vel=1.60 fps Inflow=2.46 cfs 0.181 af
n=0.027 L=409.0' S=0.0149 '/' Capacity=111.96 cfs Outflow=2.27 cfs 0.181 af

Reach C3B4: Channel 3B-4 Avg. Flow Depth=0.91' Max Vel=2.69 fps Inflow=16.44 cfs 1.477 af
n=0.045 L=157.7' S=0.0124 '/' Capacity=45.10 cfs Outflow=16.39 cfs 1.477 af

Reach C3B5: Channel 3B-5 Avg. Flow Depth=0.27' Max Vel=1.85 fps Inflow=4.15 cfs 0.311 af
n=0.027 L=666.2' S=0.0162 '/' Capacity=116.57 cfs Outflow=3.64 cfs 0.311 af

Reach C3B6: Channel 3B-6 Avg. Flow Depth=0.24' Max Vel=1.63 fps Inflow=2.62 cfs 0.193 af
n=0.027 L=434.7' S=0.0152 '/' Capacity=113.05 cfs Outflow=2.41 cfs 0.193 af

Reach C3B7: Channel 3B-7 Avg. Flow Depth=0.67' Max Vel=2.27 fps Inflow=9.14 cfs 0.815 af
n=0.045 L=157.7' S=0.0123 '/' Capacity=44.98 cfs Outflow=9.10 cfs 0.815 af

Reach C3B8: Channel 3B-8 Avg. Flow Depth=0.26' Max Vel=1.80 fps Inflow=3.73 cfs 0.281 af
n=0.027 L=648.3' S=0.0161 '/' Capacity=116.17 cfs Outflow=3.29 cfs 0.281 af

Reach C3B9: Channel 3B-9 Avg. Flow Depth=0.25' Max Vel=1.67 fps Inflow=2.90 cfs 0.213 af
n=0.027 L=451.9' S=0.0152 '/' Capacity=113.04 cfs Outflow=2.66 cfs 0.213 af

Reach C3C: Channel 3C Avg. Flow Depth=0.25' Max Vel=1.72 fps Inflow=3.09 cfs 0.226 af
n=0.027 L=410.8' S=0.0158 '/' Capacity=353.14 cfs Outflow=2.88 cfs 0.226 af

Reach C3D: Channel 3D Avg. Flow Depth=0.27' Max Vel=1.85 fps Inflow=4.16 cfs 0.312 af
n=0.027 L=671.6' S=0.0161 '/' Capacity=116.42 cfs Outflow=3.65 cfs 0.312 af

Reach C4A1: Channel 4A-1 Avg. Flow Depth=0.39' Max Vel=1.86 fps Inflow=8.21 cfs 0.670 af
n=0.027 L=407.8' S=0.0100 '/' Capacity=281.15 cfs Outflow=7.84 cfs 0.670 af

Reach C4A2: Channel 4A-2 Avg. Flow Depth=0.20' Max Vel=1.43 fps Inflow=1.50 cfs 0.110 af
n=0.027 L=148.7' S=0.0149 '/' Capacity=111.77 cfs Outflow=1.47 cfs 0.110 af

Reach C4A3: Channel 4A-3 Avg. Flow Depth=0.25' Max Vel=1.35 fps Inflow=2.47 cfs 0.179 af
n=0.027 L=372.9' S=0.0098 '/' Capacity=278.51 cfs Outflow=2.26 cfs 0.179 af

Reach C4B1: Channel 4B-1 Avg. Flow Depth=0.86' Max Vel=3.08 fps Inflow=17.30 cfs 1.530 af
n=0.045 L=66.0' S=0.0173 '/' Capacity=53.30 cfs Outflow=17.28 cfs 1.530 af

Reach C4B2: Channel 4B-2 Avg. Flow Depth=0.32' Max Vel=1.96 fps Inflow=5.94 cfs 0.436 af
n=0.027 L=700.3' S=0.0149 '/' Capacity=111.99 cfs Outflow=5.21 cfs 0.436 af

Reach C4B3: Channel 4B-3 Avg. Flow Depth=0.18' Max Vel=1.61 fps Inflow=1.39 cfs 0.102 af
n=0.027 L=141.7' S=0.0215 '/' Capacity=134.28 cfs Outflow=1.37 cfs 0.102 af

Reach C4B4: Channel 4B-4 Avg. Flow Depth=0.67' Max Vel=2.70 fps Inflow=11.01 cfs 0.967 af
n=0.045 L=206.0' S=0.0172 '/' Capacity=53.24 cfs Outflow=10.96 cfs 0.967 af

Reach C4B5: Channel 4B-5 Avg. Flow Depth=0.31' Max Vel=1.92 fps Inflow=5.39 cfs 0.399 af
n=0.027 L=666.3' S=0.0149 '/' Capacity=112.09 cfs Outflow=4.76 cfs 0.399 af

Reach C4B6: Channel 4B-6 Avg. Flow Depth=0.25' Max Vel=1.64 fps Inflow=2.80 cfs 0.207 af
n=0.027 L=372.8' S=0.0146 '/' Capacity=110.95 cfs Outflow=2.63 cfs 0.207 af

Reach C4B7: Channel 4B-7 Avg. Flow Depth=0.30' Max Vel=1.72 fps Inflow=2.59 cfs 0.188 af
n=0.045 L=191.3' S=0.0173 '/' Capacity=53.27 cfs Outflow=2.56 cfs 0.188 af

Reach C4C: Channel 4C Avg. Flow Depth=0.21' Max Vel=1.72 fps Inflow=2.26 cfs 0.155 af
n=0.027 L=447.2' S=0.0199 '/' Capacity=396.27 cfs Outflow=2.07 cfs 0.155 af

Reach C5A: Channel 5A Avg. Flow Depth=0.60' Max Vel=3.31 fps Inflow=6.31 cfs 0.379 af
n=0.027 L=507.4' S=0.0183 '/' Capacity=68.33 cfs Outflow=6.00 cfs 0.379 af

Reach C5B: Channel 5B Avg. Flow Depth=0.46' Max Vel=3.35 fps Inflow=3.63 cfs 0.217 af
n=0.027 L=343.0' S=0.0269 '/' Capacity=82.66 cfs Outflow=3.55 cfs 0.217 af

Pond ED: Existing Ditch Peak Elev=381.88' Storage=89,974 cf Inflow=93.75 cfs 11.916 af
Outflow=56.89 cfs 11.850 af

Pond O1: Outlet 1 Peak Elev=400.56' Storage=880 cf Inflow=4.44 cfs 0.249 af
12.0" Round Culvert n=0.013 L=118.5' S=0.0102 '/' Outflow=3.08 cfs 0.249 af

Pond O2: Outlet 2 Peak Elev=403.18' Storage=14,685 cf Inflow=33.48 cfs 2.923 af
18.0" Round Culvert x 2.00 n=0.013 L=159.4' S=0.0100 '/' Outflow=19.96 cfs 2.923 af

Pond O3: Outlet 3 Peak Elev=403.25' Storage=16,245 cf Inflow=34.82 cfs 3.104 af
18.0" Round Culvert x 2.00 n=0.013 L=152.2' S=0.0100 '/' Outflow=20.27 cfs 3.104 af

Pond O4: Outlet 4 Peak Elev=401.75' Storage=8,711 cf Inflow=27.05 cfs 2.356 af
18.0" Round Culvert x 2.00 n=0.013 L=192.0' S=0.0100 '/' Outflow=18.67 cfs 2.356 af

Pond O5: Outlet 5 Peak Elev=402.01' Storage=5,455 cf Inflow=9.48 cfs 0.597 af
12.0" Round Culvert n=0.013 L=162.6' S=0.0100 '/' Outflow=3.59 cfs 0.597 af

Total Runoff Area = 77.977 ac Runoff Volume = 12.513 af Average Runoff Depth = 1.93"
100.00% Pervious = 77.977 ac 0.00% Impervious = 0.000 ac

Summary for Subcatchment S1A: Subcatchment 1A

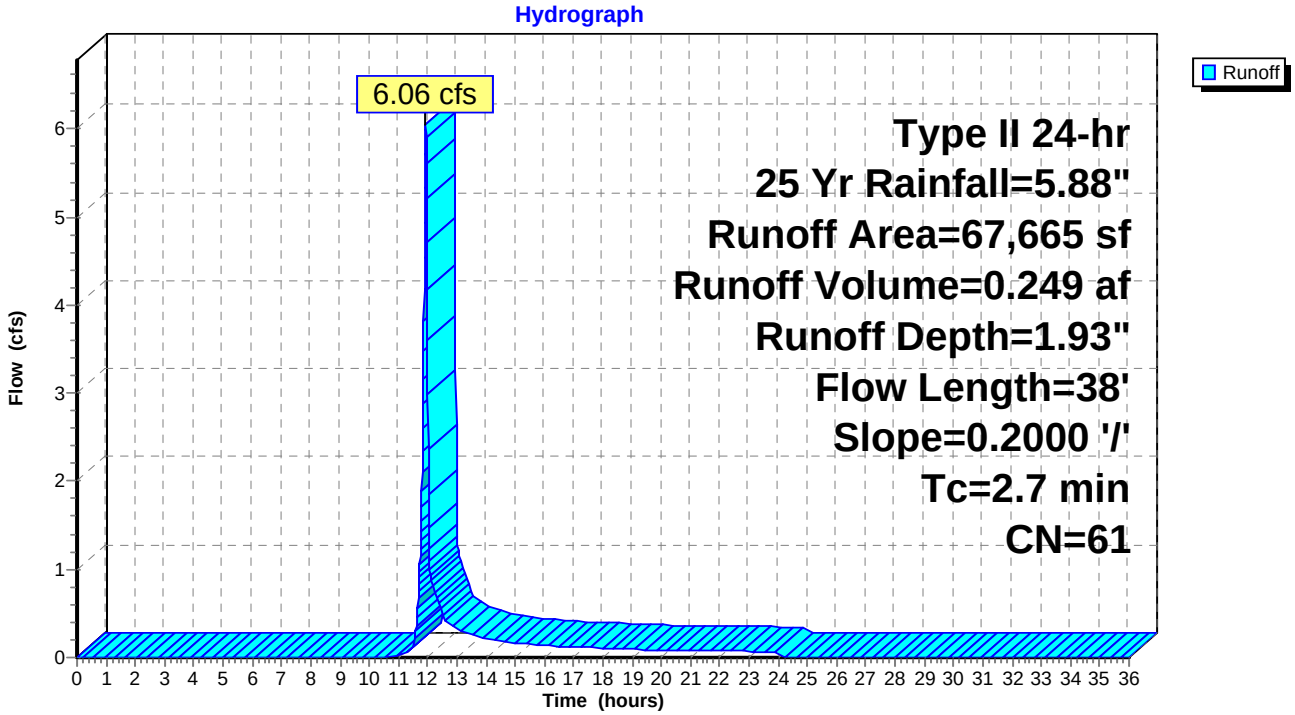
Runoff = 6.06 cfs @ 11.94 hrs, Volume= 0.249 af, Depth= 1.93"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
Type II 24-hr 25 Yr Rainfall=5.88"

Area (sf)	CN	Description
67,665	61	>75% Grass cover, Good, HSG B
67,665		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
2.7	38	0.2000	0.23		**Sheet Flow, Sheet Flow** Grass: Short n= 0.150 P2= 1.39"

Subcatchment S1A: Subcatchment 1A



Summary for Subcatchment S2A1: Subcatchment 2A-1

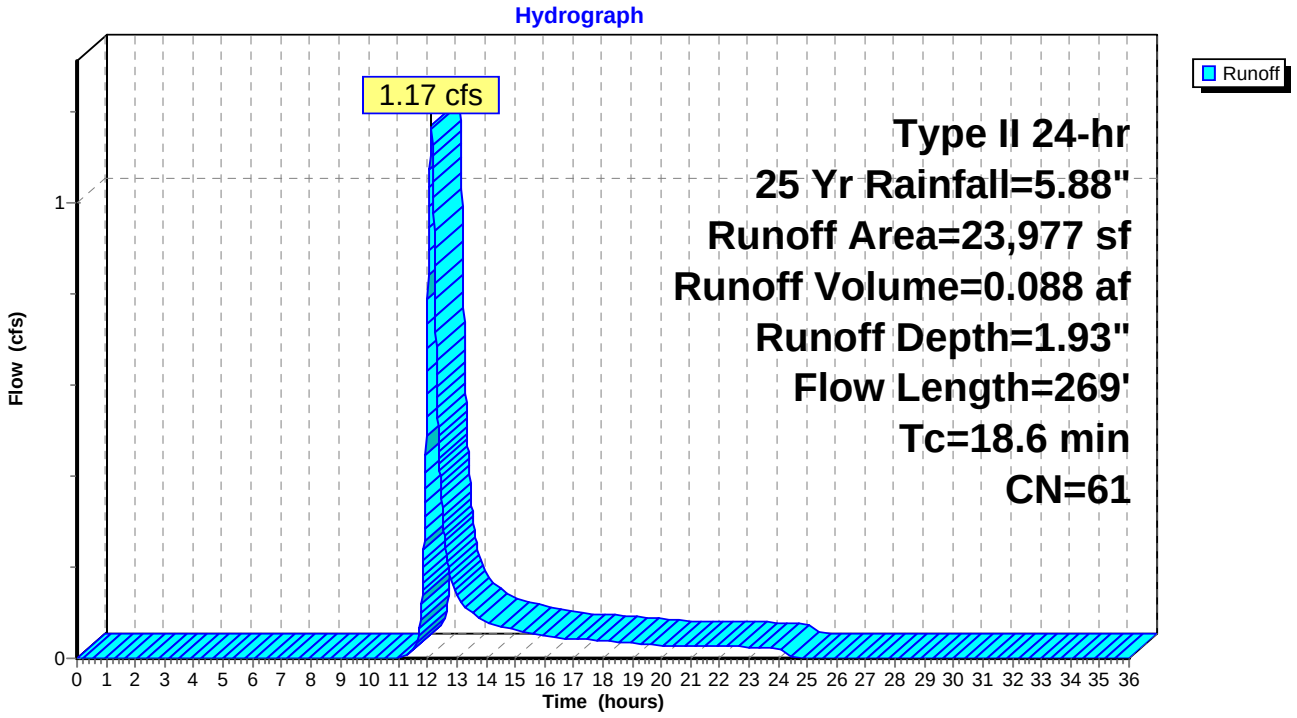
Runoff = 1.17 cfs @ 12.13 hrs, Volume= 0.088 af, Depth= 1.93"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
Type II 24-hr 25 Yr Rainfall=5.88"

Area (sf)	CN	Description
23,977	61	>75% Grass cover, Good, HSG B
23,977		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
15.6	100	0.0178	0.11		**Sheet Flow, Sheet Flow** Grass: Short n= 0.150 P2= 1.39"
3.0	169	0.0179	0.94		**Shallow Concentrated Flow, Shallow Conc.** Short Grass Pasture Kv= 7.0 fps
18.6	269	Total			

Subcatchment S2A1: Subcatchment 2A-1



Summary for Subcatchment S2A2: Subcatchment 2A-2

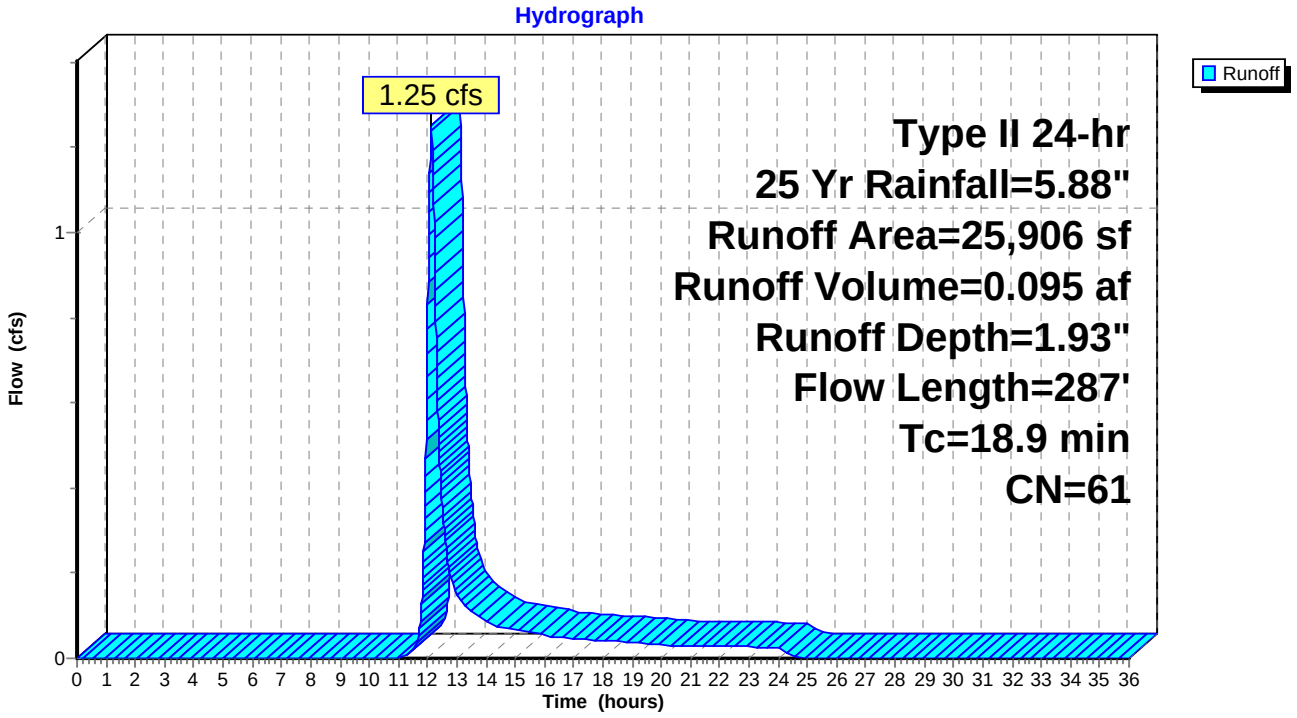
Runoff = 1.25 cfs @ 12.12 hrs, Volume= 0.095 af, Depth= 1.93"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
Type II 24-hr 25 Yr Rainfall=5.88"

Area (sf)	CN	Description
25,906	61	>75% Grass cover, Good, HSG B
25,906		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
15.6	100	0.0177	0.11		**Sheet Flow, Sheet Flow** Grass: Short n= 0.150 P2= 1.39"
3.3	187	0.0178	0.93		**Shallow Concentrated Flow, Shallow Conc.** Short Grass Pasture Kv= 7.0 fps
18.9	287	Total			

Subcatchment S2A2: Subcatchment 2A-2



Summary for Subcatchment S2A3: Subcatchment 2A-3

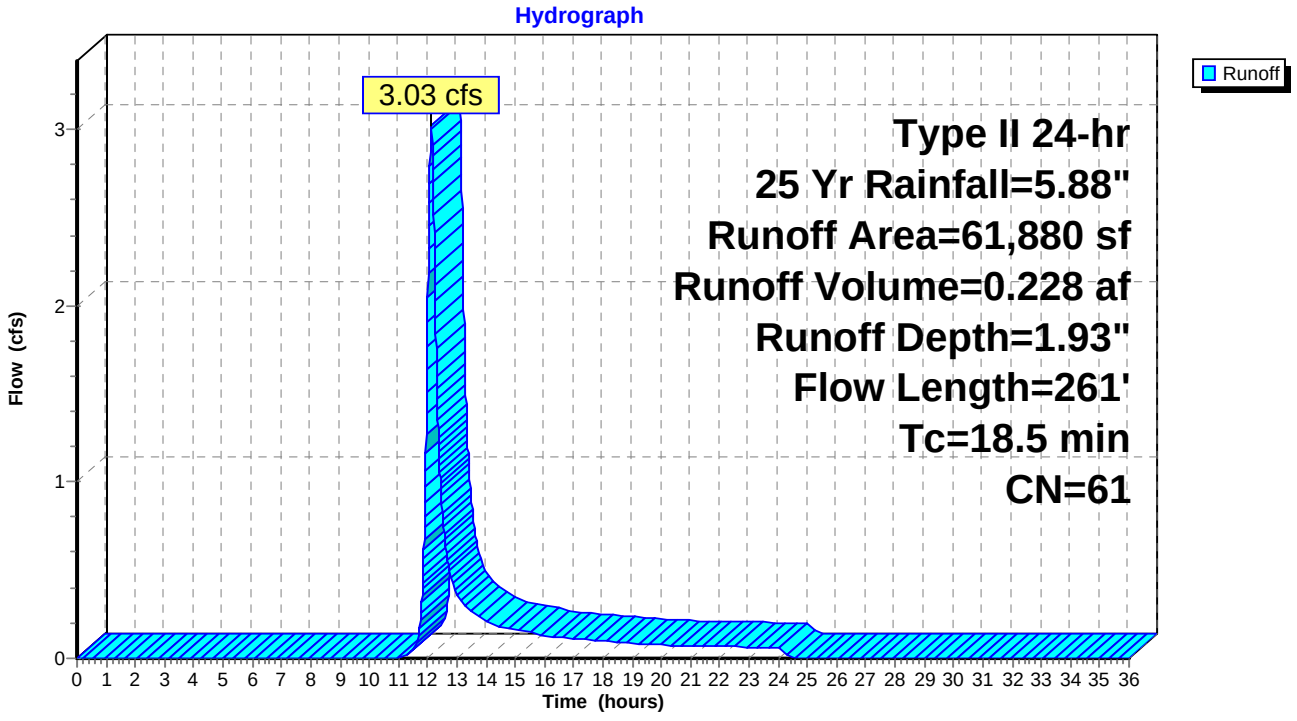
Runoff = 3.03 cfs @ 12.12 hrs, Volume= 0.228 af, Depth= 1.93"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
Type II 24-hr 25 Yr Rainfall=5.88"

Area (sf)	CN	Description
61,880	61	>75% Grass cover, Good, HSG B
61,880		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
15.6	100	0.0177	0.11		**Sheet Flow, Sheet Flow** Grass: Short n= 0.150 P2= 1.39"
2.9	161	0.0179	0.94		**Shallow Concentrated Flow, Shallow Conc.** Short Grass Pasture Kv= 7.0 fps
18.5	261	Total			

Subcatchment S2A3: Subcatchment 2A-3



Summary for Subcatchment S2B1: Subcatchment 2B-1

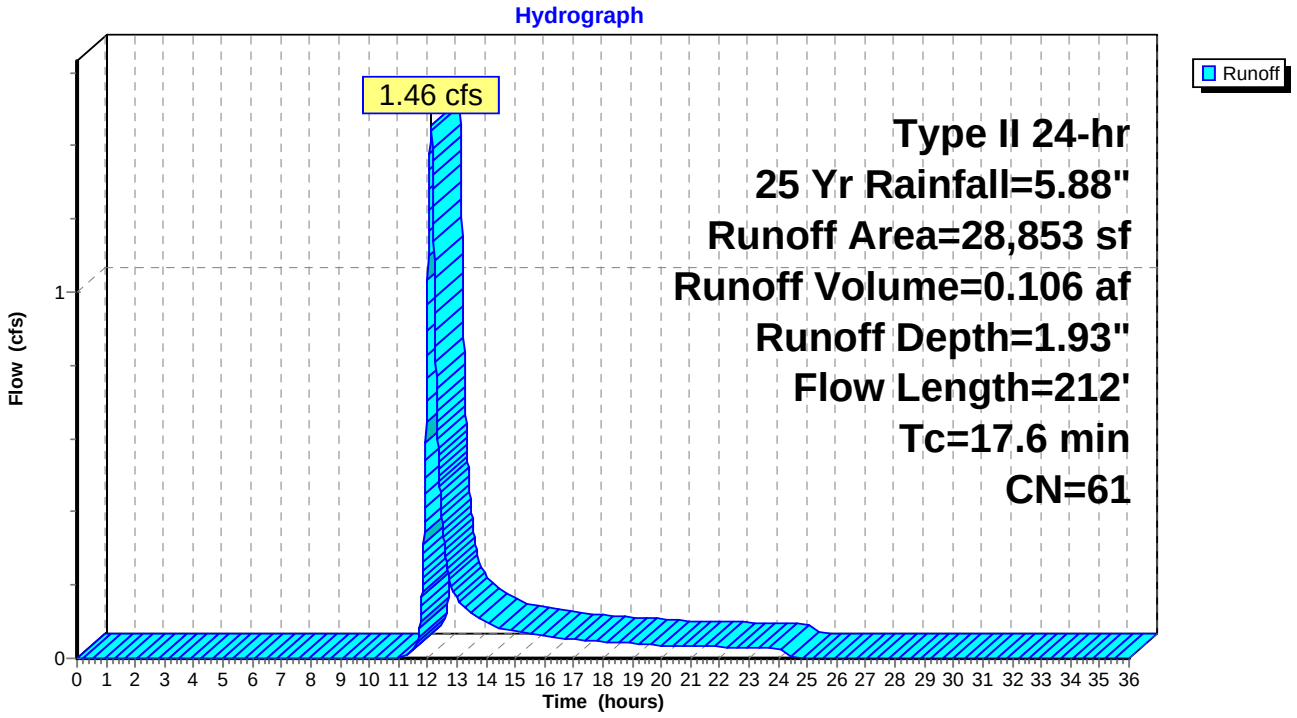
Runoff = 1.46 cfs @ 12.11 hrs, Volume= 0.106 af, Depth= 1.93"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
Type II 24-hr 25 Yr Rainfall=5.88"

Area (sf)	CN	Description
28,853	61	>75% Grass cover, Good, HSG B
28,853		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
15.6	100	0.0178	0.11		**Sheet Flow, Sheet Flow** Grass: Short n= 0.150 P2= 1.39"
2.0	112	0.0182	0.94		**Shallow Concentrated Flow, Shallow Conc.** Short Grass Pasture Kv= 7.0 fps
17.6	212	Total			

Subcatchment S2B1: Subcatchment 2B-1



Summary for Subcatchment S2B10: Subcatchment 2B-10

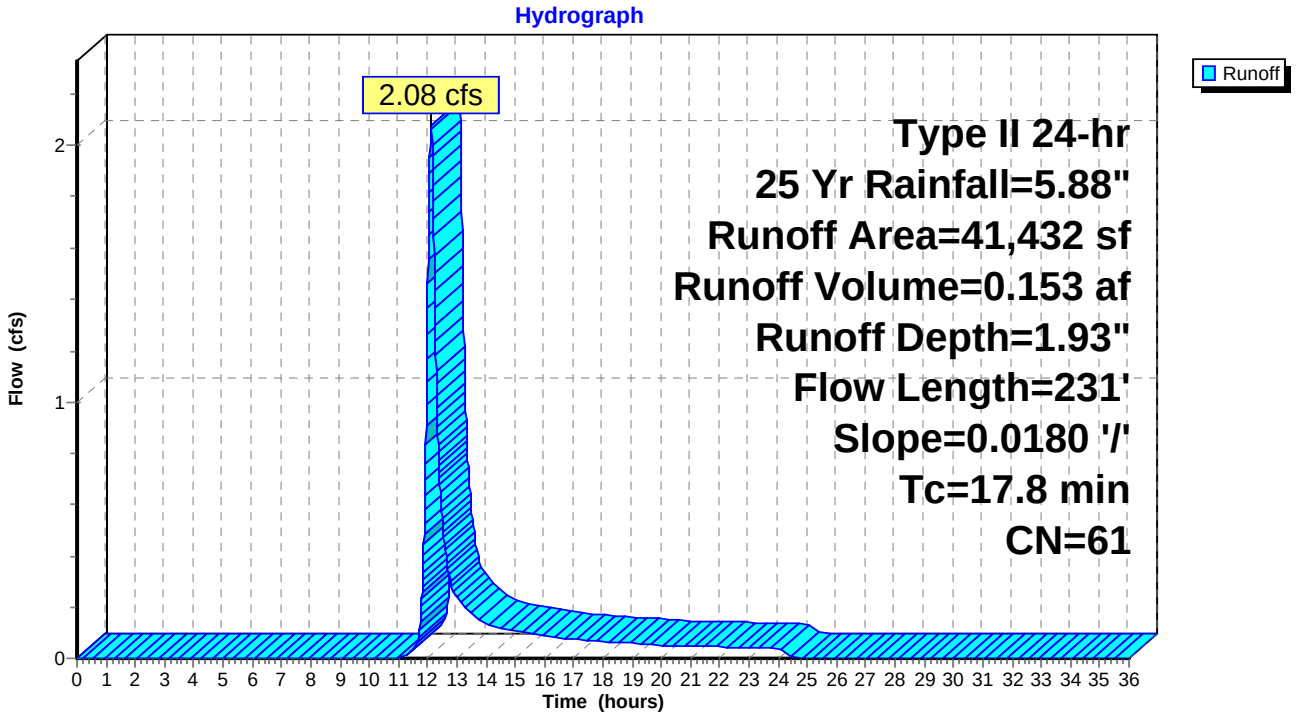
Runoff = 2.08 cfs @ 12.12 hrs, Volume= 0.153 af, Depth= 1.93"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
Type II 24-hr 25 Yr Rainfall=5.88"

Area (sf)	CN	Description
41,432	61	>75% Grass cover, Good, HSG B
41,432		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
15.5	100	0.0180	0.11		**Sheet Flow, Sheet Flow** Grass: Short n= 0.150 P2= 1.39"
2.3	131	0.0180	0.94		**Shallow Concentrated Flow, Shallow Conc.** Short Grass Pasture Kv= 7.0 fps
17.8	231	Total			

Subcatchment S2B10: Subcatchment 2B-10



Summary for Subcatchment S2B11: Subcatchment 2B-11

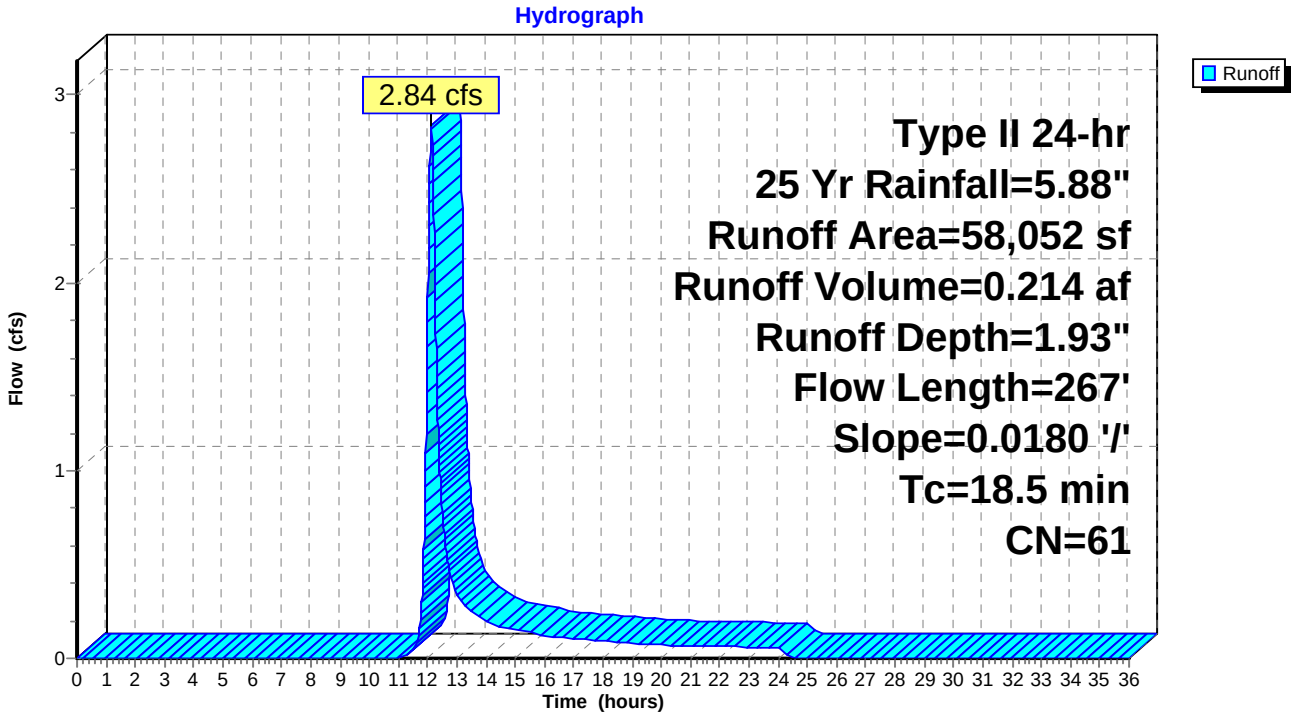
Runoff = 2.84 cfs @ 12.12 hrs, Volume= 0.214 af, Depth= 1.93"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
Type II 24-hr 25 Yr Rainfall=5.88"

Area (sf)	CN	Description
58,052	61	>75% Grass cover, Good, HSG B
58,052		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
15.5	100	0.0180	0.11		**Sheet Flow, Sheet Flow** Grass: Short n= 0.150 P2= 1.39"
3.0	167	0.0180	0.94		**Shallow Concentrated Flow, Shallow Conc.** Short Grass Pasture Kv= 7.0 fps
18.5	267	Total			

Subcatchment S2B11: Subcatchment 2B-11



Summary for Subcatchment S2B12: Subcatchment 2B-12

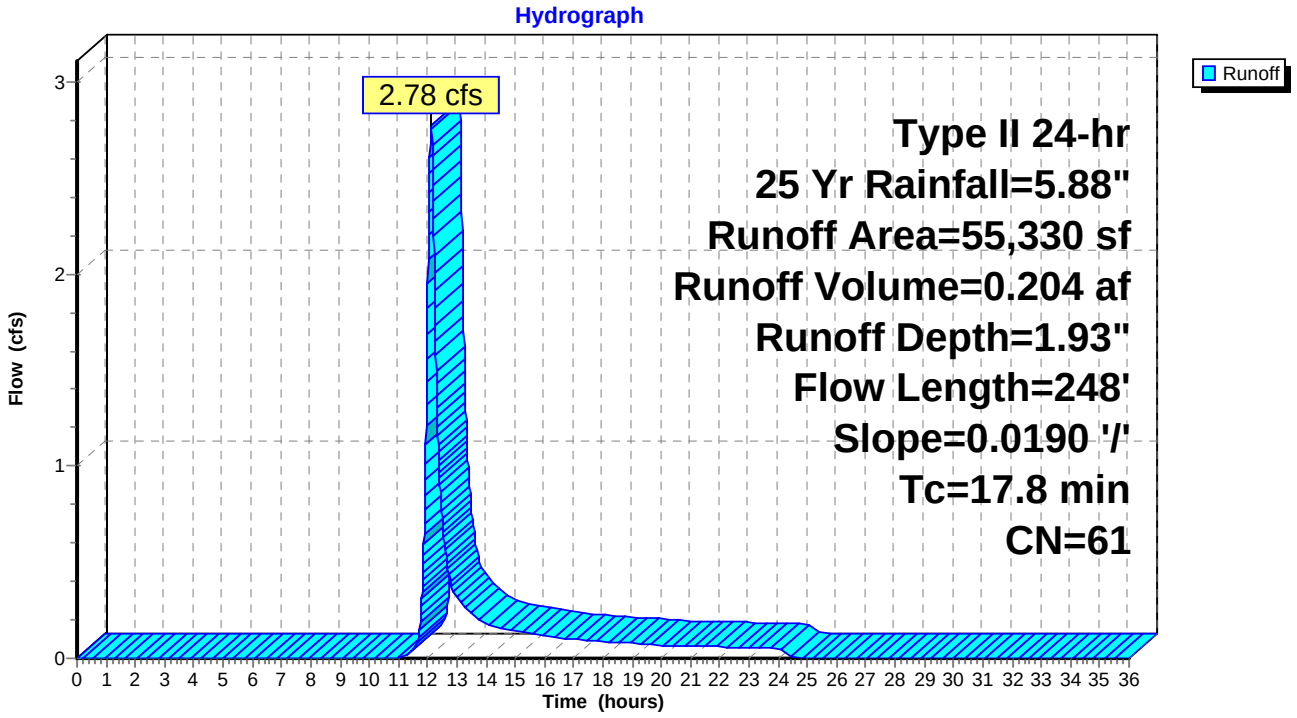
Runoff = 2.78 cfs @ 12.12 hrs, Volume= 0.204 af, Depth= 1.93"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
Type II 24-hr 25 Yr Rainfall=5.88"

Area (sf)	CN	Description
55,330	61	>75% Grass cover, Good, HSG B
55,330		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
15.2	100	0.0190	0.11		**Sheet Flow, Sheet Flow** Grass: Short n= 0.150 P2= 1.39"
2.6	148	0.0190	0.96		**Shallow Concentrated Flow, Shallow Conc.** Short Grass Pasture Kv= 7.0 fps
17.8	248	Total			

Subcatchment S2B12: Subcatchment 2B-12



Summary for Subcatchment S2B13: Subcatchment 2B-13

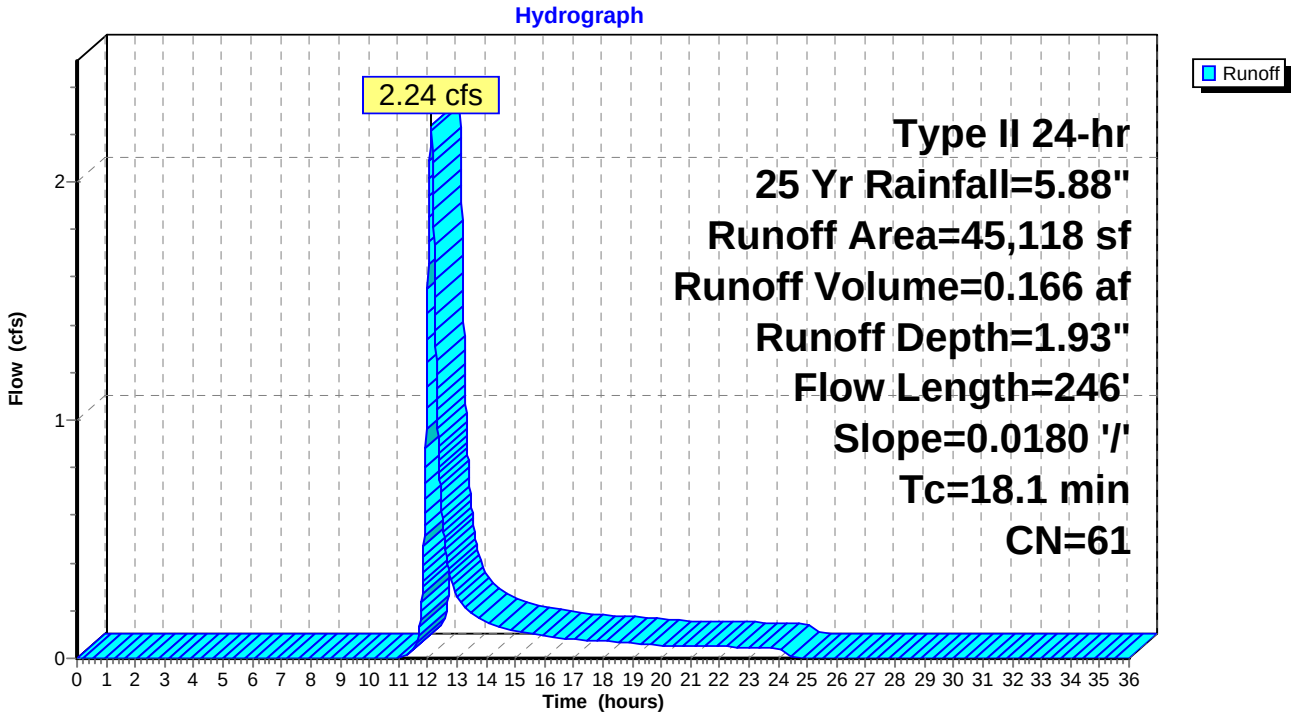
Runoff = 2.24 cfs @ 12.12 hrs, Volume= 0.166 af, Depth= 1.93"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
Type II 24-hr 25 Yr Rainfall=5.88"

Area (sf)	CN	Description
45,118	61	>75% Grass cover, Good, HSG B
45,118		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
15.5	100	0.0180	0.11		**Sheet Flow, Sheet Flow** Grass: Short n= 0.150 P2= 1.39"
2.6	146	0.0180	0.94		**Shallow Concentrated Flow, Shallow Conc.** Short Grass Pasture Kv= 7.0 fps
18.1	246	Total			

Subcatchment S2B13: Subcatchment 2B-13



Summary for Subcatchment S2B2: Subcatchment 2B-2

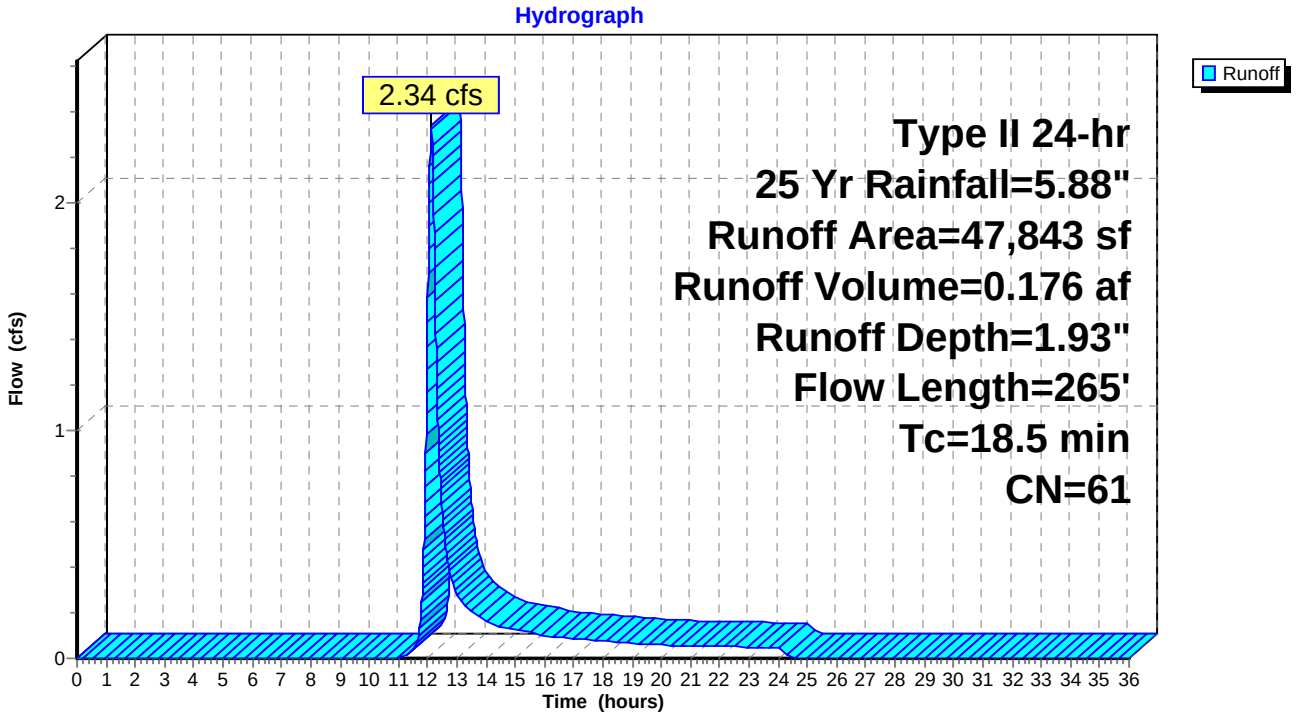
Runoff = 2.34 cfs @ 12.12 hrs, Volume= 0.176 af, Depth= 1.93"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
Type II 24-hr 25 Yr Rainfall=5.88"

Area (sf)	CN	Description
47,843	61	>75% Grass cover, Good, HSG B
47,843		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
15.6	100	0.0178	0.11		**Sheet Flow, Sheet Flow** Grass: Short n= 0.150 P2= 1.39"
2.9	165	0.0179	0.94		**Shallow Concentrated Flow, Shallow Conc.** Short Grass Pasture Kv= 7.0 fps
18.5	265	Total			

Subcatchment S2B2: Subcatchment 2B-2



Summary for Subcatchment S2B3: Subcatchment 2B-3

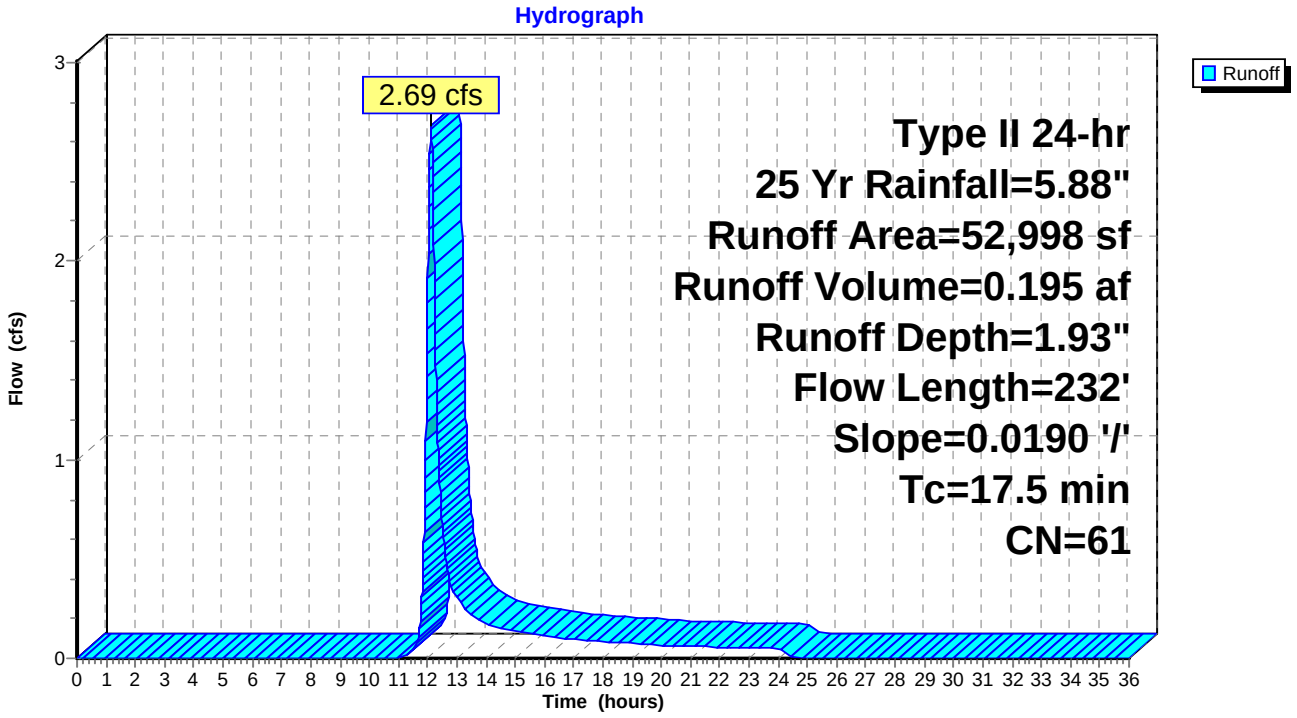
Runoff = 2.69 cfs @ 12.11 hrs, Volume= 0.195 af, Depth= 1.93"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
Type II 24-hr 25 Yr Rainfall=5.88"

Area (sf)	CN	Description
52,998	61	>75% Grass cover, Good, HSG B
52,998		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
15.2	100	0.0190	0.11		**Sheet Flow, Sheet Flow** Grass: Short n= 0.150 P2= 1.39"
2.3	132	0.0190	0.96		**Shallow Concentrated Flow, Shallow Conc.** Short Grass Pasture Kv= 7.0 fps
17.5	232	Total			

Subcatchment S2B3: Subcatchment 2B-3



Summary for Subcatchment S2B4: Subcatchment 2B-4

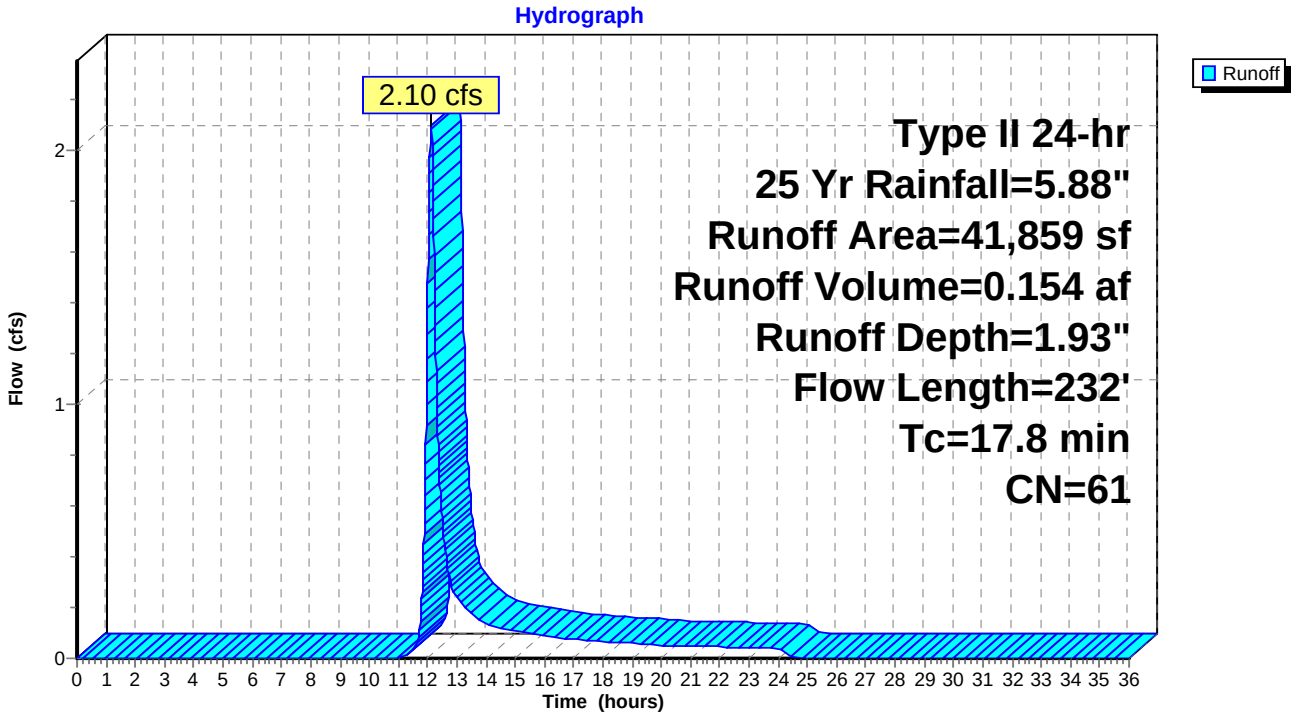
Runoff = 2.10 cfs @ 12.12 hrs, Volume= 0.154 af, Depth= 1.93"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
Type II 24-hr 25 Yr Rainfall=5.88"

Area (sf)	CN	Description
41,859	61	>75% Grass cover, Good, HSG B
41,859		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
15.5	100	0.0179	0.11		**Sheet Flow, Sheet Flow** Grass: Short n= 0.150 P2= 1.39"
2.3	132	0.0190	0.96		**Shallow Concentrated Flow, Shallow Conc.** Short Grass Pasture Kv= 7.0 fps
17.8	232	Total			

Subcatchment S2B4: Subcatchment 2B-4



Summary for Subcatchment S2B5: Subcatchment 2B-5

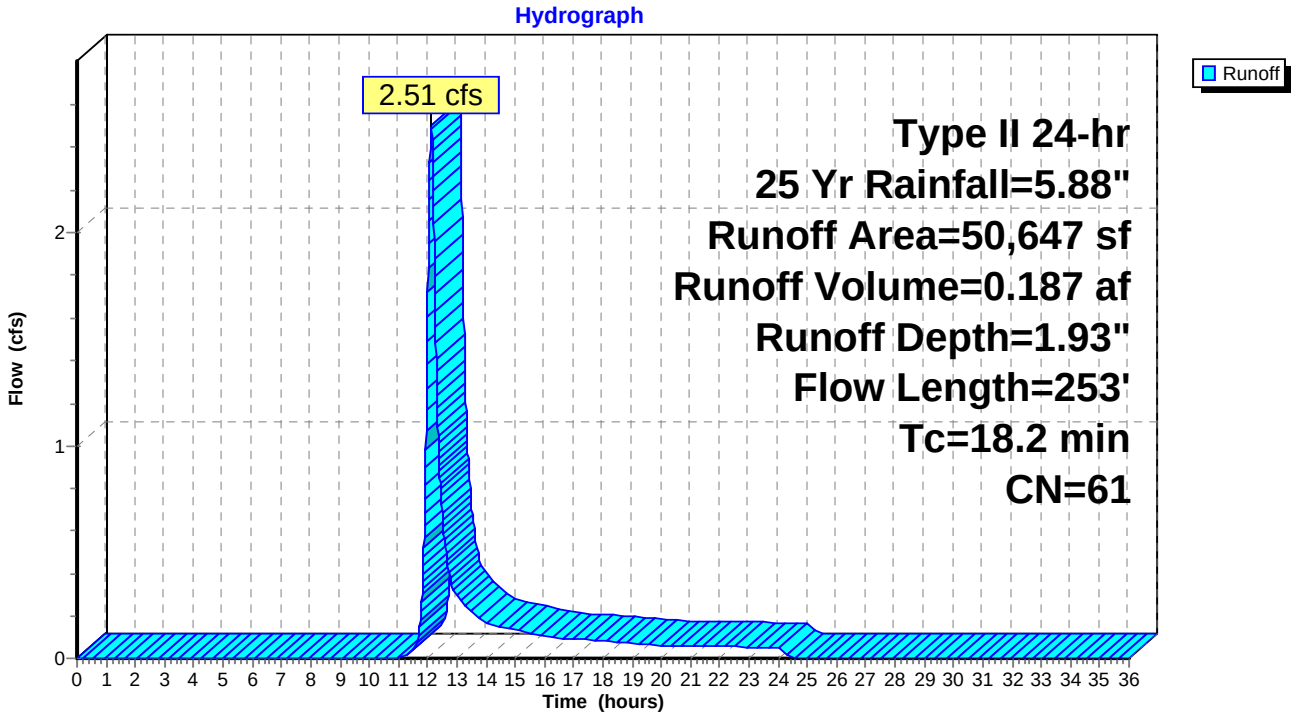
Runoff = 2.51 cfs @ 12.12 hrs, Volume= 0.187 af, Depth= 1.93"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
Type II 24-hr 25 Yr Rainfall=5.88"

Area (sf)	CN	Description
50,647	61	>75% Grass cover, Good, HSG B
50,647		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
15.5	100	0.0180	0.11		**Sheet Flow, Sheet Flow** Grass: Short n= 0.150 P2= 1.39"
2.7	153	0.0179	0.94		**Shallow Concentrated Flow, Shallow Conc.** Short Grass Pasture Kv= 7.0 fps
18.2	253	Total			

Subcatchment S2B5: Subcatchment 2B-5



Summary for Subcatchment S2B6: Subcatchment 2B-6

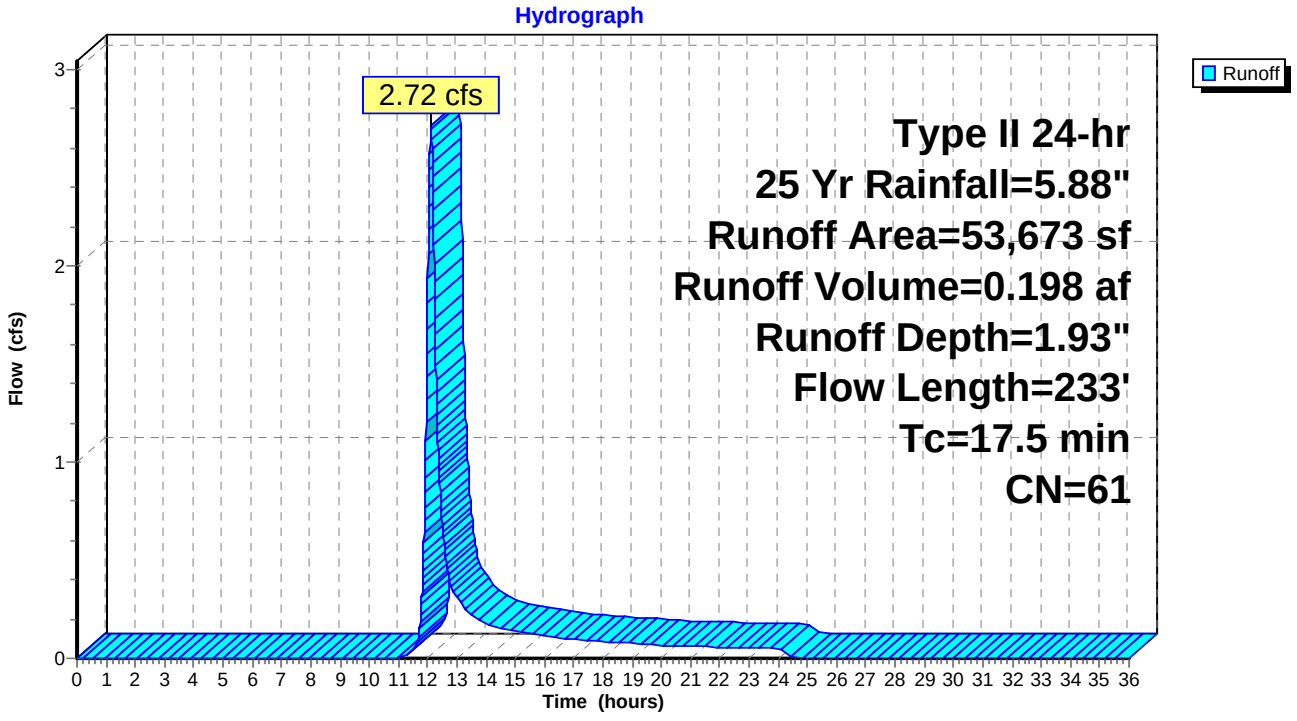
Runoff = 2.72 cfs @ 12.11 hrs, Volume= 0.198 af, Depth= 1.93"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
Type II 24-hr 25 Yr Rainfall=5.88"

Area (sf)	CN	Description
53,673	61	>75% Grass cover, Good, HSG B
53,673		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
15.2	100	0.0190	0.11		**Sheet Flow, Sheet Flow** Grass: Short n= 0.150 P2= 1.39"
2.3	133	0.0188	0.96		**Shallow Concentrated Flow, Shallow Conc.** Short Grass Pasture Kv= 7.0 fps
17.5	233	Total			

Subcatchment S2B6: Subcatchment 2B-6



Summary for Subcatchment S2B7: Subcatchment 2B-7

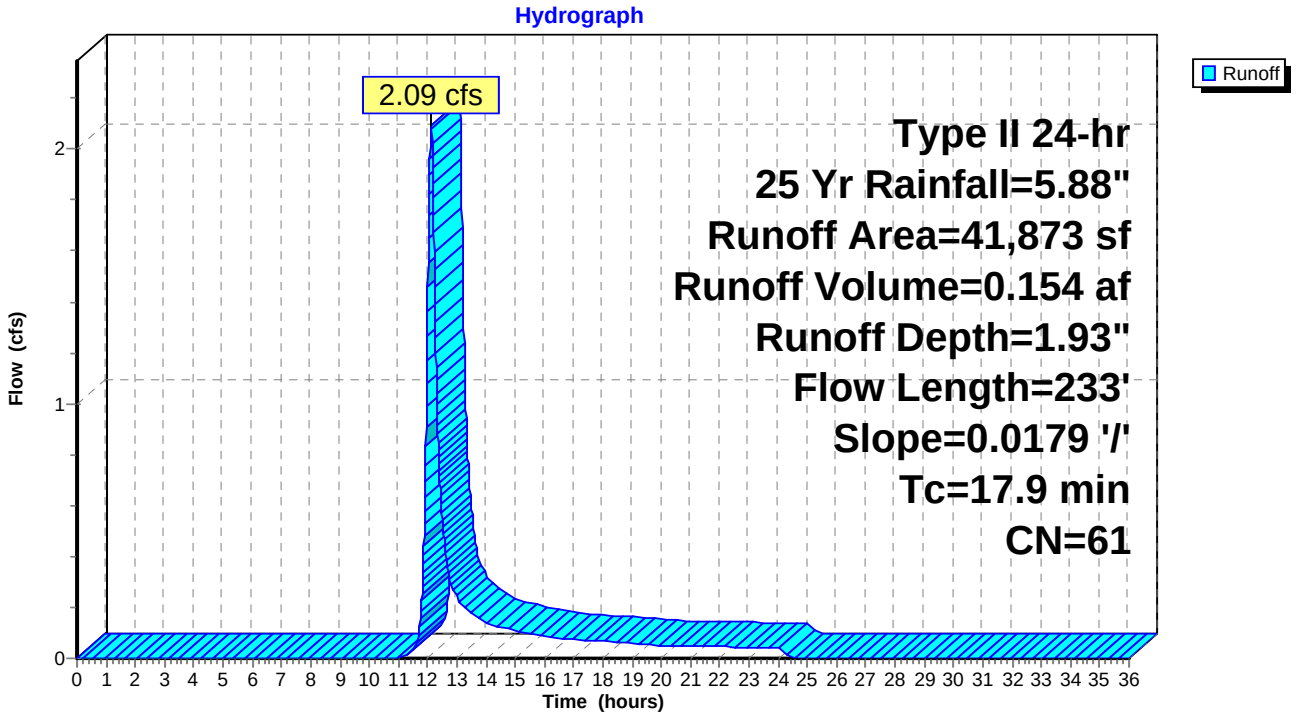
Runoff = 2.09 cfs @ 12.11 hrs, Volume= 0.154 af, Depth= 1.93"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
Type II 24-hr 25 Yr Rainfall=5.88"

Area (sf)	CN	Description
41,873	61	>75% Grass cover, Good, HSG B
41,873		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
15.5	100	0.0179	0.11		**Sheet Flow, Sheet Flow** Grass: Short n= 0.150 P2= 1.39"
2.4	133	0.0179	0.94		**Shallow Concentrated Flow, Shallow Conc.** Short Grass Pasture Kv= 7.0 fps
17.9	233	Total			

Subcatchment S2B7: Subcatchment 2B-7



Summary for Subcatchment S2B8: Subcatchment 2B-8

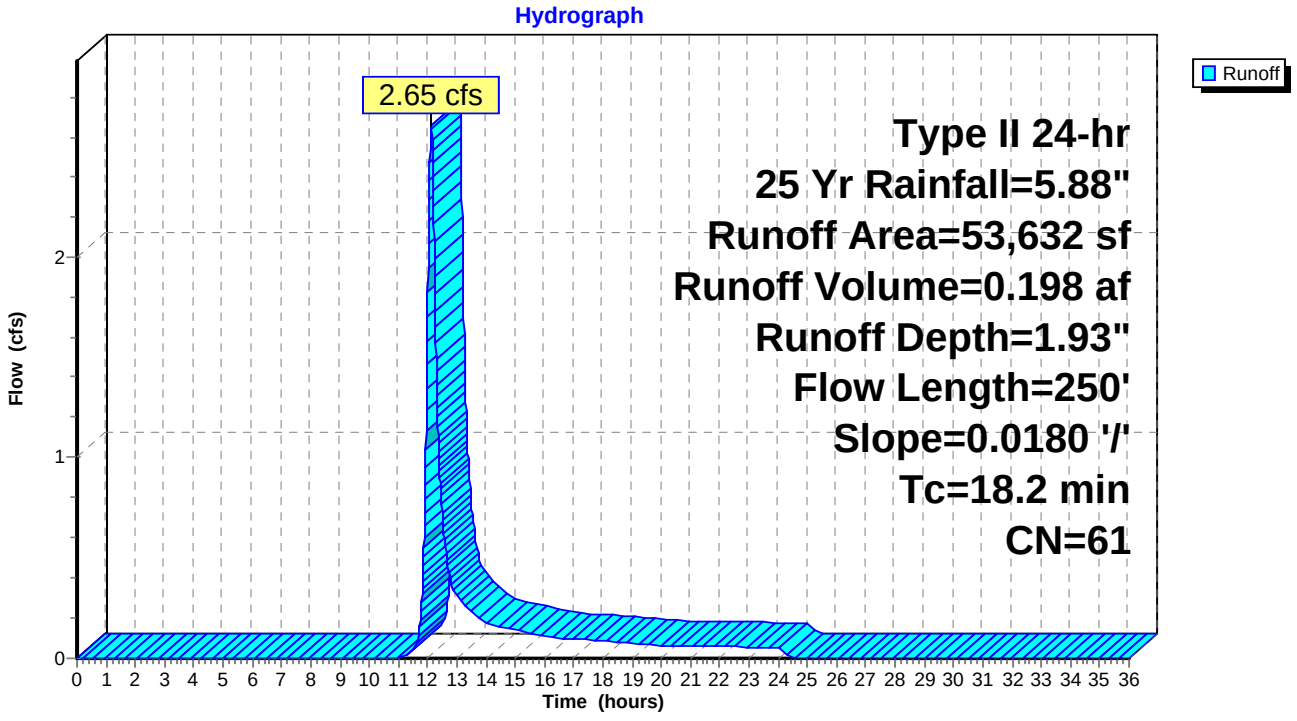
Runoff = 2.65 cfs @ 12.12 hrs, Volume= 0.198 af, Depth= 1.93"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
Type II 24-hr 25 Yr Rainfall=5.88"

Area (sf)	CN	Description
53,632	61	>75% Grass cover, Good, HSG B
53,632		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
15.5	100	0.0180	0.11		**Sheet Flow, Sheet Flow** Grass: Short n= 0.150 P2= 1.39"
2.7	150	0.0180	0.94		**Shallow Concentrated Flow, Shallow Conc.** Short Grass Pasture Kv= 7.0 fps
18.2	250	Total			

Subcatchment S2B8: Subcatchment 2B-8



Summary for Subcatchment S2B9: Subcatchment 2B-9

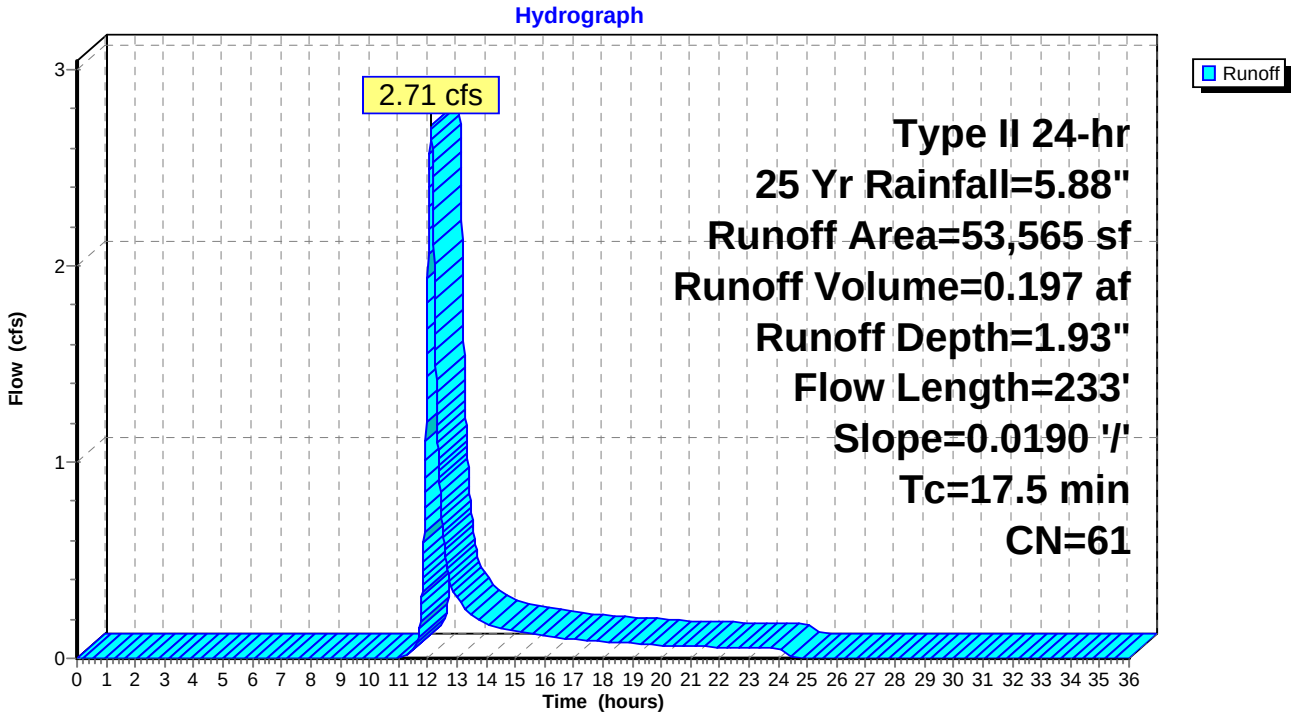
Runoff = 2.71 cfs @ 12.11 hrs, Volume= 0.197 af, Depth= 1.93"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
Type II 24-hr 25 Yr Rainfall=5.88"

Area (sf)	CN	Description
53,565	61	>75% Grass cover, Good, HSG B
53,565		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
15.2	100	0.0190	0.11		**Sheet Flow, Sheet Flow** Grass: Short n= 0.150 P2= 1.39"
2.3	133	0.0190	0.96		**Shallow Concentrated Flow, Shallow Conc.** Short Grass Pasture Kv= 7.0 fps
17.5	233	Total			

Subcatchment S2B9: Subcatchment 2B-9



Summary for Subcatchment S2C: Subcatchment 2C

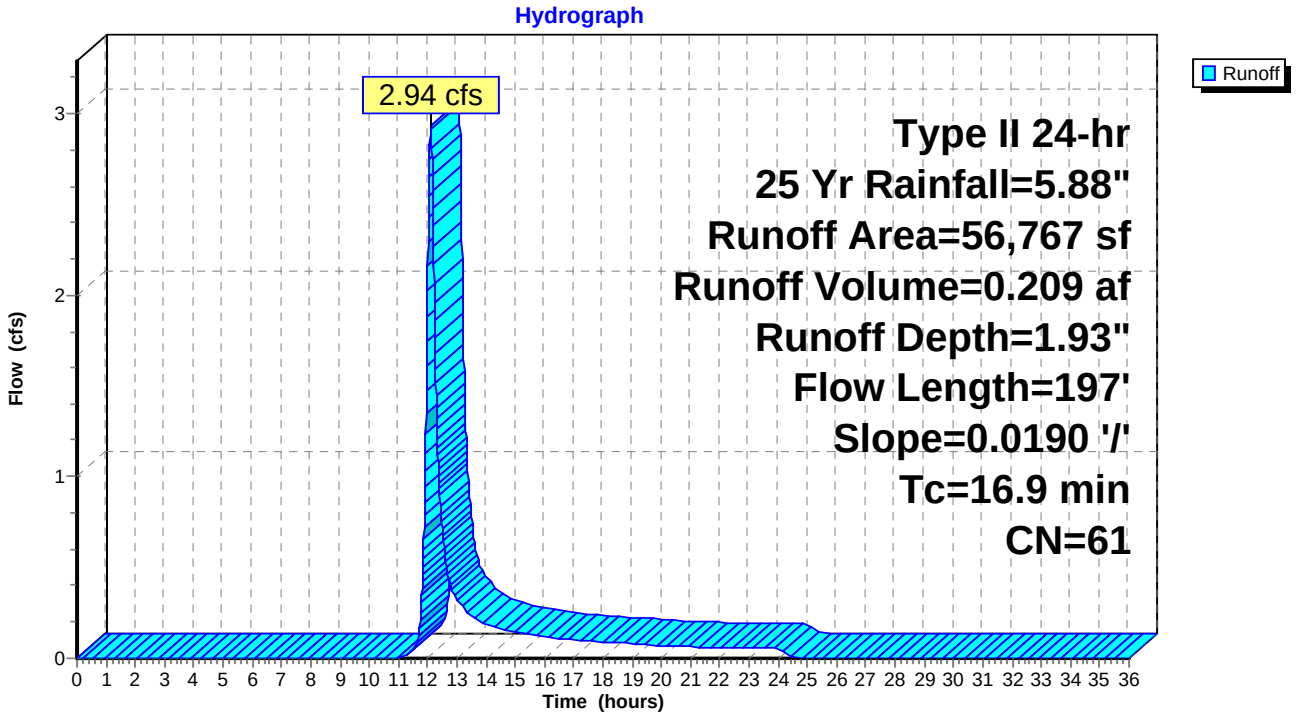
Runoff = 2.94 cfs @ 12.11 hrs, Volume= 0.209 af, Depth= 1.93"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
Type II 24-hr 25 Yr Rainfall=5.88"

Area (sf)	CN	Description
56,767	61	>75% Grass cover, Good, HSG B
56,767		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
15.2	100	0.0190	0.11		**Sheet Flow, Sheet Flow** Grass: Short n= 0.150 P2= 1.39"
1.7	97	0.0190	0.96		**Shallow Concentrated Flow, Shallow Conc.** Short Grass Pasture Kv= 7.0 fps
16.9	197	Total			

Subcatchment S2C: Subcatchment 2C



Summary for Subcatchment S3A1: Subcatchment 3A-1

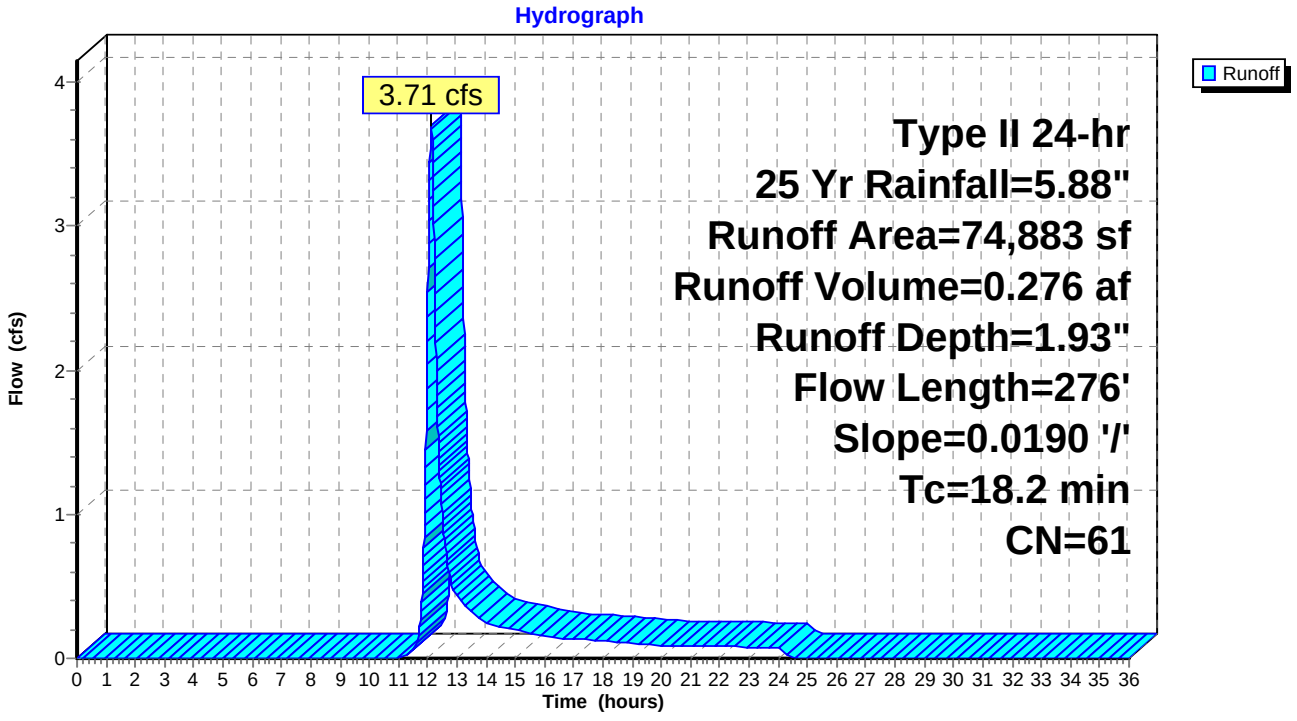
Runoff = 3.71 cfs @ 12.12 hrs, Volume= 0.276 af, Depth= 1.93"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
Type II 24-hr 25 Yr Rainfall=5.88"

Area (sf)	CN	Description
74,883	61	>75% Grass cover, Good, HSG B
74,883		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
15.2	100	0.0190	0.11		**Sheet Flow, Sheet Flow** Grass: Short n= 0.150 P2= 1.39"
3.0	176	0.0190	0.96		**Shallow Concentrated Flow, Shallow Conc.** Short Grass Pasture Kv= 7.0 fps
18.2	276	Total			

Subcatchment S3A1: Subcatchment 3A-1



Summary for Subcatchment S3A2: Subcatchment 3A-2

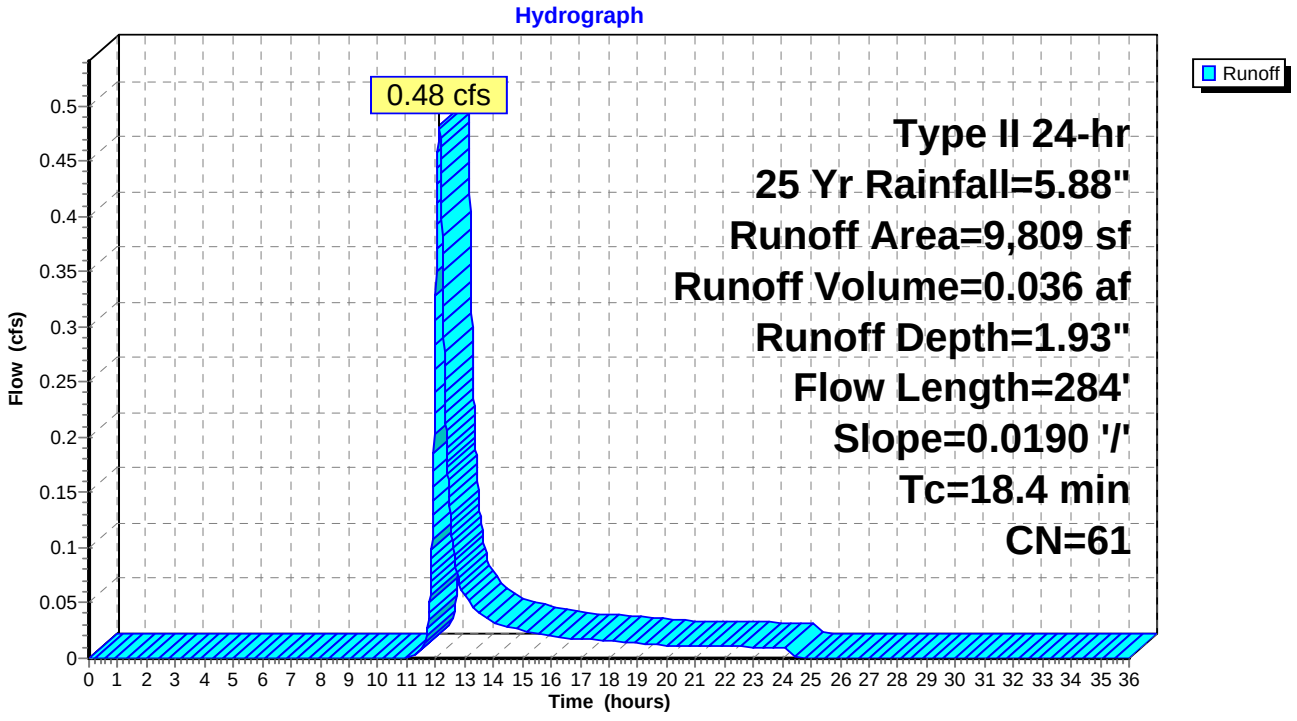
Runoff = 0.48 cfs @ 12.12 hrs, Volume= 0.036 af, Depth= 1.93"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
Type II 24-hr 25 Yr Rainfall=5.88"

Area (sf)	CN	Description
9,809	61	>75% Grass cover, Good, HSG B
9,809		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
15.2	100	0.0190	0.11		**Sheet Flow, Sheet Flow** Grass: Short n= 0.150 P2= 1.39"
3.2	184	0.0190	0.96		**Shallow Concentrated Flow, Shallow Conc.** Short Grass Pasture Kv= 7.0 fps
18.4	284	Total			

Subcatchment S3A2: Subcatchment 3A-2



Summary for Subcatchment S3A3: Subcatchment 3A-3

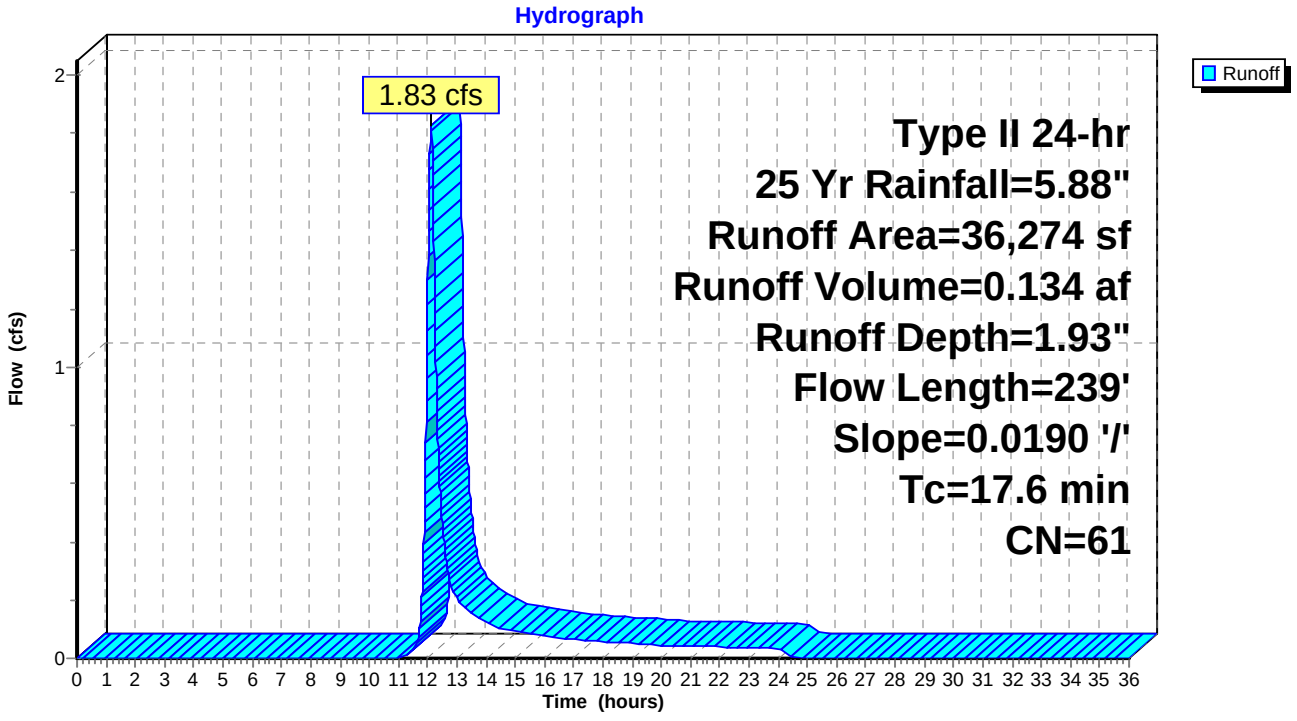
Runoff = 1.83 cfs @ 12.11 hrs, Volume= 0.134 af, Depth= 1.93"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
Type II 24-hr 25 Yr Rainfall=5.88"

Area (sf)	CN	Description
36,274	61	>75% Grass cover, Good, HSG B
36,274		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
15.2	100	0.0190	0.11		**Sheet Flow, Sheet Flow** Grass: Short n= 0.150 P2= 1.39"
2.4	139	0.0190	0.96		**Shallow Concentrated Flow, Shallow Conc.** Short Grass Pasture Kv= 7.0 fps
17.6	239	Total			

Subcatchment S3A3: Subcatchment 3A-3



Summary for Subcatchment S3B1: Subcatchment 3B-1

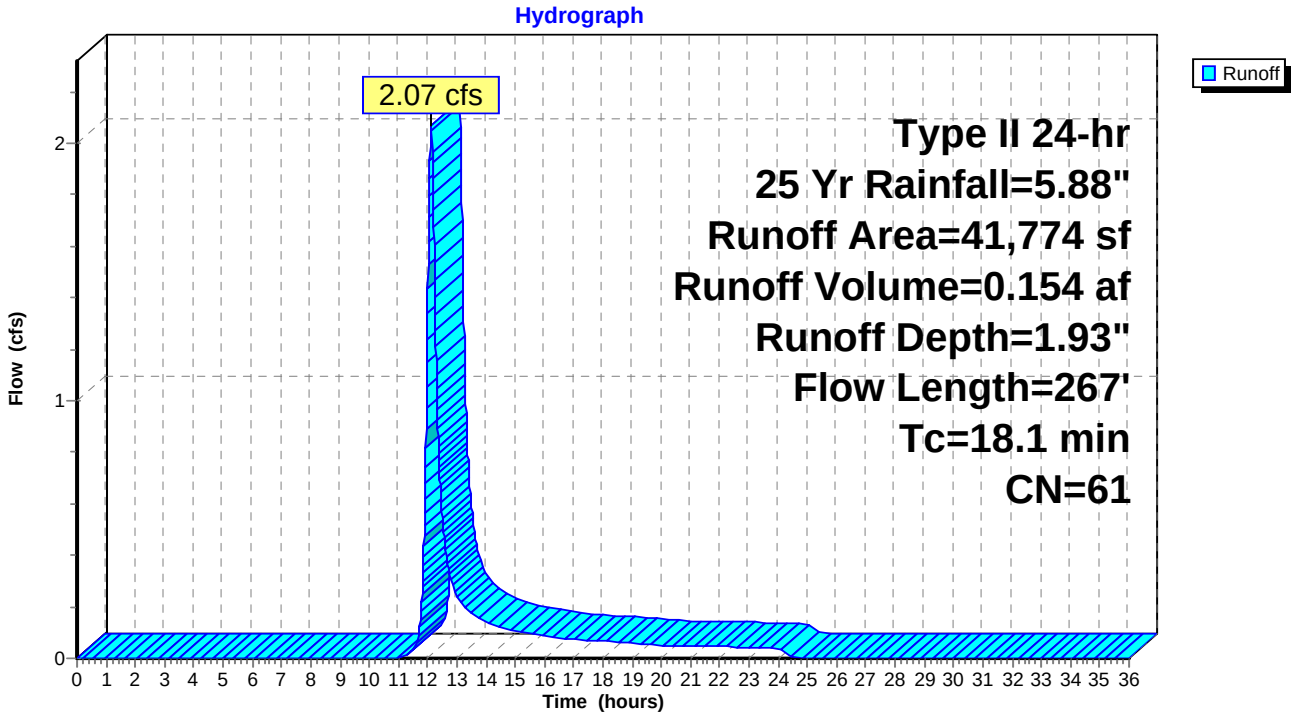
Runoff = 2.07 cfs @ 12.12 hrs, Volume= 0.154 af, Depth= 1.93"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
Type II 24-hr 25 Yr Rainfall=5.88"

Area (sf)	CN	Description
41,774	61	>75% Grass cover, Good, HSG B
41,774		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
15.2	100	0.0188	0.11		**Sheet Flow, Sheet Flow** Grass: Short n= 0.150 P2= 1.39"
2.9	167	0.0186	0.95		**Shallow Concentrated Flow, Shallow Conc.** Short Grass Pasture Kv= 7.0 fps
18.1	267	Total			

Subcatchment S3B1: Subcatchment 3B-1



Summary for Subcatchment S3B10: Subcatchment 3B-10

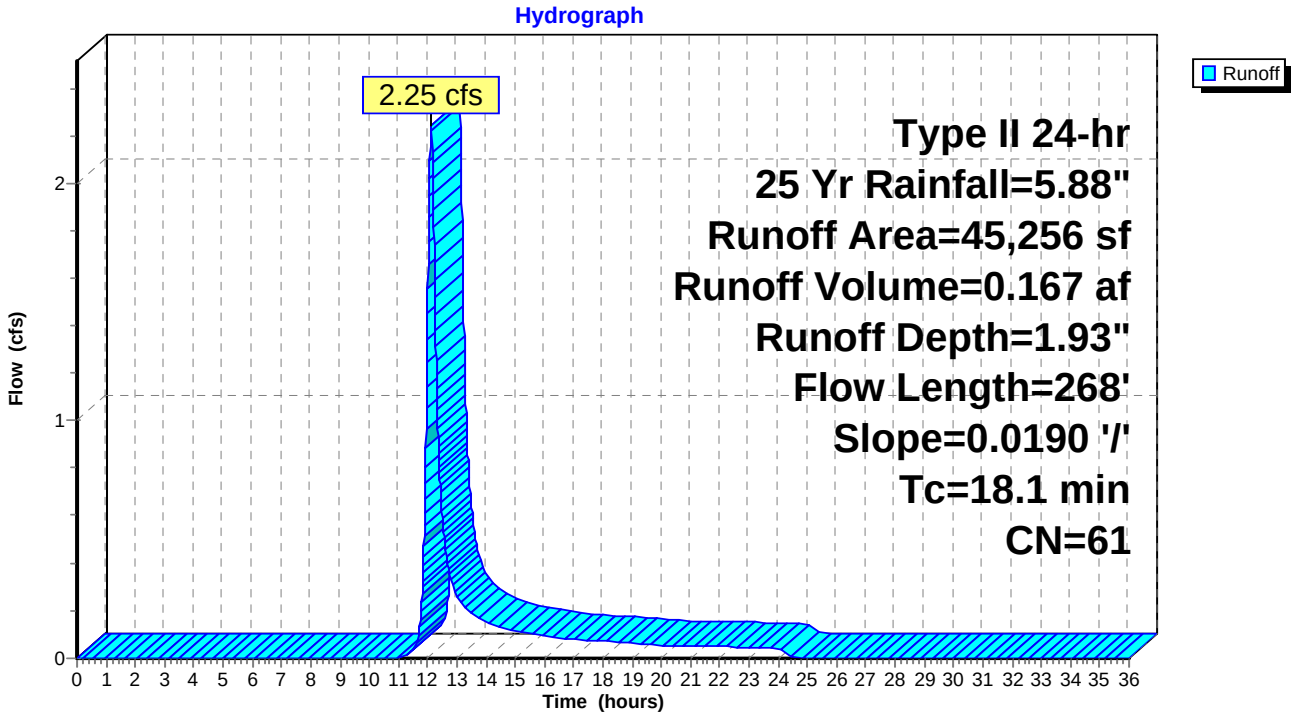
Runoff = 2.25 cfs @ 12.12 hrs, Volume= 0.167 af, Depth= 1.93"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
Type II 24-hr 25 Yr Rainfall=5.88"

Area (sf)	CN	Description
45,256	61	>75% Grass cover, Good, HSG B
45,256		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
15.2	100	0.0190	0.11		**Sheet Flow, Sheet Flow** Grass: Short n= 0.150 P2= 1.39"
2.9	168	0.0190	0.96		**Shallow Concentrated Flow, Shallow Conc.** Short Grass Pasture Kv= 7.0 fps
18.1	268	Total			

Subcatchment S3B10: Subcatchment 3B-10



Summary for Subcatchment S3B2: Subcatchment 3B-2

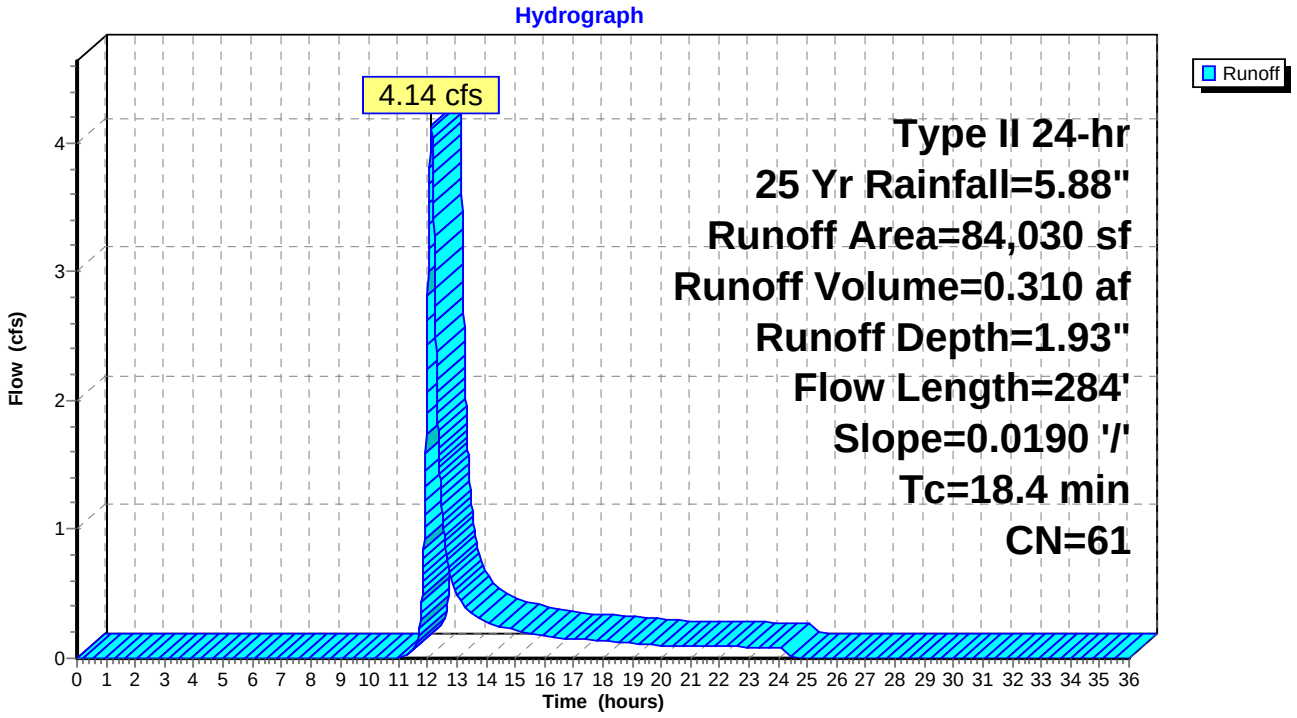
Runoff = 4.14 cfs @ 12.12 hrs, Volume= 0.310 af, Depth= 1.93"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
Type II 24-hr 25 Yr Rainfall=5.88"

Area (sf)	CN	Description
84,030	61	>75% Grass cover, Good, HSG B
84,030		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
15.2	100	0.0190	0.11		**Sheet Flow, Sheet Flow** Grass: Short n= 0.150 P2= 1.39"
3.2	184	0.0190	0.96		**Shallow Concentrated Flow, Shallow Conc.** Short Grass Pasture Kv= 7.0 fps
18.4	284	Total			

Subcatchment S3B2: Subcatchment 3B-2



Summary for Subcatchment S3B3: Subcatchment 3B-3

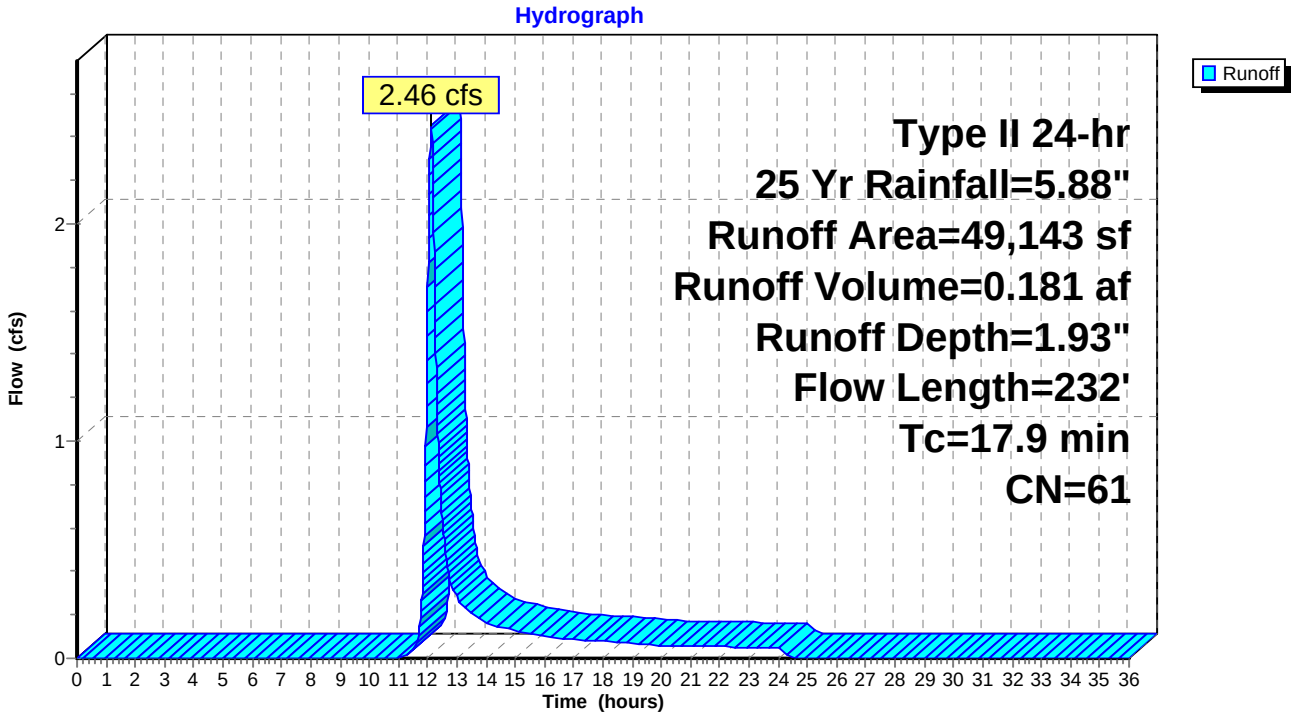
Runoff = 2.46 cfs @ 12.11 hrs, Volume= 0.181 af, Depth= 1.93"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
Type II 24-hr 25 Yr Rainfall=5.88"

Area (sf)	CN	Description
49,143	61	>75% Grass cover, Good, HSG B
49,143		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
15.5	100	0.0180	0.11		**Sheet Flow, Sheet Flow** Grass: Short n= 0.150 P2= 1.39"
2.4	132	0.0175	0.93		**Shallow Concentrated Flow, Shallow Conc.** Short Grass Pasture Kv= 7.0 fps
17.9	232	Total			

Subcatchment S3B3: Subcatchment 3B-3



Summary for Subcatchment S3B4: Subcatchment 3B-4

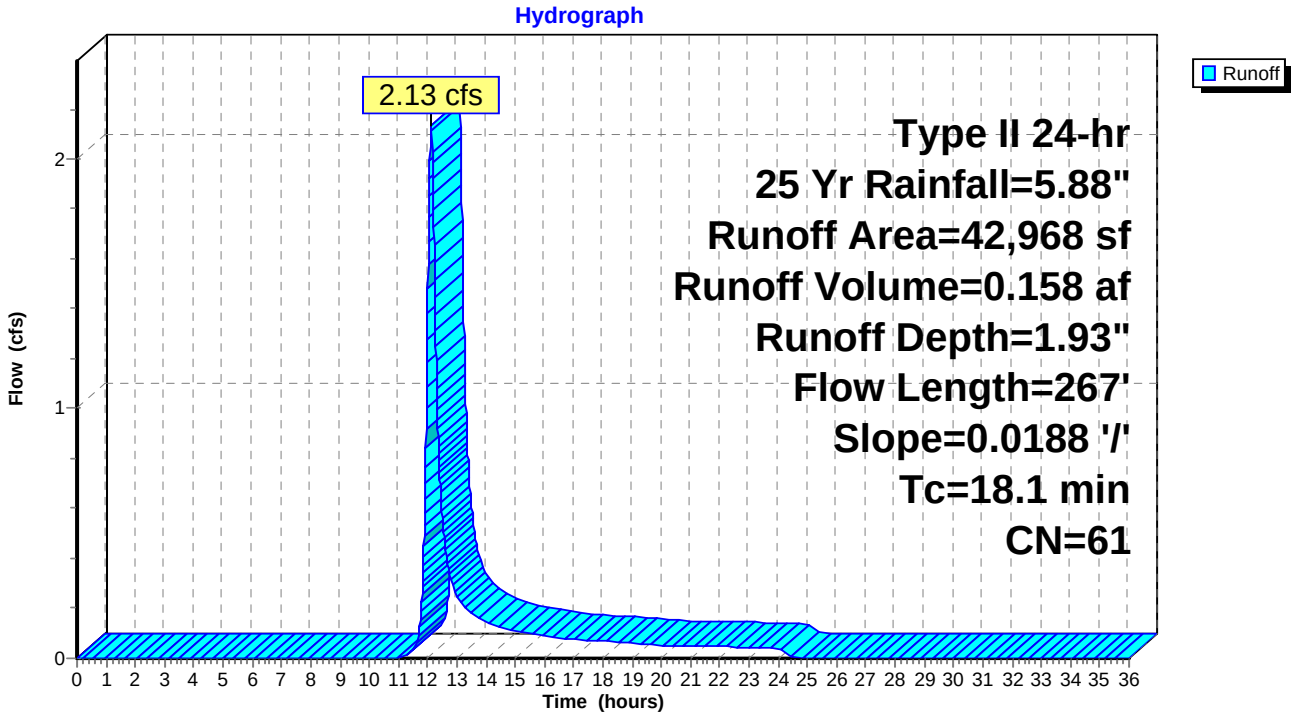
Runoff = 2.13 cfs @ 12.12 hrs, Volume= 0.158 af, Depth= 1.93"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
Type II 24-hr 25 Yr Rainfall=5.88"

Area (sf)	CN	Description
42,968	61	>75% Grass cover, Good, HSG B
42,968		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
15.2	100	0.0188	0.11		**Sheet Flow, Sheet Flow** Grass: Short n= 0.150 P2= 1.39"
2.9	167	0.0188	0.96		**Shallow Concentrated Flow, Shallow Conc.** Short Grass Pasture Kv= 7.0 fps
18.1	267	Total			

Subcatchment S3B4: Subcatchment 3B-4



Summary for Subcatchment S3B5: Subcatchment 3B-5

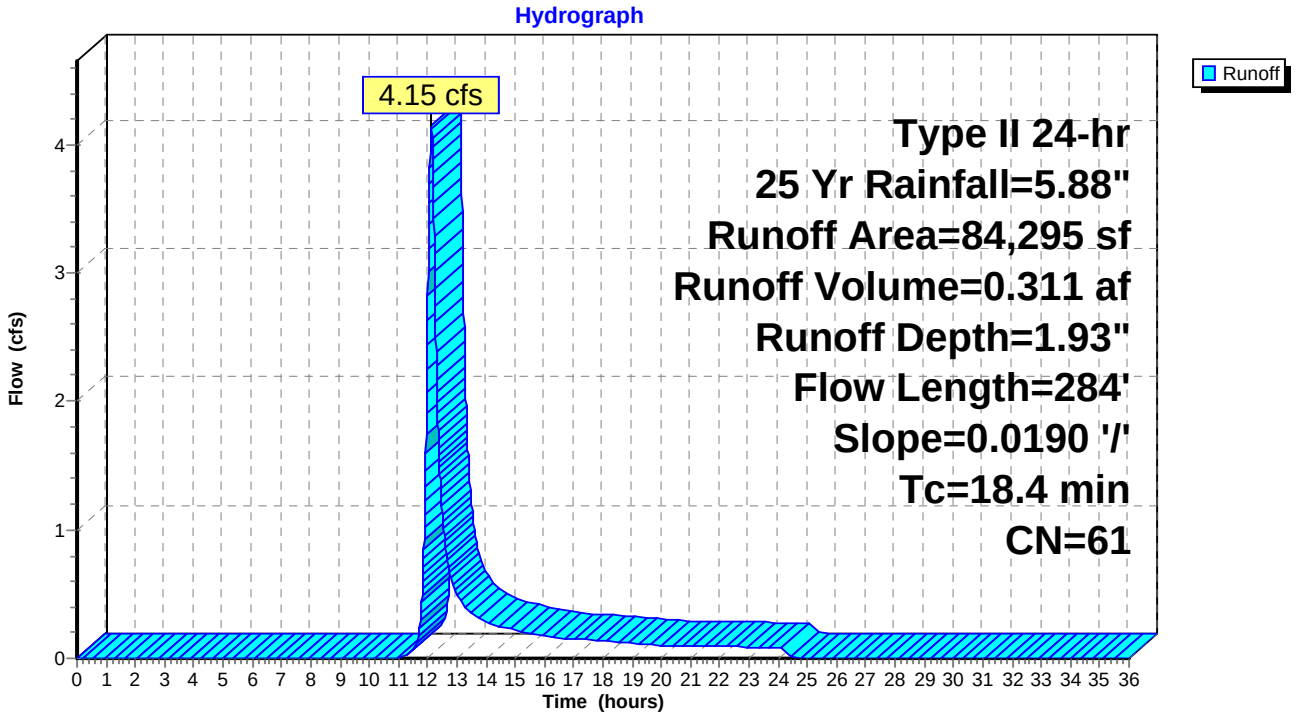
Runoff = 4.15 cfs @ 12.12 hrs, Volume= 0.311 af, Depth= 1.93"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
Type II 24-hr 25 Yr Rainfall=5.88"

Area (sf)	CN	Description
84,295	61	>75% Grass cover, Good, HSG B
84,295		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
15.2	100	0.0190	0.11		**Sheet Flow, Sheet Flow** Grass: Short n= 0.150 P2= 1.39"
3.2	184	0.0190	0.96		**Shallow Concentrated Flow, Shallow Conc.** Short Grass Pasture Kv= 7.0 fps
18.4	284	Total			

Subcatchment S3B5: Subcatchment 3B-5



Summary for Subcatchment S3B6: Subcatchment 3B-6

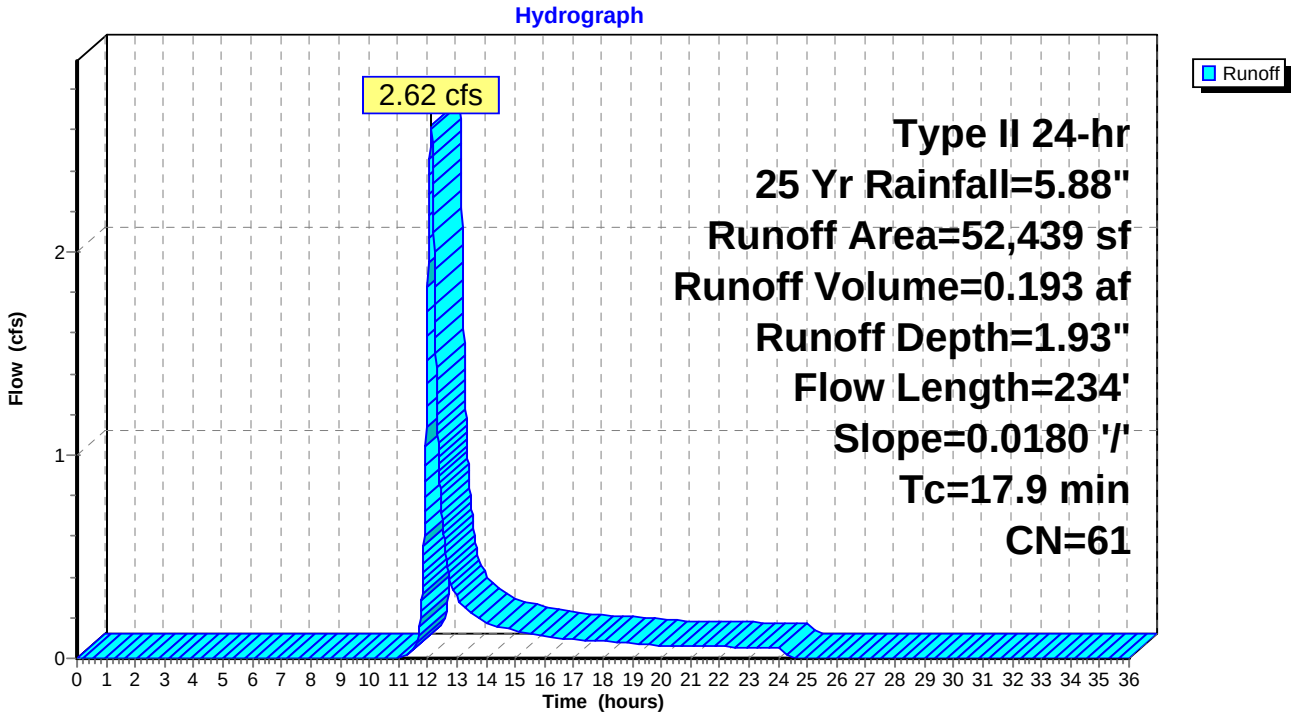
Runoff = 2.62 cfs @ 12.11 hrs, Volume= 0.193 af, Depth= 1.93"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
Type II 24-hr 25 Yr Rainfall=5.88"

Area (sf)	CN	Description
52,439	61	>75% Grass cover, Good, HSG B
52,439		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
15.5	100	0.0180	0.11		**Sheet Flow, Sheet Flow** Grass: Short n= 0.150 P2= 1.39"
2.4	134	0.0180	0.94		**Shallow Concentrated Flow, Shallow Conc.** Short Grass Pasture Kv= 7.0 fps
17.9	234	Total			

Subcatchment S3B6: Subcatchment 3B-6



Summary for Subcatchment S3B7: Subcatchment 3B-7

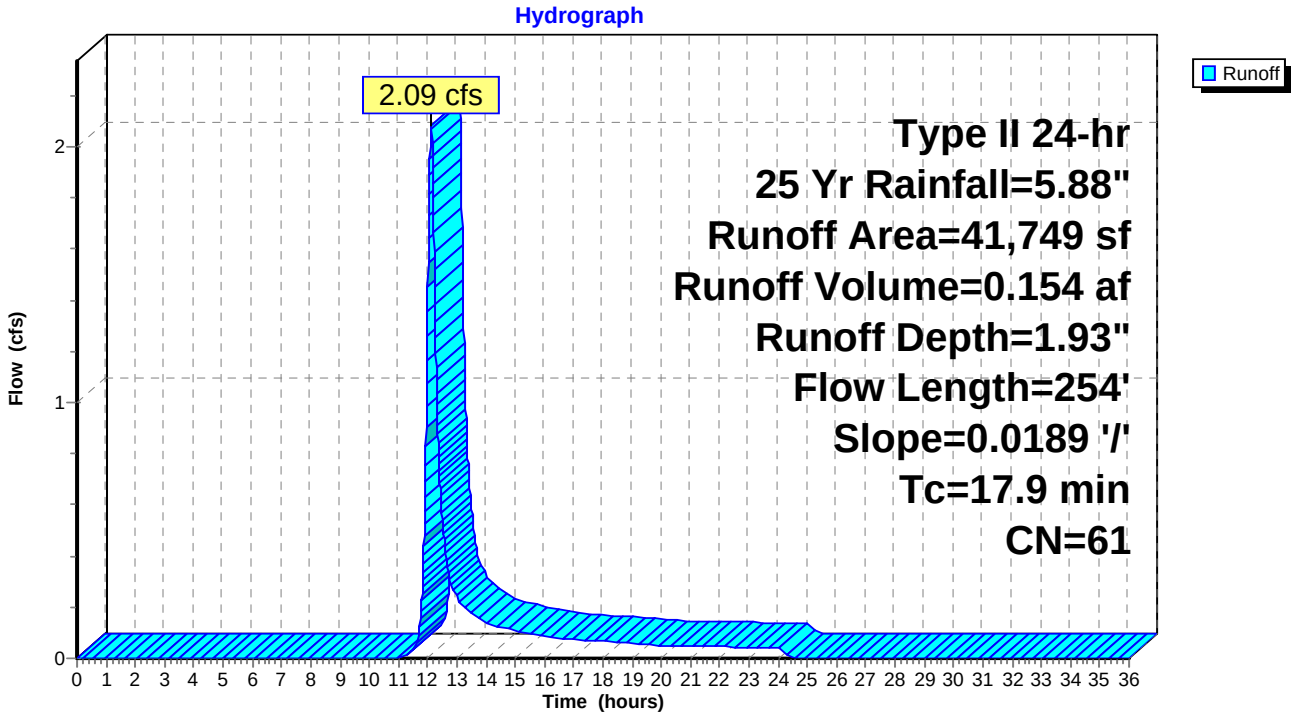
Runoff = 2.09 cfs @ 12.11 hrs, Volume= 0.154 af, Depth= 1.93"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
Type II 24-hr 25 Yr Rainfall=5.88"

Area (sf)	CN	Description
41,749	61	>75% Grass cover, Good, HSG B
41,749		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
15.2	100	0.0189	0.11		**Sheet Flow, Sheet Flow** Grass: Short n= 0.150 P2= 1.39"
2.7	154	0.0189	0.96		**Shallow Concentrated Flow, Shallow Conc.** Short Grass Pasture Kv= 7.0 fps
17.9	254	Total			

Subcatchment S3B7: Subcatchment 3B-7



Summary for Subcatchment S3B8: Subcatchment 3B-8

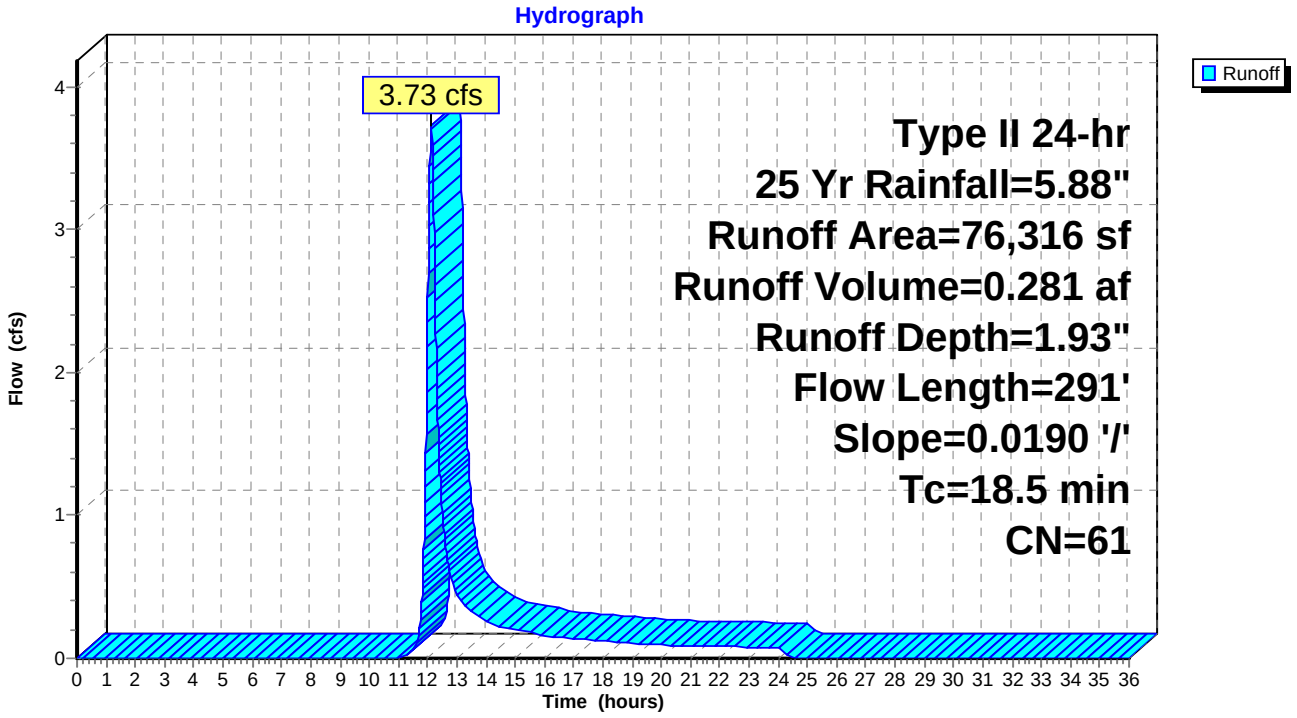
Runoff = 3.73 cfs @ 12.12 hrs, Volume= 0.281 af, Depth= 1.93"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
Type II 24-hr 25 Yr Rainfall=5.88"

Area (sf)	CN	Description
76,316	61	>75% Grass cover, Good, HSG B
76,316		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
15.2	100	0.0190	0.11		**Sheet Flow, Sheet Flow** Grass: Short n= 0.150 P2= 1.39"
3.3	191	0.0190	0.96		**Shallow Concentrated Flow, Shallow Conc.** Short Grass Pasture Kv= 7.0 fps
18.5	291	Total			

Subcatchment S3B8: Subcatchment 3B-8



Summary for Subcatchment S3B9: Subcatchment 3B-9

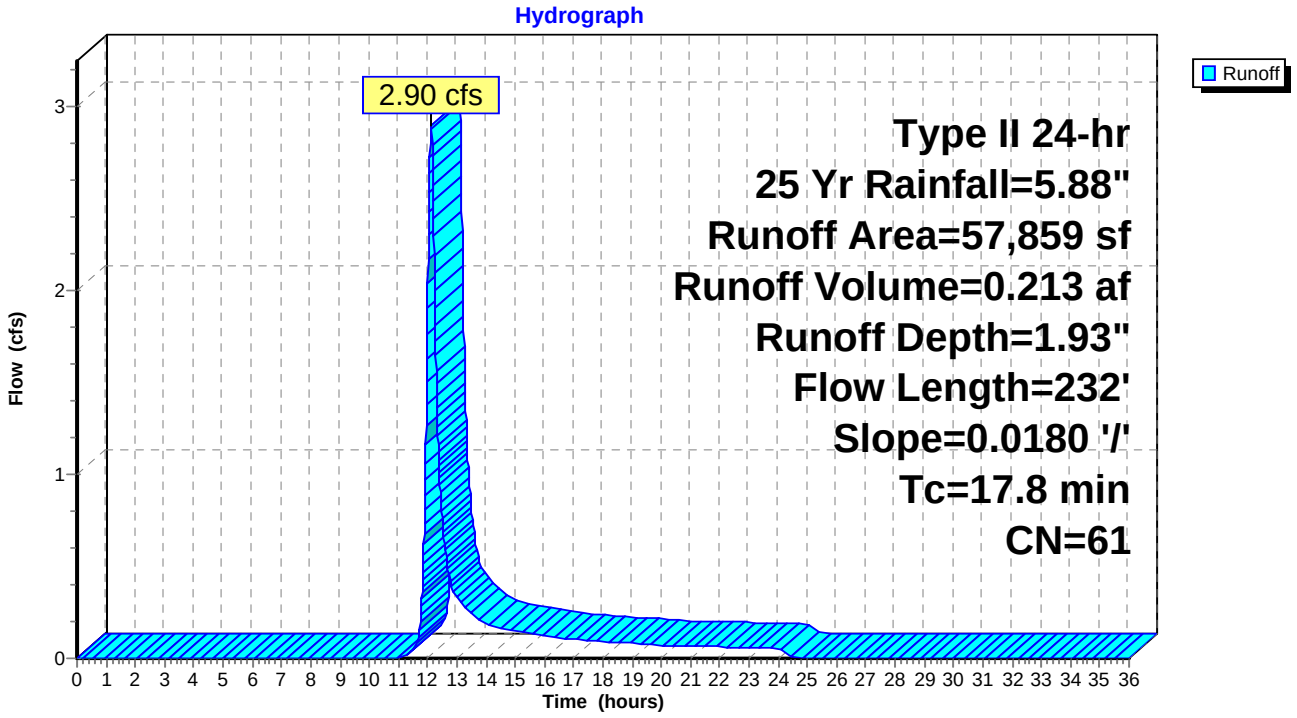
Runoff = 2.90 cfs @ 12.12 hrs, Volume= 0.213 af, Depth= 1.93"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
Type II 24-hr 25 Yr Rainfall=5.88"

Area (sf)	CN	Description
57,859	61	>75% Grass cover, Good, HSG B
57,859		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
15.5	100	0.0180	0.11		**Sheet Flow, Sheet Flow** Grass: Short n= 0.150 P2= 1.39"
2.3	132	0.0180	0.94		**Shallow Concentrated Flow, Shallow Conc.** Short Grass Pasture Kv= 7.0 fps
17.8	232	Total			

Subcatchment S3B9: Subcatchment 3B-9



Summary for Subcatchment S3C: Subcatchment 3C

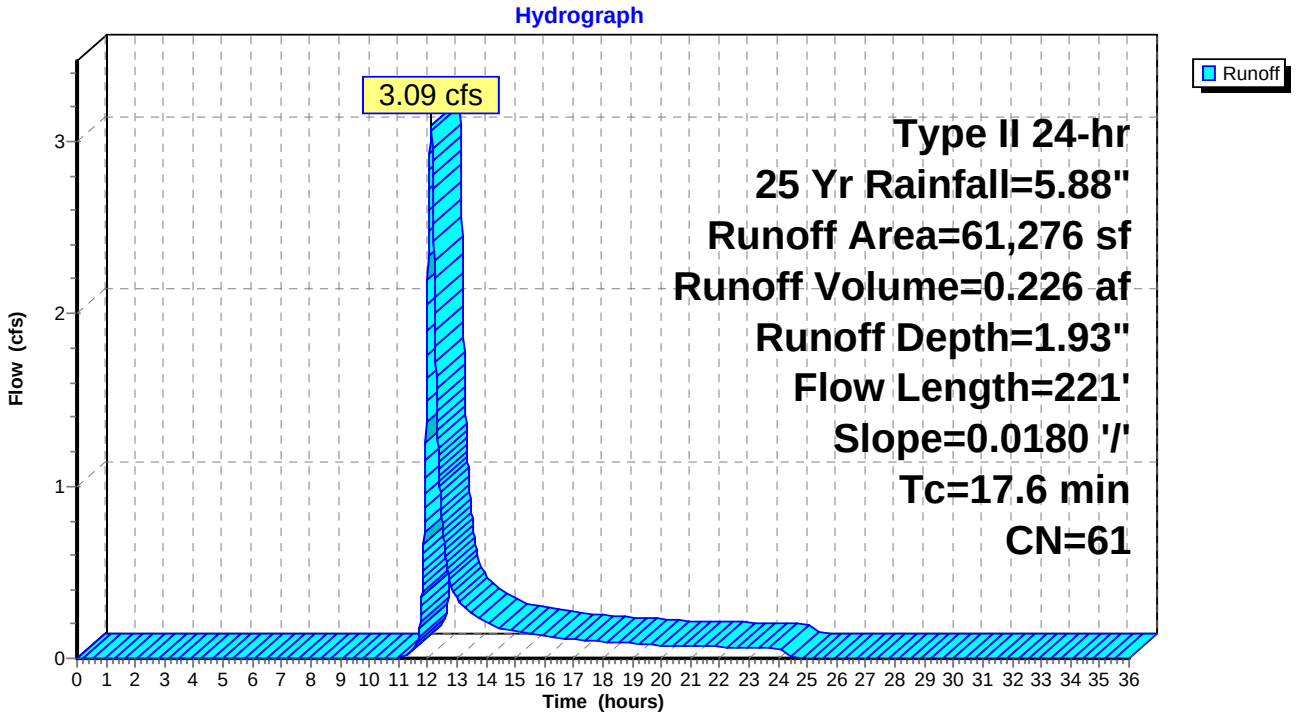
Runoff = 3.09 cfs @ 12.11 hrs, Volume= 0.226 af, Depth= 1.93"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
Type II 24-hr 25 Yr Rainfall=5.88"

Area (sf)	CN	Description
61,276	61	>75% Grass cover, Good, HSG B
61,276		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
15.5	100	0.0180	0.11		**Sheet Flow, Sheet Flow** Grass: Short n= 0.150 P2= 1.39"
2.1	121	0.0180	0.94		**Shallow Concentrated Flow, Shallow Conc.** Short Grass Pasture Kv= 7.0 fps
17.6	221	Total			

Subcatchment S3C: Subcatchment 3C



Summary for Subcatchment S3D: Subcatchment 3D

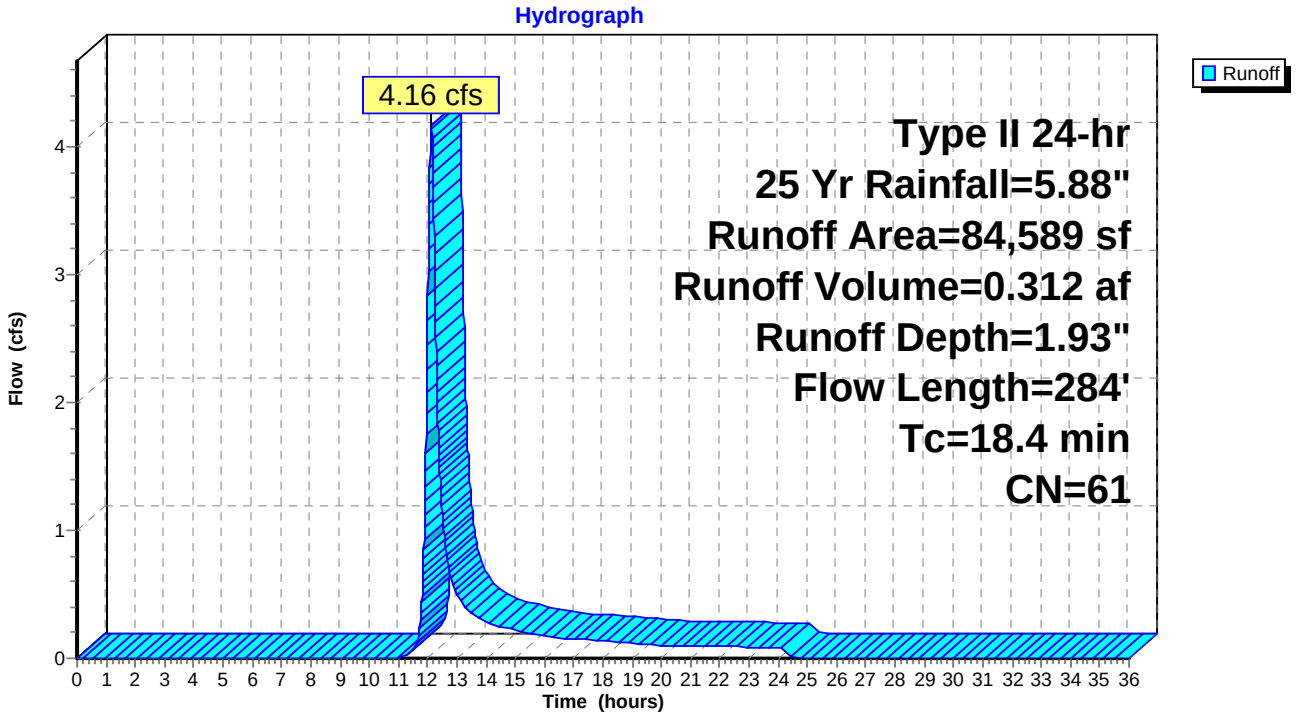
Runoff = 4.16 cfs @ 12.12 hrs, Volume= 0.312 af, Depth= 1.93"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
Type II 24-hr 25 Yr Rainfall=5.88"

Area (sf)	CN	Description
84,589	61	>75% Grass cover, Good, HSG B
84,589		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
15.2	100	0.0190	0.11		**Sheet Flow, Sheet Flow** Grass: Short n= 0.150 P2= 1.39"
3.2	184	0.0188	0.96		**Shallow Concentrated Flow, Shallow Conc.** Short Grass Pasture Kv= 7.0 fps
18.4	284	Total			

Subcatchment S3D: Subcatchment 3D



Summary for Subcatchment S4A1: Subcatchment 4A-1

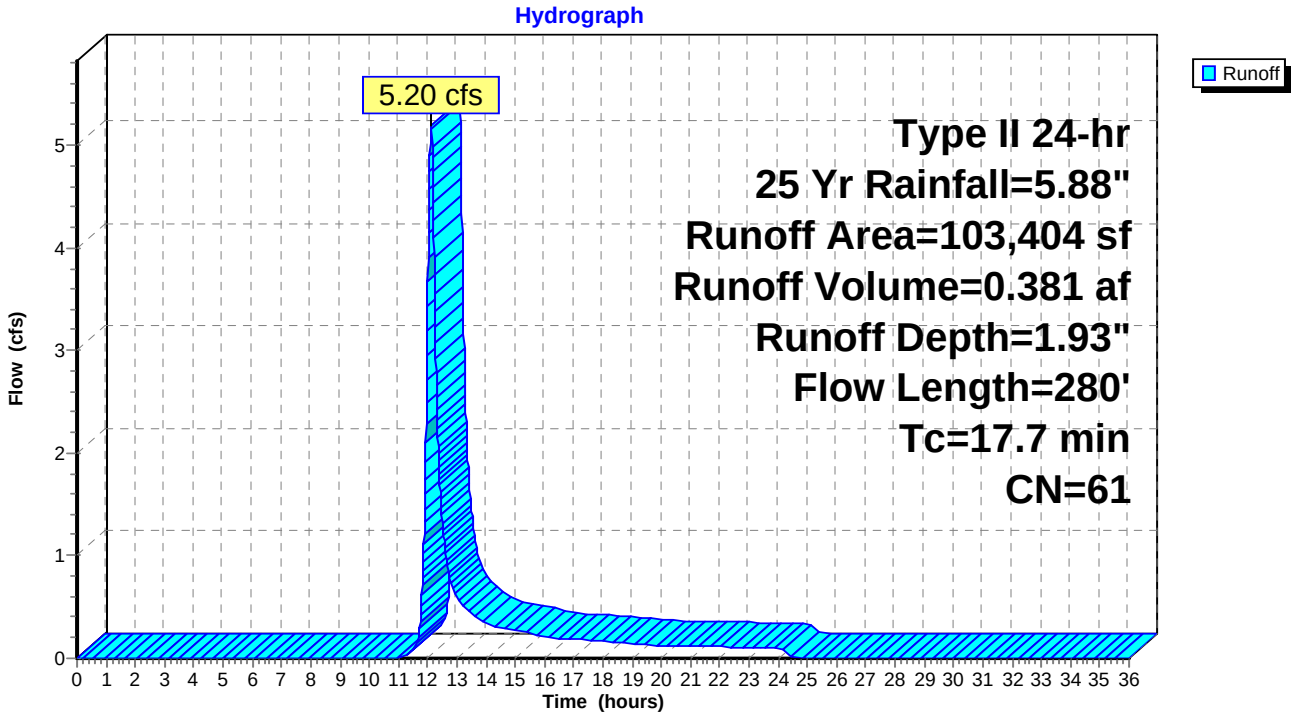
Runoff = 5.20 cfs @ 12.11 hrs, Volume= 0.381 af, Depth= 1.93"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
Type II 24-hr 25 Yr Rainfall=5.88"

Area (sf)	CN	Description
103,404	61	>75% Grass cover, Good, HSG B
103,404		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
14.7	100	0.0204	0.11		**Sheet Flow, Sheet Flow** Grass: Short n= 0.150 P2= 1.39"
3.0	180	0.0203	1.00		**Shallow Concentrated Flow, Shallow Conc.** Short Grass Pasture Kv= 7.0 fps
17.7	280	Total			

Subcatchment S4A1: Subcatchment 4A-1



Summary for Subcatchment S4A2: Subcatchment 4A-2

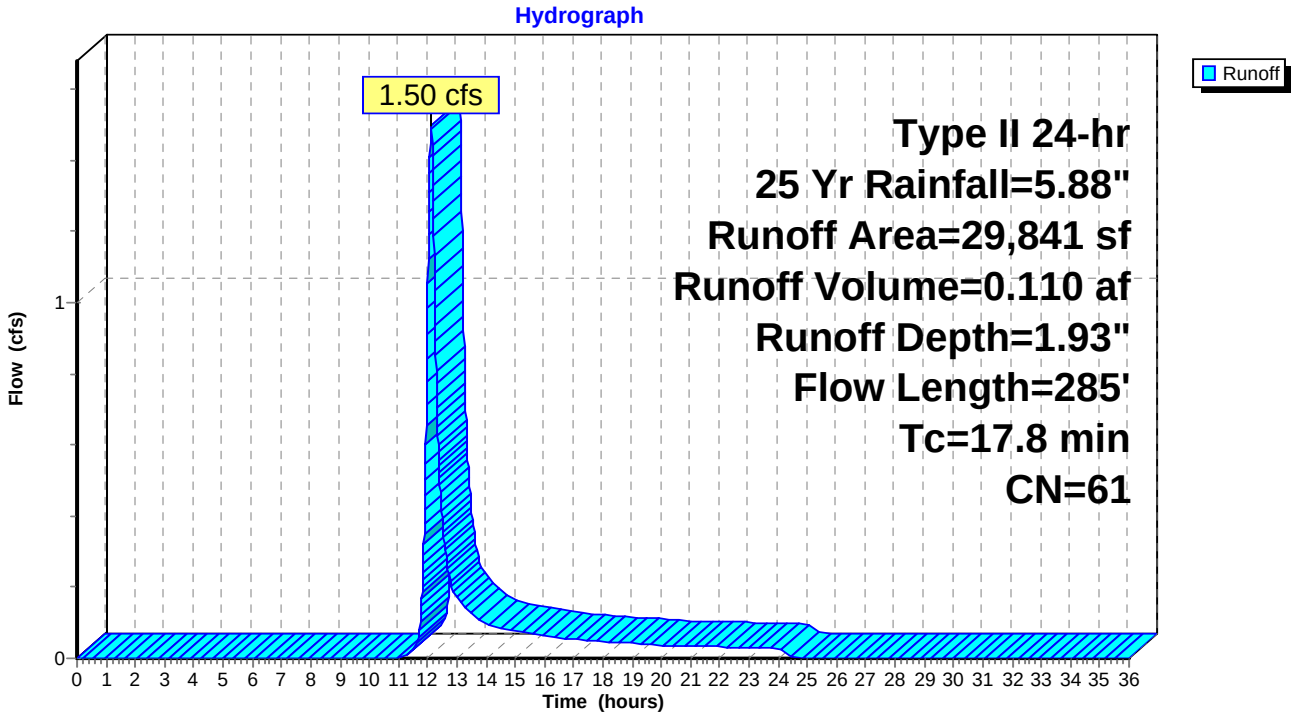
Runoff = 1.50 cfs @ 12.12 hrs, Volume= 0.110 af, Depth= 1.93"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
Type II 24-hr 25 Yr Rainfall=5.88"

Area (sf)	CN	Description
29,841	61	>75% Grass cover, Good, HSG B
29,841		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
14.7	100	0.0205	0.11		**Sheet Flow, Sheet Flow** Grass: Short n= 0.150 P2= 1.39"
3.1	185	0.0204	1.00		**Shallow Concentrated Flow, Shallow Conc.** Short Grass Pasture Kv= 7.0 fps
17.8	285	Total			

Subcatchment S4A2: Subcatchment 4A-2



Summary for Subcatchment S4A3: Subcatchment 4A-3

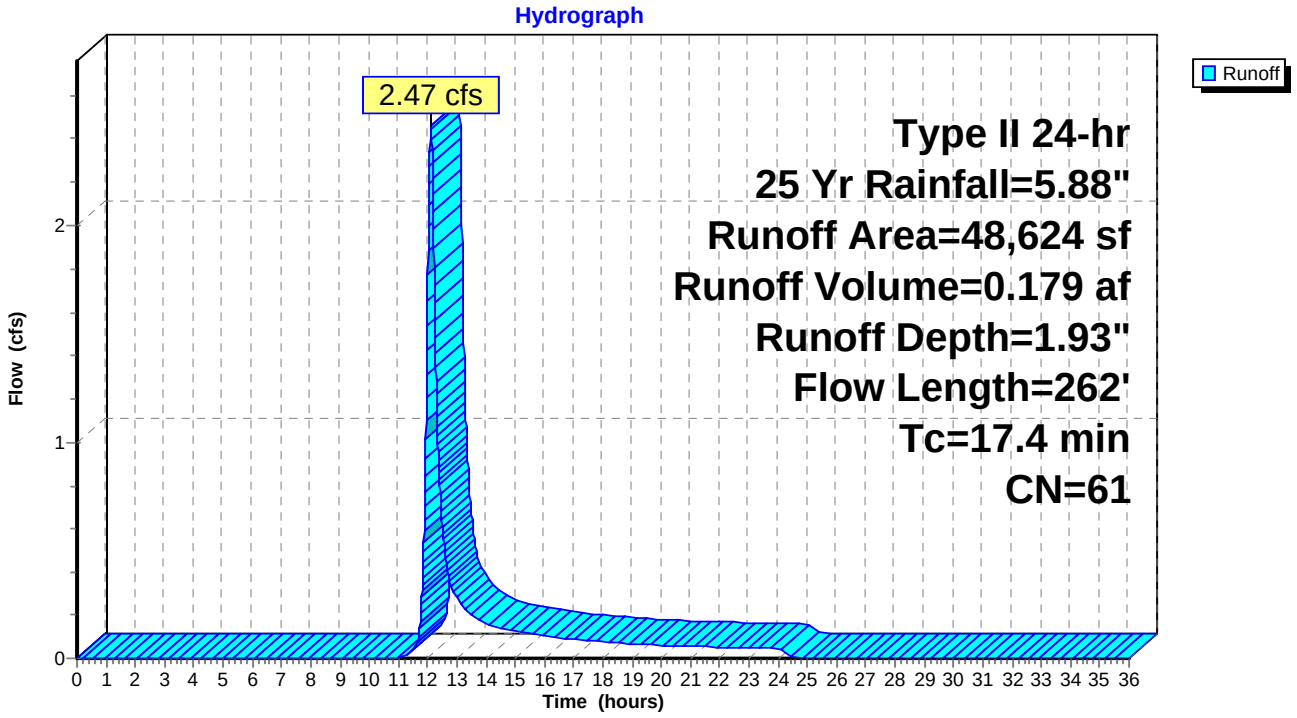
Runoff = 2.47 cfs @ 12.11 hrs, Volume= 0.179 af, Depth= 1.93"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
Type II 24-hr 25 Yr Rainfall=5.88"

Area (sf)	CN	Description
48,624	61	>75% Grass cover, Good, HSG B
48,624		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
14.7	100	0.0204	0.11		**Sheet Flow, Sheet Flow** Grass: Short n= 0.150 P2= 1.39"
2.7	162	0.0209	1.01		**Shallow Concentrated Flow, Shallow Conc.** Short Grass Pasture Kv= 7.0 fps
17.4	262	Total			

Subcatchment S4A3: Subcatchment 4A-3



Summary for Subcatchment S4B1: Subcatchment 4B-1

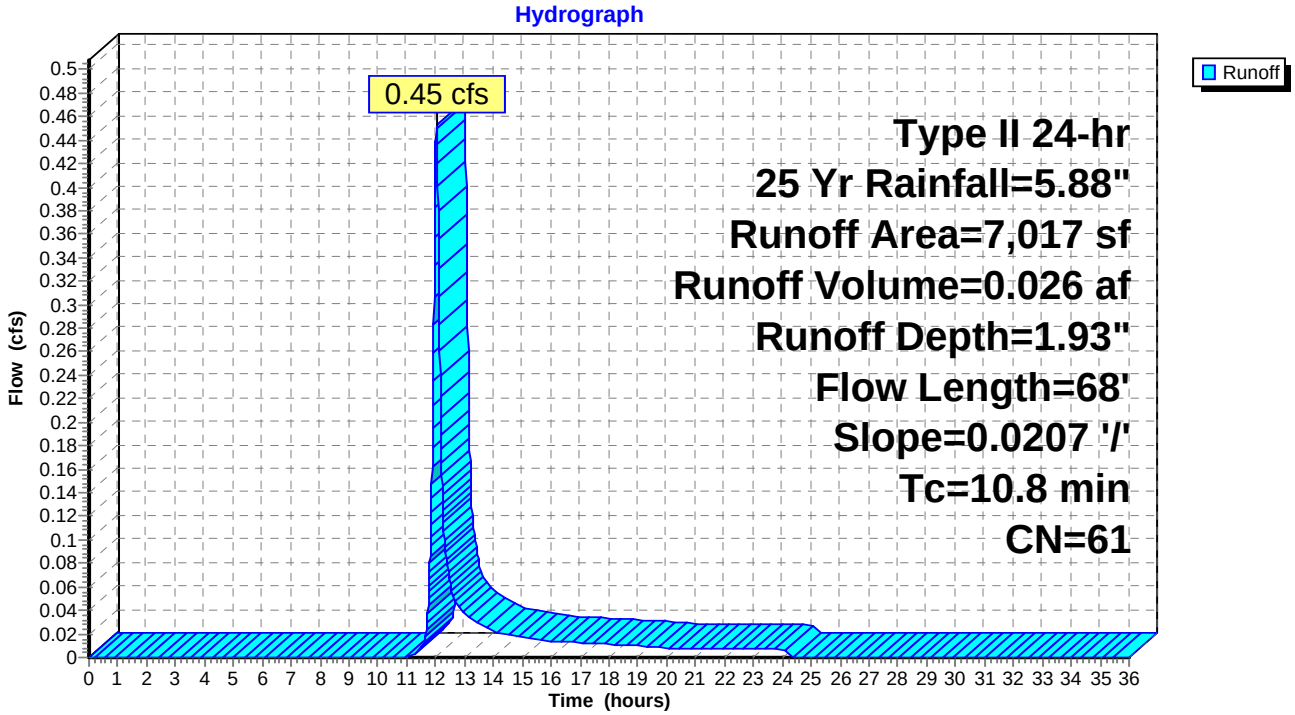
Runoff = 0.45 cfs @ 12.03 hrs, Volume= 0.026 af, Depth= 1.93"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
Type II 24-hr 25 Yr Rainfall=5.88"

Area (sf)	CN	Description
7,017	61	>75% Grass cover, Good, HSG B
7,017		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
10.8	68	0.0207	0.11		**Sheet Flow, Sheet Flow** Grass: Short n= 0.150 P2= 1.39"

Subcatchment S4B1: Subcatchment 4B-1



Summary for Subcatchment S4B2: Subcatchment 4B-2

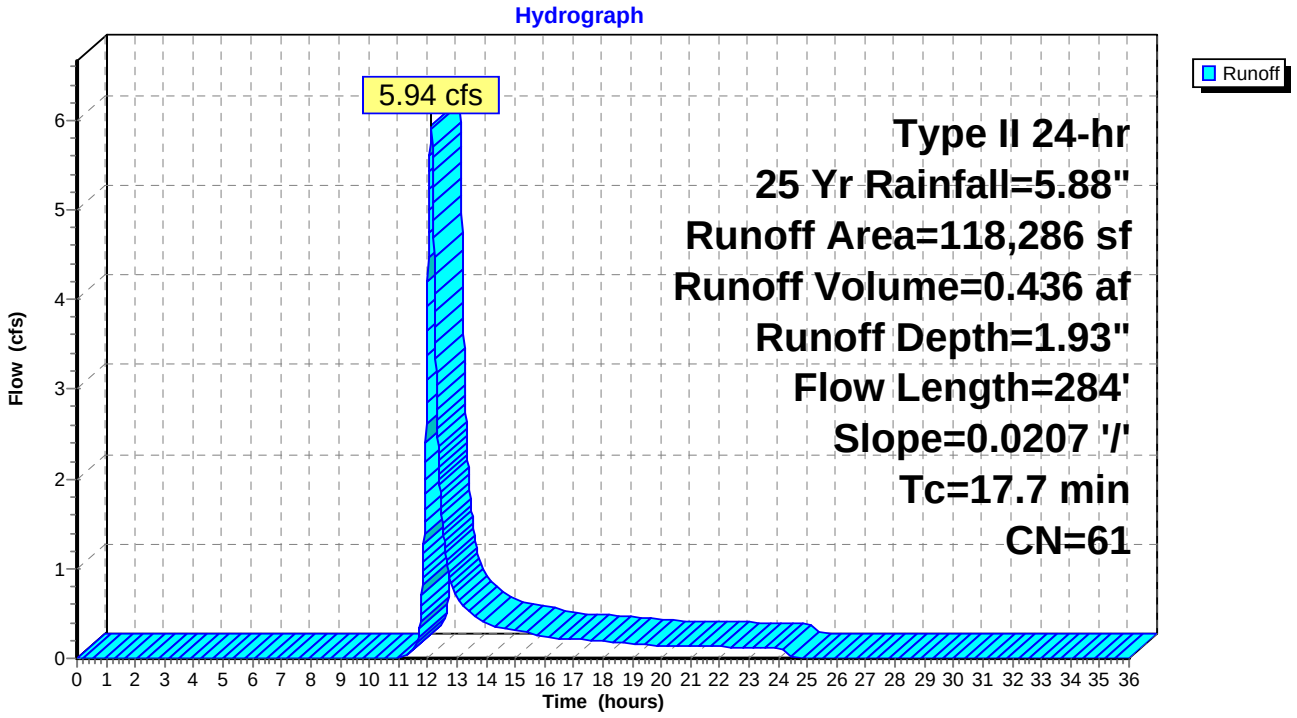
Runoff = 5.94 cfs @ 12.11 hrs, Volume= 0.436 af, Depth= 1.93"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
Type II 24-hr 25 Yr Rainfall=5.88"

Area (sf)	CN	Description
118,286	61	>75% Grass cover, Good, HSG B
118,286		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
14.7	100	0.0207	0.11		**Sheet Flow, Sheet Flow** Grass: Short n= 0.150 P2= 1.39"
3.0	184	0.0207	1.01		**Shallow Concentrated Flow, Shallow Conc.** Short Grass Pasture Kv= 7.0 fps
17.7	284	Total			

Subcatchment S4B2: Subcatchment 4B-2



Summary for Subcatchment S4B3: Subcatchment 4B-3

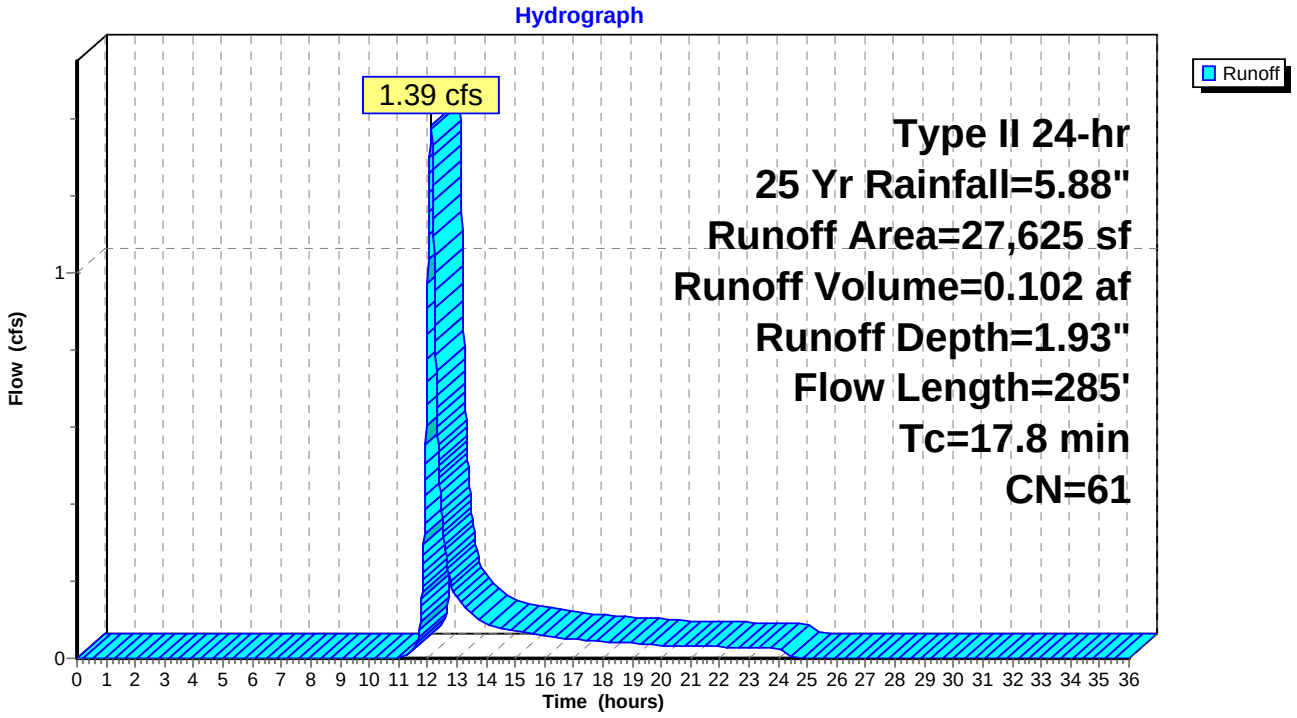
Runoff = 1.39 cfs @ 12.12 hrs, Volume= 0.102 af, Depth= 1.93"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
Type II 24-hr 25 Yr Rainfall=5.88"

Area (sf)	CN	Description
27,625	61	>75% Grass cover, Good, HSG B
27,625		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
14.7	100	0.0206	0.11		**Sheet Flow, Sheet Flow** Grass: Short n= 0.150 P2= 1.39"
3.1	185	0.0204	1.00		**Shallow Concentrated Flow, Shallow Conc.** Short Grass Pasture Kv= 7.0 fps
17.8	285	Total			

Subcatchment S4B3: Subcatchment 4B-3



Summary for Subcatchment S4B4: Subcatchment 3B-4

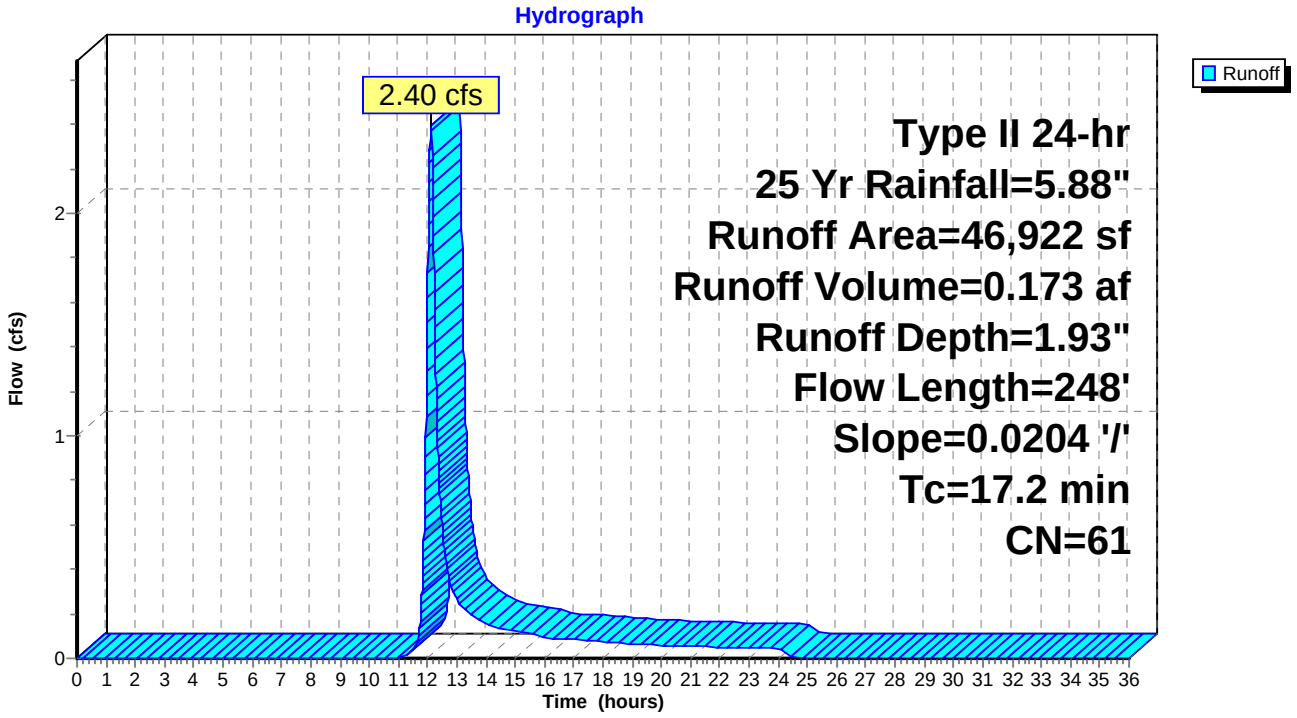
Runoff = 2.40 cfs @ 12.10 hrs, Volume= 0.173 af, Depth= 1.93"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
Type II 24-hr 25 Yr Rainfall=5.88"

Area (sf)	CN	Description
46,922	61	>75% Grass cover, Good, HSG B
46,922		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
14.7	100	0.0204	0.11		**Sheet Flow, Sheet Flow** Grass: Short n= 0.150 P2= 1.39"
2.5	148	0.0204	1.00		**Shallow Concentrated Flow, Shallow Conc.** Short Grass Pasture Kv= 7.0 fps
17.2	248	Total			

Subcatchment S4B4: Subcatchment 3B-4



Summary for Subcatchment S4B5: Subcatchment 4B-5

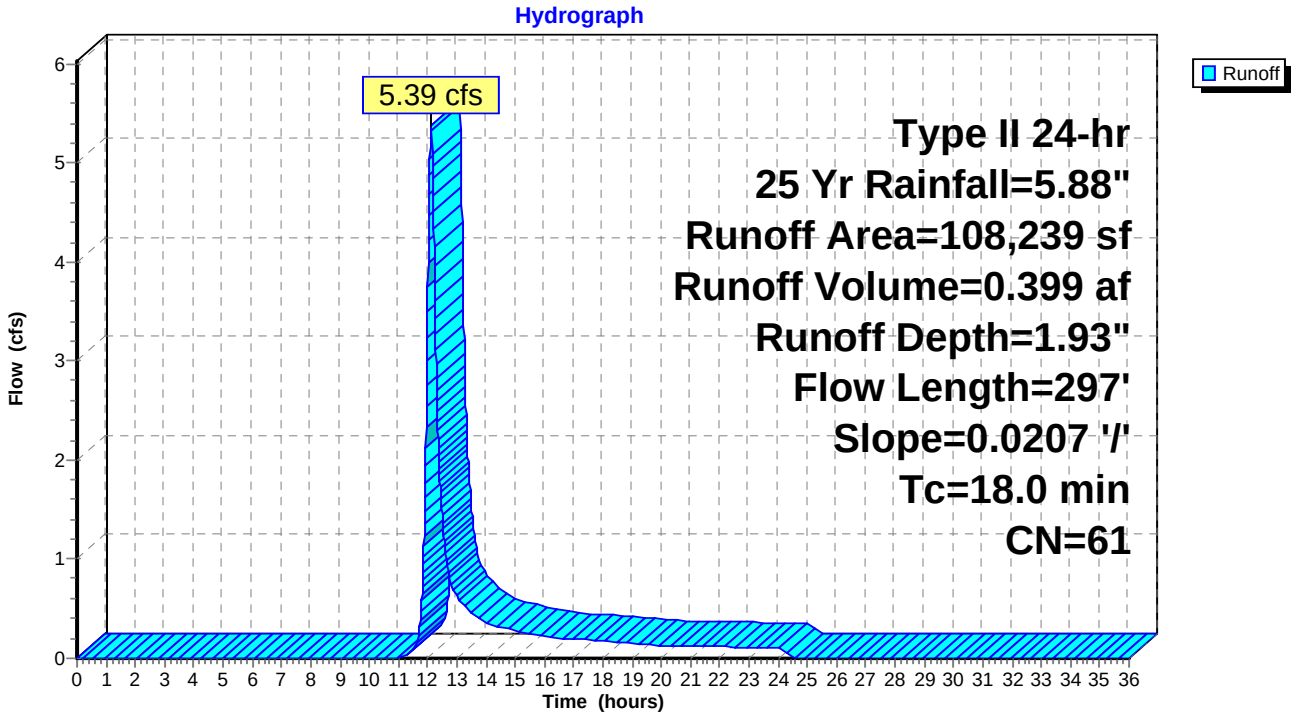
Runoff = 5.39 cfs @ 12.12 hrs, Volume= 0.399 af, Depth= 1.93"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
Type II 24-hr 25 Yr Rainfall=5.88"

Area (sf)	CN	Description
108,239	61	>75% Grass cover, Good, HSG B
108,239		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
14.7	100	0.0207	0.11		**Sheet Flow, Sheet Flow** Grass: Short n= 0.150 P2= 1.39"
3.3	197	0.0207	1.01		**Shallow Concentrated Flow, Shallow Conc.** Short Grass Pasture Kv= 7.0 fps
18.0	297	Total			

Subcatchment S4B5: Subcatchment 4B-5



Summary for Subcatchment S4B6: Subcatchment 4B-6

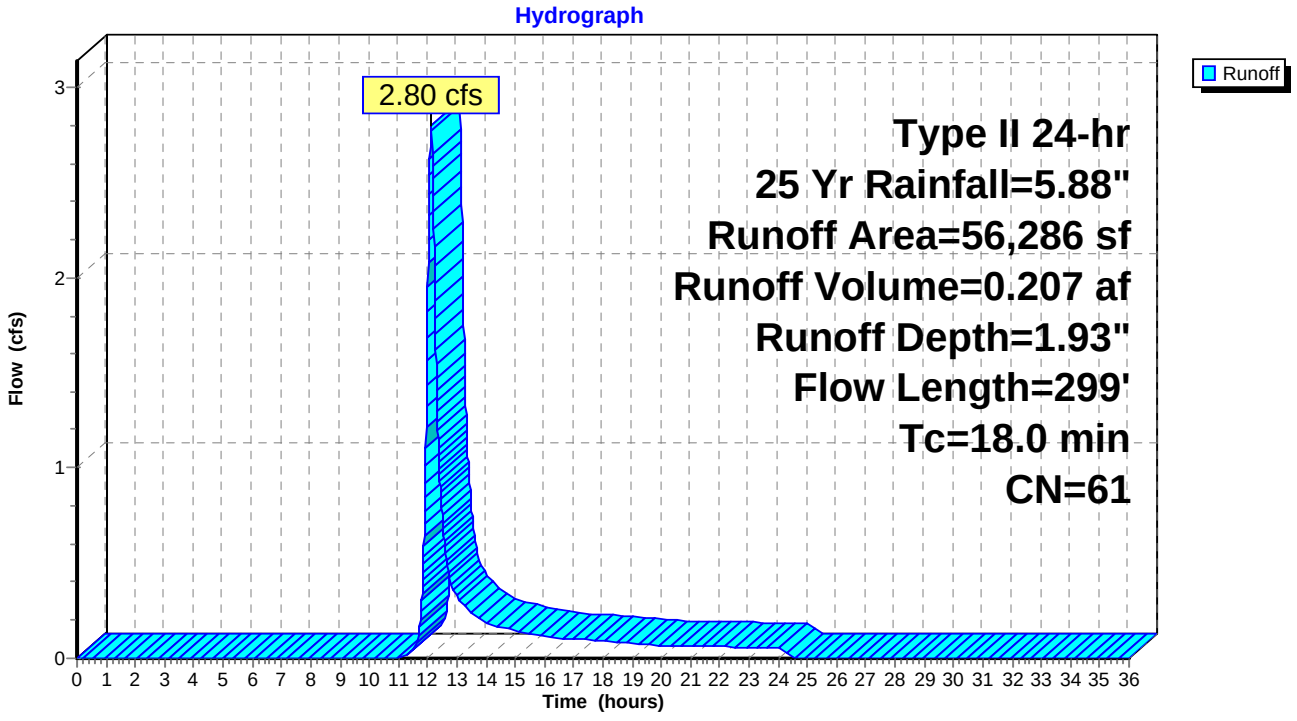
Runoff = 2.80 cfs @ 12.12 hrs, Volume= 0.207 af, Depth= 1.93"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
Type II 24-hr 25 Yr Rainfall=5.88"

Area (sf)	CN	Description
56,286	61	>75% Grass cover, Good, HSG B
56,286		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
14.7	100	0.0207	0.11		**Sheet Flow, Sheet Flow** Grass: Short n= 0.150 P2= 1.39"
3.3	199	0.0206	1.00		**Shallow Concentrated Flow, Shallow Conc.** Short Grass Pasture Kv= 7.0 fps
18.0	299	Total			

Subcatchment S4B6: Subcatchment 4B-6



Summary for Subcatchment S4B7: Subcatchment 4B-7

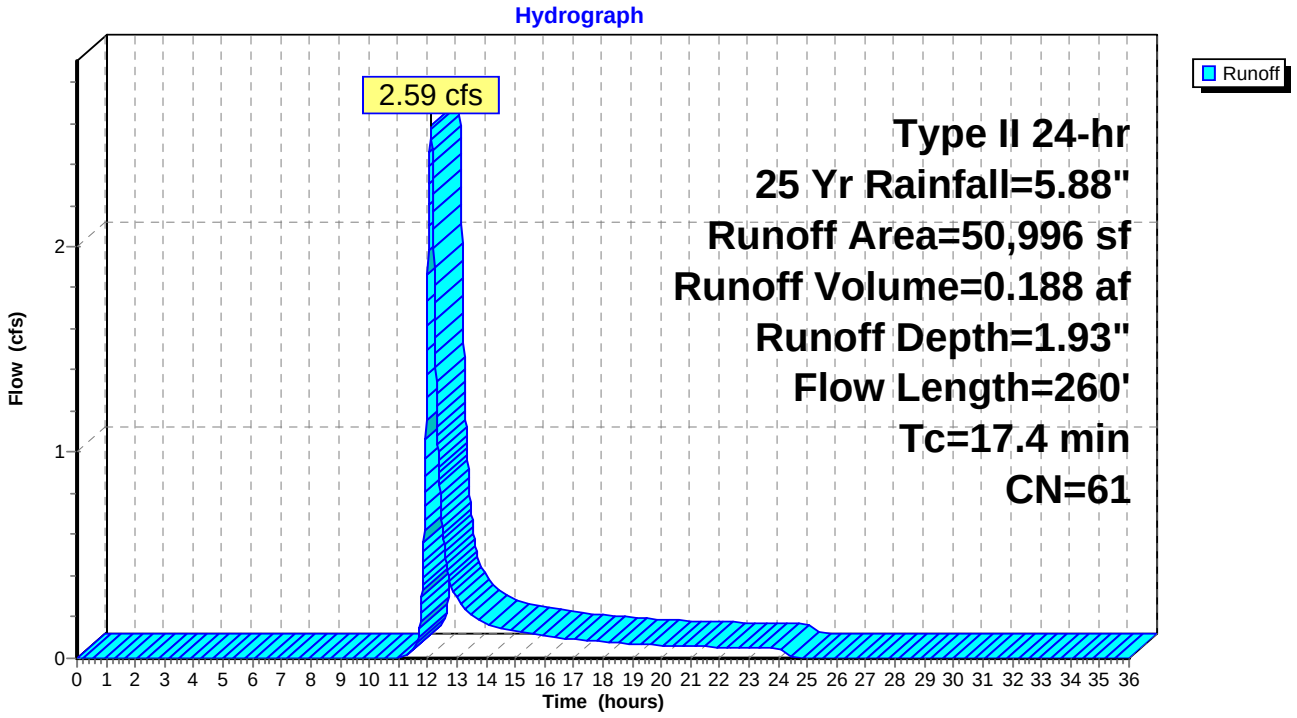
Runoff = 2.59 cfs @ 12.11 hrs, Volume= 0.188 af, Depth= 1.93"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
Type II 24-hr 25 Yr Rainfall=5.88"

Area (sf)	CN	Description
50,996	61	>75% Grass cover, Good, HSG B
50,996		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
14.7	100	0.0207	0.11		**Sheet Flow, Sheet Flow** Grass: Short n= 0.150 P2= 1.39"
2.7	160	0.0205	1.00		**Shallow Concentrated Flow, Shallow Conc.** Short Grass Pasture Kv= 7.0 fps
17.4	260	Total			

Subcatchment S4B7: Subcatchment 4B-7



Summary for Subcatchment S4C: Subcatchment 4C

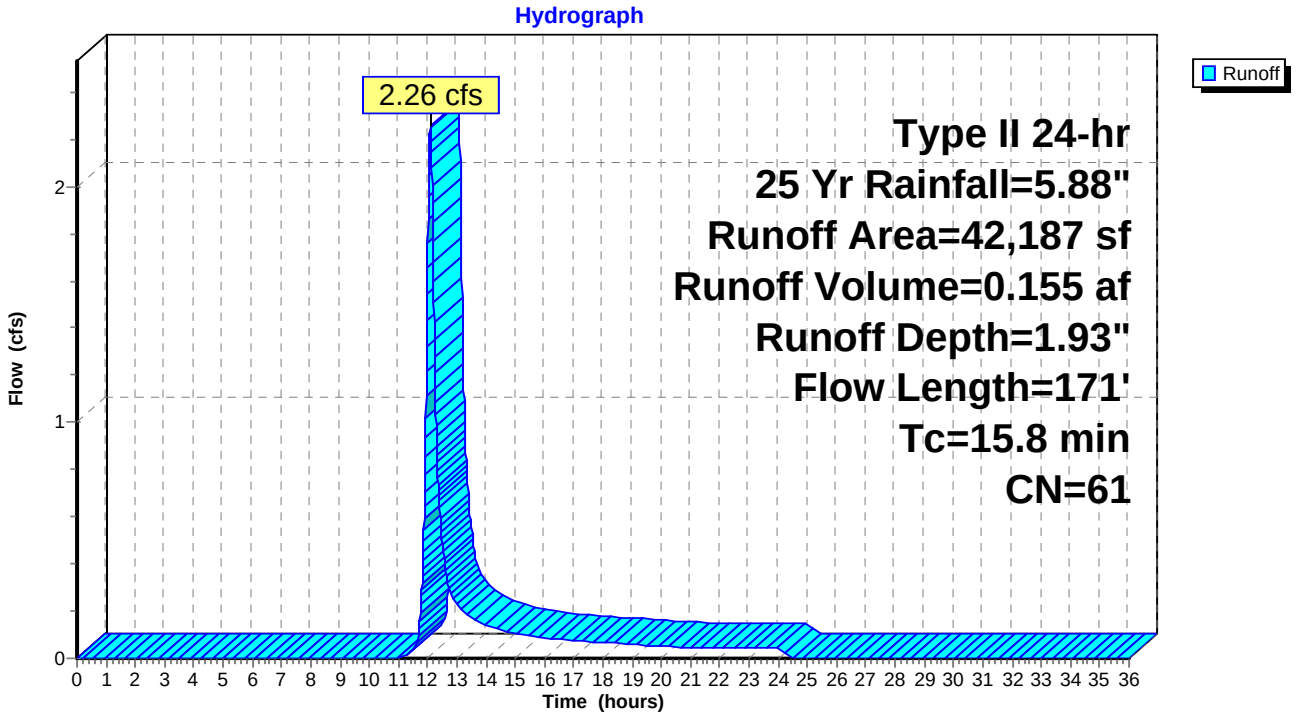
Runoff = 2.26 cfs @ 12.09 hrs, Volume= 0.155 af, Depth= 1.93"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
Type II 24-hr 25 Yr Rainfall=5.88"

Area (sf)	CN	Description
42,187	61	>75% Grass cover, Good, HSG B
42,187		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
14.6	100	0.0209	0.11		**Sheet Flow, Sheet Flow** Grass: Short n= 0.150 P2= 1.39"
1.2	71	0.0204	1.00		**Shallow Concentrated Flow, Shallow Conc.** Short Grass Pasture Kv= 7.0 fps
15.8	171	Total			

Subcatchment S4C: Subcatchment 4C



Summary for Subcatchment S5A: Subcatchment 5A

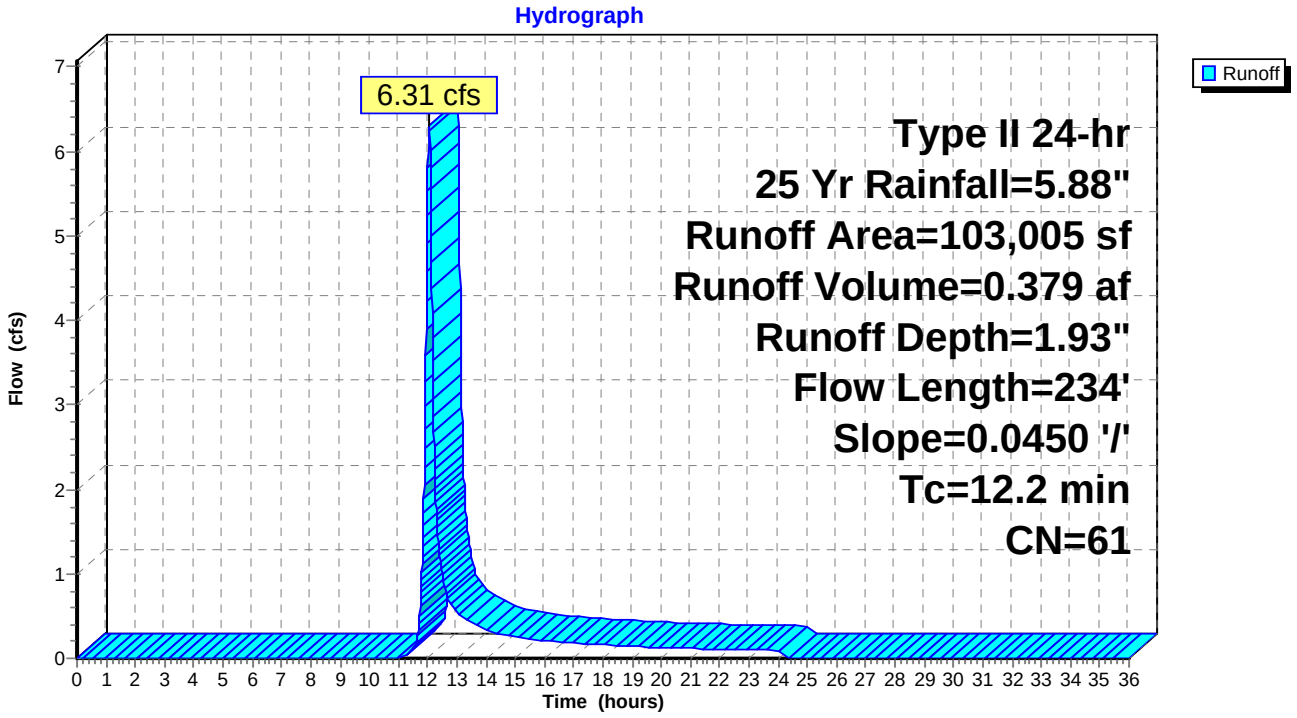
Runoff = 6.31 cfs @ 12.05 hrs, Volume= 0.379 af, Depth= 1.93"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
Type II 24-hr 25 Yr Rainfall=5.88"

Area (sf)	CN	Description
103,005	61	>75% Grass cover, Good, HSG B
103,005		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
10.7	100	0.0450	0.16		**Sheet Flow, Sheet Flow** Grass: Short n= 0.150 P2= 1.39"
1.5	134	0.0450	1.48		**Shallow Concentrated Flow, Shallow Conc.** Short Grass Pasture Kv= 7.0 fps
12.2	234	Total			

Subcatchment S5A: Subcatchment 5A



Summary for Subcatchment S5B: Subcatchment 5B

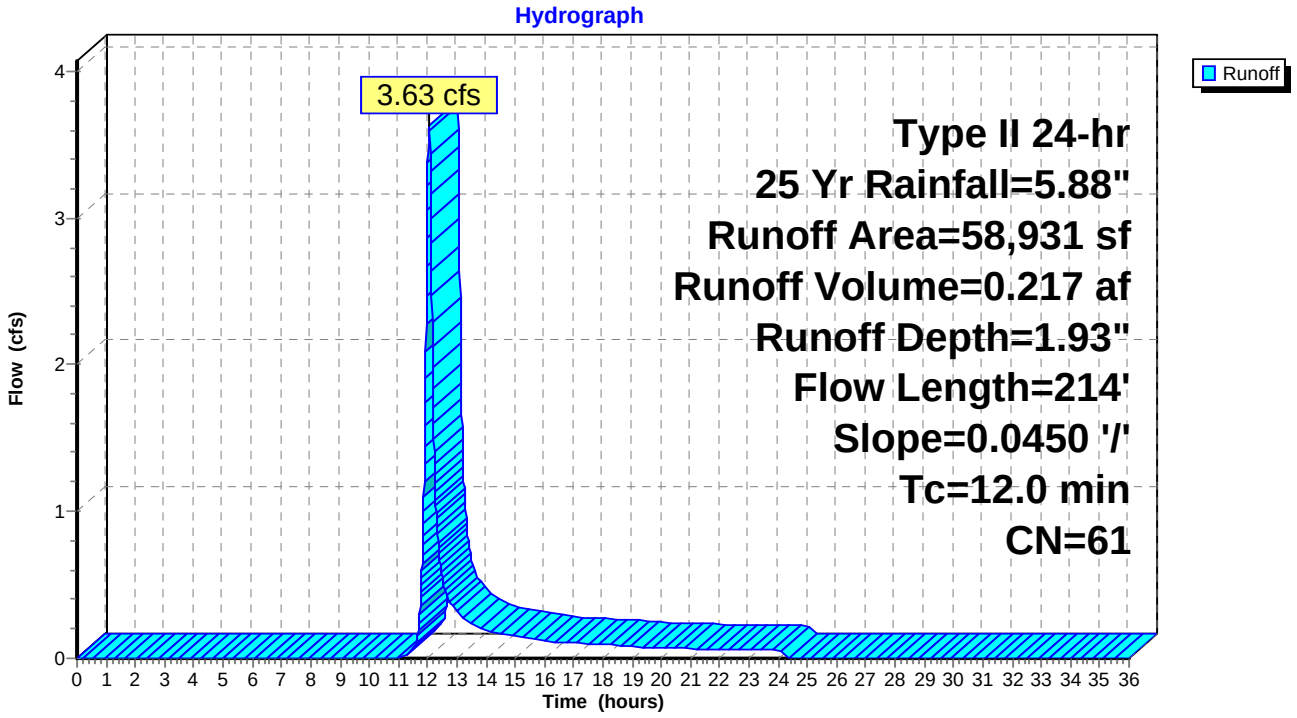
Runoff = 3.63 cfs @ 12.05 hrs, Volume= 0.217 af, Depth= 1.93"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
Type II 24-hr 25 Yr Rainfall=5.88"

Area (sf)	CN	Description
58,931	61	>75% Grass cover, Good, HSG B
58,931		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
10.7	100	0.0450	0.16		**Sheet Flow, Sheet Flow** Grass: Short n= 0.150 P2= 1.39"
1.3	114	0.0450	1.48		**Shallow Concentrated Flow, Shallow Conc.** Short Grass Pasture Kv= 7.0 fps
12.0	214	Total			

Subcatchment S5B: Subcatchment 5B



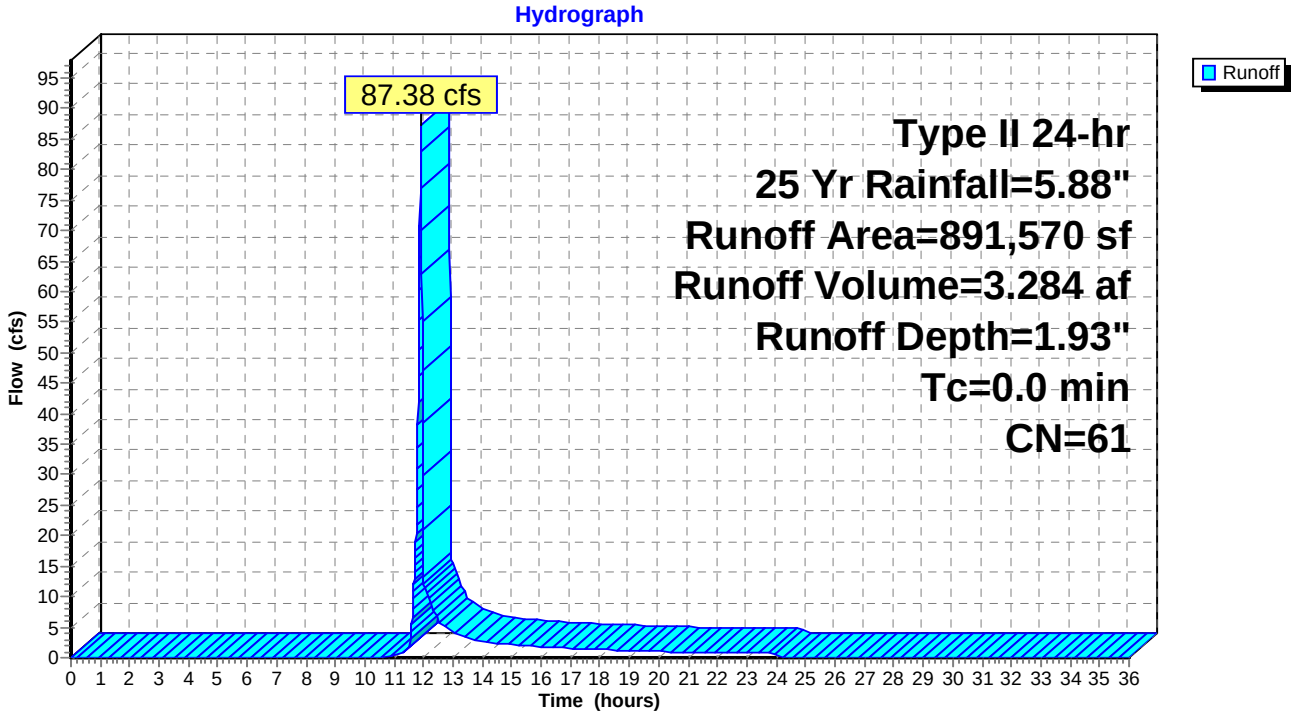
Summary for Subcatchment SED: Subcatchment Existing Ditch

Runoff = 87.38 cfs @ 11.90 hrs, Volume= 3.284 af, Depth= 1.93"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
Type II 24-hr 25 Yr Rainfall=5.88"

Area (sf)	CN	Description
891,570	61	>75% Grass cover, Good, HSG B
891,570		100.00% Pervious Area

Subcatchment SED: Subcatchment Existing Ditch



Summary for Reach 1RR: Outlet 1 Riprap

Inflow Area = 1.553 ac, 0.00% Impervious, Inflow Depth = 1.93" for 25 Yr event
Inflow = 3.08 cfs @ 12.16 hrs, Volume= 0.249 af
Outflow = 3.07 cfs @ 12.18 hrs, Volume= 0.249 af, Atten= 0%, Lag= 1.1 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs / 2
Max. Velocity= 2.71 fps, Min. Travel Time= 0.7 min
Avg. Velocity = 0.78 fps, Avg. Travel Time= 2.3 min

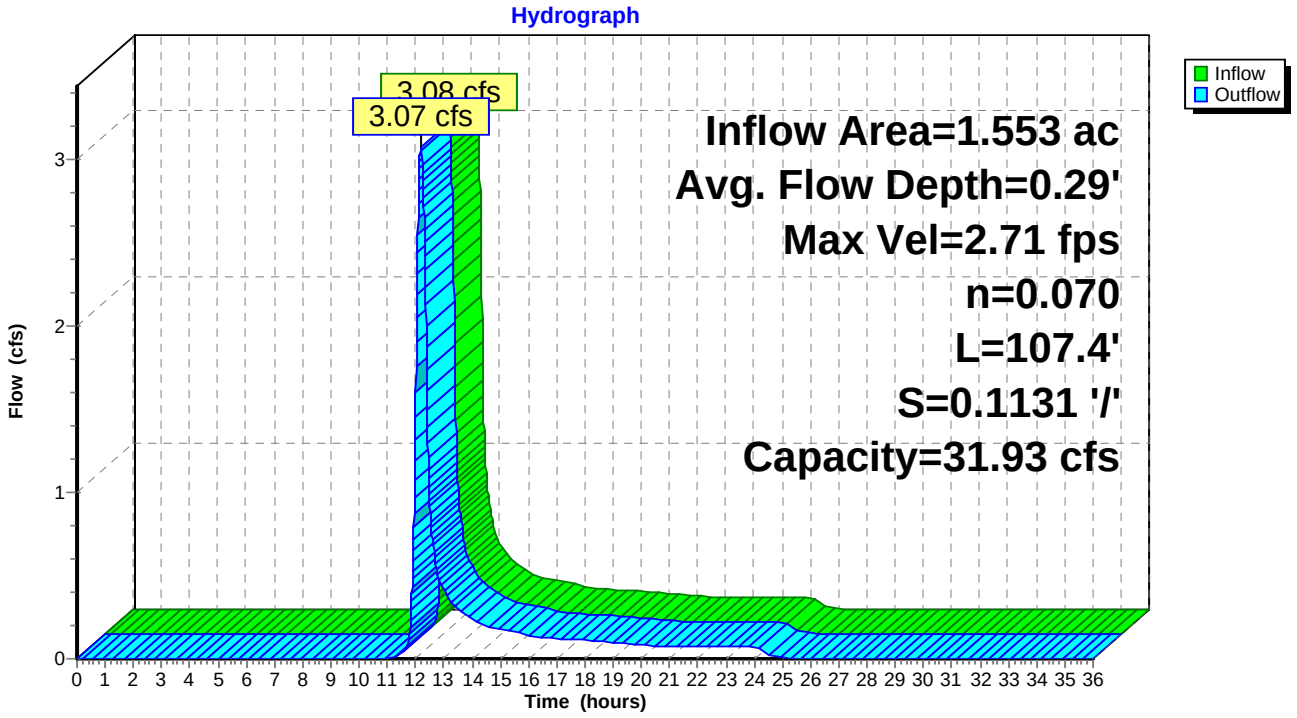
Peak Storage= 122 cf @ 12.17 hrs
Average Depth at Peak Storage= 0.29'
Bank-Full Depth= 1.00' Flow Area= 6.0 sf, Capacity= 31.93 cfs

3.00' x 1.00' deep channel, n= 0.070
Side Slope Z-value= 3.0 '/' Top Width= 9.00'
Length= 107.4' Slope= 0.1131 '/'
Inlet Invert= 398.14', Outlet Invert= 385.99'



‡

Reach 1RR: Outlet 1 Riprap



Summary for Reach 2RR: Outlet 2 Riprap

Inflow Area = 18.214 ac, 0.00% Impervious, Inflow Depth = 1.93" for 25 Yr event
Inflow = 19.96 cfs @ 12.48 hrs, Volume= 2.923 af
Outflow = 19.96 cfs @ 12.49 hrs, Volume= 2.923 af, Atten= 0%, Lag= 0.7 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs / 2
Max. Velocity= 4.70 fps, Min. Travel Time= 0.4 min
Avg. Velocity = 1.64 fps, Avg. Travel Time= 1.1 min

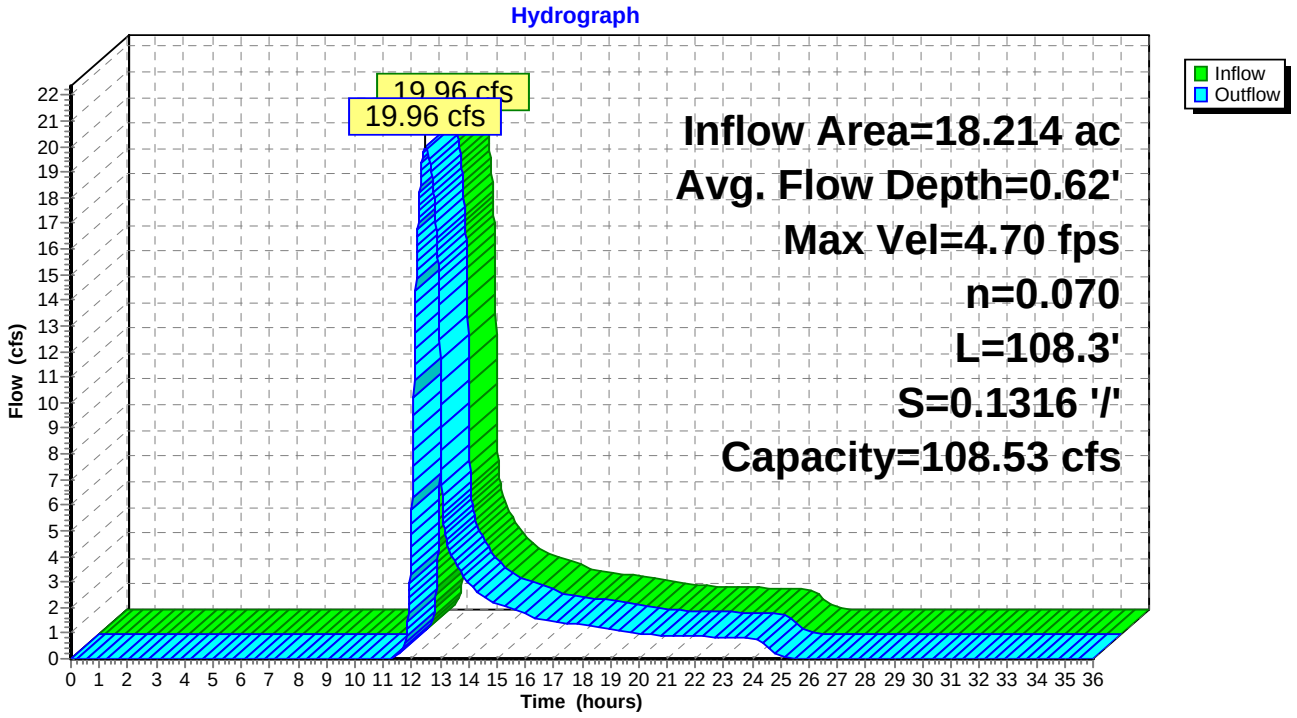
Peak Storage= 460 cf @ 12.48 hrs
Average Depth at Peak Storage= 0.62'
Bank-Full Depth= 1.50' Flow Area= 14.3 sf, Capacity= 108.53 cfs

5.00' x 1.50' deep channel, n= 0.070
Side Slope Z-value= 3.0 '/' Top Width= 14.00'
Length= 108.3' Slope= 0.1316 '/'
Inlet Invert= 398.29', Outlet Invert= 384.04'



‡

Reach 2RR: Outlet 2 Riprap



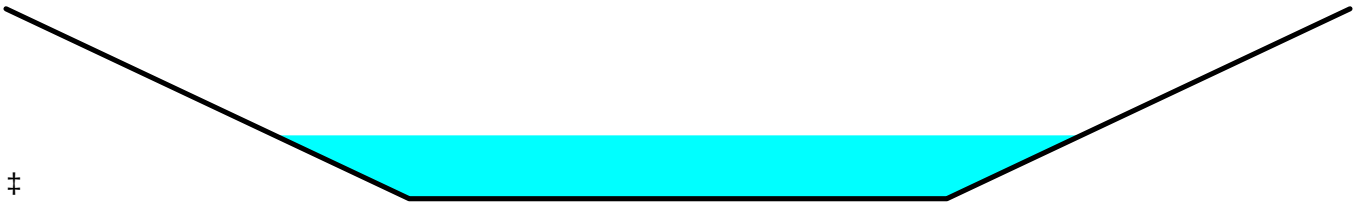
Summary for Reach 3RR: Outlet 3 Riprap

Inflow Area = 19.345 ac, 0.00% Impervious, Inflow Depth = 1.93" for 25 Yr event
Inflow = 20.27 cfs @ 12.51 hrs, Volume= 3.104 af
Outflow = 20.27 cfs @ 12.52 hrs, Volume= 3.104 af, Atten= 0%, Lag= 0.5 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs / 2
Max. Velocity= 5.40 fps, Min. Travel Time= 0.3 min
Avg. Velocity = 1.82 fps, Avg. Travel Time= 0.8 min

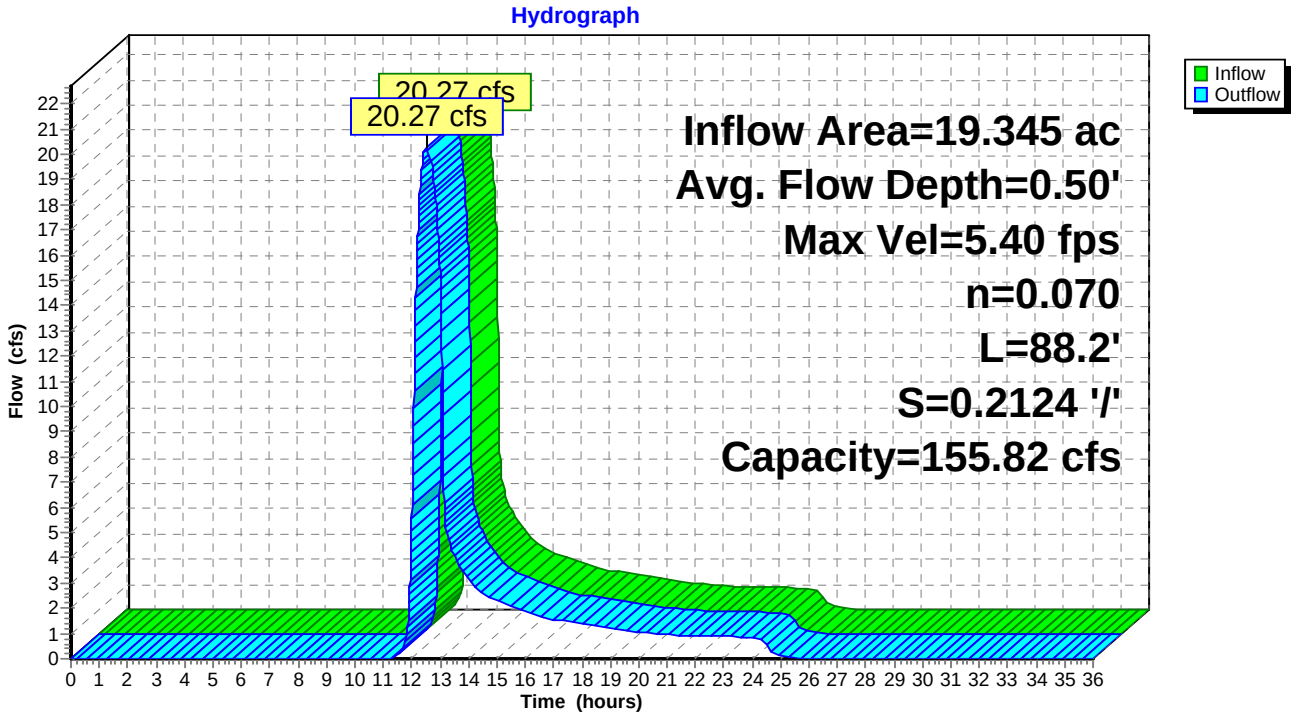
Peak Storage= 331 cf @ 12.51 hrs
Average Depth at Peak Storage= 0.50'
Bank-Full Depth= 1.50' Flow Area= 15.8 sf, Capacity= 155.82 cfs

6.00' x 1.50' deep channel, n= 0.070
Side Slope Z-value= 3.0 '/' Top Width= 15.00'
Length= 88.2' Slope= 0.2124 '/'
Inlet Invert= 398.72', Outlet Invert= 379.99'



‡

Reach 3RR: Outlet 3 Riprap



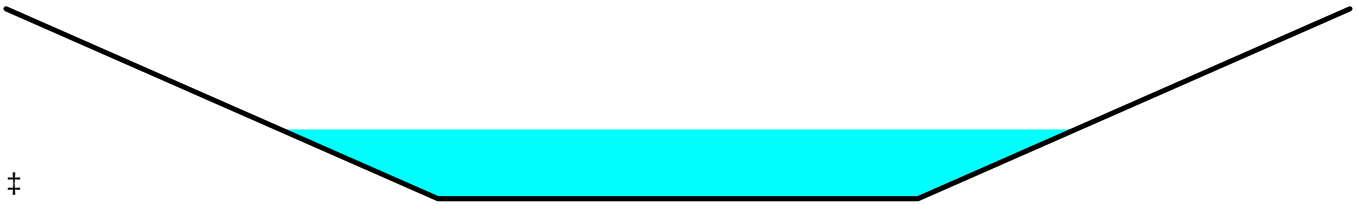
Summary for Reach 4RR: Outlet 4 Riprap

Inflow Area = 14.679 ac, 0.00% Impervious, Inflow Depth = 1.93" for 25 Yr event
Inflow = 18.67 cfs @ 12.43 hrs, Volume= 2.356 af
Outflow = 18.67 cfs @ 12.44 hrs, Volume= 2.356 af, Atten= 0%, Lag= 0.5 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs / 2
Max. Velocity= 5.13 fps, Min. Travel Time= 0.3 min
Avg. Velocity = 1.66 fps, Avg. Travel Time= 0.9 min

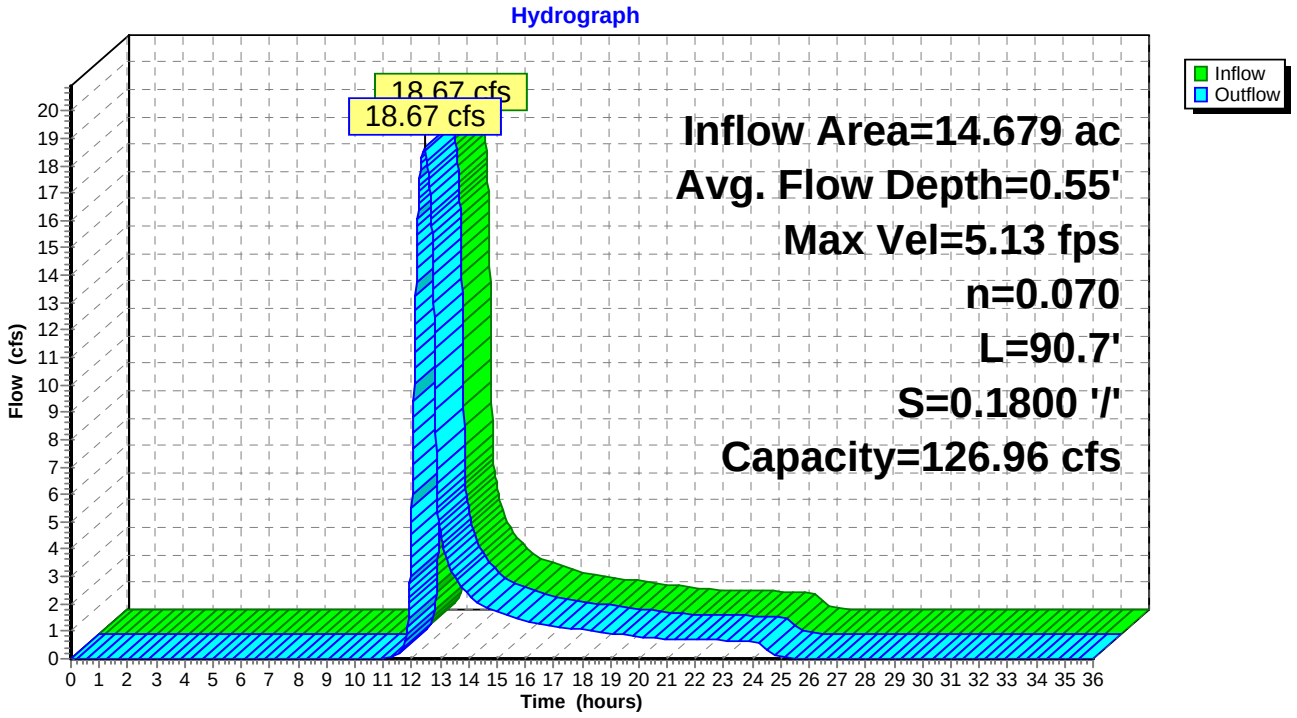
Peak Storage= 330 cf @ 12.43 hrs
Average Depth at Peak Storage= 0.55'
Bank-Full Depth= 1.50' Flow Area= 14.3 sf, Capacity= 126.96 cfs

5.00' x 1.50' deep channel, n= 0.070
Side Slope Z-value= 3.0 '/' Top Width= 14.00'
Length= 90.7' Slope= 0.1800 '/'
Inlet Invert= 397.23', Outlet Invert= 380.90'



‡

Reach 4RR: Outlet 4 Riprap



Summary for Reach 5RR: Slope Riprap

Inflow Area = 3.718 ac, 0.00% Impervious, Inflow Depth = 1.93" for 25 Yr event
Inflow = 3.59 cfs @ 12.31 hrs, Volume= 0.597 af
Outflow = 3.59 cfs @ 12.32 hrs, Volume= 0.597 af, Atten= 0%, Lag= 0.5 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs / 2
Max. Velocity= 3.17 fps, Min. Travel Time= 0.3 min
Avg. Velocity = 1.31 fps, Avg. Travel Time= 0.6 min

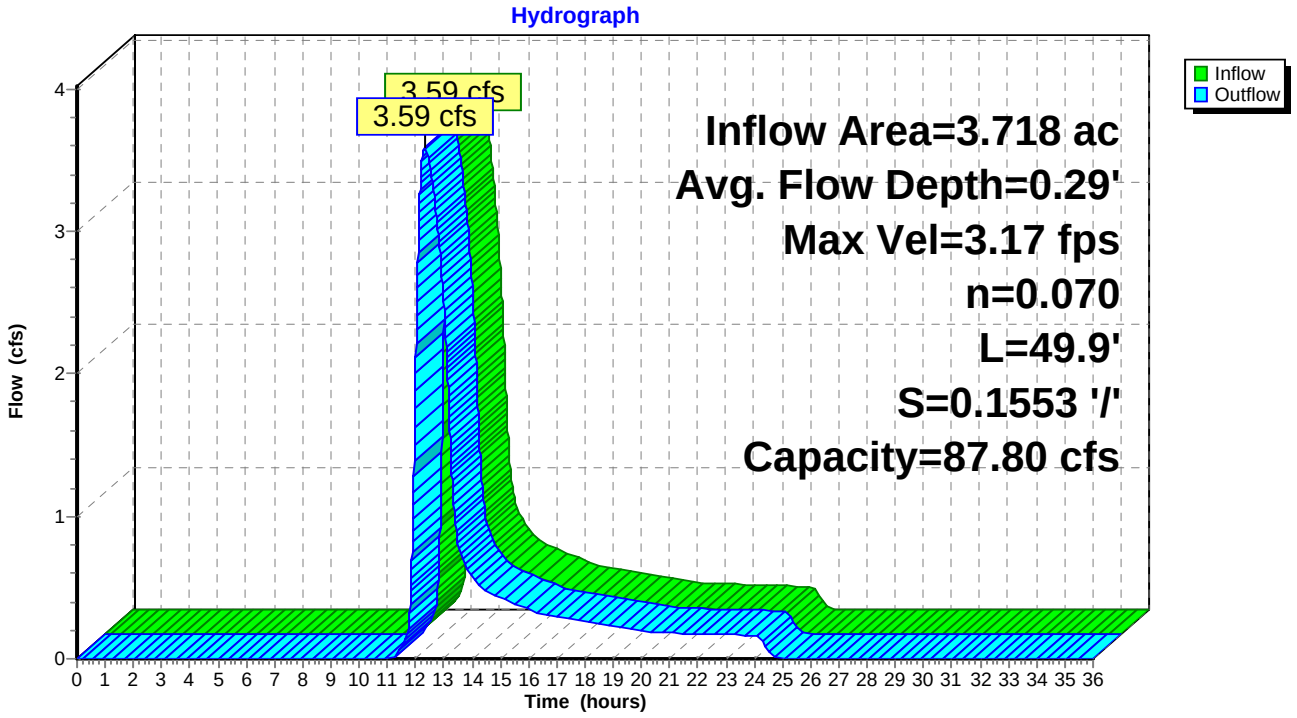
Peak Storage= 56 cf @ 12.32 hrs
Average Depth at Peak Storage= 0.29'
Bank-Full Depth= 1.50' Flow Area= 11.3 sf, Capacity= 87.80 cfs

3.00' x 1.50' deep channel, n= 0.070
Side Slope Z-value= 3.0 '/' Top Width= 12.00'
Length= 49.9' Slope= 0.1553 '/'
Inlet Invert= 398.26', Outlet Invert= 390.51'



‡

Reach 5RR: Slope Riprap



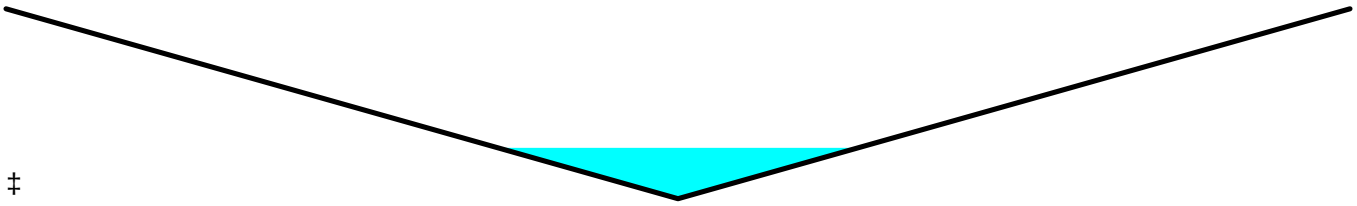
Summary for Reach C1A: Channel 1A

Inflow Area = 1.553 ac, 0.00% Impervious, Inflow Depth = 1.93" for 25 Yr event
Inflow = 6.06 cfs @ 11.94 hrs, Volume= 0.249 af
Outflow = 4.44 cfs @ 12.09 hrs, Volume= 0.249 af, Atten= 27%, Lag= 9.0 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs / 2
Max. Velocity= 2.44 fps, Min. Travel Time= 6.2 min
Avg. Velocity = 0.84 fps, Avg. Travel Time= 17.8 min

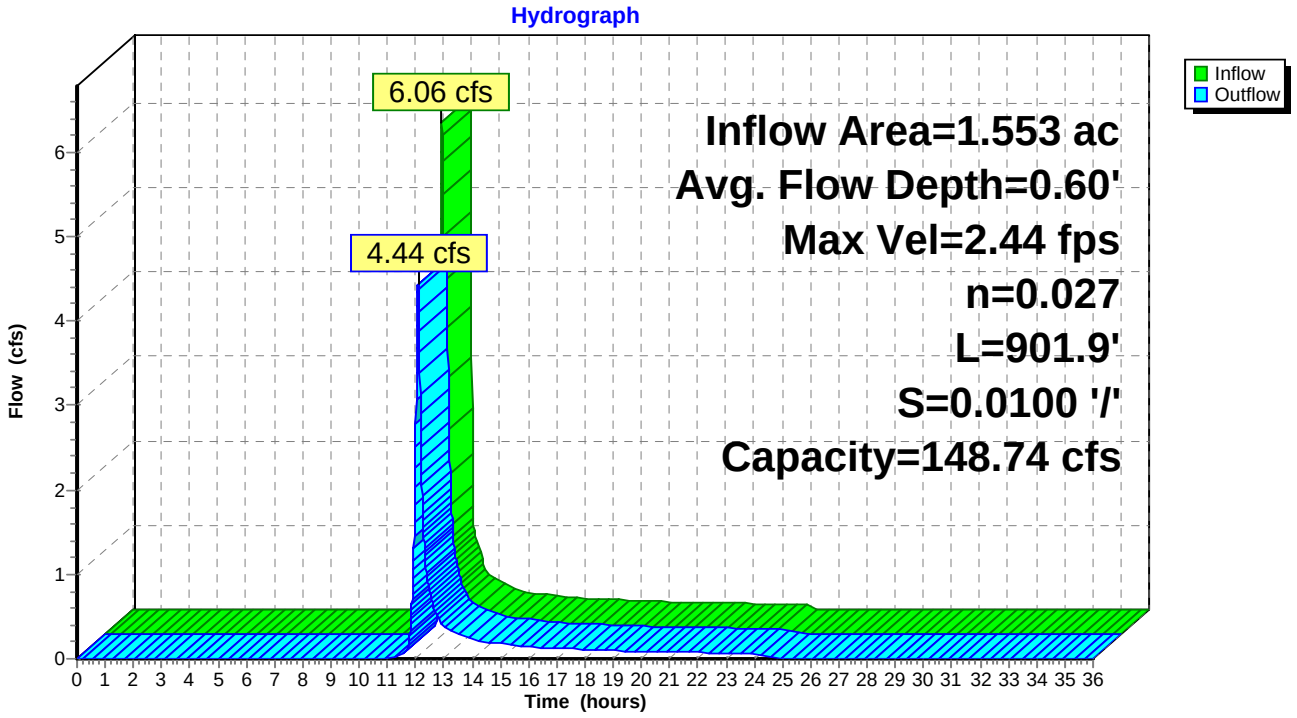
Peak Storage= 1,642 cf @ 11.99 hrs
Average Depth at Peak Storage= 0.60'
Bank-Full Depth= 2.25' Flow Area= 25.3 sf, Capacity= 148.74 cfs

0.00' x 2.25' deep channel, n= 0.027
Side Slope Z-value= 5.0 '/' Top Width= 22.50'
Length= 901.9' Slope= 0.0100 '/'
Inlet Invert= 408.02', Outlet Invert= 399.00'



‡

Reach C1A: Channel 1A



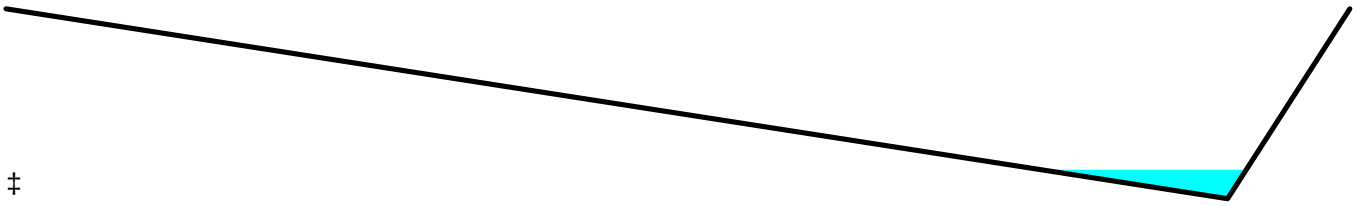
Summary for Reach C2A1: Channel 2A-1

Inflow Area = 2.566 ac, 0.00% Impervious, Inflow Depth = 1.93" for 25 Yr event
Inflow = 4.72 cfs @ 12.22 hrs, Volume= 0.412 af
Outflow = 4.71 cfs @ 12.24 hrs, Volume= 0.412 af, Atten= 0%, Lag= 0.7 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
Max. Velocity= 3.29 fps, Min. Travel Time= 0.4 min
Avg. Velocity = 1.37 fps, Avg. Travel Time= 1.0 min

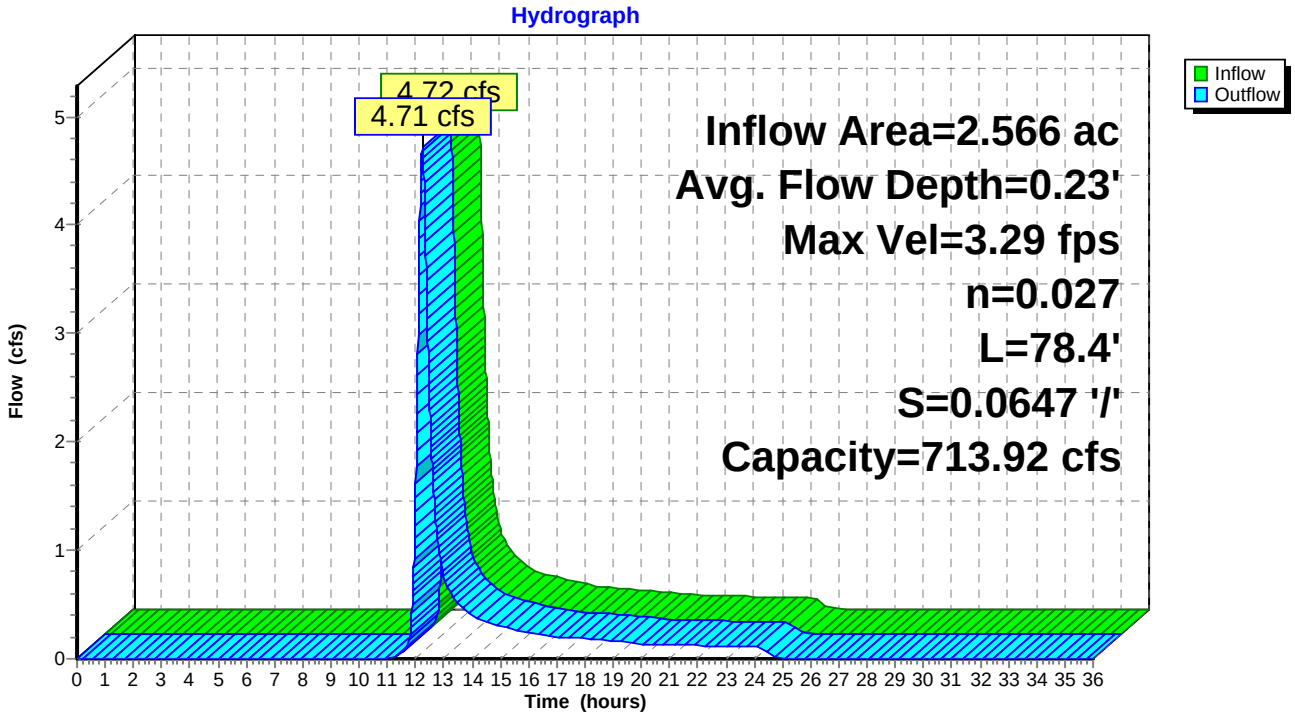
Peak Storage= 112 cf @ 12.23 hrs
Average Depth at Peak Storage= 0.23'
Bank-Full Depth= 1.50' Flow Area= 61.9 sf, Capacity= 713.92 cfs

0.00' x 1.50' deep channel, n= 0.027
Side Slope Z-value= 50.0 5.0 '/' Top Width= 82.50'
Length= 78.4' Slope= 0.0647 '/'
Inlet Invert= 406.78', Outlet Invert= 401.71'



‡

Reach C2A1: Channel 2A-1



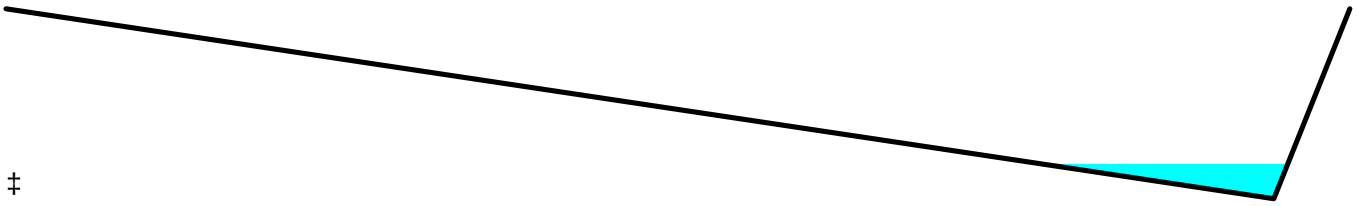
Summary for Reach C2A2: Channel 2A-2

Inflow Area = 0.595 ac, 0.00% Impervious, Inflow Depth = 1.93" for 25 Yr event
Inflow = 1.25 cfs @ 12.12 hrs, Volume= 0.095 af
Outflow = 1.23 cfs @ 12.18 hrs, Volume= 0.095 af, Atten= 2%, Lag= 3.6 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
Max. Velocity= 1.38 fps, Min. Travel Time= 1.9 min
Avg. Velocity = 0.59 fps, Avg. Travel Time= 4.5 min

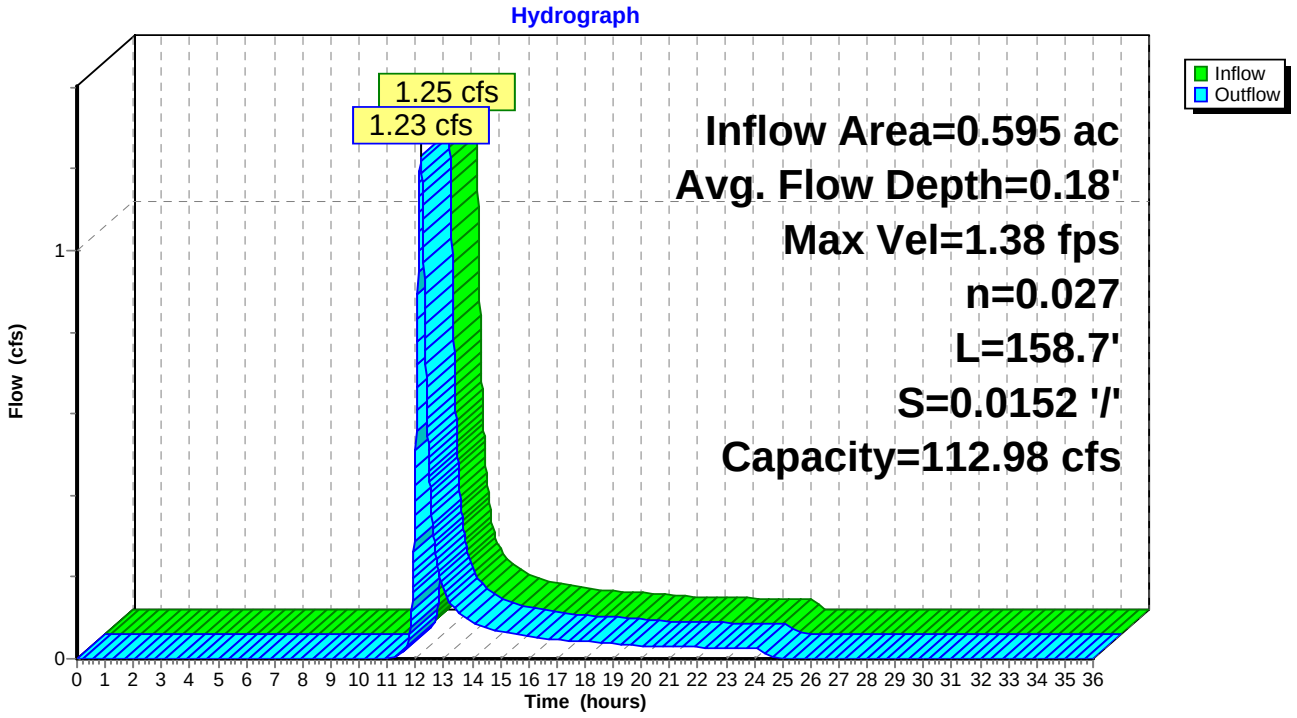
Peak Storage= 142 cf @ 12.15 hrs
Average Depth at Peak Storage= 0.18'
Bank-Full Depth= 1.00' Flow Area= 26.5 sf, Capacity= 112.98 cfs

0.00' x 1.00' deep channel, n= 0.027
Side Slope Z-value= 50.0 3.0 '/' Top Width= 53.00'
Length= 158.7' Slope= 0.0152 '/'
Inlet Invert= 405.19', Outlet Invert= 402.78'



‡

Reach C2A2: Channel 2A-2



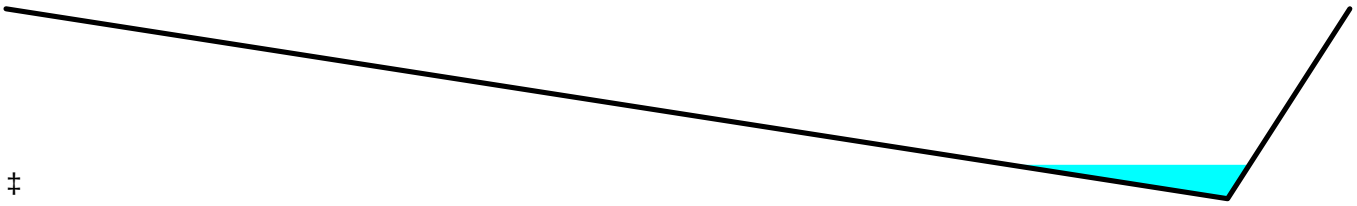
Summary for Reach C2A3: Channel 2A-3

Inflow Area = 1.421 ac, 0.00% Impervious, Inflow Depth = 1.93" for 25 Yr event
Inflow = 3.03 cfs @ 12.12 hrs, Volume= 0.228 af
Outflow = 2.74 cfs @ 12.27 hrs, Volume= 0.228 af, Atten= 9%, Lag= 8.9 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
Max. Velocity= 1.40 fps, Min. Travel Time= 5.1 min
Avg. Velocity = 0.56 fps, Avg. Travel Time= 12.6 min

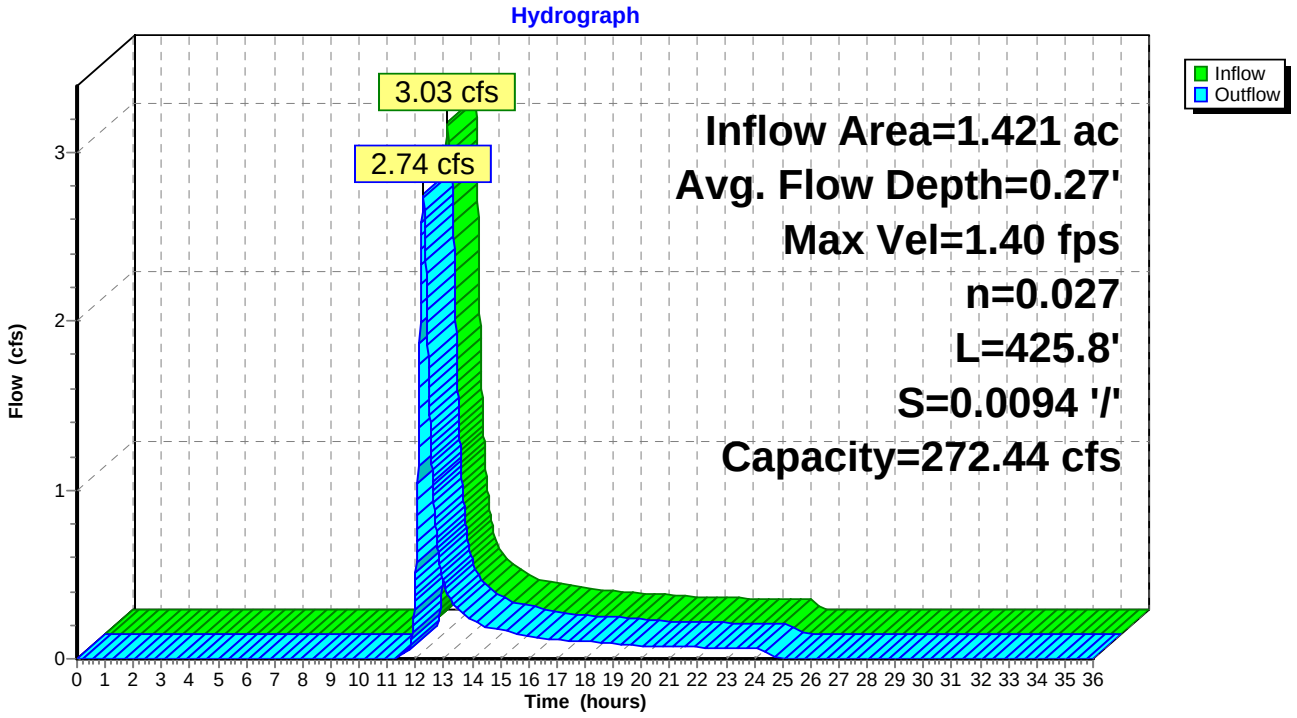
Peak Storage= 838 cf @ 12.18 hrs
Average Depth at Peak Storage= 0.27'
Bank-Full Depth= 1.50' Flow Area= 61.9 sf, Capacity= 272.44 cfs

0.00' x 1.50' deep channel, n= 0.027
Side Slope Z-value= 50.0 5.0 '/' Top Width= 82.50'
Length= 425.8' Slope= 0.0094 '/'
Inlet Invert= 406.79', Outlet Invert= 402.78'



‡

Reach C2A3: Channel 2A-3



Summary for Reach C2B1: Channel 2B-1

Inflow Area = 14.345 ac, 0.00% Impervious, Inflow Depth = 1.93" for 25 Yr event
Inflow = 26.40 cfs @ 12.27 hrs, Volume= 2.302 af
Outflow = 26.36 cfs @ 12.28 hrs, Volume= 2.302 af, Atten= 0%, Lag= 1.1 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
Max. Velocity= 3.03 fps, Min. Travel Time= 0.6 min
Avg. Velocity = 0.94 fps, Avg. Travel Time= 2.1 min

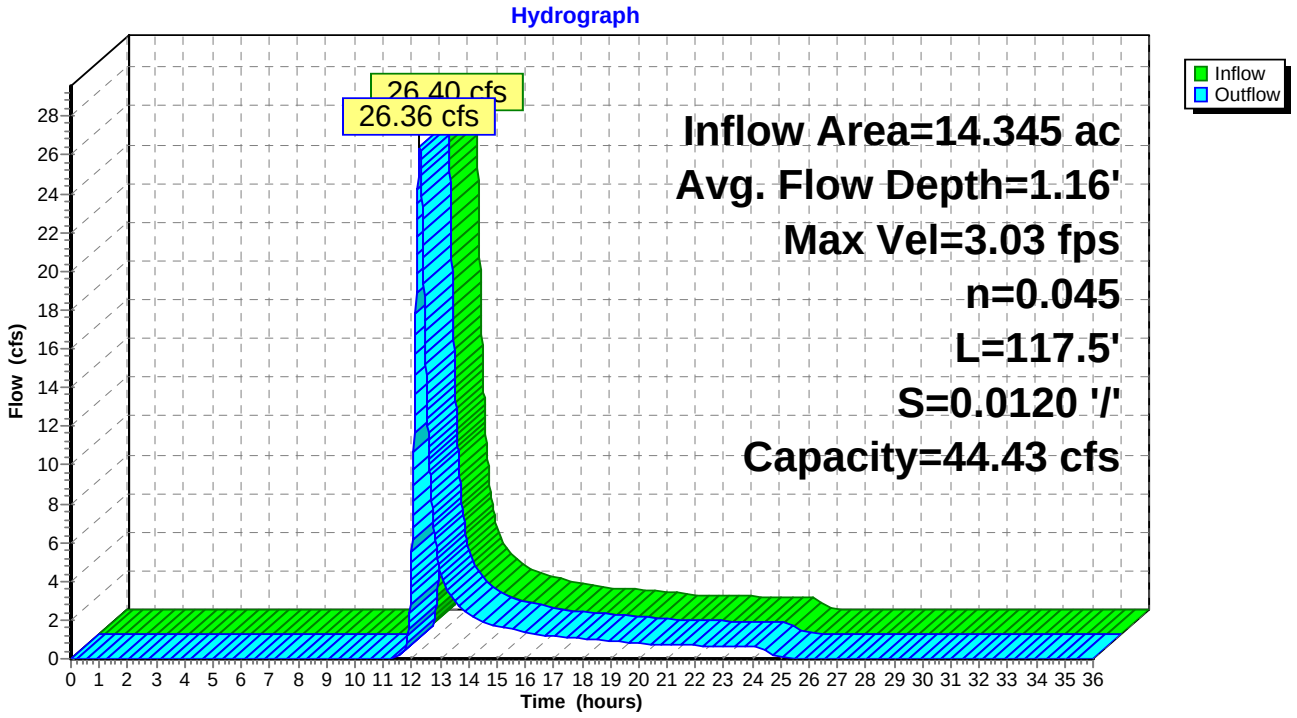
Peak Storage= 1,022 cf @ 12.27 hrs
Average Depth at Peak Storage= 1.16'
Bank-Full Depth= 1.50' Flow Area= 12.8 sf, Capacity= 44.43 cfs

4.00' x 1.50' deep channel, n= 0.045
Side Slope Z-value= 3.0 '/' Top Width= 13.00'
Length= 117.5' Slope= 0.0120 '/'
Inlet Invert= 401.66', Outlet Invert= 400.25'



‡

Reach C2B1: Channel 2B-1



Summary for Reach C2B10: Channel 2B-10

Inflow Area = 4.590 ac, 0.00% Impervious, Inflow Depth = 1.93" for 25 Yr event
Inflow = 8.66 cfs @ 12.21 hrs, Volume= 0.737 af
Outflow = 8.62 cfs @ 12.24 hrs, Volume= 0.737 af, Atten= 0%, Lag= 2.1 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
Max. Velocity= 2.22 fps, Min. Travel Time= 1.2 min
Avg. Velocity = 0.68 fps, Avg. Travel Time= 3.9 min

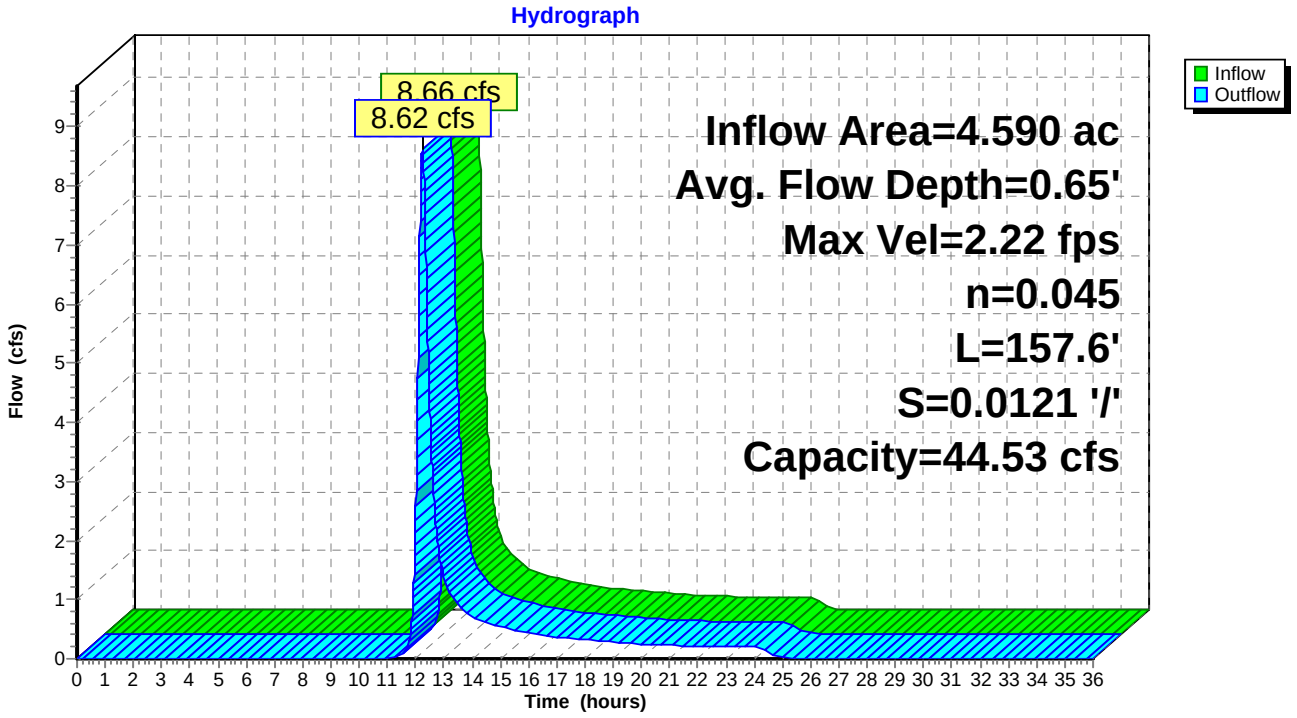
Peak Storage= 613 cf @ 12.22 hrs
Average Depth at Peak Storage= 0.65'
Bank-Full Depth= 1.50' Flow Area= 12.8 sf, Capacity= 44.53 cfs

4.00' x 1.50' deep channel, n= 0.045
Side Slope Z-value= 3.0 '/' Top Width= 13.00'
Length= 157.6' Slope= 0.0121 '/'
Inlet Invert= 407.36', Outlet Invert= 405.46'



‡

Reach C2B10: Channel 2B-10



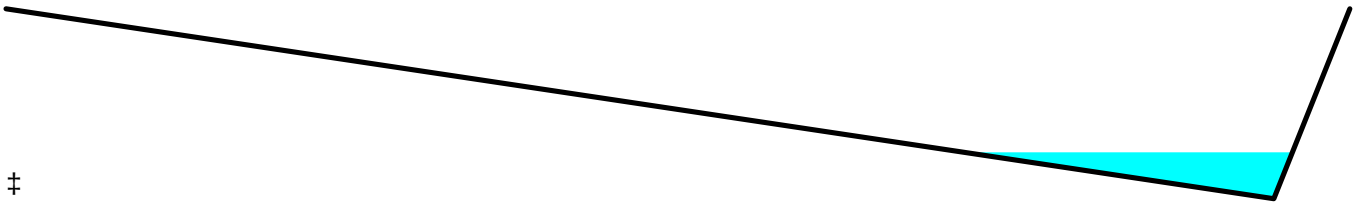
Summary for Reach C2B11: Channel 2B-11

Inflow Area = 1.333 ac, 0.00% Impervious, Inflow Depth = 1.93" for 25 Yr event
Inflow = 2.84 cfs @ 12.12 hrs, Volume= 0.214 af
Outflow = 2.61 cfs @ 12.26 hrs, Volume= 0.214 af, Atten= 8%, Lag= 8.1 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
Max. Velocity= 1.65 fps, Min. Travel Time= 4.6 min
Avg. Velocity = 0.66 fps, Avg. Travel Time= 11.6 min

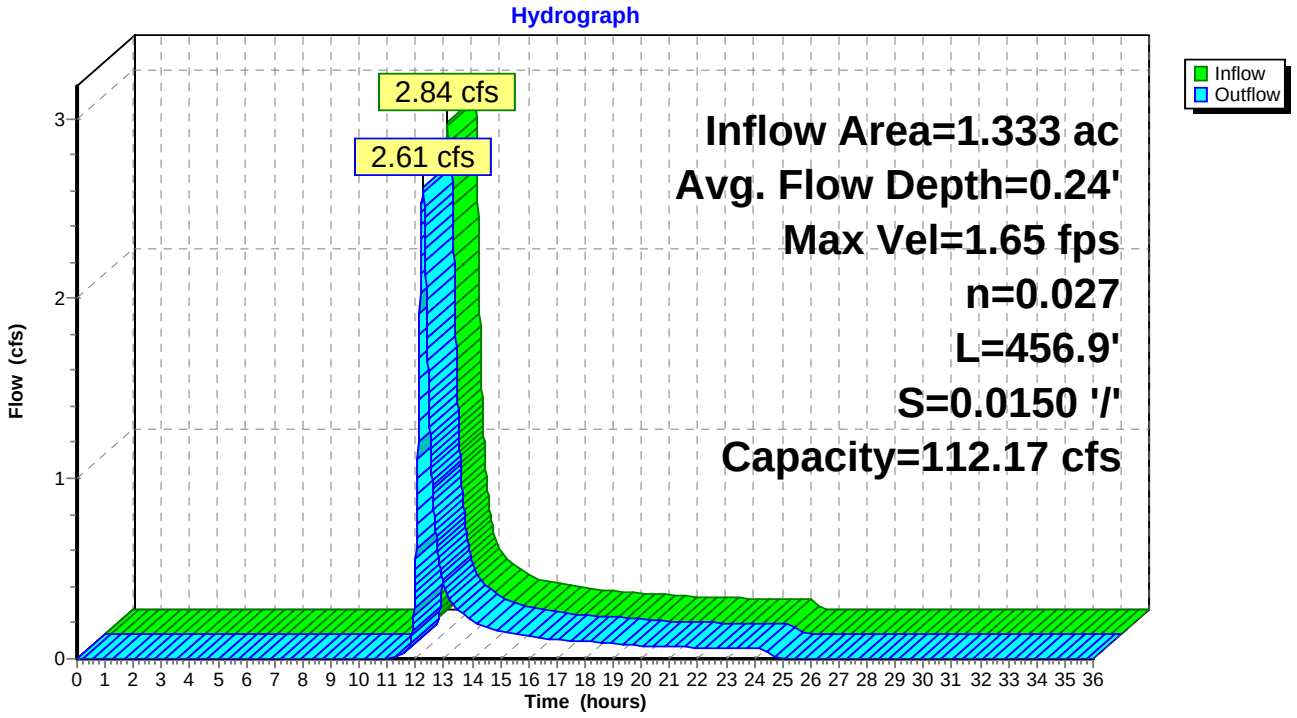
Peak Storage= 722 cf @ 12.18 hrs
Average Depth at Peak Storage= 0.24'
Bank-Full Depth= 1.00' Flow Area= 26.5 sf, Capacity= 112.17 cfs

0.00' x 1.00' deep channel, n= 0.027
Side Slope Z-value= 50.0 3.0 '/' Top Width= 53.00'
Length= 456.9' Slope= 0.0150 '/'
Inlet Invert= 414.61', Outlet Invert= 407.77'



‡

Reach C2B11: Channel 2B-11



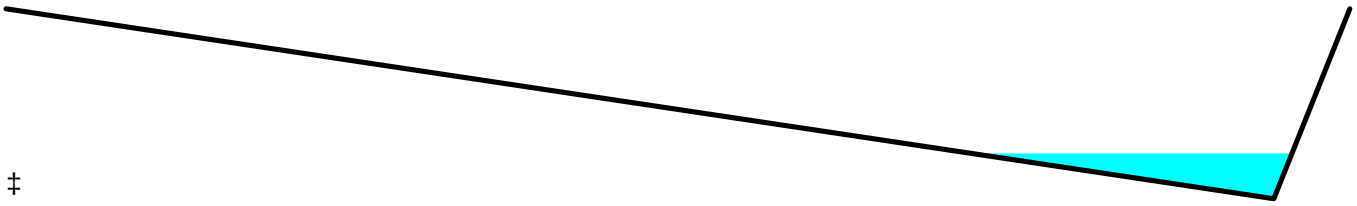
Summary for Reach C2B12: Channel 2B-12

Inflow Area = 1.270 ac, 0.00% Impervious, Inflow Depth = 1.93" for 25 Yr event
Inflow = 2.78 cfs @ 12.12 hrs, Volume= 0.204 af
Outflow = 2.54 cfs @ 12.25 hrs, Volume= 0.204 af, Atten= 9%, Lag= 7.9 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
Max. Velocity= 1.69 fps, Min. Travel Time= 4.6 min
Avg. Velocity = 0.67 fps, Avg. Travel Time= 11.7 min

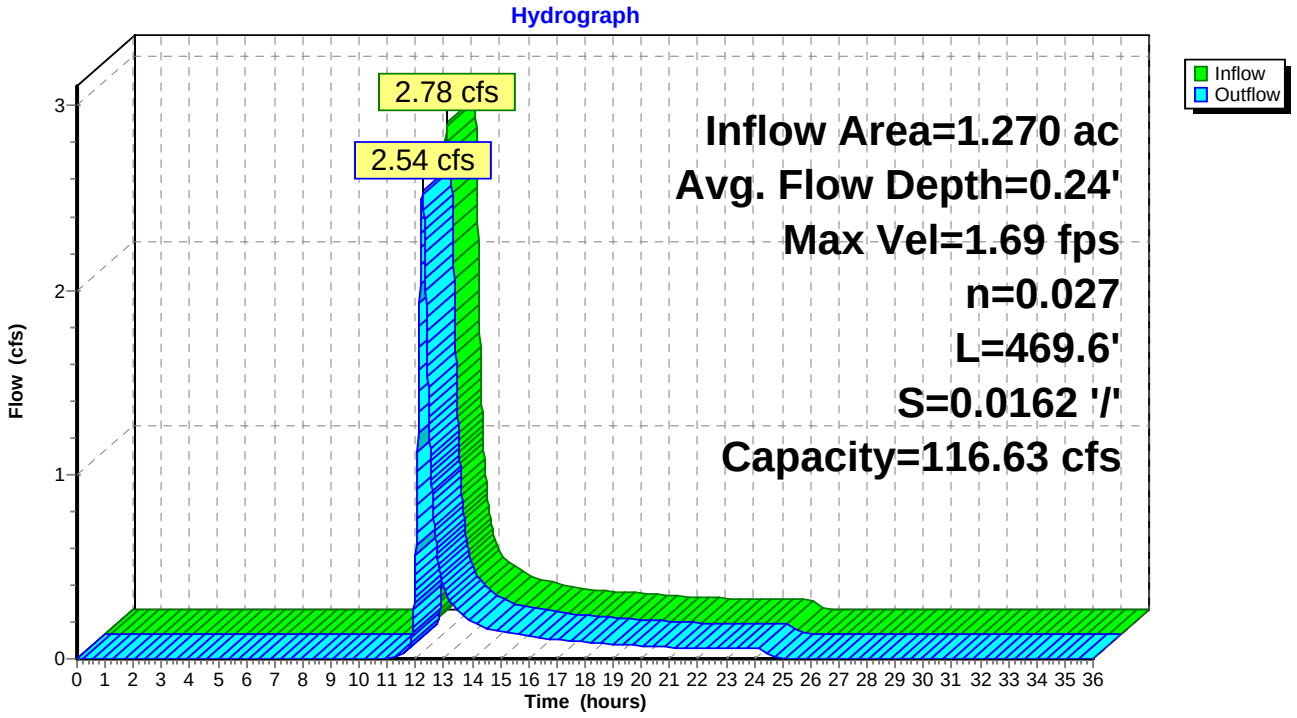
Peak Storage= 705 cf @ 12.17 hrs
Average Depth at Peak Storage= 0.24'
Bank-Full Depth= 1.00' Flow Area= 26.5 sf, Capacity= 116.63 cfs

0.00' x 1.00' deep channel, n= 0.027
Side Slope Z-value= 50.0 3.0 '/' Top Width= 53.00'
Length= 469.6' Slope= 0.0162 '/'
Inlet Invert= 415.37', Outlet Invert= 407.77'



‡

Reach C2B12: Channel 2B-12



Summary for Reach C2B13: Channel 2B-13

Inflow Area = 1.036 ac, 0.00% Impervious, Inflow Depth = 1.93" for 25 Yr event
Inflow = 2.24 cfs @ 12.12 hrs, Volume= 0.166 af
Outflow = 2.22 cfs @ 12.16 hrs, Volume= 0.166 af, Atten= 1%, Lag= 2.7 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
Max. Velocity= 1.46 fps, Min. Travel Time= 1.6 min
Avg. Velocity = 0.45 fps, Avg. Travel Time= 5.2 min

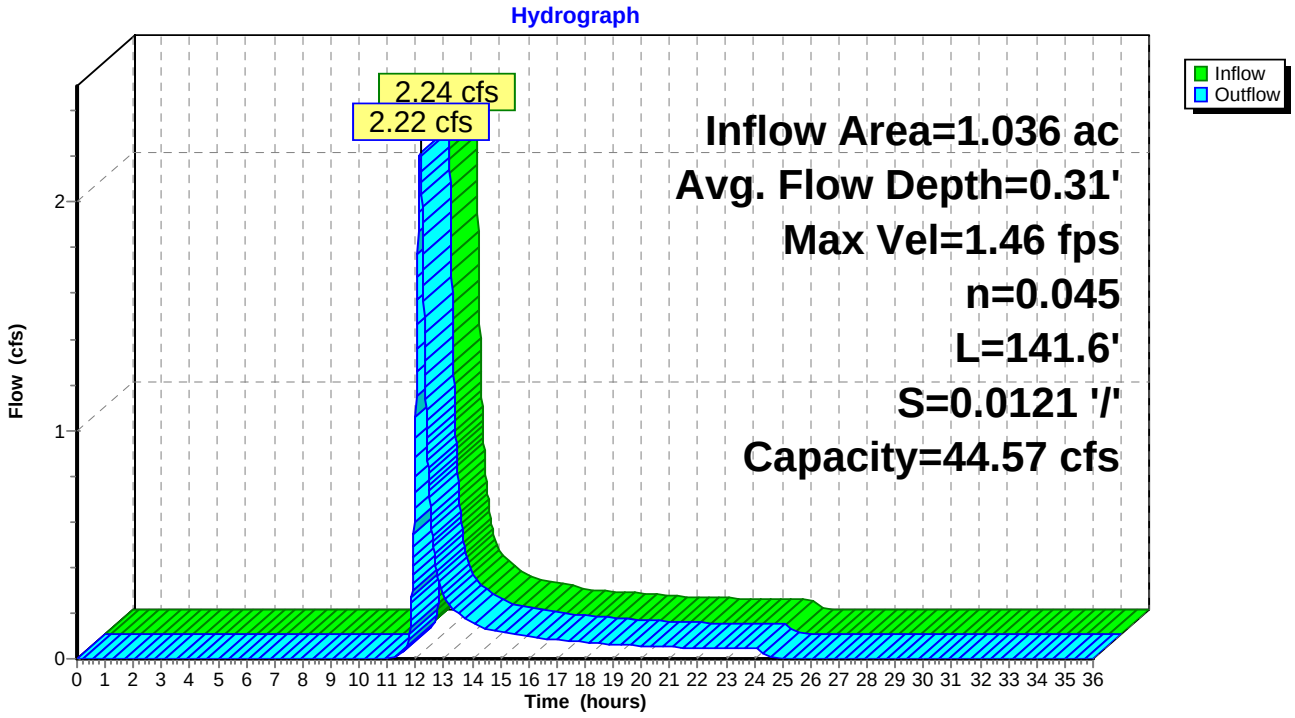
Peak Storage= 215 cf @ 12.14 hrs
Average Depth at Peak Storage= 0.31'
Bank-Full Depth= 1.50' Flow Area= 12.8 sf, Capacity= 44.57 cfs

4.00' x 1.50' deep channel, n= 0.045
Side Slope Z-value= 3.0 '/' Top Width= 13.00'
Length= 141.6' Slope= 0.0121 '/'
Inlet Invert= 409.07', Outlet Invert= 407.36'



‡

Reach C2B13: Channel 2B-13



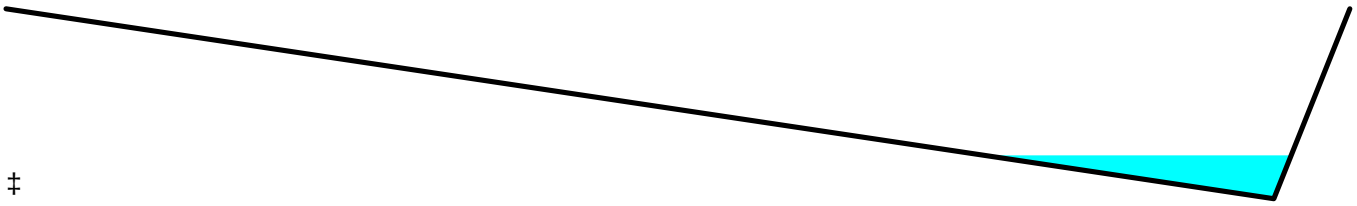
Summary for Reach C2B2: Channel 2B-2

Inflow Area = 1.098 ac, 0.00% Impervious, Inflow Depth = 1.93" for 25 Yr event
Inflow = 2.34 cfs @ 12.12 hrs, Volume= 0.176 af
Outflow = 2.17 cfs @ 12.25 hrs, Volume= 0.176 af, Atten= 7%, Lag= 7.8 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
Max. Velocity= 1.57 fps, Min. Travel Time= 4.4 min
Avg. Velocity = 0.63 fps, Avg. Travel Time= 11.0 min

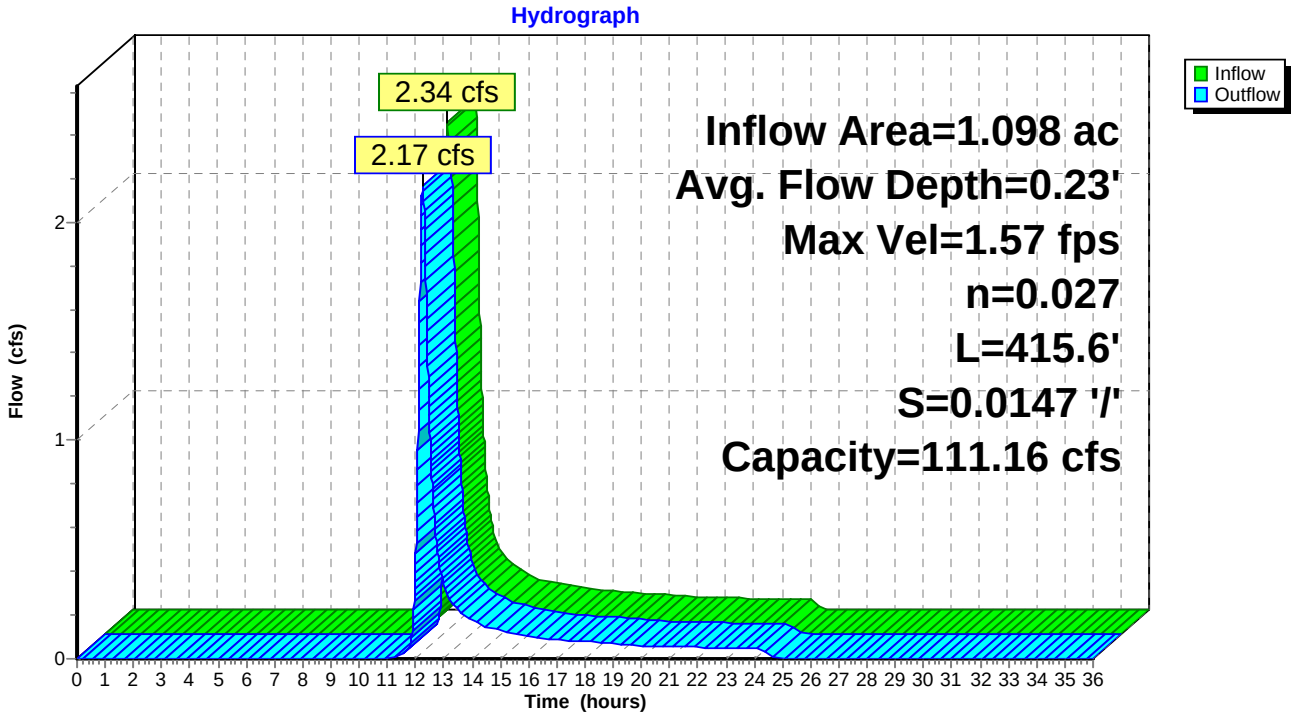
Peak Storage= 575 cf @ 12.18 hrs
Average Depth at Peak Storage= 0.23'
Bank-Full Depth= 1.00' Flow Area= 26.5 sf, Capacity= 111.16 cfs

0.00' x 1.00' deep channel, n= 0.027
Side Slope Z-value= 50.0 3.0 '/' Top Width= 53.00'
Length= 415.6' Slope= 0.0147 '/'
Inlet Invert= 409.22', Outlet Invert= 403.11'



‡

Reach C2B2: Channel 2B-2



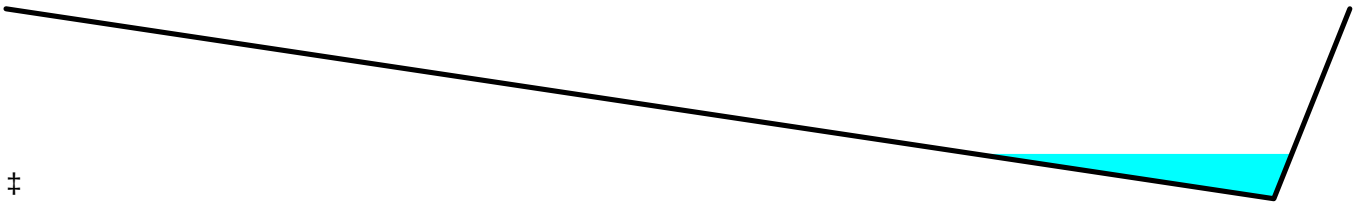
Summary for Reach C2B3: Channel 2B-3

Inflow Area = 1.217 ac, 0.00% Impervious, Inflow Depth = 1.93" for 25 Yr event
Inflow = 2.69 cfs @ 12.11 hrs, Volume= 0.195 af
Outflow = 2.49 cfs @ 12.23 hrs, Volume= 0.195 af, Atten= 7%, Lag= 7.1 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
Max. Velocity= 1.69 fps, Min. Travel Time= 4.1 min
Avg. Velocity = 0.67 fps, Avg. Travel Time= 10.3 min

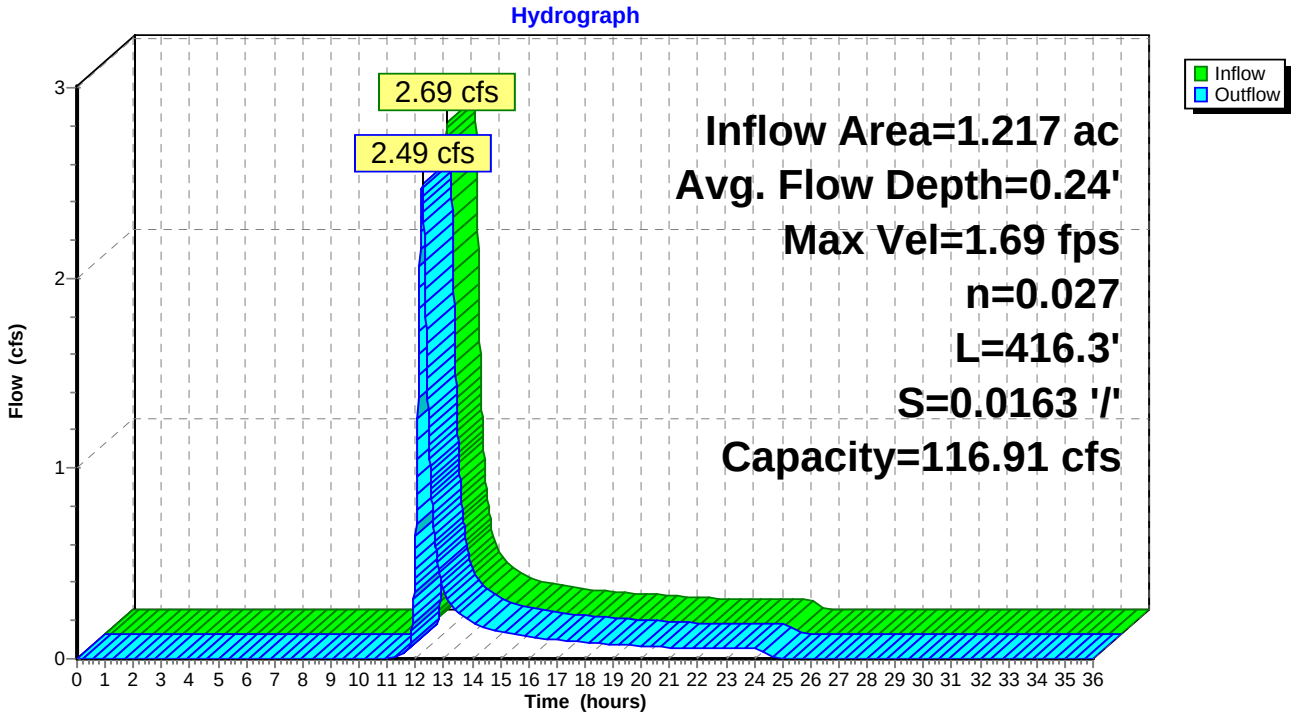
Peak Storage= 615 cf @ 12.16 hrs
Average Depth at Peak Storage= 0.24'
Bank-Full Depth= 1.00' Flow Area= 26.5 sf, Capacity= 116.91 cfs

0.00' x 1.00' deep channel, n= 0.027
Side Slope Z-value= 50.0 3.0 '/' Top Width= 53.00'
Length= 416.3' Slope= 0.0163 '/'
Inlet Invert= 409.80', Outlet Invert= 403.03'



‡

Reach C2B3: Channel 2B-3



Summary for Reach C2B4: Channel 2B-4

Inflow Area = 11.368 ac, 0.00% Impervious, Inflow Depth = 1.93" for 25 Yr event
Inflow = 21.07 cfs @ 12.25 hrs, Volume= 1.824 af
Outflow = 21.01 cfs @ 12.28 hrs, Volume= 1.824 af, Atten= 0%, Lag= 1.6 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
Max. Velocity= 2.85 fps, Min. Travel Time= 0.9 min
Avg. Velocity = 0.88 fps, Avg. Travel Time= 3.0 min

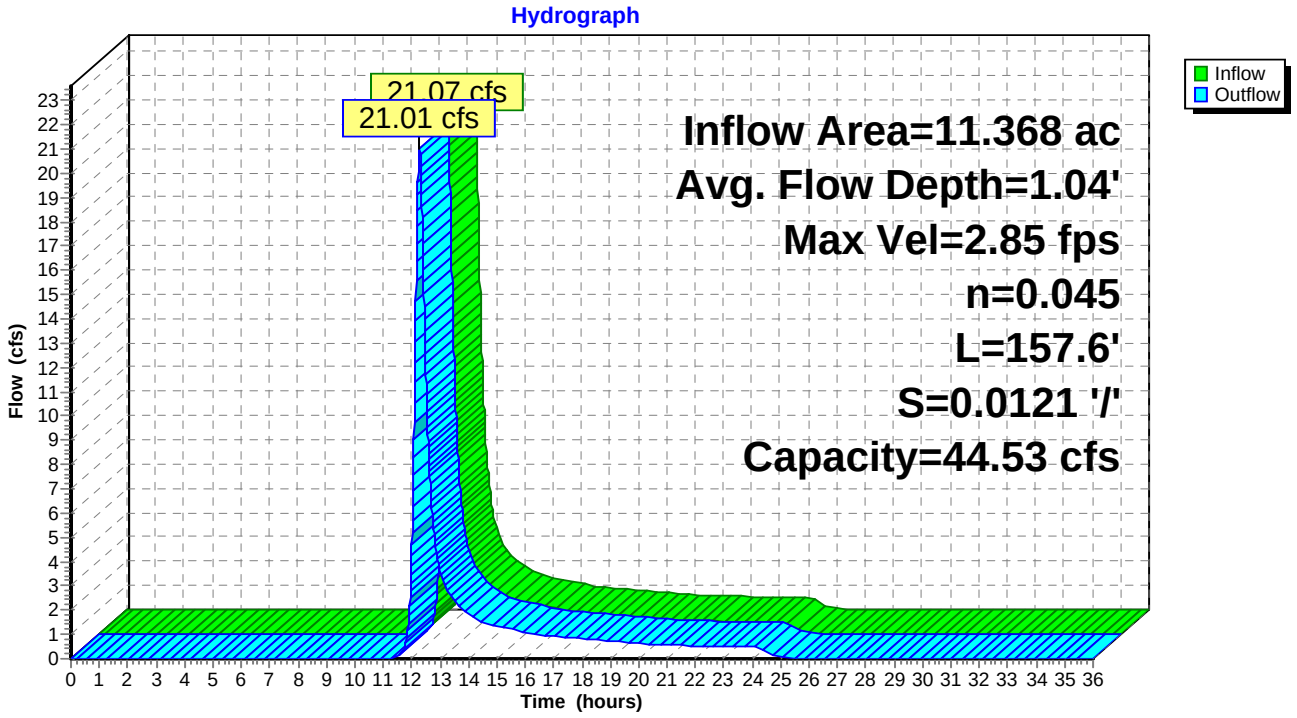
Peak Storage= 1,161 cf @ 12.26 hrs
Average Depth at Peak Storage= 1.04'
Bank-Full Depth= 1.50' Flow Area= 12.8 sf, Capacity= 44.53 cfs

4.00' x 1.50' deep channel, n= 0.045
Side Slope Z-value= 3.0 '/' Top Width= 13.00'
Length= 157.6' Slope= 0.0121 '/'
Inlet Invert= 403.56', Outlet Invert= 401.66'



‡

Reach C2B4: Channel 2B-4



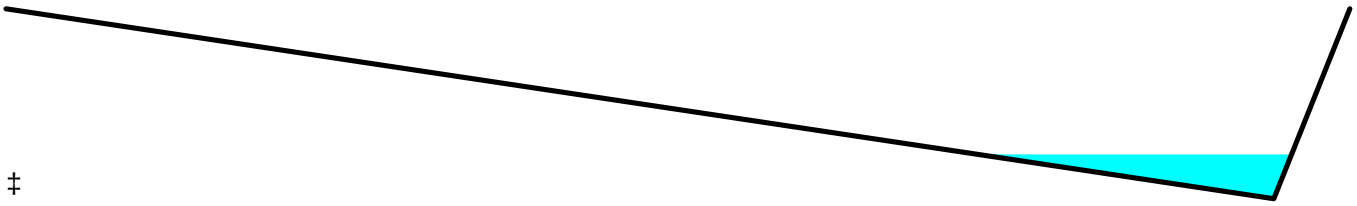
Summary for Reach C2B5: Channel 2B-5

Inflow Area = 1.163 ac, 0.00% Impervious, Inflow Depth = 1.93" for 25 Yr event
Inflow = 2.51 cfs @ 12.12 hrs, Volume= 0.187 af
Outflow = 2.31 cfs @ 12.25 hrs, Volume= 0.187 af, Atten= 8%, Lag= 7.8 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
Max. Velocity= 1.60 fps, Min. Travel Time= 4.4 min
Avg. Velocity = 0.64 fps, Avg. Travel Time= 11.0 min

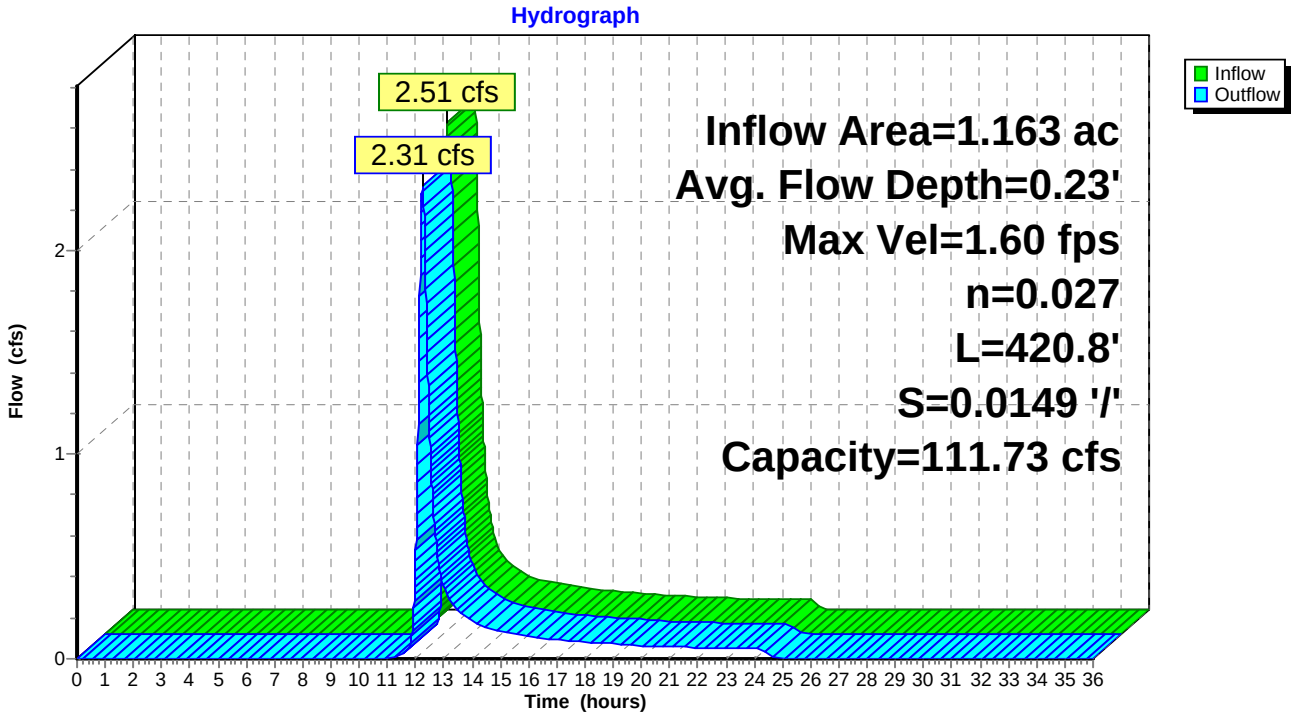
Peak Storage= 609 cf @ 12.17 hrs
Average Depth at Peak Storage= 0.23'
Bank-Full Depth= 1.00' Flow Area= 26.5 sf, Capacity= 111.73 cfs

0.00' x 1.00' deep channel, n= 0.027
Side Slope Z-value= 50.0 3.0 '/' Top Width= 53.00'
Length= 420.8' Slope= 0.0149 '/'
Inlet Invert= 410.91', Outlet Invert= 404.66'



‡

Reach C2B5: Channel 2B-5



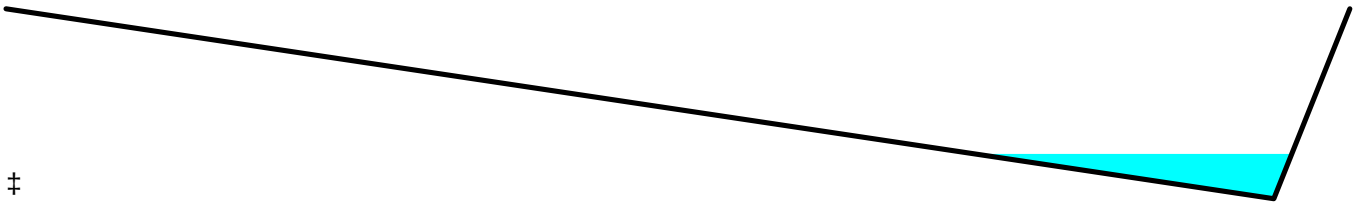
Summary for Reach C2B6: Channel 2B-6

Inflow Area = 1.232 ac, 0.00% Impervious, Inflow Depth = 1.93" for 25 Yr event
Inflow = 2.72 cfs @ 12.11 hrs, Volume= 0.198 af
Outflow = 2.48 cfs @ 12.25 hrs, Volume= 0.198 af, Atten= 9%, Lag= 8.1 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
Max. Velocity= 1.68 fps, Min. Travel Time= 4.7 min
Avg. Velocity = 0.66 fps, Avg. Travel Time= 11.9 min

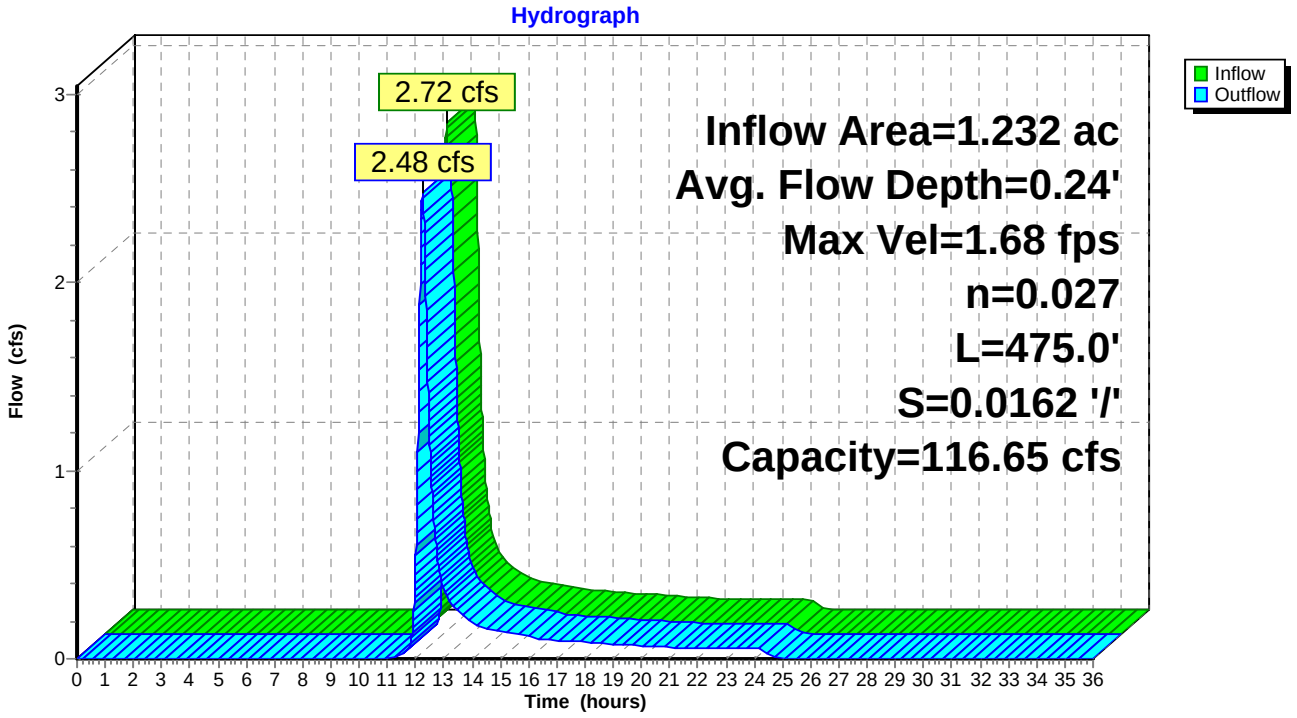
Peak Storage= 700 cf @ 12.17 hrs
Average Depth at Peak Storage= 0.24'
Bank-Full Depth= 1.00' Flow Area= 26.5 sf, Capacity= 116.65 cfs

0.00' x 1.00' deep channel, n= 0.027
Side Slope Z-value= 50.0 3.0 '/' Top Width= 53.00'
Length= 475.0' Slope= 0.0162 '/'
Inlet Invert= 412.33', Outlet Invert= 404.64'



‡

Reach C2B6: Channel 2B-6



Summary for Reach C2B7: Channel 2B-7

Inflow Area = 8.012 ac, 0.00% Impervious, Inflow Depth = 1.93" for 25 Yr event
Inflow = 15.00 cfs @ 12.23 hrs, Volume= 1.286 af
Outflow = 14.95 cfs @ 12.26 hrs, Volume= 1.286 af, Atten= 0%, Lag= 1.8 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
Max. Velocity= 2.60 fps, Min. Travel Time= 1.0 min
Avg. Velocity = 0.80 fps, Avg. Travel Time= 3.3 min

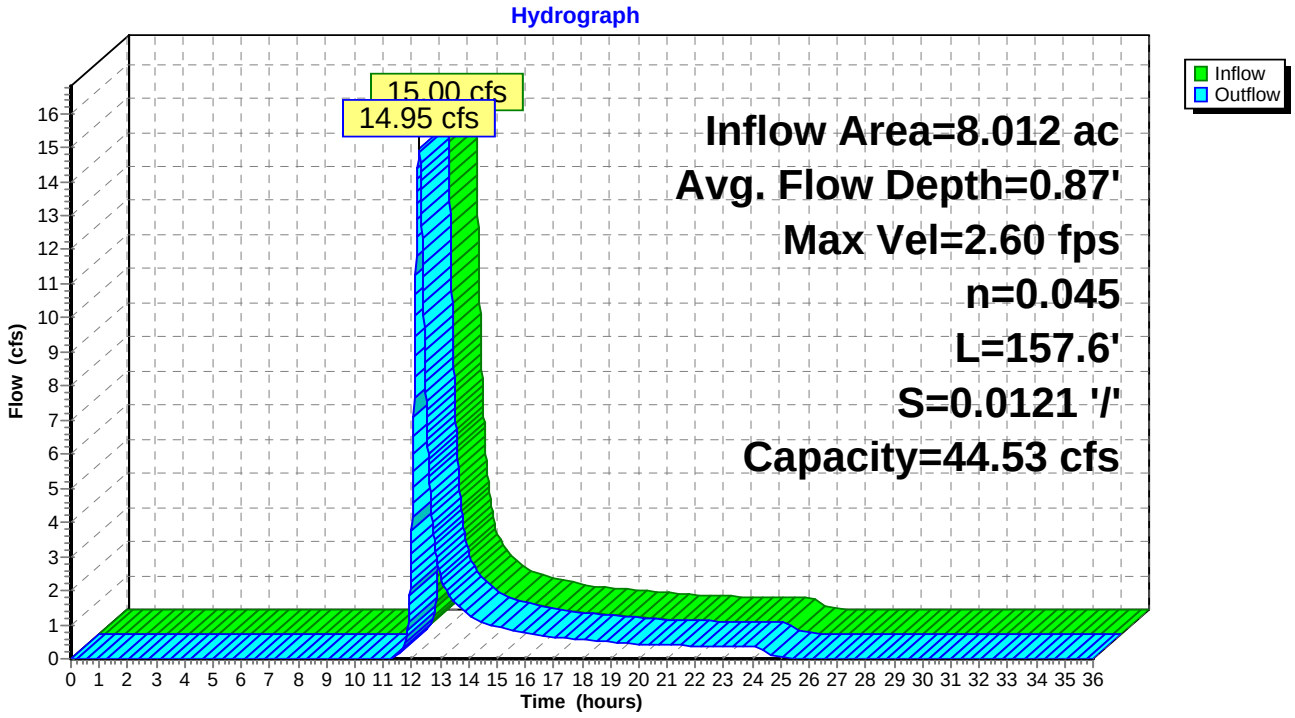
Peak Storage= 908 cf @ 12.24 hrs
Average Depth at Peak Storage= 0.87'
Bank-Full Depth= 1.50' Flow Area= 12.8 sf, Capacity= 44.53 cfs

4.00' x 1.50' deep channel, n= 0.045
Side Slope Z-value= 3.0 '/' Top Width= 13.00'
Length= 157.6' Slope= 0.0121 '/'
Inlet Invert= 405.46', Outlet Invert= 403.56'



‡

Reach C2B7: Channel 2B-7



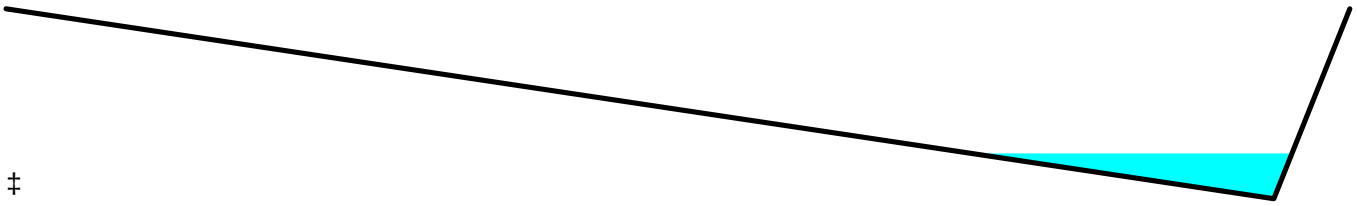
Summary for Reach C2B8: Channel 2B-8

Inflow Area = 1.231 ac, 0.00% Impervious, Inflow Depth = 1.93" for 25 Yr event
Inflow = 2.65 cfs @ 12.12 hrs, Volume= 0.198 af
Outflow = 2.44 cfs @ 12.25 hrs, Volume= 0.198 af, Atten= 8%, Lag= 8.0 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
Max. Velocity= 1.63 fps, Min. Travel Time= 4.5 min
Avg. Velocity = 0.65 fps, Avg. Travel Time= 11.3 min

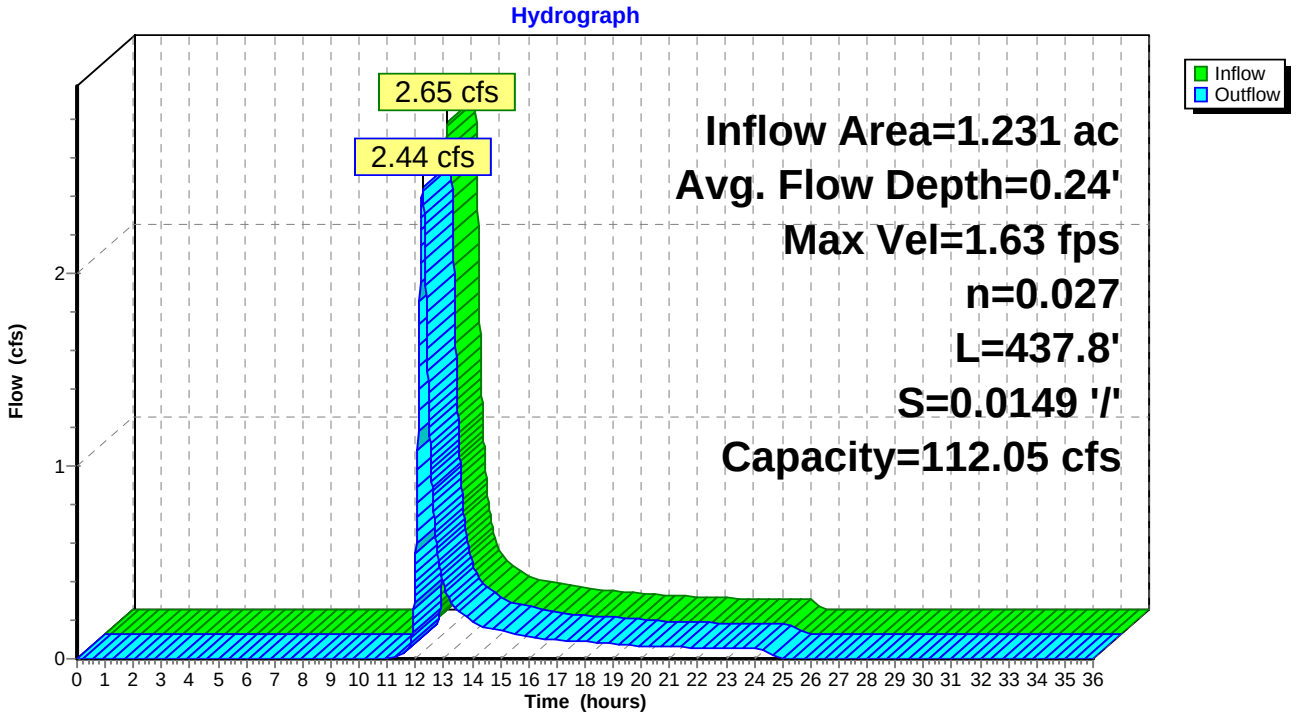
Peak Storage= 658 cf @ 12.17 hrs
Average Depth at Peak Storage= 0.24'
Bank-Full Depth= 1.00' Flow Area= 26.5 sf, Capacity= 112.05 cfs

0.00' x 1.00' deep channel, n= 0.027
Side Slope Z-value= 50.0 3.0 '/' Top Width= 53.00'
Length= 437.8' Slope= 0.0149 '/'
Inlet Invert= 412.74', Outlet Invert= 406.20'



‡

Reach C2B8: Channel 2B-8



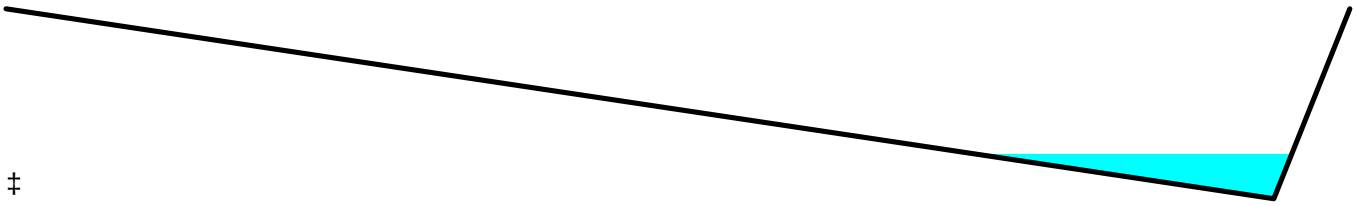
Summary for Reach C2B9: Channel 2B-9

Inflow Area = 1.230 ac, 0.00% Impervious, Inflow Depth = 1.93" for 25 Yr event
Inflow = 2.71 cfs @ 12.11 hrs, Volume= 0.197 af
Outflow = 2.47 cfs @ 12.25 hrs, Volume= 0.197 af, Atten= 9%, Lag= 8.1 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
Max. Velocity= 1.68 fps, Min. Travel Time= 4.7 min
Avg. Velocity = 0.67 fps, Avg. Travel Time= 11.8 min

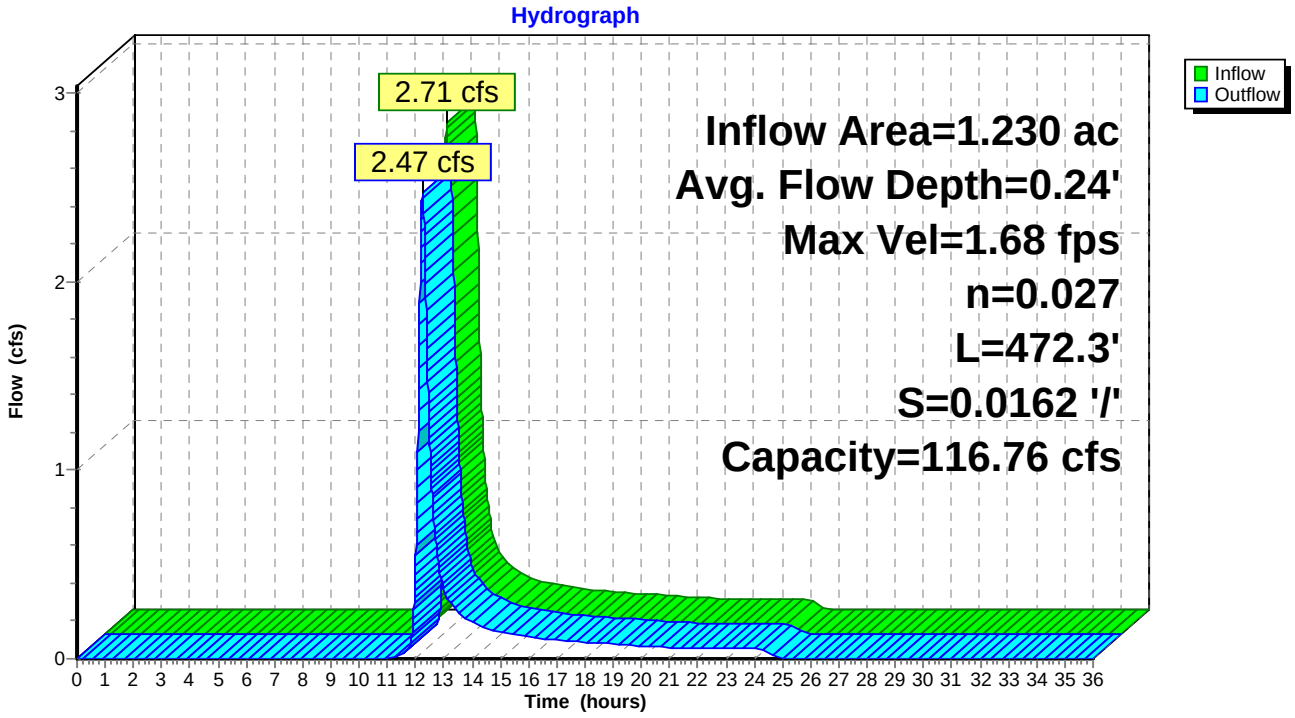
Peak Storage= 695 cf @ 12.17 hrs
Average Depth at Peak Storage= 0.24'
Bank-Full Depth= 1.00' Flow Area= 26.5 sf, Capacity= 116.76 cfs

0.00' x 1.00' deep channel, n= 0.027
Side Slope Z-value= 50.0 3.0 '/' Top Width= 53.00'
Length= 472.3' Slope= 0.0162 '/'
Inlet Invert= 413.86', Outlet Invert= 406.20'



‡

Reach C2B9: Channel 2B-9



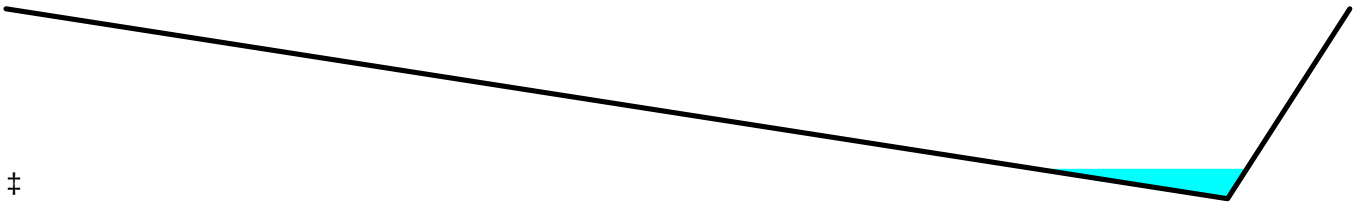
Summary for Reach C2C: Channel 2C

Inflow Area = 1.303 ac, 0.00% Impervious, Inflow Depth = 1.93" for 25 Yr event
Inflow = 2.94 cfs @ 12.11 hrs, Volume= 0.209 af
Outflow = 2.67 cfs @ 12.24 hrs, Volume= 0.209 af, Atten= 9%, Lag= 7.8 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
Max. Velocity= 1.74 fps, Min. Travel Time= 4.6 min
Avg. Velocity = 0.71 fps, Avg. Travel Time= 11.3 min

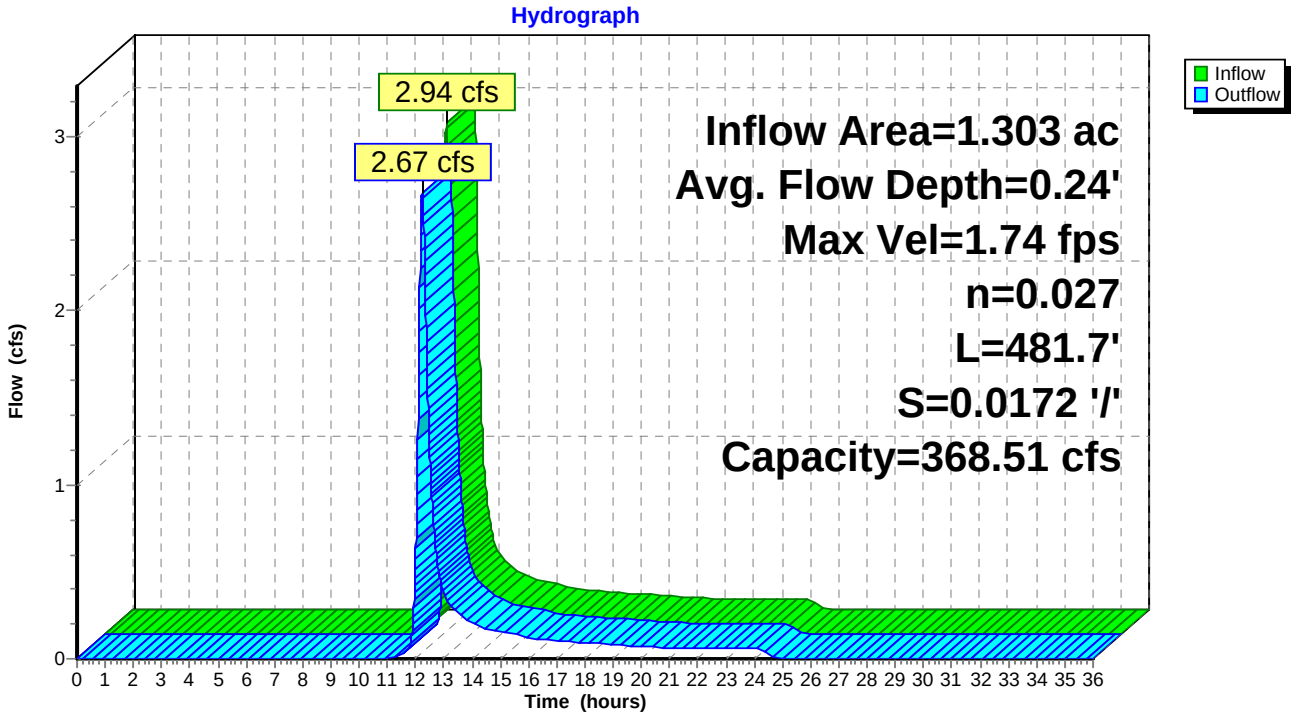
Peak Storage= 740 cf @ 12.16 hrs
Average Depth at Peak Storage= 0.24'
Bank-Full Depth= 1.50' Flow Area= 61.9 sf, Capacity= 368.51 cfs

0.00' x 1.50' deep channel, n= 0.027
Side Slope Z-value= 50.0 5.0 '/' Top Width= 82.50'
Length= 481.7' Slope= 0.0172 '/'
Inlet Invert= 410.00', Outlet Invert= 401.70'



‡

Reach C2C: Channel 2C



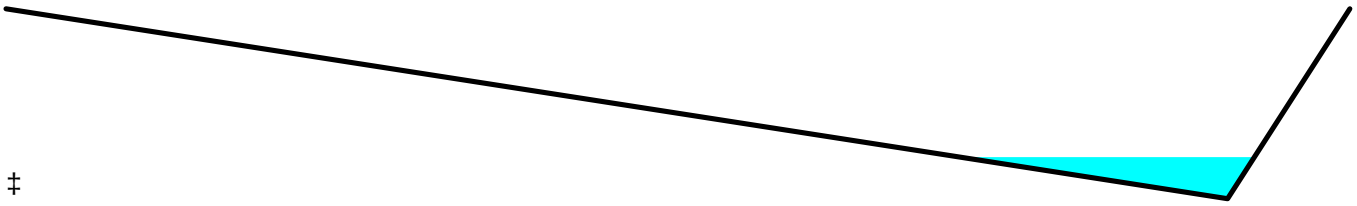
Summary for Reach C3A1: Channel 3A-1

Inflow Area = 2.777 ac, 0.00% Impervious, Inflow Depth = 1.93" for 25 Yr event
Inflow = 5.54 cfs @ 12.15 hrs, Volume= 0.446 af
Outflow = 5.25 cfs @ 12.27 hrs, Volume= 0.446 af, Atten= 5%, Lag= 6.9 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
Max. Velocity= 1.77 fps, Min. Travel Time= 3.9 min
Avg. Velocity = 0.71 fps, Avg. Travel Time= 9.8 min

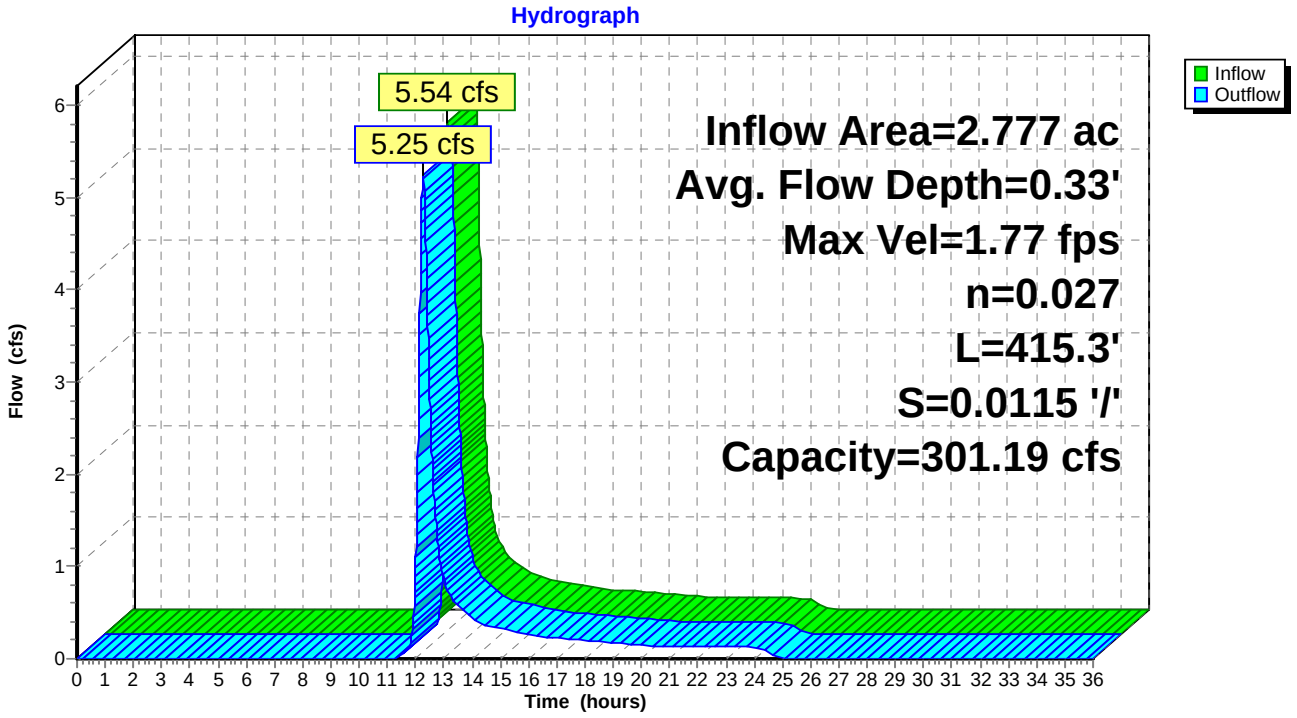
Peak Storage= 1,232 cf @ 12.20 hrs
Average Depth at Peak Storage= 0.33'
Bank-Full Depth= 1.50' Flow Area= 61.9 sf, Capacity= 301.19 cfs

0.00' x 1.50' deep channel, n= 0.027
Side Slope Z-value= 50.0 5.0 '/' Top Width= 82.50'
Length= 415.3' Slope= 0.0115 '/'
Inlet Invert= 406.44', Outlet Invert= 401.66'



‡

Reach C3A1: Channel 3A-1



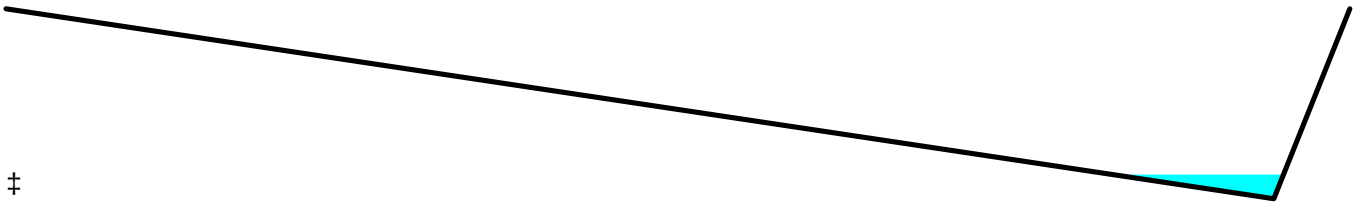
Summary for Reach C3A2: Channel 3A-2

Inflow Area = 0.225 ac, 0.00% Impervious, Inflow Depth = 1.93" for 25 Yr event
Inflow = 0.48 cfs @ 12.12 hrs, Volume= 0.036 af
Outflow = 0.48 cfs @ 12.15 hrs, Volume= 0.036 af, Atten= 1%, Lag= 1.5 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
Max. Velocity= 1.12 fps, Min. Travel Time= 0.9 min
Avg. Velocity = 0.49 fps, Avg. Travel Time= 1.9 min

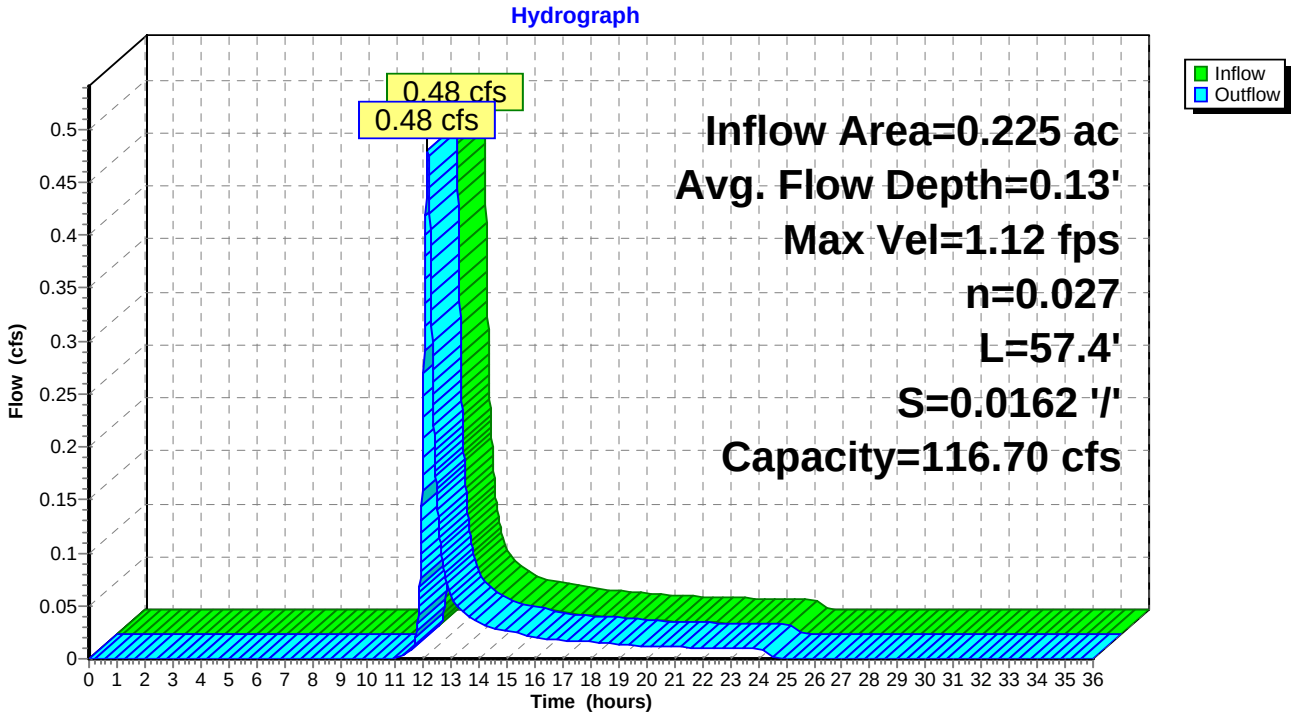
Peak Storage= 25 cf @ 12.13 hrs
Average Depth at Peak Storage= 0.13'
Bank-Full Depth= 1.00' Flow Area= 26.5 sf, Capacity= 116.70 cfs

0.00' x 1.00' deep channel, n= 0.027
Side Slope Z-value= 50.0 3.0 '/' Top Width= 53.00'
Length= 57.4' Slope= 0.0162 '/'
Inlet Invert= 407.37', Outlet Invert= 406.44'



‡

Reach C3A2: Channel 3A-2



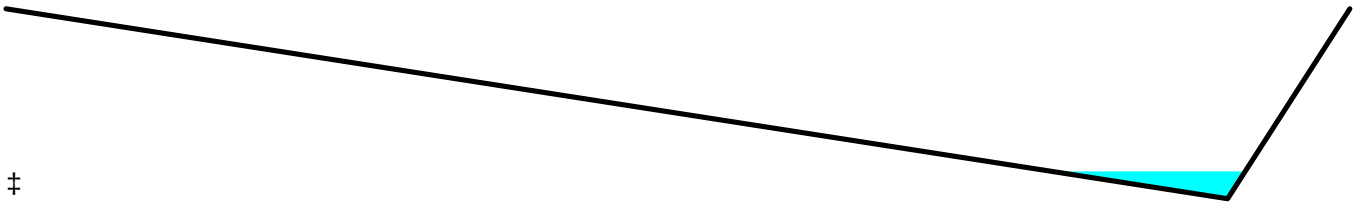
Summary for Reach C3A3: Channel 3A-3

Inflow Area = 0.833 ac, 0.00% Impervious, Inflow Depth = 1.93" for 25 Yr event
Inflow = 1.83 cfs @ 12.11 hrs, Volume= 0.134 af
Outflow = 1.71 cfs @ 12.22 hrs, Volume= 0.134 af, Atten= 6%, Lag= 6.8 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
Max. Velocity= 1.34 fps, Min. Travel Time= 3.8 min
Avg. Velocity = 0.56 fps, Avg. Travel Time= 9.1 min

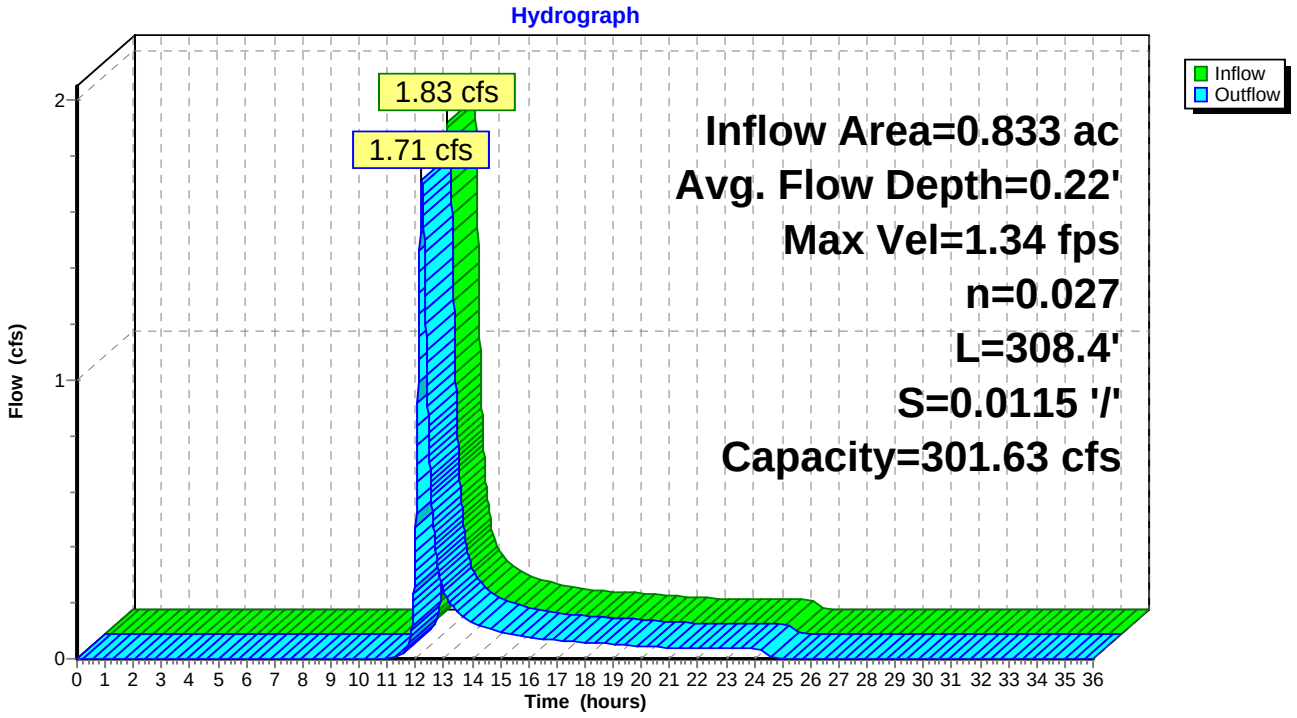
Peak Storage= 395 cf @ 12.16 hrs
Average Depth at Peak Storage= 0.22'
Bank-Full Depth= 1.50' Flow Area= 61.9 sf, Capacity= 301.63 cfs

0.00' x 1.50' deep channel, n= 0.027
Side Slope Z-value= 50.0 5.0 '/' Top Width= 82.50'
Length= 308.4' Slope= 0.0115 '/'
Inlet Invert= 410.00', Outlet Invert= 406.44'



‡

Reach C3A3: Channel 3A-3



Summary for Reach C3B1: Channel 3B-1

Inflow Area = 13.219 ac, 0.00% Impervious, Inflow Depth = 1.93" for 25 Yr event
Inflow = 23.42 cfs @ 12.27 hrs, Volume= 2.121 af
Outflow = 23.36 cfs @ 12.30 hrs, Volume= 2.121 af, Atten= 0%, Lag= 1.5 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
Max. Velocity= 2.96 fps, Min. Travel Time= 0.8 min
Avg. Velocity = 0.89 fps, Avg. Travel Time= 2.8 min

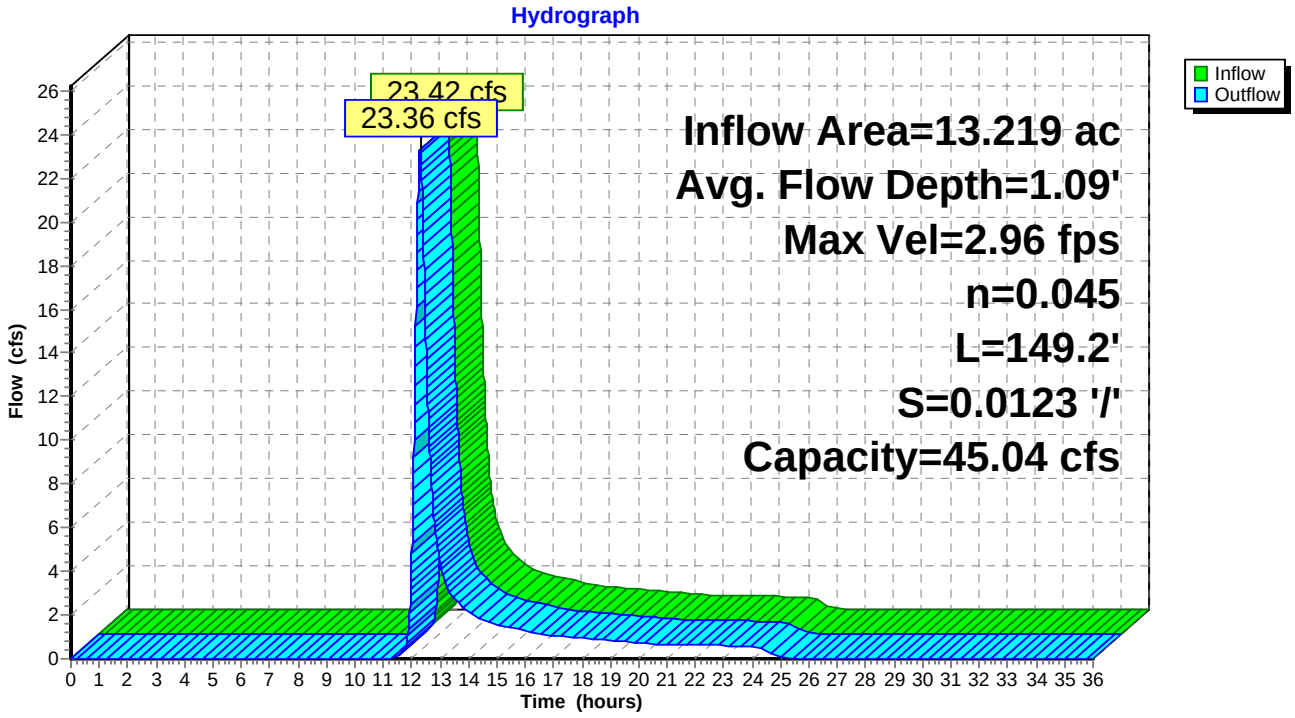
Peak Storage= 1,178 cf @ 12.28 hrs
Average Depth at Peak Storage= 1.09'
Bank-Full Depth= 1.50' Flow Area= 12.8 sf, Capacity= 45.04 cfs

4.00' x 1.50' deep channel, n= 0.045
Side Slope Z-value= 3.0 '/' Top Width= 13.00'
Length= 149.2' Slope= 0.0123 '/'
Inlet Invert= 402.13', Outlet Invert= 400.29'



‡

Reach C3B1: Channel 3B-1



Summary for Reach C3B10: Channel 3B-10

Inflow Area = 1.039 ac, 0.00% Impervious, Inflow Depth = 1.93" for 25 Yr event
Inflow = 2.25 cfs @ 12.12 hrs, Volume= 0.167 af
Outflow = 2.22 cfs @ 12.16 hrs, Volume= 0.167 af, Atten= 1%, Lag= 2.6 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
Max. Velocity= 1.48 fps, Min. Travel Time= 1.6 min
Avg. Velocity = 0.46 fps, Avg. Travel Time= 5.2 min

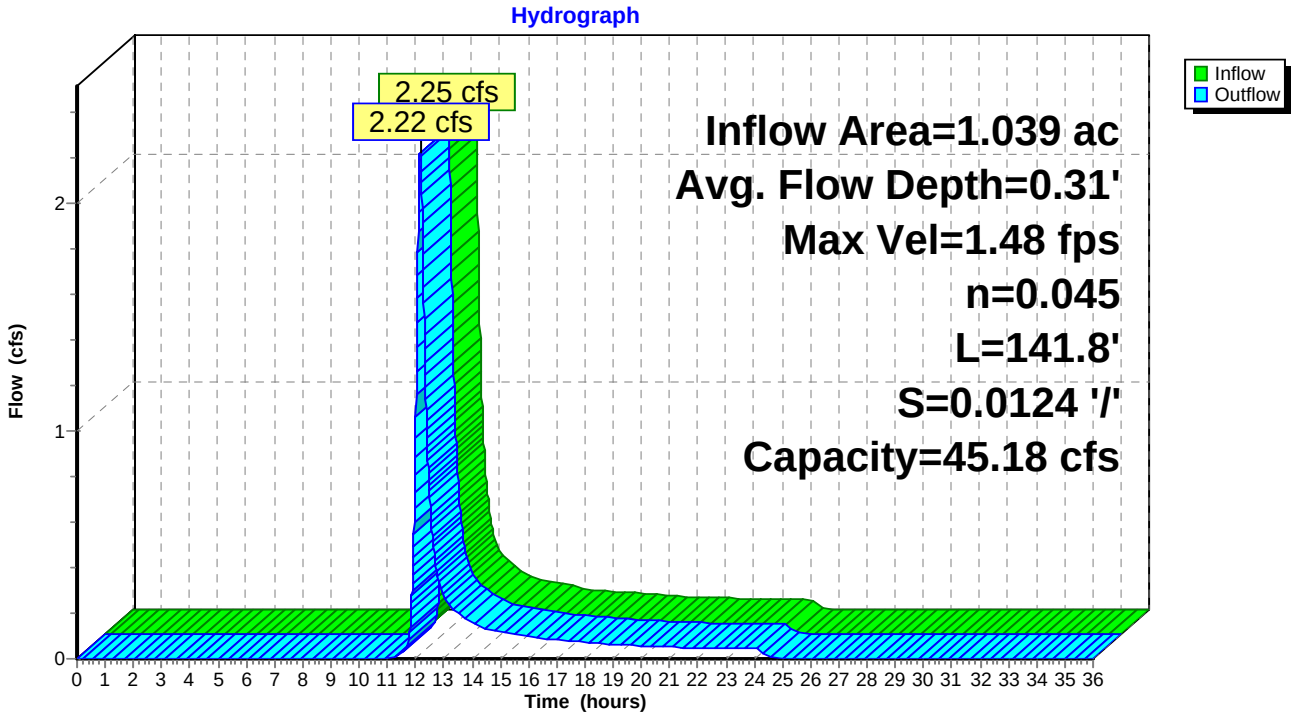
Peak Storage= 214 cf @ 12.14 hrs
Average Depth at Peak Storage= 0.31'
Bank-Full Depth= 1.50' Flow Area= 12.8 sf, Capacity= 45.18 cfs

4.00' x 1.50' deep channel, n= 0.045
Side Slope Z-value= 3.0 '/' Top Width= 13.00'
Length= 141.8' Slope= 0.0124 '/'
Inlet Invert= 407.78', Outlet Invert= 406.02'



‡

Reach C3B10: Channel 3B-10



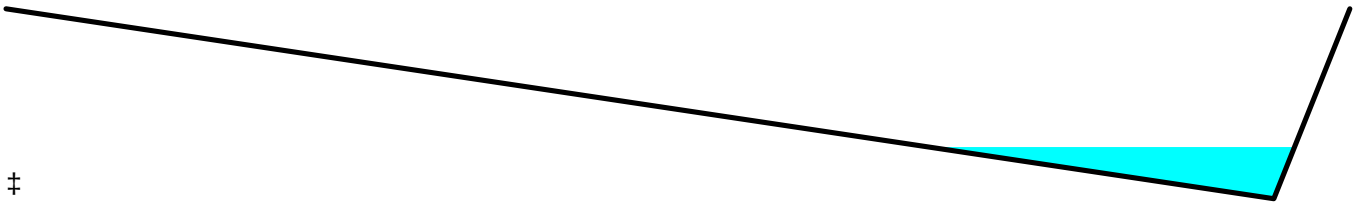
Summary for Reach C3B2: Channel 3B-2

Inflow Area = 1.929 ac, 0.00% Impervious, Inflow Depth = 1.93" for 25 Yr event
Inflow = 4.14 cfs @ 12.12 hrs, Volume= 0.310 af
Outflow = 3.63 cfs @ 12.29 hrs, Volume= 0.310 af, Atten= 12%, Lag= 10.3 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
Max. Velocity= 1.85 fps, Min. Travel Time= 6.0 min
Avg. Velocity = 0.70 fps, Avg. Travel Time= 15.9 min

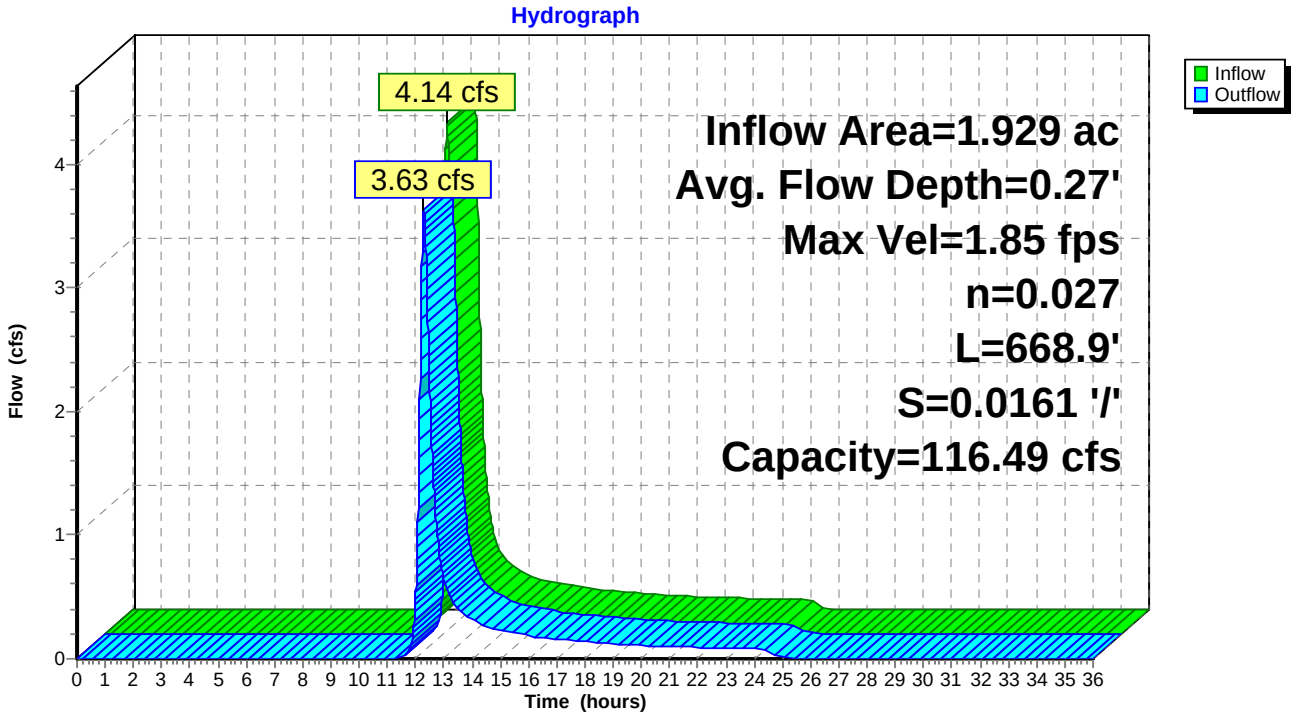
Peak Storage= 1,314 cf @ 12.19 hrs
Average Depth at Peak Storage= 0.27'
Bank-Full Depth= 1.00' Flow Area= 26.5 sf, Capacity= 116.49 cfs

0.00' x 1.00' deep channel, n= 0.027
Side Slope Z-value= 50.0 3.0 '/' Top Width= 53.00'
Length= 668.9' Slope= 0.0161 '/'
Inlet Invert= 414.15', Outlet Invert= 403.35'



‡

Reach C3B2: Channel 3B-2



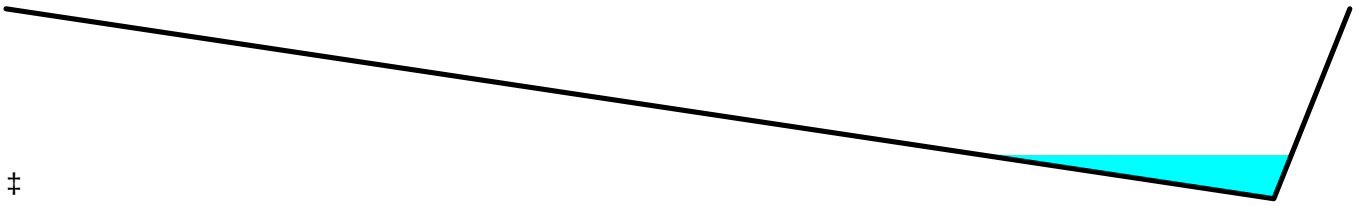
Summary for Reach C3B3: Channel 3B-3

Inflow Area = 1.128 ac, 0.00% Impervious, Inflow Depth = 1.93" for 25 Yr event
Inflow = 2.46 cfs @ 12.11 hrs, Volume= 0.181 af
Outflow = 2.27 cfs @ 12.24 hrs, Volume= 0.181 af, Atten= 8%, Lag= 7.6 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
Max. Velocity= 1.60 fps, Min. Travel Time= 4.3 min
Avg. Velocity = 0.64 fps, Avg. Travel Time= 10.7 min

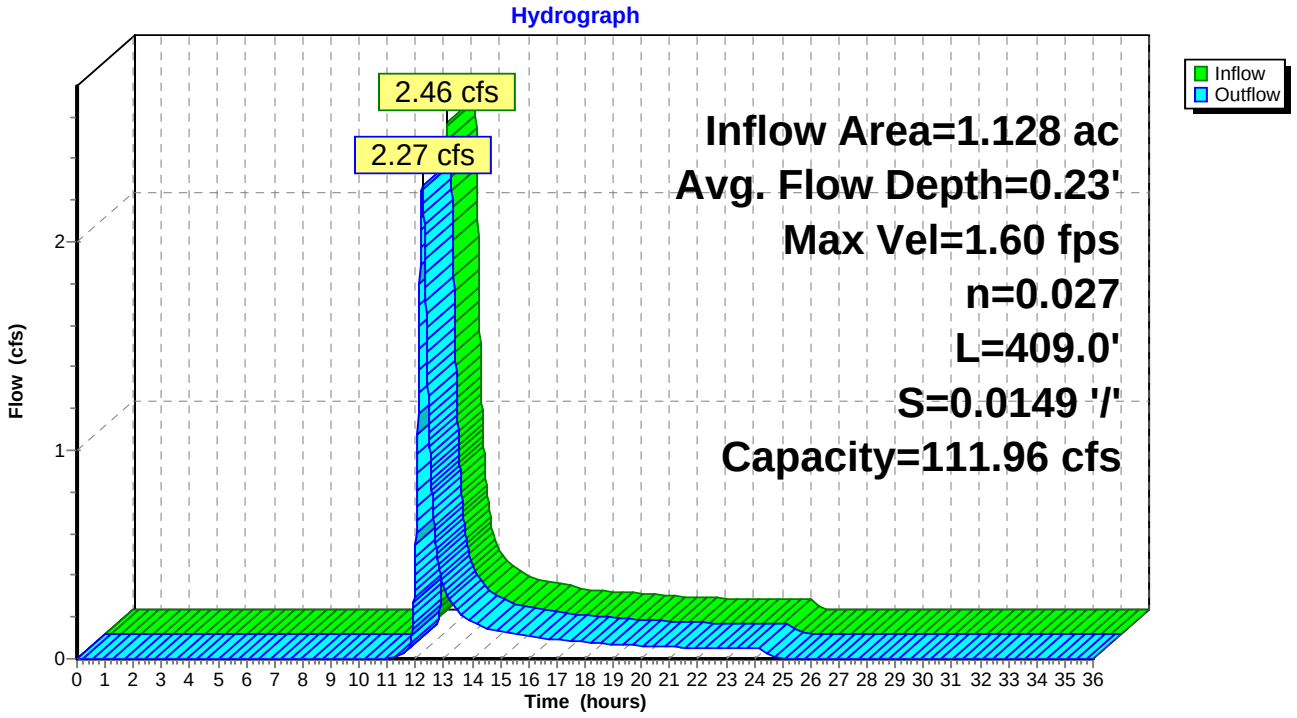
Peak Storage= 583 cf @ 12.17 hrs
Average Depth at Peak Storage= 0.23'
Bank-Full Depth= 1.00' Flow Area= 26.5 sf, Capacity= 111.96 cfs

0.00' x 1.00' deep channel, n= 0.027
Side Slope Z-value= 50.0 3.0 '/' Top Width= 53.00'
Length= 409.0' Slope= 0.0149 '/'
Inlet Invert= 409.44', Outlet Invert= 403.34'



‡

Reach C3B3: Channel 3B-3



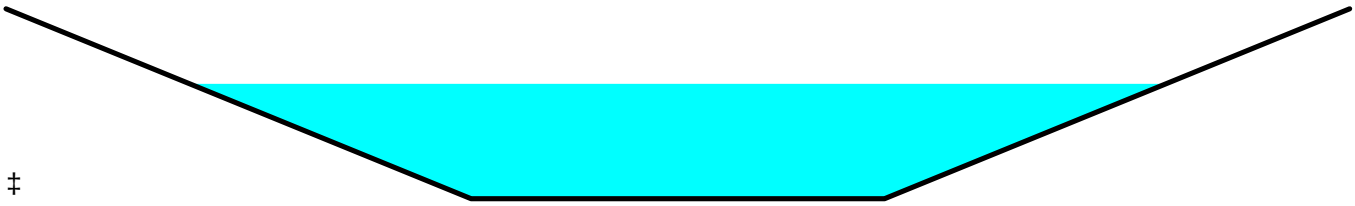
Summary for Reach C3B4: Channel 3B-4

Inflow Area = 9.203 ac, 0.00% Impervious, Inflow Depth = 1.93" for 25 Yr event
Inflow = 16.44 cfs @ 12.25 hrs, Volume= 1.477 af
Outflow = 16.39 cfs @ 12.28 hrs, Volume= 1.477 af, Atten= 0%, Lag= 1.7 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
Max. Velocity= 2.69 fps, Min. Travel Time= 1.0 min
Avg. Velocity = 0.81 fps, Avg. Travel Time= 3.3 min

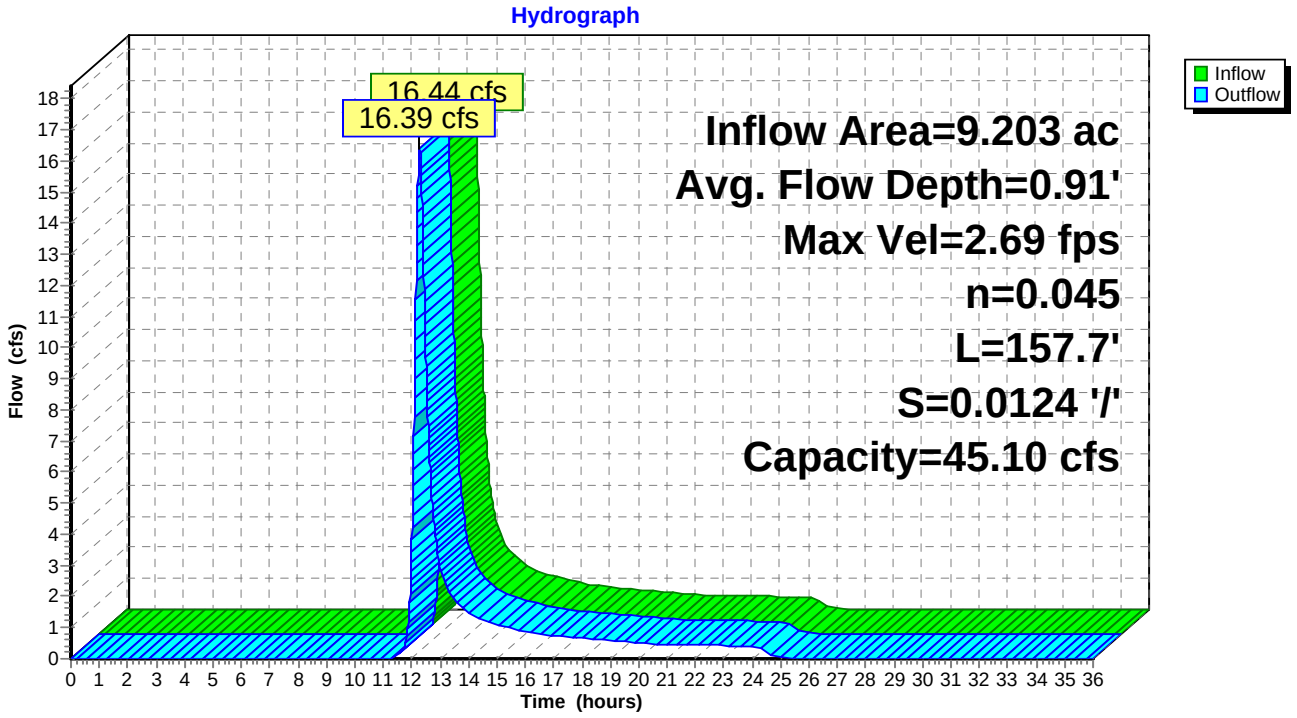
Peak Storage= 962 cf @ 12.27 hrs
Average Depth at Peak Storage= 0.91'
Bank-Full Depth= 1.50' Flow Area= 12.8 sf, Capacity= 45.10 cfs

4.00' x 1.50' deep channel, n= 0.045
Side Slope Z-value= 3.0 '/' Top Width= 13.00'
Length= 157.7' Slope= 0.0124 '/'
Inlet Invert= 404.08', Outlet Invert= 402.13'



‡

Reach C3B4: Channel 3B-4



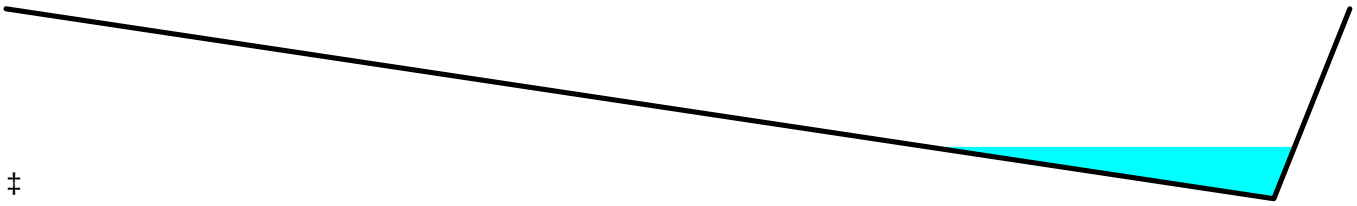
Summary for Reach C3B5: Channel 3B-5

Inflow Area = 1.935 ac, 0.00% Impervious, Inflow Depth = 1.93" for 25 Yr event
Inflow = 4.15 cfs @ 12.12 hrs, Volume= 0.311 af
Outflow = 3.64 cfs @ 12.29 hrs, Volume= 0.311 af, Atten= 12%, Lag= 10.3 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
Max. Velocity= 1.85 fps, Min. Travel Time= 6.0 min
Avg. Velocity = 0.70 fps, Avg. Travel Time= 15.8 min

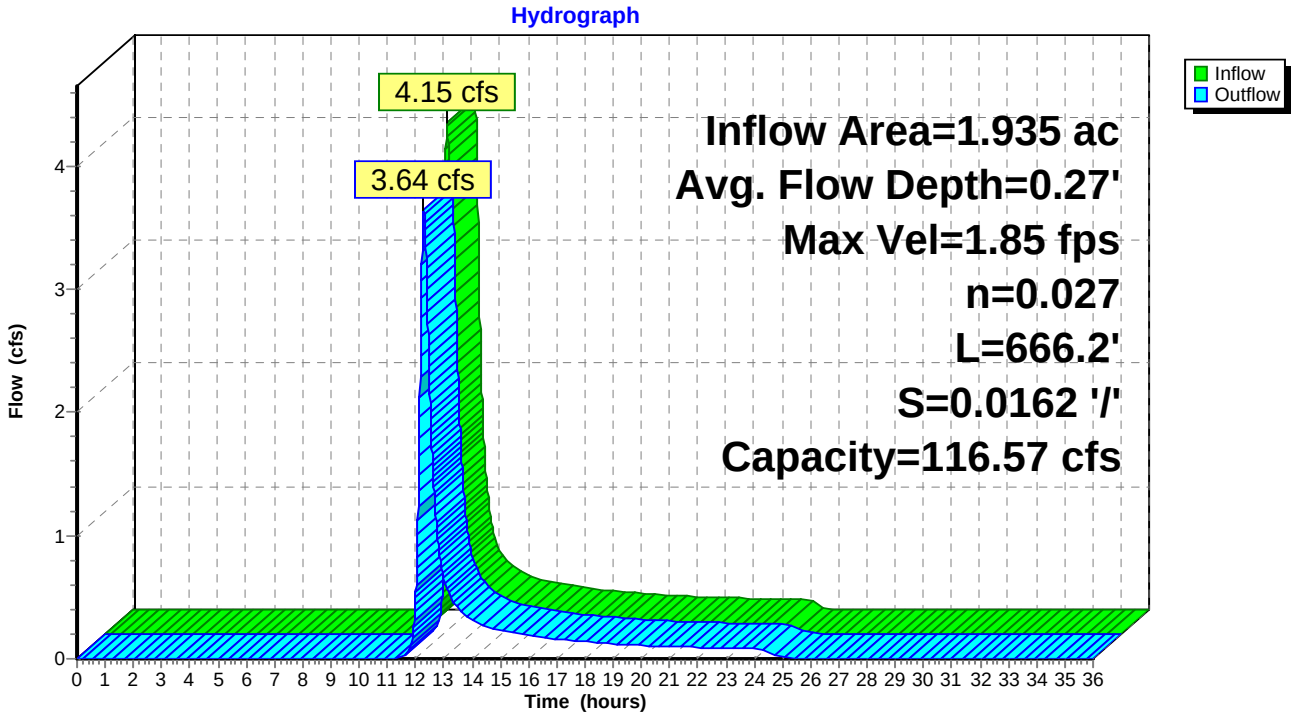
Peak Storage= 1,312 cf @ 12.19 hrs
Average Depth at Peak Storage= 0.27'
Bank-Full Depth= 1.00' Flow Area= 26.5 sf, Capacity= 116.57 cfs

0.00' x 1.00' deep channel, n= 0.027
Side Slope Z-value= 50.0 3.0 '/' Top Width= 53.00'
Length= 666.2' Slope= 0.0162 '/'
Inlet Invert= 415.68', Outlet Invert= 404.91'



‡

Reach C3B5: Channel 3B-5



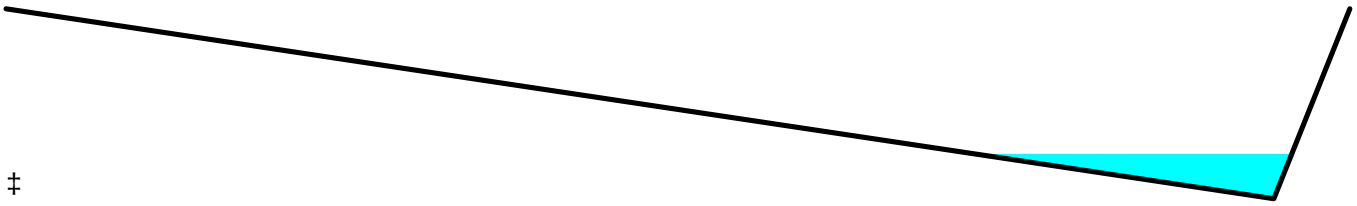
Summary for Reach C3B6: Channel 3B-6

Inflow Area = 1.204 ac, 0.00% Impervious, Inflow Depth = 1.93" for 25 Yr event
Inflow = 2.62 cfs @ 12.11 hrs, Volume= 0.193 af
Outflow = 2.41 cfs @ 12.24 hrs, Volume= 0.193 af, Atten= 8%, Lag= 7.8 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
Max. Velocity= 1.63 fps, Min. Travel Time= 4.4 min
Avg. Velocity = 0.65 fps, Avg. Travel Time= 11.1 min

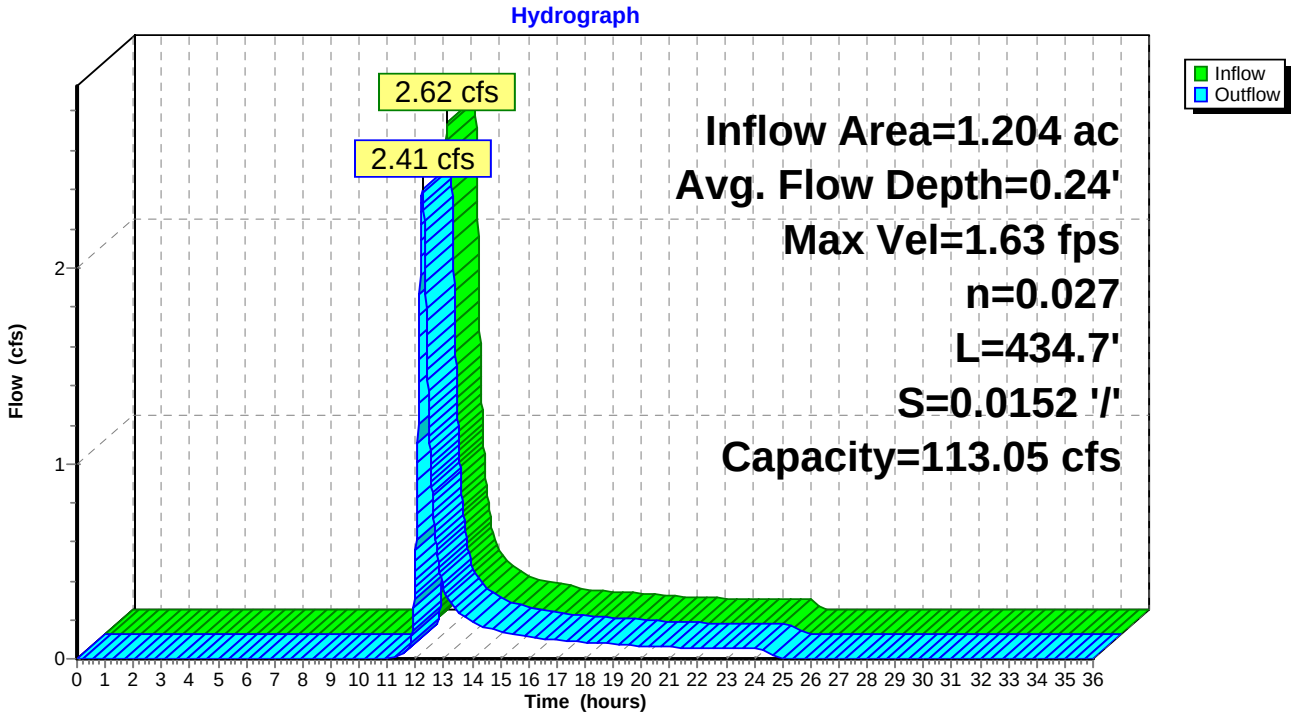
Peak Storage= 643 cf @ 12.17 hrs
Average Depth at Peak Storage= 0.24'
Bank-Full Depth= 1.00' Flow Area= 26.5 sf, Capacity= 113.05 cfs

0.00' x 1.00' deep channel, n= 0.027
Side Slope Z-value= 50.0 3.0 '/' Top Width= 53.00'
Length= 434.7' Slope= 0.0152 '/'
Inlet Invert= 411.52', Outlet Invert= 404.91'



‡

Reach C3B6: Channel 3B-6



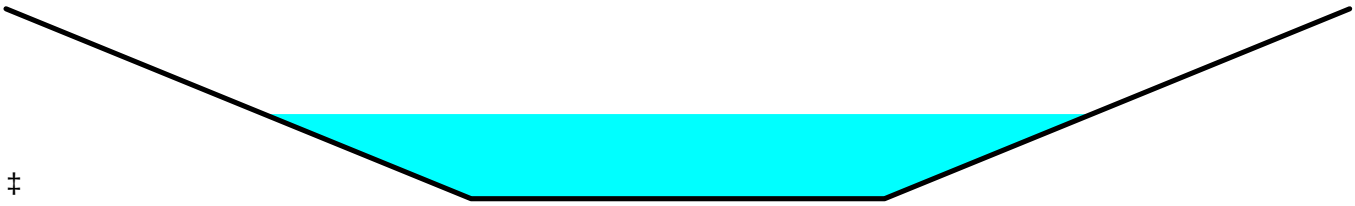
Summary for Reach C3B7: Channel 3B-7

Inflow Area = 5.078 ac, 0.00% Impervious, Inflow Depth = 1.93" for 25 Yr event
Inflow = 9.14 cfs @ 12.23 hrs, Volume= 0.815 af
Outflow = 9.10 cfs @ 12.26 hrs, Volume= 0.815 af, Atten= 0%, Lag= 2.0 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
Max. Velocity= 2.27 fps, Min. Travel Time= 1.2 min
Avg. Velocity = 0.69 fps, Avg. Travel Time= 3.8 min

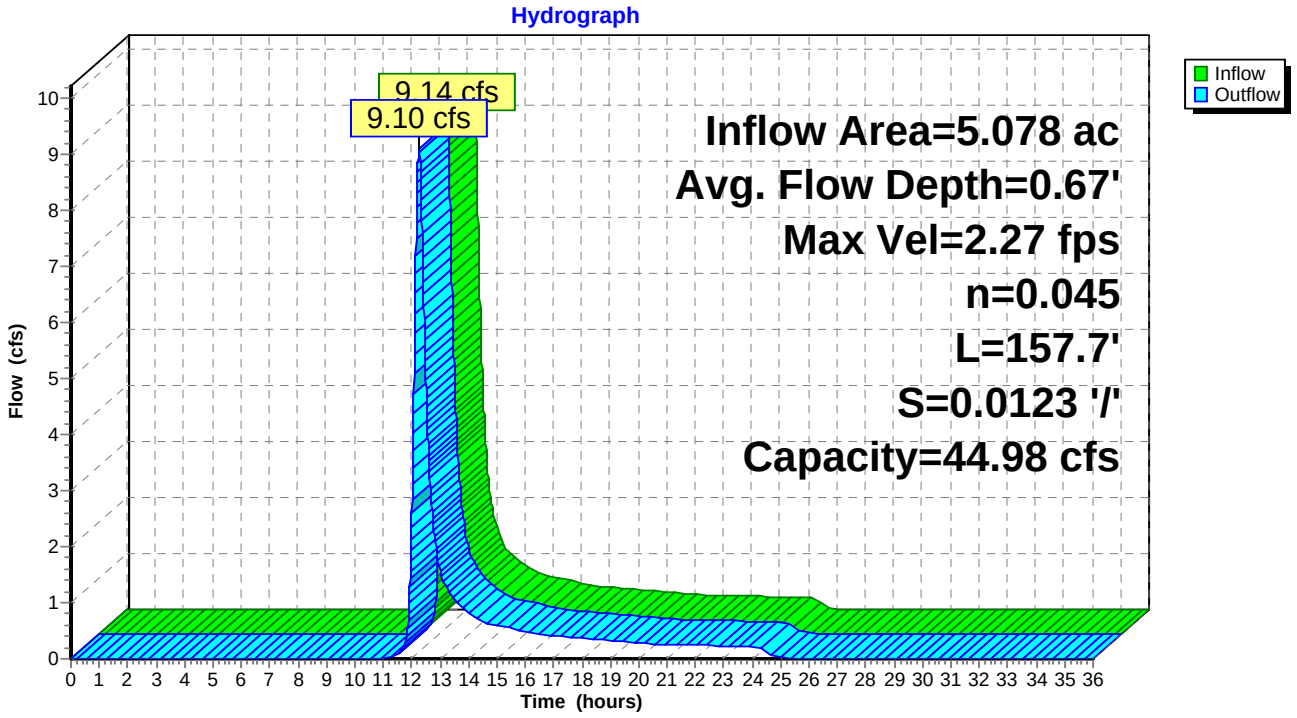
Peak Storage= 633 cf @ 12.24 hrs
Average Depth at Peak Storage= 0.67'
Bank-Full Depth= 1.50' Flow Area= 12.8 sf, Capacity= 44.98 cfs

4.00' x 1.50' deep channel, n= 0.045
Side Slope Z-value= 3.0 '/' Top Width= 13.00'
Length= 157.7' Slope= 0.0123 '/'
Inlet Invert= 406.02', Outlet Invert= 404.08'



‡

Reach C3B7: Channel 3B-7



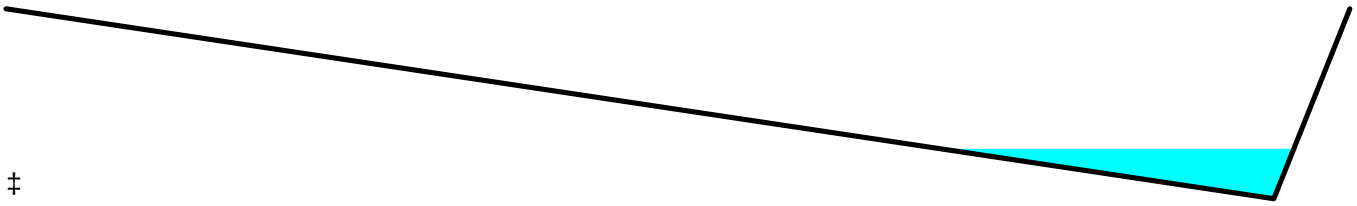
Summary for Reach C3B8: Channel 3B-8

Inflow Area = 1.752 ac, 0.00% Impervious, Inflow Depth = 1.93" for 25 Yr event
Inflow = 3.73 cfs @ 12.12 hrs, Volume= 0.281 af
Outflow = 3.29 cfs @ 12.29 hrs, Volume= 0.281 af, Atten= 12%, Lag= 10.4 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
Max. Velocity= 1.80 fps, Min. Travel Time= 6.0 min
Avg. Velocity = 0.69 fps, Avg. Travel Time= 15.7 min

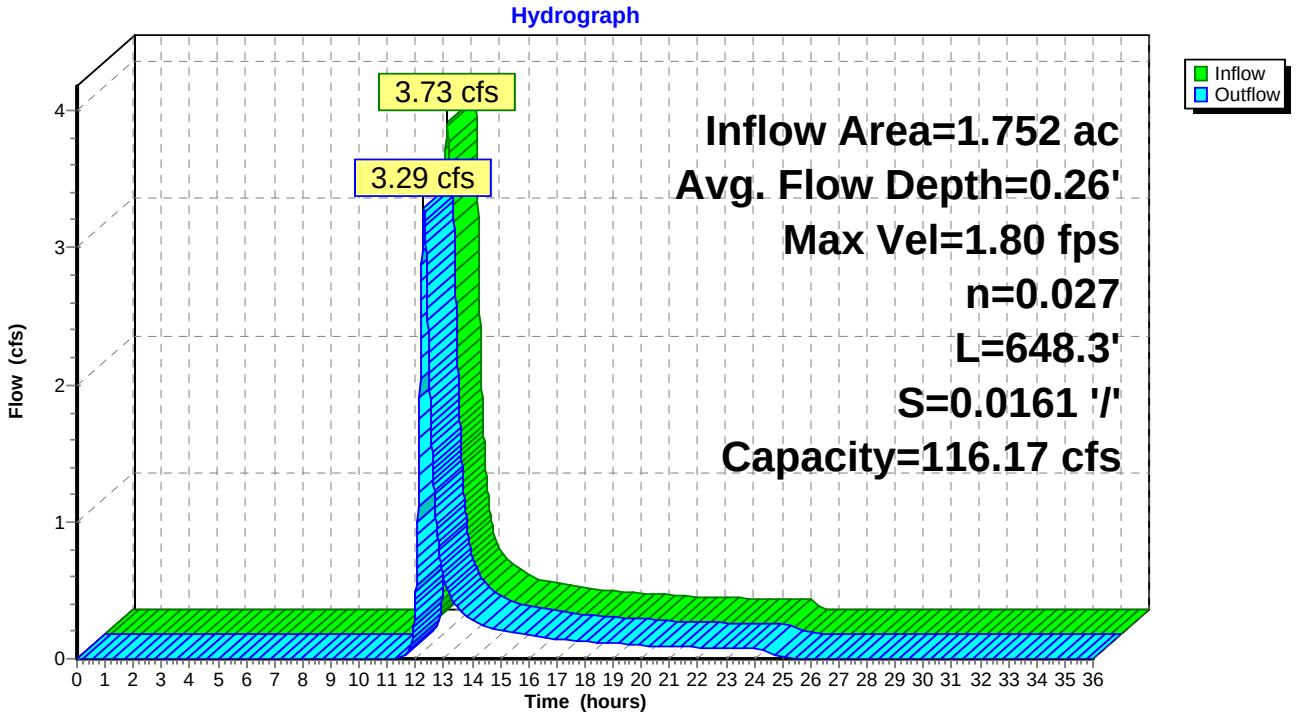
Peak Storage= 1,186 cf @ 12.19 hrs
Average Depth at Peak Storage= 0.26'
Bank-Full Depth= 1.00' Flow Area= 26.5 sf, Capacity= 116.17 cfs

0.00' x 1.00' deep channel, n= 0.027
Side Slope Z-value= 50.0 3.0 '/' Top Width= 53.00'
Length= 648.3' Slope= 0.0161 '/'
Inlet Invert= 416.88', Outlet Invert= 406.47'



‡

Reach C3B8: Channel 3B-8



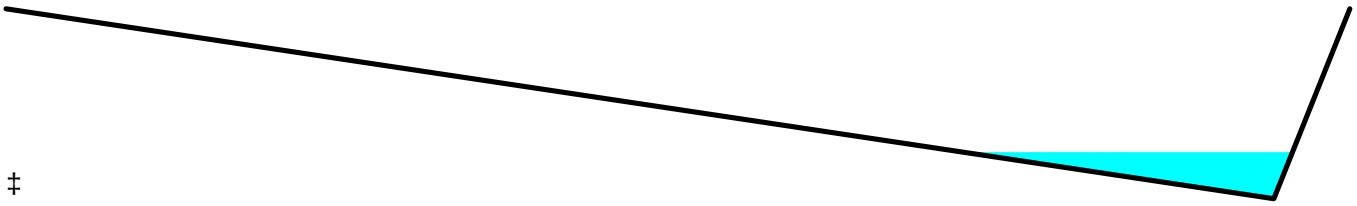
Summary for Reach C3B9: Channel 3B-9

Inflow Area = 1.328 ac, 0.00% Impervious, Inflow Depth = 1.93" for 25 Yr event
Inflow = 2.90 cfs @ 12.12 hrs, Volume= 0.213 af
Outflow = 2.66 cfs @ 12.24 hrs, Volume= 0.213 af, Atten= 8%, Lag= 7.7 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
Max. Velocity= 1.67 fps, Min. Travel Time= 4.5 min
Avg. Velocity = 0.66 fps, Avg. Travel Time= 11.4 min

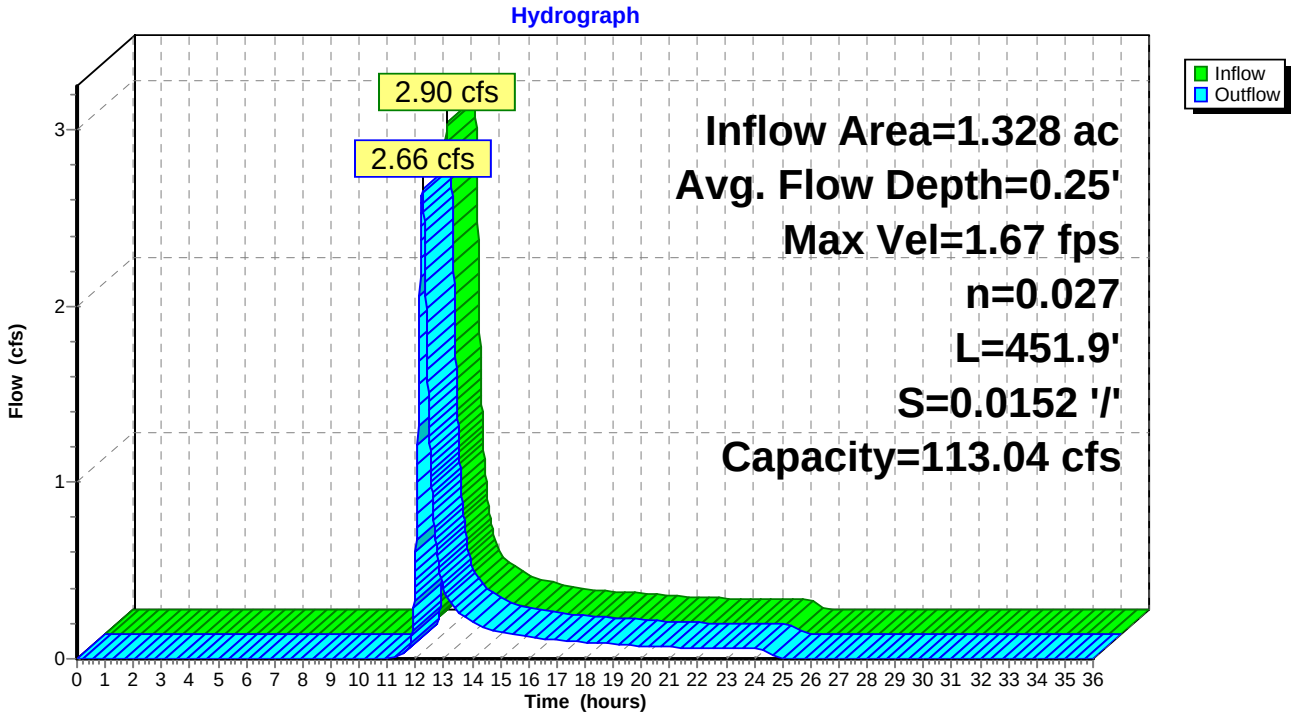
Peak Storage= 721 cf @ 12.17 hrs
Average Depth at Peak Storage= 0.25'
Bank-Full Depth= 1.00' Flow Area= 26.5 sf, Capacity= 113.04 cfs

0.00' x 1.00' deep channel, n= 0.027
Side Slope Z-value= 50.0 3.0 '/' Top Width= 53.00'
Length= 451.9' Slope= 0.0152 '/'
Inlet Invert= 413.34', Outlet Invert= 406.47'



‡

Reach C3B9: Channel 3B-9



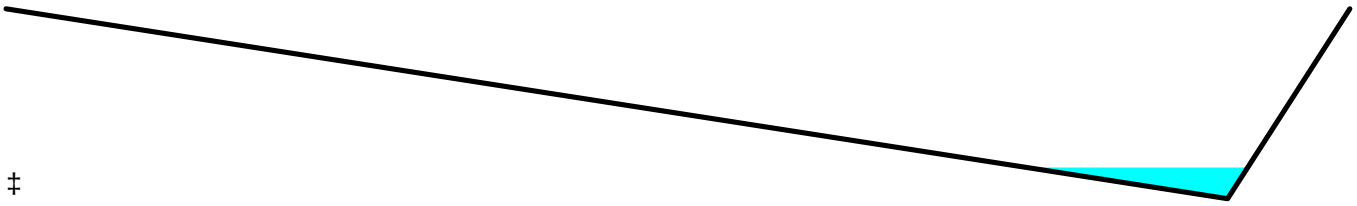
Summary for Reach C3C: Channel 3C

Inflow Area = 1.407 ac, 0.00% Impervious, Inflow Depth = 1.93" for 25 Yr event
Inflow = 3.09 cfs @ 12.11 hrs, Volume= 0.226 af
Outflow = 2.88 cfs @ 12.23 hrs, Volume= 0.226 af, Atten= 7%, Lag= 7.0 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
Max. Velocity= 1.72 fps, Min. Travel Time= 4.0 min
Avg. Velocity = 0.71 fps, Avg. Travel Time= 9.7 min

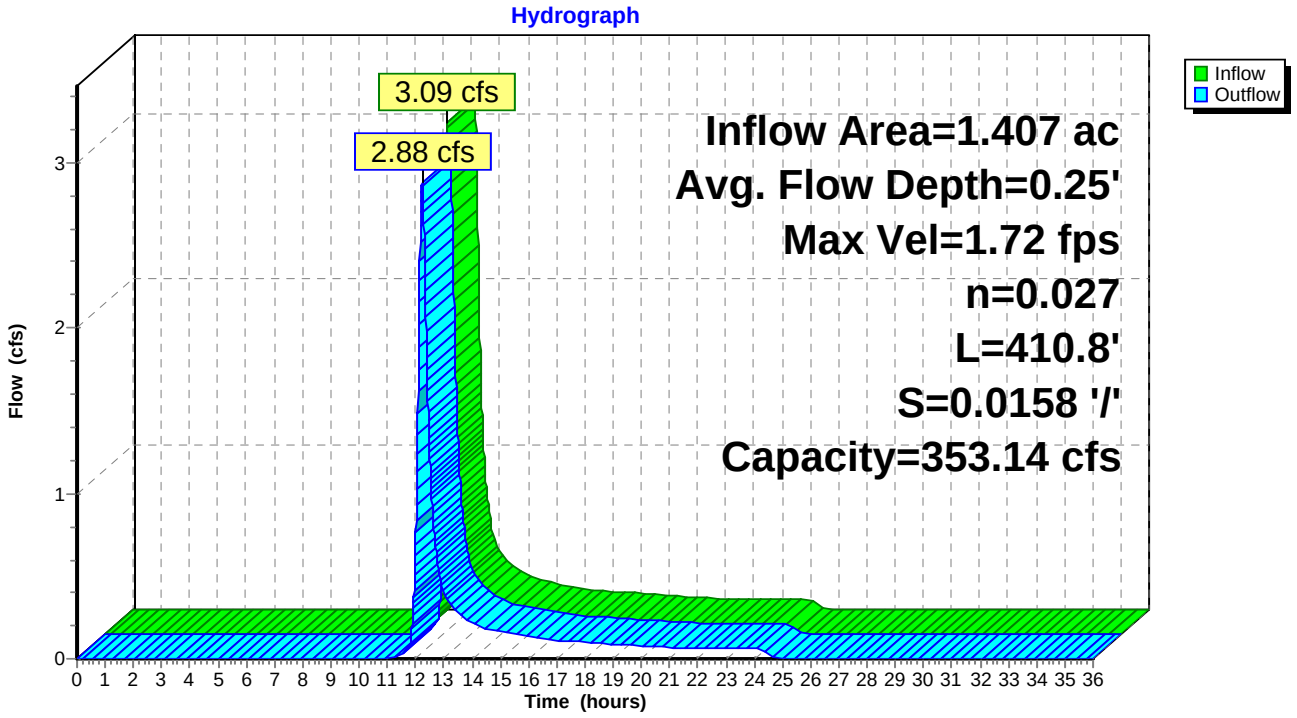
Peak Storage= 690 cf @ 12.16 hrs
Average Depth at Peak Storage= 0.25'
Bank-Full Depth= 1.50' Flow Area= 61.9 sf, Capacity= 353.14 cfs

0.00' x 1.50' deep channel, n= 0.027
Side Slope Z-value= 50.0 5.0 '/' Top Width= 82.50'
Length= 410.8' Slope= 0.0158 '/'
Inlet Invert= 408.19', Outlet Invert= 401.69'



‡

Reach C3C: Channel 3C



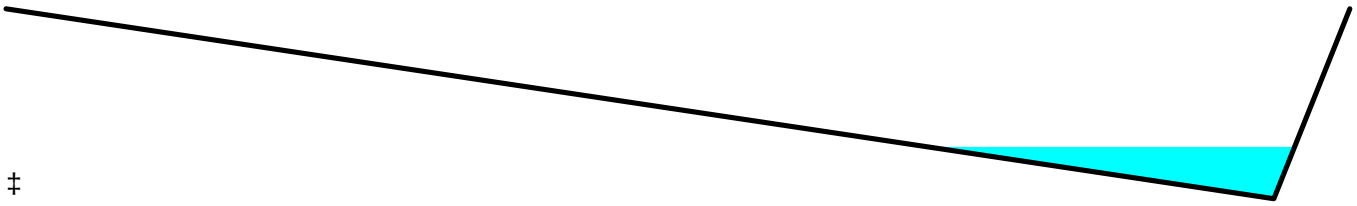
Summary for Reach C3D: Channel 3D

Inflow Area = 1.942 ac, 0.00% Impervious, Inflow Depth = 1.93" for 25 Yr event
Inflow = 4.16 cfs @ 12.12 hrs, Volume= 0.312 af
Outflow = 3.65 cfs @ 12.29 hrs, Volume= 0.312 af, Atten= 12%, Lag= 10.4 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
Max. Velocity= 1.85 fps, Min. Travel Time= 6.1 min
Avg. Velocity = 0.70 fps, Avg. Travel Time= 16.0 min

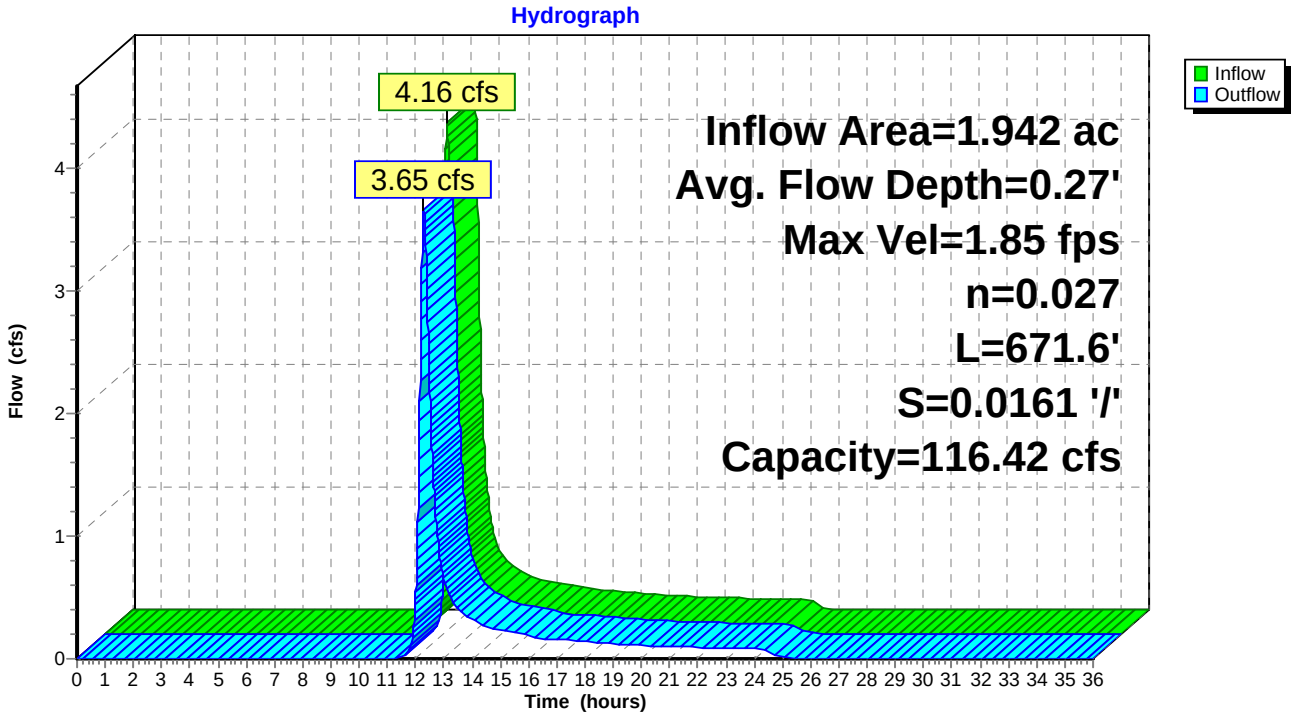
Peak Storage= 1,326 cf @ 12.19 hrs
Average Depth at Peak Storage= 0.27'
Bank-Full Depth= 1.00' Flow Area= 26.5 sf, Capacity= 116.42 cfs

0.00' x 1.00' deep channel, n= 0.027
Side Slope Z-value= 50.0 3.0 '/' Top Width= 53.00'
Length= 671.6' Slope= 0.0161 '/'
Inlet Invert= 412.62', Outlet Invert= 401.79'



‡

Reach C3D: Channel 3D



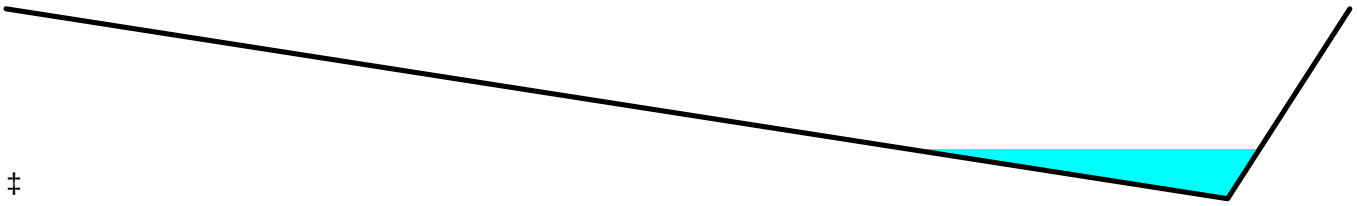
Summary for Reach C4A1: Channel 4A-1

Inflow Area = 4.175 ac, 0.00% Impervious, Inflow Depth = 1.93" for 25 Yr event
Inflow = 8.21 cfs @ 12.15 hrs, Volume= 0.670 af
Outflow = 7.84 cfs @ 12.26 hrs, Volume= 0.670 af, Atten= 5%, Lag= 6.6 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
Max. Velocity= 1.86 fps, Min. Travel Time= 3.7 min
Avg. Velocity = 0.72 fps, Avg. Travel Time= 9.4 min

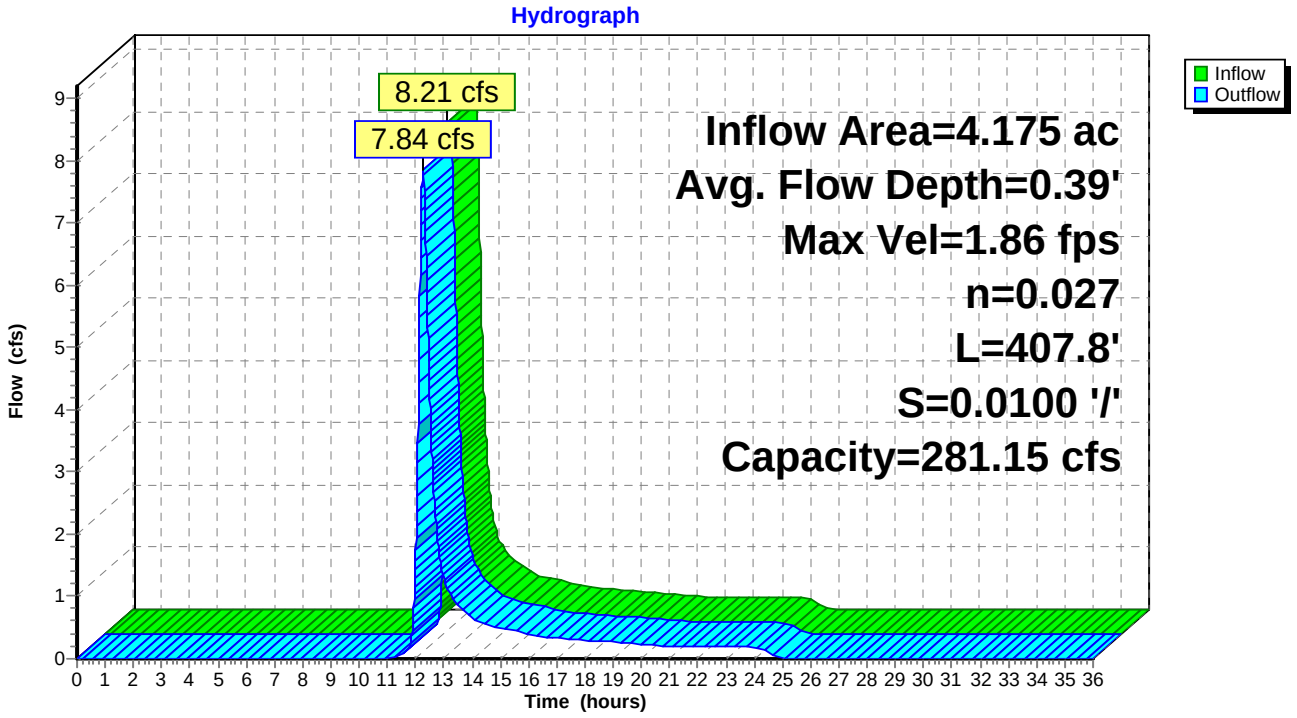
Peak Storage= 1,722 cf @ 12.20 hrs
Average Depth at Peak Storage= 0.39'
Bank-Full Depth= 1.50' Flow Area= 61.9 sf, Capacity= 281.15 cfs

0.00' x 1.50' deep channel, n= 0.027
Side Slope Z-value= 50.0 5.0 '/' Top Width= 82.50'
Length= 407.8' Slope= 0.0100 '/'
Inlet Invert= 404.51', Outlet Invert= 400.42'



‡

Reach C4A1: Channel 4A-1



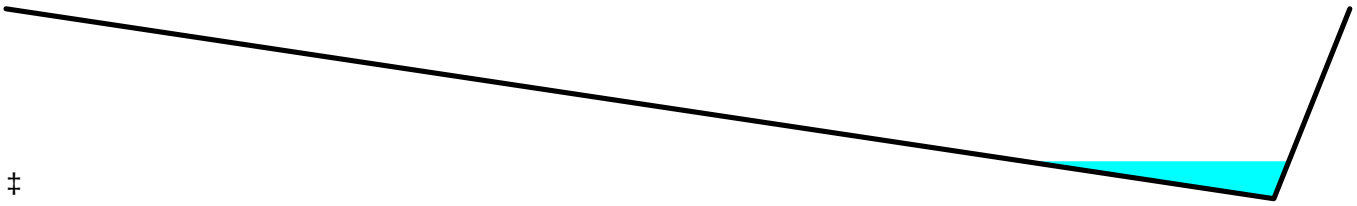
Summary for Reach C4A2: Channel 4A-2

Inflow Area = 0.685 ac, 0.00% Impervious, Inflow Depth = 1.93" for 25 Yr event
Inflow = 1.50 cfs @ 12.12 hrs, Volume= 0.110 af
Outflow = 1.47 cfs @ 12.16 hrs, Volume= 0.110 af, Atten= 2%, Lag= 2.9 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
Max. Velocity= 1.43 fps, Min. Travel Time= 1.7 min
Avg. Velocity = 0.61 fps, Avg. Travel Time= 4.1 min

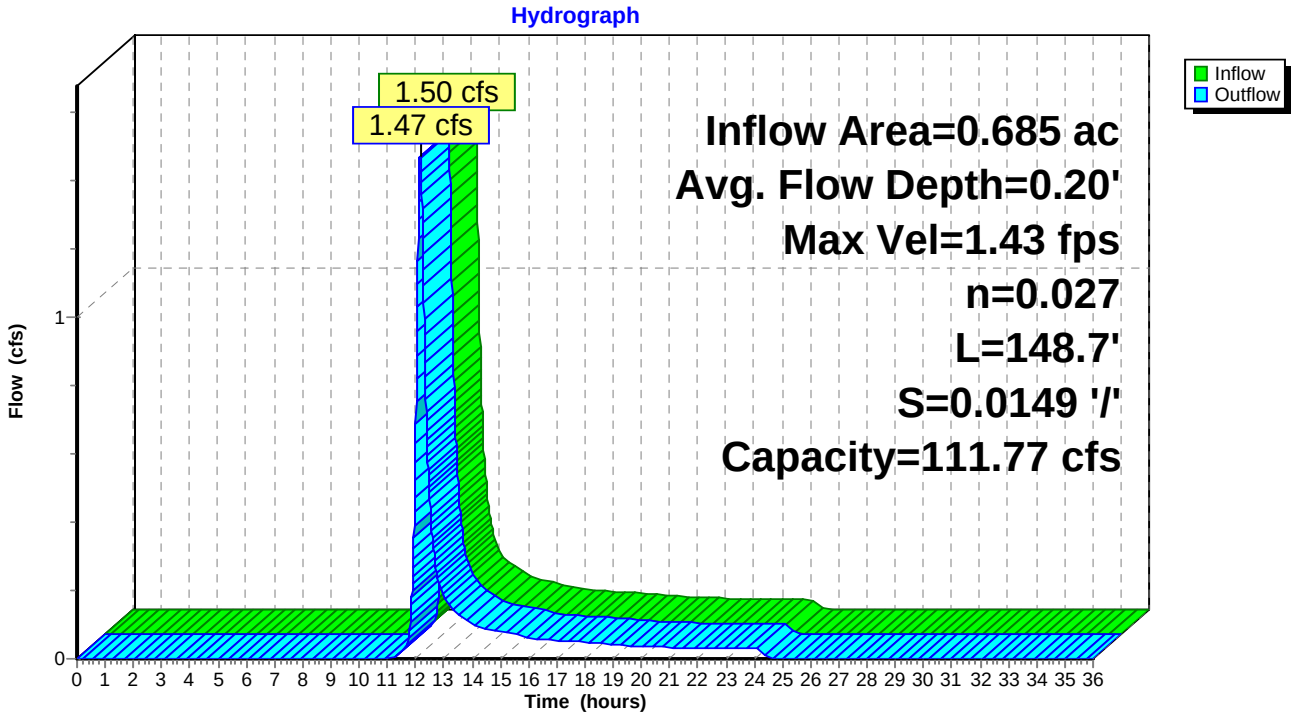
Peak Storage= 153 cf @ 12.14 hrs
Average Depth at Peak Storage= 0.20'
Bank-Full Depth= 1.00' Flow Area= 26.5 sf, Capacity= 111.77 cfs

0.00' x 1.00' deep channel, n= 0.027
Side Slope Z-value= 50.0 3.0 '/' Top Width= 53.00'
Length= 148.7' Slope= 0.0149 '/'
Inlet Invert= 406.75', Outlet Invert= 404.54'



‡

Reach C4A2: Channel 4A-2



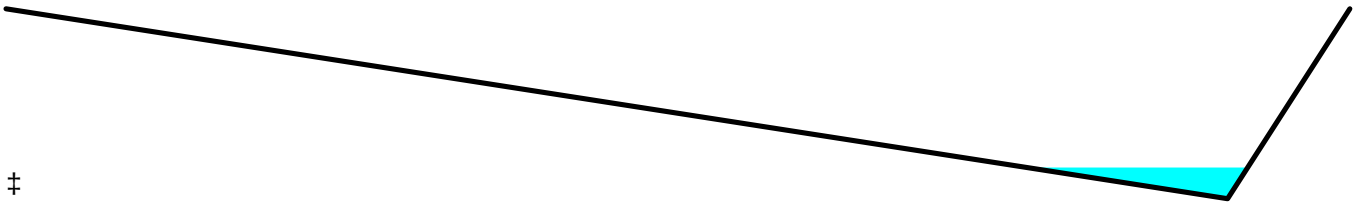
Summary for Reach C4A3: Channel 4A-3

Inflow Area = 1.116 ac, 0.00% Impervious, Inflow Depth = 1.93" for 25 Yr event
Inflow = 2.47 cfs @ 12.11 hrs, Volume= 0.179 af
Outflow = 2.26 cfs @ 12.24 hrs, Volume= 0.179 af, Atten= 9%, Lag= 7.8 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
Max. Velocity= 1.35 fps, Min. Travel Time= 4.6 min
Avg. Velocity = 0.55 fps, Avg. Travel Time= 11.3 min

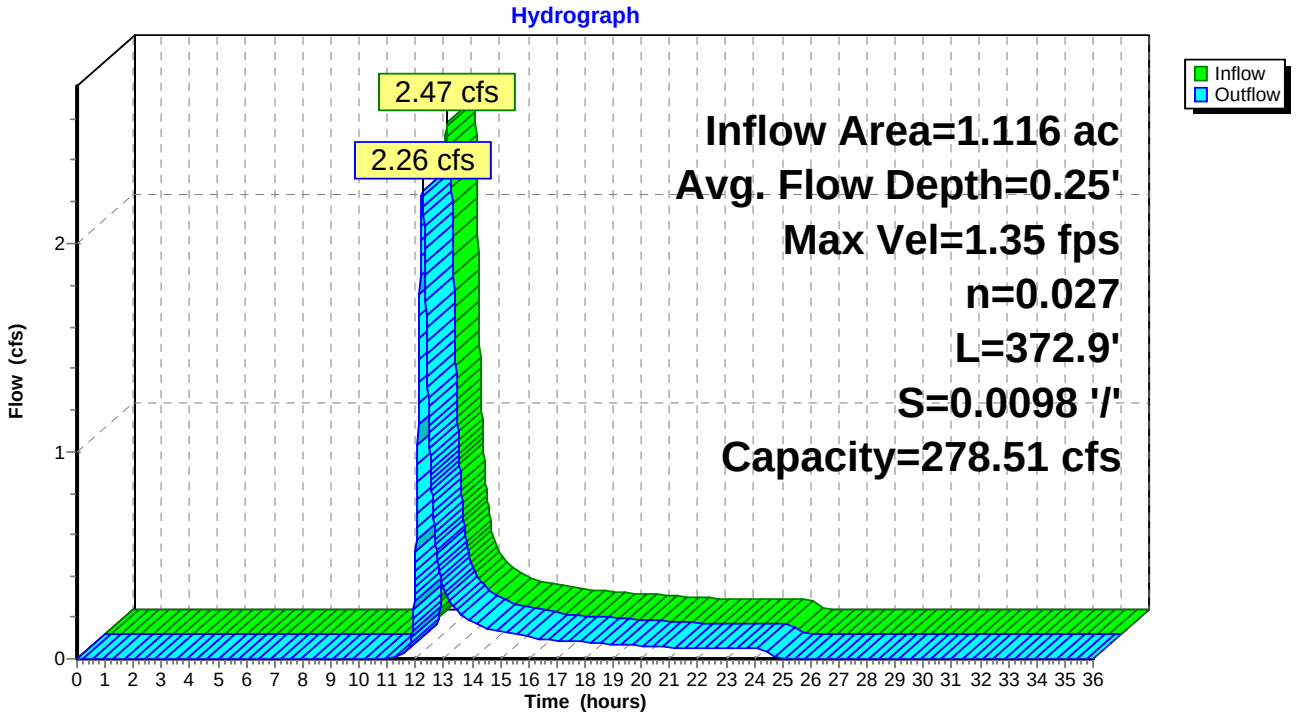
Peak Storage= 623 cf @ 12.17 hrs
Average Depth at Peak Storage= 0.25'
Bank-Full Depth= 1.50' Flow Area= 61.9 sf, Capacity= 278.51 cfs

0.00' x 1.50' deep channel, n= 0.027
Side Slope Z-value= 50.0 5.0 '/' Top Width= 82.50'
Length= 372.9' Slope= 0.0098 '/'
Inlet Invert= 408.18', Outlet Invert= 404.51'



‡

Reach C4A3: Channel 4A-3



Summary for Reach C4B1: Channel 4B-1

Inflow Area = 9.536 ac, 0.00% Impervious, Inflow Depth = 1.93" for 25 Yr event
Inflow = 17.30 cfs @ 12.26 hrs, Volume= 1.530 af
Outflow = 17.28 cfs @ 12.27 hrs, Volume= 1.530 af, Atten= 0%, Lag= 0.6 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
Max. Velocity= 3.08 fps, Min. Travel Time= 0.4 min
Avg. Velocity = 0.91 fps, Avg. Travel Time= 1.2 min

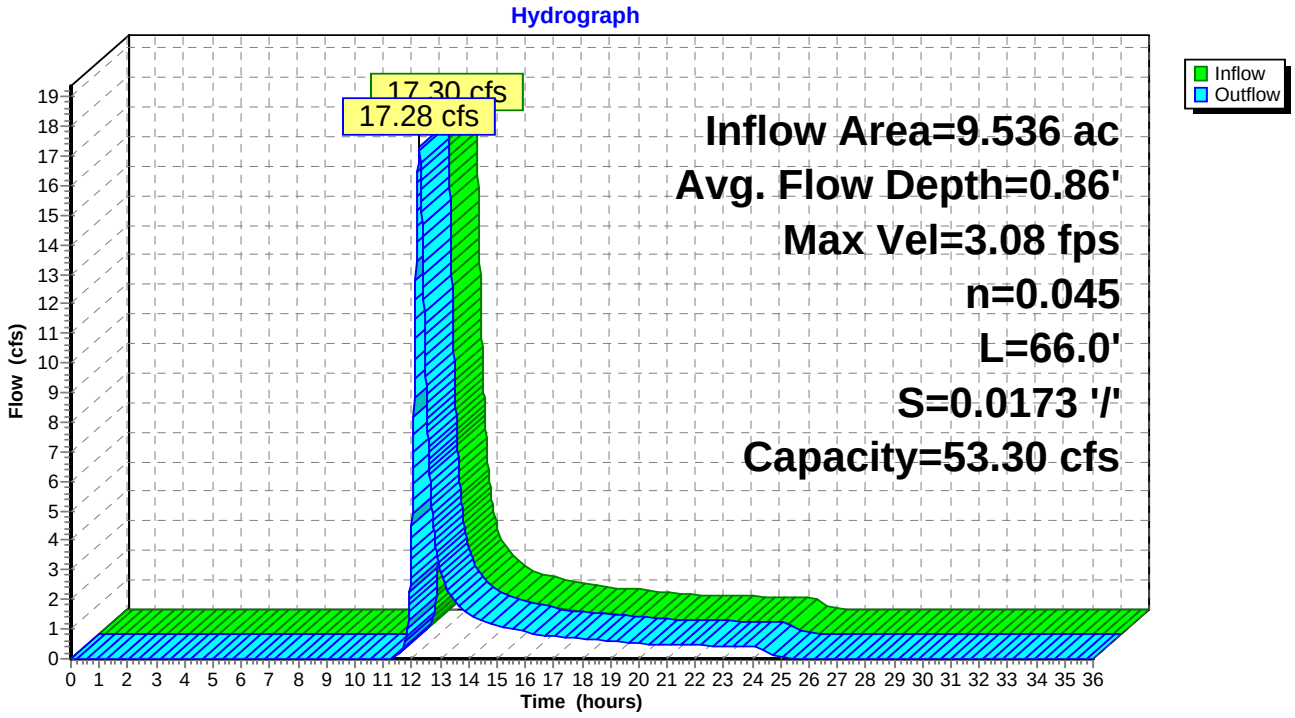
Peak Storage= 371 cf @ 12.26 hrs
Average Depth at Peak Storage= 0.86'
Bank-Full Depth= 1.50' Flow Area= 12.8 sf, Capacity= 53.30 cfs

4.00' x 1.50' deep channel, n= 0.045
Side Slope Z-value= 3.0 '/' Top Width= 13.00'
Length= 66.0' Slope= 0.0173 '/'
Inlet Invert= 400.31', Outlet Invert= 399.17'



‡

Reach C4B1: Channel 4B-1



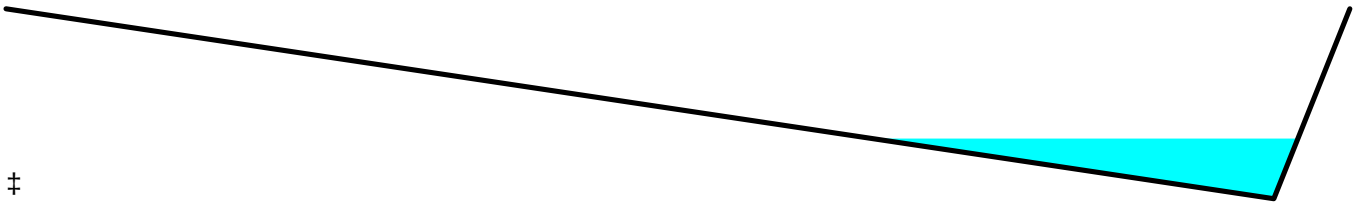
Summary for Reach C4B2: Channel 4B-2

Inflow Area = 2.715 ac, 0.00% Impervious, Inflow Depth = 1.93" for 25 Yr event
Inflow = 5.94 cfs @ 12.11 hrs, Volume= 0.436 af
Outflow = 5.21 cfs @ 12.28 hrs, Volume= 0.436 af, Atten= 12%, Lag= 10.2 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
Max. Velocity= 1.96 fps, Min. Travel Time= 5.9 min
Avg. Velocity = 0.72 fps, Avg. Travel Time= 16.2 min

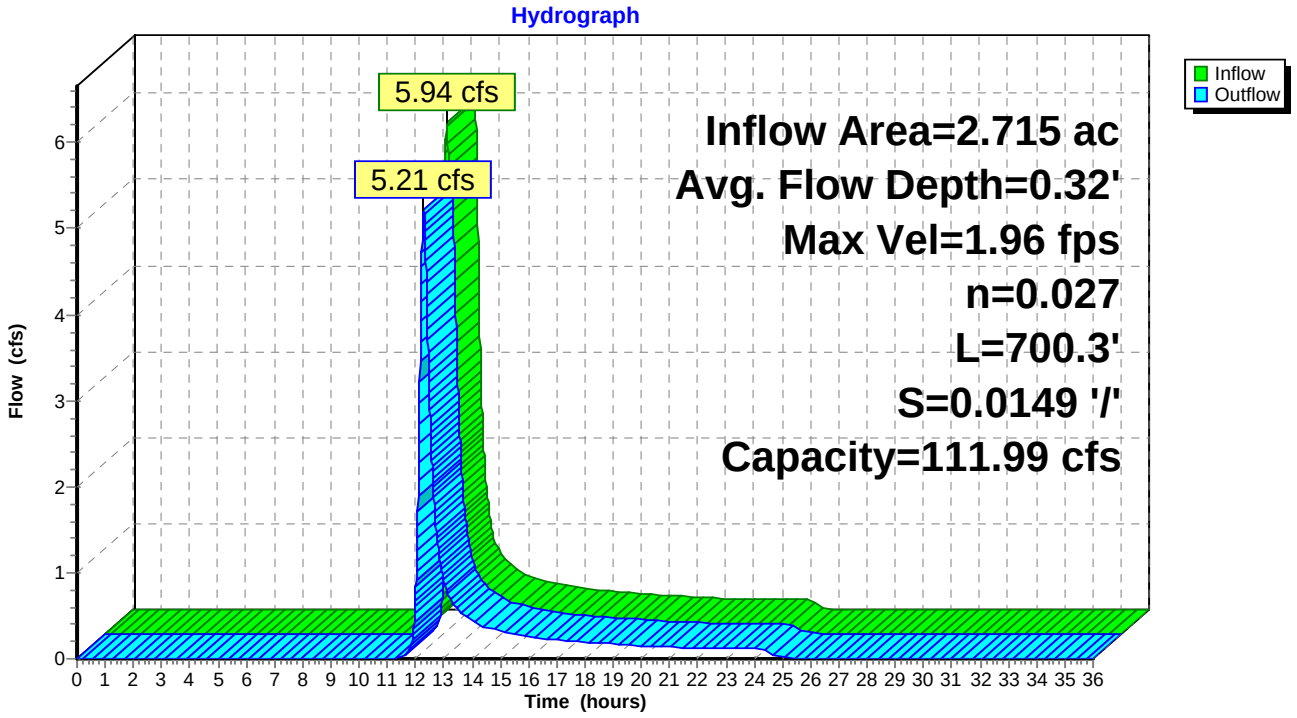
Peak Storage= 1,860 cf @ 12.18 hrs
Average Depth at Peak Storage= 0.32'
Bank-Full Depth= 1.00' Flow Area= 26.5 sf, Capacity= 111.99 cfs

0.00' x 1.00' deep channel, n= 0.027
Side Slope Z-value= 50.0 3.0 '/' Top Width= 53.00'
Length= 700.3' Slope= 0.0149 '/'
Inlet Invert= 412.08', Outlet Invert= 401.63'



‡

Reach C4B2: Channel 4B-2



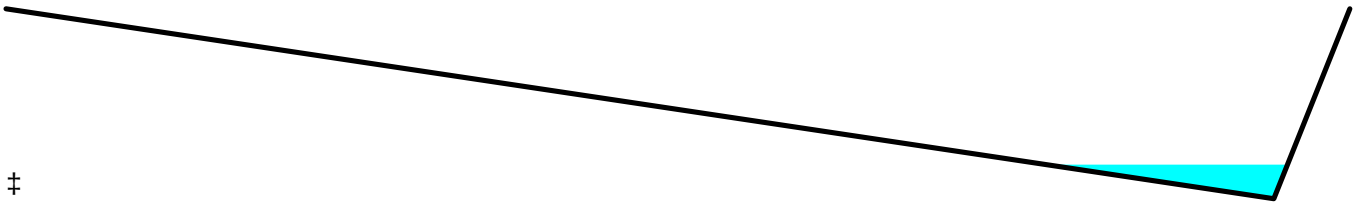
Summary for Reach C4B3: Channel 4B-3

Inflow Area = 0.634 ac, 0.00% Impervious, Inflow Depth = 1.93" for 25 Yr event
Inflow = 1.39 cfs @ 12.12 hrs, Volume= 0.102 af
Outflow = 1.37 cfs @ 12.16 hrs, Volume= 0.102 af, Atten= 1%, Lag= 2.4 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
Max. Velocity= 1.61 fps, Min. Travel Time= 1.5 min
Avg. Velocity = 0.69 fps, Avg. Travel Time= 3.4 min

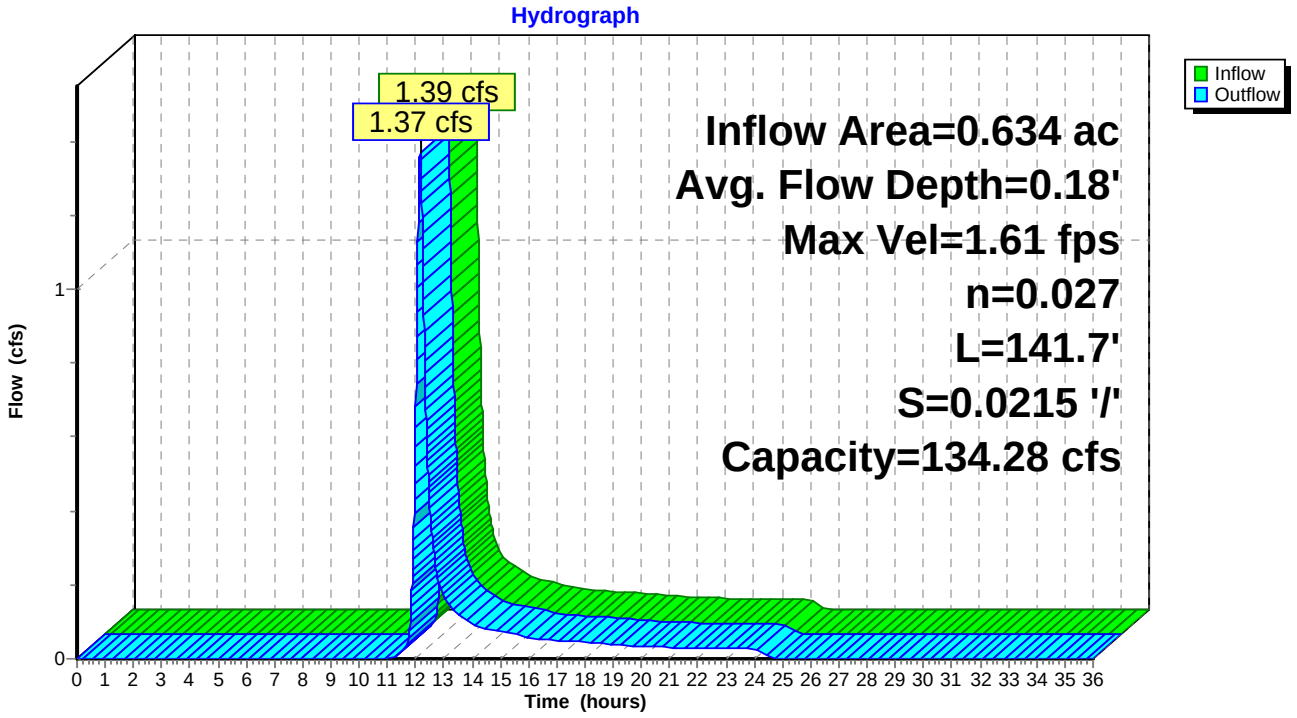
Peak Storage= 121 cf @ 12.13 hrs
Average Depth at Peak Storage= 0.18'
Bank-Full Depth= 1.00' Flow Area= 26.5 sf, Capacity= 134.28 cfs

0.00' x 1.00' deep channel, n= 0.027
Side Slope Z-value= 50.0 3.0 '/' Top Width= 53.00'
Length= 141.7' Slope= 0.0215 '/'
Inlet Invert= 404.78', Outlet Invert= 401.74'



‡

Reach C4B3: Channel 4B-3



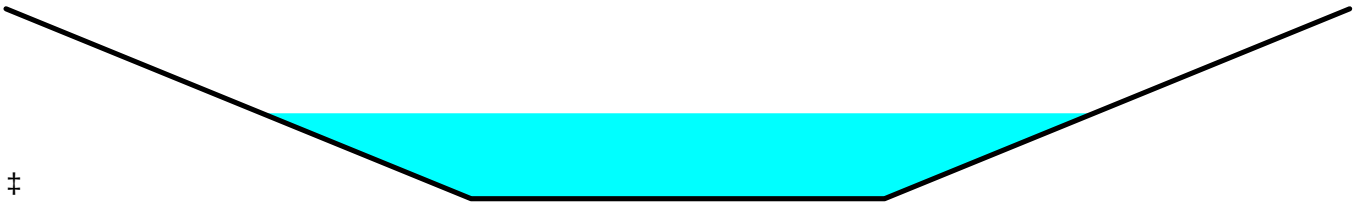
Summary for Reach C4B4: Channel 4B-4

Inflow Area = 6.025 ac, 0.00% Impervious, Inflow Depth = 1.93" for 25 Yr event
Inflow = 11.01 cfs @ 12.22 hrs, Volume= 0.967 af
Outflow = 10.96 cfs @ 12.26 hrs, Volume= 0.967 af, Atten= 0%, Lag= 2.2 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
Max. Velocity= 2.70 fps, Min. Travel Time= 1.3 min
Avg. Velocity = 0.81 fps, Avg. Travel Time= 4.2 min

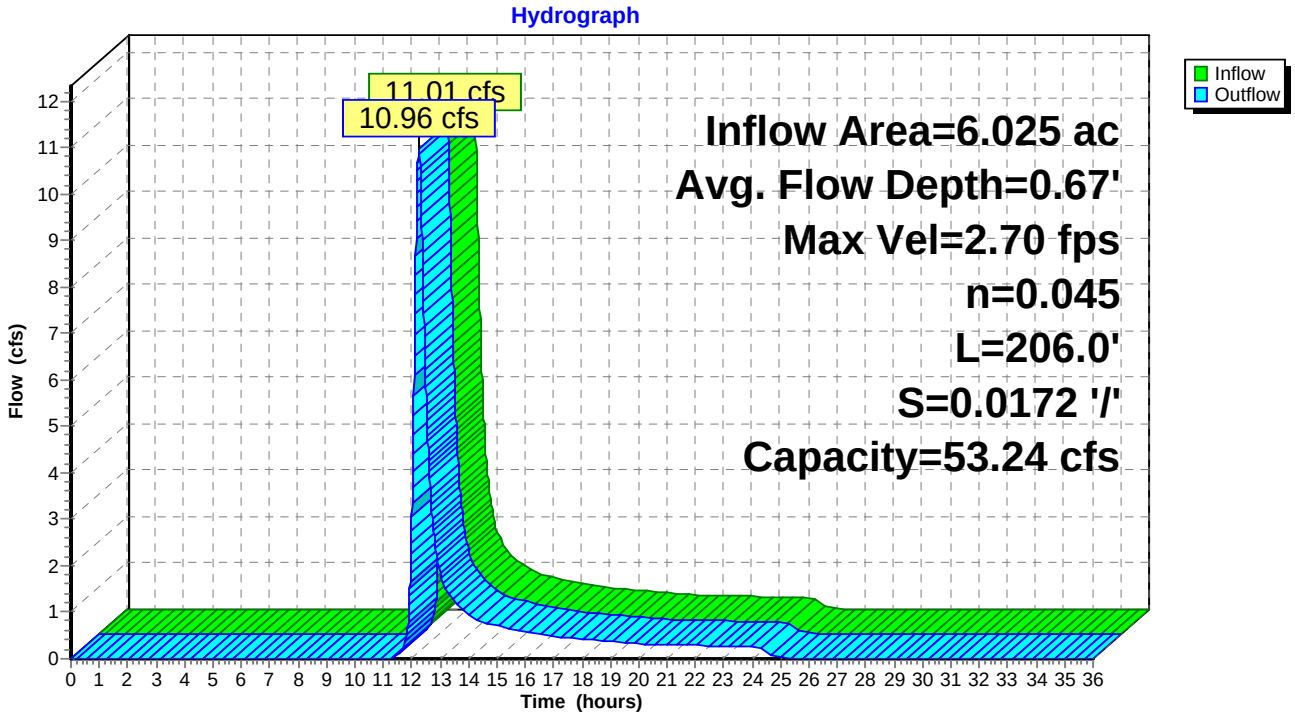
Peak Storage= 836 cf @ 12.23 hrs
Average Depth at Peak Storage= 0.67'
Bank-Full Depth= 1.50' Flow Area= 12.8 sf, Capacity= 53.24 cfs

4.00' x 1.50' deep channel, n= 0.045
Side Slope Z-value= 3.0 '/' Top Width= 13.00'
Length= 206.0' Slope= 0.0172 '/'
Inlet Invert= 403.86', Outlet Invert= 400.31'



‡

Reach C4B4: Channel 4B-4



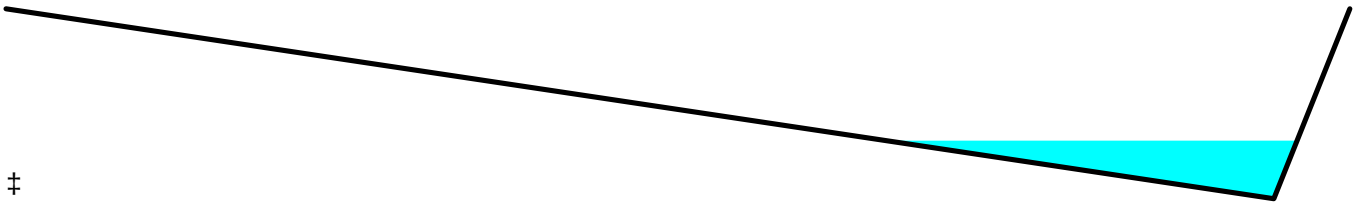
Summary for Reach C4B5: Channel 4B-5

Inflow Area = 2.485 ac, 0.00% Impervious, Inflow Depth = 1.93" for 25 Yr event
Inflow = 5.39 cfs @ 12.12 hrs, Volume= 0.399 af
Outflow = 4.76 cfs @ 12.28 hrs, Volume= 0.399 af, Atten= 12%, Lag= 9.9 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
Max. Velocity= 1.92 fps, Min. Travel Time= 5.8 min
Avg. Velocity = 0.71 fps, Avg. Travel Time= 15.5 min

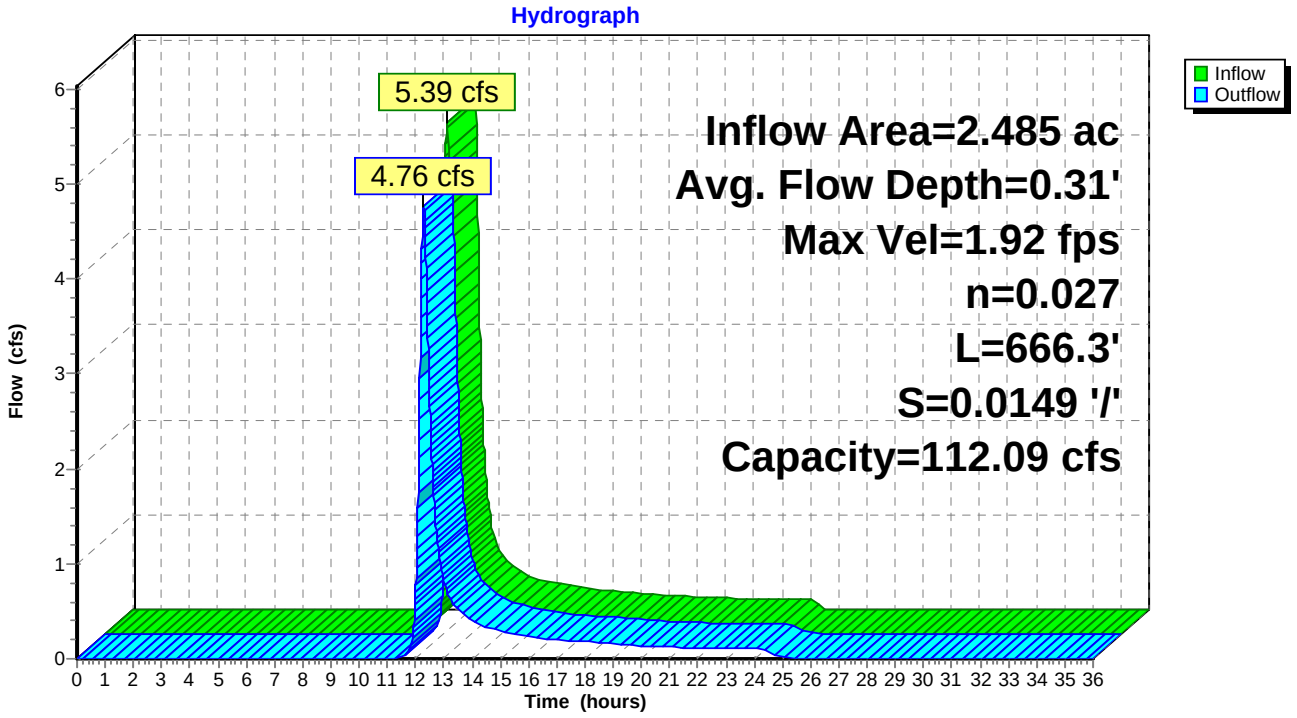
Peak Storage= 1,652 cf @ 12.18 hrs
Average Depth at Peak Storage= 0.31'
Bank-Full Depth= 1.00' Flow Area= 26.5 sf, Capacity= 112.09 cfs

0.00' x 1.00' deep channel, n= 0.027
Side Slope Z-value= 50.0 3.0 '/' Top Width= 53.00'
Length= 666.3' Slope= 0.0149 '/'
Inlet Invert= 414.51', Outlet Invert= 404.55'



‡

Reach C4B5: Channel 4B-5



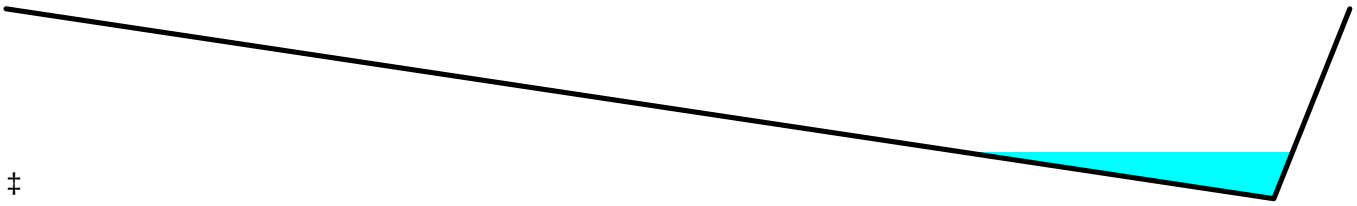
Summary for Reach C4B6: Channel 4B-6

Inflow Area = 1.292 ac, 0.00% Impervious, Inflow Depth = 1.93" for 25 Yr event
Inflow = 2.80 cfs @ 12.12 hrs, Volume= 0.207 af
Outflow = 2.63 cfs @ 12.23 hrs, Volume= 0.207 af, Atten= 6%, Lag= 6.6 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
Max. Velocity= 1.64 fps, Min. Travel Time= 3.8 min
Avg. Velocity = 0.66 fps, Avg. Travel Time= 9.4 min

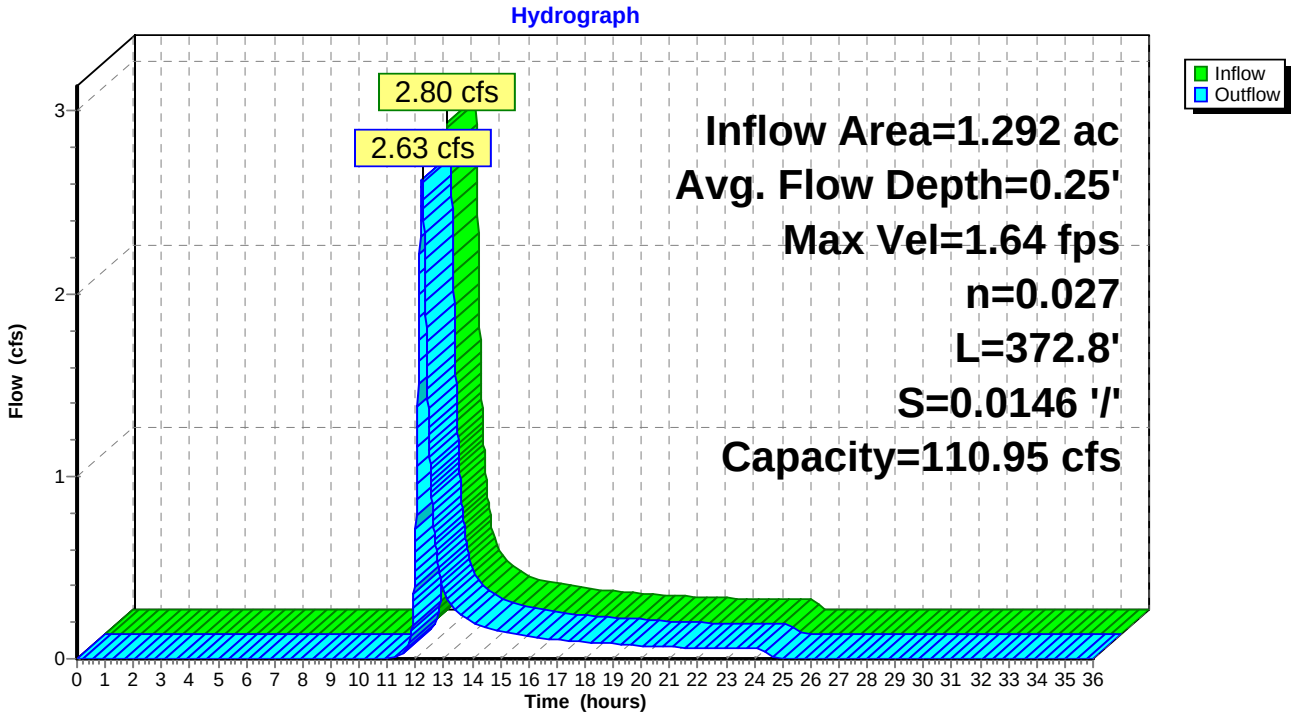
Peak Storage= 598 cf @ 12.16 hrs
Average Depth at Peak Storage= 0.25'
Bank-Full Depth= 1.00' Flow Area= 26.5 sf, Capacity= 110.95 cfs

0.00' x 1.00' deep channel, n= 0.027
Side Slope Z-value= 50.0 3.0 '/' Top Width= 53.00'
Length= 372.8' Slope= 0.0146 '/'
Inlet Invert= 410.09', Outlet Invert= 404.63'



‡

Reach C4B6: Channel 4B-6



Summary for Reach C4B7: Channel 4B-7

Inflow Area = 1.171 ac, 0.00% Impervious, Inflow Depth = 1.93" for 25 Yr event
Inflow = 2.59 cfs @ 12.11 hrs, Volume= 0.188 af
Outflow = 2.56 cfs @ 12.16 hrs, Volume= 0.188 af, Atten= 1%, Lag= 3.0 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
Max. Velocity= 1.72 fps, Min. Travel Time= 1.8 min
Avg. Velocity = 0.53 fps, Avg. Travel Time= 6.0 min

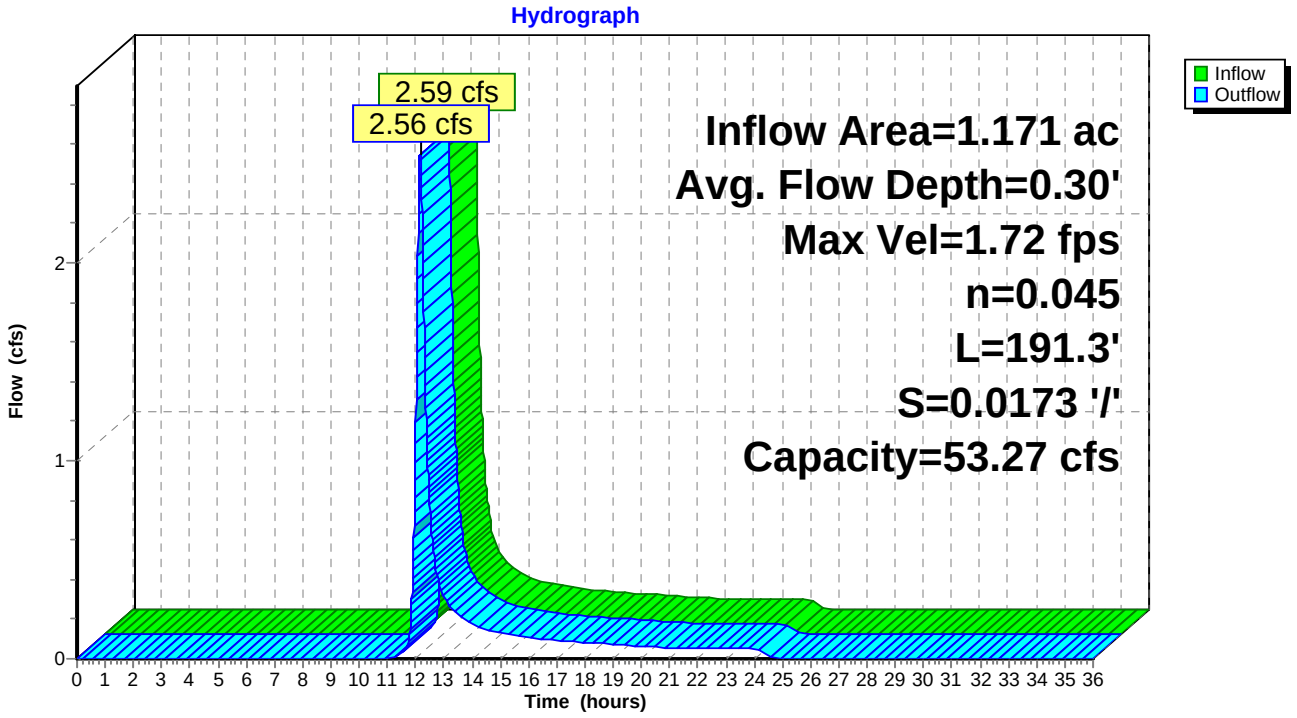
Peak Storage= 283 cf @ 12.13 hrs
Average Depth at Peak Storage= 0.30'
Bank-Full Depth= 1.50' Flow Area= 12.8 sf, Capacity= 53.27 cfs

4.00' x 1.50' deep channel, n= 0.045
Side Slope Z-value= 3.0 '/' Top Width= 13.00'
Length= 191.3' Slope= 0.0173 '/'
Inlet Invert= 407.16', Outlet Invert= 403.86'



‡

Reach C4B7: Channel 4B-7



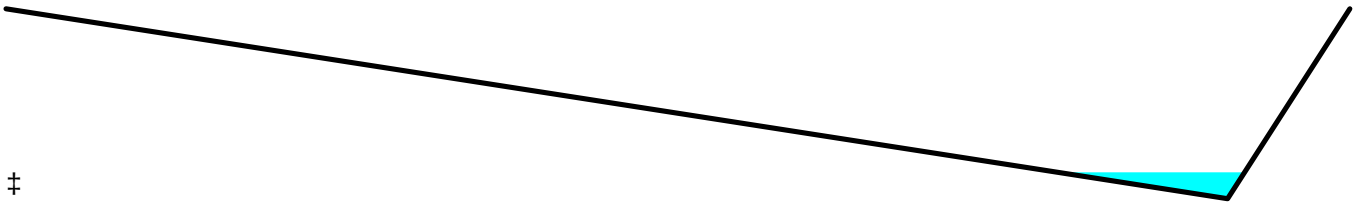
Summary for Reach C4C: Channel 4C

Inflow Area = 0.968 ac, 0.00% Impervious, Inflow Depth = 1.93" for 25 Yr event
Inflow = 2.26 cfs @ 12.09 hrs, Volume= 0.155 af
Outflow = 2.07 cfs @ 12.21 hrs, Volume= 0.155 af, Atten= 9%, Lag= 7.4 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
Max. Velocity= 1.72 fps, Min. Travel Time= 4.3 min
Avg. Velocity = 0.71 fps, Avg. Travel Time= 10.5 min

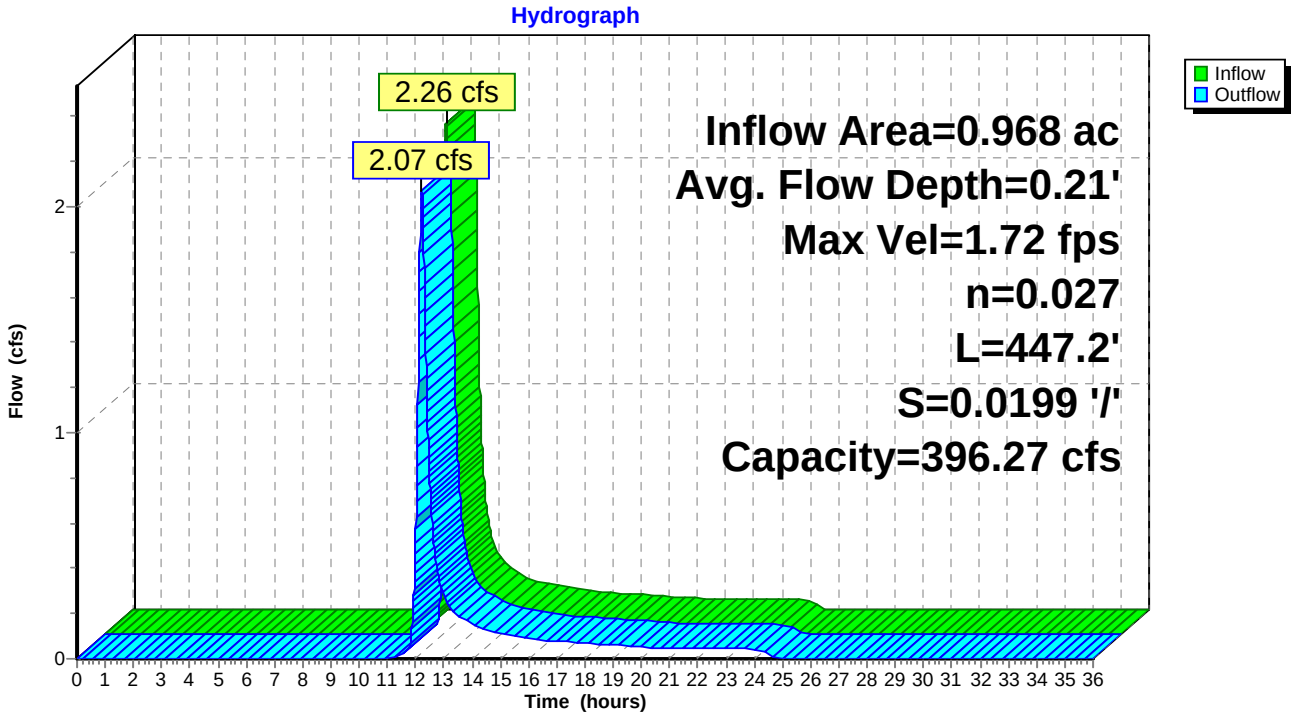
Peak Storage= 537 cf @ 12.14 hrs
Average Depth at Peak Storage= 0.21'
Bank-Full Depth= 1.50' Flow Area= 61.9 sf, Capacity= 396.27 cfs

0.00' x 1.50' deep channel, n= 0.027
Side Slope Z-value= 50.0 5.0 '/' Top Width= 82.50'
Length= 447.2' Slope= 0.0199 '/'
Inlet Invert= 409.40', Outlet Invert= 400.49'



‡

Reach C4C: Channel 4C



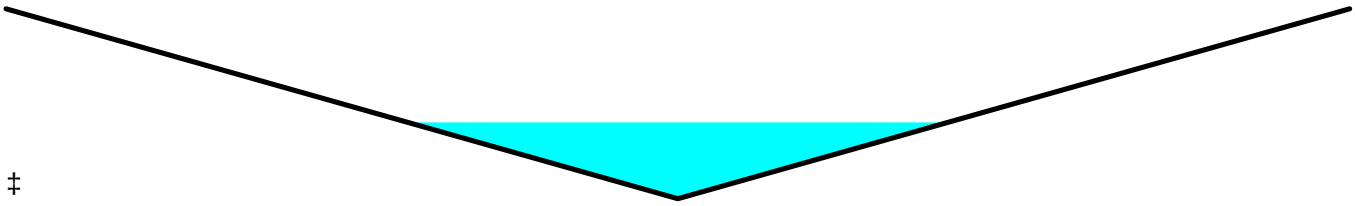
Summary for Reach C5A: Channel 5A

Inflow Area = 2.365 ac, 0.00% Impervious, Inflow Depth = 1.93" for 25 Yr event
Inflow = 6.31 cfs @ 12.05 hrs, Volume= 0.379 af
Outflow = 6.00 cfs @ 12.12 hrs, Volume= 0.379 af, Atten= 5%, Lag= 4.4 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs / 2
Max. Velocity= 3.31 fps, Min. Travel Time= 2.6 min
Avg. Velocity = 1.27 fps, Avg. Travel Time= 6.7 min

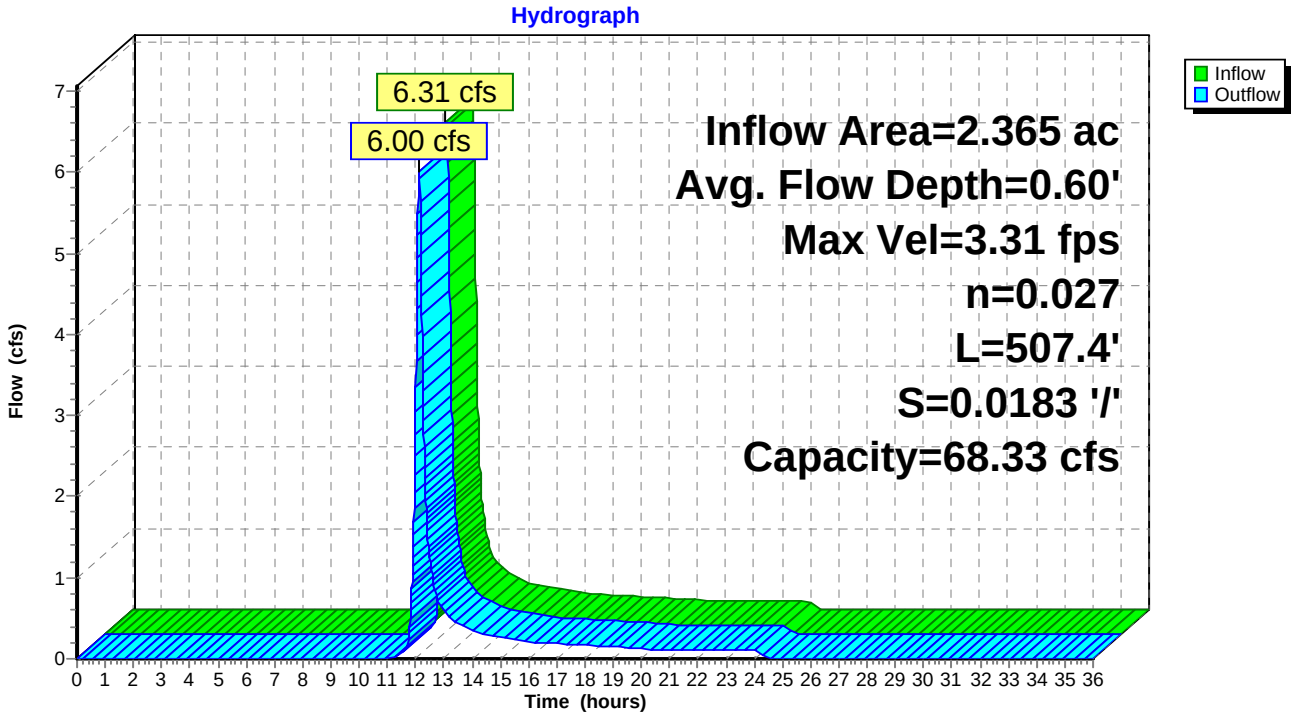
Peak Storage= 922 cf @ 12.08 hrs
Average Depth at Peak Storage= 0.60'
Bank-Full Depth= 1.50' Flow Area= 11.3 sf, Capacity= 68.33 cfs

0.00' x 1.50' deep channel, n= 0.027
Side Slope Z-value= 5.0 '/' Top Width= 15.00'
Length= 507.4' Slope= 0.0183 '/'
Inlet Invert= 409.37', Outlet Invert= 400.06'



‡

Reach C5A: Channel 5A



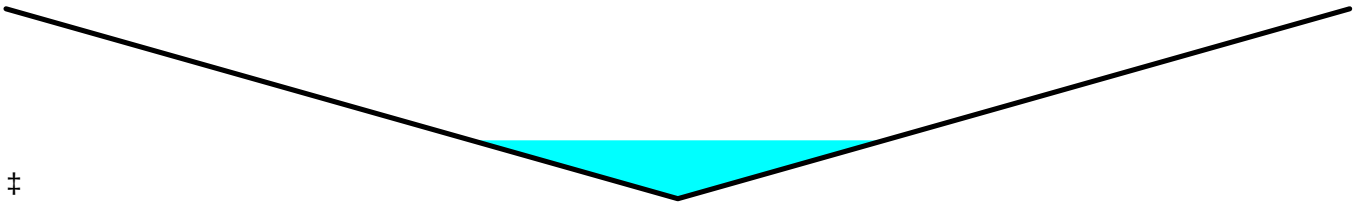
Summary for Reach C5B: Channel 5B

Inflow Area = 1.353 ac, 0.00% Impervious, Inflow Depth = 1.93" for 25 Yr event
Inflow = 3.63 cfs @ 12.05 hrs, Volume= 0.217 af
Outflow = 3.55 cfs @ 12.10 hrs, Volume= 0.217 af, Atten= 2%, Lag= 3.1 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs / 2
Max. Velocity= 3.35 fps, Min. Travel Time= 1.7 min
Avg. Velocity = 1.34 fps, Avg. Travel Time= 4.3 min

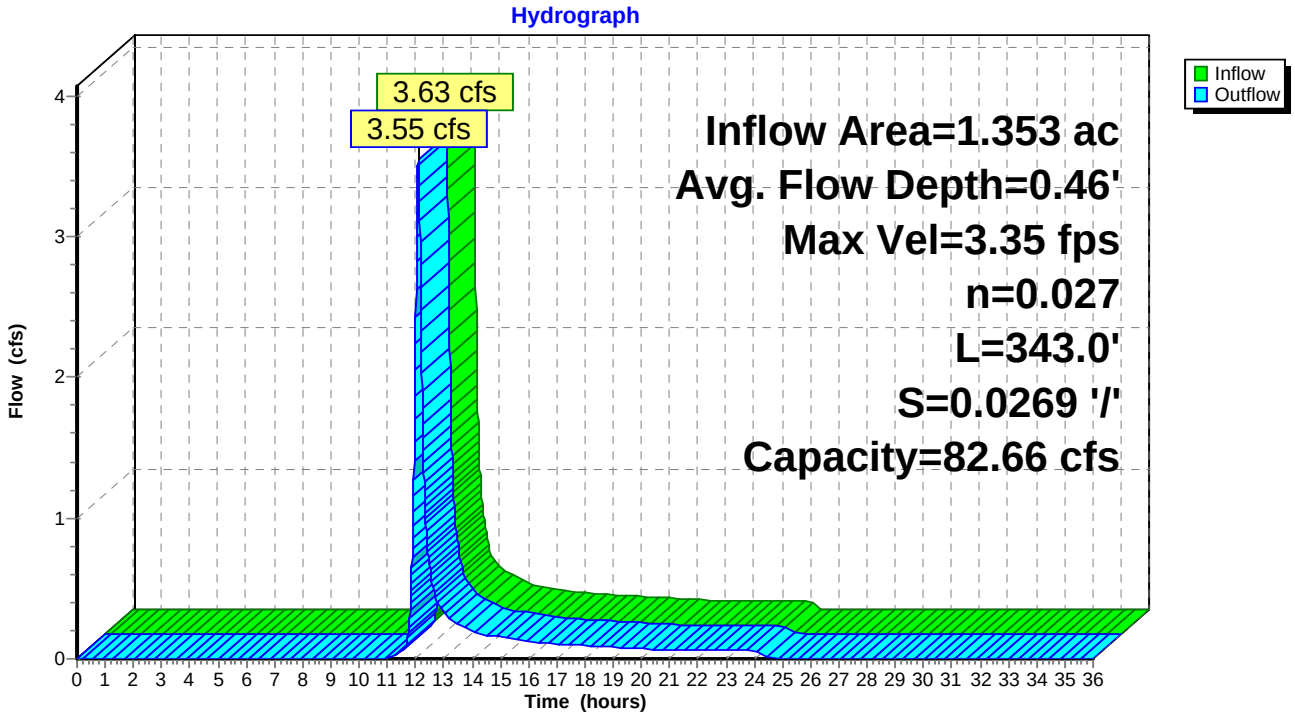
Peak Storage= 364 cf @ 12.07 hrs
Average Depth at Peak Storage= 0.46'
Bank-Full Depth= 1.50' Flow Area= 11.3 sf, Capacity= 82.66 cfs

0.00' x 1.50' deep channel, n= 0.027
Side Slope Z-value= 5.0 '/' Top Width= 15.00'
Length= 343.0' Slope= 0.0269 '/'
Inlet Invert= 409.27', Outlet Invert= 400.06'



‡

Reach C5B: Channel 5B



Summary for Pond ED: Existing Ditch

Inflow Area = 74.259 ac, 0.00% Impervious, Inflow Depth = 1.93" for 25 Yr event
Inflow = 93.75 cfs @ 11.90 hrs, Volume= 11.916 af
Outflow = 56.89 cfs @ 12.76 hrs, Volume= 11.850 af, Atten= 39%, Lag= 51.6 min
Primary = 56.89 cfs @ 12.76 hrs, Volume= 11.850 af

Routing by Stor-Ind method, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
Peak Elev= 381.88' @ 12.76 hrs Surf.Area= 84,439 sf Storage= 89,974 cf

Plug-Flow detention time= 35.6 min calculated for 11.846 af (99% of inflow)
Center-of-Mass det. time= 32.3 min (910.6 - 878.3)

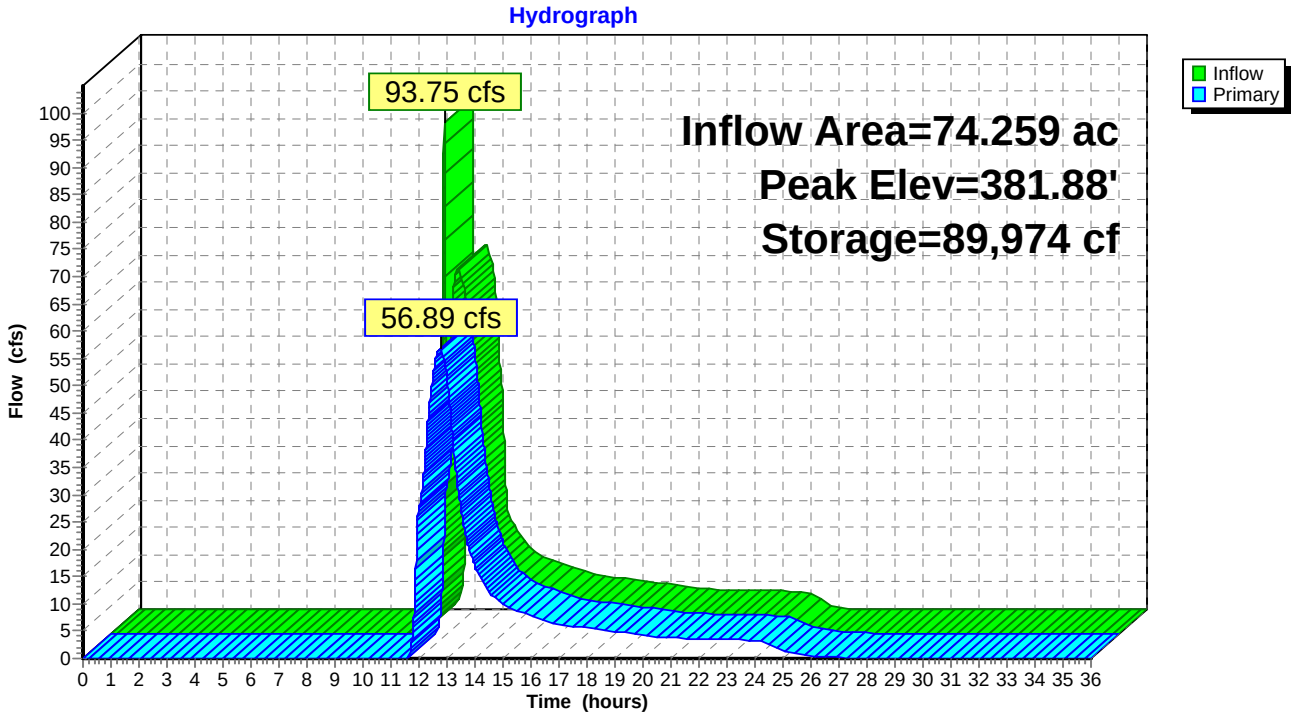
Volume	Invert	Avail.Storage	Storage Description
#1	379.60'	525,286 cf	**Custom Stage Data (Prismatic)** Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
379.60	1,580	0	0
380.00	12,876	2,891	2,891
381.00	46,484	29,680	32,571
382.00	89,767	68,126	100,697
383.00	137,236	113,502	214,198
384.00	191,498	164,367	378,565
384.70	227,705	146,721	525,286

Device	Routing	Invert	Outlet Devices
#1	Primary	380.00'	**Custom Weir/Orifice, Cv= 2.62 (C= 3.28)** Head (feet) 0.00 10.00 Width (feet) 3.00 53.00

Primary OutFlow Max=56.87 cfs @ 12.76 hrs HW=381.88' (Free Discharge)
↑—**1=Custom Weir/Orifice** (Weir Controls 56.87 cfs @ 3.94 fps)

Pond ED: Existing Ditch



Summary for Pond O1: Outlet 1

Inflow Area = 1.553 ac, 0.00% Impervious, Inflow Depth = 1.93" for 25 Yr event
Inflow = 4.44 cfs @ 12.09 hrs, Volume= 0.249 af
Outflow = 3.08 cfs @ 12.16 hrs, Volume= 0.249 af, Atten= 31%, Lag= 4.5 min
Primary = 3.08 cfs @ 12.16 hrs, Volume= 0.249 af

Routing by Stor-Ind method, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
Peak Elev= 400.56' @ 12.16 hrs Surf.Area= 1,518 sf Storage= 880 cf

Plug-Flow detention time= 2.2 min calculated for 0.249 af (100% of inflow)
Center-of-Mass det. time= 2.2 min (874.6 - 872.4)

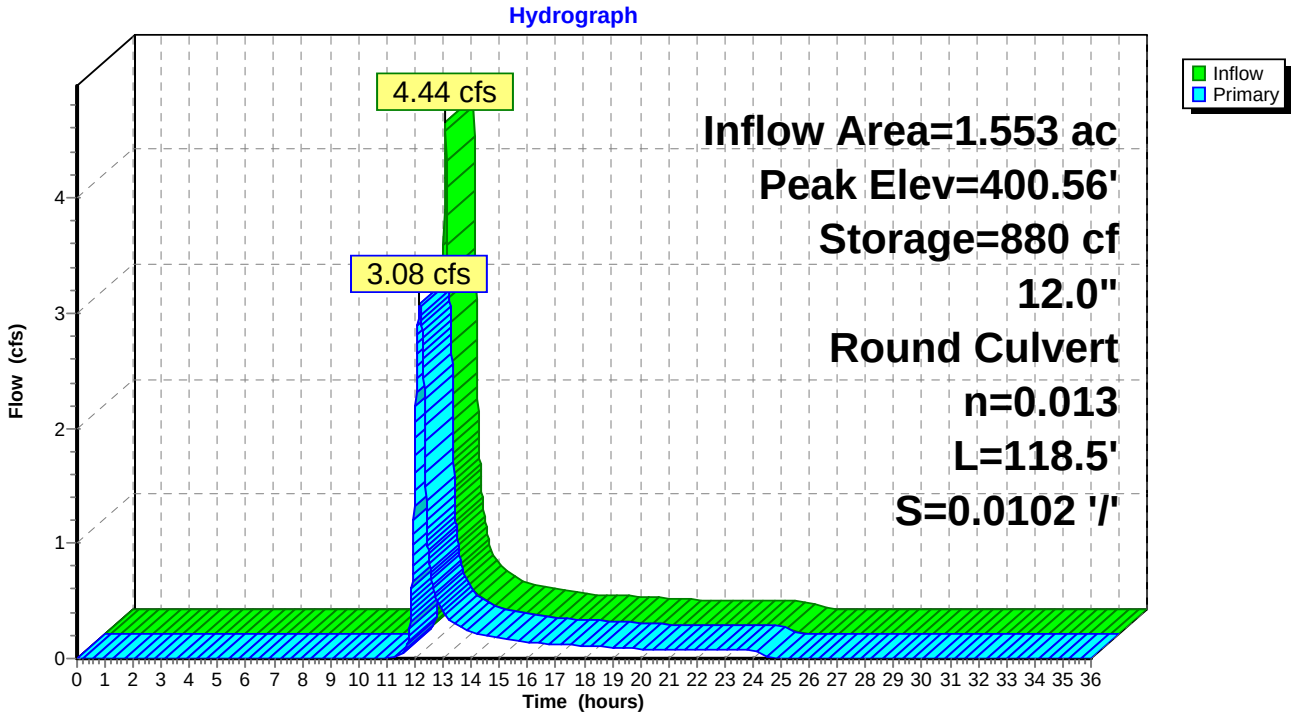
Volume	Invert	Avail.Storage	Storage Description
#1	399.00'	63,548 cf	**Custom Stage Data (Prismatic)** Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
399.00	0	0	0
400.00	579	290	290
401.00	2,248	1,414	1,703
402.00	5,001	3,625	5,328
403.00	8,817	6,909	12,237
404.00	13,732	11,275	23,511
405.00	19,744	16,738	40,249
406.00	26,853	23,299	63,548

Device	Routing	Invert	Outlet Devices
#1	Primary	399.00'	**12.0" Round Culvert** L= 118.5' CPP, projecting, no headwall, Ke= 0.900 Inlet / Outlet Invert= 399.00' / 397.79' S= 0.0102 '/' Cc= 0.900 n= 0.013 Corrugated PE, smooth interior, Flow Area= 0.79 sf

Primary OutFlow Max=3.08 cfs @ 12.16 hrs HW=400.56' (Free Discharge)
1=Culvert (Inlet Controls 3.08 cfs @ 3.92 fps)

Pond O1: Outlet 1



Summary for Pond O2: Outlet 2

Inflow Area = 18.214 ac, 0.00% Impervious, Inflow Depth = 1.93" for 25 Yr event
Inflow = 33.48 cfs @ 12.27 hrs, Volume= 2.923 af
Outflow = 19.96 cfs @ 12.48 hrs, Volume= 2.923 af, Atten= 40%, Lag= 12.4 min
Primary = 19.96 cfs @ 12.48 hrs, Volume= 2.923 af

Routing by Stor-Ind method, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
Peak Elev= 403.18' @ 12.48 hrs Surf.Area= 21,846 sf Storage= 14,685 cf

Plug-Flow detention time= 4.1 min calculated for 2.922 af (100% of inflow)
Center-of-Mass det. time= 4.1 min (887.7 - 883.5)

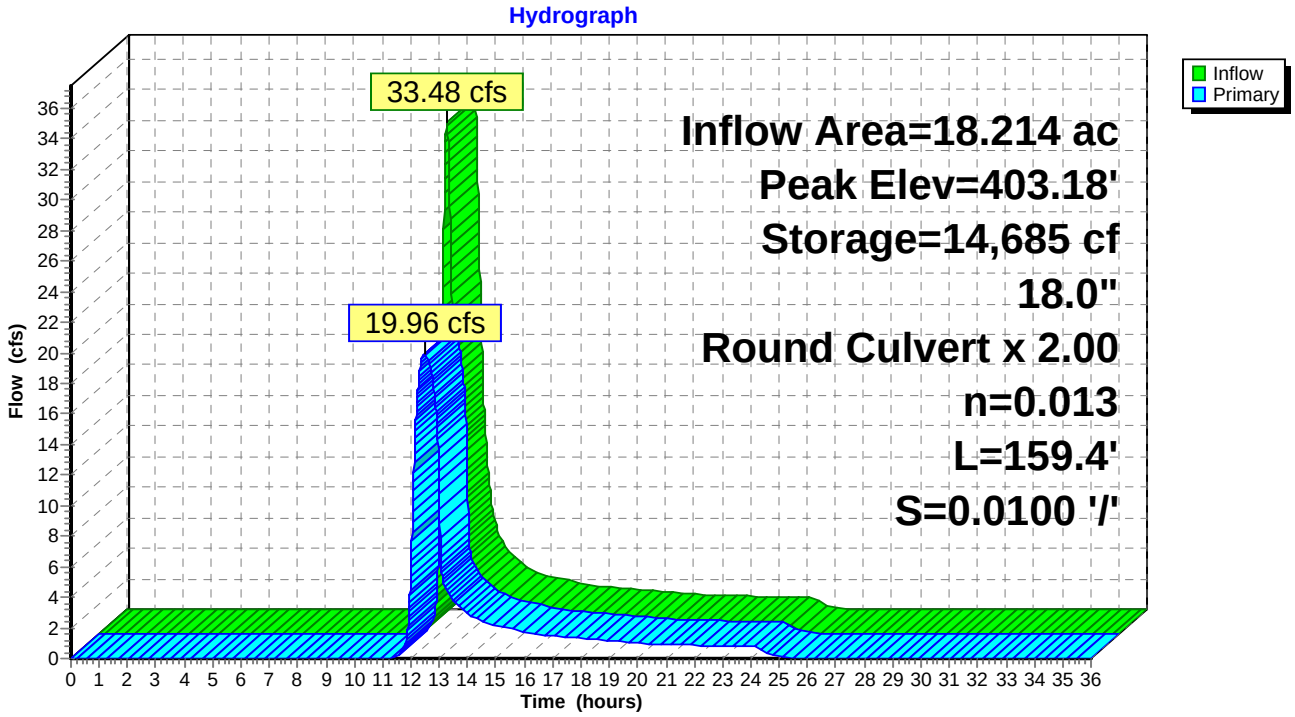
Volume	Invert	Avail.Storage	Storage Description
#1	400.25'	239,681 cf	**Custom Stage Data (Prismatic)** Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
400.25	0	0	0
401.00	557	209	209
402.00	2,553	1,555	1,764
403.00	16,466	9,510	11,273
404.00	46,676	31,571	42,844
405.00	94,316	70,496	113,340
406.00	158,366	126,341	239,681

Device	Routing	Invert	Outlet Devices
#1	Primary	400.22'	**18.0" Round Dual HDPE_Round 18" X 2.00** L= 159.4' CPP, projecting, no headwall, Ke= 0.900 Inlet / Outlet Invert= 400.22' / 398.63' S= 0.0100 '/' Cc= 0.900 n= 0.013 Corrugated PE, smooth interior, Flow Area= 1.77 sf

Primary OutFlow Max=19.96 cfs @ 12.48 hrs HW=403.18' (Free Discharge)
1=Dual HDPE_Round 18" (Inlet Controls 19.96 cfs @ 5.65 fps)

Pond O2: Outlet 2



Summary for Pond O3: Outlet 3

Inflow Area = 19.345 ac, 0.00% Impervious, Inflow Depth = 1.93" for 25 Yr event
Inflow = 34.82 cfs @ 12.29 hrs, Volume= 3.104 af
Outflow = 20.27 cfs @ 12.51 hrs, Volume= 3.104 af, Atten= 42%, Lag= 13.3 min
Primary = 20.27 cfs @ 12.51 hrs, Volume= 3.104 af

Routing by Stor-Ind method, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
Peak Elev= 403.25' @ 12.51 hrs Surf.Area= 23,847 sf Storage= 16,245 cf

Plug-Flow detention time= 4.5 min calculated for 3.104 af (100% of inflow)
Center-of-Mass det. time= 4.5 min (889.2 - 884.8)

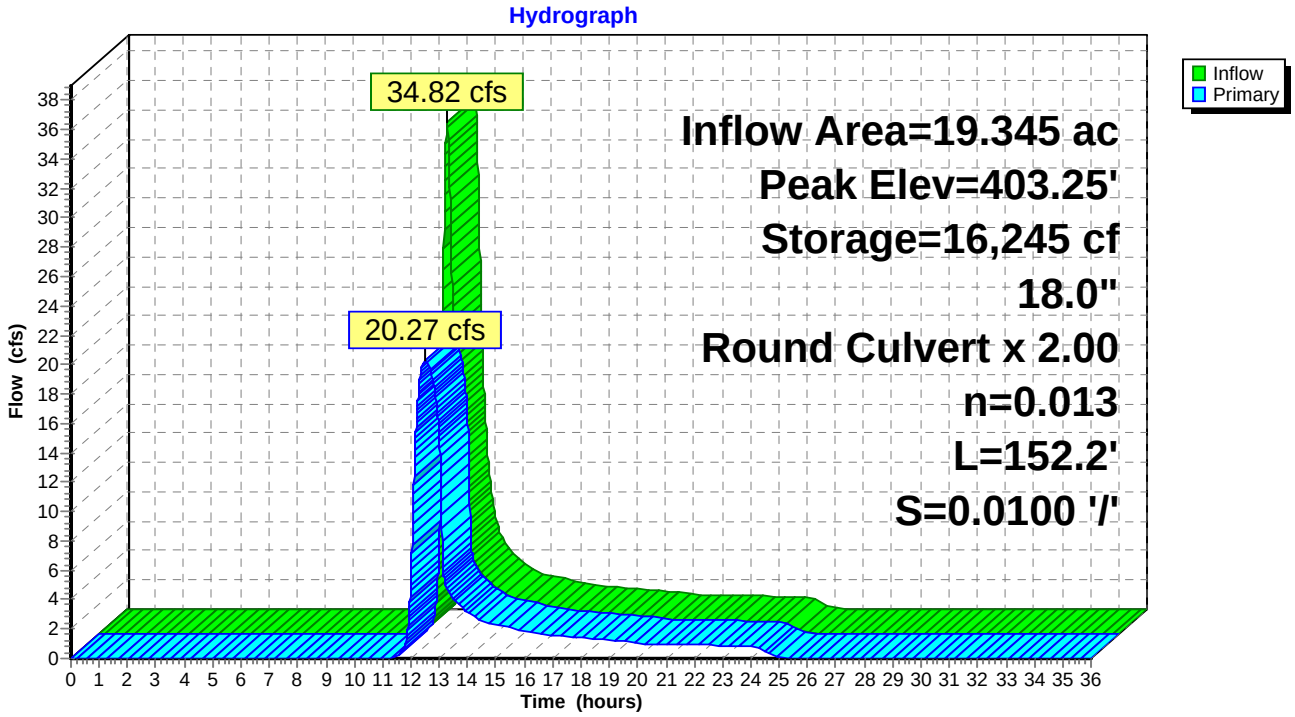
Volume	Invert	Avail.Storage	Storage Description
#1	400.29'	426,445 cf	**Custom Stage Data (Prismatic)** Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
400.29	0	0	0
401.00	558	198	198
402.00	2,504	1,531	1,729
403.00	16,565	9,535	11,264
404.00	46,104	31,335	42,598
405.00	92,058	69,081	111,679
406.00	153,474	122,766	234,445
407.00	230,526	192,000	426,445

Device	Routing	Invert	Outlet Devices
#1	Primary	400.22'	**18.0" Round Dual HDPE_Round 18" X 2.00** L= 152.2' CPP, projecting, no headwall, Ke= 0.900 Inlet / Outlet Invert= 400.22' / 398.70' S= 0.0100 '/' Cc= 0.900 n= 0.013 Corrugated PE, smooth interior, Flow Area= 1.77 sf

Primary OutFlow Max=20.27 cfs @ 12.51 hrs HW=403.25' (Free Discharge)
1=Dual HDPE_Round 18" (Inlet Controls 20.27 cfs @ 5.74 fps)

Pond O3: Outlet 3



Summary for Pond O4: Outlet 4

Inflow Area = 14.679 ac, 0.00% Impervious, Inflow Depth = 1.93" for 25 Yr event
Inflow = 27.05 cfs @ 12.26 hrs, Volume= 2.356 af
Outflow = 18.67 cfs @ 12.43 hrs, Volume= 2.356 af, Atten= 31%, Lag= 9.9 min
Primary = 18.67 cfs @ 12.43 hrs, Volume= 2.356 af

Routing by Stor-Ind method, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
Peak Elev= 401.75' @ 12.43 hrs Surf.Area= 13,372 sf Storage= 8,711 cf

Plug-Flow detention time= 2.5 min calculated for 2.356 af (100% of inflow)
Center-of-Mass det. time= 2.5 min (885.2 - 882.8)

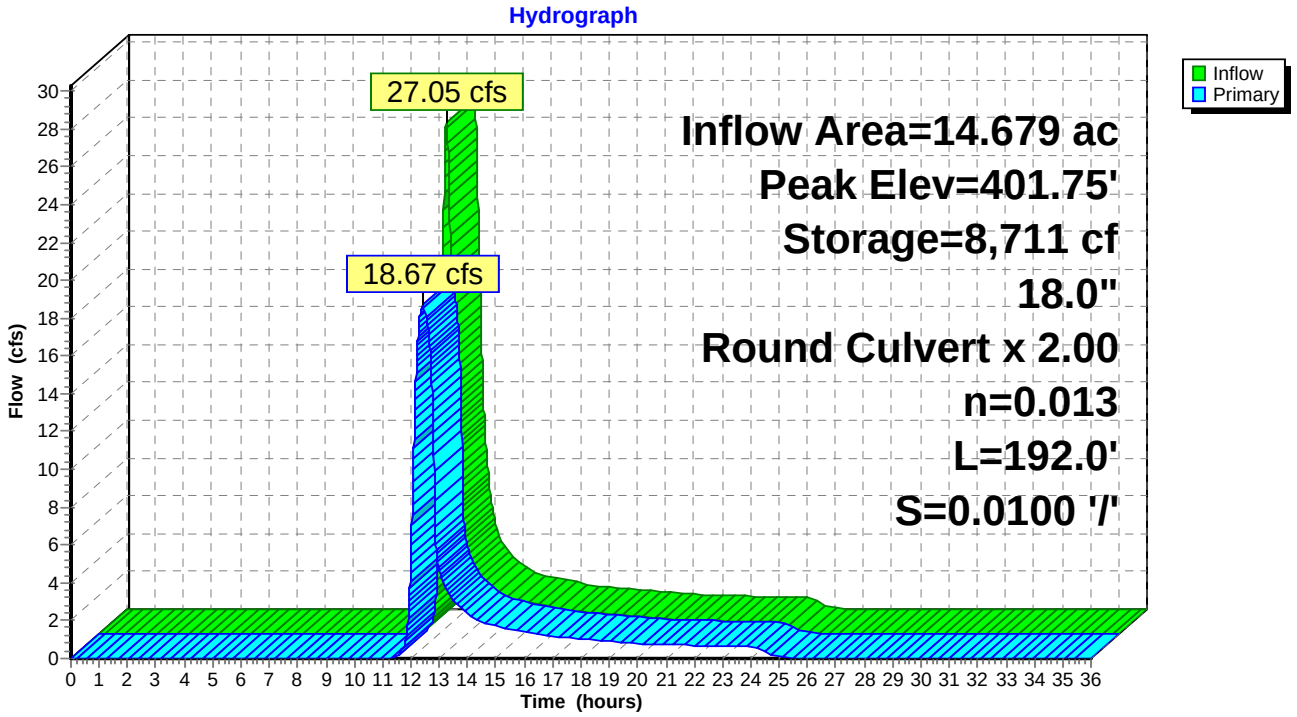
Volume	Invert	Avail.Storage	Storage Description
#1	399.17'	568,136 cf	**Custom Stage Data (Prismatic)** Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
399.17	0	0	0
400.00	549	228	228
401.00	3,640	2,095	2,322
402.00	16,597	10,119	12,441
403.00	40,488	28,543	40,983
404.00	76,724	58,606	99,589
405.00	123,336	100,030	199,619
406.00	181,353	152,345	351,964
407.00	250,992	216,173	568,136

Device	Routing	Invert	Outlet Devices
#1	Primary	399.07'	**18.0" Round Dual HDPE_Round 18" X 2.00** L= 192.0' CPP, projecting, no headwall, Ke= 0.900 Inlet / Outlet Invert= 399.07' / 397.15' S= 0.0100 '/' Cc= 0.900 n= 0.013 Corrugated PE, smooth interior, Flow Area= 1.77 sf

Primary OutFlow Max=18.67 cfs @ 12.43 hrs HW=401.75' (Free Discharge)
1=Dual HDPE_Round 18" (Inlet Controls 18.67 cfs @ 5.28 fps)

Pond O4: Outlet 4



Summary for Pond O5: Outlet 5

Inflow Area = 3.718 ac, 0.00% Impervious, Inflow Depth = 1.93" for 25 Yr event
Inflow = 9.48 cfs @ 12.11 hrs, Volume= 0.597 af
Outflow = 3.59 cfs @ 12.31 hrs, Volume= 0.597 af, Atten= 62%, Lag= 12.1 min
Primary = 3.59 cfs @ 12.31 hrs, Volume= 0.597 af

Routing by Stor-Ind method, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
Peak Elev= 402.01' @ 12.31 hrs Surf.Area= 6,941 sf Storage= 5,455 cf

Plug-Flow detention time= 12.0 min calculated for 0.596 af (100% of inflow)
Center-of-Mass det. time= 12.0 min (882.0 - 870.0)

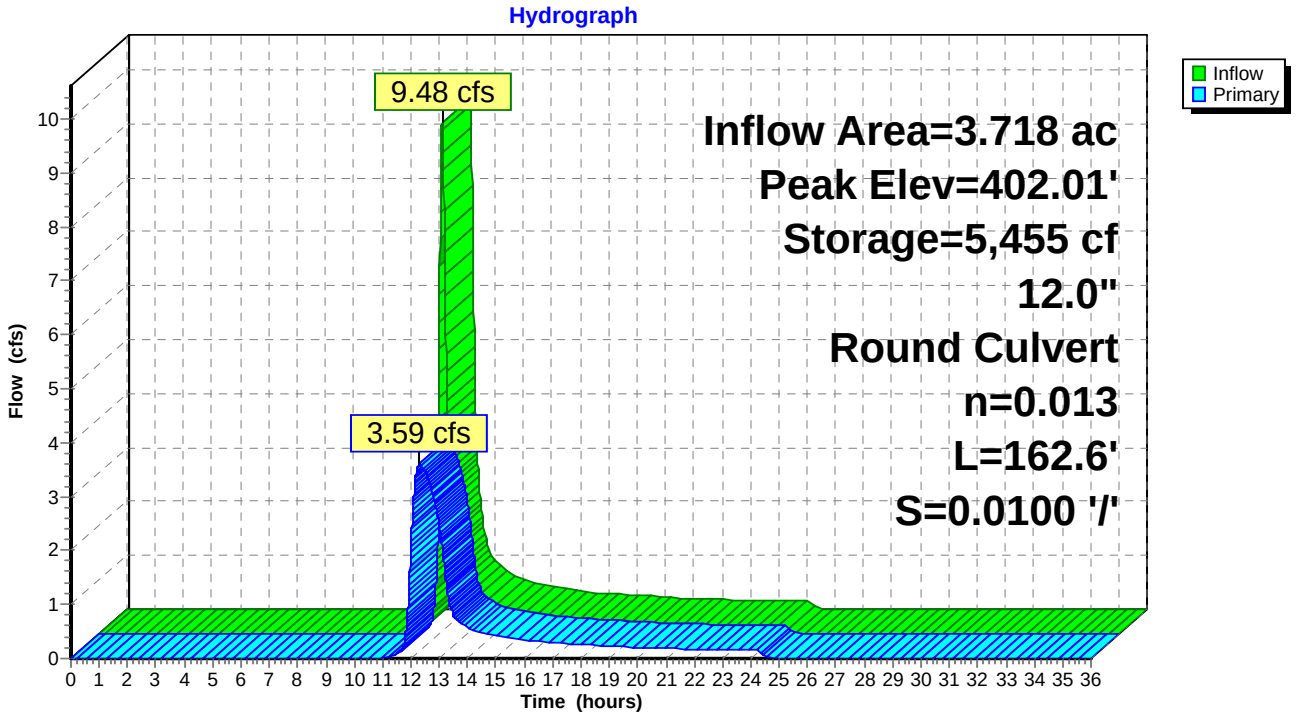
Volume	Invert	Avail.Storage	Storage Description
#1	400.06'	360,355 cf	**Custom Stage Data (Prismatic)** Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
400.06	0	0	0
401.00	2,018	948	948
402.00	6,877	4,448	5,396
403.00	14,403	10,640	16,036
404.00	24,594	19,499	35,534
405.00	37,486	31,040	66,574
406.00	53,086	45,286	111,860
407.00	71,401	62,244	174,104
408.00	92,441	81,921	256,025
409.00	116,219	104,330	360,355

Device	Routing	Invert	Outlet Devices
#1	Primary	400.06'	**12.0" Round Culvert** L= 162.6' CPP, projecting, no headwall, Ke= 0.900 Inlet / Outlet Invert= 400.06' / 398.43' S= 0.0100 '/' Cc= 0.900 n= 0.013 Corrugated PE, smooth interior, Flow Area= 0.79 sf

Primary OutFlow Max=3.59 cfs @ 12.31 hrs HW=402.01' (Free Discharge)
1=Culvert (Inlet Controls 3.59 cfs @ 4.57 fps)

Pond O5: Outlet 5



Time span=0.00-36.00 hrs, dt=0.01 hrs, 3601 points
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN
Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

Subcatchment S1A: Subcatchment 1A Runoff Area=67,665 sf 0.00% Impervious Runoff Depth=3.12"
Flow Length=38' Slope=0.2000 '/' Tc=2.7 min CN=61 Runoff=9.85 cfs 0.404 af

Subcatchment S2A1: Subcatchment 2A-1 Runoff Area=23,977 sf 0.00% Impervious Runoff Depth=3.12"
Flow Length=269' Tc=18.6 min CN=61 Runoff=1.96 cfs 0.143 af

Subcatchment S2A2: Subcatchment 2A-2 Runoff Area=25,906 sf 0.00% Impervious Runoff Depth=3.12"
Flow Length=287' Tc=18.9 min CN=61 Runoff=2.10 cfs 0.155 af

Subcatchment S2A3: Subcatchment 2A-3 Runoff Area=61,880 sf 0.00% Impervious Runoff Depth=3.12"
Flow Length=261' Tc=18.5 min CN=61 Runoff=5.08 cfs 0.369 af

Subcatchment S2B1: Subcatchment 2B-1 Runoff Area=28,853 sf 0.00% Impervious Runoff Depth=3.12"
Flow Length=212' Tc=17.6 min CN=61 Runoff=2.44 cfs 0.172 af

Subcatchment S2B10: Subcatchment 2B-10 Runoff Area=41,432 sf 0.00% Impervious Runoff Depth=3.12"
Flow Length=231' Slope=0.0180 '/' Tc=17.8 min CN=61 Runoff=3.47 cfs 0.247 af

Subcatchment S2B11: Subcatchment 2B-11 Runoff Area=58,052 sf 0.00% Impervious Runoff Depth=3.12"
Flow Length=267' Slope=0.0180 '/' Tc=18.5 min CN=61 Runoff=4.77 cfs 0.347 af

Subcatchment S2B12: Subcatchment 2B-12 Runoff Area=55,330 sf 0.00% Impervious Runoff Depth=3.12"
Flow Length=248' Slope=0.0190 '/' Tc=17.8 min CN=61 Runoff=4.64 cfs 0.330 af

Subcatchment S2B13: Subcatchment 2B-13 Runoff Area=45,118 sf 0.00% Impervious Runoff Depth=3.12"
Flow Length=246' Slope=0.0180 '/' Tc=18.1 min CN=61 Runoff=3.75 cfs 0.269 af

Subcatchment S2B2: Subcatchment 2B-2 Runoff Area=47,843 sf 0.00% Impervious Runoff Depth=3.12"
Flow Length=265' Tc=18.5 min CN=61 Runoff=3.93 cfs 0.286 af

Subcatchment S2B3: Subcatchment 2B-3 Runoff Area=52,998 sf 0.00% Impervious Runoff Depth=3.12"
Flow Length=232' Slope=0.0190 '/' Tc=17.5 min CN=61 Runoff=4.49 cfs 0.316 af

Subcatchment S2B4: Subcatchment 2B-4 Runoff Area=41,859 sf 0.00% Impervious Runoff Depth=3.12"
Flow Length=232' Tc=17.8 min CN=61 Runoff=3.51 cfs 0.250 af

Subcatchment S2B5: Subcatchment 2B-5 Runoff Area=50,647 sf 0.00% Impervious Runoff Depth=3.12"
Flow Length=253' Tc=18.2 min CN=61 Runoff=4.20 cfs 0.302 af

Subcatchment S2B6: Subcatchment 2B-6 Runoff Area=53,673 sf 0.00% Impervious Runoff Depth=3.12"
Flow Length=233' Tc=17.5 min CN=61 Runoff=4.55 cfs 0.320 af

Subcatchment S2B7: Subcatchment 2B-7 Runoff Area=41,873 sf 0.00% Impervious Runoff Depth=3.12"
Flow Length=233' Slope=0.0179 '/' Tc=17.9 min CN=61 Runoff=3.50 cfs 0.250 af

Subcatchment S2B8: Subcatchment 2B-8 Runoff Area=53,632 sf 0.00% Impervious Runoff Depth=3.12"
Flow Length=250' Slope=0.0180 '/' Tc=18.2 min CN=61 Runoff=4.45 cfs 0.320 af

Subcatchment S2B9: Subcatchment 2B-9 Runoff Area=53,565 sf 0.00% Impervious Runoff Depth=3.12"
Flow Length=233' Slope=0.0190 '/' Tc=17.5 min CN=61 Runoff=4.54 cfs 0.320 af

Subcatchment S2C: Subcatchment 2C Runoff Area=56,767 sf 0.00% Impervious Runoff Depth=3.12"
Flow Length=197' Slope=0.0190 '/' Tc=16.9 min CN=61 Runoff=4.90 cfs 0.339 af

Subcatchment S3A1: Subcatchment 3A-1 Runoff Area=74,883 sf 0.00% Impervious Runoff Depth=3.12"
Flow Length=276' Slope=0.0190 '/' Tc=18.2 min CN=61 Runoff=6.21 cfs 0.447 af

Subcatchment S3A2: Subcatchment 3A-2 Runoff Area=9,809 sf 0.00% Impervious Runoff Depth=3.12"
Flow Length=284' Slope=0.0190 '/' Tc=18.4 min CN=61 Runoff=0.81 cfs 0.059 af

Subcatchment S3A3: Subcatchment 3A-3 Runoff Area=36,274 sf 0.00% Impervious Runoff Depth=3.12"
Flow Length=239' Slope=0.0190 '/' Tc=17.6 min CN=61 Runoff=3.06 cfs 0.217 af

Subcatchment S3B1: Subcatchment 3B-1 Runoff Area=41,774 sf 0.00% Impervious Runoff Depth=3.12"
Flow Length=267' Tc=18.1 min CN=61 Runoff=3.47 cfs 0.249 af

Subcatchment S3B10: Subcatchment 3B-10 Runoff Area=45,256 sf 0.00% Impervious Runoff Depth=3.12"
Flow Length=268' Slope=0.0190 '/' Tc=18.1 min CN=61 Runoff=3.76 cfs 0.270 af

Subcatchment S3B2: Subcatchment 3B-2 Runoff Area=84,030 sf 0.00% Impervious Runoff Depth=3.12"
Flow Length=284' Slope=0.0190 '/' Tc=18.4 min CN=61 Runoff=6.92 cfs 0.502 af

Subcatchment S3B3: Subcatchment 3B-3 Runoff Area=49,143 sf 0.00% Impervious Runoff Depth=3.12"
Flow Length=232' Tc=17.9 min CN=61 Runoff=4.11 cfs 0.293 af

Subcatchment S3B4: Subcatchment 3B-4 Runoff Area=42,968 sf 0.00% Impervious Runoff Depth=3.12"
Flow Length=267' Slope=0.0188 '/' Tc=18.1 min CN=61 Runoff=3.57 cfs 0.256 af

Subcatchment S3B5: Subcatchment 3B-5 Runoff Area=84,295 sf 0.00% Impervious Runoff Depth=3.12"
Flow Length=284' Slope=0.0190 '/' Tc=18.4 min CN=61 Runoff=6.94 cfs 0.503 af

Subcatchment S3B6: Subcatchment 3B-6 Runoff Area=52,439 sf 0.00% Impervious Runoff Depth=3.12"
Flow Length=234' Slope=0.0180 '/' Tc=17.9 min CN=61 Runoff=4.39 cfs 0.313 af

Subcatchment S3B7: Subcatchment 3B-7 Runoff Area=41,749 sf 0.00% Impervious Runoff Depth=3.12"
Flow Length=254' Slope=0.0189 '/' Tc=17.9 min CN=61 Runoff=3.49 cfs 0.249 af

Subcatchment S3B8: Subcatchment 3B-8 Runoff Area=76,316 sf 0.00% Impervious Runoff Depth=3.12"
Flow Length=291' Slope=0.0190 '/' Tc=18.5 min CN=61 Runoff=6.26 cfs 0.456 af

Subcatchment S3B9: Subcatchment 3B-9 Runoff Area=57,859 sf 0.00% Impervious Runoff Depth=3.12"
Flow Length=232' Slope=0.0180 '/' Tc=17.8 min CN=61 Runoff=4.85 cfs 0.345 af

Subcatchment S3C: Subcatchment 3C Runoff Area=61,276 sf 0.00% Impervious Runoff Depth=3.12"
Flow Length=221' Slope=0.0180 '/' Tc=17.6 min CN=61 Runoff=5.17 cfs 0.366 af

Subcatchment S3D: Subcatchment 3D Runoff Area=84,589 sf 0.00% Impervious Runoff Depth=3.12"
Flow Length=284' Tc=18.4 min CN=61 Runoff=6.97 cfs 0.505 af

Subcatchment S4A1: Subcatchment 4A-1 Runoff Area=103,404 sf 0.00% Impervious Runoff Depth=3.12"
Flow Length=280' Tc=17.7 min CN=61 Runoff=8.70 cfs 0.617 af

Subcatchment S4A2: Subcatchment 4A-2 Runoff Area=29,841 sf 0.00% Impervious Runoff Depth=3.12"
Flow Length=285' Tc=17.8 min CN=61 Runoff=2.50 cfs 0.178 af

Subcatchment S4A3: Subcatchment 4A-3 Runoff Area=48,624 sf 0.00% Impervious Runoff Depth=3.12"
Flow Length=262' Tc=17.4 min CN=61 Runoff=4.13 cfs 0.290 af

Subcatchment S4B1: Subcatchment 4B-1 Runoff Area=7,017 sf 0.00% Impervious Runoff Depth=3.12"
Flow Length=68' Slope=0.0207 '/' Tc=10.8 min CN=61 Runoff=0.75 cfs 0.042 af

Subcatchment S4B2: Subcatchment 4B-2 Runoff Area=118,286 sf 0.00% Impervious Runoff Depth=3.12"
Flow Length=284' Slope=0.0207 '/' Tc=17.7 min CN=61 Runoff=9.95 cfs 0.706 af

Subcatchment S4B3: Subcatchment 4B-3 Runoff Area=27,625 sf 0.00% Impervious Runoff Depth=3.12"
Flow Length=285' Tc=17.8 min CN=61 Runoff=2.31 cfs 0.165 af

Subcatchment S4B4: Subcatchment 3B-4 Runoff Area=46,922 sf 0.00% Impervious Runoff Depth=3.12"
Flow Length=248' Slope=0.0204 '/' Tc=17.2 min CN=61 Runoff=4.02 cfs 0.280 af

Subcatchment S4B5: Subcatchment 4B-5 Runoff Area=108,239 sf 0.00% Impervious Runoff Depth=3.12"
Flow Length=297' Slope=0.0207 '/' Tc=18.0 min CN=61 Runoff=9.01 cfs 0.646 af

Subcatchment S4B6: Subcatchment 4B-6 Runoff Area=56,286 sf 0.00% Impervious Runoff Depth=3.12"
Flow Length=299' Tc=18.0 min CN=61 Runoff=4.69 cfs 0.336 af

Subcatchment S4B7: Subcatchment 4B-7 Runoff Area=50,996 sf 0.00% Impervious Runoff Depth=3.12"
Flow Length=260' Tc=17.4 min CN=61 Runoff=4.33 cfs 0.304 af

Subcatchment S4C: Subcatchment 4C Runoff Area=42,187 sf 0.00% Impervious Runoff Depth=3.12"
Flow Length=171' Tc=15.8 min CN=61 Runoff=3.77 cfs 0.252 af

Subcatchment S5A: Subcatchment 5A Runoff Area=103,005 sf 0.00% Impervious Runoff Depth=3.12"
Flow Length=234' Slope=0.0450 '/' Tc=12.2 min CN=61 Runoff=10.46 cfs 0.615 af

Subcatchment S5B: Subcatchment 5B Runoff Area=58,931 sf 0.00% Impervious Runoff Depth=3.12"
Flow Length=214' Slope=0.0450 '/' Tc=12.0 min CN=61 Runoff=6.03 cfs 0.352 af

Subcatchment SED: Subcatchment Runoff Area=891,570 sf 0.00% Impervious Runoff Depth=3.12"
Tc=0.0 min CN=61 Runoff=141.57 cfs 5.322 af

Reach 1RR: Outlet 1 Riprap Avg. Flow Depth=0.34' Max Vel=2.93 fps Inflow=3.97 cfs 0.404 af
n=0.070 L=107.4' S=0.1131 '/' Capacity=31.93 cfs Outflow=3.96 cfs 0.404 af

Reach 2RR: Outlet 2 Riprap Avg. Flow Depth=0.67' Max Vel=4.92 fps Inflow=23.29 cfs 4.736 af
n=0.070 L=108.3' S=0.1316 '/' Capacity=108.53 cfs Outflow=23.29 cfs 4.736 af

Reach 3RR: Outlet 3 Riprap Avg. Flow Depth=0.55' Max Vel=5.67 fps Inflow=23.63 cfs 5.030 af
n=0.070 L=88.2' S=0.2124 '/' Capacity=155.82 cfs Outflow=23.63 cfs 5.030 af

Reach 4RR: Outlet 4 Riprap Avg. Flow Depth=0.61' Max Vel=5.43 fps Inflow=22.51 cfs 3.817 af
n=0.070 L=90.7' S=0.1800 '/' Capacity=126.96 cfs Outflow=22.51 cfs 3.817 af

Reach 5RR: Slope Riprap Avg. Flow Depth=0.32' Max Vel=3.35 fps Inflow=4.27 cfs 0.967 af
n=0.070 L=49.9' S=0.1553 '/' Capacity=87.80 cfs Outflow=4.27 cfs 0.967 af

Reach C1A: Channel 1A Avg. Flow Depth=0.74' Max Vel=2.80 fps Inflow=9.85 cfs 0.404 af
n=0.027 L=901.9' S=0.0100 '/' Capacity=148.74 cfs Outflow=7.69 cfs 0.404 af

Reach C2A1: Channel 2A-1 Avg. Flow Depth=0.28' Max Vel=3.77 fps Inflow=8.17 cfs 0.667 af
n=0.027 L=78.4' S=0.0647 '/' Capacity=713.92 cfs Outflow=8.16 cfs 0.667 af

Reach C2A2: Channel 2A-2 Avg. Flow Depth=0.22' Max Vel=1.57 fps Inflow=2.10 cfs 0.155 af
n=0.027 L=158.7' S=0.0152 '/' Capacity=112.98 cfs Outflow=2.07 cfs 0.155 af

Reach C2A3: Channel 2A-3 Avg. Flow Depth=0.33' Max Vel=1.60 fps Inflow=5.08 cfs 0.369 af
n=0.027 L=425.8' S=0.0094 '/' Capacity=272.44 cfs Outflow=4.70 cfs 0.369 af

Reach C2B1: Channel 2B-1 Avg. Flow Depth=1.52' Max Vel=3.51 fps Inflow=45.82 cfs 3.730 af
n=0.045 L=117.5' S=0.0120 '/' Capacity=44.43 cfs Outflow=45.77 cfs 3.730 af

Reach C2B10: Channel 2B-10 Avg. Flow Depth=0.87' Max Vel=2.59 fps Inflow=14.94 cfs 1.193 af
n=0.045 L=157.6' S=0.0121 '/' Capacity=44.53 cfs Outflow=14.88 cfs 1.193 af

Reach C2B11: Channel 2B-11 Avg. Flow Depth=0.30' Max Vel=1.89 fps Inflow=4.77 cfs 0.347 af
n=0.027 L=456.9' S=0.0150 '/' Capacity=112.17 cfs Outflow=4.47 cfs 0.347 af

Reach C2B12: Channel 2B-12 Avg. Flow Depth=0.29' Max Vel=1.93 fps Inflow=4.64 cfs 0.330 af
n=0.027 L=469.6' S=0.0162 '/' Capacity=116.63 cfs Outflow=4.34 cfs 0.330 af

Reach C2B13: Channel 2B-13 Avg. Flow Depth=0.41' Max Vel=1.72 fps Inflow=3.75 cfs 0.269 af
n=0.045 L=141.6' S=0.0121 '/' Capacity=44.57 cfs Outflow=3.72 cfs 0.269 af

Reach C2B2: Channel 2B-2 Avg. Flow Depth=0.28' Max Vel=1.79 fps Inflow=3.93 cfs 0.286 af
n=0.027 L=415.6' S=0.0147 '/' Capacity=111.16 cfs Outflow=3.70 cfs 0.286 af

Reach C2B3: Channel 2B-3 Avg. Flow Depth=0.29' Max Vel=1.93 fps Inflow=4.49 cfs 0.316 af
n=0.027 L=416.3' S=0.0163 '/' Capacity=116.91 cfs Outflow=4.24 cfs 0.316 af

Reach C2B4: Channel 2B-4 Avg. Flow Depth=1.36' Max Vel=3.31 fps Inflow=36.52 cfs 2.956 af
n=0.045 L=157.6' S=0.0121 '/' Capacity=44.53 cfs Outflow=36.43 cfs 2.956 af

Reach C2B5: Channel 2B-5 Avg. Flow Depth=0.29' Max Vel=1.83 fps Inflow=4.20 cfs 0.302 af
n=0.027 L=420.8' S=0.0149 '/' Capacity=111.73 cfs Outflow=3.95 cfs 0.302 af

Reach C2B6: Channel 2B-6 Avg. Flow Depth=0.29' Max Vel=1.92 fps Inflow=4.55 cfs 0.320 af
n=0.027 L=475.0' S=0.0162 '/' Capacity=116.65 cfs Outflow=4.23 cfs 0.320 af

Reach C2B7: Channel 2B-7 Avg. Flow Depth=1.15' Max Vel=3.02 fps Inflow=25.94 cfs 2.083 af
n=0.045 L=157.6' S=0.0121 '/' Capacity=44.53 cfs Outflow=25.86 cfs 2.083 af

Reach C2B8: Channel 2B-8 Avg. Flow Depth=0.29' Max Vel=1.86 fps Inflow=4.45 cfs 0.320 af
n=0.027 L=437.8' S=0.0149 '/' Capacity=112.05 cfs Outflow=4.17 cfs 0.320 af

Reach C2B9: Channel 2B-9 Avg. Flow Depth=0.29' Max Vel=1.92 fps Inflow=4.54 cfs 0.320 af
n=0.027 L=472.3' S=0.0162 '/' Capacity=116.76 cfs Outflow=4.23 cfs 0.320 af

Reach C2C: Channel 2C Avg. Flow Depth=0.29' Max Vel=1.99 fps Inflow=4.90 cfs 0.339 af
n=0.027 L=481.7' S=0.0172 '/' Capacity=368.51 cfs Outflow=4.56 cfs 0.339 af

Reach C3A1: Channel 3A-1 Avg. Flow Depth=0.40' Max Vel=2.03 fps Inflow=9.46 cfs 0.722 af
n=0.027 L=415.3' S=0.0115 '/' Capacity=301.19 cfs Outflow=9.07 cfs 0.722 af

Reach C3A2: Channel 3A-2 Avg. Flow Depth=0.15' Max Vel=1.27 fps Inflow=0.81 cfs 0.059 af
n=0.027 L=57.4' S=0.0162 '/' Capacity=116.70 cfs Outflow=0.81 cfs 0.059 af

Reach C3A3: Channel 3A-3 Avg. Flow Depth=0.26' Max Vel=1.53 fps Inflow=3.06 cfs 0.217 af
n=0.027 L=308.4' S=0.0115 '/' Capacity=301.63 cfs Outflow=2.91 cfs 0.217 af

Reach C3B1: Channel 3B-1 Avg. Flow Depth=1.43' Max Vel=3.44 fps Inflow=40.87 cfs 3.437 af
n=0.045 L=149.2' S=0.0123 '/' Capacity=45.04 cfs Outflow=40.80 cfs 3.437 af

Reach C3B10: Channel 3B-10 Avg. Flow Depth=0.41' Max Vel=1.74 fps Inflow=3.76 cfs 0.270 af
n=0.045 L=141.8' S=0.0124 '/' Capacity=45.18 cfs Outflow=3.73 cfs 0.270 af

Reach C3B2: Channel 3B-2 Avg. Flow Depth=0.33' Max Vel=2.12 fps Inflow=6.92 cfs 0.502 af
n=0.027 L=668.9' S=0.0161 '/' Capacity=116.49 cfs Outflow=6.26 cfs 0.502 af

Reach C3B3: Channel 3B-3 Avg. Flow Depth=0.28' Max Vel=1.82 fps Inflow=4.11 cfs 0.293 af
n=0.027 L=409.0' S=0.0149 '/' Capacity=111.96 cfs Outflow=3.87 cfs 0.293 af

Reach C3B4: Channel 3B-4 Avg. Flow Depth=1.20' Max Vel=3.13 fps Inflow=28.65 cfs 2.393 af
n=0.045 L=157.7' S=0.0124 '/' Capacity=45.10 cfs Outflow=28.58 cfs 2.393 af

Reach C3B5: Channel 3B-5 Avg. Flow Depth=0.33' Max Vel=2.12 fps Inflow=6.94 cfs 0.503 af
n=0.027 L=666.2' S=0.0162 '/' Capacity=116.57 cfs Outflow=6.28 cfs 0.503 af

Reach C3B6: Channel 3B-6 Avg. Flow Depth=0.29' Max Vel=1.86 fps Inflow=4.39 cfs 0.313 af
n=0.027 L=434.7' S=0.0152 '/' Capacity=113.05 cfs Outflow=4.11 cfs 0.313 af

Reach C3B7: Channel 3B-7 Avg. Flow Depth=0.89' Max Vel=2.66 fps Inflow=15.92 cfs 1.320 af
n=0.045 L=157.7' S=0.0123 '/' Capacity=44.98 cfs Outflow=15.86 cfs 1.320 af

Reach C3B8: Channel 3B-8 Avg. Flow Depth=0.32' Max Vel=2.06 fps Inflow=6.26 cfs 0.456 af
n=0.027 L=648.3' S=0.0161 '/' Capacity=116.17 cfs Outflow=5.67 cfs 0.456 af

Reach C3B9: Channel 3B-9 Avg. Flow Depth=0.30' Max Vel=1.91 fps Inflow=4.85 cfs 0.345 af
n=0.027 L=451.9' S=0.0152 '/' Capacity=113.04 cfs Outflow=4.55 cfs 0.345 af

Reach C3C: Channel 3C Avg. Flow Depth=0.30' Max Vel=1.96 fps Inflow=5.17 cfs 0.366 af
n=0.027 L=410.8' S=0.0158 '/' Capacity=353.14 cfs Outflow=4.90 cfs 0.366 af

Reach C3D: Channel 3D Avg. Flow Depth=0.33' Max Vel=2.12 fps Inflow=6.97 cfs 0.505 af
n=0.027 L=671.6' S=0.0161 '/' Capacity=116.42 cfs Outflow=6.29 cfs 0.505 af

Reach C4A1: Channel 4A-1 Avg. Flow Depth=0.48' Max Vel=2.13 fps Inflow=14.11 cfs 1.086 af
n=0.027 L=407.8' S=0.0100 '/' Capacity=281.15 cfs Outflow=13.59 cfs 1.086 af

Reach C4A2: Channel 4A-2 Avg. Flow Depth=0.24' Max Vel=1.63 fps Inflow=2.50 cfs 0.178 af
n=0.027 L=148.7' S=0.0149 '/' Capacity=111.77 cfs Outflow=2.47 cfs 0.178 af

Reach C4A3: Channel 4A-3 Avg. Flow Depth=0.30' Max Vel=1.54 fps Inflow=4.13 cfs 0.290 af
n=0.027 L=372.9' S=0.0098 '/' Capacity=278.51 cfs Outflow=3.85 cfs 0.290 af

Reach C4B1: Channel 4B-1 Avg. Flow Depth=1.13' Max Vel=3.58 fps Inflow=30.07 cfs 2.480 af
n=0.045 L=66.0' S=0.0173 '/' Capacity=53.30 cfs Outflow=30.04 cfs 2.480 af

Reach C4B2: Channel 4B-2 Avg. Flow Depth=0.39' Max Vel=2.25 fps Inflow=9.95 cfs 0.706 af
n=0.027 L=700.3' S=0.0149 '/' Capacity=111.99 cfs Outflow=8.99 cfs 0.706 af

Reach C4B3: Channel 4B-3 Avg. Flow Depth=0.22' Max Vel=1.83 fps Inflow=2.31 cfs 0.165 af
n=0.027 L=141.7' S=0.0215 '/' Capacity=134.28 cfs Outflow=2.30 cfs 0.165 af

Reach C4B4: Channel 4B-4 Avg. Flow Depth=0.90' Max Vel=3.16 fps Inflow=19.14 cfs 1.567 af
n=0.045 L=206.0' S=0.0172 '/' Capacity=53.24 cfs Outflow=19.07 cfs 1.567 af

Reach C4B5: Channel 4B-5 Avg. Flow Depth=0.37' Max Vel=2.20 fps Inflow=9.01 cfs 0.646 af
n=0.027 L=666.3' S=0.0149 '/' Capacity=112.09 cfs Outflow=8.19 cfs 0.646 af

Reach C4B6: Channel 4B-6 Avg. Flow Depth=0.30' Max Vel=1.88 fps Inflow=4.69 cfs 0.336 af
n=0.027 L=372.8' S=0.0146 '/' Capacity=110.95 cfs Outflow=4.47 cfs 0.336 af

Reach C4B7: Channel 4B-7 Avg. Flow Depth=0.40' Max Vel=2.03 fps Inflow=4.33 cfs 0.304 af
n=0.045 L=191.3' S=0.0173 '/' Capacity=53.27 cfs Outflow=4.29 cfs 0.304 af

Reach C4C: Channel 4C Avg. Flow Depth=0.26' Max Vel=1.97 fps Inflow=3.77 cfs 0.252 af
n=0.027 L=447.2' S=0.0199 '/' Capacity=396.27 cfs Outflow=3.52 cfs 0.252 af

Reach C5A: Channel 5A Avg. Flow Depth=0.73' Max Vel=3.76 fps Inflow=10.46 cfs 0.615 af
n=0.027 L=507.4' S=0.0183 '/' Capacity=68.33 cfs Outflow=10.07 cfs 0.615 af

Reach C5B: Channel 5B Avg. Flow Depth=0.56' Max Vel=3.80 fps Inflow=6.03 cfs 0.352 af
n=0.027 L=343.0' S=0.0269 '/' Capacity=82.66 cfs Outflow=5.91 cfs 0.352 af

Pond ED: Existing Ditch Peak Elev=382.15' Storage=115,012 cf Inflow=160.17 cfs 19.309 af
Outflow=75.66 cfs 19.243 af

Pond O1: Outlet 1 Peak Elev=401.27' Storage=2,396 cf Inflow=7.69 cfs 0.404 af
12.0" Round Culvert n=0.013 L=118.5' S=0.0102 '/' Outflow=3.97 cfs 0.404 af

Pond O2: Outlet 2 Peak Elev=403.98' Storage=41,727 cf Inflow=58.15 cfs 4.736 af
18.0" Round Culvert x 2.00 n=0.013 L=159.4' S=0.0100 '/' Outflow=23.29 cfs 4.736 af

Pond O3: Outlet 3 Peak Elev=404.06' Storage=45,654 cf Inflow=60.67 cfs 5.030 af
18.0" Round Culvert x 2.00 n=0.013 L=152.2' S=0.0100 '/' Outflow=23.63 cfs 5.030 af

Pond O4: Outlet 4 Peak Elev=402.63' Storage=27,587 cf Inflow=46.97 cfs 3.817 af
18.0" Round Culvert x 2.00 n=0.013 L=192.0' S=0.0100 '/' Outflow=22.51 cfs 3.817 af

Pond O5: Outlet 5 Peak Elev=402.65' Storage=11,473 cf Inflow=15.89 cfs 0.967 af
12.0" Round Culvert n=0.013 L=162.6' S=0.0100 '/' Outflow=4.27 cfs 0.967 af

Total Runoff Area = 77.977 ac Runoff Volume = 20.276 af Average Runoff Depth = 3.12"
100.00% Pervious = 77.977 ac 0.00% Impervious = 0.000 ac

Summary for Subcatchment S1A: Subcatchment 1A

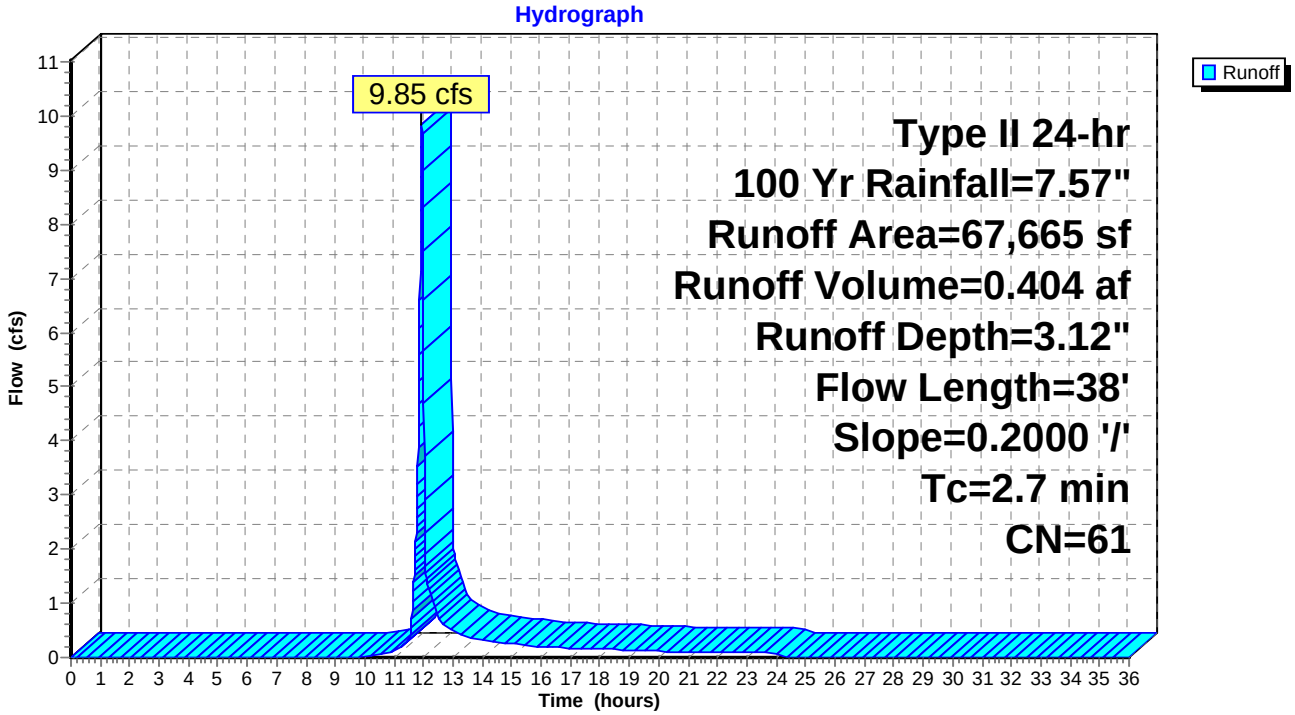
Runoff = 9.85 cfs @ 11.94 hrs, Volume= 0.404 af, Depth= 3.12"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
Type II 24-hr 100 Yr Rainfall=7.57"

Area (sf)	CN	Description
67,665	61	>75% Grass cover, Good, HSG B
67,665		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
2.7	38	0.2000	0.23		**Sheet Flow, Sheet Flow** Grass: Short n= 0.150 P2= 1.39"

Subcatchment S1A: Subcatchment 1A



Summary for Subcatchment S2A1: Subcatchment 2A-1

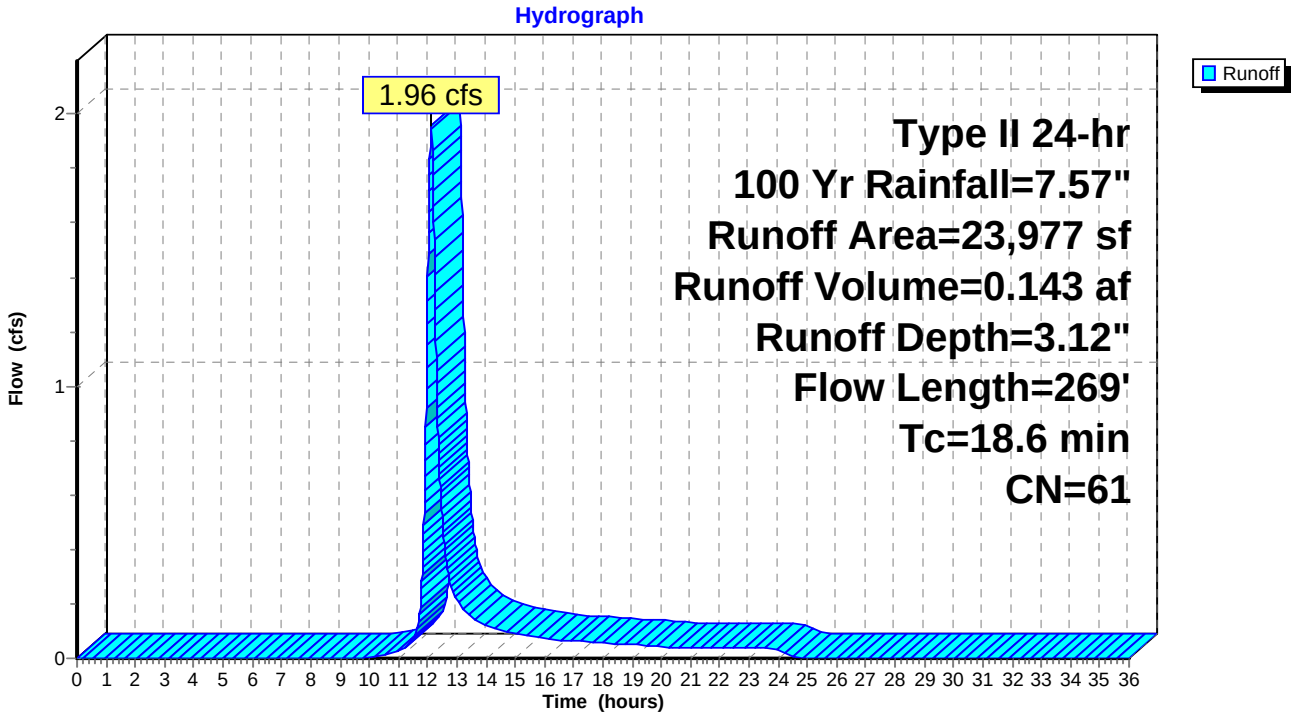
Runoff = 1.96 cfs @ 12.12 hrs, Volume= 0.143 af, Depth= 3.12"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
Type II 24-hr 100 Yr Rainfall=7.57"

Area (sf)	CN	Description
23,977	61	>75% Grass cover, Good, HSG B
23,977		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
15.6	100	0.0178	0.11		**Sheet Flow, Sheet Flow** Grass: Short n= 0.150 P2= 1.39"
3.0	169	0.0179	0.94		**Shallow Concentrated Flow, Shallow Conc.** Short Grass Pasture Kv= 7.0 fps
18.6	269	Total			

Subcatchment S2A1: Subcatchment 2A-1



Summary for Subcatchment S2A2: Subcatchment 2A-2

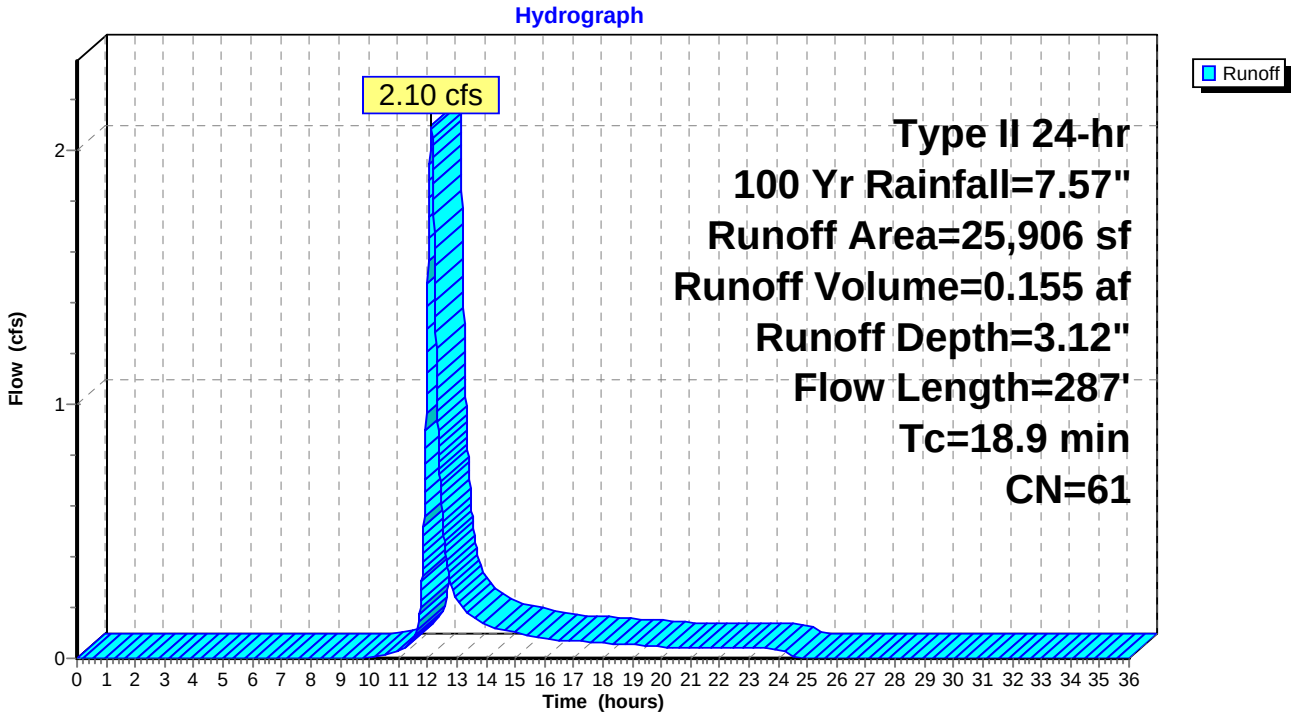
Runoff = 2.10 cfs @ 12.12 hrs, Volume= 0.155 af, Depth= 3.12"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
Type II 24-hr 100 Yr Rainfall=7.57"

Area (sf)	CN	Description
25,906	61	>75% Grass cover, Good, HSG B
25,906		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
15.6	100	0.0177	0.11		**Sheet Flow, Sheet Flow** Grass: Short n= 0.150 P2= 1.39"
3.3	187	0.0178	0.93		**Shallow Concentrated Flow, Shallow Conc.** Short Grass Pasture Kv= 7.0 fps
18.9	287	Total			

Subcatchment S2A2: Subcatchment 2A-2



Summary for Subcatchment S2A3: Subcatchment 2A-3

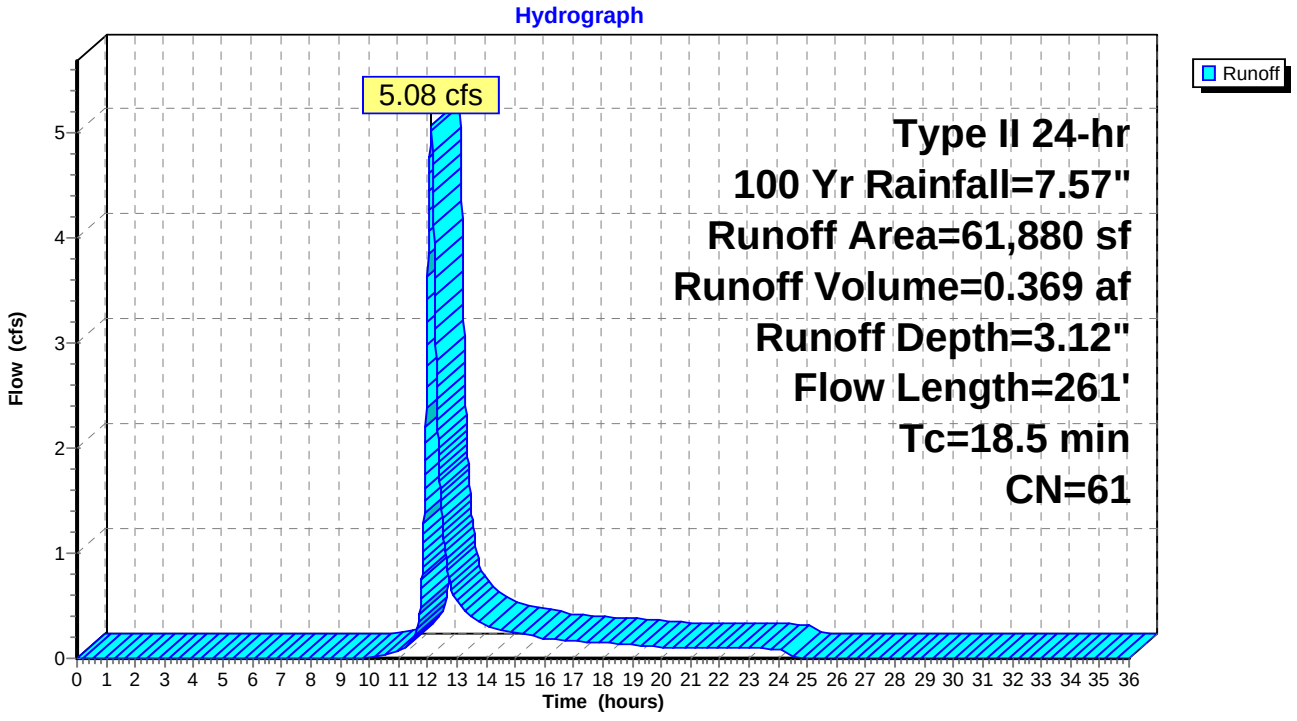
Runoff = 5.08 cfs @ 12.11 hrs, Volume= 0.369 af, Depth= 3.12"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
Type II 24-hr 100 Yr Rainfall=7.57"

Area (sf)	CN	Description
61,880	61	>75% Grass cover, Good, HSG B
61,880		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
15.6	100	0.0177	0.11		**Sheet Flow, Sheet Flow** Grass: Short n= 0.150 P2= 1.39"
2.9	161	0.0179	0.94		**Shallow Concentrated Flow, Shallow Conc.** Short Grass Pasture Kv= 7.0 fps
18.5	261	Total			

Subcatchment S2A3: Subcatchment 2A-3



Summary for Subcatchment S2B1: Subcatchment 2B-1

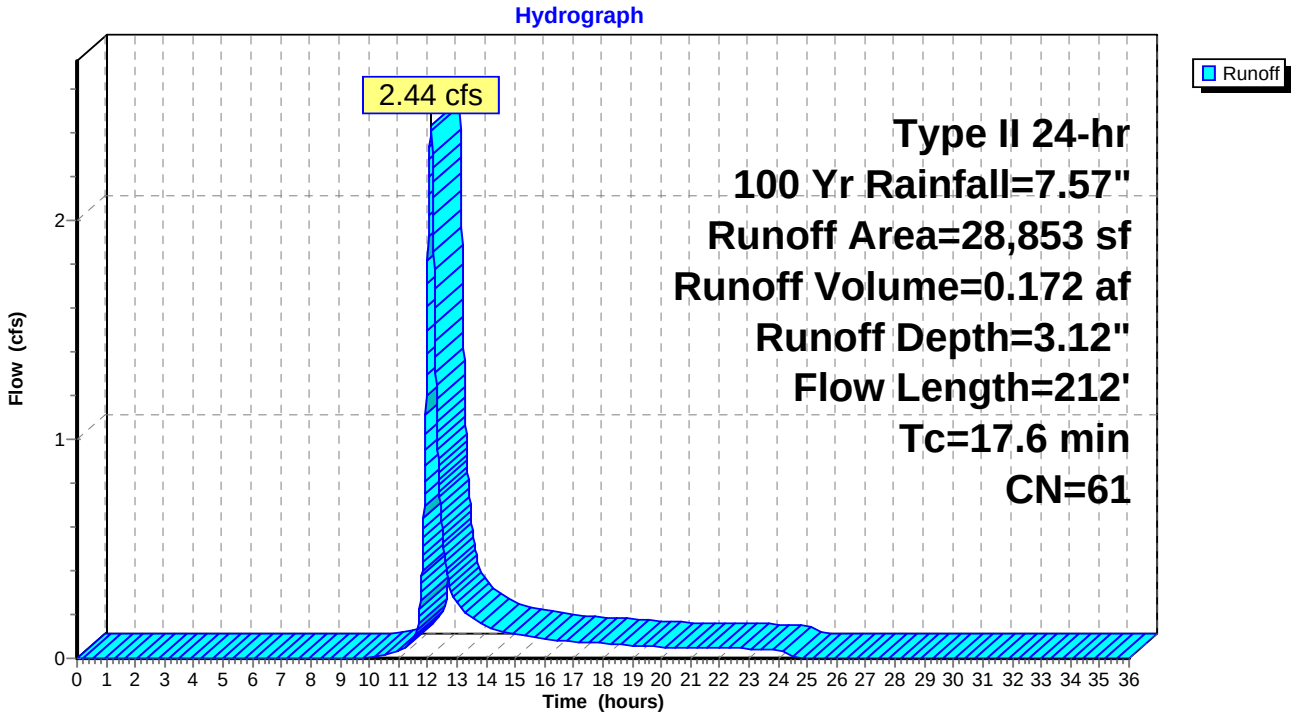
Runoff = 2.44 cfs @ 12.11 hrs, Volume= 0.172 af, Depth= 3.12"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
Type II 24-hr 100 Yr Rainfall=7.57"

Area (sf)	CN	Description
28,853	61	>75% Grass cover, Good, HSG B
28,853		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
15.6	100	0.0178	0.11		**Sheet Flow, Sheet Flow** Grass: Short n= 0.150 P2= 1.39"
2.0	112	0.0182	0.94		**Shallow Concentrated Flow, Shallow Conc.** Short Grass Pasture Kv= 7.0 fps
17.6	212	Total			

Subcatchment S2B1: Subcatchment 2B-1



Summary for Subcatchment S2B10: Subcatchment 2B-10

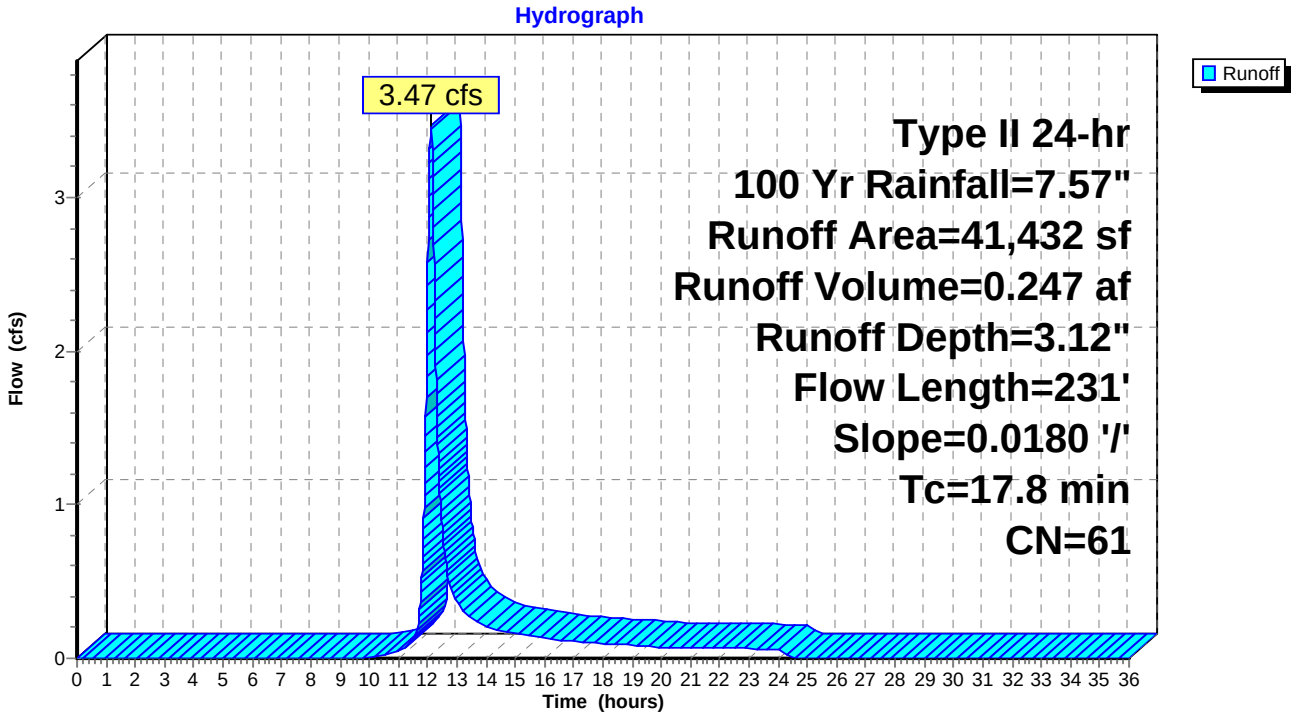
Runoff = 3.47 cfs @ 12.11 hrs, Volume= 0.247 af, Depth= 3.12"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
Type II 24-hr 100 Yr Rainfall=7.57"

Area (sf)	CN	Description
41,432	61	>75% Grass cover, Good, HSG B
41,432		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
15.5	100	0.0180	0.11		**Sheet Flow, Sheet Flow** Grass: Short n= 0.150 P2= 1.39"
2.3	131	0.0180	0.94		**Shallow Concentrated Flow, Shallow Conc.** Short Grass Pasture Kv= 7.0 fps
17.8	231	Total			

Subcatchment S2B10: Subcatchment 2B-10



Summary for Subcatchment S2B11: Subcatchment 2B-11

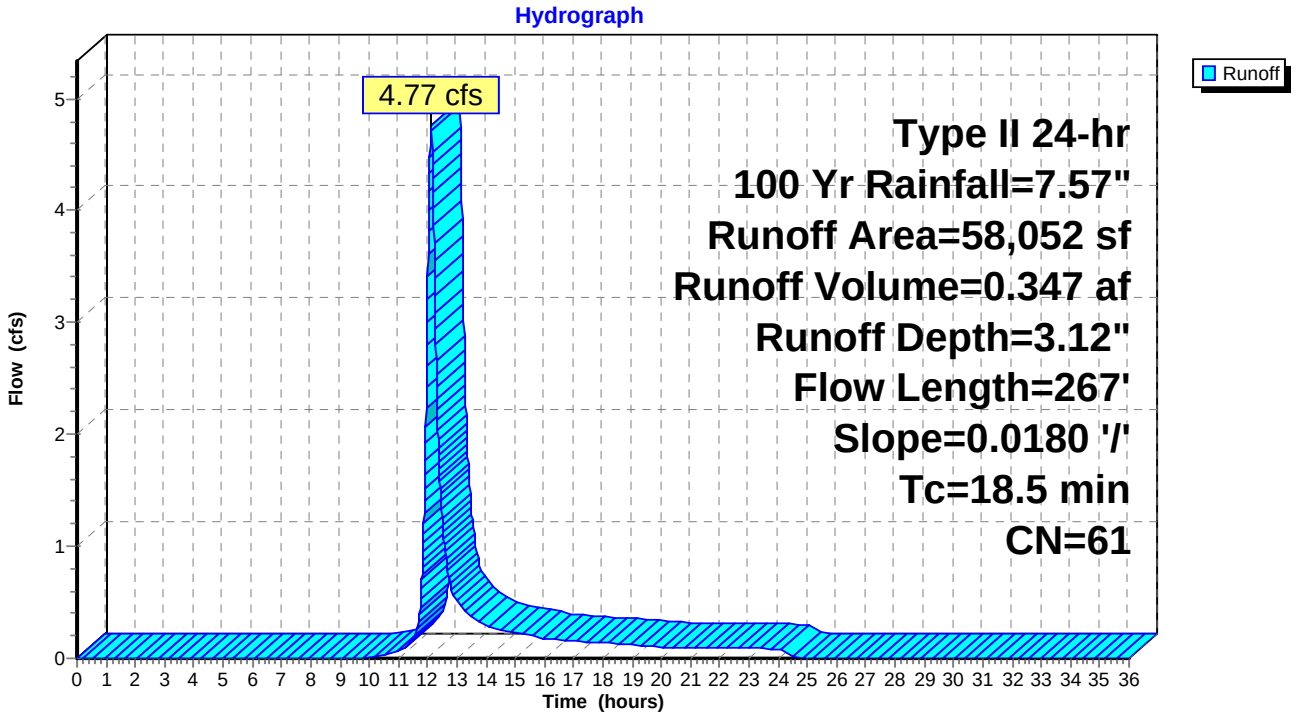
Runoff = 4.77 cfs @ 12.11 hrs, Volume= 0.347 af, Depth= 3.12"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
Type II 24-hr 100 Yr Rainfall=7.57"

Area (sf)	CN	Description
58,052	61	>75% Grass cover, Good, HSG B
58,052		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
15.5	100	0.0180	0.11		**Sheet Flow, Sheet Flow** Grass: Short n= 0.150 P2= 1.39"
3.0	167	0.0180	0.94		**Shallow Concentrated Flow, Shallow Conc.** Short Grass Pasture Kv= 7.0 fps
18.5	267	Total			

Subcatchment S2B11: Subcatchment 2B-11



Summary for Subcatchment S2B12: Subcatchment 2B-12

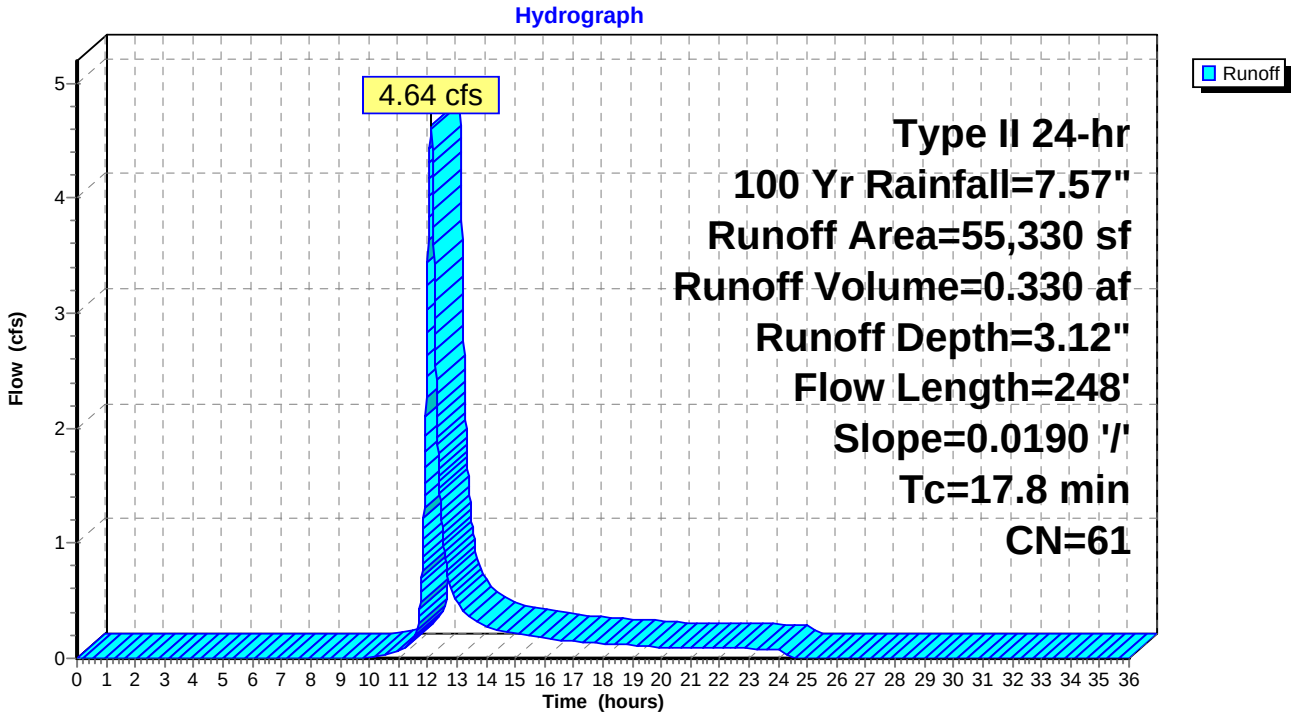
Runoff = 4.64 cfs @ 12.11 hrs, Volume= 0.330 af, Depth= 3.12"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
Type II 24-hr 100 Yr Rainfall=7.57"

Area (sf)	CN	Description
55,330	61	>75% Grass cover, Good, HSG B
55,330		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
15.2	100	0.0190	0.11		**Sheet Flow, Sheet Flow** Grass: Short n= 0.150 P2= 1.39"
2.6	148	0.0190	0.96		**Shallow Concentrated Flow, Shallow Conc.** Short Grass Pasture Kv= 7.0 fps
17.8	248	Total			

Subcatchment S2B12: Subcatchment 2B-12



Summary for Subcatchment S2B13: Subcatchment 2B-13

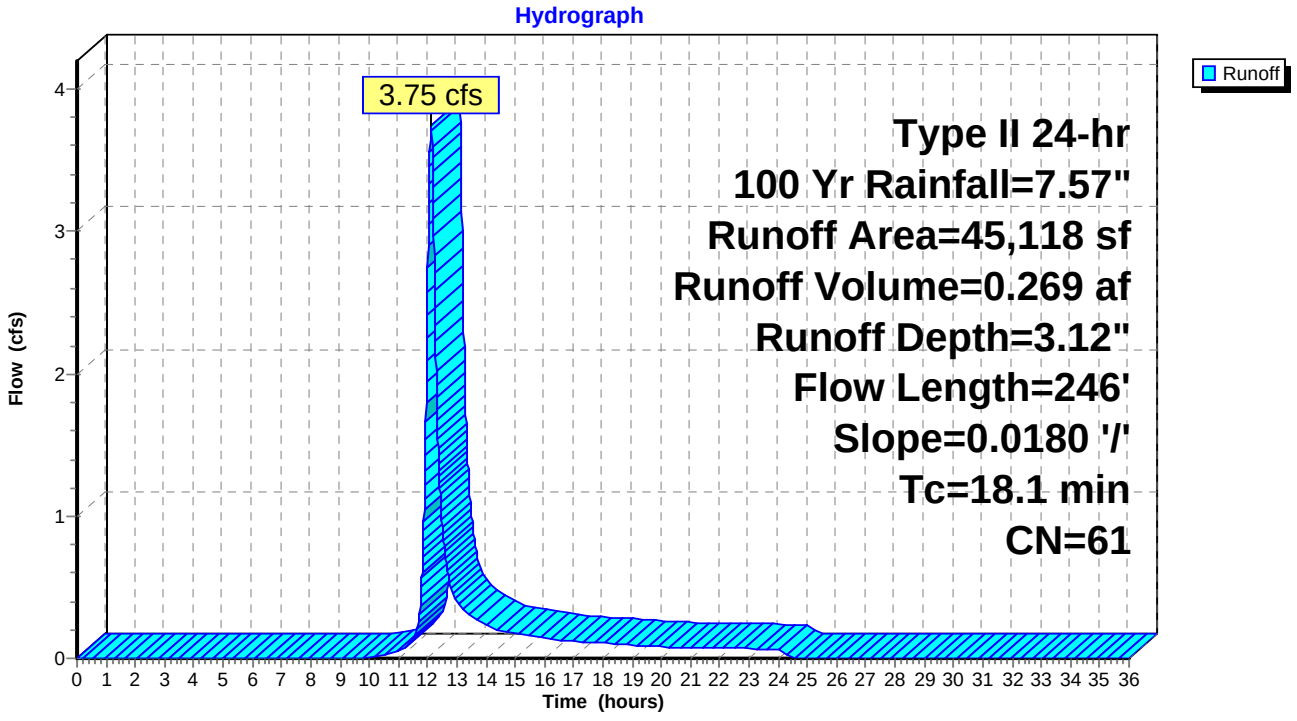
Runoff = 3.75 cfs @ 12.11 hrs, Volume= 0.269 af, Depth= 3.12"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
Type II 24-hr 100 Yr Rainfall=7.57"

Area (sf)	CN	Description
45,118	61	>75% Grass cover, Good, HSG B
45,118		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
15.5	100	0.0180	0.11		**Sheet Flow, Sheet Flow** Grass: Short n= 0.150 P2= 1.39"
2.6	146	0.0180	0.94		**Shallow Concentrated Flow, Shallow Conc.** Short Grass Pasture Kv= 7.0 fps
18.1	246	Total			

Subcatchment S2B13: Subcatchment 2B-13



Summary for Subcatchment S2B2: Subcatchment 2B-2

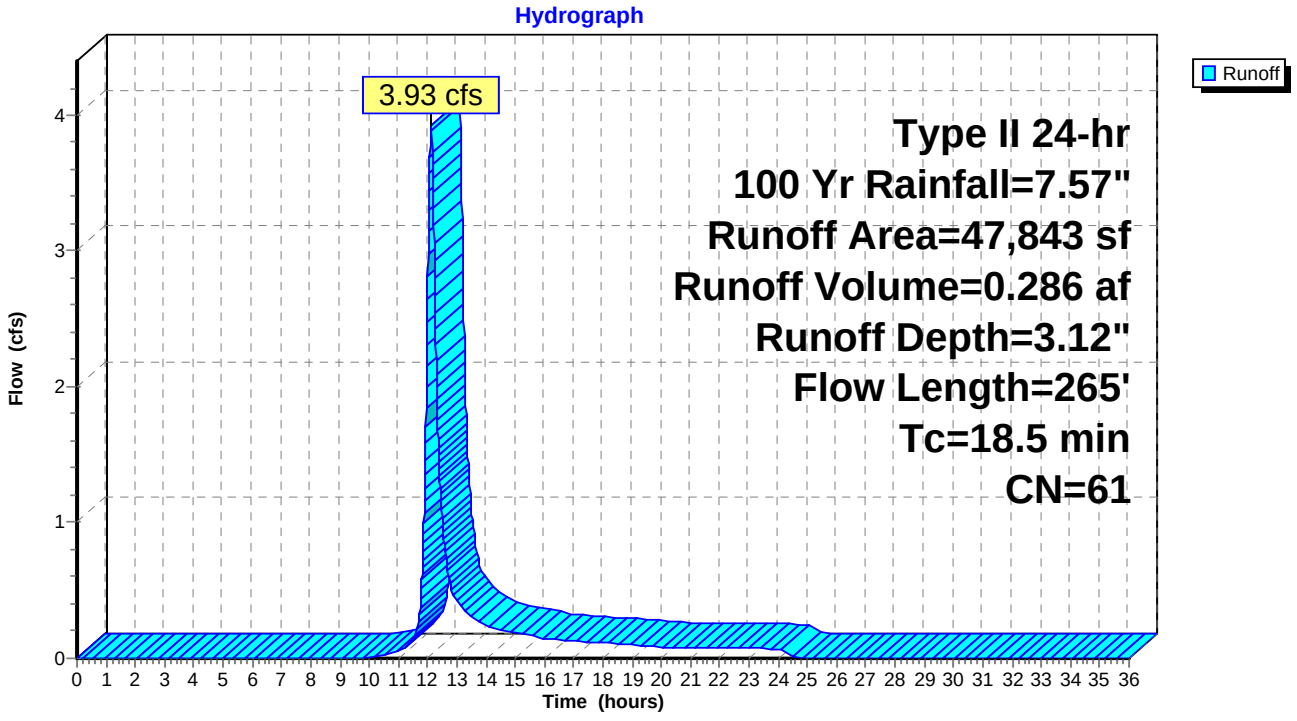
Runoff = 3.93 cfs @ 12.11 hrs, Volume= 0.286 af, Depth= 3.12"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
Type II 24-hr 100 Yr Rainfall=7.57"

Area (sf)	CN	Description
47,843	61	>75% Grass cover, Good, HSG B
47,843		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
15.6	100	0.0178	0.11		**Sheet Flow, Sheet Flow** Grass: Short n= 0.150 P2= 1.39"
2.9	165	0.0179	0.94		**Shallow Concentrated Flow, Shallow Conc.** Short Grass Pasture Kv= 7.0 fps
18.5	265	Total			

Subcatchment S2B2: Subcatchment 2B-2



Summary for Subcatchment S2B3: Subcatchment 2B-3

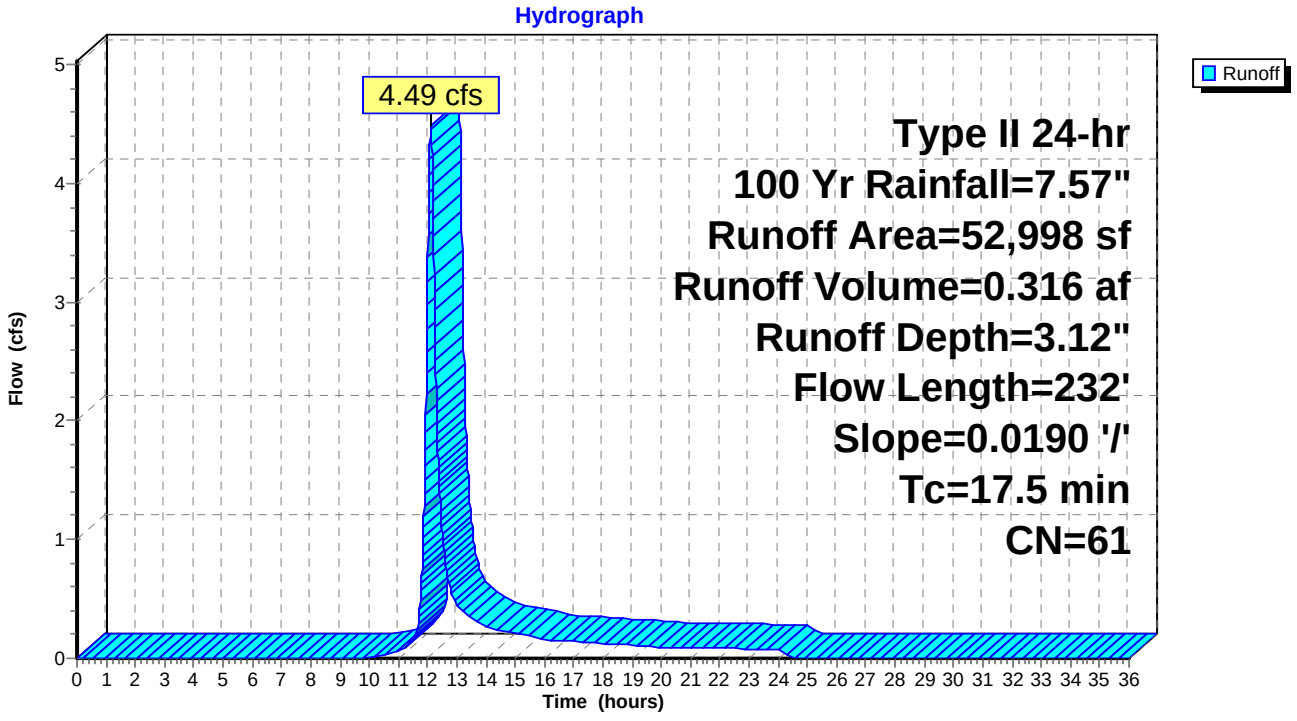
Runoff = 4.49 cfs @ 12.11 hrs, Volume= 0.316 af, Depth= 3.12"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
Type II 24-hr 100 Yr Rainfall=7.57"

Area (sf)	CN	Description
52,998	61	>75% Grass cover, Good, HSG B
52,998		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
15.2	100	0.0190	0.11		**Sheet Flow, Sheet Flow** Grass: Short n= 0.150 P2= 1.39"
2.3	132	0.0190	0.96		**Shallow Concentrated Flow, Shallow Conc.** Short Grass Pasture Kv= 7.0 fps
17.5	232	Total			

Subcatchment S2B3: Subcatchment 2B-3



Summary for Subcatchment S2B4: Subcatchment 2B-4

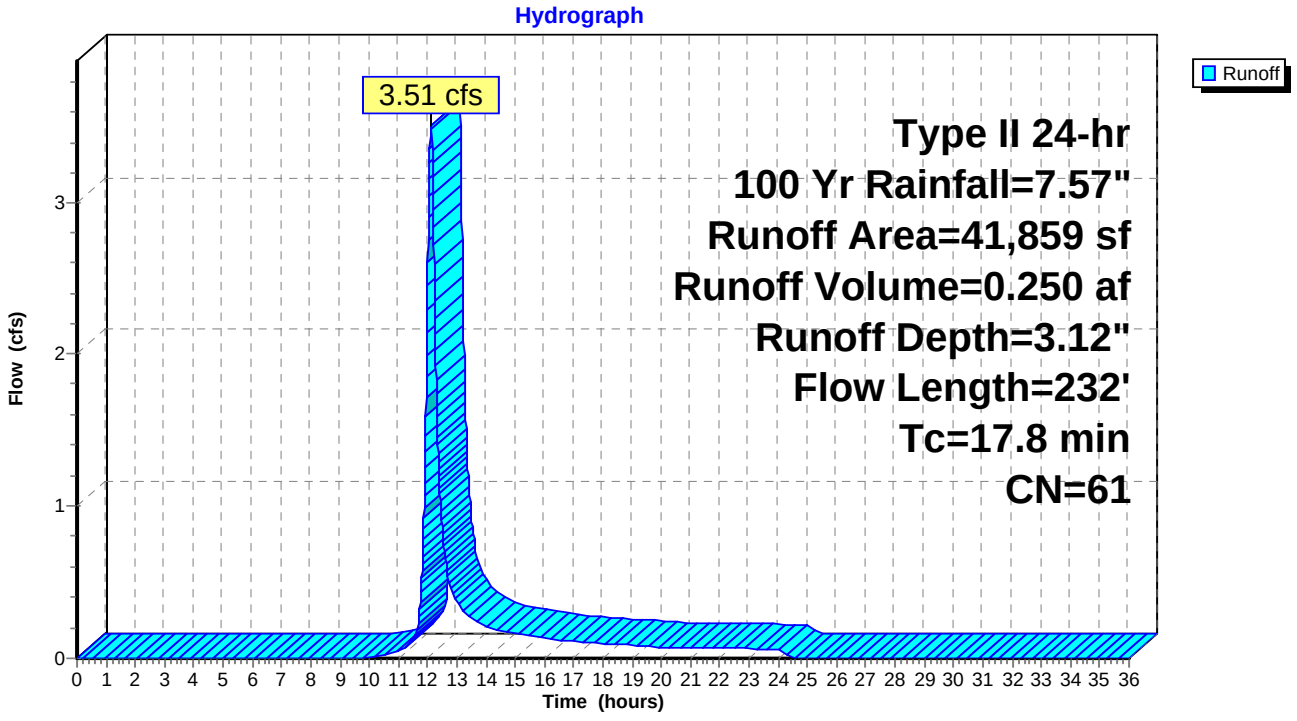
Runoff = 3.51 cfs @ 12.11 hrs, Volume= 0.250 af, Depth= 3.12"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
Type II 24-hr 100 Yr Rainfall=7.57"

Area (sf)	CN	Description
41,859	61	>75% Grass cover, Good, HSG B
41,859		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
15.5	100	0.0179	0.11		**Sheet Flow, Sheet Flow** Grass: Short n= 0.150 P2= 1.39"
2.3	132	0.0190	0.96		**Shallow Concentrated Flow, Shallow Conc.** Short Grass Pasture Kv= 7.0 fps
17.8	232	Total			

Subcatchment S2B4: Subcatchment 2B-4



Summary for Subcatchment S2B5: Subcatchment 2B-5

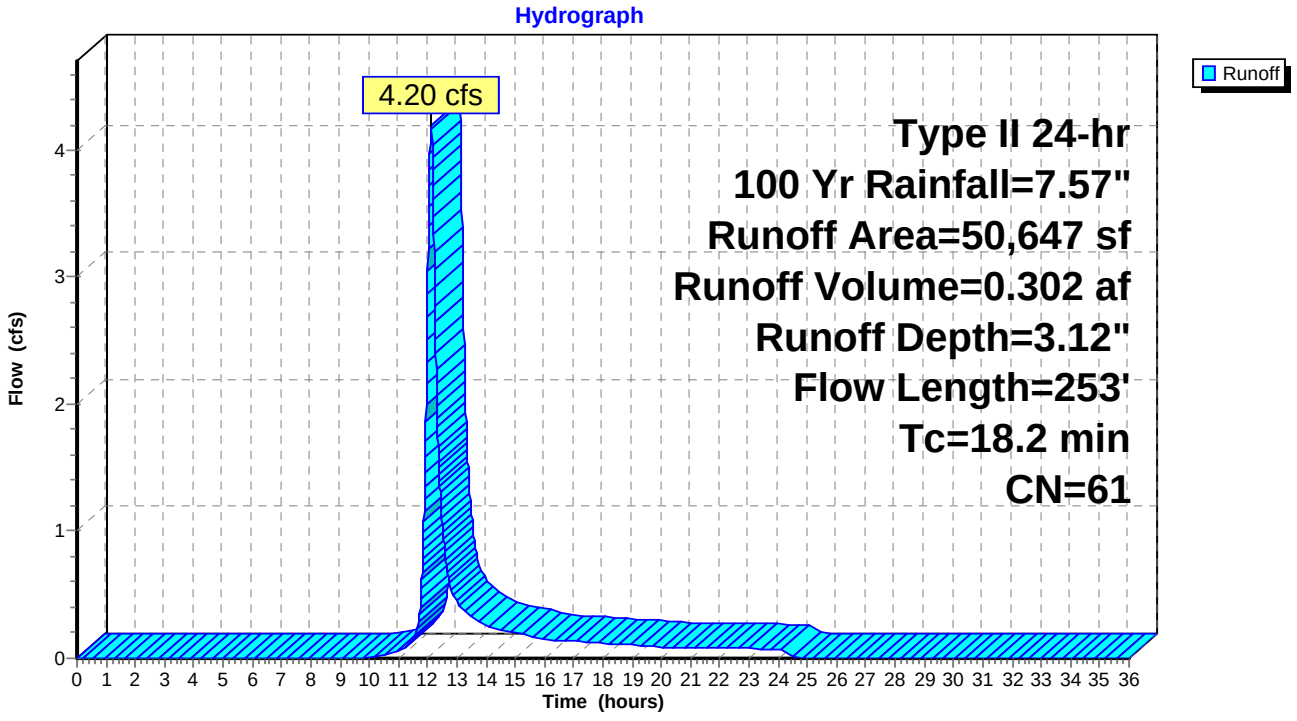
Runoff = 4.20 cfs @ 12.11 hrs, Volume= 0.302 af, Depth= 3.12"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
Type II 24-hr 100 Yr Rainfall=7.57"

Area (sf)	CN	Description
50,647	61	>75% Grass cover, Good, HSG B
50,647		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
15.5	100	0.0180	0.11		**Sheet Flow, Sheet Flow** Grass: Short n= 0.150 P2= 1.39"
2.7	153	0.0179	0.94		**Shallow Concentrated Flow, Shallow Conc.** Short Grass Pasture Kv= 7.0 fps
18.2	253	Total			

Subcatchment S2B5: Subcatchment 2B-5



Summary for Subcatchment S2B6: Subcatchment 2B-6

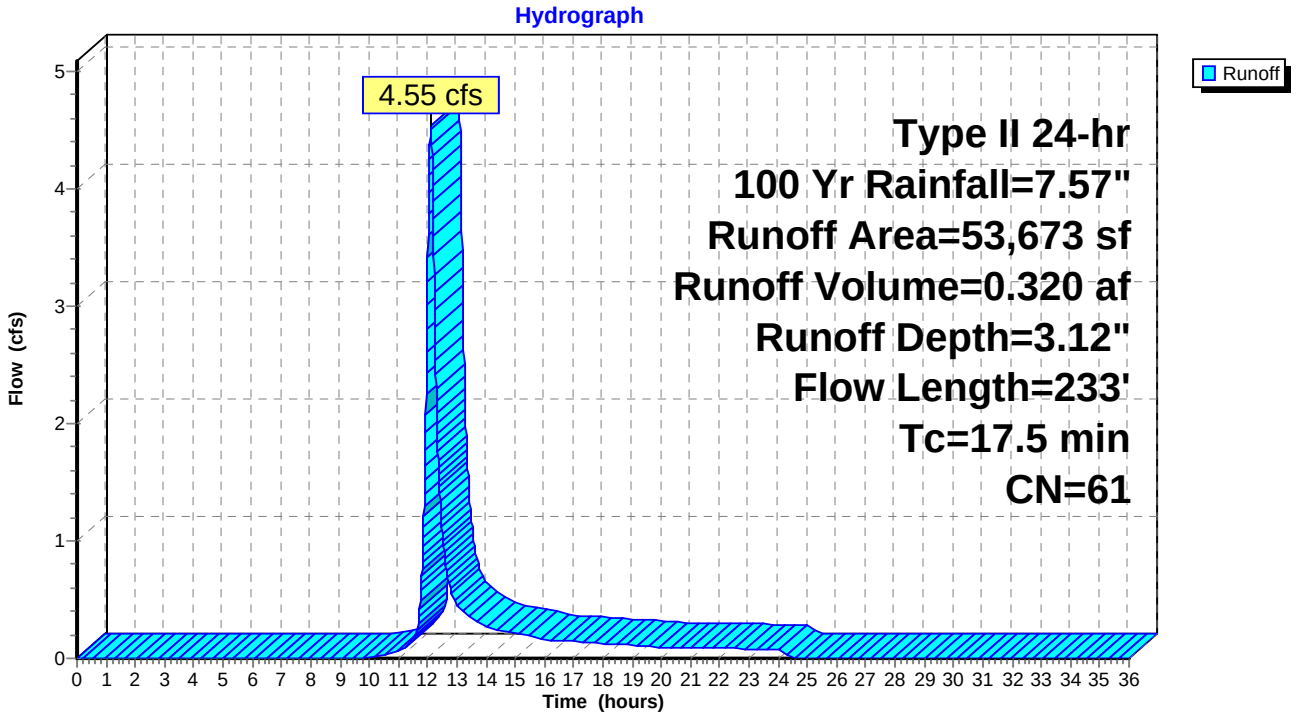
Runoff = 4.55 cfs @ 12.11 hrs, Volume= 0.320 af, Depth= 3.12"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
Type II 24-hr 100 Yr Rainfall=7.57"

Area (sf)	CN	Description
53,673	61	>75% Grass cover, Good, HSG B
53,673		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
15.2	100	0.0190	0.11		**Sheet Flow, Sheet Flow** Grass: Short n= 0.150 P2= 1.39"
2.3	133	0.0188	0.96		**Shallow Concentrated Flow, Shallow Conc.** Short Grass Pasture Kv= 7.0 fps
17.5	233	Total			

Subcatchment S2B6: Subcatchment 2B-6



Summary for Subcatchment S2B7: Subcatchment 2B-7

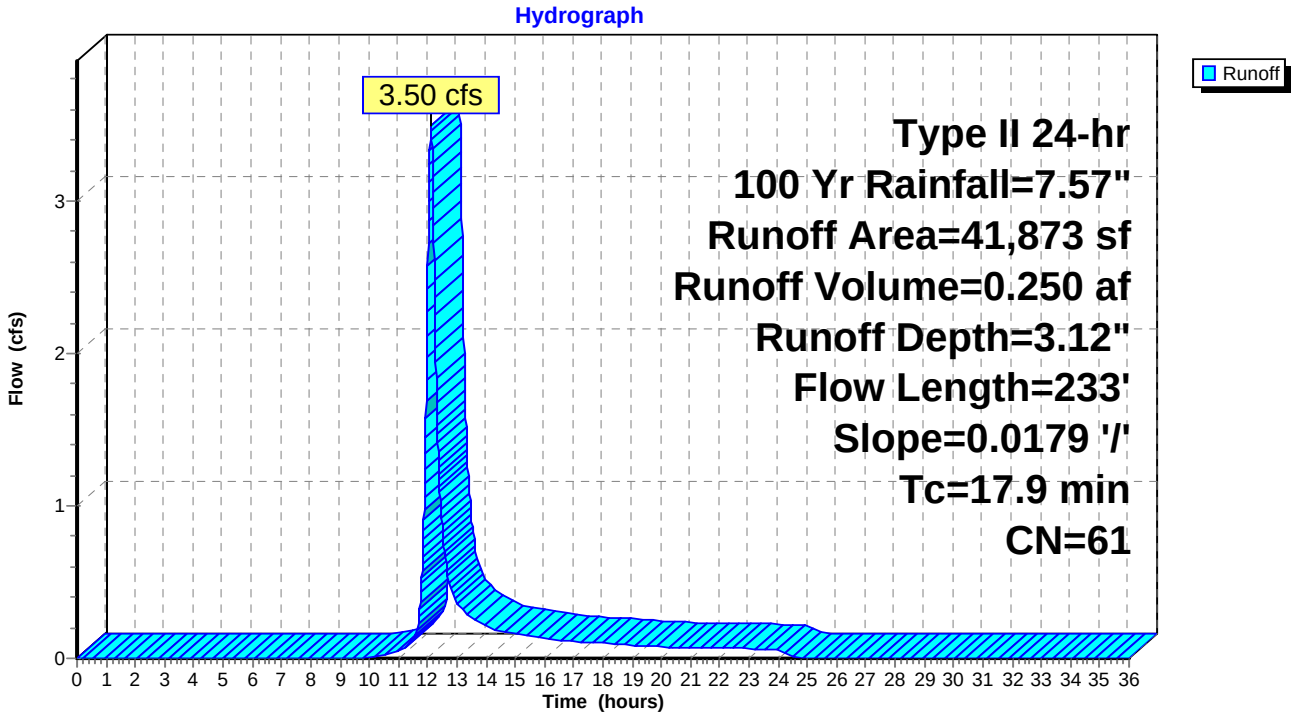
Runoff = 3.50 cfs @ 12.11 hrs, Volume= 0.250 af, Depth= 3.12"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
Type II 24-hr 100 Yr Rainfall=7.57"

Area (sf)	CN	Description
41,873	61	>75% Grass cover, Good, HSG B
41,873		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
15.5	100	0.0179	0.11		**Sheet Flow, Sheet Flow** Grass: Short n= 0.150 P2= 1.39"
2.4	133	0.0179	0.94		**Shallow Concentrated Flow, Shallow Conc.** Short Grass Pasture Kv= 7.0 fps
17.9	233	Total			

Subcatchment S2B7: Subcatchment 2B-7



Summary for Subcatchment S2B8: Subcatchment 2B-8

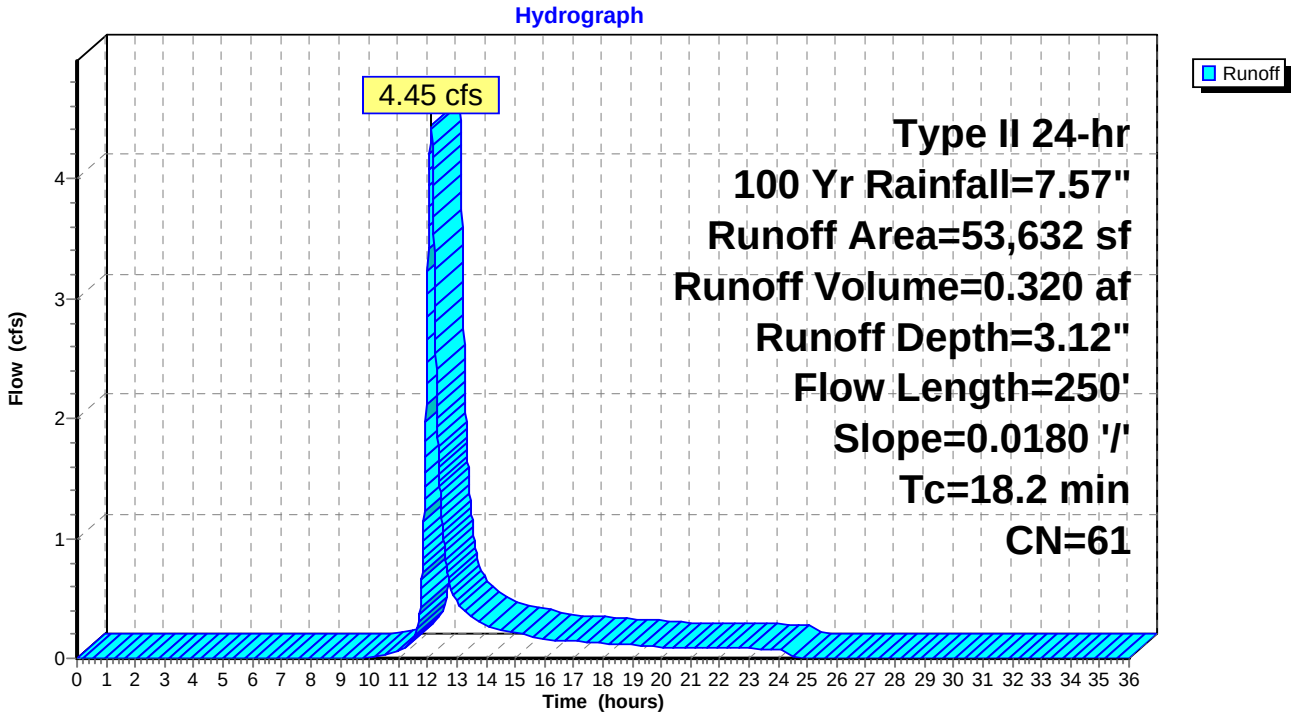
Runoff = 4.45 cfs @ 12.11 hrs, Volume= 0.320 af, Depth= 3.12"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
Type II 24-hr 100 Yr Rainfall=7.57"

Area (sf)	CN	Description
53,632	61	>75% Grass cover, Good, HSG B
53,632		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
15.5	100	0.0180	0.11		**Sheet Flow, Sheet Flow** Grass: Short n= 0.150 P2= 1.39"
2.7	150	0.0180	0.94		**Shallow Concentrated Flow, Shallow Conc.** Short Grass Pasture Kv= 7.0 fps
18.2	250	Total			

Subcatchment S2B8: Subcatchment 2B-8



Summary for Subcatchment S2B9: Subcatchment 2B-9

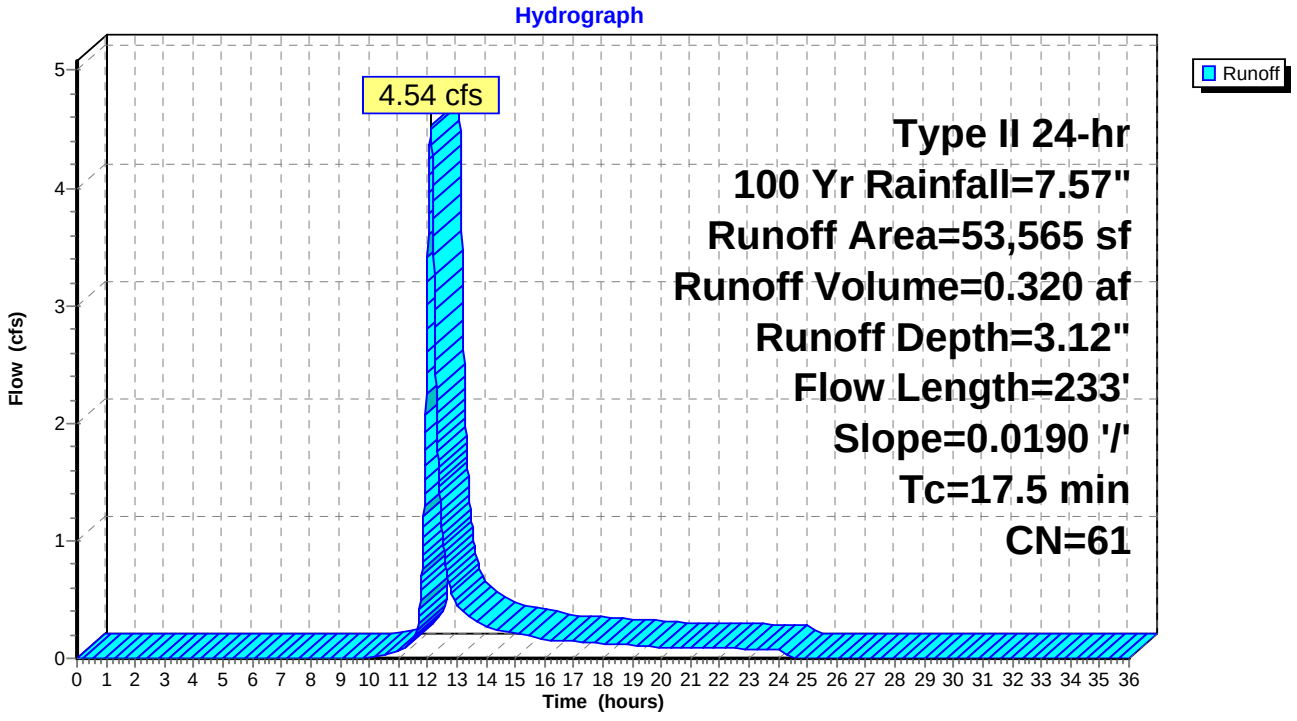
Runoff = 4.54 cfs @ 12.11 hrs, Volume= 0.320 af, Depth= 3.12"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
Type II 24-hr 100 Yr Rainfall=7.57"

Area (sf)	CN	Description
53,565	61	>75% Grass cover, Good, HSG B
53,565		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
15.2	100	0.0190	0.11		**Sheet Flow, Sheet Flow** Grass: Short n= 0.150 P2= 1.39"
2.3	133	0.0190	0.96		**Shallow Concentrated Flow, Shallow Conc.** Short Grass Pasture Kv= 7.0 fps
17.5	233	Total			

Subcatchment S2B9: Subcatchment 2B-9



Summary for Subcatchment S2C: Subcatchment 2C

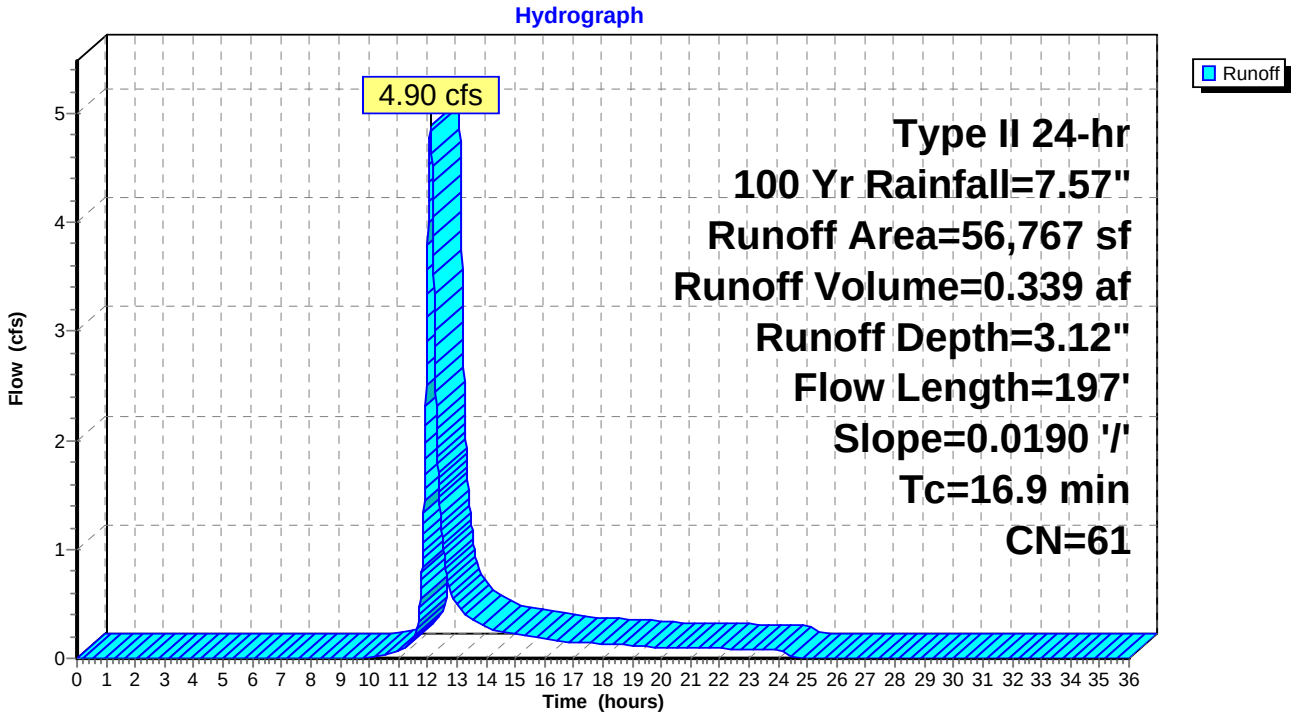
Runoff = 4.90 cfs @ 12.10 hrs, Volume= 0.339 af, Depth= 3.12"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
Type II 24-hr 100 Yr Rainfall=7.57"

Area (sf)	CN	Description
56,767	61	>75% Grass cover, Good, HSG B
56,767		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
15.2	100	0.0190	0.11		**Sheet Flow, Sheet Flow** Grass: Short n= 0.150 P2= 1.39"
1.7	97	0.0190	0.96		**Shallow Concentrated Flow, Shallow Conc.** Short Grass Pasture Kv= 7.0 fps
16.9	197	Total			

Subcatchment S2C: Subcatchment 2C



Summary for Subcatchment S3A1: Subcatchment 3A-1

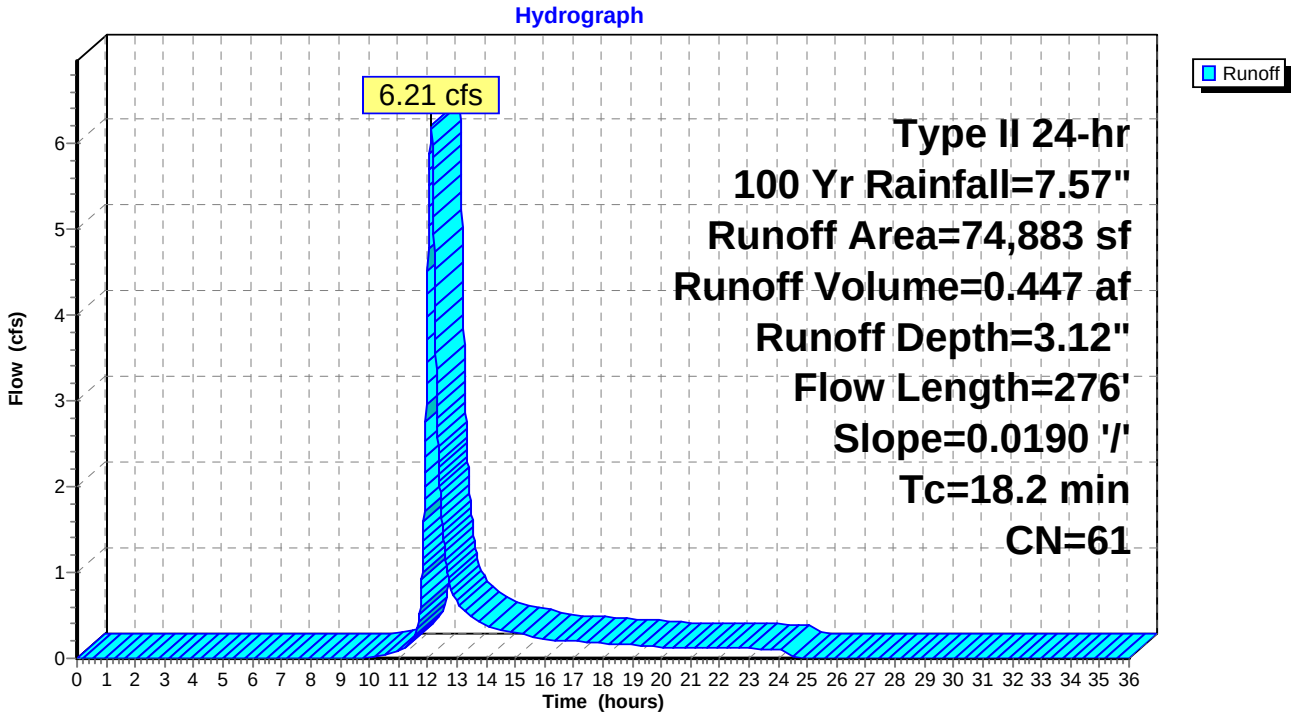
Runoff = 6.21 cfs @ 12.11 hrs, Volume= 0.447 af, Depth= 3.12"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
Type II 24-hr 100 Yr Rainfall=7.57"

Area (sf)	CN	Description
74,883	61	>75% Grass cover, Good, HSG B
74,883		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
15.2	100	0.0190	0.11		**Sheet Flow, Sheet Flow** Grass: Short n= 0.150 P2= 1.39"
3.0	176	0.0190	0.96		**Shallow Concentrated Flow, Shallow Conc.** Short Grass Pasture Kv= 7.0 fps
18.2	276	Total			

Subcatchment S3A1: Subcatchment 3A-1



Summary for Subcatchment S3A2: Subcatchment 3A-2

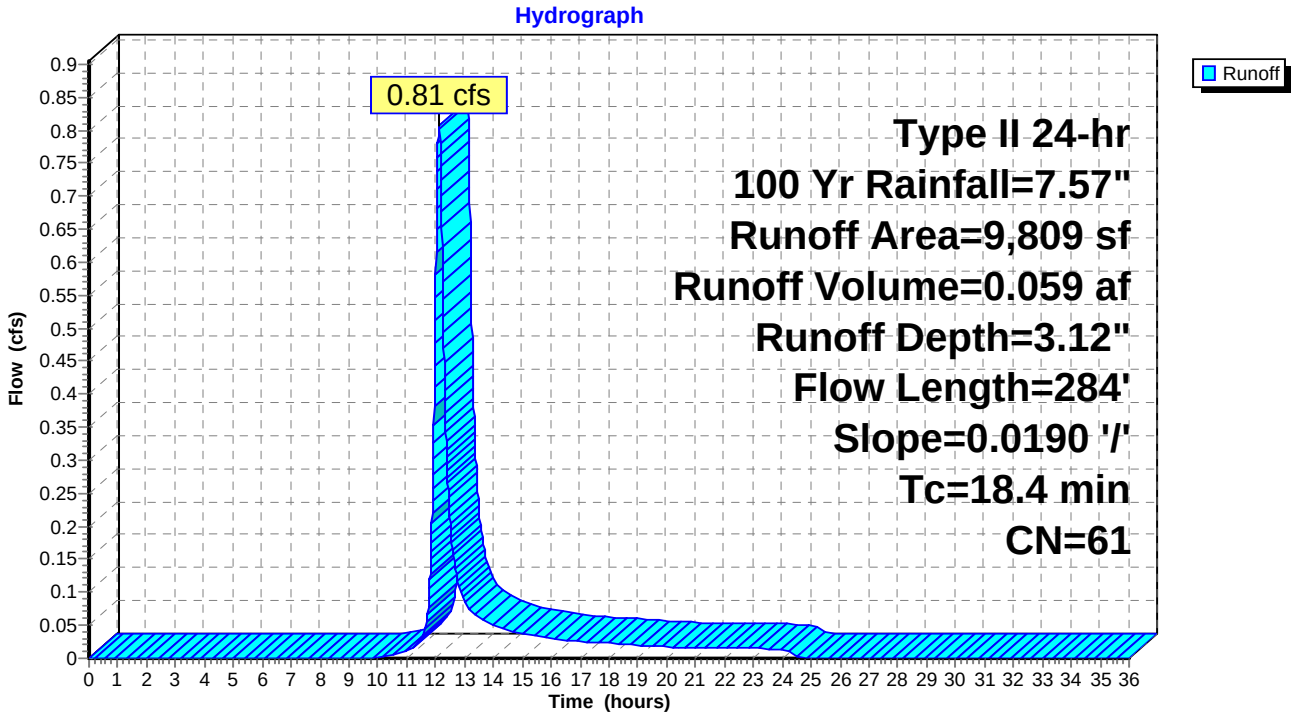
Runoff = 0.81 cfs @ 12.12 hrs, Volume= 0.059 af, Depth= 3.12"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
Type II 24-hr 100 Yr Rainfall=7.57"

Area (sf)	CN	Description
9,809	61	>75% Grass cover, Good, HSG B
9,809		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
15.2	100	0.0190	0.11		**Sheet Flow, Sheet Flow** Grass: Short n= 0.150 P2= 1.39"
3.2	184	0.0190	0.96		**Shallow Concentrated Flow, Shallow Conc.** Short Grass Pasture Kv= 7.0 fps
18.4	284	Total			

Subcatchment S3A2: Subcatchment 3A-2



Summary for Subcatchment S3A3: Subcatchment 3A-3

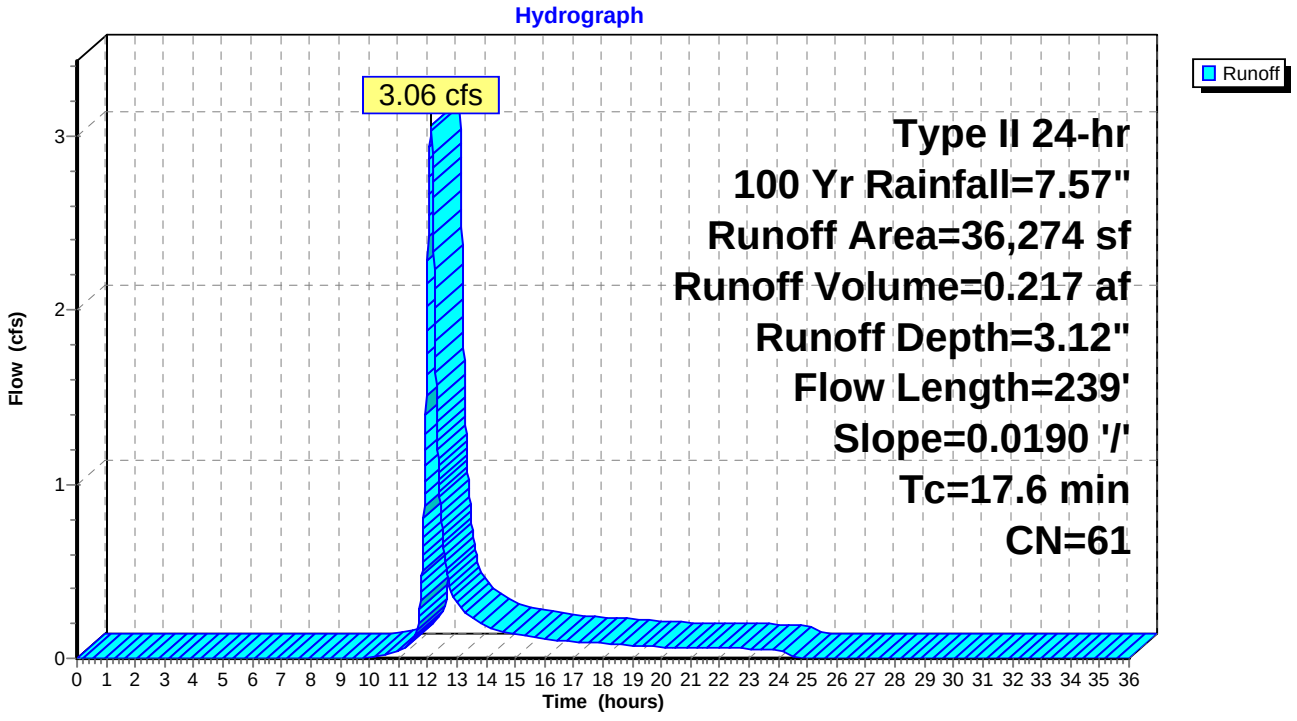
Runoff = 3.06 cfs @ 12.11 hrs, Volume= 0.217 af, Depth= 3.12"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
Type II 24-hr 100 Yr Rainfall=7.57"

Area (sf)	CN	Description
36,274	61	>75% Grass cover, Good, HSG B
36,274		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
15.2	100	0.0190	0.11		**Sheet Flow, Sheet Flow** Grass: Short n= 0.150 P2= 1.39"
2.4	139	0.0190	0.96		**Shallow Concentrated Flow, Shallow Conc.** Short Grass Pasture Kv= 7.0 fps
17.6	239	Total			

Subcatchment S3A3: Subcatchment 3A-3



Summary for Subcatchment S3B1: Subcatchment 3B-1

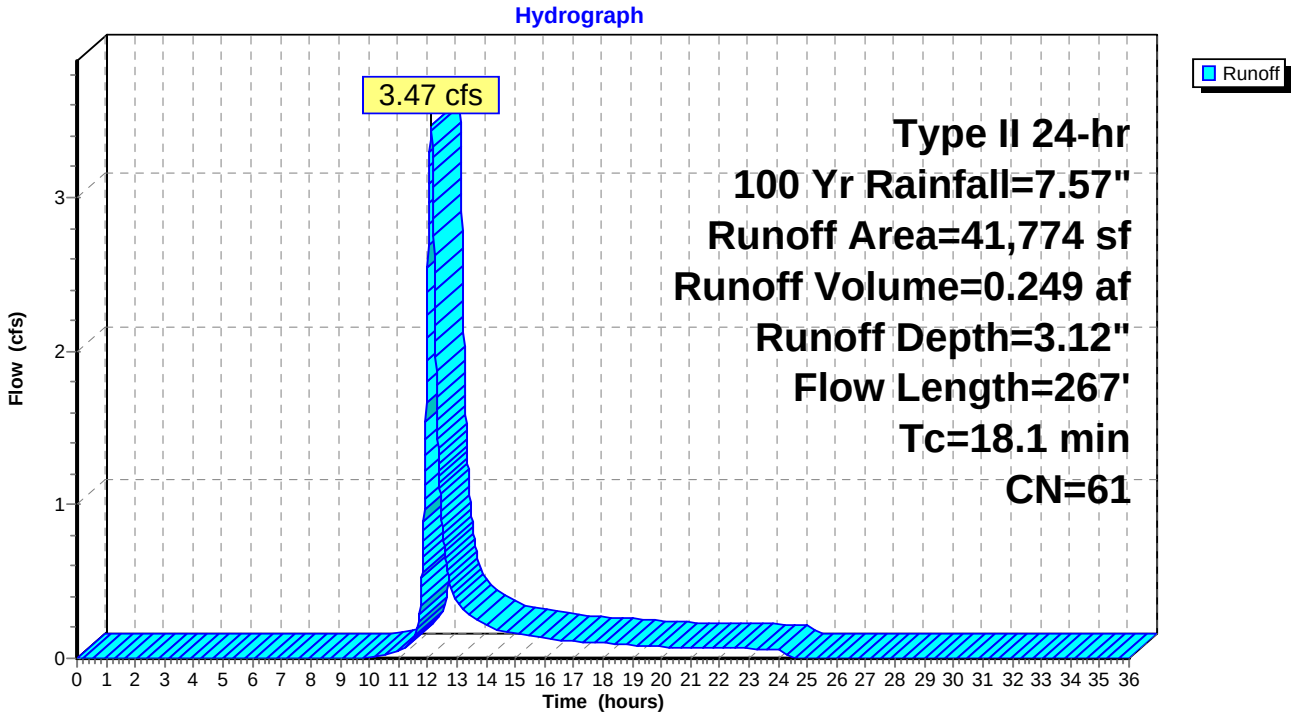
Runoff = 3.47 cfs @ 12.11 hrs, Volume= 0.249 af, Depth= 3.12"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
Type II 24-hr 100 Yr Rainfall=7.57"

Area (sf)	CN	Description
41,774	61	>75% Grass cover, Good, HSG B
41,774		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
15.2	100	0.0188	0.11		**Sheet Flow, Sheet Flow** Grass: Short n= 0.150 P2= 1.39"
2.9	167	0.0186	0.95		**Shallow Concentrated Flow, Shallow Conc.** Short Grass Pasture Kv= 7.0 fps
18.1	267	Total			

Subcatchment S3B1: Subcatchment 3B-1



Summary for Subcatchment S3B10: Subcatchment 3B-10

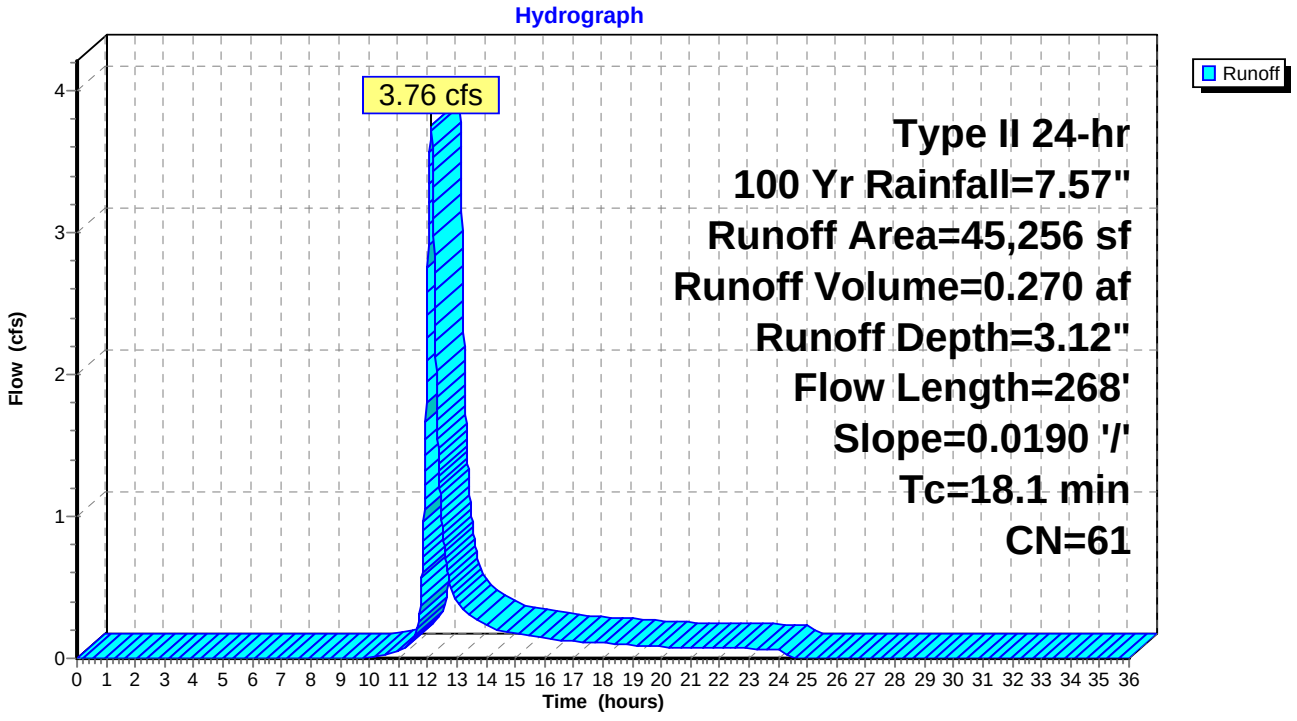
Runoff = 3.76 cfs @ 12.11 hrs, Volume= 0.270 af, Depth= 3.12"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
Type II 24-hr 100 Yr Rainfall=7.57"

Area (sf)	CN	Description
45,256	61	>75% Grass cover, Good, HSG B
45,256		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
15.2	100	0.0190	0.11		**Sheet Flow, Sheet Flow** Grass: Short n= 0.150 P2= 1.39"
2.9	168	0.0190	0.96		**Shallow Concentrated Flow, Shallow Conc.** Short Grass Pasture Kv= 7.0 fps
18.1	268	Total			

Subcatchment S3B10: Subcatchment 3B-10



Summary for Subcatchment S3B2: Subcatchment 3B-2

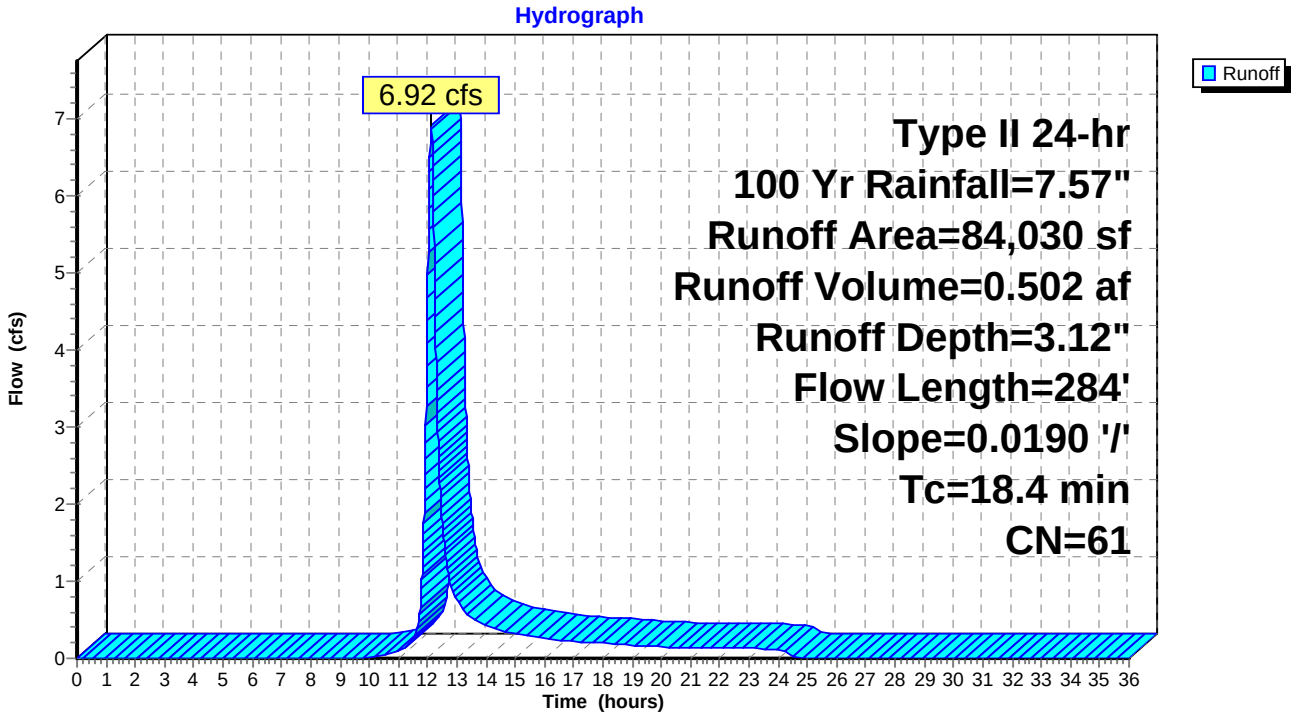
Runoff = 6.92 cfs @ 12.12 hrs, Volume= 0.502 af, Depth= 3.12"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
Type II 24-hr 100 Yr Rainfall=7.57"

Area (sf)	CN	Description
84,030	61	>75% Grass cover, Good, HSG B
84,030		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
15.2	100	0.0190	0.11		**Sheet Flow, Sheet Flow** Grass: Short n= 0.150 P2= 1.39"
3.2	184	0.0190	0.96		**Shallow Concentrated Flow, Shallow Conc.** Short Grass Pasture Kv= 7.0 fps
18.4	284	Total			

Subcatchment S3B2: Subcatchment 3B-2



Summary for Subcatchment S3B3: Subcatchment 3B-3

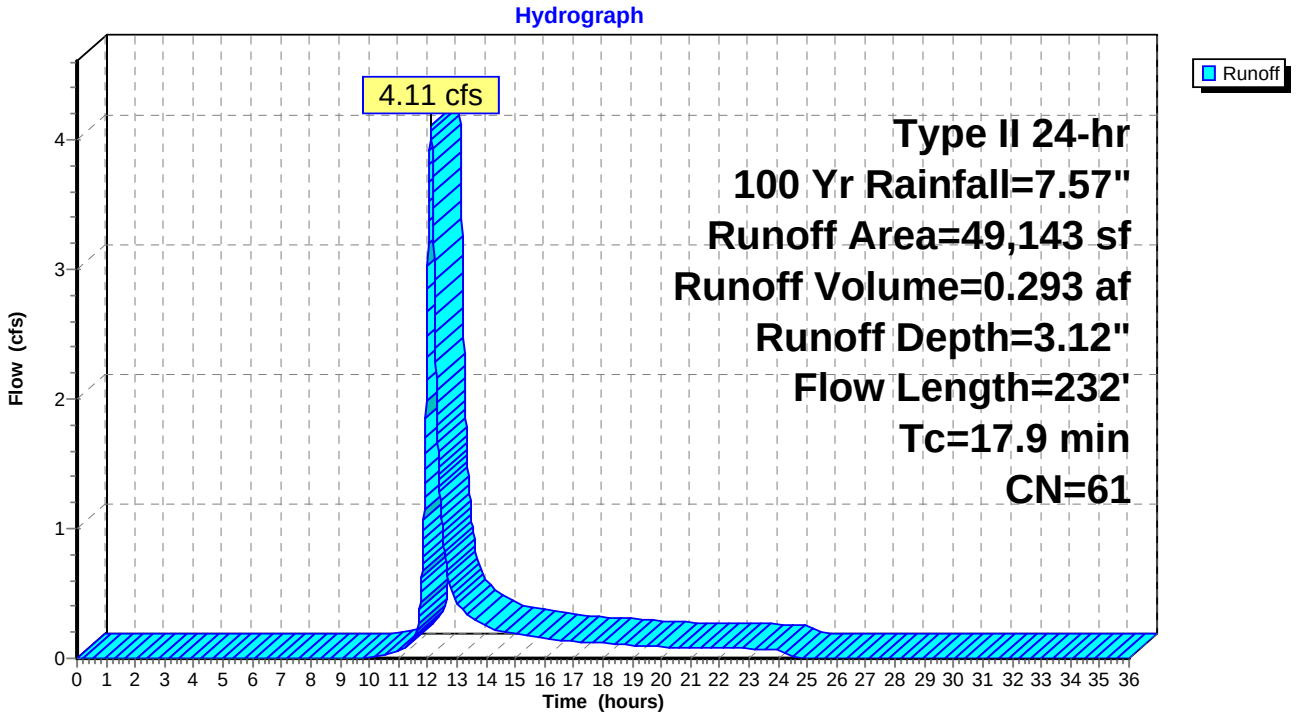
Runoff = 4.11 cfs @ 12.11 hrs, Volume= 0.293 af, Depth= 3.12"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
Type II 24-hr 100 Yr Rainfall=7.57"

Area (sf)	CN	Description
49,143	61	>75% Grass cover, Good, HSG B
49,143		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
15.5	100	0.0180	0.11		**Sheet Flow, Sheet Flow** Grass: Short n= 0.150 P2= 1.39"
2.4	132	0.0175	0.93		**Shallow Concentrated Flow, Shallow Conc.** Short Grass Pasture Kv= 7.0 fps
17.9	232	Total			

Subcatchment S3B3: Subcatchment 3B-3



Summary for Subcatchment S3B4: Subcatchment 3B-4

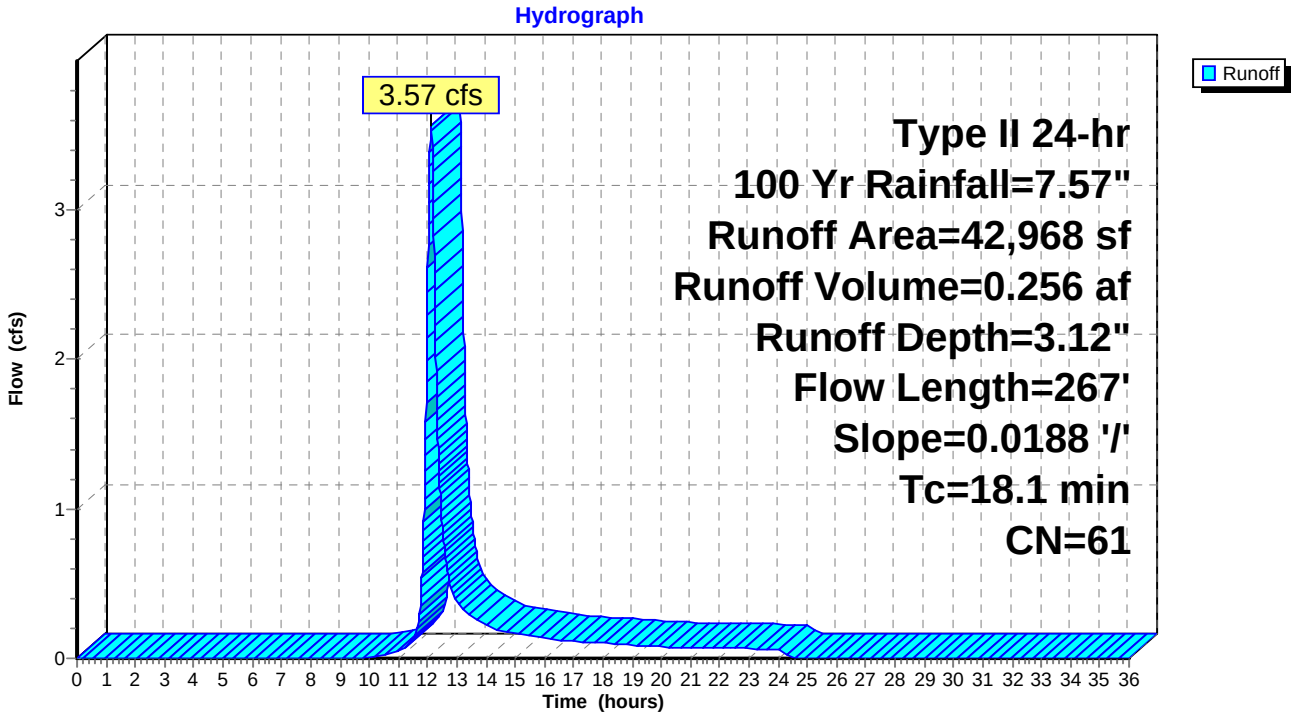
Runoff = 3.57 cfs @ 12.11 hrs, Volume= 0.256 af, Depth= 3.12"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
Type II 24-hr 100 Yr Rainfall=7.57"

Area (sf)	CN	Description
42,968	61	>75% Grass cover, Good, HSG B
42,968		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
15.2	100	0.0188	0.11		**Sheet Flow, Sheet Flow** Grass: Short n= 0.150 P2= 1.39"
2.9	167	0.0188	0.96		**Shallow Concentrated Flow, Shallow Conc.** Short Grass Pasture Kv= 7.0 fps
18.1	267	Total			

Subcatchment S3B4: Subcatchment 3B-4



Summary for Subcatchment S3B5: Subcatchment 3B-5

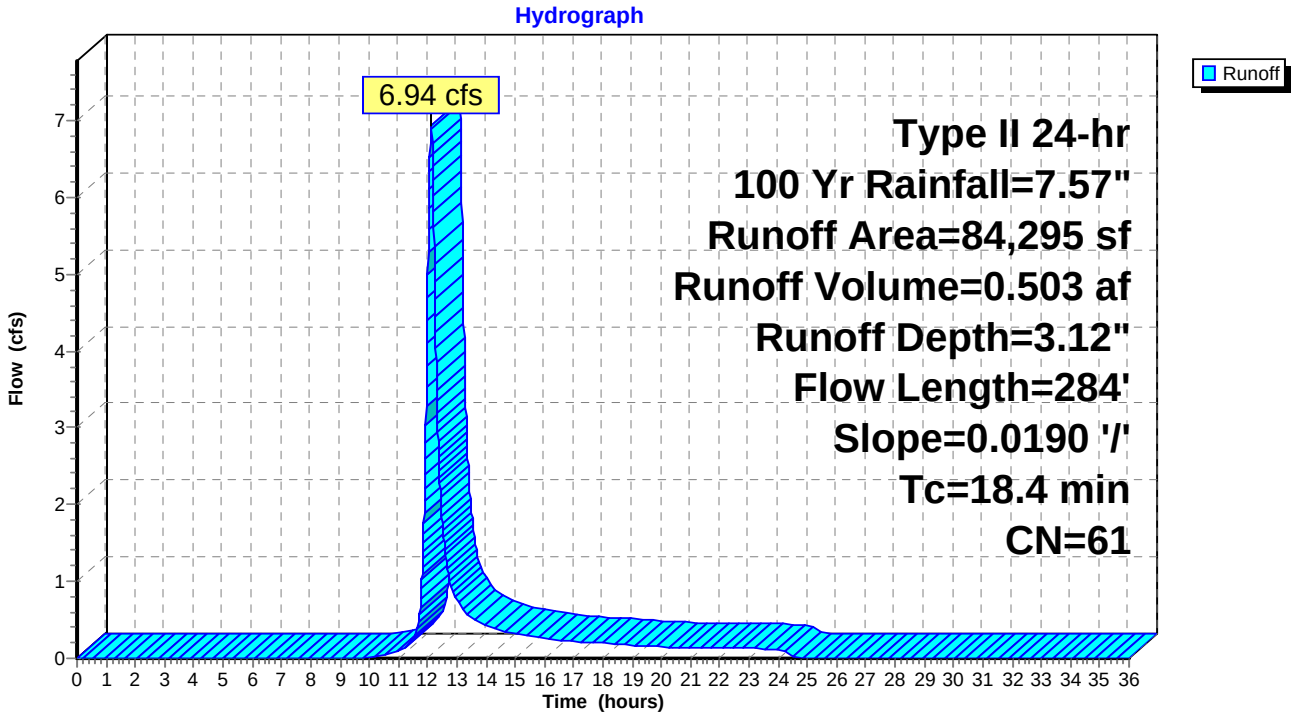
Runoff = 6.94 cfs @ 12.12 hrs, Volume= 0.503 af, Depth= 3.12"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
Type II 24-hr 100 Yr Rainfall=7.57"

Area (sf)	CN	Description
84,295	61	>75% Grass cover, Good, HSG B
84,295		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
15.2	100	0.0190	0.11		**Sheet Flow, Sheet Flow** Grass: Short n= 0.150 P2= 1.39"
3.2	184	0.0190	0.96		**Shallow Concentrated Flow, Shallow Conc.** Short Grass Pasture Kv= 7.0 fps
18.4	284	Total			

Subcatchment S3B5: Subcatchment 3B-5



Summary for Subcatchment S3B6: Subcatchment 3B-6

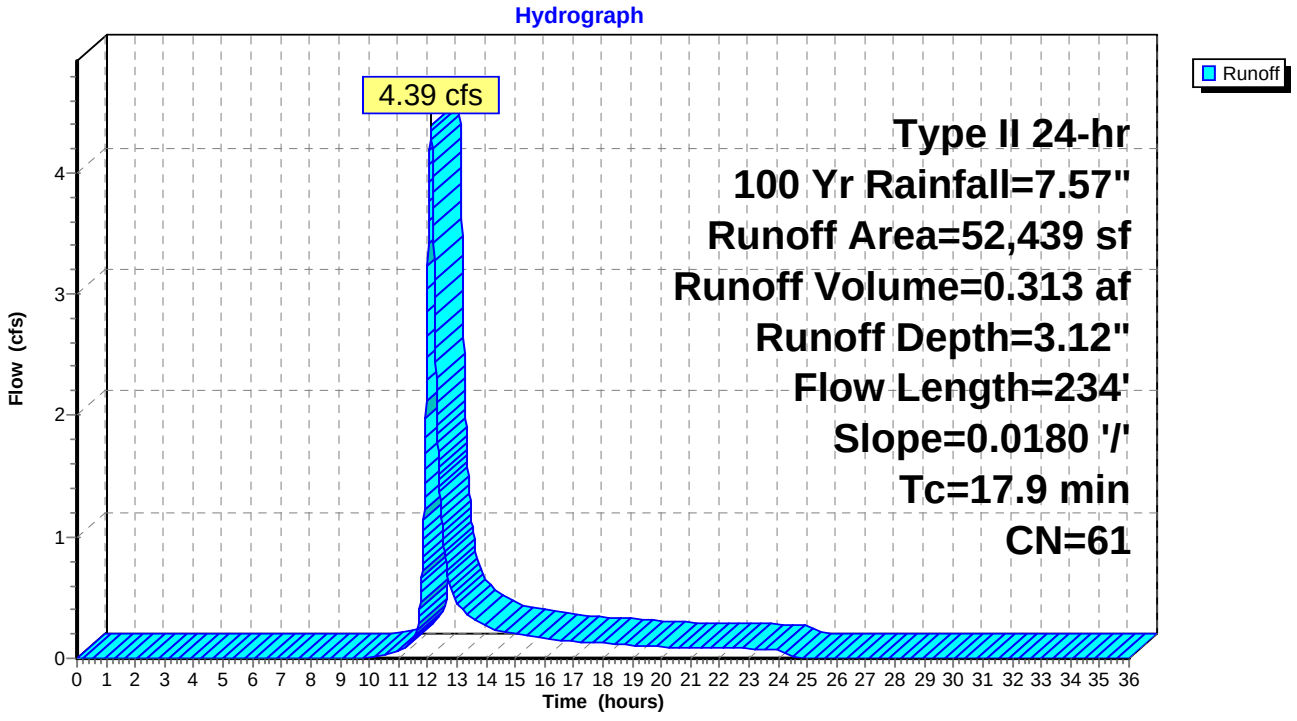
Runoff = 4.39 cfs @ 12.11 hrs, Volume= 0.313 af, Depth= 3.12"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
Type II 24-hr 100 Yr Rainfall=7.57"

Area (sf)	CN	Description
52,439	61	>75% Grass cover, Good, HSG B
52,439		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
15.5	100	0.0180	0.11		**Sheet Flow, Sheet Flow** Grass: Short n= 0.150 P2= 1.39"
2.4	134	0.0180	0.94		**Shallow Concentrated Flow, Shallow Conc.** Short Grass Pasture Kv= 7.0 fps
17.9	234	Total			

Subcatchment S3B6: Subcatchment 3B-6



Summary for Subcatchment S3B7: Subcatchment 3B-7

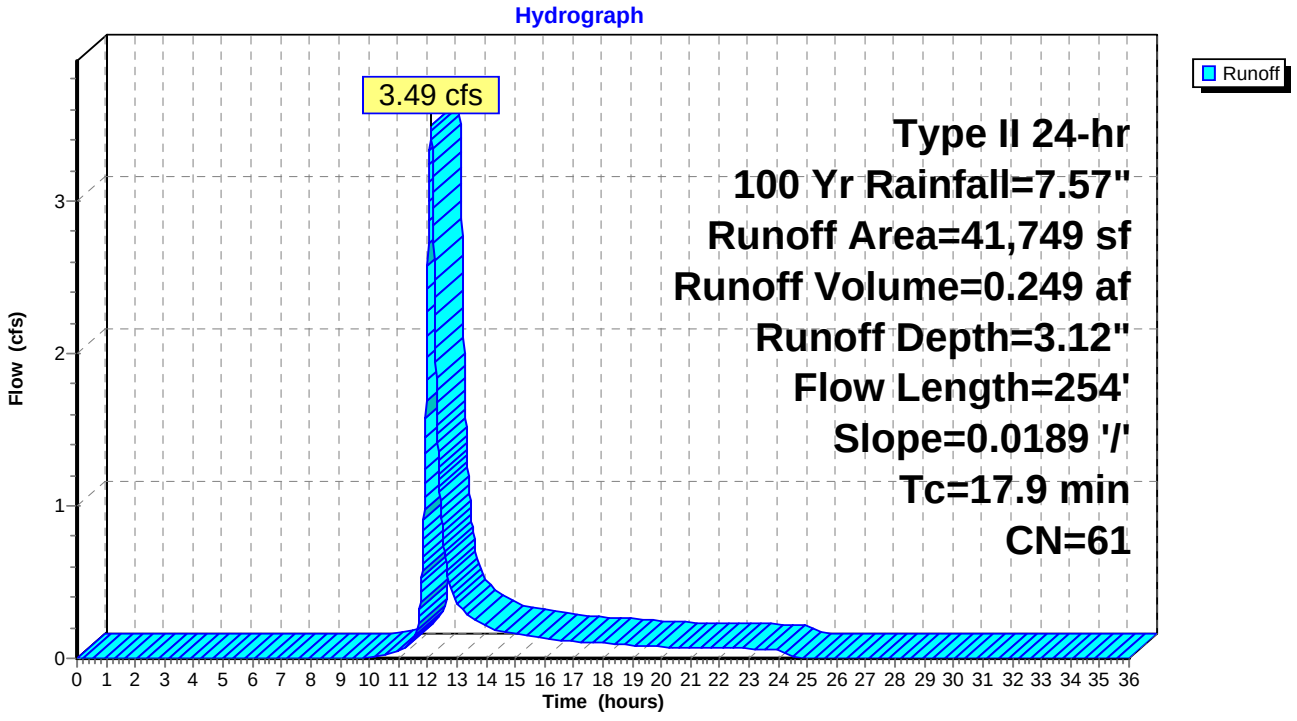
Runoff = 3.49 cfs @ 12.11 hrs, Volume= 0.249 af, Depth= 3.12"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
Type II 24-hr 100 Yr Rainfall=7.57"

Area (sf)	CN	Description
41,749	61	>75% Grass cover, Good, HSG B
41,749		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
15.2	100	0.0189	0.11		**Sheet Flow, Sheet Flow** Grass: Short n= 0.150 P2= 1.39"
2.7	154	0.0189	0.96		**Shallow Concentrated Flow, Shallow Conc.** Short Grass Pasture Kv= 7.0 fps
17.9	254	Total			

Subcatchment S3B7: Subcatchment 3B-7



Summary for Subcatchment S3B8: Subcatchment 3B-8

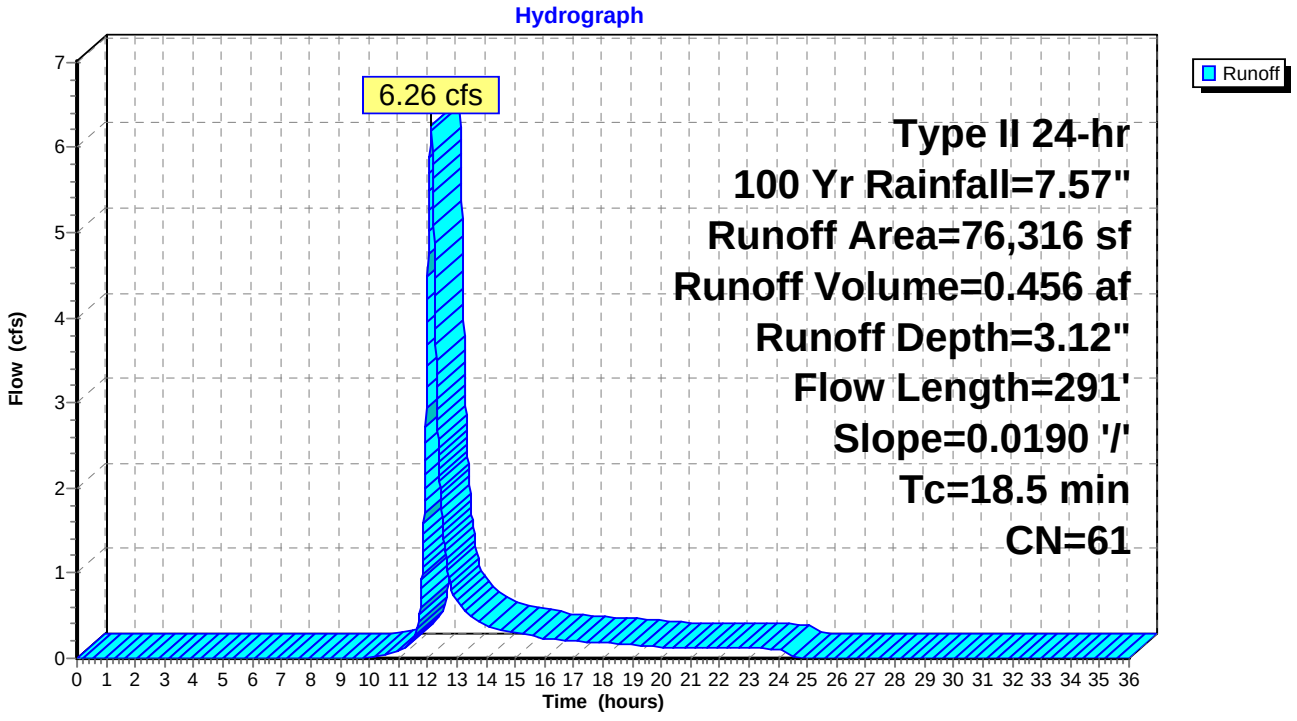
Runoff = 6.26 cfs @ 12.11 hrs, Volume= 0.456 af, Depth= 3.12"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
Type II 24-hr 100 Yr Rainfall=7.57"

Area (sf)	CN	Description
76,316	61	>75% Grass cover, Good, HSG B
76,316		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
15.2	100	0.0190	0.11		**Sheet Flow, Sheet Flow** Grass: Short n= 0.150 P2= 1.39"
3.3	191	0.0190	0.96		**Shallow Concentrated Flow, Shallow Conc.** Short Grass Pasture Kv= 7.0 fps
18.5	291	Total			

Subcatchment S3B8: Subcatchment 3B-8



Summary for Subcatchment S3B9: Subcatchment 3B-9

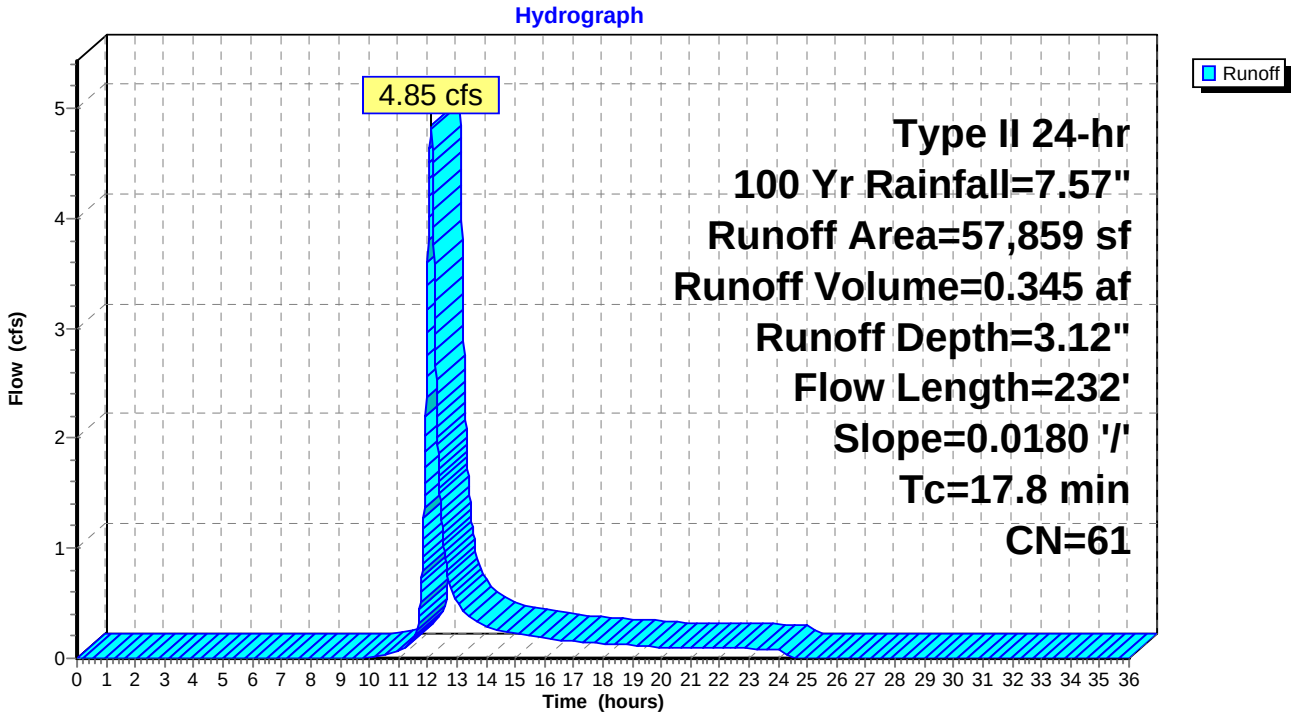
Runoff = 4.85 cfs @ 12.11 hrs, Volume= 0.345 af, Depth= 3.12"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
Type II 24-hr 100 Yr Rainfall=7.57"

Area (sf)	CN	Description
57,859	61	>75% Grass cover, Good, HSG B
57,859		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
15.5	100	0.0180	0.11		**Sheet Flow, Sheet Flow** Grass: Short n= 0.150 P2= 1.39"
2.3	132	0.0180	0.94		**Shallow Concentrated Flow, Shallow Conc.** Short Grass Pasture Kv= 7.0 fps
17.8	232	Total			

Subcatchment S3B9: Subcatchment 3B-9



Summary for Subcatchment S3C: Subcatchment 3C

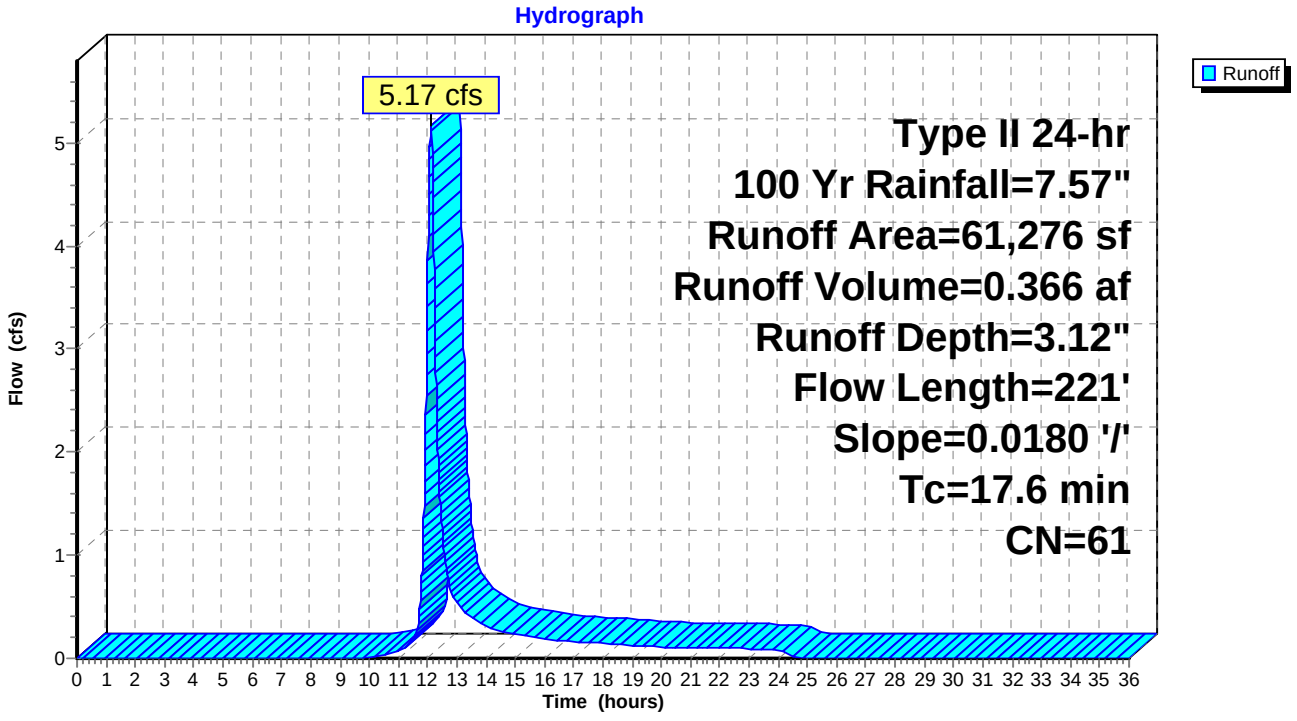
Runoff = 5.17 cfs @ 12.11 hrs, Volume= 0.366 af, Depth= 3.12"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
Type II 24-hr 100 Yr Rainfall=7.57"

Area (sf)	CN	Description
61,276	61	>75% Grass cover, Good, HSG B
61,276		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
15.5	100	0.0180	0.11		**Sheet Flow, Sheet Flow** Grass: Short n= 0.150 P2= 1.39"
2.1	121	0.0180	0.94		**Shallow Concentrated Flow, Shallow Conc.** Short Grass Pasture Kv= 7.0 fps
17.6	221	Total			

Subcatchment S3C: Subcatchment 3C



Summary for Subcatchment S3D: Subcatchment 3D

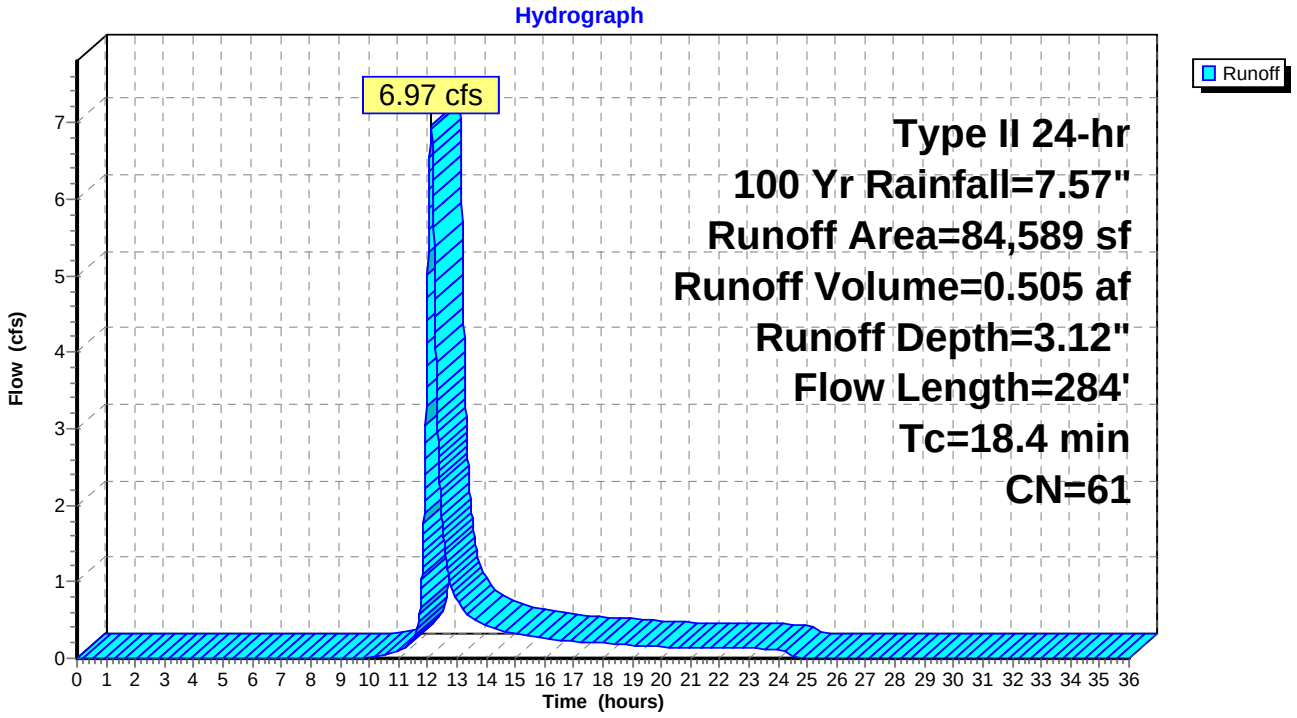
Runoff = 6.97 cfs @ 12.12 hrs, Volume= 0.505 af, Depth= 3.12"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
Type II 24-hr 100 Yr Rainfall=7.57"

Area (sf)	CN	Description
84,589	61	>75% Grass cover, Good, HSG B
84,589		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
15.2	100	0.0190	0.11		**Sheet Flow, Sheet Flow** Grass: Short n= 0.150 P2= 1.39"
3.2	184	0.0188	0.96		**Shallow Concentrated Flow, Shallow Conc.** Short Grass Pasture Kv= 7.0 fps
18.4	284	Total			

Subcatchment S3D: Subcatchment 3D



Summary for Subcatchment S4A1: Subcatchment 4A-1

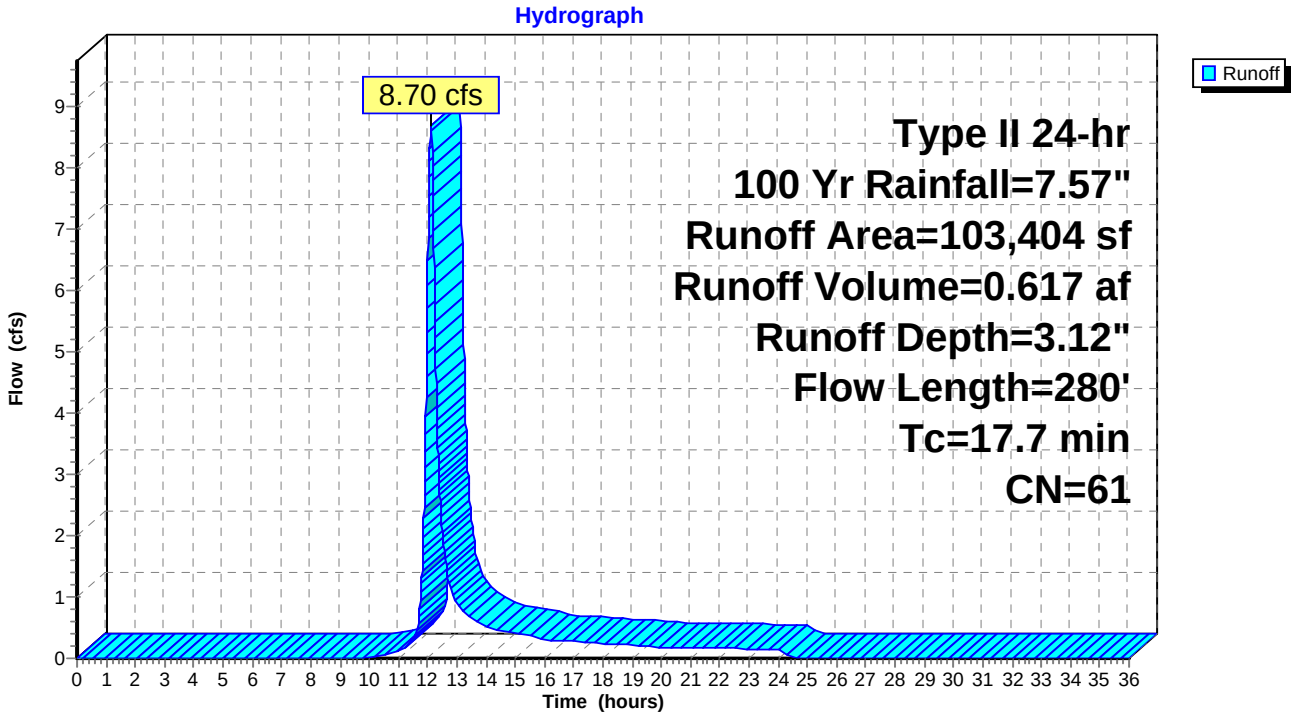
Runoff = 8.70 cfs @ 12.10 hrs, Volume= 0.617 af, Depth= 3.12"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
Type II 24-hr 100 Yr Rainfall=7.57"

Area (sf)	CN	Description
103,404	61	>75% Grass cover, Good, HSG B
103,404		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
14.7	100	0.0204	0.11		**Sheet Flow, Sheet Flow** Grass: Short n= 0.150 P2= 1.39"
3.0	180	0.0203	1.00		**Shallow Concentrated Flow, Shallow Conc.** Short Grass Pasture Kv= 7.0 fps
17.7	280	Total			

Subcatchment S4A1: Subcatchment 4A-1



Summary for Subcatchment S4A2: Subcatchment 4A-2

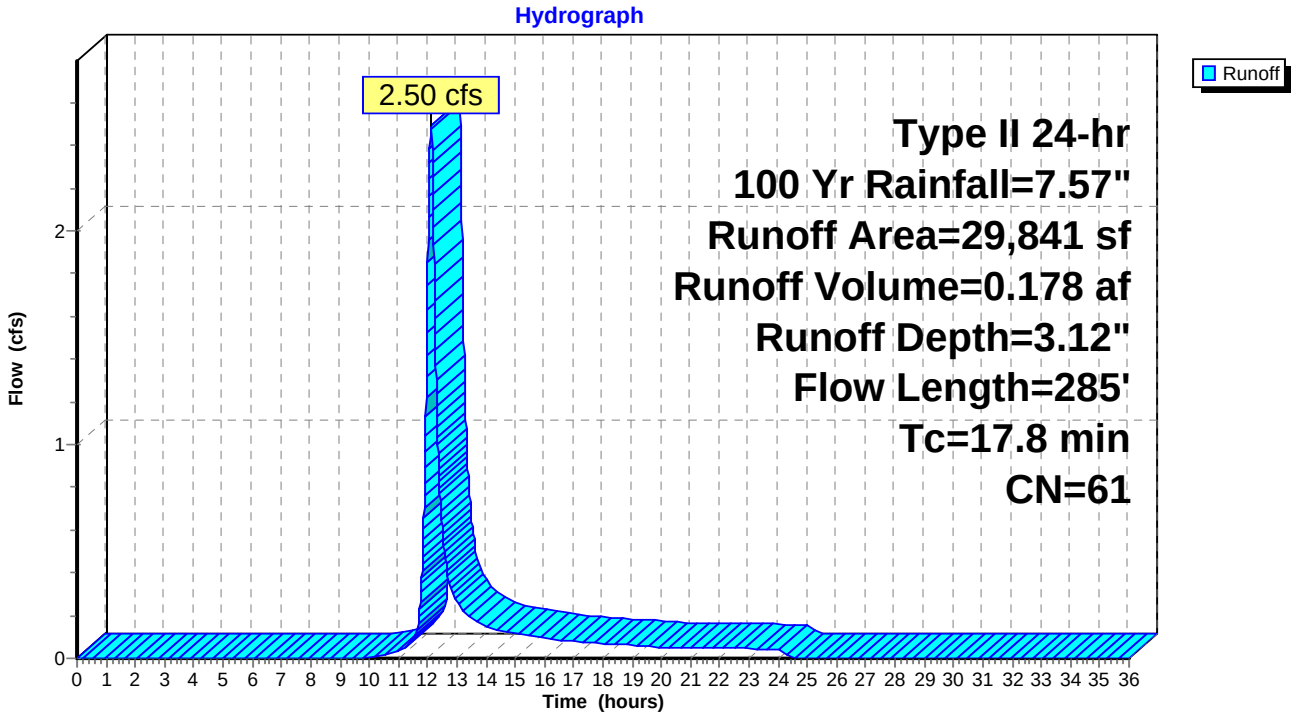
Runoff = 2.50 cfs @ 12.11 hrs, Volume= 0.178 af, Depth= 3.12"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
Type II 24-hr 100 Yr Rainfall=7.57"

Area (sf)	CN	Description
29,841	61	>75% Grass cover, Good, HSG B
29,841		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
14.7	100	0.0205	0.11		**Sheet Flow, Sheet Flow** Grass: Short n= 0.150 P2= 1.39"
3.1	185	0.0204	1.00		**Shallow Concentrated Flow, Shallow Conc.** Short Grass Pasture Kv= 7.0 fps
17.8	285	Total			

Subcatchment S4A2: Subcatchment 4A-2



Summary for Subcatchment S4A3: Subcatchment 4A-3

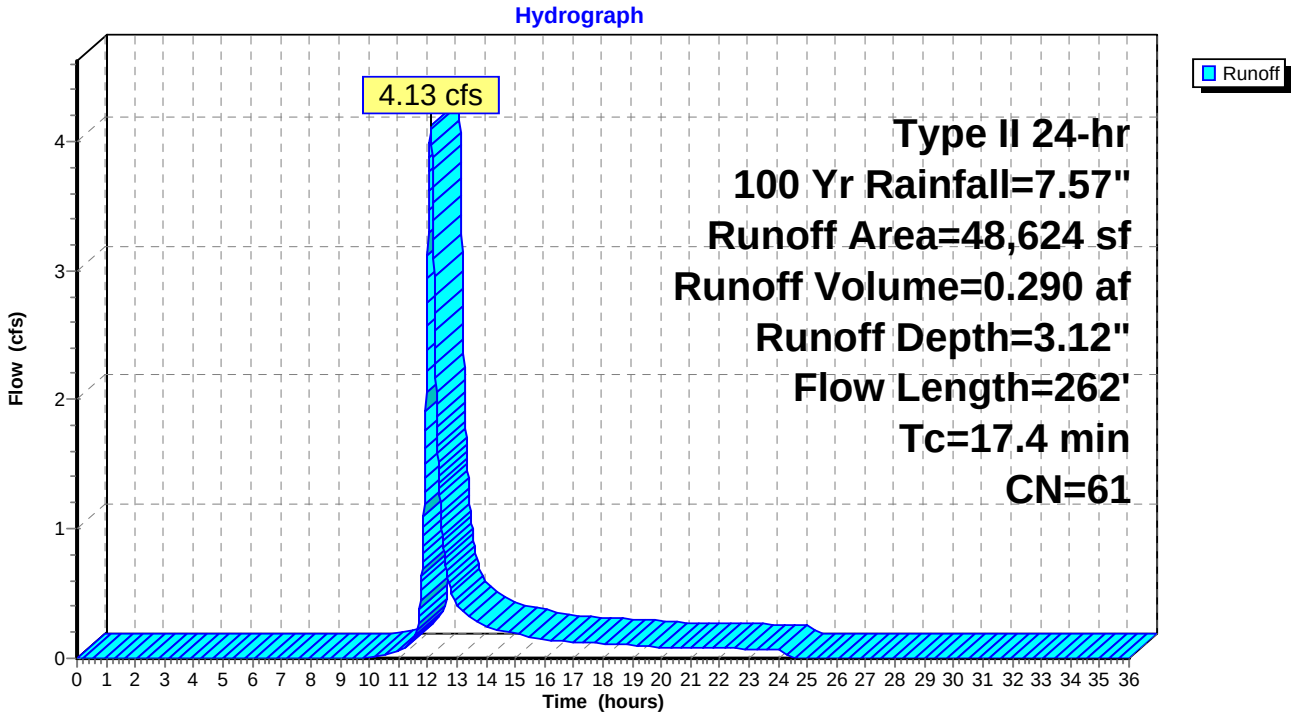
Runoff = 4.13 cfs @ 12.10 hrs, Volume= 0.290 af, Depth= 3.12"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
Type II 24-hr 100 Yr Rainfall=7.57"

Area (sf)	CN	Description
48,624	61	>75% Grass cover, Good, HSG B
48,624		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
14.7	100	0.0204	0.11		**Sheet Flow, Sheet Flow** Grass: Short n= 0.150 P2= 1.39"
2.7	162	0.0209	1.01		**Shallow Concentrated Flow, Shallow Conc.** Short Grass Pasture Kv= 7.0 fps
17.4	262	Total			

Subcatchment S4A3: Subcatchment 4A-3



Summary for Subcatchment S4B1: Subcatchment 4B-1

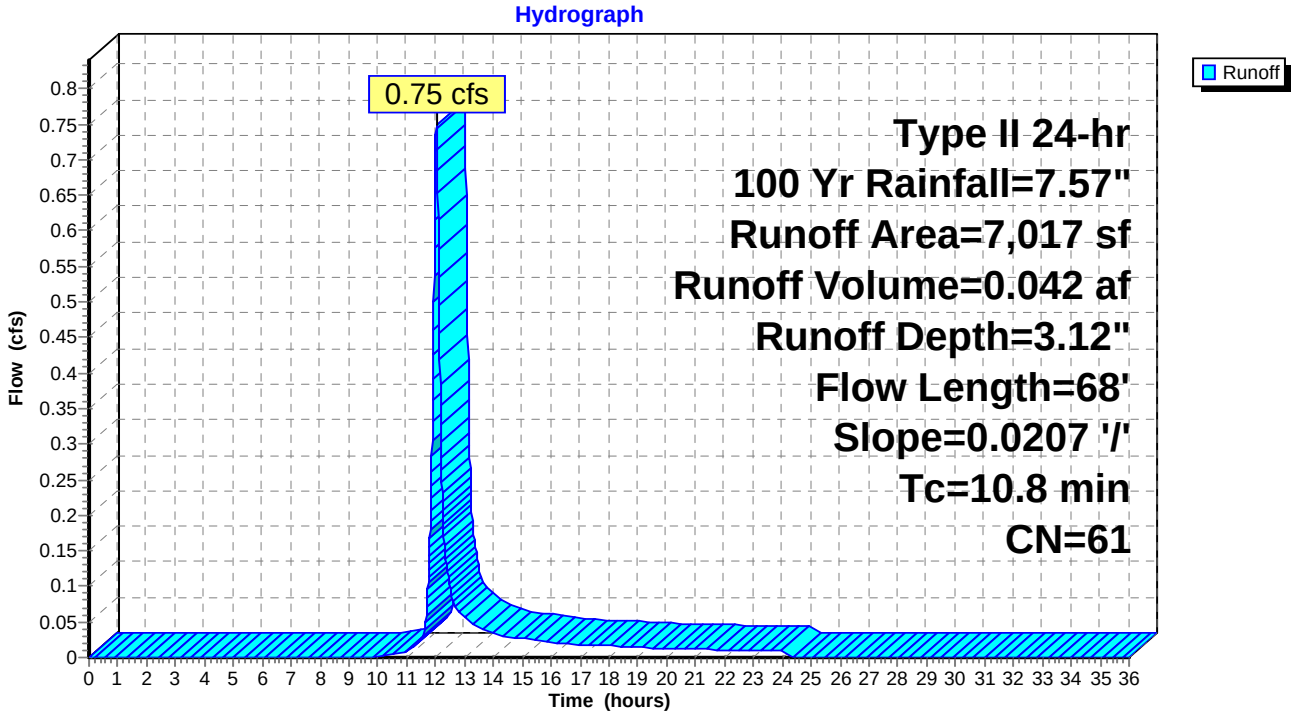
Runoff = 0.75 cfs @ 12.03 hrs, Volume= 0.042 af, Depth= 3.12"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
Type II 24-hr 100 Yr Rainfall=7.57"

Area (sf)	CN	Description
7,017	61	>75% Grass cover, Good, HSG B
7,017		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
10.8	68	0.0207	0.11		**Sheet Flow, Sheet Flow** Grass: Short n= 0.150 P2= 1.39"

Subcatchment S4B1: Subcatchment 4B-1



Summary for Subcatchment S4B2: Subcatchment 4B-2

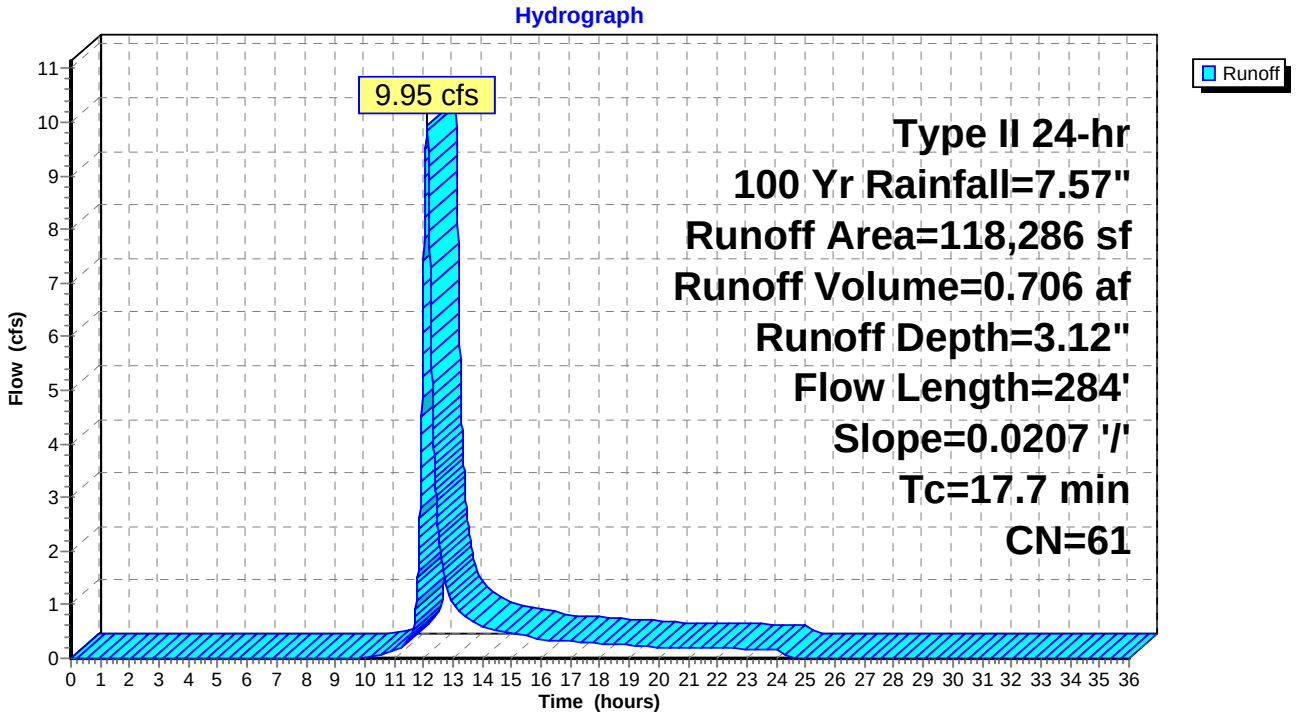
Runoff = 9.95 cfs @ 12.10 hrs, Volume= 0.706 af, Depth= 3.12"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
Type II 24-hr 100 Yr Rainfall=7.57"

Area (sf)	CN	Description
118,286	61	>75% Grass cover, Good, HSG B
118,286		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
14.7	100	0.0207	0.11		**Sheet Flow, Sheet Flow** Grass: Short n= 0.150 P2= 1.39"
3.0	184	0.0207	1.01		**Shallow Concentrated Flow, Shallow Conc.** Short Grass Pasture Kv= 7.0 fps
17.7	284	Total			

Subcatchment S4B2: Subcatchment 4B-2



Summary for Subcatchment S4B3: Subcatchment 4B-3

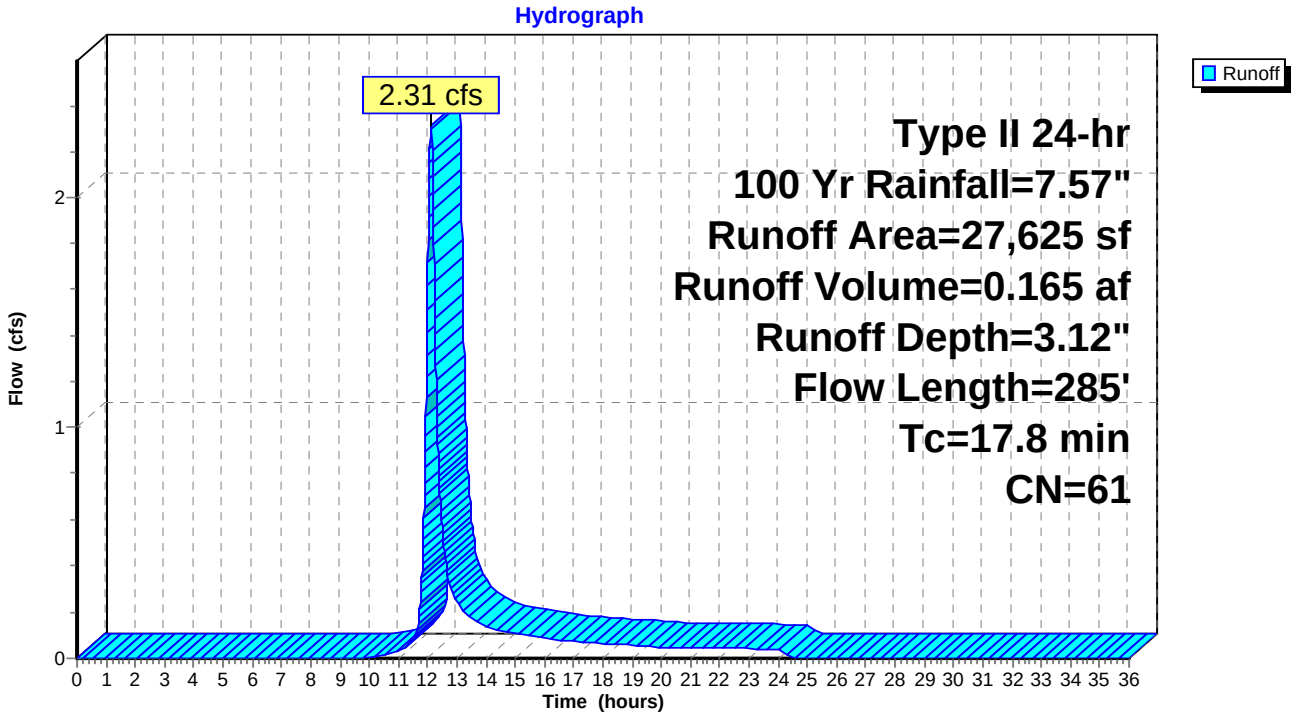
Runoff = 2.31 cfs @ 12.11 hrs, Volume= 0.165 af, Depth= 3.12"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
Type II 24-hr 100 Yr Rainfall=7.57"

Area (sf)	CN	Description
27,625	61	>75% Grass cover, Good, HSG B
27,625		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
14.7	100	0.0206	0.11		**Sheet Flow, Sheet Flow** Grass: Short n= 0.150 P2= 1.39"
3.1	185	0.0204	1.00		**Shallow Concentrated Flow, Shallow Conc.** Short Grass Pasture Kv= 7.0 fps
17.8	285	Total			

Subcatchment S4B3: Subcatchment 4B-3



Summary for Subcatchment S4B4: Subcatchment 3B-4

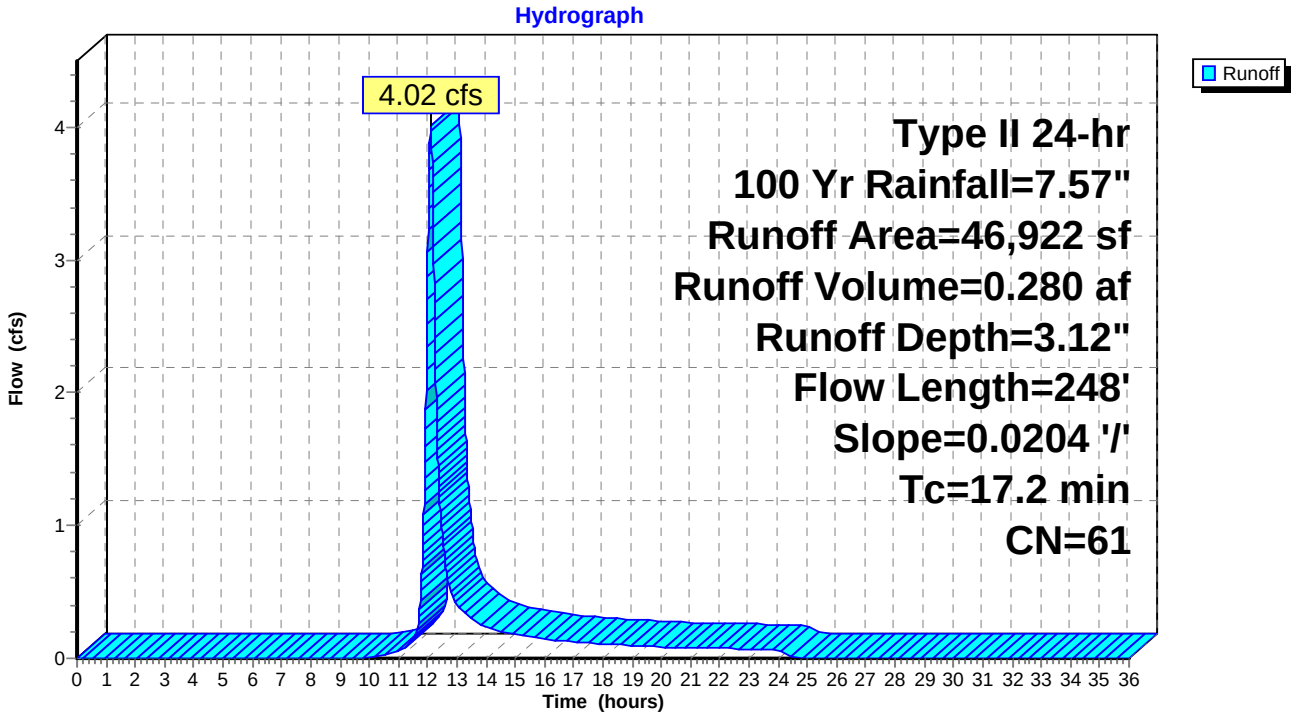
Runoff = 4.02 cfs @ 12.10 hrs, Volume= 0.280 af, Depth= 3.12"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
Type II 24-hr 100 Yr Rainfall=7.57"

Area (sf)	CN	Description
46,922	61	>75% Grass cover, Good, HSG B
46,922		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
14.7	100	0.0204	0.11		**Sheet Flow, Sheet Flow** Grass: Short n= 0.150 P2= 1.39"
2.5	148	0.0204	1.00		**Shallow Concentrated Flow, Shallow Conc.** Short Grass Pasture Kv= 7.0 fps
17.2	248	Total			

Subcatchment S4B4: Subcatchment 3B-4



Summary for Subcatchment S4B5: Subcatchment 4B-5

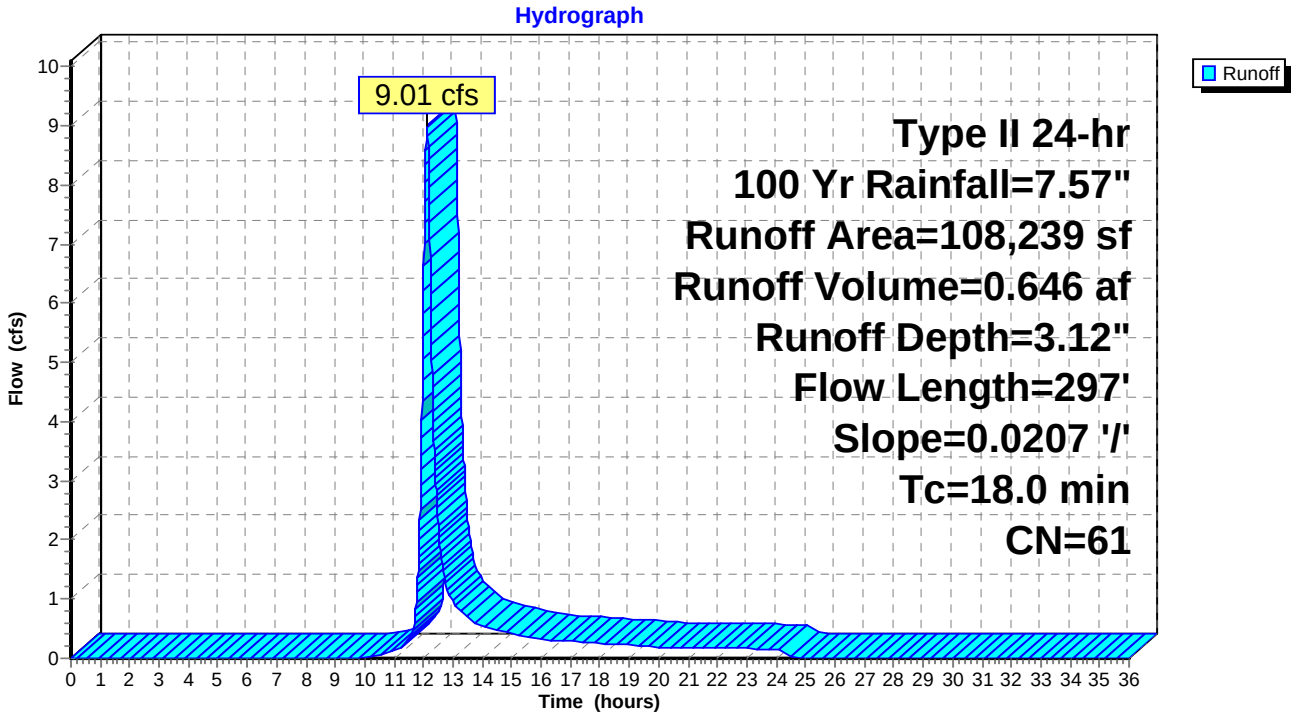
Runoff = 9.01 cfs @ 12.11 hrs, Volume= 0.646 af, Depth= 3.12"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
Type II 24-hr 100 Yr Rainfall=7.57"

Area (sf)	CN	Description
108,239	61	>75% Grass cover, Good, HSG B
108,239		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
14.7	100	0.0207	0.11		**Sheet Flow, Sheet Flow** Grass: Short n= 0.150 P2= 1.39"
3.3	197	0.0207	1.01		**Shallow Concentrated Flow, Shallow Conc.** Short Grass Pasture Kv= 7.0 fps
18.0	297	Total			

Subcatchment S4B5: Subcatchment 4B-5



Summary for Subcatchment S4B6: Subcatchment 4B-6

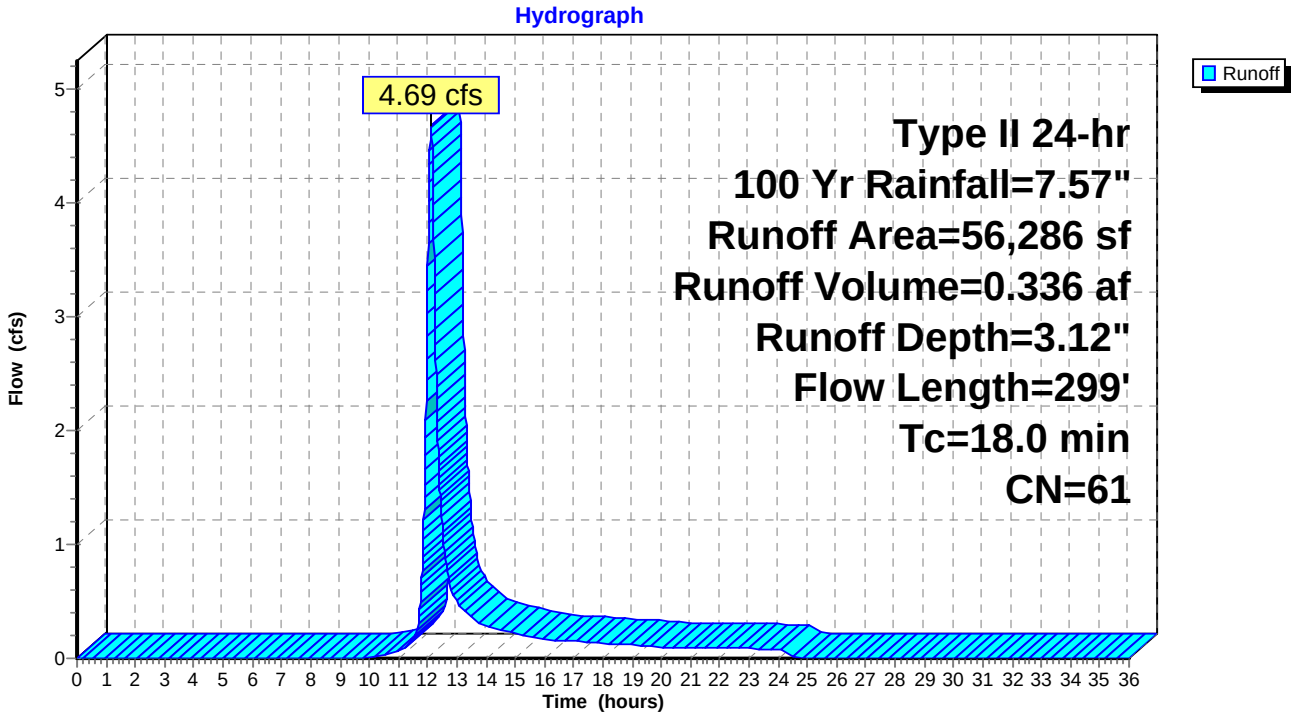
Runoff = 4.69 cfs @ 12.11 hrs, Volume= 0.336 af, Depth= 3.12"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
Type II 24-hr 100 Yr Rainfall=7.57"

Area (sf)	CN	Description
56,286	61	>75% Grass cover, Good, HSG B
56,286		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
14.7	100	0.0207	0.11		**Sheet Flow, Sheet Flow** Grass: Short n= 0.150 P2= 1.39"
3.3	199	0.0206	1.00		**Shallow Concentrated Flow, Shallow Conc.** Short Grass Pasture Kv= 7.0 fps
18.0	299	Total			

Subcatchment S4B6: Subcatchment 4B-6



Summary for Subcatchment S4B7: Subcatchment 4B-7

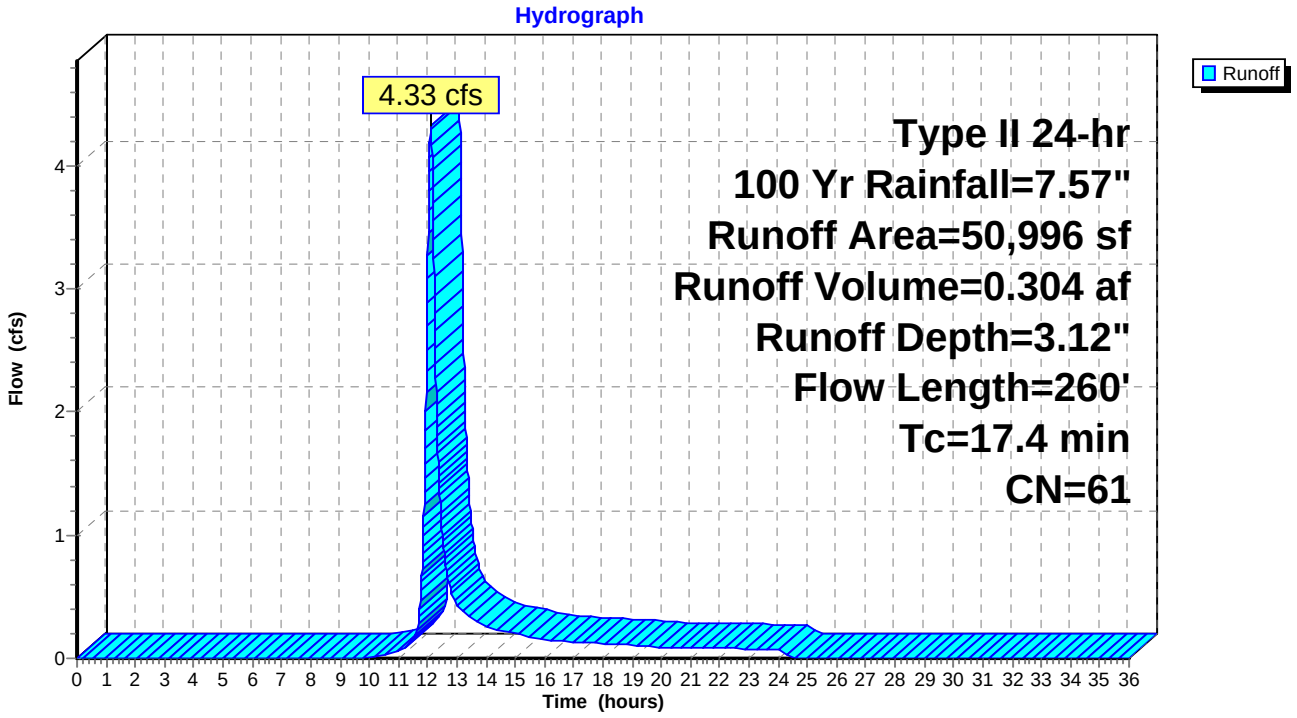
Runoff = 4.33 cfs @ 12.10 hrs, Volume= 0.304 af, Depth= 3.12"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
Type II 24-hr 100 Yr Rainfall=7.57"

Area (sf)	CN	Description
50,996	61	>75% Grass cover, Good, HSG B
50,996		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
14.7	100	0.0207	0.11		**Sheet Flow, Sheet Flow** Grass: Short n= 0.150 P2= 1.39"
2.7	160	0.0205	1.00		**Shallow Concentrated Flow, Shallow Conc.** Short Grass Pasture Kv= 7.0 fps
17.4	260	Total			

Subcatchment S4B7: Subcatchment 4B-7



Summary for Subcatchment S4C: Subcatchment 4C

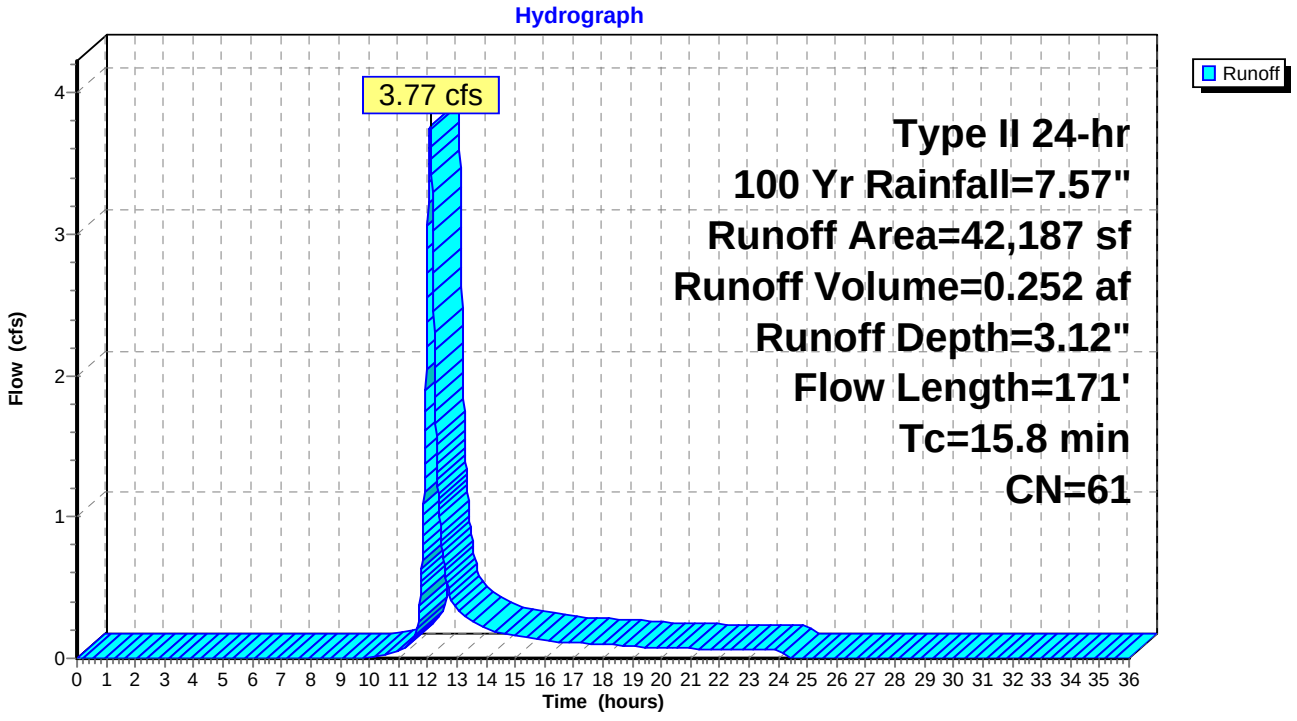
Runoff = 3.77 cfs @ 12.09 hrs, Volume= 0.252 af, Depth= 3.12"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
Type II 24-hr 100 Yr Rainfall=7.57"

Area (sf)	CN	Description
42,187	61	>75% Grass cover, Good, HSG B
42,187		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
14.6	100	0.0209	0.11		**Sheet Flow, Sheet Flow** Grass: Short n= 0.150 P2= 1.39"
1.2	71	0.0204	1.00		**Shallow Concentrated Flow, Shallow Conc.** Short Grass Pasture Kv= 7.0 fps
15.8	171	Total			

Subcatchment S4C: Subcatchment 4C



Summary for Subcatchment S5A: Subcatchment 5A

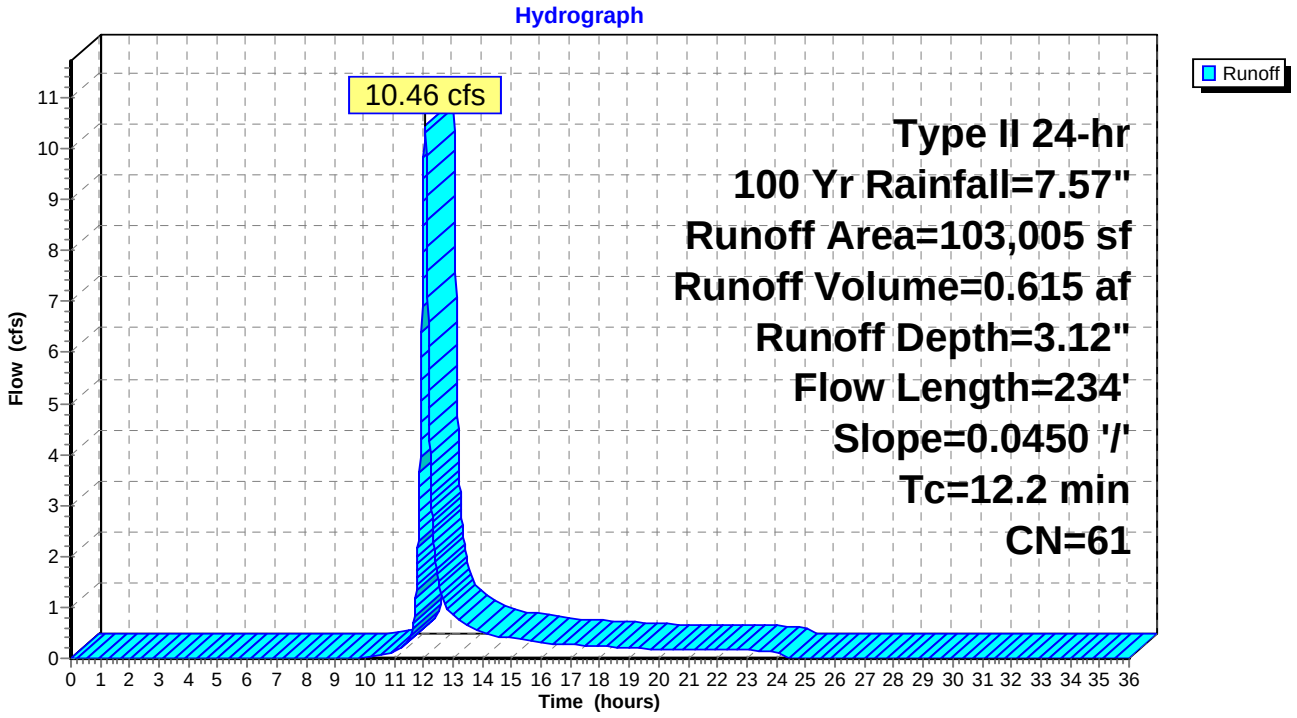
Runoff = 10.46 cfs @ 12.05 hrs, Volume= 0.615 af, Depth= 3.12"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
Type II 24-hr 100 Yr Rainfall=7.57"

Area (sf)	CN	Description
103,005	61	>75% Grass cover, Good, HSG B
103,005		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
10.7	100	0.0450	0.16		**Sheet Flow, Sheet Flow** Grass: Short n= 0.150 P2= 1.39"
1.5	134	0.0450	1.48		**Shallow Concentrated Flow, Shallow Conc.** Short Grass Pasture Kv= 7.0 fps
12.2	234	Total			

Subcatchment S5A: Subcatchment 5A



Summary for Subcatchment S5B: Subcatchment 5B

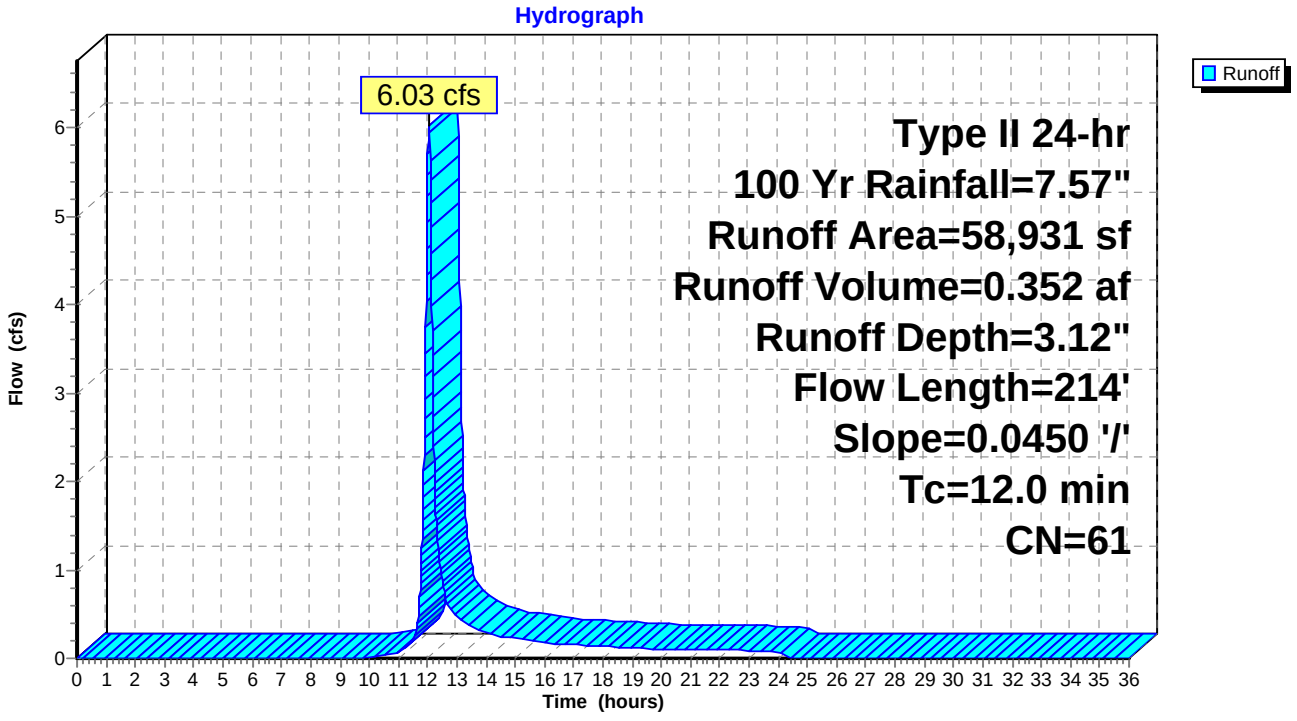
Runoff = 6.03 cfs @ 12.04 hrs, Volume= 0.352 af, Depth= 3.12"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
Type II 24-hr 100 Yr Rainfall=7.57"

Area (sf)	CN	Description
58,931	61	>75% Grass cover, Good, HSG B
58,931		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
10.7	100	0.0450	0.16		**Sheet Flow, Sheet Flow** Grass: Short n= 0.150 P2= 1.39"
1.3	114	0.0450	1.48		**Shallow Concentrated Flow, Shallow Conc.** Short Grass Pasture Kv= 7.0 fps
12.0	214	Total			

Subcatchment S5B: Subcatchment 5B



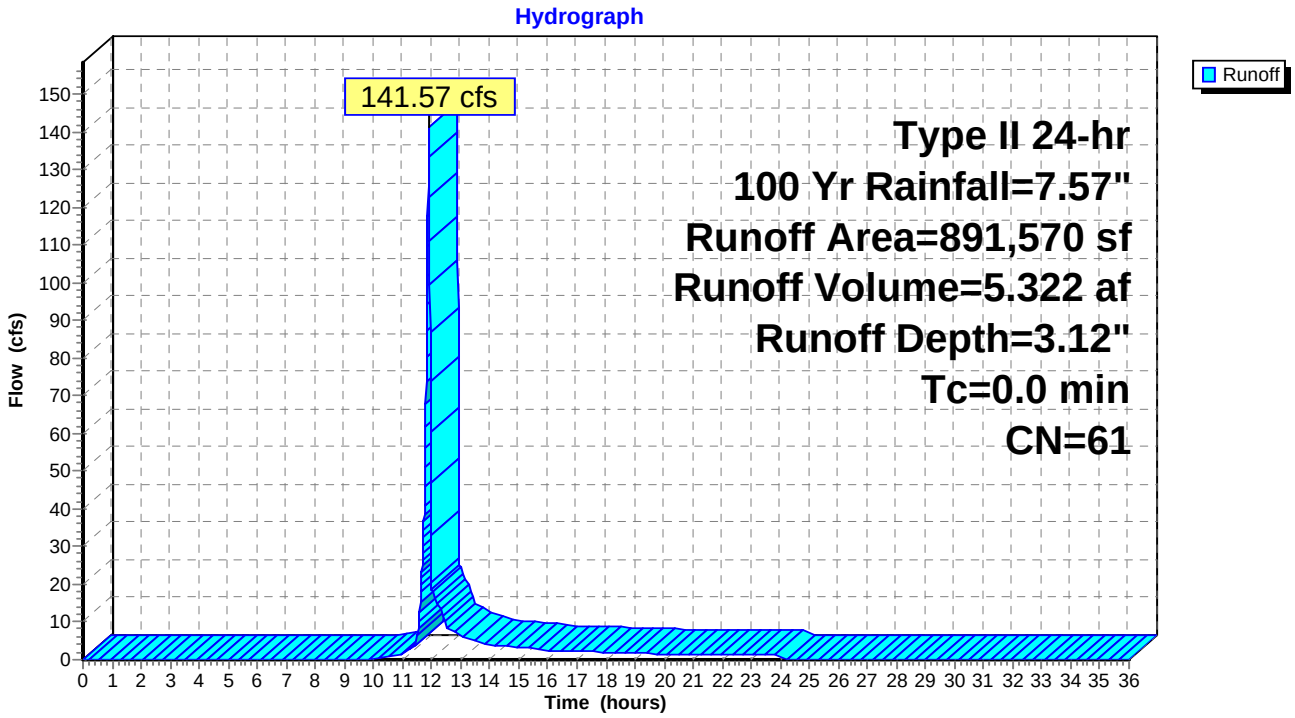
Summary for Subcatchment SED: Subcatchment Existing Ditch

Runoff = 141.57 cfs @ 11.90 hrs, Volume= 5.322 af, Depth= 3.12"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
Type II 24-hr 100 Yr Rainfall=7.57"

Area (sf)	CN	Description
891,570	61	>75% Grass cover, Good, HSG B
891,570		100.00% Pervious Area

Subcatchment SED: Subcatchment Existing Ditch



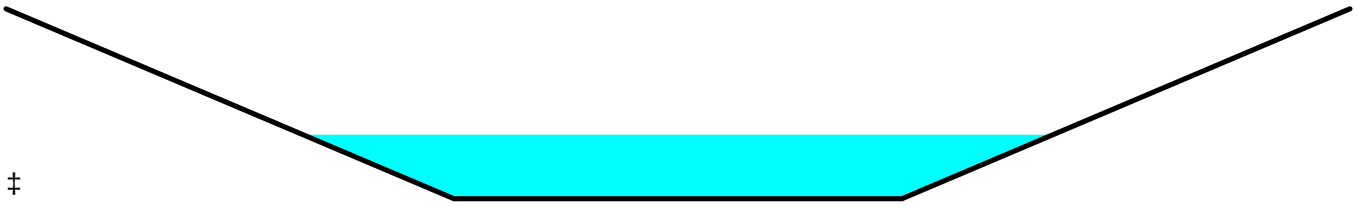
Summary for Reach 1RR: Outlet 1 Riprap

Inflow Area = 1.553 ac, 0.00% Impervious, Inflow Depth = 3.12" for 100 Yr event
Inflow = 3.97 cfs @ 12.17 hrs, Volume= 0.404 af
Outflow = 3.96 cfs @ 12.19 hrs, Volume= 0.404 af, Atten= 0%, Lag= 1.1 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs / 2
Max. Velocity= 2.93 fps, Min. Travel Time= 0.6 min
Avg. Velocity = 0.88 fps, Avg. Travel Time= 2.0 min

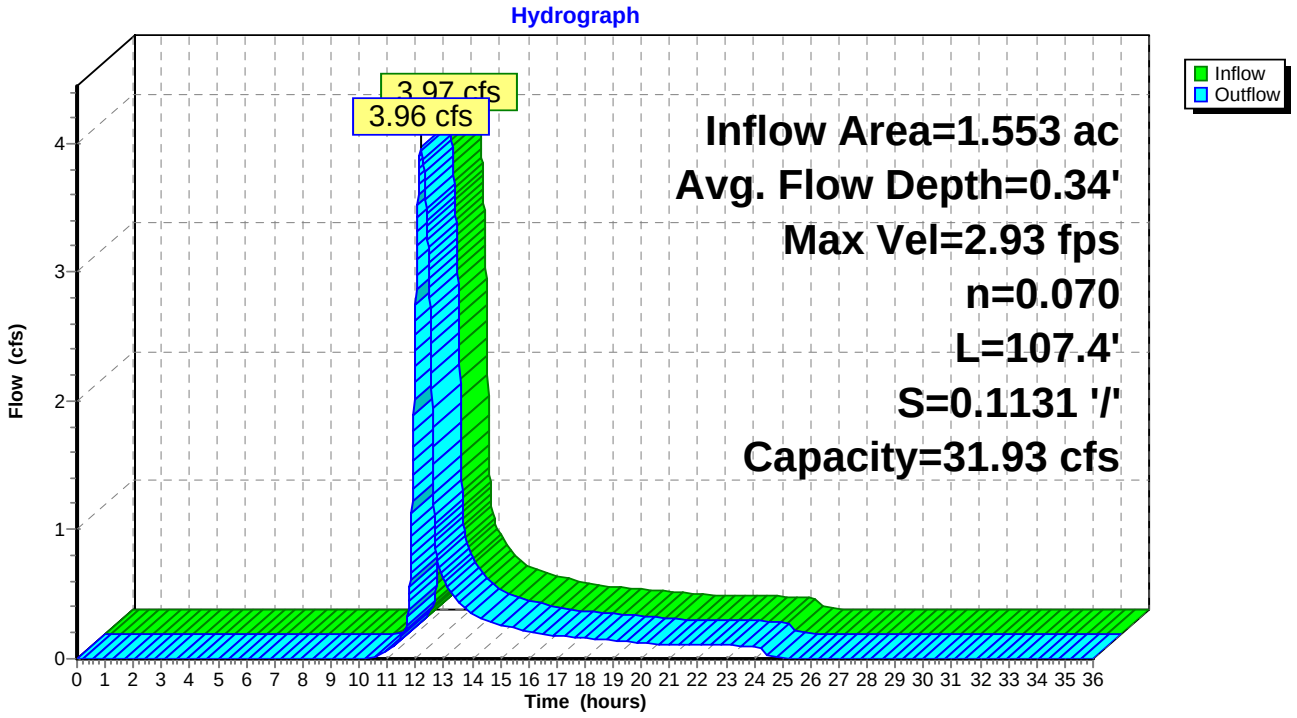
Peak Storage= 145 cf @ 12.18 hrs
Average Depth at Peak Storage= 0.34'
Bank-Full Depth= 1.00' Flow Area= 6.0 sf, Capacity= 31.93 cfs

3.00' x 1.00' deep channel, n= 0.070
Side Slope Z-value= 3.0 '/' Top Width= 9.00'
Length= 107.4' Slope= 0.1131 '/'
Inlet Invert= 398.14', Outlet Invert= 385.99'



‡

Reach 1RR: Outlet 1 Riprap



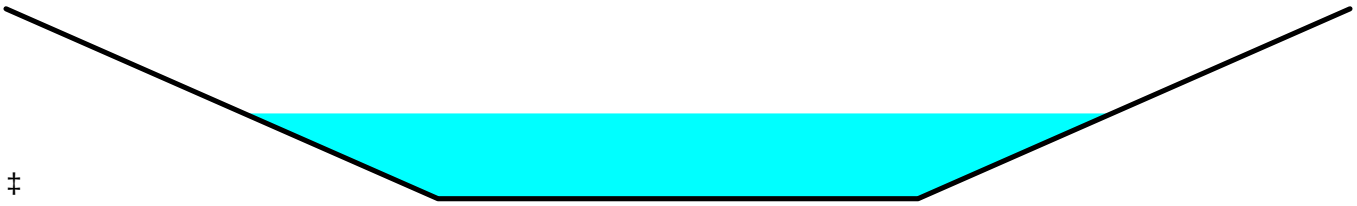
Summary for Reach 2RR: Outlet 2 Riprap

Inflow Area = 18.214 ac, 0.00% Impervious, Inflow Depth = 3.12" for 100 Yr event
Inflow = 23.29 cfs @ 12.55 hrs, Volume= 4.736 af
Outflow = 23.29 cfs @ 12.56 hrs, Volume= 4.736 af, Atten= 0%, Lag= 0.6 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs / 2
Max. Velocity= 4.92 fps, Min. Travel Time= 0.4 min
Avg. Velocity = 1.87 fps, Avg. Travel Time= 1.0 min

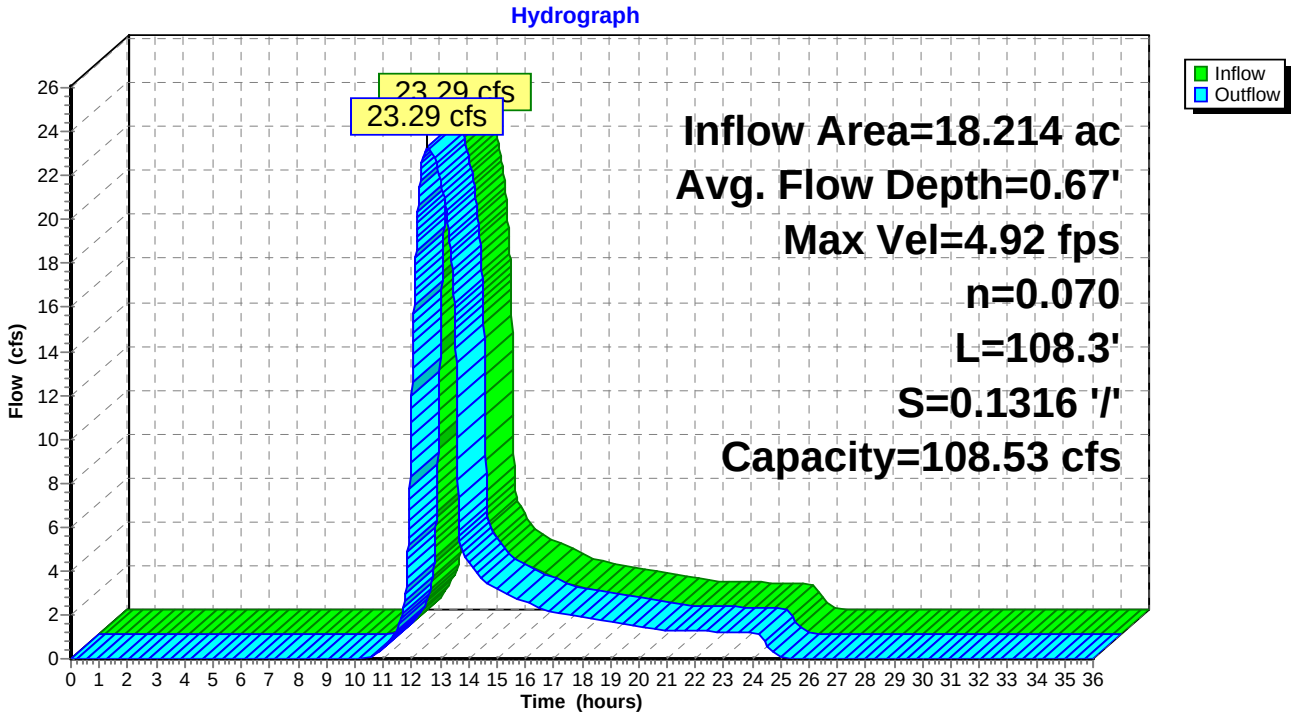
Peak Storage= 513 cf @ 12.55 hrs
Average Depth at Peak Storage= 0.67'
Bank-Full Depth= 1.50' Flow Area= 14.3 sf, Capacity= 108.53 cfs

5.00' x 1.50' deep channel, n= 0.070
Side Slope Z-value= 3.0 '/' Top Width= 14.00'
Length= 108.3' Slope= 0.1316 '/'
Inlet Invert= 398.29', Outlet Invert= 384.04'



‡

Reach 2RR: Outlet 2 Riprap



Summary for Reach 3RR: Outlet 3 Riprap

Inflow Area = 19.345 ac, 0.00% Impervious, Inflow Depth = 3.12" for 100 Yr event
Inflow = 23.63 cfs @ 12.58 hrs, Volume= 5.030 af
Outflow = 23.63 cfs @ 12.59 hrs, Volume= 5.030 af, Atten= 0%, Lag= 0.4 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs / 2
Max. Velocity= 5.67 fps, Min. Travel Time= 0.3 min
Avg. Velocity = 2.08 fps, Avg. Travel Time= 0.7 min

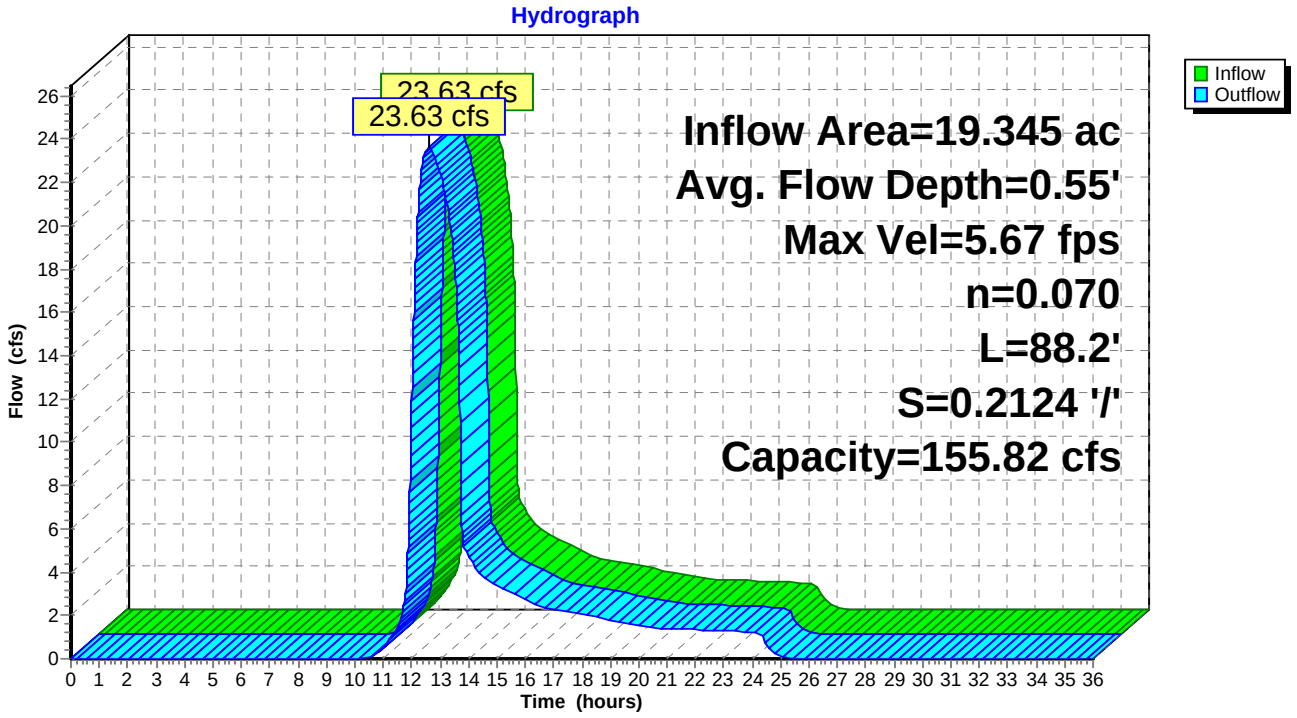
Peak Storage= 368 cf @ 12.58 hrs
Average Depth at Peak Storage= 0.55'
Bank-Full Depth= 1.50' Flow Area= 15.8 sf, Capacity= 155.82 cfs

6.00' x 1.50' deep channel, n= 0.070
Side Slope Z-value= 3.0 '/' Top Width= 15.00'
Length= 88.2' Slope= 0.2124 '/'
Inlet Invert= 398.72', Outlet Invert= 379.99'



‡

Reach 3RR: Outlet 3 Riprap



Summary for Reach 4RR: Outlet 4 Riprap

Inflow Area = 14.679 ac, 0.00% Impervious, Inflow Depth = 3.12" for 100 Yr event
Inflow = 22.51 cfs @ 12.49 hrs, Volume= 3.817 af
Outflow = 22.51 cfs @ 12.50 hrs, Volume= 3.817 af, Atten= 0%, Lag= 0.5 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs / 2
Max. Velocity= 5.43 fps, Min. Travel Time= 0.3 min
Avg. Velocity = 1.89 fps, Avg. Travel Time= 0.8 min

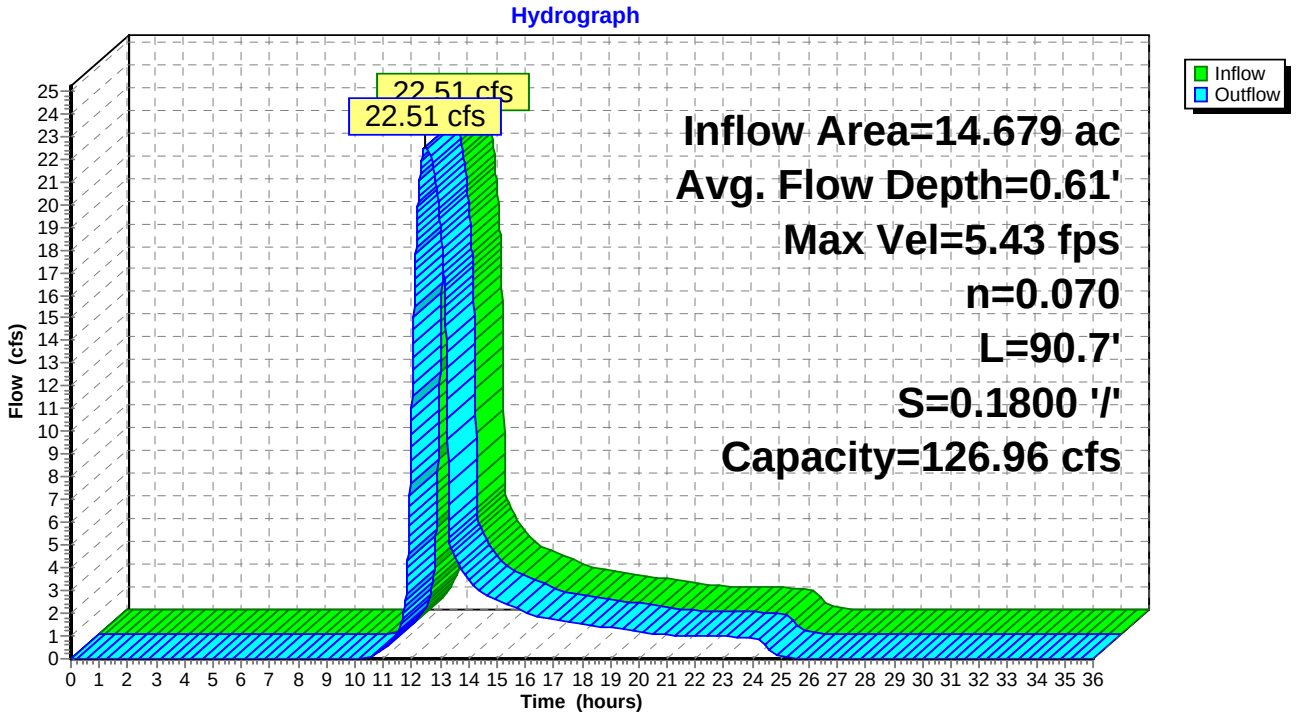
Peak Storage= 376 cf @ 12.49 hrs
Average Depth at Peak Storage= 0.61'
Bank-Full Depth= 1.50' Flow Area= 14.3 sf, Capacity= 126.96 cfs

5.00' x 1.50' deep channel, n= 0.070
Side Slope Z-value= 3.0 '/' Top Width= 14.00'
Length= 90.7' Slope= 0.1800 '/'
Inlet Invert= 397.23', Outlet Invert= 380.90'



‡

Reach 4RR: Outlet 4 Riprap



Summary for Reach 5RR: Slope Riprap

Inflow Area = 3.718 ac, 0.00% Impervious, Inflow Depth = 3.12" for 100 Yr event
Inflow = 4.27 cfs @ 12.37 hrs, Volume= 0.967 af
Outflow = 4.27 cfs @ 12.37 hrs, Volume= 0.967 af, Atten= 0%, Lag= 0.4 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs / 2
Max. Velocity= 3.35 fps, Min. Travel Time= 0.2 min
Avg. Velocity = 1.50 fps, Avg. Travel Time= 0.6 min

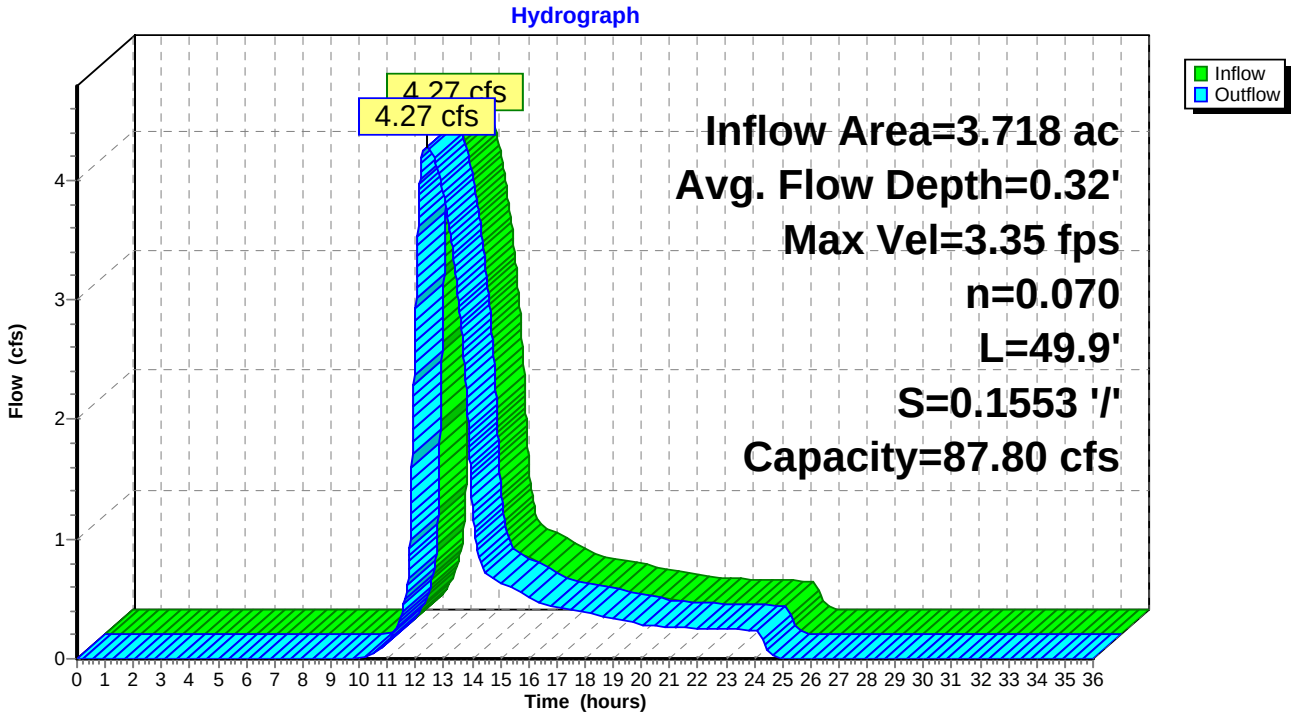
Peak Storage= 64 cf @ 12.37 hrs
Average Depth at Peak Storage= 0.32'
Bank-Full Depth= 1.50' Flow Area= 11.3 sf, Capacity= 87.80 cfs

3.00' x 1.50' deep channel, n= 0.070
Side Slope Z-value= 3.0 '/' Top Width= 12.00'
Length= 49.9' Slope= 0.1553 '/'
Inlet Invert= 398.26', Outlet Invert= 390.51'



‡

Reach 5RR: Slope Riprap



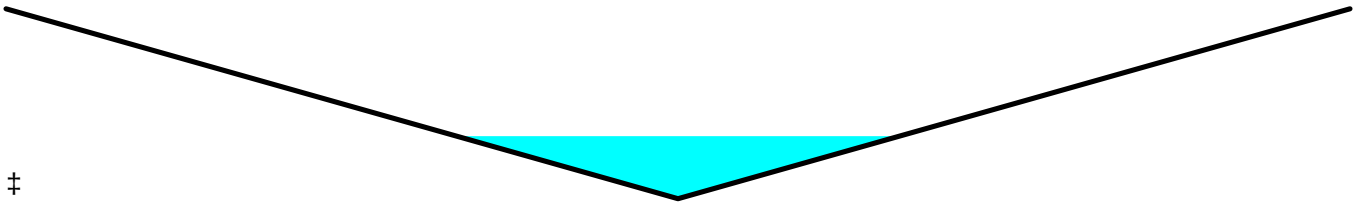
Summary for Reach C1A: Channel 1A

Inflow Area = 1.553 ac, 0.00% Impervious, Inflow Depth = 3.12" for 100 Yr event
Inflow = 9.85 cfs @ 11.94 hrs, Volume= 0.404 af
Outflow = 7.69 cfs @ 12.07 hrs, Volume= 0.404 af, Atten= 22%, Lag= 7.8 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs / 2
Max. Velocity= 2.80 fps, Min. Travel Time= 5.4 min
Avg. Velocity = 0.92 fps, Avg. Travel Time= 16.4 min

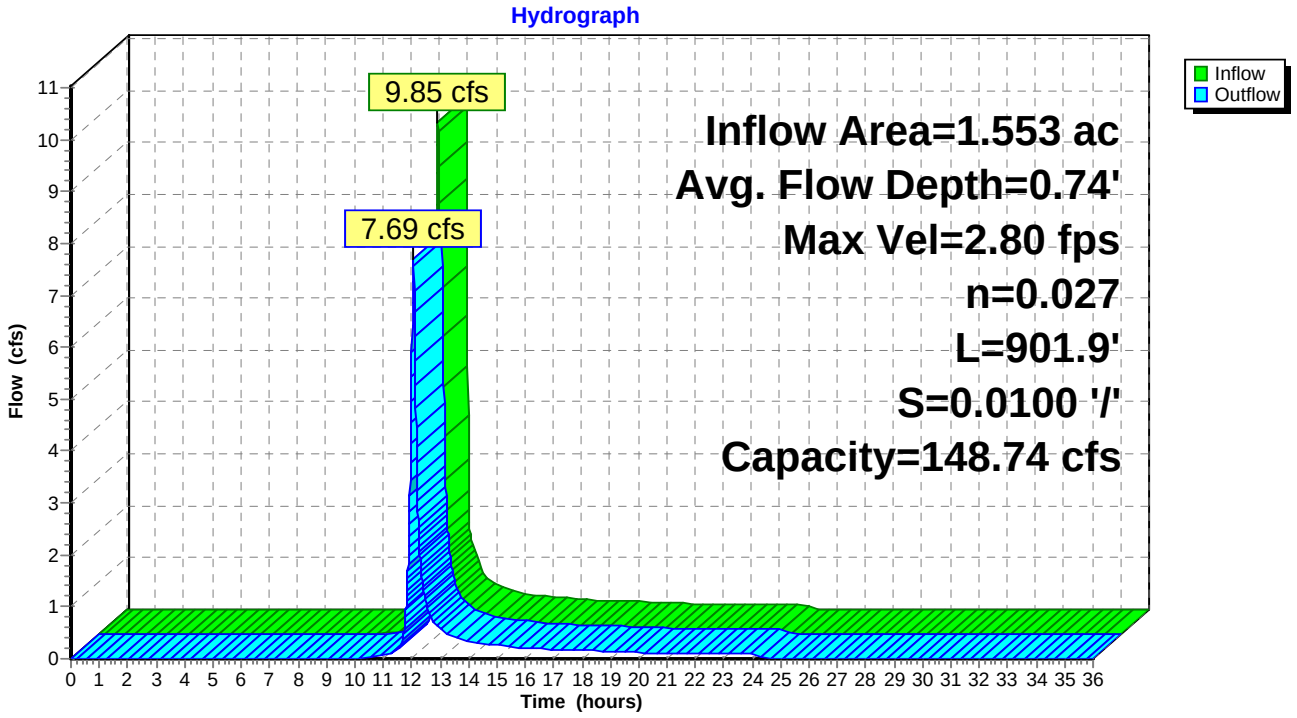
Peak Storage= 2,476 cf @ 11.98 hrs
Average Depth at Peak Storage= 0.74'
Bank-Full Depth= 2.25' Flow Area= 25.3 sf, Capacity= 148.74 cfs

0.00' x 2.25' deep channel, n= 0.027
Side Slope Z-value= 5.0 '/' Top Width= 22.50'
Length= 901.9' Slope= 0.0100 '/'
Inlet Invert= 408.02', Outlet Invert= 399.00'



‡

Reach C1A: Channel 1A



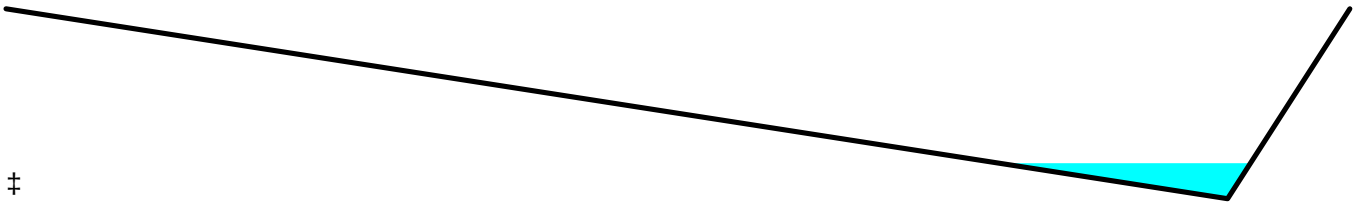
Summary for Reach C2A1: Channel 2A-1

Inflow Area = 2.566 ac, 0.00% Impervious, Inflow Depth = 3.12" for 100 Yr event
Inflow = 8.17 cfs @ 12.20 hrs, Volume= 0.667 af
Outflow = 8.16 cfs @ 12.21 hrs, Volume= 0.667 af, Atten= 0%, Lag= 0.6 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
Max. Velocity= 3.77 fps, Min. Travel Time= 0.3 min
Avg. Velocity = 1.49 fps, Avg. Travel Time= 0.9 min

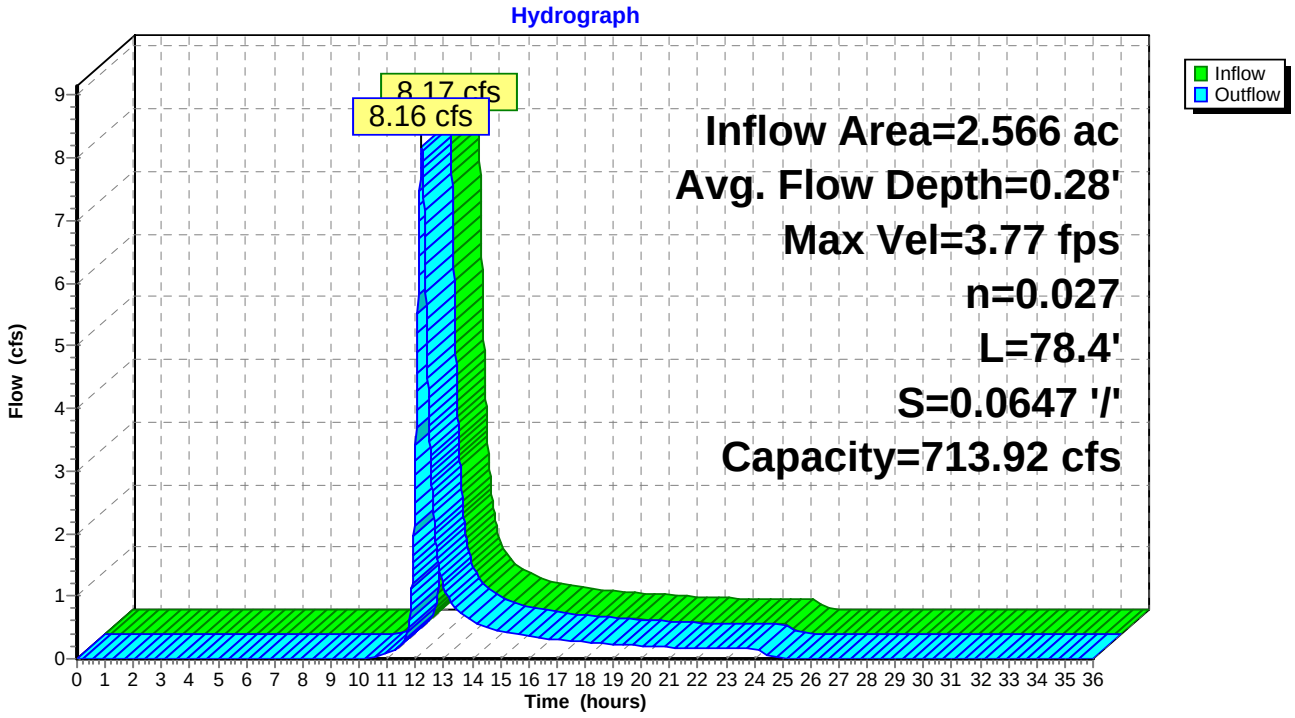
Peak Storage= 170 cf @ 12.21 hrs
Average Depth at Peak Storage= 0.28'
Bank-Full Depth= 1.50' Flow Area= 61.9 sf, Capacity= 713.92 cfs

0.00' x 1.50' deep channel, n= 0.027
Side Slope Z-value= 50.0 5.0 '/' Top Width= 82.50'
Length= 78.4' Slope= 0.0647 '/'
Inlet Invert= 406.78', Outlet Invert= 401.71'



‡

Reach C2A1: Channel 2A-1



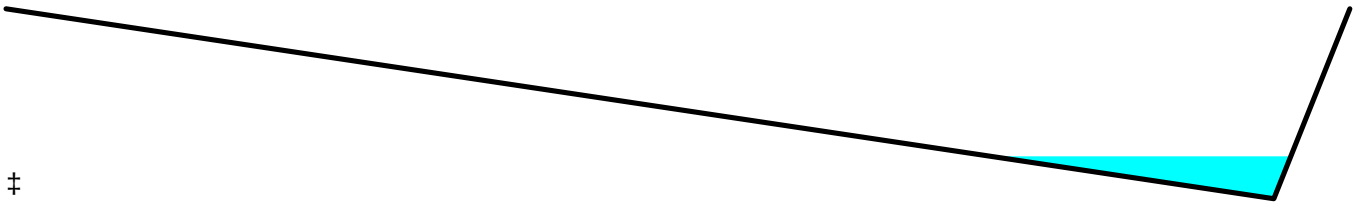
Summary for Reach C2A2: Channel 2A-2

Inflow Area = 0.595 ac, 0.00% Impervious, Inflow Depth = 3.12" for 100 Yr event
Inflow = 2.10 cfs @ 12.12 hrs, Volume= 0.155 af
Outflow = 2.07 cfs @ 12.17 hrs, Volume= 0.155 af, Atten= 1%, Lag= 3.0 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
Max. Velocity= 1.57 fps, Min. Travel Time= 1.7 min
Avg. Velocity = 0.64 fps, Avg. Travel Time= 4.1 min

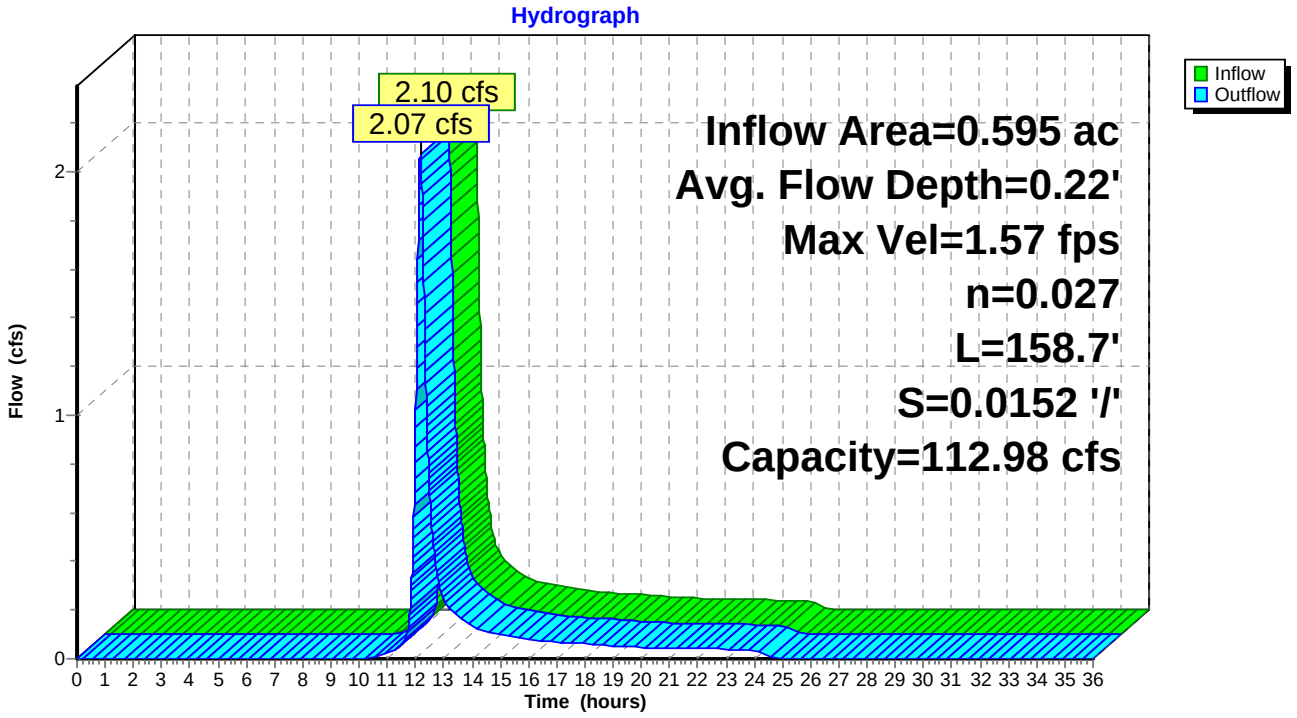
Peak Storage= 210 cf @ 12.14 hrs
Average Depth at Peak Storage= 0.22'
Bank-Full Depth= 1.00' Flow Area= 26.5 sf, Capacity= 112.98 cfs

0.00' x 1.00' deep channel, n= 0.027
Side Slope Z-value= 50.0 3.0 '/' Top Width= 53.00'
Length= 158.7' Slope= 0.0152 '/'
Inlet Invert= 405.19', Outlet Invert= 402.78'



‡

Reach C2A2: Channel 2A-2



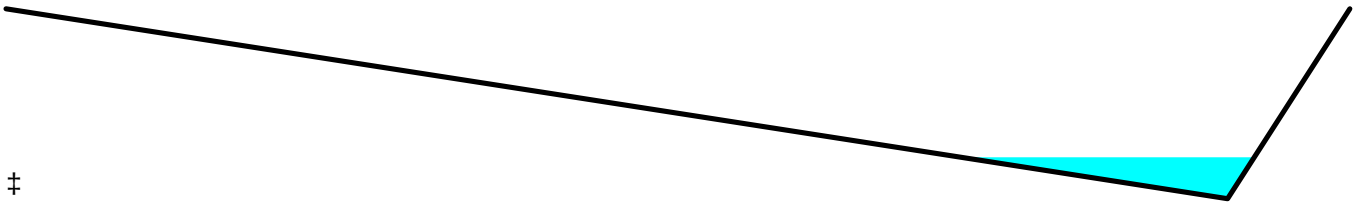
Summary for Reach C2A3: Channel 2A-3

Inflow Area = 1.421 ac, 0.00% Impervious, Inflow Depth = 3.12" for 100 Yr event
Inflow = 5.08 cfs @ 12.11 hrs, Volume= 0.369 af
Outflow = 4.70 cfs @ 12.24 hrs, Volume= 0.369 af, Atten= 7%, Lag= 7.9 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
Max. Velocity= 1.60 fps, Min. Travel Time= 4.4 min
Avg. Velocity = 0.61 fps, Avg. Travel Time= 11.6 min

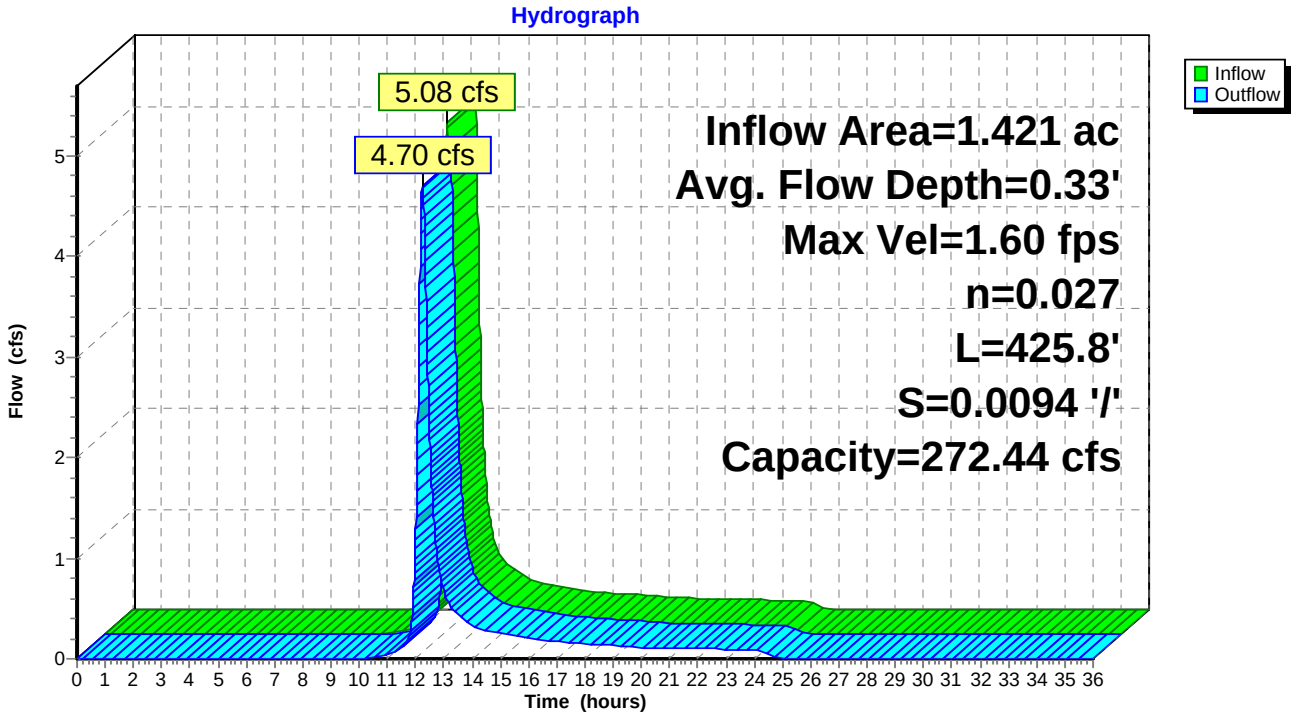
Peak Storage= 1,255 cf @ 12.17 hrs
Average Depth at Peak Storage= 0.33'
Bank-Full Depth= 1.50' Flow Area= 61.9 sf, Capacity= 272.44 cfs

0.00' x 1.50' deep channel, n= 0.027
Side Slope Z-value= 50.0 5.0 '/' Top Width= 82.50'
Length= 425.8' Slope= 0.0094 '/'
Inlet Invert= 406.79', Outlet Invert= 402.78'



‡

Reach C2A3: Channel 2A-3



Summary for Reach C2B1: Channel 2B-1

Inflow Area = 14.345 ac, 0.00% Impervious, Inflow Depth = 3.12" for 100 Yr event
Inflow = 45.82 cfs @ 12.24 hrs, Volume= 3.730 af
Outflow = 45.77 cfs @ 12.25 hrs, Volume= 3.730 af, Atten= 0%, Lag= 1.0 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
Max. Velocity= 3.51 fps, Min. Travel Time= 0.6 min
Avg. Velocity = 1.06 fps, Avg. Travel Time= 1.9 min

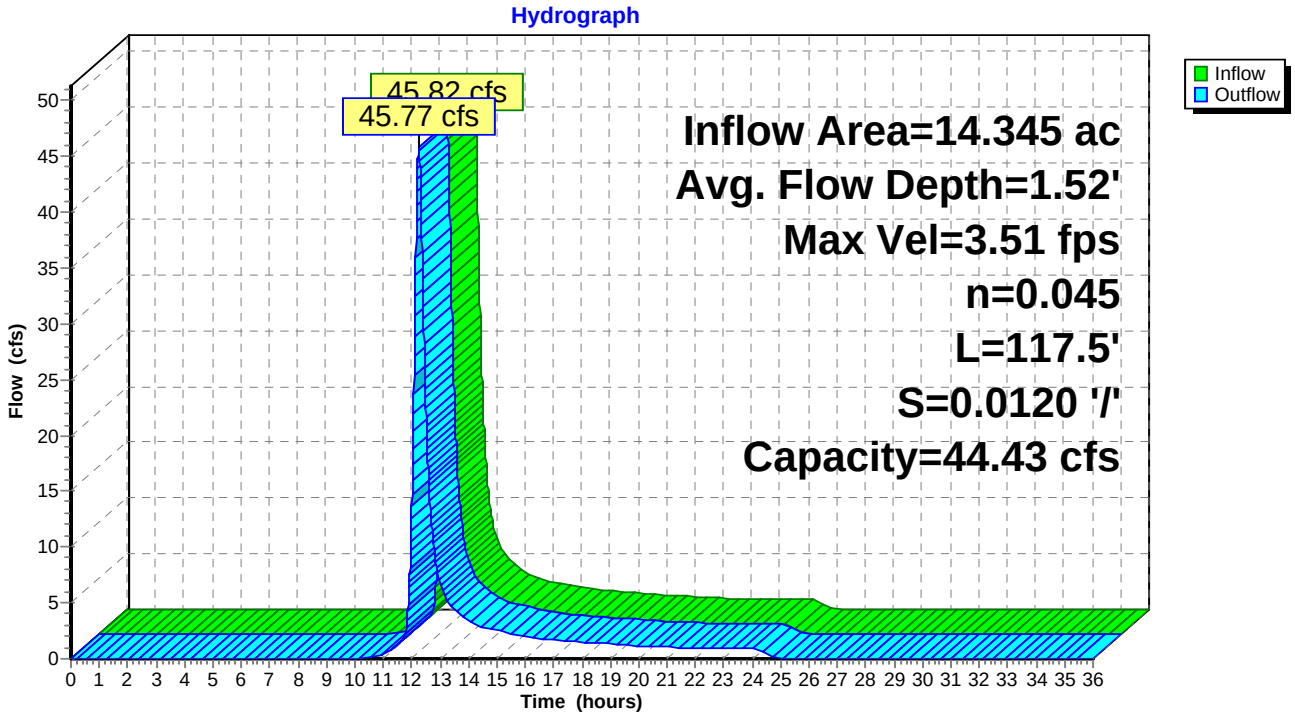
Peak Storage= 1,532 cf @ 12.24 hrs
Average Depth at Peak Storage= 1.52'
Bank-Full Depth= 1.50' Flow Area= 12.8 sf, Capacity= 44.43 cfs

4.00' x 1.50' deep channel, n= 0.045
Side Slope Z-value= 3.0 '/' Top Width= 13.00'
Length= 117.5' Slope= 0.0120 '/'
Inlet Invert= 401.66', Outlet Invert= 400.25'



‡

Reach C2B1: Channel 2B-1



Summary for Reach C2B10: Channel 2B-10

Inflow Area = 4.590 ac, 0.00% Impervious, Inflow Depth = 3.12" for 100 Yr event
Inflow = 14.94 cfs @ 12.19 hrs, Volume= 1.193 af
Outflow = 14.88 cfs @ 12.22 hrs, Volume= 1.193 af, Atten= 0%, Lag= 1.7 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
Max. Velocity= 2.59 fps, Min. Travel Time= 1.0 min
Avg. Velocity = 0.77 fps, Avg. Travel Time= 3.4 min

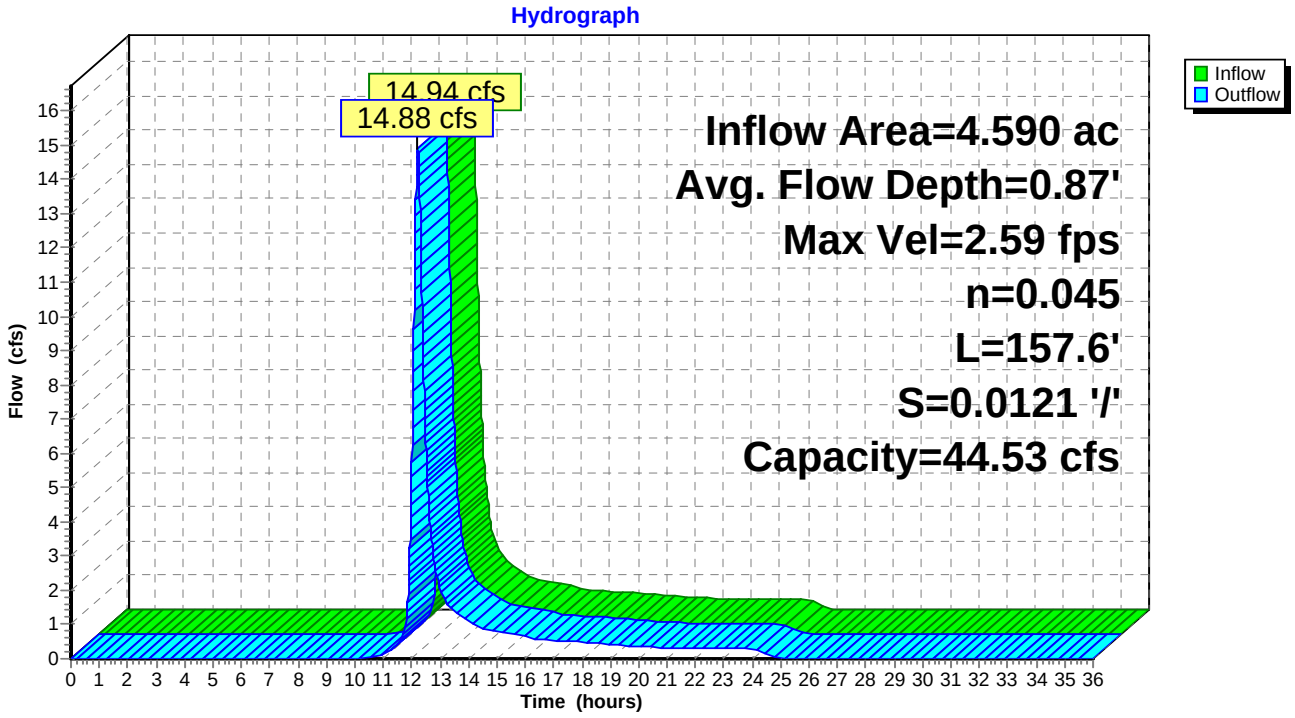
Peak Storage= 905 cf @ 12.20 hrs
Average Depth at Peak Storage= 0.87'
Bank-Full Depth= 1.50' Flow Area= 12.8 sf, Capacity= 44.53 cfs

4.00' x 1.50' deep channel, n= 0.045
Side Slope Z-value= 3.0 '/' Top Width= 13.00'
Length= 157.6' Slope= 0.0121 '/'
Inlet Invert= 407.36', Outlet Invert= 405.46'



‡

Reach C2B10: Channel 2B-10



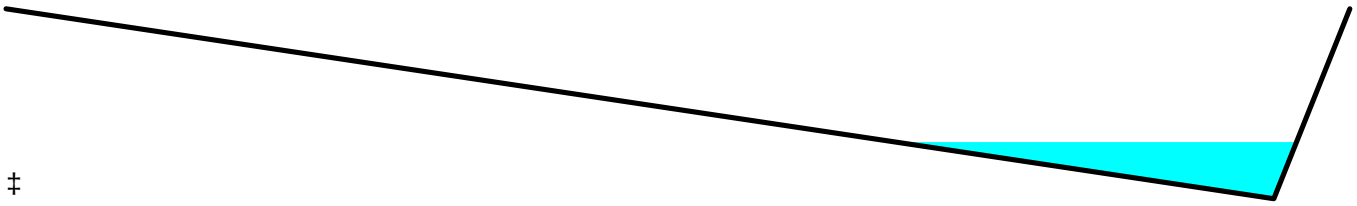
Summary for Reach C2B11: Channel 2B-11

Inflow Area = 1.333 ac, 0.00% Impervious, Inflow Depth = 3.12" for 100 Yr event
Inflow = 4.77 cfs @ 12.11 hrs, Volume= 0.347 af
Outflow = 4.47 cfs @ 12.23 hrs, Volume= 0.347 af, Atten= 6%, Lag= 7.2 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
Max. Velocity= 1.89 fps, Min. Travel Time= 4.0 min
Avg. Velocity = 0.71 fps, Avg. Travel Time= 10.7 min

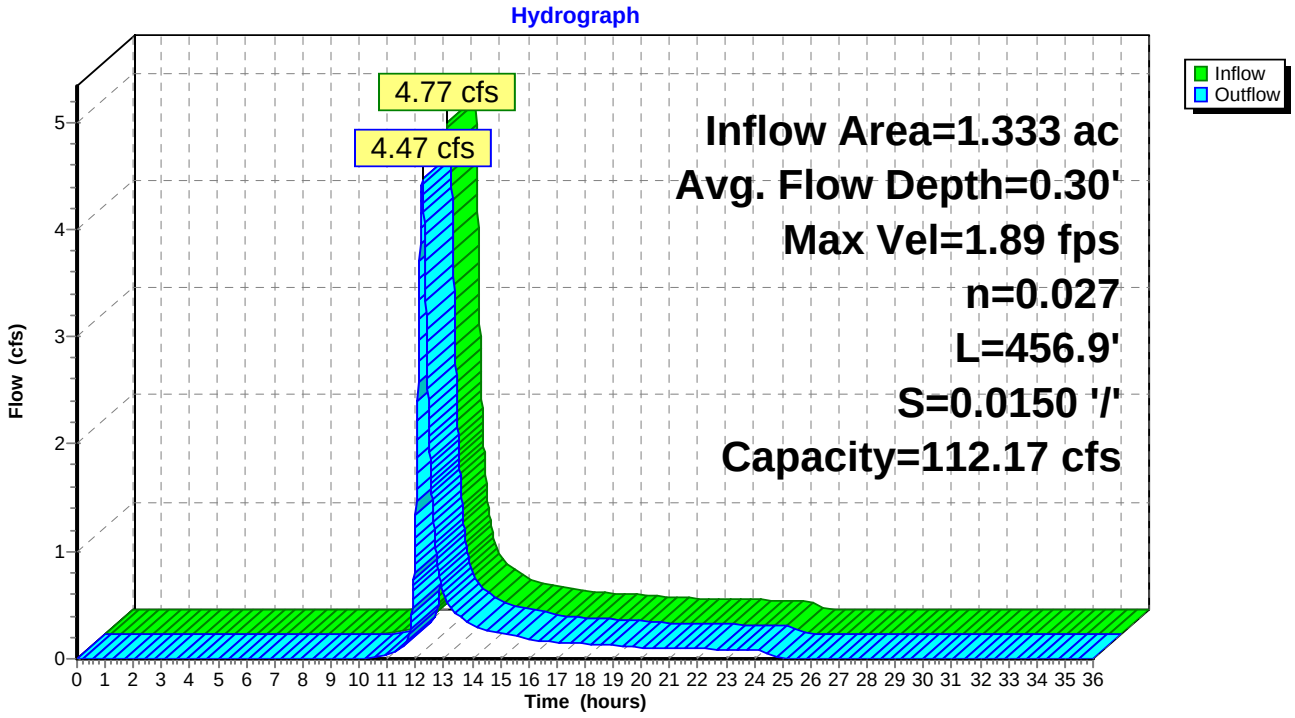
Peak Storage= 1,079 cf @ 12.17 hrs
Average Depth at Peak Storage= 0.30'
Bank-Full Depth= 1.00' Flow Area= 26.5 sf, Capacity= 112.17 cfs

0.00' x 1.00' deep channel, n= 0.027
Side Slope Z-value= 50.0 3.0 '/' Top Width= 53.00'
Length= 456.9' Slope= 0.0150 '/'
Inlet Invert= 414.61', Outlet Invert= 407.77'



‡

Reach C2B11: Channel 2B-11



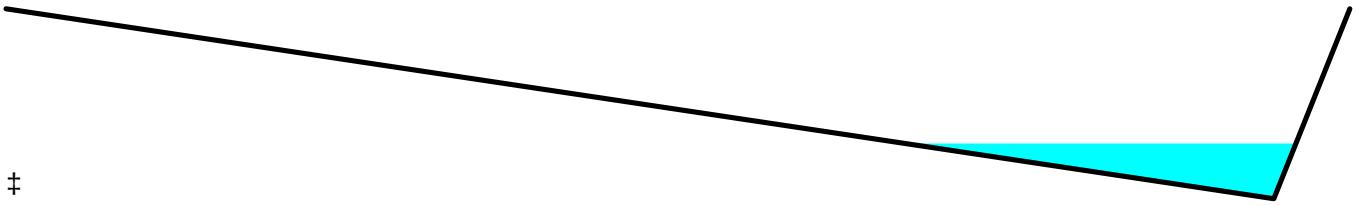
Summary for Reach C2B12: Channel 2B-12

Inflow Area = 1.270 ac, 0.00% Impervious, Inflow Depth = 3.12" for 100 Yr event
Inflow = 4.64 cfs @ 12.11 hrs, Volume= 0.330 af
Outflow = 4.34 cfs @ 12.22 hrs, Volume= 0.330 af, Atten= 6%, Lag= 6.9 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
Max. Velocity= 1.93 fps, Min. Travel Time= 4.0 min
Avg. Velocity = 0.73 fps, Avg. Travel Time= 10.7 min

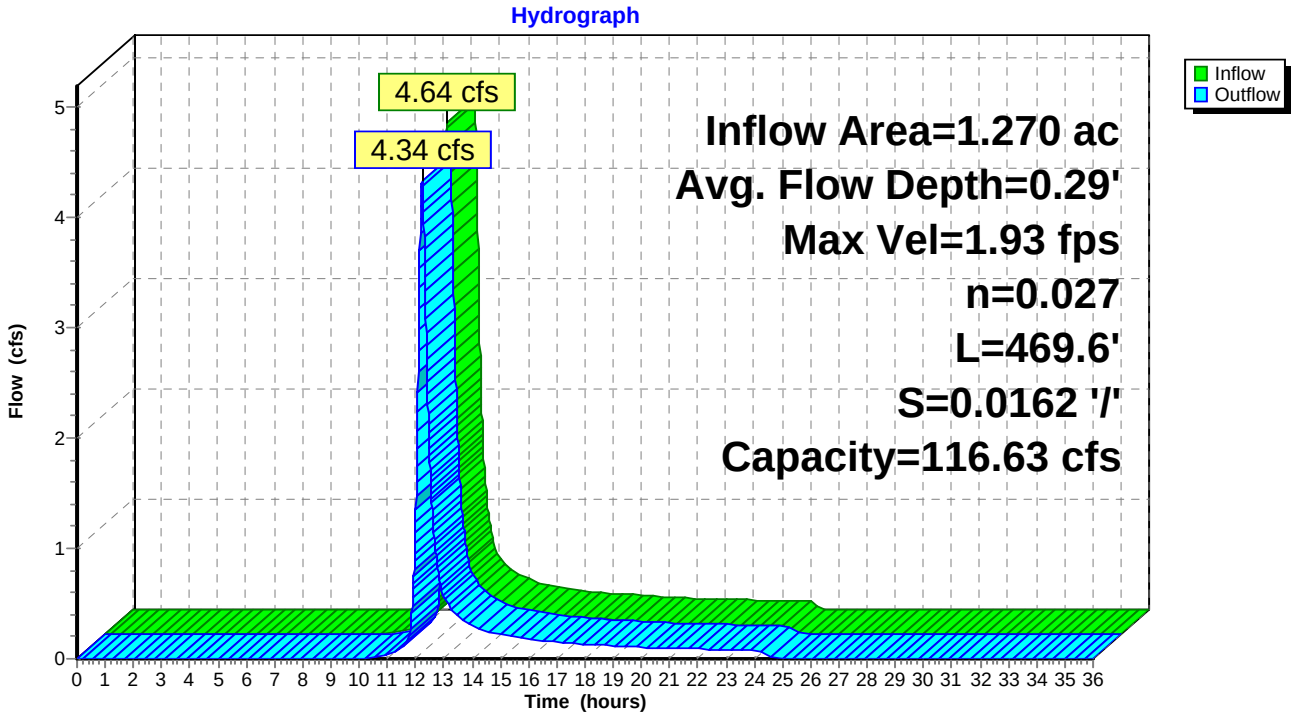
Peak Storage= 1,054 cf @ 12.16 hrs
Average Depth at Peak Storage= 0.29'
Bank-Full Depth= 1.00' Flow Area= 26.5 sf, Capacity= 116.63 cfs

0.00' x 1.00' deep channel, n= 0.027
Side Slope Z-value= 50.0 3.0 '/' Top Width= 53.00'
Length= 469.6' Slope= 0.0162 '/'
Inlet Invert= 415.37', Outlet Invert= 407.77'



‡

Reach C2B12: Channel 2B-12



Summary for Reach C2B13: Channel 2B-13

Inflow Area = 1.036 ac, 0.00% Impervious, Inflow Depth = 3.12" for 100 Yr event
Inflow = 3.75 cfs @ 12.11 hrs, Volume= 0.269 af
Outflow = 3.72 cfs @ 12.15 hrs, Volume= 0.269 af, Atten= 1%, Lag= 2.3 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
Max. Velocity= 1.72 fps, Min. Travel Time= 1.4 min
Avg. Velocity = 0.51 fps, Avg. Travel Time= 4.6 min

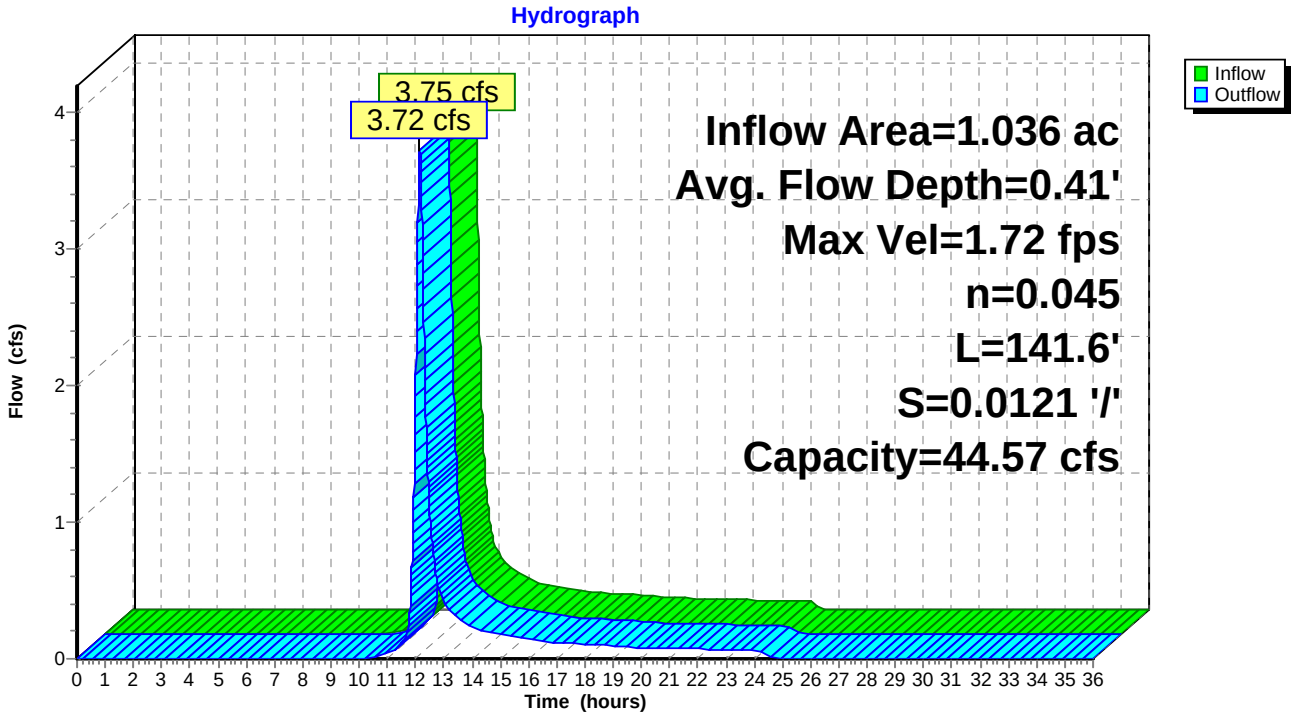
Peak Storage= 306 cf @ 12.13 hrs
Average Depth at Peak Storage= 0.41'
Bank-Full Depth= 1.50' Flow Area= 12.8 sf, Capacity= 44.57 cfs

4.00' x 1.50' deep channel, n= 0.045
Side Slope Z-value= 3.0 '/' Top Width= 13.00'
Length= 141.6' Slope= 0.0121 '/'
Inlet Invert= 409.07', Outlet Invert= 407.36'



‡

Reach C2B13: Channel 2B-13



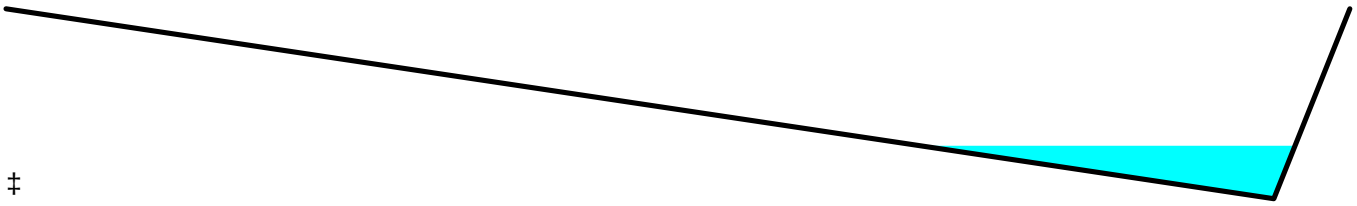
Summary for Reach C2B2: Channel 2B-2

Inflow Area = 1.098 ac, 0.00% Impervious, Inflow Depth = 3.12" for 100 Yr event
Inflow = 3.93 cfs @ 12.11 hrs, Volume= 0.286 af
Outflow = 3.70 cfs @ 12.23 hrs, Volume= 0.286 af, Atten= 6%, Lag= 6.9 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
Max. Velocity= 1.79 fps, Min. Travel Time= 3.9 min
Avg. Velocity = 0.69 fps, Avg. Travel Time= 10.1 min

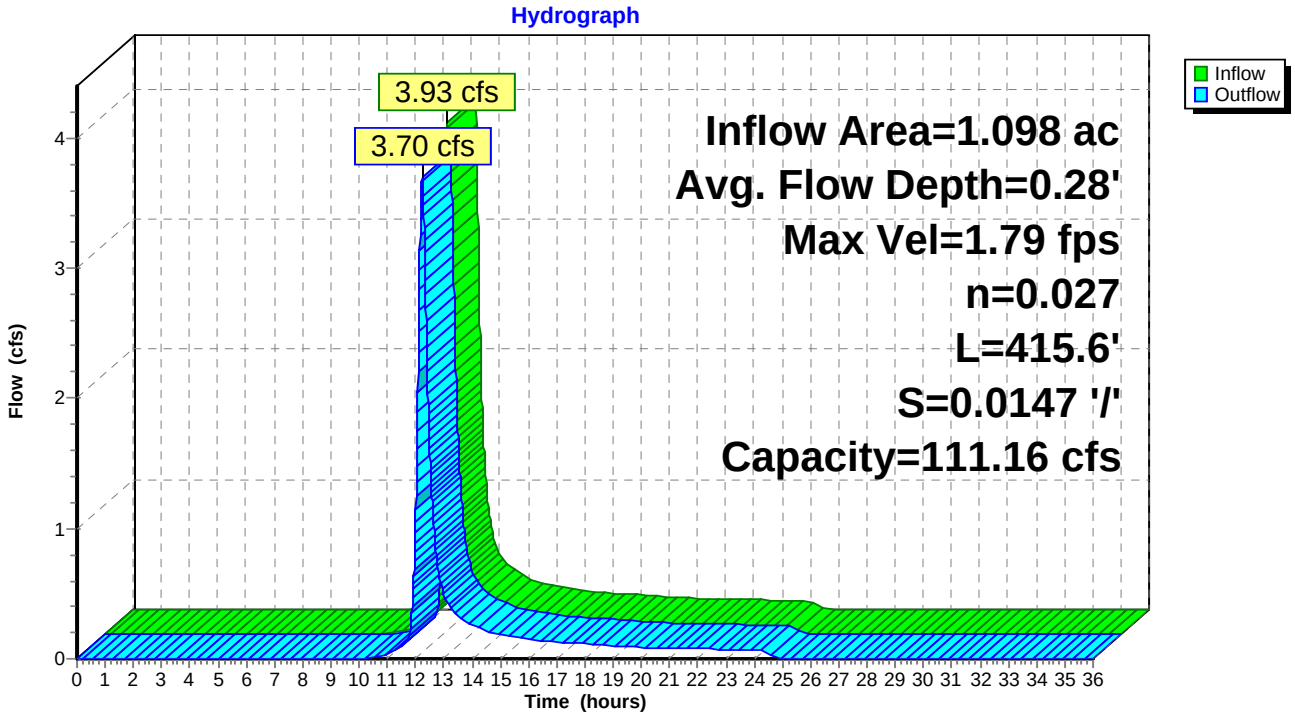
Peak Storage= 858 cf @ 12.16 hrs
Average Depth at Peak Storage= 0.28'
Bank-Full Depth= 1.00' Flow Area= 26.5 sf, Capacity= 111.16 cfs

0.00' x 1.00' deep channel, n= 0.027
Side Slope Z-value= 50.0 3.0 '/' Top Width= 53.00'
Length= 415.6' Slope= 0.0147 '/'
Inlet Invert= 409.22', Outlet Invert= 403.11'



‡

Reach C2B2: Channel 2B-2



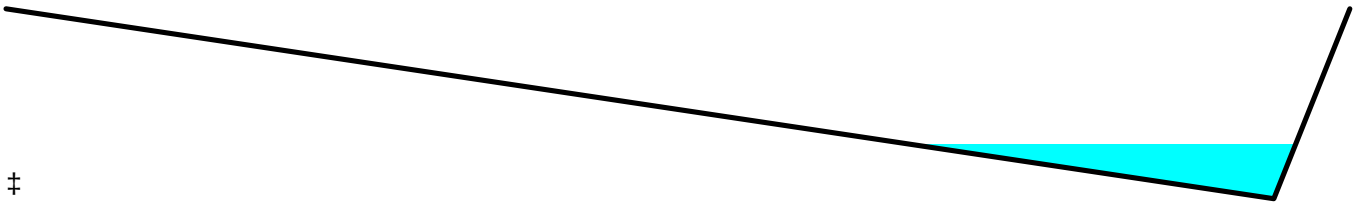
Summary for Reach C2B3: Channel 2B-3

Inflow Area = 1.217 ac, 0.00% Impervious, Inflow Depth = 3.12" for 100 Yr event
Inflow = 4.49 cfs @ 12.11 hrs, Volume= 0.316 af
Outflow = 4.24 cfs @ 12.21 hrs, Volume= 0.316 af, Atten= 6%, Lag= 6.1 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
Max. Velocity= 1.93 fps, Min. Travel Time= 3.6 min
Avg. Velocity = 0.73 fps, Avg. Travel Time= 9.5 min

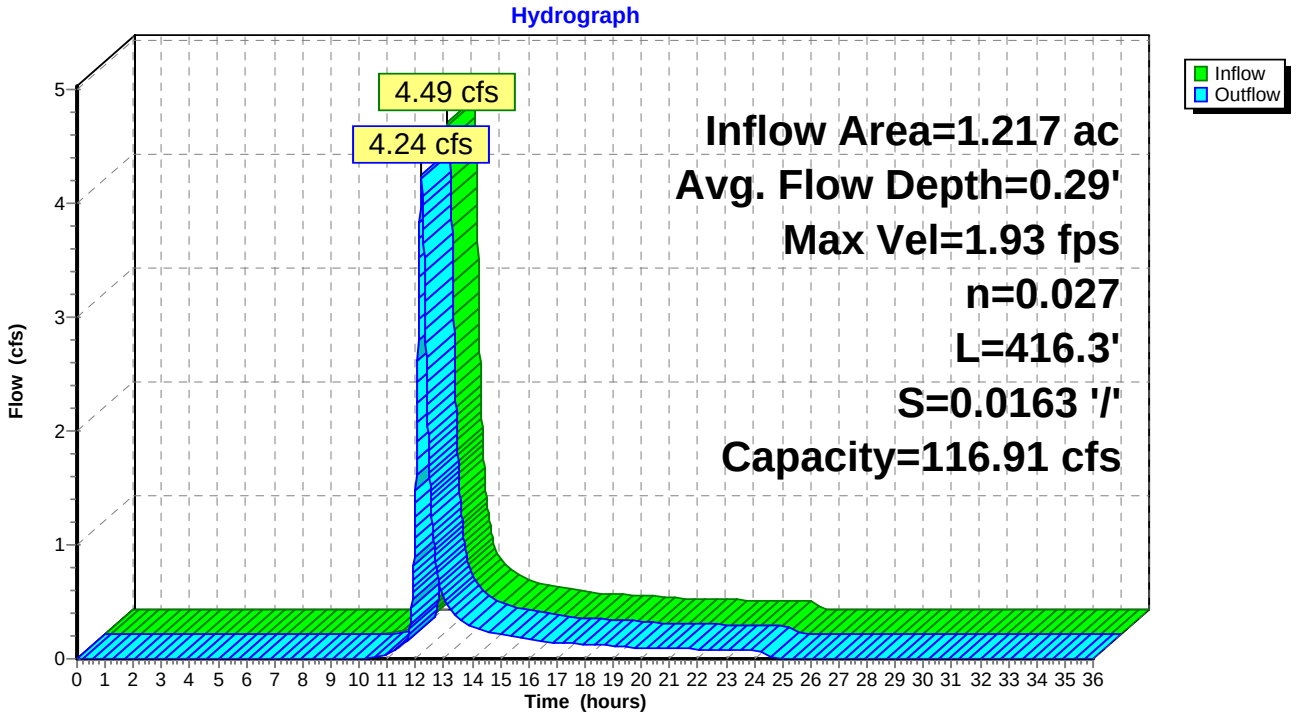
Peak Storage= 917 cf @ 12.15 hrs
Average Depth at Peak Storage= 0.29'
Bank-Full Depth= 1.00' Flow Area= 26.5 sf, Capacity= 116.91 cfs

0.00' x 1.00' deep channel, n= 0.027
Side Slope Z-value= 50.0 3.0 '/' Top Width= 53.00'
Length= 416.3' Slope= 0.0163 '/'
Inlet Invert= 409.80', Outlet Invert= 403.03'



‡

Reach C2B3: Channel 2B-3



Summary for Reach C2B4: Channel 2B-4

Inflow Area = 11.368 ac, 0.00% Impervious, Inflow Depth = 3.12" for 100 Yr event
Inflow = 36.52 cfs @ 12.22 hrs, Volume= 2.956 af
Outflow = 36.43 cfs @ 12.25 hrs, Volume= 2.956 af, Atten= 0%, Lag= 1.4 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
Max. Velocity= 3.31 fps, Min. Travel Time= 0.8 min
Avg. Velocity = 0.99 fps, Avg. Travel Time= 2.6 min

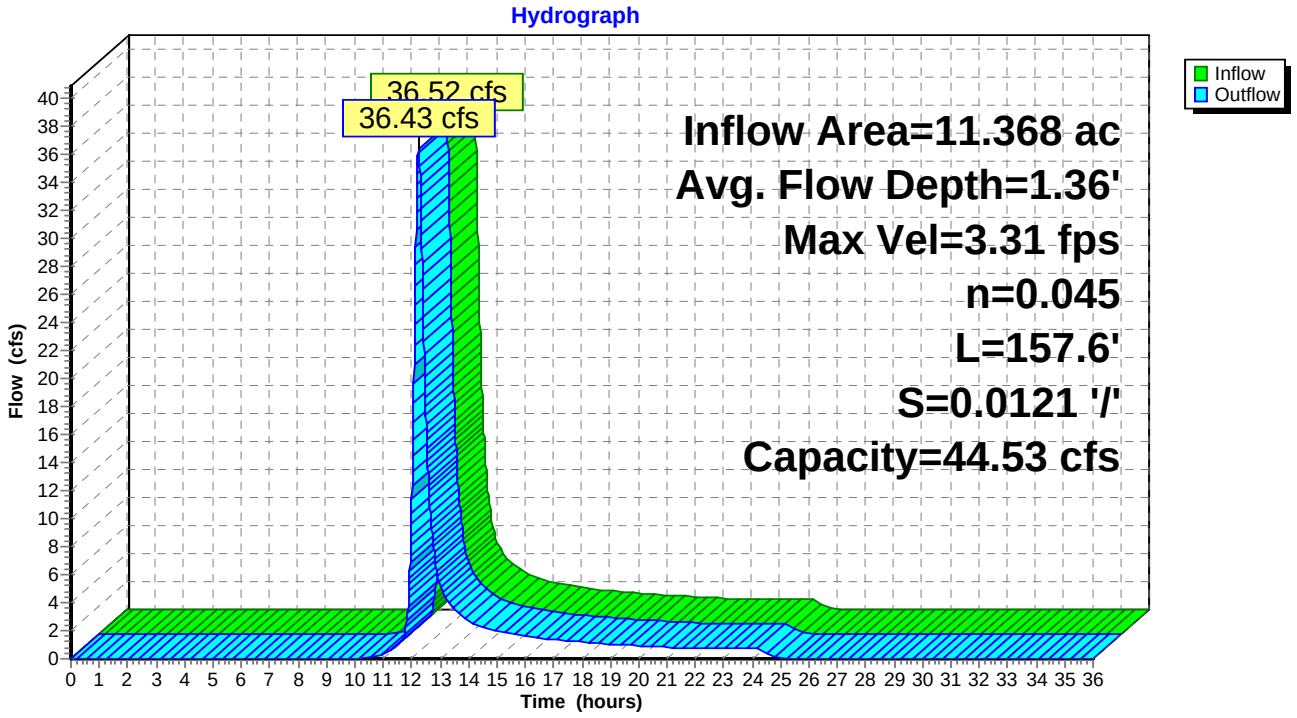
Peak Storage= 1,734 cf @ 12.23 hrs
Average Depth at Peak Storage= 1.36'
Bank-Full Depth= 1.50' Flow Area= 12.8 sf, Capacity= 44.53 cfs

4.00' x 1.50' deep channel, n= 0.045
Side Slope Z-value= 3.0 '/' Top Width= 13.00'
Length= 157.6' Slope= 0.0121 '/'
Inlet Invert= 403.56', Outlet Invert= 401.66'



‡

Reach C2B4: Channel 2B-4



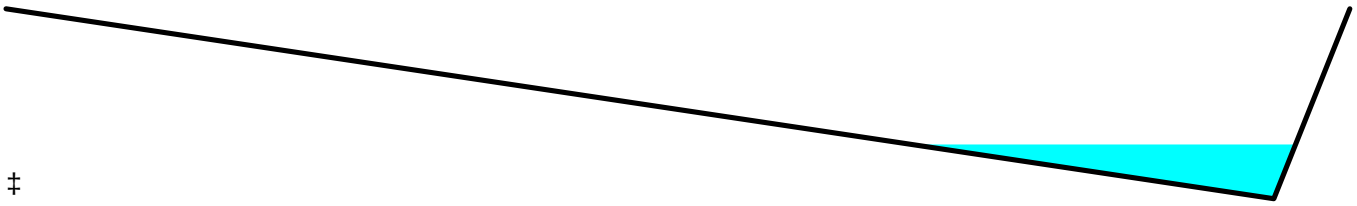
Summary for Reach C2B5: Channel 2B-5

Inflow Area = 1.163 ac, 0.00% Impervious, Inflow Depth = 3.12" for 100 Yr event
Inflow = 4.20 cfs @ 12.11 hrs, Volume= 0.302 af
Outflow = 3.95 cfs @ 12.22 hrs, Volume= 0.302 af, Atten= 6%, Lag= 6.7 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
Max. Velocity= 1.83 fps, Min. Travel Time= 3.8 min
Avg. Velocity = 0.70 fps, Avg. Travel Time= 10.1 min

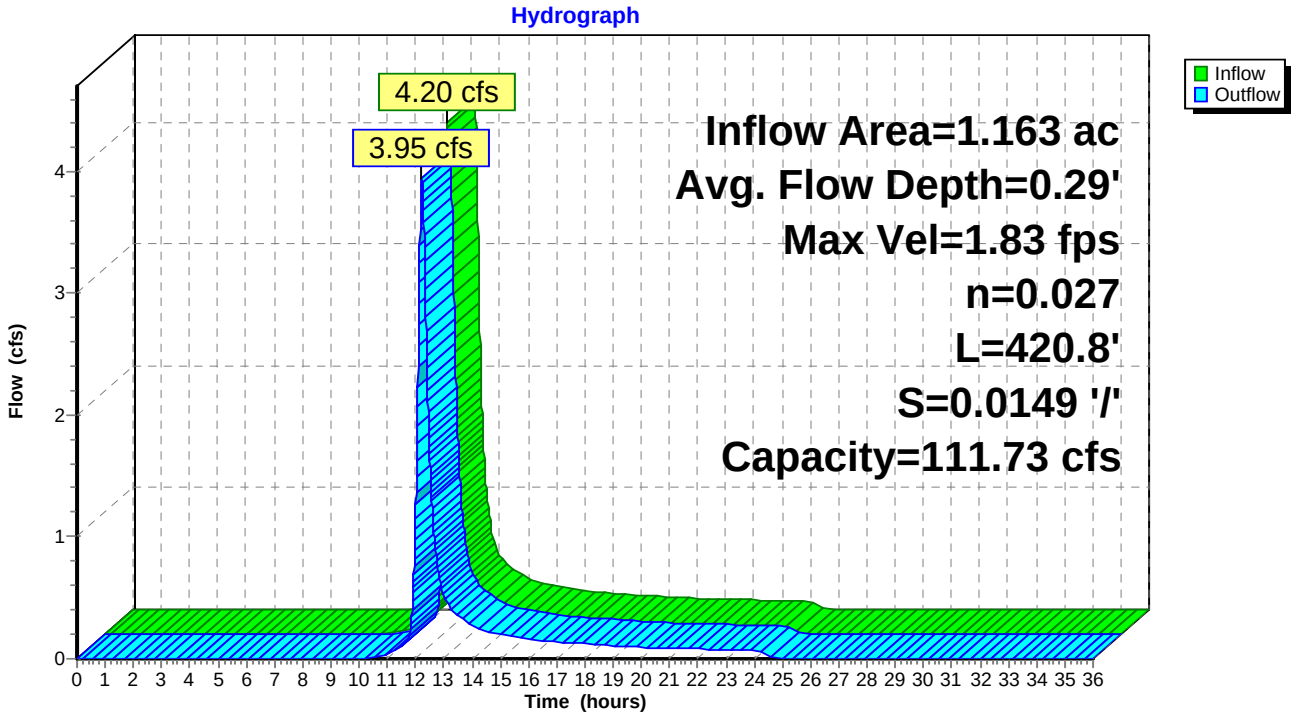
Peak Storage= 909 cf @ 12.16 hrs
Average Depth at Peak Storage= 0.29'
Bank-Full Depth= 1.00' Flow Area= 26.5 sf, Capacity= 111.73 cfs

0.00' x 1.00' deep channel, n= 0.027
Side Slope Z-value= 50.0 3.0 '/' Top Width= 53.00'
Length= 420.8' Slope= 0.0149 '/'
Inlet Invert= 410.91', Outlet Invert= 404.66'



‡

Reach C2B5: Channel 2B-5



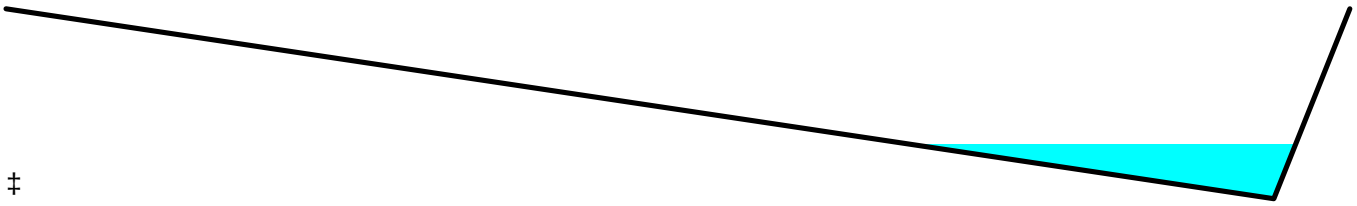
Summary for Reach C2B6: Channel 2B-6

Inflow Area = 1.232 ac, 0.00% Impervious, Inflow Depth = 3.12" for 100 Yr event
Inflow = 4.55 cfs @ 12.11 hrs, Volume= 0.320 af
Outflow = 4.23 cfs @ 12.22 hrs, Volume= 0.320 af, Atten= 7%, Lag= 7.0 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
Max. Velocity= 1.92 fps, Min. Travel Time= 4.1 min
Avg. Velocity = 0.72 fps, Avg. Travel Time= 10.9 min

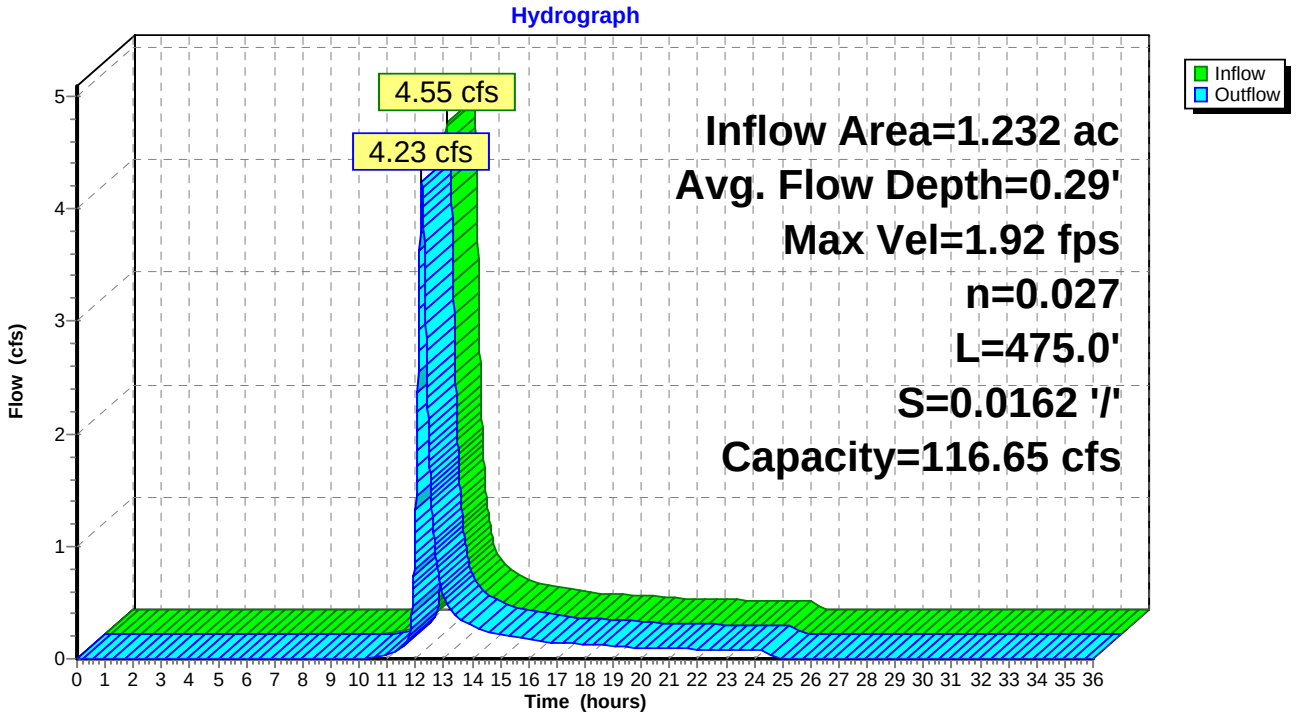
Peak Storage= 1,046 cf @ 12.15 hrs
Average Depth at Peak Storage= 0.29'
Bank-Full Depth= 1.00' Flow Area= 26.5 sf, Capacity= 116.65 cfs

0.00' x 1.00' deep channel, n= 0.027
Side Slope Z-value= 50.0 3.0 '/' Top Width= 53.00'
Length= 475.0' Slope= 0.0162 '/'
Inlet Invert= 412.33', Outlet Invert= 404.64'



‡

Reach C2B6: Channel 2B-6



Summary for Reach C2B7: Channel 2B-7

Inflow Area = 8.012 ac, 0.00% Impervious, Inflow Depth = 3.12" for 100 Yr event
Inflow = 25.94 cfs @ 12.21 hrs, Volume= 2.083 af
Outflow = 25.86 cfs @ 12.24 hrs, Volume= 2.083 af, Atten= 0%, Lag= 1.5 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
Max. Velocity= 3.02 fps, Min. Travel Time= 0.9 min
Avg. Velocity = 0.90 fps, Avg. Travel Time= 2.9 min

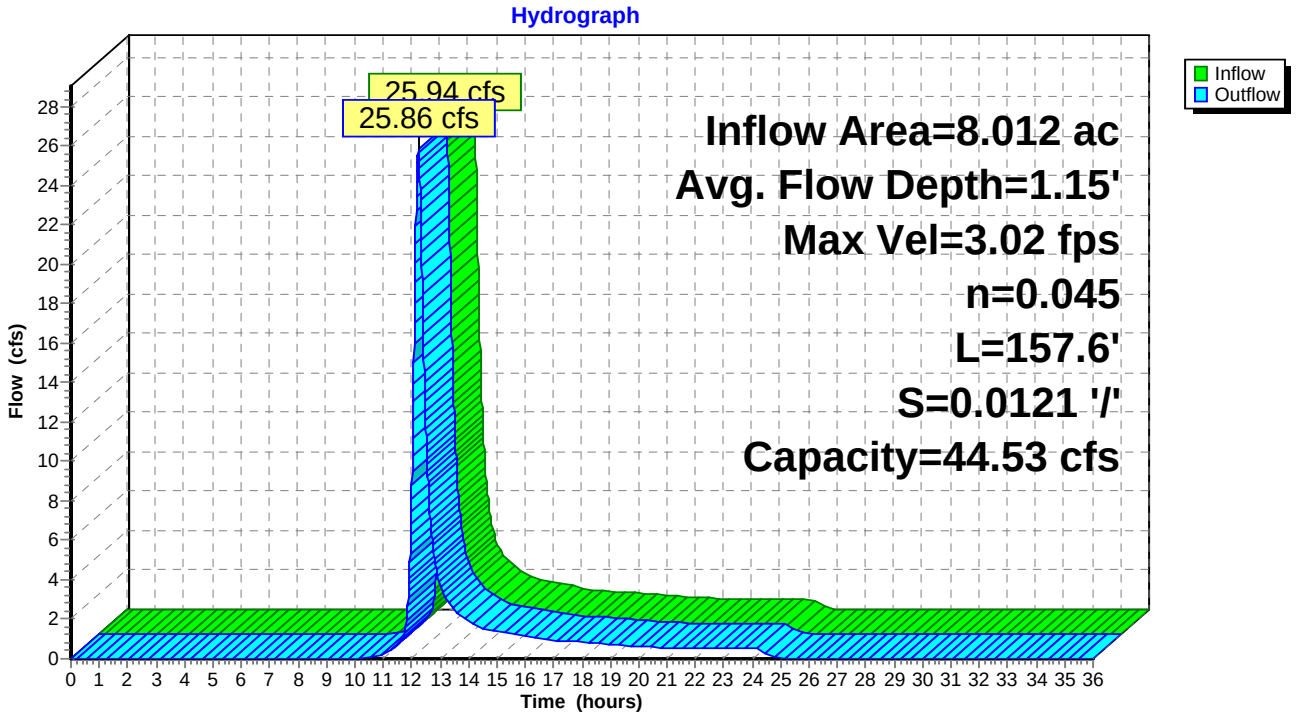
Peak Storage= 1,350 cf @ 12.22 hrs
Average Depth at Peak Storage= 1.15'
Bank-Full Depth= 1.50' Flow Area= 12.8 sf, Capacity= 44.53 cfs

4.00' x 1.50' deep channel, n= 0.045
Side Slope Z-value= 3.0 '/' Top Width= 13.00'
Length= 157.6' Slope= 0.0121 '/'
Inlet Invert= 405.46', Outlet Invert= 403.56'



‡

Reach C2B7: Channel 2B-7



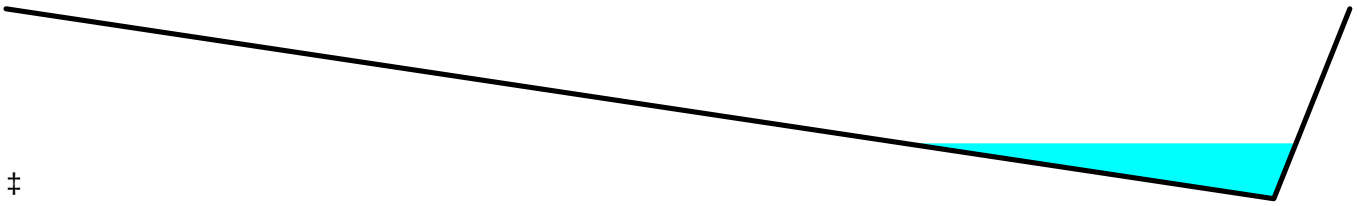
Summary for Reach C2B8: Channel 2B-8

Inflow Area = 1.231 ac, 0.00% Impervious, Inflow Depth = 3.12" for 100 Yr event
Inflow = 4.45 cfs @ 12.11 hrs, Volume= 0.320 af
Outflow = 4.17 cfs @ 12.23 hrs, Volume= 0.320 af, Atten= 6%, Lag= 6.9 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
Max. Velocity= 1.86 fps, Min. Travel Time= 3.9 min
Avg. Velocity = 0.70 fps, Avg. Travel Time= 10.4 min

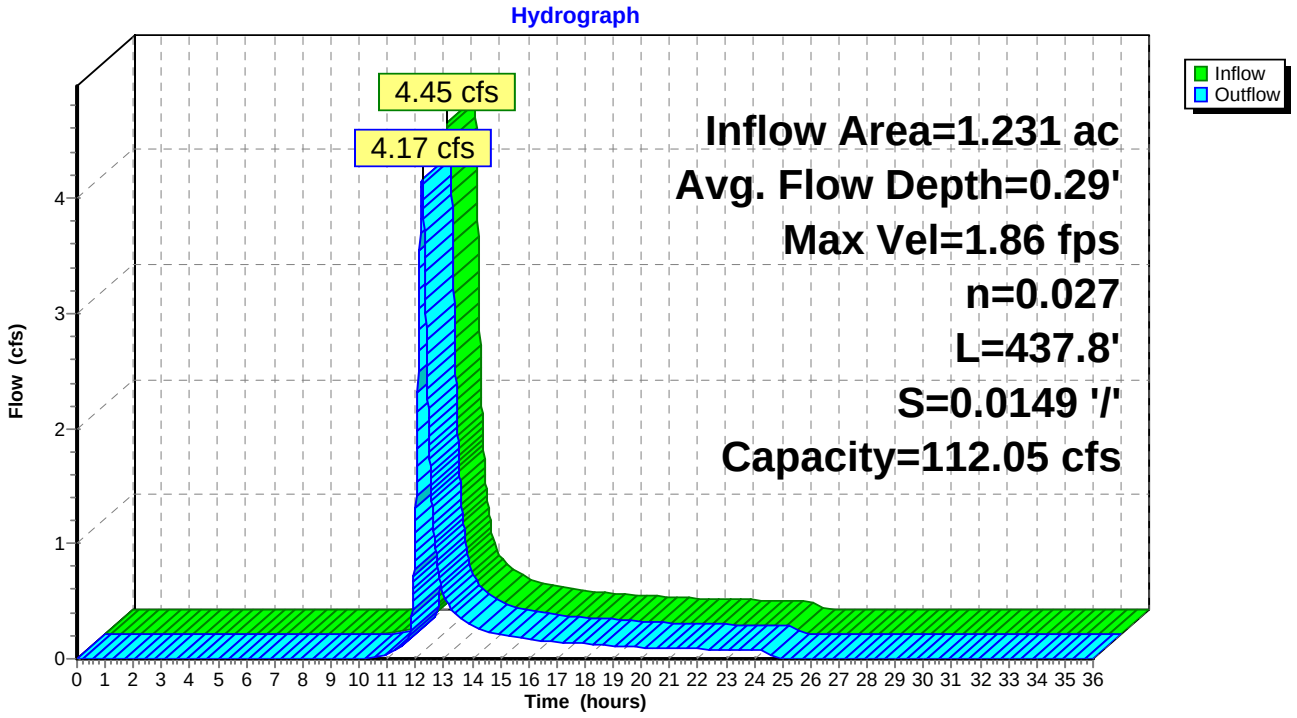
Peak Storage= 983 cf @ 12.16 hrs
Average Depth at Peak Storage= 0.29'
Bank-Full Depth= 1.00' Flow Area= 26.5 sf, Capacity= 112.05 cfs

0.00' x 1.00' deep channel, n= 0.027
Side Slope Z-value= 50.0 3.0 '/' Top Width= 53.00'
Length= 437.8' Slope= 0.0149 '/'
Inlet Invert= 412.74', Outlet Invert= 406.20'



‡

Reach C2B8: Channel 2B-8



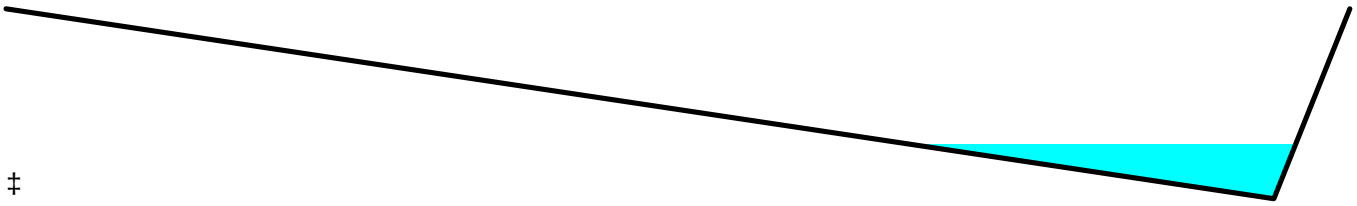
Summary for Reach C2B9: Channel 2B-9

Inflow Area = 1.230 ac, 0.00% Impervious, Inflow Depth = 3.12" for 100 Yr event
Inflow = 4.54 cfs @ 12.11 hrs, Volume= 0.320 af
Outflow = 4.23 cfs @ 12.22 hrs, Volume= 0.320 af, Atten= 7%, Lag= 7.0 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
Max. Velocity= 1.92 fps, Min. Travel Time= 4.1 min
Avg. Velocity = 0.72 fps, Avg. Travel Time= 10.9 min

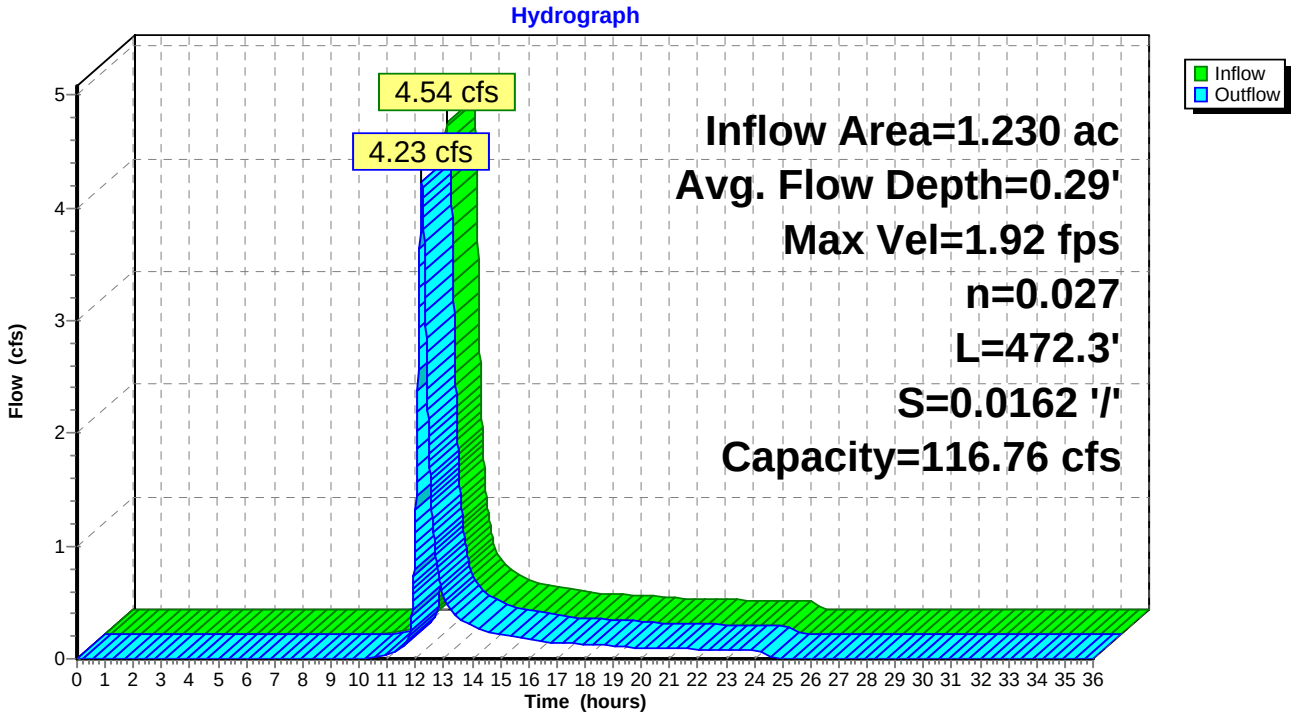
Peak Storage= 1,039 cf @ 12.15 hrs
Average Depth at Peak Storage= 0.29'
Bank-Full Depth= 1.00' Flow Area= 26.5 sf, Capacity= 116.76 cfs

0.00' x 1.00' deep channel, n= 0.027
Side Slope Z-value= 50.0 3.0 '/' Top Width= 53.00'
Length= 472.3' Slope= 0.0162 '/'
Inlet Invert= 413.86', Outlet Invert= 406.20'



‡

Reach C2B9: Channel 2B-9



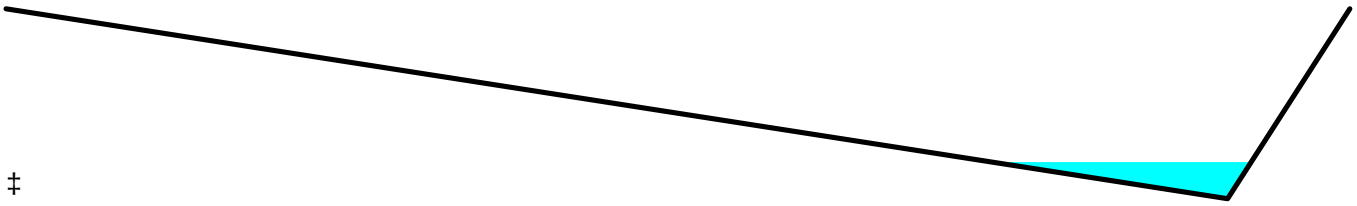
Summary for Reach C2C: Channel 2C

Inflow Area = 1.303 ac, 0.00% Impervious, Inflow Depth = 3.12" for 100 Yr event
Inflow = 4.90 cfs @ 12.10 hrs, Volume= 0.339 af
Outflow = 4.56 cfs @ 12.21 hrs, Volume= 0.339 af, Atten= 7%, Lag= 6.9 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
Max. Velocity= 1.99 fps, Min. Travel Time= 4.0 min
Avg. Velocity = 0.77 fps, Avg. Travel Time= 10.4 min

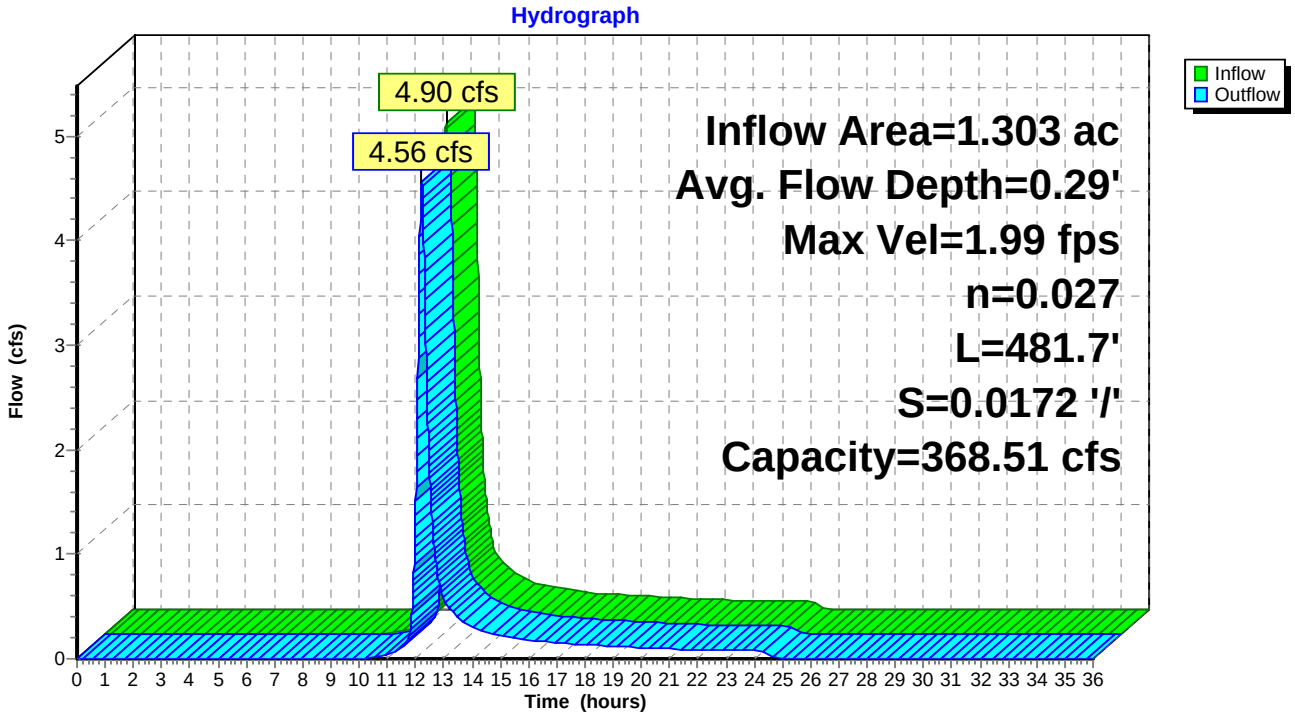
Peak Storage= 1,106 cf @ 12.15 hrs
Average Depth at Peak Storage= 0.29'
Bank-Full Depth= 1.50' Flow Area= 61.9 sf, Capacity= 368.51 cfs

0.00' x 1.50' deep channel, n= 0.027
Side Slope Z-value= 50.0 5.0 '/' Top Width= 82.50'
Length= 481.7' Slope= 0.0172 '/'
Inlet Invert= 410.00', Outlet Invert= 401.70'



‡

Reach C2C: Channel 2C



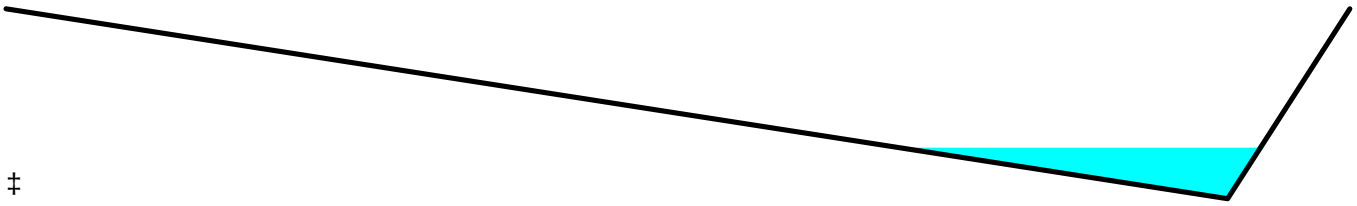
Summary for Reach C3A1: Channel 3A-1

Inflow Area = 2.777 ac, 0.00% Impervious, Inflow Depth = 3.12" for 100 Yr event
Inflow = 9.46 cfs @ 12.14 hrs, Volume= 0.722 af
Outflow = 9.07 cfs @ 12.24 hrs, Volume= 0.722 af, Atten= 4%, Lag= 5.9 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
Max. Velocity= 2.03 fps, Min. Travel Time= 3.4 min
Avg. Velocity = 0.77 fps, Avg. Travel Time= 9.0 min

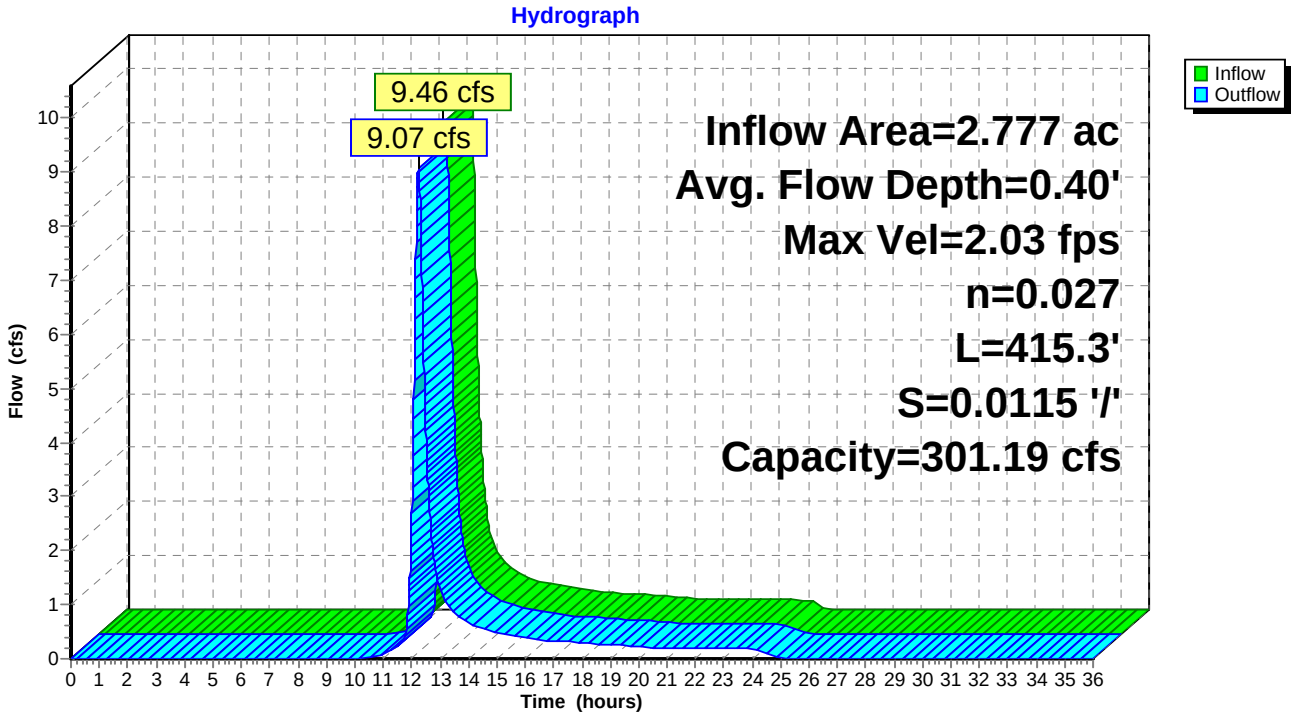
Peak Storage= 1,858 cf @ 12.18 hrs
Average Depth at Peak Storage= 0.40'
Bank-Full Depth= 1.50' Flow Area= 61.9 sf, Capacity= 301.19 cfs

0.00' x 1.50' deep channel, n= 0.027
Side Slope Z-value= 50.0 5.0 '/' Top Width= 82.50'
Length= 415.3' Slope= 0.0115 '/'
Inlet Invert= 406.44', Outlet Invert= 401.66'



‡

Reach C3A1: Channel 3A-1



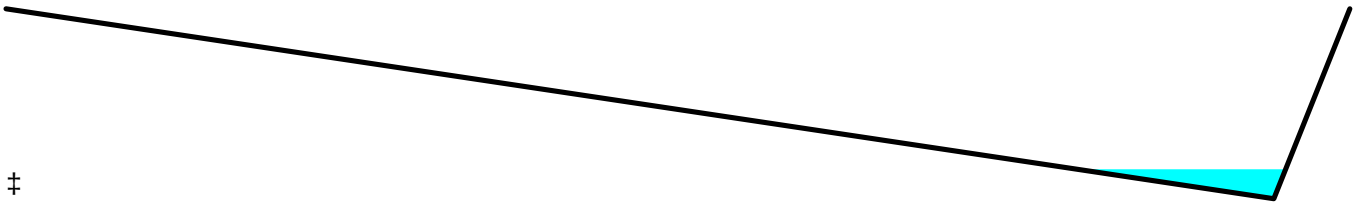
Summary for Reach C3A2: Channel 3A-2

Inflow Area = 0.225 ac, 0.00% Impervious, Inflow Depth = 3.12" for 100 Yr event
Inflow = 0.81 cfs @ 12.12 hrs, Volume= 0.059 af
Outflow = 0.81 cfs @ 12.14 hrs, Volume= 0.059 af, Atten= 0%, Lag= 1.2 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
Max. Velocity= 1.27 fps, Min. Travel Time= 0.8 min
Avg. Velocity = 0.54 fps, Avg. Travel Time= 1.8 min

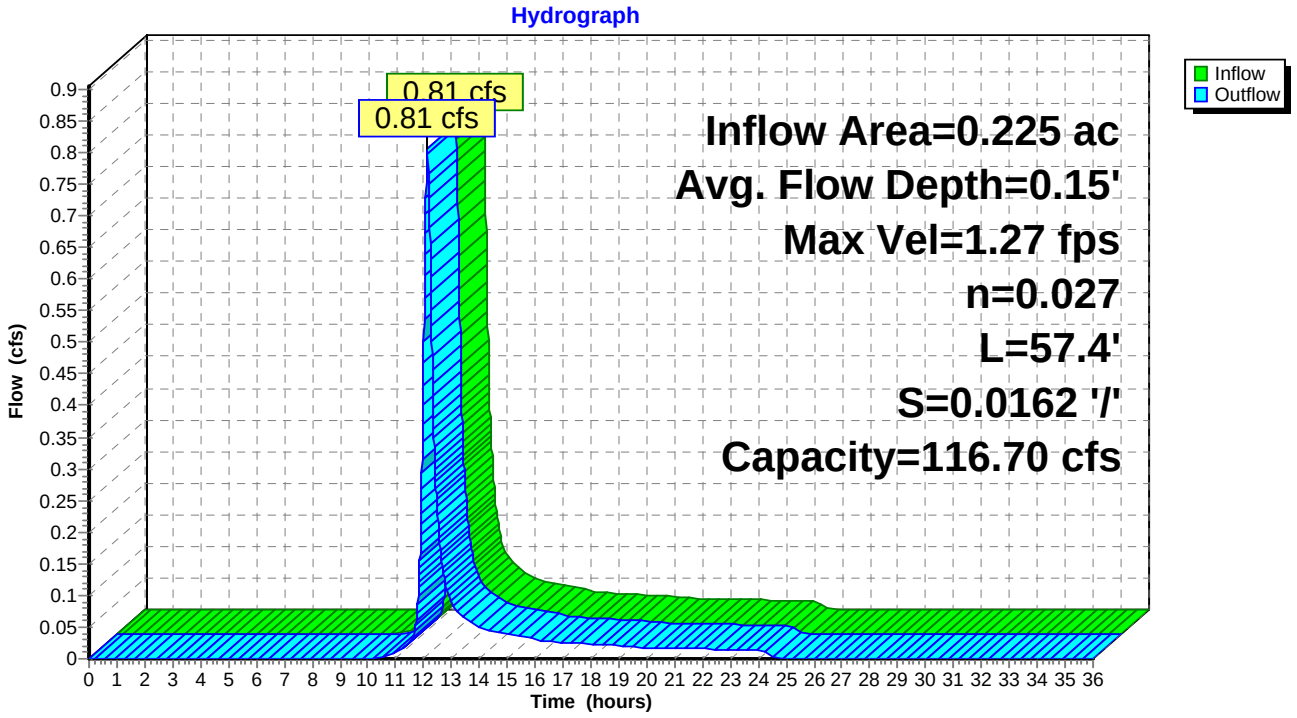
Peak Storage= 36 cf @ 12.13 hrs
Average Depth at Peak Storage= 0.15'
Bank-Full Depth= 1.00' Flow Area= 26.5 sf, Capacity= 116.70 cfs

0.00' x 1.00' deep channel, n= 0.027
Side Slope Z-value= 50.0 3.0 '/' Top Width= 53.00'
Length= 57.4' Slope= 0.0162 '/'
Inlet Invert= 407.37', Outlet Invert= 406.44'



‡

Reach C3A2: Channel 3A-2



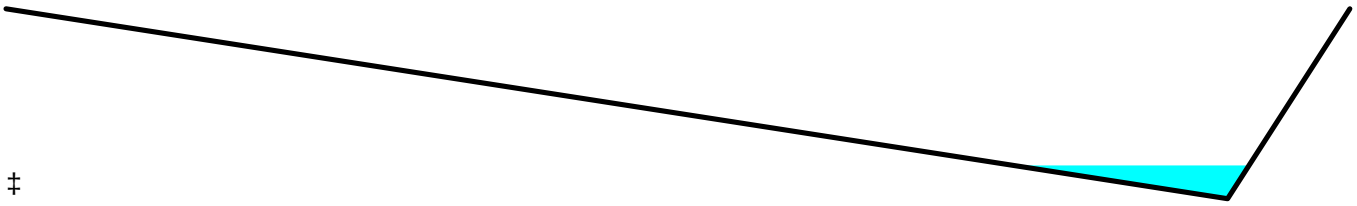
Summary for Reach C3A3: Channel 3A-3

Inflow Area = 0.833 ac, 0.00% Impervious, Inflow Depth = 3.12" for 100 Yr event
Inflow = 3.06 cfs @ 12.11 hrs, Volume= 0.217 af
Outflow = 2.91 cfs @ 12.20 hrs, Volume= 0.217 af, Atten= 5%, Lag= 5.9 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
Max. Velocity= 1.53 fps, Min. Travel Time= 3.4 min
Avg. Velocity = 0.61 fps, Avg. Travel Time= 8.4 min

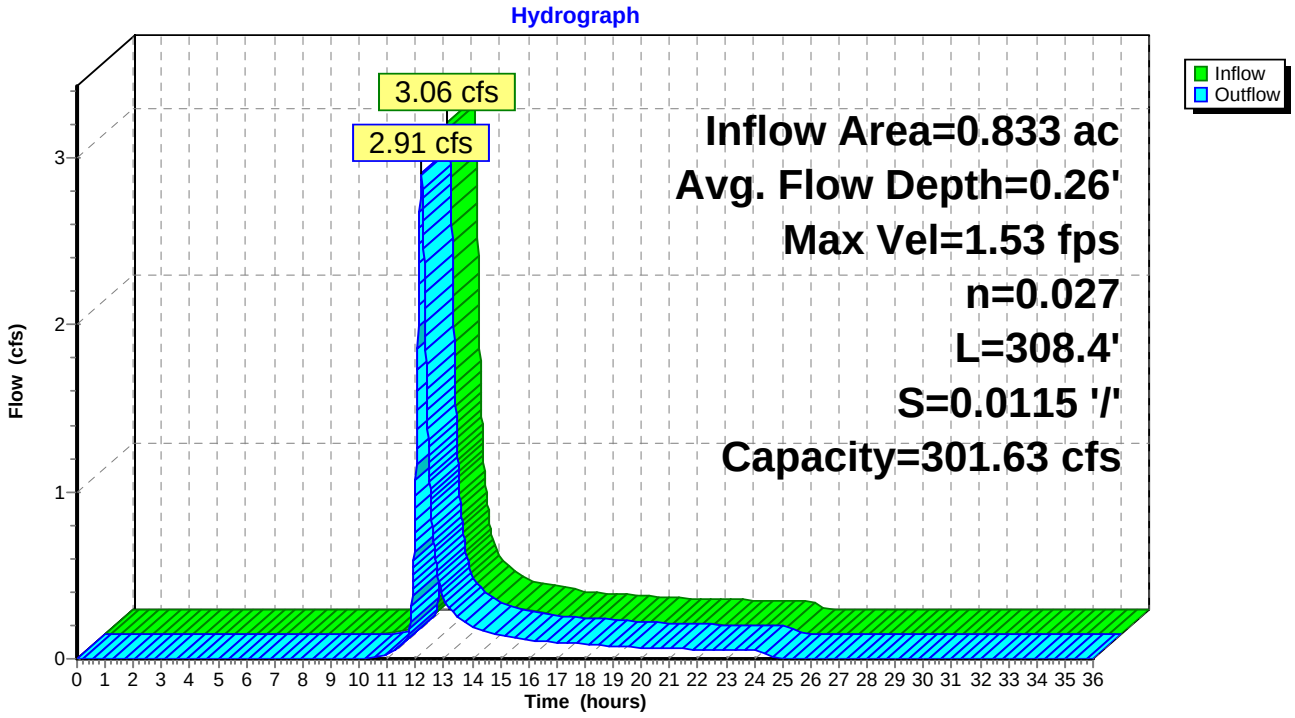
Peak Storage= 588 cf @ 12.15 hrs
Average Depth at Peak Storage= 0.26'
Bank-Full Depth= 1.50' Flow Area= 61.9 sf, Capacity= 301.63 cfs

0.00' x 1.50' deep channel, n= 0.027
Side Slope Z-value= 50.0 5.0 '/' Top Width= 82.50'
Length= 308.4' Slope= 0.0115 '/'
Inlet Invert= 410.00', Outlet Invert= 406.44'



‡

Reach C3A3: Channel 3A-3



Summary for Reach C3B1: Channel 3B-1

Inflow Area = 13.219 ac, 0.00% Impervious, Inflow Depth = 3.12" for 100 Yr event
Inflow = 40.87 cfs @ 12.24 hrs, Volume= 3.437 af
Outflow = 40.80 cfs @ 12.26 hrs, Volume= 3.437 af, Atten= 0%, Lag= 1.3 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
Max. Velocity= 3.44 fps, Min. Travel Time= 0.7 min
Avg. Velocity = 1.00 fps, Avg. Travel Time= 2.5 min

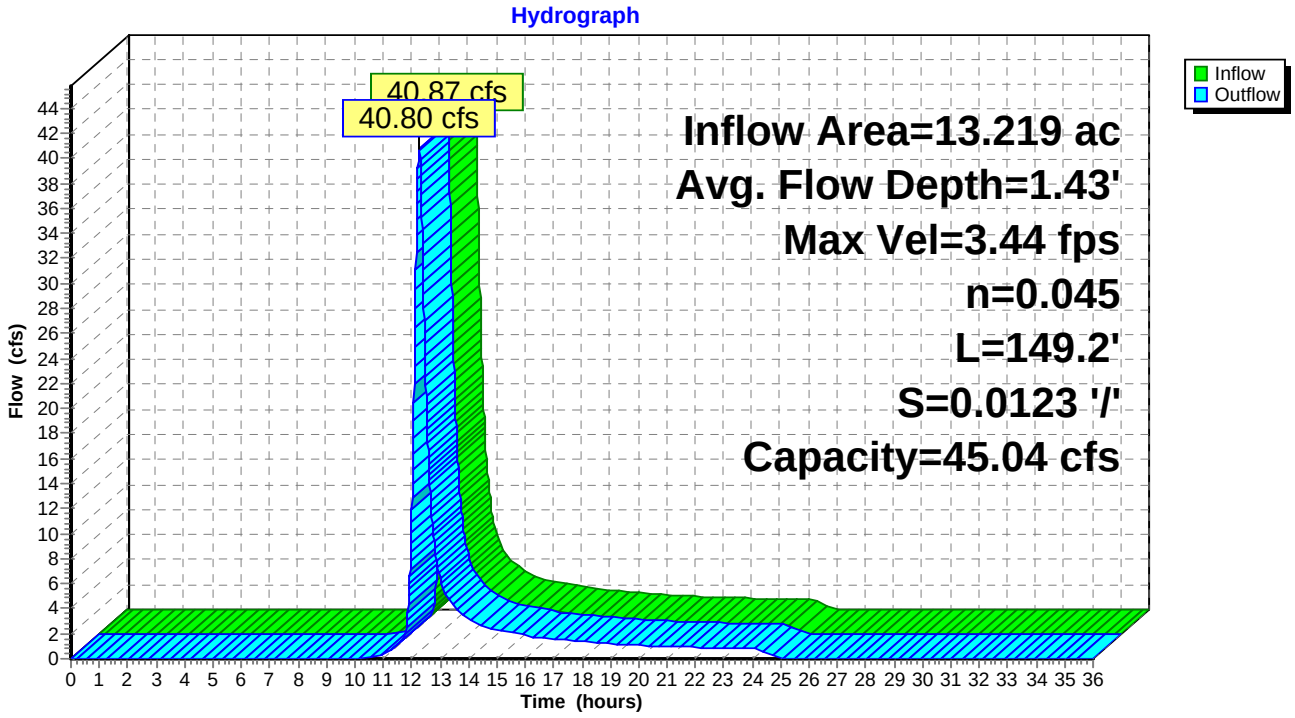
Peak Storage= 1,769 cf @ 12.25 hrs
Average Depth at Peak Storage= 1.43'
Bank-Full Depth= 1.50' Flow Area= 12.8 sf, Capacity= 45.04 cfs

4.00' x 1.50' deep channel, n= 0.045
Side Slope Z-value= 3.0 '/' Top Width= 13.00'
Length= 149.2' Slope= 0.0123 '/'
Inlet Invert= 402.13', Outlet Invert= 400.29'



‡

Reach C3B1: Channel 3B-1



Summary for Reach C3B10: Channel 3B-10

Inflow Area = 1.039 ac, 0.00% Impervious, Inflow Depth = 3.12" for 100 Yr event
Inflow = 3.76 cfs @ 12.11 hrs, Volume= 0.270 af
Outflow = 3.73 cfs @ 12.15 hrs, Volume= 0.270 af, Atten= 1%, Lag= 2.3 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
Max. Velocity= 1.74 fps, Min. Travel Time= 1.4 min
Avg. Velocity = 0.52 fps, Avg. Travel Time= 4.5 min

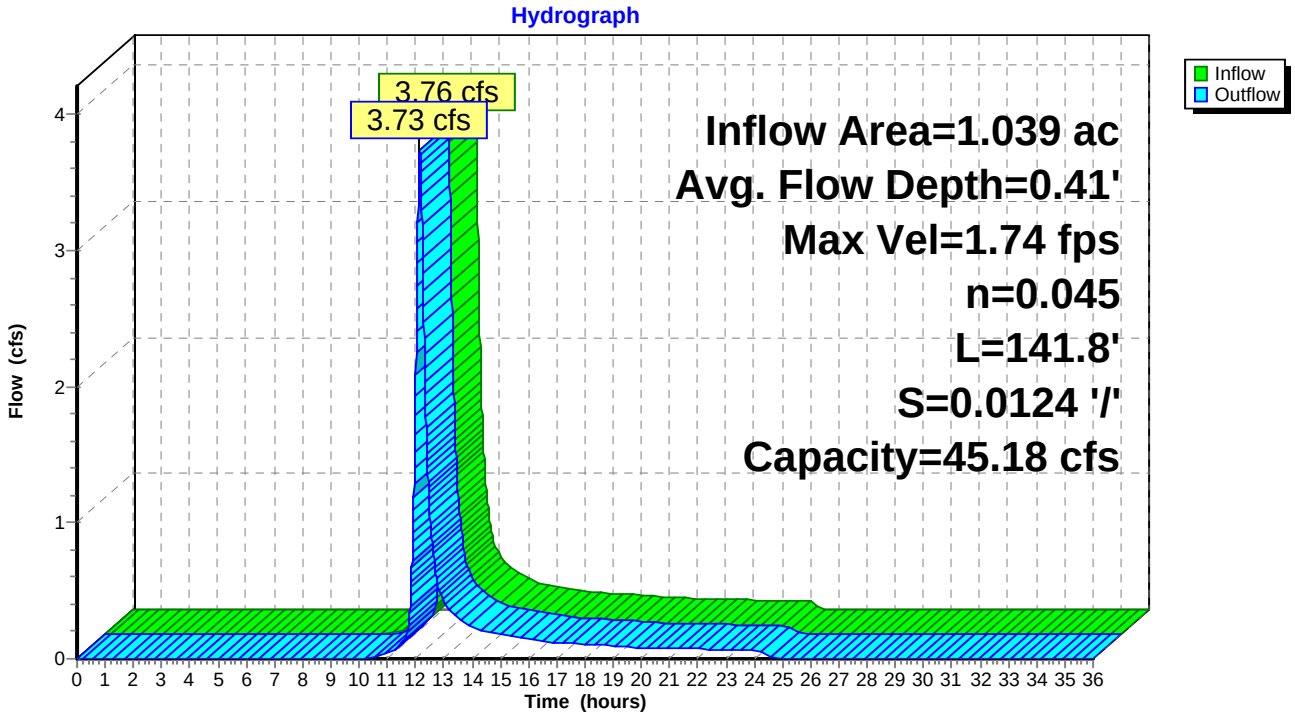
Peak Storage= 304 cf @ 12.13 hrs
Average Depth at Peak Storage= 0.41'
Bank-Full Depth= 1.50' Flow Area= 12.8 sf, Capacity= 45.18 cfs

4.00' x 1.50' deep channel, n= 0.045
Side Slope Z-value= 3.0 '/' Top Width= 13.00'
Length= 141.8' Slope= 0.0124 '/'
Inlet Invert= 407.78', Outlet Invert= 406.02'



‡

Reach C3B10: Channel 3B-10



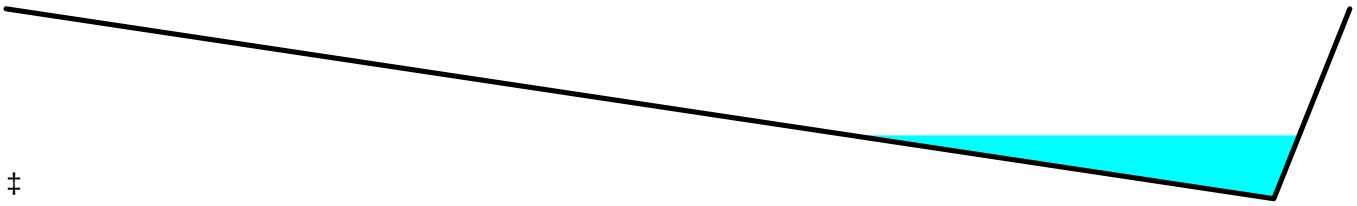
Summary for Reach C3B2: Channel 3B-2

Inflow Area = 1.929 ac, 0.00% Impervious, Inflow Depth = 3.12" for 100 Yr event
Inflow = 6.92 cfs @ 12.12 hrs, Volume= 0.502 af
Outflow = 6.26 cfs @ 12.27 hrs, Volume= 0.502 af, Atten= 10%, Lag= 8.9 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
Max. Velocity= 2.12 fps, Min. Travel Time= 5.3 min
Avg. Velocity = 0.76 fps, Avg. Travel Time= 14.6 min

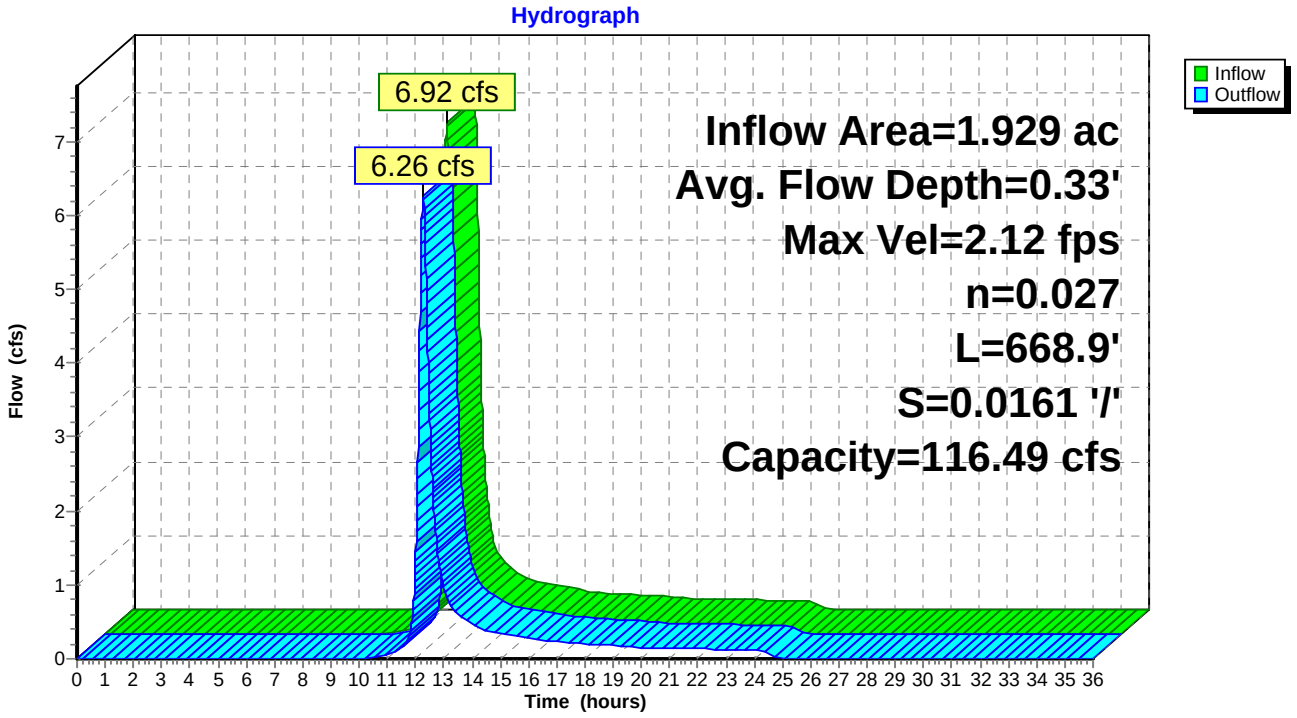
Peak Storage= 1,978 cf @ 12.18 hrs
Average Depth at Peak Storage= 0.33'
Bank-Full Depth= 1.00' Flow Area= 26.5 sf, Capacity= 116.49 cfs

0.00' x 1.00' deep channel, n= 0.027
Side Slope Z-value= 50.0 3.0 '/' Top Width= 53.00'
Length= 668.9' Slope= 0.0161 '/'
Inlet Invert= 414.15', Outlet Invert= 403.35'



‡

Reach C3B2: Channel 3B-2



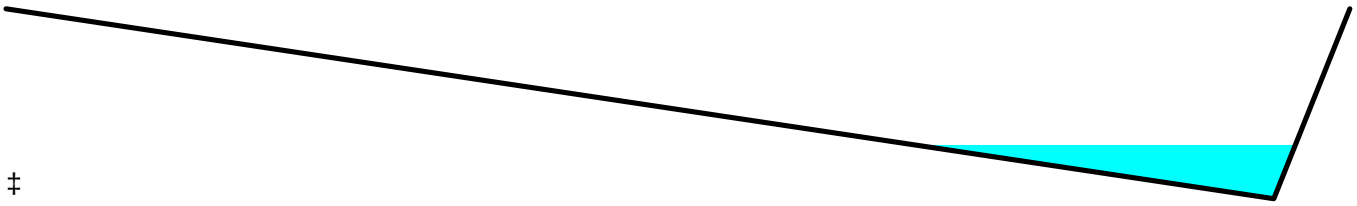
Summary for Reach C3B3: Channel 3B-3

Inflow Area = 1.128 ac, 0.00% Impervious, Inflow Depth = 3.12" for 100 Yr event
Inflow = 4.11 cfs @ 12.11 hrs, Volume= 0.293 af
Outflow = 3.87 cfs @ 12.22 hrs, Volume= 0.293 af, Atten= 6%, Lag= 6.5 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
Max. Velocity= 1.82 fps, Min. Travel Time= 3.7 min
Avg. Velocity = 0.70 fps, Avg. Travel Time= 9.8 min

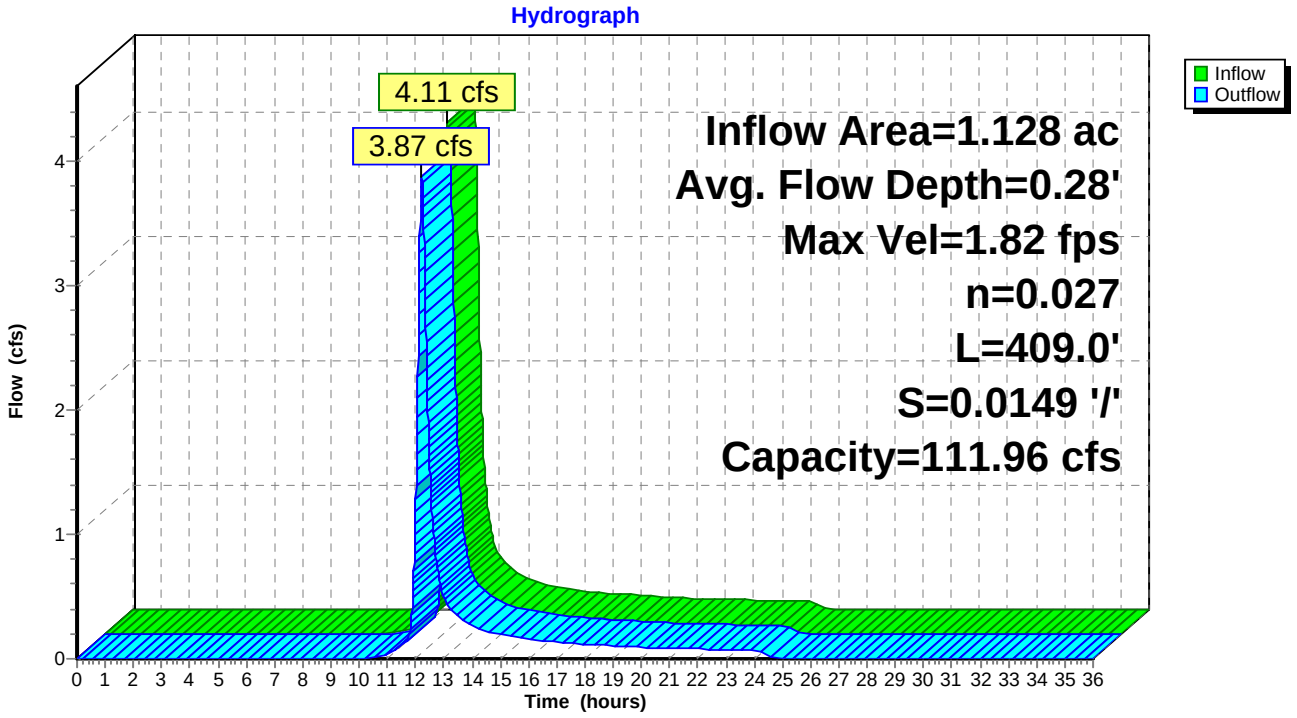
Peak Storage= 869 cf @ 12.16 hrs
Average Depth at Peak Storage= 0.28'
Bank-Full Depth= 1.00' Flow Area= 26.5 sf, Capacity= 111.96 cfs

0.00' x 1.00' deep channel, n= 0.027
Side Slope Z-value= 50.0 3.0 '/' Top Width= 53.00'
Length= 409.0' Slope= 0.0149 '/'
Inlet Invert= 409.44', Outlet Invert= 403.34'



‡

Reach C3B3: Channel 3B-3



Summary for Reach C3B4: Channel 3B-4

Inflow Area = 9.203 ac, 0.00% Impervious, Inflow Depth = 3.12" for 100 Yr event
Inflow = 28.65 cfs @ 12.23 hrs, Volume= 2.393 af
Outflow = 28.58 cfs @ 12.25 hrs, Volume= 2.393 af, Atten= 0%, Lag= 1.5 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
Max. Velocity= 3.13 fps, Min. Travel Time= 0.8 min
Avg. Velocity = 0.91 fps, Avg. Travel Time= 2.9 min

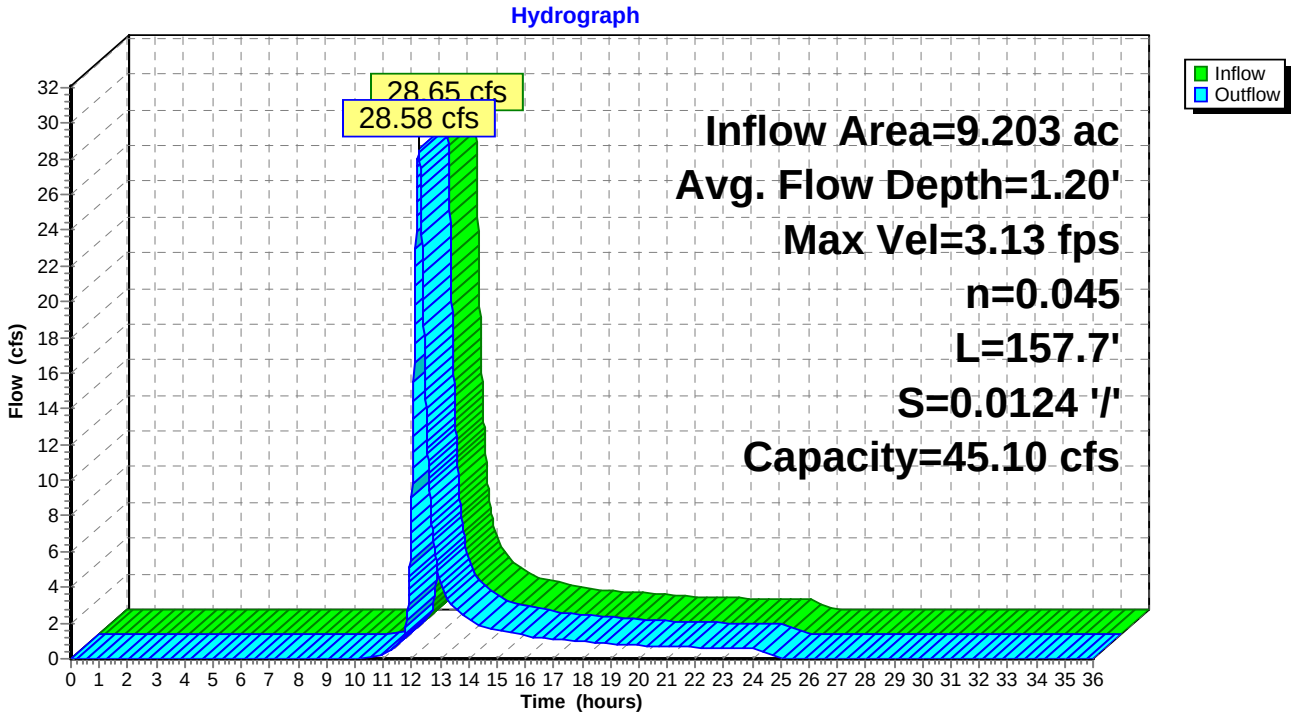
Peak Storage= 1,440 cf @ 12.24 hrs
Average Depth at Peak Storage= 1.20'
Bank-Full Depth= 1.50' Flow Area= 12.8 sf, Capacity= 45.10 cfs

4.00' x 1.50' deep channel, n= 0.045
Side Slope Z-value= 3.0 '/' Top Width= 13.00'
Length= 157.7' Slope= 0.0124 '/'
Inlet Invert= 404.08', Outlet Invert= 402.13'



‡

Reach C3B4: Channel 3B-4



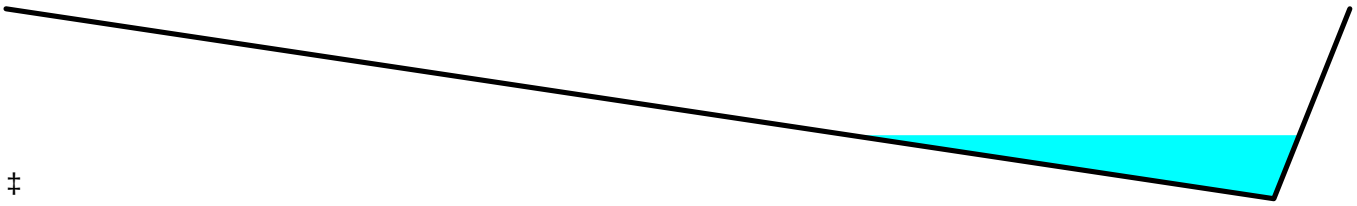
Summary for Reach C3B5: Channel 3B-5

Inflow Area = 1.935 ac, 0.00% Impervious, Inflow Depth = 3.12" for 100 Yr event
Inflow = 6.94 cfs @ 12.12 hrs, Volume= 0.503 af
Outflow = 6.28 cfs @ 12.26 hrs, Volume= 0.503 af, Atten= 10%, Lag= 8.8 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
Max. Velocity= 2.12 fps, Min. Travel Time= 5.2 min
Avg. Velocity = 0.76 fps, Avg. Travel Time= 14.5 min

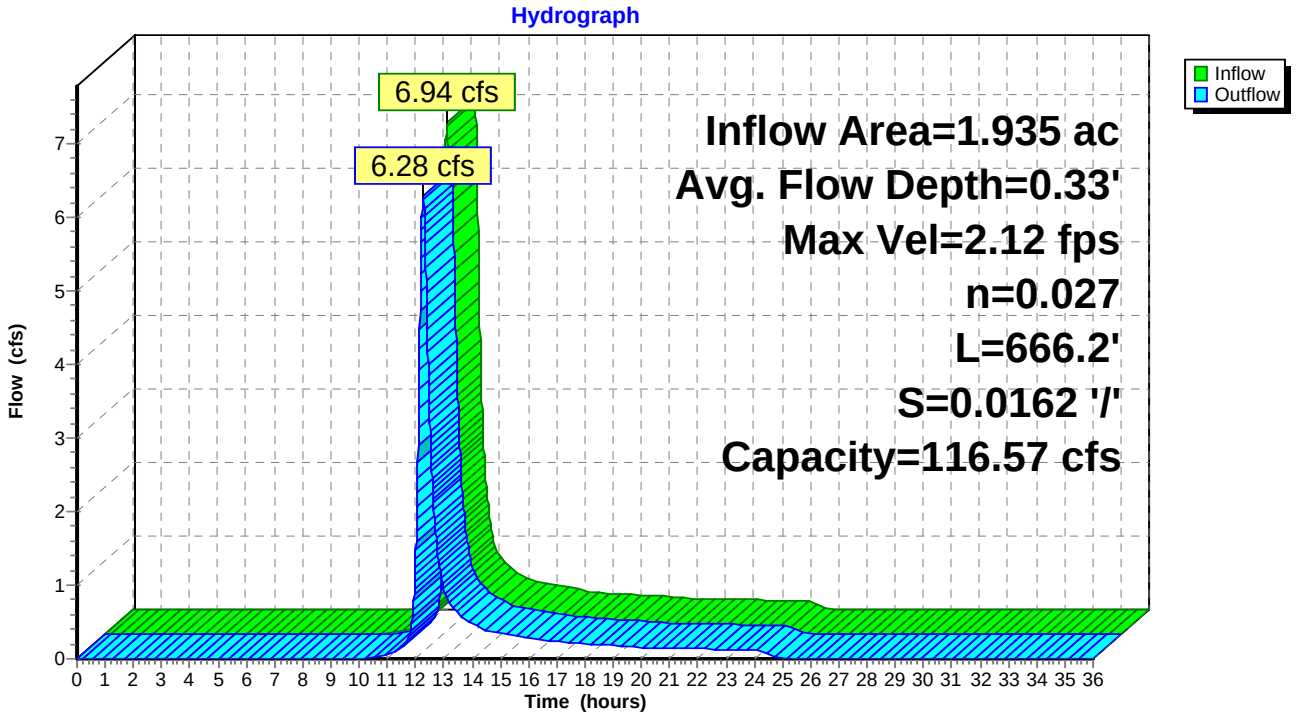
Peak Storage= 1,975 cf @ 12.18 hrs
Average Depth at Peak Storage= 0.33'
Bank-Full Depth= 1.00' Flow Area= 26.5 sf, Capacity= 116.57 cfs

0.00' x 1.00' deep channel, n= 0.027
Side Slope Z-value= 50.0 3.0 '/' Top Width= 53.00'
Length= 666.2' Slope= 0.0162 '/'
Inlet Invert= 415.68', Outlet Invert= 404.91'



‡

Reach C3B5: Channel 3B-5



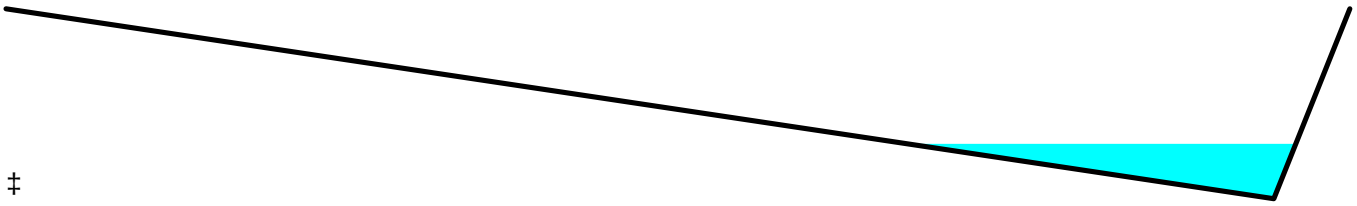
Summary for Reach C3B6: Channel 3B-6

Inflow Area = 1.204 ac, 0.00% Impervious, Inflow Depth = 3.12" for 100 Yr event
Inflow = 4.39 cfs @ 12.11 hrs, Volume= 0.313 af
Outflow = 4.11 cfs @ 12.22 hrs, Volume= 0.313 af, Atten= 6%, Lag= 6.7 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
Max. Velocity= 1.86 fps, Min. Travel Time= 3.9 min
Avg. Velocity = 0.71 fps, Avg. Travel Time= 10.2 min

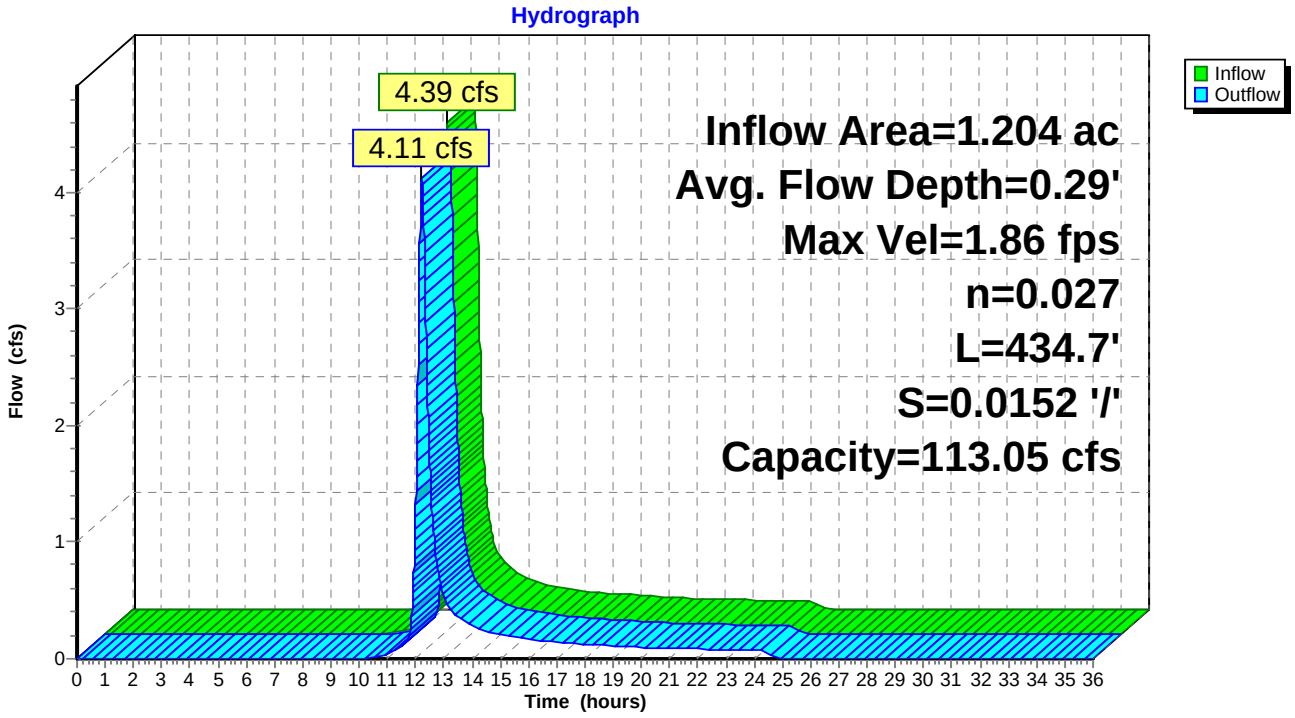
Peak Storage= 960 cf @ 12.16 hrs
Average Depth at Peak Storage= 0.29'
Bank-Full Depth= 1.00' Flow Area= 26.5 sf, Capacity= 113.05 cfs

0.00' x 1.00' deep channel, n= 0.027
Side Slope Z-value= 50.0 3.0 '/' Top Width= 53.00'
Length= 434.7' Slope= 0.0152 '/'
Inlet Invert= 411.52', Outlet Invert= 404.91'



‡

Reach C3B6: Channel 3B-6



Summary for Reach C3B7: Channel 3B-7

Inflow Area = 5.078 ac, 0.00% Impervious, Inflow Depth = 3.12" for 100 Yr event
Inflow = 15.92 cfs @ 12.20 hrs, Volume= 1.320 af
Outflow = 15.86 cfs @ 12.23 hrs, Volume= 1.320 af, Atten= 0%, Lag= 1.7 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
Max. Velocity= 2.66 fps, Min. Travel Time= 1.0 min
Avg. Velocity = 0.77 fps, Avg. Travel Time= 3.4 min

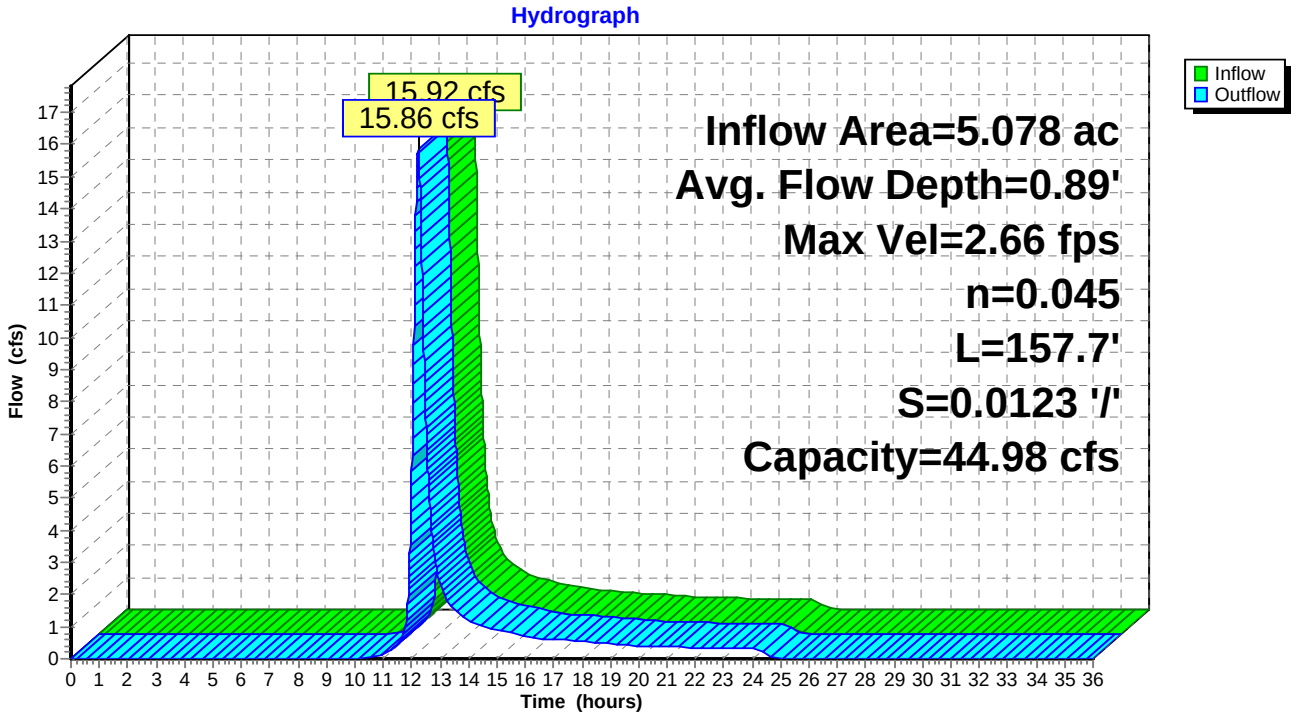
Peak Storage= 941 cf @ 12.22 hrs
Average Depth at Peak Storage= 0.89'
Bank-Full Depth= 1.50' Flow Area= 12.8 sf, Capacity= 44.98 cfs

4.00' x 1.50' deep channel, n= 0.045
Side Slope Z-value= 3.0 '/' Top Width= 13.00'
Length= 157.7' Slope= 0.0123 '/'
Inlet Invert= 406.02', Outlet Invert= 404.08'



‡

Reach C3B7: Channel 3B-7



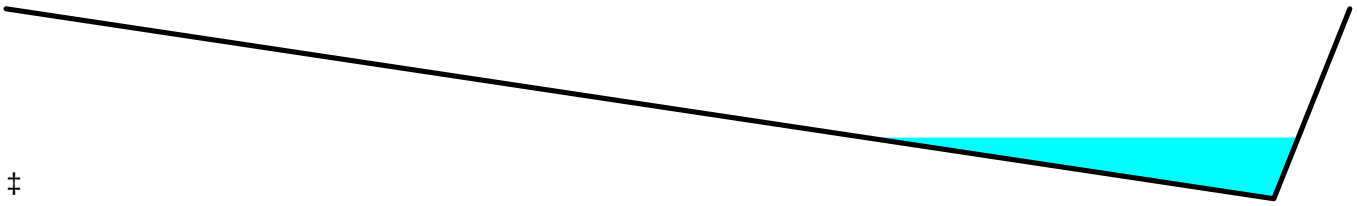
Summary for Reach C3B8: Channel 3B-8

Inflow Area = 1.752 ac, 0.00% Impervious, Inflow Depth = 3.12" for 100 Yr event
Inflow = 6.26 cfs @ 12.11 hrs, Volume= 0.456 af
Outflow = 5.67 cfs @ 12.27 hrs, Volume= 0.456 af, Atten= 10%, Lag= 9.2 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
Max. Velocity= 2.06 fps, Min. Travel Time= 5.2 min
Avg. Velocity = 0.75 fps, Avg. Travel Time= 14.5 min

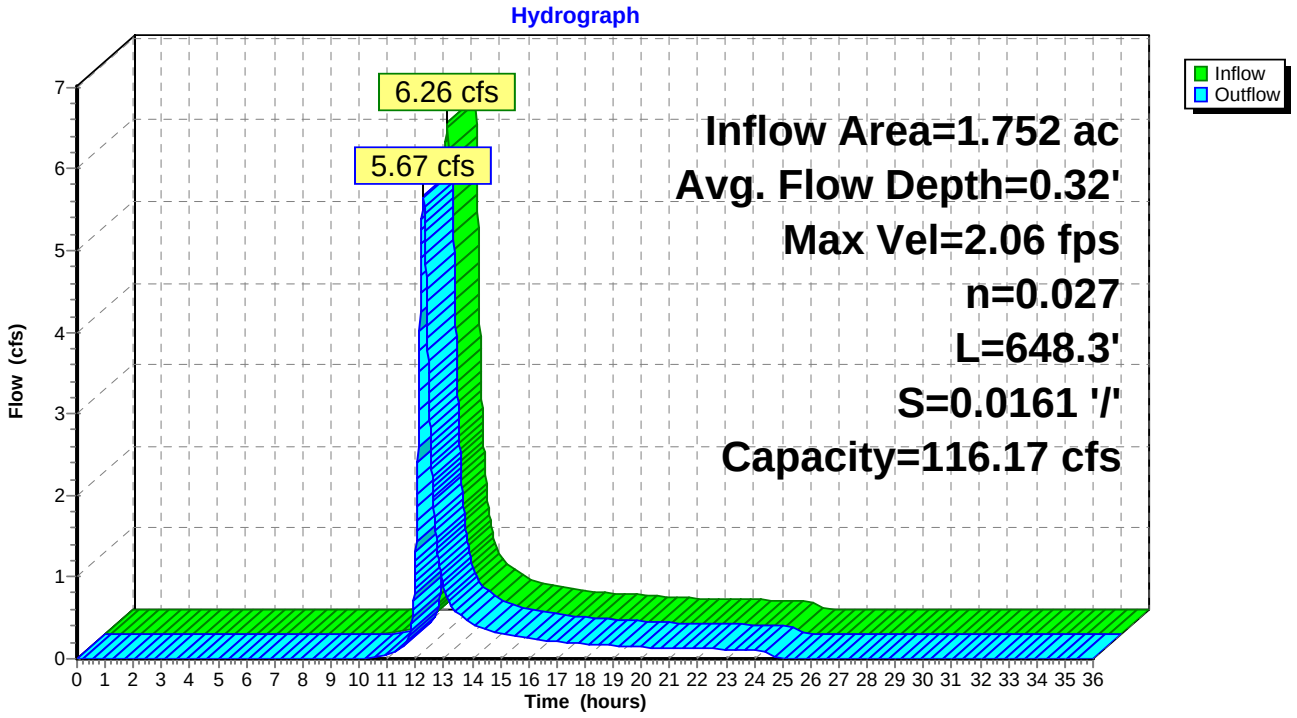
Peak Storage= 1,784 cf @ 12.18 hrs
Average Depth at Peak Storage= 0.32'
Bank-Full Depth= 1.00' Flow Area= 26.5 sf, Capacity= 116.17 cfs

0.00' x 1.00' deep channel, n= 0.027
Side Slope Z-value= 50.0 3.0 '/' Top Width= 53.00'
Length= 648.3' Slope= 0.0161 '/'
Inlet Invert= 416.88', Outlet Invert= 406.47'



‡

Reach C3B8: Channel 3B-8



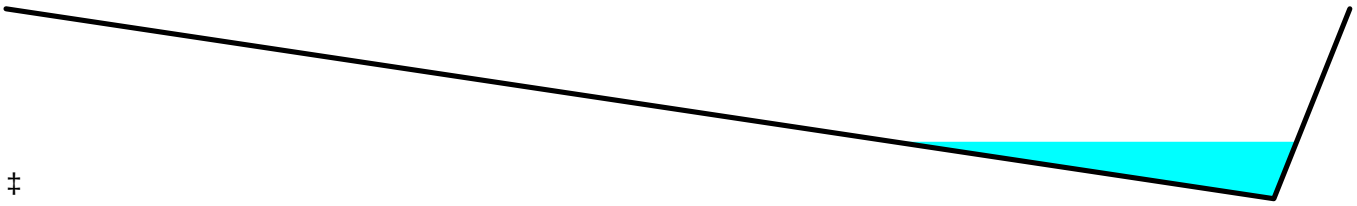
Summary for Reach C3B9: Channel 3B-9

Inflow Area = 1.328 ac, 0.00% Impervious, Inflow Depth = 3.12" for 100 Yr event
Inflow = 4.85 cfs @ 12.11 hrs, Volume= 0.345 af
Outflow = 4.55 cfs @ 12.22 hrs, Volume= 0.345 af, Atten= 6%, Lag= 6.7 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
Max. Velocity= 1.91 fps, Min. Travel Time= 3.9 min
Avg. Velocity = 0.72 fps, Avg. Travel Time= 10.5 min

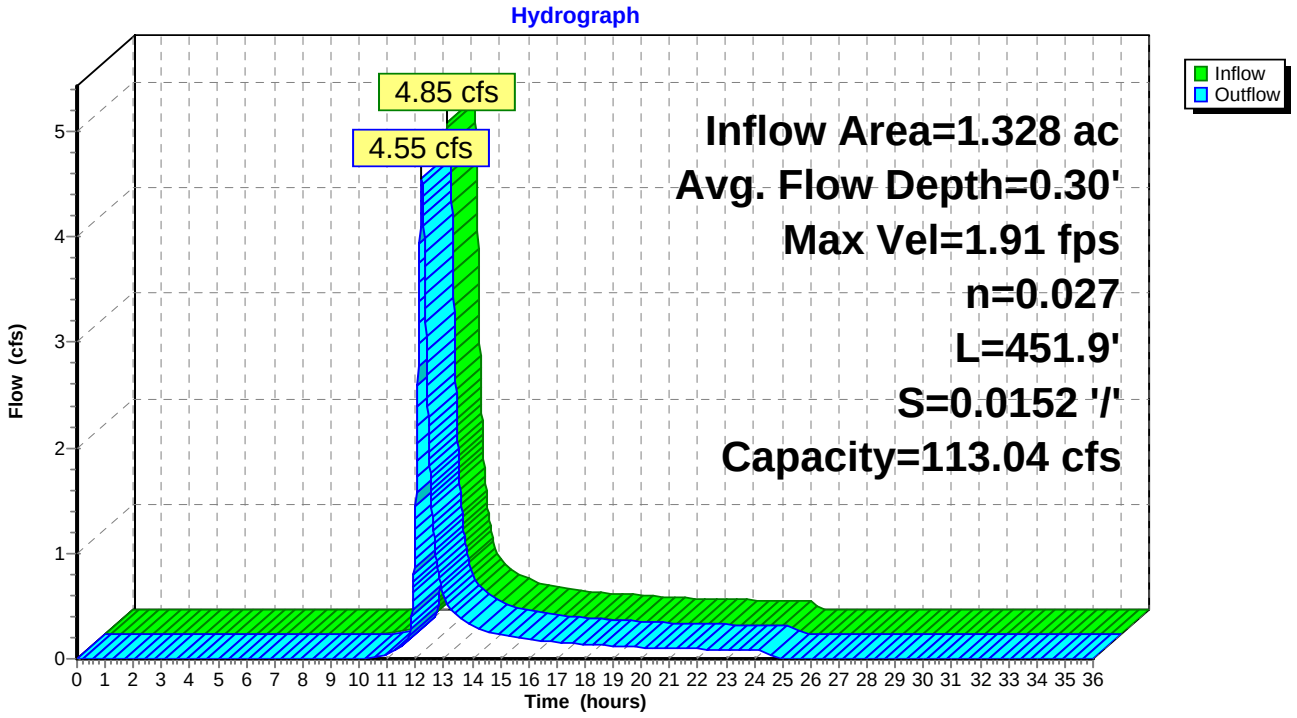
Peak Storage= 1,076 cf @ 12.16 hrs
Average Depth at Peak Storage= 0.30'
Bank-Full Depth= 1.00' Flow Area= 26.5 sf, Capacity= 113.04 cfs

0.00' x 1.00' deep channel, n= 0.027
Side Slope Z-value= 50.0 3.0 '/' Top Width= 53.00'
Length= 451.9' Slope= 0.0152 '/'
Inlet Invert= 413.34', Outlet Invert= 406.47'



‡

Reach C3B9: Channel 3B-9



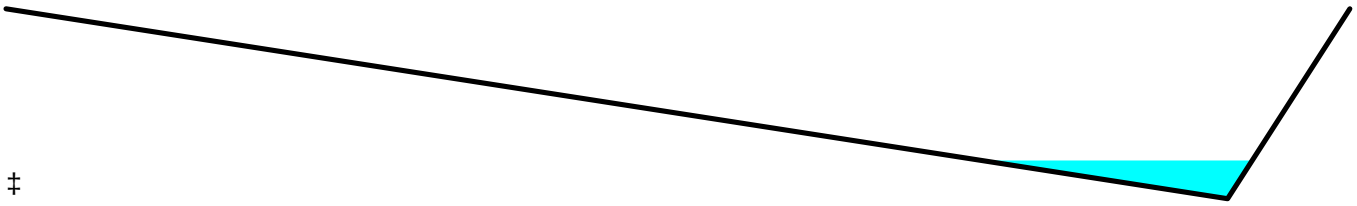
Summary for Reach C3C: Channel 3C

Inflow Area = 1.407 ac, 0.00% Impervious, Inflow Depth = 3.12" for 100 Yr event
Inflow = 5.17 cfs @ 12.11 hrs, Volume= 0.366 af
Outflow = 4.90 cfs @ 12.21 hrs, Volume= 0.366 af, Atten= 5%, Lag= 6.1 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
Max. Velocity= 1.96 fps, Min. Travel Time= 3.5 min
Avg. Velocity = 0.77 fps, Avg. Travel Time= 8.9 min

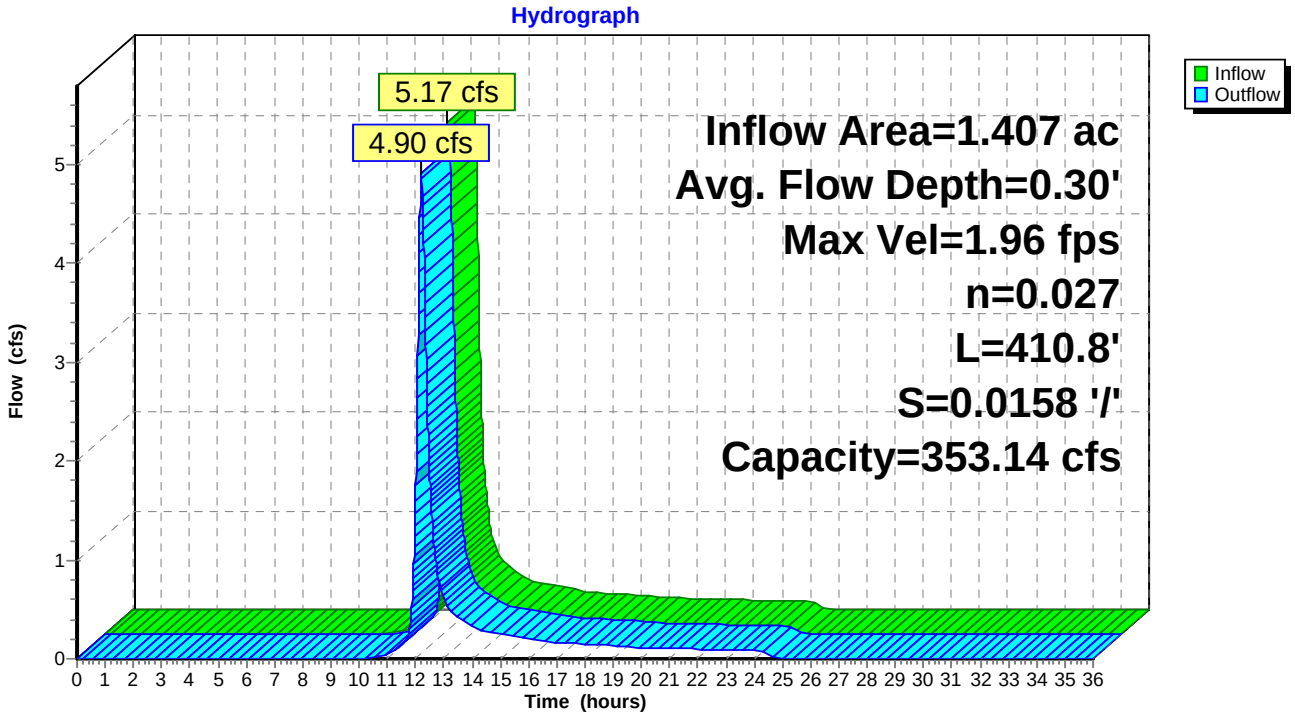
Peak Storage= 1,028 cf @ 12.15 hrs
Average Depth at Peak Storage= 0.30'
Bank-Full Depth= 1.50' Flow Area= 61.9 sf, Capacity= 353.14 cfs

0.00' x 1.50' deep channel, n= 0.027
Side Slope Z-value= 50.0 5.0 '/' Top Width= 82.50'
Length= 410.8' Slope= 0.0158 '/'
Inlet Invert= 408.19', Outlet Invert= 401.69'



‡

Reach C3C: Channel 3C



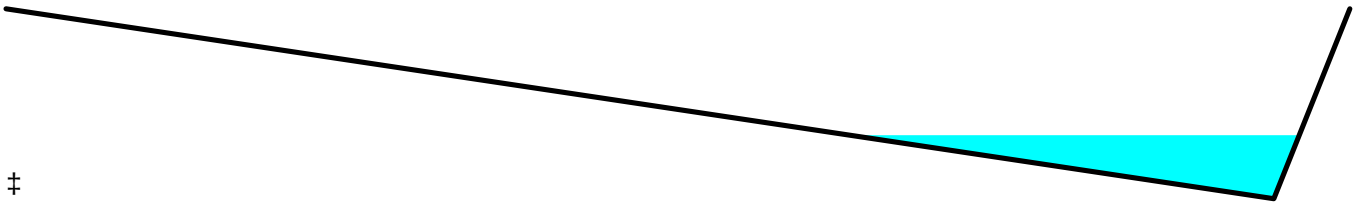
Summary for Reach C3D: Channel 3D

Inflow Area = 1.942 ac, 0.00% Impervious, Inflow Depth = 3.12" for 100 Yr event
Inflow = 6.97 cfs @ 12.12 hrs, Volume= 0.505 af
Outflow = 6.29 cfs @ 12.27 hrs, Volume= 0.505 af, Atten= 10%, Lag= 8.9 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
Max. Velocity= 2.12 fps, Min. Travel Time= 5.3 min
Avg. Velocity = 0.76 fps, Avg. Travel Time= 14.7 min

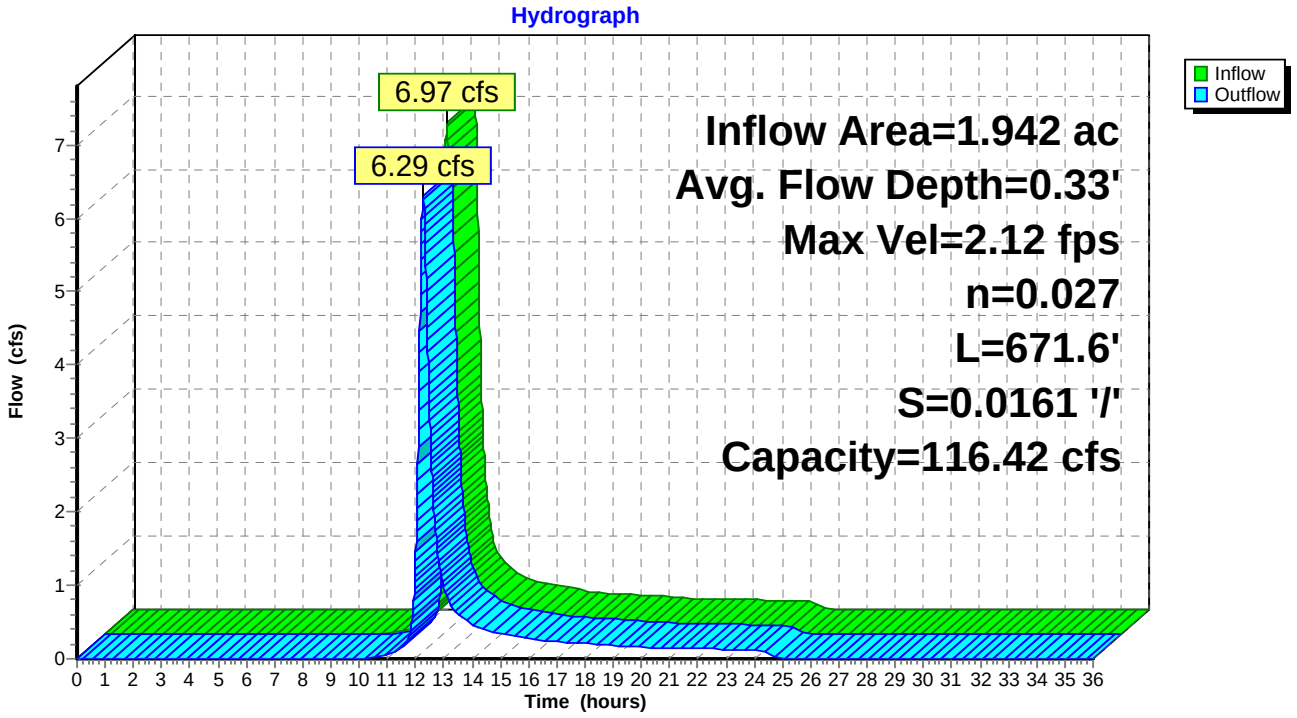
Peak Storage= 1,996 cf @ 12.18 hrs
Average Depth at Peak Storage= 0.33'
Bank-Full Depth= 1.00' Flow Area= 26.5 sf, Capacity= 116.42 cfs

0.00' x 1.00' deep channel, n= 0.027
Side Slope Z-value= 50.0 3.0 '/' Top Width= 53.00'
Length= 671.6' Slope= 0.0161 '/'
Inlet Invert= 412.62', Outlet Invert= 401.79'



‡

Reach C3D: Channel 3D



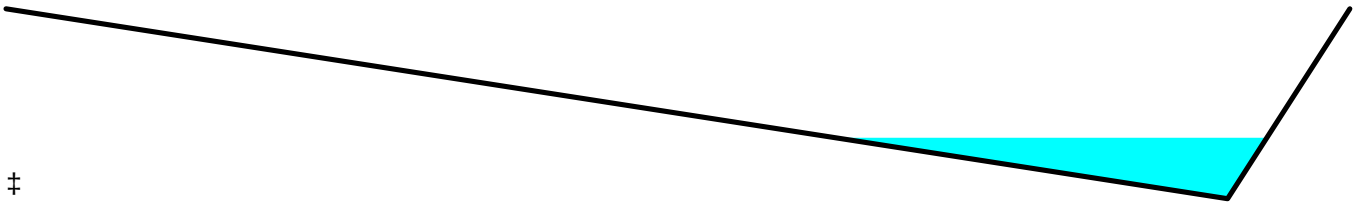
Summary for Reach C4A1: Channel 4A-1

Inflow Area = 4.175 ac, 0.00% Impervious, Inflow Depth = 3.12" for 100 Yr event
Inflow = 14.11 cfs @ 12.14 hrs, Volume= 1.086 af
Outflow = 13.59 cfs @ 12.24 hrs, Volume= 1.086 af, Atten= 4%, Lag= 5.7 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
Max. Velocity= 2.13 fps, Min. Travel Time= 3.2 min
Avg. Velocity = 0.79 fps, Avg. Travel Time= 8.6 min

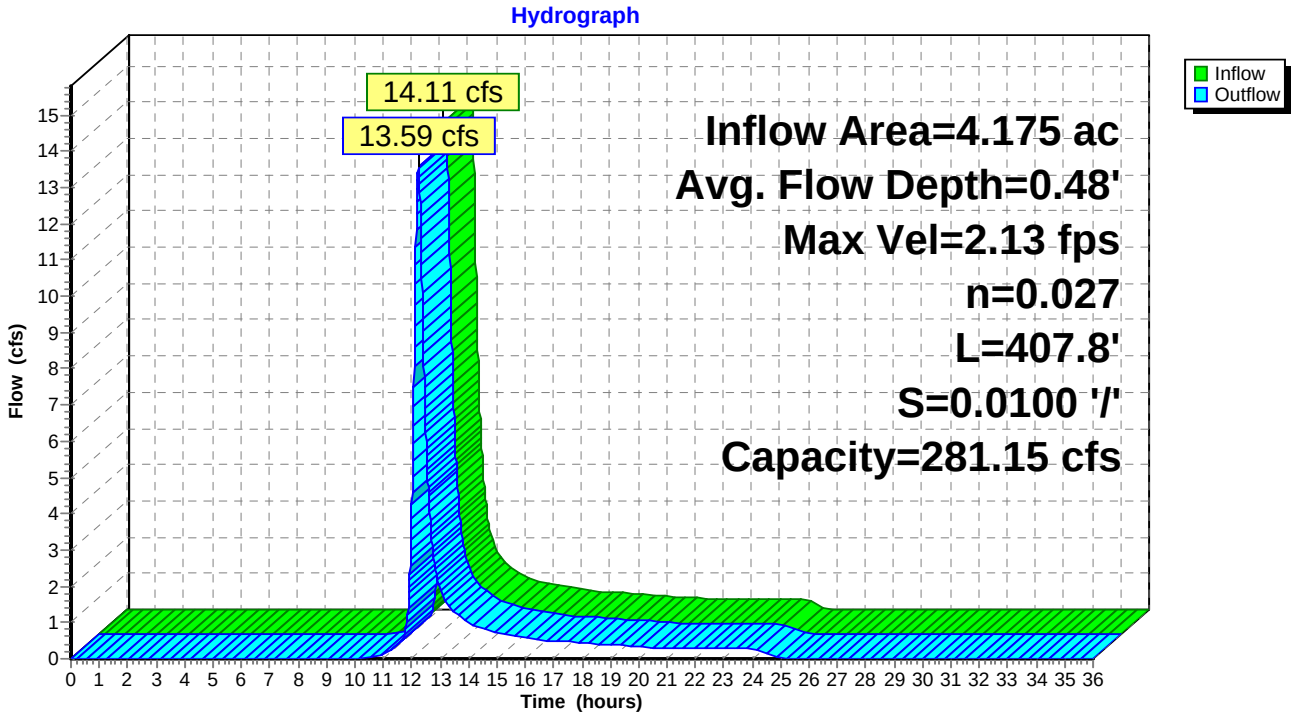
Peak Storage= 2,602 cf @ 12.18 hrs
Average Depth at Peak Storage= 0.48'
Bank-Full Depth= 1.50' Flow Area= 61.9 sf, Capacity= 281.15 cfs

0.00' x 1.50' deep channel, n= 0.027
Side Slope Z-value= 50.0 5.0 '/' Top Width= 82.50'
Length= 407.8' Slope= 0.0100 '/'
Inlet Invert= 404.51', Outlet Invert= 400.42'



‡

Reach C4A1: Channel 4A-1



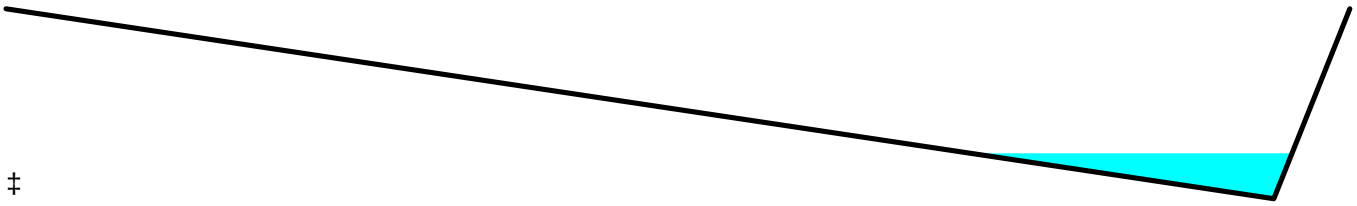
Summary for Reach C4A2: Channel 4A-2

Inflow Area = 0.685 ac, 0.00% Impervious, Inflow Depth = 3.12" for 100 Yr event
Inflow = 2.50 cfs @ 12.11 hrs, Volume= 0.178 af
Outflow = 2.47 cfs @ 12.15 hrs, Volume= 0.178 af, Atten= 1%, Lag= 2.6 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
Max. Velocity= 1.63 fps, Min. Travel Time= 1.5 min
Avg. Velocity = 0.66 fps, Avg. Travel Time= 3.7 min

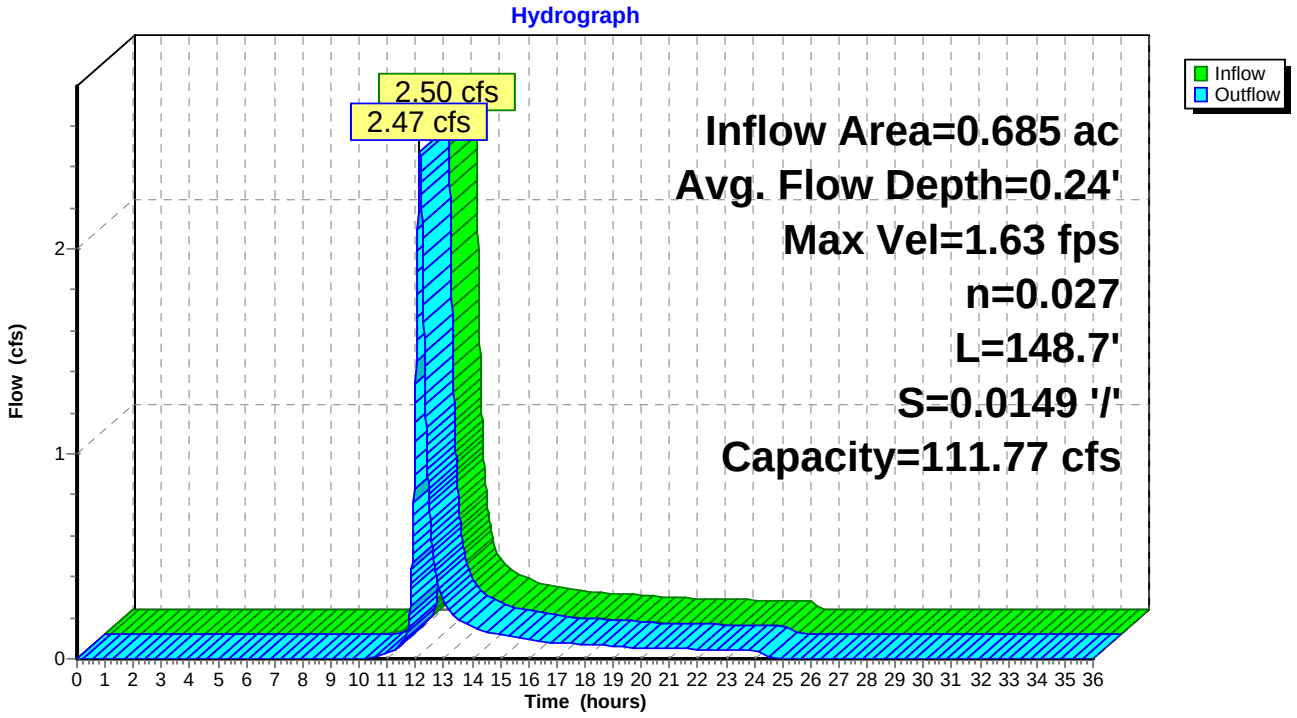
Peak Storage= 226 cf @ 12.13 hrs
Average Depth at Peak Storage= 0.24'
Bank-Full Depth= 1.00' Flow Area= 26.5 sf, Capacity= 111.77 cfs

0.00' x 1.00' deep channel, n= 0.027
Side Slope Z-value= 50.0 3.0 '/' Top Width= 53.00'
Length= 148.7' Slope= 0.0149 '/'
Inlet Invert= 406.75', Outlet Invert= 404.54'



‡

Reach C4A2: Channel 4A-2



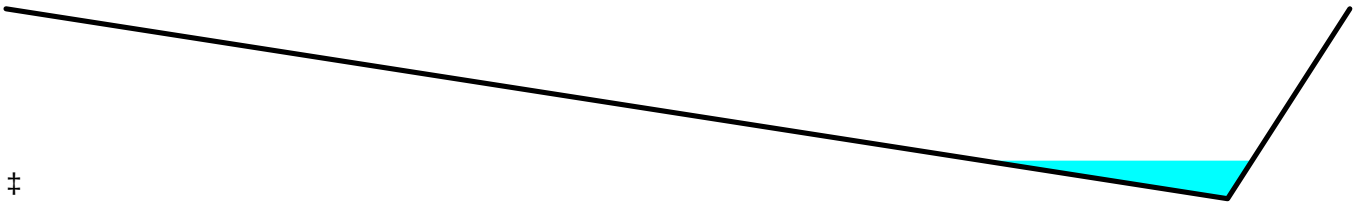
Summary for Reach C4A3: Channel 4A-3

Inflow Area = 1.116 ac, 0.00% Impervious, Inflow Depth = 3.12" for 100 Yr event
Inflow = 4.13 cfs @ 12.10 hrs, Volume= 0.290 af
Outflow = 3.85 cfs @ 12.22 hrs, Volume= 0.290 af, Atten= 7%, Lag= 7.0 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
Max. Velocity= 1.54 fps, Min. Travel Time= 4.0 min
Avg. Velocity = 0.60 fps, Avg. Travel Time= 10.4 min

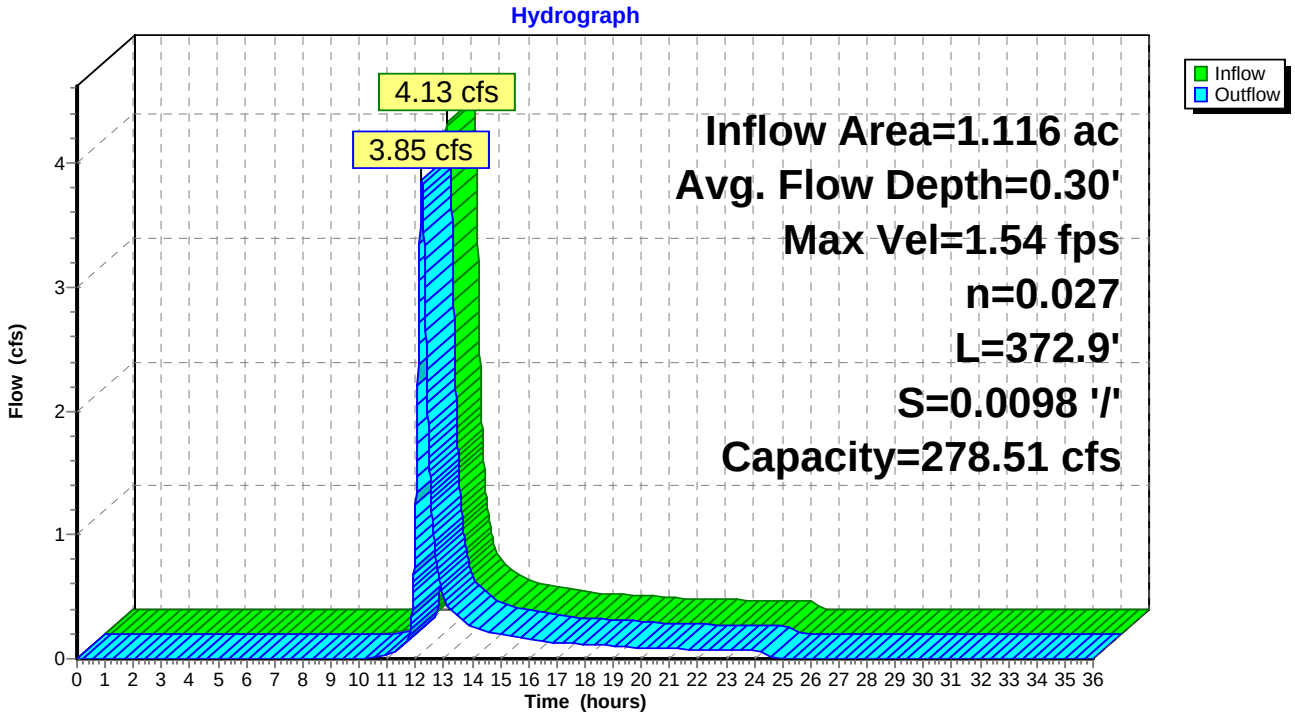
Peak Storage= 931 cf @ 12.15 hrs
Average Depth at Peak Storage= 0.30'
Bank-Full Depth= 1.50' Flow Area= 61.9 sf, Capacity= 278.51 cfs

0.00' x 1.50' deep channel, n= 0.027
Side Slope Z-value= 50.0 5.0 '/' Top Width= 82.50'
Length= 372.9' Slope= 0.0098 '/'
Inlet Invert= 408.18', Outlet Invert= 404.51'



‡

Reach C4A3: Channel 4A-3



Summary for Reach C4B1: Channel 4B-1

Inflow Area = 9.536 ac, 0.00% Impervious, Inflow Depth = 3.12" for 100 Yr event
Inflow = 30.07 cfs @ 12.23 hrs, Volume= 2.480 af
Outflow = 30.04 cfs @ 12.24 hrs, Volume= 2.480 af, Atten= 0%, Lag= 0.5 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
Max. Velocity= 3.58 fps, Min. Travel Time= 0.3 min
Avg. Velocity = 1.03 fps, Avg. Travel Time= 1.1 min

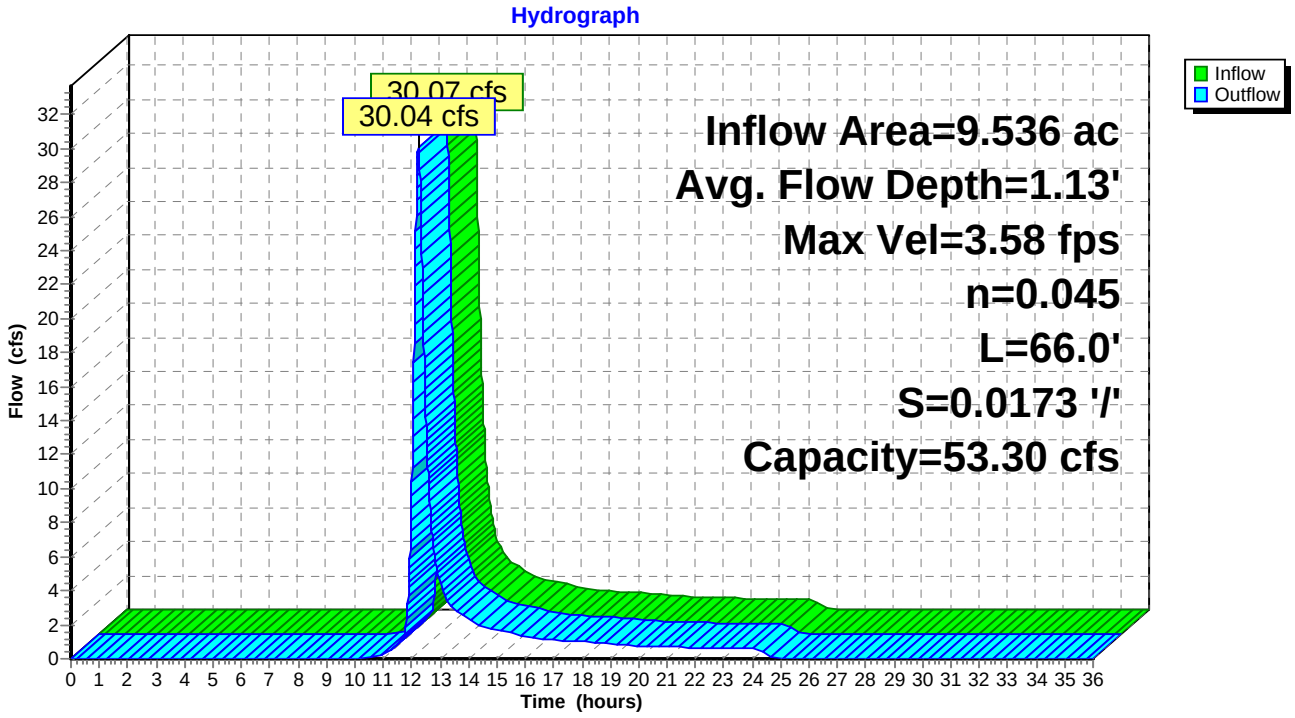
Peak Storage= 553 cf @ 12.24 hrs
Average Depth at Peak Storage= 1.13'
Bank-Full Depth= 1.50' Flow Area= 12.8 sf, Capacity= 53.30 cfs

4.00' x 1.50' deep channel, n= 0.045
Side Slope Z-value= 3.0 '/' Top Width= 13.00'
Length= 66.0' Slope= 0.0173 '/'
Inlet Invert= 400.31', Outlet Invert= 399.17'



‡

Reach C4B1: Channel 4B-1



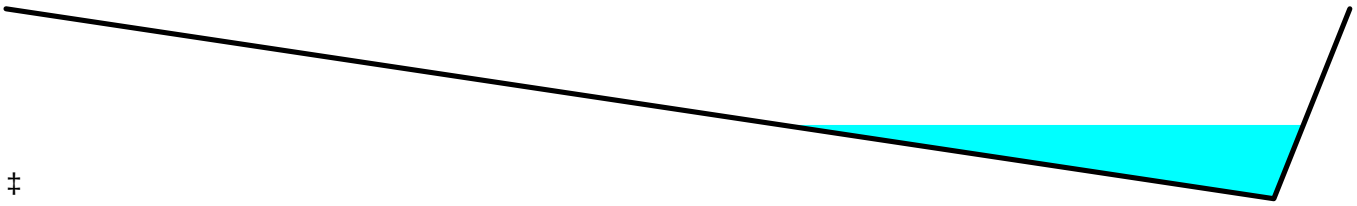
Summary for Reach C4B2: Channel 4B-2

Inflow Area = 2.715 ac, 0.00% Impervious, Inflow Depth = 3.12" for 100 Yr event
Inflow = 9.95 cfs @ 12.10 hrs, Volume= 0.706 af
Outflow = 8.99 cfs @ 12.25 hrs, Volume= 0.706 af, Atten= 10%, Lag= 9.0 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
Max. Velocity= 2.25 fps, Min. Travel Time= 5.2 min
Avg. Velocity = 0.79 fps, Avg. Travel Time= 14.8 min

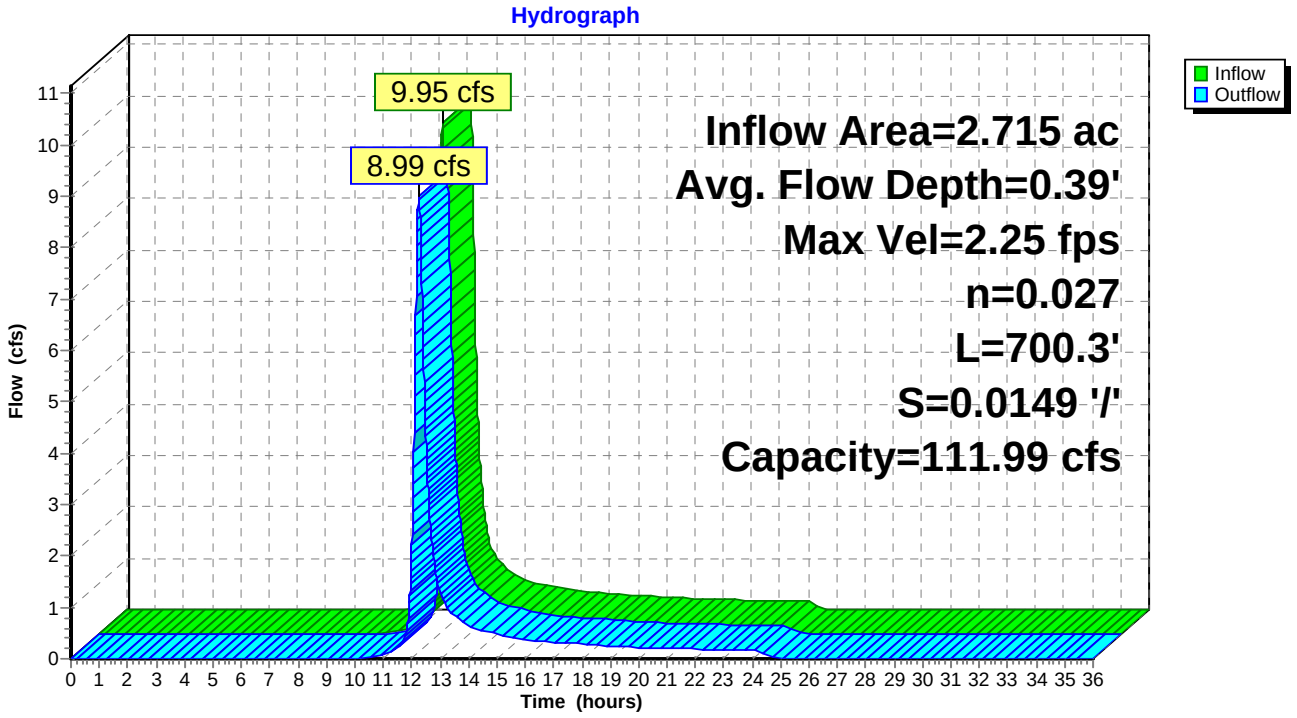
Peak Storage= 2,799 cf @ 12.17 hrs
Average Depth at Peak Storage= 0.39'
Bank-Full Depth= 1.00' Flow Area= 26.5 sf, Capacity= 111.99 cfs

0.00' x 1.00' deep channel, n= 0.027
Side Slope Z-value= 50.0 3.0 '/' Top Width= 53.00'
Length= 700.3' Slope= 0.0149 '/'
Inlet Invert= 412.08', Outlet Invert= 401.63'



‡

Reach C4B2: Channel 4B-2



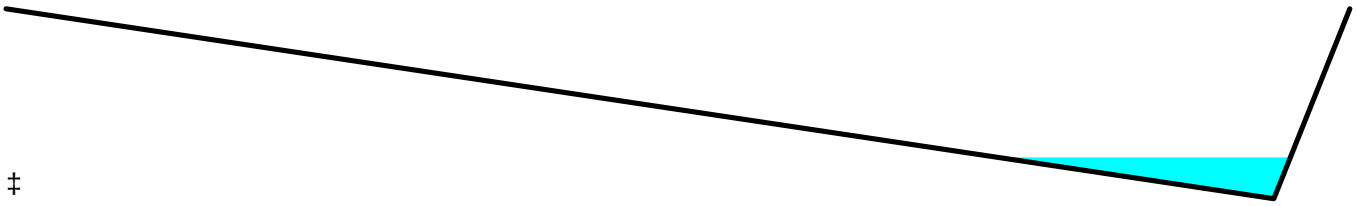
Summary for Reach C4B3: Channel 4B-3

Inflow Area = 0.634 ac, 0.00% Impervious, Inflow Depth = 3.12" for 100 Yr event
Inflow = 2.31 cfs @ 12.11 hrs, Volume= 0.165 af
Outflow = 2.30 cfs @ 12.15 hrs, Volume= 0.165 af, Atten= 1%, Lag= 2.2 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
Max. Velocity= 1.83 fps, Min. Travel Time= 1.3 min
Avg. Velocity = 0.75 fps, Avg. Travel Time= 3.1 min

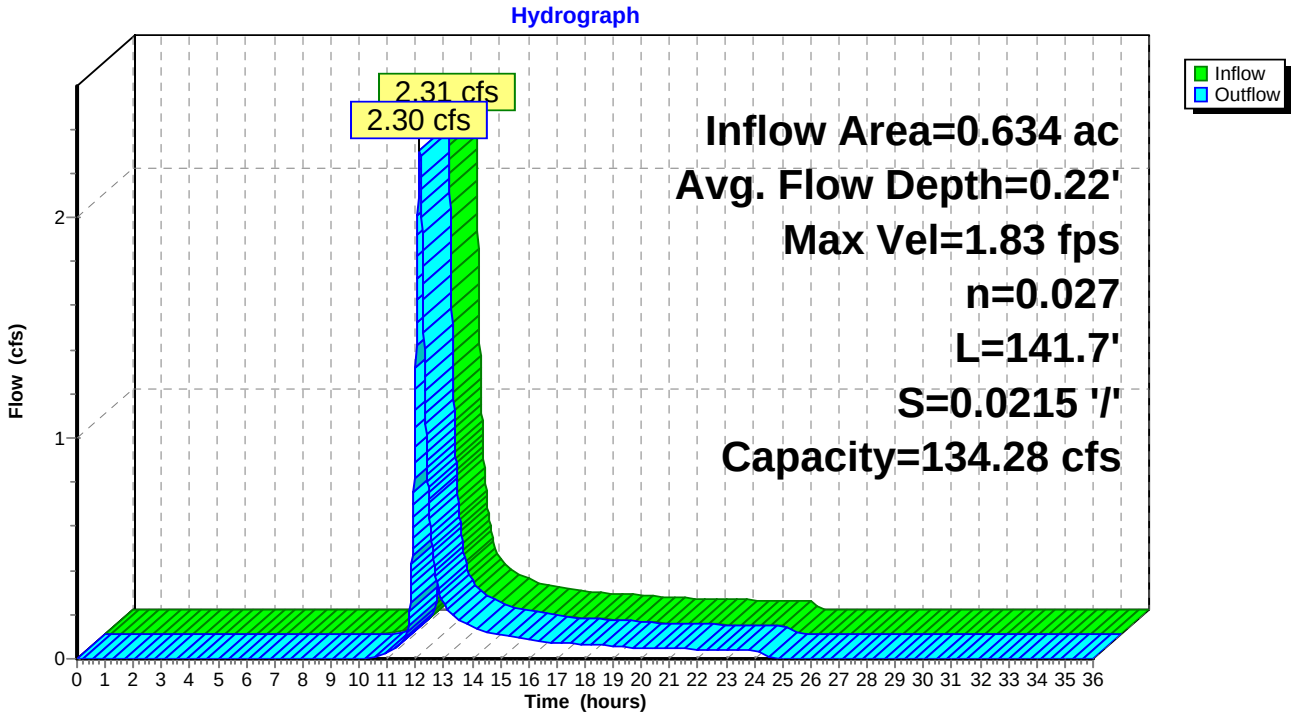
Peak Storage= 178 cf @ 12.13 hrs
Average Depth at Peak Storage= 0.22'
Bank-Full Depth= 1.00' Flow Area= 26.5 sf, Capacity= 134.28 cfs

0.00' x 1.00' deep channel, n= 0.027
Side Slope Z-value= 50.0 3.0 '/' Top Width= 53.00'
Length= 141.7' Slope= 0.0215 '/'
Inlet Invert= 404.78', Outlet Invert= 401.74'



‡

Reach C4B3: Channel 4B-3



Summary for Reach C4B4: Channel 4B-4

Inflow Area = 6.025 ac, 0.00% Impervious, Inflow Depth = 3.12" for 100 Yr event
Inflow = 19.14 cfs @ 12.20 hrs, Volume= 1.567 af
Outflow = 19.07 cfs @ 12.23 hrs, Volume= 1.567 af, Atten= 0%, Lag= 1.9 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
Max. Velocity= 3.16 fps, Min. Travel Time= 1.1 min
Avg. Velocity = 0.91 fps, Avg. Travel Time= 3.8 min

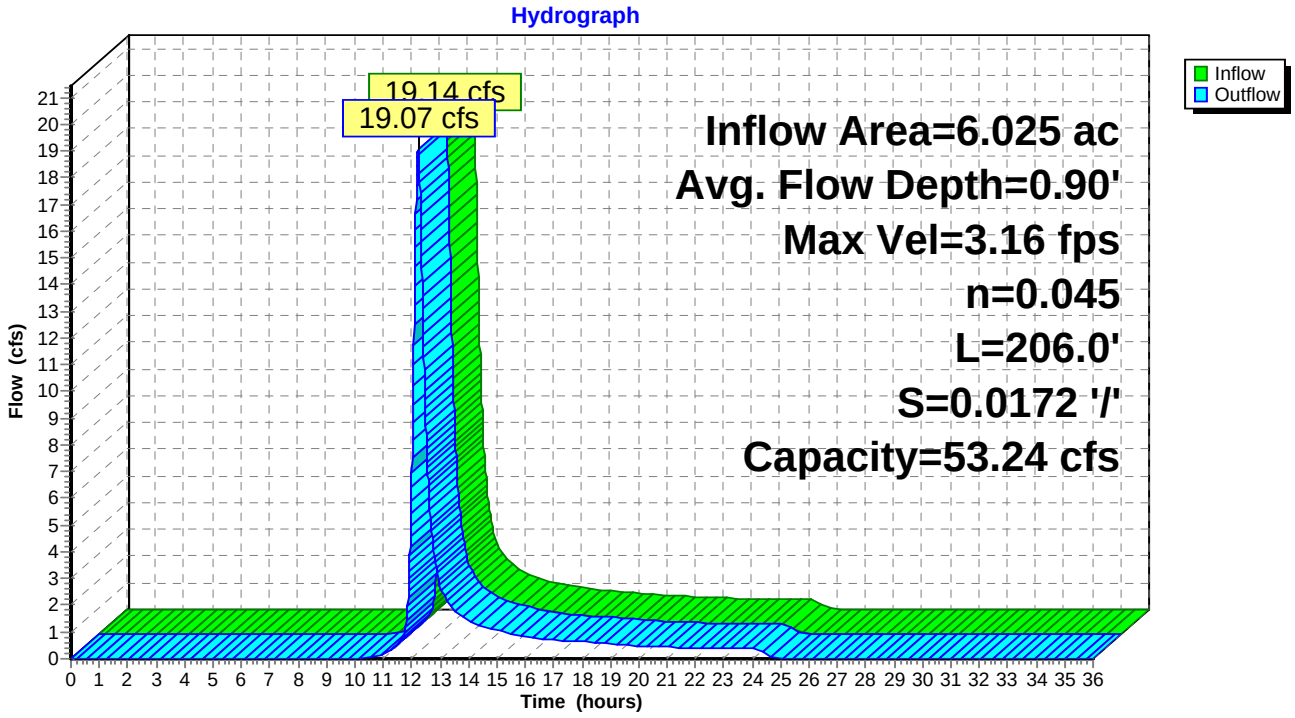
Peak Storage= 1,243 cf @ 12.21 hrs
Average Depth at Peak Storage= 0.90'
Bank-Full Depth= 1.50' Flow Area= 12.8 sf, Capacity= 53.24 cfs

4.00' x 1.50' deep channel, n= 0.045
Side Slope Z-value= 3.0 '/' Top Width= 13.00'
Length= 206.0' Slope= 0.0172 '/'
Inlet Invert= 403.86', Outlet Invert= 400.31'



‡

Reach C4B4: Channel 4B-4



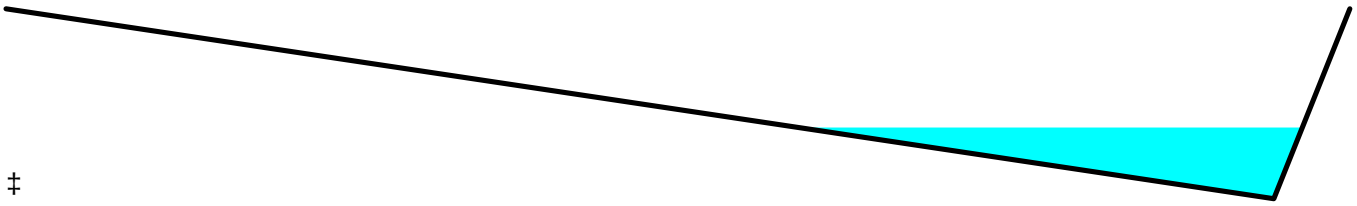
Summary for Reach C4B5: Channel 4B-5

Inflow Area = 2.485 ac, 0.00% Impervious, Inflow Depth = 3.12" for 100 Yr event
Inflow = 9.01 cfs @ 12.11 hrs, Volume= 0.646 af
Outflow = 8.19 cfs @ 12.25 hrs, Volume= 0.646 af, Atten= 9%, Lag= 8.9 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
Max. Velocity= 2.20 fps, Min. Travel Time= 5.0 min
Avg. Velocity = 0.78 fps, Avg. Travel Time= 14.3 min

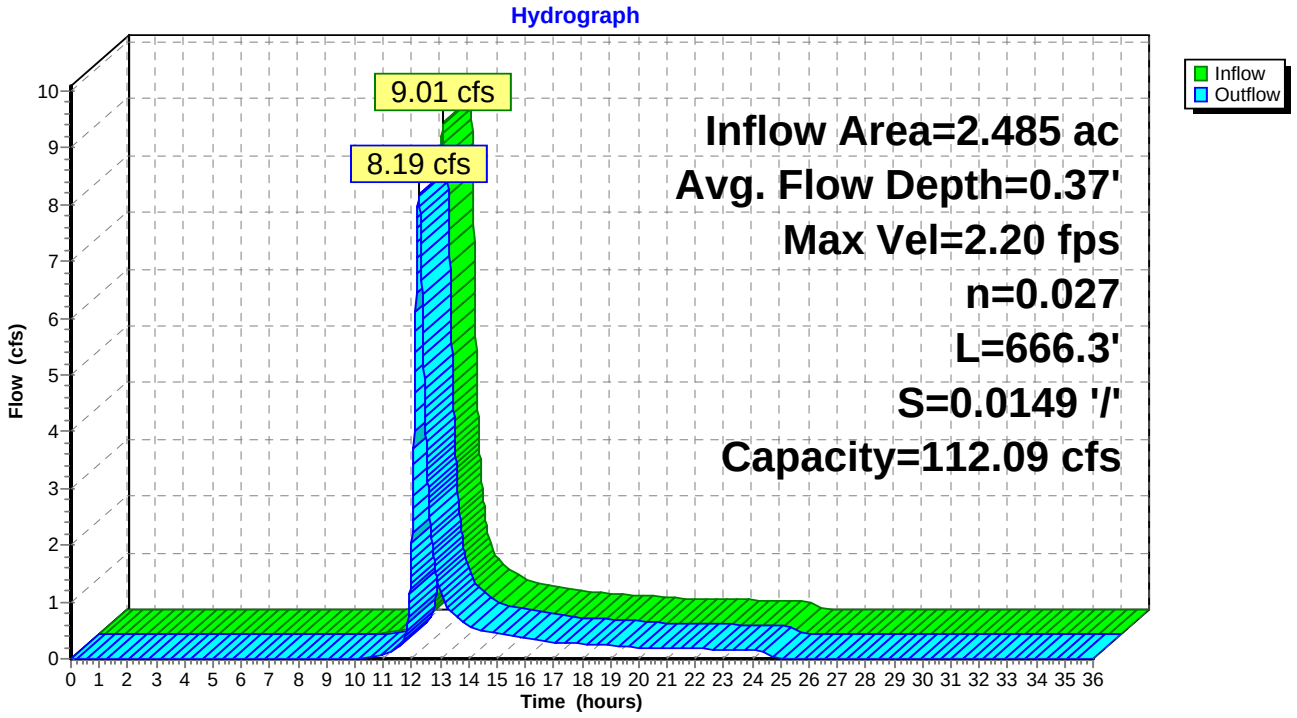
Peak Storage= 2,483 cf @ 12.17 hrs
Average Depth at Peak Storage= 0.37'
Bank-Full Depth= 1.00' Flow Area= 26.5 sf, Capacity= 112.09 cfs

0.00' x 1.00' deep channel, n= 0.027
Side Slope Z-value= 50.0 3.0 '/' Top Width= 53.00'
Length= 666.3' Slope= 0.0149 '/'
Inlet Invert= 414.51', Outlet Invert= 404.55'



‡

Reach C4B5: Channel 4B-5



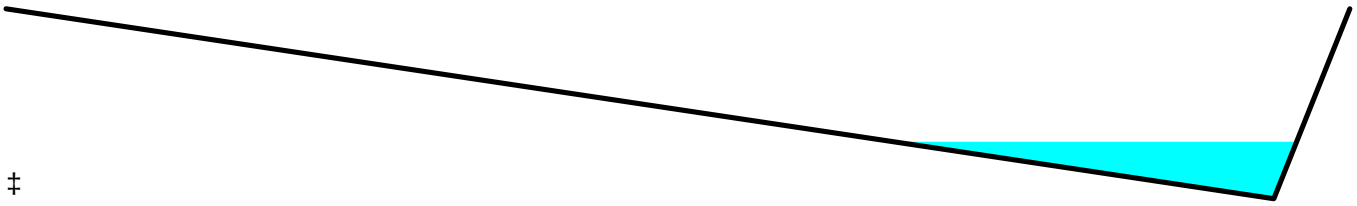
Summary for Reach C4B6: Channel 4B-6

Inflow Area = 1.292 ac, 0.00% Impervious, Inflow Depth = 3.12" for 100 Yr event
Inflow = 4.69 cfs @ 12.11 hrs, Volume= 0.336 af
Outflow = 4.47 cfs @ 12.21 hrs, Volume= 0.336 af, Atten= 5%, Lag= 6.0 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
Max. Velocity= 1.88 fps, Min. Travel Time= 3.3 min
Avg. Velocity = 0.72 fps, Avg. Travel Time= 8.6 min

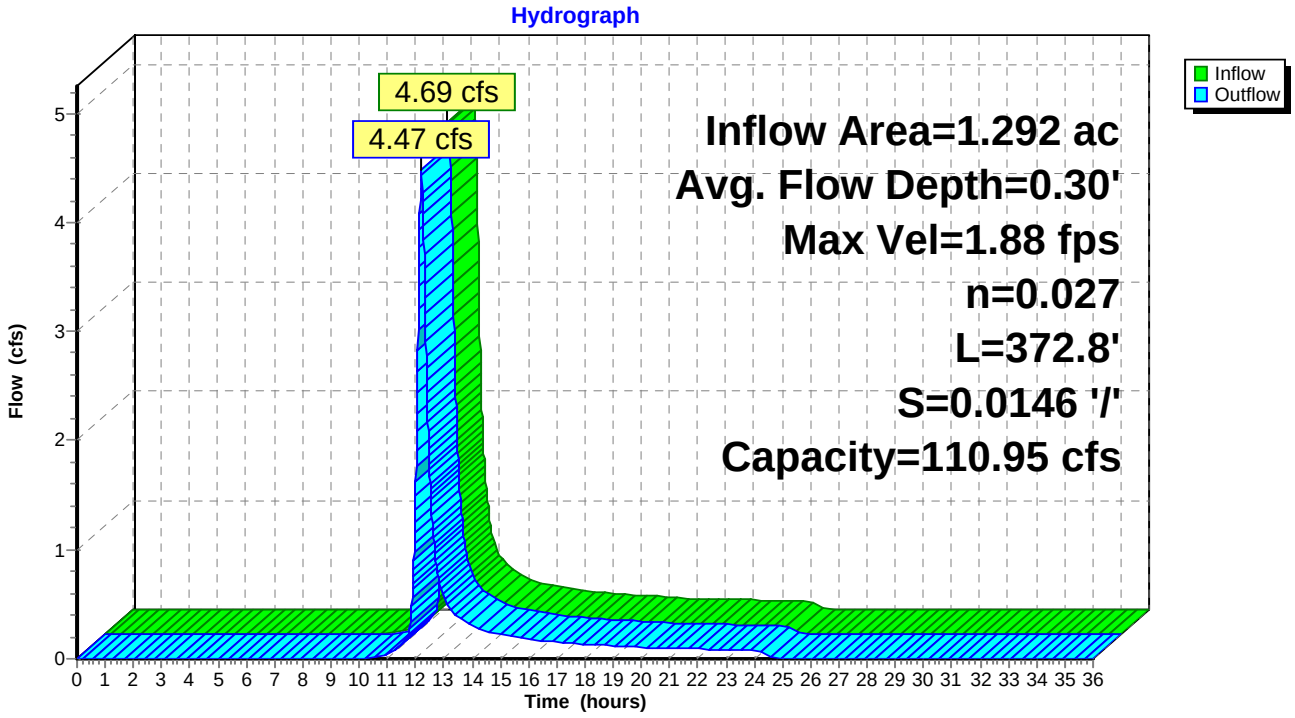
Peak Storage= 889 cf @ 12.15 hrs
Average Depth at Peak Storage= 0.30'
Bank-Full Depth= 1.00' Flow Area= 26.5 sf, Capacity= 110.95 cfs

0.00' x 1.00' deep channel, n= 0.027
Side Slope Z-value= 50.0 3.0 '/' Top Width= 53.00'
Length= 372.8' Slope= 0.0146 '/'
Inlet Invert= 410.09', Outlet Invert= 404.63'



‡

Reach C4B6: Channel 4B-6



Summary for Reach C4B7: Channel 4B-7

Inflow Area = 1.171 ac, 0.00% Impervious, Inflow Depth = 3.12" for 100 Yr event
Inflow = 4.33 cfs @ 12.10 hrs, Volume= 0.304 af
Outflow = 4.29 cfs @ 12.15 hrs, Volume= 0.304 af, Atten= 1%, Lag= 2.7 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
Max. Velocity= 2.03 fps, Min. Travel Time= 1.6 min
Avg. Velocity = 0.60 fps, Avg. Travel Time= 5.3 min

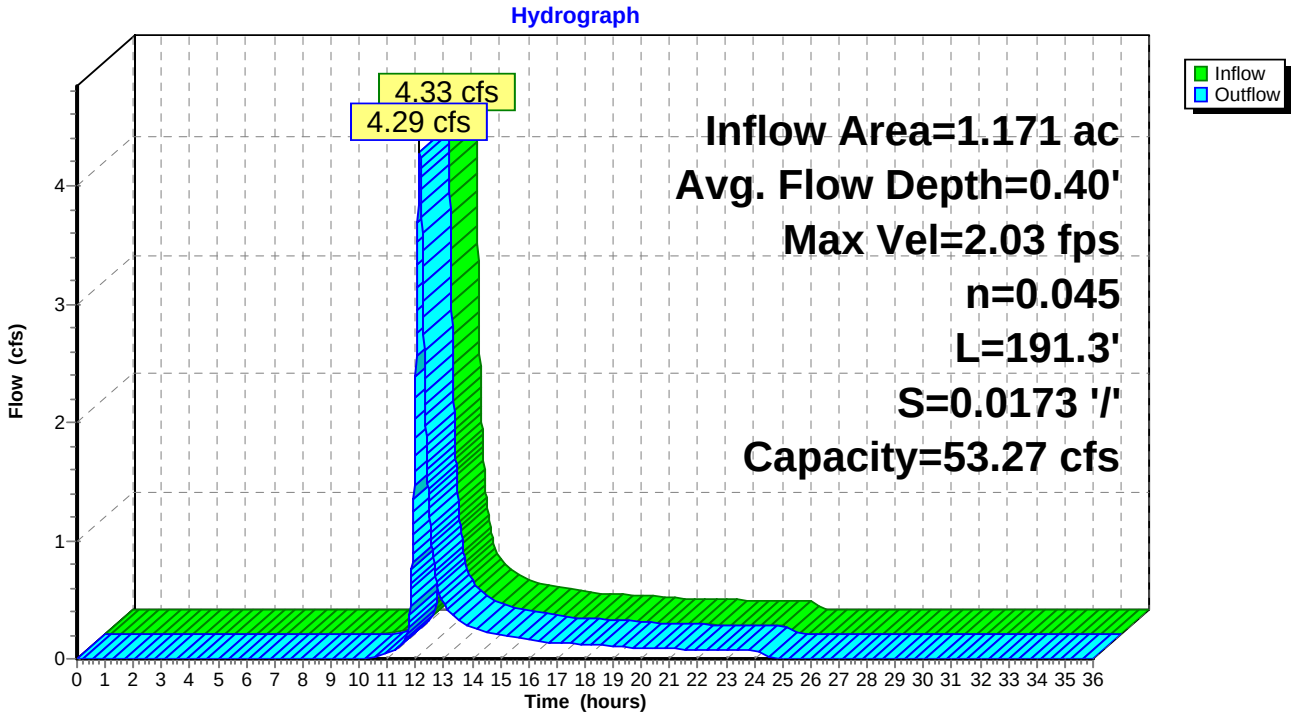
Peak Storage= 403 cf @ 12.12 hrs
Average Depth at Peak Storage= 0.40'
Bank-Full Depth= 1.50' Flow Area= 12.8 sf, Capacity= 53.27 cfs

4.00' x 1.50' deep channel, n= 0.045
Side Slope Z-value= 3.0 '/' Top Width= 13.00'
Length= 191.3' Slope= 0.0173 '/'
Inlet Invert= 407.16', Outlet Invert= 403.86'



‡

Reach C4B7: Channel 4B-7



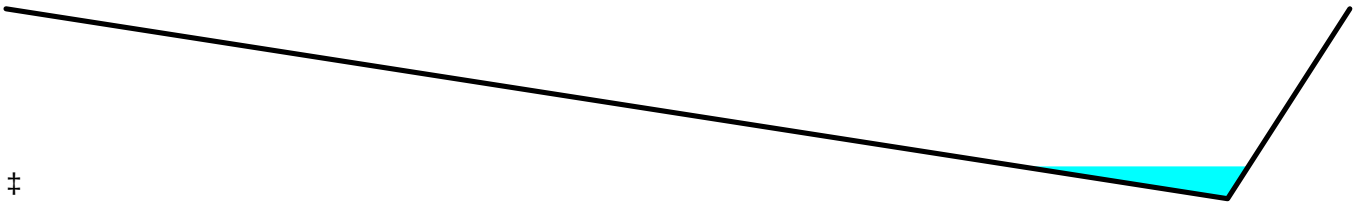
Summary for Reach C4C: Channel 4C

Inflow Area = 0.968 ac, 0.00% Impervious, Inflow Depth = 3.12" for 100 Yr event
Inflow = 3.77 cfs @ 12.09 hrs, Volume= 0.252 af
Outflow = 3.52 cfs @ 12.19 hrs, Volume= 0.252 af, Atten= 7%, Lag= 6.5 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
Max. Velocity= 1.97 fps, Min. Travel Time= 3.8 min
Avg. Velocity = 0.77 fps, Avg. Travel Time= 9.6 min

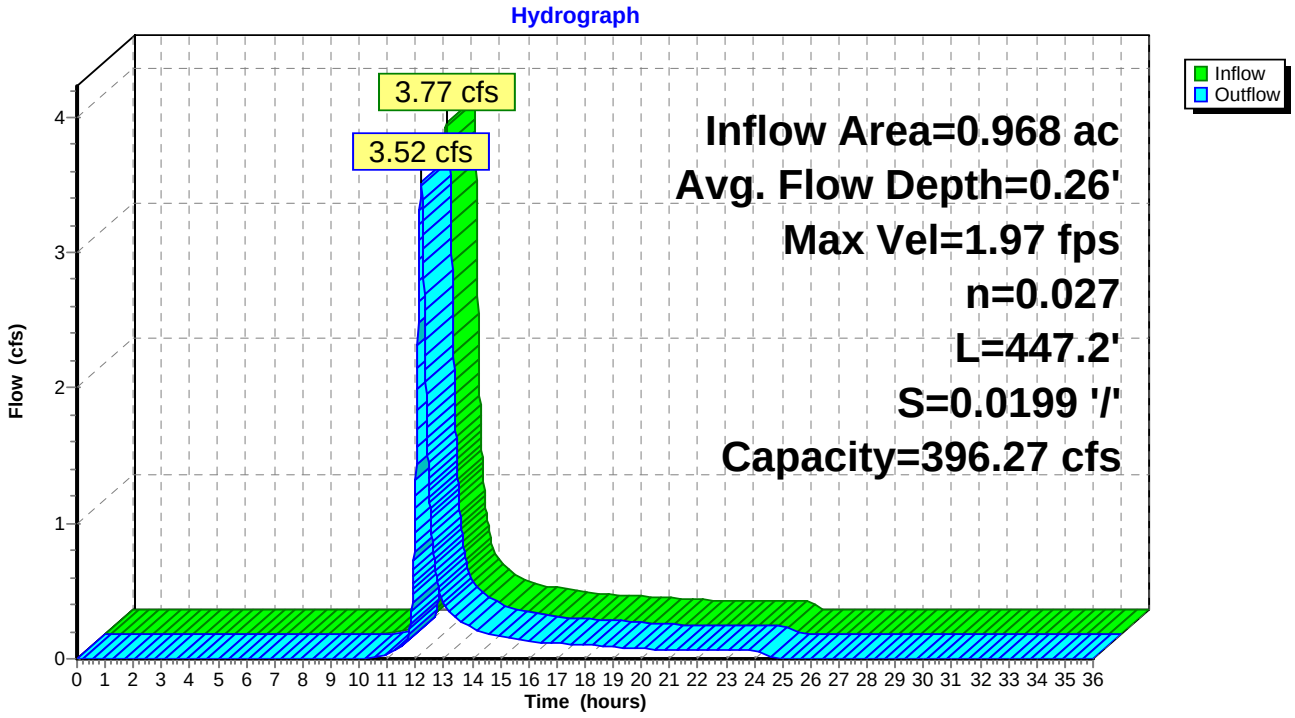
Peak Storage= 801 cf @ 12.13 hrs
Average Depth at Peak Storage= 0.26'
Bank-Full Depth= 1.50' Flow Area= 61.9 sf, Capacity= 396.27 cfs

0.00' x 1.50' deep channel, n= 0.027
Side Slope Z-value= 50.0 5.0 '/' Top Width= 82.50'
Length= 447.2' Slope= 0.0199 '/'
Inlet Invert= 409.40', Outlet Invert= 400.49'



‡

Reach C4C: Channel 4C



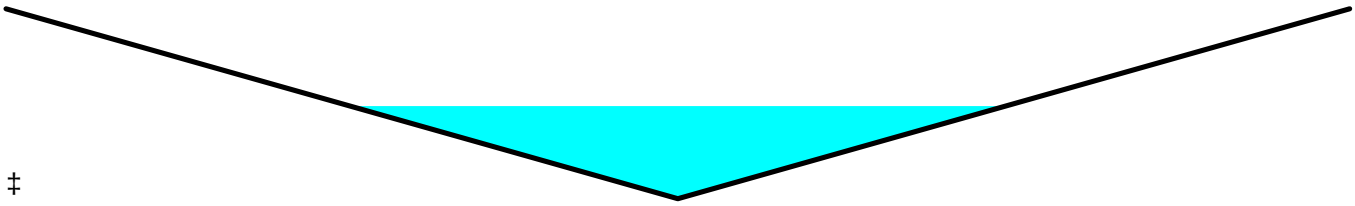
Summary for Reach C5A: Channel 5A

Inflow Area = 2.365 ac, 0.00% Impervious, Inflow Depth = 3.12" for 100 Yr event
Inflow = 10.46 cfs @ 12.05 hrs, Volume= 0.615 af
Outflow = 10.07 cfs @ 12.11 hrs, Volume= 0.615 af, Atten= 4%, Lag= 3.8 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs / 2
Max. Velocity= 3.76 fps, Min. Travel Time= 2.2 min
Avg. Velocity = 1.39 fps, Avg. Travel Time= 6.1 min

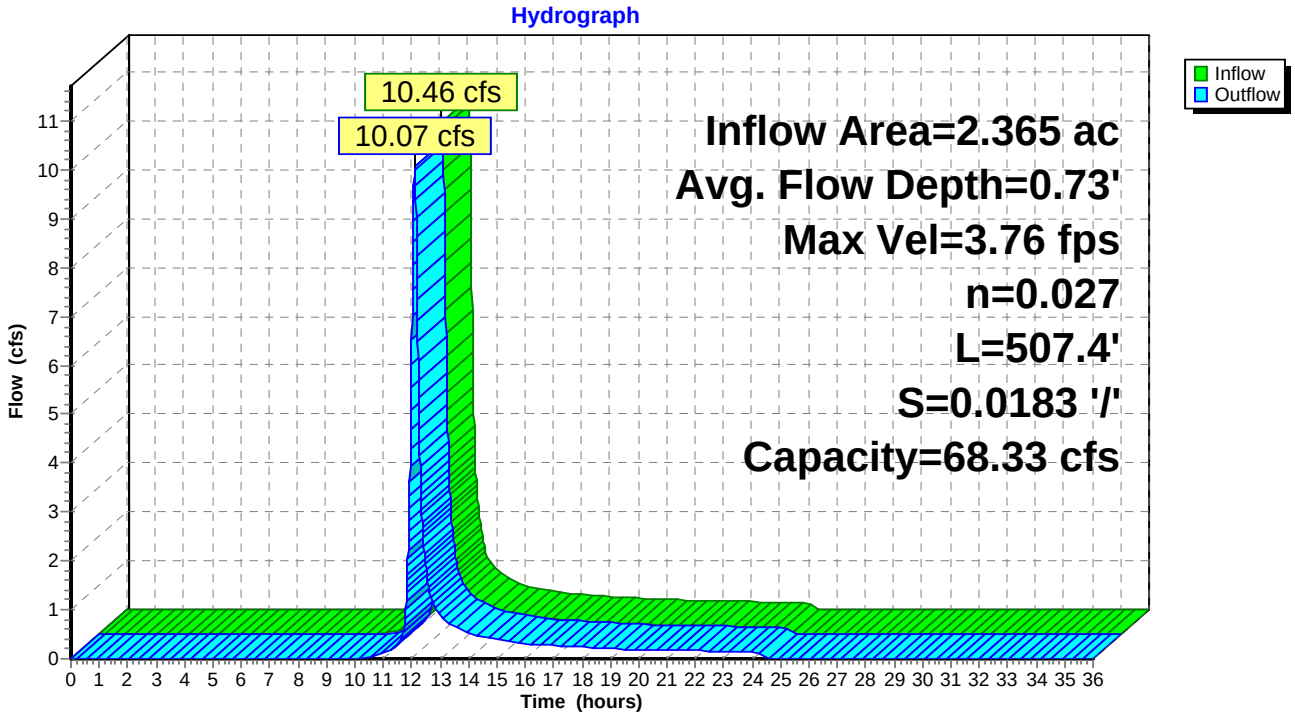
Peak Storage= 1,359 cf @ 12.07 hrs
Average Depth at Peak Storage= 0.73'
Bank-Full Depth= 1.50' Flow Area= 11.3 sf, Capacity= 68.33 cfs

0.00' x 1.50' deep channel, n= 0.027
Side Slope Z-value= 5.0 '/' Top Width= 15.00'
Length= 507.4' Slope= 0.0183 '/'
Inlet Invert= 409.37', Outlet Invert= 400.06'



‡

Reach C5A: Channel 5A



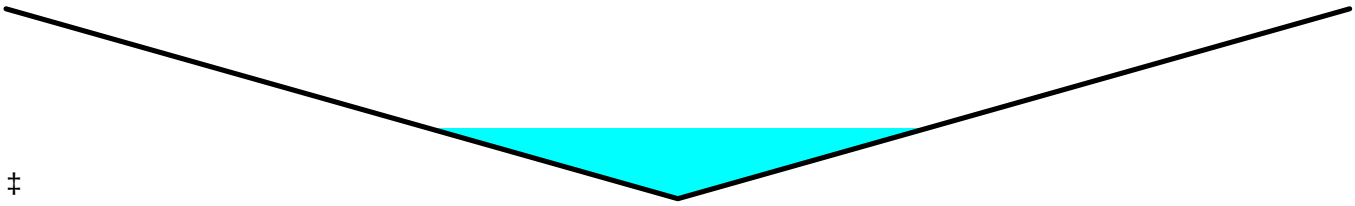
Summary for Reach C5B: Channel 5B

Inflow Area = 1.353 ac, 0.00% Impervious, Inflow Depth = 3.12" for 100 Yr event
Inflow = 6.03 cfs @ 12.04 hrs, Volume= 0.352 af
Outflow = 5.91 cfs @ 12.09 hrs, Volume= 0.352 af, Atten= 2%, Lag= 2.7 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs / 2
Max. Velocity= 3.80 fps, Min. Travel Time= 1.5 min
Avg. Velocity = 1.46 fps, Avg. Travel Time= 3.9 min

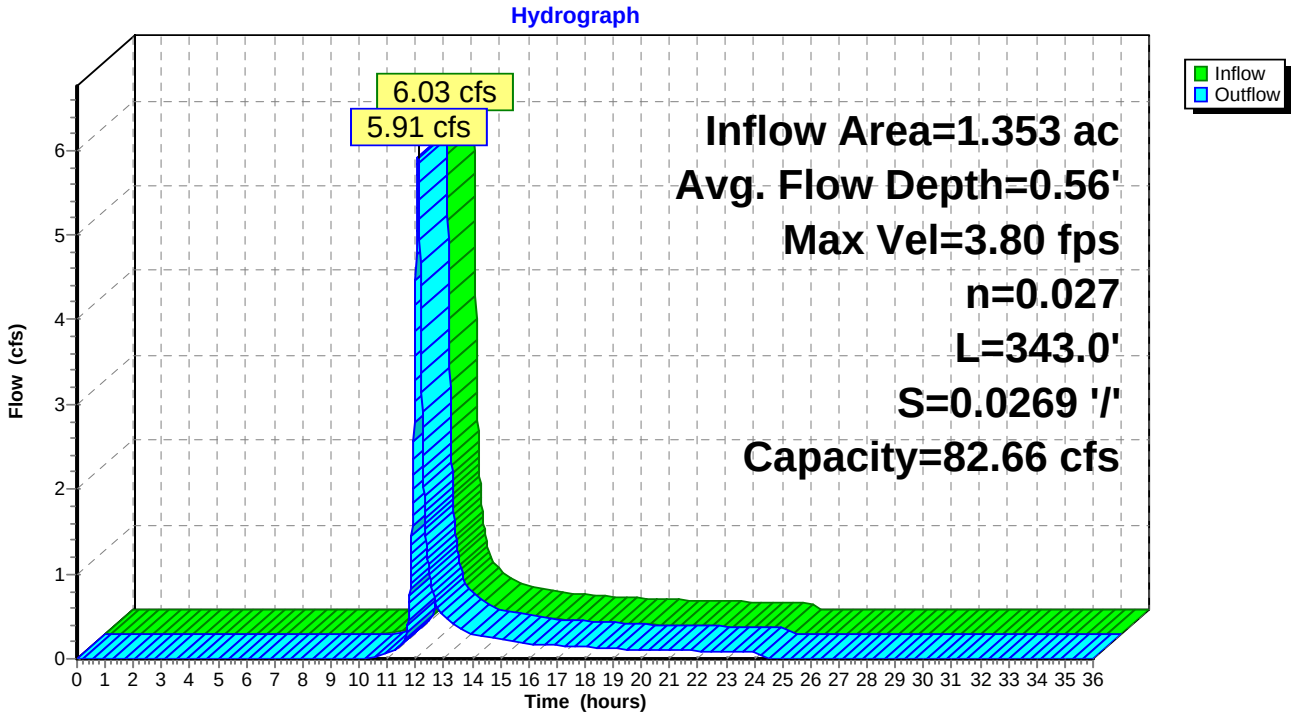
Peak Storage= 534 cf @ 12.06 hrs
Average Depth at Peak Storage= 0.56'
Bank-Full Depth= 1.50' Flow Area= 11.3 sf, Capacity= 82.66 cfs

0.00' x 1.50' deep channel, n= 0.027
Side Slope Z-value= 5.0 '/' Top Width= 15.00'
Length= 343.0' Slope= 0.0269 '/'
Inlet Invert= 409.27', Outlet Invert= 400.06'



‡

Reach C5B: Channel 5B



Summary for Pond ED: Existing Ditch

Inflow Area = 74.259 ac, 0.00% Impervious, Inflow Depth = 3.12" for 100 Yr event
Inflow = 160.17 cfs @ 11.90 hrs, Volume= 19.309 af
Outflow = 75.66 cfs @ 12.79 hrs, Volume= 19.243 af, Atten= 53%, Lag= 53.2 min
Primary = 75.66 cfs @ 12.79 hrs, Volume= 19.243 af

Routing by Stor-Ind method, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
Peak Elev= 382.15' @ 12.79 hrs Surf.Area= 97,042 sf Storage= 115,012 cf

Plug-Flow detention time= 31.9 min calculated for 19.243 af (100% of inflow)
Center-of-Mass det. time= 29.7 min (896.6 - 866.9)

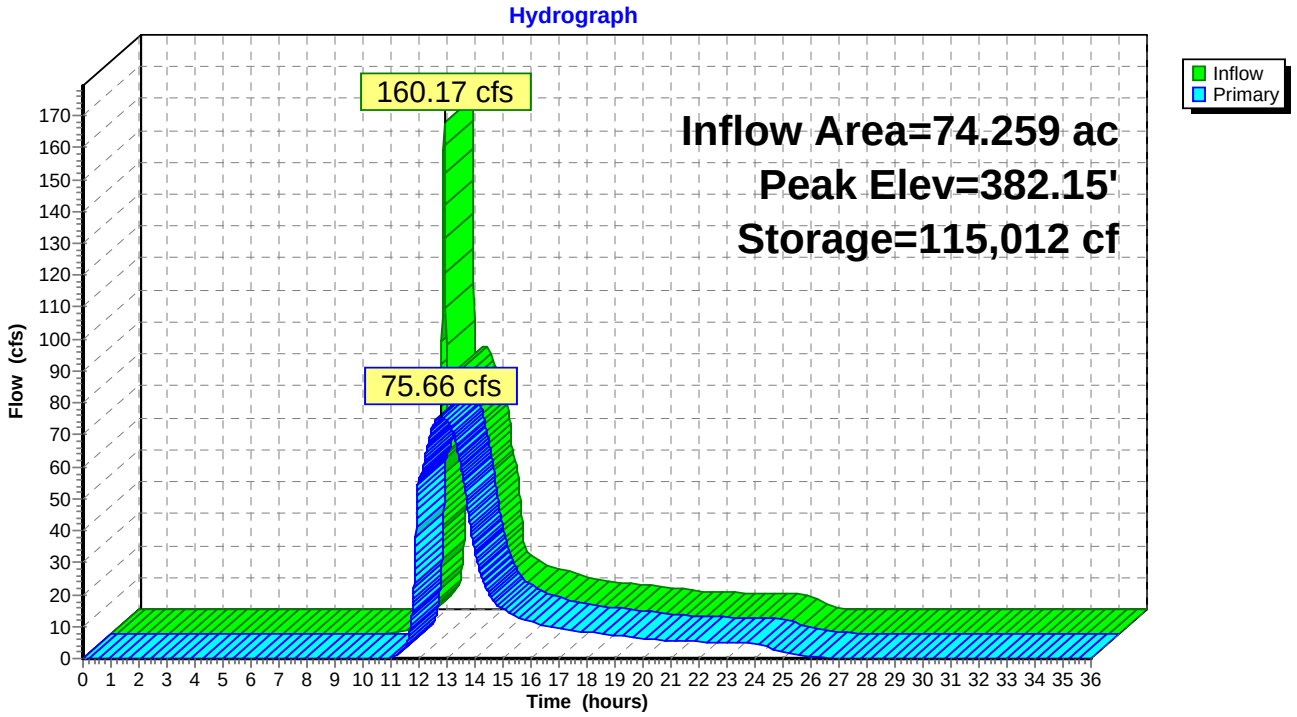
Volume	Invert	Avail.Storage	Storage Description
#1	379.60'	525,286 cf	**Custom Stage Data (Prismatic)** Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
379.60	1,580	0	0
380.00	12,876	2,891	2,891
381.00	46,484	29,680	32,571
382.00	89,767	68,126	100,697
383.00	137,236	113,502	214,198
384.00	191,498	164,367	378,565
384.70	227,705	146,721	525,286

Device	Routing	Invert	Outlet Devices
#1	Primary	380.00'	**Custom Weir/Orifice, Cv= 2.62 (C= 3.28)** Head (feet) 0.00 10.00 Width (feet) 3.00 53.00

Primary OutFlow Max=75.61 cfs @ 12.79 hrs HW=382.15' (Free Discharge)
1=Custom Weir/Orifice (Weir Controls 75.61 cfs @ 4.19 fps)

Pond ED: Existing Ditch



Summary for Pond O1: Outlet 1

Inflow Area = 1.553 ac, 0.00% Impervious, Inflow Depth = 3.12" for 100 Yr event
Inflow = 7.69 cfs @ 12.07 hrs, Volume= 0.404 af
Outflow = 3.97 cfs @ 12.17 hrs, Volume= 0.404 af, Atten= 48%, Lag= 6.4 min
Primary = 3.97 cfs @ 12.17 hrs, Volume= 0.404 af

Routing by Stor-Ind method, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
Peak Elev= 401.27' @ 12.17 hrs Surf.Area= 2,978 sf Storage= 2,396 cf

Plug-Flow detention time= 3.8 min calculated for 0.404 af (100% of inflow)
Center-of-Mass det. time= 3.8 min (859.6 - 855.8)

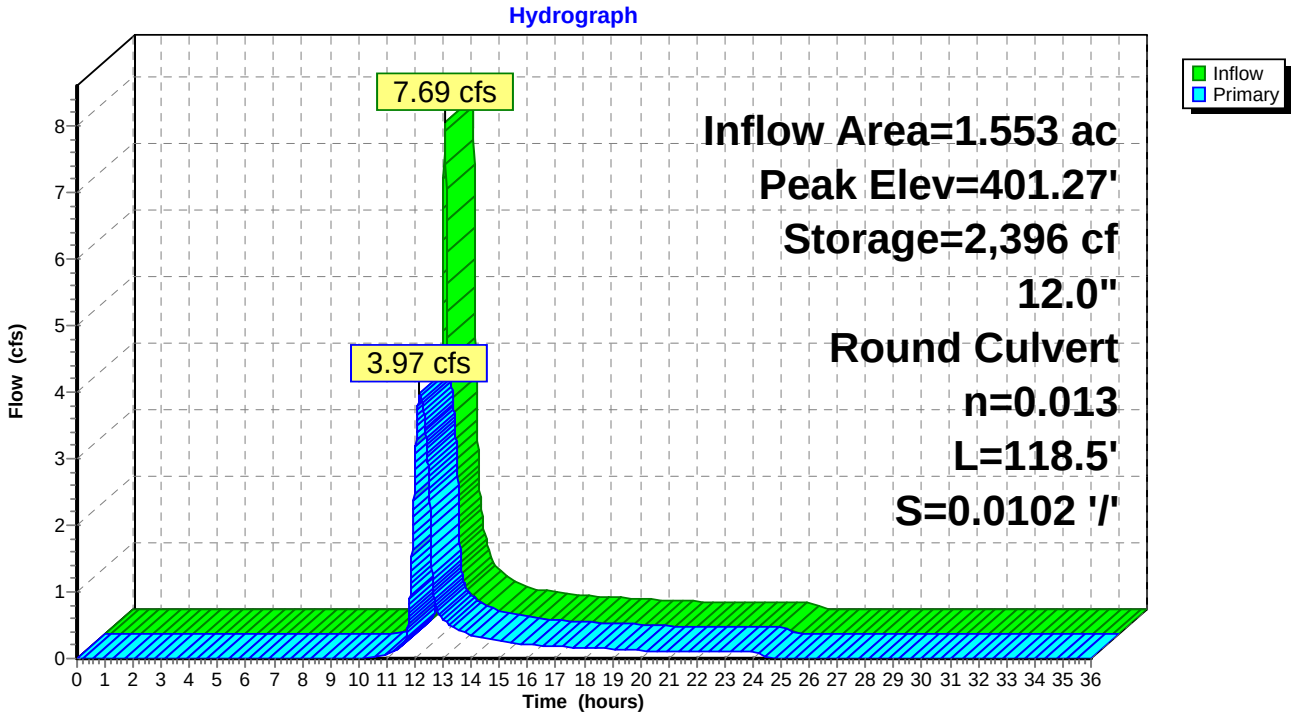
Volume	Invert	Avail.Storage	Storage Description
#1	399.00'	63,548 cf	**Custom Stage Data (Prismatic)** Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
399.00	0	0	0
400.00	579	290	290
401.00	2,248	1,414	1,703
402.00	5,001	3,625	5,328
403.00	8,817	6,909	12,237
404.00	13,732	11,275	23,511
405.00	19,744	16,738	40,249
406.00	26,853	23,299	63,548

Device	Routing	Invert	Outlet Devices
#1	Primary	399.00'	**12.0" Round Culvert** L= 118.5' CPP, projecting, no headwall, Ke= 0.900 Inlet / Outlet Invert= 399.00' / 397.79' S= 0.0102 '/' Cc= 0.900 n= 0.013 Corrugated PE, smooth interior, Flow Area= 0.79 sf

Primary OutFlow Max=3.97 cfs @ 12.17 hrs HW=401.26' (Free Discharge)
1=Culvert (Inlet Controls 3.97 cfs @ 5.05 fps)

Pond O1: Outlet 1



Summary for Pond O2: Outlet 2

Inflow Area = 18.214 ac, 0.00% Impervious, Inflow Depth = 3.12" for 100 Yr event
Inflow = 58.15 cfs @ 12.24 hrs, Volume= 4.736 af
Outflow = 23.29 cfs @ 12.55 hrs, Volume= 4.736 af, Atten= 60%, Lag= 18.3 min
Primary = 23.29 cfs @ 12.55 hrs, Volume= 4.736 af

Routing by Stor-Ind method, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
Peak Elev= 403.98' @ 12.55 hrs Surf.Area= 45,947 sf Storage= 41,727 cf

Plug-Flow detention time= 11.0 min calculated for 4.735 af (100% of inflow)
Center-of-Mass det. time= 11.0 min (878.1 - 867.1)

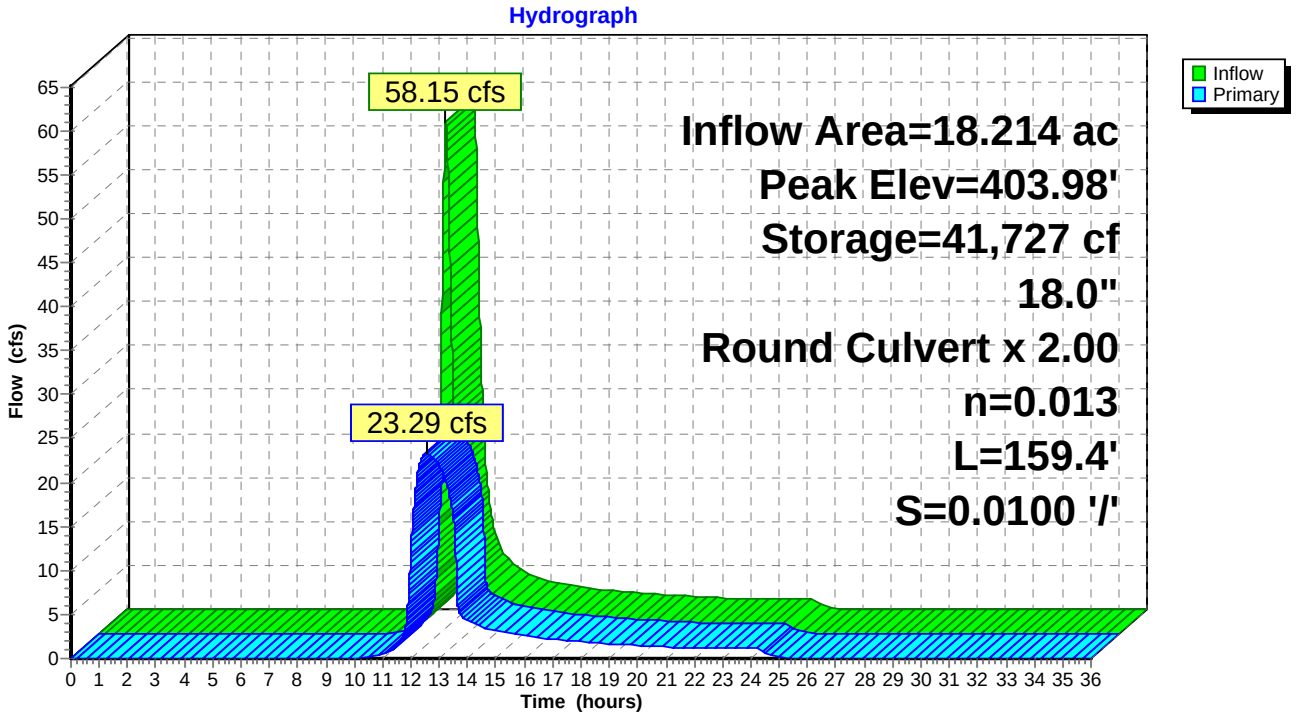
Volume	Invert	Avail.Storage	Storage Description
#1	400.25'	239,681 cf	**Custom Stage Data (Prismatic)** Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
400.25	0	0	0
401.00	557	209	209
402.00	2,553	1,555	1,764
403.00	16,466	9,510	11,273
404.00	46,676	31,571	42,844
405.00	94,316	70,496	113,340
406.00	158,366	126,341	239,681

Device	Routing	Invert	Outlet Devices
#1	Primary	400.22'	**18.0" Round Dual HDPE_Round 18" X 2.00** L= 159.4' CPP, projecting, no headwall, Ke= 0.900 Inlet / Outlet Invert= 400.22' / 398.63' S= 0.0100 '/' Cc= 0.900 n= 0.013 Corrugated PE, smooth interior, Flow Area= 1.77 sf

Primary OutFlow Max=23.29 cfs @ 12.55 hrs HW=403.98' (Free Discharge)
1=Dual HDPE_Round 18" (Inlet Controls 23.29 cfs @ 6.59 fps)

Pond O2: Outlet 2



Summary for Pond O3: Outlet 3

Inflow Area = 19.345 ac, 0.00% Impervious, Inflow Depth = 3.12" for 100 Yr event
Inflow = 60.67 cfs @ 12.26 hrs, Volume= 5.030 af
Outflow = 23.63 cfs @ 12.58 hrs, Volume= 5.030 af, Atten= 61%, Lag= 19.5 min
Primary = 23.63 cfs @ 12.58 hrs, Volume= 5.030 af

Routing by Stor-Ind method, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
Peak Elev= 404.06' @ 12.58 hrs Surf.Area= 49,055 sf Storage= 45,654 cf

Plug-Flow detention time= 12.0 min calculated for 5.029 af (100% of inflow)
Center-of-Mass det. time= 12.0 min (880.3 - 868.2)

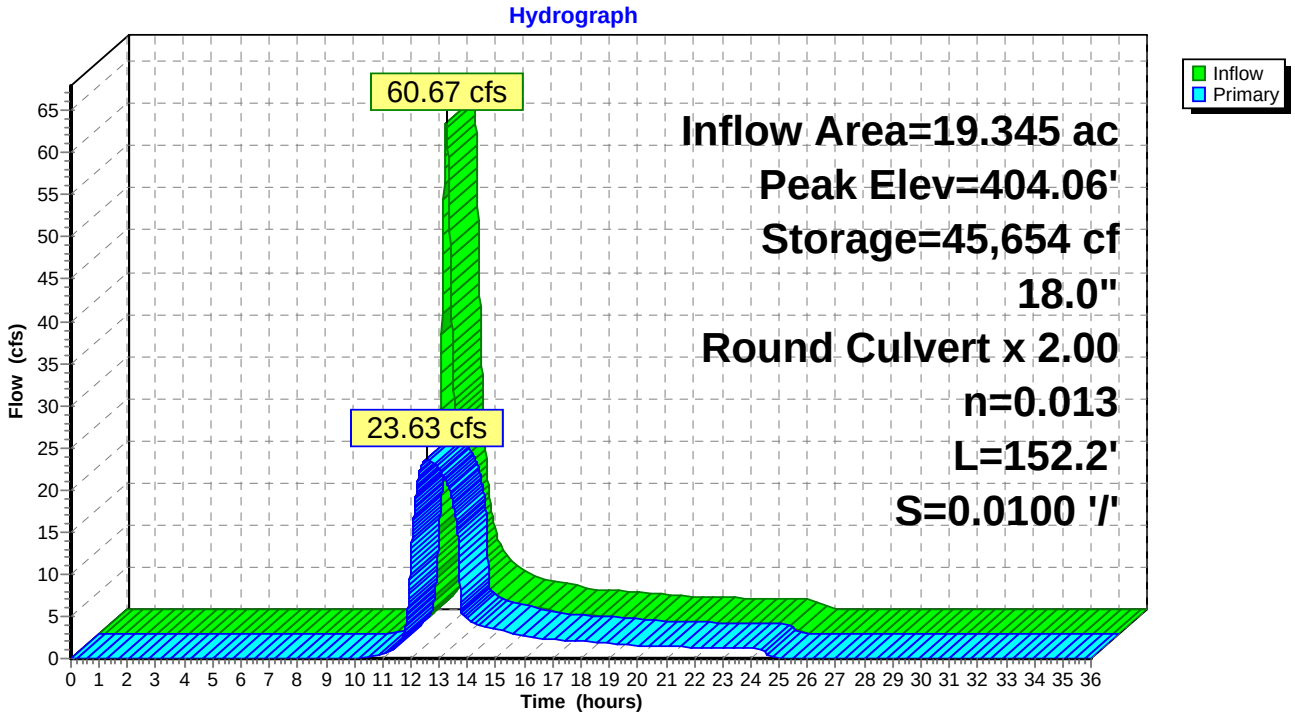
Volume	Invert	Avail.Storage	Storage Description
#1	400.29'	426,445 cf	**Custom Stage Data (Prismatic)** Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
400.29	0	0	0
401.00	558	198	198
402.00	2,504	1,531	1,729
403.00	16,565	9,535	11,264
404.00	46,104	31,335	42,598
405.00	92,058	69,081	111,679
406.00	153,474	122,766	234,445
407.00	230,526	192,000	426,445

Device	Routing	Invert	Outlet Devices
#1	Primary	400.22'	**18.0" Round Dual HDPE_Round 18" X 2.00** L= 152.2' CPP, projecting, no headwall, Ke= 0.900 Inlet / Outlet Invert= 400.22' / 398.70' S= 0.0100 '/' Cc= 0.900 n= 0.013 Corrugated PE, smooth interior, Flow Area= 1.77 sf

Primary OutFlow Max=23.63 cfs @ 12.58 hrs HW=404.06' (Free Discharge)
1=Dual HDPE_Round 18" (Inlet Controls 23.63 cfs @ 6.69 fps)

Pond O3: Outlet 3



Summary for Pond O4: Outlet 4

Inflow Area = 14.679 ac, 0.00% Impervious, Inflow Depth = 3.12" for 100 Yr event
Inflow = 46.97 cfs @ 12.24 hrs, Volume= 3.817 af
Outflow = 22.51 cfs @ 12.49 hrs, Volume= 3.817 af, Atten= 52%, Lag= 15.2 min
Primary = 22.51 cfs @ 12.49 hrs, Volume= 3.817 af

Routing by Stor-Ind method, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
Peak Elev= 402.63' @ 12.49 hrs Surf.Area= 31,610 sf Storage= 27,587 cf

Plug-Flow detention time= 7.1 min calculated for 3.817 af (100% of inflow)
Center-of-Mass det. time= 7.1 min (873.6 - 866.5)

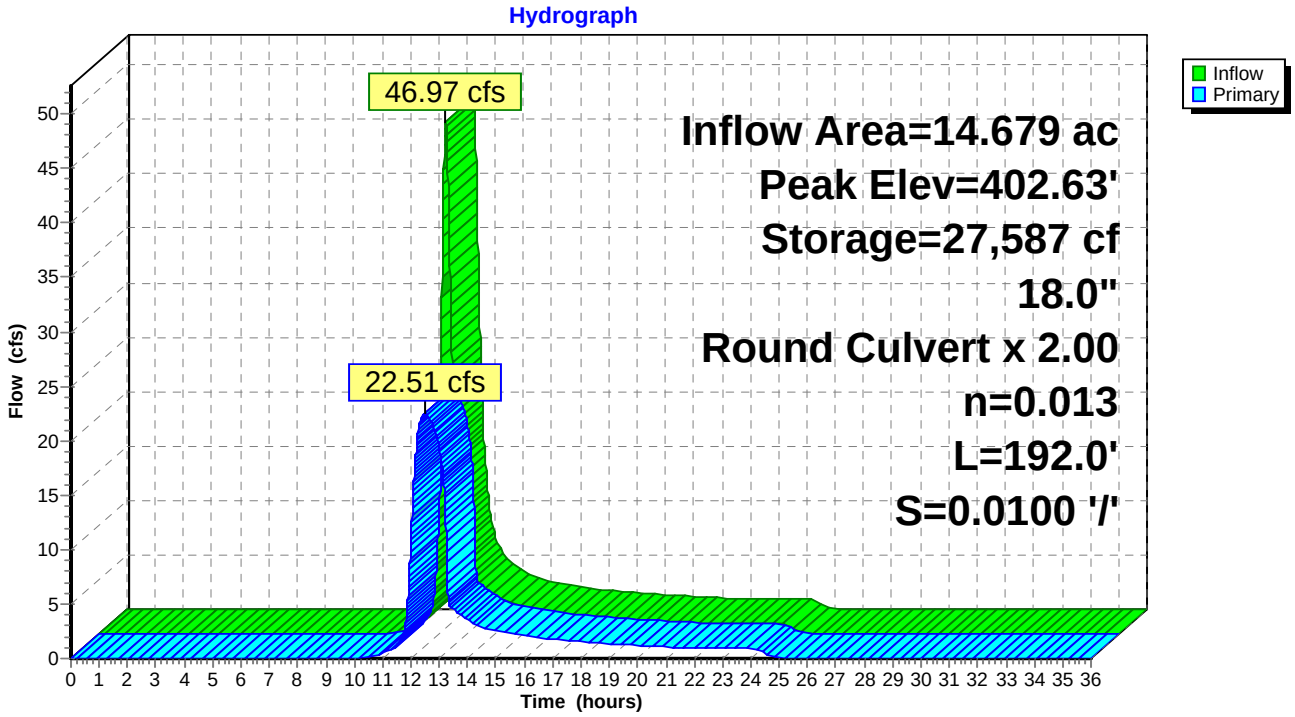
Volume	Invert	Avail.Storage	Storage Description
#1	399.17'	568,136 cf	**Custom Stage Data (Prismatic)** Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
399.17	0	0	0
400.00	549	228	228
401.00	3,640	2,095	2,322
402.00	16,597	10,119	12,441
403.00	40,488	28,543	40,983
404.00	76,724	58,606	99,589
405.00	123,336	100,030	199,619
406.00	181,353	152,345	351,964
407.00	250,992	216,173	568,136

Device	Routing	Invert	Outlet Devices
#1	Primary	399.07'	**18.0" Round Dual HDPE_Round 18" X 2.00** L= 192.0' CPP, projecting, no headwall, Ke= 0.900 Inlet / Outlet Invert= 399.07' / 397.15' S= 0.0100 '/' Cc= 0.900 n= 0.013 Corrugated PE, smooth interior, Flow Area= 1.77 sf

Primary OutFlow Max=22.51 cfs @ 12.49 hrs HW=402.63' (Free Discharge)
1=Dual HDPE_Round 18" (Inlet Controls 22.51 cfs @ 6.37 fps)

Pond O4: Outlet 4



Summary for Pond O5: Outlet 5

Inflow Area = 3.718 ac, 0.00% Impervious, Inflow Depth = 3.12" for 100 Yr event
Inflow = 15.89 cfs @ 12.10 hrs, Volume= 0.967 af
Outflow = 4.27 cfs @ 12.37 hrs, Volume= 0.967 af, Atten= 73%, Lag= 16.0 min
Primary = 4.27 cfs @ 12.37 hrs, Volume= 0.967 af

Routing by Stor-Ind method, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
Peak Elev= 402.65' @ 12.37 hrs Surf.Area= 11,780 sf Storage= 11,473 cf

Plug-Flow detention time= 20.2 min calculated for 0.966 af (100% of inflow)
Center-of-Mass det. time= 20.2 min (874.9 - 854.7)

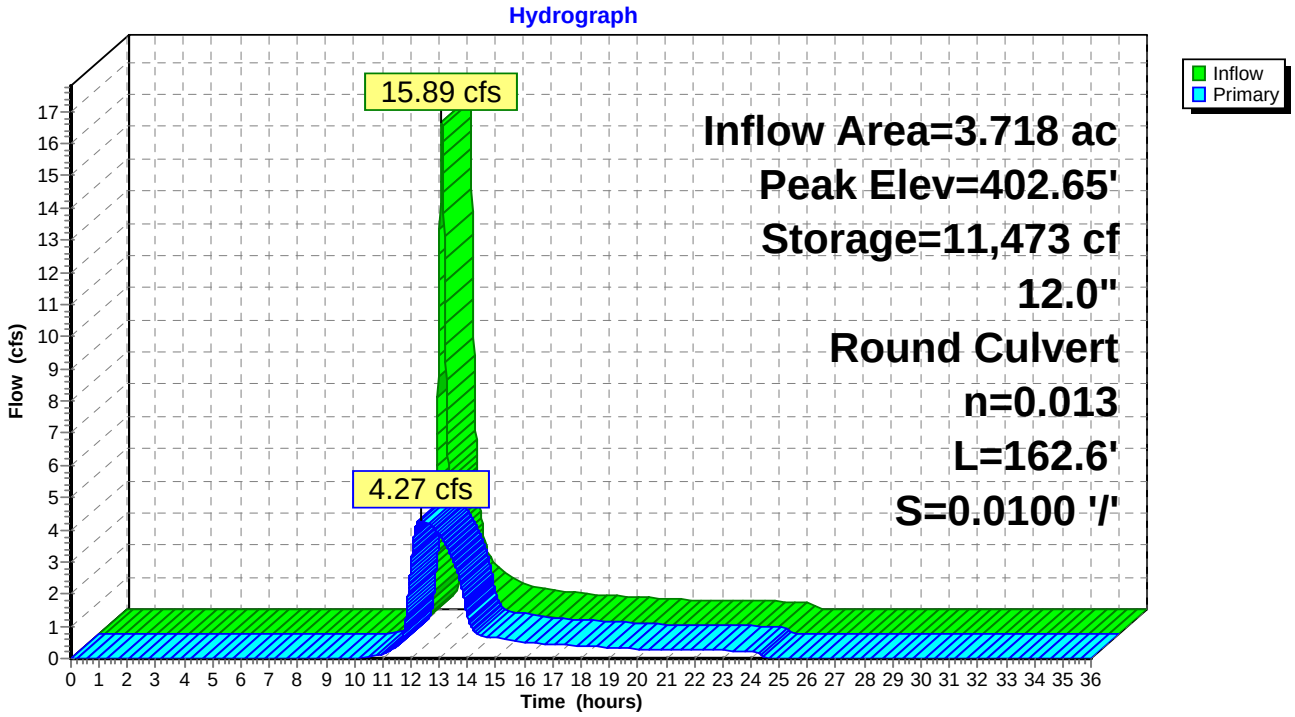
Volume	Invert	Avail.Storage	Storage Description
#1	400.06'	360,355 cf	**Custom Stage Data (Prismatic)** Listed below (Recalc)

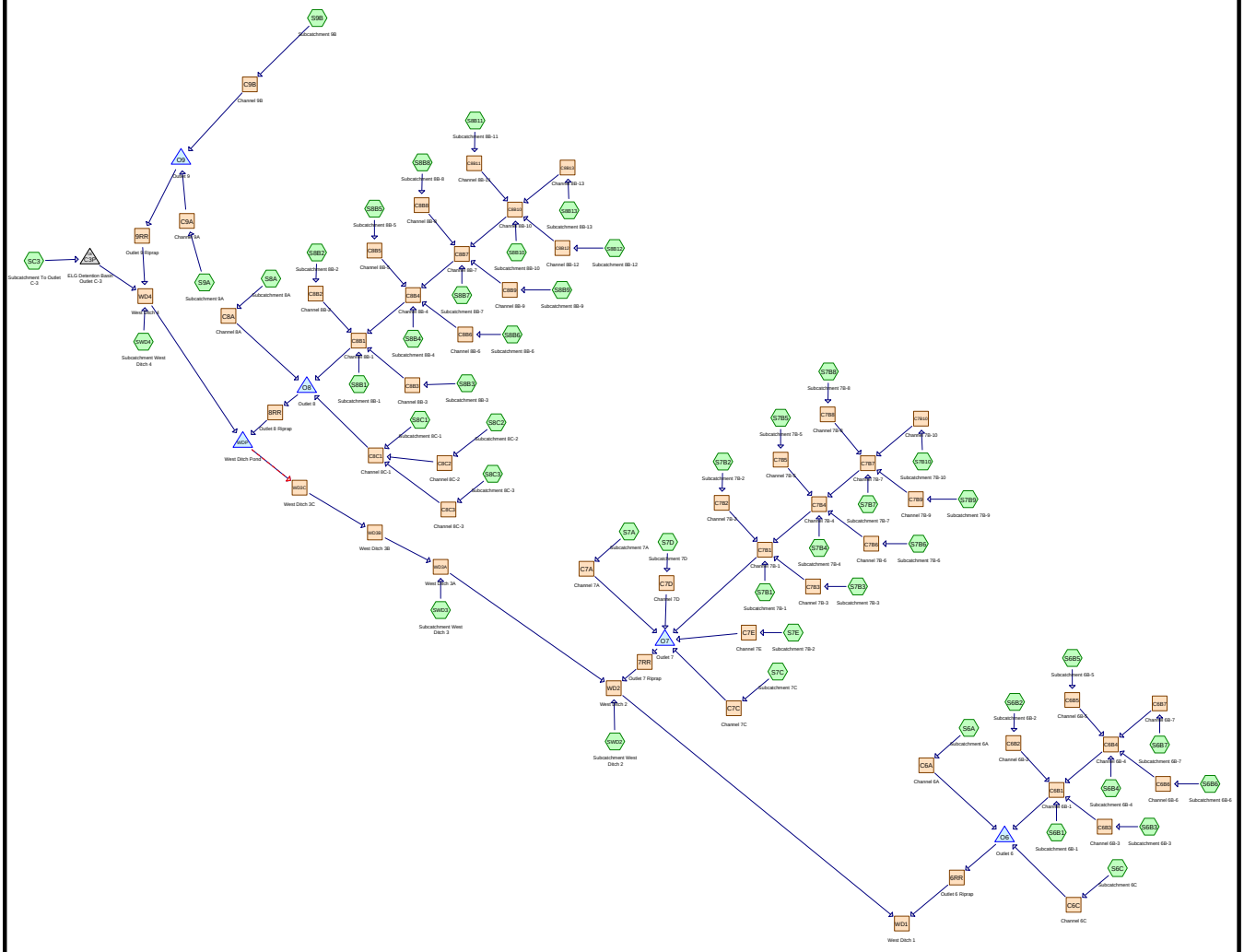
Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
400.06	0	0	0
401.00	2,018	948	948
402.00	6,877	4,448	5,396
403.00	14,403	10,640	16,036
404.00	24,594	19,499	35,534
405.00	37,486	31,040	66,574
406.00	53,086	45,286	111,860
407.00	71,401	62,244	174,104
408.00	92,441	81,921	256,025
409.00	116,219	104,330	360,355

Device	Routing	Invert	Outlet Devices
#1	Primary	400.06'	**12.0" Round Culvert** L= 162.6' CPP, projecting, no headwall, Ke= 0.900 Inlet / Outlet Invert= 400.06' / 398.43' S= 0.0100 '/' Cc= 0.900 n= 0.013 Corrugated PE, smooth interior, Flow Area= 0.79 sf

Primary OutFlow Max=4.27 cfs @ 12.37 hrs HW=402.65' (Free Discharge)
1=Culvert (Barrel Controls 4.27 cfs @ 5.44 fps)

Pond O5: Outlet 5





Subcat Reach Pond Link

Routing Diagram for 129530 - RCPA Closure_WEST_2017-12-18
Prepared by {enter your company name here}, Printed 5/29/2018
HydroCAD® 10.00 s/n 08262 © 2013 HydroCAD Software Solutions LLC

Area Listing (all nodes)

Area (acres)	CN	Description (subcatchment-numbers)
74.185	61	>75% Grass cover, Good, HSG B (S6A, S6B1, S6B2, S6B3, S6B4, S6B5, S6B6, S6B7, S6C, S7A, S7B1, S7B10, S7B2, S7B3, S7B4, S7B5, S7B6, S7B7, S7B8, S7B9, S7C, S7D, S7E, S8A, S8B1, S8B10, S8B11, S8B12, S8B13, S8B2, S8B3, S8B4, S8B5, S8B6, S8B7, S8B8, S8B9, S8C1, S8C2, S8C3, S9A, S9B, SC3, SWD2, SWD3, SWD4)
74.185	**61**	**TOTAL AREA**

Soil Listing (all nodes)

Area (acres)	Soil Group	Subcatchment Numbers
0.000	HSG A	
74.185	HSG B	S6A, S6B1, S6B2, S6B3, S6B4, S6B5, S6B6, S6B7, S6C, S7A, S7B1, S7B10, S7B2, S7B3, S7B4, S7B5, S7B6, S7B7, S7B8, S7B9, S7C, S7D, S7E, S8A, S8B1, S8B10, S8B11, S8B12, S8B13, S8B2, S8B3, S8B4, S8B5, S8B6, S8B7, S8B8, S8B9, S8C1, S8C2, S8C3, S9A, S9B, SC3, SWD2, SWD3, SWD4
0.000	HSG C	
0.000	HSG D	
0.000	Other	
74.185		**TOTAL AREA**

Ground Covers (all nodes)

HSG-A (acres)	HSG-B (acres)	HSG-C (acres)	HSG-D (acres)	Other (acres)	Total (acres)	Ground Cover	Subcatchment Numbers
0.000	74.185	0.000	0.000	0.000	74.185	>75% Grass cover, Good	S6A, S6B1, S6B2, S6B3, S6B4, S6B5, S6B6, S6B7, S6C, S7A, S7B1, S7B10, S7B2, S7B3, S7B4, S7B5, S7B6, S7B7, S7B8, S7B9, S7C, S7D, S7E, S8A, S8B1, S8B10, S8B11, S8B12, S8B13, S8B2, S8B3, S8B4, S8B5, S8B6, S8B7, S8B8, S8B9, S8C1, S8C2, S8C3, S9A, S9B, SC3, SWD2, SWD3, SWD4

Ground Covers (all nodes) (continued)

HSG-A (acres)	HSG-B (acres)	HSG-C (acres)	HSG-D (acres)	Other (acres)	Total (acres)	Ground Cover	Subcatchment Numbers
0.000	**74.185**	**0.000**	**0.000**	**0.000**	**74.185**	**TOTAL AREA**	

Pipe Listing (all nodes)

Line#	Node Number	In-Invert (feet)	Out-Invert (feet)	Length (feet)	Slope (ft/ft)	n	Diam/Width (inches)	Height (inches)	Inside-Fill (inches)
1	C3P	401.25	401.00	90.0	0.0028	0.013	36.0	0.0	0.0
2	O6	399.48	397.79	162.7	0.0104	0.013	18.0	0.0	0.0
3	O7	400.21	398.70	150.3	0.0100	0.013	18.0	0.0	0.0
4	O8	400.19	398.57	162.1	0.0100	0.013	18.0	0.0	0.0
5	O9	403.04	400.96	207.6	0.0100	0.013	12.0	0.0	0.0
6	WDP	396.52	396.31	43.1	0.0049	0.011	12.0	0.0	0.0

Time span=0.00-36.00 hrs, dt=0.01 hrs, 3601 points
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN
Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

Subcatchment S6A: Subcatchment 6A Runoff Area=107,669 sf 0.00% Impervious Runoff Depth=1.93"
Flow Length=266' Slope=0.0200 '/' Tc=17.7 min CN=61 Runoff=5.41 cfs 0.397 af

Subcatchment S6B1: Subcatchment 6B-1 Runoff Area=11,969 sf 0.00% Impervious Runoff Depth=1.93"
Flow Length=86' Slope=0.0202 '/' Tc=13.1 min CN=61 Runoff=0.71 cfs 0.044 af

Subcatchment S6B2: Subcatchment 6B-2 Runoff Area=87,104 sf 0.00% Impervious Runoff Depth=1.93"
Flow Length=287' Tc=18.1 min CN=61 Runoff=4.32 cfs 0.321 af

Subcatchment S6B3: Subcatchment 6B-3 Runoff Area=68,355 sf 0.00% Impervious Runoff Depth=1.93"
Flow Length=287' Slope=0.0198 '/' Tc=18.1 min CN=61 Runoff=3.39 cfs 0.252 af

Subcatchment S6B4: Subcatchment 6B-4 Runoff Area=48,635 sf 0.00% Impervious Runoff Depth=1.93"
Flow Length=247' Tc=17.4 min CN=61 Runoff=2.47 cfs 0.179 af

Subcatchment S6B5: Subcatchment 6B-5 Runoff Area=87,286 sf 0.00% Impervious Runoff Depth=1.93"
Flow Length=299' Slope=0.0200 '/' Tc=18.3 min CN=61 Runoff=4.30 cfs 0.322 af

Subcatchment S6B6: Subcatchment 6B-6 Runoff Area=57,704 sf 0.00% Impervious Runoff Depth=1.93"
Flow Length=298' Slope=0.0199 '/' Tc=18.2 min CN=61 Runoff=2.86 cfs 0.213 af

Subcatchment S6B7: Subcatchment 6B-7 Runoff Area=51,632 sf 0.00% Impervious Runoff Depth=1.93"
Flow Length=254' Tc=17.5 min CN=61 Runoff=2.62 cfs 0.190 af

Subcatchment S6C: Subcatchment 6C Runoff Area=88,097 sf 0.00% Impervious Runoff Depth=1.93"
Flow Length=256' Slope=0.0200 '/' Tc=17.5 min CN=61 Runoff=4.46 cfs 0.325 af

Subcatchment S7A: Subcatchment 7A Runoff Area=50,266 sf 0.00% Impervious Runoff Depth=1.93"
Flow Length=233' Slope=0.0190 '/' Tc=17.5 min CN=61 Runoff=2.55 cfs 0.185 af

Subcatchment S7B1: Subcatchment 7B-1 Runoff Area=43,024 sf 0.00% Impervious Runoff Depth=1.93"
Flow Length=275' Slope=0.0187 '/' Tc=18.3 min CN=61 Runoff=2.12 cfs 0.158 af

Subcatchment S7B10: Subcatchment 7B-10 Runoff Area=44,287 sf 0.00% Impervious Runoff Depth=1.93"
Flow Length=273' Slope=0.0191 '/' Tc=18.1 min CN=61 Runoff=2.20 cfs 0.163 af

Subcatchment S7B2: Subcatchment 7B-2 Runoff Area=63,449 sf 0.00% Impervious Runoff Depth=1.93"
Flow Length=286' Slope=0.0189 '/' Tc=18.4 min CN=61 Runoff=3.12 cfs 0.234 af

Subcatchment S7B3: Subcatchment 7B-3 Runoff Area=69,275 sf 0.00% Impervious Runoff Depth=1.93"
Flow Length=222' Tc=17.7 min CN=61 Runoff=3.48 cfs 0.255 af

Subcatchment S7B4: Subcatchment 7B-4 Runoff Area=42,441 sf 0.00% Impervious Runoff Depth=1.93"
Flow Length=270' Tc=18.1 min CN=61 Runoff=2.11 cfs 0.156 af

Subcatchment S7B5: Subcatchment 7B-5 Runoff Area=64,377 sf 0.00% Impervious Runoff Depth=1.93"
Flow Length=289' Slope=0.0190 '/' Tc=18.5 min CN=61 Runoff=3.15 cfs 0.237 af

Subcatchment S7B6: Subcatchment 7B-6 Runoff Area=73,533 sf 0.00% Impervious Runoff Depth=1.93"
Flow Length=219' Slope=0.0181 '/' Tc=17.6 min CN=61 Runoff=3.71 cfs 0.271 af

Subcatchment S7B7: Subcatchment 7B-7 Runoff Area=41,018 sf 0.00% Impervious Runoff Depth=1.93"
Flow Length=264' Slope=0.0190 '/' Tc=18.0 min CN=61 Runoff=2.04 cfs 0.151 af

Subcatchment S7B8: Subcatchment 7B-8 Runoff Area=67,702 sf 0.00% Impervious Runoff Depth=1.93"
Flow Length=300' Slope=0.0191 '/' Tc=18.5 min CN=61 Runoff=3.31 cfs 0.249 af

Subcatchment S7B9: Subcatchment 7B-9 Runoff Area=70,336 sf 0.00% Impervious Runoff Depth=1.93"
Flow Length=243' Slope=0.0181 '/' Tc=18.0 min CN=61 Runoff=3.50 cfs 0.259 af

Subcatchment S7C: Subcatchment 7C Runoff Area=59,435 sf 0.00% Impervious Runoff Depth=1.93"
Flow Length=234' Slope=0.0180 '/' Tc=17.9 min CN=61 Runoff=2.97 cfs 0.219 af

Subcatchment S7D: Subcatchment 7D Runoff Area=55,095 sf 0.00% Impervious Runoff Depth=1.93"
Flow Length=285' Slope=0.0187 '/' Tc=18.5 min CN=61 Runoff=2.70 cfs 0.203 af

Subcatchment S7E: Subcatchment 7B-2 Runoff Area=59,001 sf 0.00% Impervious Runoff Depth=1.93"
Flow Length=222' Tc=17.8 min CN=61 Runoff=2.96 cfs 0.217 af

Subcatchment S8A: Subcatchment 8A Runoff Area=60,732 sf 0.00% Impervious Runoff Depth=1.93"
Flow Length=242' Slope=0.0180 '/' Tc=18.0 min CN=61 Runoff=3.02 cfs 0.224 af

Subcatchment S8B1: Subcatchment 8B-1 Runoff Area=29,334 sf 0.00% Impervious Runoff Depth=1.93"
Flow Length=186' Tc=16.9 min CN=61 Runoff=1.52 cfs 0.108 af

Subcatchment S8B10: Subcatchment 8B-10 Runoff Area=41,538 sf 0.00% Impervious Runoff Depth=1.93"
Flow Length=238' Tc=17.7 min CN=61 Runoff=2.09 cfs 0.153 af

Subcatchment S8B11: Subcatchment 8B-11 Runoff Area=58,315 sf 0.00% Impervious Runoff Depth=1.93"
Flow Length=249' Slope=0.0180 '/' Tc=18.1 min CN=61 Runoff=2.89 cfs 0.215 af

Subcatchment S8B12: Subcatchment 8B-12 Runoff Area=63,277 sf 0.00% Impervious Runoff Depth=1.93"
Flow Length=256' Slope=0.0190 '/' Tc=17.9 min CN=61 Runoff=3.17 cfs 0.233 af

Subcatchment S8B13: Subcatchment 8B-13 Runoff Area=45,176 sf 0.00% Impervious Runoff Depth=1.93"
Flow Length=256' Slope=0.0180 '/' Tc=18.3 min CN=61 Runoff=2.23 cfs 0.166 af

Subcatchment S8B2: Subcatchment 8B-2 Runoff Area=50,121 sf 0.00% Impervious Runoff Depth=1.93"
Flow Length=239' Tc=18.1 min CN=61 Runoff=2.49 cfs 0.185 af

Subcatchment S8B3: Subcatchment 8B-3 Runoff Area=70,613 sf 0.00% Impervious Runoff Depth=1.93"
Flow Length=223' Slope=0.0189 '/' Tc=17.3 min CN=61 Runoff=3.60 cfs 0.260 af

Subcatchment S8B4: Subcatchment 8B-4 Runoff Area=41,972 sf 0.00% Impervious Runoff Depth=1.93"
Flow Length=247' Tc=18.1 min CN=61 Runoff=2.08 cfs 0.155 af

Subcatchment S8B5: Subcatchment 8B-5 Runoff Area=54,051 sf 0.00% Impervious Runoff Depth=1.93"
Flow Length=249' Slope=0.0180 '/' Tc=18.1 min CN=61 Runoff=2.68 cfs 0.199 af

Subcatchment S8B6: Subcatchment 8B-6 Runoff Area=71,026 sf 0.00% Impervious Runoff Depth=1.93"
Flow Length=223' Slope=0.0190 '/' Tc=17.3 min CN=61 Runoff=3.62 cfs 0.262 af

Subcatchment S8B7: Subcatchment 8B-7 Runoff Area=41,671 sf 0.00% Impervious Runoff Depth=1.93"
Flow Length=242' Slope=0.0178 '/' Tc=18.1 min CN=61 Runoff=2.07 cfs 0.154 af

Subcatchment S8B8: Subcatchment 8B-8 Runoff Area=56,491 sf 0.00% Impervious Runoff Depth=1.93"
Flow Length=252' Slope=0.0180 '/' Tc=18.2 min CN=61 Runoff=2.80 cfs 0.208 af

Subcatchment S8B9: Subcatchment 8B-9 Runoff Area=71,094 sf 0.00% Impervious Runoff Depth=1.93"
Flow Length=240' Slope=0.0190 '/' Tc=17.6 min CN=61 Runoff=3.59 cfs 0.262 af

Subcatchment S8C1: Subcatchment 8C-1 Runoff Area=27,926 sf 0.00% Impervious Runoff Depth=1.93"
Flow Length=281' Slope=0.0190 '/' Tc=18.3 min CN=61 Runoff=1.38 cfs 0.103 af

Subcatchment S8C2: Subcatchment 8C-2 Runoff Area=48,818 sf 0.00% Impervious Runoff Depth=1.93"
Flow Length=223' Tc=17.2 min CN=61 Runoff=2.50 cfs 0.180 af

Subcatchment S8C3: Subcatchment 8C-3 Runoff Area=52,295 sf 0.00% Impervious Runoff Depth=1.93"
Flow Length=231' Slope=0.0190 '/' Tc=17.5 min CN=61 Runoff=2.65 cfs 0.193 af

Subcatchment S9A: Subcatchment 9A Runoff Area=13,386 sf 0.00% Impervious Runoff Depth=1.93"
Flow Length=31' Slope=0.2000 '/' Tc=2.3 min CN=61 Runoff=1.22 cfs 0.049 af

Subcatchment S9B: Subcatchment 9B Runoff Area=33,728 sf 0.00% Impervious Runoff Depth=1.93"
Flow Length=46' Slope=0.2000 '/' Tc=3.2 min CN=61 Runoff=2.96 cfs 0.124 af

Subcatchment SC3: Subcatchment To Runoff Area=122,354 sf 0.00% Impervious Runoff Depth=1.93"
Tc=5.0 min CN=61 Runoff=10.00 cfs 0.451 af

Subcatchment SWD2: Subcatchment West Runoff Area=311,837 sf 0.00% Impervious Runoff Depth=1.93"
Tc=0.0 min CN=61 Runoff=30.56 cfs 1.149 af

Subcatchment SWD3: Subcatchment West Runoff Area=183,615 sf 0.00% Impervious Runoff Depth=1.93"
Tc=0.0 min CN=61 Runoff=17.99 cfs 0.676 af

Subcatchment SWD4: Subcatchment West Runoff Area=270,446 sf 0.00% Impervious Runoff Depth=1.93"
Tc=0.0 min CN=61 Runoff=26.50 cfs 0.996 af

Reach 6RR: Outlet 6 Riprap Avg. Flow Depth=0.55' Max Vel=5.06 fps Inflow=18.47 cfs 2.241 af
n=0.070 L=100.9' S=0.1746 '/' Capacity=125.03 cfs Outflow=18.47 cfs 2.241 af

Reach 7RR: Outlet 7 Riprap Avg. Flow Depth=0.39' Max Vel=5.95 fps Inflow=20.06 cfs 2.959 af
n=0.070 L=65.0' S=0.3338 '/' Capacity=229.48 cfs Outflow=20.06 cfs 2.959 af

Reach 8RR: Outlet 8 Riprap Avg. Flow Depth=0.68' Max Vel=6.00 fps Inflow=20.60 cfs 3.258 af
n=0.070 L=7.5' S=0.2187 '/' Capacity=104.18 cfs Outflow=20.60 cfs 3.258 af

Reach 9RR: Outlet 9 Riprap Avg. Flow Depth=0.33' Max Vel=1.88 fps Inflow=2.52 cfs 0.174 af
n=0.070 L=4.5' S=0.0467 '/' Capacity=48.13 cfs Outflow=2.52 cfs 0.174 af

Reach C6A: Channel 6A Avg. Flow Depth=0.31' Max Vel=1.81 fps Inflow=5.41 cfs 0.397 af
n=0.027 L=582.3' S=0.0129 '/' Capacity=319.25 cfs Outflow=4.84 cfs 0.397 af

Reach C6B1: Channel 6B-1 Avg. Flow Depth=0.88' Max Vel=3.03 fps Inflow=17.83 cfs 1.520 af
n=0.045 L=88.7' S=0.0162 '/' Capacity=51.67 cfs Outflow=17.81 cfs 1.520 af

Reach C6B2: Channel 6B-2 Avg. Flow Depth=0.29' Max Vel=1.83 fps Inflow=4.32 cfs 0.321 af
n=0.027 L=519.3' S=0.0149 '/' Capacity=112.00 cfs Outflow=3.95 cfs 0.321 af

Reach C6B3: Channel 6B-3 Avg. Flow Depth=0.26' Max Vel=1.73 fps Inflow=3.39 cfs 0.252 af
n=0.027 L=420.3' S=0.0149 '/' Capacity=111.98 cfs Outflow=3.17 cfs 0.252 af

Reach C6B4: Channel 6B-4 Avg. Flow Depth=0.67' Max Vel=2.61 fps Inflow=10.50 cfs 0.904 af
n=0.045 L=198.6' S=0.0162 '/' Capacity=51.64 cfs Outflow=10.45 cfs 0.904 af

Reach C6B5: Channel 6B-5 Avg. Flow Depth=0.28' Max Vel=1.83 fps Inflow=4.30 cfs 0.322 af
n=0.027 L=550.0' S=0.0150 '/' Capacity=112.15 cfs Outflow=3.90 cfs 0.322 af

Reach C6B6: Channel 6B-6 Avg. Flow Depth=0.24' Max Vel=1.71 fps Inflow=2.86 cfs 0.213 af
n=0.027 L=433.2' S=0.0161 '/' Capacity=116.37 cfs Outflow=2.65 cfs 0.213 af

Reach C6B7: Channel 6B-7 Avg. Flow Depth=0.31' Max Vel=1.70 fps Inflow=2.62 cfs 0.190 af
n=0.045 L=181.9' S=0.0163 '/' Capacity=51.73 cfs Outflow=2.58 cfs 0.190 af

Reach C6C: Channel 6C Avg. Flow Depth=0.28' Max Vel=1.84 fps Inflow=4.46 cfs 0.325 af
n=0.027 L=551.1' S=0.0152 '/' Capacity=346.19 cfs Outflow=4.02 cfs 0.325 af

Reach C7A: Channel 7A Avg. Flow Depth=0.23' Max Vel=1.58 fps Inflow=2.55 cfs 0.185 af
n=0.027 L=531.3' S=0.0150 '/' Capacity=343.41 cfs Outflow=2.25 cfs 0.185 af

Reach C7B1: Channel 7B-1 Avg. Flow Depth=1.10' Max Vel=2.98 fps Inflow=23.90 cfs 2.135 af
n=0.045 L=151.5' S=0.0124 '/' Capacity=45.18 cfs Outflow=23.84 cfs 2.135 af

Reach C7B10: Channel 7B-10 Avg. Flow Depth=0.30' Max Vel=1.47 fps Inflow=2.20 cfs 0.163 af
n=0.045 L=141.7' S=0.0124 '/' Capacity=45.20 cfs Outflow=2.18 cfs 0.163 af

Reach C7B2: Channel 7B-2 Avg. Flow Depth=0.25' Max Vel=1.74 fps Inflow=3.12 cfs 0.234 af
n=0.027 L=533.9' S=0.0162 '/' Capacity=116.76 cfs Outflow=2.82 cfs 0.234 af

Reach C7B3: Channel 7B-3 Avg. Flow Depth=0.26' Max Vel=1.73 fps Inflow=3.48 cfs 0.255 af
n=0.027 L=541.5' S=0.0149 '/' Capacity=112.06 cfs Outflow=3.13 cfs 0.255 af

Reach C7B4: Channel 7B-4 Avg. Flow Depth=0.92' Max Vel=2.70 fps Inflow=16.74 cfs 1.487 af
n=0.045 L=157.6' S=0.0124 '/' Capacity=45.11 cfs Outflow=16.69 cfs 1.487 af

Reach C7B5: Channel 7B-5 Avg. Flow Depth=0.24' Max Vel=1.73 fps Inflow=3.15 cfs 0.237 af
n=0.027 L=536.5' S=0.0162 '/' Capacity=121.12 cfs Outflow=2.85 cfs 0.237 af

Reach C7B6: Channel 7B-6 Avg. Flow Depth=0.27' Max Vel=1.75 fps Inflow=3.71 cfs 0.271 af
n=0.027 L=563.2' S=0.0150 '/' Capacity=112.16 cfs Outflow=3.31 cfs 0.271 af

Reach C7B7: Channel 7B-7 Avg. Flow Depth=0.67' Max Vel=2.29 fps Inflow=9.26 cfs 0.823 af
n=0.045 L=157.6' S=0.0124 '/' Capacity=45.23 cfs Outflow=9.23 cfs 0.823 af

Reach C7B8: Channel 7B-8 Avg. Flow Depth=0.25' Max Vel=1.76 fps Inflow=3.31 cfs 0.249 af
n=0.027 L=539.2' S=0.0162 '/' Capacity=116.66 cfs Outflow=3.00 cfs 0.249 af

Reach C7B9: Channel 7B-9 Avg. Flow Depth=0.26' Max Vel=1.73 fps Inflow=3.50 cfs 0.259 af
n=0.027 L=586.4' S=0.0150 '/' Capacity=112.37 cfs Outflow=3.10 cfs 0.259 af

Reach C7C: Channel 7C Avg. Flow Depth=0.25' Max Vel=1.56 fps Inflow=2.97 cfs 0.219 af
n=0.027 L=524.7' S=0.0131 '/' Capacity=321.24 cfs Outflow=2.64 cfs 0.219 af

Reach C7D: Channel 7D Avg. Flow Depth=0.24' Max Vel=1.69 fps Inflow=2.70 cfs 0.203 af
n=0.027 L=374.2' S=0.0162 '/' Capacity=116.57 cfs Outflow=2.55 cfs 0.203 af

Reach C7E: Channel 7E Avg. Flow Depth=0.25' Max Vel=1.68 fps Inflow=2.96 cfs 0.217 af
n=0.027 L=397.5' S=0.0150 '/' Capacity=112.17 cfs Outflow=2.76 cfs 0.217 af

Reach C8A: Channel 8A Avg. Flow Depth=0.24' Max Vel=1.78 fps Inflow=3.02 cfs 0.224 af
n=0.027 L=457.9' S=0.0177 '/' Capacity=373.85 cfs Outflow=2.80 cfs 0.224 af

Reach C8B1: Channel 8B-1 Avg. Flow Depth=1.22' Max Vel=3.10 fps Inflow=29.00 cfs 2.559 af
n=0.045 L=123.7' S=0.0119 '/' Capacity=44.21 cfs Outflow=28.96 cfs 2.559 af

Reach C8B10: Channel 8B-10 Avg. Flow Depth=0.66' Max Vel=2.22 fps Inflow=8.89 cfs 0.767 af
n=0.045 L=157.6' S=0.0119 '/' Capacity=44.18 cfs Outflow=8.85 cfs 0.767 af

Reach C8B11: Channel 8B-11 Avg. Flow Depth=0.25' Max Vel=1.66 fps Inflow=2.89 cfs 0.215 af
n=0.027 L=468.4' S=0.0151 '/' Capacity=112.56 cfs Outflow=2.65 cfs 0.215 af

Reach C8B12: Channel 8B-12 Avg. Flow Depth=0.24' Max Vel=1.79 fps Inflow=3.17 cfs 0.233 af
n=0.027 L=560.3' S=0.0175 '/' Capacity=121.31 cfs Outflow=2.84 cfs 0.233 af

Reach C8B13: Channel 8B-13 Avg. Flow Depth=0.31' Max Vel=1.45 fps Inflow=2.23 cfs 0.166 af
n=0.045 L=141.7' S=0.0119 '/' Capacity=44.29 cfs Outflow=2.21 cfs 0.166 af

Reach C8B2: Channel 8B-2 Avg. Flow Depth=0.23' Max Vel=1.60 fps Inflow=2.49 cfs 0.185 af
n=0.027 L=405.7' S=0.0149 '/' Capacity=111.86 cfs Outflow=2.31 cfs 0.185 af

Reach C8B3: Channel 8B-3 Avg. Flow Depth=0.26' Max Vel=1.79 fps Inflow=3.60 cfs 0.260 af
n=0.027 L=574.7' S=0.0161 '/' Capacity=116.44 cfs Outflow=3.21 cfs 0.260 af

Reach C8B4: Channel 8B-4 Avg. Flow Depth=1.09' Max Vel=2.90 fps Inflow=22.90 cfs 2.006 af
n=0.045 L=157.6' S=0.0119 '/' Capacity=44.18 cfs Outflow=22.83 cfs 2.006 af

Reach C8B5: Channel 8B-5 Avg. Flow Depth=0.24' Max Vel=1.63 fps Inflow=2.68 cfs 0.199 af
n=0.027 L=445.5' S=0.0149 '/' Capacity=112.01 cfs Outflow=2.46 cfs 0.199 af

Reach C8B6: Channel 8B-6 Avg. Flow Depth=0.26' Max Vel=1.80 fps Inflow=3.62 cfs 0.262 af
n=0.027 L=577.3' S=0.0162 '/' Capacity=116.68 cfs Outflow=3.23 cfs 0.262 af

Reach C8B7: Channel 8B-7 Avg. Flow Depth=0.90' Max Vel=2.63 fps Inflow=15.99 cfs 1.391 af
n=0.045 L=157.6' S=0.0119 '/' Capacity=44.29 cfs Outflow=15.94 cfs 1.391 af

Reach C8B8: Channel 8B-8 Avg. Flow Depth=0.24' Max Vel=1.64 fps Inflow=2.80 cfs 0.208 af
n=0.027 L=469.2' S=0.0150 '/' Capacity=112.14 cfs Outflow=2.55 cfs 0.208 af

Reach C8B9: Channel 8B-9 Avg. Flow Depth=0.26' Max Vel=1.79 fps Inflow=3.59 cfs 0.262 af
n=0.027 L=580.0' S=0.0162 '/' Capacity=116.59 cfs Outflow=3.20 cfs 0.262 af

Reach C8C1: Channel 8C-1 Avg. Flow Depth=0.32' Max Vel=2.01 fps Inflow=5.72 cfs 0.475 af
n=0.027 L=99.4' S=0.0153 '/' Capacity=347.16 cfs Outflow=5.70 cfs 0.475 af

Reach C8C2: Channel 8C-2 Avg. Flow Depth=0.23' Max Vel=1.65 fps Inflow=2.50 cfs 0.180 af
n=0.027 L=324.6' S=0.0158 '/' Capacity=115.25 cfs Outflow=2.37 cfs 0.180 af

Reach C8C3: Channel 8C-3 Avg. Flow Depth=0.24' Max Vel=1.54 fps Inflow=2.65 cfs 0.193 af
n=0.027 L=481.7' S=0.0136 '/' Capacity=327.12 cfs Outflow=2.37 cfs 0.193 af

Reach C9A: Channel 9A Avg. Flow Depth=0.30' Max Vel=2.47 fps Inflow=1.22 cfs 0.049 af
n=0.027 L=240.5' S=0.0254 '/' Capacity=237.07 cfs Outflow=1.15 cfs 0.049 af

Reach C9B: Channel 9B Avg. Flow Depth=0.49' Max Vel=2.12 fps Inflow=2.96 cfs 0.124 af
n=0.027 L=497.6' S=0.0100 '/' Capacity=148.80 cfs Outflow=2.48 cfs 0.124 af

Reach WD1: West Ditch 1 Avg. Flow Depth=1.39' Max Vel=2.81 fps Inflow=133.58 cfs 202.056 af
n=0.027 L=500.0' S=0.0020 '/' Capacity=37,261.12 cfs Outflow=133.41 cfs 201.449 af

Reach WD2: West Ditch 2 Avg. Flow Depth=1.33' Max Vel=2.55 fps Inflow=117.21 cfs 201.284 af
n=0.027 L=1,126.8' S=0.0017 '/' Capacity=28,641.03 cfs Outflow=115.13 cfs 199.814 af

Reach WD3A: West Ditch 3A Avg. Flow Depth=0.60' Max Vel=5.25 fps Inflow=99.17 cfs 197.621 af
n=0.027 L=721.4' S=0.0190 '/' Capacity=19,260.28 cfs Outflow=98.56 cfs 197.176 af

Reach WD3B: West Ditch 3B Avg. Flow Depth=0.61' Max Vel=5.13 fps Inflow=96.92 cfs 197.019 af
n=0.045 L=118.5' S=0.0500 '/' Capacity=18,722.69 cfs Outflow=96.88 cfs 196.945 af

Reach WD3C: West Ditch 3C Avg. Flow Depth=0.88' Max Vel=3.45 fps Inflow=97.01 cfs 197.157 af
n=0.027 L=147.1' S=0.0050 '/' Capacity=9,902.04 cfs Outflow=96.92 cfs 197.019 af

Reach WD4: West Ditch 4 Avg. Flow Depth=1.67' Max Vel=4.38 fps Inflow=99.35 cfs 195.063 af
n=0.027 L=867.7' S=0.0051 '/' Capacity=923.29 cfs Outflow=94.68 cfs 194.410 af

Pond C3P: ELG Detention Basin Outlet C-3 Peak Elev=403.94' Inflow=75.00 cfs 193.893 af
36.0" Round Culvert x 3.00 n=0.013 L=90.0' S=0.0028 '/' Outflow=75.00 cfs 193.893 af

Pond O6: Outlet 6 Peak Elev=402.12' Storage=7,934 cf Inflow=26.67 cfs 2.241 af
18.0" Round Culvert x 2.00 n=0.013 L=162.7' S=0.0104 '/' Outflow=18.47 cfs 2.241 af

Pond O7: Outlet 7 Peak Elev=403.19' Storage=14,797 cf Inflow=33.62 cfs 2.959 af
18.0" Round Culvert x 2.00 n=0.013 L=150.3' S=0.0100 '/' Outflow=20.06 cfs 2.959 af

Pond O8: Outlet 8 Peak Elev=403.29' Storage=18,344 cf Inflow=37.01 cfs 3.258 af
18.0" Round Culvert x 2.00 n=0.013 L=162.1' S=0.0100 '/' Outflow=20.60 cfs 3.258 af

Pond O9: Outlet 9 Peak Elev=404.25' Storage=578 cf Inflow=3.26 cfs 0.174 af
12.0" Round Culvert n=0.013 L=207.6' S=0.0100 '/' Outflow=2.52 cfs 0.174 af

Pond WDP: West Ditch Pond Peak Elev=400.13' Storage=28,883 cf Inflow=100.79 cfs 197.669 af
Primary=33.36 cfs 92.790 af Secondary=63.65 cfs 104.367 af Outflow=97.01 cfs 197.157 af

Total Runoff Area = 74.185 ac Runoff Volume = 11.905 af Average Runoff Depth = 1.93"
100.00% Pervious = 74.185 ac 0.00% Impervious = 0.000 ac

Summary for Subcatchment S6A: Subcatchment 6A

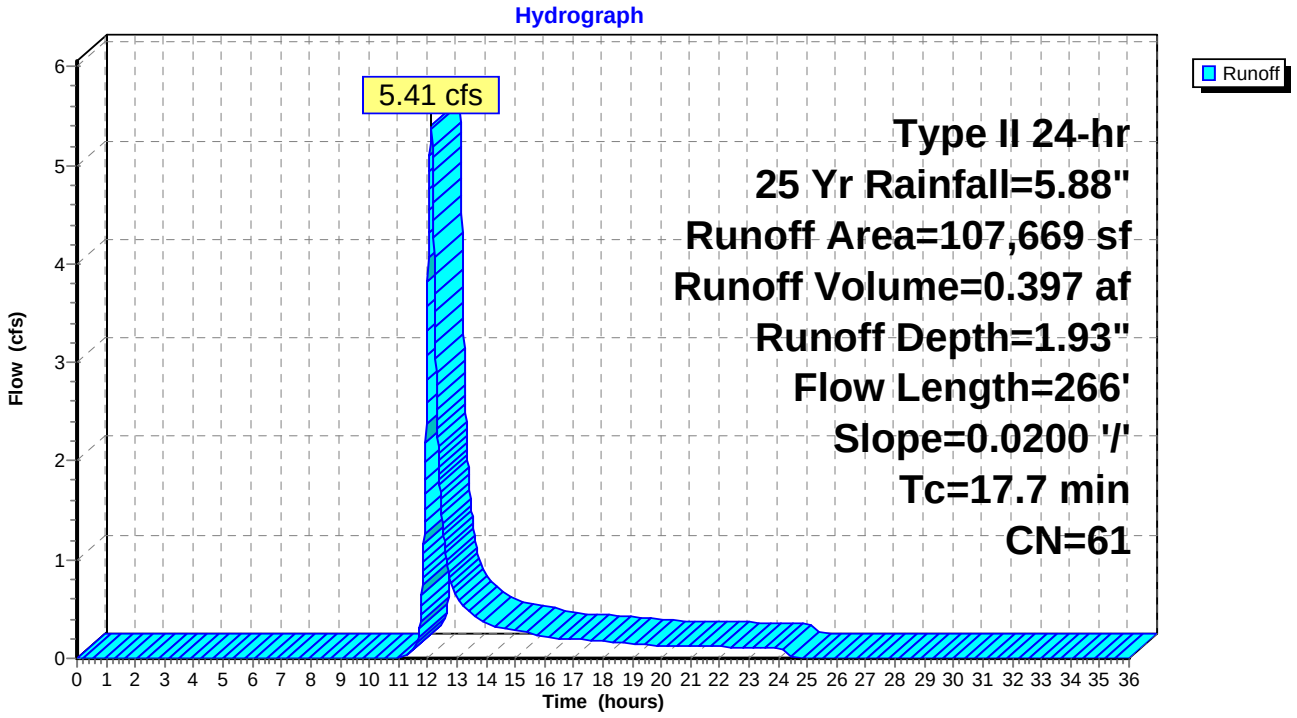
Runoff = 5.41 cfs @ 12.11 hrs, Volume= 0.397 af, Depth= 1.93"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
Type II 24-hr 25 Yr Rainfall=5.88"

Area (sf)	CN	Description
107,669	61	>75% Grass cover, Good, HSG B
107,669		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
14.9	100	0.0200	0.11		**Sheet Flow, Sheet Flow** Grass: Short n= 0.150 P2= 1.39"
2.8	166	0.0200	0.99		**Shallow Concentrated Flow, Shallow Conc.** Short Grass Pasture Kv= 7.0 fps
17.7	266	Total			

Subcatchment S6A: Subcatchment 6A



Summary for Subcatchment S6B1: Subcatchment 6B-1

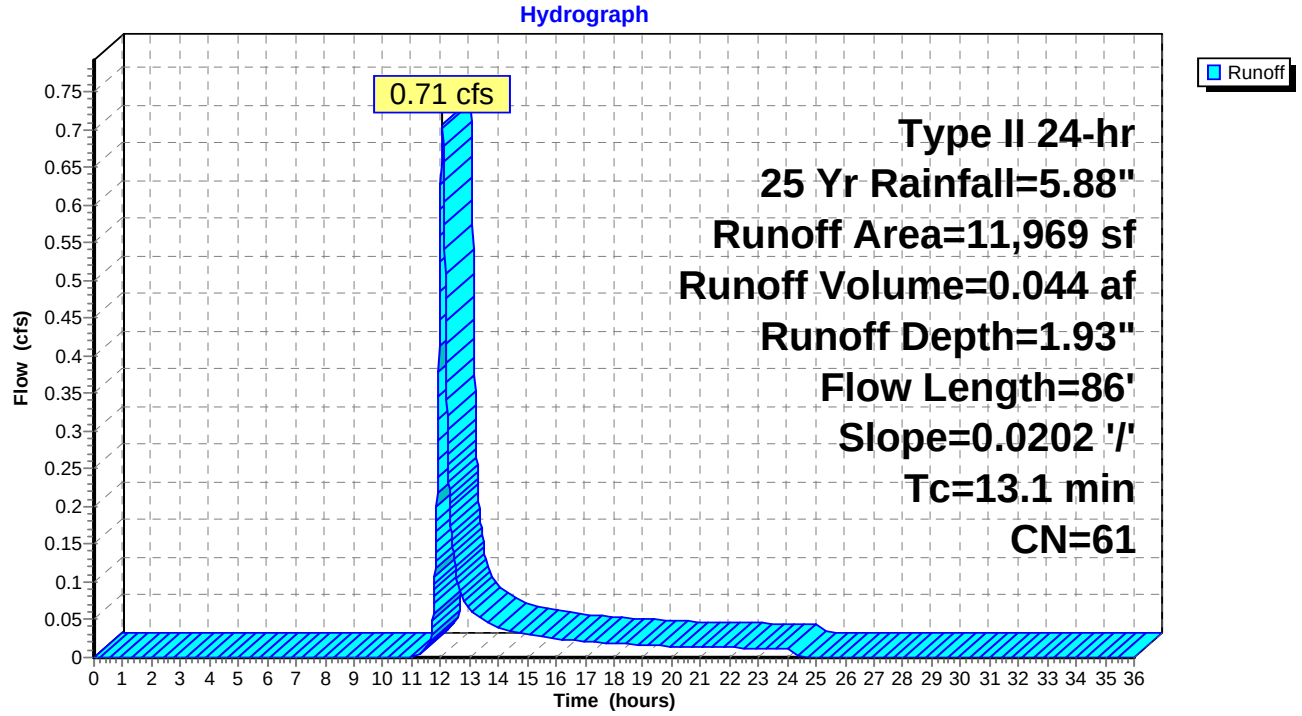
Runoff = 0.71 cfs @ 12.06 hrs, Volume= 0.044 af, Depth= 1.93"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
Type II 24-hr 25 Yr Rainfall=5.88"

Area (sf)	CN	Description
11,969	61	>75% Grass cover, Good, HSG B
11,969		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
13.1	86	0.0202	0.11		**Sheet Flow, Sheet Flow** Grass: Short n= 0.150 P2= 1.39"

Subcatchment S6B1: Subcatchment 6B-1



Summary for Subcatchment S6B2: Subcatchment 6B-2

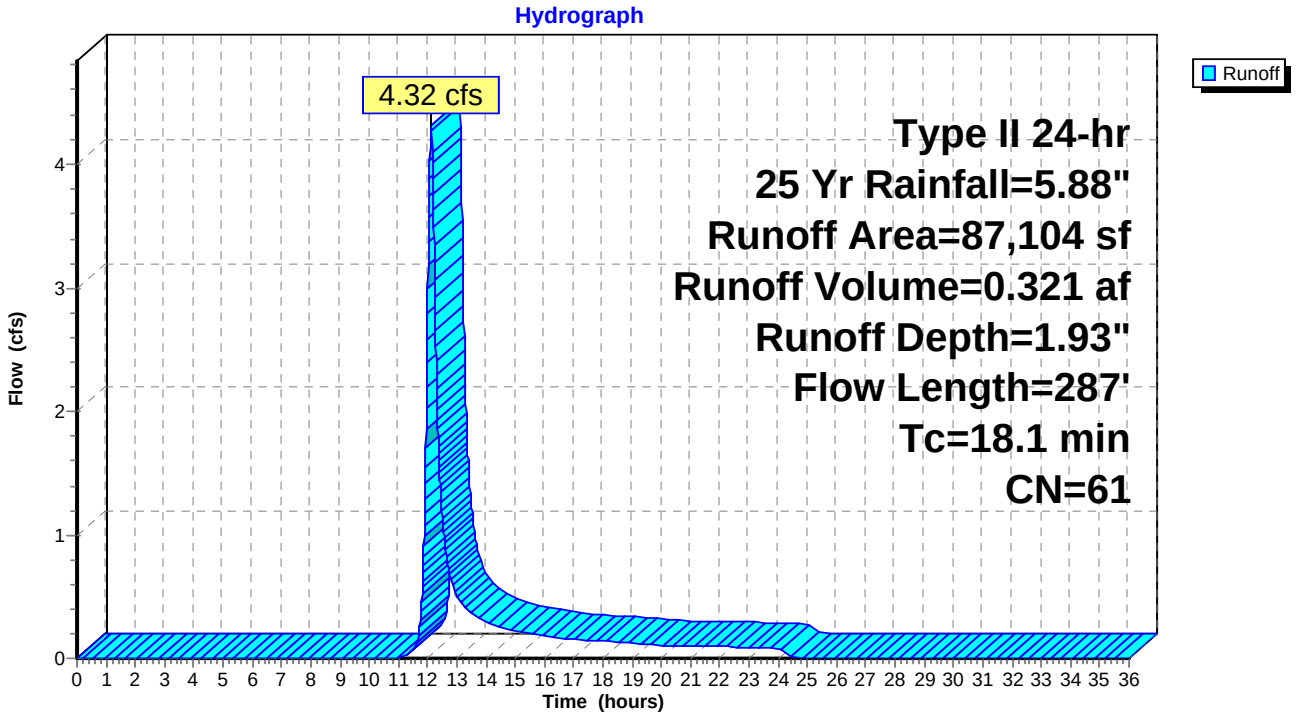
Runoff = 4.32 cfs @ 12.12 hrs, Volume= 0.321 af, Depth= 1.93"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
Type II 24-hr 25 Yr Rainfall=5.88"

Area (sf)	CN	Description
87,104	61	>75% Grass cover, Good, HSG B
87,104		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
14.9	100	0.0200	0.11		**Sheet Flow, Sheet Flow** Grass: Short n= 0.150 P2= 1.39"
3.2	187	0.0198	0.98		**Shallow Concentrated Flow, Shallow Conc.** Short Grass Pasture Kv= 7.0 fps
18.1	287	Total			

Subcatchment S6B2: Subcatchment 6B-2



Summary for Subcatchment S6B3: Subcatchment 6B-3

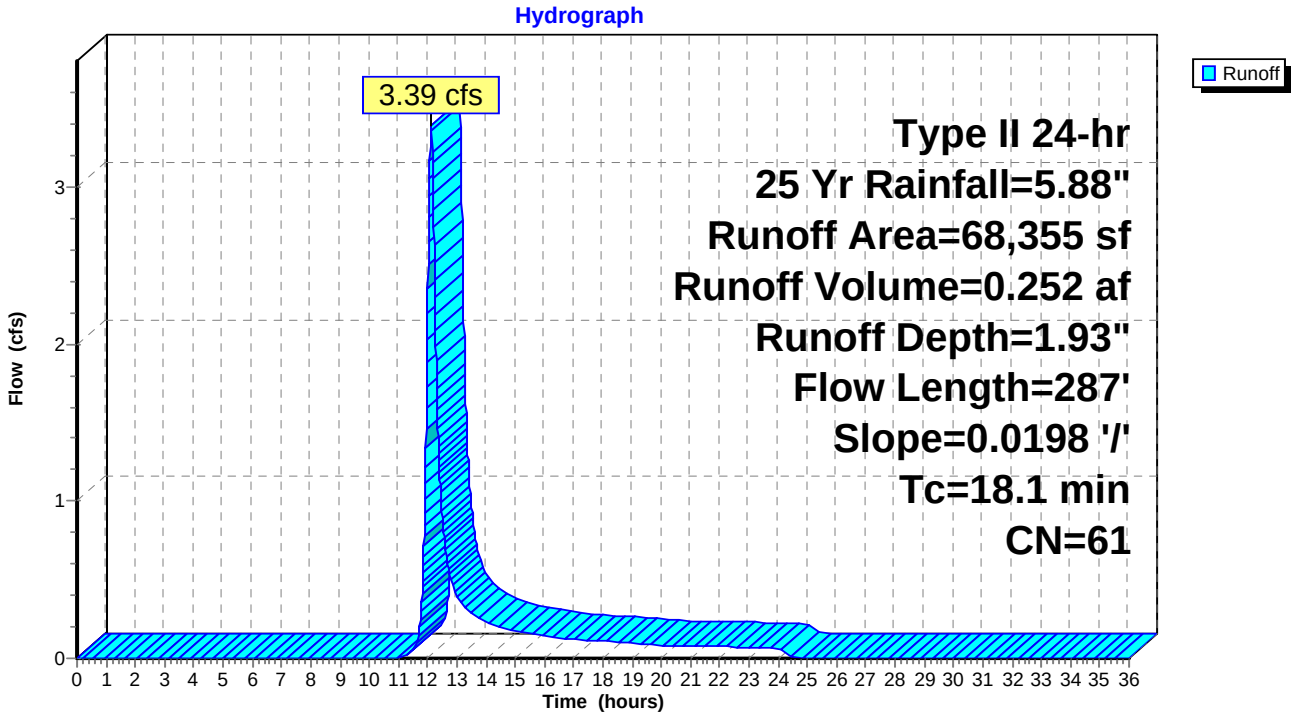
Runoff = 3.39 cfs @ 12.12 hrs, Volume= 0.252 af, Depth= 1.93"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
Type II 24-hr 25 Yr Rainfall=5.88"

Area (sf)	CN	Description
68,355	61	>75% Grass cover, Good, HSG B
68,355		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
14.9	100	0.0198	0.11		**Sheet Flow, Sheet Flow** Grass: Short n= 0.150 P2= 1.39"
3.2	187	0.0198	0.98		**Shallow Concentrated Flow, Shallow Conc.** Short Grass Pasture Kv= 7.0 fps
18.1	287	Total			

Subcatchment S6B3: Subcatchment 6B-3



Summary for Subcatchment S6B4: Subcatchment 6B-4

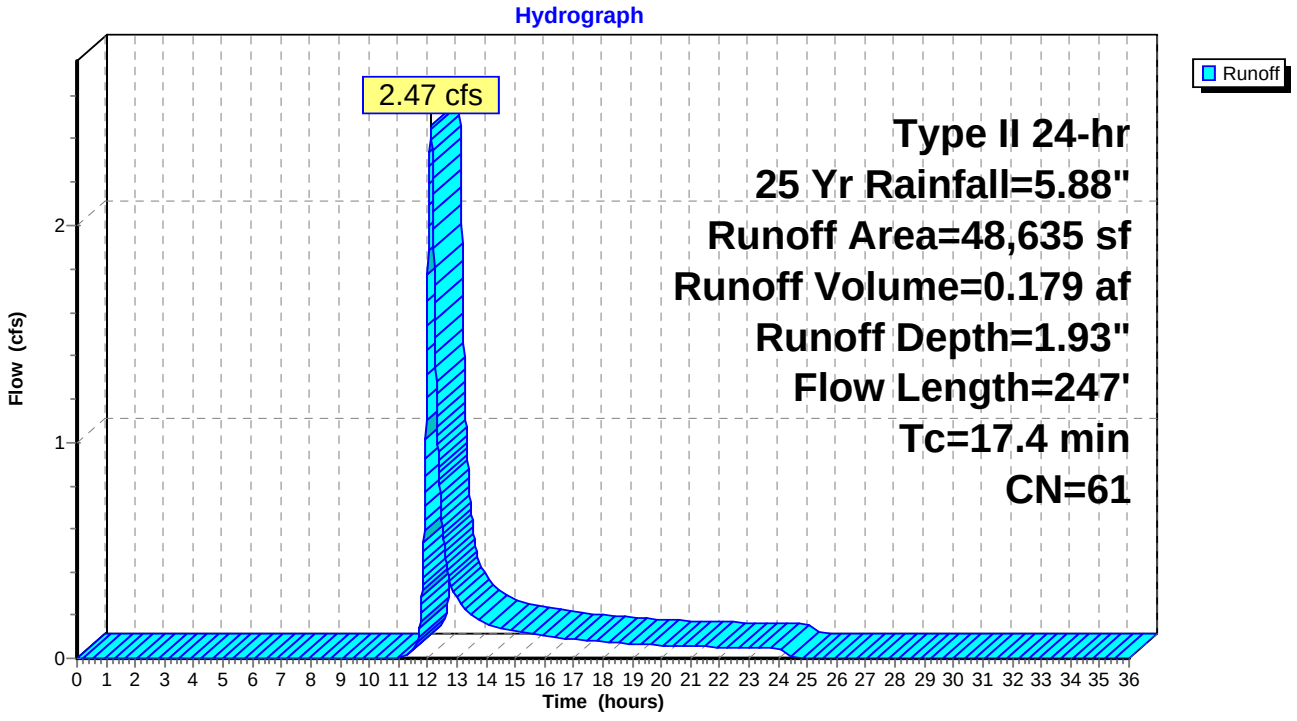
Runoff = 2.47 cfs @ 12.11 hrs, Volume= 0.179 af, Depth= 1.93"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
Type II 24-hr 25 Yr Rainfall=5.88"

Area (sf)	CN	Description
48,635	61	>75% Grass cover, Good, HSG B
48,635		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
14.9	100	0.0198	0.11		**Sheet Flow, Sheet Flow** Grass: Short n= 0.150 P2= 1.39"
2.5	147	0.0197	0.98		**Shallow Concentrated Flow, Shallow Conc.** Short Grass Pasture Kv= 7.0 fps
17.4	247	Total			

Subcatchment S6B4: Subcatchment 6B-4



Summary for Subcatchment S6B5: Subcatchment 6B-5

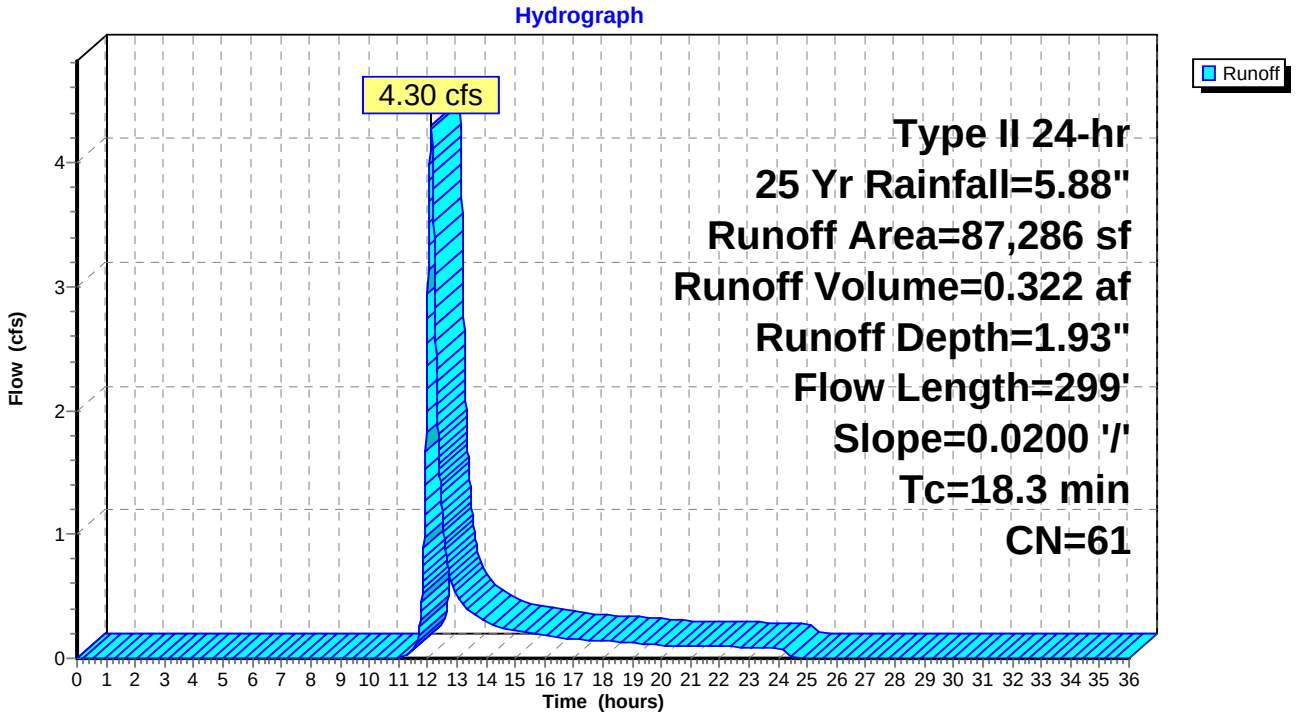
Runoff = 4.30 cfs @ 12.12 hrs, Volume= 0.322 af, Depth= 1.93"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
Type II 24-hr 25 Yr Rainfall=5.88"

Area (sf)	CN	Description
87,286	61	>75% Grass cover, Good, HSG B
87,286		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
14.9	100	0.0200	0.11		**Sheet Flow, Sheet Flow** Grass: Short n= 0.150 P2= 1.39"
3.4	199	0.0200	0.99		**Shallow Concentrated Flow, Shallow Conc.** Short Grass Pasture Kv= 7.0 fps
18.3	299	Total			

Subcatchment S6B5: Subcatchment 6B-5



Summary for Subcatchment S6B6: Subcatchment 6B-6

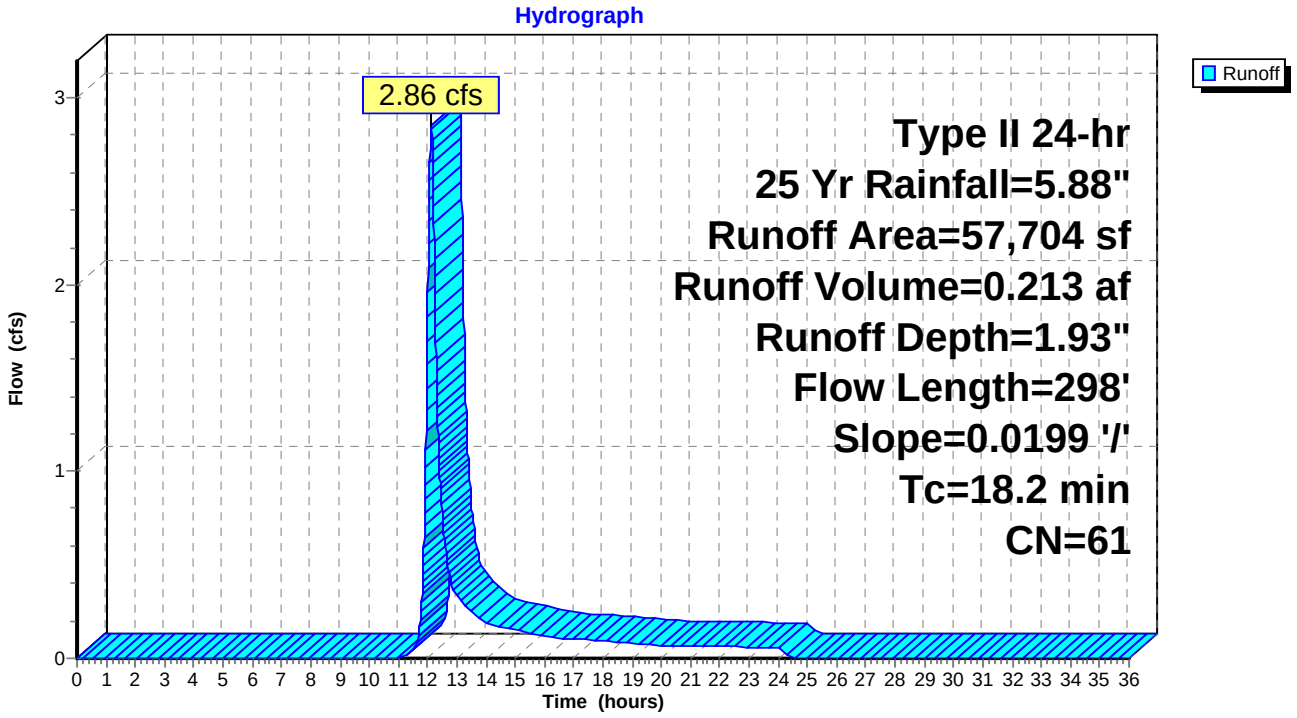
Runoff = 2.86 cfs @ 12.12 hrs, Volume= 0.213 af, Depth= 1.93"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
Type II 24-hr 25 Yr Rainfall=5.88"

Area (sf)	CN	Description
57,704	61	>75% Grass cover, Good, HSG B
57,704		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
14.9	100	0.0199	0.11		**Sheet Flow, Sheet Flow** Grass: Short n= 0.150 P2= 1.39"
3.3	198	0.0199	0.99		**Shallow Concentrated Flow, Shallow Conc.** Short Grass Pasture Kv= 7.0 fps
18.2	298	Total			

Subcatchment S6B6: Subcatchment 6B-6



Summary for Subcatchment S6B7: Subcatchment 6B-7

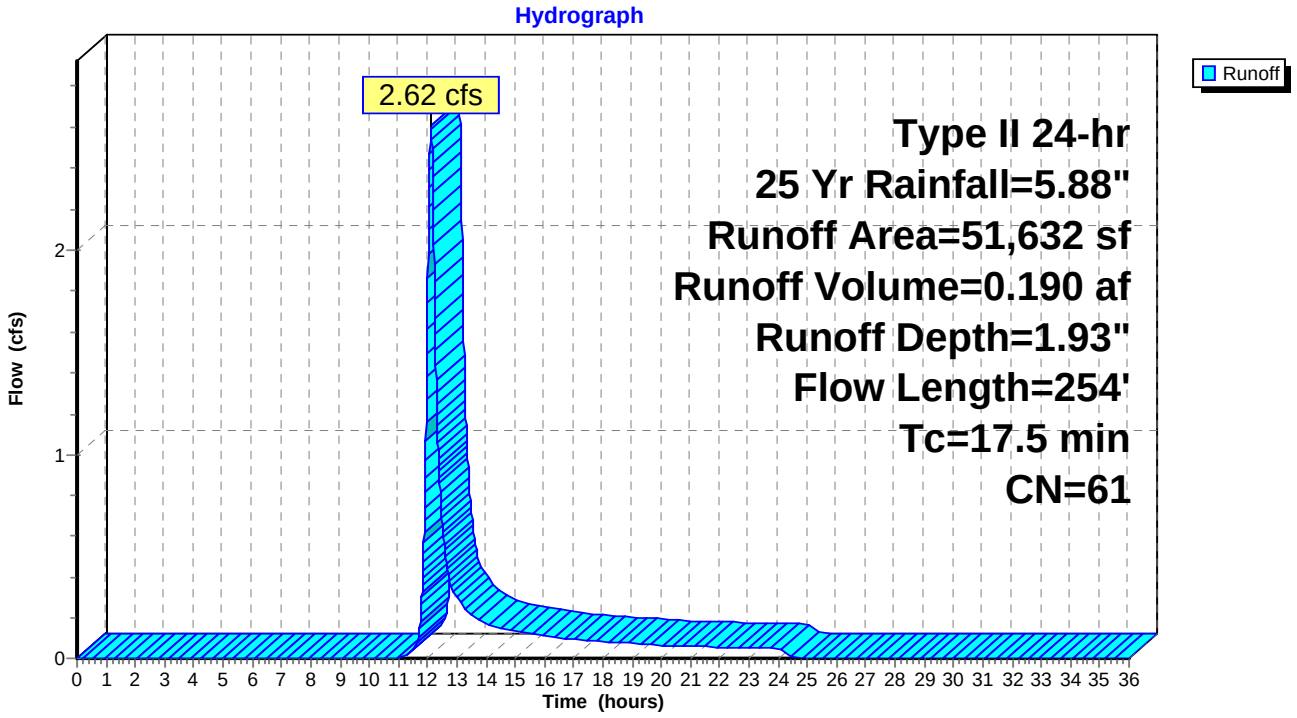
Runoff = 2.62 cfs @ 12.11 hrs, Volume= 0.190 af, Depth= 1.93"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
Type II 24-hr 25 Yr Rainfall=5.88"

Area (sf)	CN	Description
51,632	61	>75% Grass cover, Good, HSG B
51,632		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
14.9	100	0.0200	0.11		**Sheet Flow, Sheet Flow** Grass: Short n= 0.150 P2= 1.39"
2.6	154	0.0198	0.98		**Shallow Concentrated Flow, Shallow Conc.** Short Grass Pasture Kv= 7.0 fps
17.5	254	Total			

Subcatchment S6B7: Subcatchment 6B-7



Summary for Subcatchment S6C: Subcatchment 6C

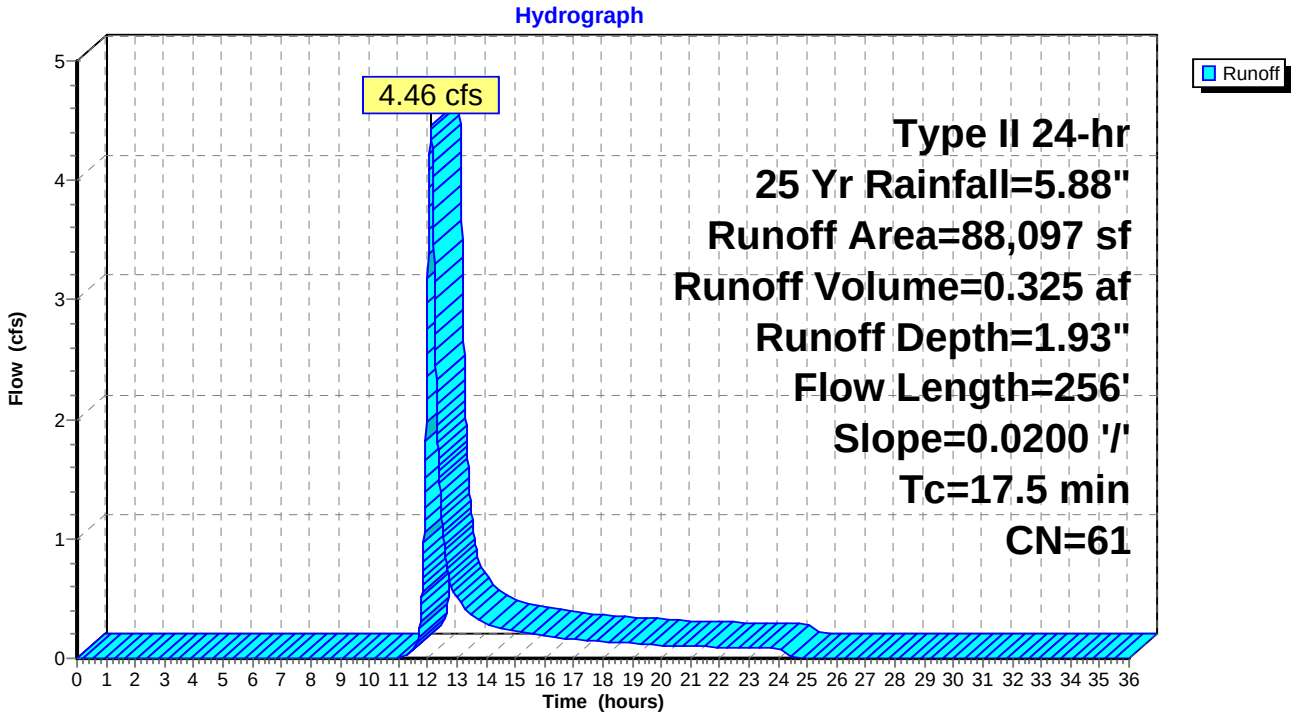
Runoff = 4.46 cfs @ 12.11 hrs, Volume= 0.325 af, Depth= 1.93"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
Type II 24-hr 25 Yr Rainfall=5.88"

Area (sf)	CN	Description
88,097	61	>75% Grass cover, Good, HSG B
88,097		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
14.9	100	0.0200	0.11		**Sheet Flow, Sheet Flow** Grass: Short n= 0.150 P2= 1.39"
2.6	156	0.0200	0.99		**Shallow Concentrated Flow, Shallow Conc.** Short Grass Pasture Kv= 7.0 fps
17.5	256	Total			

Subcatchment S6C: Subcatchment 6C



Summary for Subcatchment S7A: Subcatchment 7A

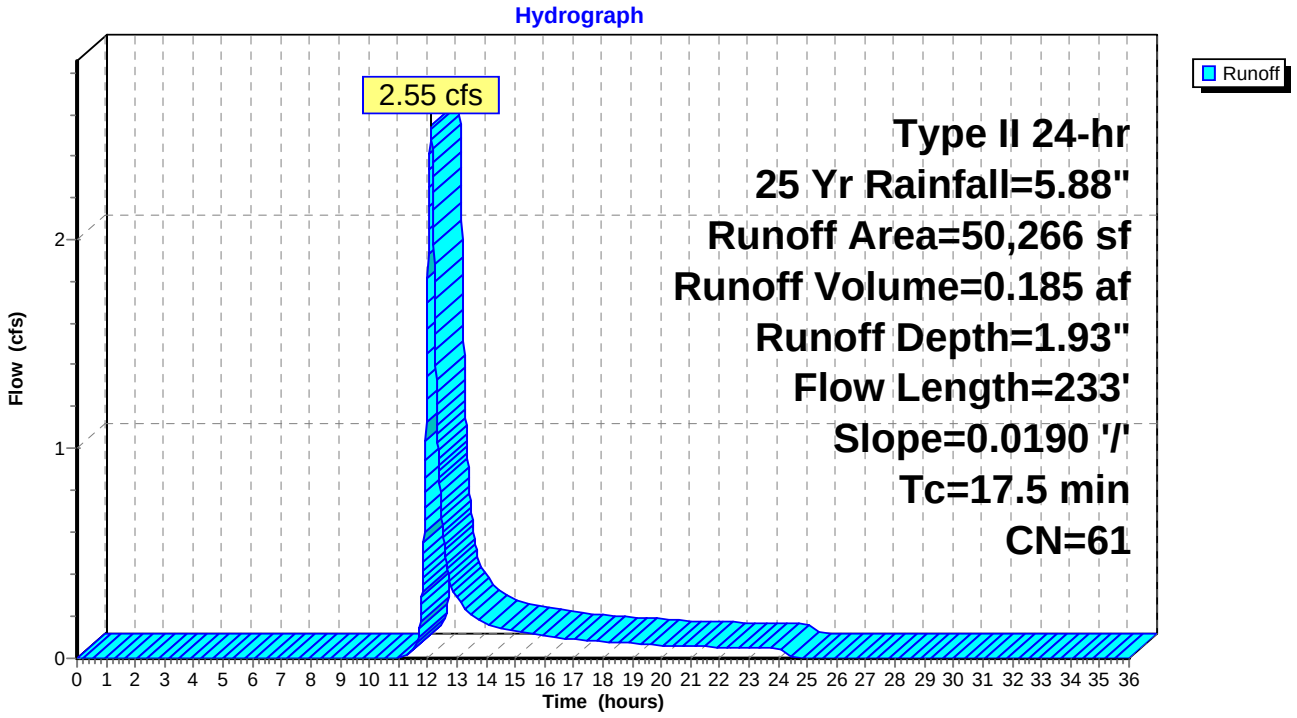
Runoff = 2.55 cfs @ 12.11 hrs, Volume= 0.185 af, Depth= 1.93"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
Type II 24-hr 25 Yr Rainfall=5.88"

Area (sf)	CN	Description
50,266	61	>75% Grass cover, Good, HSG B
50,266		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
15.2	100	0.0190	0.11		**Sheet Flow, Sheet Flow** Grass: Short n= 0.150 P2= 1.39"
2.3	133	0.0190	0.96		**Shallow Concentrated Flow, Shallow Conc.** Short Grass Pasture Kv= 7.0 fps
17.5	233	Total			

Subcatchment S7A: Subcatchment 7A



Summary for Subcatchment S7B1: Subcatchment 7B-1

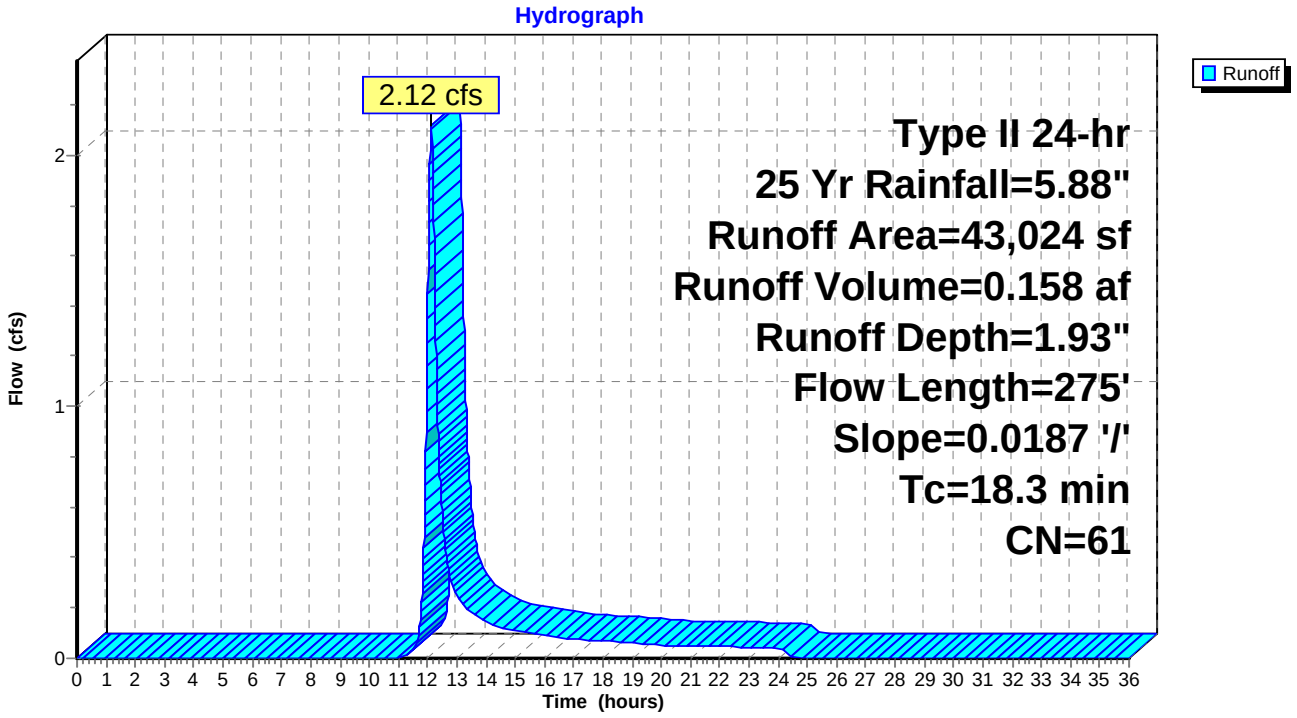
Runoff = 2.12 cfs @ 12.12 hrs, Volume= 0.158 af, Depth= 1.93"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
Type II 24-hr 25 Yr Rainfall=5.88"

Area (sf)	CN	Description
43,024	61	>75% Grass cover, Good, HSG B
43,024		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
15.3	100	0.0187	0.11		**Sheet Flow, Sheet Flow** Grass: Short n= 0.150 P2= 1.39"
3.0	175	0.0187	0.96		**Shallow Concentrated Flow, Shallow Conc.** Short Grass Pasture Kv= 7.0 fps
18.3	275	Total			

Subcatchment S7B1: Subcatchment 7B-1



Summary for Subcatchment S7B10: Subcatchment 7B-10

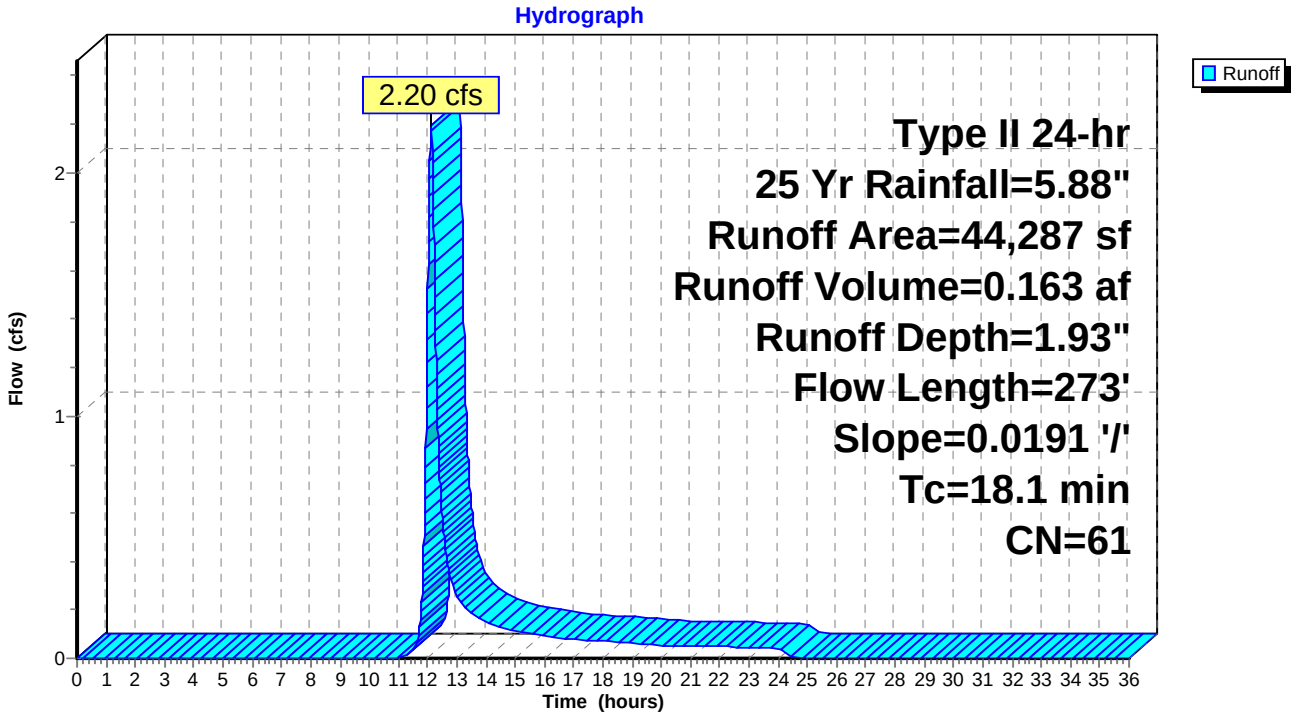
Runoff = 2.20 cfs @ 12.12 hrs, Volume= 0.163 af, Depth= 1.93"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
Type II 24-hr 25 Yr Rainfall=5.88"

Area (sf)	CN	Description
44,287	61	>75% Grass cover, Good, HSG B
44,287		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
15.1	100	0.0191	0.11		**Sheet Flow, Sheet Flow** Grass: Short n= 0.150 P2= 1.39"
3.0	173	0.0191	0.97		**Shallow Concentrated Flow, Shallow Conc.** Short Grass Pasture Kv= 7.0 fps
18.1	273	Total			

Subcatchment S7B10: Subcatchment 7B-10



Summary for Subcatchment S7B2: Subcatchment 7B-2

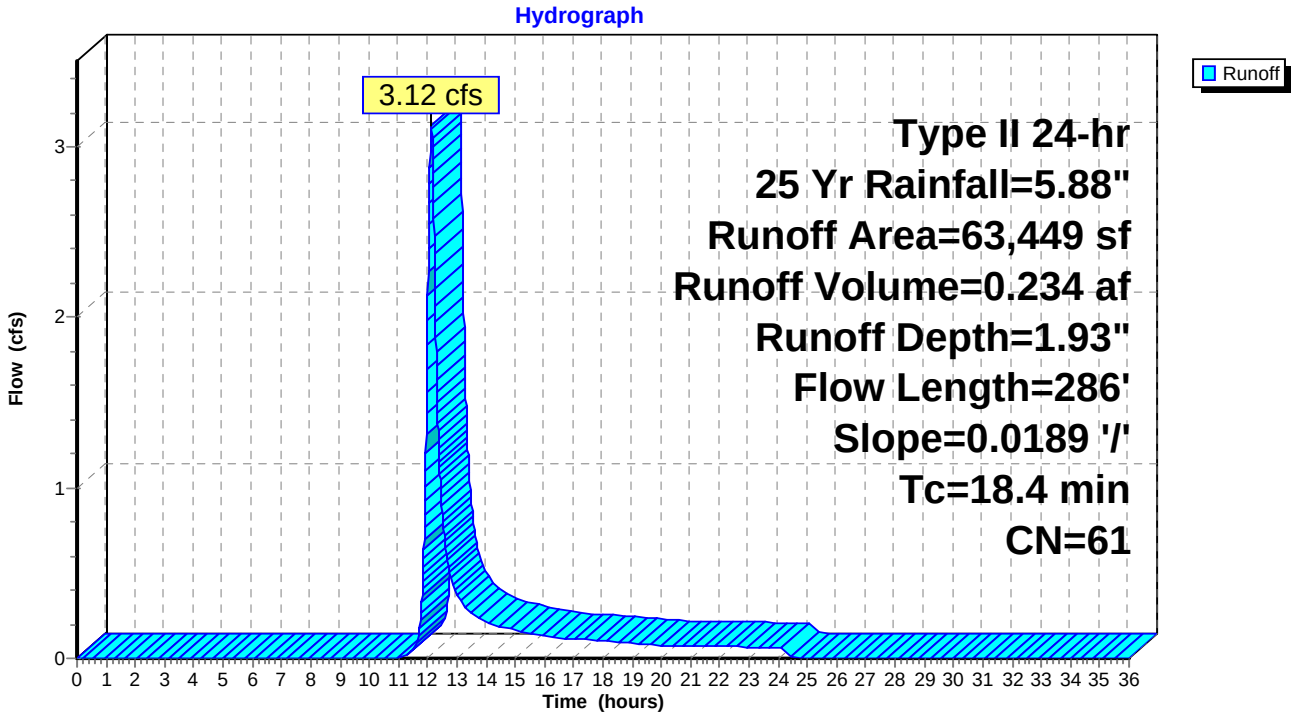
Runoff = 3.12 cfs @ 12.12 hrs, Volume= 0.234 af, Depth= 1.93"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
Type II 24-hr 25 Yr Rainfall=5.88"

Area (sf)	CN	Description
63,449	61	>75% Grass cover, Good, HSG B
63,449		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
15.2	100	0.0189	0.11		**Sheet Flow, Sheet Flow** Grass: Short n= 0.150 P2= 1.39"
3.2	186	0.0189	0.96		**Shallow Concentrated Flow, Shallow Conc.** Short Grass Pasture Kv= 7.0 fps
18.4	286	Total			

Subcatchment S7B2: Subcatchment 7B-2



Summary for Subcatchment S7B3: Subcatchment 7B-3

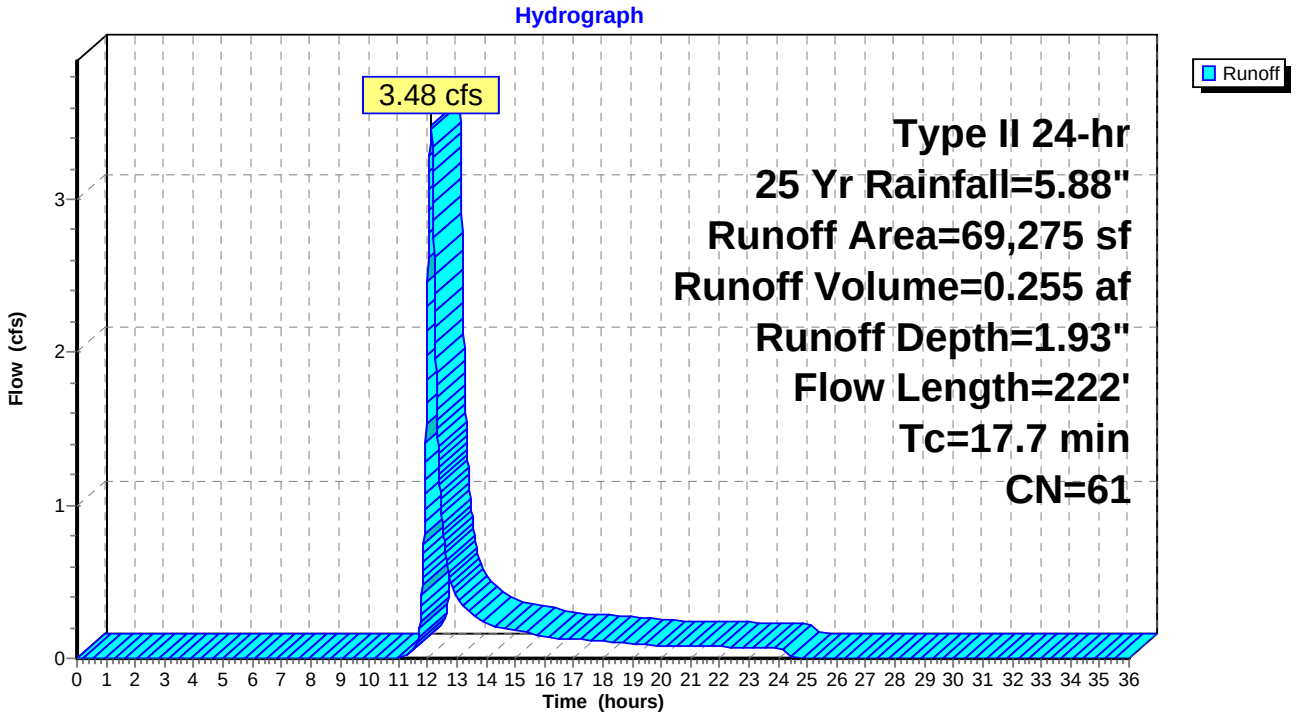
Runoff = 3.48 cfs @ 12.11 hrs, Volume= 0.255 af, Depth= 1.93"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
Type II 24-hr 25 Yr Rainfall=5.88"

Area (sf)	CN	Description
69,275	61	>75% Grass cover, Good, HSG B
69,275		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
15.5	100	0.0181	0.11		**Sheet Flow, Sheet Flow** Grass: Short n= 0.150 P2= 1.39"
2.2	122	0.0179	0.94		**Shallow Concentrated Flow, Shallow Conc.** Short Grass Pasture Kv= 7.0 fps
17.7	222	Total			

Subcatchment S7B3: Subcatchment 7B-3



Summary for Subcatchment S7B4: Subcatchment 7B-4

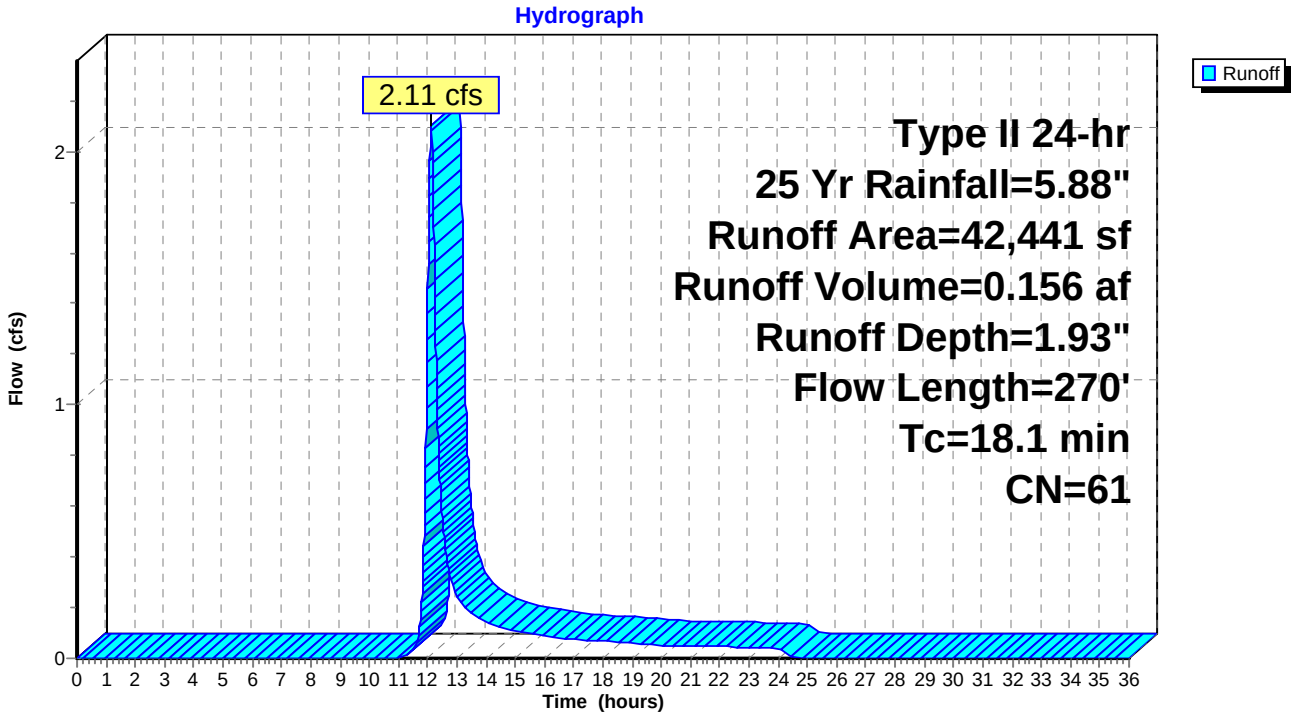
Runoff = 2.11 cfs @ 12.12 hrs, Volume= 0.156 af, Depth= 1.93"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
Type II 24-hr 25 Yr Rainfall=5.88"

Area (sf)	CN	Description
42,441	61	>75% Grass cover, Good, HSG B
42,441		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
15.2	100	0.0189	0.11		**Sheet Flow, Sheet Flow** Grass: Short n= 0.150 P2= 1.39"
2.9	170	0.0191	0.97		**Shallow Concentrated Flow, Shallow Conc.** Short Grass Pasture Kv= 7.0 fps
18.1	270	Total			

Subcatchment S7B4: Subcatchment 7B-4



Summary for Subcatchment S7B5: Subcatchment 7B-5

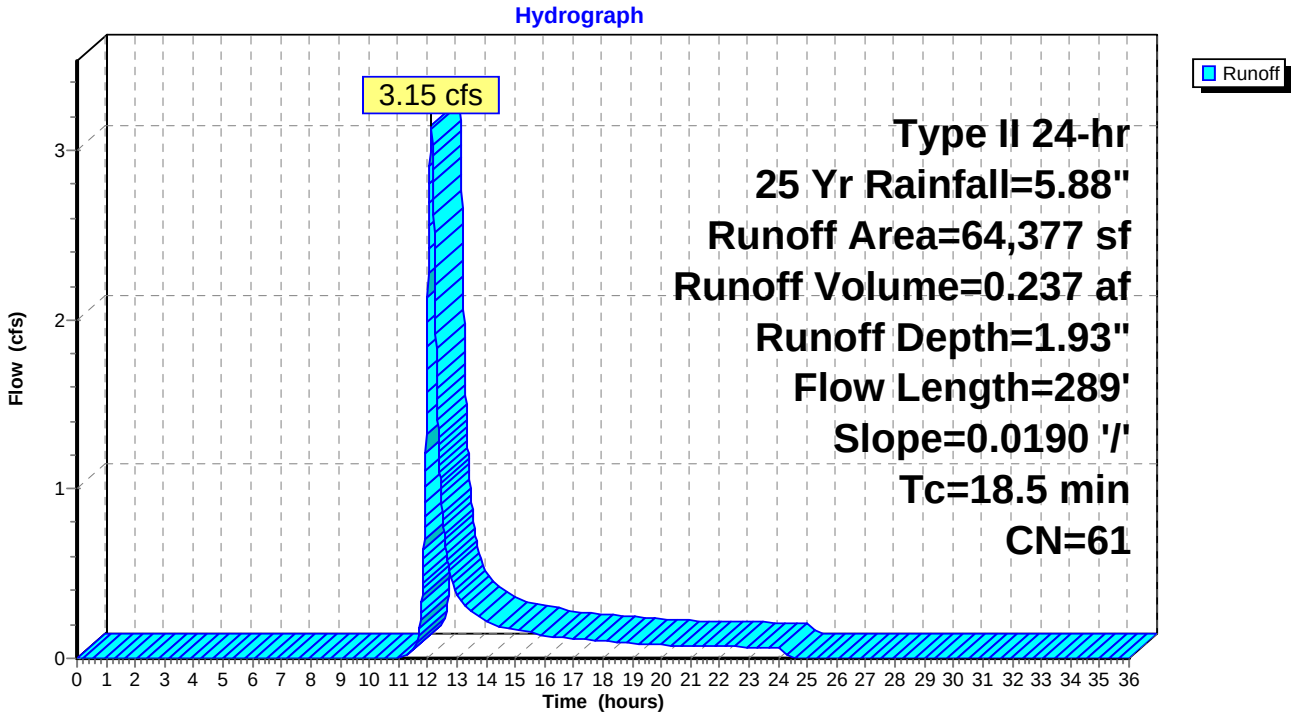
Runoff = 3.15 cfs @ 12.12 hrs, Volume= 0.237 af, Depth= 1.93"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
Type II 24-hr 25 Yr Rainfall=5.88"

Area (sf)	CN	Description
64,377	61	>75% Grass cover, Good, HSG B
64,377		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
15.2	100	0.0190	0.11		**Sheet Flow, Sheet Flow** Grass: Short n= 0.150 P2= 1.39"
3.3	189	0.0190	0.96		**Shallow Concentrated Flow, Shallow Conc.** Short Grass Pasture Kv= 7.0 fps
18.5	289	Total			

Subcatchment S7B5: Subcatchment 7B-5



Summary for Subcatchment S7B6: Subcatchment 7B-6

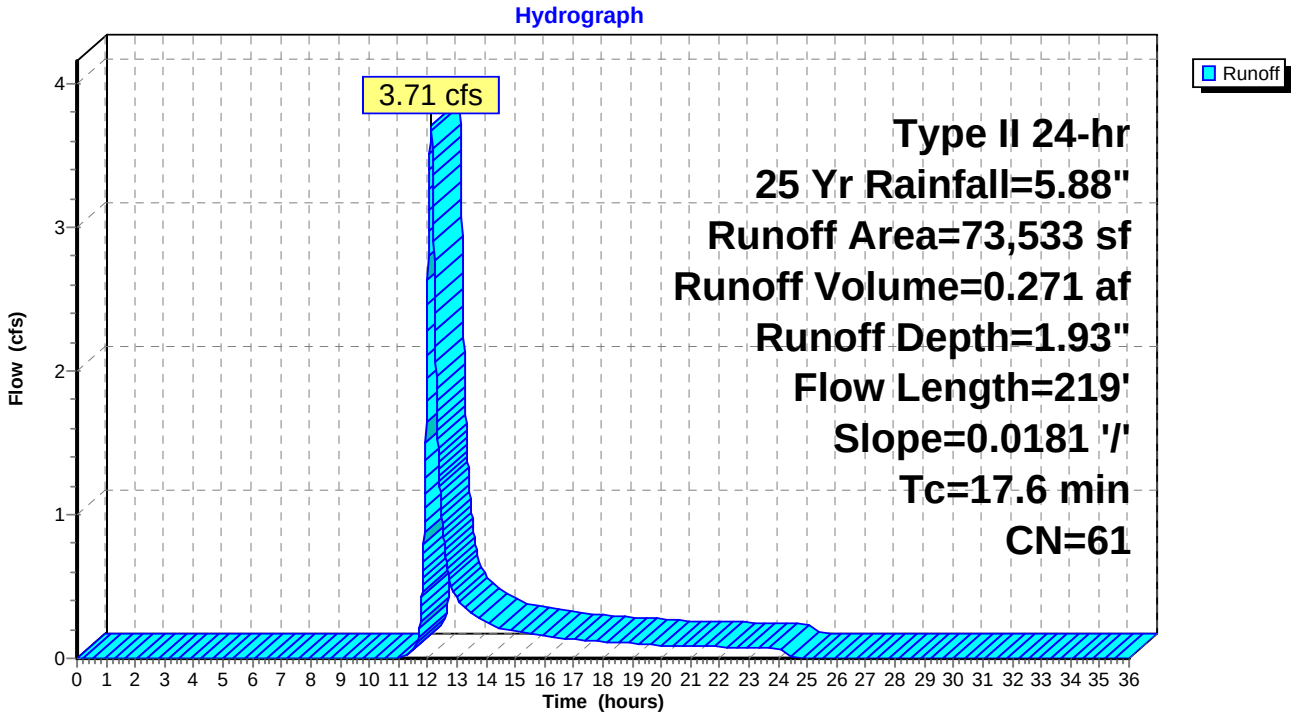
Runoff = 3.71 cfs @ 12.11 hrs, Volume= 0.271 af, Depth= 1.93"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
Type II 24-hr 25 Yr Rainfall=5.88"

Area (sf)	CN	Description
73,533	61	>75% Grass cover, Good, HSG B
73,533		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
15.5	100	0.0181	0.11		**Sheet Flow, Sheet Flow** Grass: Short n= 0.150 P2= 1.39"
2.1	119	0.0181	0.94		**Shallow Concentrated Flow, Shallow Conc.** Short Grass Pasture Kv= 7.0 fps
17.6	219	Total			

Subcatchment S7B6: Subcatchment 7B-6



Summary for Subcatchment S7B7: Subcatchment 7B-7

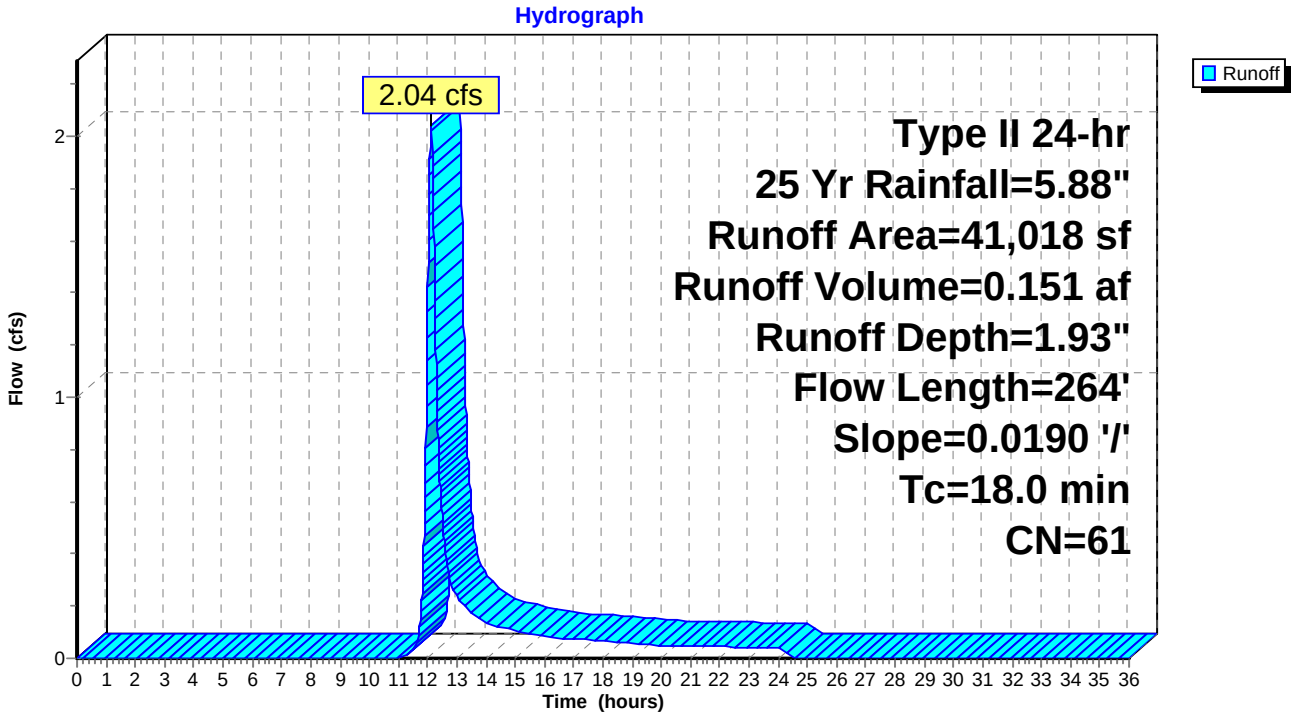
Runoff = 2.04 cfs @ 12.12 hrs, Volume= 0.151 af, Depth= 1.93"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
Type II 24-hr 25 Yr Rainfall=5.88"

Area (sf)	CN	Description
41,018	61	>75% Grass cover, Good, HSG B
41,018		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
15.2	100	0.0190	0.11		**Sheet Flow, Sheet Flow** Grass: Short n= 0.150 P2= 1.39"
2.8	164	0.0190	0.96		**Shallow Concentrated Flow, Shallow Conc.** Short Grass Pasture Kv= 7.0 fps
18.0	264	Total			

Subcatchment S7B7: Subcatchment 7B-7



Summary for Subcatchment S7B8: Subcatchment 7B-8

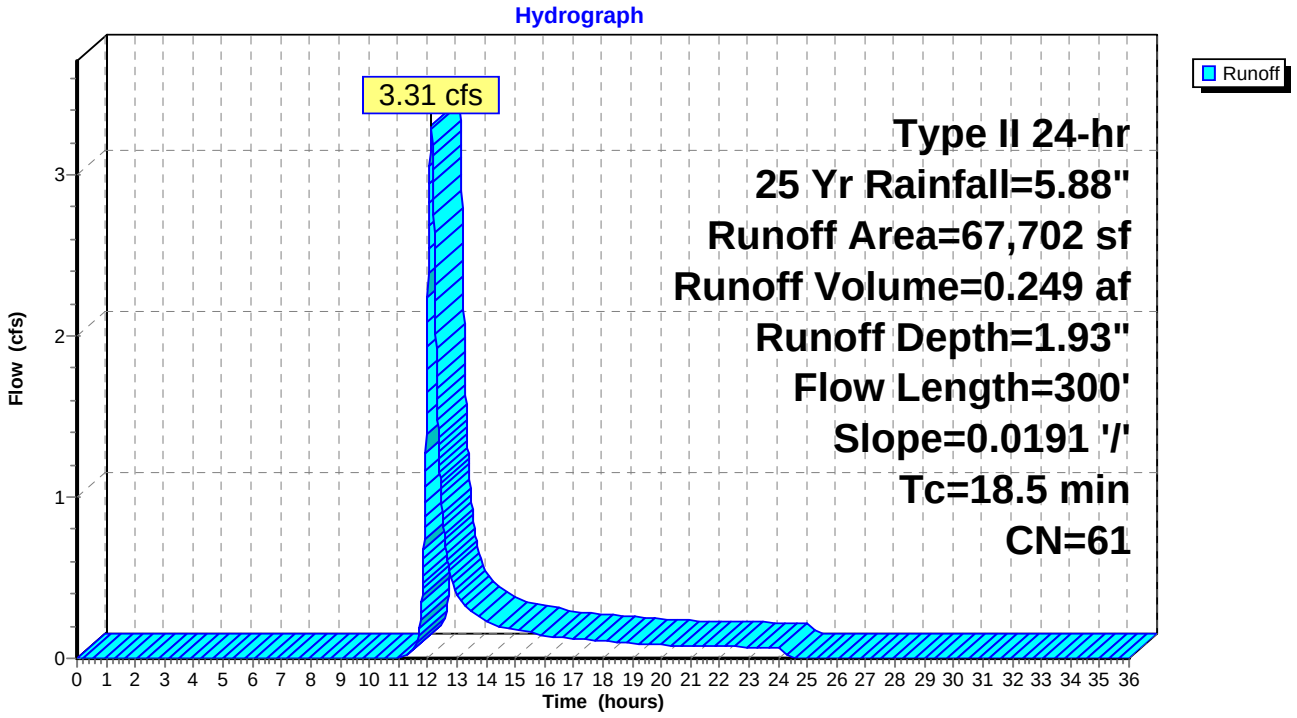
Runoff = 3.31 cfs @ 12.12 hrs, Volume= 0.249 af, Depth= 1.93"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
Type II 24-hr 25 Yr Rainfall=5.88"

Area (sf)	CN	Description
67,702	61	>75% Grass cover, Good, HSG B
67,702		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
15.1	100	0.0191	0.11		**Sheet Flow, Sheet Flow** Grass: Short n= 0.150 P2= 1.39"
3.4	200	0.0191	0.97		**Shallow Concentrated Flow, Shallow Conc.** Short Grass Pasture Kv= 7.0 fps
18.5	300	Total			

Subcatchment S7B8: Subcatchment 7B-8



Summary for Subcatchment S7B9: Subcatchment 7B-9

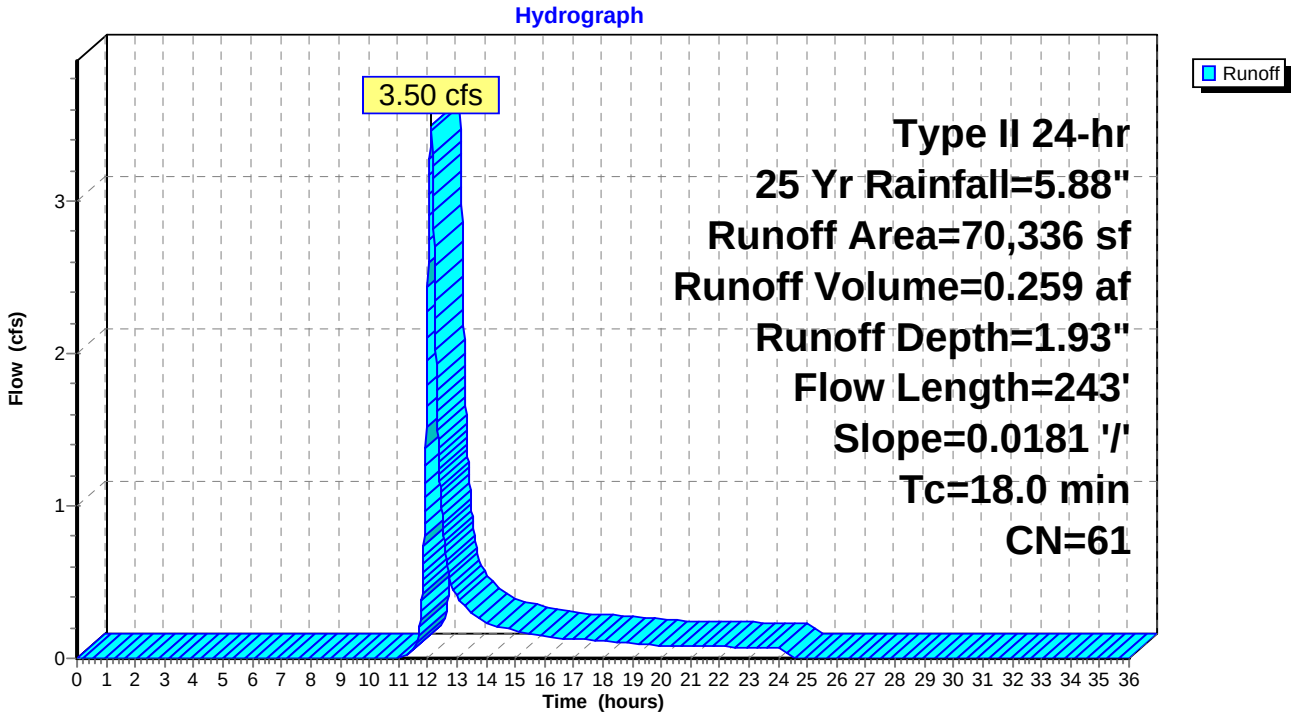
Runoff = 3.50 cfs @ 12.12 hrs, Volume= 0.259 af, Depth= 1.93"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
Type II 24-hr 25 Yr Rainfall=5.88"

Area (sf)	CN	Description
70,336	61	>75% Grass cover, Good, HSG B
70,336		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
15.5	100	0.0181	0.11		**Sheet Flow, Sheet Flow** Grass: Short n= 0.150 P2= 1.39"
2.5	143	0.0181	0.94		**Shallow Concentrated Flow, Shallow Conc.** Short Grass Pasture Kv= 7.0 fps
18.0	243	Total			

Subcatchment S7B9: Subcatchment 7B-9



Summary for Subcatchment S7C: Subcatchment 7C

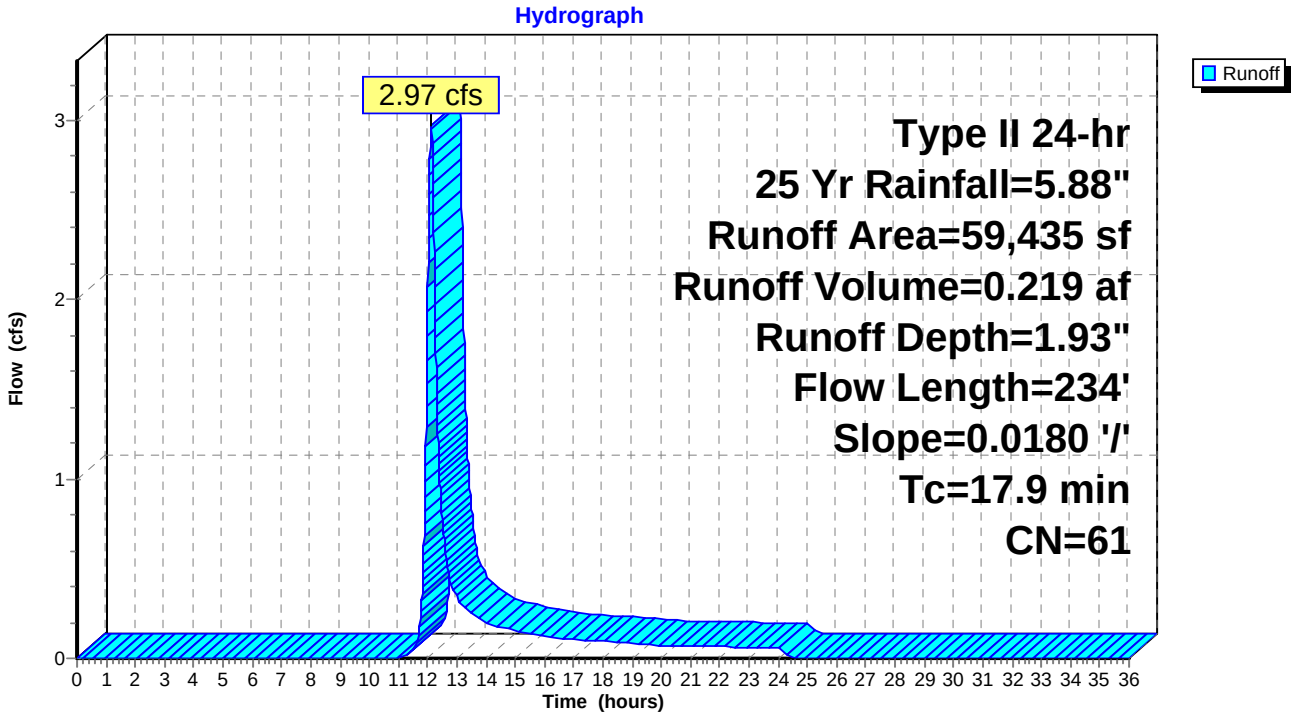
Runoff = 2.97 cfs @ 12.11 hrs, Volume= 0.219 af, Depth= 1.93"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
Type II 24-hr 25 Yr Rainfall=5.88"

Area (sf)	CN	Description
59,435	61	>75% Grass cover, Good, HSG B
59,435		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
15.5	100	0.0180	0.11		**Sheet Flow, Sheet Flow** Grass: Short n= 0.150 P2= 1.39"
2.4	134	0.0180	0.94		**Shallow Concentrated Flow, Shallow Conc.** Short Grass Pasture Kv= 7.0 fps
17.9	234	Total			

Subcatchment S7C: Subcatchment 7C



Summary for Subcatchment S7D: Subcatchment 7D

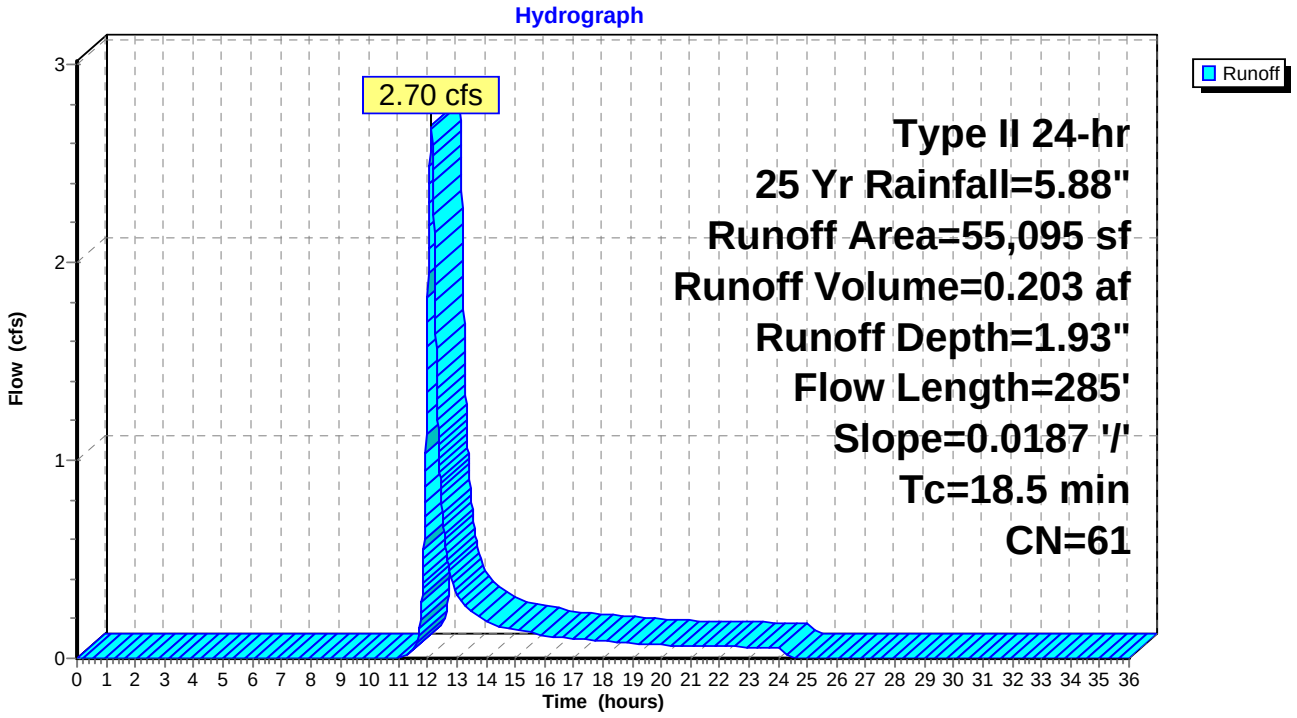
Runoff = 2.70 cfs @ 12.12 hrs, Volume= 0.203 af, Depth= 1.93"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
Type II 24-hr 25 Yr Rainfall=5.88"

Area (sf)	CN	Description
55,095	61	>75% Grass cover, Good, HSG B
55,095		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
15.3	100	0.0187	0.11		**Sheet Flow, Sheet Flow** Grass: Short n= 0.150 P2= 1.39"
3.2	185	0.0187	0.96		**Shallow Concentrated Flow, Shallow Conc.** Short Grass Pasture Kv= 7.0 fps
18.5	285	Total			

Subcatchment S7D: Subcatchment 7D



Summary for Subcatchment S7E: Subcatchment 7B-2

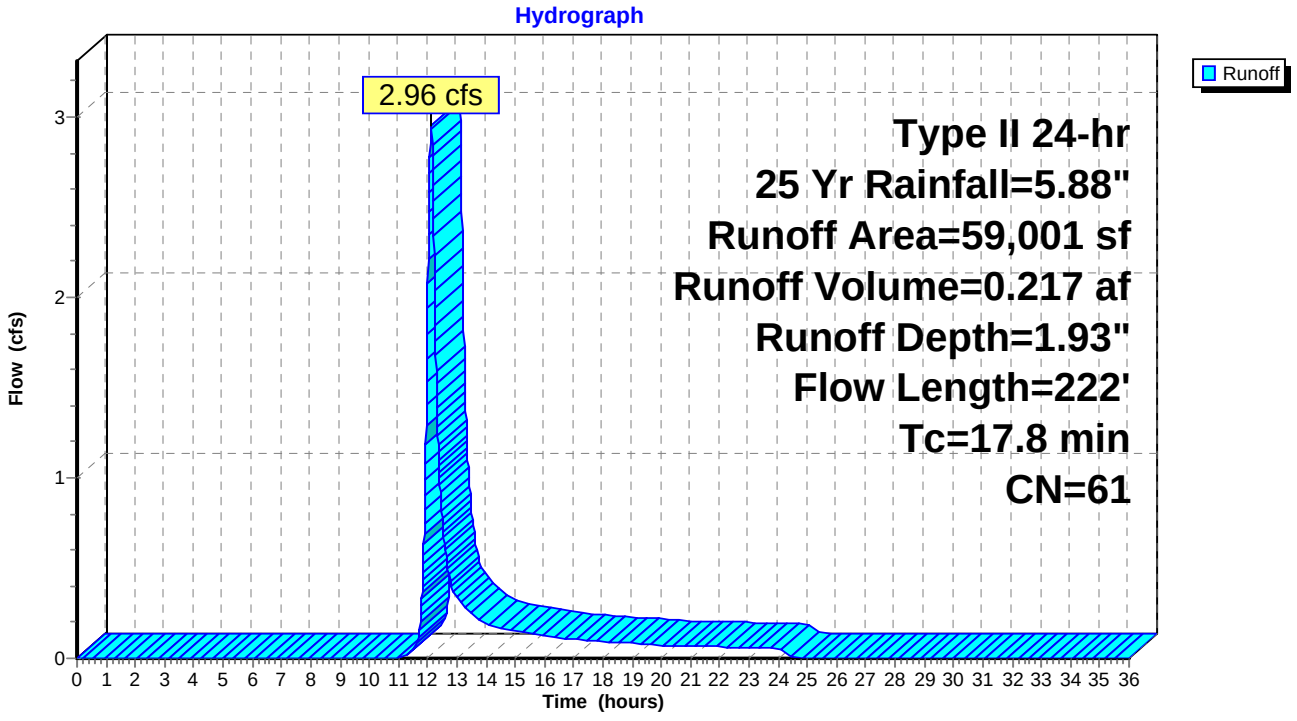
Runoff = 2.96 cfs @ 12.12 hrs, Volume= 0.217 af, Depth= 1.93"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
Type II 24-hr 25 Yr Rainfall=5.88"

Area (sf)	CN	Description
59,001	61	>75% Grass cover, Good, HSG B
59,001		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
15.6	100	0.0178	0.11		**Sheet Flow, Sheet Flow** Grass: Short n= 0.150 P2= 1.39"
2.2	122	0.0177	0.93		**Shallow Concentrated Flow, Shallow Conc.** Short Grass Pasture Kv= 7.0 fps
17.8	222	Total			

Subcatchment S7E: Subcatchment 7B-2



Summary for Subcatchment S8A: Subcatchment 8A

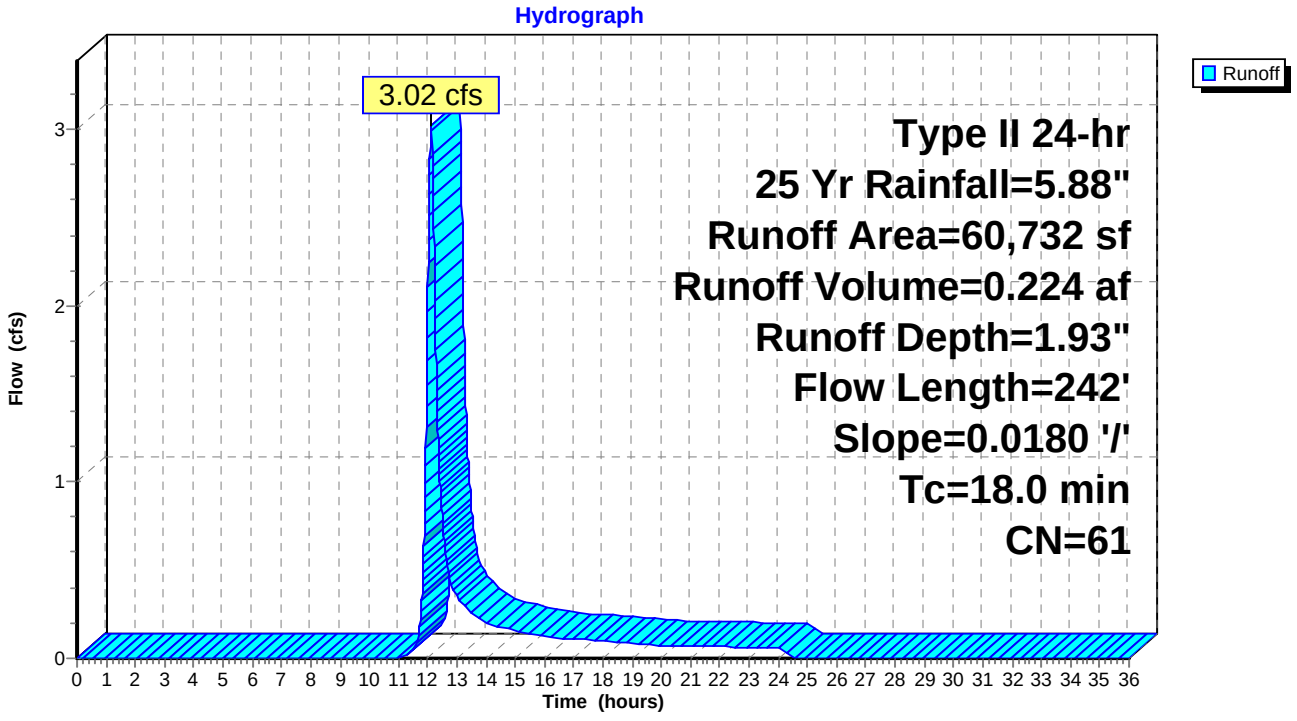
Runoff = 3.02 cfs @ 12.12 hrs, Volume= 0.224 af, Depth= 1.93"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
Type II 24-hr 25 Yr Rainfall=5.88"

Area (sf)	CN	Description
60,732	61	>75% Grass cover, Good, HSG B
60,732		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
15.5	100	0.0180	0.11		**Sheet Flow, Sheet Flow** Grass: Short n= 0.150 P2= 1.39"
2.5	142	0.0180	0.94		**Shallow Concentrated Flow, Shallow Conc.** Short Grass Pasture Kv= 7.0 fps
18.0	242	Total			

Subcatchment S8A: Subcatchment 8A



Summary for Subcatchment S8B1: Subcatchment 8B-1

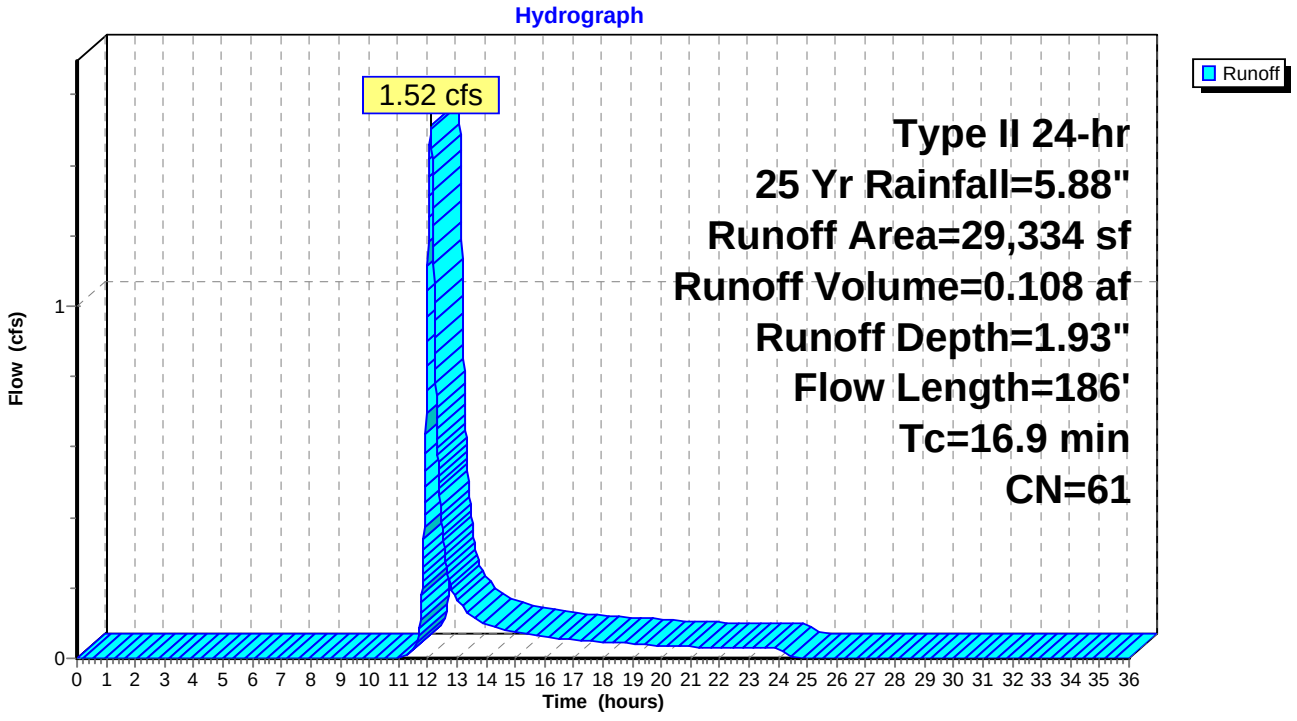
Runoff = 1.52 cfs @ 12.11 hrs, Volume= 0.108 af, Depth= 1.93"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
Type II 24-hr 25 Yr Rainfall=5.88"

Area (sf)	CN	Description
29,334	61	>75% Grass cover, Good, HSG B
29,334		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
15.4	100	0.0184	0.11		**Sheet Flow, Sheet Flow** Grass: Short n= 0.150 P2= 1.39"
1.5	86	0.0180	0.94		**Shallow Concentrated Flow, Shallow Conc.** Short Grass Pasture Kv= 7.0 fps
16.9	186	Total			

Subcatchment S8B1: Subcatchment 8B-1



Summary for Subcatchment S8B10: Subcatchment 8B-10

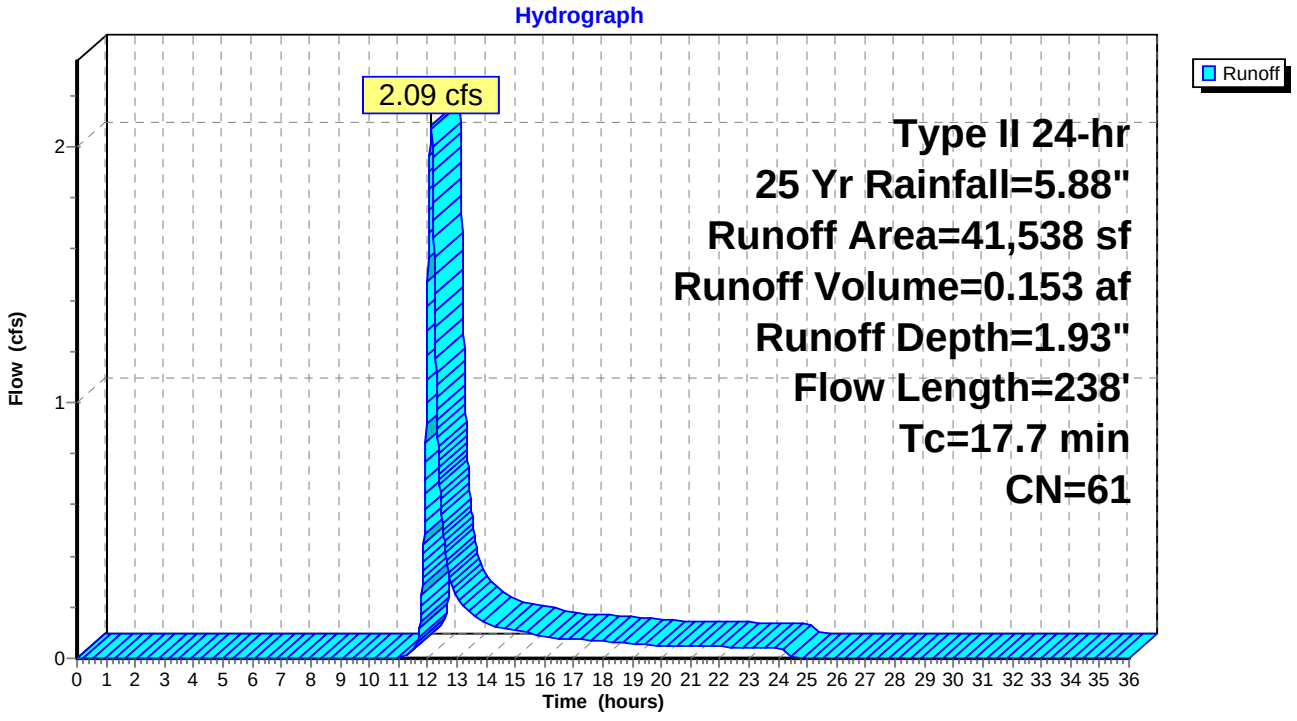
Runoff = 2.09 cfs @ 12.11 hrs, Volume= 0.153 af, Depth= 1.93"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
Type II 24-hr 25 Yr Rainfall=5.88"

Area (sf)	CN	Description
41,538	61	>75% Grass cover, Good, HSG B
41,538		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
15.2	100	0.0190	0.11		**Sheet Flow, Sheet Flow** Grass: Short n= 0.150 P2= 1.39"
2.5	138	0.0179	0.94		**Shallow Concentrated Flow, Shallow Conc.** Short Grass Pasture Kv= 7.0 fps
17.7	238	Total			

Subcatchment S8B10: Subcatchment 8B-10



Summary for Subcatchment S8B11: Subcatchment 8B-11

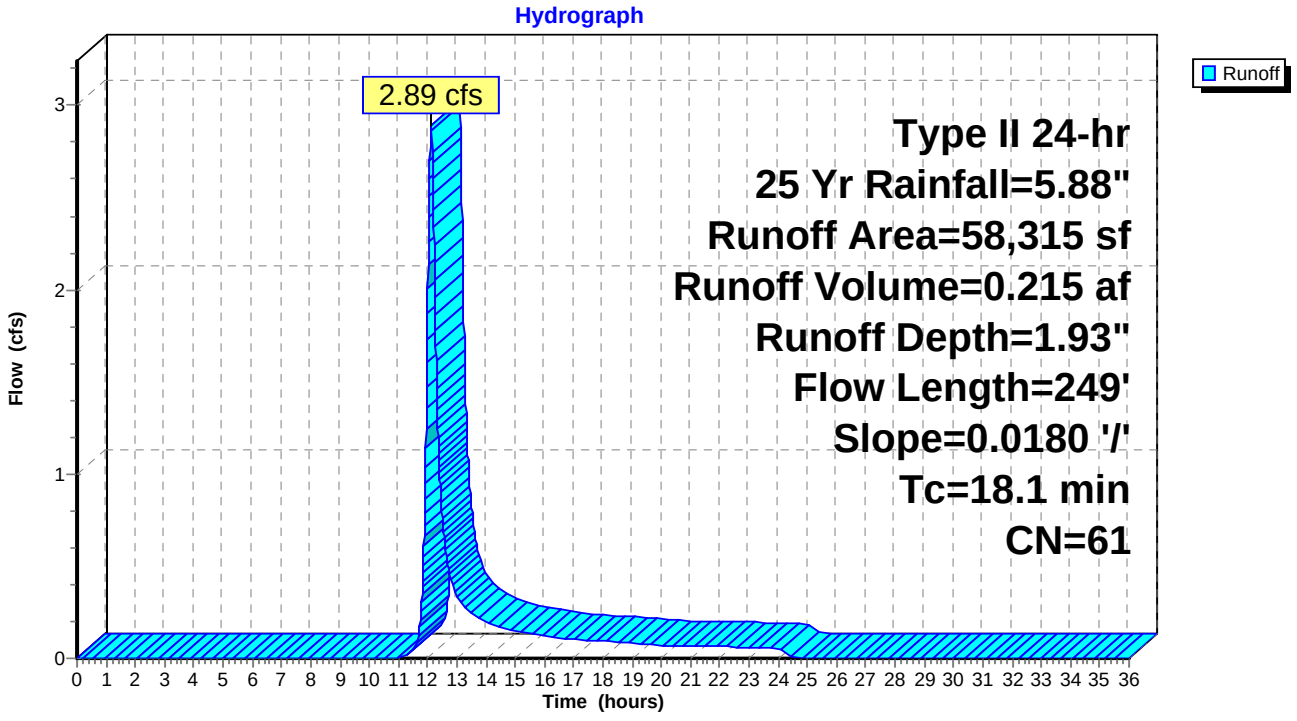
Runoff = 2.89 cfs @ 12.12 hrs, Volume= 0.215 af, Depth= 1.93"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
Type II 24-hr 25 Yr Rainfall=5.88"

Area (sf)	CN	Description
58,315	61	>75% Grass cover, Good, HSG B
58,315		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
15.5	100	0.0180	0.11		**Sheet Flow, Sheet Flow** Grass: Short n= 0.150 P2= 1.39"
2.6	149	0.0180	0.94		**Shallow Concentrated Flow, Shallow Conc.** Short Grass Pasture Kv= 7.0 fps
18.1	249	Total			

Subcatchment S8B11: Subcatchment 8B-11



Summary for Subcatchment S8B12: Subcatchment 8B-12

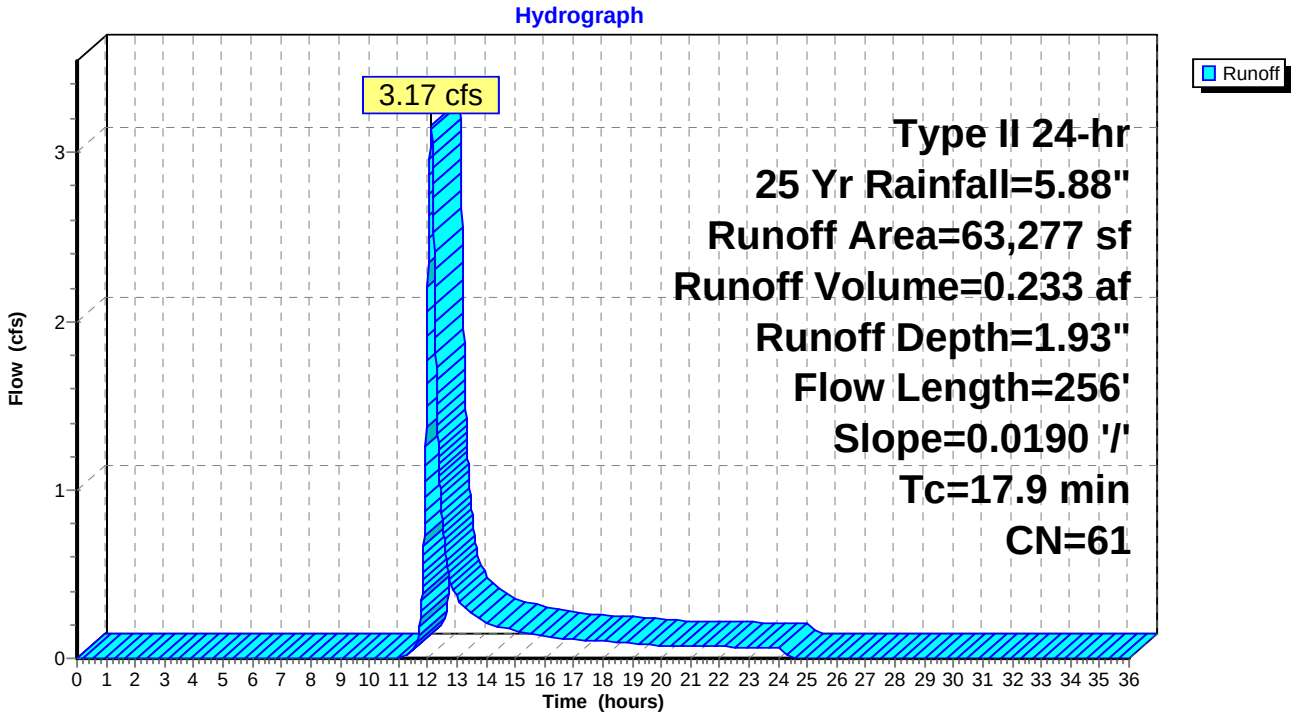
Runoff = 3.17 cfs @ 12.11 hrs, Volume= 0.233 af, Depth= 1.93"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
Type II 24-hr 25 Yr Rainfall=5.88"

Area (sf)	CN	Description
63,277	61	>75% Grass cover, Good, HSG B
63,277		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
15.2	100	0.0190	0.11		**Sheet Flow, Sheet Flow** Grass: Short n= 0.150 P2= 1.39"
2.7	156	0.0190	0.96		**Shallow Concentrated Flow, Shallow Conc.** Short Grass Pasture Kv= 7.0 fps
17.9	256	Total			

Subcatchment S8B12: Subcatchment 8B-12



Summary for Subcatchment S8B13: Subcatchment 8B-13

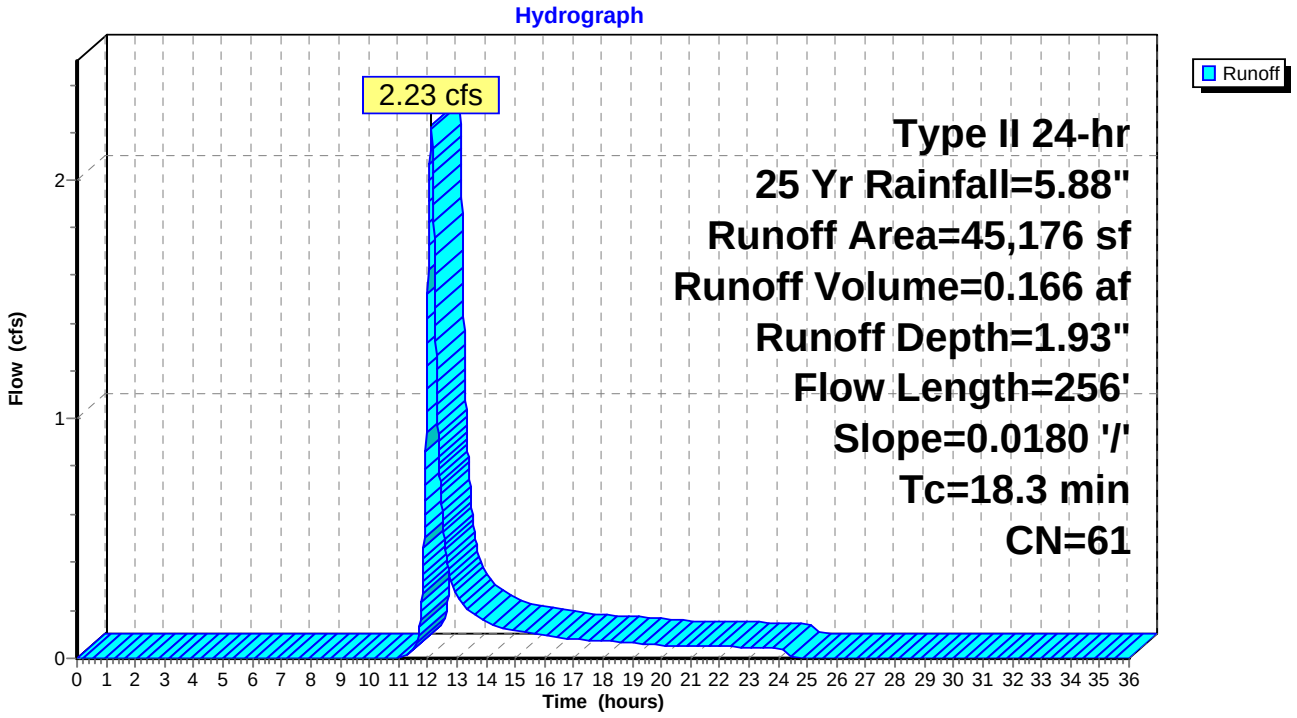
Runoff = 2.23 cfs @ 12.12 hrs, Volume= 0.166 af, Depth= 1.93"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
Type II 24-hr 25 Yr Rainfall=5.88"

Area (sf)	CN	Description
45,176	61	>75% Grass cover, Good, HSG B
45,176		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
15.5	100	0.0180	0.11		**Sheet Flow, Sheet Flow** Grass: Short n= 0.150 P2= 1.39"
2.8	156	0.0180	0.94		**Shallow Concentrated Flow, Shallow Conc.** Short Grass Pasture Kv= 7.0 fps
18.3	256	Total			

Subcatchment S8B13: Subcatchment 8B-13



Summary for Subcatchment S8B2: Subcatchment 8B-2

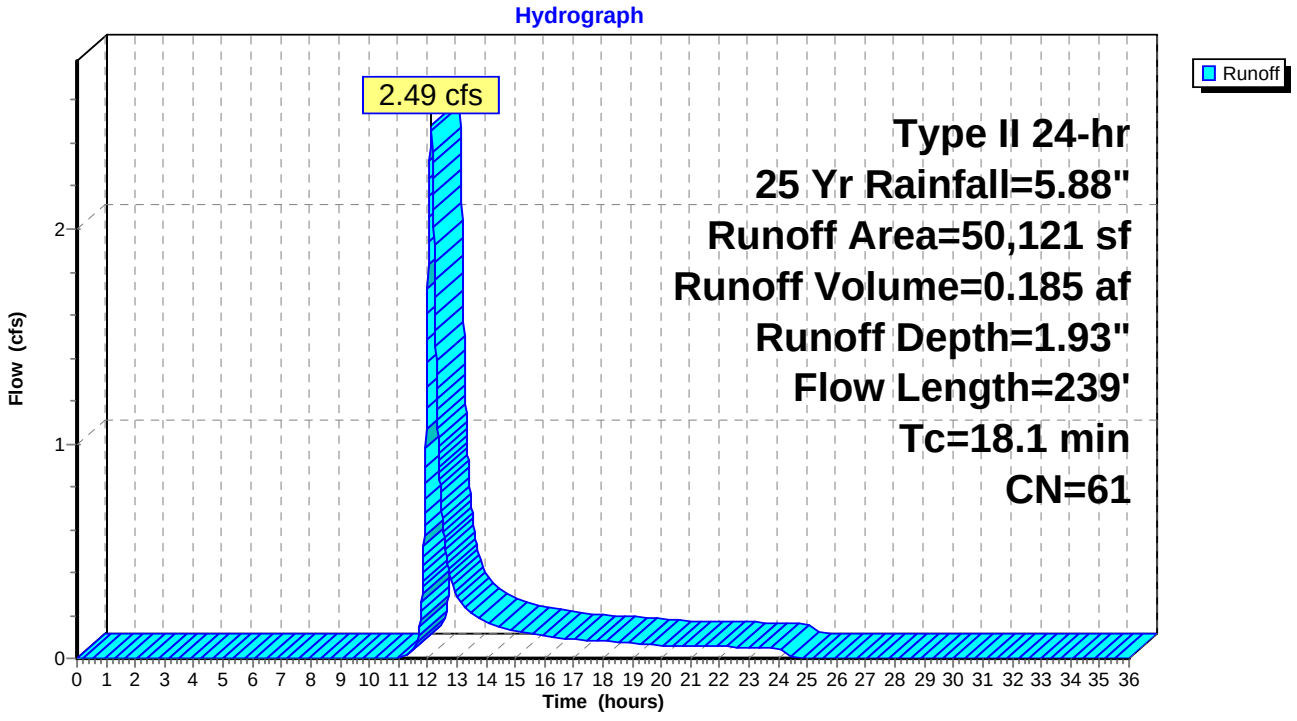
Runoff = 2.49 cfs @ 12.12 hrs, Volume= 0.185 af, Depth= 1.93"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
Type II 24-hr 25 Yr Rainfall=5.88"

Area (sf)	CN	Description
50,121	61	>75% Grass cover, Good, HSG B
50,121		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
15.6	100	0.0176	0.11		**Sheet Flow, Sheet Flow** Grass: Short n= 0.150 P2= 1.39"
2.5	139	0.0177	0.93		**Shallow Concentrated Flow, Shallow Conc.** Short Grass Pasture Kv= 7.0 fps
18.1	239	Total			

Subcatchment S8B2: Subcatchment 8B-2



Summary for Subcatchment S8B3: Subcatchment 8B-3

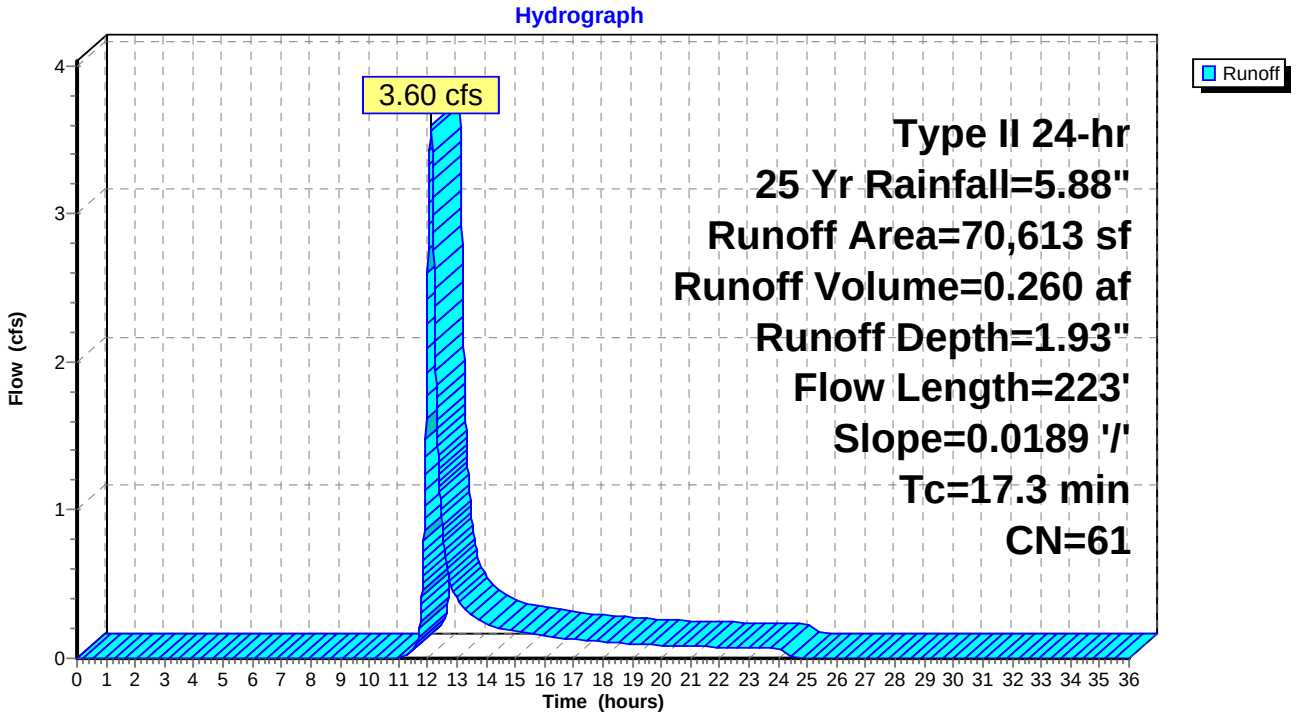
Runoff = 3.60 cfs @ 12.11 hrs, Volume= 0.260 af, Depth= 1.93"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
Type II 24-hr 25 Yr Rainfall=5.88"

Area (sf)	CN	Description
70,613	61	>75% Grass cover, Good, HSG B
70,613		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
15.2	100	0.0189	0.11		**Sheet Flow, Sheet Flow** Grass: Short n= 0.150 P2= 1.39"
2.1	123	0.0189	0.96		**Shallow Concentrated Flow, Shallow Conc.** Short Grass Pasture Kv= 7.0 fps
17.3	223	Total			

Subcatchment S8B3: Subcatchment 8B-3



Summary for Subcatchment S8B4: Subcatchment 8B-4

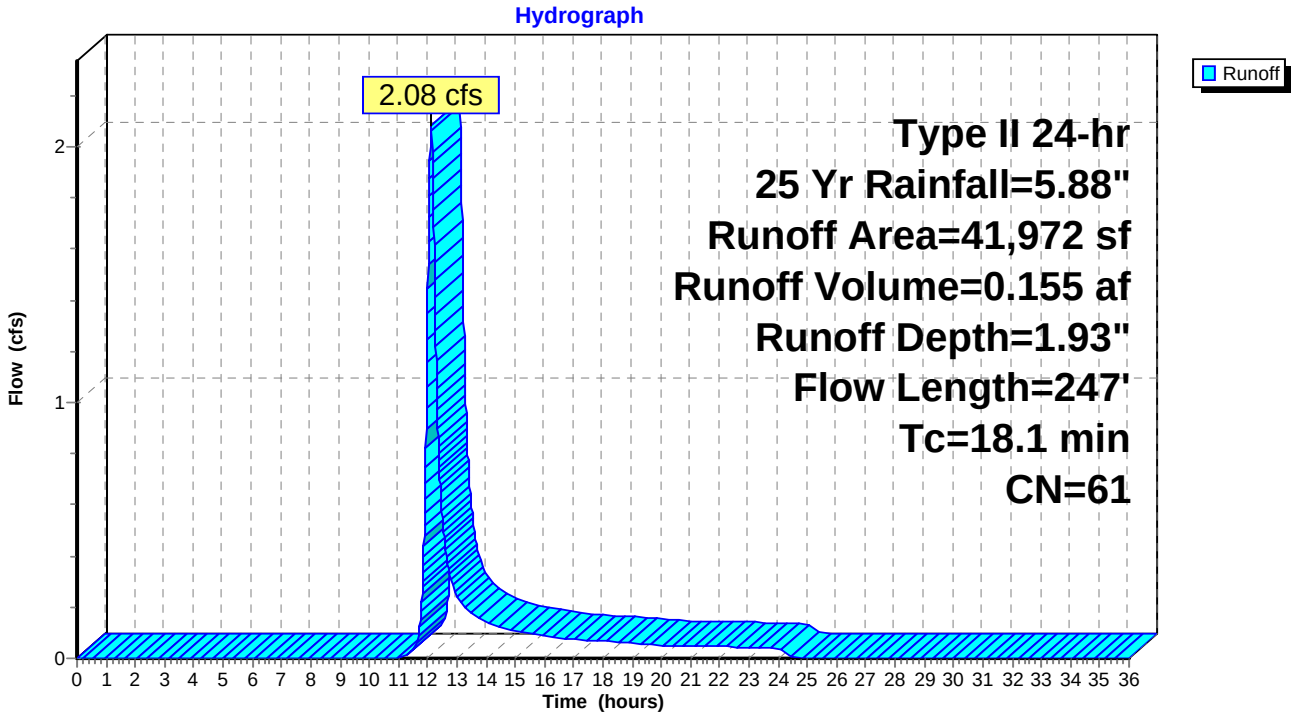
Runoff = 2.08 cfs @ 12.12 hrs, Volume= 0.155 af, Depth= 1.93"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
Type II 24-hr 25 Yr Rainfall=5.88"

Area (sf)	CN	Description
41,972	61	>75% Grass cover, Good, HSG B
41,972		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
15.5	100	0.0181	0.11		**Sheet Flow, Sheet Flow** Grass: Short n= 0.150 P2= 1.39"
2.6	147	0.0177	0.93		**Shallow Concentrated Flow, Shallow Conc.** Short Grass Pasture Kv= 7.0 fps
18.1	247	Total			

Subcatchment S8B4: Subcatchment 8B-4



Summary for Subcatchment S8B5: Subcatchment 8B-5

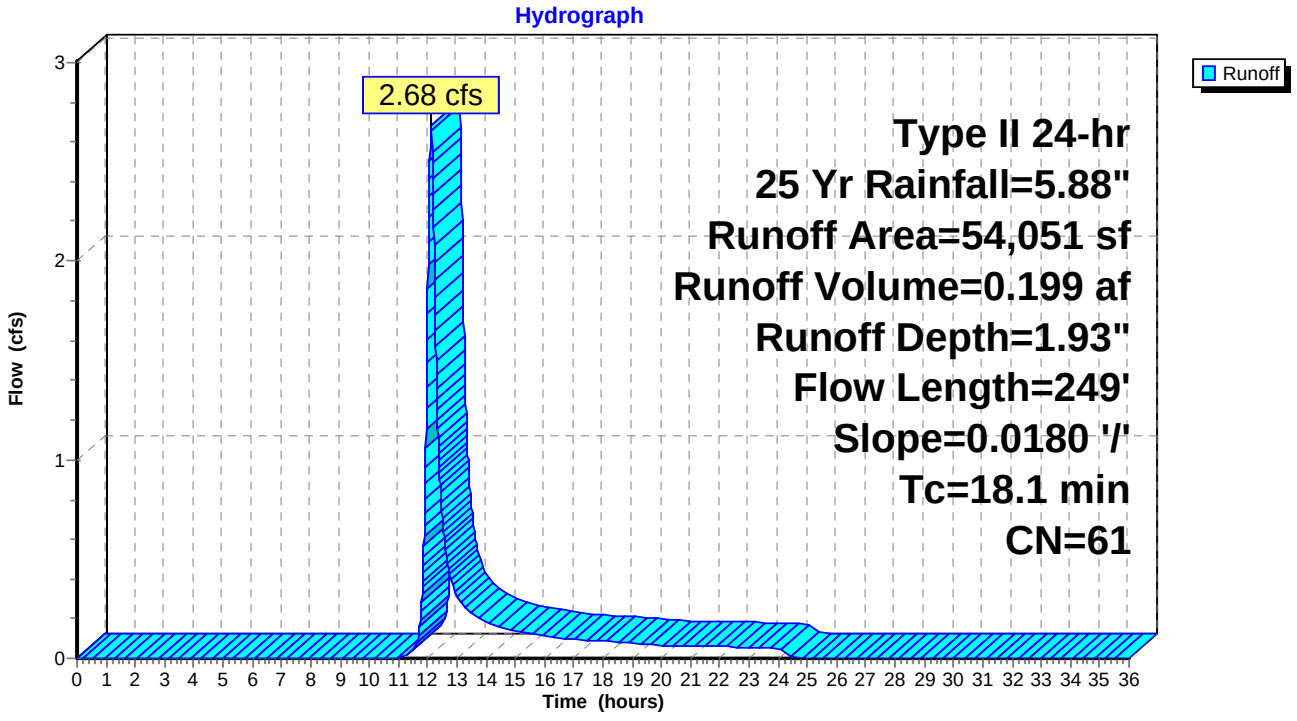
Runoff = 2.68 cfs @ 12.12 hrs, Volume= 0.199 af, Depth= 1.93"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
Type II 24-hr 25 Yr Rainfall=5.88"

Area (sf)	CN	Description
54,051	61	>75% Grass cover, Good, HSG B
54,051		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
15.5	100	0.0180	0.11		**Sheet Flow, Sheet Flow** Grass: Short n= 0.150 P2= 1.39"
2.6	149	0.0180	0.94		**Shallow Concentrated Flow, Shallow Conc.** Short Grass Pasture Kv= 7.0 fps
18.1	249	Total			

Subcatchment S8B5: Subcatchment 8B-5



Summary for Subcatchment S8B6: Subcatchment 8B-6

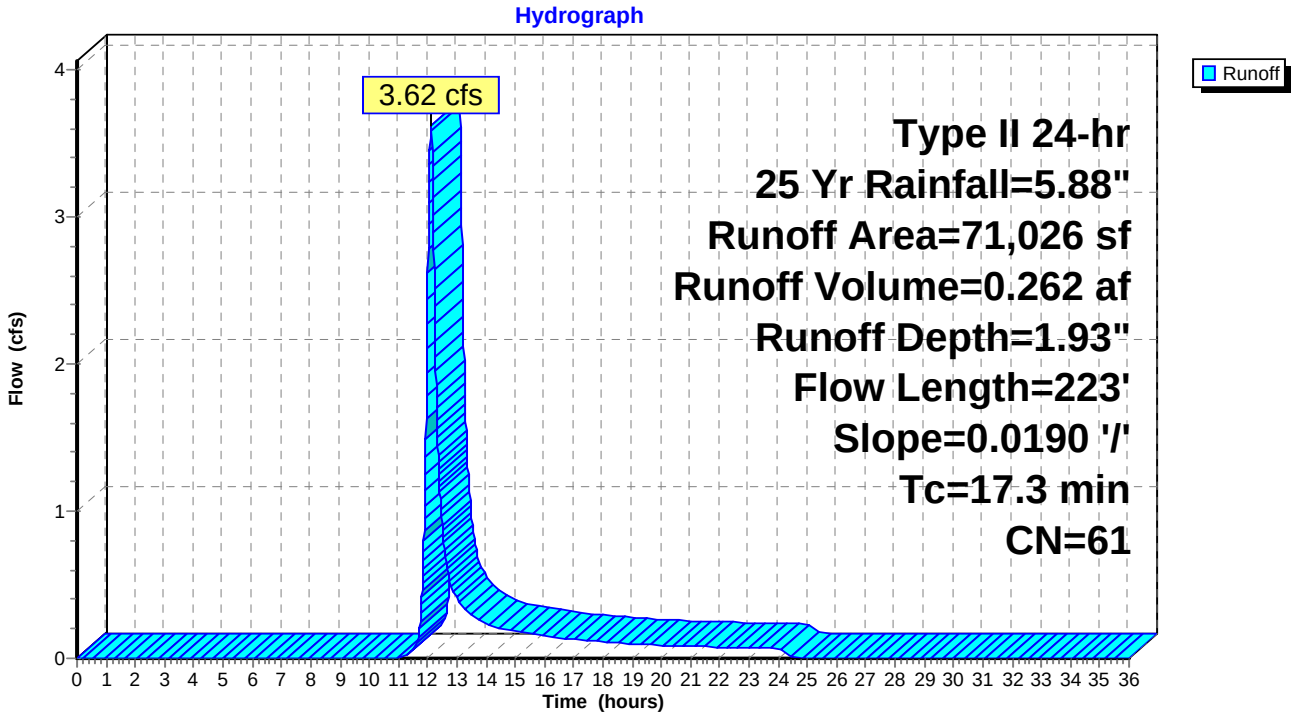
Runoff = 3.62 cfs @ 12.11 hrs, Volume= 0.262 af, Depth= 1.93"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
Type II 24-hr 25 Yr Rainfall=5.88"

Area (sf)	CN	Description
71,026	61	>75% Grass cover, Good, HSG B
71,026		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
15.2	100	0.0190	0.11		**Sheet Flow, Sheet Flow** Grass: Short n= 0.150 P2= 1.39"
2.1	123	0.0190	0.96		**Shallow Concentrated Flow, Shallow Conc.** Short Grass Pasture Kv= 7.0 fps
17.3	223	Total			

Subcatchment S8B6: Subcatchment 8B-6



Summary for Subcatchment S8B7: Subcatchment 8B-7

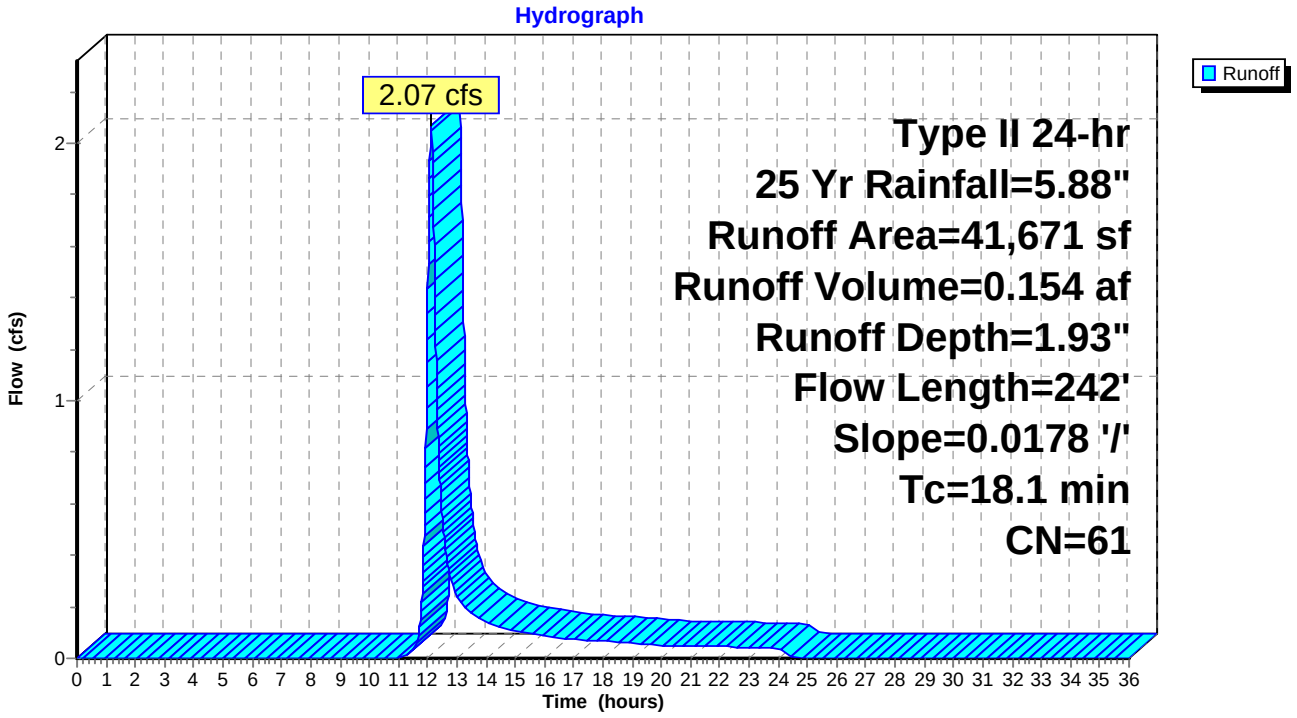
Runoff = 2.07 cfs @ 12.12 hrs, Volume= 0.154 af, Depth= 1.93"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
Type II 24-hr 25 Yr Rainfall=5.88"

Area (sf)	CN	Description
41,671	61	>75% Grass cover, Good, HSG B
41,671		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
15.6	100	0.0178	0.11		**Sheet Flow, Sheet Flow** Grass: Short n= 0.150 P2= 1.39"
2.5	142	0.0178	0.93		**Shallow Concentrated Flow, Shallow Conc.** Short Grass Pasture Kv= 7.0 fps
18.1	242	Total			

Subcatchment S8B7: Subcatchment 8B-7



Summary for Subcatchment S8B8: Subcatchment 8B-8

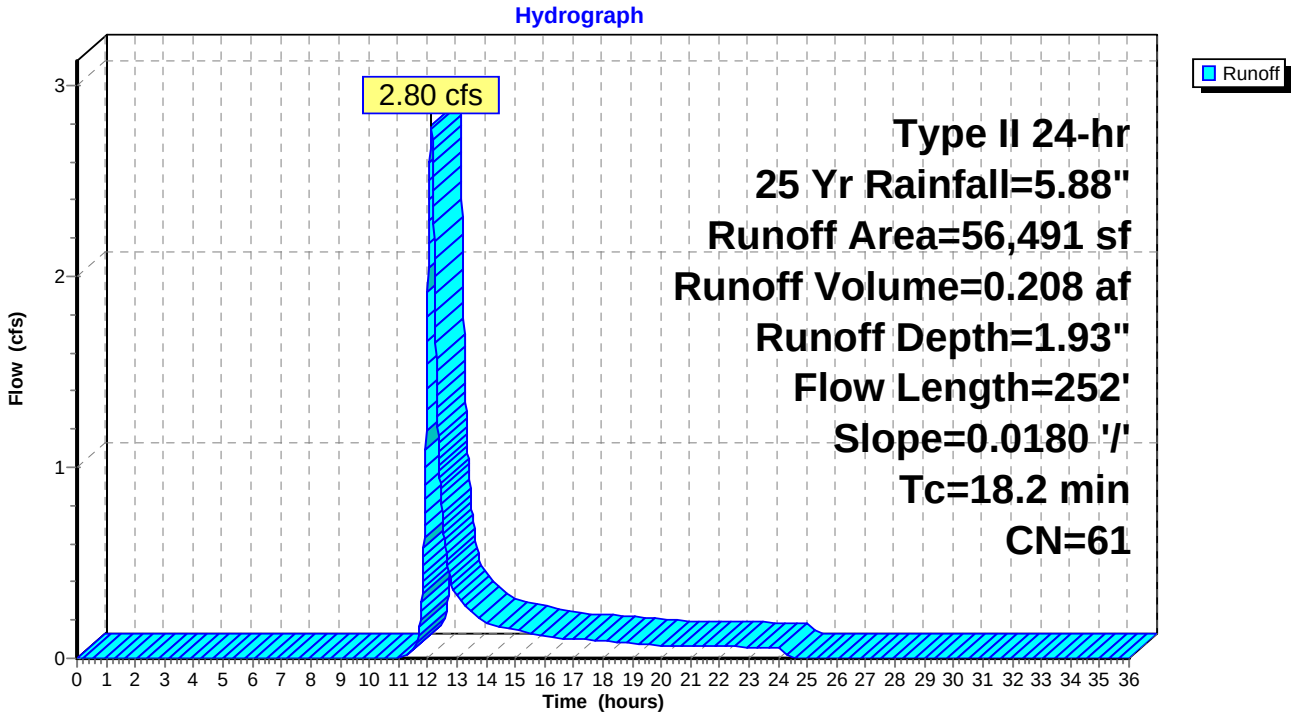
Runoff = 2.80 cfs @ 12.12 hrs, Volume= 0.208 af, Depth= 1.93"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
Type II 24-hr 25 Yr Rainfall=5.88"

Area (sf)	CN	Description
56,491	61	>75% Grass cover, Good, HSG B
56,491		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
15.5	100	0.0180	0.11		**Sheet Flow, Sheet Flow** Grass: Short n= 0.150 P2= 1.39"
2.7	152	0.0180	0.94		**Shallow Concentrated Flow, Shallow Conc.** Short Grass Pasture Kv= 7.0 fps
18.2	252	Total			

Subcatchment S8B8: Subcatchment 8B-8



Summary for Subcatchment S8B9: Subcatchment 8B-9

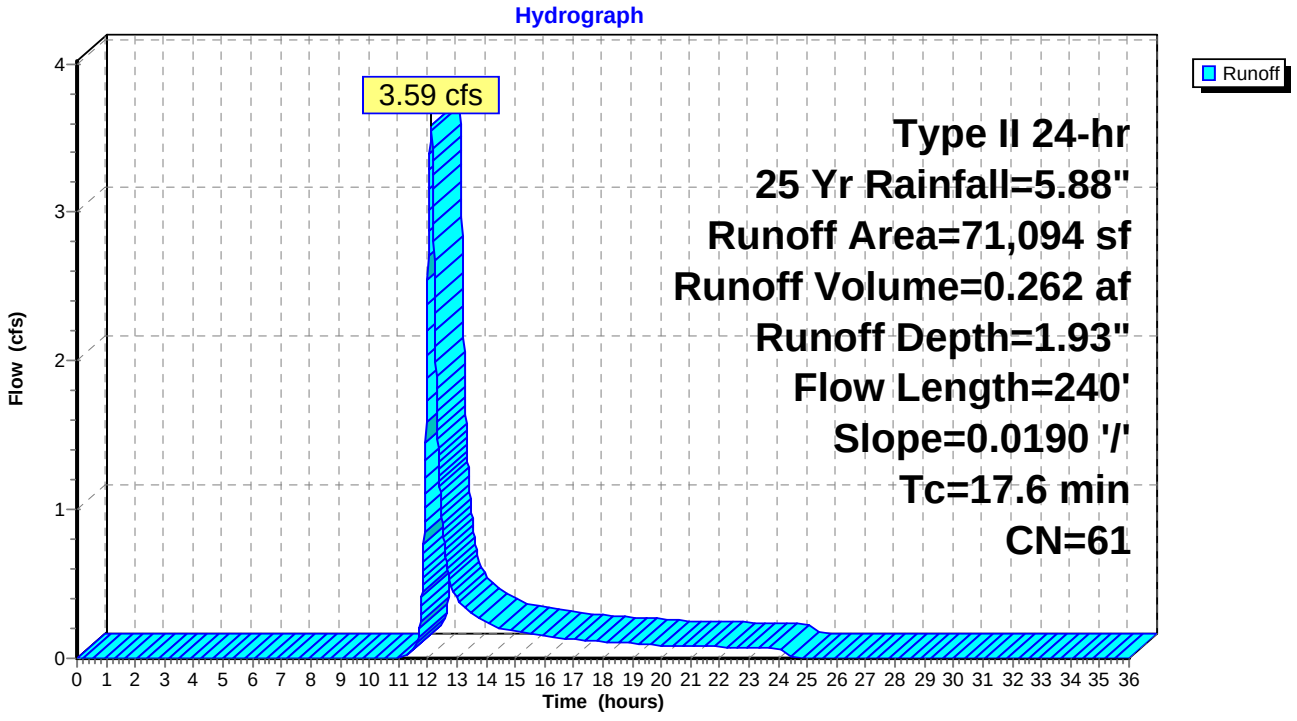
Runoff = 3.59 cfs @ 12.11 hrs, Volume= 0.262 af, Depth= 1.93"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
Type II 24-hr 25 Yr Rainfall=5.88"

Area (sf)	CN	Description
71,094	61	>75% Grass cover, Good, HSG B
71,094		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
15.2	100	0.0190	0.11		**Sheet Flow, Sheet Flow** Grass: Short n= 0.150 P2= 1.39"
2.4	140	0.0190	0.96		**Shallow Concentrated Flow, Shallow Conc.** Short Grass Pasture Kv= 7.0 fps
17.6	240	Total			

Subcatchment S8B9: Subcatchment 8B-9



Summary for Subcatchment S8C1: Subcatchment 8C-1

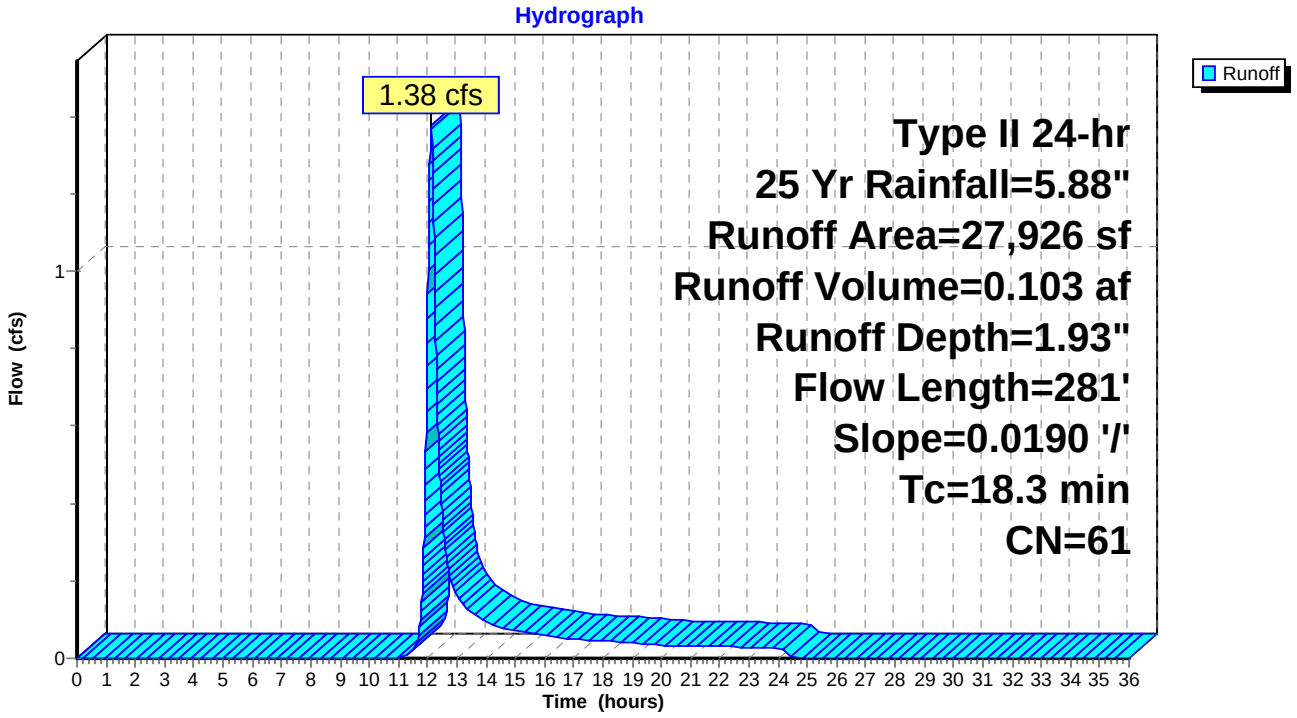
Runoff = 1.38 cfs @ 12.12 hrs, Volume= 0.103 af, Depth= 1.93"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
Type II 24-hr 25 Yr Rainfall=5.88"

Area (sf)	CN	Description
27,926	61	>75% Grass cover, Good, HSG B
27,926		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
15.2	100	0.0190	0.11		**Sheet Flow, Sheet Flow** Grass: Short n= 0.150 P2= 1.39"
3.1	181	0.0190	0.96		**Shallow Concentrated Flow, Shallow Conc.** Short Grass Pasture Kv= 7.0 fps
18.3	281	Total			

Subcatchment S8C1: Subcatchment 8C-1



Summary for Subcatchment S8C2: Subcatchment 8C-2

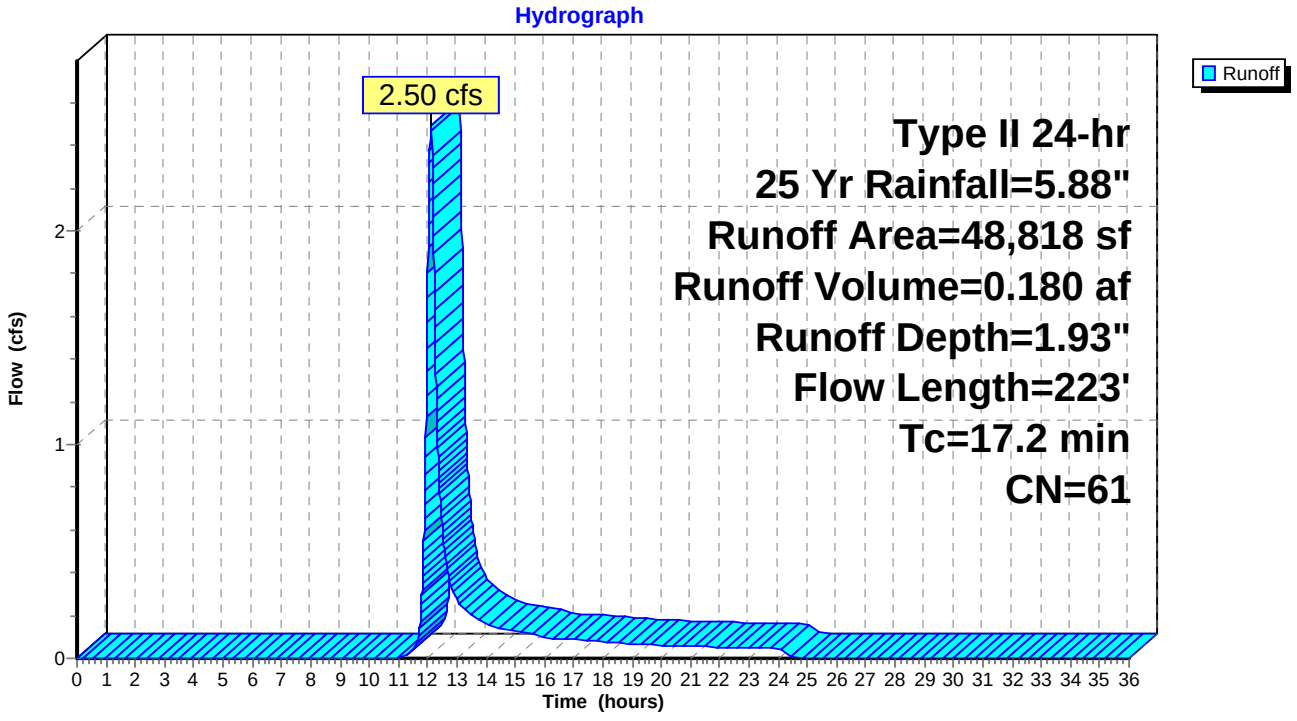
Runoff = 2.50 cfs @ 12.10 hrs, Volume= 0.180 af, Depth= 1.93"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
Type II 24-hr 25 Yr Rainfall=5.88"

Area (sf)	CN	Description
48,818	61	>75% Grass cover, Good, HSG B
48,818		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
15.1	100	0.0192	0.11		**Sheet Flow, Sheet Flow** Grass: Short n= 0.150 P2= 1.39"
2.1	123	0.0190	0.96		**Shallow Concentrated Flow, Shallow Conc.** Short Grass Pasture Kv= 7.0 fps
17.2	223	Total			

Subcatchment S8C2: Subcatchment 8C-2



Summary for Subcatchment S8C3: Subcatchment 8C-3

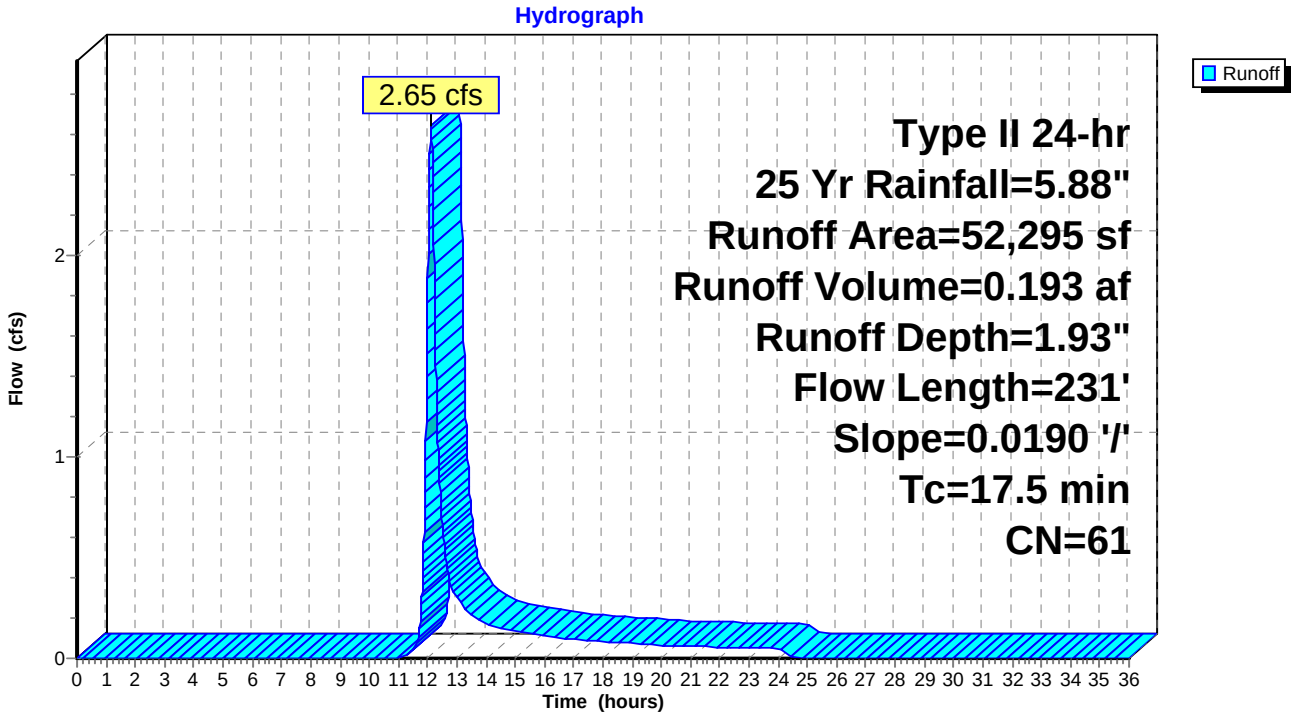
Runoff = 2.65 cfs @ 12.11 hrs, Volume= 0.193 af, Depth= 1.93"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
Type II 24-hr 25 Yr Rainfall=5.88"

Area (sf)	CN	Description
52,295	61	>75% Grass cover, Good, HSG B
52,295		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
15.2	100	0.0190	0.11		**Sheet Flow, Sheet Flow** Grass: Short n= 0.150 P2= 1.39"
2.3	131	0.0190	0.96		**Shallow Concentrated Flow, Shallow Conc.** Short Grass Pasture Kv= 7.0 fps
17.5	231	Total			

Subcatchment S8C3: Subcatchment 8C-3



Summary for Subcatchment S9A: Subcatchment 9A

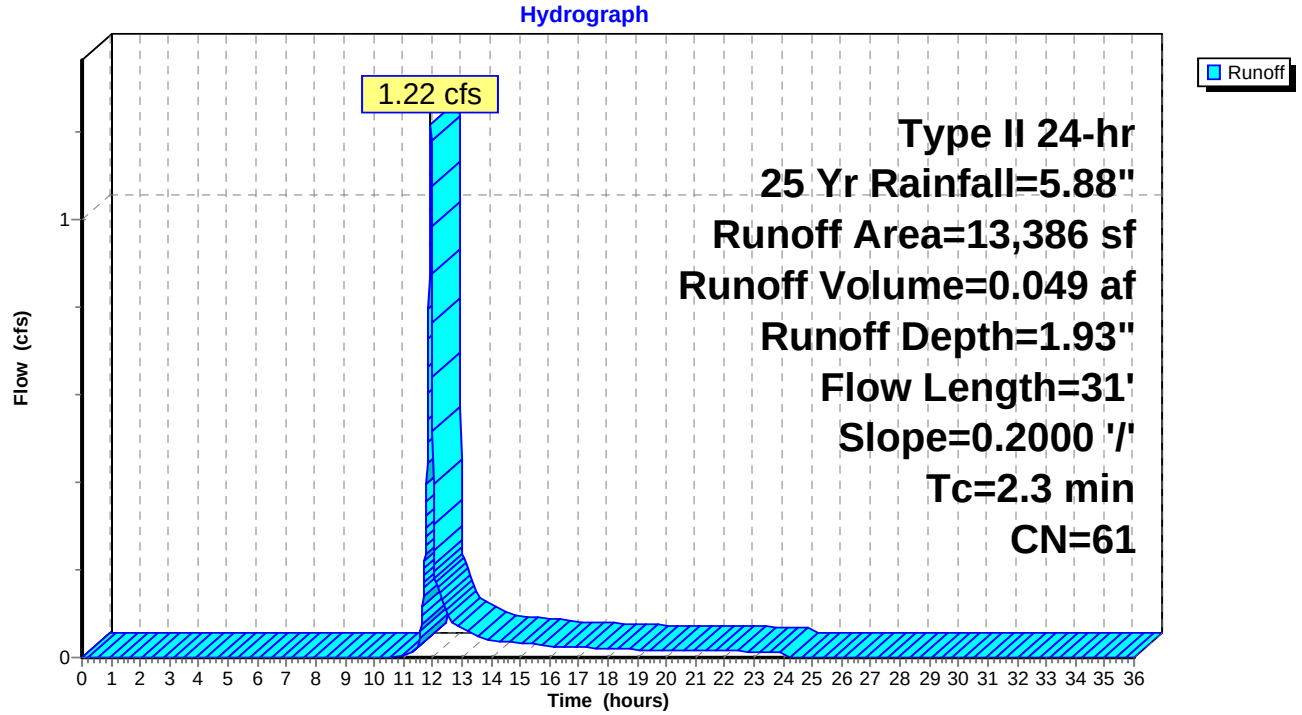
Runoff = 1.22 cfs @ 11.93 hrs, Volume= 0.049 af, Depth= 1.93"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
Type II 24-hr 25 Yr Rainfall=5.88"

Area (sf)	CN	Description
13,386	61	>75% Grass cover, Good, HSG B
13,386		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
2.3	31	0.2000	0.22		**Sheet Flow, Sheet Flow** Grass: Short n= 0.150 P2= 1.39"

Subcatchment S9A: Subcatchment 9A



Summary for Subcatchment S9B: Subcatchment 9B

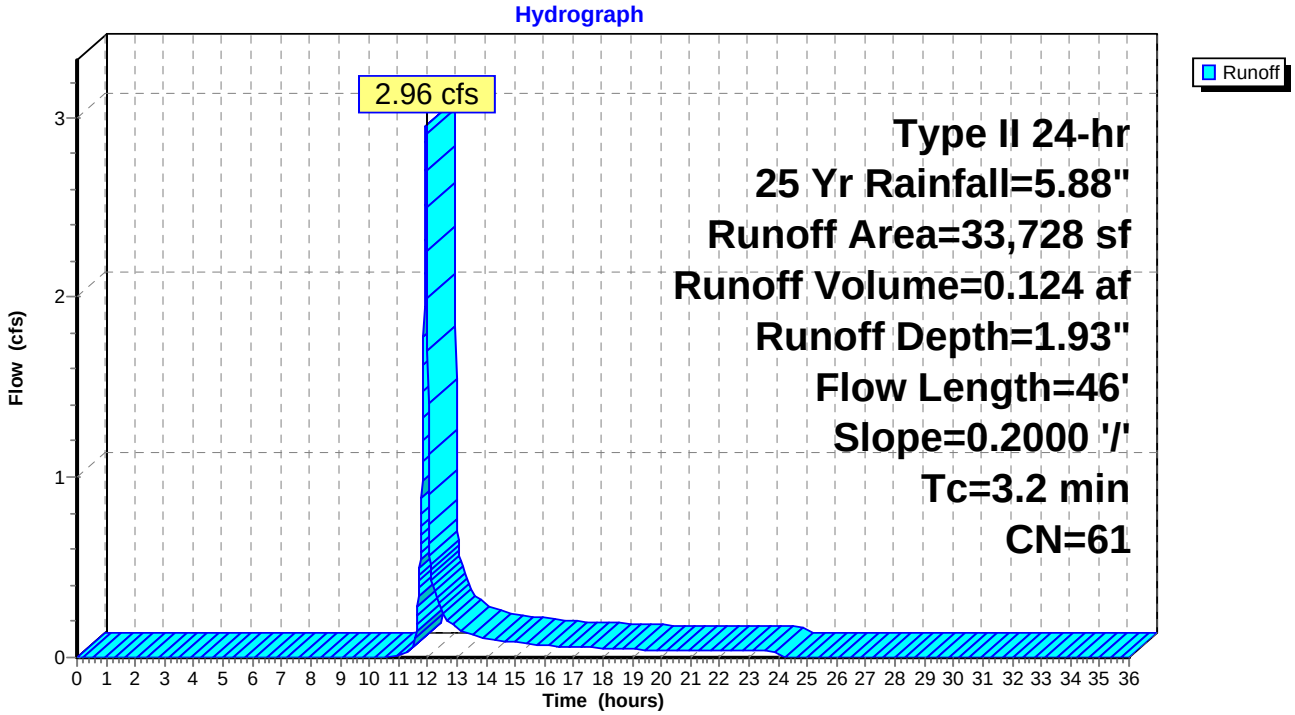
Runoff = 2.96 cfs @ 11.94 hrs, Volume= 0.124 af, Depth= 1.93"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
Type II 24-hr 25 Yr Rainfall=5.88"

Area (sf)	CN	Description
33,728	61	>75% Grass cover, Good, HSG B
33,728		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
3.2	46	0.2000	0.24		**Sheet Flow, Sheet Flow** Grass: Short n= 0.150 P2= 1.39"

Subcatchment S9B: Subcatchment 9B



Summary for Subcatchment SC3: Subcatchment To Outlet C-3

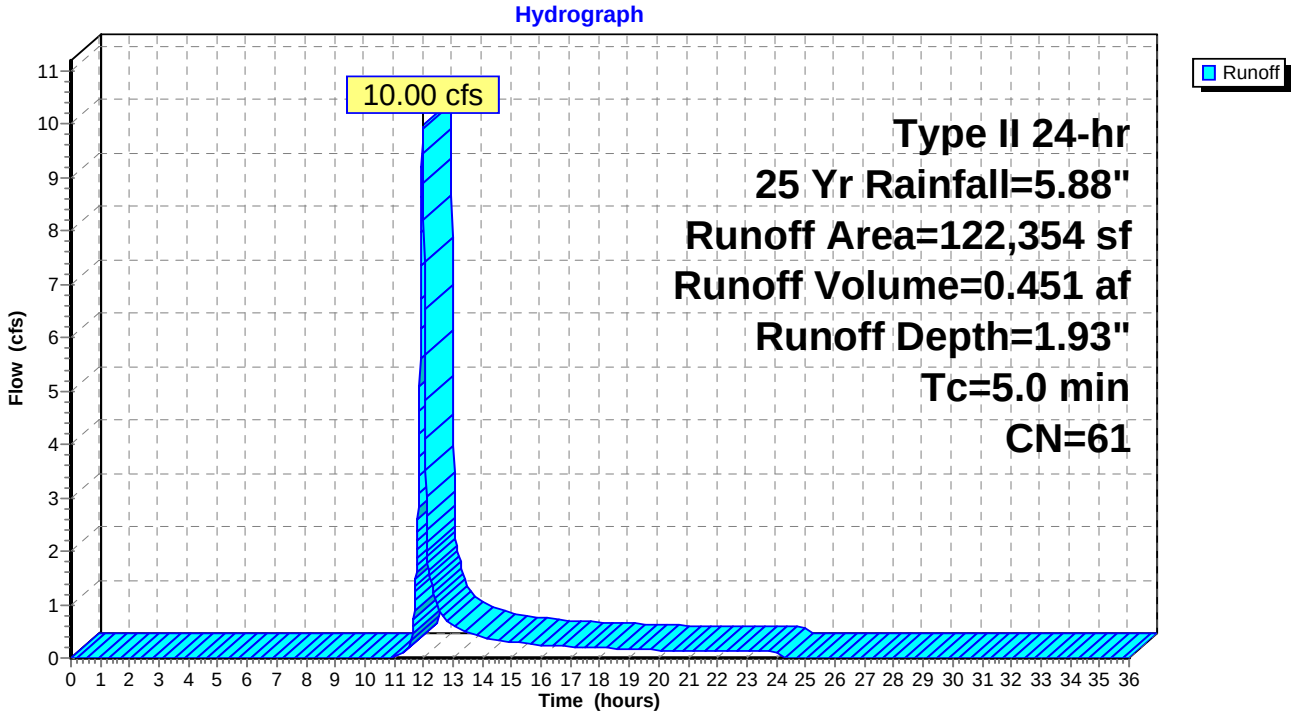
Runoff = 10.00 cfs @ 11.97 hrs, Volume= 0.451 af, Depth= 1.93"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
Type II 24-hr 25 Yr Rainfall=5.88"

Area (sf)	CN	Description
122,354	61	>75% Grass cover, Good, HSG B
122,354		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.0					**Direct Entry, Direct Entry**

Subcatchment SC3: Subcatchment To Outlet C-3



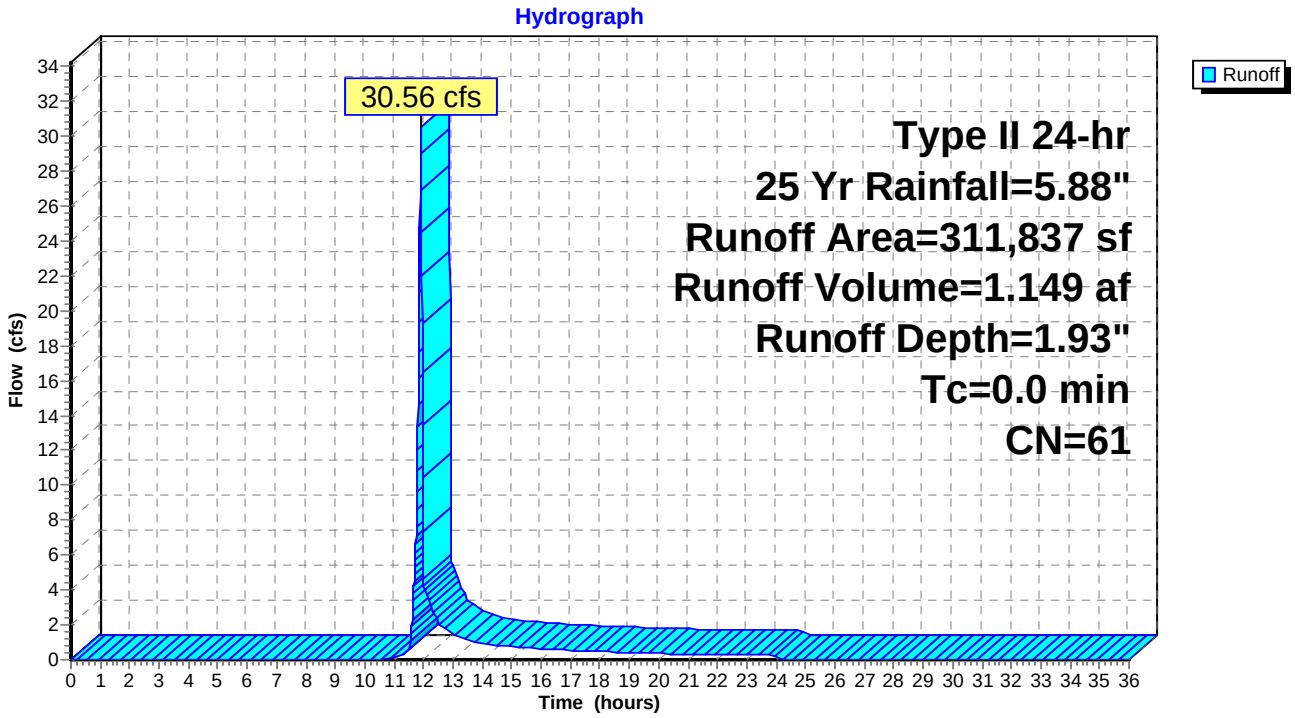
Summary for Subcatchment SWD2: Subcatchment West Ditch 2

Runoff = 30.56 cfs @ 11.90 hrs, Volume= 1.149 af, Depth= 1.93"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
Type II 24-hr 25 Yr Rainfall=5.88"

Area (sf)	CN	Description
311,837	61	>75% Grass cover, Good, HSG B
311,837		100.00% Pervious Area

Subcatchment SWD2: Subcatchment West Ditch 2



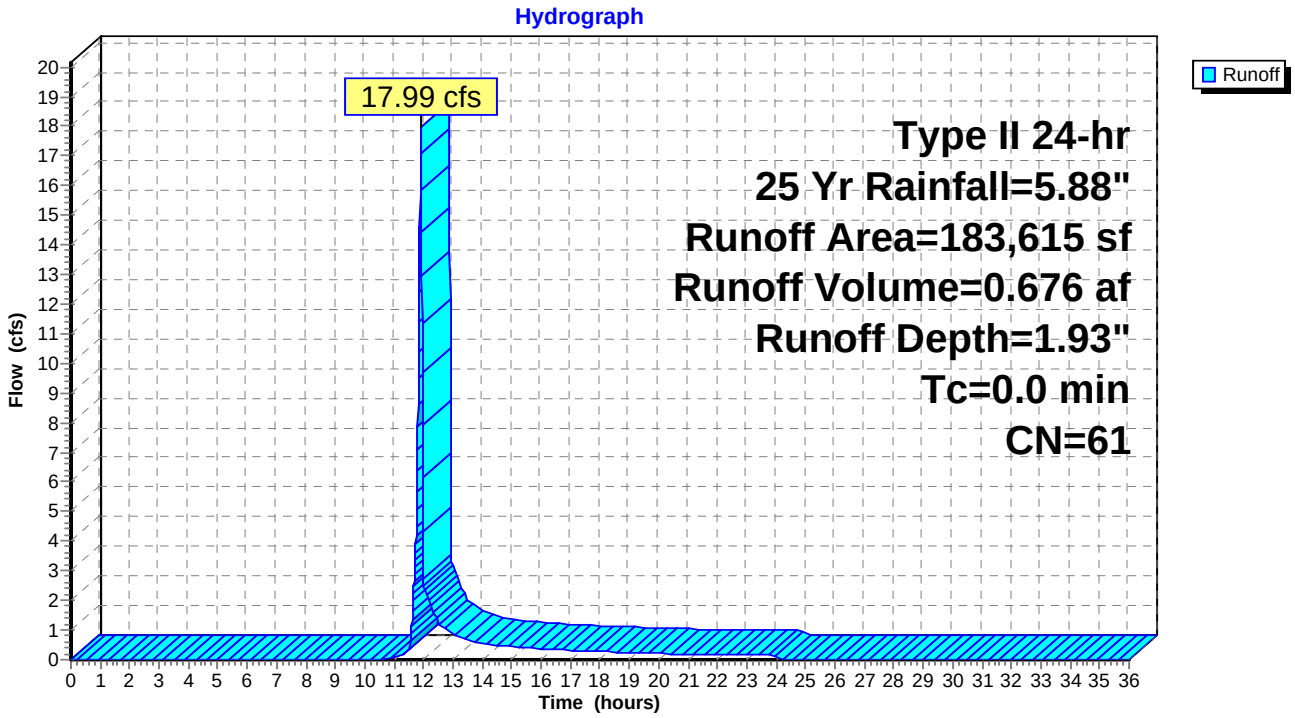
Summary for Subcatchment SWD3: Subcatchment West Ditch 3

Runoff = 17.99 cfs @ 11.90 hrs, Volume= 0.676 af, Depth= 1.93"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
Type II 24-hr 25 Yr Rainfall=5.88"

Area (sf)	CN	Description
183,615	61	>75% Grass cover, Good, HSG B
183,615		100.00% Pervious Area

Subcatchment SWD3: Subcatchment West Ditch 3



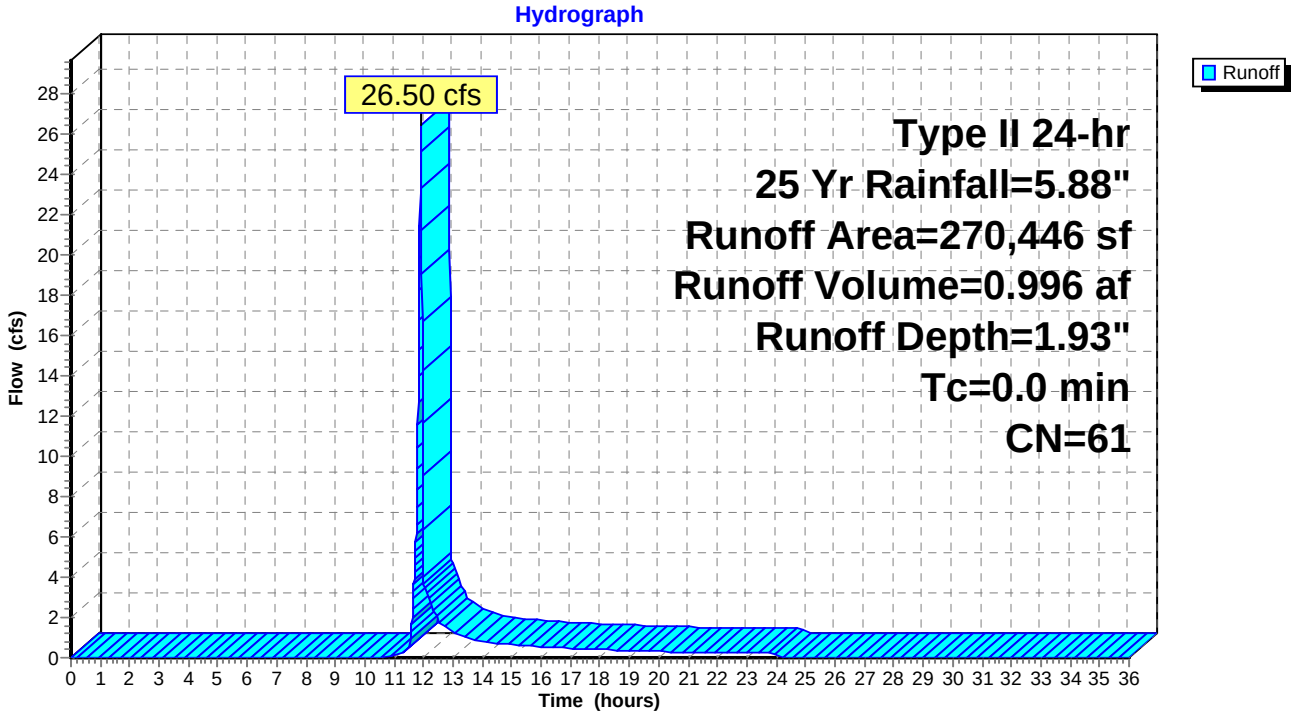
Summary for Subcatchment SWD4: Subcatchment West Ditch 4

Runoff = 26.50 cfs @ 11.90 hrs, Volume= 0.996 af, Depth= 1.93"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
Type II 24-hr 25 Yr Rainfall=5.88"

Area (sf)	CN	Description
270,446	61	>75% Grass cover, Good, HSG B
270,446		100.00% Pervious Area

Subcatchment SWD4: Subcatchment West Ditch 4



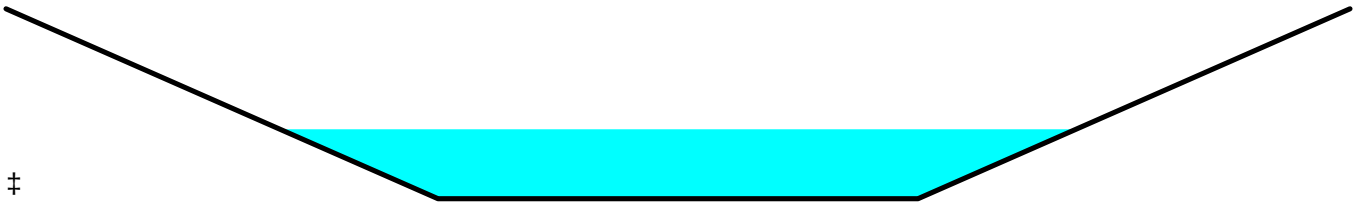
Summary for Reach 6RR: Outlet 6 Riprap

Inflow Area = 13.968 ac, 0.00% Impervious, Inflow Depth = 1.93" for 25 Yr event
Inflow = 18.47 cfs @ 12.41 hrs, Volume= 2.241 af
Outflow = 18.47 cfs @ 12.42 hrs, Volume= 2.241 af, Atten= 0%, Lag= 0.6 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs / 2
Max. Velocity= 5.06 fps, Min. Travel Time= 0.3 min
Avg. Velocity = 1.66 fps, Avg. Travel Time= 1.0 min

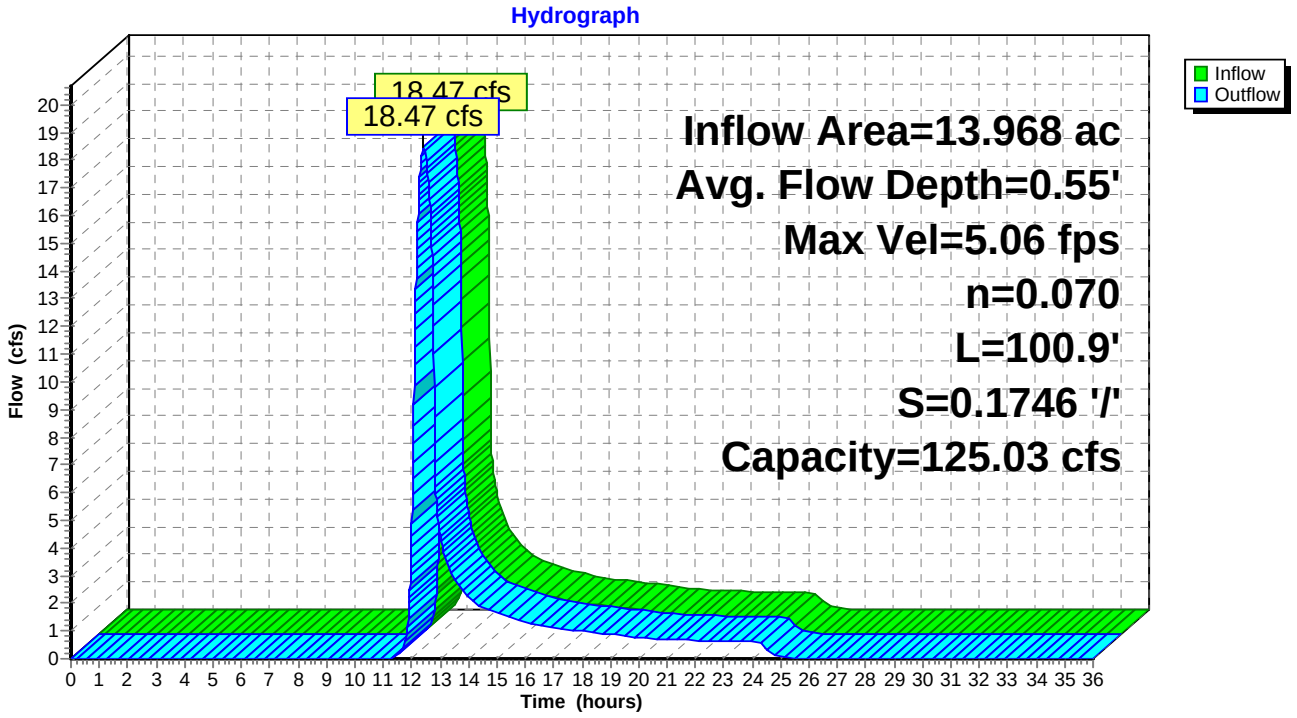
Peak Storage= 368 cf @ 12.42 hrs
Average Depth at Peak Storage= 0.55'
Bank-Full Depth= 1.50' Flow Area= 14.3 sf, Capacity= 125.03 cfs

5.00' x 1.50' deep channel, n= 0.070
Side Slope Z-value= 3.0 '/' Top Width= 14.00'
Length= 100.9' Slope= 0.1746 '/'
Inlet Invert= 397.65', Outlet Invert= 380.03'



‡

Reach 6RR: Outlet 6 Riprap



Summary for Reach 7RR: Outlet 7 Riprap

Inflow Area = 18.440 ac, 0.00% Impervious, Inflow Depth = 1.93" for 25 Yr event
Inflow = 20.06 cfs @ 12.49 hrs, Volume= 2.959 af
Outflow = 20.06 cfs @ 12.50 hrs, Volume= 2.959 af, Atten= 0%, Lag= 0.3 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs / 2
Max. Velocity= 5.95 fps, Min. Travel Time= 0.2 min
Avg. Velocity = 1.98 fps, Avg. Travel Time= 0.5 min

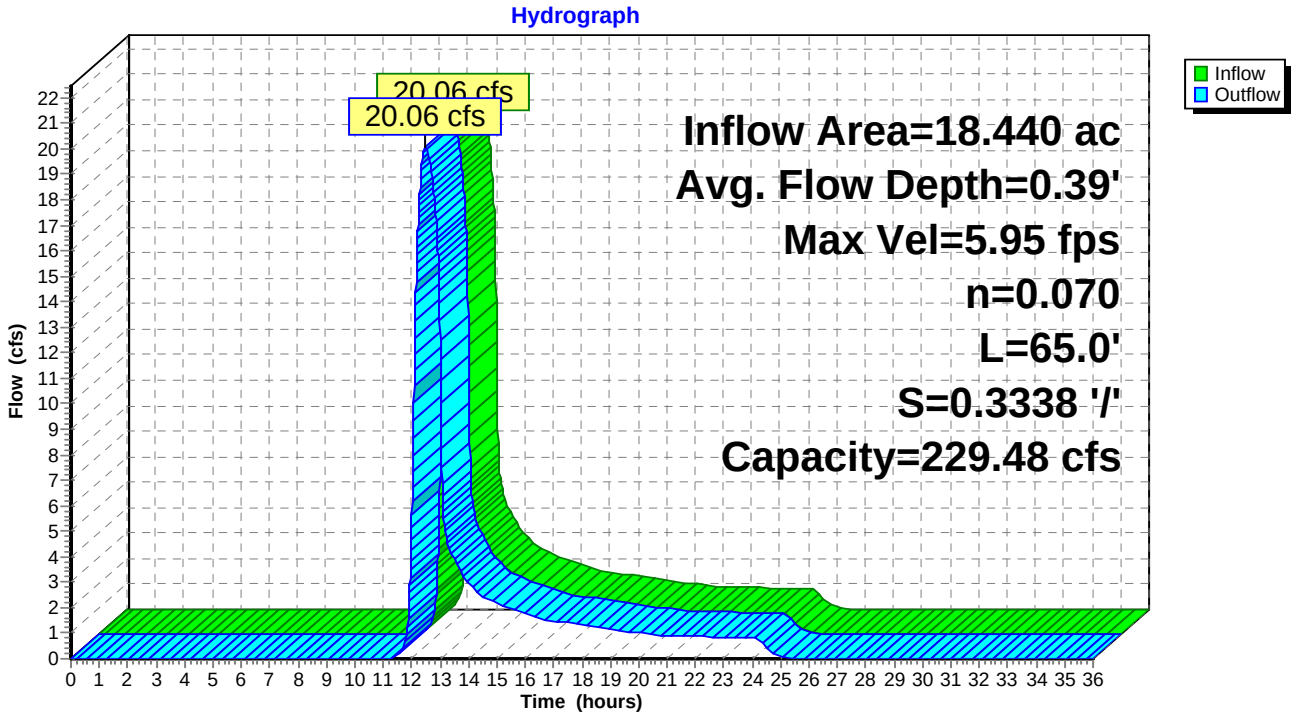
Peak Storage= 219 cf @ 12.49 hrs
Average Depth at Peak Storage= 0.39'
Bank-Full Depth= 1.50' Flow Area= 18.0 sf, Capacity= 229.48 cfs

7.50' x 1.50' deep channel, n= 0.070
Side Slope Z-value= 3.0 '/' Top Width= 16.50'
Length= 65.0' Slope= 0.3338 '/'
Inlet Invert= 398.67', Outlet Invert= 376.97'



‡

Reach 7RR: Outlet 7 Riprap



Summary for Reach 8RR: Outlet 8 Riprap

Inflow Area = 20.304 ac, 0.00% Impervious, Inflow Depth = 1.93" for 25 Yr event
Inflow = 20.60 cfs @ 12.51 hrs, Volume= 3.258 af
Outflow = 20.60 cfs @ 12.51 hrs, Volume= 3.258 af, Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs / 2
Max. Velocity= 6.00 fps, Min. Travel Time= 0.0 min
Avg. Velocity = 2.25 fps, Avg. Travel Time= 0.1 min

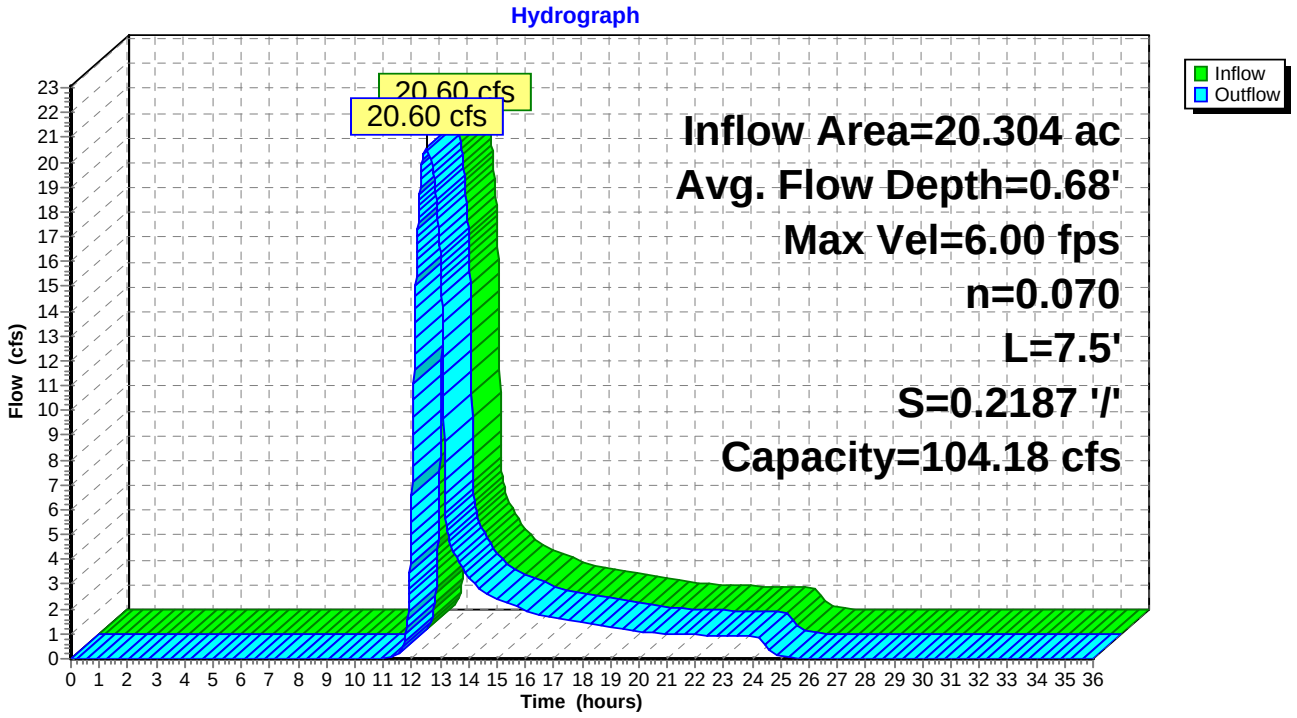
Peak Storage= 26 cf @ 12.51 hrs
Average Depth at Peak Storage= 0.68'
Bank-Full Depth= 1.50' Flow Area= 11.3 sf, Capacity= 104.18 cfs

3.00' x 1.50' deep channel, n= 0.070
Side Slope Z-value= 3.0 '/' Top Width= 12.00'
Length= 7.5' Slope= 0.2187 '/'
Inlet Invert= 398.57', Outlet Invert= 396.93'



‡

Reach 8RR: Outlet 8 Riprap



Summary for Reach 9RR: Outlet 9 Riprap

Inflow Area = 1.082 ac, 0.00% Impervious, Inflow Depth = 1.93" for 25 Yr event
Inflow = 2.52 cfs @ 12.08 hrs, Volume= 0.174 af
Outflow = 2.52 cfs @ 12.09 hrs, Volume= 0.174 af, Atten= 0%, Lag= 0.1 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs / 2
Max. Velocity= 1.88 fps, Min. Travel Time= 0.0 min
Avg. Velocity = 0.56 fps, Avg. Travel Time= 0.1 min

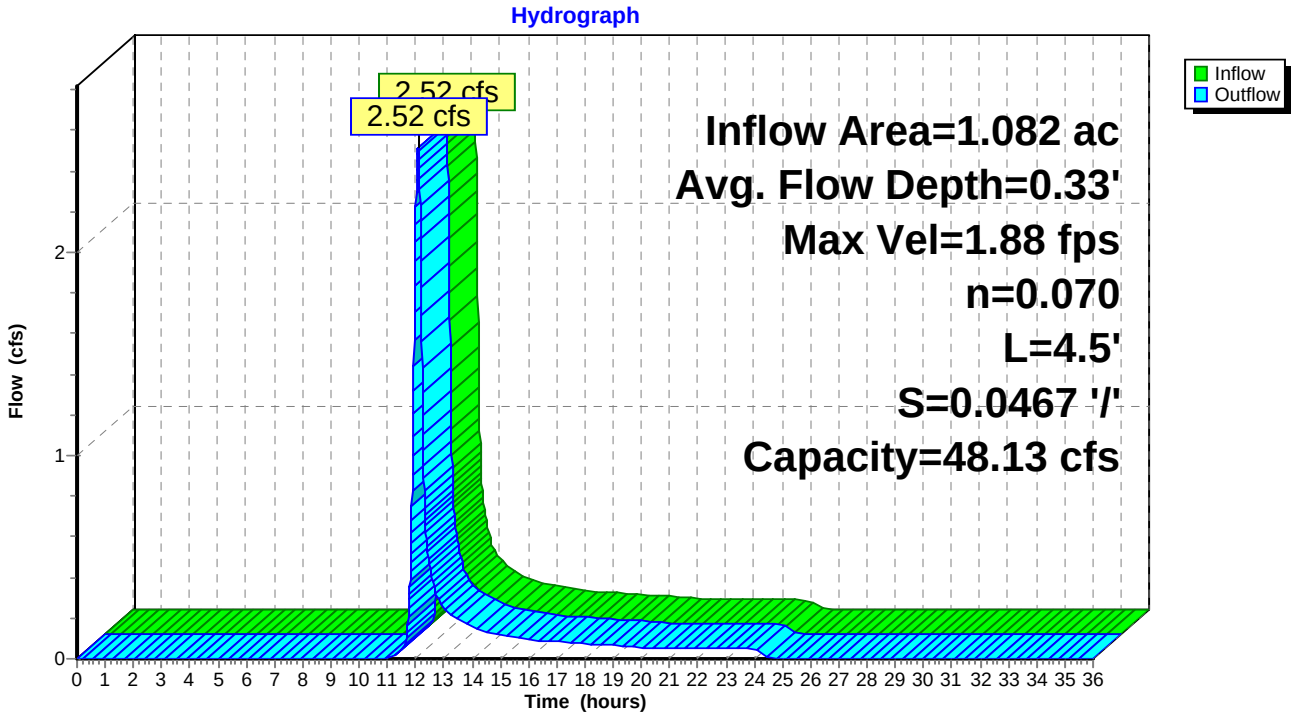
Peak Storage= 6 cf @ 12.08 hrs
Average Depth at Peak Storage= 0.33'
Bank-Full Depth= 1.50' Flow Area= 11.3 sf, Capacity= 48.13 cfs

3.00' x 1.50' deep channel, n= 0.070
Side Slope Z-value= 3.0 '/' Top Width= 12.00'
Length= 4.5' Slope= 0.0467 '/'
Inlet Invert= 400.94', Outlet Invert= 400.73'

‡



Reach 9RR: Outlet 9 Riprap



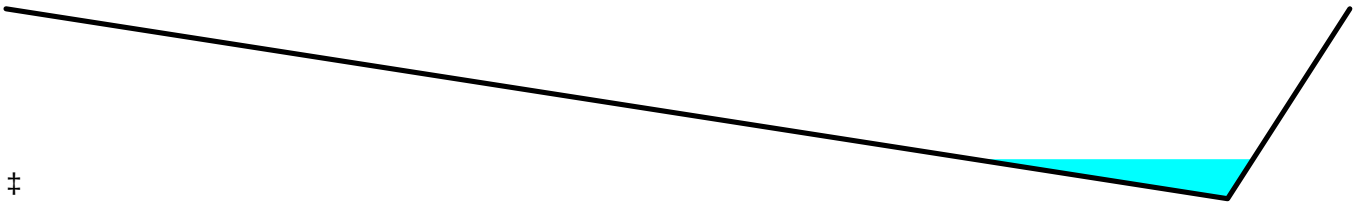
Summary for Reach C6A: Channel 6A

Inflow Area = 2.472 ac, 0.00% Impervious, Inflow Depth = 1.93" for 25 Yr event
Inflow = 5.41 cfs @ 12.11 hrs, Volume= 0.397 af
Outflow = 4.84 cfs @ 12.27 hrs, Volume= 0.397 af, Atten= 11%, Lag= 9.3 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
Max. Velocity= 1.81 fps, Min. Travel Time= 5.4 min
Avg. Velocity = 0.71 fps, Avg. Travel Time= 13.7 min

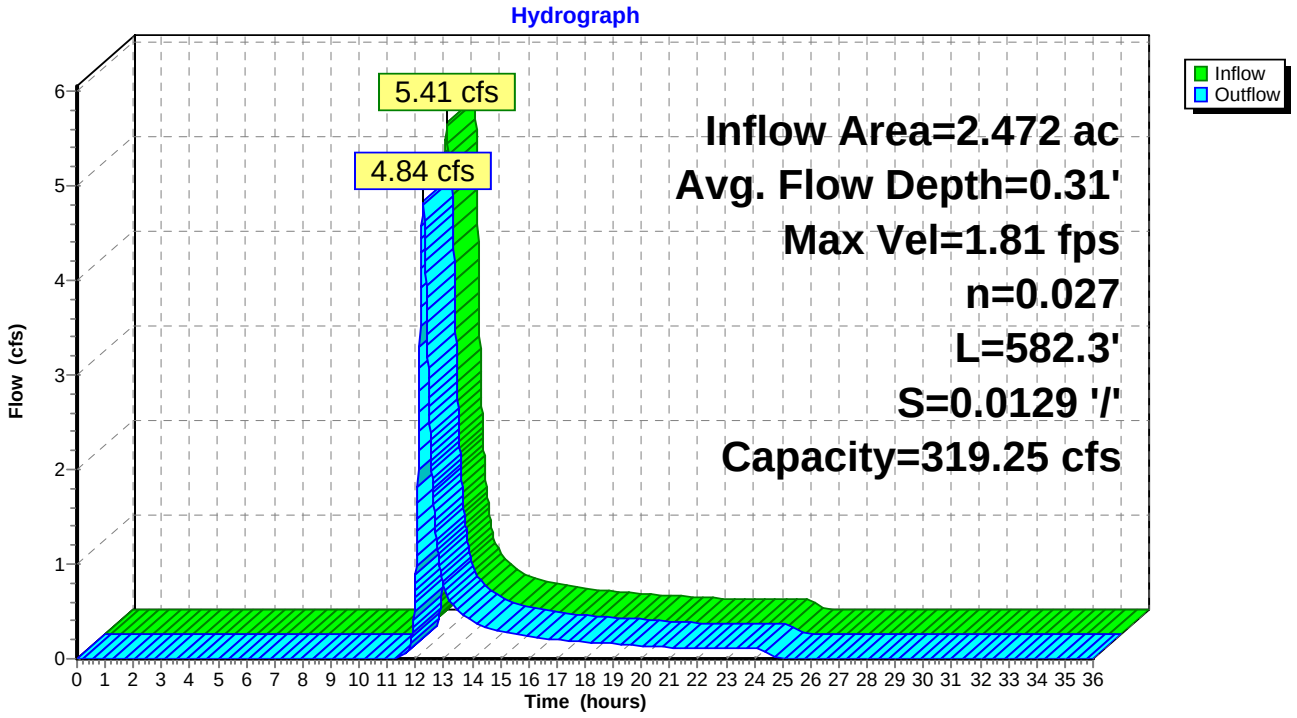
Peak Storage= 1,556 cf @ 12.18 hrs
Average Depth at Peak Storage= 0.31'
Bank-Full Depth= 1.50' Flow Area= 61.9 sf, Capacity= 319.25 cfs

0.00' x 1.50' deep channel, n= 0.027
Side Slope Z-value= 50.0 5.0 '/' Top Width= 82.50'
Length= 582.3' Slope= 0.0129 '/'
Inlet Invert= 408.42', Outlet Invert= 400.89'



‡

Reach C6A: Channel 6A



Summary for Reach C6B1: Channel 6B-1

Inflow Area = 9.474 ac, 0.00% Impervious, Inflow Depth = 1.93" for 25 Yr event
Inflow = 17.83 cfs @ 12.24 hrs, Volume= 1.520 af
Outflow = 17.81 cfs @ 12.26 hrs, Volume= 1.520 af, Atten= 0%, Lag= 0.8 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
Max. Velocity= 3.03 fps, Min. Travel Time= 0.5 min
Avg. Velocity = 0.93 fps, Avg. Travel Time= 1.6 min

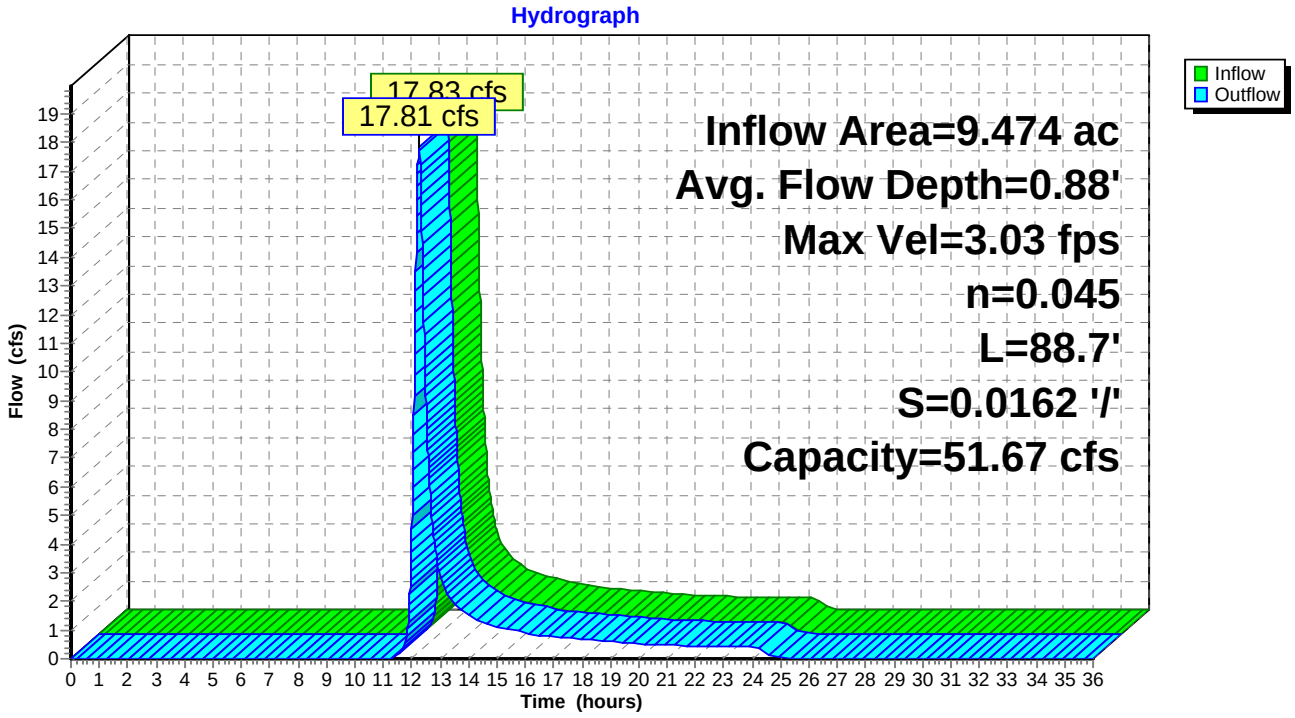
Peak Storage= 521 cf @ 12.25 hrs
Average Depth at Peak Storage= 0.88'
Bank-Full Depth= 1.50' Flow Area= 12.8 sf, Capacity= 51.67 cfs

4.00' x 1.50' deep channel, n= 0.045
Side Slope Z-value= 3.0 '/' Top Width= 13.00'
Length= 88.7' Slope= 0.0162 '/'
Inlet Invert= 401.01', Outlet Invert= 399.57'



‡

Reach C6B1: Channel 6B-1



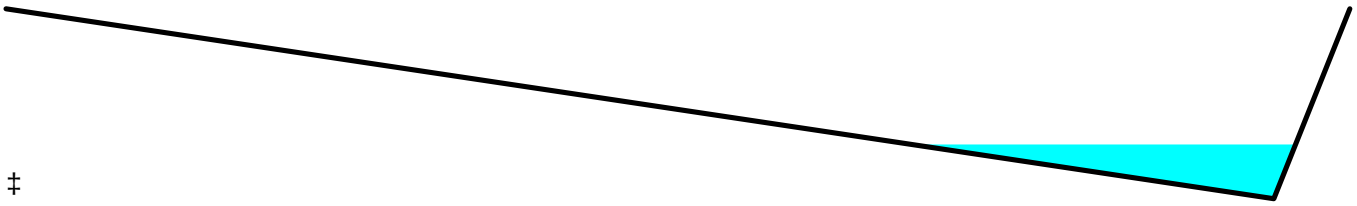
Summary for Reach C6B2: Channel 6B-2

Inflow Area = 2.000 ac, 0.00% Impervious, Inflow Depth = 1.93" for 25 Yr event
Inflow = 4.32 cfs @ 12.12 hrs, Volume= 0.321 af
Outflow = 3.95 cfs @ 12.25 hrs, Volume= 0.321 af, Atten= 9%, Lag= 8.1 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
Max. Velocity= 1.83 fps, Min. Travel Time= 4.7 min
Avg. Velocity = 0.71 fps, Avg. Travel Time= 12.2 min

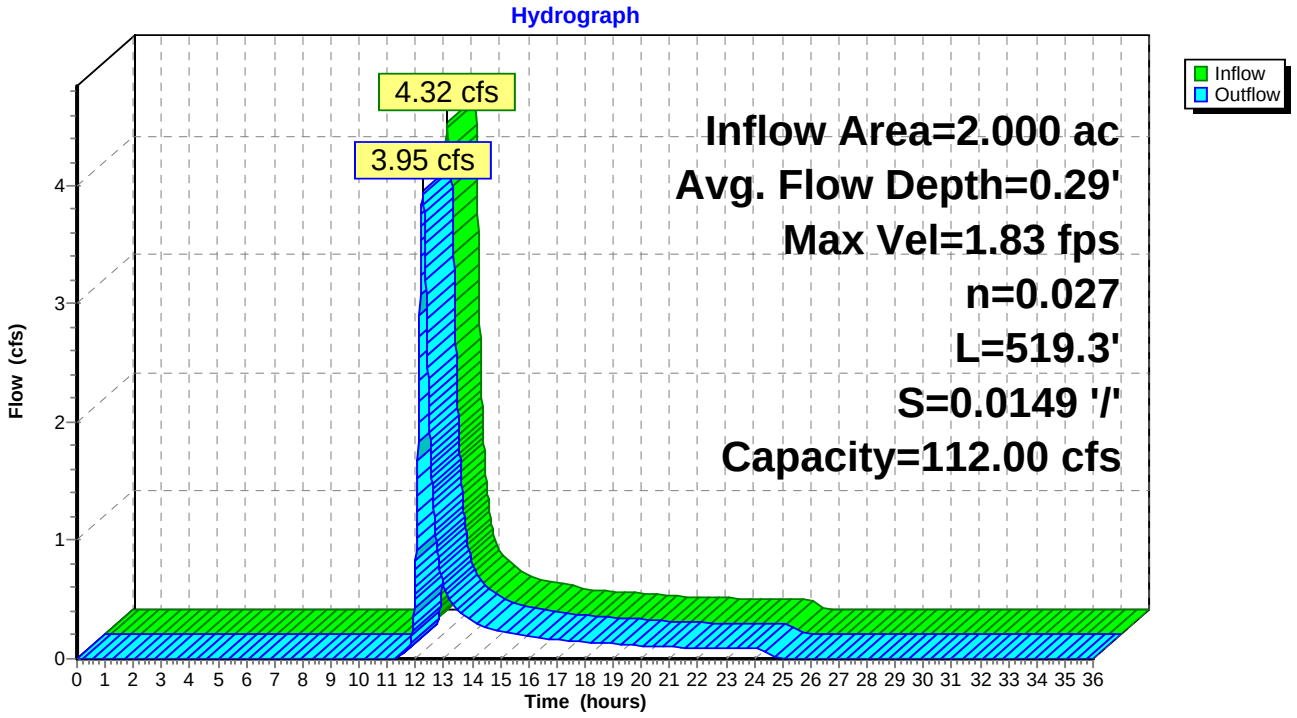
Peak Storage= 1,121 cf @ 12.18 hrs
Average Depth at Peak Storage= 0.29'
Bank-Full Depth= 1.00' Flow Area= 26.5 sf, Capacity= 112.00 cfs

0.00' x 1.00' deep channel, n= 0.027
Side Slope Z-value= 50.0 3.0 '/' Top Width= 53.00'
Length= 519.3' Slope= 0.0149 '/'
Inlet Invert= 410.04', Outlet Invert= 402.29'



‡

Reach C6B2: Channel 6B-2



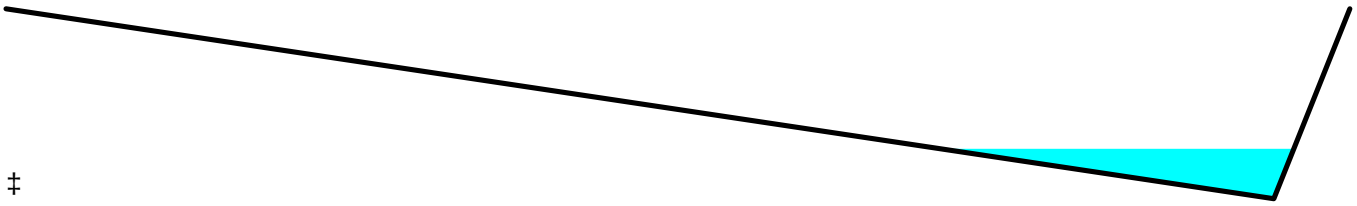
Summary for Reach C6B3: Channel 6B-3

Inflow Area = 1.569 ac, 0.00% Impervious, Inflow Depth = 1.93" for 25 Yr event
Inflow = 3.39 cfs @ 12.12 hrs, Volume= 0.252 af
Outflow = 3.17 cfs @ 12.24 hrs, Volume= 0.252 af, Atten= 7%, Lag= 7.0 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
Max. Velocity= 1.73 fps, Min. Travel Time= 4.0 min
Avg. Velocity = 0.69 fps, Avg. Travel Time= 10.2 min

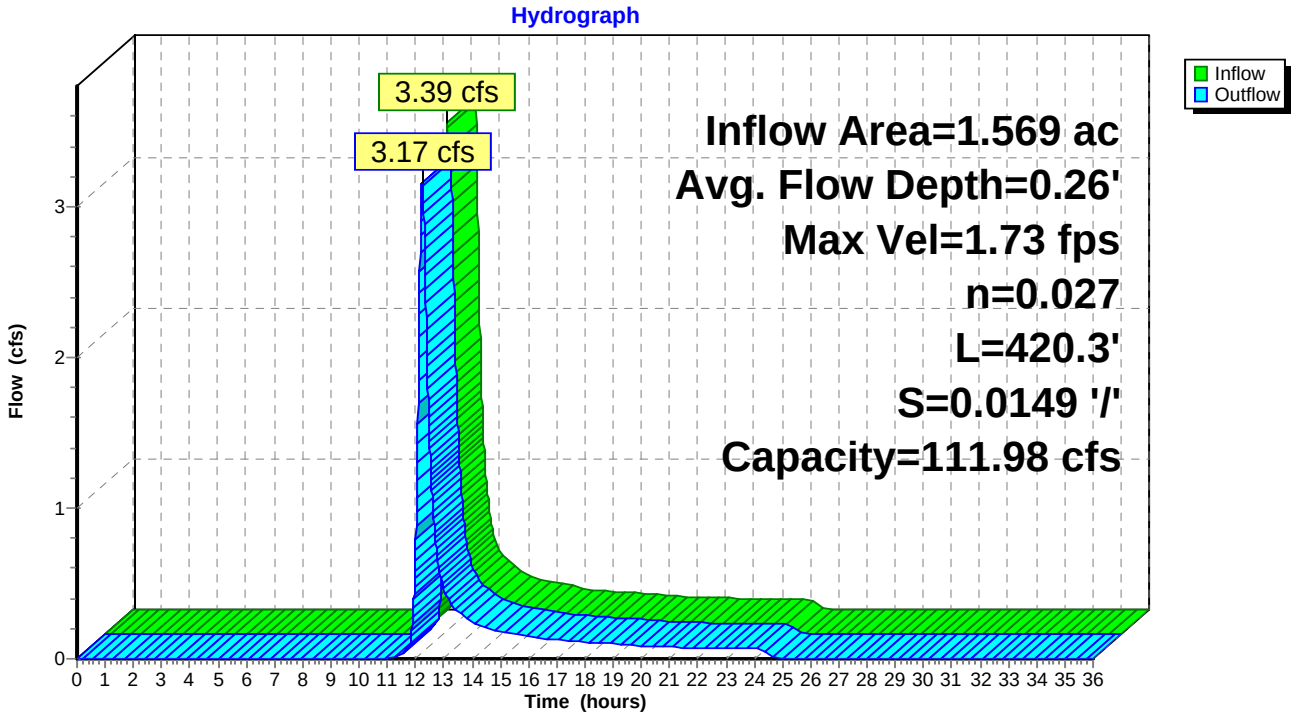
Peak Storage= 768 cf @ 12.17 hrs
Average Depth at Peak Storage= 0.26'
Bank-Full Depth= 1.00' Flow Area= 26.5 sf, Capacity= 111.98 cfs

0.00' x 1.00' deep channel, n= 0.027
Side Slope Z-value= 50.0 3.0 '/' Top Width= 53.00'
Length= 420.3' Slope= 0.0149 '/'
Inlet Invert= 408.56', Outlet Invert= 402.29'



‡

Reach C6B3: Channel 6B-3



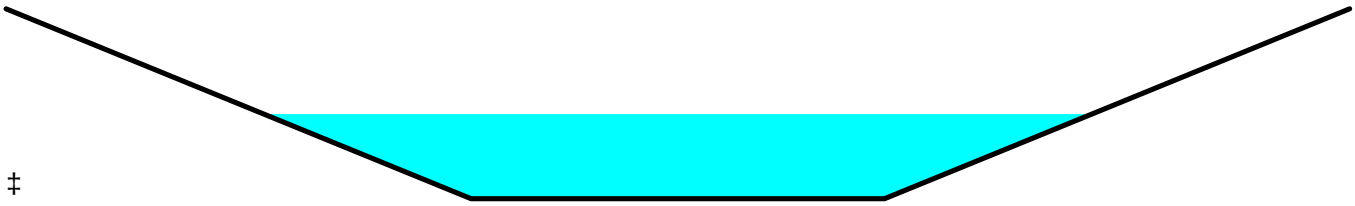
Summary for Reach C6B4: Channel 6B-4

Inflow Area = 5.630 ac, 0.00% Impervious, Inflow Depth = 1.93" for 25 Yr event
Inflow = 10.50 cfs @ 12.21 hrs, Volume= 0.904 af
Outflow = 10.45 cfs @ 12.25 hrs, Volume= 0.904 af, Atten= 0%, Lag= 2.2 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
Max. Velocity= 2.61 fps, Min. Travel Time= 1.3 min
Avg. Velocity = 0.79 fps, Avg. Travel Time= 4.2 min

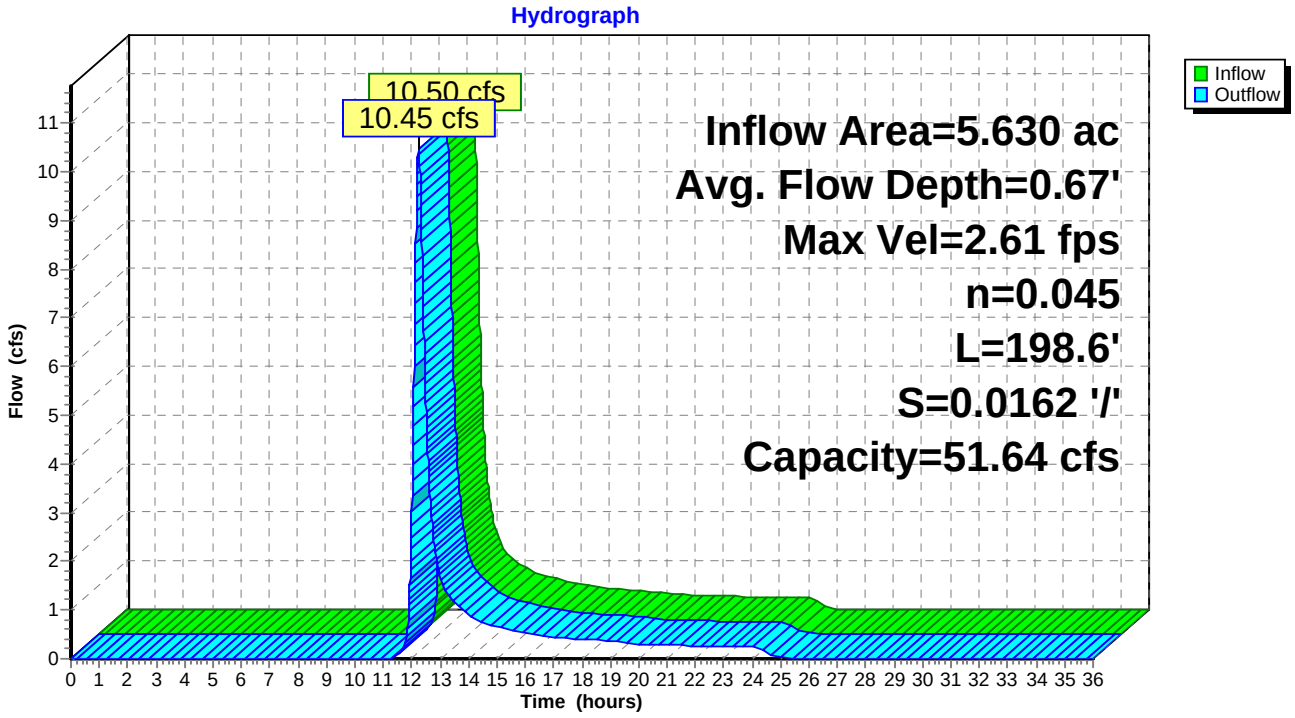
Peak Storage= 797 cf @ 12.23 hrs
Average Depth at Peak Storage= 0.67'
Bank-Full Depth= 1.50' Flow Area= 12.8 sf, Capacity= 51.64 cfs

4.00' x 1.50' deep channel, n= 0.045
Side Slope Z-value= 3.0 '/' Top Width= 13.00'
Length= 198.6' Slope= 0.0162 '/'
Inlet Invert= 404.23', Outlet Invert= 401.01'



‡

Reach C6B4: Channel 6B-4



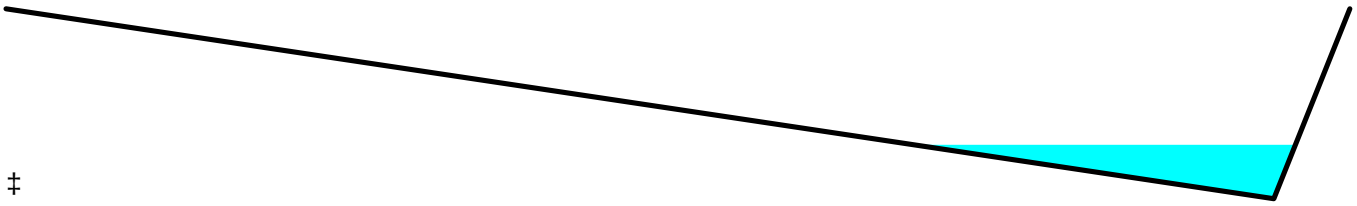
Summary for Reach C6B5: Channel 6B-5

Inflow Area = 2.004 ac, 0.00% Impervious, Inflow Depth = 1.93" for 25 Yr event
Inflow = 4.30 cfs @ 12.12 hrs, Volume= 0.322 af
Outflow = 3.90 cfs @ 12.26 hrs, Volume= 0.322 af, Atten= 9%, Lag= 8.7 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
Max. Velocity= 1.83 fps, Min. Travel Time= 5.0 min
Avg. Velocity = 0.70 fps, Avg. Travel Time= 13.1 min

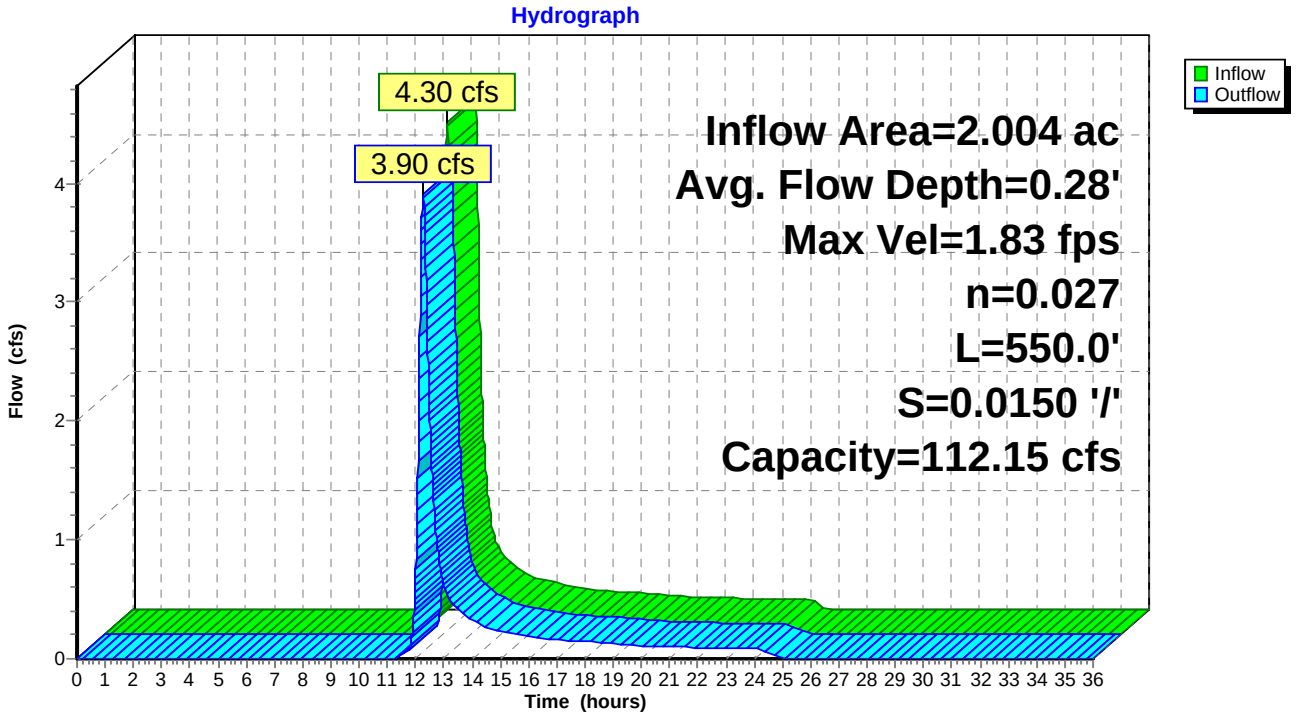
Peak Storage= 1,175 cf @ 12.18 hrs
Average Depth at Peak Storage= 0.28'
Bank-Full Depth= 1.00' Flow Area= 26.5 sf, Capacity= 112.15 cfs

0.00' x 1.00' deep channel, n= 0.027
Side Slope Z-value= 50.0 3.0 '/' Top Width= 53.00'
Length= 550.0' Slope= 0.0150 '/'
Inlet Invert= 413.13', Outlet Invert= 404.90'



‡

Reach C6B5: Channel 6B-5



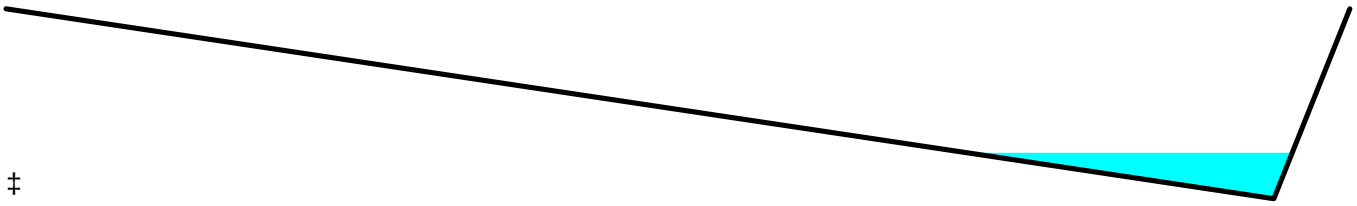
Summary for Reach C6B6: Channel 6B-6

Inflow Area = 1.325 ac, 0.00% Impervious, Inflow Depth = 1.93" for 25 Yr event
Inflow = 2.86 cfs @ 12.12 hrs, Volume= 0.213 af
Outflow = 2.65 cfs @ 12.24 hrs, Volume= 0.213 af, Atten= 7%, Lag= 7.5 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
Max. Velocity= 1.71 fps, Min. Travel Time= 4.2 min
Avg. Velocity = 0.68 fps, Avg. Travel Time= 10.6 min

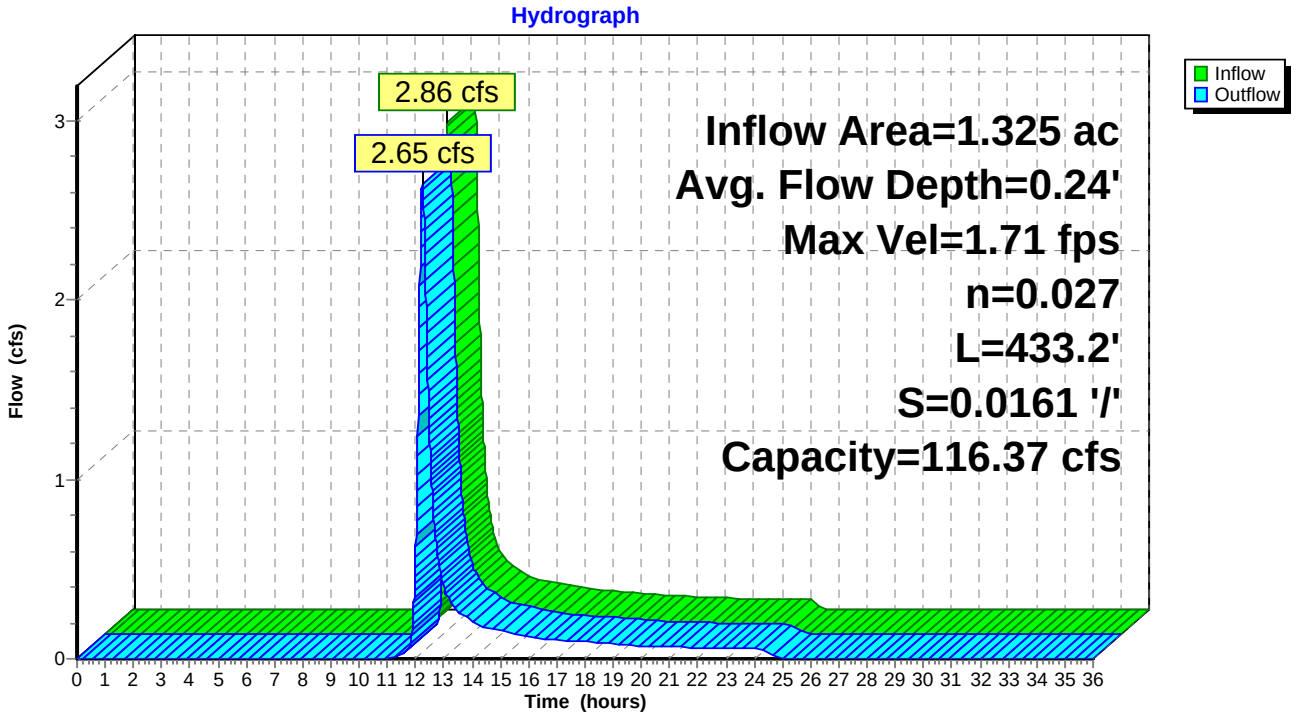
Peak Storage= 673 cf @ 12.17 hrs
Average Depth at Peak Storage= 0.24'
Bank-Full Depth= 1.00' Flow Area= 26.5 sf, Capacity= 116.37 cfs

0.00' x 1.00' deep channel, n= 0.027
Side Slope Z-value= 50.0 3.0 '/' Top Width= 53.00'
Length= 433.2' Slope= 0.0161 '/'
Inlet Invert= 411.88', Outlet Invert= 404.90'



‡

Reach C6B6: Channel 6B-6



Summary for Reach C6B7: Channel 6B-7

Inflow Area = 1.185 ac, 0.00% Impervious, Inflow Depth = 1.93" for 25 Yr event
Inflow = 2.62 cfs @ 12.11 hrs, Volume= 0.190 af
Outflow = 2.58 cfs @ 12.16 hrs, Volume= 0.190 af, Atten= 1%, Lag= 3.0 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
Max. Velocity= 1.70 fps, Min. Travel Time= 1.8 min
Avg. Velocity = 0.52 fps, Avg. Travel Time= 5.8 min

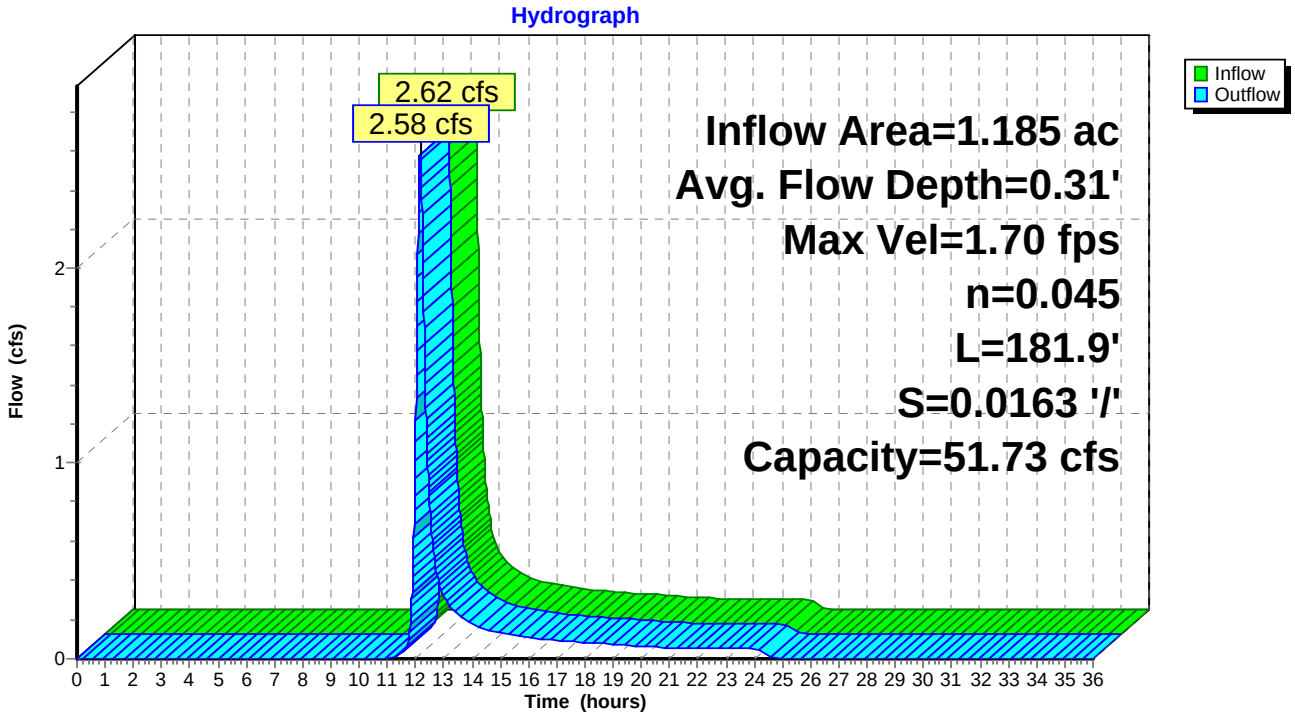
Peak Storage= 277 cf @ 12.13 hrs
Average Depth at Peak Storage= 0.31'
Bank-Full Depth= 1.50' Flow Area= 12.8 sf, Capacity= 51.73 cfs

4.00' x 1.50' deep channel, n= 0.045
Side Slope Z-value= 3.0 '/' Top Width= 13.00'
Length= 181.9' Slope= 0.0163 '/'
Inlet Invert= 407.19', Outlet Invert= 404.23'



‡

Reach C6B7: Channel 6B-7



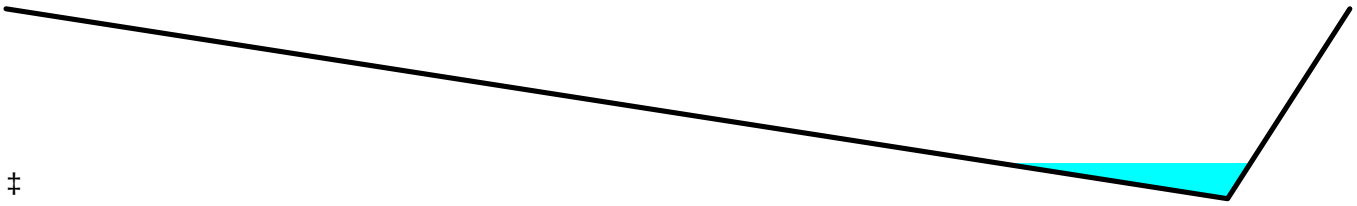
Summary for Reach C6C: Channel 6C

Inflow Area = 2.022 ac, 0.00% Impervious, Inflow Depth = 1.93" for 25 Yr event
Inflow = 4.46 cfs @ 12.11 hrs, Volume= 0.325 af
Outflow = 4.02 cfs @ 12.25 hrs, Volume= 0.325 af, Atten= 10%, Lag= 8.6 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
Max. Velocity= 1.84 fps, Min. Travel Time= 5.0 min
Avg. Velocity = 0.73 fps, Avg. Travel Time= 12.5 min

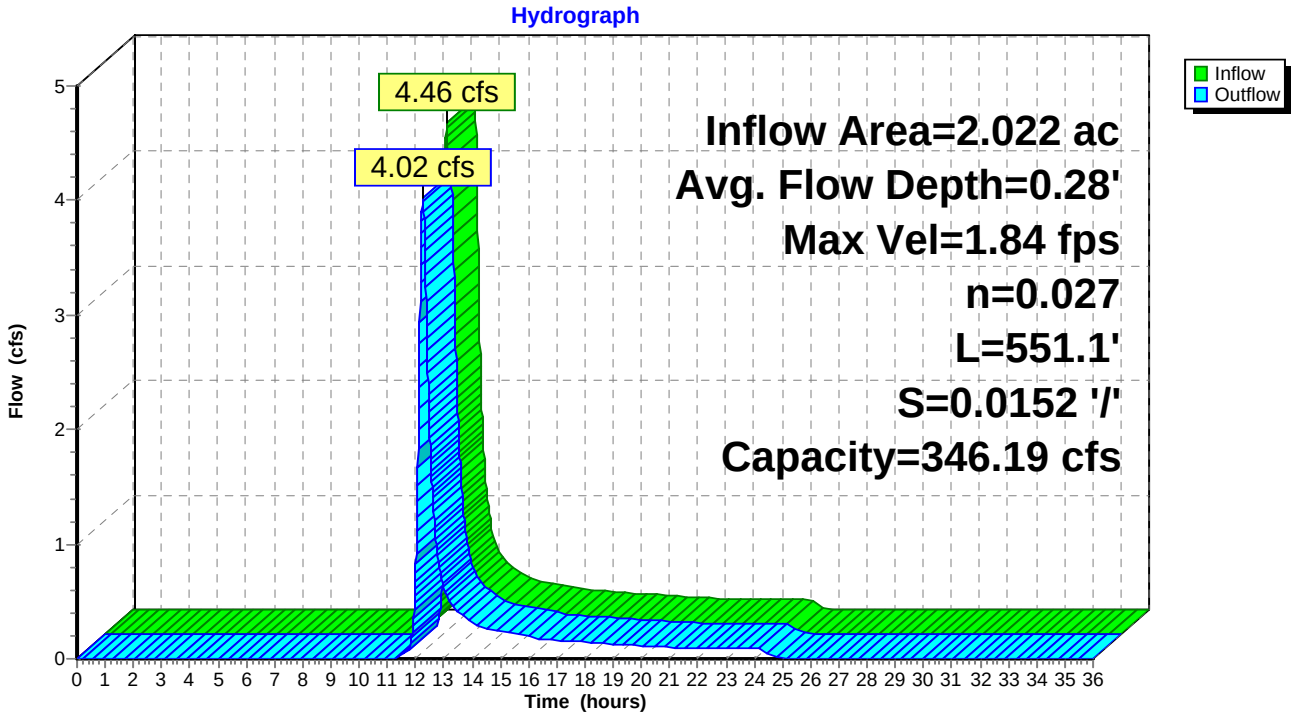
Peak Storage= 1,207 cf @ 12.17 hrs
Average Depth at Peak Storage= 0.28'
Bank-Full Depth= 1.50' Flow Area= 61.9 sf, Capacity= 346.19 cfs

0.00' x 1.50' deep channel, n= 0.027
Side Slope Z-value= 50.0 5.0 '/' Top Width= 82.50'
Length= 551.1' Slope= 0.0152 '/'
Inlet Invert= 409.28', Outlet Invert= 400.90'



‡

Reach C6C: Channel 6C



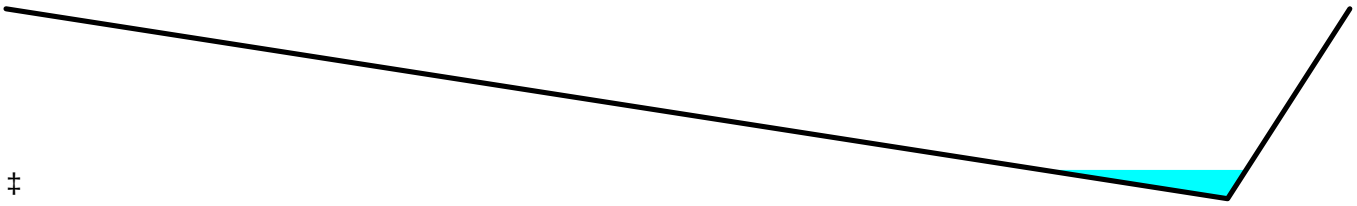
Summary for Reach C7A: Channel 7A

Inflow Area = 1.154 ac, 0.00% Impervious, Inflow Depth = 1.93" for 25 Yr event
Inflow = 2.55 cfs @ 12.11 hrs, Volume= 0.185 af
Outflow = 2.25 cfs @ 12.27 hrs, Volume= 0.185 af, Atten= 12%, Lag= 9.6 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
Max. Velocity= 1.58 fps, Min. Travel Time= 5.6 min
Avg. Velocity = 0.64 fps, Avg. Travel Time= 13.7 min

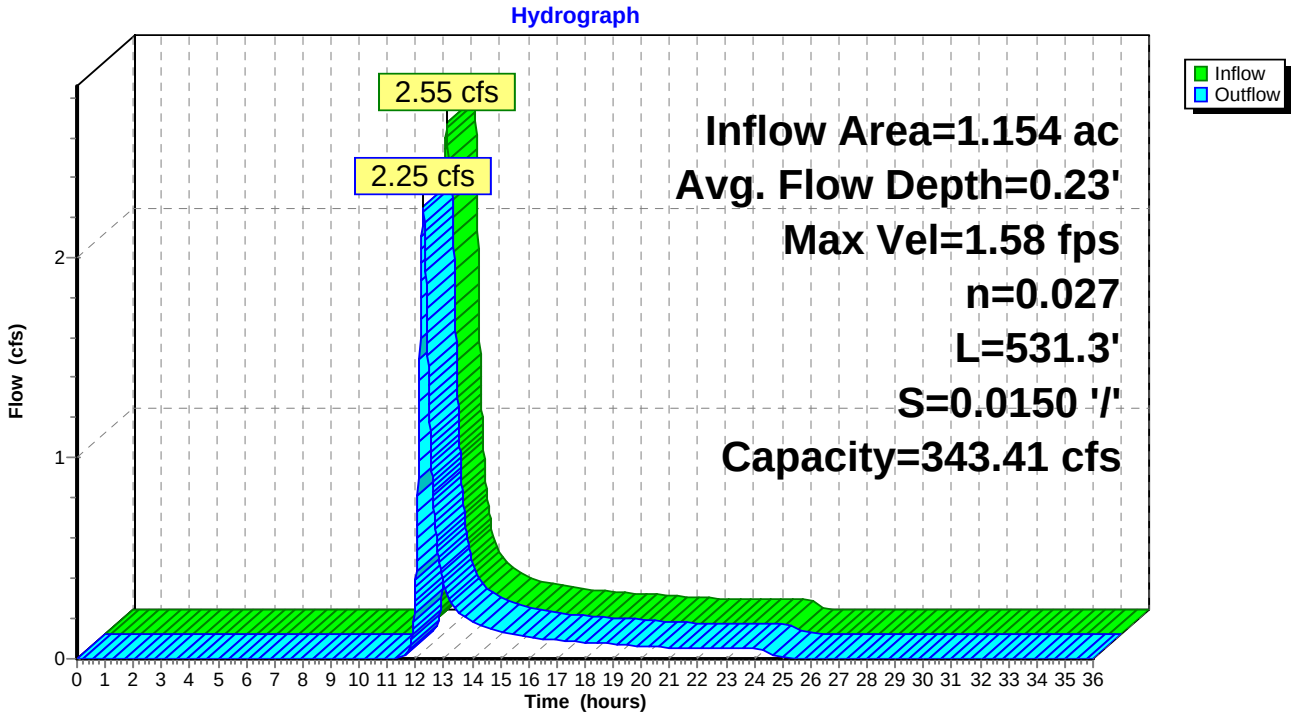
Peak Storage= 757 cf @ 12.18 hrs
Average Depth at Peak Storage= 0.23'
Bank-Full Depth= 1.50' Flow Area= 61.9 sf, Capacity= 343.41 cfs

0.00' x 1.50' deep channel, n= 0.027
Side Slope Z-value= 50.0 5.0 '/' Top Width= 82.50'
Length= 531.3' Slope= 0.0150 '/'
Inlet Invert= 409.60', Outlet Invert= 401.65'



‡

Reach C7A: Channel 7A



Summary for Reach C7B1: Channel 7B-1

Inflow Area = 13.302 ac, 0.00% Impervious, Inflow Depth = 1.93" for 25 Yr event
Inflow = 23.90 cfs @ 12.27 hrs, Volume= 2.135 af
Outflow = 23.84 cfs @ 12.30 hrs, Volume= 2.135 af, Atten= 0%, Lag= 1.5 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
Max. Velocity= 2.98 fps, Min. Travel Time= 0.8 min
Avg. Velocity = 0.91 fps, Avg. Travel Time= 2.8 min

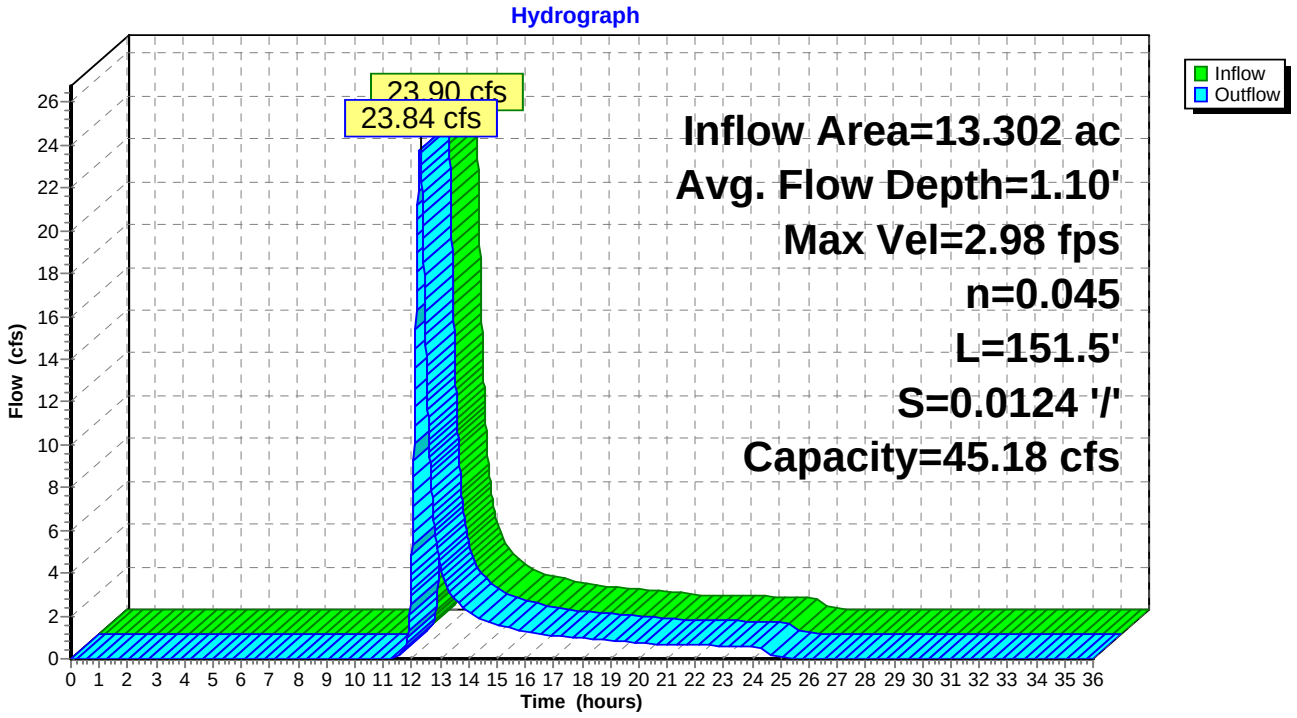
Peak Storage= 1,211 cf @ 12.28 hrs
Average Depth at Peak Storage= 1.10'
Bank-Full Depth= 1.50' Flow Area= 12.8 sf, Capacity= 45.18 cfs

4.00' x 1.50' deep channel, n= 0.045
Side Slope Z-value= 3.0 '/' Top Width= 13.00'
Length= 151.5' Slope= 0.0124 '/'
Inlet Invert= 402.11', Outlet Invert= 400.23'



‡

Reach C7B1: Channel 7B-1



Summary for Reach C7B10: Channel 7B-10

Inflow Area = 1.017 ac, 0.00% Impervious, Inflow Depth = 1.93" for 25 Yr event
Inflow = 2.20 cfs @ 12.12 hrs, Volume= 0.163 af
Outflow = 2.18 cfs @ 12.16 hrs, Volume= 0.163 af, Atten= 1%, Lag= 2.6 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
Max. Velocity= 1.47 fps, Min. Travel Time= 1.6 min
Avg. Velocity = 0.45 fps, Avg. Travel Time= 5.2 min

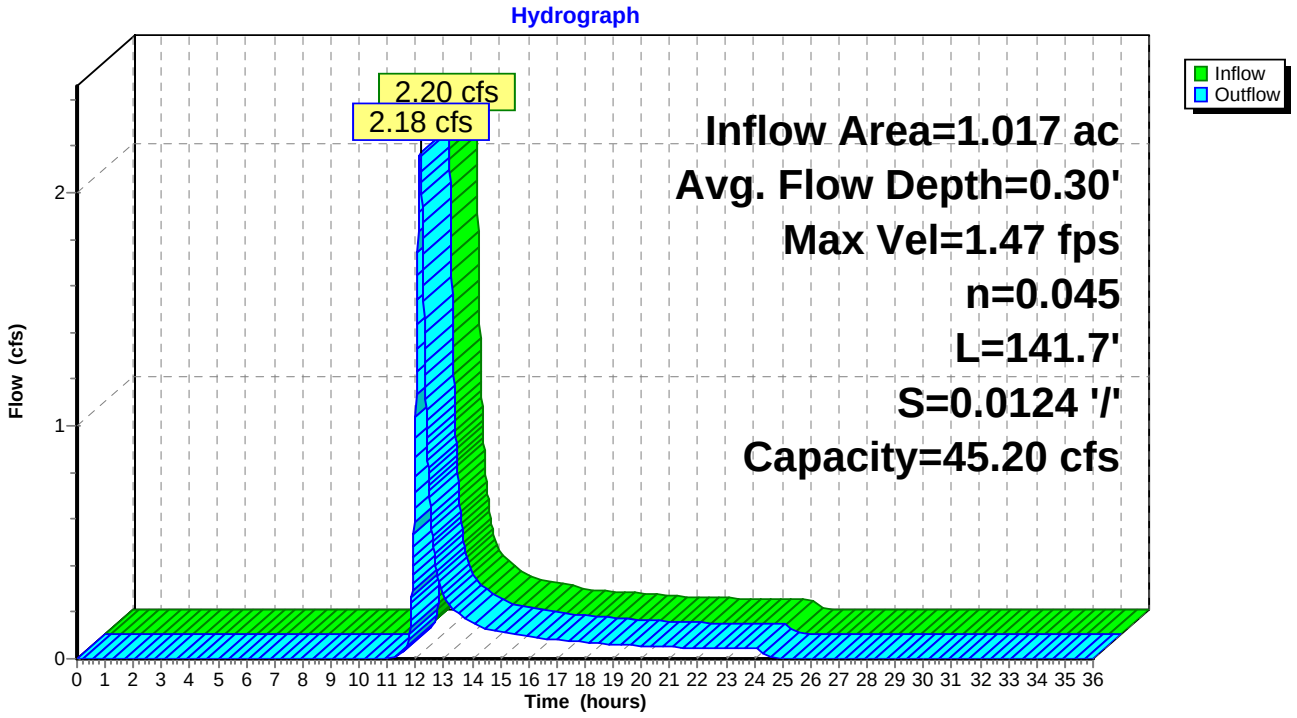
Peak Storage= 211 cf @ 12.14 hrs
Average Depth at Peak Storage= 0.30'
Bank-Full Depth= 1.50' Flow Area= 12.8 sf, Capacity= 45.20 cfs

4.00' x 1.50' deep channel, n= 0.045
Side Slope Z-value= 3.0 '/' Top Width= 13.00'
Length= 141.7' Slope= 0.0124 '/'
Inlet Invert= 407.78', Outlet Invert= 406.02'



‡

Reach C7B10: Channel 7B-10



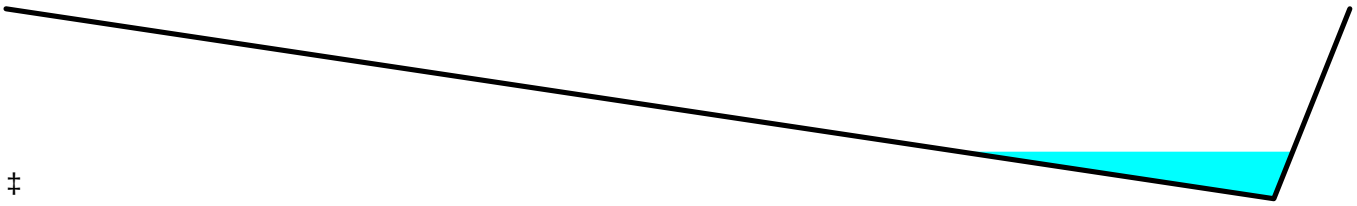
Summary for Reach C7B2: Channel 7B-2

Inflow Area = 1.457 ac, 0.00% Impervious, Inflow Depth = 1.93" for 25 Yr event
Inflow = 3.12 cfs @ 12.12 hrs, Volume= 0.234 af
Outflow = 2.82 cfs @ 12.27 hrs, Volume= 0.234 af, Atten= 10%, Lag= 8.9 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
Max. Velocity= 1.74 fps, Min. Travel Time= 5.1 min
Avg. Velocity = 0.68 fps, Avg. Travel Time= 13.1 min

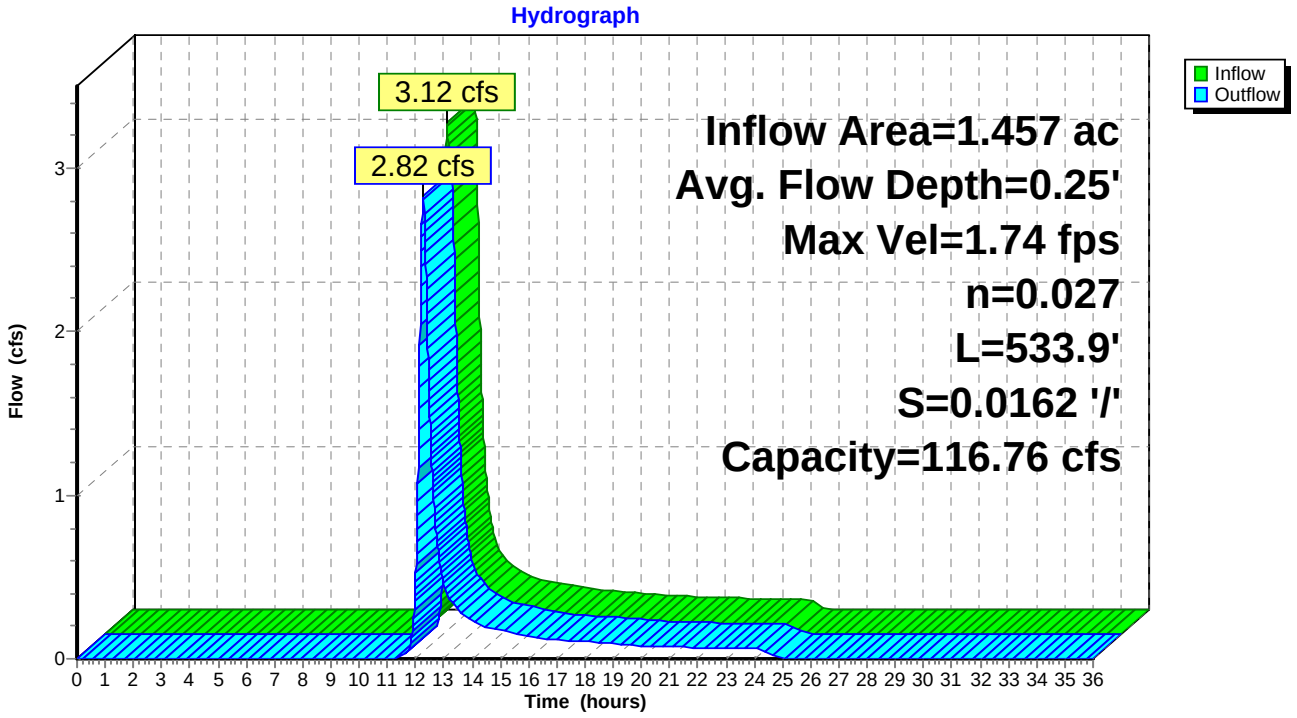
Peak Storage= 867 cf @ 12.18 hrs
Average Depth at Peak Storage= 0.25'
Bank-Full Depth= 1.00' Flow Area= 26.5 sf, Capacity= 116.76 cfs

0.00' x 1.00' deep channel, n= 0.027
Side Slope Z-value= 50.0 3.0 '/' Top Width= 53.00'
Length= 533.9' Slope= 0.0162 '/'
Inlet Invert= 411.98', Outlet Invert= 403.32'



‡

Reach C7B2: Channel 7B-2



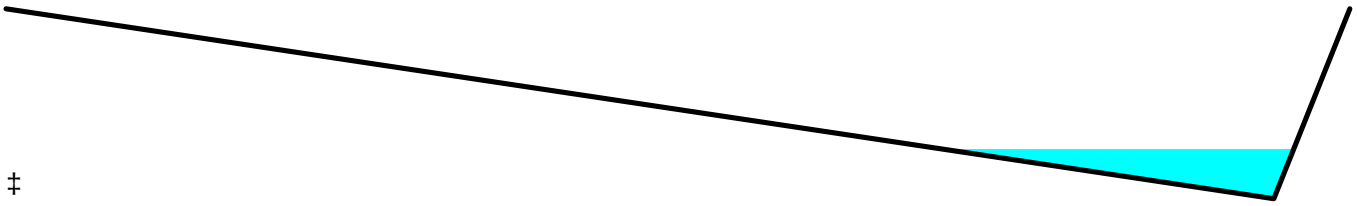
Summary for Reach C7B3: Channel 7B-3

Inflow Area = 1.590 ac, 0.00% Impervious, Inflow Depth = 1.93" for 25 Yr event
Inflow = 3.48 cfs @ 12.11 hrs, Volume= 0.255 af
Outflow = 3.13 cfs @ 12.26 hrs, Volume= 0.255 af, Atten= 10%, Lag= 9.0 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
Max. Velocity= 1.73 fps, Min. Travel Time= 5.2 min
Avg. Velocity = 0.67 fps, Avg. Travel Time= 13.5 min

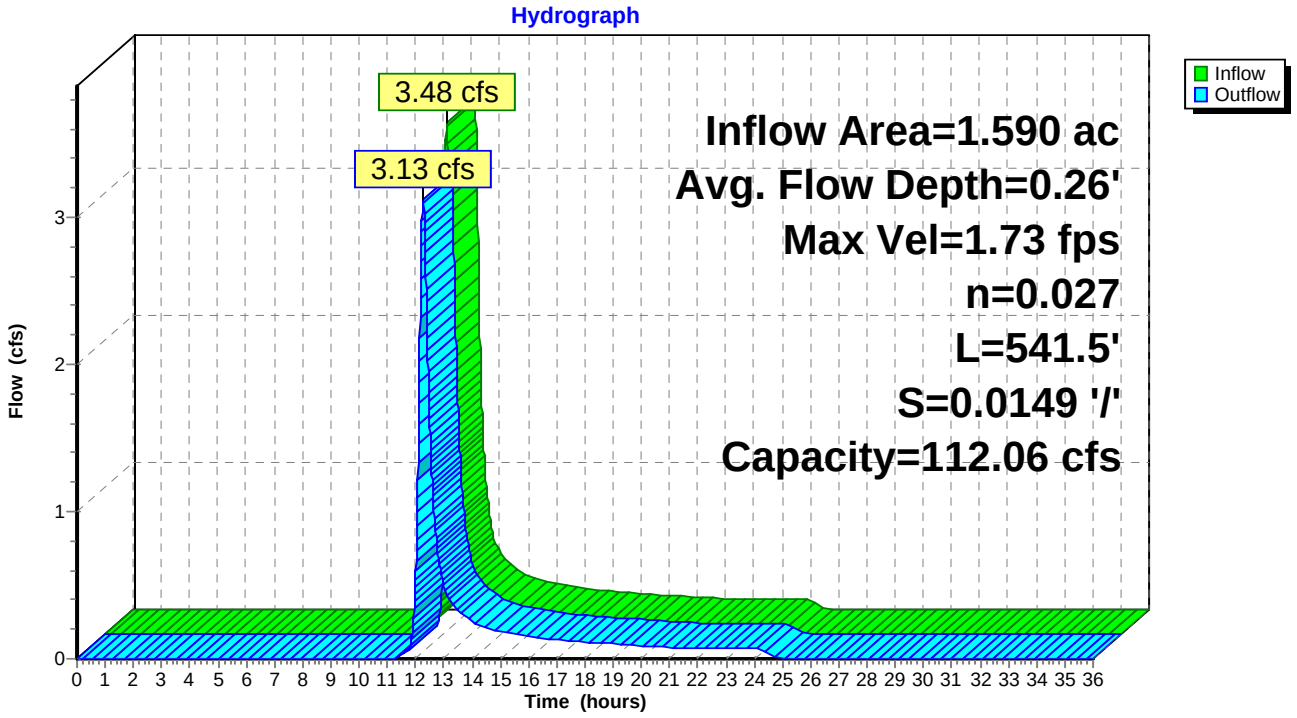
Peak Storage= 980 cf @ 12.18 hrs
Average Depth at Peak Storage= 0.26'
Bank-Full Depth= 1.00' Flow Area= 26.5 sf, Capacity= 112.06 cfs

0.00' x 1.00' deep channel, n= 0.027
Side Slope Z-value= 50.0 3.0 '/' Top Width= 53.00'
Length= 541.5' Slope= 0.0149 '/'
Inlet Invert= 411.43', Outlet Invert= 403.34'



‡

Reach C7B3: Channel 7B-3



Summary for Reach C7B4: Channel 7B-4

Inflow Area = 9.268 ac, 0.00% Impervious, Inflow Depth = 1.93" for 25 Yr event
Inflow = 16.74 cfs @ 12.26 hrs, Volume= 1.487 af
Outflow = 16.69 cfs @ 12.28 hrs, Volume= 1.487 af, Atten= 0%, Lag= 1.7 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
Max. Velocity= 2.70 fps, Min. Travel Time= 1.0 min
Avg. Velocity = 0.82 fps, Avg. Travel Time= 3.2 min

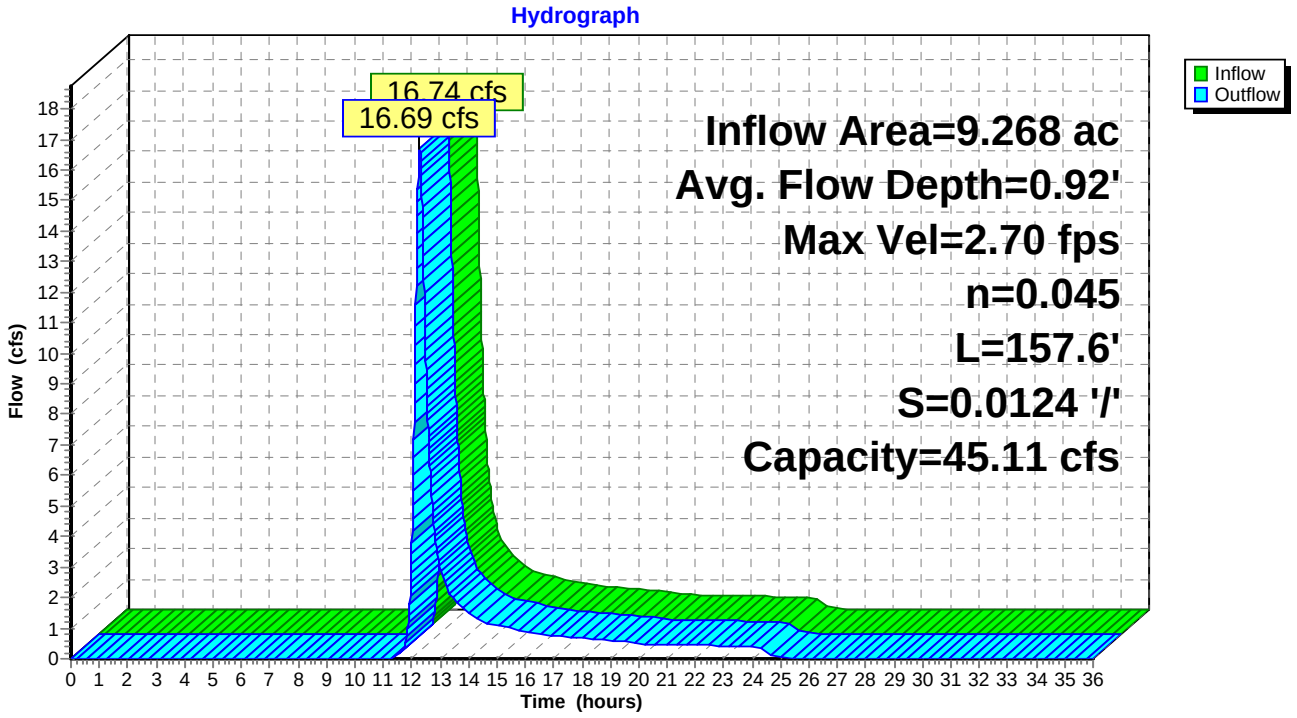
Peak Storage= 974 cf @ 12.27 hrs
Average Depth at Peak Storage= 0.92'
Bank-Full Depth= 1.50' Flow Area= 12.8 sf, Capacity= 45.11 cfs

4.00' x 1.50' deep channel, n= 0.045
Side Slope Z-value= 3.0 '/' Top Width= 13.00'
Length= 157.6' Slope= 0.0124 '/'
Inlet Invert= 404.06', Outlet Invert= 402.11'



‡

Reach C7B4: Channel 7B-4



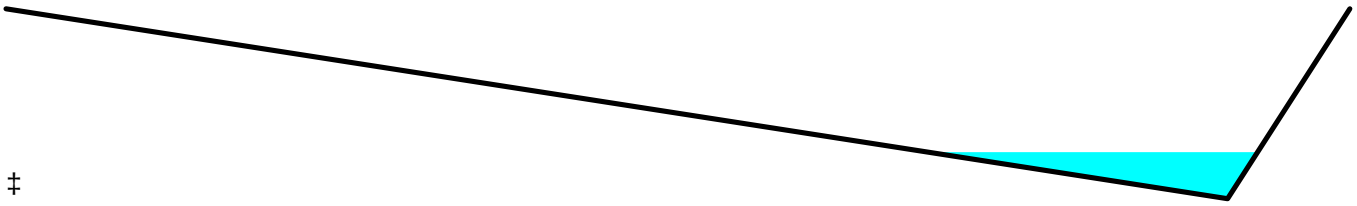
Summary for Reach C7B5: Channel 7B-5

Inflow Area = 1.478 ac, 0.00% Impervious, Inflow Depth = 1.93" for 25 Yr event
Inflow = 3.15 cfs @ 12.12 hrs, Volume= 0.237 af
Outflow = 2.85 cfs @ 12.27 hrs, Volume= 0.237 af, Atten= 10%, Lag= 9.1 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
Max. Velocity= 1.73 fps, Min. Travel Time= 5.2 min
Avg. Velocity = 0.68 fps, Avg. Travel Time= 13.2 min

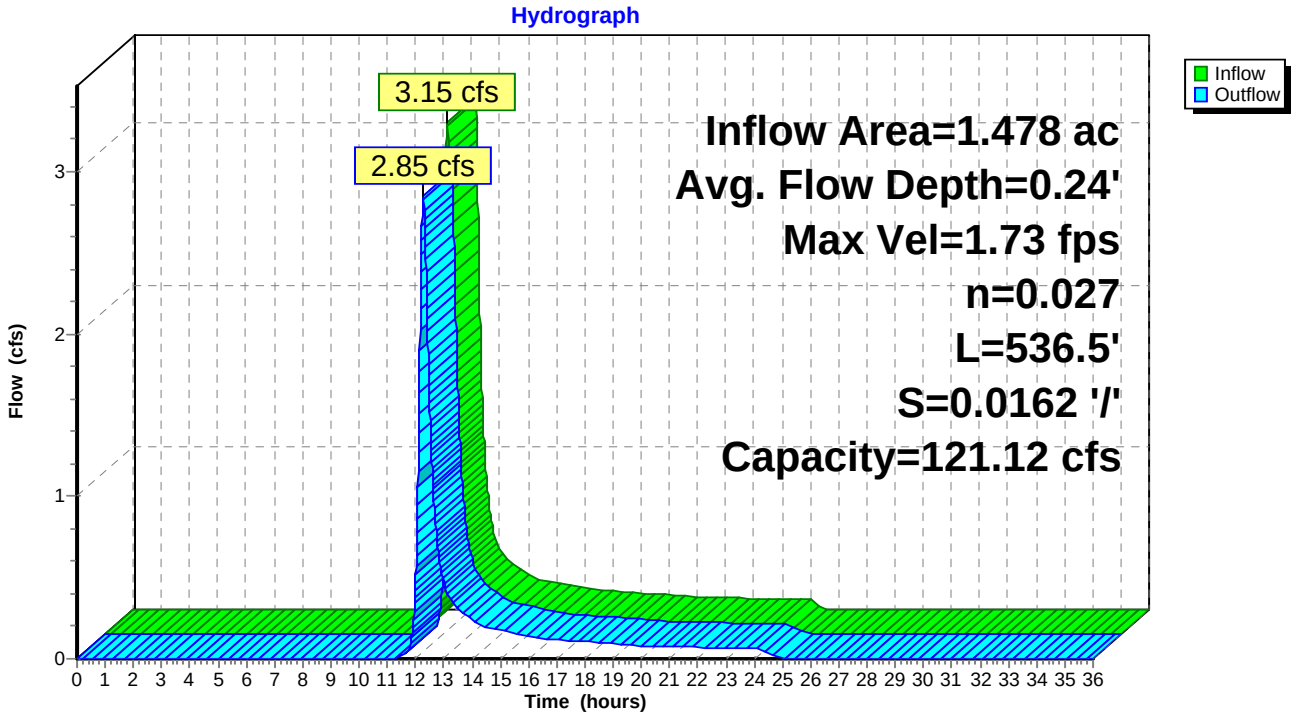
Peak Storage= 886 cf @ 12.19 hrs
Average Depth at Peak Storage= 0.24'
Bank-Full Depth= 1.00' Flow Area= 27.5 sf, Capacity= 121.12 cfs

0.00' x 1.00' deep channel, n= 0.027
Side Slope Z-value= 50.0 5.0 '/' Top Width= 55.00'
Length= 536.5' Slope= 0.0162 '/'
Inlet Invert= 413.58', Outlet Invert= 404.90'



‡

Reach C7B5: Channel 7B-5



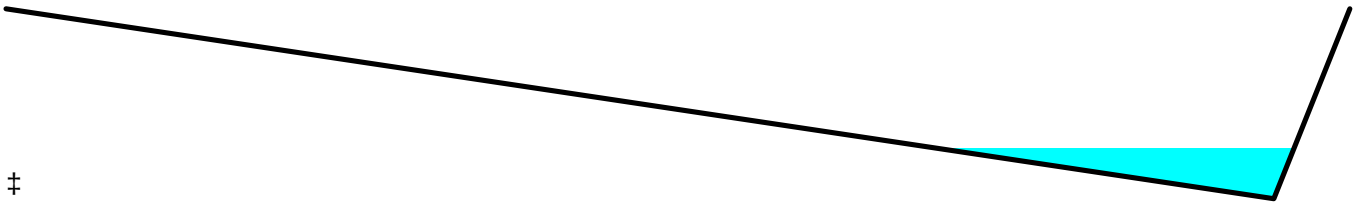
Summary for Reach C7B6: Channel 7B-6

Inflow Area = 1.688 ac, 0.00% Impervious, Inflow Depth = 1.93" for 25 Yr event
Inflow = 3.71 cfs @ 12.11 hrs, Volume= 0.271 af
Outflow = 3.31 cfs @ 12.26 hrs, Volume= 0.271 af, Atten= 11%, Lag= 9.3 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
Max. Velocity= 1.75 fps, Min. Travel Time= 5.3 min
Avg. Velocity = 0.67 fps, Avg. Travel Time= 13.9 min

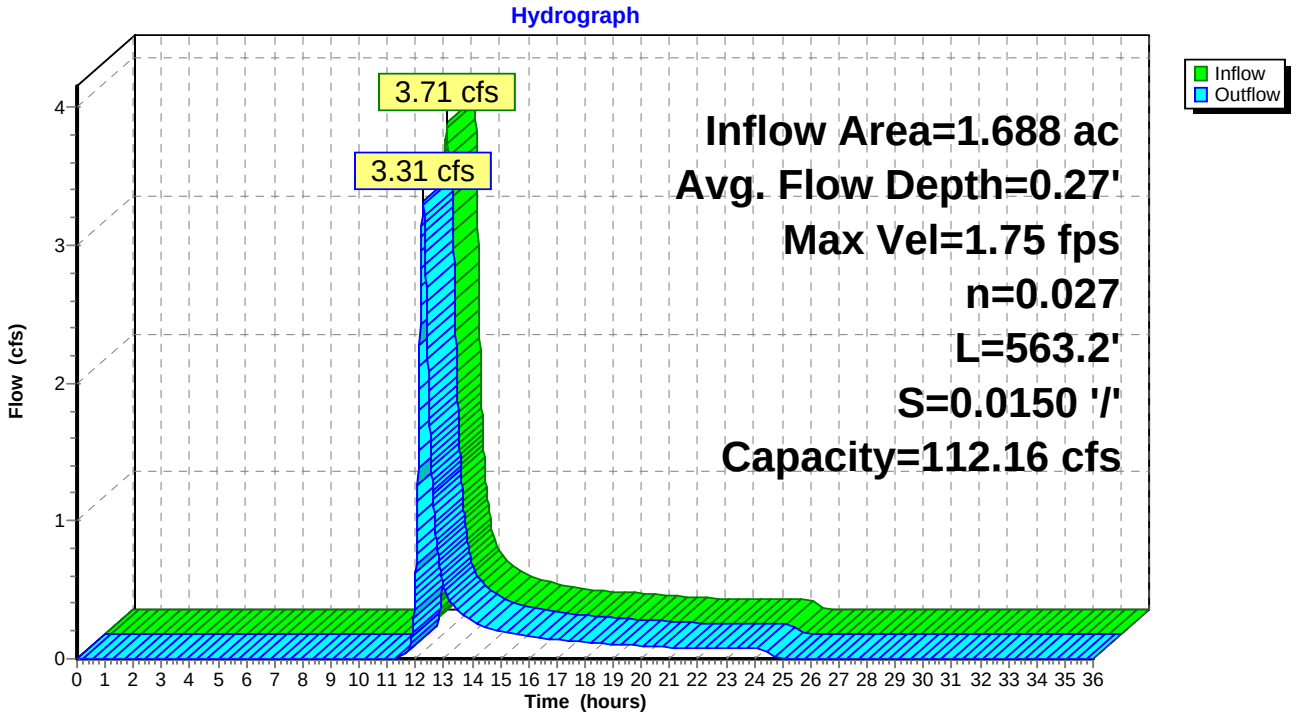
Peak Storage= 1,063 cf @ 12.18 hrs
Average Depth at Peak Storage= 0.27'
Bank-Full Depth= 1.00' Flow Area= 26.5 sf, Capacity= 112.16 cfs

0.00' x 1.00' deep channel, n= 0.027
Side Slope Z-value= 50.0 3.0 '/' Top Width= 53.00'
Length= 563.2' Slope= 0.0150 '/'
Inlet Invert= 413.33', Outlet Invert= 404.90'



‡

Reach C7B6: Channel 7B-6



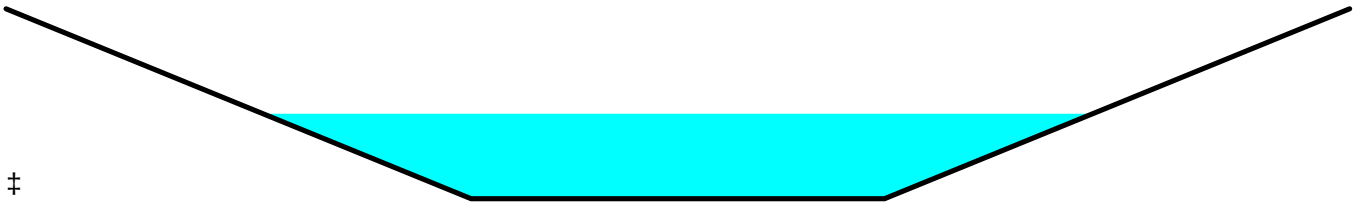
Summary for Reach C7B7: Channel 7B-7

Inflow Area = 5.127 ac, 0.00% Impervious, Inflow Depth = 1.93" for 25 Yr event
Inflow = 9.26 cfs @ 12.23 hrs, Volume= 0.823 af
Outflow = 9.23 cfs @ 12.26 hrs, Volume= 0.823 af, Atten= 0%, Lag= 2.0 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
Max. Velocity= 2.29 fps, Min. Travel Time= 1.1 min
Avg. Velocity = 0.69 fps, Avg. Travel Time= 3.8 min

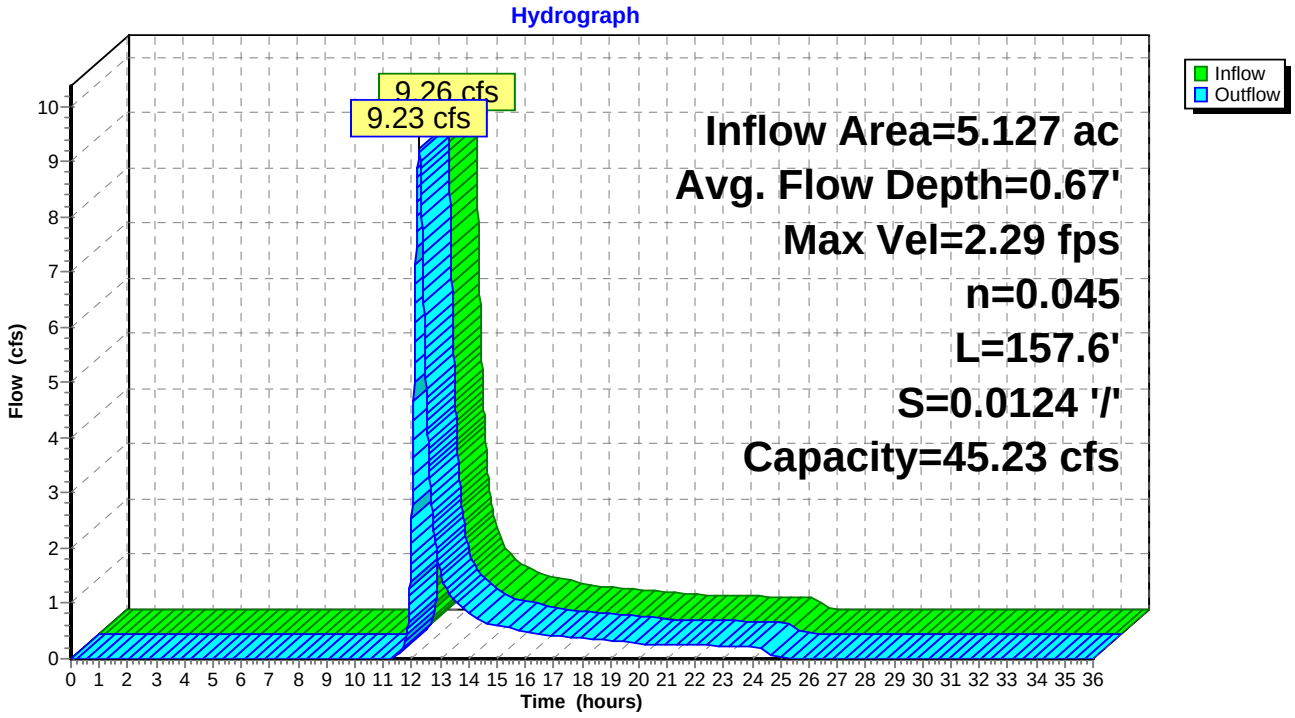
Peak Storage= 636 cf @ 12.24 hrs
Average Depth at Peak Storage= 0.67'
Bank-Full Depth= 1.50' Flow Area= 12.8 sf, Capacity= 45.23 cfs

4.00' x 1.50' deep channel, n= 0.045
Side Slope Z-value= 3.0 '/' Top Width= 13.00'
Length= 157.6' Slope= 0.0124 '/'
Inlet Invert= 406.02', Outlet Invert= 404.06'



‡

Reach C7B7: Channel 7B-7



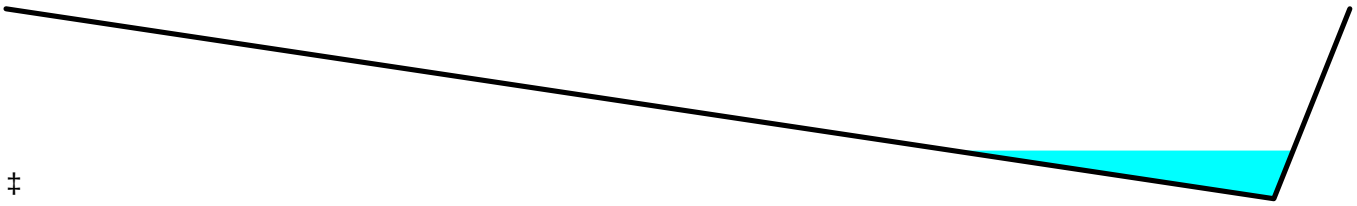
Summary for Reach C7B8: Channel 7B-8

Inflow Area = 1.554 ac, 0.00% Impervious, Inflow Depth = 1.93" for 25 Yr event
Inflow = 3.31 cfs @ 12.12 hrs, Volume= 0.249 af
Outflow = 3.00 cfs @ 12.27 hrs, Volume= 0.249 af, Atten= 9%, Lag= 8.9 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
Max. Velocity= 1.76 fps, Min. Travel Time= 5.1 min
Avg. Velocity = 0.69 fps, Avg. Travel Time= 13.0 min

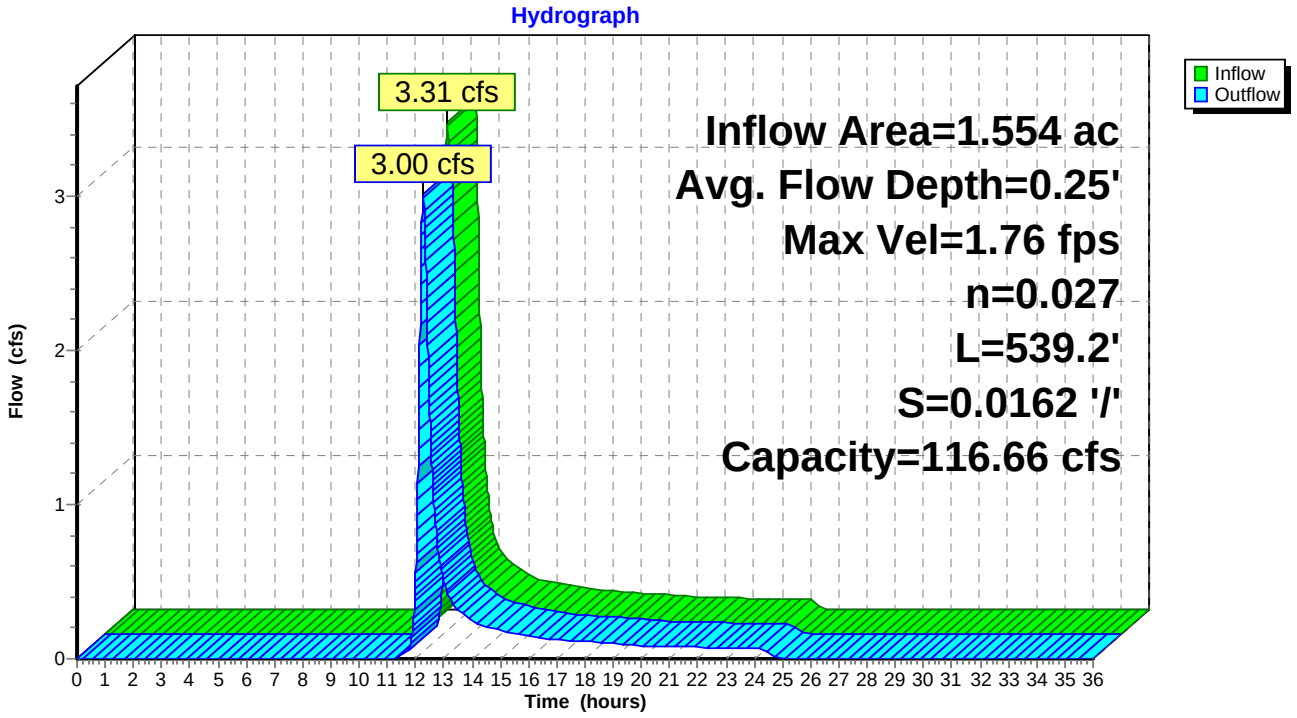
Peak Storage= 918 cf @ 12.18 hrs
Average Depth at Peak Storage= 0.25'
Bank-Full Depth= 1.00' Flow Area= 26.5 sf, Capacity= 116.66 cfs

0.00' x 1.00' deep channel, n= 0.027
Side Slope Z-value= 50.0 3.0 '/' Top Width= 53.00'
Length= 539.2' Slope= 0.0162 '/'
Inlet Invert= 415.20', Outlet Invert= 406.47'



‡

Reach C7B8: Channel 7B-8



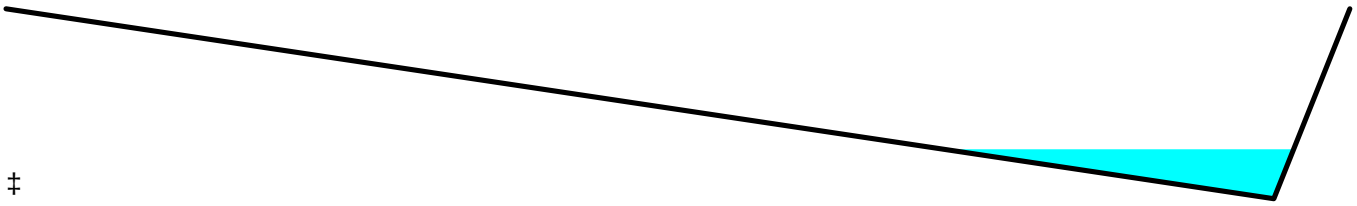
Summary for Reach C7B9: Channel 7B-9

Inflow Area = 1.615 ac, 0.00% Impervious, Inflow Depth = 1.93" for 25 Yr event
Inflow = 3.50 cfs @ 12.12 hrs, Volume= 0.259 af
Outflow = 3.10 cfs @ 12.28 hrs, Volume= 0.259 af, Atten= 11%, Lag= 9.7 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
Max. Velocity= 1.73 fps, Min. Travel Time= 5.7 min
Avg. Velocity = 0.66 fps, Avg. Travel Time= 14.7 min

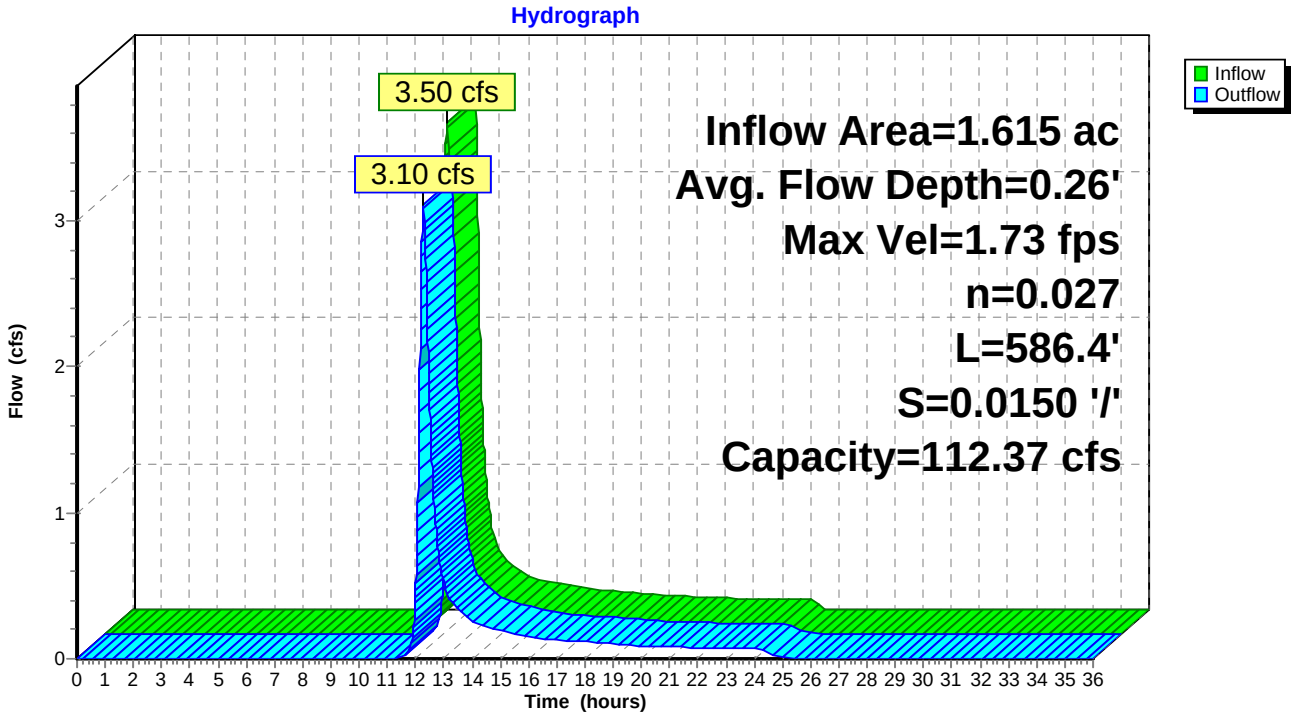
Peak Storage= 1,054 cf @ 12.18 hrs
Average Depth at Peak Storage= 0.26'
Bank-Full Depth= 1.00' Flow Area= 26.5 sf, Capacity= 112.37 cfs

0.00' x 1.00' deep channel, n= 0.027
Side Slope Z-value= 50.0 3.0 '/' Top Width= 53.00'
Length= 586.4' Slope= 0.0150 '/'
Inlet Invert= 415.26', Outlet Invert= 406.45'



‡

Reach C7B9: Channel 7B-9



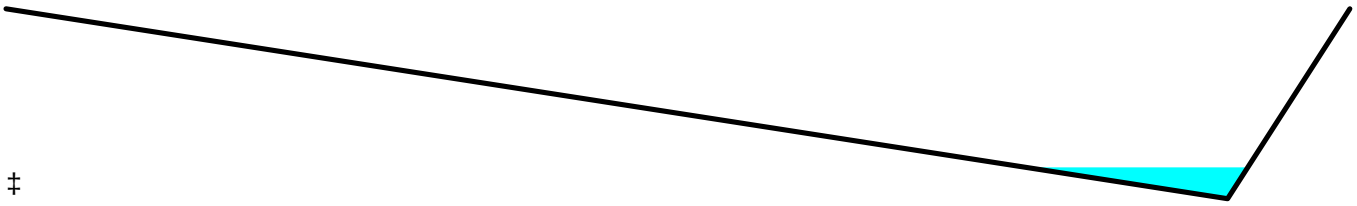
Summary for Reach C7C: Channel 7C

Inflow Area = 1.364 ac, 0.00% Impervious, Inflow Depth = 1.93" for 25 Yr event
Inflow = 2.97 cfs @ 12.11 hrs, Volume= 0.219 af
Outflow = 2.64 cfs @ 12.27 hrs, Volume= 0.219 af, Atten= 11%, Lag= 9.7 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
Max. Velocity= 1.56 fps, Min. Travel Time= 5.6 min
Avg. Velocity = 0.63 fps, Avg. Travel Time= 13.9 min

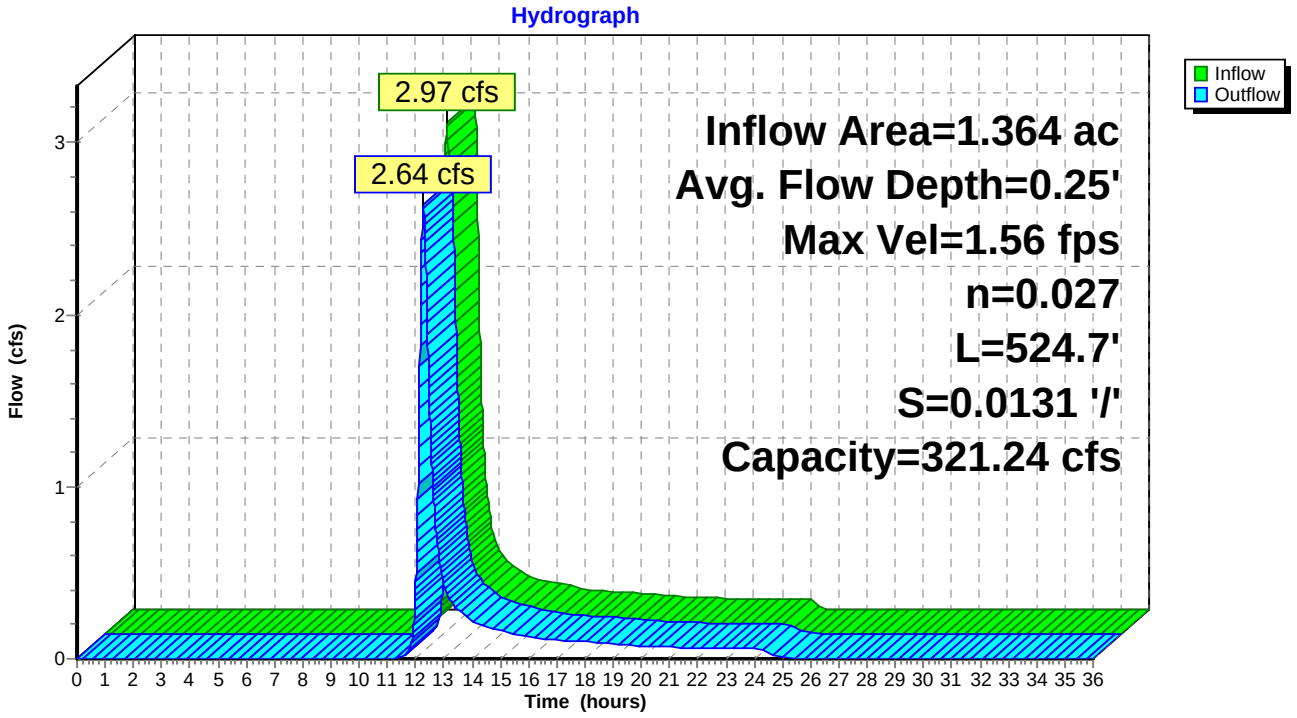
Peak Storage= 885 cf @ 12.18 hrs
Average Depth at Peak Storage= 0.25'
Bank-Full Depth= 1.50' Flow Area= 61.9 sf, Capacity= 321.24 cfs

0.00' x 1.50' deep channel, n= 0.027
Side Slope Z-value= 50.0 5.0 '/' Top Width= 82.50'
Length= 524.7' Slope= 0.0131 '/'
Inlet Invert= 408.50', Outlet Invert= 401.63'



‡

Reach C7C: Channel 7C



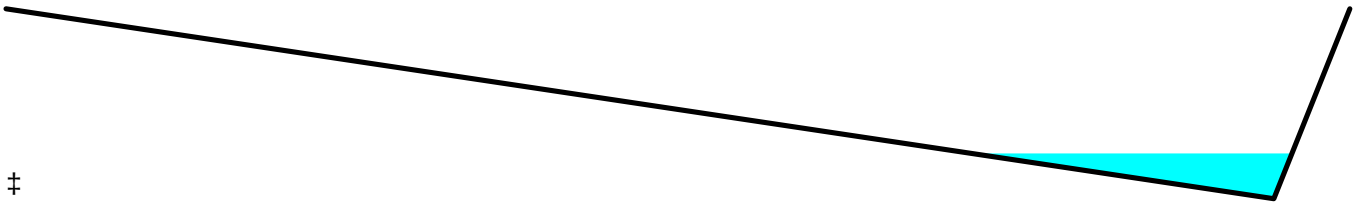
Summary for Reach C7D: Channel 7D

Inflow Area = 1.265 ac, 0.00% Impervious, Inflow Depth = 1.93" for 25 Yr event
Inflow = 2.70 cfs @ 12.12 hrs, Volume= 0.203 af
Outflow = 2.55 cfs @ 12.23 hrs, Volume= 0.203 af, Atten= 5%, Lag= 6.6 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
Max. Velocity= 1.69 fps, Min. Travel Time= 3.7 min
Avg. Velocity = 0.69 fps, Avg. Travel Time= 9.1 min

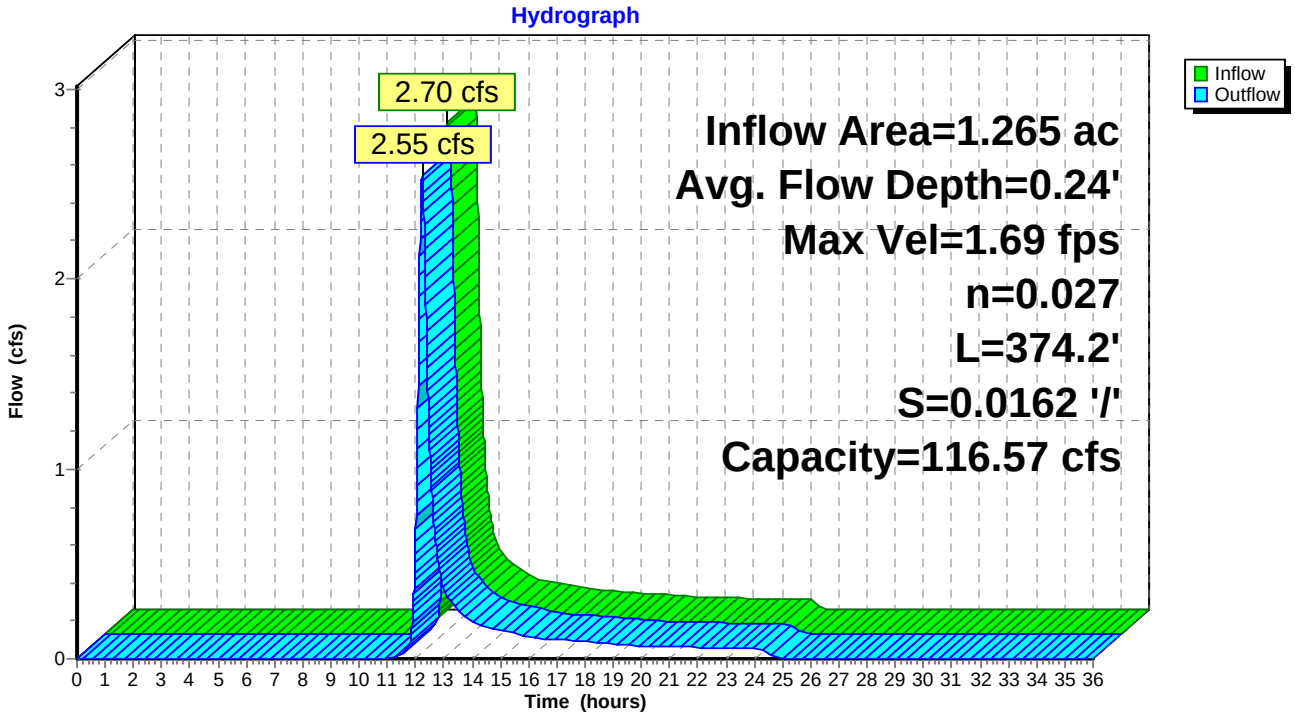
Peak Storage= 564 cf @ 12.17 hrs
Average Depth at Peak Storage= 0.24'
Bank-Full Depth= 1.00' Flow Area= 26.5 sf, Capacity= 116.57 cfs

0.00' x 1.00' deep channel, n= 0.027
Side Slope Z-value= 50.0 3.0 '/' Top Width= 53.00'
Length= 374.2' Slope= 0.0162 '/'
Inlet Invert= 407.84', Outlet Invert= 401.79'



‡

Reach C7D: Channel 7D



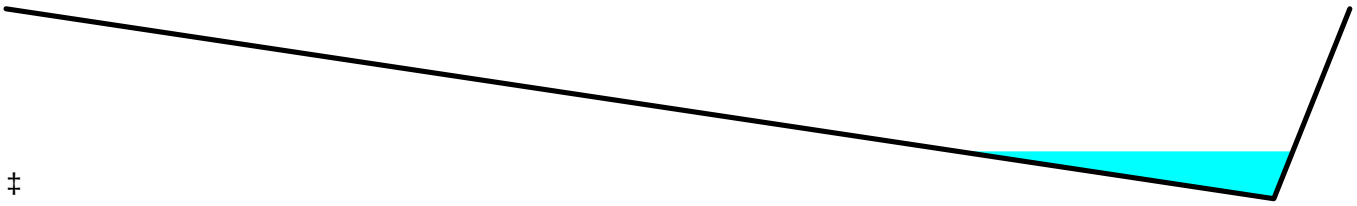
Summary for Reach C7E: Channel 7E

Inflow Area = 1.354 ac, 0.00% Impervious, Inflow Depth = 1.93" for 25 Yr event
Inflow = 2.96 cfs @ 12.12 hrs, Volume= 0.217 af
Outflow = 2.76 cfs @ 12.23 hrs, Volume= 0.217 af, Atten= 7%, Lag= 6.8 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
Max. Velocity= 1.68 fps, Min. Travel Time= 4.0 min
Avg. Velocity = 0.67 fps, Avg. Travel Time= 9.9 min

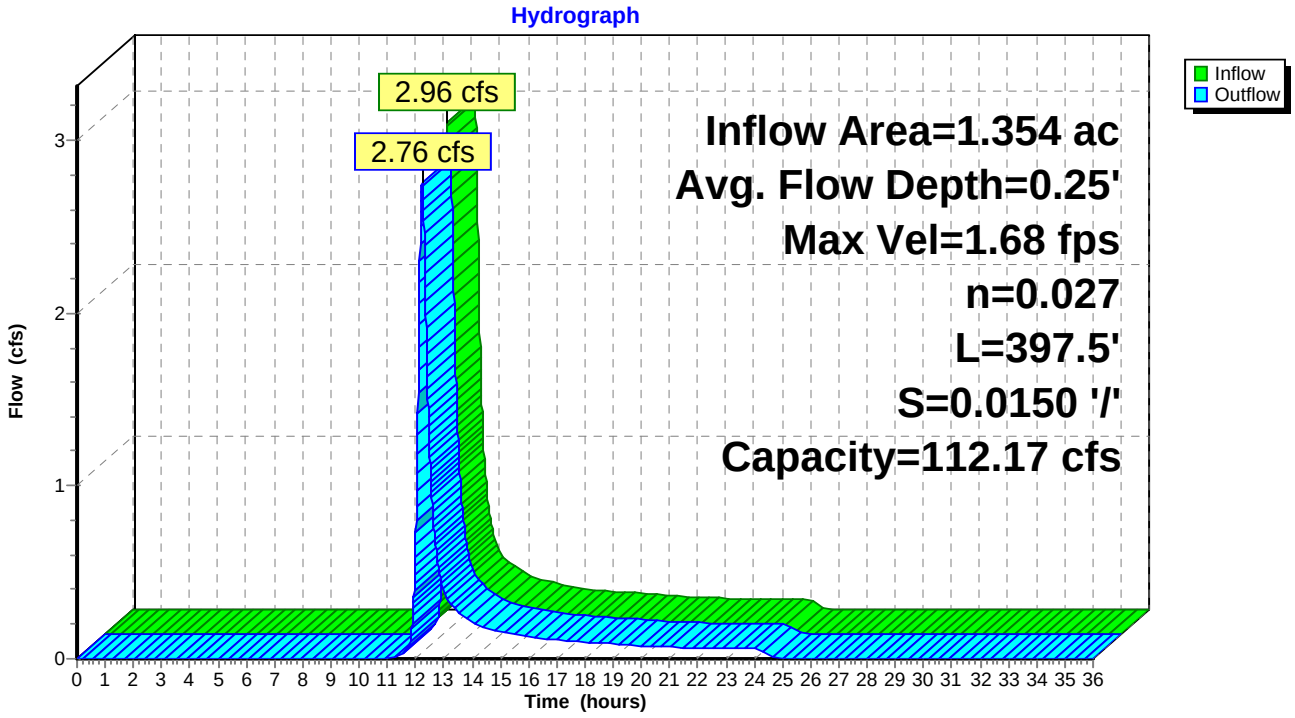
Peak Storage= 655 cf @ 12.16 hrs
Average Depth at Peak Storage= 0.25'
Bank-Full Depth= 1.00' Flow Area= 26.5 sf, Capacity= 112.17 cfs

0.00' x 1.00' deep channel, n= 0.027
Side Slope Z-value= 50.0 3.0 '/' Top Width= 53.00'
Length= 397.5' Slope= 0.0150 '/'
Inlet Invert= 407.73', Outlet Invert= 401.78'



‡

Reach C7E: Channel 7E



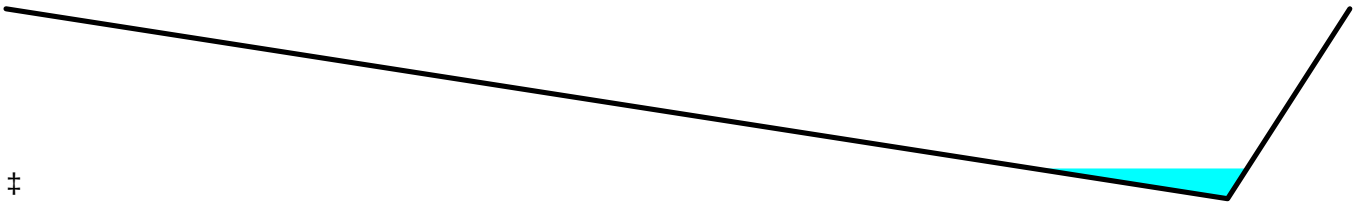
Summary for Reach C8A: Channel 8A

Inflow Area = 1.394 ac, 0.00% Impervious, Inflow Depth = 1.93" for 25 Yr event
Inflow = 3.02 cfs @ 12.12 hrs, Volume= 0.224 af
Outflow = 2.80 cfs @ 12.24 hrs, Volume= 0.224 af, Atten= 7%, Lag= 7.5 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
Max. Velocity= 1.78 fps, Min. Travel Time= 4.3 min
Avg. Velocity = 0.73 fps, Avg. Travel Time= 10.4 min

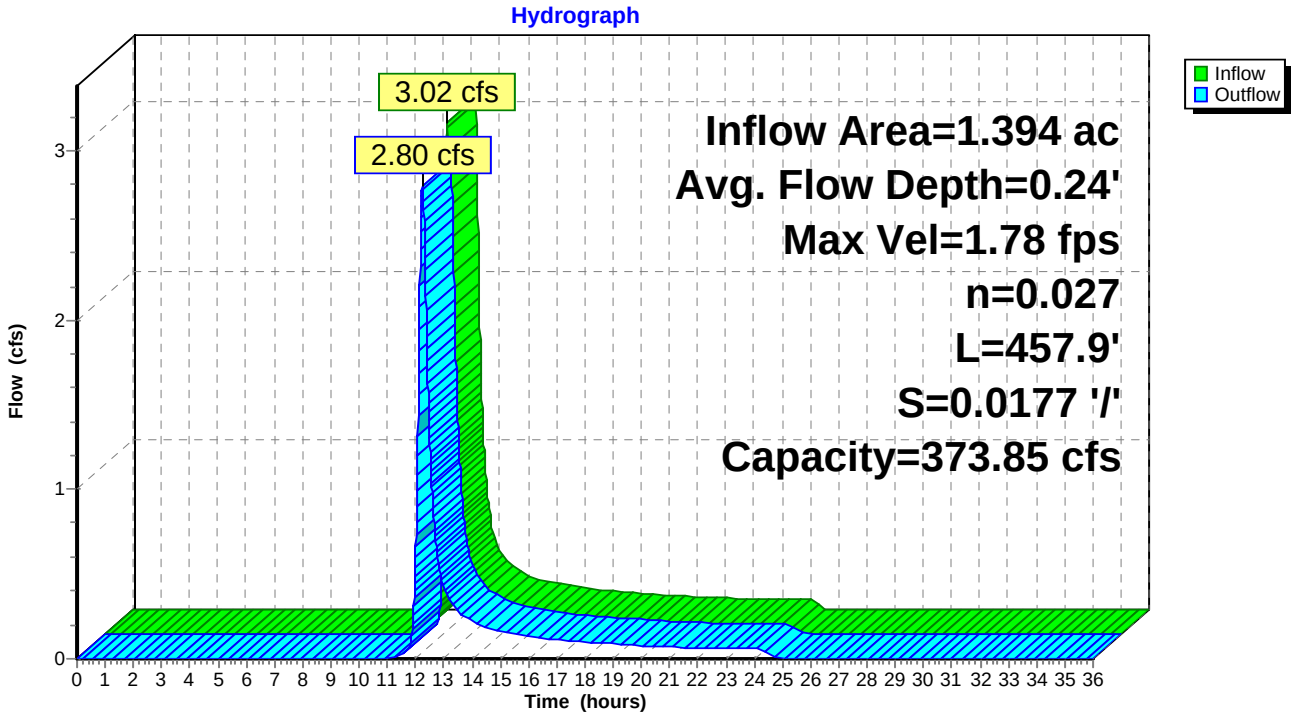
Peak Storage= 721 cf @ 12.17 hrs
Average Depth at Peak Storage= 0.24'
Bank-Full Depth= 1.50' Flow Area= 61.9 sf, Capacity= 373.85 cfs

0.00' x 1.50' deep channel, n= 0.027
Side Slope Z-value= 50.0 5.0 '/' Top Width= 82.50'
Length= 457.9' Slope= 0.0177 '/'
Inlet Invert= 409.77', Outlet Invert= 401.65'



‡

Reach C8A: Channel 8A



Summary for Reach C8B1: Channel 8B-1

Inflow Area = 15.948 ac, 0.00% Impervious, Inflow Depth = 1.93" for 25 Yr event
Inflow = 29.00 cfs @ 12.28 hrs, Volume= 2.559 af
Outflow = 28.96 cfs @ 12.30 hrs, Volume= 2.559 af, Atten= 0%, Lag= 1.2 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
Max. Velocity= 3.10 fps, Min. Travel Time= 0.7 min
Avg. Velocity = 0.94 fps, Avg. Travel Time= 2.2 min

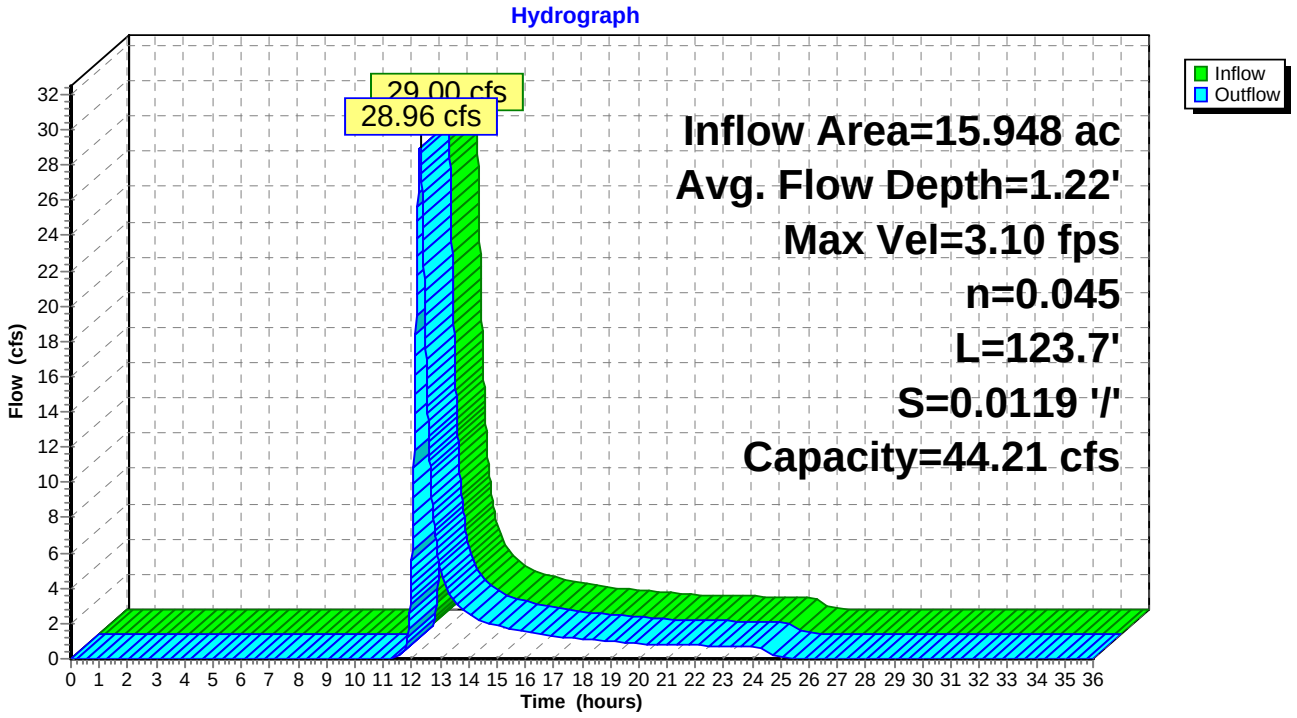
Peak Storage= 1,157 cf @ 12.28 hrs
Average Depth at Peak Storage= 1.22'
Bank-Full Depth= 1.50' Flow Area= 12.8 sf, Capacity= 44.21 cfs

4.00' x 1.50' deep channel, n= 0.045
Side Slope Z-value= 3.0 '/' Top Width= 13.00'
Length= 123.7' Slope= 0.0119 '/'
Inlet Invert= 401.76', Outlet Invert= 400.29'



‡

Reach C8B1: Channel 8B-1



Summary for Reach C8B10: Channel 8B-10

Inflow Area = 4.782 ac, 0.00% Impervious, Inflow Depth = 1.93" for 25 Yr event
Inflow = 8.89 cfs @ 12.22 hrs, Volume= 0.767 af
Outflow = 8.85 cfs @ 12.25 hrs, Volume= 0.767 af, Atten= 0%, Lag= 2.0 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
Max. Velocity= 2.22 fps, Min. Travel Time= 1.2 min
Avg. Velocity = 0.68 fps, Avg. Travel Time= 3.9 min

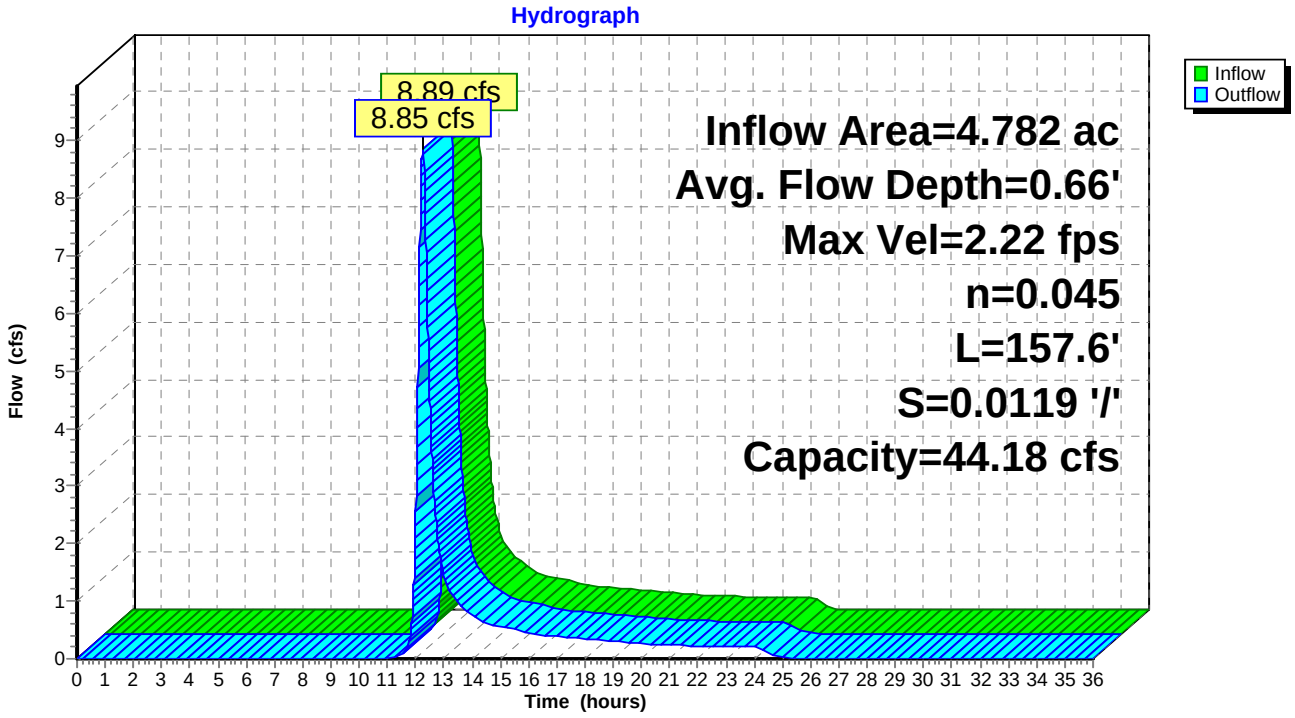
Peak Storage= 628 cf @ 12.23 hrs
Average Depth at Peak Storage= 0.66'
Bank-Full Depth= 1.50' Flow Area= 12.8 sf, Capacity= 44.18 cfs

4.00' x 1.50' deep channel, n= 0.045
Side Slope Z-value= 3.0 '/' Top Width= 13.00'
Length= 157.6' Slope= 0.0119 '/'
Inlet Invert= 407.38', Outlet Invert= 405.51'



‡

Reach C8B10: Channel 8B-10



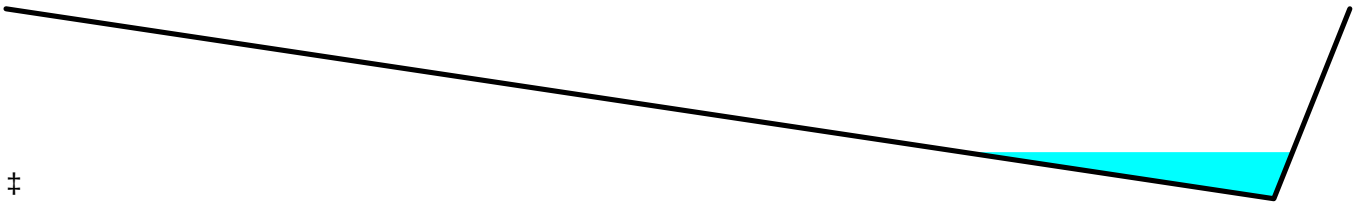
Summary for Reach C8B11: Channel 8B-11

Inflow Area = 1.339 ac, 0.00% Impervious, Inflow Depth = 1.93" for 25 Yr event
Inflow = 2.89 cfs @ 12.12 hrs, Volume= 0.215 af
Outflow = 2.65 cfs @ 12.25 hrs, Volume= 0.215 af, Atten= 9%, Lag= 8.1 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
Max. Velocity= 1.66 fps, Min. Travel Time= 4.7 min
Avg. Velocity = 0.66 fps, Avg. Travel Time= 11.9 min

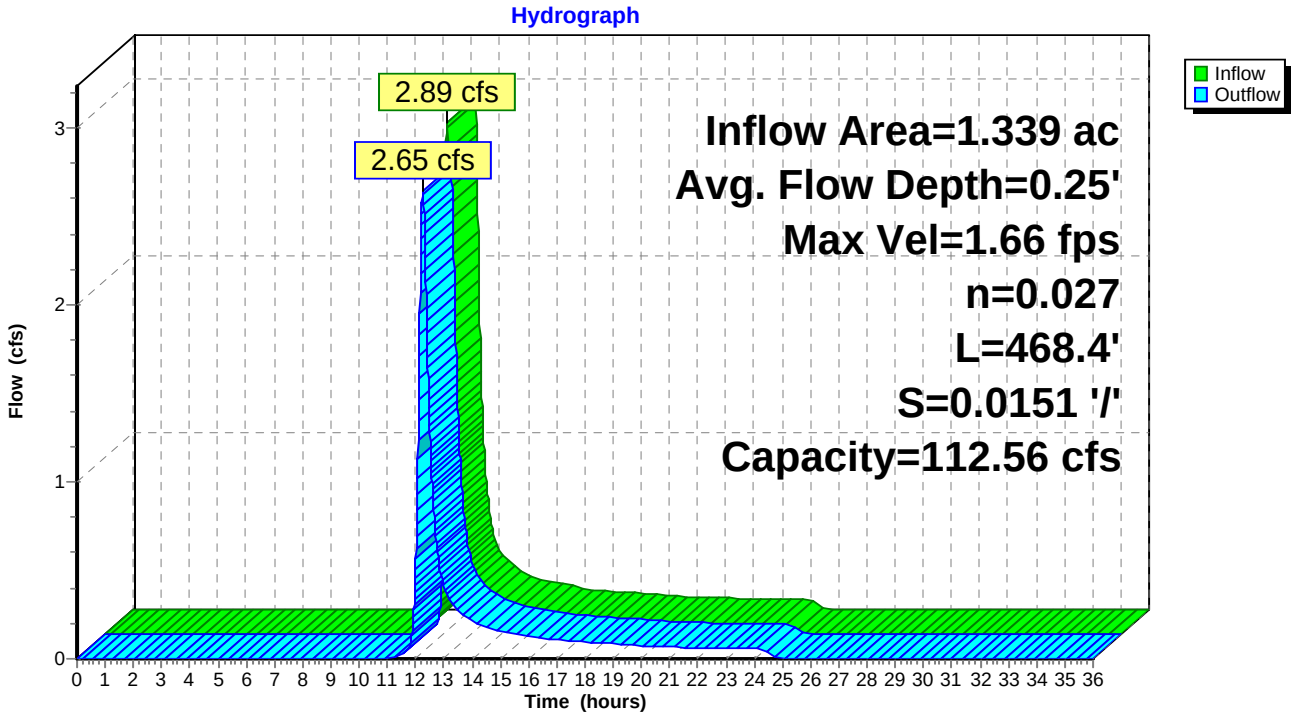
Peak Storage= 746 cf @ 12.17 hrs
Average Depth at Peak Storage= 0.25'
Bank-Full Depth= 1.00' Flow Area= 26.5 sf, Capacity= 112.56 cfs

0.00' x 1.00' deep channel, n= 0.027
Side Slope Z-value= 50.0 3.0 '/' Top Width= 53.00'
Length= 468.4' Slope= 0.0151 '/'
Inlet Invert= 414.82', Outlet Invert= 407.76'



‡

Reach C8B11: Channel 8B-11



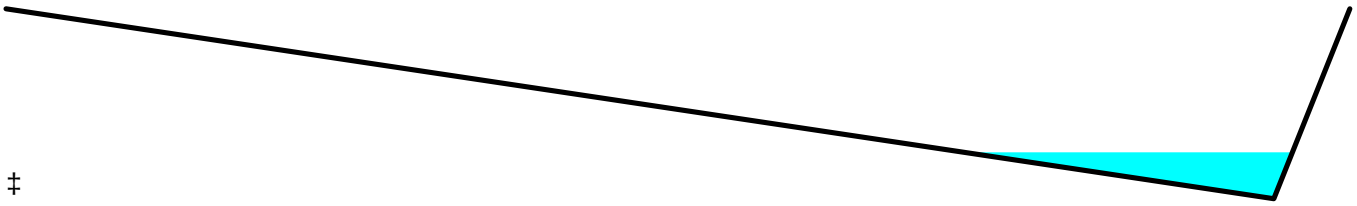
Summary for Reach C8B12: Channel 8B-12

Inflow Area = 1.453 ac, 0.00% Impervious, Inflow Depth = 1.93" for 25 Yr event
Inflow = 3.17 cfs @ 12.11 hrs, Volume= 0.233 af
Outflow = 2.84 cfs @ 12.26 hrs, Volume= 0.233 af, Atten= 10%, Lag= 9.1 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
Max. Velocity= 1.79 fps, Min. Travel Time= 5.2 min
Avg. Velocity = 0.70 fps, Avg. Travel Time= 13.3 min

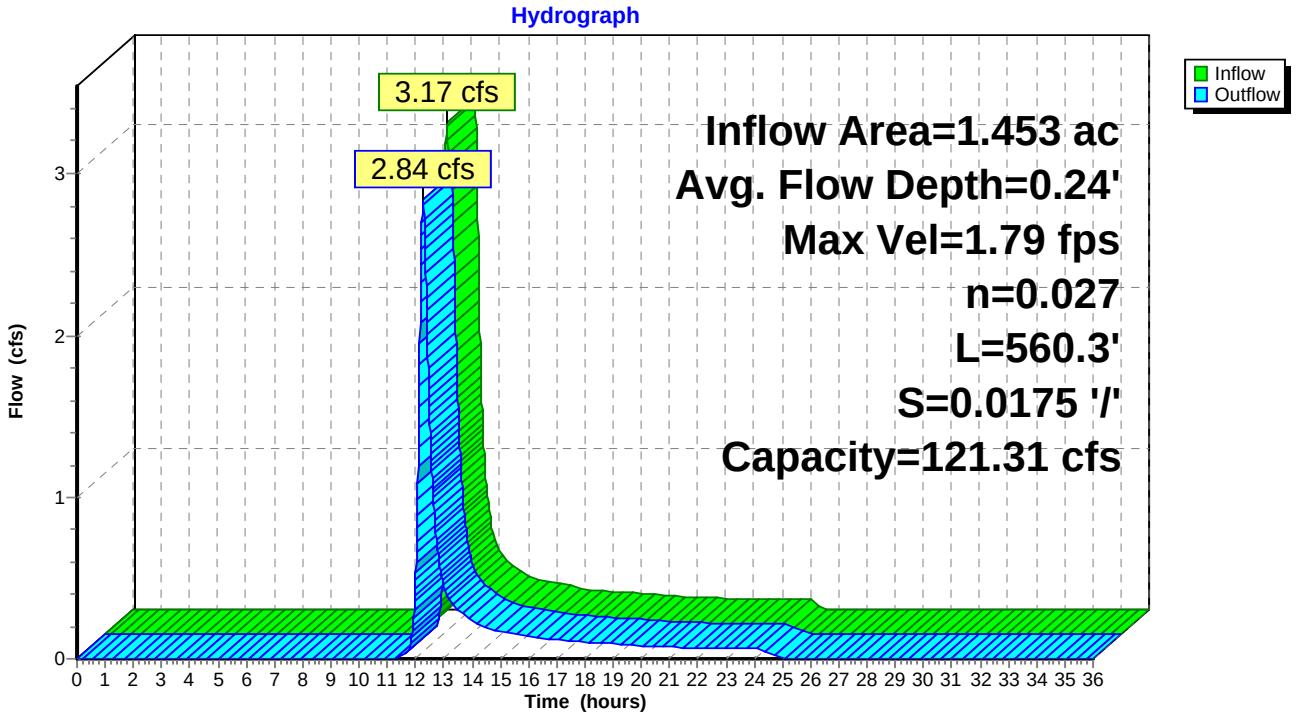
Peak Storage= 889 cf @ 12.18 hrs
Average Depth at Peak Storage= 0.24'
Bank-Full Depth= 1.00' Flow Area= 26.5 sf, Capacity= 121.31 cfs

0.00' x 1.00' deep channel, n= 0.027
Side Slope Z-value= 50.0 3.0 '/' Top Width= 53.00'
Length= 560.3' Slope= 0.0175 '/'
Inlet Invert= 417.57', Outlet Invert= 407.76'



‡

Reach C8B12: Channel 8B-12



Summary for Reach C8B13: Channel 8B-13

Inflow Area = 1.037 ac, 0.00% Impervious, Inflow Depth = 1.93" for 25 Yr event
Inflow = 2.23 cfs @ 12.12 hrs, Volume= 0.166 af
Outflow = 2.21 cfs @ 12.17 hrs, Volume= 0.166 af, Atten= 1%, Lag= 2.8 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
Max. Velocity= 1.45 fps, Min. Travel Time= 1.6 min
Avg. Velocity = 0.45 fps, Avg. Travel Time= 5.2 min

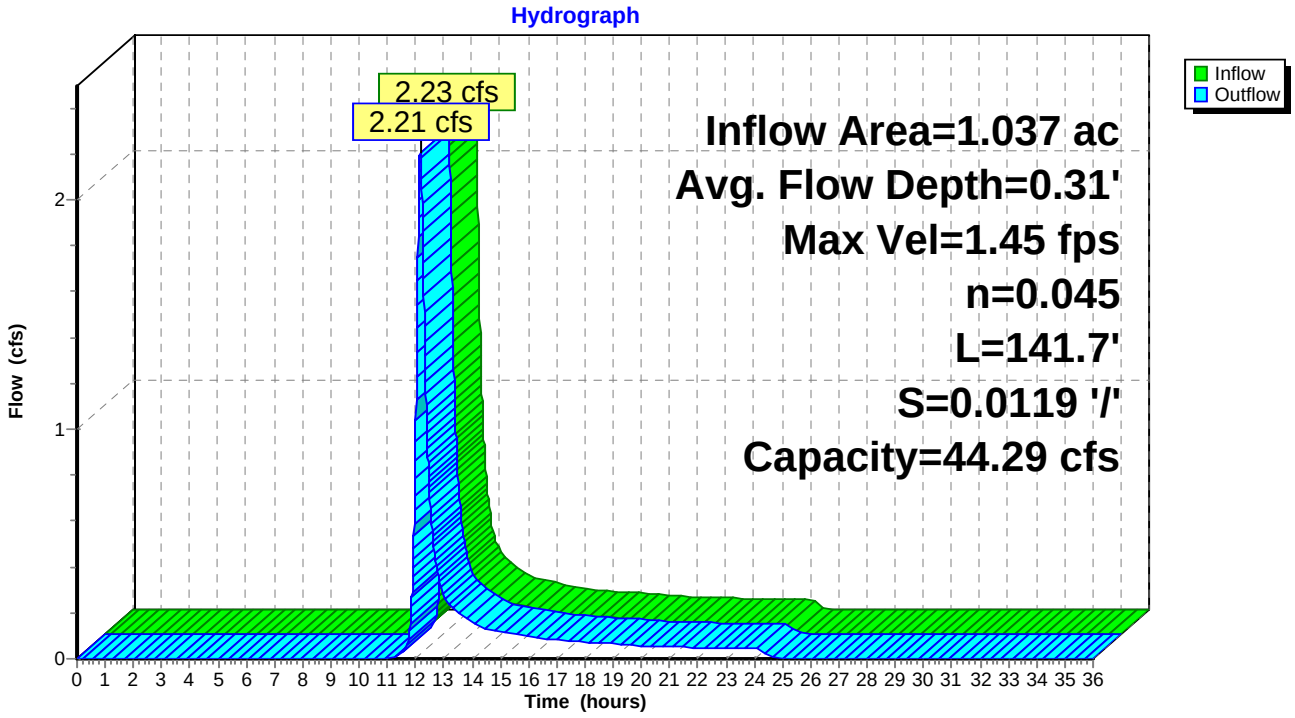
Peak Storage= 215 cf @ 12.14 hrs
Average Depth at Peak Storage= 0.31'
Bank-Full Depth= 1.50' Flow Area= 12.8 sf, Capacity= 44.29 cfs

4.00' x 1.50' deep channel, n= 0.045
Side Slope Z-value= 3.0 '/' Top Width= 13.00'
Length= 141.7' Slope= 0.0119 '/'
Inlet Invert= 409.07', Outlet Invert= 407.38'



‡

Reach C8B13: Channel 8B-13



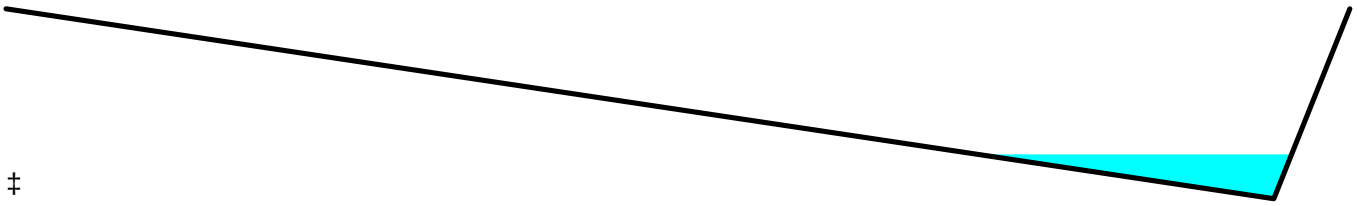
Summary for Reach C8B2: Channel 8B-2

Inflow Area = 1.151 ac, 0.00% Impervious, Inflow Depth = 1.93" for 25 Yr event
Inflow = 2.49 cfs @ 12.12 hrs, Volume= 0.185 af
Outflow = 2.31 cfs @ 12.24 hrs, Volume= 0.185 af, Atten= 7%, Lag= 7.3 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
Max. Velocity= 1.60 fps, Min. Travel Time= 4.2 min
Avg. Velocity = 0.64 fps, Avg. Travel Time= 10.5 min

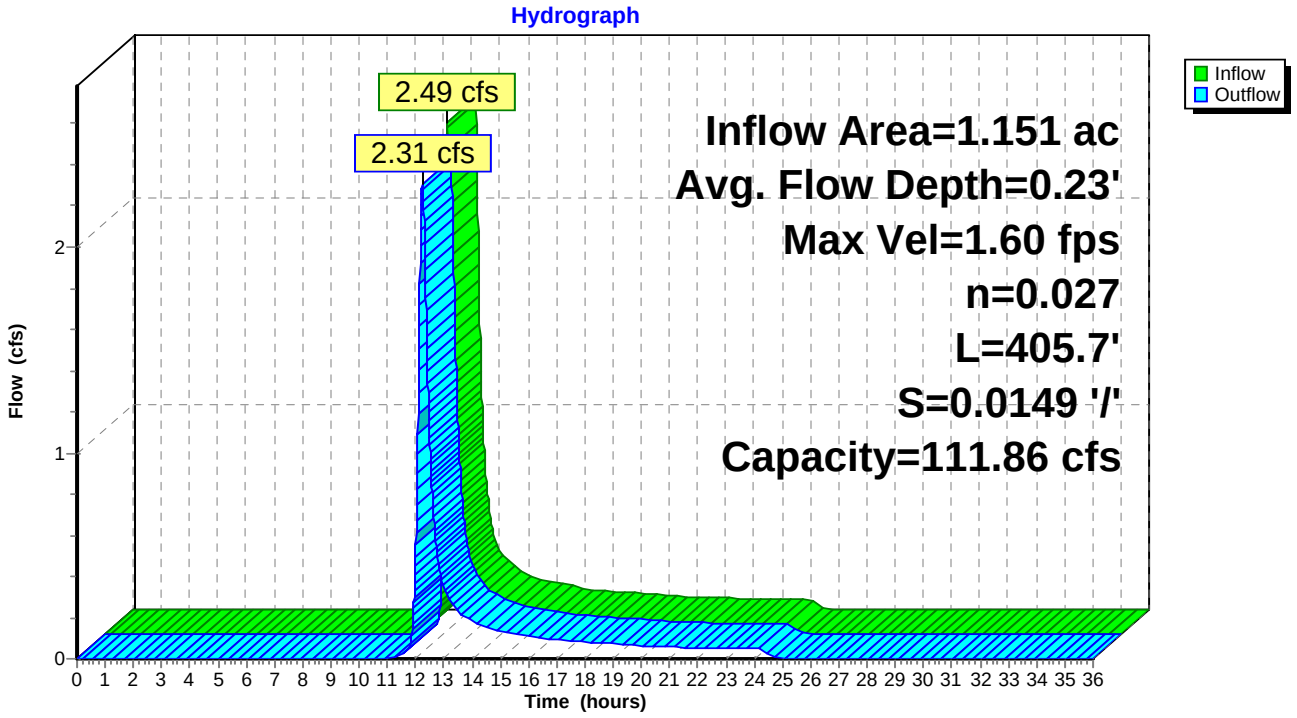
Peak Storage= 585 cf @ 12.17 hrs
Average Depth at Peak Storage= 0.23'
Bank-Full Depth= 1.00' Flow Area= 26.5 sf, Capacity= 111.86 cfs

0.00' x 1.00' deep channel, n= 0.027
Side Slope Z-value= 50.0 3.0 '/' Top Width= 53.00'
Length= 405.7' Slope= 0.0149 '/'
Inlet Invert= 409.11', Outlet Invert= 403.07'



‡

Reach C8B2: Channel 8B-2



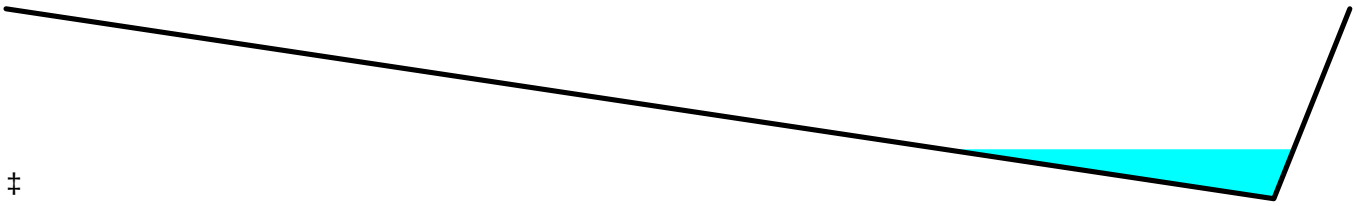
Summary for Reach C8B3: Channel 8B-3

Inflow Area = 1.621 ac, 0.00% Impervious, Inflow Depth = 1.93" for 25 Yr event
Inflow = 3.60 cfs @ 12.11 hrs, Volume= 0.260 af
Outflow = 3.21 cfs @ 12.26 hrs, Volume= 0.260 af, Atten= 11%, Lag= 9.2 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
Max. Velocity= 1.79 fps, Min. Travel Time= 5.4 min
Avg. Velocity = 0.69 fps, Avg. Travel Time= 13.9 min

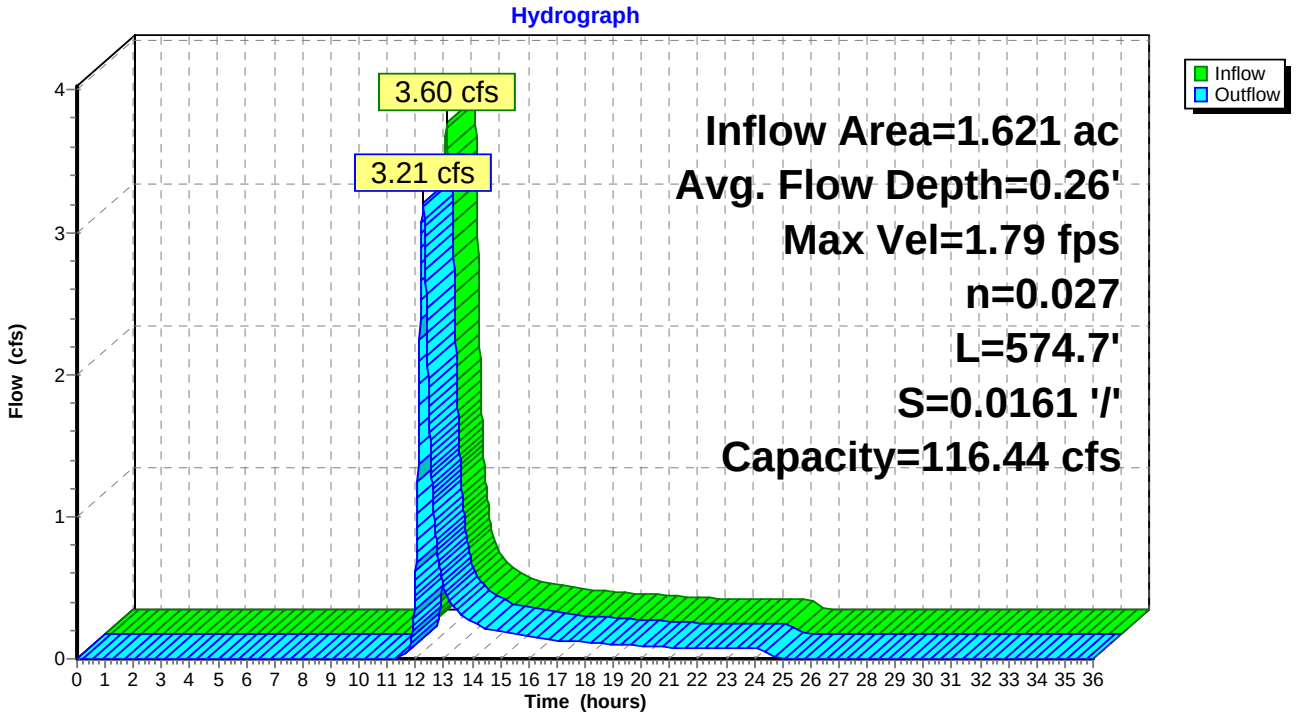
Peak Storage= 1,030 cf @ 12.17 hrs
Average Depth at Peak Storage= 0.26'
Bank-Full Depth= 1.00' Flow Area= 26.5 sf, Capacity= 116.44 cfs

0.00' x 1.00' deep channel, n= 0.027
Side Slope Z-value= 50.0 3.0 '/' Top Width= 53.00'
Length= 574.7' Slope= 0.0161 '/'
Inlet Invert= 412.34', Outlet Invert= 403.07'



‡

Reach C8B3: Channel 8B-3



Summary for Reach C8B4: Channel 8B-4

Inflow Area = 12.503 ac, 0.00% Impervious, Inflow Depth = 1.93" for 25 Yr event
Inflow = 22.90 cfs @ 12.26 hrs, Volume= 2.006 af
Outflow = 22.83 cfs @ 12.29 hrs, Volume= 2.006 af, Atten= 0%, Lag= 1.6 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
Max. Velocity= 2.90 fps, Min. Travel Time= 0.9 min
Avg. Velocity = 0.88 fps, Avg. Travel Time= 3.0 min

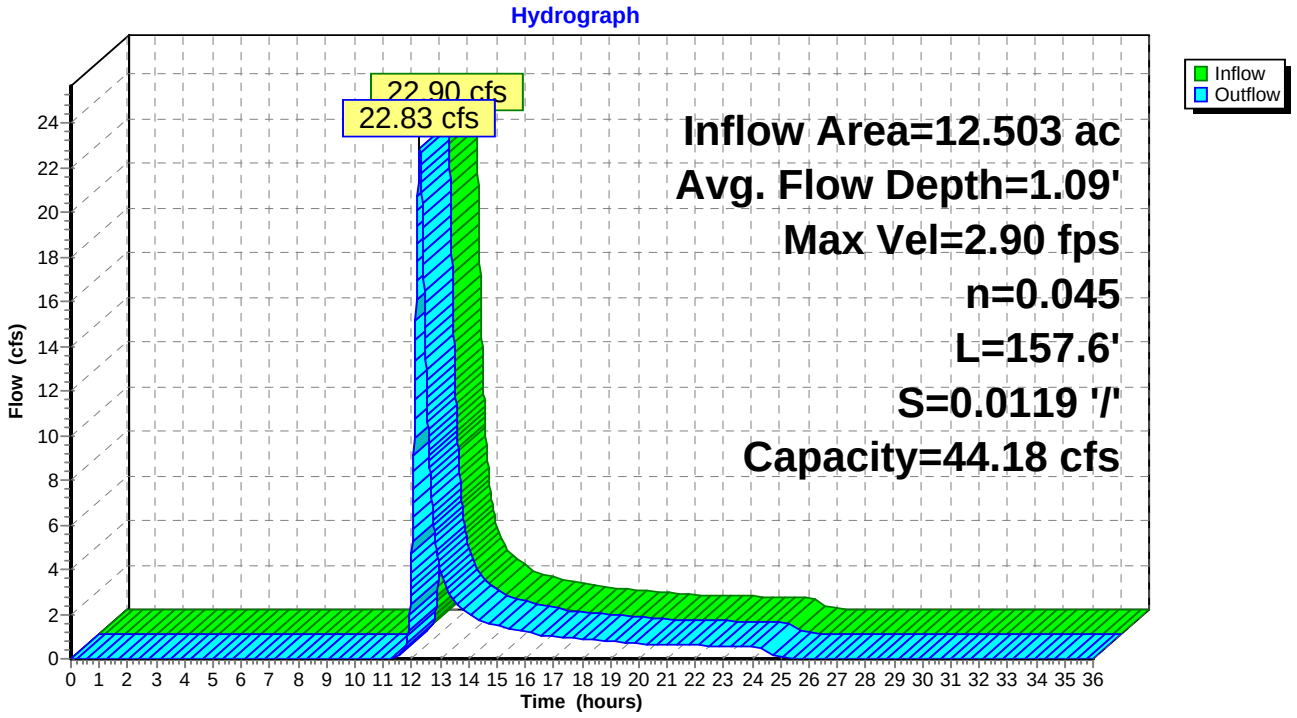
Peak Storage= 1,241 cf @ 12.27 hrs
Average Depth at Peak Storage= 1.09'
Bank-Full Depth= 1.50' Flow Area= 12.8 sf, Capacity= 44.18 cfs

4.00' x 1.50' deep channel, n= 0.045
Side Slope Z-value= 3.0 '/' Top Width= 13.00'
Length= 157.6' Slope= 0.0119 '/'
Inlet Invert= 403.63', Outlet Invert= 401.76'



‡

Reach C8B4: Channel 8B-4



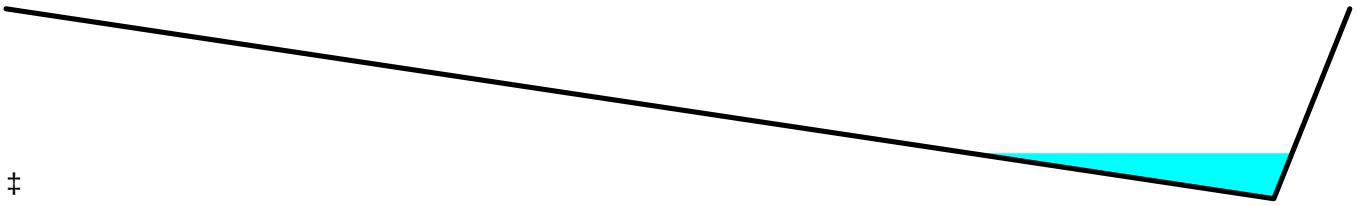
Summary for Reach C8B5: Channel 8B-5

Inflow Area = 1.241 ac, 0.00% Impervious, Inflow Depth = 1.93" for 25 Yr event
Inflow = 2.68 cfs @ 12.12 hrs, Volume= 0.199 af
Outflow = 2.46 cfs @ 12.25 hrs, Volume= 0.199 af, Atten= 8%, Lag= 7.9 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
Max. Velocity= 1.63 fps, Min. Travel Time= 4.6 min
Avg. Velocity = 0.65 fps, Avg. Travel Time= 11.5 min

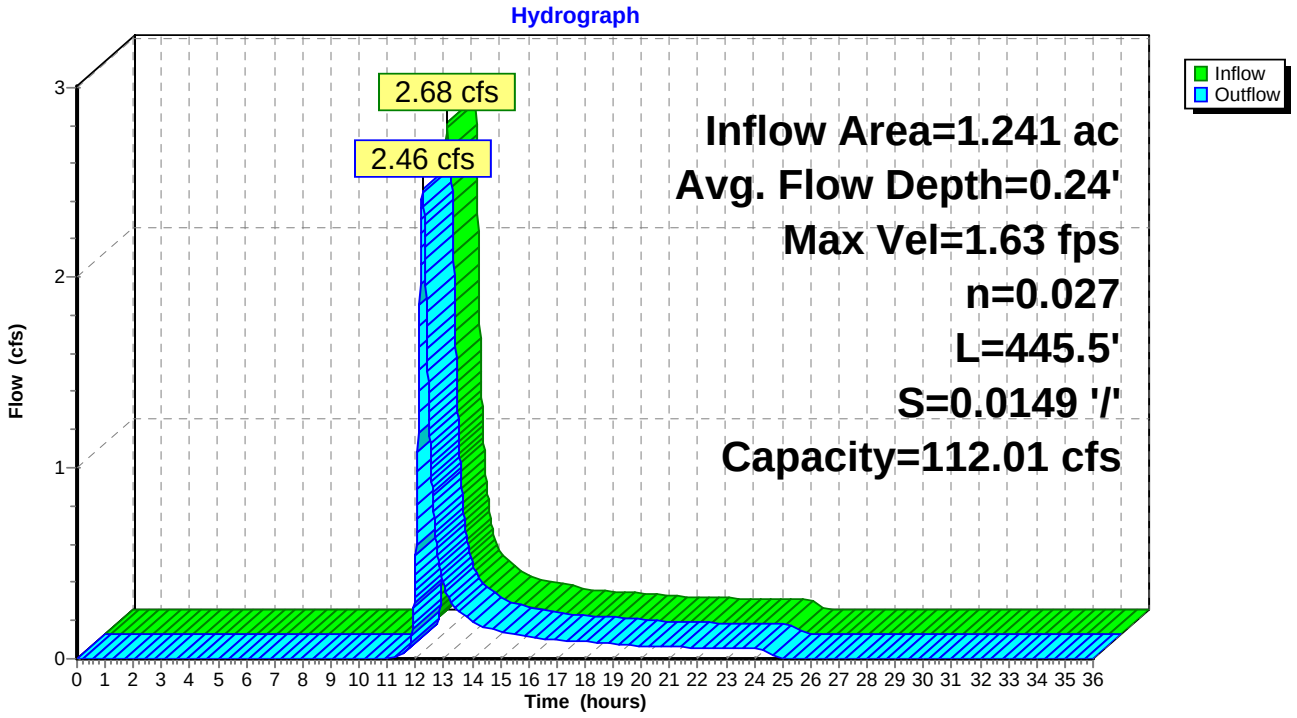
Peak Storage= 675 cf @ 12.17 hrs
Average Depth at Peak Storage= 0.24'
Bank-Full Depth= 1.00' Flow Area= 26.5 sf, Capacity= 112.01 cfs

0.00' x 1.00' deep channel, n= 0.027
Side Slope Z-value= 50.0 3.0 '/' Top Width= 53.00'
Length= 445.5' Slope= 0.0149 '/'
Inlet Invert= 411.28', Outlet Invert= 404.63'



‡

Reach C8B5: Channel 8B-5



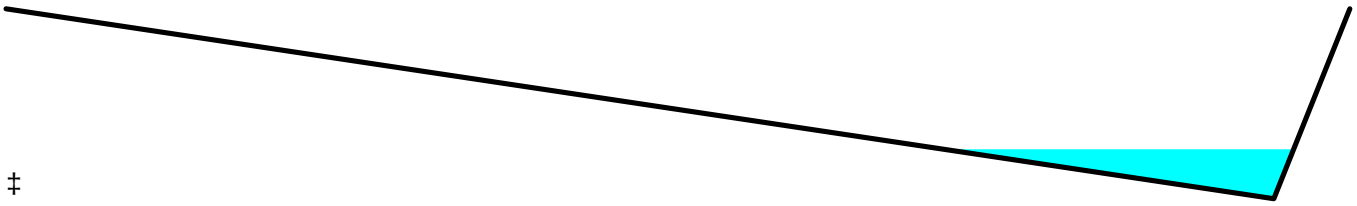
Summary for Reach C8B6: Channel 8B-6

Inflow Area = 1.631 ac, 0.00% Impervious, Inflow Depth = 1.93" for 25 Yr event
Inflow = 3.62 cfs @ 12.11 hrs, Volume= 0.262 af
Outflow = 3.23 cfs @ 12.26 hrs, Volume= 0.262 af, Atten= 11%, Lag= 9.2 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
Max. Velocity= 1.80 fps, Min. Travel Time= 5.4 min
Avg. Velocity = 0.69 fps, Avg. Travel Time= 13.9 min

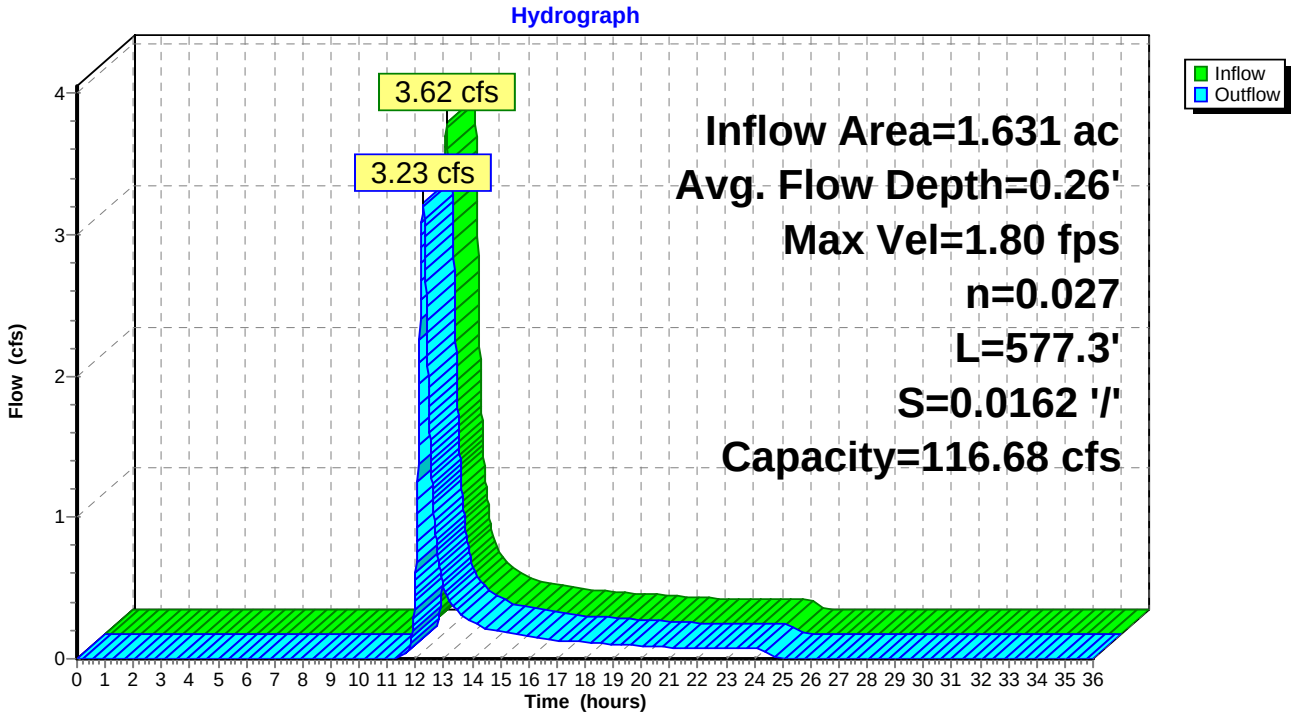
Peak Storage= 1,037 cf @ 12.17 hrs
Average Depth at Peak Storage= 0.26'
Bank-Full Depth= 1.00' Flow Area= 26.5 sf, Capacity= 116.68 cfs

0.00' x 1.00' deep channel, n= 0.027
Side Slope Z-value= 50.0 3.0 '/' Top Width= 53.00'
Length= 577.3' Slope= 0.0162 '/'
Inlet Invert= 413.96', Outlet Invert= 404.61'



‡

Reach C8B6: Channel 8B-6



Summary for Reach C8B7: Channel 8B-7

Inflow Area = 8.668 ac, 0.00% Impervious, Inflow Depth = 1.93" for 25 Yr event
Inflow = 15.99 cfs @ 12.24 hrs, Volume= 1.391 af
Outflow = 15.94 cfs @ 12.27 hrs, Volume= 1.391 af, Atten= 0%, Lag= 1.7 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
Max. Velocity= 2.63 fps, Min. Travel Time= 1.0 min
Avg. Velocity = 0.80 fps, Avg. Travel Time= 3.3 min

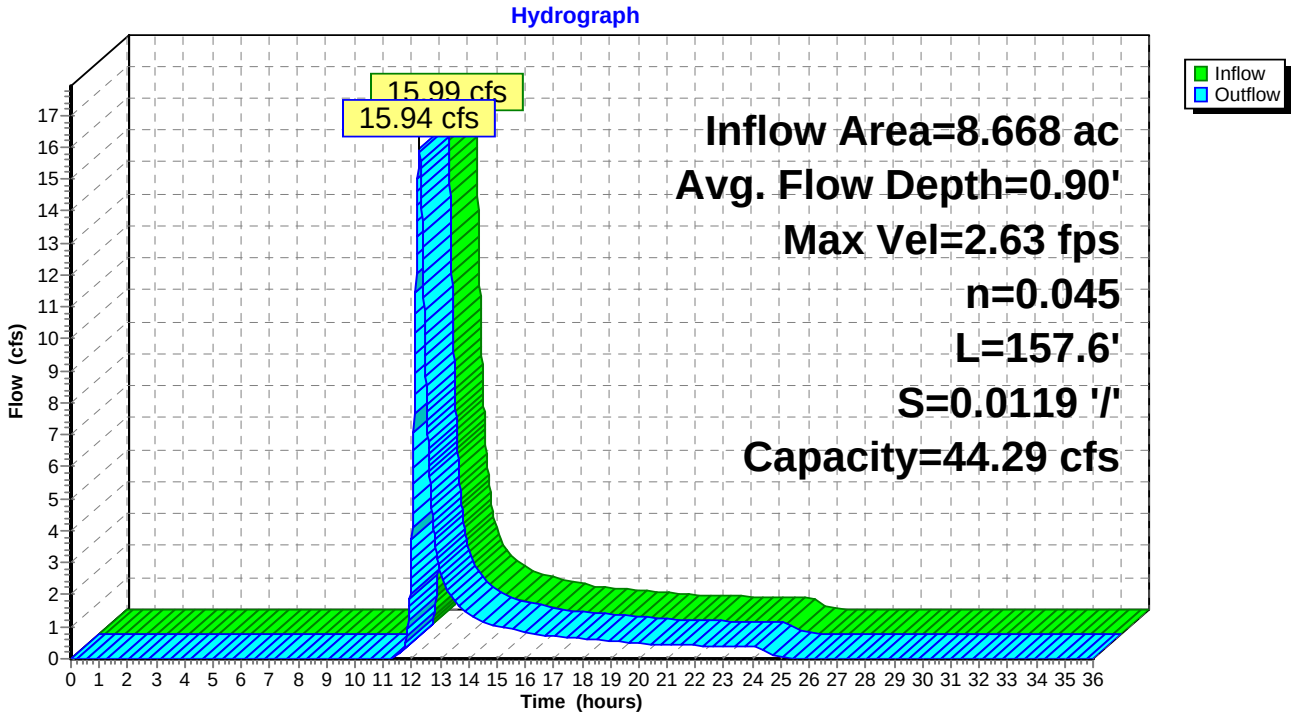
Peak Storage= 954 cf @ 12.26 hrs
Average Depth at Peak Storage= 0.90'
Bank-Full Depth= 1.50' Flow Area= 12.8 sf, Capacity= 44.29 cfs

4.00' x 1.50' deep channel, n= 0.045
Side Slope Z-value= 3.0 '/' Top Width= 13.00'
Length= 157.6' Slope= 0.0119 '/'
Inlet Invert= 405.51', Outlet Invert= 403.63'



‡

Reach C8B7: Channel 8B-7



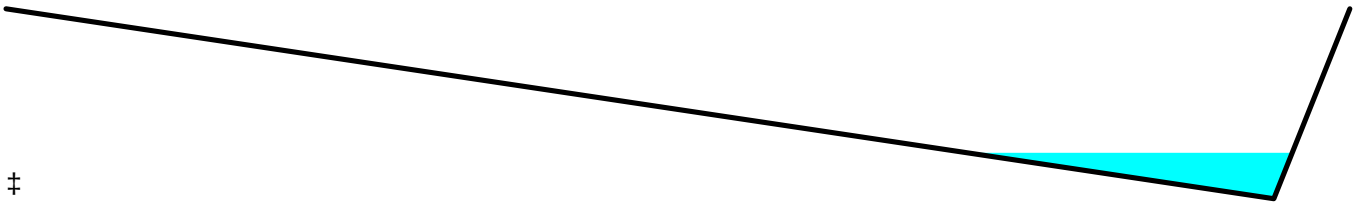
Summary for Reach C8B8: Channel 8B-8

Inflow Area = 1.297 ac, 0.00% Impervious, Inflow Depth = 1.93" for 25 Yr event
Inflow = 2.80 cfs @ 12.12 hrs, Volume= 0.208 af
Outflow = 2.55 cfs @ 12.26 hrs, Volume= 0.208 af, Atten= 9%, Lag= 8.4 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
Max. Velocity= 1.64 fps, Min. Travel Time= 4.8 min
Avg. Velocity = 0.65 fps, Avg. Travel Time= 12.0 min

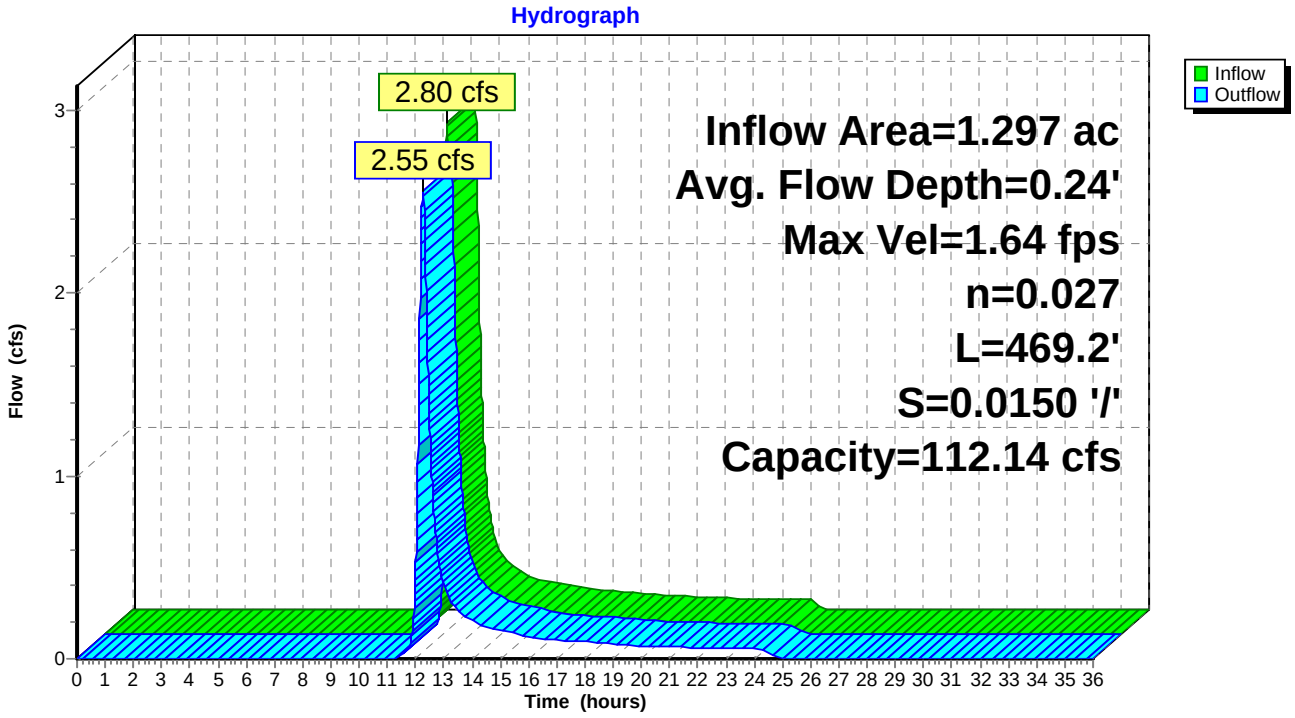
Peak Storage= 729 cf @ 12.18 hrs
Average Depth at Peak Storage= 0.24'
Bank-Full Depth= 1.00' Flow Area= 26.5 sf, Capacity= 112.14 cfs

0.00' x 1.00' deep channel, n= 0.027
Side Slope Z-value= 50.0 3.0 '/' Top Width= 53.00'
Length= 469.2' Slope= 0.0150 '/'
Inlet Invert= 413.21', Outlet Invert= 406.19'



‡

Reach C8B8: Channel 8B-8



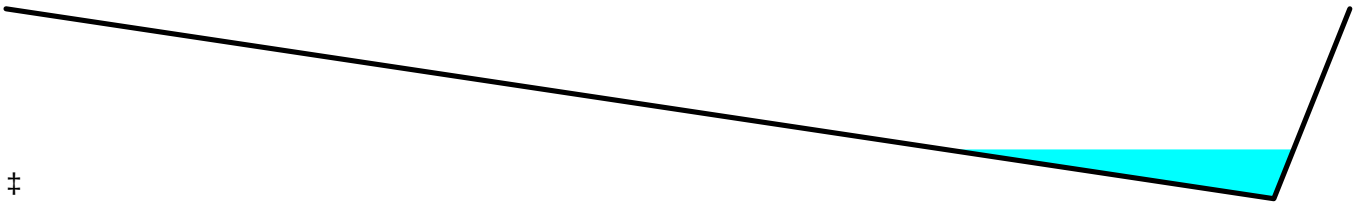
Summary for Reach C8B9: Channel 8B-9

Inflow Area = 1.632 ac, 0.00% Impervious, Inflow Depth = 1.93" for 25 Yr event
Inflow = 3.59 cfs @ 12.11 hrs, Volume= 0.262 af
Outflow = 3.20 cfs @ 12.27 hrs, Volume= 0.262 af, Atten= 11%, Lag= 9.4 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
Max. Velocity= 1.79 fps, Min. Travel Time= 5.4 min
Avg. Velocity = 0.69 fps, Avg. Travel Time= 14.0 min

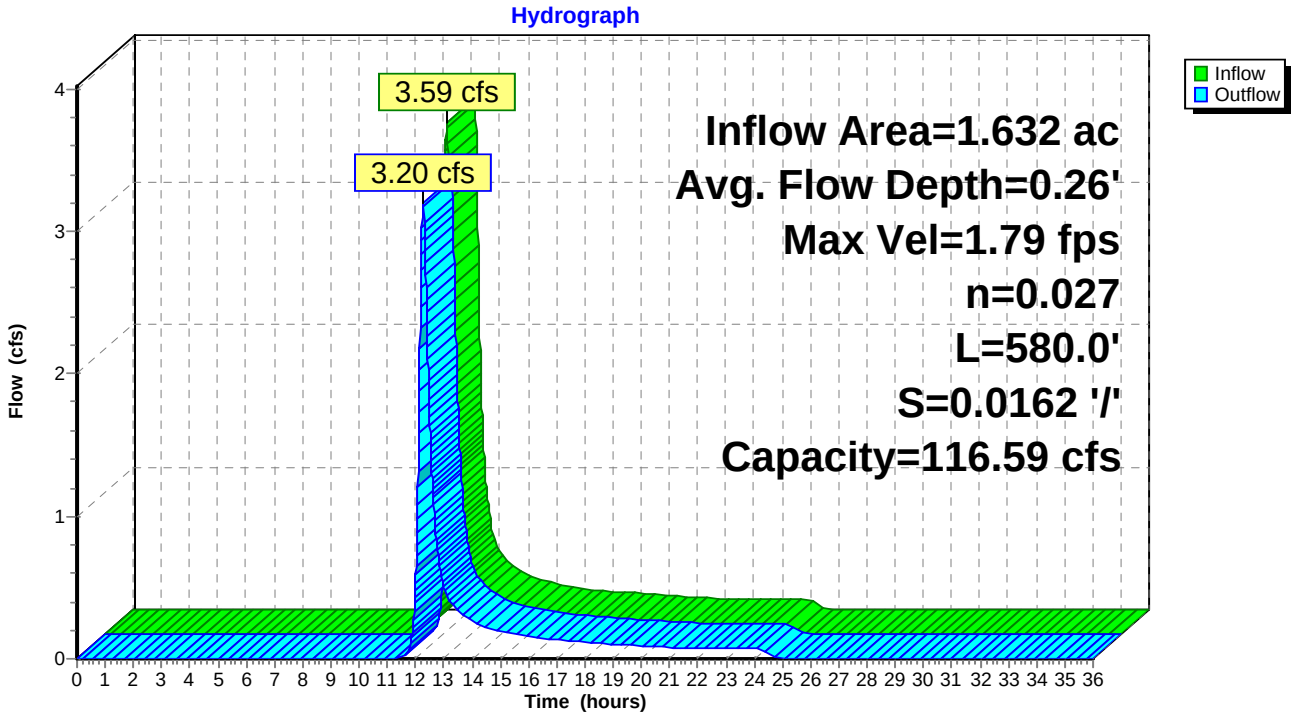
Peak Storage= 1,036 cf @ 12.18 hrs
Average Depth at Peak Storage= 0.26'
Bank-Full Depth= 1.00' Flow Area= 26.5 sf, Capacity= 116.59 cfs

0.00' x 1.00' deep channel, n= 0.027
Side Slope Z-value= 50.0 3.0 '/' Top Width= 53.00'
Length= 580.0' Slope= 0.0162 '/'
Inlet Invert= 415.58', Outlet Invert= 406.20'



‡

Reach C8B9: Channel 8B-9



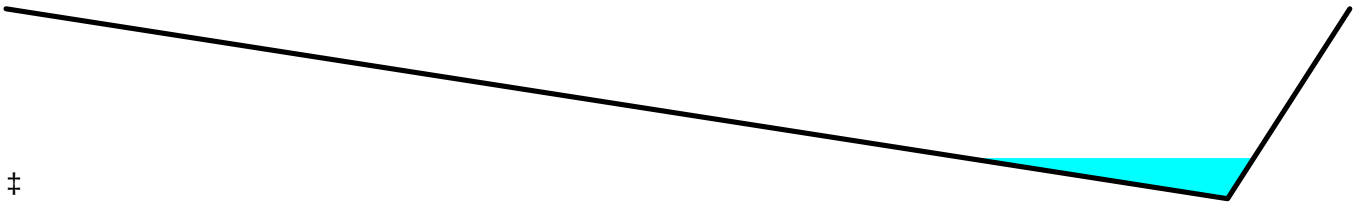
Summary for Reach C8C1: Channel 8C-1

Inflow Area = 2.962 ac, 0.00% Impervious, Inflow Depth = 1.93" for 25 Yr event
Inflow = 5.72 cfs @ 12.21 hrs, Volume= 0.475 af
Outflow = 5.70 cfs @ 12.24 hrs, Volume= 0.475 af, Atten= 0%, Lag= 1.4 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
Max. Velocity= 2.01 fps, Min. Travel Time= 0.8 min
Avg. Velocity = 0.81 fps, Avg. Travel Time= 2.1 min

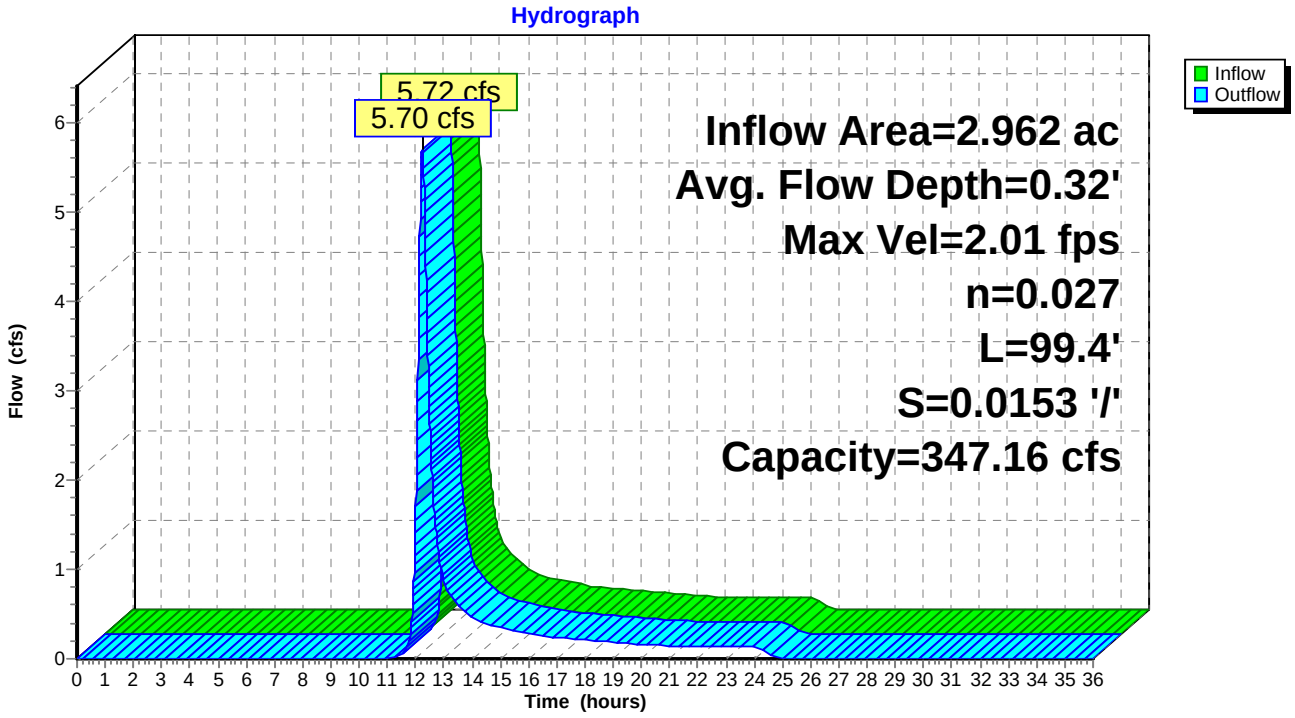
Peak Storage= 282 cf @ 12.22 hrs
Average Depth at Peak Storage= 0.32'
Bank-Full Depth= 1.50' Flow Area= 61.9 sf, Capacity= 347.16 cfs

0.00' x 1.50' deep channel, n= 0.027
Side Slope Z-value= 50.0 5.0 '/' Top Width= 82.50'
Length= 99.4' Slope= 0.0153 '/'
Inlet Invert= 403.17', Outlet Invert= 401.65'



‡

Reach C8C1: Channel 8C-1



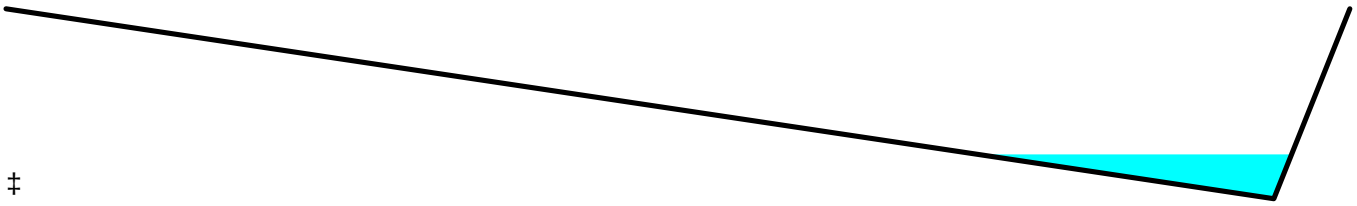
Summary for Reach C8C2: Channel 8C-2

Inflow Area = 1.121 ac, 0.00% Impervious, Inflow Depth = 1.93" for 25 Yr event
Inflow = 2.50 cfs @ 12.10 hrs, Volume= 0.180 af
Outflow = 2.37 cfs @ 12.20 hrs, Volume= 0.180 af, Atten= 5%, Lag= 5.9 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
Max. Velocity= 1.65 fps, Min. Travel Time= 3.3 min
Avg. Velocity = 0.67 fps, Avg. Travel Time= 8.1 min

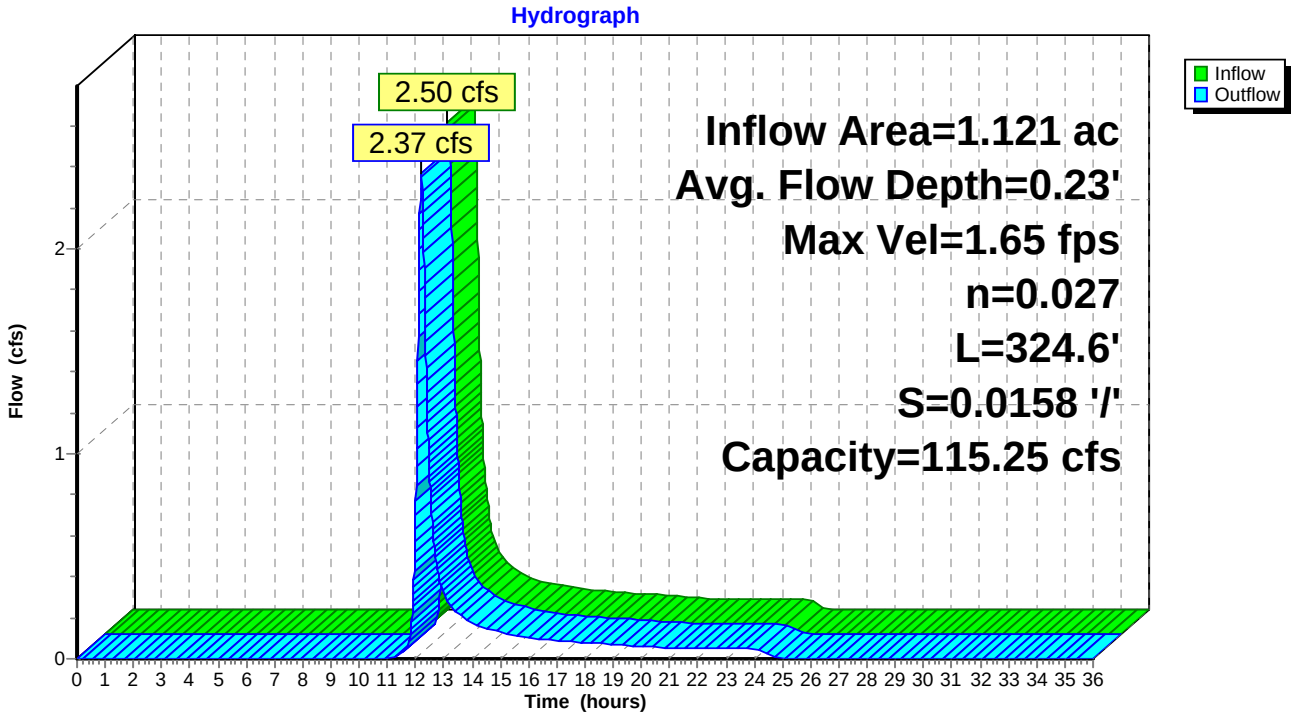
Peak Storage= 467 cf @ 12.15 hrs
Average Depth at Peak Storage= 0.23'
Bank-Full Depth= 1.00' Flow Area= 26.5 sf, Capacity= 115.25 cfs

0.00' x 1.00' deep channel, n= 0.027
Side Slope Z-value= 50.0 3.0 '/' Top Width= 53.00'
Length= 324.6' Slope= 0.0158 '/'
Inlet Invert= 408.30', Outlet Invert= 403.17'



‡

Reach C8C2: Channel 8C-2



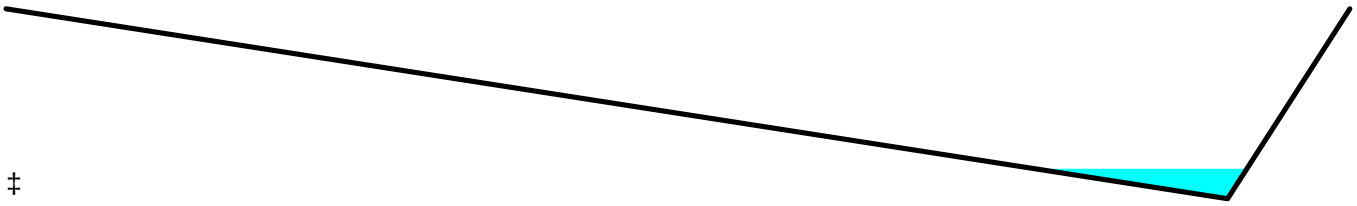
Summary for Reach C8C3: Channel 8C-3

Inflow Area = 1.201 ac, 0.00% Impervious, Inflow Depth = 1.93" for 25 Yr event
Inflow = 2.65 cfs @ 12.11 hrs, Volume= 0.193 af
Outflow = 2.37 cfs @ 12.26 hrs, Volume= 0.193 af, Atten= 10%, Lag= 8.9 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
Max. Velocity= 1.54 fps, Min. Travel Time= 5.2 min
Avg. Velocity = 0.63 fps, Avg. Travel Time= 12.8 min

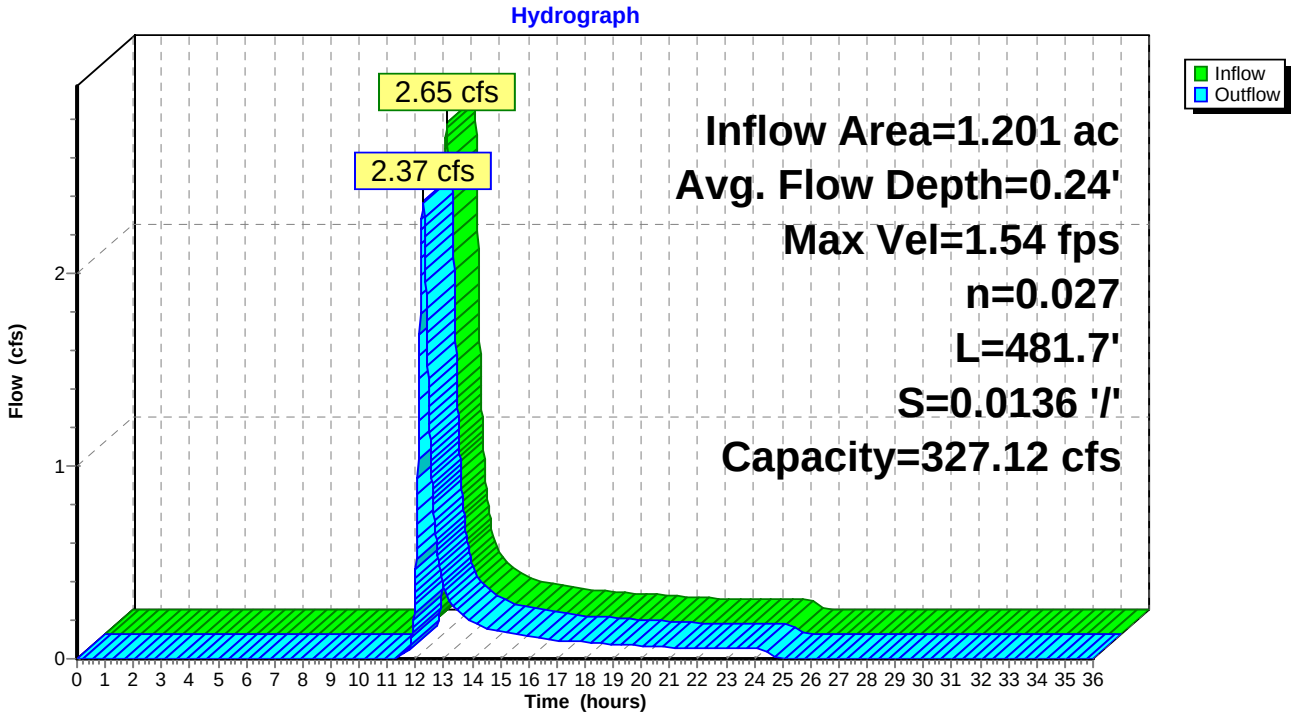
Peak Storage= 741 cf @ 12.17 hrs
Average Depth at Peak Storage= 0.24'
Bank-Full Depth= 1.50' Flow Area= 61.9 sf, Capacity= 327.12 cfs

0.00' x 1.50' deep channel, n= 0.027
Side Slope Z-value= 50.0 5.0 '/' Top Width= 82.50'
Length= 481.7' Slope= 0.0136 '/'
Inlet Invert= 409.58', Outlet Invert= 403.04'



‡

Reach C8C3: Channel 8C-3



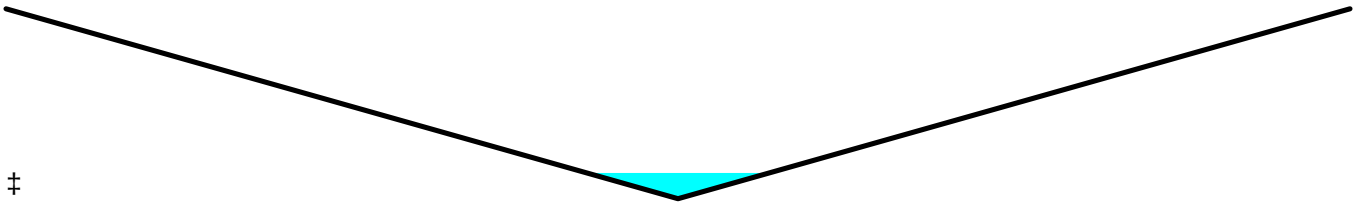
Summary for Reach C9A: Channel 9A

Inflow Area = 0.307 ac, 0.00% Impervious, Inflow Depth = 1.93" for 25 Yr event
Inflow = 1.22 cfs @ 11.93 hrs, Volume= 0.049 af
Outflow = 1.15 cfs @ 11.98 hrs, Volume= 0.049 af, Atten= 6%, Lag= 2.7 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs / 2
Max. Velocity= 2.47 fps, Min. Travel Time= 1.6 min
Avg. Velocity = 0.95 fps, Avg. Travel Time= 4.2 min

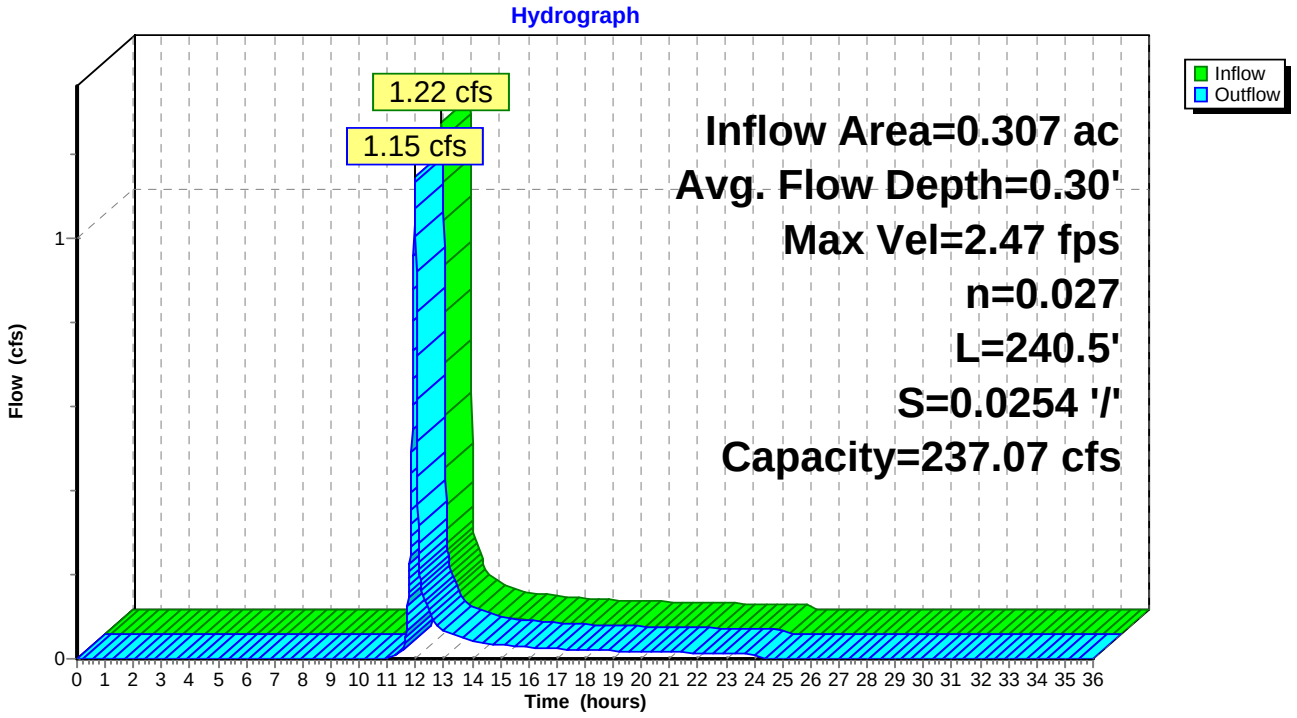
Peak Storage= 112 cf @ 11.95 hrs
Average Depth at Peak Storage= 0.30'
Bank-Full Depth= 2.25' Flow Area= 25.3 sf, Capacity= 237.07 cfs

0.00' x 2.25' deep channel, n= 0.027
Side Slope Z-value= 5.0 '/' Top Width= 22.50'
Length= 240.5' Slope= 0.0254 '/'
Inlet Invert= 409.15', Outlet Invert= 403.04'



‡

Reach C9A: Channel 9A



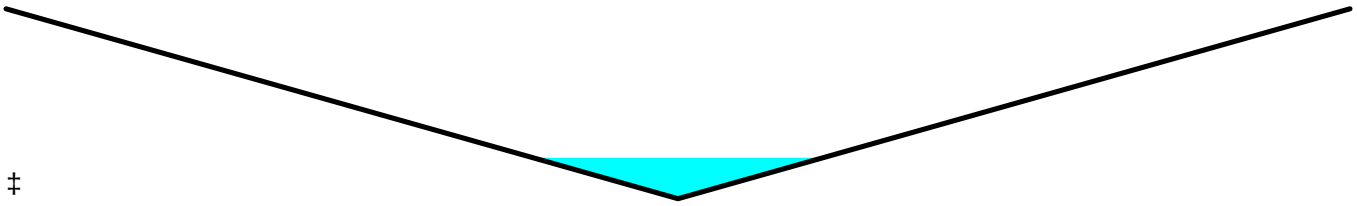
Summary for Reach C9B: Channel 9B

Inflow Area = 0.774 ac, 0.00% Impervious, Inflow Depth = 1.93" for 25 Yr event
Inflow = 2.96 cfs @ 11.94 hrs, Volume= 0.124 af
Outflow = 2.48 cfs @ 12.05 hrs, Volume= 0.124 af, Atten= 16%, Lag= 6.1 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs / 2
Max. Velocity= 2.12 fps, Min. Travel Time= 3.9 min
Avg. Velocity = 0.78 fps, Avg. Travel Time= 10.7 min

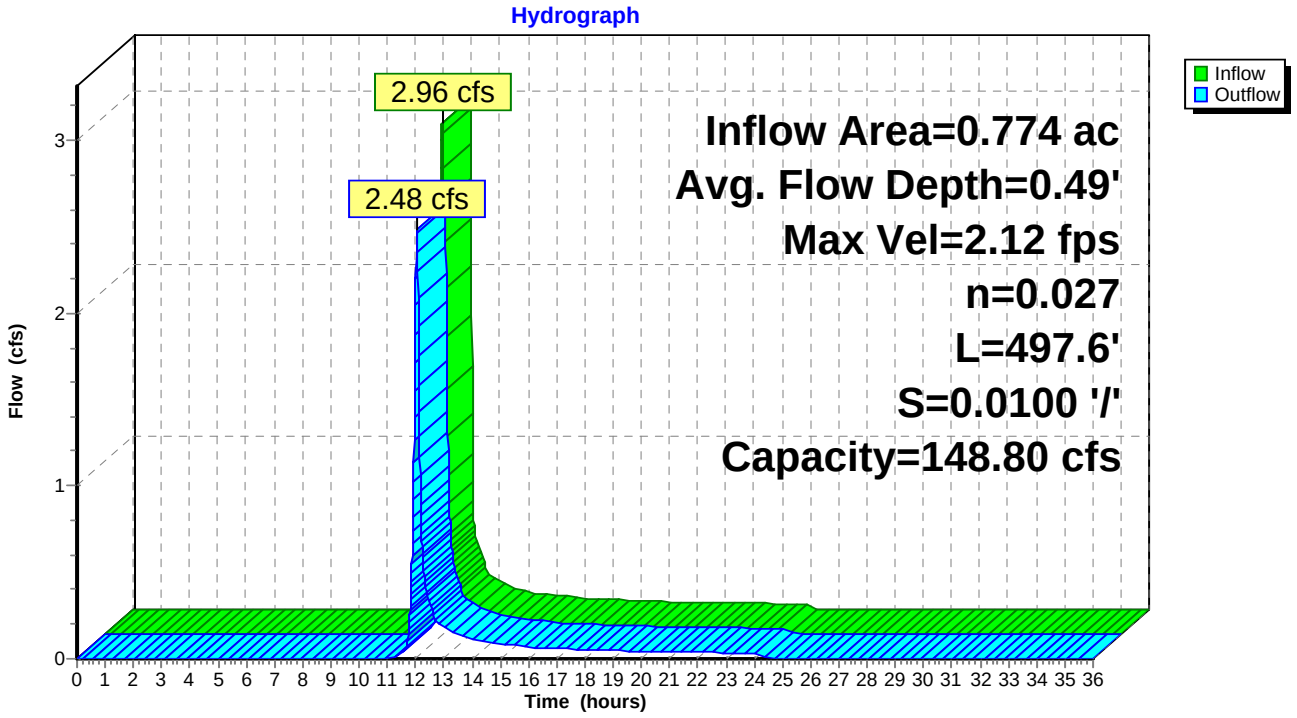
Peak Storage= 586 cf @ 11.98 hrs
Average Depth at Peak Storage= 0.49'
Bank-Full Depth= 2.25' Flow Area= 25.3 sf, Capacity= 148.80 cfs

0.00' x 2.25' deep channel, n= 0.027
Side Slope Z-value= 5.0 '/' Top Width= 22.50'
Length= 497.6' Slope= 0.0100 '/'
Inlet Invert= 408.02', Outlet Invert= 403.04'



‡

Reach C9B: Channel 9B



Summary for Reach WD1: West Ditch 1

Inflow Area = 74.185 ac, 0.00% Impervious, Inflow Depth > 32.68" for 25 Yr event
Inflow = 133.58 cfs @ 12.44 hrs, Volume= 202.056 af
Outflow = 133.41 cfs @ 12.53 hrs, Volume= 201.449 af, Atten= 0%, Lag= 5.5 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
Max. Velocity= 2.81 fps, Min. Travel Time= 3.0 min
Avg. Velocity = 2.21 fps, Avg. Travel Time= 3.8 min

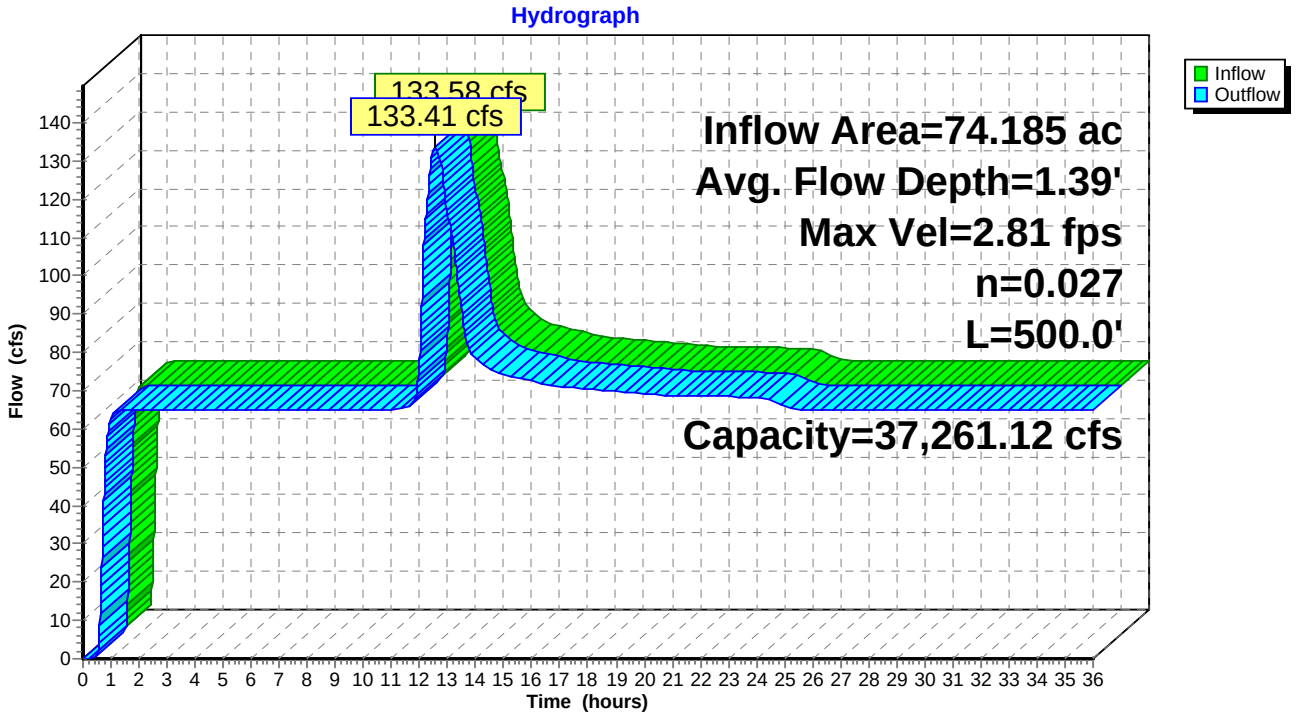
Peak Storage= 23,724 cf @ 12.48 hrs
Average Depth at Peak Storage= 1.39'
Bank-Full Depth= 25.00' Flow Area= 2,625.0 sf, Capacity= 37,261.12 cfs

30.00' x 25.00' deep channel, n= 0.027
Side Slope Z-value= 3.0 '/' Top Width= 180.00'
Length= 500.0' Slope= 0.0020 '/'
Inlet Invert= 373.99', Outlet Invert= 373.00'



‡

Reach WD1: West Ditch 1



Summary for Reach WD2: West Ditch 2

Inflow Area = 60.217 ac, 0.00% Impervious, Inflow Depth > 40.11" for 25 Yr event
Inflow = 117.21 cfs @ 12.18 hrs, Volume= 201.284 af
Outflow = 115.13 cfs @ 12.45 hrs, Volume= 199.814 af, Atten= 2%, Lag= 16.0 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
Max. Velocity= 2.55 fps, Min. Travel Time= 7.4 min
Avg. Velocity = 2.10 fps, Avg. Travel Time= 8.9 min

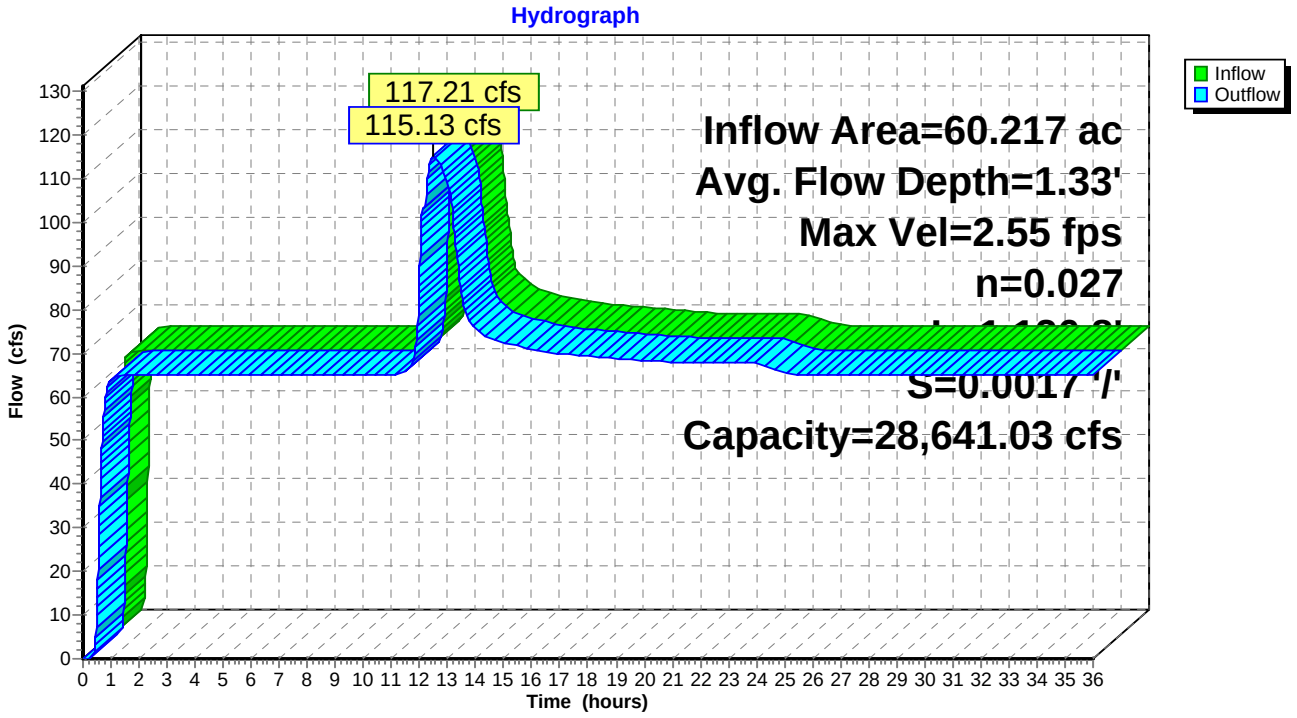
Peak Storage= 50,960 cf @ 12.33 hrs
Average Depth at Peak Storage= 1.33'
Bank-Full Depth= 23.00' Flow Area= 2,277.0 sf, Capacity= 28,641.03 cfs

30.00' x 23.00' deep channel, n= 0.027
Side Slope Z-value= 3.0 '/' Top Width= 168.00'
Length= 1,126.8' Slope= 0.0017 '/'
Inlet Invert= 375.92', Outlet Invert= 373.99'



‡

Reach WD2: West Ditch 2



Summary for Reach WD3A: West Ditch 3A

Inflow Area = 34.618 ac, 0.00% Impervious, Inflow Depth > 68.50" for 25 Yr event
Inflow = 99.17 cfs @ 12.09 hrs, Volume= 197.621 af
Outflow = 98.56 cfs @ 12.16 hrs, Volume= 197.176 af, Atten= 1%, Lag= 3.9 min

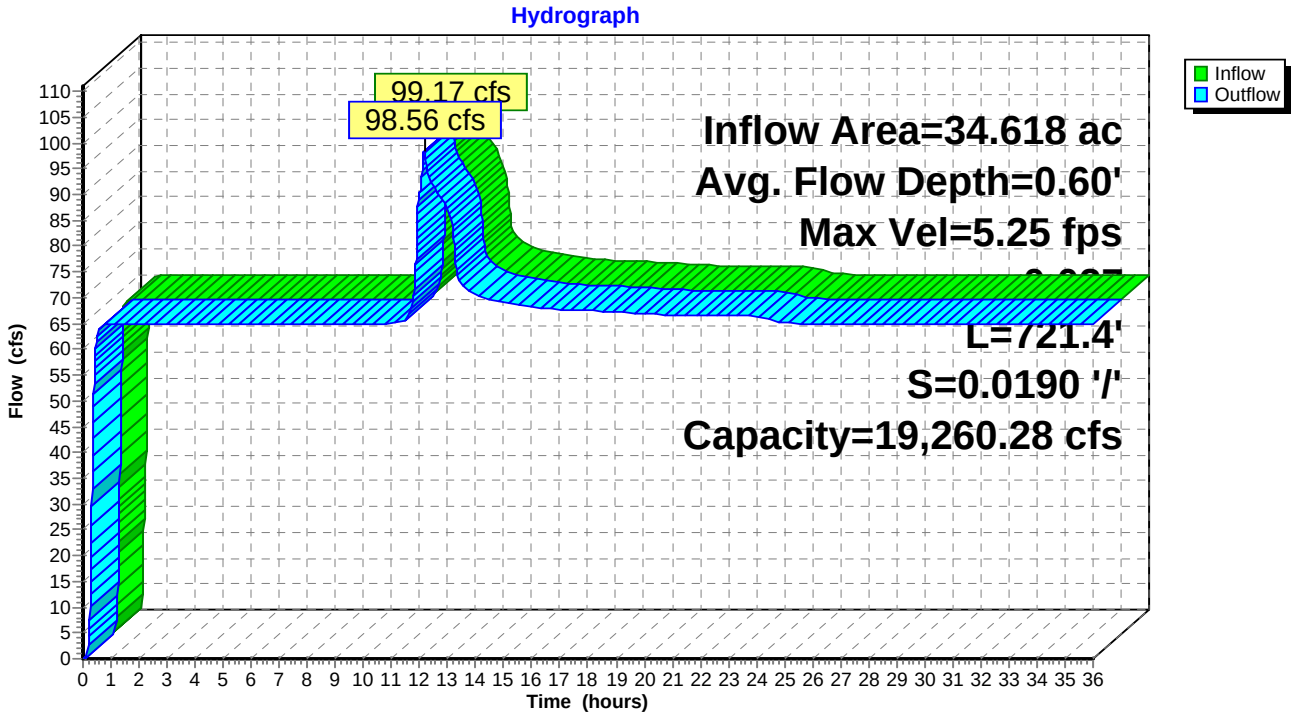
Routing by Stor-Ind+Trans method, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs / 2
Max. Velocity= 5.25 fps, Min. Travel Time= 2.3 min
Avg. Velocity = 4.51 fps, Avg. Travel Time= 2.7 min

Peak Storage= 13,548 cf @ 12.12 hrs
Average Depth at Peak Storage= 0.60'
Bank-Full Depth= 12.00' Flow Area= 648.0 sf, Capacity= 19,260.28 cfs

30.00' x 12.00' deep channel, n= 0.027
Side Slope Z-value= 2.0 '/' Top Width= 78.00'
Length= 721.4' Slope= 0.0190 '/'
Inlet Invert= 389.65', Outlet Invert= 375.92'



Reach WD3A: West Ditch 3A



Summary for Reach WD3B: West Ditch 3B

Inflow Area = 30.403 ac, 0.00% Impervious, Inflow Depth > 77.76" for 25 Yr event
Inflow = 96.92 cfs @ 12.08 hrs, Volume= 197.019 af
Outflow = 96.88 cfs @ 12.09 hrs, Volume= 196.945 af, Atten= 0%, Lag= 0.6 min

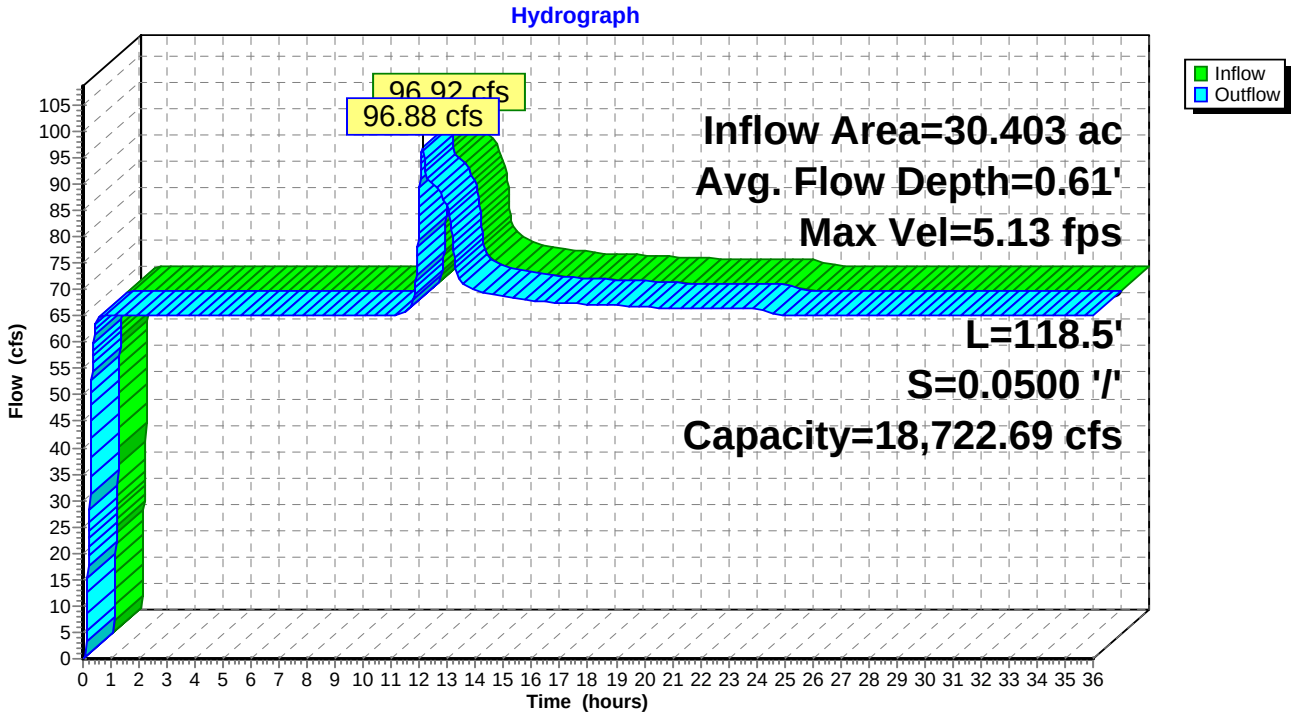
Routing by Stor-Ind+Trans method, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs / 2
Max. Velocity= 5.13 fps, Min. Travel Time= 0.4 min
Avg. Velocity = 4.43 fps, Avg. Travel Time= 0.4 min

Peak Storage= 2,240 cf @ 12.08 hrs
Average Depth at Peak Storage= 0.61'
Bank-Full Depth= 12.00' Flow Area= 648.0 sf, Capacity= 18,722.69 cfs

30.00' x 12.00' deep channel, n= 0.045
Side Slope Z-value= 2.0 '/' Top Width= 78.00'
Length= 118.5' Slope= 0.0500 '/'
Inlet Invert= 395.57', Outlet Invert= 389.65'



Reach WD3B: West Ditch 3B



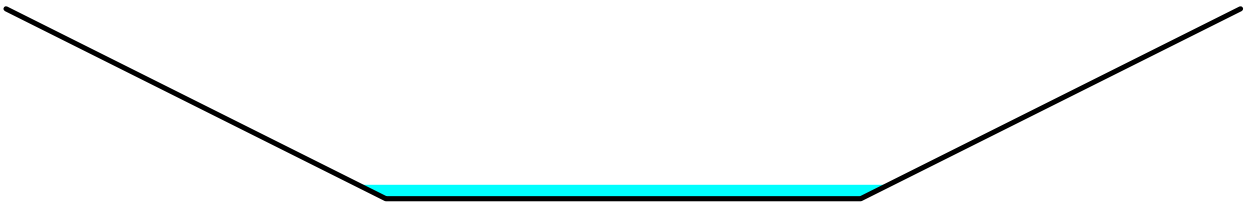
Summary for Reach WD3C: West Ditch 3C

Inflow Area = 30.403 ac, 0.00% Impervious, Inflow Depth > 77.82" for 25 Yr event
Inflow = 97.01 cfs @ 12.06 hrs, Volume= 197.157 af
Outflow = 96.92 cfs @ 12.08 hrs, Volume= 197.019 af, Atten= 0%, Lag= 1.2 min

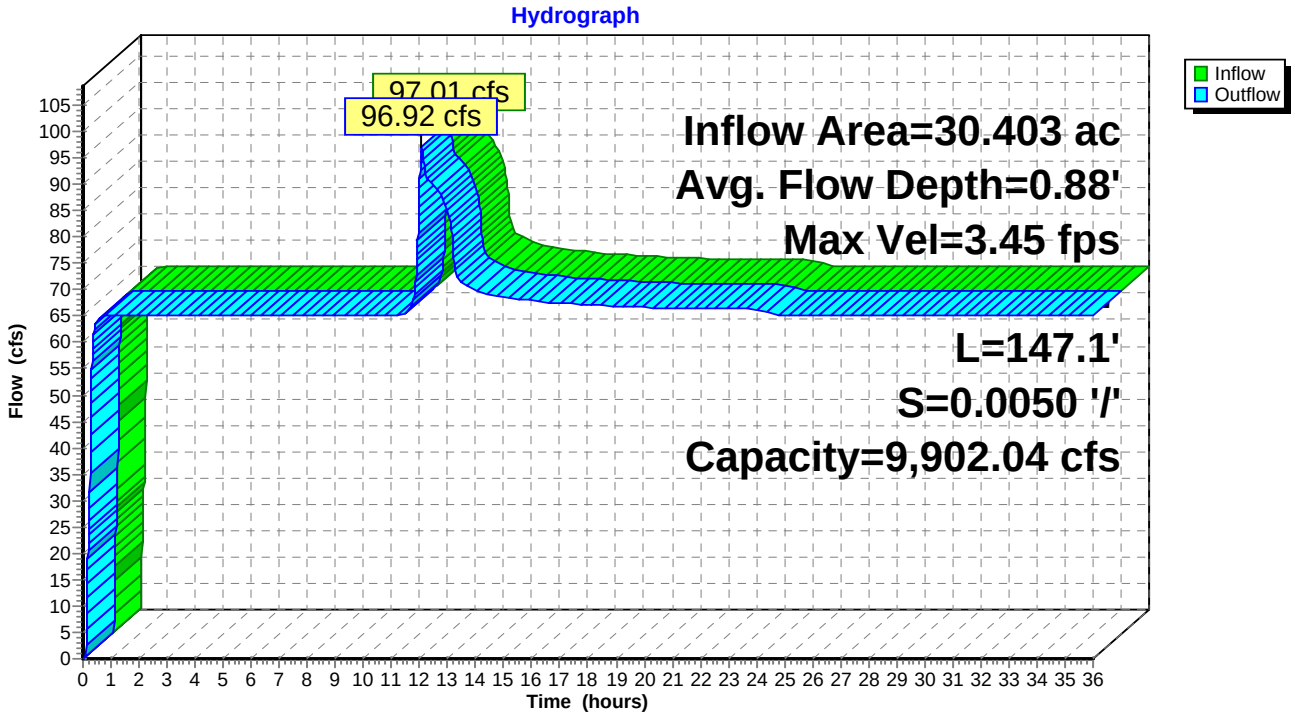
Routing by Stor-Ind+Trans method, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs / 2
Max. Velocity= 3.45 fps, Min. Travel Time= 0.7 min
Avg. Velocity = 2.99 fps, Avg. Travel Time= 0.8 min

Peak Storage= 4,135 cf @ 12.07 hrs
Average Depth at Peak Storage= 0.88'
Bank-Full Depth= 12.00' Flow Area= 648.0 sf, Capacity= 9,902.04 cfs

30.00' x 12.00' deep channel, n= 0.027
Side Slope Z-value= 2.0 '/' Top Width= 78.00'
Length= 147.1' Slope= 0.0050 '/'
Inlet Invert= 396.31', Outlet Invert= 395.57'



Reach WD3C: West Ditch 3C



Summary for Reach WD4: West Ditch 4

Inflow Area = 10.099 ac, 0.00% Impervious, Inflow Depth > 231.78" for 25 Yr event
Inflow = 99.35 cfs @ 11.90 hrs, Volume= 195.063 af
Outflow = 94.68 cfs @ 11.99 hrs, Volume= 194.410 af, Atten= 5%, Lag= 5.5 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs / 2
Max. Velocity= 4.38 fps, Min. Travel Time= 3.3 min
Avg. Velocity = 3.94 fps, Avg. Travel Time= 3.7 min

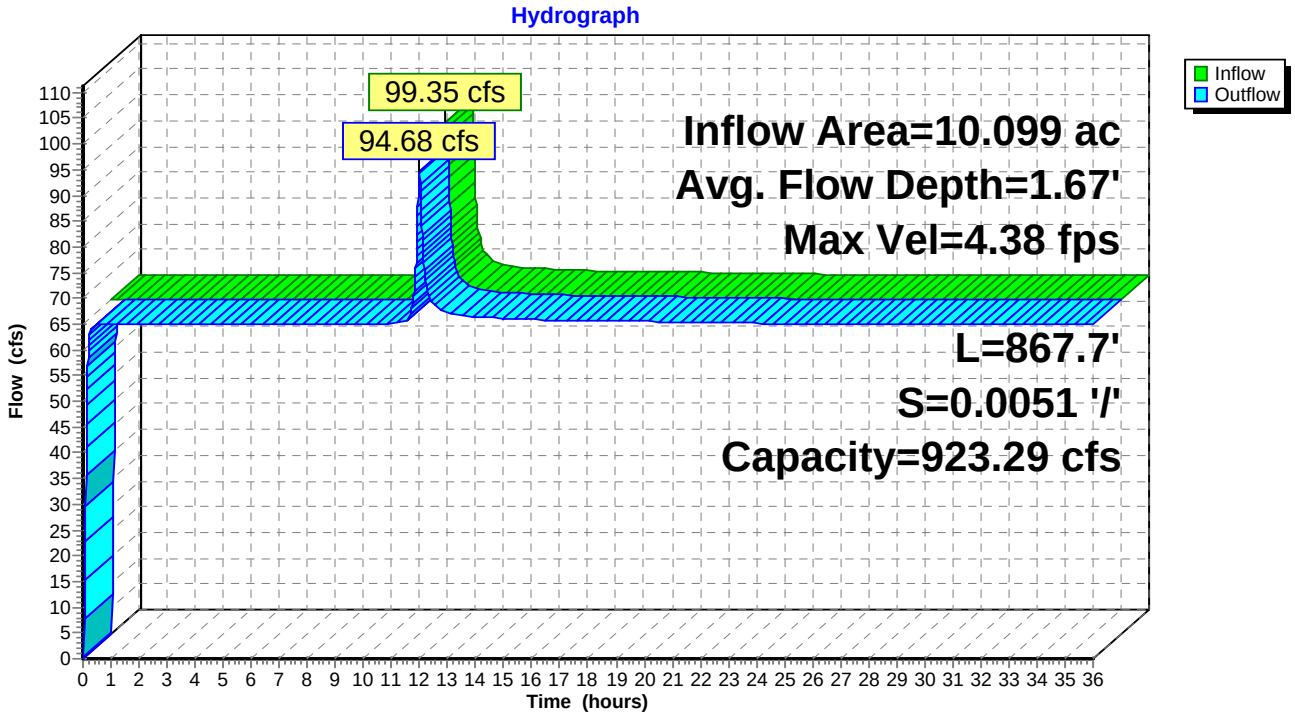
Peak Storage= 18,782 cf @ 11.94 hrs
Average Depth at Peak Storage= 1.67'
Bank-Full Depth= 5.00' Flow Area= 115.0 sf, Capacity= 923.29 cfs

8.00' x 5.00' deep channel, n= 0.027
Side Slope Z-value= 3.0 '/' Top Width= 38.00'
Length= 867.7' Slope= 0.0051 '/'
Inlet Invert= 400.98', Outlet Invert= 396.52'



‡

Reach WD4: West Ditch 4



Summary for Pond C3P: ELG Detention Basin Outlet C-3

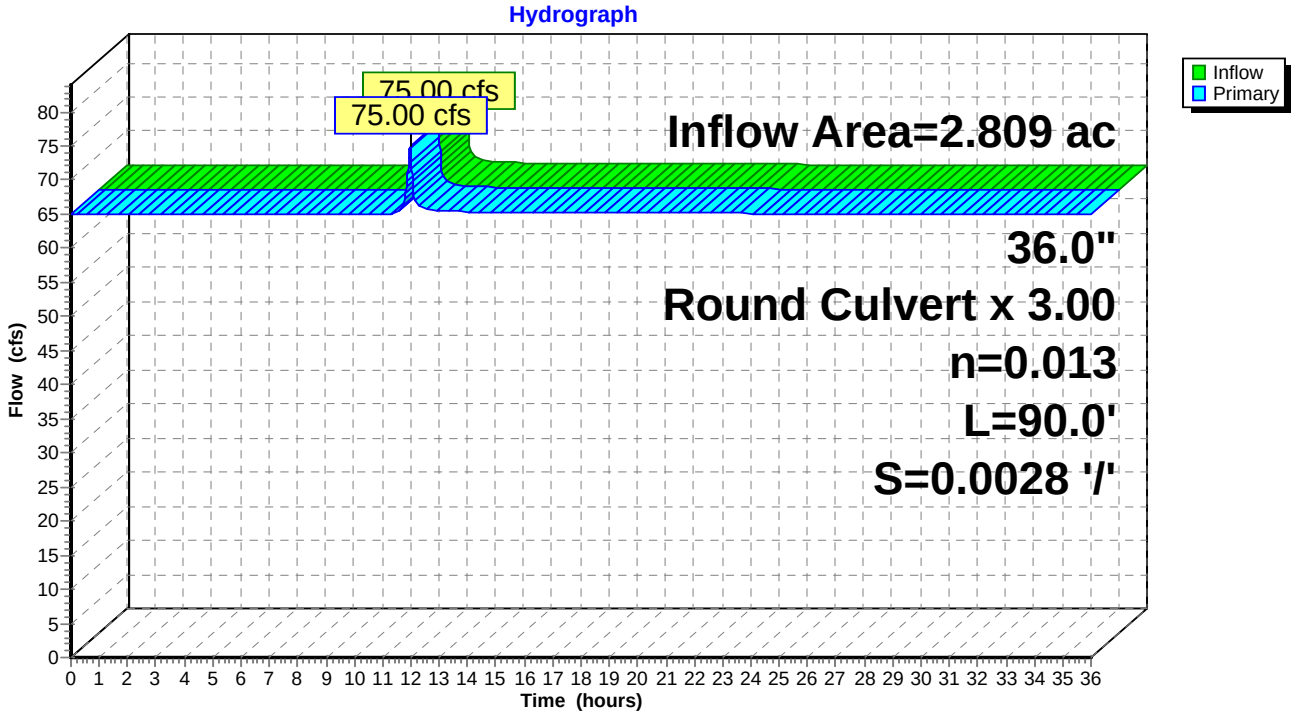
Inflow Area = 2.809 ac, 0.00% Impervious, Inflow Depth > 828.35" for 25 Yr event
Inflow = 75.00 cfs @ 11.97 hrs, Volume= 193.893 af, Incl. 65.00 cfs Base Flow
Outflow = 75.00 cfs @ 11.97 hrs, Volume= 193.893 af, Atten= 0%, Lag= 0.0 min
Primary = 75.00 cfs @ 11.97 hrs, Volume= 193.893 af

Routing by Stor-Ind method, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
Peak Elev= 403.94' @ 11.97 hrs

Device	Routing	Invert	Outlet Devices
#1	Primary	401.25'	**36.0" Round Three HDPE_Round 36" X 3.00** L= 90.0' CPP, projecting, no headwall, Ke= 0.900 Inlet / Outlet Invert= 401.25' / 401.00' S= 0.0028 '/' Cc= 0.900 n= 0.013 Corrugated PE, smooth interior, Flow Area= 7.07 sf

Primary OutFlow Max=74.98 cfs @ 11.97 hrs HW=403.94' (Free Discharge)
└**1=Three HDPE_Round 36"** (Barrel Controls 74.98 cfs @ 4.94 fps)

Pond C3P: ELG Detention Basin Outlet C-3



Summary for Pond O6: Outlet 6

Inflow Area = 13.968 ac, 0.00% Impervious, Inflow Depth = 1.93" for 25 Yr event
Inflow = 26.67 cfs @ 12.26 hrs, Volume= 2.241 af
Outflow = 18.47 cfs @ 12.41 hrs, Volume= 2.241 af, Atten= 31%, Lag= 9.3 min
Primary = 18.47 cfs @ 12.41 hrs, Volume= 2.241 af

Routing by Stor-Ind method, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
Peak Elev= 402.12' @ 12.41 hrs Surf.Area= 12,724 sf Storage= 7,934 cf

Plug-Flow detention time= 2.2 min calculated for 2.241 af (100% of inflow)
Center-of-Mass det. time= 2.2 min (884.7 - 882.5)

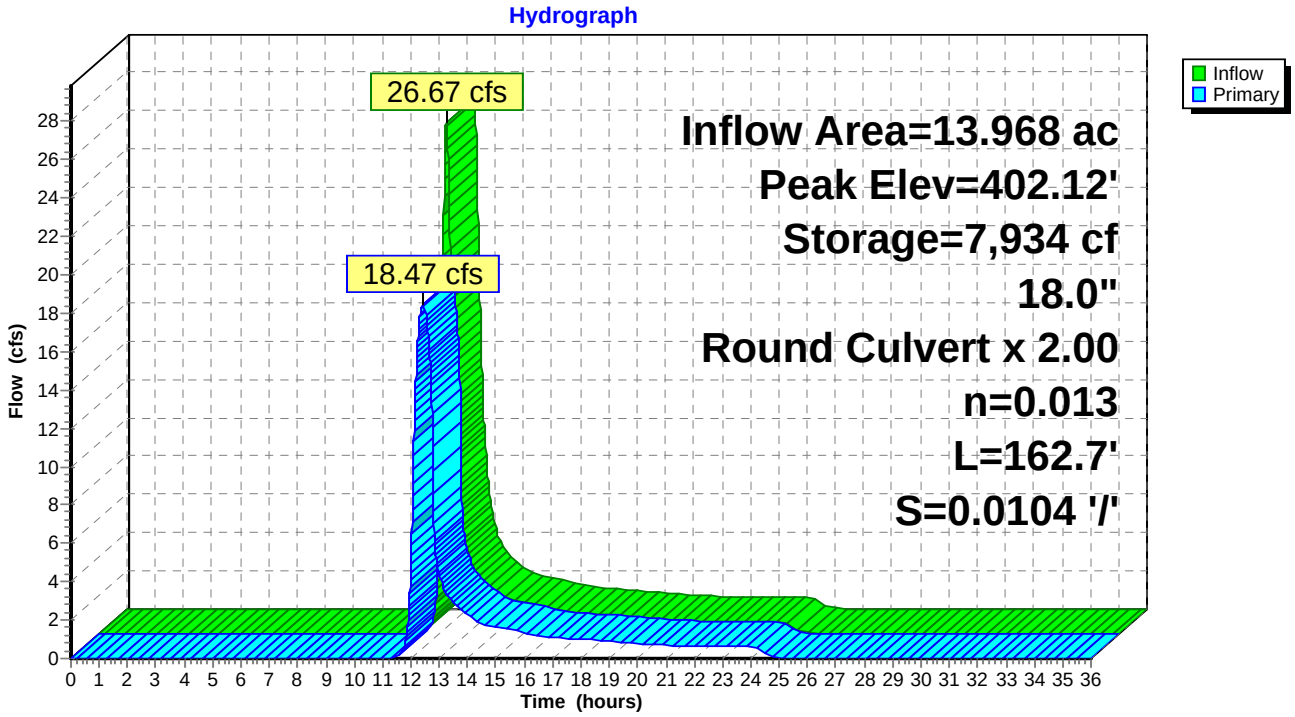
Volume	Invert	Avail.Storage	Storage Description
#1	399.57'	514,337 cf	**Custom Stage Data (Prismatic)** Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
399.57	0	0	0
400.00	256	55	55
401.00	1,259	758	813
402.00	10,236	5,748	6,560
403.00	31,016	20,626	27,186
404.00	65,281	48,149	75,335
405.00	112,873	89,077	164,412
406.00	171,318	142,096	306,507
407.00	244,341	207,830	514,337

Device	Routing	Invert	Outlet Devices
#1	Primary	399.48'	**18.0" Round Dual HDPE_Round 18" X 2.00** L= 162.7' CPP, projecting, no headwall, Ke= 0.900 Inlet / Outlet Invert= 399.48' / 397.79' S= 0.0104 '/' Cc= 0.900 n= 0.013 Corrugated PE, smooth interior, Flow Area= 1.77 sf

Primary OutFlow Max=18.47 cfs @ 12.41 hrs HW=402.12' (Free Discharge)
↑—**1=Dual HDPE_Round 18"** (Inlet Controls 18.47 cfs @ 5.23 fps)

Pond O6: Outlet 6



Summary for Pond O7: Outlet 7

Inflow Area = 18.440 ac, 0.00% Impervious, Inflow Depth = 1.93" for 25 Yr event
Inflow = 33.62 cfs @ 12.28 hrs, Volume= 2.959 af
Outflow = 20.06 cfs @ 12.49 hrs, Volume= 2.959 af, Atten= 40%, Lag= 12.6 min
Primary = 20.06 cfs @ 12.49 hrs, Volume= 2.959 af

Routing by Stor-Ind method, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
Peak Elev= 403.19' @ 12.49 hrs Surf.Area= 21,922 sf Storage= 14,797 cf

Plug-Flow detention time= 4.2 min calculated for 2.958 af (100% of inflow)
Center-of-Mass det. time= 4.2 min (888.5 - 884.4)

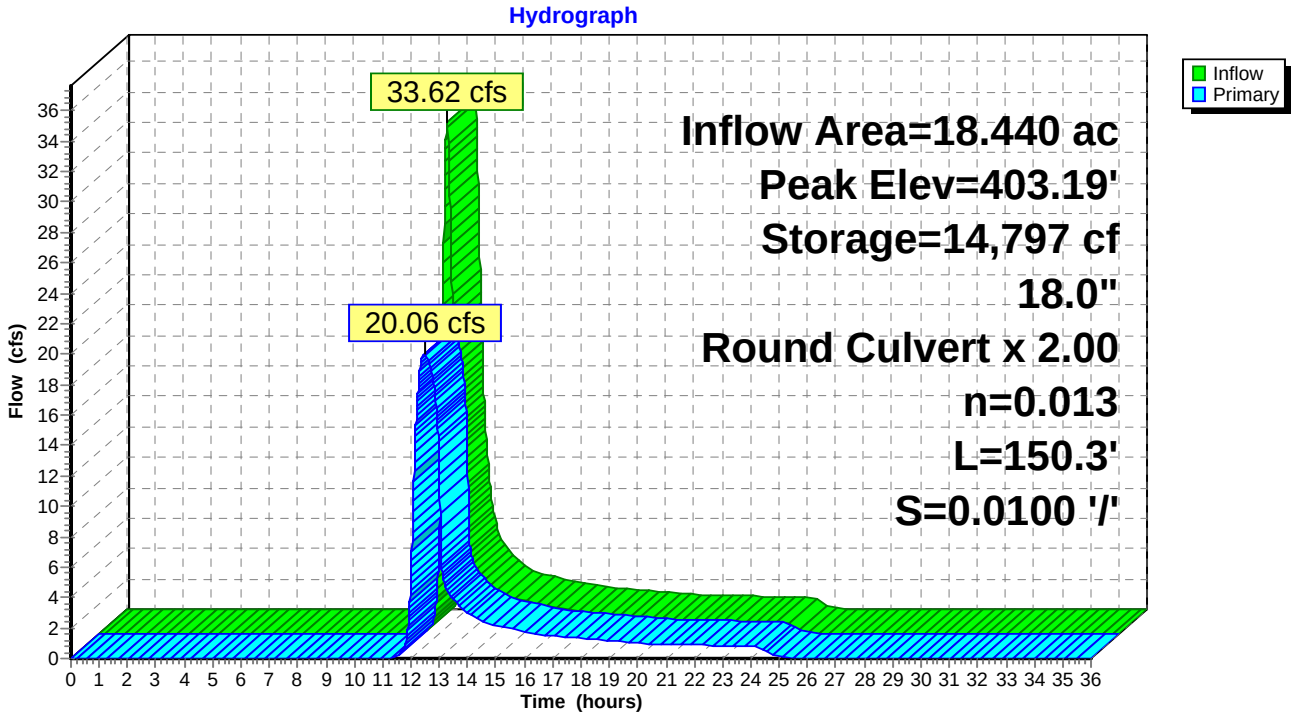
Volume	Invert	Avail.Storage	Storage Description
#1	400.23'	424,234 cf	**Custom Stage Data (Prismatic)** Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
400.23	0	0	0
401.00	585	225	225
402.00	2,505	1,545	1,770
403.00	16,330	9,418	11,188
404.00	45,968	31,149	42,337
405.00	91,639	68,804	111,140
406.00	152,673	122,156	233,296
407.00	229,203	190,938	424,234

Device	Routing	Invert	Outlet Devices
#1	Primary	400.21'	**18.0" Round Dual HDPE_Round 18" X 2.00** L= 150.3' CPP, projecting, no headwall, Ke= 0.900 Inlet / Outlet Invert= 400.21' / 398.70' S= 0.0100 '/' Cc= 0.900 n= 0.013 Corrugated PE, smooth interior, Flow Area= 1.77 sf

Primary OutFlow Max=20.06 cfs @ 12.49 hrs HW=403.19' (Free Discharge)
1=Dual HDPE_Round 18" (Inlet Controls 20.06 cfs @ 5.67 fps)

Pond O7: Outlet 7



Summary for Pond O8: Outlet 8

Inflow Area = 20.304 ac, 0.00% Impervious, Inflow Depth = 1.93" for 25 Yr event
Inflow = 37.01 cfs @ 12.28 hrs, Volume= 3.258 af
Outflow = 20.60 cfs @ 12.51 hrs, Volume= 3.258 af, Atten= 44%, Lag= 13.7 min
Primary = 20.60 cfs @ 12.51 hrs, Volume= 3.258 af

Routing by Stor-Ind method, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
Peak Elev= 403.29' @ 12.51 hrs Surf.Area= 25,759 sf Storage= 18,344 cf

Plug-Flow detention time= 5.0 min calculated for 3.258 af (100% of inflow)
Center-of-Mass det. time= 5.0 min (889.3 - 884.4)

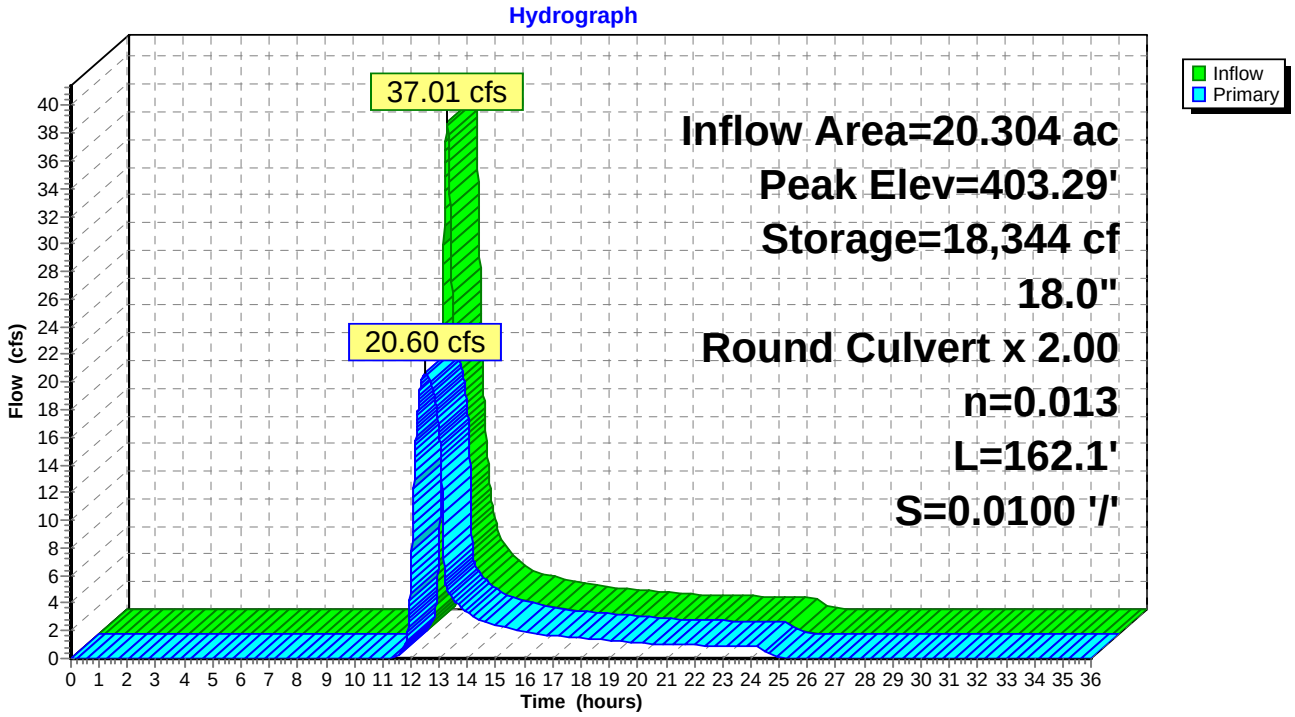
Volume	Invert	Avail.Storage	Storage Description
#1	400.29'	1,052,068 cf	**Custom Stage Data (Prismatic)** Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
400.29	0	0	0
401.00	576	204	204
402.00	2,837	1,707	1,911
403.00	17,431	10,134	12,045
404.00	45,983	31,707	43,752
405.00	90,635	68,309	112,061
406.00	149,897	120,266	232,327
407.00	222,736	186,317	418,643
408.00	314,187	268,462	687,105
409.00	415,739	364,963	1,052,068

Device	Routing	Invert	Outlet Devices
#1	Primary	400.19'	**18.0" Round Dual HDPE_Round 18" X 2.00** L= 162.1' CPP, projecting, no headwall, Ke= 0.900 Inlet / Outlet Invert= 400.19' / 398.57' S= 0.0100 '/' Cc= 0.900 n= 0.013 Corrugated PE, smooth interior, Flow Area= 1.77 sf

Primary OutFlow Max=20.60 cfs @ 12.51 hrs HW=403.29' (Free Discharge)
1=Dual HDPE_Round 18" (Inlet Controls 20.60 cfs @ 5.83 fps)

Pond O8: Outlet 8



Summary for Pond O9: Outlet 9

Inflow Area = 1.082 ac, 0.00% Impervious, Inflow Depth = 1.93" for 25 Yr event
Inflow = 3.26 cfs @ 12.02 hrs, Volume= 0.174 af
Outflow = 2.52 cfs @ 12.08 hrs, Volume= 0.174 af, Atten= 23%, Lag= 3.6 min
Primary = 2.52 cfs @ 12.08 hrs, Volume= 0.174 af

Routing by Stor-Ind method, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
Peak Elev= 404.25' @ 12.08 hrs Surf.Area= 1,230 sf Storage= 578 cf

Plug-Flow detention time= 2.3 min calculated for 0.174 af (100% of inflow)
Center-of-Mass det. time= 2.3 min (866.9 - 864.7)

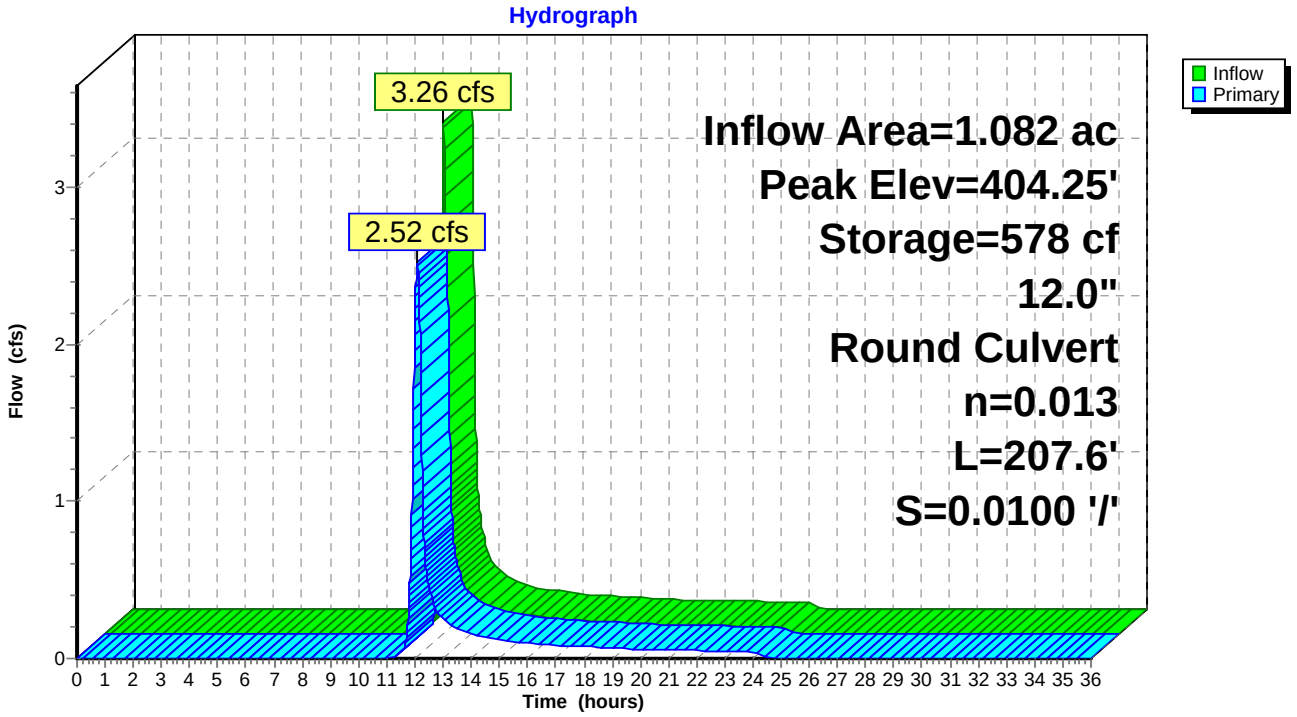
Volume	Invert	Avail.Storage	Storage Description
#1	403.04'	30,366 cf	**Custom Stage Data (Prismatic)** Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
403.04	0	0	0
404.00	696	334	334
405.00	2,805	1,751	2,085
406.00	6,367	4,586	6,671
407.00	11,442	8,905	15,575
408.00	18,140	14,791	30,366

Device	Routing	Invert	Outlet Devices
#1	Primary	403.04'	**12.0" Round Culvert** L= 207.6' CPP, projecting, no headwall, Ke= 0.900 Inlet / Outlet Invert= 403.04' / 400.96' S= 0.0100 '/' Cc= 0.900 n= 0.013 Corrugated PE, smooth interior, Flow Area= 0.79 sf

Primary OutFlow Max=2.52 cfs @ 12.08 hrs HW=404.25' (Free Discharge)
1=Culvert (Inlet Controls 2.52 cfs @ 3.21 fps)

Pond O9: Outlet 9



Summary for Pond WDP: West Ditch Pond

Inflow Area = 30.403 ac, 0.00% Impervious, Inflow Depth > 78.02" for 25 Yr event
Inflow = 100.79 cfs @ 12.01 hrs, Volume= 197.669 af
Outflow = 97.01 cfs @ 12.06 hrs, Volume= 197.157 af, Atten= 4%, Lag= 3.1 min
Primary = 33.36 cfs @ 12.06 hrs, Volume= 92.790 af
Secondary = 63.65 cfs @ 12.06 hrs, Volume= 104.367 af

Routing by Stor-Ind method, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs / 2
Peak Elev= 400.13' @ 12.06 hrs Surf.Area= 18,024 sf Storage= 28,883 cf

Plug-Flow detention time= 5.7 min calculated for 197.102 af (100% of inflow)
Center-of-Mass det. time= 2.9 min (1,081.5 - 1,078.6)

Volume	Invert	Avail.Storage	Storage Description
#1	396.50'	47,075 cf	**Custom Stage Data (Prismatic)**Listed below (Recalc)

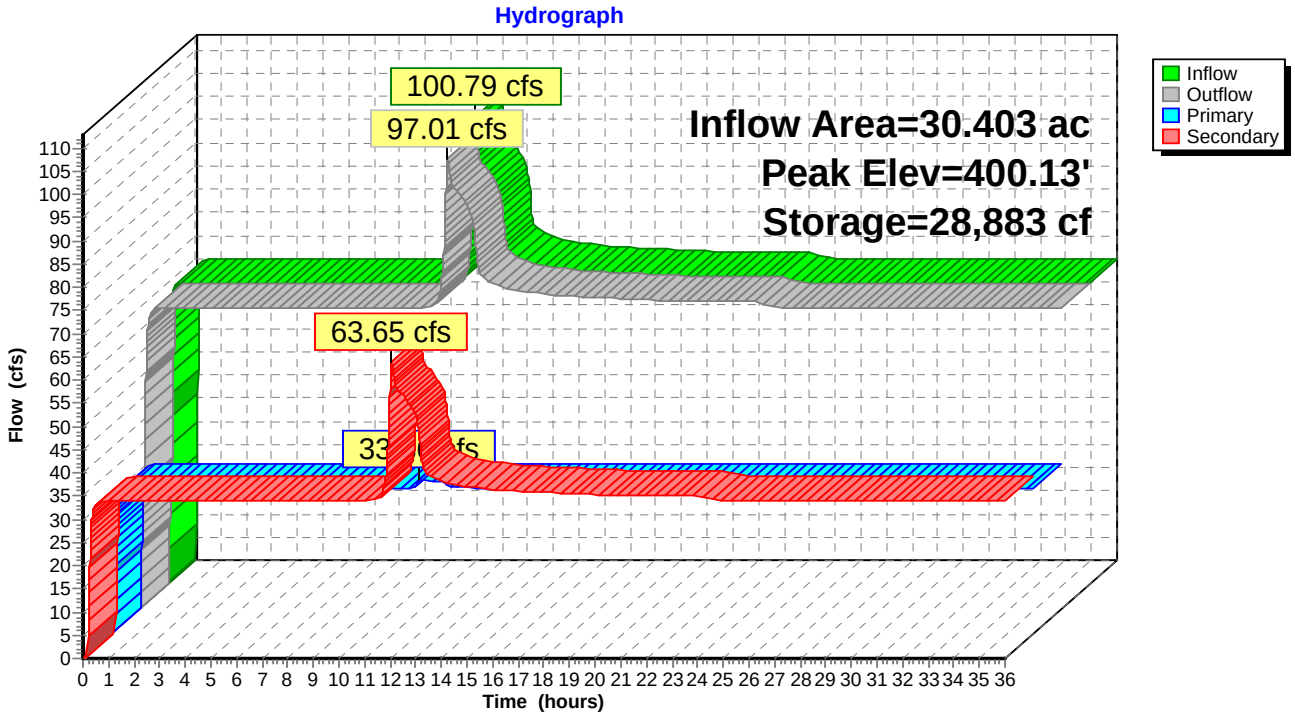
Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
396.50	0	0	0
397.00	1,892	473	473
398.00	5,746	3,819	4,292
399.00	10,818	8,282	12,574
400.00	17,108	13,963	26,537
401.00	23,968	20,538	47,075

Device	Routing	Invert	Outlet Devices
#1	Primary	396.52'	**12.0" Round Five 12" Culverts X 5.00** L= 43.1' Box, headwall w/3 square edges, Ke= 0.500 Inlet / Outlet Invert= 396.52' / 396.31' S= 0.0049 '/' Cc= 0.900 n= 0.011 Concrete pipe, straight & clean, Flow Area= 0.79 sf
#2	Secondary	399.00'	**20.0' long x 30.0' breadth Broad-Crested Rectangular Weir** Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 Coef. (English) 2.68 2.70 2.70 2.64 2.63 2.64 2.64 2.63

Primary OutFlow Max=33.36 cfs @ 12.06 hrs HW=400.13' (Free Discharge)
1=Five 12" Culverts (Inlet Controls 33.36 cfs @ 8.50 fps)

Secondary OutFlow Max=63.64 cfs @ 12.06 hrs HW=400.13' (Free Discharge)
2=Broad-Crested Rectangular Weir (Weir Controls 63.64 cfs @ 2.81 fps)

Pond WDP: West Ditch Pond



Time span=0.00-36.00 hrs, dt=0.01 hrs, 3601 points
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN
Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

Subcatchment S6A: Subcatchment 6A Runoff Area=107,669 sf 0.00% Impervious Runoff Depth=3.12"
Flow Length=266' Slope=0.0200 '/' Tc=17.7 min CN=61 Runoff=9.06 cfs 0.643 af

Subcatchment S6B1: Subcatchment 6B-1 Runoff Area=11,969 sf 0.00% Impervious Runoff Depth=3.12"
Flow Length=86' Slope=0.0202 '/' Tc=13.1 min CN=61 Runoff=1.18 cfs 0.071 af

Subcatchment S6B2: Subcatchment 6B-2 Runoff Area=87,104 sf 0.00% Impervious Runoff Depth=3.12"
Flow Length=287' Tc=18.1 min CN=61 Runoff=7.23 cfs 0.520 af

Subcatchment S6B3: Subcatchment 6B-3 Runoff Area=68,355 sf 0.00% Impervious Runoff Depth=3.12"
Flow Length=287' Slope=0.0198 '/' Tc=18.1 min CN=61 Runoff=5.68 cfs 0.408 af

Subcatchment S6B4: Subcatchment 6B-4 Runoff Area=48,635 sf 0.00% Impervious Runoff Depth=3.12"
Flow Length=247' Tc=17.4 min CN=61 Runoff=4.13 cfs 0.290 af

Subcatchment S6B5: Subcatchment 6B-5 Runoff Area=87,286 sf 0.00% Impervious Runoff Depth=3.12"
Flow Length=299' Slope=0.0200 '/' Tc=18.3 min CN=61 Runoff=7.20 cfs 0.521 af

Subcatchment S6B6: Subcatchment 6B-6 Runoff Area=57,704 sf 0.00% Impervious Runoff Depth=3.12"
Flow Length=298' Slope=0.0199 '/' Tc=18.2 min CN=61 Runoff=4.78 cfs 0.344 af

Subcatchment S6B7: Subcatchment 6B-7 Runoff Area=51,632 sf 0.00% Impervious Runoff Depth=3.12"
Flow Length=254' Tc=17.5 min CN=61 Runoff=4.37 cfs 0.308 af

Subcatchment S6C: Subcatchment 6C Runoff Area=88,097 sf 0.00% Impervious Runoff Depth=3.12"
Flow Length=256' Slope=0.0200 '/' Tc=17.5 min CN=61 Runoff=7.46 cfs 0.526 af

Subcatchment S7A: Subcatchment 7A Runoff Area=50,266 sf 0.00% Impervious Runoff Depth=3.12"
Flow Length=233' Slope=0.0190 '/' Tc=17.5 min CN=61 Runoff=4.26 cfs 0.300 af

Subcatchment S7B1: Subcatchment 7B-1 Runoff Area=43,024 sf 0.00% Impervious Runoff Depth=3.12"
Flow Length=275' Slope=0.0187 '/' Tc=18.3 min CN=61 Runoff=3.55 cfs 0.257 af

Subcatchment S7B10: Subcatchment 7B-10 Runoff Area=44,287 sf 0.00% Impervious Runoff Depth=3.12"
Flow Length=273' Slope=0.0191 '/' Tc=18.1 min CN=61 Runoff=3.68 cfs 0.264 af

Subcatchment S7B2: Subcatchment 7B-2 Runoff Area=63,449 sf 0.00% Impervious Runoff Depth=3.12"
Flow Length=286' Slope=0.0189 '/' Tc=18.4 min CN=61 Runoff=5.23 cfs 0.379 af

Subcatchment S7B3: Subcatchment 7B-3 Runoff Area=69,275 sf 0.00% Impervious Runoff Depth=3.12"
Flow Length=222' Tc=17.7 min CN=61 Runoff=5.83 cfs 0.414 af

Subcatchment S7B4: Subcatchment 7B-4 Runoff Area=42,441 sf 0.00% Impervious Runoff Depth=3.12"
Flow Length=270' Tc=18.1 min CN=61 Runoff=3.53 cfs 0.253 af

Subcatchment S7B5: Subcatchment 7B-5 Runoff Area=64,377 sf 0.00% Impervious Runoff Depth=3.12"
Flow Length=289' Slope=0.0190 '/' Tc=18.5 min CN=61 Runoff=5.28 cfs 0.384 af

Subcatchment S7B6: Subcatchment 7B-6 Runoff Area=73,533 sf 0.00% Impervious Runoff Depth=3.12"
Flow Length=219' Slope=0.0181 '/' Tc=17.6 min CN=61 Runoff=6.21 cfs 0.439 af

Subcatchment S7B7: Subcatchment 7B-7 Runoff Area=41,018 sf 0.00% Impervious Runoff Depth=3.12"
Flow Length=264' Slope=0.0190 '/' Tc=18.0 min CN=61 Runoff=3.42 cfs 0.245 af

Subcatchment S7B8: Subcatchment 7B-8 Runoff Area=67,702 sf 0.00% Impervious Runoff Depth=3.12"
Flow Length=300' Slope=0.0191 '/' Tc=18.5 min CN=61 Runoff=5.56 cfs 0.404 af

Subcatchment S7B9: Subcatchment 7B-9 Runoff Area=70,336 sf 0.00% Impervious Runoff Depth=3.12"
Flow Length=243' Slope=0.0181 '/' Tc=18.0 min CN=61 Runoff=5.86 cfs 0.420 af

Subcatchment S7C: Subcatchment 7C Runoff Area=59,435 sf 0.00% Impervious Runoff Depth=3.12"
Flow Length=234' Slope=0.0180 '/' Tc=17.9 min CN=61 Runoff=4.97 cfs 0.355 af

Subcatchment S7D: Subcatchment 7D Runoff Area=55,095 sf 0.00% Impervious Runoff Depth=3.12"
Flow Length=285' Slope=0.0187 '/' Tc=18.5 min CN=61 Runoff=4.52 cfs 0.329 af

Subcatchment S7E: Subcatchment 7B-2 Runoff Area=59,001 sf 0.00% Impervious Runoff Depth=3.12"
Flow Length=222' Tc=17.8 min CN=61 Runoff=4.94 cfs 0.352 af

Subcatchment S8A: Subcatchment 8A Runoff Area=60,732 sf 0.00% Impervious Runoff Depth=3.12"
Flow Length=242' Slope=0.0180 '/' Tc=18.0 min CN=61 Runoff=5.06 cfs 0.363 af

Subcatchment S8B1: Subcatchment 8B-1 Runoff Area=29,334 sf 0.00% Impervious Runoff Depth=3.12"
Flow Length=186' Tc=16.9 min CN=61 Runoff=2.53 cfs 0.175 af

Subcatchment S8B10: Subcatchment 8B-10 Runoff Area=41,538 sf 0.00% Impervious Runoff Depth=3.12"
Flow Length=238' Tc=17.7 min CN=61 Runoff=3.49 cfs 0.248 af

Subcatchment S8B11: Subcatchment 8B-11 Runoff Area=58,315 sf 0.00% Impervious Runoff Depth=3.12"
Flow Length=249' Slope=0.0180 '/' Tc=18.1 min CN=61 Runoff=4.84 cfs 0.348 af

Subcatchment S8B12: Subcatchment 8B-12 Runoff Area=63,277 sf 0.00% Impervious Runoff Depth=3.12"
Flow Length=256' Slope=0.0190 '/' Tc=17.9 min CN=61 Runoff=5.30 cfs 0.378 af

Subcatchment S8B13: Subcatchment 8B-13 Runoff Area=45,176 sf 0.00% Impervious Runoff Depth=3.12"
Flow Length=256' Slope=0.0180 '/' Tc=18.3 min CN=61 Runoff=3.73 cfs 0.270 af

Subcatchment S8B2: Subcatchment 8B-2 Runoff Area=50,121 sf 0.00% Impervious Runoff Depth=3.12"
Flow Length=239' Tc=18.1 min CN=61 Runoff=4.16 cfs 0.299 af

Subcatchment S8B3: Subcatchment 8B-3 Runoff Area=70,613 sf 0.00% Impervious Runoff Depth=3.12"
Flow Length=223' Slope=0.0189 '/' Tc=17.3 min CN=61 Runoff=6.01 cfs 0.422 af

Subcatchment S8B4: Subcatchment 8B-4 Runoff Area=41,972 sf 0.00% Impervious Runoff Depth=3.12"
Flow Length=247' Tc=18.1 min CN=61 Runoff=3.49 cfs 0.251 af

Subcatchment S8B5: Subcatchment 8B-5 Runoff Area=54,051 sf 0.00% Impervious Runoff Depth=3.12"
Flow Length=249' Slope=0.0180 '/' Tc=18.1 min CN=61 Runoff=4.49 cfs 0.323 af

Subcatchment S8B6: Subcatchment 8B-6 Runoff Area=71,026 sf 0.00% Impervious Runoff Depth=3.12"
Flow Length=223' Slope=0.0190 '/' Tc=17.3 min CN=61 Runoff=6.05 cfs 0.424 af

Subcatchment S8B7: Subcatchment 8B-7 Runoff Area=41,671 sf 0.00% Impervious Runoff Depth=3.12"
Flow Length=242' Slope=0.0178 '/' Tc=18.1 min CN=61 Runoff=3.46 cfs 0.249 af

Subcatchment S8B8: Subcatchment 8B-8 Runoff Area=56,491 sf 0.00% Impervious Runoff Depth=3.12"
Flow Length=252' Slope=0.0180 '/' Tc=18.2 min CN=61 Runoff=4.68 cfs 0.337 af

Subcatchment S8B9: Subcatchment 8B-9 Runoff Area=71,094 sf 0.00% Impervious Runoff Depth=3.12"
Flow Length=240' Slope=0.0190 '/' Tc=17.6 min CN=61 Runoff=6.00 cfs 0.424 af

Subcatchment S8C1: Subcatchment 8C-1 Runoff Area=27,926 sf 0.00% Impervious Runoff Depth=3.12"
Flow Length=281' Slope=0.0190 '/' Tc=18.3 min CN=61 Runoff=2.30 cfs 0.167 af

Subcatchment S8C2: Subcatchment 8C-2 Runoff Area=48,818 sf 0.00% Impervious Runoff Depth=3.12"
Flow Length=223' Tc=17.2 min CN=61 Runoff=4.18 cfs 0.291 af

Subcatchment S8C3: Subcatchment 8C-3 Runoff Area=52,295 sf 0.00% Impervious Runoff Depth=3.12"
Flow Length=231' Slope=0.0190 '/' Tc=17.5 min CN=61 Runoff=4.43 cfs 0.312 af

Subcatchment S9A: Subcatchment 9A Runoff Area=13,386 sf 0.00% Impervious Runoff Depth=3.12"
Flow Length=31' Slope=0.2000 '/' Tc=2.3 min CN=61 Runoff=1.98 cfs 0.080 af

Subcatchment S9B: Subcatchment 9B Runoff Area=33,728 sf 0.00% Impervious Runoff Depth=3.12"
Flow Length=46' Slope=0.2000 '/' Tc=3.2 min CN=61 Runoff=4.82 cfs 0.201 af

Subcatchment SC3: Subcatchment To Runoff Area=122,354 sf 0.00% Impervious Runoff Depth=3.12"
Tc=5.0 min CN=61 Runoff=16.33 cfs 0.730 af

Subcatchment SWD2: Subcatchment West Runoff Area=311,837 sf 0.00% Impervious Runoff Depth=3.12"
Tc=0.0 min CN=61 Runoff=49.52 cfs 1.861 af

Subcatchment SWD3: Subcatchment West Runoff Area=183,615 sf 0.00% Impervious Runoff Depth=3.12"
Tc=0.0 min CN=61 Runoff=29.16 cfs 1.096 af

Subcatchment SWD4: Subcatchment West Runoff Area=270,446 sf 0.00% Impervious Runoff Depth=3.12"
Tc=0.0 min CN=61 Runoff=42.94 cfs 1.614 af

Reach 6RR: Outlet 6 Riprap Avg. Flow Depth=0.61' Max Vel=5.35 fps Inflow=22.13 cfs 3.632 af
n=0.070 L=100.9' S=0.1746 '/' Capacity=125.03 cfs Outflow=22.13 cfs 3.632 af

Reach 7RR: Outlet 7 Riprap Avg. Flow Depth=0.43' Max Vel=6.28 fps Inflow=23.42 cfs 4.795 af
n=0.070 L=65.0' S=0.3338 '/' Capacity=229.48 cfs Outflow=23.42 cfs 4.795 af

Reach 8RR: Outlet 8 Riprap Avg. Flow Depth=0.74' Max Vel=6.26 fps Inflow=23.99 cfs 5.280 af
n=0.070 L=7.5' S=0.2187 '/' Capacity=104.18 cfs Outflow=23.99 cfs 5.280 af

Reach 9RR: Outlet 9 Riprap Avg. Flow Depth=0.39' Max Vel=2.04 fps Inflow=3.33 cfs 0.281 af
n=0.070 L=4.5' S=0.0467 '/' Capacity=48.13 cfs Outflow=3.32 cfs 0.281 af

Reach C6A: Channel 6A Avg. Flow Depth=0.38' Max Vel=2.07 fps Inflow=9.06 cfs 0.643 af
n=0.027 L=582.3' S=0.0129 '/' Capacity=319.25 cfs Outflow=8.31 cfs 0.643 af

Reach C6B1: Channel 6B-1 Avg. Flow Depth=1.16' Max Vel=3.53 fps Inflow=30.73 cfs 2.463 af
n=0.045 L=88.7' S=0.0162 '/' Capacity=51.67 cfs Outflow=30.70 cfs 2.463 af

Reach C6B2: Channel 6B-2 Avg. Flow Depth=0.35' Max Vel=2.09 fps Inflow=7.23 cfs 0.520 af
n=0.027 L=519.3' S=0.0149 '/' Capacity=112.00 cfs Outflow=6.76 cfs 0.520 af

Reach C6B3: Channel 6B-3 Avg. Flow Depth=0.32' Max Vel=1.98 fps Inflow=5.68 cfs 0.408 af
n=0.027 L=420.3' S=0.0149 '/' Capacity=111.98 cfs Outflow=5.39 cfs 0.408 af

Reach C6B4: Channel 6B-4 Avg. Flow Depth=0.89' Max Vel=3.05 fps Inflow=18.17 cfs 1.464 af
n=0.045 L=198.6' S=0.0162 '/' Capacity=51.64 cfs Outflow=18.10 cfs 1.464 af

Reach C6B5: Channel 6B-5 Avg. Flow Depth=0.35' Max Vel=2.09 fps Inflow=7.20 cfs 0.521 af
n=0.027 L=550.0' S=0.0150 '/' Capacity=112.15 cfs Outflow=6.69 cfs 0.521 af

Reach C6B6: Channel 6B-6 Avg. Flow Depth=0.30' Max Vel=1.95 fps Inflow=4.78 cfs 0.344 af
n=0.027 L=433.2' S=0.0161 '/' Capacity=116.37 cfs Outflow=4.51 cfs 0.344 af

Reach C6B7: Channel 6B-7 Avg. Flow Depth=0.41' Max Vel=2.00 fps Inflow=4.37 cfs 0.308 af
n=0.045 L=181.9' S=0.0163 '/' Capacity=51.73 cfs Outflow=4.33 cfs 0.308 af

Reach C6C: Channel 6C Avg. Flow Depth=0.35' Max Vel=2.10 fps Inflow=7.46 cfs 0.526 af
n=0.027 L=551.1' S=0.0152 '/' Capacity=346.19 cfs Outflow=6.89 cfs 0.526 af

Reach C7A: Channel 7A Avg. Flow Depth=0.28' Max Vel=1.81 fps Inflow=4.26 cfs 0.300 af
n=0.027 L=531.3' S=0.0150 '/' Capacity=343.41 cfs Outflow=3.87 cfs 0.300 af

Reach C7B1: Channel 7B-1 Avg. Flow Depth=1.44' Max Vel=3.47 fps Inflow=41.63 cfs 3.459 af
n=0.045 L=151.5' S=0.0124 '/' Capacity=45.18 cfs Outflow=41.55 cfs 3.459 af

Reach C7B10: Channel 7B-10 Avg. Flow Depth=0.41' Max Vel=1.73 fps Inflow=3.68 cfs 0.264 af
n=0.045 L=141.7' S=0.0124 '/' Capacity=45.20 cfs Outflow=3.65 cfs 0.264 af

Reach C7B2: Channel 7B-2 Avg. Flow Depth=0.30' Max Vel=1.99 fps Inflow=5.23 cfs 0.379 af
n=0.027 L=533.9' S=0.0162 '/' Capacity=116.76 cfs Outflow=4.83 cfs 0.379 af

Reach C7B3: Channel 7B-3 Avg. Flow Depth=0.32' Max Vel=1.98 fps Inflow=5.83 cfs 0.414 af
n=0.027 L=541.5' S=0.0149 '/' Capacity=112.06 cfs Outflow=5.36 cfs 0.414 af

Reach C7B4: Channel 7B-4 Avg. Flow Depth=1.21' Max Vel=3.15 fps Inflow=29.13 cfs 2.410 af
n=0.045 L=157.6' S=0.0124 '/' Capacity=45.11 cfs Outflow=29.05 cfs 2.410 af

Reach C7B5: Channel 7B-5 Avg. Flow Depth=0.30' Max Vel=1.97 fps Inflow=5.28 cfs 0.384 af
n=0.027 L=536.5' S=0.0162 '/' Capacity=121.12 cfs Outflow=4.88 cfs 0.384 af

Reach C7B6: Channel 7B-6 Avg. Flow Depth=0.33' Max Vel=2.01 fps Inflow=6.21 cfs 0.439 af
n=0.027 L=563.2' S=0.0150 '/' Capacity=112.16 cfs Outflow=5.69 cfs 0.439 af

Reach C7B7: Channel 7B-7 Avg. Flow Depth=0.90' Max Vel=2.68 fps Inflow=16.12 cfs 1.333 af
n=0.045 L=157.6' S=0.0124 '/' Capacity=45.23 cfs Outflow=16.07 cfs 1.333 af

Reach C7B8: Channel 7B-8 Avg. Flow Depth=0.31' Max Vel=2.02 fps Inflow=5.56 cfs 0.404 af
n=0.027 L=539.2' S=0.0162 '/' Capacity=116.66 cfs Outflow=5.15 cfs 0.404 af

Reach C7B9: Channel 7B-9 Avg. Flow Depth=0.32' Max Vel=1.98 fps Inflow=5.86 cfs 0.420 af
n=0.027 L=586.4' S=0.0150 '/' Capacity=112.37 cfs Outflow=5.34 cfs 0.420 af

Reach C7C: Channel 7C Avg. Flow Depth=0.30' Max Vel=1.79 fps Inflow=4.97 cfs 0.355 af
n=0.027 L=524.7' S=0.0131 '/' Capacity=321.24 cfs Outflow=4.53 cfs 0.355 af

Reach C7D: Channel 7D Avg. Flow Depth=0.29' Max Vel=1.93 fps Inflow=4.52 cfs 0.329 af
n=0.027 L=374.2' S=0.0162 '/' Capacity=116.57 cfs Outflow=4.33 cfs 0.329 af

Reach C7E: Channel 7E Avg. Flow Depth=0.30' Max Vel=1.92 fps Inflow=4.94 cfs 0.352 af
n=0.027 L=397.5' S=0.0150 '/' Capacity=112.17 cfs Outflow=4.70 cfs 0.352 af

Reach C8A: Channel 8A Avg. Flow Depth=0.29' Max Vel=2.03 fps Inflow=5.06 cfs 0.363 af
n=0.027 L=457.9' S=0.0177 '/' Capacity=373.85 cfs Outflow=4.77 cfs 0.363 af

Reach C8B1: Channel 8B-1 Avg. Flow Depth=1.60' Max Vel=3.58 fps Inflow=50.47 cfs 4.147 af
n=0.045 L=123.7' S=0.0119 '/' Capacity=44.21 cfs Outflow=50.41 cfs 4.147 af

Reach C8B10: Channel 8B-10 Avg. Flow Depth=0.89' Max Vel=2.60 fps Inflow=15.39 cfs 1.243 af
n=0.045 L=157.6' S=0.0119 '/' Capacity=44.18 cfs Outflow=15.34 cfs 1.243 af

Reach C8B11: Channel 8B-11 Avg. Flow Depth=0.30' Max Vel=1.90 fps Inflow=4.84 cfs 0.348 af
n=0.027 L=468.4' S=0.0151 '/' Capacity=112.56 cfs Outflow=4.53 cfs 0.348 af

Reach C8B12: Channel 8B-12 Avg. Flow Depth=0.30' Max Vel=2.05 fps Inflow=5.30 cfs 0.378 af
n=0.027 L=560.3' S=0.0175 '/' Capacity=121.31 cfs Outflow=4.87 cfs 0.378 af

Reach C8B13: Channel 8B-13 Avg. Flow Depth=0.41' Max Vel=1.71 fps Inflow=3.73 cfs 0.270 af
n=0.045 L=141.7' S=0.0119 '/' Capacity=44.29 cfs Outflow=3.70 cfs 0.270 af

Reach C8B2: Channel 8B-2 Avg. Flow Depth=0.28' Max Vel=1.83 fps Inflow=4.16 cfs 0.299 af
n=0.027 L=405.7' S=0.0149 '/' Capacity=111.86 cfs Outflow=3.93 cfs 0.299 af

Reach C8B3: Channel 8B-3 Avg. Flow Depth=0.32' Max Vel=2.05 fps Inflow=6.01 cfs 0.422 af
n=0.027 L=574.7' S=0.0161 '/' Capacity=116.44 cfs Outflow=5.51 cfs 0.422 af

Reach C8B4: Channel 8B-4 Avg. Flow Depth=1.42' Max Vel=3.37 fps Inflow=39.79 cfs 3.251 af
n=0.045 L=157.6' S=0.0119 '/' Capacity=44.18 cfs Outflow=39.70 cfs 3.251 af

Reach C8B5: Channel 8B-5 Avg. Flow Depth=0.29' Max Vel=1.86 fps Inflow=4.49 cfs 0.323 af
n=0.027 L=445.5' S=0.0149 '/' Capacity=112.01 cfs Outflow=4.21 cfs 0.323 af

Reach C8B6: Channel 8B-6 Avg. Flow Depth=0.32' Max Vel=2.06 fps Inflow=6.05 cfs 0.424 af
n=0.027 L=577.3' S=0.0162 '/' Capacity=116.68 cfs Outflow=5.54 cfs 0.424 af

Reach C8B7: Channel 8B-7 Avg. Flow Depth=1.19' Max Vel=3.06 fps Inflow=27.73 cfs 2.254 af
n=0.045 L=157.6' S=0.0119 '/' Capacity=44.29 cfs Outflow=27.65 cfs 2.254 af

Reach C8B8: Channel 8B-8 Avg. Flow Depth=0.30' Max Vel=1.88 fps Inflow=4.68 cfs 0.337 af
n=0.027 L=469.2' S=0.0150 '/' Capacity=112.14 cfs Outflow=4.37 cfs 0.337 af

Reach C8B9: Channel 8B-9 Avg. Flow Depth=0.32' Max Vel=2.05 fps Inflow=6.00 cfs 0.424 af
n=0.027 L=580.0' S=0.0162 '/' Capacity=116.59 cfs Outflow=5.49 cfs 0.424 af

Reach C8C1: Channel 8C-1 Avg. Flow Depth=0.39' Max Vel=2.30 fps Inflow=9.86 cfs 0.770 af
n=0.027 L=99.4' S=0.0153 '/' Capacity=347.16 cfs Outflow=9.84 cfs 0.770 af

Reach C8C2: Channel 8C-2 Avg. Flow Depth=0.28' Max Vel=1.88 fps Inflow=4.18 cfs 0.291 af
n=0.027 L=324.6' S=0.0158 '/' Capacity=115.25 cfs Outflow=4.01 cfs 0.291 af

Reach C8C3: Channel 8C-3 Avg. Flow Depth=0.29' Max Vel=1.77 fps Inflow=4.43 cfs 0.312 af
n=0.027 L=481.7' S=0.0136 '/' Capacity=327.12 cfs Outflow=4.07 cfs 0.312 af

Reach C9A: Channel 9A Avg. Flow Depth=0.37' Max Vel=2.80 fps Inflow=1.98 cfs 0.080 af
n=0.027 L=240.5' S=0.0254 '/' Capacity=237.07 cfs Outflow=1.88 cfs 0.080 af

Reach C9B: Channel 9B Avg. Flow Depth=0.59' Max Vel=2.41 fps Inflow=4.82 cfs 0.201 af
n=0.027 L=497.6' S=0.0100 '/' Capacity=148.80 cfs Outflow=4.20 cfs 0.201 af

Reach WD1: West Ditch 1 Avg. Flow Depth=1.56' Max Vel=3.01 fps Inflow=163.01 cfs 209.527 af
n=0.027 L=500.0' S=0.0020 '/' Capacity=37,261.12 cfs Outflow=162.42 cfs 208.937 af

Reach WD2: West Ditch 2 Avg. Flow Depth=1.50' Max Vel=2.74 fps Inflow=153.33 cfs 207.318 af
n=0.027 L=1,126.8' S=0.0017 '/' Capacity=28,641.03 cfs Outflow=141.81 cfs 205.895 af

Reach WD3A: West Ditch 3A Avg. Flow Depth=0.68' Max Vel=5.70 fps Inflow=122.89 cfs 201.090 af
n=0.027 L=721.4' S=0.0190 '/' Capacity=19,260.28 cfs Outflow=121.87 cfs 200.661 af

Reach WD3B: West Ditch 3B Avg. Flow Depth=0.68' Max Vel=5.55 fps Inflow=119.38 cfs 200.066 af
n=0.045 L=118.5' S=0.0500 '/' Capacity=18,722.69 cfs Outflow=119.26 cfs 199.994 af

Reach WD3C: West Ditch 3C Avg. Flow Depth=1.00' Max Vel=3.72 fps Inflow=119.54 cfs 200.199 af
n=0.027 L=147.1' S=0.0050 '/' Capacity=9,902.04 cfs Outflow=119.38 cfs 200.066 af

Reach WD4: West Ditch 4 Avg. Flow Depth=1.84' Max Vel=4.61 fps Inflow=121.57 cfs 196.068 af
n=0.027 L=867.7' S=0.0051 '/' Capacity=923.29 cfs Outflow=114.34 cfs 195.431 af

Pond C3P: ELG Detention Basin Outlet C-3 Peak Elev=404.09' Inflow=81.33 cfs 194.173 af
36.0" Round Culvert x 3.00 n=0.013 L=90.0' S=0.0028 '/' Outflow=81.33 cfs 194.173 af

Pond O6: Outlet 6 Peak Elev=402.94' Storage=25,494 cf Inflow=45.89 cfs 3.632 af
18.0" Round Culvert x 2.00 n=0.013 L=162.7' S=0.0104 '/' Outflow=22.13 cfs 3.632 af

Pond O7: Outlet 7 Peak Elev=404.00' Storage=42,232 cf Inflow=58.48 cfs 4.795 af
18.0" Round Culvert x 2.00 n=0.013 L=150.3' S=0.0100 '/' Outflow=23.42 cfs 4.795 af

Pond O8: Outlet 8 Peak Elev=404.13' Storage=49,996 cf Inflow=64.44 cfs 5.280 af
18.0" Round Culvert x 2.00 n=0.013 L=162.1' S=0.0100 '/' Outflow=23.99 cfs 5.280 af

Pond O9: Outlet 9 Peak Elev=404.78' Storage=1,521 cf Inflow=5.57 cfs 0.281 af
12.0" Round Culvert n=0.013 L=207.6' S=0.0100 '/' Outflow=3.33 cfs 0.281 af

Pond WDP: West Ditch Pond Peak Elev=400.37' Storage=33,389 cf Inflow=126.03 cfs 200.711 af
Primary=34.62 cfs 93.006 af Secondary=84.92 cfs 107.192 af Outflow=119.54 cfs 200.199 af

Total Runoff Area = 74.185 ac Runoff Volume = 19.290 af Average Runoff Depth = 3.12"
100.00% Pervious = 74.185 ac 0.00% Impervious = 0.000 ac

Summary for Subcatchment S6A: Subcatchment 6A

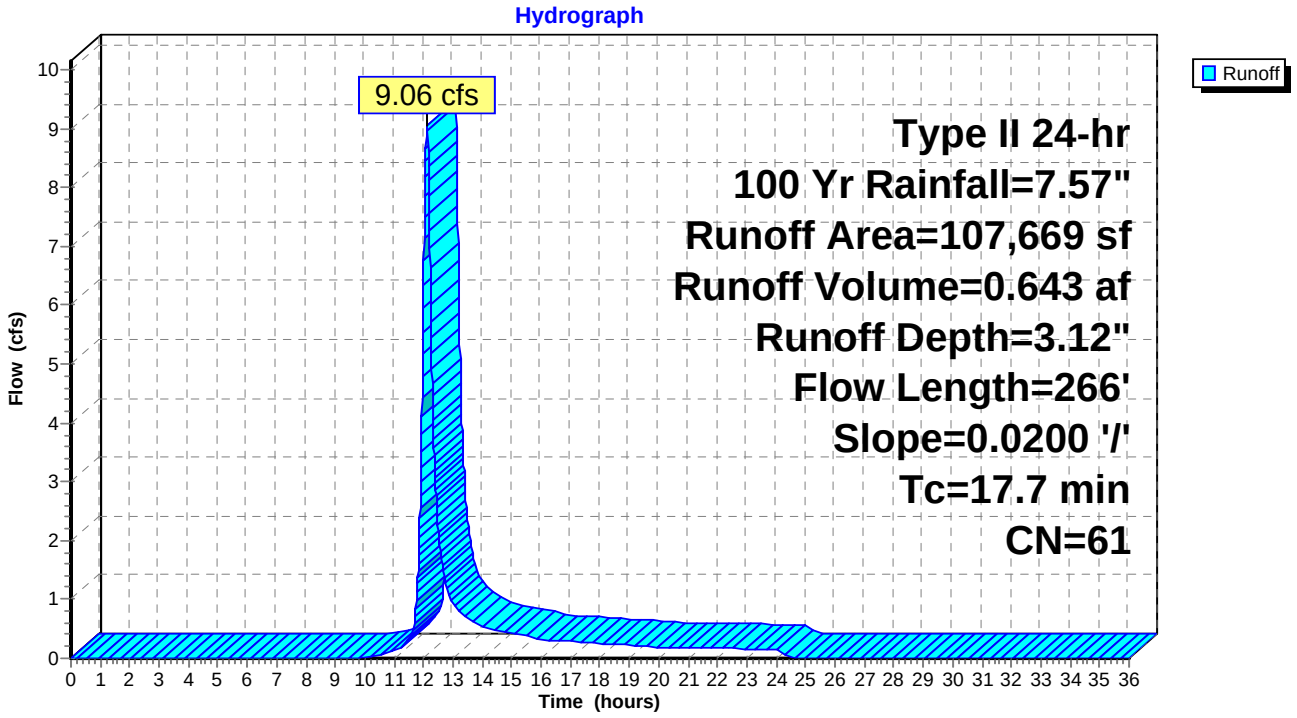
Runoff = 9.06 cfs @ 12.10 hrs, Volume= 0.643 af, Depth= 3.12"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
Type II 24-hr 100 Yr Rainfall=7.57"

Area (sf)	CN	Description
107,669	61	>75% Grass cover, Good, HSG B
107,669		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
14.9	100	0.0200	0.11		**Sheet Flow, Sheet Flow** Grass: Short n= 0.150 P2= 1.39"
2.8	166	0.0200	0.99		**Shallow Concentrated Flow, Shallow Conc.** Short Grass Pasture Kv= 7.0 fps
17.7	266	Total			

Subcatchment S6A: Subcatchment 6A



Summary for Subcatchment S6B1: Subcatchment 6B-1

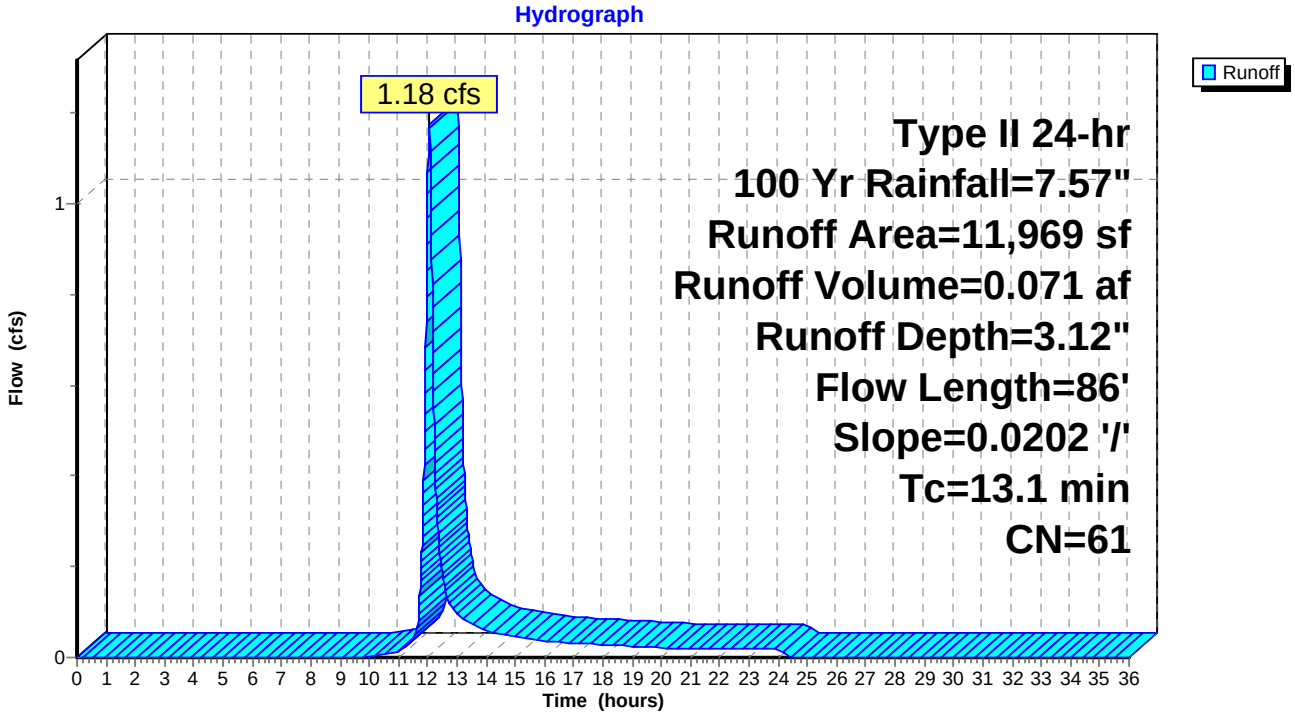
Runoff = 1.18 cfs @ 12.06 hrs, Volume= 0.071 af, Depth= 3.12"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
Type II 24-hr 100 Yr Rainfall=7.57"

Area (sf)	CN	Description
11,969	61	>75% Grass cover, Good, HSG B
11,969		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
13.1	86	0.0202	0.11		**Sheet Flow, Sheet Flow** Grass: Short n= 0.150 P2= 1.39"

Subcatchment S6B1: Subcatchment 6B-1



Summary for Subcatchment S6B2: Subcatchment 6B-2

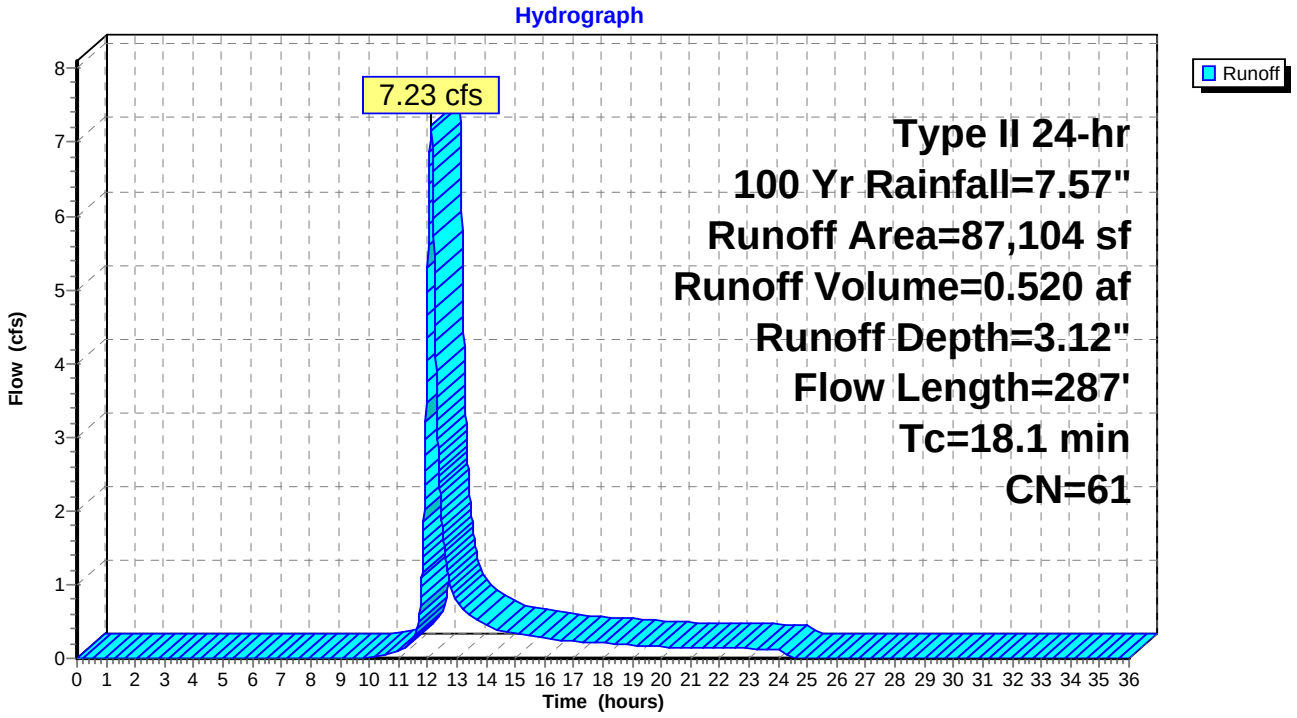
Runoff = 7.23 cfs @ 12.11 hrs, Volume= 0.520 af, Depth= 3.12"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
Type II 24-hr 100 Yr Rainfall=7.57"

Area (sf)	CN	Description
87,104	61	>75% Grass cover, Good, HSG B
87,104		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
14.9	100	0.0200	0.11		**Sheet Flow, Sheet Flow** Grass: Short n= 0.150 P2= 1.39"
3.2	187	0.0198	0.98		**Shallow Concentrated Flow, Shallow Conc.** Short Grass Pasture Kv= 7.0 fps
18.1	287	Total			

Subcatchment S6B2: Subcatchment 6B-2



Summary for Subcatchment S6B3: Subcatchment 6B-3

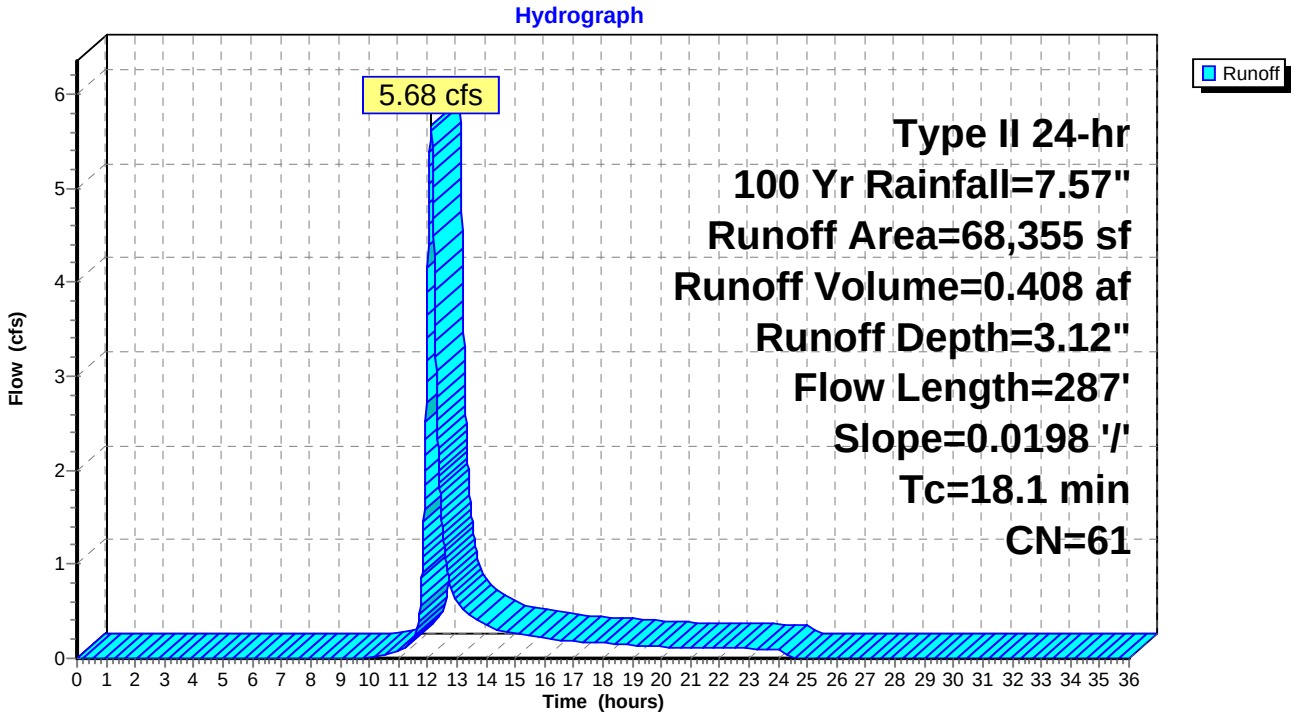
Runoff = 5.68 cfs @ 12.11 hrs, Volume= 0.408 af, Depth= 3.12"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
Type II 24-hr 100 Yr Rainfall=7.57"

Area (sf)	CN	Description
68,355	61	>75% Grass cover, Good, HSG B
68,355		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
14.9	100	0.0198	0.11		**Sheet Flow, Sheet Flow** Grass: Short n= 0.150 P2= 1.39"
3.2	187	0.0198	0.98		**Shallow Concentrated Flow, Shallow Conc.** Short Grass Pasture Kv= 7.0 fps
18.1	287	Total			

Subcatchment S6B3: Subcatchment 6B-3



Summary for Subcatchment S6B4: Subcatchment 6B-4

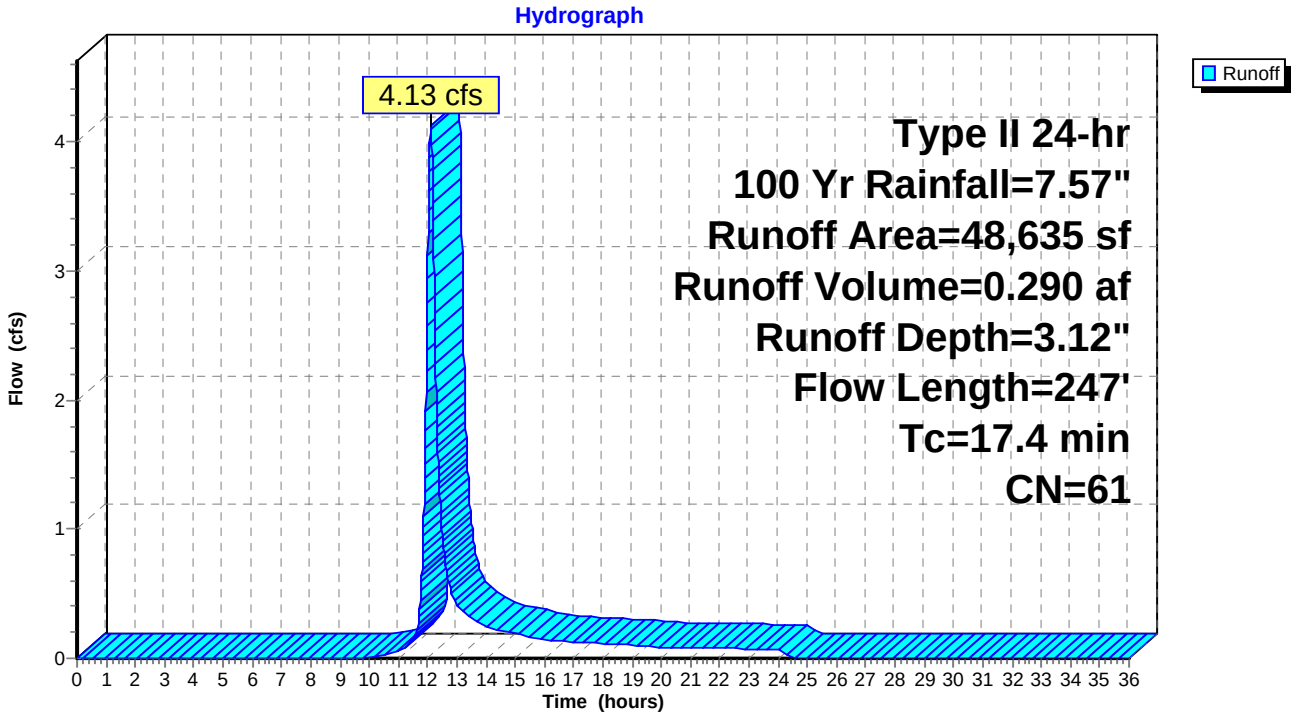
Runoff = 4.13 cfs @ 12.10 hrs, Volume= 0.290 af, Depth= 3.12"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
Type II 24-hr 100 Yr Rainfall=7.57"

Area (sf)	CN	Description
48,635	61	>75% Grass cover, Good, HSG B
48,635		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
14.9	100	0.0198	0.11		**Sheet Flow, Sheet Flow** Grass: Short n= 0.150 P2= 1.39"
2.5	147	0.0197	0.98		**Shallow Concentrated Flow, Shallow Conc.** Short Grass Pasture Kv= 7.0 fps
17.4	247	Total			

Subcatchment S6B4: Subcatchment 6B-4



Summary for Subcatchment S6B5: Subcatchment 6B-5

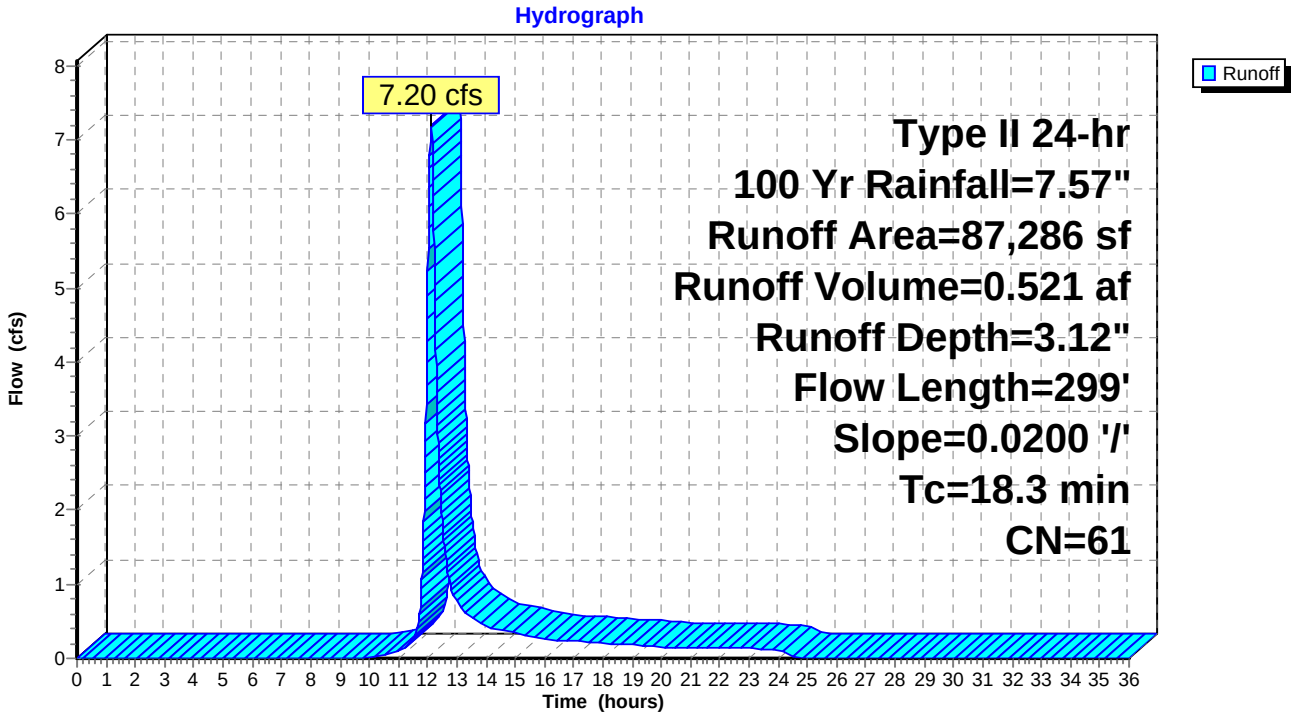
Runoff = 7.20 cfs @ 12.11 hrs, Volume= 0.521 af, Depth= 3.12"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
Type II 24-hr 100 Yr Rainfall=7.57"

Area (sf)	CN	Description
87,286	61	>75% Grass cover, Good, HSG B
87,286		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
14.9	100	0.0200	0.11		**Sheet Flow, Sheet Flow** Grass: Short n= 0.150 P2= 1.39"
3.4	199	0.0200	0.99		**Shallow Concentrated Flow, Shallow Conc.** Short Grass Pasture Kv= 7.0 fps
18.3	299	Total			

Subcatchment S6B5: Subcatchment 6B-5



Summary for Subcatchment S6B6: Subcatchment 6B-6

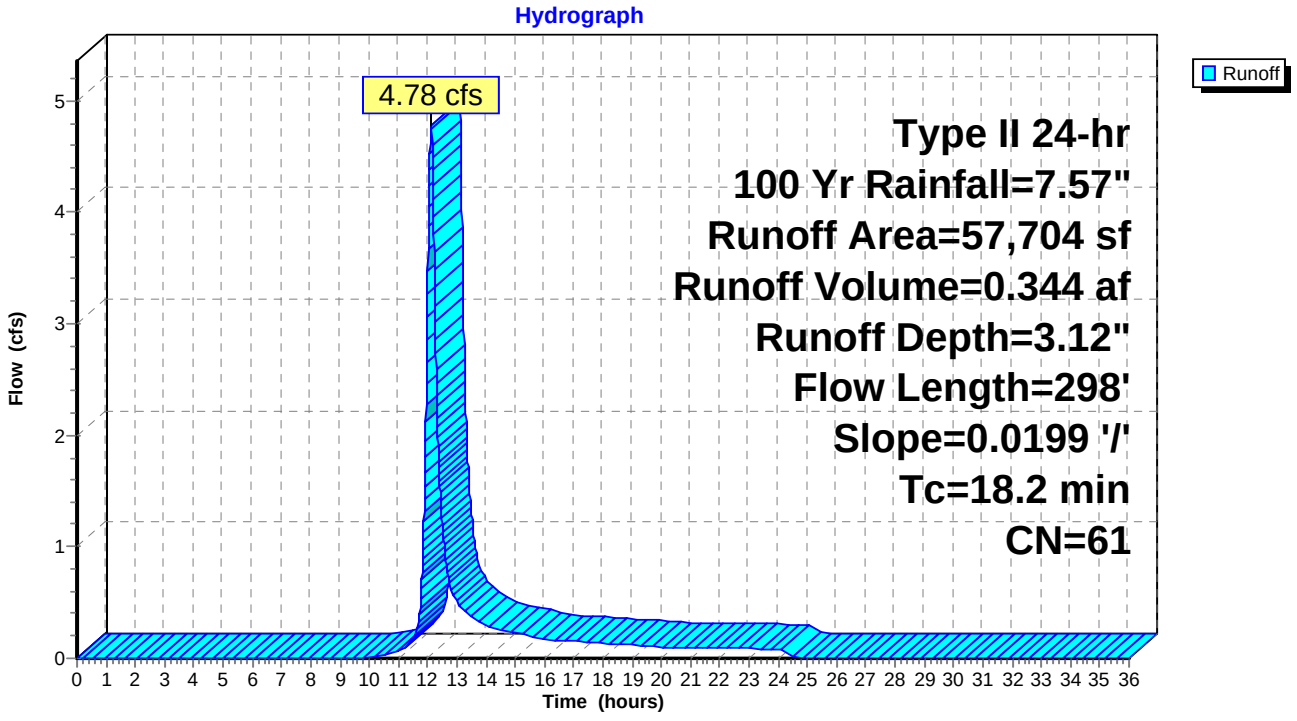
Runoff = 4.78 cfs @ 12.11 hrs, Volume= 0.344 af, Depth= 3.12"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
Type II 24-hr 100 Yr Rainfall=7.57"

Area (sf)	CN	Description
57,704	61	>75% Grass cover, Good, HSG B
57,704		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
14.9	100	0.0199	0.11		**Sheet Flow, Sheet Flow** Grass: Short n= 0.150 P2= 1.39"
3.3	198	0.0199	0.99		**Shallow Concentrated Flow, Shallow Conc.** Short Grass Pasture Kv= 7.0 fps
18.2	298	Total			

Subcatchment S6B6: Subcatchment 6B-6



Summary for Subcatchment S6B7: Subcatchment 6B-7

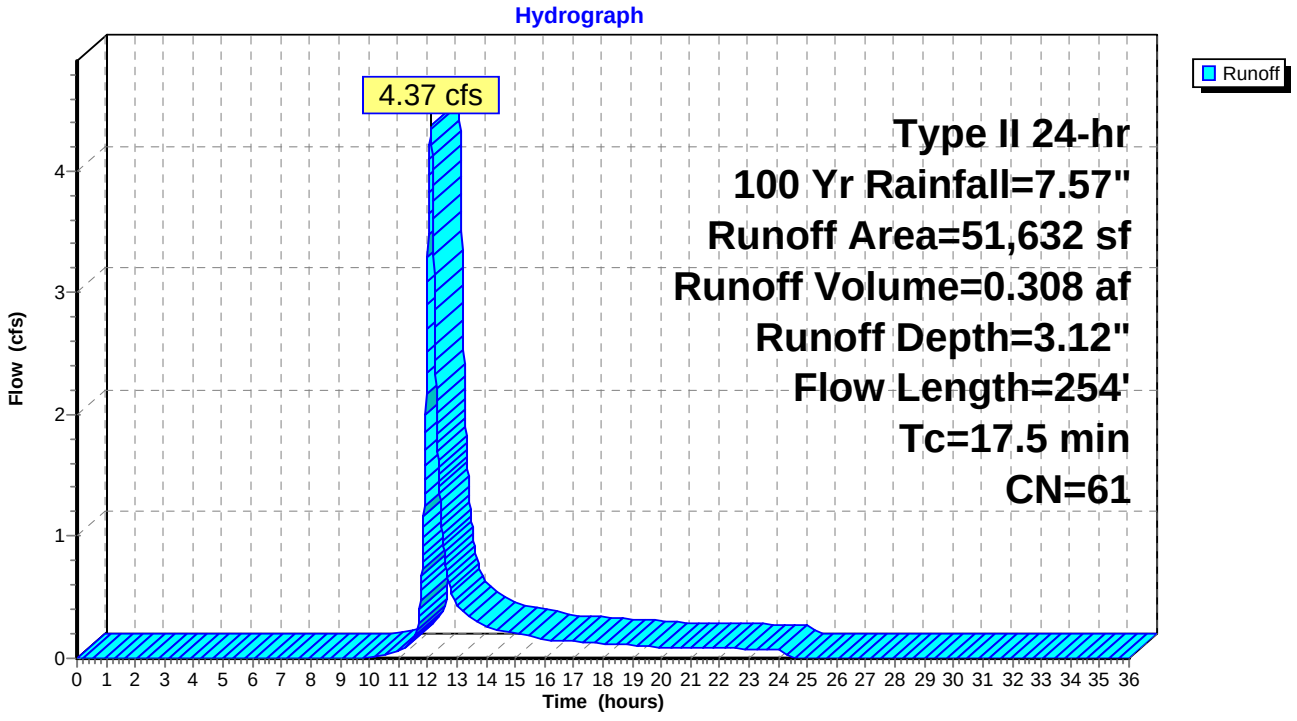
Runoff = 4.37 cfs @ 12.11 hrs, Volume= 0.308 af, Depth= 3.12"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
Type II 24-hr 100 Yr Rainfall=7.57"

Area (sf)	CN	Description
51,632	61	>75% Grass cover, Good, HSG B
51,632		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
14.9	100	0.0200	0.11		**Sheet Flow, Sheet Flow** Grass: Short n= 0.150 P2= 1.39"
2.6	154	0.0198	0.98		**Shallow Concentrated Flow, Shallow Conc.** Short Grass Pasture Kv= 7.0 fps
17.5	254	Total			

Subcatchment S6B7: Subcatchment 6B-7



Summary for Subcatchment S6C: Subcatchment 6C

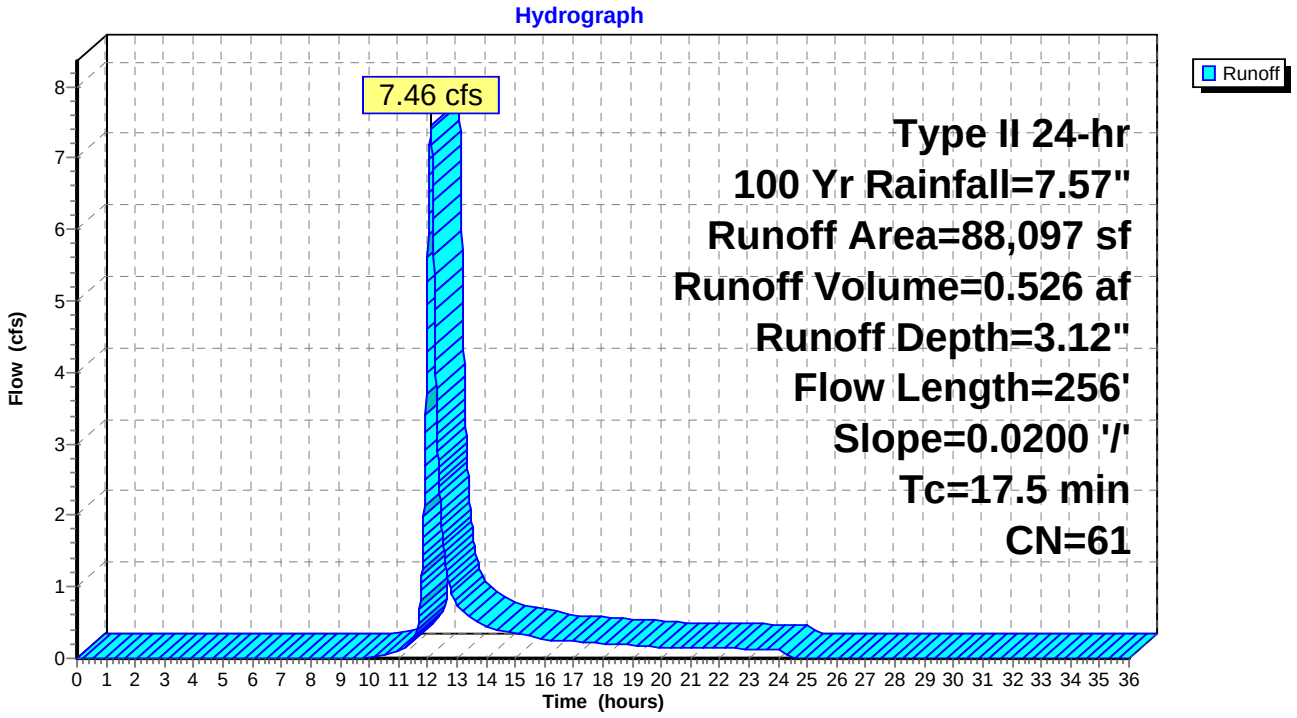
Runoff = 7.46 cfs @ 12.11 hrs, Volume= 0.526 af, Depth= 3.12"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
Type II 24-hr 100 Yr Rainfall=7.57"

Area (sf)	CN	Description
88,097	61	>75% Grass cover, Good, HSG B
88,097		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
14.9	100	0.0200	0.11		**Sheet Flow, Sheet Flow** Grass: Short n= 0.150 P2= 1.39"
2.6	156	0.0200	0.99		**Shallow Concentrated Flow, Shallow Conc.** Short Grass Pasture Kv= 7.0 fps
17.5	256	Total			

Subcatchment S6C: Subcatchment 6C



Summary for Subcatchment S7A: Subcatchment 7A

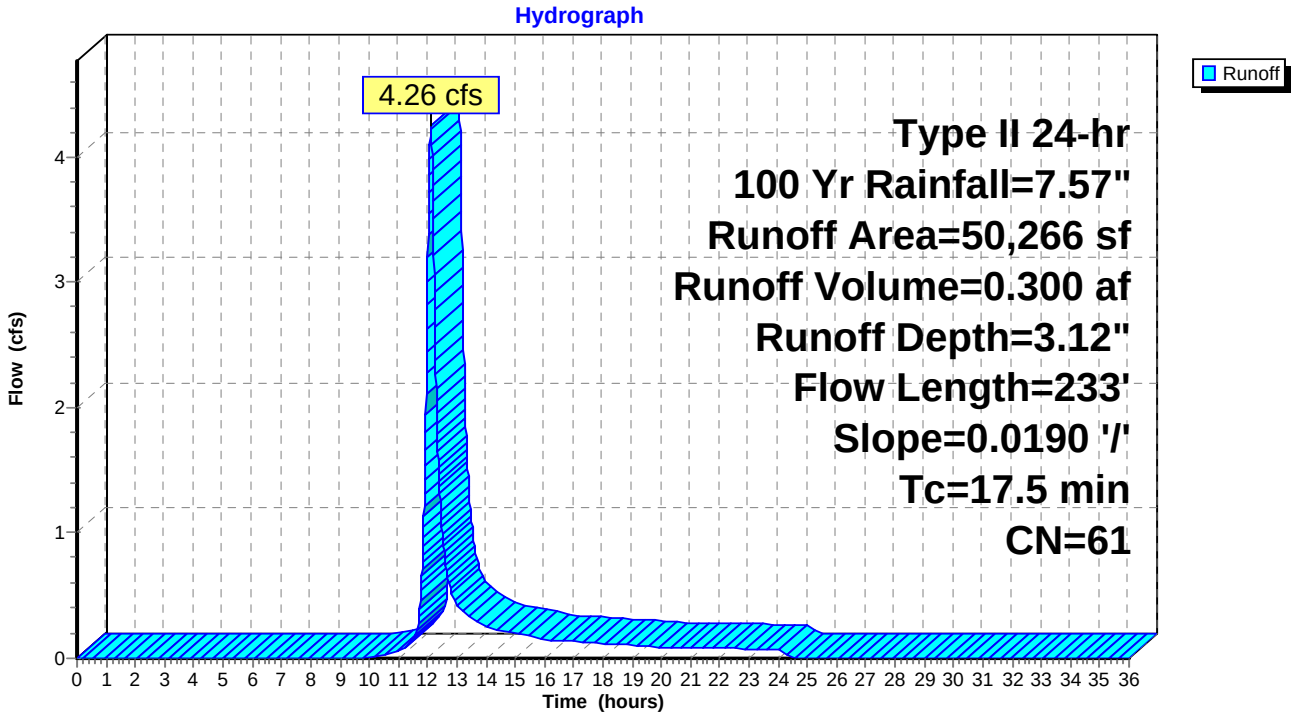
Runoff = 4.26 cfs @ 12.11 hrs, Volume= 0.300 af, Depth= 3.12"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
Type II 24-hr 100 Yr Rainfall=7.57"

Area (sf)	CN	Description
50,266	61	>75% Grass cover, Good, HSG B
50,266		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
15.2	100	0.0190	0.11		**Sheet Flow, Sheet Flow** Grass: Short n= 0.150 P2= 1.39"
2.3	133	0.0190	0.96		**Shallow Concentrated Flow, Shallow Conc.** Short Grass Pasture Kv= 7.0 fps
17.5	233	Total			

Subcatchment S7A: Subcatchment 7A



Summary for Subcatchment S7B1: Subcatchment 7B-1

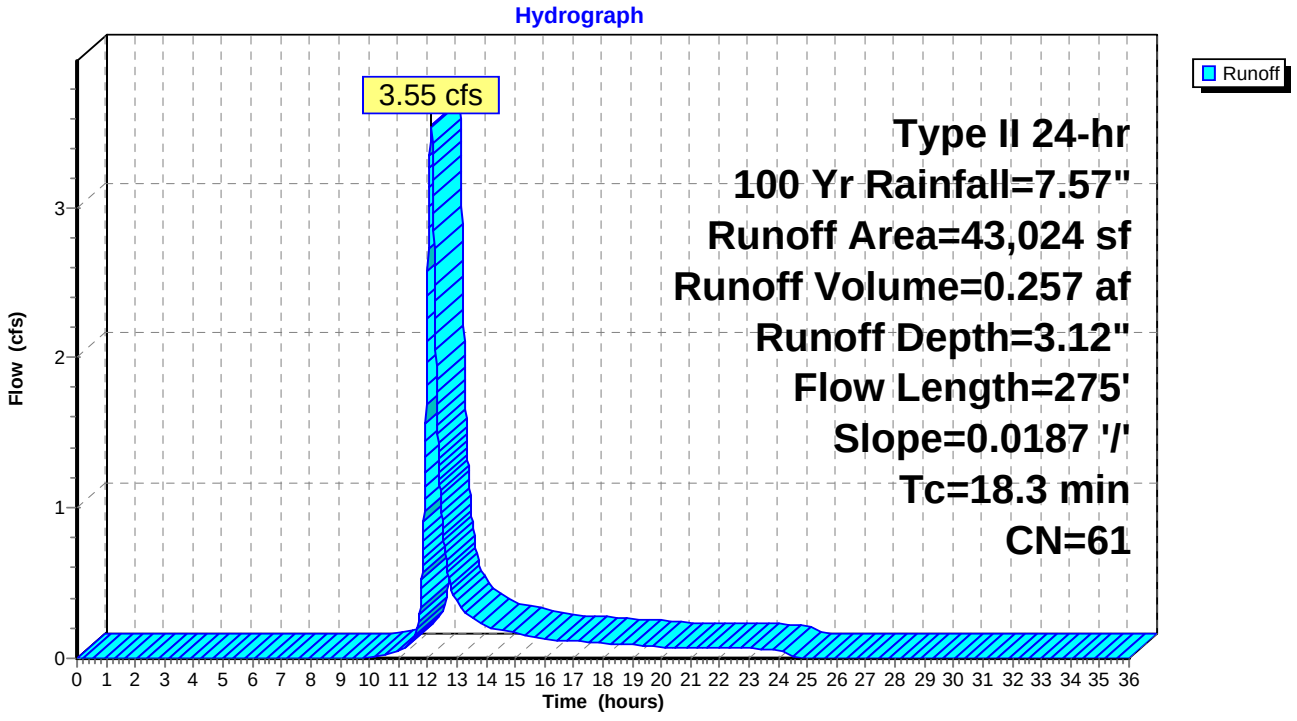
Runoff = 3.55 cfs @ 12.11 hrs, Volume= 0.257 af, Depth= 3.12"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
Type II 24-hr 100 Yr Rainfall=7.57"

Area (sf)	CN	Description
43,024	61	>75% Grass cover, Good, HSG B
43,024		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
15.3	100	0.0187	0.11		**Sheet Flow, Sheet Flow** Grass: Short n= 0.150 P2= 1.39"
3.0	175	0.0187	0.96		**Shallow Concentrated Flow, Shallow Conc.** Short Grass Pasture Kv= 7.0 fps
18.3	275	Total			

Subcatchment S7B1: Subcatchment 7B-1



Summary for Subcatchment S7B10: Subcatchment 7B-10

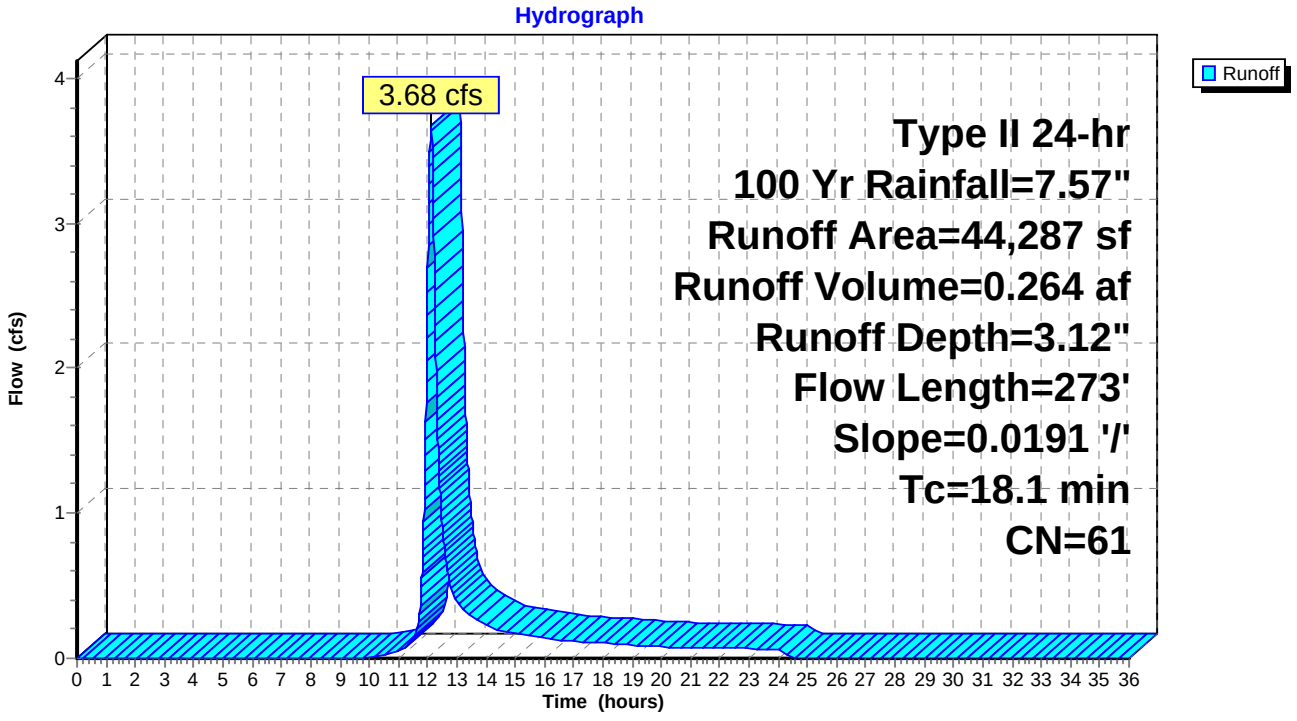
Runoff = 3.68 cfs @ 12.11 hrs, Volume= 0.264 af, Depth= 3.12"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
Type II 24-hr 100 Yr Rainfall=7.57"

Area (sf)	CN	Description
44,287	61	>75% Grass cover, Good, HSG B
44,287		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
15.1	100	0.0191	0.11		**Sheet Flow, Sheet Flow** Grass: Short n= 0.150 P2= 1.39"
3.0	173	0.0191	0.97		**Shallow Concentrated Flow, Shallow Conc.** Short Grass Pasture Kv= 7.0 fps
18.1	273	Total			

Subcatchment S7B10: Subcatchment 7B-10



Summary for Subcatchment S7B2: Subcatchment 7B-2

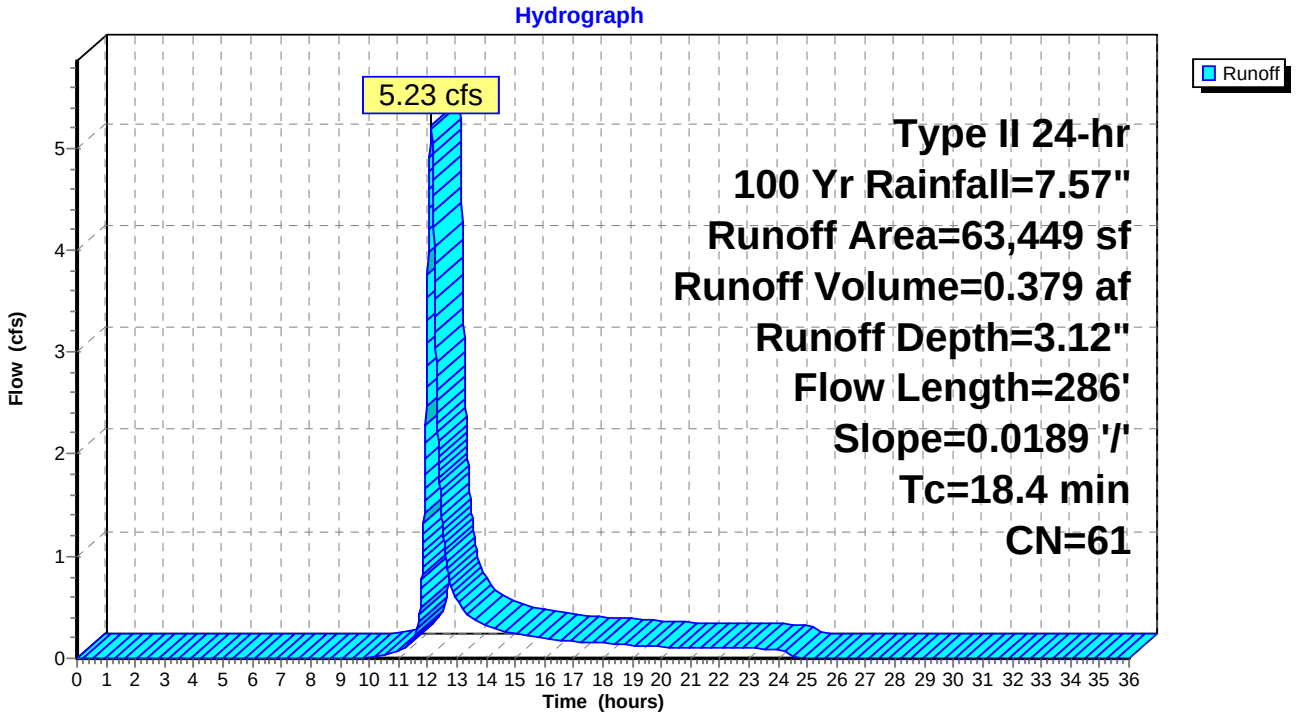
Runoff = 5.23 cfs @ 12.12 hrs, Volume= 0.379 af, Depth= 3.12"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
Type II 24-hr 100 Yr Rainfall=7.57"

Area (sf)	CN	Description
63,449	61	>75% Grass cover, Good, HSG B
63,449		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
15.2	100	0.0189	0.11		**Sheet Flow, Sheet Flow** Grass: Short n= 0.150 P2= 1.39"
3.2	186	0.0189	0.96		**Shallow Concentrated Flow, Shallow Conc.** Short Grass Pasture Kv= 7.0 fps
18.4	286	Total			

Subcatchment S7B2: Subcatchment 7B-2



Summary for Subcatchment S7B3: Subcatchment 7B-3

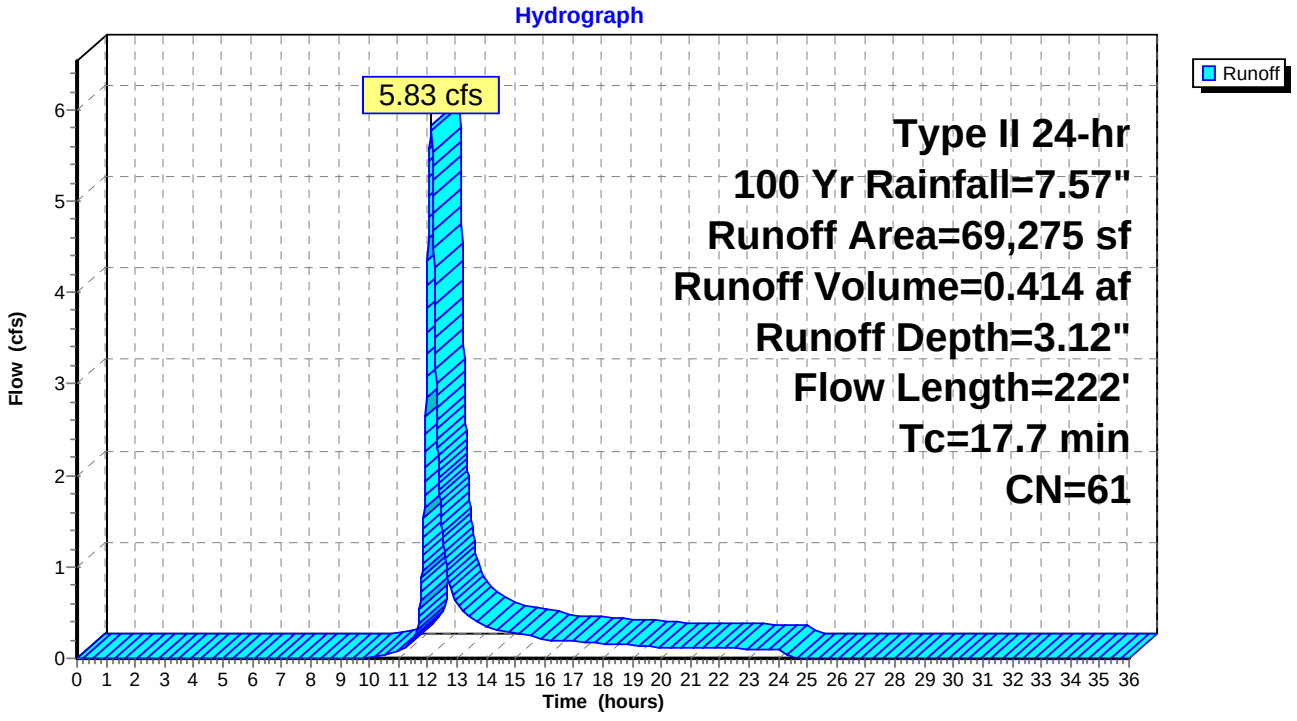
Runoff = 5.83 cfs @ 12.10 hrs, Volume= 0.414 af, Depth= 3.12"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
Type II 24-hr 100 Yr Rainfall=7.57"

Area (sf)	CN	Description
69,275	61	>75% Grass cover, Good, HSG B
69,275		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
15.5	100	0.0181	0.11		**Sheet Flow, Sheet Flow** Grass: Short n= 0.150 P2= 1.39"
2.2	122	0.0179	0.94		**Shallow Concentrated Flow, Shallow Conc.** Short Grass Pasture Kv= 7.0 fps
17.7	222	Total			

Subcatchment S7B3: Subcatchment 7B-3



Summary for Subcatchment S7B4: Subcatchment 7B-4

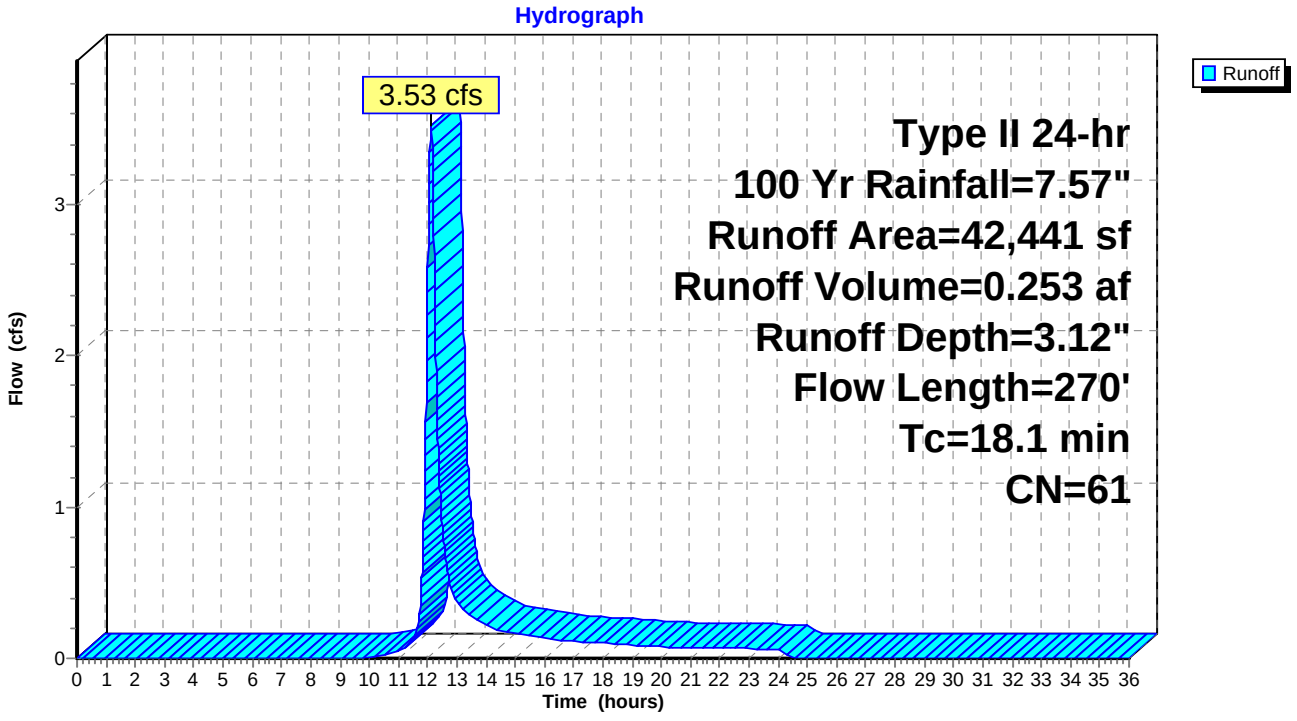
Runoff = 3.53 cfs @ 12.11 hrs, Volume= 0.253 af, Depth= 3.12"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
Type II 24-hr 100 Yr Rainfall=7.57"

Area (sf)	CN	Description
42,441	61	>75% Grass cover, Good, HSG B
42,441		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
15.2	100	0.0189	0.11		**Sheet Flow, Sheet Flow** Grass: Short n= 0.150 P2= 1.39"
2.9	170	0.0191	0.97		**Shallow Concentrated Flow, Shallow Conc.** Short Grass Pasture Kv= 7.0 fps
18.1	270	Total			

Subcatchment S7B4: Subcatchment 7B-4



Summary for Subcatchment S7B5: Subcatchment 7B-5

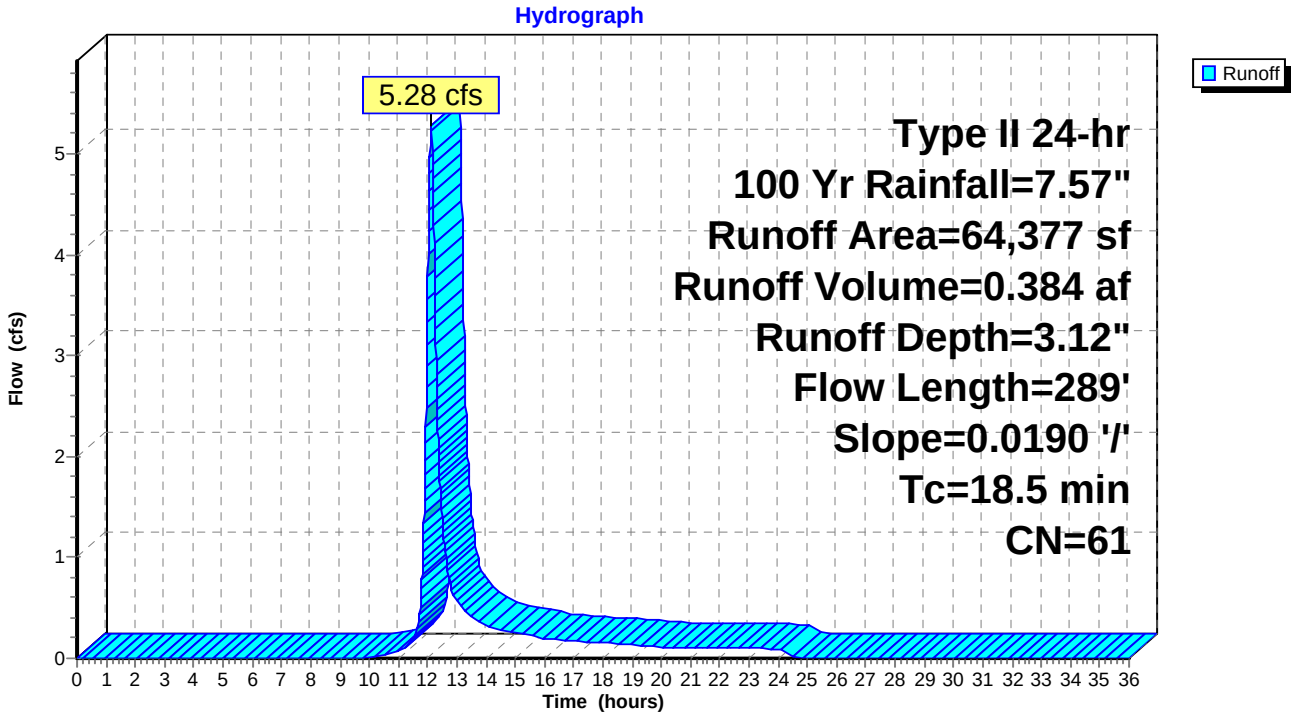
Runoff = 5.28 cfs @ 12.11 hrs, Volume= 0.384 af, Depth= 3.12"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
Type II 24-hr 100 Yr Rainfall=7.57"

Area (sf)	CN	Description
64,377	61	>75% Grass cover, Good, HSG B
64,377		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
15.2	100	0.0190	0.11		**Sheet Flow, Sheet Flow** Grass: Short n= 0.150 P2= 1.39"
3.3	189	0.0190	0.96		**Shallow Concentrated Flow, Shallow Conc.** Short Grass Pasture Kv= 7.0 fps
18.5	289	Total			

Subcatchment S7B5: Subcatchment 7B-5



Summary for Subcatchment S7B6: Subcatchment 7B-6

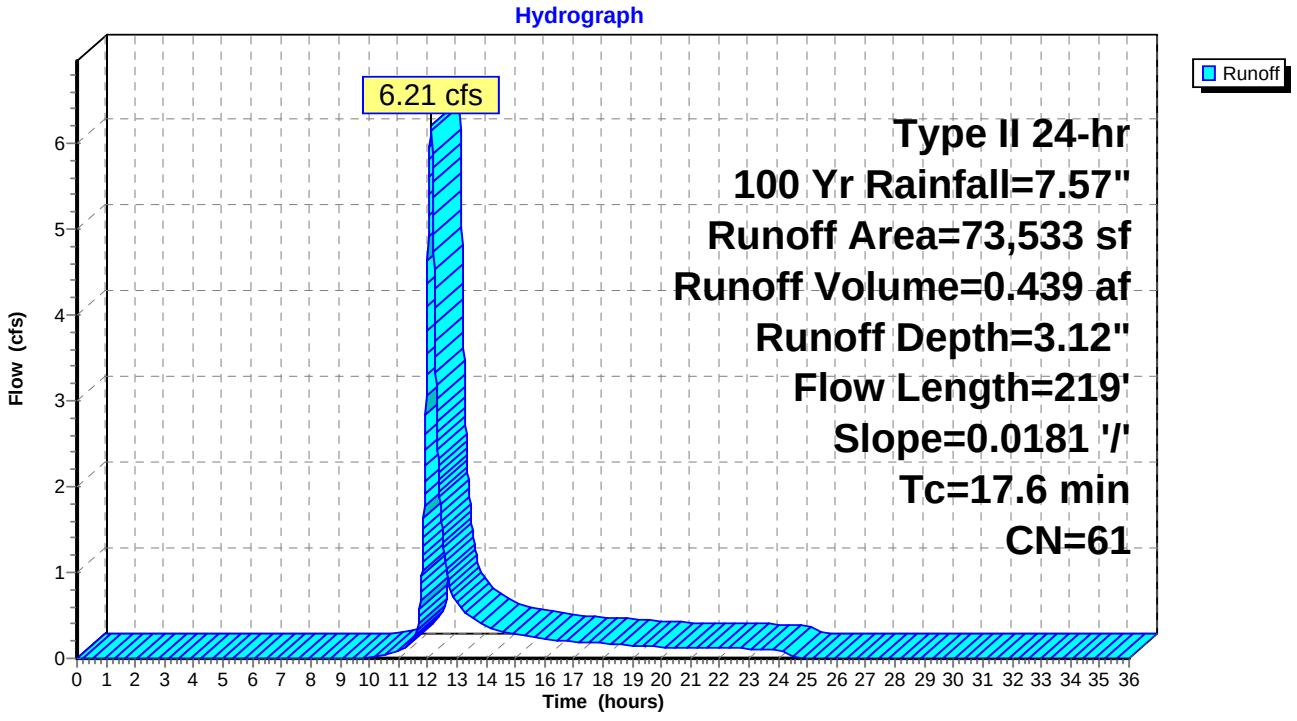
Runoff = 6.21 cfs @ 12.11 hrs, Volume= 0.439 af, Depth= 3.12"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
Type II 24-hr 100 Yr Rainfall=7.57"

Area (sf)	CN	Description
73,533	61	>75% Grass cover, Good, HSG B
73,533		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
15.5	100	0.0181	0.11		**Sheet Flow, Sheet Flow** Grass: Short n= 0.150 P2= 1.39"
2.1	119	0.0181	0.94		**Shallow Concentrated Flow, Shallow Conc.** Short Grass Pasture Kv= 7.0 fps
17.6	219	Total			

Subcatchment S7B6: Subcatchment 7B-6



Summary for Subcatchment S7B7: Subcatchment 7B-7

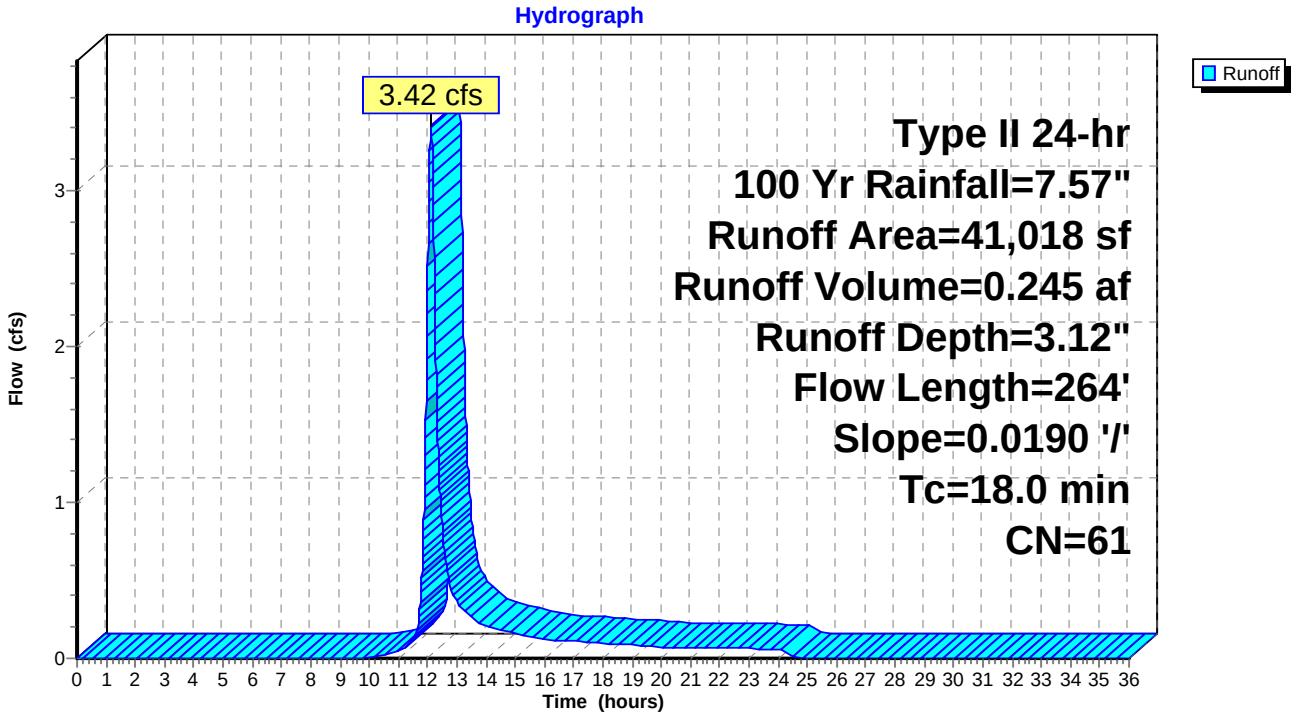
Runoff = 3.42 cfs @ 12.11 hrs, Volume= 0.245 af, Depth= 3.12"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
Type II 24-hr 100 Yr Rainfall=7.57"

Area (sf)	CN	Description
41,018	61	>75% Grass cover, Good, HSG B
41,018		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
15.2	100	0.0190	0.11		**Sheet Flow, Sheet Flow** Grass: Short n= 0.150 P2= 1.39"
2.8	164	0.0190	0.96		**Shallow Concentrated Flow, Shallow Conc.** Short Grass Pasture Kv= 7.0 fps
18.0	264	Total			

Subcatchment S7B7: Subcatchment 7B-7



Summary for Subcatchment S7B8: Subcatchment 7B-8

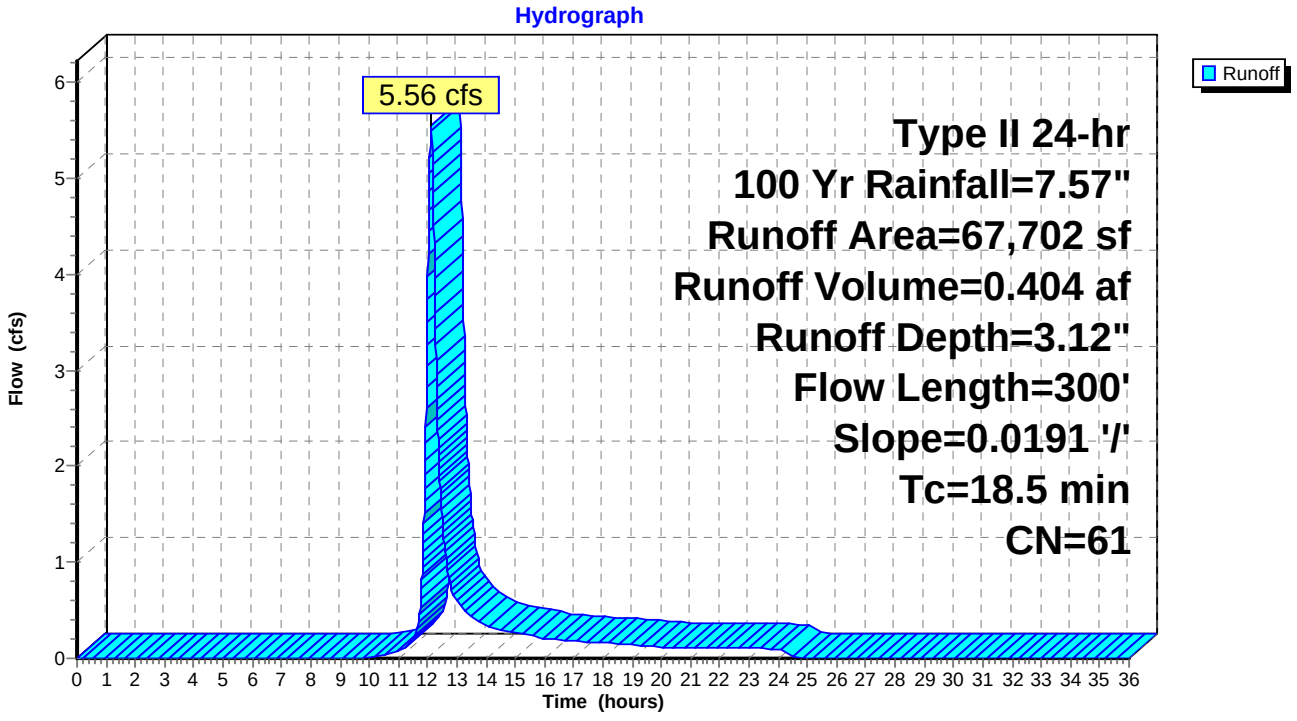
Runoff = 5.56 cfs @ 12.11 hrs, Volume= 0.404 af, Depth= 3.12"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
Type II 24-hr 100 Yr Rainfall=7.57"

Area (sf)	CN	Description
67,702	61	>75% Grass cover, Good, HSG B
67,702		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
15.1	100	0.0191	0.11		**Sheet Flow, Sheet Flow** Grass: Short n= 0.150 P2= 1.39"
3.4	200	0.0191	0.97		**Shallow Concentrated Flow, Shallow Conc.** Short Grass Pasture Kv= 7.0 fps
18.5	300	Total			

Subcatchment S7B8: Subcatchment 7B-8



Summary for Subcatchment S7B9: Subcatchment 7B-9

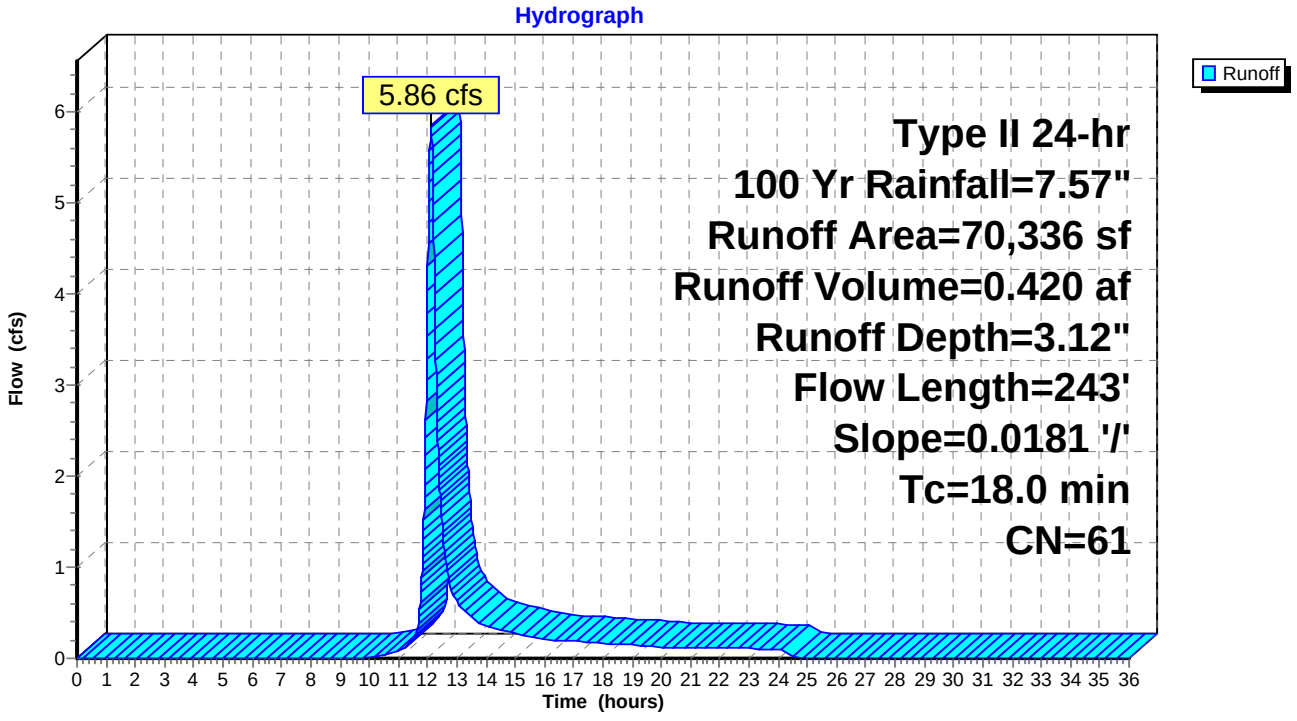
Runoff = 5.86 cfs @ 12.11 hrs, Volume= 0.420 af, Depth= 3.12"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
Type II 24-hr 100 Yr Rainfall=7.57"

Area (sf)	CN	Description
70,336	61	>75% Grass cover, Good, HSG B
70,336		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
15.5	100	0.0181	0.11		**Sheet Flow, Sheet Flow** Grass: Short n= 0.150 P2= 1.39"
2.5	143	0.0181	0.94		**Shallow Concentrated Flow, Shallow Conc.** Short Grass Pasture Kv= 7.0 fps
18.0	243	Total			

Subcatchment S7B9: Subcatchment 7B-9



Summary for Subcatchment S7C: Subcatchment 7C

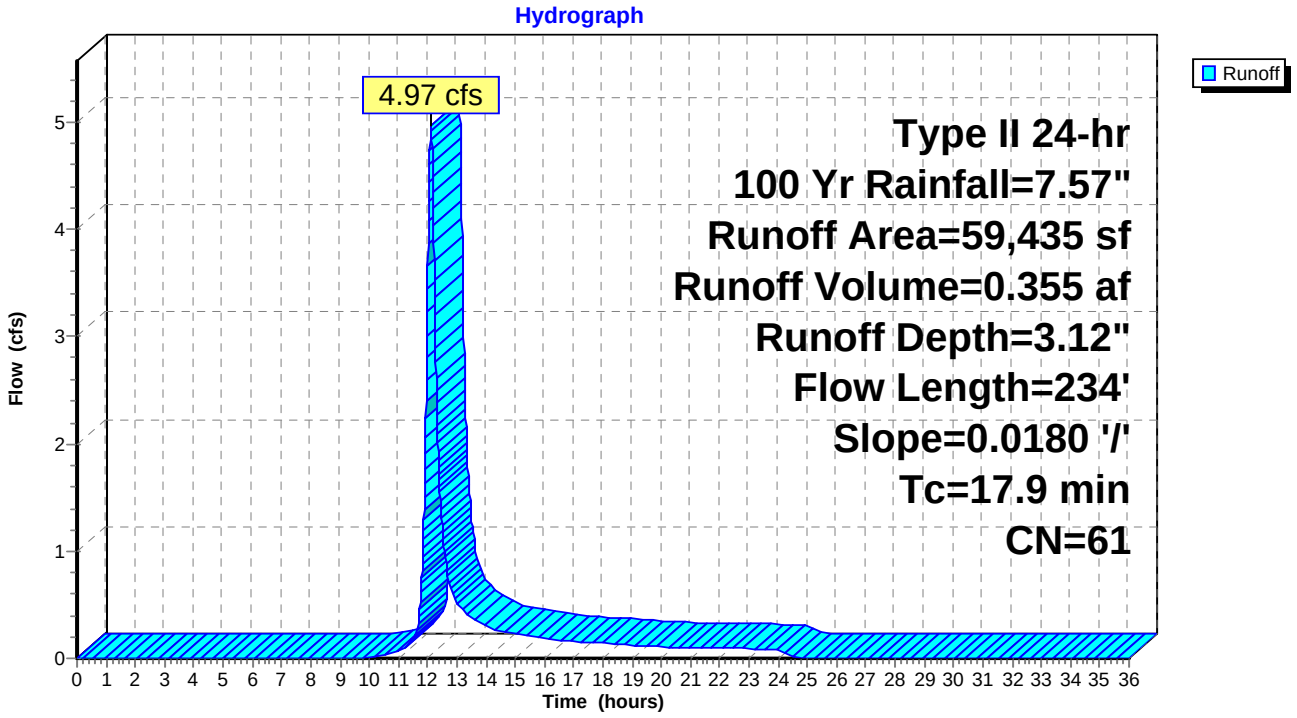
Runoff = 4.97 cfs @ 12.11 hrs, Volume= 0.355 af, Depth= 3.12"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
Type II 24-hr 100 Yr Rainfall=7.57"

Area (sf)	CN	Description
59,435	61	>75% Grass cover, Good, HSG B
59,435		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
15.5	100	0.0180	0.11		**Sheet Flow, Sheet Flow** Grass: Short n= 0.150 P2= 1.39"
2.4	134	0.0180	0.94		**Shallow Concentrated Flow, Shallow Conc.** Short Grass Pasture Kv= 7.0 fps
17.9	234	Total			

Subcatchment S7C: Subcatchment 7C



Summary for Subcatchment S7D: Subcatchment 7D

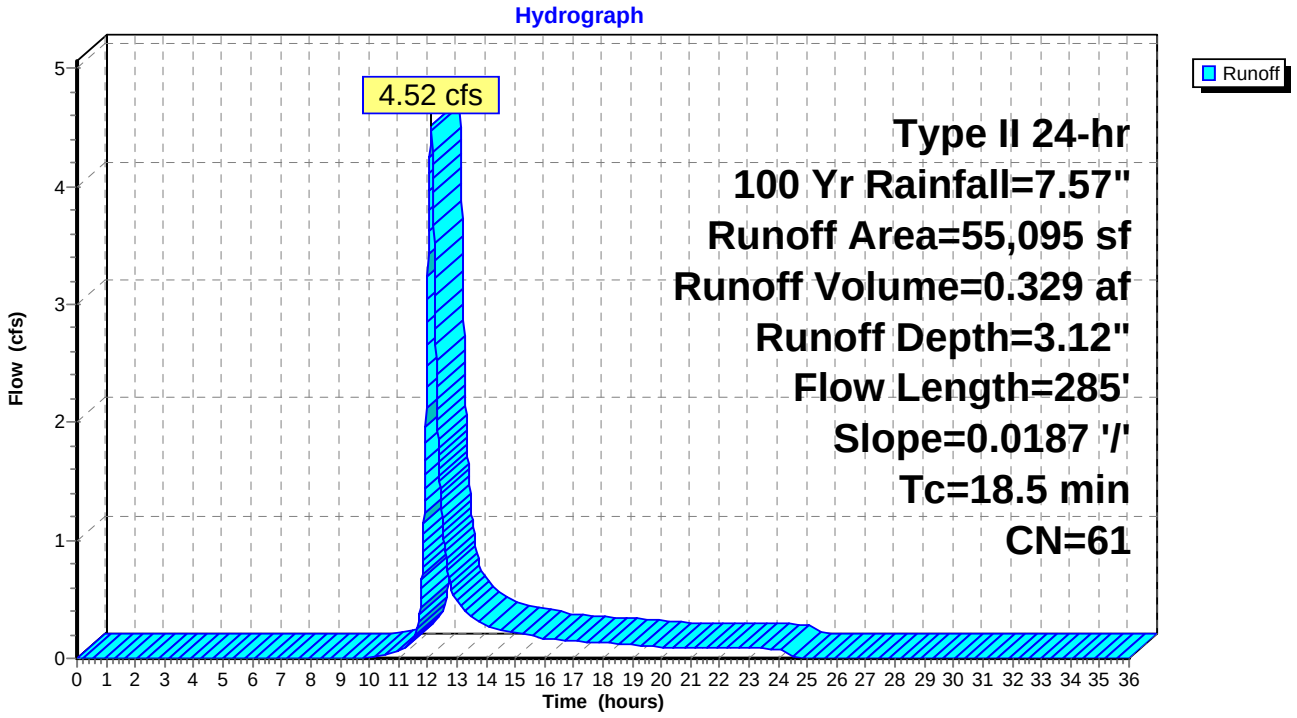
Runoff = 4.52 cfs @ 12.11 hrs, Volume= 0.329 af, Depth= 3.12"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
Type II 24-hr 100 Yr Rainfall=7.57"

Area (sf)	CN	Description
55,095	61	>75% Grass cover, Good, HSG B
55,095		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
15.3	100	0.0187	0.11		**Sheet Flow, Sheet Flow** Grass: Short n= 0.150 P2= 1.39"
3.2	185	0.0187	0.96		**Shallow Concentrated Flow, Shallow Conc.** Short Grass Pasture Kv= 7.0 fps
18.5	285	Total			

Subcatchment S7D: Subcatchment 7D



Summary for Subcatchment S7E: Subcatchment 7B-2

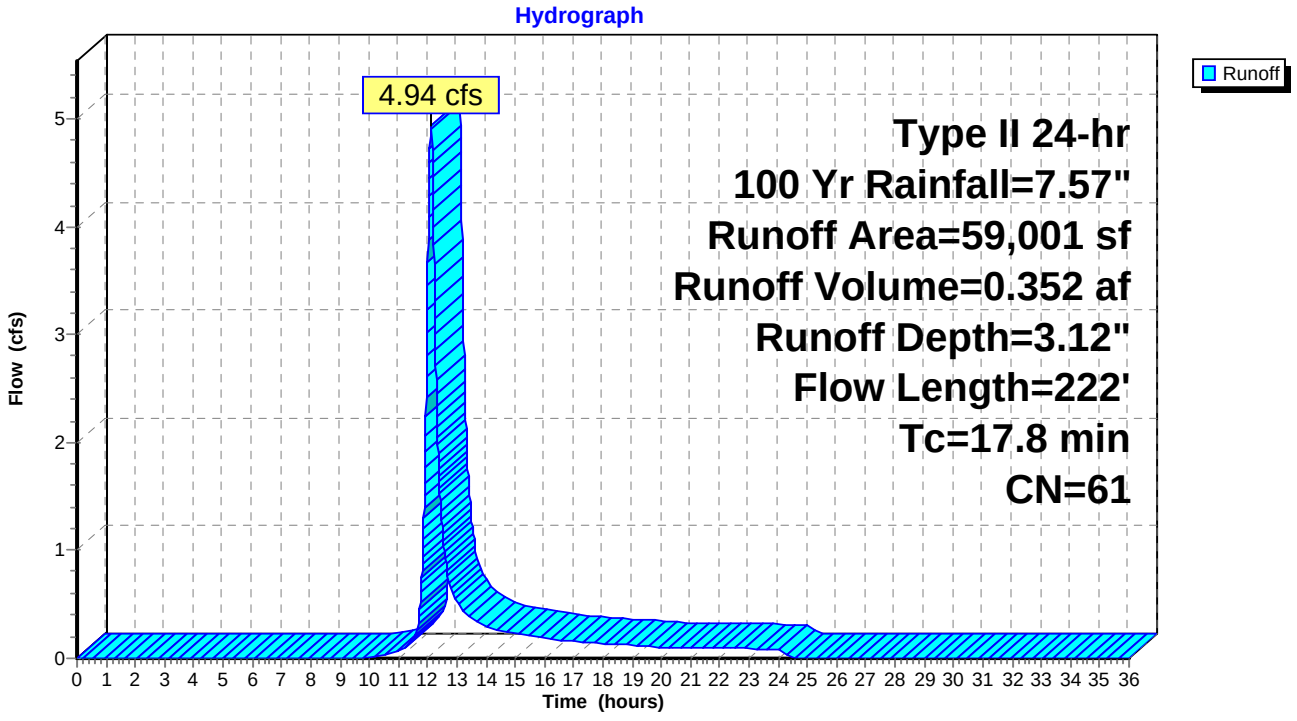
Runoff = 4.94 cfs @ 12.11 hrs, Volume= 0.352 af, Depth= 3.12"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
Type II 24-hr 100 Yr Rainfall=7.57"

Area (sf)	CN	Description
59,001	61	>75% Grass cover, Good, HSG B
59,001		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
15.6	100	0.0178	0.11		**Sheet Flow, Sheet Flow** Grass: Short n= 0.150 P2= 1.39"
2.2	122	0.0177	0.93		**Shallow Concentrated Flow, Shallow Conc.** Short Grass Pasture Kv= 7.0 fps
17.8	222	Total			

Subcatchment S7E: Subcatchment 7B-2



Summary for Subcatchment S8A: Subcatchment 8A

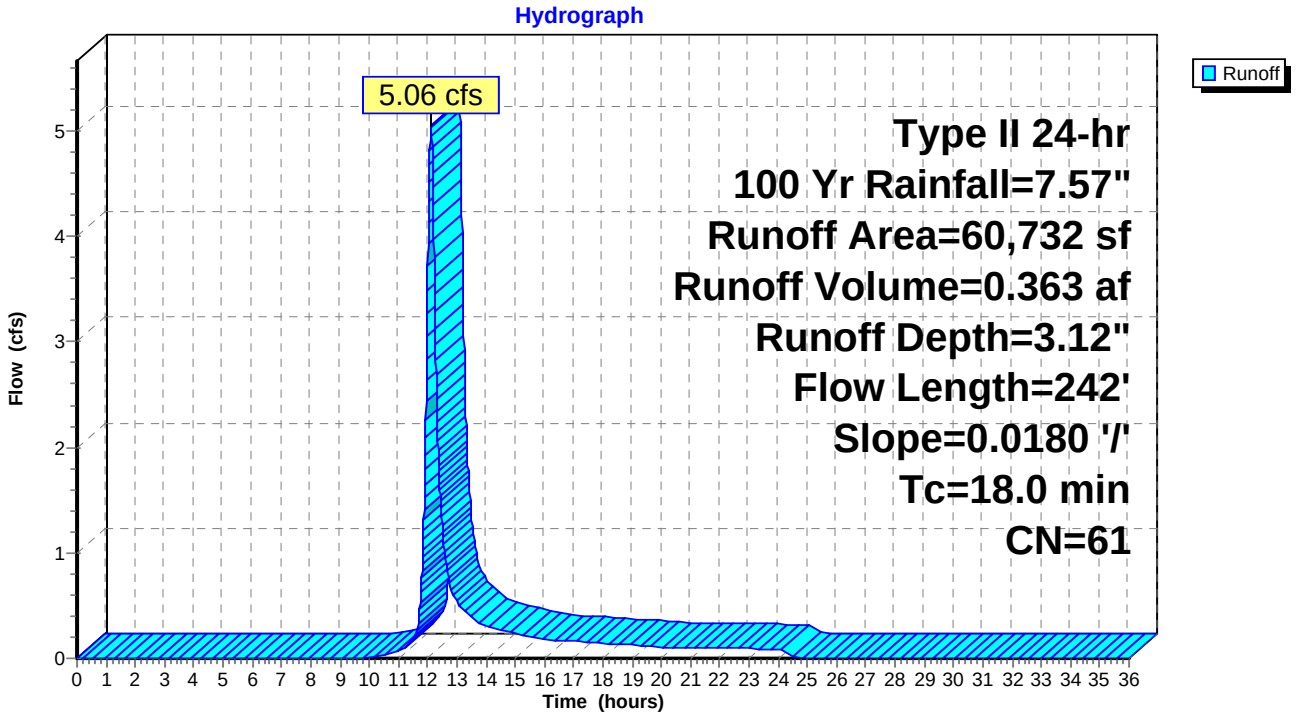
Runoff = 5.06 cfs @ 12.11 hrs, Volume= 0.363 af, Depth= 3.12"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
Type II 24-hr 100 Yr Rainfall=7.57"

Area (sf)	CN	Description
60,732	61	>75% Grass cover, Good, HSG B
60,732		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
15.5	100	0.0180	0.11		**Sheet Flow, Sheet Flow** Grass: Short n= 0.150 P2= 1.39"
2.5	142	0.0180	0.94		**Shallow Concentrated Flow, Shallow Conc.** Short Grass Pasture Kv= 7.0 fps
18.0	242	Total			

Subcatchment S8A: Subcatchment 8A



Summary for Subcatchment S8B1: Subcatchment 8B-1

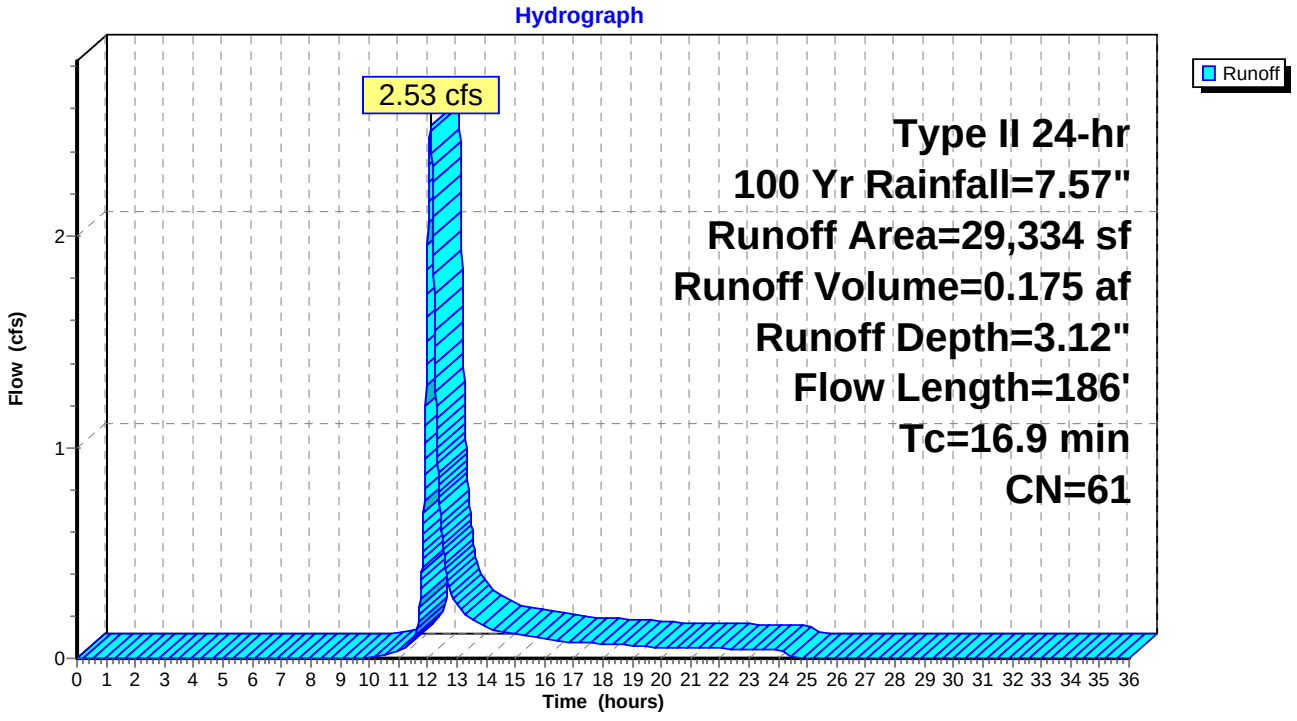
Runoff = 2.53 cfs @ 12.10 hrs, Volume= 0.175 af, Depth= 3.12"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
Type II 24-hr 100 Yr Rainfall=7.57"

Area (sf)	CN	Description
29,334	61	>75% Grass cover, Good, HSG B
29,334		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
15.4	100	0.0184	0.11		**Sheet Flow, Sheet Flow** Grass: Short n= 0.150 P2= 1.39"
1.5	86	0.0180	0.94		**Shallow Concentrated Flow, Shallow Conc.** Short Grass Pasture Kv= 7.0 fps
16.9	186	Total			

Subcatchment S8B1: Subcatchment 8B-1



Summary for Subcatchment S8B10: Subcatchment 8B-10

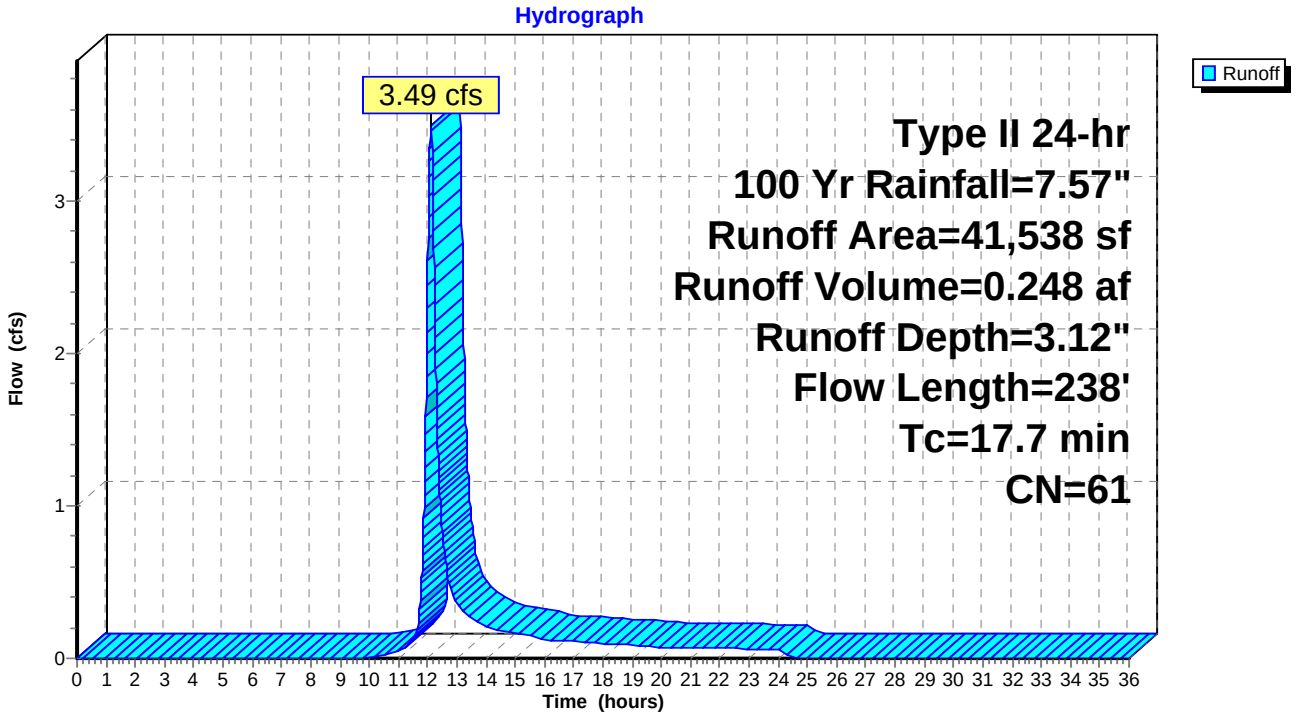
Runoff = 3.49 cfs @ 12.10 hrs, Volume= 0.248 af, Depth= 3.12"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
Type II 24-hr 100 Yr Rainfall=7.57"

Area (sf)	CN	Description
41,538	61	>75% Grass cover, Good, HSG B
41,538		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
15.2	100	0.0190	0.11		**Sheet Flow, Sheet Flow** Grass: Short n= 0.150 P2= 1.39"
2.5	138	0.0179	0.94		**Shallow Concentrated Flow, Shallow Conc.** Short Grass Pasture Kv= 7.0 fps
17.7	238	Total			

Subcatchment S8B10: Subcatchment 8B-10



Summary for Subcatchment S8B11: Subcatchment 8B-11

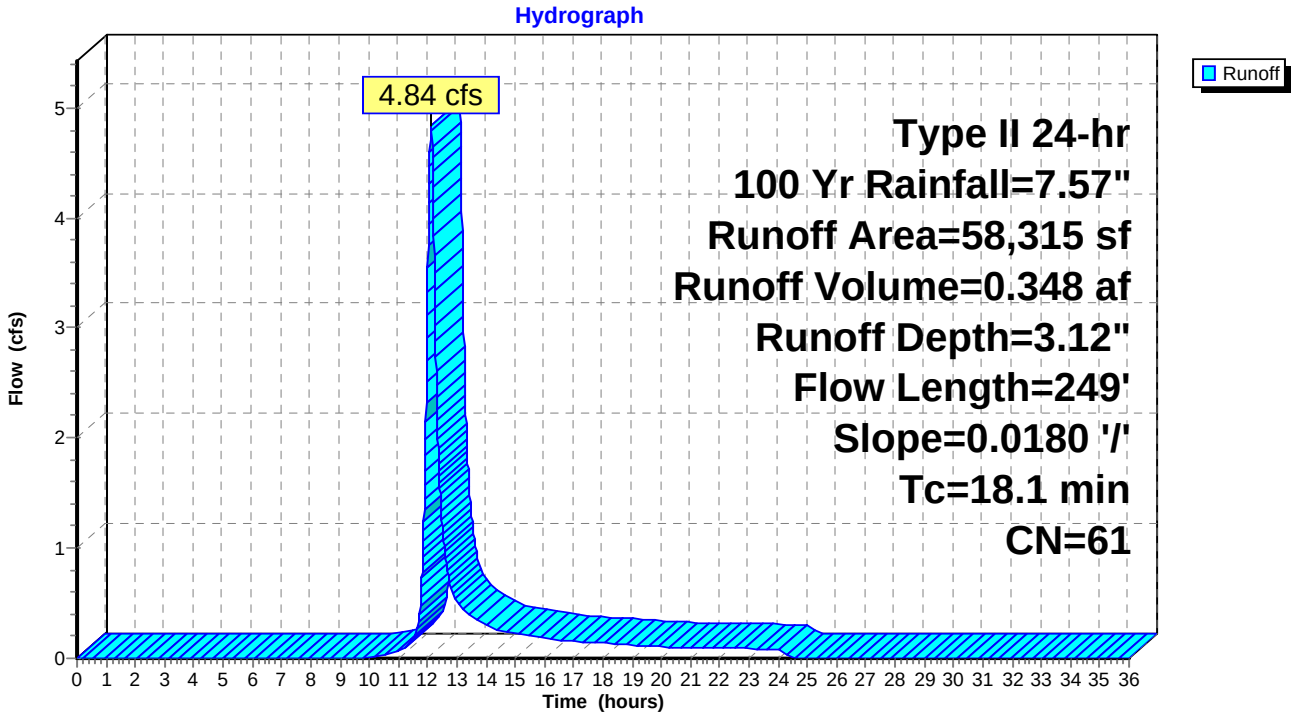
Runoff = 4.84 cfs @ 12.11 hrs, Volume= 0.348 af, Depth= 3.12"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
Type II 24-hr 100 Yr Rainfall=7.57"

Area (sf)	CN	Description
58,315	61	>75% Grass cover, Good, HSG B
58,315		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
15.5	100	0.0180	0.11		**Sheet Flow, Sheet Flow** Grass: Short n= 0.150 P2= 1.39"
2.6	149	0.0180	0.94		**Shallow Concentrated Flow, Shallow Conc.** Short Grass Pasture Kv= 7.0 fps
18.1	249	Total			

Subcatchment S8B11: Subcatchment 8B-11



Summary for Subcatchment S8B12: Subcatchment 8B-12

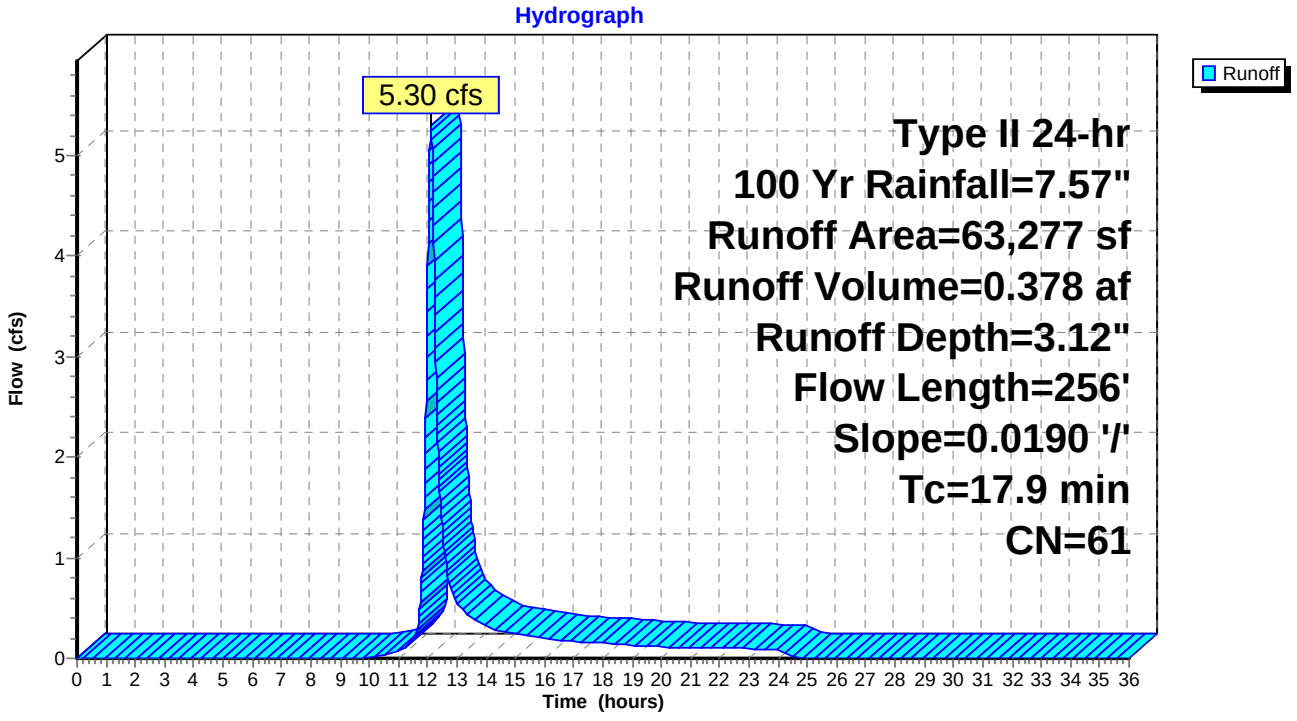
Runoff = 5.30 cfs @ 12.11 hrs, Volume= 0.378 af, Depth= 3.12"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
Type II 24-hr 100 Yr Rainfall=7.57"

Area (sf)	CN	Description
63,277	61	>75% Grass cover, Good, HSG B
63,277		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
15.2	100	0.0190	0.11		**Sheet Flow, Sheet Flow** Grass: Short n= 0.150 P2= 1.39"
2.7	156	0.0190	0.96		**Shallow Concentrated Flow, Shallow Conc.** Short Grass Pasture Kv= 7.0 fps
17.9	256	Total			

Subcatchment S8B12: Subcatchment 8B-12



Summary for Subcatchment S8B13: Subcatchment 8B-13

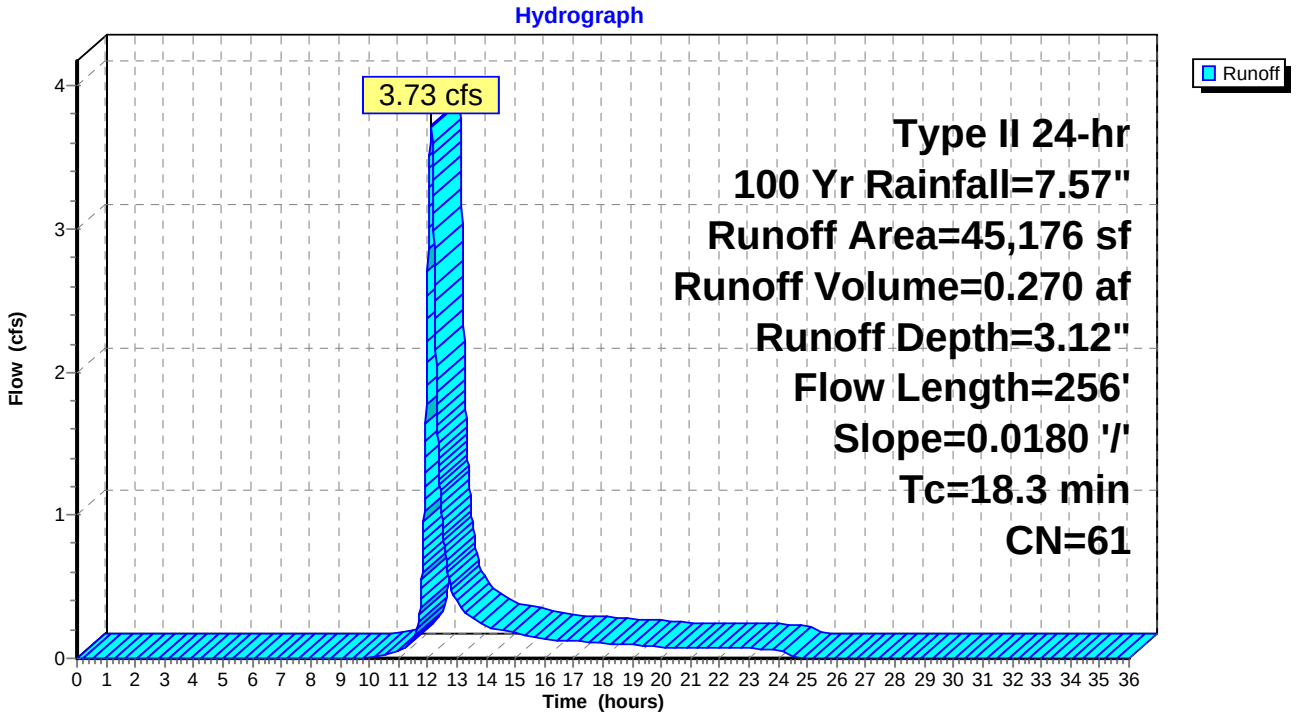
Runoff = 3.73 cfs @ 12.11 hrs, Volume= 0.270 af, Depth= 3.12"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
Type II 24-hr 100 Yr Rainfall=7.57"

Area (sf)	CN	Description
45,176	61	>75% Grass cover, Good, HSG B
45,176		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
15.5	100	0.0180	0.11		**Sheet Flow, Sheet Flow** Grass: Short n= 0.150 P2= 1.39"
2.8	156	0.0180	0.94		**Shallow Concentrated Flow, Shallow Conc.** Short Grass Pasture Kv= 7.0 fps
18.3	256	Total			

Subcatchment S8B13: Subcatchment 8B-13



Summary for Subcatchment S8B2: Subcatchment 8B-2

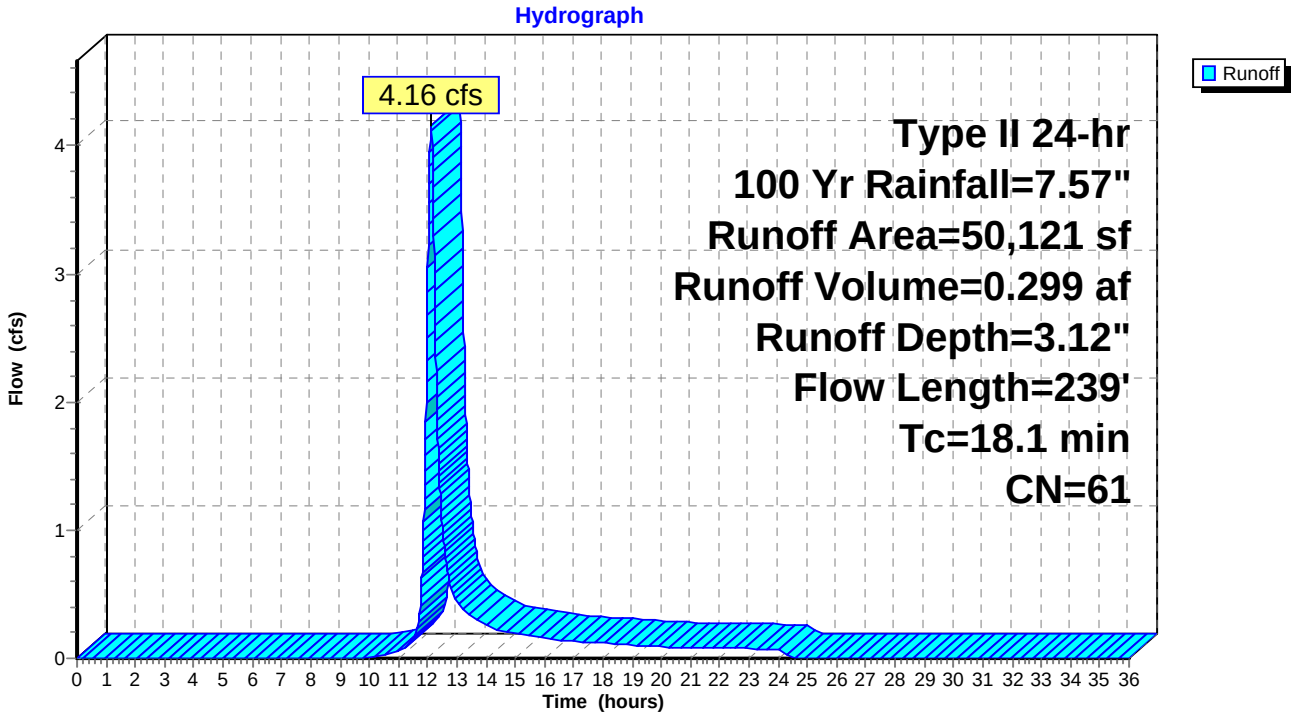
Runoff = 4.16 cfs @ 12.11 hrs, Volume= 0.299 af, Depth= 3.12"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
Type II 24-hr 100 Yr Rainfall=7.57"

Area (sf)	CN	Description
50,121	61	>75% Grass cover, Good, HSG B
50,121		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
15.6	100	0.0176	0.11		**Sheet Flow, Sheet Flow** Grass: Short n= 0.150 P2= 1.39"
2.5	139	0.0177	0.93		**Shallow Concentrated Flow, Shallow Conc.** Short Grass Pasture Kv= 7.0 fps
18.1	239	Total			

Subcatchment S8B2: Subcatchment 8B-2



Summary for Subcatchment S8B3: Subcatchment 8B-3

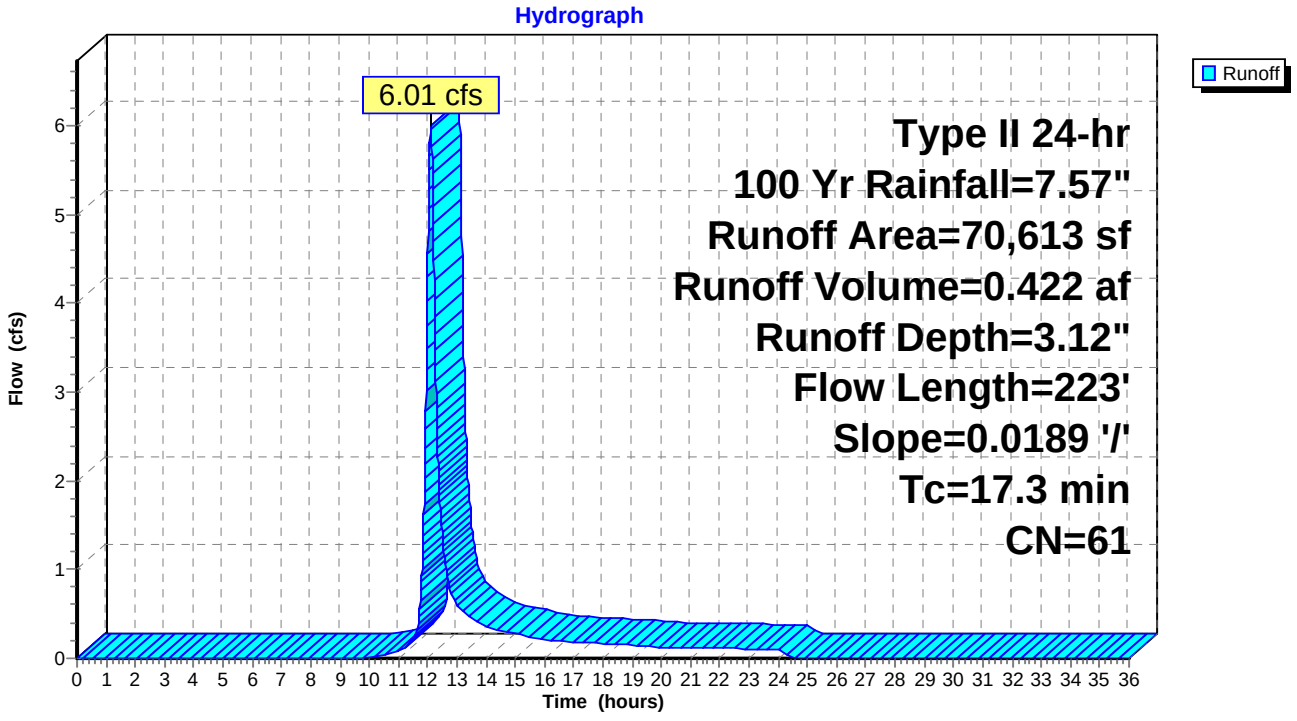
Runoff = 6.01 cfs @ 12.10 hrs, Volume= 0.422 af, Depth= 3.12"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
Type II 24-hr 100 Yr Rainfall=7.57"

Area (sf)	CN	Description
70,613	61	>75% Grass cover, Good, HSG B
70,613		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
15.2	100	0.0189	0.11		**Sheet Flow, Sheet Flow** Grass: Short n= 0.150 P2= 1.39"
2.1	123	0.0189	0.96		**Shallow Concentrated Flow, Shallow Conc.** Short Grass Pasture Kv= 7.0 fps
17.3	223	Total			

Subcatchment S8B3: Subcatchment 8B-3



Summary for Subcatchment S8B4: Subcatchment 8B-4

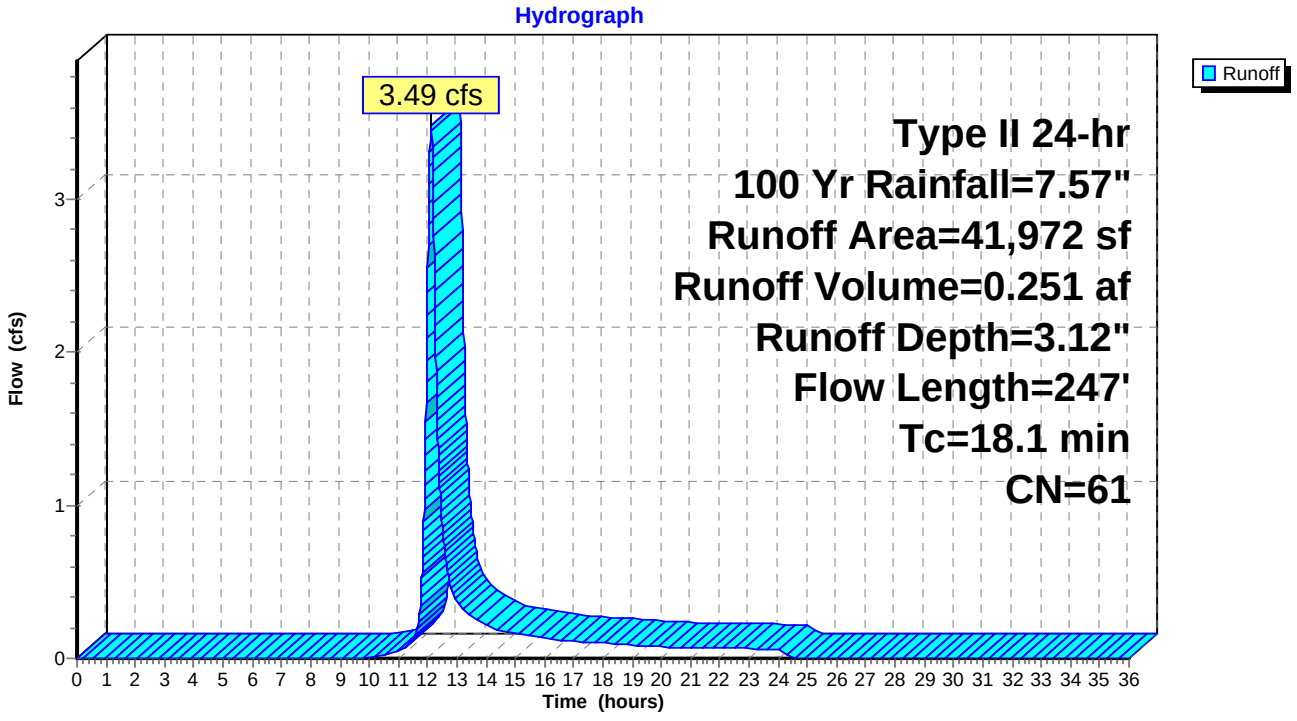
Runoff = 3.49 cfs @ 12.11 hrs, Volume= 0.251 af, Depth= 3.12"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
Type II 24-hr 100 Yr Rainfall=7.57"

Area (sf)	CN	Description
41,972	61	>75% Grass cover, Good, HSG B
41,972		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
15.5	100	0.0181	0.11		**Sheet Flow, Sheet Flow** Grass: Short n= 0.150 P2= 1.39"
2.6	147	0.0177	0.93		**Shallow Concentrated Flow, Shallow Conc.** Short Grass Pasture Kv= 7.0 fps
18.1	247	Total			

Subcatchment S8B4: Subcatchment 8B-4



Summary for Subcatchment S8B5: Subcatchment 8B-5

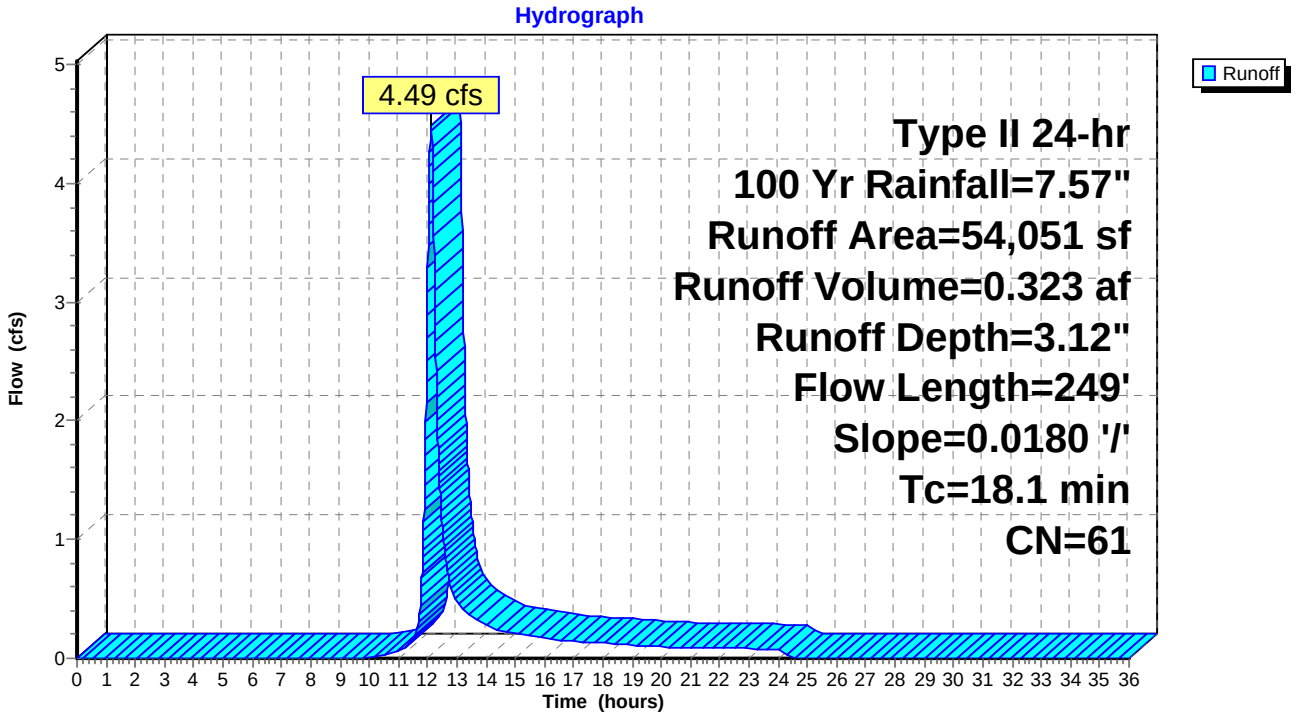
Runoff = 4.49 cfs @ 12.11 hrs, Volume= 0.323 af, Depth= 3.12"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
Type II 24-hr 100 Yr Rainfall=7.57"

Area (sf)	CN	Description
54,051	61	>75% Grass cover, Good, HSG B
54,051		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
15.5	100	0.0180	0.11		**Sheet Flow, Sheet Flow** Grass: Short n= 0.150 P2= 1.39"
2.6	149	0.0180	0.94		**Shallow Concentrated Flow, Shallow Conc.** Short Grass Pasture Kv= 7.0 fps
18.1	249	Total			

Subcatchment S8B5: Subcatchment 8B-5



Summary for Subcatchment S8B6: Subcatchment 8B-6

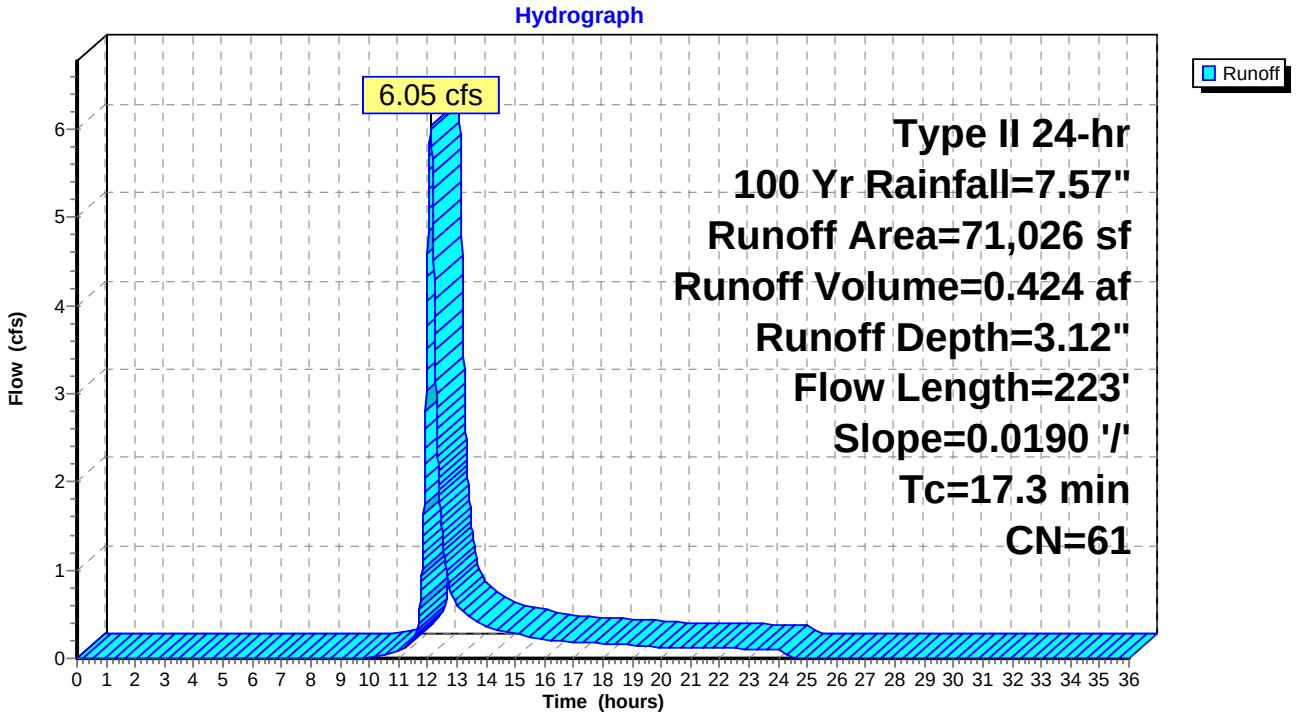
Runoff = 6.05 cfs @ 12.10 hrs, Volume= 0.424 af, Depth= 3.12"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
Type II 24-hr 100 Yr Rainfall=7.57"

Area (sf)	CN	Description
71,026	61	>75% Grass cover, Good, HSG B
71,026		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
15.2	100	0.0190	0.11		**Sheet Flow, Sheet Flow** Grass: Short n= 0.150 P2= 1.39"
2.1	123	0.0190	0.96		**Shallow Concentrated Flow, Shallow Conc.** Short Grass Pasture Kv= 7.0 fps
17.3	223	Total			

Subcatchment S8B6: Subcatchment 8B-6



Summary for Subcatchment S8B7: Subcatchment 8B-7

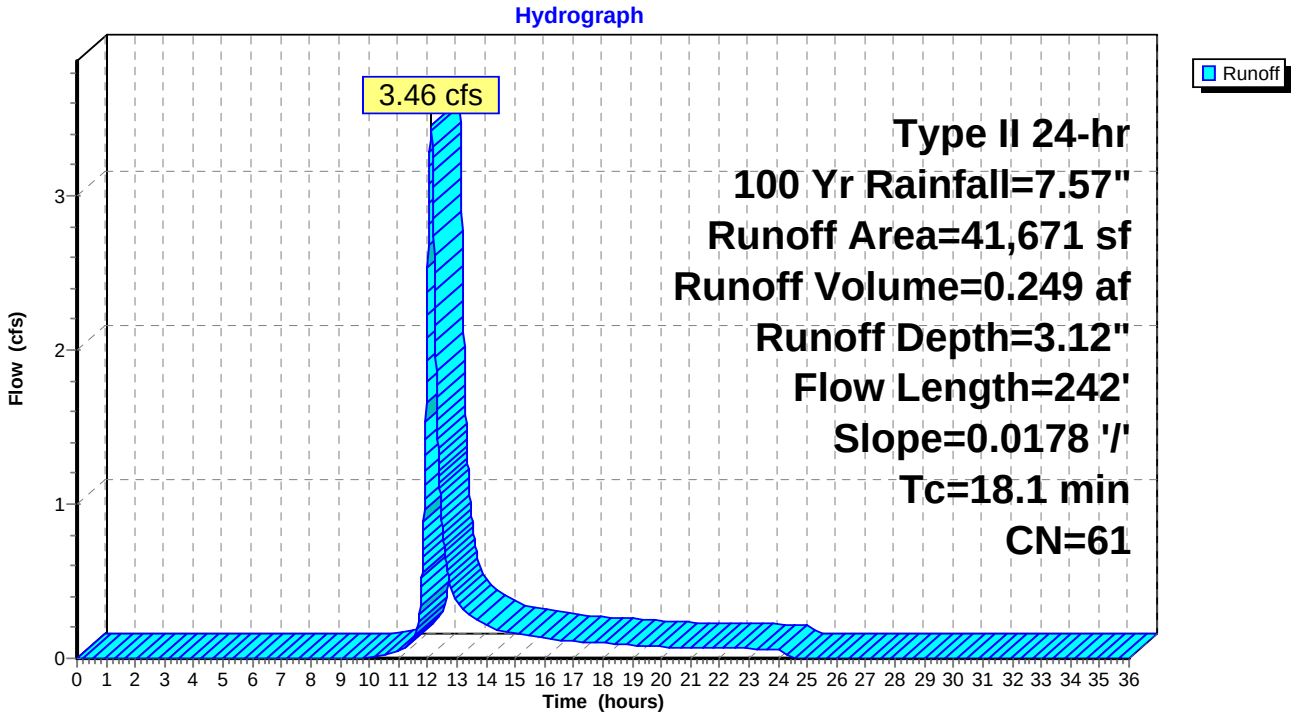
Runoff = 3.46 cfs @ 12.11 hrs, Volume= 0.249 af, Depth= 3.12"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
Type II 24-hr 100 Yr Rainfall=7.57"

Area (sf)	CN	Description
41,671	61	>75% Grass cover, Good, HSG B
41,671		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
15.6	100	0.0178	0.11		**Sheet Flow, Sheet Flow** Grass: Short n= 0.150 P2= 1.39"
2.5	142	0.0178	0.93		**Shallow Concentrated Flow, Shallow Conc.** Short Grass Pasture Kv= 7.0 fps
18.1	242	Total			

Subcatchment S8B7: Subcatchment 8B-7



Summary for Subcatchment S8B8: Subcatchment 8B-8

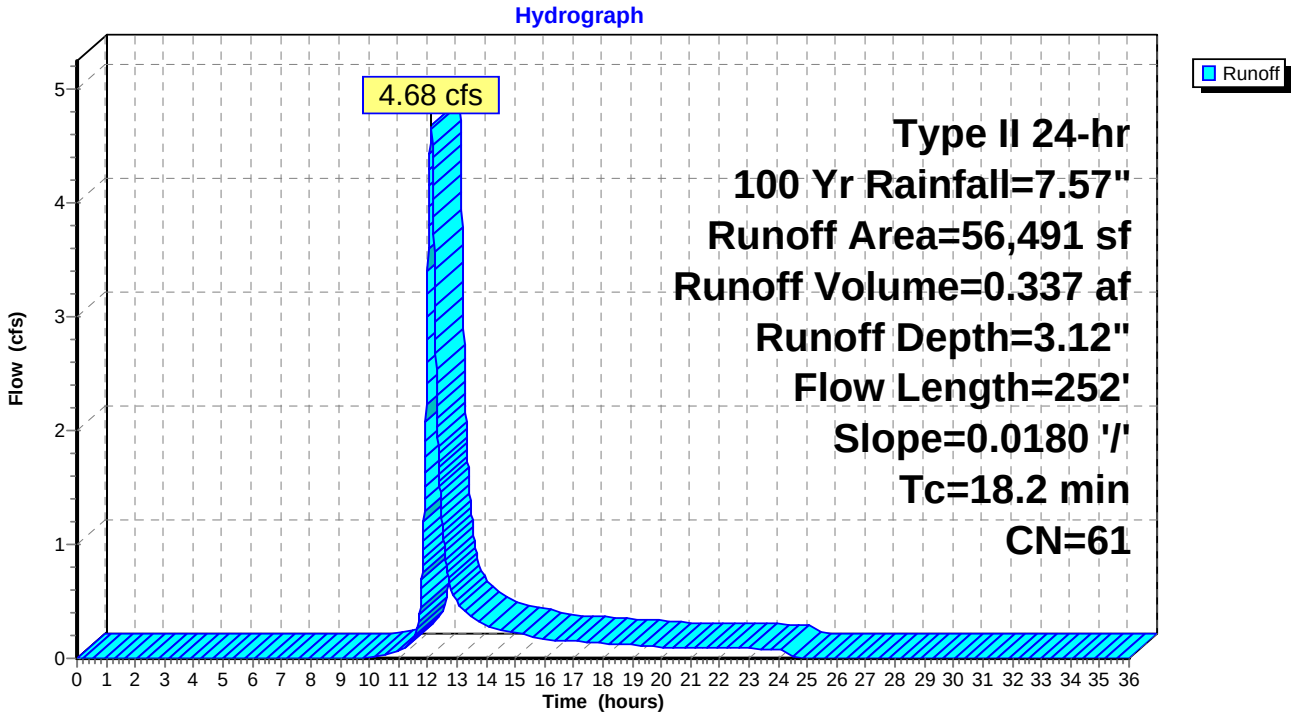
Runoff = 4.68 cfs @ 12.11 hrs, Volume= 0.337 af, Depth= 3.12"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
Type II 24-hr 100 Yr Rainfall=7.57"

Area (sf)	CN	Description
56,491	61	>75% Grass cover, Good, HSG B
56,491		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
15.5	100	0.0180	0.11		**Sheet Flow, Sheet Flow** Grass: Short n= 0.150 P2= 1.39"
2.7	152	0.0180	0.94		**Shallow Concentrated Flow, Shallow Conc.** Short Grass Pasture Kv= 7.0 fps
18.2	252	Total			

Subcatchment S8B8: Subcatchment 8B-8



Summary for Subcatchment S8B9: Subcatchment 8B-9

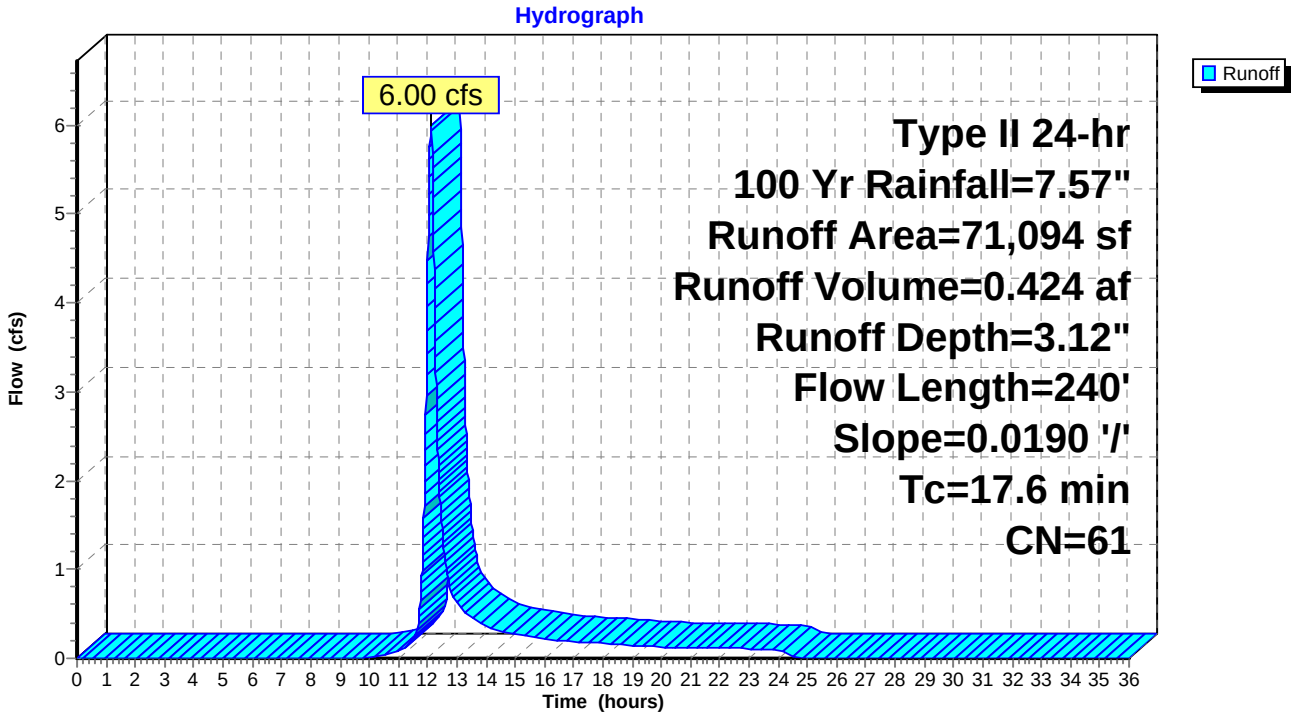
Runoff = 6.00 cfs @ 12.11 hrs, Volume= 0.424 af, Depth= 3.12"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
Type II 24-hr 100 Yr Rainfall=7.57"

Area (sf)	CN	Description
71,094	61	>75% Grass cover, Good, HSG B
71,094		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
15.2	100	0.0190	0.11		**Sheet Flow, Sheet Flow** Grass: Short n= 0.150 P2= 1.39"
2.4	140	0.0190	0.96		**Shallow Concentrated Flow, Shallow Conc.** Short Grass Pasture Kv= 7.0 fps
17.6	240	Total			

Subcatchment S8B9: Subcatchment 8B-9



Summary for Subcatchment S8C1: Subcatchment 8C-1

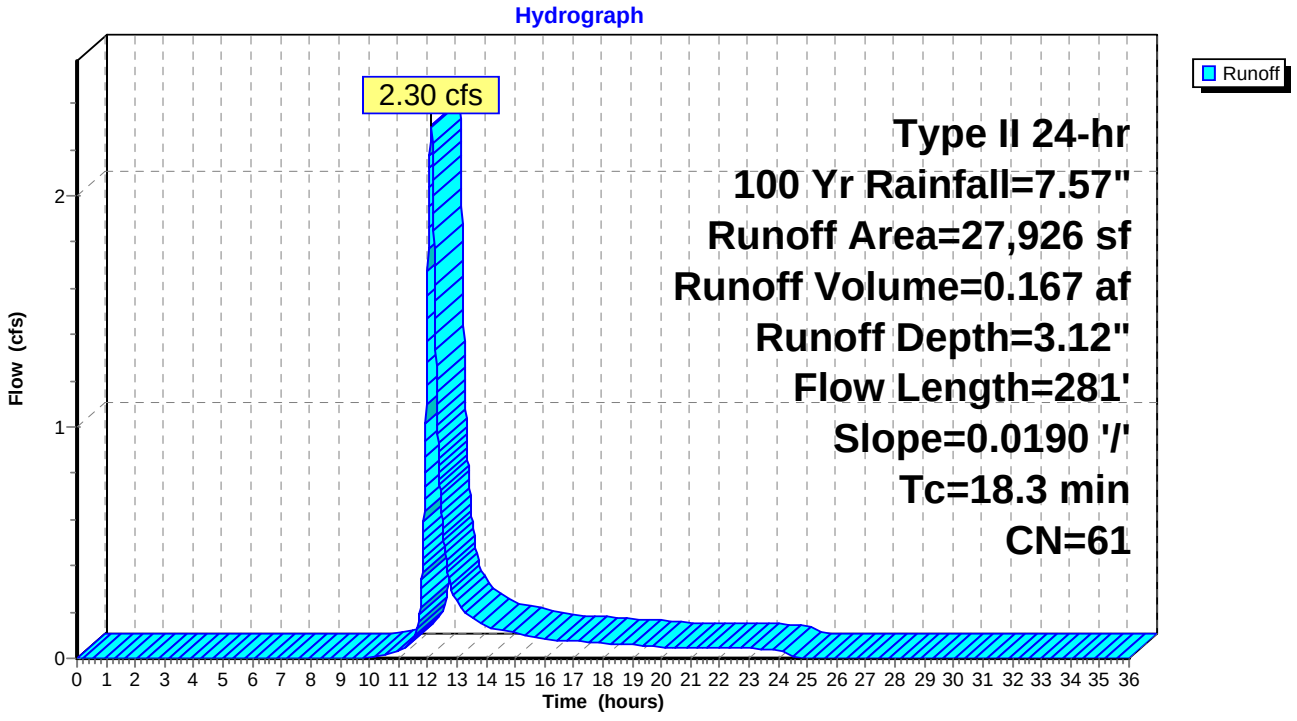
Runoff = 2.30 cfs @ 12.11 hrs, Volume= 0.167 af, Depth= 3.12"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
Type II 24-hr 100 Yr Rainfall=7.57"

Area (sf)	CN	Description
27,926	61	>75% Grass cover, Good, HSG B
27,926		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
15.2	100	0.0190	0.11		**Sheet Flow, Sheet Flow** Grass: Short n= 0.150 P2= 1.39"
3.1	181	0.0190	0.96		**Shallow Concentrated Flow, Shallow Conc.** Short Grass Pasture Kv= 7.0 fps
18.3	281	Total			

Subcatchment S8C1: Subcatchment 8C-1



Summary for Subcatchment S8C2: Subcatchment 8C-2

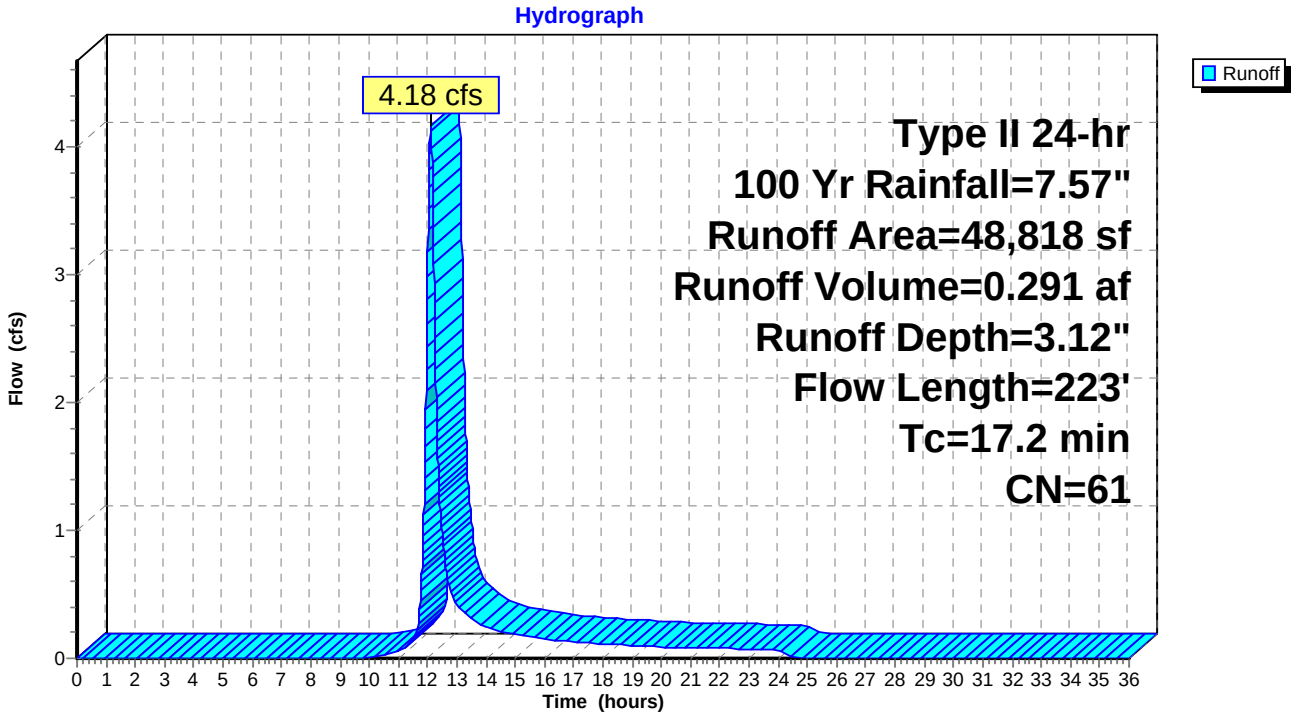
Runoff = 4.18 cfs @ 12.10 hrs, Volume= 0.291 af, Depth= 3.12"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
Type II 24-hr 100 Yr Rainfall=7.57"

Area (sf)	CN	Description
48,818	61	>75% Grass cover, Good, HSG B
48,818		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
15.1	100	0.0192	0.11		**Sheet Flow, Sheet Flow** Grass: Short n= 0.150 P2= 1.39"
2.1	123	0.0190	0.96		**Shallow Concentrated Flow, Shallow Conc.** Short Grass Pasture Kv= 7.0 fps
17.2	223	Total			

Subcatchment S8C2: Subcatchment 8C-2



Summary for Subcatchment S8C3: Subcatchment 8C-3

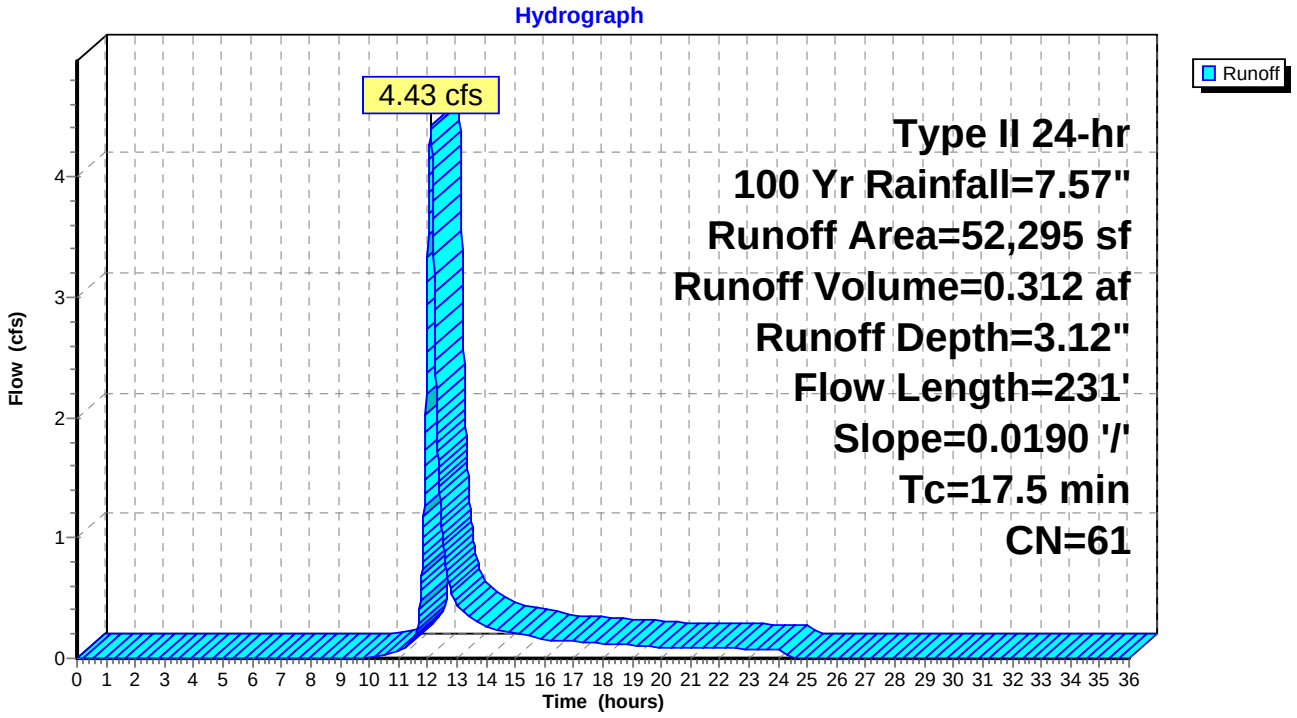
Runoff = 4.43 cfs @ 12.11 hrs, Volume= 0.312 af, Depth= 3.12"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
Type II 24-hr 100 Yr Rainfall=7.57"

Area (sf)	CN	Description
52,295	61	>75% Grass cover, Good, HSG B
52,295		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
15.2	100	0.0190	0.11		**Sheet Flow, Sheet Flow** Grass: Short n= 0.150 P2= 1.39"
2.3	131	0.0190	0.96		**Shallow Concentrated Flow, Shallow Conc.** Short Grass Pasture Kv= 7.0 fps
17.5	231	Total			

Subcatchment S8C3: Subcatchment 8C-3



Summary for Subcatchment S9A: Subcatchment 9A

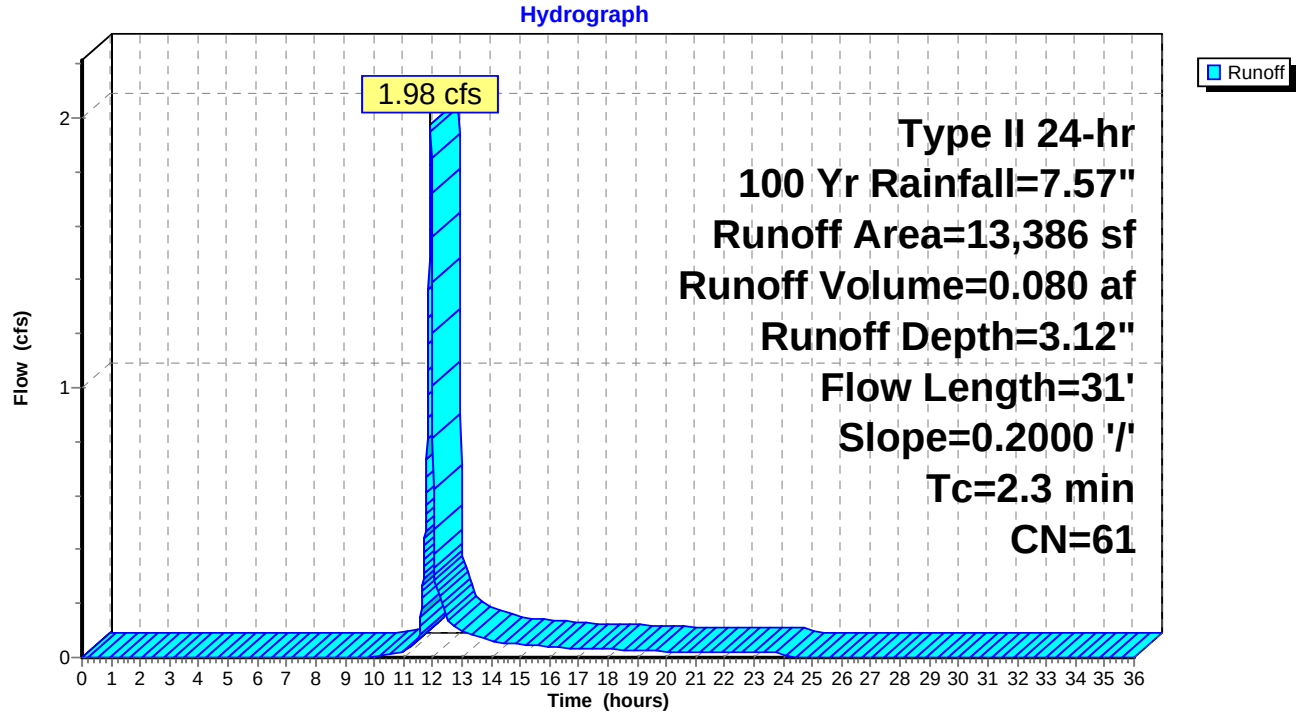
Runoff = 1.98 cfs @ 11.93 hrs, Volume= 0.080 af, Depth= 3.12"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
Type II 24-hr 100 Yr Rainfall=7.57"

Area (sf)	CN	Description
13,386	61	>75% Grass cover, Good, HSG B
13,386		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
2.3	31	0.2000	0.22		**Sheet Flow, Sheet Flow** Grass: Short n= 0.150 P2= 1.39"

Subcatchment S9A: Subcatchment 9A



Summary for Subcatchment S9B: Subcatchment 9B

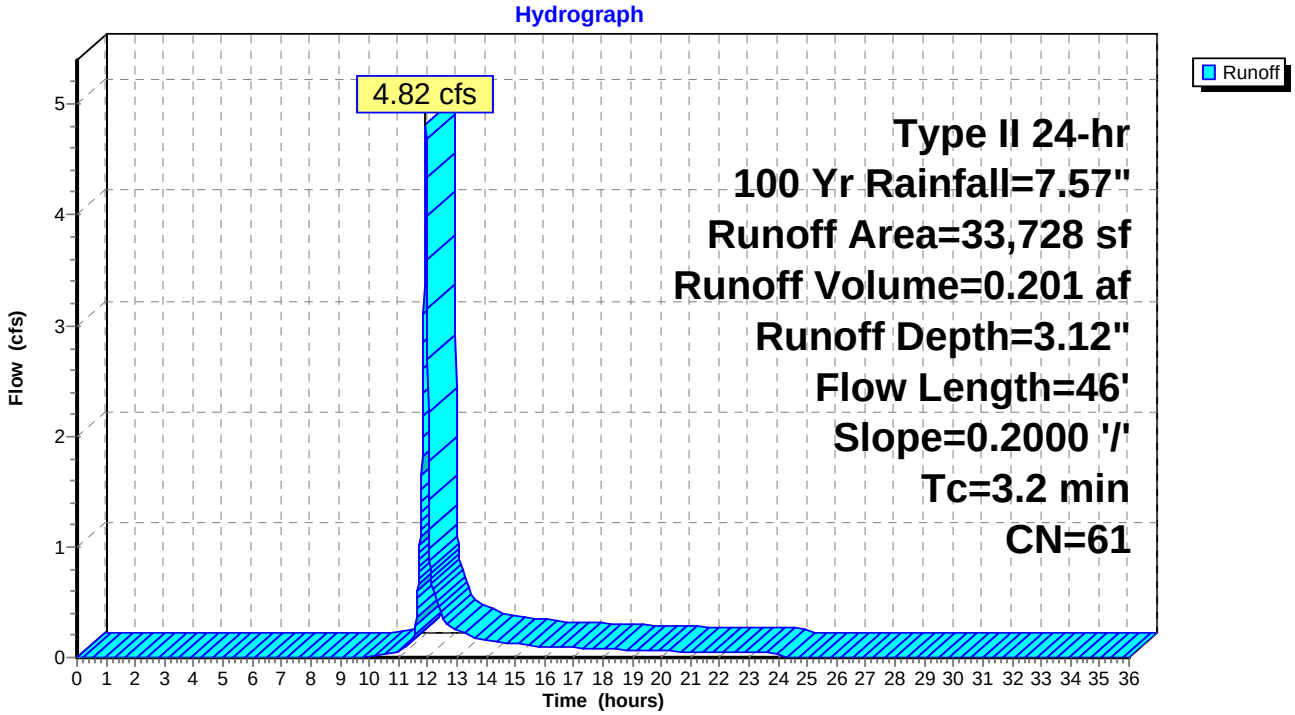
Runoff = 4.82 cfs @ 11.94 hrs, Volume= 0.201 af, Depth= 3.12"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
Type II 24-hr 100 Yr Rainfall=7.57"

Area (sf)	CN	Description
33,728	61	>75% Grass cover, Good, HSG B
33,728		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
3.2	46	0.2000	0.24		**Sheet Flow, Sheet Flow** Grass: Short n= 0.150 P2= 1.39"

Subcatchment S9B: Subcatchment 9B



Summary for Subcatchment SC3: Subcatchment To Outlet C-3

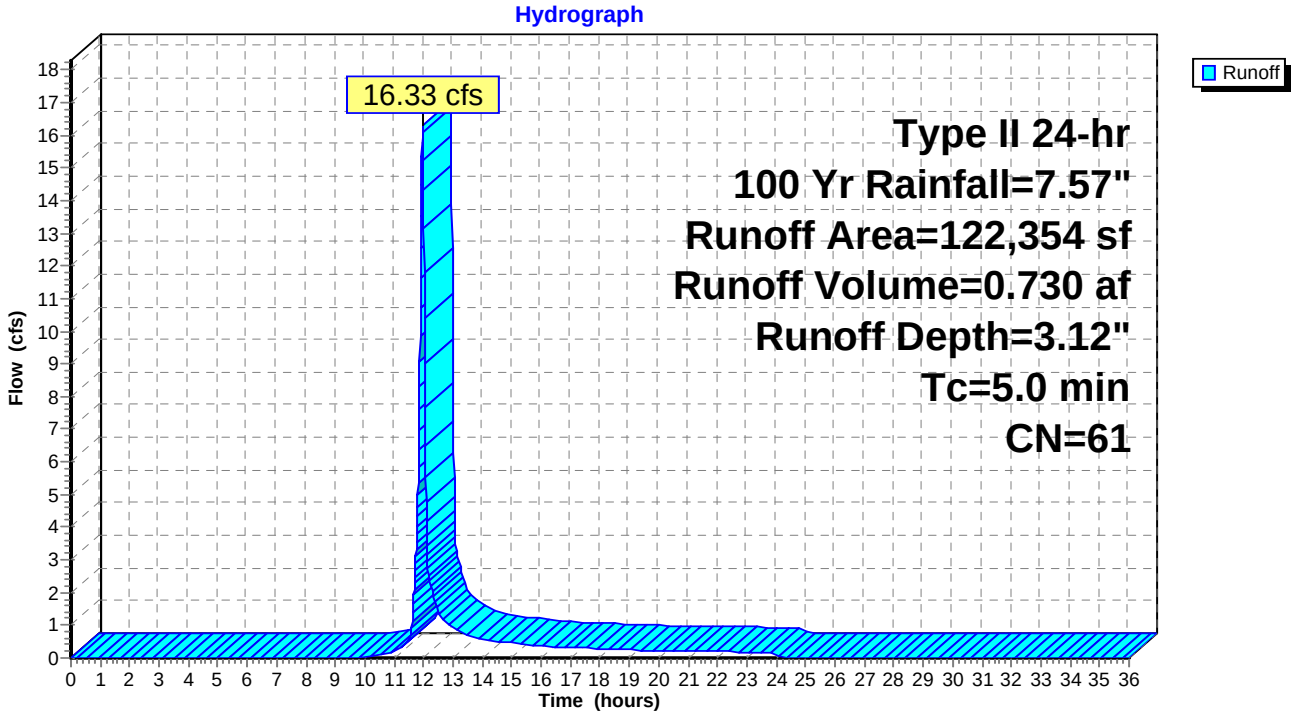
Runoff = 16.33 cfs @ 11.96 hrs, Volume= 0.730 af, Depth= 3.12"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
Type II 24-hr 100 Yr Rainfall=7.57"

Area (sf)	CN	Description
122,354	61	>75% Grass cover, Good, HSG B
122,354		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.0					**Direct Entry, Direct Entry**

Subcatchment SC3: Subcatchment To Outlet C-3



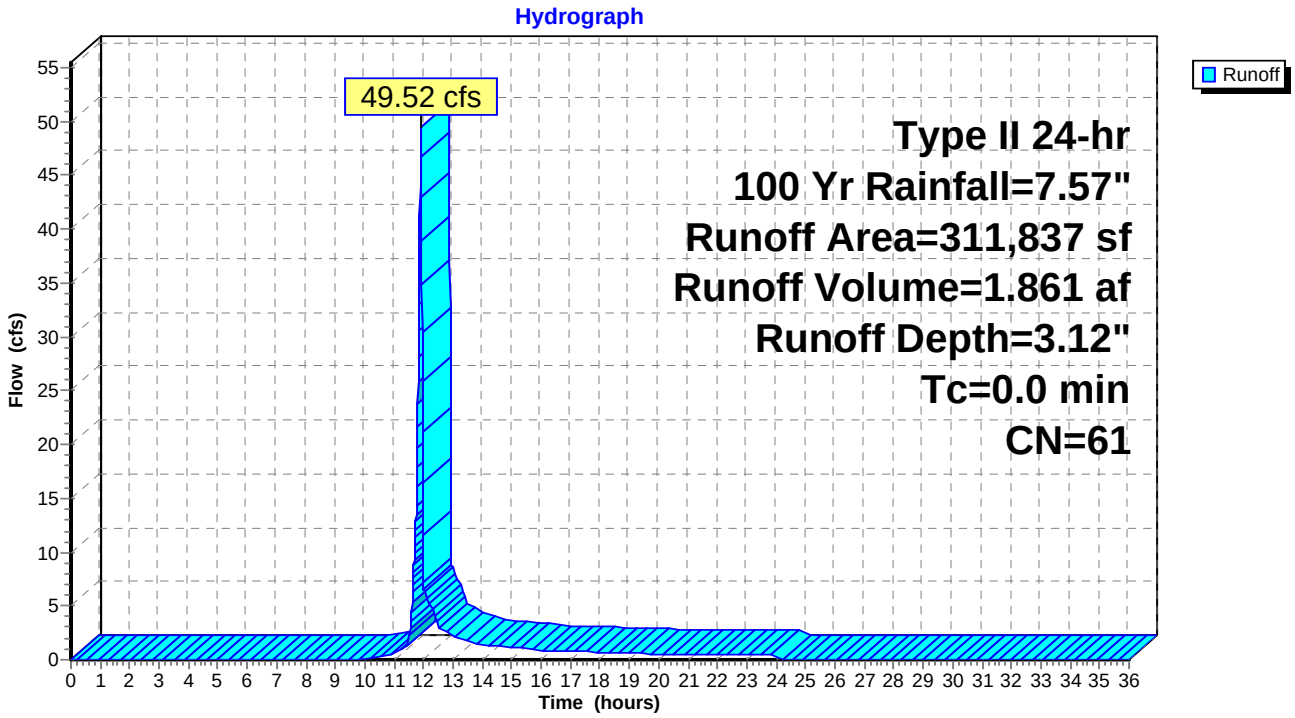
Summary for Subcatchment SWD2: Subcatchment West Ditch 2

Runoff = 49.52 cfs @ 11.90 hrs, Volume= 1.861 af, Depth= 3.12"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
Type II 24-hr 100 Yr Rainfall=7.57"

Area (sf)	CN	Description
311,837	61	>75% Grass cover, Good, HSG B
311,837		100.00% Pervious Area

Subcatchment SWD2: Subcatchment West Ditch 2



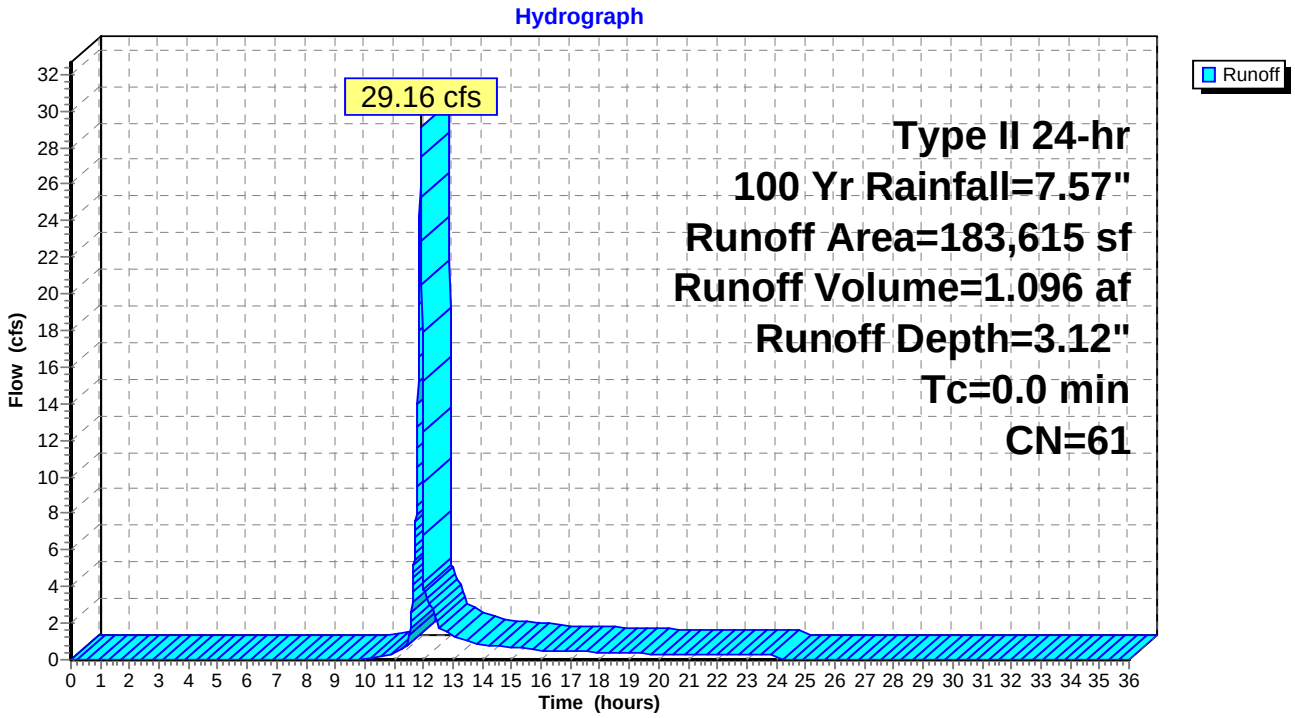
Summary for Subcatchment SWD3: Subcatchment West Ditch 3

Runoff = 29.16 cfs @ 11.90 hrs, Volume= 1.096 af, Depth= 3.12"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
Type II 24-hr 100 Yr Rainfall=7.57"

Area (sf)	CN	Description
183,615	61	>75% Grass cover, Good, HSG B
183,615		100.00% Pervious Area

Subcatchment SWD3: Subcatchment West Ditch 3



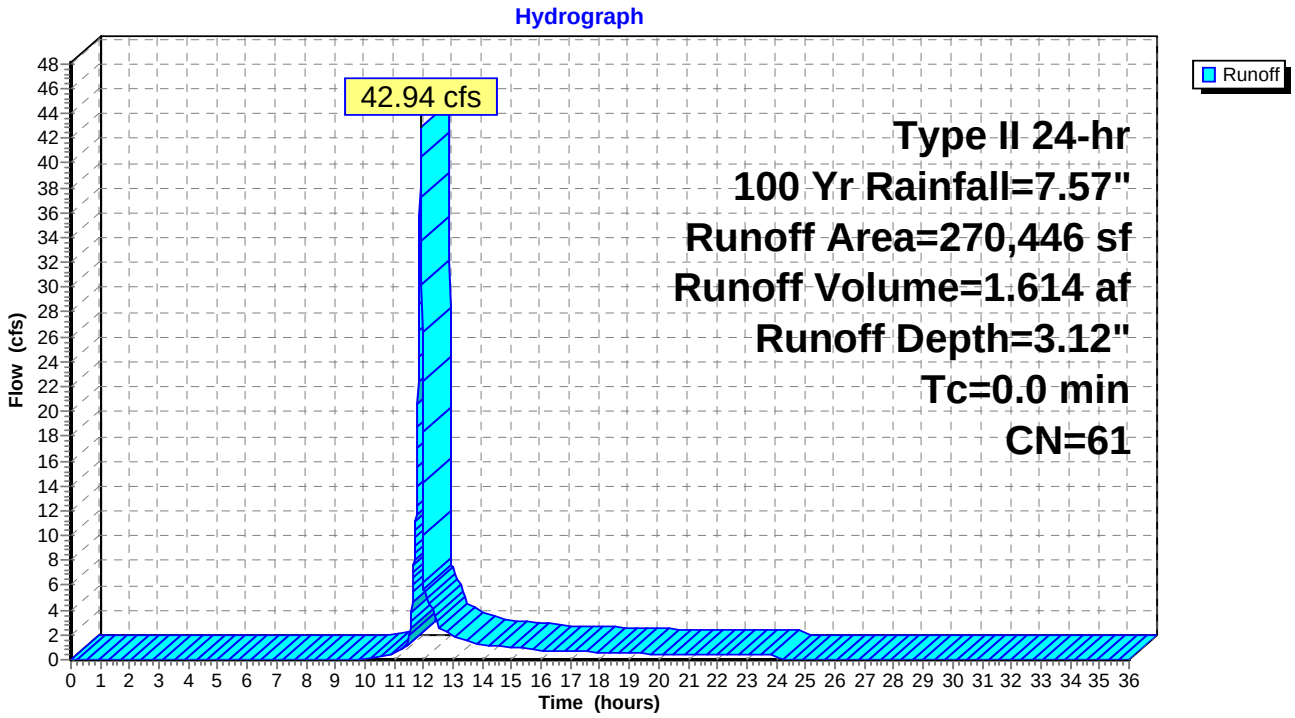
Summary for Subcatchment SWD4: Subcatchment West Ditch 4

Runoff = 42.94 cfs @ 11.90 hrs, Volume= 1.614 af, Depth= 3.12"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
Type II 24-hr 100 Yr Rainfall=7.57"

Area (sf)	CN	Description
270,446	61	>75% Grass cover, Good, HSG B
270,446		100.00% Pervious Area

Subcatchment SWD4: Subcatchment West Ditch 4



Summary for Reach 6RR: Outlet 6 Riprap

Inflow Area = 13.968 ac, 0.00% Impervious, Inflow Depth = 3.12" for 100 Yr event
Inflow = 22.13 cfs @ 12.48 hrs, Volume= 3.632 af
Outflow = 22.13 cfs @ 12.48 hrs, Volume= 3.632 af, Atten= 0%, Lag= 0.5 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs / 2
Max. Velocity= 5.35 fps, Min. Travel Time= 0.3 min
Avg. Velocity = 1.89 fps, Avg. Travel Time= 0.9 min

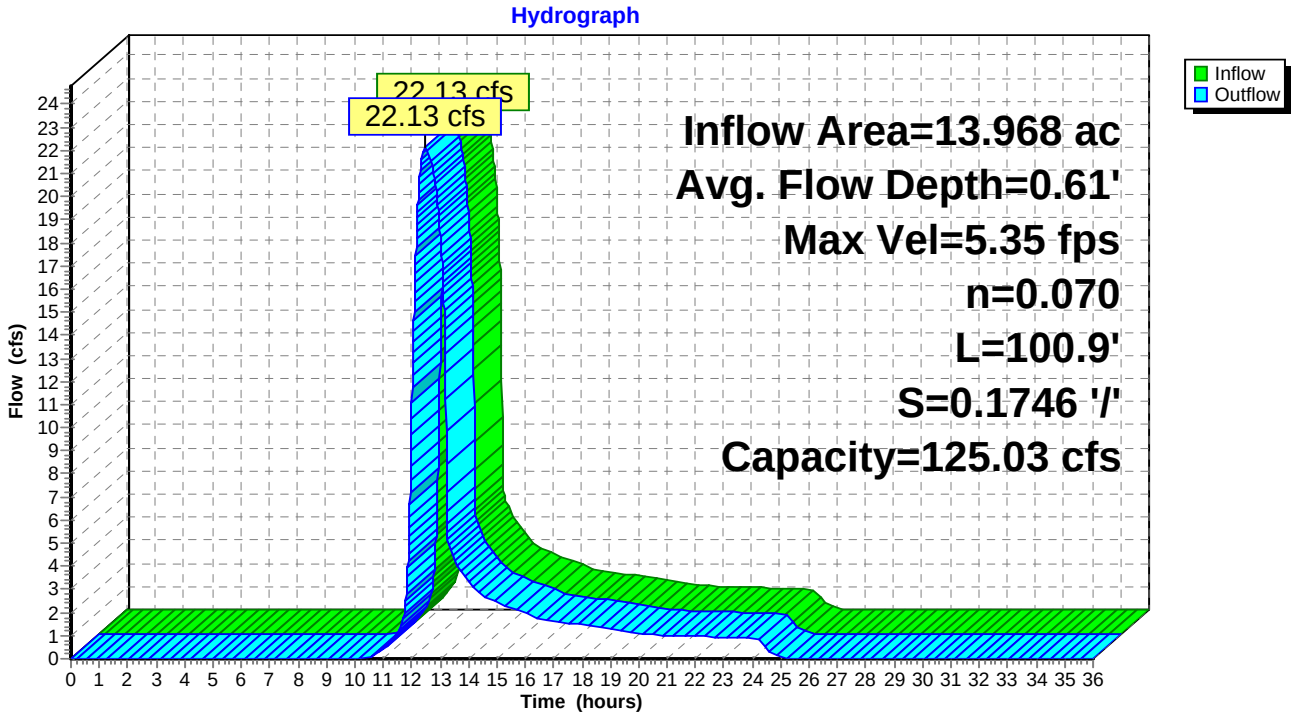
Peak Storage= 417 cf @ 12.48 hrs
Average Depth at Peak Storage= 0.61'
Bank-Full Depth= 1.50' Flow Area= 14.3 sf, Capacity= 125.03 cfs

5.00' x 1.50' deep channel, n= 0.070
Side Slope Z-value= 3.0 '/' Top Width= 14.00'
Length= 100.9' Slope= 0.1746 '/'
Inlet Invert= 397.65', Outlet Invert= 380.03'



‡

Reach 6RR: Outlet 6 Riprap



Summary for Reach 7RR: Outlet 7 Riprap

Inflow Area = 18.440 ac, 0.00% Impervious, Inflow Depth = 3.12" for 100 Yr event
Inflow = 23.42 cfs @ 12.56 hrs, Volume= 4.795 af
Outflow = 23.42 cfs @ 12.57 hrs, Volume= 4.795 af, Atten= 0%, Lag= 0.3 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs / 2
Max. Velocity= 6.28 fps, Min. Travel Time= 0.2 min
Avg. Velocity = 2.28 fps, Avg. Travel Time= 0.5 min

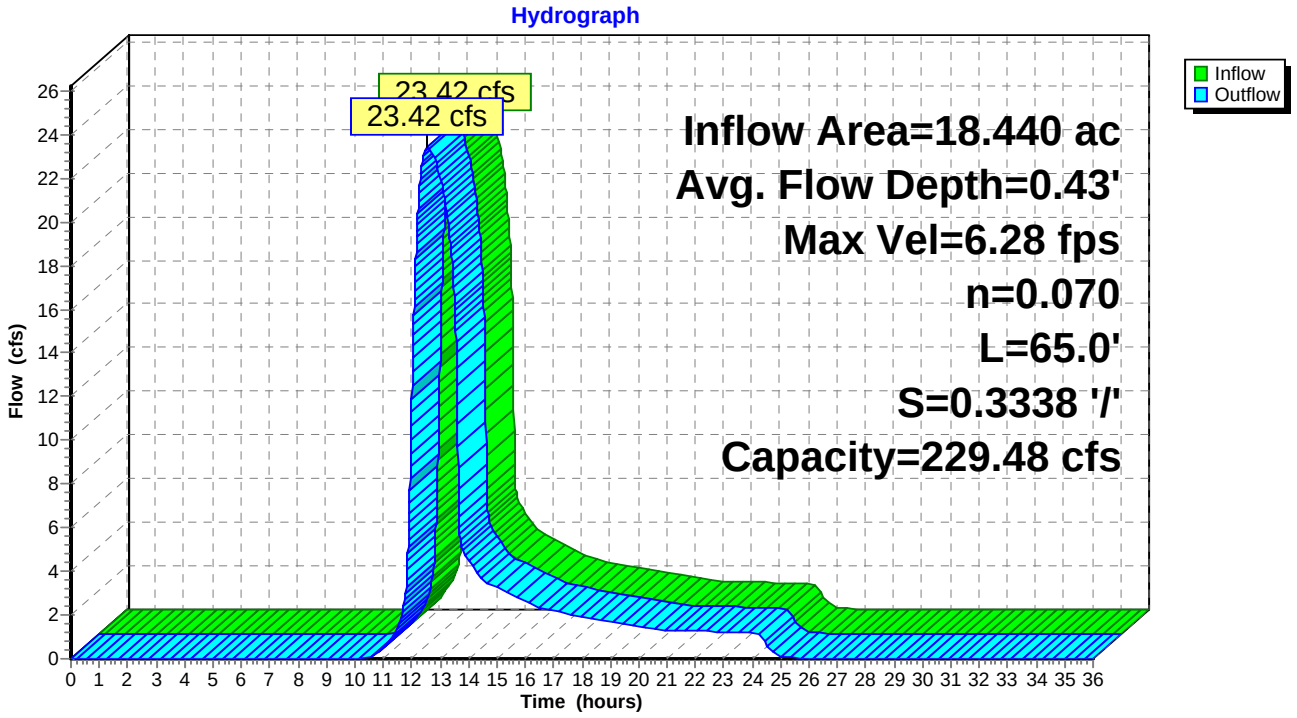
Peak Storage= 242 cf @ 12.56 hrs
Average Depth at Peak Storage= 0.43'
Bank-Full Depth= 1.50' Flow Area= 18.0 sf, Capacity= 229.48 cfs

7.50' x 1.50' deep channel, n= 0.070
Side Slope Z-value= 3.0 '/' Top Width= 16.50'
Length= 65.0' Slope= 0.3338 '/'
Inlet Invert= 398.67', Outlet Invert= 376.97'



‡

Reach 7RR: Outlet 7 Riprap



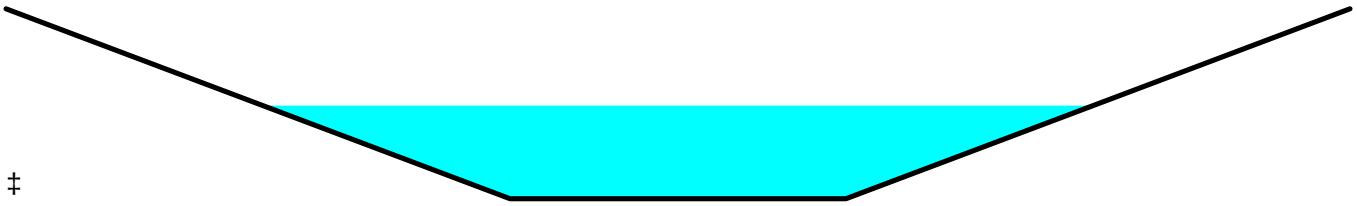
Summary for Reach 8RR: Outlet 8 Riprap

Inflow Area = 20.304 ac, 0.00% Impervious, Inflow Depth = 3.12" for 100 Yr event
Inflow = 23.99 cfs @ 12.58 hrs, Volume= 5.280 af
Outflow = 23.99 cfs @ 12.58 hrs, Volume= 5.280 af, Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs / 2
Max. Velocity= 6.26 fps, Min. Travel Time= 0.0 min
Avg. Velocity = 2.54 fps, Avg. Travel Time= 0.0 min

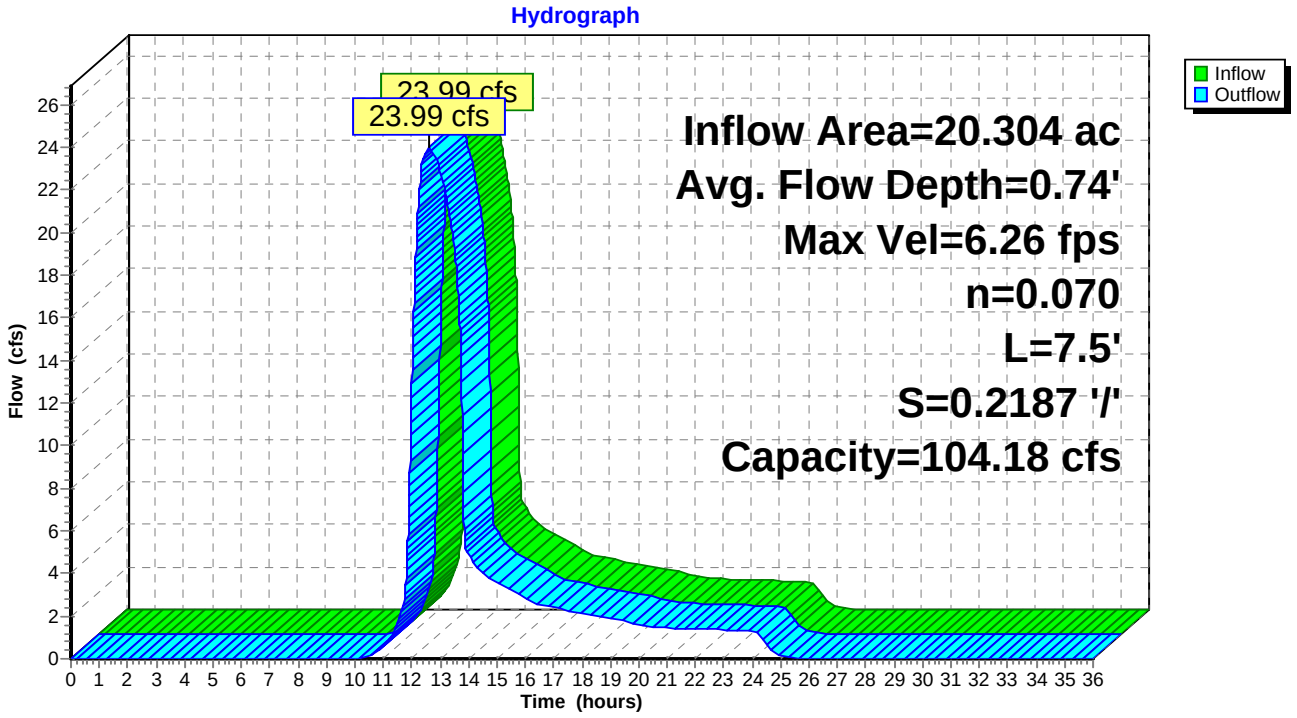
Peak Storage= 29 cf @ 12.58 hrs
Average Depth at Peak Storage= 0.74'
Bank-Full Depth= 1.50' Flow Area= 11.3 sf, Capacity= 104.18 cfs

3.00' x 1.50' deep channel, n= 0.070
Side Slope Z-value= 3.0 '/' Top Width= 12.00'
Length= 7.5' Slope= 0.2187 '/'
Inlet Invert= 398.57', Outlet Invert= 396.93'



‡

Reach 8RR: Outlet 8 Riprap



Summary for Reach 9RR: Outlet 9 Riprap

Inflow Area = 1.082 ac, 0.00% Impervious, Inflow Depth = 3.12" for 100 Yr event
Inflow = 3.33 cfs @ 12.10 hrs, Volume= 0.281 af
Outflow = 3.32 cfs @ 12.10 hrs, Volume= 0.281 af, Atten= 0%, Lag= 0.1 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs / 2
Max. Velocity= 2.04 fps, Min. Travel Time= 0.0 min
Avg. Velocity = 0.64 fps, Avg. Travel Time= 0.1 min

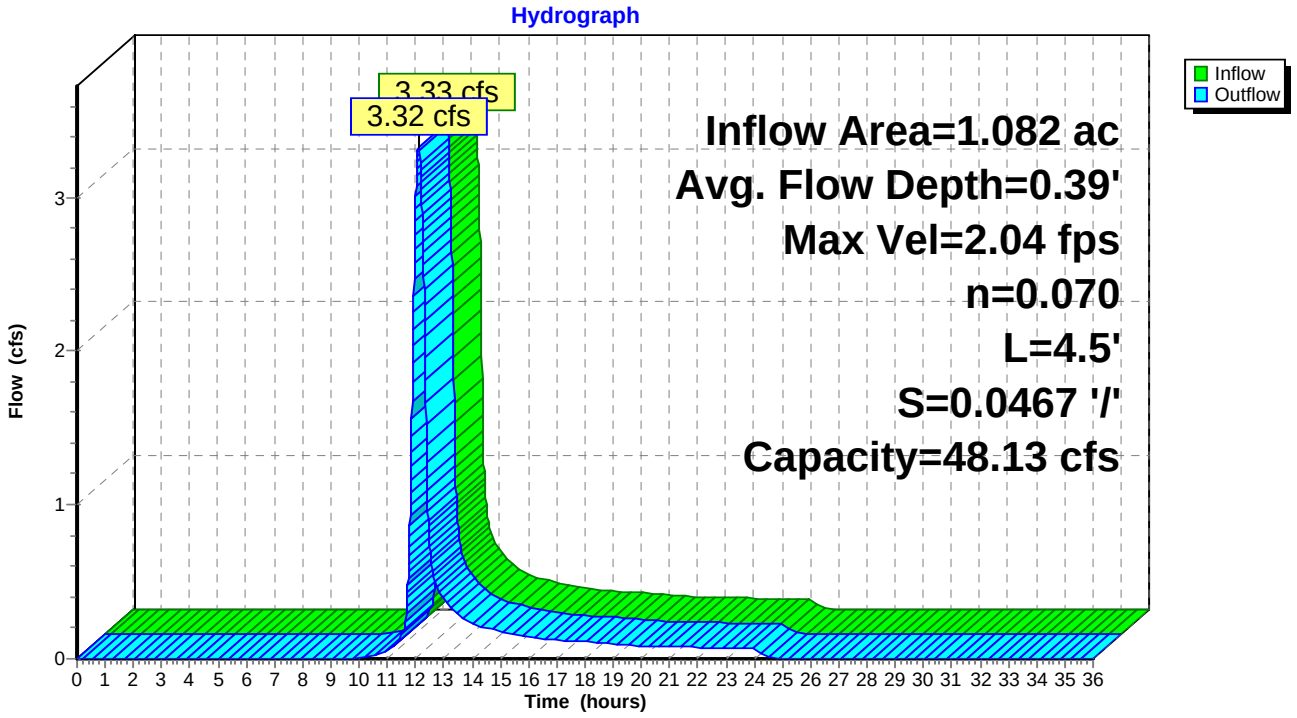
Peak Storage= 7 cf @ 12.10 hrs
Average Depth at Peak Storage= 0.39'
Bank-Full Depth= 1.50' Flow Area= 11.3 sf, Capacity= 48.13 cfs

3.00' x 1.50' deep channel, n= 0.070
Side Slope Z-value= 3.0 '/' Top Width= 12.00'
Length= 4.5' Slope= 0.0467 '/'
Inlet Invert= 400.94', Outlet Invert= 400.73'



‡

Reach 9RR: Outlet 9 Riprap



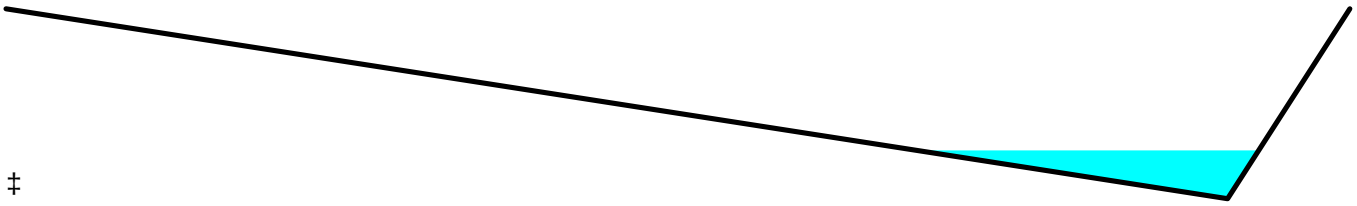
Summary for Reach C6A: Channel 6A

Inflow Area = 2.472 ac, 0.00% Impervious, Inflow Depth = 3.12" for 100 Yr event
Inflow = 9.06 cfs @ 12.10 hrs, Volume= 0.643 af
Outflow = 8.31 cfs @ 12.24 hrs, Volume= 0.643 af, Atten= 8%, Lag= 8.2 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
Max. Velocity= 2.07 fps, Min. Travel Time= 4.7 min
Avg. Velocity = 0.77 fps, Avg. Travel Time= 12.6 min

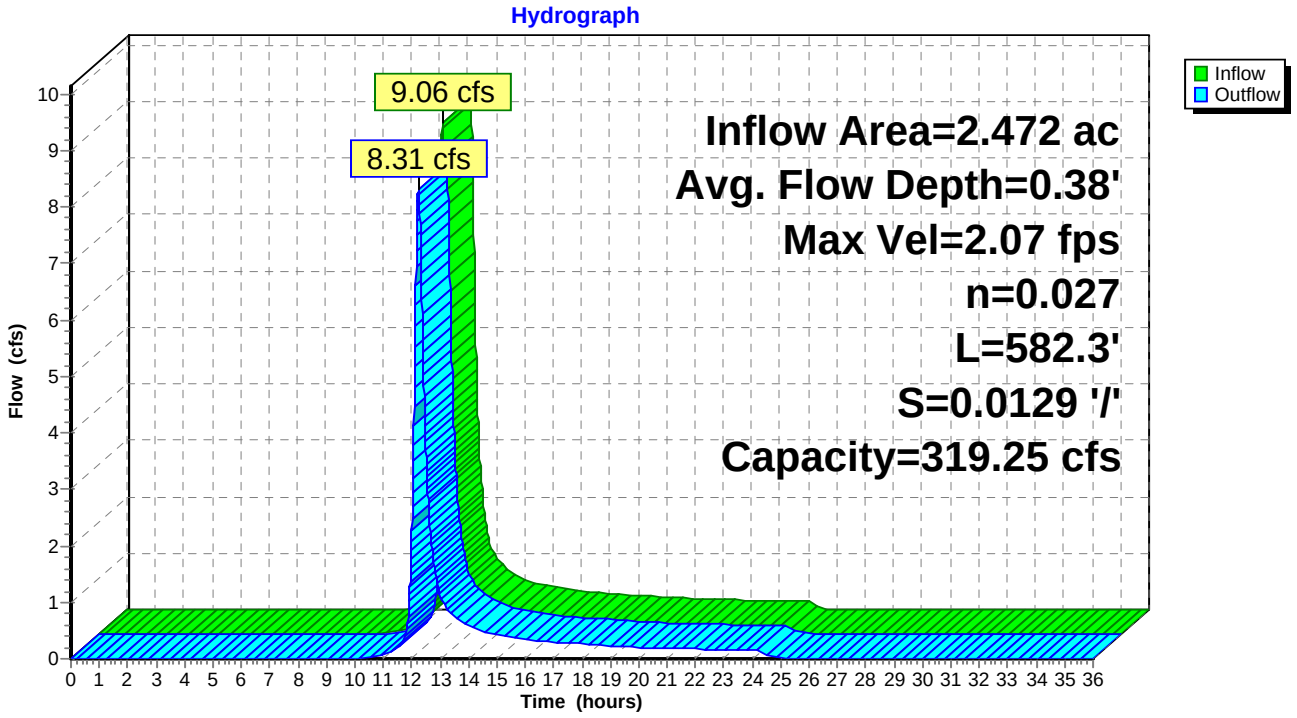
Peak Storage= 2,335 cf @ 12.16 hrs
Average Depth at Peak Storage= 0.38'
Bank-Full Depth= 1.50' Flow Area= 61.9 sf, Capacity= 319.25 cfs

0.00' x 1.50' deep channel, n= 0.027
Side Slope Z-value= 50.0 5.0 '/' Top Width= 82.50'
Length= 582.3' Slope= 0.0129 '/'
Inlet Invert= 408.42', Outlet Invert= 400.89'



‡

Reach C6A: Channel 6A



Summary for Reach C6B1: Channel 6B-1

Inflow Area = 9.474 ac, 0.00% Impervious, Inflow Depth = 3.12" for 100 Yr event
Inflow = 30.73 cfs @ 12.22 hrs, Volume= 2.463 af
Outflow = 30.70 cfs @ 12.23 hrs, Volume= 2.463 af, Atten= 0%, Lag= 0.7 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
Max. Velocity= 3.53 fps, Min. Travel Time= 0.4 min
Avg. Velocity = 1.04 fps, Avg. Travel Time= 1.4 min

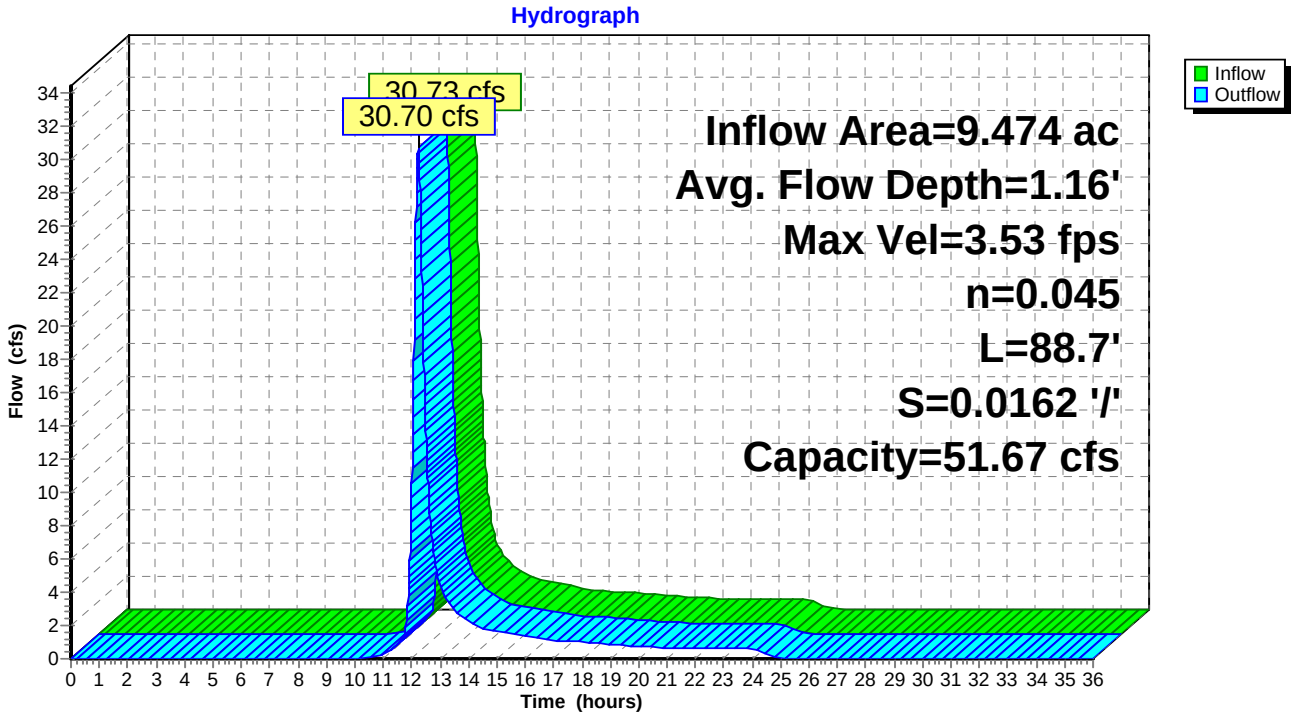
Peak Storage= 773 cf @ 12.23 hrs
Average Depth at Peak Storage= 1.16'
Bank-Full Depth= 1.50' Flow Area= 12.8 sf, Capacity= 51.67 cfs

4.00' x 1.50' deep channel, n= 0.045
Side Slope Z-value= 3.0 '/' Top Width= 13.00'
Length= 88.7' Slope= 0.0162 '/'
Inlet Invert= 401.01', Outlet Invert= 399.57'



‡

Reach C6B1: Channel 6B-1



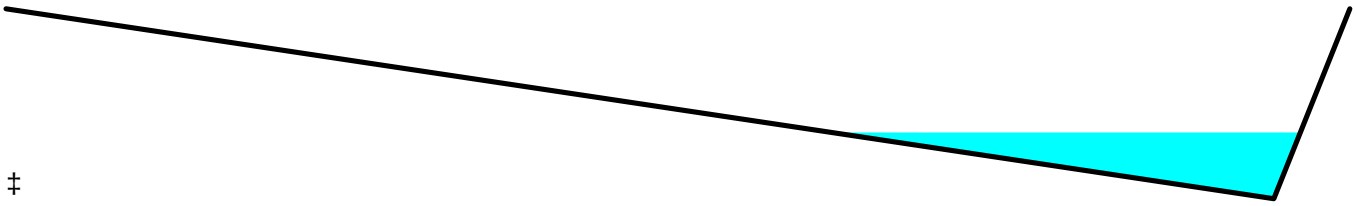
Summary for Reach C6B2: Channel 6B-2

Inflow Area = 2.000 ac, 0.00% Impervious, Inflow Depth = 3.12" for 100 Yr event
Inflow = 7.23 cfs @ 12.11 hrs, Volume= 0.520 af
Outflow = 6.76 cfs @ 12.23 hrs, Volume= 0.520 af, Atten= 7%, Lag= 7.1 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
Max. Velocity= 2.09 fps, Min. Travel Time= 4.1 min
Avg. Velocity = 0.77 fps, Avg. Travel Time= 11.2 min

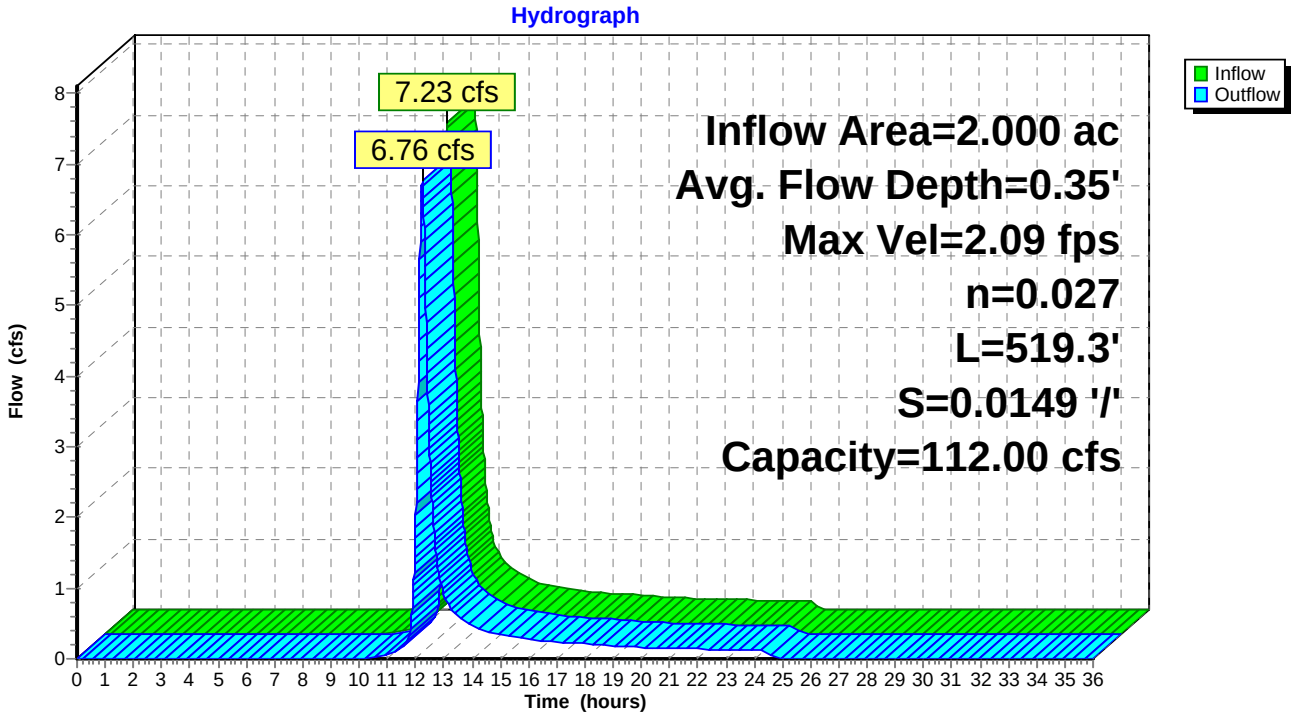
Peak Storage= 1,675 cf @ 12.16 hrs
Average Depth at Peak Storage= 0.35'
Bank-Full Depth= 1.00' Flow Area= 26.5 sf, Capacity= 112.00 cfs

0.00' x 1.00' deep channel, n= 0.027
Side Slope Z-value= 50.0 3.0 '/' Top Width= 53.00'
Length= 519.3' Slope= 0.0149 '/'
Inlet Invert= 410.04', Outlet Invert= 402.29'



‡

Reach C6B2: Channel 6B-2



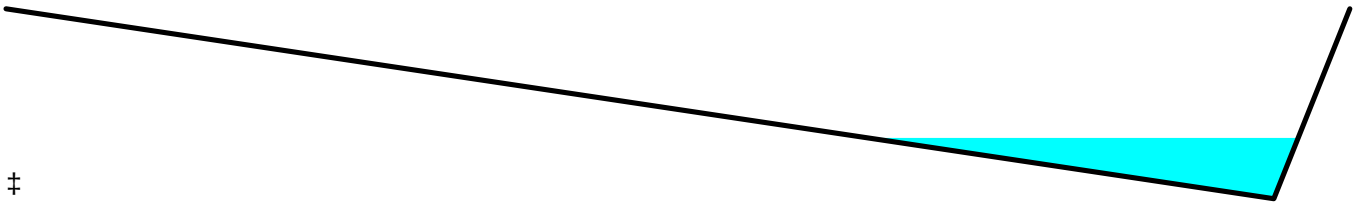
Summary for Reach C6B3: Channel 6B-3

Inflow Area = 1.569 ac, 0.00% Impervious, Inflow Depth = 3.12" for 100 Yr event
Inflow = 5.68 cfs @ 12.11 hrs, Volume= 0.408 af
Outflow = 5.39 cfs @ 12.21 hrs, Volume= 0.408 af, Atten= 5%, Lag= 6.1 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
Max. Velocity= 1.98 fps, Min. Travel Time= 3.5 min
Avg. Velocity = 0.75 fps, Avg. Travel Time= 9.4 min

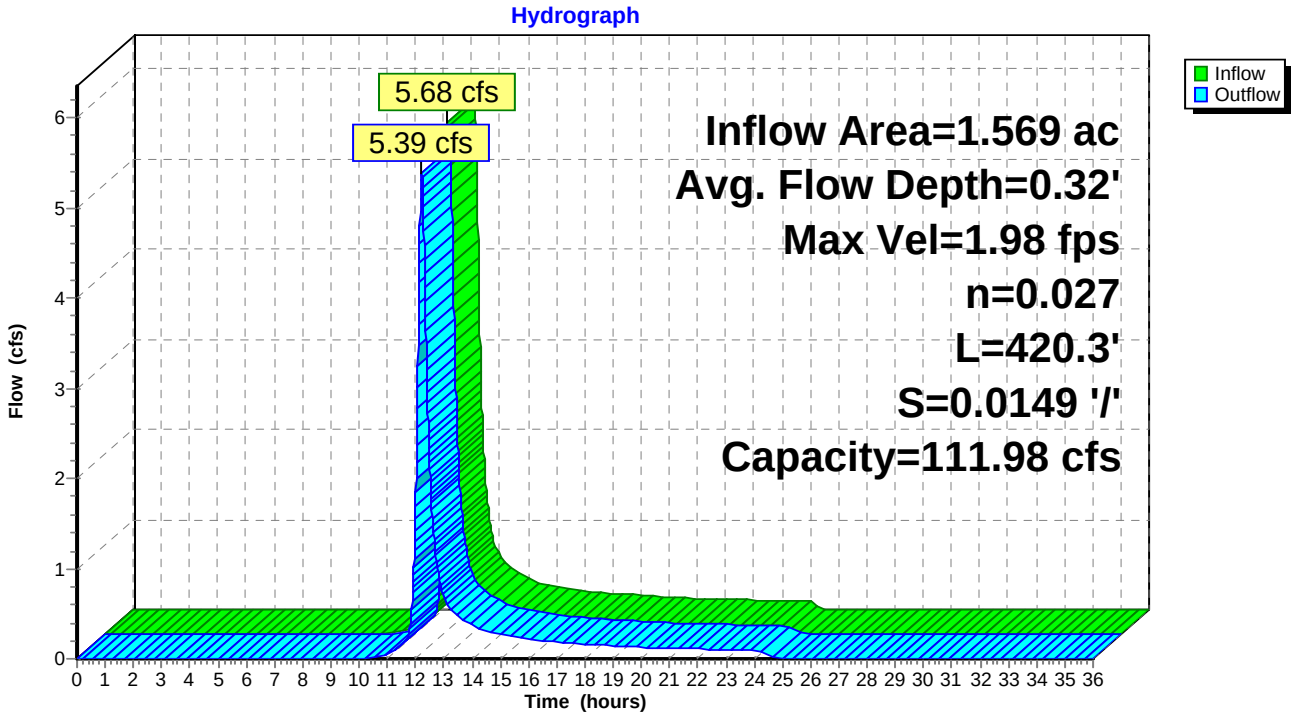
Peak Storage= 1,144 cf @ 12.16 hrs
Average Depth at Peak Storage= 0.32'
Bank-Full Depth= 1.00' Flow Area= 26.5 sf, Capacity= 111.98 cfs

0.00' x 1.00' deep channel, n= 0.027
Side Slope Z-value= 50.0 3.0 '/' Top Width= 53.00'
Length= 420.3' Slope= 0.0149 '/'
Inlet Invert= 408.56', Outlet Invert= 402.29'



‡

Reach C6B3: Channel 6B-3



Summary for Reach C6B4: Channel 6B-4

Inflow Area = 5.630 ac, 0.00% Impervious, Inflow Depth = 3.12" for 100 Yr event
Inflow = 18.17 cfs @ 12.19 hrs, Volume= 1.464 af
Outflow = 18.10 cfs @ 12.22 hrs, Volume= 1.464 af, Atten= 0%, Lag= 1.9 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
Max. Velocity= 3.05 fps, Min. Travel Time= 1.1 min
Avg. Velocity = 0.90 fps, Avg. Travel Time= 3.7 min

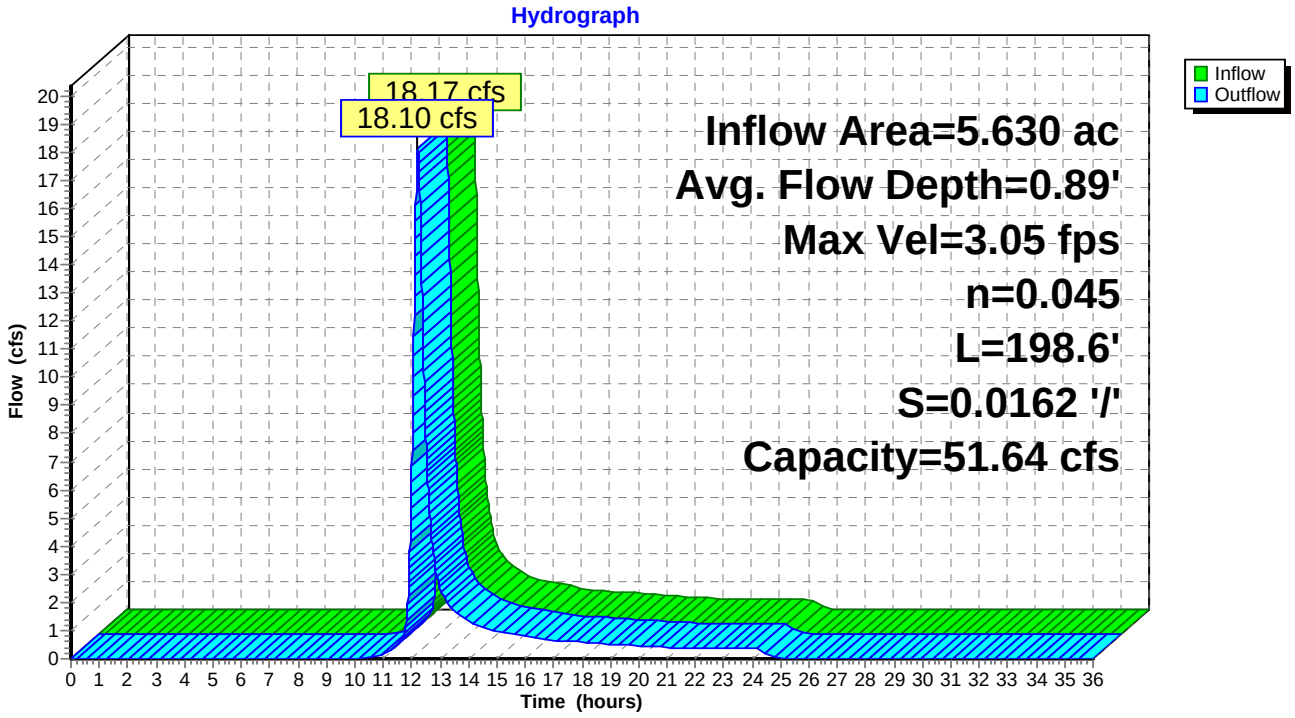
Peak Storage= 1,180 cf @ 12.20 hrs
Average Depth at Peak Storage= 0.89'
Bank-Full Depth= 1.50' Flow Area= 12.8 sf, Capacity= 51.64 cfs

4.00' x 1.50' deep channel, n= 0.045
Side Slope Z-value= 3.0 '/' Top Width= 13.00'
Length= 198.6' Slope= 0.0162 '/'
Inlet Invert= 404.23', Outlet Invert= 401.01'



‡

Reach C6B4: Channel 6B-4



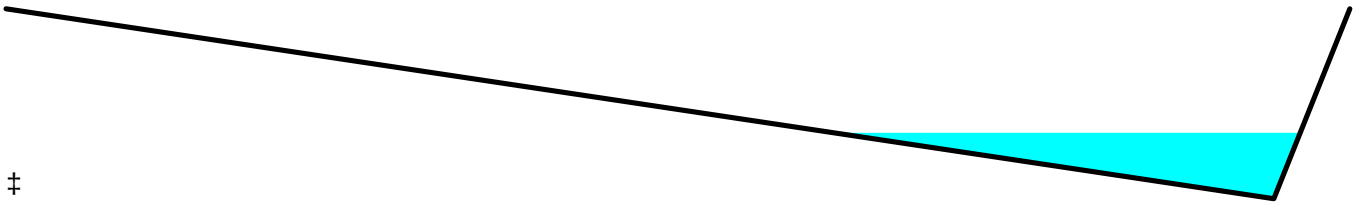
Summary for Reach C6B5: Channel 6B-5

Inflow Area = 2.004 ac, 0.00% Impervious, Inflow Depth = 3.12" for 100 Yr event
Inflow = 7.20 cfs @ 12.11 hrs, Volume= 0.521 af
Outflow = 6.69 cfs @ 12.24 hrs, Volume= 0.521 af, Atten= 7%, Lag= 7.5 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
Max. Velocity= 2.09 fps, Min. Travel Time= 4.4 min
Avg. Velocity = 0.76 fps, Avg. Travel Time= 12.0 min

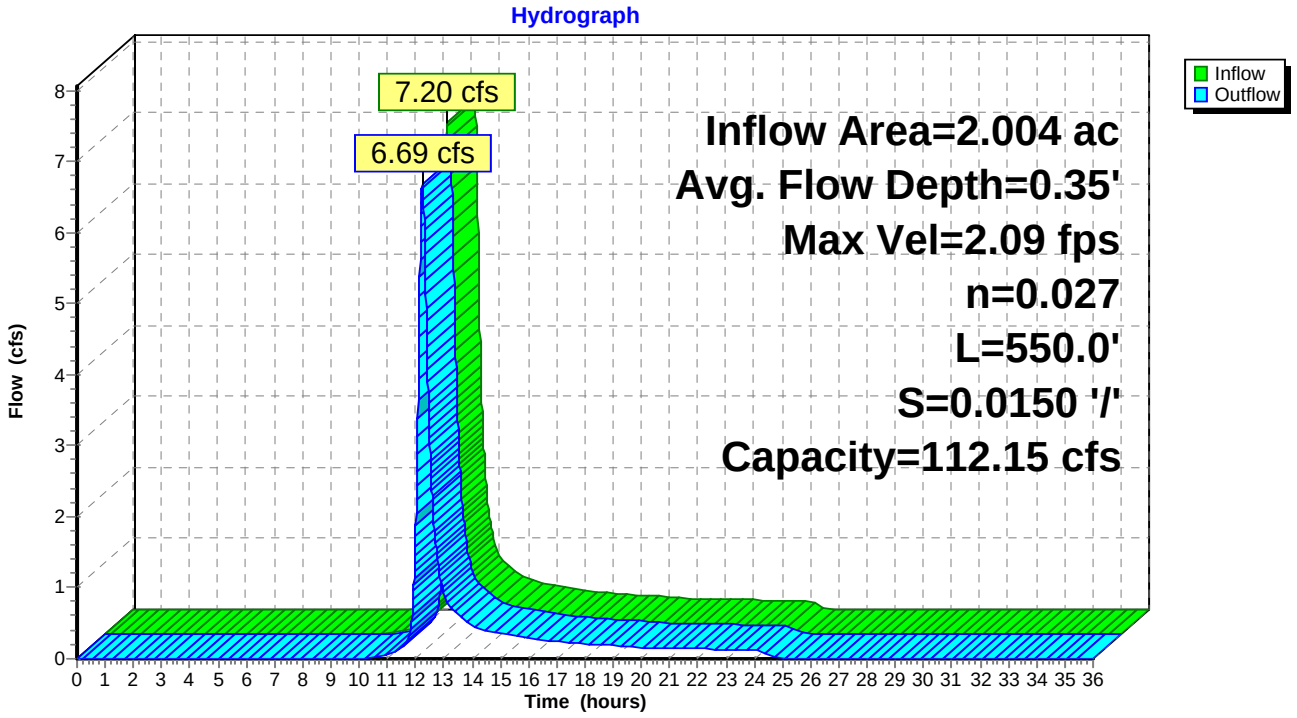
Peak Storage= 1,759 cf @ 12.17 hrs
Average Depth at Peak Storage= 0.35'
Bank-Full Depth= 1.00' Flow Area= 26.5 sf, Capacity= 112.15 cfs

0.00' x 1.00' deep channel, n= 0.027
Side Slope Z-value= 50.0 3.0 '/' Top Width= 53.00'
Length= 550.0' Slope= 0.0150 '/'
Inlet Invert= 413.13', Outlet Invert= 404.90'



‡

Reach C6B5: Channel 6B-5



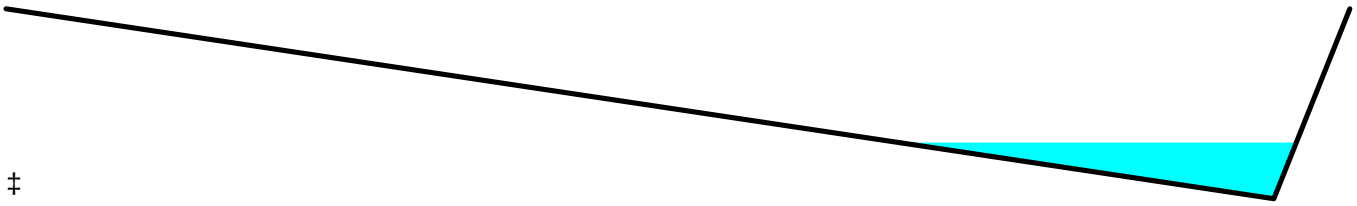
Summary for Reach C6B6: Channel 6B-6

Inflow Area = 1.325 ac, 0.00% Impervious, Inflow Depth = 3.12" for 100 Yr event
Inflow = 4.78 cfs @ 12.11 hrs, Volume= 0.344 af
Outflow = 4.51 cfs @ 12.22 hrs, Volume= 0.344 af, Atten= 6%, Lag= 6.5 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
Max. Velocity= 1.95 fps, Min. Travel Time= 3.7 min
Avg. Velocity = 0.74 fps, Avg. Travel Time= 9.7 min

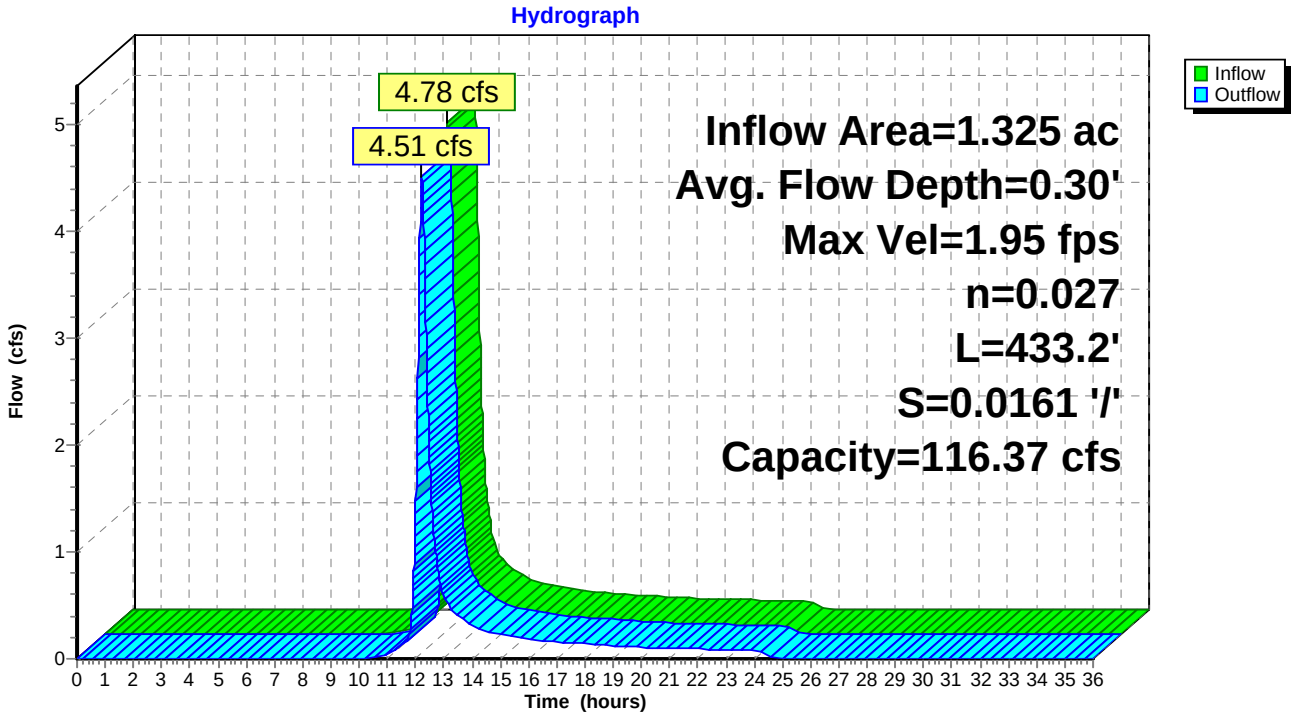
Peak Storage= 1,004 cf @ 12.16 hrs
Average Depth at Peak Storage= 0.30'
Bank-Full Depth= 1.00' Flow Area= 26.5 sf, Capacity= 116.37 cfs

0.00' x 1.00' deep channel, n= 0.027
Side Slope Z-value= 50.0 3.0 '/' Top Width= 53.00'
Length= 433.2' Slope= 0.0161 '/'
Inlet Invert= 411.88', Outlet Invert= 404.90'



‡

Reach C6B6: Channel 6B-6



Summary for Reach C6B7: Channel 6B-7

Inflow Area = 1.185 ac, 0.00% Impervious, Inflow Depth = 3.12" for 100 Yr event
Inflow = 4.37 cfs @ 12.11 hrs, Volume= 0.308 af
Outflow = 4.33 cfs @ 12.15 hrs, Volume= 0.308 af, Atten= 1%, Lag= 2.4 min

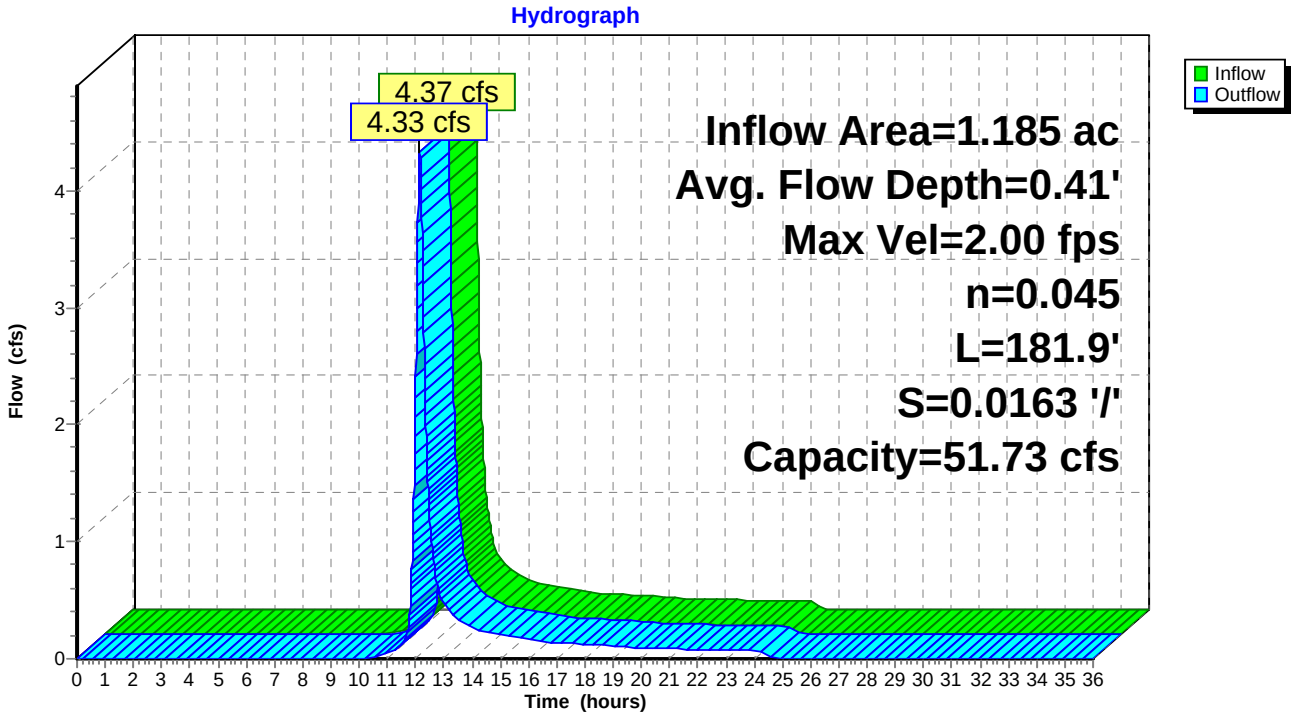
Routing by Stor-Ind+Trans method, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
Max. Velocity= 2.00 fps, Min. Travel Time= 1.5 min
Avg. Velocity = 0.59 fps, Avg. Travel Time= 5.1 min

Peak Storage= 394 cf @ 12.12 hrs
Average Depth at Peak Storage= 0.41'
Bank-Full Depth= 1.50' Flow Area= 12.8 sf, Capacity= 51.73 cfs

4.00' x 1.50' deep channel, n= 0.045
Side Slope Z-value= 3.0 '/' Top Width= 13.00'
Length= 181.9' Slope= 0.0163 '/'
Inlet Invert= 407.19', Outlet Invert= 404.23'



Reach C6B7: Channel 6B-7



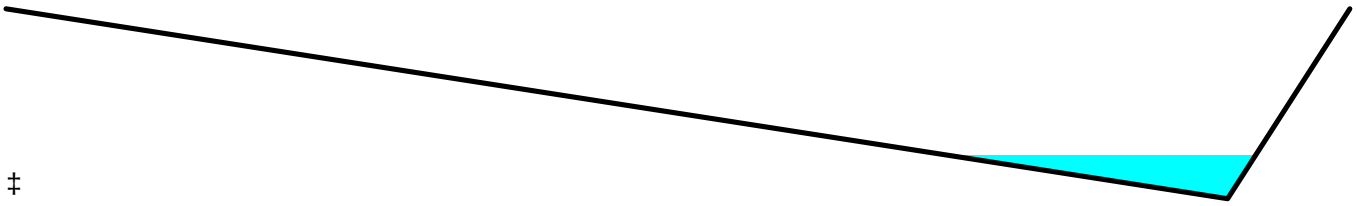
Summary for Reach C6C: Channel 6C

Inflow Area = 2.022 ac, 0.00% Impervious, Inflow Depth = 3.12" for 100 Yr event
Inflow = 7.46 cfs @ 12.11 hrs, Volume= 0.526 af
Outflow = 6.89 cfs @ 12.23 hrs, Volume= 0.526 af, Atten= 8%, Lag= 7.4 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
Max. Velocity= 2.10 fps, Min. Travel Time= 4.4 min
Avg. Velocity = 0.80 fps, Avg. Travel Time= 11.5 min

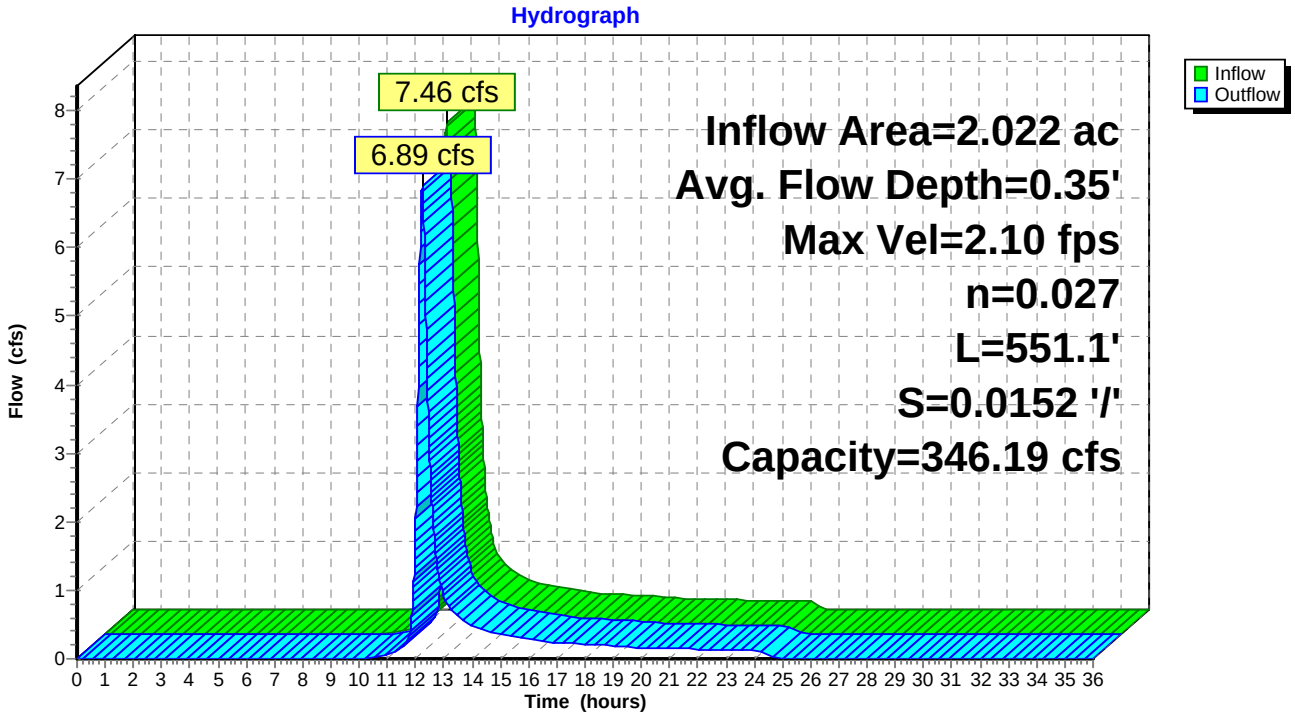
Peak Storage= 1,808 cf @ 12.16 hrs
Average Depth at Peak Storage= 0.35'
Bank-Full Depth= 1.50' Flow Area= 61.9 sf, Capacity= 346.19 cfs

0.00' x 1.50' deep channel, n= 0.027
Side Slope Z-value= 50.0 5.0 '/' Top Width= 82.50'
Length= 551.1' Slope= 0.0152 '/'
Inlet Invert= 409.28', Outlet Invert= 400.90'



‡

Reach C6C: Channel 6C



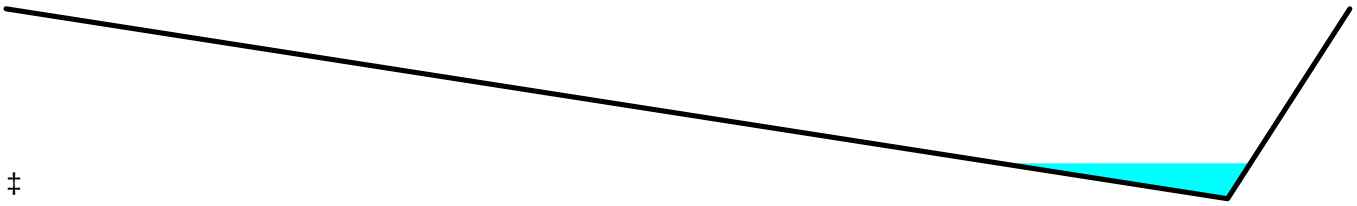
Summary for Reach C7A: Channel 7A

Inflow Area = 1.154 ac, 0.00% Impervious, Inflow Depth = 3.12" for 100 Yr event
Inflow = 4.26 cfs @ 12.11 hrs, Volume= 0.300 af
Outflow = 3.87 cfs @ 12.24 hrs, Volume= 0.300 af, Atten= 9%, Lag= 8.2 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
Max. Velocity= 1.81 fps, Min. Travel Time= 4.9 min
Avg. Velocity = 0.70 fps, Avg. Travel Time= 12.7 min

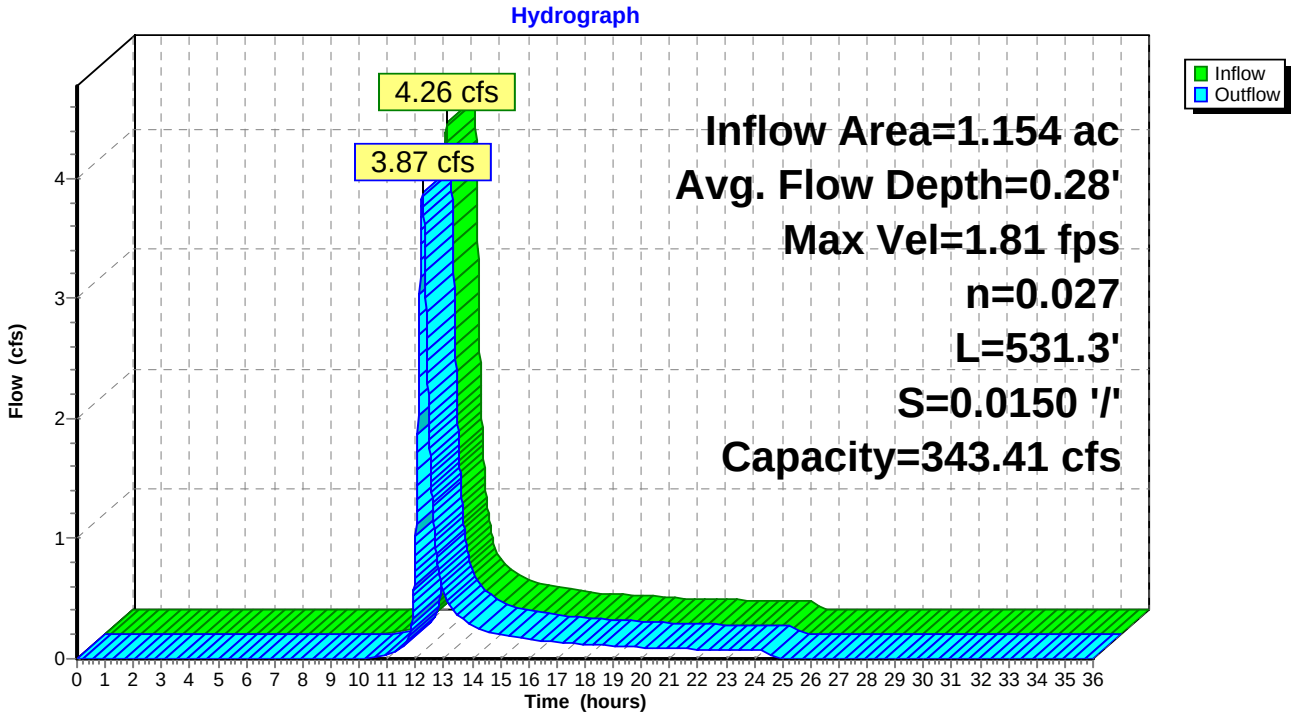
Peak Storage= 1,138 cf @ 12.16 hrs
Average Depth at Peak Storage= 0.28'
Bank-Full Depth= 1.50' Flow Area= 61.9 sf, Capacity= 343.41 cfs

0.00' x 1.50' deep channel, n= 0.027
Side Slope Z-value= 50.0 5.0 '/' Top Width= 82.50'
Length= 531.3' Slope= 0.0150 '/'
Inlet Invert= 409.60', Outlet Invert= 401.65'



‡

Reach C7A: Channel 7A



Summary for Reach C7B1: Channel 7B-1

Inflow Area = 13.302 ac, 0.00% Impervious, Inflow Depth = 3.12" for 100 Yr event
Inflow = 41.63 cfs @ 12.24 hrs, Volume= 3.459 af
Outflow = 41.55 cfs @ 12.26 hrs, Volume= 3.459 af, Atten= 0%, Lag= 1.3 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
Max. Velocity= 3.47 fps, Min. Travel Time= 0.7 min
Avg. Velocity = 1.02 fps, Avg. Travel Time= 2.5 min

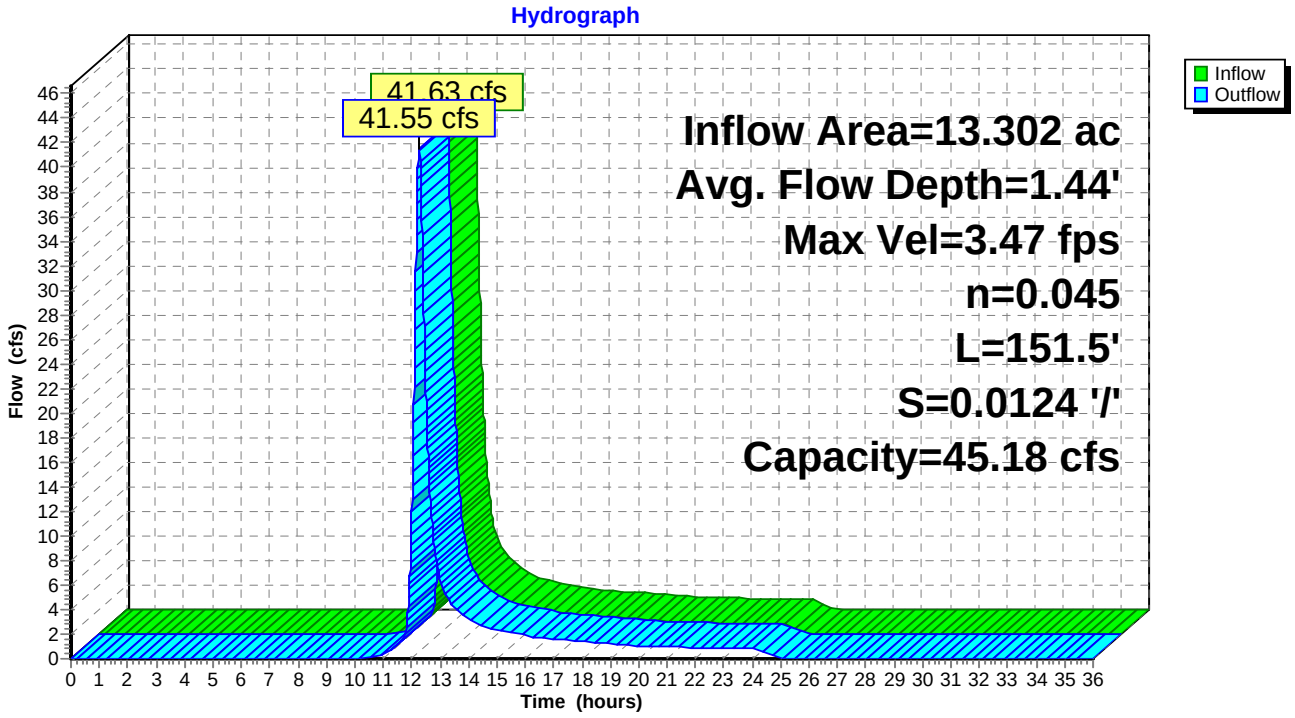
Peak Storage= 1,817 cf @ 12.25 hrs
Average Depth at Peak Storage= 1.44'
Bank-Full Depth= 1.50' Flow Area= 12.8 sf, Capacity= 45.18 cfs

4.00' x 1.50' deep channel, n= 0.045
Side Slope Z-value= 3.0 '/' Top Width= 13.00'
Length= 151.5' Slope= 0.0124 '/'
Inlet Invert= 402.11', Outlet Invert= 400.23'



‡

Reach C7B1: Channel 7B-1



Summary for Reach C7B10: Channel 7B-10

Inflow Area = 1.017 ac, 0.00% Impervious, Inflow Depth = 3.12" for 100 Yr event
Inflow = 3.68 cfs @ 12.11 hrs, Volume= 0.264 af
Outflow = 3.65 cfs @ 12.15 hrs, Volume= 0.264 af, Atten= 1%, Lag= 2.3 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
Max. Velocity= 1.73 fps, Min. Travel Time= 1.4 min
Avg. Velocity = 0.52 fps, Avg. Travel Time= 4.6 min

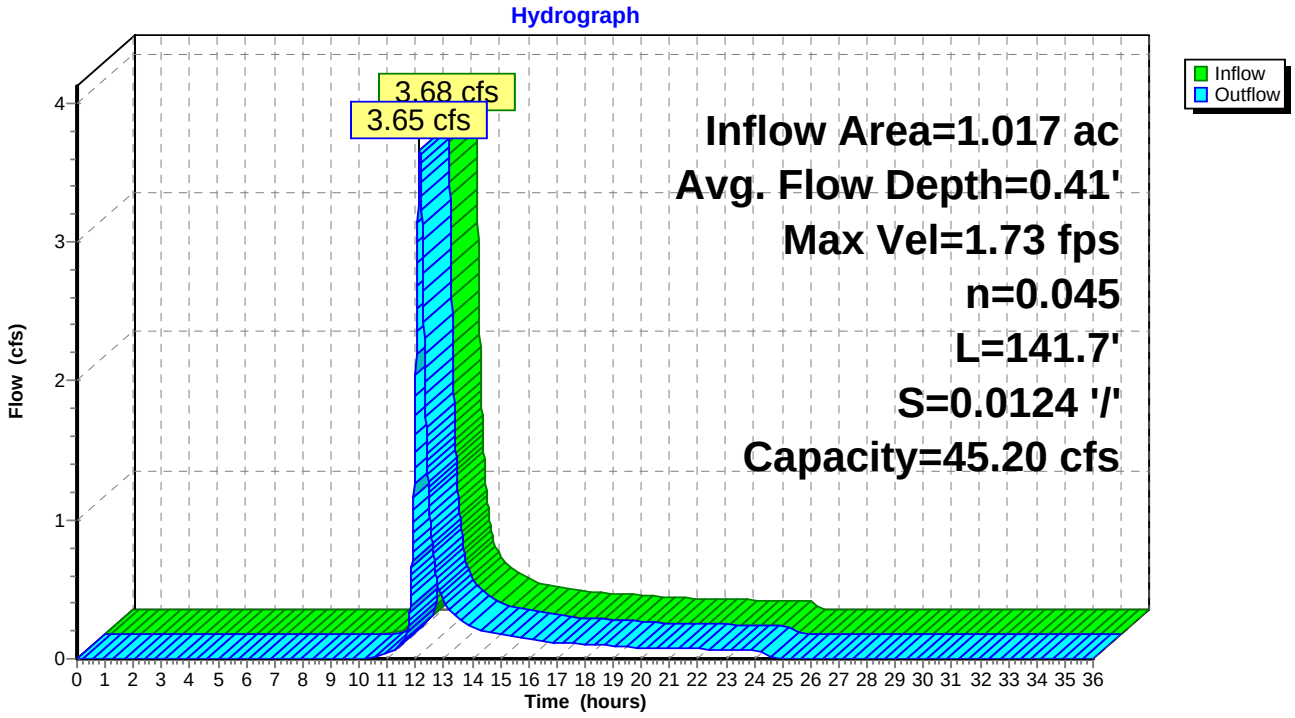
Peak Storage= 299 cf @ 12.13 hrs
Average Depth at Peak Storage= 0.41'
Bank-Full Depth= 1.50' Flow Area= 12.8 sf, Capacity= 45.20 cfs

4.00' x 1.50' deep channel, n= 0.045
Side Slope Z-value= 3.0 '/' Top Width= 13.00'
Length= 141.7' Slope= 0.0124 '/'
Inlet Invert= 407.78', Outlet Invert= 406.02'



‡

Reach C7B10: Channel 7B-10



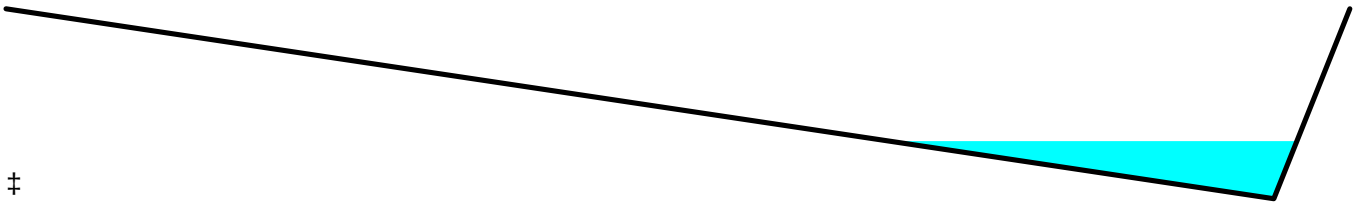
Summary for Reach C7B2: Channel 7B-2

Inflow Area = 1.457 ac, 0.00% Impervious, Inflow Depth = 3.12" for 100 Yr event
Inflow = 5.23 cfs @ 12.12 hrs, Volume= 0.379 af
Outflow = 4.83 cfs @ 12.24 hrs, Volume= 0.379 af, Atten= 8%, Lag= 7.6 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
Max. Velocity= 1.99 fps, Min. Travel Time= 4.5 min
Avg. Velocity = 0.74 fps, Avg. Travel Time= 12.0 min

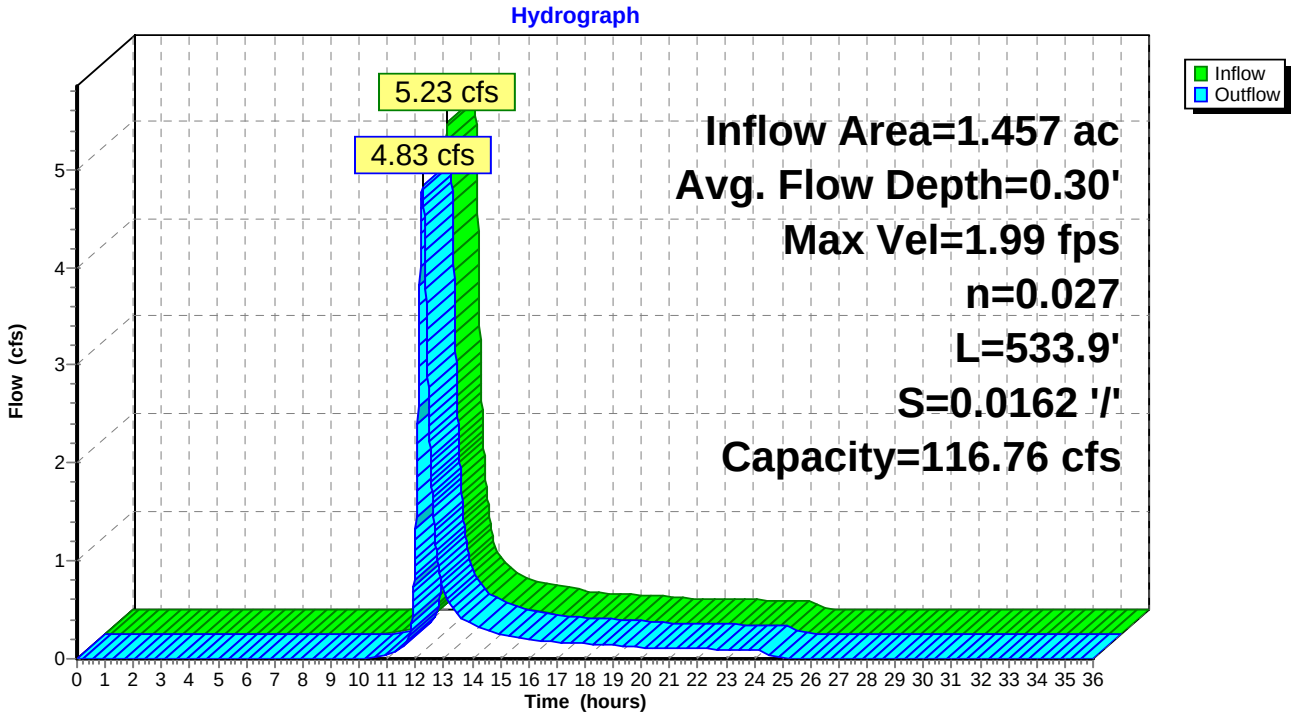
Peak Storage= 1,299 cf @ 12.17 hrs
Average Depth at Peak Storage= 0.30'
Bank-Full Depth= 1.00' Flow Area= 26.5 sf, Capacity= 116.76 cfs

0.00' x 1.00' deep channel, n= 0.027
Side Slope Z-value= 50.0 3.0 '/' Top Width= 53.00'
Length= 533.9' Slope= 0.0162 '/'
Inlet Invert= 411.98', Outlet Invert= 403.32'



‡

Reach C7B2: Channel 7B-2



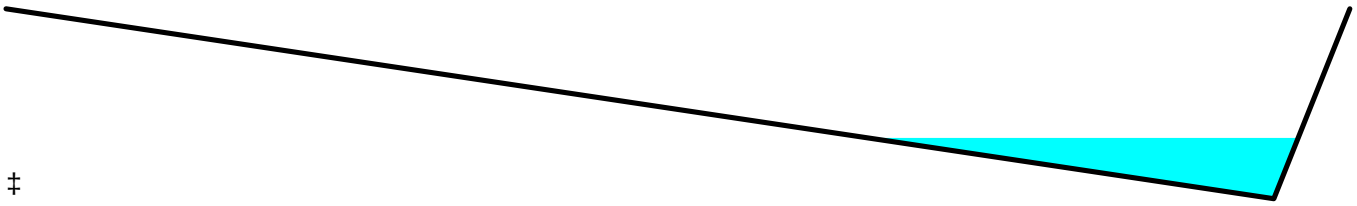
Summary for Reach C7B3: Channel 7B-3

Inflow Area = 1.590 ac, 0.00% Impervious, Inflow Depth = 3.12" for 100 Yr event
Inflow = 5.83 cfs @ 12.10 hrs, Volume= 0.414 af
Outflow = 5.36 cfs @ 12.24 hrs, Volume= 0.414 af, Atten= 8%, Lag= 8.0 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
Max. Velocity= 1.98 fps, Min. Travel Time= 4.6 min
Avg. Velocity = 0.73 fps, Avg. Travel Time= 12.4 min

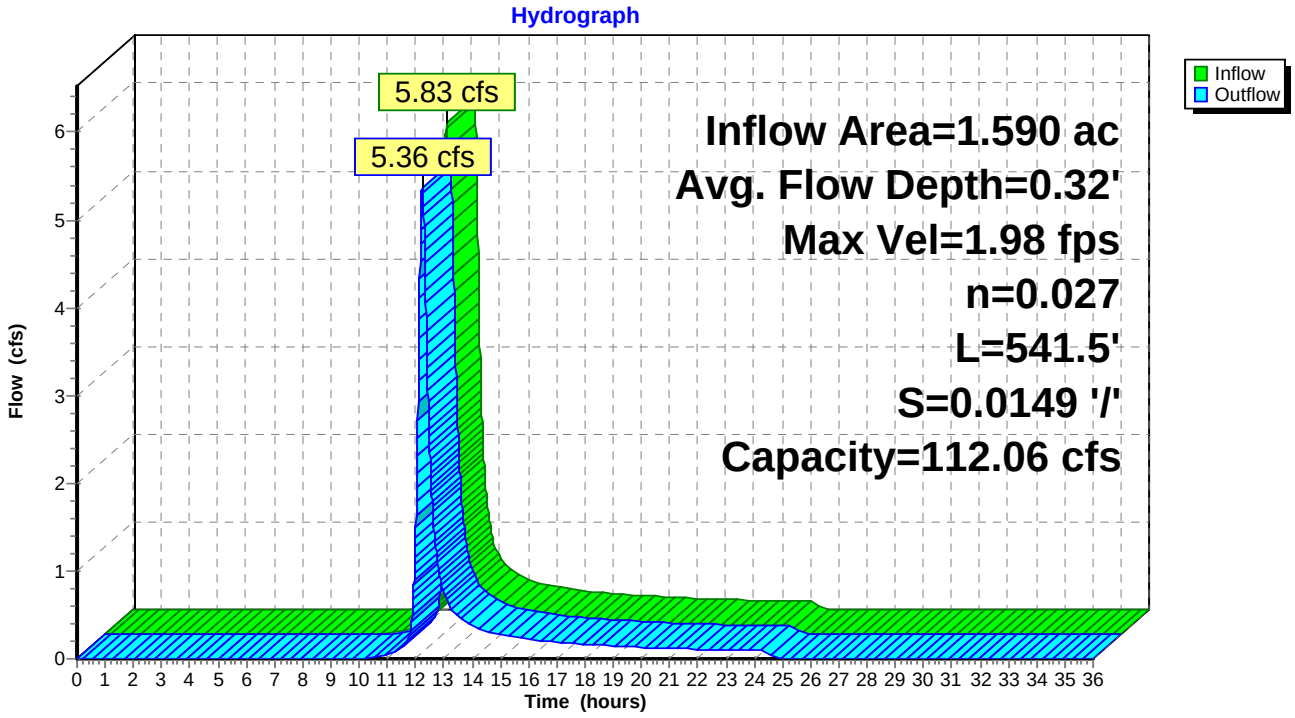
Peak Storage= 1,469 cf @ 12.16 hrs
Average Depth at Peak Storage= 0.32'
Bank-Full Depth= 1.00' Flow Area= 26.5 sf, Capacity= 112.06 cfs

0.00' x 1.00' deep channel, n= 0.027
Side Slope Z-value= 50.0 3.0 '/' Top Width= 53.00'
Length= 541.5' Slope= 0.0149 '/'
Inlet Invert= 411.43', Outlet Invert= 403.34'



‡

Reach C7B3: Channel 7B-3



Summary for Reach C7B4: Channel 7B-4

Inflow Area = 9.268 ac, 0.00% Impervious, Inflow Depth = 3.12" for 100 Yr event
Inflow = 29.13 cfs @ 12.23 hrs, Volume= 2.410 af
Outflow = 29.05 cfs @ 12.25 hrs, Volume= 2.410 af, Atten= 0%, Lag= 1.5 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
Max. Velocity= 3.15 fps, Min. Travel Time= 0.8 min
Avg. Velocity = 0.92 fps, Avg. Travel Time= 2.9 min

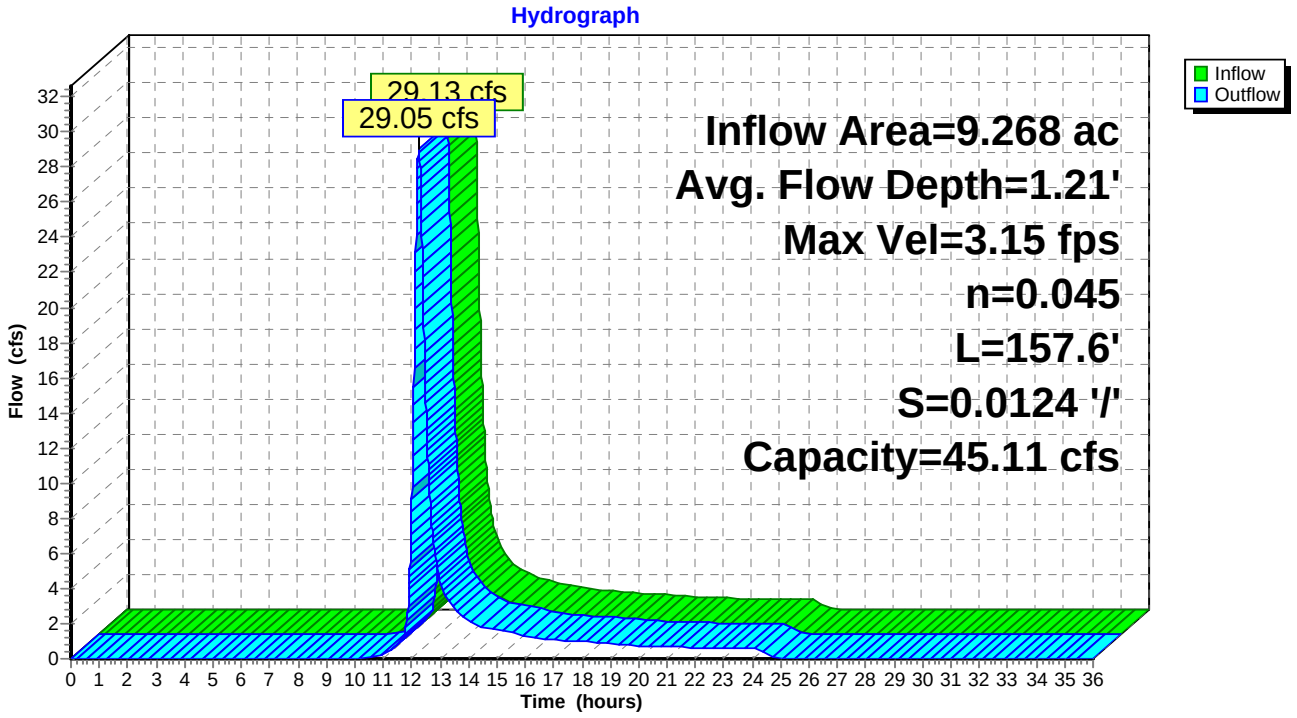
Peak Storage= 1,456 cf @ 12.24 hrs
Average Depth at Peak Storage= 1.21'
Bank-Full Depth= 1.50' Flow Area= 12.8 sf, Capacity= 45.11 cfs

4.00' x 1.50' deep channel, n= 0.045
Side Slope Z-value= 3.0 '/' Top Width= 13.00'
Length= 157.6' Slope= 0.0124 '/'
Inlet Invert= 404.06', Outlet Invert= 402.11'



‡

Reach C7B4: Channel 7B-4



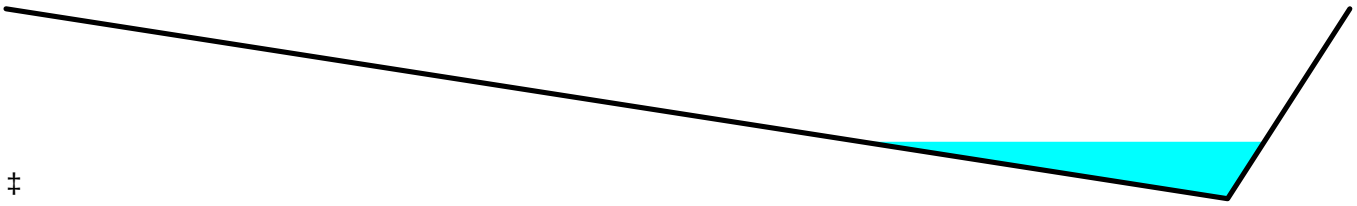
Summary for Reach C7B5: Channel 7B-5

Inflow Area = 1.478 ac, 0.00% Impervious, Inflow Depth = 3.12" for 100 Yr event
Inflow = 5.28 cfs @ 12.11 hrs, Volume= 0.384 af
Outflow = 4.88 cfs @ 12.25 hrs, Volume= 0.384 af, Atten= 8%, Lag= 8.0 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
Max. Velocity= 1.97 fps, Min. Travel Time= 4.5 min
Avg. Velocity = 0.74 fps, Avg. Travel Time= 12.2 min

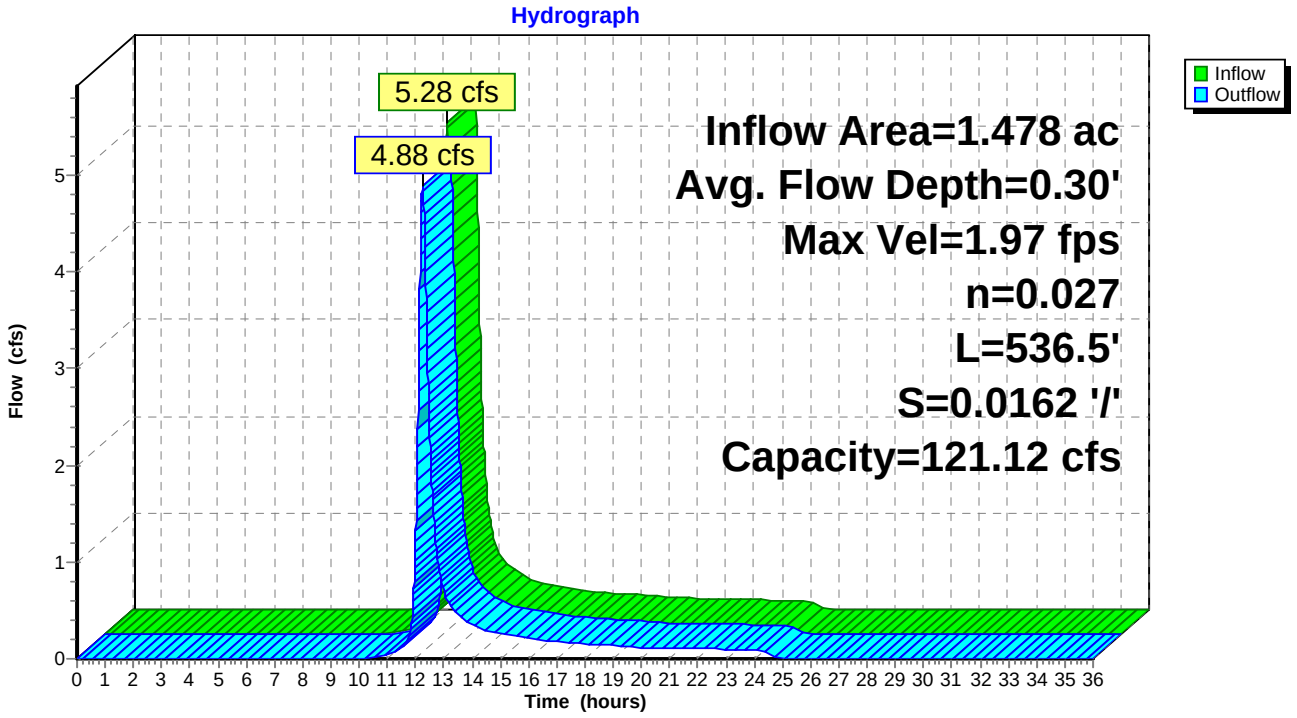
Peak Storage= 1,328 cf @ 12.17 hrs
Average Depth at Peak Storage= 0.30'
Bank-Full Depth= 1.00' Flow Area= 27.5 sf, Capacity= 121.12 cfs

0.00' x 1.00' deep channel, n= 0.027
Side Slope Z-value= 50.0 5.0 '/' Top Width= 55.00'
Length= 536.5' Slope= 0.0162 '/'
Inlet Invert= 413.58', Outlet Invert= 404.90'



‡

Reach C7B5: Channel 7B-5



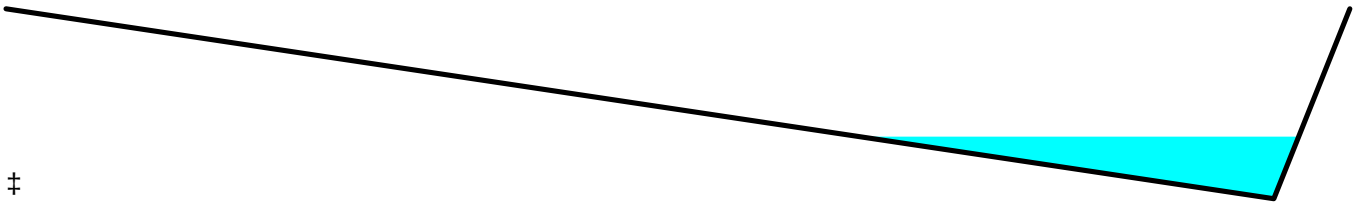
Summary for Reach C7B6: Channel 7B-6

Inflow Area = 1.688 ac, 0.00% Impervious, Inflow Depth = 3.12" for 100 Yr event
Inflow = 6.21 cfs @ 12.11 hrs, Volume= 0.439 af
Outflow = 5.69 cfs @ 12.24 hrs, Volume= 0.439 af, Atten= 8%, Lag= 8.0 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
Max. Velocity= 2.01 fps, Min. Travel Time= 4.7 min
Avg. Velocity = 0.73 fps, Avg. Travel Time= 12.8 min

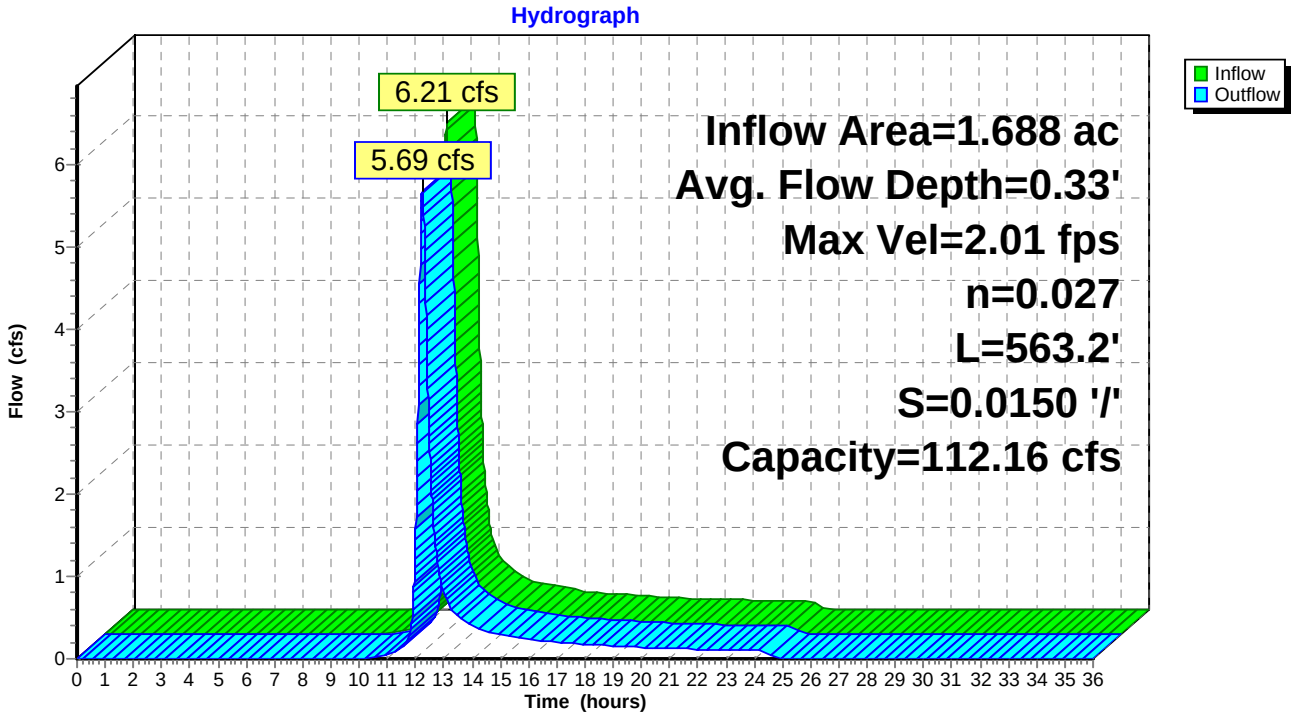
Peak Storage= 1,595 cf @ 12.16 hrs
Average Depth at Peak Storage= 0.33'
Bank-Full Depth= 1.00' Flow Area= 26.5 sf, Capacity= 112.16 cfs

0.00' x 1.00' deep channel, n= 0.027
Side Slope Z-value= 50.0 3.0 '/' Top Width= 53.00'
Length= 563.2' Slope= 0.0150 '/'
Inlet Invert= 413.33', Outlet Invert= 404.90'



‡

Reach C7B6: Channel 7B-6



Summary for Reach C7B7: Channel 7B-7

Inflow Area = 5.127 ac, 0.00% Impervious, Inflow Depth = 3.12" for 100 Yr event
Inflow = 16.12 cfs @ 12.21 hrs, Volume= 1.333 af
Outflow = 16.07 cfs @ 12.24 hrs, Volume= 1.333 af, Atten= 0%, Lag= 1.7 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
Max. Velocity= 2.68 fps, Min. Travel Time= 1.0 min
Avg. Velocity = 0.78 fps, Avg. Travel Time= 3.4 min

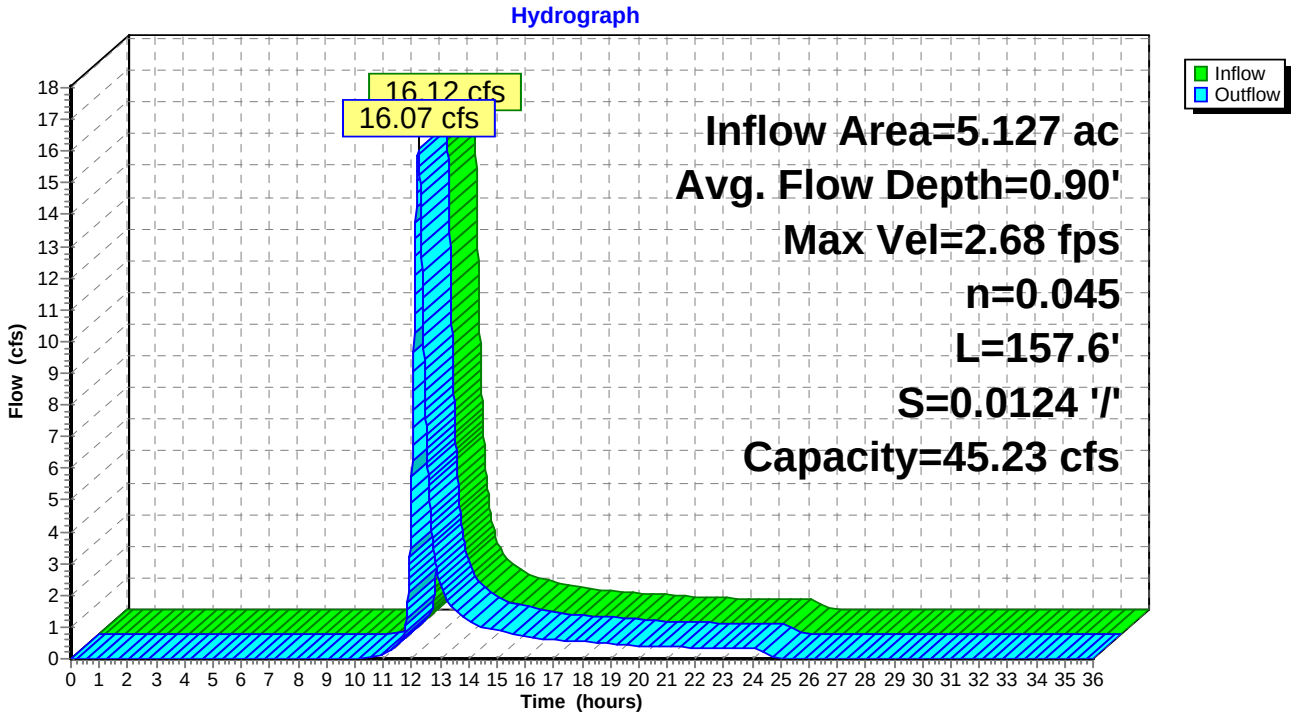
Peak Storage= 946 cf @ 12.22 hrs
Average Depth at Peak Storage= 0.90'
Bank-Full Depth= 1.50' Flow Area= 12.8 sf, Capacity= 45.23 cfs

4.00' x 1.50' deep channel, n= 0.045
Side Slope Z-value= 3.0 '/' Top Width= 13.00'
Length= 157.6' Slope= 0.0124 '/'
Inlet Invert= 406.02', Outlet Invert= 404.06'



‡

Reach C7B7: Channel 7B-7



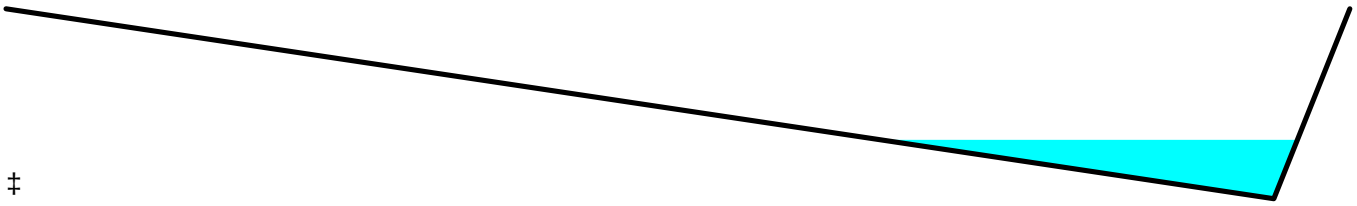
Summary for Reach C7B8: Channel 7B-8

Inflow Area = 1.554 ac, 0.00% Impervious, Inflow Depth = 3.12" for 100 Yr event
Inflow = 5.56 cfs @ 12.11 hrs, Volume= 0.404 af
Outflow = 5.15 cfs @ 12.24 hrs, Volume= 0.404 af, Atten= 7%, Lag= 7.9 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
Max. Velocity= 2.02 fps, Min. Travel Time= 4.5 min
Avg. Velocity = 0.75 fps, Avg. Travel Time= 12.0 min

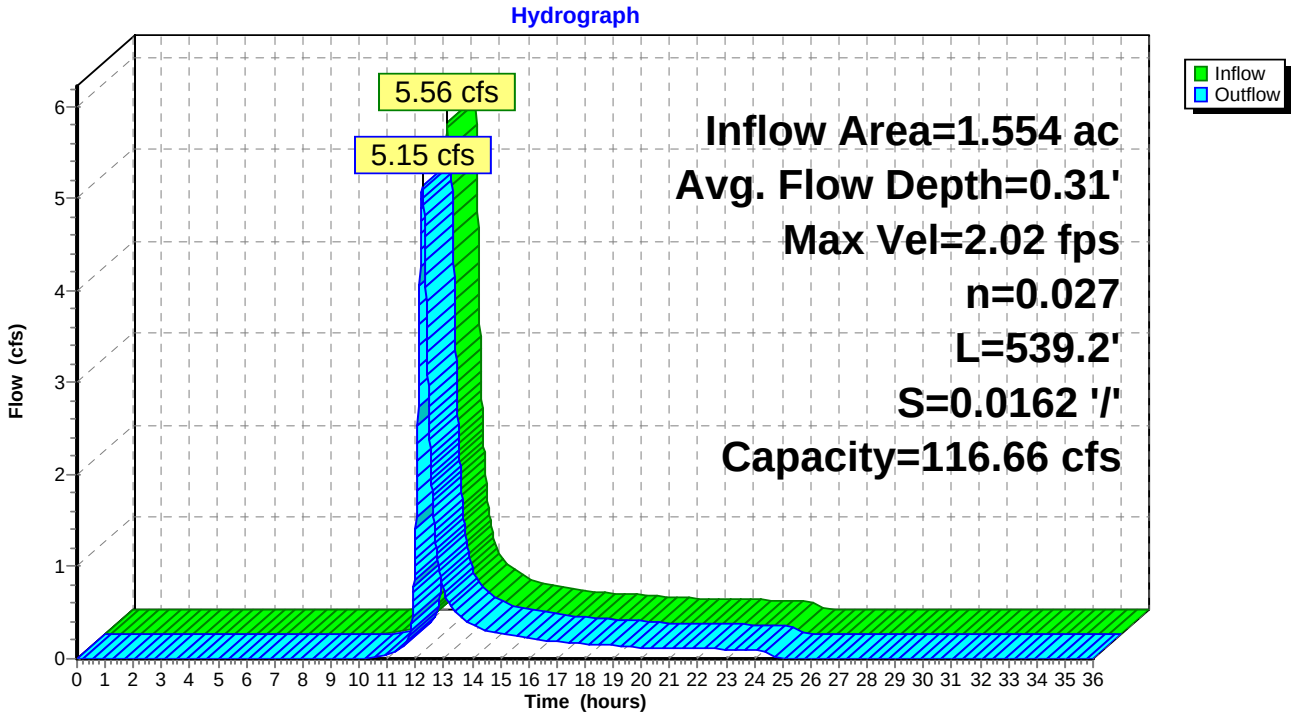
Peak Storage= 1,376 cf @ 12.17 hrs
Average Depth at Peak Storage= 0.31'
Bank-Full Depth= 1.00' Flow Area= 26.5 sf, Capacity= 116.66 cfs

0.00' x 1.00' deep channel, n= 0.027
Side Slope Z-value= 50.0 3.0 '/' Top Width= 53.00'
Length= 539.2' Slope= 0.0162 '/'
Inlet Invert= 415.20', Outlet Invert= 406.47'



‡

Reach C7B8: Channel 7B-8



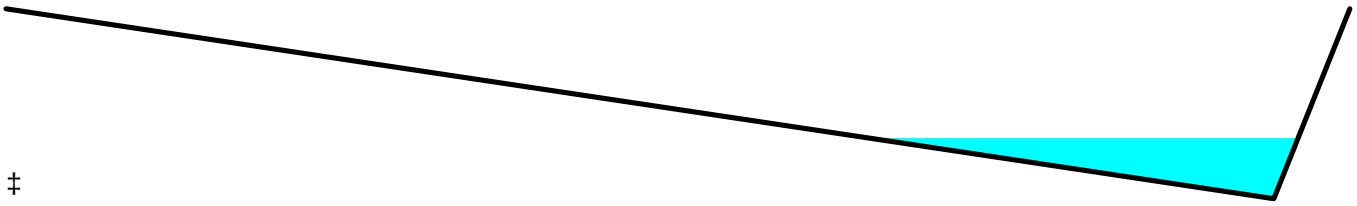
Summary for Reach C7B9: Channel 7B-9

Inflow Area = 1.615 ac, 0.00% Impervious, Inflow Depth = 3.12" for 100 Yr event
Inflow = 5.86 cfs @ 12.11 hrs, Volume= 0.420 af
Outflow = 5.34 cfs @ 12.25 hrs, Volume= 0.420 af, Atten= 9%, Lag= 8.7 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
Max. Velocity= 1.98 fps, Min. Travel Time= 4.9 min
Avg. Velocity = 0.72 fps, Avg. Travel Time= 13.5 min

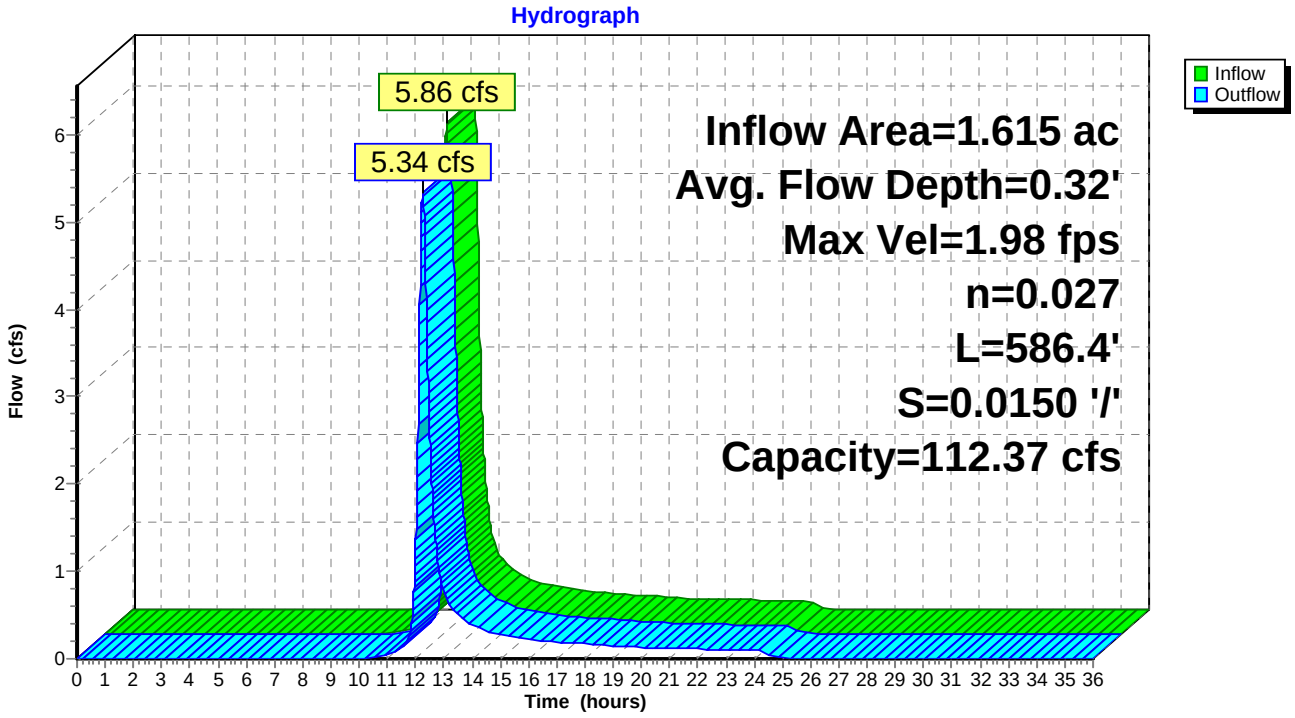
Peak Storage= 1,583 cf @ 12.17 hrs
Average Depth at Peak Storage= 0.32'
Bank-Full Depth= 1.00' Flow Area= 26.5 sf, Capacity= 112.37 cfs

0.00' x 1.00' deep channel, n= 0.027
Side Slope Z-value= 50.0 3.0 '/' Top Width= 53.00'
Length= 586.4' Slope= 0.0150 '/'
Inlet Invert= 415.26', Outlet Invert= 406.45'



‡

Reach C7B9: Channel 7B-9



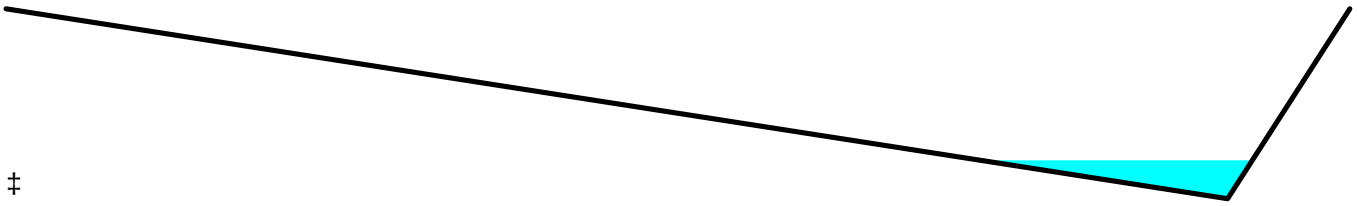
Summary for Reach C7C: Channel 7C

Inflow Area = 1.364 ac, 0.00% Impervious, Inflow Depth = 3.12" for 100 Yr event
Inflow = 4.97 cfs @ 12.11 hrs, Volume= 0.355 af
Outflow = 4.53 cfs @ 12.25 hrs, Volume= 0.355 af, Atten= 9%, Lag= 8.3 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
Max. Velocity= 1.79 fps, Min. Travel Time= 4.9 min
Avg. Velocity = 0.69 fps, Avg. Travel Time= 12.8 min

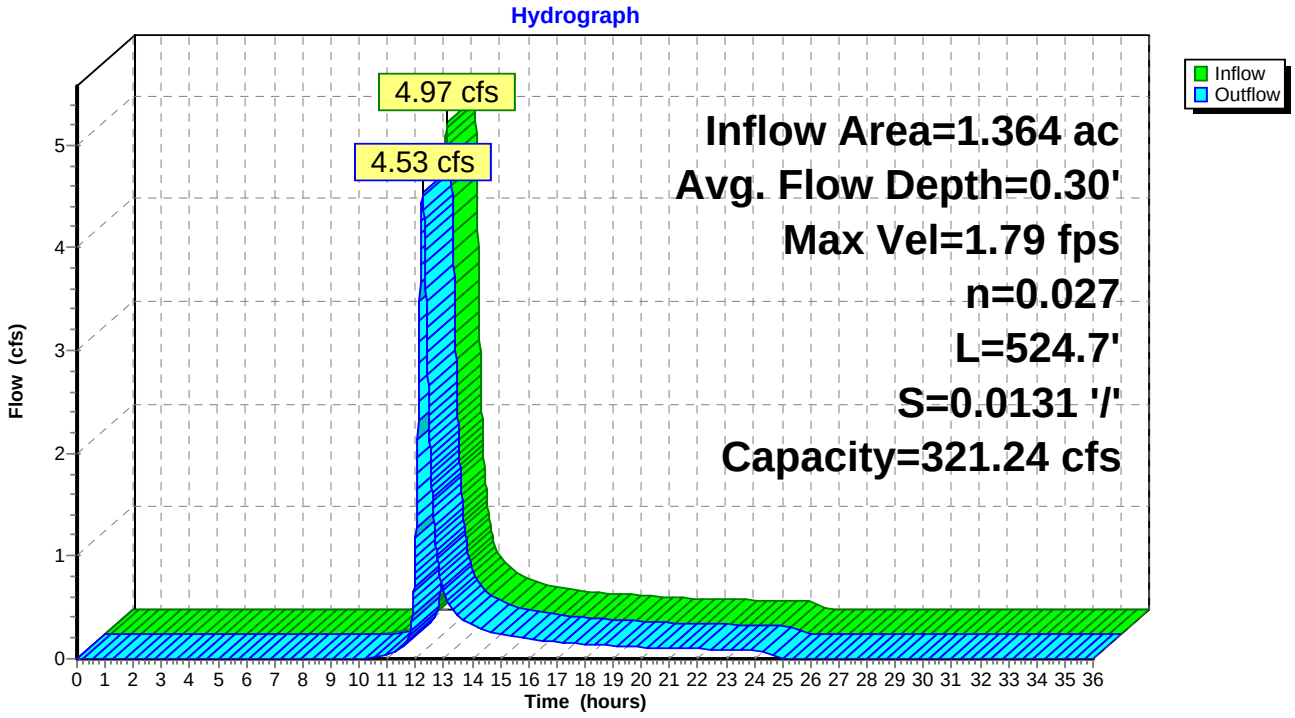
Peak Storage= 1,329 cf @ 12.17 hrs
Average Depth at Peak Storage= 0.30'
Bank-Full Depth= 1.50' Flow Area= 61.9 sf, Capacity= 321.24 cfs

0.00' x 1.50' deep channel, n= 0.027
Side Slope Z-value= 50.0 5.0 '/' Top Width= 82.50'
Length= 524.7' Slope= 0.0131 '/'
Inlet Invert= 408.50', Outlet Invert= 401.63'



‡

Reach C7C: Channel 7C



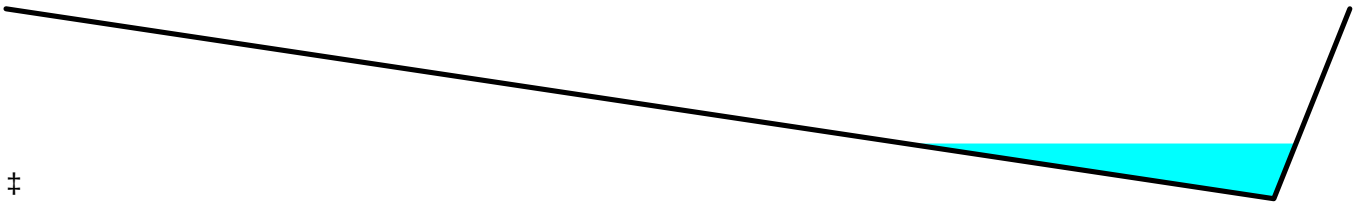
Summary for Reach C7D: Channel 7D

Inflow Area = 1.265 ac, 0.00% Impervious, Inflow Depth = 3.12" for 100 Yr event
Inflow = 4.52 cfs @ 12.11 hrs, Volume= 0.329 af
Outflow = 4.33 cfs @ 12.21 hrs, Volume= 0.329 af, Atten= 4%, Lag= 5.9 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
Max. Velocity= 1.93 fps, Min. Travel Time= 3.2 min
Avg. Velocity = 0.75 fps, Avg. Travel Time= 8.4 min

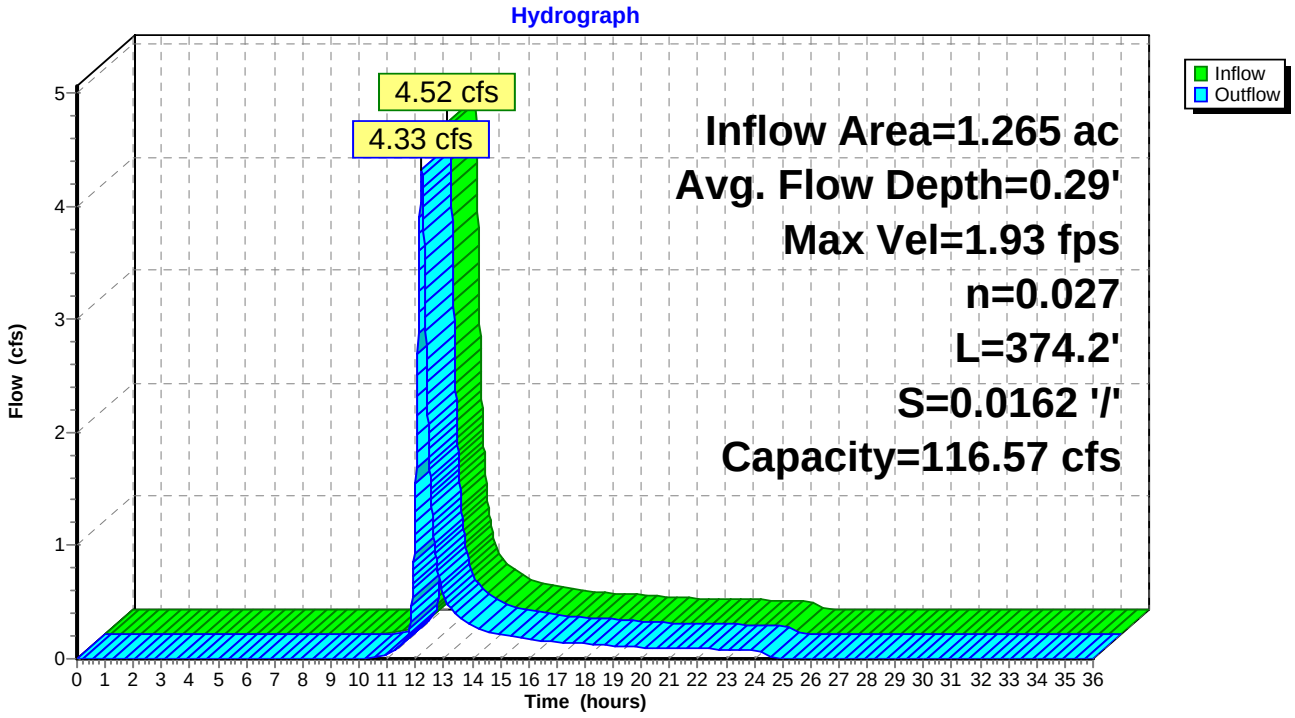
Peak Storage= 839 cf @ 12.16 hrs
Average Depth at Peak Storage= 0.29'
Bank-Full Depth= 1.00' Flow Area= 26.5 sf, Capacity= 116.57 cfs

0.00' x 1.00' deep channel, n= 0.027
Side Slope Z-value= 50.0 3.0 '/' Top Width= 53.00'
Length= 374.2' Slope= 0.0162 '/'
Inlet Invert= 407.84', Outlet Invert= 401.79'



‡

Reach C7D: Channel 7D



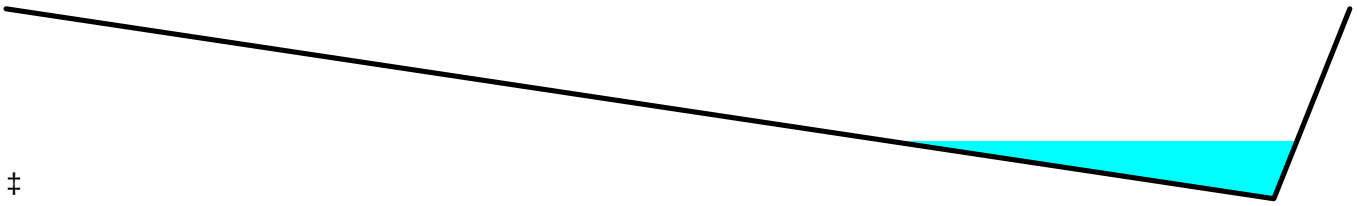
Summary for Reach C7E: Channel 7E

Inflow Area = 1.354 ac, 0.00% Impervious, Inflow Depth = 3.12" for 100 Yr event
Inflow = 4.94 cfs @ 12.11 hrs, Volume= 0.352 af
Outflow = 4.70 cfs @ 12.21 hrs, Volume= 0.352 af, Atten= 5%, Lag= 5.9 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
Max. Velocity= 1.92 fps, Min. Travel Time= 3.5 min
Avg. Velocity = 0.73 fps, Avg. Travel Time= 9.1 min

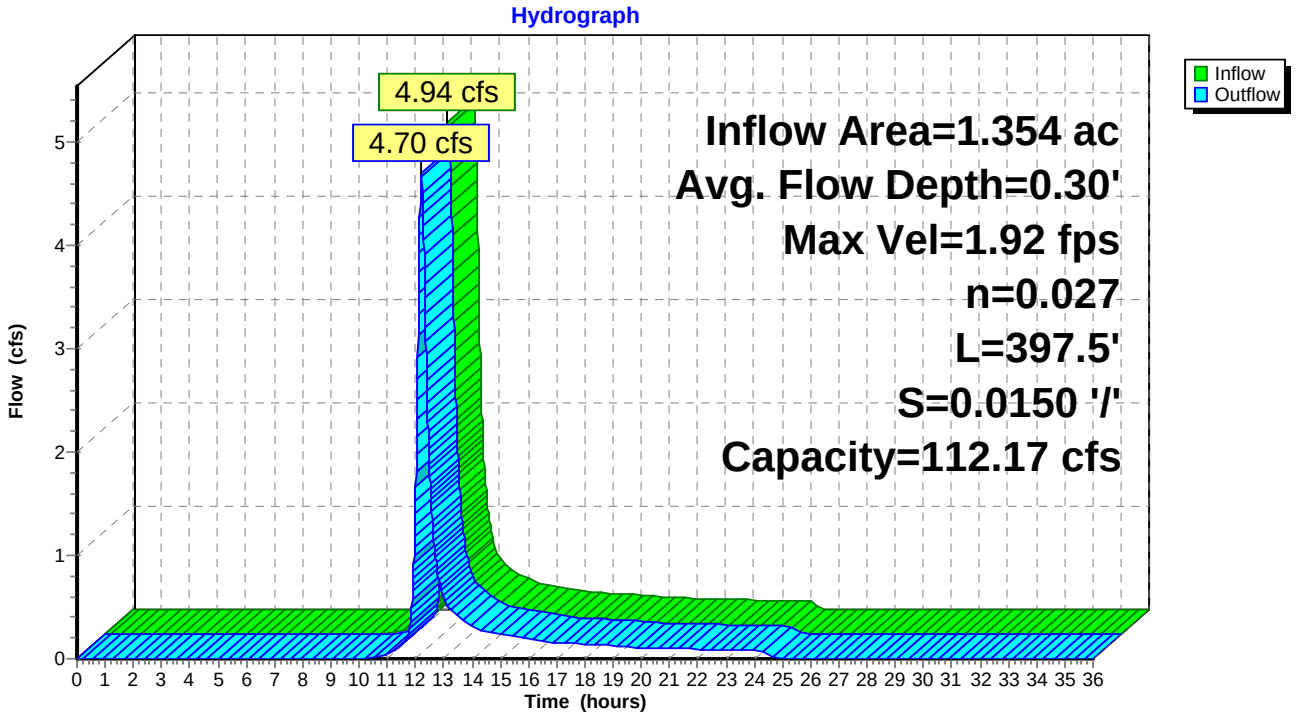
Peak Storage= 975 cf @ 12.15 hrs
Average Depth at Peak Storage= 0.30'
Bank-Full Depth= 1.00' Flow Area= 26.5 sf, Capacity= 112.17 cfs

0.00' x 1.00' deep channel, n= 0.027
Side Slope Z-value= 50.0 3.0 '/' Top Width= 53.00'
Length= 397.5' Slope= 0.0150 '/'
Inlet Invert= 407.73', Outlet Invert= 401.78'



‡

Reach C7E: Channel 7E



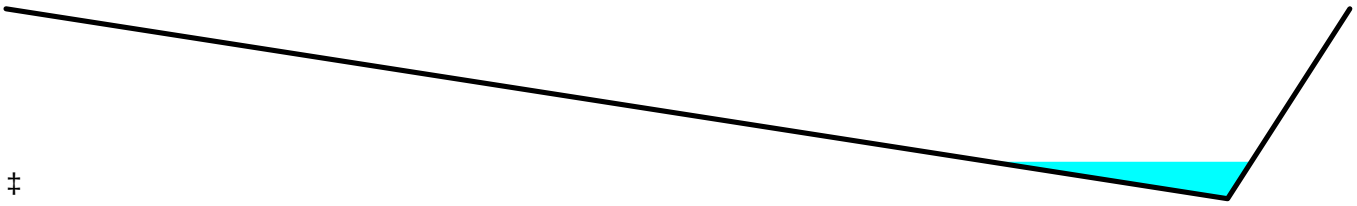
Summary for Reach C8A: Channel 8A

Inflow Area = 1.394 ac, 0.00% Impervious, Inflow Depth = 3.12" for 100 Yr event
Inflow = 5.06 cfs @ 12.11 hrs, Volume= 0.363 af
Outflow = 4.77 cfs @ 12.22 hrs, Volume= 0.363 af, Atten= 6%, Lag= 6.7 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
Max. Velocity= 2.03 fps, Min. Travel Time= 3.8 min
Avg. Velocity = 0.80 fps, Avg. Travel Time= 9.6 min

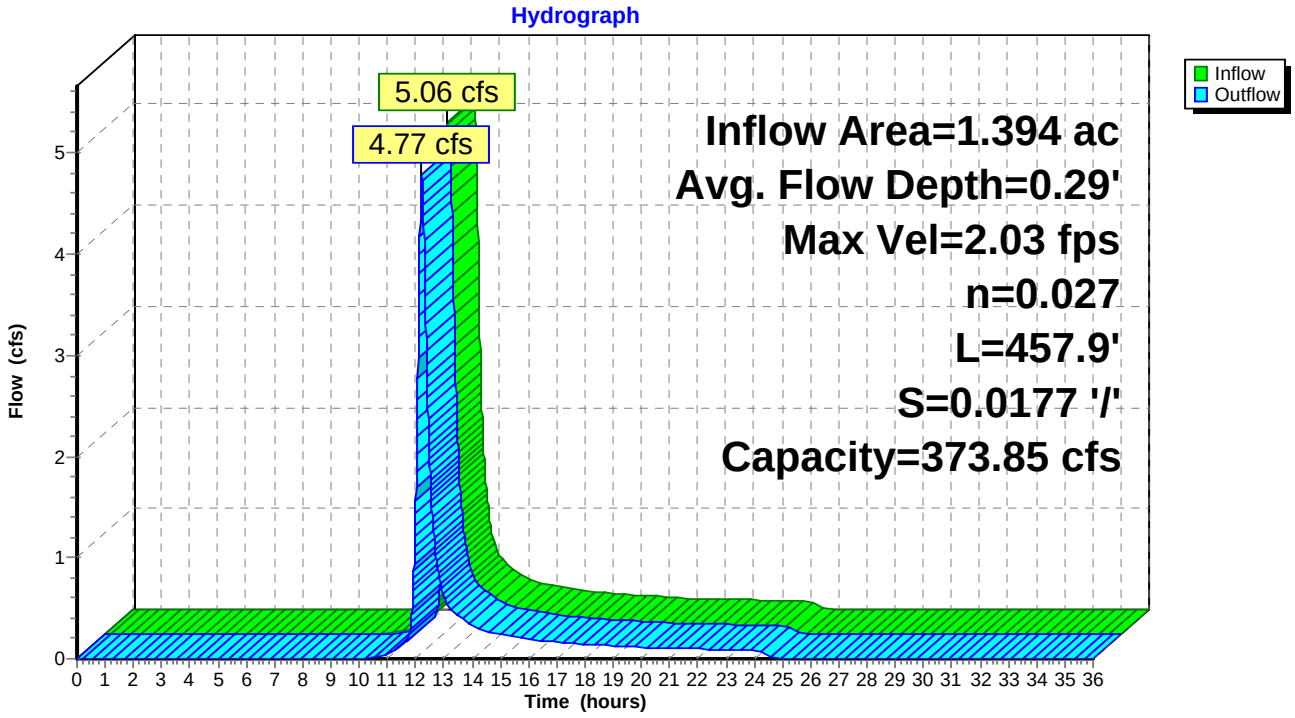
Peak Storage= 1,076 cf @ 12.16 hrs
Average Depth at Peak Storage= 0.29'
Bank-Full Depth= 1.50' Flow Area= 61.9 sf, Capacity= 373.85 cfs

0.00' x 1.50' deep channel, n= 0.027
Side Slope Z-value= 50.0 5.0 '/' Top Width= 82.50'
Length= 457.9' Slope= 0.0177 '/'
Inlet Invert= 409.77', Outlet Invert= 401.65'



‡

Reach C8A: Channel 8A



Summary for Reach C8B1: Channel 8B-1

Inflow Area = 15.948 ac, 0.00% Impervious, Inflow Depth = 3.12" for 100 Yr event
Inflow = 50.47 cfs @ 12.25 hrs, Volume= 4.147 af
Outflow = 50.41 cfs @ 12.26 hrs, Volume= 4.147 af, Atten= 0%, Lag= 1.0 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
Max. Velocity= 3.58 fps, Min. Travel Time= 0.6 min
Avg. Velocity = 1.06 fps, Avg. Travel Time= 1.9 min

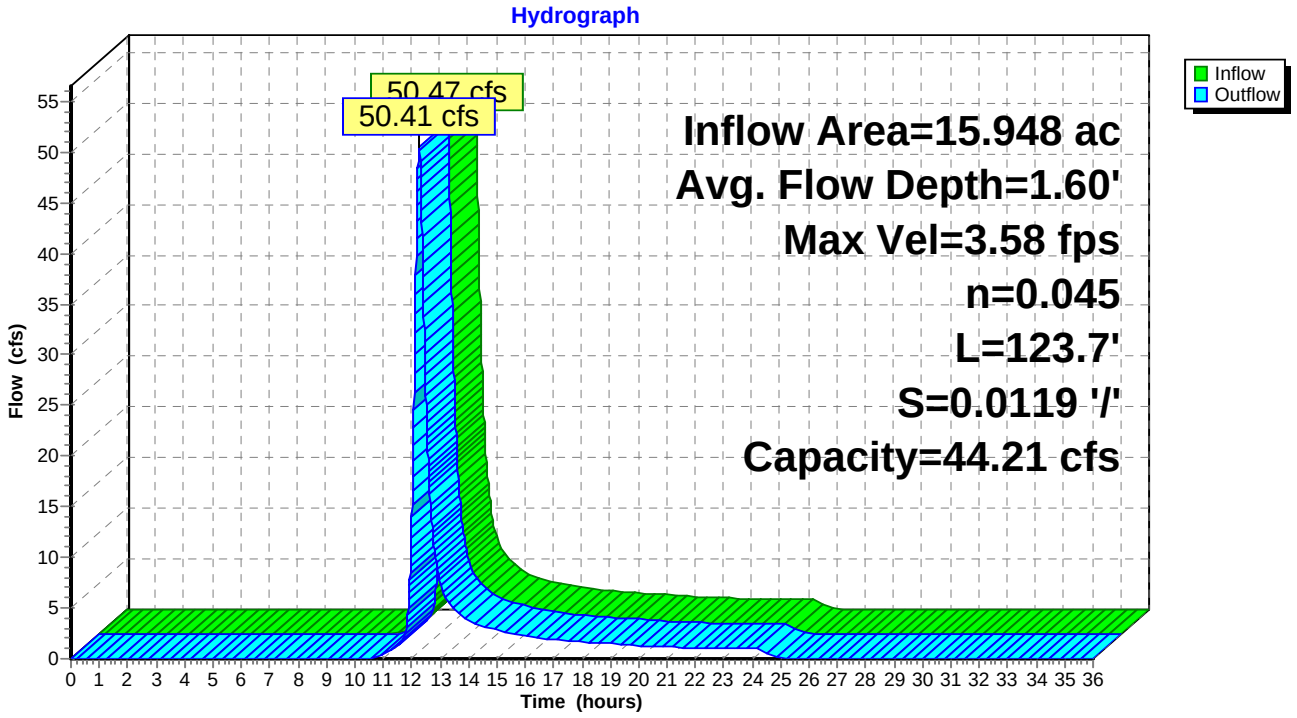
Peak Storage= 1,740 cf @ 12.25 hrs
Average Depth at Peak Storage= 1.60'
Bank-Full Depth= 1.50' Flow Area= 12.8 sf, Capacity= 44.21 cfs

4.00' x 1.50' deep channel, n= 0.045
Side Slope Z-value= 3.0 '/' Top Width= 13.00'
Length= 123.7' Slope= 0.0119 '/'
Inlet Invert= 401.76', Outlet Invert= 400.29'



‡

Reach C8B1: Channel 8B-1



Summary for Reach C8B10: Channel 8B-10

Inflow Area = 4.782 ac, 0.00% Impervious, Inflow Depth = 3.12" for 100 Yr event
Inflow = 15.39 cfs @ 12.20 hrs, Volume= 1.243 af
Outflow = 15.34 cfs @ 12.22 hrs, Volume= 1.243 af, Atten= 0%, Lag= 1.7 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
Max. Velocity= 2.60 fps, Min. Travel Time= 1.0 min
Avg. Velocity = 0.76 fps, Avg. Travel Time= 3.4 min

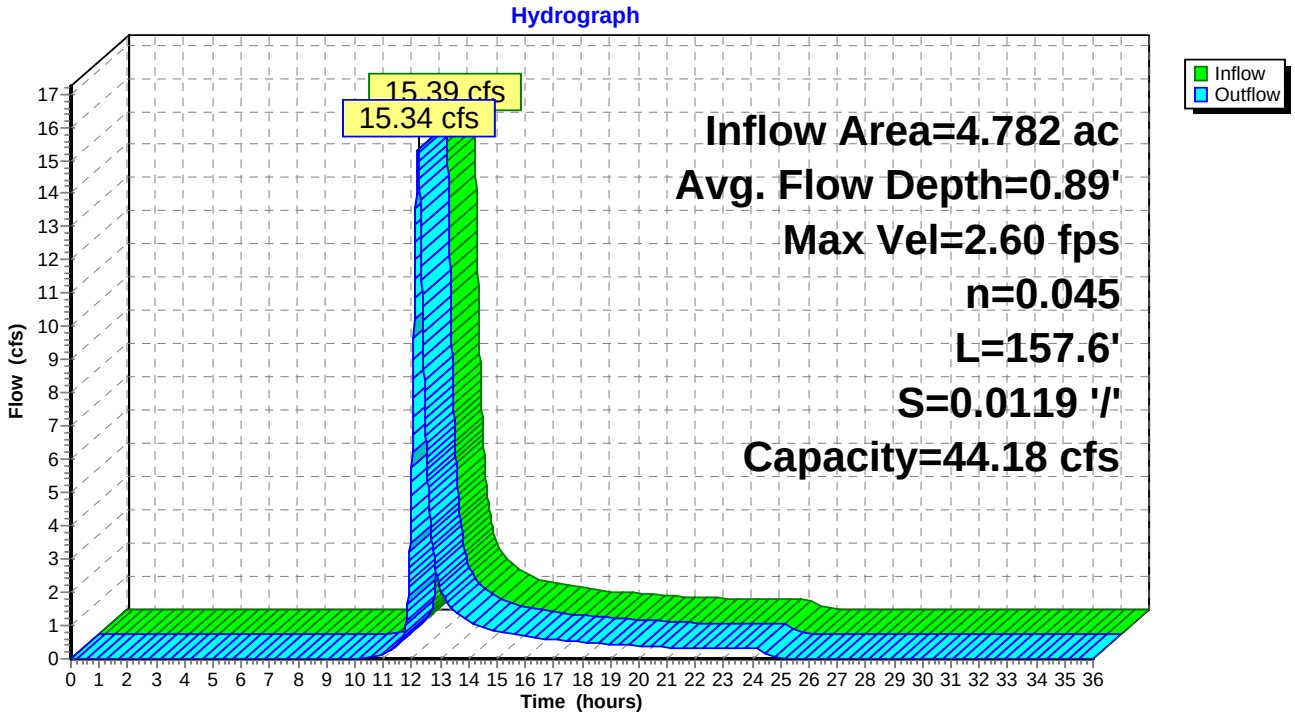
Peak Storage= 930 cf @ 12.21 hrs
Average Depth at Peak Storage= 0.89'
Bank-Full Depth= 1.50' Flow Area= 12.8 sf, Capacity= 44.18 cfs

4.00' x 1.50' deep channel, n= 0.045
Side Slope Z-value= 3.0 '/' Top Width= 13.00'
Length= 157.6' Slope= 0.0119 '/'
Inlet Invert= 407.38', Outlet Invert= 405.51'



‡

Reach C8B10: Channel 8B-10



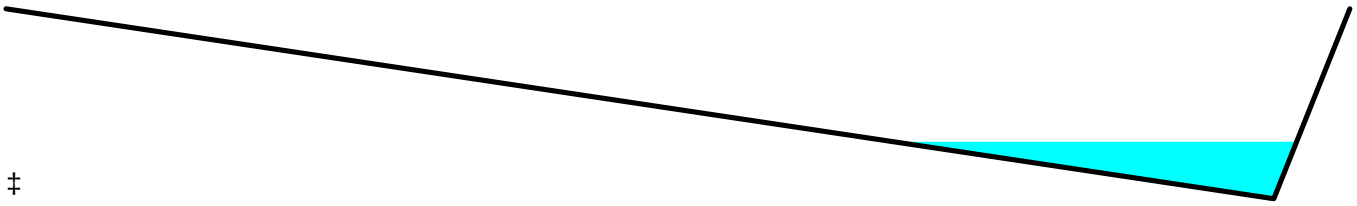
Summary for Reach C8B11: Channel 8B-11

Inflow Area = 1.339 ac, 0.00% Impervious, Inflow Depth = 3.12" for 100 Yr event
Inflow = 4.84 cfs @ 12.11 hrs, Volume= 0.348 af
Outflow = 4.53 cfs @ 12.23 hrs, Volume= 0.348 af, Atten= 7%, Lag= 7.1 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
Max. Velocity= 1.90 fps, Min. Travel Time= 4.1 min
Avg. Velocity = 0.72 fps, Avg. Travel Time= 10.9 min

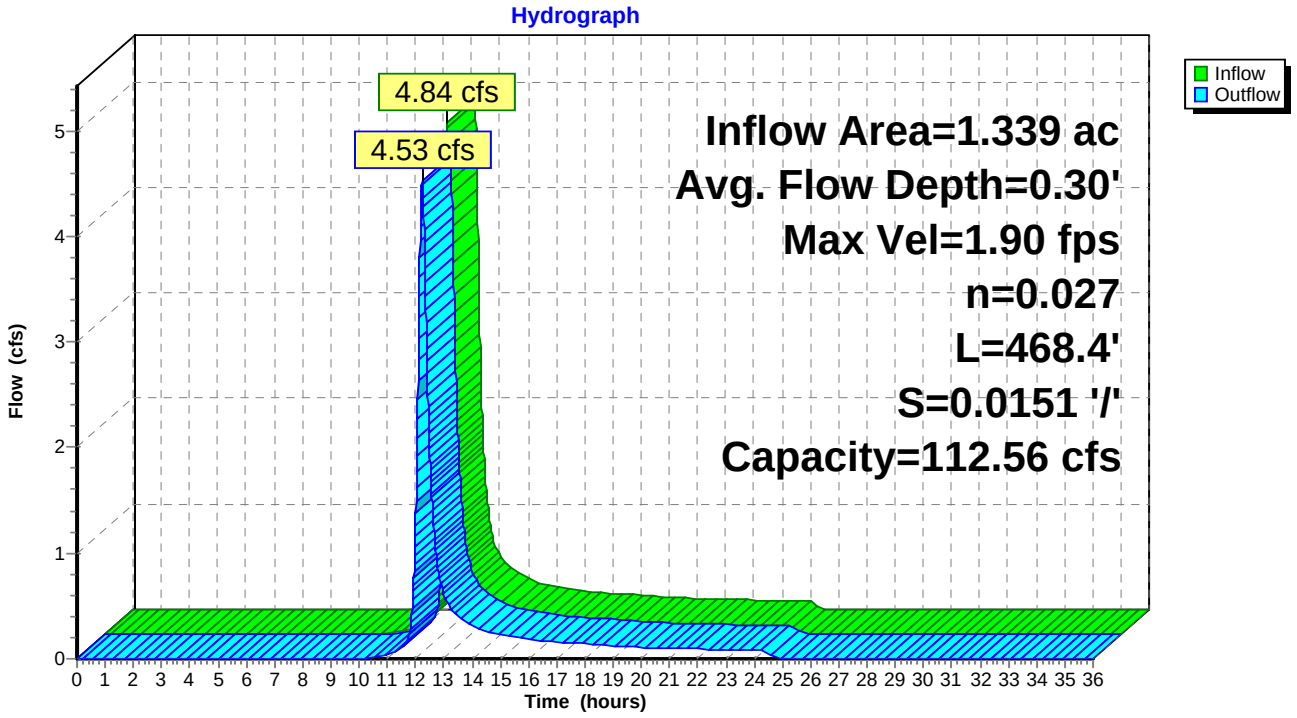
Peak Storage= 1,115 cf @ 12.16 hrs
Average Depth at Peak Storage= 0.30'
Bank-Full Depth= 1.00' Flow Area= 26.5 sf, Capacity= 112.56 cfs

0.00' x 1.00' deep channel, n= 0.027
Side Slope Z-value= 50.0 3.0 '/' Top Width= 53.00'
Length= 468.4' Slope= 0.0151 '/'
Inlet Invert= 414.82', Outlet Invert= 407.76'



‡

Reach C8B11: Channel 8B-11



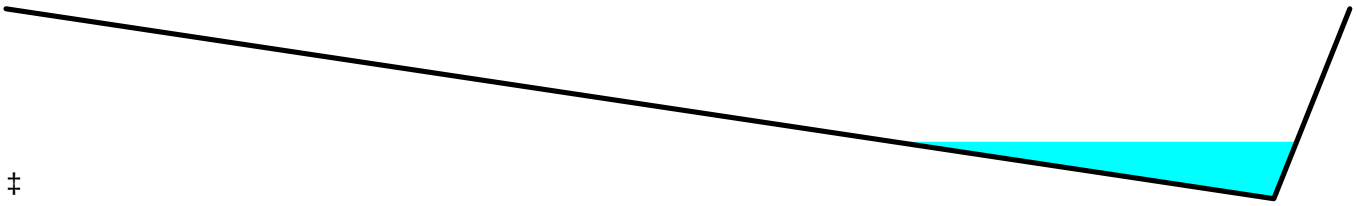
Summary for Reach C8B12: Channel 8B-12

Inflow Area = 1.453 ac, 0.00% Impervious, Inflow Depth = 3.12" for 100 Yr event
Inflow = 5.30 cfs @ 12.11 hrs, Volume= 0.378 af
Outflow = 4.87 cfs @ 12.24 hrs, Volume= 0.378 af, Atten= 8%, Lag= 7.8 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
Max. Velocity= 2.05 fps, Min. Travel Time= 4.6 min
Avg. Velocity = 0.76 fps, Avg. Travel Time= 12.3 min

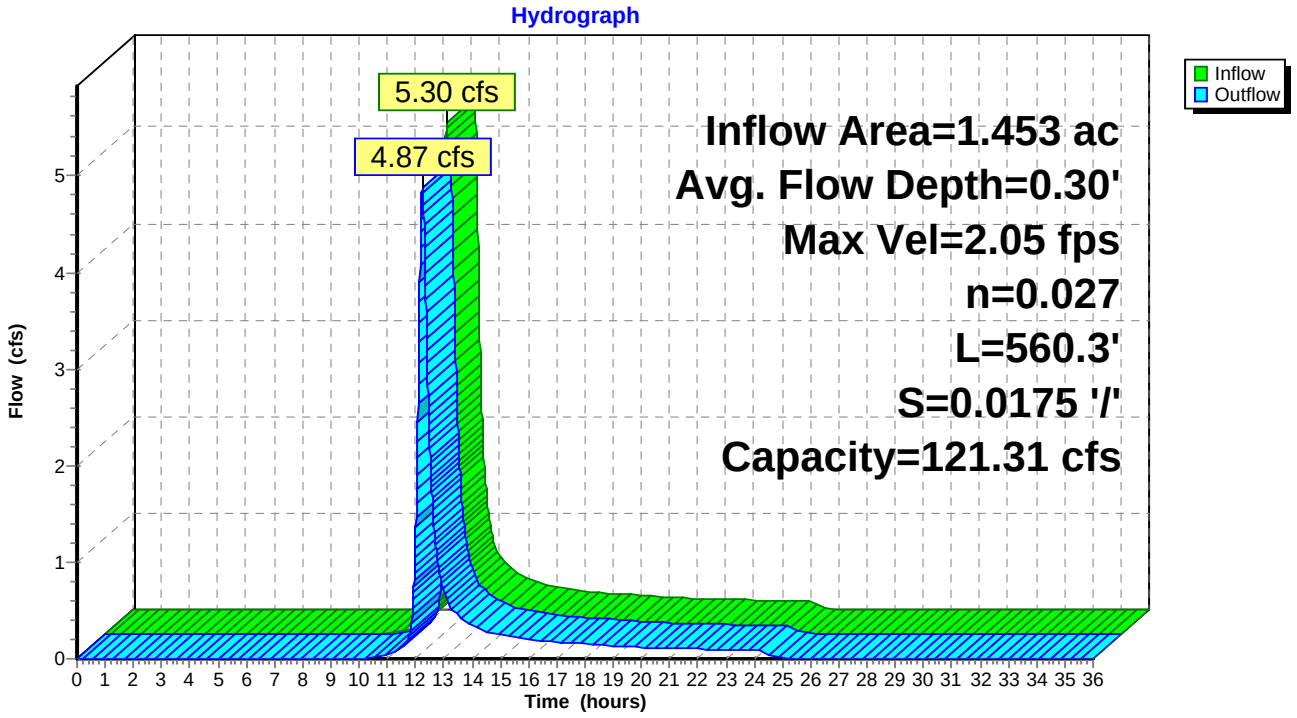
Peak Storage= 1,332 cf @ 12.16 hrs
Average Depth at Peak Storage= 0.30'
Bank-Full Depth= 1.00' Flow Area= 26.5 sf, Capacity= 121.31 cfs

0.00' x 1.00' deep channel, n= 0.027
Side Slope Z-value= 50.0 3.0 '/' Top Width= 53.00'
Length= 560.3' Slope= 0.0175 '/'
Inlet Invert= 417.57', Outlet Invert= 407.76'



‡

Reach C8B12: Channel 8B-12



Summary for Reach C8B13: Channel 8B-13

Inflow Area = 1.037 ac, 0.00% Impervious, Inflow Depth = 3.12" for 100 Yr event
Inflow = 3.73 cfs @ 12.11 hrs, Volume= 0.270 af
Outflow = 3.70 cfs @ 12.15 hrs, Volume= 0.270 af, Atten= 1%, Lag= 2.3 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
Max. Velocity= 1.71 fps, Min. Travel Time= 1.4 min
Avg. Velocity = 0.51 fps, Avg. Travel Time= 4.6 min

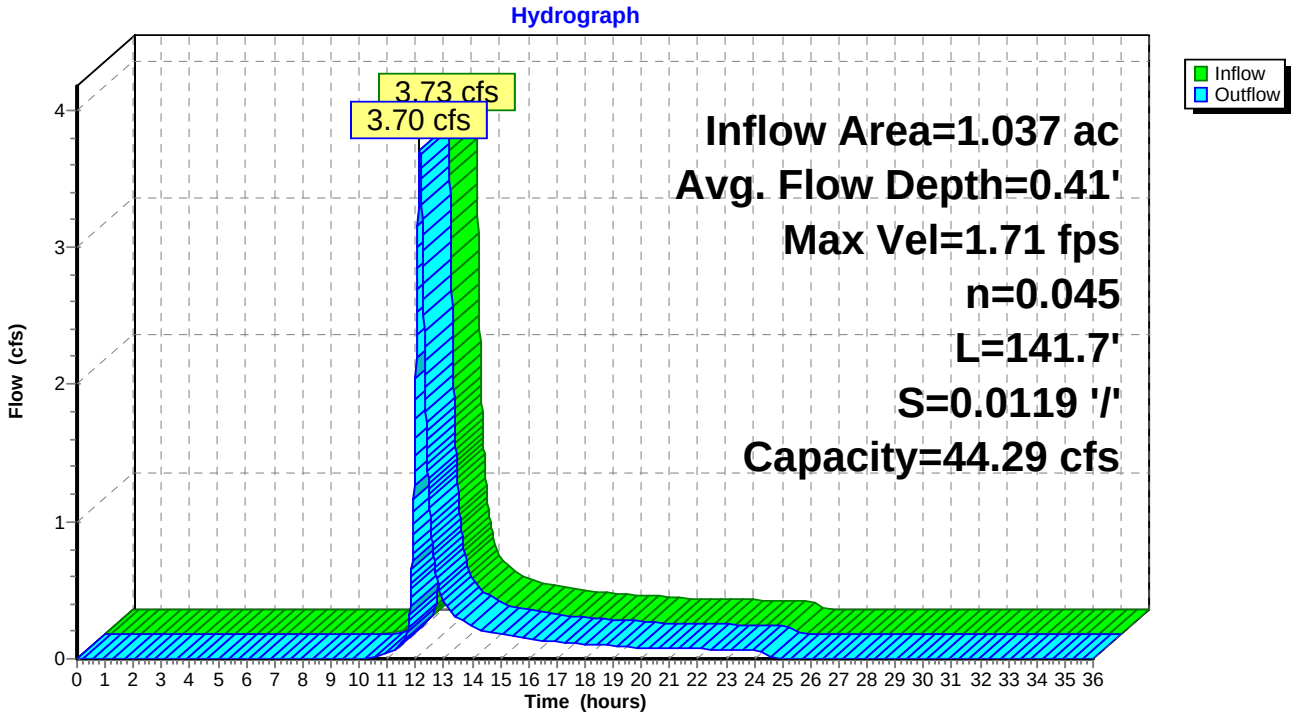
Peak Storage= 306 cf @ 12.13 hrs
Average Depth at Peak Storage= 0.41'
Bank-Full Depth= 1.50' Flow Area= 12.8 sf, Capacity= 44.29 cfs

4.00' x 1.50' deep channel, n= 0.045
Side Slope Z-value= 3.0 '/' Top Width= 13.00'
Length= 141.7' Slope= 0.0119 '/'
Inlet Invert= 409.07', Outlet Invert= 407.38'



‡

Reach C8B13: Channel 8B-13



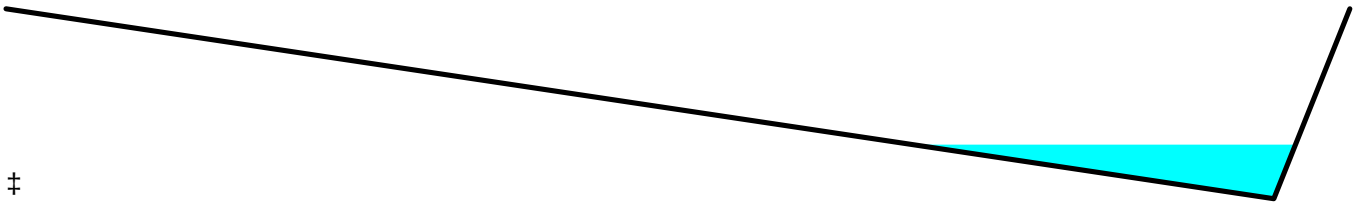
Summary for Reach C8B2: Channel 8B-2

Inflow Area = 1.151 ac, 0.00% Impervious, Inflow Depth = 3.12" for 100 Yr event
Inflow = 4.16 cfs @ 12.11 hrs, Volume= 0.299 af
Outflow = 3.93 cfs @ 12.22 hrs, Volume= 0.299 af, Atten= 6%, Lag= 6.4 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
Max. Velocity= 1.83 fps, Min. Travel Time= 3.7 min
Avg. Velocity = 0.70 fps, Avg. Travel Time= 9.7 min

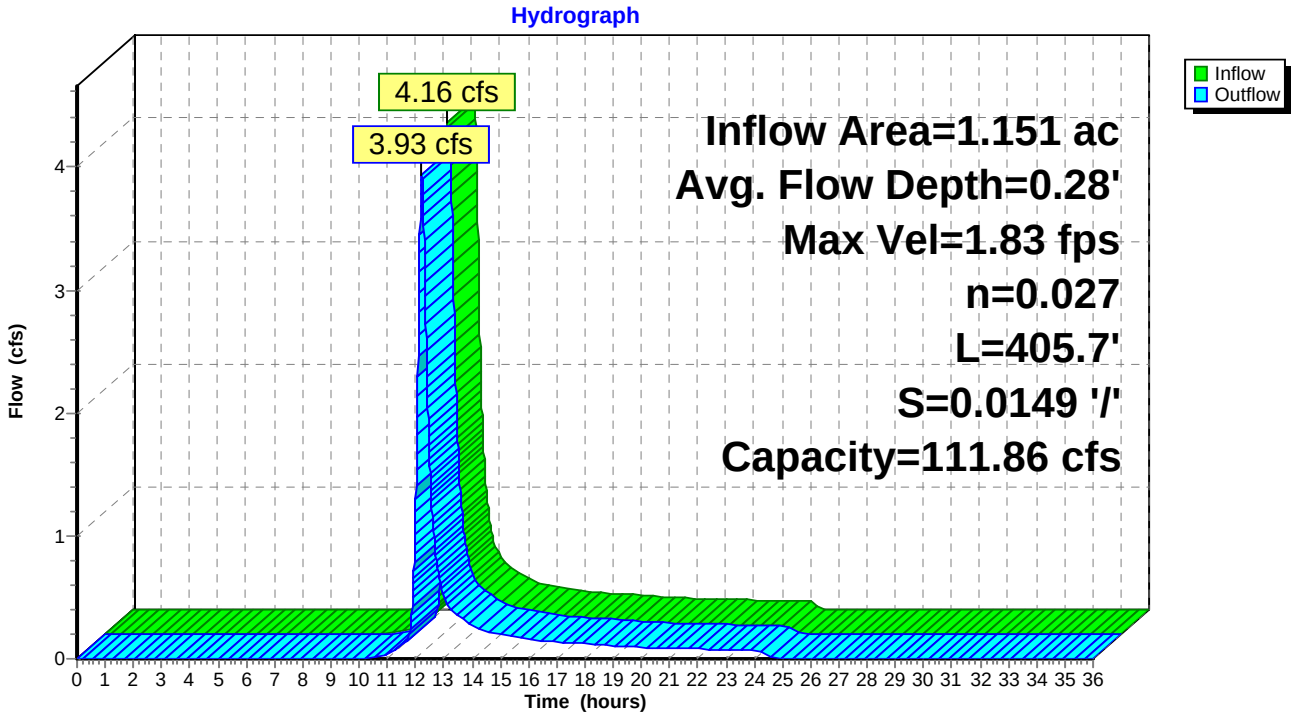
Peak Storage= 873 cf @ 12.16 hrs
Average Depth at Peak Storage= 0.28'
Bank-Full Depth= 1.00' Flow Area= 26.5 sf, Capacity= 111.86 cfs

0.00' x 1.00' deep channel, n= 0.027
Side Slope Z-value= 50.0 3.0 '/' Top Width= 53.00'
Length= 405.7' Slope= 0.0149 '/'
Inlet Invert= 409.11', Outlet Invert= 403.07'



‡

Reach C8B2: Channel 8B-2



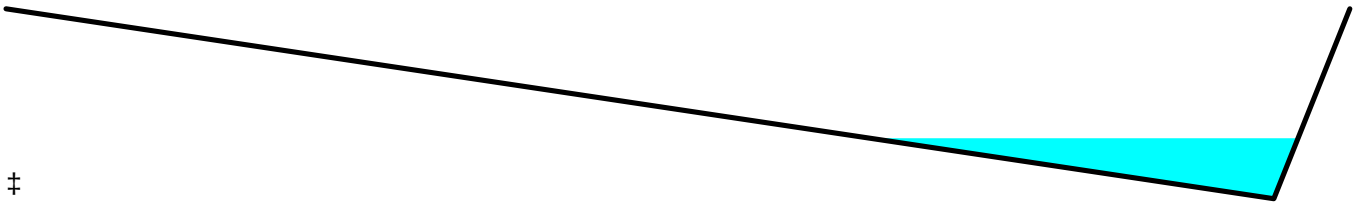
Summary for Reach C8B3: Channel 8B-3

Inflow Area = 1.621 ac, 0.00% Impervious, Inflow Depth = 3.12" for 100 Yr event
Inflow = 6.01 cfs @ 12.10 hrs, Volume= 0.422 af
Outflow = 5.51 cfs @ 12.24 hrs, Volume= 0.422 af, Atten= 8%, Lag= 8.1 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
Max. Velocity= 2.05 fps, Min. Travel Time= 4.7 min
Avg. Velocity = 0.75 fps, Avg. Travel Time= 12.8 min

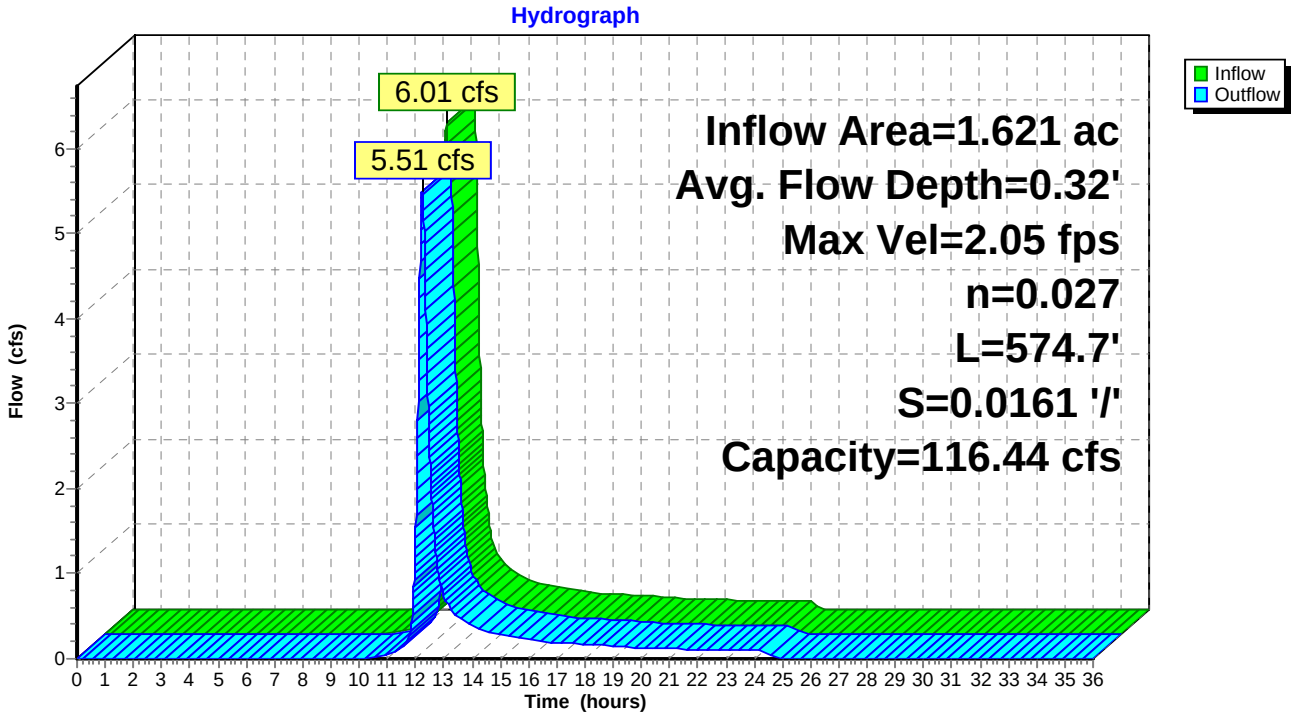
Peak Storage= 1,545 cf @ 12.16 hrs
Average Depth at Peak Storage= 0.32'
Bank-Full Depth= 1.00' Flow Area= 26.5 sf, Capacity= 116.44 cfs

0.00' x 1.00' deep channel, n= 0.027
Side Slope Z-value= 50.0 3.0 '/' Top Width= 53.00'
Length= 574.7' Slope= 0.0161 '/'
Inlet Invert= 412.34', Outlet Invert= 403.07'



‡

Reach C8B3: Channel 8B-3



Summary for Reach C8B4: Channel 8B-4

Inflow Area = 12.503 ac, 0.00% Impervious, Inflow Depth = 3.12" for 100 Yr event
Inflow = 39.79 cfs @ 12.23 hrs, Volume= 3.251 af
Outflow = 39.70 cfs @ 12.26 hrs, Volume= 3.251 af, Atten= 0%, Lag= 1.4 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
Max. Velocity= 3.37 fps, Min. Travel Time= 0.8 min
Avg. Velocity = 0.99 fps, Avg. Travel Time= 2.6 min

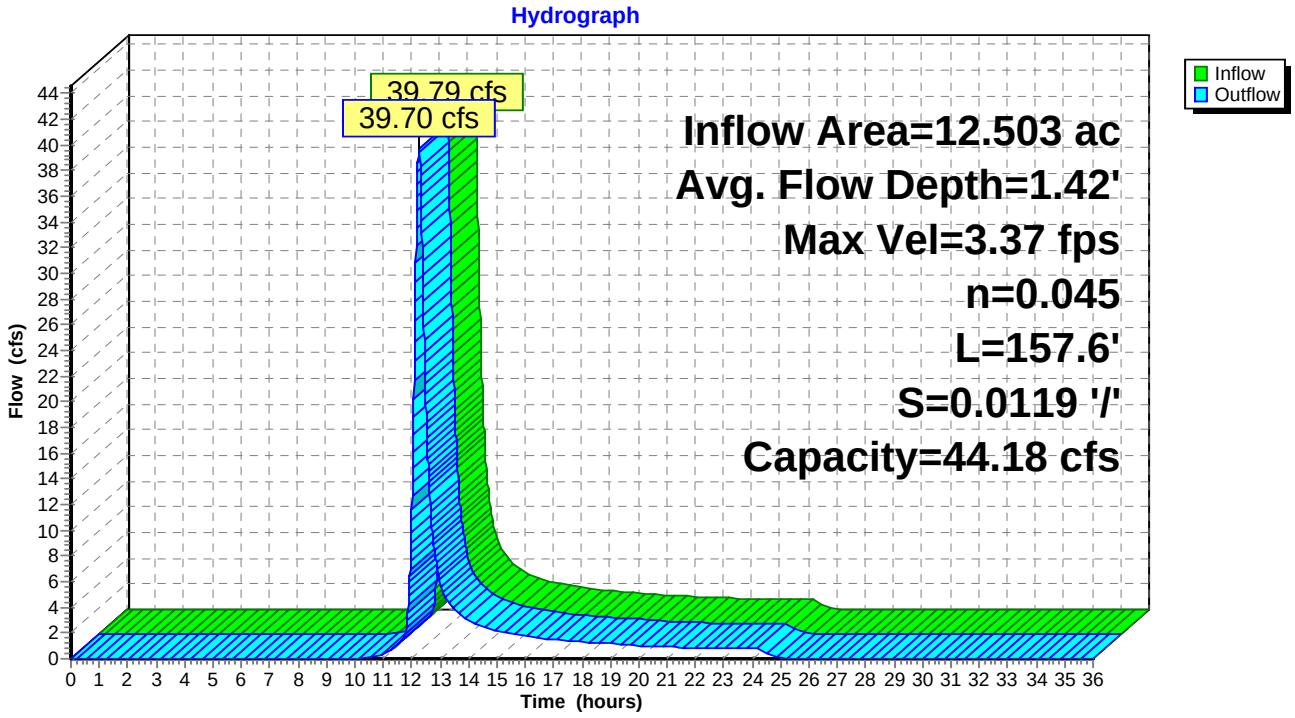
Peak Storage= 1,858 cf @ 12.24 hrs
Average Depth at Peak Storage= 1.42'
Bank-Full Depth= 1.50' Flow Area= 12.8 sf, Capacity= 44.18 cfs

4.00' x 1.50' deep channel, n= 0.045
Side Slope Z-value= 3.0 '/' Top Width= 13.00'
Length= 157.6' Slope= 0.0119 '/'
Inlet Invert= 403.63', Outlet Invert= 401.76'



‡

Reach C8B4: Channel 8B-4



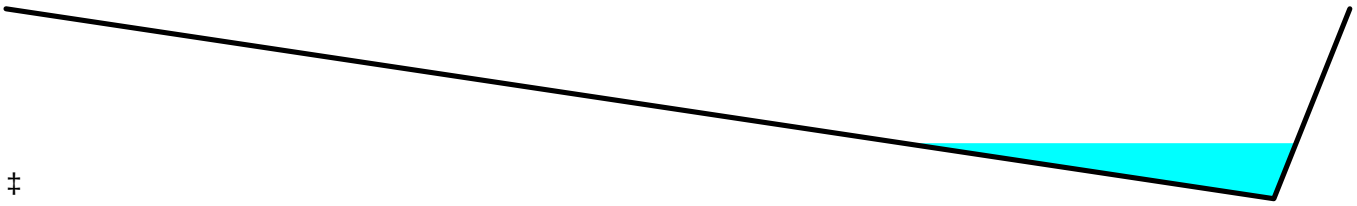
Summary for Reach C8B5: Channel 8B-5

Inflow Area = 1.241 ac, 0.00% Impervious, Inflow Depth = 3.12" for 100 Yr event
Inflow = 4.49 cfs @ 12.11 hrs, Volume= 0.323 af
Outflow = 4.21 cfs @ 12.23 hrs, Volume= 0.323 af, Atten= 6%, Lag= 6.9 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
Max. Velocity= 1.86 fps, Min. Travel Time= 4.0 min
Avg. Velocity = 0.70 fps, Avg. Travel Time= 10.5 min

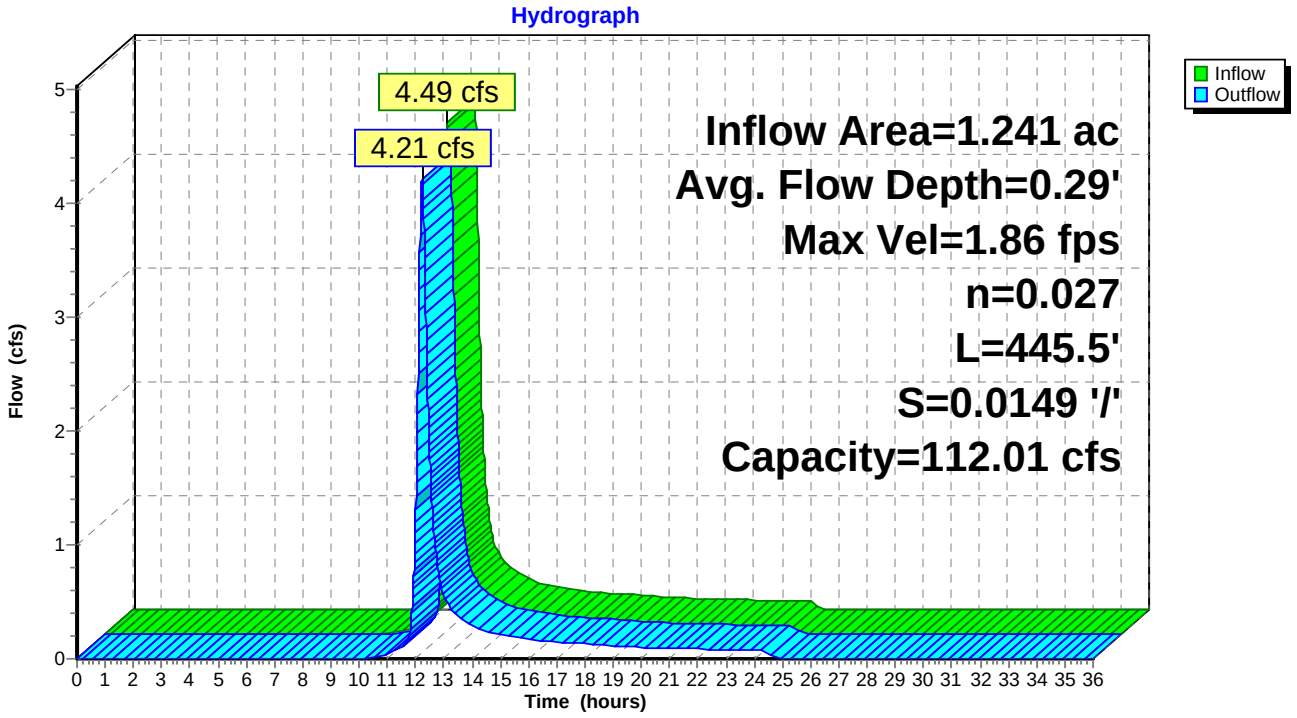
Peak Storage= 1,008 cf @ 12.16 hrs
Average Depth at Peak Storage= 0.29'
Bank-Full Depth= 1.00' Flow Area= 26.5 sf, Capacity= 112.01 cfs

0.00' x 1.00' deep channel, n= 0.027
Side Slope Z-value= 50.0 3.0 '/' Top Width= 53.00'
Length= 445.5' Slope= 0.0149 '/'
Inlet Invert= 411.28', Outlet Invert= 404.63'



‡

Reach C8B5: Channel 8B-5



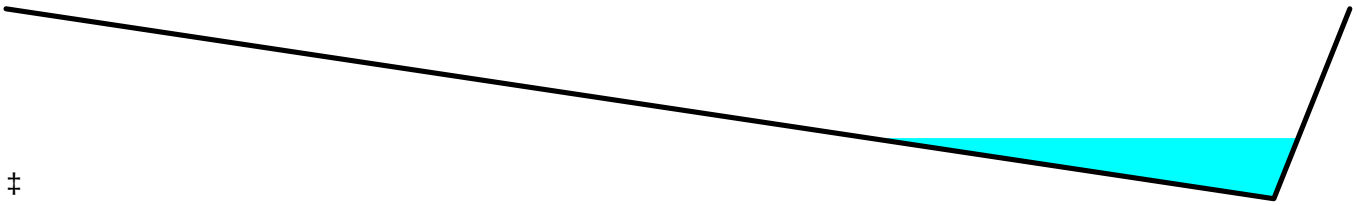
Summary for Reach C8B6: Channel 8B-6

Inflow Area = 1.631 ac, 0.00% Impervious, Inflow Depth = 3.12" for 100 Yr event
Inflow = 6.05 cfs @ 12.10 hrs, Volume= 0.424 af
Outflow = 5.54 cfs @ 12.24 hrs, Volume= 0.424 af, Atten= 8%, Lag= 8.1 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
Max. Velocity= 2.06 fps, Min. Travel Time= 4.7 min
Avg. Velocity = 0.75 fps, Avg. Travel Time= 12.8 min

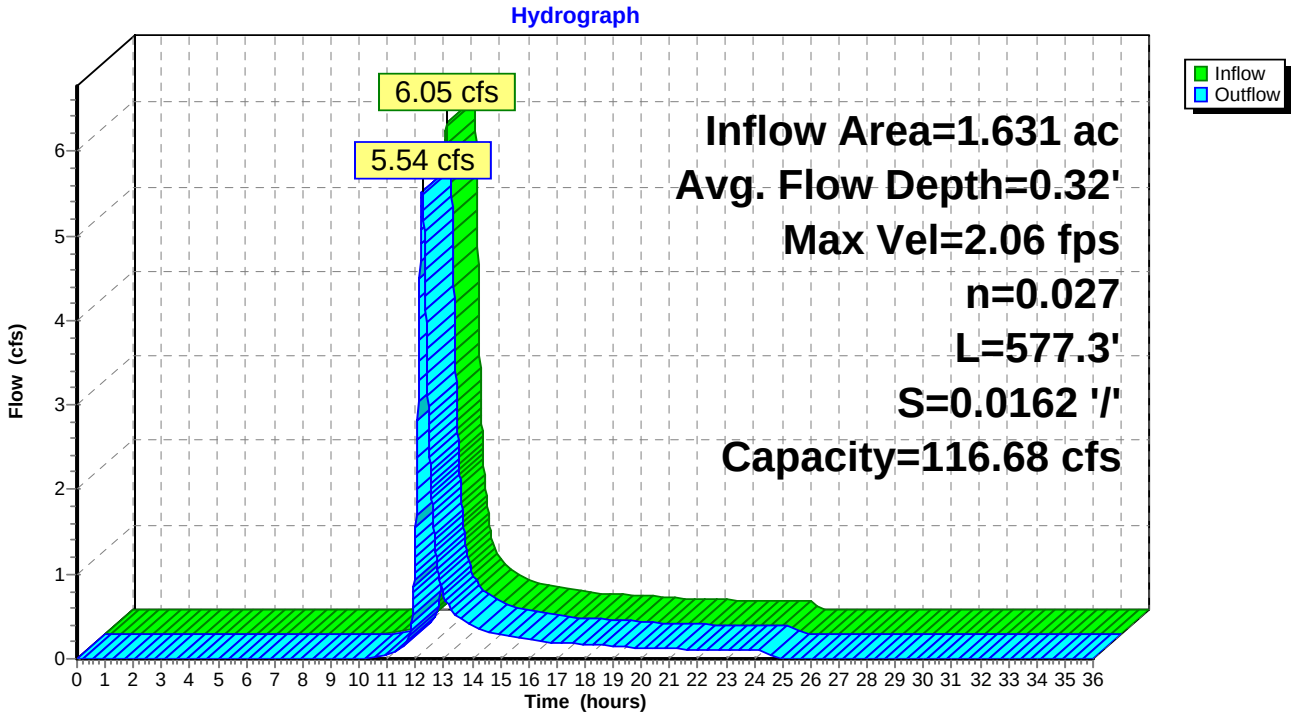
Peak Storage= 1,556 cf @ 12.16 hrs
Average Depth at Peak Storage= 0.32'
Bank-Full Depth= 1.00' Flow Area= 26.5 sf, Capacity= 116.68 cfs

0.00' x 1.00' deep channel, n= 0.027
Side Slope Z-value= 50.0 3.0 '/' Top Width= 53.00'
Length= 577.3' Slope= 0.0162 '/'
Inlet Invert= 413.96', Outlet Invert= 404.61'



‡

Reach C8B6: Channel 8B-6



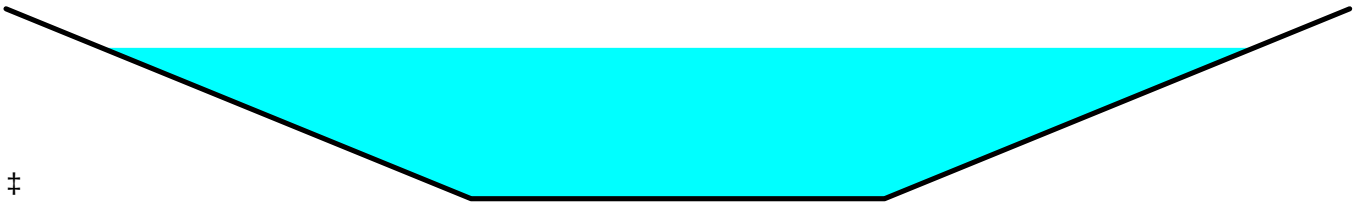
Summary for Reach C8B7: Channel 8B-7

Inflow Area = 8.668 ac, 0.00% Impervious, Inflow Depth = 3.12" for 100 Yr event
Inflow = 27.73 cfs @ 12.22 hrs, Volume= 2.254 af
Outflow = 27.65 cfs @ 12.25 hrs, Volume= 2.254 af, Atten= 0%, Lag= 1.5 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
Max. Velocity= 3.06 fps, Min. Travel Time= 0.9 min
Avg. Velocity = 0.90 fps, Avg. Travel Time= 2.9 min

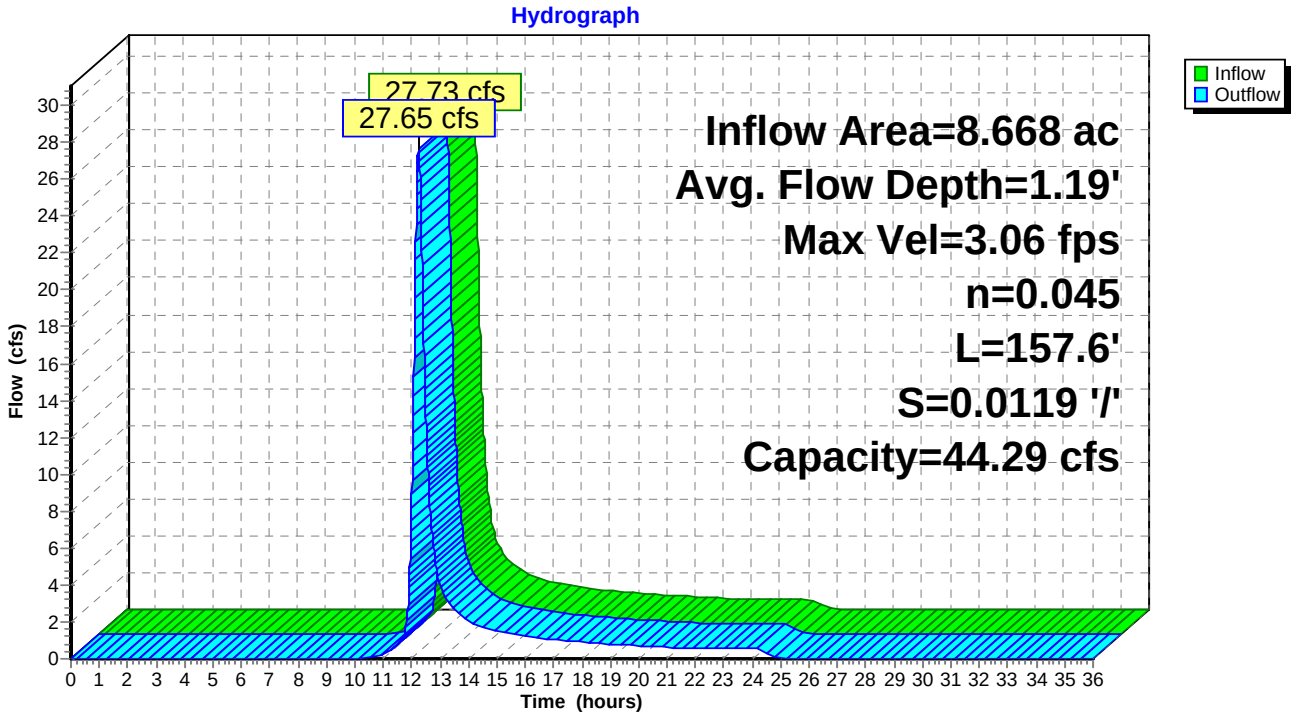
Peak Storage= 1,423 cf @ 12.23 hrs
Average Depth at Peak Storage= 1.19'
Bank-Full Depth= 1.50' Flow Area= 12.8 sf, Capacity= 44.29 cfs

4.00' x 1.50' deep channel, n= 0.045
Side Slope Z-value= 3.0 '/' Top Width= 13.00'
Length= 157.6' Slope= 0.0119 '/'
Inlet Invert= 405.51', Outlet Invert= 403.63'



‡

Reach C8B7: Channel 8B-7



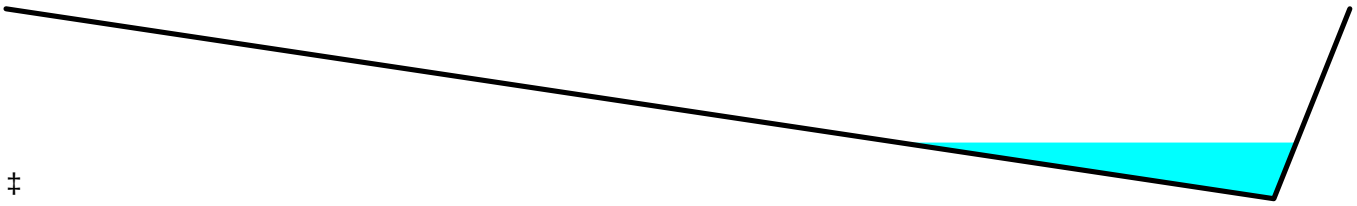
Summary for Reach C8B8: Channel 8B-8

Inflow Area = 1.297 ac, 0.00% Impervious, Inflow Depth = 3.12" for 100 Yr event
Inflow = 4.68 cfs @ 12.11 hrs, Volume= 0.337 af
Outflow = 4.37 cfs @ 12.23 hrs, Volume= 0.337 af, Atten= 7%, Lag= 7.3 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
Max. Velocity= 1.88 fps, Min. Travel Time= 4.2 min
Avg. Velocity = 0.71 fps, Avg. Travel Time= 11.1 min

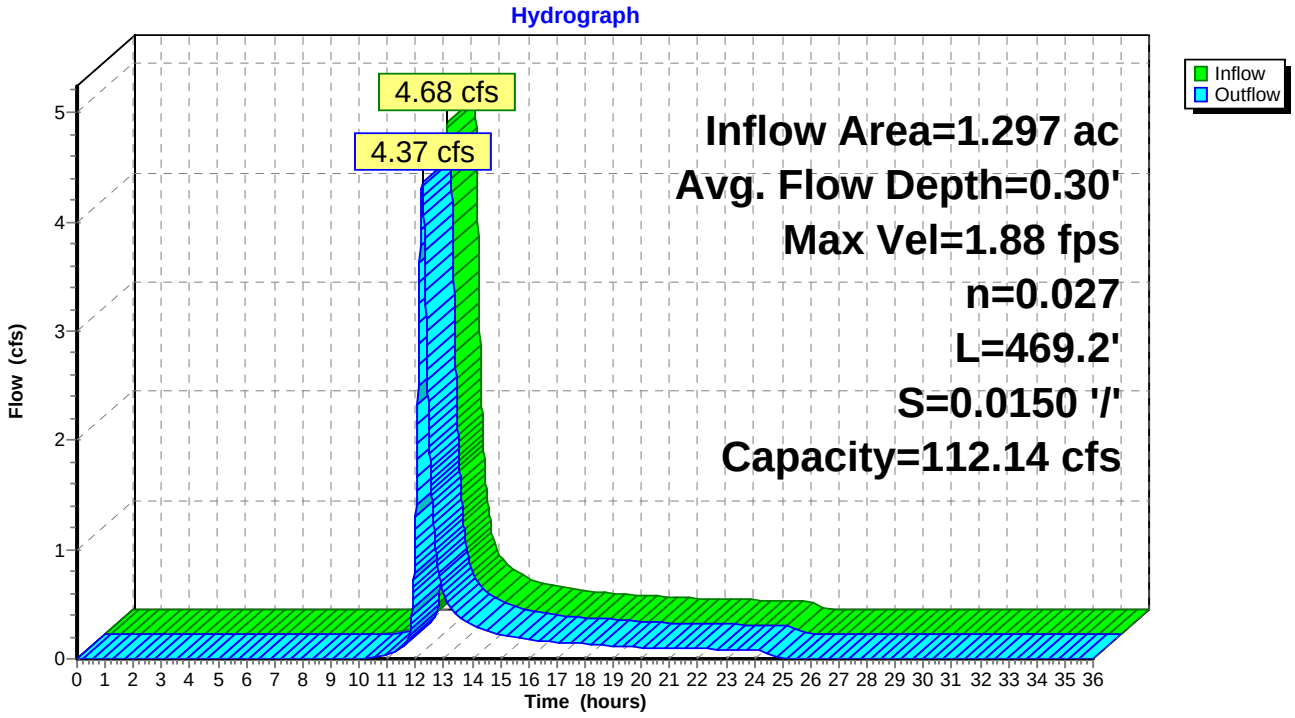
Peak Storage= 1,090 cf @ 12.16 hrs
Average Depth at Peak Storage= 0.30'
Bank-Full Depth= 1.00' Flow Area= 26.5 sf, Capacity= 112.14 cfs

0.00' x 1.00' deep channel, n= 0.027
Side Slope Z-value= 50.0 3.0 '/' Top Width= 53.00'
Length= 469.2' Slope= 0.0150 '/'
Inlet Invert= 413.21', Outlet Invert= 406.19'



‡

Reach C8B8: Channel 8B-8



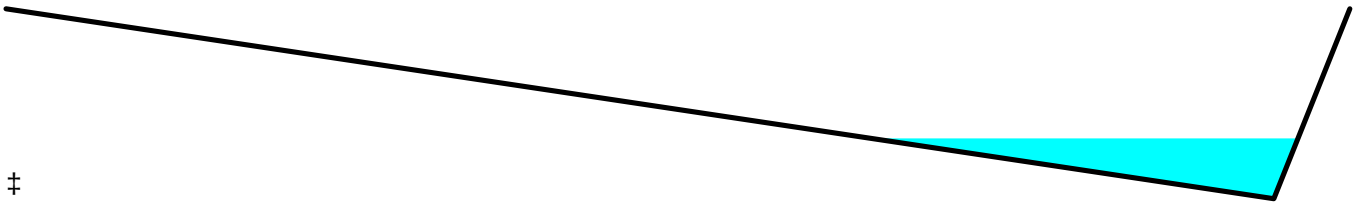
Summary for Reach C8B9: Channel 8B-9

Inflow Area = 1.632 ac, 0.00% Impervious, Inflow Depth = 3.12" for 100 Yr event
Inflow = 6.00 cfs @ 12.11 hrs, Volume= 0.424 af
Outflow = 5.49 cfs @ 12.24 hrs, Volume= 0.424 af, Atten= 8%, Lag= 8.1 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
Max. Velocity= 2.05 fps, Min. Travel Time= 4.7 min
Avg. Velocity = 0.75 fps, Avg. Travel Time= 12.9 min

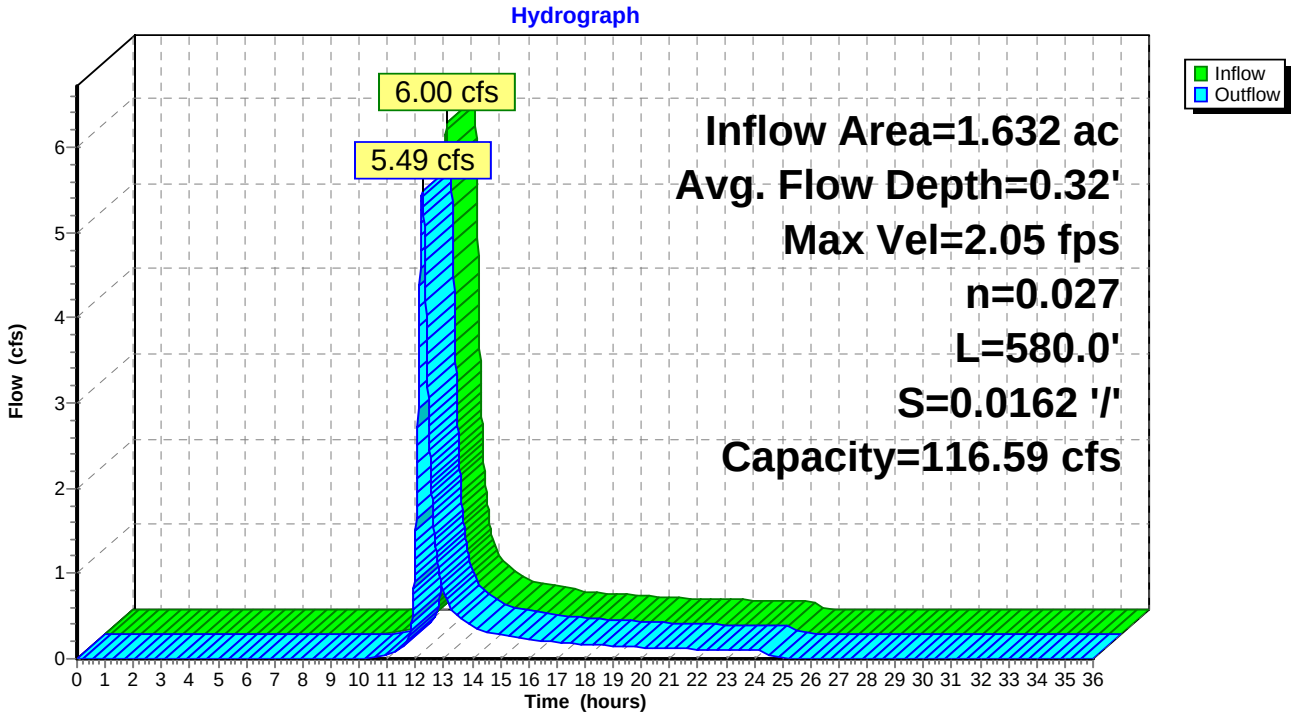
Peak Storage= 1,554 cf @ 12.16 hrs
Average Depth at Peak Storage= 0.32'
Bank-Full Depth= 1.00' Flow Area= 26.5 sf, Capacity= 116.59 cfs

0.00' x 1.00' deep channel, n= 0.027
Side Slope Z-value= 50.0 3.0 '/' Top Width= 53.00'
Length= 580.0' Slope= 0.0162 '/'
Inlet Invert= 415.58', Outlet Invert= 406.20'



‡

Reach C8B9: Channel 8B-9



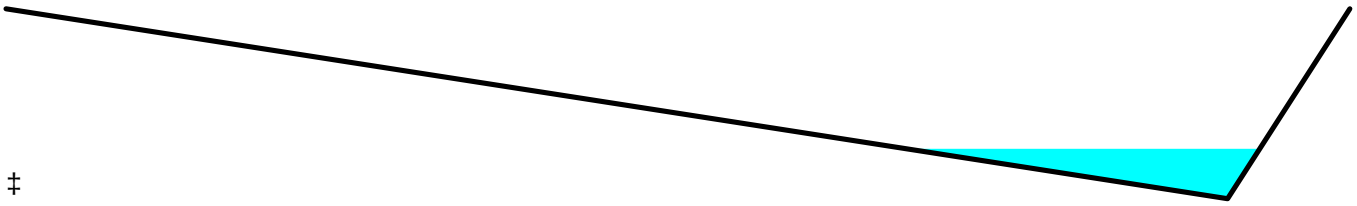
Summary for Reach C8C1: Channel 8C-1

Inflow Area = 2.962 ac, 0.00% Impervious, Inflow Depth = 3.12" for 100 Yr event
Inflow = 9.86 cfs @ 12.19 hrs, Volume= 0.770 af
Outflow = 9.84 cfs @ 12.21 hrs, Volume= 0.770 af, Atten= 0%, Lag= 1.3 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
Max. Velocity= 2.30 fps, Min. Travel Time= 0.7 min
Avg. Velocity = 0.88 fps, Avg. Travel Time= 1.9 min

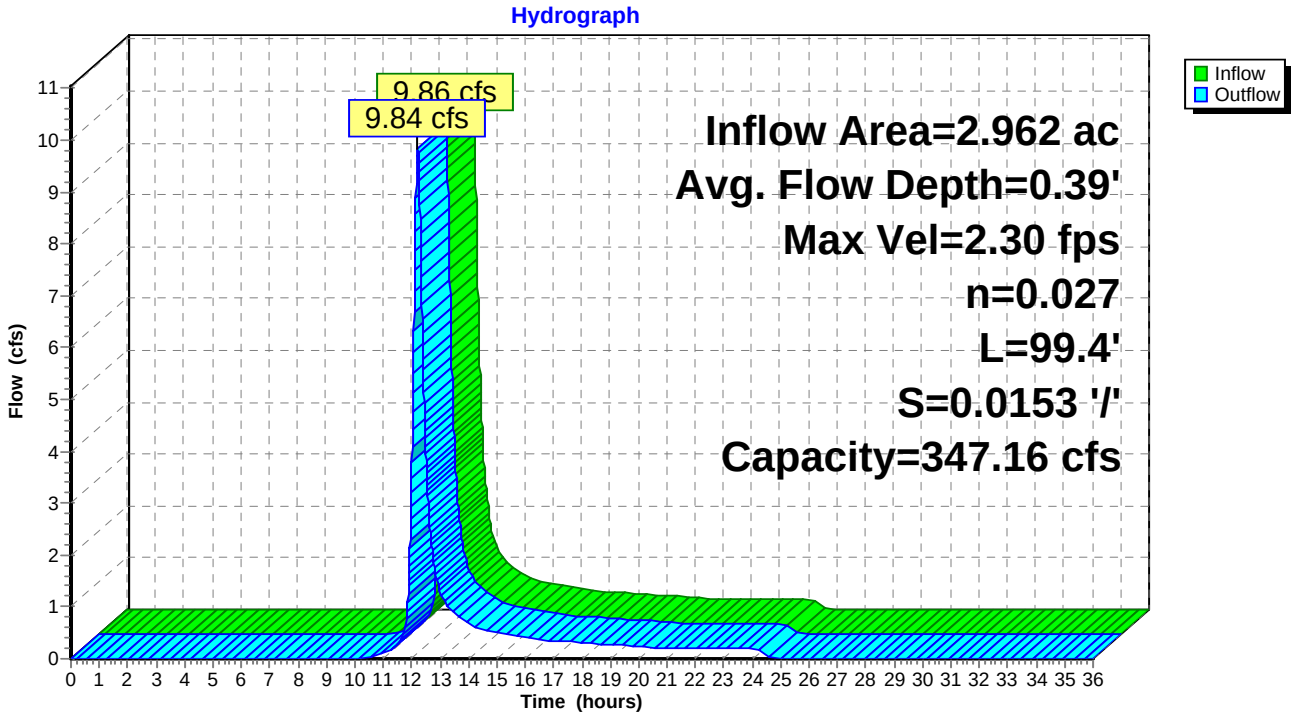
Peak Storage= 425 cf @ 12.20 hrs
Average Depth at Peak Storage= 0.39'
Bank-Full Depth= 1.50' Flow Area= 61.9 sf, Capacity= 347.16 cfs

0.00' x 1.50' deep channel, n= 0.027
Side Slope Z-value= 50.0 5.0 '/' Top Width= 82.50'
Length= 99.4' Slope= 0.0153 '/'
Inlet Invert= 403.17', Outlet Invert= 401.65'



‡

Reach C8C1: Channel 8C-1



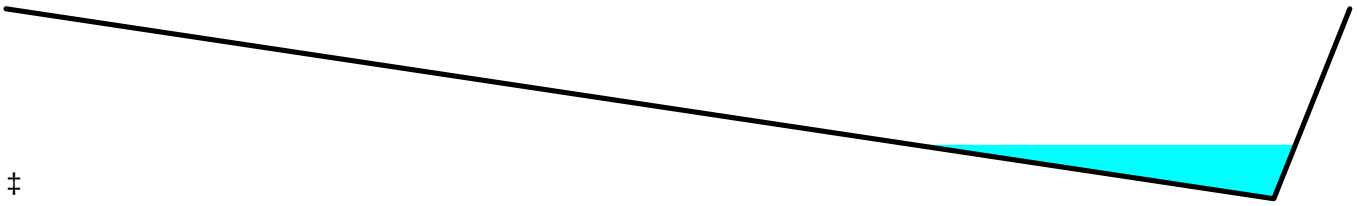
Summary for Reach C8C2: Channel 8C-2

Inflow Area = 1.121 ac, 0.00% Impervious, Inflow Depth = 3.12" for 100 Yr event
Inflow = 4.18 cfs @ 12.10 hrs, Volume= 0.291 af
Outflow = 4.01 cfs @ 12.19 hrs, Volume= 0.291 af, Atten= 4%, Lag= 5.1 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
Max. Velocity= 1.88 fps, Min. Travel Time= 2.9 min
Avg. Velocity = 0.73 fps, Avg. Travel Time= 7.4 min

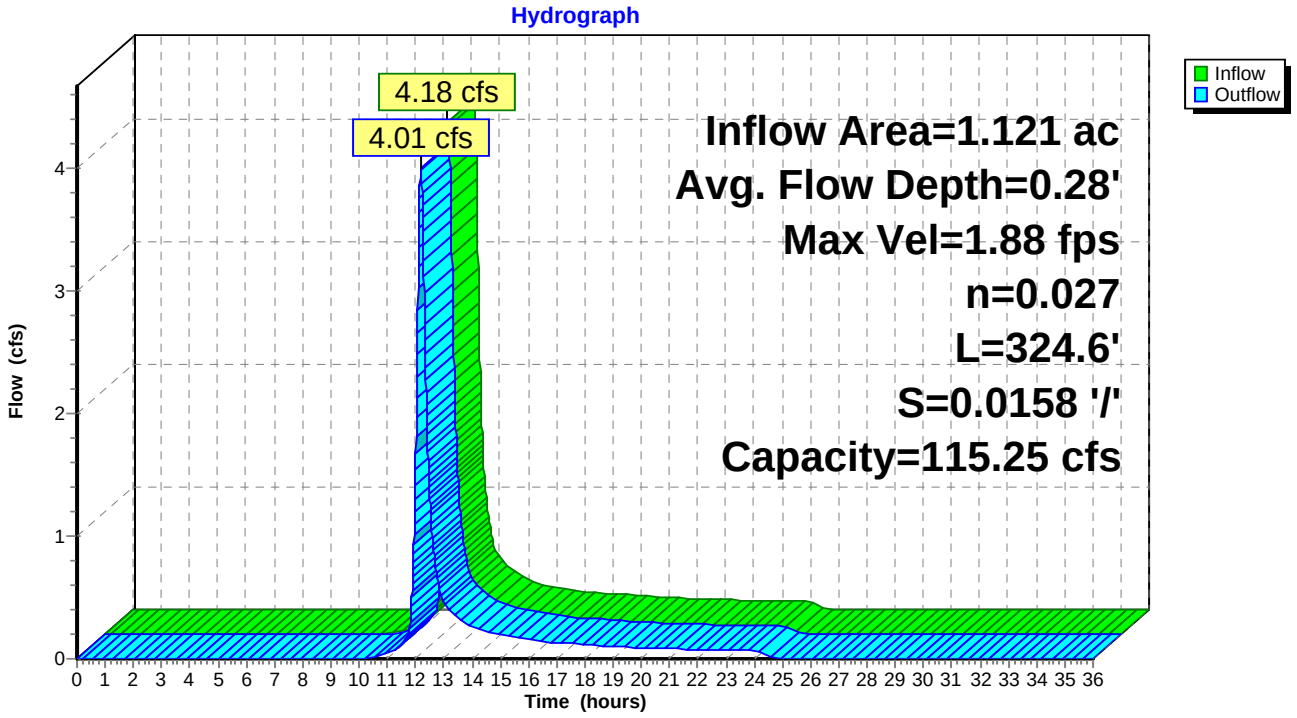
Peak Storage= 693 cf @ 12.14 hrs
Average Depth at Peak Storage= 0.28'
Bank-Full Depth= 1.00' Flow Area= 26.5 sf, Capacity= 115.25 cfs

0.00' x 1.00' deep channel, n= 0.027
Side Slope Z-value= 50.0 3.0 '/' Top Width= 53.00'
Length= 324.6' Slope= 0.0158 '/'
Inlet Invert= 408.30', Outlet Invert= 403.17'



‡

Reach C8C2: Channel 8C-2



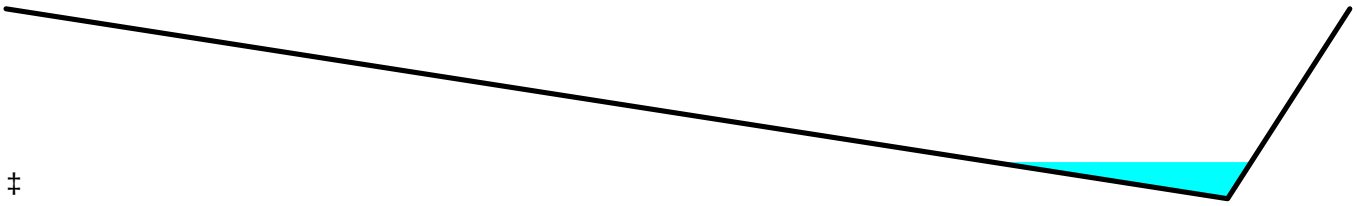
Summary for Reach C8C3: Channel 8C-3

Inflow Area = 1.201 ac, 0.00% Impervious, Inflow Depth = 3.12" for 100 Yr event
Inflow = 4.43 cfs @ 12.11 hrs, Volume= 0.312 af
Outflow = 4.07 cfs @ 12.23 hrs, Volume= 0.312 af, Atten= 8%, Lag= 7.7 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
Max. Velocity= 1.77 fps, Min. Travel Time= 4.5 min
Avg. Velocity = 0.68 fps, Avg. Travel Time= 11.8 min

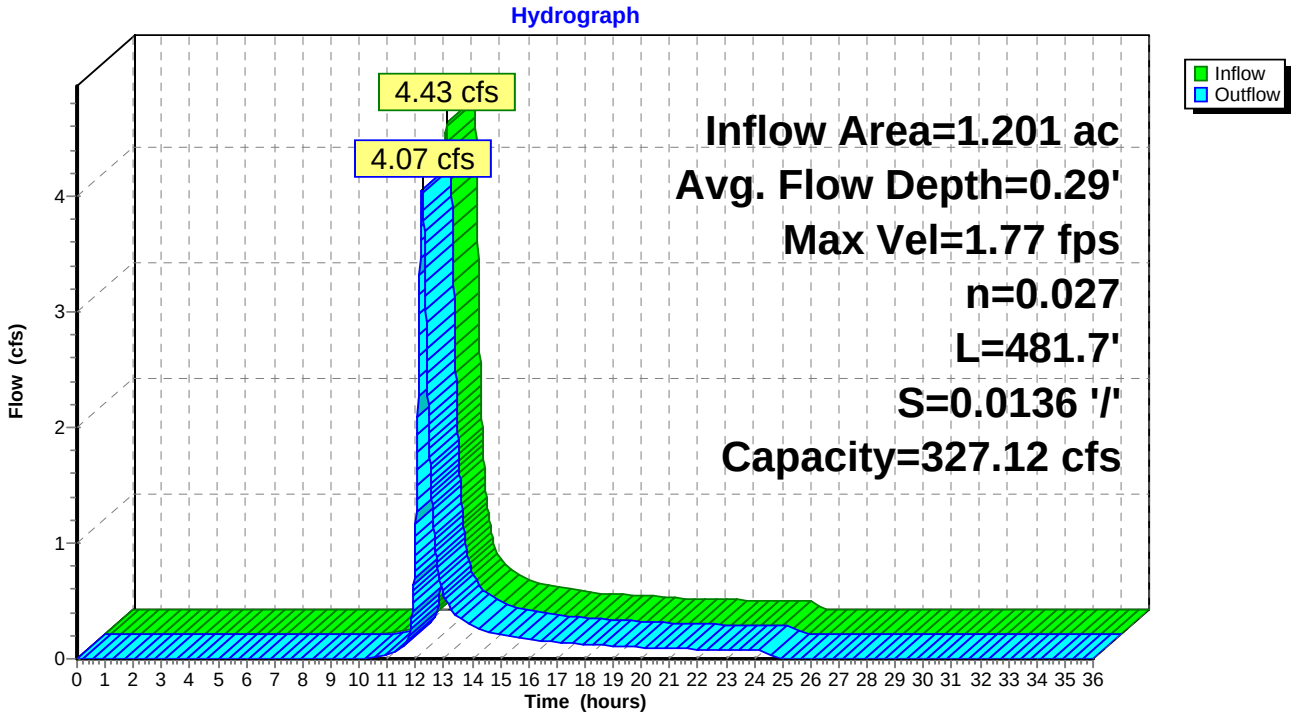
Peak Storage= 1,111 cf @ 12.16 hrs
Average Depth at Peak Storage= 0.29'
Bank-Full Depth= 1.50' Flow Area= 61.9 sf, Capacity= 327.12 cfs

0.00' x 1.50' deep channel, n= 0.027
Side Slope Z-value= 50.0 5.0 '/' Top Width= 82.50'
Length= 481.7' Slope= 0.0136 '/'
Inlet Invert= 409.58', Outlet Invert= 403.04'



‡

Reach C8C3: Channel 8C-3



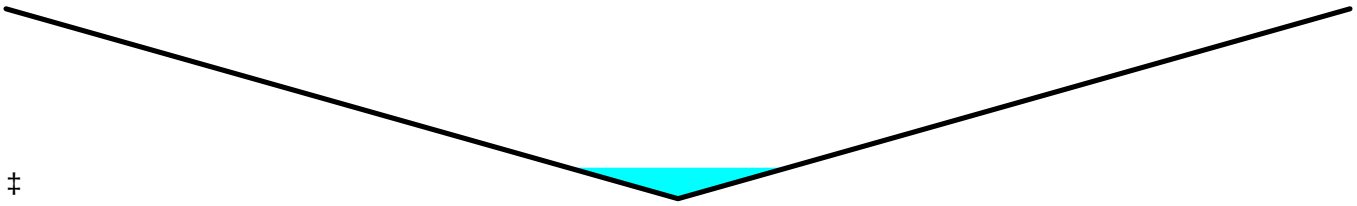
Summary for Reach C9A: Channel 9A

Inflow Area = 0.307 ac, 0.00% Impervious, Inflow Depth = 3.12" for 100 Yr event
Inflow = 1.98 cfs @ 11.93 hrs, Volume= 0.080 af
Outflow = 1.88 cfs @ 11.97 hrs, Volume= 0.080 af, Atten= 5%, Lag= 2.3 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs / 2
Max. Velocity= 2.80 fps, Min. Travel Time= 1.4 min
Avg. Velocity = 1.03 fps, Avg. Travel Time= 3.9 min

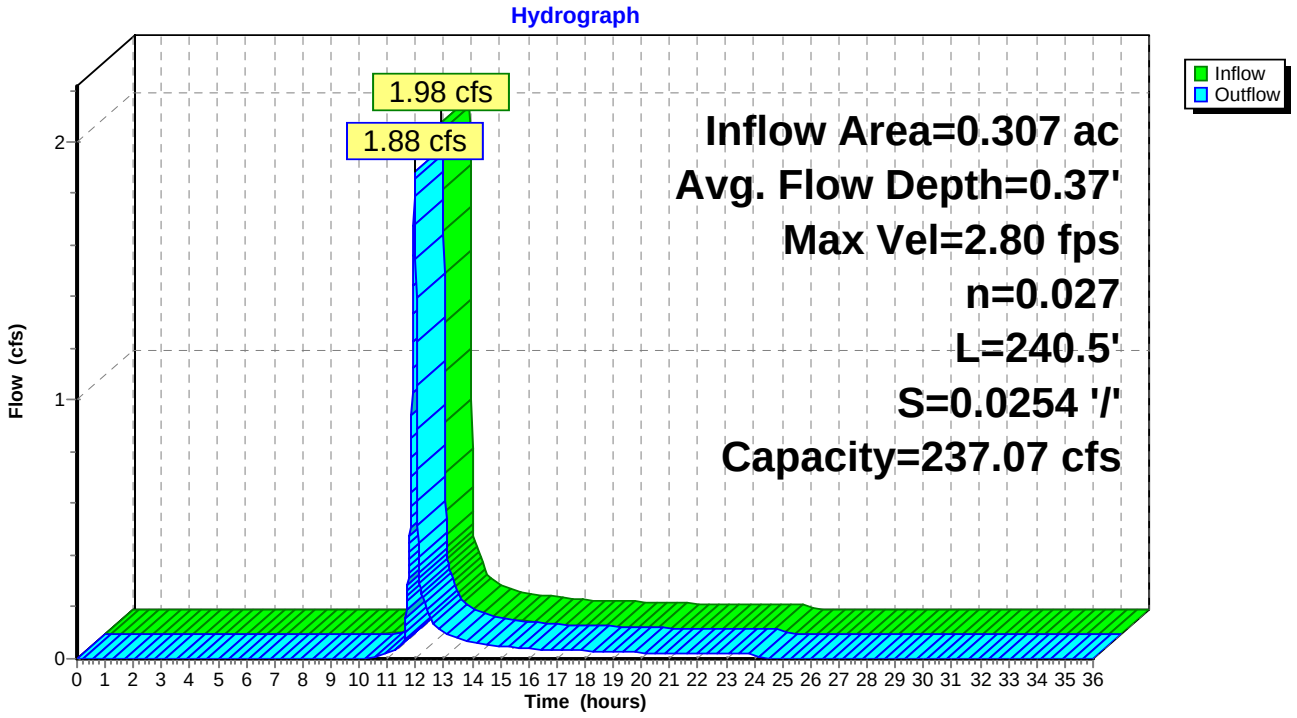
Peak Storage= 162 cf @ 11.95 hrs
Average Depth at Peak Storage= 0.37'
Bank-Full Depth= 2.25' Flow Area= 25.3 sf, Capacity= 237.07 cfs

0.00' x 2.25' deep channel, n= 0.027
Side Slope Z-value= 5.0 '/' Top Width= 22.50'
Length= 240.5' Slope= 0.0254 '/'
Inlet Invert= 409.15', Outlet Invert= 403.04'



‡

Reach C9A: Channel 9A



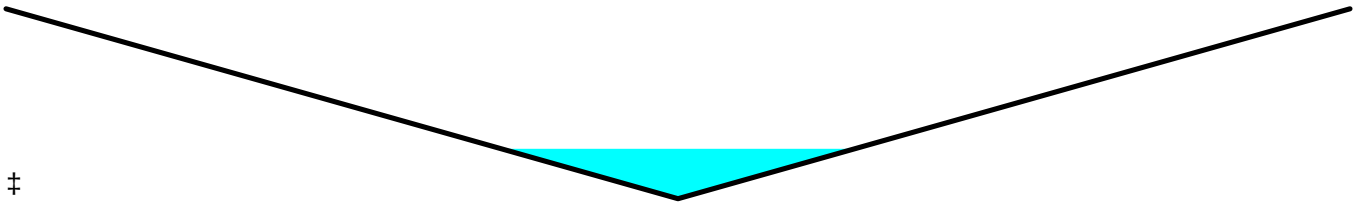
Summary for Reach C9B: Channel 9B

Inflow Area = 0.774 ac, 0.00% Impervious, Inflow Depth = 3.12" for 100 Yr event
Inflow = 4.82 cfs @ 11.94 hrs, Volume= 0.201 af
Outflow = 4.20 cfs @ 12.03 hrs, Volume= 0.201 af, Atten= 13%, Lag= 5.3 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs / 2
Max. Velocity= 2.41 fps, Min. Travel Time= 3.4 min
Avg. Velocity = 0.84 fps, Avg. Travel Time= 9.8 min

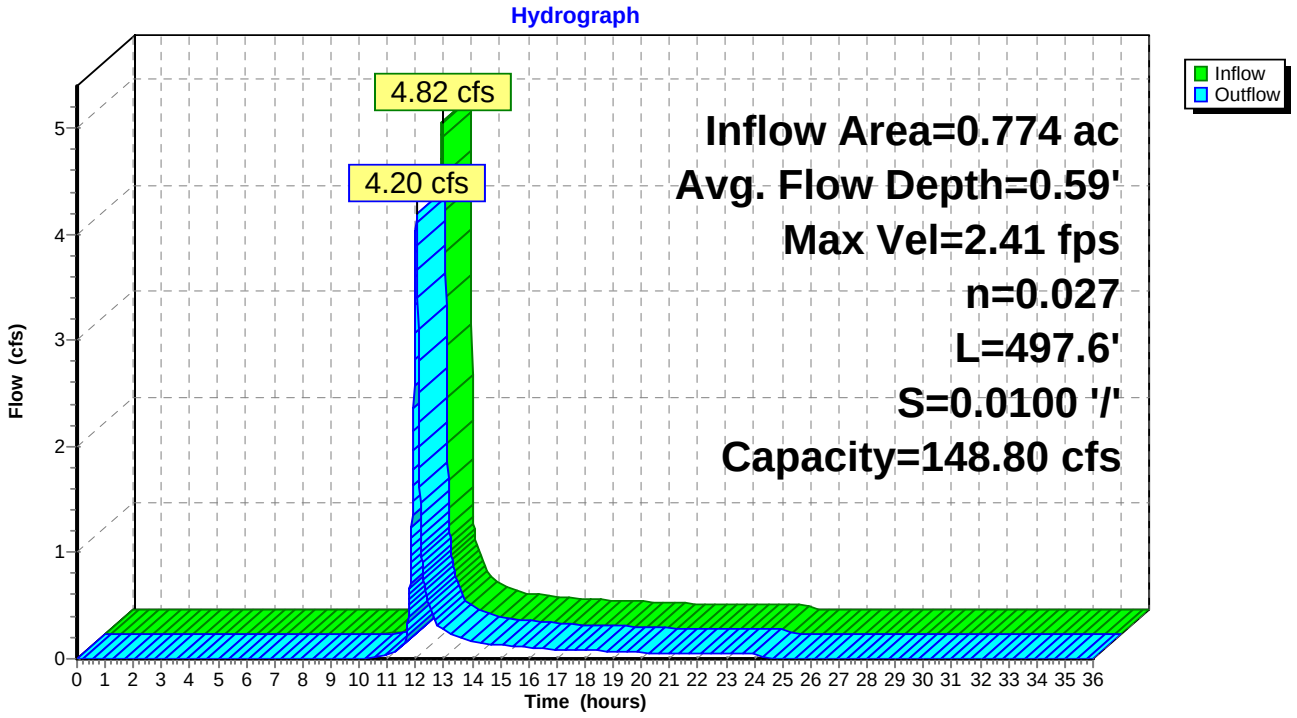
Peak Storage= 868 cf @ 11.97 hrs
Average Depth at Peak Storage= 0.59'
Bank-Full Depth= 2.25' Flow Area= 25.3 sf, Capacity= 148.80 cfs

0.00' x 2.25' deep channel, n= 0.027
Side Slope Z-value= 5.0 '/' Top Width= 22.50'
Length= 497.6' Slope= 0.0100 '/'
Inlet Invert= 408.02', Outlet Invert= 403.04'



‡

Reach C9B: Channel 9B



Summary for Reach WD1: West Ditch 1

Inflow Area = 74.185 ac, 0.00% Impervious, Inflow Depth > 33.89" for 100 Yr event
Inflow = 163.01 cfs @ 12.31 hrs, Volume= 209.527 af
Outflow = 162.42 cfs @ 12.39 hrs, Volume= 208.937 af, Atten= 0%, Lag= 4.6 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
Max. Velocity= 3.01 fps, Min. Travel Time= 2.8 min
Avg. Velocity = 2.24 fps, Avg. Travel Time= 3.7 min

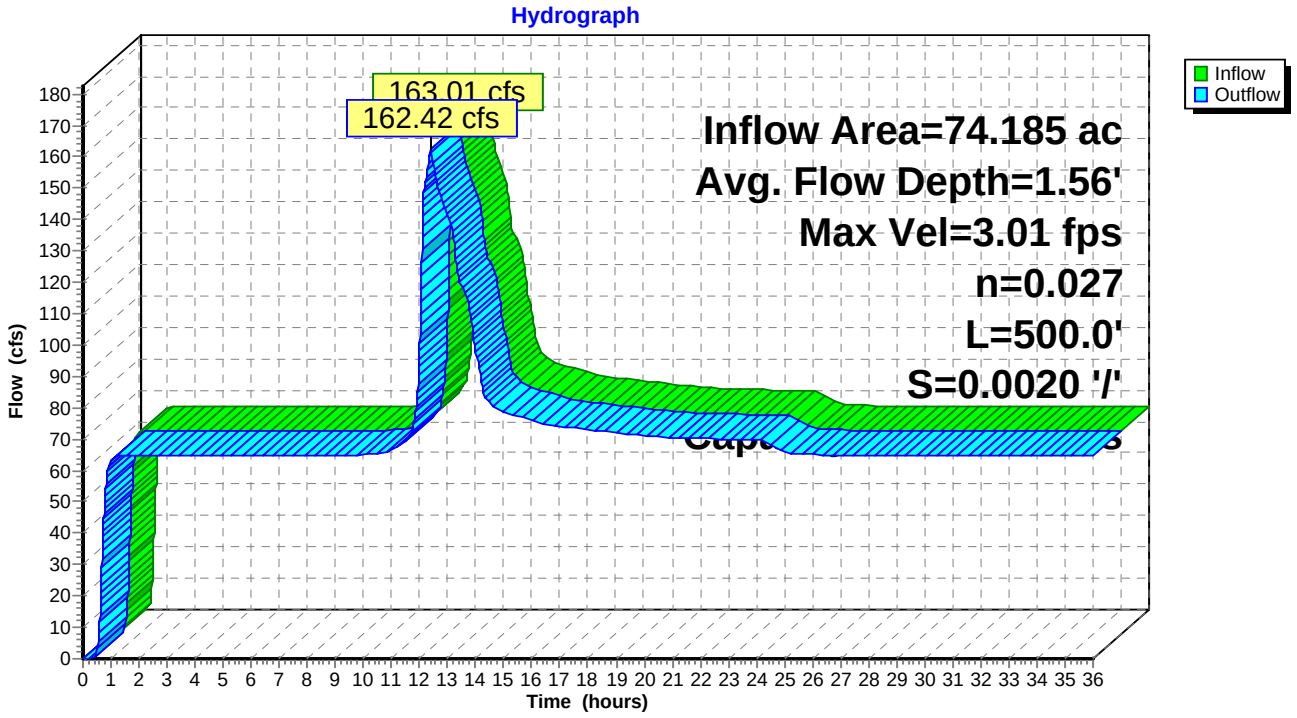
Peak Storage= 27,017 cf @ 12.34 hrs
Average Depth at Peak Storage= 1.56'
Bank-Full Depth= 25.00' Flow Area= 2,625.0 sf, Capacity= 37,261.12 cfs

30.00' x 25.00' deep channel, n= 0.027
Side Slope Z-value= 3.0 '/' Top Width= 180.00'
Length= 500.0' Slope= 0.0020 '/'
Inlet Invert= 373.99', Outlet Invert= 373.00'



‡

Reach WD1: West Ditch 1



Summary for Reach WD2: West Ditch 2

Inflow Area = 60.217 ac, 0.00% Impervious, Inflow Depth > 41.31" for 100 Yr event
Inflow = 153.33 cfs @ 11.91 hrs, Volume= 207.318 af
Outflow = 141.81 cfs @ 12.30 hrs, Volume= 205.895 af, Atten= 8%, Lag= 23.7 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
Max. Velocity= 2.74 fps, Min. Travel Time= 6.9 min
Avg. Velocity = 2.12 fps, Avg. Travel Time= 8.9 min

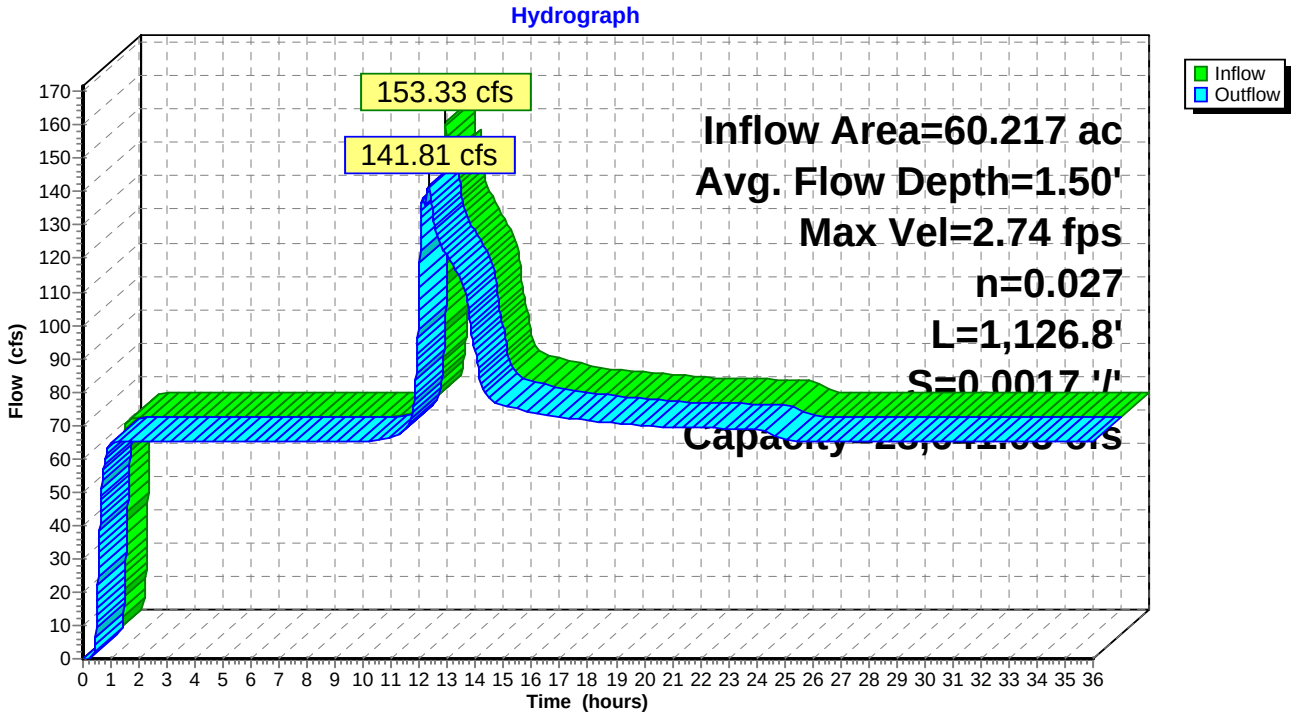
Peak Storage= 58,389 cf @ 12.19 hrs
Average Depth at Peak Storage= 1.50'
Bank-Full Depth= 23.00' Flow Area= 2,277.0 sf, Capacity= 28,641.03 cfs

30.00' x 23.00' deep channel, n= 0.027
Side Slope Z-value= 3.0 '/' Top Width= 168.00'
Length= 1,126.8' Slope= 0.0017 '/'
Inlet Invert= 375.92', Outlet Invert= 373.99'



‡

Reach WD2: West Ditch 2



Summary for Reach WD3A: West Ditch 3A

Inflow Area = 34.618 ac, 0.00% Impervious, Inflow Depth > 69.71" for 100 Yr event
Inflow = 122.89 cfs @ 12.07 hrs, Volume= 201.090 af
Outflow = 121.87 cfs @ 12.13 hrs, Volume= 200.661 af, Atten= 1%, Lag= 3.4 min

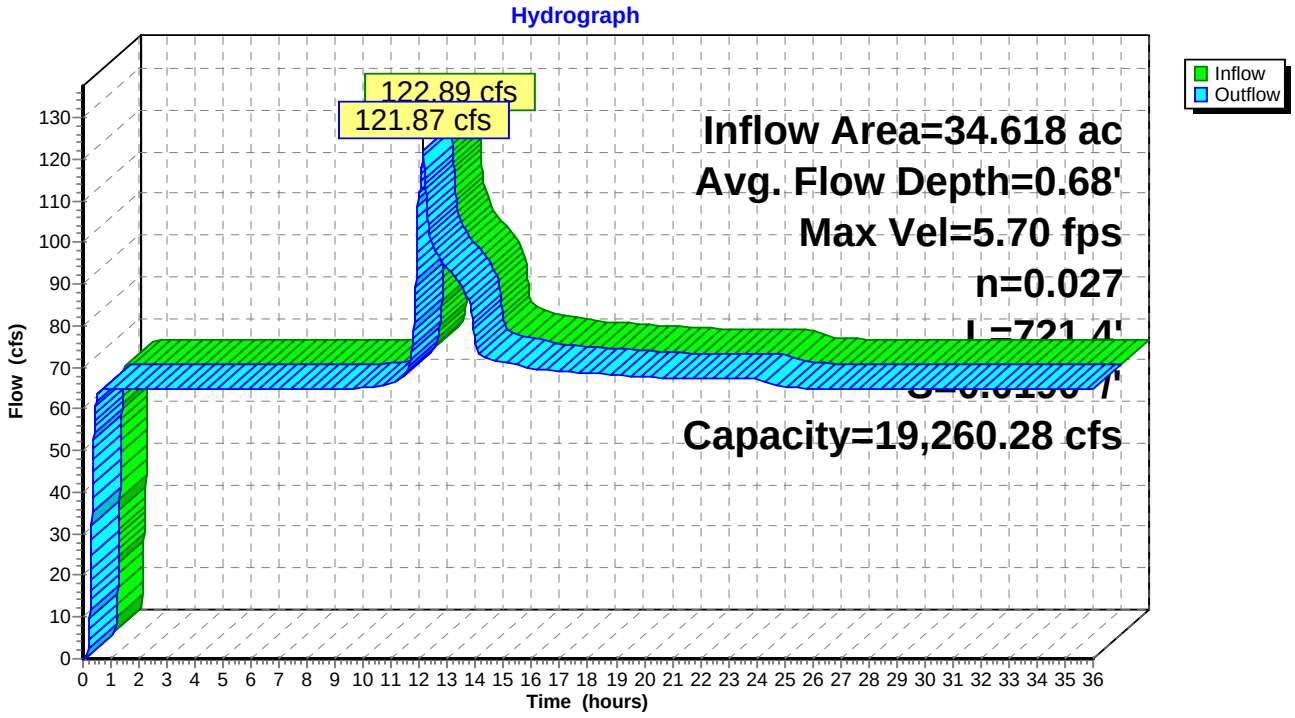
Routing by Stor-Ind+Trans method, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs / 2
Max. Velocity= 5.70 fps, Min. Travel Time= 2.1 min
Avg. Velocity = 4.54 fps, Avg. Travel Time= 2.6 min

Peak Storage= 15,430 cf @ 12.09 hrs
Average Depth at Peak Storage= 0.68'
Bank-Full Depth= 12.00' Flow Area= 648.0 sf, Capacity= 19,260.28 cfs

30.00' x 12.00' deep channel, n= 0.027
Side Slope Z-value= 2.0 '/' Top Width= 78.00'
Length= 721.4' Slope= 0.0190 '/'
Inlet Invert= 389.65', Outlet Invert= 375.92'



Reach WD3A: West Ditch 3A



Summary for Reach WD3B: West Ditch 3B

Inflow Area = 30.403 ac, 0.00% Impervious, Inflow Depth > 78.97" for 100 Yr event
Inflow = 119.38 cfs @ 12.06 hrs, Volume= 200.066 af
Outflow = 119.26 cfs @ 12.07 hrs, Volume= 199.994 af, Atten= 0%, Lag= 0.6 min

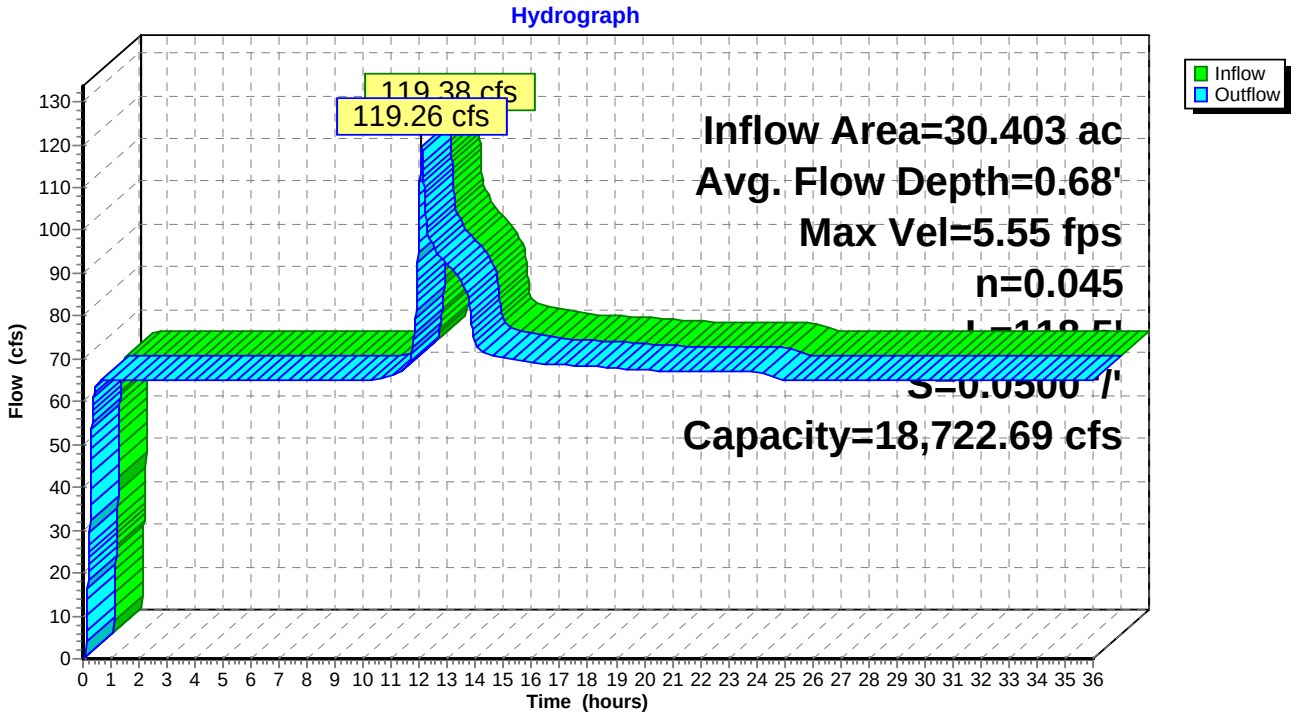
Routing by Stor-Ind+Trans method, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs / 2
Max. Velocity= 5.55 fps, Min. Travel Time= 0.4 min
Avg. Velocity = 4.45 fps, Avg. Travel Time= 0.4 min

Peak Storage= 2,545 cf @ 12.06 hrs
Average Depth at Peak Storage= 0.68'
Bank-Full Depth= 12.00' Flow Area= 648.0 sf, Capacity= 18,722.69 cfs

30.00' x 12.00' deep channel, n= 0.045
Side Slope Z-value= 2.0 '/' Top Width= 78.00'
Length= 118.5' Slope= 0.0500 '/'
Inlet Invert= 395.57', Outlet Invert= 389.65'



Reach WD3B: West Ditch 3B



Summary for Reach WD3C: West Ditch 3C

Inflow Area = 30.403 ac, 0.00% Impervious, Inflow Depth > 79.02" for 100 Yr event
Inflow = 119.54 cfs @ 12.04 hrs, Volume= 200.199 af
Outflow = 119.38 cfs @ 12.06 hrs, Volume= 200.066 af, Atten= 0%, Lag= 1.1 min

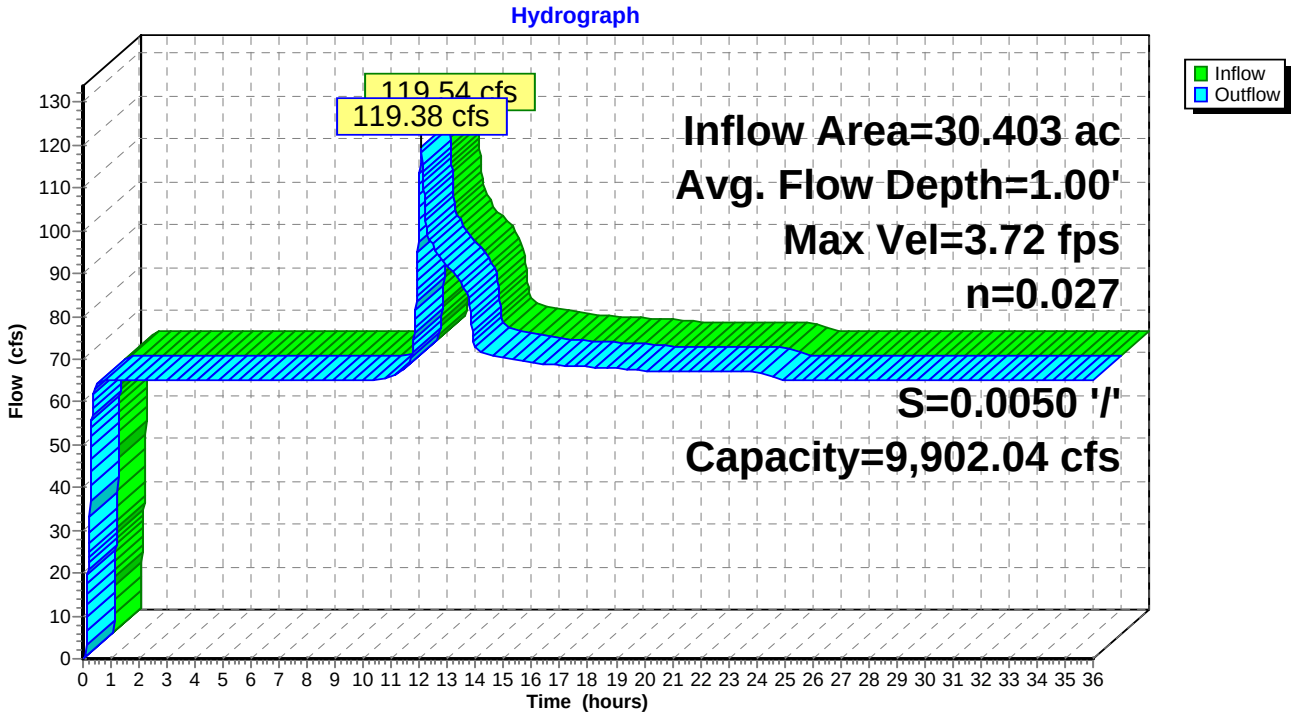
Routing by Stor-Ind+Trans method, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs / 2
Max. Velocity= 3.72 fps, Min. Travel Time= 0.7 min
Avg. Velocity = 3.00 fps, Avg. Travel Time= 0.8 min

Peak Storage= 4,716 cf @ 12.05 hrs
Average Depth at Peak Storage= 1.00'
Bank-Full Depth= 12.00' Flow Area= 648.0 sf, Capacity= 9,902.04 cfs

30.00' x 12.00' deep channel, n= 0.027
Side Slope Z-value= 2.0 '/' Top Width= 78.00'
Length= 147.1' Slope= 0.0050 '/'
Inlet Invert= 396.31', Outlet Invert= 395.57'



Reach WD3C: West Ditch 3C



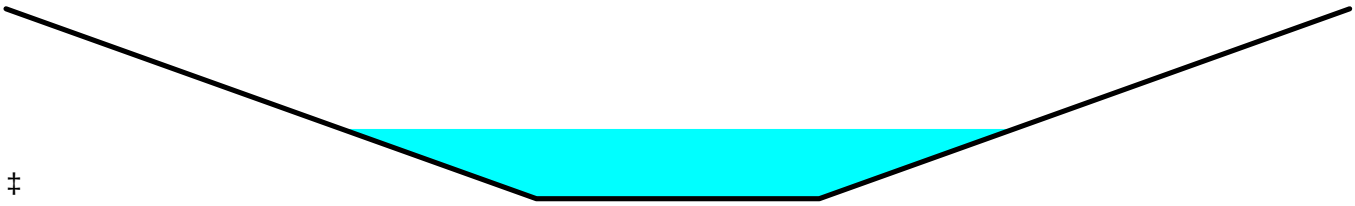
Summary for Reach WD4: West Ditch 4

Inflow Area = 10.099 ac, 0.00% Impervious, Inflow Depth > 232.97" for 100 Yr event
Inflow = 121.57 cfs @ 11.90 hrs, Volume= 196.068 af
Outflow = 114.34 cfs @ 11.99 hrs, Volume= 195.431 af, Atten= 6%, Lag= 5.1 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs / 2
Max. Velocity= 4.61 fps, Min. Travel Time= 3.1 min
Avg. Velocity = 3.94 fps, Avg. Travel Time= 3.7 min

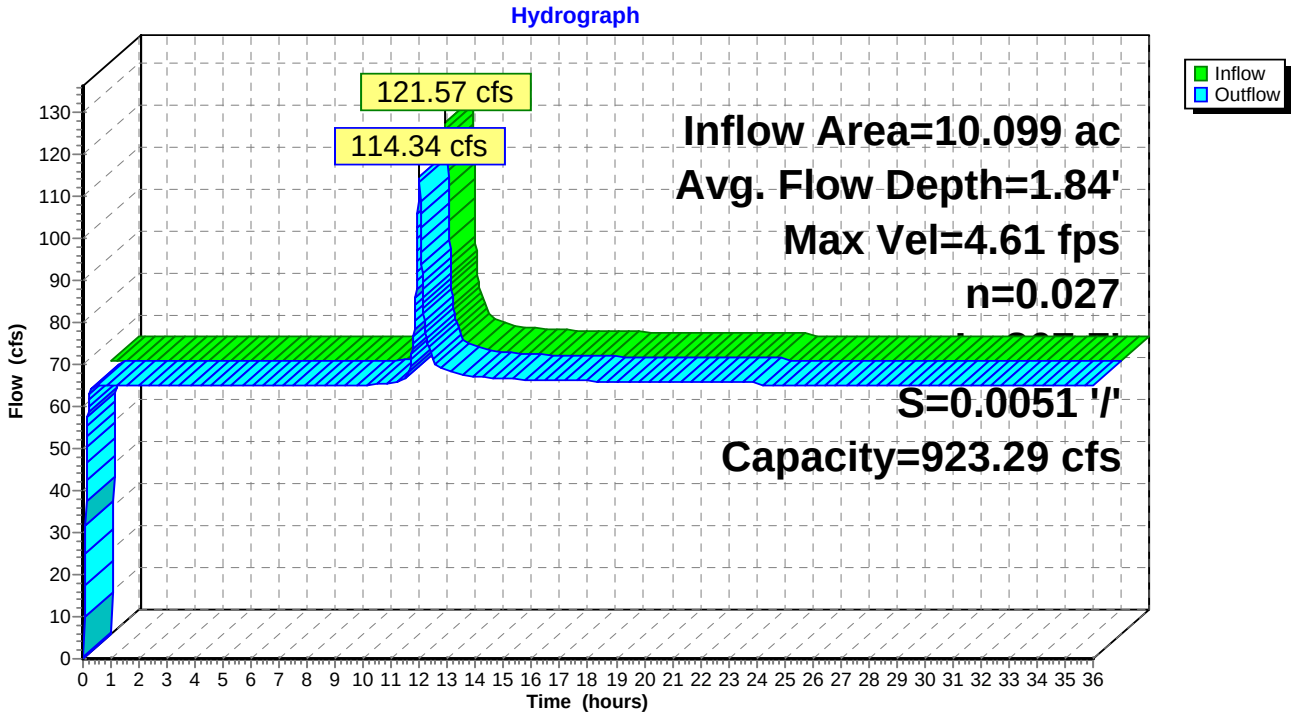
Peak Storage= 21,516 cf @ 11.93 hrs
Average Depth at Peak Storage= 1.84'
Bank-Full Depth= 5.00' Flow Area= 115.0 sf, Capacity= 923.29 cfs

8.00' x 5.00' deep channel, n= 0.027
Side Slope Z-value= 3.0 '/' Top Width= 38.00'
Length= 867.7' Slope= 0.0051 '/'
Inlet Invert= 400.98', Outlet Invert= 396.52'



‡

Reach WD4: West Ditch 4



Summary for Pond C3P: ELG Detention Basin Outlet C-3

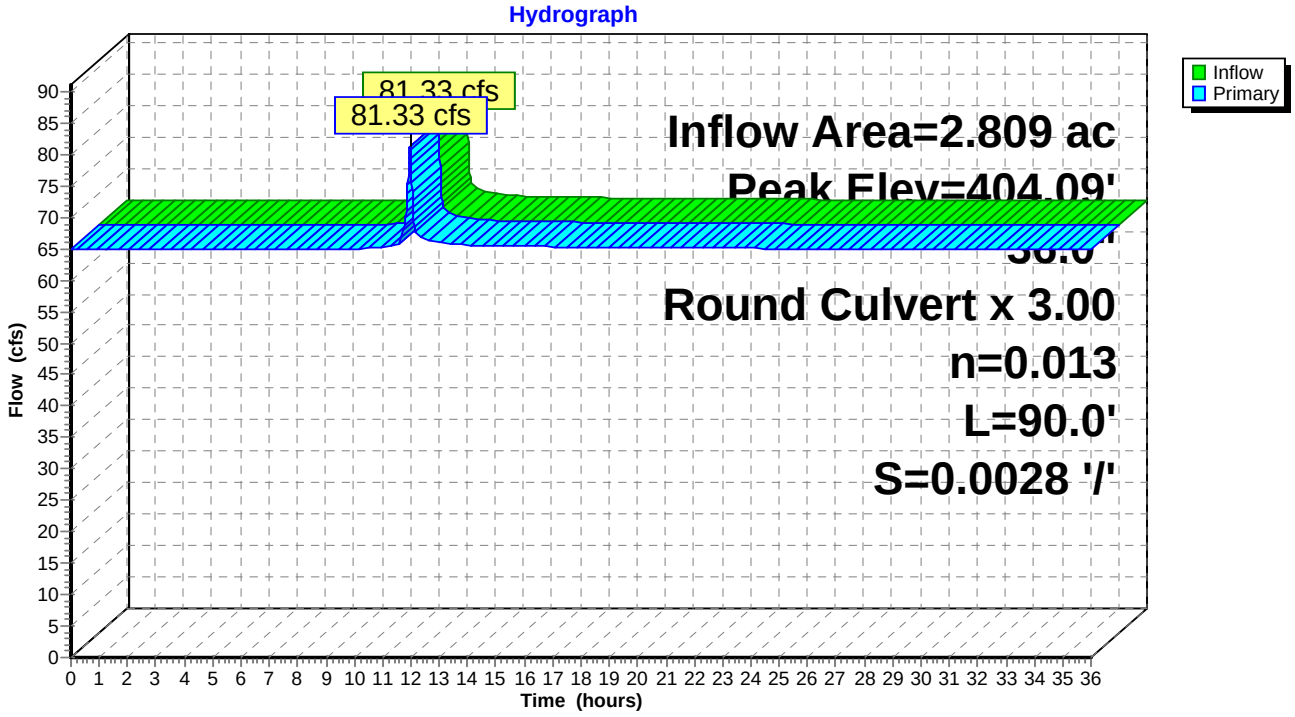
Inflow Area = 2.809 ac, 0.00% Impervious, Inflow Depth > 829.54" for 100 Yr event
Inflow = 81.33 cfs @ 11.96 hrs, Volume= 194.173 af, Incl. 65.00 cfs Base Flow
Outflow = 81.33 cfs @ 11.96 hrs, Volume= 194.173 af, Atten= 0%, Lag= 0.0 min
Primary = 81.33 cfs @ 11.96 hrs, Volume= 194.173 af

Routing by Stor-Ind method, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
Peak Elev= 404.09' @ 11.96 hrs

Device	Routing	Invert	Outlet Devices
#1	Primary	401.25'	**36.0" Round Three HDPE_Round 36" X 3.00** L= 90.0' CPP, projecting, no headwall, Ke= 0.900 Inlet / Outlet Invert= 401.25' / 401.00' S= 0.0028 '/' Cc= 0.900 n= 0.013 Corrugated PE, smooth interior, Flow Area= 7.07 sf

Primary OutFlow Max=81.29 cfs @ 11.96 hrs HW=404.09' (Free Discharge)
└**1=Three HDPE_Round 36"** (Barrel Controls 81.29 cfs @ 5.05 fps)

Pond C3P: ELG Detention Basin Outlet C-3



Summary for Pond O6: Outlet 6

Inflow Area = 13.968 ac, 0.00% Impervious, Inflow Depth = 3.12" for 100 Yr event
Inflow = 45.89 cfs @ 12.23 hrs, Volume= 3.632 af
Outflow = 22.13 cfs @ 12.48 hrs, Volume= 3.632 af, Atten= 52%, Lag= 14.5 min
Primary = 22.13 cfs @ 12.48 hrs, Volume= 3.632 af

Routing by Stor-Ind method, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
Peak Elev= 402.94' @ 12.48 hrs Surf.Area= 29,861 sf Storage= 25,494 cf

Plug-Flow detention time= 6.6 min calculated for 3.632 af (100% of inflow)
Center-of-Mass det. time= 6.6 min (872.8 - 866.2)

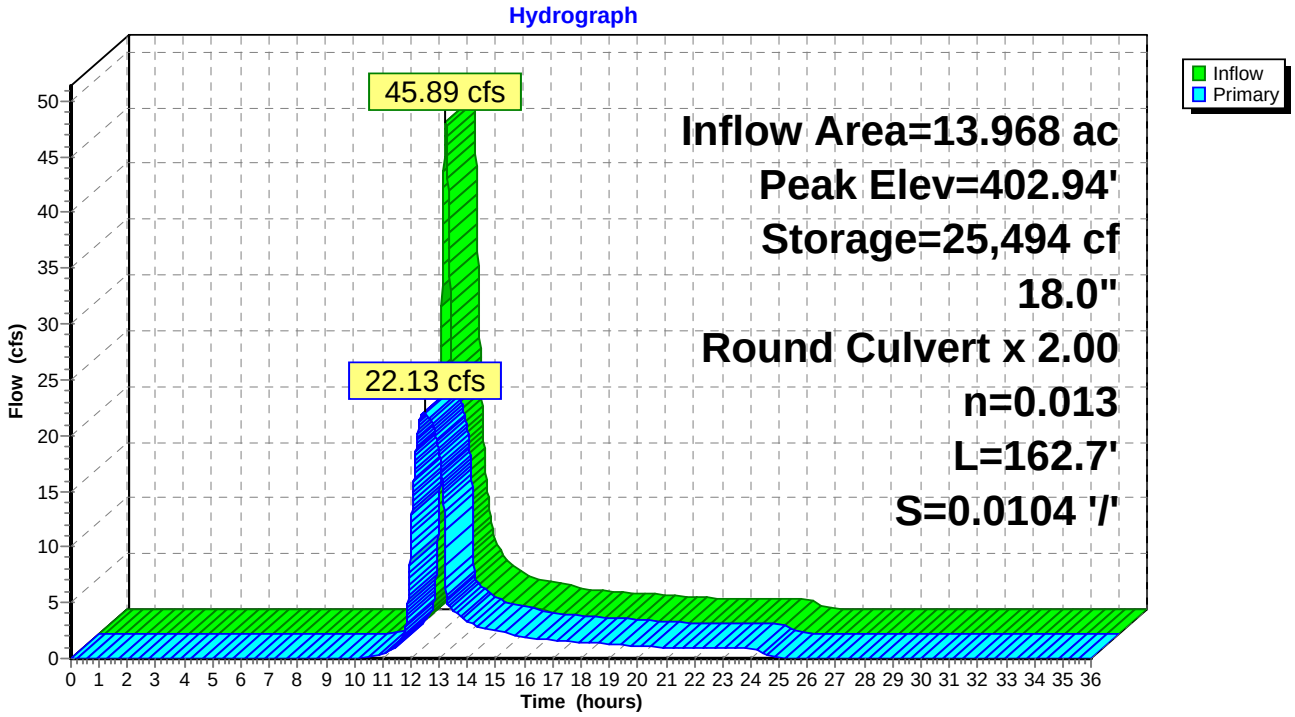
Volume	Invert	Avail.Storage	Storage Description
#1	399.57'	514,337 cf	**Custom Stage Data (Prismatic)** Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
399.57	0	0	0
400.00	256	55	55
401.00	1,259	758	813
402.00	10,236	5,748	6,560
403.00	31,016	20,626	27,186
404.00	65,281	48,149	75,335
405.00	112,873	89,077	164,412
406.00	171,318	142,096	306,507
407.00	244,341	207,830	514,337

Device	Routing	Invert	Outlet Devices
#1	Primary	399.48'	**18.0" Round Dual HDPE_Round 18" X 2.00** L= 162.7' CPP, projecting, no headwall, Ke= 0.900 Inlet / Outlet Invert= 399.48' / 397.79' S= 0.0104 '/' Cc= 0.900 n= 0.013 Corrugated PE, smooth interior, Flow Area= 1.77 sf

Primary OutFlow Max=22.13 cfs @ 12.48 hrs HW=402.94' (Free Discharge)
1=Dual HDPE_Round 18" (Inlet Controls 22.13 cfs @ 6.26 fps)

Pond O6: Outlet 6



Summary for Pond O7: Outlet 7

Inflow Area = 18.440 ac, 0.00% Impervious, Inflow Depth = 3.12" for 100 Yr event
Inflow = 58.48 cfs @ 12.25 hrs, Volume= 4.795 af
Outflow = 23.42 cfs @ 12.56 hrs, Volume= 4.795 af, Atten= 60%, Lag= 18.6 min
Primary = 23.42 cfs @ 12.56 hrs, Volume= 4.795 af

Routing by Stor-Ind method, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
Peak Elev= 404.00' @ 12.56 hrs Surf.Area= 45,900 sf Storage= 42,232 cf

Plug-Flow detention time= 11.1 min calculated for 4.795 af (100% of inflow)
Center-of-Mass det. time= 11.1 min (879.0 - 867.9)

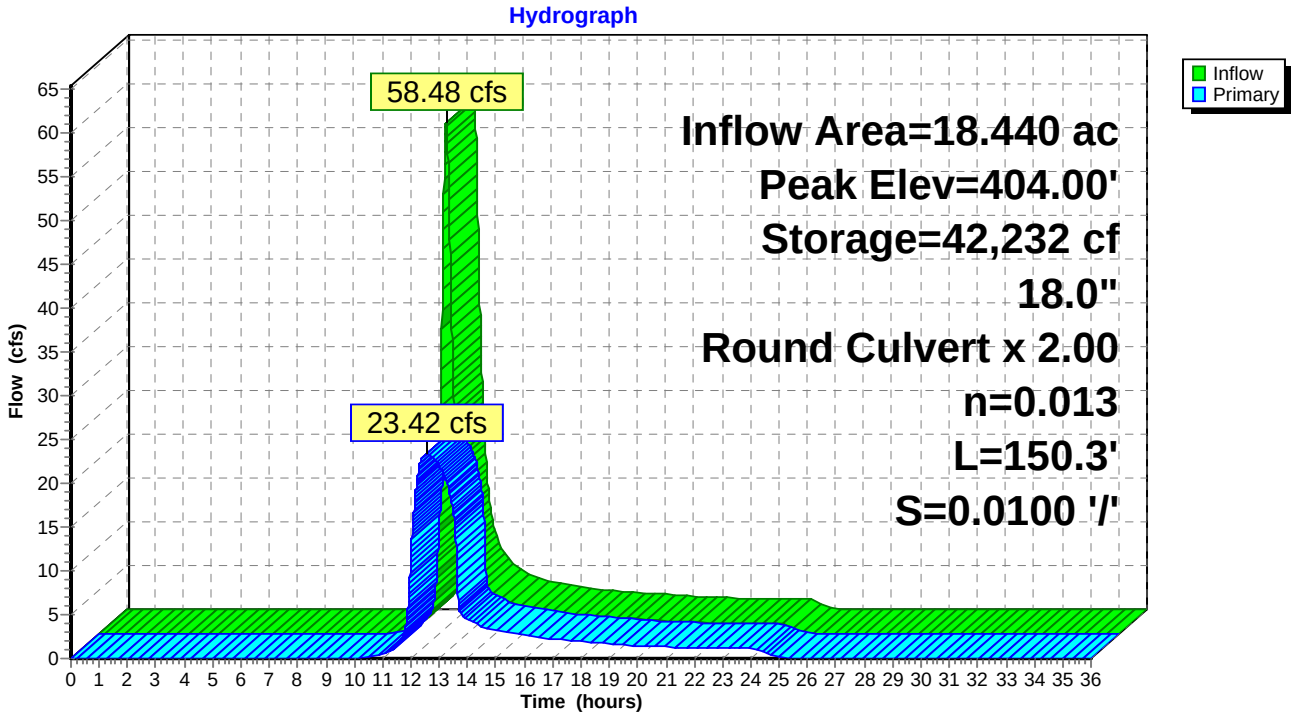
Volume	Invert	Avail.Storage	Storage Description
#1	400.23'	424,234 cf	**Custom Stage Data (Prismatic)** Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
400.23	0	0	0
401.00	585	225	225
402.00	2,505	1,545	1,770
403.00	16,330	9,418	11,188
404.00	45,968	31,149	42,337
405.00	91,639	68,804	111,140
406.00	152,673	122,156	233,296
407.00	229,203	190,938	424,234

Device	Routing	Invert	Outlet Devices
#1	Primary	400.21'	**18.0" Round Dual HDPE_Round 18" X 2.00** L= 150.3' CPP, projecting, no headwall, Ke= 0.900 Inlet / Outlet Invert= 400.21' / 398.70' S= 0.0100 '/' Cc= 0.900 n= 0.013 Corrugated PE, smooth interior, Flow Area= 1.77 sf

Primary OutFlow Max=23.42 cfs @ 12.56 hrs HW=404.00' (Free Discharge)
1=Dual HDPE_Round 18" (Inlet Controls 23.42 cfs @ 6.63 fps)

Pond O7: Outlet 7



Summary for Pond O8: Outlet 8

Inflow Area = 20.304 ac, 0.00% Impervious, Inflow Depth = 3.12" for 100 Yr event
Inflow = 64.44 cfs @ 12.25 hrs, Volume= 5.280 af
Outflow = 23.99 cfs @ 12.58 hrs, Volume= 5.280 af, Atten= 63%, Lag= 19.8 min
Primary = 23.99 cfs @ 12.58 hrs, Volume= 5.280 af

Routing by Stor-Ind method, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
Peak Elev= 404.13' @ 12.58 hrs Surf.Area= 51,692 sf Storage= 49,996 cf

Plug-Flow detention time= 13.1 min calculated for 5.280 af (100% of inflow)
Center-of-Mass det. time= 13.1 min (880.9 - 867.8)

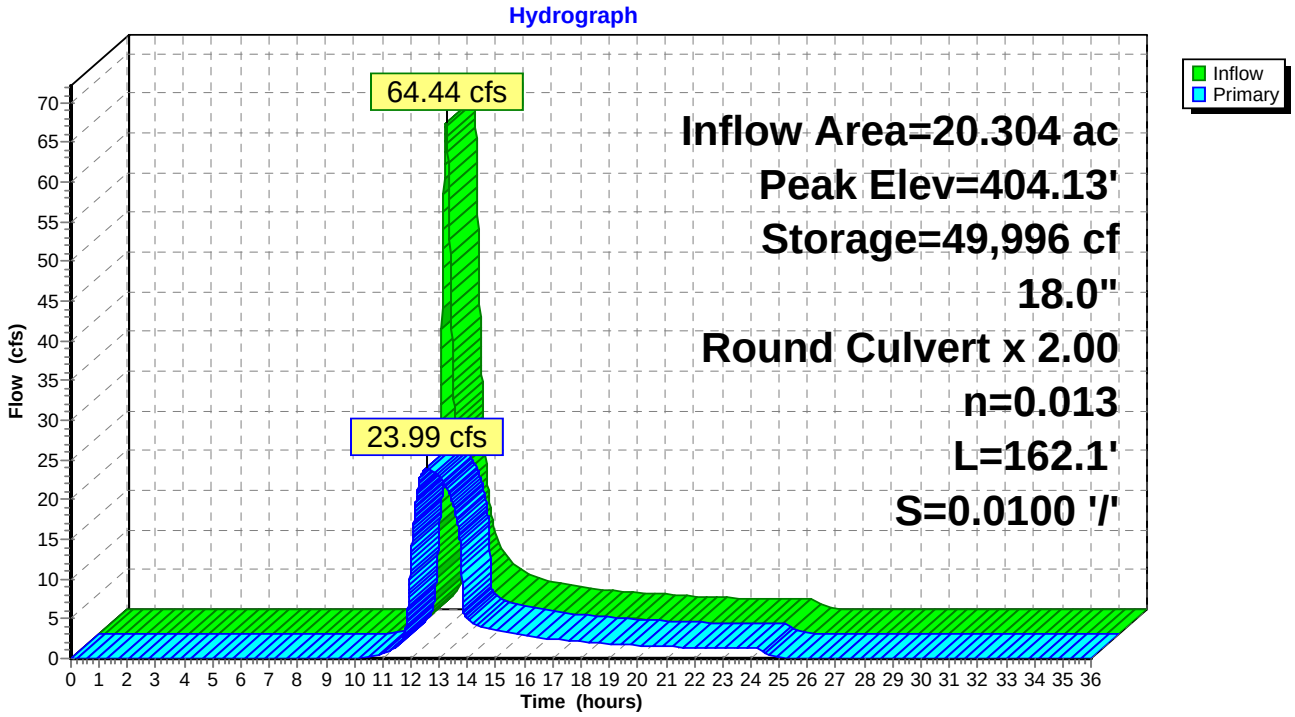
Volume	Invert	Avail.Storage	Storage Description
#1	400.29'	1,052,068 cf	**Custom Stage Data (Prismatic)** Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
400.29	0	0	0
401.00	576	204	204
402.00	2,837	1,707	1,911
403.00	17,431	10,134	12,045
404.00	45,983	31,707	43,752
405.00	90,635	68,309	112,061
406.00	149,897	120,266	232,327
407.00	222,736	186,317	418,643
408.00	314,187	268,462	687,105
409.00	415,739	364,963	1,052,068

Device	Routing	Invert	Outlet Devices
#1	Primary	400.19'	**18.0" Round Dual HDPE_Round 18" X 2.00** L= 162.1' CPP, projecting, no headwall, Ke= 0.900 Inlet / Outlet Invert= 400.19' / 398.57' S= 0.0100 '/' Cc= 0.900 n= 0.013 Corrugated PE, smooth interior, Flow Area= 1.77 sf

Primary OutFlow Max=23.99 cfs @ 12.58 hrs HW=404.13' (Free Discharge)
1=Dual HDPE_Round 18" (Inlet Controls 23.99 cfs @ 6.79 fps)

Pond O8: Outlet 8



Summary for Pond O9: Outlet 9

Inflow Area = 1.082 ac, 0.00% Impervious, Inflow Depth = 3.12" for 100 Yr event
Inflow = 5.57 cfs @ 12.01 hrs, Volume= 0.281 af
Outflow = 3.33 cfs @ 12.10 hrs, Volume= 0.281 af, Atten= 40%, Lag= 5.1 min
Primary = 3.33 cfs @ 12.10 hrs, Volume= 0.281 af

Routing by Stor-Ind method, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
Peak Elev= 404.78' @ 12.10 hrs Surf.Area= 2,343 sf Storage= 1,521 cf

Plug-Flow detention time= (not calculated: outflow precedes inflow)
Center-of-Mass det. time= 3.3 min (852.2 - 849.0)

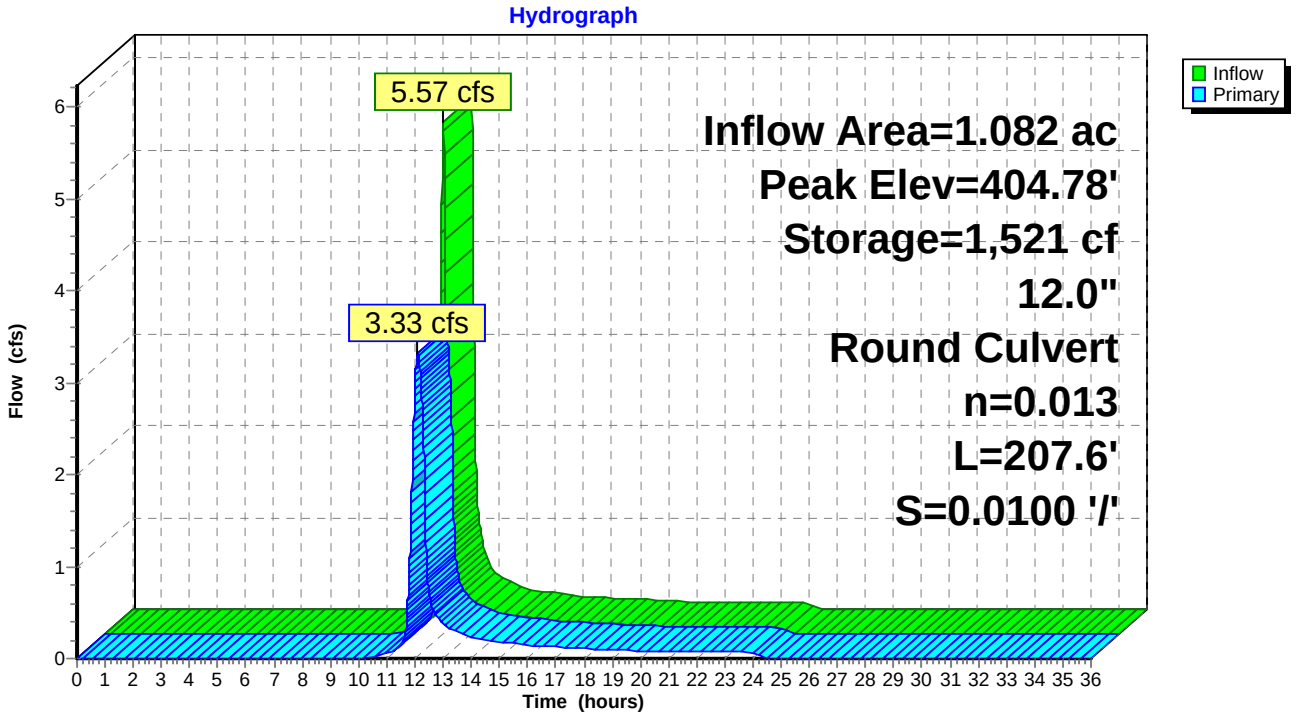
Volume	Invert	Avail.Storage	Storage Description
#1	403.04'	30,366 cf	**Custom Stage Data (Prismatic)** Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
403.04	0	0	0
404.00	696	334	334
405.00	2,805	1,751	2,085
406.00	6,367	4,586	6,671
407.00	11,442	8,905	15,575
408.00	18,140	14,791	30,366

Device	Routing	Invert	Outlet Devices
#1	Primary	403.04'	**12.0" Round Culvert** L= 207.6' CPP, projecting, no headwall, Ke= 0.900 Inlet / Outlet Invert= 403.04' / 400.96' S= 0.0100 '/' Cc= 0.900 n= 0.013 Corrugated PE, smooth interior, Flow Area= 0.79 sf

Primary OutFlow Max=3.32 cfs @ 12.10 hrs HW=404.78' (Free Discharge)
1=Culvert (Inlet Controls 3.32 cfs @ 4.23 fps)

Pond O9: Outlet 9



Summary for Pond WDP: West Ditch Pond

Inflow Area = 30.403 ac, 0.00% Impervious, Inflow Depth > 79.22" for 100 Yr event
Inflow = 126.03 cfs @ 12.00 hrs, Volume= 200.711 af
Outflow = 119.54 cfs @ 12.04 hrs, Volume= 200.199 af, Atten= 5%, Lag= 2.9 min
Primary = 34.62 cfs @ 12.04 hrs, Volume= 93.006 af
Secondary = 84.92 cfs @ 12.04 hrs, Volume= 107.192 af

Routing by Stor-Ind method, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs / 2
Peak Elev= 400.37' @ 12.04 hrs Surf.Area= 19,665 sf Storage= 33,389 cf

Plug-Flow detention time= 5.6 min calculated for 200.143 af (100% of inflow)
Center-of-Mass det. time= 2.9 min (1,078.0 - 1,075.1)

Volume	Invert	Avail.Storage	Storage Description
#1	396.50'	47,075 cf	**Custom Stage Data (Prismatic)**Listed below (Recalc)

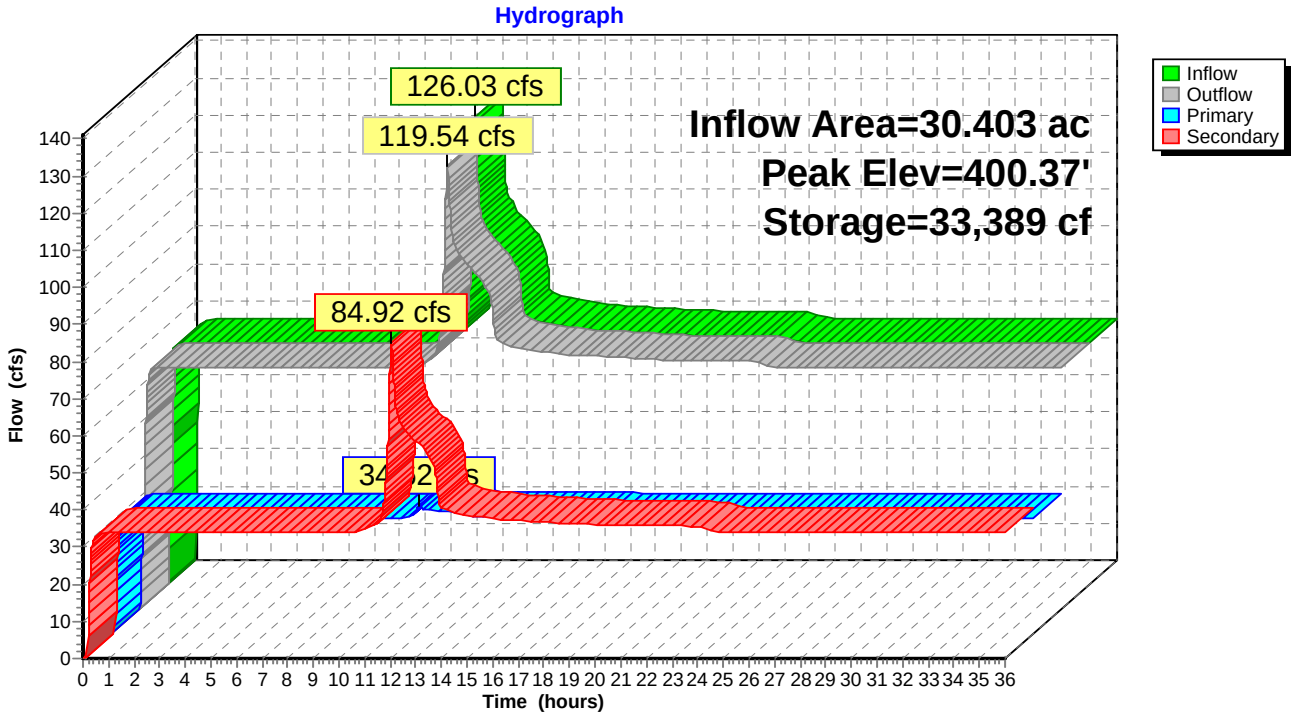
Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
396.50	0	0	0
397.00	1,892	473	473
398.00	5,746	3,819	4,292
399.00	10,818	8,282	12,574
400.00	17,108	13,963	26,537
401.00	23,968	20,538	47,075

Device	Routing	Invert	Outlet Devices
#1	Primary	396.52'	**12.0" Round Five 12" Culverts X 5.00** L= 43.1' Box, headwall w/3 square edges, Ke= 0.500 Inlet / Outlet Invert= 396.52' / 396.31' S= 0.0049 '/' Cc= 0.900 n= 0.011 Concrete pipe, straight & clean, Flow Area= 0.79 sf
#2	Secondary	399.00'	**20.0' long x 30.0' breadth Broad-Crested Rectangular Weir** Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 Coef. (English) 2.68 2.70 2.70 2.64 2.63 2.64 2.64 2.63

Primary OutFlow Max=34.62 cfs @ 12.04 hrs HW=400.37' (Free Discharge)
1=Five 12" Culverts (Inlet Controls 34.62 cfs @ 8.82 fps)

Secondary OutFlow Max=84.87 cfs @ 12.04 hrs HW=400.37' (Free Discharge)
2=Broad-Crested Rectangular Weir (Weir Controls 84.87 cfs @ 3.09 fps)

Pond WDP: West Ditch Pond



ATTACHMENT 4

EROSION CONTROL CALCULATIONS

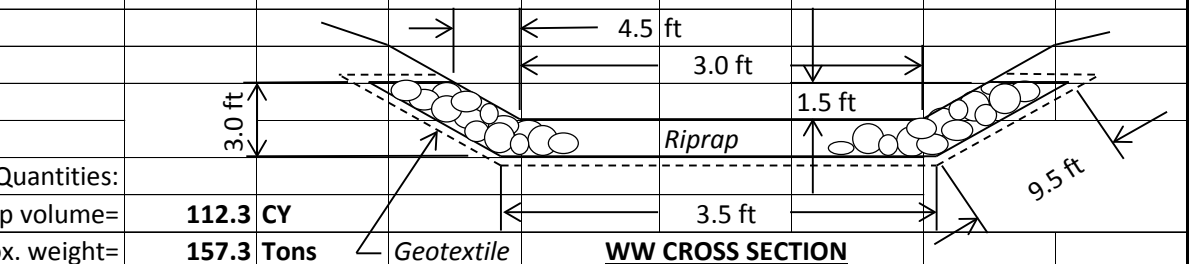
Trapezoidal Riprap-Lined Waterway Design.xlsm

Landowner	Rush Island - Outlet 2		County	2RR - Outlet Channel			V 1.2015	
Computed By	KH		Date	11/10/2017			1/15/2015	
Checked by			Date					

Note: Macros must be enabled in this spreadsheet in order for the "Solve" button to work.

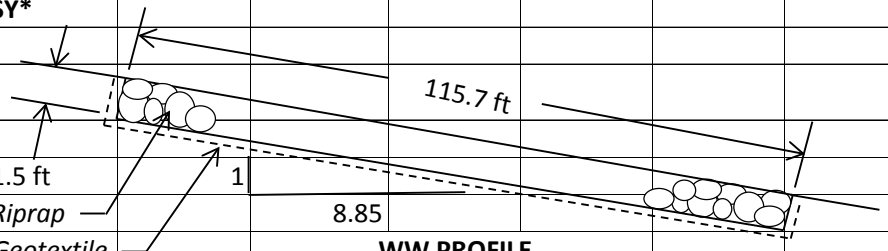
Design flow, Q=	3.1	cfs			WW horiz. Length=	115.0	ft
Slope, S=	0.113	ft/ft =	8.85	:1	U/S WW F.L. elev=	0.3	ft
Bottom Width, W=	3	ft			D/S WW F.L. elev=	**-12.7**	ft
Side slope, Z=	3	:1			Waterway drop=	**13.0**	ft
Safety factor=	1.2		Typically 1.2		WW length along slope=	**115.7**	ft
Rock shape =	Angular						
Min. req'd D50=	**3.47**	in			*Spreadsheet formatting key:*		
D50 used=	6.00	in			XXX	*=Input cells*	
n=	**0.044**				**X.XX**	*=Output from "Solve" button*	
Freeboard=	1.20	ft			**X.XX**	*=Other computed output*	
					Red text	*=Instructions, warnings, info*	
Flow depth, d=	**0.23**	ft	**Calculated**				
Critical depth, d_c=	**0.29**	ft					
Critical slope, S_c=	**0.048**	ft/ft	$0.7S_c$ =	**0.0333**	ft/ft		
			$1.3S_c$ =	**0.0618**	ft/ft		
Design slope, S=	0.1130	ft/ft	*Design slope OK. Flow is Supercritical.*				
Velocity=	**3.71**	fps			Est. riprap unit wt=	1.4	Tons/CY
			Rock shape = Angular		Rock Gs =	2.65	

Riprap thickness:			Required riprap gradation for D50 selected				
Minimum=	**1.00**	ft	%	Rock dia., inches		Rock weight, lb	
Provided=	1.50	ft	Smaller	min.	max.	min.	max.
			100	**9.0**	**12.0**	**53**	**126**
Sideslope height:			85	**7.8**	**10.8**	**35**	**92**
Minimum=	**1.43**	ft	50	**6.0**	**9.0**	**16**	**53**
Provided=	1.50	ft	10	**4.8**	**7.8**	**8**	**35**



WW CROSS SECTION

Quantities:		
Riprap volume=	**112.3**	**CY**
Approx. weight=	**157.3**	**Tons**
Geotextile area=	**421.5**	**SY***



WW PROFILE

*Geotextile area includes actual covered surfaces only (no extra for laps or anchorage)

Trapezoidal Riprap-Lined Waterway Design.xlsm

Landowner	Rush Island - Outlet 2		County	2RR - Outlet Channel			V 1.2015	
Computed By	KH		Date	11/10/2017			1/15/2015	
Checked by			Date					

Note: Macros must be enabled in this spreadsheet in order for the "Solve" button to work.

Design flow, Q=	20	cfs			WW horiz. Length=	105.0	ft
Slope, S=	0.132	ft/ft =	7.58	:1	U/S WW F.L. elev=	0.6	ft
Bottom Width, W=	5	ft			D/S WW F.L. elev=	**-13.3**	ft
Side slope, Z=	3	:1			Waterway drop=	**13.9**	ft
Safety factor=	1.2		Typically 1.2		WW length along slope=	**105.9**	ft
Rock shape =	Angular						
Min. req'd D50=	**7.46**	in			*Spreadsheet formatting key:*		
D50 used=	9.00	in			XXX	*=Input cells*	
n=	**0.048**				**X.XX**	*=Output from "Solve" button*	
Freeboard=	0.93	ft			**X.XX**	*=Other computed output*	
					Red text	*=Instructions, warnings, info*	
Flow depth, d=	**0.50**	ft	**Calculated**				
Critical depth, d_c=	**0.69**	ft					
Critical slope, S_c=	**0.043**	ft/ft	$0.7S_c$ =	**0.0301**	ft/ft		
			$1.3S_c$ =	**0.0559**	ft/ft		
Design slope, S=	0.1320	ft/ft	*Design slope OK. Flow is Supercritical.*				
Velocity=	**6.10**	fps			Est. riprap unit wt=	1.4	Tons/CY
			Rock shape = Angular		Rock Gs =	2.65	

Riprap thickness:

Minimum= **1.50** ft

Provided= 2.00 ft

Required riprap gradation for D50 selected

% Smaller	Rock dia., inches min.	Rock dia., inches max.	Rock weight, lb min.	Rock weight, lb max.
100	**13.5**	**18.0**	**179**	**425**
85	**11.7**	**16.2**	**117**	**310**
50	**9.0**	**13.5**	**53**	**179**
10	**7.2**	**11.7**	**27**	**117**

Sideslope height:

Minimum= **1.43** ft

Provided= 1.50 ft

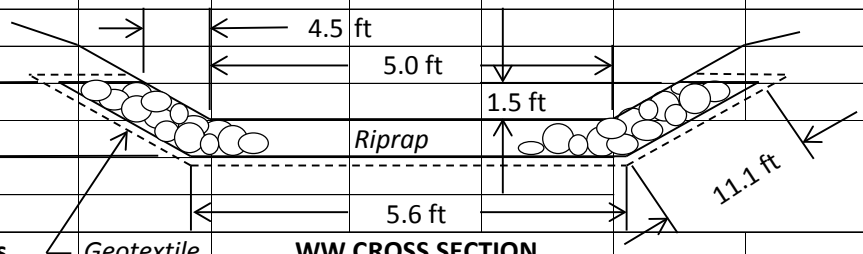
Quantities:

Riprap volume= **165.8** **CY**

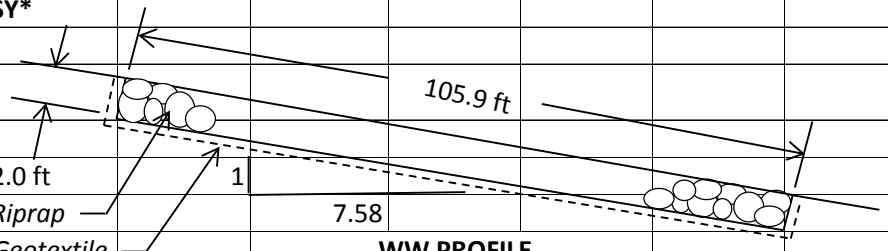
Approx. weight= **232.1** **Tons**

Geotextile area= **493.8** **SY***

*Geotextile area includes actual covered surfaces only (no extra for laps or anchorage)



WW CROSS SECTION



WW PROFILE

Trapezoidal Riprap-Lined Waterway Design.xlsm

Landowner	Rush Island - Outlet 3		County	3RR - Outlet Channel			V 1.2015	
Computed By	KH		Date	11/10/2017			1/15/2015	
Checked by			Date					

Note: Macros must be enabled in this spreadsheet in order for the "Solve" button to work.

Design flow, Q=	20.3	cfs			WW horiz. Length=	87.0	ft
Slope, S=	0.2129	ft/ft =	4.70	:1	U/S WW F.L. elev=	0.5	ft
Bottom Width, W=	6	ft			D/S WW F.L. elev=	**-18.1**	ft
Side slope, Z=	3	:1			Waterway drop=	**18.5**	ft
Safety factor=	1.2		Typically 1.2		WW length along slope=	**88.9**	ft
Rock shape =	Angular						
Min. req'd D50=	**7.91**	in			*Spreadsheet formatting key:*		
D50 used=	9.00	in			XXX	*=Input cells*	
n=	**0.052**				**X.XX**	*=Output from "Solve" button*	
Freeboard=	1.03	ft			**X.XX**	*=Other computed output*	
					Red text	*=Instructions, warnings, info*	
Flow depth, d=	**0.42**	ft	**Calculated**				
Critical depth, d_c=	**0.63**	ft					
Critical slope, S_c=	**0.050**	ft/ft	$0.7S_c$ =	**0.0350**	ft/ft		
			$1.3S_c$ =	**0.0649**	ft/ft		
Design slope, S=	0.2129	ft/ft	*Design slope OK. Flow is Supercritical.*				
Velocity=	**6.64**	fps			Est. riprap unit wt=	1.4	Tons/CY
			Rock shape = Angular		Rock Gs =	2.65	

Riprap thickness:

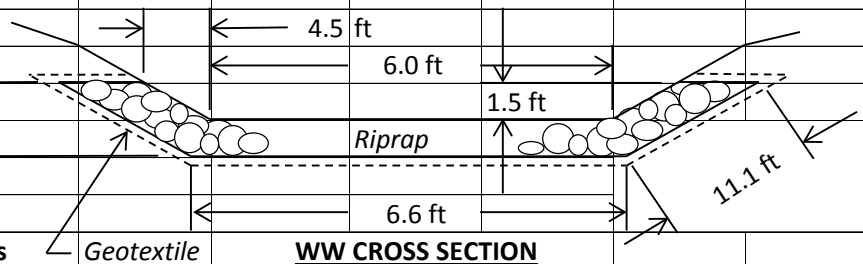
Required riprap gradation for D50 selected

Minimum=	**1.50**	ft	%	Rock dia., inches		Rock weight, lb	
Provided=	2.00	ft	Smaller	min.	max.	min.	max.
			100	**13.5**	**18.0**	**179**	**425**
Sideslope height:			85	**11.7**	**16.2**	**117**	**310**
Minimum=	**1.45**	ft	50	**9.0**	**13.5**	**53**	**179**
Provided=	1.50	ft	10	**7.2**	**11.7**	**27**	**117**

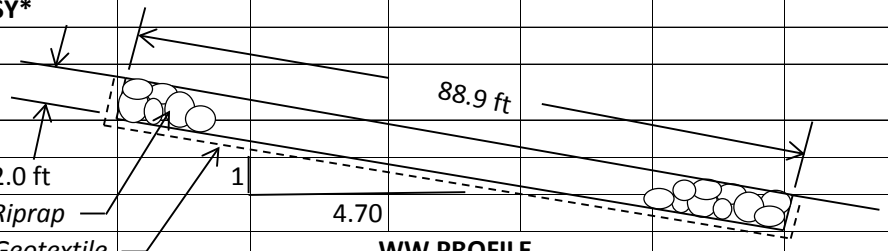
Quantities:

Riprap volume=	**145.9**	**CY**
Approx. weight=	**204.2**	**Tons**
Geotextile area=	**427.9**	**SY***

*Geotextile area includes actual covered surfaces only (no extra for laps or anchorage)



WW CROSS SECTION



WW PROFILE

Trapezoidal Riprap-Lined Waterway Design.xlsm

Landowner	Rush Island - Outlet 4		County	4RR - Outlet Channel			V 1.2015	
Computed By	KH		Date	11/10/2017			1/15/2015	
Checked by			Date					

Note: Macros must be enabled in this spreadsheet in order for the "Solve" button to work.

Design flow, Q=	18.7	cfs			WW horiz. Length=	108.0 ft
Slope, S=	0.18	ft/ft =	5.56	:1	U/S WW F.L. elev=	0.7 ft
Bottom Width, W=	5	ft			D/S WW F.L. elev=	**-18.7** ft
Side slope, Z=	3	:1			Waterway drop=	**19.4** ft
Safety factor=	1.2		Typically 1.2		WW length along slope=	**109.7** ft
Rock shape =	Angular					
Min. req'd D50=	**7.92**	in			*Spreadsheet formatting key:*	
D50 used=	9.00	in			XXX	*=Input cells*
n=	**0.050**				**X.XX**	*=Output from "Solve" button*
Freeboard=	0.91	ft			**X.XX**	*=Other computed output*
					Red text	*=Instructions, warnings, info*
Flow depth, d=	**0.46**	ft	**Calculated**			
Critical depth, d_c=	**0.66**	ft				
Critical slope, S_c=	**0.048**	ft/ft	$0.7S_c$ =	**0.0333**	ft/ft	
			$1.3S_c$ =	**0.0619**	ft/ft	
Design slope, S=	0.1800	ft/ft	*Design slope OK. Flow is Supercritical.*			
Velocity=	**6.44**	fps			Est. riprap unit wt=	1.4 Tons/CY
			Rock shape = Angular		Rock Gs =	2.65

Riprap thickness:

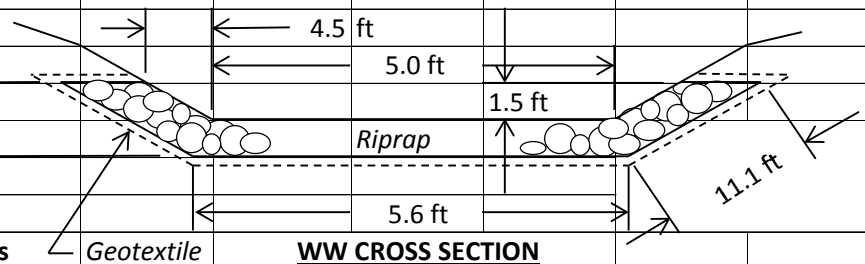
Required riprap gradation for D50 selected

Minimum=	**1.50**	ft	%	Rock dia., inches		Rock weight, lb	
Provided=	2.00	ft	Smaller	min.	max.	min.	max.
			100	**13.5**	**18.0**	**179**	**425**
Sideslope height:			85	**11.7**	**16.2**	**117**	**310**
Minimum=	**1.37**	ft	50	**9.0**	**13.5**	**53**	**179**
Provided=	1.50	ft	10	**7.2**	**11.7**	**27**	**117**

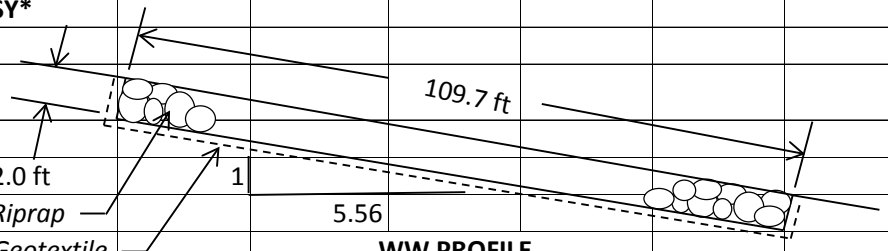
Quantities:

Riprap volume=	**171.8**	**CY**
Approx. weight=	**240.5**	**Tons**
Geotextile area=	**511.0**	**SY***

*Geotextile area includes actual covered surfaces only (no extra for laps or anchorage)



WW CROSS SECTION



WW PROFILE

Trapezoidal Riprap-Lined Waterway Design.xlsm

Landowner	Rush Island - Outlet 1		County	1RR - Outlet Channel			V 1.2015	
Computed By	KH		Date	11/10/2017			1/15/2015	
Checked by			Date					

Note: Macros must be enabled in this spreadsheet in order for the "Solve" button to work.

Design flow, Q=	3.6	cfs			WW horiz. Length=	25.0	ft
Slope, S=	0.155	ft/ft =	6.45	:1	U/S WW F.L. elev=	0.3	ft
Bottom Width, W=	3	ft			D/S WW F.L. elev=	**-3.6**	ft
Side slope, Z=	3	:1			Waterway drop=	**3.9**	ft
Safety factor=	1.2		Typically 1.2		WW length along slope=	**25.3**	ft
Rock shape =	Angular						
Min. req'd D50=	**4.14**	in			*Spreadsheet formatting key:*		
D50 used=	6.00	in			XXX	*=Input cells*	
n=	**0.047**				**X.XX**	*=Output from "Solve" button*	
Freeboard=	1.20	ft			**X.XX**	*=Other computed output*	
					Red text	*=Instructions, warnings, info*	
Flow depth, d=	**0.23**	ft	**Calculated**				
Critical depth, d_c=	**0.32**	ft					
Critical slope, S_c=	**0.051**	ft/ft	$0.7S_c$ =	**0.0356**	ft/ft		
			$1.3S_c$ =	**0.0660**	ft/ft		
Design slope, S=	0.1550	ft/ft	*Design slope OK. Flow is Supercritical.*				
Velocity=	**4.19**	fps			Est. riprap unit wt=	1.4	Tons/CY
			Rock shape = Angular		Rock Gs =	2.65	

Riprap thickness:
Minimum= **1.00** ft
Provided= 1.50 ft

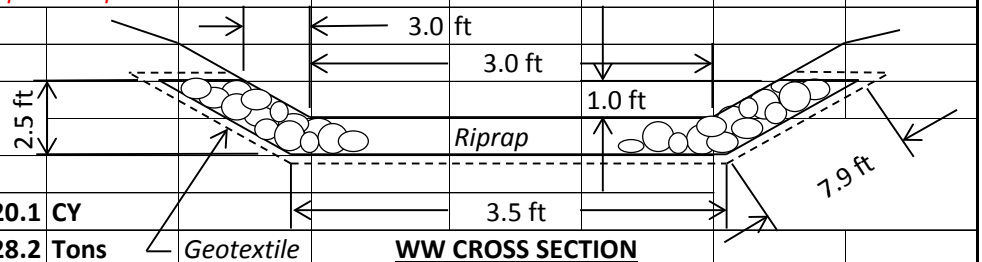
Sideslope height:
Minimum= **1.43** ft
Provided= 1.00 ft

Select taller riprap sideslopes

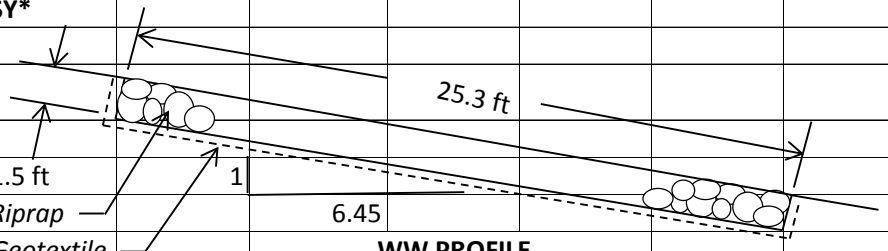
Required riprap gradation for D50 selected

% Smaller	Rock dia., inches min.	Rock dia., inches max.	Rock weight, lb min.	Rock weight, lb max.
100	**9.0**	**12.0**	**53**	**126**
85	**7.8**	**10.8**	**35**	**92**
50	**6.0**	**9.0**	**16**	**53**
10	**4.8**	**7.8**	**8**	**35**

Quantities:
Riprap volume= **20.1** **CY**
Approx. weight= **28.2** **Tons**
Geotextile area= **90.5** **SY***



WW CROSS SECTION



WW PROFILE

*Geotextile area includes actual covered surfaces only (no extra for laps or anchorage)

Trapezoidal Riprap-Lined Waterway Design.xlsm

Landowner	Rush Island - Outlet 6		County	6RR - Outlet Channel			V 1.2015	
Computed By	KH		Date	11/10/2017			1/15/2015	
Checked by			Date					

Note: Macros must be enabled in this spreadsheet in order for the "Solve" button to work.

Design flow, Q=	18.5	cfs			WW horiz. Length=	167.0	ft
Slope, S=	0.1213	ft/ft =	8.24	:1	U/S WW F.L. elev=	0.6	ft
Bottom Width, W=	5	ft			D/S WW F.L. elev=	**-19.7**	ft
Side slope, Z=	3	:1			Waterway drop=	**20.3**	ft
Safety factor=	1.2		Typically 1.2		WW length along slope=	**168.2**	ft
Rock shape =	Angular						
Min. req'd D50=	**6.98**	in			*Spreadsheet formatting key:*		
D50 used=	9.00	in			XXX	*=Input cells*	
n=	**0.048**				**X.XX**	*=Output from "Solve" button*	
Freeboard=	0.90	ft			**X.XX**	*=Other computed output*	
					Red text	*=Instructions, warnings, info*	
Flow depth, d=	**0.49**	ft	**Calculated**				
Critical depth, d_c=	**0.65**	ft					
Critical slope, S_c=	**0.042**	ft/ft	$0.7S_c$ =	**0.0297**	ft/ft		
			$1.3S_c$ =	**0.0552**	ft/ft		
Design slope, S=	0.1213	ft/ft	*Design slope OK. Flow is Supercritical.*				
Velocity=	**5.83**	fps			Est. riprap unit wt=	1.4	Tons/CY
			Rock shape = Angular		Rock Gs =	2.65	

Riprap thickness:

Minimum= **1.50** ft

Provided= 2.00 ft

Required riprap gradation for D50 selected

% Smaller	Rock dia., inches min.	Rock dia., inches max.	Rock weight, lb min.	Rock weight, lb max.
100	**13.5**	**18.0**	**179**	**425**
85	**11.7**	**16.2**	**117**	**310**
50	**9.0**	**13.5**	**53**	**179**
10	**7.2**	**11.7**	**27**	**117**

Sideslope height:

Minimum= **1.39** ft

Provided= 1.50 ft

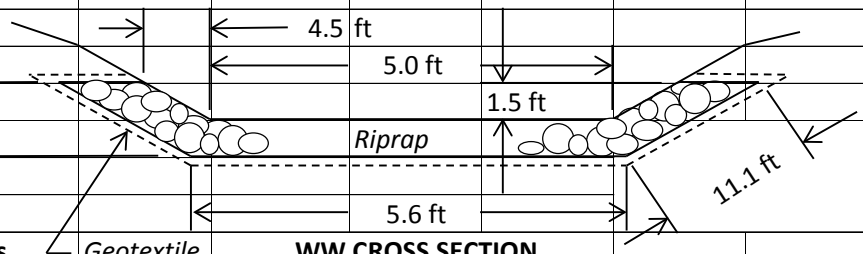
Quantities:

Riprap volume= **263.4** **CY**

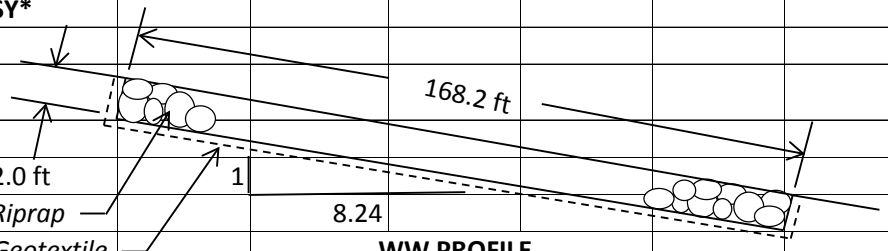
Approx. weight= **368.7** **Tons**

Geotextile area= **773.7** **SY***

*Geotextile area includes actual covered surfaces only (no extra for laps or anchorage)



WW CROSS SECTION



WW PROFILE

Trapezoidal Riprap-Lined Waterway Design.xlsm

Landowner	Rush Island - Outlet 7		County	7RR - Outlet Channel			V 1.2015	
Computed By	KH		Date	11/10/2017			1/15/2015	
Checked by			Date					

Note: Macros must be enabled in this spreadsheet in order for the "Solve" button to work.

Design flow, Q=	20.1	cfs			WW horiz. Length=	60.0	ft
Slope, S=	0.3417	ft/ft =	2.93	:1	U/S WW F.L. elev=	0.4	ft
Bottom Width, W=	7.5	ft			D/S WW F.L. elev=	**-20.1**	ft
Side slope, Z=	3	:1			Waterway drop=	**20.5**	ft
Safety factor=	1.2		Typically 1.2		WW length along slope=	**63.4**	ft
Rock shape =	Angular						
Min. req'd D50=	**8.09**	in			*Spreadsheet formatting key:*		
D50 used=	9.00	in			XXX	*=Input cells*	
n=	**0.055**				**X.XX**	*=Output from "Solve" button*	
Freeboard=	0.93	ft			**X.XX**	*=Other computed output*	
					Red text	*=Instructions, warnings, info*	
Flow depth, d=	**0.34**	ft	**Calculated**				
Critical depth, d_c=	**0.56**	ft					
Critical slope, S_c=	**0.059**	ft/ft	$0.7S_c$ =	**0.0410**	ft/ft		
			$1.3S_c$ =	**0.0761**	ft/ft		
Design slope, S=	0.3417	ft/ft	*Design slope OK. Flow is Supercritical.*				
Velocity=	**7.00**	fps			Est. riprap unit wt=	1.4	Tons/CY
			Rock shape = Angular		Rock Gs =	2.65	

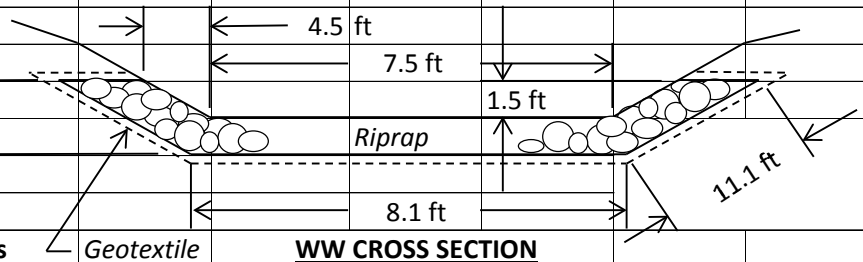
Riprap thickness:

Required riprap gradation for D50 selected

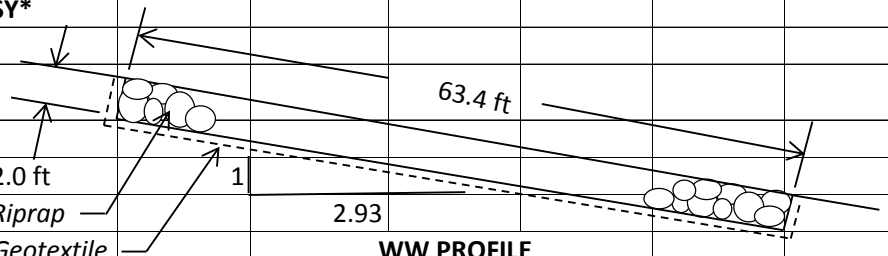
Minimum=	**1.50**	ft	%	Rock dia., inches		Rock weight, lb	
Provided=	2.00	ft	Smaller	min.	max.	min.	max.
			100	**13.5**	**18.0**	**179**	**425**
Sideslope height:			85	**11.7**	**16.2**	**117**	**310**
Minimum=	**1.27**	ft	50	**9.0**	**13.5**	**53**	**179**
Provided=	1.50	ft	10	**7.2**	**11.7**	**27**	**117**

Quantities:			
Riprap volume=	**111.0**	**CY**	
Approx. weight=	**155.4**	**Tons**	
Geotextile area=	**321.6**	**SY***	

*Geotextile area includes actual covered surfaces only (no extra for laps or anchorage)



WW CROSS SECTION

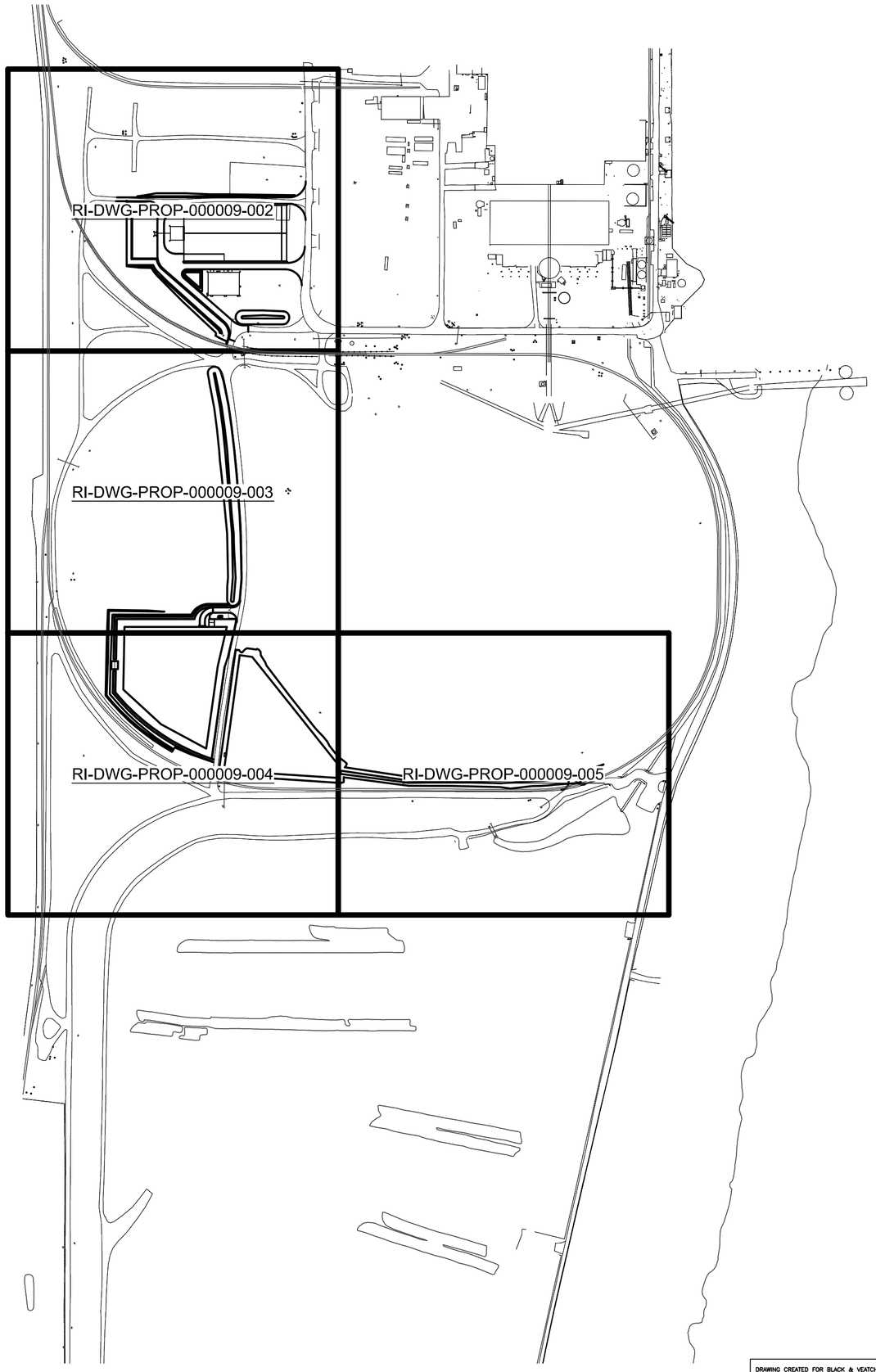


WW PROFILE

ATTACHMENT 5

Grading and Drainage Drawings

By Black & Veatch
31 May 2017



GENERAL NOTES

1. GENERAL NOTES APPLICABLE TO ALL GRADING AND DRAINAGE DRAWINGS.
2. COORDINATES SHOWN ARE BASED ON THE RUSH ISLAND PLANT GRID SYSTEM. SEE THIS DRAWING FOR CONVERSION TO THE MISSOURI STATE PLANE COORDINATE SYSTEM, AND LOCATIONS OF PROJECT SURVEY CONTROL MONUMENTS.
3. GRADE SHALL SLOPE UNIFORMLY BETWEEN FINISH SPOT ELEVATIONS AND CONTOURS SHOWN ON THE PLANS.
4. A SMOOTH VERTICAL TRANSITION SHALL BE PROVIDED AT ROAD INTERSECTIONS.
5. SLOPES SHALL BE 3(H):1(V) OR FLATTER, UNLESS NOTED OTHERWISE.
6. THE CONTRACTOR IS RESPONSIBLE FOR TYING FINISHED CONTOURS INTO EXISTING CONTOURS IN AREAS WHERE THERE IS INSUFFICIENT SURVEY DATA OF THE EXISTING GRADE.
7. DISTURBED AREAS NOT RECEIVING AGGREGATE, ASPHALT, OR CONCRETE SURFACING SHALL BE SEEDED.
8. SPOT ELEVATIONS AND CONTOURS ON THESE DRAWINGS ARE TOP OF FINISHED GRADE. SUBTRACT FINISH SURFACING MATERIAL THICKNESS TO OBTAIN TOP OF SUBGRADE.
9. SLOPE GRADE TO DRAIN IN DIRECTION OF FLOW ARROWS.
10. THE FINISHED GRADE SHALL BE SET 6 INCHES BELOW TOP OF CONCRETE UNLESS NOTED OTHERWISE. FINISHED GRADE SHOULD SLOPE AWAY FROM THE STRUCTURE AT A MINIMUM SLOPE OF 1% FOR THE FIRST 10'. SLOPE SHOULD CONTINUE AT 1/2% MINIMUM AFTER THE INITIAL 10'.
11. ASPHALT PAVEMENT REMOVED DURING THE INSTALLATION OF NEW UNDERGROUND UTILITIES AND FOUNDATIONS, OR DISTURBED DURING GRADING ACTIVITIES SHALL BE REPLACED TO PRE-EXISTING CONDITIONS.
12. SEE RI-DWG-PROP-000011 DRAWINGS FOR UNDERGROUND UTILITY DETAILS.
13. IN DISTURBED AREAS NOT SPECIFICALLY SHOWN ON THESE DRAWINGS, GRADE AND SURFACING SHALL BE RESTORED TO PRE-CONSTRUCTION CONDITIONS AFTER COMPLETION OF THE WORK.

LEGEND APPLICABLE TO ALL DRAWINGS

- PROPERTY LINE
- LIMIT OF RIGHT-OF-WAY (R/W)
- FENCE
- CONTOUR (99)
- AREA INLET
- STORM WATER SYSTEM
- CULVERT
- DITCH/SWALE FLOW INDICATOR
- GRADE SURFACE FLOW INDICATOR
- SPOT ELEVATION (123.45)
- SURVEY CONTROL MONUMENT
- EXISTING FENCE (OR)
- EXISTING CONTOUR (99)
- EXISTING CULVERT

- ASPHALT SURFACING
- AGGREGATE SURFACING
- REINFORCED CONCRETE
- EARTH
- RIPRAP
- SAND/BEDDING MAT'L
- GRASS
- WETLANDS
- SECTION OR DETAIL NUMBER (1 / 001)
- DRAWING DESIGNATION NUMBER

ABBREVIATIONS APPLICABLE TO ALL S3000 DRAWINGS

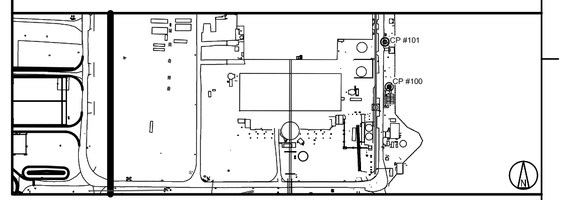
A	-	ARC LENGTH	LS	-	LIFT STATION
AGG	-	AGGREGATE	LTR	-	LATER
APPROX	-	APPROXIMATE	MATL	-	MATERIAL
ASPH	-	ASPHALT	MH	-	MANHOLE
AVG	-	AVERAGE	MSL	-	MEAN SEA LEVEL
BLDG	-	BUILDING	MW	-	MONITORING WELL
BMH	-	BOTTOM OF MANHOLE ELEVATION	N	-	NORTH
BOD	-	BOTTOM OF ELECTRICAL DUCT BANK	NO,	-	NUMBER
BOP	-	BOTTOM OF PIPE	NTS	-	NOT TO SCALE
BU	-	BELL-UP	OD	-	OUTSIDE DIAMETER
CHDPE	-	CORRUGATED HIGH DENSITY POLYETHYLENE PIPE	OWS	-	OIL/WATER SEPARATOR
CJ	-	CONTRACTION JOINT	PC	-	POINT OF CURVATURE
CL	-	CENTERLINE	PE	-	PLAIN END
CMP	-	CORRUGATED METAL PIPE	PI	-	POINT OF INTERSECTION
CO	-	CLEANOUT	PL	-	PROPERTY LINE
D	-	DEGREE OF CURVE	PLCS	-	PLACES
Δ	-	DELTA ANGLE OF HORIZONTAL CURVE	PRC	-	POINT OF REVERSE CURVE
DI	-	DUCTILE IRON	PT	-	POINT OF TANGENT
DIA	-	DIAMETER	PVC	-	POINT OF VERTICAL CURVE
DIM	-	DIMENSION	PVI	-	POINT OF VERTICAL INTERSECTION
DWG	-	DRAWING	PVT	-	POINT OF VERTICAL TANGENT
E	-	EAST	R	-	RADIUS
EA	-	EACH	RCP	-	REINFORCED CONCRETE PIPE
EF	-	EACH FACE	RD	-	ROOF DRAIN
EGP	-	EDGE OF PAVEMENT	RED	-	REDUCER
EGS	-	EDGE OF SHOULDER	REQD	-	REQUIRED
EHH	-	ELECTRICAL HANDHOLE	REV	-	REVISION
EL	-	ELEVATION	R/W	-	RIGHT-OF-WAY
EJ	-	EXPANSION JOINT	S	-	SOUTH
EW	-	EACH WAY	SE	-	SUPERELEVATION
EXP	-	EXPANSION	SIM	-	SIMILAR
FD	-	FLOOR DRAIN	STA	-	STATION
FDN	-	FOUNDATION	T	-	TANGENT LENGTH
FF	-	FINISHED FLOOR	TMH	-	TOP OF MANHOLE
FG	-	FINISHED GRADE	TOC	-	TOP OF CONCRETE
FRP	-	FIBER REINFORCED PIPE	TOG	-	TOP OF GRATING
FT	-	FOOT	TOP	-	TOP OF PAVEMENT
HC	-	HANDICAPPED	TYP	-	TYPICAL
HDPE	-	HIGH DENSITY POLYETHYLENE	UNO	-	UNLESS NOTED OTHERWISE
HVCM	-	HORIZ & VERT CONTROL MONUMENT	DS	-	DESIGN SPEED
HP	-	HIGH POINT	VERT	-	VERTICAL
ID	-	INSIDE DIAMETER	W	-	WEST
IN	-	INCH	W/	-	WITH
INV	-	INVERT	W/O	-	WITHOUT
L	-	LENGTH	WP	-	WORK POINT
LC	-	LENGTH OF VERTICAL CURVE			

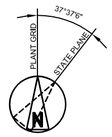
PROJECT SURVEY CONTROL

CONTROL MONUMENT LOCATIONS

MONUMENT NO.	PLANT COORDINATES		MONUMENT NO.	STATE PLANE COORDINATES		ELEVATION
	NORTHING	EASTING		NORTHING	EASTING	
CP #100	9634.91	8359.03	CP #100	836904.47	888625.99	409.05
CP #101	9797.37	8343.56	CP #101	837023.71	888514.57	409.39

CONTROL IS BASED ON THE MISSOURI STATE PLANE COORDINATE - EAST ZONE NAD83 SYSTEM, THE ELEVATIONS ARE BASED ON THE NAVD88 DATUM.





APPROVED FOR CONSTRUCTION

THE DISTRIBUTION AND USE OF THE NATIVE FORMAT CAD FILE OF THIS DRAWING IS UNCONTROLLED. THE USER SHALL VERIFY TRACEABILITY OF THIS DRAWING TO THE LATEST CONTROLLED VERSION.

BLACK & VEATCH
Building a world of difference®

ALL BACKCIRCLE CHANGES PER ECN-N-S-0001

DRAWING CREATED FOR BLACK & VEATCH PROJECT 190611, AMEREN MISSOURI PROJECT J02PM.

I HEREBY CERTIFY THAT THIS DOCUMENT WAS PREPARED BY ME OR UNDER MY DIRECT SUPERVISION AND THAT I AM A DULY REGISTERED PROFESSIONAL ENGINEER UNDER THE LAWS OF THE STATE OF MISSOURI

SIGNED NATHAN DOUGLAS KAISER

DATE 05/31/17 REG NO. 2002016675

STATE OF MISSOURI
NATHAN DOUGLAS KAISER
PE-2002016675
PROFESSIONAL ENGINEER

DRAWING RECORD

REV.	DATE	PROJECT NO.	DRAFTING DRFTR	CHK'D	SUPV	ENGR	DESCRIPTION
00A	05/12/16	---	RRH	JJD	ILE	---	ISSUED FOR CLIENT REVIEW
00B	07/22/16	---	RJW	JDA	ILE	---	ISSUED FOR IFC
00C	03/13/17	---	NJO	JMS	ILE	JJD	ISSUED FOR CLIENT REVIEW
00D	05/31/17	---	SES	JMS	ILE	JJD	ISSUED FOR CONSTRUCTION

NOTICE OF LIMITED RESPONSIBILITY
THE RESPONSIBILITY OF THE UNDERSIGNED ENGINEER IS LIMITED TO THE DESIGN WORK SHOWN ON PROJECT AND DOCUMENTS BEARING HIS/HER SEAL. SIGNATURE OR INITIALS. NEITHER DOES NOT HAVE AUTHORITY OVER THE PROJECT AS A WHOLE. THE UNDERSIGNED DISCLAIMS ANY RESPONSIBILITY FOR WORK DONE UNDER SUBSEQUENT CONTRACTS AND FOR ANY OTHER DOCUMENTS ASSOCIATED WITH THE PROJECT WHICH DO NOT BEAR HIS/HER SEAL, SIGNATURE OR INITIALS.

CONSTRUCTION

MARK UP DRAWING NO.	REV.
---	---

SCALE	---
UNIT NO.	---
DWG. SIZE	---
SUB CLASS	---

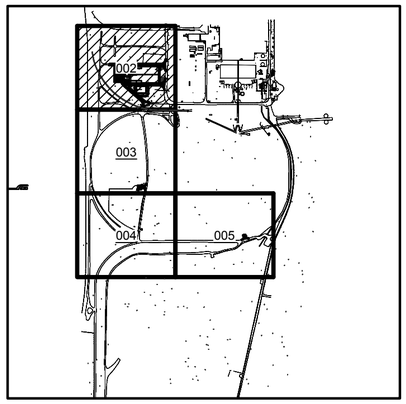
GRADING AND DRAINAGE
KEY PLAN, LEGEND AND GENERAL NOTES

SITE: RUSH ISLAND ENERGY CENTER

Ameren MISSOURI

DRAWING NO.
RI-DWG-PROP-000009-001

REVISION NO. 00D



KEY PLAN

LEGEND:

- CONCRETE
- AGGREGATE ROAD
- AGGREGATE SURFACING

NOTES:

1. SEE DRAWING RI-DWG-PROP-000009-001 FOR LEGEND AND GENERAL NOTES.
2. EXISTING CULVERT TO BE PLUGGED AND ABANDONED IN PLACE.
3. EXISTING CULVERT TO BE DEMOLISHED AND REPLACED AS SHOWN ON THIS DRAWING.
4. MATCH EXISTING EDGE OF ROAD ELEVATION. SAWCUT EXISTING ASPHALT IF REQUIRED TO PROVIDE CLEAN EDGE.
5. CONCRETE PAVING JOINTING, TYP. SEE CONCRETE JOINTING NOTES THIS DRAWING.
6. ALL DISTURBED AREAS NOT RECEIVING CONCRETE OR AGGREGATE SHALL BE SEEDED.
7. PLACE CURB PER TYPICAL ADHESIVE REINFORCING CURB DETAIL ON DWG RI-DWG-PROP-000009-011 AT EDGE OF CONCRETE ON NORTH, WEST AND SOUTH SIDES OF DEWATERING AREA.

CONCRETE JOINTING NOTES:

C-1. SAWCUT JOINTS SHALL BE CUT IN A UNIFORM PATTERN AND SHALL NOT EXCEED 12' SPACING.

C-2. CONSTRUCTION JOINTS SHALL BE INSTALLED WHEN PAVING OPERATIONS CEASE FOR MORE THAN 30 MINUTES. CONSTRUCTION JOINTS SHALL NOT BE CLOSER THAN 5' FROM A SAWCUT JOINT.

C-3. ISOLATION JOINTS SHALL BE PLACED TO PROVIDE SEPARATION BETWEEN THE CONCRETE PAVING AND STRUCTURES.

REFERENCE DRAWINGS:

RI-DWG-PROP-000009-001	KEY PLAN, LEGEND AND GENERAL NOTES
RI-DWG-PROP-000009-003	GRADING AND DRAINAGE PLAN
RI-DWG-PROP-000009-004	GRADING AND DRAINAGE PLAN
RI-DWG-PROP-000009-005	GRADING AND DRAINAGE PLAN
RI-DWG-PROP-000009-010	GRADING SECTIONS AND DETAILS
RI-DWG-PROP-000009-011	GRADING SECTIONS AND DETAILS
RI-DWG-PROP-000009-012	MANHOLE AND CATCHBASIN DETAILS

ALL BACKCIRCLE CHANGES PER ECN-N-S-0001

MATCHLINES N 9,220 - FOR CONTINUATION SEE RI-DWG-PROP-000009-003

30' 20' 10' 0 30' 60'

1" = 30'

37°37'6"

PLANT GRID

STATE PLANE

N

APPROVED FOR CONSTRUCTION

THE DISTRIBUTION AND USE OF THE NATIVE FORMAT CAD FILE OF THIS DRAWING IS UNCONTROLLED. THE USER SHALL VERIFY TRACEABILITY OF THIS DRAWING TO THE LATEST CONTROLLED VERSION.

BLACK & VEATCH
Building a world of difference®

DRAWING CREATED FOR BLACK & VEATCH PROJECT 190611, AMEREN MISSOURI PROJECT J02PM.

I HEREBY CERTIFY THAT THIS DOCUMENT WAS PREPARED BY ME OR UNDER MY DIRECT SUPERVISION AND THAT I AM A DULY REGISTERED PROFESSIONAL ENGINEER UNDER THE LAWS OF THE STATE OF MISSOURI.

SIGNED NATHAN DOUGLAS KAISER

DATE 05/23/17 REG NO. 2002016675

STATE OF MISSOURI
NATHAN DOUGLAS KAISER
PE-2002016675
PROFESSIONAL ENGINEER

31-May-2017

DRAWING RECORD

REV.	DATE	PROJECT NO.	DRAFTING DRFTR	CHK'D	SUPV	ENGR	DESCRIPTION
00A	06/17/16	--	RRH	JJD	ILE	JDA	ISSUED FOR CLIENT REVIEW
00B	07/22/16	--	RJW	JDA	ILE	--	ISSUED FOR IM
00C	03/13/17	--	NJO	JMS	ILE	JJD	ISSUED FOR CLIENT REVIEW
00D	05/23/17	--	SES	NDK	ILE	JJD	ISSUED FOR PERMITTING
00E	05/31/17	--	SES	JMS	ILE	JJD	ISSUED FOR CONSTRUCTION

CONSTRUCTION

NOTICE OF LIMITED RESPONSIBILITY
THE RESPONSIBILITY OF THE UNDERSIGNED ENGINEER IS LIMITED TO THE DESIGN WORK SHOWN ON PROJECT AND ITS ACCEPTABILITY TO THE ENGINEER BASED ON ENGINEERING DUTIES PERFORMED. THIS DRAWING IS A PARTIAL PLAN SET AND MAY REQUIRE ADDITIONAL WORK UNDER DIFFERENT REVISIONS AND ANY OTHER DOCUMENTS ASSOCIATED WITH THE PROJECT WHICH DO NOT BEAR HIS/HER SEAL, SIGNATURE OR DETAILS.

MARK UP DRAWING NO.	REV.
----	----

SCALE: 1:30
UNIT NO.: —
DWG. SIZE: —
SUB CLASS: —

GRADING AND DRAINAGE PLAN

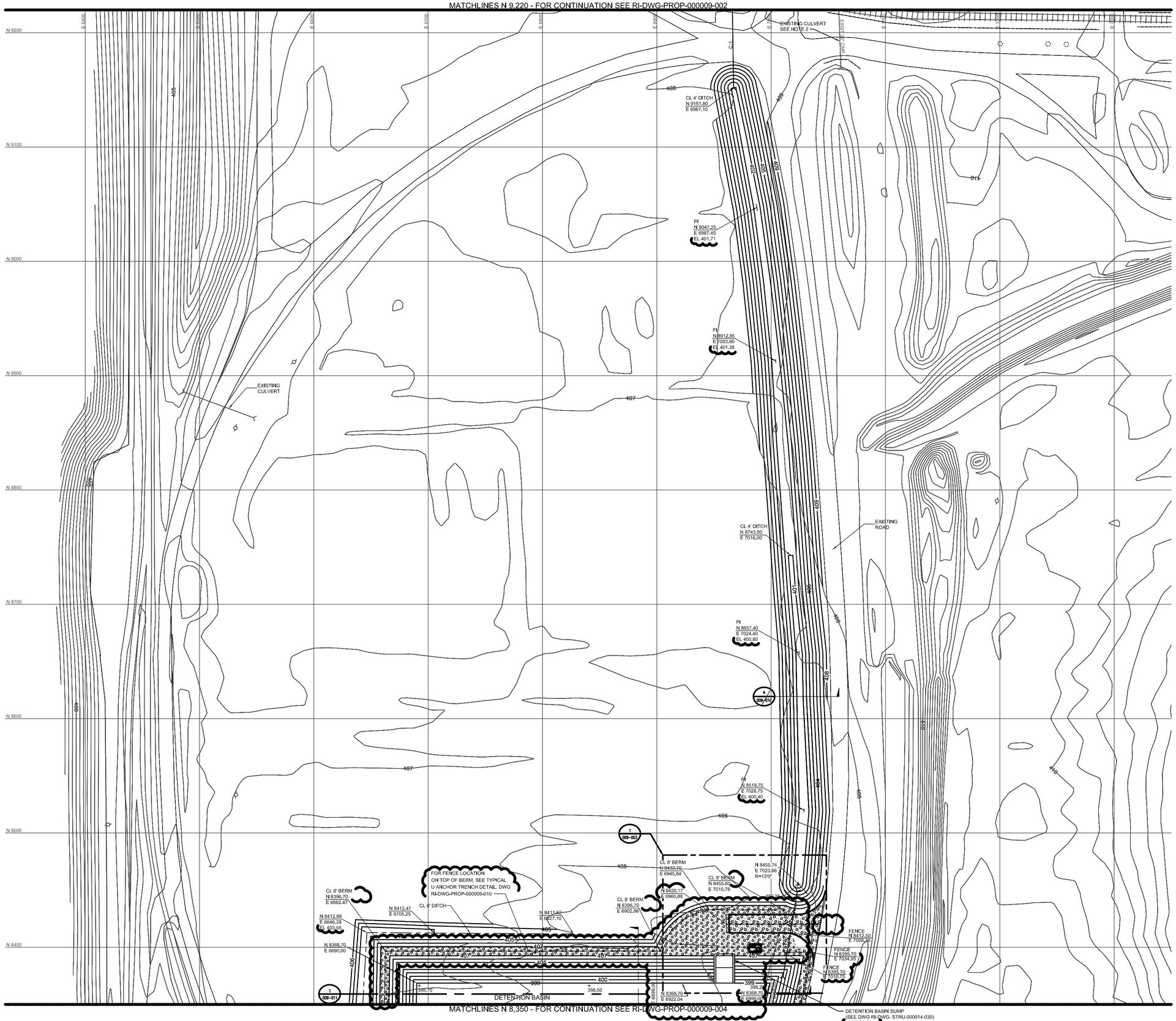
SITE: RUSH ISLAND ENERGY CENTER

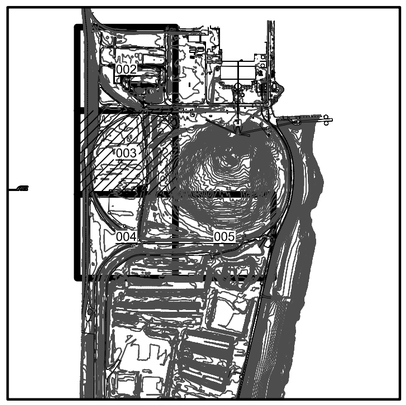
Ameren MISSOURI

DRAWING NO. RI-DWG-PROP-000009-002

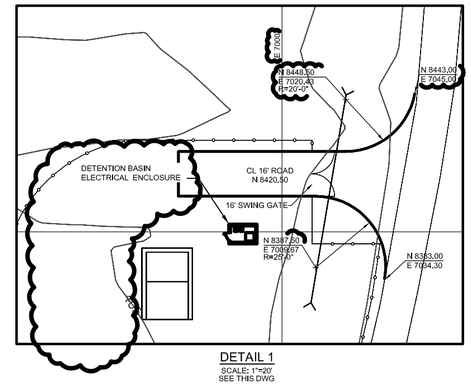
REVISION NO. 00E

MATCHLINES N 9,220 - FOR CONTINUATION SEE RI-DWG-PROP-000009-002





KEY PLAN



DETAIL 1
SCALE: 1"=20'
SEE THIS DWG

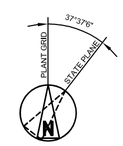
NOTES:

1. SEE DRAWING RI-DWG-PROP-000009-001 FOR LEGEND AND GENERAL NOTES.
2. EXISTING CULVERT TO BE PLUGGED AND ABANDONED IN PLACE.
3. ALL DISTURBED AREAS NOT RECEIVING CONRETE OR AGGREGATE SHALL BE SEEDED.
4. SEE TYPICAL DETAIL ON DRAWING RI-DWG-PROP-000009-010 FOR LINER ATTACHMENT TO CONCRETE STRUCTURE.

REFERENCE DRAWINGS:

RI-DWG-PROP-000009-001	KEY PLAN, LEGEND AND GENERAL NOTES
RI-DWG-PROP-000009-002	GRADING AND DRAINAGE PLAN
RI-DWG-PROP-000009-004	GRADING AND DRAINAGE PLAN
RI-DWG-PROP-000009-005	GRADING AND DRAINAGE PLAN
RI-DWG-PROP-000009-010	GRADING SECTIONS AND DETAILS
RI-DWG-PROP-000009-011	GRADING SECTIONS AND DETAILS
RI-DWG-PROP-000009-012	MANHOLE AND CATCHBASIN DETAILS

ALL BACKCIRCLE CHANGES PER ECN-N-S-0001



30' 20' 10' 0 30' 60'
1" = 30'

MATCHLINES N 8,350 - FOR CONTINUATION SEE RI-DWG-PROP-000009-004

APPROVED FOR CONSTRUCTION

THE DISTRIBUTION AND USE OF THE NATIVE FORMAT CAD FILE OF THIS DRAWING IS UNCONTROLLED. THE USER SHALL VERIFY TRACEABILITY OF THIS DRAWING TO THE LATEST CONTROLLED VERSION.

BLACK & VEATCH
Building a world of difference

DRAWING CREATED FOR BLACK & VEATCH
PROJECT 190611, AMEREN MISSOURI
PROJECT J02PM.

I HEREBY CERTIFY THAT THIS DOCUMENT WAS PREPARED BY ME OR UNDER MY DIRECT SUPERVISION AND THAT I AM A DULY REGISTERED PROFESSIONAL ENGINEER UNDER THE LAWS OF THE STATE OF MISSOURI

SIGNED NATHAN DOUGLAS KAISER
DATE 05/31/2017 REG NO. 2002016675

STATE OF MISSOURI
NATHAN DOUGLAS KAISER
PE-2002016675
PROFESSIONAL ENGINEER
31-May-2017

DRAWING RECORD

REV.	DATE	PROJECT NO.	DRAFTING DRFTR	CHK'D1	SUPV	ENGR	DESCRIPTION
00A	05/12/16	---	RRH	JJD	ILE	*****	ISSUED FOR CLIENT REVIEW
00B	07/22/16	---	RJW	JDA	ILE	---	ISSUED FOR BID
00C	01/11/17	---	NJO	JDA	ILE	---	ISSUED FOR BID
00D	03/13/17	---	NJO	JMS	ILE	JJD	ISSUED FOR CLIENT REVIEW
00E	05/31/17	---	SES	JMS	ILE	JJD	ISSUED FOR CONSTRUCTION

NOTICE OF LIMITED RESPONSIBILITY
THE RESPONSIBILITY OF THE UNDERSIGNED ENDS AT LIMITS OF DESIGN WORK SHOWN ON PROJECT AND DOCUMENTS BEARING HIS/HER SEAL. UNDERSIGNED DISCLAIMS ANY RESPONSIBILITY FOR WORK DONE UNDER SUBSEQUENT REVISIONS AND ALTERATIONS TO THESE OR OTHER DOCUMENTS ASSOCIATED WITH THE PROJECT WHICH DO NOT BEAR HIS/HER SEAL.

CONSTRUCTION

MARK UP DRAWING NO.	REV.
---	---

SCALE	1:30
UNIT NO.	---
DWG. SIDE	---
SUB CLASS	---

GRADING AND DRAINAGE PLAN

SITE: RUSH ISLAND ENERGY CENTER

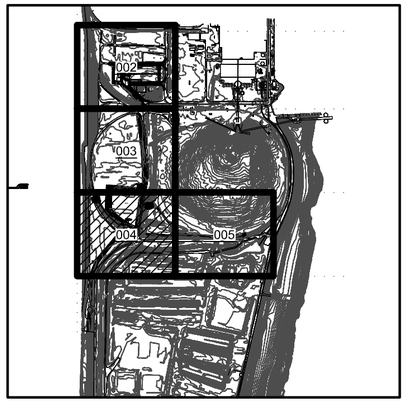
Ameren MISSOURI

DRAWING NO.
RI-DWG-PROP-000009-003

REVISION NO. 00E

MATCHLINES N 8,350 - FOR CONTINUATION SEE RI-DWG-PROP-000009-003

MATCHLINES E 7,350 - FOR CONTINUATION SEE RI-DWG-PROP-000009-005



KEY PLAN

DETENTION BASIN

COAL YARD RUNOFF POND

FOR FENCE LOCATION SEE TYPICAL U ANCHOR TRENCH DETAIL, DWG RI-DWG-PROP-000009-011

FOR FENCE LOCATION ON TOP OF BERM, SEE TYPICAL U ANCHOR TRENCH DETAIL, DWG RI-DWG-PROP-000009-011

CL 6' DITCH

CL 8' BERM
N 8269.24
E 6664.03
CL 8' BERM
8232.24
E 6663.32

CL 8' BERM
N 8165.66
E 6656.04

CL 8' BERM
N 7957.20
E 6960.00

N 8345.40
E 6642.48

N 8175.50
E 6686.25

N 8586.33
E 7171.50
R= 635'-0"

N 8247.70
E 6970.90

N 8276.25
E 7083.90

N 8281.50
E 7045.90

N 7995.90
E 6935.70

N 7986.97
E 6832.13

N 7928.75
E 6997.30

N 7923.75
E 7033.33

EXISTING MONITORING WELL P11S TO BE PLUGGED AND ABANDONED IN PLACE (BY OTHERS)

DRAW-DOWN STRUCTURE (SEE DWG RIDWG/PROP-000009-12)

EXISTING CULVERT SEE NOTE 4

EXISTING CULVERT SEE NOTE 2

SEE NOTE 3

OVERFLOW DITCH (BY OTHERS)

OVERFLOW DITCH TO NEW OUTFALL (BY OTHERS)

398.75

406.50

398.50

N 8300
N 8200
N 8100
N 8000
N 7900
N 7800
N 7700
N 7600
N 7500

E 8300
E 8200
E 8100
E 8000
E 7900
E 7800
E 7700

NOTES:

1. SEE DRAWING RI-DWG-PROP-000009-001 FOR LEGEND AND GENERAL NOTES.
2. EXISTING CULVERT TO BE PLUGGED AND ABANDONED IN PLACE.
3. CONTRACTOR SHALL TIE EXISTING STORMWATER DITCH INTO COAL YARD RUNOFF POND.
4. ALL DISTURBED AREAS NOT RECEIVING CONCRETE OR AGGREGATE SHALL BE SEEDED.
5. EXISTING CULVERT TO BE DEMOLISHED AND REPLACED AS SHOWN ON THIS DRAWING.

REFERENCE DRAWINGS:

RI-DWG-PROP-000009-001	KEY PLAN, LEGEND AND GENERAL NOTES
RI-DWG-PROP-000009-002	GRADING AND DRAINAGE PLAN
RI-DWG-PROP-000009-003	GRADING AND DRAINAGE PLAN
RI-DWG-PROP-000009-005	GRADING AND DRAINAGE PLAN
RI-DWG-PROP-000009-010	GRADING SECTIONS AND DETAILS
RI-DWG-PROP-000009-011	GRADING SECTIONS AND DETAILS
RI-DWG-PROP-000009-012	MANHOLE AND CATCHBASIN DETAILS

ALL BACKCIRCLE CHANGES PER ECN-N-S-0001

30' 20' 10' 0 30' 60'
1" = 30'

37°37'6"
PLANT GRID
STATE PLANE
N

APPROVED FOR CONSTRUCTION

THE DISTRIBUTION AND USE OF THE NATIVE FORMAT CAD FILE OF THIS DRAWING IS UNCONTROLLED. THE USER SHALL VERIFY TRACEABILITY OF THIS DRAWING TO THE LATEST CONTROLLED VERSION.

BLACK & VEATCH
Building a world of difference®

DRAWING CREATED FOR BLACK & VEATCH PROJECT 190811, AMEREN MISSOURI PROJECT J02PM.

I HEREBY CERTIFY THAT THIS DOCUMENT WAS PREPARED BY ME OR UNDER MY DIRECT SUPERVISION AND THAT I AM A DULY REGISTERED PROFESSIONAL ENGINEER UNDER THE LAWS OF THE STATE OF MISSOURI

SIGNED NATHAN DOUGLAS KAISER

DATE 05/31/2017 REG NO. 2002016675

STATE OF MISSOURI
NATHAN DOUGLAS KAISER
PE-2002016675
PROFESSIONAL ENGINEER

31-May-2017

DRAWING RECORD

REV.	DATE	PROJECT NO.	DRFTR	CHK'D	SUPV	ENGR	DESCRIPTION
00A	05/12/16	—	RRH	JJD	ILE	—	ISSUED FOR CLIENT REVIEW
00B	07/22/16	—	RJW	JDA	ILE	—	ISSUED FOR IFR
00C	01/11/17	—	NJO	JDA	ILE	—	ISSUED FOR IFR
00D	03/13/17	—	NJO	JMS	ILE	JJD	ISSUED FOR CLIENT REVIEW
00E	05/31/17	—	SES	JMS	ILE	JJD	ISSUED FOR CONSTRUCTION

NOTICE OF LIMITED RESPONSIBILITY

THE RESPONSIBILITY OF THE UNDERSIGNED ENGINEER IS LIMITED TO THE DESIGN WORK SHOWN ON PROJECT AND DOCUMENTS BEARING HIS/HER SEAL, SIGNATURE OR INITIALS. HE/SHE DOES NOT HAVE AUTHORITY OVER THE WORK OF OTHERS AND IS NOT RESPONSIBLE FOR CONSTRUCTION MEANS, METHODS, TECHNIQUES, SEQUENCES, PROCEDURES, SAFETY PRECAUTIONS AND PROGRAMS IN CONNECTION WITH THE WORK, FOR CHANGES MADE IN THE DRAWINGS AND SPECIFICATIONS BY OTHERS, FOR CHANGES TO THE WORK MADE BY OTHERS, FOR REVISIONS MADE BY OTHERS TO THE DRAWINGS AND SPECIFICATIONS, OR FOR ANY OTHER DOCUMENTS ASSOCIATED WITH THE PROJECT WHICH DO NOT BEAR HIS/HER SEAL, SIGNATURE OR INITIALS.

CONSTRUCTION

MARK UP DRAWING NO. —

REV. —

SCALE 1:30
UNIT NO. —
DWG. SIZE —
SUB CLASS —

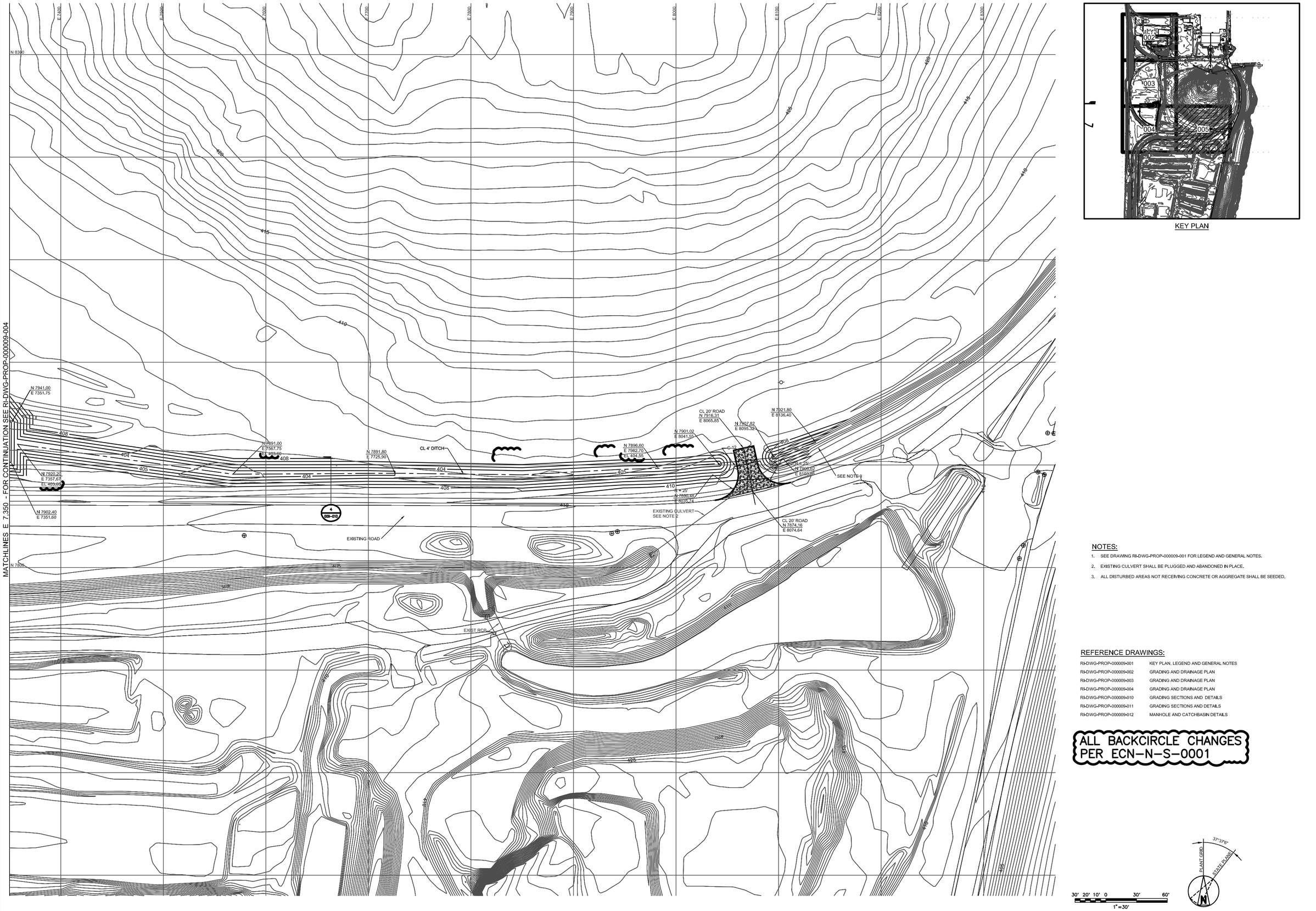
GRADING AND DRAINAGE PLAN

SITE: RUSH ISLAND ENERGY CENTER

Ameren MISSOURI

DRAWING NO. RI-DWG-PROP-000009-004

REVISION NO. 00E



KEY PLAN

NOTES:

1. SEE DRAWING RI-DWG-PROP-000009-001 FOR LEGEND AND GENERAL NOTES.
2. EXISTING CULVERT SHALL BE PLUGGED AND ABANDONED IN PLACE.
3. ALL DISTURBED AREAS NOT RECEIVING CONCRETE OR AGGREGATE SHALL BE SEEDED.

REFERENCE DRAWINGS:

RI-DWG-PROP-000009-001	KEY PLAN, LEGEND AND GENERAL NOTES
RI-DWG-PROP-000009-002	GRADING AND DRAINAGE PLAN
RI-DWG-PROP-000009-003	GRADING AND DRAINAGE PLAN
RI-DWG-PROP-000009-004	GRADING AND DRAINAGE PLAN
RI-DWG-PROP-000009-010	GRADING SECTIONS AND DETAILS
RI-DWG-PROP-000009-011	GRADING SECTIONS AND DETAILS
RI-DWG-PROP-000009-012	MANHOLE AND CATCHBASIN DETAILS

ALL BACKCIRCLE CHANGES PER ECN-N-S-0001

30' 20' 10' 0 30' 60'
1" = 30'

APPROVED FOR CONSTRUCTION

THE DISTRIBUTION AND USE OF THE NATIVE FORMAT CAD FILE OF THIS DRAWING IS UNCONTROLLED. THE USER SHALL VERIFY TRACEABILITY OF THIS DRAWING TO THE LATEST CONTROLLED VERSION.

BLACK & VEATCH
Building a world of difference®

DRAWING CREATED FOR BLACK & VEATCH
PROJECT 190611, AMEREN MISSOURI
PROJECT J02PM.

I HEREBY CERTIFY THAT THIS DOCUMENT WAS PREPARED BY ME OR UNDER MY DIRECT SUPERVISION AND THAT I AM A DULY REGISTERED PROFESSIONAL ENGINEER UNDER THE LAWS OF THE STATE OF MISSOURI

SIGNED NATHAN DOUGLAS KAISER

DATE 05/31/2017 REG NO. 2002016675

STATE OF MISSOURI
NATHAN DOUGLAS KAISER
PE-2002016675
PROFESSIONAL ENGINEER
31-May-2017

NOTICE OF LIMITED RESPONSIBILITY
THE RESPONSIBILITY OF THE UNDERSIGNED ENGINEER IS LIMITED TO THE DESIGN WORK SHOWN ON PROJECT AND DOCUMENTS BEARING HIS/HER SEAL. SIGNATURE OR INITIALS. HE/SHE DOES NOT HAVE AUTHORITY OVER THE REVISION AND MODIFICATION OF UNDERSIGNED DISCLAIMS ANY RESPONSIBILITY FOR WORK DONE UNDER SUBSEQUENT SIGNATURE OR INITIALS ON DOCUMENTS ASSOCIATED WITH THE PROJECT WHICH DO NOT BEAR HIS/HER SEAL.

CONSTRUCTION

MARK UP DRAWING NO.	REV.
—	—

SCALE	1:30
UNIT NO.	—
DWG. SIZE	—
SUB CLASS	—

GRADING AND DRAINAGE PLAN
—
—

SITE: RUSH ISLAND ENERGY CENTER

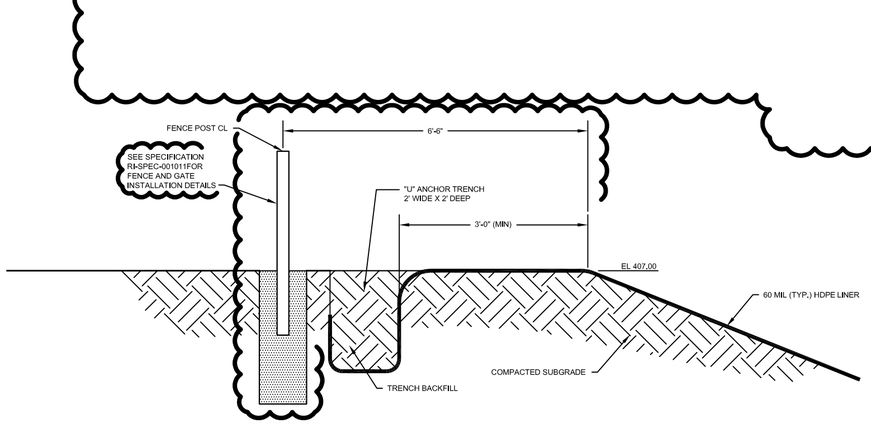
Ameren MISSOURI

DRAWING NO. RI-DWG-PROP-000009-005

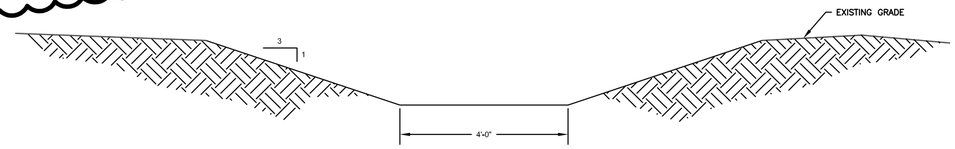
REVISION NO. 00D

DRAWING RECORD

REV.	DATE	PROJECT NO.	DRAFTING DRFTR	CHK'D	SUPV	ENGR	DESCRIPTION
00A	05/12/16	---	RRH	JJD	ILE	---	ISSUED FOR CLIENT REVIEW
00B	07/22/16	---	RJW	JDA	ILE	---	ISSUED FOR IFR
00C	03/13/17	---	NJO	JMS	ILE	JJD	ISSUED FOR CLIENT REVIEW
00D	05/31/17	---	SES	JMS	ILE	JJD	ISSUED FOR CONSTRUCTION



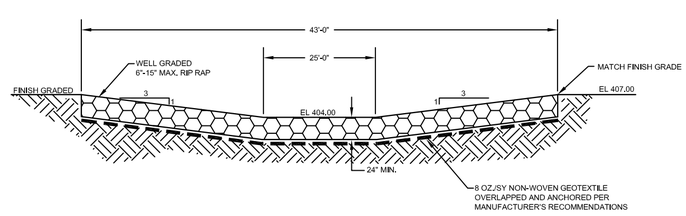
TYPICAL "U" ANCHOR TRENCH DETAIL
NO SCALE
SEE THIS DRAWING



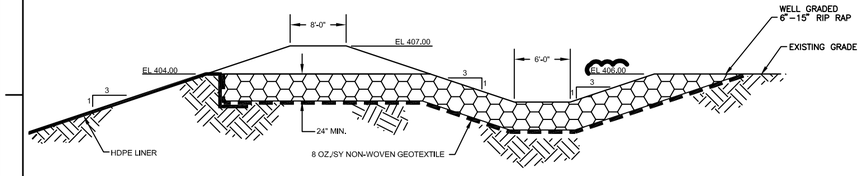
SECTION 4
TYPICAL STORMWATER DITCH
NOT TO SCALE
SEE DWG RI-DWG-PROP-000009 SHEET 2 THROUGH 5

CULVERT TABLE

CULVERT NO.	DWG. NO	CENTERLINE COORDINATES INLET END NORTH	INLET END EAST	OUTLET END NORTH	OUTLET END EAST	LENGTH	INLET INV ELEVATION	OUTLET INV ELEVATION	END TYPE	PIPE DIAMETER	NUMBER OF BARRELS	PIPE MATERIAL	REMARKS
C-1	RI-DWG-PROP-000009-002 & 003	CB-01	CB-01	9151,80	6967,10	70'	402,20	401,85	PROJECTING	48"	1	CHDPE	SEE DWG RI-DWG-PROP-000009-003
C-2	RI-DWG-PROP-000009-003	8448,83	7022,86	8374,70	7010,39	75'	400,25	399,85	PROJECTING	48"	1	CHDPE	USE 48" TIDEFLEX TF-1 DUCKBILL CHECK VALVE AT OUTLET END, SEE DWGRI-DWG-PROP-000009-003
C-3	RI-DWG-PROP-000009-004	7990,00	6821,00	7917,25	6768,00	90'	401,25	401,00	PROJECTING	36"	3	CMP	USE 36" TIDEFLEX TF-1 DUCKBILL CHECK VALVE AT OUTLET END (ALL BARRELS). SEE DWG RI-DWG-PROP-000009-004
C-4	RI-DWG-PROP-000009-004	7974,80	6995,20	7989,00	6947,00	50'	400,25	399,65	PROJECTING	42"	1	CHDPE	DRAW DOWN STRUCTURE OUTLET PIPE, SEE DWG RI-DWG-PROP-000009-004. USE 42" TIDEFLEX TF-1 DUCKBILL CHECK VALVE AT OUTLET END
C-5	RI-DWG-PROP-000009-002	9274,55	6988,82	CB-01	CB-01	50'	402,65	402,40	-	48"	1	CMP	SEE DWG RI-DWG-PROP-000009-002
C-6	RI-DWG-PROP-000009-002	9265,00	7057,00	9279,00	6989,75	70'	403,00	402,65	PROJECTING	42"	1	CHDPE	SEE DWG RI-DWG-PROP-000009-002
C-7	RI-DWG-PROP-000009-002	9323,30	7115,40	9070,30	7080,90	64'	403,30	403,00	PROJECTING	36"	1	CHDPE	SEE DWG RI-DWG-PROP-000009-002
C-8	RI-DWG-PROP-000009-002	MH-01	MH-01	9325,25	7181,50	96'	404,00	403,50	PROJECTING	36"	1	CHDPE	SEE DWG RI-DWG-PROP-000009-002
C-9	RI-DWG-PROP-000009-002	9420,13	7273,70	MH-01	MH-01	102'	404,75	404,00	PROJECTING	36"	1	CHDPE	SEE DWG RI-DWG-PROP-000009-002
C-10	RI-DWG-PROP-000009-002	CB-02	CB-02	MH-01	MH-01	-	-	-	-	15"	1	CHDPE	SEE DWG RI-DWG-PROP-000009-002
C-11	RI-DWG-PROP-000009-002	9439,25	6894,25	9407,75	6867,00	42'	407,50	407,00	PROJECTING	15"	1	CHDPE	SEE DWG RI-DWG-PROP-000009-002
C-12	RI-DWG-PROP-000009-005	7907,00	8093,75	7901,75	8044,00	50'	404,90	404,70	PROJECTING	30"	1	CHDPE	SEE DWG RI-DWG-PROP-000009-005



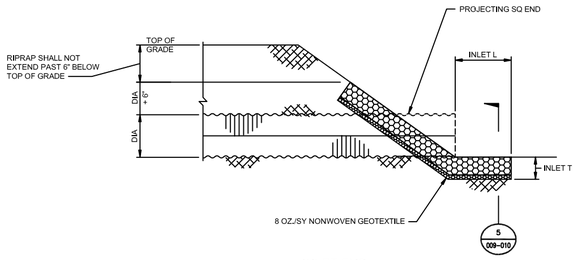
SECTION 2
EMERGENCY SPILLWAY
NO SCALE
SEE DWG RI-DWG-PROP-000009-004



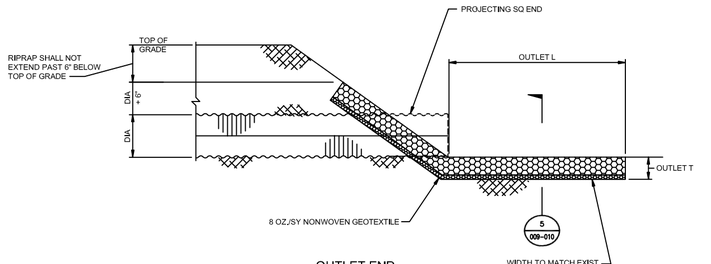
SECTION 3
NO SCALE
SEE DWG RI-DWG-PROP-000009-004

RIPRAP TABLE

CULVERT NO.	INLET L	OUTLET L	INLET T	OUTLET T	INLET W	OUTLET W	INLET D50	OUTLET D50	REMARKS
C-1	-	10'-0"	-	1'-6"	-	4'-0"	-	6"	
C-2	5'-0"	-	1'-6"	-	4'-0"	-	6"	-	
C-3	15'-0"	30'-0"	1'-6"	1'-6"	25'-0"	25'-0"	6"	6"	
C-4	-	-	-	-	-	-	-	-	
C-5	5'-0"	-	1'-6"	-	4'-0"	-	6"	-	
C-6	5'-0"	10'-0"	1'-6"	1'-6"	4'-0"	4'-0"	6"	6"	
C-7	5'-0"	10'-0"	1'-6"	1'-6"	4'-0"	4'-0"	6"	6"	
C-8	-	10'-0"	-	1'-6"	-	4'-0"	-	6"	
C-9	5'-0"	-	1'-6"	-	4'-0"	-	6"	-	
C-10	-	-	-	-	-	-	-	-	
C-11	5'-0"	10'-0"	1'-6"	1'-6"	4'-0"	4'-0"	6"	6"	
C-12	5'-0"	10'-0"	1'-6"	1'-6"	4'-0"	4'-0"	6"	6"	

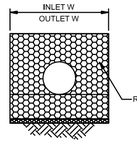


INLET END
SEE RIPRAP TABLE



OUTLET END
SEE RIPRAP TABLE

TYPICAL CULVERT RIPRAP
NOT TO SCALE



SECTION 5
NOT TO SCALE
SEE THIS DWG
SEE RIPRAP TABLE

NOTES:

1. SEE DRAWING RI-DWG-PROP-000009-001 FOR LEGEND AND GENERAL NOTES.

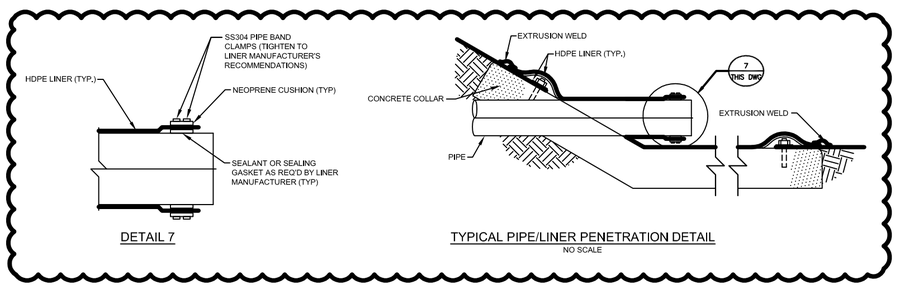
REFERENCE DRAWINGS:

RI-DWG-PROP-000009-001	KEY PLAN, LEGEND AND GENERAL NOTES
RI-DWG-PROP-000009-002	GRADING AND DRAINAGE PLAN
RI-DWG-PROP-000009-003	GRADING AND DRAINAGE PLAN
RI-DWG-PROP-000009-004	GRADING AND DRAINAGE PLAN
RI-DWG-PROP-000009-005	GRADING AND DRAINAGE PLAN
RI-DWG-PROP-000009-011	GRADING SECTIONS AND DETAILS
RI-DWG-PROP-000009-012	MANHOLE AND CATCHBASIN DETAILS

ALL BACKCIRCLE CHANGES PER ECN-N-S-0001

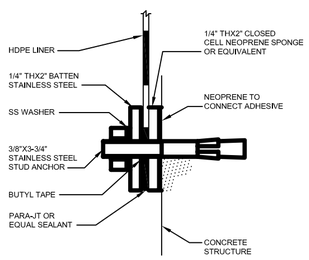
APPROVED FOR CONSTRUCTION
THE DISTRIBUTION AND USE OF THE NATIVE FORMAT CAD FILE OF THIS DRAWING IS UNCONTROLLED. THE USER SHALL VERIFY TRACEABILITY OF THIS DRAWING TO THE LATEST CONTROLLED VERSION.

BLACK & VEATCH
Building a world of difference



DETAIL 7

TYPICAL PIPE/LINER PENETRATION DETAIL
NO SCALE



TYPICAL LINER ATTACHMENT DETAIL
NO SCALE

DRAWING CREATED FOR BLACK & VEATCH PROJECT 188552, AMEREN MISSOURI PROJECT J02L9.

I HEREBY CERTIFY THAT THIS DOCUMENT WAS PREPARED BY ME OR UNDER MY DIRECT SUPERVISION AND THAT I AM A DULY REGISTERED PROFESSIONAL ENGINEER UNDER THE LAWS OF THE STATE OF MISSOURI

SIGNED NATHAN DOUGLAS KAISER
DATE 05/31/2017 REG NO. 2002016675

STATE OF MISSOURI
NATHAN DOUGLAS KAISER
PE-2002016675
PROFESSIONAL ENGINEER
31-May-2017

NOTICE OF LIMITED RESPONSIBILITY
THE RESPONSIBILITY OF THE UNDERSIGNED ENGINEER IS LIMITED TO THE DESIGN WORK SHOWN ON PROJECT AND DOES NOT EXTEND TO ANY CHANGES MADE TO THE DRAWINGS AFTER THEY HAVE BEEN ISSUED FOR CONSTRUCTION OR TO THE PROJECT AS A WHOLE. THE UNDERSIGNED DOES NOT HAVE ANY RESPONSIBILITY FOR WORK DONE UNDER SUBSEQUENT REVISIONS AND ANY OTHER DOCUMENTS ASSOCIATED WITH THE PROJECT WHICH DO NOT BEAR HIS/HER SEAL, SIGNATURE OR INITIALS.

CONSTRUCTION
MARK UP DRAWING NO. ---- REV. ----

SCALE —
UNIT NO. —
DWG. SIZE —
SUB CLASS —

GRADING AND DRAINAGE SECTIONS AND DETAILS

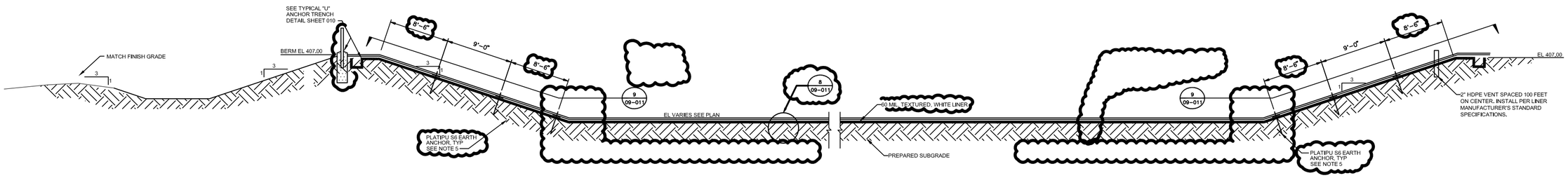
SITE: RUSH ISLAND ENERGY CENTER

Ameren MISSOURI

DRAWING NO. RI-DWG-PROP-000009-010
REVISION NO. 00D

DRAWING RECORD

REV.	DATE	PROJECT NO.	DRAFTING DRFTR	CHK'D	SUPV	ENGR	DESCRIPTION
00A	05/12/16	---	RRH	JJD	ILE	---	ISSUED FOR CLIENT REVIEW
00B	07/22/16	---	RJW	JDA	ILE	---	ISSUED FOR IFB
00C	03/13/17	---	NJO	JMS	ILE	JJD	ISSUED FOR CLIENT REVIEW
00D	05/31/17	---	SES	JMS	ILE	JJD	ISSUED FOR CONSTRUCTION



SECTION 1

NO SCALE

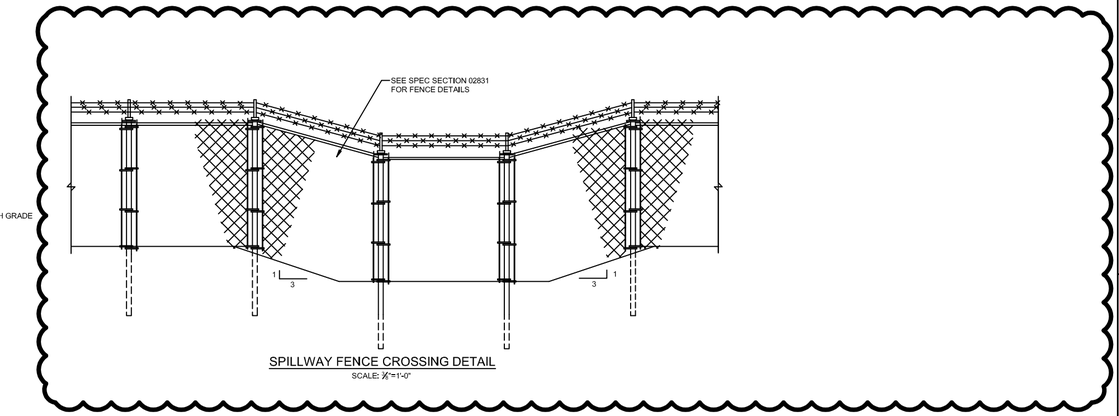
SEE DWGS RI-DWG-PROP-000009-003 AND RI-DWG-PROP-000009-004



SECTION 2

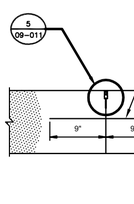
NO SCALE

SEE DWG RI-DWG-PROP-000009-004



SPILLWAY FENCE CROSSING DETAIL

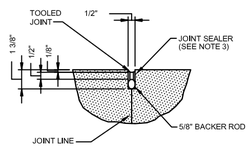
SCALE: 1/4"=1'-0"



CONSTRUCTION JOINT

DETAIL 4

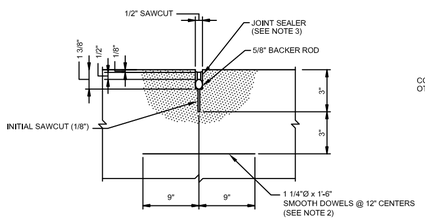
NO SCALE



DETAIL 5

NO SCALE

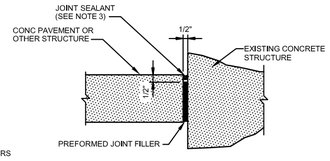
SEE THIS DWG



SAWCUT CONTRACTION JOINT (SJ)

DETAIL 6

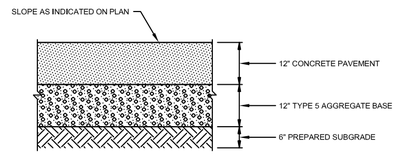
NO SCALE



ISOLATION JOINT (IJ)

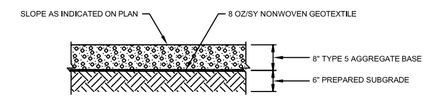
DETAIL 7

NO SCALE



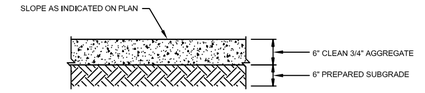
CONCRETE PAVING SECTION

NO SCALE



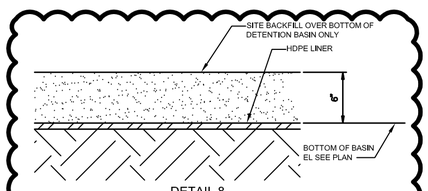
AGGREGATE ROAD SECTION

NO SCALE



AGGREGATE SURFACING SECTION

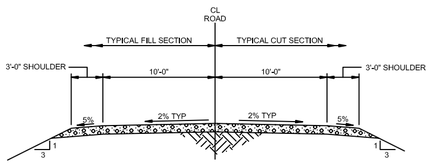
NO SCALE



DETAIL 8

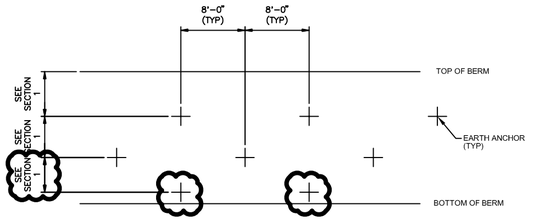
NO SCALE

SEE THIS DWG



TYPICAL ROAD SECTION

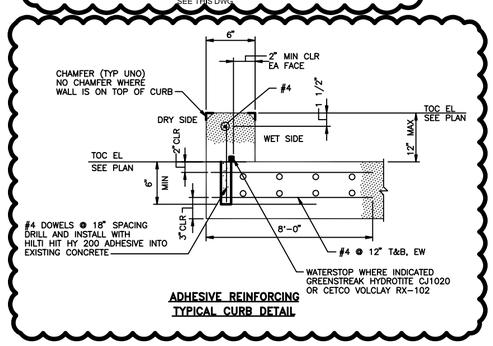
NO SCALE



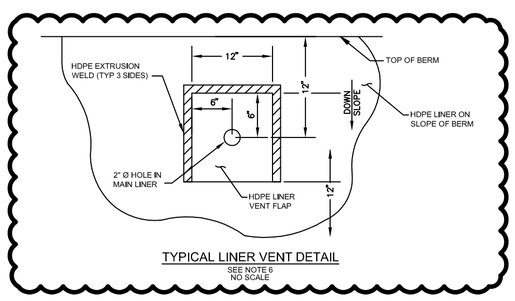
SECTION 9

SEE THIS DWG

NOT TO SCALE



ADHESIVE REINFORCING TYPICAL CURB DETAIL



TYPICAL LINER VENT DETAIL

SEE NOTE 6

NO SCALE

ALL BACKCIRCLE CHANGES PER ECN-N-S-0001

NOTES:

1. SEE DRAWING RI-DWG-PROP-000009-001 FOR LEGEND AND GENERAL NOTES.
2. DOWELS SHALL BE EPOXY-COATED SMOOTH STEEL BARS CONFORMING TO SPECIFICATION REQUIREMENTS. DOWELS SHALL BE GREASED AND WRAPPED ON ONE END. PLACE DOWELS AT LEAST 6" FROM THE EDGES OF PAVEMENT.
3. JOINT SEALANT SHALL BE TOOLED DOWN BELOW THE PAVEMENT SURFACE IN ACCORDANCE WITH THE SEALANT MANUFACTURER'S INSTRUCTIONS.
4. INITIAL SAW CUTS AT PAVEMENT JOINTS SHALL BE MADE AFTER THE CONCRETE HAS HARDENED ENOUGH TO BE CUT WITHOUT SPALLING OR RAVELING AND BEFORE ANY RANDOM CRACKS DEVELOP.
5. ANCHORS SHALL BE INSTALLED TO A MINIMUM DEPTH OF 5 FEET BELOW GRADE. ALL EARTH ANCHORS SHALL BE FIELD LOAD TESTED. AFTER INSTALLATION TO BETWEEN 1450 LBS AND 1550 LBS. AT EACH ANCHOR LOCATION. AN HDPE PATCH SHALL BE EXTRUSION WELDED TO THE LINER. AFTER LOAD TESTING, ALTERNATE EARTH ANCHOR SUPPLIERS OR ANCHOR TYPES MUST BE APPROVED BY THE ENGINEER PRIOR TO INSTALLATION.
6. LINER VENTS SHALL BE INSTALLED EVERY 100 FEET PER TYPICAL DETAIL ON THIS DRAWING.

REFERENCE DRAWINGS:

RI-DWG-PROP-000009-001	KEY PLAN, LEGEND AND GENERAL NOTES
RI-DWG-PROP-000009-002	GRADING AND DRAINAGE PLAN
RI-DWG-PROP-000009-003	GRADING AND DRAINAGE PLAN
RI-DWG-PROP-000009-004	GRADING AND DRAINAGE PLAN
RI-DWG-PROP-000009-005	GRADING AND DRAINAGE PLAN
RI-DWG-PROP-000009-010	GRADING SECTIONS AND DETAILS
RI-DWG-PROP-000009-012	MANHOLE AND CATCHBASIN DETAILS

APPROVED FOR CONSTRUCTION

THE DISTRIBUTION AND USE OF THE NATIVE FORMAT CAD FILE OF THIS DRAWING IS UNCONTROLLED. THE USER SHALL VERIFY TRACEABILITY OF THIS DRAWING TO THE LATEST CONTROLLED VERSION.

BLACK & VEATCH Building a world of difference®

DRAWING CREATED FOR BLACK & VEATCH PROJECT 190611, AMEREN MISSOURI PROJECT J02PM.

I HEREBY CERTIFY THAT THIS DOCUMENT WAS PREPARED BY ME OR UNDER MY DIRECT SUPERVISION AND THAT I AM A DULY REGISTERED PROFESSIONAL ENGINEER UNDER THE LAWS OF THE STATE OF MISSOURI

SIGNED NATHAN DOUGLAS KAISER

DATE 05/31/2017 REG NO. 2002016675

STATE OF MISSOURI NATHAN DOUGLAS KAISER PE-2002016675 PROFESSIONAL ENGINEER

31-May-2017

NOTICE OF LIMITED RESPONSIBILITY

THE RESPONSIBILITY OF THE PROFESSIONAL ENGINEER IS LIMITED TO THE SERVICES WORK SHOWN ON PROJECT AND DOCUMENTS BEARING THE SEAL OF THE PROFESSIONAL ENGINEER. AS AGENT OF THE OWNER, AUTHORITY OVER THE PROJECT AS A WHOLE, THE UNDERSIGNED DISCLAIMS ANY RESPONSIBILITY FOR WORK DONE UNDER SUBSEQUENT REVISIONS AND INSTALLATIONS. THESE DOCUMENTS ASSOCIATED WITH THE PROJECT WHICH DO NOT BEAR HIS/HER SEAL.

SCALE	---
UNIT NO.	---
DWG. SIDE	---
SUB CLASS	---

CONSTRUCTION

MARK UP DRAWING NO.	REV.
---	---

GRADING AND DRAINAGE SECTIONS AND DRAINAGE

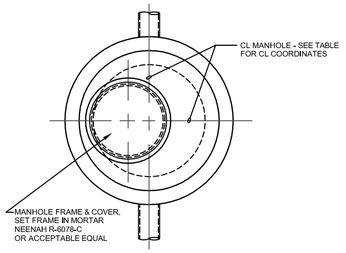
SITE: RUSH ISLAND ENERGY CENTER

DRAWING NO. RI-DWG-PROP-000009-011

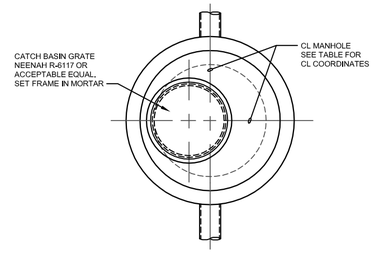
REVISION NO. 00E

DRAWING RECORD

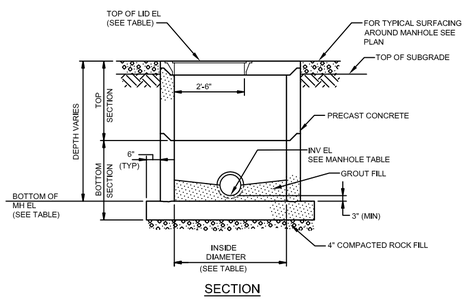
REV.	DATE	PROJECT NO.	DRFTR	CHK'D	SUPV	ENGR	DESCRIPTION
00A	05/12/16	---	RRH	JJD	ILE	----	ISSUED FOR CLIENT REVIEW
00B	07/22/16	---	RJW	JDA	ILE	---	ISSUED FOR BID
00C	01/11/17	---	NJO	JDA	ILE	---	ISSUED FOR BID
00D	03/13/17	---	NJO	JMS	ILE	JJD	ISSUED FOR CLIENT REVIEW
00E	05/31/17	---	SES	JMS	ILE	JJD	ISSUED FOR CONSTRUCTION



PLAN

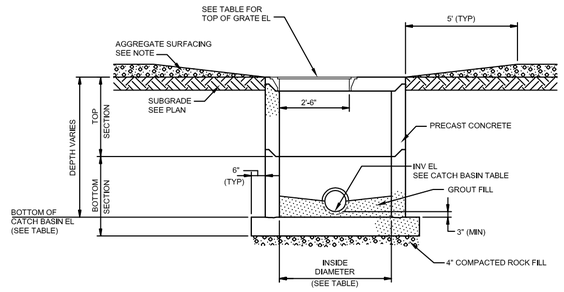


PLAN



SECTION

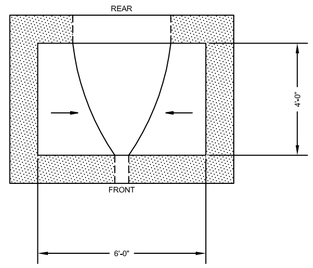
TYPICAL PRECAST MANHOLE
NO SCALE



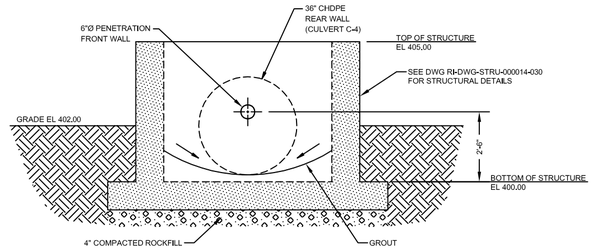
SECTION

NOTE: AGGREGATE SURFACING SHALL TRANSITION FROM 0 AT THE EDGE OF THE MANHOLE TO FULL DEPTH WITHIN 5' OF THE MANHOLE EDGE

TYPICAL PRECAST CATCH BASIN
NO SCALE

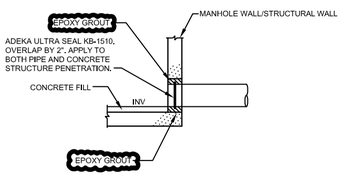


PLAN

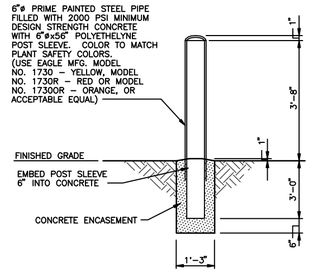


SECTION

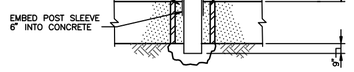
PRECAST COAL POND DRAW-DOWN STRUCTURE
NO SCALE
SEE DWG RI-DWG-PROP-000009-004



TYPICAL WALL PENETRATION DETAIL
NO SCALE

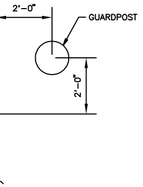


TYPICAL GUARD POST
NO SCALE
NOTE: MAXIMUM SPACING BETWEEN POSTS = 4'-0"



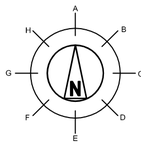
TYPICAL GUARD POST IN SLEEVE DETAIL
NO SCALE
NOTE: MAXIMUM SPACING BETWEEN POSTS = 4'-0"

ALL BACKCIRCLE CHANGES PER ECN-N-S-0001



GUARD POST LOCATIONS (FIELD VERIFY)	
NORTH	EAST
9671.34	6870.86
9671.34	7192.86
9495.34	7192.86
9495.34	6870.86
9560.34	6829.86
9606.34	6829.86
9588.06	6791.86
9588.06	6780.86
9575.06	6780.86
9575.06	6791.86
9464.80	6945.85
9464.80	7046.18
9390.39	6945.85
9390.39	7046.18

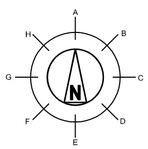
NOTE: GUARDPOST TO BE PLACED 2 FEET IN BOTH DIRECTIONS FROM THE CORNER OF THE STRUCTURE.



MANHOLE TABLE

STRUCTURE NO.	DRAWING NO.	CENTERLINE COORDINATES		STRUCTURE SIZE ID	TOP OF LID ELEVATION	BOTTOM OF MANHOLE ELEVATION	INLET & OUTLET PIPE INFORMATION																REMARKS
							A		B		C		D		E		F		G		H		
		NORTH	EAST				INV EL	DIA	INV EL	DIA	INV EL	DIA	INV EL	DIA	INV EL	DIA	INV EL	DIA	INV EL	DIA	INV EL	DIA	
MH-01	RI-DWG-PROP-000009-002	9420.00	7225.00	5'-0"	410.00	403.75	404.00	15"	-	-	404.00	36"	-	-	404.00	36"	-	-	-	-	-	-	-

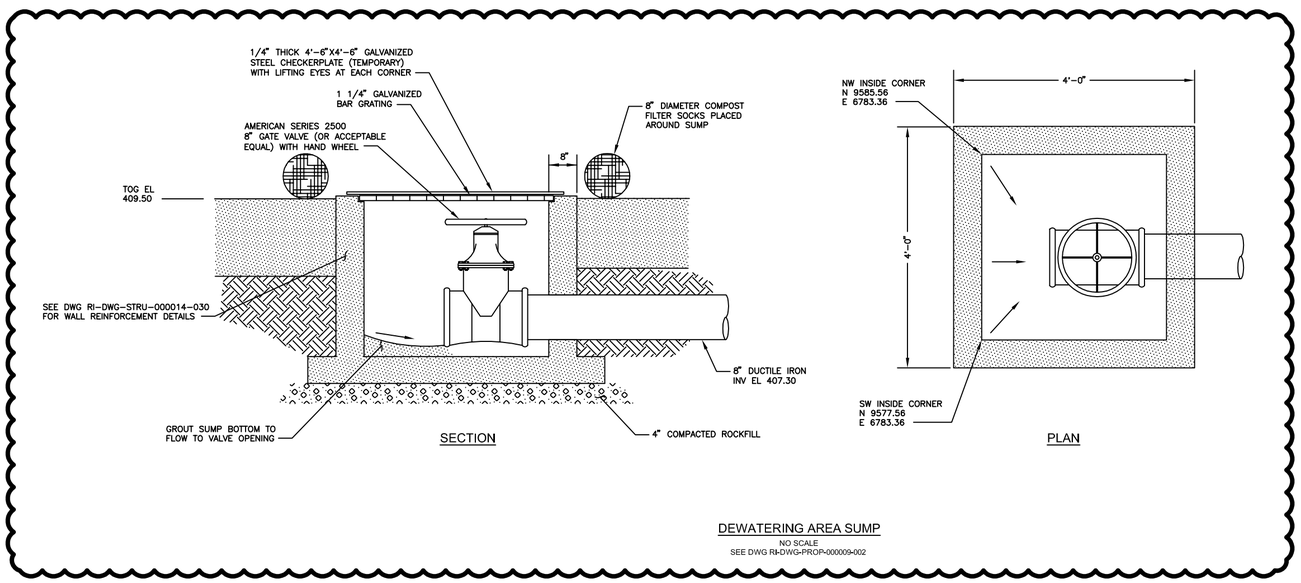
ALL DIMENSIONS ARE IN FEET, EXCEPT DIAMETER, WHICH IS IN INCHES
ALL PIPE SHALL BE CHDPE



CATCH BASIN TABLE

STRUCTURE NO.	DRAWING NO.	CENTERLINE COORDINATES		STRUCTURE SIZE ID	TOP OF GRATE ELEVATION	BOTTOM OF CATCH BASIN ELEVATION	INLET & OUTLET PIPE INFORMATION																REMARKS
							A		B		C		D		E		F		G		H		
		NORTH	EAST				INV EL	DIA	INV EL	DIA	INV EL	DIA	INV EL	DIA	INV EL	DIA	INV EL	DIA	INV EL	DIA	INV EL	DIA	
CB-01	RI-DWG-PROP-000009-002	9225.25	6966.00	5'-0"	407.00	402.00	-	-	402.40	36"	-	-	-	-	402.20	48"	-	-	-	-	-	-	-
CB-02	RI-DWG-PROP-000009-002	9575.00	7235.00	5'-0"	408.5	404.00	-	-	-	-	-	-	-	-	404.75	15"	-	-	-	-	-	-	-

ALL DIMENSIONS ARE IN FEET, EXCEPT DIAMETER, WHICH IS IN INCHES
ALL PIPE SHALL BE CHDPE



SECTION

PLAN

DEWATERING AREA SUMP
NO SCALE
SEE DWG RI-DWG-PROP-000009-002

NOTES:

1. SEE DRAWING RI-DWG-PROP-000009-001 FOR LEGEND AND GENERAL NOTES.

REFERENCE DRAWINGS:

RI-DWG-PROP-000009-001	KEY PLAN, LEGEND AND GENERAL NOTES
RI-DWG-PROP-000009-002	GRADING AND DRAINAGE PLAN
RI-DWG-PROP-000009-003	GRADING AND DRAINAGE PLAN
RI-DWG-PROP-000009-004	GRADING AND DRAINAGE PLAN
RI-DWG-PROP-000009-005	GRADING AND DRAINAGE PLAN
RI-DWG-PROP-000009-010	GRADING SECTIONS AND DETAILS
RI-DWG-PROP-000009-011	GRADING SECTIONS AND DETAILS

APPROVED FOR CONSTRUCTION

THE DISTRIBUTION AND USE OF THE NATIVE FORMAT CAD FILE OF THIS DRAWING IS UNCONTROLLED. THE USER SHALL VERIFY TRACEABILITY OF THIS DRAWING TO THE LATEST CONTROLLED VERSION.

DRAWING CREATED FOR BLACK & VEATCH PROJECT 190611, AMEREN MISSOURI PROJECT J02PM.

I HEREBY CERTIFY THAT THIS DOCUMENT WAS PREPARED BY ME OR UNDER MY DIRECT SUPERVISION AND THAT I AM A DULY REGISTERED PROFESSIONAL ENGINEER UNDER THE LAWS OF THE STATE OF MISSOURI

SIGNED NATHAN DOUGLAS KAISER
DATE 05/31/2017 REG NO. 2002016675

STATE OF MISSOURI NATHAN DOUGLAS KAISER PE-2002016675 PROFESSIONAL ENGINEER
31-May-2017

BLACK & VEATCH Building a world of difference®

NOTICE OF LIMITED RESPONSIBILITY
THE RESPONSIBILITY OF THE UNDERSIGNED ENGINEER IS LIMITED TO THE DESIGN WORK SHOWN ON PROJECT AND DOCUMENTS. ENGINEER'S SEAL, SIGNATURE OR INITIALS ON THESE DOCUMENTS DO NOT EXTEND RESPONSIBILITY BEYOND THE SCOPE OF THE ENGINEER'S WORK. ENGINEER IS NOT RESPONSIBLE FOR UNAUTHORIZED REVISIONS TO THESE DOCUMENTS. ANY OTHER DOCUMENTS ASSOCIATED WITH THE PROJECT WHICH DO NOT BEAR HIS/HER SEAL, SIGNATURE OR INITIALS.

CONSTRUCTION

MARK UP DRAWING NO.	REV.
---	---

SCALE	---
UNIT NO.	---
DWG. SIZE	
SUB CLASS	

GRADING AND DRAINAGE
MANHOLE AND CATCHBASIN DETAILS

DRAWING RECORD

REV.	DATE	PROJECT NO.	DRAFTING DRFTR	CHKD	SUPV	ENGR	DESCRIPTION
00A	06/17/16	---	RRH	JJD	ILE	JDA	ISSUED FOR CLIENT REVIEW
00B	07/22/16	---	RJW	JDA	ILE	---	ISSUED FOR BID
00C	03/13/17	---	NJO	JMS	ILE	JJD	ISSUED FOR CLIENT REVIEW
00D	05/01/17	---	SES	JMS	ILE	JJD	ISSUED FOR CONSTRUCTION

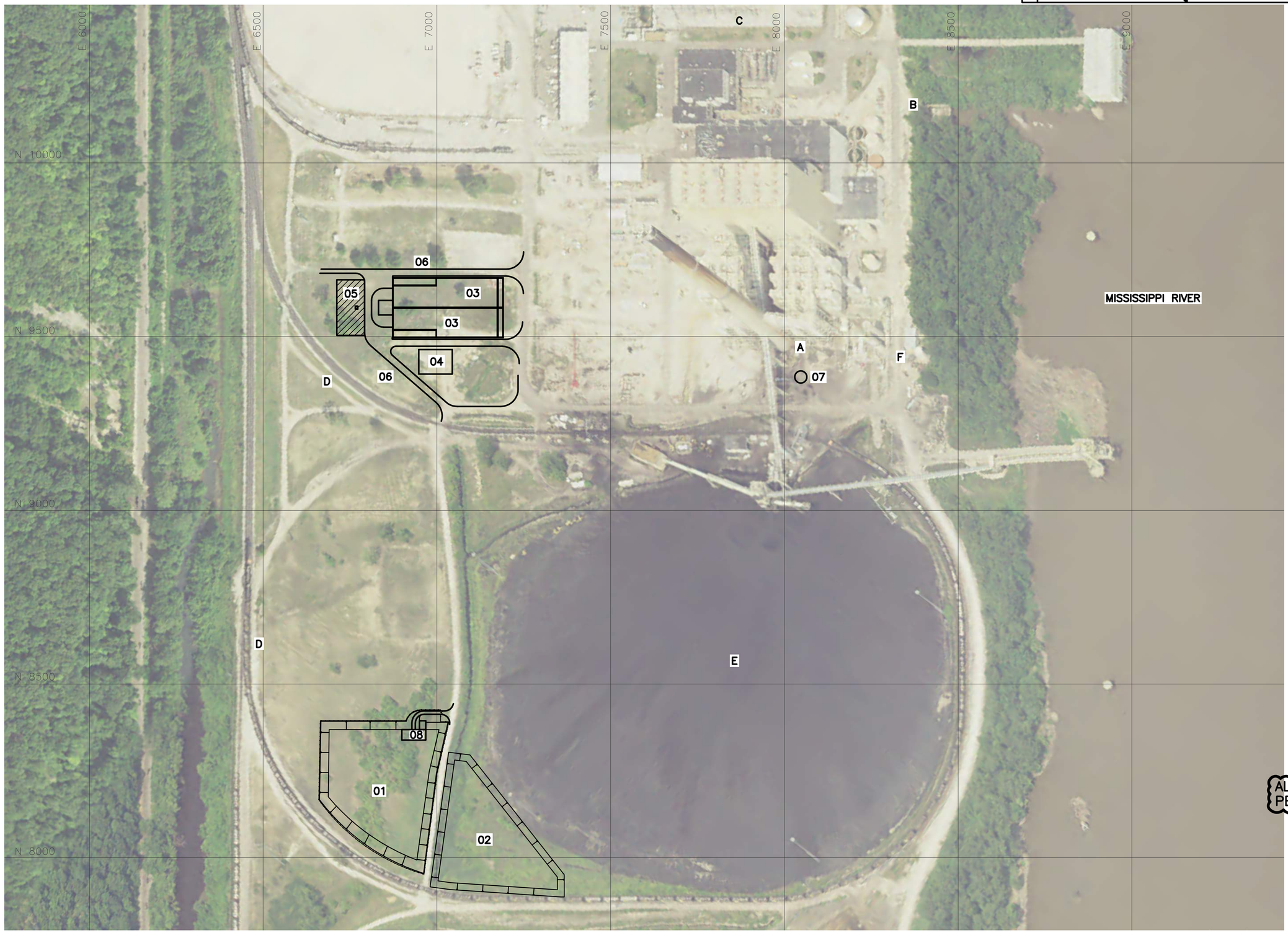
SITE: RUSH ISLAND ENERGY CENTER

Ameren MISSOURI

DRAWING NO.
RI-DWG-PROP-000009-012
REVISION NO. 00D

EXISTING FACILITIES LEGEND	
ID	FACILITY
A	UNITS 1 & 2 CHIMNEY
B	OUTFALL 001A (SEAL PIT)
C	SWITCHYARD
D	RAILROAD
E	COAL YARD
F	PROCESS DRAIN LIFT STATION

FACILITIES LEGEND					
ID	FACILITY	FOUNDATION	TIEDOWN LOCATION NORTH	TIEDOWN LOCATION EAST	REMARKS
01	DETENTION BASIN	N/A	SEE REMARKS	SEE REMARKS	SEE RI-DWG-PROP-000009-004
02	COAL YARD RUNOFF POND	N/A	SEE REMARKS	SEE REMARKS	SEE RI-DWG-PROP-000009-004
03	LVW SETTLING BASINS	RI-DWG-STRU-000014 SHT 001-003	9498.33	6873.84	SOUTHWEST INSIDE CORNER
04	LVW TREATMENT BUILDING	RI-DWG-STRU-000014 SHT 010	9462.80	6947.85	NORTHWEST BUILDING LINE
05	DEWATERING AREA SLAB	N/A	SEE REMARKS	SEE REMARKS	SEE RI-DWG-PROP-000009-002
06	20'-0" WIDE ACCESS ROAD	N/A	SEE REMARKS	SEE REMARKS	SEE RI-DWG-PROP-000009-002
07	DEMINERALIZER WASTE NEUTRALIZATION WATER TANK	RI-DWG-STRU-000014 SHT 020	SEE REMARKS	SEE REMARKS	SEE RI-DWG-PIPE-000012-005
08	DETENTION BASIN SUMP & LIFT STATION	RI-DWG-STRU-000014 SHT 030	SEE REMARKS	SEE REMARKS	SEE RI-DWG-STRU-000014-030



ALL BACKCIRCLE CHANGES PER ECN-N-S-0001

APPROVED FOR CONSTRUCTION

THE DISTRIBUTION AND USE OF THE NATIVE FORMAT CAD FILE OF THIS DRAWING IS UNCONTROLLED. THE USER SHALL VERIFY TRACEABILITY OF THIS DRAWING TO THE LATEST CONTROLLED VERSION.

37.1190°
PLANT
STATE PLANE

NOTES:

1. ELEVATIONS SHOWN ARE AT TOP OF GRADE, UNLESS NOTED OTHERWISE.
2. COORDINATES SHOWN ARE PLANT GRID.

REFERENCE DRAWINGS:

RI-8550-Y-91863 PLANT SITE PLAN
RI-DWG-BLDG-0000XX-001 LVW TREATMENT BLDG - EQUIPMENT ARRANGEMENT

100' 50' 0 100' 200'
1"=100'

DRAWING CREATED FOR BLACK & VEATCH PROJECT 190611, AMEREN MISSOURI PROJECT J02PM.

I HEREBY CERTIFY THAT THIS DOCUMENT WAS PREPARED BY ME OR UNDER MY DIRECT SUPERVISION AND THAT I AM A DULY REGISTERED PROFESSIONAL ENGINEER UNDER THE LAWS OF THE STATE OF MISSOURI.

SIGNED NATHAN DOUGLAS KAISER
DATE 05/23/2017 REG NO. 2002016675

STATE OF MISSOURI
NATHAN DOUGLAS KAISER
PE-2002016675
PROFESSIONAL ENGINEER
31-May-2017

NOTICE OF LIMITED RESPONSIBILITY

THE RESPONSIBILITY OF THE UNDERSIGNED ENGINEER IS LIMITED TO THE DESIGN WORK SHOWN ON PROJECT AND DOCUMENTS BEARING HIS/HER SEAL, SIGNATURE OR INITIALS. HE/SHE DOES NOT HAVE AUTHORITY OVER THE PROJECT AS A WHOLE. THE UNDERSIGNED DISCLAIMS ANY RESPONSIBILITY FOR WORK DONE UNDER SUBSEQUENT REVISIONS AND ANY OTHER DOCUMENTS ASSOCIATED WITH THE PROJECT WHICH DO NOT BEAR HIS/HER SEAL, SIGNATURE OR INITIALS.

SCALE	1" = 100'
UNIT NO.	
DWG. SIZE	34X44
SUB CLASS	

DRAWING RECORD

REV.	DATE	PROJECT NO.	DRAFTING DRFTR	DRAFTING CHK'D	DRAFTING SUPV	DRAFTING ENGR	DESCRIPTION
00F	05/31/17	—	JSH	NDK	ILE	JSH	ISSUED FOR CONSTRUCTION
00B	05/16/16	—	JSH	—	ILE	JSH	ISSUED FOR CLIENT REVIEW
00C	07/21/16	—	JSH	—	ILE	JSH	ISSUED FOR BID
00D	03/13/17	—	NJO	JMS	ILE	JJD	ISSUED FOR CLIENT REVIEW
00E	05/23/17	—	JWS	NDK	ILE	JJD	ISSUED FOR PERMITTING

CONSTRUCTION

MARK UP DRAWING NO.	REV.

PROPERTY-SITE
SITE ARRANGMENT

SITE: RUSH ISLAND ENERGY CENTER

Ameren MISSOURI

DRAWING NO.
RI-DWG-PROP-000010-001

REVISION NO. 00F

ATTACHMENT 6

Construction Specification RI-SPEC-001059

By Ameren Missouri and Haley & Aldrich, Inc.
29 January 2018

(Specifications submitted previously as part of the initial Ameren construction permit request to MDNR dated 26 February 2018)

APPENDIX E

HYDROLOGY AND HYDRAULICS

AMEREN MISSOURI RUSH ISLAND ENERGY CENTER
EVALUATION OF CCR UNITS
40 CFR PART 257
JEFFERSON COUNTY, MISSOURI

APPENDIX E: INFLOW DESIGN FLOOD CONTROL SYSTEM PLAN §257.82

TABLE OF CONTENTS

Section Page

1.0 INTRODUCTION....1
1.1 Purpose....1
2.0 REVIEW OF INITIAL INFLOW DESIGN FLOOD CONTROL SYSTEM PLAN....2
3.0 CONCLUSIONS....2
4.0 REFERENCES....3

LIST OF FIGURES

Figure 1 .... Site Map

AMEREN MISSOURI RUSH ISLAND ENERGY CENTER
EVALUATION OF CCR UNITS
ST. LOUIS COUNTY, MISSOURI

APPENDIX E: INFLOW DESIGN FLOOD CONTROL SYSTEM PLAN §257.82

1.0 INTRODUCTION

The Rush Island Energy Center (REC) is in southern Jefferson County, Missouri, in the Mississippi River floodplain. The plant is south of the City of Festus and north of the City of Bloomsdale. The REC has one active surface impoundment. The surface impoundment is located just west of the Mississippi River and north of Isle du Bois Creek. The Rush Island Dam is in Sections 3 and 4, Township 39 North, Range 7 East of the 5th Principal Meridian. An aerial showing the surface impoundment is attached as Figure 1.

The Rush Island Dam is a single stage industrial dam. The perimeter of the dam has a length of approximately 9,750-lineal feet and a maximum height of 46 feet. The upstream and downstream slopes of the dam are sloped at 3 horizontal (H) to 1 vertical (V). The Rush Island Dam is permitted by the Missouri Department of Natural Resources (MDNR) under registration permit ID No. MO-40179. The RCPA no longer receives CCRs, has been dewatered and is currently being closed. The impoundment is no longer used for CCR disposal and water treatment.

1.1 Purpose

40 CFR §257.82 requires the owner or operator of an existing CCR surface impoundment to prepare initial and periodic inflow design flood control system plans for the CCR unit. The plan should document how the inflow design flood control system has been designed, constructed, operated and maintained to meet the requirements of §257.82. The section specifies that the inflow design flood control system must adequately manage flow into the CCR unit during and following the peak discharge of the inflow design flood and must manage flow from the CCR unit to collect and control the peak discharge resulting from the inflow design flood. Because the existing CCR surface impoundment at the Rush Island Energy Center is classified as Low Hazard Potential dams, 40 CFR §257.82 requires that the 100-Year flood is used as the design flood in this analysis.

2.0 REVIEW OF INITIAL INFLOW DESIGN FLOOD CONTROL SYSTEM PLAN

The initial inflow design flood control system plan was completed for the active CCR surface impoundment RCPA at the Rush Island Energy Center in 2016. Subsequently, RCPA has been dewatered and is currently being closed. Stormwater falling within the footprint of these impoundments is actively managed by the closure contractor to prevent overtopping of the perimeter embankment. During closure construction the principal spillway was grouted closed, and the emergency spillway was removed. Rainfall falling within the footprint of the RCPA is routed over closure turf to 9 different stormwater outlets located around the perimeter embankment.

3.0 CONCLUSIONS

RCPA has been dewatered and is currently being closed. Closure of RCPA was designed so that water is not permanently impounded within the perimeter embankment. The interior of the RCPA has been graded and capped to route stormwater to 9 locations around the perimeter embankment. Stormwater is discharged through gravity outlet pipes with stormwater management features to prevent erosion. An inflow design flood control system plan is no longer applicable or necessary for the RCPA.

4.0 REFERENCES

Environmental Protection Agency. (2015). “Hazardous and Solid Waste Management System; Disposal of Coal Combustion Residuals From Electric Utilities; Final Rule.” 40 CFR Parts 257 and 261., Vol. 80, No. 74.



Legend

Embankment

Spillway

N

0 250 500 Feet

AMEREN MISSOURI
RUSH ISLAND ENERGY CENTER
ACTIVE CCR SURFACE IMPOUNDMENTS
FIGURE 1

Ameren MISSOURI

REITZ & JENS, INC. CONSULTING ENGINEERS