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19 December 2012

Mr. Scott Martin
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Subject: DRAFT Remedial Alternative Screening - Technical Memorandum
Focused Remedial Investigation/Feasibility Study Work Plan: OU1 Outfall Ditch
Terry Creek Dredge Spoil Site - Brunswick, GA

Dear Mr. Martin:

On behalf of Hercules Incorporated (Hercules) a wholly owned subsidiary of Ashland, Inc., Geosyntec Consultants is pleased to submit five copies of the draft Remedial Alternative Screening - Technical Memorandum for the Terry Creek Dredge Spoil Site. The Tech Memo presents the results of the field data collected during the implementation of the remedial investigation for OU1. The data collected has served to further refine the understanding of chemical and physical aspects of the Outfall Ditch. Hercules believes that these data are adequate and of sufficient quality to move forward with the Feasibility Study needed to determine an appropriate, cost-effective remedial action for OU1 that will control the source of contamination and provide long-term risk reduction. After EPA's team has had an opportunity to review, we welcome written comments and/or the opportunity to meet to discuss the proposed remedial options prior to a detailed analysis the completion of the FS. Otherwise, if EPA or GaEPD have no comments we will continue to move forward with the focused RI/FS for the Outfall Ditch.

If you have any questions or comments please contact Mr. Tim Hassett at 302-995-3456 or the undersigned at 678-202-9500.

Sincerely,

Sender
Title

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Attachments: *Remedial Alternative Screening - Technical Memorandum for Terry Creek OU1 RI/FS*

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REMEDIAL ALTERNATIVE SCREENING TECHNICAL MEMORANDUM

TERRY CREEK OU1 RI/FS

Prepared by

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1255 Roberts Boulevard, Suite 200
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Project Number GK4443A

December 2012

DRAFT

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TABLE OF CONTENTS

1. BACKGROUND 1
   1.1 Overview and Purpose 1
   1.2 General Response Actions and Remedial Alternatives 2
   1.3 Organization of Report 3

2. REMEDIAL INVESTIGATION RESULTS SUMMARY 4
   2.1 Sediment Sampling 4
      2.1.1 Pre-Weir Results 5
      2.1.2 Post-Weir Results 5
      2.1.3 Summary of Toxaphene Concentrations in Sediment 6
   2.2 Bathymetry Data 6
   2.3 Surface Water Sampling 7
   2.4 Pore Water Sampling 8
   2.5 Surface Water / Groundwater Interactions 8
   2.6 Hydrologic and Hydraulic Investigation 9

3. GEOTECHNICAL INVESTIGATION RESULTS 13
   3.1 Summary of Geotechnical Investigation 13
   3.2 Summary of Soil Analytical Results 14

4. PRELIMINARY SCREENING OF REMEDIAL ALTERNATIVES 15
   4.1 Overview 15
   4.2 Remedial Action Objectives 15
   4.3 Description of Remedial Alternatives 15
      4.3.1 Alternative 1: No Further Action 15
      4.3.2 Alternative 2: Monitored Natural Recovery 15
      4.3.3 Alternative 3: Sediment Removal 16
      4.3.4 Alternative 4: Containment 16
   4.4 Preliminary Screening Evaluation 17
      4.4.1 Alternative 1: No Further Action 18
      4.4.2 Alternative 2: Monitored Natural Recovery 19

TABLE OF CONTENTS (Continued)

4.4.3 Alternative 3: Sediment Removal 20
4.4.4 Alternative 4A: Sheet Pile Channel 22
4.4.5 Alternative 4B: Discharge Conveyance Pipe 24
4.4.6 Alternative 4C: Sub-Aqueous Cap 25
4.4.7 Alternative 4D: Backfill OU1 and Reroute the Outfall 27

5. CONCLUSIONS 30

6. CITED REFERENCES 32

LIST OF TABLES

Table 1 Sample Analyte List for Terry Creek OU1 RI/FS
Table 2 Toxaphene Concentrations in Outfall Ditch Sediment Samples
Table 3 Summary of Detected Compounds in Sediment
Table 4 Summary of Detected Compounds in Surface Water
Table 5 Summary of Detected Compounds in Pore Water
Table 6 Summary of Detected Compounds in Sub-surface Soil
Table 7 Summary of Remedial Alternative Screening

LIST OF FIGURES

Figure 1 Location of Terry Creek Site
Figure 2 Terry Creek Site Operable Units
Figure 3 Post Removal Toxaphene Concentrations in Surface Sediment, Terry and Dupree Creeks
Figure 4 Toxaphene in Shallow Sediment Samples (0 to 0.5-ft)
Figure 5 Toxaphene in Sub-surface Sediment Samples (0.5 to 2.0-ft)
Figure 6 Toxaphene in Deep Sediment Samples (2.0 to 10-ft)
Figure 7 Toxaphene Concentrations in Core Samples
Figure 8 Distribution of Toxaphene Concentrations
Figure 9 Toxaphene in Surface Sediment 1999 and 2012

TABLE OF CONTENTS (Continued)

Figure 10 Bathymetric Survey of the Outfall Ditch, April 2012
Figure 11 Sediment Elevation Change: 1999 – 2012
Figure 12 Surface water and pore water sample locations
Figure 13 Toxaphene in Subsurface Soil
Figure 14 Volume of toxaphene contaminated sediment
Figure 15 Remedial Alternative Conceptual Design: Sheet Pile Channel
Figure 16 Remedial Alternative Conceptual Design: Discharge Conveyance Pipe
Figure 17 Remedial Alternative Conceptual Design: Sub-Aqueous Pipe
Figure 18 Remedial Alternative Conceptual Design: Fabriform Ditch
Figure 19 Remedial Alternative Conceptual Design: Backfill and Re-Route

LIST OF APPENDICES

Appendix A Analytical Results for Sediment Sampling
Appendix B Analytical Results for Surface Water Sampling
Appendix C Analytical Results for Sediment Pore Water Sampling
Appendix D Hydrologic Investigation
Appendix E Geotechnical Pre-Weir Investigation: Subsurface Stratigraphy and Material Properties

1. BACKGROUND

1.1 Overview and Purpose

Geosyntec Consultants (Geosyntec) is conducting a Focused Remedial Investigation and Feasibility Study (RI/FS) on behalf of Hercules Incorporated (Hercules) for the Outfall Ditch/Operable Unit 1 (OU1) at the Terry Creek Site (Site) located in Brunswick, Georgia (Figure 1). It is noted that the terms "OU1" and "Outfall Ditch" are used interchangeably throughout this document.

The Outfall Ditch is a Hercules-constructed conveyance system that was used until 1972 to discharge untreated wastewater from the Plant that contained toxaphene. After 1972, wastewater was treated prior to discharge and toxaphene concentrations in the discharge decreased significantly. The weir, located approximately in the middle of the Outfall Ditch, was constructed in approximately 1976. Currently, non-contact cooling water, cooling water blowdown/ condensate, and storm water runoff from the former Hercules Plant (now Pinova Plant) and surrounding neighborhoods are discharged under a National Pollutant Discharge Elimination System (NPDES) permit through the Outfall Ditch via the "N" Street ditch. The NPDES monitoring point for the "N" Street ditch outfall is on the west side of Highway 17, just upstream from the Outfall Ditch.

The Focused RI/FS is being conducted in accordance with the *Focused RI/FS Work Plan Operable Unit 1 (OU1) Outfall Ditch* (Work Plan) and pursuant to the 30 September 1999 Administrative Order on Consent (AOC) between Hercules and the United States Environmental Protection Agency (USEPA). The USEPA approved the Work Plan in a letter dated 5 January 2012. Due to the relatively small size of OU1 (Figure 2), the existing residual toxaphene concentrations present in the OU1 sediments and developing analytical methods and toxicity reference values for weathered toxaphene, EPA and Hercules agreed to perform a Focused RI/FS that may allow for the selection of a final remedy at OU1 that is not reliant on the toxaphene analytical methodology or toxicity reference value development. As stated in the Work Plan, selected remedial action objectives and cleanup goals defined for OU1 will be a narrative performance-based goal (i.e., protectiveness achieved via pathway elimination) rather than numerical risk-based concentrations. The rationale for prioritizing remedial actions at OU1 was presented in the Site Management Plan (Geosyntec, 2009) and reiterated in the Work Plan. Following the 1999-2000 removal action at the Site, the highest relative residual concentrations of toxaphene were found

in the Outfall Ditch. Therefore, prioritizing and implementing remedial actions at the Outfall Ditch will address a significant source of toxaphene to the Terry and Dupree Creek system.

The purpose of this Technical Memorandum is to summarize the RI data; evaluate and screen the remedial alternatives based upon the RI data; and to refine, as needed, the remedial alternatives prior to performing a detailed and comparative analysis in the Focused RI/FS Report.

1.2 General Response Actions and Remedial Alternatives

General response actions and remedial alternatives for the Outfall Ditch were presented in the Work Plan. Consistent with USEPA's *Contaminated Sediment Remediation Guidance for Hazardous Waste Sites* (USEPA 2005), sediment remedies fall into three General Response Actions: sediment removal, sediment containment (i.e., capping) and monitored natural recovery (MNR). Furthermore, to be consistent with the requirements of the National Contingency Plan (NCP), a No Further Action (NFA) remedy was also included. The Remedial Alternatives presented in the Focused RI/FS Work Plan are listed below and are further described in the context of the RI data in Section 4.

- No Further Action
- Monitored Natural Recovery
- Sediment Removal
- Containment
  - Sheet Pile Channel
  - Discharge Conveyance Pipe
  - Sub-aqueous Cap
  - Re-route the Channel and backfill the Outfall Ditch

1.3 Organization of Report

The remainder of this Technical Memorandum is organized as follows:

- RI data are summarized in Section 2;
- Geotechnical investigation results are summarized in Section 3;
- Remedial alternatives/technologies are evaluated and screened in Section 4;
- Conclusions are presented in Section 5; and
- Cited references are listed in Section 6.

2. REMEDIAL INVESTIGATION RESULTS SUMMARY

Results of the remedial investigations are summarized below. The interpretation of data for this Technical Memorandum was conducted to develop a more advanced understanding of current conditions in the Outfall Ditch with which to further screen the remedial alternatives presented in the Work Plan. A more detailed analysis of the results including a screening level ecological risk assessment (SLERA) will be provided in the Focused RI/FS Report.

2.1 Sediment Sampling

In accordance with the Focused RI/FS Work Plan, sediment cores were collected from 17 locations along the Outfall Ditch. Three cores were collected along each of five transects; two transects were located in the Pre-Weir section and three transects were located in the Post-Weir section of the Outfall Ditch. Furthermore, two cores were collected from near each outlet of the triple box culvert at Highway 17 (see Figure 3). Samples were collected from 27 February through 1 March 2012. Along each transect, two shallow cores (0 to 2.0-ft) and one deep core (up to 10-ft) were collected; only shallow cores were collected from the culvert. The shallow cores were sub-divided into two intervals: the surface interval (0 to 0.5-ft) and the sub-surface interval (0.5 to 2.0 ft); the deeper cores were subdivided the same, but then at 2-ft intervals from two feet to the bottom of the core. Each interval was analyzed for toxaphene using both Method 1 for "technical toxaphene" and Method 2 for the total area under the curve (TAUC)[1]. The same depth intervals (0 to 0.5-ft and 0.5 to 2.0-ft) across each transect were composited together and analyzed for Target Analyte List/Target Compound List (TAL/TCL) constituents (see Table 1).

The sediment toxaphene results are summarized in the following subsections, while the entire Focused RI sediment dataset is included in Appendix A. The surface concentrations of toxaphene in the Outfall Ditch are shown on Figures 4 (0.0 to 0.5 ft) and 5 (0.5 to 2 ft). Figure 6 shows the toxaphene concentrations in sub-surface sediment. Toxaphene concentrations for the sediment samples are presented in Table 2. Table 3 summarizes the detections for the additional compounds analyzed. Other

[1] A limited number of samples (10) were also analyzed for toxaphene congeners using Method 8276. However, the data are intended for informational purposes only and will not be used in the RI/FS process. These data are to be provided in a separate document.

compounds detected in sediment, at relatively low concentrations, included pesticides, metals, polyaromatic hydrocarbons (PAHs), and volatile organic compounds (VOCs). Dioxins were also measured and detected in two sediment samples. These compounds will be addressed in the Focused RI/FS report as part of the SLERA.

2.1.1 Pre-Weir Results

Concentrations of toxaphene in Pre-Weir sediments ranged from non-detect to 84 milligram per kilogram (mg/kg).[2] The highest detected toxaphene concentration was along the north bank of the Outfall Ditch in Transect 1 from the 2- to 4-ft depth interval (SD-OD1N-03). The deepest sample interval (6- to 8-ft) at this core location (sample SD-OD1N-05) was non-detect for toxaphene. The second highest toxaphene concentration of 75 mg/kg was found in the surface sample (0- to 0.5-ft) at the north end of the culvert at Highway 17 (SD-ODCN-01). The remainder of the locations had toxaphene concentrations ranging from 1.0 mg/kg to 22 mg/kg with an average concentration of 10 mg/kg.

2.1.2 Post-Weir Results

Concentrations of toxaphene in Post-Weir sediments ranged from non-detect to 210 mg/kg. The highest concentrations were observed in the deeper sample intervals from the southernmost sample locations (SD-OD5S-04 and SD-OD5S-05) in the wide mud-flat along Transect 5. Toxaphene concentrations at this core location were 29 mg/kg in the 2- to 4-ft interval, 210 mg/kg in the 4- to 6-ft interval, and 120 mg/kg in the 6- to 8-ft interval. The two surface intervals had significantly lower concentrations at 0.70 mg/kg and 0.55 mg/kg in the 0- to 0.5-ft and the 0.5- to 2.0-ft intervals, respectively. The shallow surface interval (0- to 0.5-ft) along both Transects 4 and 5 had concentrations at or below 1 mg/kg. Surface intervals along Transect 3, closer to the weir, were higher with concentrations ranging from 1.4 mg/kg to 25 mg/kg. The deeper intervals of the center core along Transect 3 were near or below the detection limit for toxaphene.

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[2] All toxaphene concentrations are reported here as Method 2 (TAUC) values. Toxaphene by Method 1, while generally somewhat lower in concentration, correlated very well with Method 2 results (R-squared = 0.87; $p<0.001$). Both Method 1 and Method 2 data are reported in the data tables.

2.1.3 Summary of Toxaphene Concentrations in Sediment

Figure 7 depicts a sketch detail of the Outfall Ditch along with the location and concentration ranges of toxaphene in the sediment cores. Each color band at the location of each core sample represents the concentration ranges at that location and depth. Lowest concentrations (<1 mg/kg) are shown in blue and the highest concentrations are shown in red (>50 mg/kg). The figure indicates that much of the toxaphene contamination is found at depth with the exception of the culvert locations. Further analysis of the toxaphene concentration distributions supports this finding as shown on Figure 8. The higher toxaphene concentrations are within the depth intervals between 2- and 8-ft. Figure 8 also shows the distribution of concentrations from west to east (i.e., from the culvert to Transect 5), depicting higher concentrations at the culvert and at the mouth with Dupree Creek, with generally lower concentrations in the middle.

Surface sediment concentrations of toxaphene measured in 2012 are substantially lower compared to the levels measured during the post-excavation investigation of the 1999-2000 removal action. Figure 9 shows the toxaphene concentrations in surface sediments as measured in 2000 along with the data collected during the current investigation. It can be readily observed that nearly all samples in 2000 exceeded 50 mg/kg. During the March 2012 sampling, only a single surficial sample exceeded this concentration.

2.2 Bathymetry Data

A bathymetric map of the Outfall Ditch was generated by ARC Surveying and Mapping (ARC Surveying) of Jacksonville, Florida, using differential GPS for positioning and a Knudsen 320M dual-frequency fathometer operating at 24 KHz and 200KHz. The 2012 bathymetry of the Outfall Ditch is presented on Figure 10. The elevation of the Post-Weir sediment is approximately 1 to 5 feet lower than the Pre-Weir sediment. The weir is likely facilitating sedimentation of suspended solids in the Pre-Weir area.

In 1999, Geosyntec, on behalf of Hercules, performed a sediment excavation in the Outfall Ditch. The removal action excavated approximately 7,500 cubic yards of sediment in the Pre-Weir area and approximately 9,400 cubic yards in the Post-Weir area. A post-excavation bathymetric survey was performed by ARC Surveying following the removal action. The 2012 bathymetric survey was compared to the 1999 post-excavation survey and the difference in the sediment elevation was used to

calculate the thickness of sediment accumulation over the last, approximately, 13 years. Figure 11 shows the difference between the sediment elevation in 1999 and 2012. The accumulated volume of sediment since the removal action in the Pre-Weir is approximately 7,500 cubic yards and in the post weir approximately 10,500 cubic yards. These data indicate that sediment has accumulated within the Outfall Ditch at a significant rate since the 1999/2000 removal action.

Between November 2003 and February 2004, the Georgia DOT replaced the culvert under Highway 17 leading from the N Street Ditch at the Plant to the Outfall Ditch in the Marsh Wood Storage Area. The new culvert, the Triple Box Culvert, was constructed approximately 40-ft to the south and the Outfall Ditch was re-configured to meet the entrance of the culvert. Construction plans indicate that the existing culvert was to remain in place and filled with lightweight flowable fill. Further, it is important to note that based on field observations, the Triple Box Culvert is half full of sediment and will ultimately require some maintenance dredging/cleaning to maintain flows through the culvert.

2.3 Surface Water Sampling

Surface water samples were collected from just above the sediment-water interface at two locations: the mouth of the Outfall Ditch with Dupree Creek and east of the Highway 17 culvert. Figure 12 shows the locations of the surface water samples. Samples were collected on 4 April and 5 April 2012 during a spring tide near the mid-point of both flood and ebb tides to correspond with times of higher surface water velocities (i.e., higher tidal amplitude, greater surface water velocities). Samples were collected and analyzed as both the total and dissolved fractions (i.e., unfiltered and filtered). Additional samples were collected on 21 August 2012 after a rainfall event. Samples were collected at both the mouth and culvert on the ebb tide. An additional sample was collected at the culvert on the flood tide.

Toxaphene was not detected in any of the surface water samples. A summary of the detected compounds in surface water samples is presented in Table 4. Detected compounds included various metals, semi-volatile organic compounds (SVOCs), and VOCs. These compounds were detected at low concentrations and will be further addressed in the Focused RI/FS report as part of the SLERA. The complete dataset is included in Appendix B.

2.4 Pore Water Sampling

Pore water samples were collected in the Pre-Weir and Post-Weir of the Outfall Ditch (see Figure 12). Pore water was collected using the MHE Products PushPoint sampler. An 8-inch diameter stainless steel platform was carefully fitted to the guard rod and secured before insertion into the sediments. The platform ensured proper sampling depth and minimized the potential for draw-down of surface water. The PushPoint was fitted with a nylon screen filter to avoid being clogged by fine particles and then inserted into the sediment to a depth of 12 inches. The guard rod was carefully removed to allow water to flow through the PushPoint and attached to a length of Tygon tubing and a peristaltic pump. The pump was carefully monitored and operated at a very low speed to slowly extract pore water from the surrounding sediments. A photograph of the PushPoint in use at both high tide and low tide is shown on Figure 12. Several liters of water were collected over a period of three to six hours. Samples were collected and analyzed as both the total and dissolved fractions (i.e., unfiltered and filtered).

Toxaphene was detected in pore water samples collected from the Pre-Weir at a concentration of 17 µg/L in the unfiltered sample and 8.8 µg/L in the filtered sample. Toxaphene was not detected in the Post-Weir samples. A summary of the detected concentrations of various compounds analyzed in pore water samples is presented in Table 5. Metals and a few SVOCs and VOCs were detected at low levels. These compounds will be addressed in the Focused RI/FS report as part of the SLERA. The complete dataset is included in Appendix C.

2.5 Surface Water / Groundwater Interactions

The Focused RI included an assessment of the surface water / groundwater interactions in the Outfall Ditch. The seepage of water through the sediment bed is the result of a surface water / groundwater gradient. The gradient results from variations between the groundwater elevation and surface water elevation, which is influenced by storm water runoff, process flows, and tidal conditions. Pressure transducers were used to measure the surface water elevation in the Pre-Weir and Post-Weir area of the Outfall Ditch and groundwater elevations in nested piezometers installed adjacent to the Outfall Ditch. The locations of the measurement points are presented in Appendix D.

Darcy's law for fluid flow though porous media was employed to calculate the seepage rates. Details of the approach are provided within Appendix D.

The principal assumption in the application of Darcy's law for this analysis is that the aquifer surrounding the Outfall Ditch area is homogeneous and can be characterized as medium sand, as supported by the result of the geotechnical investigation. A hydraulic conductivity value of medium sands (1×10^{-4} cm/sec or 0.28 ft/day (Fetter 2001)) was used to estimate groundwater discharge. This analysis resulted in a calculated time-series of groundwater seepage into the Outfall Ditch and groundwater recharge rates from the Outfall Ditch throughout the period of the investigation. The direction of groundwater flow depends on the head difference between groundwater in piezometers and surface water in the Outfall Ditch. A summary of the seepage rates from the time-series is provided below:

Location	Groundwater Seepage Rate (Average ± SD in ft^3/sec)
Pre-Weir	9.9E-05 ± 2.7E-05
Post-Weir	1.9E-04 ± 9.7E-05

The results of the surface water / groundwater interactions indicate that the seepage rate for the Pre-Weir is 64 gallons per day (gpd) and the seepage rate for the Post-Weir is 122 gpd.

2.6 Hydrologic and Hydraulic Investigation

The hydrologic and hydraulic investigation was performed to develop a conceptual model of the major features and components of the non-tidal flows to the Outfall Ditch through the Triple Box Culvert, which appears to be the major source of non-tidal flows to the Outfall Ditch (see Figure 3). Non-tidal flow conditions are of primary concern because each remedial alternative includes a weir or valve mechanism for mitigating the contribution of tidal flows back into the proposed conveyance structure (i.e. the remedial alternative). The conceptual model was developed through an investigation, analysis, and calculation of the hydrodynamic properties of discharges from the Triple Box Culvert for various extreme precipitation events. In addition, the investigation included the observation of tidal flows within the Outfall Ditch to develop an insight

into the particle separation and sediment transport potential the Outfall Ditch. The conceptual model and study of tidal flows will assist in the assessment of design and construction feasibility for hydraulic technologies utilized in the remedial alternatives. The details of the investigation summary discussed in this section are included in Appendix D.

A desktop review of available documents and field reconnaissance was performed to develop a conceptual understanding of the sources of flows to the Outfall Ditch (GDOT, 2001; Pinova, 2010; Stantec, 2009). This investigation showed that the flows to the Outfall Ditch were mainly from the Triple Box Culvert, which conveys flows from the Pinova Plant drainage system under Highway 17. Additional inflows to the Triple Box Culvert were from drainage pipes that are used to manage storm water runoff for various segments of Highway 17 (GDOT, 2001). The Pinova Plant drainage system was evaluated to characterize the flow contributions from the facility and the surrounding neighborhoods.

Total flow contributions from the facility were estimated using information provided by Pinova to EPA in a recent NPDES Permit Application (Pinova, 2010). The document demonstrates that the Pinova Plant drainage system collects storm water runoff from the facility drainage areas and process flows from on-going operations. In addition, the Pinova Plant drainage system receives storm water runoff from upstream surrounding neighborhoods, which were characterized using the basis of a previous study performed by Stantec for the City of Brunswick (Stantec, 2009) and assumptions of the physical limitations of the conveyance features for these storm water runoff flows.

This investigation produced a basis for a conceptual model for total inflows to the Triple Box Culvert. The development of this conceptual model was back-checked with the design of the Triple Box Culvert to confirm that the potential of total inflows was representative of the Triple Box Culvert discharge capacity; the simulated discharge flows for the 100-year, 24-hour storm event were comparable with the estimated design capacity of the Triple Box Culvert (see Appendix D for details). The simulation results of the conceptual model for various extreme precipitation events are summarized below. These results can be used to evaluate the feasibility for hydraulic technologies (e.g., pipe sizing, energy dissipation features, tidal gates, etc.) that are incorporated in the remedial alternatives.

24-hour Storm Event	Triple Box Culvert Discharge Rate (cfs)	Triple Box Culvert Discharge Velocity (ft/s)	Triple Box Culvert Peak Shear Stress (lb/ft^2)
2-Year	683	13.2	0.62
25-Year	1011	14.5	0.72
50-Year	1161	14.9	0.75
100-Year	1286	15.3	0.78

These simulation results indicate that the discharge velocity of flows from the Triple Box Culvert may approach or exceed 15 feet per second (fps) for extreme precipitation events. This high discharge velocity may result in significant deterioration of downstream conveyance structures that are constructed without erosion resistant materials. As a result, remedial alternatives should include energy dissipation features and materials to mitigate the potential for failure resulting from a high discharge velocity. Furthermore, this high discharge velocity provides significant transport potential for suspended solids within flows of the Triple Box Culvert. However, the shear stresses calculated within the Triple Box Culvert and, therefore, the area immediately downstream of the outlet, are relatively low. Thus, discharge flows are not expected to result in particle separation in the outlet area. The shear stresses were compared with the allowable shear stress (3 lb/ft^2) for un-vegetated non-degradable reinforced erosion control products (RECPs) [NRCS, 2007]. Un-vegetated non-degradable RECPs were used as a comparison to demonstrate threshold that would be considered beyond the Focused RI/FS.

Furthermore, it is important to note that the simulated peak discharge flow rates from the Triple Box Culvert were significant and should be considered in the development of a construction stormwater management plan for the applicable remedial alternatives. These discharge flows may greatly affect construction sequencing and procedures for implementing remedial alternatives.

The measurement and analyses of hydrodynamic properties of tidal flows within the Outfall Ditch were performed through measurements of surface water and groundwater elevations and the calculation of shear stress at the mouth of the discharge into Dupree Creek. The surface water elevations within the Outfall Ditch were calculated to fluctuate between -4 and 6-ft mean sea level (ft-MSL). The groundwater elevations in

the surrounding areas were calculated to fluctuate between 1- and 4-ft MSL. Very low tidal flow velocity (<0.5 fps) measurements were recorded at the mouth during each tide cycle; therefore, the observed sediment transport capacity was low. However, the calculated shear stresses (3.4 lb/ft^2) are significant (compared to allowable shear stresses of non-degradable RECPs) and could initiate soil/sediment movement. The high shear stresses were the result of the high surface water depths calculated near the mouth of the Outfall Ditch.

3. GEOTECHNICAL INVESTIGATION RESULTS

The results of the geotechnical investigation are summarized below. The interpretation of geotechnical data for this Technical Memorandum was conducted to develop a more advanced understanding of current conditions in the Outfall Ditch with which to further screen the remedial alternatives presented in the Work Plan. Details of the geotechnical investigation are presented in Appendix E.

3.1 Summary of Geotechnical Investigation

The purpose of the geotechnical investigation was to provide a baseline understanding from focused sampling and analyses of existing conditions at the site to assess the feasibility of various remedial alternatives. . The scope of work consisted of drilling eleven Standard Penetration Test (SPT) borings and associated laboratory testing. Nine borings were advanced to a total depth of 16-ft below ground surface (bgs) and two borings (i.e., B-10 and B-11) were advanced to a total depth of 36-ft bgs (Figure 13).

The subsurface conditions on the southern side of the Outfall Ditch consist of a 4- to 8-ft thick layer of poorly graded sand (SP) underlain by a 4- to 6-ft thick layer of clayey sand (SC). The SC layer is generally underlain by SP to the depths of borings. In locations within 200-ft of Dupree Creek, a high plasticity clay (CH) layer was encountered below the SC layer. This CH layer was about 7-ft thick at the location of borings B-2 and B-1, and extends to a thickness of about 14-ft at B-11, which is located near the intersection of the Outfall Ditch and Dupree Creek. A dense SP layer underlies the CH to the depth of boring at B-11.

The subsurface conditions on the northern side of the Outfall Ditch consist of SP to the depths of borings (i.e., 16-ft) with 1- to 2-ft thick interlayers of SC and CH to a limited extent. In locations within 200-ft of Dupree Creek, a high plasticity clay (CH) layer was encountered within the SP layer. This CH layer was about 7-ft thick at the location of boring B-9, and extends to a thickness of about 14-ft at B-10, which is located near the intersection of the Outfall Ditch and Dupree Creek. Another CH layer with about 4-ft of thickness is located deeper, and is underlain by a dense SP layer to the depth of boring at B-10. Subsurface profiles are shown in Attachment C of Appendix E.

The SPT blow counts (N values) of the shallower SP layers ranged from 0 to 16 with an average value of 6. The N values of the deeper SP layer located in the deep borings (B-

10 and B-11) ranged from 0 to 50 with an average value of 12. The N values of the SC layer located east of the Outfall Ditch ranged from 0 to 14 with an average value of 5. The N values of the CH located within 200-ft of Dupree Creek ranged 0 to 7 with an average value of 2. These N values indicate that (i) the shallower SP layer is loose; (ii) the deeper SP layer is medium dense; (iii) the SC layer is loose; and (iv) the CH layer is very soft to soft. The groundwater table was observed at approximately 4- to 6-ft bgs.

Within the Outfall Ditch, the Pre-Weir sediments were characterized as dark gray, non-plastic, clayey silty sand with a Unified Soil Classification System (USCS) classification of SM. The Post-Weir sediments were characterized as dark gray, highly plastic, fat clay with a USCS classification of CH. Coarser particles entering the Outfall Ditch from the culvert will settle out in the Pre-Weir as velocities decrease resulting in coarser particles being deposited in the Pre-Weir and leaving only finer particles that overflow the weir to be deposited in the Post-Weir. The total unit weights of Pre-Weir sediments and Post-Weir sediments were estimated to be 100 pounds per cubic foot (pcf) and 85 pcf, respectively. In general, these sediments are very soft in their in-situ condition. Compaction test results showed that the maximum dry unit weight and optimum moisture content of Pre-Weir sediments under standard Proctor effort were approximately 87.7 pcf and 25.0%, respectively. For Post-Weir sediments, the maximum dry unit weight and optimum moisture content under standard Proctor effort were approximately 67.0 pcf and 47.5%, respectively.

3.2 Summary of Soil Analytical Results

At each of the nine shallow borings, a sample was collected from the 6- to 8-ft depth interval and analyzed for TAL/TCL constituents. These data will be used as an initial assessment of whether subsurface soils from the Marsh Wood Storage Area have the potential to be used as borrow materials during construction activities.

Toxaphene was not detected in the sub-surface soil samples in the Marsh Wood Storage Area (part of OU2) area south of the Outfall Ditch (Figure 2). However, in the Marsh Wood Storage Area to the north of the Outfall Ditch, toxaphene concentrations ranged from 100 µg/kg to 2,400 µg/kg. The concentrations of toxaphene in soils are shown on Figure 13. In addition to toxaphene, other compounds detected in soil included pesticides, metals, PAHs, and VOCs. A summary of the detected compound concentrations in subsurface soils is presented in Table 6. The complete analytical dataset is included in Appendix E.

4. PRELIMINARY SCREENING OF REMEDIAL ALTERNATIVES

4.1 Overview

This section provides a brief description of the remedial action objectives (RAOs) followed by a description of the remedial alternatives provided in the Focused RI/FS Work Plan and a preliminary screening of the remedial alternatives based on the collected RI data. Where applicable, the RI data were used to refine the remedial alternatives.

4.2 Remedial Action Objectives

Consistent with the Work Plan, the following RAOs have been developed for OU1:

1. Eliminate or minimize direct exposure pathways to potential receptors to elevated residual toxaphene concentrations present in OU1 sediments; and

2. Eliminate or minimize transport of toxaphene-contaminated sediments to downstream locations.

4.3 Description of Remedial Alternatives

Subsection 4.3 briefly describes the assembled remedial alternatives, whereas they are preliminarily screened in the context of the Focused RI data in Subsection 4.4.

4.3.1 Alternative 1: No Further Action

The No Further Action (NFA) alternative includes site monitoring and general maintenance (i.e., erosion control, maintenance of fencing, etc.).

4.3.2 Alternative 2: Monitored Natural Recovery

Monitored Natural Recovery (MNR) involves leaving contaminated sediments in place, allowing ongoing physical, chemical and/or biological processes to reduce contaminant concentration and bioavailability (e.g., burial, transformation).

4.3.3 Alternative 3: Sediment Removal

This remedial alternative includes the removal (i.e., dredging or excavation) of sediments within the Outfall Ditch that contain residual toxaphene contamination. Factors to be considered as part of the evaluation of a removal alternative include: removal volume, disposal and/or treatment requirements for the excavated materials, ability to contain suspended sediments during removal activities to minimize further residual contamination, diversion of surface water during remedy implementation, ability to confirm that the contaminated material has been successfully removed, and potential for re-contamination of the remediated areas.

4.3.4 Alternative 4: Containment

his general response action includes an evaluation of in-place containment alternatives (i.e., capping) that may be used to isolate sediments in the Outfall Ditch. Factors to be considered as part of the evaluation of each containment alternative include: geotechnical properties of the subsurface and construction materials, durability of cap materials, potential groundwater and surface water influences on the performance of the capping technology, ability to contain suspended sediments during installation activities, diversion of surface water and control of tidal influence during construction, potential for re-contamination of the remediated areas, performance/integrity, and constructability.

Specific potential containment alternatives that have preliminarily been identified include:

4.3.4.1 Alternative 4A: Sheet Pile Channel

For this alternative, two rows of sheet pile would be installed parallel to the centerline of the Outfall Ditch to create a reduced width channel with vertical sidewalls. Soils would be backfilled to fill the space between the sheet pile and the existing ditch slopes. A layer of clean fill and armoring would be installed between the sheet piles to cap the sediments within the sheet pile walls. A conceptual design of this alternative is shown in Figure 15.

4.3.4.2 Alternative 4B: Discharge Conveyance Pipe

For this alternative, a pipe would be installed from the OU1 inlet structure (Triple Box Culvert) to the channel outlet within the existing OU1 open channel to convey surface water discharges. The channel would be backfilled with soils and pipe bedding materials to create a soil cap and eliminate exposure pathways to contaminated sediment and concern for sediment transport downstream. A concrete transition structure would be constructed at the inlet of the pipe to transition from the culvert beneath Highway 17 to the pipe section. At the pipe outlet, a headwall would be constructed and a tidal valve would be fitted to control tidal backflow from Dupree Creek into the pipe. A conceptual design of this alternative is shown in Figure 16.

4.3.4.3 Alternative 4C: Sub-Aqueous Cap

This alternative includes several process options including (i) the construction of a cap comprised of concrete (i.e., Fabriform ditch), (ii) the installation of a subaqueous cap using Aquablok, and (iii) the construction of an engineered sand cap with stone (i.e., rip rap) armoring. The cap would be installed within the OU1 open channel. The sand cap and Aquablok would be installed in situ on the existing Outfall Ditch bathymetry. A conceptual design of this alternative is shown in Figure 17 (Aquablok) and Figure 18 (Fabriform).

4.3.4.4 Alternative 4D: Backfill OU1 and Re-Route the Outfall

For this alternative, the Outfall Ditch would be backfilled and a new channel would be constructed in an area adjacent to the existing OU1 channel. The excavated soils would be used as backfill within the Outfall Ditch. A conceptual design of this alternative is shown in Figure 19.

4.4 Preliminary Screening Evaluation

The remedial alternatives briefly described in Subsection 4.3 have been screened against three broad screening criteria: effectiveness, implementability, and cost. Screening for effectiveness mainly considers the protectiveness of each remedial alternative for receptors and the mitigation of toxaphene-contaminated sediment transport. Implementability is a measure of the technical and administrative feasibility of constructing, operating and maintaining a remedial alternative, while the cost evaluation is based more on a relative comparison of costs among the remedial

alternatives. These preliminary evaluations for each alternative have been summarized in Table 7.

4.4.1 Alternative 1: No Further Action

No Further Action (NFA) includes site monitoring and general maintenance (i.e., erosion control, maintenance of fencing, etc.), but no further active remediation within OU1 and/or additional "limited" action alternatives such as deed restrictions would be implemented.

The data collected during the Focused RI do not affect the implementability of this alternative, which is carried through consistent with the requirements of the NCP.

NFA is readily implementable and has the lowest relative cost. With respect to effectiveness, NFA does not promote conditions for eliminating or minimizing the exposure of receptors to elevated toxaphene concentrations in sediments or transport of toxaphene-contaminated sediments to downgradient locations. The analytical results of sediment sampling in the Pre-Weir and Post-Weir indicate that toxaphene concentrations within the surface sediment are lower compared to those below 4-ft from the surface. However, the average toxaphene concentration in surface sediments is approximately 10 mg/kg, which is well above the OSWER sediment screening value for technical toxaphene of 0.028 mg/kg (USEPA 1996). The OSWER screening value is being used for screening purposes in the Focused RI/FS due to the uncertainty associated with developing a numeric, risk-based goal without weathered toxaphene toxicity factors.

While limited site monitoring and general site maintenance (including sediment removal to restore the discharge capacity of the Triple Box Culvert) may be part of this alternative, the cost to implement this alternative is low since no active remediation and/or limited actions (such as deed restrictions) are included. Alternative 1 does not achieve the stated RAOs; however, it is retained for further analysis consistent with Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) protocols.

4.4.2 Alternative 2: Monitored Natural Recovery

Monitored Natural Recovery (MNR) involves leaving contaminated sediments in place, allowing ongoing physical and biological processes to reduce contaminant concentration and bioavailability (e.g., burial, transformation).

Residual concentrations of toxaphene found during the post-excavation investigation of the 1999-2000 removal action sampling in comparison to the sediment sampling during the Focused RI indicate that natural processes (i.e., mainly, the deposition of recent sediments on top of existing contaminated sediments), while occurring, have not occurred to the extent necessary to minimize the exposure of receptors to toxaphene-impacted sediments. While concentrations in surface sediments found during this Focused RI are much lower than the post-excavation concentrations measured in 2000, toxaphene continues to be measured in these sediments at concentrations well above the screening value (see Figure 9). Also, after the sharp decline in fish tissue concentrations following the previous removal action, fish tissue concentrations have leveled off, indicating that ongoing deposition has not eliminated the elevated residual toxaphene concentrations in sediments to ecological receptors and MNR will not be able to meet the stated RAOs.

It is noted that Plant-related toxaphene contamination has recently been addressed through the completion of remedial activities in 2009. It is expected that sediment loads originating from upstream locations will result in sediments being deposited within the Outfall Ditch that are not impacted by toxaphene. However, it is likely that maintenance dredging in the Outfall Ditch will be required to keep the Triple Box Culvert functioning properly. Removal of these surficial sediments will expose deeper, more contaminated sediments and essentially reduce the effectiveness of the MNR remedy. Further, maintenance dredging may also result in the re-suspension of sediments with elevated toxaphene concentrations and impede the effectiveness of MNR further downstream.

Bathymetry data show that a significant quantity of sediment has accumulated within the Pre- and Post-Weir sections of the Outfall Ditch. The mass accumulation in the Pre-Weir section is expected due to the increased settling capacity as a result of the weir structure; however, sediment has also accumulated in the Post-Weir section. Since the weir structure limits the amount of sediment transport from upgradient sources, it can be presumed that some of the sediment accumulation in the Post-Weir is likely from other

sources such as sediment transport from Dupree Creek or erosion of soils from the Marsh Wood Storage Yard.

Similar to Alternative 1, MNR is readily implementable and has the second-lowest capital costs relative to the other alternatives. However, in order for MNR to be a stand-alone remedial alternative, additional data collection and further analysis/modeling would likely be needed to support demonstrating its effectiveness. Further, long-term monitoring requirements are expected to add substantial life-cycle costs to this remedial alternative and combined with the additional studies and associated costs required to support the effectiveness of this alternative, the final costs for this remedial alternative could potentially exceed the total costs of a more active remedial alternative.

While natural recovery is believed to be occurring to varying degrees, several factors preclude MNR from serving as a stand-alone remedial approach for OU1. These factors include the following: residual contamination above screening levels exists within OU1 approximately 13 years after remedial dredging; the exposure of subsurface sediments after maintenance dredging will essentially reduce its potential effectiveness and concerns for sediment re-suspension during maintenance dredging. Therefore, MNR is eliminated from further consideration and detailed analysis of MNR for OU1 and will not be included in the FS.

4.4.3 Alternative 3: Sediment Removal

This alternative includes dredging (below the depth of surface water and groundwater) or excavation (under dry conditions) of contaminated sediments within the Outfall Ditch. Removed sediments would then be dewatered and/or stabilized onsite and subsequently shipped offsite for disposal and/or potentially treatment if required to meet land disposal restrictions (LDRs).

Factors affecting the implementability of this alternative include: removal volume; disposal and/or treatment requirements for the excavated materials; ability to contain suspended sediments during removal activities; management of surface water during remedy implementation; dewatering of the excavation footprint due to upwelling into OU1 from the high water table; ability to confirm that the contaminated materials have been successfully removed; and potential for elevated residual concentrations in the remediated areas.

To evaluate potential removal volumes, the volume of toxaphene contaminated sediment at various concentrations was calculated. In Figure 14, the upper left figure shows that more than 17,000 cubic yards of sediment have a concentration greater than the OSWER screening value. This is a significant quantity of sediment and essentially includes all the soft sediments in the Outfall Ditch. It is possible that the contaminated volumes could be much greater since the vertical extent is not defined at certain locations due to the vibracore hitting "hard" sediments/soil or obstructions. Partial excavation/removal was not considered since removing shallower sediments would only expose deeper, more contaminated sediments. Additionally, partial removal of shallow sediments and then placing a barrier over the residual contamination in sediments left behind is being evaluated under the containment alternatives.

The effectiveness of this remedy is limited by some implementation constraints. Despite the previous 1999-2000 removal action that resulted in the removal of 16,800 yd3 of sediments and a 90% mass reduction of toxaphene within the Outfall Ditch, sediments with residual contamination still remain in place. This is consistent with data from other dredging sites that indicate residual contamination after dredging may vary from 2% to 9% of the mass removed (NRC, 2007). While additional dredging would remove contaminated sediments and further reduce contaminant mass, it is very likely that complete removal is not achievable with this technology and that residual contamination would still be left behind. Given that a risk assessment cannot be performed at this time (due to the lack of weathered toxaphene congener toxicity data), an acceptable residual toxaphene concentration in sediments following excavation cannot be determined, making the effectiveness of this remedy uncertain.

Other implementation challenges associated with the excavation alternative include water management. Elevated residual toxaphene concentrations in sediments are found at depths of 6- to 8-ft bgs, which corresponds to elevations of -8 to -10 ft-MSL. Removal of these sediments in "dry conditions" would necessitate the installation of a groundwater dewatering and treatment system to control seepage into the open excavation. Tidal influences would also have to be controlled with barriers (i.e. sheet piles installed to extensive depths) at the mouth of the Outfall Ditch. In addition to the management of tidal surface water and groundwater seepage, the 8 MGD discharge from the Pinova Plant and stormwater surges from the upstream neighborhood must also be managed. The consequences of a pump failing around the system would include inundation of the excavation with water and/or upstream flooding. Considering these consequences, it is likely that an alternative by-pass ditch would need to be excavated to

handle the peak flows or storm surges. If a by-pass ditch would need to be constructed to complete the excavation alternative, it would then make more sense to just re-route the ditch in lieu of trying to excavate all of the sediments out of the existing ditch.

Another factor affecting the effectiveness of this alternative is re-contamination of the Outfall Ditch sediments after excavation. While the toxaphene source upstream at the Plant site has been mitigated, there is a substantial likelihood of recontamination of the Outfall Ditch sediments from Dupree Creek. Based on the 2012 data, the Post-Weir surface sediments have toxaphene concentrations elevated above the screening level. Since the weir facilitates sediment deposition upstream of the weir, it can be surmised that the sources of the Post-Weir sediment impacts include sources other than the plant discharges.

The cost to address water management issues and the offsite disposal of a significant volume of sediment make this alternative the most expensive alternative to implement.

Therefore, based on the uncertainties discussed above, its technical implementation challenges related to water management and it's probable ineffectiveness due to i) re-contamination and ii) not being able to achieve complete removal of all toxaphene-impacted sediment, the sediment removal alternative is eliminated from further consideration and a detailed analysis will not be included in the FS.

4.4.4 Alternative 4A: Sheet Pile Channel

This remedial alternative includes the removal of the existing weir structure and the installation of two rows of sheet piles parallel through the centerline of the Outfall Ditch to create a reduced-width channel with vertical sidewalls. Areas between the sheet piles and the existing ditch slopes would be backfilled with clean soils to eliminate or minimize exposure of receptors to contaminated sediments. In order to eliminate or minimize exposure to contaminated sediments and eliminate or minimize sediment erosion, a layer of clean fill and armoring would be installed between the sheet piles to cap the remaining sediments.

The sheet pile channel will be hydraulically designed to meet or exceed the design discharge capacity of the Triple Box Culvert. Furthermore, the sheet pile channel will be constructed of materials to mitigate channel erosion through the conveyance of discharges with high flow velocities.

The sheet pile channel option would involve driving sheet piles through the Outfall Ditch sediments and into the subsurface soils below the sediments. Subsurface obstructions such as buried logs have been observed along the Outfall Ditch and would be expected to complicate sheet pile installations. As summarized previously, the sediments are soft and shallow subsurface soils are either loose or soft. Therefore, the passive resistance available for the sheet piles is expected to be low. Shear strengths for global slope stability analysis of the excavation are also expected to be low. The loose sand material may be liquefiable under seismic loading conditions. These conditions may lead to the need for larger sheet pile embedment depths for a given excavation or channel depth. There may be challenges involved in using anchors in soft or loose soils to reduce the depth of embedment. These geotechnical considerations will need to be considered for the sheet pile channel as part of the detailed analysis based on the selected channel dimensions.

Similar to the other alternatives that involve excavation/dredging activities, the implementability and effectiveness of the sheet pile channel is affected by the ability to manage surface water during remedial construction and contain suspended sediments.

Based on the collected data, modifications to this alternative include adding a headwall and check valve assembly at the sheet pile channel outlet to prevent re-entry of tidal backflow and potential re-contamination of the sheet pile channel. Furthermore, heavy sediment loads are expected to be deposited onto the channel surface from the Triple Box Culvert discharge, which may require the construction and maintenance of a pretreatment (sediment settling) system and/or maintenance sediment removal from the channel. Additionally, based on the Outfall Ditch bathymetry and Triple Box Culvert invert elevations, the sediments between the sheet piles would need to be excavated to a depth below the bottom of the Triple Box Culvert to facilitate capping and backfilling with clean fill and armoring. Excavated sediments would need to be stabilized and used as backfill for the areas outside of the sheet pile channel and capped with clean fill.

This option is considered effective, feasible and implementable at this stage, but may involve some significant geotechnical design and construction/stormwater challenges. This remedial alternative is protective of receptors by eliminating or reducing exposure pathways to Outfall Ditch sediments and the transport of toxaphene-contaminated sediments to downgradient locations.

The costs are estimated to be less than the sediment removal alternative (mainly due to the ability to manage excavated sediments onsite) but greater than the other containment/capping alternatives screened due to the use of permanent sheet piles and extensive soil backfill. Overall, the sheet pile channel remedial alternative is retained for a more detailed evaluation during the development of the FS.

4.4.5 Alternative 4B: Discharge Conveyance Pipe

This alternative includes the installation of a pipe from the Triple Box Culvert to the channel outlet within the existing OU1 channel. Following the installation of the pipe, the channel surrounding the pipe would be backfilled with clean soils to create a soil cap, thus eliminating or reducing receptor exposure to Outfall Ditch sediments and/or erosion, and subsequent transport, of contaminated sediments downstream. A concrete transition structure would be constructed at the inlet of the pipe to transition from the Triple Box Culvert to the pipe section. This structure may also include a pretreatment system for facilitating sedimentation of suspended solids present in discharge flows from the Triple Box Culvert. At the pipe outlet, a headwall would be constructed and a tidal valve would be fitted to the outlet to prevent tidal backflow.

In order to discharge from the Triple Box Culvert to the discharge conveyance pipe, the sediments along the alignment of the discharge conveyance pipe would need to be excavated to the bottom elevation of Triple Box Culverts. Currently, the Triple Box Culvert is approximately half-filled with sediments. Excavated sediments from the discharge conveyance pipe trench alignment could potentially be stabilized and used as subsurface backfill in and around the pipe. Design calculations will need to be performed to confirm that the design and material properties of the conveyance pipes and the soil backfill mitigate the uplift force from the groundwater hydraulic gradient.

Bearing capacity and settlement of the soft sediment foundation and underlying loose/soft subsurface soils will be the primary geotechnical consideration. The potential for grade reversal will be influenced by the varying subsurface conditions along the route of the pipe. At a conceptual level, it appears that more compressible materials (i.e. finer sediments in the Outfall Ditch and CH material) are located on the downstream eastern side (i.e. Dupree Creek side) than the western side. Therefore, it appears that designing the pipe to address grade reversal concerns is feasible.

Based on the collected data, modifications to this alternative include adding a sediment settling basin downstream from the Triple Box Culvert and having to excavate sediment from the bottom of the channel to facilitate construction of the pipe.

Similar to the other alternatives that involve excavation/dredging activities, the implementability and effectiveness of the conveyance pipe is affected by the ability to contain suspended sediments during remedial construction as well as manage surface water during construction.

This option is considered effective, feasible and implementable at this stage, but may involve some significant geotechnical design and construction/stormwater challenges. The costs are estimated to be less than the sediment removal alternative (mainly due to smaller sediment removal volumes as well as the ability to manage excavated sediments onsite) and similar to the other containment/capping alternatives screened. Overall, the discharge conveyance pipe remedial alternative is retained for a more detailed evaluation during the development of the FS.

4.4.6 Alternative 4C: Sub-Aqueous Cap

This alternative includes several process options including (i) the construction of a cap comprised of concrete (i.e., Fabriform ditch), (ii) the installation of a subaqueous cap using Aquablok, and (iii) the construction of an armored sand cap. This option would eliminate or minimize the exposure of potential receptors to elevated residual toxaphene concentrations in sediments and the downgradient transport of toxaphene-contaminated sediments within the Outfall Ditch. The cap would be installed across the length and width of the OU1 open channel. At the outlet of the Outfall Ditch, a headwall would be constructed and a tidal valve would be fitted to control tidal backflow into the capped area to minimize the potential to re-contaminate the Outfall Ditch via sediment deposition from Dupree Creek.

Similar to the sheet pile channel and discharge conveyance pipe remedial alternatives, Outfall Ditch sediments would need to be excavated to below the bottom of the Triple Box Culvert invert elevation to allow the discharges to enter the capped area unimpeded. However, unlike the sheet pile channel and discharge conveyance pipe remedial alternatives, these excavated sediments would need to be managed through offsite transportation and disposal, adding substantial operational complexity (onsite dewatering and/or stabilization) and costs to this remedial alternative. Furthermore,

impermeable caps, such as the concrete Fabriform and Aquablok cap, will need to be appropriately designed/sized to prevent uplift forces that may result from groundwater seepage/hydraulic gradients.

The implementability and effectiveness of the sub-aqueous cap is affected by the ability to contain suspended sediments during remedial construction as well as manage surface water during construction. The subaqueous cap remedial alternative is considered effective, feasible and implementable at this stage, but may involve some significant geotechnical/construction challenges, especially involving the Aquablok and armored sand cap process options.

The costs are estimated to be less than the sediment removal alternative and similar to the other containment/capping alternatives screened. Costs may be higher for these alternatives since sediments excavated to facilitate construction will need to be disposed offsite.

Overall, the subaqueous cap remedial alternative is retained for a more detailed evaluation during the development of the FS. A summary of the various process options is provided below.

4.4.6.1 Process Option 1: Fabriform

The "Fabriform" process option involves constructing a Farbriform-lined ditch across the length of the Outfall Ditch. Outfall Ditch sediments would need to be excavated to below the bottom of the Triple Box Culvert to allow the discharges to enter the Fabriform ditch unimpeded. The ditch excavation will need to be performed in the soft ditch sediments. In addition to the ditch slope stability, settlement and potential for grade reversal will need to be evaluated. The potential for grade reversal will be influenced by the varying subsurface conditions along the route of the Fabriform ditch. At a conceptual level, it appears that more compressible materials (i.e. finer sediments in the Outfall Ditch and CH material) are located on the eastern (downstream) side (i.e. Dupree Creek side) than the western side. Therefore, it appears that designing the Fabriform ditch to address grade reversal concerns is feasible. This option is considered feasible at this stage, but may have some geotechnical/construction challenges.

4.4.6.2 Process Option 2: Aquablok

The "Aquablok" process option involves installing a sub-aqueous cap using Aquablok. Outfall Ditch sediments would need to be excavated to below the bottom of the Triple Box Culvert to allow discharges to flow to the capped area unimpeded. Slope stability and settlement will need to be evaluated. Settlement concerns related to potential for grade reversal are valid for this option as well and were addressed above. The installation of the product would need to be closely supervised to confirm that the correct minimum product depth is installed throughout the Outfall Ditch and that the product is not washed away in the vicinity of the Triple Box Culvert. This option is considered feasible at this stage, but may have some geotechnical/construction challenges.

4.4.6.3 Process Option 3: Armored Sand Cap

The "Armored Sand Cap" process option is a refinement of the impermeable cap designs and involves installing a sub-aqueous cap constructed from sand that is protected from erosion and weathering by rip-rap armoring. This process option differs from the impermeable caps because the high permeability of sand will resolve concerns of uplift forces. However, the increased permeability may result in seepage piping, which would have to be investigated during detailed design. As with the other capping alternatives, Outfall Ditch sediments would need to be excavated several feet below the bottom of the Triple Box Culvert to construct the alternative and to allow discharges to flow to the capped area unimpeded. Excavated materials would need to be transported and disposed of offsite. Settlement concerns related to the potential for grade reversal were addressed above. These concerns are valid for this option as well. Slope stability of the sand on the tidal flats and Outfall Ditch banks would have to be further evaluated. This option is considered feasible at this stage, but may have some geotechnical/ construction challenges.

4.4.7 Alternative 4D: Backfill OU1 and Reroute the Outfall

4.4.7.1 Process Option 1: Open Channel

This alternative includes rerouting the discharge to a newly constructed open channel and backfilling the existing channel with clean fill or soils, thus eliminating or reducing the exposure of receptors to elevated residual toxaphene concentrations in sediments

and the transport of toxaphene-contaminated sediments to downgradient locations. The new channel would be excavated in the area adjacent north or south of the existing Outfall Ditch. Since the subsurface soil samples along the northern route had toxaphene concentrations similar to surface sediments in the Outfall Ditch, additional analytical testing of subsurface soils along the proposed re-routing would be required to further evaluate whether a liner/barrier would be required in the newly constructed ditch. The transition zone at the inlet of the new open channel would be designed to dissipate the potential high velocity flows from the Triple Box Culvert. The transition zone would be designed to minimize bank erosion due to the changing direction of the discharges and the high discharge velocity. The excavated soils from constructing the new discharge channel could be used to backfill the Outfall Ditch. The main advantage to this alternative is that most of the construction could be performed in the "dry" and avoids most of the water management issues required for constructing other alternatives. Although it is noted that excavation of the new channel would also be at depths below the water table and management of groundwater seepage will still be required.

The geotechnical considerations for this alternative include: (i) excavation in the loose poorly graded sand with a relatively high groundwater table, and (ii) backfilling of the soft and compressible sediments in the Outfall Ditch. Slope stability and grade reversal potential will need to be evaluated for the excavation of the new channel. The design of the backfilling of the Outfall Ditch will need to consider the effect of settlement on the final grades for effective post construction surface water management. Similar to other alternatives, a sediment control structure would be required downstream of the Triple Box Culvert, which would require periodic maintenance to remove accumulated sediments. At the outlet of the new outfall, a headwall with a tidal valve would be constructed to control tidal backflow into the new channel and minimize the potential for sediment re-contamination from Dupree Creek.

4.4.7.2 Process Option 2: Conveyance Pipe

This process option is a refinement of Alternative 4B (i.e., conveyance pipe in existing Outfall Ditch), but discharges would be routed through a conveyance pipe installed in a newly constructed "channel" located to the north or south of the existing Outfall Ditch. As such, similar geotechnical and constructability issues apply compared to the re-routed open channel as well as Alternative 4B. A concrete transition structure would be constructed at the inlet of the pipe to transition from the Triple Box Culvert to the pipe

section. This structure may also include a pretreatment system for facilitating sedimentation of suspended solids present in discharge flows from the Triple Box Culvert.

This option is considered effective, feasible and implementable at this stage, but may involve some geotechnical and construction challenges. This remedial alternative is protective of receptors by eliminating or reducing exposure to elevated residual toxaphene concentrations in sediments and the transport of toxaphene-contaminated sediments to downgradient locations.

The costs are estimated to be less than the sediment removal alternative and similar to other containment/capping alternatives screened. The open channel option may be less costly than the conveyance pipe option depending on the usability of excavated soil as backfill versus the increase in materials cost from conveyance pipe.

Overall, this remedial alternative is retained for a more detailed evaluation during the development of the FS, with a more refined evaluation of the two process options (i.e., open channel versus conveyance pipe).

5. CONCLUSIONS

The goal of most remedial actions is to implement cost-effective remedies that control the source of contamination and provide long-term risk reduction to human health and the environment. The data collection summarized within this Technical Memorandum has served to further refine the understanding of chemical and physical aspects of the Outfall Ditch that are needed to develop and evaluate remedies for OU1.

The first remedial alternative presented was No Further Action. The residual toxaphene concentrations in sediment samples in the Outfall Ditch average almost 20 mg/kg. Although developing a risk-based numerical screening value is outside the scope of the current investigation, it is noted that these concentrations are elevated above the OSWER sediment screening level of 0.028 mg/Kg and that NFA is not a viable alternative. However, to conform to the NCP, NFA will be retained as an option for further evaluation in the FS.

Monitored Natural Recovery was also screened as an alternative. MNR has essentially been occurring within the Outfall Ditch since the completion of the removal action in 2000. And while it is noted that surficial concentrations of toxaphene have substantially declined over time; the levels of residual contamination would indicate that the rate of recovery through MNR alone is not fast enough for this alternative to serve adequately as a remedy for OU1. MNR will not be included for further screening in the FS.

Sediment removal was the third remedial alternative considered. The RI data demonstrated that a significant volume of sediment above the OSWER screening level remains in the Outfall Ditch. Based on challenges associated with water management during construction including tidal waters, upstream discharges from the Plant, and groundwater seepage, and the alternative's probable ineffectiveness due to not being able to achieve complete removal of all toxaphene-impacted sediment as well as the potential for re-contamination of the excavation, the sediment removal alternative was eliminated from further consideration and a detailed analysis will not be included in the FS.

The final remedial alternative screened included various capping/containment options. This alternative includes sheet piling the ditch and capping the sediments, installing a discharge conveyance pipe within the Outfall Ditch, installation of various subaqueous caps, and re-routing the discharge through a newly constructed open channel or a

discharge pipe and backfilling the existing Outfall Ditch. Each of these options will be further evaluated in the FS. However, each option has some technical challenges to overcome:

- The Sheet Pile Channel will have to consider the geotechnical challenges and cost of installing sheet piles to significant depths and the possibility of encountering obstructions such as logs.

- The Discharge Conveyance Pipe located within the existing Outfall Ditch will require the deepening of the channel in order to install the pipe at an adequate depth. Surface water and transport of bulk, as well as suspended contaminated sediments will need to be managed.

- The Sub-Aqueous Cap and its three process options all require the installation of a headwall and tidal valve at the mouth of Dupree Creek to prevent recontamination.

- The Backfill and Re-Route the Outfall either as an open channel or a pipe will require the import of significant quantities of clean fill, as well as excavation of a new channel below the depth of the water table to convey the discharge water from the Pinova Plant.

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TABLES

Table 1. Sample Analyte List for Terry Creek OU1 RI/FS

Geosyntec consultants

TAL metals	Volatile Organic Compounds	Semi-Volatile Organic Compounds	Pesticides	Polychlorinated Biphenyls / Dioxins
Aluminum	Acetone	Acenaphthene	Aldrin	Aroclor® 1016
Antimony	Benzene	Acenaphthylene	alpha-BHC	Aroclor® 1221
Arsenic	Bromodichloromethane	Anthracene	beta-BHC	Aroclor® 1232
Barium	Bromoform	Benzo(a)anthracene	delta-BHC	Aroclor® 1242
Beryllium	Bromomethane	Benzo(a)pyrene	gamma-BHC (Lindane)	Aroclor® 1248
Calcium	Carbon Disulfide	Benzo(b)fluoranthene	alpha-Chlordane	Aroclor® 1254
Chromium	Carbon Tetrachloride	Benzo(g,h,i)perylene	gamma-Chlordane	Aroclor® 1260
Cobalt	Chlorobenzene	Benzo(k)fluoranthene	4,4'-DDD	Aroclor® 1268
Copper	Chloroethane	4-Bromophenyl-phenylether	4,4'-DDE	
Lead	Chloromethane	Butylbenzylphthalate	4,4'-DDT	
Magnesium	Dibromochloromethane	Carbazole	Dieldrin	Dioxins
Mercury	1,2-Dichloroethane	4-Chloro-3-methylphenol	Endosulfan I	1,2,3,4,6,7,8-Heptachlorodibenzo-p-dioxin (HpCDD)
Nickel	1,1-Dichloroethene	4-Chloroaniline	Endosulfan II	1,2,3,4,6,7,8-Heptachlorodibenzofuran (HpCDF)
Potassium	1,2-Dichloroethene (total)	bis(2-Chloroethoxy)methane	Endosulfan sulfate	1,2,3,4,7,8,9-Heptachlorodibenzofuran (HpCDF)
Selenium	1,2-Dichloropropane	bis-(2-Chloroethyl)ether	Endrin	1,2,3,4,7,8-Hexachlorodibenzo-p-dioxin (HxCDD)
Silver	cis-1,3-Dichloropropene	2-Chloronaphthalene	Endrin aldehyde	1,2,3,4,7,8-Hexachlorodibenzofuran (HxCDF)
Sodium	trans-1,3-Dichloropropene	2-Chlorophenol	Endrin ketone	1,2,3,6,7,8-Hexachlorodibenzo-p-dioxin (HxCDD)
Thallium	Ethylbenzene	4-Chlorophenyl-phenylether	Heptachlor	1,2,3,6,7,8-Hexachlorodibenzofuran (HxCDF)
Vanadium	2-Hexanone	2,2'-oxybis(1-Chloropropane)	Heptachlor epoxide	1,2,3,7,8,9-Hexachlorodibenzo-p-dioxin (HxCDD)
Zinc	4-Methyl-2-pentanone	Chrysene	Methoxychlor	1,2,3,7,8,9-Hexachlorodibenzofuran (HxCDF)
	Methylene Chloride	Dibenzo(a,h)anthracene	**Toxaphene**	1,2,3,7,8-Pentachlorodibenzo-p-dioxin (PeCDD)
Cyanide	Styrene	1,2-Dichlorobenzene	(Method 1)	1,2,3,7,8-Pentachlorodibenzofuran (PeCDF)
	1,1,2,2-Tetrachloroethane	1,3-Dichlorobenzene	**Chlorinated camphenes**	2,3,4,6,7,8-Hexachlorodibenzofuran (HxCDF)
	Tetrachloroethene	1,4-Dichlorobenzene	(Method 2)	2,3,4,7,8-Pentachlorodibenzofuran (PeCDF)
	Toluene	3,3'-Dichlorobenzidine		2,3,7,8-Tetrachlorodibenzo-p-dioxin (TCDD)
	1,1,1-Trichloroethane	2,4-Dichlorophenol	Toxaphene Breakdown	2,3,7,8-Tetrachlorodibenzofuran (TCDF)
	1,1,2-Trichloroethane	Diethylphthalate	Products	1,2,3,4,6,7,8,9-Octachlorodibenzo-p-dioxin (OCDD)
	Trichloroethene	2,4-Dimethylphenol	**Hx-Sed**	1,2,3,4,6,7,8,9-Octachlorodibenzofuran (OCDF)
	Vinyl Chloride	2,4-Dinitrophenol	**Hp-Sed**	
	Xylenes (total)	2,4-Dinitrotoluene	**Parlar 26**	
		2,6-Dinitrotoluene	**Parlar 40**	
		Di-n-octylphthalate	**Parlar 41**	
		bis(2-Ethylhexyl)phthalate	**Parlar 44**	
		Fluoranthene	**Parlar 50**	
		Fluorene	**Parlar 62**	
		Hexachlorobenzene		
		Hexachlorobutadiene		
		Hexachlorocyclopentadiene		
		Hexachloroethane		
		Indeno(1,2,3-cd)pyrene		
		Isophorone		
		2-Methylnaphthalene		
		2-Methylphenol		
		4-Methylphenol		
		Naphthalene		
		2-Nitroaniline		
		3-Nitroaniline		
		4-Nitroaniline		
		Nitrobenzene		
		2-Nitrophenol		
		4-Nitrophenol		
		N-Nitroso-di-n-propylamine		
		N-Nitroso-diphenylamine		
		Pentachlorophenol		
		Phenanthrene		
		Phenol		
		Pyrene		
		1,2,4-Trichlorobenzene		
		2,4,5-Trichlorophenol		
		2,4,6-Trichlorophenol		

Table 2. Toxaphene Concentrations in Outfall Ditch Sediment Samples

Field ID	Depth (ft)	Toxaphene (µg/kg)		Total Organic Carbon (mg/kg)
		Method 1 (Technical)	Method 2 (TAUC)	
SD-OD1C-01	0 - 0.5	5400 J	10,000	--
SD-OD1C-02	0.5 - 2	8,200	12,000	--
SD-OD1N-01	0 - 0.5	12,000 J	3,400	170,000 J
SD-OD1N-02	0.5 - 2	27,000	10,000	49,000
SD-OD1N-03	2 - 4	62,000	84,000	88,000
SD-OD1N-04	4 - 6	9,400	20,000	30,000
SD-OD1N-05	6 - 8	110 U	37 U	1,500
SD-OD1S-01	0 - 0.5	1,800 J	960	140,000 J
SD-OD1S-02	0.5 - 2	4,500 J	11,000	130,000 J
SD-OD1T-01	0 - 0.5	5,300	5,900	11,000
SD-OD1T-02	0.5 - 2	6,700	7,400	7,300
SD-OD2C-01	0 - 0.5	21,000 J	19,000	510,000 J
SD-OD2C-02	0.5 - 2	14,000 J	12,000	320,000 J
SD-OD2N-01	0 - 0.5	2,000 J	2,600	370,000 J
SD-OD2N-02	0.5 - 2	3,600 J	3,400	190,000 J
SD-OD2S-01	0 - 0.5	14,000 J	9,500	200,000 J
SD-OD2S-02	0.5 - 2	3,000	5,600	88,000
SD-OD2T-01	0 - 0.5	5,100 J	6,300	180,000 J
SD-OD2T-02	0.5 - 2	6,900 J	4,200	180,000 J
SD-OD2T-03	2 - 4	4,900 J	9,600	91,000 J
SD-OD2T-04	4 - 6	7,600	16,000	180,000
SD-OD2T-05	6 - 8	5,000	9,700	270,000
SD-OD3C-01	0 - 0.5	630 J	1,500	53,000 J
SD-OD3C-02	0.5 - 2	7,900	12,000	48,000
SD-OD3N-01	0 - 0.5	550 J	1,400	54,000 J
SD-OD3N-02	0.5 - 2	15,000	18,000	35,000
SD-OD3S-01	0 - 0.5	860 J	2,000	55,000 J
SD-OD3S-02	0.5 - 2	7,100 J	13,000	37,000 J
SD-OD3T-01	0 - 0.5	11,000 J	25,000	53,000 J
SD-OD3T-02	0.5 - 2	440 J	1,500	37,000 J
SD-OD3T-03	2 - 4	78,000	35,000	69,000
SD-OD3T-04	4 - 6	3,500	2,400	46,000
SD-OD3T-05	6 - 8	170 U	77 J	75,000
SD-OD3T-06	8 - 10	46 U	46 U	5,400
SD-OD4C-01	0 - 0.5	190 J	610	--
SD-OD4C-02	0.5 - 2	660 J	1,600	--
SD-OD4N-01	0 - 0.5	210 J	440	49,000 J
SD-OD4N-02	0.5 - 2	280 J	940	45,000 J
SD-OD4N-03	2 - 4	570	990	52,000
SD-OD4N-04	4 - 6	8,500	21,000	65,000
SD-OD4N-05	6 - 8	5,100	13,000	72,000
SD-OD4S-01	0 - 0.5	170 J	630	40,000 J
SD-OD4S-02	0.5 - 2	310 J	1,000	48,000 J
SD-OD4T-01	0 - 0.5	500 J	1,300	48,000 J
SD-OD4T-02	0.5 - 2	530	1,100	36,000
SD-OD5C-01	0 - 0.5	360 J	R	60,000 J
SD-OD5C-02	0.5 - 2	8,500 J	21,000	55,000 J
SD-OD5N-01	0 - 0.5	320 J	1,100	46,000 J
SD-OD5N-02	0.5 - 2	6,100 J	14,000	68,000 J
SD-OD5S-01	0 - 0.5	270 J	700	35,000 J
SD-OD5S-02	0.5 - 2	190 J	550	51,000
SD-OD5S-03	2 - 4	10,000	29,000	170,000
SD-OD5S-04	4 - 6	170,000	210,000	180,000
SD-OD5S-05	6 - 8	87,000	120,000	77,000
SD-OD5T-01	0 - 0.5	1,100 J	240	54,000 J
SD-OD5T-02	0.5 - 2	16,000	31,000	120,000
SD-ODCC-02	0.5 - 2	17,000	22,000	38,000
SD-ODCN-01	0 - 0.5	71,000	75,000	4,000
SD-ODCS-01	0 - 0.5	5,700 J	5,300	110,000 J

NOTES:
U: not detected;
J: estimated concent

Table 3. Summary of Detected Compounds in Sediment, Terry Creek OU1 RI/FS

Compound Name	SD-OD1C-01	SD-OD1C-02	SD-OD2C-01	SD-OD2C-02	SD-OD3C-01	SD-OD3C-02	SD-OD4C-01	SD-OD4C-02	SD-OD5C-01	SD-OD5C-02
Depth (ft)	0 - 0.5	0.5 - 2	0 - 0.5	0.5 - 2	0 - 0.5	0.5 - 2	0 - 0.5	0.5 - 2	0 - 0.5	0.5 - 2
Toxaphene (µg/kg)										
Method 1 (Technical)	**5,400 J**	**8,200**	**21,000 J**	**14,000 J**	**630 J**	**7,900**	**190 J**	**660 J**	**360 J**	**8,500 J**
Method 2 (TAUC)	**10,000**	**12,000**	**19,000**	**12,000**	**1,500**	**12,000**	**610**	**1,600**	R	**21,000**
Pesticides (µg/kg)										
4,4-DDD	38 UJ	110 U	600 UJ	150 UJ	29 UJ	110 U	2.3 UJ	0.41 UJ	R	43 UJ
4,4-DDE	38 UJ	110 U	600 UJ	150 UJ	29 UJ	110 U	1.8 UJ	**5.8 J**	R	34 UJ
Aldrin	19 UJ	55 U	310 UJ	**44 J**	15 UJ	56 U	4.3 UJ	0.77 UJ	R	**320 J**
gamma-BHC (Lindane)	19 UJ	55 U	310 UJ	77 UJ	15 UJ	56 U	1 UJ	**0.52 J**	R	**40 J**
SVOCs (µg/kg)										
1,1-Biphenyl	1,500 UJ	850 U	3,000 UJ	3,000 UJ	1,400 UJ	1,100 U	280 UJ	250 UJ	370 UJ	**290 J**
2-Methylnaphthalene	310 UJ	170 U	610 UJ	620 UJ	290 UJ	220 U	130 UJ	110 UJ	170 UJ	120 UJ
2-Methylphenol	1,500 UJ	850 U	3,000 UJ	3,000 UJ	1,400 UJ	1,100 U	240 UJ	220 UJ	330 UJ	220 UJ
3 & 4 Methylphenol	1,500 UJ	**190 J**	**2,900 J**	**2,700 J**	1,400 UJ	1,100 U	280 UJ	250 UJ	380 UJ	260 UJ
Acenaphthene	310 UJ	170 U	610 UJ	620 UJ	290 UJ	220 U	130 UJ	110 UJ	170 UJ	120 UJ
Acenaphthylene	310 UJ	170 U	**510 J**	**510 J**	290 UJ	220 U	130 UJ	110 UJ	170 UJ	120 UJ
Acetophenone	1,500 UJ	850 U	3,000 UJ	3,000 UJ	1,400 UJ	1,100 U	260 UJ	230 UJ	350 UJ	240 UJ
Anthracene	310 UJ	170 U	610 UJ	620 UJ	290 UJ	220 U	130 UJ	110 UJ	170 UJ	120 UJ
Benzaldehyde	**490 J**	**290 J**	**2200 J**	**2300 J**	1,400 UJ	1,100 U	380 UJ	340 UJ	510 UJ	**580 J**
Benzo[a]anthracene	310 UJ	170 U	610 UJ	620 UJ	290 UJ	220 U	130 UJ	110 UJ	170 UJ	120 UJ
Benzo[a]pyrene	310 UJ	170 U	610 UJ	620 UJ	290 UJ	220 U	46 UJ	41 UJ	62 UJ	43 UJ
Benzo[b]fluoranthene	310 UJ	170 U	610 UJ	620 UJ	290 UJ	220 U	130 UJ	110 UJ	170 UJ	120 UJ
Benzo[g,h,i]perylene	310 UJ	170 U	610 UJ	620 UJ	290 UJ	220 U	130 UJ	110 UJ	170 UJ	120 UJ
Benzo[k]fluoranthene	310 UJ	170 U	610 UJ	620 UJ	290 UJ	220 U	77 UJ	69 UJ	100 UJ	71 UJ
Chrysene	310 UJ	170 U	610 UJ	620 UJ	290 UJ	220 U	130 UJ	110 UJ	170 UJ	120 UJ
Dibenzofuran	1,500 UJ	850 U	3,000 UJ	3,000 UJ	1,400 UJ	1,100 U	260 UJ	230 UJ	350 UJ	240 UJ
Di-n-butyl phthalate	7,800 UJ	4,400 U	16,000 UJ	16,000 UJ	7,400 UJ	5,600 U	650 UJ	580 UJ	880 UJ	610 UJ
Fluoranthene	**190 J**	**100 J**	**700 J**	**630 J**	290 UJ	**110 J**	130 UJ	110 UJ	170 UJ	120 UJ
Fluorene	310 UJ	170 U	610 UJ	620 UJ	290 UJ	220 U	130 UJ	110 UJ	170 UJ	120 UJ
Indeno[1,2,3-cd]pyrene	310 UJ	170 U	610 UJ	620 UJ	290 UJ	220 U	130 UJ	110 UJ	170 UJ	120 UJ
Naphthalene	**430 J**	**270**	**1400 J**	**1900 J**	**210 J**	**210 J**	130 UJ	**160 J**	**170 J**	240 UJ
Phenanthrene	**190 J**	**150 J**	**650 J**	**820 J**	290 UJ	**120 J**	92 UJ	82 UJ	120 UJ	86 UJ
Phenol	**430 J**	850 U	**1700 J**	**1200 J**	1,400 UJ	1,100 U	250 UJ	220 UJ	340 UJ	230 UJ
Pyrene	**180 J**	**130 J**	**320 J**	**700 J**	290 UJ	220 U	130 UJ	110 UJ	170 UJ	120 UJ
VOCs (µg/kg)										
2-Butanone	**49 J**	**31 J**	**110 J**	**440 J**	**42 J**	**34 J**	**40 J**	**24 J**	**72 J**	8.6 U
4-Methyl-2-pentanone	26 UJ	**16 J**	15 UJ	29 UJ	140 UJ	50 U	20 UJ	17 UJ	19 UJ	15 U
Acetone	**310 J**	170 U	**760 J**	**2100 J**	**150 J**	**160**	**150 J**	**130 J**	**240 J**	**180**
Benzene	4.5 UJ	2.5 U	2.6 UJ	5 UJ	27 UJ	10 U	3.5 UJ	3 UJ	3.3 UJ	2.6 U
Carbon disulfide	**8.5 J**	**5.5 J**	**13 J**	**26 J**	**31 J**	**12**	5.3 UJ	**32 J**	**22 J**	**7.4 J**
Chlorobenzene	5.9 UJ	3.4 U	3.4 UJ	6.6 UJ	27 UJ	10 U	4.6 UJ	3.9 UJ	4.3 UJ	3.5 U
Cyclohexane	8 UJ	**5.4 J**	4.6 UJ	9 UJ	55 UJ	20 U	6.3 UJ	5.3 UJ	5.9 UJ	4.7 U
Isopropylbenzene	12 UJ	6.6 U	**9.5 J**	**31 J**	27 UJ	10 U	9.2 UJ	7.7 UJ	8.6 UJ	**7.9 J**
Methyl acetate	31 UJ	17 U	18 UJ	35 UJ	55 UJ	20 U	24 UJ	20 UJ	23 UJ	18 U
Methylcyclohexane	5.3 UJ	3 U	3 UJ	5.9 UJ	55 UJ	20 U	4.2 UJ	3.5 UJ	3.9 UJ	3.1 U
Toluene	5.2 UJ	2.9 U	3 UJ	**6.1 J**	27 UJ	**1.9 J**	4.1 UJ	3.4 UJ	3.8 UJ	3 U

Table [illegible]. continued

Geosyntec consultants

Compound Name	SD-OD1C-01	SD-OD1C-02	SD-OD2C-01	SD-OD2C-02	SD-OD3C-01	SD-OD3C-02	SD-OD4C-01	SD-OD4C-02	SD-OD5C-01	SD-OD5C-02
Depth (ft)	0 - 0.5	0.5 - 2	0 - 0.5	0.5 - 2	0 - 0.5	0.5 - 2	0 - 0.5	0.5 - 2	0 - 0.5	0.5 - 2
Metals (mg/kg)										
Aluminum	15,000 J	8,900	34,000 J	46,000 J	33,000 J	26,000	22,000 J	34,000 J	38,000 J	26,000 J
Arsenic	9.4 J	7	17 J	33 J	13 J	12	15 J	14 J	17 J	14 J
Barium	66 J	59	160 J	290 J	39 J	35	25 J	36 J	43 J	31 J
Beryllium	0.5 J	0.31 J	1 J	1.5 J	1.4 J	1	1.4 J	1.6 J	1.8 J	1.4 J
Cadmium	0.55 J	0.41 J	1.3 J	1.8 J	0.49 J	1.6 U	0.34 UJ	0.33 UJ	0.5 UJ	0.34 UJ
Calcium	7,600 J	8,900	25,000 J	46,000 J	4,000 J	4,000	4,300 J	5,900 J	6,600 J	5,700 J
Chromium	43 J	23	83 J	110 J	53 J	46	43 J	52 J	64 J	48 J
Cobalt	3.1 J	2 J	6.2 J	9.1 J	6.2 J	5	5.5 J	6.6 J	7.4 J	5.6 J
Copper	86 J	71	160 J	240 J	51 J	30	18 J	24 J	27 J	37 J
Iron	13,000 J	7,900	28,000 J	38,000 J	27,000 J	25,000	25,000 J	29,000 J	34,000 J	27,000 J
Lead	72 J	47	93 J	160 J	32 J	30	25 J	28 J	31 J	29 J
Magnesium	5,200 J	2,800	14,000 J	18,000 J	8,800 J	7,300	8,400 J	9,100 J	11,000 J	7,000 J
Manganese	200 J	160	460 J	770 J	310 J	260	280 J	330 J	440 J	320 J
Mercury	0.75 J	0	1.5 J	2.3 J	0.21 J	0	0.14 J	0.16 J	0.15 J	0.23 J
Nickel	14 J	9 J	25 J	36 J	16 J	13	11 J	15 J	18 J	13 J
Potassium	2,600	1,400	8,000	10,000	4,900	4,000	4,400	4,800	6,000	4,200
Silver	4.2 UJ	2.4 U	8.9 UJ	8.6 UJ	4 UJ	3.2 U	0.33 UJ	0.32 UJ	0.48 UJ	0.42 J
Sodium	18,000 J	6,900	62,000 J	66,000 J	33,000 J	20,000	31,000 J	29,000 J	43,000 J	18,000 J
Vanadium	30 J	17	60 J	82 J	65 J	59	59 J	70 J	79 J	65 J
Zinc	340 J	280	580 J	860 J	140 J	120	81 J	110 J	110 J	97 J
Other (mg/kg)										
Cyanide, Total	2.3 UJ	1.2 UJ	4.5 UJ	3.4 J	2.1 UJ	1.6 U	0.8 UJ	0.71 UJ	1.1 UJ	0.96 J
Total Organic Carbon	NA	NA	510,000 J	320,000 J	53,000 J	48,000	NA	NA	60,000 J	55,000 J

Compound Name	SD-ODCC-02	SD-OD1N-05	SD-OD2T-05	SD-OD3T-06	SD-OD4N-05	SD-OD5S-01	SD-OD5S-05	SD-ODCN-01	SD-ODCS-01
Depth (ft)	0.5 - 2	6 - 8	6 - 8	8 - 10	6 - 8	0 - 0.5	6 - 8	0 - 0.5	0 - 0.5
Toxaphene (µg/kg)									
Method 1 (Technical)	**17,000**	110 U	**5,000**	46 U	**5,100**	**270 J**	**87,000**	**71,000**	**5,700 J**
Method 2 (TAUC)	**22,000**	37 U	**9,700**	46 U	**13,000**	**700**	**120,000**	**75,000**	**5,300**
Pesticides (µg/kg)									
4,4-DDD	470 U	2 U	90 U	0.18 U	7.2 U	**3.3 J**	150 U	120 U	27 UJ
4,4-DDE	470 U	2 U	90 U	0.15 U	5.7 U	0.42 UJ	120 U	**470**	**68 J**
Aldrin	**190 J**	1.1 U	**58**	0.35 U	13 U	0.99 UJ	**780 J**	60 U	14 UJ
gamma-BHC (Lindane)	**19 J**	1.1 U	**22 J**	0.085 U	**33 J**	0.24 UJ	67 U	**7.4 J**	14 UJ
SVOCs (µg/kg)									
1,1-Biphenyl	470 U	41 U	**620 J**	11 U	**320 J**	320 UJ	**460 J**	590 U	1,400 UJ
2-Methylnaphthalene	96 U	8.3 U	180 U	5.1 U	98 U	140 UJ	**85 J**	120 U	280 UJ
2-Methylphenol	470 U	41 U	900 U	9.7 U	190 U	280 UJ	150 U	590 U	**340 J**
3 & 4 Methylphenol	**560**	41 U	**2,200**	11 U	220 U	320 UJ	**330 J**	590 U	**2,200 J**
Acenaphthene	96 U	**5.1 J**	**140 J**	5.1 U	98 U	140 UJ	**240**	120 U	280 UJ
Acenaphthylene	**49 J**	8.3 U	**200**	5.1 U	98 U	140 UJ	81 U	120 U	**430 J**
Acetophenone	470 U	41 U	900 U	11 U	200 U	300 UJ	**450 J**	590 U	1,400 UJ
Anthracene	96 U	**4.8 J**	180 U	5.1 U	98 U	140 UJ	81 U	120 U	280 UJ
Benzaldehyde	**230 J**	41 U	**1,100**	15 U	**630 J**	430 UJ	**1,700**	590 U	**1,200 J**
Benzo[a]anthracene	**99**	**5.4 J**	**130 J**	5.1 U	98 U	140 UJ	81 U	120 U	280 UJ
Benzo[a]pyrene	**130**	8.3 U	180 U	1.9 U	36 U	53 UJ	29 U	120 U	280 UJ
Benzo[b]fluoranthene	**120**	**6.3 J**	180 U	5.1 U	98 U	140 UJ	81 U	120 U	280 UJ
Benzo[g,h,i]perylene	**75 J**	8.3 U	180 U	5.1 U	98 U	140 UJ	81 U	120 U	280 UJ
Benzo[k]fluoranthene	**110**	8.3 U	180 U	3.1 U	60 U	88 UJ	49 U	120 U	280 UJ
Chrysene	**130**	**7.2 J**	180 U	5.1 U	98 U	140 UJ	81 U	120 U	280 UJ
Dibenzofuran	470 U	41 U	900 U	10 U	200 U	290 UJ	**230 J**	590 U	1,400 UJ
Di-n-butyl phthalate	2,400 U	210 U	4,700 U	**96 J**	510 U	750 UJ	420 U	3,000 U	7,100 UJ
Fluoranthene	**250**	**16**	**190**	**9.5 J**	98 U	140 UJ	81 U	120 U	**150 J**
Fluorene	96 U	**4.3 J**	**98 J**	5.1 U	98 U	140 UJ	**280**	120 U	280 UJ
Indeno[1,2,3-cd]pyrene	**57 J**	8.3 U	180 U	5.1 U	98 U	140 UJ	81 U	120 U	280 UJ
Naphthalene	**160**	8.3 U	**400**	5.1 U	**110 J**	140 UJ	**460**	120 U	**1,300 J**
Phenanthrene	**130**	**5.1 J**	**270**	3.7 U	72 U	110 UJ	**260**	120 U	**280 J**
Phenol	**110 J**	41 U	**1,100**	51 U	190 U	290 UJ	**360 J**	590 U	**5,900 J**
Pyrene	**210**	**16**	**160 J**	**7.1 J**	98 U	140 UJ	81 U	**60 J**	280 UJ
VOCs (µg/kg)									
2-Butanone	**3.5 J**	23 U	**15 J**	**3 J**	**23 J**	NA	**460 J**	NA	NA
4-Methyl-2-pentanone	24 U	23 U	78 U	4.6 U	14 U	NA	750 U	NA	NA
Acetone	**35 J**	**18 J**	**230**	**15 J**	**130 J**	NA	**8,700 J**	NA	NA
Benzene	4.8 U	4.6 U	16 U	0.81 U	2.4 U	NA	**1,600**	NA	NA
Carbon disulfide	**5.5**	**2.3 J**	16 U	**2.2 J**	**13 J**	NA	**250 J**	NA	NA
Chlorobenzene	4.8 U	4.6 U	16 U	1.1 U	3.1 U	NA	**300 J**	NA	NA
Cyclohexane	9.6 U	9.2 U	31 U	1.4 U	4.2 U	NA	230 U	NA	NA
Isopropylbenzene	4.8 U	4.6 U	16 U	2.1 U	6.2 U	NA	**8,900**	NA	NA
Methyl acetate	9.6 U	9.2 U	31 U	5.5 U	16 U	NA	**2,200**	NA	NA
Methylcyclohexane	9.6 U	9.2 U	31 U	0.95 U	2.8 U	NA	**300 J**	NA	NA
Toluene	4.8 U	4.6 U	16 U	0.93 U	2.7 U	NA	**600 J**	NA	NA

Compound Name	SD-ODCC-02	SD-OD1N-05	SD-OD2T-05	SD-OD3T-06	SD-OD4N-05	SD-OD5S-01	SD-OD5S-05	SD-ODCN-01	SD-ODCS-01
Depth (ft)	0.5 - 2	6 - 8	6 - 8	8 - 10	6 - 8	0 - 0.5	6 - 8	0 - 0.5	0 - 0.5
Metals (mg/kg)									
Aluminum	**3,600**	**1,500**	**18,000**	**11,000**	**47,000**	NA	**32,000**	**1,700**	**12,000 J**
Arsenic	**1.6 J**	**3**	**3.6 J**	**8**	**15**	NA	**14**	**1 J**	**13 J**
Barium	**21**	**4**	**82**	**18**	**56**	NA	**36**	**7**	**84 J**
Beryllium	**0.12 J**	**0.21 J**	**0.43 J**	**1**	**2**	NA	**2**	**0.08 J**	**0.34 J**
Cadmium	**0.15 J**	0.57 U	**0.3 J**	0.15 U	0.29 U	NA	0.24 U	0.87 U	**0.71 J**
Calcium	**4,900**	**6,400**	**7,400**	**2,400**	**3,700**	NA	**6,500**	**23,000**	**12,000 J**
Chromium	**8**	**5**	**32**	**19**	**60**	NA	**47**	**4**	**45 J**
Cobalt	**0.76 J**	**0.49 J**	**2.1 J**	**3**	**9**	NA	**7**	**0.38 J**	**2.4 J**
Copper	**26**	2.8 U	**70**	**2.4 J**	**57**	NA	**70**	**3.8 J**	**68 J**
Iron	**3,600**	**2,400**	**12,000**	**12,000**	**36,000**	NA	**31,000**	**1,500**	**10,000 J**
Lead	**22**	**2**	**51**	**9**	**32**	NA	**31**	**5**	**45 J**
Magnesium	**1,800**	**400**	**3,700**	**1,500**	**6,400**	NA	**5,800**	**1,100**	**4,300 J**
Manganese	**45**	**23**	**120**	**71**	**460**	NA	**350**	**38**	**230 J**
Mercury	**1**	0.021 U	**1**	**0.024 J**	**0**	NA	**0**	**0.016 J**	**6.2 J**
Nickel	**3.9 J**	**0.89 J**	**14**	**4.2 J**	**20**	NA	**21**	**1.6 J**	**14 J**
Potassium	**720**	**160**	**1,400**	**870**	**3,600**	NA	**3,000**	**540**	**3,000**
Silver	1.3 U	1.1 U	2.7 U	0.14 U	0.28 U	NA	**9**	1.7 U	3.9 UJ
Sodium	**6,100**	**220 J**	**5,600**	**690**	**6,900**	NA	**3,100**	**3,000**	**16,000 J**
Vanadium	**9**	**5**	**28**	**28**	**85**	NA	**72**	**6**	**21 J**
Zinc	**140**	**4**	**190**	**15**	**82**	NA	**58**	**25**	**220 J**
Other (mg/kg)									
Cyanide, Total	0.71 U	0.6 U	**0.75 J**	0.31 U	0.6 U	NA	**1 J**	0.87 U	2 UJ
Total Organic Carbon	**38,000**	**1,500**	**270,000**	**5,400**	**72,000**	**35,000 J**	**77,000**	**4,000**	**110,000 J**

Dioxin data (pg/g)

Compound	SD-OD2T-04	SD-OD5C-02
Depth (ft)	4 - 6	0.5 - 2
1,2,3,4,6,7,8-HpCDD	**140**	**79 J**
1,2,3,4,6,7,8-HpCDF	**32**	**7.2 J**
1,2,3,4,7,8-HxCDF	**5.4 J**	2.8 UJ
1,2,3,6,7,8-HxCDD	**8**	4.2 UJ
1,2,3,7,8,9-HxCDD	ND	**6.1 J**
1,2,3,7,8-PeCDF	**11**	12 UJ
2,3,4,7,8-PeCDF	**11**	13 UJ
OCDD	**1,700**	**980 J**
OCDF	**78**	**12 J**
Total HpCDD	**420**	**270 J**
Total HpCDF	**93**	**15 J**
Total HxCDD	**72**	**140 J**
Total HxCDF	**52**	**28 J**
Total PeCDD	**12**	**7.6 J**
Total PeCDF	**470**	**1,200 J**
Total TCDD	**11**	**17 J**
Total TCDF	**1,300**	**810 J**

Notes:
U: not detected; J: estimated concentration; R: rejected; NA: not analyzed
Detected values are indicated in bold type.

Table 4. Summary of Detected Compounds in Surface Water, Terry Creek OU1 RI/FS

	Culvert Samples								Mouth Samples					
	SW-DCEB-01	SW-DCEB-02	SW-DCEB-03	SW-DCEB-04	SW-DCFL-01	SW-DCFL-02	SW-DCFL-03	SW-DCFL-04	SW-DMEB-01	SW-DMEB-02	SW-DMEB-03	SW-DMEB-04	SW-DMFL-01	SW-DMFL-02
Compound Name	ebb tide, filtered	ebb tide, unfiltered	ebb tide, filtered, wet weather	ebb tide, unfiltered, wet weather	flood tide, filtered	flood tide, unfiltered	flood tide, filtered, wet weather	flood tide, unfiltered, wet weather	ebb tide, filtered	ebb tide, unfiltered	ebb tide, filtered, wet weather	ebb tide, unfiltered, wet weather	flood tide, filtered	flood tide, unfiltered
Toxaphene (µg/L)														
Method 1 (Technical)	0.53 U	0.51 U	0.52 U	0.47 U	0.51 U	0.48 U	0.46 U	0.52 U	0.51 U	0.47 U	0.54 U	0.5 U	0.47 U	0.51 U
Method 2 (TAUC)	0.53 U	0.51 U	0.52 U	0.47 U	0.51 U	0.48 U	0.46 U	0.52 U	0.24 U	0.47 U	0.54 U	0.5 U	0.47 U	0.51 U
SVOCs (µg/L)														
Acetophenone	0.95 U	**0.39 J**	**0.11 J**	**0.11 J**	1.1 U	0.1 U	0.092 U	0.096 U	1 U	1 U	0.1 U	0.11 U	0.093 U	1 U
Benzaldehyde	0.095 U	**0.19 J**	**0.4 J**	**0.43 J**	0.11 U	0.1 U	0.092 U	0.096 U	0.1 U	0.1 U	0.1 U	0.11 U	0.093 U	0.1 U
Caprolactam	0.12 U	0.13 U	**24**	0.13 U	**0.18 J**	0.13 U	**0.21 J**	**0.15 J**	**0.25 J**	0.14 U	**0.2 J**	**0.19 J**	0.12 U	0.14 U
Diethyl phthalate	**0.12 J**	0.11 U	0.11 U	0.11 U	0.12 U	0.11 U	0.1 U	0.11 U	**0.11 J**	0.11 U	0.11 U	0.12 U	0.1 U	0.12 U
Naphthalene	0.095 U	0.1 U	0.1 U	**0.3**	0.11 U	0.1 U	0.092 U	0.096 U	0.1 U	0.1 U	0.1 U	0.11 U	0.093 U	0.1 U
VOCs (µg/L)														
Acetone	NA	**6.1 J**	NA	5 U	NA	5 U	NA	NA	NA	5 U	NA	NA	NA	5 UJ
Benzene	NA	**0.53 J**	NA	0.25 U	NA	0.25 U	NA	NA	NA	0.25 U	NA	NA	NA	0.25 U
Carbon tetrachloride	NA	**9**	NA	**0.66 J**	NA	0.5 UJ	NA	NA	NA	0.5 U	NA	NA	NA	0.5 U
Chlorobenzene	NA	**0.78 J**	NA	0.25 U	NA	0.25 U	NA	NA	NA	0.25 U	NA	NA	NA	0.25 U
Chloroform	NA	**3.3**	NA	**0.39 J**	NA	0.14 U	NA	NA	NA	0.14 U	NA	NA	NA	0.14 U
Ethylbenzene	NA	**2.3**	NA	**0.4 J**	NA	0.11 U	NA	NA	NA	0.11 U	NA	NA	NA	0.11 U
Isopropylbenzene	NA	**0.91 J**	NA	**0.16 J**	NA	0.1 U	NA	NA	NA	0.1 U	NA	NA	NA	0.1 U
Xylenes, Total	NA	**16**	NA	**2.5**	NA	0.2 U	NA	NA	NA	0.2 U	NA	NA	NA	**0.2 J**
Metals (mg/L)														
Aluminum	**0.07 J**	**0.11**	NA	**1.4**	0.05 U	**0.89**	0.05 U	**1.2**	0.05 U	**2**	0.05 U	**1.4**	0.05 U	**0.0029**
Arsenic	**0.0039**	**0.0037**	NA	**0.0057**	**0.0025**	**0.0031 J**	**0.0026**	**0.0034**	**0.0028**	**0.0032**	**0.0027**	**0.0031 J**	**0.0024 J**	**0.0029 J**
Barium	**0.086**	**0.088**	NA	**0.057**	**0.028**	**0.032**	**0.023**	**0.028**	**0.033**	**0.039**	**0.016**	**0.018 J**	**0.029**	**0.03**
Cadmium	0.00013 U	0.00013 U	NA	0.00026 U	0.00026 U	0.00026 U	0.00026 U	0.00052 U	**0.00017 J**	0.00065 U	0.00026 U	0.00052 U	0.00026 U	0.00026 U
Calcium	**84**	**84**	NA	**390**	**310**	**320**	**350**	**340**	**310**	**280**	**390**	**370**	**310**	**310**
Chromium	0.0025 U	0.0025 U	NA	0.0025 U	0.0025 U	0.005 U	0.0025 U	0.0025 U	0.0025 U	**0.0034 J**	0.0025 U	0.005 U	0.0025 U	**0.0026 J**
Cobalt	0.0005 U	0.0005 U	NA	**0.0011**	**0.0014**	**0.0012**	**0.00081**	**0.0011**	**0.00086**	**0.0015**	**0.00075**	**0.00092 J**	**0.0012**	**0.0013**
Copper	0.0011 U	**0.0012 J**	NA	**0.0015 J**	0.0011 U	0.0022 U	0.0011 U	0.0011 U	0.0011 U	**0.0012 J**	0.0011 U	0.0022 U	0.0011 U	0.0011 U
Iron	0.044 U	**0.17**	NA	**0.94**	0.044 U	**0.54**	0.044 U	**0.85**	0.044 U	**1.3**	0.044 U	**0.96**	0.044 U	**1**
Lead	**0.0021**	0.0005 U	NA	**0.001 J**	0.0005 U	0.0005 U	0.0005 U	**0.00078 J**	0.0005 U	0.0015 U	0.0005 U	0.001 U	0.0015 U	0.0015 U
Magnesium	**52**	**54**	NA	**1,100**	**1,100**	**1,100**	**1,200**	**1,000**	**980**	**940**	**1,200**	**1,100**	**1,100**	**1,100**
Manganese	**0.035**	**0.037**	NA	**0.21**	**0.099**	**0.14**	**0.091**	**0.12**	**0.095**	**0.12**	**0.0091**	**0.034**	**0.13**	**0.15**
Mercury	0.000091 U	0.000091 U	NA	0.000091 U	0.000091 U	0.000091 U	0.000091 U	0.000091 U	0.000091 U	0.000091 U	0.000091 U	**0.00012 J**	0.000091 U	0.000091 U
Nickel	0.002 U	0.002 U	NA	0.002 U	0.002 U	0.004 U	0.002 U	0.002 U	0.002 U	0.002 U	0.002 U	0.004 U	0.002 U	**0.0025 J**
Potassium	**9.6**	**10**	NA	**390**	**340**	**370**	**350**	**340**	**330**	**300**	**390**	**360**	**350**	**340**
Selenium	0.0011 U	0.0011 U	NA	0.0022 U	0.0022 U	0.0022 U	**0.0011 J**	0.0022 U	0.0022 U	0.0011 U	0.0044 U	0.0044 U	0.0022 U	0.0022 U
Sodium	**210**	**230**	NA	**9,300**	**8,200**	**8,300**	**9,700**	**9,000**	**8,000**	**7,800**	**10,000**	**9,300**	**8,800**	**8,700**
Vanadium	**0.0041 J**	**0.0045 J**	NA	**0.0074 J**	**0.0039 J**	0.0064 U	**0.0048 J**	**0.0074 J**	**0.0042 J**	**0.0083 J**	**0.0044 J**	0.013 U	**0.0042 J**	**0.0078 J**
Zinc	0.0084 U	**0.0099 J**	NA	**0.025 J**	**0.014 J**	0.017 U	**0.015 J**	**0.017 J**	**0.013 J**	0.017 U	**0.015 J**	0.034 U	**0.014 J**	**0.019 J**
Other (mg/L)														
Cyanide, Total	0.005 U	0.005 U		0.005 U	**0.006 J**	0.005 U	**0.013**	**0.0065 J**	**0.0062 J**	0.005 U	**0.0094 J**	**0.008 J**	0.005 U	0.005 U
Total Suspended Solids		**5.5**		**43**		**30**		**31**		**29**		**43**		**37**

	SW-DCSH-05	SW-DCSL-06	SW-DMSH-05	SW-DMSL-06
	high slack in culvert	low slack in culvert	high slack in mouth	low slack in mouth
Total Suspended Solids	**24**	5 U	**48**	**44**

NOTES:
U: not detected; J: estimated concentration
NA: not analyzed

Table 5. Summary of Detected Compounds in Pore Water, Terry Creek OU1 RI/FS

Compound Name	PW-ODPO-01 filtered	PW-ODPO-02 total	PW-ODPR-01 filtered	PW-ODPR-02 unfiltered
Toxaphene (µg/L)				
Method 1 (Technical)	**2.3 J**	9.5 U	0.49 U	0.49 U
Method 2 (TAUC)	**8.8**	**17**	0.49 U	0.49 U
SVOCs (µg/L)				
Benzaldehyde	**0.52 J**	**0.57 J**	**0.54 J**	**0.46 J**
Diethyl phthalate	0.11 U	0.12 U	**0.21 J**	**0.31 J**
Hexachlorocyclopentadiene	R	R	R	R
Phenol	**0.25 J**	**0.36 J**	0.13 U	**0.15 J**
VOCs (µg/L)				
Acetone	**10 J**	5 U	5 U	5 U
Methyl tert-butyl ether	0.2 U	0.2 U	**1.5 J**	**1.7 J**
Toluene	**0.33 J**	0.33 U	**0.37 J**	**0.63 J**
Metals (mg/L)				
Aluminum	0.05 U	**0.35**	0.05 U	**1.6**
Arsenic	**0.0016 J**	**0.002 J**	**0.0013 J**	**0.0021 J**
Barium	**0.098**	**0.1**	**0.14**	**0.18**
Calcium	**220**	**210**	**220**	**260**
Chromium	**0.0077**	**0.0032 J**	**0.0045 J**	**0.0094**
Cobalt	**0.0022**	**0.00039 J**	**0.00092**	**0.00092**
Copper	**0.0011 J**	**0.0019 J**	0.0011 U	**0.0048 J**
Iron	**0.091 J**	**0.41**	**0.064 J**	**1.3**
Lead	0.0005 U	0.0005 U	0.0005 U	**0.0043**
Magnesium	**580**	**590**	**290**	**330**
Manganese	**0.49**	**0.58**	**0.087**	**0.096**
Nickel	**0.0031 J**	0.002 U	0.002 U	**0.0024 J**
Potassium	**200**	**180**	**86**	**100**
Sodium	**5,300**	**5,000**	**1,900**	**2,200**
Vanadium	**0.0073 J**	**0.0053 J**	**0.0058 J**	**0.01**
Zinc	0.0084 U	0.0084 U	0.0084 U	**0.031**

Notes:
U: not detected; J: estimated concentration, R: rejected after data validation

Table 6. Summary of Detected Compounds in Sub-Surface Soil, Terry Creek OU1 RI/FS

Compound Name	SO-MNB6-01	SO-MNB7-01	SO-MNB8-01	SO-MNB9-01	SO-MSB1-01	SO-MSB2-01	SO-MSB3-01	SO-MSB4-01	SO-MSB5-01
Depth (ft)	6 - 8	6 - 8	6 - 8	6 - 8	6 - 8	6 - 8	6 - 8	6 - 8	8 - 10
Toxaphene (µg/kg)									
Method 1 (Technical)	**71 J**	**2,700**	**140**	**210 J**	39 U	37 U	44 U	37 U	37 U
Method 2 (TAUC)	**100**	**2,400**	**210**	**210**	39 U	37 U	44 U	37 U	37 U
Pesticides/PCBs (µg/kg)									
Aldrin	0.26 U	5.3 U	0.31 U	0.34 U	0.29 U	0.27 U	0.33 U	0.28 U	**1.3**
Dieldrin	0.16 U	3.3 U	0.19 U	0.21 U	**0.74 J**	**0.76 J**	**0.22 J**	**0.23 J**	**6.7**
SVOCs (µg/kg)									
2-Methylnaphthalene	39 U	39 U	4.5 U	51 U	**16**	4 U	4.9 U	4.1 U	**5.4 J**
Acetophenone	80 U	80 U	9.2 U	100 U	9 U	**8.6 J**	10 U	8.4 U	8.4 U
Benzaldehyde	**450**	**460**	45 U	510 U	**95**	**170**	15 U	12 U	41 U
Bis(2-ethylhexyl) phthalate	71 U	71 U	90 U	92 U	**400**	81 U	97 U	**560**	82 U
Di-n-butyl phthalate	200 U	200 U	23 U	260 U	**74 J**	21 U	25 U	**22 J**	**30 J**
Fluoranthene	39 U	39 U	4.5 U	51 U	4.4 U	**4.3 J**	4.9 U	4.1 U	4.1 U
Naphthalene	39 U	39 U	4.5 U	51 U	**11**	4 U	4.9 U	4.1 U	4.1 U
Phenanthrene	28 U	28 U	3.3 U	37 U	**8.5 J**	2.9 U	3.5 U	3 U	**6.6 J**
Pyrene	39 U	39 U	4.5 U	51 U	4.4 U	**5.3 J**	4.9 U	4.1 U	4.1 U
VOCs (µg/kg)									
2-Butanone	2.4 U	**11 J**	2.6 U	**6.7 J**	**5 J**	**3.2 J**	**8.9 J**	2.4 U	2.2 U
Acetone	50 U	52 U	55 U	68 U	**100**	**120**	**69**	50 U	46 U
Carbon disulfide	1.1 U	**2.1 J**	1.2 U	**9.4**	**2.9 J**	**4.3 J**	**13**	1.1 U	**13**
Metals (mg/kg)									
Aluminum	**6,100**	**7,800**	**5,000**	**7,900**	**8,600**	**18,000**	**11,000**	**11,000**	**4,300**
Arsenic	**0.67 J**	**1.5 J**	**0.98 J**	**25 J**	**12**	**6.1**	**5.8**	**6.5**	**3.4**
Barium	**8.4**	**12**	**21**	**9 J**	**53**	**120**	**14**	**9.1**	**10**
Beryllium	**0.1 J**	**0.32 J**	**0.1 J**	**0.18 J**	**0.51 J**	**0.69**	**0.26 J**	**0.13 J**	**0.11 J**
Calcium	**210**	**650**	**430**	**260 J**	**30,000**	**19,000**	**3,000**	**1,300**	**1,100**
Chromium	**9.1**	**8.8**	**8.9**	**14 J**	**14**	**24**	**17**	**11**	**5.6**
Cobalt	**0.32 J**	**0.5 J**	**0.23 J**	**0.38 J**	**3.1**	**6.5**	**1.2 J**	**0.44 J**	**0.3 J**
Copper	1.2 U	**1.6 J**	**3.5**	1.5 UJ	**20**	1.3 U	1.5 U	**1.3 J**	**4.4**
Iron	**1,800**	**2,300**	**2,900**	**16,000**	**15,000**	**16,000**	**11,000**	**12,000**	**7,800**
Lead	**3.8**	**6.5**	**3**	**5.3 J**	**50**	**8.9**	**9**	**5**	**4.2**
Magnesium	**380**	**780**	**360**	**900 J**	**2,100**	**2,500**	**1,000**	**460**	**330**
Manganese	**14**	**14**	**13**	**36 J**	**130**	**490**	**22**	**13**	**18**
Mercury	0.0088 U	**0.046**	0.0098 U	0.011 U	**0.069**	**0.049**	**0.056**	**0.021**	**0.0093 J**
Nickel	**0.7 J**	**1.2 J**	**0.76 J**	**1.4 J**	**5.7**	**7.5**	**2 J**	**1.4 J**	**1.1 J**
Potassium	**220**	**440**	**190**	**580**	**1,300**	**1,800**	**680**	**340**	**170**
Sodium	88 U	**310**	**460**	**1,000 J**	**2,900**	**2,000**	**580**	**98 J**	**150 J**
Vanadium	**7**	**13**	**5**	**25**	**21**	**26**	**30**	**21**	**8**
Zinc	**2.2**	**3.9**	**3.4**	**5.3 J**	**96**	**13**	**7.9**	**5**	**4.9**
Cyanide, Total	0.24 U	0.24 U	**0.39 J**	0.32 UJ	0.27 U	0.25 U	0.3 U	0.25 U	0.26 U

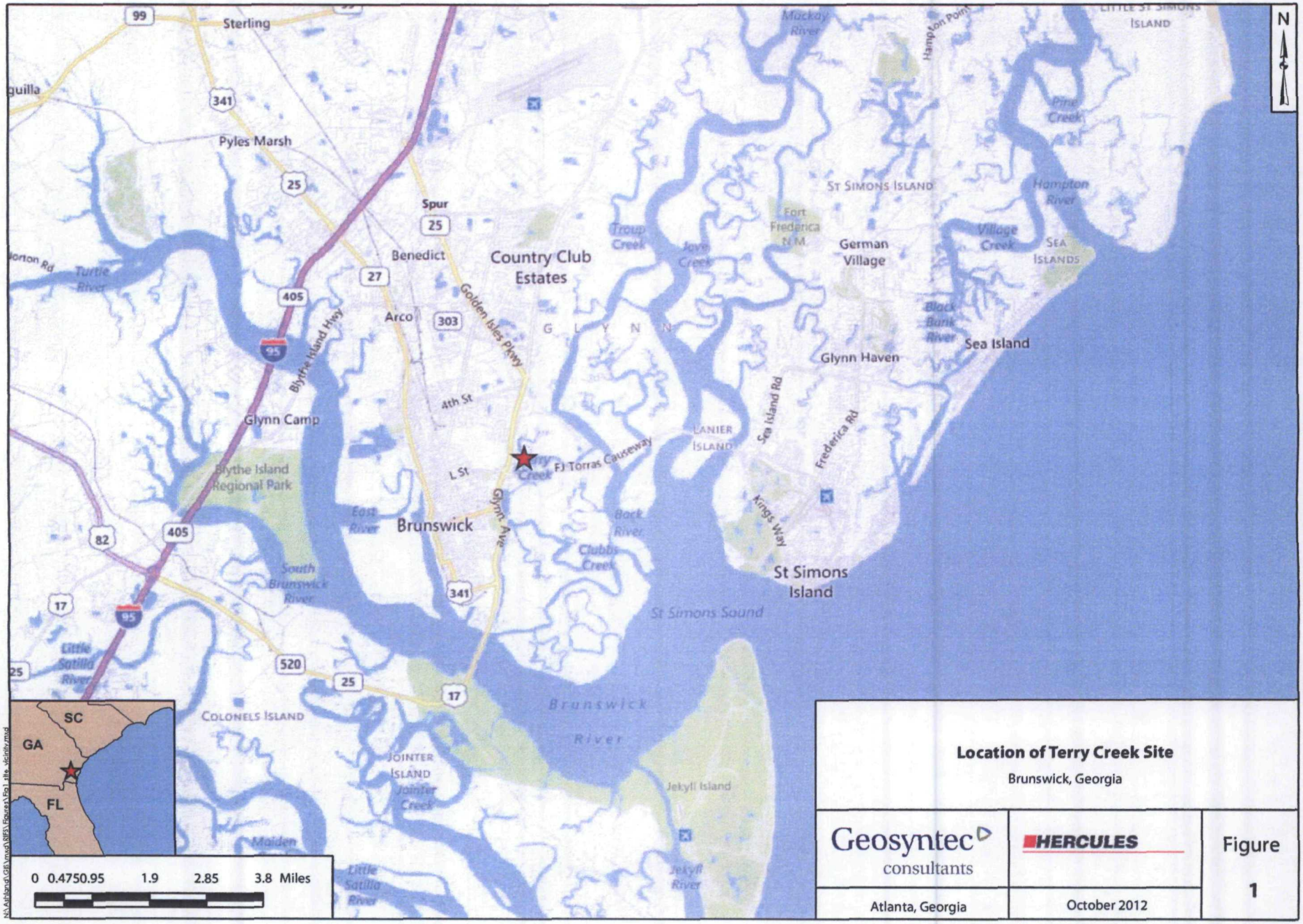
Notes:
U: not detected; J: estimated concentration, R: rejected after data validation

Table 7. Summary of Remedial Alternatives

No.	Remedial Alternative	Brief Description	Cost	Ease of Implementability	Effectiveness	Comments
1	**No Further Action**	Site monitoring, general maintenance; No further active remedidation	Low	Easy	Low	Retained for compliance with CERCLA.
2	**Monitored Natural Recovery**	Requires substantial data collection and modeling to predict future conditions	Medium	Moderate	Low	MNR may be occurring; however, elevated residual concentrations in Outfall Ditch sediments and the likely need to do maintenance dredging to keep the box culverts open and fully functional will expose deeper sediment with higher concentrations which results in poor effectiveness both short term and long term. Acceptable risk-based concentrations cannot be determined at this time without weathered toxaphene risk assessment; implementation of this alternative will require addtional long term monitoring and risk assessment to determine effectiveness and therefore does not meet the intent of a Focused Feasibiity Study to perform source control.
3	**Sediment Removal**	Removal of toxaphene contaminated sediment by dredging or excavation	High	Difficult	Low	Highest concentrations found at depth, which increases remedial complexity; all dredging leaves behind residual contamination; acceptable risk-based cleanup standards cannot be determined at this time without weathered toxaphene risk assessment; implementation of ths alternative is extremely difficult due to management of discharge flows, tidal flows, and groundwater influx while dredging/excavating below water table. Also, there is likelihood of recontamination from Dupree Creek after dredging/excavation.

4	**Containment**	*All options include removal of existing weir, installation of transition structure to manage sediment load from upstream, and installation of headwall/sheet pile wall at Dupree Creek with tidal valve to control the tide and potential recontamination issues.*				
4A	**Sheet Pile Channel**	Two parallel rows of sheet pile through Outfall Ditch with clean sand cap and armoring	Medium	Low	High	Significant excavation necessary to get to depth of box culvert for adequate flow which will expose deeper sediments with higher concentrations of toxaphene; subsurface obstructions (e.g., logs) expected, which increases complexity of sheet pile installation; installation of sheet pile in loose/soft soils will increase cost; signifcant armoring necessary to manage storm flow velocity.
4B	**Discharge Conveyance Pipe within Existing Ditch**	Pipe through Outfall Ditch, backfill ditch	Medium	Moderate	High	Significant excavation activities necessary to get to depth of box culvert for adequate flow; management of discharge and tidal flows during construction.
4C	**Sub-Aqueous Cap**	Cap existing sediments	Medium	Moderate	Medium	Significant excavation activities necessary to get to depth of box culvert for adequate flow; signifcant armoring necessary to manage storm flows. Potential recontamination issues from Dupree Creek. Cap design will need to address groundwater upwelling pressure and armoring for resistance to erosional forces. Pilot study may need to be perfromed to evalute performance of different cap materials (sand, aquablok and fabriform).
4D	**Backfill Existing Ditch and Re-Route Channel**	Excavate new channel for discharge flow to Dupree Creek	Medium	Moderate	High	Excavation of new channel through high water table. Management of water during backfill of existing channel. Depending on subgrade concentrations, a liner may need to be installed along the alignment of the new ditch.
	Backfill Existing Ditch and Re-Route as Pipe	Excavate new channel for pipe placement to carry discharge flow to Dupree Creek	Medium	Moderate	High	Excavation of new pipe location through high water table. Management of water during backfill of existing channel.

FIGURES



Location of Terry Creek Site

Brunswick, Georgia

Geosyntec consultants

HERCULES

Figure 1

Atlanta, Georgia

October 2012

Terry Creek Site Operable Units

Brunswick, Georgia

Geosyntec consultants	HERCULES	Figure
Atlanta, Georgia	October 2012	2

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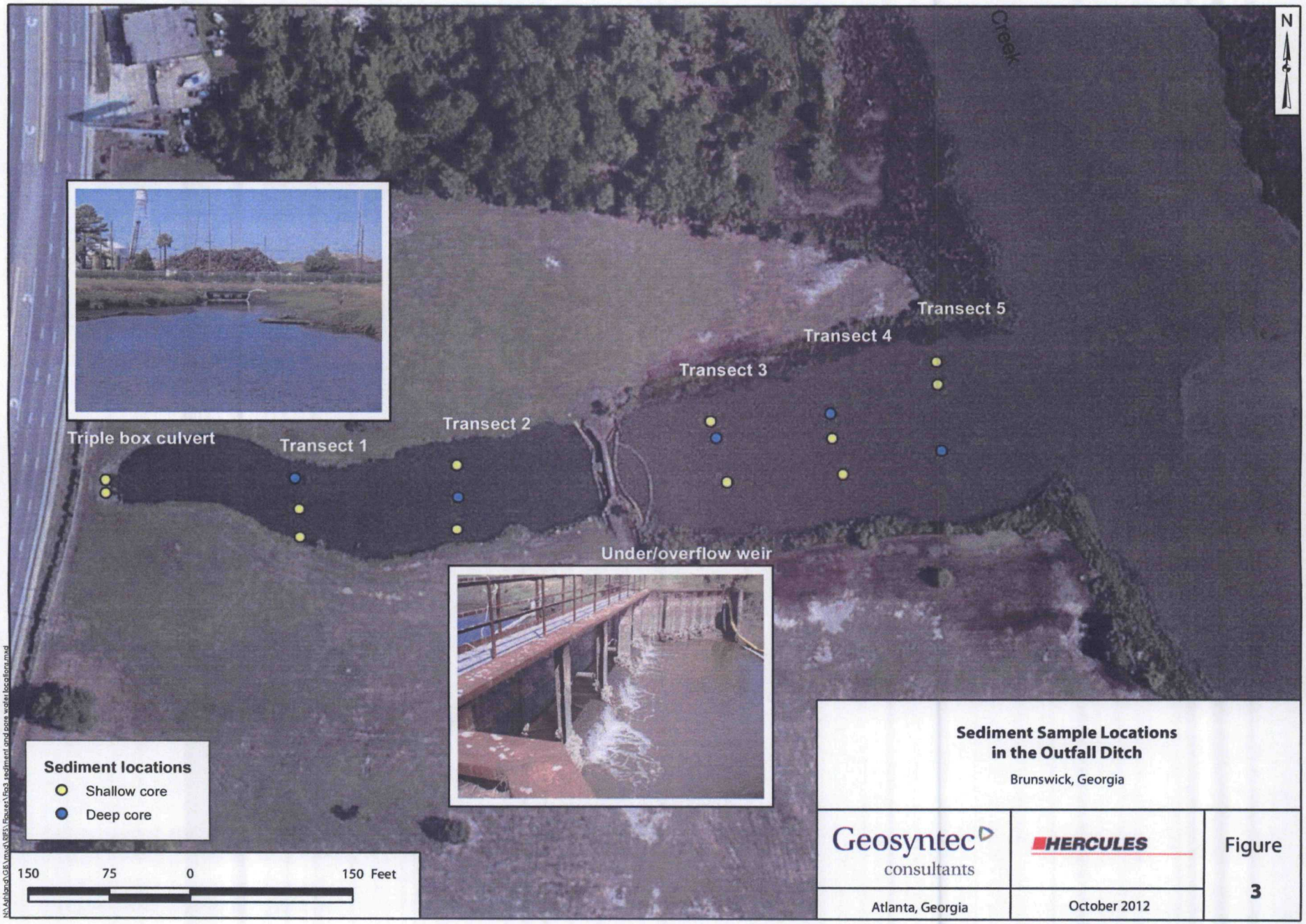
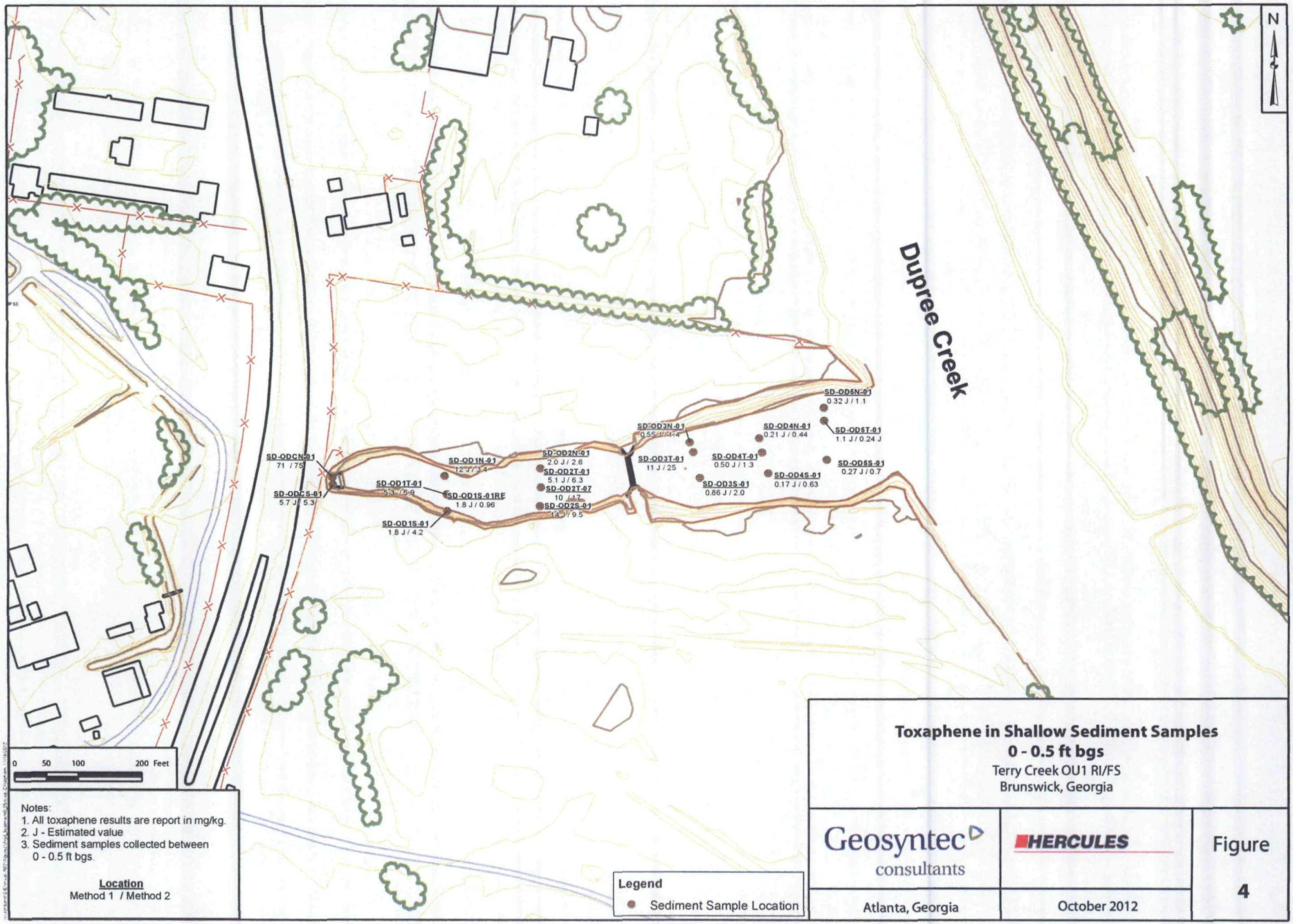


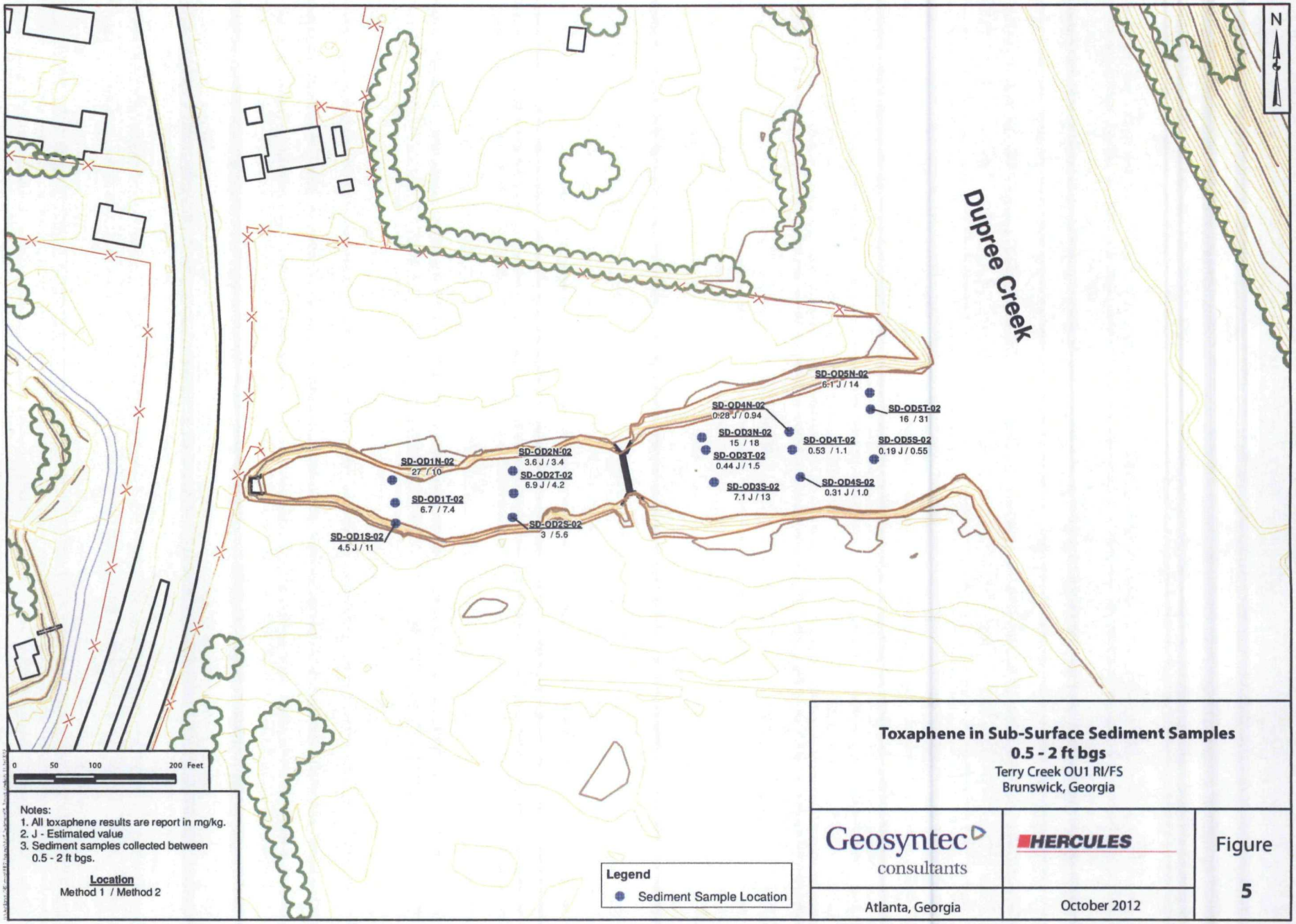
Sediment Sample Locations in the Outfall Ditch

Brunswick, Georgia

Geosyntec consultants	HERCULES	Figure
Atlanta, Georgia	October 2012	3

N:\Ashland\GIS\mxd\RFS\Figure1\fig3 sediment and pore water locations.mxd


N
Dupree Creek
SD-OD6N-01
0.32 J / 1.1
SD-OD5T-01
1.1 J / 0.24 J
SD-OD4N-01
0.21 J / 0.44
SD-OD3N-01
0.55 J / 4.4
SD-OD4T-01
0.50 J / 1.3
SD-OD6S-01
0.27 J / 0.7
SD-OD4S-01
0.17 J / 0.63
SD-OD3T-01
11 J / 25
SD-OD3S-01
0.86 J / 2.0
SD-OD2N-01
2.0 J / 2.6
SD-OD2T-01
5.1 J / 6.3
SD-OD2T-07
10 J / 17
SD-OD2S-01
14 J / 9.5
SD-OD1N-01
12 J / 3.4
SD-OD1S-01RF
1.8 J / 0.96
SD-OD1S-01
1.8 J / 4.2
SD-OD1T-01
3.3 J / 5.9
SD-ODCN-01
71 / 75
SD-ODCS-01
5.7 J / 5.3
0 50 100 200 Feet
Notes:
1. All toxaphene results are report in mg/kg.
2. J - Estimated value
3. Sediment samples collected between 0 - 0.5 ft bgs.
Location
Method 1 / Method 2
Legend
Sediment Sample Location
Toxaphene in Shallow Sediment Samples
0 - 0.5 ft bgs
Terry Creek OU1 RI/FS
Brunswick, Georgia
Geosyntec consultants
HERCULES
Figure
4
Atlanta, Georgia
October 2012



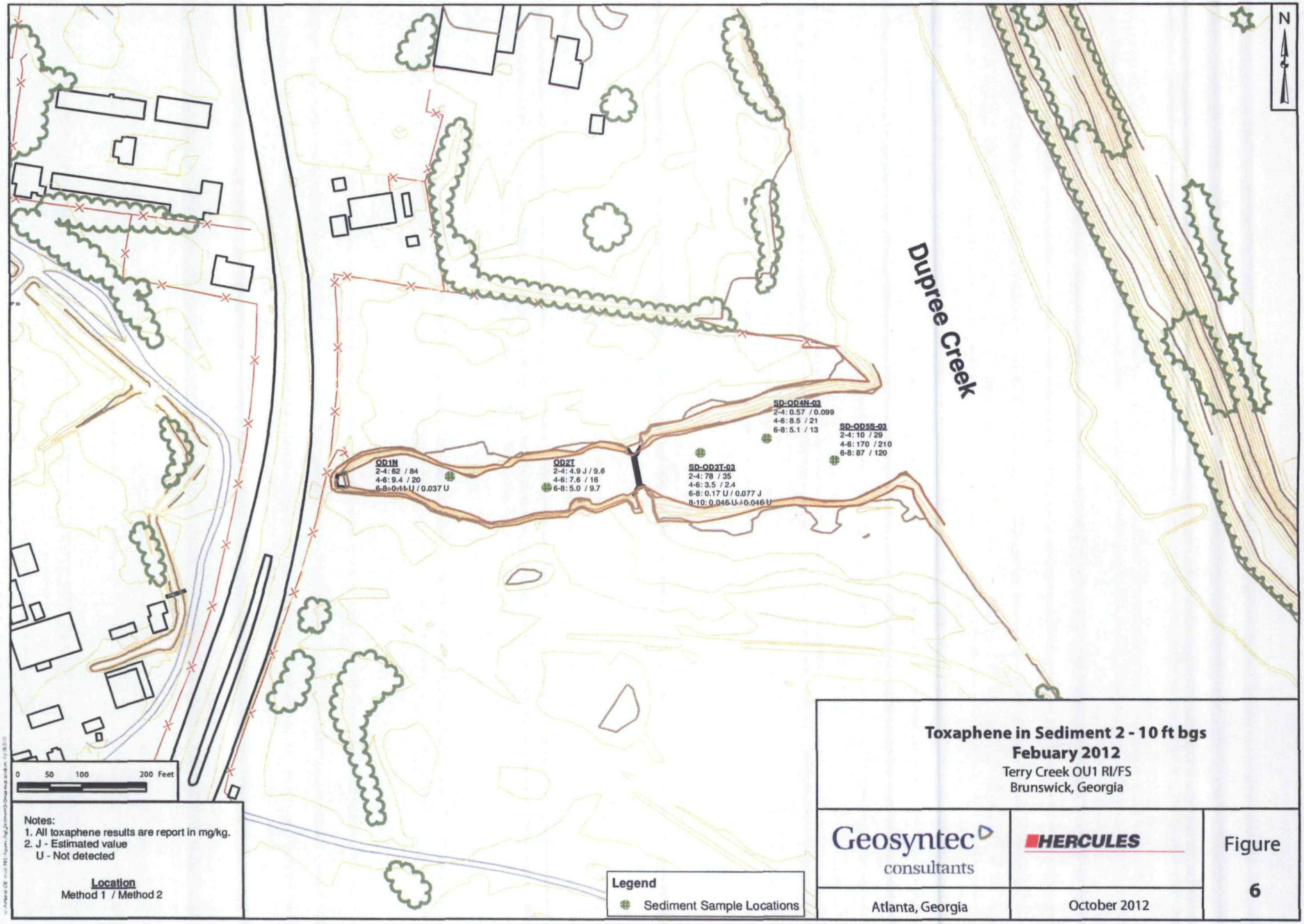
Notes:
1. All toxaphene results are report in mg/kg.
2. J - Estimated value
3. Sediment samples collected between 0.5 - 2 ft bgs.

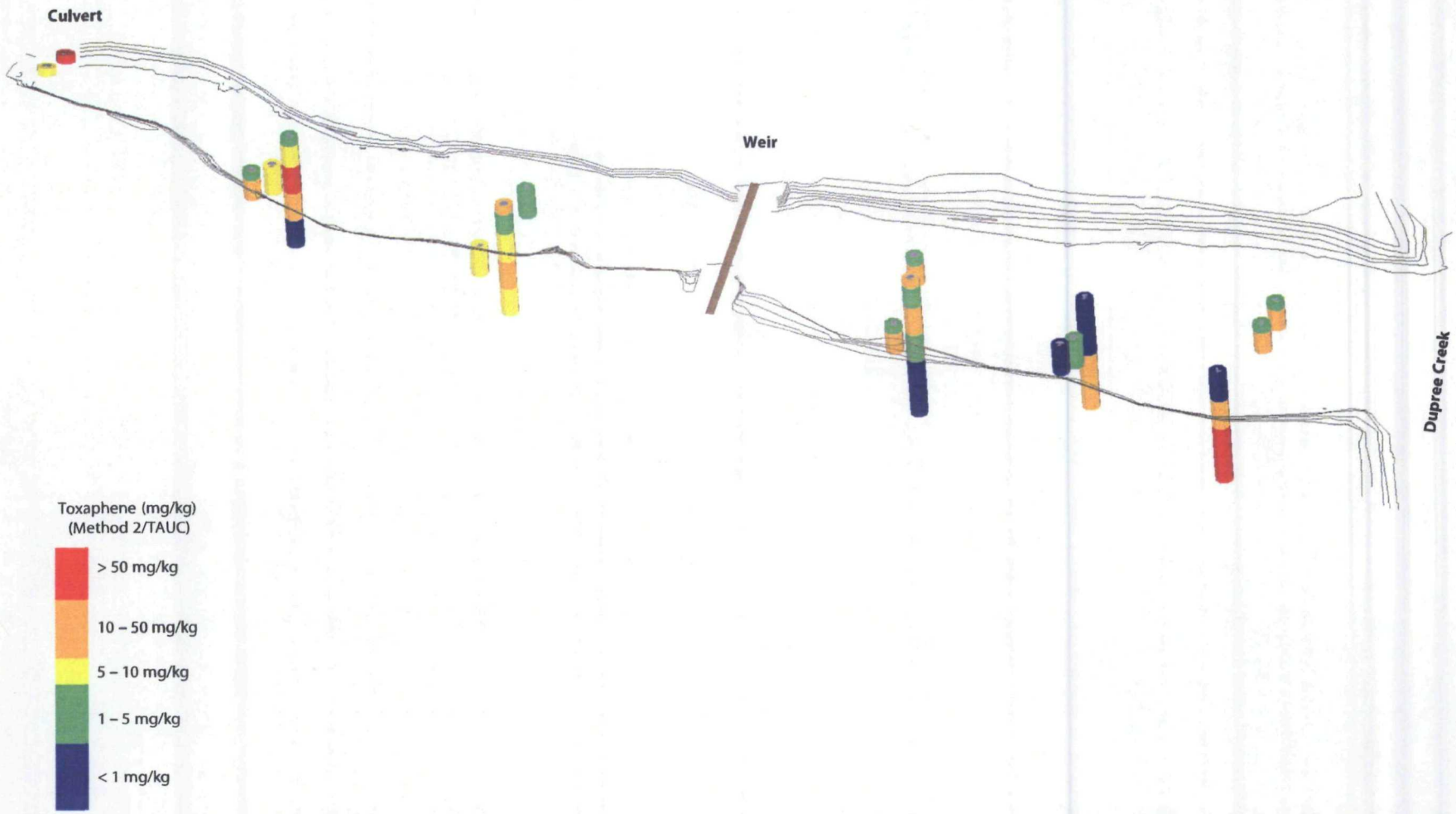
Location
Method 1 / Method 2

Toxaphene in Sub-Surface Sediment Samples
0.5 - 2 ft bgs
Terry Creek OU1 RI/FS
Brunswick, Georgia

Geosyntec consultants | HERCULES | Figure 5

Atlanta, Georgia | October 2012


N
Dupree Creek
OD1N
2-4: 62 / 84
4-6: 9.4 / 20
6-8: 0.11 U / 0.037 U
OD2T
2-4: 4.9 J / 9.6
4-6: 7.6 / 16
6-8: 5.0 / 9.7
SD-OD3T-03
2-4: 78 / 35
4-6: 3.5 / 2.4
6-8: 0.17 U / 0.077 J
8-10: 0.046 U / 0.046 U
SD-OD4N-03
2-4: 0.57 / 0.099
4-6: 8.5 / 21
6-8: 5.1 / 13
SD-OD5S-03
2-4: 10 / 29
4-6: 170 / 210
6-8: 87 / 120
0 50 100 200 Feet
Notes:
1. All toxaphene results are report in mg/kg.
2. J - Estimated value
U - Not detected
Location
Method 1 / Method 2
Legend
Sediment Sample Locations
Toxaphene in Sediment 2 - 10 ft bgs
Febuary 2012
Terry Creek OU1 RI/FS
Brunswick, Georgia
Geosyntec consultants
HERCULES
Figure
6
Atlanta, Georgia
October 2012



Toxaphene Concentrations in Core Samples

Terry Creek OU1 RI/FS
Brunswick, Georgia

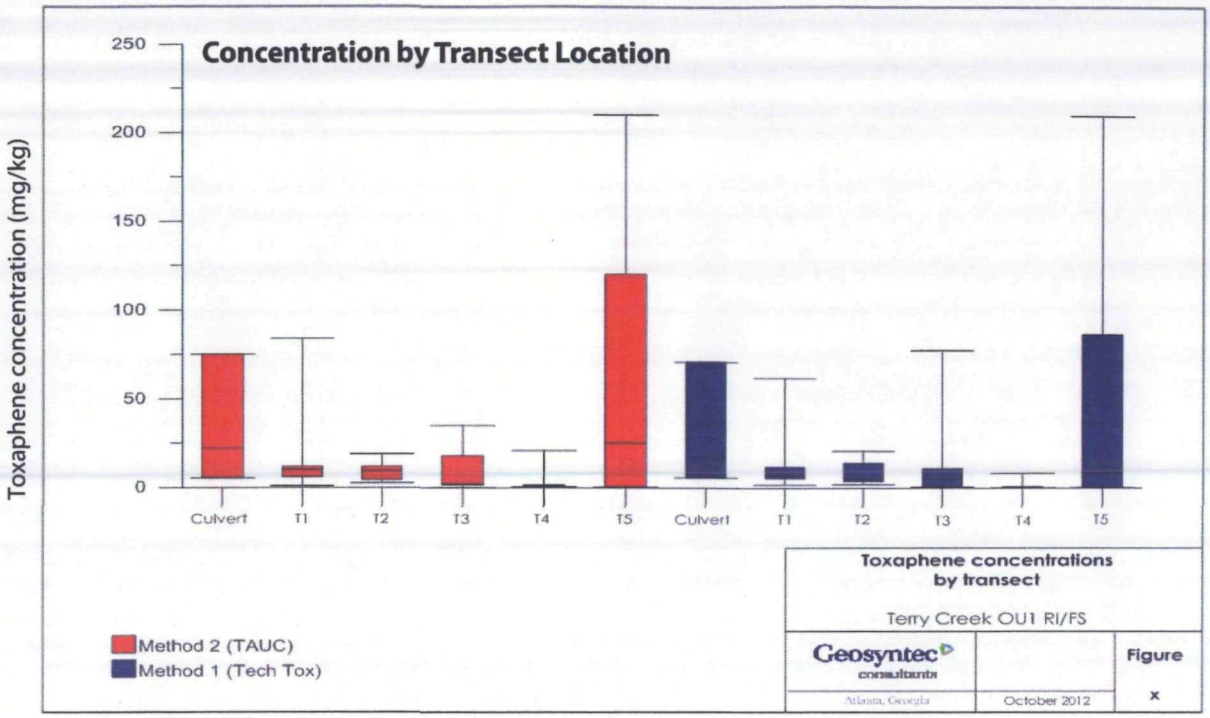
Geosyntec consultants
Atlanta, Georgia

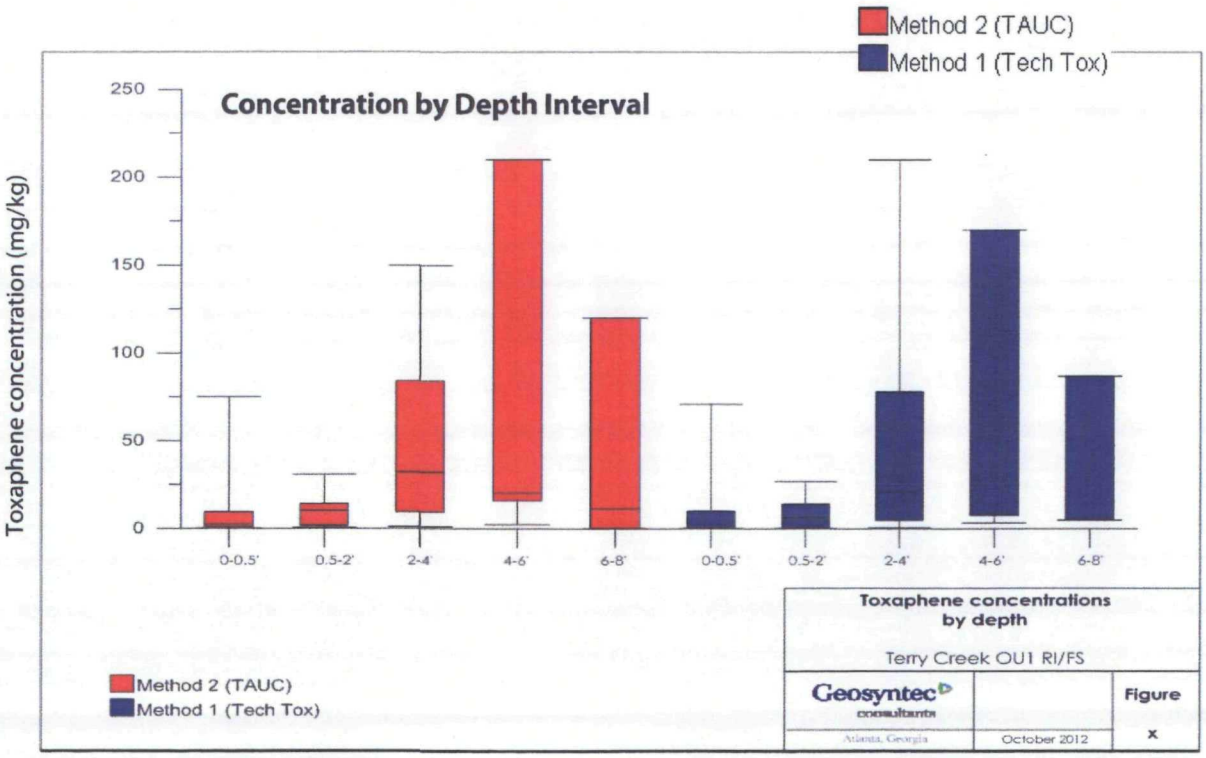
HERCULES

October 2012

Figure 7

N:\Athens\OU1 RIFS Report\Tech Memo\Figures and Tables\Fig7_toxaphene in cores.ppt

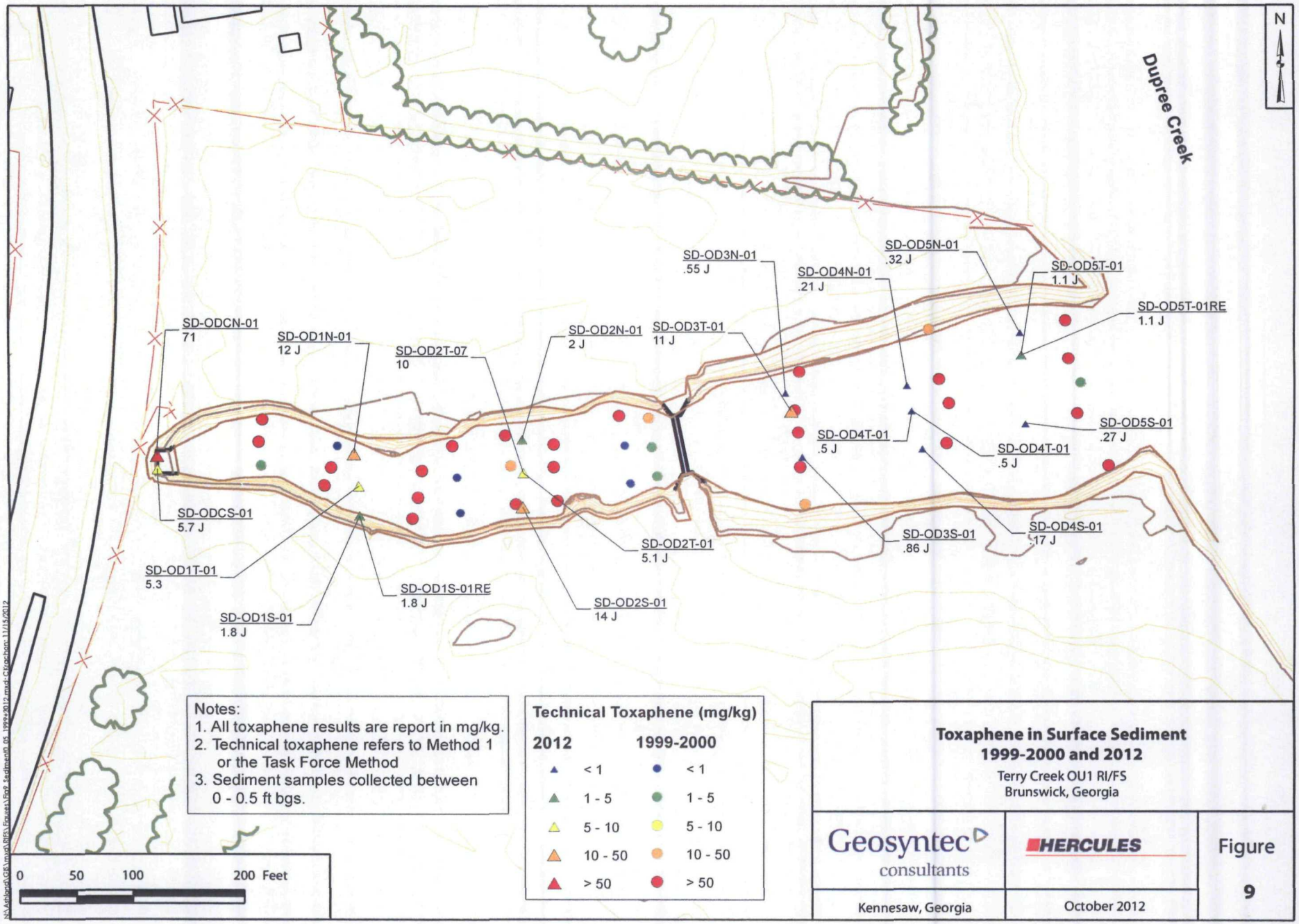


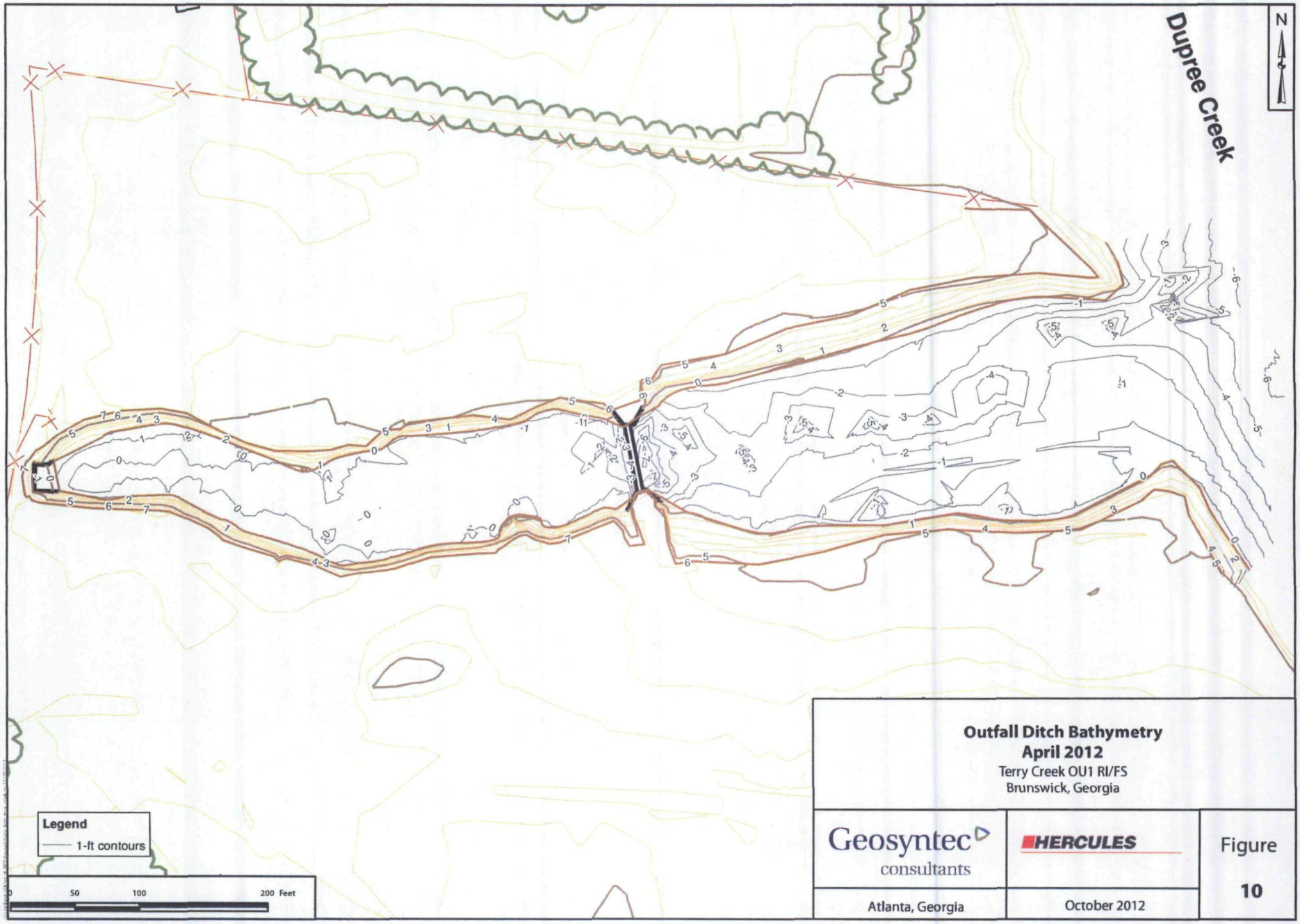


NOTE:
Data distributions presented as box-whisker plots, as defined here:

Distribution of Toxaphene Concentrations Terry Creek OU1 RI/FS Brunswick, Georgia	Geosyntec consultants Atlanta, Georgia	HERCULES October 2012	Figure 8

N:\Ashland\OU1 RI\5 Report\Tech Memo\Figures and Tables\Fig8_toxaphene box-whisker.ppt


N
Dupree Creek
SD-ODCN-01
71
SD-OD1N-01
12 J
SD-OD2T-07
10
SD-OD2N-01
2 J
SD-OD3T-01
11 J
SD-OD3N-01
.55 J
SD-OD4N-01
.21 J
SD-OD5N-01
.32 J
SD-OD5T-01
1.1 J
SD-OD5T-01RE
1.1 J
SD-OD5S-01
.27 J
SD-OD4T-01
.5 J
SD-OD4T-01
.5 J
SD-OD4S-01
.17 J
SD-OD3S-01
.86 J
SD-OD2T-01
5.1 J
SD-OD2S-01
14 J
SD-ODCS-01
5.7 J
SD-OD1T-01
5.3
SD-OD1S-01RE
1.8 J
SD-OD1S-01
1.8 J
0 50 100 200 Feet
Notes:
1. All toxaphene results are report in mg/kg.
2. Technical toxaphene refers to Method 1 or the Task Force Method
3. Sediment samples collected between 0 - 0.5 ft bgs.
Technical Toxaphene (mg/kg)
2012
1999-2000
< 1
1 - 5
5 - 10
10 - 50
> 50
Toxaphene in Surface Sediment
1999-2000 and 2012
Terry Creek OU1 RI/FS
Brunswick, Georgia
Geosyntec consultants
HERCULES
Figure
9
Kennesaw, Georgia
October 2012



Outfall Ditch Bathymetry
April 2012
Terry Creek OU1 RI/FS
Brunswick, Georgia

Geosyntec consultants	HERCULES	Figure
Atlanta, Georgia	October 2012	10

Elevations Table			
Number	Minimum Elevation	Maximum Elevation	Color
1	0.000	1.000	
2	1.000	2.000	
3	2.000	3.000	
4	3.000	4.000	
5	4.000	5.000	
6	5.000	6.000	
7	6.000	7.000	
8	7.000	8.000	
9	8.000	9.000	
10	9.000	10.000	
11	10.000	11.000	
12	11.000	12.000	

NOTE:
Elevation change calculated where

Sediment elevation change: 1999-2012

Terry Creek OU1 RI/FS
Brunswick, Georgia

Geosyntec consultants
Atlanta, Georgia

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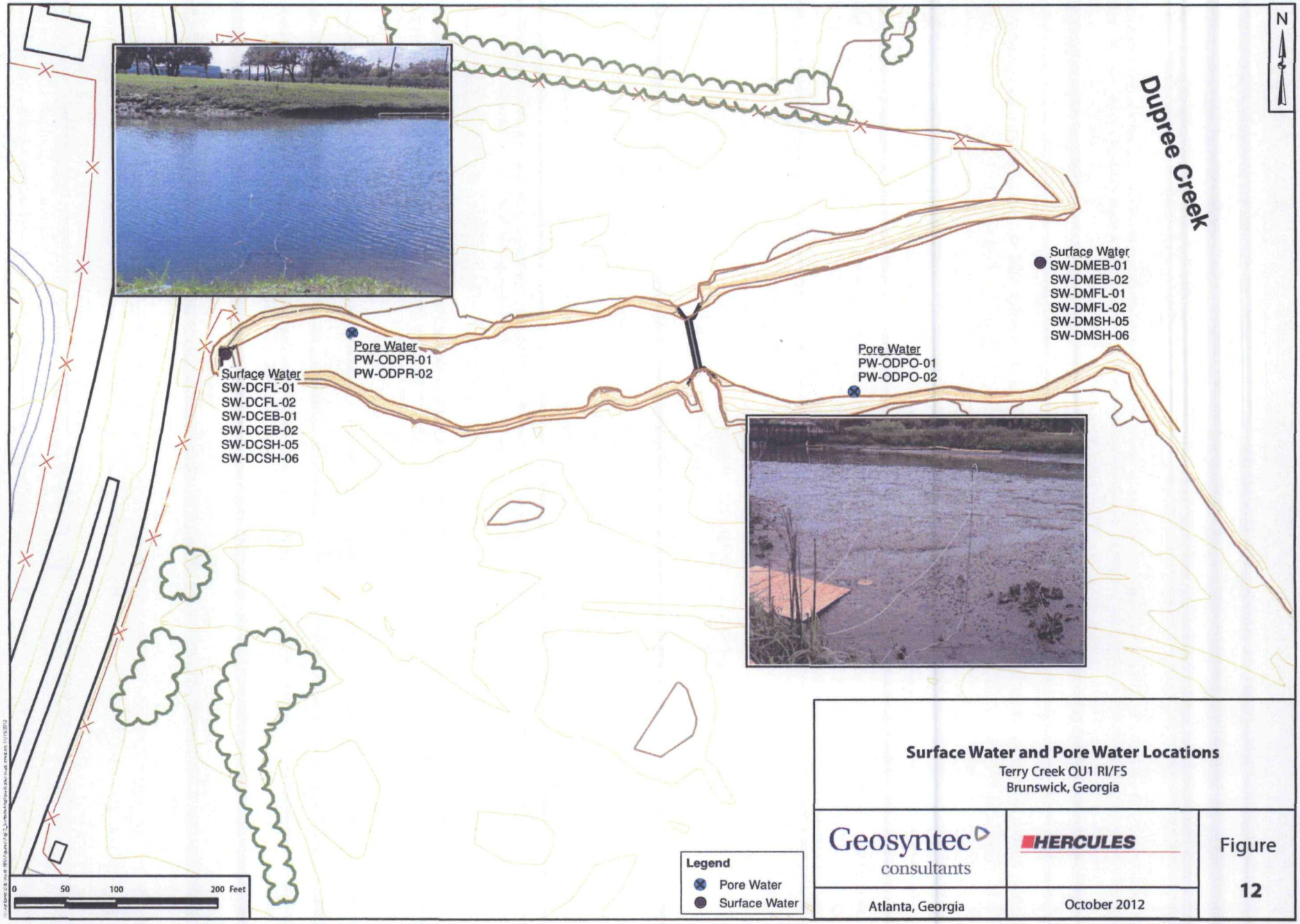
October 2012

Figure 11

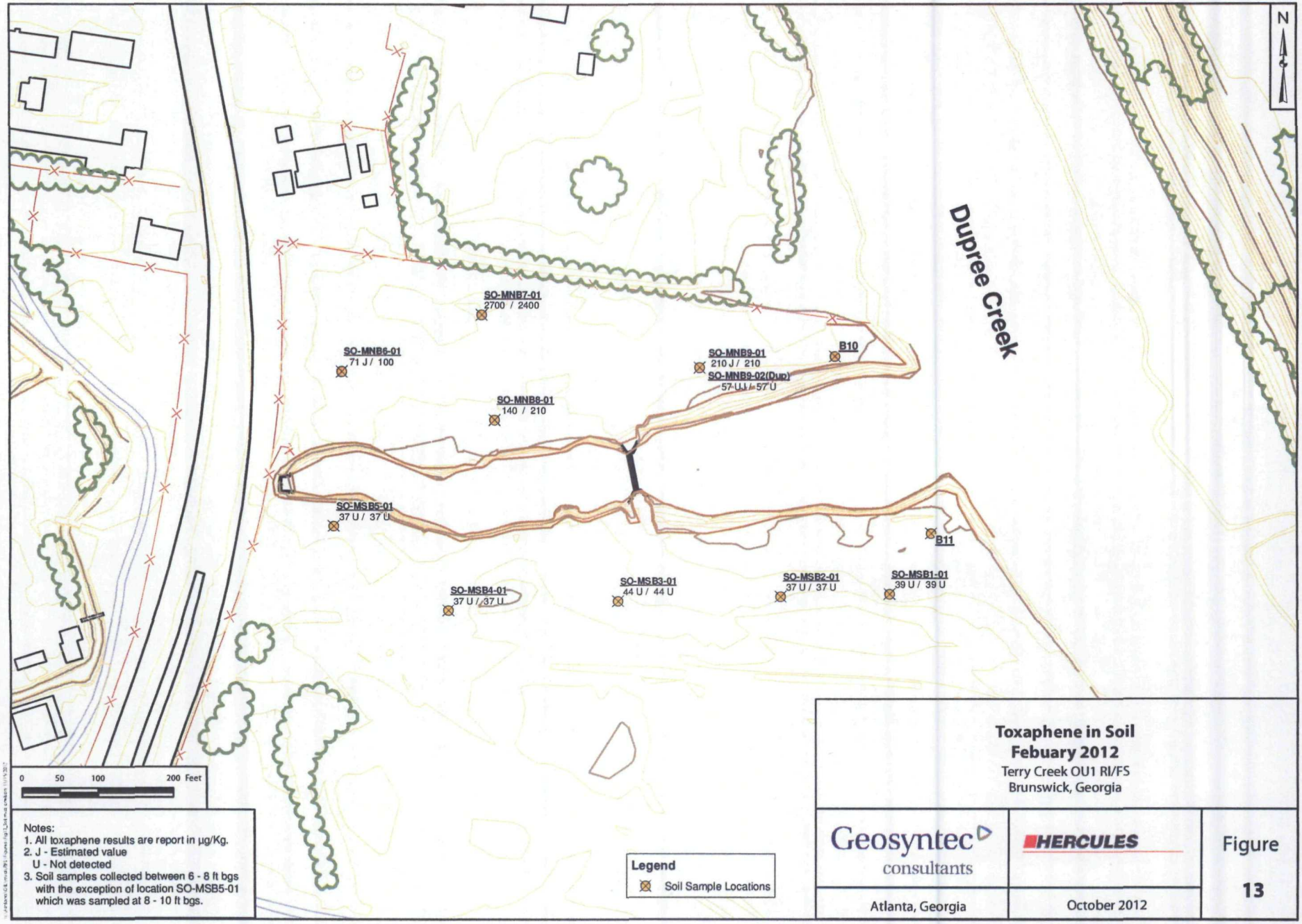
N:\Ashland\OU1 RIFS Report\Tech Memo\Figures and Tables\Fig11_sediment elevation change.pdf



Surface Water and Pore Water Locations
Terry Creek OU1 RI/FS
Brunswick, Georgia

Geosyntec consultants | HERCULES | Figure 12

Atlanta, Georgia | October 2012



Notes:
1. All toxaphene results are report in µg/Kg.
2. J - Estimated value
   U - Not detected
3. Soil samples collected between 6 - 8 ft bgs with the exception of location SO-MSB5-01 which was sampled at 8 - 10 ft bgs.

Toxaphene in Soil
Febuary 2012
Terry Creek OU1 RI/FS
Brunswick, Georgia

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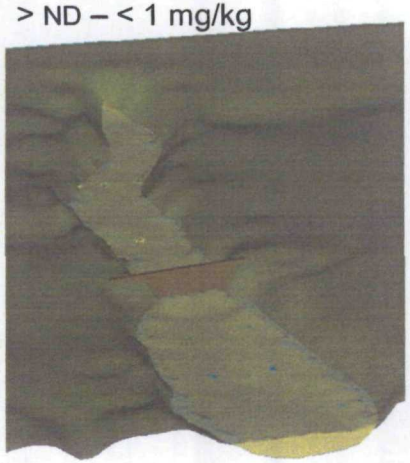
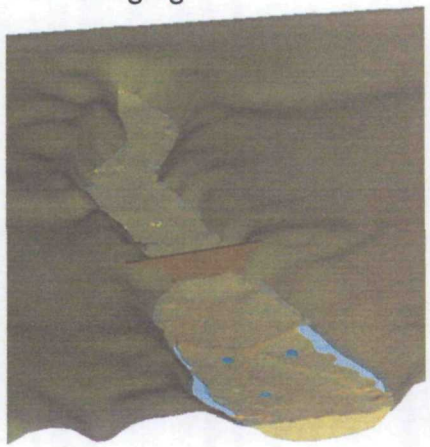
October 2012

Figure 13

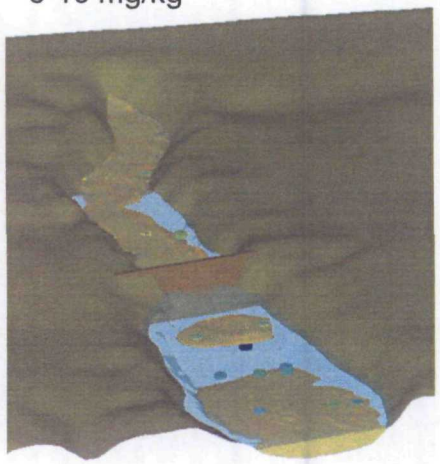
> ND – < 1 mg/kg



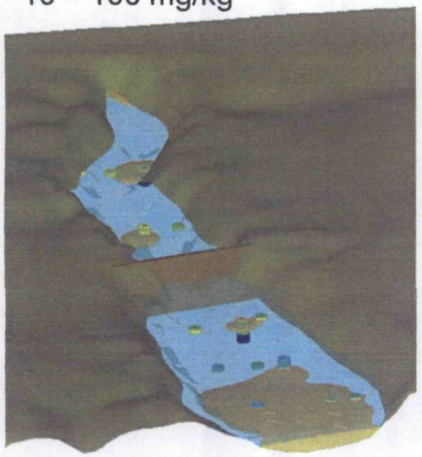
1 – 5 mg/kg



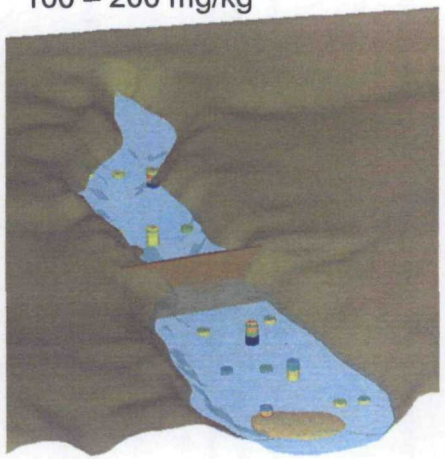
5-10 mg/kg



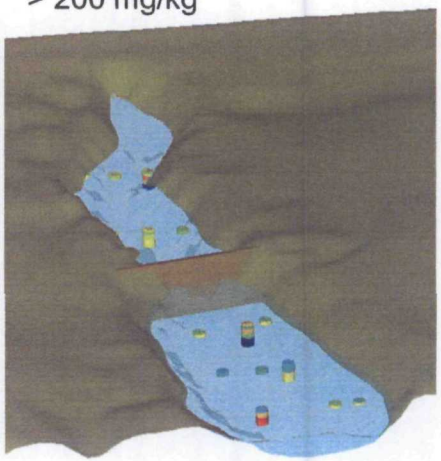
10 – 100 mg/kg



100 – 200 mg/kg



> 200 mg/kg



Volume of toxaphene-impacted sediment at specified concentration

Concentration mg/kg	Volume yd^3
ND - 1	17,121
1 - 5	15,742
5 - 10	8,150
10 - 100	3,891
100 - 200	389
> 200	<1

NEED TO UPDATE TABLE

Volume of toxaphene contaminated sediment

Terry Creek OU1 RI/FS
Brunswick, Georgia

Geosyntec consultants
Atlanta, Georgia

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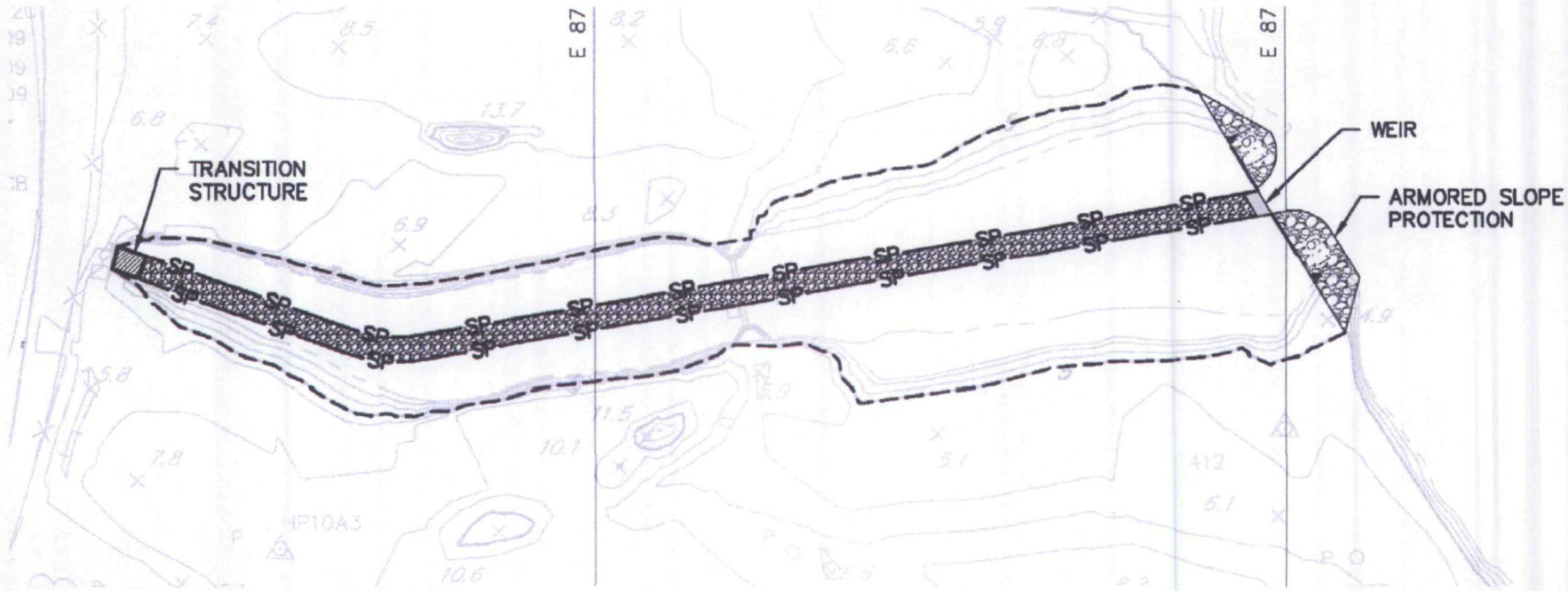
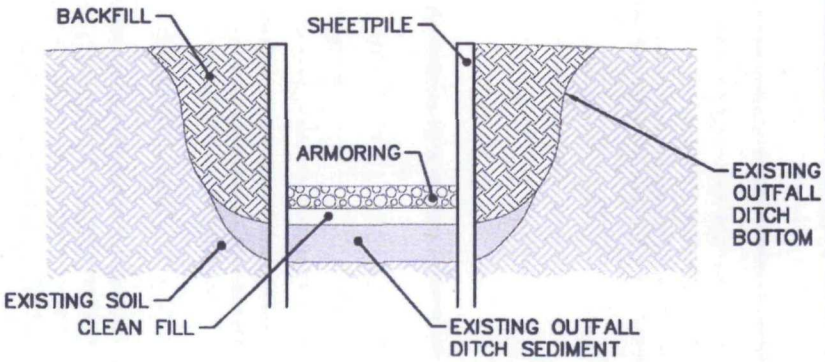
Figure 14

"N:\Ashland\OU1 RIFS Report\Tech Memo\Figures and Tables\Fig14_toxaphene volumes.ppt"





Remedial Alternative Conceptual Design
Sheet Pile Channel
Terry Creek OU1 RI/FS
Brunswick, Georgia

Geosyntec consultants
Atlanta, Georgia

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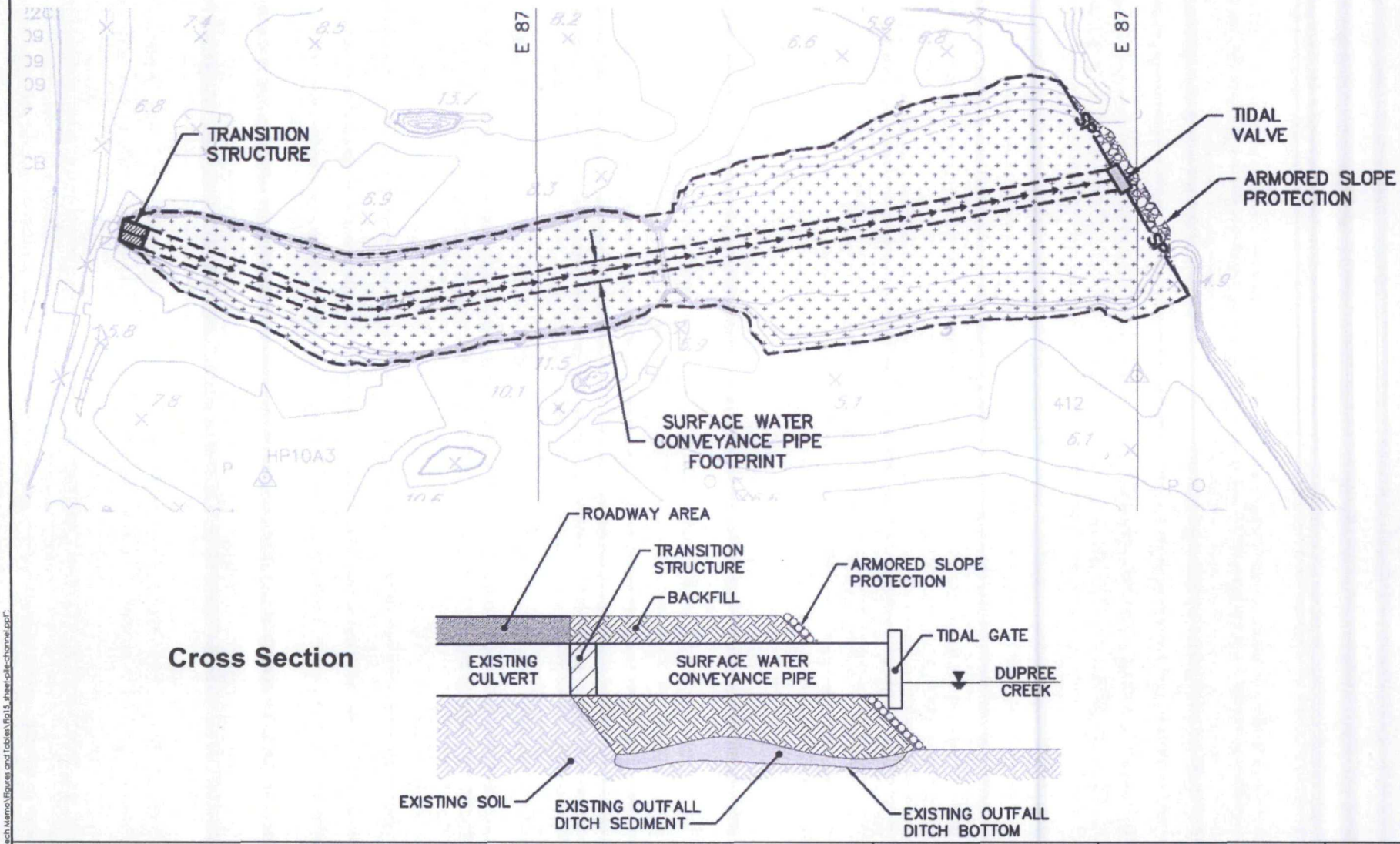
October 2012

Figure
15

N:\Ashland\OU1 RI\FS Report\Tech Memo\Figures and Tables\fig15_sheet-pile-channel.pdf



Remedial Alternative Conceptual Design
Discharge Conveyance Pipe
Terry Creek OU1 RI/FS
Brunswick, Georgia

Geosyntec consultants
Atlanta, Georgia

HERCULES
October 2012

Figure
16

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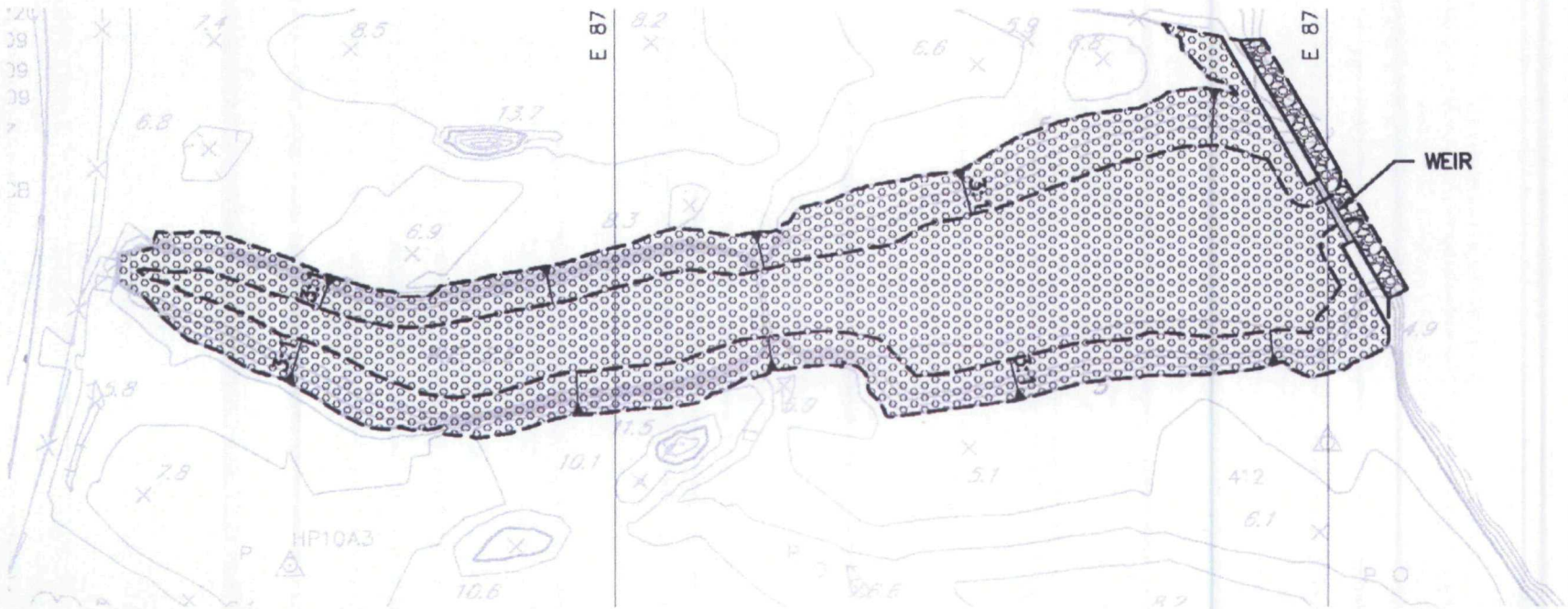
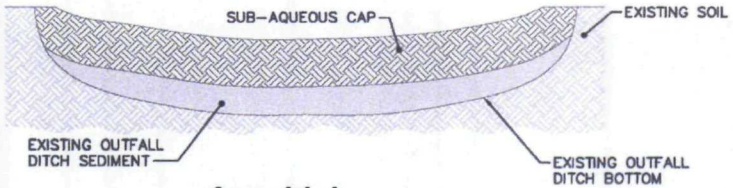
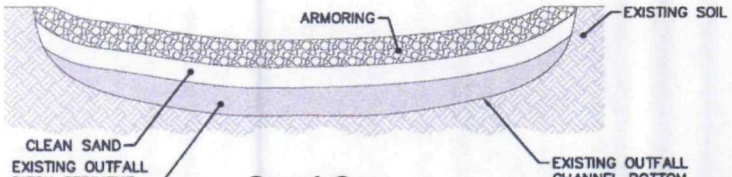


Cross Sections



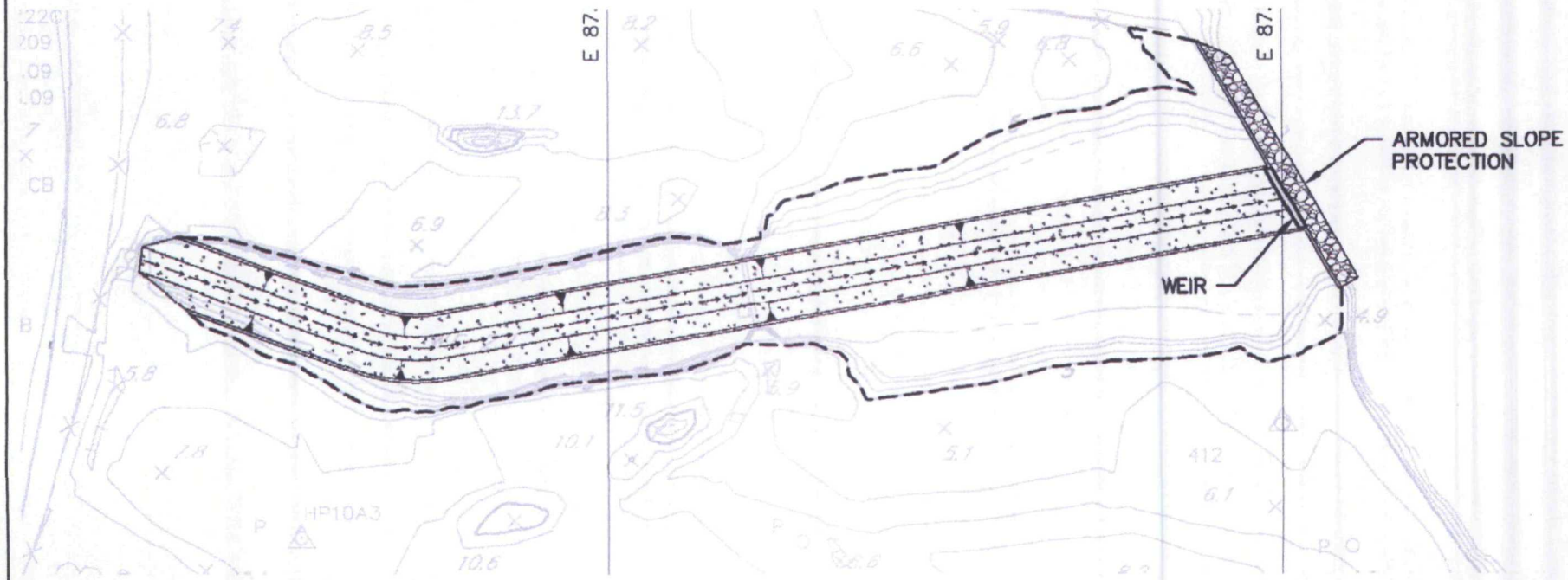
Aquablok



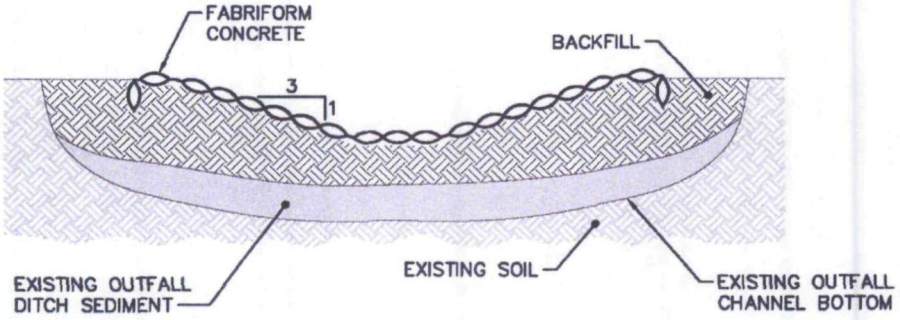
Sand Cap

Remedial Alternative Conceptual Design **Sub-Aqueous Cap** Terry Creek OU1 RI/FS Brunswick, Georgia	Geosyntec consultants Atlanta, Georgia	HERCULES October 2012	**Figure** **17**

N:\Ashland\OU1 RIFS Report\Tech Memo\Figures and Tables\Fig15_sheet-pile-channel.ppt



Cross Section



Remedial Alternative Conceptual Design
Fabriform Ditch
Terry Creek OU1 RI/FS
Brunswick, Georgia

Geosyntec consultants
Atlanta, Georgia

HERCULES
October 2012

Figure 18

N:\Ashland\OU1 RIFS Report\Tech Memo\Figures and Tables\Fig15_sheet-pile-channel.ppt

Remedial Alternative Conceptual Design
Backfill and Re-Route
Terry Creek OU1 RI/FS
Brunswick, Georgia

Geosyntec consultants
Atlanta, Georgia

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October 2012

Figure
19

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APPENDIX A

Analytical Results for Sediment Sampling

Table A-1. Analytical Results for Sediment Samples, Terry Creek OU1 RI/FS

Compound Name	SD-OD1C-01	SD-OD1C-02	SD-OD1N-05	SD-OD2C-01	SD-OD2C-02	SD-OD2T-05	SD-OD3C-01	SD-OD3C-02	SD-OD3T-06	SD-OD4C-01
Depth (ft)	0 - 0.5	0.5 - 2	6 - 8	0 - 0.5	0.5 - 2	6 - 8	0 - 0.5	0.5 - 2	8 - 10	0 - 0.5
Toxaphene (µg/kg)										
Method 1 (Technical)	5400 J	8,200	110 U	21,000 J	14,000 J	5,000	630 J	7,900	46 U	190 J
Method 2 (TAUC)	10,000	12,000	37 U	19,000	12,000	9,700	1,500	12,000	46 U	610
Pesticides (µg/kg)										
4,4-DDD	38 UJ	110 U	2 U	600 UJ	150 UJ	90 U	29 UJ	110 U	0.18 U	2.3 UJ
4,4-DDE	38 UJ	110 U	2 U	600 UJ	150 UJ	90 U	29 UJ	110 U	0.15 U	1.8 UJ
4,4-DDT	38 UJ	110 U	2 U	600 UJ	150 UJ	90 U	29 UJ	110 U	0.18 U	2.2 UJ
Aldrin	19 UJ	55 U	1.1 U	310 UJ	44 J	58	15 UJ	56 U	0.35 U	4.3 UJ
alpha-BHC	19 UJ	55 U	1.1 U	310 UJ	77 UJ	47 U	15 UJ	56 U	0.085 U	1 UJ
alpha-Chlordane	19 UJ	55 U	1.1 U	310 UJ	77 UJ	47 U	15 UJ	56 U	0.11 U	1.3 UJ
beta-BHC	19 UJ	55 U	1.1 U	310 UJ	77 UJ	47 U	15 UJ	56 U	0.085 U	1 UJ
delta-BHC	19 UJ	55 U	1.1 U	310 UJ	77 UJ	47 U	15 UJ	56 U	0.1 U	1.2 UJ
Dieldrin	38 UJ	110 U	2 U	600 UJ	150 UJ	90 U	29 UJ	110 U	0.22 U	2.7 UJ
Endosulfan I	19 UJ	55 U	1.1 U	310 UJ	77 UJ	47 U	15 UJ	56 U	0.12 U	1.4 UJ
Endosulfan II	38 UJ	110 U	2 U	600 UJ	150 UJ	90 U	29 UJ	110 U	0.18 U	2.2 UJ
Endosulfan sulfate	38 UJ	110 U	2 U	600 UJ	150 UJ	90 U	29 UJ	110 U	0.18 U	2.3 UJ
Endrin	38 UJ	110 U	2 U	600 UJ	150 UJ	90 U	29 UJ	110 U	0.56 U	6.9 UJ
Endrin aldehyde	38 UJ	110 U	2 U	600 UJ	150 UJ	90 U	29 UJ	110 U	0.23 U	2.8 UJ
Endrin ketone	38 UJ	110 U	2 U	600 UJ	150 UJ	90 U	29 UJ	110 U	0.21 U	2.6 UJ
gamma-BHC (Lindane)	19 UJ	55 U	1.1 U	310 UJ	77 UJ	22 J	15 UJ	56 U	0.085 U	1 UJ
gamma-Chlordane	19 UJ	55 U	1.1 U	310 UJ	77 UJ	47 U	15 UJ	56 U	0.12 U	1.5 UJ
Heptachlor	19 UJ	55 U	1.1 U	310 UJ	77 UJ	47 U	15 UJ	56 U	0.064 U	0.79 UJ
Heptachlor epoxide	19 UJ	55 U	1.1 U	310 UJ	77 UJ	47 U	15 UJ	56 U	0.11 U	1.3 UJ
Methoxychlor	38 UJ	110 U	2 U	600 UJ	150 UJ	90 U	29 UJ	110 U	0.27 U	3.3 UJ
PCB-1016	380 UJ	430 U	20 U	750 UJ	150 UJ	230 U	71 UJ	270 U	2.2 U	5.5 UJ
PCB-1221	770 UJ	860 U	41 U	1,500 UJ	300 UJ	460 U	140 UJ	550 U	3.7 U	9.1 UJ
PCB-1232	380 UJ	430 U	20 U	750 UJ	150 UJ	230 U	71 UJ	270 U	2.5 U	6.3 UJ
PCB-1242	380 UJ	430 U	20 U	750 UJ	150 UJ	230 U	71 UJ	270 U	2.2 U	5.3 UJ
PCB-1248	380 UJ	430 U	20 U	750 UJ	150 UJ	230 U	71 UJ	270 U	5.5 U	14 UJ
PCB-1254	380 UJ	430 U	20 U	750 UJ	150 UJ	230 U	71 UJ	270 U	1.8 U	4.4 UJ
PCB-1260	380 UJ	430 U	20 U	750 UJ	150 UJ	230 U	71 UJ	270 U	5.2 U	13 UJ
PCB-1268	380 UJ	430 U	20 U	750 UJ	150 UJ	230 U	71 UJ	270 U	1.3 U	3.2 UJ
SVOCs (µg/kg)										
1,1-Biphenyl	1,500 UJ	850 U	41 U	3,000 UJ	3,000 UJ	620 J	1,400 UJ	1,100 U	11 U	280 UJ
2,2-oxybis[1-chloropropane]	1,500 UJ	850 U	41 U	3,000 UJ	3,000 UJ	900 U	1,400 UJ	1,100 U	11 U	280 UJ
2,4,5-Trichlorophenol	1,500 UJ	850 U	41 U	3,000 UJ	3,000 UJ	900 U	1,400 UJ	1,100 U	12 U	290 UJ
2,4,6-Trichlorophenol	1,500 UJ	850 U	41 U	3,000 UJ	3,000 UJ	900 U	1,400 UJ	1,100 U	12 U	300 UJ
2,4-Dichlorophenol	1,500 UJ	850 U	41 U	3,000 UJ	3,000 UJ	900 U	1,400 UJ	1,100 U	11 U	280 UJ
2,4-Dimethylphenol	3,000 UJ	1700 U	82 U	6,000 UJ	6,100 UJ	1,800 U	2,900 UJ	2,200 U	12 U	290 UJ
2,4-Dinitrophenol	15000 UJ	R	410 UJ	30,000 UJ	30,000 UJ	9,000 U	14000 UJ	11000 U	26 U	650 UJ

Table . .-1. continued

Geosyntec consultants

Compound Name	SD-OD1C-01	SD-OD1C-02	SD-OD1N-05	SD-OD2C-01	SD-OD2C-02	SD-OD2T-05	SD-OD3C-01	SD-OD3C-02	SD-OD3T-06	SD-OD4C-01
Depth (ft)	0 - 0.5	0.5 - 2	6 - 8	0 - 0.5	0.5 - 2	6 - 8	0 - 0.5	0.5 - 2	8 - 10	0 - 0.5
2,4-Dinitrotoluene	1,500 UJ	850 U	41 U	3,000 UJ	3,000 UJ	900 U	1,400 UJ	1,100 U	12 U	290 UJ
2,6-Dinitrotoluene	1,500 UJ	850 U	41 U	3,000 UJ	3,000 UJ	900 U	1,400 UJ	1,100 U	12 U	300 UJ
2-Chloronaphthalene	1,500 UJ	850 U	41 U	3,000 UJ	3,000 UJ	900 U	1,400 UJ	1,100 U	9.3 U	230 UJ
2-Chlorophenol	1,500 UJ	850 U	41 U	3,000 UJ	3,000 UJ	900 U	1,400 UJ	1,100 U	8.2 U	200 UJ
2-Methylnaphthalene	310 UJ	170 U	8.3 U	610 UJ	620 UJ	180 U	290 UJ	220 U	5.1 U	130 UJ
2-Methylphenol	1,500 UJ	850 U	41 U	3,000 UJ	3,000 UJ	900 U	1,400 UJ	1,100 U	9.7 U	240 UJ
2-Nitroaniline	7,800 UJ	4,400 U	210 U	16,000 UJ	16,000 UJ	4,700 U	7,400 UJ	5,600 U	11 U	270 UJ
2-Nitrophenol	1,500 UJ	850 U	41 U	3,000 UJ	3,000 UJ	900 U	1,400 UJ	1,100 U	9 U	220 UJ
3 & 4 Methylphenol	1,500 UJ	190 J	41 U	2900 J	2700 J	2,200	1,400 UJ	1,100 U	11 U	280 UJ
3,3-Dichlorobenzidine	R	R	R	R	R	R	R	R	R	650 UJ
3-Nitroaniline	7,800 UJ	4,400 U	210 U	16,000 UJ	16,000 UJ	4,700 U	7,400 UJ	5,600 U	10 U	260 UJ
4,6-Dinitro-2-methylphenol	7,800 UJ	R	210 UJ	16,000 UJ	16,000 UJ	4,700 U	7,400 UJ	5,600 U	26 U	650 UJ
4-Bromophenyl phenyl ether	1,500 UJ	850 U	41 U	3,000 UJ	3,000 UJ	900 U	1,400 UJ	1,100 U	11 U	270 UJ
4-Chloro-3-methylphenol	1,500 UJ	850 U	41 U	3,000 UJ	3,000 UJ	900 U	1,400 UJ	1,100 U	11 U	270 UJ
4-Chloroaniline	3,000 UJ	1700 U	82 U	6,000 UJ	6,100 UJ	1,800 U	2,900 UJ	2,200 U	8 U	200 UJ
4-Chlorophenyl phenyl ether	1,500 UJ	850 U	41 U	3,000 UJ	3,000 UJ	900 U	1,400 UJ	1,100 U	9.9 U	250 UJ
4-Nitroaniline	7,800 UJ	4,400 U	210 U	16,000 UJ	16,000 UJ	4,700 U	7,400 UJ	5,600 U	13 U	320 UJ
4-Nitrophenol	7,800 UJ	4,400 U	210 U	16,000 UJ	16,000 UJ	4,700 U	7,400 UJ	5,600 U	110 U	2,800 UJ
Acenaphthene	310 UJ	170 U	5.1 J	610 UJ	620 UJ	140 J	290 UJ	220 U	5.1 U	130 UJ
Acenaphthylene	310 UJ	170 U	8.3 U	510 J	510 J	200	290 UJ	220 U	5.1 U	130 UJ
Acetophenone	1,500 UJ	850 U	41 U	3,000 UJ	3,000 UJ	900 U	1,400 UJ	1,100 U	11 U	260 UJ
Anthracene	310 UJ	170 U	4.8 J	610 UJ	620 UJ	180 U	290 UJ	220 U	5.1 U	130 UJ
Atrazine	1,500 UJ	850 U	41 U	3,000 UJ	3,000 UJ	900 U	1,400 UJ	1,100 U	12 U	290 UJ
Benzaldehyde	490 J	290 J	41 U	2,200 J	2,300 J	1,100	1,400 UJ	1,100 U	15 U	380 UJ
Benzo[a]anthracene	310 UJ	170 U	5.4 J	610 UJ	620 UJ	130 J	290 UJ	220 U	5.1 U	130 UJ
Benzo[a]pyrene	310 UJ	170 U	8.3 U	610 UJ	620 UJ	180 U	290 UJ	220 U	1.9 U	46 UJ
Benzo[b]fluoranthene	310 UJ	170 U	6.3 J	610 UJ	620 UJ	180 U	290 UJ	220 U	5.1 U	130 UJ
Benzo[g,h,i]perylene	310 UJ	170 U	8.3 U	610 UJ	620 UJ	180 U	290 UJ	220 U	5.1 U	130 UJ
Benzo[k]fluoranthene	310 UJ	170 U	8.3 U	610 UJ	620 UJ	180 U	290 UJ	220 U	3.1 U	77 UJ
Bis(2-chloroethoxy)methane	1,500 UJ	850 U	41 U	3,000 UJ	3,000 UJ	900 U	1,400 UJ	1,100 U	10 U	250 UJ
Bis(2-chloroethyl)ether	1,500 UJ	850 U	41 U	3,000 UJ	3,000 UJ	900 U	1,400 UJ	1,100 U	10 U	250 UJ
Bis(2-ethylhexyl) phthalate	3,000 UJ	1700 UJ	82 UJ	6,000 UJ	6100 UJ	1,800 U	2,900 UJ	2,200 U	100 U	230 UJ
Butyl benzyl phthalate	1,500 UJ	850 U	41 U	3,000 UJ	3,000 UJ	900 U	1,400 UJ	1,100 U	8.5 U	210 UJ
Caprolactam	1,500 UJ	850 U	41 U	3,000 UJ	3,000 UJ	900 U	1,400 UJ	1,100 U	11 U	270 UJ
Carbazole	1,500 UJ	850 U	41 U	3,000 UJ	3,000 UJ	900 U	1,400 UJ	1,100 U	10 U	260 UJ
Chrysene	310 UJ	170 U	7.2 J	610 UJ	620 UJ	180 U	290 UJ	220 U	5.1 U	130 UJ
Dibenz(a,h)anthracene	310 UJ	170 U	8.3 U	610 UJ	620 UJ	180 U	290 UJ	220 U	5.1 U	130 UJ
Dibenzofuran	1,500 UJ	850 U	41 U	3,000 UJ	3,000 UJ	900 U	1,400 UJ	1,100 U	10 U	260 UJ
Diethyl phthalate	1,500 UJ	850 U	41 U	3,000 UJ	3,000 UJ	900 U	1,400 UJ	1,100 U	51 U	280 UJ
Dimethyl phthalate	1,500 UJ	850 U	41 U	3,000 UJ	3,000 UJ	900 U	1,400 UJ	1,100 U	12 U	290 UJ
Di-n-butyl phthalate	7,800 UJ	4,400 U	210 U	16,000 UJ	16,000 UJ	4,700 U	7,400 UJ	5,600 U	96 J	650 UJ

Table A-1. continued

Geosyntec consultants

Compound Name	SD-OD1C-01	SD-OD1C-02	SD-OD1N-05	SD-OD2C-01	SD-OD2C-02	SD-OD2T-05	SD-OD3C-01	SD-OD3C-02	SD-OD3T-06	SD-OD4C-01
Depth (ft)	0 - 0.5	0.5 - 2	6 - 8	0 - 0.5	0.5 - 2	6 - 8	0 - 0.5	0.5 - 2	8 - 10	0 - 0.5
Di-n-octyl phthalate	1,500 UJ	850 U	41 U	3,000 UJ	3,000 UJ	900 U	1,400 UJ	1,100 U	5.6 U	140 UJ
Fluoranthene	190 J	100 J	16	700 J	630 J	190	290 UJ	110 J	9.5 J	130 UJ
Fluorene	310 UJ	170 U	4.3 J	610 UJ	620 UJ	98 J	290 UJ	220 U	5.1 U	130 UJ
Hexachlorobenzene	1,500 UJ	850 U	41 U	3,000 UJ	3,000 UJ	900 U	1,400 UJ	1,100 U	12 U	290 UJ
Hexachlorobutadiene	1,500 UJ	850 U	41 U	3,000 UJ	3,000 UJ	900 U	1,400 UJ	1,100 U	11 U	260 UJ
Hexachlorocyclopentadiene	3,000 UJ	R	82 U	6,000 UJ	6,100 UJ	1,800 U	2,900 UJ	2,200 U	5.7 U	140 UJ
Hexachloroethane	1,500 UJ	850 U	41 U	3,000 UJ	3,000 UJ	900 U	1,400 UJ	1,100 U	9 U	220 UJ
Indeno[1,2,3-cd]pyrene	310 UJ	170 U	8.3 U	610 UJ	620 UJ	180 U	290 UJ	220 U	5.1 U	130 UJ
Isophorone	1,500 UJ	850 U	41 U	3,000 UJ	3,000 UJ	900 U	1,400 UJ	1,100 U	11 U	270 UJ
Naphthalene	430 J	270	8.3 U	1400 J	1,900 J	400	210 J	210 J	5.1 U	130 UJ
Nitrobenzene	1,500 UJ	850 U	41 U	3,000 UJ	3,000 UJ	900 U	1,400 UJ	1,100 U	10 U	250 UJ
N-Nitrosodi-n-propylamine	1,500 UJ	850 U	41 U	3,000 UJ	3,000 UJ	900 U	1,400 UJ	1,100 U	12 U	290 UJ
N-Nitrosodiphenylamine	1,500 UJ	850 U	41 U	3,000 UJ	3,000 UJ	900 U	1,400 UJ	1,100 U	9.4 U	230 UJ
Pentachlorophenol	7,800 UJ	4400 U	210 U	16,000 UJ	16,000 UJ	4,700 U	7,400 UJ	5,600 U	26 U	650 UJ
Phenanthrene	190 J	150 J	5.1 J	650 J	820 J	270	290 UJ	120 J	3.7 U	92 UJ
Phenol	430 J	850 U	41 U	1700 J	1200 J	1,100	1,400 UJ	1,100 U	51 U	250 UJ
Pyrene	180 J	130 J	16	320 J	700 J	160 J	290 UJ	220 U	7.1 J	130 UJ
VOCs (µg/kg)										
1,1,1-Trichloroethane	3.6 UJ	2.1 U	4.6 U	2.1 UJ	4.1 UJ	16 U	27 UJ	10 U	0.65 U	2.9 UJ
1,1,2,2-Tetrachloroethane	9.8 UJ	5.6 U	4.6 U	5.6 UJ	11 UJ	16 U	27 UJ	10 U	1.8 U	7.7 UJ
1,1,2-Trichloro-1,2,2-	8 UJ	4.5 U	4.6 U	4.6 UJ	9 UJ	16 U	27 UJ	10 U	1.4 U	6.3 UJ
1,1,2-Trichloroethane	8 UJ	4.5 U	4.6 U	4.6 UJ	9 UJ	16 U	27 UJ	10 U	1.4 U	6.3 UJ
1,1-Dichloroethane	6.7 UJ	3.8 U	4.6 U	3.9 UJ	7.6 UJ	16 U	27 UJ	10 U	1.2 U	5.3 UJ
1,1-Dichloroethene	9.2 UJ	5.2 U	4.6 U	5.3 UJ	10 UJ	16 U	27 UJ	10 U	1.7 U	7.2 UJ
1,2,4-Trichlorobenzene	5.5 UJ	3.1 U	4.6 U	3.1 UJ	6.1 UJ	16 U	27 UJ	10 U	0.98 U	4.3 UJ
1,2-Dibromo-3-Chloropropane	27 UJ	15 U	9.2 U	16 UJ	30 UJ	31 U	55 UJ	20 U	4.9 U	21 UJ
1,2-Dibromoethane	9.2 UJ	5.2 U	4.6 U	5.3 UJ	10 UJ	16 U	27 UJ	10 U	1.7 U	7.2 UJ
1,2-Dichlorobenzene	8 UJ	4.5 U	4.6 U	4.6 UJ	9 UJ	16 U	27 UJ	10 U	1.4 U	6.3 UJ
1,2-Dichloroethane	6.7 UJ	3.8 U	4.6 U	3.9 UJ	7.6 UJ	16 U	27 UJ	10 U	1.2 U	5.3 UJ
1,2-Dichloropropane	5.3 UJ	3 U	4.6 U	3 UJ	5.9 UJ	16 U	27 UJ	10 U	0.95 U	4.2 UJ
1,3-Dichlorobenzene	9.8 UJ	5.6 U	4.6 U	5.6 UJ	11 UJ	16 U	27 UJ	10 U	1.8 U	7.7 UJ
1,4-Dichlorobenzene	4.5 UJ	2.6 U	4.6 U	2.6 UJ	5.1 UJ	16 U	27 UJ	10 U	0.82 U	3.6 UJ
2-Butanone	49 J	31 J	23 U	110 J	440 J	15 J	42 J	34 J	3 J	40 J
2-Hexanone	20 UJ	12 U	23 U	12 UJ	23 UJ	78 U	140 UJ	50 U	3.6 U	16 UJ
4-Methyl-2-pentanone	26 UJ	16 J	23 U	15 UJ	29 UJ	78 U	140 UJ	50 U	4.6 U	20 UJ
Acetone	310 J	170 U	18 J	760 J	2100 J	230	150 J	160	15 J	150 J
Benzene	4.5 UJ	2.5 U	4.6 U	2.6 UJ	5 UJ	16 U	27 UJ	10 U	0.81 U	3.5 UJ
Bromodichloromethane	5.9 UJ	3.4 U	4.6 U	3.4 UJ	6.7 UJ	16 U	27 UJ	10 U	1.1 U	4.7 UJ
Bromoform	9.2 UJ	5.2 U	4.6 U	5.3 UJ	10 UJ	16 U	27 UJ	10 U	1.7 U	7.2 UJ
Bromomethane	9.2 UJ	5.2 U	4.6 U	5.3 UJ	10 UJ	16 U	27 UJ	10 U	1.7 U	7.2 UJ
Carbon disulfide	8.5 J	5.5 J	2.3 J	13 J	26 J	16 U	31 J	12	2.2 J	5.3 UJ

Compound Name	SD-OD1C-01	SD-OD1C-02	SD-OD1N-05	SD-OD2C-01	SD-OD2C-02	SD-OD2T-05	SD-OD3C-01	SD-OD3C-02	SD-OD3T-06	SD-OD4C-01
Depth (ft)	0 - 0.5	0.5 - 2	6 - 8	0 - 0.5	0.5 - 2	6 - 8	0 - 0.5	0.5 - 2	8 - 10	0 - 0.5
Carbon tetrachloride	5.1 UJ	2.9 U	4.6 U	2.9 UJ	5.7 UJ	16 U	27 UJ	10 U	0.92 U	4 UJ
Chlorobenzene	5.9 UJ	3.4 U	4.6 U	3.4 UJ	6.6 UJ	16 U	27 UJ	10 U	1.1 U	4.6 UJ
Chloroethane	17 UJ	9.4 U	4.6 U	9.5 UJ	19 UJ	16 U	27 UJ	10 U	3 U	13 UJ
Chloroform	6.7 UJ	3.8 U	4.6 U	3.9 UJ	7.6 UJ	16 U	27 UJ	10 U	1.2 U	5.3 UJ
Chloromethane	6.1 UJ	3.5 U	4.6 U	3.5 UJ	6.9 UJ	16 U	27 UJ	10 U	1.1 U	4.8 UJ
cis-1,2-Dichloroethene	8.6 UJ	4.9 U	4.6 U	4.9 UJ	9.7 UJ	16 U	27 UJ	10 U	1.5 U	6.8 UJ
cis-1,3-Dichloropropene	5.1 UJ	2.9 U	4.6 U	2.9 UJ	5.7 UJ	16 U	27 UJ	10 U	0.92 U	4 UJ
Cyclohexane	8 UJ	5.4 J	9.2 U	4.6 UJ	9 UJ	31 U	55 UJ	20 U	1.4 U	6.3 UJ
Dibromochloromethane	10 UJ	5.9 U	4.6 U	6 UJ	12 UJ	16 U	27 UJ	10 U	1.9 U	8.2 UJ
Dichlorodifluoromethane	5.8 UJ	3.3 U	4.6 U	3.3 UJ	6.5 UJ	16 U	27 UJ	10 U	1 U	4.5 UJ
Ethylbenzene	8 UJ	4.5 U	4.6 U	4.6 UJ	9 UJ	16 U	27 UJ	10 U	1.4 U	6.3 UJ
Isopropylbenzene	12 UJ	6.6 U	4.6 U	9.5 J	31 J	16 U	27 UJ	10 U	2.1 U	9.2 UJ
Methyl acetate	31 UJ	17 U	9.2 U	18 UJ	35 UJ	31 U	55 UJ	20 U	5.5 U	24 UJ
Methyl tert-butyl ether	6.1 UJ	3.5 U	9.2 U	3.5 UJ	6.9 UJ	31 U	55 UJ	20 U	1.1 U	4.8 UJ
Methylcyclohexane	5.3 UJ	3 U	9.2 U	3 UJ	5.9 UJ	31 U	55 UJ	20 U	0.95 U	4.2 UJ
Methylene Chloride	6 UJ	3.4 U	4.6 U	3.5 UJ	6.8 UJ	16 U	27 UJ	10 U	1.1 U	4.7 UJ
Styrene	5.7 UJ	3.2 U	4.6 U	3.3 UJ	6.4 UJ	16 U	27 UJ	10 U	1 U	4.5 UJ
Tetrachloroethene	12 UJ	6.6 U	4.6 U	6.7 UJ	13 UJ	16 U	27 UJ	10 U	2.1 U	9.2 UJ
Toluene	5.2 UJ	2.9 U	4.6 U	3 UJ	6.1 J	16 U	27 UJ	1.9 J	0.93 U	4.1 UJ
trans-1,2-Dichloroethene	3.9 UJ	2.2 U	4.6 U	2.2 UJ	4.4 UJ	16 U	27 UJ	10 U	0.7 U	3 UJ
trans-1,3-Dichloropropene	5.3 UJ	3 U	4.6 U	3.1 UJ	6 UJ	16 U	27 UJ	10 U	0.96 U	4.2 UJ
Trichloroethene	8 UJ	4.5 U	4.6 U	4.6 UJ	9 UJ	16 U	27 UJ	10 U	1.4 U	6.3 UJ
Trichlorofluoromethane	7.4 UJ	4.2 U	4.6 U	4.2 UJ	8.3 UJ	16 U	27 UJ	10 U	1.3 U	5.8 UJ
Vinyl chloride	9.2 UJ	5.2 U	4.6 U	5.3 UJ	10 UJ	16 U	27 UJ	10 U	1.7 U	7.2 UJ
Xylenes, Total	6.7 UJ	3.8 U	9.2 U	3.9 UJ	8.4 J	31 U	55 UJ	20 U	1.2 U	5.3 UJ
Metals (mg/kg)										
Aluminum	15,000 J	8,900	1,500	34,000 J	46,000 J	18,000	33,000 J	26,000	11,000	22,000 J
Antimony	8.3 UJ	4.9 U	2.3 U	18 UJ	17 UJ	5.4 U	8.1 UJ	6.4 U	0.77 U	1.8 UJ
Arsenic	9.4 J	6.6	3.2	17 J	33 J	3.6 J	13 J	12	7.5	15 J
Barium	66 J	59	4.2	160 J	290 J	82	39 J	35	18	25 J
Beryllium	0.5 J	0.31 J	0.21 J	1 J	1.5 J	0.43 J	1.4 J	1.3	0.62	1.4 J
Cadmium	0.55 J	0.41 J	0.57 U	1.3 J	1.8 J	0.3 J	0.49 J	1.6 U	0.15 U	0.34 UJ
Calcium	7,600 J	8,900	6,400	25,000 J	46,000 J	7,400	4,000 J	4,000	2,400	4,300 J
Chromium	43 J	23	4.6	83 J	110 J	32	53 J	46	19	43 J
Cobalt	3.1 J	2 J	0.49 J	6.2 J	9.1 J	2.1 J	6.2 J	5.4	2.6	5.5 J
Copper	86 J	71	2.8 U	160 J	240 J	70	51 J	30	2.4 J	18 J
Iron	13,000 J	7,900	2,400	28,000 J	38,000 J	12,000	27,000 J	25,000	12,000	25,000 J
Lead	72 J	47	1.6	93 J	160 J	51	32 J	30	8.9	25 J
Magnesium	5,200 J	2,800	400	14,000 J	18000 J	3,700	8,800 J	7,300	1,500	8,400 J
Manganese	200 J	160	23	460 J	770 J	120	310 J	260	71	280 J
Mercury	0.75 J	0.22	0.021 U	1.5 J	2.3 J	0.82	0.21 J	0.16	0.024 J	0.14 J

Table ..-1. continued

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Compound Name	SD-OD1C-01	SD-OD1C-02	SD-OD1N-05	SD-OD2C-01	SD-OD2C-02	SD-OD2T-05	SD-OD3C-01	SD-OD3C-02	SD-OD3T-06	SD-OD4C-01
Depth (ft)	0 - 0.5	0.5 - 2	6 - 8	0 - 0.5	0.5 - 2	6 - 8	0 - 0.5	0.5 - 2	8 - 10	0 - 0.5
Nickel	14 J	9 J	0.89 J	25 J	36 J	14	16 J	13	4.2 J	11 J
Potassium	2,600	1,400	160	8,000	10,000	1,400	4,900	4,000	870	4,400
Selenium	10 UJ	6.1 U	2.8 U	22 UJ	22 UJ	6.7 U	10 UJ	8 U	1.5 U	3.4 UJ
Silver	4.2 UJ	2.4 U	1.1 U	8.9 UJ	8.6 UJ	2.7 U	4 UJ	3.2 U	0.14 U	0.33 UJ
Sodium	18,000 J	6,900	220 J	62,000 J	66,000 J	5,600	33,000 J	20,000	690	31,000 J
Thallium	10 UJ	6.1 U	2.8 U	22 UJ	22 UJ	6.7 U	10 UJ	8 U	1.4 U	3.4 UJ
Vanadium	30 J	17	4.9	60 J	82 J	28	65 J	59	28	59 J
Zinc	340 J	280	3.8	580 J	860 J	190	140 J	120	15	81 J
Other (mg/kg)										
Cyanide, Total	2.3 UJ	1.2 UJ	0.6 U	4.5 UJ	3.4 J	0.75 J	2.1 UJ	1.6 U	0.31 U	0.8 UJ
Total Organic Carbon	NA	NA	1,500	510,000 J	320000 J	270,000	53,000 J	48,000	5,400	NA

Compound Name	SD-OD4C-02	SD-OD4N-05	SD-OD5C-01	SD-OD5C-02	SD-OD5S-01	SD-OD5S-05	SD-ODCC-02	SD-ODCN-01	SD-ODCS-01
Depth (ft)	0.5 - 2	6 - 8	0 - 0.5	0.5 - 2	0 - 0.5	6 - 8	0.5 - 2	0 - 0.5	0 - 0.5
Toxaphene (µg/kg)									
Method 1 (Technical)	660 J	5,100	360 J	8,500 J	270 J	87,000	17,000	71,000	5,700 J
Method 2 (TAUC)	1,600	13,000	940	21,000	700	120,000	22,000	75,000	5,300
Pesticides (µg/kg)									
4,4-DDD	0.41 UJ	7.2 U	5 J	43 UJ	3.3 J	150 U	470 U	120 U	27 UJ
4,4-DDE	5.8 J	5.7 U	9.3 J	34 UJ	0.42 UJ	120 U	470 U	470	68 J
4,4-DDT	0.39 UJ	6.9 U	0.59 UJ	41 UJ	0.51 UJ	140 U	470 U	120 U	27 UJ
Aldrin	0.77 UJ	13 U	1.2 UJ	320 J	0.99 UJ	780 J	190 J	60 U	14 UJ
alpha-BHC	0.19 UJ	3.3 U	0.28 UJ	20 UJ	0.24 UJ	67 U	240 U	60 U	14 UJ
alpha-Chlordane	0.24 UJ	4.2 U	0.36 UJ	25 UJ	0.31 UJ	86 U	240 U	60 U	14 UJ
beta-BHC	0.19 UJ	3.3 U	0.28 UJ	20 UJ	0.24 UJ	67 U	240 U	60 U	14 UJ
delta-BHC	0.22 UJ	3.9 U	0.34 UJ	23 UJ	0.29 UJ	80 U	240 U	60 U	14 UJ
Dieldrin	0.48 UJ	8.4 U	0.72 UJ	50 UJ	0.62 UJ	170 U	470 U	120 U	27 UJ
Endosulfan I	0.26 UJ	4.5 U	0.39 UJ	27 UJ	0.33 UJ	92 U	240 U	60 U	14 UJ
Endosulfan II	0.39 UJ	6.9 U	0.59 UJ	41 UJ	0.51 UJ	140 U	470 U	120 U	27 UJ
Endosulfan sulfate	0.41 UJ	7.2 U	0.62 UJ	43 UJ	0.53 UJ	150 U	470 U	120 U	27 UJ
Endrin	1.2 UJ	22 U	1.9 UJ	130 UJ	1.6 UJ	450 U	470 U	120 U	27 UJ
Endrin aldehyde	0.51 UJ	8.9 U	0.77 UJ	54 UJ	0.66 UJ	180 U	470 U	120 U	27 UJ
Endrin ketone	0.46 UJ	8.1 U	0.7 UJ	48 UJ	0.59 UJ	170 U	470 U	120 U	27 UJ
gamma-BHC (Lindane)	0.52 J	33 J	1.1 J	40 J	0.24 UJ	67 U	19 J	7.4 J	14 UJ
gamma-Chlordane	0.27 UJ	4.8 U	0.41 UJ	29 UJ	0.35 UJ	98 U	240 U	60 U	14 UJ
Heptachlor	0.14 UJ	2.5 U	0.21 UJ	15 UJ	0.18 UJ	51 U	240 U	60 U	14 UJ
Heptachlor epoxide	0.24 UJ	4.2 U	0.36 UJ	25 UJ	0.31 UJ	86 U	240 U	60 U	14 UJ
Methoxychlor	0.6 UJ	10 U	0.9 UJ	63 UJ	0.77 UJ	210 U	470 U	120 U	27 UJ
PCB-1016	5 UJ	22 U	7.5 UJ	26 UJ	6.4 UJ	360 U	470 U	1200 U	69 UJ
PCB-1221	8.2 UJ	36 U	12 UJ	43 UJ	11 UJ	590 U	960 U	2,400 U	140 UJ
PCB-1232	5.6 UJ	25 U	8.5 UJ	29 UJ	7.3 UJ	400 U	470 U	1200 U	69 UJ
PCB-1242	4.8 UJ	21 U	7.2 UJ	25 UJ	6.2 UJ	340 U	470 U	1200 U	69 UJ
PCB-1248	12 UJ	54 U	19 UJ	64 UJ	16 UJ	880 U	470 U	1200 U	69 UJ
PCB-1254	3.9 UJ	17 U	5.9 UJ	21 UJ	5.1 UJ	280 U	470 U	1200 U	69 UJ
PCB-1260	11 UJ	50 U	17 UJ	60 UJ	15 UJ	820 U	470 U	1200 U	69 UJ
PCB-1268	2.9 UJ	13 U	4.4 UJ	15 UJ	3.7 UJ	210 U	470 U	1200 U	69 UJ
SVOCs (µg/kg)									
1,1-Biphenyl	250 UJ	320 J	370 UJ	290 J	320 UJ	460 J	470 U	590 U	1,400 UJ
2,2-oxybis[1-chloropropane]	250 UJ	210 U	370 UJ	260 UJ	320 UJ	180 U	470 U	590 U	1,400 UJ
2,4,5-Trichlorophenol	260 UJ	230 U	390 UJ	270 UJ	330 UJ	190 U	470 U	590 U	1,400 UJ
2,4,6-Trichlorophenol	270 UJ	240 U	410 UJ	280 UJ	350 UJ	190 U	470 U	590 U	1,400 UJ
2,4-Dichlorophenol	250 UJ	210 U	370 UJ	260 UJ	320 UJ	180 UJ	470 U	590 U	1,400 UJ
2,4-Dimethylphenol	260 UJ	230 U	390 UJ	270 UJ	330 UJ	190 U	940 U	1,200 U	2,700 UJ
2,4-Dinitrophenol	580 UJ	510 U	880 UJ	R	750 UJ	420 U	4,700 U	5,900 UJ	14,000 UJ

Tab. .1. continued

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Compound Name	SD-OD4C-02	SD-OD4N-05	SD-OD5C-01	SD-OD5C-02	SD-OD5S-01	SD-OD5S-05	SD-ODCC-02	SD-ODCN-01	SD-ODCS-01
Depth (ft)	0.5 - 2	6 - 8	0 - 0.5	0.5 - 2	0 - 0.5	6 - 8	0.5 - 2	0 - 0.5	0 - 0.5
2,4-Dinitrotoluene	260 UJ	220 U	390 UJ	270 UJ	330 UJ	180 U	470 U	590 U	1,400 UJ
2,6-Dinitrotoluene	270 UJ	240 U	410 UJ	280 UJ	350 UJ	190 U	470 U	590 U	1,400 UJ
2-Chloronaphthalene	210 UJ	180 U	310 UJ	210 UJ	260 UJ	150 U	470 U	590 U	1,400 UJ
2-Chlorophenol	180 UJ	160 U	270 UJ	190 UJ	230 UJ	130 U	470 U	590 U	1,400 UJ
2-Methylnaphthalene	110 UJ	98 U	170 UJ	120 UJ	140 UJ	85 J	96 U	120 U	280 UJ
2-Methylphenol	220 UJ	190 U	330 UJ	220 UJ	280 UJ	150 U	470 U	590 U	340 J
2-Nitroaniline	240 UJ	210 U	360 UJ	250 UJ	310 UJ	170 U	2,400 U	3,000 U	7,100 UJ
2-Nitrophenol	200 UJ	170 U	300 UJ	210 UJ	250 UJ	140 U	470 U	590 U	1,400 UJ
3 & 4 Methylphenol	250 UJ	220 U	380 UJ	260 UJ	320 UJ	330 J	560	590 U	2200 J
3,3-Dichlorobenzidine	580 UJ	510 U	880 UJ	R	R	R	R	1200 U	2700 UJ
3-Nitroaniline	230 UJ	200 U	350 UJ	R	290 UJ	160 U	2,400 U	3,000 U	7,100 UJ
4,6-Dinitro-2-methylphenol	580 UJ	510 U	880 UJ	R	750 UJ	420 UJ	2,400 U	3,000 UJ	7,100 UJ
4-Bromophenyl phenyl ether	240 UJ	210 U	360 UJ	250 UJ	300 UJ	170 U	470 U	590 U	1,400 UJ
4-Chloro-3-methylphenol	240 UJ	210 U	360 UJ	250 UJ	310 UJ	170 U	470 U	590 U	1,400 UJ
4-Chloroaniline	180 UJ	160 U	270 UJ	R	230 UJ	130 U	940 U	1,200 U	2,700 UJ
4-Chlorophenyl phenyl ether	220 UJ	190 U	330 UJ	230 UJ	280 UJ	160 U	470 U	590 U	1,400 UJ
4-Nitroaniline	280 UJ	250 U	430 UJ	R	360 UJ	200 U	2,400 U	3,000 U	7,100 UJ
4-Nitrophenol	2,500 UJ	2,200 U	3,800 UJ	R	3,200 UJ	1,800 U	2,400 U	3,000 U	7,100 UJ
Acenaphthene	110 UJ	98 U	170 UJ	120 UJ	140 UJ	240	96 U	120 U	280 UJ
Acenaphthylene	110 UJ	98 U	170 UJ	120 UJ	140 UJ	81 U	49 J	120 U	430 J
Acetophenone	230 UJ	200 U	350 UJ	240 UJ	300 UJ	450 J	470 U	590 U	1,400 UJ
Anthracene	110 UJ	98 U	170 UJ	120 UJ	140 UJ	81 U	96 U	120 U	280 UJ
Atrazine	260 UJ	230 U	390 UJ	270 UJ	330 UJ	190 U	470 U	590 U	1,400 UJ
Benzaldehyde	340 UJ	630 J	510 UJ	580 J	430 UJ	1,700	230 J	590 U	1,200 J
Benzo[a]anthracene	110 UJ	98 U	170 UJ	120 UJ	140 UJ	81 U	99	120 U	280 UJ
Benzo[a]pyrene	41 UJ	36 U	62 UJ	43 UJ	53 UJ	29 U	130	120 U	280 UJ
Benzo[b]fluoranthene	110 UJ	98 U	170 UJ	120 UJ	140 UJ	81 U	120	120 U	280 UJ
Benzo[g,h,i]perylene	110 UJ	98 U	170 UJ	120 UJ	140 UJ	81 U	75 J	120 U	280 UJ
Benzo[k]fluoranthene	69 UJ	60 U	100 UJ	71 UJ	88 UJ	49 U	110	120 U	280 UJ
Bis(2-chloroethoxy)methane	220 UJ	190 U	340 UJ	230 UJ	290 UJ	160 U	470 U	590 U	1,400 UJ
Bis(2-chloroethyl)ether	220 UJ	190 U	340 UJ	230 UJ	290 UJ	160 U	470 U	590 U	1,400 UJ
Bis(2-ethylhexyl) phthalate	210 UJ	180 U	3400 UJ	210 UJ	260 UJ	150 U	940 U	1,200 U	2,700 UJ
Butyl benzyl phthalate	190 UJ	160 U	280 UJ	200 UJ	240 UJ	130 U	470 U	590 U	1,400 UJ
Caprolactam	240 UJ	210 U	360 UJ	250 UJ	310 UJ	170 U	470 U	590 U	1,400 UJ
Carbazole	230 UJ	200 U	350 UJ	240 UJ	290 UJ	160 U	470 U	590 U	1,400 UJ
Chrysene	110 UJ	98 U	170 UJ	120 UJ	140 UJ	81 U	130	120 U	280 UJ
Dibenz(a,h)anthracene	110 UJ	98 U	170 UJ	120 UJ	140 UJ	81 U	96 U	120 U	280 UJ
Dibenzofuran	230 UJ	200 U	350 UJ	240 UJ	290 UJ	230 J	470 U	590 U	1,400 UJ
Diethyl phthalate	250 UJ	220 U	380 UJ	260 UJ	320 UJ	180 U	470 U	590 U	1,400 UJ
Dimethyl phthalate	260 UJ	220 U	390 UJ	270 UJ	330 UJ	180 U	470 U	590 U	1,400 UJ
Di-n-butyl phthalate	580 UJ	510 U	880 UJ	610 UJ	750 UJ	420 U	2,400 U	3,000 U	7,100 UJ

Compound Name	SD-OD4C-02	SD-OD4N-05	SD-OD5C-01	SD-OD5C-02	SD-OD5S-01	SD-OD5S-05	SD-ODCC-02	SD-ODCN-01	SD-ODCS-01
Depth (ft)	0.5 - 2	6 - 8	0 - 0.5	0.5 - 2	0 - 0.5	6 - 8	0.5 - 2	0 - 0.5	0 - 0.5
Di-n-octyl phthalate	120 UJ	110 U	190 UJ	130 UJ	160 UJ	88 U	470 U	590 U	1,400 UJ
Fluoranthene	110 UJ	98 U	170 UJ	120 UJ	140 UJ	81 U	250	120 U	150 J
Fluorene	110 UJ	98 U	170 UJ	120 UJ	140 UJ	280	96 U	120 U	280 UJ
Hexachlorobenzene	260 UJ	230 U	390 UJ	270 UJ	330 UJ	190 U	470 U	590 U	1,400 UJ
Hexachlorobutadiene	230 UJ	200 U	350 UJ	240 UJ	300 UJ	170 U	470 U	590 U	1,400 UJ
Hexachlorocyclopentadiene	130 UJ	110 U	190 UJ	R	160 UJ	91 U	940 U	1,200 U	2,700 UJ
Hexachloroethane	200 UJ	170 U	300 UJ	210 UJ	250 UJ	140 U	470 U	590 U	1,400 UJ
Indeno[1,2,3-cd]pyrene	110 UJ	98 U	170 UJ	120 UJ	140 UJ	81 U	57 J	120 U	280 UJ
Isophorone	240 UJ	210 U	360 UJ	250 UJ	310 UJ	170 U	470 U	590 U	1,400 UJ
Naphthalene	160 J	110 J	170 J	240 UJ	140 UJ	460	160	120 U	1,300 J
Nitrobenzene	230 UJ	200 U	340 UJ	240 UJ	290 UJ	160 U	470 U	590 U	1,400 UJ
N-Nitrosodi-n-propylamine	260 UJ	220 U	390 UJ	270 UJ	330 UJ	180 U	470 U	590 U	1,400 UJ
N-Nitrosodiphenylamine	210 UJ	180 U	310 UJ	220 UJ	270 UJ	150 U	470 U	590 U	1,400 UJ
Pentachlorophenol	580 UJ	510 U	880 UJ	610 UJ	750 UJ	420 UJ	2,400 U	3,000 U	7,100 UJ
Phenanthrene	82 UJ	72 U	120 UJ	86 UJ	110 UJ	260	130	120 U	280 J
Phenol	220 UJ	190 U	340 UJ	230 UJ	290 UJ	360 J	110 J	590 U	5,900 J
Pyrene	110 UJ	98 U	170 UJ	120 UJ	140 UJ	81 U	210	60 J	280 UJ
VOCs (µg/kg)									
1,1,1-Trichloroethane	2.4 UJ	1.9 U	2.7 UJ	2.1 U	NA	110 U	4.8 U	NA	NA
1,1,2,2-Tetrachloroethane	6.5 UJ	5.2 U	7.2 UJ	5.8 U	NA	290 U	4.8 U	NA	NA
1,1,2-Trichloro-1,2,2-	5.3 UJ	4.2 U	5.9 UJ	4.7 U	NA	230 U	4.8 U	NA	NA
1,1,2-Trichloroethane	5.3 UJ	4.2 U	5.9 UJ	4.7 U	NA	230 U	4.8 U	NA	NA
1,1-Dichloroethane	4.4 UJ	3.6 U	5 UJ	4 U	NA	200 U	4.8 U	NA	NA
1,1-Dichloroethene	6.1 UJ	4.9 U	6.8 UJ	5.4 U	NA	270 U	4.8 U	NA	NA
1,2,4-Trichlorobenzene	3.6 UJ	2.9 U	4 UJ	3.2 U	NA	160 U	4.8 U	NA	NA
1,2-Dibromo-3-Chloropropane	18 UJ	14 U	20 UJ	16 U	NA	790 U	9.6 U	NA	NA
1,2-Dibromoethane	6.1 UJ	4.9 U	6.8 UJ	5.4 U	NA	270 U	4.8 U	NA	NA
1,2-Dichlorobenzene	5.3 UJ	4.2 U	5.9 UJ	4.7 U	NA	230 U	4.8 U	NA	NA
1,2-Dichloroethane	4.4 UJ	3.6 U	5 UJ	4 U	NA	200 U	4.8 U	NA	NA
1,2-Dichloropropane	3.5 UJ	2.8 U	3.9 UJ	3.1 U	NA	150 U	4.8 U	NA	NA
1,3-Dichlorobenzene	6.5 UJ	5.2 U	7.2 UJ	5.8 U	NA	290 U	4.8 U	NA	NA
1,4-Dichlorobenzene	3 UJ	2.4 U	3.3 UJ	2.7 U	NA	130 U	4.8 U	NA	NA
2-Butanone	24 J	23 J	72 J	8.6 U	NA	460 J	3.5 J	NA	NA
2-Hexanone	13 UJ	11 U	15 UJ	12 U	NA	590 U	24 U	NA	NA
4-Methyl-2-pentanone	17 UJ	14 U	19 UJ	15 U	NA	750 U	24 U	NA	NA
Acetone	130 J	130 J	240 J	180	NA	8700 J	35 J	NA	NA
Benzene	3 UJ	2.4 U	3.3 UJ	2.6 U	NA	1600	4.8 U	NA	NA
Bromodichloromethane	3.9 UJ	3.1 U	4.4 UJ	3.5 U	NA	170 U	4.8 U	NA	NA
Bromoform	6.1 UJ	4.9 U	6.8 UJ	5.4 U	NA	270 U	4.8 U	NA	NA
Bromomethane	6.1 UJ	4.9 U	6.8 UJ	5.4 U	NA	270 U	4.8 U	NA	NA
Carbon disulfide	32 J	13 J	22 J	7.4 J	NA	250 J	5.5	NA	NA

Compound Name	SD-OD4C-02	SD-OD4N-05	SD-OD5C-01	SD-OD5C-02	SD-OD5S-01	SD-OD5S-05	SD-ODCC-02	SD-ODCN-01	SD-ODCS-01
Depth (ft)	0.5 - 2	6 - 8	0 - 0.5	0.5 - 2	0 - 0.5	6 - 8	0.5 - 2	0 - 0.5	0 - 0.5
Carbon tetrachloride	3.4 UJ	2.7 U	3.7 UJ	3 U	NA	150 U	4.8 U	NA	NA
Chlorobenzene	3.9 UJ	3.1 U	4.3 UJ	3.5 U	NA	300 J	4.8 U	NA	NA
Chloroethane	11 UJ	8.7 U	12 UJ	9.7 U	NA	480 U	4.8 U	NA	NA
Chloroform	4.4 UJ	3.6 U	5 UJ	4 U	NA	200 U	4.8 U	NA	NA
Chloromethane	4 UJ	3.2 U	4.5 UJ	3.6 U	NA	180 U	4.8 U	NA	NA
cis-1,2-Dichloroethene	5.7 UJ	4.5 U	6.3 UJ	5 U	NA	250 U	4.8 U	NA	NA
cis-1,3-Dichloropropene	3.4 UJ	2.7 U	3.7 UJ	3 U	NA	150 U	4.8 U	NA	NA
Cyclohexane	5.3 UJ	4.2 U	5.9 UJ	4.7 U	NA	230 U	9.6 U	NA	NA
Dibromochloromethane	6.9 UJ	5.5 U	7.7 UJ	6.1 U	NA	300 U	4.8 U	NA	NA
Dichlorodifluoromethane	3.8 UJ	3 U	4.2 UJ	3.4 U	NA	170 U	4.8 U	NA	NA
Ethylbenzene	5.3 UJ	4.2 U	5.9 UJ	4.7 U	NA	230 U	4.8 U	NA	NA
Isopropylbenzene	7.7 UJ	6.2 U	8.6 UJ	7.9 J	NA	8900	4.8 U	NA	NA
Methyl acetate	20 UJ	16 U	23 UJ	18 U	NA	2200	9.6 U	NA	NA
Methyl tert-butyl ether	4 UJ	3.2 U	4.5 UJ	3.6 U	NA	180 U	9.6 U	NA	NA
Methylcyclohexane	3.5 UJ	2.8 U	3.9 UJ	3.1 U	NA	300 J	9.6 U	NA	NA
Methylene Chloride	4 UJ	3.2 U	4.4 UJ	3.5 U	NA	180 U	4.8 U	NA	NA
Styrene	3.8 UJ	3 U	4.2 UJ	3.3 U	NA	170 U	4.8 U	NA	NA
Tetrachloroethene	7.7 UJ	6.2 U	8.6 UJ	6.8 U	NA	340 U	4.8 U	NA	NA
Toluene	3.4 UJ	2.7 U	3.8 UJ	3 U	NA	600 J	4.8 U	NA	NA
trans-1,2-Dichloroethene	2.5 UJ	2 U	2.8 UJ	2.3 U	NA	110 U	4.8 U	NA	NA
trans-1,3-Dichloropropene	3.5 UJ	2.8 U	3.9 UJ	3.1 U	NA	160 U	4.8 U	NA	NA
Trichloroethene	5.3 UJ	4.2 U	5.9 UJ	4.7 U	NA	230 U	4.8 U	NA	NA
Trichlorofluoromethane	4.8 UJ	3.9 U	5.4 UJ	4.3 U	NA	210 U	4.8 U	NA	NA
Vinyl chloride	6.1 UJ	4.9 U	6.8 UJ	5.4 U	NA	270 U	4.8 U	NA	NA
Xylenes, Total	4.4 UJ	3.6 U	5 UJ	4 U	NA	200 U	9.6 U	NA	NA
Metals (mg/kg)									
Aluminum	34,000 J	47,000	38,000 J	26,000 J	NA	32,000	3,600	1,700	12,000 J
Antimony	1.8 UJ	1.6 U	2.6 UJ	1.8 UJ	NA	1.3 U	2.6 U	3.5 U	7.8 UJ
Arsenic	14 J	15	17 J	14 J	NA	14	1.6 J	1 J	13 J
Barium	36 J	56	43 J	31 J	NA	36	21	6.9	84 J
Beryllium	1.6 J	1.8	1.8 J	1.4 J	NA	1.5	0.12 J	0.08 J	0.34 J
Cadmium	0.33 UJ	0.29 U	0.5 UJ	0.34 UJ	NA	0.24 U	0.15 J	0.87 U	0.71 J
Calcium	5,900 J	3,700	6,600 J	5,700 J	NA	6,500	4,900	23,000	12,000 J
Chromium	52 J	60	64 J	48 J	NA	47	8	3.9	45 J
Cobalt	6.6 J	8.7	7.4 J	5.6 J	NA	6.7	0.76 J	0.38 J	2.4 J
Copper	24 J	57	27 J	37 J	NA	70	26	3.8 J	68 J
Iron	29,000 J	36,000	34,000 J	27,000 J	NA	31,000	3,600	1,500	10,000 J
Lead	28 J	32	31 J	29 J	NA	31	22	5.2	45 J
Magnesium	9,100 J	6,400	11,000 J	7,000 J	NA	5,800	1,800	1,100	4,300 J
Manganese	330 J	460	440 J	320 J	NA	350	45	38	230 J
Mercury	0.16 J	0.18	0.15 J	0.23 J	NA	0.07	1.4	0.016 J	6.2 J

Tabl. .-1. continued

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Compound Name	SD-OD4C-02	SD-OD4N-05	SD-OD5C-01	SD-OD5C-02	SD-OD5S-01	SD-OD5S-05	SD-ODCC-02	SD-ODCN-01	SD-ODCS-01
Depth (ft)	0.5 - 2	6 - 8	0 - 0.5	0.5 - 2	0 - 0.5	6 - 8	0.5 - 2	0 - 0.5	0 - 0.5
Nickel	15 J	20	18 J	13 J	NA	21	3.9 J	1.6 J	14 J
Potassium	4,800	3,600	6,000	4,200	NA	3,000	720	540	3,000
Selenium	3.3 UJ	2.9 U	5 UJ	3.4 UJ	NA	2.4 U	3.3 U	4.4 U	9.8 UJ
Silver	0.32 UJ	0.28 U	0.48 UJ	0.42 J	NA	9.1	1.3 U	1.7 U	3.9 UJ
Sodium	29,000 J	6,900	43,000 J	18000 J	NA	3,100	6,100	3,000	16,000 J
Thallium	3.3 UJ	2.9 U	4.9 UJ	3.3 UJ	NA	2.4 U	3.3 U	4.4 U	9.8 UJ
Vanadium	70 J	85	79 J	65 J	NA	72	9.2	6.3	21 J
Zinc	110 J	82	110 J	97 J	NA	58	140	25	220 J
Other (mg/kg)									
Cyanide, Total	0.71 UJ	0.6 U	1.1 UJ	0.96 J	NA	1 J	0.71 U	0.87 U	2 UJ
Total Organic Carbon	NA	72,000	60,000 J	55,000 J	35000 J	77,000	38,000	4,000	110,000 J

Notes:

U: not detected; J: estimated concentration; R: rejected after data validation; NA: not analyzed

APPENDIX B

Analytical Results for Surface Water Sampling

Table B-1. Analytical Results for Surface Water, Terry Creek OU1 RI/FS

	Culvert Samples							
	SW-DCEB-01	SW-DCEB-02	SW-DCEB-03	SW-DCEB-04	SW-DCFL-01	SW-DCFL-02	SW-DCFL-03	SW-DCFL-04
Compound Name	ebb tide, filtered	ebb tide, unfiltered	ebb tide, filtered, wet weather	ebb tide, unfiltered, wet weather	flood tide, filtered	flood tide, unfiltered	flood tide, filtered, wet weather	flood tide, unfiltered, wet weather
Toxaphene (µg/L)								
Method 1 (Technical)	0.53 U	0.51 U	0.52 U	0.47 U	0.51 U	0.48 U	0.46 U	0.52 U
Method 2 (TAUC)	0.53 U	0.51 U	0.52 U	0.47 U	0.51 U	0.48 U	0.46 U	0.52 U
Pesticides (µg/L)								
4,4-DDD	0.0068 U	0.0067 U	0.0068 U	0.0061 U	0.0066 U	0.0062 U	0.006 U	0.0068 U
4,4-DDE	0.0081 U	0.0079 U	0.008 U	0.0072 U	0.0079 U	0.0073 UJ	0.0071 U	0.008 U
4,4-DDT	0.01 U	0.0099 U	0.01 U	0.0091 U	0.0099 U	0.0092 U	0.009 U	0.01 U
Aldrin	0.0074 U	0.0072 U	0.0073 U	0.0066 U	0.0071 U	0.0067 U	0.0065 U	0.0073 U
alpha-BHC	0.006 U	0.0058 U	0.0059 U	0.0053 U	0.0058 U	0.0054 U	0.0053 U	0.0059 U
alpha-Chlordane	0.0063 U	0.0061 U	0.0062 U	0.0056 U	0.0061 U	0.0057 UJ	0.0055 U	0.0063 U
beta-BHC	0.007 U	0.0069 U	0.007 U	0.0063 U	0.0068 U	0.0064 U	0.0062 U	0.007 U
delta-BHC	0.005 U	0.0049 U	0.005 U	0.0045 U	0.0049 U	0.0046 U	0.0044 U	0.005 U
Dieldrin	0.0096 U	0.0093 U	0.0095 U	0.0085 U	0.0093 U	0.0087 UJ	0.0084 U	0.0095 U
Endosulfan I	0.0044 U	0.0043 U	0.0044 U	0.0039 U	0.0043 U	0.004 U	0.0039 U	0.0044 U
Endosulfan II	0.01 UJ	0.01 UJ	0.01 U	0.0092 U	0.01 UJ	0.0093 UJ	0.0091 U	0.01 U
Endosulfan sulfate	0.0071 UJ	0.007 UJ	0.0071 U	0.0064 U	0.0069 UJ	0.0065 UJ	0.0063 U	0.0071 U
Endrin	0.01 UJ	0.0099 UJ	0.01 U	0.0091 U	0.0099 UJ	0.0092 UJ	0.009 U	0.01 U
Endrin aldehyde	0.017 U	0.016 U	0.017 U	0.015 U	0.016 U	0.015 U	0.015 U	0.017 U
Endrin ketone	0.0088 U	0.0086 U	0.0087 U	0.0079 U	0.0086 U	0.008 U	0.0078 U	0.0088 U
gamma-BHC (Lindane)	0.0062 U	0.006 U	0.0061 U	0.0055 U	0.006 U	0.0056 U	0.0055 U	0.0062 U
gamma-Chlordane	0.0054 U	0.0052 U	0.0053 U	0.0048 U	0.0052 U	0.0049 U	0.0047 U	0.0053 U
Heptachlor	0.0074 U	0.0072 U	0.0073 U	0.0066 U	0.0071 U	0.0067 U	0.0065 U	0.0073 U
Heptachlor epoxide	0.0063 U	0.0061 U	0.0062 U	0.0056 U	0.0061 U	0.0057 U	0.0055 U	0.0063 U
Methoxychlor	0.014 U	0.013 U	0.014 U	0.012 U	0.013 U	0.012 U	0.012 U	0.014 U
PCB-1016	0.075 U	0.073 U	0.074 U	0.067 U	0.072 U	0.068 U	0.066 U	0.074 U
PCB-1221	0.29 U	0.29 U	0.29 U	0.26 U	0.29 U	0.27 U	0.26 U	0.29 U
PCB-1232	0.12 U	0.11 U	0.11 U	0.1 U	0.11 U	0.1 U	0.1 U	0.11 U
PCB-1242	0.19 U	0.18 U	0.19 U	0.17 U	0.18 U	0.17 U	0.17 U	0.19 U
PCB-1248	0.38 U	0.37 U	0.37 U	0.34 U	0.37 U	0.34 U	0.33 U	0.38 U
PCB-1254	0.27 U	0.27 U	0.27 U	0.24 U	0.27 U	0.25 U	0.24 U	0.27 U
PCB-1260	0.21 U	0.2 U	0.21 U	0.19 U	0.2 U	0.19 U	0.18 U	0.21 U
PCB-1268	0.27 U	0.27 U	0.27 U	0.24 U	0.27 U	0.25 U	0.24 U	0.27 U
SVOCs (µg/L)								
1,1-Biphenyl	0.095 U	0.1 U	0.1 U	0.096 U	0.11 U	0.1 U	0.092 U	0.096 U
2,2-oxybis[1-chloropropane]	0.095 U	0.1 U	0.1 U	0.096 U	0.11 U	0.1 U	0.092 U	0.096 U
2,4,5-Trichlorophenol	0.11 U	0.12 U	0.12 U	0.12 U	0.13 U	0.12 U	0.11 U	0.12 U
2,4,6-Trichlorophenol	0.16 U	0.18 U	0.17 U	0.16 U	0.18 U	0.17 U	0.16 U	0.16 U
2,4-Dichlorophenol	0.095 U	0.1 U	0.1 U	0.096 U	0.11 U	0.1 U	0.092 U	0.096 U
2,4-Dimethylphenol	0.65 U	0.71 U	0.7 U	0.66 U	0.75 U	0.71 U	0.64 U	0.67 U

	Culvert Samples							
	SW-DCEB-01	SW-DCEB-02	SW-DCEB-03	SW-DCEB-04	SW-DCFL-01	SW-DCFL-02	SW-DCFL-03	SW-DCFL-04
Compound Name	ebb tide, filtered	ebb tide, unfiltered	ebb tide, filtered, wet weather	ebb tide, unfiltered, wet weather	flood tide, filtered	flood tide, unfiltered	flood tide, filtered, wet weather	flood tide, unfiltered, wet weather
2,4-Dinitrophenol	1 U	1.1 U	1.1 U	1.1 U	1.2 U	1.1 U	1 U	1.1 U
2,4-Dinitrotoluene	0.11 U	0.12 U	0.12 U	0.12 U	0.13 U	0.12 U	0.11 U	0.12 U
2,6-Dinitrotoluene	0.12 U	0.13 U	0.13 U	0.13 U	0.14 U	0.13 U	0.12 U	0.13 U
2-Chloronaphthalene	0.095 U	0.1 U	0.1 U	0.096 U	0.11 U	0.1 U	0.092 U	0.096 U
2-Chlorophenol	0.11 U	0.12 U	0.12 U	0.12 U	0.13 U	0.12 U	0.11 U	0.12 U
2-Methylnaphthalene	0.095 U	0.1 U	0.1 U	0.096 U	0.11 U	0.1 U	0.092 U	0.096 U
2-Methylphenol	0.7 U	0.76 U	0.75 U	0.71 U	0.8 U	0.76 U	0.68 U	0.71 U
2-Nitroaniline	0.15 U	0.17 U	0.16 U	0.15 U	0.17 U	0.16 U	0.15 U	0.15 U
2-Nitrophenol	0.095 U	0.1 U	0.1 U	0.096 U	0.11 U	0.1 U	0.092 U	0.096 U
3 & 4 Methylphenol	0.62 U	0.68 U	0.67 U	0.64 U	0.72 U	0.68 U	0.61 U	0.64 U
3,3'-Dichlorobenzidine			2 U	1.9 U			1.8 U	1.9 U
3,3-Dichlorobenzidine	1.9 U	2.1 U			2.2 U	R		
3-Nitroaniline	0.15 U	0.17 U	0.16 U	0.15 U	0.17 U	R	0.15 U	0.15 U
4,6-Dinitro-2-methylphenol	0.12 U	0.13 U	0.13 U	0.13 U	0.14 U	0.13 U	0.12 U	0.13 U
4-Bromophenyl phenyl ether	0.11 U	0.12 U	0.12 U	0.12 U	0.13 U	0.12 U	0.11 U	0.12 U
4-Chloro-3-methylphenol	0.11 U	0.12 U	0.12 U	0.12 U	0.13 U	0.12 U	0.11 U	0.12 U
4-Chloroaniline	0.34 U	0.37 U	0.36 U	0.35 U	0.39 U	R	0.33 U	0.35 U
4-Chlorophenyl phenyl ether	0.095 U	0.1 U	0.1 U	0.096 U	0.11 U	0.1 U	0.092 U	0.096 U
4-Nitroaniline	0.47 U	0.52 U	0.51 U	0.48 U	0.54 U	R	0.46 U	0.48 U
4-Nitrophenol	0.47 U	0.52 U	0.51 U	0.48 U	0.54 U	0.51 U	0.46 U	0.48 U
Acenaphthene	0.095 U	0.1 U	0.1 U	0.096 U	0.11 U	0.1 U	0.092 U	0.096 U
Acenaphthylene	0.095 U	0.1 U	0.1 U	0.096 U	0.11 U	0.1 U	0.092 U	0.096 U
Acetophenone	0.95 U	0.39 J	0.11 J	0.11 J	1.1 U	0.1 U	0.092 U	0.096 U
Anthracene	0.095 U	0.1 U	0.1 U	0.096 U	0.11 U	0.1 U	0.092 U	0.096 U
Atrazine	0.33 U	0.36 U	0.35 U	0.34 U	0.38 U	0.36 U	0.32 U	0.34 U
Benzaldehyde	0.095 U	0.19 J	0.4 J	0.43 J	0.11 U	0.1 U	0.092 U	0.096 U
Benzo[a]anthracene	0.095 U	0.1 U	0.1 U	0.096 U	0.11 U	0.1 U	0.092 U	0.096 U
Benzo[a]pyrene	0.095 U	0.1 U	0.1 U	0.096 U	0.11 U	0.1 U	0.092 U	0.096 U
Benzo[b]fluoranthene	0.095 U	0.1 U	0.1 U	0.096 U	0.11 U	0.1 U	0.092 U	0.096 U
Benzo[g,h,i]perylene	0.095 U	0.1 U	0.1 U	0.096 U	0.11 U	0.1 U	0.092 U	0.096 U
Benzo[k]fluoranthene	0.095 U	0.1 U	0.1 U	0.096 U	0.11 U	0.1 U	0.092 U	0.096 U
Bis(2-chloroethoxy)methane	0.095 U	0.1 U	0.1 U	0.096 U	0.11 U	0.1 U	0.092 U	0.096 U
Bis(2-chloroethyl)ether	0.095 U	0.1 U	0.1 U	0.096 U	0.11 U	0.1 U	0.092 U	0.096 U
Bis(2-ethylhexyl) phthalate	0.61 U	0.66 U	0.65 U	0.62 U	0.7 U	0.66 U	0.59 U	0.62 U
Butyl benzyl phthalate	0.11 U	0.12 U	0.12 U	0.12 U	0.13 U	0.12 U	0.11 U	0.12 U
Caprolactam	0.12 U	0.13 U	24	0.13 U	0.18 J	0.13 U	0.21 J	0.15 J
Carbazole	0.095 U	0.1 U	0.1 U	0.096 U	0.11 U	0.1 U	0.092 U	0.096 U
Chrysene	0.043 U	0.046 U	0.046 U	0.043 U	0.049 U	0.046 U	0.042 U	0.043 U
Dibenz(a,h)anthracene	0.095 U	0.1 U	0.1 U	0.096 U	0.11 U	0.1 U	0.092 U	0.096 U
Dibenzofuran	0.095 U	0.1 U	0.1 U	0.096 U	0.11 U	0.1 U	0.092 U	0.096 U

	Culvert Samples							
	SW-DCEB-01	SW-DCEB-02	SW-DCEB-03	SW-DCEB-04	SW-DCFL-01	SW-DCFL-02	SW-DCFL-03	SW-DCFL-04
Compound Name	ebb tide, filtered	ebb tide, unfiltered	ebb tide, filtered, wet weather	ebb tide, unfiltered, wet weather	flood tide, filtered	flood tide, unfiltered	flood tide, filtered, wet weather	flood tide, unfiltered, wet weather
Diethyl phthalate	0.12 J	0.11 U	0.11 U	0.11 U	0.12 U	0.11 U	0.1 U	0.11 U
Dimethyl phthalate	0.095 U	0.1 U	0.1 U	0.096 U	0.11 U	0.1 U	0.092 U	0.096 U
Di-n-butyl phthalate	0.37 U	0.4 U	0.39 U	0.38 U	0.42 U	0.4 U	0.36 U	0.38 U
Di-n-octyl phthalate	0.16 U	0.18 U	0.17 U	0.16 U	0.18 U	0.17 U	0.16 U	0.16 U
Fluoranthene	0.095 U	0.1 U	0.1 U	0.096 U	0.11 U	0.1 U	0.092 U	0.096 U
Fluorene	0.095 U	0.1 U	0.1 U	0.096 U	0.11 U	0.1 U	0.092 U	0.096 U
Hexachlorobenzene	0.095 U	0.1 U	0.1 U	0.096 U	0.11 U	0.1 U	0.092 U	0.096 U
Hexachlorobutadiene	0.095 U	0.1 U	0.1 U	0.096 U	0.11 U	0.1 U	0.092 U	0.096 U
Hexachlorocyclopentadiene	0.47 U	0.52 U	0.51 U	0.48 U	0.54 U	0.51 U	0.46 U	0.48 U
Hexachloroethane	0.47 U	0.52 U	0.51 U	0.48 U	0.54 U	0.51 U	0.46 U	0.48 U
Indeno[1,2,3-cd]pyrene	0.095 U	0.1 U	0.1 U	0.096 U	0.11 U	0.1 U	0.092 U	0.096 U
Isophorone	0.095 U	0.1 U	0.1 U	0.096 U	0.11 U	0.1 U	0.092 U	0.096 U
Naphthalene	0.095 U	0.1 U	0.1 U	0.3	0.11 U	0.1 U	0.092 U	0.096 U
Nitrobenzene	0.095 U	0.1 U	0.1 U	0.096 U	0.11 U	0.1 U	0.092 U	0.096 U
N-Nitrosodi-n-propylamine	0.12 U	0.13 U	0.13 U	0.13 U	0.14 U	0.13 U	0.12 U	0.13 U
N-Nitrosodiphenylamine	0.35 U	0.38 U	0.37 U	0.36 U	0.4 U	0.38 U	0.34 U	0.36 U
Pentachlorophenol	0.38 U	0.41 U	0.4 U	0.38 U	0.44 U	0.41 U	0.37 U	0.39 U
Phenanthrene	0.095 U	0.1 U	0.1 U	0.096 U	0.11 U	0.1 U	0.092 U	0.096 U
Phenol	0.12 U	0.13 U	0.13 U	0.13 U	0.14 U	0.13 U	0.12 U	0.13 U
Pyrene	0.095 U	0.1 U	0.1 U	0.096 U	0.11 U	0.1 U	0.092 U	0.096 U
VOCs (µg/L)								
1,1,1-Trichloroethane	NA	0.5 U	NA	0.5 U	NA	0.5 U	NA	NA
1,1,2,2-Tetrachloroethane	NA	0.18 U	NA	0.18 U	NA	0.18 U	NA	NA
1,1,2-Trichloro-1,2,2-	NA	0.5 U	NA	0.5 U	NA	0.5 U	NA	NA
1,1,2-Trichloroethane	NA	0.13 U	NA	0.13 U	NA	0.13 U	NA	NA
1,1-Dichloroethane	NA	0.25 U	NA	0.25 U	NA	0.25 U	NA	NA
1,1-Dichloroethene	NA	0.11 U	NA	0.11 U	NA	0.11 U	NA	NA
1,2,4-Trichlorobenzene	NA	0.25 U	NA	0.25 U	NA	0.25 U	NA	NA
1,2-Dibromo-3-	NA	0.44 U	NA	0.44 U	NA	0.44 UJ	NA	NA
1,2-Dibromoethane	NA	0.25 U	NA	0.25 U	NA	0.25 U	NA	NA
1,2-Dichlorobenzene	NA	0.21 U	NA	0.21 U	NA	0.21 U	NA	NA
1,2-Dichloroethane	NA	0.1 U	NA	0.1 U	NA	0.1 U	NA	NA
1,2-Dichloropropane	NA	0.13 U	NA	0.13 U	NA	0.13 U	NA	NA
1,3-Dichlorobenzene	NA	0.25 U	NA	0.25 U	NA	0.25 U	NA	NA
1,4-Dichlorobenzene	NA	0.28 U	NA	0.28 U	NA	0.28 U	NA	NA
2-Butanone	NA	1 U	NA	1 U	NA	1 U	NA	NA
2-Hexanone	NA	1 U	NA	1 U	NA	1 U	NA	NA
4-Methyl-2-pentanone	NA	1 U	NA	1 U	NA	1 U	NA	NA
Acetone	NA	6.1 J	NA	5 U	NA	5 U	NA	NA
Benzene	NA	0.53 J	NA	0.25 U	NA	0.25 U	NA	NA

	Culvert Samples							
	SW-DCEB-01	SW-DCEB-02	SW-DCEB-03	SW-DCEB-04	SW-DCFL-01	SW-DCFL-02	SW-DCFL-03	SW-DCFL-04
Compound Name	ebb tide, filtered	ebb tide, unfiltered	ebb tide, filtered, wet weather	ebb tide, unfiltered, wet weather	flood tide, filtered	flood tide, unfiltered	flood tide, filtered, wet weather	flood tide, unfiltered, wet weather
Bromodichloromethane	NA	0.25 U	NA	0.25 U	NA	0.25 U	NA	NA
Bromoform	NA	0.5 U	NA	0.5 U	NA	0.5 UJ	NA	NA
Bromomethane	NA	0.8 U	NA	0.8 U	NA	0.8 U	NA	NA
Carbon disulfide	NA	0.6 U	NA	0.6 U	NA	0.6 U	NA	NA
Carbon tetrachloride	NA	9	NA	0.66 J	NA	0.5 UJ	NA	NA
Chlorobenzene	NA	0.78 J	NA	0.25 U	NA	0.25 U	NA	NA
Chloroethane	NA	1 U	NA	1 U	NA	1 U	NA	NA
Chloroform	NA	3.3	NA	0.39 J	NA	0.14 U	NA	NA
Chloromethane	NA	0.33 U	NA	0.33 U	NA	0.33 U	NA	NA
cis-1,2-Dichloroethene	NA	0.15 U	NA	0.15 U	NA	0.15 U	NA	NA
cis-1,3-Dichloropropene	NA	0.11 U	NA	0.11 U	NA	0.11 U	NA	NA
Cyclohexane	NA	0.25 U	NA	0.25 U	NA	0.25 U	NA	NA
Dibromochloromethane	NA	0.1 U	NA	0.1 U	NA	0.1 UJ	NA	NA
Dichlorodifluoromethane	NA	0.25 U	NA	0.25 U	NA	0.25 U	NA	NA
Ethylbenzene	NA	2.3	NA	0.4 J	NA	0.11 U	NA	NA
Isopropylbenzene	NA	0.91 J	NA	0.16 J	NA	0.1 U	NA	NA
Methyl acetate	NA	0.19 U	NA	0.19 U	NA	0.19 U	NA	NA
Methyl tert-butyl ether	NA	0.2 U	NA	0.2 U	NA	0.2 U	NA	NA
Methylcyclohexane	NA	0.1 U	NA	0.1 U	NA	0.1 U	NA	NA
Methylene Chloride	NA	1 U	NA	1 U	NA	1 U	NA	NA
Styrene	NA	0.11 U	NA	0.11 U	NA	0.11 U	NA	NA
Tetrachloroethene	NA	0.15 U	NA	0.2 J	NA	0.15 U	NA	NA
Toluene	NA	0.33 J	NA	0.33 U	NA	0.33 U	NA	NA
trans-1,2-Dichloroethene	NA	0.2 U	NA	0.2 U	NA	0.2 U	NA	NA
trans-1,3-Dichloropropene	NA	0.21 U	NA	0.21 U	NA	0.21 U	NA	NA
Trichloroethene	NA	0.13 U	NA	0.13 U	NA	0.13 U	NA	NA
Trichlorofluoromethane	NA	0.25 U	NA	0.25 U	NA	0.25 U	NA	NA
Vinyl chloride	NA	0.18 U	NA	0.18 U	NA	0.18 U	NA	NA
Xylenes, Total	NA	16	NA	2.5	NA	0.2 U	NA	NA
Metals (mg/L)								
Aluminum	0.07 J	0.11	NA	1.4	0.05 U	0.89	0.05 U	1.2
Antimony	0.002 U	0.002 U	NA	0.004 U	0.004 U	0.004 U	0.004 U	0.008 U
Arsenic	0.0039	0.0037	NA	0.0057	0.0025	0.0031 J	0.0026	0.0034
Barium	0.086	0.088	NA	0.057	0.028	0.032	0.023	0.028
Beryllium	0.00015 U	0.00015 U	NA	0.0006 U	0.0003 U	0.00015 U	0.00015 U	0.0006 U
Cadmium	0.00013 U	0.00013 U	NA	0.00026 U	0.00026 U	0.00026 U	0.00026 U	0.00052 U
Calcium	84	84	NA	390	310	320	350	340
Chromium	0.0025 U	0.0025 U	NA	0.0025 U	0.0025 U	0.005 U	0.0025 U	0.0025 U
Cobalt	0.0005 U	0.0005 U	NA	0.0011	0.0014	0.0012	0.00081	0.0011
Copper	0.0011 U	0.0012 J	NA	0.0015 J	0.0011 U	0.0022 U	0.0011 U	0.0011 U

	Culvert Samples							
	SW-DCEB-01	SW-DCEB-02	SW-DCEB-03	SW-DCEB-04	SW-DCFL-01	SW-DCFL-02	SW-DCFL-03	SW-DCFL-04
Compound Name	ebb tide, filtered	ebb tide, unfiltered	ebb tide, filtered, wet weather	ebb tide, unfiltered, wet weather	flood tide, filtered	flood tide, unfiltered	flood tide, filtered, wet weather	flood tide, unfiltered, wet weather
Iron	0.044 U	0.17	NA	0.94	0.044 U	0.54	0.044 U	0.85
Lead	0.0021	0.0005 U	NA	0.001 J	0.0005 U	0.0005 U	0.0005 U	0.00078 J
Magnesium	52	54	NA	1,100	1,100	1,100	1,200	1,000
Manganese	0.035	0.037	NA	0.21	0.099	0.14	0.091	0.12
Mercury	0.000091 U	0.000091 U	NA	0.000091 U	0.000091 U	0.000091 U	0.000091 U	0.000091 U
Nickel	0.002 U	0.002 U	NA	0.002 U	0.002 U	0.004 U	0.002 U	0.002 U
Potassium	9.6	10	NA	390	340	370	350	340
Selenium	0.0011 U	0.0011 U	NA	0.0022 U	0.0022 U	0.0022 U	0.0011 J	0.0022 U
Silver	0.00018 U	0.00018 U	NA	0.00036 U	0.00036 U	0.00036 U	0.00036 U	0.00072 U
Sodium	210	230	NA	9,300	8,200	8,300	9,700	9,000
Thallium	0.00025 U	0.00025 U	NA	0.0005 U	0.00025 U	0.00025 U	0.00025 U	0.00025 U
Vanadium	0.0041 J	0.0045 J	NA	0.0074 J	0.0039 J	0.0064 U	0.0048 J	0.0074 J
Zinc	0.0084 U	0.0099 J	NA	0.025 J	0.014 J	0.017 U	0.015 J	0.017 J
Cyanide, Total	0.005 U	0.005 U	NA	0.005 U	0.006 J	0.005 U	0.013	0.0065 J
Total Suspended Solids	NA	5.5	NA	43	NA	30	NA	31

NOTES:
U: not detected; J: estimated concentration; R: rejected after data analysis
NA: not analyzed

	Mouth Samples					
	SW-DMEB-01	SW-DMEB-02	SW-DMEB-03	SW-DMEB-04	SW-DMFL-01	SW-DMFL-02
Compound Name	ebb tide, filtered	ebb tide, unfiltered	ebb tide, filtered, wet weather	ebb tide, unfiltered, wet weather	flood tide, filtered	flood tide, unfiltered
Toxaphene (µg/L)						
Method 1 (Technical)	0.24 U	0.47 U	0.54 U	0.5 U	0.47 U	0.51 U
Method 2 (TAUC)	0.51 U	0.47 U	0.54 U	0.5 U	0.47 U	0.51 U
Pesticides (µg/L)						
4,4-DDD	0.0066 U	0.0061 U	0.0071 U	0.0065 U	0.0061 U	0.0066 U
4,4-DDE	0.0078 U	0.0072 U	0.0084 U	0.0077 U	0.0072 U	0.0078 U
4,4-DDT	0.0098 U	0.009 U	0.011 U	0.0097 U	0.0091 U	0.0098 U
Aldrin	0.0071 U	0.0065 U	0.0076 U	0.007 U	0.0065 U	0.0071 U
alpha-BHC	0.0058 U	0.0053 U	0.0062 U	0.0057 U	0.0053 U	0.0058 U
alpha-Chlordane	0.0061 U	0.0056 U	0.0065 U	0.006 U	0.0056 U	0.0061 U
beta-BHC	0.0068 U	0.0062 U	0.0073 U	0.0067 U	0.0063 U	0.0068 U
delta-BHC	0.0049 U	0.0045 U	0.0052 U	0.0048 U	0.0045 U	0.0049 U
Dieldrin	0.0092 U	0.0085 U	0.0099 U	0.0091 U	0.0085 U	0.0092 U
Endosulfan I	0.0043 U	0.0039 U	0.0046 U	0.0042 U	0.0039 U	0.0043 U
Endosulfan II	0.0099 UJ	0.0091 UJ	0.011 U	0.0098 U	0.0092 UJ	0.0099 UJ
Endosulfan sulfate	0.0069 UJ	0.0063 UJ	0.0074 U	0.0068 U	0.0064 UJ	0.0069 UJ
Endrin	0.0098 UJ	0.009 UJ	0.011 U	0.0097 U	0.0091 UJ	0.0098 UJ
Endrin aldehyde	0.016 U	0.015 U	0.017 U	0.016 U	0.015 U	0.016 U
Endrin ketone	0.0085 U	0.0078 U	0.0091 U	0.0084 U	0.0079 U	0.0085 U
gamma-BHC (Lindane)	0.006 U	0.0055 U	0.0064 U	0.0059 U	0.0055 U	0.006 U
gamma-Chlordane	0.0052 U	0.0048 U	0.0056 U	0.0051 U	0.0048 U	0.0052 U
Heptachlor	0.0071 U	0.0065 U	0.0076 U	0.007 U	0.0065 U	0.0071 U
Heptachlor epoxide	0.0061 U	0.0056 U	0.0065 U	0.006 U	0.0056 U	0.0061 U
Methoxychlor	0.013 U	0.012 U	0.014 U	0.013 U	0.012 U	0.013 U
PCB-1016	0.072 U	0.066 U	0.077 U	0.071 U	0.066 U	0.072 U
PCB-1221	0.28 U	0.26 U	0.3 U	0.28 U	0.26 U	0.28 U
PCB-1232	0.11 U	0.1 U	0.12 U	0.11 U	0.1 U	0.11 U
PCB-1242	0.18 U	0.17 U	0.2 U	0.18 U	0.17 U	0.18 U
PCB-1248	0.36 U	0.34 U	0.39 U	0.36 U	0.34 U	0.37 U
PCB-1254	0.26 U	0.24 U	0.28 U	0.26 U	0.24 U	0.26 U
PCB-1260	0.2 U	0.19 U	0.22 U	0.2 U	0.19 U	0.2 U
PCB-1268	0.26 U	0.24 U	0.28 U	0.26 U	0.24 U	0.26 U
SVOCs (µg/L)						
1,1-Biphenyl	0.1 U	0.1 U	0.1 U	0.11 U	0.093 U	0.1 U
2,2-oxybis[1-chloropropane]	0.1 U	0.1 U	0.1 U	0.11 U	0.093 U	0.1 U
2,4,5-Trichlorophenol	0.12 U	0.12 U	0.12 U	0.13 U	0.11 U	0.13 U
2,4,6-Trichlorophenol	0.17 U	0.18 U	0.17 U	0.19 U	0.16 U	0.18 U
2,4-Dichlorophenol	0.1 U	0.1 U	0.1 U	0.11 U	0.093 U	0.1 U
2,4-Dimethylphenol	0.71 U	0.72 U	0.71 U	0.77 U	0.64 U	0.72 U

	Mouth Samples					
	SW-DMEB-01	SW-DMEB-02	SW-DMEB-03	SW-DMEB-04	SW-DMFL-01	SW-DMFL-02
Compound Name	ebb tide, filtered	ebb tide, unfiltered	ebb tide, filtered, wet weather	ebb tide, unfiltered, wet weather	flood tide, filtered	flood tide, unfiltered
2,4-Dinitrophenol	1.1 U	1.1 U	1.1 U	1.2 U	1 U	1.2 U
2,4-Dinitrotoluene	0.12 U	0.12 U	0.12 U	0.13 U	0.11 U	0.13 U
2,6-Dinitrotoluene	0.13 U	0.14 U	0.13 U	0.14 U	0.12 U	0.14 U
2-Chloronaphthalene	0.1 U	0.1 U	0.1 U	0.11 U	0.093 U	0.1 U
2-Chlorophenol	0.12 U	0.12 U	0.12 U	0.13 U	0.11 U	0.13 U
2-Methylnaphthalene	0.1 U	0.1 U	0.1 U	0.11 U	0.093 U	0.1 U
2-Methylphenol	0.76 U	0.77 U	0.76 U	0.82 U	0.69 U	0.78 U
2-Nitroaniline	0.16 U	0.17 U	0.16 U	0.18 U	0.15 U	0.17 U
2-Nitrophenol	0.1 U	0.1 U	0.1 U	0.11 U	0.093 U	0.1 U
3 & 4 Methylphenol	0.68 U	0.69 U	0.67 U	0.73 U	0.62 U	0.69 U
3,3'-Dichlorobenzidine			2 U	2.2 U		
3,3-Dichlorobenzidine	2 U	2.1 U			1.9 U	2.1 U
3-Nitroaniline	0.16 U	0.17 U	0.16 U	0.18 U	0.15 U	0.17 U
4,6-Dinitro-2-methylphenol	0.13 U	0.14 U	0.13 U	0.14 U	0.12 U	0.14 U
4-Bromophenyl phenyl ether	0.12 U	0.12 U	0.12 U	0.13 U	0.11 U	0.13 U
4-Chloro-3-methylphenol	0.12 U	0.12 U	0.12 U	0.13 U	0.11 U	0.13 U
4-Chloroaniline	0.37 U	0.37 U	0.37 U	0.4 U	0.34 U	0.38 U
4-Chlorophenyl phenyl ether	0.1 U	0.1 U	0.1 U	0.11 U	0.093 U	0.1 U
4-Nitroaniline	0.51 U	0.52 U	0.51 U	0.56 U	0.47 U	0.52 U
4-Nitrophenol	0.51 U	0.52 U	0.51 U	0.56 U	0.47 U	0.52 U
Acenaphthene	0.1 U	0.1 U	0.1 U	0.11 U	0.093 U	0.1 U
Acenaphthylene	0.1 U	0.1 U	0.1 U	0.11 U	0.093 U	0.1 U
Acetophenone	1 U	1 U	0.1 U	0.11 U	0.093 U	1 U
Anthracene	0.1 U	0.1 U	0.1 U	0.11 U	0.093 U	0.1 U
Atrazine	0.36 U	0.36 U	0.36 U	0.39 U	0.33 U	0.37 U
Benzaldehyde	0.1 U	0.1 U	0.1 U	0.11 U	0.093 U	0.1 U
Benzo[a]anthracene	0.1 U	0.1 U	0.1 U	0.11 U	0.093 U	0.1 U
Benzo[a]pyrene	0.1 U	0.1 U	0.1 U	0.11 U	0.093 U	0.1 U
Benzo[b]fluoranthene	0.1 U	0.1 U	0.1 U	0.11 U	0.093 U	0.1 U
Benzo[g,h,i]perylene	0.1 U	0.1 U	0.1 U	0.11 U	0.093 U	0.1 U
Benzo[k]fluoranthene	0.1 U	0.1 U	0.1 U	0.11 U	0.093 U	0.1 U
Bis(2-chloroethoxy)methane	0.1 U	0.1 U	0.1 U	0.11 U	0.093 U	0.1 U
Bis(2-chloroethyl)ether	0.1 U	0.1 U	0.1 U	0.11 U	0.093 U	0.1 U
Bis(2-ethylhexyl) phthalate	0.66 U	0.67 U	0.65 U	0.71 U	0.6 U	0.67 U
Butyl benzyl phthalate	0.12 U	0.12 U	0.12 U	0.13 U	0.11 U	0.13 U
Caprolactam	0.25 J	0.14 U	0.2 J	0.19 J	0.12 U	0.14 U
Carbazole	0.1 U	0.1 U	0.1 U	0.11 U	0.093 U	0.1 U
Chrysene	0.046 U	0.047 U	0.046 U	0.05 U	0.042 U	0.047 U
Dibenz(a,h)anthracene	0.1 U	0.1 U	0.1 U	0.11 U	0.093 U	0.1 U
Dibenzofuran	0.1 U	0.1 U	0.1 U	0.11 U	0.093 U	0.1 U

Table _ 1 Continued

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	Mouth Samples					
	SW-DMEB-01	SW-DMEB-02	SW-DMEB-03	SW-DMEB-04	SW-DMFL-01	SW-DMFL-02
Compound Name	ebb tide, filtered	ebb tide, unfiltered	ebb tide, filtered, wet weather	ebb tide, unfiltered, wet weather	flood tide, filtered	flood tide, unfiltered
Diethyl phthalate	0.11 J	0.11 U	0.11 U	0.12 U	0.1 U	0.12 U
Dimethyl phthalate	0.1 U	0.1 U	0.1 U	0.11 U	0.093 U	0.1 U
Di-n-butyl phthalate	0.4 U	0.41 U	0.4 U	0.43 U	0.36 U	0.41 U
Di-n-octyl phthalate	0.17 U	0.18 U	0.17 U	0.19 U	0.16 U	0.18 U
Fluoranthene	0.1 U	0.1 U	0.1 U	0.11 U	0.093 U	0.1 U
Fluorene	0.1 U	0.1 U	0.1 U	0.11 U	0.093 U	0.1 U
Hexachlorobenzene	0.1 U	0.1 U	0.1 U	0.11 U	0.093 U	0.1 U
Hexachlorobutadiene	0.1 U	0.1 U	0.1 U	0.11 U	0.093 U	0.1 U
Hexachlorocyclopentadiene	0.51 U	0.52 U	0.51 U	0.56 U	0.47 U	0.52 U
Hexachloroethane	0.51 U	0.52 U	0.51 U	0.56 U	0.47 U	0.52 U
Indeno[1,2,3-cd]pyrene	0.1 U	0.1 U	0.1 U	0.11 U	0.093 U	0.1 U
Isophorone	0.1 U	0.1 U	0.1 U	0.11 U	0.093 U	0.1 U
Naphthalene	0.1 U	0.1 U	0.1 U	0.11 U	0.093 U	0.1 U
Nitrobenzene	0.1 U	0.1 U	0.1 U	0.11 U	0.093 U	0.1 U
N-Nitrosodi-n-propylamine	0.13 U	0.14 U	0.13 U	0.14 U	0.12 U	0.14 U
N-Nitrosodiphenylamine	0.38 U	0.38 U	0.38 U	0.41 U	0.35 U	0.39 U
Pentachlorophenol	0.41 U	0.42 U	0.41 U	0.44 U	0.37 U	0.42 U
Phenanthrene	0.1 U	0.1 U	0.1 U	0.11 U	0.093 U	0.1 U
Phenol	0.13 U	0.14 U	0.13 U	0.14 U	0.12 U	0.14 U
Pyrene	0.1 U	0.1 U	0.1 U	0.11 U	0.093 U	0.1 U
VOCs (µg/L)						
1,1,1-Trichloroethane	NA	0.5 U	NA	NA	NA	0.5 U
1,1,2,2-Tetrachloroethane	NA	0.18 U	NA	NA	NA	0.18 U
1,1,2-Trichloro-1,2,2-	NA	0.5 U	NA	NA	NA	0.5 U
1,1,2-Trichloroethane	NA	0.13 U	NA	NA	NA	0.13 U
1,1-Dichloroethane	NA	0.25 U	NA	NA	NA	0.25 U
1,1-Dichloroethene	NA	0.11 U	NA	NA	NA	0.11 U
1,2,4-Trichlorobenzene	NA	0.25 U	NA	NA	NA	0.25 U
1,2-Dibromo-3-	NA	0.44 U	NA	NA	NA	0.44 U
1,2-Dibromoethane	NA	0.25 U	NA	NA	NA	0.25 U
1,2-Dichlorobenzene	NA	0.21 U	NA	NA	NA	0.21 U
1,2-Dichloroethane	NA	0.1 U	NA	NA	NA	0.1 U
1,2-Dichloropropane	NA	0.13 U	NA	NA	NA	0.13 U
1,3-Dichlorobenzene	NA	0.25 U	NA	NA	NA	0.25 U
1,4-Dichlorobenzene	NA	0.28 U	NA	NA	NA	0.28 U
2-Butanone	NA	1 U	NA	NA	NA	1 U
2-Hexanone	NA	1 U	NA	NA	NA	1 U
4-Methyl-2-pentanone	NA	1 U	NA	NA	NA	1 U
Acetone	NA	5 U	NA	NA	NA	5 UJ
Benzene	NA	0.25 U	NA	NA	NA	0.25 U

Table 1 Continued

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	Mouth Samples					
	SW-DMEB-01	SW-DMEB-02	SW-DMEB-03	SW-DMEB-04	SW-DMFL-01	SW-DMFL-02
Compound Name	ebb tide, filtered	ebb tide, unfiltered	ebb tide, filtered, wet weather	ebb tide, unfiltered, wet weather	flood tide, filtered	flood tide, unfiltered
Bromodichloromethane	NA	0.25 U	NA	NA	NA	0.25 U
Bromoform	NA	0.5 U	NA	NA	NA	0.5 U
Bromomethane	NA	0.8 U	NA	NA	NA	0.8 U
Carbon disulfide	NA	0.6 U	NA	NA	NA	0.6 U
Carbon tetrachloride	NA	0.5 U	NA	NA	NA	0.5 U
Chlorobenzene	NA	0.25 U	NA	NA	NA	0.25 U
Chloroethane	NA	1 U	NA	NA	NA	1 U
Chloroform	NA	0.14 U	NA	NA	NA	0.14 U
Chloromethane	NA	0.33 U	NA	NA	NA	0.33 U
cis-1,2-Dichloroethene	NA	0.15 U	NA	NA	NA	0.15 U
cis-1,3-Dichloropropene	NA	0.11 U	NA	NA	NA	0.11 U
Cyclohexane	NA	0.25 U	NA	NA	NA	0.25 U
Dibromochloromethane	NA	0.1 U	NA	NA	NA	0.1 U
Dichlorodifluoromethane	NA	0.25 U	NA	NA	NA	0.25 U
Ethylbenzene	NA	0.11 U	NA	NA	NA	0.11 U
Isopropylbenzene	NA	0.1 U	NA	NA	NA	0.1 U
Methyl acetate	NA	0.19 U	NA	NA	NA	0.19 U
Methyl tert-butyl ether	NA	0.2 U	NA	NA	NA	0.2 U
Methylcyclohexane	NA	0.1 U	NA	NA	NA	0.1 U
Methylene Chloride	NA	1 U	NA	NA	NA	1 U
Styrene	NA	0.11 U	NA	NA	NA	0.11 U
Tetrachloroethene	NA	0.15 U	NA	NA	NA	0.15 U
Toluene	NA	0.33 U	NA	NA	NA	0.33 U
trans-1,2-Dichloroethene	NA	0.2 U	NA	NA	NA	0.2 U
trans-1,3-Dichloropropene	NA	0.21 U	NA	NA	NA	0.21 U
Trichloroethene	NA	0.13 U	NA	NA	NA	0.13 U
Trichlorofluoromethane	NA	0.25 U	NA	NA	NA	0.25 U
Vinyl chloride	NA	0.18 U	NA	NA	NA	0.18 U
Xylenes, Total	NA	0.2 U	NA	NA	NA	0.2 J
Metals (mg/L)						
Aluminum	0.05 U	2	0.05 U	1.4	0.05 U	0.0029
Antimony	0.002 U	0.01 U	0.004 U	0.008 U	0.004 U	0.004 U
Arsenic	0.0028	0.0032	0.0027	0.0031 J	0.0024 J	0.0029 J
Barium	0.033	0.039	0.016	0.018 J	0.029	0.03
Beryllium	0.0003 U	0.0003 U	0.0006 U	0.0006 U	0.0003 U	0.00015 U
Cadmium	0.00017 J	0.00065 U	0.00026 U	0.00052 U	0.00026 U	0.00026 U
Calcium	310	280	390	370	310	310
Chromium	0.0025 U	0.0034 J	0.0025 U	0.005 U	0.0025 U	0.0026 J
Cobalt	0.00086	0.0015	0.00075	0.00092 J	0.0012	0.0013
Copper	0.0011 U	0.0012 J	0.0011 U	0.0022 U	0.0011 U	0.0011 U

Table 1 Continued

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	Mouth Samples									
	SW-DMEB-01	SW-DMEB-02	SW-DMEB-03	SW-DMEB-04	SW-DMFL-01	SW-DMFL-02				
Compound Name	ebb tide, filtered	ebb tide, unfiltered	ebb tide, filtered, wet weather	ebb tide, unfiltered, wet weather	flood tide, filtered	flood tide, unfiltered				
Iron	0.044 U	1.3	0.044 U	0.96	0.044 U	1				
Lead	0.0005 U	0.0015 U	0.0005 U	0.001 U	0.0015 U	0.0015 U				
Magnesium	980	940	1,200	1,100	1,100	1,100				
Manganese	0.095	0.12	0.0091	0.034	0.13	0.15				
Mercury	0.000091 U	0.000091 U	0.000091 U	0.00012 J	0.000091 U	0.000091 U				
Nickel	0.002 U	0.002 U	0.002 U	0.004 U	0.002 U	0.0025 J				
Potassium	330	300	390	360	350	340				
Selenium	0.0022 U	0.0011 U	0.0044 U	0.0044 U	0.0022 U	0.0022 U				
Silver	0.00018 U	0.0009 U	0.00036 U	0.00072 U	0.00036 U	0.00036 U				
Sodium	8,000	7,800	10,000	9,300	8,800	8,700				
Thallium	0.00025 U	0.00025 U	0.00025 U	0.0005 U	0.00025 U	0.00025 U				
Vanadium	0.0042 J	0.0083 J	0.0044 J	0.013 U	0.0042 J	0.0078 J				
Zinc	0.013 J	0.017 U	0.015 J	0.034 U	0.014 J	0.019 J	SW-DCSH-05	SW-DCSL-06	SW-DMSH-05	SW-DMSL-06
Cyanide, Total	0.0062 J	0.005 U	0.0094 J	0.008 J	0.005 U	0.005 U	high slack in culvert	low slack in culvert	high slack in mouth	low slack in mouth
Total Suspended Solids	NA	29	NA	43	NA	37	**24**	5 U	**48**	**44**

APPENDIX C

Analytical Results for Sediment Pore Water Sampling

Table C-1. Analytical Results for Pore Water Samples, Terry Creek OU1 RI/FS

Compound Name	PW-ODPO-01 dissolved	PW-ODPO-02 total	PW-ODPR-01 dissolved	PW-ODPR-02 total
Toxaphene (µg/L)				
Method 1 (Technical)	2.3 J	9.5 U	0.49 U	0.49 U
Method 2 (TAUC)	**8.8**	**17**	0.49 U	0.49 U
Pesticides/PCBs (µg/L)				
4,4-DDD	0.13 U	0.12 U	0.0063 U	0.0064 U
4,4-DDE	0.15 U	0.15 U	0.0075 U	0.0076 U
4,4-DDT	0.19 U	0.18 U	0.0094 U	0.0095 U
Aldrin	0.14 U	0.13 U	0.0068 U	0.0069 U
alpha-BHC	0.11 U	0.11 U	0.0056 U	0.0056 U
alpha-Chlordane	0.12 U	0.11 U	0.0058 U	0.0059 U
beta-BHC	0.13 U	0.13 U	0.0065 U	0.0066 U
delta-BHC	0.093 U	0.091 U	0.0047 U	0.0047 U
Dieldrin	0.18 U	0.17 U	0.0089 U	0.0089 U
Endosulfan I	0.082 U	0.08 U	0.0041 U	0.0041 U
Endosulfan II	0.19 U	0.19 U	0.0095 U	0.0096 U
Endosulfan sulfate	0.13 U	0.13 U	0.0066 U	0.0067 U
Endrin	0.19 U	0.18 U	0.0094 U	0.0095 U
Endrin aldehyde	0.31 U	0.3 U	0.016 U	0.016 U
Endrin ketone	0.16 U	0.16 U	0.0082 U	0.0083 U
gamma-BHC (Lindane)	0.11 U	0.11 U	0.0057 U	0.0058 U
gamma-Chlordane	0.099 U	0.097 U	0.005 U	0.005 U
Heptachlor	0.14 U	0.13 U	0.0068 U	0.0069 U
Heptachlor epoxide	0.12 U	0.11 U	0.0058 U	0.0059 U
Methoxychlor	0.25 U	0.25 U	0.013 U	0.013 U
PCB-1016	0.069 U	1.3 U	0.069 U	0.07 U
PCB-1221	0.27 U	5.3 U	0.27 U	0.28 U
PCB-1232	0.11 U	2.1 U	0.11 U	0.11 U
PCB-1242	0.18 U	3.4 U	0.18 U	0.18 U
PCB-1248	0.35 U	6.8 U	0.35 U	0.35 U
PCB-1254	0.25 U	4.9 U	0.25 U	0.26 U
PCB-1260	0.19 U	3.8 U	0.19 U	0.2 U
PCB-1268	0.25 U	4.9 U	0.25 U	0.26 U
SVOCs (µg/L)				
1,1-Biphenyl	0.1 U	0.11 U	0.1 U	0.12 U
2,2-oxybis[1-chloropropane]	0.1 U	0.11 U	0.1 U	0.12 U
2,4,5-Trichlorophenol	0.12 U	0.13 U	0.12 U	0.14 U
2,4,6-Trichlorophenol	0.18 U	0.18 U	0.17 U	0.2 U
2,4-Dichlorophenol	0.1 U	0.11 U	0.1 U	0.12 U
2,4-Dimethylphenol	0.71 U	0.74 U	0.7 U	0.81 U
2,4-Dinitrophenol	1.1 U	1.2 U	1.1 U	1.3 U
2,4-Dinitrotoluene	0.12 U	0.13 U	0.12 U	0.14 U
2,6-Dinitrotoluene	0.13 U	0.14 U	0.13 U	0.15 U
2-Chloronaphthalene	0.1 U	0.11 U	0.1 U	0.12 U
2-Chlorophenol	0.12 U	0.13 U	0.12 U	0.14 U
2-Methylnaphthalene	0.1 U	0.11 U	0.1 U	0.12 U
2-Methylphenol	0.76 U	0.79 U	0.76 U	0.86 U
2-Nitroaniline	0.16 U	0.17 U	0.16 U	0.19 U
2-Nitrophenol	0.1 U	0.11 U	0.1 U	0.12 U
3 & 4 Methylphenol	0.68 U	0.7 U	0.67 U	0.77 U
3,3-Dichlorobenzidine	2.1 U	2.1 U	2 U	2.3 U
3-Nitroaniline	0.16 U	0.17 U	0.16 U	0.19 U
4,6-Dinitro-2-methylphenol	0.13 U	0.14 U	0.13 U	0.15 U
4-Bromophenyl phenyl ether	0.12 U	0.13 U	0.12 U	0.14 U
4-Chloro-3-methylphenol	0.12 U	0.13 U	0.12 U	0.14 U
4-Chloroaniline	0.37 U	0.38 U	0.37 U	0.42 U

Table C-1 Continued

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Compound Name	PW-ODPO-01 dissolved	PW-ODPO-02 total	PW-ODPR-01 dissolved	PW-ODPR-02 total
4-Chlorophenyl phenyl ether	0.1 U	0.11 U	0.1 U	0.12 U
4-Nitroaniline	0.52 U	0.53 U	0.51 U	0.58 U
4-Nitrophenol	0.52 U	0.53 U	0.51 U	0.58 U
Acenaphthene	0.1 U	0.11 U	0.1 U	0.12 U
Acenaphthylene	0.1 U	0.11 U	0.1 U	0.12 U
Acetophenone	1 U	1.1 U	1 U	1.2 U
Anthracene	0.1 U	0.11 U	0.1 U	0.12 U
Atrazine	0.36 U	0.37 U	0.36 U	0.41 U
Benzaldehyde	0.52 J	0.57 J	0.54 J	0.46 J
Benzo[a]anthracene	0.1 U	0.11 U	0.1 U	0.12 U
Benzo[a]pyrene	0.1 U	0.11 U	0.1 U	0.12 U
Benzo[b]fluoranthene	0.1 U	0.11 U	0.1 U	0.12 U
Benzo[g,h,i]perylene	0.1 U	0.11 U	0.1 U	0.12 U
Benzo[k]fluoranthene	0.1 U	0.11 U	0.1 U	0.12 U
Bis(2-chloroethoxy)methane	0.1 U	0.11 U	0.1 U	0.12 U
Bis(2-chloroethyl)ether	0.1 U	0.11 U	0.1 U	0.12 U
Bis(2-ethylhexyl) phthalate	0.66 U	0.68 U	0.65 U	0.75 U
Butyl benzyl phthalate	0.12 U	0.13 U	0.12 U	0.14 U
Caprolactam	0.13 U	0.14 U	0.13 U	0.15 U
Carbazole	0.1 U	0.11 U	0.1 U	0.12 U
Chrysene	0.046 U	0.048 U	0.046 U	0.053 U
Dibenz(a,h)anthracene	0.1 U	0.11 U	0.1 U	0.12 U
Dibenzofuran	0.1 U	0.11 U	0.1 U	0.12 U
Diethyl phthalate	0.11 U	0.12 U	0.21 J	0.31 J
Dimethyl phthalate	0.1 U	0.11 U	0.1 U	0.12 U
Di-n-butyl phthalate	0.4 U	0.42 U	0.4 U	0.46 U
Di-n-octyl phthalate	0.18 U	0.18 U	0.17 U	0.2 U
Fluoranthene	0.1 U	0.11 U	0.1 U	0.12 U
Fluorene	0.1 U	0.11 U	0.1 U	0.12 U
Hexachlorobenzene	0.1 U	0.11 U	0.1 U	0.12 U
Hexachlorobutadiene	0.1 U	0.11 U	0.1 U	0.12 U
Hexachlorocyclopentadiene	R	R	R	R
Hexachloroethane	0.52 U	0.53 U	0.51 U	0.58 U
Indeno[1,2,3-cd]pyrene	0.1 U	0.11 U	0.1 U	0.12 U
Isophorone	0.1 U	0.11 U	0.1 U	0.12 U
Naphthalene	0.1 U	0.11 U	0.1 U	0.16 J
Nitrobenzene	0.1 U	0.11 U	0.1 U	0.12 U
N-Nitrosodi-n-propylamine	0.13 U	0.14 U	0.13 U	0.15 U
N-Nitrosodiphenylamine	0.38 U	0.39 U	0.38 U	0.43 U
Pentachlorophenol	0.41 U	0.43 U	0.41 U	0.47 U
Phenanthrene	0.1 U	0.11 U	0.1 U	0.12 U
Phenol	0.25 J	0.36 J	0.13 U	0.15 J
Pyrene	0.1 U	0.11 U	0.1 U	0.12 U
VOCs (µg/L)				
1,1,1-Trichloroethane	0.5 U	0.5 U	0.5 U	0.5 U
1,1,2,2-Tetrachloroethane	0.18 U	0.18 U	0.18 U	0.18 U
1,1,2-Trichloro-1,2,2-trifluoroethane	0.5 U	0.5 U	0.5 U	0.5 U
1,1,2-Trichloroethane	0.13 U	0.13 U	0.13 U	0.13 U
1,1-Dichloroethane	0.25 U	0.25 U	0.25 U	0.25 U
1,1-Dichloroethene	0.11 U	0.11 U	0.11 U	0.11 U
1,2,4-Trichlorobenzene	0.25 U	0.25 U	0.25 U	0.25 U
1,2-Dibromo-3-Chloropropane	0.44 U	0.44 U	0.44 U	0.44 U
1,2-Dibromoethane	0.25 U	0.25 U	0.25 U	0.25 U
1,2-Dichlorobenzene	0.21 U	0.21 U	0.21 U	0.21 U
1,2-Dichloroethane	0.1 U	0.1 U	0.1 U	0.1 U
1,2-Dichloropropane	0.13 U	0.13 U	0.13 U	0.13 U
1,3-Dichlorobenzene	0.25 U	0.25 U	0.25 U	0.25 U

Table C-1 Continued

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Compound Name	PW-ODPO-01 dissolved	PW-ODPO-02 total	PW-ODPR-01 dissolved	PW-ODPR-02 total
1,4-Dichlorobenzene	0.28 U	0.28 U	0.28 U	0.28 U
2-Butanone	1 U	1 U	1 U	1 U
2-Hexanone	1 U	1 U	1 U	1 U
4-Methyl-2-pentanone	1 U	1 U	1 U	1 U
Acetone	10 J	5 U	5 U	5 U
Benzene	0.25 U	0.25 U	0.25 U	0.25 U
Bromodichloromethane	0.25 U	0.25 U	0.25 U	0.25 U
Bromoform	0.5 U	0.5 U	0.5 U	0.5 U
Bromomethane	0.8 U	0.8 U	0.8 U	0.8 U
Carbon disulfide	0.6 U	0.6 U	0.6 U	0.6 U
Carbon tetrachloride	0.5 U	0.5 U	0.5 U	0.5 U
Chlorobenzene	0.25 U	0.25 U	0.25 U	0.25 U
Chloroethane	1 U	1 U	1 U	1 U
Chloroform	0.14 U	0.14 U	0.14 U	0.14 U
Chloromethane	0.33 U	0.33 U	0.33 U	0.33 U
cis-1,2-Dichloroethene	0.15 U	0.15 U	0.15 U	0.15 U
cis-1,3-Dichloropropene	0.11 U	0.11 U	0.11 U	0.11 U
Cyclohexane	0.25 U	0.25 U	0.25 U	0.25 U
Dibromochloromethane	0.1 U	0.1 U	0.1 U	0.1 U
Dichlorodifluoromethane	0.25 U	0.25 U	0.25 U	0.25 U
Ethylbenzene	0.11 U	0.11 U	0.11 U	0.11 U
Isopropylbenzene	0.1 U	0.1 U	0.1 U	0.1 U
Methyl acetate	0.19 U	0.19 U	0.19 U	0.19 U
Methyl tert-butyl ether	0.2 U	0.2 U	1.5 J	1.7 J
Methylcyclohexane	0.1 U	0.1 U	0.1 U	0.1 U
Methylene Chloride	1 U	1 U	1 U	1 U
Styrene	0.11 U	0.11 U	0.11 U	0.11 U
Tetrachloroethene	0.15 U	0.15 U	0.15 U	0.15 U
Toluene	0.33 J	0.33 U	0.37 J	0.63 J
trans-1,2-Dichloroethene	0.2 U	0.2 U	0.2 U	0.2 U
trans-1,3-Dichloropropene	0.21 U	0.21 U	0.21 U	0.21 U
Trichloroethene	0.13 U	0.13 U	0.13 U	0.13 U
Trichlorofluoromethane	0.25 U	0.25 U	0.25 U	0.25 U
Vinyl chloride	0.18 U	0.18 U	0.18 U	0.18 U
Xylenes, Total	0.2 U	0.2 U	0.2 U	0.2 U
Metals (mg/L)				
Aluminum	0.05 U	0.35	0.05 U	1.6
Antimony	0.004 U	0.004 U	0.004 U	0.004 U
Arsenic	0.0016 J	0.002 J	0.0013 J	0.0021 J
Barium	0.098	0.1	0.14	0.18
Beryllium	0.00015 U	0.00015 U	0.00015 U	0.00015 U
Cadmium	0.00013 U	0.00013 UJ	0.00013 U	0.00013 U
Calcium	220	210	220	260
Chromium	0.0077	0.0032 J	0.0045 J	0.0094
Cobalt	0.0022	0.00039 J	0.00092	0.00092
Copper	0.0011 J	0.0019 J	0.0011 U	0.0048 J
Iron	0.091 J	0.41	0.064 J	1.3
Lead	0.0005 U	0.0005 U	0.0005 U	0.0043
Magnesium	580	590	290	330
Manganese	0.49	0.58	0.087	0.096
Mercury	0.000091 U	0.000091 U	0.000091 U	0.000091 U
Nickel	0.0031 J	0.002 U	0.002 U	0.0024 J
Potassium	200	180	86	100
Selenium	0.0022 U	0.0022 U	0.0022 U	0.0022 U
Silver	0.00018 U	0.00018 U	0.00018 U	0.00018 U
Sodium	5,300	5,000	1,900	2,200
Thallium	0.00025 U	0.00025 U	0.00025 U	0.00025 U

Table C-1 Continued

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Compound Name	PW-ODPO-01	PW-ODPO-02	PW-ODPR-01	PW-ODPR-02
	dissolved	total	dissolved	total
Vanadium	0.0073 J	0.0053 J	0.0058 J	0.01
Zinc	0.0084 U	0.0084 U	0.0084 U	0.031
Cyanide, Total	0.005 U	0.005 U	0.005 U	0.005 U

Notes:

U: not detected; J: estimated concentration, R: rejected after data validation

APPENDIX D

Hydrologic Investigation

APPENDIX E

Geotechnical Pre-Weir Investigation: Subsurface Stratigraphy and Material Properties

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Memorandum

Date: 18 June 2012

To: Cristin Corless Krachon, Project Scientist

From: Ramil Mijares, Ph.D., Senior Staff Engineer
Ramachandran Kulasingam, Ph.D., P.E., Senior Engineer

Subject: Geotechnical Investigation: Subsurface Stratigraphy and Material Properties
Terry Creek Site, Brunswick, Georgia

The purpose of this memorandum is to present the results of the limited geotechnical subsurface investigation activities performed in accordance with the focused Remedial Investigation and Feasibility Study (RI/FS) Work Plan prepared by Geosyntec Consultants (Geosyntec) for Operable Unit 1 (OU1) at the Terry Creek Site (Site) located in Brunswick, Georgia. The intent of the geotechnical investigation was to evaluate the existing subsurface conditions at the Site to aid in the development and evaluation of a remedy for OU1.

The remainder of this memorandum is organized to present: (i) a summary of the geotechnical investigation activities; (ii) interpretation of subsurface stratigraphy; (iii) a summary of geotechnical laboratory analyses and interpretation of material properties (i.e., index properties, compressibility, and shear strength); and (iv) recommendation on material properties to be used in developing and evaluating remedial alternatives.

GEOTECHNICAL INVESTIGATION

The scope of work performed by Geosyntec consisted of drilling 11 Standard Penetration Test (SPT) borings shown in Figure 1. Five (5) borings were located along the potential re-routing alignment of the Outfall Ditch, four (4) borings were located north of the Outfall Ditch, and the remaining borings were located in areas that will provide data that are representative of subsurface soil below the Outfall Ditch. Borings B-1 through B-9 were advanced to a total depth of 16 feet, below ground surface (bgs). Borings B-10 and B-11 were advanced to a total depth of 36 feet, bgs. Table 1 presents the coordinates of the borings and the ground surface elevation. The SPT borings were advanced using hollow stem auger (HSA) drilling techniques on February 27 to 29, 2012. The geotechnical drilling services were provided by SAEDACCO, Inc. of Fort Mill, South Carolina under subcontract to Geosyntec.

SPTs and soil sampling were performed using continuous split-spoon sampling procedures in accordance with ASTM D1586 "Standard Test Method for Standard Penetration Test (SPT) and

Split-Barrel Sampling of Soils". The subsurface soils encountered were logged in accordance with ASTM D2488 "Standard Practice for Description and Identification of Soils (Visual-Manual Procedure)". Lithologic field logs for each borings are presented in Attachment A. The lithologic boring logs include general soil classification and description, recovery percentage, recorded blow counts and the corresponding SPT N value. The approximate depth to groundwater at each boring location, as indicated by the saturated conditions of the soils, was also noted during drilling and included on the respective lithologic boring logs.

A total of three (3) thin-walled Shelby tube samples from predominantly clayey layers were also collected. Upon completion of drilling activities, each borehole was grouted from the bottom up to the ground surface with neat cement.

Furthermore, two sediment samples were obtained from the Outfall Ditch, one from the pre-weir and one from the post-weir section as shown in Figure 1. The samples were collected using a vibracoring device up to a depth of approximately 10 feet below the sediment-water interface.

A photography log with select photographs during the geotechnical site investigation is presented in Attachment B.

SUBSURFACE STRATIGRAPHY

The subsurface stratigraphy in the OU1 Site was developed based on the geotechnical information interpreted from the lithologic boring logs presented in Attachment A. Subsurface profiles developed for the northern (i.e., north of the Outfall Ditch) and southern (i.e., south of the Outfall Ditch) sides of the OU1 site are presented in Attachment C. The subsurface conditions encountered during the geotechnical investigation are summarized as follows:

- Sand (shallow): Sand was encountered on the upper portions of the OU1 Site and was found to extend approximately up to 4 to 8 feet, bgs on the southern side of the OU1 Site, as illustrated in Subsurface Profile 1 on Attachment C. It was found to extend throughout the depth of Boreholes B-6 through B-8 on the northern side of the OU1 Site, as illustrated in Subsurface Profile 2 on Attachment C, with pockets of Clayey Sand and Clay at varying intervals. The Sand consisted primarily of poorly graded, fine to medium sand. The SPT N value ranged from 0 to 16 with an average value of 6 as shown in Figure 2.

- Clayey Sand: Clayey Sand was encountered on the southern side of the OU1 Site on the borings located along the potential re-routing alignment of the Outfall Ditch (i.e., Boreholes B-1 through B-5 and B-11), as illustrated in Subsurface Profile 1 on Attachment C, and was found to extend approximately from 4 to 8 feet, bgs up to 8 to 14 feet, bgs. The Clayey Sand consisted primarily of fine to medium sand with some

clay. Presence of crushed shells was found in some areas. The SPT N value ranged from 0 to 14 with an average value of 5 as shown in Figure 2.

- Sand (deep): Sand was encountered on the lower portions of the OU1 Site on the bottom of the boreholes extending approximately from 10 to 14 feet, bgs on shallow borings and approximately from 24 to 28 feet, bgs on deep borings. The Sand consisted primarily of poorly graded, fine to medium sand. The SPT N value ranged from 0 to 50 with an average value of 12 as shown in Figure 2.

- Clay: Clay was encountered in the eastern side of the OU1 Site (i.e., Boreholes B-1, B-2, B-9, B-10 and B-11) and was found to extend approximately from 4 to 10 feet, bgs up to 14 to 18 feet, bgs. It was also found to extend up to approximately 24 to 28 feet, bgs on Boreholes B-10 and B-11. The Clay consisted of highly plastic, sandy fat clay to fat clay. The SPT N value ranged from 0 to 7 with an average value of 2 as shown in Figure 2.

Groundwater table was observed approximately 4 to 6 feet, bgs. Trace organic material (i.e., mostly small roots) was identified in the upper portions (i.e., approximately 0 to 4 feet, bgs) of the OU1 Site.

The descriptions of Outfall Ditch sediments are as follows:

- Pre-Weir Sediments: The Pre-Weir Sediments consist of sediments located within the Outfall Ditch on the west side of the weir. The Pre-Weir Sediments were characterized as dark gray, non-plastic, clayey silty sand with a USCS classification of SM.

- Post-Weir Sediments: The Post-Weir Sediments consist of sediments located within the Outfall Ditch on the east side of the weir. The Post-Weir Sediments were characterized as dark gray, highly plastic, fat clay with a USCS classification of CH.

MATERIAL PROPERTIES

Properties of the subsurface soils and sediments from the Outfall Ditch were selected based on laboratory data, empirical correlations using in-situ test data when laboratory data were not available, or prior experience with similar materials. Representative and undisturbed soil samples from selected depth intervals were collected in the field from the soil borings. The soil samples, including the sediment samples, were sent to Excel Geotechnical Testing, Inc. in Roswell, Georgia for laboratory testing, which included:

- Index property tests (i.e., moisture content, particle size, and Atterberg limits); and

- Performance tests (i.e., compaction tests, hydraulic conductivity tests, one-dimensional consolidation tests, and consolidated undrained (CU) triaxial compression tests with pore water pressure measurements).

The results of all geotechnical laboratory testing are presented in Attachment D.

Moisture Content

Moisture content tests were performed in accordance with ASTM D2216 "Standard Test Methods for Laboratory Determination of Water (Moisture) Content of Soil and Rock by Mass". The results of the moisture content tests are presented in Attachment D. The measured natural moisture contents were also plotted with respect to depth as shown in Figure 3.

For Sand, the in-situ moisture contents range from 14 to 75 percent with an average of 31 percent. For Clayey Sand, the in-situ moisture contents range from 24 to 74 percent with an average of 36 percent. For Clay, the in-situ moisture contents range from 25 to 134 percent with an average of 62 percent. A sample of Pre-Weir Sediments has a moisture content of 71 percent and a sample of Post-Weir Sediments has a moisture content of 135 percent.

Particle-Size Analysis

Particle size analyses were performed for materials in the OU1 Site. The particle size distribution was measured using mechanical sieves and hydrometer methods in accordance with ASTM D422 "Standard Test Method for Particle-Size Analysis of Soils". A total of nine (9) particle-size analyses were performed using the samples obtained from the soil borings, one (1) particle-size analysis was performed using a sample of Pre-Weir Sediments, and one (1) particle-size analysis was performed using a sample of Post-Weir Sediments. The particle-size distribution curves are presented in Attachment D.

The results of the particle-size analyses indicated that the soil samples tested are generally classified as either poorly graded sand or clay. The results also confirmed the visual classification descriptions from the field. The results of the particle-size analyses for the sediment samples indicated that Pre-Weir Sediments primarily consist of sand (73 percent) with fines content of 25 percent while the Post-Weir Sediments have fines content of 90 percent with only 10 percent sand.

Atterberg Limits

Atterberg limits were measured for Clay and Sediments (Pre-Weir and Post-Weir) in accordance with ASTM D4318 "Standard Test Methods for Liquid Limit, Plastic Limit, and Plasticity Index of Soils". Atterberg limit tests were performed on five (5) samples of Clay [i.e., Boreholes B-2

(10-14 feet, bgs), B-7 (2-6 feet, bgs), B-10 (7-16 feet, bgs), B-10 (24-26 feet, bgs), and B-11 (10-18 feet, bgs)], a sample of Pre-Weir Sediments, and a sample of Post-Weir Sediments. The results of the Atterberg limit tests are presented in Attachment D.

The resulting liquid limit (LL), plastic limit (PL), and plasticity index (PI) were plotted with respect to depth as shown in Figure 4. The Atterberg limits were also plotted on Casagrande's plasticity chart shown in Figure 5. Based on the standard plasticity chart, samples of Clay have a USCS classification of CH (high plasticity clay). The sample of Pre-Weir Sediments was found to be non-plastic with a USCS classification of SM (silty sand). The sample of Post-Weir Sediments was found to be CH.

Unit Weight

The unit weights of samples of Clay were measured during consolidated undrained (CU) triaxial tests. The results are plotted in Figure 6 as a function of depth. The unit weights of samples of Sand, Clayey Sand, Pre-Weir Sediments, and Post-Weir Sediments were estimated from the measured moisture content of samples taken below the groundwater table (i.e., under saturated condition) and assuming a specific gravity of soil solids of 2.65. The total unit weight recommended for Clay is 110 pcf. The recommended total unit weight of Sand and Clayey Sand is 120 pcf. The recommended total unit weights of Pre-Weir Sediments and Post-Weir Sediments are 100 pcf and 85 pcf, respectively.

Compaction Characteristics

Standard Proctor compaction tests were performed on samples of Sand, Pre-Weir Sediments, and Post-Weir Sediments in accordance with ASTM D698 "Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Standard Effort (12,400 ft-lbf/ft^3)". The results of the standard Proctor compaction tests are presented in Attachment D.

Figure 7 shows the compiled Proctor compaction curves. Also shown for comparison in Figure 7 are the zero air void curves based on specific gravity of soil solids ranging from 2.60 to 2.75. The optimum moisture content corresponds to the moisture content of the soil at which the maximum dry unit weight can be attained. As shown in Figure 7, as the sample becomes coarser the resulting optimum moisture content becomes lower and the maximum dry unit weight becomes higher. Table 2 presents the calculated optimum moisture contents and maximum dry densities.

Hydraulic Conductivity

Hydraulic conductivity tests were performed on Outfall Ditch sediment samples obtained from the east side of the weir (Location S-1 in Figure 1), i.e., Post-Weir Sediments, in accordance with

ASTM D5084 "Standard Test Methods for Measurement of Hydraulic Conductivity of Saturated Porous Materials Using a Flexible Wall Permeameter". The samples were remolded in the laboratory at optimum moisture content and dry unit weight corresponding to 95% of the standard Proctor maximum dry unit weight. The results of the hydraulic conductivity tests are presented in Attachment D. The measured saturated hydraulic conductivity of the sediments is 2.8×10^{-5} cm/s under an effective confining pressure of 125 psf and 3.4×10^{-6} cm/s under an effective confining pressure of 500 psf.

Consolidation Parameters

To evaluate the consolidation characteristics of fine-grained soils and sediments, one-dimensional (1-D) consolidation tests were performed in accordance with ASTM D2435 "Standard Test Methods for One-Dimensional Consolidation Properties of Soils Using Incremental Loading". One 1-D consolidation test was performed on undisturbed sample of Clay [i.e., Shelby tube sample from Borehole B-11, ST-GTB11 (22-24 feet, bgs)]. Due to the loose nature of the sediments, undisturbed samples of sediments could not be collected for consolidation testing. The Outfall Ditch sediment samples obtained from the east side of the weir (Location S-1 in Figure 1), i.e., Post-Weir Sediments, were remolded in the laboratory at optimum moisture content and dry unit weight corresponding to 95% of the standard Proctor maximum dry unit weight. One 1-D consolidation test was performed on the remolded Post-Weir Sediments.

The undisturbed sample of Clay was consolidated incrementally at consolidation pressures of 100 psf, 250 psf, 500 psf, 1000 psf, 2000 psf, 4000 psf and then unloaded to consolidation pressure of 1000 psf, and then incrementally reloaded at consolidation pressures of 4000 psf, 8000 psf, and 16000 psf. The remolded sample of Post-Weir Sediments was consolidated under similar loading-unloading-reloading sequence except that the 250 psf and 500 psf consolidation pressures were eliminated. The results of the consolidation tests are presented in Attachment D.

The preconsolidation pressures (P_c') calculated from the consolidation test results, using Casagrande method, were plotted with respect to depth in Figure 8. The profile of the in-situ effective vertical stress was calculated for the sample of Clay and plotted as well in Figure 8. The overconsolidation ratio, which is the ratio of P_c' to the in-situ effective vertical stress, was also calculated and plotted in Figure 9 as a function of depth. Based on this figure, the Clay was assumed to be normally consolidated (OCR = 1.0).

The modified compression index ($C_{c\varepsilon}$) was calculated by taking the slope of the fitted straight line through the linear portion of the strain versus log of consolidation pressure curve. The modified recompression index ($C_{r\varepsilon}$) was calculated by taking the slope of the fitted straight line through the unloading and reloading portions of the strain versus log of consolidation pressure

curve. The calculated $C_{c\varepsilon}$ and $C_{r\varepsilon}$ values were plotted with depth as shown in Figures 10 and 11, respectively.

The coefficient of consolidation (C_v) was calculated using the Taylor method (i.e., the square root of time method) for all loading increments. The calculated C_v values were plotted as a function of stress ratio (σ_v'/σ_p') as shown in Figure 12 for Clay and in Figure 13 for reconstituted Post-Weir Sediments. Furthermore, the C_v values were calculated for stress ratios less than 1.0 and greater than 1.0. The C_v value for Clay for a stress ratio below 1.0 was selected to be 0.035 cm^2/min (0.054 ft^2/day); while for a stress ratio above 1.0, the C_v value for Clay was selected to be 0.019 cm^2/min (0.029 ft^2/day). The C_v value for reconstituted Post-Weir Sediments for a stress ratio below 1.0 and above 1.0 were selected to be 0.466 cm^2/min (0.722 ft^2/day) and 0.226 cm^2/min (0.350 ft^2/day), respectively.

The modified coefficient of secondary compression index ($C_{\alpha\varepsilon}$) was calculated by taking the slope of the long-term portion of the strain versus log of time curve for all loading increments. The calculated $C_{\alpha\varepsilon}$ values were plotted as a function of stress ratio (σ_v'/σ_p') as shown in Figure 14 for Clay. For reconstituted Post-Weir Sediments, the sample generally did not exhibit secondary compression during consolidation testing. The $C_{\alpha\varepsilon}$ values for Clay were also calculated for stress ratios less than 1.0 and greater than 1.0. The $C_{\alpha\varepsilon}$ value for a stress ratio below 1.0 was selected to be 0.0027; while for a stress ratio above 1.0, the $C_{\alpha\varepsilon}$ value was selected to be 0.0052.

Undrained Shear Strength

Consolidated undrained (CU) triaxial tests were performed on samples of Clay, Pre-Weir Sediments, and Post-Weir Sediments in accordance with ASTM D4767 "Standard Test Method for Consolidated Undrained Triaxial Compression Test for Cohesive Soils". For Clay, CU triaxial tests were performed on Shelby tube samples obtained from boreholes B-1, B-10, and B-11 [i.e., ST-GTB1 (10-12 feet, bgs), ST-GTB10 (26-28 feet, bgs), and ST-GTB11 (22-24 feet, bgs), respectively]. Three-point CU triaxial test was conducted for ST-GTB1 under effective consolidation pressures of 850 psf, 1700 psf, and 3400 psf. One-point CU triaxial test was conducted for ST-GTB10 and ST-GTB11 under effective consolidation pressures of 6600 psf and 5600 psf, respectively.

Samples of Pre-Weir Sediments and Post-Weir Sediments were remolded in the laboratory at optimum moisture content and dry unit weight corresponding to 95% of the standard Proctor maximum dry unit weight. For Pre-Weir Sediments, one-point CU triaxial test was conducted under an effective consolidation pressure of 375 psf. For Post-Weir Sediments, three-point CU triaxial test was conducted under an effective consolidation pressure of 100 psf, 250 psf, and 500 psf. The results of the CU triaxial tests are presented in Attachment D.

Undrained shear strength properties were interpreted from the CU triaxial tests. The undrained shear strength (S_u) is equal to half of the deviator stress at failure for each soil specimen. The failure criterion corresponds to the maximum deviator stress attained or the deviator stress at 15 percent axial strain, whichever occurred first during testing. The S_u measured in each CU triaxial test corresponds to the effective consolidation pressure applied in the laboratory. Hence, the interpretation of shear strengths will not be too affected by the sample disturbance. An increase in effective consolidation pressure causes a decrease in void ratio and an increase in undrained shear strength.

The undrained shear strength ratios were calculated by dividing the measured S_u by the applied effective consolidation pressure (σ_c') in the laboratory. Figure 15 shows the plot of the undrained shear strength ratios versus the applied σ_c'. The shear strength ratios generally decrease with higher consolidation pressures and reach a lower bound ratio as shown in Figure 15. The recommended undrained shear strength ratio for Clay is also presented in Figure 15. With a minimum undrained shear strength ratio of 0.32 (for a Clay with plasticity index of approximately 31 percent) under a CU triaxial compression test, the corresponding undrained shear strength ratio under direct simple shear is 0.24 as illustrated in Figure 16. Hence, an undrained shear strength ratio of 0.24 is recommended for Clay. As presented in Table 3, using an estimated average SPT N value of 2 for Clay, the recommended minimum S_u is conservatively chosen as 200 psf.

Drained Shear Strength

The drained shear strength parameters, i.e., effective stress friction angles (ϕ') and effective stress cohesion (c'), for Clay, Pre-Weir Sediments, and Post-Weir Sediments were estimated using the data from the CU test results. Using the effective stresses at failure for each CU test, Mohr-Coulomb failure envelopes were plotted in Figure 17 for Clay. Similarly, Figure 18 shows the effective stress Mohr-Coulomb failure envelopes for Pre-Weir Sediments and Post-Weir Sediments.

Based on the failure envelope plots, the following are the recommended drained shear strength parameters:

- For Clay, the ϕ' is recommended to be 28 degrees and the c' is recommended to be 133 psf;
- For reconstituted Pre-Weir Sediments, the ϕ' is recommended to be 25 degrees and c' is recommended to be 0 psf; and

- For reconstituted Post-Weir Sediments, the ϕ' is recommended to be 41 degrees and c' is recommended to be 18 psf.

The drained shear strength parameters for other materials (i.e., Sand and Clayey Sand) were estimated using the empirical relationship between the SPT N value and ϕ' shown in Table 4 [Kulhawy and Mayne, 1990]. Using an estimated average SPT N value of 6 for Sand (shallow) and 12 for Sand (deep), the recommended ϕ' are 29 and 31 degrees, respectively. With an estimated average SPT N value of 5 for Clayey Sand, the recommended ϕ' is 28 degrees.

SUMMARY OF RECOMMENDED MATERIAL PROPERTIES

Table 5 summarizes the recommended material properties to be used in developing and evaluating remedial alternatives for OU1.

REFERENCES

Kulhawy, F. H. and Mayne, P. W. (1990). "Manual on Estimating Soil Properties for Foundation Design", EPRI EL-6800, Research Project 1493-6.

Ladd, C. C. (1991). "Stability Evaluation During Staged Construction", ASCE Journal of Geotechnical Engineering, Vol. 117, No. 4, pp. 540-615.

* * * * *

TABLES

Table 1. Borehole coordinates and ground surface elevation

Borehole	Easting (ft)	Northing (ft)	Ground Elevation (ft)
B1	873441.84	424577.29	5.63
B2	873297.88	424574.12	6.89
B3	873083.00	424568.45	7.50
B4	872858.90	424556.17	7.68
B5	872708.48	424671.36	6.76
B6	872719.05	424878.34	6.67
B7	872903.56	424953.52	6.89
B8	872920.67	424813.55	5.84
B9	873190.91	424882.57	6.33
B10	873369.92	424897.58	6.35
B11	873496.33	424659.61	5.10

Table 2. Optimum moisture content and maximum dry density

Soil	Optimum Moisture Content (%)	Maximum Dry Density (pcf)
Sand	14.9	105.2
Sediments (Pre-Weir)	25.0	87.7
Sediments (Post-Weir)	47.5	67.0

Table 3. Empirical relation between undrained shear strength and SPT N value [Kulhawy and Mayne, 1990]

N Value (blows/ft or 305 mm)	Consistency	Approximate s_u/p_a
0 to 2	very soft	< 1/8
2 to 4	soft	1/8 to 1/4
4 to 8	medium	1/4 to 1/2
8 to 15	stiff	1/2 to 1
15 to 30	very stiff	1 to 2
> 30	hard	> 2

Source: Terzaghi and Peck (4), p. 347.

where P_a is the atmospheric pressure which is approximately 2,000 psf.

Table 4. Empirical relation between friction angle and SPT N value

[Kulhawy and Mayne, 1990]

N Value (blows/ft or 305 mm)	Relative Density	Approximate $\bar{\phi}_{tc}$ (degrees)	
		(a)	(b)
0 to 4	very loose	< 28	< 30
4 to 10	loose	28 to 30	30 to 35
10 to 30	medium	30 to 36	35 to 40
30 to 50	dense	36 to 41	40 to 45
> 50	very dense	> 41	> 45

a - Source: Peck, Hanson, and Thornburn (12), p. 310.
b - Source: Meyerhof (13), p. 17.

Table 5. Summary of recommended material properties

Soil	Total Unit Weight (pcf)	Drained Shear Strength		Undrained Shear Strength		Consolidation Parameters				
		ϕ' (degrees)	c' (psf)	Min. S_u (psf)	S_u / σ_v'	$C_{c\varepsilon}$	$C_{r\varepsilon}$	σ_v' / σ_p'	C_v (ft^2/day)	$C_{\alpha\varepsilon}$
Sand (Shallow)	120	29	0	N/A	N/A	N/A	N/A	< 1.0	N/A	N/A
								> 1.0	N/A	N/A
Clayey Sand	120	28	0	N/A	N/A	N/A	N/A	< 1.0	N/A	N/A
								> 1.0	N/A	N/A
Sand (Deep)	120	31	0	N/A	N/A	N/A	N/A	< 1.0	N/A	N/A
								> 1.0	N/A	N/A
Clay	110	28	133	200	0.24	0.212	0.030	< 1.0	0.054	0.0027
								> 1.0	0.029	0.0052
Pre-Weir Sediments	100	25[1]	0[1]	N/A	N/A	N/A	N/A	< 1.0	N/A	N/A
								> 1.0	N/A	N/A
Post-Weir Sediments	85	41[1]	18[1]	-	-	0.217[1]	0.028[1]	< 1.0	0.722 [1]	-
								> 1.0	0.350 [1]	-

Notes:

N/A = Not Applicable

[1] This is valid for reconstituted sediments (i.e., the sediments are removed and re-compacted).

FIGURES

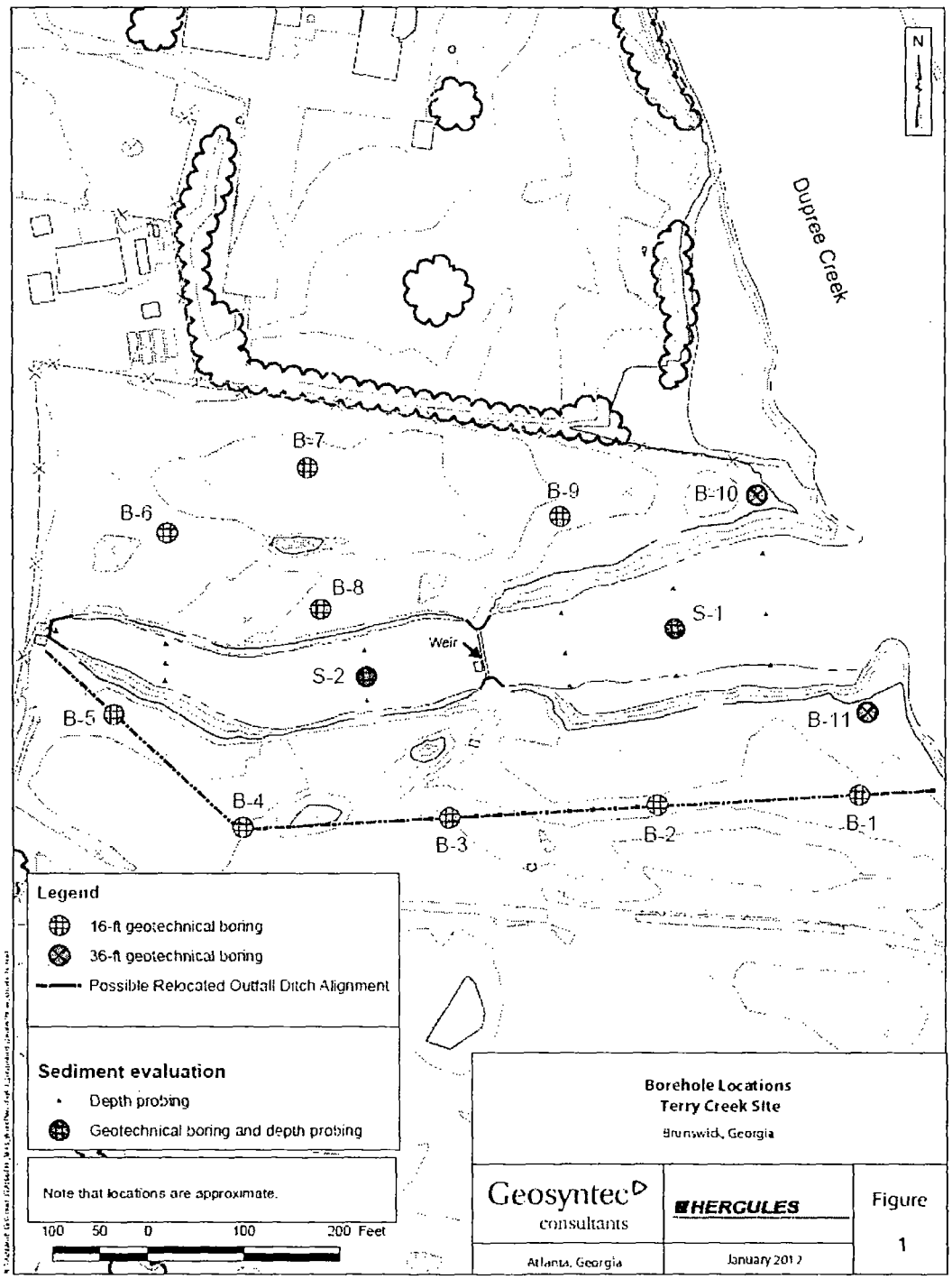

Figure 1. Borehole Locations (Note: Borehole coordinates are provided in Table 1)

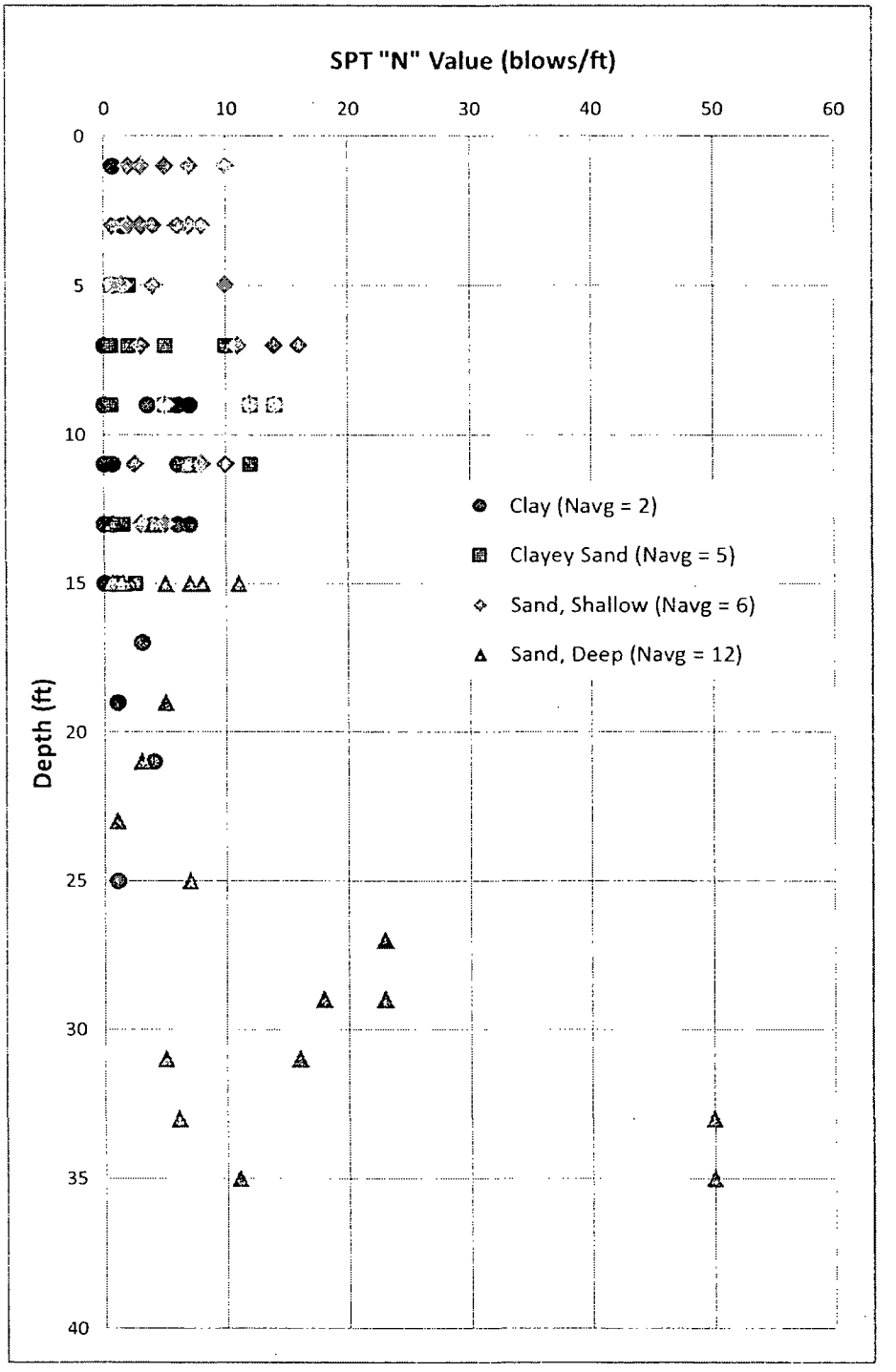

Figure 2. Plot of SPT N Values versus Depth

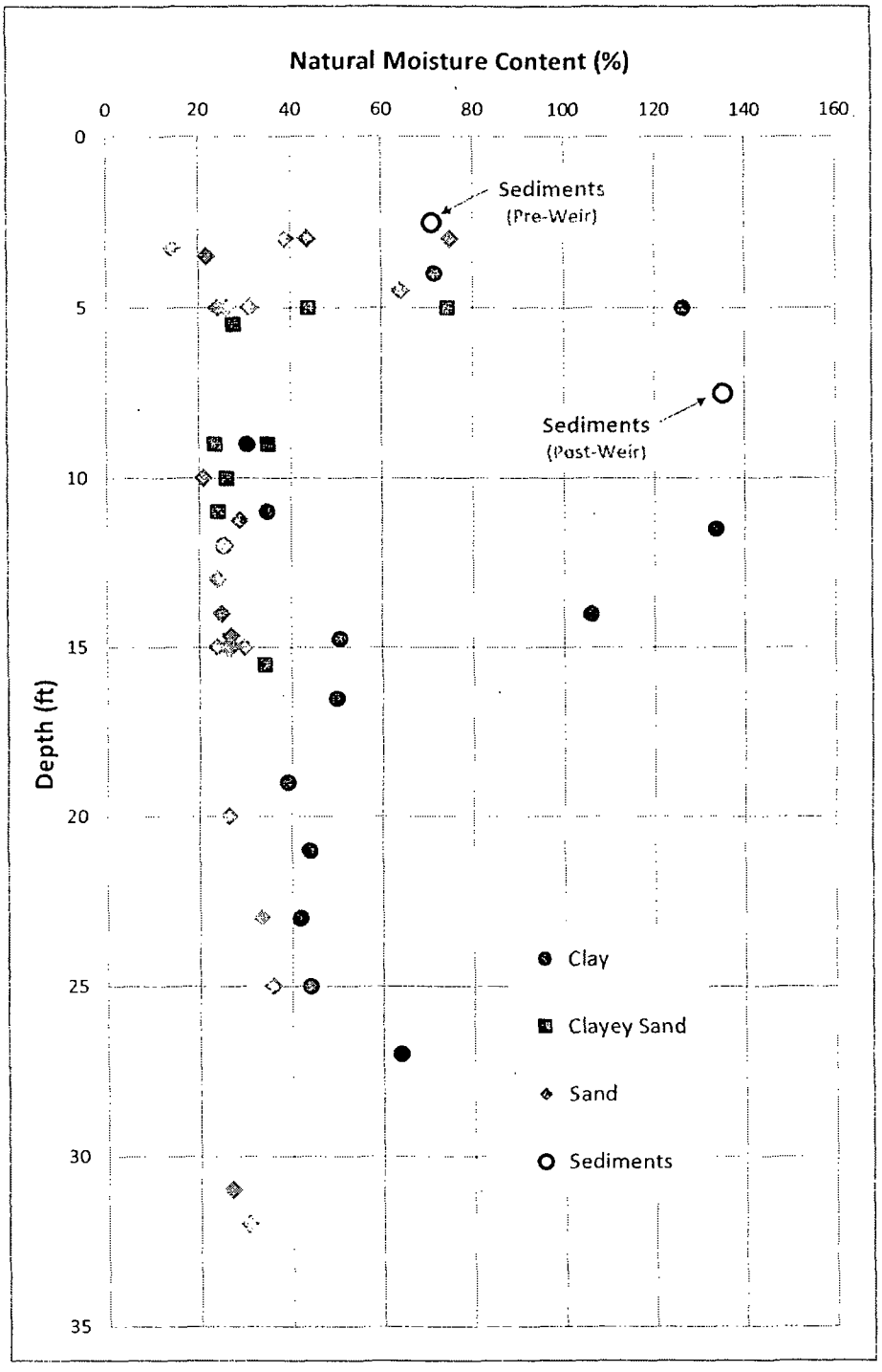

Figure 3. Plot of Natural Moisture Content versus Depth

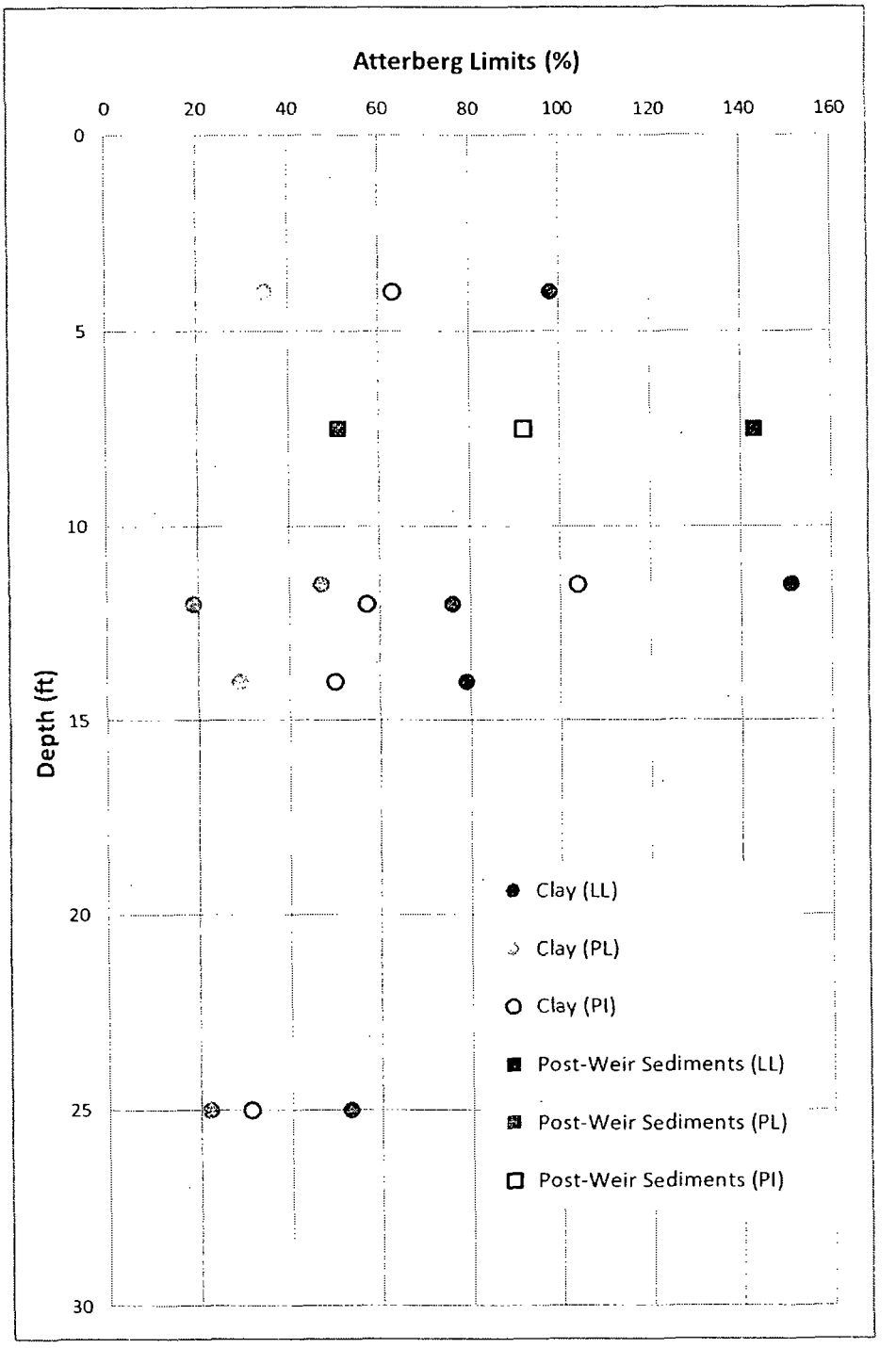

Figure 4. Plot of Atterberg Limits versus Depth

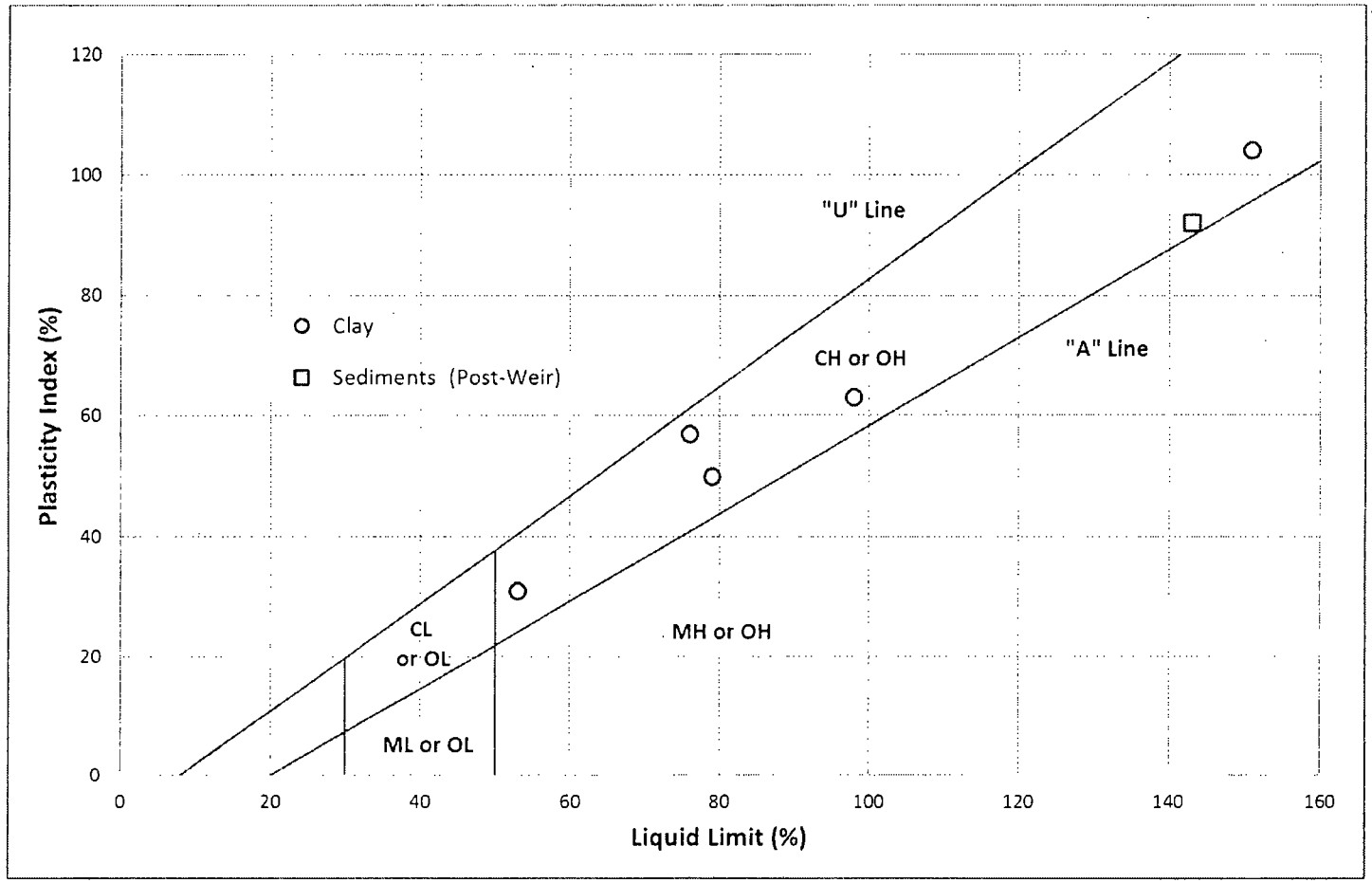

Figure 5. Casagrande's Plasticity Chart

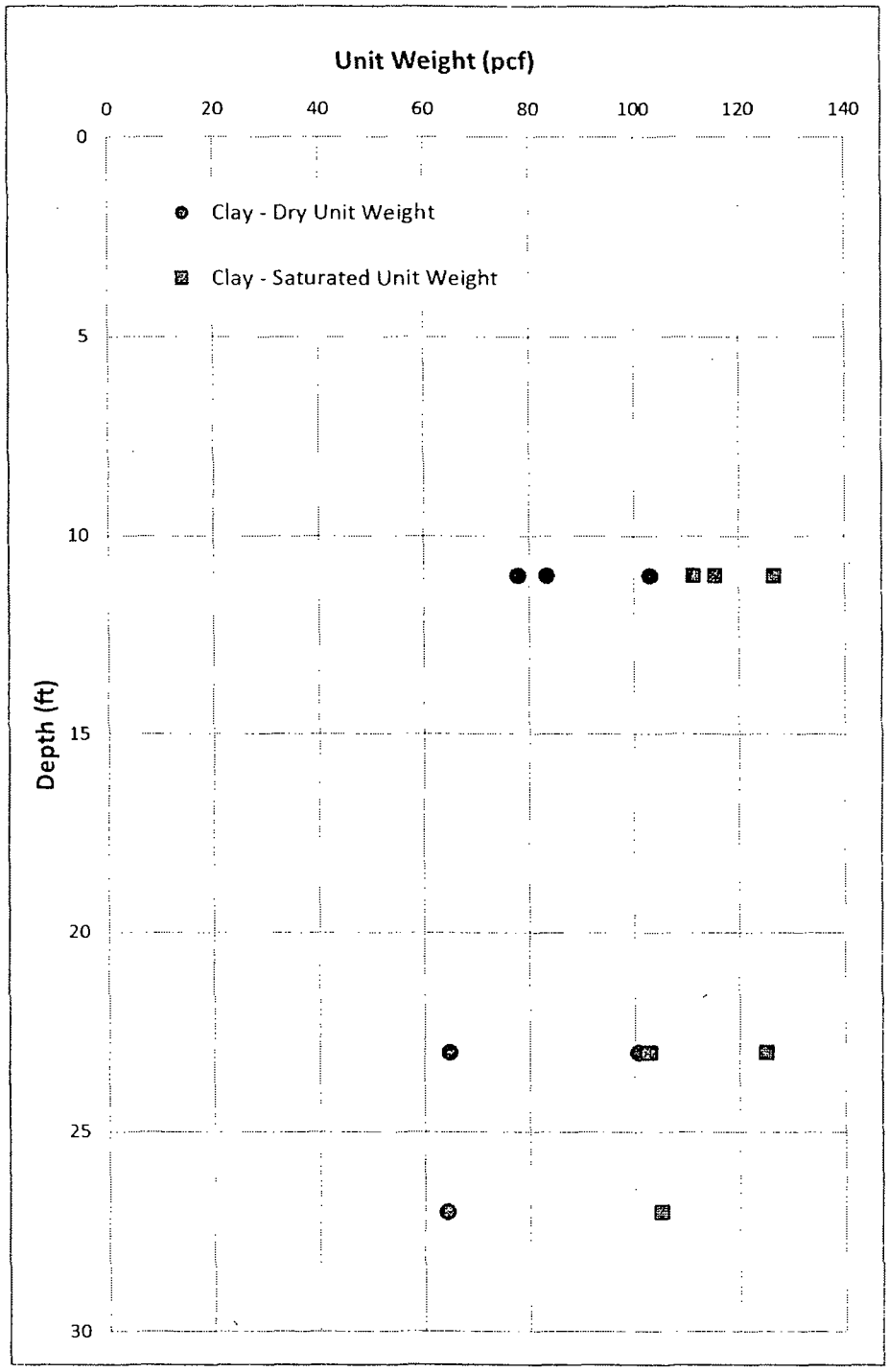

Figure 6. Plot of Total Unit Weight versus Depth (from CU Triaxial Test Samples)

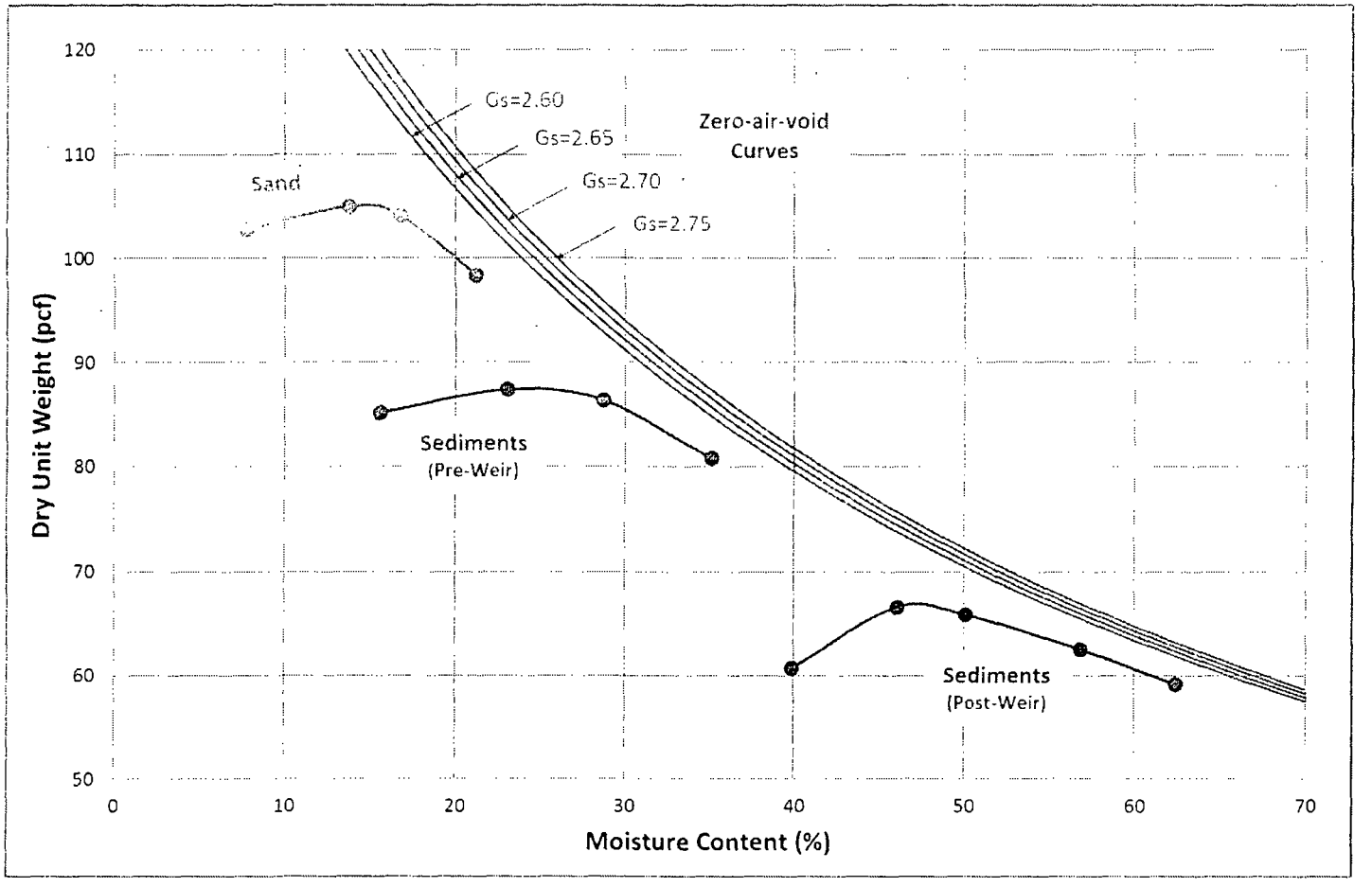

Figure 7. Compiled Proctor Compaction Curves

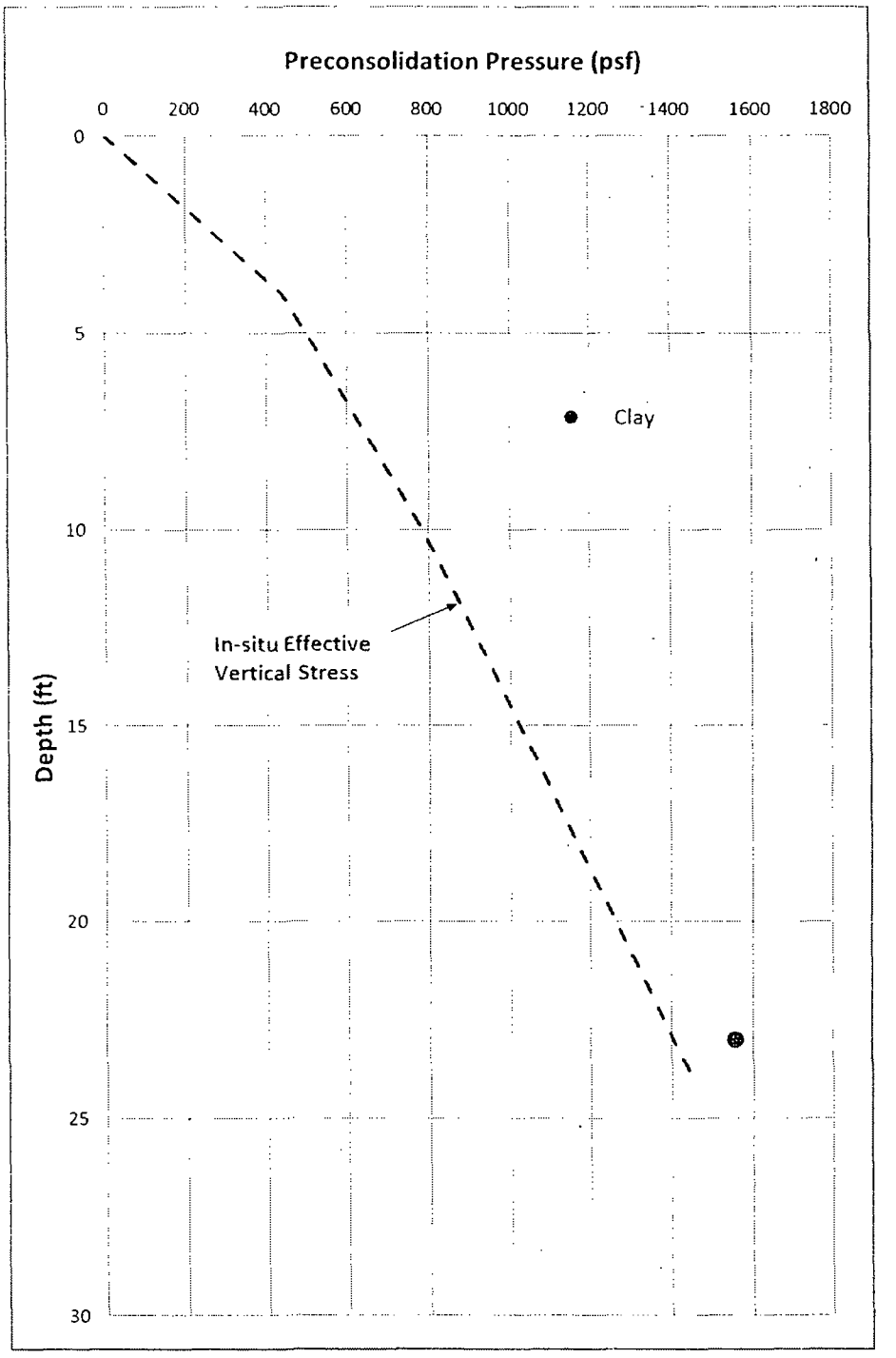

Figure 8. Profile of Preconsolidation Pressure (P_c')

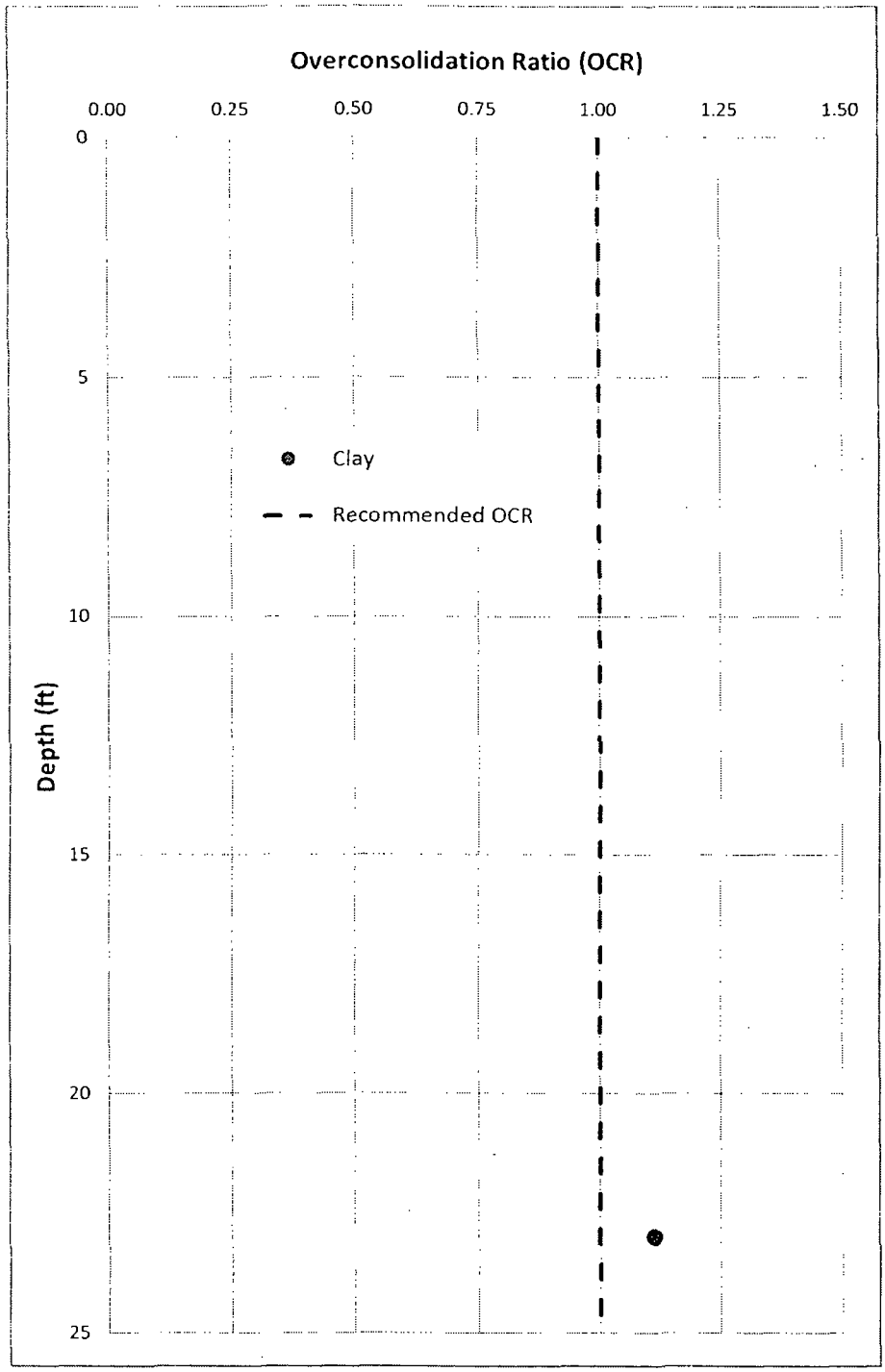

Figure 9. Profile of Overconsolidation Ratio (OCR)

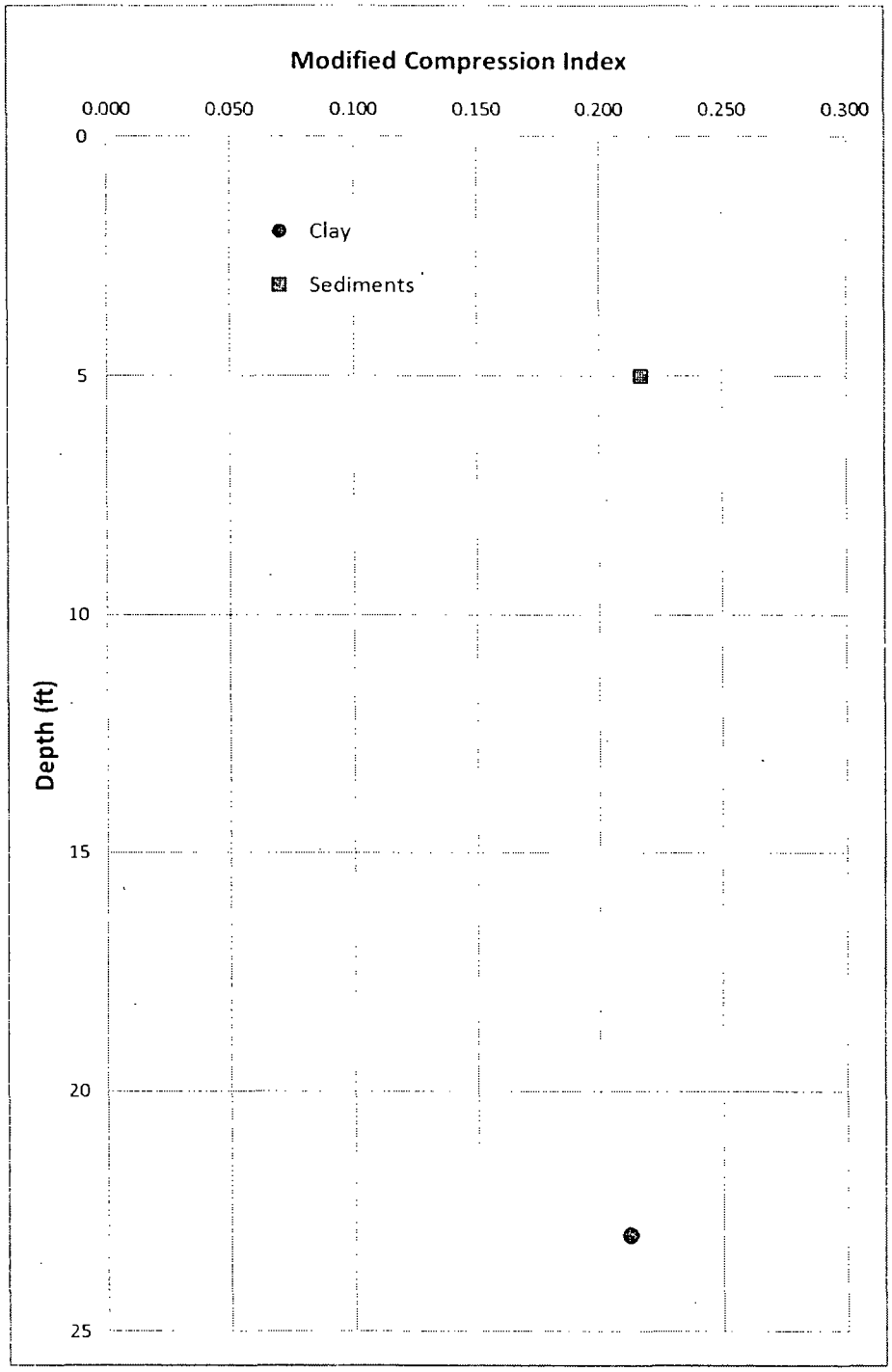

Figure 10. Modified Compression Index vs. Depth

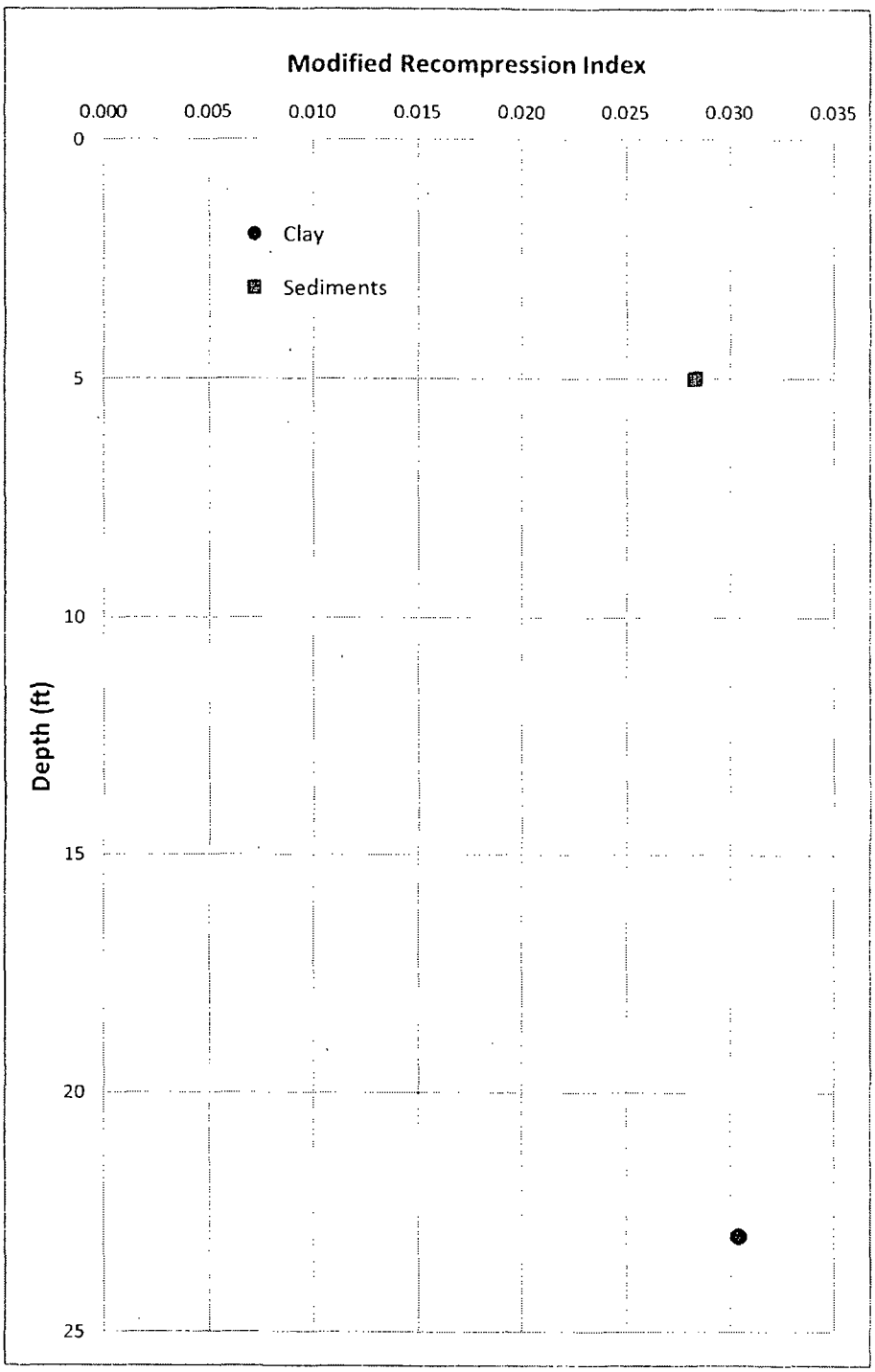

Figure 11. Modified Recompression Index vs. Depth

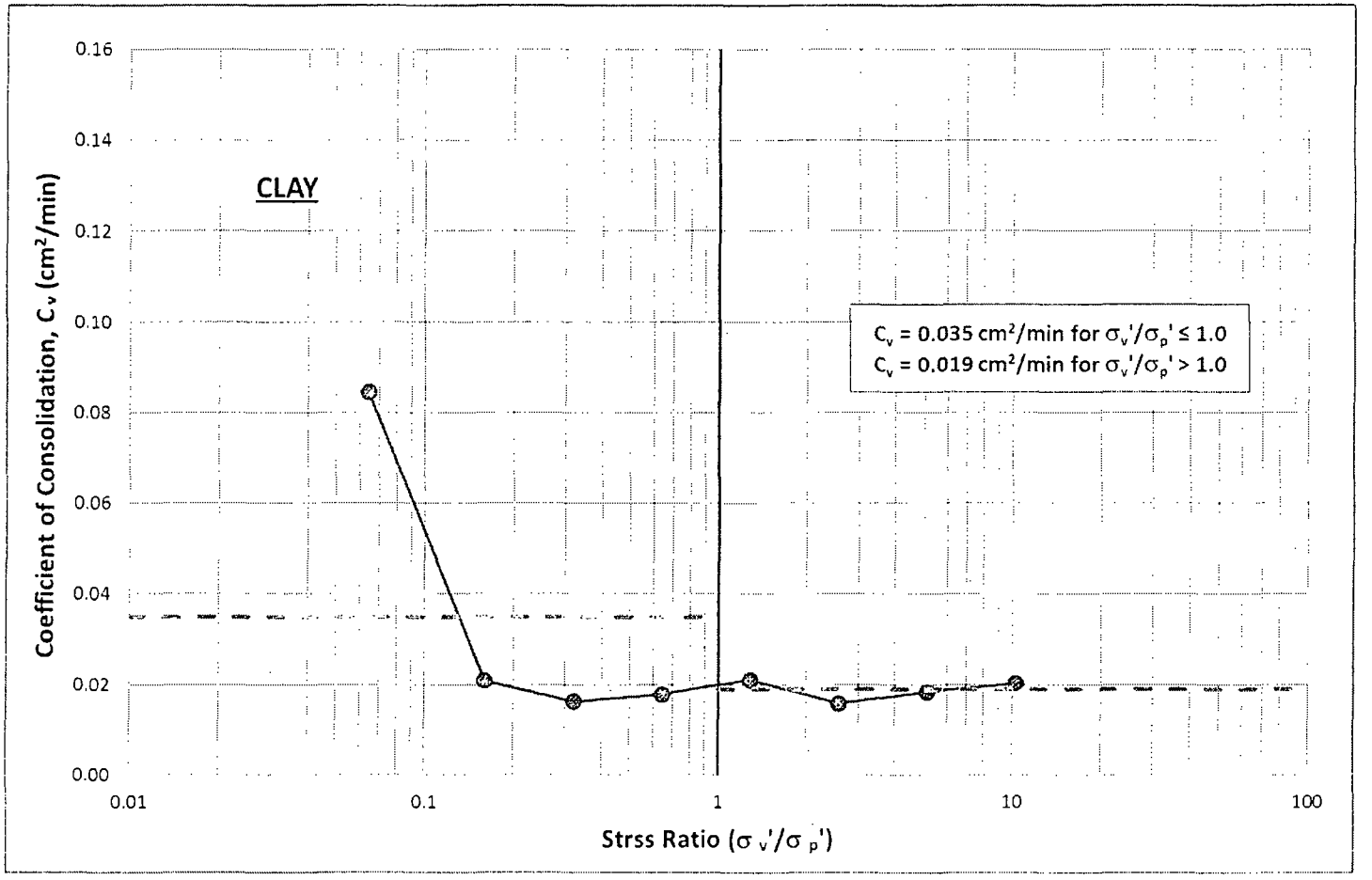

Figure 12. Coefficient of Consolidation (C_v) with Stress Ratio (σ_v'/σ_p') for Clay

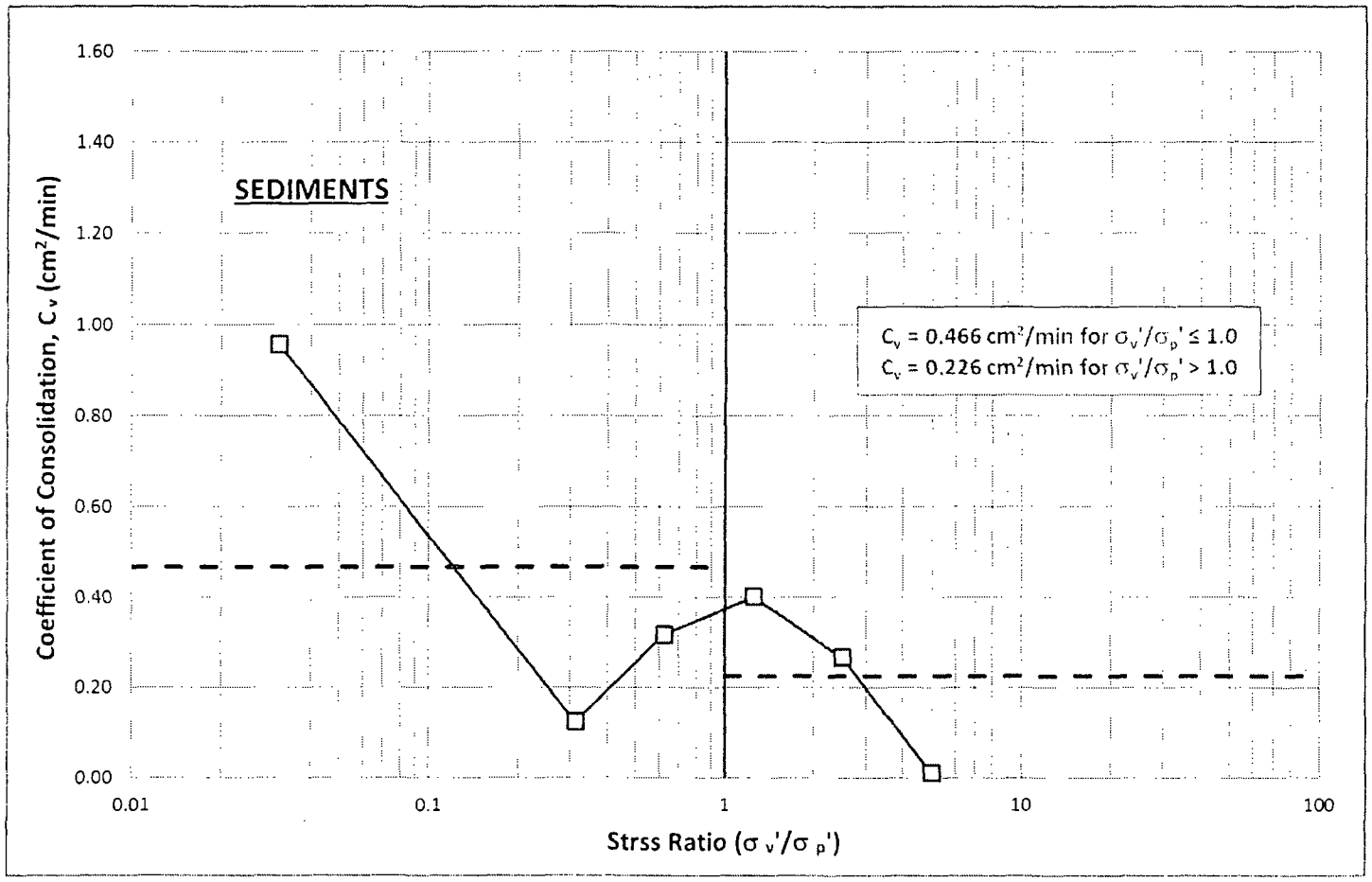

Figure 13. Coefficient of Consolidation (C_v) with Stress Ratio (σ_v'/σ_p') for Post-Weir Sediments

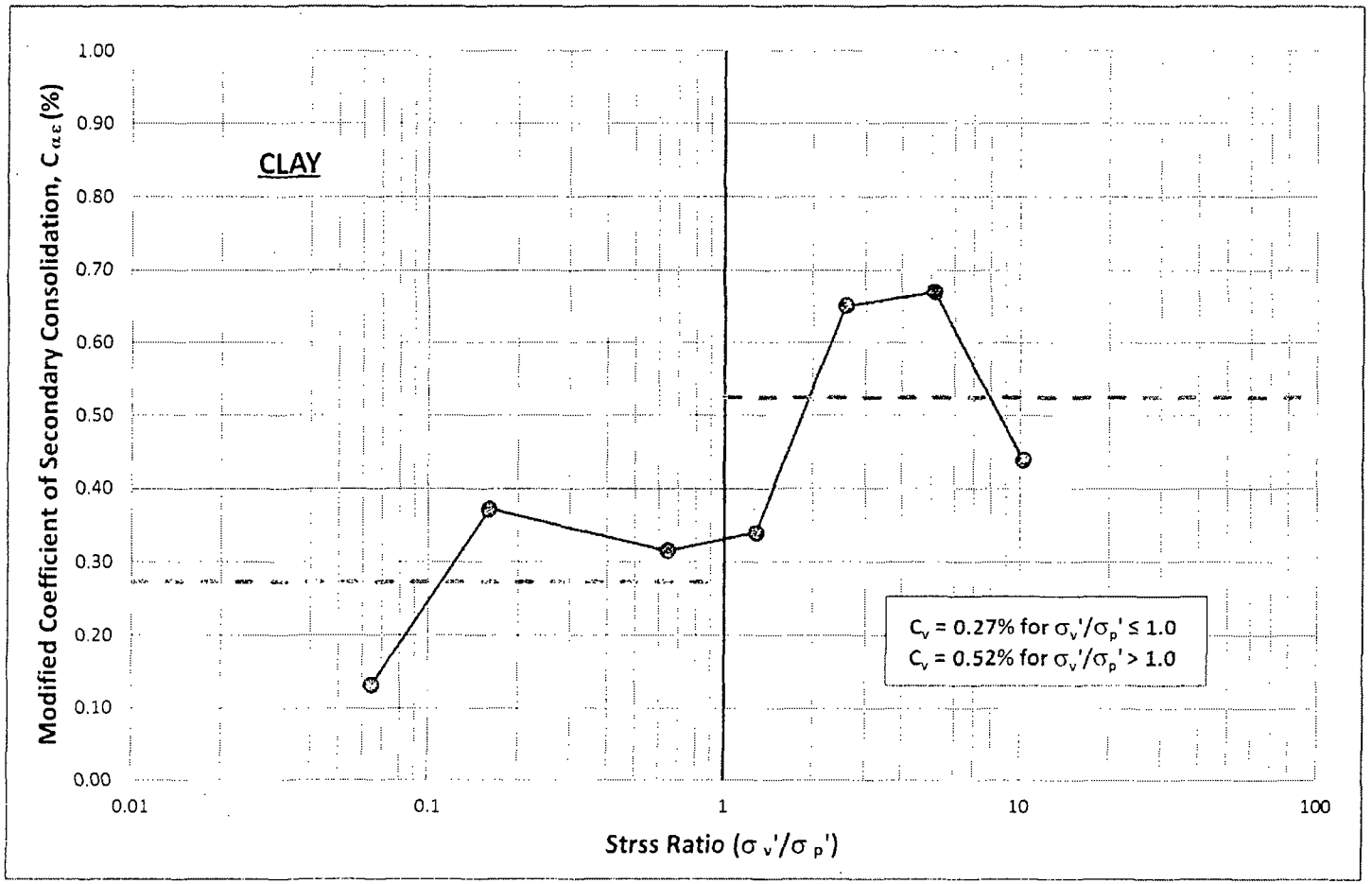

Figure 14. Modified Coefficient Secondary Compression ($C_{\alpha\varepsilon}$) with Stress Ratio (σ_v'/σ_p')

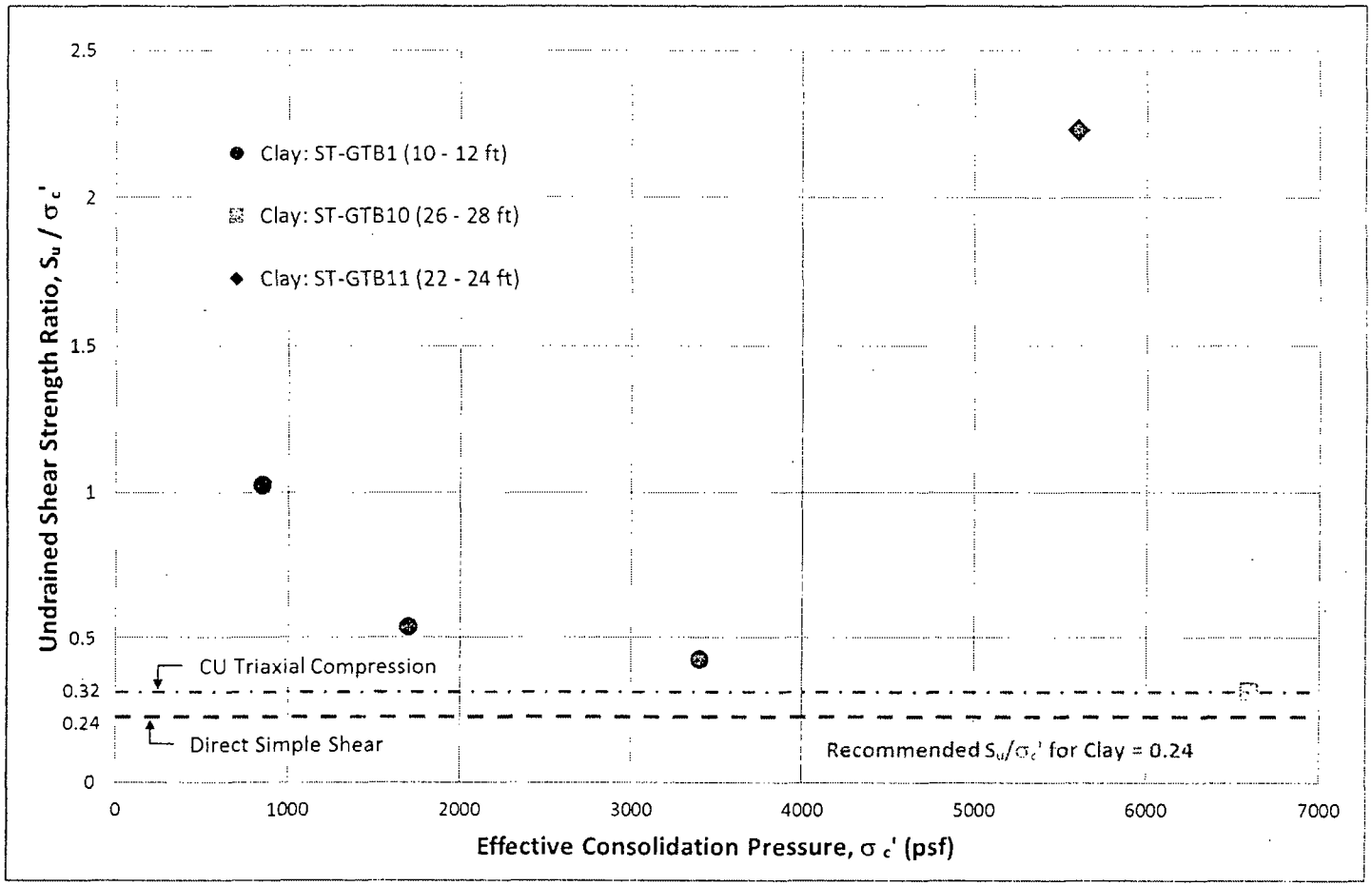

Figure 15. Undrained Shear Strength Ratio from CU Tests

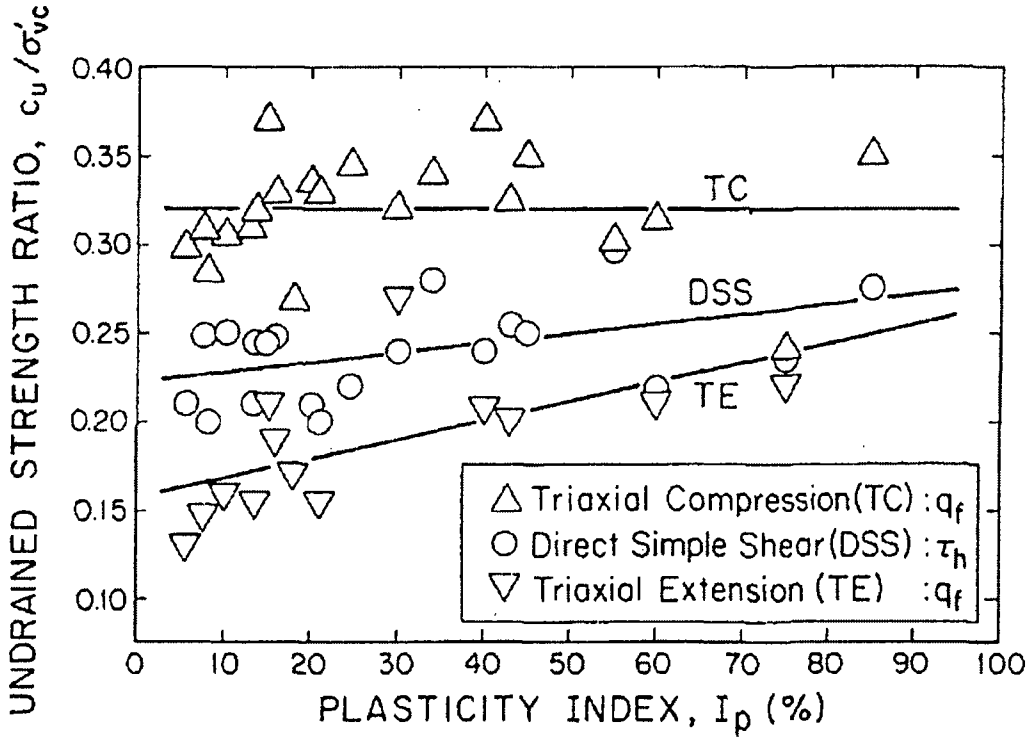

FIG. 15. Undrained Strength Anisotropy from CK_0U Tests on Normally Consolidated Clays and Silts [Data from Lefebvre et al. (1983); Vaid and Campanella (1974); and Various MIT and NGI Reports]

Figure 16. Undrained Strength Anisotropy [Ladd, 1991]

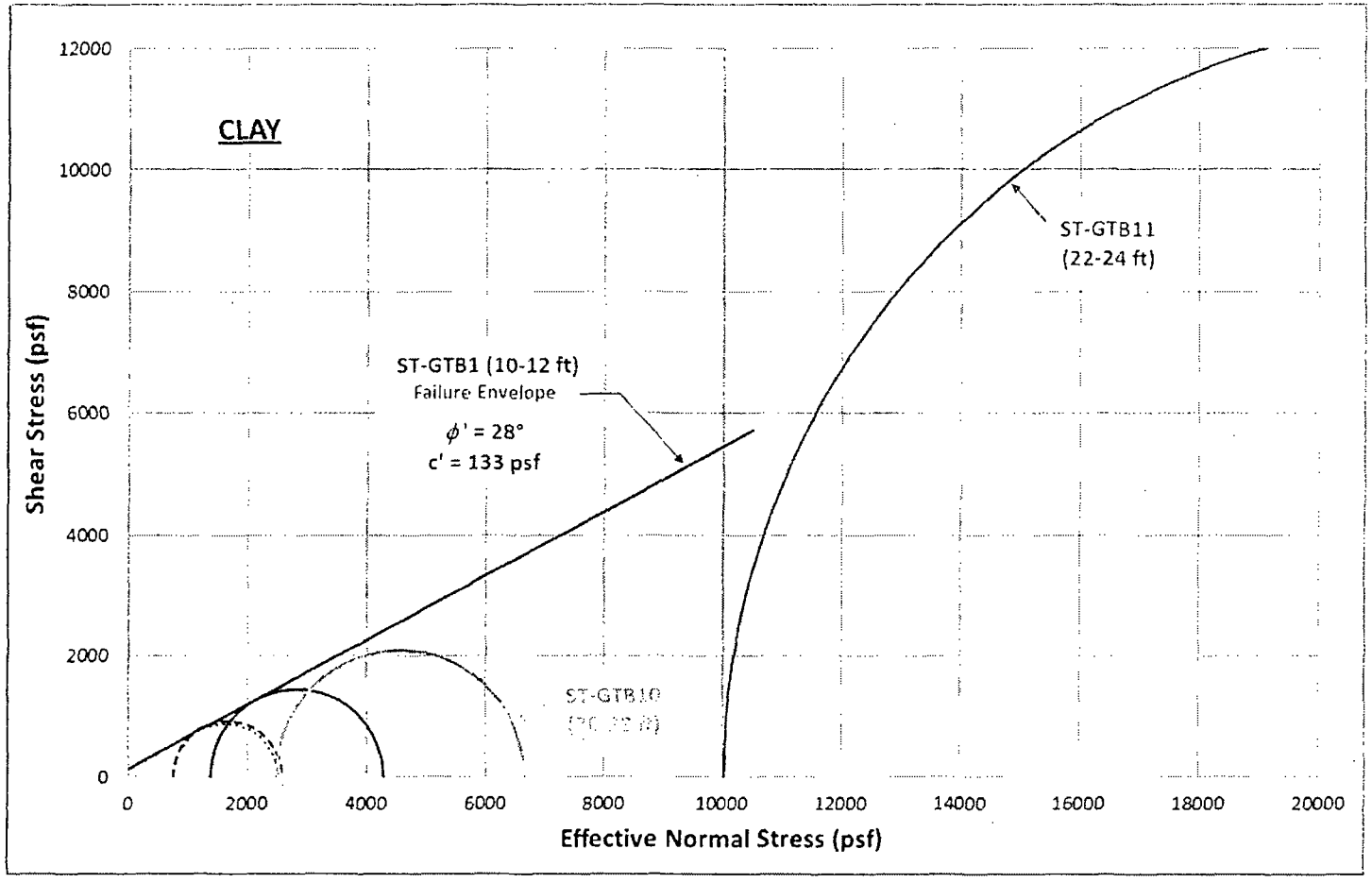

Figure 17. Mohr-Coulomb Failure Envelopes from CU Triaxial Tests for Clay

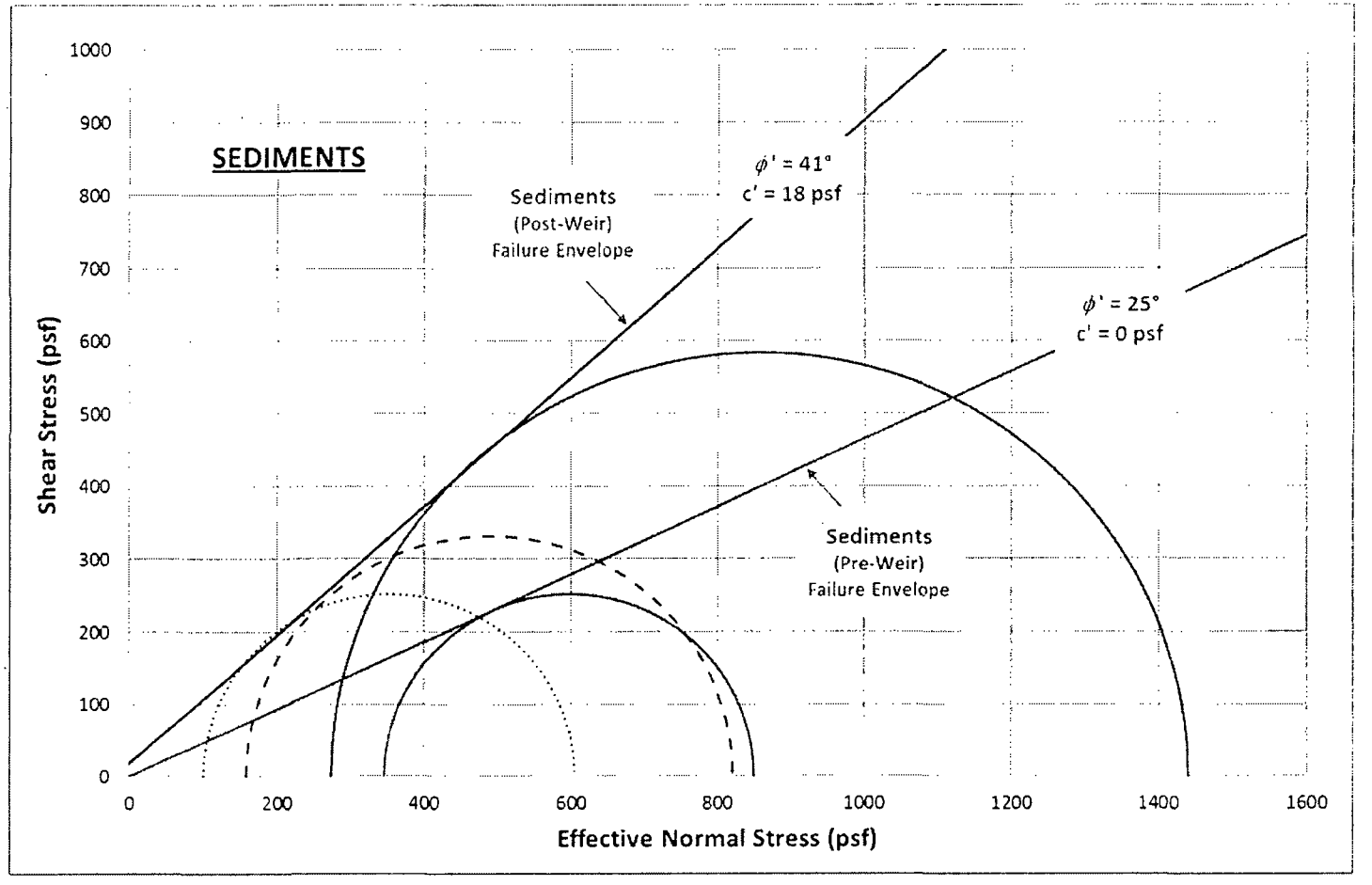

Figure 18. Mohr-Coulomb Failure Envelopes from CU Triaxial Tests for Pre-Weir Sediment and Post-Weir Sediments

ATTACHMENT A

LITHOLOGIC BORING LOGS

Geosyntec consultants

1200 Riverplace Boulevard,
Suite 710,
Jacksonville, Florida 32207

BORING LOG

BOREHOLE ID: *B-1*

GENERAL INFORMATION

PROJECT NO: *GK4443*
CLIENT: *Hercules Incorporated*
SITE LOCATION: *Brunswick, Georgia*
BORING DATE: *2/28/2012*
GEOSYNTEC SUPERVISOR: *Ramil Mijares*
DRILLING CONTRACTOR: *SAEDACCO*
DRILLER NAME: *Stefan Smith*

TECHNICAL INFORMATION

DRILLING METHOD: *Hollow Stem Auger*
RIG TYPE: *D-50*
BOREHOLE DIA: *4.25 in.*
NORTHING: *424577.29*
EASTING: *873441.84*
GROUND ELEVATION: *5.63'*

Depth (ft)	Water Level	Lithologic Description	Pattern	Unified Soil Classification	SPT Blowcount	SPT-Curve (0 5 10 15 20 25 30 35 40 45 50)	Recovery	Comments
0		Fine to medium sand with roots; Very dark gray (Munsell Gley 1 3/N); Moist; Poorly graded; Loose		SP	1-2-1-2			
		Same as 0'-2'			1-1-2-2			Lower 1 ft (3-4): Clayey sand with crushed shells; Dark gray (Munsell 5Y 4/1); Moist; Poorly graded;Loose
5		Clayey sand with crushed shells; Dark gray (Munsell 5Y 4/1); Saturated; Poorly graded; Loose		SC	1/12"-1/12"			
		Clayey sand; Very dark gray (Munsell Gley 1 3/N); Saturated; Poorly graded; Loose			1-2-3-5			Lower 1 ft (7-8): Sandy fat clay; Dark gray (Munsell Gley 1 4/N); Saturated; Firm; Analytical sample SO-MSB1-01 2/28/12 9:45 for COPC analysis
		Sandy fat clay; Dark gray (Munsell Gley 1 4/N); Saturated; Firm		CH	3-3-4-1			
10		N/A			N/A			Shelby tube sample collected
		Sandy fat clay; Dark gray (Munsell Gley 1 4/N); Saturated; Firm			3-5-2-2			
15		Fine to medium sand with crushed shells; Gray (Munsell 5Y 5/1); Saturated; Poorly graded; Loose		SP	3-5-6-4			

All depths referenced to ground surface.

Total Depth: 16'

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1200 Riverplace Boulevard,
Suite 710,
Jacksonville, Florida 32207

BORING LOG

BOREHOLE ID: *B-2*

GENERAL INFORMATION

PROJECT NO: *GK4443*
CLIENT: *Hercules Incorporated*
SITE LOCATION: *Brunswick, Georgia*
BORING DATE: *2/28/2012*
GEOSYNTEC SUPERVISOR: *Ramil Mijares*
DRILLING CONTRACTOR: *SAEDACCO*
DRILLER NAME: *Stefan Smith*

TECHNICAL INFORMATION

DRILLING METHOD: *Hollow Stem Auger*
RIG TYPE: *D-50*
BOREHOLE DIA: *2.25 in.*
NORTHING: *424574.12*
EASTING: *873297.88*
GROUND ELEVATION: *6.89'*

Depth (ft)	Water Level	Lithologic Description	Pattern	Unified Soil Classification	SPT Blowcount	SPT-Curve (0 5 10 15 20 25 30 35 40 45 50)	Recovery	Comments
0		Fine to medium sand with roots; Very dark gray (Munsell Gley 1 3/N); Moist; Poorly graded; Loose		SP	3-2-3-2			
		Medium sand with roots and mulch; Very dark gray (Munsell Gley 1 3/N); Moist; Poorly graded; Loose			2-1-1-2			
5		Clayey sand with roots; Very dark gray to black (Munsell Gley 1 3/N to 2.5/N); Moist; Poorly graded; Loose		SC	1-1/18"			
		Clayey sand; Very dark gray to black (Munsell Gley 1 3/N to 2.5/N); Moist; Poorly graded; Loose			1-2-3-4			No analytical sample obtained due to small recovery
	▽	Sandy fat clay; Dark gray (Munsell Gley 1 4/N); Saturated; Firm		CH	2-2-4-4			Analytical sample SO-MSB2-01 2/28/12 9:05 for COPC analysis
10					2-2-4-4			
					2-3-3-6			
15		Fine to medium sand with crushed shells; Gray (Munsell 5Y 5/1); Saturated; Poorly graded; Loose		SP	3-4-4-3			

All depths referenced to ground surface.

Total Depth: 16'

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1200 Riverplace Boulevard,
Suite 710,
Jacksonville, Florida 32207

BORING LOG

BOREHOLE ID: *B-3*

GENERAL INFORMATION

PROJECT NO: *GK4443*
CLIENT: *Hercules Incorporated*
SITE LOCATION: *Brunswick, Georgia*
BORING DATE: *2/27/2012*
GEOSYNTEC SUPERVISOR: *Ramil Mijares*
DRILLING CONTRACTOR: *SAEDACCO*
DRILLER NAME: *Stefan Smith*

TECHNICAL INFORMATION

DRILLING METHOD: *Hollow Stem Auger*
RIG TYPE: *D-50*
BOREHOLE DIA: *4.25 in.*
NORTHING: *424568.45*
EASTING: *873083.00*
GROUND ELEVATION: *7.50'*

Depth (ft)	Water Level	Lithologic Description	Pattern	Unified Soil Classification	SPT Blowcount	SPT-Curve (0 5 10 15 20 25 30 35 40 45 50)	Recovery	Comments
0		Medium sand with roots; Very dark gray (Munsell Gley 1 3/N); Moist; Poorly graded; Loose		SP	2-1-2-3			
		Fine to medium sand; Light gray (Munsell 5Y 7/1); Moist; Poorly graded; Loose			2-4-2-2			Upper 1 ft (2-3) = Very dark gray sand with roots (Munsell Gley 1 3/N); Moist; Loose
	▽	Fine to medium sand; Gray (Munsell 5Y 5/1); Saturated; Poorly graded; Loose			1/24"			
5		Clayey sand; Gray (Munsell 5Y 5/1); Saturated; Poorly graded; Loose		SC	1-1-1-3			Analytical sample SO-MSB3-01 2/27/12 16:35 for COPC analysis
		Clayey sand; Dark gray (Munsell 5Y 4/1); Saturated; Poorly graded; Medium dense			1-2-3-7			
10					3-6-6-5			
		Fine to medium sand; Gray (Munsell 5Y 5/1); Saturated; Poorly graded; Loose		SP	2-2-2-2			
15					2-1/18"			

All depths referenced to ground surface.

Total Depth: 16'

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1200 Riverplace Boulevard,
Suite 710,
Jacksonville, Florida 32207

BORING LOG

BOREHOLE ID: *B-4*

GENERAL INFORMATION

PROJECT NO: *GK4443*
CLIENT: *Hercules Incorporated*
SITE LOCATION: *Brunswick, Georgia*
BORING DATE: *2/27/2012*
GEOSYNTEC SUPERVISOR: *Ramil Mijares*
DRILLING CONTRACTOR: *SAEDACCO*
DRILLER NAME: *Stefan Smith*

TECHNICAL INFORMATION

DRILLING METHOD: *Hollow Stem Auger*
RIG TYPE: *D-50*
BOREHOLE DIA: *2.25 in.*
NORTHING: *424556.17*
EASTING: *872858.90*
GROUND ELEVATION: *7.68'*

Depth (ft)	Water Level	Lithologic Description	Pattern	Unified Soil Classification	SPT Blowcount	SPT-Curve (0 5 10 15 20 25 30 35 40 45 50)	Recovery	Comments
0		Fine to medium sand with isolated shell fragments; Light gray (Munsell 5Y 7/1); Moist; Poorly graded; Loose		SP	2-3-4-5			Upper 1 ft (0-1) = Very dark gray sand with roots (Munsell Gley 1 3/N); Moist; Loose
		Fine to medium sand; Light gray (Munsell 5Y 7/1); Moist; Poorly graded; Loose			5-5-3-2			Upper 6 in (2-2.5) = Brown sand (Munsell 10YR 4/3); Moist; Loose
		Medium sand; Dark gray (Munsell 5Y 4/1); Saturated; Poorly graded; Loose			2-3-1-3			
5		Clayey sand; Gray (Munsell 5Y 5/1); Saturated; Poorly graded; Medium dense		SC	3-5-5-6			Analytical sample SO-MSB4-01 2/27/12 17:05 for COPC analysis
					5-6-6-6			
10		Fine to medium sand; Gray (Munsell 5Y 5/1); Saturated; Poorly graded; Loose		SP	3-3-4-3			
					1-1-3-1			
15					1-1/18"			

All depths referenced to ground surface.

Total Depth: 16'

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1200 Riverplace Boulevard,
Suite 710,
Jacksonville, Florida 32207

BORING LOG

BOREHOLE ID: *B-5*

GENERAL INFORMATION

PROJECT NO: *GK4443*
CLIENT: *Hercules Incorporated*
SITE LOCATION: *Brunswick, Georgia*
BORING DATE: *2/28/2012*
GEOSYNTEC SUPERVISOR: *Ramil Mijares*
DRILLING CONTRACTOR: *SAEDACCO*
DRILLER NAME: *Stefan Smith*

TECHNICAL INFORMATION

DRILLING METHOD: *Hollow Stem Auger*
RIG TYPE: *D-50*
BOREHOLE DIA: *2.25 in.*
NORTHING: *424671.36*
EASTING: *872708.48*
GROUND ELEVATION: *6.76'*

Depth (ft)	Water Level	Lithologic Description	Pattern	Unified Soil Classification	SPT Blowcount	SPT-Curve (0 5 10 15 20 25 30 35 40 45 50)	Recovery	Comments
0		Fine to medium sand with roots; Very dark gray (Munsell Gley 1 3/N); Moist; Poorly graded; Loose		SP	2-5-5-5			
		Fine to medium sand; Very dark gray (Munsell Gley 1 3/N); Moist; Poorly graded; Loose			2-2-1-2			
5		Medium sand; Very dark gray (Munsell 5Y 3/1); Moist; Poorly graded; Loose			1/12"-1-4			
	▽	Medium sand; Very dark to light gray (Munsell 5Y 3/1 to 5Y 7/1); Saturated; Poorly graded; Loose			2-7-7-11			Analytical sample SO-MSB5-01 2/28/12 7:50 for COPC analysis
		Clayey sand; Dark gray (Munsell 5Y 4/1); Saturated; Poorly graded; Medium dense		SC	5-7-7-8			
10		Clayey sand; Dark gray (Munsell 5Y 4/1); Saturated; Poorly graded; Loose			4-3-4-4			
					1/18"-2			Lower 1 ft (13-14) = Fat clay with sand; Dark gray (Munsell Gley 1 4/N); Saturated; Very soft
15		Fine to medium sand; Gray (Munsell 5Y 5/1); Saturated; Poorly graded; Loose		SP	WH-3-4-4			

All depths referenced to ground surface.

Total Depth: 16'

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BORING LOG

BOREHOLE ID: *B-6*

GENERAL INFORMATION

PROJECT NO: *GK4443*
CLIENT: *Hercules Incorporated*
SITE LOCATION: *Brunswick, Georgia*
BORING DATE: *2/29/2012*
GEOSYNTEC SUPERVISOR: *Ramil Mijares*
DRILLING CONTRACTOR: *SAEDACCO*
DRILLER NAME: *Stefan Smith*

TECHNICAL INFORMATION

DRILLING METHOD: *Hollow Stem Auger*
RIG TYPE: *D-50*
BOREHOLE DIA: *4.25 in.*
NORTHING: *424878.34*
EASTING: *872719.05*
GROUND ELEVATION: *6.67'*

Depth (ft)	Water Level	Lithologic Description	Pattern	Unified Soil Classification	SPT Blowcount	SPT-Curve (0 5 10 15 20 25 30 35 40 45 50)	Recovery	Comments
0		Fine to medium sand with roots; Very dark gray (Munsell Gley 1 3/N); Moist; Poorly graded; Loose		SP	2-2-3-3			Upper 6 in (2-2.5) = Fine to medium sand with roots; Very dark gray (Munsell Gley 1 3/N); Moist; Poorly graded; Loose
		Fine to medium sand; Dark gray (Munsell 5Y 4/1); Moist; Poorly graded; Loose			4-3-4-3			
5					3-5-5-5			
	▽	Fine to medium sand; Light gray (Munsell 5Y 7/1); Saturated; Poorly graded; Medium dense			8-7-9-11			Analytical sample SO-MNB6-01 2/29/12 12:00 for COPC analysis
					3-8-6-6			
10					1-5-5-6			
		Clayey sand; Dark gray (Munsell Gley 1 4/N); Saturated; Poorly graded; Loose		SC	1-1-1/12"			Upper 1 ft (12-13) = Fine to medium sand; Light gray (Munsell 5Y 7/1); Saturated; Poorly graded; Loose
15		Fine to medium sand; Gray (Munsell 5Y 5/1); Saturated; Poorly graded; Loose		SP	1/12"-1-4			Lower 8 in (15 1/3-16) = Clayey sand; Very dark gray (Munsell Gley 1 3/N); Saturated; Poorly graded; Loose

All depths referenced to ground surface.

Total Depth: 16'

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BORING LOG

BOREHOLE ID: *B-7*

GENERAL INFORMATION

PROJECT NO: *GK4443*
CLIENT: *Hercules Incorporated*
SITE LOCATION: *Brunswick, Georgia*
BORING DATE: *2/29/2012*
GEOSYNTEC SUPERVISOR: *Ramil Mijares*
DRILLING CONTRACTOR: *SAEDACCO*
DRILLER NAME: *Stefan Smith*

TECHNICAL INFORMATION

DRILLING METHOD: *Hollow Stem Auger*
RIG TYPE: *D-50*
BOREHOLE DIA: *4.25 in.*
NORTHING: *424953.52*
EASTING: *872903.56*
GROUND ELEVATION: *6.89'*

Depth (ft)	Water Level	Lithologic Description	Pattern	Unified Soil Classification	SPT Blowcount	SPT-Curve (0 5 10 15 20 25 30 35 40 45 50)	Recovery	Comments
0		Fine to medium sand with roots; Very dark gray (Munsell Gley 1 3/N); Moist; Poorly graded; Loose		SP	2-2-1-1			
		Clay with sand and roots; Very dark gray (Munsell Gley 1 3/N); Moist; Soft		CH	1/12"-1-2			
5		Clay with sand; Very dark gray (Munsell Gley 1 3/N); Moist; Soft			1/12"-1-1			
		Fine to medium sand; Gray (Munsell 5Y 5/1); Saturated; Poorly graded; Loose		SP	1-1-2-5			Analytical sample SO-MNB7-01 2/29/12 11:05 for COPC analysis
		Fine to medium sand; Gray (Munsell 5Y 5/1); Saturated; Poorly graded; Medium dense			3-5-7-7			
10		Fine to medium sand; Light gray (Munsell 5Y 7/1); Saturated; Poorly graded; Loose			2-4-4-2			
					1-2-3-1			
15		Clayey sand; Very dark gray (Munsell Gley 1 3/N); Saturated; Poorly graded; Loose		SC	1/12"-2-3			Upper 1 ft (14-15) = Fine to medium sand; Light gray (Munsell 5Y 7/1); Saturated; Poorly graded; Loose

All depths referenced to ground surface.

Total Depth: 16'

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BORING LOG

BOREHOLE ID: *B-8*

GENERAL INFORMATION

PROJECT NO: *GK4443*
CLIENT: *Hercules Incorporated*
SITE LOCATION: *Brunswick, Georgia*
BORING DATE: *2/29/2012*
GEOSYNTEC SUPERVISOR: *Ramil Mijares*
DRILLING CONTRACTOR: *SAEDACCO*
DRILLER NAME: *Stefan Smith*

TECHNICAL INFORMATION

DRILLING METHOD: *Hollow Stem Auger*
RIG TYPE: *D-50*
BOREHOLE DIA: *2.25 in.*
NORTHING: *424813.55*
EASTING: *872920.67*
GROUND ELEVATION: *5.84'*

Depth (ft)	Water Level	Lithologic Description	Pattern	Unified Soil Classification	SPT Blowcount	SPT-Curve (0 5 10 15 20 25 30 35 40 45 50)	Recovery	Comments
0		Fine to medium sand with roots; Very dark gray (Munsell Gley 1 3/N); Moist; Poorly graded; Loose		SP	1-1-1-1			Upper 1ft (2-3) = Fine to medium sand with roots; Very dark gray (Munsell Gley 1 3/N); Moist; Poorly graded; Loose
		Fine to medium sand; Dark gray (Munsell 5Y 4/1); Moist; Poorly graded; Loose			2-3-4-3			Upper 1ft (4-5) = Fine to medium sand; Dark gray (Munsell 5Y 4/1); Saturated; Poorly graded; Loose
5		Clayey sand; Olive gray (Munsell 5Y 4/2); Saturated; Poorly graded; Loose		SC	1/12"-1-1			Analytical sample SO-MNB8-01 2/29/12 10:10 for COPC analysis; Analytical sample SO-MNB8-01 (MS/MSD) 2/29/12 10:10 for COPC analysis
		Fine to medium sand; Light gray (Munsell 5Y 7/1); Saturated; Poorly graded; Loose		SP	4-5-6-4			
					3-3-2-3			
10					1/12"-2-3			
					1-2-1-4			
15		Fine to medium sand; Gray (Munsell 5Y 5/1); Saturated; Poorly graded; Loose			1-3-2-2			

All depths referenced to ground surface.

Total Depth: 16'

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BORING LOG

BOREHOLE ID: *B-9*

GENERAL INFORMATION

PROJECT NO: *GK4443*
CLIENT: *Hercules Incorporated*
SITE LOCATION: *Brunswick, Georgia*
BORING DATE: *2/29/2012*
GEOSYNTEC SUPERVISOR: *Ramil Mijares*
DRILLING CONTRACTOR: *SAEDACCO*
DRILLER NAME: *Stefan Smith*

TECHNICAL INFORMATION

DRILLING METHOD: *Hollow Stem Auger*
RIG TYPE: *D-50*
BOREHOLE DIA: *4.25 in.*
NORTHING: *424882.57*
EASTING: *873190.91*
GROUND ELEVATION: *6.33'*

Depth (ft)	Water Level	Lithologic Description	Pattern	Unified Soil Classification	SPT Blowcount	SPT-Curve (0 5 10 15 20 25 30 35 40 45 50)	Recovery	Comments
0		Fine to medium sand with roots; Very dark gray (Munsell Gley 1 3/N); Moist; Poorly graded; Loose		SP	2-1-2-2 WH-1/18"			
5		Sandy fat clay with mulch; Dark gray (Munsell Gley 1 4/N); Moist; Soft		CH	WH-1/18"			
	▽	Sandy fat clay; Dark gray (Munsell Gley 1 4/N); Saturated; Soft			WH 1/12"-3-3			Analytical sample SO-MNB9-01 2/29/12 9:00 for COPC analysis; Analytical sample SO-MNB9-02 2/29/12 9:30 for COPC analysis for duplicate
10		Fine to medium sand; Gray (Munsell 5Y 6/1); Saturated; Poorly graded; Loose		SP	2-3-5-5			Upper 6 in (10-10.5) = Sandy fat clay with some sand and mulch; Dark gray (Munsell Gley 1 4/N); Saturated; Soft
		Sandy fat clay; Dark gray (Munsell Gley 1 4/N); Saturated; Soft		CH	2-3-1-1 WH/12"-1-3			Lower 1 ft (13-14) = Fine to medium sand; Gray (Munsell 5Y 6/1); Saturated; Poorly graded; Loose Lower 6 in (15.5-16) = Clayey sand; Dark gray (Munsell 5Y 4/1); Saturated; Poorly graded; Loose
15								

All depths referenced to ground surface.

Total Depth: 16'

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BORING LOG

BOREHOLE ID: *B-10*

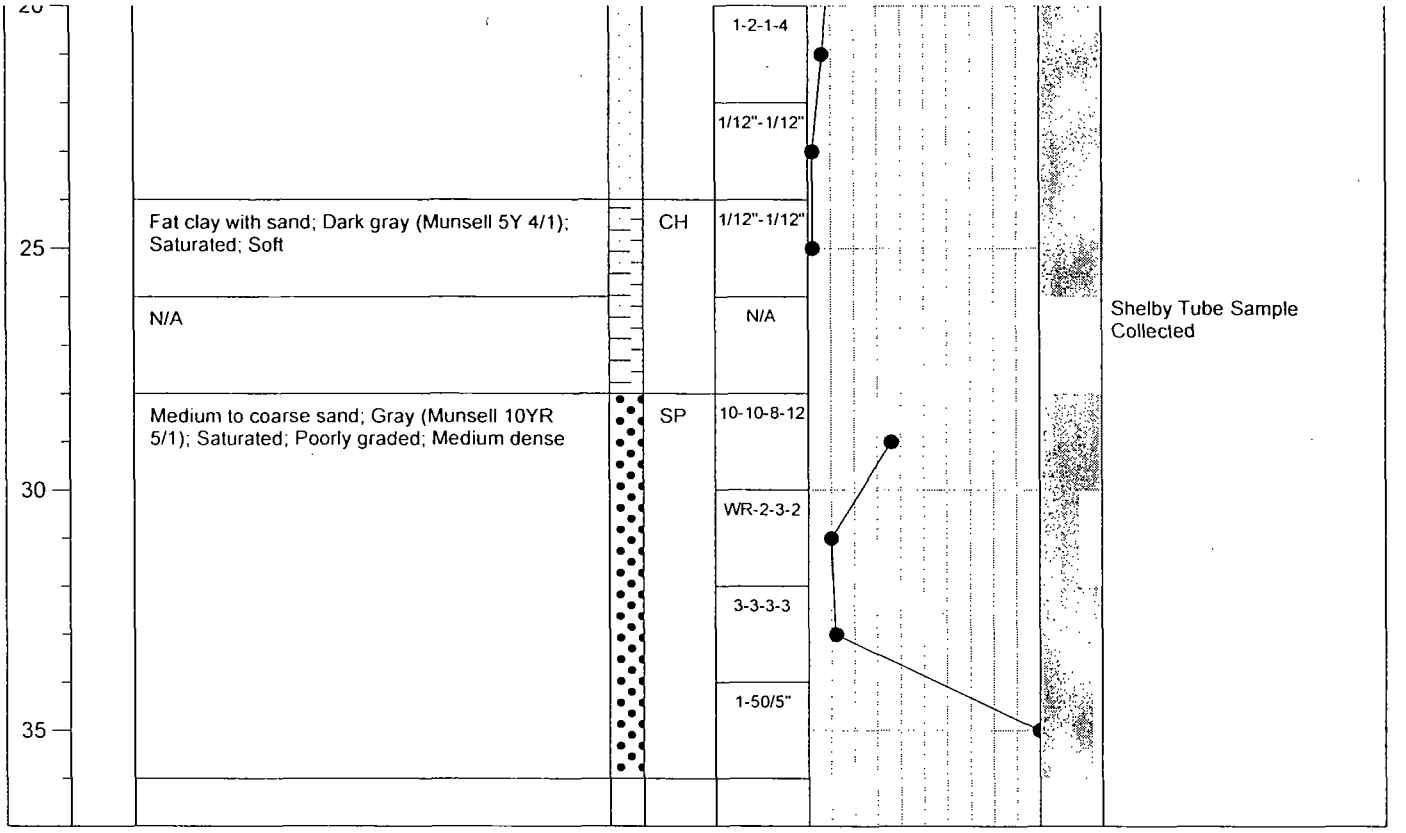
GENERAL INFORMATION

PROJECT NO: *GK4443*
CLIENT: *Hercules Incorporated*
SITE LOCATION: *Brunswick, Georgia*
BORING DATE: *2/28/2012*
GEOSYNTEC SUPERVISOR: *Ramil Mijares*
DRILLING CONTRACTOR: *SAEDACCO*
DRILLER NAME: *Stefan Smith*

TECHNICAL INFORMATION

DRILLING METHOD: *Hollow Stem Auger*
RIG TYPE: *D-50*
BOREHOLE DIA: *4.25 in.*
NORTHING: *424897.58*
EASTING: *873369.92*
GROUND ELEVATION: *6.35'*

Depth (ft)	Water Level	Lithologic Description	Pattern	Unified Soil Classification	SPT Blowcount	SPT-Curve (0 5 10 15 20 25 30 35 40 45 50)	Recovery	Comments
0		Fine to medium sand with roots; Very dark gray (Munsell Gley 1 3/N); Moist; Poorly graded; Loose		SP	1-1-1-1			
					1-2-2-3			
					1/24"			Lower 1 ft (5-6): Fat clay; Very dark gray (Munsell Gley 1 3/N); Saturated; Very soft
5	▽							
		Fat clay; Very dark gray (Munsell Gley 1 3/N); Saturated; Very soft		CH	WH			Upper 1 ft (6-7): Fat clay with sand; Very dark gray (Munsell Gley 1 3/N); Saturated; Very soft
					WH			
10					WH			
					WH			
					WH/18"-1			
15								
		Fat clay with sand with some crushed shells; Dark gray (Munsell 5Y 4/1); Saturated; Soft			1-1-2-2			Lower 1 ft (17-18): Fine to medium sand with crushed shells; Gray (Munsell 5Y 5/1); Saturated; Poorly graded; Loose
		Fine to medium sand with crushed shells; Gray (Munsell 5Y 5/1); Saturated; Poorly graded; Loose		SP	1-2-3-3			
20								



All depths referenced to ground surface.

Total Depth: 36'

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BORING LOG

BOREHOLE ID: *B-11*

GENERAL INFORMATION

PROJECT NO: *GK4443*
CLIENT: *Hercules Incorporated*
SITE LOCATION: *Brunswick, Georgia*
BORING DATE: *2/28/2012*
GEOSYNTEC SUPERVISOR: *Ramil Mijares*
DRILLING CONTRACTOR: *SAEDACCO*
DRILLER NAME: *Stefan Smith*

TECHNICAL INFORMATION

DRILLING METHOD: *Hollow Stem Auger*
RIG TYPE: *D-50*
BOREHOLE DIA: *4.25 in.*
NORTHING: *424659.61*
EASTING: *873496.33*
GROUND ELEVATION: *5.10'*

Depth (ft)	Water Level	Lithologic Description	Pattern	Unified Soil Classification	SPT Blowcount	SPT-Curve (0 5 10 15 20 25 30 35 40 45 50)	Recovery	Comments
0		Fat clay with sand; Dark gray (Munsell 5Y 4/1); Moist; Soft		CH	1-1/18"			
		Fine to medium sand; Very dark gray (Munsell Gley 1 3/N); Moist; Poorly graded; Loose		SP	1-1-2-1			
5	▽	Clayey sand; Very dark gray (Munsell Gley 1 3/N); Saturated; Poorly graded; Very loose		SC	2-1-1-1			
		No recovery			1/24"			
		Clayey sand; Very dark gray to black (Munsell Gley 1 3/N to 2.5/N); Saturated; Poorly graded; Very loose			1/24"			
10		Fat clay with sand; Very dark gray (Munsell 5Y 3/1); Saturated; Soft		CH	1/18"-1			
					1/18"-1			
15		Fat clay with sand; Dark gray (Munsell 5Y 4/1); Saturated; Soft			WH			
					WH/12"-3-4			
		Fat clay with sand with some crushed shells; Dark gray (Munsell 5Y 4/1); Saturated; Soft			2-1/12"-2			
20					1-2-2-5			

	N/A		N/A		Shelby Tube Sample Collected
25	Medium sand; Gray (Munsell 10YR 5/1); Saturated; Poorly graded; Loose	SP	1-4-3-6		
	Medium to coarse sand; Gray (Munsell 10YR 5/1); Saturated; Poorly graded; Medium dense		10-13-10-6		
			2-9-14-17		
30			3-10-6-4		
			14-16-50/5"		
35			15-6-5-5		

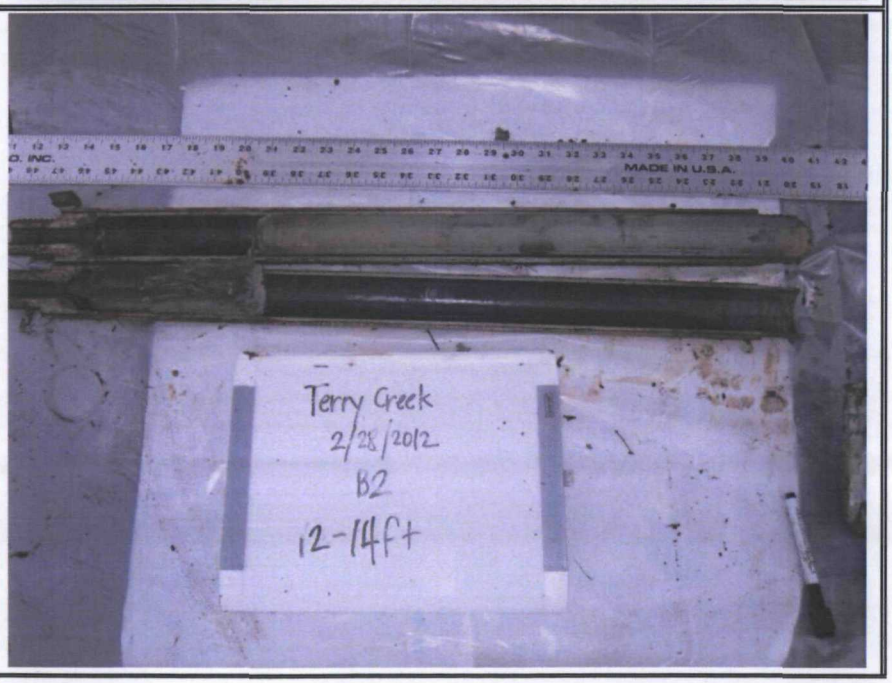
All depths referenced to ground surface.

Total Depth: 16'

ATTACHMENT B

PHOTO LOGS

GEOSYNTEC CONSULTANTS Photographic Documentation	
Client: Hercules Incorporated	Project Number: GK4443
Project Name: Terry Creek OU1 RI/FS	Project Location: Brunswick, Georgia

Photograph 1 Date: 27 February 2012 Direction: N/A Comments: Drilling SPT boring using hollow stem auger technique.	
Photograph 2 Date: 28 February 2012 Direction: N/A Comments: Split-spoon sample from Borehole B-2 (12 to 14 feet below ground surface) where sandy fat clay is observed.	

GEOSYNTEC CONSULTANTS Photographic Documentation	
Client: Hercules Incorporated	Project Number: GK4443
Project Name: Terry Creek OU1 RI/FS	Project Location: Brunswick, Georgia

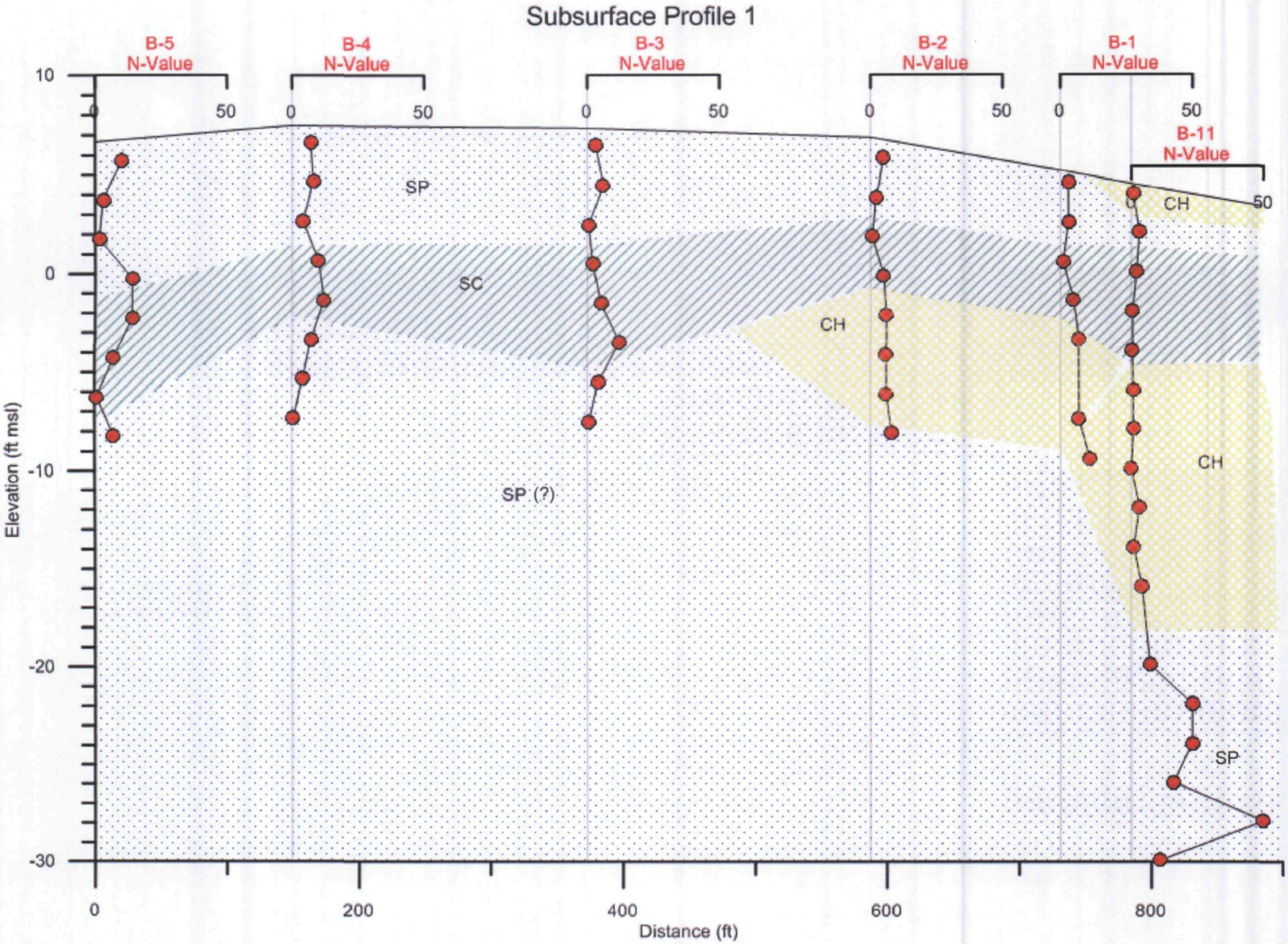
Photograph 3 Date: 29 February 2012 Direction: N/A Comments: Split-spoon sample from Borehole B-8 (14 to 16 feet below ground surface) where poorly graded sand is observed.	
Photograph 4 Date: 28 February 2012 Direction: N/A Comments: Shelby tube sample from Borehole B-10 (26 to 28 feet below ground surface).	

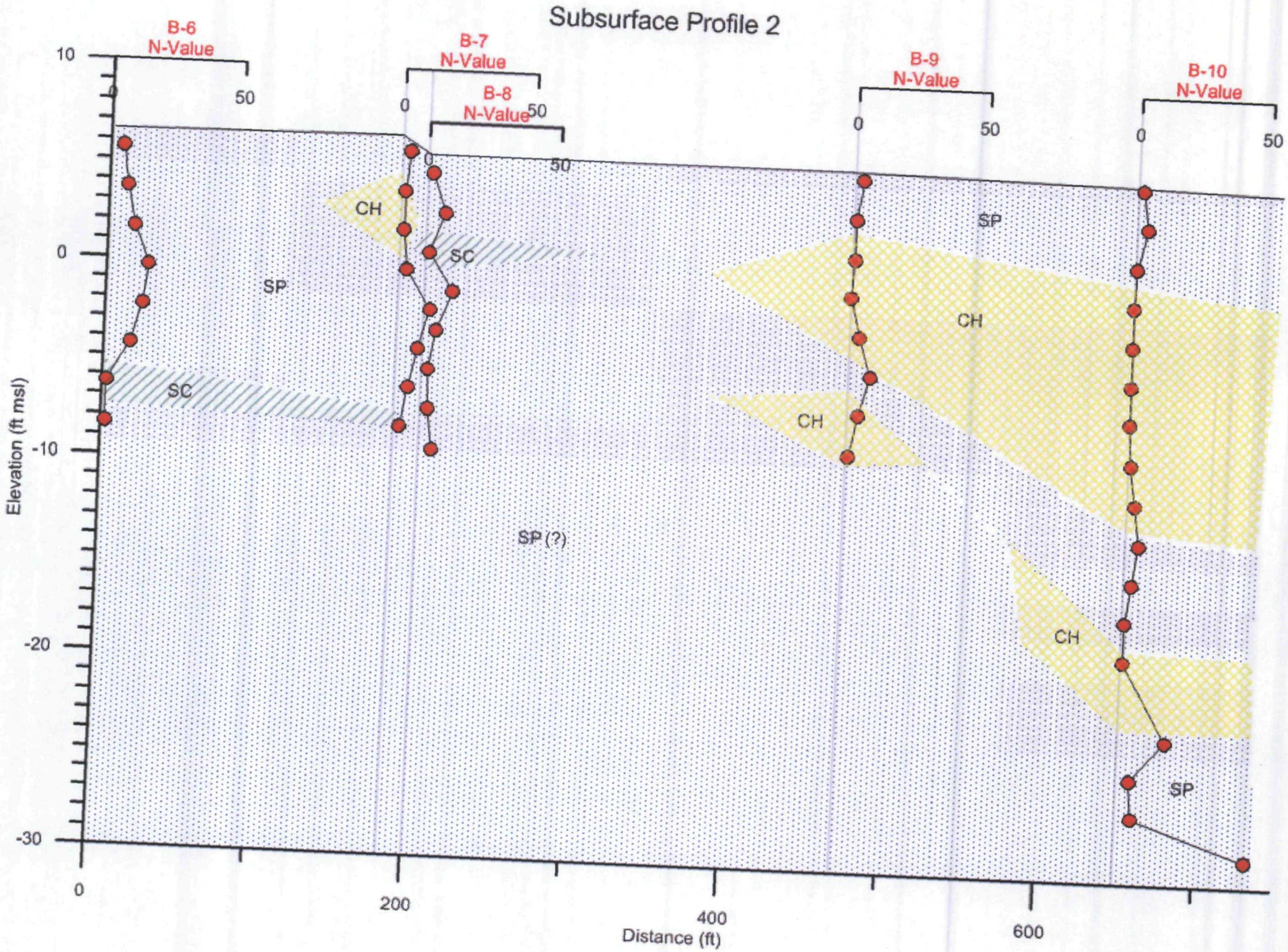
GEOSYNTEC CONSULTANTS Photographic Documentation	
Client: Hercules Incorporated	Project Number: GK4443
Project Name: Terry Creek OU1 RI/FS	Project Location: Brunswick, Georgia

Photograph 5 Date: 29 February 2012 Direction: N/A Comments: Disturbed and undisturbed Shelby tube samples collected for laboratory testing.	
Photograph 6 Date: 29 February 2012 Direction: N/A Comments: View of a completed (i.e., grouted) borehole location.	

ATTACHMENT C

SUBSURFACE PROFILES


Subsurface Profile 1
B-5
N-Value
B-4
N-Value
B-3
N-Value
B-2
N-Value
B-1
N-Value
B-11
N-Value
0
50
SP
SC
CH
SP (?)
Elevation (ft msl)
10
0
-10
-20
-30
0
200
400
600
800
Distance (ft)


Subsurface Profile 2
B-6
N-Value
B-7
N-Value
B-8
N-Value
B-9
N-Value
B-10
N-Value
0
50
SP
SC
CH
SP (?)
Elevation (ft msl)
10
0
-10
-20
-30
0
200
400
600
Distance (ft)

ATTACHMENT D

GEOTECHNICAL LABORATORY TEST RESULTS

Excel Geotechnical Testing, Inc.
"Excellence in Testing"
953 Forrest Street, Roswell, Georgia 30075
Tel: (770) 910 7537 Fax: (770) 910 7538

Test Results Summary

Project Name: Terry Creek OU1 RI/FS
Project No.: 534

Sample Information			Test Information									
Boring No.	Depth	Lab. No.	Moisture Content	Sieve Analysis ASTM D 422			Atterberg Limits ASTM D 4318			Engineering Classific.	Notes
			ASTM D 2216	Gravel Content	Sand Content	Fines Content	LL	PL	PI	ASTM D 2487	
(-)	(ft)	(-)	(%)	(%)	(%)	(%)	(-)	(-)	(-)	(-)	
GT-MSB1-01	0-2	12C003									
GT-MSB1-02	4-6	12C004	44.0								
GT-MSB1-03	8-10	12C005	30.5								
GT-MSB1-04	14-16	12C006	30.0								
GT-MSB2-01	0-2	12C007									
GT-MSB2-02	2-4	12C008	75.3								
GT-MSB2-03	10-14	12C009	25.3	0	39.8	60.2	76	19	57	CH	1 & 2
GT-MSB2-04	14-16	12C010	23.8								
GT-MSB3-01	0-2	12C011									
GT-MSB3-02	3-4	12C012	21.9								
GT-MSB3-03	8-12	12C013	25.9								
GT-MSB3-04	12-16	12C014	25.0								
GT-MSB4-01	2.5-4	12C015	14.3								
GT-MSB4-02	4-6	12C016	24.3								
GT-MSB4-03	8-10	12C017	23.5								
GT-MSB4-04	10-16	12C018	24.0	0	83.4	16.6					
GT-MSB5-01	0-2	12C019									
GT-MSB5-02	4-6	12C020	31.3								
GT-MSB5-03	10-12	12C021	24.1								
GT-MSB5-04	14-16	12C022	26.2								
GT-MNB6-01	0-2	12C023									
GT-MNB6-02	4-6	12C024	26.2								
GT-MNB6-03	8-12	12C025	21.1								
GT-MNB6-04	14-15 1/3	12C026	26.9								
GT-MNB7-01	0-2	12C027									
GT-MNB7-02	2-6	12C028	71.5	0.2	33.6	66.2	98	35	63	CH	1 & 2
GT-MNB7-03	10-14	12C029	25.5								
GT-MNB7-04	15-16	12C030	34.1								

Notes:
1 - See Soil Index Properties page for hydrometer test results
2 - See Soil Index Properties page for specific gravity test results
3 - Bucket Sample.

Excel Geotechnical Testing, Inc.
"Excellence in Testing"
953 Forrest Street, Roswell, Georgia 30075
Tel: (770) 910 7537 Fax: (770) 910 7538

Test Results Summary

Project Name: Terry Creek OU1 RI/FS
Project No.: 534

Sample Information			Test Information									
Boring No.	Depth	Lab. No.	Moisture Content	Sieve Analysis ASTM D 422			Atterberg Limits ASTM D 4318			Engineering Classific.	Notes
			ASTM D 2216	Gravel Content	Sand Content	Fines Content	LL	PL	PI	ASTM D 2487	
(-)	(ft)	(-)	(%)	(%)	(%)	(%)	(-)	(-)	(-)	(-)	
GT-MNB8-01	0-2	12C031									
GT-MNB8-02	5-6	12C032	27.6								
GT-MNB8-03	10-14	12C033	25.8	0	86.7	13.3					
GT-MNB8-04	14-16	12C034	27.1								
GT-MNB9-01	0-2	12C035									
GT-MNB9-02	4-6	12C036	126.1								
GT-MNB9-03	10.5-12	12C037	28.8								
GT-MNB9-04	14-15.5	12C038	50.6								
GT-MNB10-01	0-2	12C039									
GT-MNB10-02	2-4	12C040	38.9								
GT-MNB10-03	4-5	12C041	64.2								
GT-MNB10-04	7-16	12C042	133.6	0	7.6	92.7	151	47	104	CH	1
GT-MNB10-05	16-17	12C043	49.9								
GT-MNB10-06	18-22	12C044	26.5								
GT-MNB10-07	22-24	12C045	53.4								
GT-MNB10-08	24-26	12C046	42.9	0	45.2	54.8	53	22	31	CH	1
GT-MNB10-09	28-30	12C047	30.6	1.2	67.6	31.2					
GT-MSB11-01	0-2	12C048									
GT-MSB11-02	2-4	12C049	42.8								
GT-MSB11-03	4-6	12C050	74.4								
GT-MSB11-04	8-10	12C051	35.1								
GT-MSB11-05	10-18	12C052	106.0	2.7	25.2	72.6	79	29	50	CH	1
GT-MSB11-06	18-20	12C053	39.2								
GT-MSB11-07	20-22	12C054	43.9								
GT-MSB11-08	24-26	12C055	36.1								
GT-MSB11-09	26-36	12C056	27.0	0.7	62.1	37.2					
SD-S101-Post Weir	0-5	12C057									3
SD-S102-POST Weir	5-10	12C058	135.1	0.2	9.7	90.1	143	51	92	CH	1 & 3
SD-S101-Pre Weir	0-5	12C059	71.0	1.9	72.7	25.4	NP	NP	NP	SM	1 & 3

Notes:
1 - See Soil Index Properties page for hydrometer test results
2 - See Soil Index Properties page for specific gravity test results.
3 - Bucket Sample.

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Test Results Summary

Project Name: Terry Creek OU1 RI/FS
Project No.: 534

Sample Information			Test Information									
Boring No.	Depth	Lab. No.	Moisture Content	Sieve Analysis ASTM D 422			Atterberg Limits ASTM D 4318			Engineering Classific.	Notes
			ASTM D 2216	Gravel Content	Sand Content	Fines Content	L.L.	PL	PI	ASTM D 2487	
(-)	(ft)	(-)	(%)	(%)	(%)	(%)	(-)	(-)	(-)	(-)	
ST-SD-Post T4-5	0-3.75	12C060									
ST-GTB1	10-12	12C061									
ST-GTB10	26-28	12C062									
ST-GTB11	22-24	12C063									
ST-SD-Pre Weir	0-2.5	12C064									

Notes:
1 - See Soil Index Properties page for hydrometer test results.
2 - See Soil Index Properties page for specific gravity test results.
3 - Bucket Sample.

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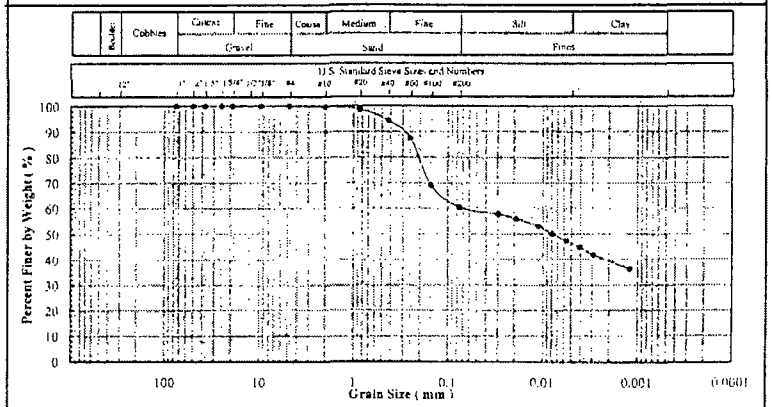
Project Name: Terry Creek OU1 RI/FS
Project No: 534
Client Sample ID: GT-MSB2-03 (10-14')
Lab Sample No: 12C009

ASTM C136, D 422, D 854, D 2216, D 4318

SOIL INDEX PROPERTIES

Gravel Size, Sand, Gravel, Moist. Cont. Sieve Classification, Atterberg Limits



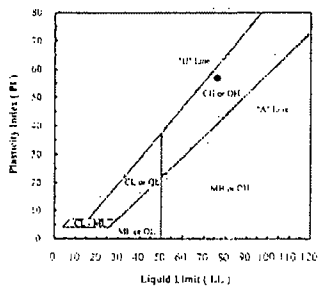
Sieve No.	Size (mm)	% Finer
3"	75	100.0
2"	50	100.0
1.5"	37.5	100.0
1"	25	100.0
3/4"	19	100.0
3/8"	9.5	100.0
#4	4.75	100.0
#10	2.00	99.8
#20	0.850	98.7
#40	0.425	94.3
#60	0.250	87.4
#100	0.150	69.1
#200	0.075	60.2

Hydrometer Particle Diameter (mm)	% Finer
0.0297	57.7
0.0114	53.0
0.0057	47.5
0.0029	41.9
0.0012	36.4

Gravel (%):	
Sand (%):	39.8
Fines (%):	60.2
Silt (%):	13.9
Clay (%):	46.3

Coeff. Unif. (Cu):	
Coeff. Curv. (Cc):	

Specific Gravity (-):	2.71



Client Sample ID	Lab Sample No.	Moisture Content (%)	Fines Content < No. 200 (%)	Atterberg Limits LL (-)	PL (-)	PI (-)	Engineering Classification
GT-MSB2-03 (10-14')	12C009	25.3	60.2	76	19	57	CH - Sandy fat clay

Note 1):

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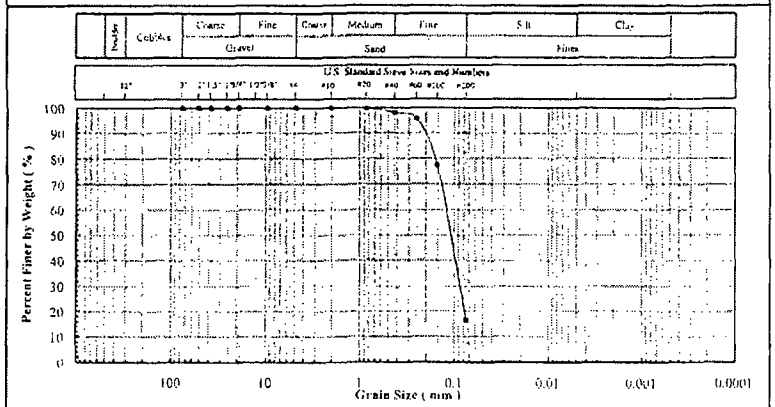
Project Name:	Terry Creek OU1 RI/FS
Project No:	554
Client Sample ID	GT-MSB4-04 (10-16')
Lab Sample No:	12C018

ASTM C136, D 422, D 854, D 1140, D 2216, D 2487, D 4318

SOIL INDEX PROPERTIES

Grain Size, Spec. Gravity, Moist. Content, Eng. Classification, Atterberg Limits

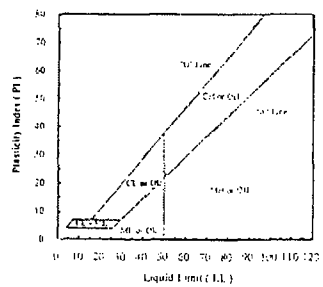


Sieve No.	Size (mm)	% Finer
3"	75	100.0
2"	50	100.0
1.5"	37.5	100.0
1"	25	100.0
3/4"	19	100.0
3/8"	9.5	100.0
#4	4.75	100.0
#10	2.00	100.0
#20	0.850	99.8
#40	0.425	98.2
#60	0.250	95.7
#100	0.150	77.5
#200	0.075	16.6

Hydrometer Particle Diameter (mm)	% Finer

Gravel (%):	
Sand (%):	83.4
Fines (%):	16.6
Silt (%):	
Clay (%):	

Specific Gravity (-):	
Coeff. Unif. (Cu):	
Coeff. Curv. (Cc):	



Client Sample ID.	Lab Sample No.	Moisture Content (%)	Fines Content < No. 200 (%)	Atterberg Limits LL (-)	PL (-)	PI (-)	Engineering Classification
GT-MSB4-04 (10-16')	12C018	24.0	16.6				

Note(s)

Excel Geotechnical Testing, Inc.
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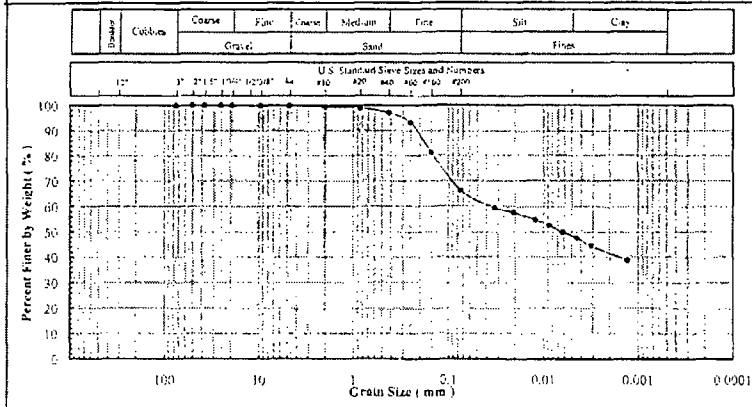
Project Name:	Terry Creek OU1 RI/FS
Project No:	534
Client Sample ID.	GT-MNB7-02 (2-6')
Lab Sample No:	12C028

ASTM C136, D 422, D 854, D 1140, D 2216, D 2487, D 4318

SOIL INDEX PROPERTIES

Grain Size, Spec. Gravity, Moist. Content, Eng. Classification, Atterberg Limits

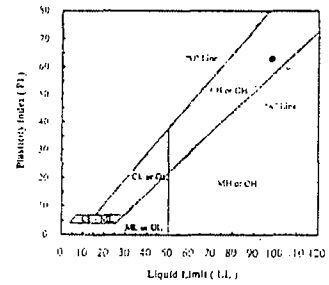


Sieve No.	Size (mm)	% Finer
3"	75	100.0
2"	50	100.0
1.5"	37.5	100.0
1"	25	100.0
3/4"	19	100.0
3/8"	9.5	100.0
#4	4.75	99.8
#10	2.00	99.4
#20	0.850	99.0
#40	0.425	97.1
#60	0.250	93.3
#100	0.150	81.4
#200	0.075	66.2

Hydrometer Particle Diameter (mm)	% Finer
0.0326	59.4
0.0123	54.8
0.0052	50.0
0.0031	44.5
0.0012	38.7

Gravel (%):	0.2
Sand (%):	33.0
Fines (%):	66.2
Silt (%):	32.7
Clay (%):	44.5

Specific Gravity (-):	2.49
Coeff. Unif. (Cu):	
Coeff. Curv. (Cc):	



Client Sample ID.	Lab Sample No.	Moisture Content (%)	Fines Content < No. 200 (%)	Atterberg Limits LL (-)	PL (-)	PI (-)	Engineering Classification
GT-MNB7-02 (2-6')	12C028	71.5	66.2	98	35	63	CH - Sandy fat clay

Note(s): Organic matters in soil may affect the hydrometer test results

Atterberg results and the engineering classification may be affected by the organic matters in the test material

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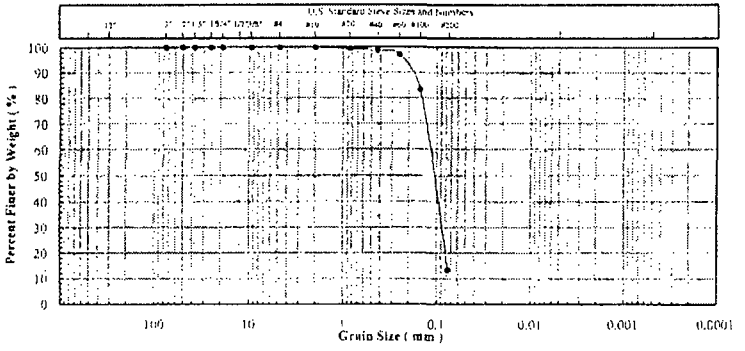
Project Name:	Terry Creek OU1 RI/FS
Project No:	534
Client Sample ID:	GT-MNB8-03 (10-14')
Lab Sample No:	12C033

ASTM C 136, D 422, D 854, D 1140, D 2216, D 2487, D 4318

SOIL INDEX PROPERTIES

Grain Size, Specific Gravity, Moisture Content, Eng. Classification, Atterberg Limits

Boulders	Cobbles	Gravel: Coarse	Gravel: Fine	Sand: Coarse	Sand: Medium	Sand: Fine	Fines: Silt	Fines: Clay



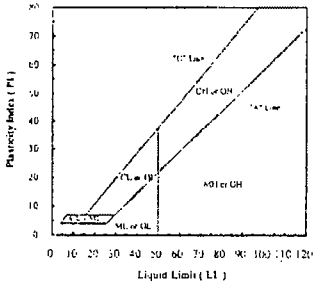
Sieve No	Size (mm)	% Finer
3"	75	100.0
2"	50	100.0
1.5"	37.5	100.0
1"	25	100.0
3/4"	19	100.0
3/8"	9.5	100.0
#4	4.75	100.0
#10	2.00	99.9
#20	0.850	99.4
#40	0.425	98.8
#60	0.250	97.2
#100	0.150	83.5
#200	0.075	13.3

Hydrometer Particle Diameter (mm)	% Finer

Gravel (%):	
Sand (%):	86.7
Fines (%):	13.3
Silt (%):	
Clay (%):	

Specific Gravity (-):	

Coeff. Unif. (Cu):	
Coeff. Curv. (Cc):	



Client Sample ID.	Lab Sample No:	Moisture Content (%)	Fines Content < No. 200 (%)	Atterberg Limits LL (-)	PL (-)	PI (-)	Engineering Classification
GT-MNB8-03 (10-14')	12C033	25.8	13.3				

Note(s):

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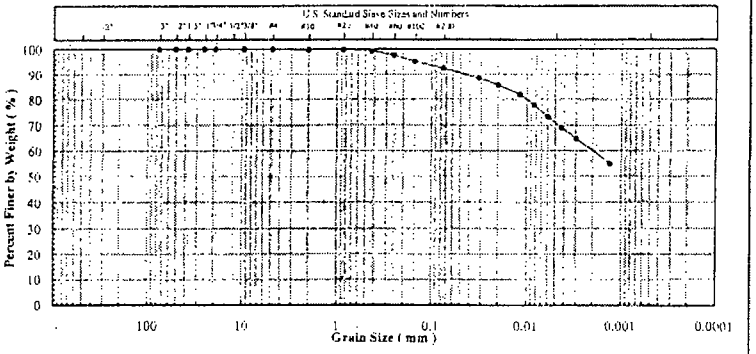
Project Name:	Terry Creek OU1 RI/FS
Project No:	534
Client Sample ID:	GT-MNB10-04 (7-16')
Lab Sample No:	12C042

ASTM C 136, D 422, D 854, D 1140, D 2216, D 2487, D 4318

SOIL INDEX PROPERTIES

Grain Size, Specific Gravity, Moisture Content, Eng. Classification, Atterberg Limits

Boulders	Cobbles	Gravel: Coarse	Gravel: Fine	Sand: Coarse	Sand: Medium	Sand: Fine	Fines: Silt	Fines: Clay



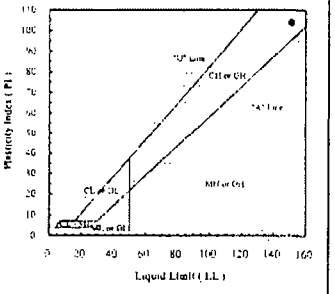
Sieve No.	Size (mm)	% Finer
3"	75	100.0
2"	50	100.0
1.5"	37.5	100.0
1"	25	100.0
3/4"	19	100.0
3/8"	9.5	100.0
#4	4.75	100.0
#10	2.00	99.8
#20	0.850	99.8
#40	0.425	99.2
#60	0.250	97.7
#100	0.150	95.2
#200	0.075	92.4

Hydrometer Particle Diameter (mm)	% Finer
0.0118	88.5
0.0118	82.0
0.0060	73.2
0.0030	61.8
0.0013	55.0

Gravel (%):	
Sand (%):	7.6
Fines (%):	92.4
Silt (%):	21.7
Clay (%):	70.7

Specific Gravity (-):	2.55

Coeff. Unif. (Cu):	
Coeff. Curv. (Cc):	



Client Sample ID.	Lab Sample No:	Moisture Content (%)	Fines Content < No. 200 (%)	Atterberg Limits LL (-)	PL (-)	PI (-)	Engineering Classification
GT-MNB10-04 (7-16')	12C042	133.6	92.4	151	47	104	CH - Fat clay

Note(s): Organic matters in soil may affect the hydrometer test results.
Atterberg results and the engineering classification may be affected by the organic matters in the test material.
An assumed specific gravity of 2.55 was used when analyzing the hydrometer test results.

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Project Name:	Terry Creek OU1 RI/FS
Project No:	534
Client Sample ID:	GT-MNB10-08 (24-26')
Lab Sample No:	12C016

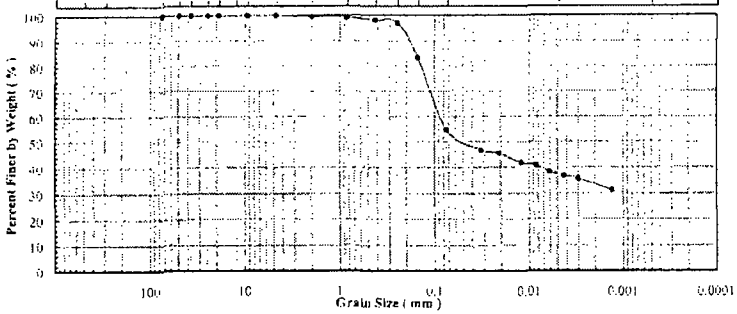
ASTM C 136, D 422, D 854, D 1140, D 2216, D 2487, D 4318

SOIL INDEX PROPERTIES

Grain Size, Spec. Gravity, Moist. Cont., Atg. Classification, Atterberg Limits

Boulders	Cobbles	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
		Gravel		Sand			Fines	

U.S. Standard Sieve Size and Numbers



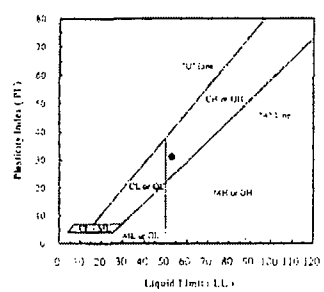
Sieve No.	Size (mm)	% Finer
3"	75	100.0
2"	50	100.0
1.5"	37.5	100.0
1"	25	100.0
3/4"	19	100.0
3/8"	9.5	100.0
#4	4.75	100.0
#10	2.00	99.6
#20	0.850	99.2
#40	0.425	98.2
#60	0.250	97.2
#100	0.150	95.5
#200	0.075	54.8

Hydrometer Particle Diameter (mm)	% Finer
0.0327	46.8
0.0120	41.7
0.0061	38.2
0.0030	35.6
0.0013	31.4

Gravel (%):	
Sand (%):	45.2
Fines (%):	54.8
Silt (%):	17.4
Clay (%):	37.4

Specific Gravity (-):	2.60

Coeff. Unif. (Cu):	
Coeff. Curv. (Cc):	



Client Sample ID.	Lab Sample No:	Moisture Content (%)	Fines Content < No. 200 (%)	Atterberg Limits LL (-)	PL (-)	PI (-)	Engineering Classification
GT-MNB10-08 (24-26')	12C046	43.9	54.8	53	22	31	CH - Sandy fat clay

Note(s): Organic matters in soil may affect the hydrometer test results.
Atterberg results and the engineering classification may be affected by the organic matters in the test material.
An assumed specific gravity of 2.60 was used when analyzing the hydrometer test results.

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Project Name:	Terry Creek OU1 RI/FS
Project No:	534
Client Sample ID	GT-MNB10-09 (28-30')
Lab Sample No:	12C047

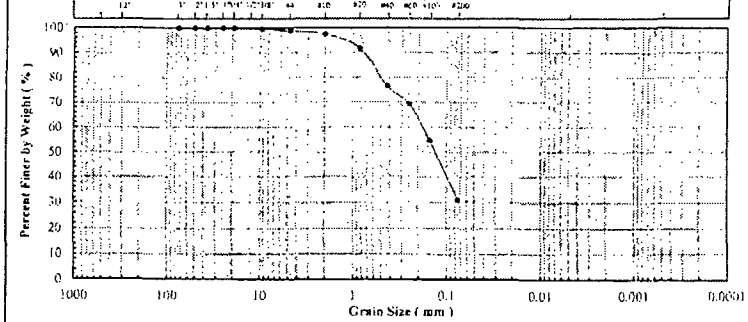
ASTM C 136, D 422, D 854, D 1140, D 2216, D 2487, D 4318

SOIL INDEX PROPERTIES

Grain Size, Spec. Gravity, Moist. Content, Atg. Classification, Atterberg Limits

Boulders	Cobbles	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
		Gravel		Sand			Fines	

U.S. Standard Sieve Sizes and Numbers



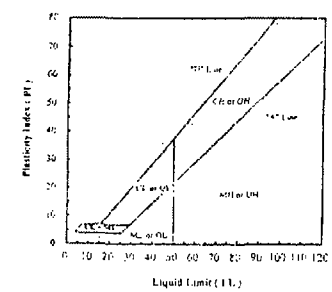
Sieve No.	Size (mm)	% Finer
3"	75	100.0
2"	50	100.0
1.5"	37.5	100.0
1"	25	100.0
3/4"	19	100.0
3/8"	9.5	99.7
#4	4.75	98.8
#10	2.00	97.6
#20	0.850	96.8
#40	0.425	95.5
#60	0.250	93.6
#100	0.150	54.7
#200	0.075	31.2

Hydrometer Particle Diameter (mm)	% Finer

Gravel (%):	1.2
Sand (%):	67.6
Fines (%):	31.2
Silt (%):	
Clay (%):	

Specific Gravity (-):	

Coeff. Unif. (Cu):	
Coeff. Curv. (Cc):	



Client Sample ID.	Lab Sample No:	Moisture Content (%)	Fines Content < No. 200 (%)	Atterberg Limits LL (-)	PL (-)	PI (-)	Engineering Classification
GT-MNB10-09 (28-30')	12C047	30.6	31.2				

Note(s):

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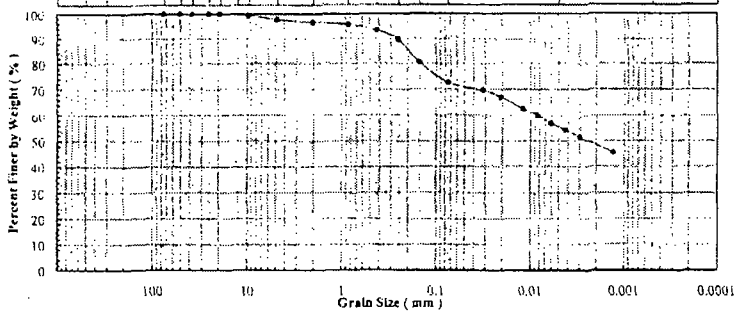
Project Name:	Terry Creek OU1 RI/FS
Project No:	534
Client Sample ID	GT-MSB11-05 (10-18')
Lab Sample No:	12C052

SOIL INDEX PROPERTIES

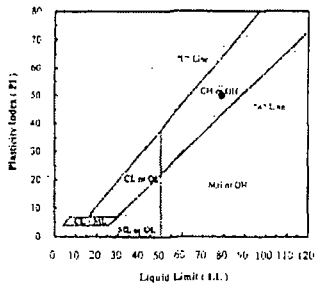
Boulders	Cobbles	Gravel: Coarse	Gravel: Fine	Sand: Coarse	Sand: Medium	Sand: Fine	Fines: Silt	Fines: Clay



Sieve No.	Size (mm)	% Finer
3"	75	100.0
2"	50	100.0
1.5"	37.5	100.0
1"	25	100.0
3/4"	19	100.0
3/8"	9.5	99.4
#4	4.75	97.8
#10	2.00	96.8
#20	0.850	95.8
#40	0.425	93.4
#60	0.250	89.6
#100	0.150	80.6
#200	0.075	72.6

Hydrometer Particle Diameter (mm)	% Finer
0.0319	69.6
0.0119	62.5
0.0061	56.9
0.0030	51.4
0.0013	45.4

Gravel (%):	2.2
Sand (%):	25.2
Fines (%):	72.6
Silt (%):	17.3
Clay (%):	55.3
Coeff. Unif. (Cu):	
Coeff. Curv. (Cc):	
Specific Gravity (-):	2.55



Client Sample ID.	Lab Sample No:	Moisture Content (%)	Fines Content < No. 200 (%)	Atterberg Limits LL (-)	PL (-)	PI (-)	Engineering Classification
GT-MSB11-05 (10-18')	12C052	106.0	72.6	79	29	50	CH - Sandy fat clay

Note(s). Organic matters in soil may affect the hydrometer test results
Atterberg results and the engineering classification may be affected by the organic matters in the test material
An assumed specific gravity of 2.55 was used when analyzing the hydrometer test results

3-19-12

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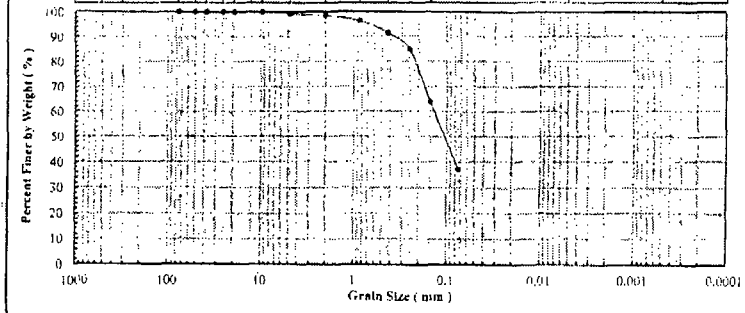
Project Name:	Terry Creek OU1 RI/FS
Project No:	534
Client Sample ID:	GT-MSB11-09 (26-36')
Lab Sample No:	12C056

SOIL INDEX PROPERTIES

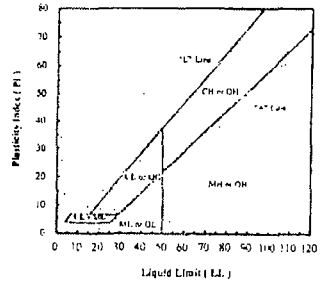
Boulders	Cobbles	Gravel: Coarse	Gravel: Fine	Sand: Coarse	Sand: Medium	Sand: Fine	Fines: Silt	Fines: Clay



Sieve No.	Size (mm)	% Finer
3"	75	100.0
2"	50	100.0
1.5"	37.5	100.0
1"	25	100.0
3/4"	19	100.0
3/8"	9.5	100.0
#4	4.75	99.3
#10	2.00	98.6
#20	0.850	95.5
#40	0.425	91.7
#60	0.250	85.0
#100	0.150	64.1
#200	0.075	37.2

Hydrometer Particle Diameter (mm)	% Finer

Gravel (%):	0.7
Sand (%):	62.1
Fines (%):	37.2
Silt (%):	
Clay (%):	
Coeff. Unif. (Cu):	
Coeff. Curv. (Cc):	
Specific Gravity (-):	



Client Sample ID.	Lab Sample No:	Moisture Content (%)	Fines Content < No. 200 (%)	Atterberg Limits LL (-)	PL (-)	PI (-)	Engineering Classification
GT-MSB11-09 (26-36')	12C056	27.0	37.2				

Note(s).

3-19-12

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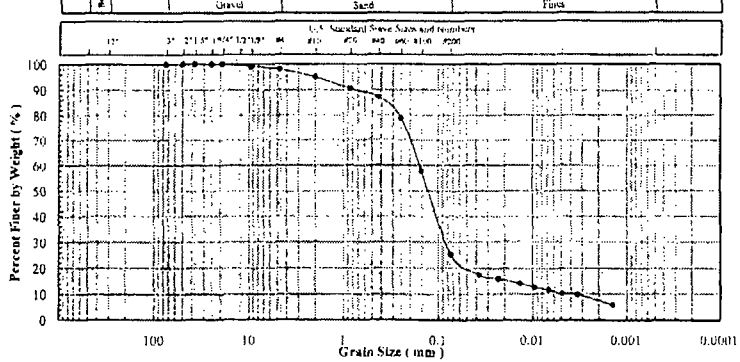
Tel. (770) 910 7537 Fax: (770) 910 7538

Project Name:	Terry Creek OU1 RI/FS
Project No:	534
Client Sample ID:	SD-S201-Pre Weir (0-5')
Lab Sample No:	12C059

SOIL INDEX PROPERTIES

Boulder	Cobbles	Gravel: Coarse	Gravel: Fine	Sand: Coarse	Sand: Medium	Sand: Fine	Fines: Silt	Fines: Clay



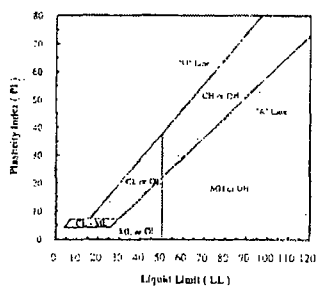
Sieve No.	Size (mm)	% Finer
3"	75	100.0
2"	50	100.0
1.5"	37.5	100.0
1"	25	100.0
3/4"	19	100.0
3/8"	9.5	99.2
#4	4.75	98.1
#10	2.00	95.2
#20	0.850	90.7
#40	0.425	87.3
#60	0.250	78.9
#100	0.150	58.0
#200	0.075	25.4

Specific Gravity (-):	2.55

Hydrometer Particle Diameter (mm)	% Finer
0.0269	17.4
0.0136	14.2
0.0068	11.6
0.0034	9.9
0.0014	6.1

Gravel (%):	1.9
Sand (%):	72.7
Fines (%):	25.4
Silt (%):	15.1
Clay (%):	10.3

Coeff. Unif. (Cu):	
Coeff. Curv. (Cc):	



Client Sample ID.	Lab Sample No:	Moisture Content (%)	Fines Content < No. 200 (%)	Atterberg Limits LL (-)	PL (-)	PI (-)	Engineering Classification
D-S201-Pre Weir (0-	12C059	71.0	25.4	NP	NP	NP	SM - Silty sand

Note(s): Organic matters in soil may affect the hydrometer test results
Atterberg results and the engineering classification may be affected by the organic matters in the test material
An assumed specific gravity of 2.55 was used when analyzing the hydrometer test results.

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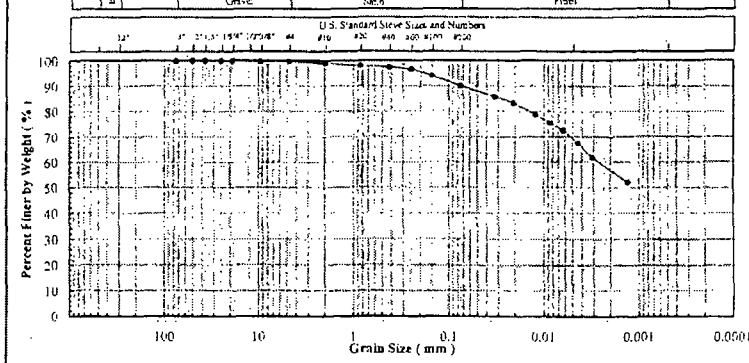
Project Name:	Terry Creek OU1 RI/FS
Project No:	534
Client Sample ID:	SD-S102- Post Weir (5-10')
Lab Sample No:	12C058

SOIL INDEX PROPERTIES

Boulder	Cobbles	Gravel: Coarse	Gravel: Fine	Sand: Coarse	Sand: Medium	Sand: Fine	Fines: Silt	Fines: Clay



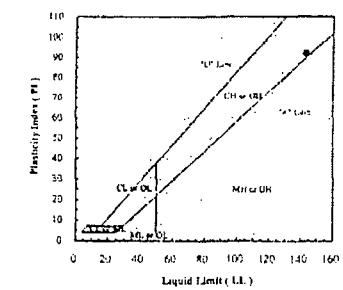
Sieve No.	Size (mm)	% Finer
3"	75	100.0
2"	50	100.0
1.5"	37.5	100.0
1"	25	100.0
3/4"	19	100.0
3/8"	9.5	99.8
#4	4.75	99.8
#10	2.00	99.6
#20	0.850	98.2
#40	0.425	97.5
#60	0.250	96.6
#100	0.150	94.1
#200	0.075	90.1

Specific Gravity (-):	2.55

Hydrometer Particle Diameter (mm)	% Finer
0.0339	85.8
0.0123	78.8
0.0062	72.3
0.0031	62.0
0.0013	51.8

Gravel (%):	0.2
Sand (%):	9.7
Fines (%):	90.1
Silt (%):	21.1
Clay (%):	69.0

Coeff. Unif. (Cu):	
Coeff. Curv. (Cc):	



Client Sample ID.	Lab Sample No:	Moisture Content (%)	Fines Content < No. 200 (%)	Atterberg Limits LL (-)	PL (-)	PI (-)	Engineering Classification
SD-S102- Post Weir (5-10')	12C058	135.1	90.1	143	51	92	CH - Fat clay

Note(s): Organic matters in soil may affect the hydrometer test results.
Atterberg results and the engineering classification may be affected by the organic matters in the test material
An assumed specific gravity of 2.55 was used when analyzing the hydrometer test results

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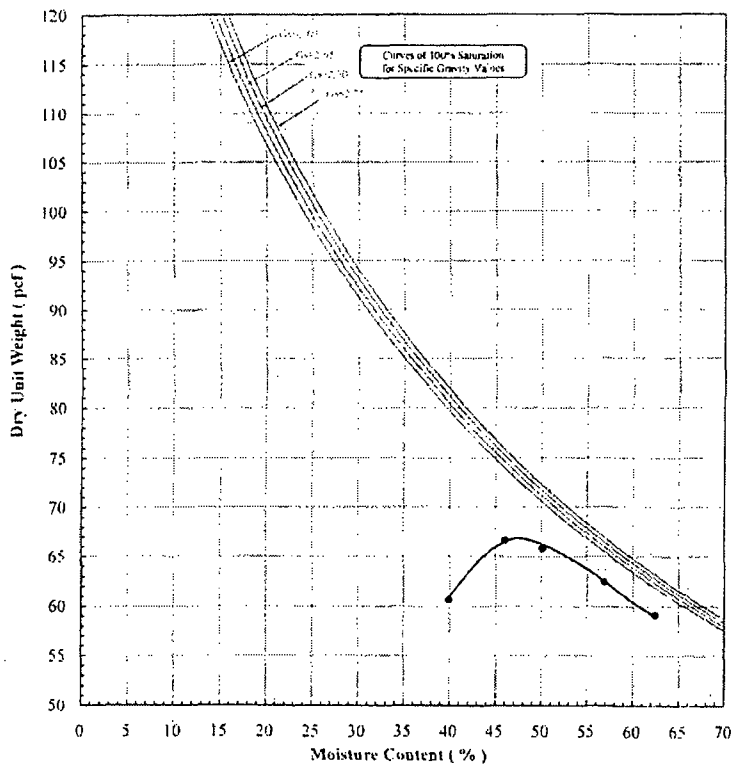
Project Name:	Terry Creek OUI RI/FS
Project No:	534
Client Sample ID	Mix-01*
Lab Sample No:	12D043

ASTM D 698 - Method B **COMPACTION MOISTURE-DENSITY RELATIONSHIP** Moist Preparation



Client/Site Sample ID.	Lab Sample No:	Maximum Dry Unit Weight (pcf)	Optimum Moisture Content (%)	Visual Soil Description
Mix-01*	12D043	67.0	47.5	Dark gray silty clay

Note(s) * A mixture of Bucket-SD-S101 (0-5') Post Weir, Bucket-SD-S102 (5-10') Post Weir and Shelby-SDPostT4-5 (0-3.75')

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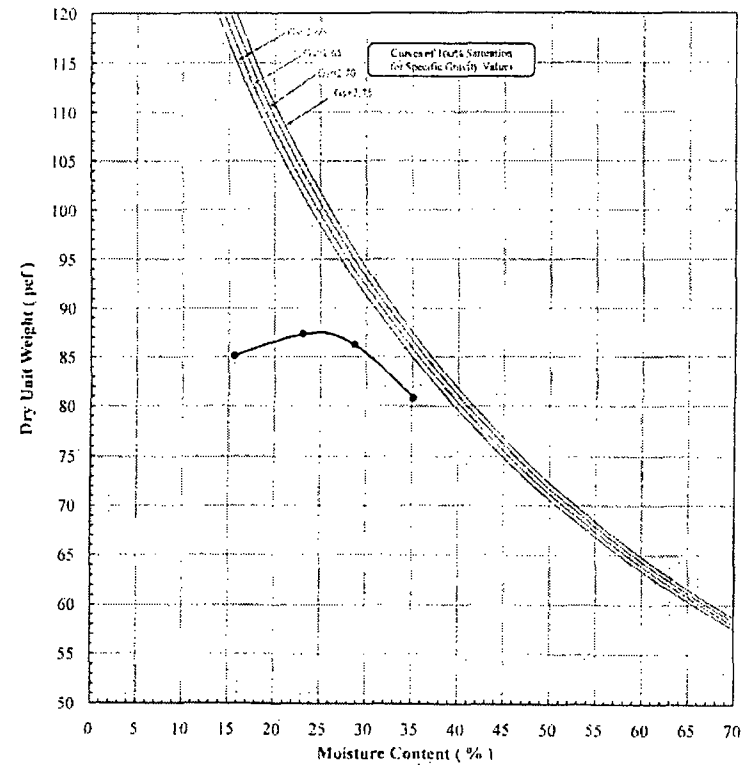
Project Name:	Terry Creek OUI RI/FS
Project No:	534
Client Sample ID:	Mix-02*
Lab Sample No:	12D044

ASTM D 698 - Method B **COMPACTION MOISTURE-DENSITY RELATIONSHIP** Moist Preparation



Client/Site Sample ID.	Lab Sample No:	Maximum Dry Unit Weight (pcf)	Optimum Moisture Content (%)	Visual Soil Description
Mix-02*	12D044	87.7	25.0	Dark gray clayey silty sand

Note(s) * A mixture of Bucket-SD-S201 (0-5') Pre Weir and Shelby-SD Pre Weir (0-2.5')

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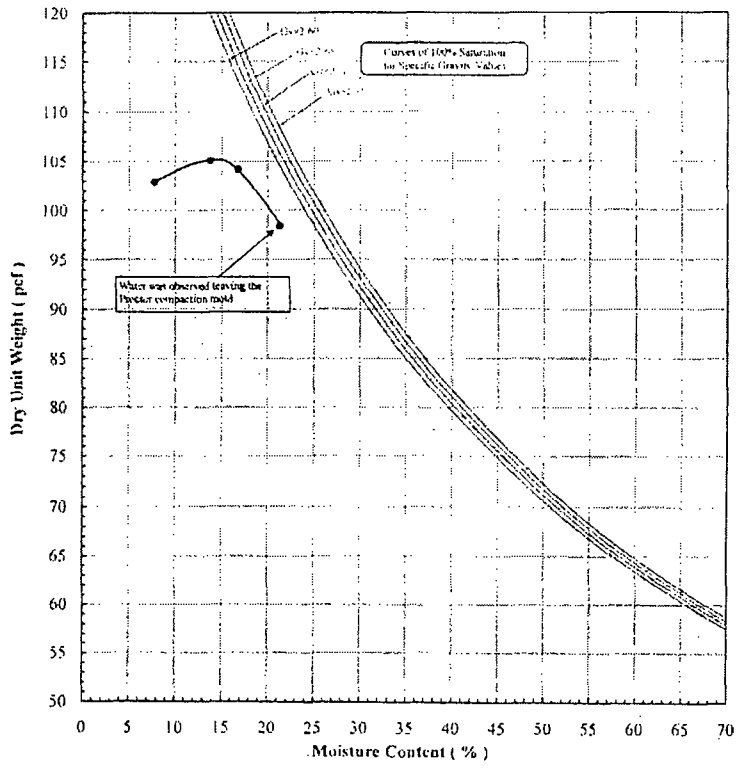
Project Name:	Terry Creek OU1 RI/FS
Project No:	534
Client Sample ID:	Mix-03*
Lab Sample No:	12D045

ASTM D 698 - Method B

COMPACTION MOISTURE-DENSITY RELATIONSHIP

Moist Preparation



Client/Site Sample ID.	Lab Sample No:	Maximum Dry Unit Weight (pcf)	Optimum Moisture Content (%)	Visual Soil Description
Mix-03*	12D045	105.2	14.9	Gray-tan slightly clayey silty sand

Notes) * A mixture of GT-MSB1-04 (14-16'), GT-MSB2-04 (14-16'), GT-MSB3-04 (12-16'), GT-MSB4-04 (10-16'), GT-MSB5-04 (14-16'), GT-MSB7-03 (10-14') and GT-MSB8-03 (10-14')

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FLEXIBLE WALL PERMEABILITY TEST [1]

ASTM D5084

Project Name:	Terry Creek OU1 RI/FS
Project Number:	534
Client Name:	Geosyntec Consultants
Site Sample ID:	Mix-01*
Lab Sample Number:	12D043
Material Type:	Soil
Specified Value (cm/sec):	NA
Date Test Started:	5/8/2012

Remolded Specimen	Proctor [3] Compaction		Specimen Initial Conditions [5]		Test Conditions					Hydraulic Conductivity [5]
	Max. DUW	Opt. MC	Dry Unit Weight	Moisture Content	Cell Press.	Back Press.	Consolid. Press.	Permeant Liquid [7]	Average Gradient	
(-)	(pcf)	(%)	(pcf)	(%)	(psi)	(psi)	(psi)	(-)	(-)	(cm/s)
Notes 2 , 3 & 4	67.0	47.5	63.8	47.3	75.9	75.0	0.9	DTW	7	2.8E-5
					78.5	75.0	3.5		8	3.4E-6

Notes:

1. Method C, "Falling-Head, Increasing-Tailwater" test procedures were followed during the testing.
2. All particles larger than 3/8 inch, if any, were discarded when forming the remolded specimen
3. Remolded specimen was formed by tamping the soil in 0.5 inch thick layers
4. Remolded specimen approximately 2.8 inches in diameter and 2.5 inches in height.
5. Maximum Dry Unit Weight (DUW) and Optimum Moisture Content (MC) based on the Standard Proctor Compaction Test (ASTM D 698)
6. Based on the target values of 95% of the maximum dry unit weight and at the optimum moisture.
7. Type of permeant liquid DTW = Desired Tap Water, DDI = Desired Deionized Water
8. Specimen had a honeycomb structure which could strongly affect the permeability value (i.e., higher values are measured than should be expected).

* A mixture of Bucket-SD-S101 (0-5') Post Weir, Bucket-SD-S102 (5-10') Post Weir and Shelby-SDPostT4-5 (0-3.75')

Deviations:

Laboratory temperature at 22 ±3 °C
Test specimen final conditions are not presented

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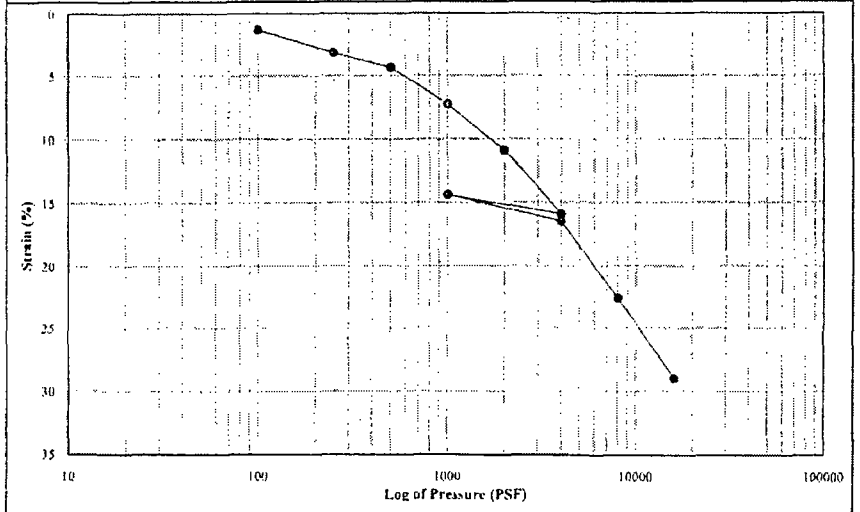
Project Name: Terry Creek OU1 RI/FS
Project No: 534
Client Sample ID: ST-GTB11
Lab Sample No: 12C063

ASTM D 2435

ONE-DIMENSIONAL CONSOLIDATION TEST



Client Sample ID	Lab Sample No.	Specimen Quality 1-10 (Bad to Good)	Test Specimen Initial Conditions: Height (cm)	Diameter (cm)	Dry Unit Weight (pcf)	Moisture Content (%)	Consolidation Pressure (psf)	Pressure Increment Duration (min)	Accumulated Vertical Strain (%)	Figure No	Remarks
ST-GTB11	12C063	8	2.54	6.35	64.6	59.2	100	316	1.28	1	
							250	1034	3.14	2	
							500	265	4.53	3	
							1000	1152	7.27	4	
							2000	1448	10.88	5	
							4000	1417	15.92	6	
							1000	1103	14.37	7	
							4000	1562	16.48	8	
							8000	1505	22.59	9	
							16000	1321	28.97	10	

Note(s)

1. For each pressure increment, the vertical strain values were calculated based on the final deformation measurements

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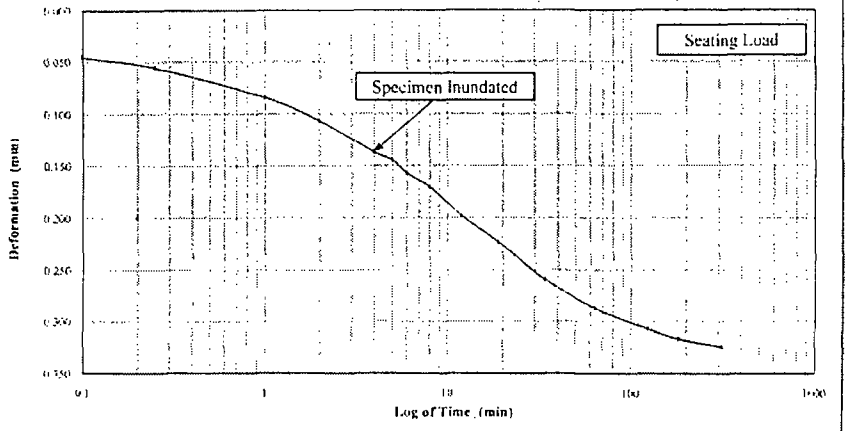
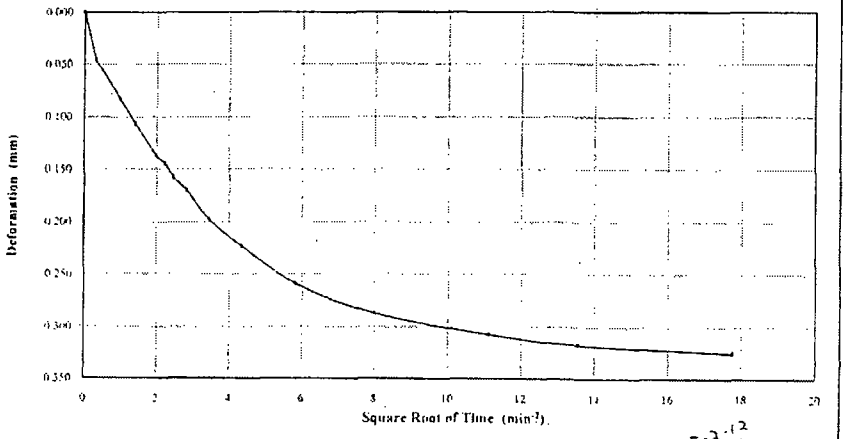
Project Name: Terry Creek OU1 RI/FS
Project No: 534
Client Sample ID: ST-GTB11
Lab Sample No: 12C063

ASTM D 2435

ONE-DIMENSIONAL CONSOLIDATION TEST

Figure 1 - 100 psf





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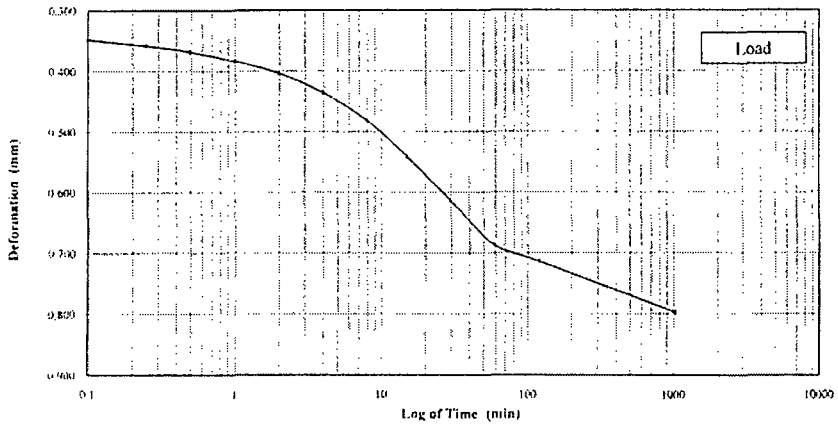
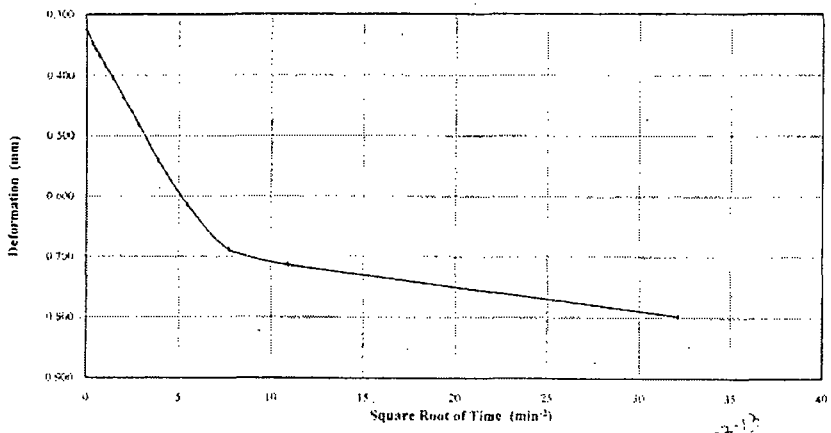
Project Name: Terry Creek OU1 RI/FS
Project No: 534
Client Sample ID: ST-GTB11
Lab Sample No: 12C063

ASTM D 2435

ONE-DIMENSIONAL CONSOLIDATION TEST

Figure 2 - 250 psf





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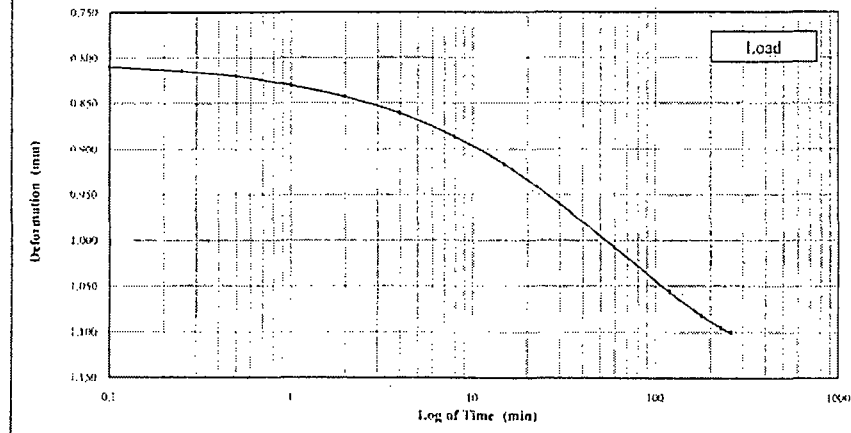
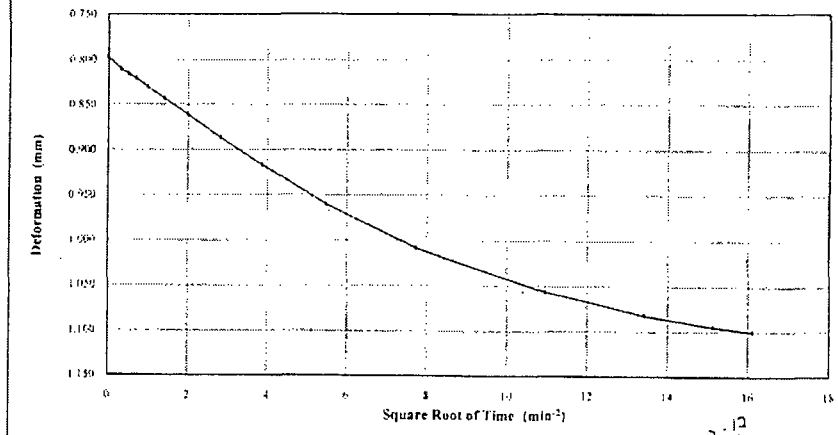
Project Name: Terry Creek OU1 RI/FS
Project No: 534
Client Sample ID: ST-GTB11
Lab Sample No: 12C063

ASTM D 2435

ONE-DIMENSIONAL CONSOLIDATION TEST

Figure 3 - 500 psf





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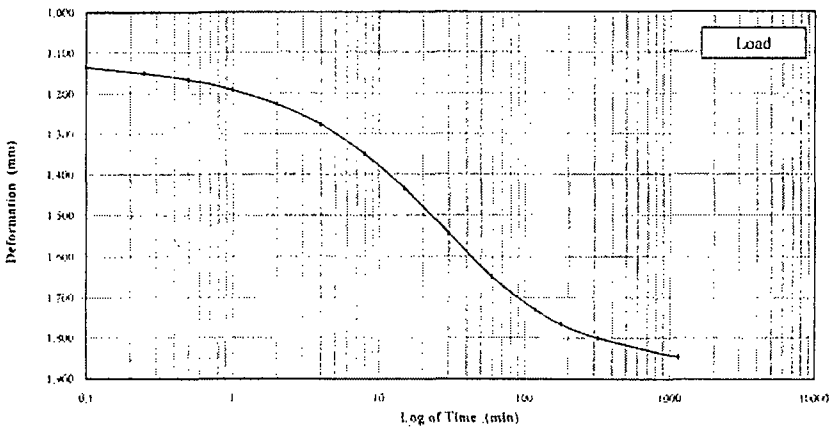
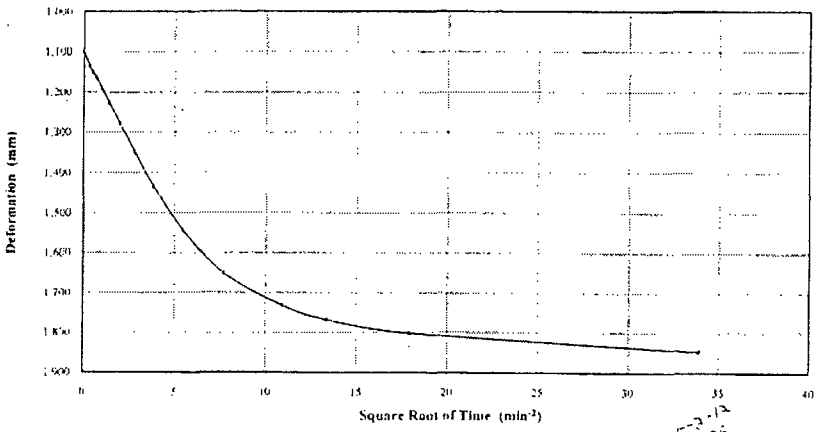
Project Name: Terry Creek OU1 RI/FS
Project No: 534
Client Sample ID: ST-GTB11
Lab Sample No: 12C063

ASTM D 2435

ONE-DIMENSIONAL CONSOLIDATION TEST

Figure 4 - 1000 psf





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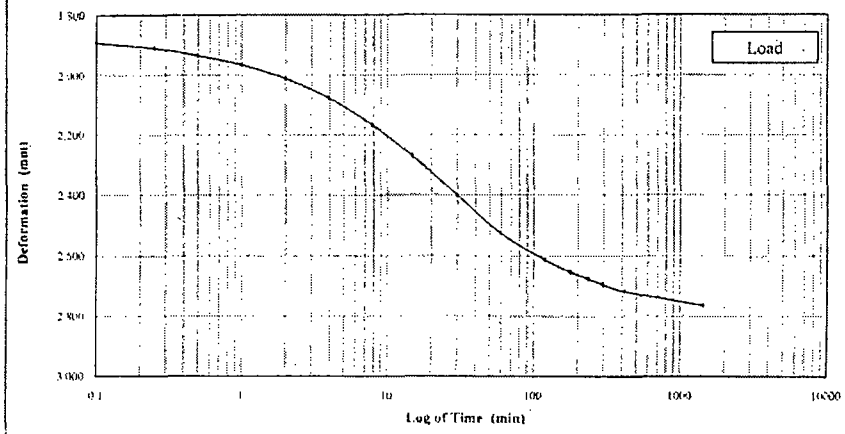
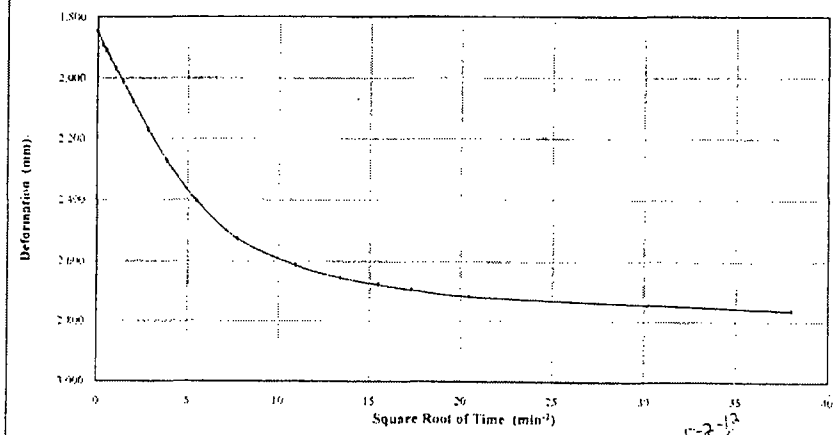
Project Name: Terry Creek OU1 RI/FS
Project No: 534
Client Sample ID: ST-GTB11
Lab Sample No: 12C063

ASTM D 2435

ONE-DIMENSIONAL CONSOLIDATION TEST

Figure 5 - 2000 psf





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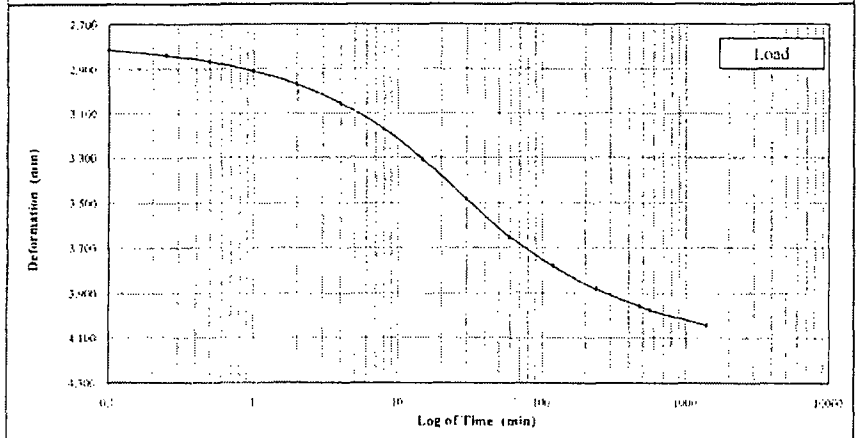
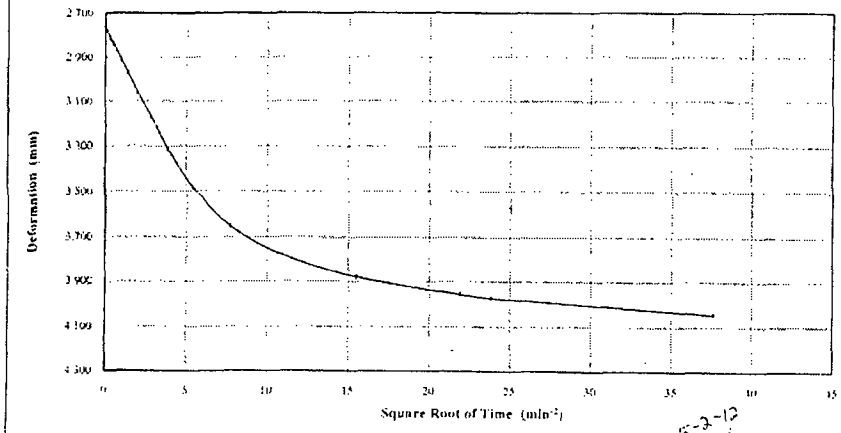
Project Name: Terry Creek OU1 RI/FS
Project No: 534
Client Sample ID: ST-GTB11
Lab Sample No: 12C063

ASTM D 2435

ONE-DIMENSIONAL CONSOLIDATION TEST

Figure 6 - 4000 psf





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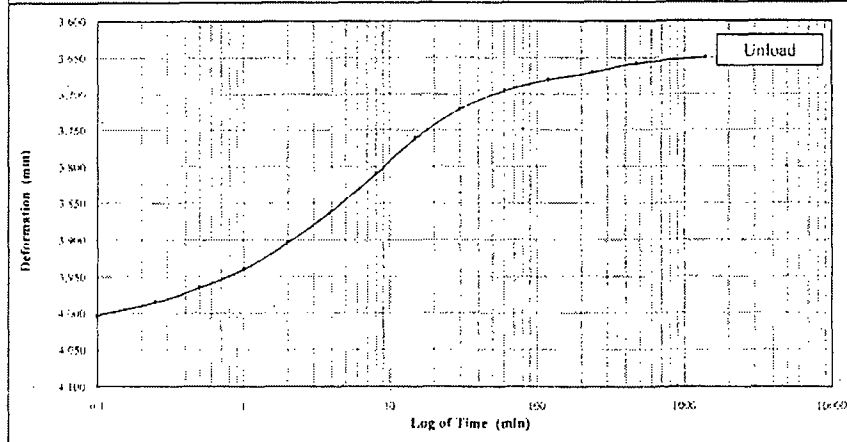
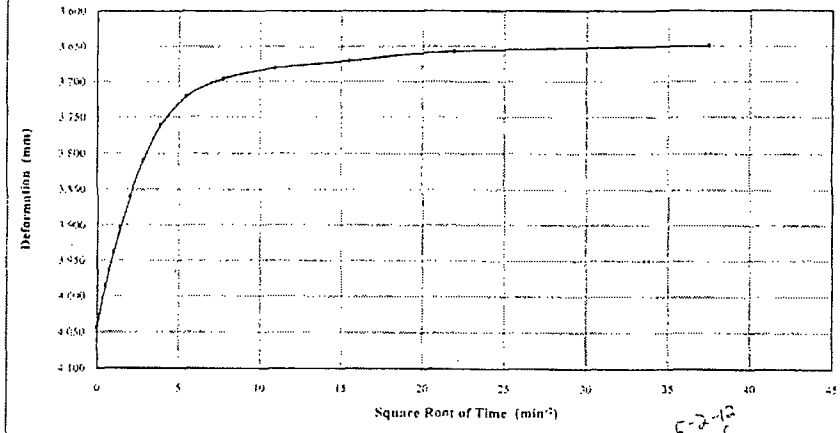
Project Name: Terry Creek OU1 RI/FS
Project No: 534
Client Sample ID: ST-GTB11
Lab Sample No: 12C063

ASTM D 2435

ONE-DIMENSIONAL CONSOLIDATION TEST

Figure 7 - 1000 psf





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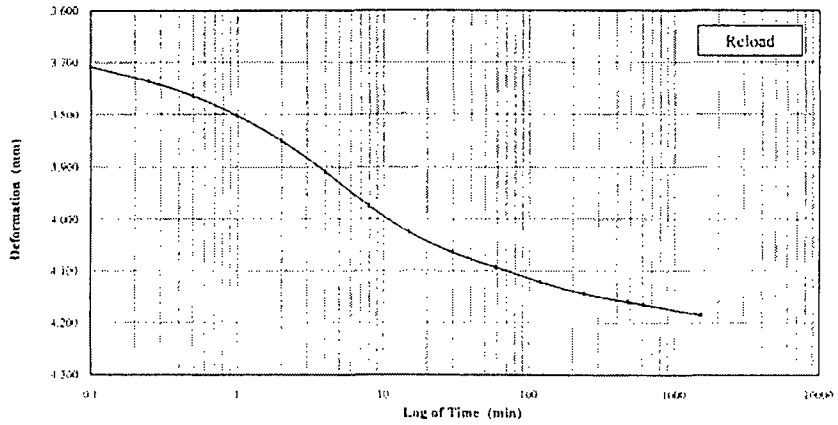
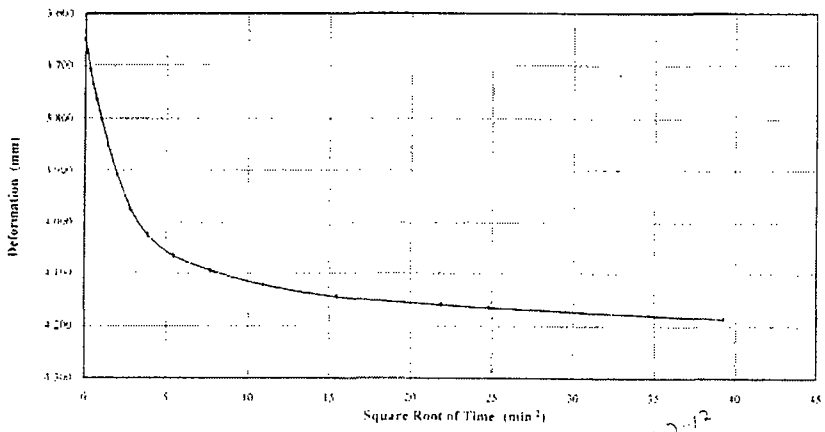
Project Name: Terry Creek OU1 RI/FS
Project No: 534
Client Sample ID: ST-GTB11
Lab Sample No: 12C063

ASTM D 2435

ONE-DIMENSIONAL CONSOLIDATION TEST

Figure 8 - 4000 psf





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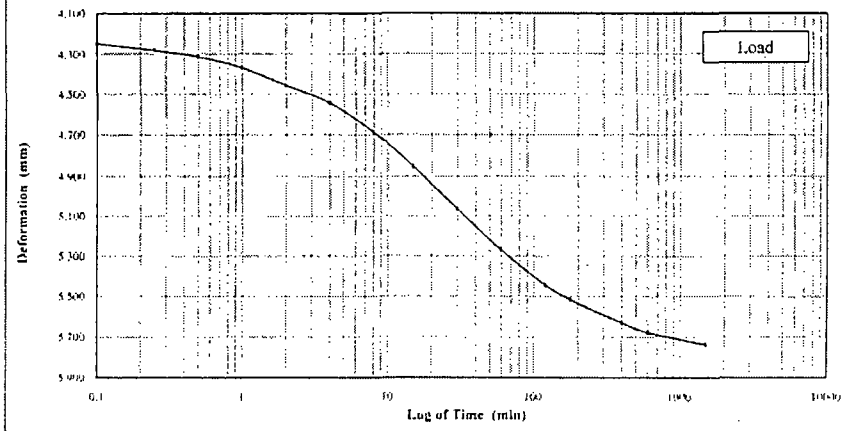
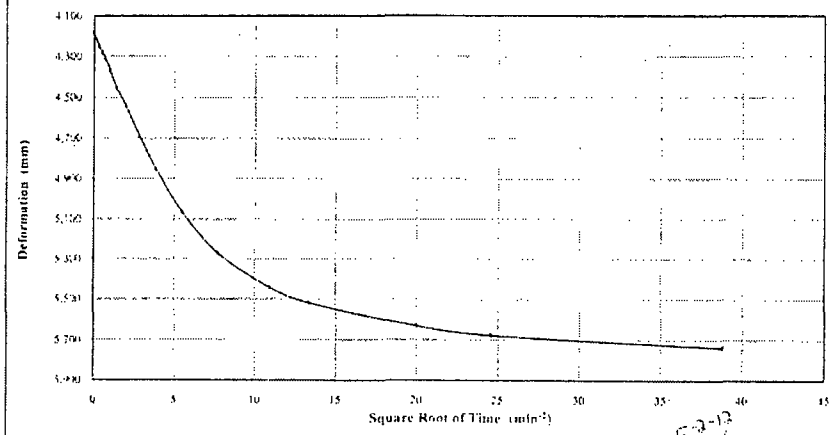
Project Name: Terry Creek OU1 RI/FS
Project No: 534
Client Sample ID: ST-GTB11
Lab Sample No: 12C063

ASTM D 2435

ONE-DIMENSIONAL CONSOLIDATION TEST

Figure 9 - 8000 psf





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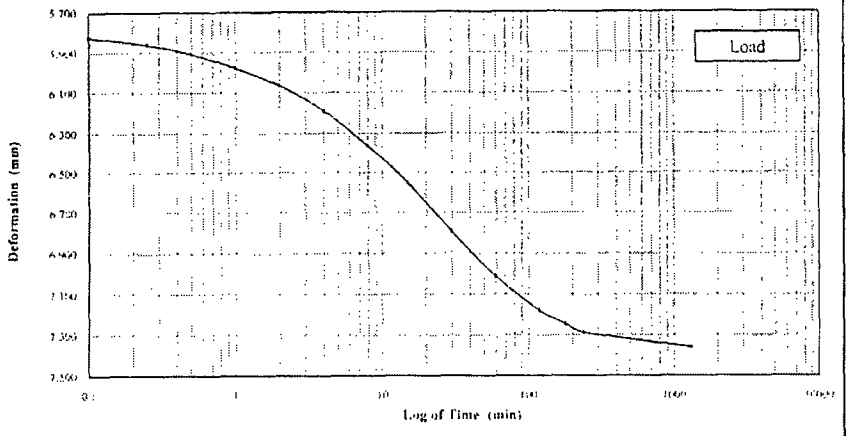
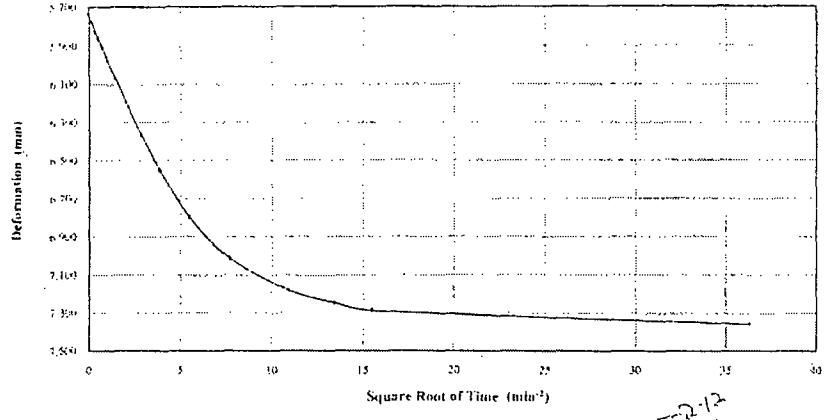
Project Name: Terry Creek OU1 RI/FS
Project No: 534
Client Sample ID: ST-GTB11
Lab Sample No: 12C063

ASTM D 2435

ONE-DIMENSIONAL CONSOLIDATION TEST

Figure 10 - 16000 psf





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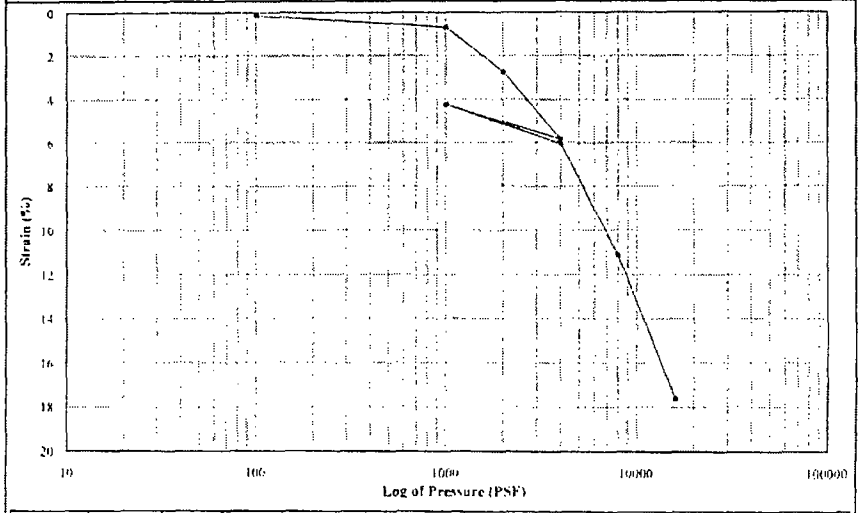
Project Name: Terry Creek OU1 RI/FS
Project No: 534
Client Sample ID: Mix-01*
Lab Sample No: 12D043

ASTM D 2435

ONE-DIMENSIONAL CONSOLIDATION TEST



Client Sample ID	Lab Sample No	Specimen Quality 1-10 (Best to Clean)	Test Specimen Initial Conditions: Height (cm)	Diameter (cm)	Dry Unit Weight (pcf)	Moisture Content (%)	Consolidation Pressure (psf)	Pressure Increment Duration (min)	Accumulated Vertical Strain (%)	Figure No	Remarks
Mix-01*	12D043	7	2.54	6.35	92.7	47.2	100	64	0.15	1	
							1000	320	0.65	2	
							2000	1133	2.73	3	
							4000	360	5.83	4	
							1000	1045	4.23	5	
							4000	350	6.04	6	
							8000	1095	11.12	7	
							16000	5741	13.64	8	

Note(s)
1. For each pressure increment, the vertical strain values were calculated based on the final deformation measurements.
* A mixture of Bucket-SD-S101 (0-5') Post Weir, Bucket-SD-S102 (5-10') Post Weir and Shelby-SDPostT4-5 (0-3.75')

5-11-12
SAS

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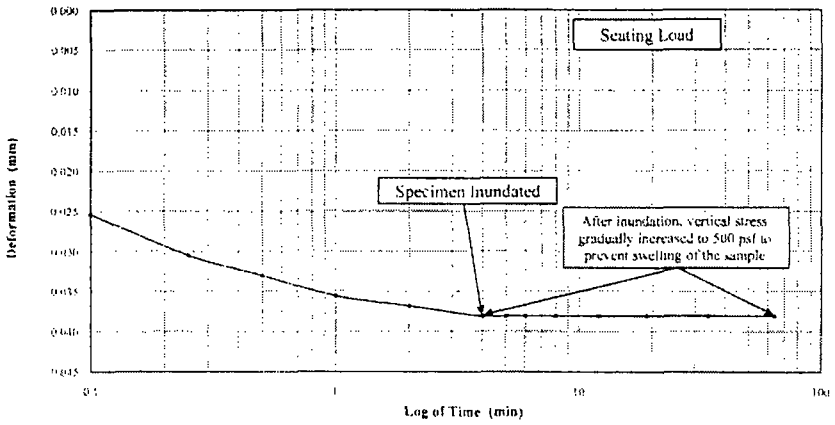
Tel: (770) 910 7537 Fax: (770) 910 7538

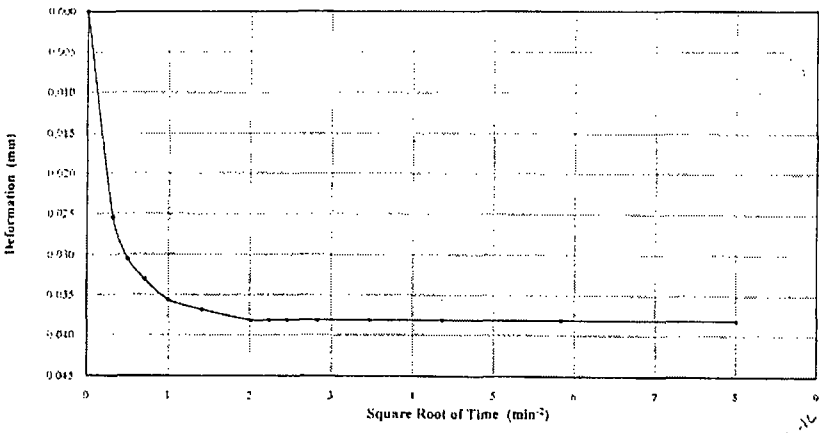
Project Name: Terry Creek OU1 RI/FS
Project No: 534
Client Sample ID: Mix-01*
Lab Sample No: 12D043

ASTM D 2435

ONE-DIMENSIONAL CONSOLIDATION TEST

Figure 1 - 100 psf





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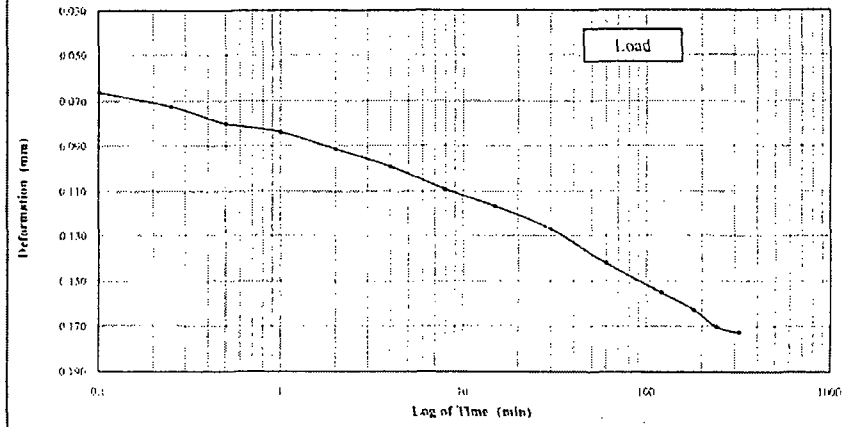
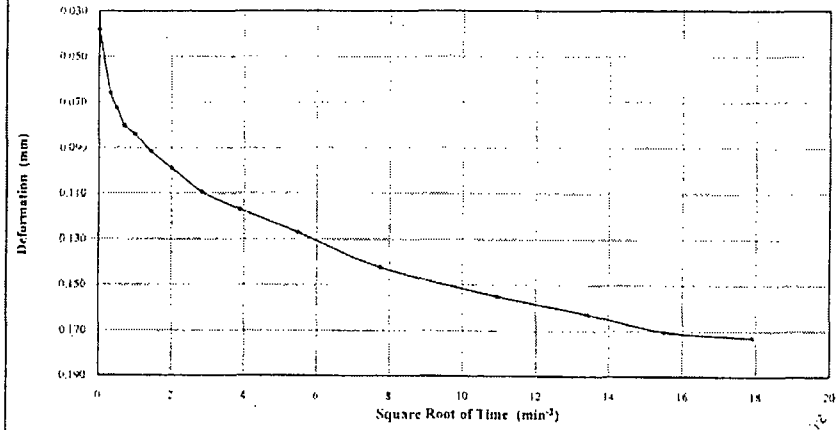
Project Name: Terry Creek OU1 RI/FS
Project No: 534
Client Sample ID: Mix-01*
Lab Sample No: 12D043

ASTM D 2435

ONE-DIMENSIONAL CONSOLIDATION TEST

Figure 2 - 1000 psf





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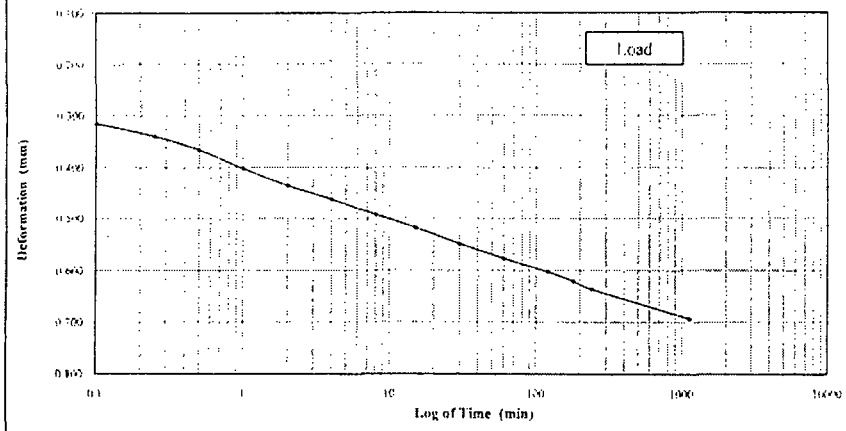
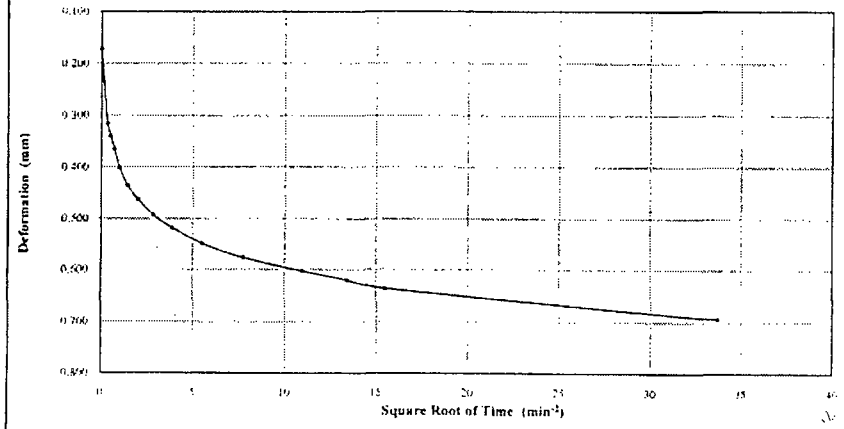
Project Name: Terry Creek OU1 RI/FS
Project No: 534
Client Sample ID: Mix-01*
Lab Sample No: 12D043

ASTM D 2435

ONE-DIMENSIONAL CONSOLIDATION TEST

Figure 3 - 2000 psf





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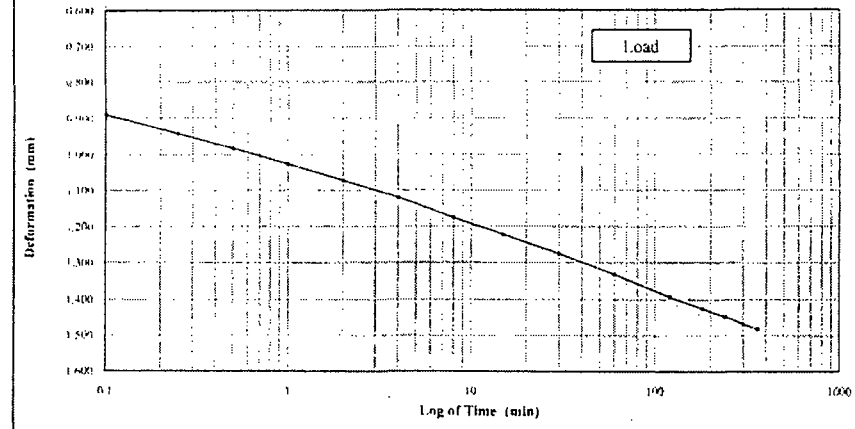
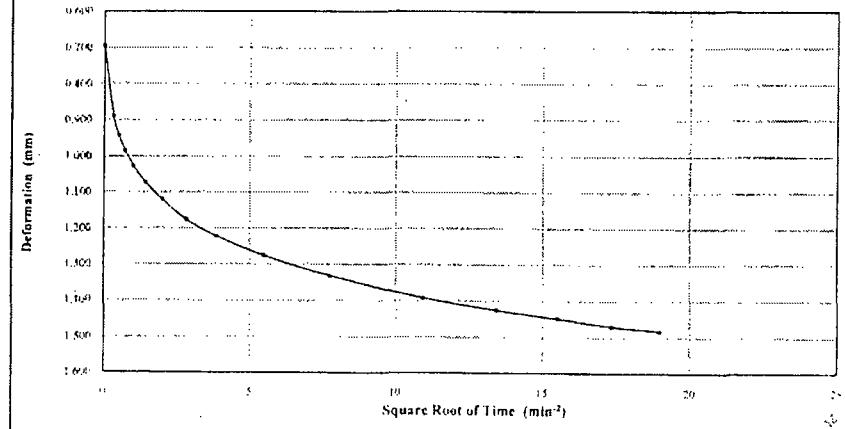
Project Name: Terry Creek OU1 RI/FS
Project No: 534
Client Sample ID: Mix-01*
Lab Sample No: 12D043

ASTM D 2435

ONE-DIMENSIONAL CONSOLIDATION TEST

Figure 4 - 4000 psf





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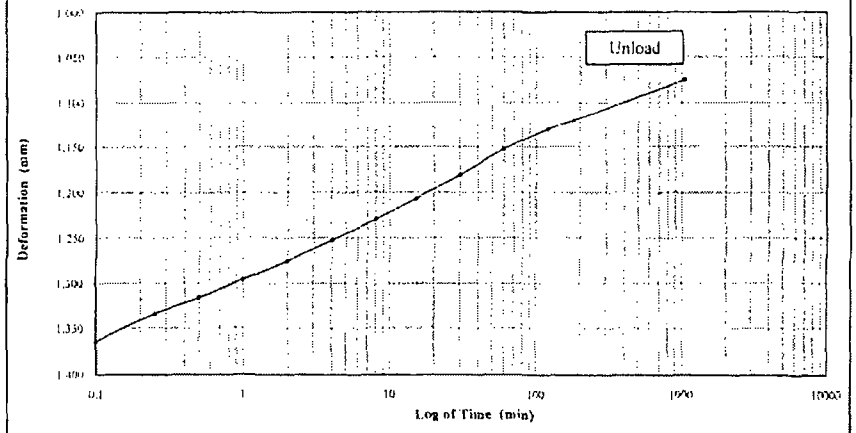
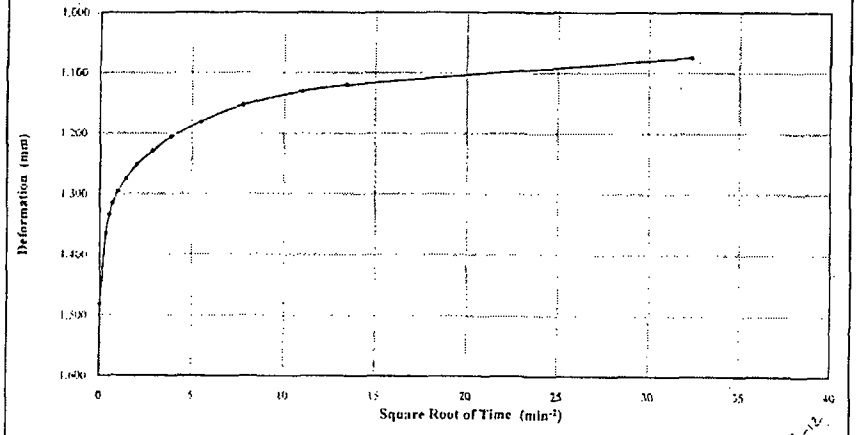
Project Name: Terry Creek OU1 RI/FS
Project No: 534
Client Sample ID: Mix-01*
Lab Sample No: 12D043

ASTM D 2435

ONE-DIMENSIONAL CONSOLIDATION TEST

Figure 5 - 1000 psf





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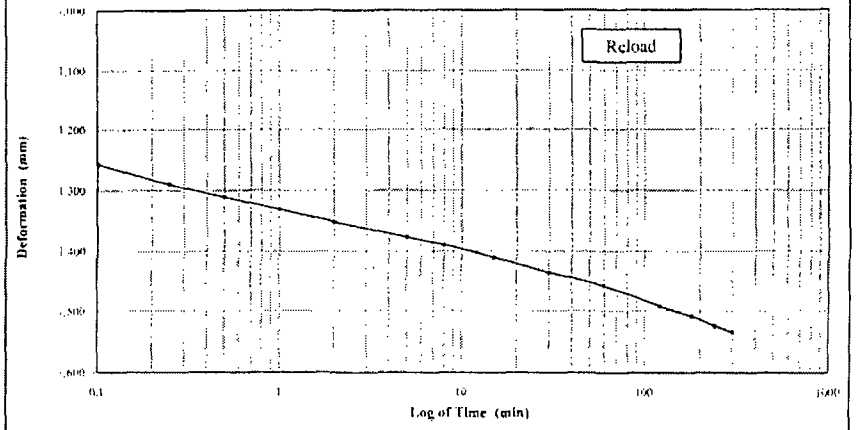
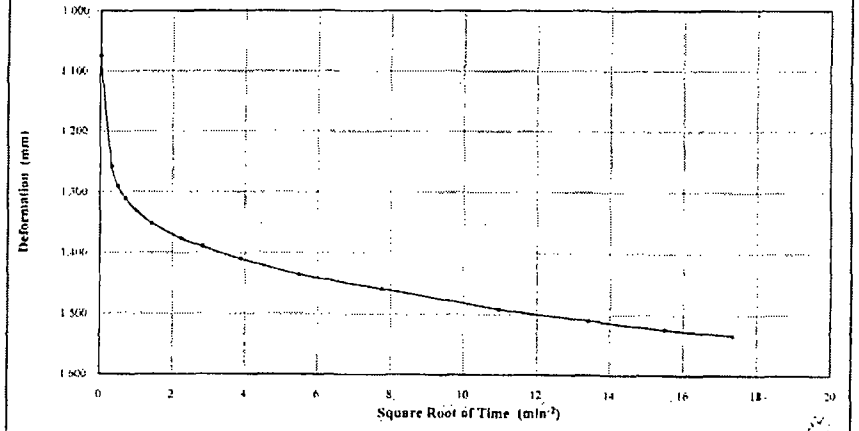
Project Name: Terry Creek OU1 RI/FS
Project No: 534
Client Sample ID: Mix-01*
Lab Sample No: 12D043

ASTM D 2435

ONE-DIMENSIONAL CONSOLIDATION TEST

Figure 6 - 4000 psf





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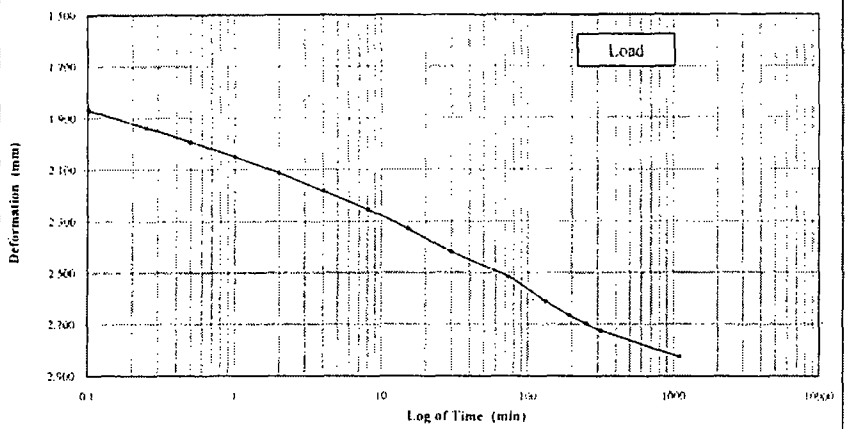
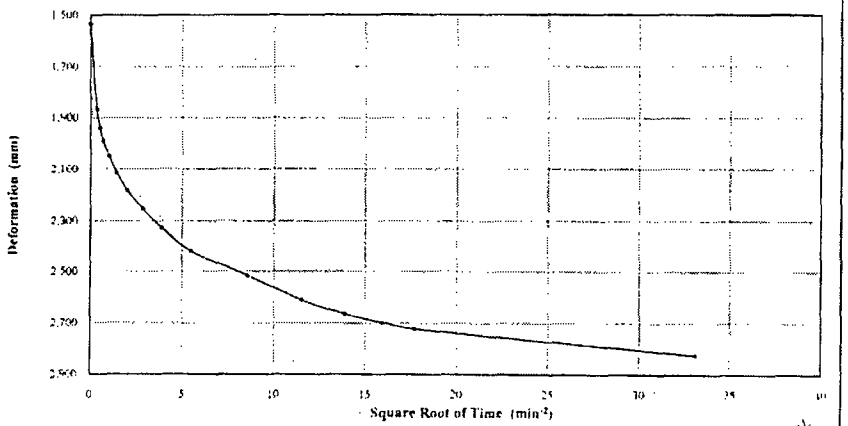
Project Name: Terry Creek OU1 RI/FS
Project No. 534
Client Sample ID: Mix-01*
Lab Sample No: 12D043

ASTM D 2435

ONE-DIMENSIONAL CONSOLIDATION TEST

Figure 7 - 8000 psf





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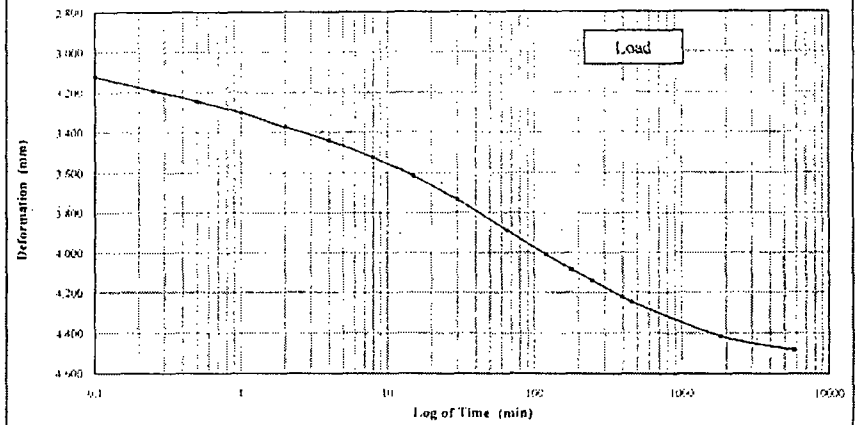
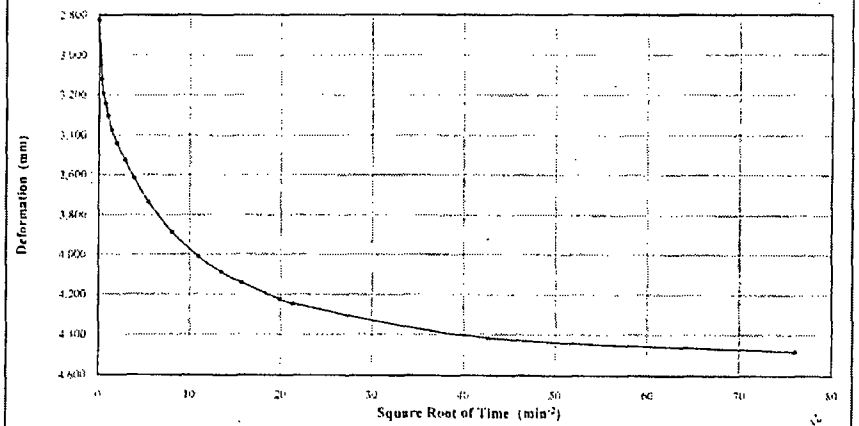
Project Name: Terry Creek OU1 RI/FS
Project No: 534
Client Sample ID: Mix-01*
Lab Sample No: 12D043

ASTM D 2435

ONE-DIMENSIONAL CONSOLIDATION TEST

Figure 8 - 16000 psf





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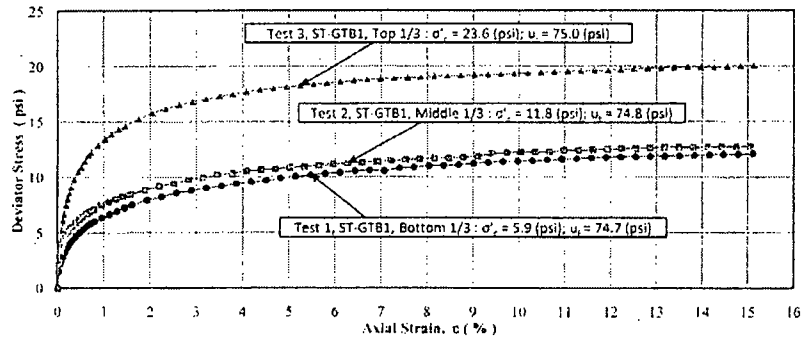
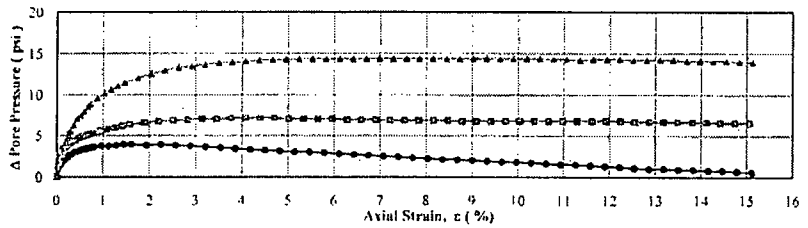
Project Name:	Terry Creek OU1 RI/FS
Project No:	534
Site Sample ID:	ST-GTB1
Lab Sample No:	12C061

ASTM D 4767

CONSOLIDATED-UNDRAINED (CU) TRIAXIAL TEST WITH PORE PRESSURE MEASUREMENTS

Figure 1





Test Specimen No	Maximum Strength				
	$\sigma'_1 - \sigma'_3$ (psi)	σ'_1 (psi)	σ'_3 (psi)	u (psi)	ε_a (%)
1	12.1	17.4	5.3	75.3	15.1
2	12.7	17.9	5.2	81.4	15.1
3	20.1	29.7	9.6	89.0	15.1

Test Specimen No	Strength at App. 15% Axial Strain				
	$\sigma'_1 - \sigma'_3$ (psi)	σ'_1 (psi)	σ'_3 (psi)	u (psi)	ε_a (%)
1	12.1	17.4	5.3	75.3	15.1
2	12.7	17.9	5.2	81.4	15.1
3	20.1	29.7	9.6	89.0	15.1

Notes:
σ'_c = Consolidation pressure, (psi)
σ'_1 = Effective axial stress (psi)
u = Pore pressure (psi)
u_i = Initial pore pressure, (psi)
σ'_3 = Effective radial stress (confining pressure), (psi)
ε_a = Axial strain, (%)
$\sigma'_1 - \sigma'_3$ = Deviator stress, (psi)

5-2-12
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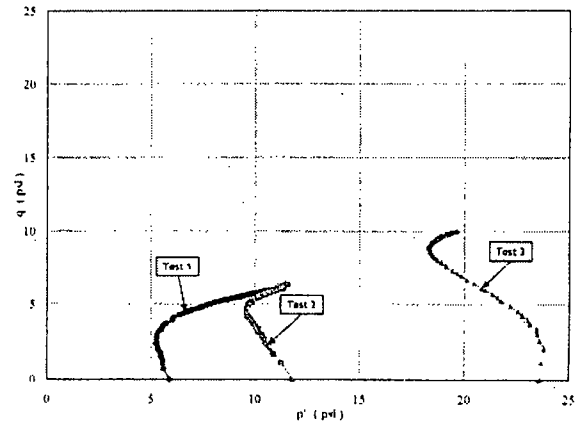
Project Name:	Terry Creek OU1 RI/FS
Project No:	534
Site Sample ID:	ST-GTB1
Lab Sample No:	12C061

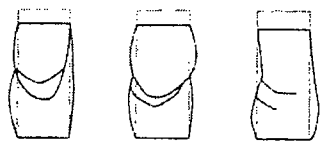
ASTM D 4767

CONSOLIDATED-UNDRAINED (CU) TRIAXIAL TEST WITH PORE PRESSURE MEASUREMENTS

Figure 2



Test Specimen No	Initial Conditions							Strain Rate	Specimen Quality
	Height (in.)	Diameter (in.)	Moisture Content (%)	Dry Unit Weight (pcf)	B Parameter (-)	u_i (psi)	σ'_c (psi)	(%/min)	Bad to Good (1 to 10)
1	6.22	2.94	38.5	83.4	0.99	74.7	5.9	0.012	8
2	6.78	2.82	25.0	103.0	0.96	74.8	11.8	0.031	8
3	6.85	2.81	42.9	77.9	0.98	75.0	23.6	0.020	5



Specimen No 1 Specimen No 2 Specimen No 3

Notes:
u_i = Initial pore pressure (psi)
σ'_c = Consolidation pressure, (psi)

5-2-12
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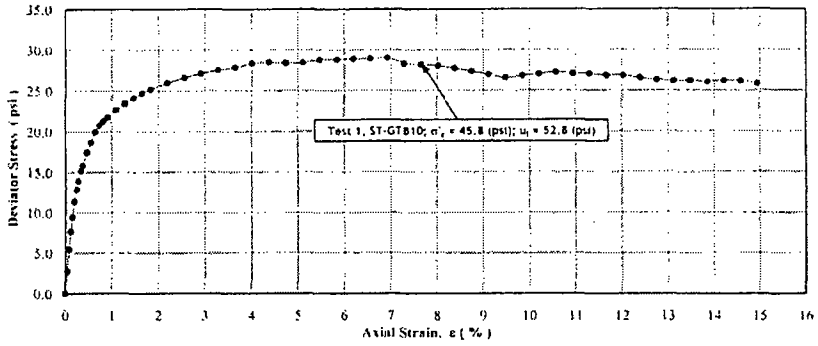
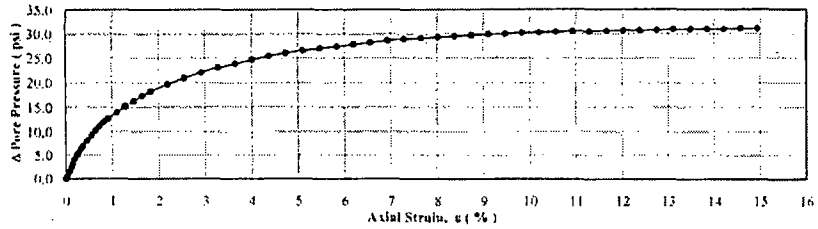
Project Name:	Terry Creek OU1 RI/FS
Project No:	534
Site Sample ID:	ST-GTB10
Lab Sample No:	12C062

ASTM D 4767

CONSOLIDATED-UNDRAINED (CU) TRIAXIAL TEST WITH PORE PRESSURE MEASUREMENTS

Figure 1





Test Specimen No	Maximum Strength				
	$\sigma'_1 - \sigma'_3$ (psi)	σ'_1 (psi)	σ'_3 (psi)	u (psi)	ε_a (%)
1	29.0	46.2	17.2	81.4	6.9
2					
3					

Test Specimen No	Strength at App. 15% Axial Strain				
	$\sigma'_1 - \sigma'_3$ (psi)	σ'_1 (psi)	σ'_3 (psi)	u (psi)	ε_a (%)
1	25.8	40.5	14.7	83.9	14.9
2					
3					

Notes:

σ'_c = Consolidation pressure, (psi)
σ'_1 = Effective axial stress, (psi)
u = Pore pressure,(psi)
u_i = Initial pore pressure,(psi)
σ'_3 = Effective radial stress (confining pressure), (psi)
ε_a = Axial strain, (%)
$\sigma'_1 - \sigma'_3$ = Deviator stress, (psi)

Sample consisted of hard and soft layers with moisture contents ranging from low 40's to high 80's (%).
Sample experienced an axial strain of 12.5% during the consolidation stage of the test

5-17-12
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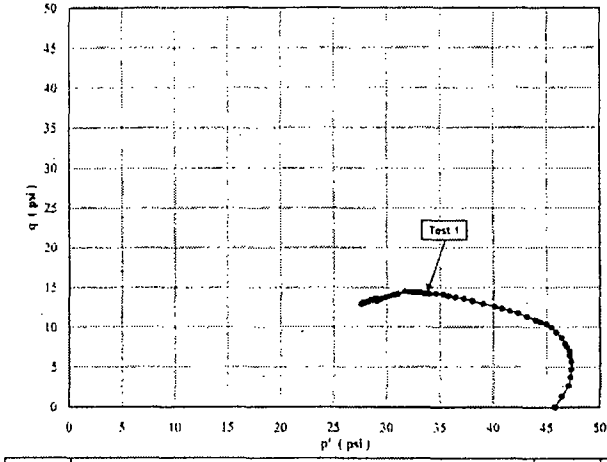
Project Name:	Terry Creek OU1 RI/FS
Project No:	534
Site Sample ID:	ST-GTB10
Lab Sample No:	12C062

ASTM D 4767

CONSOLIDATED-UNDRAINED (CU) TRIAXIAL TEST WITH PORE PRESSURE MEASUREMENTS

Figure 2



Test Specimen No	Initial Conditions							Strain Rate	Specimen Quality
	Height (in.)	Diameter (in.)	Moisture Content (%)	Dry Unit Weight (pcf)	B Parameter (-)	u_i (psi)	σ'_c (psi)	(% / min)	Bad to Good (1 to 10)
1	6.24	2.83	63.9	64.1	0.98	52.8	45.8	0.032	3
2									
3									

Notes:

u_i = Initial pore pressure,(psi)
σ'_c = Consolidation pressure, (psi)

Sample consisted of hard and soft layers with moisture contents ranging from low 40's to high 80's (%)
Sample experienced an axial strain of 12.5% during the consolidation stage of the test

5-17-12
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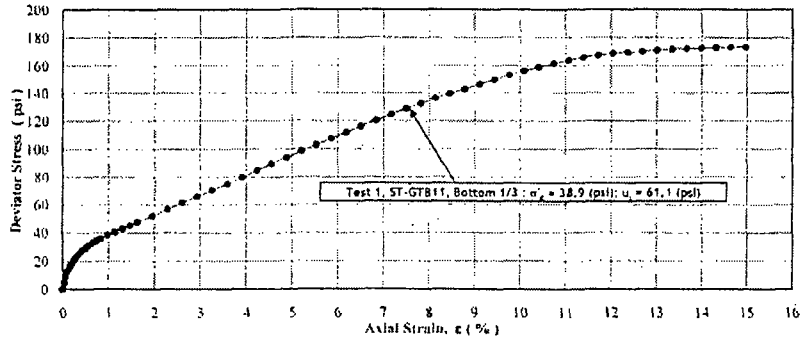
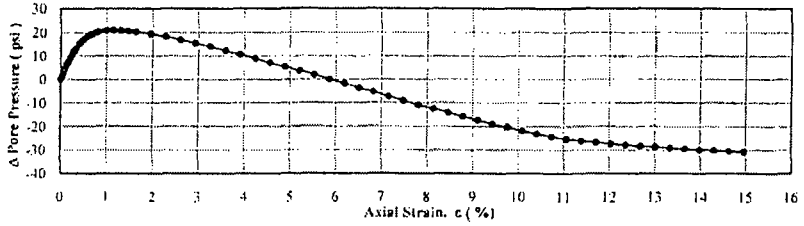
Project Name:	Terry Creek OU1 RI/FS
Project No:	534
Site Sample ID:	ST-GTB11
Lab Sample No:	12C063

ASTM D 4767

CONSOLIDATED-UNDRAINED (CU) TRIAXIAL TEST WITH PORE PRESSURE MEASUREMENTS

Figure 1





Test Specimen No	Maximum Strength				
	$\sigma'_1 - \sigma'_3$ (psi)	σ'_1 (psi)	σ'_3 (psi)	u (psi)	ε_a (%)
1	173.3	242.9	69.6	38.4	15.0
2					
3					

Test Specimen No	Strength at App. 15% Axial Strain				
	$\sigma'_1 - \sigma'_3$ (psi)	σ'_1 (psi)	σ'_3 (psi)	u (psi)	ε_a (%)
1	173.3	242.9	69.6	38.4	15.0
2					
3					

Notes

σ'_c = Consolidation pressure, (psi)
σ'_1 = Effective axial stress, (psi)
u = Pore pressure (psi)
u_c = Initial pore pressure (psi)
σ'_3 = Effective radial stress (confining pressure), (psi)
ε_a = Axial strain, (%)
$\sigma'_1 - \sigma'_3$ = Deviator stress, (psi)

Ext 2
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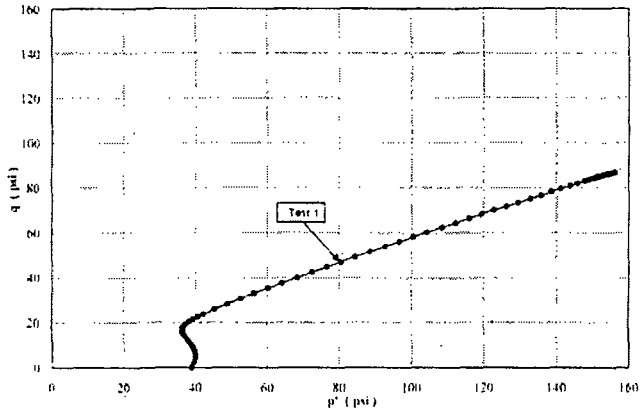
Project Name:	Terry Creek OU1 RI/FS
Project No:	534
Site Sample ID:	ST-GTB11
Lab Sample No:	12C063

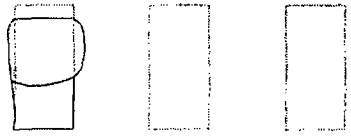
ASTM D 4767

CONSOLIDATED-UNDRAINED (CU) TRIAXIAL TEST WITH PORE PRESSURE MEASUREMENTS

Figure 2



Test Specimen No.	Initial Conditions							Strain Rate	Specimen Quality
	Height (in.)	Diameter (in.)	Moisture Content (%)	Dry Unit Weight (pcf)	B Parameter (-)	u_c (psi)	σ'_c (psi)	(% / min)	Bad to Good (1 to 10)
1	6.15	2.90	24.2	100.6	0.98	61.1	38.9	0.064	5
2									
3									



Specimen No 1 Specimen No. 2 Specimen No. 3

Notes

u = Initial pore pressure (psi)
σ'_c = Consolidation pressure (psi)

5-7-12
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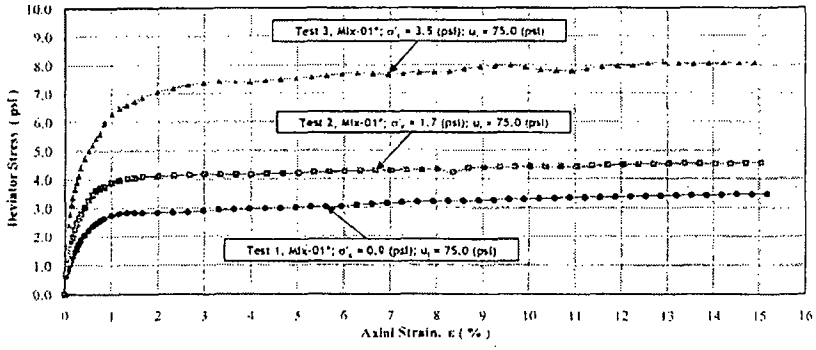
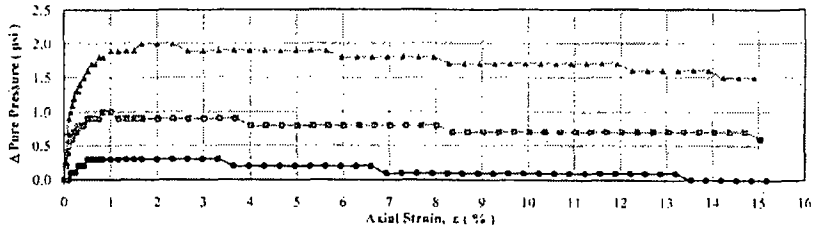
Project Name:	Terry Creek OU1 RI/FS
Project No:	534
Site Sample ID:	Mix-01*
Lab Sample No:	12D043

ASTM D 4767

CONSOLIDATED-UNDRAINED (CU) TRIAXIAL TEST WITH PORE PRESSURE MEASUREMENTS

Figure 1





Test Specimen No	Maximum Strength				
	$\sigma'_1 - \sigma'_3$ (psi)	σ'_1 (psi)	σ'_3 (psi)	u (psi)	ε_a (%)
1	3.5	4.2	0.7	75.2	15.2
2	4.6	5.7	1.1	75.6	15.0
3	8.1	10.0	1.9	76.6	12.9

Test Specimen No.	Strength at App. 15% Axial Strain				
	$\sigma'_1 - \sigma'_3$ (psi)	σ'_1 (psi)	σ'_3 (psi)	u (psi)	ε_a (%)
1	3.5	4.2	0.7	75.2	15.2
2	4.6	5.7	1.1	75.6	15.0
3	8.1	10.1	2.0	76.5	14.9

Notes

σ'_c = Consolidation pressure, (psi)
σ'_1 = Effective axial stress, (psi)
u = Pore pressure,(psi)
u = Initial pore pressure,(psi)
σ'_3 = Effective radial stress (confining pressure), (psi)
ε_a = Axial strain, (%)
$\sigma'_1 - \sigma'_3$ = Deviator stress, (psi)

* A mixture of Bucket-SD-S101 (0-5') Post Weir, Bucket-SD-S102 (5-10') Post Weir and Shelby-SDPostT4-5 (0-3.75')

5-17-12 NJK

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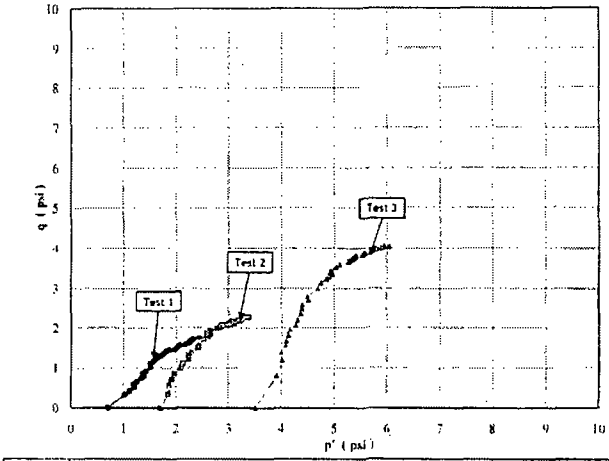
"Excellence in Testing"
953 Forrest Street, Roswell, Georgia 30075
Tel: (770) 910 7537 1666 Fax: (770) 910 7538

Project Name:	Terry Creek OU1 RI/FS
Project No:	534
Site Sample ID:	Mix-01*
Lab Sample No:	12D043

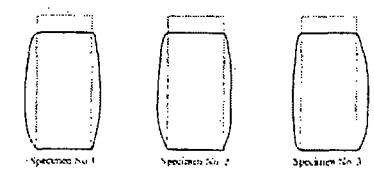
ASTM D 4767

CONSOLIDATED-UNDRAINED (CU) TRIAXIAL TEST WITH PORE PRESSURE MEASUREMENTS

Figure 2



Test Specimen No	Initial Conditions							Strain Rate	Specimen Quality Bad to Good
	Height (in.)	Diameter (in.)	Moisture Content (%)	Dry Unit Weight (pcf)	B Parameter (-)	u (psi)	σ'_c (psi)	(% / min)	(1 to 10)
1	6.06	2.84	47.2	62.7	0.98	75.2	0.7	0.066	8
2	5.98	2.84	47.4	63.7	0.96	75.0	1.7	0.063	8
3	6.04	2.84	47.4	64.2	1.09	75.0	3.5	0.066	8



Notes

u = Initial pore pressure, (psi)
σ'_c = Consolidation pressure, (psi)

* A mixture of Bucket-SD-S101 (0-5') Post Weir, Bucket-SD-S102 (5-10') Post Weir and Shelby-SDPostT4-5 (0-3.75')

5-17-12 NJK

Excel Geotechnical Testing, Inc.
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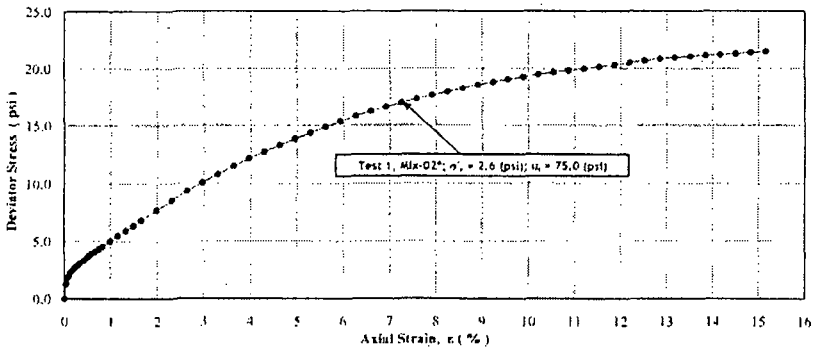
953 Forrest Street, Roswell, Georgia 30075
Tel: (770) 910 7537 Fax: (770) 910 7538

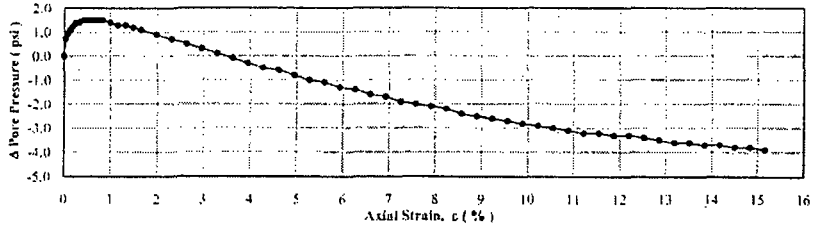
Project Name:	Terry Creek OU1 RI/FS
Project No:	534
Site Sample ID:	Mix-02*
Lab Sample No:	12D044

ASTM D 4767

CONSOLIDATED-UNDRAINED (CU) TRIAXIAL TEST WITH PORE PRESSURE MEASUREMENTS

Figure 1





Test Specimen No	Maximum Strength				
	$\sigma'_1 - \sigma'_3$ (psi)	σ'_1 (psi)	σ'_3 (psi)	u (psi)	ε_1 (%)
1	3.5	5.9	2.4	75.2	15.2
2					
3					

Test Specimen No	Strength at App. 15% Axial Strain				
	$\sigma_1 - \sigma'_3$ (psi)	σ'_1 (psi)	σ'_3 (psi)	u (psi)	ε_1 (%)
1	3.5	5.9	2.4	75.2	15.2
2					
3					

Notes:
σ'_c = Consolidation pressure, (psi)
σ'_1 = Effective axial stress, (psi)
u = Pore pressure,(psi)
u_i = Initial pore pressure,(psi)
σ'_3 = Effective radial stress (confining pressure), (psi)
ε_1 = Axial strain, (%)
$\sigma_1 - \sigma'_3$ = Deviator stress, (psi)

* A mixture of Bucket-SD-5201 (0-5') Pre Weir and Shelby-SD Pre Weir (0-2.5')

5-17-12 JR

Excel Geotechnical Testing, Inc.
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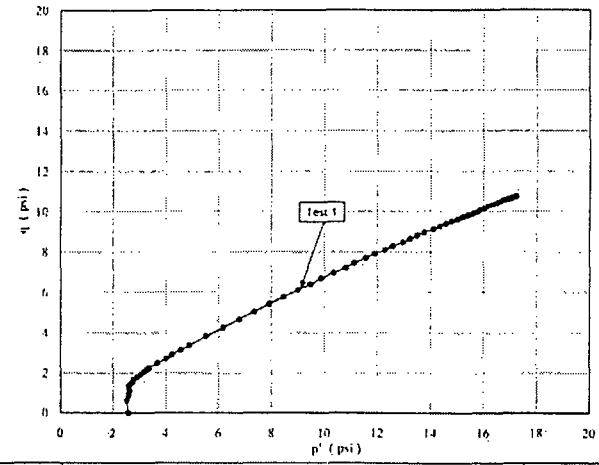
953 Forrest Street, Roswell, Georgia 30075
Tel: (770) 910 7537 1666 Fax: (770) 910 7538

Project Name:	Terry Creek OU1 RI/FS
Project No:	534
Site Sample ID:	Mix-02*
Lab Sample No:	12D044

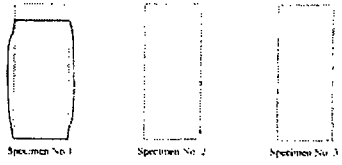
ASTM D 4767

CONSOLIDATED-UNDRAINED (CU) TRIAXIAL TEST WITH PORE PRESSURE MEASUREMENTS

Figure 2



Test Specimen No	Initial Conditions							Strain Rate	Specimen Quality
	Height (in.)	Diameter (in.)	Moisture Content (%)	Dry Unit Weight (pcf)	B Parameter (--)	u_i (psi)	σ'_c (psi)	(%/min)	Bad to Good (1 to 10)
1	6.07	2.83	25.4	92.2	0.98	75.0	2.6	0.066	7
2									
3									



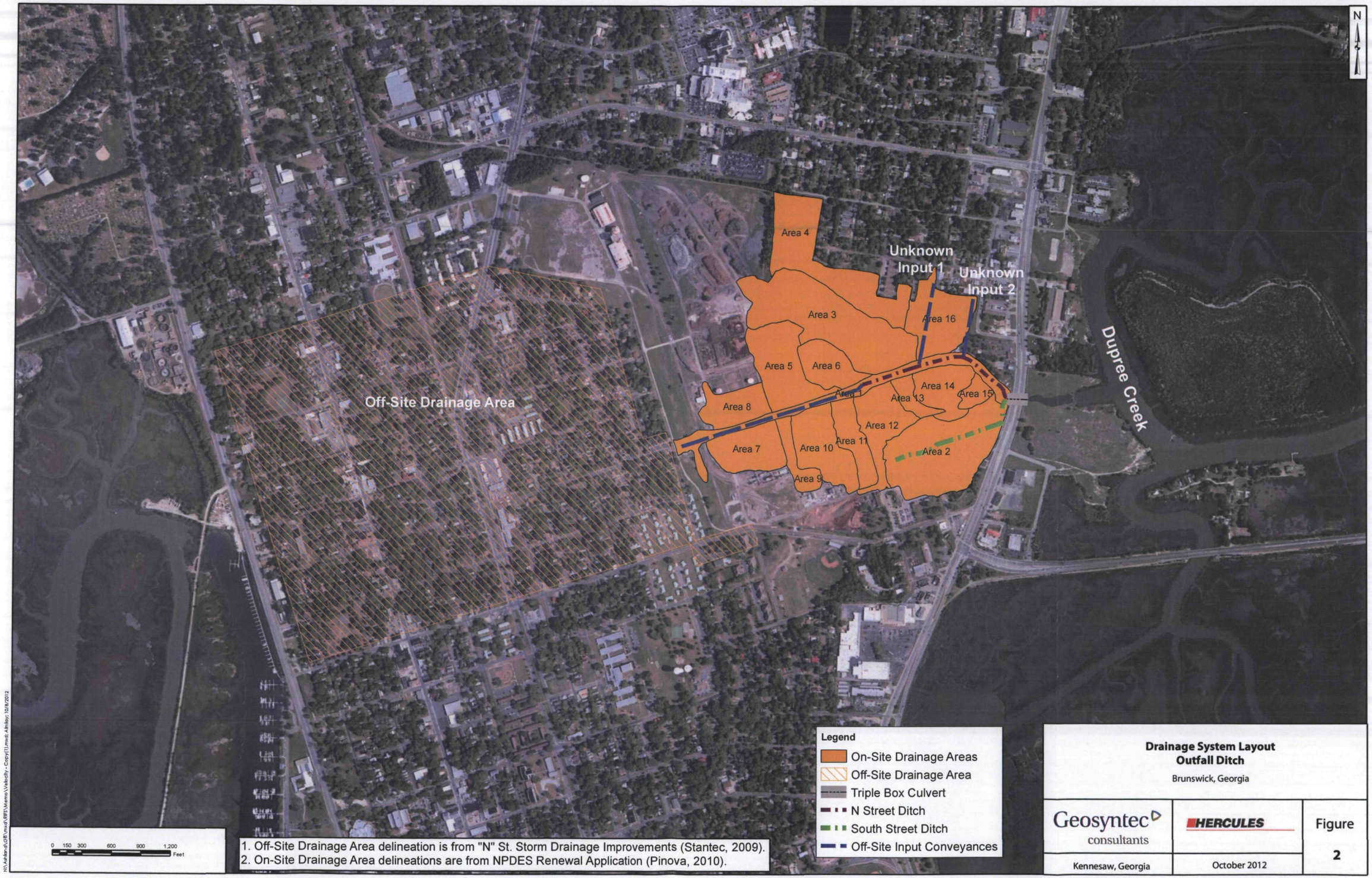
Notes:
u_i = Initial pore pressure,(psi)
σ'_c = Consolidation pressure, (psi)

* A mixture of Bucket-SD-5201 (0-5') Pre Weir and Shelby-SD Pre Weir (0-2.5')

5-17-12 JR

APPENDIX D

Figures



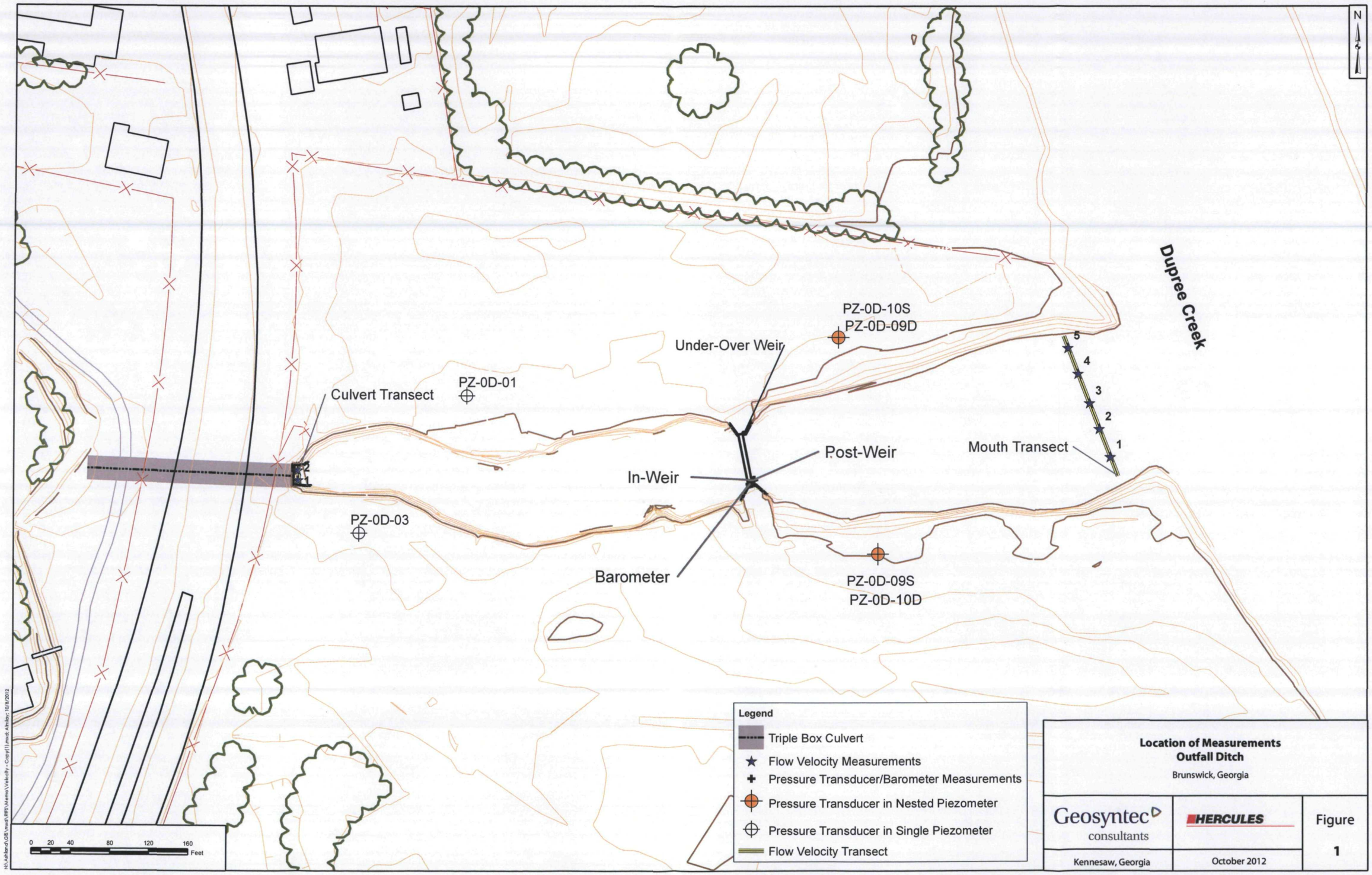
1. Off-Site Drainage Area delineation is from "N" St. Storm Drainage Improvements (Stantec, 2009).
2. On-Site Drainage Area delineations are from NPDES Renewal Application (Pinova, 2010).

Drainage System Layout
Outfall Ditch
Brunswick, Georgia

Geosyntec consultants | HERCULES | Figure 2

Kennesaw, Georgia | October 2012

H:\Ashland\GIS\mxd\RIFS Memo\Velocity - Copy(1).mxd; A Hess; 10/8/2012



Location of Measurements
Outfall Ditch
Brunswick, Georgia

Geosyntec consultants | HERCULES | Figure 1

Kennesaw, Georgia | October 2012

Location of Climate Stations
Outfall Ditch

Brunswick, Georgia

Geosyntec consultants	HERCULES	Figure
Kennesaw, Georgia	October 2012	3

APPENDIX D

Attachment 1

Sheet Title: Flow Rate Calculations for Mouth and Culvert Transects
Purpose: Display calculation of average velocity using depth and velocity measurements.
Prepared By: Ashton Imlay
Date: 9/17/2012
Reviewed By: Jesus Sanchez
Date: 9/18/2012
Cell Color Codes: Data columns
Calculation columns

Notes: 1. Each Measurement is from Matrix: SW, Type: Surface Water, Location A: Outfall Ditch.
2. Columns "2-Point Method" through "3-Point Method" were calculated using methods from "Stream-gaging procedure," USGS Water Supply Paper 888, 1943.
3. Measurements locations are visualized in N:\Ashland\OU1 RIFS Implementation\surface water investigation\Proposed Hydrologic Investigation.pdf.
4. Average of 0.2- and 0.8-Depth Velocity Measurements.
5. Average of 2-Point Method and 0.6-Depth Method.
6. Average of 0.2-, 0.6-, and 0.8-Depth Velocity Measurements.
7. Velocity measurements were collected by Caroline Nelson.

Sampling Location	Tidal Stage	Date	Time	Transect Location	Depth of Measurement (ft)	Flow velocity (ft/sec)	Average Velocity			
							2-Point Method[4] (ft/sec)	0.6-Depth Method (ft/sec)	3-Point Method[5] (ft/sec)	3-Point Method[6] (ft/sec)
Mouth	Ebb Tide	4/4/2012	10:00	4	1.12	0.50	0.42	0.25	0.34	0.36
					2.10	0.25				
					2.82	0.34				
Culvert	Ebb Tide	4/4/2012	12:04	1	0.26	0.65	0.49	0.43	0.46	0.47
					0.79	0.43				
					1.05	0.32				
			11:48	2	0.23	0.78	0.72	0.54	0.63	0.66
					0.69	0.54				
					0.92	0.65				
Mouth	Flood Tide	4/4/2012	17:22	3	1.31	0.09	0.07	0.00	0.03	0.04
					3.94	0.00				
					5.25	0.04				
			16:45	4	0.66	0.05	0.26	0.45	0.35	0.32
					1.97	0.45				
					2.62	0.47				
			16:03	5	0.39	0.17	0.19	0.15	0.17	0.17
					1.18	0.15				
					1.57	0.20				
Culvert	Flood Tide	4/4/2012	18:12	1	1.05	0.00	0.00	0.00	0.00	0.00
					3.15	0.00				
					4.20	0.00				
			18:23	2	1.25	0.00	0.00	0.00	0.00	0.00
					3.35	0.00				
					4.46	0.00				
Mouth	Slack High	4/4/2012	7:15	1	0.39	0.00	0.00	0.00	0.00	0.00
					1.18	0.00				
					1.57	0.00				
			7:40	2	0.39	0.00	0.00	0.00	0.00	0.00
					0.98	0.00				
					1.57	0.00				
			8:10	3	1.87	0.28	0.14	0.00	0.07	0.09
					5.61	0.00				
					7.48	0.00				
			8:41	4	0.49	0.27	0.14	0.28	0.21	0.18
					2.95	0.28				
					3.94	0.00				
			9:15	5	0.75	0.11	0.12	0.12	0.12	0.12
					2.26	0.12				
					3.02	0.12				
Mouth	Slack Low	4/4/2012	13:40	4	0.36	0.00	0.00	0.00	0.00	0.00
					1.08	0.00				
					1.44	0.00				
Culvert	Slack High	4/5/2012	8:17	1	1.12	0.00	0.00	0.00	0.00	0.00
					3.35	0.00				
					4.46	0.00				
			8:00	2	1.15	0.00	0.00	0.00	0.00	0.00
					3.44	0.00				
					4.59	0.00				
Culvert	Slack Low	4/4/2012	14:20	1	0.21	0.57	0.54	0.62	0.58	0.57
					0.63	0.62				
					0.84	0.51				
			14:10	2	0.25	0.67	0.70	0.67	0.68	0.69
					0.75	0.67				
					1.00	0.72				

APPENDIX D

Attachment 2

Sheet Title: Raw Data from Pressure Transducer
Purpose: Display the data measured by the pressure transducer.
Prepared By: Ashton Imlay
Date: 9/7/2012
Reviewed By: Jesus Sanchez
Date: 9/13/2012
Cell Color Codes: Data columns
Calculation columns
Notes: "Pre-Weir" transducer malfunctioned in field. Column was not included due to lack of data.
No data was collected between 3/11/12 01:55 and 3/11/12 03:00 due to the Daylight Saving Time adjustment.

Date & Time	BaroTROLL (psi)	PZ-OD-01 (psi)	PZ-OD-03 (psi)	PZ-OD-09S (psi)	PZ-OD-09D (psi)	PZ-OD-10S (psi)	PZ-OD-10D (psi)	In-Weir (psi)	Post-Weir (psi)
02/29/2012 19:00	14.8	14.8	14.8	14.8	14.8	14.8	14.8	16.5	14.8
02/29/2012 19:05	14.8	14.7	14.8	14.8	14.8	14.8	14.8	16.5	14.8
02/29/2012 19:10	14.8	14.7	14.8	14.7	14.8	14.8	14.8	16.5	14.8
02/29/2012 19:15	14.8	14.7	14.8	14.8	14.8	14.8	14.8	16.5	14.8
02/29/2012 19:20	14.8	14.7	14.8	14.8	14.8	14.8	14.8	16.5	14.8
02/29/2012 19:25	14.8	14.7	14.8	14.8	14.8	14.8	14.8	16.5	14.8
02/29/2012 19:30	14.8	14.7	14.8	14.8	14.8	14.8	14.8	16.5	14.8
02/29/2012 19:35	14.8	14.7	14.8	14.8	14.8	14.8	14.8	16.5	14.8
02/29/2012 19:40	14.8	14.7	14.7	14.8	14.8	14.8	14.8	16.5	14.8
02/29/2012 19:45	14.8	14.7	14.8	14.8	14.8	14.8	14.8	16.5	14.8
02/29/2012 19:50	14.8	14.7	14.8	14.8	14.8	14.8	14.8	16.5	14.8
02/29/2012 19:55	14.8	14.7	14.8	14.8	14.8	14.8	14.8	16.5	14.8
02/29/2012 20:00	14.8	14.7	14.7	14.7	14.8	14.8	14.8	16.5	14.8
02/29/2012 20:05	14.8	14.7	14.8	14.8	14.8	14.8	14.8	16.5	14.8
02/29/2012 20:10	14.8	14.7	14.8	14.8	14.8	14.8	14.8	16.5	14.8
02/29/2012 20:15	14.8	14.7	14.8	14.8	14.8	14.8	14.8	16.5	14.8
02/29/2012 20:20	14.8	14.7	14.8	14.8	14.8	14.8	14.8	16.5	14.8
02/29/2012 20:25	14.8	14.7	14.8	14.8	14.8	14.8	14.8	16.5	14.8
02/29/2012 20:30	14.8	14.7	14.8	14.8	14.8	14.8	14.8	16.5	14.8
02/29/2012 20:35	14.8	14.7	14.7	14.8	14.8	14.8	14.8	16.5	14.8
02/29/2012 20:40	14.8	14.7	14.7	14.8	14.8	14.8	14.8	16.5	14.8
02/29/2012 20:45	14.8	14.7	14.8	14.8	14.8	14.8	14.8	16.5	14.8
02/29/2012 20:50	14.8	14.7	14.8	14.8	14.8	14.8	14.8	16.5	14.8
02/29/2012 20:55	14.8	14.7	14.8	14.8	14.8	14.8	14.8	16.5	14.8
02/29/2012 21:00	14.8	14.7	14.8	14.8	14.8	14.8	14.8	16.5	14.8
02/29/2012 21:05	14.8	14.7	14.8	14.8	14.8	14.8	14.8	16.5	14.8
02/29/2012 21:10	14.8	14.7	14.8	14.8	14.8	14.8	14.8	16.5	14.8
02/29/2012 21:15	14.8	14.7	14.8	14.8	14.8	14.8	14.8	16.5	14.8
02/29/2012 21:20	14.8	14.7	14.8	14.8	14.8	14.8	14.8	16.5	14.8
02/29/2012 21:25	14.8	14.7	14.8	14.8	14.8	14.8	14.8	16.5	14.8
02/29/2012 21:30	14.8	14.7	14.8	14.8	14.8	14.8	14.8	16.5	14.8
02/29/2012 21:35	14.8	14.7	14.8	14.8	14.8	14.8	14.8	16.5	14.8
02/29/2012 21:40	14.8	14.7	14.8	14.8	14.8	14.8	14.8	16.5	14.8
02/29/2012 21:45	14.8	14.7	14.8	14.8	14.8	14.8	14.8	16.5	14.8
02/29/2012 21:50	14.8	14.7	14.8	14.8	14.8	14.8	14.8	16.5	14.8
02/29/2012 21:55	14.8	14.7	14.8	14.8	14.8	14.8	14.8	16.5	14.8
02/29/2012 22:00	14.8	14.7	14.8	14.8	14.8	14.8	14.8	16.5	14.8
02/29/2012 22:05	14.8	14.7	14.8	14.8	14.8	14.8	14.8	16.5	14.8
02/29/2012 22:10	14.8	14.7	14.8	14.8	14.8	14.8	14.8	16.5	14.8

Sheet Title: Relative pressure difference between each transducer and the BaroTROLL measurements
Purpose: Display the first step to calculating water surface elevation (WSE) and compute the relative pressure for each transducer.
Prepared By: Ashton Imlay
Date: 9/7/2012
Reviewed By: Jesus Sanchez
Date: 9/13/2012
Cell Color Codes: Data columns
Calculation columns
Notes: "Pre-Weir" transducer malfunctioned in field. Column was not included due to lack of data.

Date & Time	PZ-OD-01 (psi)	PZ-OD-03 (psi)	PZ-OD-09S (psi)	PZ-OD-09D (psi)	PZ-OD-10S (psi)	PZ-OD-10D (psi)	In-Weir (psi)	Post-Weir (psi)
02/29/2012 19:00	-0.1	0.0	0.0	0.0	0.0	0.0	1.7	0.0
02/29/2012 19:05	-0.1	0.0	0.0	0.0	0.0	0.0	1.7	0.0
02/29/2012 19:10	-0.1	0.0	0.0	0.0	0.0	0.0	1.7	0.0
02/29/2012 19:15	-0.1	0.0	0.0	0.0	0.0	0.0	1.7	0.0
02/29/2012 19:20	-0.1	-0.1	0.0	0.0	0.0	0.0	1.7	0.0
02/29/2012 19:25	-0.1	-0.1	-0.1	0.0	0.0	0.0	1.7	0.0
02/29/2012 19:30	-0.1	0.0	-0.1	0.0	0.0	0.0	1.7	0.0
02/29/2012 19:35	-0.1	0.0	0.0	0.0	0.0	0.0	1.7	0.0
02/29/2012 19:40	-0.1	-0.1	0.0	0.0	0.0	0.0	1.7	0.0
02/29/2012 19:45	-0.1	0.0	0.0	0.0	0.0	0.0	1.7	0.0
02/29/2012 19:50	-0.1	0.0	0.0	0.0	0.0	0.0	1.7	0.0
02/29/2012 19:55	-0.1	0.0	0.0	0.0	0.0	0.0	1.7	0.0
02/29/2012 20:00	-0.1	0.0	0.0	0.0	0.0	0.0	1.7	0.0
02/29/2012 20:05	-0.1	0.0	0.0	0.0	0.0	0.0	1.7	0.0
02/29/2012 20:10	-0.1	0.0	0.0	0.0	0.0	0.0	1.7	0.0
02/29/2012 20:15	-0.1	0.0	0.0	0.0	0.0	0.0	1.7	0.0
02/29/2012 20:20	-0.1	0.0	0.0	0.0	0.0	0.0	1.7	0.0
02/29/2012 20:25	-0.1	0.0	0.0	0.0	0.0	0.0	1.7	0.0
02/29/2012 20:30	-0.1	0.0	0.0	0.0	0.0	0.0	1.7	0.0
02/29/2012 20:35	-0.1	0.0	0.0	0.0	0.0	0.0	1.7	0.0
02/29/2012 20:40	-0.1	0.0	0.0	0.0	0.0	0.0	1.7	0.0
02/29/2012 20:45	-0.1	0.0	0.0	0.0	0.0	0.0	1.7	0.0
02/29/2012 20:50	-0.1	0.0	0.0	0.0	0.0	0.0	1.7	0.0
02/29/2012 20:55	-0.1	0.0	0.0	0.0	0.0	0.0	1.7	0.0
02/29/2012 21:00	-0.1	0.0	0.0	0.0	0.0	0.0	1.7	0.0
02/29/2012 21:05	-0.1	0.0	0.0	0.0	0.0	0.0	1.7	0.0
02/29/2012 21:10	-0.1	0.0	0.0	0.0	0.0	0.0	1.7	0.0
02/29/2012 21:15	-0.1	0.0	0.0	0.0	0.0	0.0	1.7	0.0
02/29/2012 21:20	-0.1	0.0	0.0	0.0	0.0	0.0	1.7	0.0
02/29/2012 21:25	-0.1	0.0	0.0	0.0	0.0	0.0	1.7	0.0
02/29/2012 21:30	-0.1	0.0	0.0	0.0	0.0	0.0	1.7	0.0
02/29/2012 21:35	-0.1	-0.1	-0.1	0.0	0.0	0.0	1.7	0.0
02/29/2012 21:40	-0.1	0.0	0.0	0.0	0.0	0.0	1.7	0.0
02/29/2012 21:45	-0.1	0.0	0.0	0.0	0.0	0.0	1.7	0.0

Sheet Title: Conversion from pressure units to water height units
Purpose: Display conversion from pressure units to water height units.
Prepared By: Ashton Imlay
Date: 9/7/2012
Reviewed By: Jesus Sanchez
Date: 9/13/2012
Cell Color Codes: Data columns
Calculation columns
Notes: "Pre-Weir" transducer malfunctioned in field. Column was not included due to lack of data.
Calculation: Pressure difference from "Pressure Differences" sheet, divided by the specific weight of water (62.4 lb/cu.ft.). Then convert all inches to feet.

Date & Time	PZ-OD-01 (ft)	PZ-OD-03 (ft)	PZ-OD-09S (ft)	PZ-OD-09D (ft)	PZ-OD-10S (ft)	PZ-OD-10D (ft)	In-Weir (ft)	Post-Weir (ft)
02/29/2012 19:00	-0.1	-0.1	-0.1	0.0	-0.1	0.1	3.8	0.0
02/29/2012 19:05	-0.1	-0.1	-0.1	0.0	-0.1	0.1	3.8	-0.1
02/29/2012 19:10	-0.1	-0.1	-0.1	0.0	-0.1	0.0	3.9	-0.1
02/29/2012 19:15	-0.1	-0.1	-0.1	0.0	-0.1	0.1	3.8	0.0
02/29/2012 19:20	-0.1	-0.1	-0.1	0.0	-0.1	0.1	3.9	0.0
02/29/2012 19:25	-0.1	-0.1	-0.1	0.0	-0.1	0.1	3.8	-0.1
02/29/2012 19:30	-0.1	-0.1	-0.1	0.0	-0.1	0.1	3.8	-0.1
02/29/2012 19:35	-0.1	-0.1	-0.1	0.0	-0.1	0.1	3.8	0.0
02/29/2012 19:40	-0.1	-0.1	-0.1	0.0	-0.1	0.1	3.8	0.0
02/29/2012 19:45	-0.1	-0.1	-0.1	0.0	-0.1	0.1	3.8	0.0
02/29/2012 19:50	-0.1	-0.1	-0.1	0.0	-0.1	0.1	3.9	0.0
02/29/2012 19:55	-0.1	-0.1	-0.1	0.0	-0.1	0.1	3.8	-0.1
02/29/2012 20:00	-0.1	-0.1	-0.1	0.0	-0.1	0.1	3.9	0.0
02/29/2012 20:05	-0.1	-0.1	-0.1	0.0	-0.1	0.1	3.8	0.0
02/29/2012 20:10	-0.1	-0.1	-0.1	0.0	-0.1	0.1	3.9	0.0
02/29/2012 20:15	-0.1	-0.1	-0.1	0.0	-0.1	0.1	3.9	0.0
02/29/2012 20:20	-0.1	-0.1	-0.1	0.0	-0.1	0.1	3.8	-0.1
02/29/2012 20:25	-0.1	-0.1	-0.1	0.0	-0.1	0.1	3.9	-0.1
02/29/2012 20:30	-0.1	-0.1	-0.1	0.0	-0.1	0.1	3.9	-0.1
02/29/2012 20:35	-0.1	-0.1	-0.1	0.0	-0.1	0.1	3.9	0.0
02/29/2012 20:40	-0.1	-0.1	-0.1	0.0	-0.1	0.1	3.9	-0.1
02/29/2012 20:45	-0.1	-0.1	-0.1	0.0	-0.1	0.1	3.9	0.0
02/29/2012 20:50	-0.1	-0.1	-0.1	0.0	-0.1	0.1	3.9	0.0
02/29/2012 20:55	-0.1	-0.1	-0.1	0.0	-0.1	0.1	3.9	-0.1
02/29/2012 21:00	-0.1	-0.1	-0.1	0.0	-0.1	0.1	3.8	-0.1
02/29/2012 21:05	-0.1	-0.1	-0.1	0.0	-0.1	0.1	3.9	0.0
02/29/2012 21:10	-0.1	-0.1	-0.1	0.0	-0.1	0.1	3.9	0.0
02/29/2012 21:15	-0.1	-0.1	-0.1	0.0	-0.1	0.1	3.9	0.0
02/29/2012 21:20	-0.1	-0.1	-0.1	0.0	-0.1	0.1	3.9	0.0
02/29/2012 21:25	-0.1	-0.1	-0.1	0.0	-0.1	0.1	3.9	0.0
02/29/2012 21:30	-0.1	-0.1	-0.1	0.0	-0.1	0.1	3.9	0.0
02/29/2012 21:35	-0.1	-0.1	-0.1	0.0	-0.1	0.1	3.9	0.0
02/29/2012 21:40	-0.1	-0.1	-0.1	0.0	-0.1	0.1	3.9	-0.1
02/29/2012 21:45	-0.1	-0.1	-0.1	0.0	-0.1	0.0	3.9	0.0

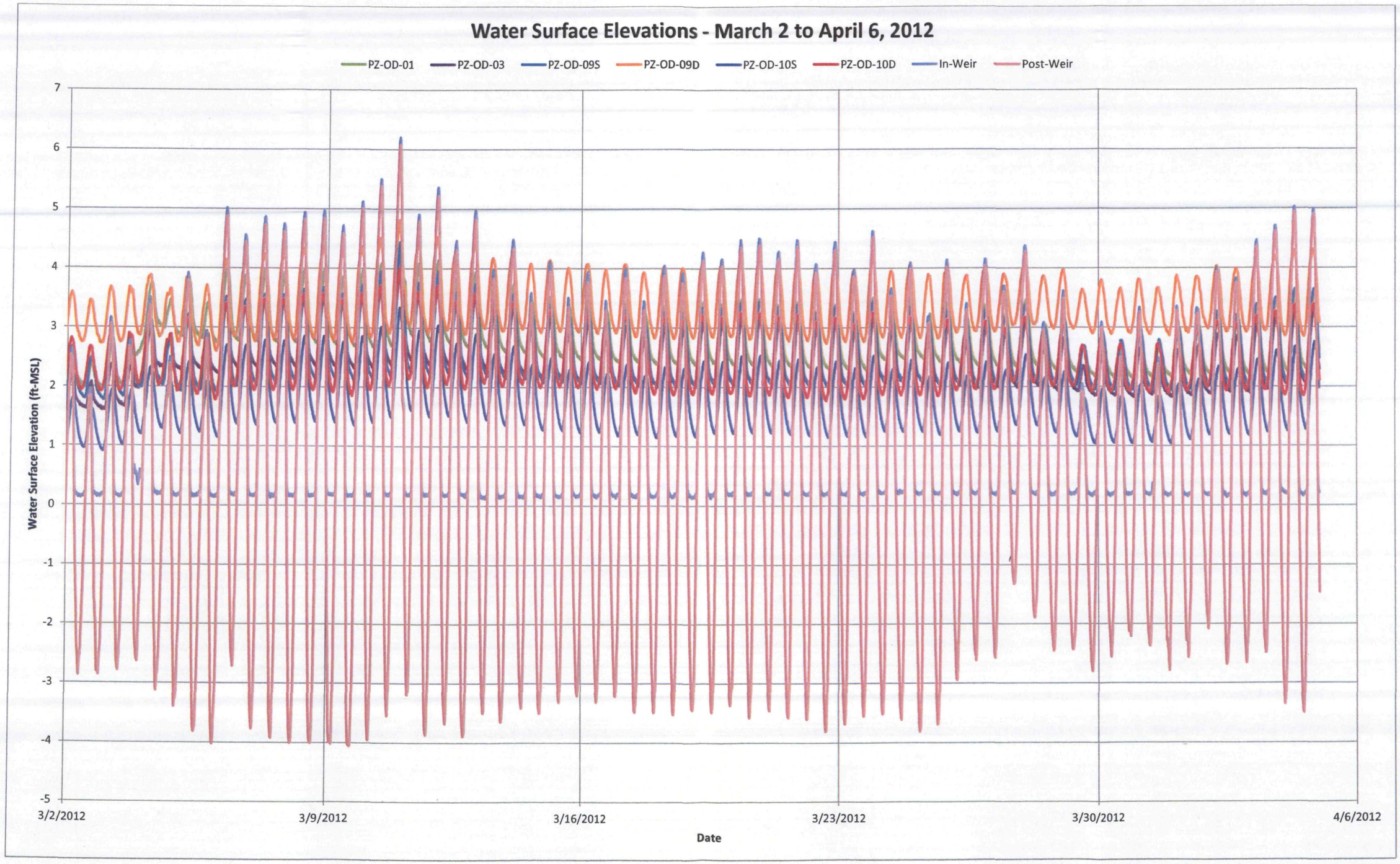
Sheet Title: Calibration of In-Weir Device Elevation
Purpose: To calibrate the In-Weir water surface elevation using high tide data.
Prepared By: Ashton Imlay
Date: 9/7/2012
Reviewed By: Jesus Sanchez
Date: 9/13/2012
Cell Color Codes: Data columns
Calculation columns
Notes: Difference =Abs(In-Weir - Post-Weir)
Maximum Difference: from measurements between 3/2-4/4
Maximum Difference is measured to calibrate the In-Weir and Post-Weir elevations to be equal at high tide.

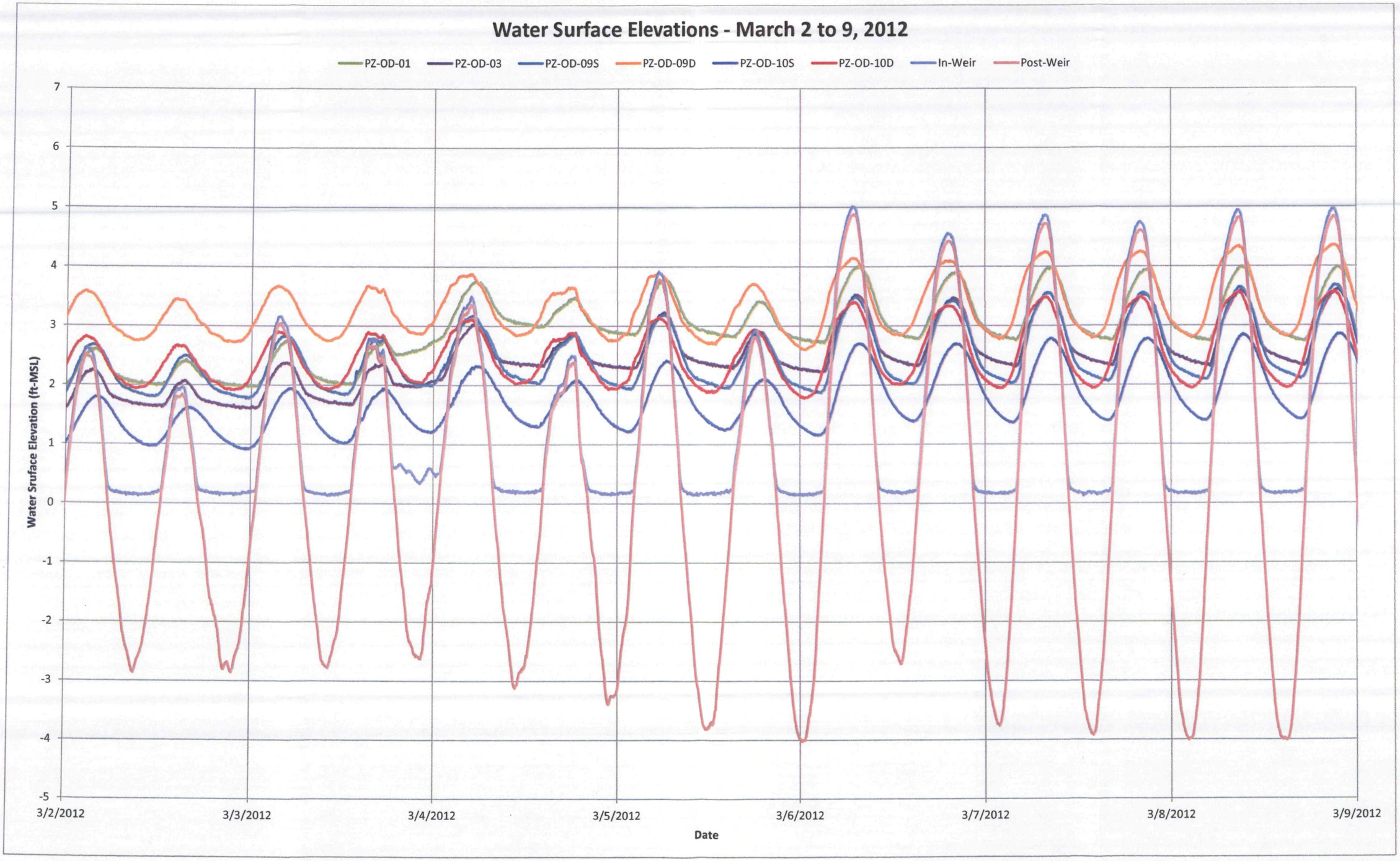
Maximum Difference
5.0

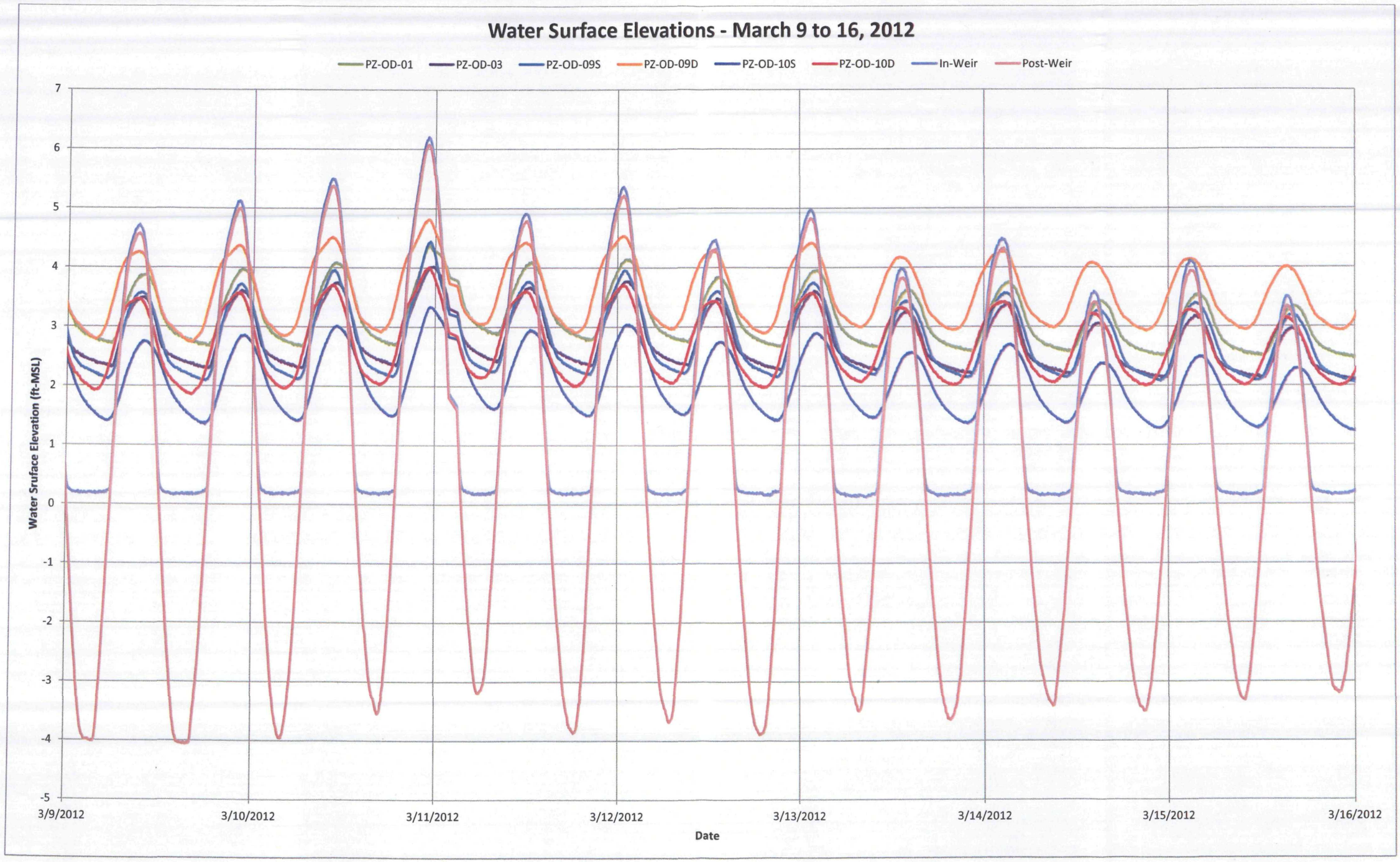
Date & Time	In-Weir	Post-Weir	Difference
02/29/2012 19:00	3.8	0.0	3.9
02/29/2012 19:05	3.8	-0.1	3.9
02/29/2012 19:10	3.9	-0.1	3.9
02/29/2012 19:15	3.8	0.0	3.9
02/29/2012 19:20	3.9	0.0	3.9
02/29/2012 19:25	3.8	-0.1	3.9
02/29/2012 19:30	3.8	-0.1	3.9
02/29/2012 19:35	3.8	0.0	3.9
02/29/2012 19:40	3.8	0.0	3.9
02/29/2012 19:45	3.8	0.0	3.9
02/29/2012 19:50	3.9	0.0	3.9
02/29/2012 19:55	3.8	-0.1	3.9
02/29/2012 20:00	3.9	0.0	3.9
02/29/2012 20:05	3.8	0.0	3.9
02/29/2012 20:10	3.9	0.0	3.9
02/29/2012 20:15	3.9	0.0	3.9
02/29/2012 20:20	3.8	-0.1	3.9
02/29/2012 20:25	3.9	-0.1	3.9
02/29/2012 20:30	3.9	-0.1	3.9
02/29/2012 20:35	3.9	0.0	3.9
02/29/2012 20:40	3.9	-0.1	3.9
02/29/2012 20:45	3.9	0.0	3.9
02/29/2012 20:50	3.9	0.0	3.9
02/29/2012 20:55	3.9	-0.1	3.9
02/29/2012 21:00	3.8	-0.1	3.9
02/29/2012 21:05	3.9	0.0	3.9
02/29/2012 21:10	3.9	0.0	3.9
02/29/2012 21:15	3.9	0.0	3.9
02/29/2012 21:20	3.9	0.0	3.9
02/29/2012 21:25	3.9	0.0	3.9
02/29/2012 21:30	3.9	0.0	3.9

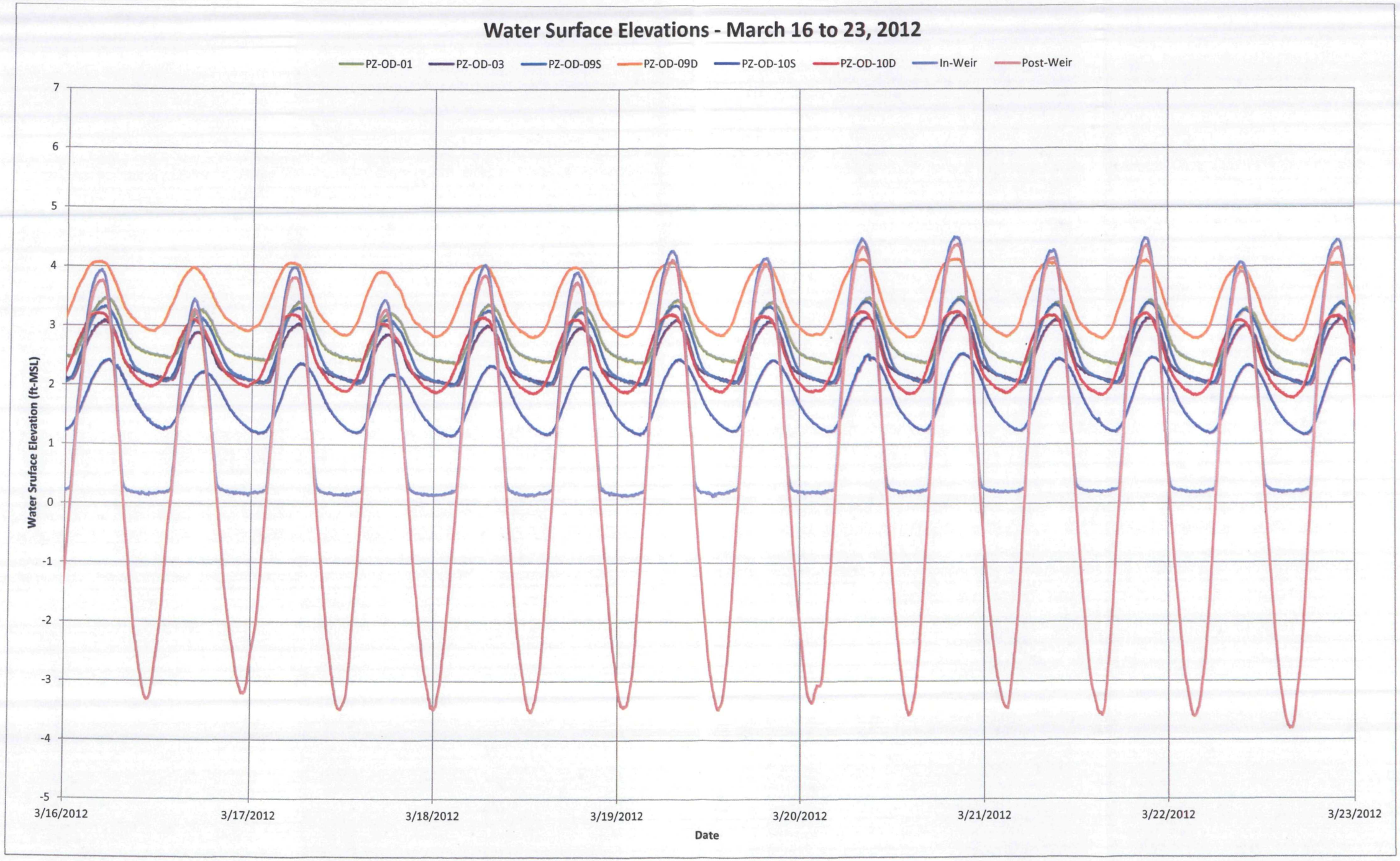
Sheet Title: Conversion from water height units to water surface elevation
Purpose: To display conversion from water height units to water surface elevation.
Prepared By: Ashton Imlay
Date: 9/7/2012
Reviewed By: Jesus Sanchez
Date: 9/13/2012
Cell Color Codes: Data columns
Calculation columns
Notes: "Pre-Weir" transducer malfunctioned in field. Column was not included due to lack of data.
"Post-Weir" length of wire calibrated so that the measured elevation on 4/4/12 @ 11:05am matched surveyor field measurement.
"In-Weir" Measuring Device Elevation is the "Post-Weir" elevation added to the minimum difference calculated on the "In-Weir Device Elev Calibration" worksheet
"Length Wire" data is referencing "Field Notes" worksheet

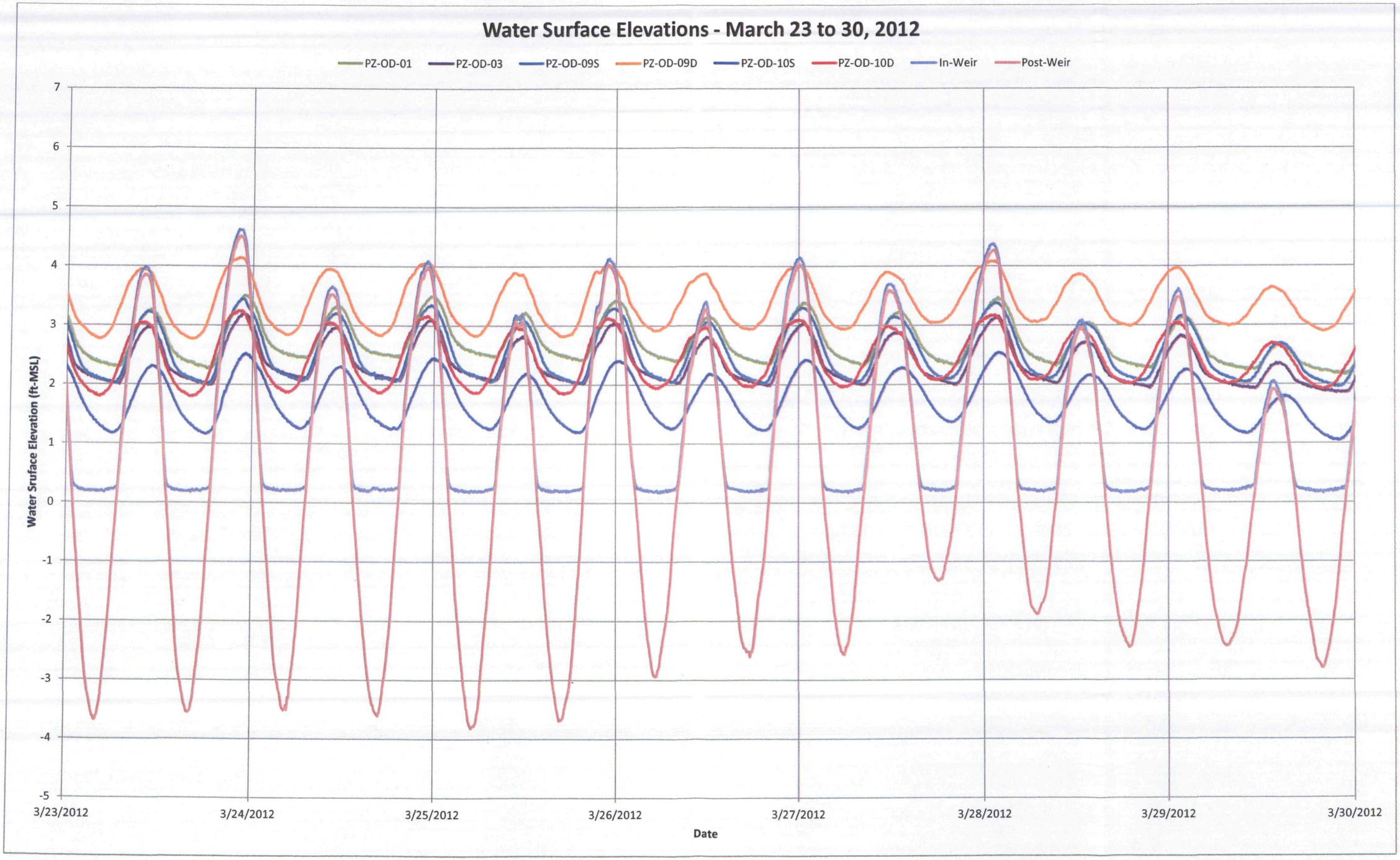
Reference	8.07	9.43	7.55	7.34	7.62	8.31		
Length Wire	16.2	16.2	16.0	36.3	16.2	33.4		
Measuring Device Elevation (ft-MSL)	-8.1	-6.8	-8.5	-29.0	-8.6	-25.1	-3.7	-8.7
Date & Time	PZ-OD-01	PZ-OD-03	PZ-OD-09S	PZ-OD-09D	PZ-OD-10S	PZ-OD-10D	In-Weir	Post-Weir
2/29/2012 19:00	-8.3	-6.9	-8.6	-28.9	-8.7	-25.0	0.1	-8.8
2/29/2012 19:05	-8.3	-6.9	-8.5	-28.9	-8.7	-25.0	0.1	-8.8
2/29/2012 19:10	-8.3	-6.9	-8.6	-29.0	-8.7	-25.0	0.1	-8.8
2/29/2012 19:15	-8.3	-6.9	-8.6	-28.9	-8.7	-25.0	0.1	-8.8
2/29/2012 19:20	-8.3	-6.9	-8.6	-28.9	-8.7	-25.0	0.1	-8.8
2/29/2012 19:25	-8.3	-6.9	-8.6	-29.0	-8.7	-25.0	0.1	-8.8
2/29/2012 19:30	-8.3	-6.9	-8.6	-28.9	-8.7	-25.0	0.1	-8.8
2/29/2012 19:35	-8.3	-6.9	-8.6	-28.9	-8.7	-25.0	0.1	-8.8
2/29/2012 19:40	-8.3	-6.9	-8.6	-28.9	-8.7	-25.0	0.1	-8.8
2/29/2012 19:45	-8.3	-6.9	-8.6	-28.9	-8.7	-25.0	0.1	-8.8
2/29/2012 19:50	-8.3	-6.9	-8.6	-28.9	-8.7	-25.0	0.1	-8.8
2/29/2012 19:55	-8.3	-6.9	-8.6	-28.9	-8.7	-25.0	0.1	-8.8
2/29/2012 20:00	-8.3	-6.9	-8.6	-28.9	-8.7	-25.0	0.1	-8.8
2/29/2012 20:05	-8.3	-6.9	-8.6	-28.9	-8.7	-25.0	0.1	-8.8
2/29/2012 20:10	-8.3	-6.8	-8.5	-28.9	-8.7	-25.0	0.1	-8.8
2/29/2012 20:15	-8.3	-6.9	-8.6	-29.0	-8.7	-25.0	0.1	-8.8
2/29/2012 20:20	-8.3	-6.9	-8.6	-28.9	-8.7	-25.0	0.1	-8.8
2/29/2012 20:25	-8.2	-6.9	-8.6	-28.9	-8.7	-25.0	0.1	-8.8
2/29/2012 20:30	-8.3	-6.9	-8.6	-28.9	-8.7	-25.0	0.1	-8.8
2/29/2012 20:35	**-8.3**	**-6.9**	**-8.6**	**-28.9**	**-8.7**	**-25.0**	**0.2**	**-8.8**
2/29/2012 20:40	-8.3	-6.9	-8.6	-28.9	-8.7	-25.0	0.2	-8.8
2/29/2012 20:45	-8.3	-6.9	-8.6	-28.9	-8.7	-25.0	0.2	-8.8
2/29/2012 20:50	-8.3	-6.9	-8.6	-28.9	-8.7	-25.0	0.2	-8.8
2/29/2012 20:55	-8.3	-6.9	-8.6	-28.9	-8.7	-25.0	0.1	-8.8
2/29/2012 21:00	-8.3	-6.9	-8.6	-28.9	-8.7	-25.0	0.1	-8.8
2/29/2012 21:05	-8.3	-6.9	-8.6	-28.9	-8.7	-25.0	0.2	-8.8
2/29/2012 21:10	-8.3	-6.9	-8.5	-28.9	-8.7	-25.0	0.2	-8.8
2/29/2012 21:15	-8.3	-6.9	-8.6	-28.9	-8.7	-25.0	0.2	-8.8
2/29/2012 21:20	-8.3	-6.9	-8.5	-28.9	-8.7	-25.0	0.2	-8.8
2/29/2012 21:25	-8.3	-6.9	-8.6	-28.9	-8.7	-25.0	0.1	-8.8

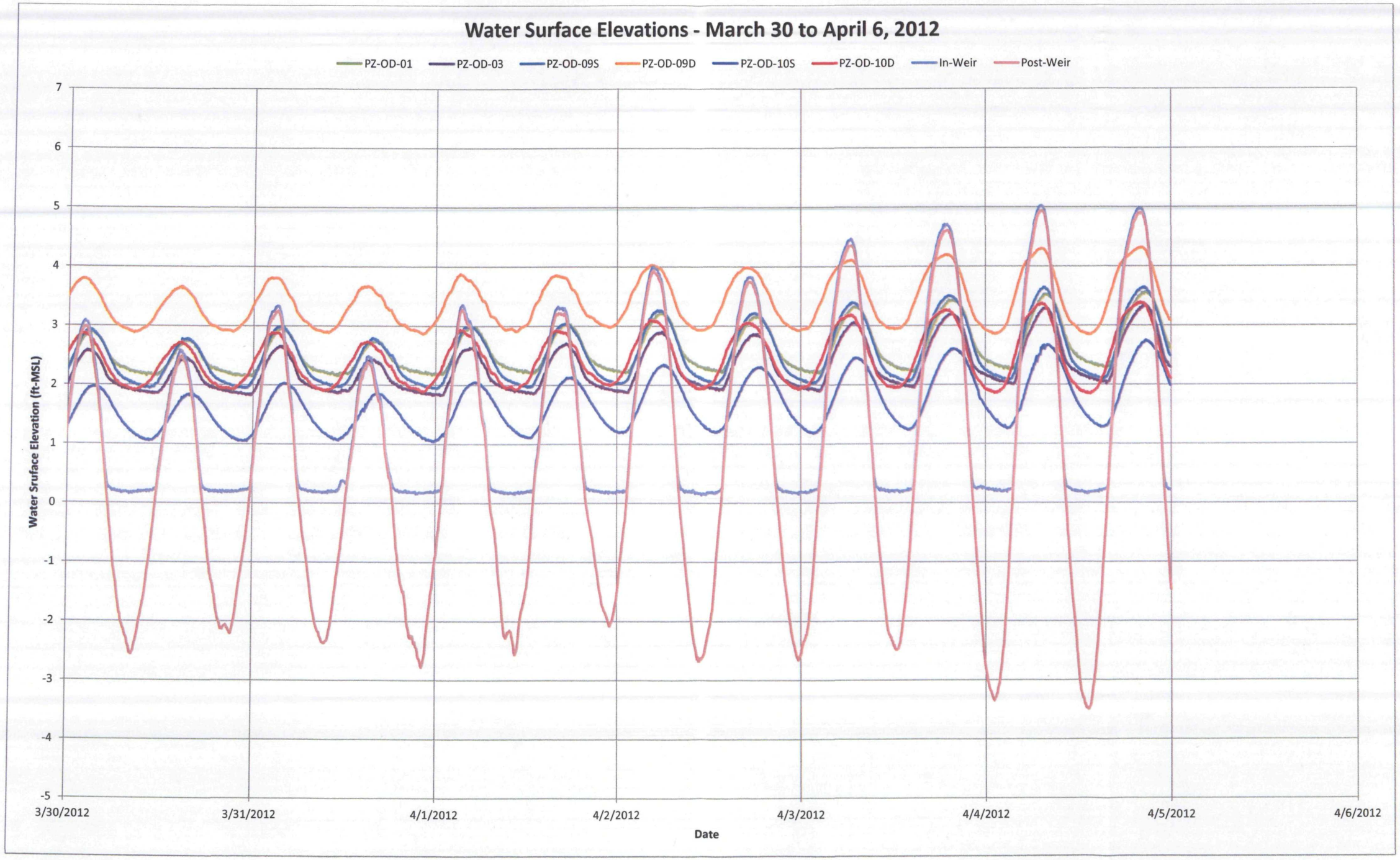

Water Surface Elevations - March 2 to April 6, 2012
PZ-OD-01
PZ-OD-03
PZ-OD-09S
PZ-OD-09D
PZ-OD-10S
PZ-OD-10D
In-Weir
Post-Weir
Water Surface Elevation (ft-MSL)
7
6
5
4
3
2
1
0
-1
-2
-3
-4
-5
3/2/2012
3/9/2012
3/16/2012
3/23/2012
3/30/2012
4/6/2012
Date


Water Surface Elevations - March 2 to 9, 2012
PZ-OD-01
PZ-OD-03
PZ-OD-09S
PZ-OD-09D
PZ-OD-10S
PZ-OD-10D
In-Weir
Post-Weir
Water Sruface Elevation (ft-MSL)
7
6
5
4
3
2
1
0
-1
-2
-3
-4
-5
3/2/2012
3/3/2012
3/4/2012
3/5/2012
3/6/2012
3/7/2012
3/8/2012
3/9/2012
Date


Water Surface Elevations - March 9 to 16, 2012
PZ-OD-01
PZ-OD-03
PZ-OD-09S
PZ-OD-09D
PZ-OD-10S
PZ-OD-10D
In-Weir
Post-Weir
Water Sruface Elevation (ft-MSL)
7
6
5
4
3
2
1
0
-1
-2
-3
-4
-5
3/9/2012
3/10/2012
3/11/2012
3/12/2012
3/13/2012
3/14/2012
3/15/2012
3/16/2012
Date


Water Surface Elevations - March 16 to 23, 2012
PZ-OD-01
PZ-OD-03
PZ-OD-09S
PZ-OD-09D
PZ-OD-10S
PZ-OD-10D
In-Weir
Post-Weir
Water Sruface Elevation (ft-MSL)
7
6
5
4
3
2
1
0
-1
-2
-3
-4
-5
3/16/2012
3/17/2012
3/18/2012
3/19/2012
3/20/2012
3/21/2012
3/22/2012
3/23/2012
Date


Water Surface Elevations - March 23 to 30, 2012
PZ-OD-01
PZ-OD-03
PZ-OD-09S
PZ-OD-09D
PZ-OD-10S
PZ-OD-10D
In-Weir
Post-Weir
Water Sruface Elevation (ft-MSL)
7
6
5
4
3
2
1
0
-1
-2
-3
-4
-5
3/23/2012
3/24/2012
3/25/2012
3/26/2012
3/27/2012
3/28/2012
3/29/2012
3/30/2012
Date


Water Surface Elevations - March 30 to April 6, 2012
PZ-OD-01
PZ-OD-03
PZ-OD-09S
PZ-OD-09D
PZ-OD-10S
PZ-OD-10D
In-Weir
Post-Weir
Water Sruface Elevation (ft-MSL)
7
6
5
4
3
2
1
0
-1
-2
-3
-4
-5
3/30/2012
3/31/2012
4/1/2012
4/2/2012
4/3/2012
4/4/2012
4/5/2012
4/6/2012
Date

APPENDIX D

Attachment 3

STATE	PROJECT NUMBER	SHEET NO.	TOTAL SHEETS
GA.	STP-009-2(68)	41	381

REVISION DATES

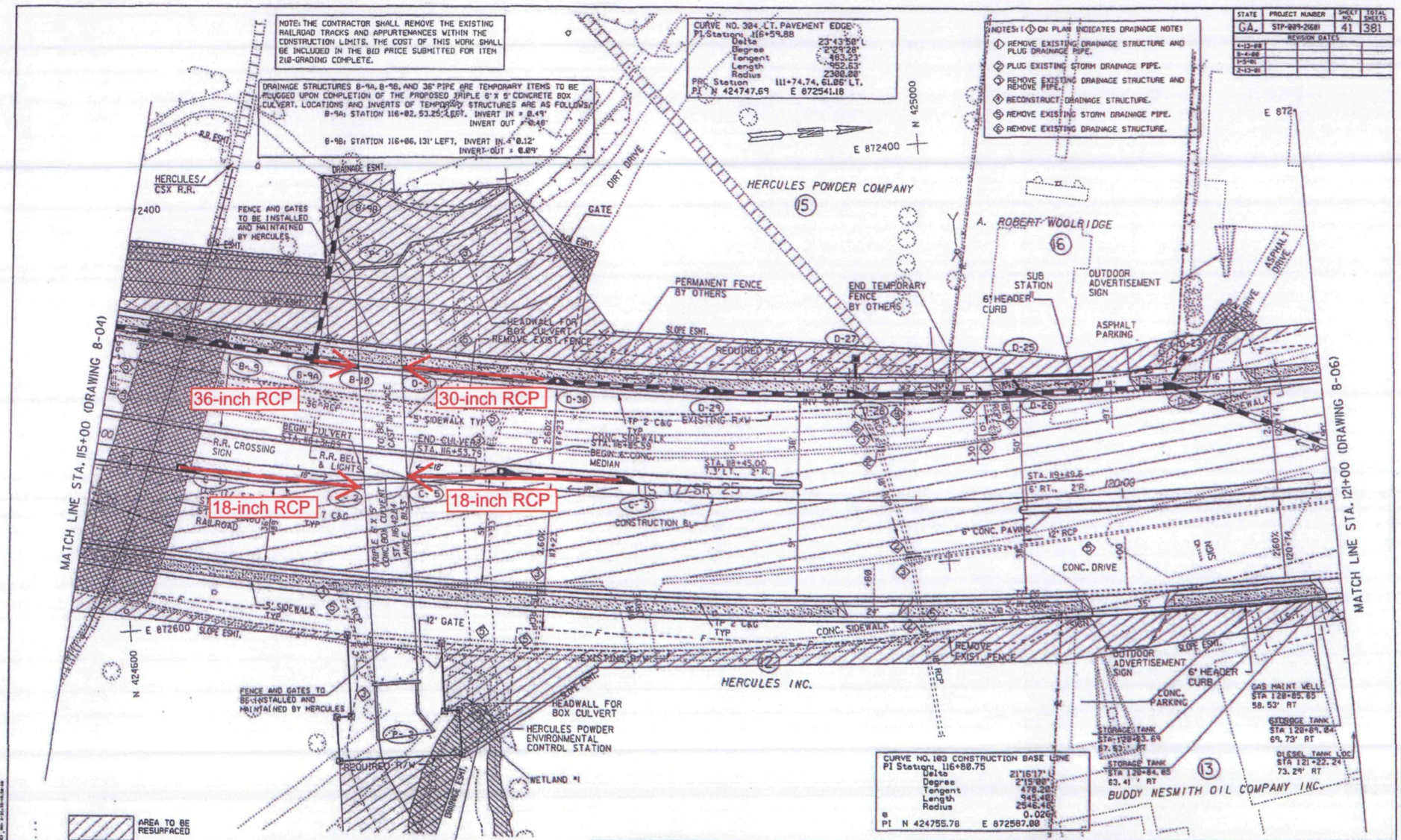
4-13-00			
5-4-00			
1-5-01			
2-13-01			

NOTE: THE CONTRACTOR SHALL REMOVE THE EXISTING RAILROAD TRACKS AND APPURTENANCES WITHIN THE CONSTRUCTION LIMITS. THE COST OF THIS WORK SHALL BE INCLUDED IN THE BID PRICE SUBMITTED FOR ITEM 210-GRADING COMPLETE.

DRAINAGE STRUCTURES B-9A, B-9B, AND 36" PIPE ARE TEMPORARY ITEMS TO BE PLUGGED UPON COMPLETION OF THE PROPOSED TRIPLE 6' X 5' CONCRETE BOX CULVERT. LOCATIONS AND INVERTS OF TEMPORARY STRUCTURES ARE AS FOLLOWS:
B-9A: STATION 116+02, 53.25' LEFT, INVERT IN = 0.49'
INVERT OUT = 0.48'
B-9B: STATION 116+06, 131' LEFT, INVERT IN = 0.12'
INVERT OUT = 0.09'

CURVE NO. 304 LT. PAVEMENT EDGE
PI Station: 116+59.88
Delta 23°43'50" L
Degree 2°29'28"
Tangent 493.23'
Length 952.63'
Radius 2308.00'
PRC Station 111+74.74, 61.86' LT.
PI N 424747.69 E 872541.18

NOTES: (ⓘ ON PLAN INDICATES DRAINAGE NOTE)
1. REMOVE EXISTING DRAINAGE STRUCTURE AND PLUG DRAINAGE PIPE.
2. PLUG EXISTING STORM DRAINAGE PIPE.
3. REMOVE EXISTING DRAINAGE STRUCTURE AND REMOVE PIPE.
4. RECONSTRUCT DRAINAGE STRUCTURE.
5. REMOVE EXISTING STORM DRAINAGE PIPE.
6. REMOVE EXISTING DRAINAGE STRUCTURE.



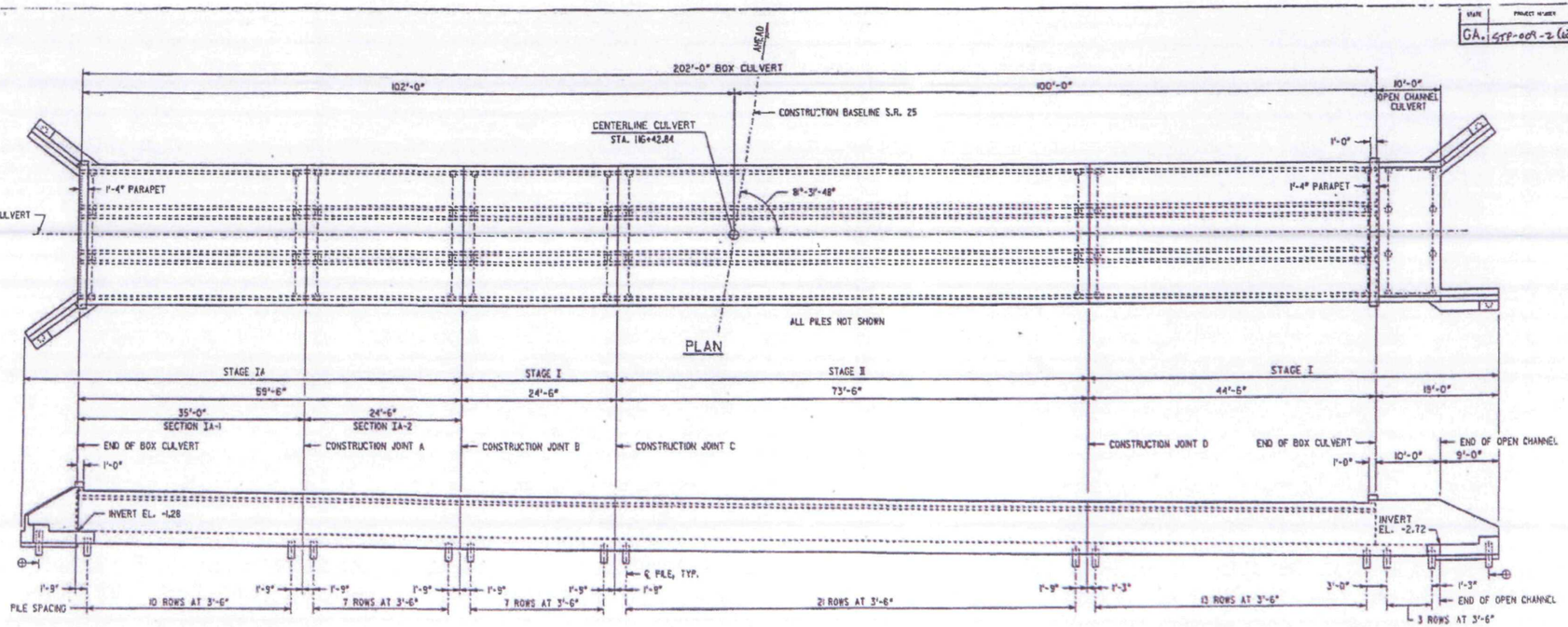
CURVE NO. 103 CONSTRUCTION BASE LINE
PI Station: 116+80.75
Delta 21°16'17" L
Degree 2°15'00"
Tangent 476.20'
Length 945.48'
Radius 2546.48'
e 0.026
PI N 424755.78 E 872587.00

STATE OF GEORGIA
DEPARTMENT OF TRANSPORTATION
OFFICE OF URBAN DESIGN

CONSTRUCTION PLAN
S.R. 25
STA. 115+00 TO STA. 121+00

DRAWING NO. 8-05

STATE	PROJECT NUMBER	SHEET NO.	TOTAL SHEETS
GA.	STP-009-2(60)	201	381



⊕ SEE CULVERT END DETAILS FOR LOCATION OF WING PILES.

ELEVATION

GENERAL NOTES

SPECIFICATIONS - GEORGIA STANDARD SPECIFICATIONS, 1993 EDITION, AND 1997 SUPPLEMENTAL SPECIFICATIONS AS MODIFIED BY CONTRACT DOCUMENTS.

REINFORCING STEEL - ALL REINFORCING STEEL SHALL BE PLACED AND TIED IN ACCORDANCE WITH THE GEORGIA STANDARD SPECIFICATIONS. WELDING OF REINFORCING STEEL WILL NOT BE PERMITTED. SEE GEORGIA STANDARD 3901(8-69) FOR BAR BENDING DETAILS.

REINFORCING COVER - PROVIDE 2" MINIMUM COVER TO ALL REINFORCING UNLESS OTHERWISE NOTED.

CHAMFER - ALL EXPOSED CONCRETE EDGES SHALL BE CHAMFERED 3/4 INCH UNLESS OTHERWISE NOTED.

STAGE CONSTRUCTION - CONSTRUCTION SEQUENCE AND TRAFFIC CONTROL SHALL BE ACCORDING TO THE ROADWAY STAGING PLANS, WITH IA BEING THE FIRST STAGE.

CONSTRUCTION JOINTS - CULVERT LONGITUDINAL REINFORCING SHALL NOT BE CONTINUOUS THRU CONSTRUCTION JOINTS LABELED "B", "C", OR "D". AT ALL OTHER VERTICAL CONSTRUCTION JOINTS, EACH LONGITUDINAL BAR SHALL BE CONTINUED THRU THE JOINT TO PROVIDE 1'-6" MINIMUM LAP SPLICES.

TEMPORARY SHORING - THE COST OF ALL TEMPORARY SHORING AND TEMPORARY MEASURES FOR CONTROLLING GROUND OR SURFACE WATER AS NECESSARY FOR CULVERT CONSTRUCTION, SHALL BE INCLUDED IN THE OVERALL BID SUBMITTED.

PILING - ALL PILES SHALL BE TREATED TIMBER PER SECTION 520.

PLAN DRIVING OBJECTIVE - DRIVE ALL PILES TO A DRIVING RESISTANCE OF 24 TONS AFTER ACHIEVING A MINIMUM TIP ELEVATION OF -25.

GENERAL NOTES CONT....

TEST PILES - DRIVE TEST PILES AT THE FOLLOWING LOCATIONS:
ONE TREATED TIMBER X 35 FT AT STAGE IA (WEST END).
ONE TREATED TIMBER X 35 FT AT STAGE I (EAST END).

DRIVING DATA PILES - ONE DRIVING DATA PILE SHALL BE REQUIRED AT EACH OF THE THREE CONSTRUCTION STAGES -- IA, I AND II.

EXISTING CULVERT - SEE ROADWAY PLANS FOR REQUIREMENTS AND PAYMENT FOR REMOVAL OF EXISTING CULVERT.

INCIDENTAL ITEMS - COST INCIDENTAL TO THE WORK THAT IS NOT SPECIFICALLY COVERED BY THE GEORGIA STANDARD SPECIFICATIONS, SUPPLEMENTAL SPECIFICATIONS AND/OR SPECIAL PROVISIONS SHALL BE INCLUDED IN THE OVERALL BID SUBMITTED. THIS INCLUDES THE COST OF DRAIN HOLES, COARSE AGGREGATE DRAIN FILTERS AND OTHER INCIDENTAL ITEMS NECESSARY TO COMPLETE THE WORK.

DESIGN DATA

TRIPLE 6X5 CONCRETE BOX CULVERT ---------- SPECIAL DESIGN

SPECIFICATIONS ---------- AASHTO 1977

LIVE LOADING ---------- TYPICAL HS20-44 AND/OR MILITARY

CONCRETE ---------- CLASS A, f_c = 3,000 PSI

REINFORCEMENT STEEL ---------- GRADE 40, f_y = 40,000 PSI

MAXIMUM DESIGN FILL HEIGHT ---------- 6 FEET

SUMMARY OF QUANTITIES

PAY ITEM NUMBER	QUANTITY	UNIT	PAY ITEM
500-3101	607	CY	CLASS A CONCRETE
511-1000	52630	LB	BAR REINF STEEL
520-2500	5650	LF	PILING, TIMBER - TREATED
520-3500	2	EA	TEST PILE, TIMBER - TREATED
520-4500	1	EA	LOAD TEST, TIMBER - TREATED (IF REQD)

CULVERT

GEORGIA
DEPARTMENT OF TRANSPORTATION
PRECONSTRUCTION DIVISION-OFFICE OF BRIDGE DESIGN

PLAN AND ELEVATION
TRIPLE 6X5 BOX CULVERT (STA. 116+42)
S.R. 25 WIDENING / RECONSTRUCTION
GLYNN COUNTY STP-009-2(60)

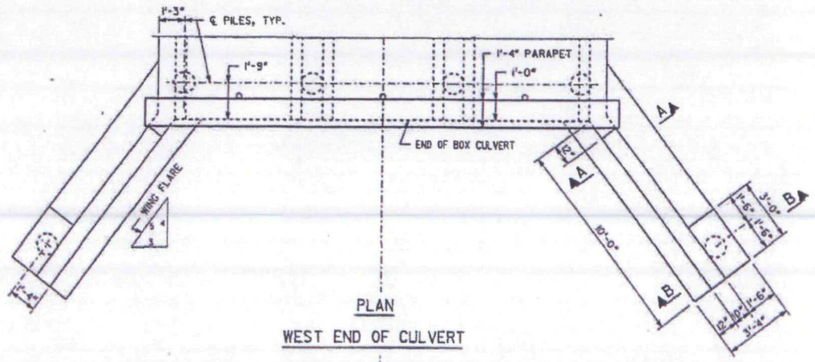
NO SCALE FEBRUARY 1995

BRIDGE SHEET 1 OF 4

DATE | REVISIONS | BY

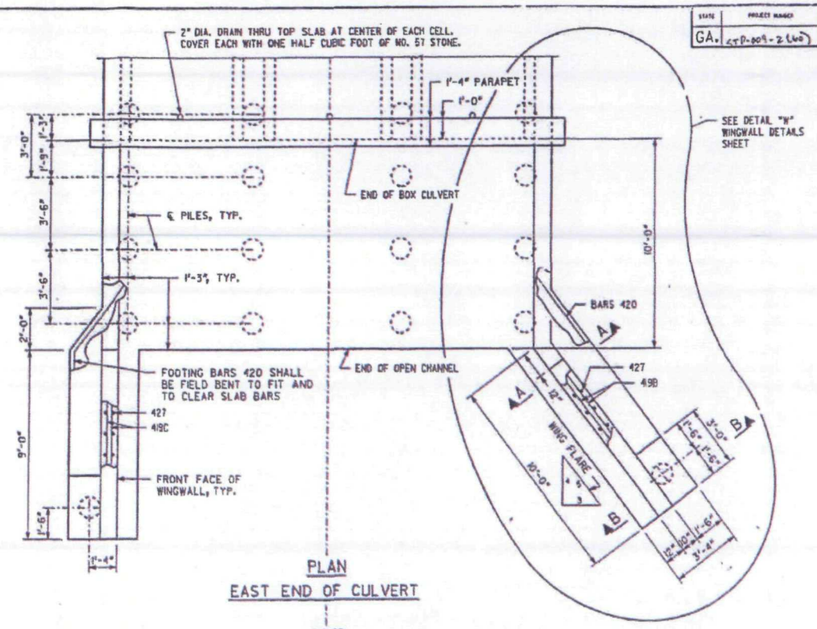
DESIGNED CCP | CHECKED WEI | REVIEWED JPT/MCD
DRAWN DW | DESIGN GROUP WEI | APPROVED PVL

STATE	PROJECT NUMBER	SHEET NO.	TOTAL SHEETS
GA.	STP-009-2(60)	208	381



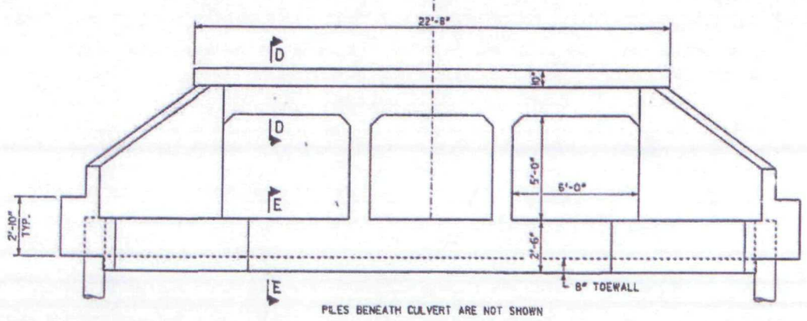
PLAN

WEST END OF CULVERT



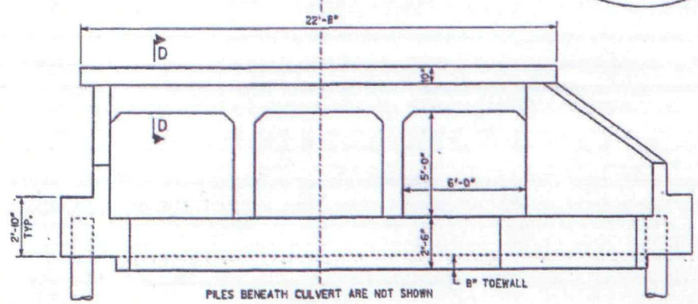
PLAN

EAST END OF CULVERT



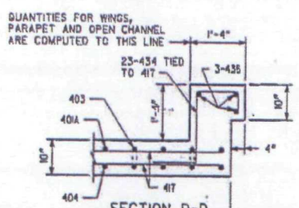
ELEVATION

WEST END OF CULVERT

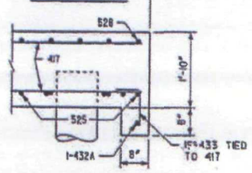


ELEVATION

EAST END OF CULVERT



SECTION D-D



SECTION E-E

QUANTITIES (FOR INFORMATION ONLY)				
ITEM	CULVERT BARREL PER LINEAR FOOT	WEST END & WINGS (2) AND PARAPET	EAST END & OPEN CHANNEL, WINGS (2) AND PARAPET	TOTAL CULVERT
CY. CLASS "A" CONCRETE	2.821	12.5	30.3	607.0
LBS. BAR REINF. STEEL	241.175	1190	3205	52,630

QUANTITIES GIVEN PER LINEAR FOOT ARE AVERAGED OVER 200 FT OF BARREL LENGTH. CONCRETE DISPLACED BY PILES HAS BEEN DEDUCTED. LBS REINFORCING STEEL INCLUDES THREE LAP SPLICES FOR EACH LONGITUDINAL BAR 417.

BRIDGE SHEET 2 OF 4

BY	REVISIONS	DATE

CULVERT

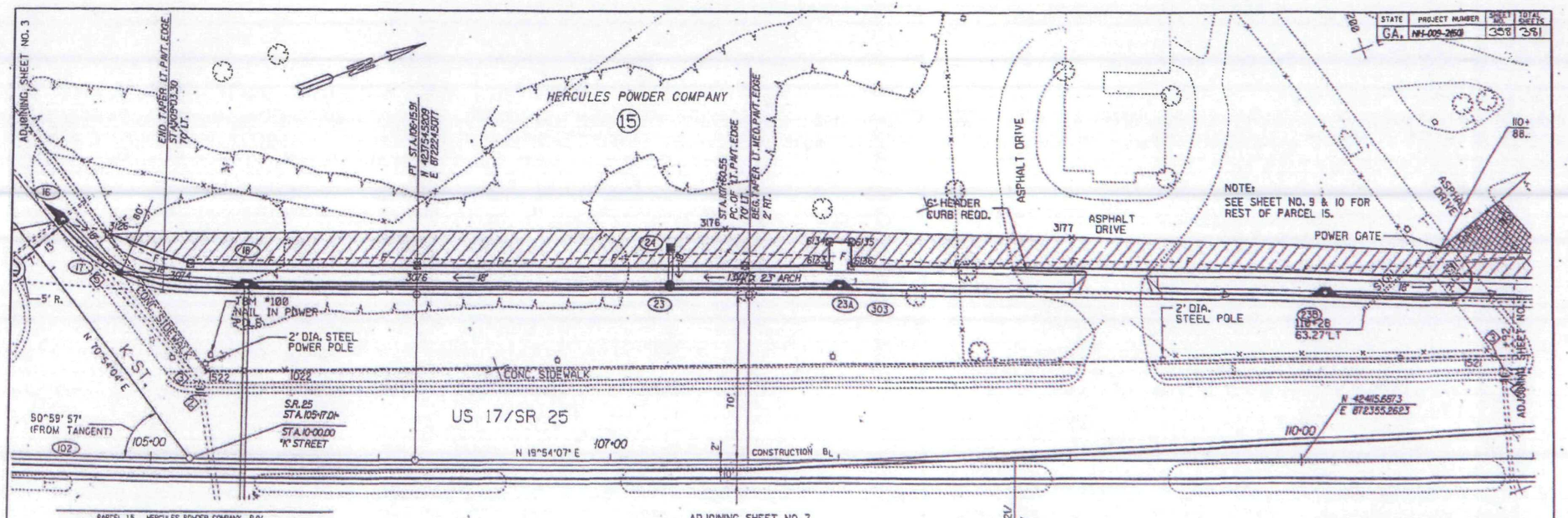
GEORGIA
DEPARTMENT OF TRANSPORTATION
PRECONSTRUCTION DIVISION-OFFICE OF BRIDGE DESIGN

DETAILS AT ENDS
TRIPLE 6X5 BOX CULVERT (STA. 116+42)
S.R. 25 WIDENING / RECONSTRUCTION
GLYNN COUNTY STP-009-2(60)

NO SCALE FEBRUARY 1999

DESIGNED CCP	CHECKED WEI	TOP. EN. JPT/MCD
DRAWN DM	DESIGN ENGR. WEI	APPROVED PVL

STATE	PROJECT NUMBER	SHEET NO.	TOTAL SHEETS
GA.	NH-009-2(60)	358	381



PARCEL 15 HERCULES POWDER COMPANY R/W

PNT	STATION DIST	OFFSET BEARING	COORDINATES	ALIGNMENT
1522	105+23.5343	37.6896 L	N 423688.9817 E 872157.9346	S.R. 25
	72.8802	S 72-40'20.8" W		
3126	104+78.6353	53.6768 L	N 423659.5376 E 872089.2022	S.R. 25
	37.9978	N 38-52'53.8" E		
3874	105+15.0000	82.0000 L	N 423686.8125 E 872112.8897	S.R. 25
	99.8802	N 20-16'49.2" E		
3876	106+15.8902	82.0000 L	N 423782.4316 E 872147.4848	S.R. 25
	142.4789	N 19-54'07.1" E		
3875	107+58.3690	82.0000 L	N 423916.2935 E 872195.9827	S.R. 25
ARC LENGTH=	36.6389	CHORD BEARING= N 20-00'35.6" E		
LNTH CHORD=	36.6299	R= 9715.1595	DEG= 00-35'23.1"	
6133	107+94.9987	81.9318 L	N 423958.0122 E 872208.4369	S.R. 25
	16.1918	N 70-05'58.1" W		
6134	107+94.9988	92.1221 L	N 423954.2815 E 872198.8545	S.R. 25
	10.0000	N 20-00'58.4" E		
6135	108+84.9983	92.8752 L	N 423963.6700 E 872282.2998	S.R. 25
	16.1911	S 70-05'34.7" E		
6136	108+84.9983	81.8882 L	N 423968.2080 E 872211.8811	S.R. 25
ARC LENGTH=	378.3975	CHORD BEARING= N 21-10'00.7" E		
LNTH CHORD=	378.3751	R= 9715.1595	DEG= 00-35'23.1"	
3877	111+75.2599	73.8516 L	N 424305.3476 E 872246.2363	S.R. 25
ARC LENGTH=	422.1844	CHORD BEARING= N 13-41'34.8" E		
LNTH CHORD=	421.5861	R= 2288.0000	DEG= 02-30'15.1"	
6154	116+87.8637	62.4326 L	N 424788.2773 E 872476.8861	S.R. 25
	28.7414	N 88-27'42.4" W		
ARC LENGTH=	47.6784	CHORD BEARING= N 11-11'38.7" E		
LNTH CHORD=	47.6695	R= 2288.0000	DEG= 02-30'16.1"	
6145	STA 116+55.7174	61.6327 L	N 424755.8399 E 872474.2623	S.R. 25
ARC LENGTH=	354.1838	CHORD BEARING= S 7-24'53.5" W		
LNTH CHORD=	354.0328	R= 2288.0000	DEG= 02-30'15.1"	
3010	119+16.9924	56.7836 L	N 425886.4476 E 872512.8458	S.R. 25
	11.1889	S 38-46'31.2" E		
1534	119+15.5243	47.6875 L	N 425884.7691 E 872523.8296	S.R. 25
ARC LENGTH=	381.2316	CHORD BEARING= S 85-33'43.8" W		
LNTH CHORD=	380.5844	R= 1328.1162	DEG= 04-19'14.1"	
1210	116+89.7281	38.4762 L	N 424785.6881 E 872493.8844	S.R. 25
	231.3892	S 13-59'21.7" W		
1844	119+74.6249	48.9169 L	N 424481.8736 E 872437.9485	S.R. 25
	288.2561	S 19-17'19.9" W		
1521	118+83.4718	43.5496 L	N 424288.9987 E 872242.7285	S.R. 25
	535.9000	S 19-17'19.9" W		
1822	105+57.3123	37.6486 L	N 423712.6288 E 872169.8073	S.R. 25
	33.5200	S 19-17'19.9" W		
1522	105+23.5343	37.6896 L	N 423688.9817 E 872157.9346	S.R. 25

REDO R/W: 48256.3281 SF REDO R/W: 1.070 ACRES
REMAINDER: 1.98 ACRES

PARCEL 15 EASM'T FOR CONST. & MAINT. OF SLOPES

PNT	STATION	OFFSET	ALIGNMENT
3126	104+78.6353	93.9766 L	S.R. 25
3176	107+58.0000	97.5000 L	S.R. 25
3177	109+80.0000	94.0000 L	S.R. 25
3178	113+50.0000	73.0000 L	S.R. 25
3179	115+80.0000	71.0000 L	S.R. 25
6138	116+85.3451	77.4354 L	S.R. 25
6154	116+87.8637	62.4326 L	S.R. 25
ARC LENGTH=	423.1844		
CHORD BEAR=	S 17-04'34.0" W		
LNTH CHORD=	421.5861	R= 2288.0000	
DEG=	02-30'15.1"		
3877	111+75.2599	73.8516 L	S.R. 25
ARC LENGTH=	378.3975		
CHORD BEAR=	S 21-16'06.7" W		
LNTH CHORD=	378.3751	R= 9715.1595	
DEG=	00-35'23.1"		
6136	108+84.9983	81.8882 L	S.R. 25
6135	108+84.9912	92.8752 L	S.R. 25
6134	107+94.9988	92.1221 L	S.R. 25
6133	107+94.9987	81.9318 L	S.R. 25
ARC LENGTH=	36.6389		
CHORD BEAR=	S 20-00'35.6" W		
LNTH CHORD=	36.6299	R= 9715.1595	
DEG=	00-35'23.1"		
3875	107+58.3690	82.0000 L	S.R. 25
3876	106+15.8902	82.0000 L	S.R. 25
3874	105+15.0000	82.0000 L	S.R. 25
3126	104+78.6353	93.9766 L	S.R. 25
REDO EASMT AREA=	12488.9816 SF		

PARCEL 15 EASM'T FOR CONST. & MAINT. OF DRAIN STRUCTURE

PNT	STATION	OFFSET	ALIGNMENT
6154	116+87.8637	62.4326 L	S.R. 25
6139	115+54.4788	148.1181 L	S.R. 25
6140	116+31.8874	145.6803 L	S.R. 25
6141	116+32.8516	135.7963 L	S.R. 25
6142	116+91.5151	143.6444 L	S.R. 25
6143	116+95.2659	188.4942 L	S.R. 25
6144	116+56.6312	182.5182 L	S.R. 25
6145	116+55.7174	61.6327 L	S.R. 25
ARC LENGTH=	47.6784		
CHORD BEAR=	S 11-11'38.7" W		
LNTH CHORD=	47.6695	R= 2288.0000	
DEG=	02-30'15.1"		
6154	116+87.8637	62.4326 L	S.R. 25
REDO DRAIN EASMT AREA=	5337.6192 SF		

PARCEL 15 / TOTAL EASMT AREA = 19,335.6848 SF

CURVE 102 CONSTRUCTION BASE LINE
PI Station 103+31.86

Delta	4°15'45" L
Degree	8°45'00"
Tangent	284.38'
Length	568.32'
Radius	763.94'
*	NORMAL CROWN

PI N 423487.21 E 872127.73

CURVE NO. 303 LT. PAVEMENT EDGE
PI Station 109+66.65

Delta	2°27'34" R
Degree	0°35'26"
Tangent	208.23'
Length	416.89'
Radius	9703.18'

PC Station 107+60.55 70' RT.
PI N 424217.40 E 872317.64

LEGEND

REQUIRED R/W LINE	
PROPERTY AND EXISTING R/W LINE	
REQUIRED R/W MARKER	
BEGIN LIMIT OF ACCESS	BLA
END LIMIT OF ACCESS	ELA
LIMIT OF ACCESS	
REQUIRED R/W AND LIMIT OF ACCESS	
CONSTRUCTION LIMITS (FILL)	
CONSTRUCTION LIMITS (CUT)	
EASM'T FOR CONST & MAINT OF SLOPES	
EASM'T FOR CONST. OF SLOPES	
EASM'T FOR CONST OF DRIVEWAYS	

GRAPHIC SCALE: 1" = 20'
20 0 20 40 60

DATE	REVISIONS
11/14/96	RELOCATED HEADER CURB WITHIN REQD R/W
" "	PARCEL 15

DEPARTMENT OF TRANSPORTATION
RIGHT OF WAY MAP
PROJECT NH-009-2(60) GLYNN COUNTY
DATE MAY-16-94 SHEET NO. 8
G. M. D. 26

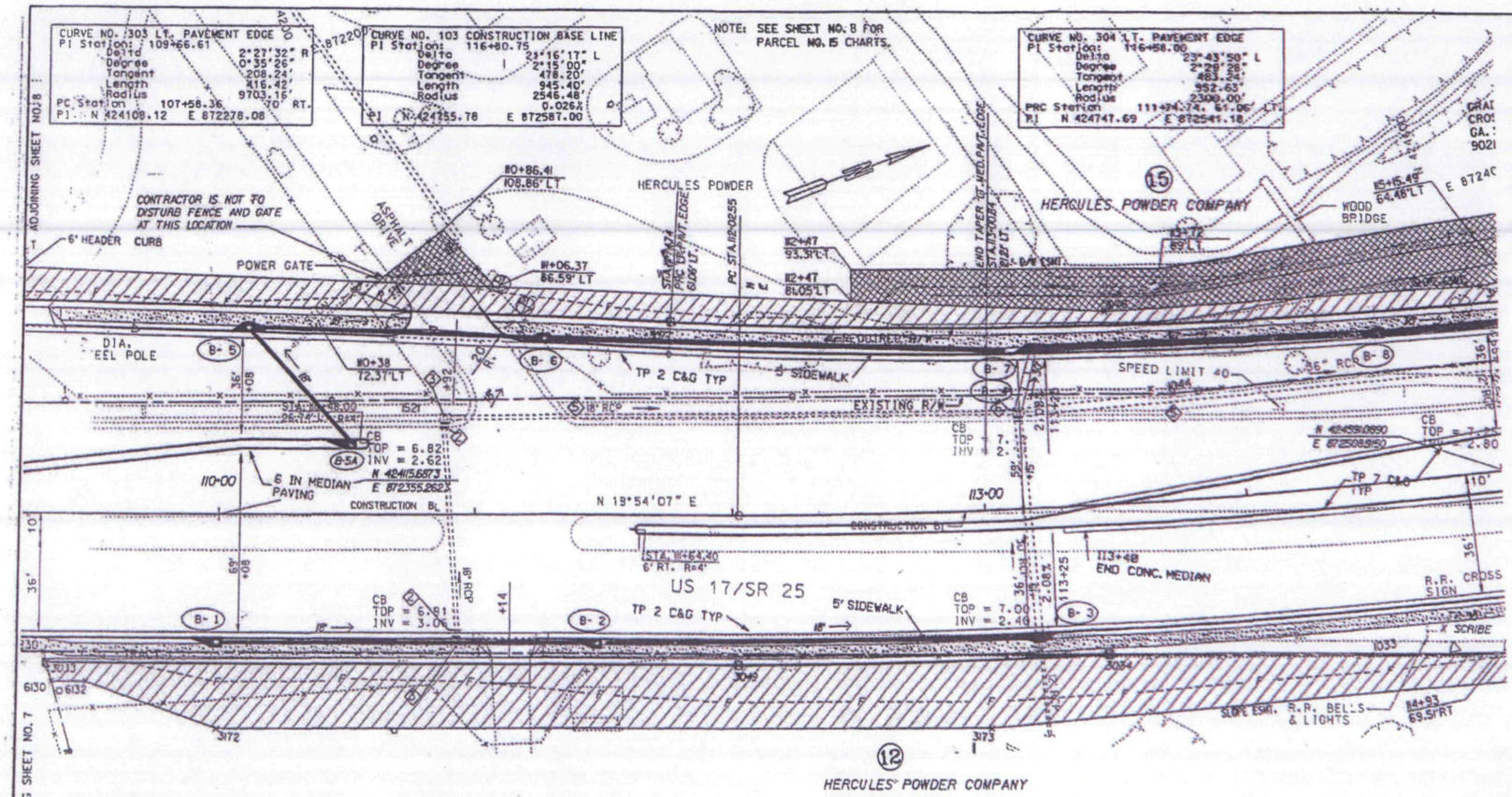
STATE	PROJECT NUMBER	SHEET NO.	TOTAL SHEETS
GA.	NH-009-2(60)	35A	38

CURVE NO. 303 LT. PAVEMENT EDGE
PI Station: 109+66.61
Delta 2°27'32" R
Degree 0°35'26"
Tangent 208.24'
Length 416.42'
Radius 9703.16'
PC Station 107+58.36 70' RT.
PI N 424108.12 E 872278.08

CURVE NO. 103 CONSTRUCTION BASE LINE
PI Station: 116+80.75
Delta 23°16'17" L
Degree 2°15'00"
Tangent 478.20'
Length 945.40'
Radius 2546.48'
0.026%
PI N 424755.78 E 872587.00

NOTE: SEE SHEET NO. 8 FOR PARCEL NO. 15 CHARTS.

CURVE NO. 304 LT. PAVEMENT EDGE
PI Station: 116+58.00
Delta 23°43'50" L
Degree 2°29'28"
Tangent 483.24'
Length 952.63'
Radius 2300.00'
PRC Station 111+74.74 61.06' LT.
PI N 424747.69 E 872541.18



PARCEL 12 EASM'T FOR CONST. & MAINT. OF SLOPES

PNT	OFFSET	STATION	ALIGNMENT
3033	50.000 R	109+34.419	S.R. 25
3049	50.000 R	112+82.559	S.R. 25
ARC LENGTH = 145.812			
CHORD BEAR = N 18°17'53" E			
LNTH CHORD = 145.793		R = 2684.479	
DEG= 02°12'00"			
3034	50.000 R	113+45.115	S.R. 25
1033	65.629 R	114+43.097	S.R. 25
ARC LENGTH = 194.358			
CHORD BEAR = N 15°27'51" E			
LNTH CHORD = 194.184		R = 1256.578	
DEG= 08°33'38"			
6146	76.2280 R	116+31.782	S.R. 25
6155	78.6280 R	116+50.153	S.R. 25
3174	81.000 R	115+88.000	S.R. 25
3172	83.500 R	113+88.000	S.R. 25
3172	90.500 R	110+88.000	S.R. 25
6132	65.000 R	109+45.992	S.R. 25
6130	64.927 R	109+34.456	S.R. 25
3033	50.000 R	109+34.419	S.R. 25
REQD EASMT AREA= 12728 SF			

PARCEL 12 EASM'T FOR CONST. & MAINT. OF DRAINAGE

PNT	STATION	OFFSET	ALIGNMENT
6149	116+33.9165	137.1872 R	S.R. 25
6854	116+45.6300	245.9007 R	S.R. 25
6825	116+62.3074	243.5782 R	S.R. 25
6150	116+85.4323	126.5315 R	S.R. 25
6149	116+33.9165	137.1872 R	S.R. 25
REQD EASMT AREA= 4174.7253 SF			

PARCEL 12 EASM'T FOR CONST. & MAINT. OF SLOPES

PNT	STATION	OFFSET	ALIGNMENT
6153	116+75.5305	76.4449 R	S.R. 25
6152	116+88.8994	186.4319 R	S.R. 25
6151	116+86.7598	187.5120 R	S.R. 25
6150	116+85.4323	126.5315 R	S.R. 25
6149	116+33.9165	123.1872 R	S.R. 25
6148	116+36.8026	118.6353 R	S.R. 25
6147	116+32.4157	114.7818 R	S.R. 25
6146	116+31.7822	76.2280 R	S.R. 25
3175	117+58.8000	63.8000 R	S.R. 25
3165	117+85.5017	76.2484 R	S.R. 25
3035	119+67.0430	56.0000 R	S.R. 25
ARC LENGTH= 12.4917			
CHORD BEAR= S 82°49'23.8" W			
LNTH CHORD= 12.4917		R= 2684.479	
DEG= 02°11'55.8"			
3035	119+55.4298	58.0000 R	S.R. 25
ARC LENGTH= 297.9451			
CHORD BEAR= S 82°25'52.2" W			
LNTH CHORD= 297.3159		R= 1256.9647	
DEG= 04°33'23.8"			
6153	116+75.5305	76.4449 R	S.R. 25
REQD EASMT AREA= 4858.9621 SF			

PARCEL 12 / TOTAL EASMT AREA = 17588.9621 SF

PARCEL 12 HERCULES INC. R/W TRACT 1

PNT	STATION DIST	OFFSET BEARING	COORDINATES	ALIGNMENT
230	109+33.1694	51.7362 R	N 424834.8523 E 872383.8388	S.R. 25
	415.1281	N 19°59'58.1" E		
3034	113+45.1149	58.0000 R	N 424424.0176 E 872524.5328	S.R. 25
ARC LENGTH= 145.8128		CHORD BEARING= S 18°17'53.8" W		
LNTH CHORD= 145.7938		R= 2684.4791	DEG= 02°11'55.8"	
3049	112+82.5588	58.0000 R	N 424286.3965 E 872478.7468	S.R. 25
	268.1388	S 19°54'07.1" W		
3033	109+34.4193	58.0000 R	N 424834.2795 E 872367.4729	S.R. 25
	4.4442	N 86°29'45.9" W		
230	109+33.1694	51.7362 R	N 424834.5523 E 872383.8388	S.R. 25
REQD R/W= 1531.1532 SF		REQD R/W= 0.0352 ACRES		

PARCEL 12 HERCULES INC. R/W TRACT 2

PNT	STATION DIST	OFFSET BEARING	COORDINATES	ALIGNMENT
6146	116+31.7822	76.2280 R	N 424786.5368 E 872616.7839	S.R. 25
ARC LENGTH= 45.5838		CHORD BEARING= N 18°01'51.1" E		
LNTH CHORD= 45.5805		R= 1256.9780	DEG= 04°33'23.8"	
6153	116+75.5305	76.4449 R	N 424751.3438 E 872616.6291	S.R. 25
	32.2784	S 88°28'24.5" E		
6152	116+88.8994	186.4319 R	N 424758.4848 E 872658.8948	S.R. 25
	6.9992	N 81°31'31.3" E		
6151	116+86.7598	187.5120 R	N 424757.4818 E 872658.8818	S.R. 25
	21.6817	S 88°28'15.4" E		
6150	116+85.4323	126.5315 R	N 424756.9858 E 872672.6708	S.R. 25
	58.9398	S 81°31'48.3" W		
6149	116+33.9165	123.1872 R	N 424697.9388 E 872671.1828	S.R. 25
	21.6817	N 88°28'15.4" W		
6148	116+36.8026	118.6353 R	N 424698.5858 E 872649.5898	S.R. 25
	6.9965	N 81°31'53.8" E		
6147	116+32.4157	114.7818 R	N 424695.5888 E 872649.8768	S.R. 25
	35.8868	N 88°28'25.8" W		
6146	116+31.7822	76.2280 R	N 424786.5368 E 872616.7839	S.R. 25
REQD R/W= 2871.9981 SF		REQD R/W= 0.0659 ACRES		

PARCEL 12 HERCULES INC. R/W TRACT 3

PNT	OFFSET/ DIST	STATION/ BEARING	ALIGNMENT
3035	58.000 R	119+55.429	S.R. 25
ARC LENGTH =	12.732		
CHORD BEAR = N	84°25'18" W		
LNTH CHORD =	12.732	R = 1256.978	
DEG=	84°33'38"		
	8.000 S	78°24'17" E	
1285	55.394 R	119+67.782	S.R. 25
	1.612 S	82°14'24" E	
3036	58.000 R	119+67.643	S.R. 25
ARC LENGTH =	12.492		
CHORD BEAR = S	82°49'29" W		
LNTH CHORD =	12.492	R = 2684.479	
DEG=	02°12'00"		
3035	58.000 R	119+55.429	S.R. 25
REQD R/W =	9.9962 SF		
REQD R/W =	0.0002	ACRES	

PARCEL 12 / TOTAL REQD R/W = 4413.8995 SF = 0.1013 ACRES

GRAPHIC SCALE: 1" = 20'
20 0 20 40 60

LEGEND

- REQUIRED R/W LINE
- PROPERTY AND EXISTING R/W LINE
- REQUIRED R/W MARKER
- BEGIN LIMIT OF ACCESS — BLA
- END LIMIT OF ACCESS — ELA
- LIMIT OF ACCESS
- REQUIRED R/W AND LIMIT OF ACCESS
- CONSTRUCTION LIMITS (FILL)
- CONSTRUCTION LIMITS (CUT)
- EASM'T FOR CONST & MAINT OF SLOPES
- EASM'T FOR CONST OF SLOPES
- EASM'T FOR CONST OF DRIVEWAYS

DATE	REVISIONS
8/24/94	NOTE DELETED FOR FENCE RELOCATION BY OWNER
9-14-94	PARC. 12 - REV. DESCRIPTION & REV. TO TRACT
9-14-94	REVISED STATIONS & STA. 10+00.00
9-20-94	PARC. 12 - REV. SLOPE EASM. DESCRIPTION
9-20-94	AND TOTALS.
9-21-94	PARC. 12 - REV. SLOPE EASM. DESCRIPTION AND TOTALS.

DEPARTMENT OF TRANSPORTATION

RIGHT OF WAY MAP

PROJECT NH-009-2(60) GLYNN COUNTY
DATE MAY-16-94 SHEET NO. 9
G.M.D. 26

STATE	PROJECT NUMBER	SHEET NO.	TOTAL SHEETS
GA.	NH-009-2(60)	360	331

HERCULES POWDER COMPANY

RAILROAD CONST. ℄
STA. 8+60

GRADE CROSSING GA. STD. 902IA

WOOD BRIDGE

115+15.49
64.48'LT

116+02
100.59'LT

115+57.02
63.74'LT

EASMT. FOR CONST. & MAINT. OF DRAIN. STRUCTURE

117+13
119.85'LT

117+40
115'LT

117+34
96.56'LT

HEADWALL FOR BOX CULVERT

HERCULES POWDER COMPANY

(15)

A. ROBERT WOOLRIDGE

(16)

SUB STATION

6" HEADER CURB

REQUIRED R/W

SPEED LIMIT 40

36" RCP

EXISTING R/W

CONC. SIDEWALK

CB
TOP = 7.49
INV = 3.89

CONSTRUCTION BL

R.R. CROSSING SIGN

R.R. BELLS & LIGHTS

US 17/SR 25

119+00

N 424991.0856
E 872508.9150

U.S. 17/ S.R. 25
STA. 115+27.15
STA. 10+00.00
RAILROAD

N 424986.8700
E 872569.4300

CB
TOP = 7.72
INV = 3.23

R.R. CROSSING SIGN

CB
TOP = 7.43

EXISTING R/W

SCRIBE

CONC. SIDEWALK

TRACT 3

R.R. BELLS & LIGHTS

114+93
69.51'RT

115+33
72.21'RT

HERCULES INC.

HERCULES INC.

HERCULES POWDER COMPANY

(12)

HEADWALL FOR BOX CULVERT

HERCULES POWDER ENVIRONMENTAL CONTROL STATION

RAILROAD CONST. ℄
STA. 10+95.00
POINT OF SWITCH

ADJUSTMENT OF R.R. TRACK BY OTHERS. CONTRACTOR SHALL NOTIFY AND COORDINATE WITH THE PROPERTY OWNER WHEN THE ADJUSTMENT IS NECESSARY.

TRACT 2

REQUIRED R/W

EASMT. FOR CONST. AND MAINTENANCE OF DRAINAGE

ADJOINING SHEET NO. 9

ADJOINING SHEET NO. 8

GRAPHIC SCALE: 1" = 20'

20 0 20 40 60

CURVE NO. 103 CONSTRUCTION BASE LINE	
PI Station:	116+80.75
Delta	21°16'17" L
Degree	2°15'00"
Tangent	478.20'
Length	945.40'
Radius	2546.48'
e	0.026ft
PI N 424755.78	E 872567.00

CURVE NO. 304 LT. PAVEMENT EDGE	
PI Station:	116+59.88
Delta	23°43'50" L
Degree	2°29'28"
Tangent	483.23'
Length	952.63'
Radius	2300.00'
PRC Station	111+74.74 61.06' LT.
PI N 424747.69	E 872541.18

NOTES:
1. SEE SHEET NO. 08 FOR PARCEL NO. 15 CHARTS.
2. SEE SHEET NO. 09 FOR PARCEL NO. 12 CHARTS.
3. SEE SHEET NO. 11 FOR PARCEL NO. 16 CHARTS.

LEGEND

REQUIRED R/W LINE	
PROPERTY AND EXISTING R/W LINE	
REQUIRED R/W MARKER	
BEGIN LIMIT OF ACCESS	BLA
END LIMIT OF ACCESS	ELA
LIMIT OF ACCESS	
REQUIRED R/W AND LIMIT OF ACCESS	
CONSTRUCTION LIMITS (FILL)	
CONSTRUCTION LIMITS (CUT)	
EASM'T FOR CONST & MAINT OF SLOPES	
EASM'T FOR CONST OF SLOPES	
EASM'T FOR CONST OF DRIVEWAYS	

DATE	REVISIONS
10NOV94	ADDED TRACK ADJ. NOTE, PAR. 15
5-16-94	PAR. 12 - ADDED NOTE FOR DRAINAGE
"	EASEMENT, REV. TO SHOW MEDIAN
"	OPENING @ STA. 117+80.00
4-12-94	PAR. 12 - SHIFTED DRIVE.
"	PAR. 15 - ADDED DRIVE.

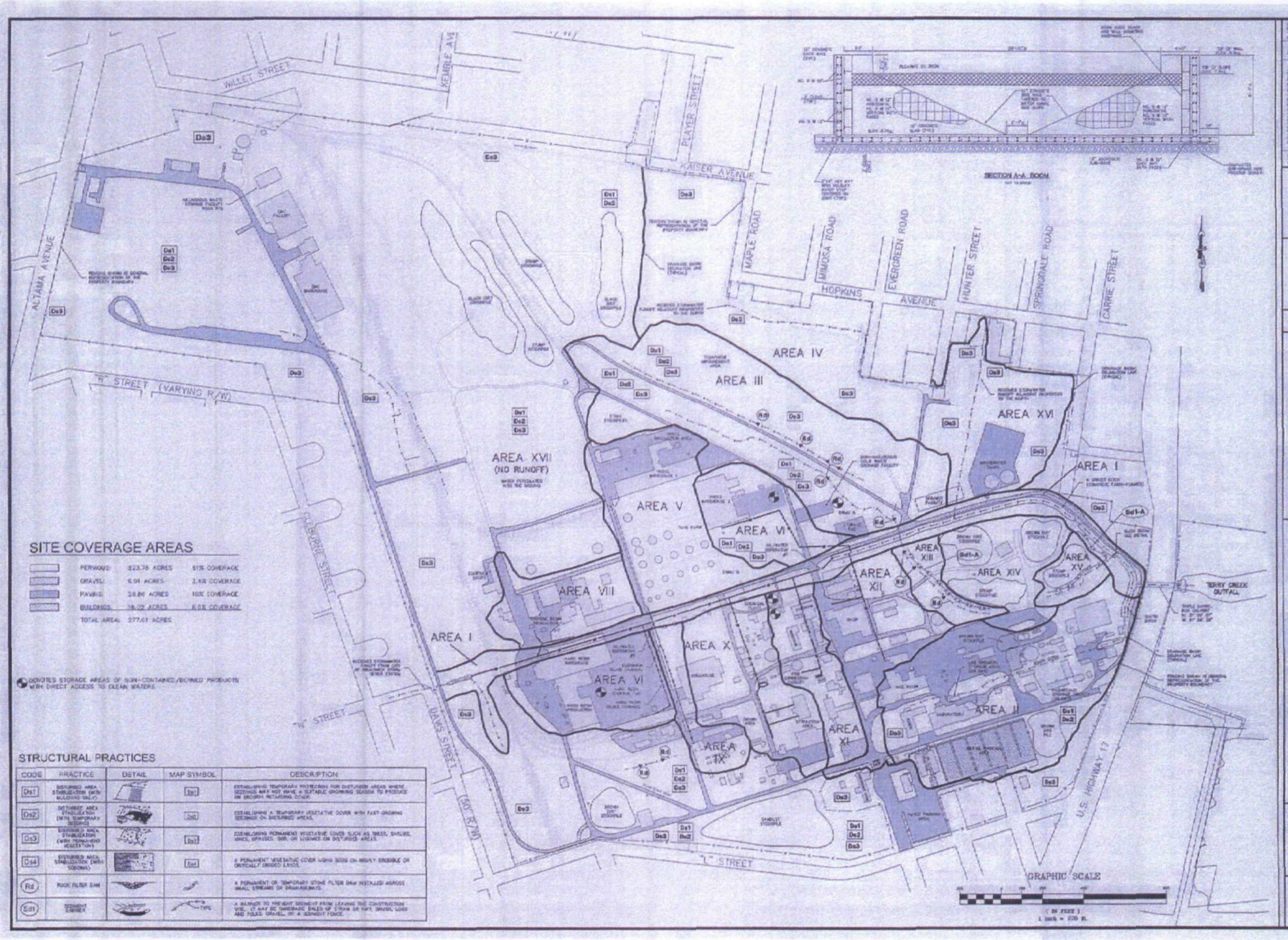
DEPARTMENT OF TRANSPORTATION

RIGHT OF WAY MAP

PROJECT NH-009-2(60) GLYNN COUNTY
DATE MAY-16-94 SHEET NO: 10
G. M. D. 26

APPENDIX D

Attachment 4



SITE COVERAGE AREAS

	PERVIOUS:	323.78 ACRES	51% COVERAGE
	GRAVEL:	6.94 ACRES	2.4% COVERAGE
	PAVING:	28.86 ACRES	10% COVERAGE
	BUILDINGS:	18.02 ACRES	6.0% COVERAGE
	TOTAL AREA:	377.61 ACRES	

DENOTES STORAGE AREAS OF NON-CONTAINED/BERMED PRODUCTS WITH DIRECT ACCESS TO CLEAN WATERS

STRUCTURAL PRACTICES

CODE	PRACTICE	DETAIL	MAP SYMBOL	DESCRIPTION
Ds1	DISTURBED AREA STABILIZATION (WITH MULCHING ONLY)		Ds1	ESTABLISHING TEMPORARY PROTECTION FOR DISTURBED AREAS WHERE SEEDINGS MAY NOT HAVE A SUITABLE GROWING SEASON TO PRODUCE AN ERODIBLE RETARDING COVER.
Ds2	DISTURBED AREA STABILIZATION (WITH TEMPORARY SEEDING)		Ds2	ESTABLISHING A TEMPORARY VEGETATIVE COVER WITH FAST GROWING SEEDINGS ON DISTURBED AREAS.
Ds3	DISTURBED AREA STABILIZATION (WITH PERMANENT VEGETATION)		Ds3	ESTABLISHING PERMANENT VEGETATIVE COVER SUCH AS TREES, SHRUBS, VINES, GRASSES, SOD, OR LEGUMES ON DISTURBED AREAS.
Ds4	DISTURBED AREA STABILIZATION (WITH SODDING)		Ds4	A PERMANENT VEGETATIVE COVER USING SODS ON HIGHLY ERODIBLE OR CRITICALLY ERODED LANDS.
Rd	ROCK FILTER DAM			A PERMANENT OR TEMPORARY STONE FILTER DAM INSTALLED ACROSS SMALL STREAMS OR DRAINAGEWAYS.
Sd1	SEDIMENT CONTROL		TYPE	A BARRIER TO PREVENT SEDIMENT FROM LEAVING THE CONSTRUCTION SITE. IT MAY BE DAMBRAISE BALES OF STRAW OR HAY, BRUSH, LOGS AND POLES, GRAVEL, OR A SEDIMENT FENCE.

NO	REVISION DESCRIPTION	BY	DATE

EMC ENGINEERING SERVICES, INC.

SITE DRAINAGE MAP

PINOVA FACILITY

BRUNSWICK, GLYNN, GEORGIA

Prepared for:

PINOVA INCORPORATED

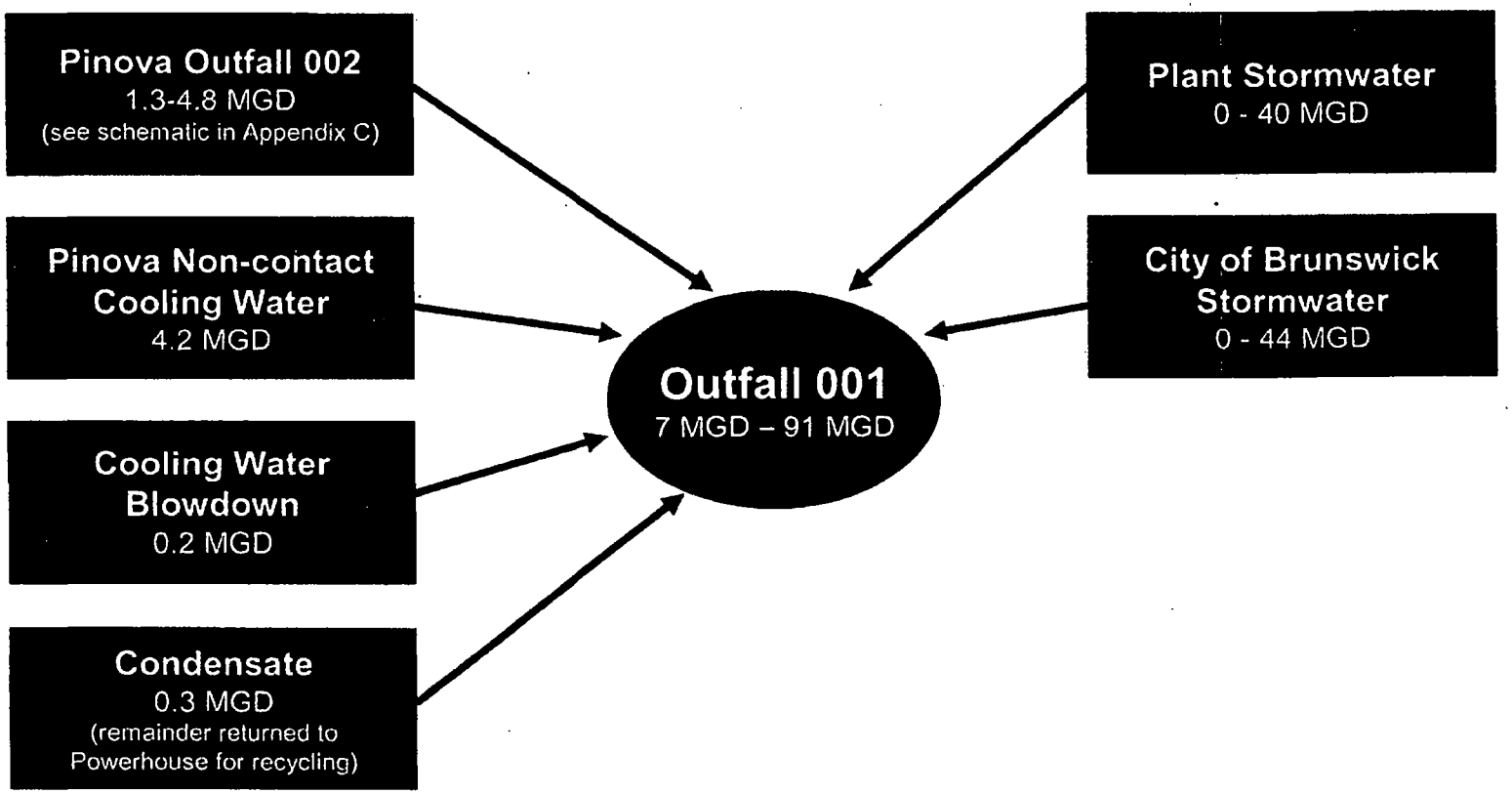
PROJECT NO.: 10-2014-012
DRAWN BY: [illegible]
DESIGNED BY:
SURVEYED BY:
SURVEY DATE: [illegible]
CHECKED BY: [illegible]
SCALE: 1" = 200'
DATE: [illegible]

SHEET 1 OF 1

APPENDIX D

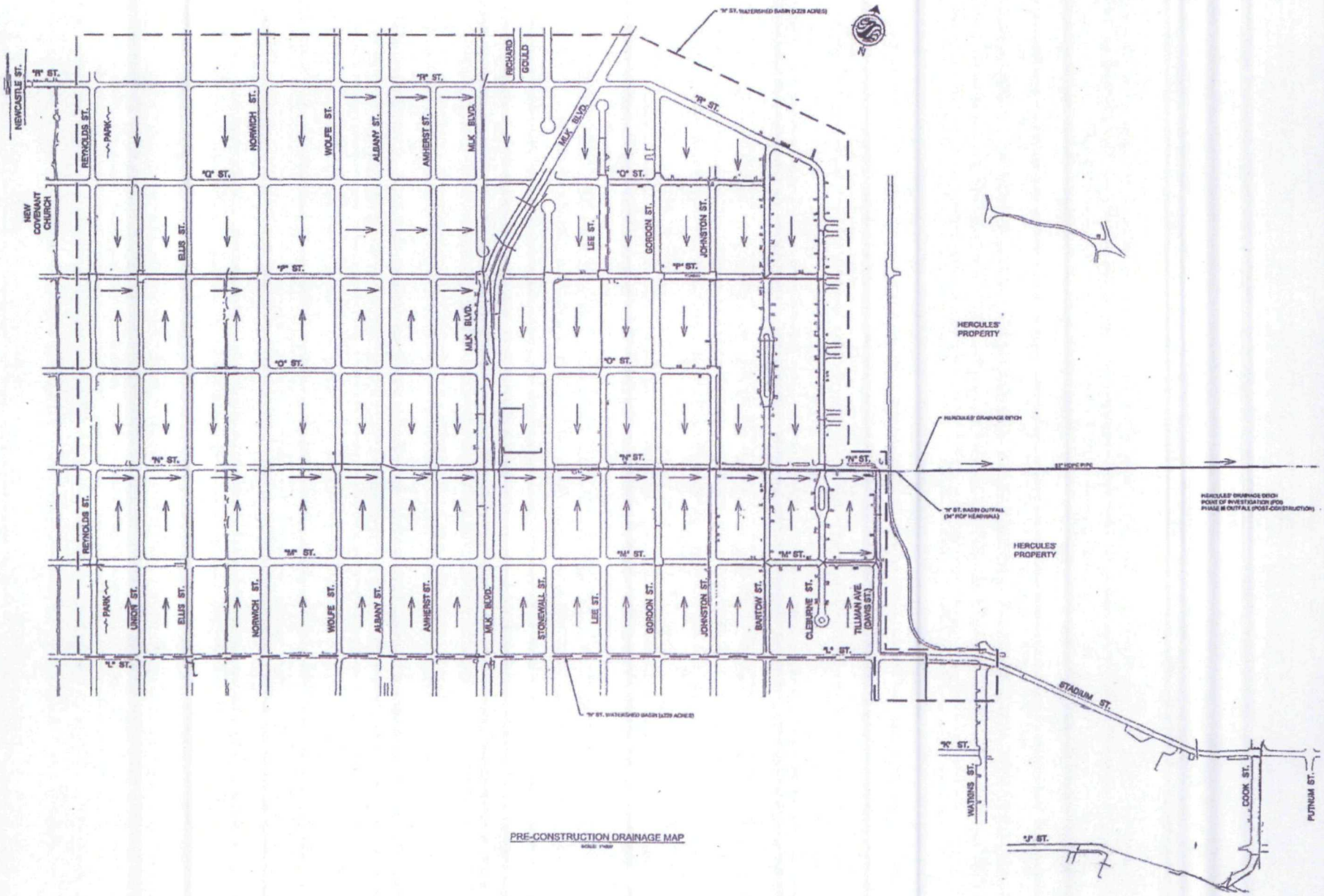
Attachment 5

Outfall 001 Schematic



APPENDIX D

Attachment 6



PRE-CONSTRUCTION DRAINAGE MAP

APPENDIX D

Attachment 7

Sheet Title: Ranked NOAA Malcolm McKinnon Airport Annual Maximum Daily Precipitation Data
Purpose: Rank annual maximum daily precipitation data by year.
Prepared By: Ashton Imlay
Date: 9/25/2012
Reviewed By: Jesus Sanchez
Date: 10/4/2012
Color Codes: Data
Calculation
Notes: 1. Data is from sheet "USW00013878 Annual Max Daily"
2. 1948 and 2012 are not included due to incomplete yearly records.

Rank	Maximum Daily Rainfall (in)	Year	Exceedance Probability
1	12.36	1969	0.016
2	9.82	1962	0.031
3	9.22	1950	0.047
4	8.19	1972	0.063
5	8.15	1996	0.078
6	7.27	1992	0.094
7	6.68	1999	0.109
8	5.77	1974	0.125
9	5.61	1987	0.141
10	5.33	1973	0.156
11	5.22	1953	0.172
12	5.15	1989	0.188
13	5.04	1965	0.203
14	5.02	1997	0.219
15	4.88	1964	0.234
16	4.85	1961	0.250
17	4.79	1985	0.266
18	4.68	2005	0.281
19	4.55	2001	0.297
20	4.49	1955	0.313
21	4.49	1957	0.328
22	4.36	1968	0.344
23	4.32	1980	0.359
24	4.30	1976	0.375
25	4.26	1984	0.391
26	4.24	1981	0.406
27	3.98	1994	0.422
28	3.97	1960	0.438
29	3.95	1995	0.453
30	3.88	1983	0.469
31	3.87	1956	0.484
32	3.74	2002	0.500

Sheet Title: Ranked NOAA Malcolm McKinnon Airport Annual Maximum Daily Precipitation Data
Purpose: Rank annual maximum daily precipitation data by year.
Prepared By: Ashton Imlay
Date: 9/25/2012
Reviewed By: Jesus Sanchez
Date: 10/4/2012
Color Codes: Data
Calculation
Notes: 1. Data is from sheet "USW00013878 Annual Max Daily"
2. 1948 and 2012 are not included due to incomplete yearly records.

Rank	Maximum Daily Rainfall (in)	Year	Exceedance Probability
33	3.73	1959	0.516
34	3.67	1978	0.531
35	3.64	2007	0.547
36	3.63	1977	0.563
37	3.47	2004	0.578
38	3.44	1998	0.594
39	3.28	1951	0.609
40	3.25	1949	0.625
41	3.24	1975	0.641
42	3.22	2011	0.656
43	3.19	1971	0.672
44	3.16	2006	0.688
45	3.14	1954	0.703
46	3.14	1958	0.719
47	3.11	1970	0.734
48	3.01	1952	0.750
49	3.01	1963	0.766
50	2.97	1979	0.781
51	2.96	1993	0.797
52	2.94	1982	0.813
53	2.90	1967	0.828
54	2.70	1988	0.844
55	2.60	1990	0.859
56	2.60	1991	0.875
57	2.59	2009	0.891
58	2.55	1966	0.906
59	2.52	1986	0.922
60	2.45	2000	0.938
61	2.30	2008	0.953
62	2.25	2010	0.969
63	1.84	2003	0.984

Sheet Title: Ranked NOAA Brunswick GA Annual Maximum Daily Precipitation Data
Purpose: Rank annual maximum daily precipitation data by year.
Prepared By: Ashton Imlay
Date: 9/25/2012
Reviewed By: Jesus Sanchez
Date: 10/4/2012
Color Codes: Data
Calculation
Notes: 1. Data is from sheet "USC00091340 Annual Max Daily"
2. 2012 is not included due to an incomplete yearly record.

Rank	Maximum Daily Rainfall (in)	Year	Exceedance Probability
1	9.92	1944	0.009
2	7.93	1950	0.019
3	7.47	1947	0.028
4	7.42	1933	0.037
5	7.30	1928	0.047
6	7.10	1942	0.056
7	6.75	1972	0.065
8	6.53	1996	0.075
9	6.30	1953	0.084
10	6.08	1935	0.093
11	6.00	1920	0.103
12	6.00	1969	0.112
13	5.70	1949	0.121
14	5.60	1994	0.131
15	5.53	1932	0.140
16	5.50	1906	0.150
17	5.45	2005	0.159
18	5.44	1937	0.168
19	4.95	1959	0.178
20	4.95	2001	0.187
21	4.80	1926	0.196
22	4.64	1930	0.206
23	4.60	1943	0.215
24	4.58	1995	0.224
25	4.52	1957	0.234
26	4.51	1964	0.243
27	4.50	1992	0.252
28	4.43	1988	0.262
29	4.39	1991	0.271
30	4.32	1966	0.280
31	4.28	1897	0.290

Sheet Title: Ranked NOAA Brunswick GA Annual Maximum Daily Precipitation Data
Purpose: Rank annual maximum daily precipitation data by year.
Prepared By: Ashton Imlay
Date: 9/25/2012
Reviewed By: Jesus Sanchez
Date: 10/4/2012
Color Codes: Data
Calculation
Notes: 1. Data is from sheet "USC00091340 Annual Max Daily"
2. 2012 is not included due to an incomplete yearly record.

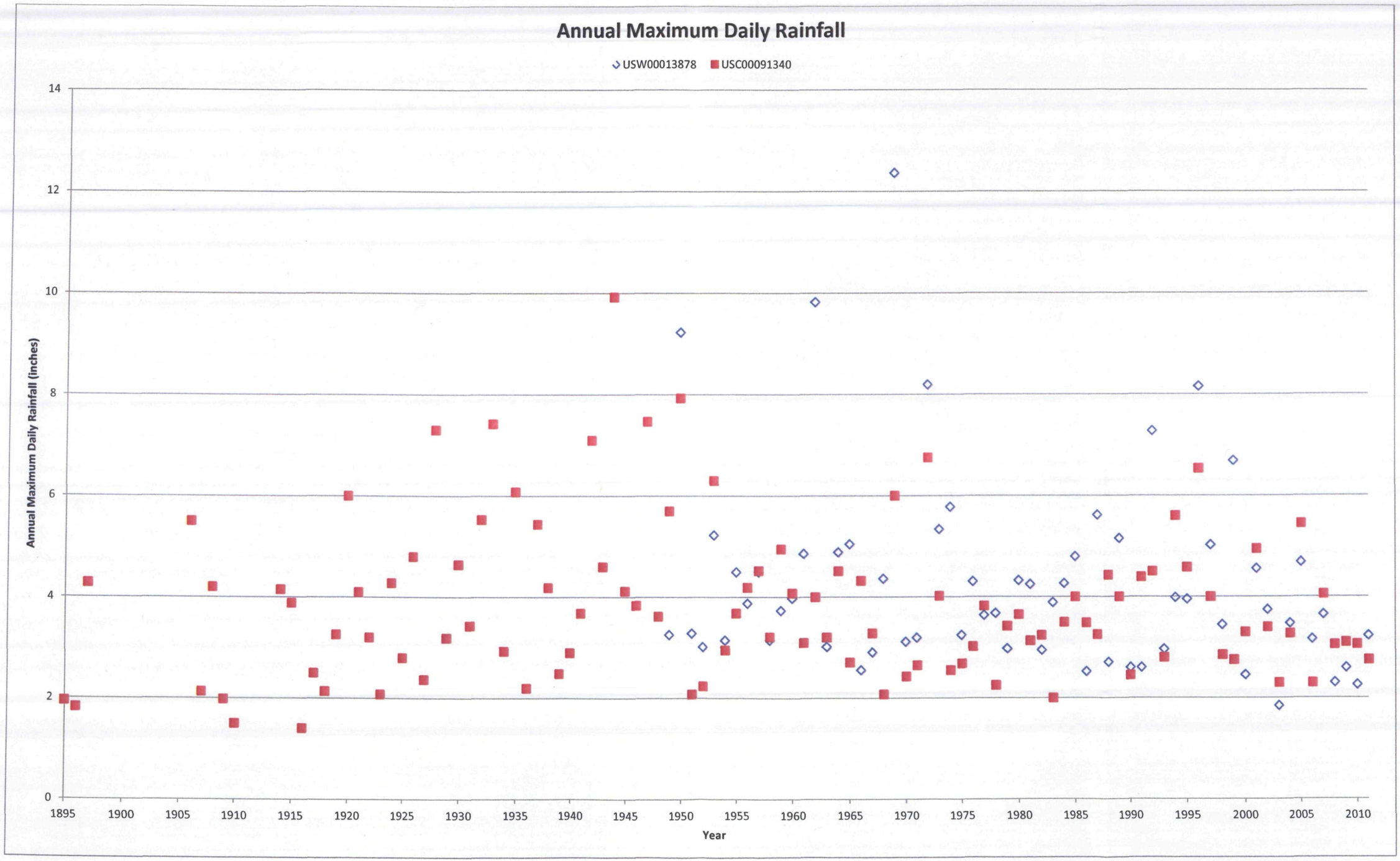
Rank	Maximum Daily Rainfall (in)	Year	Exceedance Probability
32	4.28	1924	0.299
33	4.20	1908	0.308
34	4.19	1938	0.318
35	4.19	1956	0.327
36	4.15	1914	0.336
37	4.12	1945	0.346
38	4.10	1921	0.355
39	4.08	1960	0.364
40	4.05	2007	0.374
41	4.02	1973	0.383
42	4.00	1962	0.393
43	4.00	1985	0.402
44	4.00	1989	0.411
45	4.00	1997	0.421
46	3.88	1915	0.430
47	3.84	1946	0.439
48	3.82	1977	0.449
49	3.68	1941	0.458
50	3.68	1955	0.467
51	3.65	1980	0.477
52	3.62	1948	0.486
53	3.50	1984	0.495
54	3.49	1986	0.505
55	3.43	1931	0.514
56	3.42	1979	0.523
57	3.40	2002	0.533
58	3.30	2000	0.542
59	3.28	1967	0.551
60	3.27	2004	0.561
61	3.26	1919	0.570
62	3.25	1987	0.579

Sheet Title: Ranked NOAA Brunswick GA Annual Maximum Daily Precipitation Data
Purpose: Rank annual maximum daily precipitation data by year.
Prepared By: Ashton Imlay
Date: 9/25/2012
Reviewed By: Jesus Sanchez
Date: 10/4/2012
Color Codes: Data
Calculation
Notes: 1. Data is from sheet "USC00091340 Annual Max Daily"
2. 2012 is not included due to an incomplete yearly record.

Rank	Maximum Daily Rainfall (in)	Year	Exceedance Probability
63	3.24	1982	0.589
64	3.21	1958	0.598
65	3.20	1922	0.607
66	3.20	1963	0.617
67	3.19	1929	0.626
68	3.13	1981	0.636
69	3.10	1961	0.645
70	3.10	2009	0.654
71	3.06	2010	0.664
72	3.05	2008	0.673
73	3.02	1976	0.682
74	2.95	1954	0.692
75	2.93	1934	0.701
76	2.90	1940	0.710
77	2.85	1998	0.720
78	2.80	1925	0.729
79	2.80	1993	0.738
80	2.75	1999	0.748
81	2.75	2011	0.757
82	2.71	1965	0.766
83	2.68	1975	0.776
84	2.65	1971	0.785
85	2.55	1974	0.794
86	2.50	1917	0.804
87	2.49	1939	0.813
88	2.45	1990	0.822
89	2.43	1970	0.832
90	2.37	1927	0.841
91	2.30	2003	0.850
92	2.30	2006	0.860
93	2.25	1978	0.869

Sheet Title: Ranked NOAA Brunswick GA Annual Maximum Daily Precipitation Data
Purpose: Rank annual maximum daily precipitation data by year.
Prepared By: Ashton Imlay
Date: 9/25/2012
Reviewed By: Jesus Sanchez
Date: 10/4/2012
Color Codes: Data
Calculation
Notes: 1. Data is from sheet "USC00091340 Annual Max Daily"
2. 2012 is not included due to an incomplete yearly record.

Rank	Maximum Daily Rainfall (in)	Year	Exceedance Probability
94	2.24	1952	0.879
95	2.20	1936	0.888
96	2.14	1918	0.897
97	2.13	1907	0.907
98	2.08	1923	0.916
99	2.08	1951	0.925
100	2.08	1968	0.935
101	2.00	1983	0.944
102	1.98	1909	0.953
103	1.95	1895	0.963
104	1.82	1896	0.972
105	1.50	1910	0.981
106	1.40	1916	0.991


Annual Maximum Daily Rainfall
USW00013878
USC00091340
Annual Maximum Daily Rainfall (inches)
0
2
4
6
8
10
12
14
1895
1900
1905
1910
1915
1920
1925
1930
1935
1940
1945
1950
1955
1960
1965
1970
1975
1980
1985
1990
1995
2000
2005
2010
Year

APPENDIX D

Attachment 8

Sheet Title: USGS Brunswick River Tidal Data
Purpose: Display tidal data from USGS Station 02226180 Brunswick River at St. Simons Island, GA.
Prepared By: Ashton Imlay
Date: 8/30/2012
Reviewed By: Jesus Sanchez
Date: 9/20/2012
Cell Color Codes: Data columns
Calculation columns
Notes: Raw data downloaded from http://waterdata.usgs.gov/nwis/nwisman/?site_no=02226180&agency_cd=USGS.
Gage datum is 0.0 feet above NAVD88.
Data set is listed as provisional ("provisional data subject to revision").

Date	Daily Tidal High (gage height, ft)	Daily Tidal Low (gage height, ft)
3/1/2012	1.37	-3.97
3/2/2012	1.16	-3.77
3/3/2012	1.63	-3.66
3/4/2012	2.04	-4.19
3/5/2012	2.41	-4.75
3/6/2012	3.47	-5.17
3/7/2012	3.28	-5.00
3/8/2012	3.46	-5.33
3/9/2012	3.57	-5.86
3/10/2012	4.50	-4.99
3/11/2012	3.71	-5.04
3/12/2012	3.42	-5.09
3/13/2012	2.42	-4.63
3/14/2012	2.93	-4.49
3/15/2012	2.56	-4.27
3/16/2012	2.37	-4.27
3/17/2012	2.44	-4.49
3/18/2012	2.47	-4.51
3/19/2012	2.76	-4.47
3/20/2012	2.89	-4.54
3/21/2012	2.87	-4.66
3/22/2012	2.84	-4.88
3/23/2012	3.05	-4.62
3/24/2012	2.56	-4.61
3/25/2012	2.57	-4.82
3/26/2012	2.62	-3.80
3/27/2012	2.86	-3.59
3/28/2012	1.54	-3.47
3/29/2012	2.03	-3.76
3/30/2012	1.51	-3.47
3/31/2012	1.80	-3.67

Sheet Title: USGS Brunswick River Tidal Data
Purpose: Display tidal data from USGS Station 02226180 Brunswick River at St. Simons Island, GA.
Prepared By: Ashton Imlay
Date: 8/30/2012
Reviewed By: Jesus Sanchez
Date: 9/20/2012
Cell Color Codes: Data columns
Calculation columns
Notes: Raw data downloaded from http://waterdata.usgs.gov/nwis/nwisman/?site_no=02226180&agency_cd=USGS.
Gage datum is 0.0 feet above NAVD88.
Data set is listed as provisional ("provisional data subject to revision").

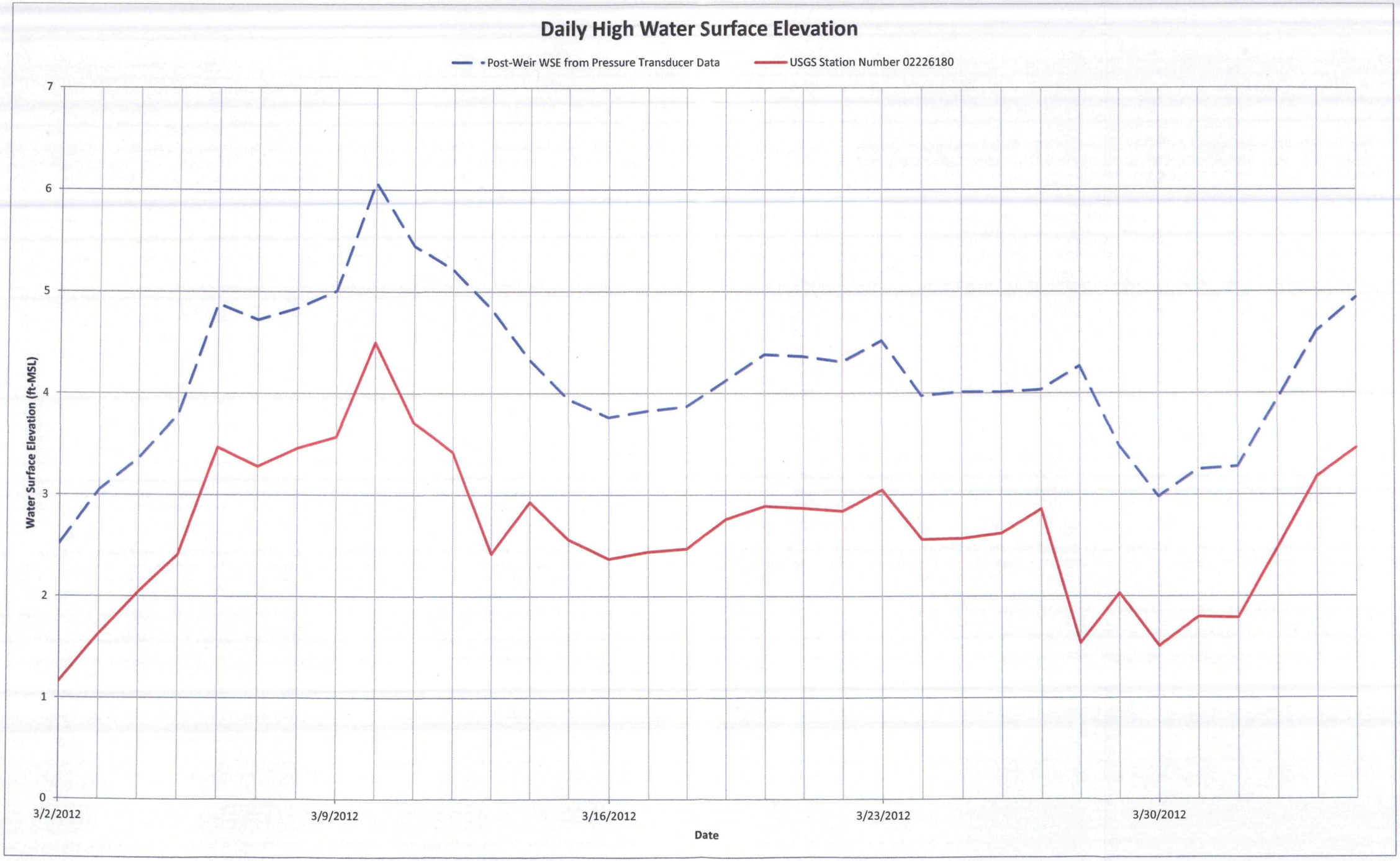
Date	Daily Tidal High (gage height, ft)	Daily Tidal Low (gage height, ft)
4/1/2012	1.79	-3.41
4/2/2012	2.48	-3.56
4/3/2012	3.18	-3.45
4/4/2012	3.46	-4.42
4/5/2012	3.93	-4.93
4/6/2012	5.14	-5.14
4/7/2012	4.65	-4.76
4/8/2012	4.12	-5.58
4/9/2012	4.27	-5.63
4/10/2012	3.84	-4.79
4/11/2012	2.55	-4.45
4/12/2012	3.58	-3.26
4/13/2012	3.37	-3.65
4/14/2012	2.86	-3.91
4/15/2012	2.34	-4.27
4/16/2012	2.31	-4.52
4/17/2012	2.52	-4.42
4/18/2012	2.93	-4.39
4/19/2012	3.37	-3.75
4/20/2012	3.86	-3.36
4/21/2012	3.69	-3.35
4/22/2012	3.21	-3.52
4/23/2012	2.79	-4.01
4/24/2012	2.41	-3.92
4/25/2012	2.07	-3.91
4/26/2012	1.79	-4.13
4/27/2012	0.90	-3.98
4/28/2012	2.00	-3.85
4/29/2012	2.38	-3.48
4/30/2012	2.40	-3.59

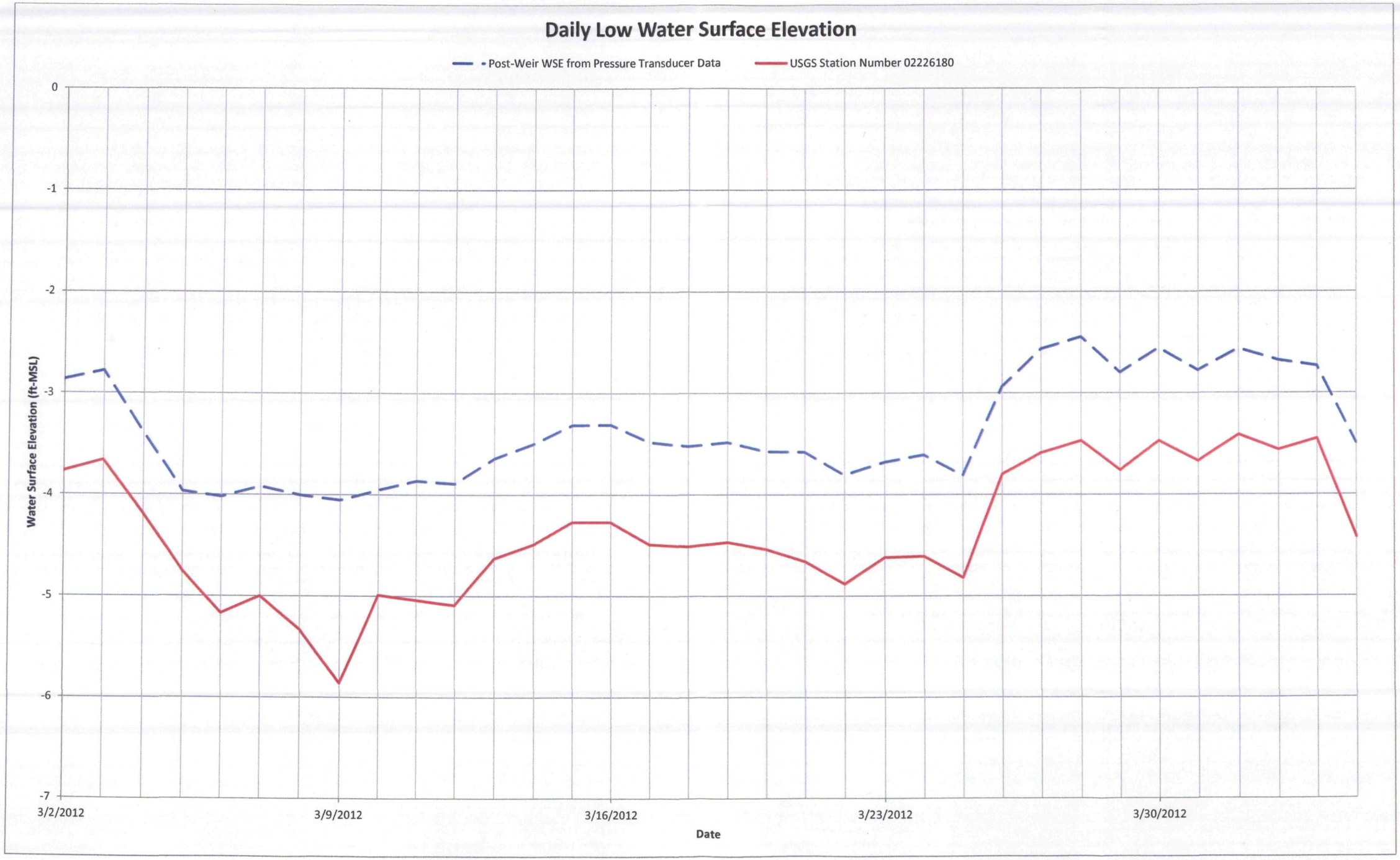
Sheet Title: Water Surface Elevation Plotting Data
Purpose: Collect calculations onto one sheet for ease of plotting.
Prepared By: Ashton Imlay
Date: 8/30/2012
Reviewed By: Jesus Sanchez
Date: 10/4/2012
Cell Color Codes: Data columns
Calculation columns
Notes:

Date	Daily High Water Elevation			Daily Low Water Elevation		
	USGS 02226180 (ft-MSL)	Post-Weir (ft-MSL)	Post-Weir - USGS (ft)	USGS 02226180 (ft-MSL)	Post-Weir (ft-MSL)	Post-Weir - USGS (ft)
3/2/2012	1.16	2.52	1.36	-3.77	-2.87	0.90
3/3/2012	1.63	3.05	1.42	-3.66	-2.78	0.88
3/4/2012	2.04	3.36	1.32	-4.19	-3.39	0.80
3/5/2012	2.41	3.79	1.38	-4.75	-3.97	0.78
3/6/2012	3.47	4.88	1.41	-5.17	-4.02	1.15
3/7/2012	3.28	4.72	1.44	-5.00	-3.92	1.08
3/8/2012	3.46	4.84	1.38	-5.33	-4.01	1.32
3/9/2012	3.57	5.01	1.44	-5.86	-4.06	1.80
3/10/2012	4.50	6.07	1.57	-4.99	-3.96	1.03
3/11/2012	3.71	5.45	1.74	-5.04	-3.87	1.17
3/12/2012	3.42	5.22	1.80	-5.09	-3.89	1.20
3/13/2012	2.42	4.83	2.41	-4.63	-3.65	0.98
3/14/2012	2.93	4.32	1.39	-4.49	-3.50	0.99
3/15/2012	2.56	3.94	1.38	-4.27	-3.32	0.95
3/16/2012	2.37	3.76	1.39	-4.27	-3.31	0.96
3/17/2012	2.44	3.82	1.38	-4.49	-3.48	1.01
3/18/2012	2.47	3.87	1.40	-4.51	-3.52	0.99
3/19/2012	2.76	4.12	1.36	-4.47	-3.49	0.98
3/20/2012	2.89	4.38	1.49	-4.54	-3.58	0.96
3/21/2012	2.87	4.36	1.49	-4.66	-3.58	1.08
3/22/2012	2.84	4.31	1.47	-4.88	-3.81	1.07
3/23/2012	3.05	4.51	1.46	-4.62	-3.68	0.94
3/24/2012	2.56	3.97	1.41	-4.61	-3.61	1.00
3/25/2012	2.57	4.01	1.44	-4.82	-3.81	1.01
3/26/2012	2.62	4.01	1.39	-3.80	-2.94	0.86
3/27/2012	2.86	4.03	1.17	-3.59	-2.57	1.02
3/28/2012	1.54	4.26	2.72	-3.47	-2.45	1.02
3/29/2012	2.03	3.48	1.45	-3.76	-2.80	0.96
3/30/2012	1.51	2.98	1.47	-3.47	-2.56	0.91
3/31/2012	1.80	3.25	1.45	-3.67	-2.78	0.89
4/1/2012	1.79	3.27	1.48	-3.41	-2.56	0.85
4/2/2012	2.48	3.93	1.45	-3.56	-2.68	0.88
4/3/2012	3.18	4.60	1.42	-3.45	-2.73	0.72
4/4/2012	3.46	4.93	1.47	-4.42	-3.50	0.92

Sheet Title: Maximum and Minimum Daily WSE Data
Purpose: Calculate maximum daily WSE, minimum daily WSE, and simple statistics.
Prepared By: Ashton Imlay
Date: 8/30/2012
Reviewed By: Jesus Sanchez
Date: 10/4/2012
Cell Color Codes: Data columns
Calculation columns
Notes: WSE data is from sheet "WSE Data" N:\Ashland\OU1 RIFS Implementation\surface water investigation\Water Level data.xlsx.
Units are in ft-MSL.

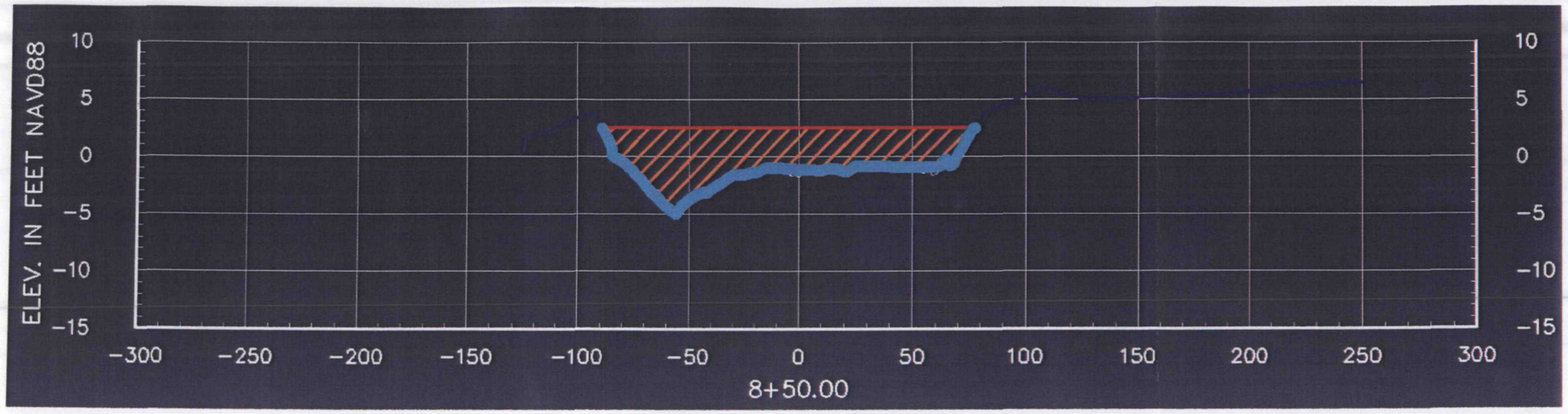
Statistic	Daily High Water Elevation		Daily Low Water Elevation	
	In-Weir	Post-Weir	In-Weir	Post-Weir
Average	4.3	4.2	0.2	-3.4
Median	4.2	4.1	0.1	-3.5
Minimum	2.6	2.5	0.1	-4.1
Maximum	6.2	6.1	0.2	-2.4


Daily High Water Surface Elevation
Post-Weir WSE from Pressure Transducer Data
USGS Station Number 02226180
Water Surface Elevation (ft-MSL)
7
6
5
4
3
2
1
0
3/2/2012
3/9/2012
3/16/2012
3/23/2012
3/30/2012
Date


Daily Low Water Surface Elevation
Post-Weir WSE from Pressure Transducer Data
USGS Station Number 02226180
Water Surface Elevation (ft-MSL)
0
-1
-2
-3
-4
-5
-6
-7
3/2/2012
3/9/2012
3/16/2012
3/23/2012
3/30/2012
Date

APPENDIX D

Attachment 9



A = Wetted Area = Hatched Area = 650 ft^2

P = Wetted Perimeter = Thick Perimeter Line = 169 ft

R = Hydraulic Radius = A/P = 650 ft^2 / 169 ft = 3.85 ft

R = A/P = 3.85 ft

ω = unit weight of water = 62.4 lb/ft^3

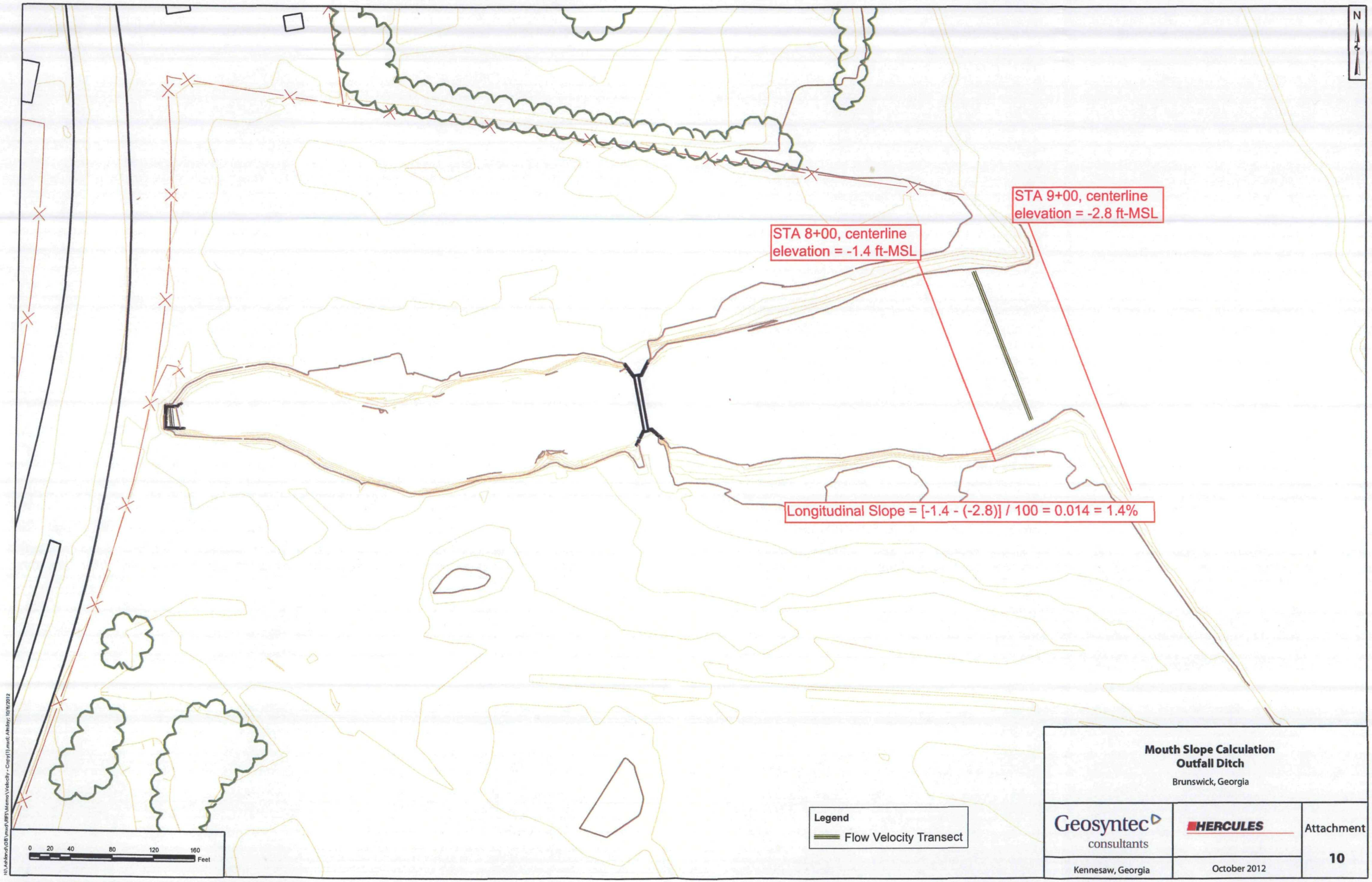
S = slope = 0.014 ft/ft

τ_0 = shear stress = ω*R*S = (62.4 lb/ft^3)*(3.85 ft)*(0.014 ft/ft) = 3.36 lb/ft^2

Note: Wetted area and wetted perimeter were measured in AutoCAD, at Station 8+50.00, and assuming a water depth of 7.5 ft at the mouth of the outfall ditch.

APPENDIX D

Attachment 10



Mouth Slope Calculation
Outfall Ditch
Brunswick, Georgia

Geosyntec consultants | HERCULES | Attachment 10

Kennesaw, Georgia | October 2012

APPENDIX D

Attachment 11

654.0807 Allowable velocity and shear stress for channel lining materials

Allowable velocity and allowable shear stress values for a number of different channel lining materials are presented in table 8–11. Data in the table were compiled from many sources by Fischenich (2001b). Information for specific soil bioengineering practices is provided in NEH654 TS14I. Ranges of allowable velocity and shear stress, therefore, are presented in the table. For manufactured products, the designer should consult the manufacturer's guidelines to determine thresholds for a specific product.

The values in table 8–11 relate to cross-sectional averaged values. The data typically come from flumes where the flow is uniform and does not exhibit the same level of turbulence as natural channels. The recommended values are empirically derived. The designer should consider modifying tabular values based on site-specific conditions such as duration of flow, soils, temperature, debris, ice load in the stream, and plant species, as well as channel shape and planform (Hoag and Fripp 2002). To account for some of these differences, Fischenich recommends that a factor of safety of between 1.2 and 1.3 be applied to the tabular values.

The allowable limits of velocity and shear stress published by manufacturers for various products are typically developed from studies using short durations. Studies have shown that extended flow duration reduces the erosion resistance of many types of erosion control products as shown in figure 8–25. Fischenich (2001b) recommends a factor of safety be applied when flow duration exceeds a couple of hours.

Table 8–11 Allowable velocity and shear stress for selected lining materials[1/]

Boundary category	Boundary type	Allowable velocity (ft/s)	Allowable shear stress (lb/ft²)	Citation(s)
Temporary degradable reinforced erosion control products (RECP)	Jute net	1–2.5	0.45	B, E, F
	Straw with net	1–3	1.5–1.65	B, E, F
	Coconut fiber with net	3–4	2.25	B, F
	Fiberglass roving	2.5–7	2	B, E, F
Nondegradable RECP	Unvegetated	5–7	3	B, D, F
	Partially established	7.5–15	4–6	B, D, F
	Fully vegetated	8–21	8	C, F
Hard surface	Gabions	1–19	10	A
	Concrete	>18	12.5	E

1/ Ranges of values generally reflect multiple sources of data or different testing conditions

(Goff 1999)
(Gray and Sotir 1996)
(Julien 1995)
(Kouwen, Li, and Simons 1980)
(Norman 1975)
(TXDOT 1999)

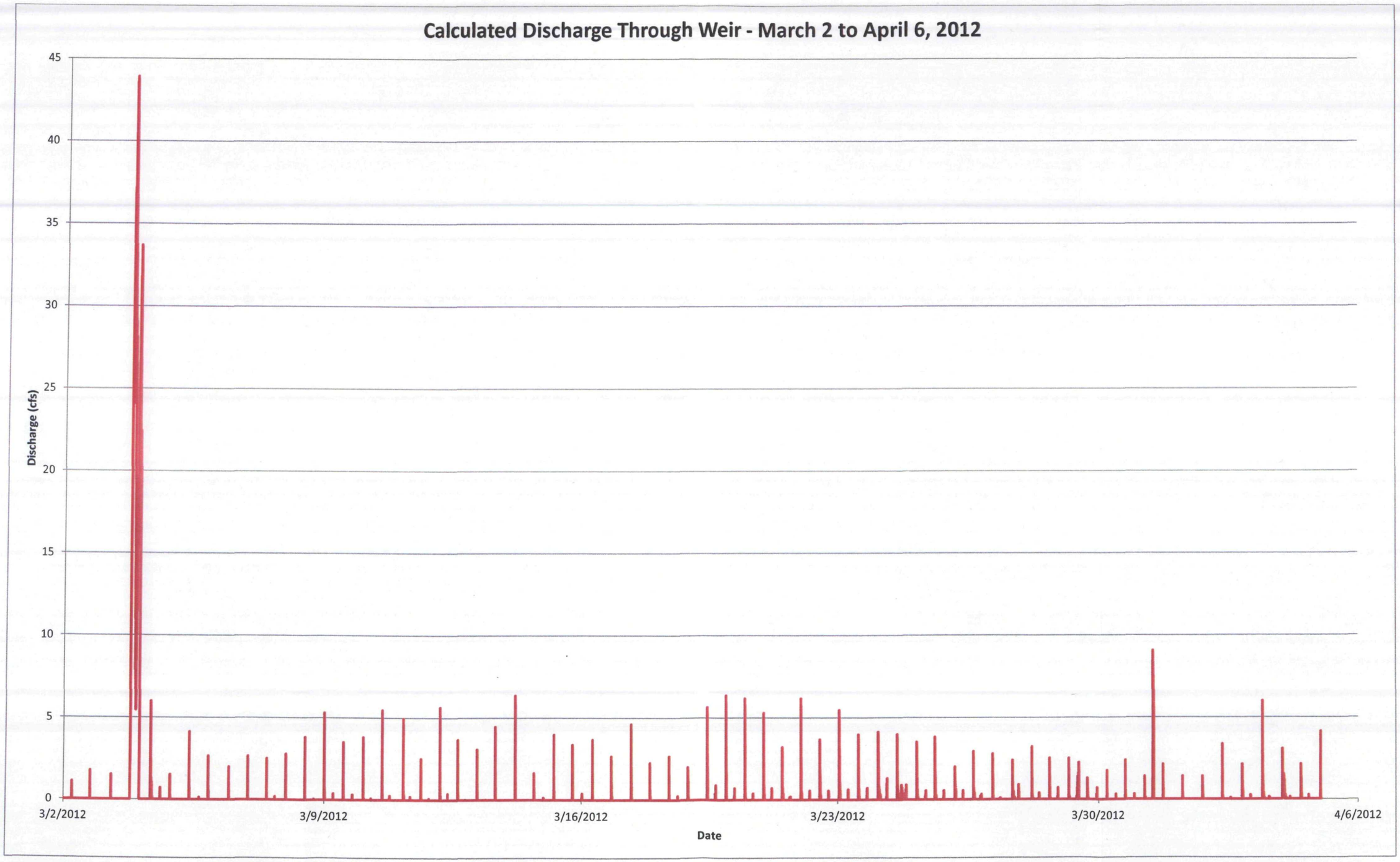
APPENDIX D

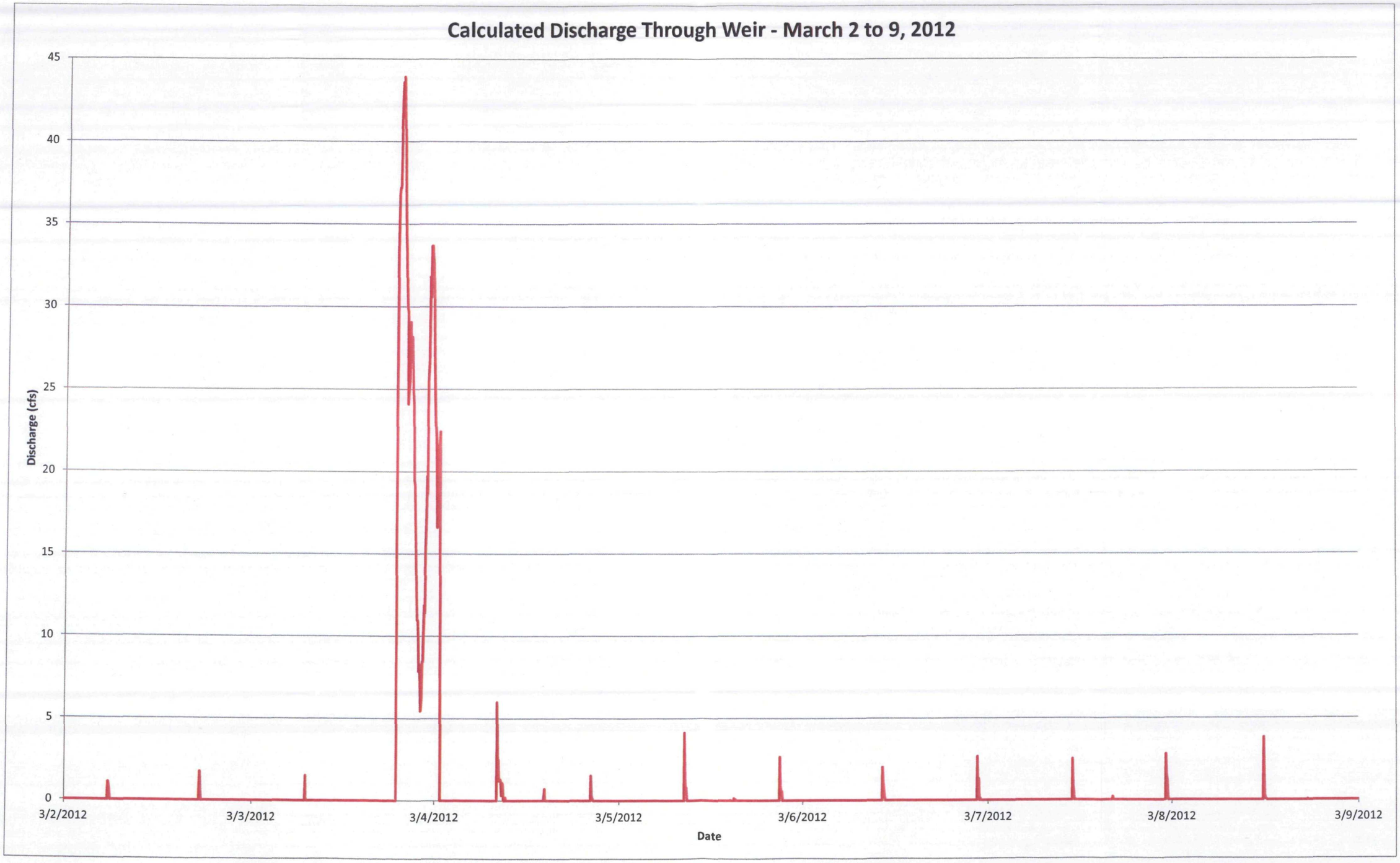
Attachment 12

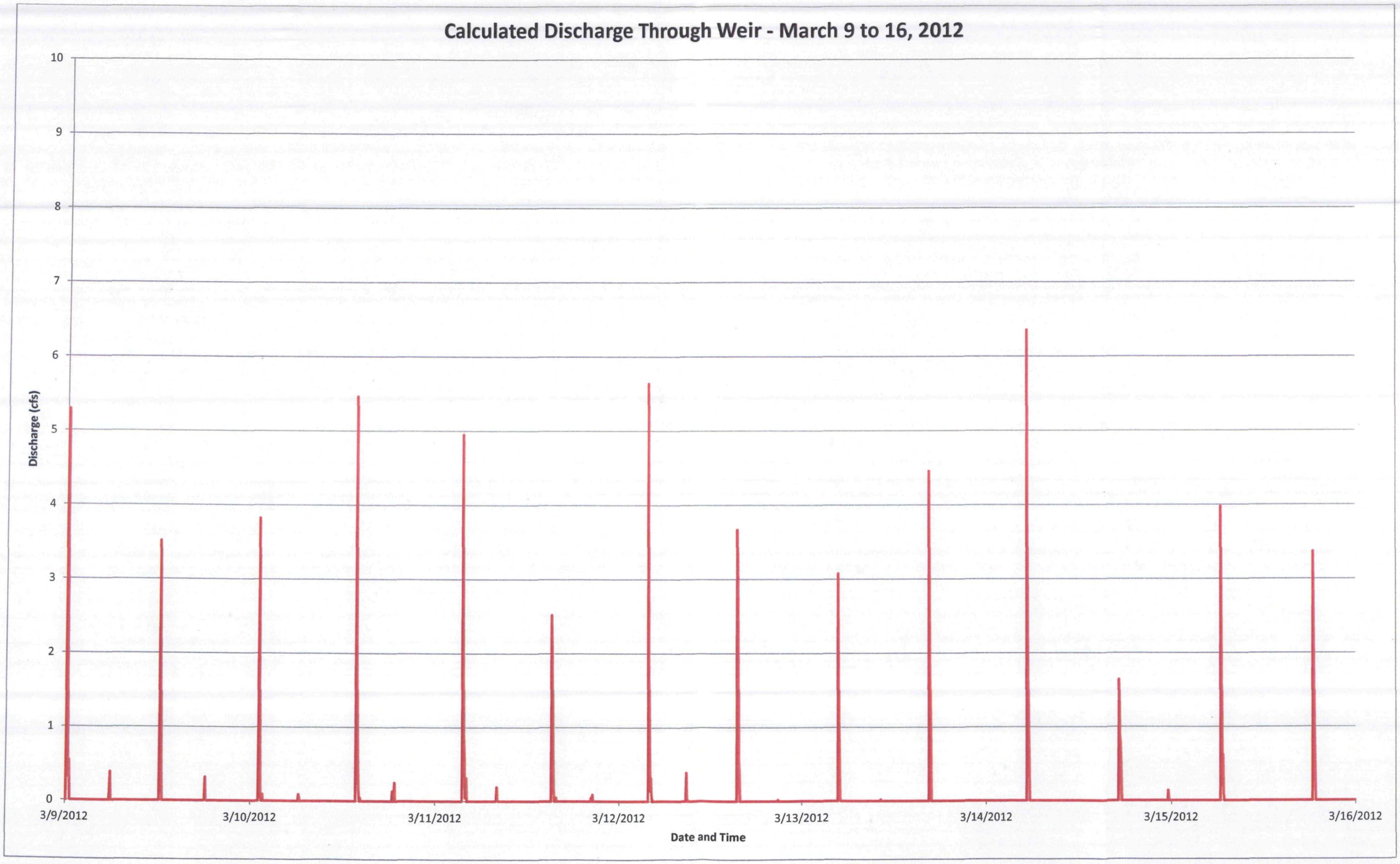
Sheet Title: Weir Dicharge Calculations
Purpose: Calculate discharge over weir at the time of each pressure transducer measurement.
Prepared By: Ashton Imlay
Date: 9/11/2012
Reviewed By: Jesus Sanchez
Date: 10/5/2012
Cell Color Codes: Data column
Calculation column

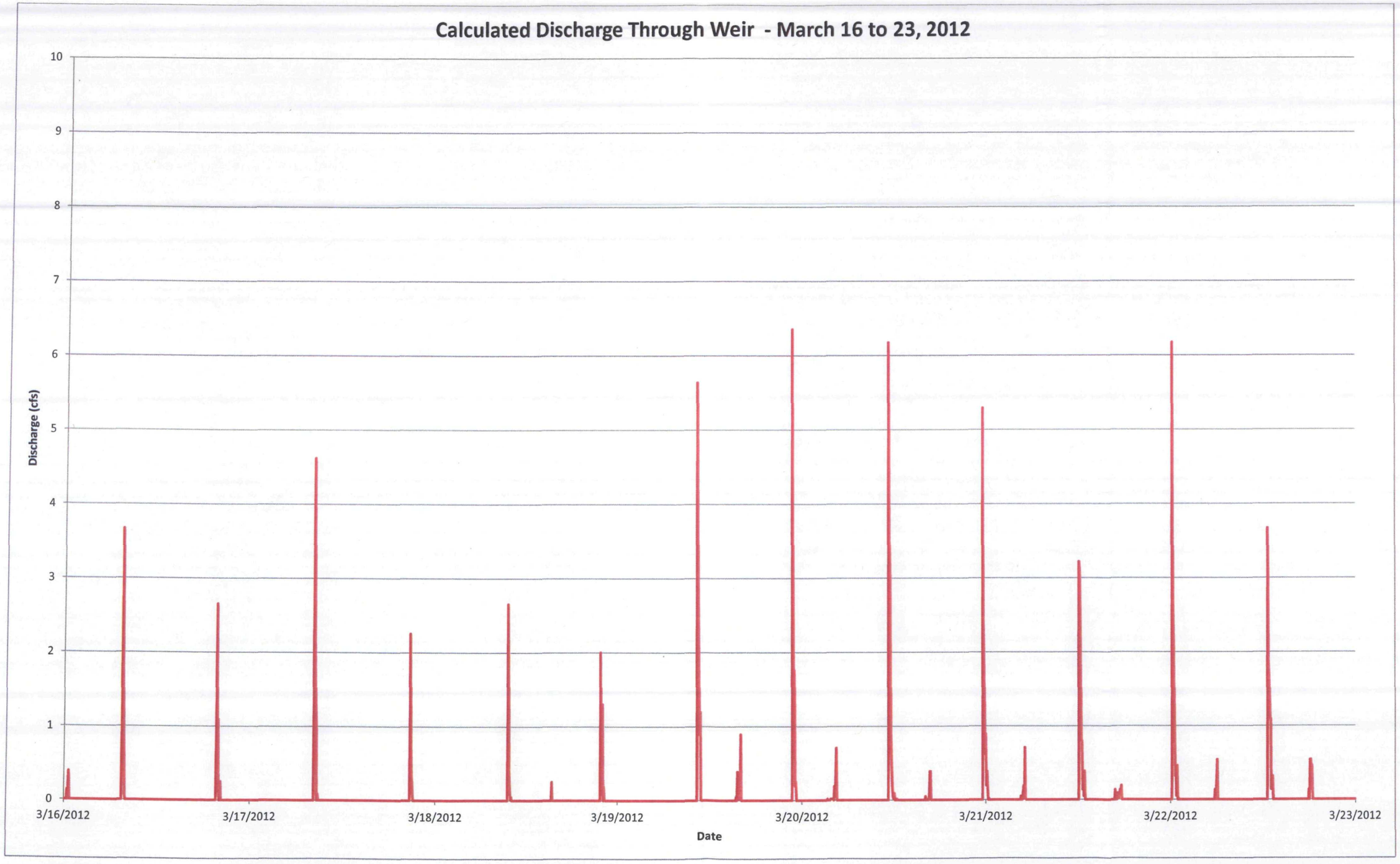
Notes: WSE Data copied from "Water Level data" (will not automatically update).
Weir crest is assumed to be 0.23 ft-MSL.
When In-Weir WSE is greater than 0.73 ft-MSL, discharge is calculated using the Suppressed Rectangular Sharp-Crested Weir Discharge Equation [$Q = C_w*B*H^{(3/2)}$].
When In-Weir WSE is less than 0.73 ft-MSL, discharge is calculated using the Contracted Rectangular Sharp-Crested Weir Discharge Equation [$Q = C_w*(B - 0.2*H)*H^{(3/2)}$].
Weir length is measured to be 52 ft with six, 1-ft wide obstructions.
"n/a" denotes the inability to use weir discharge equations because the Post-Weir WSE is not 0.2 feet below the crest of the weir (US Bureau of Reclamation, Water Measurement Manual, 2001).

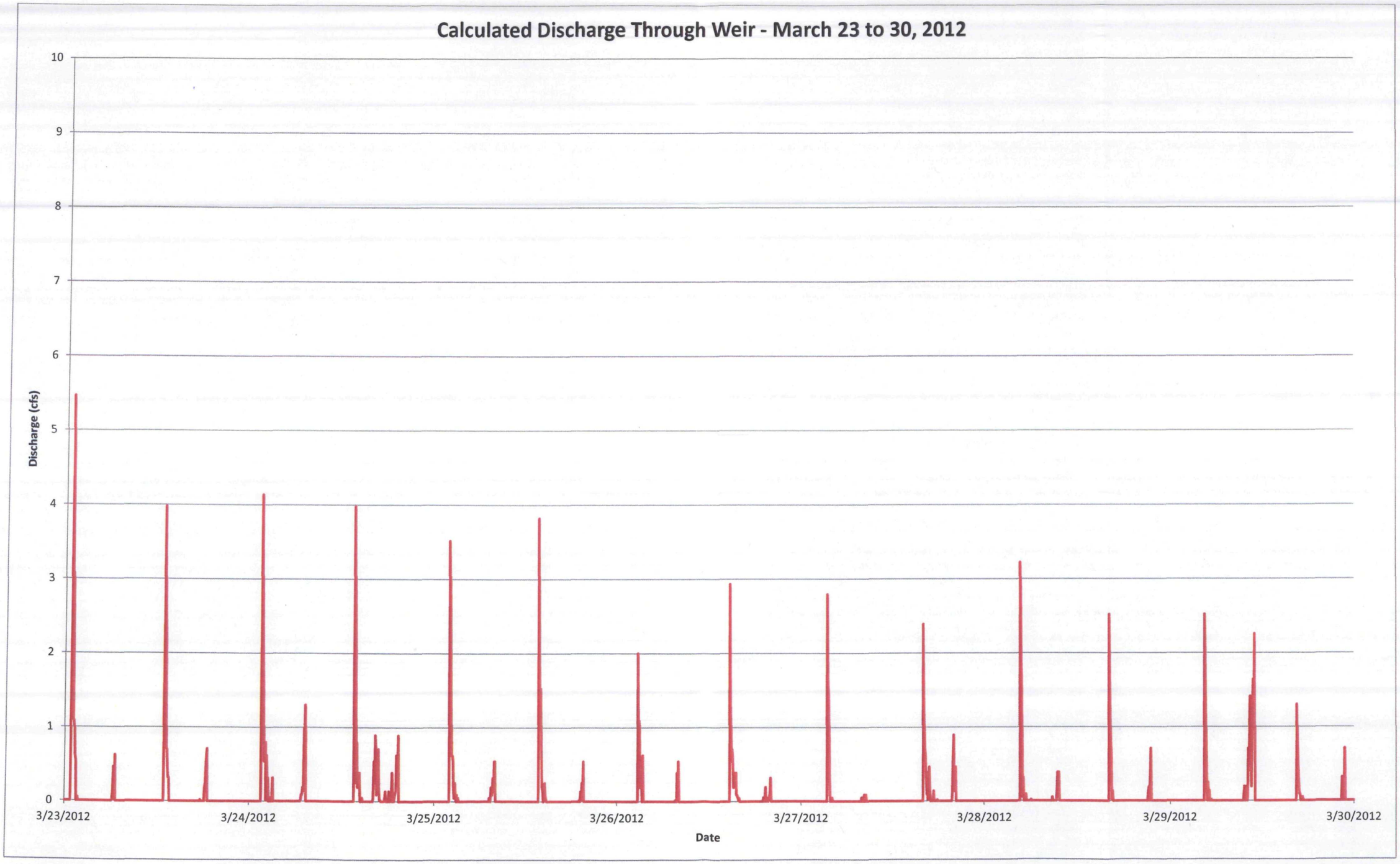
Date & Time	In-Weir WSE (ft-MSL)	Post-Weir WSE (ft-MSL)	Head Above Crest (ft)	Discharge, Q (cfs)
3/2/2012 0:00	0.2	0.2	0.0	n/a
3/2/2012 0:05	0.4	0.3	0.0	n/a
3/2/2012 0:10	0.6	0.4	0.0	n/a
3/2/2012 0:15	0.7	0.6	0.0	n/a
3/2/2012 0:20	0.8	0.7	0.0	n/a
3/2/2012 0:25	0.9	0.8	0.0	n/a
3/2/2012 0:30	1.0	0.9	0.0	n/a
3/2/2012 0:35	1.1	1.0	0.0	n/a
3/2/2012 0:40	1.3	1.1	0.0	n/a
3/2/2012 0:45	1.3	1.2	0.0	n/a
3/2/2012 0:50	1.5	1.3	0.0	n/a
3/2/2012 0:55	1.6	1.5	0.0	n/a
3/2/2012 1:00	1.7	1.5	0.0	n/a
3/2/2012 1:05	1.8	1.7	0.0	n/a
3/2/2012 1:10	1.8	1.7	0.0	n/a
3/2/2012 1:15	1.9	1.8	0.0	n/a
3/2/2012 1:20	2.0	1.9	0.0	n/a
3/2/2012 1:25	2.1	2.0	0.0	n/a
3/2/2012 1:30	2.1	2.0	0.0	n/a
3/2/2012 1:35	2.2	2.1	0.0	n/a
3/2/2012 1:40	2.2	2.1	0.0	n/a
3/2/2012 1:45	2.3	2.2	0.0	n/a
3/2/2012 1:50	2.4	2.2	0.0	n/a
3/2/2012 1:55	2.4	2.3	0.0	n/a

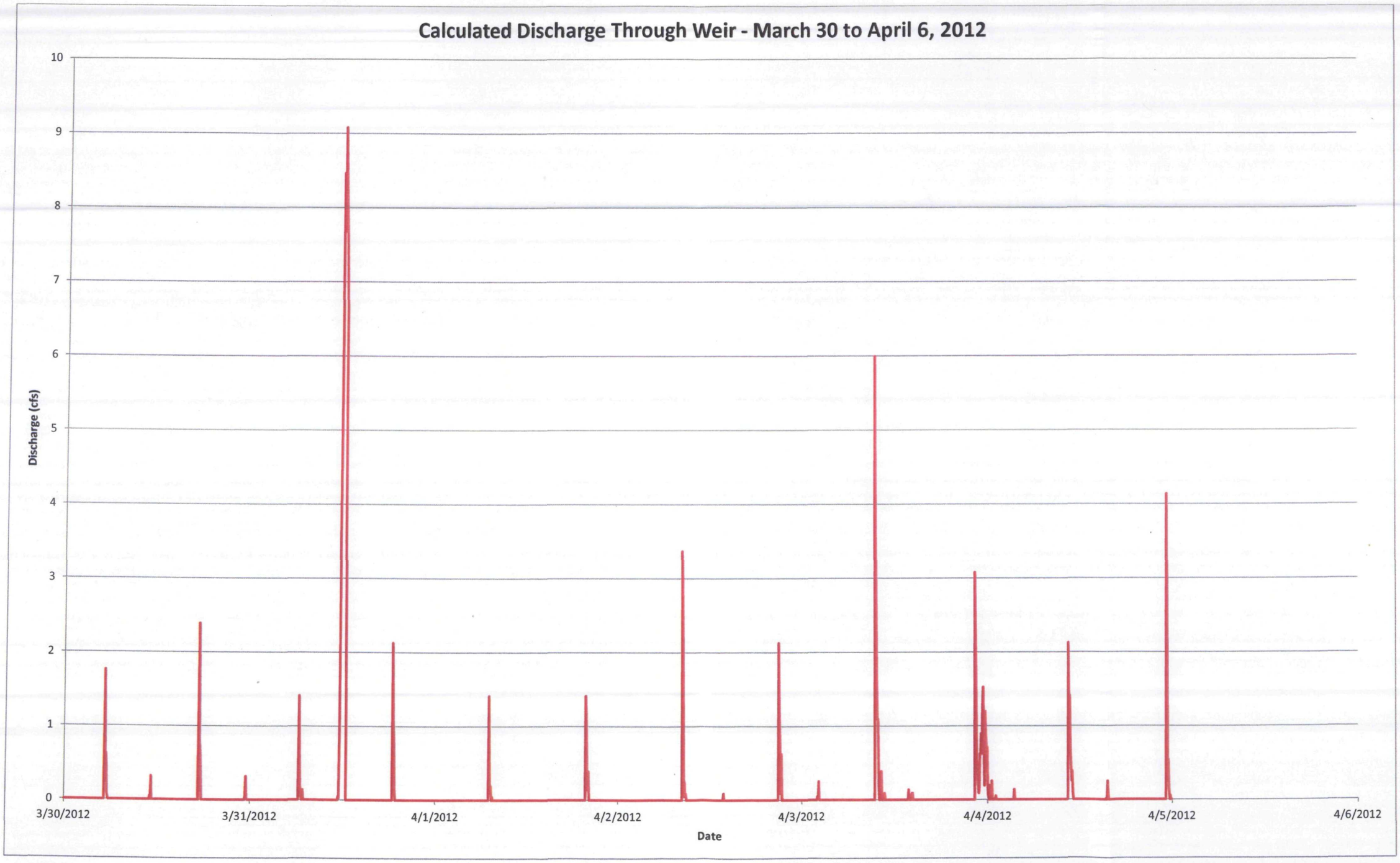

Calculated Discharge Through Weir - March 2 to April 6, 2012
Discharge (cfs)
45
40
35
30
25
20
15
10
5
0
3/2/2012
3/9/2012
3/16/2012
3/23/2012
3/30/2012
4/6/2012
Date


Calculated Discharge Through Weir - March 2 to 9, 2012
Discharge (cfs)
45
40
35
30
25
20
15
10
5
0
3/2/2012
3/3/2012
3/4/2012
3/5/2012
3/6/2012
3/7/2012
3/8/2012
3/9/2012
Date


Calculated Discharge Through Weir - March 9 to 16, 2012
Discharge (cfs)
10
9
8
7
6
5
4
3
2
1
0
3/9/2012
3/10/2012
3/11/2012
3/12/2012
3/13/2012
3/14/2012
3/15/2012
3/16/2012
Date and Time


Calculated Discharge Through Weir - March 16 to 23, 2012
Discharge (cfs)
10
9
8
7
6
5
4
3
2
1
0
3/16/2012
3/17/2012
3/18/2012
3/19/2012
3/20/2012
3/21/2012
3/22/2012
3/23/2012
Date


Calculated Discharge Through Weir - March 23 to 30, 2012
Discharge (cfs)
10
9
8
7
6
5
4
3
2
1
0
3/23/2012
3/24/2012
3/25/2012
3/26/2012
3/27/2012
3/28/2012
3/29/2012
3/30/2012
Date


Calculated Discharge Through Weir - March 30 to April 6, 2012
Discharge (cfs)
10
9
8
7
6
5
4
3
2
1
0
3/30/2012
3/31/2012
4/1/2012
4/2/2012
4/3/2012
4/4/2012
4/5/2012
4/6/2012
Date

APPENDIX D

Attachment 13

Sheet Title: List and Statistics of Peak Seepage Rate
Purpose: List assumed peak discharge rates from weir for calculating seepage rates.
Prepared By: Jesus Sanchez
Date: 10/5/2012
Reviewed By: Ashton Imlay
Date: 10/8/2012
Cell Color Codes: Data columns
Calculation columns

Notes: Assumed peak discharge rates as a result of seepage were discarded for this analysis if rainfall was recorded at either the Malcolm McKinnon Airport [USW00013878] or Brunswick GA [USC00091340] rainfall gauge. Rainfall was measured at either of those two gauges during the measurement period of interest on the following dates: 3/3, 3/4, 3/9, 3/21, 3/23, 3/24, 3/25, 3/31, 4/3.

Date	Peak Discharge Rate (cfs)
03/05/2012 15:10	0.14
03/07/2012 03:55	0.00
03/07/2012 16:20	0.19
03/10/2012 06:20	0.09
03/10/2012 18:30	0.14
03/11/2012 08:10	0.19
03/11/2012 20:35	0.09
03/12/2012 09:10	0.39
03/12/2012 20:55	0.02
03/13/2012 10:15	0.02
03/14/2012 23:35	0.14
03/16/2012 00:35	0.39
03/18/2012 15:20	0.25
03/19/2012 16:00	0.89
03/20/2012 04:30	0.71
03/20/2012 16:45	0.39
03/22/2012 06:00	0.54
03/22/2012 18:00	0.54
03/26/2012 08:05	0.54
03/26/2012 20:05	0.32
03/27/2012 08:25	0.09
03/28/2012 09:20	0.39
03/28/2012 21:30	0.71
03/29/2012 11:00	2.26
03/29/2012 22:50	0.71
03/30/2012 23:30	0.32
04/04/2012 03:25	0.14
04/04/2012 15:40	0.25

Statistic	Peak Discharge Rate (cfs)	Peak Seepage Rate (cfs/ft^2)
Minimum	0.00	8.6E-09
Median	0.29	9.1E-06
Average	0.39	1.2E-05
Maximum	2.26	7.2E-05

APPENDIX D

Attachment 14

FIGURE 114

CULVERT CAPACITY
6 x 5-FOOT (SPAN x RISE) BOX SECTION
EQUIVALENT 75-INCH CIRCULAR

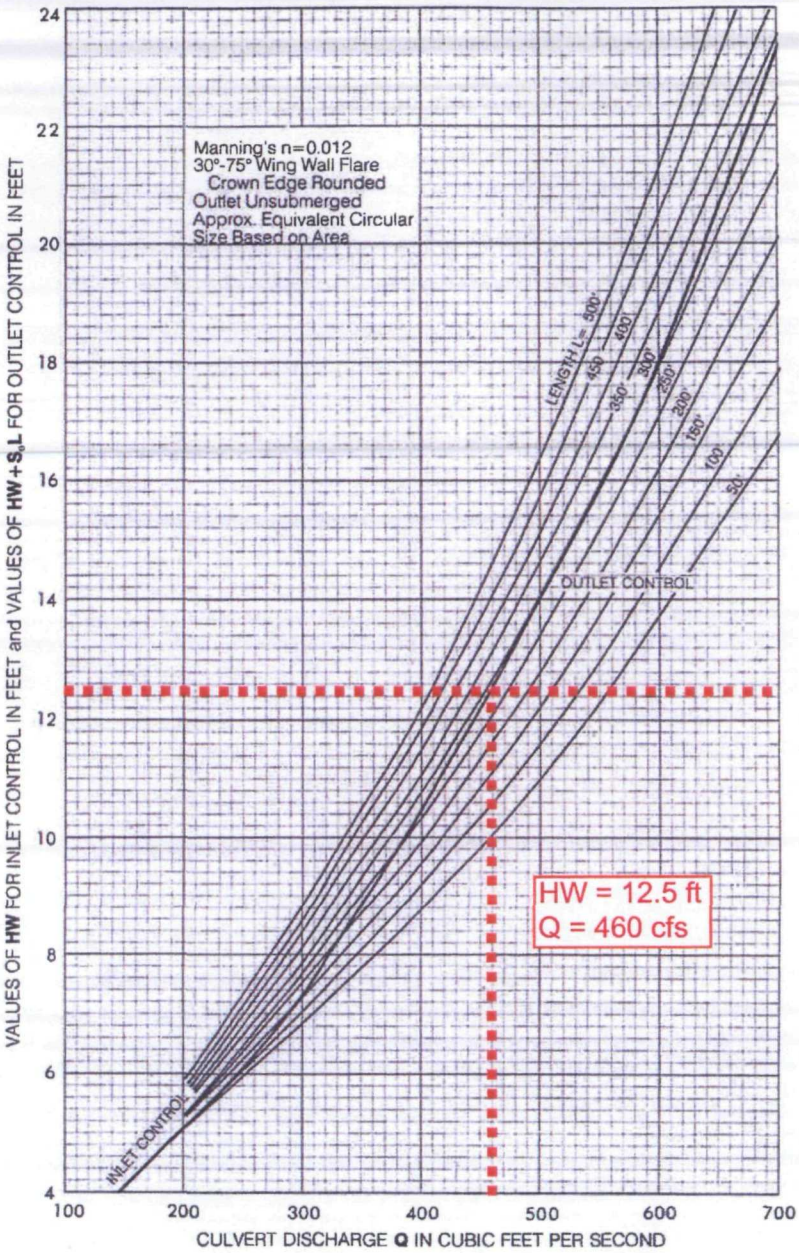
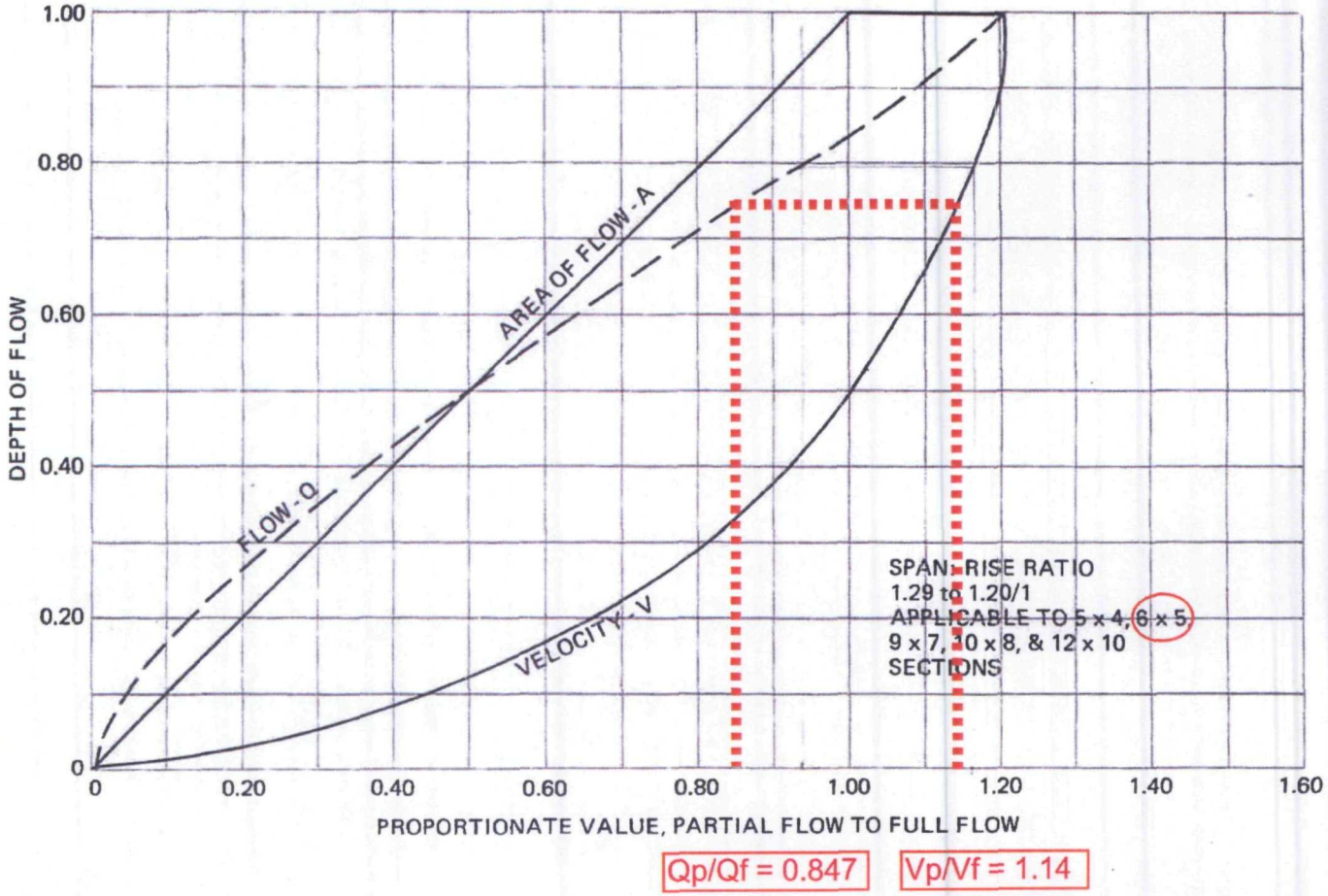


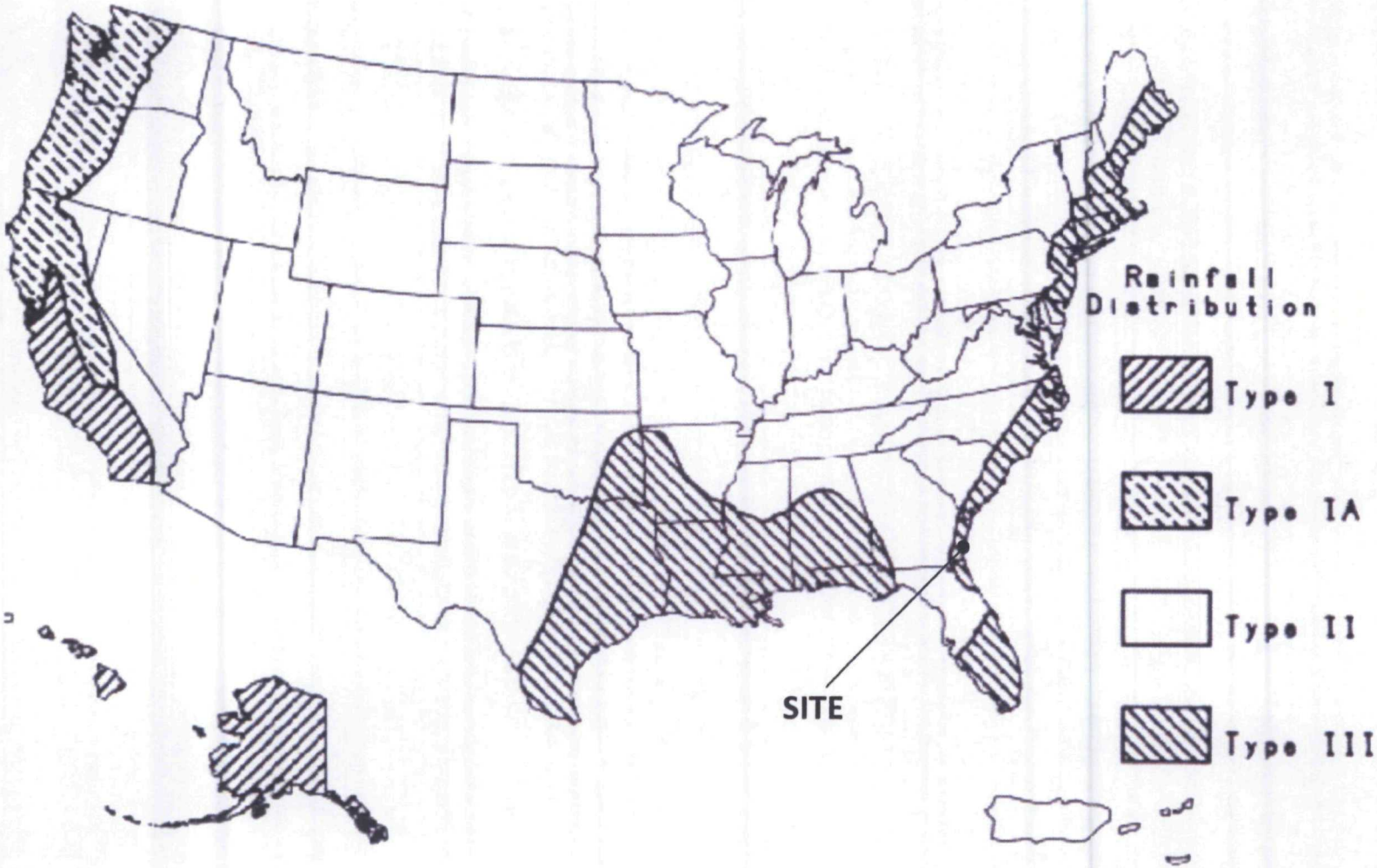
FIGURE 24.7

RELATIVE VELOCITY AND FLOW IN PRECAST BOX SECTIONS FOR ANY DEPTH OF FLOW



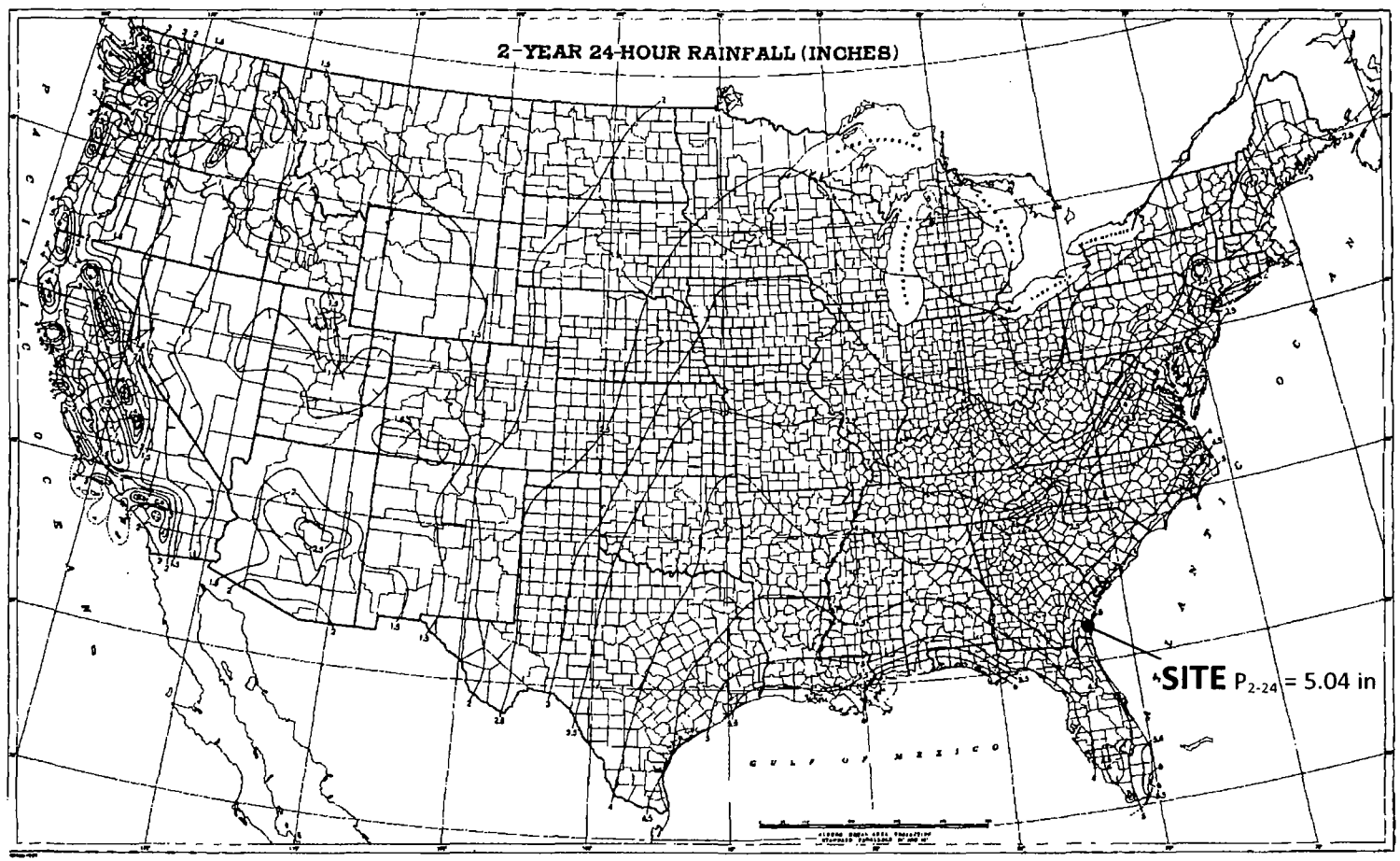
APPENDIX D

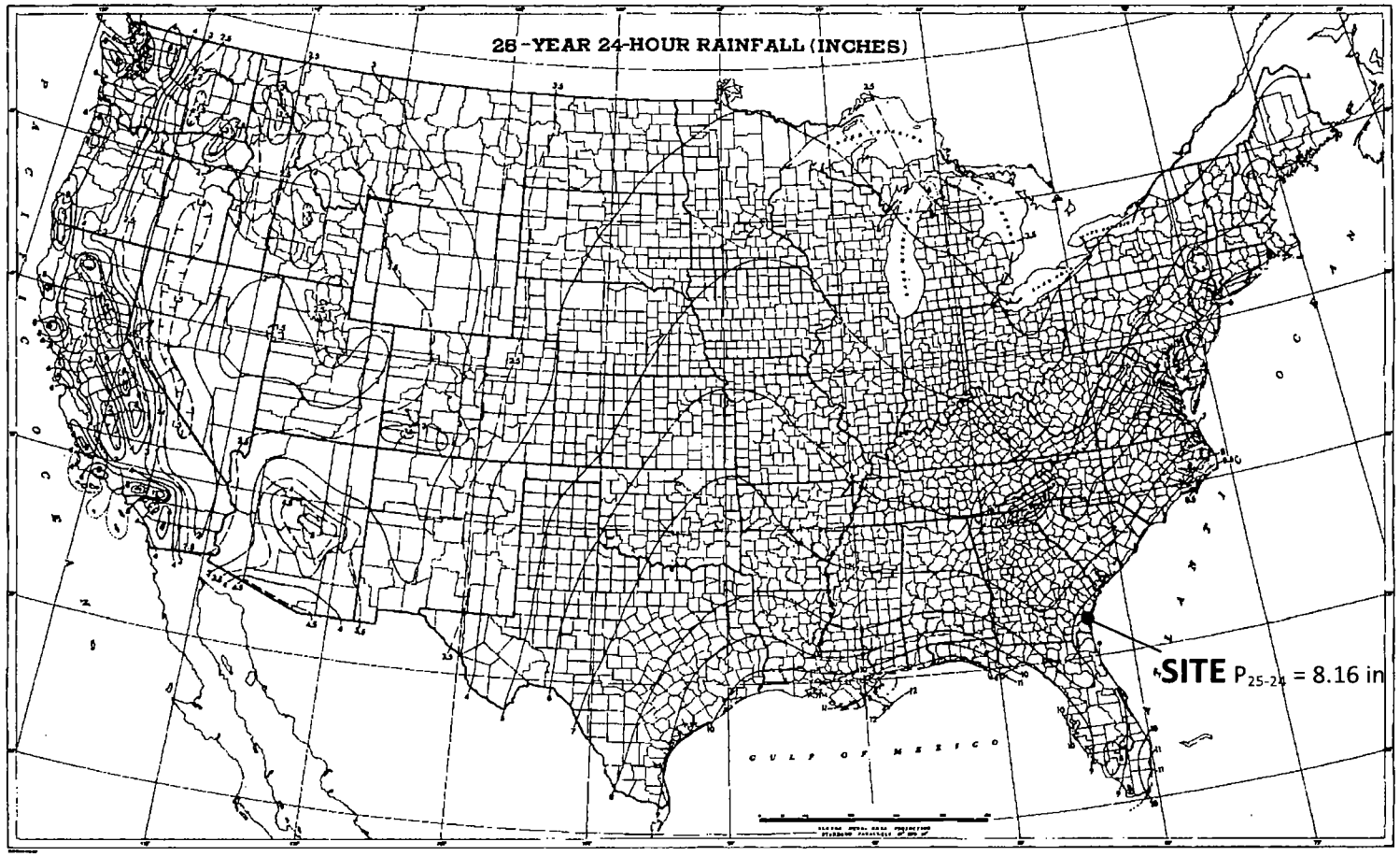
Attachment 15

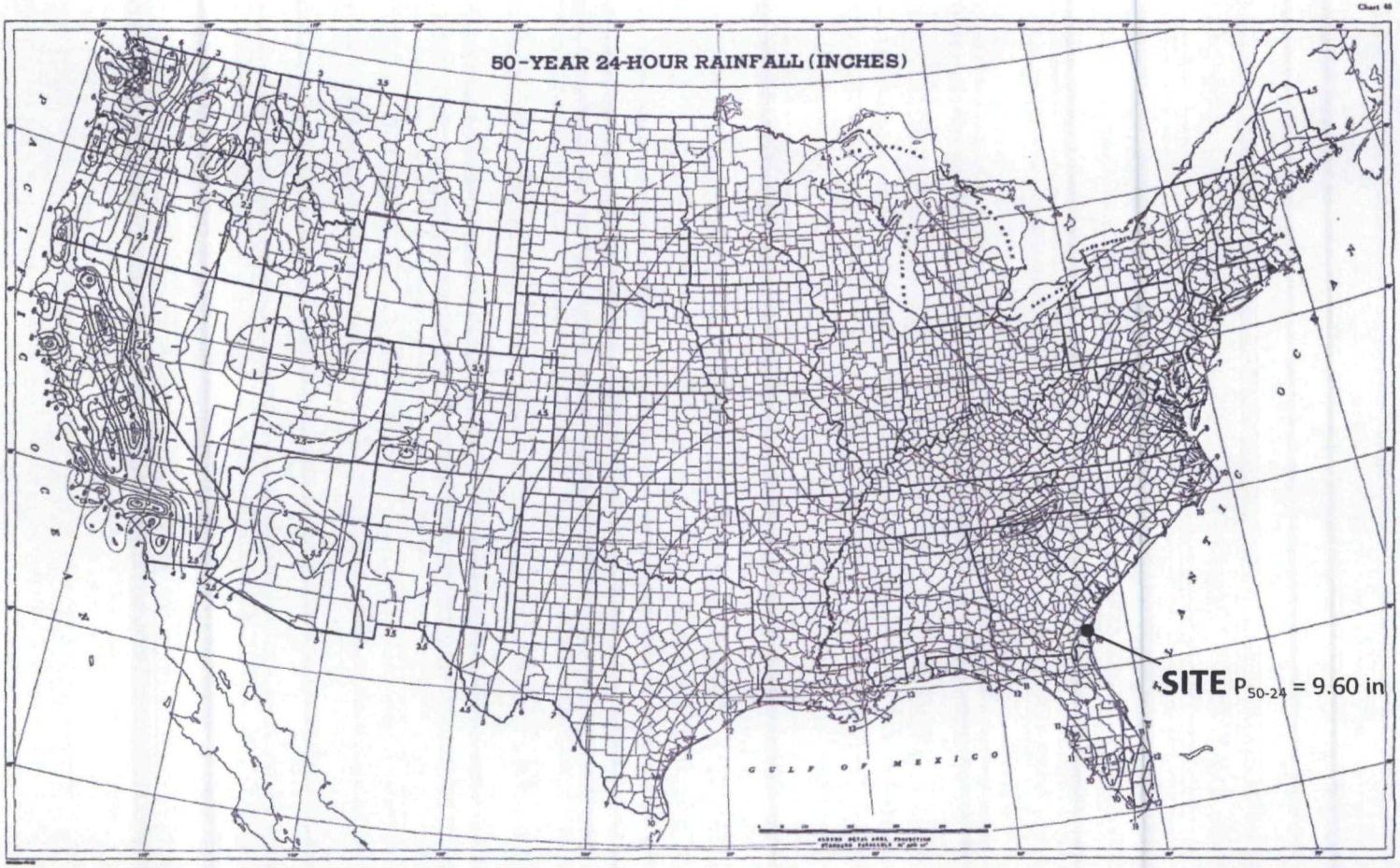

Rainfall Distribution
Type I
Type IA
Type II
Type III
SITE

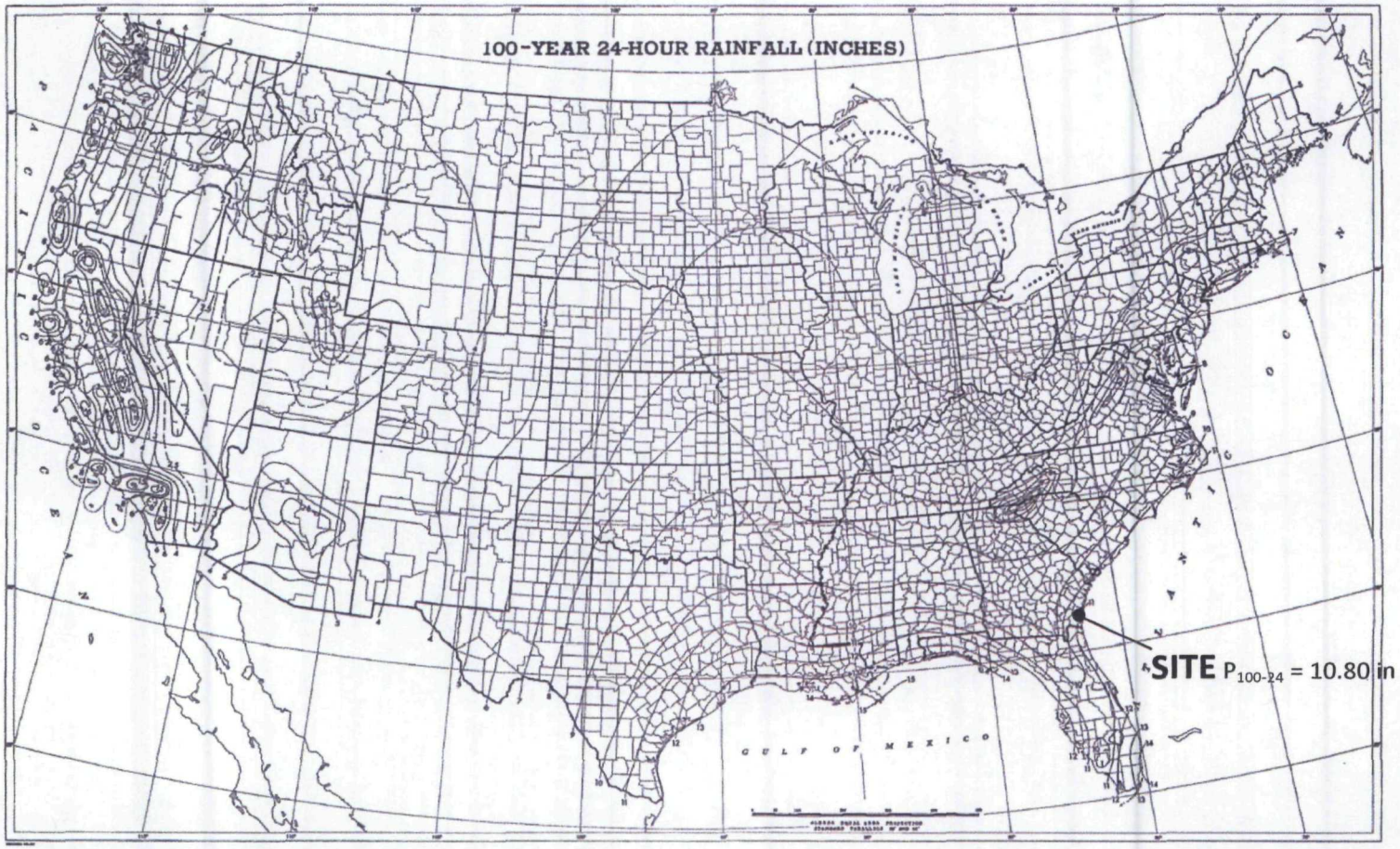
APPENDIX D

Attachment 16


2-YEAR 24-HOUR RAINFALL (INCHES)
SITE P_{2-24} = 5.04 in
GULF OF MEXICO


25-YEAR 24-HOUR RAINFALL (INCHES)
SITE P_{25-24} = 8.16 in
GULF OF MEXICO


50-YEAR 24-HOUR RAINFALL (INCHES)
GULF OF MEXICO
SITE $P_{50\text{-}24}$ = 9.60 in


100-YEAR 24-HOUR RAINFALL (INCHES)
GULF OF MEXICO
SITE $P_{100\text{-}24}$ = 10.80 in

APPENDIX D

Attachment 17

Hydrologic Soil Group—Camden and Glynn Counties, Georgia
(Hercules Site)

Map Scale: 1:9,520 if printed on A size (8.5" x 11") sheet.

N

Meters: 0 100 200 400 600

Feet: 0 500 1,000 2,000 3,000

MAP LEGEND

Area of Interest (AOI)

- Area of Interest (AOI)

Soils

- Soil Map Units

Soil Ratings

- A
- A/D
- B
- B/D
- C
- C/D
- D
- Not rated or not available

Political Features

- Cities

Water Features

- Streams and Canals

Transportation

- Rails
- Interstate Highways
- US Routes
- Major Roads
- Local Roads

MAP INFORMATION

Map Scale: 1:9,520 if printed on A size (8.5" × 11") sheet.

The soil surveys that comprise your AOI were mapped at 1:20,000.

Warning: Soil Map may not be valid at this scale.

Enlargement of maps beyond the scale of mapping can cause misunderstanding of the detail of mapping and accuracy of soil line placement. The maps do not show the small areas of contrasting soils that could have been shown at a more detailed scale.

Please rely on the bar scale on each map sheet for accurate map measurements.

Source of Map: Natural Resources Conservation Service
Web Soil Survey URL: http://websoilsurvey.nrcs.usda.gov
Coordinate System: UTM Zone 17N NAD83

This product is generated from the USDA-NRCS certified data as of the version date(s) listed below.

Soil Survey Area: Camden and Glynn Counties, Georgia
Survey Area Data: Version 5, Aug 26, 2009

Date(s) aerial images were photographed: 7/20/2007

The orthophoto or other base map on which the soil lines were compiled and digitized probably differs from the background imagery displayed on these maps. As a result, some minor shifting of map unit boundaries may be evident.

Hydrologic Soil Group

Hydrologic Soil Group— Summary by Map Unit — Camden and Glynn Counties, Georgia (GA616)				
Map unit symbol	**Map unit name**	**Rating**	**Acres in AOI**	**Percent of AOI**
Mb	Mandarin-Urban land complex	C	229.7	100.0%
Totals for Area of Interest			**229.7**	**100.0%**

Description

Hydrologic soil groups are based on estimates of runoff potential. Soils are assigned to one of four groups according to the rate of water infiltration when the soils are not protected by vegetation, are thoroughly wet, and receive precipitation from long-duration storms.

The soils in the United States are assigned to four groups (A, B, C, and D) and three dual classes (A/D, B/D, and C/D). The groups are defined as follows:

Group A. Soils having a high infiltration rate (low runoff potential) when thoroughly wet. These consist mainly of deep, well drained to excessively drained sands or gravelly sands. These soils have a high rate of water transmission.

Group B. Soils having a moderate infiltration rate when thoroughly wet. These consist chiefly of moderately deep or deep, moderately well drained or well drained soils that have moderately fine texture to moderately coarse texture. These soils have a moderate rate of water transmission.

Group C. Soils having a slow infiltration rate when thoroughly wet. These consist chiefly of soils having a layer that impedes the downward movement of water or soils of moderately fine texture or fine texture. These soils have a slow rate of water transmission.

Group D. Soils having a very slow infiltration rate (high runoff potential) when thoroughly wet. These consist chiefly of clays that have a high shrink-swell potential, soils that have a high water table, soils that have a claypan or clay layer at or near the surface, and soils that are shallow over nearly impervious material. These soils have a very slow rate of water transmission.

If a soil is assigned to a dual hydrologic group (A/D, B/D, or C/D), the first letter is for drained areas and the second is for undrained areas. Only the soils that in their natural condition are in group D are assigned to dual classes.

Rating Options

Aggregation Method: Dominant Condition

Aggregation is the process by which a set of component attribute values is reduced to a single value that represents the map unit as a whole.

A map unit is typically composed of one or more "components". A component is either some type of soil or some nonsoil entity, e.g., rock outcrop. For the attribute being aggregated, the first step of the aggregation process is to derive one attribute value for each of a map unit's components. From this set of component attributes, the next step of the aggregation process derives a single value that represents the map unit as a whole. Once a single value for each map unit is derived, a thematic map for soil map units can be rendered. Aggregation must be done because, on any soil map, map units are delineated but components are not.

For each of a map unit's components, a corresponding percent composition is recorded. A percent composition of 60 indicates that the corresponding component typically makes up approximately 60% of the map unit. Percent composition is a critical factor in some, but not all, aggregation methods.

The aggregation method "Dominant Condition" first groups like attribute values for the components in a map unit. For each group, percent composition is set to the sum of the percent composition of all components participating in that group. These groups now represent "conditions" rather than components. The attribute value associated with the group with the highest cumulative percent composition is returned. If more than one group shares the highest cumulative percent composition, the corresponding "tie-break" rule determines which value should be returned. The "tie-break" rule indicates whether the lower or higher group value should be returned in the case of a percent composition tie.

The result returned by this aggregation method represents the dominant condition throughout the map unit only when no tie has occurred.

Component Percent Cutoff: None Specified

Components whose percent composition is below the cutoff value will not be considered. If no cutoff value is specified, all components in the database will be considered. The data for some contrasting soils of minor extent may not be in the database, and therefore are not considered.

Tie-break Rule: Higher

The tie-break rule indicates which value should be selected from a set of multiple candidate values, or which value should be selected in the event of a percent composition tie.

Hydrologic Soil Group—Camden and Glynn Counties, Georgia
(Pre-Construction N St Basin)

USDA Natural Resources Conservation Service

Web Soil Survey
National Cooperative Soil Survey

MAP LEGEND

Area of Interest (AOI)

Area of Interest (AOI)

Soils

Soil Map Units

Soil Ratings

A

A/D

B

B/D

C

C/D

D

Not rated or not available

Political Features

Cities

Water Features

Streams and Canals

Transportation

Rails

Interstate Highways

US Routes

Major Roads

Local Roads

MAP INFORMATION

Map Scale: 1:10,600 if printed on A size (8.5" × 11") sheet.

The soil surveys that comprise your AOI were mapped at 1:20,000.

Please rely on the bar scale on each map sheet for accurate map measurements.

Source of Map: Natural Resources Conservation Service
Web Soil Survey URL: http://websoilsurvey.nrcs.usda.gov
Coordinate System: UTM Zone 17N NAD83

This product is generated from the USDA-NRCS certified data as of the version date(s) listed below.

Soil Survey Area: Camden and Glynn Counties, Georgia
Survey Area Data: Version 5, Aug 26, 2009

Date(s) aerial images were photographed: 12/4/2007; 7/20/2007

The orthophoto or other base map on which the soil lines were compiled and digitized probably differs from the background imagery displayed on these maps. As a result, some minor shifting of map unit boundaries may be evident.

Hydrologic Soil Group

Hydrologic Soil Group— Summary by Map Unit — Camden and Glynn Counties, Georgia (GA616)				
Map unit symbol	**Map unit name**	**Rating**	**Acres in AOI**	**Percent of AOI**
Mb	Mandarin-Urban land complex	C	306.4	99.9%
Ru	Rutlege fine sand	B/D	0.2	0.1%
Totals for Area of Interest			**306.5**	**100.0%**

Description

Hydrologic soil groups are based on estimates of runoff potential. Soils are assigned to one of four groups according to the rate of water infiltration when the soils are not protected by vegetation, are thoroughly wet, and receive precipitation from long-duration storms.

The soils in the United States are assigned to four groups (A, B, C, and D) and three dual classes (A/D, B/D, and C/D). The groups are defined as follows:

Group A. Soils having a high infiltration rate (low runoff potential) when thoroughly wet. These consist mainly of deep, well drained to excessively drained sands or gravelly sands. These soils have a high rate of water transmission.

Group B. Soils having a moderate infiltration rate when thoroughly wet. These consist chiefly of moderately deep or deep, moderately well drained or well drained soils that have moderately fine texture to moderately coarse texture. These soils have a moderate rate of water transmission.

Group C. Soils having a slow infiltration rate when thoroughly wet. These consist chiefly of soils having a layer that impedes the downward movement of water or soils of moderately fine texture or fine texture. These soils have a slow rate of water transmission.

Group D. Soils having a very slow infiltration rate (high runoff potential) when thoroughly wet. These consist chiefly of clays that have a high shrink-swell potential, soils that have a high water table, soils that have a claypan or clay layer at or near the surface, and soils that are shallow over nearly impervious material. These soils have a very slow rate of water transmission.

If a soil is assigned to a dual hydrologic group (A/D, B/D, or C/D), the first letter is for drained areas and the second is for undrained areas. Only the soils that in their natural condition are in group D are assigned to dual classes.

Rating Options

Aggregation Method: Dominant Condition

Component Percent Cutoff: None Specified

Tie-break Rule: Higher

APPENDIX D

Attachment 18

Table 2-2a Runoff curve numbers for urban areas [1]

Cover description: Cover type and hydrologic condition	Average percent impervious area [2]	Curve numbers for hydrologic soil group: A	B	C	D
Fully developed urban areas (vegetation established)					
Open space (lawns, parks, golf courses, cemeteries, etc.) [3]:					
Poor condition (grass cover < 50%)		68	79	86	89
Fair condition (grass cover 50% to 75%)		49	69	79	84
Good condition (grass cover > 75%)		39	61	74	80
Impervious areas:					
Paved parking lots, roofs, driveways, etc. (excluding right-of-way)		98	98	98	98
Streets and roads:					
Paved; curbs and storm sewers (excluding right-of-way)		98	98	98	98
Paved; open ditches (including right-of-way)		83	89	92	93
Gravel (including right-of-way)		76	85	89	91
Dirt (including right-of-way)		72	82	87	89
Western desert urban areas:					
Natural desert landscaping (pervious areas only) [4]		63	77	85	88
Artificial desert landscaping (impervious weed barrier, desert shrub with 1- to 2-inch sand or gravel mulch and basin borders)		96	96	96	96
Urban districts:					
Commercial and business	85	89	92	94	95
Industrial	72	81	88	91	93
Residential districts by average lot size:					
1/8 acre or less (town houses)	65	77	85	90	92
1/4 acre	38	61	75	83	87
1/3 acre	30	57	72	81	86
1/2 acre	25	54	70	80	85
1 acre	20	51	68	79	84
2 acres	12	46	65	77	82
Developing urban areas					
Newly graded areas (pervious areas only, no vegetation) [5]		77	86	91	94
Idle lands (CN's are determined using cover types similar to those in table 2-2c).					

[1] Average runoff condition, and $I_a = 0.2S$.

[2] The average percent impervious area shown was used to develop the composite CN's. Other assumptions are as follows: impervious areas are directly connected to the drainage system, impervious areas have a CN of 98, and pervious areas are considered equivalent to open space in good hydrologic condition. CN's for other combinations of conditions may be computed using figure 2-3 or 2-4.

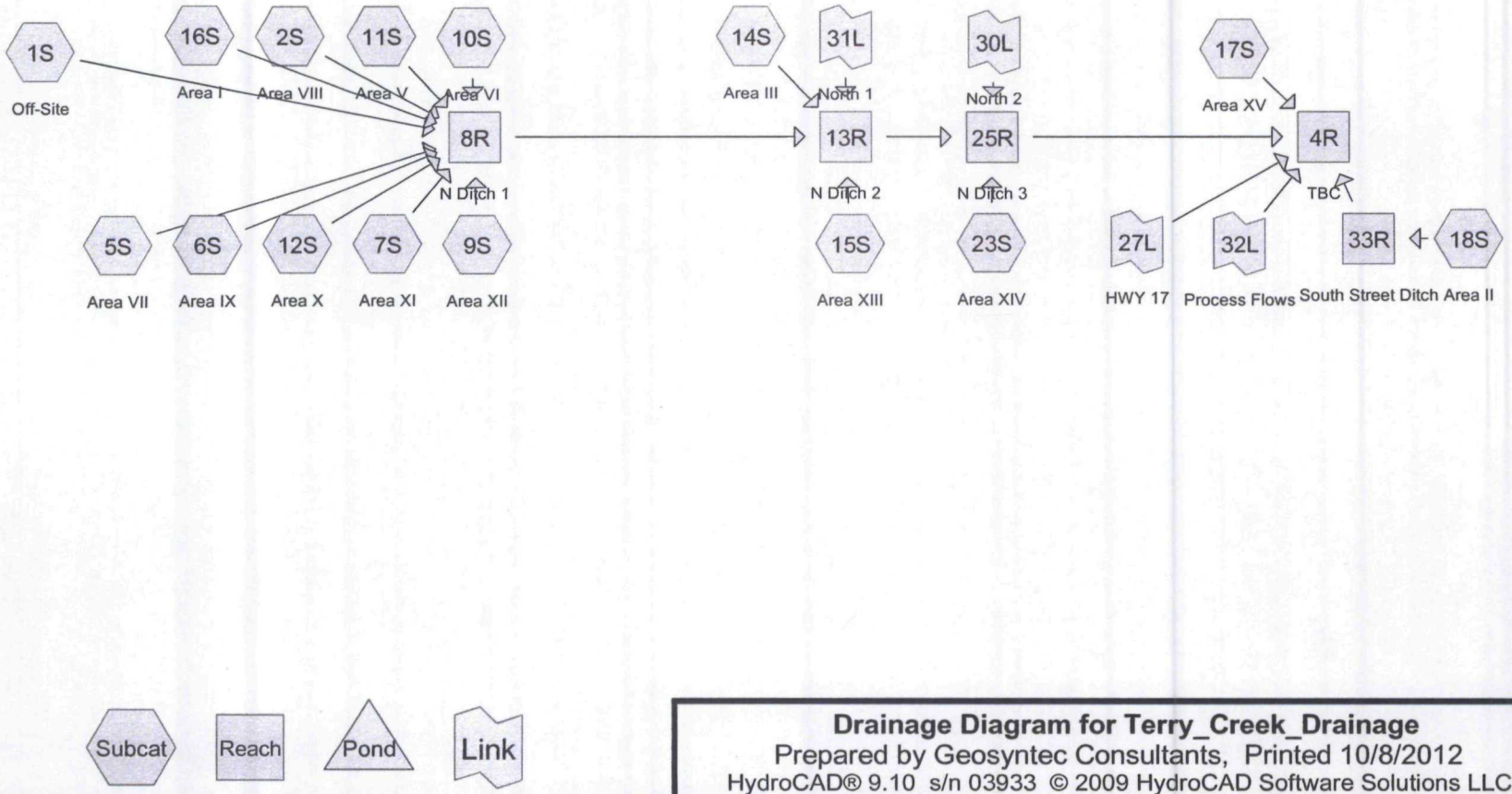
[3] CN's shown are equivalent to those of pasture. Composite CN's may be computed for other combinations of open space cover type.

[4] Composite CN's for natural desert landscaping should be computed using figures 2-3 or 2-4 based on the impervious area percentage (CN = 98) and the pervious area CN. The pervious area CN's are assumed equivalent to desert shrub in poor hydrologic condition.

[5] Composite CN's to use for the design of temporary measures during grading and construction should be computed using figure 2-3 or 2-4 based on the degree of development (impervious area percentage) and the CN's for the newly graded pervious areas.

APPENDIX D

Attachment 19



Drainage Diagram for Terry_Creek_Drainage
Prepared by Geosyntec Consultants, Printed 10/8/2012
HydroCAD® 9.10 s/n 03933 © 2009 HydroCAD Software Solutions LLC

APPENDIX D

Attachment 20

Sheet Title: Flow Calculation for 36-inch Reinforced Concrete Pipe (RCP)
Purpose: Display calculation of flow for 36-inch RCP from Unknown Input 1 (Figure 2).
Prepared By: Ashton Imlay
Date: 10/8/2012
Reviewed By: Jesus Sanchez
Date: 10/9/2012
Notes: 1. Manning's n value was found in Open Channel Hydraulics (Chow, 1959).
2. Manning's n value for RCP with manholes, inlets, etc. was used for each RCP (per Chow, 1959).

Flow Through Circular Pipe

Diameter of pipe, D=	36	inches
Longitudinal Slope, So=	0.01	ft/ft
Manning's n=	0.015	
Density of flowing liquid, rho=	1.94	slugs/ft^3

Theta radians	Theta degrees	Depth of Flow y inches	Area of Flow A ft^2	Wetted Perimeter P ft	Hydraulic Radius R ft	Average Velocity V ft/s	Discharge Q=A*V cfs	Force* F lbf
0.00	0	0.0	0.000	0.00		0.0	0.00	0.0
0.25	14	0.1	0.003	0.38	0.01	0.4	0.00	0.0
0.50	29	0.6	0.023	0.75	0.03	1.0	0.02	0.0
0.75	43	1.3	0.077	1.13	0.07	1.7	0.13	0.4
1.00	57	2.2	0.178	1.50	0.12	2.4	0.43	2.0
1.25	72	3.4	0.339	1.88	0.18	3.2	1.07	6.6
1.50	86	4.8	0.565	2.25	0.25	4.0	2.23	17.1
1.75	100	6.5	0.862	2.63	0.33	4.7	4.07	37.3
2.00	115	8.3	1.227	3.00	0.41	5.5	6.71	71.3
2.25	129	10.2	1.656	3.38	0.49	6.2	10.23	122.6
2.50	143	12.3	2.139	3.75	0.57	6.8	14.61	193.7
2.75	158	14.5	2.664	4.13	0.65	7.4	19.77	284.7
3.00	172	16.7	3.216	4.50	0.71	7.9	25.54	393.3
3.25	186	19.0	3.778	4.88	0.77	8.4	31.66	514.7
3.50	201	21.2	4.332	5.25	0.83	8.7	37.86	641.7
3.75	215	23.4	4.862	5.63	0.86	9.0	43.82	766.1
4.00	229	25.5	5.351	6.00	0.89	9.2	49.25	879.4
4.25	244	27.5	5.788	6.38	0.91	9.3	53.91	974.0
4.50	258	29.3	6.162	6.75	0.91	9.3	57.60	1044.6
4.75	272	31.0	6.468	7.13	0.91	9.3	60.23	1088.2
5.00	286	32.4	6.704	7.50	0.89	9.2	61.79	1104.8
5.25	301	33.7	6.873	7.88	0.87	9.1	62.34	1097.1
5.50	315	34.6	6.981	8.25	0.85	8.9	62.04	1069.5
5.75	329	35.4	7.041	8.63	0.82	8.7	61.08	1028.0
6.00	344	35.8	7.064	9.00	0.78	8.5	59.71	979.0
6.25	358	36.0	7.069	9.38	0.75	8.2	58.16	928.4

Sheet Title: Flow Calculation for 42-inch Corrugated Metal Pipe (CMP)
Purpose: Display calculation of flow for 42-inch CMP from the Unknown Input 2 (Figure 2).
Prepared By: Ashton Imlay
Date: 10/8/2012
Reviewed By: Jesus Sanchez
Date: 10/9/2012
Notes: 1. Manning's n value was found in Open Channel Hydraulics (Chow, 1959).

Flow Through Circular Pipe

Diameter of pipe, D=	42	inches
Longitudinal Slope, So=	0.01	ft/ft
Manning's n=	0.024	
Density of flowing liquid, rho=	1.94	slugs/ft^3

Theta radians	Theta degrees	Depth of Flow y inches	Area of Flow A ft^2	Wetted Perimeter P ft	Hydraulic Radius R ft	Average Velocity V ft/s	Discharge Q=A*V cfs	Force* F lbf
0.00	0	0.0	0.000	0.00		0.0	0.00	0.0
0.25	14	0.2	0.004	0.44	0.01	0.3	0.00	0.0
0.50	29	0.7	0.032	0.88	0.04	0.7	0.02	0.0
0.75	43	1.5	0.105	1.31	0.08	1.1	0.12	0.3
1.00	57	2.6	0.243	1.75	0.14	1.7	0.40	1.3
1.25	72	4.0	0.461	2.19	0.21	2.2	1.01	4.3
1.50	86	5.6	0.769	2.63	0.29	2.7	2.11	11.2
1.75	100	7.5	1.173	3.06	0.38	3.3	3.84	24.4
2.00	115	9.7	1.670	3.50	0.48	3.8	6.33	46.5
2.25	129	11.9	2.254	3.94	0.57	4.3	9.64	80.1
2.50	143	14.4	2.912	4.38	0.67	4.7	13.78	126.5
2.75	158	16.9	3.627	4.81	0.75	5.1	18.64	185.9
3.00	172	19.5	4.378	5.25	0.83	5.5	24.08	256.9
3.25	186	22.1	5.142	5.69	0.90	5.8	29.85	336.1
3.50	201	24.7	5.897	6.13	0.96	6.1	35.69	419.1
3.75	215	27.3	6.617	6.56	1.01	6.2	41.31	500.3
4.00	229	29.7	7.284	7.00	1.04	6.4	46.44	574.3
4.25	244	32.1	7.878	7.44	1.06	6.5	50.83	636.1
4.50	258	34.2	8.387	7.88	1.07	6.5	54.31	682.2
4.75	272	36.1	8.804	8.31	1.06	6.5	56.79	710.7
5.00	286	37.8	9.125	8.75	1.04	6.4	58.25	721.5
5.25	301	39.3	9.354	9.19	1.02	6.3	58.78	716.5
5.50	315	40.4	9.502	9.63	0.99	6.2	58.49	698.5
5.75	329	41.3	9.583	10.06	0.95	6.0	57.59	671.4
6.00	344	41.8	9.615	10.50	0.92	5.9	56.29	639.3
6.25	358	42.0	9.621	10.94	0.88	5.7	54.83	606.3

Sheet Title: Flow Calculation for 18-inch Reinforced Concrete Pipe (RCP)
Purpose: Display calculation of flow for 18-inch drainage RCP from HWY 17.
Prepared By: Ashton Imlay
Date: 10/8/2012
Reviewed By: Jesus Sanchez
Date: 10/9/2012
Notes: 1. Two 18-inch RCP pipes drain into the TBC from HWY 17.
2. Manning's n value was found in Open Channel Hydraulics (Chow, 1959).
3. Manning's n value for RCP with manholes, inlets, etc. was used for each RCP (per Chow, 1959).

Flow Through Circular Pipe

Diameter of pipe, D=	18	inches
Longitudinal Slope, So=	0.01	ft/ft
Manning's n=	0.015	
Density of flowing liquid, rho=	1.94	slugs/ft^3

Theta radians	Theta degrees	Depth of Flow y inches	Area of Flow A ft^2	Wetted Perimeter P ft	Hydraulic Radius R ft	Average Velocity V ft/s	Discharge Q=A*V cfs	Force* F lbf
0.00	0	0.0	0.000	0.00		0.0	0.00	0.0
0.25	14	0.1	0.001	0.19	0.00	0.2	0.00	0.0
0.50	29	0.3	0.006	0.38	0.02	0.6	0.00	0.0
0.75	43	0.6	0.019	0.56	0.03	1.0	0.02	0.0
1.00	57	1.1	0.045	0.75	0.06	1.5	0.07	0.2
1.25	72	1.7	0.085	0.94	0.09	2.0	0.17	0.7
1.50	86	2.4	0.141	1.13	0.13	2.5	0.35	1.7
1.75	100	3.2	0.215	1.31	0.16	3.0	0.64	3.7
2.00	115	4.1	0.307	1.50	0.20	3.4	1.06	7.1
2.25	129	5.1	0.414	1.69	0.25	3.9	1.61	12.2
2.50	143	6.2	0.535	1.88	0.29	4.3	2.30	19.2
2.75	158	7.2	0.666	2.06	0.32	4.7	3.11	28.2
3.00	172	8.4	0.804	2.25	0.36	5.0	4.02	39.0
3.25	186	9.5	0.944	2.44	0.39	5.3	4.98	51.0
3.50	201	10.6	1.083	2.63	0.41	5.5	5.96	63.6
3.75	215	11.7	1.215	2.81	0.43	5.7	6.90	76.0
4.00	229	12.7	1.338	3.00	0.45	5.8	7.75	87.2
4.25	244	13.7	1.447	3.19	0.45	5.9	8.49	96.6
4.50	258	14.7	1.541	3.38	0.46	5.9	9.07	103.6
4.75	272	15.5	1.617	3.56	0.45	5.9	9.48	107.9
5.00	286	16.2	1.676	3.75	0.45	5.8	9.73	109.6
5.25	301	16.8	1.718	3.94	0.44	5.7	9.82	108.8
5.50	315	17.3	1.745	4.13	0.42	5.6	9.77	106.1
5.75	329	17.7	1.760	4.31	0.41	5.5	9.62	101.9
6.00	344	17.9	1.766	4.50	0.39	5.3	9.40	97.1
6.25	358	18.0	1.767	4.69	0.38	5.2	9.16	92.1

Sheet Title: Flow Calculation for 30-inch Reinforced Concrete Pipe (RCP)
Purpose: Display calculation of flow for 30-inch drainage RCP from HWY 17.
Prepared By: Ashton Imlay
Date: 10/8/2012
Reviewed By: Jesus Sanchez
Date: 10/9/2012
Notes: 1. Manning's n value was found in Open Channel Hydraulics (Chow, 1959).
2. Manning's n value for RCP with manholes, inlets, etc. was used for each RCP (per Chow, 1959).

Flow Through Circular Pipe

Diameter of pipe, D=	30	inches
Longitudinal Slope, So=	0.01	ft/ft
Manning's n=	0.015	
Density of flowing liquid, rho=	1.94	slugs/ft^3

Theta radians	Theta degrees	Depth of Flow y inches	Area of Flow A ft^2	Wetted Perimeter P ft	Hydraulic Radius R ft	Average Velocity V ft/s	Discharge Q=A*V cfs	Force* F lbf
0.00	0	0.0	0.000	0.00		0.0	0.00	0.0
0.25	14	0.1	0.002	0.31	0.01	0.3	0.00	0.0
0.50	29	0.5	0.016	0.63	0.03	0.9	0.01	0.0
0.75	43	1.0	0.053	0.94	0.06	1.5	0.08	0.2
1.00	57	1.8	0.124	1.25	0.10	2.1	0.26	1.1
1.25	72	2.8	0.235	1.56	0.15	2.8	0.66	3.6
1.50	86	4.0	0.393	1.88	0.21	3.5	1.37	9.3
1.75	100	5.4	0.598	2.19	0.27	4.2	2.50	20.3
2.00	115	6.9	0.852	2.50	0.34	4.8	4.13	38.8
2.25	129	8.5	1.150	2.81	0.41	5.5	6.29	66.8
2.50	143	10.3	1.486	3.13	0.48	6.0	8.99	105.5
2.75	158	12.1	1.850	3.44	0.54	6.6	12.16	155.0
3.00	172	13.9	2.233	3.75	0.60	7.0	15.70	214.2
3.25	186	15.8	2.624	4.06	0.65	7.4	19.47	280.3
3.50	201	17.7	3.008	4.38	0.69	7.7	23.28	349.4
3.75	215	19.5	3.376	4.69	0.72	8.0	26.94	417.2
4.00	229	21.2	3.716	5.00	0.74	8.1	30.29	478.8
4.25	244	22.9	4.020	5.31	0.76	8.2	33.15	530.4
4.50	258	24.4	4.279	5.63	0.76	8.3	35.42	568.8
4.75	272	25.8	4.492	5.94	0.76	8.2	37.04	592.5
5.00	286	27.0	4.655	6.25	0.74	8.2	38.00	601.6
5.25	301	28.0	4.773	6.56	0.73	8.0	38.33	597.4
5.50	315	28.9	4.848	6.88	0.71	7.9	38.15	582.4
5.75	329	29.5	4.889	7.19	0.68	7.7	37.56	559.8
6.00	344	29.8	4.906	7.50	0.65	7.5	36.71	533.1
6.25	358	30.0	4.909	7.81	0.63	7.3	35.76	505.5

Sheet Title: Flow Calculation for 36-inch Reinforced Concrete Pipe (RCP)
Purpose: Display calculation of flow for 36-inch drainage RCP from HWY 17.
Prepared By: Ashton Imlay
Date: 10/8/2012
Reviewed By: Jesus Sanchez
Date: 10/9/2012
Notes: 1. Manning's n value was found in Open Channel Hydraulics (Chow, 1959).
2. Manning's n value for RCP with manholes, inlets, etc. was used for each RCP (per Chow, 1959).

Flow Through Circular Pipe

Diameter of pipe, D=	36	inches
Longitudinal Slope, So=	0.01	ft/ft
Manning's n=	0.015	
Density of flowing liquid, rho=	1.94	slugs/ft^3

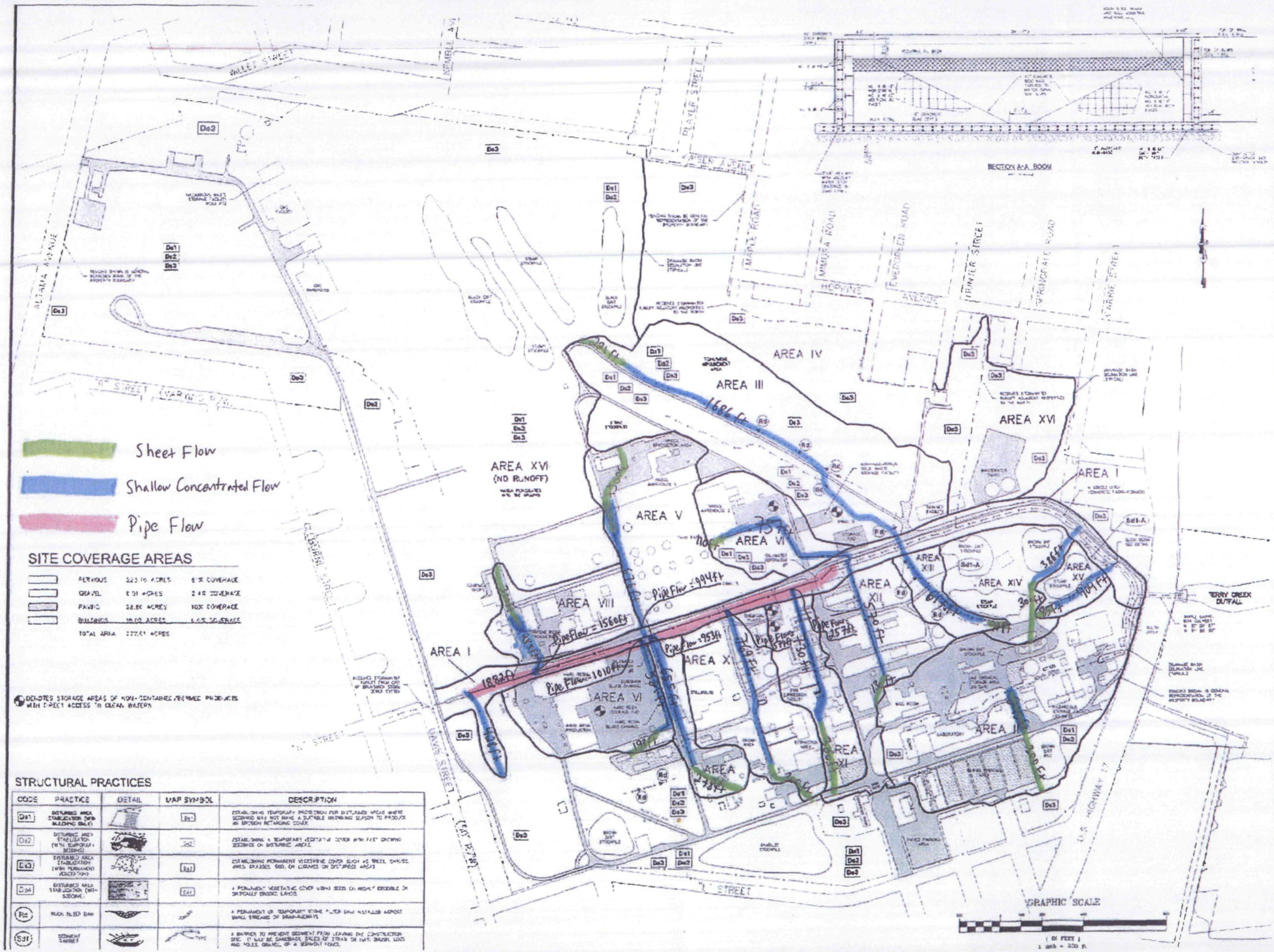
Theta radians	Theta degrees	Depth of Flow y inches	Area of Flow A ft^2	Wetted Perimeter P ft	Hydraulic Radius R ft	Average Velocity V ft/s	Discharge Q=A*V cfs	Force* F lbf
0.00	0	0.0	0.000	0.00		0.0	0.00	0.0
0.25	14	0.1	0.003	0.38	0.01	0.4	0.00	0.0
0.50	29	0.6	0.023	0.75	0.03	1.0	0.02	0.0
0.75	43	1.3	0.077	1.13	0.07	1.7	0.13	0.4
1.00	57	2.2	0.178	1.50	0.12	2.4	0.43	2.0
1.25	72	3.4	0.339	1.88	0.18	3.2	1.07	6.6
1.50	86	4.8	0.565	2.25	0.25	4.0	2.23	17.1
1.75	100	6.5	0.862	2.63	0.33	4.7	4.07	37.3
2.00	115	8.3	1.227	3.00	0.41	5.5	6.71	71.3
2.25	129	10.2	1.656	3.38	0.49	6.2	10.23	122.6
2.50	143	12.3	2.139	3.75	0.57	6.8	14.61	193.7
2.75	158	14.5	2.664	4.13	0.65	7.4	19.77	284.7
3.00	172	16.7	3.216	4.50	0.71	7.9	25.54	393.3
3.25	186	19.0	3.778	4.88	0.77	8.4	31.66	514.7
3.50	201	21.2	4.332	5.25	0.83	8.7	37.86	641.7
3.75	215	23.4	4.862	5.63	0.86	9.0	43.82	766.1
4.00	229	25.5	5.351	6.00	0.89	9.2	49.25	879.4
4.25	244	27.5	5.788	6.38	0.91	9.3	53.91	974.0
4.50	258	29.3	6.162	6.75	0.91	9.3	57.60	1044.6
4.75	272	31.0	6.468	7.13	0.91	9.3	60.23	1088.2
5.00	286	32.4	6.704	7.50	0.89	9.2	61.79	1104.8
5.25	301	33.7	6.873	7.88	0.87	9.1	62.34	1097.1
5.50	315	34.6	6.981	8.25	0.85	8.9	62.04	1069.5
5.75	329	35.4	7.041	8.63	0.82	8.7	61.08	1028.0
6.00	344	35.8	7.064	9.00	0.78	8.5	59.71	979.0
6.25	358	36.0	7.069	9.38	0.75	8.2	58.16	928.4

APPENDIX D

Attachment 21

Sheet Title: Properties of Drainage Areas and Time of Concentration Inputs
Purpose: Display the drainage area and conveyance data input to HydroCAD for Time of Concentration calculations.
Prepared By: Ashton Imlay
Date: 10/5/2012
Reviewed By: Jesus Sanchez
Date: 10/9/2012
Notes: 1. Time of Concentration information for Drainage Area No. 1S is taken from "N" St. Storm Drainage Improvements (Stantec, 2009).
2. Curve Number for Drainage Area No. 1S is a composite value.
3. Slope of 0.0005 ft/ft is specified in "N" St. Drainage Improvements (Stantec, 2009).

Drainage Area ID			AREA (acres)	CURVE NUMBER	Sheet Flow				Shallow Concentrated Flow			Channelized Flow					Pipe Flow			
No.	Name	Description			Length (ft)	Surface Description	Manning's n	Slope (ft/ft)	Length (ft)	Surface Description	Slope (ft/ft)	Length (ft)	X-Sec Area (sq. ft)	Perimeter (ft)	Manning's n	Slope (ft/ft)	Length (ft)	Diameter (in)	Manning's n	Slope (ft/ft)
1S[1]	Off-Site	65% 1/4 acre lots, 38% impervious, HSG C 35% Paved roads w/curbs & sewers, HSG C	303.15	88[2]	300	SMOOTH	0.011	0.0005[3]	1746	PAVED	0.0005[3]	2278	4.9	3.9	0.015	0.0015	-	-	-	-
												1000	15.9	7.1	0.015	0.0015	-	-	-	-
												2320	14.8	6.8	0.015	0.0007	-	-	-	-
2S	Area VIII	Urban industrial, 72% imp, HSG C	5.36	91	300	SMOOTH	0.011	0.005	285	PAVED	0.005	-	-	-	-	-	1560	52	0.015	0.0007
5S	Area VII	Urban industrial, 72% imp, HSG C	7.02	91	193	SMOOTH	0.011	0.005	521	PAVED	0.005	-	-	-	-	-	1010	52	0.015	0.0007
6S	Area IX	Urban industrial, 72% imp, HSG C	2.97	91	278	SMOOTH	0.011	0.005	655	PAVED	0.005	-	-	-	-	-	953	52	0.015	0.0007
7S	Area XI	Urban industrial, 72% imp, HSG C	4.73	91	300	SMOOTH	0.011	0.005	730	PAVED	0.005	-	-	-	-	-	257	52	0.015	0.0007
9S	Area XII	Urban industrial, 72% imp, HSG C	7.46	91	130	SMOOTH	0.011	0.005	570	PAVED	0.005	-	-	-	-	-	-	-	-	-
10S	Area VI	Urban industrial, 72% imp, HSG C	5.22	91	110	SMOOTH	0.011	0.005	757	PAVED	0.005	-	-	-	-	-	-	-	-	-
11S	Area V	Urban industrial, 72% imp, HSG C	10.11	91	300	SMOOTH	0.011	0.005	676	PAVED	0.005	-	-	-	-	-	994	52	0.015	0.0007
12S	Area X	Urban industrial, 72% imp, HSG C	8.39	91	300	SMOOTH	0.011	0.005	769	PAVED	0.005	-	-	-	-	-	577	52	0.015	0.0007
14S	Area III	Urban industrial, 72% imp, HSG C	21.22	91	221	SMOOTH	0.011	0.005	1686	PAVED	0.005	-	-	-	-	-	-	-	-	-
15S	Area XIII	Urban industrial, 72% imp, HSG C	2.09	91	90	SMOOTH	0.011	0.005	617	PAVED	0.005	-	-	-	-	-	-	-	-	-
16S	Area I	Urban industrial, 72% imp, HSG C	9.36	91	-	-	-	-	428	PAVED	0.005	-	-	-	-	-	1882	52	0.015	0.007
17S	Area XV	Urban industrial, 72% imp, HSG C	1.68	91	85	SMOOTH	0.011	0.005	404	PAVED	0.005	-	-	-	-	-	-	-	-	-
18S	Area II	Urban industrial, 72% imp, HSG C	18.30	91	300	SMOOTH	0.011	0.005	215	PAVED	0.005	-	-	-	-	-	-	-	-	-
23S	Area XIV	Urban industrial, 72% imp, HSG C	5.63	91	300	SMOOTH	0.011	0.005	386	UNPAVED	0.005	-	-	-	-	-	-	-	-	-



SITE COVERAGE AREAS

	PERVIOUS	323.76 ACRES	61% COVERAGE
	GRAVEL	6.91 ACRES	2.4% COVERAGE
	PAVING	28.80 ACRES	10% COVERAGE
	BUILDINGS	18.00 ACRES	6.4% COVERAGE
	TOTAL AREA	277.61 ACRES	

DENOTES STORAGE AREAS OF NON-CONTAINED/BERMED PRODUCTS WITH DIRECT ACCESS TO CLEAN WATERS

STRUCTURAL PRACTICES

CODE	PRACTICE	DETAIL	MAP SYMBOL	DESCRIPTION
Ds1	DISTURBED AREA STABILIZATION (WITH BUILDING ONLY)		Ds1	ESTABLISHING TEMPORARY PROTECTION FOR DISTURBED AREAS WHERE SEEDING MAY NOT HAVE A SUITABLE GROWING SEASON TO PRODUCE AN EROSION RETARDING COVER
Ds2	DISTURBED AREA STABILIZATION (WITH TEMPORARY SEEDING)		Ds2	ESTABLISHING A TEMPORARY VEGETATIVE COVER WITH FAST GROWING SEEDINGS ON DISTURBED AREAS
Ds3	DISTURBED AREA STABILIZATION (WITH PERMANENT VEGETATION)		Ds3	ESTABLISHING PERMANENT VEGETATIVE COVER SUCH AS TREES, SHRUBS, VINES, GRASSES, SOD, OR LEGUMES ON DISTURBED AREAS
Ds4	DISTURBED AREA STABILIZATION (WITH SODDING)		Ds4	A PERMANENT VEGETATIVE COVER USING SODS ON HIGHLY ERODIBLE OR ORTHICALLY GROOVE LANDS
Rd	ROCK FILTER DAM			A PERMANENT OR TEMPORARY STONE FILTER DAM INSTALLED ACROSS SMALL STREAMS OF DRAINAGEWAYS
Sd1	SEDIMENT BARRIER		TYPE	A BARRIER TO PREVENT SEDIMENT FROM LEAVING THE CONSTRUCTION SITE. IT MAY BE SANDBAGS, BALES OF STRAW OR HAY, BRUSH, LOGS AND POLES, GRAVEL, OR A SEDIMENT FENCE

NO	REVISION DESCRIPTION	BY	DATE

EMC ENGINEERING SERVICES, INC.

SITE DRAINAGE MAP

PINOVA FACILITY

BRUNSWICK, GLYNN, GEORGIA

Prepared for:

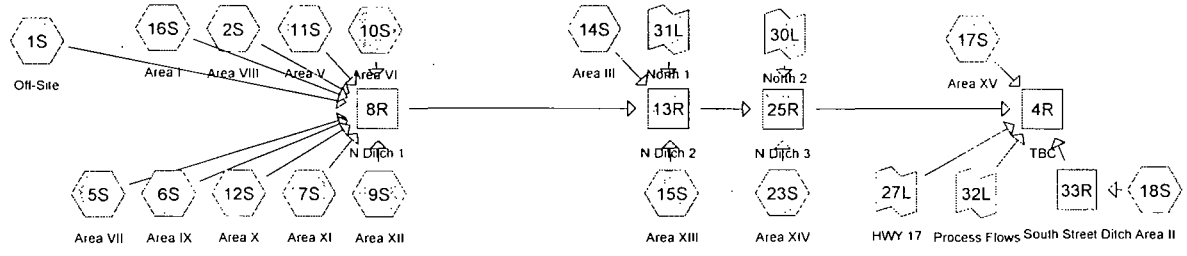
PINOVA INCORPORATED

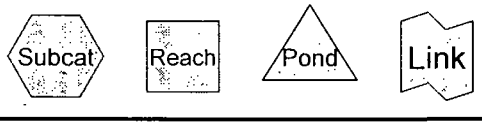
PROJECT NO.	10.20.4.017
DRAWN BY	KDG
DESIGNED BY	
SURVEYED BY	
SURVEY DATE	2014
CHECKED BY	[illegible]
SCALE	1" = 200'
DATE	4.29.2016

SHEET 1 OF 1

APPENDIX D

Attachment 22





Drainage Diagram for Terry_Creek_Drainage
Prepared by Geosyntec Consultants, Printed 10/9/2012
HydroCAD® 9.10 s/n 03933 © 2009 HydroCAD Software Solutions LLC

Area Listing (all nodes)

Area (acres)	CN	Description (subcatchment-numbers)
197.048	83	1/4 acre lots, 38% imp, HSG C (1S)
109.540	91	Urban industrial, 72% imp, HSG C (2S, 5S, 6S, 7S, 9S, 10S, 11S, 12S, 14S, 15S, 16S, 17S, 18S, 23S)
106.103	98	Paved roads w/curbs & sewers HSG C (1S)
412.691		**TOTAL AREA**

Soil Listing (all nodes)

Area (acres)	Soil Group	Subcatchment Numbers
0.000	HSG A	
0.000	HSG B	
412.691	HSG C	1S, 2S, 5S, 6S, 7S, 9S, 10S, 11S, 12S, 14S, 15S, 16S, 17S, 18S, 23S
0.000	HSG D	
0.000	Other	
412.691		**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)	Fill (inches)
1	2S	0.00	0.00	1,560.0	0.0007	0.015	52.0	0.0	0.0
2	5S	0.00	0.00	1,010.0	0.0007	0.015	52.0	0.0	0.0
3	6S	0.00	0.00	953.0	0.0007	0.015	52.0	0.0	0.0
4	7S	0.00	0.00	257.0	0.0007	0.015	52.0	0.0	0.0
5	11S	0.00	0.00	994.0	0.0007	0.015	52.0	0.0	0.0
6	12S	0.00	0.00	577.0	0.0007	0.015	52.0	0.0	0.0
7	16S	0.00	0.00	1,882.0	0.0007	0.015	52.0	0.0	0.0

Time span=0.00-24.00 hrs, dt=0.01 hrs, 2401 points
Runoff by SCS TR-20 method, UH=SCS
Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

Subcatchment1S: Off-Site Runoff Area=303.151 ac 59.70% Impervious Runoff Depth>3.64"
Flow Length=7,644' Tc=94.1 min CN=88 Runoff=386.05 cfs 91.981 af

Subcatchment2S: Area VIII Runoff Area=5.360 ac 72.00% Impervious Runoff Depth>4.01"
Flow Length=2,145' Tc=16.7 min CN=91 Runoff=17.67 cfs 1.791 af

Subcatchment5S: Area VII Runoff Area=7.020 ac 72.00% Impervious Runoff Depth>4.01"
Flow Length=1,724' Tc=14.9 min CN=91 Runoff=24.21 cfs 2.347 af

Subcatchment6S: Area IX Runoff Area=2.970 ac 72.00% Impervious Runoff Depth>4.01"
Flow Length=1,886' Tc=17.1 min CN=91 Runoff=9.71 cfs 0.992 af

Subcatchment7S: Area XI Runoff Area=4.730 ac 72.00% Impervious Runoff Depth>4.01"
Flow Length=1,287' Tc=14.0 min CN=91 Runoff=16.69 cfs 1.581 af

Subcatchment9S: Area XII Runoff Area=7.460 ac 72.00% Impervious Runoff Depth>4.02"
Flow Length=700' Slope=0.0050 '/' Tc=8.7 min CN=91 Runoff=30.72 cfs 2.496 af

Subcatchment10S: Area VI Runoff Area=5.220 ac 72.00% Impervious Runoff Depth>4.02"
Flow Length=620' Slope=0.0050 '/' Tc=7.7 min CN=91 Runoff=22.22 cfs 1.747 af

Subcatchment11S: Area V Runoff Area=10.110 ac 72.00% Impervious Runoff Depth>4.01"
Flow Length=1,970' Tc=17.8 min CN=91 Runoff=32.53 cfs 3.378 af

Subcatchment12S: Area X Runoff Area=8.390 ac 72.00% Impervious Runoff Depth>4.01"
Flow Length=1,646' Tc=16.4 min CN=91 Runoff=27.85 cfs 2.804 af

Subcatchment14S: Area III Runoff Area=21.220 ac 72.00% Impervious Runoff Depth>4.01"
Flow Length=1,907' Slope=0.0050 '/' Tc=22.8 min CN=91 Runoff=61.59 cfs 7.084 af

Subcatchment15S: Area XIII Runoff Area=2.090 ac 72.00% Impervious Runoff Depth>4.02"
Flow Length=707' Slope=0.0050 '/' Tc=8.7 min CN=91 Runoff=8.61 cfs 0.699 af

Subcatchment16S: Area I Runoff Area=9.360 ac 72.00% Impervious Runoff Depth>4.01"
Flow Length=2,310' Tc=16.3 min CN=91 Runoff=31.16 cfs 3.128 af

Subcatchment17S: Area XV Runoff Area=1.680 ac 72.00% Impervious Runoff Depth>4.02"
Flow Length=489' Slope=0.0050 '/' Tc=6.2 min CN=91 Runoff=7.53 cfs 0.562 af

Subcatchment18S: Area II Runoff Area=18.300 ac 72.00% Impervious Runoff Depth>4.02"
Flow Length=515' Slope=0.0050 '/' Tc=6.5 min CN=91 Runoff=81.11 cfs 6.126 af

Subcatchment23S: Area XIV Runoff Area=5.630 ac 72.00% Impervious Runoff Depth>4.01"
Flow Length=686' Slope=0.0050 '/' Tc=9.7 min CN=91 Runoff=22.47 cfs 1.884 af

Reach 4R: TBC Avg. Flow Depth=2.88' Max Vel=13.19 fps Inflow=683.43 cfs 635.683 af
x 3.00 n=0.012 L=212.0' S=0.0068 '/' Capacity=1,396.67 cfs Outflow=683.32 cfs 635.394 af

Reach 8R: N Ditch 1 Avg. Flow Depth=3.95' Max Vel=6.50 fps Inflow=408.01 cfs 112.246 af
n=0.015 L=560.0' S=0.0013 '/' Capacity=1,840.06 cfs Outflow=407.83 cfs 112.124 af

Reach 13R: N Ditch 2 Avg. Flow Depth=4.20' Max Vel=6.98 fps Inflow=480.02 cfs 243.608 af
n=0.015 L=575.0' S=0.0014 '/' Capacity=1,912.82 cfs Outflow=479.88 cfs 243.178 af

Reach 25R: N Ditch 3 Avg. Flow Depth=4.53' Max Vel=7.00 fps Inflow=540.58 cfs 361.699 af
n=0.015 L=490.0' S=0.0013 '/' Capacity=1,841.86 cfs Outflow=540.51 cfs 361.125 af

Reach 33R: South Street Ditch Avg. Flow Depth=2.04' Max Vel=4.16 fps Inflow=81.11 cfs 6.126 af
n=0.015 L=1,385.0' S=0.0013 '/' Capacity=289.35 cfs Outflow=68.50 cfs 6.095 af

Link 27L: HWY 17 Manual Hydrograph Inflow=120.31 cfs 238.731 af
Primary=120.31 cfs 238.731 af

Link 30L: North 2 Manual Hydrograph Inflow=58.78 cfs 116.637 af
Primary=58.78 cfs 116.637 af

Link 31L: North 1 Manual Hydrograph Inflow=62.34 cfs 123.701 af
Primary=62.34 cfs 123.701 af

Link 32L: Process Flows Manual Hydrograph Inflow=14.70 cfs 29.169 af
Primary=14.70 cfs 29.169 af

Total Runoff Area = 412.691 ac Runoff Volume = 128.601 af Average Runoff Depth = 3.74"
37.04% Pervious = 152.841 ac 62.96% Impervious = 259.850 ac

Summary for Subcatchment 1S: Off-Site

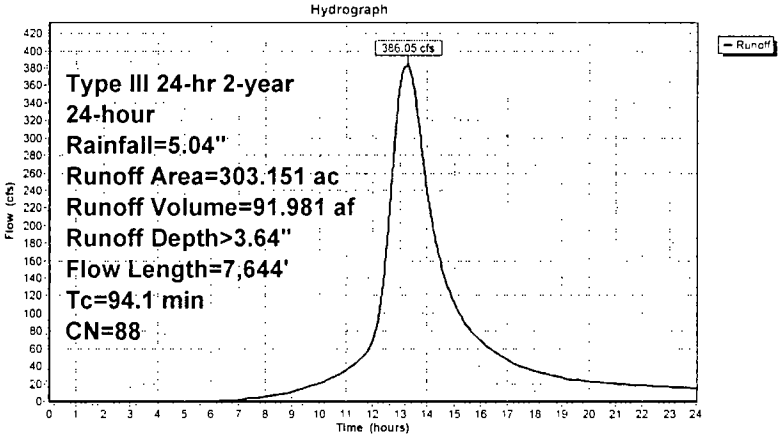
Runoff = 386.05 cfs @ 13.27 hrs, Volume= 91.981 af, Depth> 3.64"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs
Type III 24-hr 2-year, 24-hour Rainfall=5.04"

Area (ac)	CN	Description
197.048	83	1/4 acre lots, 38% imp, HSG C
106.103	98	Paved roads w/curbs & sewers, HSG C
303.151	88	Weighted Average
122.170		40.30% Pervious Area
180.981		59.70% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
10.2	300	0.0005	0.49		**Sheet Flow,** Smooth surfaces n= 0.011 P2= 5.04"
64.1	1,746	0.0005	0.45		**Shallow Concentrated Flow,** Paved Kv= 20.3 fps
8.5	2,278	0.0015	4.47	21.89	**Channel Flow,** Area= 4.9 sf Perim= 3.9' r= 1.26' n= 0.015
2.5	1,000	0.0015	6.57	104.42	**Channel Flow,** Area= 15.9 sf Perim= 7.1' r= 2.24' n= 0.015
8.8	2,320	0.0007	4.40	65.15	**Channel Flow,** Area= 14.8 sf Perim= 6.8' r= 2.18' n= 0.015
94.1	7,644	Total			

Subcatchment 1S: Off-Site



Summary for Subcatchment 2S: Area VIII

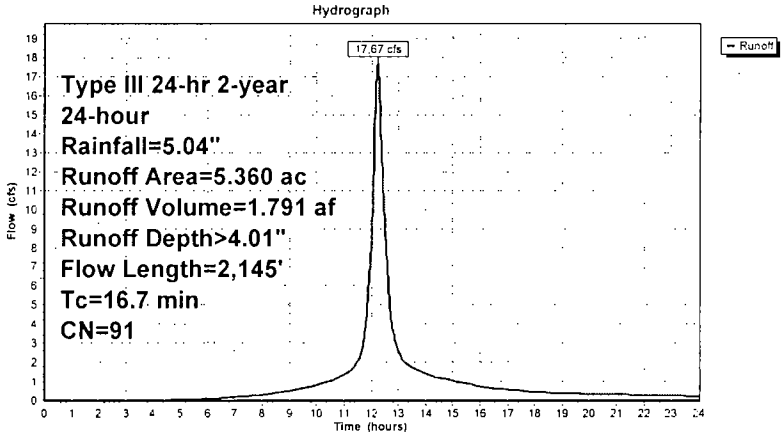
Runoff = 17.67 cfs @ 12.22 hrs, Volume= 1.791 af, Depth> 4.01"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs
Type III 24-hr 2-year, 24-hour Rainfall=5.04"

Area (ac)	CN	Description
5.360	91	Urban industrial, 72% imp, HSG C
1.501		28.00% Pervious Area
3.859		72.00% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
4.0	300	0.0050	1.24		**Sheet Flow,** Smooth surfaces n= 0.011 P2= 5.04"
3.3	285	0.0050	1.44		**Shallow Concentrated Flow,** Paved Kv= 20.3 fps
9.4	1,560	0.0007	2.76	40.77	**Pipe Channel,** 52.0" Round Area= 14.7 sf Perim= 13.6' r= 1.08' n= 0.015
16.7	2,145	Total			

Subcatchment 2S: Area VIII



Summary for Subcatchment 5S: Area VII

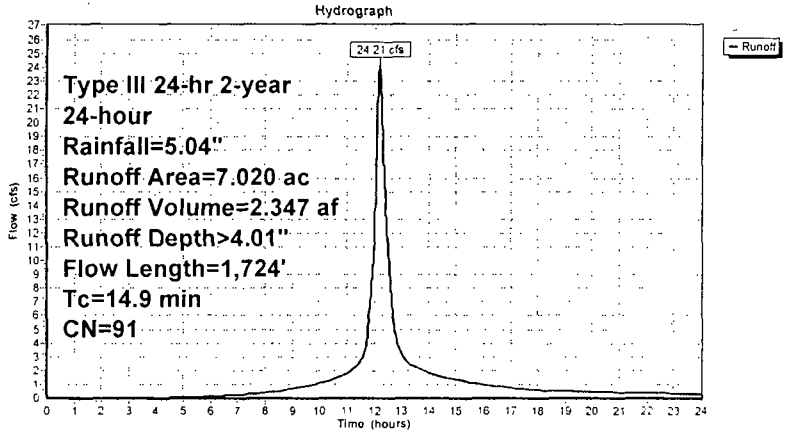
Runoff = 24.21 cfs @ 12.20 hrs, Volume= 2.347 af, Depth> 4.01"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs
Type III 24-hr 2-year, 24-hour Rainfall=5.04"

Area (ac)	CN	Description
7.020	91	Urban industrial, 72% imp, HSG C
1.966		28.00% Pervious Area
5.054		72.00% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
2.8	193	0.0050	1.13		**Sheet Flow,** Smooth surfaces n= 0.011 P2= 5.04"
6.0	521	0.0050	1.44		**Shallow Concentrated Flow,** Paved Kv= 20.3 fps
6.1	1,010	0.0007	2.76	40.77	**Pipe Channel,** 52.0" Round Area= 14.7 sf Perim= 13.6' r= 1.08' n= 0.015
14.9	1,724	Total			

Subcatchment 5S: Area VII



Summary for Subcatchment 6S: Area IX

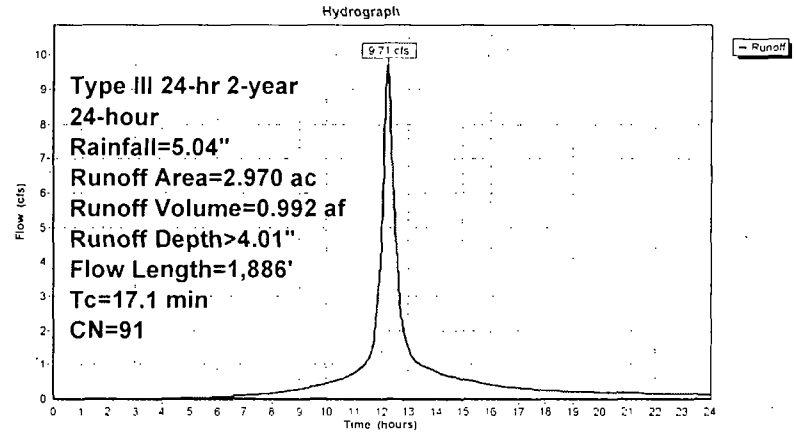
Runoff = 9.71 cfs @ 12.22 hrs, Volume= 0.992 af, Depth> 4.01"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs
Type III 24-hr 2-year, 24-hour Rainfall=5.04"

Area (ac)	CN	Description
2.970	91	Urban industrial, 72% imp, HSG C
0.832		28.00% Pervious Area
2.138		72.00% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
3.8	278	0.0050	1.22		**Sheet Flow,** Smooth surfaces n= 0.011 P2= 5.04"
7.6	655	0.0050	1.44		**Shallow Concentrated Flow,** Paved Kv= 20.3 fps
5.7	953	0.0007	2.76	40.77	**Pipe Channel,** 52.0" Round Area= 14.7 sf Perim= 13.6' r= 1.08' n= 0.015
17.1	1,886	Total			

Subcatchment 6S: Area IX



Summary for Subcatchment 7S: Area XI

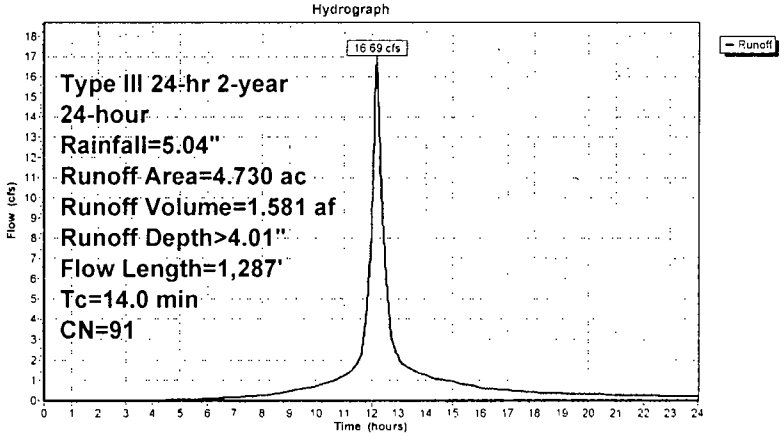
Runoff = 16.69 cfs @ 12.18 hrs, Volume= 1.581 af, Depth> 4.01"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs
Type III 24-hr 2-year, 24-hour Rainfall=5.04"

Area (ac)	CN	Description
4.730	91	Urban industrial, 72% imp, HSG C
1.324		28.00% Pervious Area
3.406		72.00% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
4.0	300	0.0050	1.24		**Sheet Flow,** Smooth surfaces n= 0.011 P2= 5.04"
8.5	730	0.0050	1.44		**Shallow Concentrated Flow,** Paved Kv= 20.3 fps
1.5	257	0.0007	2.76	40.77	**Pipe Channel,** 52.0" Round Area= 14.7 sf Perim= 13.6' r= 1.08' n= 0.015
14.0	1,287	Total			

Subcatchment 7S: Area XI



Summary for Subcatchment 9S: Area XII

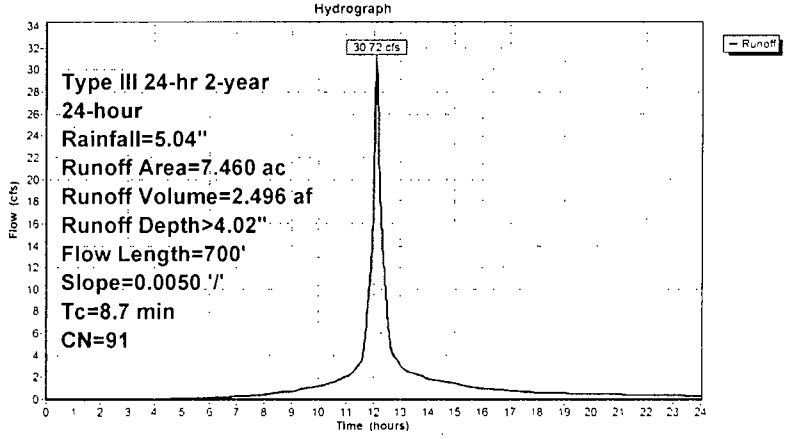
Runoff = 30.72 cfs @ 12.12 hrs, Volume= 2.496 af, Depth> 4.02"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs
Type III 24-hr 2-year, 24-hour Rainfall=5.04"

Area (ac)	CN	Description
7.460	91	Urban industrial, 72% imp, HSG C
2.089		28.00% Pervious Area
5.371		72.00% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
2.1	130	0.0050	1.04		**Sheet Flow,** Smooth surfaces n= 0.011 P2= 5.04"
6.6	570	0.0050	1.44		**Shallow Concentrated Flow,** Paved Kv= 20.3 fps
8.7	700	Total			

Subcatchment 9S: Area XII



Summary for Subcatchment 10S: Area VI

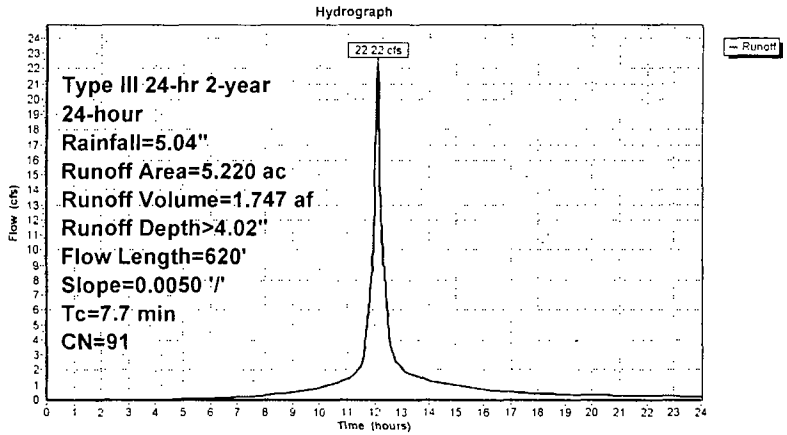
Runoff = 22.22 cfs @ 12.11 hrs, Volume= 1.747 af, Depth> 4.02"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs
Type III 24-hr 2-year, 24-hour Rainfall=5.04"

Area (ac)	CN	Description
5.220	91	Urban industrial, 72% imp, HSG C
1.462		28.00% Pervious Area
3.758		72.00% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
1.8	110	0.0050	1.01		**Sheet Flow,** Smooth surfaces n= 0.011 P2= 5.04"
5.9	510	0.0050	1.44		**Shallow Concentrated Flow,** Paved Kv= 20.3 fps
7.7	620	Total			

Subcatchment 10S: Area VI



Summary for Subcatchment 11S: Area V

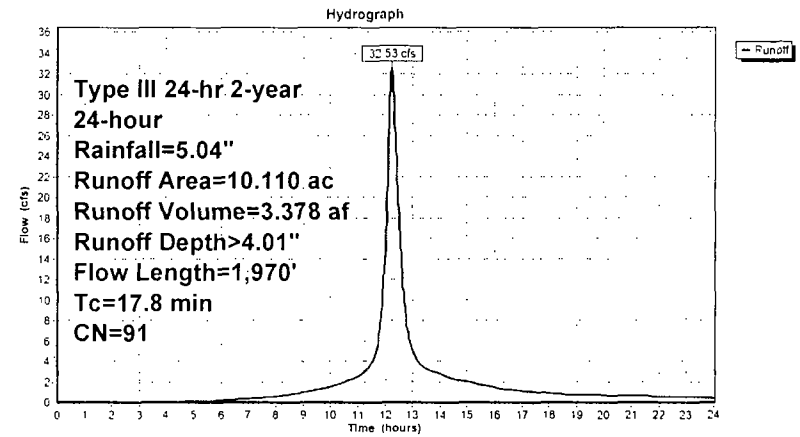
Runoff = 32.53 cfs @ 12.24 hrs, Volume= 3.378 af, Depth> 4.01"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs
Type III 24-hr 2-year, 24-hour Rainfall=5.04"

Area (ac)	CN	Description
10.110	91	Urban industrial, 72% imp, HSG C
2.831		28.00% Pervious Area
7.279		72.00% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
4.0	300	0.0050	1.24		**Sheet Flow,** Smooth surfaces n= 0.011 P2= 5.04"
7.8	676	0.0050	1.44		**Shallow Concentrated Flow,** Paved Kv= 20.3 fps
6.0	994	0.0007	2.76	40.77	**Pipe Channel,** 52.0" Round Area= 14.7 sf Perim= 13.6' r= 1.08' n= 0.015
17.8	1,970	Total			

Subcatchment 11S: Area V



Summary for Subcatchment 12S: Area X

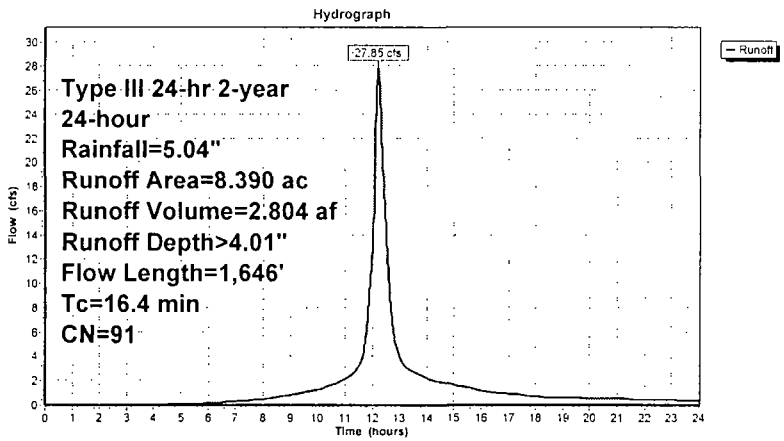
Runoff = 27.85 cfs @ 12.22 hrs, Volume= 2.804 af, Depth> 4.01"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs
Type III 24-hr 2-year, 24-hour Rainfall=5.04"

Area (ac)	CN	Description
8.390	91	Urban industrial, 72% imp, HSG C
2.349		28.00% Pervious Area
6.041		72.00% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
4.0	300	0.0050	1.24		**Sheet Flow,** Smooth surfaces n= 0.011 P2= 5.04"
8.9	769	0.0050	1.44		**Shallow Concentrated Flow,** Paved Kv= 20.3 fps
3.5	577	0.0007	2.76	40.77	**Pipe Channel,** 52.0" Round Area= 14.7 sf Perim= 13.6' r= 1.08' n= 0.015
16.4	1,646	Total			

Subcatchment 12S: Area X



Summary for Subcatchment 14S: Area III

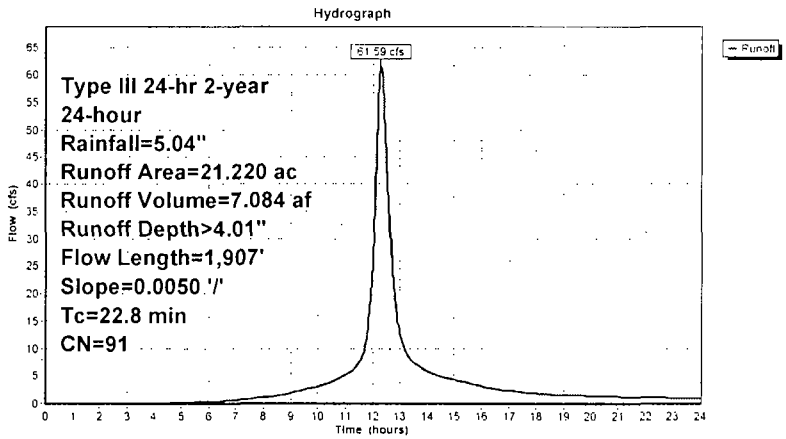
Runoff = 61.59 cfs @ 12.29 hrs, Volume= 7.084 af, Depth> 4.01"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs
Type III 24-hr 2-year, 24-hour Rainfall=5.04"

Area (ac)	CN	Description
21.220	91	Urban industrial, 72% imp, HSG C
5.942		28.00% Pervious Area
15.278		72.00% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
3.2	221	0.0050	1.16		**Sheet Flow,** Smooth surfaces n= 0.011 P2= 5.04"
19.6	1,686	0.0050	1.44		**Shallow Concentrated Flow,** Paved Kv= 20.3 fps
22.8	1,907	Total			

Subcatchment 14S: Area III



Summary for Subcatchment 15S: Area XIII

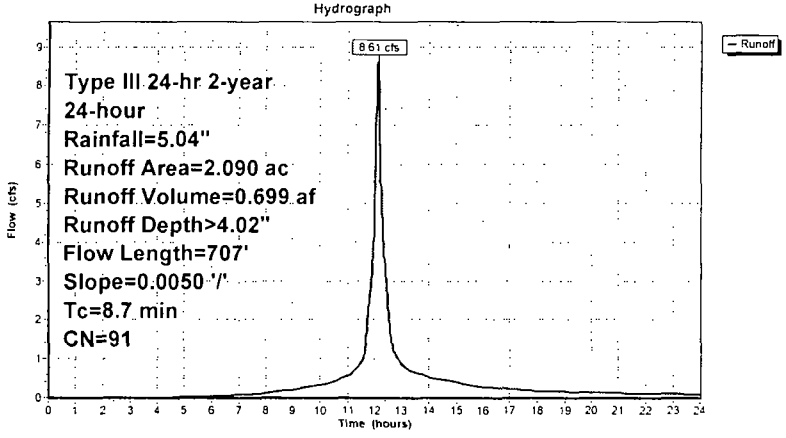
Runoff = 8.61 cfs @ 12.12 hrs, Volume= 0.699 af, Depth> 4.02"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs
Type III 24-hr 2-year, 24-hour Rainfall=5.04"

Area (ac)	CN	Description
2.090	91	Urban industrial, 72% imp, HSG C
0.585		28.00% Pervious Area
1.505		72.00% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
1.5	90	0.0050	0.97		**Sheet Flow,** Smooth surfaces n= 0.011 P2= 5.04"
7.2	617	0.0050	1.44		**Shallow Concentrated Flow,** Paved Kv= 20.3 fps
8.7	707	Total			

Subcatchment 15S: Area XIII



Summary for Subcatchment 16S: Area I

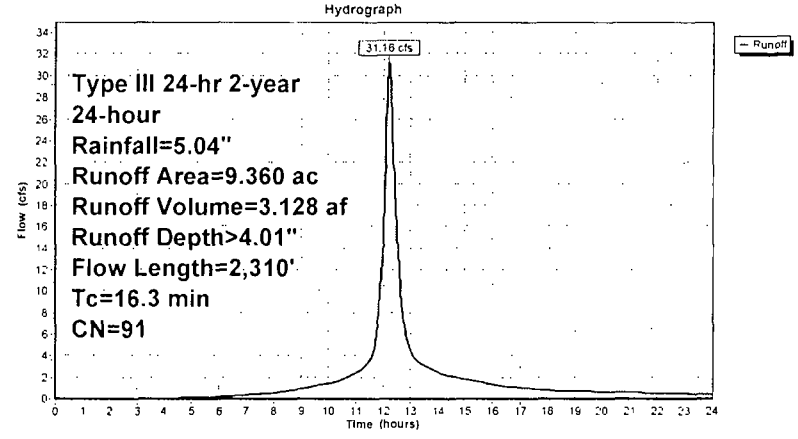
Runoff = 31.16 cfs @ 12.22 hrs, Volume= 3.128 af, Depth> 4.01"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs
Type III 24-hr 2-year, 24-hour Rainfall=5.04"

Area (ac)	CN	Description
9.360	91	Urban industrial, 72% imp, HSG C
2.621		28.00% Pervious Area
6.739		72.00% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.0	428	0.0050	1.44		**Shallow Concentrated Flow,** Paved Kv= 20.3 fps
11.3	1,882	0.0007	2.76	40.77	**Pipe Channel, Through N. Ditch 1** 52.0" Round Area= 14.7 sf Perim= 13.6' r= 1.08' n= 0.015
16.3	2,310	Total			

Subcatchment 16S: Area I



Summary for Subcatchment 17S: Area XV

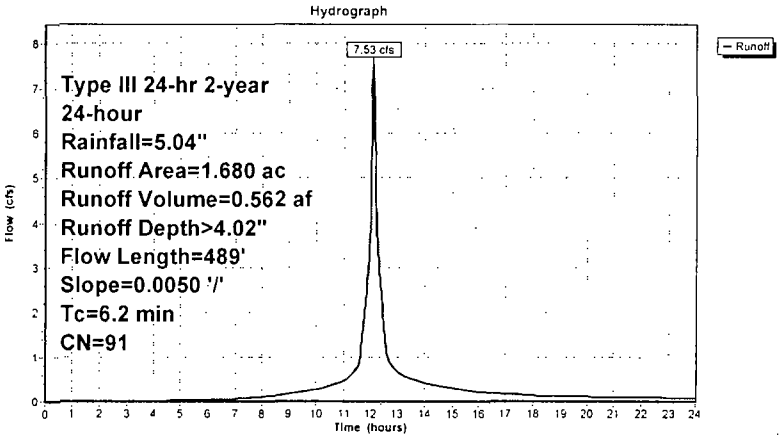
Runoff = 7.53 cfs @ 12.09 hrs, Volume= 0.562 af, Depth> 4.02"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs
Type III 24-hr 2-year, 24-hour Rainfall=5.04"

Area (ac)	CN	Description
1.680	91	Urban industrial, 72% imp, HSG C
0.470		28.00% Pervious Area
1.210		72.00% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
1.5	85	0.0050	0.96		**Sheet Flow,** Smooth surfaces n= 0.011 P2= 5.04"
4.7	404	0.0050	1.44		**Shallow Concentrated Flow,** Paved Kv= 20.3 fps
6.2	489	Total			

Subcatchment 17S: Area XV



Summary for Subcatchment 18S: Area II

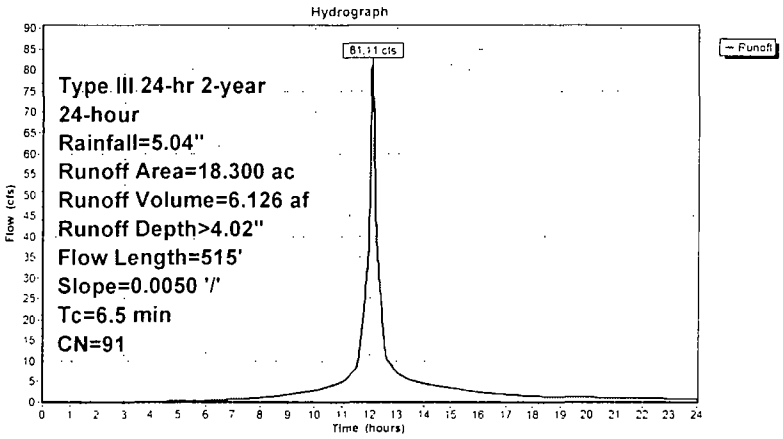
Runoff = 81.11 cfs @ 12.09 hrs, Volume= 6.126 af, Depth> 4.02"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs
Type III 24-hr 2-year, 24-hour Rainfall=5.04"

Area (ac)	CN	Description
18.300	91	Urban industrial, 72% imp, HSG C
5.124		28.00% Pervious Area
13.176		72.00% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
4.0	300	0.0050	1.24		**Sheet Flow,** Smooth surfaces n= 0.011 P2= 5.04"
2.5	215	0.0050	1.44		**Shallow Concentrated Flow,** Paved Kv= 20.3 fps
6.5	515	Total			

Subcatchment 18S: Area II



Summary for Subcatchment 23S: Area XIV

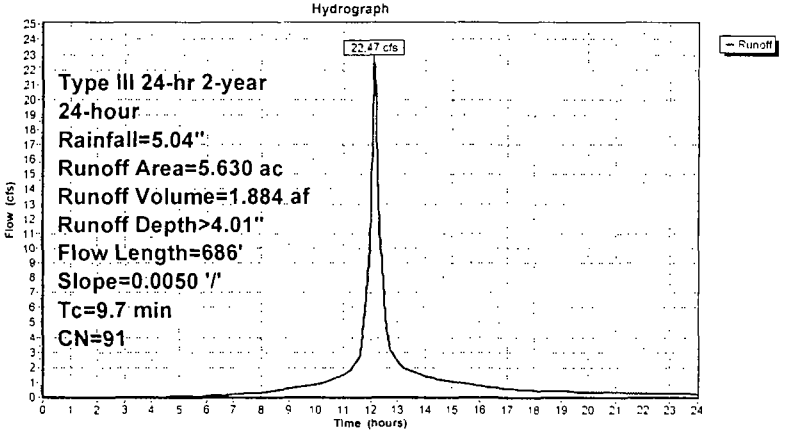
Runoff = 22.47 cfs @ 12.13 hrs, Volume= 1.884 af, Depth> 4.01"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-24.00 hrs, dt= 0 01 hrs
Type III 24-hr 2-year, 24-hour Rainfall=5.04"

Area (ac)	CN	Description
5.630	91	Urban industrial, 72% imp, HSG C
1.576		28.00% Pervious Area
4.054		72.00% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
4.0	300	0.0050	1.24		**Sheet Flow,** Smooth surfaces n= 0.011 P2= 5.04"
5.7	386	0.0050	1.14		**Shallow Concentrated Flow,** Unpaved Kv= 16.1 fps
9.7	686	Total			

Subcatchment 23S: Area XIV



Summary for Reach 4R: TBC

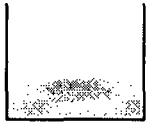
[62] Hint: Exceeded Reach 25R OUTLET depth by 0.32' @ 0.01 hrs
[63] Warning: Exceeded Reach 33R INLET depth by 0 50' @ 13.38 hrs

Inflow Area = 412.691 ac, 62.96% Impervious, Inflow Depth > 18.48" for 2-year, 24-hour event
Inflow = 683.43 cfs @ 12.31 hrs, Volume= 635.683 af
Outflow = 683.32 cfs @ 12 31 hrs, Volume= 635.394 af, Atten= 0%, Lag= 0.5 min

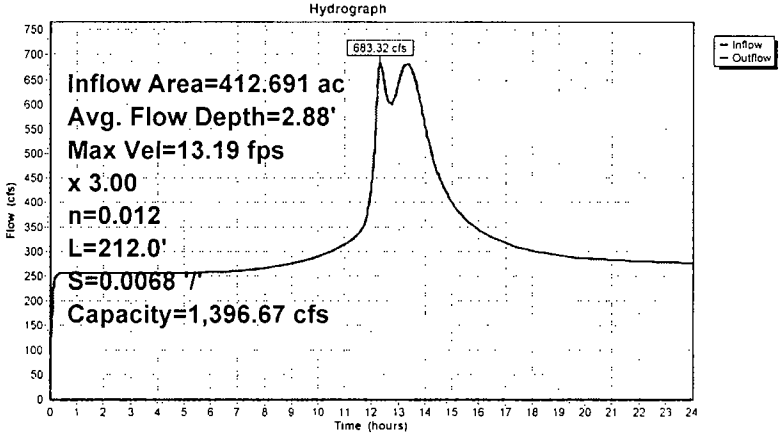
Routing by Stor-Ind+Trans method, Time Span= 0.00-24.00 hrs, dt= 0 01 hrs
Max. Velocity= 13.19 fps, Min. Travel Time= 0.3 min
Avg. Velocity = 10.57 fps, Avg. Travel Time= 0.3 min

Peak Storage= 10,985 cf @ 12.31 hrs
Average Depth at Peak Storage= 2.88'
Bank-Full Depth= 5.00', Capacity at Bank-Full= 1,396.67 cfs

A factor of 3.00 has been applied to the storage and discharge capacity
6.00' x 5.00' deep channel, n= 0.012
Length= 212.0' Slope= 0.0068 '/'
Inlet Invert= -1.28', Outlet Invert= -2.72'



Reach 4R: TBC



Summary for Reach 8R: N Ditch 1

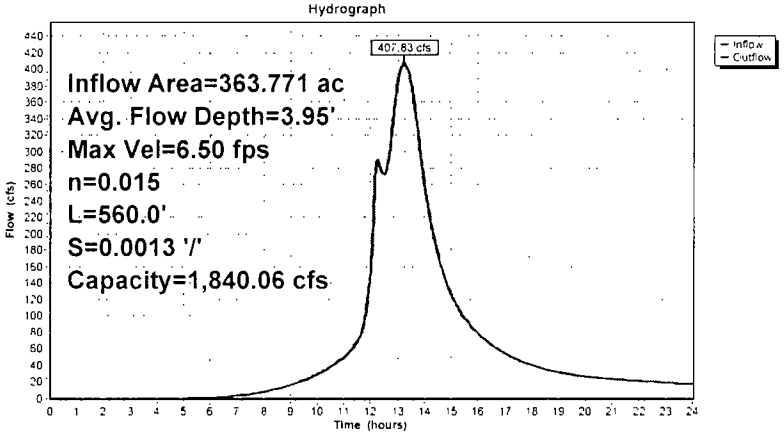
Inflow Area = 363.771 ac, 61.75% Impervious, Inflow Depth > 3.70" for 2-year, 24-hour event
Inflow = 408.01 cfs @ 13.18 hrs, Volume= 112.246 af
Outflow = 407.83 cfs @ 13.26 hrs, Volume= 112.124 af, Atten= 0%, Lag= 4.6 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs
Max. Velocity= 6.50 fps, Min. Travel Time= 1.4 min
Avg. Velocity = 3.15 fps, Avg. Travel Time= 3.0 min

Peak Storage= 35,163 cf @ 13.23 hrs
Average Depth at Peak Storage= 3.95'
Bank-Full Depth= 8.00', Capacity at Bank-Full= 1,840.06 cfs

8.00' x 8.00' deep channel, n= 0.015
Side Slope Z-value= 2.0 '/' Top Width= 40.00'
Length= 560.0' Slope= 0.0013 '/'
Inlet Invert= 0.91', Outlet Invert= 0.18'

Reach 8R: N Ditch 1



Summary for Reach 13R: N Ditch 2

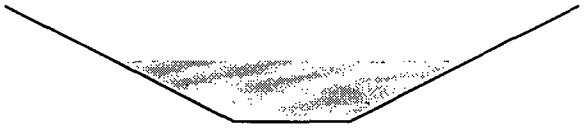
[63] Warning: Exceeded Reach 8R INLET depth by 0.72' @ 1.02 hrs

Inflow Area = 387.081 ac, 62.37% Impervious, Inflow Depth > 7.55" for 2-year, 24-hour event
Inflow = 480.02 cfs @ 13.22 hrs, Volume= 243.608 af
Outflow = 479.88 cfs @ 13.27 hrs, Volume= 243.178 af, Atten= 0%, Lag= 2.8 min

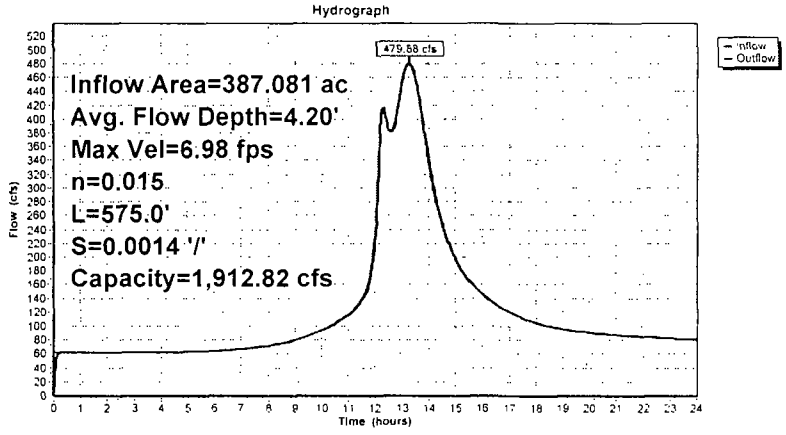
Routing by Stor-Ind+Trans method, Time Span= 0.00-24 00 hrs, dt= 0.01 hrs
Max. Velocity= 6.98 fps, Min. Travel Time= 1.4 min
Avg. Velocity = 4.59 fps, Avg. Travel Time= 2.1 min

Peak Storage= 39,552 cf @ 13.25 hrs
Average Depth at Peak Storage= 4.20'
Bank-Full Depth= 8.00', Capacity at Bank-Full= 1,912.82 cfs

8.00' x 8.00' deep channel, n= 0.015
Side Slope Z-value= 2.0 '/' Top Width= 40.00'
Length= 575.0' Slope= 0.0014 '/'
Inlet Invert= 0.18', Outlet Invert= -0.63'



Reach 13R: N Ditch 2



Summary for Reach 25R: N Ditch 3

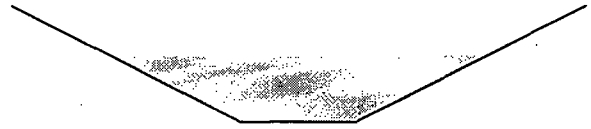
[62] Hint: Exceeded Reach 13R OUTLET depth by 0.67' @ 3 83 hrs

Inflow Area = 392.711 ac, 62 51% Impervious, Inflow Depth > 11.05" for 2-year, 24-hour event
Inflow = 540 58 cfs @ 13.27 hrs, Volume= 361.699 af
Outflow = 540.51 cfs @ 13.31 hrs, Volume= 361.125 af, Atten= 0%, Lag= 2.2 min

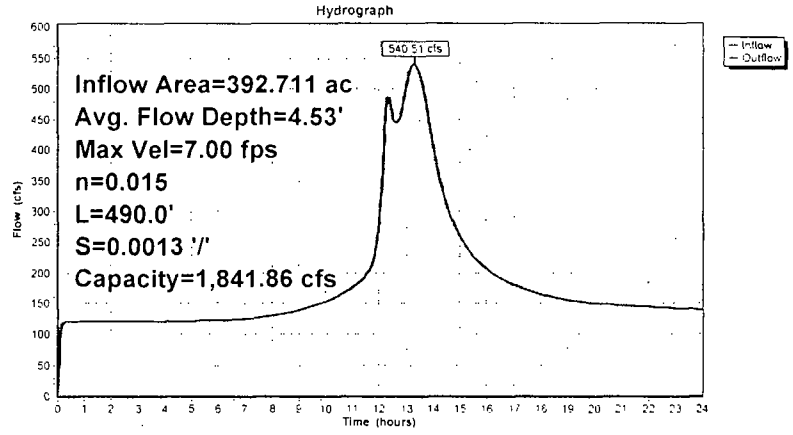
Routing by Stor-Ind+Trans method, Time Span= 0.00-24 00 hrs, dt= 0.01 hrs
Max. Velocity= 7.00 fps, Min. Travel Time= 1.2 min
Avg. Velocity = 5.11 fps, Avg. Travel Time= 1.6 min

Peak Storage= 37,836 cf @ 13 29 hrs
Average Depth at Peak Storage= 4.53'
Bank-Full Depth= 8.00', Capacity at Bank-Full= 1,841.86 cfs

8 00' x 8.00' deep channel, n= 0.015
Side Slope Z-value= 2 0 '/' Top Width= 40.00'
Length= 490 0' Slope= 0.0013 '/'
Inlet Invert= -0.63', Outlet Invert= -1 27'



Reach 25R: N Ditch 3



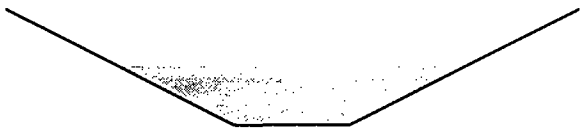
Summary for Reach 33R: South Street Ditch

Inflow Area = 18.300 ac, 72.00% Impervious, Inflow Depth > 4.02" for 2-year, 24-hour event
Inflow = 81.11 cfs @ 12.09 hrs, Volume= 6.126 af
Outflow = 68.50 cfs @ 12.24 hrs, Volume= 6.095 af, Atten= 16%, Lag= 8.7 min

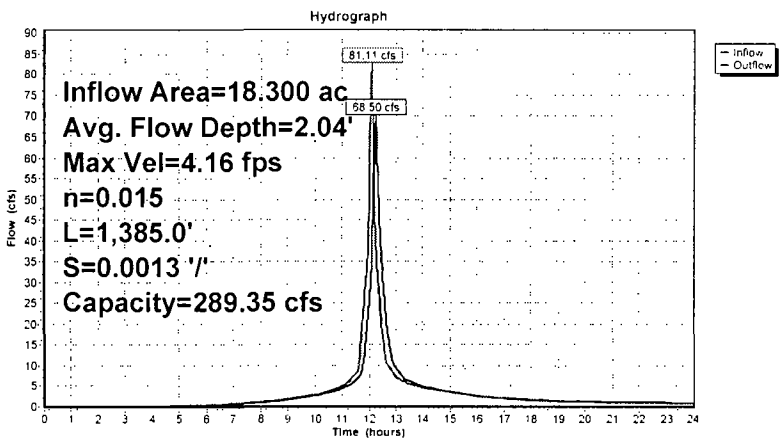
Routing by Stor-Ind+Trans method, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs
Max. Velocity= 4.16 fps, Min. Travel Time= 5.6 min
Avg. Velocity = 1.42 fps, Avg. Travel Time= 16.3 min

Peak Storage= 22,837 cf @ 12.14 hrs
Average Depth at Peak Storage= 2.04'
Bank-Full Depth= 4.00', Capacity at Bank-Full= 289.35 cfs

4.00' x 4.00' deep channel, n= 0.015
Side Slope Z-value= 2.0 '/' Top Width= 20.00'
Length= 1,385.0' Slope= 0.0013 '/'
Inlet Invert= 0.52', Outlet Invert= -1.28'



Reach 33R: South Street Ditch



Summary for Link 27L: HWY 17

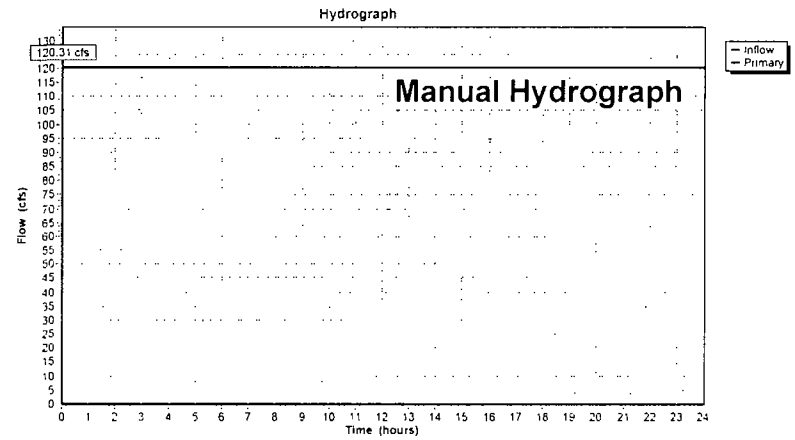
Inflow = 120.31 cfs @ 0.00 hrs, Volume= 238.731 af
Primary = 120.31 cfs @ 0.00 hrs, Volume= 238.731 af, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs

25 Point manual hydrograph, To= 0.00 hrs, dt= 1.00 hrs, cfs =

120.31	120.31	120.31	120.31	120.31	120.31	120.31	120.31	120.31	120.31
120.31	120.31	120.31	120.31	120.31	120.31	120.31	120.31	120.31	120.31
120.31	120.31	120.31	120.31	120.31					

Link 27L: HWY 17



Summary for Link 30L: North 2

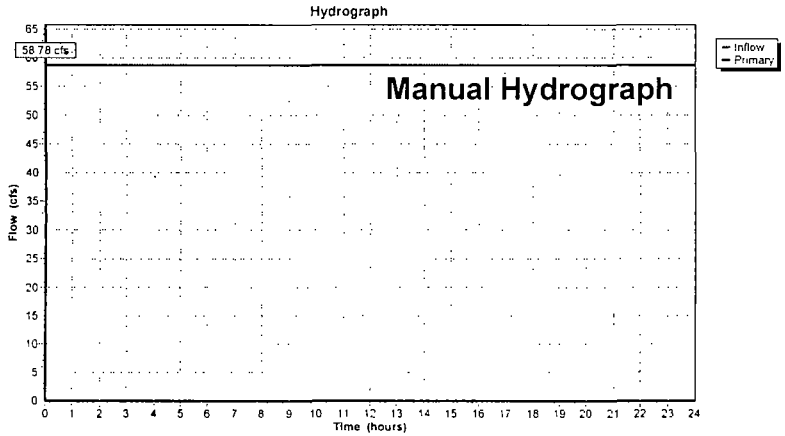
Inflow = 58.78 cfs @ 0.00 hrs, Volume= 116.637 af
Primary = 58.78 cfs @ 0.00 hrs, Volume= 116.637 af, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs

25 Point manual hydrograph, To= 0.00 hrs, dt= 1.00 hrs, cfs =

58.78	58.78	58.78	58.78	58.78	58.78	58.78	58.78	58.78	58.78
58.78	58.78	58.78	58.78	58.78	58.78	58.78	58.78	58.78	58.78
58.78	58.78	58.78	58.78	58.78					

Link 30L: North 2



Summary for Link 31L: North 1

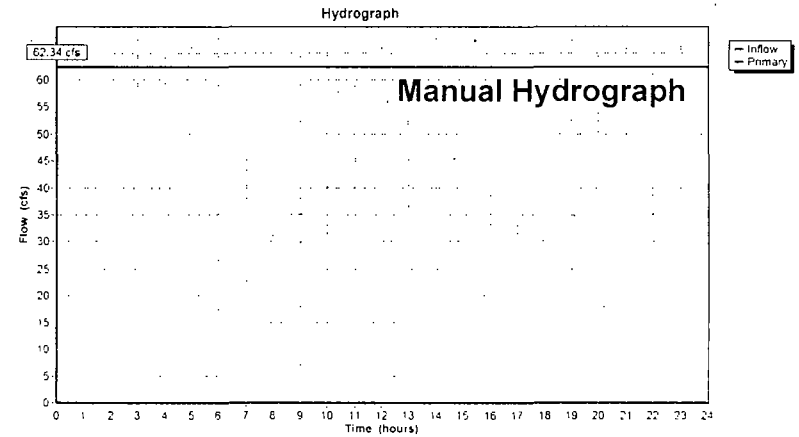
Inflow = 62.34 cfs @ 0.00 hrs, Volume= 123.701 af
Primary = 62.34 cfs @ 0.00 hrs, Volume= 123.701 af, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs

25 Point manual hydrograph, To= 0.00 hrs, dt= 1.00 hrs, cfs =

62.34	62.34	62.34	62.34	62.34	62.34	62.34	62.34	62.34	62.34
62.34	62.34	62.34	62.34	62.34	62.34	62.34	62.34	62.34	62.34
62.34	62.34	62.34	62.34	62.34					

Link 31L: North 1



Summary for Link 32L: Process Flows

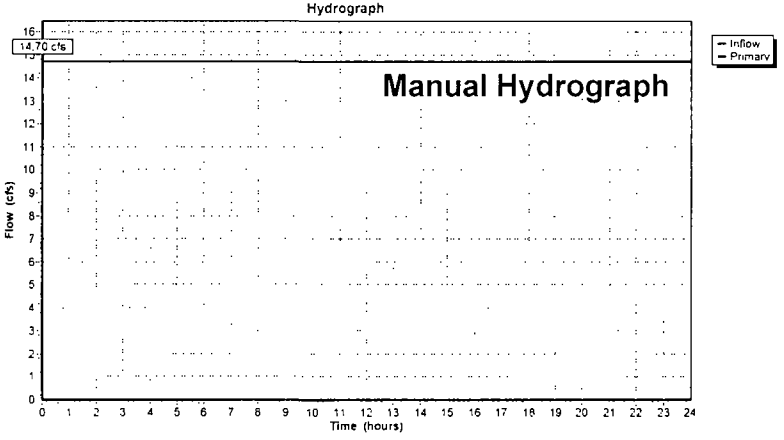
Inflow = 14.70 cfs @ 0.00 hrs, Volume= 29.169 af
Primary = 14.70 cfs @ 0.00 hrs, Volume= 29.169 af, Atten= 0%, Lag= 0.0 min

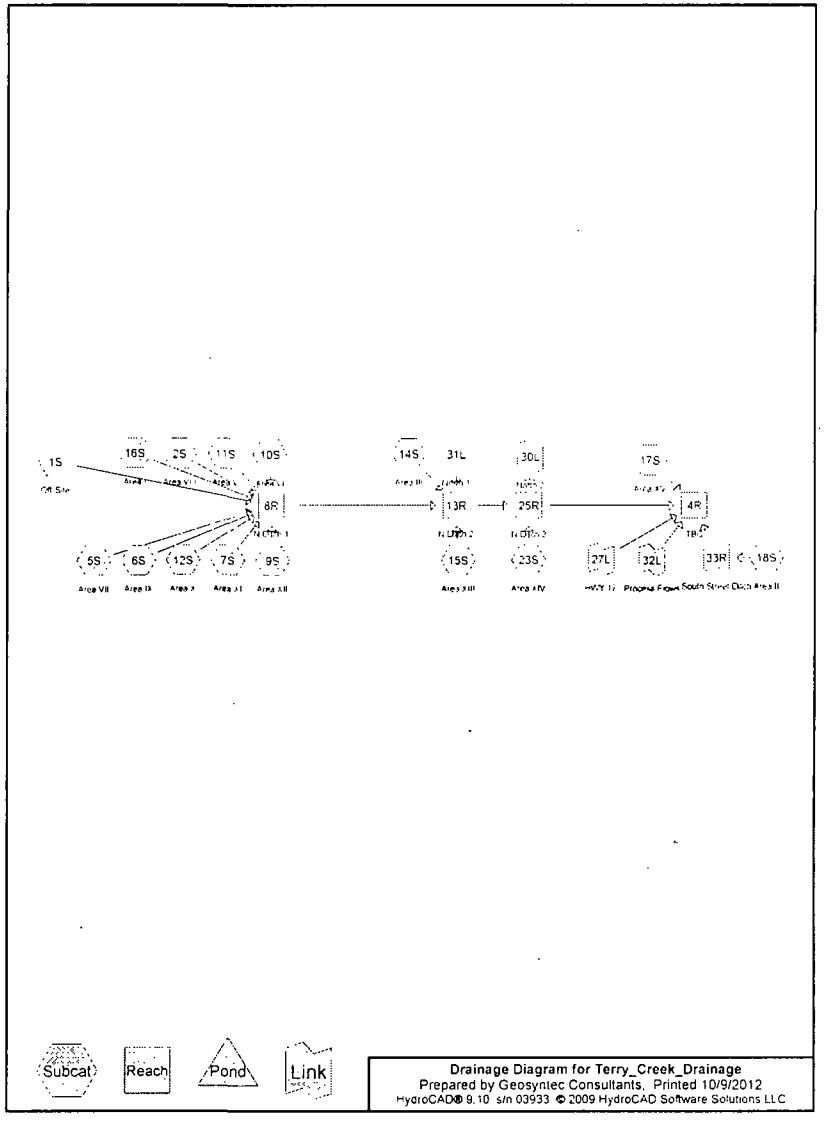
Primary outflow = Inflow, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs

25 Point manual hydrograph, To= 0.00 hrs, dt= 1.00 hrs, cfs =

14.70	14.70	14.70	14.70	14.70	14.70	14.70	14.70	14.70	14.70
14.70	14.70	14.70	14.70	14.70	14.70	14.70	14.70	14.70	14.70
14.70	14.70	14.70	14.70	14.70					

Link 32L: Process Flows





Area Listing (all nodes)

Area (acres)	CN	Description (subcatchment-numbers)
197.048	83	1/4 acre lots, 38% imp, HSG C (1S)
109.540	91	Urban industrial, 72% imp, HSG C (2S, 5S, 6S, 7S, 9S, 10S, 11S, 12S, 14S, 15S, 16S, 17S, 18S, 23S)
106.103	98	Paved roads w/curbs & sewers, HSG C (1S)
412.691		**TOTAL AREA**

Soil Listing (all nodes)

Area (acres)	Soil Group	Subcatchment Numbers
0.000	HSG A	
0.000	HSG B	
412.691	HSG C	1S, 2S, 5S, 6S, 7S, 9S, 10S, 11S, 12S, 14S, 15S, 16S, 17S, 18S, 23S
0.000	HSG D	
0.000	Other	
412.691		**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)	Fill (inches)
1	2S	0.00	0.00	1.560.0	0.0007	0.015	52.0	0.0	0.0
2	5S	0.00	0.00	1.010.0	0.0007	0.015	52.0	0.0	0.0
3	6S	0.00	0.00	953.0	0.0007	0.015	52.0	0.0	0.0
4	7S	0.00	0.00	257.0	0.0007	0.015	52.0	0.0	0.0
5	11S	0.00	0.00	994.0	0.0007	0.015	52.0	0.0	0.0
6	12S	0.00	0.00	577.0	0.0007	0.015	52.0	0.0	0.0
7	16S	0.00	0.00	1.882.0	0.0007	0.015	52.0	0.0	0.0

Time span=0.00-24.00 hrs, dt=0.01 hrs, 2401 points
Runoff by SCS TR-20 method, UH=SCS
Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

Subcatchment1S: Off-Site Runoff Area=303.151 ac 59.70% Impervious Runoff Depth>6.61"
Flow Length=7,644' Tc=94.1 min CN=88 Runoff=683.99 cfs 167.105 af

Subcatchment2S: Area VIII Runoff Area=5.360 ac 72.00% Impervious Runoff Depth>7.06"
Flow Length=2,145' Tc=16.7 min CN=91 Runoff=30.20 cfs 3.156 af

Subcatchment5S: Area VII Runoff Area=7.020 ac 72.00% Impervious Runoff Depth>7.07"
Flow Length=1,724' Tc=14.9 min CN=91 Runoff=41.36 cfs 4.134 af

Subcatchment6S: Area IX Runoff Area=2.970 ac 72.00% Impervious Runoff Depth>7.06"
Flow Length=1,886' Tc=17.1 min CN=91 Runoff=16.59 cfs 1.748 af

Subcatchment7S: Area XI Runoff Area=4.730 ac 72.00% Impervious Runoff Depth>7.07"
Flow Length=1,287' Tc=14.0 min CN=91 Runoff=28.51 cfs 2.786 af

Subcatchment9S: Area XII Runoff Area=7.460 ac 72.00% Impervious Runoff Depth>7.07"
Flow Length=700' Slope=0.0050 '/' Tc=8.7 min CN=91 Runoff=52.43 cfs 4.397 af

Subcatchment10S: Area VI Runoff Area=5.220 ac 72.00% Impervious Runoff Depth>7.07"
Flow Length=620' Slope=0.0050 '/' Tc=7.7 min CN=91 Runoff=37.92 cfs 3.077 af

Subcatchment11S: Area V Runoff Area=10.110 ac 72.00% Impervious Runoff Depth>7.06"
Flow Length=1,970' Tc=17.8 min CN=91 Runoff=55.58 cfs 5.951 af

Subcatchment12S: Area X Runoff Area=8.390 ac 72.00% Impervious Runoff Depth>7.07"
Flow Length=1,646' Tc=16.4 min CN=91 Runoff=47.59 cfs 4.940 af

Subcatchment14S: Area III Runoff Area=21.220 ac 72.00% Impervious Runoff Depth>7.06"
Flow Length=1,907' Slope=0.0050 '/' Tc=22.8 min CN=91 Runoff=105.36 cfs 12.481 af

Subcatchment15S: Area XIII Runoff Area=2.090 ac 72.00% Impervious Runoff Depth>7.07"
Flow Length=707' Slope=0.0050 '/' Tc=8.7 min CN=91 Runoff=14.69 cfs 1.232 af

Subcatchment16S: Area I Runoff Area=9.360 ac 72.00% Impervious Runoff Depth>7.07"
Flow Length=2,310' Tc=16.3 min CN=91 Runoff=53.24 cfs 5.511 af

Subcatchment17S: Area XV Runoff Area=1.680 ac 72.00% Impervious Runoff Depth>7.08"
Flow Length=489' Slope=0.0050 '/' Tc=6.2 min CN=91 Runoff=12.84 cfs 0.991 af

Subcatchment18S: Area II Runoff Area=18.300 ac 72.00% Impervious Runoff Depth>7.08"
Flow Length=515' Slope=0.0050 '/' Tc=6.5 min CN=91 Runoff=138.36 cfs 10.791 af

Subcatchment23S: Area XIV Runoff Area=5.630 ac 72.00% Impervious Runoff Depth>7.07"
Flow Length=686' Slope=0.0050 '/' Tc=9.7 min CN=91 Runoff=38.35 cfs 3.318 af

Reach 4R: TBC Avg. Flow Depth=3.88' Max Vel=14.49 fps Inflow=1,010.68 cfs 738.596 af
x 3.00 n=0.012 L=212.0' S=0.0068 '/' Capacity=1,396.67 cfs Outflow=1,010.49 cfs 738.307 af

Reach 8R: N Ditch 1 Avg. Flow Depth=5.20' Max Vel=7.54 fps Inflow=722.47 cfs 202.805 af
n=0.015 L=560.0' S=0.0013 '/' Capacity=1,840.06 cfs Outflow=722.03 cfs 202.632 af

Reach 13R: N Ditch 2 Avg. Flow Depth=5.36' Max Vel=7.97 fps Inflow=801.22 cfs 340.046 af
n=0.015 L=575.0' S=0.0014 '/' Capacity=1,912.82 cfs Outflow=800.96 cfs 339.588 af

Reach 25R: N Ditch 3 Avg. Flow Depth=5.65' Max Vel=7.90 fps Inflow=862.97 cfs 459.544 af
n=0.015 L=490.0' S=0.0013 '/' Capacity=1,841.86 cfs Outflow=862.79 cfs 458.957 af

Reach 33R: South Street Ditch Avg. Flow Depth=2.67' Max Vel=4.82 fps Inflow=138.36 cfs 10.791 af
n=0.015 L=1,385.0' S=0.0013 '/' Capacity=289.35 cfs Outflow=120.26 cfs 10.749 af

Link 27L: HWY 17 Manual Hydrograph Inflow=120.31 cfs 238.731 af
Primary=120.31 cfs 238.731 af

Link 30L: North 2 Manual Hydrograph Inflow=58.78 cfs 116.637 af
Primary=58.78 cfs 116.637 af

Link 31L: North 1 Manual Hydrograph Inflow=62.34 cfs 123.701 af
Primary=62.34 cfs 123.701 af

Link 32L: Process Flows Manual Hydrograph Inflow=14.70 cfs 29.169 af
Primary=14.70 cfs 29.169 af

Total Runoff Area = 412.691 ac Runoff Volume = 231.618 af Average Runoff Depth = 6.73"
37.04% Pervious = 152.841 ac 62.96% Impervious = 259.850 ac

Summary for Subcatchment 1S: Off-Site

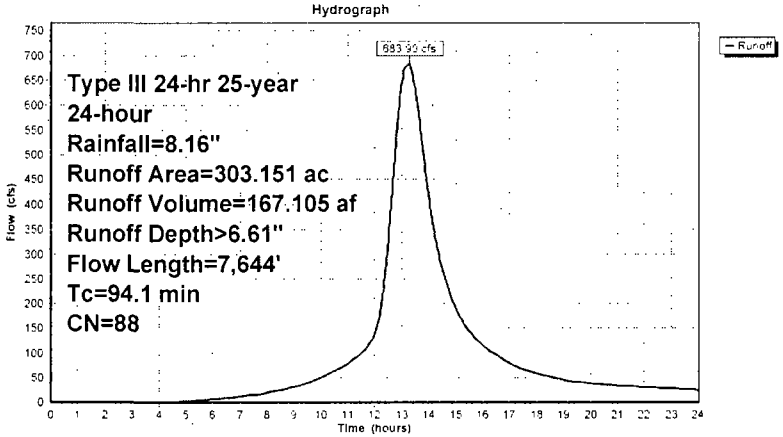
Runoff = 683.99 cfs @ 13.27 hrs, Volume= 167.105 af, Depth> 6.61"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs
Type III 24-hr 25-year, 24-hour Rainfall=8.16"

Area (ac)	CN	Description
197.048	83	1/4 acre lots, 38% imp, HSG C
106.103	98	Paved roads w/curbs & sewers, HSG C
303.151	88	Weighted Average
122.170		40.30% Pervious Area
180.981		59.70% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
10.2	300	0.0005	0.49		**Sheet Flow,** Smooth surfaces n= 0.011 P2= 5.04"
64.1	1,746	0.0005	0.45		**Shallow Concentrated Flow,** Paved Kv= 20.3 fps
8.5	2,278	0.0015	4.47	21.89	**Channel Flow,** Area= 4.9 sf Perim= 3.9' r= 1.26' n= 0.015
2.5	1,000	0.0015	6.57	104.42	**Channel Flow,** Area= 15.9 sf Perim= 7.1' r= 2.24' n= 0.015
8.8	2,320	0.0007	4.40	65.15	**Channel Flow,** Area= 14.8 sf Perim= 6.8' r= 2.18' n= 0.015
94.1	7,644	Total			

Subcatchment 1S: Off-Site



Summary for Subcatchment 2S: Area VIII

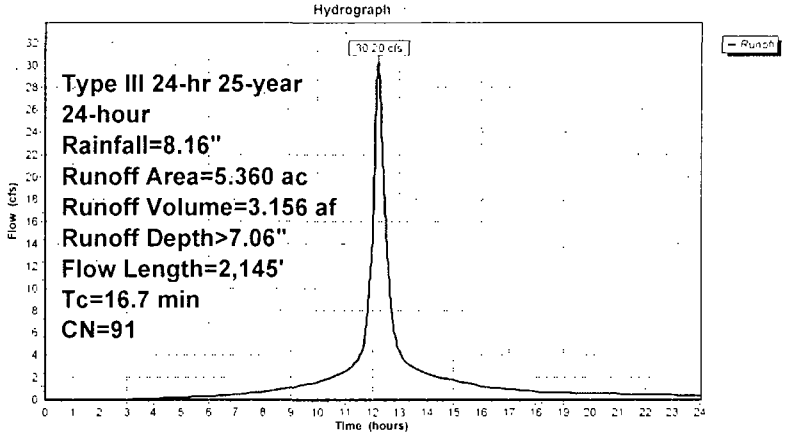
Runoff = 30.20 cfs @ 12.22 hrs, Volume= 3.156 af, Depth> 7.06"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs
Type III 24-hr 25-year, 24-hour Rainfall=8.16"

Area (ac)	CN	Description
5.360	91	Urban industrial, 72% imp, HSG C
1.501		28.00% Pervious Area
3.859		72.00% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
4.0	300	0.0050	1.24		**Sheet Flow,** Smooth surfaces n= 0.011 P2= 5.04"
3.3	285	0.0050	1.44		**Shallow Concentrated Flow,** Paved Kv= 20.3 fps
9.4	1,560	0.0007	2.76	40.77	**Pipe Channel,** 52.0" Round Area= 14.7 sf Perim= 13.6' r= 1.08' n= 0.015
16.7	2,145	Total			

Subcatchment 2S: Area VIII



Summary for Subcatchment 5S: Area VII

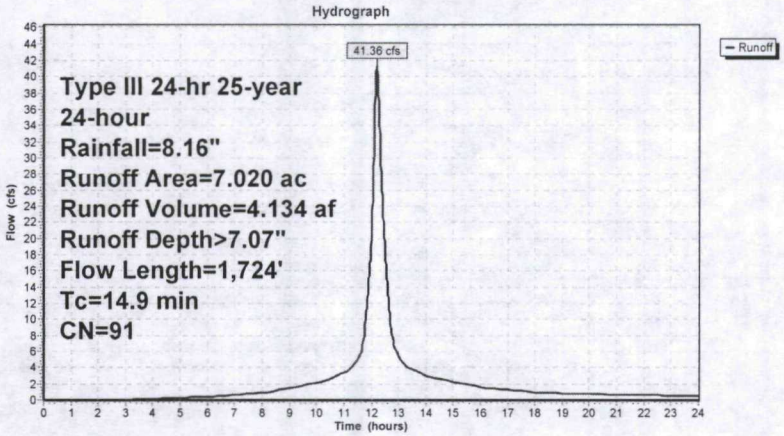
Runoff = 41.36 cfs @ 12.20 hrs, Volume= 4.134 af, Depth> 7.07"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs
Type III 24-hr 25-year, 24-hour Rainfall=8.16"

Area (ac)	CN	Description
7.020	91	Urban industrial, 72% imp, HSG C
1.966		28.00% Pervious Area
5.054		72.00% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
2.8	193	0.0050	1.13		**Sheet Flow,** Smooth surfaces n= 0.011 P2= 5.04"
6.0	521	0.0050	1.44		**Shallow Concentrated Flow,** Paved Kv= 20.3 fps
6.1	1,010	0.0007	2.76	40.77	**Pipe Channel,** 52.0" Round Area= 14.7 sf Perim= 13.6' r= 1.08' n= 0.015
14.9	1,724	Total			

Subcatchment 5S: Area VII



Summary for Subcatchment 6S: Area IX

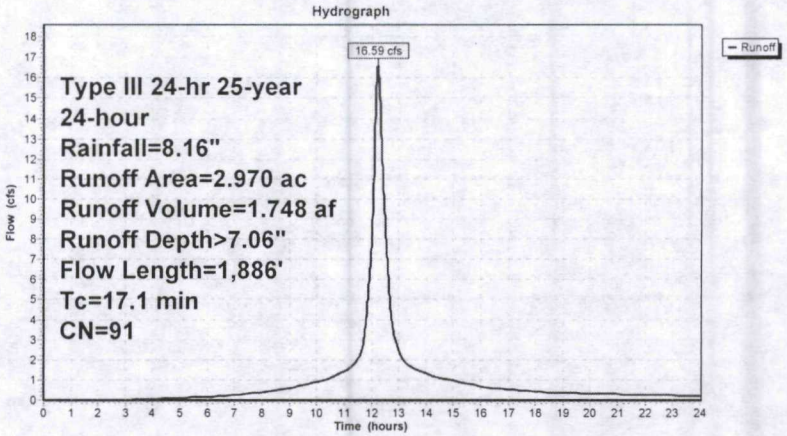
Runoff = 16.59 cfs @ 12.22 hrs, Volume= 1.748 af, Depth> 7.06"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs
Type III 24-hr 25-year, 24-hour Rainfall=8.16"

Area (ac)	CN	Description
2.970	91	Urban industrial, 72% imp, HSG C
0.832		28.00% Pervious Area
2.138		72.00% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
3.8	278	0.0050	1.22		**Sheet Flow,** Smooth surfaces n= 0.011 P2= 5.04"
7.6	655	0.0050	1.44		**Shallow Concentrated Flow,** Paved Kv= 20.3 fps
5.7	953	0.0007	2.76	40.77	**Pipe Channel,** 52.0" Round Area= 14.7 sf Perim= 13.6' r= 1.08' n= 0.015
17.1	1,886	Total			

Subcatchment 6S: Area IX



Summary for Subcatchment 7S: Area XI

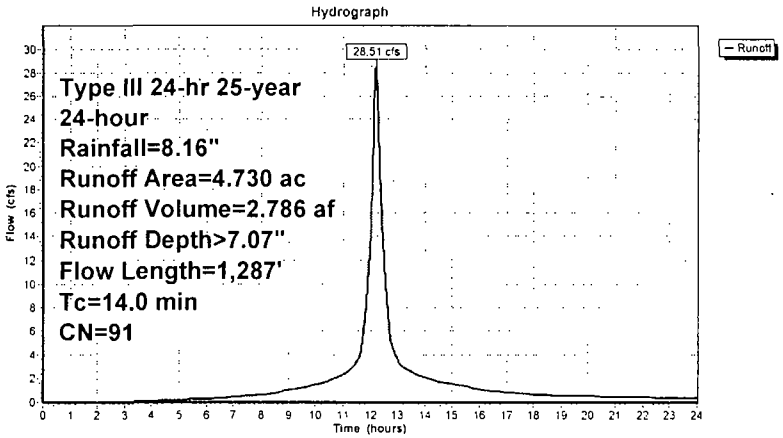
Runoff = 28.51 cfs @ 12.18 hrs, Volume= 2.786 af, Depth> 7.07"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs
Type III 24-hr 25-year, 24-hour Rainfall=8.16"

Area (ac)	CN	Description
4.730	91	Urban industrial, 72% imp, HSG C
1.324		28.00% Pervious Area
3.406		72.00% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
4.0	300	0.0050	1.24		**Sheet Flow,** Smooth surfaces n= 0.011 P2= 5.04"
8.5	730	0.0050	1.44		**Shallow Concentrated Flow,** Paved Kv= 20.3 fps
1.5	257	0.0007	2.76	40.77	**Pipe Channel,** 52.0" Round Area= 14.7 sf Perim= 13.6' r= 1.08' n= 0.015
14.0	1,287	Total			

Subcatchment 7S: Area XI



Summary for Subcatchment 9S: Area XII

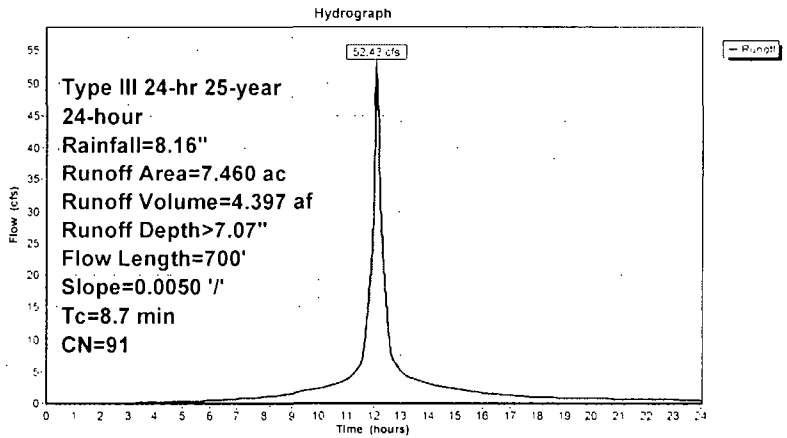
Runoff = 52.43 cfs @ 12.12 hrs, Volume= 4.397 af, Depth> 7.07"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs
Type III 24-hr 25-year, 24-hour Rainfall=8.16"

Area (ac)	CN	Description
7.460	91	Urban industrial, 72% imp, HSG C
2.089		28.00% Pervious Area
5.371		72.00% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
2.1	130	0.0050	1.04		**Sheet Flow,** Smooth surfaces n= 0.011 P2= 5.04"
6.6	570	0.0050	1.44		**Shallow Concentrated Flow,** Paved Kv= 20.3 fps
8.7	700	Total			

Subcatchment 9S: Area XII



Summary for Subcatchment 10S: Area VI

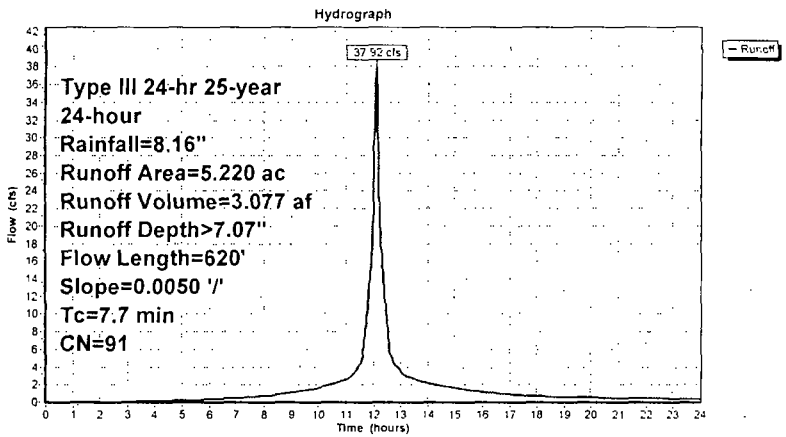
Runoff = 37.92 cfs @ 12.11 hrs, Volume= 3.077 af, Depth> 7.07"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs
Type III 24-hr 25-year, 24-hour Rainfall=8.16"

Area (ac)	CN	Description
5.220	91	Urban industrial, 72% imp, HSG C
1.462		28.00% Pervious Area
3.758		72.00% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
1.8	110	0.0050	1.01		**Sheet Flow,** Smooth surfaces n= 0.011 P2= 5.04"
5.9	510	0.0050	1.44		**Shallow Concentrated Flow,** Paved Kv= 20.3 fps
7.7	620	Total			

Subcatchment 10S: Area VI



Summary for Subcatchment 11S: Area V

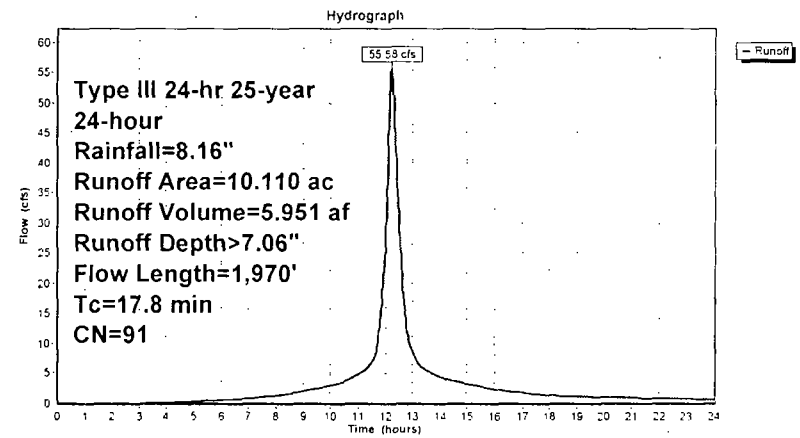
Runoff = 55.58 cfs @ 12.24 hrs, Volume= 5.951 af, Depth> 7.06"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs
Type III 24-hr 25-year, 24-hour Rainfall=8.16"

Area (ac)	CN	Description
10.110	91	Urban industrial, 72% imp, HSG C
2.831		28.00% Pervious Area
7.279		72.00% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
4.0	300	0.0050	1.24		**Sheet Flow,** Smooth surfaces n= 0.011 P2= 5.04"
7.8	676	0.0050	1.44		**Shallow Concentrated Flow,** Paved Kv= 20.3 fps
6.0	994	0.0007	2.76	40.77	**Pipe Channel,** 52.0" Round Area= 14.7 sf Perim= 13.6' r= 1.08' n= 0.015
17.8	1,970	Total			

Subcatchment 11S: Area V



Summary for Subcatchment 12S: Area X

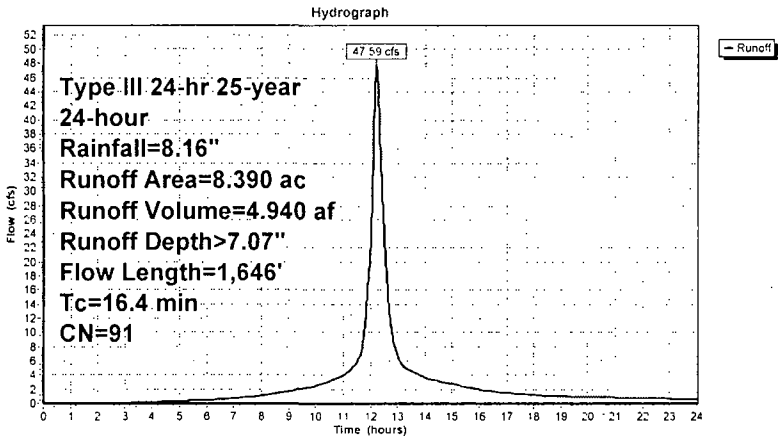
Runoff = 47.59 cfs @ 12.22 hrs, Volume= 4.940 af, Depth> 7.07"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs
Type III 24-hr 25-year, 24-hour Rainfall=8.16"

Area (ac)	CN	Description
8.390	91	Urban industrial, 72% imp, HSG C
2.349		28.00% Pervious Area
6.041		72.00% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
4.0	300	0.0050	1.24		**Sheet Flow,** Smooth surfaces n= 0.011 P2= 5.04"
8.9	769	0.0050	1.44		**Shallow Concentrated Flow,** Paved Kv= 20.3 fps
3.5	577	0.0007	2.76	40.77	**Pipe Channel,** 52.0" Round Area= 14.7 sf Perim= 13.6' r= 1.08' n= 0.015
16.4	1,646	Total			

Subcatchment 12S: Area X



Summary for Subcatchment 14S: Area III

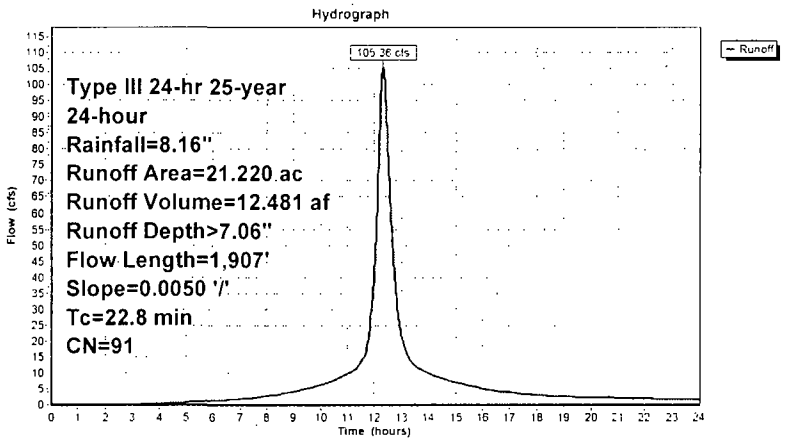
Runoff = 105.36 cfs @ 12.29 hrs, Volume= 12.481 af, Depth> 7.06"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs
Type III 24-hr 25-year, 24-hour Rainfall=8.16"

Area (ac)	CN	Description
21.220	91	Urban industrial, 72% imp, HSG C
5.942		28.00% Pervious Area
15.278		72.00% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
3.2	221	0.0050	1.16		**Sheet Flow,** Smooth surfaces n= 0.011 P2= 5.04"
19.6	1,686	0.0050	1.44		**Shallow Concentrated Flow,** Paved Kv= 20.3 fps
22.8	1,907	Total			

Subcatchment 14S: Area III



Summary for Subcatchment 15S: Area XIII

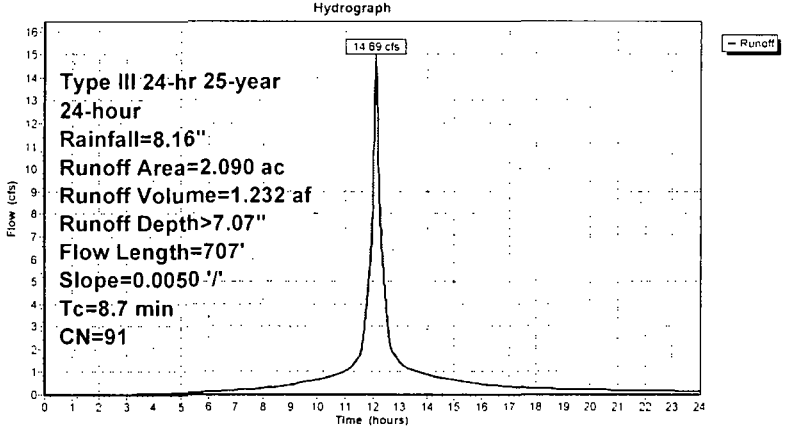
Runoff = 14.69 cfs @ 12.12 hrs, Volume= 1.232 af, Depth> 7.07"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs
Type III 24-hr 25-year, 24-hour Rainfall=8.16"

Area (ac)	CN	Description
2.090	91	Urban industrial, 72% imp, HSG C
0.585		28.00% Pervious Area
1.505		72.00% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
1.5	90	0.0050	0.97		**Sheet Flow,** Smooth surfaces n= 0.011 P2= 5.04"
7.2	617	0.0050	1.44		**Shallow Concentrated Flow,** Paved Kv= 20.3 fps
8.7	707	Total			

Subcatchment 15S: Area XIII



Summary for Subcatchment 16S: Area I

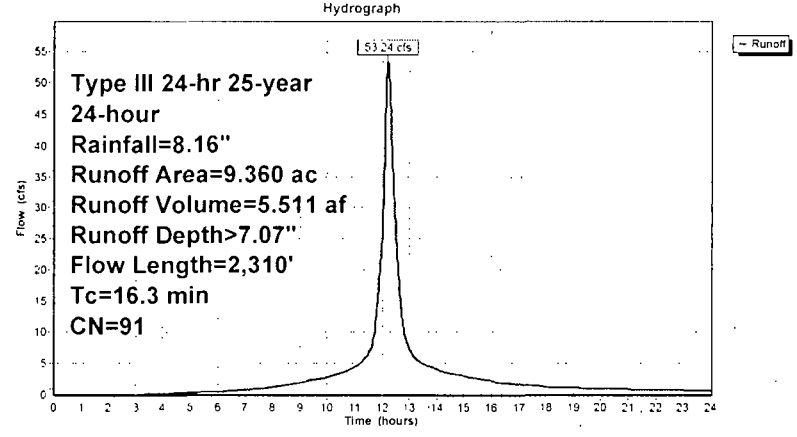
Runoff = 53.24 cfs @ 12.22 hrs, Volume= 5.511 af, Depth> 7.07"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs
Type III 24-hr 25-year, 24-hour Rainfall=8.16"

Area (ac)	CN	Description
9.360	91	Urban industrial, 72% imp, HSG C
2.621		28.00% Pervious Area
6.739		72.00% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.0	428	0.0050	1.44		**Shallow Concentrated Flow,** Paved Kv= 20.3 fps
11.3	1,882	0.0007	2.76	40.77	**Pipe Channel, Through N. Ditch 1** 52.0" Round Area= 14.7 sf Perim= 13.6' r= 1.08' n= 0.015
16.3	2,310	Total			

Subcatchment 16S: Area I



Summary for Subcatchment 17S: Area XV

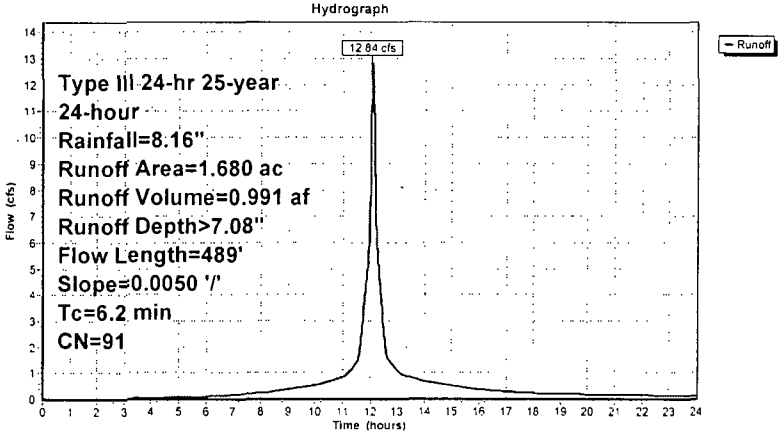
Runoff = 12.84 cfs @ 12.09 hrs, Volume= 0.991 af, Depth> 7.08"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs
Type III 24-hr 25-year, 24-hour Rainfall=8.16"

Area (ac)	CN	Description
1.680	91	Urban industrial, 72% imp, HSG C
0.470		28.00% Pervious Area
1.210		72.00% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
1.5	85	0.0050	0.96		**Sheet Flow,** Smooth surfaces n= 0.011 P2= 5.04"
4.7	404	0.0050	1.44		**Shallow Concentrated Flow,** Paved Kv= 20.3 fps
6.2	489	Total			

Subcatchment 17S: Area XV



Summary for Subcatchment 18S: Area II

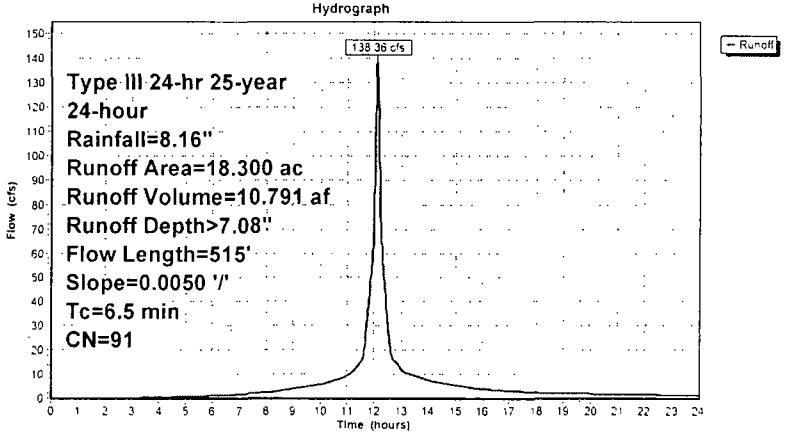
Runoff = 138.36 cfs @ 12.09 hrs, Volume= 10.791 af, Depth> 7.08"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs
Type III 24-hr 25-year, 24-hour Rainfall=8.16"

Area (ac)	CN	Description
18.300	91	Urban industrial, 72% imp, HSG C
5.124		28.00% Pervious Area
13.176		72.00% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
4.0	300	0.0050	1.24		**Sheet Flow,** Smooth surfaces n= 0.011 P2= 5.04"
2.5	215	0.0050	1.44		**Shallow Concentrated Flow,** Paved Kv= 20.3 fps
6.5	515	Total			

Subcatchment 18S: Area II



Summary for Subcatchment 23S: Area XIV

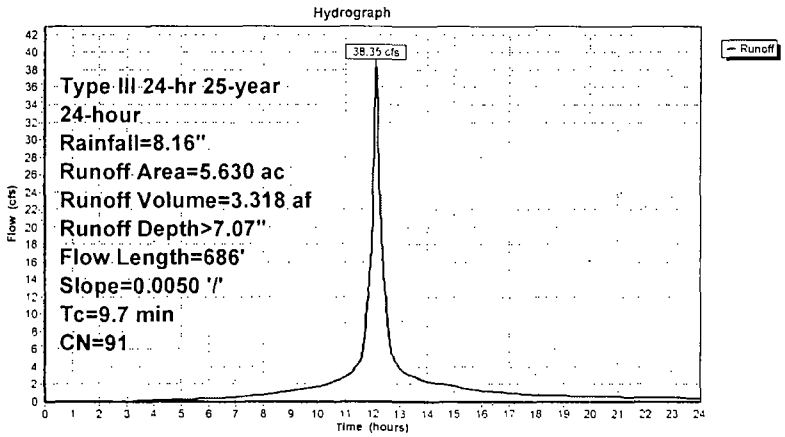
Runoff = 38.35 cfs @ 12.13 hrs, Volume= 3.318 af, Depth> 7.07"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs
Type III 24-hr 25-year, 24-hour Rainfall=8.16"

Area (ac)	CN	Description
5.630	91	Urban industrial, 72% imp, HSG C
1.576		28.00% Pervious Area
4.054		72.00% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
4.0	300	0.0050	1.24		**Sheet Flow,** Smooth surfaces n= 0.011 P2= 5.04"
5.7	386	0.0050	1.14		**Shallow Concentrated Flow,** Unpaved Kv= 16.1 fps
9.7	686	Total			

Subcatchment 23S: Area XIV



Summary for Reach 4R: TBC

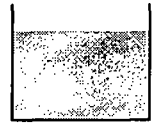
[62] Hint: Exceeded Reach 25R OUTLET depth by 0.32' @ 0.01 hrs
[63] Warning: Exceeded Reach 33R INLET depth by 1.30' @ 13.35 hrs

Inflow Area = 412.691 ac, 62.96% Impervious, Inflow Depth > 21.48" for 25-year, 24-hour event
Inflow = 1,010.68 cfs @ 12.29 hrs, Volume= 738.596 af
Outflow = 1,010.49 cfs @ 12.29 hrs, Volume= 738.307 af, Atten= 0%, Lag= 0.5 min

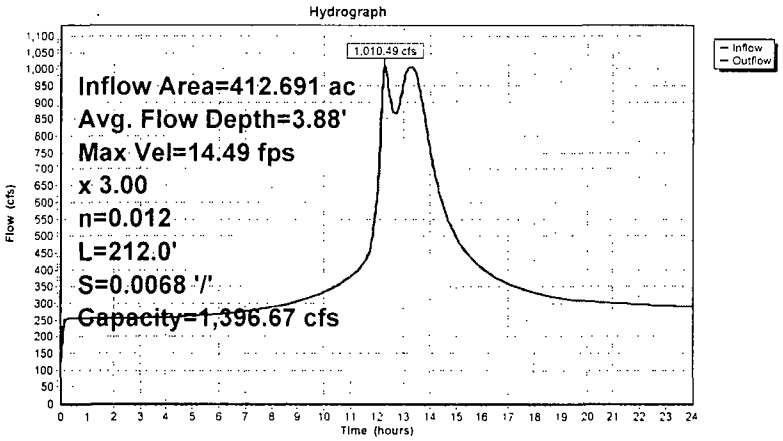
Routing by Stor-Ind+Trans method, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs
Max Velocity= 14.49 fps, Min. Travel Time= 0.2 min
Avg. Velocity = 10.93 fps, Avg. Travel Time= 0.3 min

Peak Storage= 14,790 cf @ 12.29 hrs
Average Depth at Peak Storage= 3.88'
Bank-Full Depth= 5.00', Capacity at Bank-Full= 1,396.67 cfs

A factor of 3.00 has been applied to the storage and discharge capacity
6.00' x 5.00' deep channel, n= 0.012
Length= 212.0' Slope= 0.0068 '/'
Inlet Invert= -1.28', Outlet Invert= -2.72'



Reach 4R: TBC



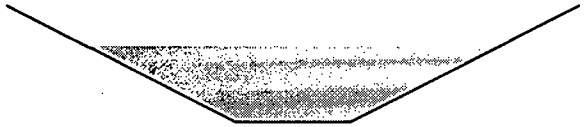
Summary for Reach 8R: N Ditch 1

Inflow Area = 363.771 ac, 61.75% Impervious, Inflow Depth > 6.69" for 25-year, 24-hour event
Inflow = 722.47 cfs @ 13.18 hrs, Volume= 202.805 af
Outflow = 722.03 cfs @ 13.22 hrs, Volume= 202.632 af, Atten= 0%, Lag= 2.3 min

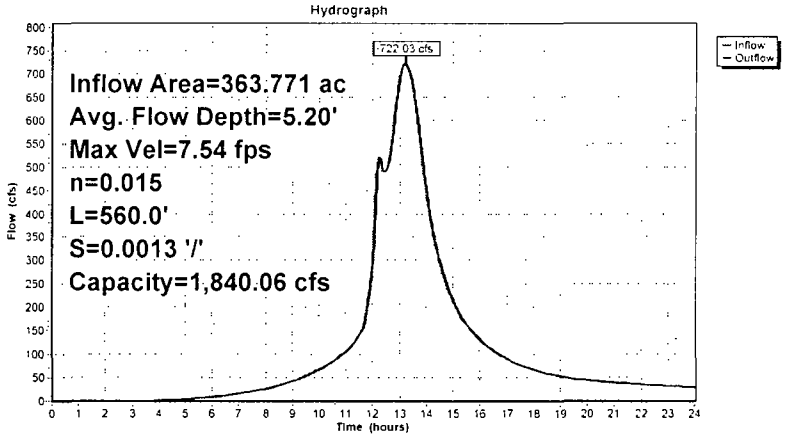
Routing by Stor-Ind+Trans method, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs
Max. Velocity= 7.54 fps, Min. Travel Time= 1.2 min
Avg. Velocity = 3.70 fps, Avg Travel Time= 2.5 min

Peak Storage= 53,609 cf @ 13.20 hrs
Average Depth at Peak Storage= 5.20'
Bank-Full Depth= 8.00', Capacity at Bank-Full= 1,840.06 cfs

8.00' x 8.00' deep channel, n= 0.015
Side Slope Z-value= 2.0 '/' Top Width= 40.00'
Length= 560.0' Slope= 0.0013 '/'
Inlet Invert= 0.91', Outlet Invert= 0.18'



Reach 8R: N Ditch 1



Summary for Reach 13R: N Ditch 2

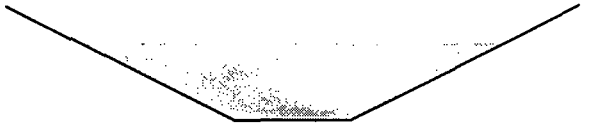
[63] Warning: Exceeded Reach 8R INLET depth by 0.72' @ 1.02 hrs

Inflow Area = 387.081 ac, 62.37% Impervious, Inflow Depth > 10.54" for 25-year, 24-hour event
Inflow = 801.22 cfs @ 13.21 hrs, Volume= 340.046 af
Outflow = 800.96 cfs @ 13.24 hrs, Volume= 339.588 af, Atten= 0%, Lag= 2.1 min

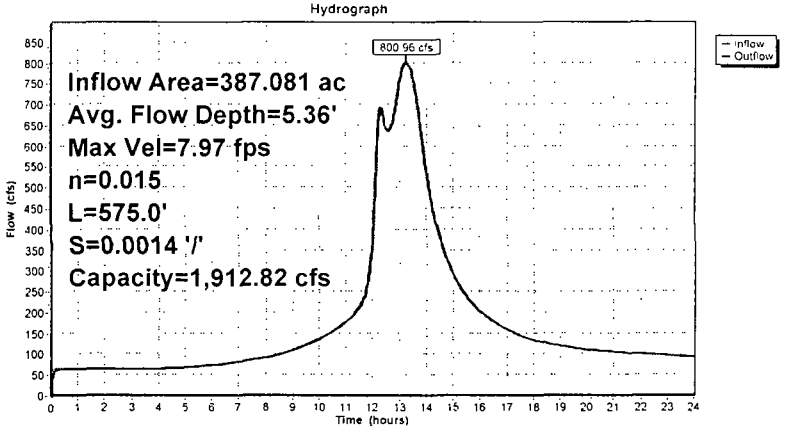
Routing by Stor-Ind+Trans method, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs
Max. Velocity= 7.97 fps, Min. Travel Time= 1.2 min
Avg. Velocity = 4.93 fps, Avg. Travel Time= 1.9 min

Peak Storage= 57,760 cf @ 13.22 hrs
Average Depth at Peak Storage= 5.36'
Bank-Full Depth= 8.00', Capacity at Bank-Full= 1,912.82 cfs

8.00' x 8.00' deep channel, n= 0.015
Side Slope Z-value= 2.0 '/' Top Width= 40.00'
Length= 575.0' Slope= 0.0014 '/'
Inlet Invert= 0.18', Outlet Invert= -0.63'



Reach 13R: N Ditch 2



Summary for Reach 25R: N Ditch 3

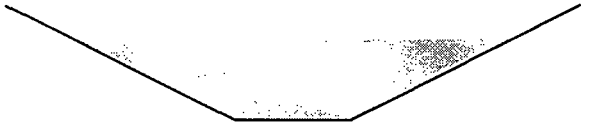
[62] Hint: Exceeded Reach 13R OUTLET depth by 0.67' @ 2.54 hrs

Inflow Area = 392.711 ac, 62.51% Impervious, Inflow Depth > 14.04" for 25-year, 24-hour event
Inflow = 862.97 cfs @ 13.24 hrs, Volume= 459.544 af
Outflow = 862.79 cfs @ 13.27 hrs, Volume= 458.957 af, Atten= 0%, Lag= 1.8 min

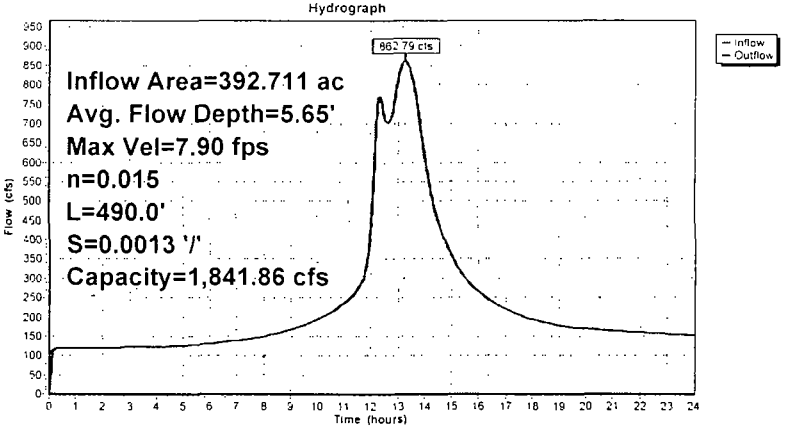
Routing by Stor-Ind+Trans method, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs
Max. Velocity= 7.90 fps, Min. Travel Time= 1.0 min
Avg. Velocity = 5.37 fps, Avg. Travel Time= 1.5 min

Peak Storage= 53,492 cf @ 13.26 hrs
Average Depth at Peak Storage= 5.65'
Bank-Full Depth= 8.00', Capacity at Bank-Full= 1,841.86 cfs

8.00' x 8.00' deep channel, n= 0.015
Side Slope Z-value= 2.0 '/' Top Width= 40.00'
Length= 490.0' Slope= 0.0013 '/'
Inlet Invert= -0.63', Outlet Invert= -1.27'



Reach 25R: N Ditch 3



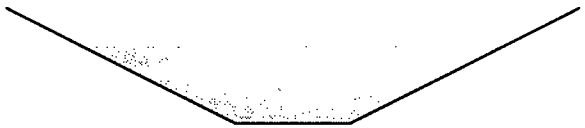
Summary for Reach 33R: South Street Ditch

Inflow Area = 18.300 ac, 72.00% Impervious, Inflow Depth > 7.08" for 25-year, 24-hour event
Inflow = 138.36 cfs @ 12.09 hrs, Volume= 10.791 af
Outflow = 120.26 cfs @ 12.22 hrs, Volume= 10.749 af, Atten= 13%, Lag= 7.6 min

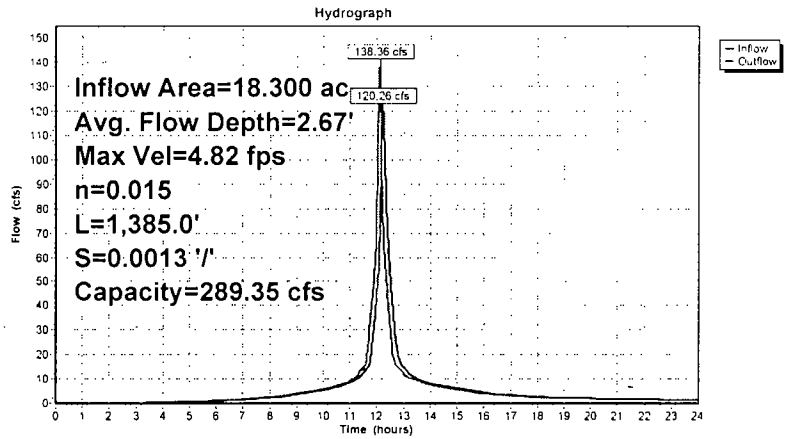
Routing by Stor-Ind+Trans method, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs
Max. Velocity= 4.82 fps, Min. Travel Time= 4.8 min
Avg. Velocity = 1.68 fps, Avg. Travel Time= 13.7 min

Peak Storage= 34,589 cf @ 12 14 hrs
Average Depth at Peak Storage= 2.67'
Bank-Full Depth= 4.00', Capacity at Bank-Full= 289.35 cfs

4.00' x 4.00' deep channel, n= 0 015
Side Slope Z-value= 2.0 '/' Top Width= 20.00'
Length= 1,385.0' Slope= 0.0013 '/'
Inlet Invert= 0 52', Outlet Invert= -1 28'



Reach 33R: South Street Ditch



Summary for Link 27L: HWY 17

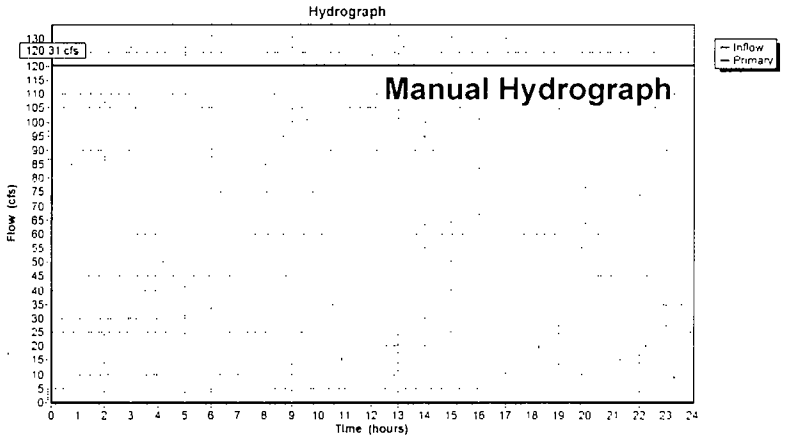
Inflow = 120.31 cfs @ 0.00 hrs, Volume= 238.731 af
Primary = 120.31 cfs @ 0.00 hrs, Volume= 238.731 af, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs

25 Point manual hydrograph, To= 0.00 hrs, dt= 1.00 hrs, cfs =

120.31	120.31	120.31	120.31	120.31	120.31	120.31	120.31	120.31	120.31
120 31	120 31	120.31	120.31	120.31	120.31	120.31	120 31	120.31	120.31
120.31	120 31	120.31	120.31	120 31					

Link 27L: HWY 17



Summary for Link 30L: North 2

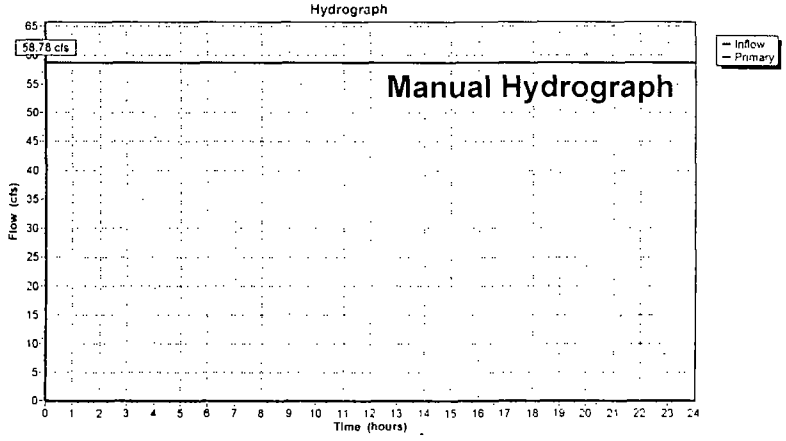
Inflow = 58.78 cfs @ 0.00 hrs, Volume= 116.637 af
Primary = 58.78 cfs @ 0.00 hrs, Volume= 116.637 af, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs

25 Point manual hydrograph, To= 0.00 hrs, dt= 1.00 hrs, cfs =

58.78	58.78	58.78	58.78	58.78	58.78	58.78	58.78	58.78	58.78
58.78	58.78	58.78	58.78	58.78	58.78	58.78	58.78	58.78	58.78
58.78	58.78	58.78	58.78	58.78					

Link 30L: North 2



Summary for Link 31L: North 1

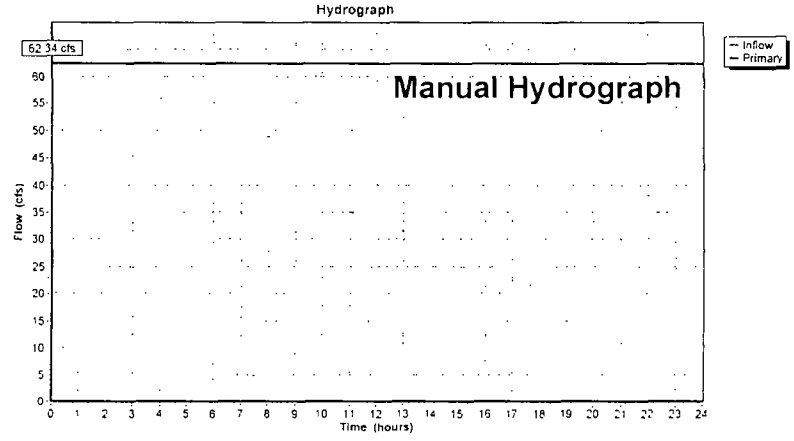
Inflow = 62.34 cfs @ 0.00 hrs, Volume= 123.701 af
Primary = 62.34 cfs @ 0.00 hrs, Volume= 123.701 af, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs

25 Point manual hydrograph, To= 0.00 hrs, dt= 1.00 hrs, cfs =

62.34	62.34	62.34	62.34	62.34	62.34	62.34	62.34	62.34	62.34
62.34	62.34	62.34	62.34	62.34	62.34	62.34	62.34	62.34	62.34
62.34	62.34	62.34	62.34	62.34					

Link 31L: North 1



Summary for Link 32L: Process Flows

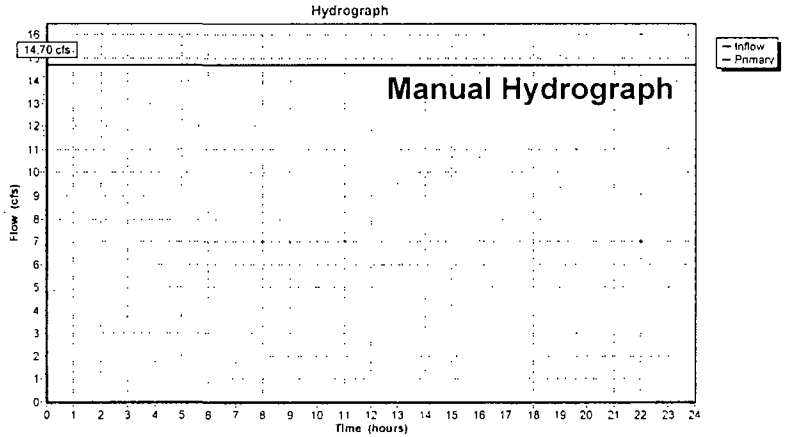
Inflow = 14.70 cfs @ 0.00 hrs, Volume= 29.169 af
Primary = 14.70 cfs @ 0.00 hrs, Volume= 29.169 af, Atten= 0%, Lag= 0.0 min

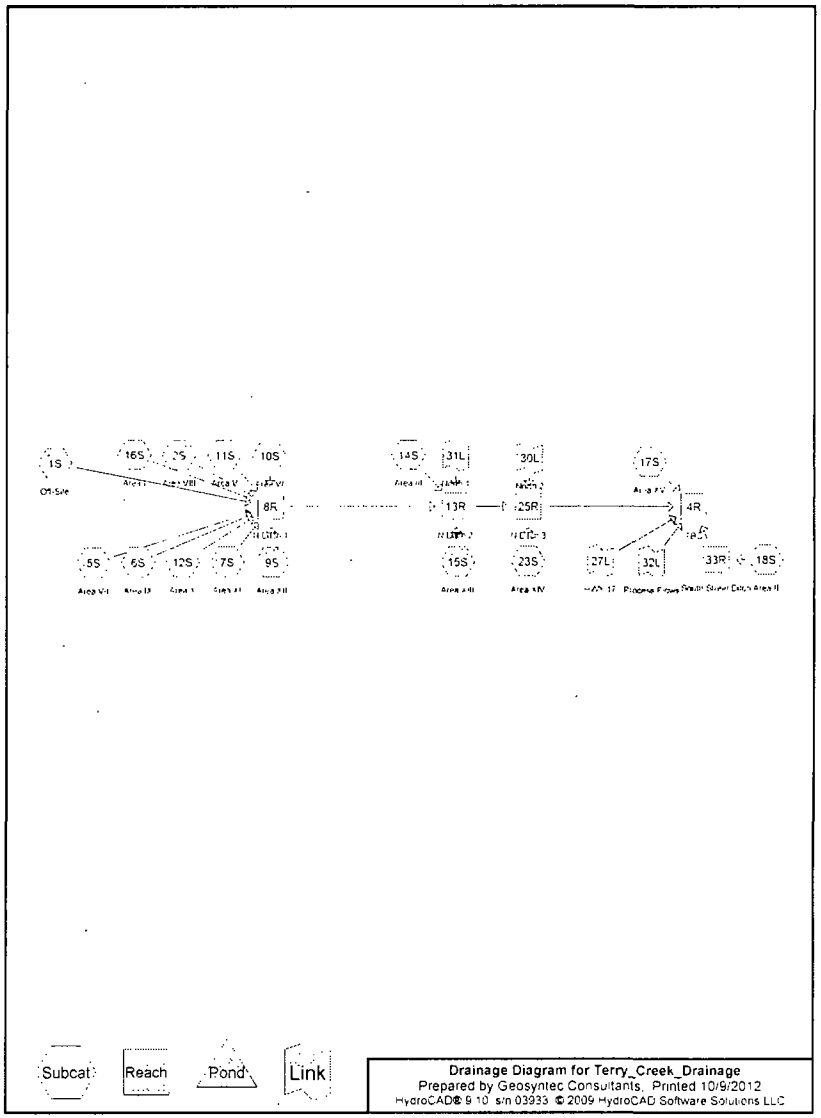
Primary outflow = Inflow, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs

25 Point manual hydrograph, To= 0.00 hrs, dt= 1.00 hrs, cfs =

14.70	14.70	14.70	14.70	14.70	14.70	14.70	14.70	14.70	14.70
14.70	14.70	14.70	14.70	14.70	14.70	14.70	14.70	14.70	14.70
14.70	14.70	14.70	14.70	14.70					

Link 32L: Process Flows





Area Listing (all nodes)

Area (acres)	CN	Description (subcatchment-numbers)
197.048	83	1/4 acre lots, 38% imp, HSG C (1S)
109.540	91	Urban industrial, 72% imp, HSG C (2S, 5S, 6S, 7S, 9S, 10S, 11S, 12S, 14S, 15S, 16S, 17S, 18S, 23S)
106.103	98	Paved roads w/curbs & sewers, HSG C (1S)
412.691		**TOTAL AREA**

Soil Listing (all nodes)

Area (acres)	Soil Group	Subcatchment Numbers
0.000	HSG A	
0.000	HSG B	
412.691	HSG C	1S, 2S, 5S, 6S, 7S, 9S, 10S, 11S, 12S, 14S, 15S, 16S, 17S, 18S, 23S
0.000	HSG D	
0.000	Other	
412.691		**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)	Fill (inches)
1	2S	0.00	0 00	1,560.0	0.0007	0.015	52.0	0.0	0.0
2	5S	0.00	0 00	1,010.0	0.0007	0 015	52 0	0.0	0.0
3	6S	0 00	0.00	953 0	0 0007	0.015	52.0	0 0	0.0
4	7S	0.00	0.00	257 0	0.0007	0 015	52 0	0 0	0 0
5	11S	0.00	0.00	994.0	0.0007	0 015	52.0	0.0	0 0
6	12S	0.00	0 00	577.0	0 0007	0.015	52 0	0.0	0 0
7	16S	0 00	0.00	1,882 0	0.0007	0.015	52 0	0.0	0.0

Time span=0.00-24.00 hrs, dt=0.01 hrs, 2401 points
Runoff by SCS TR-20 method, UH=SCS
Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

Subcatchment1S: Off-Site Runoff Area=303.151 ac 59 70% Impervious Runoff Depth>8 01"
Flow Length=7,644' Tc=94.1 min CN=88 Runoff=820 65 cfs 202 291 af

Subcatchment2S: Area VIII Runoff Area=5 360 ac 72 00% Impervious Runoff Depth>8.49"
Flow Length=2,145' Tc=16 7 min CN=91 Runoff=35 91 cfs 3.791 af

Subcatchment5S: Area VII Runoff Area=7 020 ac 72 00% Impervious Runoff Depth>8 49"
Flow Length=1,724' Tc=14.9 min CN=91 Runoff=49.19 cfs 4 966 af

Subcatchment6S: Area IX Runoff Area=2.970 ac 72 00% Impervious Runoff Depth>8 49"
Flow Length=1 886 Tc=17 1 min CN=91 Runoff=19 74 cfs 2.100 af

Subcatchment7S: Area XI Runoff Area=4 730 ac 72 00% Impervious Runoff Depth>8.49"
Flow Length=1,287' Tc=14.0 min CN=91 Runoff=33.91 cfs 3.346 af

Subcatchment9S: Area XII Runoff Area=7.460 ac 72.00% Impervious Runoff Depth>8.50"
Flow Length=700' Slope=0 0050 '/' Tc=8 7 min CN=91 Runoff=62 34 cfs 5 282 af

Subcatchment10S: Area VI Runoff Area=5 220 ac 72 00% Impervious Runoff Depth>8 50"
Flow Length=620' Slope=0.0050 '/' Tc=7.7 min CN=91 Runoff=45.08 cfs 3 697 af

Subcatchment11S: Area V Runoff Area=10 110 ac 72 00% Impervious Runoff Depth>8 48"
Flow Length=1,970' Tc=17.8 min CN=91 Runoff=66 11 cfs 7 149 af

Subcatchment12S: Area X Runoff Area=8 390 ac 72 00% Impervious Runoff Depth>8 49"
Flow Length=1 646' Tc=16 4 min CN=91 Runoff=56.60 cfs 5 934 af

Subcatchment14S: Area III Runoff Area=21.220 ac 72 00% Impervious Runoff Depth>8.48"
Flow Length=1,907' Slope=0.0050 '/' Tc=22 8 min CN=91 Runoff=125 35 cfs 14 993 af

Subcatchment15S: Area XIII Runoff Area=2 090 ac 72 00% Impervious Runoff Depth>8 50"
Flow Length=707' Slope=0.0050 '/' Tc=8 7 min CN=91 Runoff=17 46 cfs 1 480 af

Subcatchment16S: Area I Runoff Area=9 360 ac 72 00% Impervious Runoff Depth>8.49"
Flow Length=2 310' Tc=16.3 min CN=91 Runoff=63.32 cfs 6 620 af

Subcatchment17S: Area XV Runoff Area=1.680 ac 72 00% Impervious Runoff Depth>8 50"
Flow Length=489' Slope=0 0050 '/' Tc=6.2 min CN=91 Runoff=15.27 cfs 1 190 af

Subcatchment18S: Area II Runoff Area=18 300 ac 72.00% Impervious Runoff Depth>8 50"
Flow Length=515' Slope=0 0050 '/' Tc=6.5 min CN=91 Runoff=164 50 cfs 12 962 af

Subcatchment23S: Area XIV Runoff Area=5.630 ac 72.00% Impervious Runoff Depth>8 50"
Flow Length=686' Slope=0 0050 '/' Tc=9 7 min CN=91 Runoff=45 60 cfs 3 966 af

Reach 4R: TBC Avg Flow Depth=4 32' Max Vel=14 93 fps Inflow=1,160 98 cfs 786 715 af
x 3 00 n=0 012 L=212.0' S=0.0068 '/' Capacity=1,396 67 cfs Outflow=1,160 71 cfs 786.425 af

Reach 8R: N Ditch 1 Avg. Flow Depth=5.67' Max Vel=7.91 fps Inflow=866.46 cfs 245.175 af
n=0.015 L=560.0' S=0.0013 '/' Capacity=1,840.06 cfs Outflow=865.98 cfs 244.980 af

Reach 13R: N Ditch 2 Avg. Flow Depth=5.80' Max Vel=8.33 fps Inflow=948.33 cfs 385.154 af
n=0.015 L=575.0' S=0.0014 '/' Capacity=1,912.82 cfs Outflow=948.01 cfs 384.682 af

Reach 25R: N Ditch 3 Avg. Flow Depth=6.09' Max Vel=8.23 fps Inflow=1,010.62 cfs 505.305 af
n=0.015 L=490.0' S=0.0013 '/' Capacity=1,841.86 cfs Outflow=1,010.41 cfs 504.710 af

Reach 33R: South Street Ditch Avg. Flow Depth=2.91' Max Vel=5.04 fps Inflow=164.50 cfs 12.962 af
n=0.015 L=1,385.0' S=0.0013 '/' Capacity=289.35 cfs Outflow=143.99 cfs 12.915 af

Link 27L: HWY 17 Manual Hydrograph Inflow=120.31 cfs 238.731 af
Primary=120.31 cfs 238.731 af

Link 30L: North 2 Manual Hydrograph Inflow=58.78 cfs 116.637 af
Primary=58.78 cfs 116.637 af

Link 31L: North 1 Manual Hydrograph Inflow=62.34 cfs 123.701 af
Primary=62.34 cfs 123.701 af

Link 32L: Process Flows Manual Hydrograph Inflow=14.70 cfs 29.169 af
Primary=14.70 cfs 29.169 af

Total Runoff Area = 412.691 ac Runoff Volume = 279.785 af Average Runoff Depth = 8.14"
37.04% Pervious = 152.841 ac 62.96% Impervious = 259.850 ac

Summary for Subcatchment 1S: Off-Site

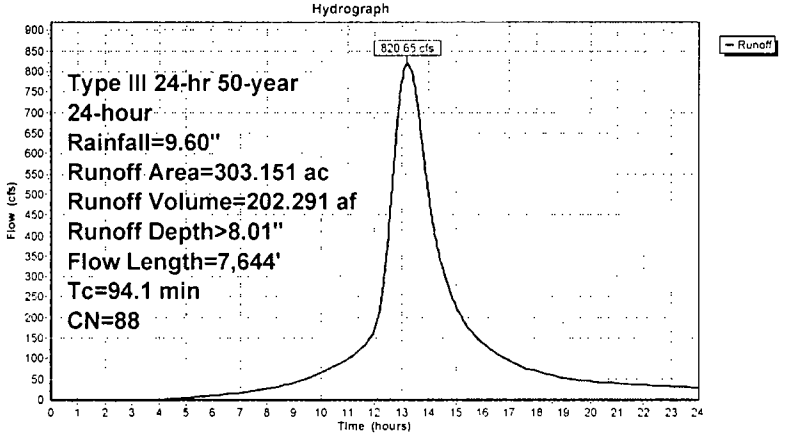
Runoff = 820.65 cfs @ 13.18 hrs, Volume= 202.291 af, Depth> 8.01"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs
Type III 24-hr 50-year, 24-hour Rainfall=9.60"

Area (ac)	CN	Description
197.048	83	1/4 acre lots, 38% imp, HSG C
106.103	98	Paved roads w/curbs & sewers, HSG C
303.151	88	Weighted Average
122.170		40.30% Pervious Area
180.981		59.70% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
10.2	300	0.0005	0.49		**Sheet Flow,** Smooth surfaces n= 0.011 P2= 5.04"
64.1	1,746	0.0005	0.45		**Shallow Concentrated Flow,** Paved Kv= 20.3 fps
8.5	2,278	0.0015	4.47	21.89	**Channel Flow,** Area= 4.9 sf Perim= 3.9' r= 1.26' n= 0.015
2.5	1,000	0.0015	6.57	104.42	**Channel Flow,** Area= 15.9 sf Perim= 7.1' r= 2.24' n= 0.015
8.8	2,320	0.0007	4.40	65.15	**Channel Flow,** Area= 14.8 sf Perim= 6.8' r= 2.18' n= 0.015
94.1	7,644	Total			

Subcatchment 1S: Off-Site



Summary for Subcatchment 2S: Area VIII

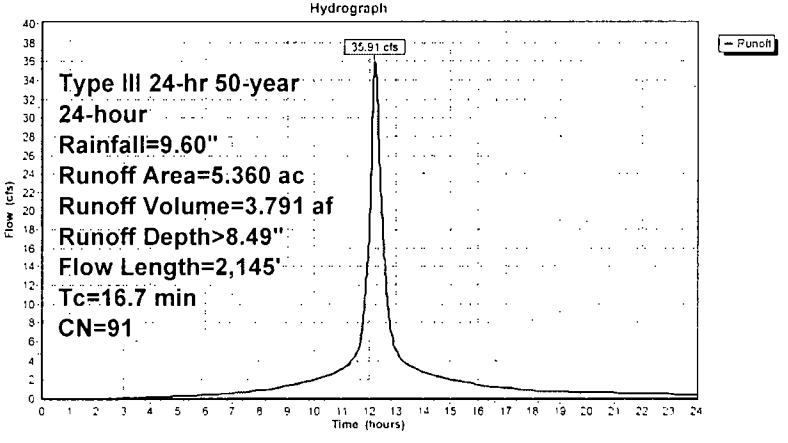
Runoff = 35.91 cfs @ 12.22 hrs, Volume= 3.791 af, Depth> 8.49"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs
Type III 24-hr 50-year, 24-hour Rainfall=9.60"

Area (ac)	CN	Description
5.360	91	Urban industrial, 72% imp, HSG C
1.501		28.00% Pervious Area
3.859		72.00% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
4.0	300	0.0050	1.24		**Sheet Flow,** Smooth surfaces n= 0.011 P2= 5.04"
3.3	285	0.0050	1.44		**Shallow Concentrated Flow,** Paved Kv= 20.3 fps
9.4	1,560	0.0007	2.76	40.77	**Pipe Channel,** 52.0" Round Area= 14.7 sf Perim= 13.6' r= 1.08' n= 0.015
16.7	2,145	Total			

Subcatchment 2S: Area VIII



Summary for Subcatchment 5S: Area VII

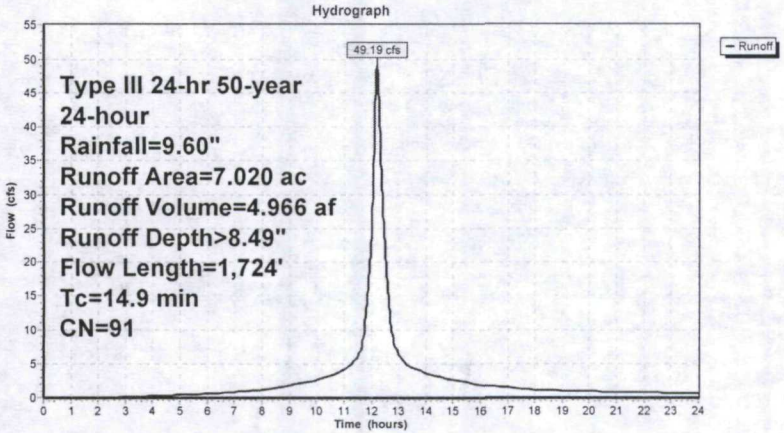
Runoff = 49.19 cfs @ 12.20 hrs, Volume= 4.966 af, Depth> 8.49"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs
Type III 24-hr 50-year, 24-hour Rainfall=9.60"

Area (ac)	CN	Description
7.020	91	Urban industrial, 72% imp, HSG C
1.966		28.00% Pervious Area
5.054		72.00% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
2.8	193	0.0050	1.13		**Sheet Flow,** Smooth surfaces n= 0.011 P2= 5.04"
6.0	521	0.0050	1.44		**Shallow Concentrated Flow,** Paved Kv= 20.3 fps
6.1	1,010	0.0007	2.76	40.77	**Pipe Channel,** 52.0" Round Area= 14.7 sf Perim= 13.6' r= 1.08' n= 0.015
14.9	1,724	Total			

Subcatchment 5S: Area VII



Summary for Subcatchment 6S: Area IX

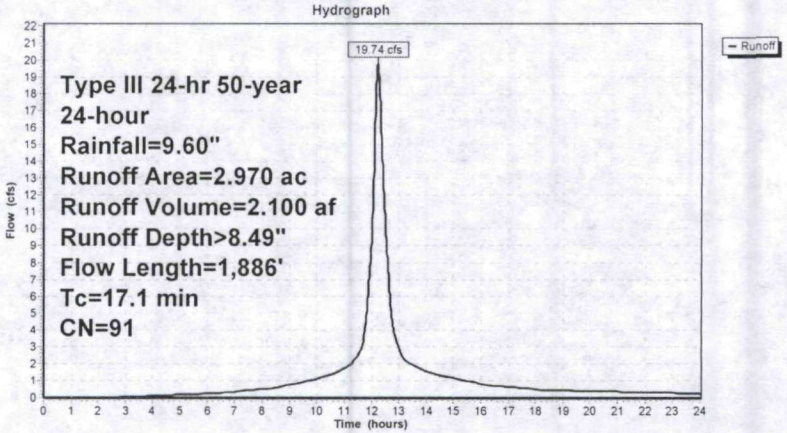
Runoff = 19.74 cfs @ 12.22 hrs, Volume= 2.100 af, Depth> 8.49"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs
Type III 24-hr 50-year, 24-hour Rainfall=9.60"

Area (ac)	CN	Description
2.970	91	Urban industrial, 72% imp, HSG C
0.832		28.00% Pervious Area
2.138		72.00% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
3.8	278	0.0050	1.22		**Sheet Flow,** Smooth surfaces n= 0.011 P2= 5.04"
7.6	655	0.0050	1.44		**Shallow Concentrated Flow,** Paved Kv= 20.3 fps
5.7	953	0.0007	2.76	40.77	**Pipe Channel,** 52.0" Round Area= 14.7 sf Perim= 13.6' r= 1.08' n= 0.015
17.1	1,886	Total			

Subcatchment 6S: Area IX



Summary for Subcatchment 7S: Area XI

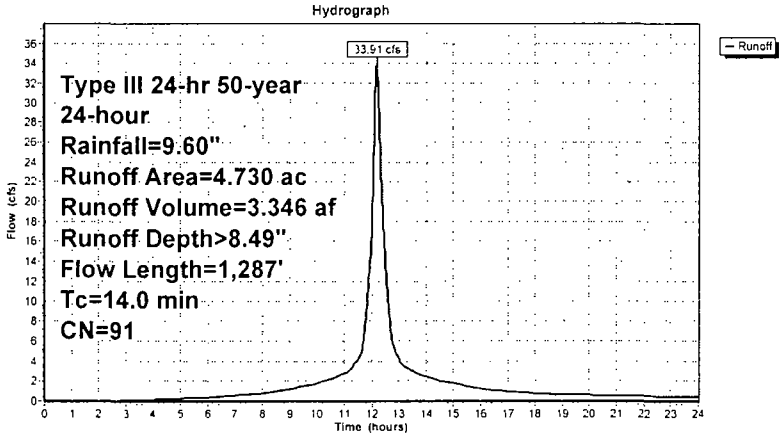
Runoff = 33.91 cfs @ 12.18 hrs, Volume= 3.346 af, Depth> 8.49"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs
Type III 24-hr 50-year, 24-hour Rainfall=9.60"

Area (ac)	CN	Description
4.730	91	Urban industrial, 72% imp, HSG C
1.324		28.00% Pervious Area
3.406		72.00% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
4.0	300	0.0050	1.24		**Sheet Flow,** Smooth surfaces n= 0.011 P2= 5.04"
8.5	730	0.0050	1.44		**Shallow Concentrated Flow,** Paved Kv= 20.3 fps
1.5	257	0.0007	2.76	40.77	**Pipe Channel,** 52.0" Round Area= 14.7 sf Perim= 13.6' r= 1.08' n= 0.015
14.0	1,287	Total			

Subcatchment 7S: Area XI



Summary for Subcatchment 9S: Area XII

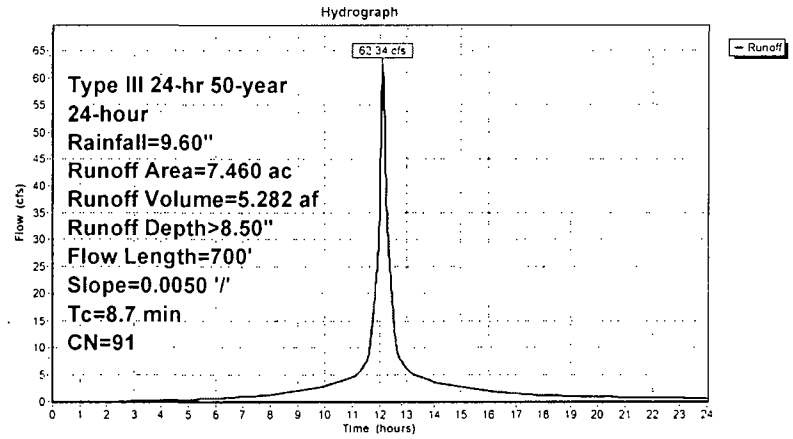
Runoff = 62.34 cfs @ 12.12 hrs, Volume= 5.282 af, Depth> 8.50"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs
Type III 24-hr 50-year, 24-hour Rainfall=9.60"

Area (ac)	CN	Description
7.460	91	Urban industrial, 72% imp, HSG C
2.089		28.00% Pervious Area
5.371		72.00% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
2.1	130	0.0050	1.04		**Sheet Flow,** Smooth surfaces n= 0.011 P2= 5.04"
6.6	570	0.0050	1.44		**Shallow Concentrated Flow,** Paved Kv= 20.3 fps
8.7	700	Total			

Subcatchment 9S: Area XII



Summary for Subcatchment 10S: Area VI

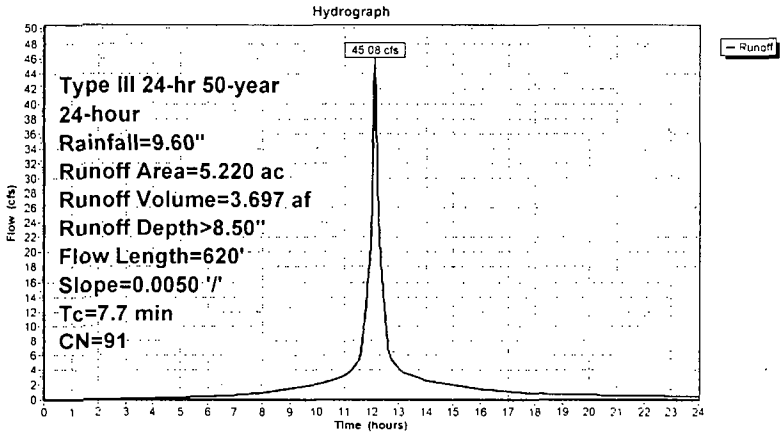
Runoff = 45.08 cfs @ 12.11 hrs, Volume= 3.697 af, Depth> 8.50"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs
Type III 24-hr 50-year, 24-hour Rainfall=9.60"

Area (ac)	CN	Description
5.220	91	Urban industrial, 72% imp, HSG C
1.462		28.00% Pervious Area
3.758		72.00% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
1.8	110	0.0050	1.01		**Sheet Flow,** Smooth surfaces n= 0.011 P2= 5.04"
5.9	510	0.0050	1.44		**Shallow Concentrated Flow,** Paved Kv= 20.3 fps
7.7	620	Total			

Subcatchment 10S: Area VI



Summary for Subcatchment 11S: Area V

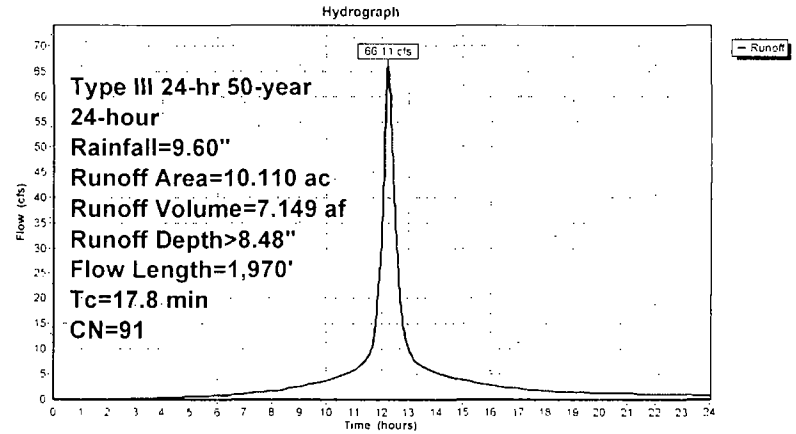
Runoff = 66.11 cfs @ 12.24 hrs, Volume= 7.149 af, Depth> 8.48"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs
Type III 24-hr 50-year, 24-hour Rainfall=9.60"

Area (ac)	CN	Description
10.110	91	Urban industrial, 72% imp, HSG C
2.831		28.00% Pervious Area
7.279		72.00% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
4.0	300	0.0050	1.24		**Sheet Flow,** Smooth surfaces n= 0.011 P2= 5.04"
7.8	676	0.0050	1.44		**Shallow Concentrated Flow,** Paved Kv= 20.3 fps
6.0	994	0.0007	2.76	40.77	**Pipe Channel,** 52.0" Round Area= 14.7 sf Perim= 13.6' r= 1.08' n= 0.015
17.8	1,970	Total			

Subcatchment 11S: Area V



Summary for Subcatchment 12S: Area X

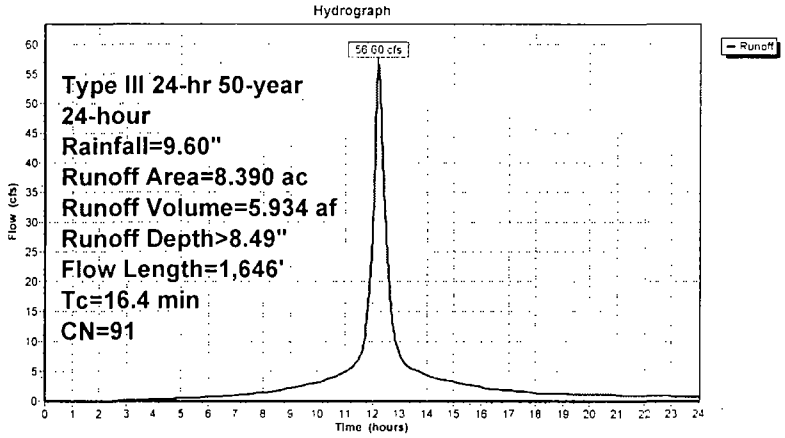
Runoff = 56.60 cfs @ 12.22 hrs, Volume= 5.934 af, Depth> 8.49"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs
Type III 24-hr 50-year, 24-hour Rainfall=9.60"

Area (ac)	CN	Description
8.390	91	Urban industrial, 72% imp, HSG C
2.349		28.00% Pervious Area
6.041		72.00% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
4.0	300	0.0050	1.24		**Sheet Flow,** Smooth surfaces n= 0.011 P2= 5.04"
8.9	769	0.0050	1.44		**Shallow Concentrated Flow,** Paved Kv= 20.3 fps
3.5	577	0.0007	2.76	40.77	**Pipe Channel,** 52.0" Round Area= 14.7 sf Perim= 13.6' r= 1.08' n= 0.015
16.4	1,646	Total			

Subcatchment 12S: Area X



Summary for Subcatchment 14S: Area III

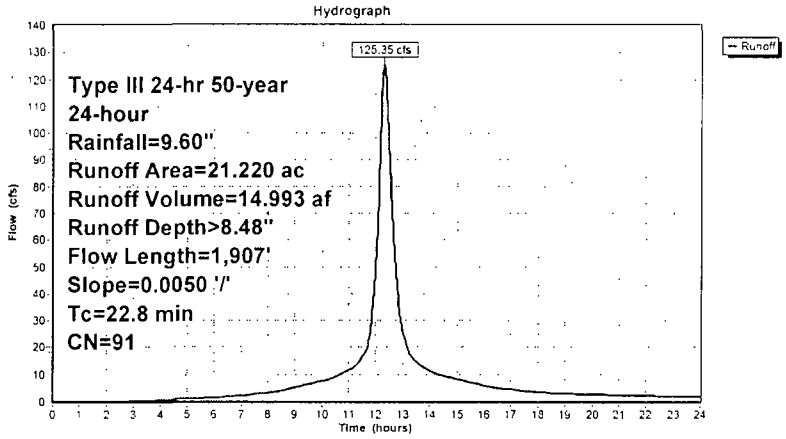
Runoff = 125.35 cfs @ 12.29 hrs, Volume= 14.993 af, Depth> 8.48"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs
Type III 24-hr 50-year, 24-hour Rainfall=9.60"

Area (ac)	CN	Description
21.220	91	Urban industrial, 72% imp, HSG C
5.942		28.00% Pervious Area
15.278		72.00% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
3.2	221	0.0050	1.16		**Sheet Flow,** Smooth surfaces n= 0.011 P2= 5.04"
19.6	1,686	0.0050	1.44		**Shallow Concentrated Flow,** Paved Kv= 20.3 fps
22.8	1,907	Total			

Subcatchment 14S: Area III



Summary for Subcatchment 15S: Area XIII

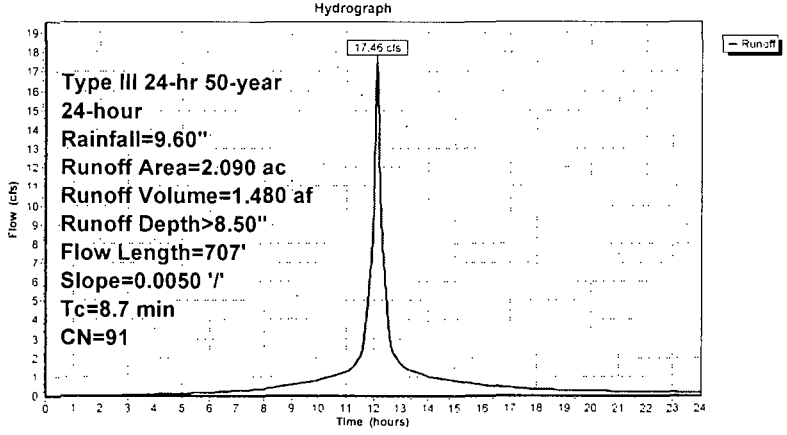
Runoff = 17.46 cfs @ 12.12 hrs, Volume= 1.480 af, Depth> 8.50"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs
Type III 24-hr 50-year, 24-hour Rainfall=9.60"

Area (ac)	CN	Description
2.090	91	Urban industrial, 72% imp, HSG C
0.585		28.00% Pervious Area
1.505		72.00% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
1.5	90	0.0050	0.97		**Sheet Flow,** Smooth surfaces n= 0.011 P2= 5.04"
7.2	617	0.0050	1.44		**Shallow Concentrated Flow,** Paved Kv= 20.3 fps
8.7	707	Total			

Subcatchment 15S: Area XIII



Summary for Subcatchment 16S: Area I

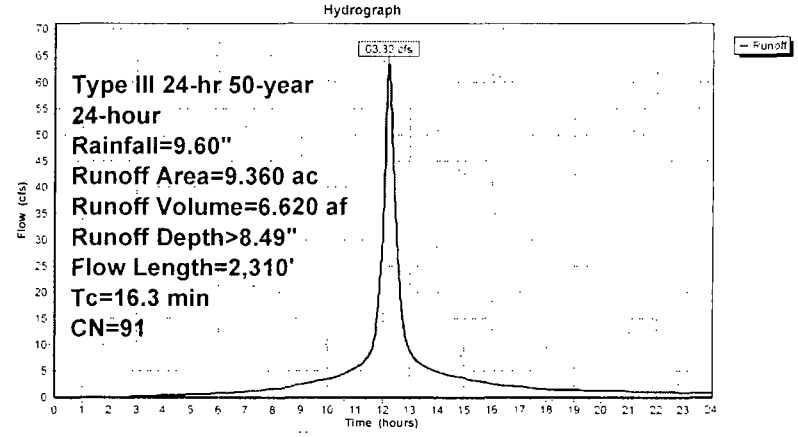
Runoff = 63.32 cfs @ 12.22 hrs, Volume= 6.620 af, Depth> 8.49"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs
Type III 24-hr 50-year, 24-hour Rainfall=9.60"

Area (ac)	CN	Description
9.360	91	Urban industrial, 72% imp, HSG C
2.621		28.00% Pervious Area
6.739		72.00% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.0	428	0.0050	1.44		**Shallow Concentrated Flow,** Paved Kv= 20.3 fps
11.3	1,882	0.0007	2.76	40.77	**Pipe Channel, Through N. Ditch 1** 52.0" Round Area= 14.7 sf Perim= 13.6' r= 1.08' n= 0.015
16.3	2,310	Total			

Subcatchment 16S: Area I



Summary for Subcatchment 17S: Area XV

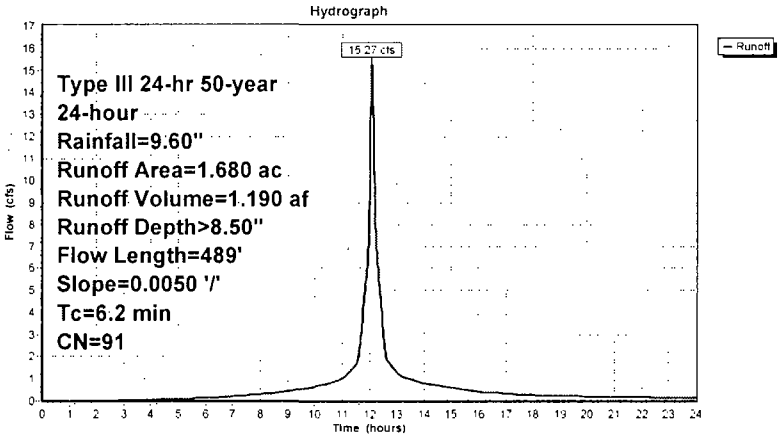
Runoff = 15.27 cfs @ 12.09 hrs, Volume= 1.190 af, Depth> 8.50"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs
Type III 24-hr 50-year, 24-hour Rainfall=9.60"

Area (ac)	CN	Description
1.680	91	Urban industrial, 72% imp, HSG C
0.470		28.00% Pervious Area
1.210		72.00% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
1.5	85	0.0050	0.96		**Sheet Flow,** Smooth surfaces n= 0.011 P2= 5.04"
4.7	404	0.0050	1.44		**Shallow Concentrated Flow,** Paved Kv= 20.3 fps
6.2	489	Total			

Subcatchment 17S: Area XV



Summary for Subcatchment 18S: Area II

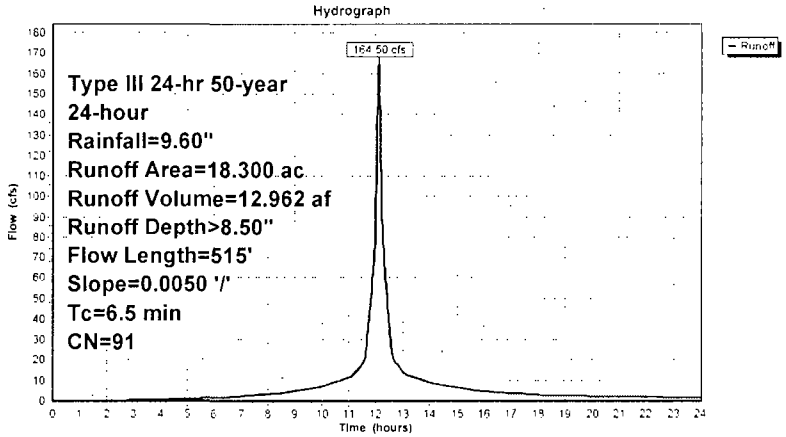
Runoff = 164.50 cfs @ 12.09 hrs, Volume= 12.962 af, Depth> 8.50"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs
Type III 24-hr 50-year, 24-hour Rainfall=9.60"

Area (ac)	CN	Description
18.300	91	Urban industrial, 72% imp, HSG C
5.124		28.00% Pervious Area
13.176		72.00% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
4.0	300	0.0050	1.24		**Sheet Flow,** Smooth surfaces n= 0.011 P2= 5.04"
2.5	215	0.0050	1.44		**Shallow Concentrated Flow,** Paved Kv= 20.3 fps
6.5	515	Total			

Subcatchment 18S: Area II



Summary for Subcatchment 23S: Area XIV

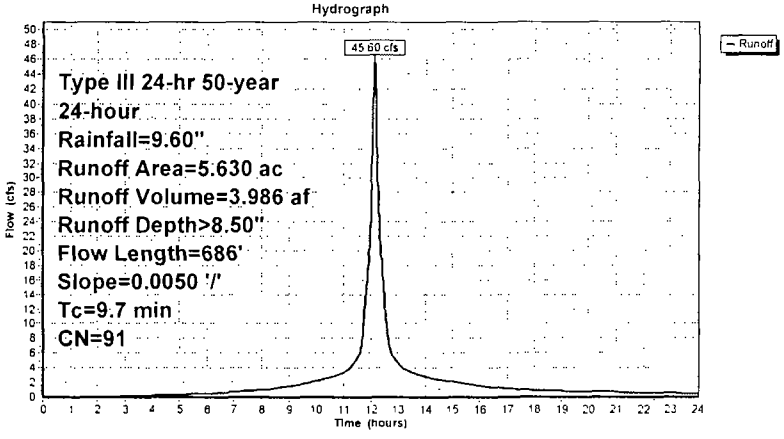
Runoff = 45.60 cfs @ 12.13 hrs, Volume= 3.986 af, Depth> 8.50"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs
Type III 24-hr 50-year, 24-hour Rainfall=9.60"

Area (ac)	CN	Description
5.630	91	Urban industrial, 72% imp, HSG C
1.576		28.00% Pervious Area
4.054		72.00% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
4.0	300	0.0050	1.24		**Sheet Flow,** Smooth surfaces n= 0.011 P2= 5.04"
5.7	386	0.0050	1.14		**Shallow Concentrated Flow,** Unpaved Kv= 16.1 fps
9.7	686	Total			

Subcatchment 23S: Area XIV



Summary for Reach 4R: TBC

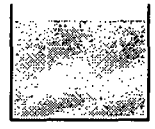
[62] Hint: Exceeded Reach 25R OUTLET depth by 0.32' @ 0.01 hrs
[63] Warning: Exceeded Reach 33R INLET depth by 1.67' @ 13.34 hrs

Inflow Area = 412.691 ac, 62.96% Impervious, Inflow Depth > 22.88" for 50-year, 24-hour event
Inflow = 1,160.98 cfs @ 12.28 hrs, Volume= 786.715 af
Outflow = 1,160.71 cfs @ 12.29 hrs, Volume= 786.425 af, Atten= 0%, Lag= 0.4 min

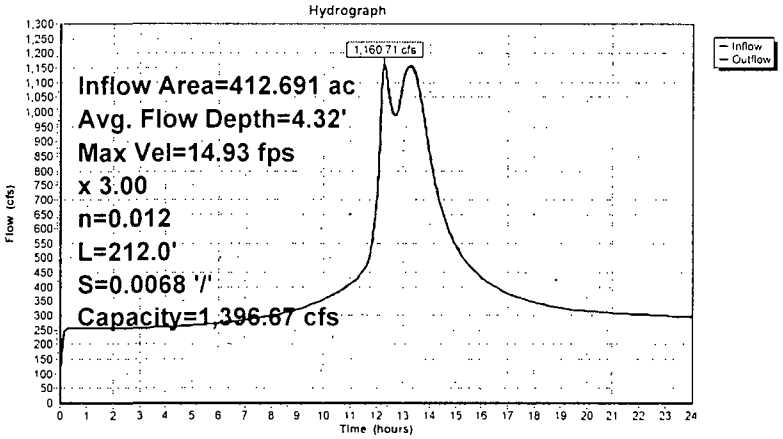
Routing by Stor-Ind+Trans method, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs
Max. Velocity= 14.93 fps, Min. Travel Time= 0.2 min
Avg. Velocity = 11.07 fps, Avg. Travel Time= 0.3 min

Peak Storage= 16,479 cf @ 12.28 hrs
Average Depth at Peak Storage= 4.32'
Bank-Full Depth= 5.00', Capacity at Bank-Full= 1,396.67 cfs

A factor of 3.00 has been applied to the storage and discharge capacity
6.00' x 5.00' deep channel, n= 0.012
Length= 212.0' Slope= 0.0068 '/'
Inlet Invert= -1.28', Outlet Invert= -2.72'



Reach 4R: TBC



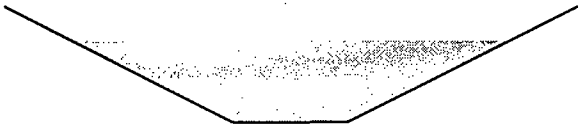
Summary for Reach 8R: N Ditch 1

Inflow Area = 363.771 ac, 61.75% Impervious, Inflow Depth > 8.09" for 50-year, 24-hour event
Inflow = 866.46 cfs @ 13.18 hrs, Volume= 245.175 af
Outflow = 865.98 cfs @ 13.21 hrs, Volume= 244.980 af, Atten= 0%, Lag= 2.1 min

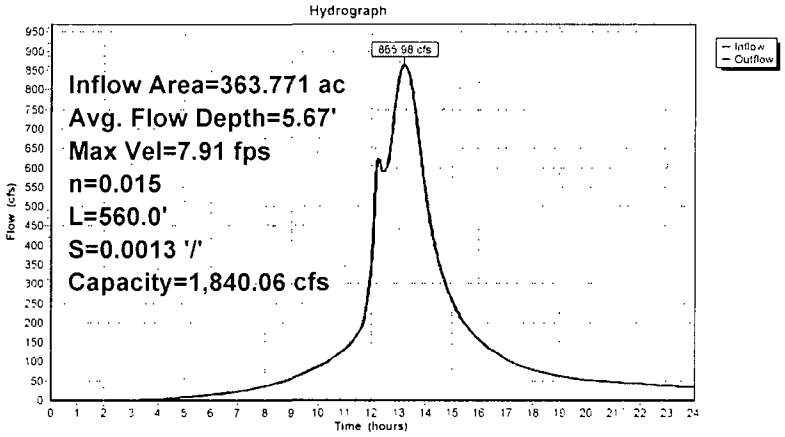
Routing by Stor-Ind+Trans method, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs
Max. Velocity= 7.91 fps, Min. Travel Time= 1.2 min
Avg. Velocity = 3.90 fps, Avg. Travel Time= 2.4 min

Peak Storage= 61,345 cf @ 13.19 hrs
Average Depth at Peak Storage= 5.67'
Bank-Full Depth= 8.00', Capacity at Bank-Full= 1,840.06 cfs

8.00' x 8.00' deep channel, n= 0.015
Side Slope Z-value= 2.0 '/' Top Width= 40.00'
Length= 560.0' Slope= 0.0013 '/'
Inlet Invert= 0.91', Outlet Invert= 0.18'



Reach 8R: N Ditch 1



Summary for Reach 13R: N Ditch 2

[63] Warning: Exceeded Reach 8R INLET depth by 0.72' @ 1.02 hrs

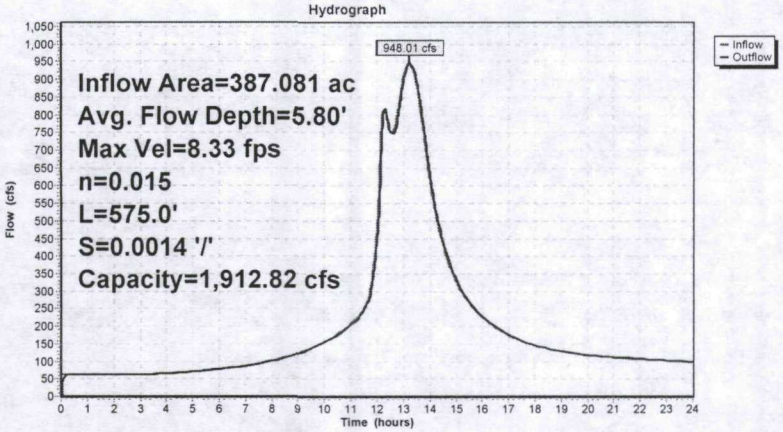
Inflow Area = 387.081 ac, 62.37% Impervious, Inflow Depth > 11.94" for 50-year, 24-hour event
Inflow = 948.33 cfs @ 13.21 hrs, Volume= 385.154 af
Outflow = 948.01 cfs @ 13.24 hrs, Volume= 384.682 af, Atten= 0%, Lag= 2.0 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs
Max. Velocity= 8.33 fps, Min. Travel Time= 1.2 min
Avg. Velocity = 5.06 fps, Avg. Travel Time= 1.9 min

Peak Storage= 65,454 cf @ 13.22 hrs
Average Depth at Peak Storage= 5.80'
Bank-Full Depth= 8.00', Capacity at Bank-Full= 1,912.82 cfs

8.00' x 8.00' deep channel, n= 0.015
Side Slope Z-value= 2.0 '/' Top Width= 40.00'
Length= 575.0' Slope= 0.0014 '/'
Inlet Invert= 0.18', Outlet Invert= -0.63'

Reach 13R: N Ditch 2



Summary for Reach 25R: N Ditch 3

[62] Hint: Exceeded Reach 13R OUTLET depth by 0.67' @ 2.19 hrs

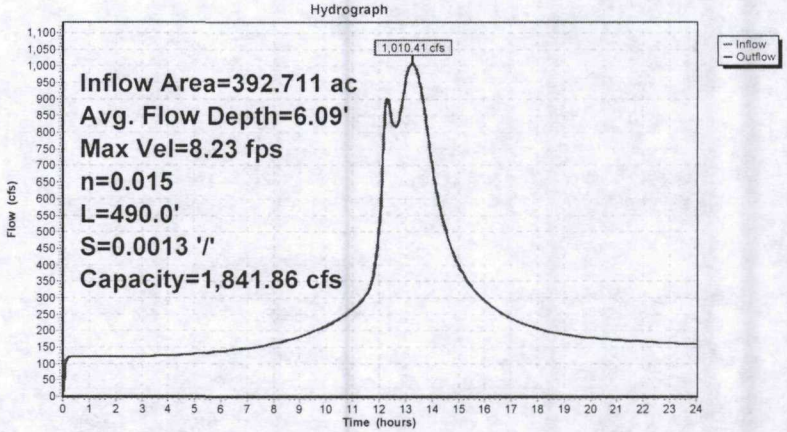
Inflow Area = 392.711 ac, 62.51% Impervious, Inflow Depth > 15.44" for 50-year, 24-hour event
Inflow = 1,010.62 cfs @ 13.24 hrs, Volume= 505.305 af
Outflow = 1,010.41 cfs @ 13.27 hrs, Volume= 504.710 af, Atten= 0%, Lag= 1.7 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs
Max. Velocity= 8.23 fps, Min. Travel Time= 1.0 min
Avg. Velocity = 5.47 fps, Avg. Travel Time= 1.5 min

Peak Storage= 60,152 cf @ 13.25 hrs
Average Depth at Peak Storage= 6.09'
Bank-Full Depth= 8.00', Capacity at Bank-Full= 1,841.86 cfs

8.00' x 8.00' deep channel, n= 0.015
Side Slope Z-value= 2.0 '/' Top Width= 40.00'
Length= 490.0' Slope= 0.0013 '/'
Inlet Invert= -0.63', Outlet Invert= -1.27'

Reach 25R: N Ditch 3



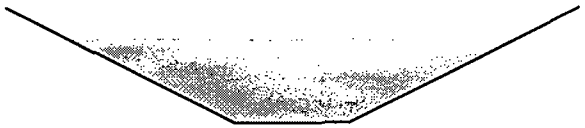
Summary for Reach 33R: South Street Ditch

Inflow Area = 18.300 ac, 72.00% Impervious, Inflow Depth > 8.50" for 50-year, 24-hour event
Inflow = 164.50 cfs @ 12 09 hrs, Volume= 12.962 af
Outflow = 143.99 cfs @ 12.21 hrs, Volume= 12 915 af, Atten= 12%, Lag= 7.3 min

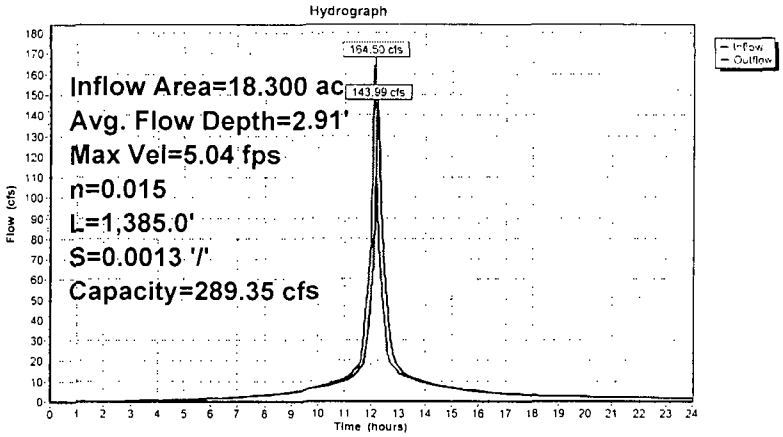
Routing by Stor-Ind+Trans method, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs
Max. Velocity= 5.04 fps, Min. Travel Time= 4.6 min
Avg. Velocity = 1.78 fps, Avg. Travel Time= 13.0 min

Peak Storage= 39,563 cf @ 12.14 hrs
Average Depth at Peak Storage= 2 91'
Bank-Full Depth= 4.00', Capacity at Bank-Full= 289 35 cfs

4.00' x 4.00' deep channel, n= 0.015
Side Slope Z-value= 2.0 '/' Top Width= 20.00'
Length= 1,385.0' Slope= 0.0013 '/'
Inlet Invert= 0.52', Outlet Invert= -1.28'



Reach 33R: South Street Ditch



Summary for Link 27L: HWY 17

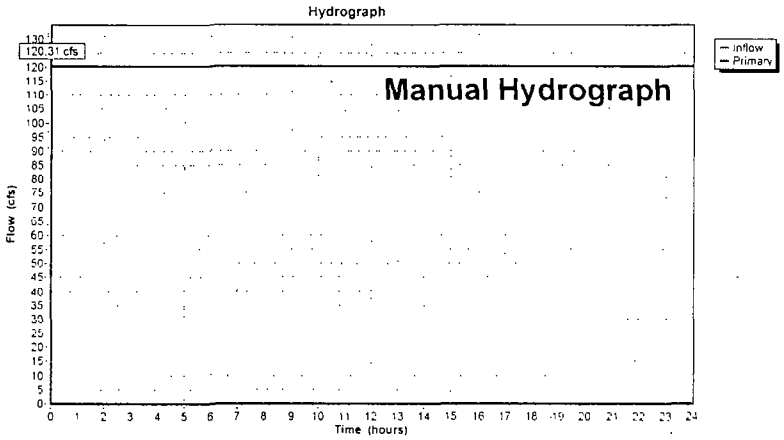
Inflow = 120.31 cfs @ 0.00 hrs, Volume= 238.731 af
Primary = 120.31 cfs @ 0.00 hrs, Volume= 238.731 af, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs

25 Point manual hydrograph, To= 0.00 hrs, dt= 1.00 hrs, cfs =

120.31	120.31	120.31	120.31	120.31	120.31	120.31	120.31	120.31	120 31
120.31	120.31	120.31	120.31	120.31	120.31	120.31	120 31	120.31	120.31
120.31	120 31	120.31	120.31	120.31					

Link 27L: HWY 17



Summary for Link 30L: North 2

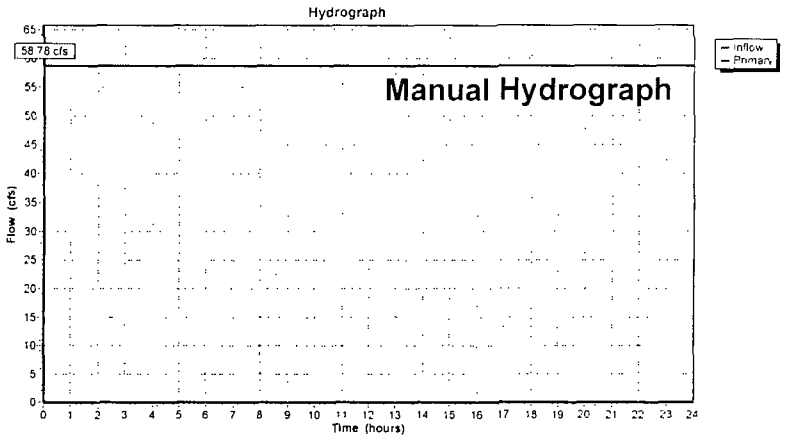
Inflow = 58.78 cfs @ 0.00 hrs, Volume= 116.637 af
Primary = 58.78 cfs @ 0.00 hrs, Volume= 116.637 af, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs

25 Point manual hydrograph, To= 0.00 hrs, dt= 1.00 hrs, cfs =

58.78	58.78	58.78	58.78	58.78	58.78	58.78	58.78	58.78	58.78
58.78	58.78	58.78	58.78	58.78	58.78	58.78	58.78	58.78	58.78
58.78	58.78	58.78	58.78	58.78					

Link 30L: North 2



Summary for Link 31L: North 1

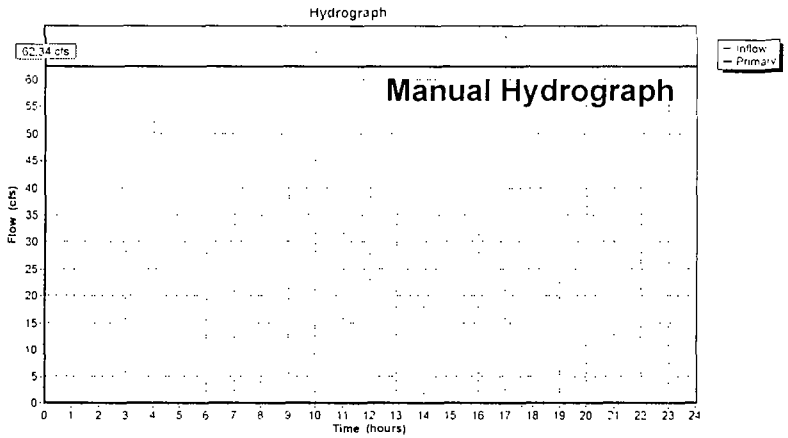
Inflow = 62.34 cfs @ 0.00 hrs, Volume= 123.701 af
Primary = 62.34 cfs @ 0.00 hrs, Volume= 123.701 af, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs

25 Point manual hydrograph, To= 0.00 hrs, dt= 1.00 hrs, cfs =

62.34	62.34	62.34	62.34	62.34	62.34	62.34	62.34	62.34	62.34
62.34	62.34	62.34	62.34	62.34	62.34	62.34	62.34	62.34	62.34
62.34	62.34	62.34	62.34	62.34					

Link 31L: North 1



Summary for Link 32L: Process Flows

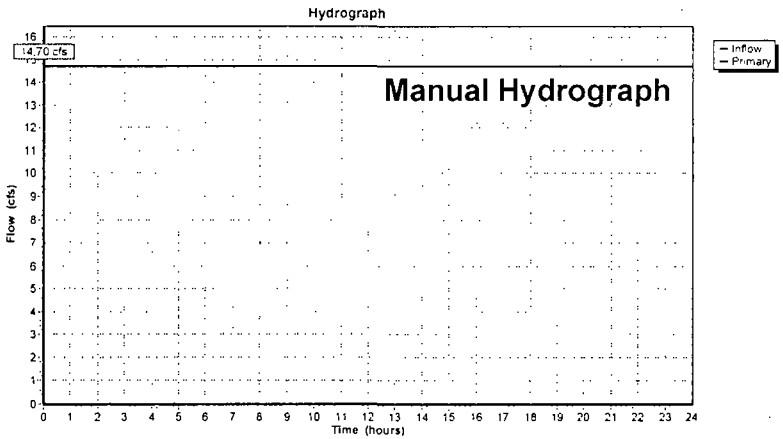
Inflow = 14.70 cfs @ 0.00 hrs, Volume= 29.169 af
Primary = 14.70 cfs @ 0.00 hrs, Volume= 29.169 af, Atten= 0%, Lag= 0.0 min

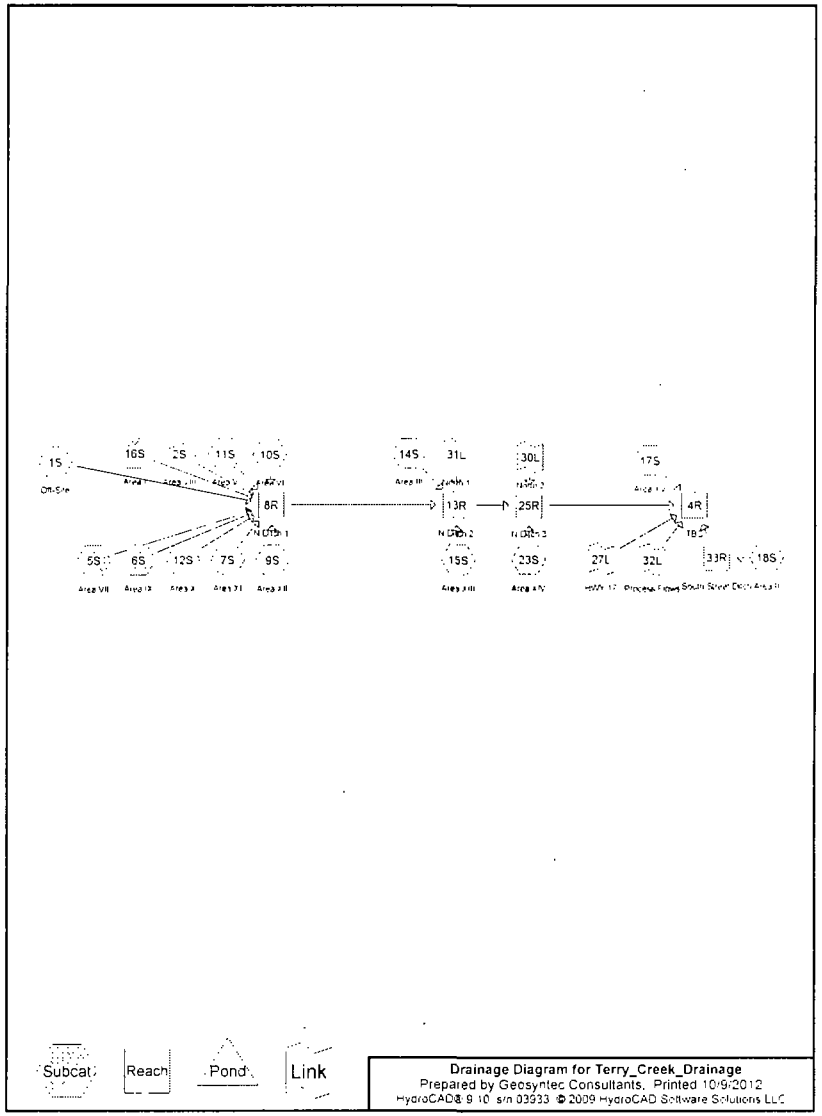
Primary outflow = Inflow, Time Span= 0 00-24 00 hrs, dt= 0.01 hrs

25 Point manual hydrograph, To= 0.00 hrs, dt= 1.00 hrs, cfs =

14.70	14.70	14.70	14.70	14.70	14.70	14.70	14.70	14.70	14.70
14.70	14.70	14.70	14.70	14.70	14.70	14.70	14.70	14.70	14.70
14.70	14.70	14.70	14.70	14.70					

Link 32L: Process Flows





Area Listing (all nodes)

Area (acres)	CN	Description (subcatchment-numbers)
197.048	83	1/4 acre lots, 38% imp, HSG C (1S)
109.540	91	Urban industrial, 72% imp, HSG C (2S, 5S, 6S, 7S, 9S, 10S, 11S, 12S, 14S, 15S, 16S, 17S, 18S, 23S)
106.103	98	Paved roads w/curbs & sewers, HSG C (1S)
412.691		**TOTAL AREA**

Soil Listing (all nodes)

Area (acres)	Soil Group	Subcatchment Numbers
0.000	HSG A	
0.000	HSG B	
412.691	HSG C	1S, 2S, 5S, 6S, 7S, 9S, 10S, 11S, 12S, 14S, 15S, 16S, 17S, 18S, 23S
0.000	HSG D	
0.000	Other	
412.691		**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)	Fill (inches)
1	2S	0 00	0.00	1.560.0	0 0007	0.015	52 0	0 0	0.0
2	5S	0.00	0.00	1 010 0	0.0007	0.015	52.0	0 0	0.0
3	6S	0.00	0 00	953.0	0.0007	0 015	52.0	0.0	0 0
4	7S	0.00	0 00	257.0	0.0007	0 015	52.0	0 0	0 0
5	11S	0.00	0 00	994.0	0.0007	0.015	52.0	0.0	0 0
6	12S	0 00	0.00	577.0	0 0007	0.015	52 0	0 0	0.0
7	16S	0.00	0.00	1,882 0	0.0007	0.015	52.0	0 0	0.0

Time span=0.00-24 00 hrs, dt=0.01 hrs, 2401 points
Runoff by SCS TR-20 method, UH=SCS
Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

Subcatchment1S: Off-Site Runoff Area=303.151 ac 59.70% Impervious Runoff Depth>9.17"
Flow Length=7,644' Tc=94.1 min CN=88 Runoff=934 25 cfs 231 740 af

Subcatchment2S: Area VIII Runoff Area=5.360 ac 72.00% Impervious Runoff Depth>9 67"
Flow Length=2 145' Tc=16.7 min CN=91 Runoff=40 66 cfs 4.321 af

Subcatchment5S: Area VII Runoff Area=7.020 ac 72 00% Impervious Runoff Depth>9 68"
Flow Length=1,724' Tc=14.9 min CN=91 Runoff=55 68 cfs 5 661 af

Subcatchment6S: Area IX Runoff Area=2 970 ac 72 00% Impervious Runoff Depth>9 67"
Flow Length=1 886' Tc=17.1 min CN=91 Runoff=22.34 cfs 2 394 af

Subcatchment7S: Area XI Runoff Area=4.730 ac 72.00% Impervious Runoff Depth>9.68"
Flow Length=1,287' Tc=14 0 min CN=91 Runoff=38 39 cfs 3 815 af

Subcatchment9S: Area XII Runoff Area=7 460 ac 72.00% Impervious Runoff Depth>9.69"
Flow Length=700' Slope=0 0050 '/' Tc=8.7 min CN=91 Runoff=70.56 cfs 6.021 af

Subcatchment10S: Area VI Runoff Area=5.220 ac 72.00% Impervious Runoff Depth>9 69"
Flow Length=620' Slope=0.0050 '/' Tc=7 7 min CN=91 Runoff=51 03 cfs 4.214 af

Subcatchment11S: Area V Runoff Area=10.110 ac 72.00% Impervious Runoff Depth>9.67"
Flow Length=1,970' Tc=17.8 min CN=91 Runoff=74.84 cfs 8 149 af

Subcatchment12S: Area X Runoff Area=8.390 ac 72.00% Impervious Runoff Depth>9.67"
Flow Length=1,646' Tc=16.4 min CN=91 Runoff=64.08 cfs 6.764 af

Subcatchment14S: Area III Runoff Area=21.220 ac 72.00% Impervious Runoff Depth>9.67"
Flow Length=1,907' Slope=0.0050 '/' Tc=22 8 min CN=91 Runoff=141 94 cfs 17 091 af

Subcatchment15S: Area XIII Runoff Area=2.090 ac 72.00% Impervious Runoff Depth>9 69"
Flow Length=707' Slope=0.0050 '/' Tc=8.7 min CN=91 Runoff=19.77 cfs 1.687 af

Subcatchment16S: Area I Runoff Area=9.360 ac 72.00% Impervious Runoff Depth>9.67 '
Flow Length=2,310' Tc=16.3 min CN=91 Runoff=71 69 cfs 7 546 af

Subcatchment17S: Area XV Runoff Area=1 680 ac 72 00% Impervious Runoff Depth>9 69'
Flow Length=489' Slope=0.0050 '/' Tc=6.2 min CN=91 Runoff=17.28 cfs 1.356 af

Subcatchment18S: Area II Runoff Area=18.300 ac 72 00% Impervious Runoff Depth>9 69"
Flow Length=515' Slope=0.0050 '/' Tc=6.5 min CN=91 Runoff=186 19 cfs 14 775 af

Subcatchment23S: Area XIV Runoff Area=5 630 ac 72 00% Impervious Runoff Depth>9.68"
Flow Length=686' Slope=0.0050 '/' Tc=9.7 min CN=91 Runoff=51.62 cfs 4.544 af

Reach 4R: TBC Avg Flow Depth=4 68' Max Vel=15 26 fps Inflow=1,285.76 cfs 826 967 af
x 3 00 n=0 012 L=212 0' S=0 0068 '/' Capacity=1,396.67 cfs Outflow=1,285 50 cfs 826.676 af

Reach 8R: N Ditch 1 Avg. Flow Depth=6 02' Max Vel=8.17 fps Inflow=985.92 cfs 280 625 af
n=0 015 L=560 0' S=0.0013 '/' Capacity=1,840.06 cfs Outflow=985.38 cfs 280.413 af

Reach 13R: N Ditch 2 Avg. Flow Depth=6 14' Max Vel=8.59 fps Inflow=1,070 38 cfs 422.892 af
n=0.015 L=575.0' S=0.0014 '/' Capacity=1,912.82 cfs Outflow=1,070 02 cfs 422.408 af

Reach 25R: N Ditch 3 Avg. Flow Depth=6 42' Max Vel=8.48 fps Inflow=1,133 13 cfs 543.589 af
n=0 015 L=490.0' S=0.0013 '/' Capacity=1,841.86 cfs Outflow=1,132.90 cfs 542.986 af

Reach 33R: South Street Ditch Avg. Flow Depth=3.09' Max Vel=5.22 fps Inflow=186 19 cfs 14.775 af
n=0.015 L=1,385.0' S=0.0013 '/' Capacity=289.35 cfs Outflow=163 86 cfs 14 725 af

Link 27L: HWY 17 Manual Hydrograph Inflow=120.31 cfs 238.731 af
Primary=120 31 cfs 238 731 af

Link 30L: North 2 Manual Hydrograph Inflow=58.78 cfs 116.637 af
Primary=58 78 cfs 116.637 af

Link 31L: North 1 Manual Hydrograph Inflow=62 34 cfs 123.701 af
Primary=62.34 cfs 123.701 af

Link 32L: Process Flows Manual Hydrograph Inflow=14 70 cfs 29.169 af
Primary=14 70 cfs 29.169 af

Total Runoff Area = 412.691 ac Runoff Volume = 320.078 af Average Runoff Depth = 9.31"
37.04% Pervious = 152.841 ac 62.96% Impervious = 259.850 ac

Summary for Subcatchment 1S: Off-Site

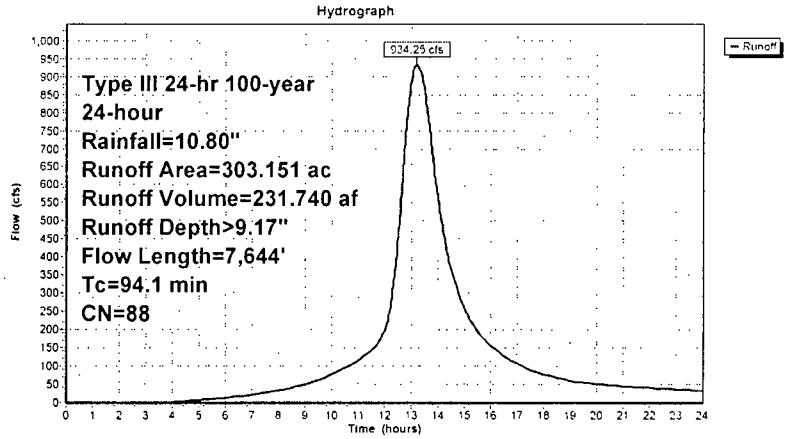
Runoff = 934.25 cfs @ 13.18 hrs. Volume= 231.740 af, Depth> 9.17"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs
Type III 24-hr 100-year, 24-hour Rainfall=10.80"

Area (ac)	CN	Description
197.048	83	1/4 acre lots, 38% imp, HSG C
106.103	98	Paved roads w/curbs & sewers, HSG C
303.151	88	Weighted Average
122.170		40.30% Pervious Area
180.981		59.70% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
10.2	300	0.0005	0.49		**Sheet Flow,** Smooth surfaces n= 0 011 P2= 5.04"
64.1	1,746	0.0005	0.45		**Shallow Concentrated Flow,** Paved Kv= 20.3 fps
8.5	2,278	0.0015	4.47	21.89	**Channel Flow,** Area= 4.9 sf Perim= 3.9' r= 1.26' n= 0.015
2.5	1,000	0.0015	6.57	104.42	**Channel Flow,** Area= 15.9 sf Perim= 7.1' r= 2.24' n= 0.015
8.8	2,320	0.0007	4.40	65 15	**Channel Flow,** Area= 14.8 sf Perim= 6.8' r= 2.18' n= 0.015
94 1	7,644	Total			

Subcatchment 1S: Off-Site



Summary for Subcatchment 2S: Area VIII

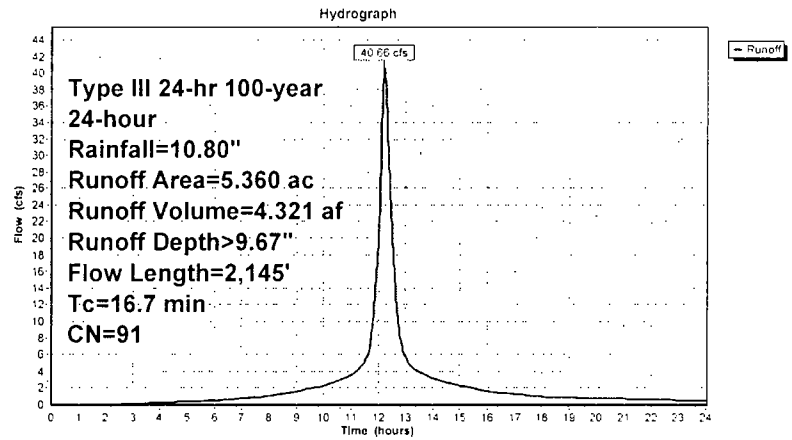
Runoff = 40.66 cfs @ 12.22 hrs, Volume= 4.321 af, Depth> 9.67"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs
Type III 24-hr 100-year, 24-hour Rainfall=10.80"

Area (ac)	CN	Description
5.360	91	Urban industrial, 72% imp, HSG C
1.501		28.00% Pervious Area
3.859		72.00% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
4.0	300	0.0050	1.24		**Sheet Flow,** Smooth surfaces n= 0.011 P2= 5.04"
3.3	285	0.0050	1.44		**Shallow Concentrated Flow,** Paved Kv= 20.3 fps
9.4	1,560	0.0007	2.76	40.77	**Pipe Channel,** 52.0" Round Area= 14.7 sf Perim= 13.6' r= 1.08' n= 0.015
16.7	2,145	Total			

Subcatchment 2S: Area VIII



Summary for Subcatchment 5S: Area VII

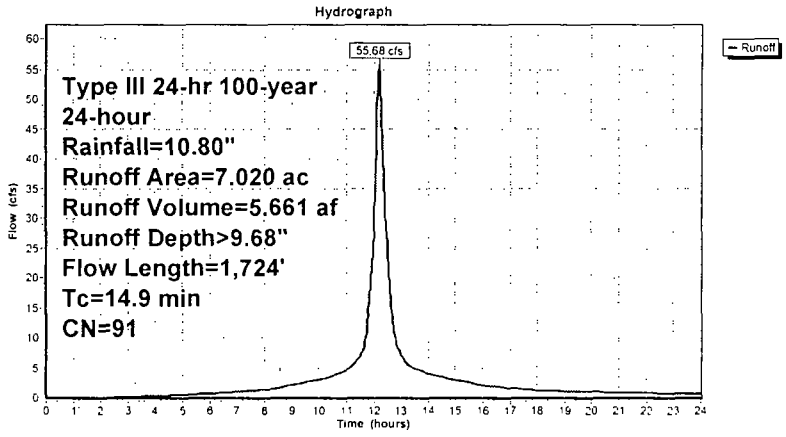
Runoff = 55.68 cfs @ 12.20 hrs, Volume= 5.661 af, Depth> 9.68"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs
Type III 24-hr 100-year, 24-hour Rainfall=10.80"

Area (ac)	CN	Description
7.020	91	Urban industrial, 72% imp, HSG C
1.966		28.00% Pervious Area
5.054		72.00% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
2.8	193	0.0050	1.13		**Sheet Flow,** Smooth surfaces n= 0.011 P2= 5.04"
6.0	521	0.0050	1.44		**Shallow Concentrated Flow,** Paved Kv= 20.3 fps
6.1	1,010	0.0007	2.76	40.77	**Pipe Channel,** 52.0" Round Area= 14.7 sf Perim= 13.6' r= 1.08' n= 0.015
14.9	1,724	Total			

Subcatchment 5S: Area VII



Summary for Subcatchment 6S: Area IX

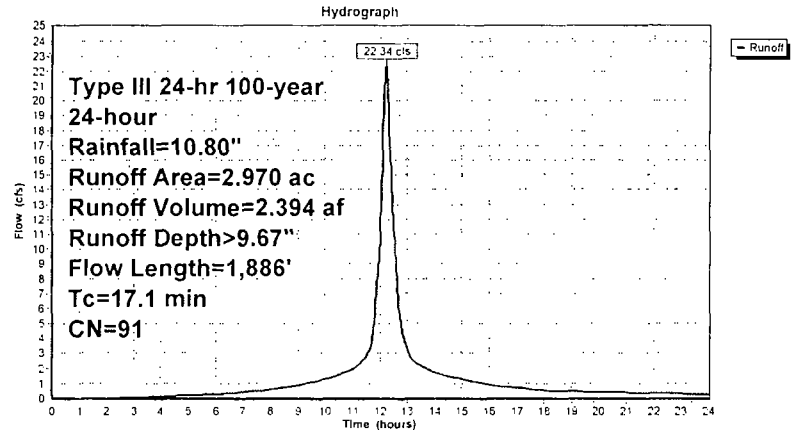
Runoff = 22.34 cfs @ 12.22 hrs, Volume= 2.394 af, Depth> 9.67"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs
Type III 24-hr 100-year, 24-hour Rainfall=10.80"

Area (ac)	CN	Description
2.970	91	Urban industrial, 72% imp, HSG C
0.832		28.00% Pervious Area
2.138		72.00% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
3.8	278	0.0050	1.22		**Sheet Flow,** Smooth surfaces n= 0.011 P2= 5.04"
7.6	655	0.0050	1.44		**Shallow Concentrated Flow,** Paved Kv= 20.3 fps
5.7	953	0.0007	2.76	40.77	**Pipe Channel,** 52.0" Round Area= 14.7 sf Perim= 13.6' r= 1.08' n= 0.015
17.1	1,886	Total			

Subcatchment 6S: Area IX



Summary for Subcatchment 7S: Area XI

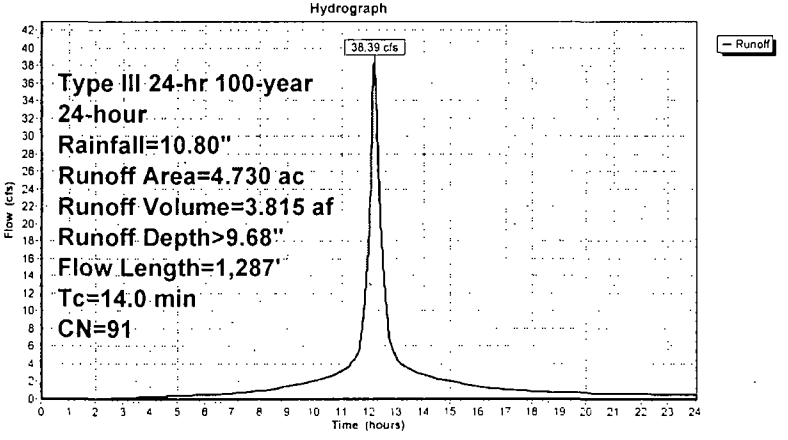
Runoff = 38.39 cfs @ 12.18 hrs, Volume= 3.815 af, Depth> 9.68"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs
Type III 24-hr 100-year, 24-hour Rainfall=10.80"

Area (ac)	CN	Description
4.730	91	Urban industrial, 72% imp, HSG C
1.324		28.00% Pervious Area
3.406		72.00% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
4.0	300	0.0050	1.24		**Sheet Flow,** Smooth surfaces n= 0.011 P2= 5.04"
8.5	730	0.0050	1.44		**Shallow Concentrated Flow,** Paved Kv= 20.3 fps
1.5	257	0.0007	2.76	40.77	**Pipe Channel,** 52.0" Round Area= 14.7 sf Perim= 13.6' r= 1.08' n= 0.015
14.0	1,287	Total			

Subcatchment 7S: Area XI



Summary for Subcatchment 9S: Area XII

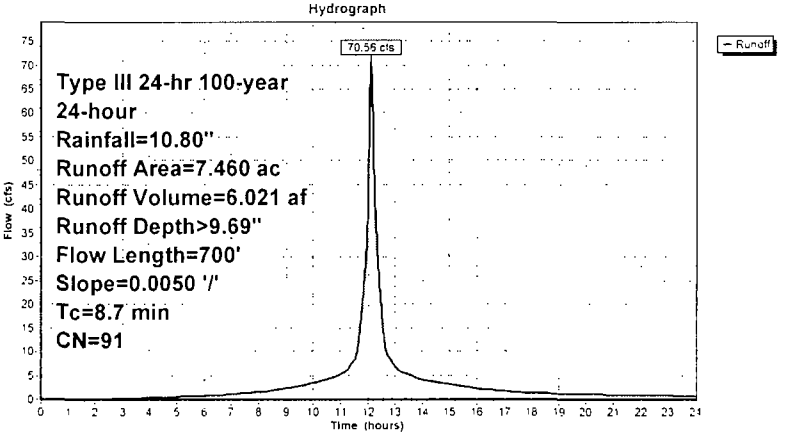
Runoff = 70.56 cfs @ 12.12 hrs, Volume= 6.021 af, Depth> 9.69"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs
Type III 24-hr 100-year, 24-hour Rainfall=10.80"

Area (ac)	CN	Description
7.460	91	Urban industrial, 72% imp, HSG C
2.089		28.00% Pervious Area
5.371		72.00% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
2.1	130	0.0050	1.04		**Sheet Flow,** Smooth surfaces n= 0.011 P2= 5.04"
6.6	570	0.0050	1.44		**Shallow Concentrated Flow,** Paved Kv= 20.3 fps
8.7	700	Total			

Subcatchment 9S: Area XII



Summary for Subcatchment 10S: Area VI

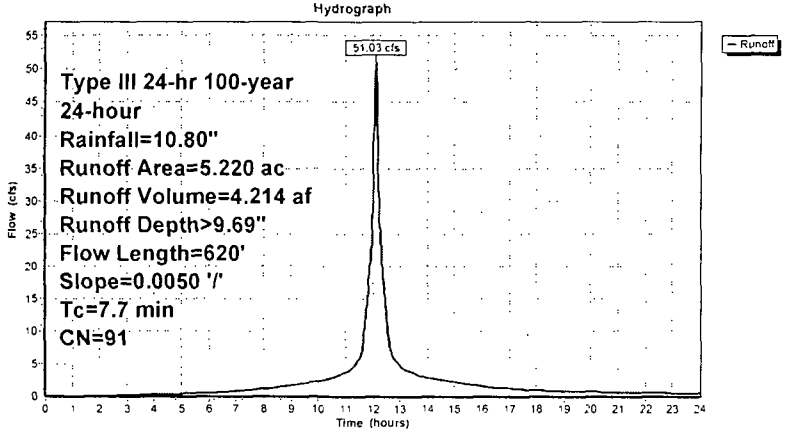
Runoff = 51.03 cfs @ 12.11 hrs, Volume= 4.214 af, Depth> 9.69"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs
Type III 24-hr 100-year, 24-hour Rainfall=10 80"

Area (ac)	CN	Description
5.220	91	Urban industrial, 72% imp, HSG C
1.462		28.00% Pervious Area
3.758		72.00% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
1.8	110	0.0050	1.01		**Sheet Flow,** Smooth surfaces n= 0.011 P2= 5.04"
5.9	510	0.0050	1.44		**Shallow Concentrated Flow,** Paved Kv= 20.3 fps
7.7	620	Total			

Subcatchment 10S: Area VI



Summary for Subcatchment 11S: Area V

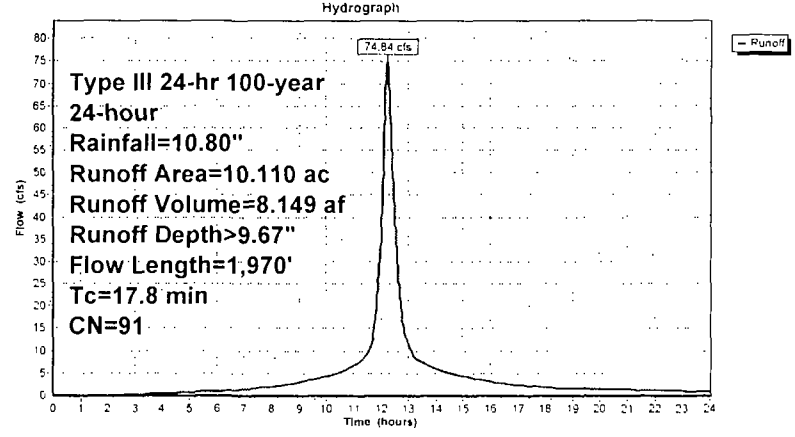
Runoff = 74.84 cfs @ 12.24 hrs, Volume= 8.149 af, Depth> 9.67"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0 00-24.00 hrs, dt= 0.01 hrs
Type III 24-hr 100-year, 24-hour Rainfall=10.80"

Area (ac)	CN	Description
10.110	91	Urban industrial, 72% imp, HSG C
2 831		28.00% Pervious Area
7.279		72.00% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
4.0	300	0.0050	1.24		**Sheet Flow,** Smooth surfaces n= 0.011 P2= 5.04"
7.8	676	0.0050	1.44		**Shallow Concentrated Flow,** Paved Kv= 20.3 fps
6.0	994	0.0007	2.76	40.77	**Pipe Channel,** 52.0" Round Area= 14.7 sf Perim= 13.6' r= 1.06' n= 0.015
17.8	1,970	Total			

Subcatchment 11S: Area V



Summary for Subcatchment 12S: Area X

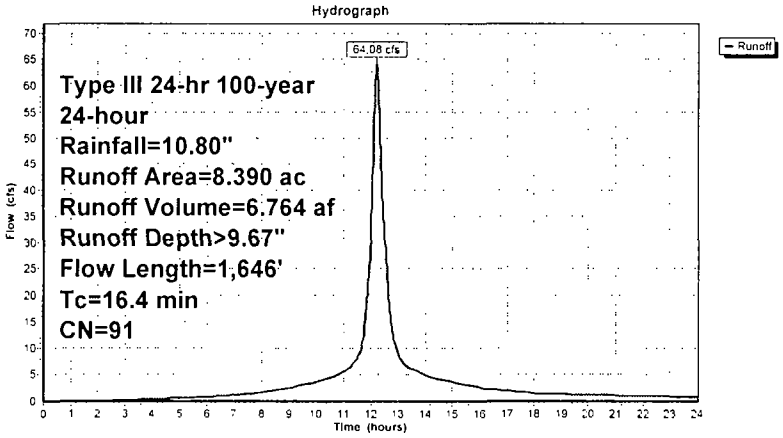
Runoff = 64.08 cfs @ 12.22 hrs, Volume= 6.764 af, Depth> 9.67"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0 00-24.00 hrs, dt= 0.01 hrs
Type III 24-hr 100-year, 24-hour Rainfall=10.80"

Area (ac)	CN	Description
8.390	91	Urban industrial, 72% imp, HSG C
2.349		28.00% Pervious Area
6.041		72.00% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
4.0	300	0.0050	1.24		**Sheet Flow,** Smooth surfaces n= 0.011 P2= 5.04"
8.9	769	0.0050	1 44		**Shallow Concentrated Flow,** Paved Kv= 20.3 fps
3.5	577	0.0007	2.76	40.77	**Pipe Channel,** 52.0" Round Area= 14.7 sf Perim= 13.6' r= 1.08' n= 0.015
16.4	1,646	Total			

Subcatchment 12S: Area X



Summary for Subcatchment 14S: Area III

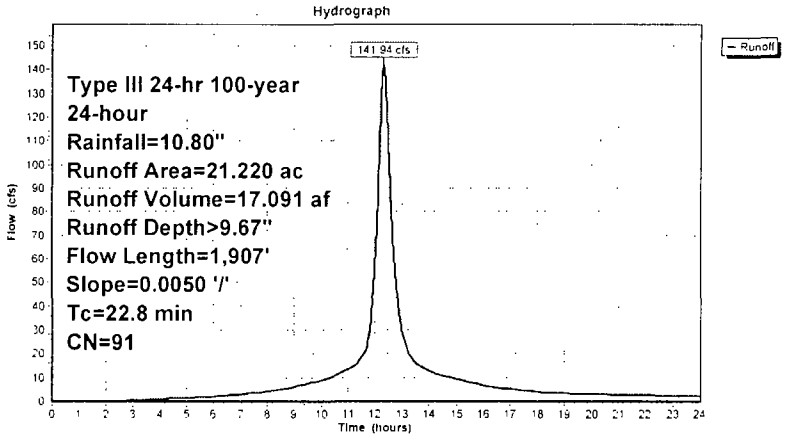
Runoff = 141.94 cfs @ 12.29 hrs, Volume= 17.091 af, Depth> 9.67"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs
Type III 24-hr 100-year, 24-hour Rainfall=10.80"

Area (ac)	CN	Description
21.220	91	Urban industrial, 72% imp, HSG C
5.942		28 00% Pervious Area
15.278		72 00% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
3 2	221	0.0050	1.16		**Sheet Flow,** Smooth surfaces n= 0.011 P2= 5.04"
19.6	1,686	0.0050	1.44		**Shallow Concentrated Flow,** Paved Kv= 20.3 fps
22.8	1,907	Total			

Subcatchment 14S: Area III



Summary for Subcatchment 15S: Area XIII

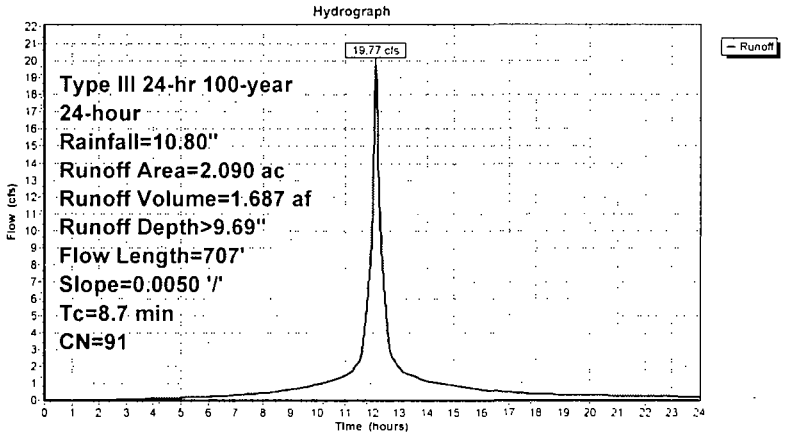
Runoff = 19.77 cfs @ 12.12 hrs, Volume= 1.687 af, Depth> 9.69"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs
Type III 24-hr 100-year, 24-hour Rainfall=10.80"

Area (ac)	CN	Description
2.090	91	Urban industrial, 72% imp, HSG C
0.585		28.00% Pervious Area
1.505		72.00% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
1.5	90	0.0050	0.97		**Sheet Flow,** Smooth surfaces n= 0.011 P2= 5.04"
7.2	617	0.0050	1.44		**Shallow Concentrated Flow,** Paved Kv= 20.3 fps
8.7	707	Total			

Subcatchment 15S: Area XIII



Summary for Subcatchment 16S: Area I

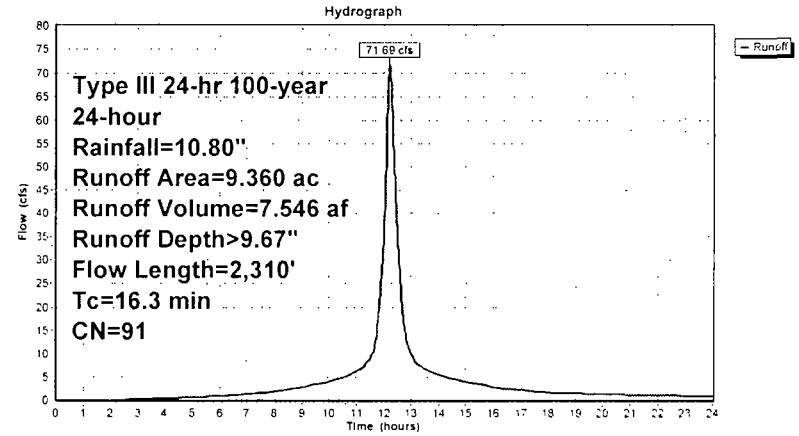
Runoff = 71.69 cfs @ 12.22 hrs, Volume= 7.546 af, Depth> 9.67"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs
Type III 24-hr 100-year, 24-hour Rainfall=10.80"

Area (ac)	CN	Description
9.360	91	Urban industrial, 72% imp, HSG C
2.621		28.00% Pervious Area
6.739		72.00% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.0	428	0.0050	1.44		**Shallow Concentrated Flow,** Paved Kv= 20.3 fps
11.3	1,882	0.0007	2.76	40.77	**Pipe Channel, Through N. Ditch 1** 52.0" Round Area= 14.7 sf Perim= 13.6' r= 1.08' n= 0.015
16.3	2,310	Total			

Subcatchment 16S: Area I



Summary for Subcatchment 17S: Area XV

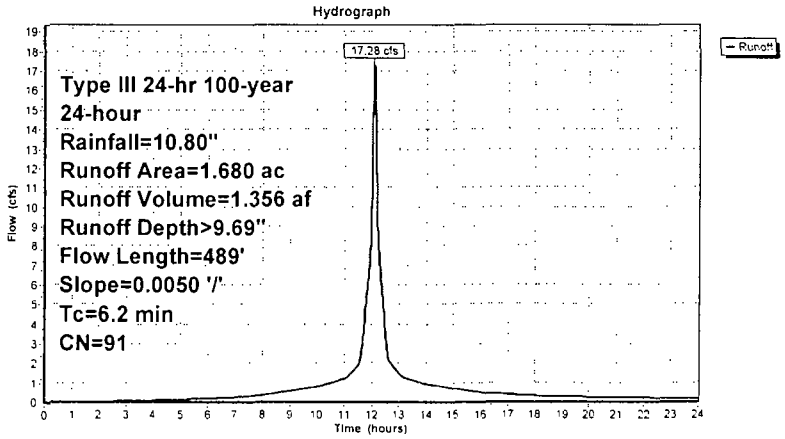
Runoff = 17.28 cfs @ 12.09 hrs, Volume= 1.356 af, Depth> 9.69"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs
Type III 24-hr 100-year, 24-hour Rainfall=10.80"

Area (ac)	CN	Description
1.680	91	Urban industrial, 72% imp, HSG C
0.470		28.00% Pervious Area
1.210		72.00% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
1.5	85	0.0050	0.96		**Sheet Flow,** Smooth surfaces n= 0.011 P2= 5.04"
4.7	404	0.0050	1.44		**Shallow Concentrated Flow,** Paved Kv= 20.3 fps
6.2	489	Total			

Subcatchment 17S: Area XV



Summary for Subcatchment 18S: Area II

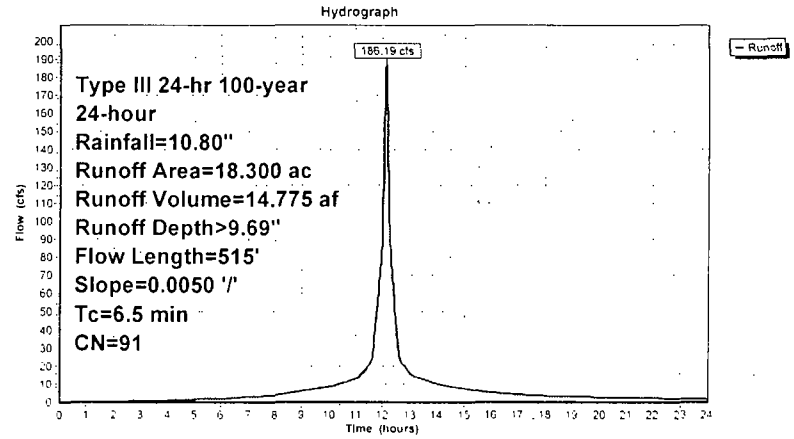
Runoff = 186.19 cfs @ 12.09 hrs, Volume= 14.775 af, Depth> 9.69"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs
Type III 24-hr 100-year, 24-hour Rainfall=10.80"

Area (ac)	CN	Description
18.300	91	Urban industrial, 72% imp, HSG C
5.124		28.00% Pervious Area
13.176		72.00% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
4.0	300	0.0050	1.24		**Sheet Flow,** Smooth surfaces n= 0.011 P2= 5.04"
2.5	215	0.0050	1.44		**Shallow Concentrated Flow,** Paved Kv= 20.3 fps
6.5	515	Total			

Subcatchment 18S: Area II



Summary for Subcatchment 23S: Area XIV

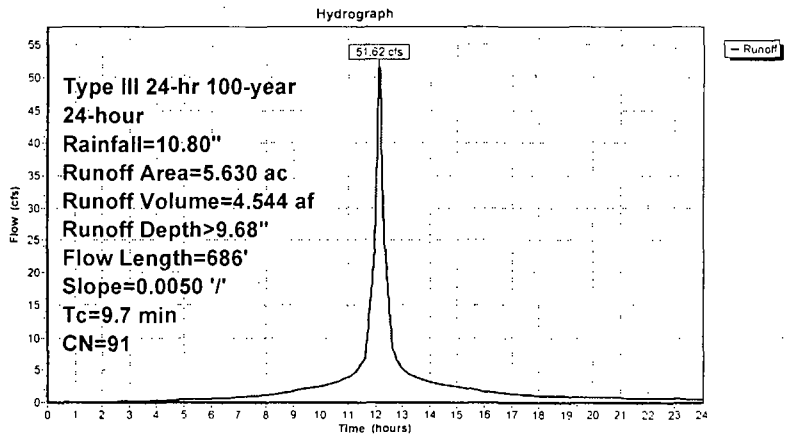
Runoff = 51.62 cfs @ 12.13 hrs, Volume= 4.544 af, Depth> 9.68"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs
Type III 24-hr 100-year, 24-hour Rainfall=10.80"

Area (ac)	CN	Description
5.630	91	Urban industrial, 72% imp, HSG C
1.576		28.00% Pervious Area
4.054		72.00% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
4.0	300	0.0050	1.24		**Sheet Flow,** Smooth surfaces n= 0.011 P2= 5.04"
5.7	386	0.0050	1.14		**Shallow Concentrated Flow,** Unpaved Kv= 16.1 fps
9.7	686	Total			

Subcatchment 23S: Area XIV



Summary for Reach 4R: TBC

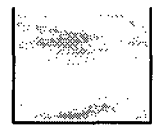
[62] Hint: Exceeded Reach 25R OUTLET depth by 0.32' @ 0.01 hrs
[63] Warning: Exceeded Reach 33R INLET depth by 1.97' @ 13.33 hrs

Inflow Area = 412.691 ac, 62.96% Impervious, Inflow Depth > 24.05" for 100-year, 24-hour event
Inflow = 1,285.76 cfs @ 12.28 hrs, Volume= 826.967 af
Outflow = 1,285.50 cfs @ 12.28 hrs, Volume= 826.676 af, Atten= 0%, Lag= 0.4 min

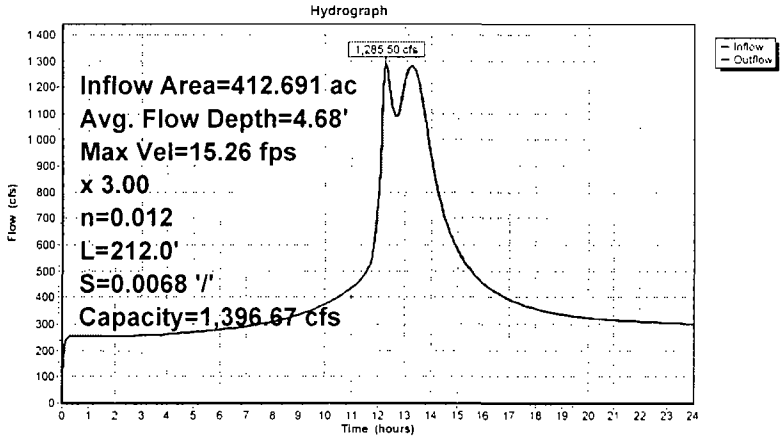
Routing by Stor-Ind+Trans method, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs
Max Velocity= 15.26 fps, Min. Travel Time= 0.2 min
Avg. Velocity = 11.19 fps, Avg. Travel Time= 0.3 min

Peak Storage= 17,862 cf @ 12.28 hrs
Average Depth at Peak Storage= 4.68'
Bank-Full Depth= 5.00', Capacity at Bank-Full= 1,396.67 cfs

A factor of 3.00 has been applied to the storage and discharge capacity
6.00' x 5.00' deep channel, n= 0.012
Length= 212.0' Slope= 0.0068 '/'
Inlet Invert= -1.28', Outlet Invert= -2.72'



Reach 4R: TBC



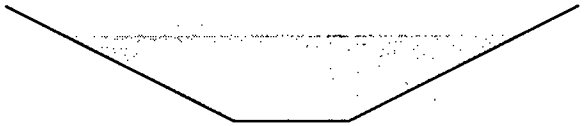
Summary for Reach 8R: N Ditch 1

Inflow Area = 363.771 ac, 61.75% Impervious, Inflow Depth > 9.26" for 100-year, 24-hour event
Inflow = 985.92 cfs @ 13.18 hrs, Volume= 280.625 af
Outflow = 985.38 cfs @ 13.21 hrs, Volume= 280.413 af, Atten= 0%, Lag= 2.0 min

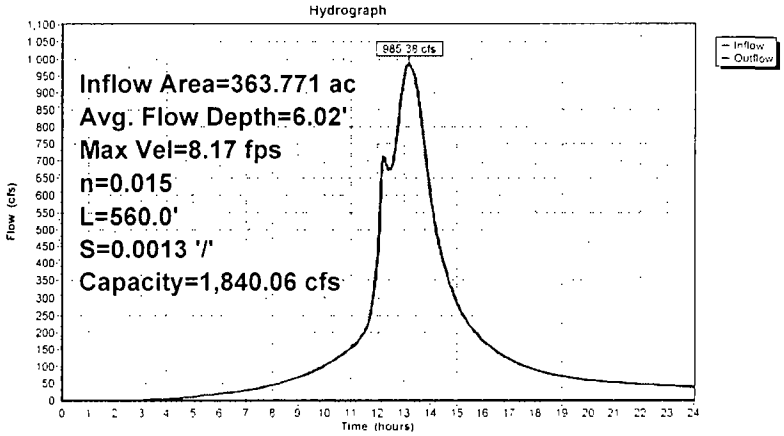
Routing by Stor-Ind+Trans method, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs
Max. Velocity= 8.17 fps, Min. Travel Time= 1.1 min
Avg. Velocity = 4.06 fps, Avg. Travel Time= 2.3 min

Peak Storage= 67,523 cf @ 13.19 hrs
Average Depth at Peak Storage= 6.02'
Bank-Full Depth= 8.00', Capacity at Bank-Full= 1,840.06 cfs

8.00' x 8.00' deep channel, n= 0.015
Side Slope Z-value= 2.0 '/' Top Width= 40.00'
Length= 560.0' Slope= 0.0013 '/'
Inlet Invert= 0.91', Outlet Invert= 0.18'



Reach 8R: N Ditch 1



Summary for Reach 13R: N Ditch 2

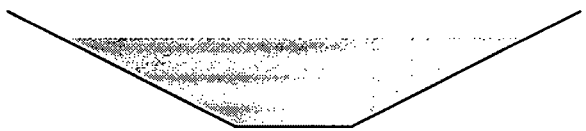
[63] Warning: Exceeded Reach 8R INLET depth by 0.72' @ 1.02 hrs

Inflow Area = 387.081 ac, 62.37% Impervious, Inflow Depth > 13.11" for 100-year, 24-hour event
Inflow = 1,070.38 cfs @ 13.20 hrs, Volume= 422.892 af
Outflow = 1,070.02 cfs @ 13.23 hrs, Volume= 422.408 af, Atten= 0%, Lag= 1 9 min

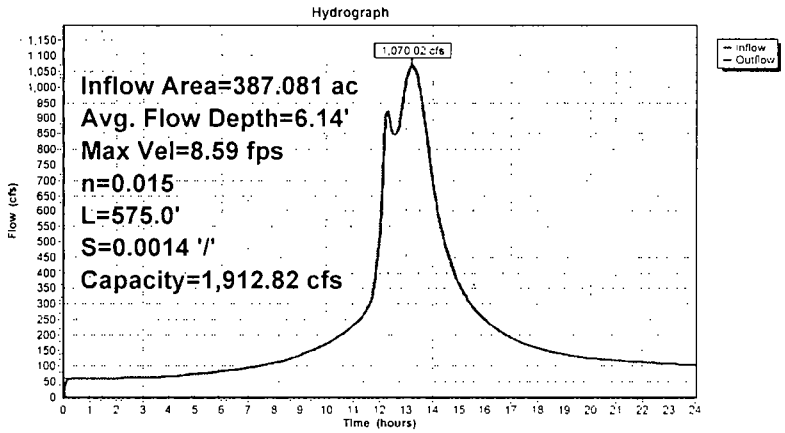
Routing by Stor-Ind+Trans method, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs
Max. Velocity= 8.59 fps, Min. Travel Time= 1.1 min
Avg. Velocity = 5.16 fps, Avg. Travel Time= 1.9 min

Peak Storage= 71,616 cf @ 13.22 hrs
Average Depth at Peak Storage= 6.14'
Bank-Full Depth= 8.00', Capacity at Bank-Full= 1,912.82 cfs

8.00' x 8.00' deep channel, n= 0.015
Side Slope Z-value= 2.0 '/' Top Width= 40.00'
Length= 575.0' Slope= 0.0014 '/'
Inlet Invert= 0.18', Outlet Invert= -0.63'



Reach 13R: N Ditch 2



Summary for Reach 25R: N Ditch 3

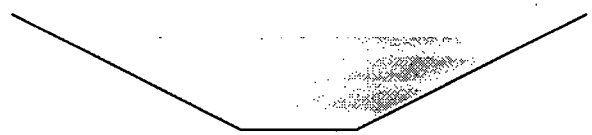
[62] Hint: Exceeded Reach 13R OUTLET depth by 0.67' @ 1.96 hrs

Inflow Area = 392.711 ac, 62.51% Impervious, Inflow Depth > 16.61" for 100-year, 24-hour event
Inflow = 1,133.13 cfs @ 13 23 hrs, Volume= 543.589 af
Outflow = 1,132.90 cfs @ 13 26 hrs, Volume= 542.986 af, Atten= 0%, Lag= 1.7 min

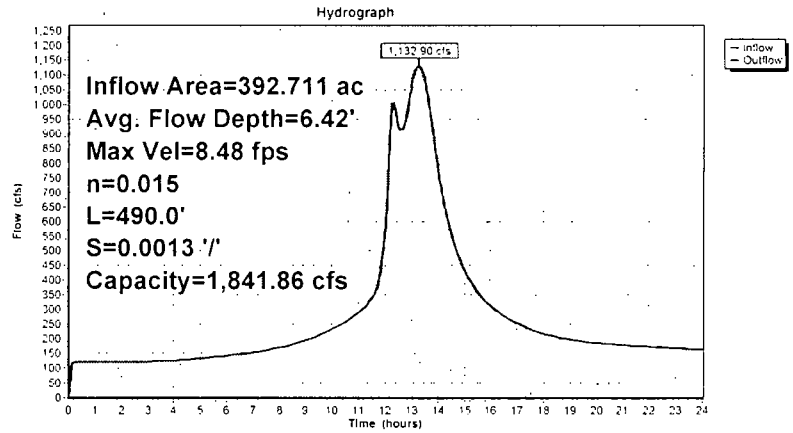
Routing by Stor-Ind+Trans method, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs
Max. Velocity= 8.48 fps, Min. Travel Time= 1.0 min
Avg Velocity = 5.56 fps, Avg. Travel Time= 1.5 min

Peak Storage= 65,493 cf @ 13.25 hrs
Average Depth at Peak Storage= 6.42'
Bank-Full Depth= 8.00', Capacity at Bank-Full= 1,841.86 cfs

8.00' x 8.00' deep channel, n= 0.015
Side Slope Z-value= 2.0 '/' Top Width= 40 00'
Length= 490.0' Slope= 0.0013 '/'
Inlet Invert= -0.63', Outlet Invert= -1.27'



Reach 25R: N Ditch 3



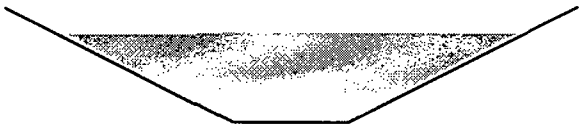
Summary for Reach 33R: South Street Ditch

Inflow Area = 18.300 ac, 72.00% Impervious, Inflow Depth > 9.69" for 100-year, 24-hour event
Inflow = 186.19 cfs @ 12.09 hrs, Volume= 14.775 af
Outflow = 163.86 cfs @ 12.21 hrs, Volume= 14.725 af, Atten= 12%, Lag= 7.1 min

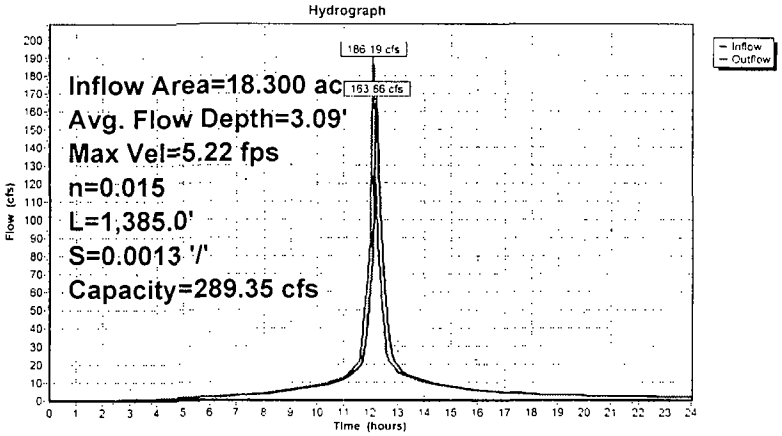
Routing by Stor-Ind+Trans method, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs
Max. Velocity= 5.22 fps, Min. Travel Time= 4.4 min
Avg. Velocity = 1.85 fps, Avg. Travel Time= 12.5 min

Peak Storage= 43,558 cf @ 12.13 hrs
Average Depth at Peak Storage= 3.09'
Bank-Full Depth= 4.00', Capacity at Bank-Full= 289.35 cfs

4.00' x 4.00' deep channel, n= 0.015
Side Slope Z-value= 2.0 '/' Top Width= 20.00'
Length= 1,385.0' Slope= 0.0013 '/'
Inlet Invert= 0.52', Outlet Invert= -1.28'



Reach 33R: South Street Ditch



Summary for Link 27L: HWY 17

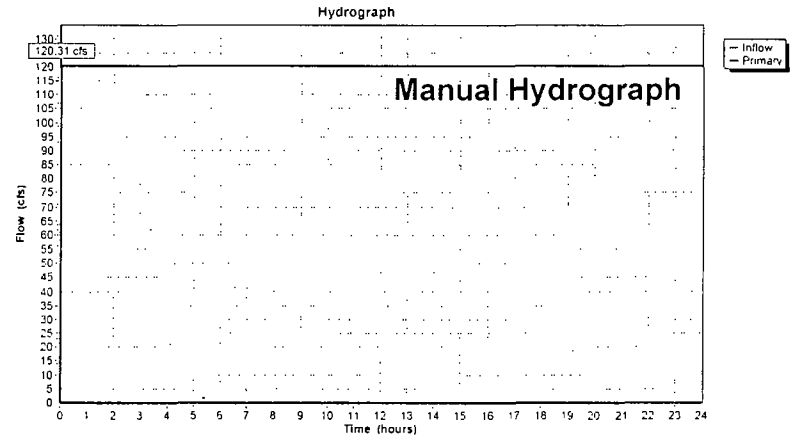
Inflow = 120.31 cfs @ 0.00 hrs, Volume= 238.731 af
Primary = 120.31 cfs @ 0.00 hrs, Volume= 238.731 af, Atten= 0% Lag= 0 0 min

Primary outflow = Inflow, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs

25 Point manual hydrograph, To= 0.00 hrs, dt= 1.00 hrs, cfs =

120.31	120.31	120 31	120 31	120.31	120.31	120.31	120.31	120.31	120 31
120.31	120.31	120.31	120 31	120.31	120 31	120.31	120.31	120 31	120 31
120.31	120.31	120.31	120 31	120.31					

Link 27L: HWY 17



Summary for Link 30L: North 2

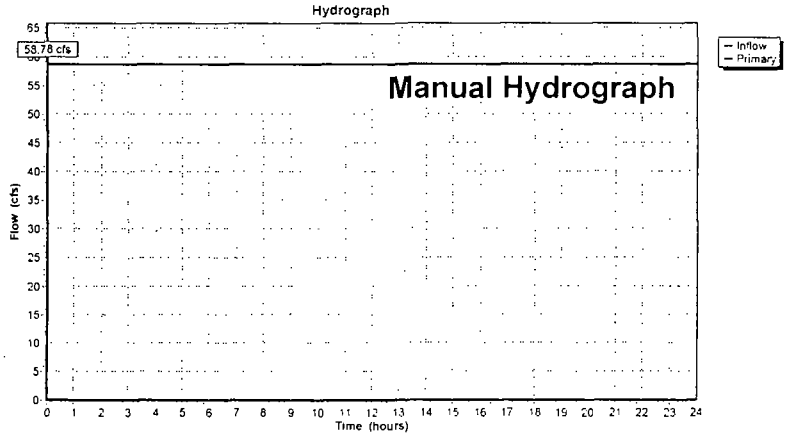
Inflow = 58.78 cfs @ 0.00 hrs, Volume= 116.637 af
Primary = 58.78 cfs @ 0.00 hrs, Volume= 116.637 af, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs

25 Point manual hydrograph, To= 0.00 hrs, dt= 1 00 hrs, cfs =

58.78	58.78	58.78	58.78	58.78	58.78	58.78	58.78	58.78	58.78
58.78	58.78	58.78	58.78	58.78	58 78	58.78	58.78	58.78	58.78
58.78	58.78	58.78	58.78	58.78					

Link 30L: North 2



Summary for Link 31L: North 1

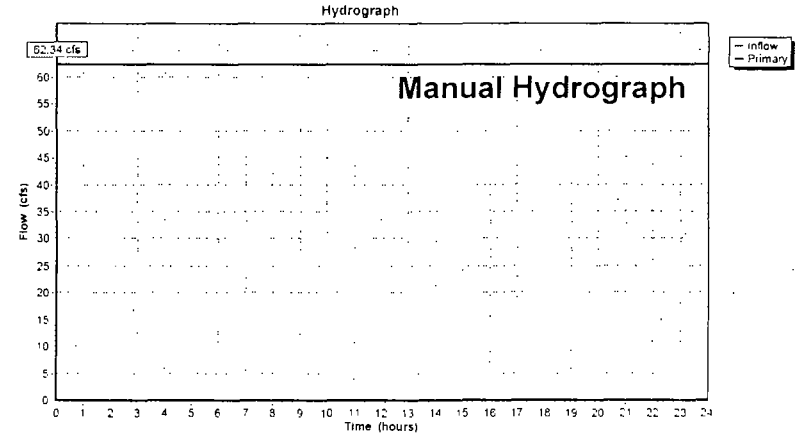
Inflow = 62.34 cfs @ 0.00 hrs, Volume= 123.701 af
Primary = 62.34 cfs @ 0.00 hrs, Volume= 123 701 af, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs

25 Point manual hydrograph, To= 0.00 hrs, dt= 1 00 hrs, cfs =

62.34	62.34	62 34	62.34	62.34	62 34	62.34	62 34	62 34	62.34
62.34	62.34	62.34	62.34	62.34	62.34	62 34	62 34	62.34	62.34
62.34	62.34	62.34	62.34	62.34					

Link 31L: North 1

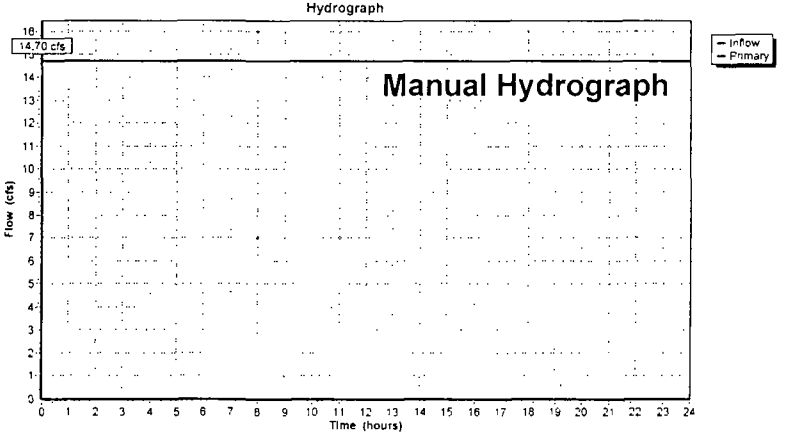


Summary for Link 32L: Process Flows

Inflow = 14.70 cfs @ 0.00 hrs, Volume= 29.169 af
Primary = 14.70 cfs @ 0.00 hrs, Volume= 29.169 af, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-24.00 hrs, dt= 0 01 hrs

25 Point manual hydrograph, To= 0.00 hrs, dt= 1.00 hrs, cfs =

14.70	14.70	14.70	14.70	14.70	14.70	14.70	14.70	14 70	14.70
14.70	14.70	14.70	14.70	14.70	14.70	14.70	14.70	14.70	14.70
14.70	14.70	14.70	14.70	14.70					

Link 32L: Process Flows