RCA ENGINEERING REPORT

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Exide Technologies Frisco Recycling Center

RCRA Permit Renewal Application

5/30/19

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1.0 INTRODUCTION AND GENERAL ENGINEERING REPORT REQUIREMENTS (SECTION V)

This RCA Engineering Report describes the design, construction, and operation of the Remediation Consolidation Area (RCA), a corrective action management unit (CAMU) proposed within a portion of the former operating plant (FOP) area of the Exide Technologies (Exide) Frisco Recycling Center. This RCA Engineering Report is an Attachment (Attachment F) to the Resource Conservation and Recovery Act (RCRA) Part B permit renewal and amendment application supplemental filing submitted to the Texas Commission on Environmental Quality (TCEQ) in August 2018 (referred to throughout as the Part B RCRA Permit Renewal Application). It was developed in accordance with the requirements described in Section V of the Part B RCRA Permit Renewal Application. This report provides support for the designation of the RCA as a CAMU and also contains information required to be included in the Engineering Report as set forth in various sections of the Part B RCRA Permit Renewal Application.

The RCA would be regulated under Resource Conservation and Recovery Act (RCRA) regulations Subpart S as a CAMU. The primary design requirements for a CAMU are outlined in 40 CFR 264.552. The CAMU regulations created an additional type of RCRA unit which is distinct from the type of units listed in RCRA Section 3004(k)[1], and the TCEQ has indicated the proposed CAMU should be incorporated in the Part B RCRA Permit Renewal Application as a miscellaneous unit for purposes of the permit application template, though the unit will be regulated under 40 CFR Part 264, Subpart S and 30 TAC § 335.152(14). The requirements under sections V.A (General Engineering Reports) and sections V.K (Miscellaneous units) are also discussed below to ensure relevant information is provided.

Also, because some of the design requirements listed in Section V.G (Landfills) of the Part B RCRA Permit Renewal Application are also informative for the proposed RCA, Section V.G requirements have also been discussed in this Engineering Report where relevant. Similarly, although the RCA does not fall under the categories of units addressed by the provisions of 30 TAC 335.204, the information relevant to landfills under that rule is provided in various reports included in the Part B RCRA Permit Renewal Application. This report addresses how the RCA design, the funnel and gate design for the proposed groundwater remedy, and the flood wall will prevent releases of wastes and waste constituents in the event of a 100-year flood and will achieve long term remedial goals by addressing migration of COCs to groundwater or surface.

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[1] Based on the EPA Memorandum dated March 13, 1996 RE: Use of Area of Contamination (AOC) Concept During RCRA Cleanups (EPA 1996), CAMUs were established as a new type of RCRA unit. The Memorandum states that "The final CAMU regulations create a new type of RCRA unit – a 'Corrective Action Management Unit' or 'CAMU'." CAMUs are distinct from the type of units listed in RCRA Section 3004(k)" (footnote omitted).

The sections below are identified according to the CAMU requirements in 40 CFR 264.552 or applicable instructions in the Part B RCRA Permit Renewal Application.

2.0 SATISFACTION OF CAMU REQUIREMENTS

2.1 40 CFR 264.552(a) General Requirements for CAMUs

Per 40 CFR 264.552(a), "Corrective action management unit means an area within a facility that is used only for managing CAMU-eligible wastes for implementing corrective action or cleanup at the facility. A CAMU must be located within the contiguous property under the control of the owner or operator where the wastes to be managed in the CAMU originated. One or more CAMUs may be designated at a facility."

The RCA will be located entirely within the boundaries of the FOP, which is owned by and under the control of Exide. The RCA will only be used for managing CAMU-eligible waste originating from operations at the FOP and generated as a part of the response action for the FOP, including waste originating at the FOP and removed from the Parkwood Boulevard parcel and downstream Stewart Creek.

2.1.1 40 CFR 264.552(a)(1) CAMU-Eligible Waste

CAMU-eligible wastes include all solid and hazardous wastes, and all media (including groundwater, surface water, soils, and sediments) and debris, that are managed for implementing cleanup[2]. As-generated wastes (either hazardous or non-hazardous) from ongoing industrial operations at a site are not CAMU-eligible wastes.

The following CAMU-eligible wastes will be placed in the RCA[3]:

- Excavated soil, battery case fragments, concrete or other remediation waste from affected properties on-Site or the Parkwood Boulevard parcel (defined as On-Site Soil Remediation Waste). This includes soils or debris generated from the installation of monitoring wells at the Site.
- Excavated soils, sediment, battery case fragments, concrete or other remediation waste from off-site Stewart Creek affected property (defined as Off-site Stewart Creek Remediation Waste).

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[2] The 1996 EPA Memorandum describes how the CAMU regulations expanded the flexibility available for management of remediation wastes beyond that offered by the AOC approach. Remediation waste is defined as, "all solid and hazardous wastes and all media (including groundwater, surface water, soils, and sediments) and debris which contain listed hazardous wastes or which themselves exhibit a hazardous waste characteristic that are managed for the purpose of implementing corrective action requirements under 40 CFR 264.1010 and RCRA sections 3008(h). For a given facility, remediation wastes may originate only from within the facility boundary, but may include wastes managed in implementing RCRA sections 30004(v) or 3008(h) for releases beyond the facility boundary."

[3] To the extent wastes are hazardous when generated and, absent the CAMU, would otherwise be subject to the Land Disposal Restrictions, the wastes will be confirmed to meet applicable CAMU treatment standards prior to disposal in the RCA. However, no hazardous wastes removed from downstream Stewart Creek (i.e., beyond the boundaries of the FOP) will be placed in the RCA.

- Excavated soils, sediment, battery case fragments, concrete or other remediation waste from on-Site Stewart Creek affected property (defined below as on-Site Stewart Creek Remediation Waste).
- Slag segregated from excavated soil and sediment from affected properties on-Site (defined below as on-Site slag).
- Soil stockpiled at the Railroad Museum (off-Site)

These wastes are further described in the Waste Analysis Plan (WAP) which is included as Attachment Q to the Part B RCRA Permit Renewal Application. There are no ongoing industrial operations or associated as-generated waste streams at the Site.

2.1.2 40 CFR 264.552(a)(3) Prohibition Against Placing Liquids in CAMUs and Other Waste Placement

The placement of bulk or non-containerized liquid hazardous waste or free liquids contained in hazardous waste (whether or not sorbents have been added) in any CAMU is prohibited except where placement of such wastes facilitates the remedy selected for the waste. The absence or presence of free liquids in either a containerized or a bulk waste must be determined in accordance with 40 CFR 264.314(b). Sorbents used to treat free liquids in CAMUs must meet the requirements of 40 CFR 264.314(d).

No liquid hazardous or non-hazardous waste or free liquids contained in hazardous or non-hazardous waste will be placed in the CAMU. Sediments and soils from Stewart Creek will be tested for the presence of free liquids in accordance with 40 CFR 264.314(d). The sampling protocol for determining the presence of free liquids is outlined in the WAP, which is included as Attachment Q to the Part B RCRA Permit Renewal Application.

2.2 40 CFR 264.552(b) Regulated Unit Incorporation

Per 40 CFR 264.552(b), the Regional Administrator may designate a regulated unit (as defined in 40 CFR 264.90(a)(2)) as a CAMU, or may incorporate a regulated unit into a CAMU, in specified circumstances.

The two currently permitted units at the FOP have been demolished and, pending certification of closure, have been designated as inactive. One of the units, known as the Raw Materials Storage Building, was a permitted containment building, and the other, known as the Battery Receiving/Storage Building, was a permitted container storage area. The footprints and the remaining concrete slabs for of both of these units are located completely within the footprint of the proposed RCA. Neither unit, however, falls within the definition of “regulated unit” under 40 CFR 264.90(a)(2), which is defined to refer to a surface impoundment, waste pile, or land treatment unit or landfill receiving hazardous waste after July 26, 1982. In any event, the inclusion of these two areas within the RCA will enhance implementation of effective, protective and reliable remedial actions for the FOP by supporting the consolidation and capping response actions and groundwater response actions as described in the Response Action Plan (RAP) and in applicable sections below (the RAP is included as Attachment M to the Part B RCRA Permit

Renewal Application). The Engineering Reports and Closure Plans previously submitted for these inactive (demolished) units are included for reference purposes as Attachment R to the Part B RCRA Permit Renewal Application. Implementation of the Closure Plan (Attachment C to the Part B RCRA Permit Renewal Application), which addresses closure of the CAMU and the FOP generally, also will achieve final closure of the Raw Materials Storage Building (containment building) and the Battery Receiving/Storage Building (container storage area), and certification of such closure will be requested concurrently with certification of closure of remediation of the FOP.

2.3 40 CFR 264.552(c) Criteria for CAMU Designation

The Criteria for CAMU designation are outlined in 40 CFR 264.552(c) as follows:

- The CAMU shall facilitate the implementation of reliable, effective, protective, and cost-effective remedies;
- Waste management activities associated with the CAMU shall not create unacceptable risks to humans or to the environment resulting from exposure to hazardous wastes or hazardous constituents;
- The CAMU shall include uncontaminated areas of the facility, only if including such areas for the purpose of managing CAMU-eligible waste is more protective than management of such wastes at contaminated areas of the facility;
- Areas within the CAMU, where wastes remain in place after closure of the CAMU, shall be managed and contained so as to minimize future releases, to the extent practicable;
- The CAMU shall expedite the timing of remedial activity implementation, when appropriate and practicable;
- The CAMU shall enable the use, when appropriate, of treatment technologies (including innovative technologies) to enhance the long-term effectiveness of remedial actions by reducing the toxicity, mobility, or volume of wastes that will remain in place after closure of the CAMU; and
- The CAMU shall, to the extent practicable, minimize the land area of the facility upon which wastes will remain in place after closure of the CAMU.

The designation of the RCA as a CAMU at the FOP will facilitate the timely implementation of the consolidation/capping and groundwater remedy outlined in the RAP (Attachment M to the A Part B RCRA Permit Renewal Application). This remedy is reliable, effective, protective and cost-effective for addressing impacted media. The rationale for selection of this remedy and description of how the remedy is designed to prevent unacceptable risk to humans or the environment is described in the RAP.

Additionally, the CAMU is located completely within the boundary of Affected Property No. 2 (not located on uncontaminated areas of the FOP) and the design minimizes the land area upon which wastes will remain in place after completion and closure of the CAMU. The Closure Plan (Attachment C to the Part B RCRA Permit Renewal Application) outlines how the RCA will be managed and contained to minimize future releases. A discussion of the funnel and gate permeable reactive barrier [PRB] wall that is proposed as the groundwater remedy, including detailed information the PRB treatment technology, and CAMU design is also included in the RAP (Attachment M to the A Part B RCRA Permit Renewal Application).

2.4 40 CFR 264.552(d) CAMU Background Information

40 CFR 264.552(d) requires the owner/operator to provide sufficient information to enable the Executive Director of the TCEQ to designate a CAMU in accordance with the criteria in that section. This must include, unless not reasonably available, information on:

- The origin of the waste and how it was subsequently managed (including a description of the timing and circumstances surrounding the disposal and/or release);
- Whether the waste was listed or identified as hazardous at the time of disposal and/or release; and
- Whether the disposal and/or release of the waste occurred before or after the land disposal requirements of part 268 of this chapter were in effect for the waste listing or characteristic.

This background information for the RCA and the contaminated media/wastes proposed for consolidation in the RCA is provided in the extensive investigation reports for the FOP and Stewart Creek. The Affected Property Assessment Report prepared by Golder in 2014 summarizes the available information available and is included as Attachment H to the Part B RCRA Permit Renewal Application.

2.5 40 CFR 264.552(e) Permit or Order Requirements

This section discusses the rationale for establishing the RCA as a CAMU on the FOP and describes how the design would prevent migration from the unit that would exceed the long-term remedial goals for the FOP. Additional information regarding the PRB is included in the RAP (Attachment M to the Part B RCRA Permit Renewal Application) and additional information regarding the geology of the FOP is included in the Geology Report (Attachment G to the Part B RCRA Permit Renewal Application).

2.5.1 40 CFR 264.552(e)(1) Aerial Configuration of the CAMU

The aerial configuration of the proposed CAMU is shown on Figure 2 of the Closure Plan included in Attachment C to the Part B RCRA Permit Renewal Application (as well as other figures throughout the Part B RCRA Permit Renewal Application).

2.5.2 40 CFR 264.552(e)(2) Specification of Applicable Design, Operation, Treatment and Closure Requirements

The specification for design for the RCA is included in Section 2.5.3 below.

Operation of the CAMU is described in the RCA Operation & Maintenance Plan which is Appendix L of the Closure Plan included in Attachment C to the Part B RCRA Permit Renewal Application and in the

RAP (for groundwater monitoring) which is included as Attachment M to the Part B RCRA Permit Renewal Application.

A description of the characteristics and design of the treatment technology used as a part of the PRB, which is included as a part of the RCA, is also included in the RAP (Attachment M to the Part B RCRA Permit Renewal Application).

The closure requirements for the RCA are included in the Closure Plan included in Attachment C to the Part B RCRA Permit Renewal Application.

2.5.3 40 CFR 264.552(e)(3) Minimum Design Requirements

The CAMU regulations afford discretion to the Executive Director of the TCEQ to approve alternate CAMU design requirements to a composite liner and leachate collection system if "(A) [t]he [Executive Director] finds that alternate design and operating practices, together with location characteristics, will prevent the migration of any hazardous constituents into the ground water or surface water at least as effectively as the liner and leachate collection systems in paragraph (e)(3)(i) of this section; or (B) [t]he CAMU is to be established in an area with existing significant levels of contamination, and the Regional Administrator finds that an alternative design, including a design that does not include a liner, would prevent migration from the unit that would exceed long-term remedial goals." 40 CFR 264.552(e)(3)(ii). The RCA meets the criteria of 40 CFR 264.552(e)(3)(ii)(B) as it is proposed as a CAMU that will be unlined and located within an area of significant in place contamination.

2.5.3.1 RCA Location

To support a finding under the 40 CFR 264.552(e)(3)(ii)(B) allowing the use of an alternate design that does not include a liner, the first criterion is that the CAMU is established in an area with existing significant levels of contamination. As described in the 2014 Affected Property Assessment Report (2014 APAR), which is included as Attachment M to the Part B RCRA Permit Renewal Application, and as shown on Figure VI.A-8 of the Geology Report for the FOP, the RCA is planned to be completely within the boundaries of Affected Property No. 2. Affected Property No. 2 is an area with significant impacts to both surface and subsurface soils. In addition, impacts to groundwater underlying the RCA have been detected. The levels of contamination within the area of the RCA are described in detail in the 2014 APAR, 2015 Supplement to the APAR, the RAP, 2018 Deep Groundwater Preliminary Design Investigation and in other historic documents for the Site. The proposed RCA area exhibited among the highest concentrations of lead and cadmium in soils and at greater depths than surrounding areas on the FOP.

2.5.3.2 Design to Prevent Contaminant Migration that Exceeds Long-Term Remedial Goals

The second design criterion to support an alternate design that does not include a liner is that the design would prevent migration from the unit that would exceed long-term remedial goals. The proposed unit includes consolidated waste that will be placed over the existing contaminated soils within the RCA. The potential exposure and migration pathways for the proposed RCA include 1) direct contact with human or ecological receptors, 2) migration through stormwater or wind transport, and 3) potential migration to groundwater through surface water infiltration and potential groundwater migration to surface water.

The long-term remedial goal for the surface soils, subsurface soils and groundwater in Affected Property No. 2 and the consolidated waste that will be placed within the RCA is to control exposure and to prevent the migration of groundwater with levels exceeding the applicable critical PCLs beyond the boundary of the proposed Funnel and Gate PRB through a combination of removal and physical controls.

A discussion of the potential contaminant migration pathways from the proposed unit and the design features for the RCA that address them in a way that meets the long-term remedial goals (including discussion of the performance measures that will be included) is presented below. Additional information regarding the specific methods that will be used to construct, operate, and measure performance of the RCA is included in the FOP Groundwater Monitoring Plan, the Closure Plan, and the RAP, all of which are included as Attachments to the Part B RCRA Permit Renewal Application.

2.5.3.2.1 Direct Contact with Human or Ecological Receptors

Following consolidation activities, the area will be capped with a multi-layer final cover system (MLFCS) design. The MLFCS specified for the RCA meets the requirements of the final cover design specified for hazardous waste landfills in 40 CFR 264.310. The MLFCS is designed to eliminate the direct contact with human or ecological exposure pathway. The MLFCS will be constructed according to the protocol described in the FOP Quality Assurance/Quality Control Plan, which is included with the Closure Plan included in Attachment C to the Part B RCRA Permit Renewal Application. This design includes a geosynthetic clay liner (GCL), geomembrane, geotextile/geocomposite, 30-in cover soil layer, and 6-inch vegetative cover soil layer. The MLFCS will be periodically inspected and maintained to ensure it continues to function as designed.

2.5.3.2.2 Surface Water/Air Transport and Infiltration

Currently, stormwater migrates from the paved surfaces of the area proposed for the RCA through cracks in the concrete to the underlying soils. Following consolidation activities, the area will be capped with an MLFCS. The MLFCS will eliminate or minimize the potential for contact of the underlying consolidated remediation waste with surface water or wind and potential infiltration of storm water. As discussed above, the MLFCS has a multi-layer design that meets the final cover design specified for hazardous waste landfills in 40 CFR 264.310 and will be constructed according to the protocol described in the FOP

Quality Assurance/Quality Control Plan. The MLFCS will be periodically inspected and maintained to ensure it continues to function as designed.

Land use restrictions and other engineering and institutional controls will be employed with capped areas to prevent future site activities that could impact the integrity of the MLFCS (e.g., excavation or support pilings for buildings). Long-term maintenance and monitoring will be implemented to maintain the grade and integrity of the MLFCS. Routine inspections for settlement, ponding of liquids, erosion, invasion by burrowing wildlife and deep-rooted vegetation will be implemented as described in the Closure Plan.

2.5.3.2.3 Subsurface Migration in Shallow Fill

The proposed area of the RCA includes the area of the former Raw Materials Storage Building (containment building) where water located in the shallow fill material at the Site was discussed in TCEQ comment No. 8 to the 2014 APAR. The water in the fill material flows to the southwest toward the French Drain System (FDS). Capping of paved areas of Affected Property No. 2 would eliminate or minimize the potential for stormwater to migrate to the subsurface and generate the shallow collected water historically observed in the area that will be the RCA. Capping of the RCA area will eliminate the infiltration of stormwater into the consolidated waste within the RCA. Capped areas would be graded to direct non-contact stormwater to stormwater management features.

The FDS will be removed and the proposed groundwater remedy will be installed. The proposed groundwater remedy is a funnel and gate permeable reactive barrier wall system (Funnel and Gate or Funnel and Gate PRB). The Funnel and Gate would be installed prior to RCA filling operations to continue to address existing and potential future migration of water through the concrete slab (concrete foundations and paved areas)/RCA area.

Long-term protection against infiltration and migration will be monitored through continued inspections, monitoring, and maintenance, as described in the Final Closure Plan for the FOP. The groundwater monitoring program outlined in the FOP Groundwater Monitoring Program will be used to measure performance of the RCA MLFCS and Funnel and Gate. The long-term remedial goal for the surface soils, subsurface soils and groundwater in Affected Property No. 2 and the consolidated waste that will be placed within the RCA is to control exposure and to prevent the migration of groundwater with levels exceeding the applicable critical PCLs as were established in the 2014 APAR, and as updated and described in the Part B Permit Application, FOP Groundwater Monitoring Plan and RAP.

2.5.3.2.4 Subsurface Migration Through More Permeable Saturated Soils and Preferential Pathways

In addition to the potential migration through shallow fill materials, the design for the RCA also addresses the potential for migration through more permeable saturated soils and other preferential pathways such as utility corridors and the former path of Stewart Creek. The installation of the Funnel and Gate in the area of the RCA, North Disposal Area and Slag Landfill provides protection for the potential migration of COCs through known more permeable areas (such as the former stream channel that is depicted on Figure 3A of Appendix 3.1 of the RAP) as well as potential pathways that potentially exist but have not been identified despite the extensive investigation activities that have been performed at the Site (including the installation of 13 new monitoring wells along the downgradient side of the RCA in 2018). The Funnel and Gate components will be installed from bedrock to near ground surface and will extend from beyond the eastern edge of the RCA to beyond the western edge of the Slag Landfill.

A detailed description of the design and rationale for the Funnel and Gate is included in the RAP (Attachment M to the Part B RCRA Permit Renewal Application), including the results of column studies.

As described above, long-term protection against migration of COCs through more permeable saturated soils and preferential pathways will be ensured through continued inspections, monitoring, and maintenance, as described in the Final Closure Plan for the FOP. The groundwater monitoring program outlined in the FOP Groundwater Monitoring Program will be used to measure performance of the Funnel and Gate. The long-term remedial goals for groundwater for the Site are defined as the PCLs for the relevant COCs established in the 2014 APAR, and as updated and described in the FOP Groundwater Monitoring Plan and RAP.

2.5.4 40 CFR 264.552(e)(4) Minimum Treatment Requirements

40 CFR 264.552(e)(4) specifies the minimum treatment requirements for “CAMU-eligible wastes, that absent the [CAMU rules], would be subject to the [Land Disposal Restrictions].” This section sets out a default standard and the criteria for adjusted standards, and EPA has indicated there is not a preference between the two approaches.[4]

The default standard is as follows:

- 40 CFR 264.552(e)(4)(iv)(B) indicates that for metals, treatment must achieve 90 percent reduction in principal hazardous constituent concentrations as measured in leachate from the treated waste or media (tested according to the TCLP) or 90 percent reduction in total constituent concentrations (when a metal removal treatment technology is used), except as provided by 264.552(e)(4)(iv)(C).
- 40 CFR 264.552(e)(4)(iv)(C) indicates that when treatment of any principal hazardous constituent to a 90 percent reduction standard would result in a concentration less than 10 times the Universal Treatment Standard for that constituent, treatment to achieve constituent concentrations less than 10 times the Universal Treatment Standard is not required. Universal Treatment Standards are identified in § 268.48 Table UTS of this chapter.

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[4] 67 Fed. Reg. 2962, 2994 (Jan. 22, 2002).

- 40 CFR 264.552(e)(4)(iv)(D) indicates that waste exhibiting the hazardous characteristic of ignitability, corrosivity or reactivity, the waste must also be treated to eliminate these characteristics.

Based on existing data from site investigations of Stewart Creek and the FOP, previous remedial actions on Stewart Creek and completed remediation for the Undeveloped Buffer Property surrounding the FOP, it is expected that the majority of the impacted media that will be excavated and be placed in the RCA is non-hazardous, and therefore, would not trigger the LDRs and would not be subject to a minimum treatment standard. To the extent any impacted media is excavated that is classified as hazardous waste, it is likely that "treatment of any principal hazardous constituent to a 90 percent reduction standard would result in a concentration less than 10 times the Universal Treatment Standard for that constituent," and therefore, "treatment to achieve constituent concentrations less than 10 times the Universal Treatment Standard is not required." If there is any hazardous waste generated that requires treatment, it would either be stabilized to achieve the CAMU treatment standard prior to disposal in the RCA, or sent off-site for treatment and disposal,

2.5.5 40 CFR 264.552(e)(5) Requirements for Groundwater Monitoring and Corrective Action

Groundwater monitoring and corrective action requirements for the RCA in accordance with 40 CFR 264.552(e)(5) are outlined in the FOP Groundwater Monitoring Plan (Attachment L to the Part B RCRA Permit Renewal Application) and the RAP (Attachment M to the Part B RCRA Permit Renewal Application).

2.5.6 40 CFR 264.552(e)(6) Closure and Post-Closure Requirements

The closure and post-closure requirements for the RCA in accordance with 40 CFR 264.552(e)(6) are outlined in the Closure Plan (Attachment C to the Part B RCRA Permit Renewal Application). As described above, it is noted that the cap specified for the RCA is a multi-layer final cover system that meets the requirements of the final cover design specified for hazardous waste landfills in 40 CFR 264.310. The proposed RCA cap includes a geomembrane/GCL composite barrier system. This type of system has proven to be an effective barrier to liquid migration[5].

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[5] Rowe, R. K., "Short- and long-term leakage through composite liners. The 7th Arthur Casagrande Lecture", Canadian Geotechnical Journal, 2012, 49(2), 141-169.

3.0 GENERAL ENGINEERING REPORTS REQUIREMENTS (SECTION V.A)

3.1 General Information (Section V.A.1)

Current and proposed RCRA-permitted waste management units at the FOP are summarized in Table V.A, which is attached to this report and included with the Part B RCRA Permit Renewal Application. The major routes of travel in the vicinity of the FOP are identified on Figure V.A-1. An overall plan view of the entire facility is attached as Figure V.A-2. A map showing the information specified in 40 CFR 270.14(b)(19), 270.14(c)(3), and 270.14(d)(1)(i) is attached as Figure V.A-3 (the wind rose is shown on Figure V.A-4).

Access to the RCA will be via existing gravel or partially concrete roads. These roads are used as necessary by cars, pick-up trucks, and waste hauling vehicles. There are generally only 1-2 vehicles on the access roads at a time.

3.2 Features to Mitigate Unsuitable Site Characteristics (Section V.A.2)

This section describes the RCA's design specifications and/or operating procedures which preclude migration of chemicals of concern (COCs) to groundwater or surface water considering the unsuitable site characteristics identified in Section II.A and II.F of the Part B RCRA Permit Renewal Application, which apply to landfills, not CAMUs. The unsuitable site characteristics are each addressed separately below.

<u>Section II.A.4: The Site is located in an area overlying a regional aquifer.</u>

According to the Texas Water Development Board's (TWDB's) maps of Major Aquifers and Minor Aquifers, the FOP is located in an area overlying the following aquifers:

- Trinity Aquifer (subcrop), which TWDB considers a major aquifer
  - According to Phillip L. Nordstrom's 1982 report, "Occurrence, Availability, and Chemical Quality of Groundwater in the Cretaceous Aquifers of North-Central Texas," the Trinity Aquifer includes the Antlers, Twin Mountains, and Paluxy Formations. Geological cross-sections included with that report indicate that the Twin Mountains Formation is located between approximately 1,400 and 2,000 feet below mean sea level (msl) in the vicinity of the FOP, and the Paluxy Formation is located between approximately 750 and 1,000 feet below msl beneath the FOP. (The Antlers Formation begins approximately 24 miles to the east of the Site.)
- Woodbine Aquifer, which TWDB considers a minor aquifer
  - According to Nordstrom, the Woodbine Aquifer is located between approximately 200 feet below msl and 100 feet above msl beneath the facility. For reference, according to the specifications included with the initial notification for construction of an on-site class 2 industrial landfill (provided to the Texas Natural Resource Conservation Commission (TNRCC) by GNB Technologies, Inc., in August 1995), the lowest portion of the CAMU's compacted clay layer is at an elevation of approximately 635 feet above msl.

Nordstrom indicates that both the Trinity Aquifer and the Woodbine Aquifer are separated from the land surface by the Eagle Ford Shale, which extends to approximately 500 feet below ground surface (or approximately 200 feet above msl) in the vicinity of the FOP. According to the United States Geological Survey's report "Basic Ground-Water Hydrology," revised in 2004, the hydraulic conductivity of shale ranges from 10^{-8} meters per day (m/d) (10^{-11} centimeters per second [cm/s]) to 10^{-4} m/d (10^{-7} cm/s). Given the thickness of the separation between the base of the CAMU and the regional aquifer and the low hydraulic conductivity of the Eagle Ford Shale, the possibility of contaminant migration from the RCA to the Trinity Aquifer or Woodbine Aquifers is highly unlikely.

Section II.A.5: The Site is located in an area where soil unit(s) are within five feet of the containment structure, or treatment zone, as applicable, that have a Unified Soil Classification of GW, GP, GM, GC, SW, SP, or SM, or a hydraulic conductivity greater than 10^{-5} centimeters per second (cm/sec).

As described in the Geology Report included with the Part B RCRA Permit Renewal Application, the geology encountered at the FOP generally consists of approximately 10 to 30 feet of moist to wet, clay-rich, colluvial soils. The colluvial soils at the FOP typically consist of clay or silty clay with minor occurrences of gravelly clay (gravel suspended in a clay matrix), sand, and clayey gravel lenses. This includes soils that have a Unified Soil Classification of GW, GP, GM, GC, SW, SP, or SM, or a hydraulic conductivity greater than 10^{-5} centimeters per second (cm/sec) within five feet of the RCA.

In order to address potential contaminant migration, the design of the RCA includes an MLFCS cap to prevent surface water infiltration which will reduce or eliminate the migration of COCs from unsaturated soils and also includes a Funnel and Gate groundwater remedy to prevent migration of COCs in groundwater at the RCA. The Funnel and Gate is designed to intercept and remediate the contaminant plume to exceed long-term remedial goals while allowing groundwater to flow.

Section II.F: Portions of the Site are located within a 100-year flood plain.

The Federal Emergency Management Agency (FEMA) Flood Insurance Rate Map (FIRM) for the site (Panel 48085C0240K, effective June 7, 2017) shows that the RCA is located within the 1% and 0.2% annual chance flood plains (see Figure VI.A-3). As described in Section II.F of the Part B RCRA Permit Renewal Application, a barrier wall to protect against potential flood waters from Stewart Creek was constructed along the southern boundary of the FOP as part of a 1987 Agreed Order with the Texas Water Commission. The steel-reinforced concrete barrier wall effectively forms a new bank to the creek. The top of the 10-inch thick barrier wall is 641 feet for a small section at west end, and a constant elevation of 637 feet amsl for the remaining wall length to the east. The effective FEMA model does not account for this existing wall, which shows flood elevations exceeding 637 feet amsl along the east side of the facility.

A Conditional Letter of Map Revision (CLOMR) application was prepared to document the proposed vertical extension of this existing barrier wall and a new lateral extension of this wall along the eastern boundary of the RCA that protects the facility from 100-year flooding of Stewart Creek. Engineering drawings of the flood wall are included in Appendix A to this report. The extended wall sections will also be made of 10-inch thick steel-reinforced concrete. The top of the barrier wall will vary from 641 to 647 feet amsl. The wall extension will provide 100-year flood protection with a minimum 3 feet of freeboard in accordance with FEMA levee certification standards. The RCA MLFCS will be behind and tied in to the flood wall.

The CLOMR application includes the structural engineering and analysis of the floodwall and the hydraulic analysis of Stewart Creek. This application demonstrates that the flood wall meets FEMA levee certification standards and will be protective of the RCA. The structural engineering calculations and design performed for the flood wall considered the potential load from the creek during flooding conditions as well as the load associated with the soil berm placed behind the wall (clean soil bermed for stormwater conveyance). To support this analysis, a geotechnical soil investigation was performed along the proposed alignment of the existing and extended flood wall. The CLOMR application, including the structural engineering calculations and design and the geotechnical investigation results were submitted to the City of Frisco on August 29, 2018 and are included as Appendix A to this report.

Upon construction of the extended flood wall, a Letter of Map Revision (LOMR) will be submitted to FEMA to reflect the as-built conditions.

3.3 Construction Schedules (Section V.A.3)

A sequence of steps will be taken to provide for the orderly final closure of the RCA. These steps and estimated implementation and activity schedule are outlined below:

- Following TCEQ’s designation of the RCA as a CAMU and approval of the FOP Remedial Action Plan (RAP), which is included with the Part B RCRA Permit Renewal Application as Attachment M, and approval of the CLOMR by FEMA, remedial activities will be initiated at the Site. These will include the following (these are also listed in the O&M Plan for the RCA which is included as Appendix L to Attachment C (Closure Plan) to the Part B RCRA Permit Renewal Application):
  - Monitoring wells within the RCA will be abandoned prior to waste placement activities (see Figure 3 of the Final Closure Plan as well as the RAP for additional information on well abandonment). Concrete walls and foundations associated with the FOP operations are present within the RCA. To facilitate waste placement, to the extent practical, the walls and above grade foundations will be demolished. The resulting rubble will be spread on the surface of the existing concrete slab.
  - The Facility’s on-site wastewater treatment facility will be demolished prior to waste placement. Remaining concrete walls and foundations will be demolished and spread over the concrete slab prior to extending the waste placement in this area.

  - A Funnel and Gate, including permeable reactive barrier (PRB), slurry wall, and sheet pile components will be constructed around the area that includes the RCA, North Disposal Area, and Slag Landfill. Groundwater monitoring wells will be installed to monitor the Funnel and Gate as described in the FOP Groundwater Monitoring Plan.
  - Groundwater monitoring will be initiated and will be performed quarterly for two years.
  - The flood wall improvements will be completed.
  - A number of utilities are present below the concrete slab in the RCA. These utilities consist of pipes, manholes, and sumps for the sanitary sewer, the storm sewer, and process drains. To prevent liquid from accumulating in the utilities and to remove the potential for collapse, the pipes, sumps, and manholes will be plugged with flowable fill or other low-permeable material prior to final closure of the area.
- Following completion of the activities listed above, it is anticipated that surface soil and sediment response actions could begin within 90 days. It is expected that the field program for the FOP can be implemented while planning activities (including permitting needed for remedial activities to be conducted in Stewart Creek in accordance with USACE requirements) are ongoing.
- FOP and Stewart Creek remediation and placement in the RCA of soil/sediment that is CAMU-eligible waste and meets CAMU treatment standards are expected to be completed in approximately three years.
- Following the final waste placement in the RCA, it is estimated that closure activities (capping, grading, seeding, etc.) can be completed in approximately four months.
- Post-closure monitoring will begin upon the completion of closure activities and will continue for a period of at least 30 years.

The construction schedule for the RCA is further discussed in the Closure Plan, which as Attachment C to the Part B RCRA Permit Renewal Application.

3.4 Plans and Specifications (Section V.A.4)

The plans and specifications for the RCA’s final cover are summarized in Section 2.0 above and Section 4.0 below as required in Section V.K of the Part B RCRA Permit Renewal Application. Where appropriate, Section 4.0 includes the information described in Section V.G of the Part B RCRA Permit Renewal Application because the information provided for landfills may be useful to understanding the protectiveness of the CAMU. Figures and calculations have been attached as necessary. Plans and specifications for the flood wall are included in the CLOMR in Appendix A to this report. Plans and specifications for the Funnel and Gate PRB are included in the RAP, which is included as Attachment M to the Part B RCRA Permit Renewal Application.

4.0 MISCELLANEOUS UNITS (SECTION V.K)

4.1 Table V.K (Section V.K.1)

Table V.K is included with the Part B RCRA Permit Renewal Application and is also included in report.

4.2 Relationship Between the Miscellaneous Unit and the Environment (Section V.K.2)

Although the RCA is regulated as a CAMU under RCRA Subpart S as discussed above and is being added to the Part B RCRA Permit Renewal Application as a miscellaneous unit, some of the design requirements listed in Section V.G (Landfills) of Part B are useful to describing the CAMU and its relationship to the environment and are discussed below.

4.2.1 List of Landfills (Section V.G.1)

The miscellaneous units at the FOP are listed in Table V.K.

4.2.2 Ignitable or Reactive Waste (Section V.G.2)

The RCA will not manage ignitable or reactive waste.

4.2.3 Incompatible Waste (Section V.G.3)

The RCA will not manage incompatible waste as defined in TCEQ Technical Guideline No. 9 revised on October 21, 2014.

4.2.4 Hazardous Wastes from Non-Specific Sources (V.G.4)

The RCA will not manage waste with United States Environmental Protection Agency (EPA) codes F020, F021, F022, F023, F026, or F027.

4.2.5 RCA Description (Section V.G.5)

The proposed RCA is a monofill with an area of approximately 8 acres and a consolidated waste capacity of approximately 82,000 cubic yards (cy). It will consist of placement of additional CAMU-eligible wastes in an area constructed above grade on the existing concrete slab in the former plant area of the FOP. A plan view of the RCA is shown on Figure V.G-1, and the final cover system is shown on Figure V.G-2.

4.2.6 Containment System (Section V.G.6)

A liner system is not proposed for the RCA. Section 2.0 contains additional discussion regarding the design of the RCA to meet alternate requirements in accordance with 40 CFR 264.552(e)(3)(ii)(B).

4.2.7 Dikes (Section V.G.7)

No dikes are proposed as part of the design of the RCA. As shown on Figures V.G-2 and V.G-3, a containment berm will be constructed around areas of waste placement within the unit. The RCA cover will tie into the existing floodwall (with planned improvements) on the south and west sides of the unit.

4.2.8 Conformance with 30 TAC 335.173 and 40 CFR 264.301(c) (Section V.G.8)

This section is not appropriate/relevant for the RCA because the RCA is a CAMU with its own requirements. CAMU provisions for design and operation under 40 CFR 264.552 are discussed in Section 2.0.

4.2.9 Site Development Plan (Section V.G.9)

The operating procedures for constructing and filling the RCA are described in Section 2.0 of the RCA Operations & Maintenance Plan (the RCA O&M Plan), which is included with the Final Closure Plan (Attachment C to the Part B RCRA Permit Renewal Application).

4.2.10 Run-on Control (Section V.G.10)

Run-on control will be provided by the containment berm around the waste placement areas and by the floodwall on the south and west borders of the RCA.

4.2.11 Run-off Control (Section V.G.11)

During operations, precipitation coming into contact with exposed waste (i.e., contact water) will be contained using containment berms and either pumped or directed to the stormwater retention pond. A containment berm will be placed north of the flood wall to limit water collecting in the Funnel and Gate PRB during waste placement.

The base for the placement of additional waste is predominantly of a concrete slab. The concrete slab has an existing surface water collection system that collects and directs water to the stormwater retention pond to the southwest of the former operational areas. Sediment dikes or check dams will be maintained at the pipe inlet in order to control sediment transport from the RCA to the stormwater retention pond. Water infiltrating through the concrete slab currently is collected in a French Drain System (FDS) located along the flood wall and conveyed to a sump located at the southwest end of the facility where it can be collected and pumped to storage tanks at the WWTP for off-site disposal or treatment and discharge, if authorized. Prior to placement of waste, the FDS will be abandoned and the Funnel and Gate PRB will be installed at the Site.

A description of surface water management during both active filling and post-closure periods is included in the Operations and Maintenance Plan which is included as Appendix L to Attachment C (Final Closure Plan) for the RCA.

Following final closure, non-contact storm water run-off from the RCA will flow radially off the northern portion of the RCA final cover on to the North Disposal Area, where it will be directed to Stewart Creek or to the North Tributary. Storm water on southern facing slopes will flow to a perimeter channel formed adjacent to the flood wall and/or directed to the existing drainage pipe and directed to the stormwater retention pond as shown on Figure 1 in Appendix K of the Final Closure Plan.

4.2.12 Wind Dispersal (Section V.G.12)

The exposed face of the RCA will be limited to the area actively being filled. No daily cover will be used at the RCA since the waste is not subject to being wind-blown. A Dust Control Plan is included as Appendix Q to the Final Closure Plan. Other areas of exposed waste may be covered by a spray applied cover or temporary cover. The design of the final cover is shown on Figure V.G-1.

4.2.13 Liquid Waste (Section V.G.13)

Soils and other CAMU-eligible wastes waste to be placed in the RCA will not contain free water or other liquids.

Impacted sediment from Stewart Creek that does not pass the Paint Filter Liquids Test will be dewatered and/or stabilized prior to placement in the RCA. As described in the FOP RAP, following placement and activation of the coffer dam/by-pass pumping system, the sediments will be allowed to dry in-place and if necessary, in-situ stabilization of high residual water content sediments will be performed using an approved drying agent. (If necessary, dewatering or stabilization could occur on adjacent banks for non-hazardous sediments.) The dewatering process is further described in the FOP RAP, which is included with the Part B RCRA Permit Renewal Application as Attachment M.

4.2.14 Approval of Alternate Design or Operating Practice (Section V.G.14)

The RCA is a CAMU being added to the industrial and hazardous waste permit as a miscellaneous unit. The elements of the RCA design and operating practices which prevent the migration of hazardous constituents into groundwater and surface water are described in Section 2.0.

4.2.15 Exemption from Double-Liner Requirements for Monofills (Section V.G.15)

The RCA is a CAMU being added to the industrial and hazardous waste permit as a miscellaneous unit. The elements of the RCA design and operating practices which prevent the migration of hazardous constituents into groundwater and surface water are described in Section 2.0.

4.2.16 Above-grade Benefits (Section V.G.16)

The base for the placement of additional waste is predominantly a concrete slab in the former plant area of the FOP. This is an effective solution that limits disturbance to the area and provides a solution that minimizes off-site truck traffic. The maximum height of the RCA above the surrounding area is approximately 14 feet; therefore, it will have little visual impact to the area. The future use of the FOP is not yet determined at this time, but will likely be commercial/industrial and/or, subject to TCEQ concurrence, recreational. The above-grade construction of the RCA will be incorporated into the plans for any future use of the Site.

4.3 Requirements for a Unit that Involves Combustion (Section V.K.3)

The operation and closure of the RCA will not involve combustion processes.

5.0 CLOSURE

Golder trusts that the information provided is sufficient to meet the project needs. If there are any questions or comments, please contact the undersigned.

Sincerely,

Golder Associates Inc.

Jeffrey B. Fassett

Jeffrey B. Fassett, P.E.
Associate and Senior Consultant

STATE OF TEXAS
JEFFREY B. FASSETT
85675
LICENSED
PROFESSIONAL ENGINEER
5/30/19

GOLDER ASSOCIATES INC.
TEXAS REGISTRATION F-2578

Anne Faeth-Boyd

Anne M Faeth-Boyd, P.G
Associate and Senior Engineer

TABLES

Table V.A: Facility Waste Management Handling Units

TCEQ Permit Unit No.	Unit Name	NOR No.	Unit Description	Capacity	Unit Status
001	Raw Material Storage Building	005	Containment building	4,150 tons	Inactive (demolished)
002	Battery Receiving/Storage Building	011	Container storage area	3,581 cy	Inactive (demolished)
N/A	North CAMU	012	Miscellanous unit	190,000 cy (approx)	Active
N/A	Remediation Consolidation Area	A	Miscellanous unit	82,000 cy	Proposed (not yet built)

Notes:
cy - cubic yards

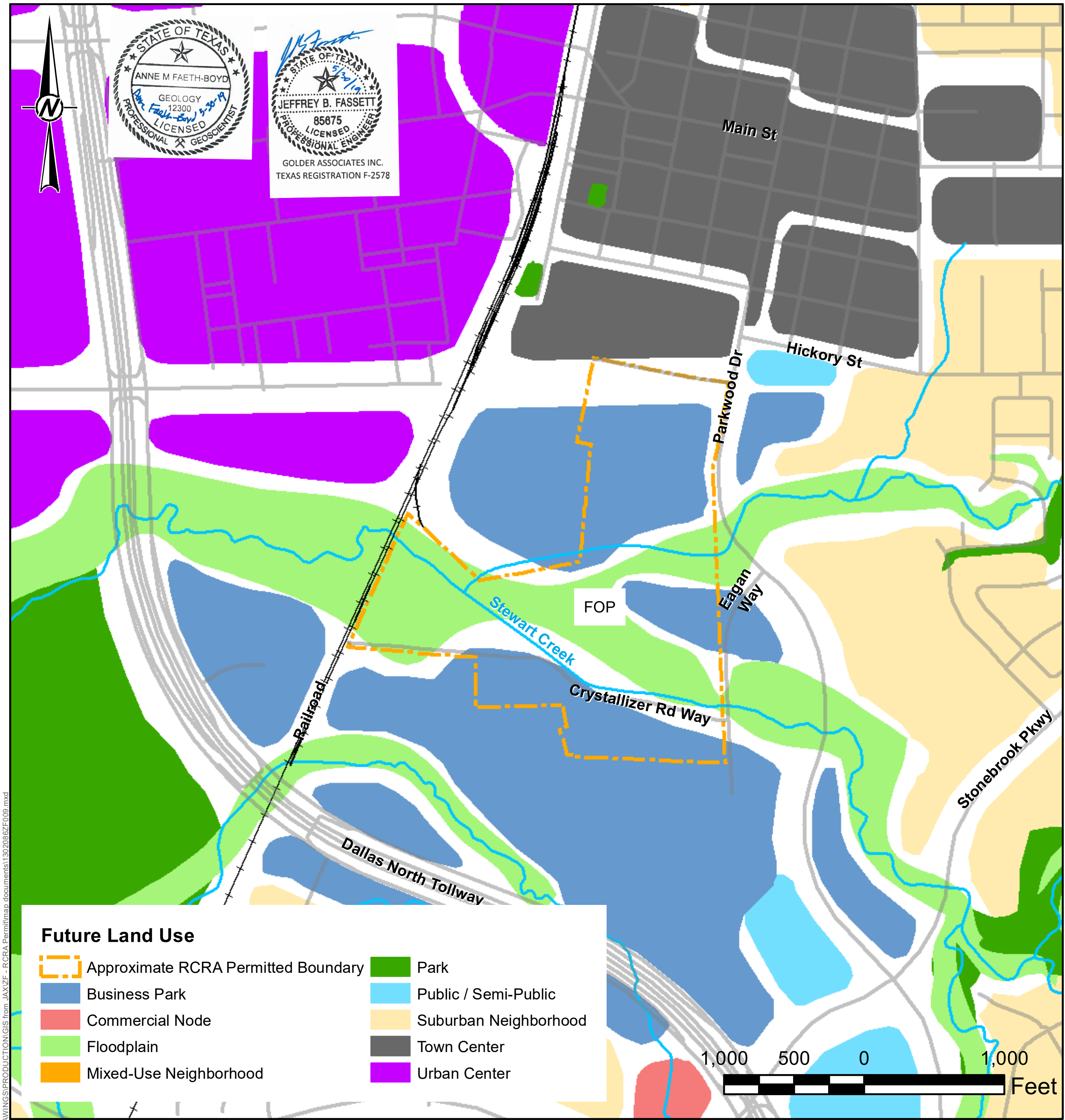
Table V.K: Miscellaneous Units

Permit Unit No.[1]	Miscellaneous Unit	NOR No.	Storage, Processing, and/or Disposal	Waste Nos.[2]	Rated Capacity	Approximate Dimensions	Unit will manage Ignitable, Reactive, Incompatible, or F020, F021, F022, F023, F026, and F027 Waste (state all that apply)
N/A	North CAMU (monofill with 15 cells)	012	Disposal	1-3	~190,000 cubic yards (~12,000 cubic yards/cell)	Length: 660 feet Width: 550 feet Depth: 17 feet Total area: 8.25 acres	No ignitable, reactive, incompatible, or F020, F021, F022, F023, F026, or F027 wastes will be treated at the CL2LF CAMU.
N/A	RCA (monofill)	A	Disposal	3, 4, 5, 6, 8, 10	82,000 cy	Length: 1,000 ft Width: 400 ft Depth (height): approx. 17ft Area: 7.94 ac	No ignitable, reactive, incompatible, or F020, F021, F022, F023, F026, or F027 wastes will be disposed of at the RCA.

Notes:

[1] Permit unit number is not applicable.

FIGURES



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12300
Anne Faeth-Boyd 5-28-19

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85675
5/30/19

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LEGEND

Roadway

Railroad

Creek Centerline

Approximate RCRA Permitted Boundary

REFERENCE

1. FUTURE LAND USE - CITY OF FRISCO COMPREHENSIVE PLAN 2015

CLIENT
EXIDE TECHNOLOGIES

PROJECT
RCRA PERMIT RENEWAL

TITLE
LAND USE PATTERNS AND ROUTES OF TRAVEL NEAR THE FACILITY

CONSULTANT
GOLDER

YYYY-MM-DD	2019-05-28
PREPARED	EFT
DESIGN	JWT
REVIEW	EPW
APPROVED	AMF

PROJECT No.	CONTROL	Rev.	FIGURE
13-02086-06	1302086ZF009.mxd	0	**V.A-1**

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IF THIS MEASUREMENT DOES NOT MATCH WHAT IS SHOWN, THE SHEET HAS BEEN MODIFIED FROM: ANSI A

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NOTES

1. The Raw Material Storage Building and Battery Receiving/Storage Building have been demolished.
2. The Stewart Creek Sediment Dredging Waste Pile and Old Drum Storage Area have been removed.
3. The Raw Material Storage Area is no longer in use.
4. The Product Waste Pile and the Slag Landfill are inactive.
5. The North Disposal Area and the South Disposal Area are closed.
6. NOR - Notice of Registration
7. RFI - RCRA Facility Investigation

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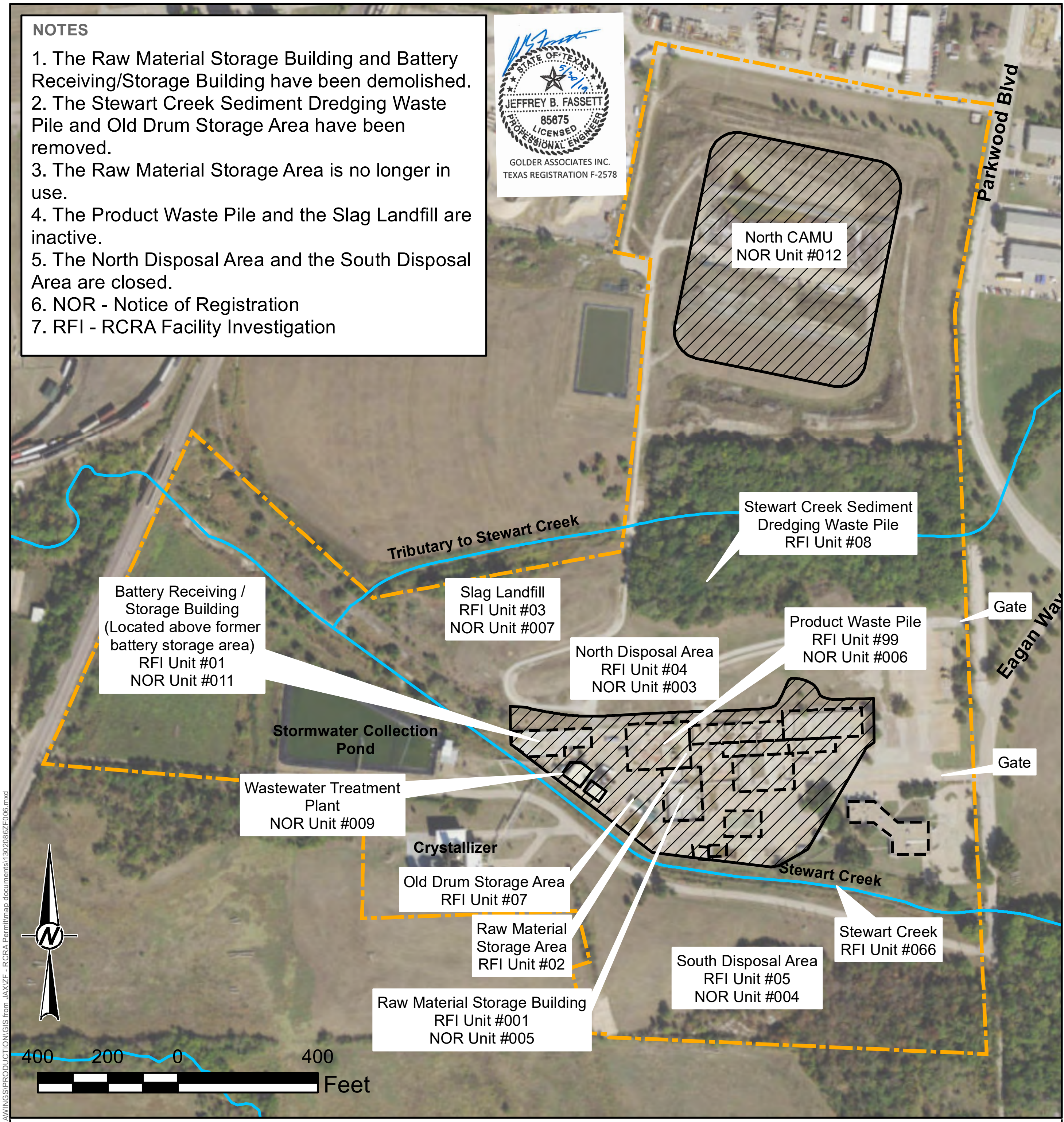

LEGEND

- Creek Centerline
- ☐ Existing Building
- Former Building
- ▨ Corrective Action Management Unit
- Approximate RCRA Permitted Boundary

ANNE M FAETH-BOYD
12300
5-30-19

REFERENCE

1. AERIAL IMAGERY - SOURCE: ESRI, DIGITALGLOBE, GEOEYE, EARTHSTAR GEOGRAPHICS, CNES/AIRBUS DS, USDA, USGS, AEROGRID, IGN, AND THE GIS USER COMMUNITY

CLIENT
EXIDE TECHNOLOGIES

PROJECT
RCRA PERMIT RENEWAL

TITLE
PLAN VIEW OF THE FORMER OPERATING PLANT

CONSULTANT
GOLDER

YYYY-MM-DD	2019-05-28
PREPARED	EFT
DESIGN	JWT
REVIEW	EPW
APPROVED	AMF

PROJECT No.	CONTROL	Rev.	FIGURE
13-0208606	1302086ZF006.mxd	0	**V.A-2**

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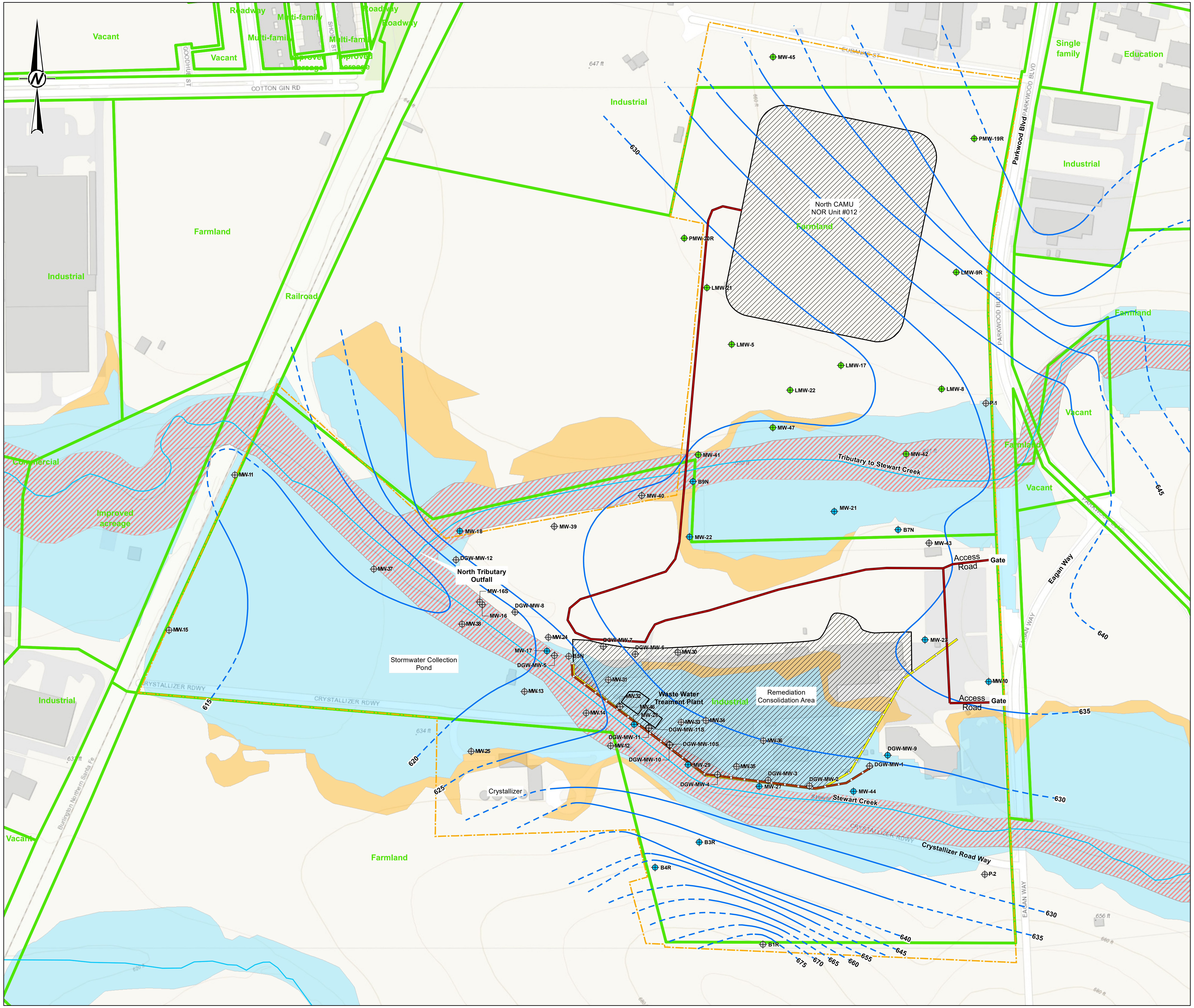

LEGEND

⊕	North CAMU Monitoring Well
⊕	Additional FOP Monitoring Wells
⊕	Existing Wells to be Decommissioned
▬	Access Road
—	Groundwater Elevation (Measured)
- -	Groundwater Elevation (Estimated)
—	Creek Centerline
▬	Existing Flood Control Wall
▬	Proposed Flood Control Wall
☐	Existing Building
▨	Corrective Action Management Unit
☐	Land Use Boundary
▨	Floodway
■	1% Annual Chance Flood Hazard
■	0.2% Annual Chance Flood Hazard
⬚	Approximate RCRA Permitted Boundary
Farmland	-- Land Use Description

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0 150 300
Feet

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NOTE(S)

1. GROUNDWATER ELEVATIONS ARE BASED ON WATER LEVEL MEASUREMENTS COLLECTED IN JANUARY 2014.

REFERENCE(S)

1. BASEMAP - SOURCES: ESRI, HERE, DELORME, INTERMAP, INCREMENT P CORP., GEBCO, USGS, FAO, NPS, NRCAN, GEOBASE, IGN, KADASTER NL, ORDNANCE SURVEY, ESRI JAPAN, METI, ESRI CHINA (HONG KONG), SWISSTOPO, MAPMYINDIA, © OPENSTREETMAP CONTRIBUTORS, AND THE GIS USER COMMUNITY.
2. LANDUSE: DATA FROM THE NORTH CENTRAL TEXAS COUNCIL OF GOVERNMENTS (NCTCOG).
3. FLOODPLAIN: DATA DOWNLOADED FROM FEMAS MAP SERVICE CENTER (MSC).

CLIENT
EXIDE TECHNOLOGIES

PROJECT
RCRA PERMIT RENEWAL

TITLE
FACILITY DETAILS

CONSULTANT
GOLDER

YYYY-MM-DD	2019-05-30
DESIGNED	JWT
PREPARED	EFT
REVIEWED	EPW
APPROVED	AMF

PROJECT NO.	CONTROL	REV.	FIGURE
13-0208606	1302086ZF007.MXD	0	V.A-3

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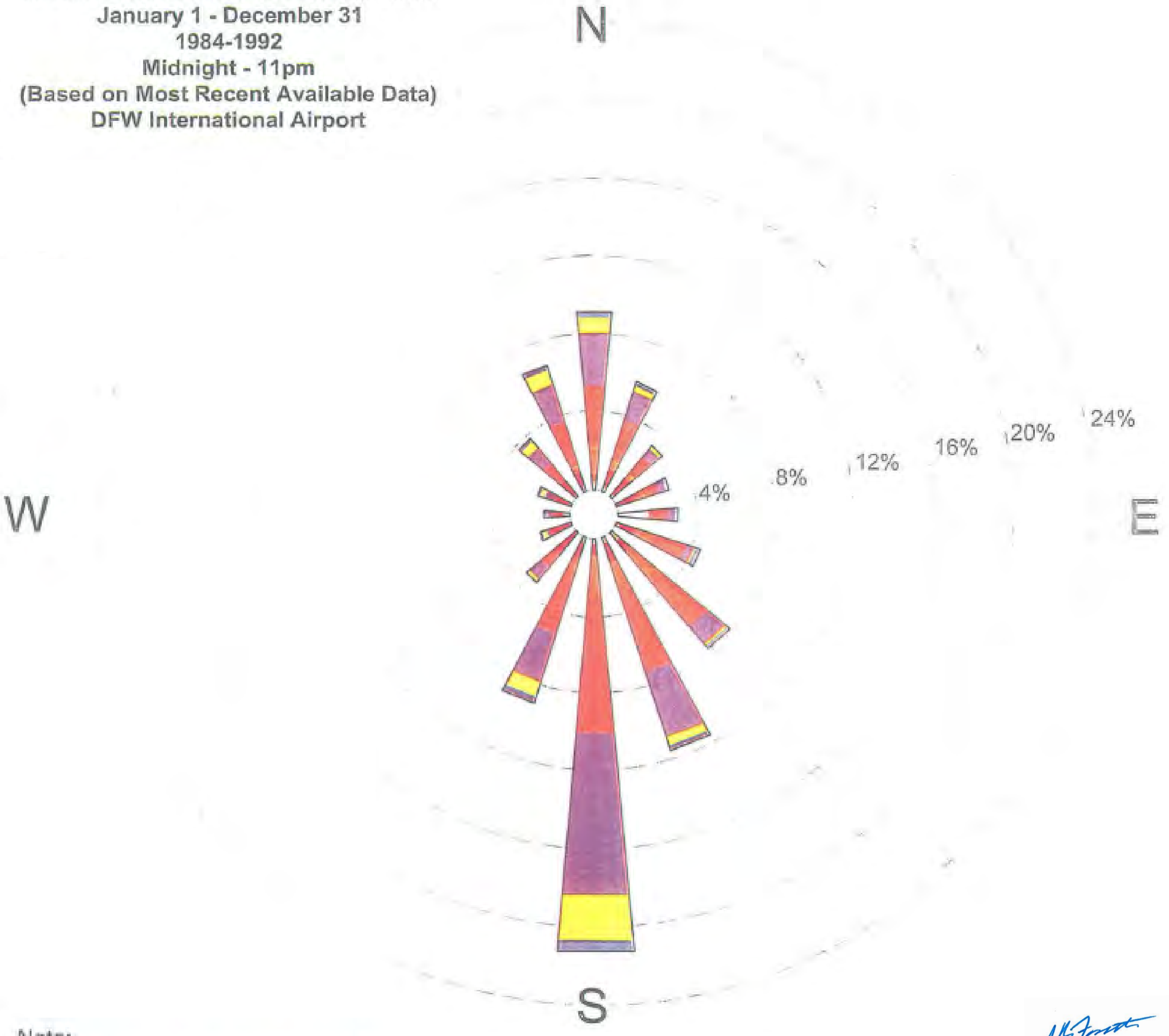
Wind Rose of Dallas/Fort Worth, Texas
January 1 - December 31
1984-1992
Midnight - 11pm
(Based on Most Recent Available Data)
DFW International Airport



Note:
1) Frequencies indicate direction from which the wind is blowing. For example, according to the wind rose, the wind is blowing from the south approximately 21 percent of the time.
2) ≥ = greater than or equal to.

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LEGEND

WIND SPEED
(Knots)

- 🟦 ≥22
- 🟨 17-21
- 🟪 11-16
- 🟥 7-10
- 🟧 4-6
- 🟩 1-3

Calm Winds - 4.64%

REFERENCE

1. THE WIND ROSE WAS ORIGINALLY INCLUDED IN APPENDIX V-1 OF THE APPLICATION FOR RENEWAL OF INDUSTRIAL AND HAZARDOUS WASTE PERMIT FOR THE FRISCO BATTERY RECYCLING CENTER DATED SEPTEMBER 28, 2010.

CLIENT
EXIDE TECHNOLOGIES

PROJECT
RCRA PERMIT RENEWAL

TITLE
WIND ROSE

CONSULTANT
GOLDER

YYYY-MM-DD	2019-05-02
PREPARED	JWT
DESIGN	JWT
REVIEW	GS
APPROVED	AMF

PROJECT No.	CONTROL	Rev.	FIGURE
13-02086	1302086ZF032.mxd	0	**V.A-4**

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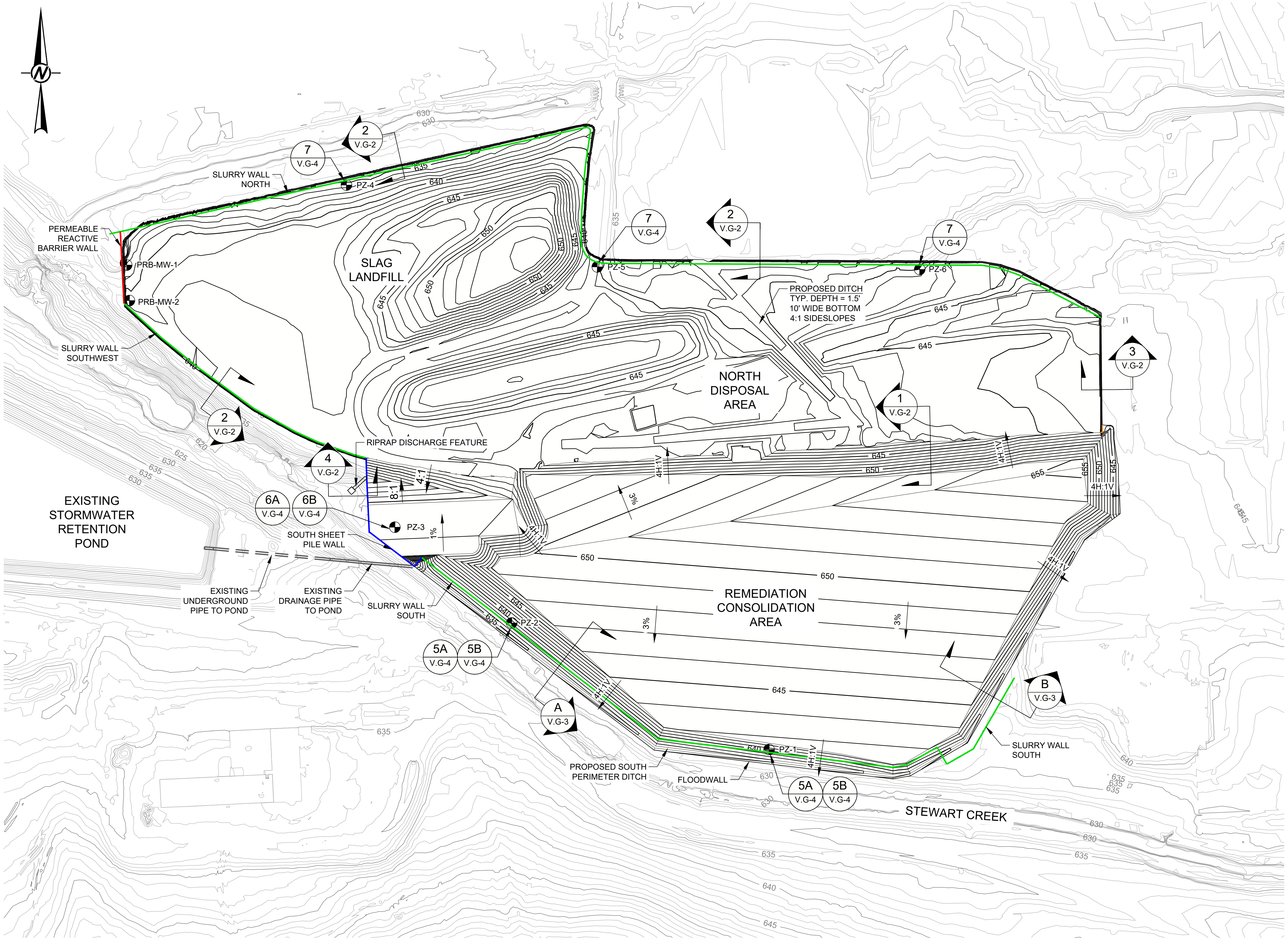

LEGEND

─	EXISTING GRADE 10 ft CONTOUR
─	EXISTING GRADE 2 ft CONTOUR
─	PROPOSED CAP 10 ft CONTOUR
─	PROPOSED CAP 2 ft CONTOUR
─	PROPOSED SHEET PILE WALL
─	PROPOSED PERMEABLE REACTIVE BARRIER WALL
─	PROPOSED SLURRY WALL

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0 75 150
1" = 150' FEET

REV.	YYYY-MM-DD	DESCRIPTION	DESIGNED	PREPARED	REVIEWED	APPROVED
A	2019-05-28	ISSUED FOR PERMITTING PURPOSES ONLY	JVH	JVH	RBL	JBF

SEAL

GOLDER ASSOCIATES, INC
TEXAS REGISTRATION F-2578

CLIENT
EXIDE TECHNOLOGIES
EXIDE FRISCO RECYCLING CENTER
FRISCO, TEXAS

CONSULTANT

GOLDER

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USA
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PROJECT
RCRA PERMIT RENEWAL APPLICATION
RCA ENGINEERING REPORT
FRISCO, COLLIN COUNTY TEXAS

TITLE
FORMER OPERATING PLANT
FINAL COVER GRADING

PROJECT NO.	SCALE	REV.		FIGURE
130208606	AS SHOWN	A	1 of 4	V.G-1

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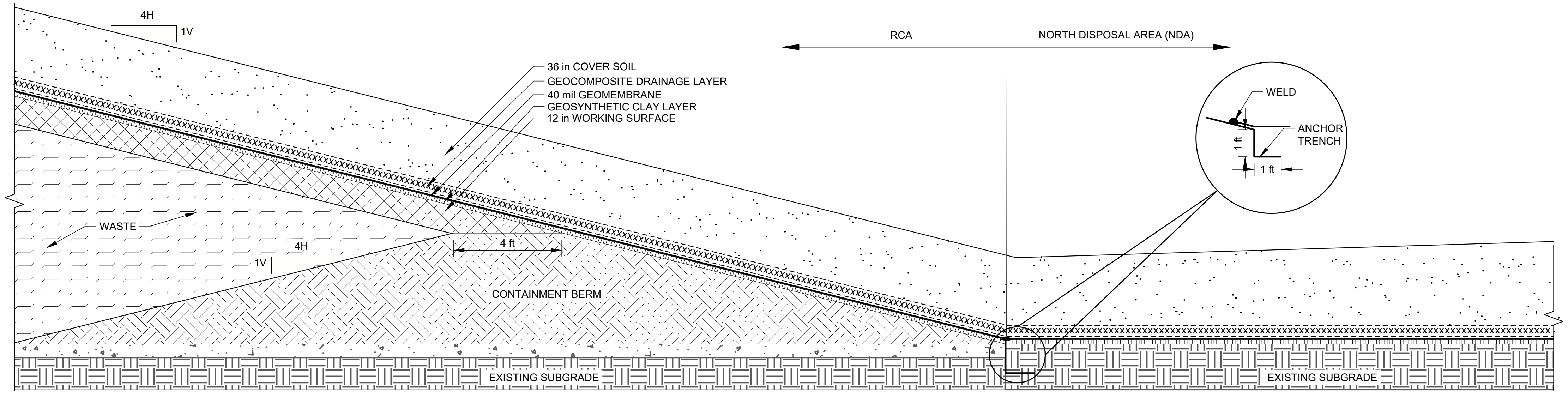
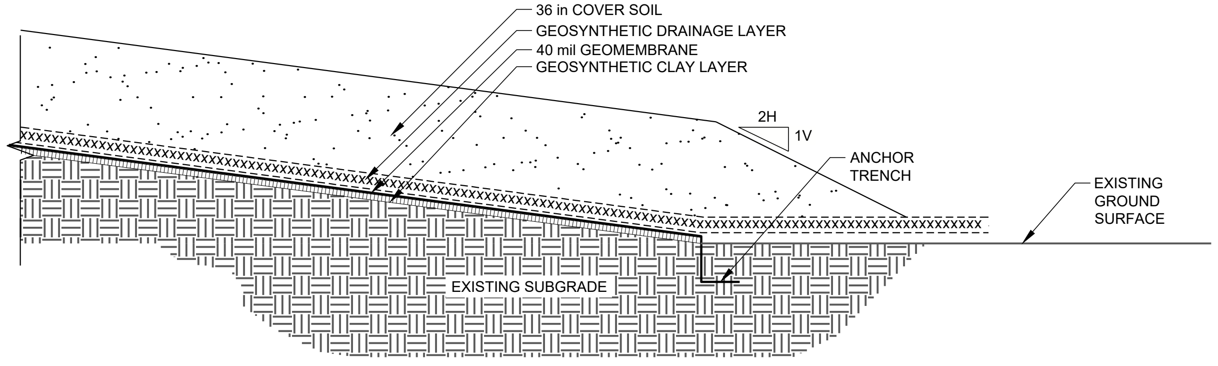
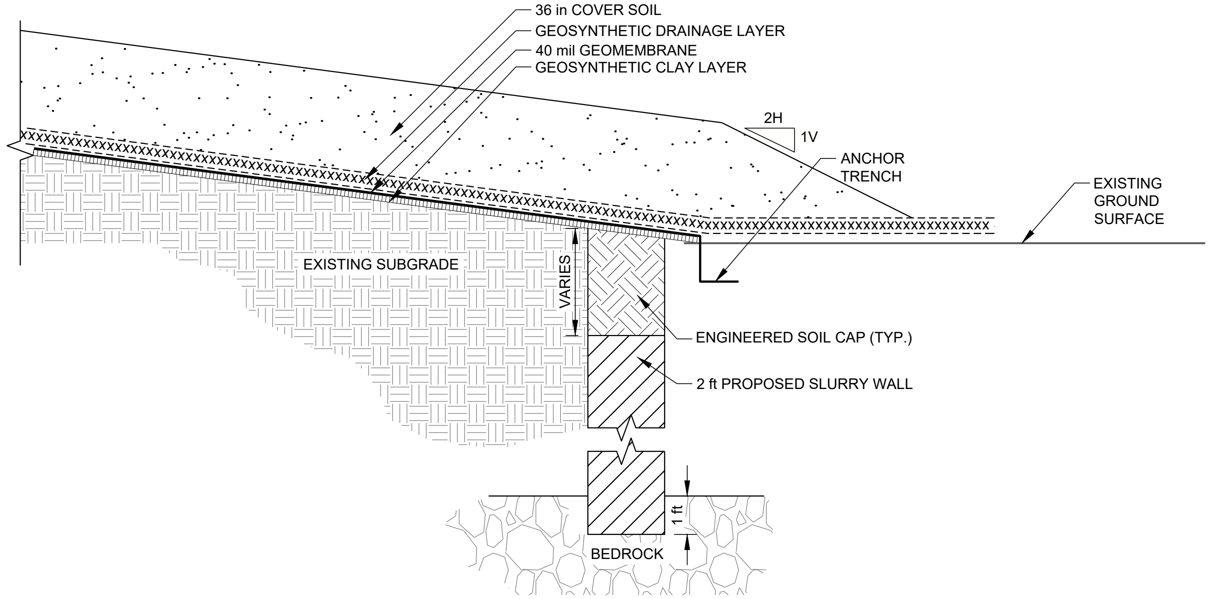


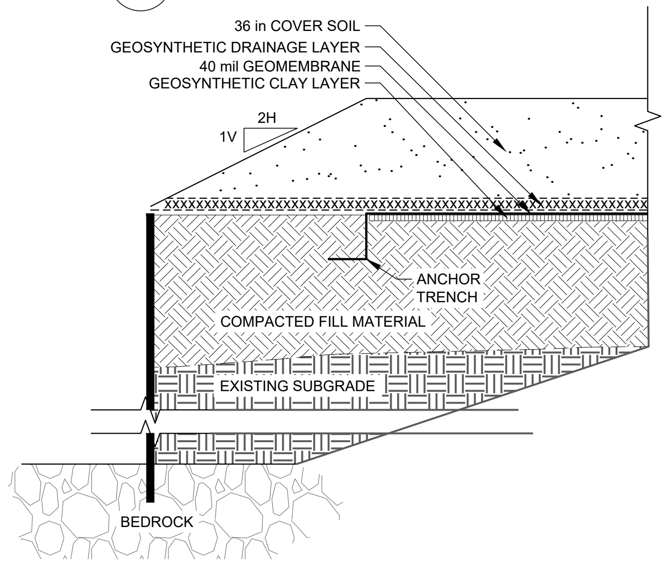
SCALE 1" = 5' 1 V.G-2 RCA AND NDA FINAL COVER TRANSITION DETAIL



SCALE 1" = 5' 3 V.G-2 NDA LANDFILL COVER DETAIL



SCALE 1" = 5' 2 V.G-2 NDA & SLAG LANDFILL COVER DETAIL



SCALE 1" = 5' 4 V.G-2 SOUTH SHEET PILE WALL DETAIL

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0 2.5 5
1" = 5' FEET

REV.	YYYY-MM-DD	DESCRIPTION	DESIGNED	PREPARED	REVIEWED	APPROVED
A	2019-05-17	ISSUED FOR PERMITTING PURPOSES ONLY	JVH	RS	RBL	JBF

SEAL

GOLDER ASSOCIATES, INC
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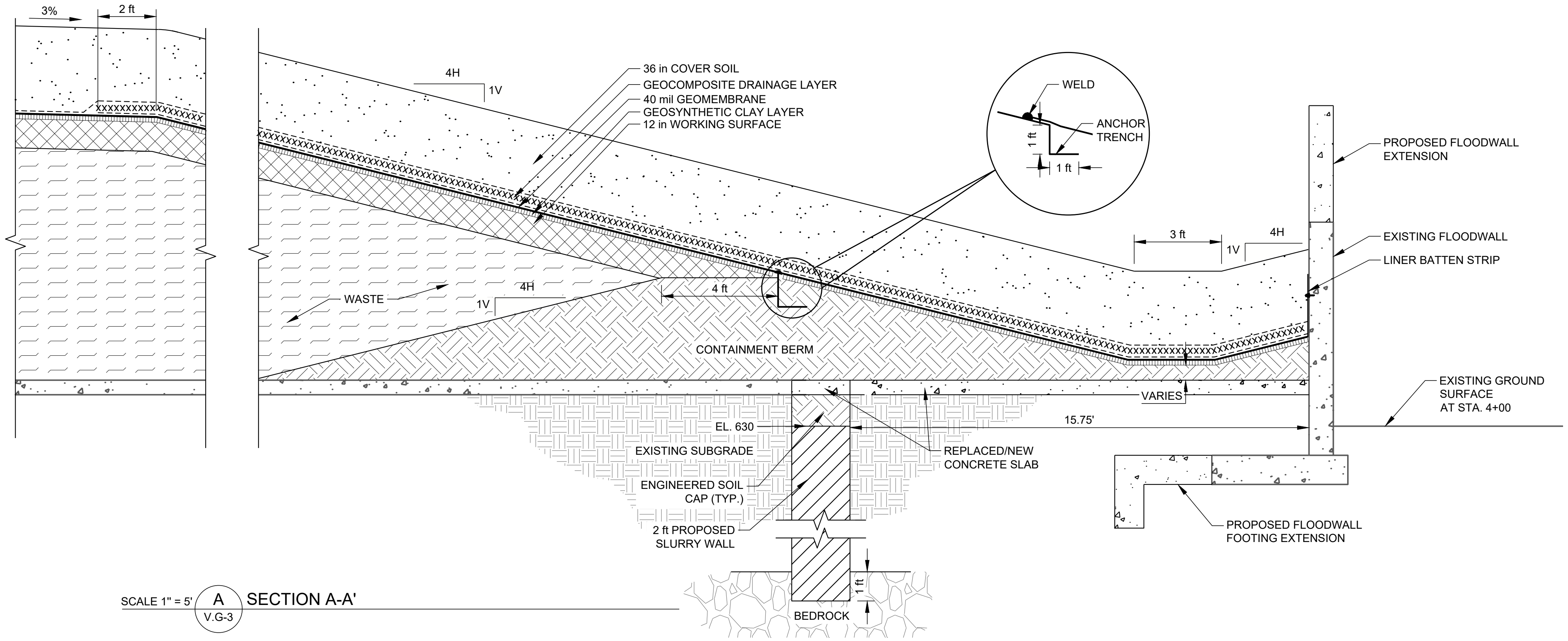
PROJECT
RCRA PERMIT RENEWAL APPLICATION
RCA ENGINEERING REPORT
FRISCO, COLLIN COUNTY TEXAS

TITLE
FORMER OPERATING PLANT
FINAL COVER SYSTEM DETAILS

PROJECT NO. 130208606
SCALE AS SHOWN
REV. A
2 of 4
FIGURE V.G-2



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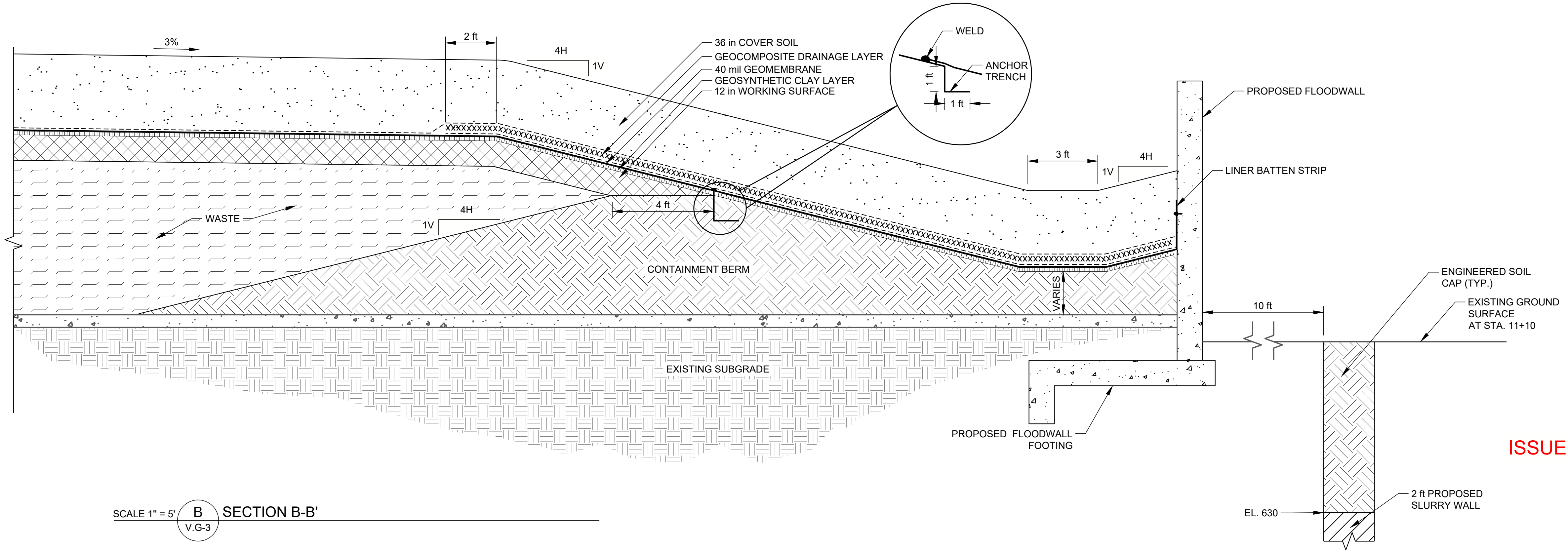

SCALE 1" = 5' B V.G-3 SECTION B-B'

JEFFREY B. FASSETT
85675
5/28/19

GOLDER ASSOCIATES INC.
TEXAS REGISTRATION F-2578

ISSUED FOR PERMITTING PUROPOSES ONLY

0 2.5 5
1" = 5' FEET

REV.	YYYY-MM-DD	DESCRIPTION	DESIGNED	PREPARED	REVIEWED	APPROVED
A	2019-05-17	ISSUED FOR PERMITTING PURPOSES ONLY	JVH	RS	RBL	JBF

SEAL

GOLDER ASSOCIATES, INC
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CLIENT
EXIDE TECHNOLOGIES
EXIDE FRISCO RECYCLING CENTER
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PROJECT
RCRA PERMIT RENEWAL APPLICATION
RCA ENGINEERING REPORT
FRISCO, COLLIN COUNTY TEXAS

TITLE
FORMER OPERATING PLANT FINAL COVER
PERIMETER CHANNEL SECTIONS

PROJECT NO.	SCALE	REV.		FIGURE
130208606	AS SHOWN	A	3 of 4	V.G-3

Path: \\houston\drafting_non-houston projects\1302086 - exide\PRODUCTION\A - RCA Closure Plan\ | File Name: 130208606A013.dwg | Last Edited By: jhubbard Date: 2019-05-20 Time:9:14:15 AM | Printed By: JHubbard Date: 2019-05-28 Time:3:29:04 PM

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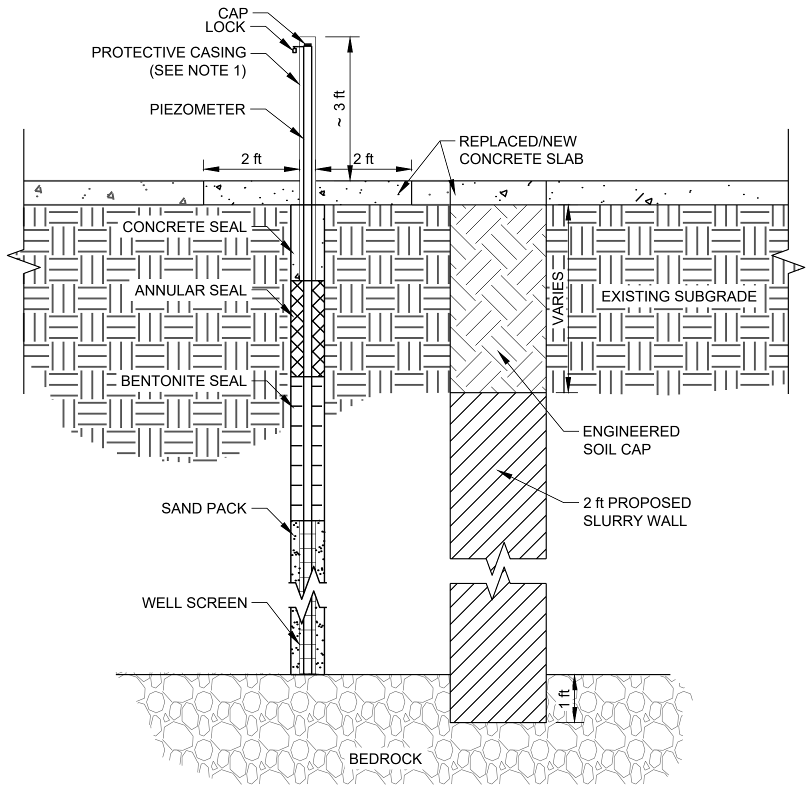
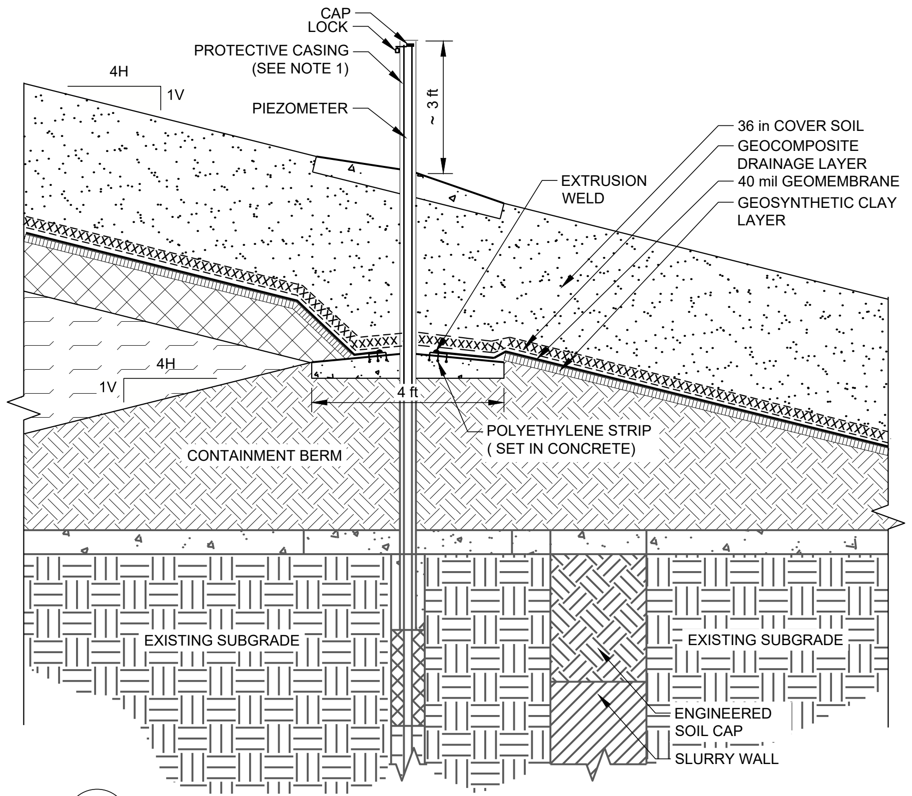


SCALE 1" = 4' 5A V.G-4 ABOVE GROUND PIEZOMETER - PZ-1 AND PZ-2



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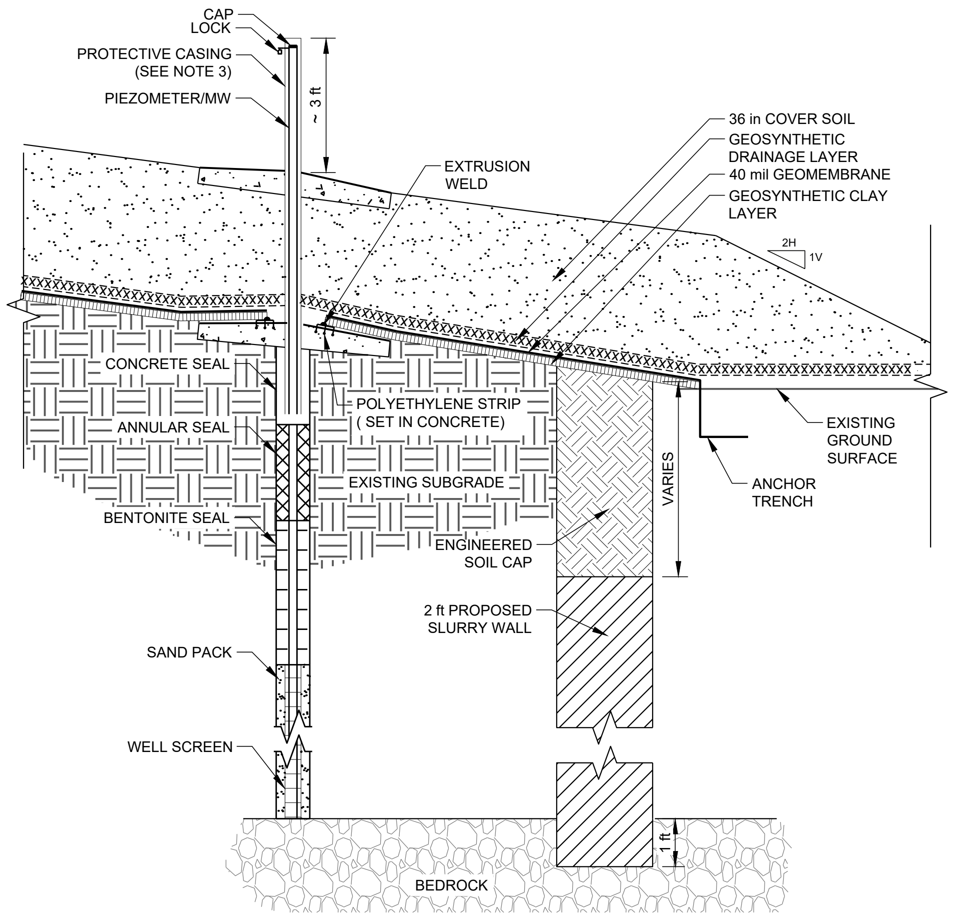
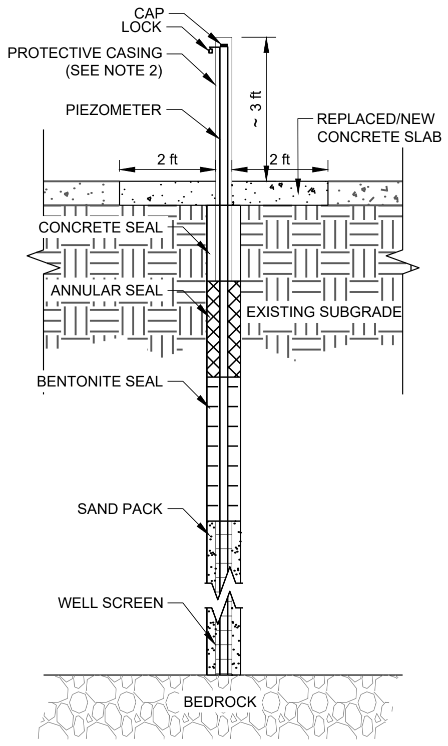


SCALE 1" = 4' 7 V.G-4 NDA AND SLAG LANDFILL PIEZOMETERS AND MONITORING WELLS



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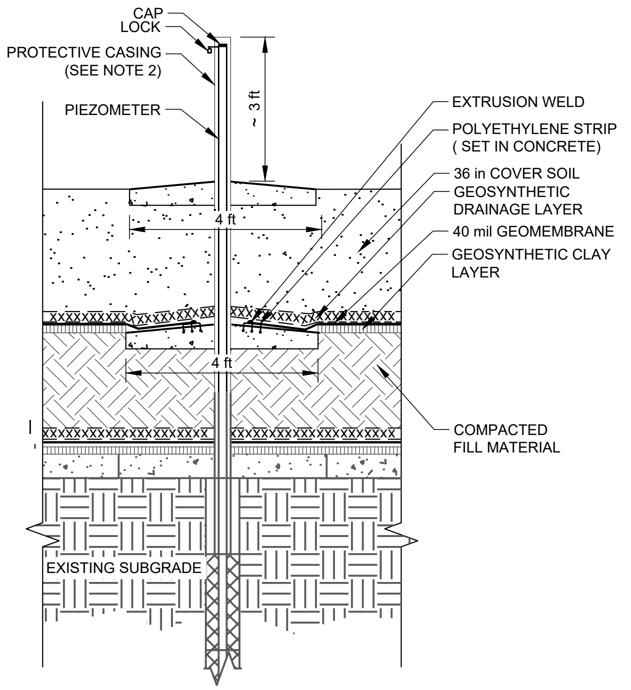

SCALE 1" = 4' 6B V.G-4 ABOVE GROUND PIEZOMETER WITHIN ENGINEERED CAP - PZ-3

NOTE(S)

1. ABOVE GROUND PIEZOMETERS PZ-1 AND PZ-2 IN RCA WILL BE INSTALLED FOLLOWING SOUTH SLURRY WALL CONSTRUCTION. THE PIEZOMETER AND PROTECTIVE CASING WILL BE EXTENDED (i) DURING PLACEMENT OF THE CONTAINMENT BERM AND (ii) DURING CONSTRUCTION OF THE FINAL COVER.
2. ABOVE GROUND PIEZOMETER PZ-3 WILL BE INSTALLED FOLLOWING CONSTRUCTION SHEETPILE WALL. THE PIEZOMETER AND PROTECTIVE CASING WILL BE EXTENDED DURING CONSTRUCTION OF THE FINAL COVER.
3. ABOVE GROUND PIEZOMETER/MONITORING WELLS IN NORTH DISPOSAL AREA (NDA) AND SLAG LANDFILL WILL BE INSTALLED FOLLOWING SLURRY WALL CONSTRUCTION.THE PIEZOMETER/WELL AND PROTECTIVE CASING WILL BE EXTENDED DURING CONSTRUCTION OF THE FINAL COVER.

JEFFREY B. FASSETT
85675

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0 2 4
1" = 4' FEET

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PROJECT NO.	SCALE	REV.		FIGURE
130208606	AS SHOWN	A	4 of 4	V.G-4

ATTACHMENT A

CONDITIONAL LETTER OF MAP REVISION (CLOMR)

White, Emily

From: Sadza, Sheina
Sent: Wednesday, August 29, 2018 12:34
Cc: White, Emily
Subject: CLOMR Submittal for Exide Frisco Recycling Center

GOLDER

Sender Name	**Sheina Sadza**
Phone	+1 (520) 888-8818 x11412
E-Mail	Sheina_Sadza@golder.com

Download Files
Available until 9/27/2018

Reply
with Cryptshare

Password: No password required.

Ms. Tillison:

Golder Associates is submitting this CLOMR application for City of Frisco review and approval on behalf of Exide Technologies. The application seeks to revise the effective FEMA floodway and floodplains along the section of Stewart Creek adjacent to this facility due to proposed floodwall improvements.

The following documents/files can be accessed using the links the bottom of this e-mail:

- PDF of CLOMR report (FEMA MT-2 Forms are in report Appendix A)
- .zip file of HEC-RAS models
- .zip file of CAD drawings for the work maps detailing the proposed floodway and floodplain revisions

Please feel free to contact me if there are any questions or if additional information is needed to help facilitate your review.

Regards,

GOLDER

Sheina Sadza, P.E.
Senior Project Engineer

4730 North Oracle Road, Suite 210, Tucson, Arizona, USA 85705
T: +1 520 888-8818 | **D:** +1 (520) 332-1412 | **golder.com**
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Work Safe, Home Safe

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To: TTillison@friscotexas.gov

CC: MBorchardt@friscotexas.gov
brad.weaver@na.exide.com
Jeff_Fassett@golder.com
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Emily_White@golder.com

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Files in this Transfer

130208606_R_001_Rev 0_20180828.pdf
HEC-RAS-Models.zip
130208606_2018CRA - Standard.zip

REPORT

Conditional Letter of Map Revision for Stewart Creek, City of Frisco, Texas

Client: Exide Technologies

Submitted to:

City of Frisco
Stormwater Division
Frisco, Texas 75034

Submitted by:

Golder Associates Inc.
4730 North Oracle Road, Suite 210, Tucson, Arizona, USA 85705

+1 520 888-8818

130208606

August 2018

Distribution List

City of Frisco (1 electronic copy)

Exide Technologies (1 electronic copy)

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TABLES

FIGURES

APPENDICES

1.0 PROJECT INFORMATION

1.1 Purpose

The Exide Technologies (Exide) Frisco Recycling Center (FRC) is a former oxide manufacturing, battery recycling and secondary lead smelting facility located at 7471 5th Street in Frisco, Collin County, Texas. The FRC currently encompasses approximately 257 acres consisting of the Former Operating Plant (FOP or Site) and the surrounding Undeveloped Buffer Property. The FOP was developed for industrial purposes in approximately 1964 when Bers Metals constructed the first FRC facility and began operations to produce lead oxide (Lake 1991). The FRC shut down operations in 2012 and demolished structures on the FOP pursuant to a settlement agreement with the City of Frisco.

Stewart Creek flows along the southern boundary of the FOP, located west of Eagan Way. In the 1980s, a floodwall was constructed along the southern boundary of the facility to protect the site from flooding from the creek. This site is in the process of closure and remediation. This study has been conducted to demonstrate that the current floodwall in combination with proposed floodwall improvements meet Federal Emergency Management Agency (FEMA) levee standards to remove the remediation consolidation area (RCA) from the effective 100-year floodplain.

1.2 Study Reach

Stewart Creek is an approximately 9-mile long channel located in Collin County, Texas from State Highway 423 to U.S. Route 289 (Preston Road). For this CLOMR application, the proposed study reach is located at the upper end of Stewart Creek, between Parkwood Boulevard and the Burlington Northern Santa Fe (BNSF) Railroad crossing of this creek, a modeled length of approximately 4,000 feet. This reach is located in Community Number 480134, Map Number 48085C, Panel Number 0240K. The predominant flow direction in this reach is east to west, with Stewart Creek Tributary 4 joining the main creek channel within this study reach. The entire length of the study area is within the City of Frisco. Two Flood Insurance Rate Map (FIRM) panel cross sections are within this reach:

- FIRM Cross Section H: BNSF Railroad
- FIRM Cross Section I: Eagan Way (called out as South Fifth Street on Flood Insurance Study [FIS] flood profile [FEMA 2017b])

1.3 Previous Studies

The floodplain limits and Base Flood Elevations (BFE's) for City of Frisco (Community Number 480134) within Collin County are based on the effective FIS for Collin County dated June 7, 2017 as shown on Map Number 48085C, Panel 0240K. There have been no approved LOMRs within this study reach since that time.

1.4 Effective FEMA Map Information

Impacted Map Number(s): 48085C02040K

Impacted Zones: Zone AE, Zone X

Effective Date: June 7, 2017

Affected Community: City of Frisco

2.0 SURVEYING AND MAPPING

Three topographic source files were used to develop a complete mapping dataset of the study reach. AutoCAD Civil 3D Version 2017 was utilized to develop a continuous topographic surface for cross section development. Horizontal projection of the map data is Texas State Plane, North Central Zone on North American Horizontal Datum of 1983 (NAD 83). Elevations for the topographic mapping are North American Vertical Datum of 1988 (NAVD 88). All units are U.S. survey feet. Files used in the development of site topography data are:

- Frisco Plant Site_topo.dwg: one-foot contour interval topography of Frisco Recycling Facility and Stewart Creek between Eagan Way and BNSF railroad. Developed by Dallas Aerial Survey in March 2017.
- Exide-Topo-2018.dwg: one-foot contour site topography for Stewart Creek upstream and downstream of the recycling facility, as-built survey data of the existing culverts at Eagan Way. Survey data developed by Brittain & Crawford of Fort Worth, Texas in March 2018.
- USGS National Elevation Dataset 10 meter Digital Elevation Model topography, interpolated to 10-foot contours, developed in 2003. This information is used to fill in small gaps in the survey data southwest of Stewart Creek crossing of BNSF Railroad and northwest of the creek crossing of Eagan Way.

Final shape files submitted to FEMA will be converted from Texas State Plane coordinate system to Universal Transverse Mercator (UTM) Zone 14 North to be consistent with the mapping on the effective FIRM.

3.0 HYDROLOGY

The hydrology for Stewart Creek is based on the effective FIS flow rates. No changes have been proposed to the hydrologic analysis as part of this study. The peak discharges referenced from the Effective FIS are summarized in Table 1. A copy of the peak discharge table from the FIS report (FEMA 2017a) is provided in Appendix B.

Table 1: Summary of Discharges within the Study Reach

Cross Section	Location/Description	Peak Discharges (cfs)			
		10% Annual Chance	2% Annual Chance	1% Annual Chance	0.2% Annual Chance
38780	Upstream Model Limit (at Parkwood Drive)	2,700	4,000	4,500	6,000
37260	~400 feet downstream of Eagan Way	4,000	6,000	6,800	9,100
34990	Downstream Model Limit (at BNSF Railroad)	4,000	6,000	6,800	9,100

Notes:

cfs = cubic feet per second

4.0 HYDRAULIC MODELING

4.1 Methods

Hydraulic modelling for this CLOMR was performed using the U.S. Army Corps of Engineers' HEC-RAS computer model, Version 5.0.3 dated September 2016 (USACE 2016). The hydraulic model for the effective FIS was developed using HEC-2 in 1977. A scanned copy of the HEC-2 model is provided in Appendix B. Based on the date of this model, the elevations within the modeling results are based on National Geodetic Vertical Datum of 1929 (NGVD 29). However, the published FIS flood profile elevations are based on North American Vertical Datum of 1988 (NAVD 88), as is the site topography. Per the FIS report (FEMA 2017a), the datum conversion factor from NGVD 29 to NAVD 88 in this area is +0.06 feet.

4.2 Hydraulic Models

Three HEC-RAS floodplain models have been developed for this CLOMR application:

- Duplicate Effective Model to replicate the model information from the effective HEC-2 hydraulic model and to establish georeferenced cross section locations for the effective model
- Existing Conditions Model that takes the georeferenced cross section locations from the duplicate model to update the hydraulic model with more recent ground topography and existing structures in the study reach not included in the effective model
- Proposed Conditions Model to determine the revised floodplain and floodway limits resulting from the extension of the existing concrete floodwall to protect the remediation area from the base (1% annual chance) flood

4.3 Model Reach

The proposed study reach is located at the upper end of Stewart Creek, between Parkwood Boulevard (Cross Section 38780) and the BNSF Railroad crossing of this creek (Cross Section 34990). The Duplicate Effective Model has been developed for this reach length of approximately 4,000 feet. However, the upstream and downstream and tie-in cross sections for the Existing and Post-Project Conditions Models are at Cross Sections 35368 and 38300, respectively. This results in a shorter revision length of approximately 3,000 feet.

There is one existing hydraulic structure within the study reach: a 5-barrel 114-inch corrugated metal pipe (CMP) culvert crossing Eagan Way, near Cross-Section 37800. This culvert crosses under a 27-foot wide paved access road.

5.0 DUPLICATE EFFECTIVE MODEL

5.1 Model Development

As previously noted, the hydraulic model for the effective FIS was developed using HEC-2; however, no electronic data files or work maps are available for direct conversion to HEC-RAS. The Duplicate Effective Model for this CLOMR study was developed by digitizing the channel centerline from the FIRM map onto the georeferenced site topography and using the channel reach lengths in the hard copy of the HEC-2 model input to determine the model cross section locations. The natural ground data and encroachment data for all the cross sections in the reach were copied from the HEC-2 hard copy directly into HEC-RAS to develop the cross-section geometries.

Manning’s n coefficients for the Duplicate Effective Model were referenced from the effective FIS hydraulic analysis (HEC-2 model) for this reach. Manning’s n values vary from 0.050 to 0.055 for the main channel and from 0.070 to 0.090 for the overbanks. The contraction and expansion coefficients noted in the existing HEC-2 model have been incorporated without modification.

The Stewart Creek crossing at Eagan Way (Cross Section 37800) is modeled in HEC-2 as a bridge structure and the top of roadway and low chord points for the bridge were incorporated into to the HEC-RAS model at Eagan Way. HEC-2 has two options for analyzing bridges: normal bridge or special bridge. The bridge at Eagan Way was modeled in HEC-2 as a normal bridge, which uses an energy balance to determine the water surface elevations through the section. To most closely approximate the HEC-2 methodology, the energy/standard step method was used to model this bridge in the HEC-RAS duplicate model (FEMA 2002).

The flow data within the HEC-2 model is as noted in Table 1, except for the 0.2% chance flows in the upstream section of the model. The 0.2% chance (500-year) flows in the effective HEC-2 model are 5,950 cubic feet per second (cfs), not 6,000 cfs as reported in the FIS report. It has been assumed that the model value was rounded up for reporting purposes. In order to develop this duplicate model to compare water surface elevations to the effective model, the 5,950 cfs value was used. Subsequent modeling of the 0.2% flood profile for existing and proposed conditions modeling will use 6,000 cfs.

5.2 Model Results

The Duplicate Effective Model HEC-RAS results for the natural flow profiles and the 100-year floodway profile are provided in Appendix C. A comparison of the effective FIS water surface elevations to those from the Duplicate Effective Model for the natural flow profiles is provided in Table 2. As noted in Section 4.1, the elevations in the HEC-2 model are in NGVD 29. The duplicate model has this elevation reference as well.

The results indicate that the model matches the upstream and downstream water surface elevations as shown on the FIS flood profiles within 0.5-foot at most locations, with the only exception being a 0.9-foot difference at the cross section immediately upstream of the Eagan Way bridge (Cross Section 37820) for the 0.2% flood profile. For the floodway model, the water surface changes align with those in the HEC-2 model, including the two negative surcharges at the upstream and downstream model limits.

Table 2: Duplicate Effective Model (DEM) Results Comparison[1]

Cross Section	10% Annual Chance		2% Annual Chance		1% Annual Chance		0.2% Annual Chance	
	Effective	DEM	Effective	DEM	Effective	DEM	Effective	DEM
38780	643.6	644.0	644.6	645.1	644.9	645.4	645.9	646.3
37860	640.0	639.9	641.4	641.3	642.2	641.9	643.8	643.5
37820	639.9	639.9	641.0	641.1	641.3	641.6	642.1	643.0
37800	639.8	639.8	640.9	640.9	641.3	641.3	642.1	642.2
37700	639.5	639.5	640.7	640.7	641.1	641.2	642.2	642.2
37260	637.8	637.8	639.0	639.1	639.4	639.5	640.5	640.5
36830	635.8	635.8	637.0	637.0	637.4	637.4	638.4	638.5
36400	634.2	634.2	635.2	635.2	635.5	635.6	636.3	636.4
35745	630.6	630.7	631.7	631.7	632.1	632.1	633.3	633.3
35368	629.3	629.3	630.8	630.8	631.3	631.4	632.7	632.7
34990	629.1	629.1	630.6	630.6	631.2	631.2	632.5	632.5

Notes:

[1] All elevations are NGVD 29

6.0 EXISTING CONDITIONS MODEL

The cross section locations established for the Duplicate Effective Model were used to build the Existing Conditions Model, particularly those cross sections that correspond with key model locations, as noted in Table 3.

Table 3: Key Model Cross Locations

Model Cross Section	Location/Description
37860	Upstream of Eagan Way
37800	Eagan Way / FIRM Cross Section I
37700	Flow Change Location
35368	Downstream Tie-In to Existing FIS

While these key cross section locations have been maintained for the Existing Conditions model, other model cross sections have been added or adjusted as needed to accurately reflect the location of the existing floodwall in north overbank area of Stewart Creek and to incorporate the roadway and culvert information for the creek crossing at Eagan Way. The ground stations and elevations at the model cross section locations have been adjusted to reflect the updated topography within the study reach. As updated topography does not extend to Cross Section 38780, the elevations for this cross section from the Duplicate Effective Model have been increased by 0.06 feet to adjust this section’s elevations to NAVD 88.

Survey data and site photos were collected to document the existing culvert properties (invert and top of road elevations, culvert size, flow condition, etc.). A detail of this existing culvert crossing is provided on Drawing C 002.

Based on review of aerial and ground level photography for the creek and review of published Manning’s n criteria (Barnes 1967), Manning’s n values were revised for the section of the channel adjacent to the Exide facility. Manning’s n value of 0.040 is used for the main channel and 0.070 for the overbanks.

Consistent with established modeling procedures for subcritical flow with gradual changes between cross sections, contraction and expansion coefficients used in the Existing and Proposed Conditions models are 0.1 and 0.3, respectively. At the cross sections surrounding the existing culvert crossing at Eagan Way, contraction and expansion coefficients are set at 0.3 and 0.5, respectively.

The Existing Conditions HEC-RAS model results, the floodwall as-built drawings and photos of the existing creek and the culvert crossing are provided in Appendix D. Table 4 summarizes the existing top of floodwall elevations, the adjacent 100-year water surface elevation and the minimum top of wall elevation that would be needed to meet the FEMA levee requirement of having 3-foot minimum freeboard.

Table 4: Existing Conditions Model Comparison to Effective FIS at Select Cross Sections[1]

Cross Section	100-Year Discharge (cfs)	Effective FIS 100-Year WSEL[2]	Existing Conditions WSEL	Existing Top of Wall Elevation	FEMA Required Top of Wall Elevation	Wall Modification Required (Y/N)
37860	4,500	642.3	642.3	N/A		
37820	4,500	641.4	642.0	N/A		
37800	4,500	641.4	641.0	N/A		
37700	6,800	641.2	640.5	N/A		
37233[3]	6,800		639.2	637	642.2	Y
37164[3]	6,800		639.2	637	642.2	Y
37091[3]	6,800		638.9	637	641.9	Y
37066[3]	6,800		638.9	637	641.9	Y
36830	6,800	637.5	638.7	637	641.7	Y
36711[3]	6,800		638.3	637	641.3	Y
36518[3]	6,800		637.0	637	640.0	Y
36249[3]	6,800		635.5	637	638.5	Y
36188[3]	6,800		635.6	641	638.5	N
36159[3]	6,800		632.4	641	635.4	N
35745	6,800	632.1	631.3	N/A		
35368	6,800	631.4	631.4	N/A		

Notes:
cfs = cubic feet per second

[1] All elevations in feet, NAVD 88

[2] Effective model values from Table 2 increased by 0.06 feet to convert from NGVD 29 to NAVD 88

[3] Cross sections not in effective FIS model, but added to Existing Conditions model to reflect existing floodwall

7.0 PROPOSED MODEL

The Proposed Model is developed to determine the proposed modifications to the floodplain and floodway limits due to extending the existing floodwall along the north bank of Stewart Creek further east to remove the remediation area from the effective floodplain. This model is also used to verify that the designed floodwall elevation will provide sufficient flood protection and freeboard to be certified as a levee.

7.1 Model Set-Up

7.1.1 Boundary Conditions

Per Federal Register 44CFR §65.6a(2), upstream and downstream tie-ins are required to be within 0.5 feet of the effective model for all recurrence intervals developed in the effective FIS. The effective water surface elevations at Cross Sections 37800 and 35368 for all recurrence intervals were referenced from the HEC-2 output data, adding 0.06 feet to convert the elevations to NAVD 88. The upstream tie-in cross section (38300) is not in the effective model, but the tie-in elevation is determined by interpolating between the two effective model cross sections (37860 and 38780). The water-surface tie-in information is summarized in Table 5.

Table 5: Water Surface Elevations per Effective FIS

Location	Water Surface Elevation (NAVD 88)			
	10% Annual Chance	2% Annual Chance	1% Annual Chance	0.2% Annual Chance
Upstream Tie-In (Cross Section 38300)	641.9	643.1	643.6	645.0
Eagan Way (FIRM Cross Section I / Cross Section 37800)	639.9	640.9	641.4	642.2
Downstream Tie-In (Cross Section 35368)	629.3	630.8	631.4	632.8

Notes:

NAVD 88 = North American Vertical Datum 1988

7.1.2 Ineffective Flow Areas or Obstructions

Ineffective flow areas have been added at the downstream end of the floodplain model to reflect a more gradual expansion of the floodplain along the left overbank. A block obstruction has been added to reflect the existing pond in the left overbank at Cross Section 36188.

7.1.3 Floodway Modeling

A floodway is currently delineated within the study reach so a new floodway analysis is required to re-define the encroachment limits for the revised 100-year floodplain. The modeling procedure involved using Encroachment Method 4 to provide an initial estimate of floodway boundaries based on an equal reduction in flood conveyance from each overbank to limit the rise in the base flood elevations to 1 foot. Using the optimal results from this initial run, the boundaries were fine-tuned using Encroachment Method 1. This method allows minor adjustments to individual cross-sections to smooth the floodway boundary lines to more closely follow the existing channel, while still meeting the 1-foot maximum surcharge criteria.

7.2 Proposed Floodwall Improvements

Structural design plans have been developed for vertically extending the existing floodwall and for extending the wall approximately 600 feet to the east. These improvements are proposed to keep Stewart Creek flows from impacting the RCA and ensure that the floodwall provides the minimum 3 feet of freeboard along the entire alignment.

In accordance with FEMA levee certification requirements in 44 CFR § 65.10, stability analyses for both the new and re-designed floodwall sections have been developed to demonstrate that the wall will be stable under expected loading conditions associated with the base flood event. The floodwall design information and related analyses are provided in Appendix H. The contingency plan for the Site, which describes the actions to be taken during severe flood events (as well as other emergencies), is provided in Appendix I. The operation and maintenance plan for the Site (including the floodwall) is provided in Appendix J.

7.3 Base Flood (1%) Profile Modeling Results

7.3.1 Supercritical Flows or Hydraulic Jumps

There are no sustained supercritical flows reported for the base flood profile. However, one or more hydraulic jumps are noted as occurring between Cross Sections 35745 and 36518. The downstream terminus of the floodwall is within this area, as is a steep gradient in the channel bed profile.

7.3.2 Downstream and Upstream Tie-Ins

For this mixed flow analysis, the downstream boundary condition is set as a known surface elevation for each profile and the upstream boundary condition is set at normal depth and is calculated as part of the modeling. The water surface elevation tie-ins for all the flood profiles are summarized in Table 6.

Table 6: Water Surface Elevations at Upstream and Downstream Tie-Ins to Effective FIS

Cross Section	10% Annual Chance		2% Annual Chance		1% Annual Chance		0.2% Annual Chance	
	Effective	Proposed	Effective	Proposed	Effective	Proposed	Effective	Proposed
38830 (Upstream Tie-In)	641.9	641.4	643.1	642.9	643.6	643.6	645.0	645.4
35368 (Downstream Tie-In)	629.3	629.3	630.8	630.8	631.4	631.4	632.8	632.4

For the base flood profile, the downstream tie-in elevation at Cross-section 35638 matches the effective FIS study exactly at 631.4 feet for the base flood. The calculated upstream tie-in elevation at Cross-section 38300 also matches the effective FIS elevation (643.6 feet) for the base flood. For all other profiles the upstream and downstream tie-ins are within 0.5 feet of the effective model.

7.3.3 100-Year Floodway Modeling

The encroachment stations for all the modeled cross sections are located either at the top of the channel bank or within the floodway fringe, the area between the channel bank and the edge of the floodplain. Per FEMA criteria, the floodway limits at the upstream and downstream study boundaries tie into the effective floodway boundaries. At the downstream end of the model (Cross Section 35368), the floodway elevation increase is set to equal 0.5 foot, which matches the floodway elevation at this cross section in the effective flood study.

7.3.4 Warnings and Error Messages

Several warning messages were generated by the Proposed Conditions Model, many of which can be explained by the variations in cross-section geometry and bed profile indicative of natural channels, as well as the changes in peak discharges within the study reach.

7.4 Modeling Summary

Table 7 summarizes the water surface elevations for the 100-year floodplain and floodway analysis generated by HEC-RAS, as well as the proposed top of wall elevations and provided freeboard. HEC-RAS model output data is provided in Appendix E. The 100-year and 500-year floodplain and 100-year floodway limits developed with the Proposed Model are shown on the Work Maps in Appendix F.

Table 7: Comparison of Proposed and Effective 100-Year Water Surface Elevations

Cross Section	100-Year Discharge (cfs)	100-Year WSEL (ft-NAVD 88)	100-Year Floodway WSEL (ft-NAVD 88)	Floodway Elevation Increase (ft)	Proposed Wall Elevation (ft-NAVD 88)	Provided Freeboard (ft)
38300	4,500	643.6	644.4	0.7		
37860	4,500	643.4	644.2	0.7		
37820	4,500	643.2	644.0	0.7		
37800	4500	643.0	643.5	0.3		
37767	4,500	643.2	643.6	0.2		
37700	6,800	643.0	643.3	0		
37483	6,800	642.5	642.6	0.2	647	4.5
37291	6,800	642.4	642.4	0	647	4.6
37164	6,800	642.3	642.4	0.1	647	4.7
37091	6,800	641.9	642.0	0.1	647	5.1
37066	6,800	641.9	642.0	0.1	647	5.1
36830	6,800	641.2	641.3	0.1	645	3.8
36711	6,800	640.5	640.5	0	645	4.5
36518	6,800	637.6	637.7	0.1	641	3.4
36249	6,800	635.5	635.5	0	641	5.5
36188	6,800	635.6	635.6	0	641	5.5
36159	6,800	632.4	632.4	0	641	8.6
35745	6,800	631.3	632.1	0.8		
35368	6,800	631.4	631.9	0.5		

Notes:
cfs = cubic feet per second
ft-NAVD88 = elevation in feet per North American Vertical Datum 1988
ft = feet

8.0 CONCLUSION

This CLOMR has been prepared as part of the proposed floodwall improvements at the Site. The proposed improvements involve vertically raising the existing floodwall and adding a new 600-foot extension of the floodwall to the east to protect the site from Stewart Creek flooding during the 100-year base flood event. The existing and new wall sections have been designed with a minimum 3-foot of freeboard and stability analyses have been completed to attest to the suitability of this proposed structure as a certified levee.

9.0 REFERENCES

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Federal Emergency Management Agency (FEMA). 2017b. Flood Insurance Study. Collin County, Texas and Incorporated Areas, Volume 3 of 4. June 7, 2017.

Federal Emergency Management Agency (FEMA). 2009. Guidelines and Specifications for Flood Hazard Mapping Partners. Appendix C: Guidance for Riverine Flooding Analyses and Mapping. November 2009.

Federal Emergency Management Agency (FEMA). 2002. Floodplain Modeling Manual. HEC-RAS Procedures for HEC-2 Modelers. April 2002.

US Army Corps of Engineers (USACE). 2016. Hydrologic Engineering Center- River Analysis System (HEC-RAS). [software package]. Version 5.0.3. September 2016.

Signature Page

Golder Associates Inc.

8/28/18

STATE OF TEXAS
JEFFREY B. FASSETT
85875
LICENSED
PROFESSIONAL ENGINEER

Sheina Sazda

Jeff Fassett, PE
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Senior Consultant

JF/SS/AFB/pb

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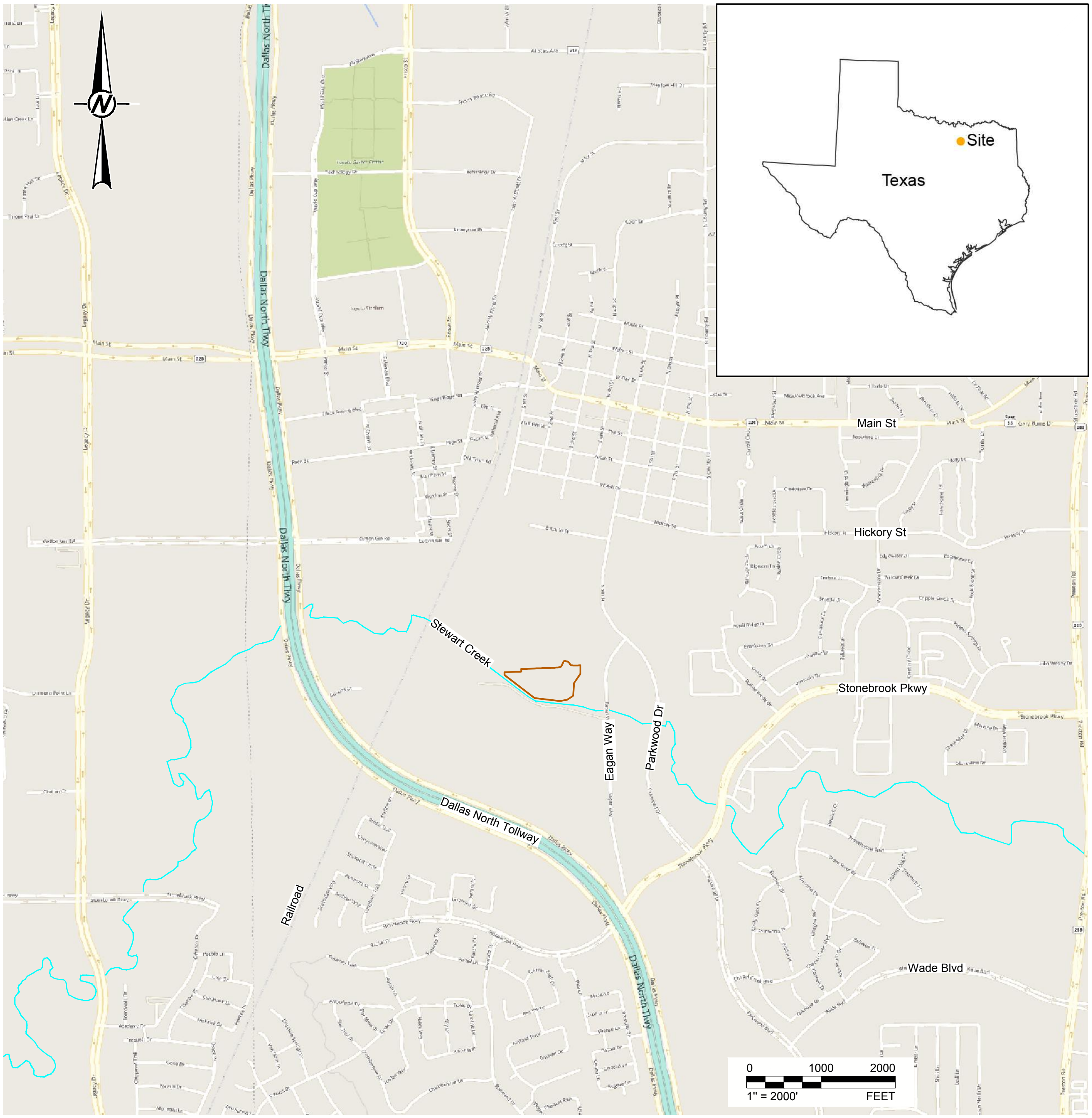
Figures



LEGEND

▭ REMEDIATION CONSOLIDATION AREA FOOTPRINT

REFERENCE(S)

1. © 2018 MICROSOFT CORPORATION © 2018 HERE BING.

CLIENT
EXIDE TECHNOLOGIES
FRISCO, TEXAS

PROJECT
FRISCO RECYCLING CENTER
CONDITIONAL LETTER OF MAP REVISION

TITLE
LOCATION MAP

CONSULTANT
GOLDER

YYYY-MM-DD	2018-08-28
DESIGNED	SPS
PREPARED	JLS
REVIEWED	SPS
APPROVED	JBF

PROJECT NO.	CONTROL	REV.	FIGURE
1302086	0006	0	1

Last Edited By: jlsanchez Date: 2018-08-28 Time:3:18:25 PM | Printed By: JLSanchez Date: 2018-08-28 Time:3:19:54 PM
Path: \\tucson\cadd\EXIDE\Frisco\99_PROJECTS\130208606_2018RCRA\0006_CLOMR\02_PRODUCTION\DWG\ | File Name: 130208606_0006_F_001.dwg

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APPENDIX A

FEMA MT-2 Forms

APPENDIX A-1

Completed MT-2 Forms and Supplemental Information

U.S. DEPARTMENT OF HOMELAND SECURITY
FEDERAL EMERGENCY MANAGEMENT AGENCY

OVERVIEW & CONCURRENCE FORM

O.M.B No. 1660-0016
Expires February 28, 2014

PAPERWORK BURDEN DISCLOSURE NOTICE

Public reporting burden for this form is estimated to average 1 hours per response. The burden estimate includes the time for reviewing instructions, searching existing data sources, gathering and maintaining the needed data, and completing, reviewing, and submitting the form. You are not required to respond to this collection of information unless it displays a valid OMB control number. Send comments regarding the accuracy of the burden estimate and any suggestions for reducing this burden to: Information Collections Management, Department of Homeland Security, Federal Emergency Management Agency, 1800 South Bell Street, Arlington, VA 20958-3005, Paperwork Reduction Project (1660-0016). Submission of the form is required to obtain or retain benefits under the National Flood Insurance Program. **Please do not send your completed survey to the above address.**

PRIVACY ACT STATEMENT

AUTHORITY: The National Flood Insurance Act of 1968, Public Law 90-448, as amended by the Flood Disaster Protection Act of 1973, Public Law 93-234.

PRINCIPAL PURPOSE(S): This information is being collected for the purpose of determining an applicant's eligibility to request changes to National Flood Insurance Program (NFIP) Flood Insurance Rate Maps (FIRM).

ROUTINE USE(S): The information on this form may be disclosed as generally permitted under 5 U.S.C § 552a(b) of the Privacy Act of 1974, as amended. This includes using this information as necessary and authorized by the routine uses published in DHS/FEMA/NFIP/LOMA-1 National Flood Insurance Program (NFIP); Letter of Map Amendment (LOMA) February 15, 2006, 71 FR 7990.

DISCLOSURE: The disclosure of information on this form is voluntary; however, failure to provide the information requested may delay or prevent FEMA from processing a determination regarding a requested change to a (NFIP) Flood Insurance Rate Maps (FIRM).

A. REQUESTED RESPONSE FROM DHS-FEMA

This request is for a (check one):

☒ CLOMR: A letter from DHS-FEMA commenting on whether a proposed project, if built as proposed, would justify a map revision, or proposed hydrology changes (See 44 CFR Ch. 1, Parts 60, 65 & 72).

☐ LOMR: A letter from DHS-FEMA officially revising the current NFIP map to show the changes to floodplains, regulatory floodway or flood elevations. (See 44 CFR Ch. 1, Parts 60, 65 & 72)

B. OVERVIEW

1. The NFIP map panel(s) affected for all impacted communities is (are):

Community No.	Community Name	State	Map No.	Panel No.	Effective Date
Example: 480301 480287	City of Katy Harris County	TX TX	48473C 48201C	0005D 0220G	02/08/83 09/28/90
480134	City of Frisco	TX	48085C	0240K	06/07/17

2. a. Flooding Source:

b. Types of Flooding: ☒ Riverine ☐ Coastal ☐ Shallow Flooding (e.g., Zones AO and AH)

☐ Alluvial fan ☐ Lakes ☐ Other (Attach Description)

3. Project Name/Identifier: Exide Recycling Facility Floodwall

4. FEMA zone designations affected: AE, X (choices: A, AH, AO, A1-A30, A99, AE, AR, V, V1-V30, VE, B, C, D, X)

5. Basis for Request and Type of Revision:

a. The basis for this revision request is (check all that apply)

☒ Physical Change ☒ Improved Methodology/Data ☒ Regulatory Floodway Revision ☒ Base Map Changes

☐ Coastal Analysis ☒ Hydraulic Analysis ☐ Hydrologic Analysis ☐ Corrections

☐ Weir-Dam Changes ☒ Levee Certification ☐ Alluvial Fan Analysis ☐ Natural Changes

☒ New Topographic Data ☐ Other (Attach Description)

Note: A photograph and narrative description of the area of concern is not required, but is very helpful during review.

b. The area of revision encompasses the following structures (check all that apply)

Structures: ☐ Channelization ☒ Levee/Floodwall ☒ Bridge/Culvert

☐ Dam ☐ Fill ☐ Other (Attach Description)

6. ☒ Documentation of ESA compliance is submitted (required to initiate CLOMR review). Please refer to the instructions for more information.

C. REVIEW FEE

Has the review fee for the appropriate request category been included? ☒ Yes Fee amount: $7,250

☐ No, Attach Explanation

Please see the DHS-FEMA Web site at http://www.fema.gov/plan/prevent/fhm/frm_fees.shtm **for Fee Amounts and Exemptions.**

D. SIGNATURE

All documents submitted in support of this request are correct to the best of my knowledge. I understand that any false statement may be punishable by fine or imprisonment under Title 18 of the United States Code, Section 1001.

Name: Brad Weaver

Company: Exide Technologies

Mailing Address:
7471 South 5th Street, P.O. Box 250
Frisco, TX 75034

Daytime Telephone No.: 214-893-4803

Fax No.:

E-Mail Address: brad.weaver@exide.com

Signature of Requester (required):

Date: 8/27/2018

As the community official responsible for floodplain management, I hereby acknowledge that we have received and reviewed this Letter of Map Revision (LOMR) or conditional LOMR request. Based upon the community's review, we find the completed or proposed project meets or is designed to meet all of the community floodplain management requirements, including the requirements for when fill is placed in the regulatory floodway, and that all necessary Federal, State, and local permits have been, or in the case of a conditional LOMR, will be obtained. For Conditional LOMR requests, the applicant has documented Endangered Species Act (ESA) compliance to FEMA prior to FEMA's review of the Conditional LOMR application. For LOMR requests, I acknowledge that compliance with Sections 9 and 10 of the ESA has been achieved independently of FEMA's process. For actions authorized, funded, or being carried out by Federal or State agencies, documentation from the agency showing its compliance with Section 7(a)(2) of the ESA will be submitted. In addition, we have determined that the land and any existing or proposed structures to be removed from the SFHA are or will be reasonably safe from flooding as defined in 44CFR 65.2(c), and that we have available upon request by FEMA, all analyses and documentation used to make this determination.

Community Official's Name and Title:

Community Name:

Mailing Address:

Daytime Telephone No.:

Fax No.:

E-Mail Address:

Community Official's Signature (required):

Date:

CERTIFICATION BY REGISTERED PROFESSIONAL ENGINEER AND/OR LAND SURVEYOR

This certification is to be signed and sealed by a licensed land surveyor, registered professional engineer, or architect authorized by law to certify elevation information data, hydrologic and hydraulic analysis, and any other supporting information as per NFIP regulations paragraph 65.2(b) and as described in the MT-2 Forms Instructions. All documents submitted in support of this request are correct to the best of my knowledge. I understand that any false statement may be punishable by fine or imprisonment under Title 18 of the United States Code, Section 1001.

Certifier's Name: Jeff Fassett

License No.: 85675

Expiration Date: 06-30-2019

Company Name: Golder Associates

Telephone No.: 281-821-6868

Fax No.:

Signature:

Date: 08/28/2018

E-Mail Address: Jeff_Fassett@golder.com

Ensure the forms that are appropriate to your revision request are included in your submittal.

Form Name and (Number)	**Required if …**
☒ Riverine Hydrology and Hydraulics Form (Form 2)	New or revised discharges or water-surface elevations
☒ Riverine Structures Form (Form 3)	Channel is modified, addition/revision of bridge/culverts, addition/revision of levee/floodwall, addition/revision of dam
☐ Coastal Analysis Form (Form 4)	New or revised coastal elevations
☐ Coastal Structures Form (Form 5)	Addition/revision of coastal structure
☐ Alluvial Fan Flooding Form (Form 6)	Flood control measures on alluvial fans

Seal (Optional)

U.S. DEPARTMENT OF HOMELAND SECURITY
FEDERAL EMERGENCY MANAGEMENT AGENCY

RIVERINE HYDROLOGY & HYDRAULICS FORM

O.M.B No. 1660-0016
Expires February 28, 2014

PAPERWORK BURDEN DISCLOSURE NOTICE

Public reporting burden for this form is estimated to average 3.5 hours per response. The burden estimate includes the time for reviewing instructions, searching existing data sources, gathering and maintaining the needed data, and completing, reviewing, and submitting the form. You are not required to respond to this collection of information unless a valid OMB control number appears in the upper right corner of this form. Send comments regarding the accuracy of the burden estimate and any suggestions for reducing this burden to: Information Collections Management, Department of Homeland Security, Federal Emergency Management Agency, 1800 South Bell Street, Arlington VA 20958-3005, Paperwork Reduction Project (1660-0016). Submission of the form is required to obtain or retain benefits under the National Flood Insurance Program. **Please do not send your completed survey to the above address.**

PRIVACY ACT STATEMENT

AUTHORITY: The National Flood Insurance Act of 1968, Public Law 90-448, as amended by the Flood Disaster Protection Act of 1973, Public Law 93-234.

PRINCIPAL PURPOSE(S): This information is being collected for the purpose of determining an applicant's eligibility to request changes to National Flood Insurance Program (NFIP) Flood Insurance Rate Maps (FIRM).

ROUTINE USE(S): The information on this form may be disclosed as generally permitted under 5 U.S.C § 552a(b) of the Privacy Act of 1974, as amended. This includes using this information as necessary and authorized by the routine uses published in DHS/FEMA/NFIP/LOMA-1 National Flood Insurance Program (NFIP); Letter of Map Amendment (LOMA) February 15, 2006, 71 FR 7990.

DISCLOSURE: The disclosure of information on this form is voluntary; however, failure to provide the information requested may delay or prevent FEMA from processing a determination regarding a requested change to a NFIP Flood Insurance Rate Maps (FIRM).

Flooding Source: Stewart Creek

Note: Fill out one form for each flooding source studied

A. HYDROLOGY

1. Reason for New Hydrologic Analysis (check all that apply)

☒ Not revised (skip to section B)
☐ Alternative methodology
☐ No existing analysis
☐ Proposed Conditions (CLOMR)
☐ Improved data
☐ Changed physical condition of watershed

2. Comparison of Representative 1%-Annual-Chance Discharges

Location	Drainage Area (Sq. Mi.)	Effective/FIS (cfs)	Revised (cfs)

3. Methodology for New Hydrologic Analysis (check all that apply)

☐ Statistical Analysis of Gage Records
☐ Regional Regression Equations
☐ Precipitation/Runoff Model → Specify Model: ____________
☐ Other (please attach description)

Please enclose all relevant models in digital format, maps, computations (including computation of parameters), and documentation to support the new analysis.

4. Review/Approval of Analysis

If your community requires a regional, state, or federal agency to review the hydrologic analysis, please attach evidence of approval/review.

5. Impacts of Sediment Transport on Hydrology

Is the hydrology for the revised flooding source(s) affected by sediment transport? ☐ Yes ☐ No

If yes, then fill out Section F (Sediment Transport) of Form 3. If No, then attach your explanation..

B. HYDRAULICS

1. Reach to be Revised

	Description	Cross Section	Water-Surface Elevations (ft.)	
			Effective	Proposed/Revised
Downstream Limit*	465 ft upstream of BNSF Railroad	35368	631.4	631.4
Upstream Limit*	500 ft east of Eagan Way	38300	643.6	643.6

*Proposed/Revised elevations must tie-into the Effective elevations within 0.5 foot at the downstream and upstream limits of revision.

2. Hydraulic Method/Model Used**:** U.S. Army Corps of Engineers HEC-RAS, Version 5.0.3

3. Pre-Submittal Review of Hydraulic Models*

DHS-FEMA has developed two review programs, CHECK-2 and CHECK-RAS, to aid in the review of HEC-2 and HEC-RAS hydraulic models, respectively. We recommend that you review your HEC-2 and HEC-RAS models with CHECK-2 and CHECK-RAS.

4.

Models Submitted	**Natural Run**		**Floodway Run**		**Datum**
Duplicate Effective Model*	File Name: StewartCreek-DEM.prj	Plan Name: AllEvents	File Name: StewartCreek-DEM.prj	Plan Name: 100Yr-FP-FW	NGVD 29
Corrected Effective Model*	File Name:	Plan Name:	File Name:	Plan Name:	
Existing or Pre-Project Conditions Model	File Name: Stewart-Existing.prj	Plan Name: Exisitng Conditions	File Name: Stewart-Existing.prj	Plan Name: 100-yr FW	NAVD 88
Revised or Post-Project Conditions Model	File Name: Stewart-Proposed.prj	Plan Name: Proposed Wall	File Name: Stewart-Propsoed.prj	Plan Name: 100-yr FW	NAVD 88
Other - (attach description)	File Name:	Plan Name:	File Name:	Plan Name:	

* For details, refer to the corresponding section of the instructions.

☒ Digital Models Submitted? (Required)

C. MAPPING REQUIREMENTS

A **certified topographic work map** must be submitted showing the following information (where applicable): the boundaries of the effective, existing, and proposed conditions 1%-annual-chance floodplain (for approximate Zone A revisions) or the boundaries of the 1%- and 0.2%-annual-chance floodplains and regulatory floodway (for detailed Zone AE, AO, and AH revisions); location and alignment of all cross sections with stationing control indicated; stream, road, and other alignments (e.g., dams, levees, etc.); current community easements and boundaries; boundaries of the requester's property; certification of a registered professional engineer registered in the subject State; location and description of reference marks; and the referenced vertical datum (NGVD, NAVD, etc.).

☒ Digital Mapping (GIS/CADD) Data Submitted (preferred)

Topographic Information**:** (Multiple Sources - See Work Maps)

Source**:** (Multiple Sources - See Work Maps)

Date**:** (Multiple Dates - See Work Maps)

Accuracy**:** +/- 1 foot

Note that the boundaries of the existing or proposed conditions floodplains and regulatory floodway to be shown on the revised FIRM and/or FBFM must tie-in with the effective floodplain and regulatory floodway boundaries. Please attach **a copy of the effective FIRM and/or FBFM**, at the same scale as the original, annotated to show the boundaries of the revised 1%-and 0.2%-annual-chance floodplains and regulatory floodway that tie-in with the boundaries of the effective 1%-and 0.2%-annual-chance floodplain and regulatory floodway at the upstream and downstream limits of the area on revision.

☒ Annotated FIRM and/or FBFM (Required)

D. COMMON REGULATORY REQUIREMENTS*

1. For LOMR/CLOMR requests, do Base Flood Elevations (BFEs) increase? ☒ Yes ☐ No

   a. For CLOMR requests, if either of the following is true, please submit **evidence of compliance with Section 65.12 of the NFIP regulations**:

   - The proposed project encroaches upon a regulatory floodway and would result in increases above 0.00 foot compared to pre-project conditions.
   - The proposed project encroaches upon a SFHA with or without BFEs established and would result in increases above 1.00 foot compared to pre-project conditions.

   b. Does this LOMR request cause increase in the BFE and/or SFHA compared with the effective BFEs and/or SFHA? ☐ Yes ☐ No

   If Yes, please attach **proof of property owner notification and acceptance (if available)**. Elements of and examples of property owner notifications can be found in the MT-2 Form 2 Instructions.

2. Does the request involve the placement or proposed placement of fill? ☐ Yes ☒ No

   If Yes, the community must be able to certify that the area to be removed from the special flood hazard area, to include any structures or proposed structures, meets all of the standards of the local floodplain ordinances, and is reasonably safe from flooding in accordance with the NFIP regulations set forth at 44 CFR 60.3(A)(3), 65.5(a)(4), and 65.6(a)(14). Please see the MT-2 instructions for more information.

3. For LOMR requests, is the regulatory floodway being revised? ☐ Yes ☐ No

   If Yes, attach **evidence of regulatory floodway revision notification**. As per Paragraph 65.7(b)(1) of the NFIP Regulations, notification is required for requests involving revisions to the regulatory floodway. (Not required for revisions to approximate 1%-annual-chance floodplains [studied Zone A designation] unless a regulatory floodway is being established. Elements and examples of regulatory floodway revision notification can be found in the MT-2 Form 2 Instructions.)

4. For CLOMR requests, please submit documentation to FEMA and the community to show that you have complied with Sections 9 and 10 of the Endangered Species Act (ESA).

   See Appendix G of CLOMR Report for ESA Documentation

For actions authorized, funded, or being carried out by Federal or State agencies, please submit documentation from the agency showing its compliance with Section 7(a)(2) of the ESA. Please see the MT-2 instructions for more detail.

* Not inclusive of all applicable regulatory requirements. For details, see 44 CFR parts 60 and 65.

DEPARTMENT OF HOMELAND SECURITY
FEDERAL EMERGENCY MANAGEMENT AGENCY

RIVERINE STRUCTURES FORM

O.M.B. NO. 1660-0016
Expires February 28, 2014

PAPERWORK BURDEN DISCLOSURE NOTICE

Public reporting burden for this form is estimated to average 7 hours per response. The burden estimate includes the time for reviewing instructions, searching existing data sources, gathering and maintaining the needed data, and completing, reviewing, and submitting the form. You are not required to respond to this collection of information unless a valid OMB control number appears in the upper right corner of this form. Send comments regarding the accuracy of the burden estimate and any suggestions for reducing this burden to: Information Collections Management, Department of Homeland Security, Federal Emergency Management Agency, 1800 South Bell Street, Arlington, VA 20598-3005, Paperwork Reduction Project (1660-0016). Submission of the form is required to obtain or retain benefits under the National Flood Insurance Program. **Please do not send your completed survey to the above address.**

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DISCLOSURE: The disclosure of information on this form is voluntary; however, failure to provide the information requested may delay or prevent FEMA from processing a determination regarding a requested change to a NFIP Flood Insurance Rate Maps (FIRM).

Flooding Source: Stewart Creek

Note**:** Fill out one form for each flooding source studied.

A. GENERAL

Complete the appropriate section(s) for each Structure listed below:

Channelization..............complete Section B
Bridge/Culvert...............complete Section C
Dam.............................complete Section D
Levee/Floodwall............complete Section E
Sediment Transport........complete Section F (if required)

Description Of Modeled Structure

1. Name of Structure: Eagan Way Culvert

Type (check one): ☐ Channelization ☒ Bridge/Culvert ☐ Levee/Floodwall ☐ Dam

Location of Structure: Stewart Creek crossing of Eagan Way

Downstream Limit/Cross Section: 37800

Upstream Limit/Cross Section: 37820

2. Name of Structure: Exide Floodwall

Type (check one): ☐ Channelization ☐ Bridge/Culvert ☒ Levee/Floodwall ☐ Dam

Location of Structure: North bank of Stewart Creek adjacent to Exide Facility

Downstream Limit/Cross Section: 36159

Upstream Limit/Cross Section: 37483

3. Name of Structure: _____

Type (check one) ☐ Channelization ☐ Bridge/Culvert ☐ Levee/Floodwall ☐ Dam

Location of Structure: _____

Downstream Limit/Cross Section: _____

Upstream Limit/Cross Section: _____

NOTE: FOR MORE STRUCTURES, ATTACH ADDITIONAL PAGES AS NEEDED.

B. CHANNELIZATION

Flooding Source: _____

Name of Structure: _____

1. Hydraulic Considerations

The channel was designed to carry _____ (cfs) and/or the _____-year flood.

The design elevation in the channel is based on (check one):

☐ Subcritical flow ☐ Critical flow ☐ Supercritical flow ☐ Energy grade line

If there is the potential for a hydraulic jump at the following locations, check all that apply and attach an explanation of how the hydraulic jump is controlled without affecting the stability of the channel.

☐ Inlet to channel ☐ Outlet of channel ☐ At Drop Structures ☐ At Transitions

☐ Other locations (specify): _____

2. Channel Design Plans

Attach the plans of the channelization certified by a registered professional engineer, as described in the instructions.

3. Accessory Structures

The channelization includes (check one):

☐ Levees [Attach Section E (Levee/Floodwall)] ☐ Drop structures ☐ Superelevated sections

☐ Transitions in cross sectional geometry ☐ Debris basin/detention basin [Attach Section D (Dam/Basin)] ☐ Energy dissipator

☐ Weir ☐ Other (Describe):

4. Sediment Transport Considerations

Are the hydraulics of the channel affected by sediment transport? ☐ Yes ☐ No

If yes, then fill out Section F (Sediment Transport) of Form 3. If No, then attach your explanation for why sediment transport was not considered.

C. BRIDGE/CULVERT

Flooding Source: Stewart Creek

Name of Structure: Eagan Way Culvert

1. This revision reflects (check one):

☐ Bridge/culvert not modeled in the FIS

☐ Modified bridge/culvert previously modeled in the FIS

☒ Revised analysis of bridge/culvert previously modeled in the FIS

2. Hydraulic model used to analyze the structure (e.g., HEC-2 with special bridge routine, WSPRO, HY8): HEC-RAS, Version 5.0.3
If different than hydraulic analysis for the flooding source, justify why the hydraulic analysis used for the flooding source could not analyze the structures. Attach justification.

3. Attach plans of the structures certified by a registered professional engineer. The plan detail and information should include the following (check the information that has been provided):

☒ Dimensions (height, width, span, radius, length)

☒ Shape (culverts only)

☒ Material

☒ Beveling or Rounding

☐ Wing Wall Angle

☐ Skew Angle

☐ Distances Between Cross Sections

☐ Erosion Protection

☐ Low Chord Elevations – Upstream and Downstream

☒ Top of Road Elevations – Upstream and Downstream

☒ Structure Invert Elevations – Upstream and Downstream

☒ Stream Invert Elevations – Upstream and Downstream

☒ Cross-Section Locations

4. Sediment Transport Considerations

Are the hydraulics of the structure affected by sediment transport? ☐ Yes ☒ No

If Yes, then fill out Section F (Sediment Transport) of Form 3. If no, then attach an explanation.

D. DAM/BASIN

Flooding Source: _____
Name of Structure: _____

1. This request is for (check one): ☐ Existing dam/basin ☐ New dam/basin ☐ Modification of existing dam/basin

2. The dam/basin was designed by (check one): ☐ Federal agency ☐ State agency ☐ Private organization ☐ Local government agency

   Name of the agency or organization: _____

3. The Dam was permitted as (check one): ☐ Federal Dam ☐ State Dam

   Provide the permit or identification number (ID) for the dam and the appropriate permitting agency or organization

   Permit or ID number ___________________ Permitting Agency or Organization ______________________________

   a. ☐ Local Government Dam ☐ Private Dam

   Provided related drawings, specification and supporting design information.

4. Does the project involve revised hydrology? ☐ Yes ☐ No

   If Yes, complete the Riverine Hydrology & Hydraulics Form (Form 2).

   Was the dam/basin designed using critical duration storm? (must account for the maximum volume of runoff)

   ☐ Yes, provide supporting documentation with your completed Form 2.

   ☐ No, provide a written explanation and justification for not using the critical duration storm.

5. Does the submittal include debris/sediment yield analysis? ☐ Yes ☐ No

   If Yes, then fill out Section F (Sediment Transport). If No, then attach your explanation for why debris/sediment analysis was not considered?

6. Does the Base Flood Elevation behind the dam/basin or downstream of the dam/basin change? ☐ Yes ☐ No

   If Yes, complete the Riverine Hydrology & Hydraulics Form (Form 2) and complete the table below.

	Stillwater Elevation Behind the Dam/Basin	
FREQUENCY (% annual chance)	FIS	REVISED
10-year (10%)	_____	_____
50-year (2%)	_____	_____
100-year (1%)	_____	_____
500-year (0.2%)	_____	_____
Normal Pool Elevation	_____	_____

7. Please attach a copy of the formal Operation and Maintenance Plan

E. LEVEE/FLOODWALL

1. System Elements

a. This Levee/Floodwall analysis is based on (check one): ☒ upgrading of an existing levee/floodwall system ☐ a newly constructed levee/floodwall system ☐ reanalysis of an existing levee/floodwall system

b. Levee elements and locations are (check one):

☐ earthen embankment, dike, berm, etc. Station _____ to _____
☒ structural floodwall Station 36159 to 37483
☐ Other (describe): Station _____ to _____

c. Structural Type (check one): ☒ monolithic cast-in place reinforced concrete ☐ reinforced concrete masonry block ☐ sheet piling ☐ Other (describe): _____

d. Has this levee/floodwall system been certified by a Federal agency to provide protection from the base flood?

☐ Yes ☒ No

If Yes, by which agency? _____

e. Attach certified drawings containing the following information (indicate drawing sheet numbers):

1. Plan of the levee embankment and floodwall structures. Sheet Numbers: Dwgs C-001,C-002
2. A profile of the levee/floodwall system showing the Base Flood Elevation (BFE), levee and/or wall crest and foundation, and closure locations for the total levee system. Sheet Numbers: Dwgs C-001,C-002
3. A profile of the BFE, closure opening outlet and inlet invert elevations, type and size of opening, and kind of closure. Sheet Numbers: N/A
4. A layout detail for the embankment protection measures. Sheet Numbers: N/A
5. Location, layout, and size and shape of the levee embankment features, foundation treatment, Floodwall structure, closure structures, and pump stations. Sheet Numbers: Dwgs S1-S6

2. Freeboard

a. The minimum freeboard provided above the BFE is:

3.4 feet

Riverine

3.0 feet or more at the downstream end and throughout ☒ Yes ☐ No

3.5 feet or more at the upstream end ☒ Yes ☐ No

4.0 feet within 100 feet upstream of all structures and/or constrictions ☒ Yes ☐ No

Coastal

1.0 foot above the height of the one percent wave associated with the 1%-annual-chance stillwater surge elevation or maximum wave runup (whichever is greater). ☐ Yes ☐ No

2.0 feet above the 1%-annual-chance stillwater surge elevation ☐ Yes ☐ No

Please note, occasionally exceptions are made to the minimum freeboard requirement. If an exception is requested, attach documentation addressing Paragraph 65.10(b)(1)(ii) of the NFIP Regulations.

If No is answered to any of the above, please attach an explanation.

b. Is there an indication from historical records that ice-jamming can affect the BFE? ☐ Yes ☒ No

If Yes, provide ice-jam analysis profile and evidence that the minimum freeboard discussed above still exists.

3. Closures

a. Openings through the levee system (check one): ☐ exists ☒ does not exist

If opening exists, list all closures:

Channel Station	Left or Right Bank	Opening Type	Highest Elevation for Opening Invert	Type of Closure Device

(Extend table on an added sheet as needed and reference)

Note: Geotechnical and geologic data

In addition to the required detailed analysis reports, data obtained during field and laboratory investigations and used in the design analysis for the following system features should be submitted in a tabulated summary form. (Reference U.S. Army Corps of Engineers [USACE] EM-1110-2-1906 Form 2086.)

4. Embankment Protection

a. The maximum levee slope land side is: 0H:1V (vertical)

b. The maximum levee slope flood side is: 0H:1V (vertical)

c. The range of velocities along the levee during the base flood is: 6.3 fps (min.) to 16.4 fps (max.)

d. Embankment material is protected by (describe what kind): Reinforced concrete floodwall (no riprap specified in design)

e. Riprap Design Parameters (check one): ☐ Velocity ☐ Tractive stress
Attach references

Reach	Sideslope	Flow Depth	Velocity	Curve or Straight	Stone Riprap			Depth of Toedown
					D_{100}	D_{50}	Thickness	
Sta to								
Sta to								
Sta to								
Sta to								
Sta to								
Sta to								

(Extend table on an added sheet as needed and reference each entry)

f. Is a bedding/filter analysis and design attached? ☐ Yes ☒ No

g. Describe the analysis used for other kinds of protection used (include copies of the design analysis):

Settlement/stabilty analyses for concrete floodwall provided with CLOMR report (Appendix H)

Attach engineering analysis to support construction plans.

5. Embankment And Foundation Stability

a. Identify locations and describe the basis for selection of critical location for analysis:
Critical slope located at approx. steepest section identified was used.

☐ Overall height: Sta.: _____, height _____ ft.

☒ Limiting foundation soil strength:

Strength ϕ = 24.2 degrees, c = 153 psf

Slope: SS = 5 (h) to 1 (v)

(Repeat as needed on an added sheet for additional locations)

b. Specify the embankment stability analysis methodology used (e.g., circular arc, sliding block, infinite slope, etc.):
Circular arc

c. Summary of stability analysis results: See Golder geotech analysis (CLOMR Report - Appendix H)

E. LEVEE/FLOODWALL (CONTINUED)

5. Embankment And Foundation Stability (continued)

Case	Loading Conditions	Critical Safety Factor	Criteria (Min.)
I	End of construction	>2	1.3
II	Sudden drawdown	Not analyzed, as flood stage is expected to be rapid	1.0
III	Critical flood stage	>2	1.4
IV	Steady seepage at flood stage	Not analyzed, as flood stage is expected to be rapid	1.4
VI	Earthquake (Case I)	>2	1.0

(Reference: USACE EM-1110-2-1913 Table 6-1)

d. Was a seepage analysis for the embankment performed? ☐ Yes ☒ No

If Yes, describe methodology used:

e. Was a seepage analysis for the foundation performed? ☐ Yes ☒ No

f. Were uplift pressures at the embankment landside toe checked? ☐ Yes ☒ No

g. Were seepage exit gradients checked for piping potential? ☐ Yes ☒ No

h. The duration of the base flood hydrograph against the embankment is 28 hours.

Attach engineering analysis to support construction plans.

6. Floodwall And Foundation Stability (Per GWC Engineering analysis in Appendix H of CLOMR Report, unless otherwise noted)

a. Describe analysis submittal based on Code (check one): ☐ UBC (1988) ☒ Other (specify): Industry Standard

b. Stability analysis submitted provides for: ☒ Overturning ☒ Sliding If not, explain: _____

c. Loading included in the analyses were: ☒ Lateral earth @ P_A = 50 psf; P_p = 275 psf

☒ Surcharge-Slope @ 3ft BGS, ☐ surface 1000 psf (see MT-2 Supplemental Information)

☐ Wind @ P_w = _____ psf

☐ Seepage (Uplift); _____ ☒ Earthquake @ P_{eq} = 0.048 %g (see MT-2 Supplemental Information)

☐ 1%-annual-chance significant wave height: _____ ft.

☐ 1%-annual-chance significant wave period: _____ sec.

d. Summary of Stability Analysis Results: Factors of Safety.
Itemize for each range in site layout dimension and loading condition limitation for each respective reach.

Loading Condition	Criteria (Min)		All Sections/Loads	All Sections/Loads	Sta	To
	Overturn	Sliding	Overturn	Sliding	Overturn	Sliding
Dead & Wind	1.5	1.5	2.0	1.5		
Dead & Soil	1.5	1.5	2.0	1.5		
Dead, Soil, Flood, & Impact	1.5	1.5	2.0	1.5		
Dead, Soil, & Seismic	1.3	1.3	1.3	1.3		

(Ref: FEMA 114 Sept 1986; USACE EM 1110-2-2502)
Note: (Extend table on an added sheet as needed and reference)

E. LEVEE/FLOODWALL (CONTINUED)

6. Floodwall And Foundation Stability (continued)

   e. Foundation bearing strength for each soil type:

Bearing Pressure	Sustained Load (psf)	Short Term Load (psf)
Computed design maximum	7191	7191
Maximum allowable	2000	2000

f. Foundation scour protection ☐ is, ☒ is not provided. If provided, attach explanation and supporting documentation:

Attach engineering analysis to support construction plans.

7. Settlement

a. Has anticipated potential settlement been determined and incorporated into the specified construction elevations to maintain the established freeboard margin? ☒ Yes ☐ No

b. The computed range of settlement is 0 ft. to 0.03 ft.

c. Settlement of the levee crest is determined to be primarily from : ☒ Foundation consolidation ☐ Embankment compression ☐ Other (Describe): _____

d. Differential settlement of floodwalls ☒ has ☐ has not been accommodated in the structural design and construction.

Attach engineering analysis to support construction plans. (See CLOMR Report Appendix H for engineering analysis)

8. Interior Drainage (See MT-2 Supplemental Information)

a. Specify size of each interior watershed:

Draining to pressure conduit: _____ acres
Draining to ponding area: _____ acres

b. Relationships Established

Ponding elevation vs. storage	☐ Yes	☒ No
Ponding elevation vs. gravity flow	☐ Yes	☒ No
Differential head vs. gravity flow	☐ Yes	☒ No

c. The river flow duration curve is enclosed: ☐ Yes ☐ No

d. Specify the discharge capacity of the head pressure conduit: _____ cfs

e. Which flooding conditions were analyzed?

• Gravity flow (Interior Watershed)	☐ Yes	☒ No
• Common storm (River Watershed)	☐ Yes	☒ No
• Historical ponding probability	☐ Yes	☒ No
• Coastal wave overtopping	☐ Yes	☒ No

If No for any of the above, attach explanation.

e. Interior drainage has been analyzed based on joint probability of interior and exterior flooding and the capacities of pumping and outlet facilities to provide the established level of flood protection. ☐ Yes ☐ No If No, attach explanation.

g. The rate of seepage through the levee system for the base flood is _____ cfs

h. The length of levee system used to drive this seepage rate in item g: _____ ft.

E. LEVEE/FLOODWALL (CONTINUED)

8. Interior Drainage (continued)

i. Will pumping plants be used for interior drainage? ☐ Yes ☒ No

If Yes, include the number of pumping plants: _____ For each pumping plant, list:

	Plant #1	Plant #2
The number of pumps		
The ponding storage capacity		
The maximum pumping rate		
The maximum pumping head		
The pumping starting elevation		
The pumping stopping elevation		
Is the discharge facility protected?		
Is there a flood warning plan?		
How much time is available between warning and flooding?		

Will the operation be automatic? ☐ Yes ☐ No

If the pumps are electric, are there backup power sources? ☐ Yes ☐ No

(Reference: USACE EM-1110-2-3101, 3102, 3103, 3104, and 3105)

Include a copy of supporting documentation of data and analysis. Provide a map showing the flooded area and maximum ponding elevations for all interior watersheds that result in flooding.

9. Other Design Criteria

a. The following items have been addressed as stated:

Liquefaction ☐ is ☒ is not a problem
Hydrocompaction ☐ is ☒ is not a problem
Heave differential movement due to soils of high shrink/swell ☐ is ☒ is not a problem

b. For each of these problems, state the basic facts and corrective action taken:

Attach supporting documentation

c. If the levee/floodwall is new or enlarged, will the structure adversely impact flood levels and/or flow velocities floodside of the structure?
☐ Yes ☐ No Attach supporting documentation

d. Sediment Transport Considerations:

Was sediment transport considered? ☐ Yes ☒ No
If Yes, then fill out Section F (Sediment Transport). If No, then attach your explanation for why sediment transport was not considered.

10. Operational Plan And Criteria (See MT-2 Supplemental Information)

a. Are the planned/installed works in full compliance with Part 65.10 of the NFIP Regulations? ☐ Yes ☐ No

b. Does the operation plan incorporate all the provisions for closure devices as required in Paragraph 65.10(c)(1) of the NFIP regulations?
☐ Yes ☐ No

c. Does the operation plan incorporate all the provisions for interior drainage as required in Paragraph 65.10(c)(2) of the NFIP regulations?
☐ Yes ☐ No If the answer is No to any of the above, please attach supporting documentation.

E. LEVEE/FLOODWALL (CONTINUED)

11. Maintenance Plan
Please attach a copy of the fomal maintenance plan for the levee/floodwall (See CLOMR Report – Appendix J)

12. Operations and Maintenance Plan

Please attach a copy of the formal Operations and Maintenance Plan for the levee/floodwall. (See CLOMR Report – Appendix J)

CERTIFICATION OF THE LEVEE DOCUMENTION

This certification is to be signed and sealed by a licensed registered professional engineer authorized by law to certify elevation information data, hydrologic and hydraulic analysis, and any other supporting information as per NFIP regulations paragraph 65.10(e) and as described in the MT-2 Forms Instructions. All documents submitted in support of this request are correct to the best of my knowledge. I understand that any false statement may be punishable by fine or imprisonment under Title 18 of the United States Code, Section 1001.

Certifier's Name: Jeff Fassett License No.: 85675 Expiration Date: 06-30-2019

Company Name: Golder Associates Telephone No.: 281-821-6868 Fax No.: _____

Signature:

Date: 08/28/2018 E-Mail Address: Jeff_Fassett@golder.com

F. SEDIMENT TRANSPORT

Flooding Source: _____

Name of Structure: _____

If there is any indication from historical records that sediment transport (including scour and deposition) can affect the Base Flood Elevation (BFE); and/or based on the stream morphology, vegetative cover, development of the watershed and bank conditions, there is a potential for debris and sediment transport (including scour and deposition) to affect the BFEs, then provide the following information along with the supporting documentation:

Sediment load associated with the base flood discharge: Volume _____ acre-feet

Debris load associated with the base flood discharge: Volume _____ acre-feet

Sediment transport rate _____ (percent concentration by volume)

Method used to estimate sediment transport: _____

Most sediment transport formulas are intended for a range of hydraulic conditions and sediment sizes; attach a detailed explanation for using the selected method.

Method used to estimate scour and/or deposition: _____

Method used to revise hydraulic or hydrologic analysis (model) to account for sediment transport: _____

Please note that bulked flows are used to evaluate the performance of a structure during the base flood; however, FEMA does not map BFEs based on bulked flows.

If a sediment analysis has not been performed, an explanation as to why sediment transport (including scour and deposition) will not affect the BFEs or structures must be provided.

STEWART CREEK CLOMR - SUPPLEMENTAL MT-2 INFORMATION

FORM 3 - RIVERINE STRUCTURES FORM

C. BRIDGE/CULVERT

1. Culvert modeled in effective FIS HEC-2 model as a bridge. HEC-RAS models developed for this study models this structure as a culvert.

3. No construction plans of the existing culvert were available. Survey information of the existing culvert crossing (elevations at the inlet, outlet, top of roadway, etc.) and ground-level photos were collected as part of this study for developing the hydraulic modeling and work maps. Produced work maps have been certified by a professional engineer.

4. Channel alignment and meander for Stewart Creek in this study limit is consistent with the model data developed for the effective FIS in 1977, indicating stable stream morphology. Existing channel is densely vegetated. Culvert inlets are unobstructed with minor observable sediment deposition at the culvert outlets. There is little evidence to suggest that significant sediment transport that would affect the base flood elevations occurs.

E. LEVEE/FLOODWALL

6.c. Surcharge and earthquake loading conditions analyzed as part of Golder's geotechnical analysis of the floodwall, provided in Appendix H of the CLOMR report.

8. Interior Drainage: Floodwall designed so that interior slopes drain away from the wall. No ponding along the inside of the wall is anticipated

9. Other design criteria

d. Sediment transport was not considered based on qualitative assessment noted in the above supplemental information for Form 3, Section C.4.

10. Operational Plan and Criteria – there are no closure devices or mechanical systems for internal drainage provided with the proposed floodwall. As such no operational plan or criteria has been developed.

APPENDIX A-2

Floodwall Ponding Calculation

TECHNICAL CALCULATIONS MEMORANDUM

DATE	August 28, 2018	**Project No.**	1302086-06
SUBJECT	Exide CLOMR	**Prepared by:**	Micah Richey
		Checked by:	Sheina Sadza
TITLE	Floodwall Ponding - 100-Year, 24-Hour Flood Duration	**Reviewed by:**	Jeff Fassett

1.0 INTRODUCTION

This calculation brief has been prepared by Golder Associates Inc. (Golder) to estimate the length of time the flood wall around the Exide property will be impacted by flood waters in Stewart Creek during the 100-year (yr), 24-hour (hr) flood event.

2.0 METHODOLOGY

The peak flow rate for the 100-yr, 24-hr storm event was referenced from the Flood Insurance Study (FIS) for Collin County and Incorporated areas (FEMA 2017). This flow rate was used to develop the 100-yr, 24-hr discharge hydrograph to estimate the time that the proposed floodwall will be exposed to flood waters in Stewart Creek.

According to the FIS study, the 100-yr, 24-hour peak discharge was developed using Natural Resource Conservation Service (NRCS) TR-20 methodology. The discharge hydrograph was then calculated using the Dimensionless unit hydrograph that is the default for TR-20 (NRCS 2007). Inputs for this hydrograph are peak discharge and time to peak discharge. Time to peak for the unit hydrograph is estimated based on the applicable 24-hour rainfall distribution and the watershed lag time. The lag time for the portion of Stewart Creek up to the floodwall was estimated by estimating the flowpath from Google Earth™ (Google, 2018) and Bureau of Reclamation methods (USBR 1989).

The Proposed Conditions HEC-RAS model was used to determine the minimum flowrate which would produce a water level in Stewart Creek that would reach the floodwall. With this minimum flow rate and the time to peak, the resulting discharge hydrograph was generated to estimate the length of time that flows in Stewart Creek impact the floodwall.

3.0 ASSUMPTIONS

- A Kn for the Great Plains of 0.069 was used in the lag time calculation (USBR 1989)

- The 100-yr, 24-hr peak flow in Stewart Creek along the floodwall is 6,800 cfs (FEMA 2017)
- NRCS Type III rainfall distribution for the site, with peak rainfall occurring at t=12.0 hours for the 100-yr, 24-hr event.

4.0 RESULTS

The minimum flowrate which would produce a water level in Stewart Creek would reach the flood wall, estimated from HEC-RAS is approximately 1,000 cfs. The lag time was estimated to be 88 minutes as shown in Table 1, attached. The unit hydrograph provided as Table 2 shows that the flood wall will be impacted by flood waters for approximately 29 hours during the 100-yr, 24-hr storm event.

5.0 REFERENCES

Federal Emergency Management Agency (FEMA). 2017. Flood Insurance Study. Collin County, Texas and Incorporated Areas, Volume 1 of 4. June 7, 2017.

Google Earth 7.3.2.5491 (July 23, 2018) (Google). Collin County, Texas. Latitude 33.138926^0, Longitude -96.804585^0, Eye alt 732 feet. http://www.earth.google.com [August 20, 2018].

US Bureau of Reclamation (USBR). 1989. Flood Hydrology Manual. Department of the Interior. Washington D.C.: United States Government Printing Office.

U.S. Natural Resources Conservation Service (NRCS). 2007. "Hydrographs" Chapter 16 of the National Engineering Handbook. Washington D.C.: U.S. Department of Agriculture.

Attachments: Table 1 & 2
Attachment 1 – Hydrograph Information
Attachment 2 – HEC-RAS Results – 1000 cfs

x:\tucson\projects\13proj\130208606 exide clomr\001\rev 0\appendices\appa-mt2-forms\floodwall ponding calculation\130208606_cal_001_rev 0_20180828.docx

Table 1 & 2

Table 1: Basin Lag Time Calculations (USBR Basin Centroid Method)

Exide Technologies
CLOMR
PROJECT NO. 1302086-06

Made by	MBR
Checked by	SPS
Approved by	JBF

Basin		Area (mi^2)	Centroid (X - Y)		Kn	C = 26*Kn	L (ft)	L (mi)	Lca (ft)	Lca (mi)	Δ El. (ft)	S (ft/ft)	S (ft/mi)	N	(L*Lca)/(S^.5)	Lg (hr)	Lg (min)
SC		3.21	Lat. 33.1384, Long. -96.8046		0.069	1.794	13,383	2.5347	7,992	1.5136	130	0.010	51	0.33	0.54	1.46	88

USBR BASIN CENTROID METHOD EQUATION:

$$L_g = C\left(\frac{LL_{ca}}{S^{0.5}}\right)^N$$

Where:

Lg = Unit hydrograph lag time, in hours
C = Constant
L = The length of the longest watercourse from the point of concentration to the boundary of the drainage basin, in miles. The point of concentration is the location on the watercourse where a hydrograph is desired.
Lca = the length along the longest watercourse from the point of concentration to a point opposite the centroid of the basin, in miles.
S = The overall slope of the longest watercourse (along L), in feet per mile.
N = exponent, typically 0.33

Table 2: NRCS Unit Hydrograph

NRCS Dimensionless Hydrograph

Time Ratios (t/T_p)	Time (min)	Discharge Ratios (q/q_p)	Discharge (cfs)
0	0	0.000	0
0.1	81	0.030	204
0.2	162	0.100	680
0.25	204	N/A	1000
0.3	242	0.190	1292
0.4	323	0.310	2108
0.5	404	0.470	3196
0.6	485	0.660	4488
0.7	565	0.820	5576
0.8	646	0.930	6324
0.9	727	0.990	6732
1.0	**808**	**1.000**	**6,800**
1.1	888	0.990	6732
1.2	969	0.930	6324
1.3	1050	0.860	5848
1.4	1131	0.780	5304
1.5	1211	0.680	4624
1.6	1292	0.560	3808
1.7	1373	0.460	3128
1.8	1454	0.390	2652
1.9	1534	0.330	2244
2.0	1615	0.280	1904
2.2	1777	0.207	1408
2.4	1938	0.147	1000
2.6	2100	0.107	728
2.8	2261	0.077	524
3.0	2423	0.055	374
3.2	2584	0.040	272
3.4	2746	0.029	197
3.6	2907	0.021	143
3.8	3069	0.015	102
4.0	3230	0.011	75
4.5	3634	0.005	34
5.0	4038	0.000	0

← Manual interpolation to determine time at Q = 1,000 cfs

Total Time 100-Year Discharge Exceeds 1,000 cfs:
1734 minutes or
28.9 hours

Attachment 1

Hydrograph Information

curvilinear hydrograph, also shown in table 16–1, has its ordinate values expressed in a dimensionless ratio q/q_p or Q_a/Q and its abscissa values as t/T_P. This unit hydrograph has a point of inflection approximately 1.7 times the time to peak (T_p). The unit hydrograph in table 16–1 has a peak rate factor (PRF) of 484 and is the default provided in the WinTR–20 program. See appendix 16A for derivation of the standard NRCS dimensionless hydrograph.

Table 16–1 Ratios for dimensionless unit hydrograph and mass curve

Time ratios (t/T_p)	Discharge ratios (q/q_p)	Mass curve ratios (Q_a/Q)
0	.000	.000
.1	.030	.001
.2	.100	.006
.3	.190	.017
.4	.310	.035
.5	.470	.065
.6	.660	.107
.7	.820	.163
.8	.930	.228
.9	.990	.300
1.0	1.000	.375
1.1	.990	.450
1.2	.930	.522
1.3	.860	.589
1.4	.780	.650
1.5	.680	.705
1.6	.560	.751
1.7	.460	.790
1.8	.390	.822
1.9	.330	.849
2.0	.280	.871
2.2	.207	.908
2.4	.147	.934
2.6	.107	.953
2.8	.077	.967
3.0	.055	.977
3.2	.040	.984
3.4	.029	.989
3.6	.021	.993
3.8	.015	.995
4.0	.011	.997
4.5	.005	.999
5.0	.000	1.000

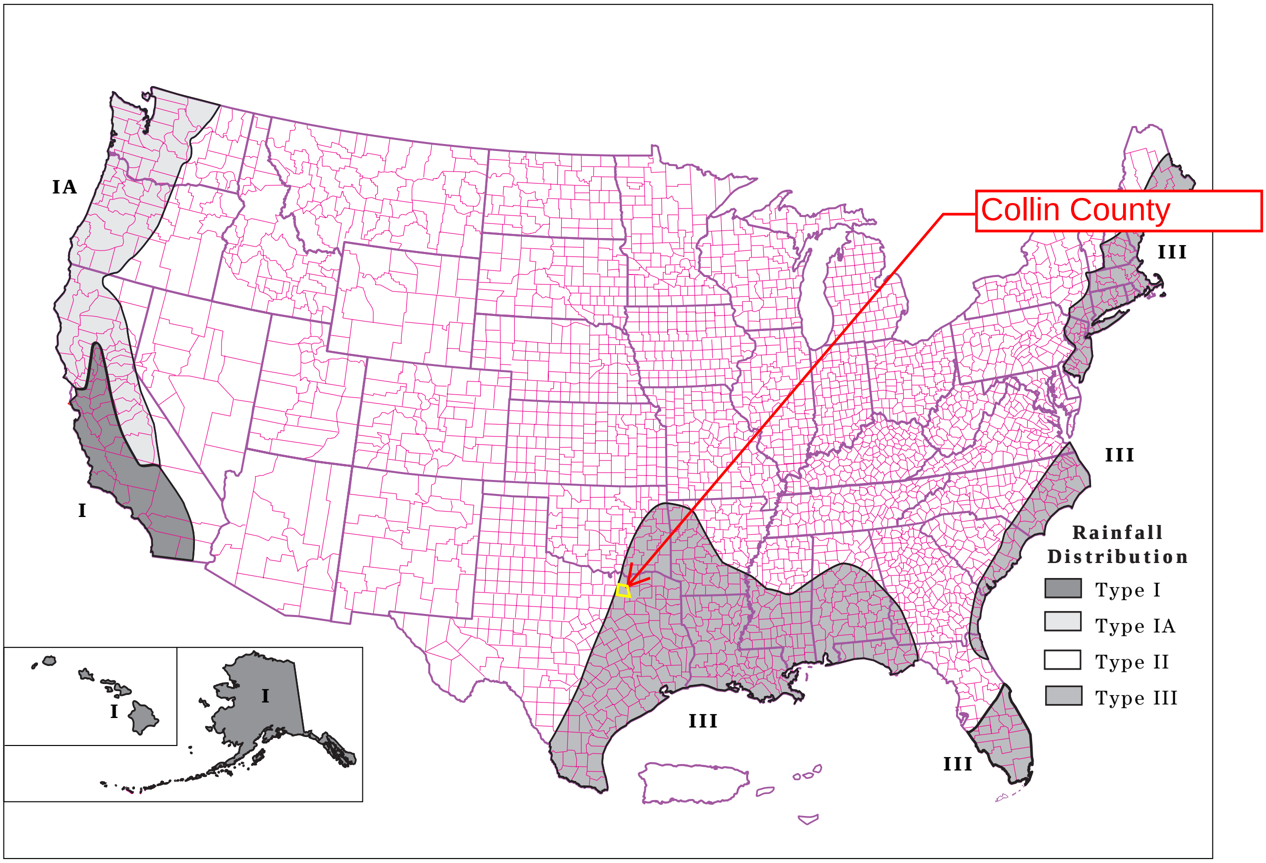
630.1603 Application of unit hydrograph

The unit hydrograph can be constructed for any location on a regularly shaped watershed, once the values of q_p and T_p are defined (fig. 16–2, areas A and B).

Area C in figure 16–2 is an irregularly shaped watershed having two regularly shaped areas (C2 and C1) with a large difference in their time of concentration. This watershed requires the development of two unit hydrographs that may be added together, forming one irregularly shaped unit hydrograph. This irregularly shaped unit hydrograph may be used to develop a flood hydrograph in the same way as the unit hydrograph developed from the dimensionless form (fig. 16–1) is used to develop the flood hydrograph. See example 16–1 which develops a composite flood hydrograph for area A shown in figure 16–2. Also, each of the two unit hydrographs developed for areas C2 and C1 in figure 16–2 may be used to develop flood hydrographs for the respective areas C2 and C1. The flood hydrographs from each area are then combined to form the hydrograph at the outlet of area C.

Many variables are integrated into the shape of a unit hydrograph. Since a dimensionless unit hydrograph is used and the only parameters readily available from field data are drainage area and time of concentration, consideration should be given to dividing the watershed into hydrologic units of uniformly shaped areas. These subareas, if at all possible, should have a homogeneous drainage pattern, homogeneous land use and approximately the same size. To assure that all contributing subareas are adequately represented, it is suggested that no subarea exceed 20 square miles in area and that the ratio of the largest to the smallest drainage area not exceed 10.

Figure B-2 Approximate geographic boundaries for NRCS (SCS) rainfall distributions



Rainfall data sources

This section lists the most current 24-hour rainfall data published by the National Weather Service (NWS) for various parts of the country. Because NWS Technical Paper 40 (TP-40) is out of print, the 24-hour rainfall maps for areas east of the 105th meridian are included here as figures B-3 through B-8. For the area generally west of the 105th meridian, TP-40 has been superseded by NOAA Atlas 2, the Precipitation-Frequency Atlas of the Western United States, published by the National Ocean and Atmospheric Administration.

East of 105th meridian

Hershfield, D.M. 1961. Rainfall frequency atlas of the United States for durations from 30 minutes to 24 hours and return periods from 1 to 100 years. U.S. Dept. Commerce, Weather Bur. Tech. Pap. No. 40. Washington, DC. 155 p.

West of 105th meridian

Miller, J.F., R.H. Frederick, and R.J. Tracey. 1973. Precipitation-frequency atlas of the Western United States. Vol. I Montana; Vol. II, Wyoming; Vol III, Colorado; Vol. IV, New Mexico; Vol V, Idaho; Vol. VI, Utah; Vol. VII, Nevada; Vol. VIII, Arizona; Vol. IX, Washington; Vol. X, Oregon; Vol. XI, California. U.S. Dept. of Commerce, National Weather Service, NOAA Atlas 2. Silver Spring, MD.

Alaska

Miller, John F. 1963. Probable maximum precipitation and rainfall-frequency data for Alaska for areas to 400 square miles, durations to 24 hours and return periods from 1 to 100 years. U.S. Dept. of Commerce, Weather Bur. Tech. Pap. No. 47. Washington, DC. 69 p.

Hawaii

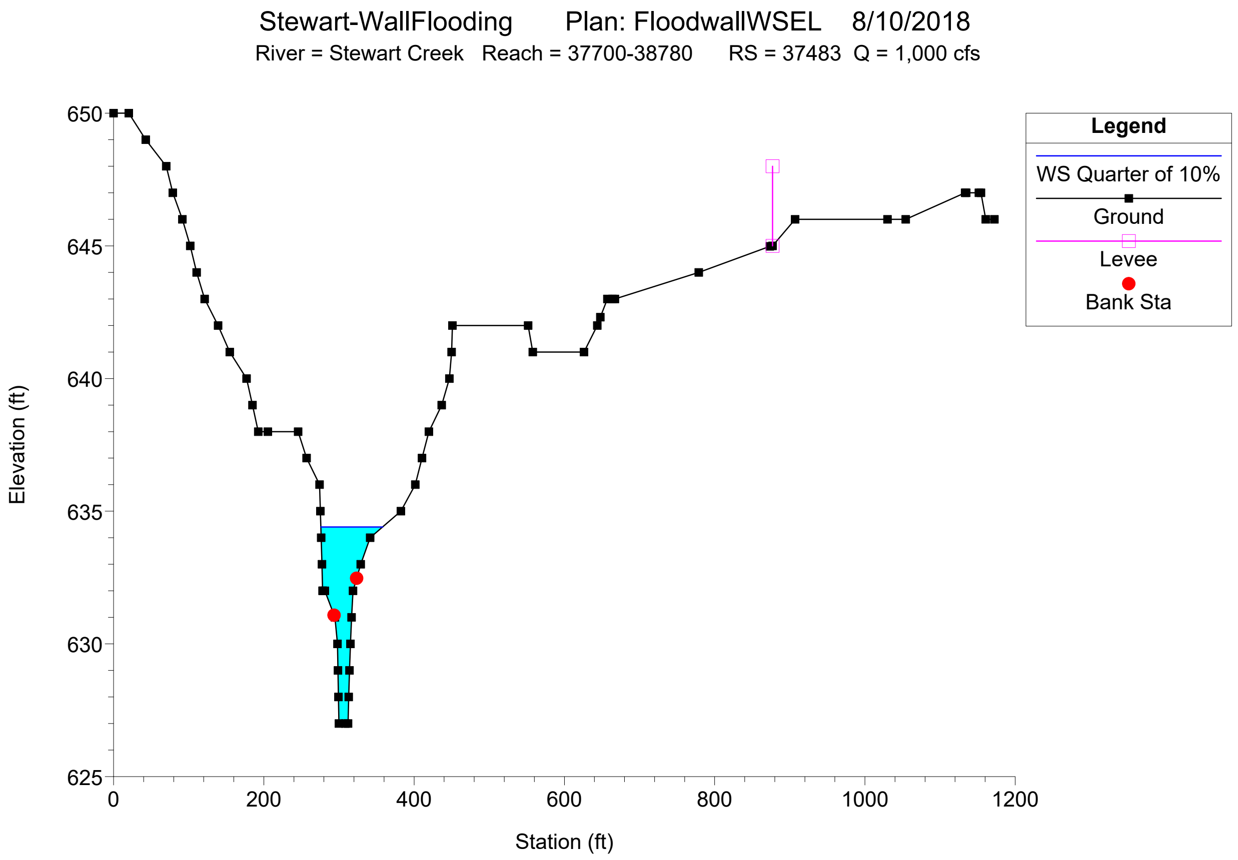
Weather Bureau. 1962. Rainfall-frequency atlas of the Hawaiian Islands for areas to 200 square miles, durations to 24 hours and return periods from 1 to 100 years. U.S. Dept. Commerce, Weather Bur. Tech. Pap. No. 43. Washington, DC. 60 p.

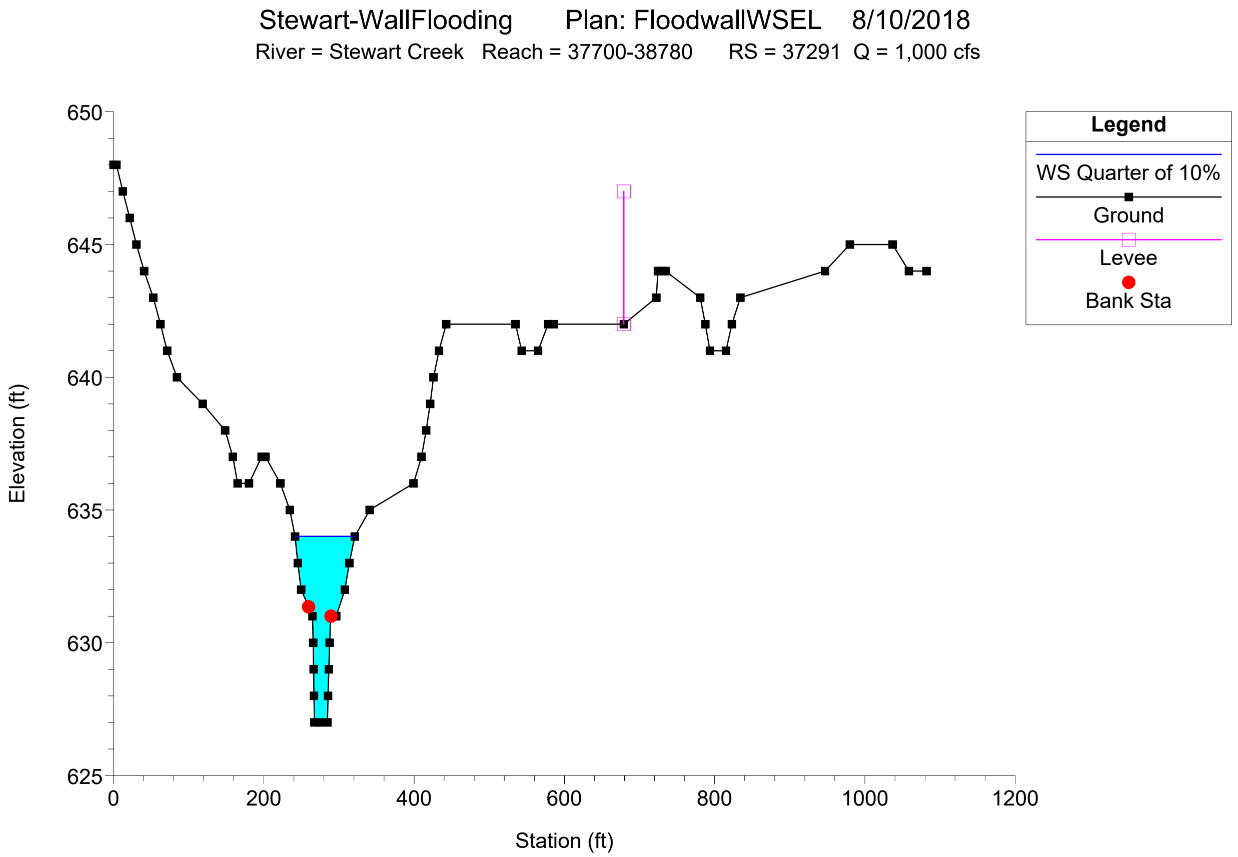
Puerto Rico and Virgin Islands

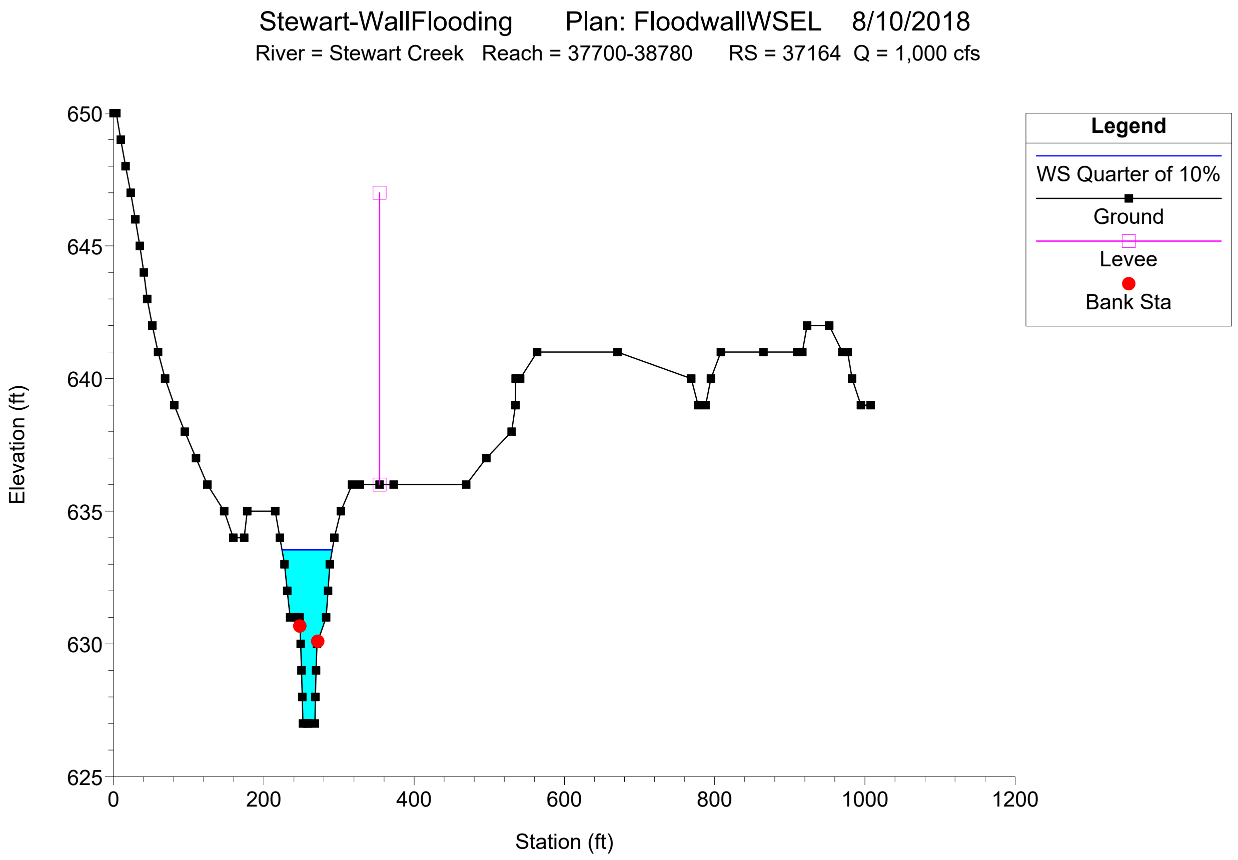
Weather Bureau. 1961. Generalized estimates of probable maximum precipitation and rainfall-frequency data for Puerto Rico and Virgin Islands for areas to 400 square miles, durations to 24 hours, and return periods from 1 to 100 years. U.S. Dept. Commerce, Weather Bur. Tech. Pap. No. 42. Washington, DC. 94 P.

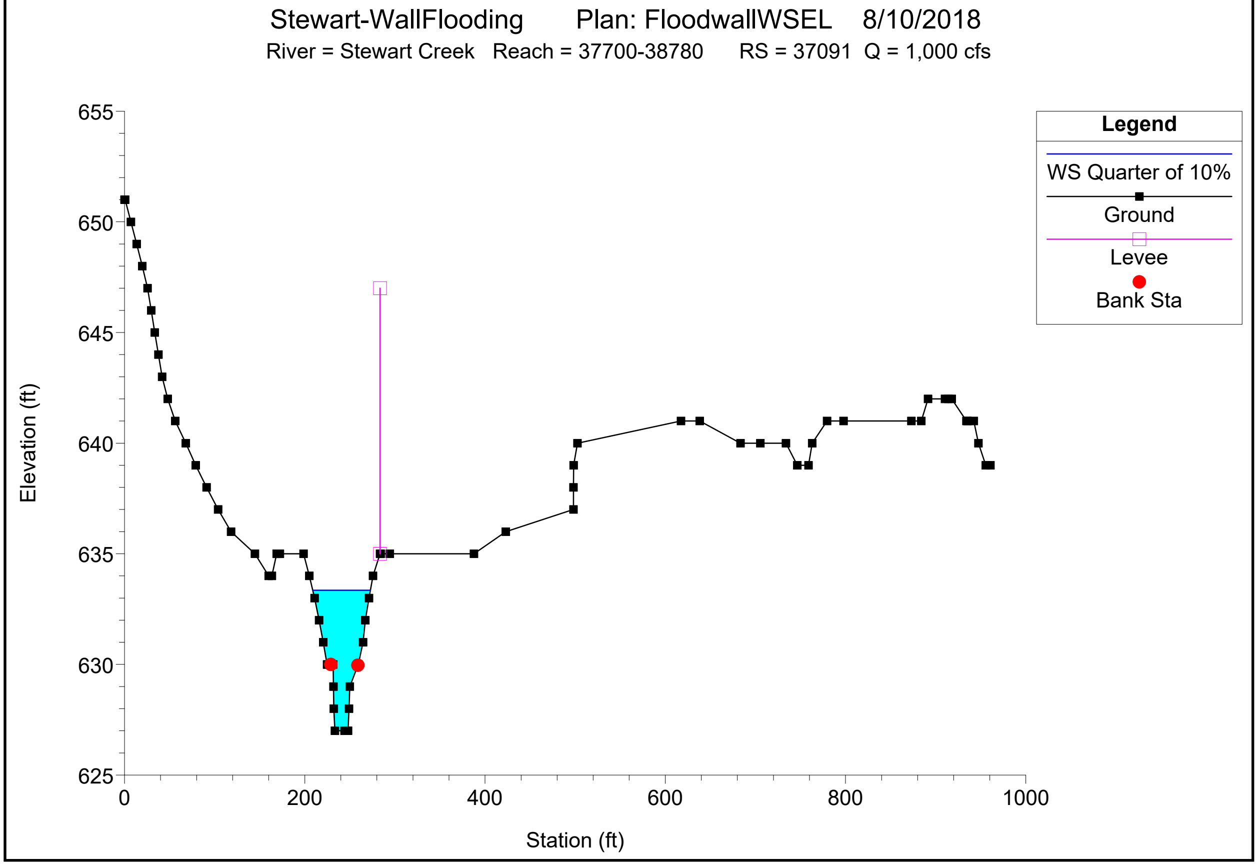
Attachment 2

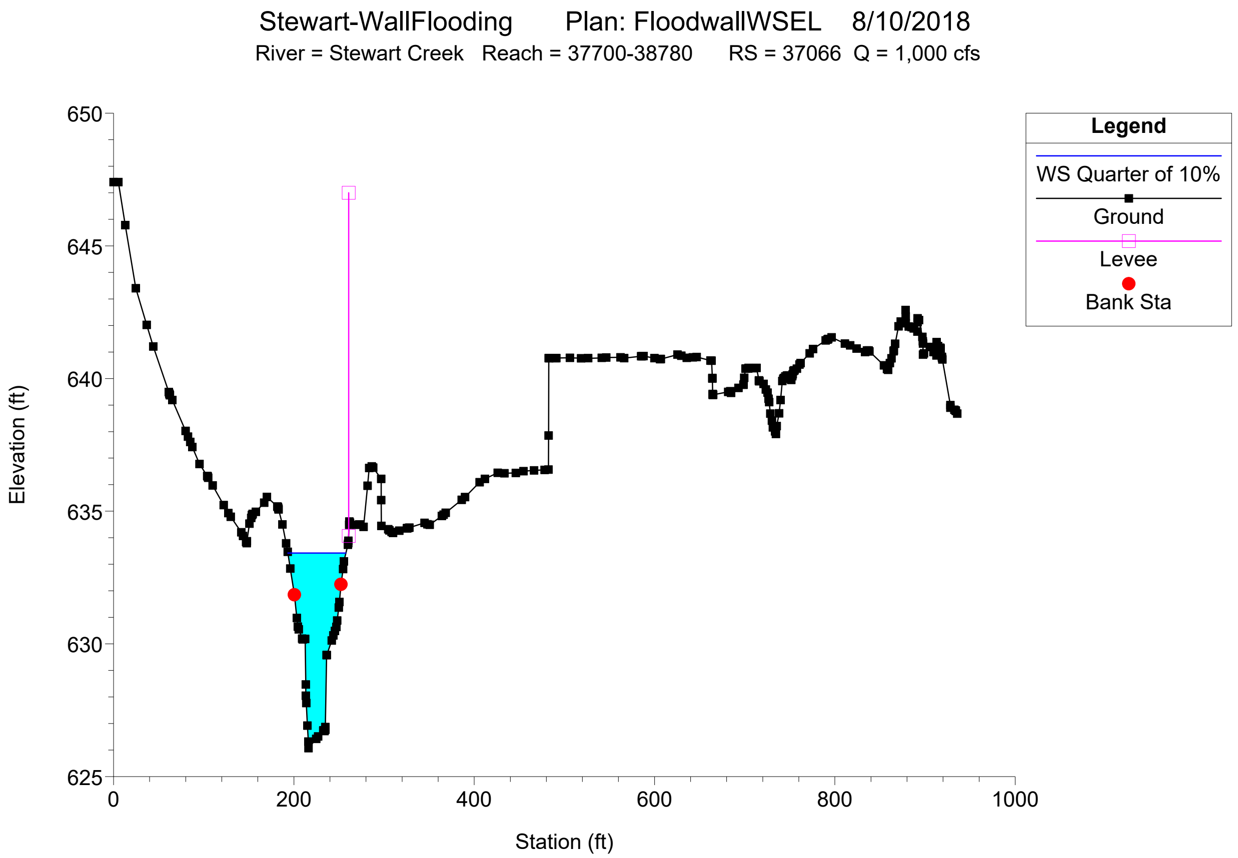
HEC-RAS Results – 1000 cfs

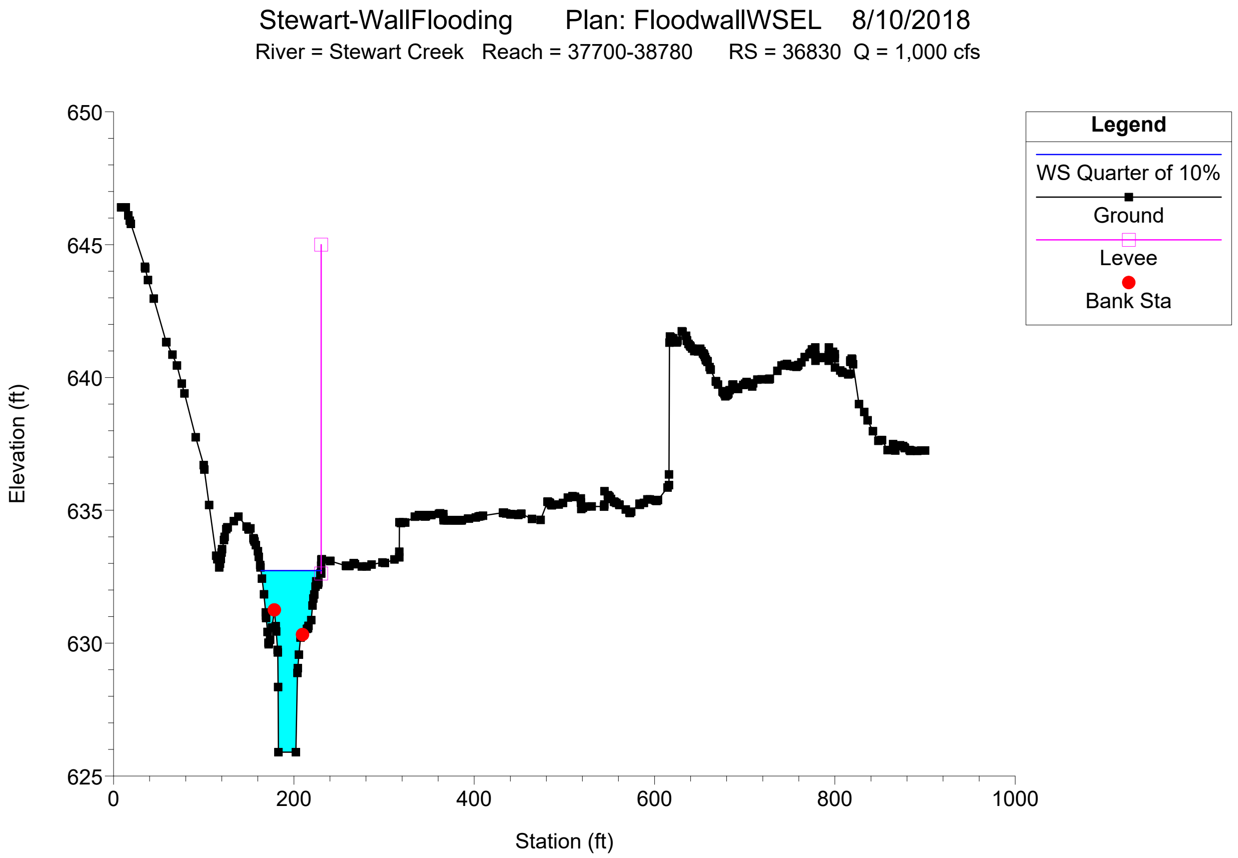

Stewart-WallFlooding Plan: FloodwallWSEL 8/10/2018
River = Stewart Creek Reach = 37700-38780 RS = 37483 Q = 1,000 cfs
Elevation (ft)
650
645
640
635
630
625
0
200
400
600
800
1000
1200
Station (ft)
Legend
WS Quarter of 10%
Ground
Levee
Bank Sta


Stewart-WallFlooding Plan: FloodwallWSEL 8/10/2018
River = Stewart Creek Reach = 37700-38780 RS = 37291 Q = 1,000 cfs
Elevation (ft)
650
645
640
635
630
625
0
200
400
600
800
1000
1200
Station (ft)
Legend
WS Quarter of 10%
Ground
Levee
Bank Sta


Stewart-WallFlooding Plan: FloodwallWSEL 8/10/2018
River = Stewart Creek Reach = 37700-38780 RS = 37164 Q = 1,000 cfs
Legend
WS Quarter of 10%
Ground
Levee
Bank Sta
Elevation (ft)
650
645
640
635
630
625
0
200
400
600
800
1000
1200
Station (ft)


Stewart-WallFlooding Plan: FloodwallWSEL 8/10/2018
River = Stewart Creek Reach = 37700-38780 RS = 37091 Q = 1,000 cfs
Legend
WS Quarter of 10%
Ground
Levee
Bank Sta
Elevation (ft)
655
650
645
640
635
630
625
0
200
400
600
800
1000
Station (ft)


Stewart-WallFlooding Plan: FloodwallWSEL 8/10/2018
River = Stewart Creek Reach = 37700-38780 RS = 37066 Q = 1,000 cfs
Elevation (ft)
650
645
640
635
630
625
0
200
400
600
800
1000
Station (ft)
Legend
WS Quarter of 10%
Ground
Levee
Bank Sta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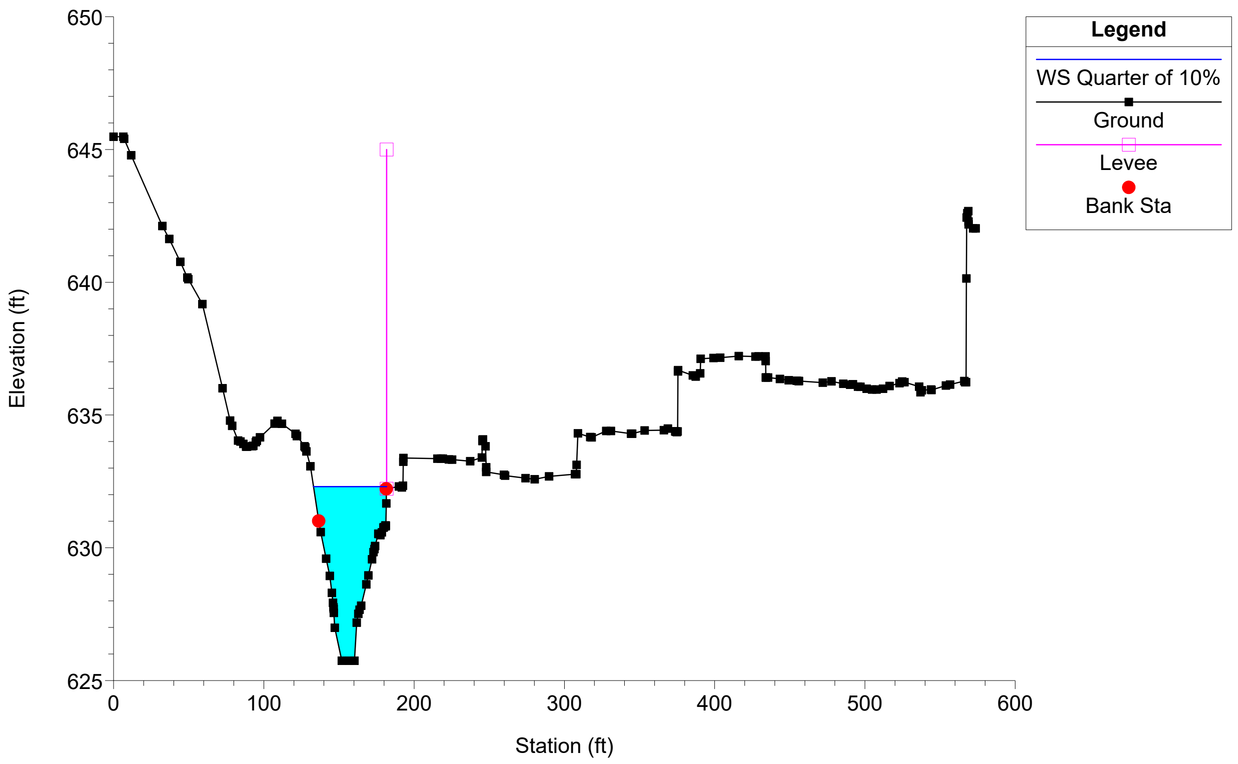
River = Stewart Creek Reach = 37700-38780 RS = 36830 Q = 1,000 cfs
Elevation (ft)
650
645
640
635
630
625
0
200
400
600
800
1000
Station (ft)
Legend
WS Quarter of 10%
Ground
Levee
Bank Sta

Stewart-WallFlooding Plan: FloodwallWSEL 8/10/2018
River = Stewart Creek Reach = 37700-38780 RS = 36711 Q = 1,000 cfs



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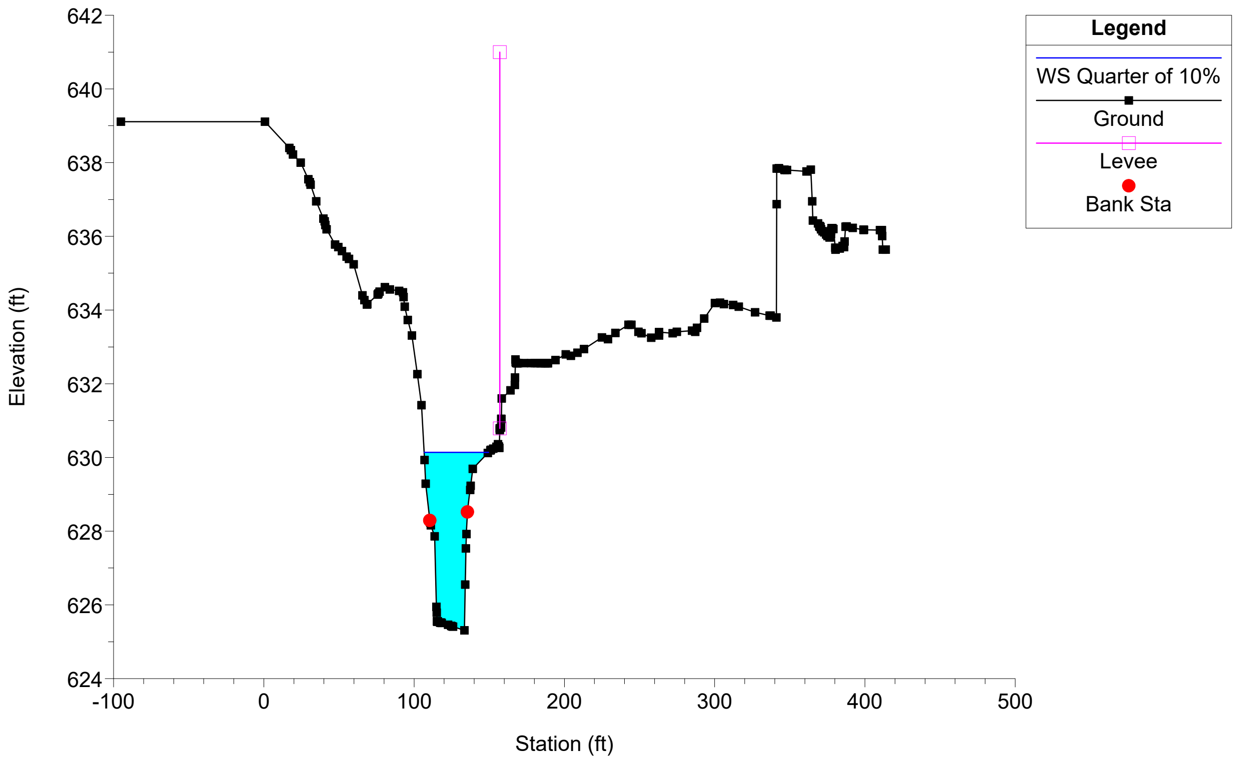
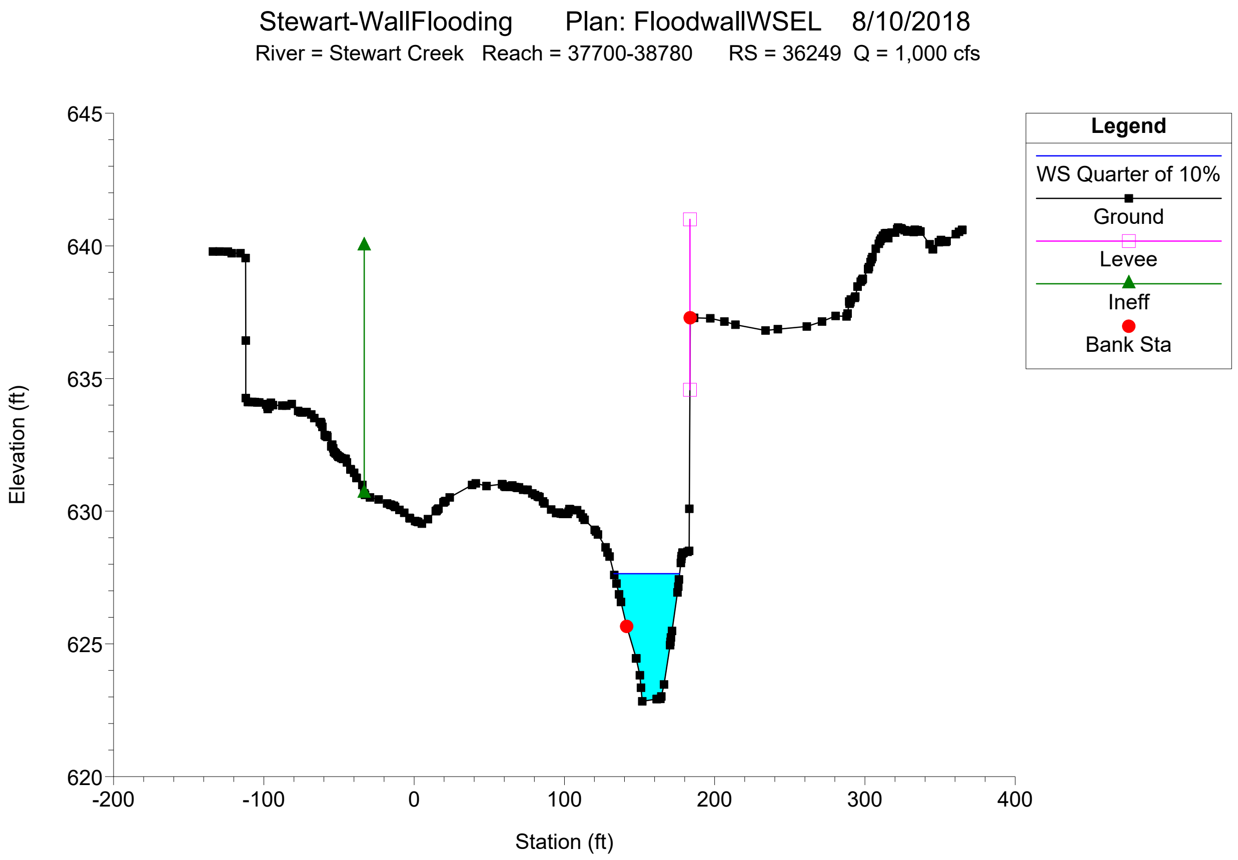
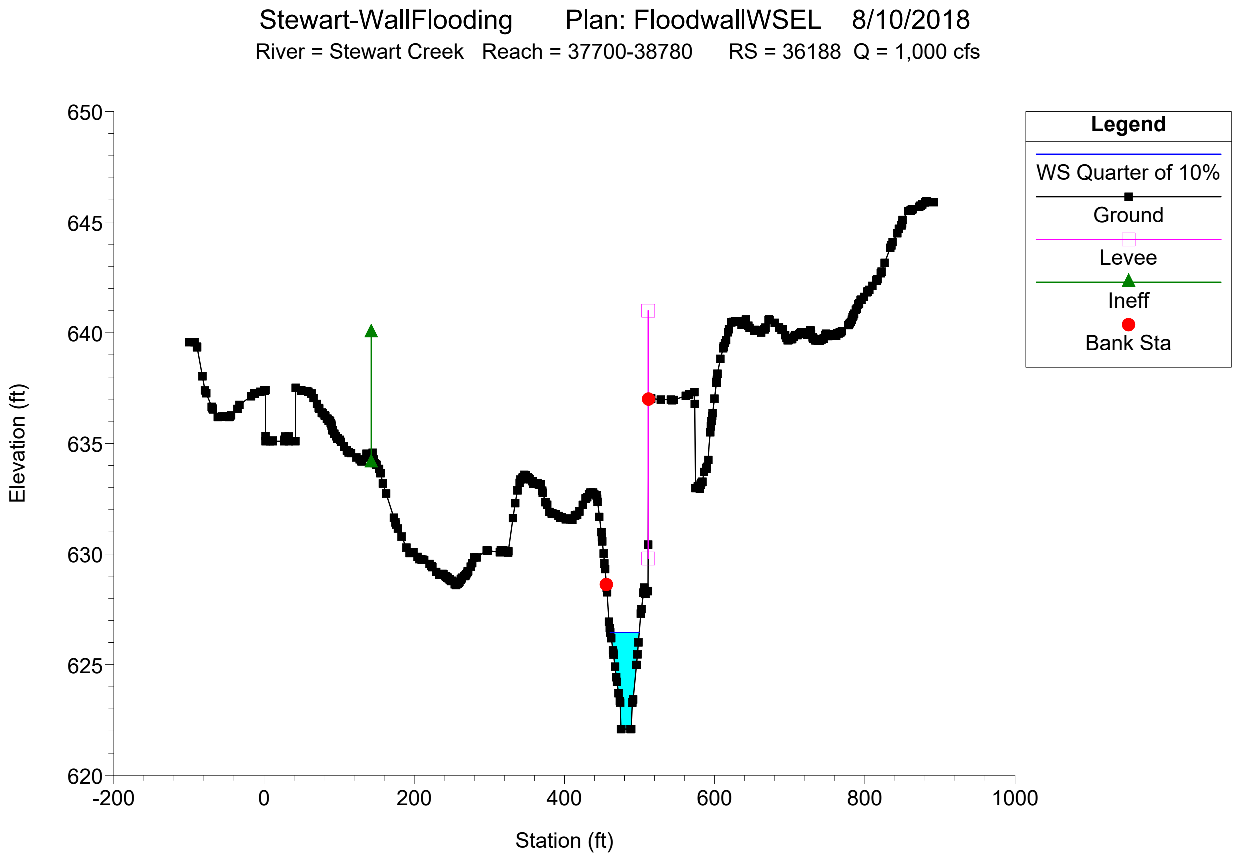
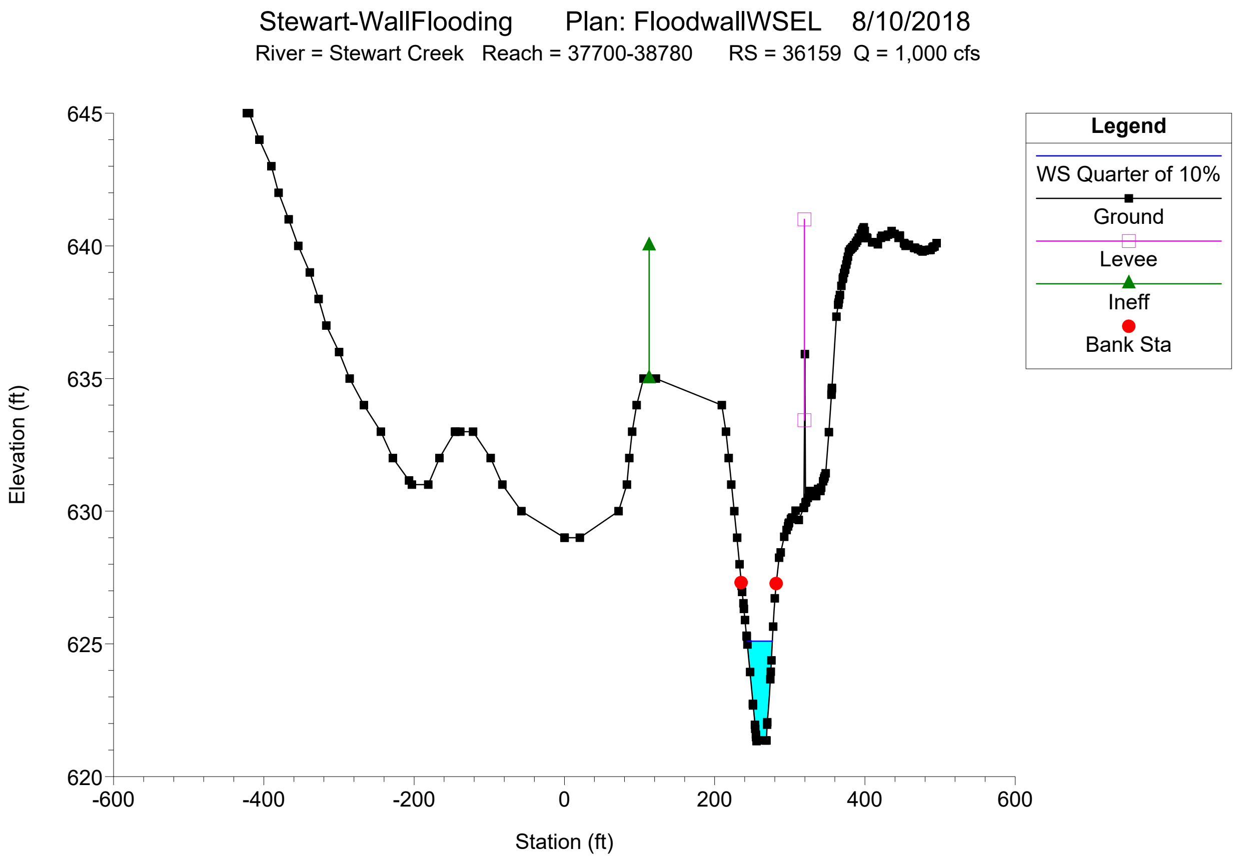




Stewart-WallFlooding Plan: FloodwallWSEL 8/10/2018
River = Stewart Creek Reach = 37700-38780 RS = 36249 Q = 1,000 cfs
Legend
WS Quarter of 10%
Ground
Levee
Ineff
Bank Sta
Elevation (ft)
645
640
635
630
625
620
Station (ft)
-200
-100
0
100
200
300
400



Stewart-WallFlooding Plan: FloodwallWSEL 8/10/2018
River = Stewart Creek Reach = 37700-38780 RS = 36188 Q = 1,000 cfs
Legend
WS Quarter of 10%
Ground
Levee
Ineff
Bank Sta
Elevation (ft)
650
645
640
635
630
625
620
Station (ft)
-200
0
200
400
600
800
1000


Stewart-WallFlooding Plan: FloodwallWSEL 8/10/2018
River = Stewart Creek Reach = 37700-38780 RS = 36159 Q = 1,000 cfs
Elevation (ft)
645
640
635
630
625
620
-600
-400
-200
0
200
400
600
Station (ft)
Legend
WS Quarter of 10%
Ground
Levee
Ineff
Bank Sta

APPENDIX B

Effective FIS Data

Frisco, Tx.
Stewart Creek   Main Stream

Input Data

```
*************************************************************
  HEC2 RELEASE DATED NOV 76 UPDATED AUG1977
  ERROR CORR -  01,02
  MODIFICATION -  50,51,52,53
*************************************************************

C
T1        FIA FLOOD STUDY
T2        FRISCO, TEXAS  MARCH 1978
T3        STEWART CREEK  MAIN STREAM        10 YEAR

J1   ICHECK      INQ       NINV       IDIR       STRT      METRIC     HVINS      Q         WSEL       FQ

        0.        2.         0.         0.   0.001570       0.0       0.0        0.   519.800      0.0

J2   NPROF      IPLOT      PRFVS      XSECV      XSECH       FN       ALLDC      IBW       CHNIM      ITRACE

      1.000       0.0     -1.000       0.0        0.0       0.0       0.0       0.0       0.0        0.0

J3   VARIABLE CODES FOR SUMMARY PRINTOUT

    150.000   201.000       0.0       0.0        0.0       0.0       0.0       0.0       0.0        0.0

QT       4.000   9900.000  15300.000  17800.000  24350.000       0.0       0.0       0.0       0.0       0.0
NC       0.060      0.070      0.050      0.100      0.300       0.0       0.0       0.0       0.0       0.0


X1       0.100     17.000    790.000    940.000      0.0         0.0       0.0       0.0    -0.100       0.0
GR     537.000      0.0      524.500    100.000    520.500    150.000   517.000   300.000   517.000   400.000
GR     516.000    500.000    515.500    790.000    515.500    810.000   512.400   870.000   509.700   890.000
GR     509.500    900.000    515.500    938.000    516.400    940.000   515.600  1000.000   515.700  1100.000
GR     517.500   1250.000    540.000   1490.000      0.0         0.0       0.0       0.0       0.0       0.0

                MAIN STREAM AT HWY 423 BRIDGE OS

X1       0.200     36.000    768.000    968.000    100.000    100.000   100.000      0.0       0.0       0.0
BT       2.000    768.000    526.000    524.700    968.000    526.000   524.700      0.0       0.0       0.0
GR     535.500      0.0      526.500    400.000    526.000    768.000   524.700   768.000   517.500   791.300
GR     524.700    791.300    524.700    793.300    517.500    793.300   515.000   816.600   524.700   816.600
GR     524.700    818.600    515.000    818.600    514.000    841.900   524.700   841.900   524.700   843.900
GR     514.000    843.900    513.000    867.200    524.700    867.200   524.700   869.200   513.000   869.200
GR     509.500    892.500    524.700    892.500    524.700    894.500   509.500   894.500   511.000   917.800
GR     524.700    917.800    524.700    919.800    511.000    919.800   518.500   943.100   524.700   943.100
GR     524.700    945.100    518.500    945.100    524.700    968.000   526.000   968.000   527.700  1150.000
GR     539.000   1450.000      0.0        0.0        0.0         0.0       0.0       0.0       0.0       0.0


                MAIN STREAM AT HWY 423 BRIDGE US

X1      12.000      0.0        0.0        0.0       25.000     25.000    25.000      0.0       0.0       0.0
X2       0.0        0.0        0.0        0.0        0.0        0.0      1.000      0.0       0.0       0.0

X1      72.000     17.000    790.000    940.000     60.000     60.000    60.000      0.0       0.100     0.0
GR     537.000      0.0      524.500    100.000    520.500    150.000   517.000   300.000   517.000   400.000
GR     516.000    500.000    515.500    790.000    515.500    810.000   512.400   870.000
```

```
 GR    509.500    900.000    515.500    938.000    516.400    940.000    515.600   1000.000    515.700   1100.000
 GR    517.500   1250.000    540.000   1490.000      0.0        0.0        0.0        0.0        0.0        0.0


 X1   3200.000     10.000    870.000    920.000   3200.000   3100.000   3188.000      0.0        5.000      0.0
 GR    535.000    300.000    525.000    500.000    520.000    800.000    515.500    870.000    509.600    890.000
 GR    509.500    900.000    510.500    910.000    516.000    920.000    516.000   1200.000    535.000   1450.000


 X1   6300.000     24.000    166.000    215.000   3000.000   3000.000   3300.000      0.0        0.0        0.0
 GR    550.000      0.0      544.300     25.000    540.300     50.000    537.300     75.000    533.600    100.000
 GR    531.000    125.000    528.900    150.000    527.000    166.000    519.300    179.000    520.600    194.000
 GR    524.000    200.000    527.400    215.000    527.300    300.000    528.400    400.000    529.200    500.000
 GR    528.400    600.000    526.500    700.000    529.900    800.000    521.400    900.000    534.400    965.000
 GR    538.800   1000.000    542.400   1025.000    545.700   1050.000    550.000   1077.000      0.0        0.0


 X1   8000.000      0.0        0.0        0.0     1700.000   1700.000   1700.000      0.0        2.700      0.0


 X1   9500.000      0.0        0.0        0.0     1200.000   1200.000   1500.000      0.0        2.500      0.0


 X1  11140.000     11.000    650.000    760.000   1640.000   1700.000   1640.000      0.0        0.0        0.0
 GR    550.000     50.000    537.000    650.000    528.000    725.000    527.200    755.000    535.500    760.000
 GR    535.500    800.000    538.000    850.000    538.500    900.000    539.000   1000.000    540.000   1210.000
 GR    550.000   1400.000      0.0        0.0        0.0        0.0        0.0        0.0        0.0        0.0
 QT      4.000   6400.000   9800.000  11300.000  15500.000      0.0        0.0        0.0        0.0        0.0


 X1  12500.000      0.0        0.0        0.0     1360.000   1360.000   1360.000      0.700      6.300      0.0


 X1  13700.000      0.0        0.0        0.0     1200.000   1200.000   1200.000      0.710      5.500      0.0


 X1  14825.000     12.000    155.000    200.000    900.000   1200.000   1125.000      0.0       -0.600      0.0
 GR    565.000      0.0      557.000    100.000    551.500    155.000    545.500    160.000    544.600    185.000
 GR    545.200    190.000    552.100    200.000    548.000    300.000    550.400    350.000    552.500    500.000
 GR    557.500    650.000    565.000    740.000      0.0        0.0        0.0        0.0        0.0        0.0


                 MAIN STREAM AT COUNTY ROAD BRIDGE DS

 X1  14915.000     12.000    178.000    208.000     90.000     90.000     90.000      0.0        0.0        0.0
 BT      2.000    178.000    553.000    546.200    183.000    552.800    546.200      0.0        0.0        0.0
 GR    565.000      0.0      553.000    178.000    544.200    178.000    544.200    183.000    552.800    183.000
 GR    551.000    208.000    544.500    250.000    544.500    300.000    551.000    350.000    552.000    450.000
 GR    557.000    600.000    565.000    740.000      0.0        0.0        0.0        0.0        0.0        0.0


                 MAIN STREAM AT COUNTY ROAD BRIDGE US

 X1  14935.000      0.0        0.0        0.0       20.000     20.000     20.000      0.0        0.0        0.0
 X2      0.0        0.0        0.0        0.0        0.0        0.0        1.000      0.0        0.0        0.0
 NC      0.070      0.070      0.050      0.0        0.0        0.0        0.0        0.0        0.0        0.0


 X1  14975.000     12.000    155.000    200.000     40.000     40.000     40.000      0.0        0.0        0.0
 GR    565.000      0.0      557.000    100.000    551.500    155.000    545.500    160.000    544.600    185.000
 GR    545.200    190.000    552.100    200.000    548.000    300.000    550.400    350.000    552.500    500.000
 GR    557.500    650.000    563.000    740.000      0.0        0.0        0.0        0.0        0.0        0.0


 X1  16900.000      0.0        0.0        0.0     1925.000   1000.000   1925.000      0.0        4.900      0.0
```

2

```
X1  18800.000     19.000    563.000    650.000   1900.000   1200.000   1900.000      0.0       -4.200      0.0
GR    582.900      0.0      574.400     48.000    570.400    100.000    565.500    300.000    565.000    400.000
GR    566.400    500.000    566.200    563.000    558.700    568.000    559.100    577.000    563.400    587.000
GR    565.000    600.000    566.200    650.000    567.500    700.000    563.400    875.000    568.500    900.000
GR    563.800   1000.000    570.200   1200.000    575.900   1400.000    581.100   1575.000      0.0        0.0


X1  20380.000      0.0        0.0        0.0     1580.000    700.000   1580.000      0.0        4.200      0.0


X1  22500.000     16.000    560.000    600.000   1800.000   1000.000   2120.000      0.0        5.300      0.0
GR    583.000      0.0      574.000     50.000    570.500    100.000    565.500    300.000    565.000    400.000
GR    566.500    500.000    566.000    560.000    558.700    568.000    559.000    578.000    563.500    590.000
GR    565.000    600.000    567.500    700.000    566.500    910.000    566.500   1100.000    574.000   1300.000
GR    581.000   1580.000      0.0        0.0        0.0        0.0        0.0        0.0        0.0        0.0


X1  24200.000     16.000    623.000    650.000    100.000   3400.000   1700.000      0.0       -5.600      0.0
GR    596.000      0.0      590.500    100.000    586.000    200.000    584.500    300.000    584.500    350.000
GR    584.000    400.000    582.000    500.000    582.000    623.000    574.500    632.000    574.900    644.000
GR    581.100    650.000    581.500    700.000    580.800    800.000    583.000    927.000    593.500   1000.000
GR    597.000   1130.000      0.0        0.0        0.0        0.0        0.0        0.0        0.0        0.0
NC      0.080      0.080      0.050      0.0        0.0        0.0        0.0        0.0        0.0        0.0


X1  26600.000      0.0        0.0        0.0     2700.000   1300.000   2400.000      0.0        5.600      0.0
QT      4.000   4000.000   6000.000   6800.000   9100.000      0.0        0.0        0.0        0.0        0.0


X1  28570.000      0.0        0.0        0.0     2100.000    900.000   1970.000      0.0        7.000      0.0


X1  30530.000     14.000    200.000    275.000   1850.000   2100.000   1960.000      0.0       -6.900      0.0
GR    626.000      0.0      625.000     50.000    608.000    150.000    603.000    200.000    595.600    210.000
GR    595.500    225.000    600.400    230.000    600.500    265.000    603.400    275.000    600.500    300.000
GR    600.600    400.000    601.400    500.000    607.200    600.000    616.500    900.000      0.0        0.0


X1  32500.000      0.0        0.0        0.0     1800.000   1800.000   1970.000      0.0        6.900      0.0


X1  33085.000      0.0        0.0        0.0      400.000    750.000    585.000      0.0        4.950      0.0
NC      0.085      0.090      0.055      0.0        0.0        0.0        0.0        0.0        0.0        0.0


X1  33670.000      0.0        0.0        0.0      400.000    750.000    585.000      0.0        4.950      0.0


X1  34250.000      8.000    500.000    570.000    400.000    650.000    580.000      0.0        0.0        0.0
GR    633.000    100.000    623.700    370.000    618.500    500.000    610.400    525.000    610.400    535.000
GR    618.500    570.000    622.300    825.000    630.000   1000.000      0.0        0.0        0.0        0.0


X1  34260.000      0.0        0.0        0.0       10.000     10.000     10.000      0.0        0.0        0.0


X1  34270.000      0.0        0.0        0.0       10.000     10.000     10.000      0.0        0.100      0.0


X1  34832.000     13.000    810.000    877.000    400.000    650.000    562.000      0.0       -0.700      0.0
GR    635.000      0.0      625.000    100.000    623.600    300.000    623.600    400.000    622.500    600.000
GR    626.000    775.000    624.300    810.000    616.600    847.000    616.000    853.000    625.200    877.000
GR    628.000   1000.000    631.300   1100.000    636.000   1140.000      0.0        0.0        0.0        0.0
```

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                        MAIN STREAM AT ST LOUIS SAN FRANCISCO RR BRIDGE DS

        X1   34932.000      63.000     710.000     780.000     100.000     100.000     100.000       0.0         1.500       0.0
        BT       2.000     675.000     634.800     633.400     869.000     635.100     633.400       0.0         0.0         0.0
        GR     635.000       0.0       634.500     100.000     634.800     675.000     630.500     675.000     624.000     687.900
        GR     633.400     687.900     633.400     688.900     624.000     688.900     624.000     701.800     633.400     701.800
        GR     633.400     702.800     624.000     702.800     623.900     710.000     622.300     715.700     633.400     715.700
        GR     633.400     716.700     622.300     716.700     624.300     729.600     633.400     729.600     633.400     730.600
        GR     624.300     730.600     616.900     743.500     633.400     743.500     633.400     744.500     616.900     744.500
        GR     617.400     757.400     633.400     757.400     633.400     758.400     617.400     758.400     617.600     767.000
        GR     620.300     771.300     633.400     771.300     633.400     772.300     620.300     772.300     623.200     780.000
        GR     623.400     785.200     633.400     785.200     633.400     786.200     623.400     786.200     623.600     799.100
        GR     633.400     799.100     633.400     800.100     623.600     800.100     624.000     813.000     633.400     813.000
        GR     633.400     814.000     624.000     814.000     624.300     826.900     633.400     826.900     633.400     827.900
        GR     624.300     827.900     624.500     840.800     633.400     840.800     633.400     841.800     624.500     841.800
        GR     624.800     850.000     626.000     854.700     633.400     854.700     633.400     855.700     626.000     855.700
        GR     629.900     869.000     635.100     869.000     637.600    1500.000       0.0         0.0         0.0         0.0


                        MAIN STREAM AT ST LOUIS SAN FRANCISCO RR BRIDGE US

        X1   34949.000       0.0         0.0         0.0        17.000      17.000      17.000       0.0         0.200       0.0
        X2       0.0         0.0         0.0         0.0         0.0         0.0         1.000       0.0         0.0         0.0


        X1   34990.000      13.000     810.000     877.000      41.000      41.000      41.000       0.0         1.100       0.0
        GR     635.000       0.0       625.000     100.000     623.600     300.000     623.600     400.000     622.500     600.000
        GR     626.000     775.000     624.300     810.000     616.600     847.000     616.000     853.000     625.200     877.000
        GR     628.000    1000.000     631.300    1100.000     636.000    1140.000       0.0         0.0         0.0         0.0


        X1   35368.000       9.000     812.000     878.000     375.000     375.000     378.000       0.0         0.0         0.0
        GR     635.000     160.000     629.000     300.000     626.500     600.000     627.500     812.000     618.800     845.000
        GR     618.800     856.000     627.500     878.000     631.000    1045.000     637.000    1200.000       0.0         0.0


        X1   35745.000       8.000     815.000     881.000     375.000     375.000     377.000       0.0         0.0         0.0
        GR     635.000     300.000     629.000     600.000     629.000     815.000     620.500     840.000     620.500     855.000
        GR     629.200     881.000     631.000    1045.000     638.000    1200.000       0.0         0.0         0.0         0.0


        X1   36400.000       9.000     150.000     215.000     750.000     750.000     755.000       0.0        -5.000       0.0
        GR     645.000      50.000     636.500     150.000     629.400     165.000     628.500     180.000     629.000     190.000
        GR     637.400     215.000     636.000     400.000     645.000     600.000     646.500     900.000       0.0         0.0


        X1   36830.000       0.0         0.0         0.0       430.000     430.000     430.000       0.0         2.100       0.0


        X1   37260.000       0.0         0.0         0.0       430.000     430.000     430.000       0.0         1.900       0.0
        QT       4.000    2700.000    4000.000    4500.000    5950.000       0.0         0.0         0.0         0.0         0.0
        NC       0.090       0.090       0.055       0.0         0.0         0.0         0.0         0.0         0.0         0.0


        X1   37700.000       0.0         0.0         0.0       600.000     320.000     440.000       0.0         2.000       0.0


                        MAIN STREAM AT COUNTY ROAD BRIDGE DS

        X1   37800.000      14.000     133.000     225.000     100.000     100.000     100.000       0.0         0.0         0.0
        BT       2.000     133.000     642.900     641.000     225.000     642.200     641.000       0.0         0.0         0.0
        GR     645.000     100.000     642.900     133.000     638.500     133.000     636.500     150.000     630.000     180.000
        GR     641.000     180.000     641.000     181.000     630.000     181.000     634.000     225.000     642.200     225.000
        GR     642.000     300.000     642.500     400.000     646.500     600.000     649.000     900.000       0.0         0.0
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            MAIN STREAM AT COUNTY ROAD BRIDGE US

X1  37820.000       0.0        0.0        0.0       20.000     20.000     20.000      0.0        0.100      0.0
X2      0.0         0.0        0.0        0.0        0.0        0.0        1.000      0.0        0.0        0.0

X1  37860.000       9.000    150.000    215.000     40.000     40.000     40.000      0.0        1.700      0.0
GR    645.000      50.000    636.500    150.000    629.400    165.000    628.500    180.000    629.000    190.000
GR    637.400     215.000    636.000    400.000    645.000    600.000    646.500    900.000      0.0        0.0
NC      0.070       0.070      0.050      0.0        0.0        0.0        0.0        0.0        0.0        0.0

X1  38780.000       0.0        0.0        0.0      700.000   1250.000    920.000      0.0        4.800      0.0

X1  39700.000       8.000    150.000    215.000    700.000   1250.000    920.000      0.0       11.500      0.0
GR    650.000       0.0      636.000    150.000    629.400    165.000    628.500    180.000    629.000    190.000
GR    637.400     215.000    637.500    400.000    645.000    600.000      0.0        0.0        0.0        0.0

X1  40700.000       8.000    174.000    240.000   1200.000    400.000   1000.000      0.0      -16.400      0.0
GR    681.500      50.000    677.000    100.000    673.600    174.000    669.000    205.000    662.100    216.000
GR    662.300     235.000    674.000    240.000    681.000    700.000      0.0        0.0        0.0        0.0

X1  41700.000       0.0        0.0        0.0     1200.000    400.000   1000.000      0.0        5.300      0.0

X1  42710.000       0.0        0.0        0.0      800.000   1000.000   1010.000      0.0        5.600      0.0

X1  43720.000       0.0        0.0        0.0      900.000   1200.000   1010.000      0.0        5.400      0.0

X1  44800.000       0.0        0.0        0.0      700.000   1100.000   1080.000      0.0        7.000      0.0

X1  45800.000      13.000    270.000    350.000   1100.000    900.000   1000.000      0.0      -10.200      0.0
GR    703.000     210.000    700.000    270.000    687.800    280.000    686.000    288.000    685.800    298.000
GR    689.000     302.000    690.000    315.000    694.200    332.000    696.000    350.000    699.000    500.000
GR    699.000     600.000    700.000    750.000    702.000    850.000      0.0        0.0        0.0        0.0

X1  46600.000       0.0        0.0        0.0      600.000   1000.000    800.000      0.0        5.300      0.0

X1  47400.000       0.0        0.0        0.0      800.000    800.000    800.000      0.0        5.100      0.0
EJ      0.0         0.0        0.0        0.0        0.0        0.0        0.0        0.0        0.0        0.0
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Frisco, Tx.
Stewart Creek MAIN STREAM

NATURAL PROFILES

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**************************************************
  HEC2 RELEASE DATED NOV 76 UPDATED  AUG1977
  ERROR CORR -  01,02
  MODIFICATION -  50,51,52,53
**************************************************

NOTE- ASTERISK (*) AT LEFT OF CROSS-SECTION NUMBER INDICATES MESSAGE IN SUMMARY OF ERRORS LIST


STEWART CREEK  MAIN STRE

SUMMARY PRINTOUT TABLE  150


      SECNO     XLCH      ELTRD     ELLC      ELMIN      Q         CWSEL     CRIWS     EG        10K*S     VCH      AREA     .01K

       0.100      0.0       0.0       0.0    509.40   9900.00    519.74      0.0    519.88     15.83     4.19   4144.82   2488.22
       0.100      0.0       0.0       0.0    509.40  15300.00    521.05      0.0    521.22     15.76     4.70   5618.32   3854.36
       0.100      0.0       0.0       0.0    509.40  17800.00    521.60      0.0    521.79     15.51     4.88   6257.41   4520.41
       0.100      0.0       0.0       0.0    509.40  24350.00    522.80      0.0    523.02     15.80     5.37   7665.80   6126.10

*      0.200    100.00    526.00    524.70    509.50   9900.00    521.02    521.02    524.15    437.51    14.20    697.19    473.30
*      0.200    100.00    526.00    524.70    509.50  15300.00    523.34    523.34    527.11    435.62    15.59    981.55    733.06
*      0.200    100.00    526.00    524.70    509.50  17800.00    524.04    524.04    528.29    466.86    16.55   1075.50    823.81
*      0.200    100.00    526.00    524.70    509.50  24350.00    528.52    528.52    530.33    390.70    11.90   2565.97   1231.90

      12.000     25.00    526.00    524.70    509.50   9900.00    523.43      0.0    524.97    176.53     9.96    994.16    745.11
      12.000     25.00    526.00    524.70    509.50  15300.00    525.70    523.34    528.36    482.44    13.11   1167.38    696.58
      12.000     25.00    526.00    524.70    509.50  17800.00    528.34      0.0    529.41    234.40     9.11   2435.33   1162.63
      12.000     25.00    526.00    524.70    509.50  24350.00    530.27      0.0    530.98    137.56     7.79   3940.30   2076.10

      72.000     60.00      0.0       0.0    509.60   9900.00    525.13      0.0    525.15      1.09     1.61  10243.55   9503.15
      72.000     60.00      0.0       0.0    509.60  15300.00    528.63      0.0    528.65      0.86     1.70  14678.01  16476.54
      72.000     60.00      0.0       0.0    509.60  17800.00    529.51      0.0    529.54      0.92     1.83  15837.94  18511.50
      72.000     60.00      0.0       0.0    509.60  24350.00    531.03      0.0    531.07      1.20     2.21  17859.12  22244.05

    3200.000   3188.00      0.0       0.0    514.50   9900.00    525.79      0.0    526.31     41.50     8.17   2186.50   1536.70
    3200.000   3188.00      0.0       0.0    514.50  15300.00    529.16    525.18    529.46     17.76     6.57   4321.50   3630.41
    3200.000   3188.00      0.0       0.0    514.50  17800.00    530.09      0.0    530.38     16.35     6.61   5051.55   4402.70
    3200.000   3188.00      0.0       0.0    514.50  24350.00    531.76      0.0    532.09     16.00     7.07   6470.90   6087.78

    6300.000   3300.00      0.0       0.0    519.30   9900.00    532.48      0.0    532.60     11.94     4.44   4176.75   2865.44
    6300.000   3300.00      0.0       0.0    519.30  15300.00    533.94      0.0    534.10     12.96     5.09   5421.00   4249.61
    6300.000   3300.00      0.0       0.0    519.30  17800.00    534.62      0.0    534.79     12.73     5.25   6016.14   4989.55
    6300.000   3300.00      0.0       0.0    519.30  24350.00    536.20      0.0    536.40     12.46     5.64   7404.74   6897.07

    8000.000   1700.00      0.0       0.0    522.00   9900.00    534.76      0.0    534.91     15.48     4.91   3826.42   2515.84
    8000.000   1700.00      0.0       0.0    522.00  15300.00    536.31      0.0    536.49     15.24     5.41   5140.87   3919.08
    8000.000   1700.00      0.0       0.0    522.00  17800.00    536.96      0.0    537.15     15.06     5.59   5697.70   4586.34
    8000.000   1700.00      0.0       0.0    522.00  24350.00    538.47      0.0    538.70     14.65     5.99   7030.01   6360.81

    9500.000   1500.00      0.0       0.0    524.50   9900.00    536.93      0.0    537.11     19.37     5.36   3545.55   2249.28
    9500.000   1500.00      0.0       0.0    524.50  15300.00    538.41      0.0    538.62     18.79     5.85   4797.77   3529.33
    9500.000   1500.00      0.0       0.0    524.50  17800.00    539.03      0.0    539.25     18.55     6.04   5322.88   4132.64
    9500.000   1500.00      0.0       0.0    524.50  24350.00    540.47      0.0    540.73     17.99     6.46   6582.71   5741.17
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   SECNO      XLCH     ELTRD     ELLC    ELMIN        Q     CWSEL    CRIWS      EG   |  10K*S     VCH      AREA      .01K

 11140.000  1640.00     0.0      0.0    527.20   9900.00   540.60     0.0    541.19 |  29.71    7.04   2278.30   1616.15
 11140.000  1640.00     0.0      0.0    527.20  15300.00   542.07     0.0    542.71 |  30.64    7.87   3428.87   2764.15
 11140.000  1640.00     0.0      0.0    527.20  17800.00   542.65     0.0    543.30 |  30.57    8.13   3924.73   3219.59
 11140.000  1640.00     0.0      0.0    527.20  24350.00   544.00     0.0    544.68 |  29.92    8.67   5162.62   4451.27

 12500.000  1360.00     0.0      0.0    533.50   6400.00   545.48     0.0    546.56 |  61.80    8.92    949.78    814.14
 12500.000  1360.00     0.0      0.0    533.50   9800.00   546.97     0.0    548.09 |  58.72    9.74   1632.05   1278.91
 12500.000  1360.00     0.0      0.0    533.50  11300.00   547.51     0.0    548.61 |  56.82    9.93   1915.86   1499.11
 12500.000  1360.00     0.0      0.0    533.50  15500.00   548.73     0.0    549.83 |  54.34   10.48   2614.35   2102.71

 13700.000  1200.00     0.0      0.0    539.00   6400.00   552.46     0.0    553.39 |  52.40    8.91   1153.89    684.12
 13700.000  1200.00     0.0      0.0    539.00   9800.00   553.87     0.0    554.88 |  54.37    9.95   1702.91   1329.07
 13700.000  1200.00     0.0      0.0    539.00  11300.00   554.33     0.0    555.40 |  56.35   10.41   1899.36   1505.32
 13700.000  1200.00     0.0      0.0    539.00  15500.00   555.49     0.0    556.68 |  59.48   11.41   2423.13   2009.78

 14825.000  1125.00     0.0      0.0    544.00   6400.00   555.76     0.0    555.91 |  11.36    4.38   2525.99   1898.94
 14825.000  1125.00     0.0      0.0    544.00   9800.00   557.35     0.0    557.53 |  12.04    4.97   3387.54   2824.00
 14825.000  1125.00     0.0      0.0    544.00  11300.00   557.93     0.0    558.12 |  12.32    5.19   3719.85   3219.17
 14825.000  1125.00     0.0      0.0    544.00  15500.00   559.33     0.0    559.56 |  13.09    5.74   4556.85   4284.32

 14915.000    90.00   552.80   546.20   544.20   6400.00   555.88     0.0    556.03 |  15.62    1.54   2127.17   1619.37
 14915.000    90.00   552.80   546.20   544.20   9800.00   557.46     0.0    557.66 |  17.71    1.97   2846.33   2328.89
 14915.000    90.00   552.80   546.20   544.20  11300.00   558.04     0.0    558.26 |  18.34    2.12   3132.67   2638.30
 14915.000    90.00   552.80   546.20   544.20  15500.00   559.45     0.0    559.72 |  19.83    2.49   3868.74   3481.15

 14935.000    20.00   552.80   546.20   544.20   6400.00   555.91     0.0    556.06 |  15.41    1.53   2139.09   1630.52
 14935.000    20.00   552.80   546.20   544.20   9800.00   557.50     0.0    557.70 |  17.48    1.96   2860.43   2343.86
 14935.000    20.00   552.80   546.20   544.20  11300.00   558.08     0.0    558.30 |  18.11    2.12   3147.94   2655.11
 14935.000    20.00   552.80   546.20   544.20  15500.00   559.49     0.0    559.76 |  19.59    2.48   3886.62   3502.40

 14975.000    40.00     0.0      0.0    544.60   6400.00   555.95     0.0    556.12 |  14.08    4.74   2325.20   1705.33
 14975.000    40.00     0.0      0.0    544.60   9800.00   557.56     0.0    557.76 |  14.41    5.31   3166.95   2582.07
 14975.000    40.00     0.0      0.0    544.60  11300.00   558.15     0.0    558.36 |  14.47    5.50   3501.68   2971.05
 14975.000    40.00     0.0      0.0    544.60  15500.00   559.57     0.0    559.83 |  14.89    6.02   4341.78   4016.47

 16900.000  1925.00     0.0      0.0    549.50   6400.00   558.96     0.0    559.44 |  48.20    7.59   1458.83    921.81
 16900.000  1925.00     0.0      0.0    549.50   9800.00   560.39     0.0    560.89 |  43.48    8.06   2096.92   1486.15
 16900.000  1925.00     0.0      0.0    549.50  11300.00   560.93     0.0    561.44 |  42.32    8.26   2357.61   1737.10
 16900.000  1925.00     0.0      0.0    549.50  15500.00   562.28     0.0    562.83 |  39.41    8.69   3065.00   2469.19

 18800.000  1900.00     0.0      0.0    554.50   6400.00   564.49     0.0    564.60 |  24.07    3.92   2760.93   1304.57
 18800.000  1900.00     0.0      0.0    554.50   9800.00   565.46     0.0    565.59 |  22.81    4.34   3753.31   2051.85
 18800.000  1900.00     0.0      0.0    554.50  11300.00   565.85     0.0    565.99 |  22.13    4.47   4176.66   2402.06
 18800.000  1900.00     0.0      0.0    554.50  15500.00   566.84     0.0    567.00 |  20.42    4.75   5272.44   3430.20

 20380.000  1580.00     0.0      0.0    558.70   6400.00   568.19     0.0    568.35 |  41.66    4.79   2283.32    991.52
 20380.000  1580.00     0.0      0.0    558.70   9800.00   568.99     0.0    569.20 |  41.50    5.38   3064.43   1521.25
 20380.000  1580.00     0.0      0.0    558.70  11300.00   569.30     0.0    569.51 |  41.38    5.59   3578.32   1756.65
 20380.000  1580.00     0.0      0.0    558.70  15500.00   570.08     0.0    570.34 |  41.03    6.10   4197.62   2419.84

 22500.000  2120.00     0.0      0.0    564.00   6400.00   574.05     0.0    574.26 |  33.64    6.02   2410.61   1103.53
 22500.000  2120.00     0.0      0.0    564.00   9800.00   574.84     0.0    575.07 |  35.25    6.60   3214.19   1650.66
 22500.000  2120.00     0.0      0.0    564.00  11300.00   575.14     0.0    575.39 |  35.81    6.83   3531.44   1888.20
 22500.000  2120.00     0.0      0.0    564.00  15500.00   575.90     0.0    576.18 |  36.75    7.33   4354.75   2556.89
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     SECNO       XLCH       ELTRD       ELLC       ELMIN        Q        CWSEL     CRIWS        EG         10K*S       VCH       AREA      .01K

   24200.000   1700.00       0.0         0.0       568.90    6400.00     579.88      0.0      580.09       28.64       6.04    2177.18   1195.96
   24200.000   1700.00       0.0         0.0       568.90    9800.00     580.90      0.0      581.15       29.64       6.63    2936.69   1793.87
   24200.000   1700.00       0.0         0.0       568.90   11300.00     581.28      0.0      581.54       30.36       6.86    3228.85   2050.66
   24200.000   1700.00       0.0         0.0       568.90   15500.00     582.21      0.0      582.51       31.83       7.44    3956.32   2747.50

   26600.000   2400.00       0.0         0.0       574.50    6400.00     585.64      0.0      585.86       30.57       6.32    2295.76   1157.58
   26600.000   2400.00       0.0         0.0       574.50    9800.00     586.81      0.0      587.04       29.87       6.77    3173.13   1793.19
   26600.000   2400.00       0.0         0.0       574.50   11300.00     587.26      0.0      587.50       29.63       6.94    3519.91   2075.85
   26600.000   2400.00       0.0         0.0       574.50   15500.00     588.37      0.0      588.63       29.20       7.36    4407.14   2868.49

   28570.000   1970.00       0.0         0.0       581.50    4000.00     591.09      0.0      591.45       52.16       7.27    1284.12    553.84
   28570.000   1970.00       0.0         0.0       581.50    6000.00     592.01      0.0      592.33       46.94       7.45    1848.64    875.76
   28570.000   1970.00       0.0         0.0       581.50    6800.00     592.35      0.0      592.66       44.37       7.44    2084.12   1020.80
   28570.000   1970.00       0.0         0.0       581.50    9100.00     593.25      0.0      593.54       38.76       7.42    2736.35   1461.56

   30530.000   1960.00       0.0         0.0       588.60    4000.00     598.02      0.0      598.19       23.09       4.30    1445.94    832.51
   30530.000   1960.00       0.0         0.0       588.60    6000.00     599.02      0.0      599.25       26.03       5.10    1840.38   1176.00
   30530.000   1960.00       0.0         0.0       588.60    6800.00     599.35      0.0      599.60       27.38       5.40    1973.88   1299.48
   30530.000   1960.00       0.0         0.0       588.60    9100.00     600.16      0.0      600.49       30.78       6.18    2325.80   1640.36

   32500.000   1970.00       0.0         0.0       595.50    4000.00     604.02      0.0      604.31       48.56       5.55    1116.50    574.01
   32500.000   1970.00       0.0         0.0       595.50    6000.00     605.15      0.0      605.49       43.64       6.08    1536.41    908.27
   32500.000   1970.00       0.0         0.0       595.50    6800.00     605.56      0.0      605.92       42.16       6.26    1697.02   1047.31
   32500.000   1970.00       0.0         0.0       595.50    9100.00     606.61      0.0      607.01       39.65       6.73    2127.06   1445.22

   33085.000    585.00       0.0         0.0       600.45    4000.00     608.29    607.61     608.77       95.26       7.02     882.37    409.84
   33085.000    585.00       0.0         0.0       600.45    6000.00     609.14      0.0      609.72       94.16       7.91    1175.75    618.34
   33085.000    585.00       0.0         0.0       600.45    6800.00     609.44      0.0      610.07       93.33       8.20    1286.57    703.88
   33085.000    585.00       0.0         0.0       600.45    9100.00     610.27      0.0      610.98       89.44       8.87    1599.51    962.22

   33670.000    585.00       0.0         0.0       605.40    4000.00     613.79      0.0      614.11       68.24       5.87    1068.24    484.21
   33670.000    585.00       0.0         0.0       605.40    6000.00     614.72      0.0      615.13       69.15       6.69    1410.43    721.54
   33670.000    585.00       0.0         0.0       605.40    6800.00     615.05      0.0      615.49       69.74       6.99    1534.56    814.28
   33670.000    585.00       0.0         0.0       605.40    9100.00     615.87      0.0      616.40       71.87       7.75    1861.79   1073.38

   34250.000    580.00       0.0         0.0       610.40    4000.00     619.08    618.64     620.93      188.69      10.93     380.22    291.20
 * 34250.000    580.00       0.0         0.0       610.40    6000.00     620.67    620.67     622.61      150.01      11.63     691.82    489.89
 * 34250.000    580.00       0.0         0.0       610.40    6800.00     621.19    621.19     623.08      138.09      11.72     844.59    578.67
 * 34250.000    580.00       0.0         0.0       610.40    9100.00     622.45    622.45     624.14      112.26      11.75    1318.41    858.89

   34260.000     10.00       0.0         0.0       610.40    4000.00     619.76    618.43     621.12      120.68       9.48     484.31    364.12
   34260.000     10.00       0.0         0.0       610.40    6000.00     621.64      0.0      622.79       80.94       9.34     996.98    666.92
   34260.000     10.00       0.0         0.0       610.40    6800.00     622.10      0.0      623.26       78.02       9.53    1173.50    769.87
   34260.000     10.00       0.0         0.0       610.40    9100.00     623.19      0.0      624.29       70.57       9.85    1648.04   1083.22

   34270.000     10.00       0.0         0.0       610.50    4000.00     619.93    618.53     621.25      115.69       9.34     496.42    371.88
   34270.000     10.00       0.0         0.0       610.50    6000.00     621.71      0.0      622.88       82.49       9.40     986.11    660.61
   34270.000     10.00       0.0         0.0       610.50    6800.00     622.16      0.0      623.35       80.58       9.64    1152.40    757.51
   34270.000     10.00       0.0         0.0       610.50    9100.00     623.24      0.0      624.37       72.70       9.96    1625.37   1067.25

   34832.000    562.00       0.0         0.0       615.30    4000.00     624.76      0.0      625.02       47.16       5.52    1489.03    582.45
   34832.000    562.00       0.0         0.0       615.30    6000.00     625.62      0.0      625.86       40.54       5.66    2186.70    942.34
   34832.000    562.00       0.0         0.0       615.30    6800.00     625.94      0.0      626.17       37.73       5.65    2464.71   1107.04
   34832.000    562.00       0.0         0.0       615.30    9100.00     626.72      0.0      626.94       34.78       5.84    3134.90   1543.07
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      SECNO       XLCH      ELTRD     ELLC      ELMIN      Q         CWSEL     CRIWS      EG        10K*S     VCH       AREA      .01K

*   34932.000    100.00    634.80    633.40    618.40    4000.00    626.93    626.93    628.49    392.52    10.57    459.44    201.90
*   34932.000    100.00    634.80    633.40    618.40    6000.00    628.04    628.04    629.88    429.48    11.87    636.04    289.52
*   34932.000    100.00    634.80    633.40    618.40    6800.00    628.25    628.25    630.38    490.95    12.84    669.27    306.90
*   34932.000    100.00    634.80    633.40    618.40    9100.00    629.26    629.26    631.68    524.75    13.93    836.67    397.25

    34949.000     17.00    634.80    633.60    618.60    4000.00    628.16      0.0     629.02    200.77     8.08    622.10    282.30
    34949.000     17.00    634.80    633.60    618.60    6000.00    629.41      0.0     630.49    233.80     9.28    827.86    392.40
    34949.000     17.00    634.80    633.60    618.60    6800.00    629.92      0.0     631.04    238.16     9.56    914.66    440.63
    34949.000     17.00    634.80    633.60    618.60    9100.00    631.06      0.0     632.41    270.03    10.60   1113.26    553.77

    34990.000     41.00      0.0       0.0     617.10    4000.00    629.13      0.0     629.16      4.23     2.15   3693.91   1943.98
    34990.000     41.00      0.0       0.0     617.10    6000.00    630.61      0.0     630.64      3.71     2.26   5118.62   3117.06
    34990.000     41.00      0.0       0.0     617.10    6800.00    631.17      0.0     631.20      3.52     2.28   5677.87   3626.62
    34990.000     41.00      0.0       0.0     617.10    9100.00    632.54      0.0     632.58      3.26     2.40   7112.90   5043.54

    35368.000    378.00      0.0       0.0     618.80    4000.00    629.28      0.0     629.58     32.93     5.45   1477.90    697.07
    35368.000    378.00      0.0       0.0     618.80    6000.00    630.77      0.0     630.96     20.35     4.88   2548.79   1330.10
    35368.000    378.00      0.0       0.0     618.80    6800.00    631.32      0.0     631.49     17.37     4.70   2986.66   1631.54
    35368.000    378.00      0.0       0.0     618.80    9100.00    632.69      0.0     632.83     12.90     4.46   4142.13   2533.27

    35745.000    377.00      0.0       0.0     620.50    4000.00    630.64      0.0     631.27     56.16     7.08    964.69    533.77
    35745.000    377.00      0.0       0.0     620.50    6000.00    631.65      0.0     632.26     53.62     7.58   1520.75    819.39
    35745.000    377.00      0.0       0.0     620.50    6800.00    632.08      0.0     632.64     49.20     7.53   1778.95    969.46
    35745.000    377.00      0.0       0.0     620.50    9100.00    633.25      0.0     633.70     38.20     7.25   2559.98   1472.32

    36400.000    755.00      0.0       0.0     623.50    4000.00    634.15      0.0     634.58     34.91     6.02   1101.99    676.97
    36400.000    755.00      0.0       0.0     623.50    6000.00    635.20      0.0     635.73     39.92     7.02   1489.80    949.66
    36400.000    755.00      0.0       0.0     623.50    6800.00    635.51      0.0     636.09     42.70     7.43   1610.85   1040.60
    36400.000    755.00      0.0       0.0     623.50    9100.00    636.31      0.0     637.01     48.88     8.41   1942.26   1301.59

    36830.000    430.00      0.0       0.0     625.60    4000.00    635.80      0.0     636.37     47.94     6.78    947.61    577.69
    36830.000    430.00      0.0       0.0     625.60    6000.00    637.01      0.0     637.63     47.68     7.50   1379.33    868.94
    36830.000    430.00      0.0       0.0     625.60    6800.00    637.41      0.0     638.05     47.96     7.76   1533.15    981.94
    36830.000    430.00      0.0       0.0     625.60    9100.00    638.41      0.0     639.11     48.87     8.41   1942.38   1301.69

    37260.000    430.00      0.0       0.0     627.50    4000.00    637.82      0.0     638.35     44.13     6.57    986.53    602.14
    37260.000    430.00      0.0       0.0     627.50    6000.00    639.03      0.0     639.61     44.32     7.30   1423.94    901.27
    37260.000    430.00      0.0       0.0     627.50    6800.00    639.44      0.0     640.04     44.41     7.54   1584.25   1020.40
    37260.000    430.00      0.0       0.0     627.50    9100.00    640.48      0.0     641.13     44.77     8.14   2013.82   1360.08

    37700.000    440.00      0.0       0.0     629.50    2700.00    639.52      0.0     639.81     24.90     4.81    888.48    541.07
    37700.000    440.00      0.0       0.0     629.50    4000.00    640.71      0.0     641.02     24.05     5.24   1305.81    815.70
    37700.000    440.00      0.0       0.0     629.50    4500.00    641.12      0.0     641.43     23.57     5.36   1460.52    926.94
    37700.000    440.00      0.0       0.0     629.50    5950.00    642.17      0.0     642.49     22.64     5.67   1881.81   1250.57

    37800.000    100.00    642.20    641.00    630.00    2700.00    639.79      0.0     640.12     36.30     4.68    577.47    448.14
    37800.000    100.00    642.20    641.00    630.00    4000.00    640.88      0.0     641.42     49.15     5.91    677.25    570.53
    37800.000    100.00    642.20    641.00    630.00    4500.00    641.33      0.0     642.00    125.17     6.54    688.00    402.22
    37800.000    100.00    642.20    641.00    630.00    5950.00    642.10      0.0     643.26    220.82     8.65    690.68    400.40

    37820.000     20.00    642.20    641.10    630.10    2700.00    639.86      0.0     640.20     36.98     4.70    573.94    443.97
    37820.000     20.00    642.20    641.10    630.10    4000.00    640.98      0.0     641.52     49.19     5.91    677.11    570.34
    37820.000     20.00    642.20    641.10    630.10    4500.00    641.58      0.0     642.25    125.40     6.54    688.00    401.85
    37820.000     20.00    642.20    641.10    630.10    5950.00    642.72      0.0     643.78    291.09     8.30    767.44    348.74
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    SECNO       XLCH      ELTRD      ELLC      ELMIN       Q        CWSEL     CRIWS       EG        10K*S       VCH      AREA     .01K

  37860.000     40.00      0.0        0.0     630.20   2700.00    639.99      0.0     640.33      29.42      5.11     815.79    497.80
  37860.000     40.00      0.0        0.0     630.20   4000.00    641.36      0.0     641.68      24.82      5.30    1287.65    802.94
  37860.000     40.00      0.0        0.0     630.20   4500.00    642.19      0.0     642.45      18.95      4.94    1603.69   1033.71
  37860.000     40.00      0.0        0.0     630.20   5950.00    643.80      0.0     644.01      14.07      4.75    2287.05   1586.07

  38780.000    920.00      0.0        0.0     635.00   2700.00    643.57      0.0     644.34      60.43      7.14     455.59    347.34
  38780.000    920.00      0.0        0.0     635.00   4000.00    644.62      0.0     645.42      58.17      7.77     760.03    524.46
  38780.000    920.00      0.0        0.0     635.00   4500.00    644.89      0.0     645.72      59.35      8.06     846.82    584.12
  38780.000    920.00      0.0        0.0     635.00   5950.00    645.90      0.0     646.63      49.34      8.05    1191.18    847.10

  39700.000    920.00      0.0        0.0     640.00   2700.00    648.86      0.0     649.61      53.76      6.96     396.19    368.26
  39700.000    920.00      0.0        0.0     640.00   4000.00    649.97      0.0     650.85      55.03      7.89     695.42    539.22
  39700.000    920.00      0.0        0.0     640.00   4500.00    650.33      0.0     651.22      54.18      8.08     803.23    611.37
  39700.000    920.00      0.0        0.0     640.00   5950.00    651.03      0.0     652.01      57.99      8.89    1034.77    781.35

  40700.000   1000.00      0.0        0.0     645.70   2700.00    655.73      0.0     656.87      99.53      8.58     314.87    270.64
  40700.000   1000.00      0.0        0.0     645.70   4000.00    657.17      0.0     658.71     120.45      9.95     401.86    364.47
  40700.000   1000.00      0.0        0.0     645.70   4500.00    657.48      0.0     659.24     130.98     10.67     422.52    393.19
  40700.000   1000.00      0.0        0.0     645.70   5950.00    658.36    657.34    660.68     146.54     12.29     513.39    491.52

  41700.000   1000.00      0.0        0.0     651.00   2700.00    662.82      0.0     663.45      46.02      6.35     426.01    397.99
  41700.000   1000.00      0.0        0.0     651.00   4000.00    664.58      0.0     665.32      41.31      7.07     680.56    622.32
  41700.000   1000.00      0.0        0.0     651.00   4500.00    665.11      0.0     665.86      39.59      7.21     810.29    715.17
  41700.000   1000.00      0.0        0.0     651.00   5950.00    666.33      0.0     667.06      35.79      7.48    1202.31    994.53

  42710.000   1010.00      0.0        0.0     656.60   2700.00    667.94      0.0     668.67      57.74      6.86     393.68    355.31
  42710.000   1010.00      0.0        0.0     656.60   4000.00    669.41      0.0     670.41      61.14      8.05     536.75    511.55
  42710.000   1010.00      0.0        0.0     656.60   4500.00    669.82      0.0     670.91      62.80      8.46     607.51    567.86
  42710.000   1010.00      0.0        0.0     656.60   5950.00    670.75      0.0     672.03      67.95      9.47     819.72    721.83

  43720.000   1010.00      0.0        0.0     662.00   2700.00    673.56      0.0     674.24      52.60      6.62     407.66    372.27
  43720.000   1010.00      0.0        0.0     662.00   4000.00    675.18      0.0     676.05      50.82      7.58     598.73    561.12
  43720.000   1010.00      0.0        0.0     662.00   4500.00    675.67      0.0     676.57      49.85      7.82     701.21    637.34
  43720.000   1010.00      0.0        0.0     662.00   5950.00    676.84      0.0     677.77      46.83      8.28    1030.30    869.49

  44800.000   1080.00      0.0        0.0     669.00   2700.00    679.91      0.0     680.76      68.87      7.37     366.48    325.34
  44800.000   1080.00      0.0        0.0     669.00   4000.00    681.48      0.0     682.59      72.17      8.49     490.63    470.85
  44800.000   1080.00      0.0        0.0     669.00   4500.00    681.91      0.0     683.12      73.73      8.92     551.92    524.08
  44800.000   1080.00      0.0        0.0     669.00   5950.00    682.86    680.69    684.32      78.86      9.98     746.66    670.02

  45800.000   1000.00      0.0        0.0     675.60   2700.00    686.09      0.0     686.71      51.69      6.35     427.08    375.55
  45800.000   1000.00      0.0        0.0     675.60   4000.00    687.66      0.0     688.42      47.59      7.09     633.31    579.84
  45800.000   1000.00      0.0        0.0     675.60   4500.00    688.15      0.0     688.94      46.63      7.31     723.02    659.02
  45800.000   1000.00      0.0        0.0     675.60   5950.00    689.29      0.0     690.12      44.12      7.74    1042.26    895.78

  46600.000    800.00      0.0        0.0     680.90   2700.00    690.79      0.0     691.57      70.84      7.12     379.30    320.79
  46600.000    800.00      0.0        0.0     680.90   4000.00    692.16      0.0     693.19      73.26      8.19     512.62    467.33
  46600.000    800.00      0.0        0.0     680.90   4500.00    692.59      0.0     693.70      73.51      8.53     572.93    524.85
  46600.000    800.00      0.0        0.0     680.90   5950.00    693.59      0.0     694.90      75.54      9.41     752.43    684.60

  47400.000    800.00      0.0        0.0     686.00   2700.00    696.18      0.0     696.88      62.10      6.73     401.11    342.64
  47400.000    800.00      0.0        0.0     686.00   4000.00    697.61      0.0     698.51      60.29      7.68     562.52    515.15
  47400.000    800.00      0.0        0.0     686.00   4500.00    698.06      0.0     699.02      60.08      7.97     634.10    580.54
  47400.000    800.00      0.0        0.0     686.00   5950.00    699.17      0.0     700.24      59.08      8.63     856.14    774.09
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STEWART CREEK  MAIN STRE

SUMMARY PRINTOUT TABLE  150

        SECNO       Q         CWSEL    DIFWSP     DIFWSX     DIFKWS     TOPWID     XLCH

         0.100   9900.00     519.74      0.0        0.0       -0.06    1096.58      0.0
         0.100  15300.00     521.05      1.31       0.0        0.05    1146.97      0.0
         0.100  17800.00     521.60      0.55       0.0        0.0     1159.80      0.0
         0.100  24350.00     522.80      1.20       0.0        0.0     1187.60      0.0

*        0.200   9900.00     521.02      0.0        1.28       0.0      114.80    100.00
*        0.200  15300.00     523.34      2.31       2.29       0.0      131.01    100.00
*        0.200  17800.00     524.04      0.70       2.44       0.0      135.94    100.00
*        0.200  24350.00     528.52      4.48       5.72       0.0      816.31    100.00

        12.000   9900.00     523.43      0.0        2.41       0.0      131.68     25.00
        12.000  15300.00     525.70      2.26       2.36       0.0      154.64     25.00
        12.000  17800.00     528.34      2.64       4.30       0.0      803.39     25.00
        12.000  24350.00     530.27      1.93       1.75       0.0      940.37     25.00

        72.000   9900.00     525.13      0.0        1.69       0.0     1234.51     60.00
        72.000  15300.00     528.63      3.50       2.93       0.0     1299.83     60.00
        72.000  17800.00     529.51      0.89       1.18       0.0     1316.38     60.00
        72.000  24350.00     531.03      1.52       0.76       0.0     1344.74     60.00

      3200.000   9900.00     525.79      0.0        0.66       0.0      510.76   3188.00
      3200.000  15300.00     529.16      3.37       0.54       0.0      757.14   3188.00
      3200.000  17800.00     530.09      0.92       0.57       0.0      821.26   3188.00
      3200.000  24350.00     531.76      1.68       0.73       0.0      876.69   3188.00

      6300.000   9900.00     532.48      0.0        6.69       0.0      844.67   3300.00
      6300.000  15300.00     533.94      1.46       4.78       0.0      864.97   3300.00
      6300.000  17800.00     534.62      0.68       4.54       0.0      873.68   3300.00
      6300.000  24350.00     536.20      1.57       4.43       0.0      896.76   3300.00

      8000.000   9900.00     534.76      0.0        2.28       0.0      838.59   1700.00
      8000.000  15300.00     536.31      1.55       2.37       0.0      861.16   1700.00
      8000.000  17800.00     536.96      0.64       2.33       0.0      868.72   1700.00
      8000.000  24350.00     538.47      1.51       2.28       0.0      890.59   1700.00

      9500.000   9900.00     536.93      0.0        2.17       0.0      833.68   1500.00
      9500.000  15300.00     538.41      1.48       2.10       0.0      855.35   1500.00
      9500.000  17800.00     539.03      0.61       2.07       0.0      863.64   1500.00
      9500.000  24350.00     540.47      1.44       2.00       0.0      883.17   1500.00

     11140.000   9900.00     540.60      0.0        3.67       0.0      737.74   1640.00
     11140.000  15300.00     542.07      1.47       3.65       0.0      833.18   1640.00
     11140.000  17800.00     542.65      0.58       3.62       0.0      871.09   1640.00
     11140.000  24350.00     544.00      1.35       3.53       0.0      959.22   1640.00

     12500.000   6400.00     545.48      0.0        4.88       0.0      341.16   1360.00
     12500.000   9800.00     546.97      1.50       4.91       0.0      519.69   1360.00
     12500.000  11300.00     547.51      0.53       4.86       0.0      544.03   1360.00
     12500.000  15500.00     548.73      1.23       4.73       0.0      599.73   1360.00

     13700.000   6400.00     552.46      0.0        6.99       0.0      368.55   1200.00
     13700.000   9800.00     553.87      1.40       6.89       0.0      413.99   1200.00
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  13700.000  15500.00     555.49     1.16       6.76       0.0      466.94    2200.00



    SECNO        Q          CWSEL     DIFWSP     DIFWSX     DIFKWS     TOPWID      XLCH

  14825.000   6400.00     555.76      0.0        3.30       0.0      509.59    1125.00
  14825.000   9800.00     557.35      1.58       3.48       0.0      567.46    1125.00
  14825.000  11300.00     557.93      0.58       3.60       0.0      581.63    1125.00
  14825.000  15500.00     559.33      1.40       3.84       0.0      615.87    1125.00

  14915.000   6400.00     555.88      0.0        0.11       0.0      431.01      90.00
  14915.000   9800.00     557.46      1.58       0.12       0.0      496.35      90.00
  14915.000  11300.00     558.04      0.58       0.12       0.0      515.12      90.00
  14915.000  15500.00     559.45      1.40       0.12       0.0      560.43      90.00

  14935.000   6400.00     555.91      0.0        0.03       0.0      432.29      20.00
  14935.000   9800.00     557.50      1.59       0.04       0.0      497.29      20.00
  14935.000  11300.00     558.08      0.58       0.04       0.0      516.10      20.00
  14935.000  15500.00     559.49      1.40       0.04       0.0      561.48      20.00

  14975.000   6400.00     555.95      0.0        0.04       0.0      493.58      40.00
  14975.000   9800.00     557.56      1.60       0.06       0.0      558.13      40.00
  14975.000  11300.00     558.15      0.59       0.06       0.0      575.18      40.00
  14975.000  15500.00     559.57      1.42       0.08       0.0      615.90      40.00

  16900.000   6400.00     558.96      0.0        3.01       0.0      417.51    1925.00
  16900.000   9800.00     560.39      1.43       2.83       0.0      474.72    1925.00
  16900.000  11300.00     560.93      0.54       2.78       0.0      496.20    1925.00
  16900.000  15500.00     562.28      1.35       2.71       0.0      551.22    1925.00

  18800.000   6400.00     564.49      0.0        5.53       0.0      982.87    1900.00
  18800.000   9800.00     565.46      0.98       5.07       0.0     1053.12    1900.00
  18800.000  11300.00     565.85      0.39       4.92       0.0     1081.71    1900.00
  18800.000  15500.00     566.84      0.99       4.56       0.0     1138.00    1900.00

  20380.000   6400.00     568.19      0.0        3.70       0.0      939.04    1580.00
  20380.000   9800.00     568.99      0.80       3.53       0.0     1004.88    1580.00
  20380.000  11300.00     569.30      0.30       3.45       0.0     1027.14    1580.00
  20380.000  15500.00     570.08      0.78       3.24       0.0     1083.10    1580.00

  22500.000   6400.00     574.05      0.0        5.86       0.0      990.11    2120.00
  22500.000   9800.00     574.84      0.79       5.85       0.0     1042.82    2120.00
  22500.000  11300.00     575.14      0.30       5.85       0.0     1062.90    2120.00
  22500.000  15500.00     575.90      0.76       5.82       0.0     1110.77    2120.00

  24200.000   6400.00     579.88      0.0        5.83       0.0      709.71    1700.00
  24200.000   9800.00     580.90      1.02       6.06       0.0      762.61    1700.00
  24200.000  11300.00     581.28      0.38       6.14       0.0      773.70    1700.00
  24200.000  15500.00     582.21      0.93       6.31       0.0      800.67    1700.00

  26600.000   6400.00     585.64      0.0        5.76       0.0      721.90    2400.00
  26600.000   9800.00     586.81      1.17       5.91       0.0      771.60    2400.00
  26600.000  11300.00     587.26      0.45       5.97       0.0      784.60    2400.00
  26600.000  15500.00     588.37      1.11       6.16       0.0      816.93    2400.00

  28570.000   4000.00     591.09      0.0        5.45       0.0      543.60    1970.00
  28570.000   6000.00     592.01      0.92       5.20       0.0      674.77    1970.00
  28570.000   6800.00     592.35      0.34       5.09       0.0      699.99    1970.00
  28570.000   9100.00     593.25      0.90       4.88       0.0      754.90    1970.00
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       SECNO        Q          CWSEL     DIFWSP     DIFWSX     DIFKWS      TOPWID      XLCH

     30530.000   4000.00      598.02      0.0        6.93       0.0       379.87    1960.00
     30530.000   6000.00      599.02      1.00       7.01       0.0       407.17    1960.00
     30530.000   6800.00      599.35      0.33       7.00       0.0       416.01    1960.00
     30530.000   9100.00      600.16      0.82       6.91       0.0       438.45    1960.00

     32500.000   4000.00      604.02      0.0        6.00       0.0       355.46    1970.00
     32500.000   6000.00      605.15      1.14       6.14       0.0       386.30    1970.00
     32500.000   6800.00      605.56      0.41       6.22       0.0       397.47    1970.00
     32500.000   9100.00      606.61      1.05       6.45       0.0       425.92    1970.00

     33085.000   4000.00      608.29      0.0        4.27       0.0       336.40     585.00
     33085.000   6000.00      609.14      0.85       3.98       0.0       359.97     585.00
     33085.000   6800.00      609.44      0.31       3.88       0.0       368.26     585.00
     33085.000   9100.00      610.27      0.83       3.65       0.0       390.73     585.00

     33670.000   4000.00      613.79      0.0        5.50       0.0       351.74     585.00
     33670.000   6000.00      614.72      0.93       5.58       0.0       377.31     585.00
     33670.000   6800.00      615.05      0.33       5.60       0.0       386.17     585.00
     33670.000   9100.00      615.87      0.83       5.61       0.0       408.60     585.00

     34250.000   4000.00      619.08      0.0        5.30       0.0       123.51     580.00
  *  34250.000   6000.00      620.67      1.59       5.95       0.0       269.55     580.00
  *  34250.000   6800.00      621.19      0.52       6.14       0.0       317.49     580.00
  *  34250.000   9100.00      622.45      1.26       6.58       0.0       427.14     580.00

     34260.000   4000.00      619.76      0.0        0.68       0.0       185.55      10.00
     34260.000   6000.00      621.64      1.87       0.97       0.0       358.98      10.00
     34260.000   6800.00      622.10      0.46       0.92       0.0       401.72      10.00
     34260.000   9100.00      623.19      1.09       0.74       0.0       462.51      10.00

     34270.000   4000.00      619.93      0.0        0.16       0.0       191.47      10.00
     34270.000   6000.00      621.71      1.78       0.07       0.0       356.18      10.00
     34270.000   6800.00      622.16      0.45       0.06       0.0       396.86      10.00
     34270.000   9100.00      623.24      1.08       0.05       0.0       460.17      10.00

     34832.000   4000.00      624.76      0.0        4.83       0.0       754.35     562.00
     34832.000   6000.00      625.62      0.87       3.92       0.0       839.57     562.00
     34832.000   6800.00      625.94      0.32       3.78       0.0       857.24     562.00
     34832.000   9100.00      626.72      0.77       3.47       0.0       898.42     562.00

  *  34932.000   4000.00      626.93      0.0        2.17       0.0       155.41     100.00
  *  34932.000   6000.00      628.04      1.11       2.42       0.0       161.70     100.00
  *  34932.000   6800.00      628.25      0.20       2.31       0.0       162.81     100.00
  *  34932.000   9100.00      629.26      1.01       2.54       0.0       168.26     100.00

     34949.000   4000.00      628.16      0.0        1.23       0.0       161.24      17.00
     34949.000   6000.00      629.41      1.25       1.37       0.0       167.98      17.00
     34949.000   6800.00      629.92      0.51       1.67       0.0       170.75      17.00
     34949.000   9100.00      631.06      1.14       1.80       0.0       176.91      17.00

     34990.000   4000.00      629.13      0.0        0.96       0.0       931.02      41.00
     34990.000   6000.00      630.61      1.48       1.19       0.0       990.78      41.00
     34990.000   6800.00      631.17      0.56       1.25       0.0      1013.27      41.00
     34990.000   9100.00      632.54      1.38       1.48       0.0      1065.68      41.00
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  SECNO        Q          CWSEL    DIFWSP    DIFWSX    DIFKWS    TOPWID     XLCH

 35368.000   4000.00     629.28     0.0       0.16      0.0      670.17    378.00
 35368.000   6000.00     630.77     1.49      0.16      0.0      775.43    378.00
 35368.000   6800.00     631.32     0.55      0.16      0.0      807.58    378.00
 35368.000   9100.00     632.69     1.37      0.15      0.0      875.10    378.00

 35745.000   4000.00     630.64     0.0       1.36      0.0      494.34    377.00
 35745.000   6000.00     631.65     1.01      0.88      0.0      591.89    377.00
 35745.000   6800.00     632.08     0.43      0.75      0.0      622.57    377.00
 35745.000   9100.00     633.25     1.17      0.56      0.0      707.31    377.00

 36400.000   4000.00     634.15     0.0       3.51      0.0      351.02    755.00
 36400.000   6000.00     635.20     1.05      3.55      0.0      386.75    755.00
 36400.000   6800.00     635.51     0.31      3.43      0.0      397.25    755.00
 36400.000   9100.00     636.31     0.80      3.06      0.0      424.66    755.00

 36830.000   4000.00     635.80     0.0       1.65      0.0      335.74    430.00
 36830.000   6000.00     637.01     1.21      1.81      0.0      376.92    430.00
 36830.000   6800.00     637.41     0.40      1.90      0.0      390.54    430.00
 36830.000   9100.00     638.41     1.00      2.10      0.0      424.67    430.00

 37260.000   4000.00     637.82     0.0       2.02      0.0      339.66    430.00
 37260.000   6000.00     639.03     1.21      2.02      0.0      380.92    430.00
 37260.000   6800.00     639.44     0.41      2.03      0.0      394.97    430.00
 37260.000   9100.00     640.48     1.04      2.07      0.0      430.35    430.00

 37700.000   2700.00     639.52     0.0       1.70      0.0      329.70    440.00
 37700.000   4000.00     640.71     1.19      1.68      0.0      370.23    440.00
 37700.000   4500.00     641.12     0.41      1.68      0.0      384.17    440.00
 37700.000   5950.00     642.17     1.05      1.69      0.0      419.79    440.00

 37800.000   2700.00     639.79     0.0       0.27      0.0       91.00    100.00
 37800.000   4000.00     640.88     1.10      0.17      0.0       91.00    100.00
 37800.000   4500.00     641.33     0.45      0.21      0.0       92.00    100.00
 37800.000   5950.00     642.10     0.77     -0.07      0.0      147.45    100.00

 37820.000   2700.00     639.86     0.0       0.07      0.0       91.00     20.00
 37820.000   4000.00     640.98     1.12      0.10      0.0       91.00     20.00
 37820.000   4500.00     641.58     0.60      0.25      0.0       92.00     20.00
 37820.000   5950.00     642.72     1.14      0.62      0.0      273.12     20.00

 37860.000   2700.00     639.99     0.0       0.13      0.0      322.12     40.00
 37860.000   4000.00     641.36     1.37      0.38      0.0      368.56     40.00
 37860.000   4500.00     642.19     0.83      0.60      0.0      396.63     40.00
 37860.000   5950.00     643.80     1.61      1.08      0.0      451.41     40.00

 38780.000   2700.00     643.57     0.0       3.59      0.0      237.04    920.00
 38780.000   4000.00     644.62     1.04      3.26      0.0      316.19    920.00
 38780.000   4500.00     644.89     0.27      2.70      0.0      325.38    920.00
 38780.000   5950.00     645.90     1.01      2.10      0.0      359.56    920.00

 39700.000   2700.00     648.86     0.0       5.29      0.0       79.47    920.00
 39700.000   4000.00     649.97     1.11      5.35      0.0      302.72    920.00
 39700.000   4500.00     650.33     0.36      5.44      0.0      315.76    920.00
 39700.000   5950.00     651.03     0.69      5.13      0.0      342.07    920.00
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     SECNO          Q            CWSEL     DIFWSP      DIFWSX      DIFKWS      TOPWID       XLCH

   40700.000     2700.00        655.73       0.0         6.87        0.0        55.31     1000.00
   40700.000     4000.00        657.17       1.44        7.20        0.0        65.62     1000.00
   40700.000     4500.00        657.48       0.31        7.15        0.0        71.88     1000.00
   40700.000     5950.00        658.36       0.88        7.33        0.0       140.88     1000.00

   41700.000     2700.00        662.82       0.0         7.09        0.0        72.95     1000.00
   41700.000     4000.00        664.58       1.75        7.40        0.0       221.58     1000.00
   41700.000     4500.00        665.11       0.53        7.63        0.0       267.94     1000.00
   41700.000     5950.00        666.33       1.22        7.97        0.0       370.30     1000.00

   42710.000     2700.00        667.94       0.0         5.12        0.0        64.72     1010.00
   42710.000     4000.00        669.41       1.47        4.84        0.0       154.71     1010.00
   42710.000     4500.00        669.82       0.41        4.72        0.0       190.56     1010.00
   42710.000     5950.00        670.75       0.92        4.42        0.0       271.00     1010.00

   43720.000     2700.00        673.56       0.0         5.62        0.0        67.14     1010.00
   43720.000     4000.00        675.18       1.62        5.76        0.0       186.49     1010.00
   43720.000     4500.00        675.67       0.49        5.84        0.0       229.58     1010.00
   43720.000     5950.00        676.84       1.17        6.09        0.0       332.09     1010.00

   44800.000     2700.00        679.91       0.0         6.36        0.0        61.64     1080.00
   44800.000     4000.00        681.48       1.57        6.31        0.0       125.96     1080.00
   44800.000     4500.00        681.91       0.43        6.24        0.0       163.06     1080.00
   44800.000     5950.00        682.86       0.95        6.02        0.0       246.30     1080.00

   45800.000     2700.00        686.09       0.0         6.17        0.0        91.43     1000.00
   45800.000     4000.00        687.66       1.57        6.18        0.0       171.23     1000.00
   45800.000     4500.00        688.15       0.49        6.24        0.0       196.05     1000.00
   45800.000     5950.00        689.29       1.14        6.43        0.0       403.55     1000.00

   46600.000     2700.00        690.79       0.0         4.70        0.0        73.34      800.00
   46600.000     4000.00        692.16       1.37        4.50        0.0       130.58      800.00
   46600.000     4500.00        692.59       0.43        4.44        0.0       152.26      800.00
   46600.000     5950.00        693.59       1.01        4.30        0.0       203.53      800.00

   47400.000     2700.00        696.18       0.0         5.39        0.0        76.49      800.00
   47400.000     4000.00        697.61       1.43        5.45        0.0       148.74      800.00
   47400.000     4500.00        698.06       0.45        5.47        0.0       171.46      800.00
   47400.000     5950.00        699.17       1.12        5.58        0.0       227.97      800.00


  SUMMARY OF ERRORS

 CAUTION  SECNO=       0.200   PROFILE= 1  CRITICAL DEPTH ASSUMED
 CAUTION  SECNO=       0.200   PROFILE= 1  PROBABLE MINIMUM SPECIFIC ENERGY
 CAUTION  SECNO=       0.200   PROFILE= 1  20 TRIALS ATTEMPTED TO BALANCE WSEL
 CAUTION  SECNO=       0.200   PROFILE= 2  CRITICAL DEPTH ASSUMED
 CAUTION  SECNO=       0.200   PROFILE= 2  PROBABLE MINIMUM SPECIFIC ENERGY
 CAUTION  SECNO=       0.200   PROFILE= 2  20 TPIALS ATTEMPTED TO BALANCE WSEL
 CAUTION  SECNO=       0.200   PROFILE= 3  CRITICAL DEPTH ASSUMED
 CAUTION  SECNO=       0.200   PROFILE= 3  PROBABLE MINIMUM SPECIFIC ENERGY
 CAUTION  SECNO=       0.200   PROFILE= 3  20 TRIALS ATTEMPTED TO BALANCE WSEL
 CAUTION  SECNO=       0.200   PROFILE= 4  CRITICAL DEPTH ASSUMED
 CAUTION  SECNO=       0.200   PROFILE= 4  PROBABLE MINIMUM SPECIFIC ENERGY
 CAUTION  SECNO=       0.200   PROFILE= 4  20 TRIALS ATTEMPTED TO BALANCE WSEL
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CAUTION  SECNO=34250.000  PROFILE= 2  CRITICAL DEPTH ASSUMED
CAUTION  SECNO=34250.000  PROFILE= 2  MINIMUM SPECIFIC ENERGY
CAUTION  SECNO=34250.000  PROFILE= 3  CRITICAL DEPTH ASSUMED
CAUTION  SECNO=34250.000  PROFILE= 3  MINIMUM SPECIFIC ENERGY
CAUTION  SECNO=34250.000  PROFILE= 4  CRITICAL DEPTH ASSUMED
CAUTION  SECNO=34250.000  PROFILE= 4  MINIMUM SPECIFIC ENERGY

CAUTION  SECNO=34932.000  PROFILE= 1  CRITICAL DEPTH ASSUMED
CAUTION  SECNO=34932.000  PROFILE= 1  PROBABLE MINIMUM SPECIFIC ENERGY
CAUTION  SECNO=34932.000  PROFILE= 1  20 TRIALS ATTEMPTED TO BALANCE WSEL
CAUTION  SECNO=34932.000  PROFILE= 2  CRITICAL DEPTH ASSUMED
CAUTION  SECNO=34932.000  PROFILE= 2  PROBABLE MINIMUM SPECIFIC ENERGY
CAUTION  SECNO=34932.000  PROFILE= 2  20 TRIALS ATTEMPTED TO BALANCE WSEL
CAUTION  SECNO=34932.000  PROFILE= 3  CRITICAL DEPTH ASSUMED
CAUTION  SECNO=34932.000  PROFILE= 3  PROBABLE MINIMUM SPECIFIC ENERGY
CAUTION  SECNO=34932.000  PROFILE= 3  20 TRIALS ATTEMPTED TO BALANCE WSEL
CAUTION  SECNO=34932.000  PROFILE= 4  CRITICAL DEPTH ASSUMED
CAUTION  SECNO=34932.000  PROFILE= 4  PROBABLE MINIMUM SPECIFIC ENERGY
CAUTION  SECNO=34932.000  PROFILE= 4  20 TRIALS ATTEMPTED TO BALANCE WSEL
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Frisco, Tx.
Stewart Creek MAIN STREAM
ENCROACHMENTS

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****************************************
EC2 RELEASE DATED NOV 76 UPDATED  AUG1977
RROR CORR -  01,02
DIFICATION -  50,51,52,53
****************************************

E- ASTERISK (*) AT LEFT OF CROSS-SECTION NUMBER INDICATES MESSAGE IN SUMMARY OF ERRORS LIST

ART CREEK MAIN STREA

MARY PRINTOUT

   SECNO      CWSEL     DIFKWS      EG       DIFEG    TOPWID     VLOB      VCH      VROB    DEPTH

     0.100    521.60     0.0     521.79     0.0    1159.80     2.19      4.88     2.56    12.20
     0.100    522.10     0.50    522.78     1.00    428.00     3.90      7.90     4.09    12.70

     0.200    524.04     0.0     528.29     0.0     135.94     0.0      16.55     0.0     14.54
     0.200    524.04     0.0     528.29     0.0     135.94     0.0      16.55     0.0     14.54

    12.000    528.34     0.0     529.41     0.0     803.39     4.47      9.11     1.52    18.84
    12.000    525.36    -2.97    529.88     0.46    122.62     0.0      17.05     0.0     15.86

    72.000    529.51     0.0     529.54     0.0    1316.38     0.95      1.83     1.07    19.91
    72.000    530.31     0.80    530.35     0.82    800.00     1.23      2.24     1.39    20.71

  5200.000    530.09     0.0     530.38     0.0     821.26     1.98      6.61     3.49    15.59
  5200.000    531.10     1.01    531.31     0.93    772.87     1.92      5.68     3.05    16.60

  6300.000    534.62     0.0     534.79     0.0     873.68     1.87      5.25     2.76    15.32
  6300.000    535.19     0.56    535.44     0.64    700.00     2.30      6.22     3.21    15.89

  8000.000    536.96     0.0     537.15     0.0     868.72     1.96      5.59     2.90    14.96
  8000.000    537.64     0.69    537.31     0.66    786.00     2.08      5.12     2.75    15.64

  9500.000    539.03     0.0     539.25     0.0     863.64     2.07      6.04     3.09    14.56
  9500.000    539.65     0.62    540.04     0.79    600.00     3.04      7.61     3.83    15.15

 11140.000    542.65     0.0     543.30     0.0     871.09     2.05      8.13     3.11    15.45
 11140.000    543.72     1.07    544.29     0.99    526.00     2.61      7.51     3.25    16.52

 12500.000    547.51     0.0     548.61     0.0     544.03     2.30      9.93     3.43    14.01
 12500.000    547.59     0.08    548.81     0.20    396.89     2.39     10.23     4.03    14.09

 13700.000    554.33     0.0     555.40     0.0     429.08     2.75     10.41     4.15    15.33
  3700.000    554.56     0.22    555.63     0.23    337.52     3.70     10.33     4.19    15.56

  4625.000    557.93     0.0     558.12     0.0     581.63     1.65      5.19     2.75    13.93
  4325.000    558.36     0.43    558.63     0.51    350.00     2.02      5.79     3.38    14.36

  4915.000    558.04     0.0     558.26     0.0     515.12     1.47      2.12     3.82    13.84
  4915.000    558.58     0.53    558.78     0.51    427.00     1.81      2.02     3.64    14.38
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     SECNO       CWSEL    DIFKWS       EG        DIFEG      TOPWID      VLOB       VCH       VROB     DEPTH

   14935.000    558.08      0.0      558.30       0.0      516.10      1.47      2.12      3.80     13.88
   14935.000    558.61      0.52     558.81       0.51     418.00      1.83      2.02      3.65     14.41

   14975.000    558.15      0.0      558.36       0.0      575.18      1.94      5.50      2.89     13.55
   14975.000    558.60      0.45     558.90       0.54     350.00      2.28      6.11      3.55     14.00

   16900.000    560.93      0.0      561.44       0.0      496.20      2.37      8.26      4.09     11.43
   16900.000    561.49      0.56     561.90       0.46     453.86      2.21      7.39      3.83     11.99

   18800.000    565.85      0.0      565.99       0.0     1081.71      2.43      4.47      2.47     11.35
   18800.000    566.43      0.58     566.70       0.71     600.00      3.37      5.64      3.31     11.93

   20380.000    569.30      0.0      569.51       0.0     1027.14      2.98      5.59      3.00     10.60
   20380.000    570.00      0.70     570.18       0.67     790.00      2.90      4.89      2.90     11.30

   22500.000    575.14      0.0      575.39       0.0     1062.90      3.00      6.83      2.68     11.14
   22500.000    575.39      0.25     575.81       0.43     650.00      4.01      8.26      3.38     11.39

   24200.000    581.28      0.0      581.54       0.0      773.70      2.80      6.66      3.53     12.38
   24200.000    581.79      0.50     582.02       0.48     625.00      2.86      6.36      3.41     12.89

   26600.000    587.26      0.0      587.50       0.0      784.60      2.56      6.94      3.19     12.76
   26600.000    587.81      0.55     588.17       0.67     500.00      3.24      7.96      3.91     13.31

   28570.000    592.35      0.0      592.66       0.0      699.99      2.33      7.44      3.01     10.85
   28570.000    593.02      0.67     593.22       0.56     641.00      2.07      6.00      2.58     11.52

   30530.000    599.35      0.0      599.60       0.0      416.01      1.34      5.40      2.80     10.75
   30530.000    599.18     -0.16     599.56      -0.04     304.86      1.53      6.28      3.42     10.58

   32500.000    605.56      0.0      605.92       0.0      397.47      1.42      6.26      3.20     10.06
   32500.000    605.93      0.37     606.23       0.31     375.00      1.51      5.76      3.03     10.43

   33085.000    609.44      0.0      610.07       0.0      368.26      1.47      8.20      4.07      8.99
   33085.000    609.40     -0.04     610.91       0.85     200.00      2.23     11.48      5.86      8.95

   33670.000    615.05      0.0      615.49       0.0      386.17      1.53      6.99      3.46      9.65
   33670.000    616.02      0.98     616.40       0.92     282.00      1.57      6.29      3.35     10.62

*  34250.000    621.19      0.0      623.08       0.0      317.49      2.50     11.72      2.36     10.79
*  34250.000    620.93     -0.26     623.14       0.06     205.79      2.55     12.48      3.18     10.53

   34260.000    622.10      0.0      623.26       0.0      401.72      2.28      9.53      2.16     11.70
   34260.000    622.29      0.19     623.35       0.10     250.00      2.83      9.18      2.73     11.89

   34270.000    622.16      0.0      623.35       0.0      396.86      2.30      9.64      2.17     11.66
   34270.000    622.41      0.25     623.43       0.08     300.00      2.38      9.03      2.62     11.91

   34832.000    625.94      0.0      626.17       0.0      857.24      2.17      5.65      0.82     10.64
   34832.000    626.37      0.43     626.88       0.72     400.00      3.09      7.44      0.0      11.07

*  34932.000    628.25      0.0      630.38       0.0      162.81      5.76     12.84      5.61      9.85
*  34932.000    628.43      0.18     630.38       0.00     160.91      5.64     12.33      5.51     10.03

   34949.000    629.92      0.0      631.04       0.0      170.75      4.78      9.56      4.65     11.32
   34949.000    629.36     -0.06     631.01      -0.03     170.38      4.82      9.68      4.69     11.26
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     SECNO       CWSEL    DIFKWS      EG       DIFEG     TOPWID      VLOB       VCH      VROB    DEPTH

   34990.000    631.17     0.0     631.20      0.0     1013.27      1.10      2.28      0.66    14.07
   34990.000    631.10    -0.07    631.24      0.05     400.00      2.00      4.16      1.18    14.00

   35368.000    631.32     0.0     631.49      0.0      807.58      1.78      4.70      1.12    12.52
   35368.000    631.85     0.53    632.05      0.56     400.00      3.41      5.00      0.0      9.10

   35745.000    632.08     0.0     632.64      0.0      622.57      2.34      7.53      1.78    11.58
   35745.000    633.15     1.08    633.61      0.98     350.00      2.56      6.70      2.11    12.65

   36400.000    635.51     0.0     636.09      0.0      397.25      1.81      7.43      2.44    12.01
   36400.000    635.87     0.36    636.43      0.34     275.00      0.0       7.21      2.73    12.37

   36630.000    637.41     0.0     638.05      0.0      390.54      1.86      7.76      2.50    11.81
   36630.000    637.70     0.30    638.58      0.53     250.00      2.19      8.54      2.90    12.10

   37260.000    639.44     0.0     640.04      0.0      394.97      1.83      7.54      2.46    11.94
   37260.000    640.06     0.62    640.62      0.58     260.00      0.0       7.14      2.75    12.56

   37700.000    641.12     0.0     641.43      0.0      384.17      1.19      5.36      1.70    11.62
   37700.000    641.58     0.46    642.07      0.63     200.00      1.61      6.17      2.02    12.08

   37800.000    641.33     0.0     642.00      0.0       92.00      0.0       6.54      0.0     11.33
   37800.000    641.98     0.65    642.65      0.65      92.00      0.0       6.54      0.0     11.98

   37820.000    641.58     0.0     642.25      0.0       92.00      0.0       6.54      0.0     11.48
   37820.000    642.27     0.69    642.93      0.69     160.82      0.0       6.52      0.43    12.17

   37860.000    642.19     0.0     642.45      0.0      396.63      1.14      4.94      1.62    11.99
   37860.000    642.92     0.73    643.11      0.66     326.00      1.32      4.30      1.59    12.72

   38760.000    644.89     0.0     645.72      0.0      325.38      1.57      8.06      2.24     9.89
   38760.000    644.72    -0.17    646.17      0.45     153.26      1.83      9.84      2.11     9.72

   39700.000    650.33     0.0     651.22      0.0      315.76      1.96      8.08      1.87    10.33
   39700.000    651.06     0.73    651.90      0.68     150.00      2.50      7.67      2.27    11.06

   40700.000    657.48     0.0     659.24      0.0       71.88      0.64     10.67      0.0     11.78
   40700.000    657.34    -0.14    659.19     -0.06      65.88      0.0      10.91      0.0     11.64

   41700.000    665.11     0.0     665.86      0.0      267.94      1.59      7.21      1.43    14.11
   41700.000    665.58     0.47    666.43      0.58      66.00      0.0       7.41      0.0     14.58

   42710.000    669.82     0.0     670.91      0.0      190.56      1.52      8.46      1.28    13.22
   42710.000    670.41     0.59    671.43      0.52      66.00      0.0       8.09      0.0     13.81

   43720.000    675.67     0.0     676.57      0.0      229.58      1.58      7.82      1.38    13.67
   43720.000    675.97     0.30    676.95      0.38      66.00      0.0       7.94      0.0     13.97

   44800.000    681.91     0.0     683.12      0.0      163.06      1.44      8.92      1.16    12.91
   44800.000    682.31     0.40    683.46      0.34      66.00      0.0       8.60      0.0     13.31

   45800.000    688.15     0.0     688.94      0.0      196.85      0.0       7.31      1.61    12.55
   45800.000    688.36     0.21    689.23      0.29      78.82      0.0       7.48      0.0     12.76

   46600.000    692.59     0.0     693.70      0.0      152.26      0.0       8.53      1.49    11.69
   46600.000    692.85     0.26    693.93      0.24      78.15      0.0       8.37      0.0     11.95
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    SECNO      CWSEL    DIFKWS      EG      DIFEG     TOPWID     VLOB       VCH      VROB     DEPTH

  47400.000    698.06     0.0     699.02     0.0     171.46      0.0       7.97      1.57     12.06
  47400.000    696.19     0.13    699.20     0.19     78.35      0.0       8.08      0.0      12.19
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STEWART CREEK MAIN STREA

SUMMARY PRINTOUT TABLE  110

      SECNO      CWSEL     DIFKWS       EG      TOPWID      QLOB        QCH        QROB      PERENC    STENCL     STCHL      STCHR     STENCR

      0.100     521.60      0.0      521.79    1159.80    6921.31    6263.63    4615.04      0.0       0.0      790.00     940.00      0.0
      0.100     522.10      0.50     522.78     428.00    5591.82   10740.20    1467.97    428.00    570.00     790.00     940.00    998.00

*     0.200     524.04      0.0      528.29     135.94       0.0    17799.98       0.0       0.0       0.0      768.00     968.00      0.0
*     0.200     524.04      0.0      528.29     135.94       0.0    17799.98       0.0     300.00    686.00     768.00     968.00    986.00

     12.000     528.34      0.0      529.41     803.39    3767.84   13936.18      95.98      0.0       0.0      768.00     968.00      0.0
     12.000     525.36     -2.97     529.88     122.62       0.0    17799.99       0.0     225.00    711.00     768.00     968.00    936.00

     72.000     529.51      0.0.     529.54    1316.38    8142.23    4462.02    5195.74      0.0       0.0      790.00     940.00      0.0
     72.000     530.31      0.80     530.35     800.00    5765.43    5738.60    6295.95    800.00    465.00     790.00     940.00   1265.00

   3200.000     530.09      0.0      530.38     821.26    2551.23    4465.17   10783.60      0.0       0.0      870.00     920.00      0.0
   3200.000     531.10      1.01     531.31     772.87    3015.01    4121.96   10663.02    790.00    560.00     870.00     920.00   1350.00

   6300.000     534.62      0.0      534.79     873.68     534.18    3026.61   14239.21      0.0       0.0      166.00     215.00      0.0
   6300.000     535.19      0.56     535.44     700.00     734.79    3760.48   13304.75    700.00    100.00     166.00     215.00    800.00

   8000.000     536.96      0.0      537.15     868.72     507.71    3124.09   14168.22      0.0       0.0      166.00     215.00      0.0
   8000.000     537.64      0.69     537.81     786.00     304.91    3036.18   14458.92    786.00    144.00     166.00     215.00    930.00

   9500.000     539.03      0.0      539.25     863.64     474.68    3250.70   14074.63      0.0       0.0      166.00     215.00      0.0
   9500.000     539.65      0.62     540.04     600.00     412.25    4326.32   13061.41    600.00    144.00     166.00     215.00    744.00

  11140.000     542.65      0.0      543.30     871.09    1511.31   10324.12    5964.56      0.0       0.0      650.00     760.00      0.0
  11140.000     543.72      1.07     544.29     526.00     959.16   10408.23    6432.61    526.00    594.00     650.00     760.00   1120.00

  12500.000     547.51      0.0      548.61     544.03     657.53    7721.98    2920.48      0.0       0.0      470.00     547.00      0.0
  12500.000     547.59      0.08     548.81     396.89     712.68    8025.97    2561.34    400.00    328.00     470.00     547.00    728.00

  13700.000     554.33      0.0      555.40     429.08     963.20    6499.04    3837.76      0.0       0.0      348.20     402.87      0.0
  13700.000     554.56      0.22     555.63     337.52     617.34    6577.67    4104.98    350.00    315.00     348.20     402.87    665.00

  14825.000     557.93      0.0      558.12     581.63     412.23    2875.31    8012.45      0.0       0.0      155.00     200.00      0.0
  14825.000     558.36      0.43     558.63     350.00     490.26    3320.04    7489.69    350.00    107.00     155.00     200.00    457.00

  14915.000     558.04      0.0      558.26     515.12     277.86     262.82   10759.32      0.0       0.0      178.00     208.00      0.0
  14915.000     558.58      0.53     558.78     427.00     290.39     268.69   10740.92    427.00    141.00     178.00     208.00    568.00

  14935.000     558.08      0.0      558.30     516.10     280.55     263.03   10756.41      0.0       0.0      178.00     208.00      0.0
  14935.000     558.61      0.52     558.81     418.00     271.85     269.88   10758.26    418.00    145.00     178.00     208.00    563.00

  14975.000     558.15      0.0      558.36     575.18     433.47    2957.03    7909.50      0.0       0.0      155.00     200.00      0.0
  14975.000     558.60      0.45     558.90     350.00     544.39    3401.99    7353.62    350.00    100.00     155.00     200.00    450.00

  16900.000     560.93      0.0      561.44     496.20     243.56    3647.49    7408.94      0.0       0.0      155.00     200.00      0.0
  16900.000     561.49      0.56     561.90     453.86     285.99    3448.09    7565.93    470.00     88.00     155.00     200.00    558.00

  18800.000     565.85      0.0      565.99    1081.71    3835.91    2349.08    5115.00      0.0       0.0      563.00     650.00      0.0
  18800.000     566.43      0.58     566.70     600.00    3449.97    3247.26    4602.76    600.00    353.00     563.00     650.00    953.00

  20380.000     569.30      0.0      569.51    1027.14    3718.22    2559.77    5012.00      0.0       0.0      563.00     650.00      0.0
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      SECNO      CWSEL    DIFKWS       EG    TOPWID      QLOB        QCH      QROB    PERENC   STENCL     STCHL     STCHR    STENCR

   22500.000    575.14      0.0     575.39   1062.90   4389.92   2245.13   4664.95      0.0       0.0    560.00    600.00      0.0
   22500.000    575.39      0.25    575.81    650.00   4365.21   2798.52   4136.26    650.00   313.00    560.00    600.00    963.00

   24200.000    581.28      0.0     581.54    773.70   3962.76   1901.89   5435.35      0.0       0.0    623.00    650.00      0.0
   24200.000    581.79      0.50    582.02    625.00   4070.23   1848.21   5381.55    625.00   292.00    623.00    650.00    917.00

   26600.000    587.26      0.0     587.50    784.60   4038.34   1994.12   5267.54      0.0       0.0    623.00    650.00      0.0
   26600.000    587.81      0.55    588.17    500.00   4965.26   2403.76   3932.98    500.00   302.00    623.00    650.00    802.00

   28570.000    592.35      0.0     592.66    699.99   1791.75   1755.06   3253.22      0.0       0.0    623.00    650.00      0.0
   28570.000    593.02      0.67    593.22    641.00   2020.84   1523.10   3256.06    641.00   291.00    623.00    650.00    932.00

   30530.000    599.35      0.0     599.60    416.01     70.48   2794.93   3934.59      0.0       0.0    200.00    275.00      0.0
   30530.000    599.18     -0.16    599.56    304.86     72.69   3171.10   3556.21    400.00    74.00    200.00    275.00    474.00

   32500.000    605.56      0.0     605.92    397.47     46.69   2916.36   3836.95      0.0       0.0    200.00    275.00      0.0
   32500.000    605.93      0.37    606.23    375.00     62.57   2840.91   3896.52    375.00   176.00    200.00    275.00    551.00

   33065.000    609.44      0.0     610.07    368.26     16.41   3164.96   3618.63      0.0       0.0    200.00    275.00      0.0
   33065.000    609.40     -0.04    610.91    200.00     22.81   4393.85   2383.34    200.00   188.00    200.00    275.00    388.00

   33670.000    615.05      0.0     615.49    386.17     35.32   3039.30   3725.38      0.0       0.0    200.00    275.00      0.0
   33670.000    616.02      0.98    616.40    282.00     14.02   3194.63   3591.35    282.00   197.00    200.00    275.00    479.00

*  34250.000    621.19      0.0     623.08    317.49    225.63   6002.12    572.24      0.0       0.0    500.00    570.00      0.0
*  34250.000    620.93     -0.26    623.14    205.79    188.43   6165.46    446.11    220.00   425.00    500.00    570.00    645.00

   34260.000    622.10      0.0     623.26    401.72    370.40   5490.09    939.51      0.0       0.0    500.00    570.00      0.0
   34260.000    622.29      0.19    623.35    250.00    394.29   5405.00   1000.70    250.00   450.00    500.00    570.00    700.00

   34270.000    622.16      0.0     623.35    396.86    361.91   5520.16    917.94      0.0       0.0    500.00    570.00      0.0
   34270.000    622.41      0.25    623.43    300.00    424.46   5330.56   1044.96    300.00   417.00    500.00    570.00    717.00

   34832.000    625.94      0.0     626.17    857.24   4294.23   2467.90     37.86      0.0       0.0    810.00    877.00      0.0
   34832.000    626.37      0.43    626.88    400.00   3341.46   3458.54      0.0     400.00   477.00    810.00    877.00    877.00

*  34932.000    628.25      0.0     630.38    162.81    369.64   5391.52   1044.84      0.0       0.0    710.00    780.00      0.0
*  34932.000    628.43      0.18    630.38    160.91    382.07   5325.74   1092.19    200.00   656.00    710.00    780.00    856.00

   34949.000    629.92      0.0     631.04    170.75    491.49   4930.72   1377.80      0.0       0.0    710.00    780.00      0.0
   34949.000    629.86     -0.06    631.01    170.38    486.53   4948.00   1365.46    200.00   664.00    710.00    780.00    864.00

   34990.000    631.17      0.0     631.20   1013.27   4956.97   1520.31    322.72      0.0       0.0    810.00    877.00      0.0
   34990.000    631.10     -0.07    631.24    400.00   4003.81   2751.95     44.24    400.00   485.00    810.00    877.00    885.00

   35368.000    631.32      0.0     631.49    807.58   3649.27   2762.98    387.75      0.0       0.0    812.00    878.00      0.0
   35368.000    631.85      0.53    632.05    400.00   6194.45    605.55      0.0     400.00   430.00    812.00    878.00    830.00

   35745.000    632.08      0.0     632.64    622.57   2100.77   4098.84    600.39      0.0       0.0    815.00    881.00      0.0
   35745.000    633.15      1.08    633.61    350.00   1956.69   4125.01    718.30    350.00   631.00    815.00    881.00    981.00

   36400.000    635.51      0.0     636.09    397.25    170.91   4359.45   2269.63      0.0       0.0    150.00    215.00      0.0
   36400.000    635.87      0.35    636.43    275.00      0.0    4400.44   2399.56    275.00   150.00    150.00    215.00    425.00

   36830.000    637.41      0.0     638.05    390.54    158.30   4452.90   2188.80      0.0       0.0    150.00    215.00      0.0
   36830.000    637.70      0.30    638.58    250.00    215.61   5065.64   1518.75    250.00   105.00    150.00    215.00    355.00
```

```
     SECNO      CWSEL     DIFKWS       EG      TOPWID      QLOB       QCH       QROB     PERENC    STENCL     STCHL     STCHR    STENCR

  37260.000    639.44      0.0      640.04    394.97    166.61   4390.77   2242.62      0.0       0.0     150.00    215.00      0.0
  37260.000    640.06      0.62     640.62    260.00      0.0    4446.12   2353.88    260.00    150.00    150.00    215.00    410.00

  37700.000    641.12      0.0      641.43    384.17     91.60   3011.93   1396.46      0.0       0.0     150.00    215.00      0.0
  37700.000    641.58      0.46     642.07    200.00    149.53   3648.08    702.39    200.00    113.00    150.00    215.00    313.00

  37800.000    641.33      0.0      642.00     92.00      0.0    4500.00      0.0       0.0       0.0     133.00    225.00      0.0
  37800.000    641.93      0.65     642.65     92.00      0.0    4500.00      0.0     250.00     54.00    133.00    225.00    304.00

  37820.000    641.58      0.0      642.25     92.00      0.0    4500.00      0.0       0.0       0.0     133.00    225.00      0.0
  37820.000    642.27      0.69     642.93    160.82      0.0    4497.32      2.68    250.00     54.00    133.00    225.00    304.00

  37860.000    642.19      0.0      642.45    396.63    106.24   2894.49   1499.27      0.0       0.0     150.00    215.00      0.0
  37860.000    642.92      0.73     643.11    326.00    117.10   2721.68   1661.22    326.00    126.00    150.00    215.00    452.00

  38760.000    644.89      0.0      645.72    325.36     33.06   3623.77    843.17      0.0       0.0     150.00    215.00      0.0
  38760.000    644.72     -0.17     646.17    153.26     31.96   4313.35    154.69    200.00     83.00    150.00    215.00    283.00

  39700.000    650.33      0.0      651.22    315.76     84.18   3893.82    521.99      0.0       0.0     150.00    215.00      0.0
  39700.000    651.06      0.73     651.90    150.00     70.63   4060.05    369.31    150.00    141.00    150.00    215.00    291.00

  40700.000    657.48      0.0      659.24     71.88      0.52   4499.48      0.0       0.0       0.0     174.00    240.00      0.0
  40700.000    657.34     -0.14     659.19     65.88      0.0    4500.00      0.0       0.00    174.00    174.00    240.00    240.00

  41700.000    665.11      0.0      665.66    267.94    118.03   4153.13    228.83      0.0       0.0     174.00    240.00      0.0
  41700.000    665.58      0.47     666.43     56.00      0.0    4500.00      0.0       0.08    174.00    174.00    240.00    240.00

  42710.000    669.82      0.0      670.91    190.56     49.27   4377.05     73.68      0.0       0.0     174.00    240.00      0.0
  42710.000    670.41      0.59     671.43     66.00      0.0    4500.00      0.0       0.03    174.00    174.00    240.00    240.00

  43720.000    675.67      0.0      676.57    229.58     81.08   4276.59    142.33      0.0       0.0     174.00    240.00      0.0
  43720.000    675.97      0.30     676.95     66.00      0.0    4500.00      0.0       0.05    174.00    174.00    240.00    240.00

  44800.000    681.91      0.0      683.12    163.06     31.22   4430.03     38.75      0.0       0.0     174.00    240.00      0.0
  44800.000    682.31      0.40     683.46     66.00      0.0    4500.00      0.0       0.02    174.00    174.00    240.00    240.00

  45800.000    688.15      0.0      688.94    196.05      0.0    4277.62    222.38      0.0       0.0     270.00    350.00      0.0
  45800.000    688.36      0.21     689.23     78.82      0.0    4500.00      0.0       0.05    270.00    270.00    350.00    350.00

  46600.000    692.59      0.0      693.70    152.26      0.0    4417.53     82.47      0.0       0.0     270.00    350.00      0.0
  46600.000    692.85      0.26     693.93     78.15      0.0    4500.00      0.0       0.02    270.00    270.00    350.00    350.00

  47400.000    698.06      0.0      699.02    171.46      0.0    4363.56    136.43      0.0       0.0     270.00    350.00      0.0
  47400.000    698.19      0.13     699.20     78.35      0.0    4500.00      0.0       0.03    270.00    270.00    350.00    350.00


 SUMMARY OF ERRORS

CAUTION  SECNO=      0.200  PROFILE= 1  CRITICAL DEPTH ASSUMED
CAUTION  SECNO=      0.200  PROFILE= 1  PROBABLE MINIMUM SPECIFIC ENERGY
CAUTION  SECNO=      0.200  PROFILE= 1  20 TRIALS ATTEMPTED TO BALANCE WSEL
CAUTION  SECNO=      0.200  PROFILE= 2  CRITICAL DEPTH ASSUMED
CAUTION  SECNO=      0.200  PROFILE= 2  PROBABLE MINIMUM SPECIFIC ENERGY
CAUTION  SECNO=      0.200  PROFILE= 2  20 TRIALS ATTEMPTED TO BALANCE WSEL
```

```
CAUTION  SECNO=34250.000  PROFILE= 2  CRITICAL DEPTH ASSUMED
CAUTION  SECNO=34250.000  PROFILE= 2  MINIMUM SPECIFIC ENERGY

CAUTION  SECNO=34932.000  PROFILE= 1  CRITICAL DEPTH ASSUMED
CAUTION  SECNO=34932.000  PROFILE= 1  PROBABLE MINIMUM SPECIFIC ENERGY
CAUTION  SECNO=34932.000  PROFILE= 1  20 TRIALS ATTEMPTED TO BALANCE WSEL
CAUTION  SECNO=34932.000  PROFILE= 2  CRITICAL DEPTH ASSUMED
CAUTION  SECNO=34932.000  PROFILE= 2  PROBABLE MINIMUM SPECIFIC ENERGY
CAUTION  SECNO=34932.000  PROFILE= 2  20 TRIALS ATTEMPTED TO BALANCE WSEL
```

24

TABLE 3A – SUMMARY OF DISCHARGES (Cont'd)

FLOODING SOURCE AND LOCATION	DRAINAGE AREA (sq. miles)	PEAK DISCHARGES (cfs) 10-PERCENT	2-PERCENT	1-PERCENT	0.2-PERCENT
SPRING CREEK (Cont'd)					
At approximately 300 feet downstream of FM 544	8.78	7,740	12,280	15,040	22,550
At approximately 1,500 feet downstream of Parker Road	6.74	6,380	10,140	12,410	18,290
Immediately upstream of Deerfield Drive	4.91	5,000	7,830	9,510	13,960
At approximately 0.57 miles downstream of Independence Parkway	3.21	3,830	5,930	7,240	10,450
Immediately upstream of Independence Parkway	1.65	2,160	3,250	3,900	5,620
At approximately 2,300 feet upstream of Legacy Drive	0.46	610	910	1,100	1,580
SPRING CREEK TRIBUTARY 4					
At its confluence with Spring Creek	0.33	620	920	1,100	1,580
STEWART CREEK					
At State Route 423	18.03	9,900	15,300	17,800	24,350
At confluence of Stewart Creek Tributary 1	10.57	6,400	9,800	11,300	15,500
At confluence of Stewart Creek Tributary 3	5.33	4,000	6,000	6,800	9,100
At confluence of Stewart Creek Tributary 4	3.21	2,700	4,000	4,500	6,000
STEWART CREEK TRIBUTARY 1					
At confluence with Stewart Creek	5.90	4,100	6,200	7,000	9,500

TABLE 4 - MANNING'S "n" VALUES (Cont’d)

Stream	Channel “n”	Overbank “n”
Stream 5B37	0.03-0.058	0.014-0.078
Tributary A Stewart Creek	*	*
Tributary to Stream 5B13	0.013-0.065	0.030-0.075
Tributary WRC-1 West Rowlett Creek	*	*
Unnamed Tributary to Muddy Creek	*	*
Unnamed Tributary to an Unnamed Tributary to Muddy Creek	*	*
Unnamed Tributary to Rowlett Creek	*	*
Unnamed Tributary to Watters Branch	*	*
Unnamed Tributary to White Rock Creek	*	*
Warden Creek	0.02-0.07	0.013-0.06
Watters Branch	0.035-0.070	0.045-0.150
West Rowlett Creek	0.055-0.065	0.045-0.120
White Rock Creek	0.020-0.070	0.014-0.095
White Rock Creek Tributary 1	0.014-0.043	0.014-0.053
White Rock Creek Tributary 2	0.03-0.067	0.014-0.078
White Rock Creek Tributary 3	0.015-0.055	0.014-0.074
White Rock Creek (East)	0.025-0.050	0.050-0.080
Wilson Creek	0.060-0.074	*
Wilson Creek Tributary 9	0.020-0.090	0.040-0.090

*Data not available

3.3 Vertical Datum

All FIS reports and FIRMs are referenced to a specific vertical datum. The vertical datum provides a starting point against which flood, ground, and structure elevations can be referenced and compared. Until recently, the standard vertical datum used for newly created or revised FIS reports and FIRMs was the National Geodetic Vertical Datum of 1929 (NGVD 29). With the completion of the North American Vertical Datum of 1988 (NAVD 88), many FIS reports and FIRMs are now prepared using NAVD 88 as the referenced vertical datum.

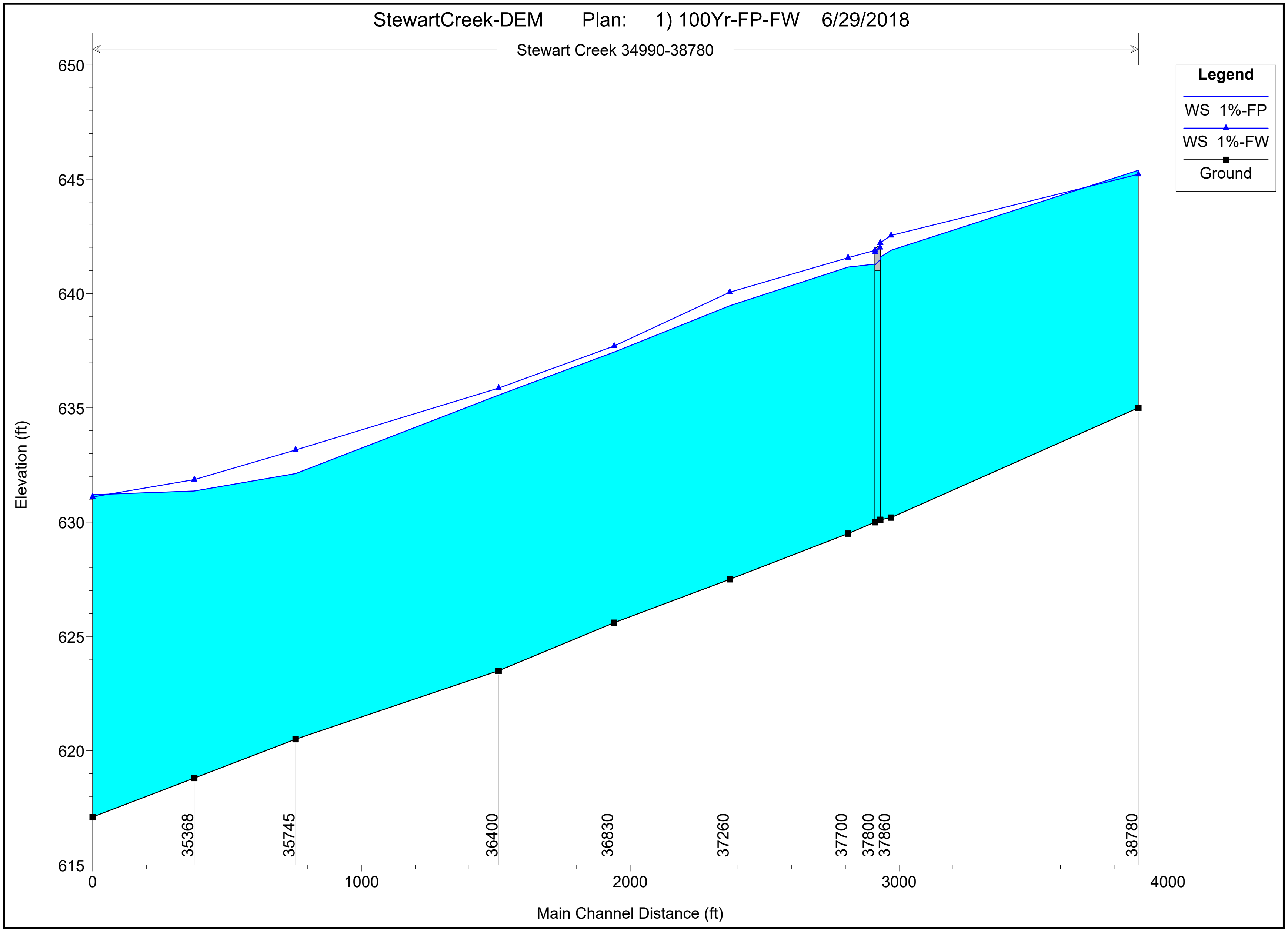
Flood elevations shown in this FIS report and on the FIRM are referenced to the NAVD 88. These flood elevations must be compared to structure and ground elevations referenced to the same vertical datum. Some of the data used in this revision were taken from the prior effective FIS reports and FIRMs and adjusted to NAVD 88. The datum conversion factor from NGVD 29 to NAVD 88 in Collin County is 0.06 feet.

For additional information regarding conversion between the NGVD 29 and NAVD 88, visit the National Geodetic Survey website at www.ngs.noaa.gov, or contact the National Geodetic Survey at the following address:

NGS Information
Services NOAA,
N/NGS12
SSMC-3, #9202

APPENDIX C

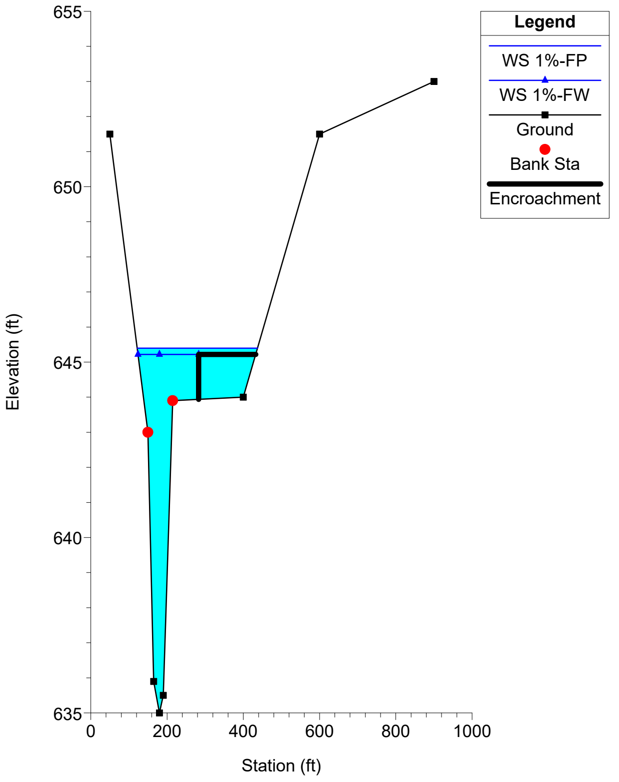
Duplicate Effective Model


StewartCreek-DEM Plan: 1) 100Yr-FP-FW 6/29/2018
Stewart Creek 34990-38780
Legend
WS 1%-FP
WS 1%-FW
Ground
Elevation (ft)
650
645
640
635
630
625
620
615
35368
35745
36400
36830
37260
37700
37800
37860
38780
0
1000
2000
3000
4000
Main Channel Distance (ft)

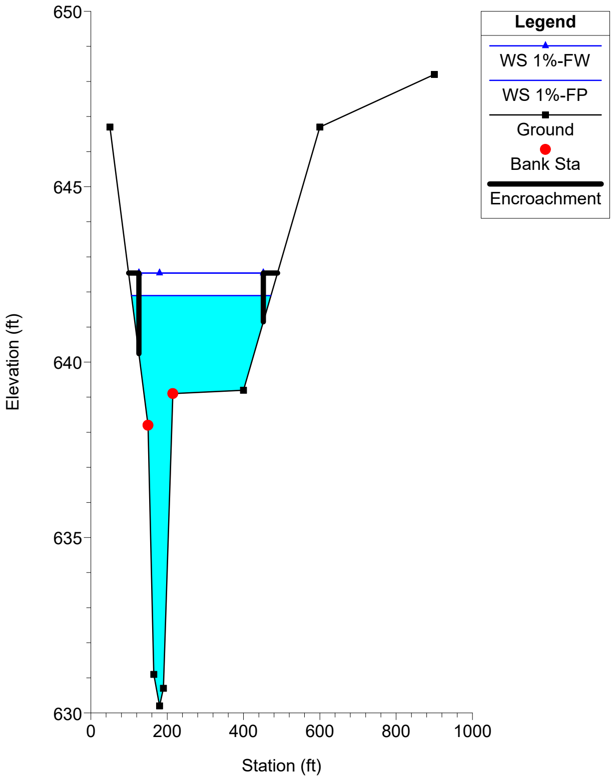
HEC-RAS Plan: 100Yr-FP-FW River: Stewart Creek Reach: 34990-38780

Reach	River Sta	Profile	Q Total	Min Ch El	W.S. Elev	Prof Delta WS	Crit W.S.	E.G. Elev	E.G. Slope	Vel Chnl	Flow Area	Top Width	Froude # Chl	Enc Sta L	Enc Sta R
			(cfs)	(ft)	(ft)	(ft)	(ft)	(ft)	(ft/ft)	(ft/s)	(sq ft)	(ft)		(ft)	(ft)
34990-38780	38780	1%-FP	4500.00	635.00	645.40			646.28	0.005405	8.06	809.63	315.43	0.52		
34990-38780	38780	1%-FW	4500.00	635.00	645.22	-0.18		646.43	0.007034	9.05	587.93	159.09	0.59	83.00	283.00
34990-38780	37860	1%-FP	4500.00	630.20	641.90			642.34	0.002969	6.05	1251.82	365.35	0.36		
34990-38780	37860	1%-FW	4500.00	630.20	642.54	0.65		642.85	0.002015	5.23	1438.72	326.00	0.30	126.00	452.00
34990-38780	37820	1%-FP	4500.00	630.10	641.59		637.59	642.17	0.004908	6.14	732.98	92.00	0.38		
34990-38780	37820	1%-FW	4500.00	630.10	642.22	0.63	637.59	642.73	0.003853	5.69	794.58	142.05	0.34	100.00	304.00
34990-38780	37819		Bridge												
34990-38780	37800	1%-FP	4500.00	630.00	641.29			641.90	0.005328	6.30	714.24	92.00	0.40		
34990-38780	37800	1%-FW	4500.00	630.00	641.89	0.60		642.42	0.004203	5.85	769.86	92.00	0.36	54.00	304.00
34990-38780	37700	1%-FP	4500.00	629.50	641.16			641.47	0.002342	5.36	1475.15	385.47	0.32		
34990-38780	37700	1%-FW	4500.00	629.50	641.57	0.41		642.06	0.002925	6.18	1030.31	200.00	0.36	113.00	313.00
34990-38780	37260	1%-FP	6800.00	627.50	639.47			640.08	0.004456	7.57	1596.68	396.04	0.44		
34990-38780	37260	1%-FW	6800.00	627.50	640.06	0.59		640.62	0.003980	7.15	1478.02	260.00	0.41	150.00	410.00
34990-38780	36830	1%-FP	6800.00	625.60	637.44			638.09	0.004786	7.77	1546.30	391.69	0.46		
34990-38780	36830	1%-FW	6800.00	625.60	637.70	0.26		638.58	0.005564	8.54	1214.55	250.00	0.50	105.00	355.00
34990-38780	36400	1%-FP	6800.00	623.50	635.56			636.14	0.004232	7.42	1630.60	398.94	0.43		
34990-38780	36400	1%-FW	6800.00	623.50	635.86	0.31		636.43	0.004157	7.22	1488.21	275.00	0.42	150.00	425.00
34990-38780	35745	1%-FP	6800.00	620.50	632.12			632.69	0.004943	7.57	1808.46	625.98	0.46		
34990-38780	35745	1%-FW	6800.00	620.50	633.16	1.04		633.62	0.003303	6.69	1721.91	350.00	0.39	631.00	981.00
34990-38780	35368	1%-FP	6800.00	618.80	631.36			631.53	0.001771	4.76	3043.94	832.97	0.28		
34990-38780	35368	1%-FW	6800.00	622.75	631.86	0.50		632.06	0.004790	5.00	1941.55	400.00	0.34	430.00	830.00
34990-38780	34990	1%-FP	6800.00	617.10	631.20		626.49	631.23	0.000359	2.31	5712.24	1014.64	0.13		
34990-38780	34990	1%-FW	6800.00	617.10	631.10	-0.10	626.87	631.25	0.001186	4.18	2700.95	400.00	0.23	485.00	885.00

StewartCreek-DEM Plan: 1) 100Yr-FP-FW 6/29/2018
River = Stewart Creek Reach = 34990-38780 RS = 38780



StewartCreek-DEM Plan: 1) 100Yr-FP-FW 6/29/2018
River = Stewart Creek Reach = 34990-38780 RS = 37860



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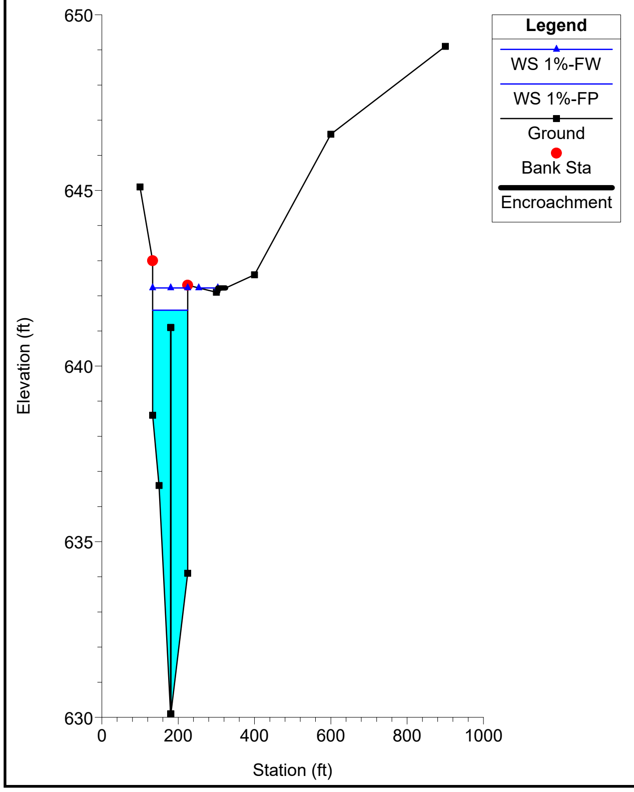
River = Stewart Creek Reach = 34990-38780 RS = 37820



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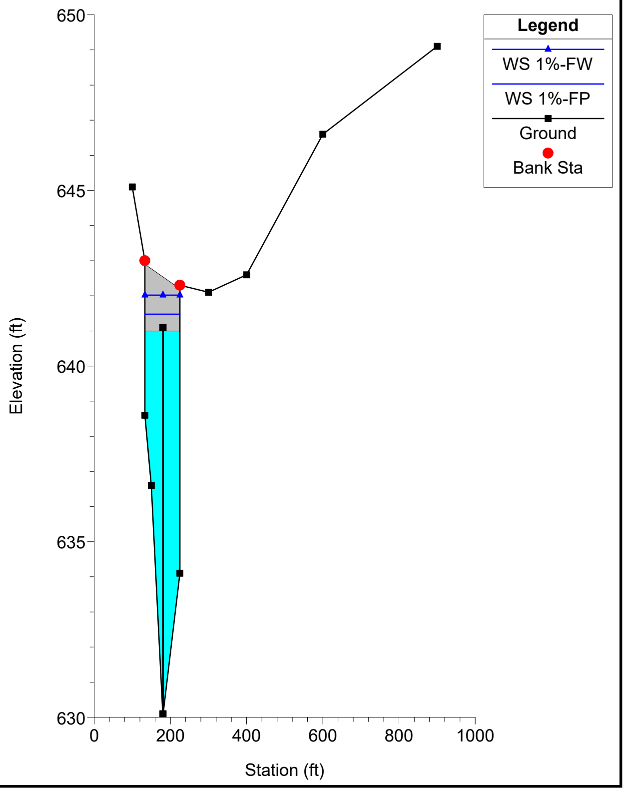
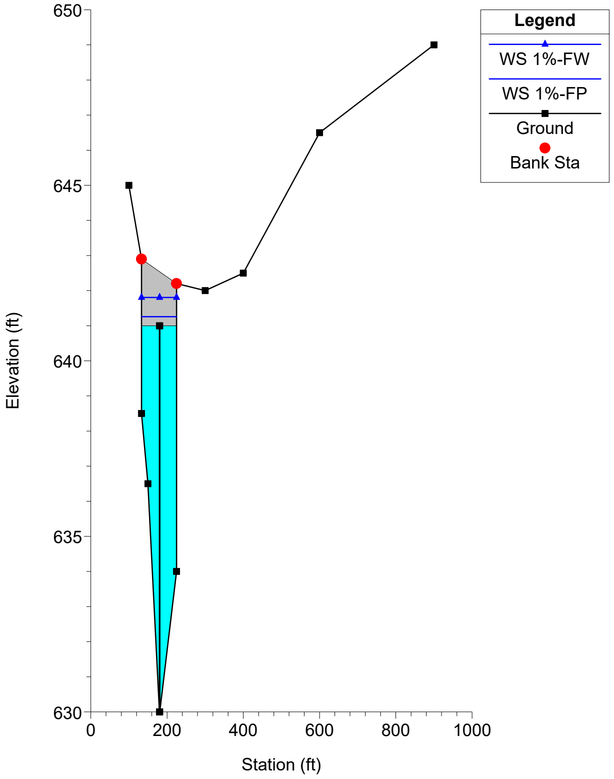
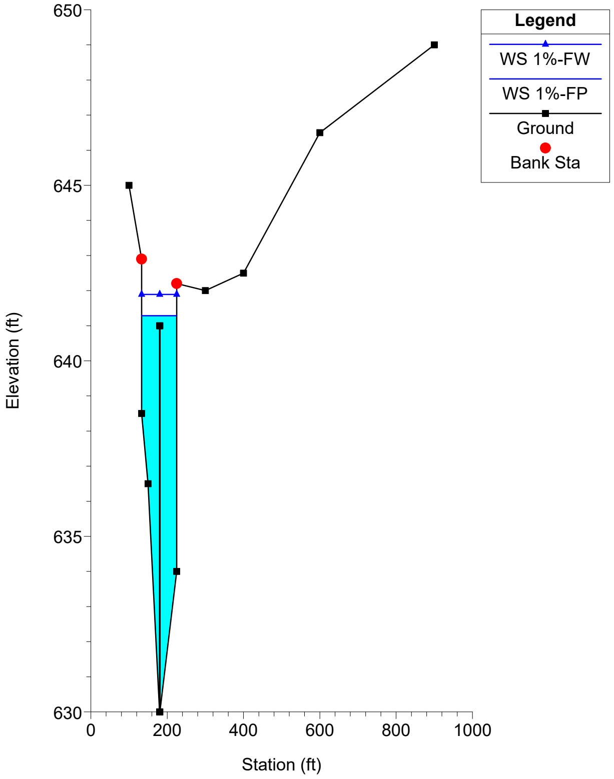
River = Stewart Creek Reach = 34990-38780 RS = 37819 BR



StewartCreek-DEM Plan: 1) 100Yr-FP-FW 6/29/2018
River = Stewart Creek Reach = 34990-38780 RS = 37819 BR



StewartCreek-DEM Plan: 1) 100Yr-FP-FW 6/29/2018
River = Stewart Creek Reach = 34990-38780 RS = 37800



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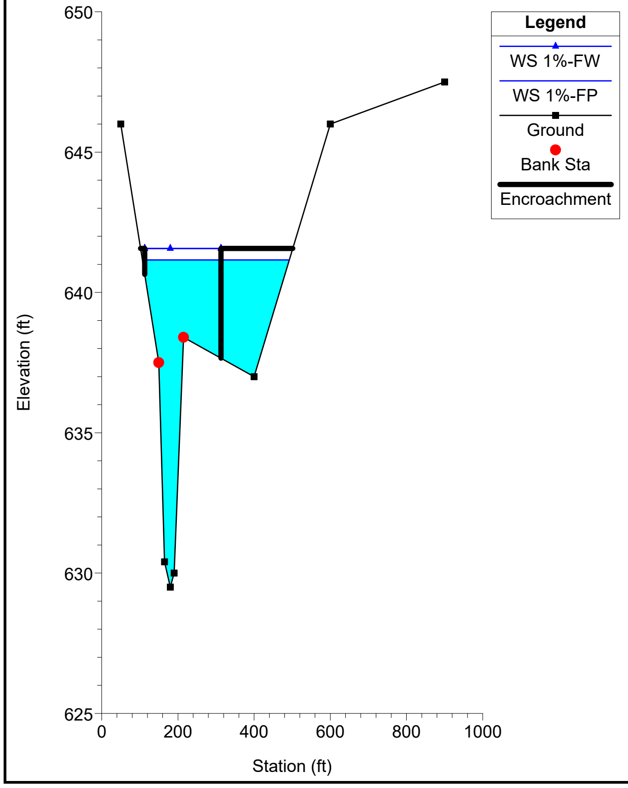
River = Stewart Creek Reach = 34990-38780 RS = 37700



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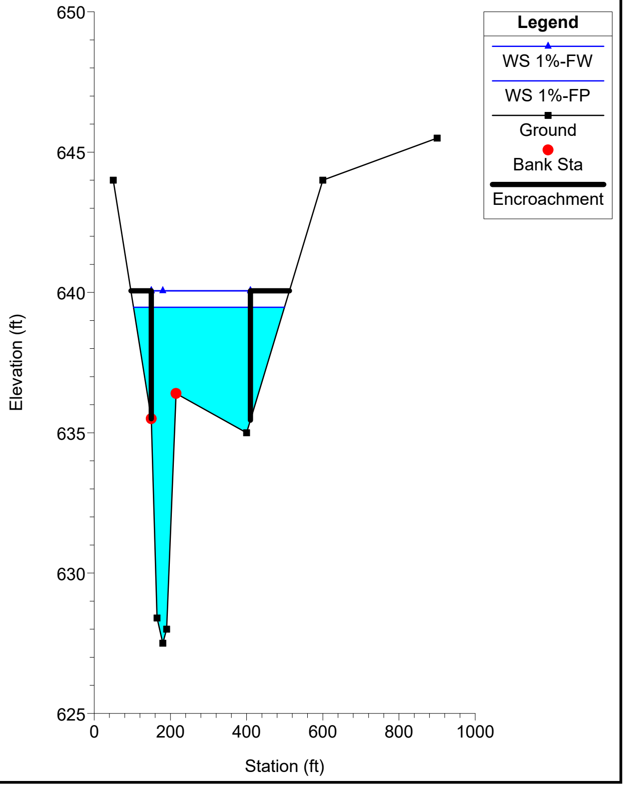
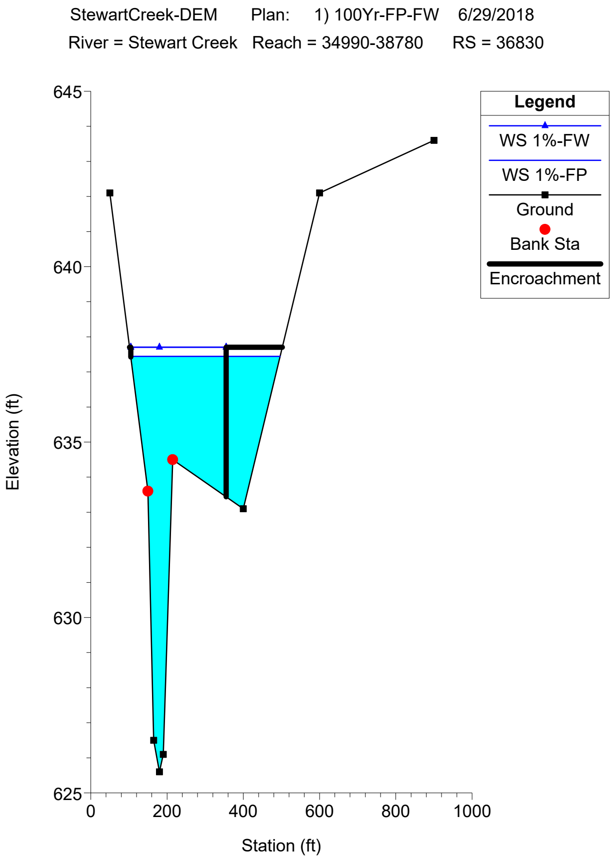
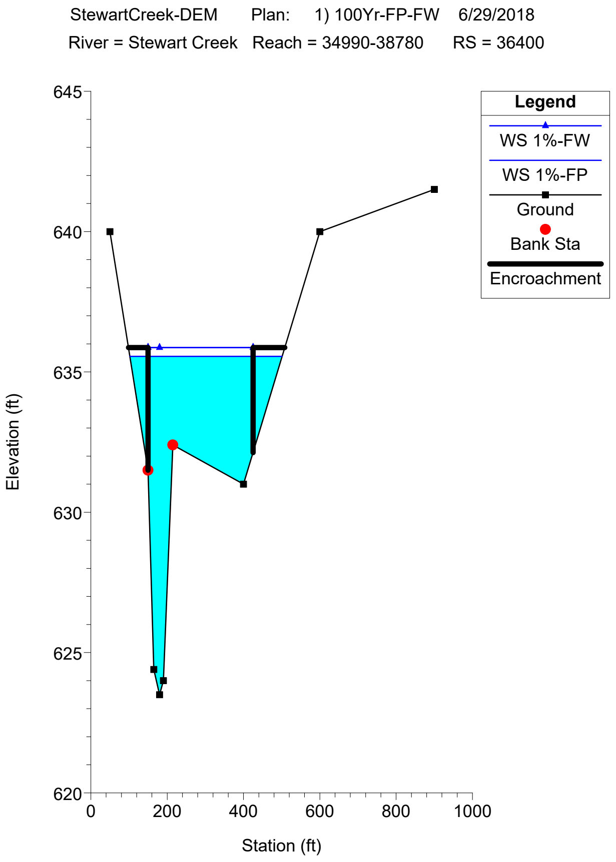
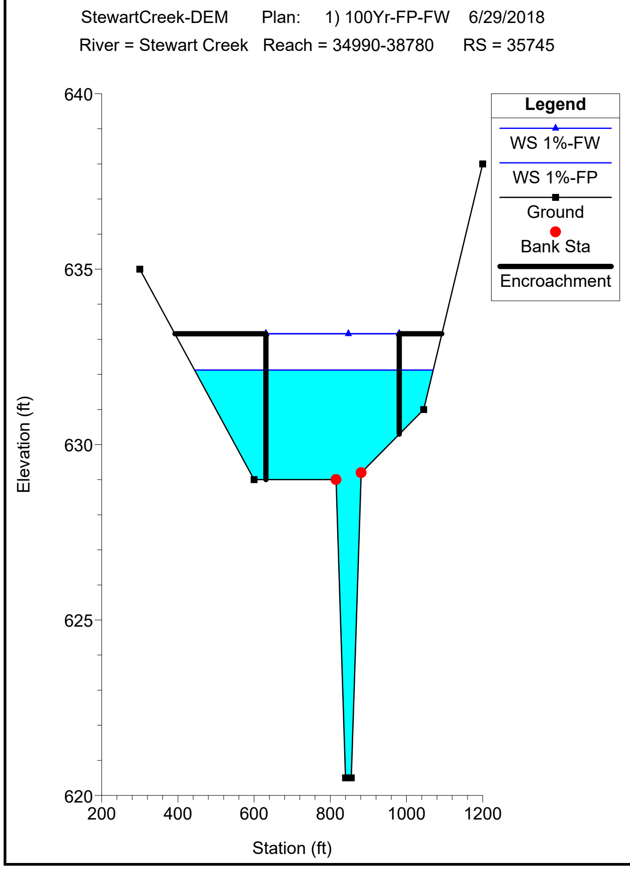
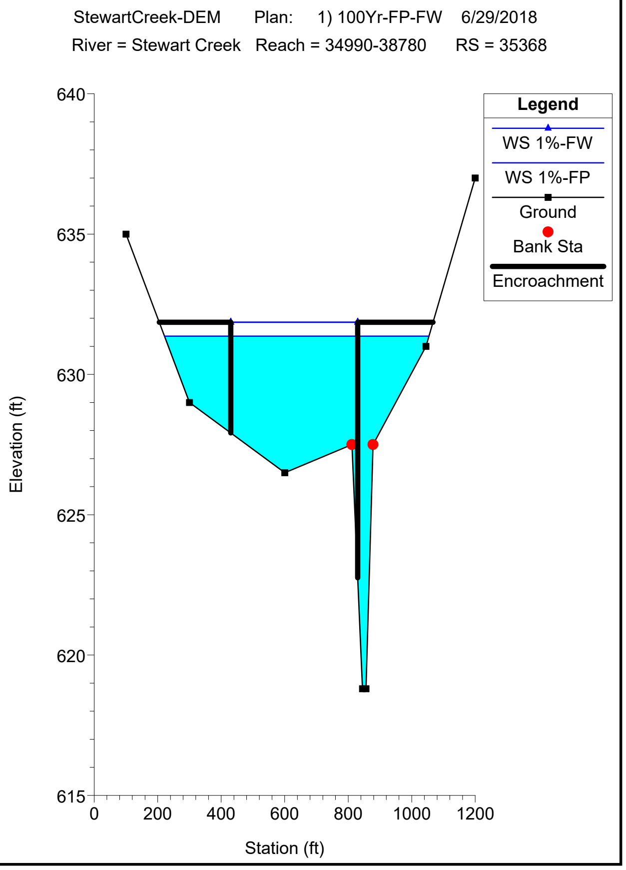
River = Stewart Creek Reach = 34990-38780 RS = 37260




StewartCreek-DEM Plan: 1) 100Yr-FP-FW 6/29/2018
River = Stewart Creek Reach = 34990-38780 RS = 36830
Legend
WS 1%-FW
WS 1%-FP
Ground
Bank Sta
Encroachment
Elevation (ft)
645
640
635
630
625
0
200
400
600
800
1000
Station (ft)


StewartCreek-DEM Plan: 1) 100Yr-FP-FW 6/29/2018
River = Stewart Creek Reach = 34990-38780 RS = 36400
Legend
WS 1%-FW
WS 1%-FP
Ground
Bank Sta
Encroachment
Elevation (ft)
645
640
635
630
625
620
0
200
400
600
800
1000
Station (ft)


StewartCreek-DEM Plan: 1) 100Yr-FP-FW 6/29/2018
River = Stewart Creek Reach = 34990-38780 RS = 35745
Legend
WS 1%-FW
WS 1%-FP
Ground
Bank Sta
Encroachment
Elevation (ft)
640
635
630
625
620
200
400
600
800
1000
1200
Station (ft)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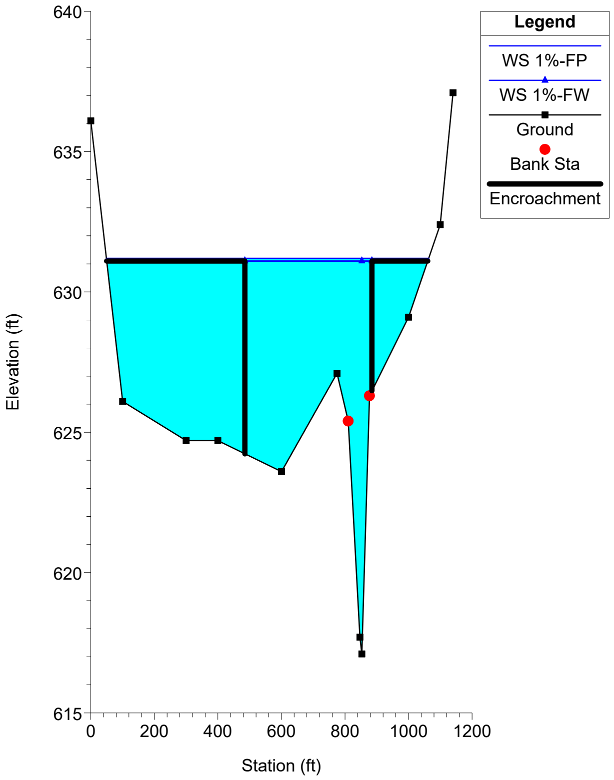
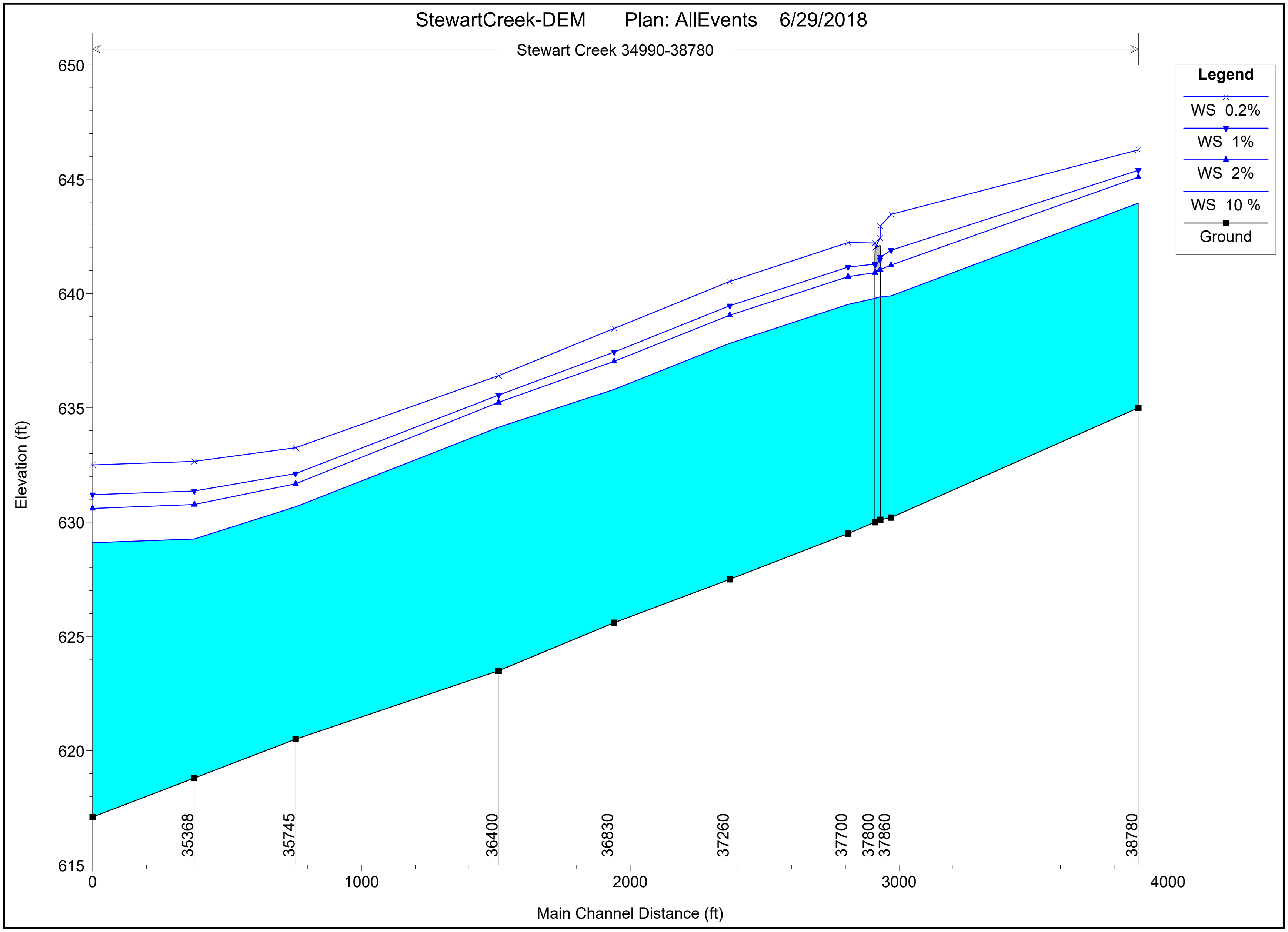
River = Stewart Creek Reach = 34990-38780 RS = 35368
Legend
WS 1%-FW
WS 1%-FP
Ground
Bank Sta
Encroachment
Elevation (ft)
640
635
630
625
620
615
0
200
400
600
800
1000
1200
Station (ft)

StewartCreek-DEM Plan: 1) 100Yr-FP-FW 6/29/2018
River = Stewart Creek Reach = 34990-38780 RS = 34990



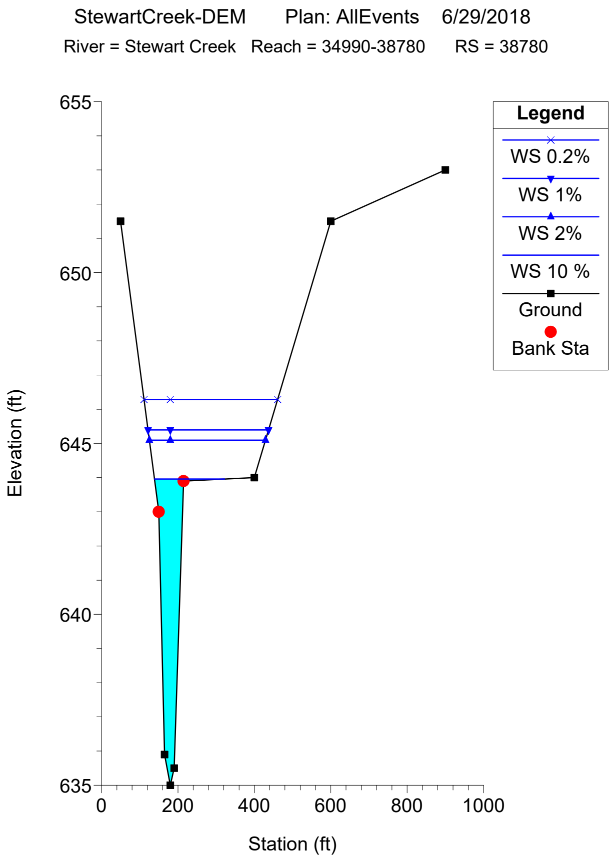

StewartCreek-DEM Plan: AllEvents 6/29/2018
Stewart Creek 34990-38780
Legend
WS 0.2%
WS 1%
WS 2%
WS 10 %
Ground
Elevation (ft)
650
645
640
635
630
625
620
615
Main Channel Distance (ft)
0
1000
2000
3000
4000
35368
35745
36400
36830
37260
37700
37800
37860
38780

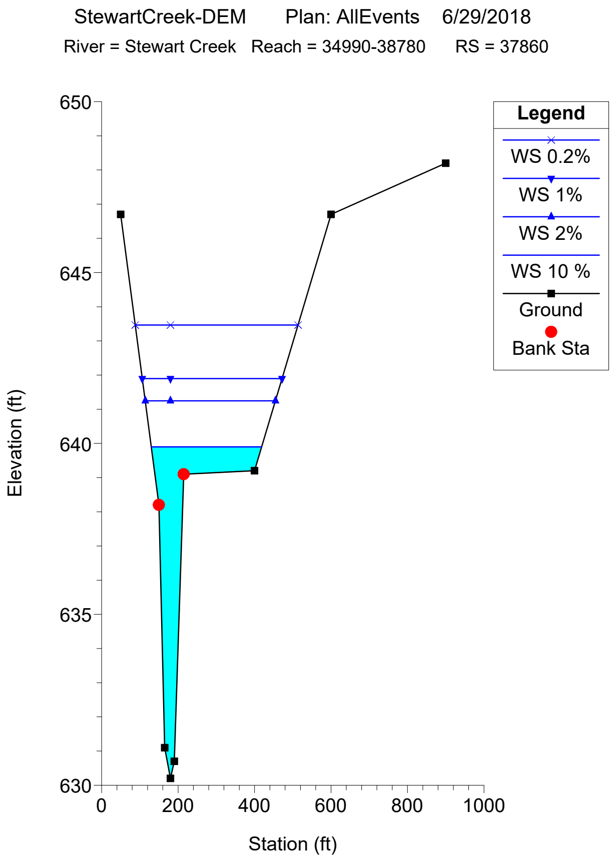
HEC-RAS Plan: AllEvents   River: Stewart Creek   Reach: 34990-38780

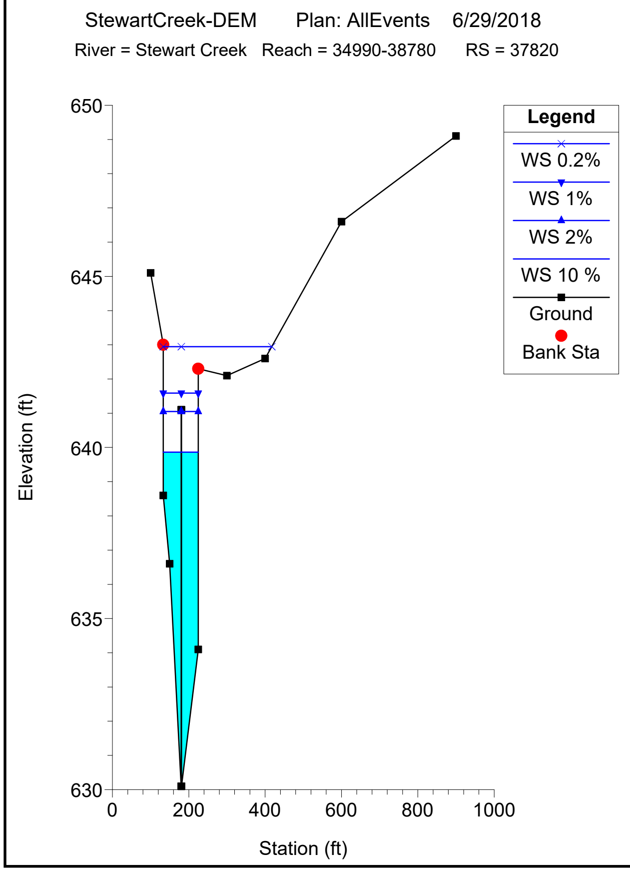
Reach	River Sta	Profile	Q Total	Min Ch El	W.S. Elev	Crit W.S.	E.G. Elev	E.G. Slope	Vel Chnl	Flow Area	Top Width	Froude # Chl
			(cfs)	(ft)	(ft)	(ft)	(ft)	(ft/ft)	(ft/s)	(sq ft)	(ft)	
34990-38780	38780	10 %	2700.00	635.00	643.96		644.70	0.005322	6.93	397.23	183.11	0.50
34990-38780	38780	2%	4000.00	635.00	645.09	642.73	645.94	0.005299	7.77	715.96	303.80	0.51
34990-38780	38780	1%	4500.00	635.00	645.40		646.28	0.005405	8.06	809.63	315.43	0.52
34990-38780	38780	0.2%	5950.00	635.00	646.29		647.17	0.005152	8.49	1105.40	349.61	0.52
34990-38780	37860	10 %	2700.00	630.20	639.90		640.41	0.003953	5.87	598.71	288.59	0.40
34990-38780	37860	2%	4000.00	630.20	641.25		641.75	0.003504	6.24	1023.13	340.45	0.39
34990-38780	37860	1%	4500.00	630.20	641.90		642.34	0.002969	6.05	1251.82	365.35	0.36
34990-38780	37860	0.2%	5950.00	630.20	643.46		643.82	0.002178	5.79	1872.19	425.64	0.32
34990-38780	37820	10 %	2700.00	630.10	639.86	636.01	640.20	0.003671	4.69	575.38	91.00	0.33
34990-38780	37820	2%	4000.00	630.10	641.05	637.17	641.58	0.004781	5.85	683.58	91.00	0.38
34990-38780	37820	1%	4500.00	630.10	641.59	637.59	642.17	0.004908	6.14	732.98	92.00	0.38
34990-38780	37820	0.2%	5950.00	630.10	642.95	638.63	643.66	0.005018	6.82	976.36	284.30	0.39
34990-38780	37819		Bridge									
34990-38780	37800	10 %	2700.00	630.00	639.79		640.13	0.003620	4.67	578.02	91.00	0.33
34990-38780	37800	2%	4000.00	630.00	640.91		641.45	0.004858	5.88	679.96	91.00	0.38
34990-38780	37800	1%	4500.00	630.00	641.29		641.90	0.005328	6.30	714.24	92.00	0.40
34990-38780	37800	0.2%	5950.00	630.00	642.21		643.07	0.006512	7.44	812.43	209.43	0.44
34990-38780	37700	10 %	2700.00	629.50	639.52		639.82	0.002492	4.81	890.07	329.87	0.32
34990-38780	37700	2%	4000.00	629.50	640.74		641.05	0.002392	5.24	1316.66	371.23	0.32
34990-38780	37700	1%	4500.00	629.50	641.16		641.47	0.002342	5.36	1475.15	385.47	0.32
34990-38780	37700	0.2%	5950.00	629.50	642.23		642.55	0.002246	5.67	1907.77	421.89	0.32
34990-38780	37260	10 %	4000.00	627.50	637.82		638.36	0.004403	6.57	991.04	340.11	0.43
34990-38780	37260	2%	6000.00	627.50	639.05		639.64	0.004442	7.32	1433.65	381.79	0.44
34990-38780	37260	1%	6800.00	627.50	639.47		640.08	0.004456	7.57	1596.68	396.04	0.44
34990-38780	37260	0.2%	9100.00	627.50	640.53		641.19	0.004498	8.19	2035.81	432.08	0.46
34990-38780	36830	10 %	4000.00	625.60	635.80		636.38	0.004789	6.78	950.57	336.04	0.44
34990-38780	36830	2%	6000.00	625.60	637.04		637.66	0.004755	7.50	1389.84	377.87	0.45
34990-38780	36830	1%	6800.00	625.60	637.44		638.09	0.004786	7.77	1546.30	391.69	0.46
34990-38780	36830	0.2%	9100.00	625.60	638.47		639.18	0.004866	8.43	1966.84	426.62	0.47
34990-38780	36400	10 %	4000.00	623.50	634.15		634.59	0.003500	6.04	1105.02	351.32	0.38
34990-38780	36400	2%	6000.00	623.50	635.24		635.77	0.003958	7.01	1506.38	388.21	0.42
34990-38780	36400	1%	6800.00	623.50	635.56		636.14	0.004232	7.42	1630.60	398.94	0.43
34990-38780	36400	0.2%	9100.00	623.50	636.41		637.10	0.004776	8.37	1982.33	427.85	0.47
34990-38780	35745	10 %	4000.00	620.50	630.67		631.30	0.005541	7.05	980.44	498.82	0.48

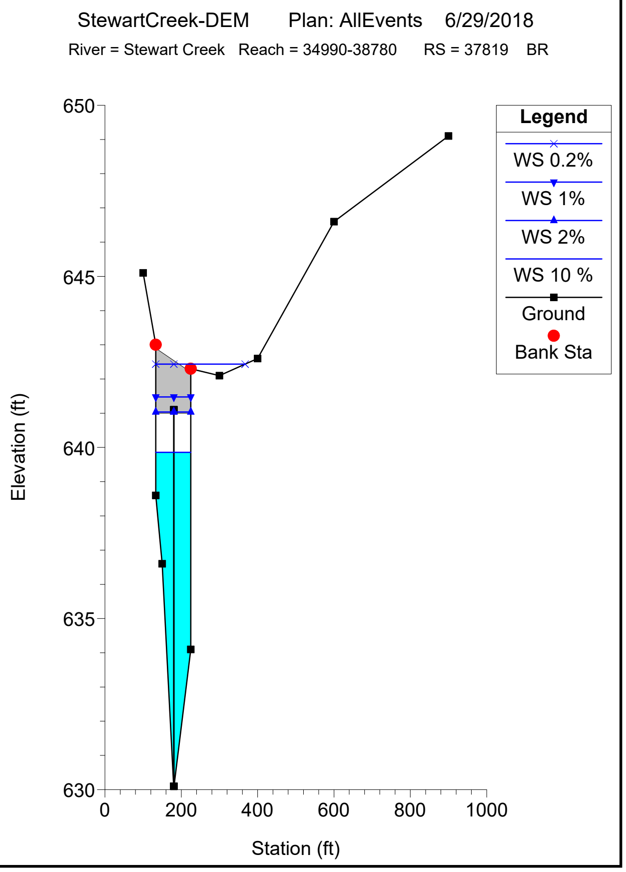
HEC-RAS Plan: AllEvents River: Stewart Creek Reach: 34990-38780 (Continued)

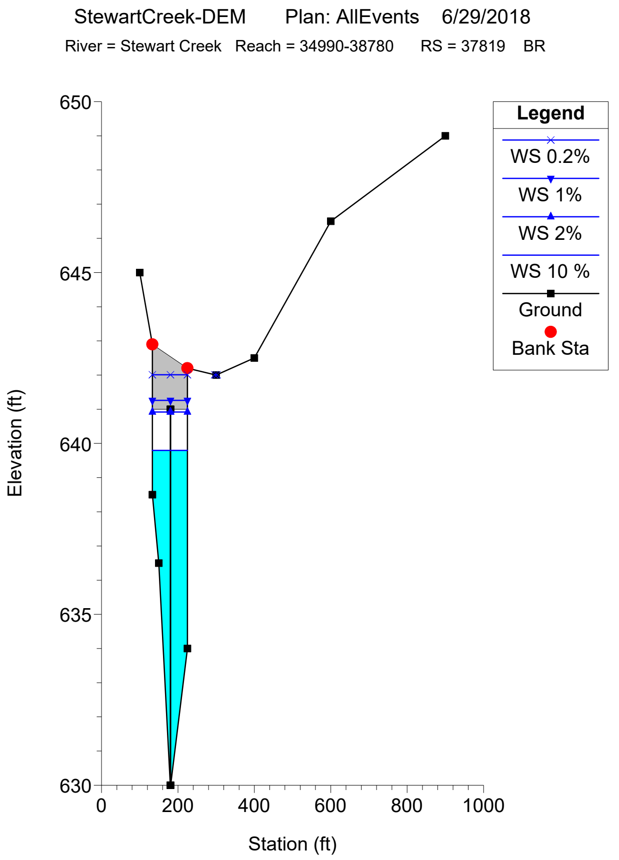
Reach	River Sta	Profile	Q Total	Min Ch El	W.S. Elev	Crit W.S.	E.G. Elev	E.G. Slope	Vel Chnl	Flow Area	Top Width	Froude # Chl
			(cfs)	(ft)	(ft)	(ft)	(ft)	(ft/ft)	(ft/s)	(sq ft)	(ft)	
34990-38780	35745	2%	6000.00	620.50	631.68		632.30	0.005406	7.63	1538.49	594.05	0.48
34990-38780	35745	1%	6800.00	620.50	632.12		632.69	0.004943	7.57	1808.46	625.98	0.46
34990-38780	35745	0.2%	9100.00	620.50	633.26		633.74	0.004038	7.45	2564.30	707.75	0.43
34990-38780	35368	10 %	4000.00	618.80	629.26		629.58	0.003459	5.57	1460.68	670.94	0.38
34990-38780	35368	2%	6000.00	618.80	630.77		630.97	0.002119	4.98	2562.13	792.90	0.30
34990-38780	35368	1%	6800.00	618.80	631.36		631.53	0.001771	4.76	3043.94	832.97	0.28
34990-38780	35368	0.2%	9100.00	618.80	632.66		632.80	0.001402	4.64	4173.01	909.64	0.26
34990-38780	34990	10 %	4000.00	617.10	629.10	625.75	629.13	0.000445	2.20	3670.34	930.00	0.14
34990-38780	34990	2%	6000.00	617.10	630.60	626.33	630.63	0.000386	2.30	5110.68	990.45	0.13
34990-38780	34990	1%	6800.00	617.10	631.20	626.45	631.23	0.000359	2.31	5712.24	1014.64	0.13
34990-38780	34990	0.2%	9100.00	617.10	632.50	626.90	632.54	0.000347	2.47	7065.20	1064.85	0.13

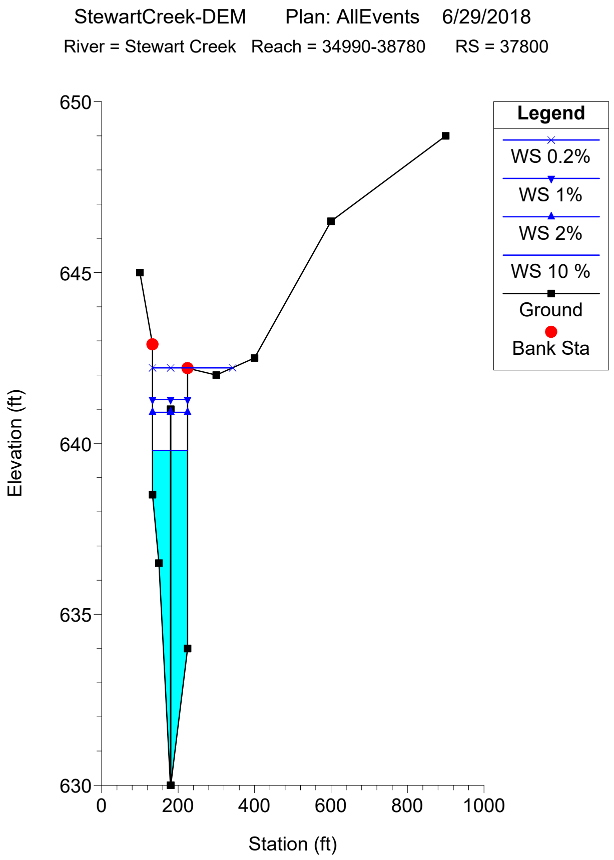

StewartCreek-DEM Plan: AllEvents 6/29/2018
River = Stewart Creek Reach = 34990-38780 RS = 38780
Legend
WS 0.2%
WS 1%
WS 2%
WS 10 %
Ground
Bank Sta
Elevation (ft)
655
650
645
640
635
Station (ft)
0
200
400
600
800
1000

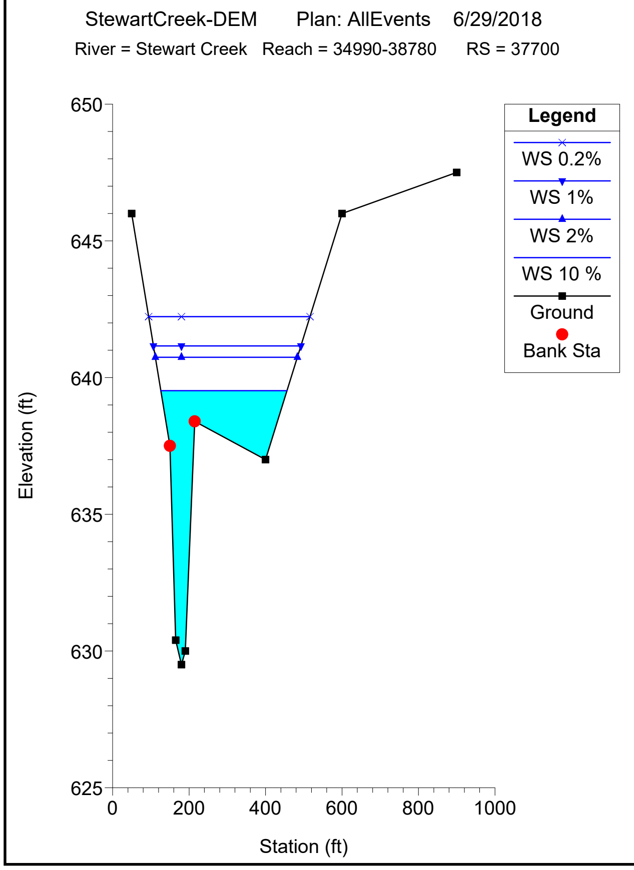

StewartCreek-DEM Plan: AllEvents 6/29/2018
River = Stewart Creek Reach = 34990-38780 RS = 37860
Legend
WS 0.2%
WS 1%
WS 2%
WS 10 %
Ground
Bank Sta
Elevation (ft)
650
645
640
635
630
Station (ft)
0
200
400
600
800
1000

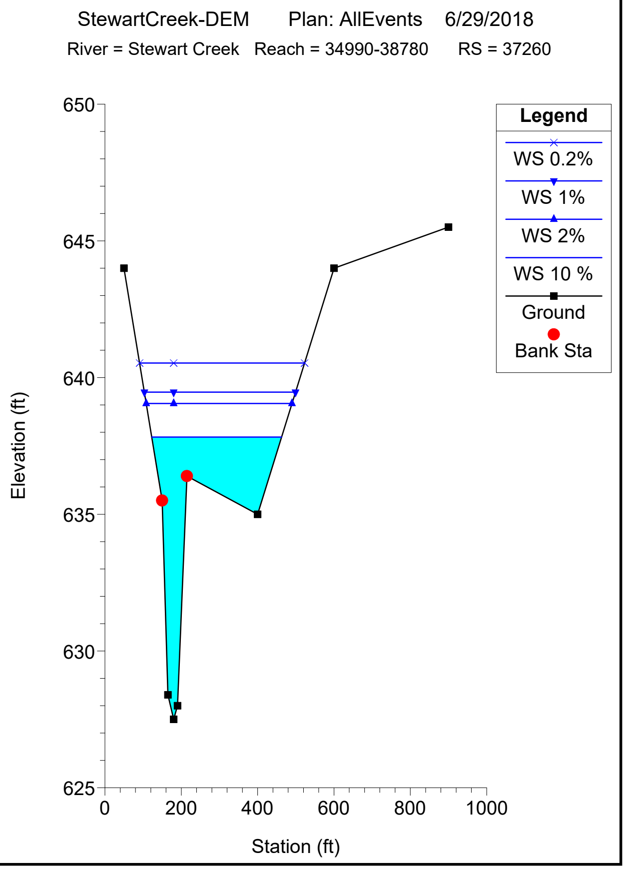

StewartCreek-DEM Plan: AllEvents 6/29/2018
River = Stewart Creek Reach = 34990-38780 RS = 37820
Legend
WS 0.2%
WS 1%
WS 2%
WS 10 %
Ground
Bank Sta
Elevation (ft)
650
645
640
635
630
Station (ft)
0
200
400
600
800
1000

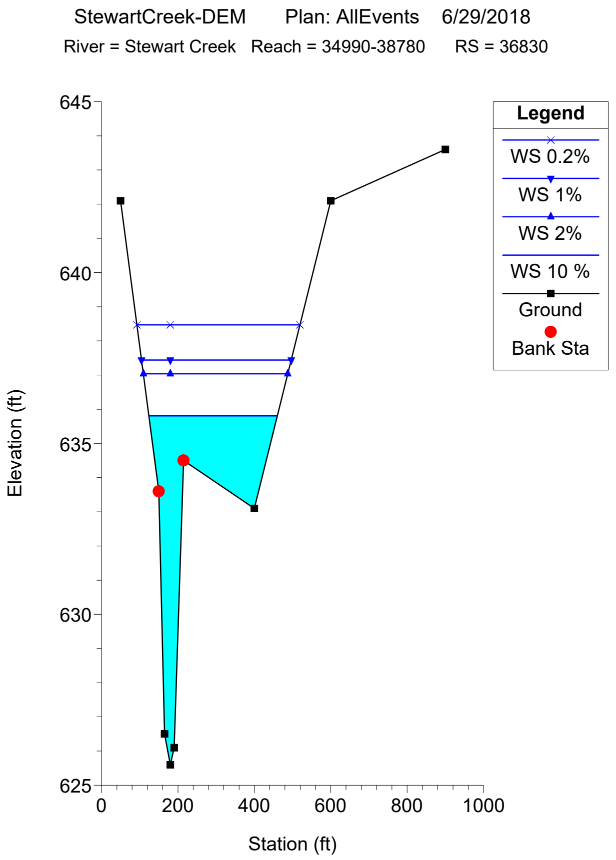

StewartCreek-DEM Plan: AllEvents 6/29/2018
River = Stewart Creek Reach = 34990-38780 RS = 37819 BR
Legend
WS 0.2%
WS 1%
WS 2%
WS 10 %
Ground
Bank Sta
Elevation (ft)
650
645
640
635
630
Station (ft)
0
200
400
600
800
1000


StewartCreek-DEM Plan: AllEvents 6/29/2018
River = Stewart Creek Reach = 34990-38780 RS = 37819 BR
Legend
WS 0.2%
WS 1%
WS 2%
WS 10 %
Ground
Bank Sta
Elevation (ft)
650
645
640
635
630
Station (ft)
0
200
400
600
800
1000


StewartCreek-DEM Plan: AllEvents 6/29/2018
River = Stewart Creek Reach = 34990-38780 RS = 37800
Legend
WS 0.2%
WS 1%
WS 2%
WS 10 %
Ground
Bank Sta
Elevation (ft)
650
645
640
635
630
Station (ft)
0
200
400
600
800
1000


StewartCreek-DEM Plan: AllEvents 6/29/2018
River = Stewart Creek Reach = 34990-38780 RS = 37700
Legend
WS 0.2%
WS 1%
WS 2%
WS 10 %
Ground
Bank Sta
Elevation (ft)
650
645
640
635
630
625
Station (ft)
0
200
400
600
800
1000


StewartCreek-DEM Plan: AllEvents 6/29/2018
River = Stewart Creek Reach = 34990-38780 RS = 37260
Legend
WS 0.2%
WS 1%
WS 2%
WS 10 %
Ground
Bank Sta
Elevation (ft)
650
645
640
635
630
625
Station (ft)
0
200
400
600
800
1000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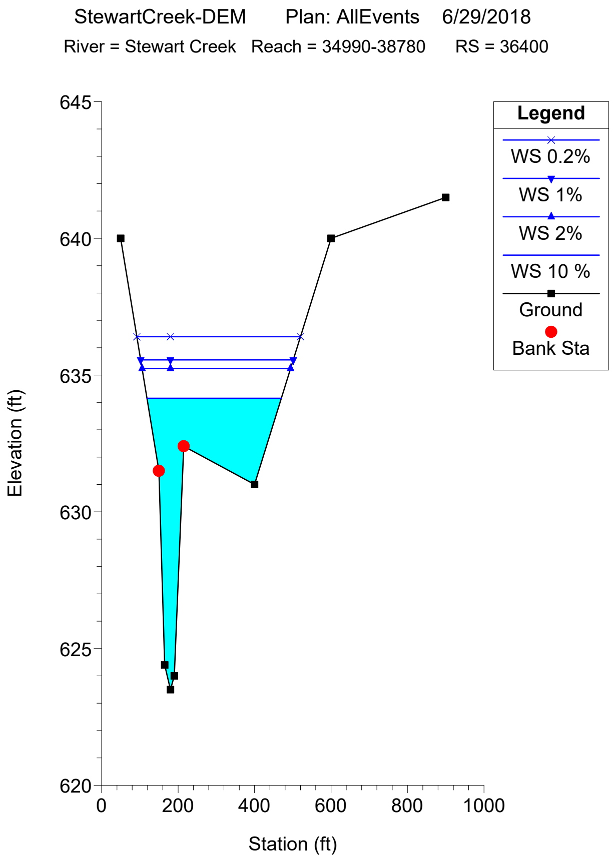
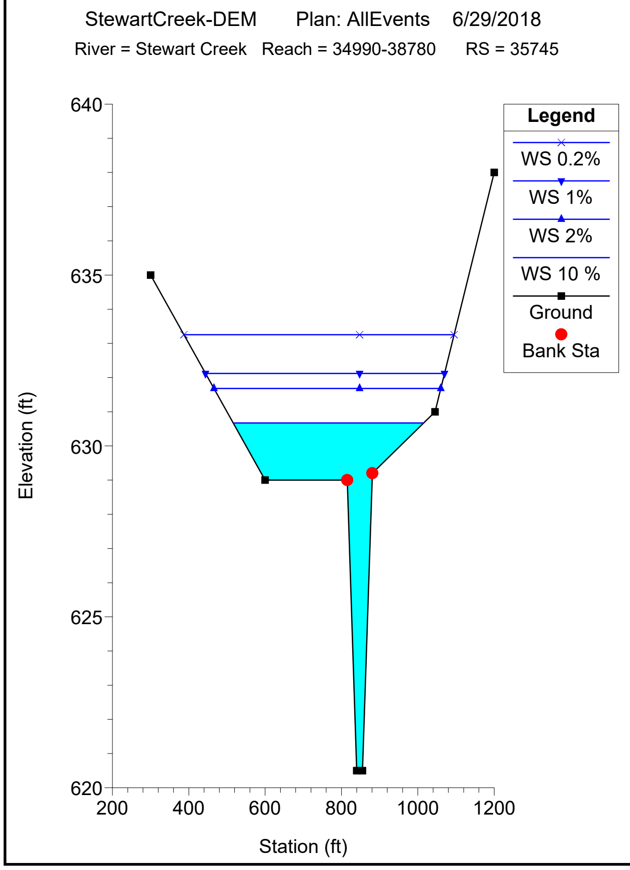
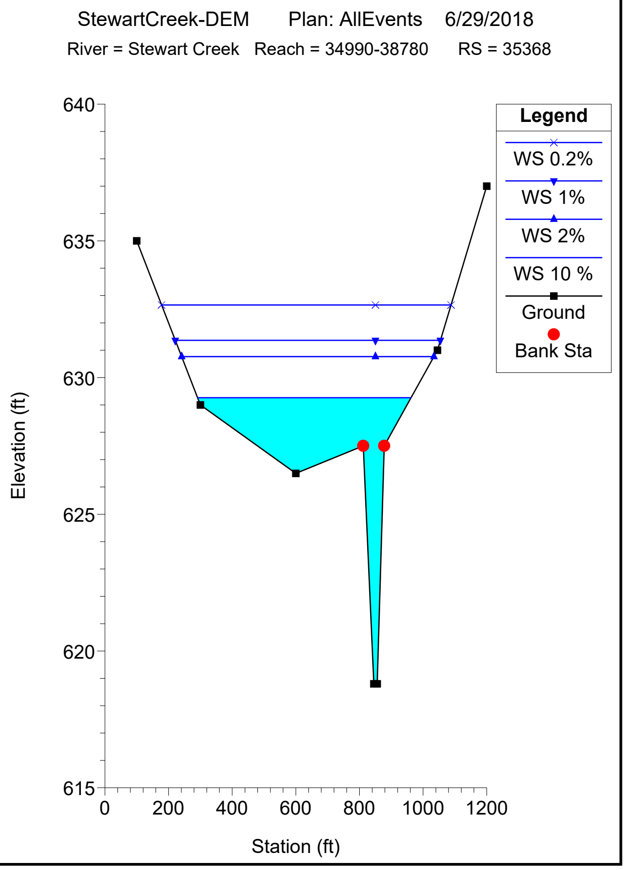
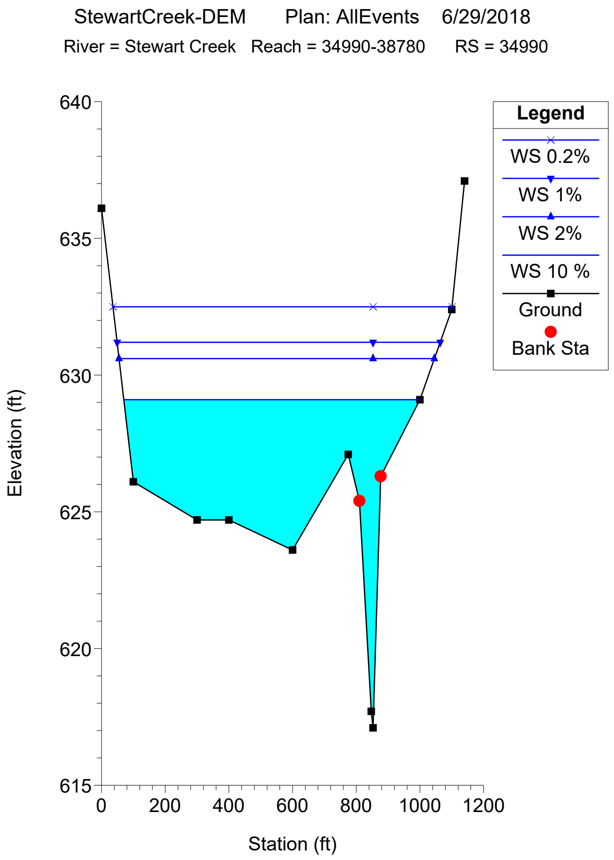
River = Stewart Creek Reach = 34990-38780 RS = 36830


StewartCreek-DEM Plan: AllEvents 6/29/2018
River = Stewart Creek Reach = 34990-38780 RS = 36400


StewartCreek-DEM Plan: AllEvents 6/29/2018
River = Stewart Creek Reach = 34990-38780 RS = 35745


StewartCreek-DEM Plan: AllEvents 6/29/2018
River = Stewart Creek Reach = 34990-38780 RS = 35368


StewartCreek-DEM Plan: AllEvents 6/29/2018
River = Stewart Creek Reach = 34990-38780 RS = 34990
Legend
WS 0.2%
WS 1%
WS 2%
WS 10 %
Ground
Bank Sta
Elevation (ft)
640
635
630
625
620
615
0
200
400
600
800
1000
1200
Station (ft)

APPENDIX D

Existing Conditions Model

APPENDIX D-1

Model Input Information

PHOTO 1 Existing 5-114” CMP Culvert at Eagan Way (Inlet) Date: May 2018	
PHOTO 2 Existing 5-114” CMP Culvert at Eagan Way (Outlet) Date: March 2018	
PHOTO 3 Stewart Creek, Looking Upstream (East) to Eagan Way, Existing Floodwall Along North Channel Bank Date: May 2018	

FIGURE 4.19
Salt Creek at Roca, Nebraska: n = 0.030; depth = 6.3 ft. Bed consists of sand and clay. (*U.S. Geological Survey*)

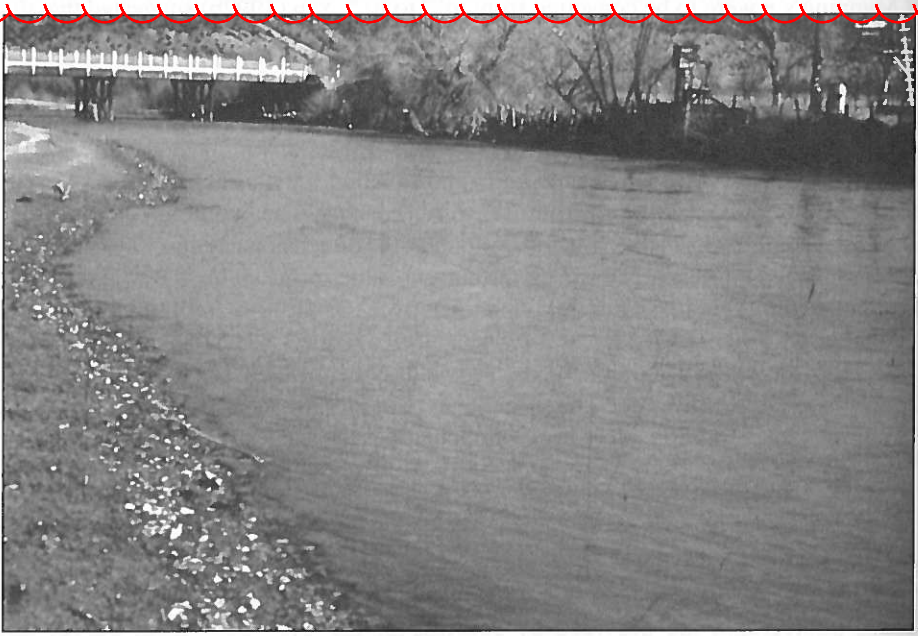


FIGURE 4.20
Rio Chama near Chamita, New Mexico: n = 0.032, 0.036; depth = 3.5, 3.1 ft. Bed consists of sand and gravel. (*U.S. Geological Survey*)

FIGURE 4.25
Etowah River near Dawsonville, Georgia: n = 0.041, 0.039, 0.035; depth = 9.8, 9.0, 4.4 ft. Bed is sand and gravel with several fallen trees in the reach. (*U.S. Geological Survey*)

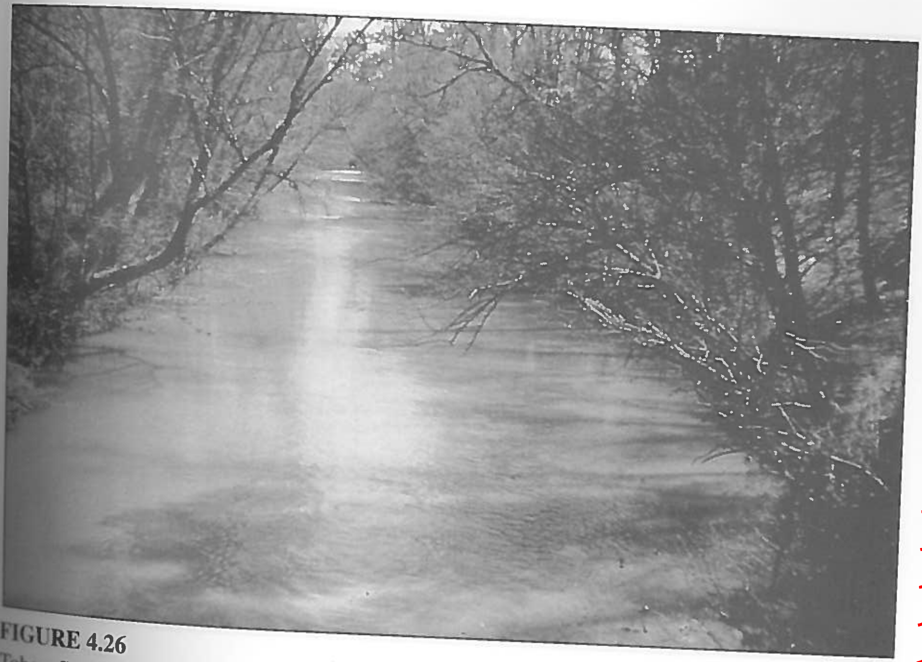
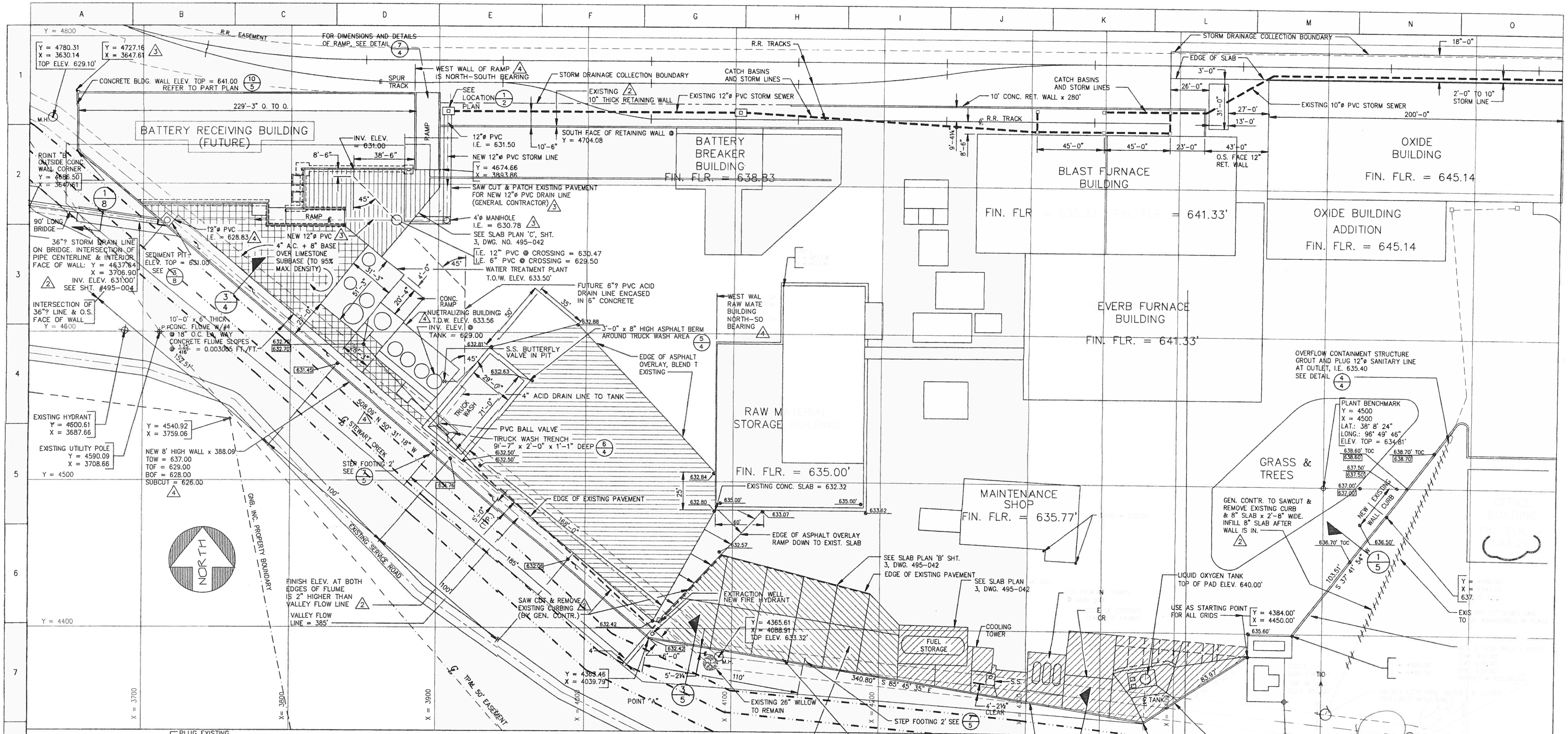
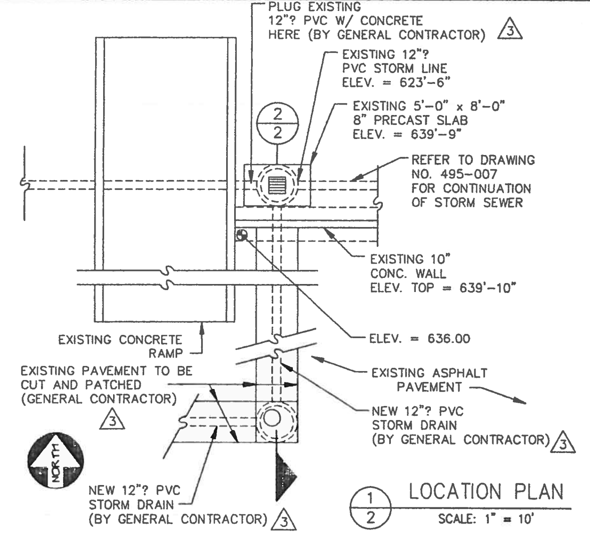


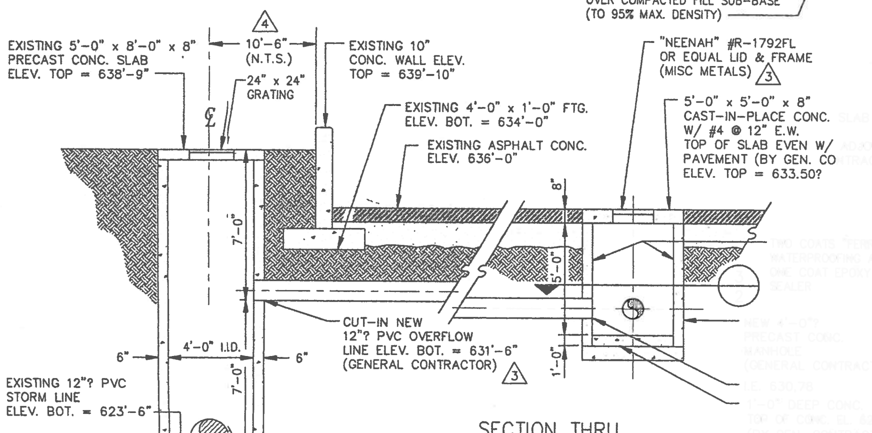
FIGURE 4.26
Tobesofkee Creek near Macon, Georgia: n = 0.043, 0.041, 0.039; depth = 9.2, 8.7, 6.3 ft. Bed consists of sand, gravel, and a few rock outcrops. (*U.S. Geological Survey*)





1/2 LOCATION PLAN

SCALE: 1" = 10'



2/2 SECTION THRU OVERFLOW CATCH BASIN

SCALE: ¼" = 1'-0"

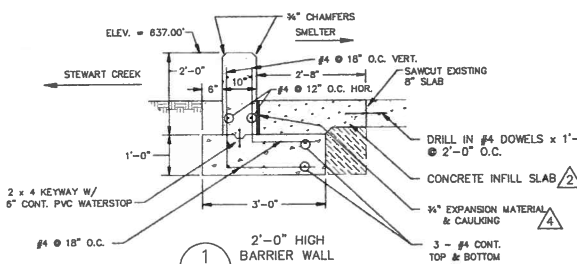
LAKE ENGINEERING & DEVELOPMENT, INC.
6000 LAKE FORREST DR. SUITE 350
ATLANTA, GEORGIA 30328

PART PLAN
MAIN PLANT AREA

DRAWN BY: K.K.G. DATE: 12/15/87
CHECKED BY: J.H.O.
JOB NO.: 495.3.10.1 SHEET 2 OF 18
DRAWING NO.: 495-002

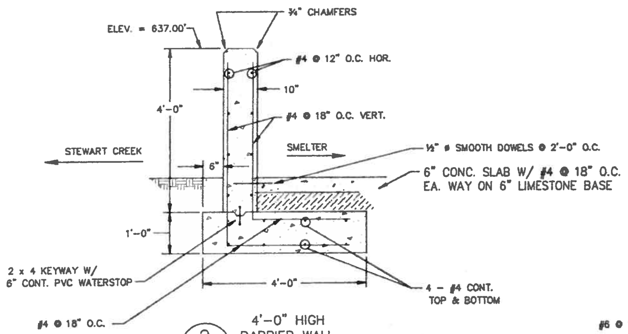
NO.	DATE	DESCRIPTION	BY
		AS-BUILT DRAWINGS	G.E.S.
4	5/9/88	GENERAL REVISIONS	G.E.S.
3	2/19/88	ADDENDUM #3	G.E.S.
2	2/5/88	ADDENDUM #2	G.E.S.

REVISIONS



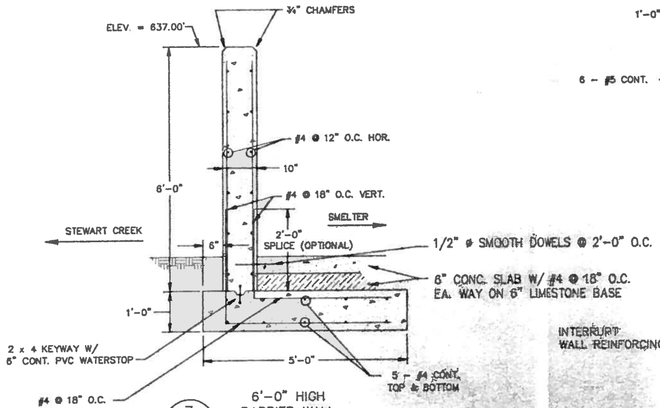
1/5 2'-0" HIGH BARRIER WALL

SCALE: ½" = 1'-0"



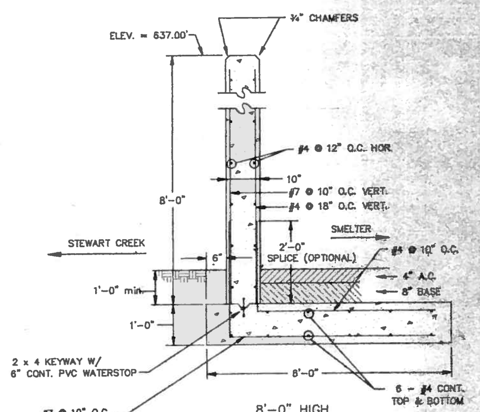
2/5 4'-0" HIGH BARRIER WALL

NOT TO SCALE



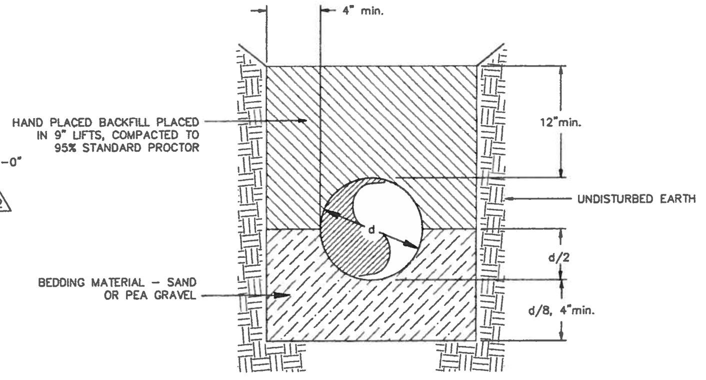
3/5 6'-0" HIGH BARRIER WALL

SCALE: ½" = 1'-0"



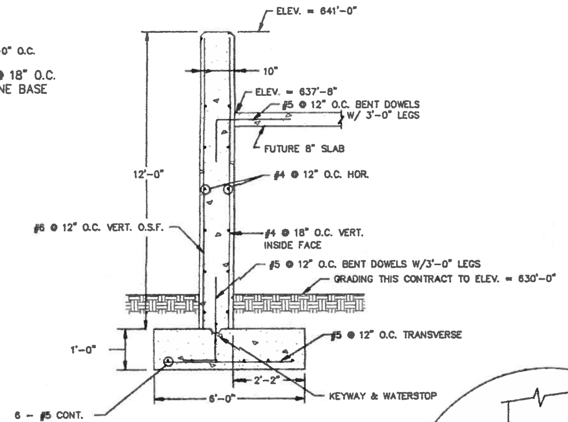
4/5 8'-0" HIGH BARRIER WALL

SCALE: ½" = 1'-0"



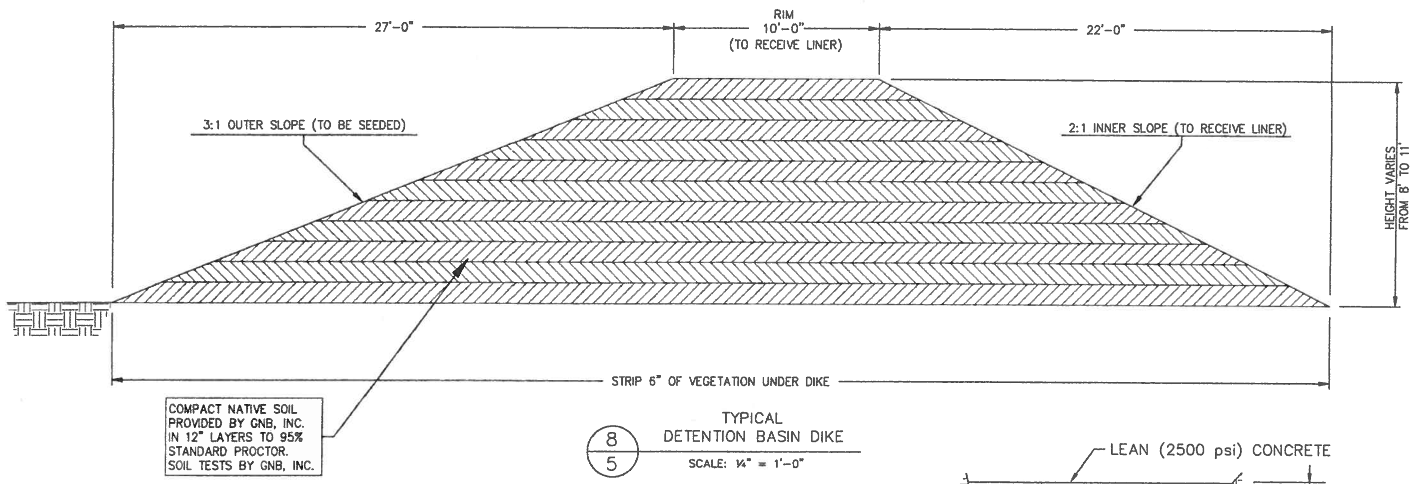
5/5 TYPICAL PIPE BEDDING DETAIL

NOT TO SCALE



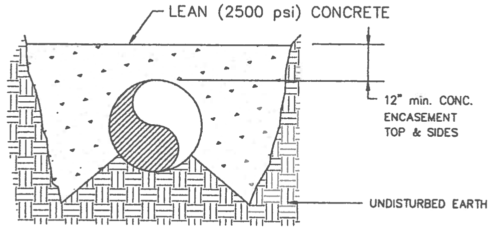
9/5 WALL SECTION 3

NOT TO SCALE



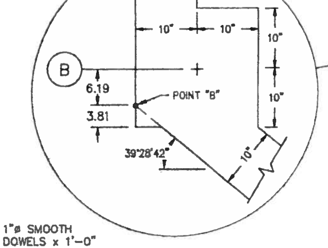
8/5 TYPICAL DETENTION BASIN DIKE

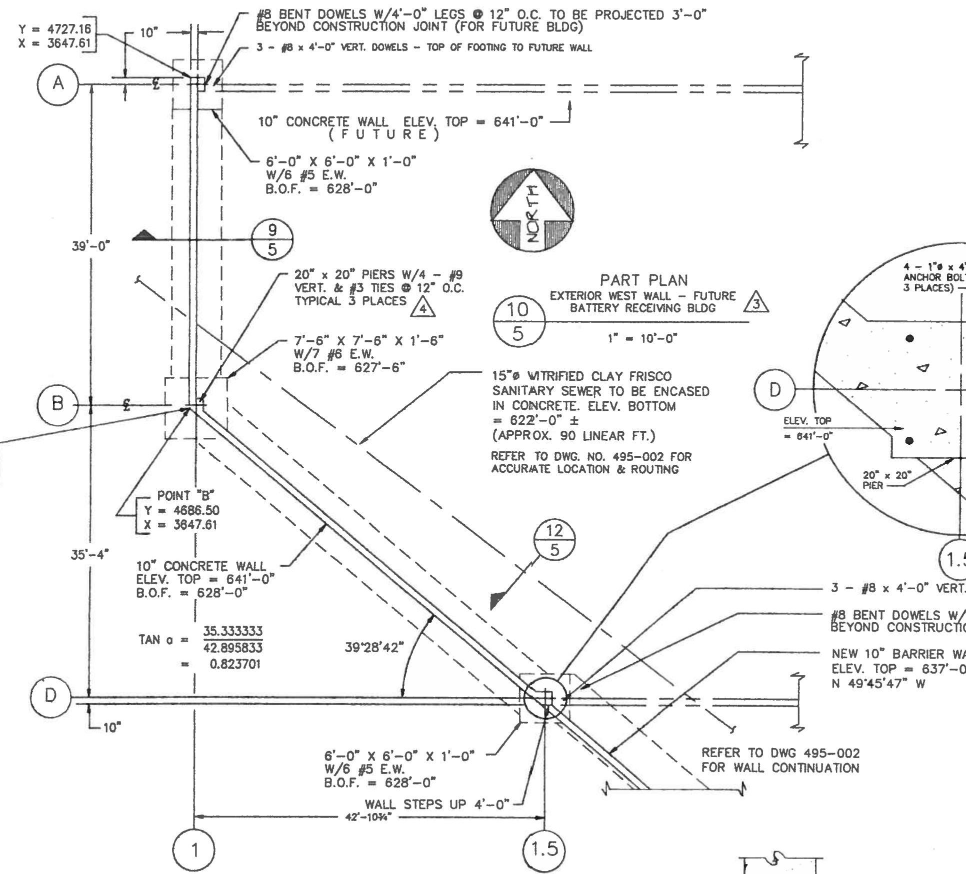
SCALE: ¼" = 1'-0"



12/5 TYPICAL SECTION CONCRETE PIPE ENCASEMENT 3

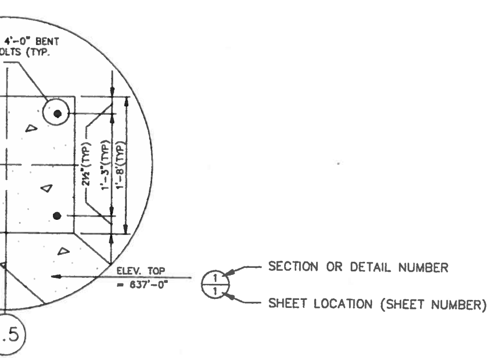
NOT TO SCALE

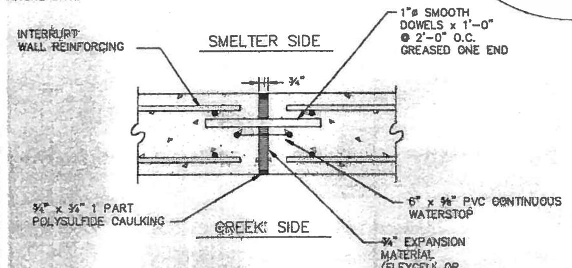




10/5 PART PLAN EXTERIOR WEST WALL - FUTURE BATTERY RECEIVING BLDG 3

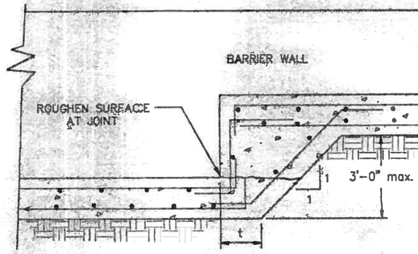
1" = 10'-0"





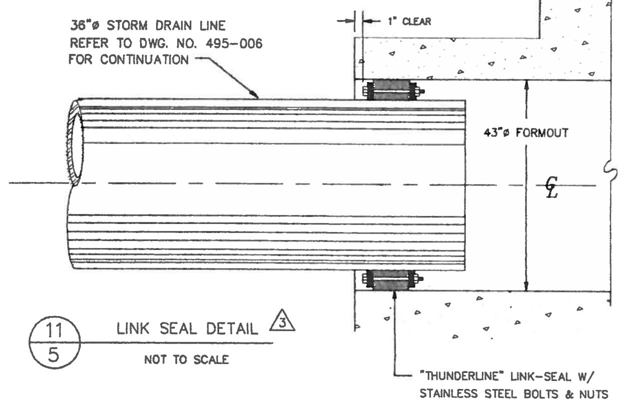
6/5 TYPICAL WALL EXPANSION JOINT (JOINTS @ 100'-0" O.C. max.)

NOT TO SCALE



7/5 FOOTING STEP DETAIL

1/2" = 1'-0"



11/5 LINK SEAL DETAIL 3

NOT TO SCALE

NO.	DATE	DESCRIPTION	BY
5	12/15/88	AS-BUILT DRAWINGS	G.E.S.
4	5/9/88	GENERAL REVISIONS	G.E.S.
3	2/19/88	ADDENDUM #3	G.E.S.
2	2/5/88	ADDENDUM #2	G.E.S.

REVISIONS

LAKE ENGINEERING & DEVELOPMENT, INC.
6000 LAKE FORREST DR. SUITE 350
ATLANTA, GEORGIA 30328

GNB, INC.
RESOURCE RECYCLING DIVISION
FRISCO,TEXAS

BARRIER WALL &
MISCELLANEOUS DETAILS

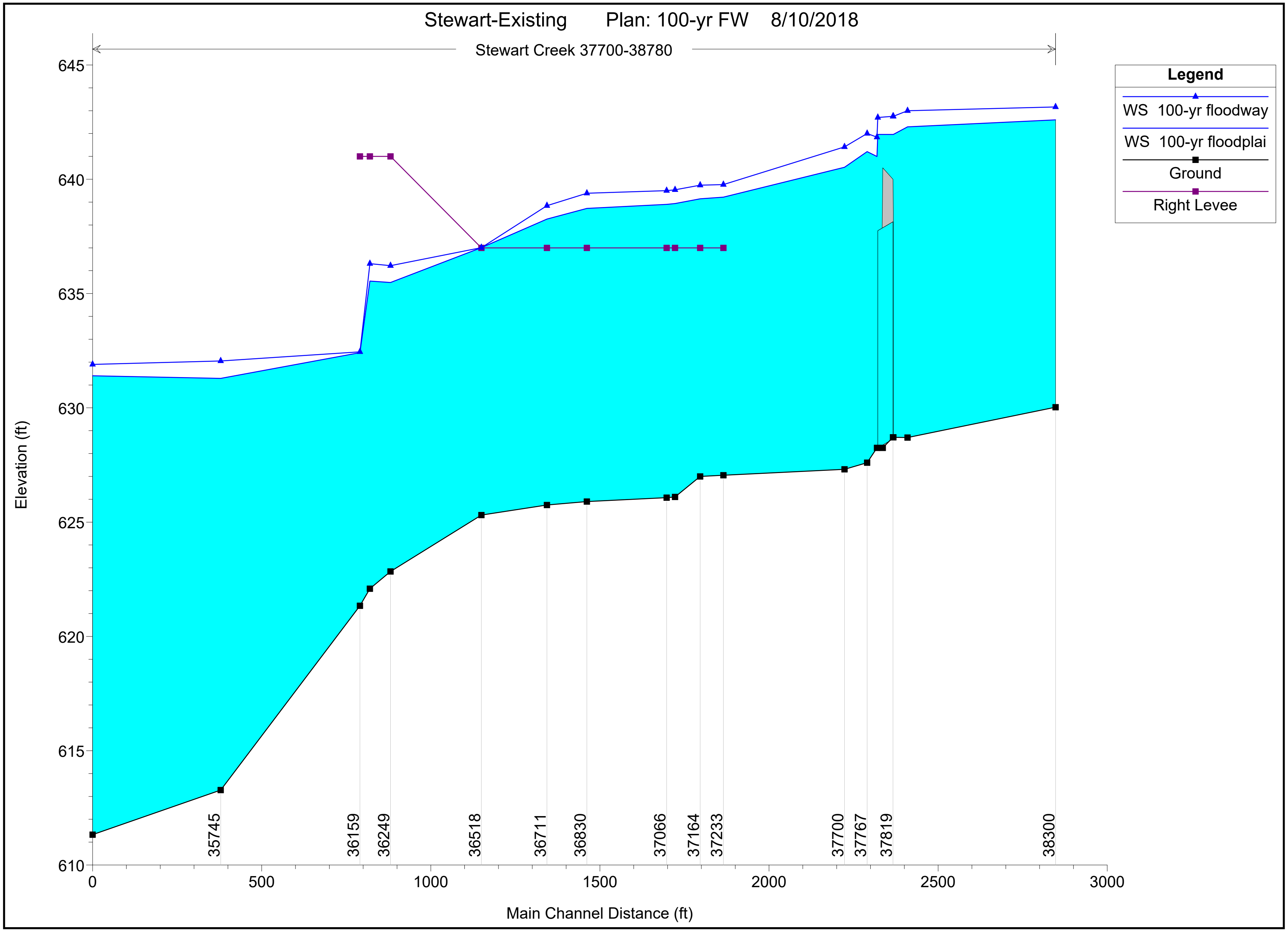
DRAWN BY: K.K.G.
DATE: 12/15/87
CHECKED BY: J.H.O.
SCALE: AS NOTED
JOB NO.: 495.3.10.1
SHEET 5 OF 18
DRAWING NO.: 495-003
GNB, INC. PROJECT NO. 862-711

495-003D PS/1:40 3-7-89 KLC

Void

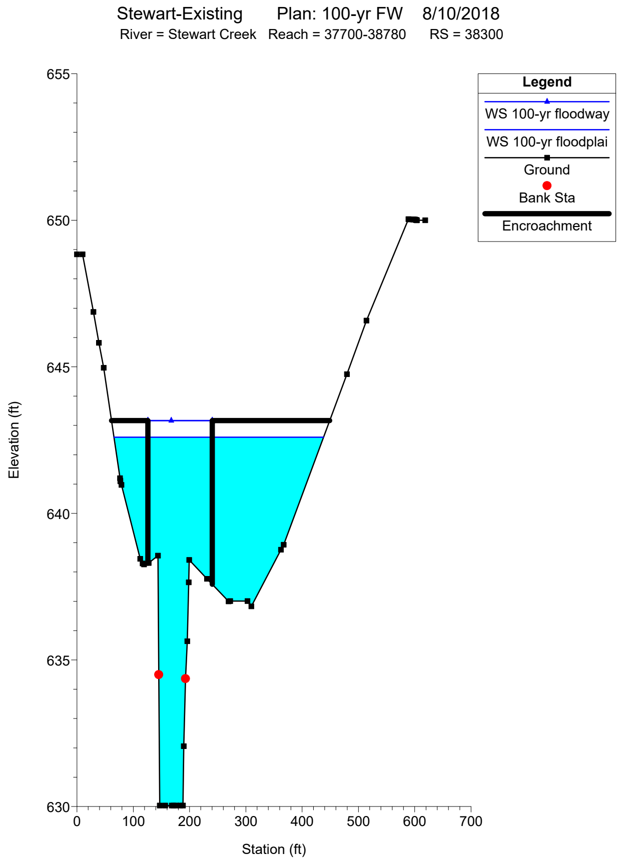
APPENDIX D-2

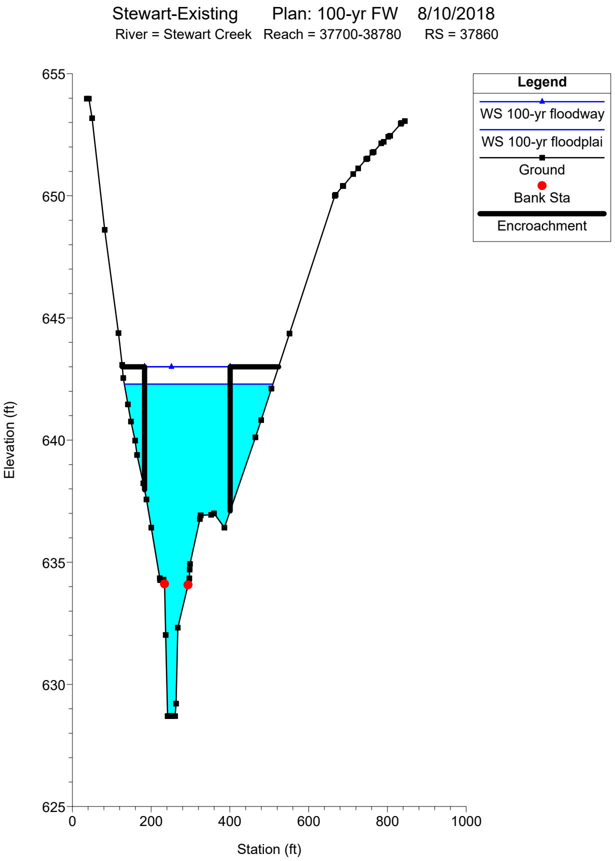
Model Results

Stewart-Existing Plan: 100-yr FW 8/10/2018
Stewart Creek 37700-38780
Legend
WS 100-yr floodway
WS 100-yr floodplai
Ground
Right Levee
Elevation (ft)
645
640
635
630
625
620
615
610
Main Channel Distance (ft)
0
500
1000
1500
2000
2500
3000
35745
36159
36249
36518
36711
36830
37066
37164
37233
37700
37767
37819
38300

HEC-RAS Plan: 100-yr FW River: Stewart Creek Reach: 37700-38780

Reach	River Sta	Profile	Q Total	Min Ch El	W.S. Elev	Prof Delta WS	Crit W.S.	E.G. Elev	E.G. Slope	Vel Chnl	Flow Area	Top Width	Froude # Chl	Enc Sta L	Enc Sta R
			(cfs)	(ft)	(ft)	(ft)	(ft)	(ft)	(ft/ft)	(ft/s)	(sq ft)	(ft)		(ft)	(ft)
37700-38780	38300	100-yr floodplai	4500.00	630.03	642.60		637.73	642.78	0.000875	4.38	1843.00	372.23	0.22		
37700-38780	38300	100-yr floodway	4500.00	630.03	643.16	0.57	636.94	643.65	0.001590	6.08	961.52	114.41	0.30	126.00	240.41
37700-38780	37860	100-yr floodplai	4500.00	628.70	642.29			642.43	0.000693	3.78	2018.23	377.30	0.20		
37700-38780	37860	100-yr floodway	4500.00	628.70	643.00	0.71		643.14	0.000604	3.68	1772.09	217.27	0.19	183.24	400.51
37700-38780	37820	100-yr floodplai	4500.00	628.71	641.96		634.87	642.33	0.000760	5.24	1381.66	362.52	0.26		
37700-38780	37820	100-yr floodway	4500.00	628.71	642.76	0.80	634.87	643.07	0.000599	4.84	1388.68	231.71	0.23	115.69	347.40
37700-38780	37819		Culvert												
37700-38780	37800	100-yr floodplai	4500.00	628.25	641.00			641.73	0.001933	6.98	738.87	144.30	0.37		
37700-38780	37800	100-yr floodway	4500.00	628.25	641.84	0.85		642.44	0.001456	6.36	867.86	250.33	0.33	160.65	422.94
37700-38780	37767	100-yr floodplai	4500.00	627.60	641.21			641.45	0.000742	5.16	1916.66	407.89	0.26		
37700-38780	37767	100-yr floodway	4500.00	627.60	642.00	0.79		642.22	0.000817	4.83	1612.67	237.43	0.23	194.70	432.13
37700-38780	37700	100-yr floodplai	6800.00	627.31	640.52		639.56	641.21	0.002920	9.55	1701.86	400.11	0.50		
37700-38780	37700	100-yr floodway	6800.00	627.31	641.42	0.89	639.61	642.00	0.002999	8.50	1444.34	228.41	0.43	163.51	391.92
37700-38780	37233	100-yr floodplai	6800.00	627.05	639.22		638.10	640.05	0.003637	10.06	1473.29	339.24	0.54		
37700-38780	37233	100-yr floodway	6800.00	627.05	639.77	0.55	638.03	640.79	0.003711	10.51	1171.70	181.71	0.55	177.60	359.31
37700-38780	37164	100-yr floodplai	6800.00	627.00	639.15		638.14	639.76	0.002961	9.53	1825.80	483.03	0.50		
37700-38780	37164	100-yr floodway	6800.00	627.00	639.74	0.60	638.20	640.47	0.002966	9.87	1498.83	268.97	0.50	166.08	435.05
37700-38780	37091	100-yr floodplai	6800.00	626.10	638.94		637.76	639.55	0.002708	8.93	1780.92	418.50	0.47		
37700-38780	37091	100-yr floodway	6800.00	626.10	639.54	0.60	637.68	640.26	0.002708	9.24	1464.42	244.70	0.47	162.77	407.47
37700-38780	37066	100-yr floodplai	6800.00	626.07	638.90		637.35	639.47	0.002178	7.68	1781.92	432.43	0.43		
37700-38780	37066	100-yr floodway	6800.00	626.07	639.50	0.60	637.18	640.19	0.002175	7.98	1453.42	239.95	0.43	150.90	390.85
37700-38780	36830	100-yr floodplai	6800.00	625.90	638.73		637.01	638.97	0.001384	6.31	2612.21	600.41	0.33		
37700-38780	36830	100-yr floodway	6800.00	625.90	639.39	0.66	637.01	639.67	0.001343	6.45	2291.59	391.47	0.33	158.71	550.18
37700-38780	36711	100-yr floodplai	6800.00	625.75	638.26		637.01	638.75	0.002133	7.61	2011.86	504.37	0.42		
37700-38780	36711	100-yr floodway	6800.00	625.75	638.84	0.58	637.01	639.44	0.002147	7.93	1538.03	238.46	0.43	128.42	366.88
37700-38780	36518	100-yr floodplai	6800.00	625.31	637.01		637.01	638.10	0.004713	11.68	1360.65	355.86	0.62		
37700-38780	36518	100-yr floodway	6800.00	625.31	637.01	0.00	637.01	638.68	0.006287	13.49	1011.20	189.34	0.72	107.24	296.58
37700-38780	36249	100-yr floodplai	6800.00	622.84	635.48		633.20	636.11	0.002606	8.14	1394.46	295.58	0.44		
37700-38780	36249	100-yr floodway	6800.00	622.84	636.22	0.74	633.38	636.90	0.002471	8.22	1315.57	177.54	0.43	6.01	183.55
37700-38780	36188	100-yr floodplai	6800.00	622.09	635.55		632.51	635.91	0.001515	6.27	1983.80	459.00	0.34		
37700-38780	36188	100-yr floodway	6800.00	622.09	636.31	0.76	632.65	636.70	0.001414	6.29	1830.87	283.48	0.33	228.00	511.48
37700-38780	36159	100-yr floodplai	6800.00	621.34	632.41		632.41	635.55	0.009288	14.87	573.80	375.01	0.88		
37700-38780	36159	100-yr floodway	6800.00	621.34	632.45	0.04	632.45	636.27	0.012064	15.89	461.20	64.35	0.94	217.67	282.02
37700-38780	35745	100-yr floodplai	6800.00	613.28	631.29		625.22	631.62	0.000725	5.38	2122.97	540.20	0.26		
37700-38780	35745	100-yr floodway	6800.00	613.28	632.05	0.76	625.00	632.58	0.000908	6.24	1383.41	137.28	0.29	779.24	918.05
37700-38780	35368	100-yr floodplai	6800.00	611.33	631.40		622.04	631.43	0.000137	1.97	6947.59	1099.98	0.09		
37700-38780	35368	100-yr floodway	6800.00	611.33	631.90	0.50	622.00	632.20	0.000763	4.74	1835.13	147.10	0.20	784.09	931.19


Stewart-Existing Plan: 100-yr FW 8/10/2018
River = Stewart Creek Reach = 37700-38780 RS = 38300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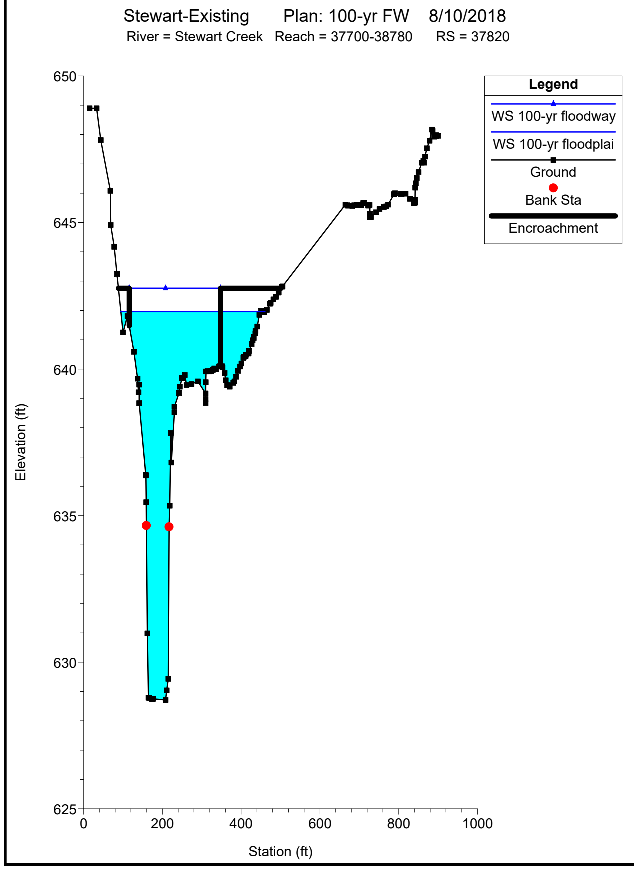
River = Stewart Creek Reach = 37700-38780 RS = 37860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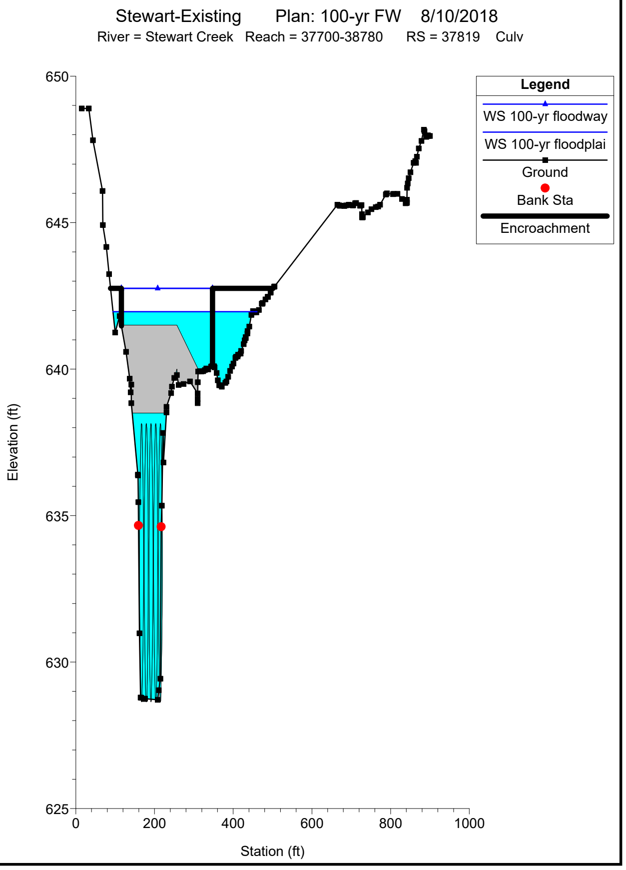
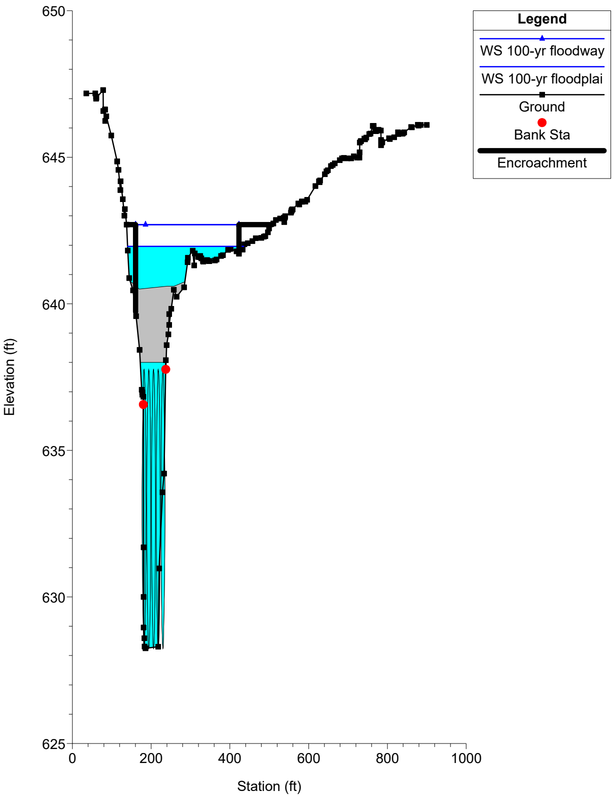
River = Stewart Creek Reach = 37700-38780 RS = 37820


Stewart-Existing Plan: 100-yr FW 8/10/2018
River = Stewart Creek Reach = 37700-38780 RS = 37819 Culv

Stewart-Existing Plan: 100-yr FW 8/10/2018
River = Stewart Creek Reach = 37700-38780 RS = 37819 Culv



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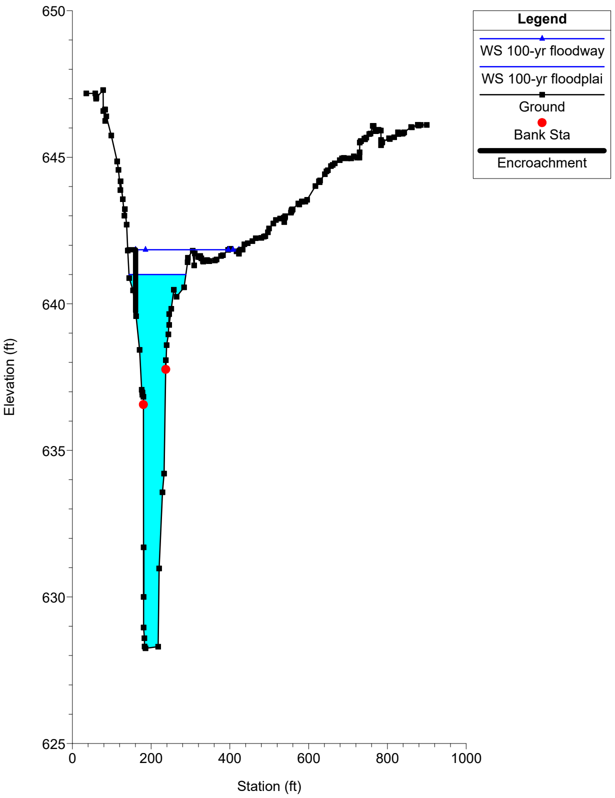
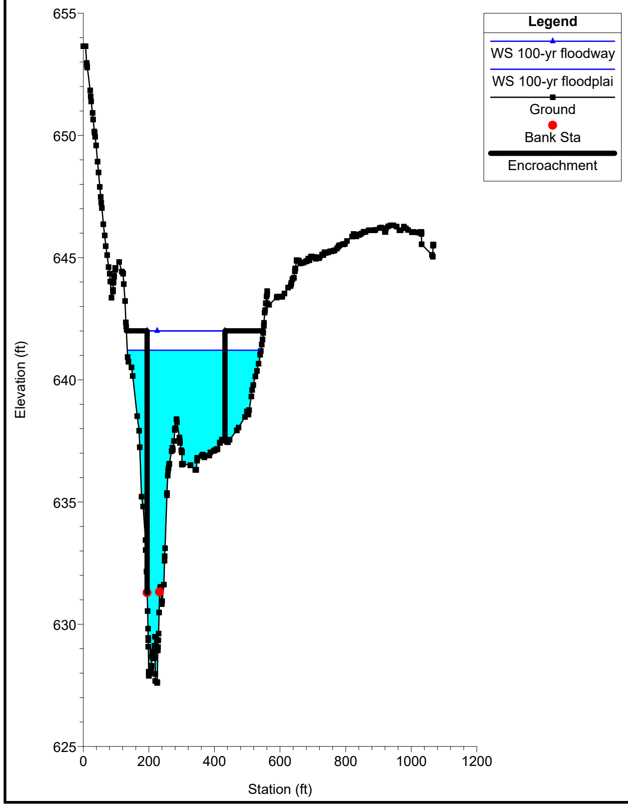
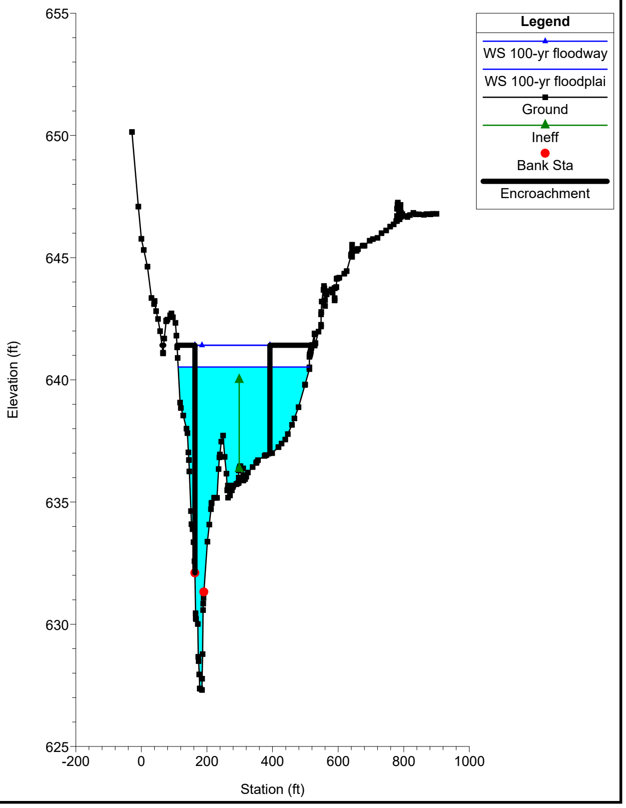
River = Stewart Creek Reach = 37700-38780 RS = 37800



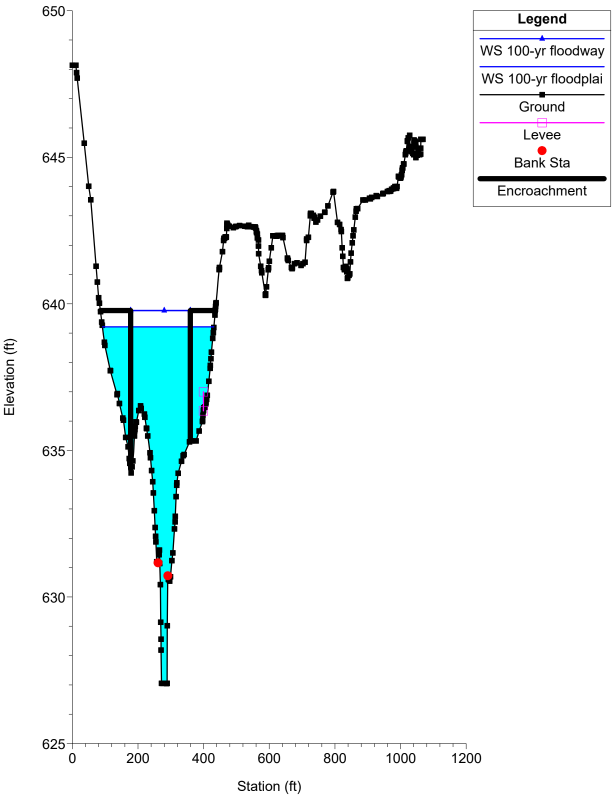
Stewart-Existing Plan: 100-yr FW 8/10/2018
River = Stewart Creek Reach = 37700-38780 RS = 37767



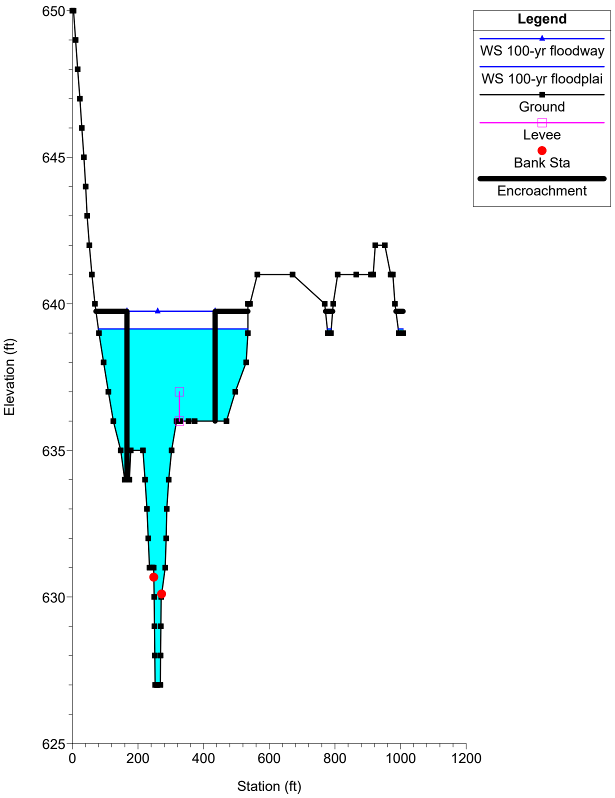
Stewart-Existing Plan: 100-yr FW 8/10/2018
River = Stewart Creek Reach = 37700-38780 RS = 37700



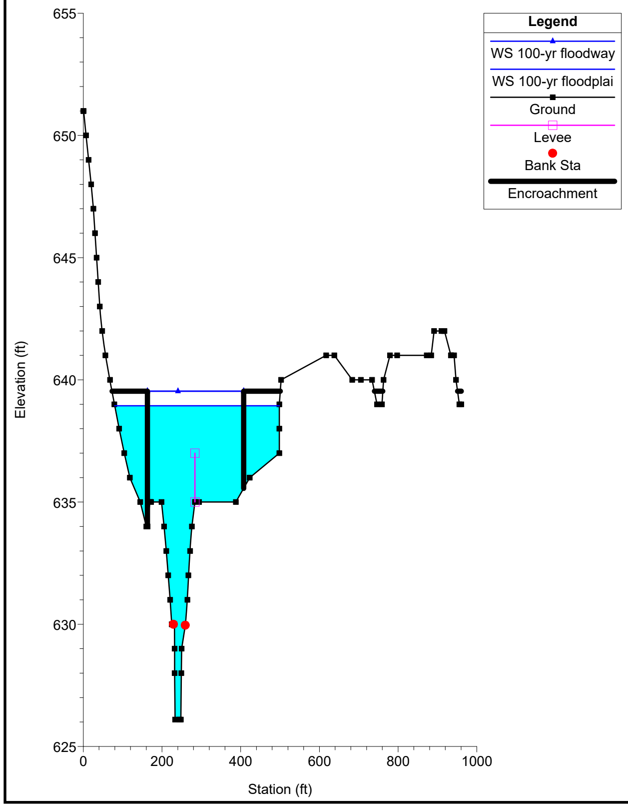
Stewart-Existing Plan: 100-yr FW 8/10/2018
River = Stewart Creek Reach = 37700-38780 RS = 37233



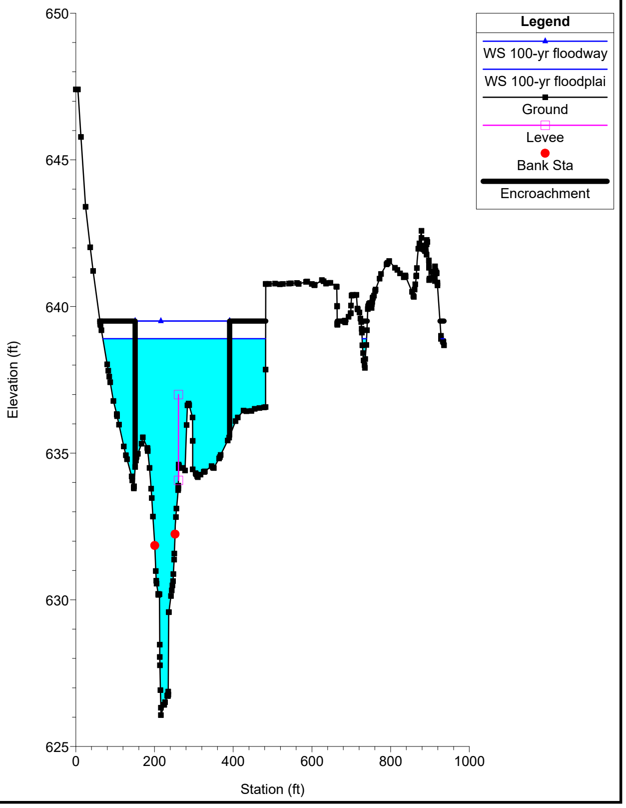
Stewart-Existing Plan: 100-yr FW 8/10/2018
River = Stewart Creek Reach = 37700-38780 RS = 37164

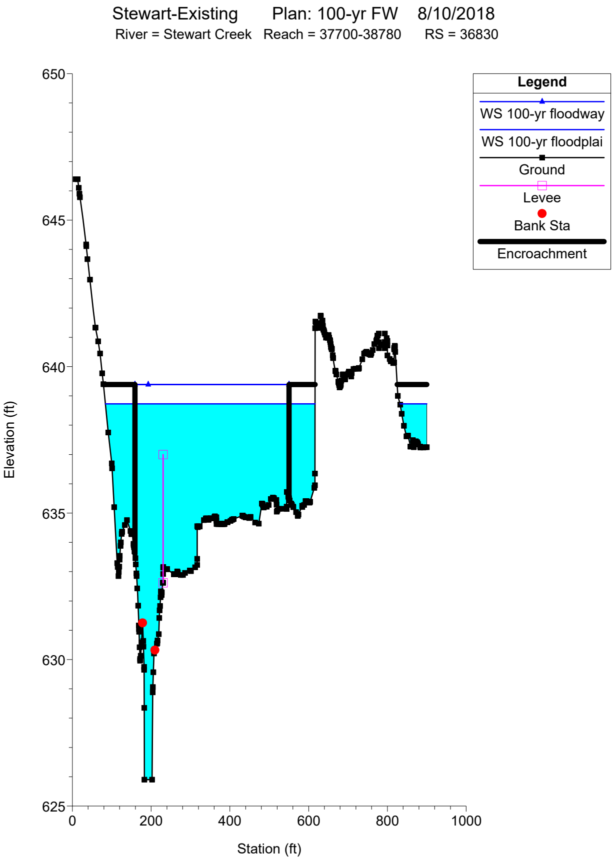


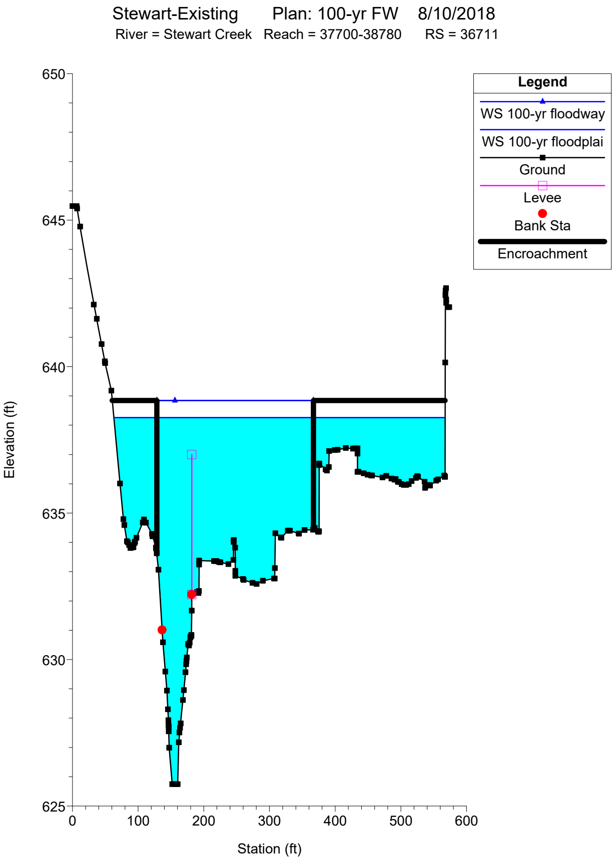
Stewart-Existing Plan: 100-yr FW 8/10/2018
River = Stewart Creek Reach = 37700-38780 RS = 37091

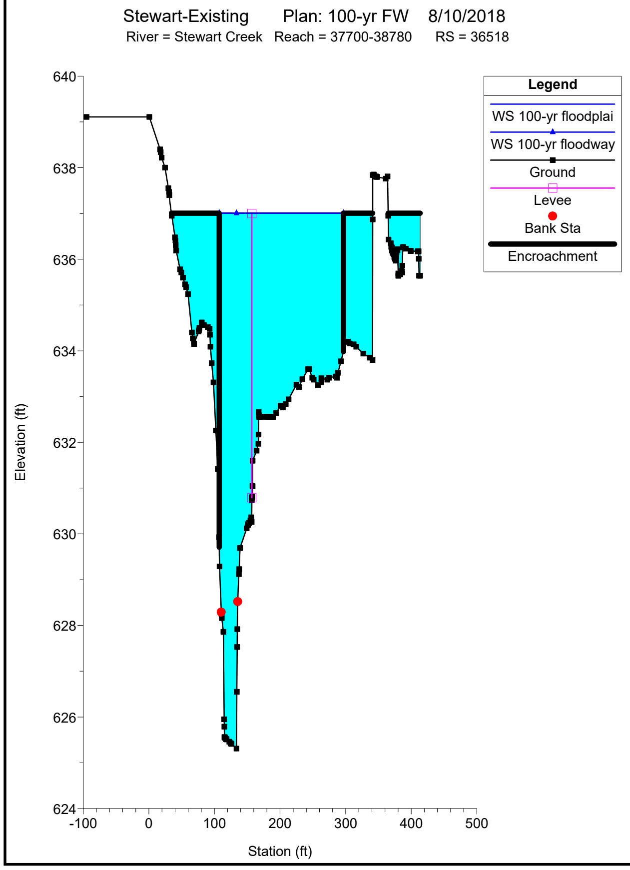


Stewart-Existing Plan: 100-yr FW 8/10/2018
River = Stewart Creek Reach = 37700-38780 RS = 37066




Stewart-Existing Plan: 100-yr FW 8/10/2018
River = Stewart Creek Reach = 37700-38780 RS = 36830
Legend
WS 100-yr floodway
WS 100-yr floodplai
Ground
Levee
Bank Sta
Encroachment
Elevation (ft)
650
645
640
635
630
625
Station (ft)
0
200
400
600
800
1000


Stewart-Existing Plan: 100-yr FW 8/10/2018
River = Stewart Creek Reach = 37700-38780 RS = 36711
Legend
WS 100-yr floodway
WS 100-yr floodplai
Ground
Levee
Bank Sta
Encroachment
Elevation (ft)
650
645
640
635
630
625
Station (ft)
0
100
200
300
400
500
600


Stewart-Existing Plan: 100-yr FW 8/10/2018
River = Stewart Creek Reach = 37700-38780 RS = 36518
Legend
WS 100-yr floodplai
WS 100-yr floodway
Ground
Levee
Bank Sta
Encroachment
Elevation (ft)
640
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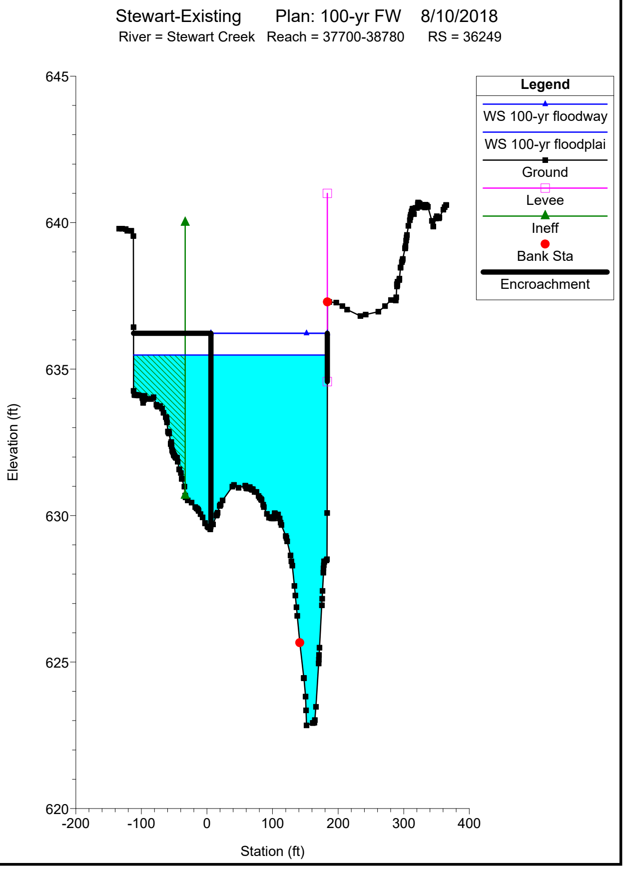
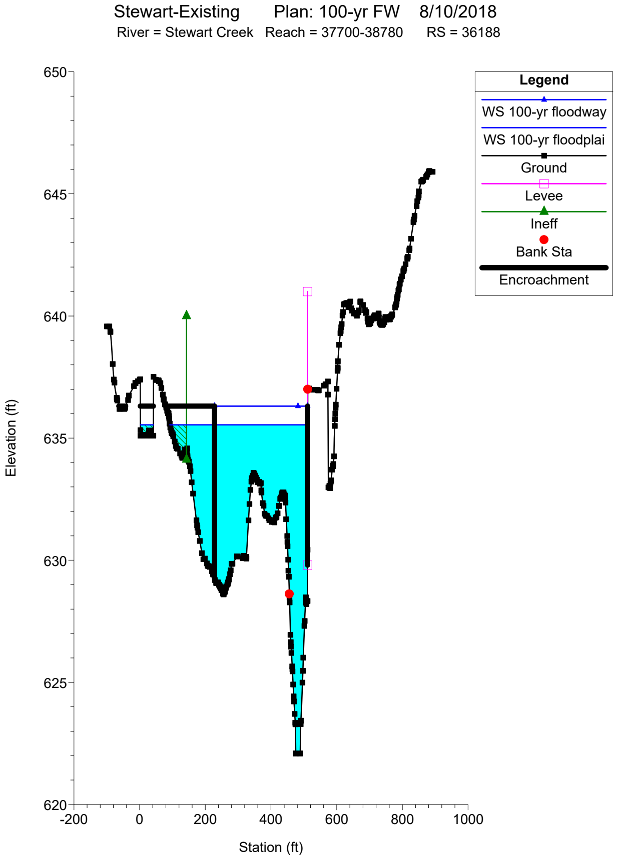
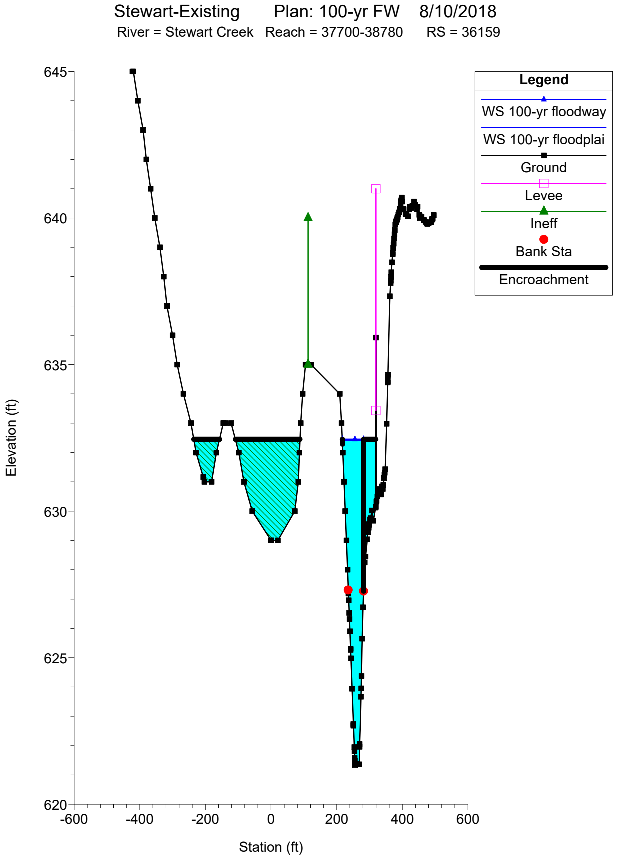
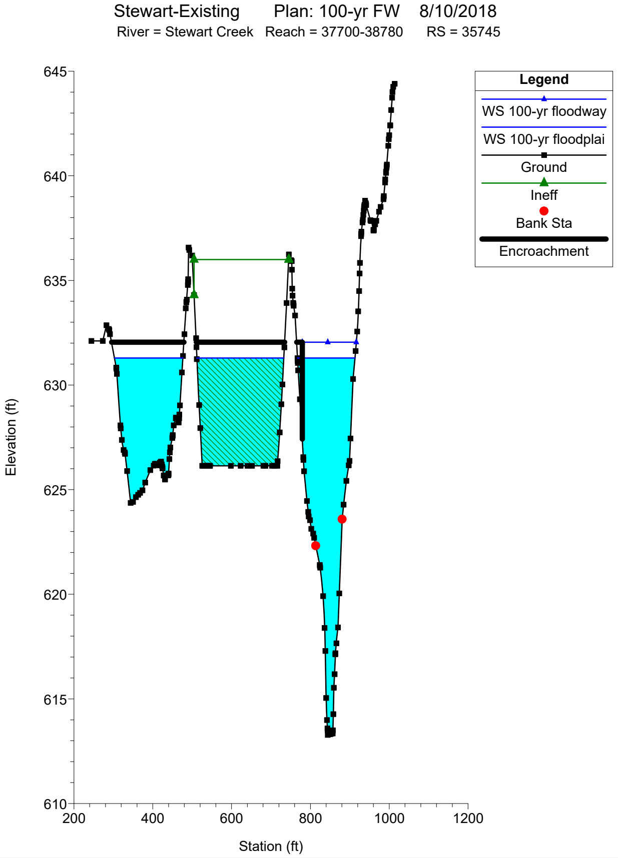
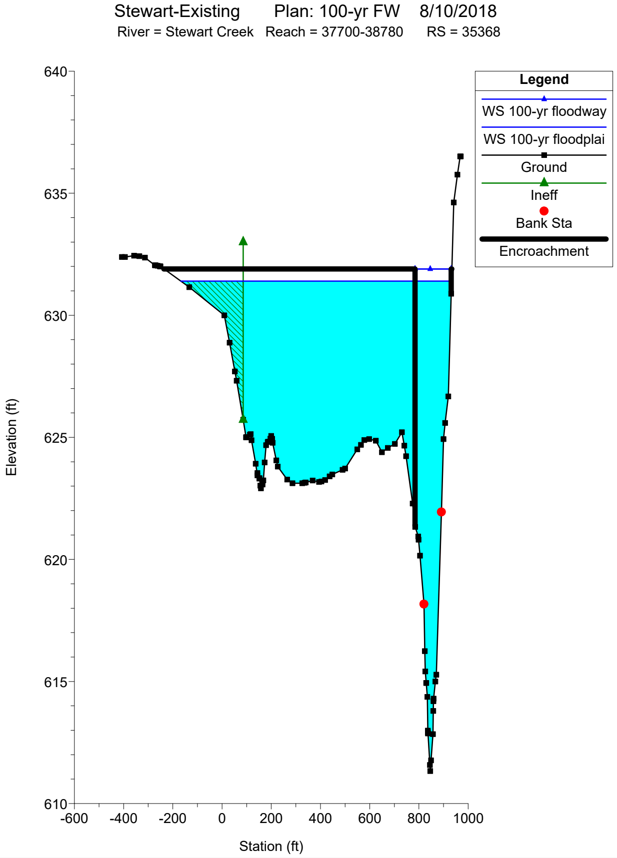
636
634
632
630
628
626
624
Station (ft)
-100
0
100
200
300
400
500

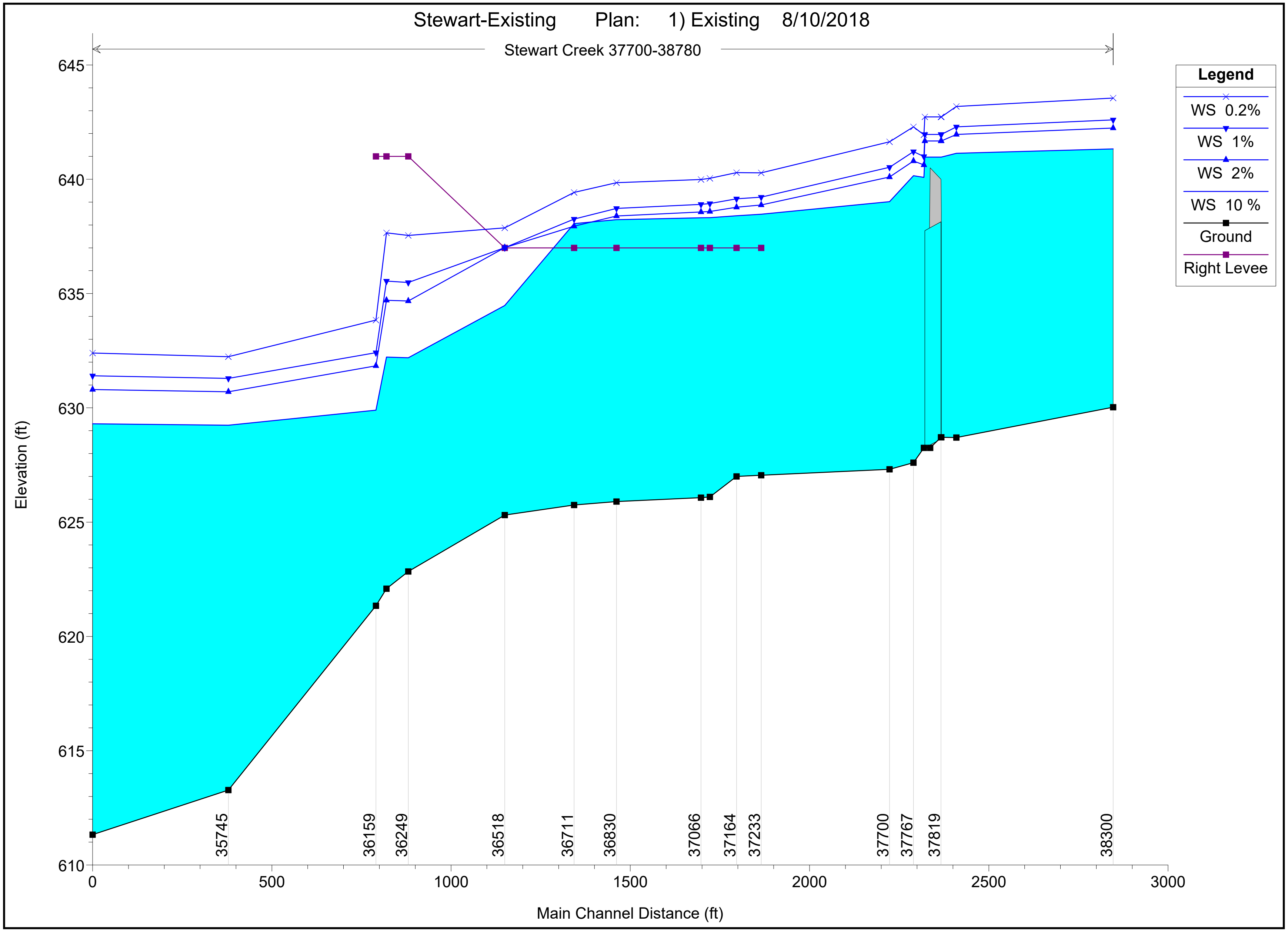

Stewart-Existing Plan: 100-yr FW 8/10/2018
River = Stewart Creek Reach = 37700-38780 RS = 36249
Legend
WS 100-yr floodway
WS 100-yr floodplai
Ground
Levee
Ineff
Bank Sta
Encroachment
Elevation (ft)
645
640
635
630
625
620
Station (ft)
-200
-100
0
100
200
300
400


Stewart-Existing Plan: 100-yr FW 8/10/2018
River = Stewart Creek Reach = 37700-38780 RS = 36188
Legend
WS 100-yr floodway
WS 100-yr floodplai
Ground
Levee
Ineff
Bank Sta
Encroachment
Elevation (ft)
650
645
640
635
630
625
620
-200
0
200
400
600
800
1000
Station (ft)


Stewart-Existing Plan: 100-yr FW 8/10/2018
River = Stewart Creek Reach = 37700-38780 RS = 36159
Legend
WS 100-yr floodway
WS 100-yr floodplai
Ground
Levee
Ineff
Bank Sta
Encroachment
Elevation (ft)
645
640
635
630
625
620
-600
-400
-200
0
200
400
600
Station (ft)


Stewart-Existing Plan: 100-yr FW 8/10/2018
River = Stewart Creek Reach = 37700-38780 RS = 35745
Legend
WS 100-yr floodway
WS 100-yr floodplai
Ground
Ineff
Bank Sta
Encroachment
Elevation (ft)
645
640
635
630
625
620
615
610
200
400
600
800
1000
1200
Station (ft)


Stewart-Existing Plan: 100-yr FW 8/10/2018
River = Stewart Creek Reach = 37700-38780 RS = 35368
Legend
WS 100-yr floodway
WS 100-yr floodplai
Ground
Ineff
Bank Sta
Encroachment
Elevation (ft)
640
635
630
625
620
615
610
-600
-400
-200
0
200
400
600
800
1000
Station (ft)


Stewart-Existing Plan: 1) Existing 8/10/2018
Stewart Creek 37700-38780
Legend
WS 0.2%
WS 1%
WS 2%
WS 10 %
Ground
Right Levee
Elevation (ft)
645
640
635
630
625
620
615
610
Main Channel Distance (ft)
0
500
1000
1500
2000
2500
3000
35745
36159
36249
36518
36711
36830
37066
37164
37233
37700
37767
37819
38300

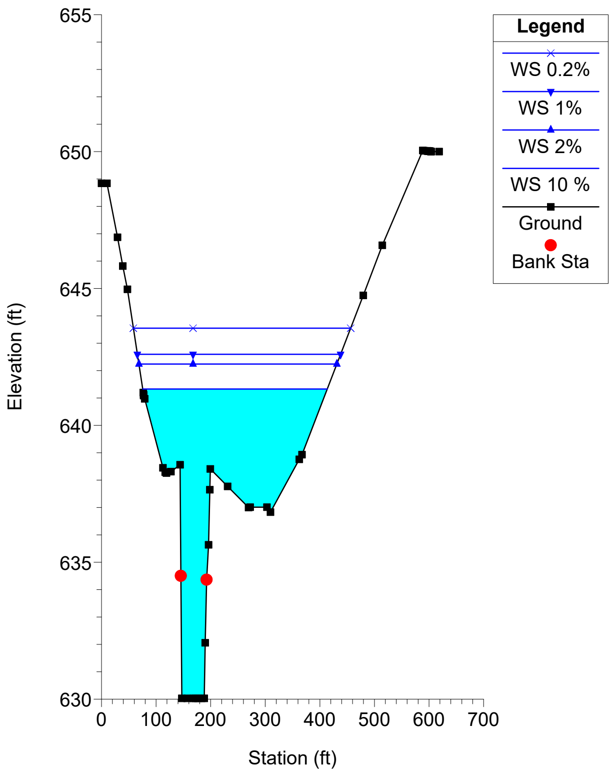
HEC-RAS Plan: Existing River: Stewart Creek Reach: 37700-38780

Reach	River Sta	Profile	Q Total	Min Ch El	W.S. Elev	Crit W.S.	E.G. Elev	E.G. Slope	Vel Chnl	Flow Area	Top Width	Froude # Chl	Levee El Right	R. Levee Frbrd
			(cfs)	(ft)	(ft)	(ft)	(ft)	(ft/ft)	(ft/s)	(sq ft)	(ft)		(ft)	(ft)
37700-38780	38300	10 %	2700.00	630.03	641.33	635.00	641.45	0.000600	3.37	1391.91	337.97	0.18		
37700-38780	38300	2%	4000.00	630.03	642.24	636.42	642.41	0.000821	4.16	1712.74	362.67	0.21		
37700-38780	38300	1%	4500.00	630.03	642.60	637.73	642.78	0.000875	4.38	1843.00	372.23	0.22		
37700-38780	38300	0.2%	6000.00	630.03	643.55	639.43	643.77	0.001007	4.94	2210.42	397.96	0.24		
37700-38780	37860	10 %	2700.00	628.70	641.13		641.21	0.000435	2.78	1602.64	341.16	0.16		
37700-38780	37860	2%	4000.00	628.70	641.96		642.09	0.000638	3.56	1895.35	366.97	0.19		
37700-38780	37860	1%	4500.00	628.70	642.29		642.43	0.000693	3.78	2018.23	377.30	0.20		
37700-38780	37860	0.2%	6000.00	628.70	643.19		643.36	0.000830	4.36	2367.10	402.10	0.22		
37700-38780	37820	10 %	2700.00	628.71	640.97	633.15	641.16	0.000409	3.64	1054.82	306.49	0.19		
37700-38780	37820	2%	4000.00	628.71	641.68	634.42	642.00	0.000671	4.85	1282.31	342.80	0.24		
37700-38780	37820	1%	4500.00	628.71	641.96	634.87	642.33	0.000760	5.24	1381.66	362.52	0.26		
37700-38780	37820	0.2%	6000.00	628.71	642.73	636.08	643.23	0.000996	6.24	1681.17	412.03	0.30		
37700-38780	37819		Culvert											
37700-38780	37800	10 %	2700.00	628.25	640.08		640.41	0.000956	4.63	625.50	96.28	0.26		
37700-38780	37800	2%	4000.00	628.25	640.63		641.27	0.001738	6.47	687.28	134.22	0.35		
37700-38780	37800	1%	4500.00	628.25	641.00		641.73	0.001933	6.98	738.87	144.30	0.37		
37700-38780	37800	0.2%	6000.00	628.25	641.95		642.98	0.002482	8.36	923.19	294.53	0.43		
37700-38780	37767	10 %	2700.00	627.60	640.15		640.30	0.000459	3.82	1501.09	374.59	0.20		
37700-38780	37767	2%	4000.00	627.60	640.80		641.03	0.000725	4.99	1750.02	399.70	0.25		
37700-38780	37767	1%	4500.00	627.60	641.21		641.45	0.000742	5.16	1916.66	407.89	0.26		
37700-38780	37767	0.2%	6000.00	627.60	642.29		642.55	0.000780	5.59	2366.04	420.63	0.27		
37700-38780	37700	10 %	4000.00	627.31	639.02	637.47	639.98	0.003499	9.52	775.82	363.40	0.53		
37700-38780	37700	2%	6000.00	627.31	640.10	639.17	640.79	0.002938	9.34	1534.15	391.31	0.50		
37700-38780	37700	1%	6800.00	627.31	640.52	639.56	641.21	0.002920	9.55	1701.86	400.11	0.50		
37700-38780	37700	0.2%	9100.00	627.31	641.64	640.08	642.32	0.002823	9.99	2158.31	430.79	0.50		
37700-38780	37233	10 %	4000.00	627.05	638.47	636.73	638.91	0.001959	7.04	1225.78	323.74	0.39	637.00	-1.47
37700-38780	37233	2%	6000.00	627.05	638.88	637.77	639.66	0.003445	9.59	1359.54	332.64	0.52	637.00	-1.88
37700-38780	37233	1%	6800.00	627.05	639.22	638.10	640.05	0.003637	10.06	1473.29	339.24	0.54	637.00	-2.22
37700-38780	37233	0.2%	9100.00	627.05	640.28	638.90	641.16	0.003699	10.80	1846.55	360.38	0.55	637.00	-3.28
37700-38780	37164	10 %	4000.00	627.00	638.40	634.98	638.76	0.001698	6.90	1488.63	442.67	0.37	637.00	-1.40
37700-38780	37164	2%	6000.00	627.00	638.78	637.82	639.39	0.002943	9.30	1655.67	449.93	0.49	637.00	-1.78
37700-38780	37164	1%	6800.00	627.00	639.15	638.14	639.76	0.002961	9.53	1825.80	483.03	0.50	637.00	-2.15
37700-38780	37164	0.2%	9100.00	627.00	640.29	638.76	640.85	0.002694	9.69	2412.31	567.00	0.48	637.00	-3.29
37700-38780	37091	10 %	4000.00	626.10	638.32	634.98	638.63	0.001382	6.14	1525.88	410.99	0.33	637.00	-1.32
37700-38780	37091	2%	6000.00	626.10	638.59	637.49	639.18	0.002613	8.59	1636.69	414.27	0.46	637.00	-1.59
37700-38780	37091	1%	6800.00	626.10	638.94	637.76	639.55	0.002708	8.93	1780.92	418.50	0.47	637.00	-1.94
37700-38780	37091	0.2%	9100.00	626.10	640.04	638.41	640.65	0.002636	9.37	2286.92	535.56	0.47	637.00	-3.04
37700-38780	37066	10 %	4000.00	626.07	638.32	634.72	638.59	0.001067	5.17	1536.25	411.82	0.30	637.00	-1.32
37700-38780	37066	2%	6000.00	626.07	638.57	636.73	639.10	0.002060	7.31	1640.74	417.88	0.41	637.00	-1.57
37700-38780	37066	1%	6800.00	626.07	638.90	637.35	639.47	0.002178	7.68	1781.92	432.43	0.43	637.00	-1.90
37700-38780	37066	0.2%	9100.00	626.07	639.99	638.07	640.59	0.002165	8.20	2286.30	502.98	0.43	637.00	-2.99
37700-38780	36830	10 %	4000.00	625.90	638.23	635.38	638.35	0.000656	4.21	2318.38	590.17	0.22	637.00	-1.23

HEC-RAS Plan: Existing   River: Stewart Creek   Reach: 37700-38780 (Continued)

Reach	River Sta	Profile	Q Total	Min Ch El	W.S. Elev	Crit W.S.	E.G. Elev	E.G. Slope	Vel Chnl	Flow Area	Top Width	Froude # Chl	Levee El Right	R. Levee Frbrd
			(cfs)	(ft)	(ft)	(ft)	(ft)	(ft/ft)	(ft/s)	(sq ft)	(ft)		(ft)	(ft)
37700-38780	36830	2%	6000.00	625.90	638.39	636.71	638.63	0.001329	6.06	2413.21	593.63	0.32	637.00	-1.39
37700-38780	36830	1%	6800.00	625.90	638.73	637.01	638.97	0.001384	6.31	2612.21	600.41	0.33	637.00	-1.73
37700-38780	36830	0.2%	9100.00	625.90	639.85	637.21	640.09	0.001310	6.53	3307.67	661.86	0.32	637.00	-2.85
37700-38780	36711	10 %	4000.00	625.75	638.06	635.11	638.25	0.000840	4.71	1912.67	503.53	0.27	637.00	-1.06
37700-38780	36711	2%	6000.00	625.75	637.95	636.78	638.41	0.002042	7.29	1854.58	503.03	0.41	637.00	-0.95
37700-38780	36711	1%	6800.00	625.75	638.26	637.01	638.75	0.002133	7.61	2011.86	504.37	0.42	637.00	-1.26
37700-38780	36711	0.2%	9100.00	625.75	639.43	637.12	639.88	0.001921	7.77	2604.10	510.78	0.41	637.00	-2.43
37700-38780	36518	10 %	4000.00	625.31	634.48	634.48	637.56	0.011583	15.39	357.51	76.06	0.93	637.00	2.52
37700-38780	36518	2%	6000.00	625.31	637.01	637.01	637.86	0.003669	10.31	1360.65	355.86	0.55	637.00	-0.01
37700-38780	36518	1%	6800.00	625.31	637.01	637.01	638.10	0.004713	11.68	1360.65	355.86	0.62	637.00	-0.01
37700-38780	36518	0.2%	9100.00	625.31	637.88	637.26	639.21	0.005580	13.37	1675.30	387.88	0.68	637.00	-0.88
37700-38780	36249	10 %	4000.00	622.84	632.19	631.87	633.34	0.005651	9.80	681.17	235.74	0.64	641.00	8.81
37700-38780	36249	2%	6000.00	622.84	634.67	632.87	635.35	0.002951	8.31	1219.32	295.57	0.47	641.00	6.33
37700-38780	36249	1%	6800.00	622.84	635.48	633.20	636.11	0.002606	8.14	1394.46	295.58	0.44	641.00	5.52
37700-38780	36249	0.2%	9100.00	622.84	637.54	634.03	638.12	0.002085	7.98	1841.51	295.63	0.40	641.00	3.46
37700-38780	36188	10 %	4000.00	622.09	632.22	630.97	632.94	0.003475	7.65	835.04	281.08	0.50	641.00	8.78
37700-38780	36188	2%	6000.00	622.09	634.71	632.17	635.14	0.001845	6.60	1673.73	401.73	0.37	641.00	6.29
37700-38780	36188	1%	6800.00	622.09	635.55	632.51	635.91	0.001515	6.27	1983.80	459.00	0.34	641.00	5.45
37700-38780	36188	0.2%	9100.00	622.09	637.66	633.76	637.95	0.001071	5.82	2762.27	591.40	0.29	641.00	3.34
37700-38780	36159	10 %	4000.00	621.34	629.90	629.90	632.57	0.011488	13.24	329.72	203.71	0.93	641.00	11.10
37700-38780	36159	2%	6000.00	621.34	631.84	631.84	634.78	0.009397	14.30	515.62	336.64	0.88	641.00	9.16
37700-38780	36159	1%	6800.00	621.34	632.41	632.41	635.55	0.009288	14.87	573.80	375.01	0.88	641.00	8.59
37700-38780	36159	0.2%	9100.00	621.34	633.84	633.84	637.53	0.009299	16.43	724.06	467.61	0.90	641.00	7.16
37700-38780	35745	10 %	4000.00	613.28	629.24	622.72	629.46	0.000551	4.19	1503.99	498.05	0.22		
37700-38780	35745	2%	6000.00	613.28	630.70	624.42	631.01	0.000695	5.11	1939.26	525.41	0.25		
37700-38780	35745	1%	6800.00	613.28	631.29	625.22	631.62	0.000725	5.38	2123.00	540.20	0.26		
37700-38780	35745	0.2%	9100.00	613.28	632.24	627.04	632.69	0.000946	6.43	2438.66	594.56	0.30		
37700-38780	35368	10 %	4000.00	611.33	629.30	619.63	629.32	0.000112	1.62	5176.22	904.12	0.08		
37700-38780	35368	2%	6000.00	611.33	630.80	621.45	630.82	0.000134	1.89	6440.23	1020.54	0.08		
37700-38780	35368	1%	6800.00	611.33	631.40	622.02	631.43	0.000137	1.97	6947.59	1099.98	0.09		
37700-38780	35368	0.2%	9100.00	611.33	632.40	624.51	632.44	0.000174	2.31	7795.48	1283.74	0.10		

Stewart-Existing Plan: 1) Existing 8/10/2018
River = Stewart Creek Reach = 37700-38780 RS = 38300



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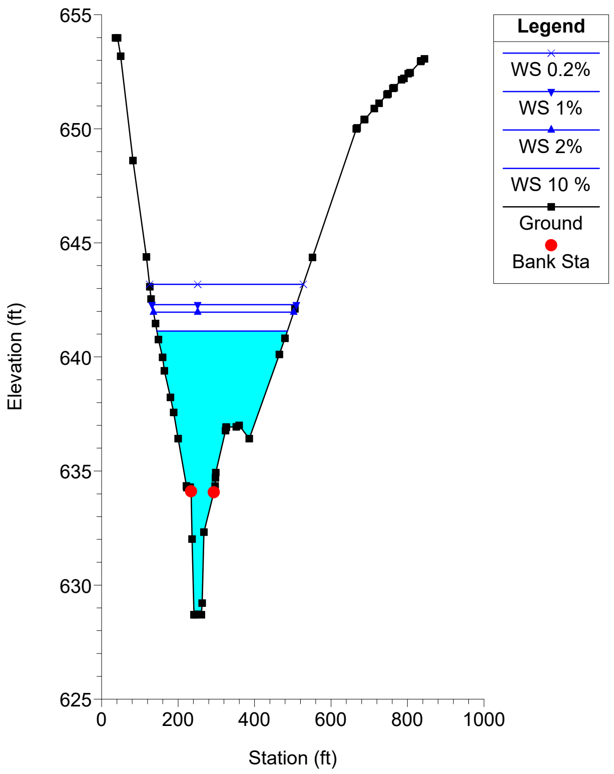

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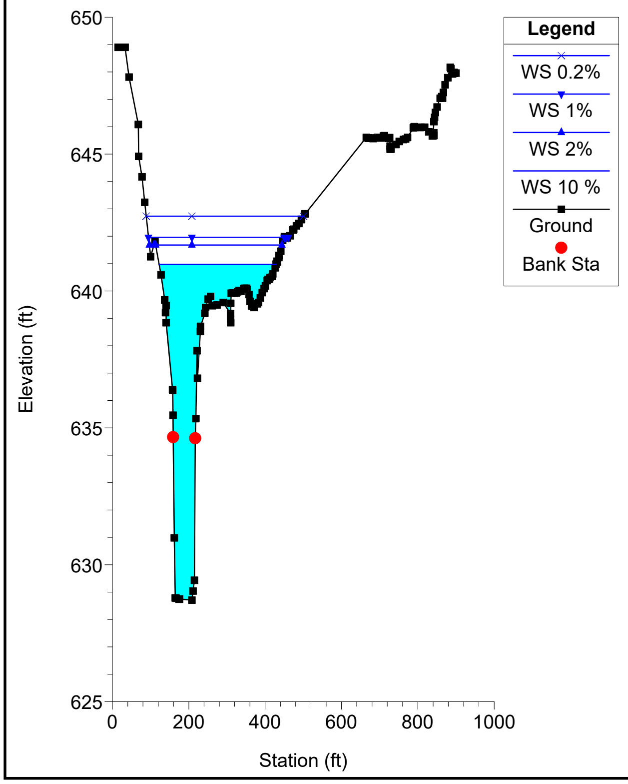
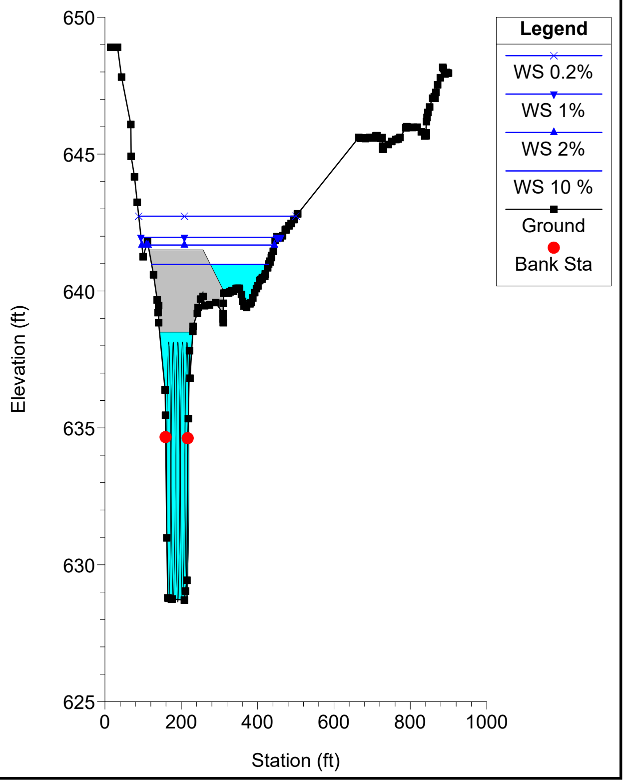
River = Stewart Creek Reach = 37700-38780 RS = 37820

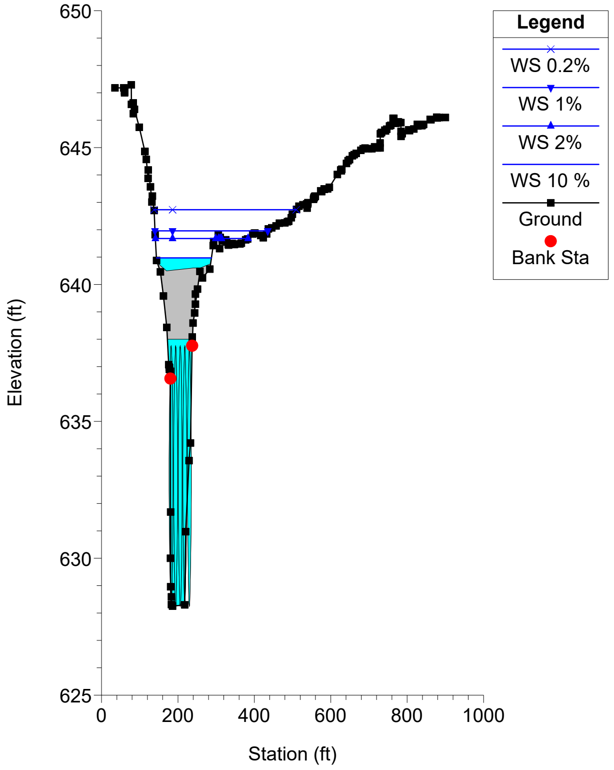


Stewart-Existing Plan: 1) Existing 8/10/2018
River = Stewart Creek Reach = 37700-38780 RS = 37819 Culv



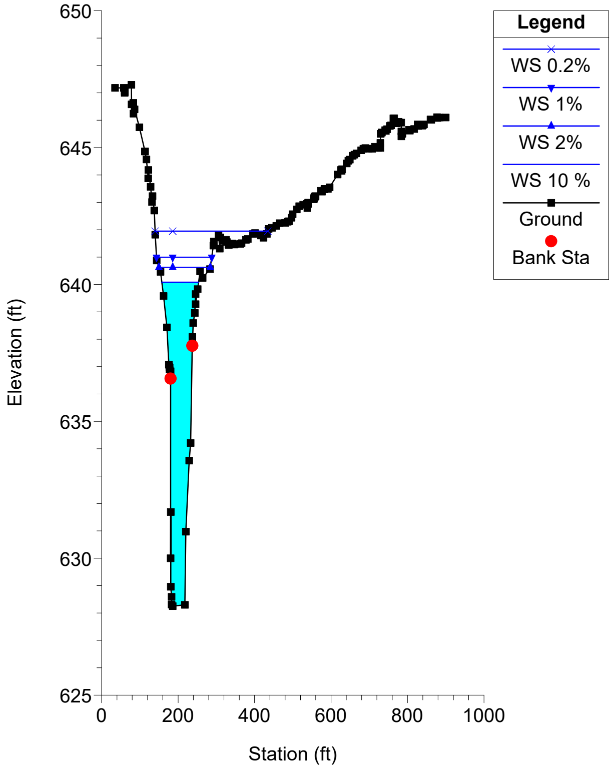
Stewart-Existing Plan: 1) Existing 8/10/2018

River = Stewart Creek Reach = 37700-38780 RS = 37819 Culv



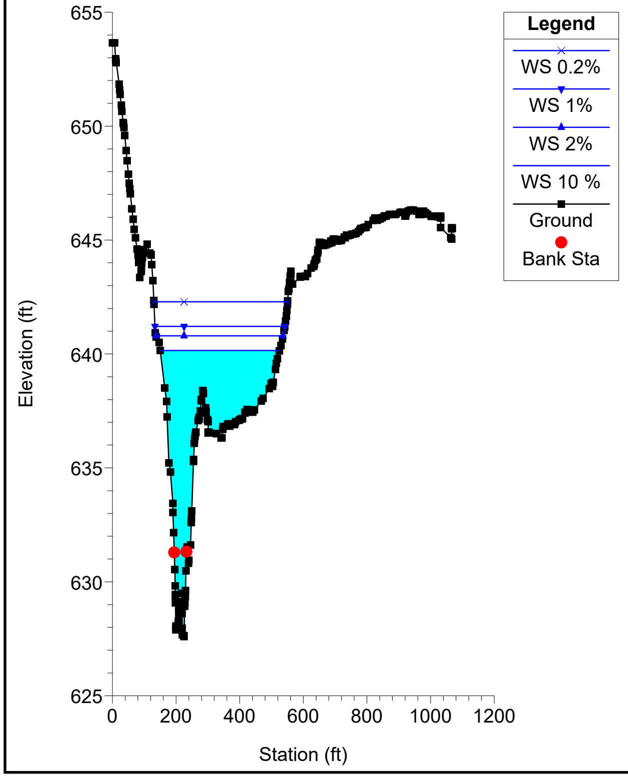
Stewart-Existing Plan: 1) Existing 8/10/2018

River = Stewart Creek Reach = 37700-38780 RS = 37800



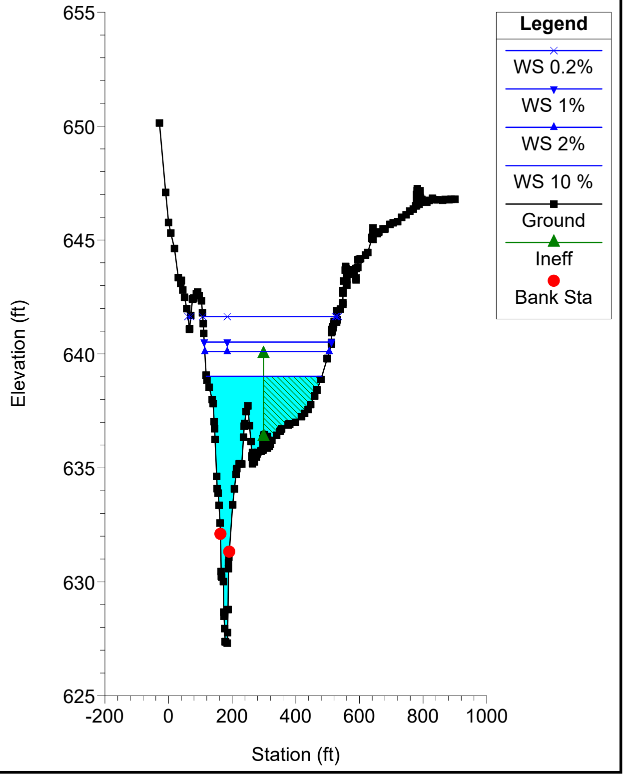
Stewart-Existing Plan: 1) Existing 8/10/2018

River = Stewart Creek Reach = 37700-38780 RS = 37767

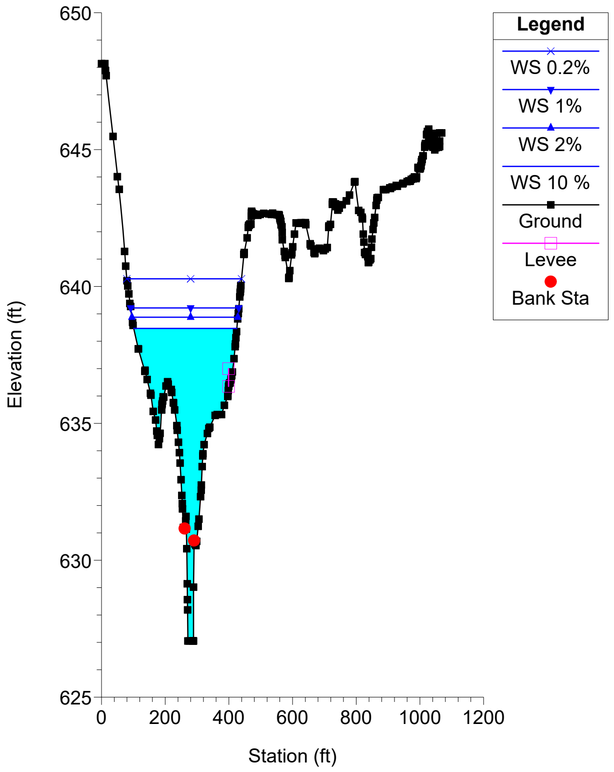


Stewart-Existing Plan: 1) Existing 8/10/2018

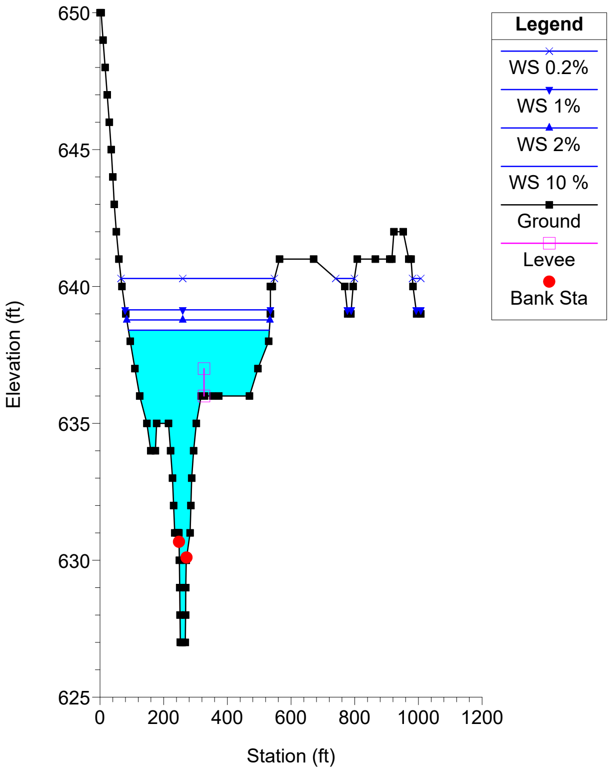
River = Stewart Creek Reach = 37700-38780 RS = 37700



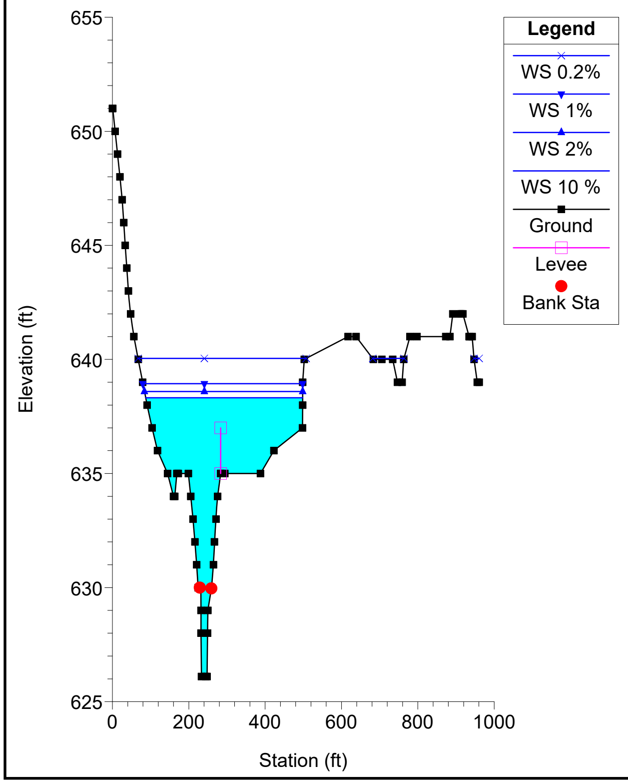
Stewart-Existing Plan: 1) Existing 8/10/2018
River = Stewart Creek Reach = 37700-38780 RS = 37233



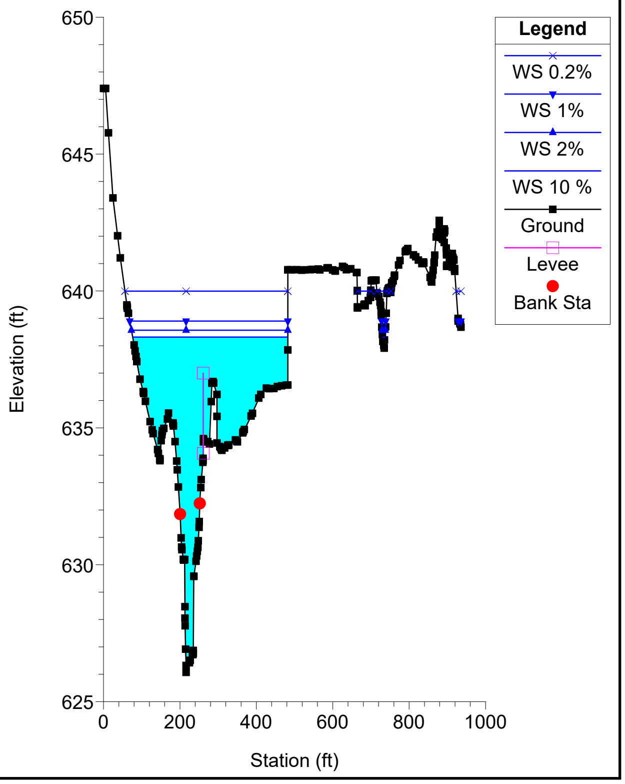
Stewart-Existing Plan: 1) Existing 8/10/2018
River = Stewart Creek Reach = 37700-38780 RS = 37164

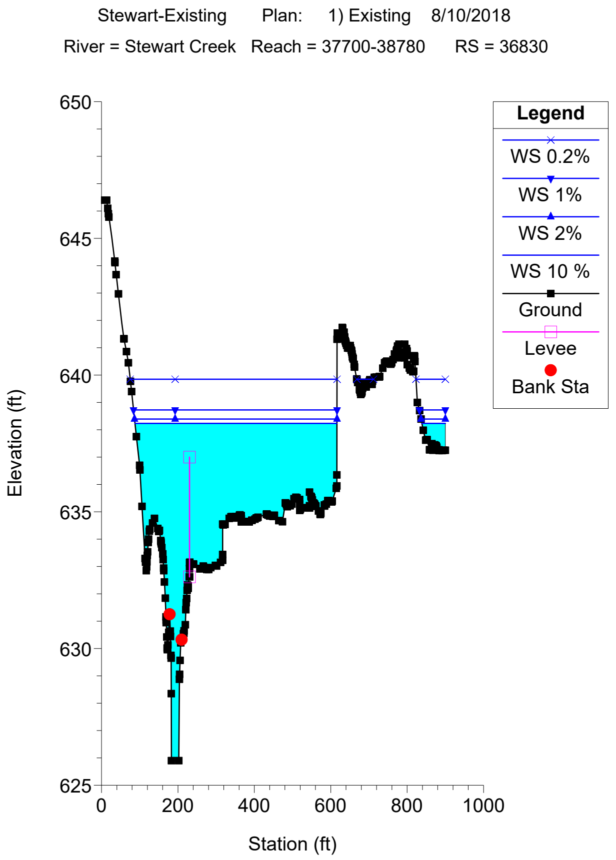


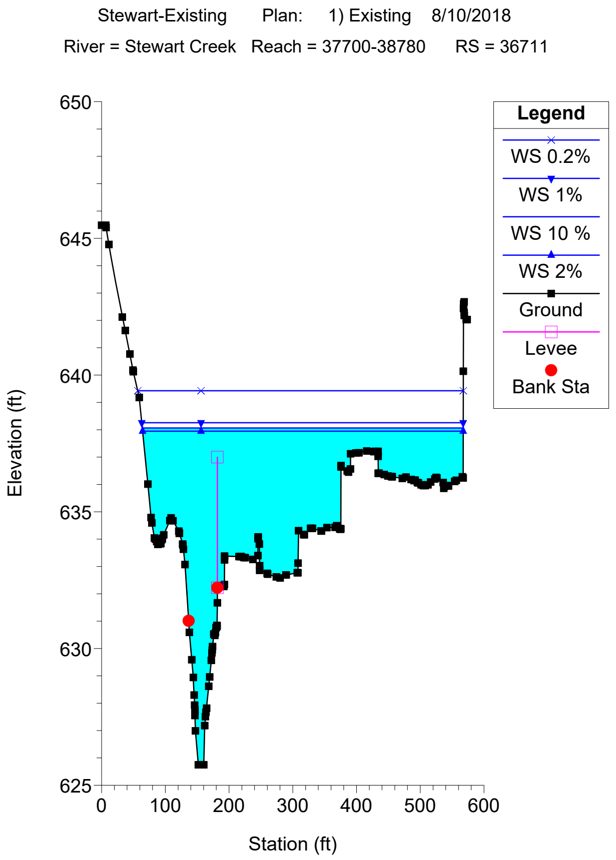
Stewart-Existing Plan: 1) Existing 8/10/2018
River = Stewart Creek Reach = 37700-38780 RS = 37091

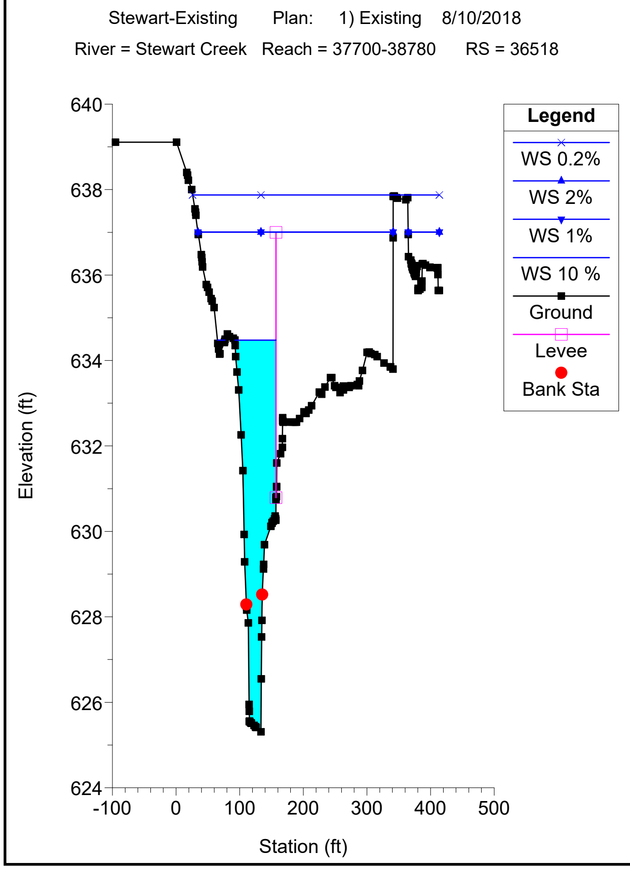


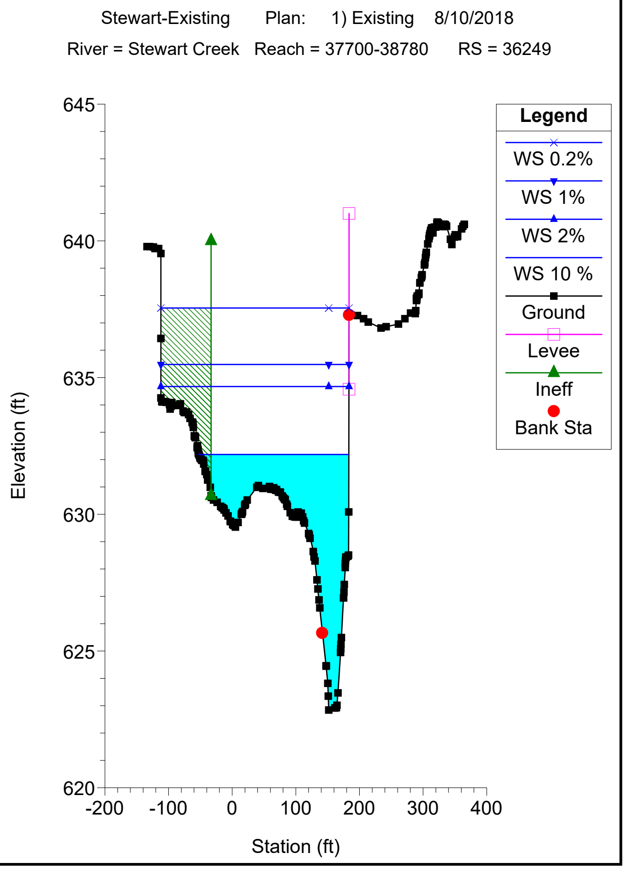
Stewart-Existing Plan: 1) Existing 8/10/2018
River = Stewart Creek Reach = 37700-38780 RS = 37066



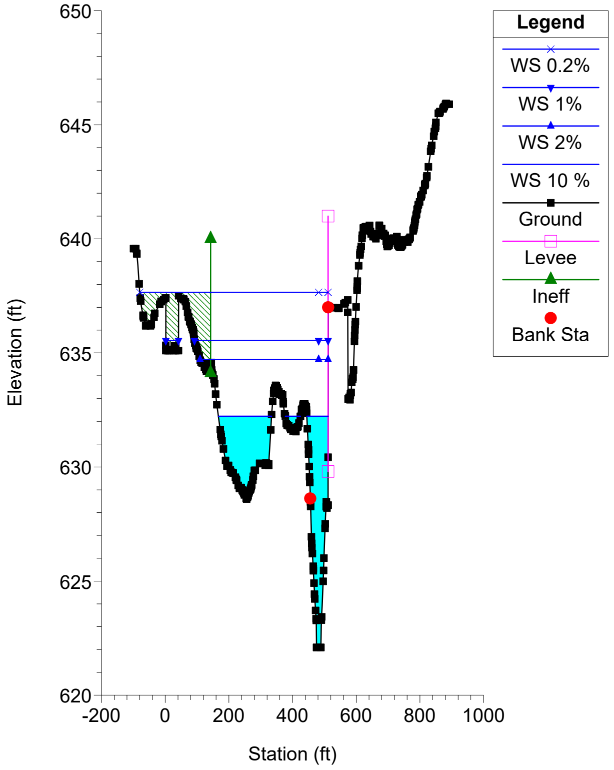

Stewart-Existing Plan: 1) Existing 8/10/2018
River = Stewart Creek Reach = 37700-38780 RS = 36830
Legend
WS 0.2%
WS 1%
WS 2%
WS 10 %
Ground
Levee
Bank Sta
Elevation (ft)
650
645
640
635
630
625
Station (ft)
0
200
400
600
800
1000


Stewart-Existing Plan: 1) Existing 8/10/2018
River = Stewart Creek Reach = 37700-38780 RS = 36711
Legend
WS 0.2%
WS 1%
WS 10 %
WS 2%
Ground
Levee
Bank Sta
Elevation (ft)
650
645
640
635
630
625
Station (ft)
0
100
200
300
400
500
600

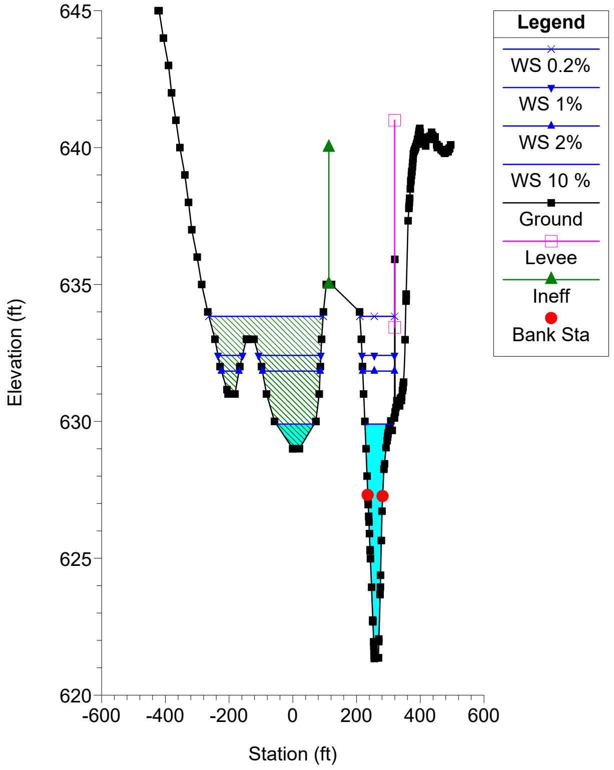

Stewart-Existing Plan: 1) Existing 8/10/2018
River = Stewart Creek Reach = 37700-38780 RS = 36518
Legend
WS 0.2%
WS 2%
WS 1%
WS 10 %
Ground
Levee
Bank Sta
Elevation (ft)
640
638
636
634
632
630
628
626
624
Station (ft)
-100
0
100
200
300
400
500


Stewart-Existing Plan: 1) Existing 8/10/2018
River = Stewart Creek Reach = 37700-38780 RS = 36249
Legend
WS 0.2%
WS 1%
WS 2%
WS 10 %
Ground
Levee
Ineff
Bank Sta
Elevation (ft)
645
640
635
630
625
620
Station (ft)
-200
-100
0
100
200
300
400

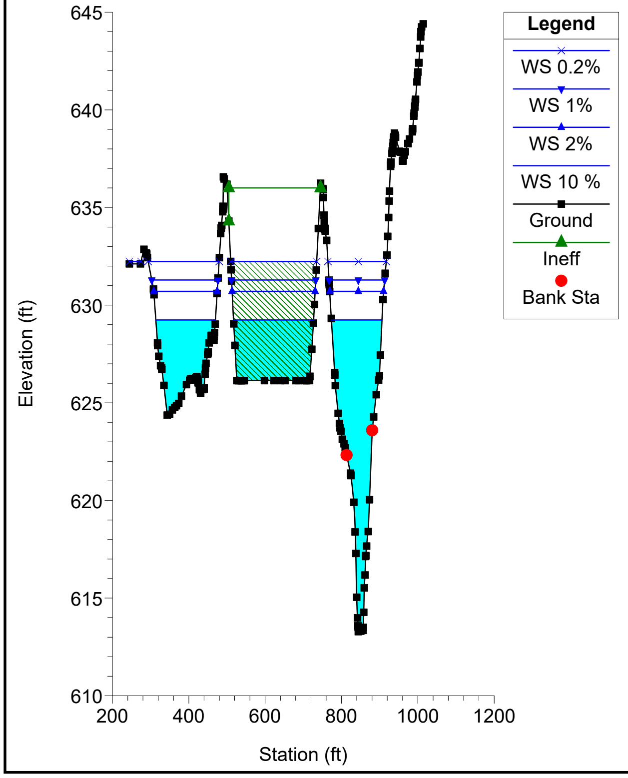
Stewart-Existing Plan: 1) Existing 8/10/2018
River = Stewart Creek Reach = 37700-38780 RS = 36188



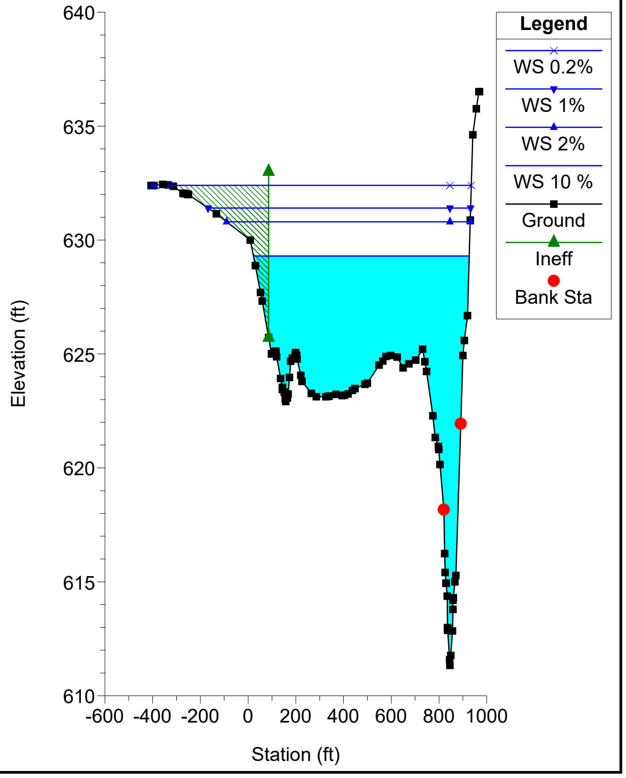
Stewart-Existing Plan: 1) Existing 8/10/2018
River = Stewart Creek Reach = 37700-38780 RS = 36159



Stewart-Existing Plan: 1) Existing 8/10/2018
River = Stewart Creek Reach = 37700-38780 RS = 35745



Stewart-Existing Plan: 1) Existing 8/10/2018
River = Stewart Creek Reach = 37700-38780 RS = 35368



APPENDIX E

Proposed Conditions Model

Upstream Model Limit Tie-In

	Water Surface Elevations by Flood Profile			
Cross Section	10%	2%	1%	0.20%
37860 (Existing FIS)[1]	639.99	641.36	642.19	643.8
38780 (Existing FIS)[1]	643.57	644.62	644.86	645.9
Tie-In Elevation at 38300 (NGVD 29)[2]	641.86	643.06	643.58	644.90
Tie-In Elevation at 38300 (NAVD 88)[3]	641.92	643.12	643.64	644.96
38300 (Proposed Model results - NAVD 88)	641.43	642.87	643.63	645.37
WSEL Difference at Upstream Model Tie-in	-0.49	-0.25	-0.01	0.41

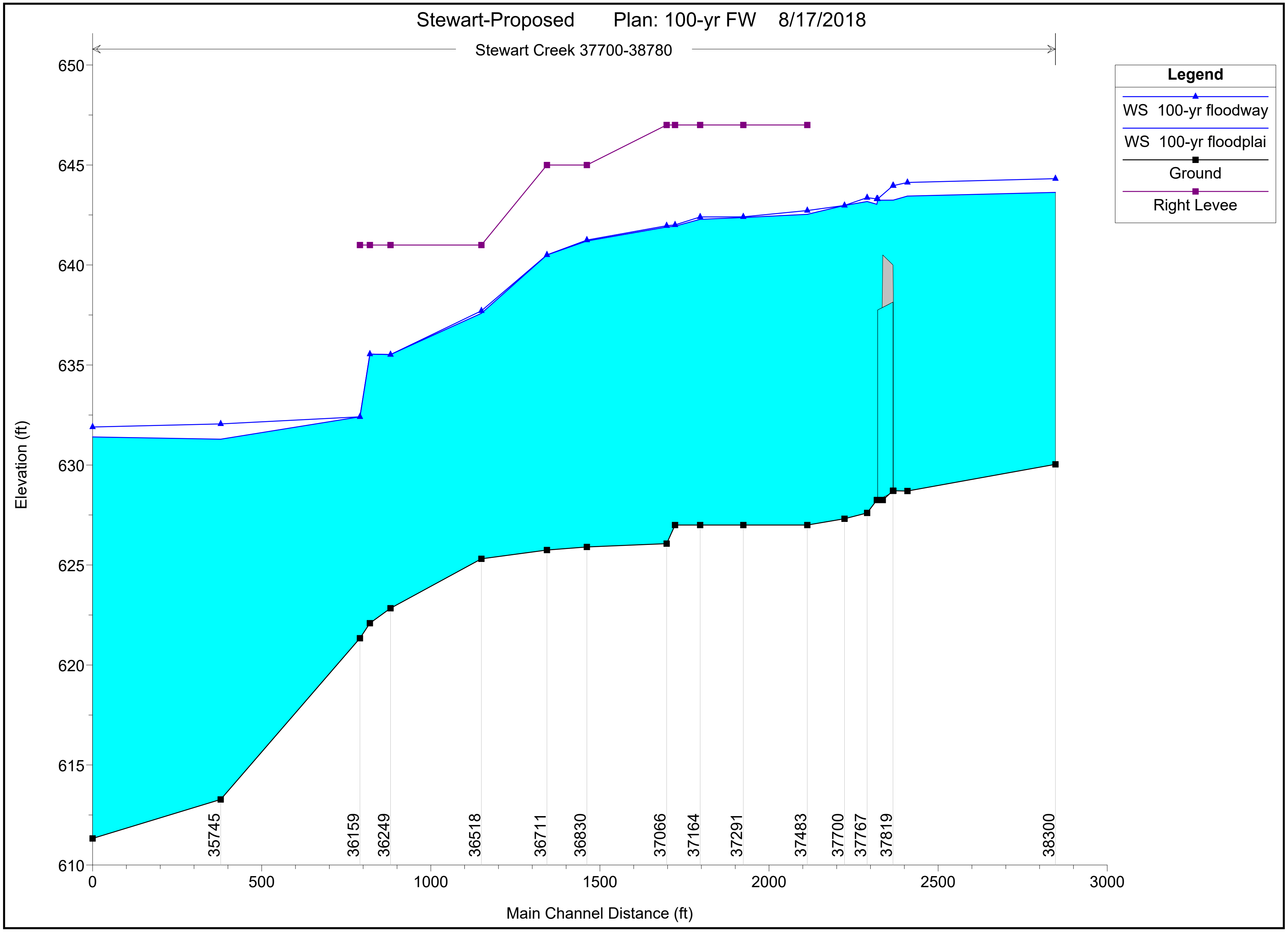
FIS Model Distance (38780 to 37860)	920
Distance from 38300 to 37860 (ft):	440

Notes:

[1] Water surface elevations referenced from Existing FIS HEC-2 Model (NGVD 29)

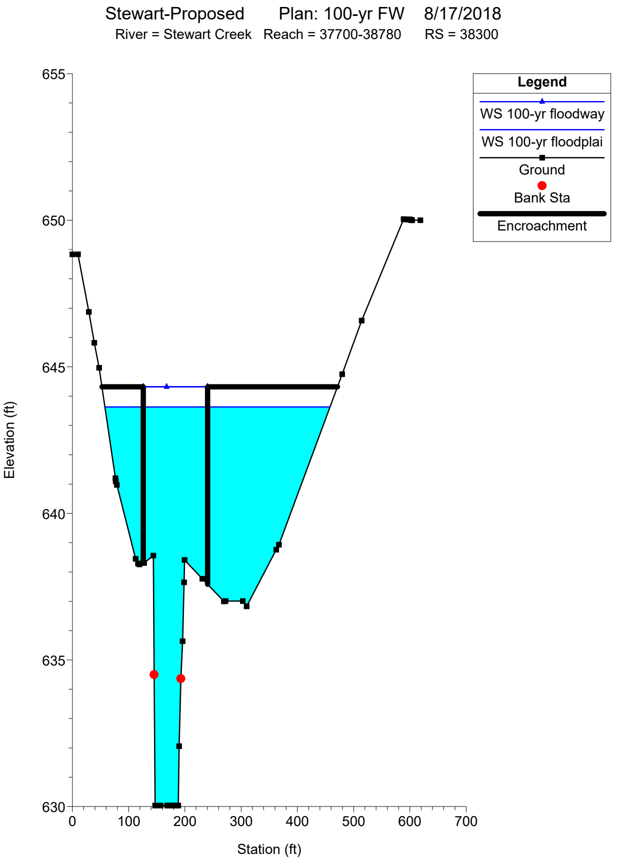
[2] Water surface elevation interpolated based on distance to FIS model cross section 37860

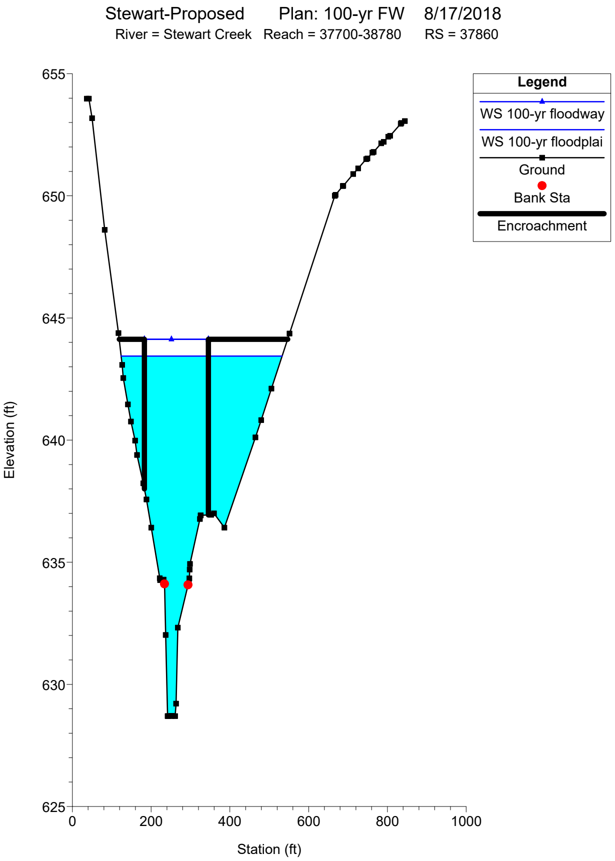
[3] Elevation adjusted to NAVD 88 by adding 0.06 ft to NGVD 29 elevation

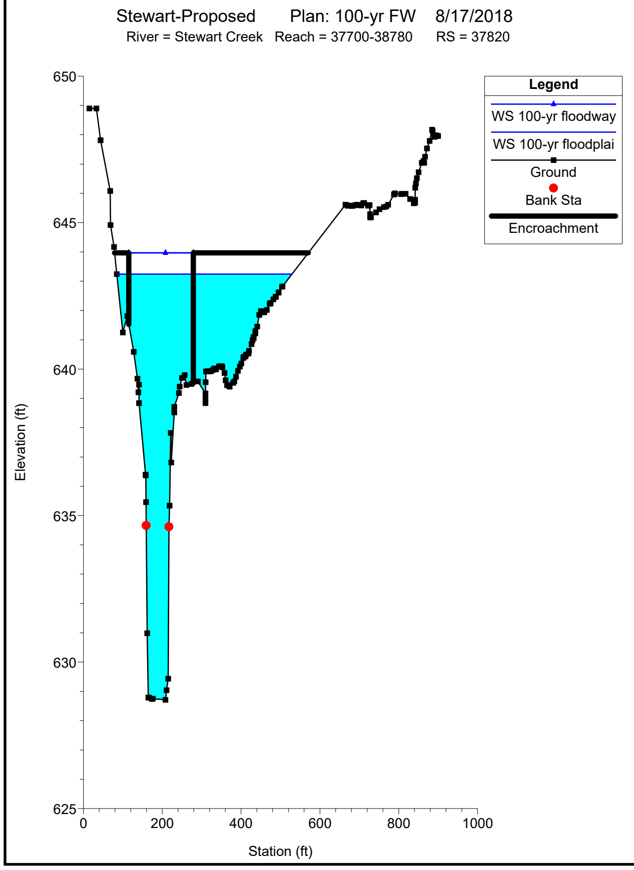
Stewart-Proposed Plan: 100-yr FW 8/17/2018
Stewart Creek 37700-38780
Legend
WS 100-yr floodway
WS 100-yr floodplai
Ground
Right Levee
Elevation (ft)
Main Channel Distance (ft)
650
645
640
635
630
625
620
615
610
0
500
1000
1500
2000
2500
3000
35745
36159
36249
36518
36711
36830
37066
37164
37291
37483
37700
37767
37819
38300

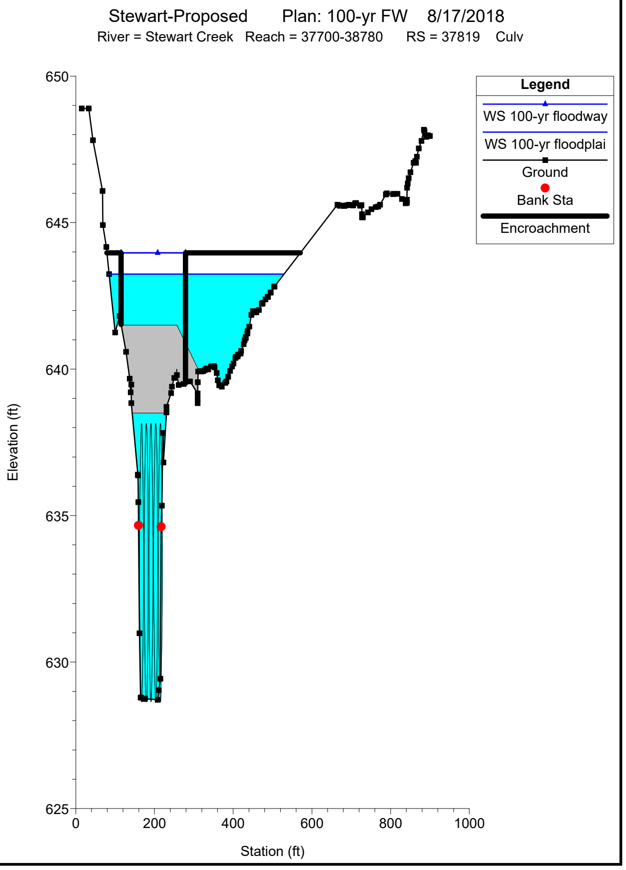
HEC-RAS Plan: 100-yr FW   River: Stewart Creek   Reach: 37700-38780

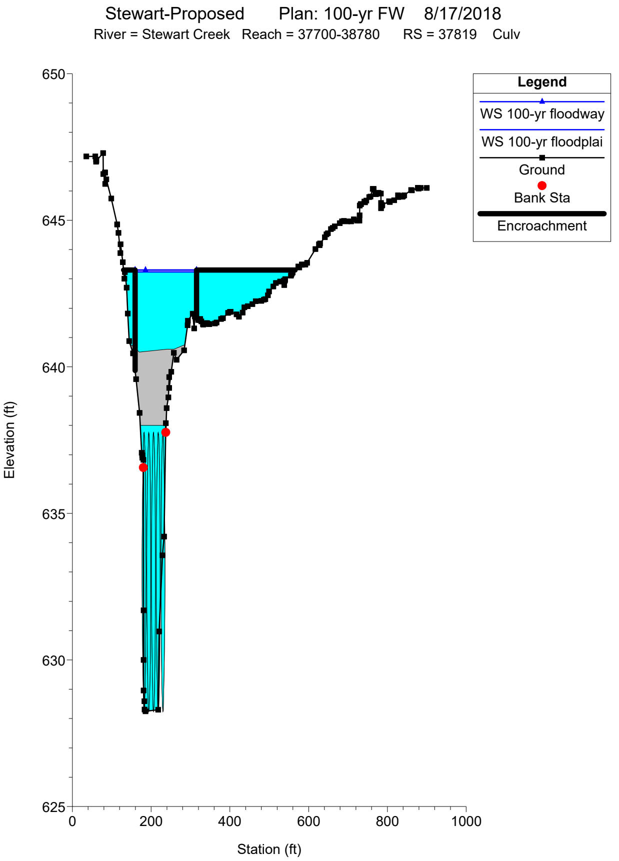
Reach	River Sta	Profile	Q Total	Min Ch El	W.S. Elev	Prof Delta WS	Crit W.S.	E.G. Elev	E.G. Slope	Vel Chnl	Flow Area	Top Width	Froude # Chl	Enc Sta L	Enc Sta R
			(cfs)	(ft)	(ft)	(ft)	(ft)	(ft)	(ft/ft)	(ft/s)	(sq ft)	(ft)		(ft)	(ft)
37700-38780	38300	100-yr floodplai	4500.00	630.03	643.63		637.73	643.75	0.000547	3.66	2241.35	400.05	0.18		
37700-38780	38300	100-yr floodway	4500.00	630.03	644.32	0.69	636.93	644.69	0.001119	5.41	1093.42	114.41	0.25	126.00	240.41
37700-38780	37860	100-yr floodplai	4500.00	628.70	643.44			643.53	0.000419	3.14	2471.23	409.13	0.16		
37700-38780	37860	100-yr floodway	4500.00	628.70	644.13	0.69		644.29	0.000562	3.77	1615.02	162.56	0.18	182.78	345.34
37700-38780	37820	100-yr floodplai	4500.00	628.71	643.24		634.85	643.47	0.000458	4.33	1899.81	444.65	0.20		
37700-38780	37820	100-yr floodway	4500.00	628.71	643.97	0.72	634.85	644.24	0.000461	4.50	1379.59	163.62	0.21	115.09	278.71
37700-38780	37819		Culvert												
37700-38780	37800	100-yr floodplai	4500.00	628.25	643.04			643.43	0.000903	5.34	1310.40	411.79	0.26		
37700-38780	37800	100-yr floodway	4500.00	628.25	643.30	0.27		643.71	0.000888	5.37	1075.37	155.92	0.26	159.28	315.20
37700-38780	37767	100-yr floodplai	4500.00	627.60	643.17			643.27	0.000299	3.61	2739.17	443.19	0.17		
37700-38780	37767	100-yr floodway	4500.00	627.60	643.37	0.20		643.61	0.000534	4.87	1570.12	170.59	0.22	168.94	339.53
37700-38780	37700	100-yr floodplai	6800.00	627.31	642.98		639.37	643.20	0.000873	5.94	2787.92	506.17	0.28		
37700-38780	37700	100-yr floodway	6800.00	627.31	642.98	0.00	639.26	643.47	0.001507	7.81	1661.92	198.57	0.37	140.68	339.25
37700-38780	37483	100-yr floodplai	6800.00	627.00	642.53		639.19	643.04	0.001689	8.00	2146.76	521.29	0.38		
37700-38780	37483	100-yr floodway	6800.00	627.00	642.72	0.18	638.74	643.29	0.001673	8.03	1489.10	166.80	0.38	244.42	411.22
37700-38780	37291	100-yr floodplai	6800.00	627.00	642.37		638.15	642.73	0.001203	6.93	2570.79	620.33	0.33		
37700-38780	37291	100-yr floodway	6800.00	627.00	642.41	0.04	638.17	642.98	0.001583	7.97	1497.75	163.34	0.37	182.36	345.70
37700-38780	37164	100-yr floodplai	6800.00	627.00	642.28		638.11	642.57	0.001019	6.57	2243.61	304.45	0.30		
37700-38780	37164	100-yr floodway	6800.00	627.00	642.40	0.12	638.05	642.74	0.001115	6.91	1952.45	221.54	0.32	132.54	354.89
37700-38780	37091	100-yr floodplai	6800.00	627.00	641.94		637.98	642.45	0.001496	7.81	1713.34	235.07	0.37		
37700-38780	37091	100-yr floodway	6800.00	627.00	642.00	0.07	637.90	642.62	0.001649	8.23	1456.96	158.16	0.39	125.30	283.70
37700-38780	37066	100-yr floodplai	6800.00	626.07	641.90		637.25	642.42	0.001214	6.82	1639.52	222.87	0.33		
37700-38780	37066	100-yr floodway	6800.00	626.07	641.97	0.07	637.19	642.58	0.001342	7.19	1382.31	146.11	0.35	114.02	260.13
37700-38780	36830	100-yr floodplai	6800.00	625.90	641.20		637.18	642.01	0.002209	9.07	1310.81	169.82	0.43		
37700-38780	36830	100-yr floodway	6800.00	625.90	641.25	0.05	637.21	642.14	0.002324	9.33	1168.21	119.05	0.44	111.17	230.22
37700-38780	36711	100-yr floodplai	6800.00	625.75	640.50		637.31	641.68	0.002655	9.71	1007.37	135.12	0.49		
37700-38780	36711	100-yr floodway	6800.00	625.75	640.50	0.01	637.26	641.80	0.002805	9.99	910.01	100.02	0.50	81.61	181.63
37700-38780	36518	100-yr floodplai	6800.00	625.31	637.58		637.58	640.64	0.008677	16.40	699.54	127.80	0.85		
37700-38780	36518	100-yr floodway	6800.00	625.31	637.71	0.13	637.71	640.75	0.008459	16.31	687.60	112.07	0.84	42.77	154.84
37700-38780	36249	100-yr floodplai	6800.00	622.84	635.52		633.26	636.09	0.002464	7.94	1586.42	295.58	0.43		
37700-38780	36249	100-yr floodway	6800.00	622.84	635.52	0.00	633.26	636.09	0.002458	7.93	1579.90	290.79	0.43	-107.24	183.55
37700-38780	36188	100-yr floodplai	6800.00	622.09	635.55		632.51	635.91	0.001515	6.27	1983.80	459.00	0.34		
37700-38780	36188	100-yr floodway	6800.00	622.09	635.55	0.00	632.53	635.91	0.001514	6.26	1973.41	361.00	0.34	150.48	511.91
37700-38780	36159	100-yr floodplai	6800.00	621.34	632.41		632.41	635.55	0.009288	14.87	573.80	375.01	0.88		
37700-38780	36159	100-yr floodway	6800.00	621.34	632.41	0.00	632.41	635.55	0.009288	14.87	573.80	102.12	0.88	183.95	338.32
37700-38780	35745	100-yr floodplai	6800.00	613.28	631.29		625.22	631.62	0.000725	5.38	2122.97	540.20	0.26		
37700-38780	35745	100-yr floodway	6800.00	613.28	632.05	0.76	625.00	632.58	0.000904	6.23	1385.52	135.09	0.29	778.64	913.73
37700-38780	35368	100-yr floodplai	6800.00	611.33	631.40		622.04	631.43	0.000137	1.97	6947.59	1099.98	0.09		
37700-38780	35368	100-yr floodway	6800.00	611.33	631.90	0.50	622.00	632.20	0.000763	4.74	1835.13	147.10	0.20	784.09	931.19

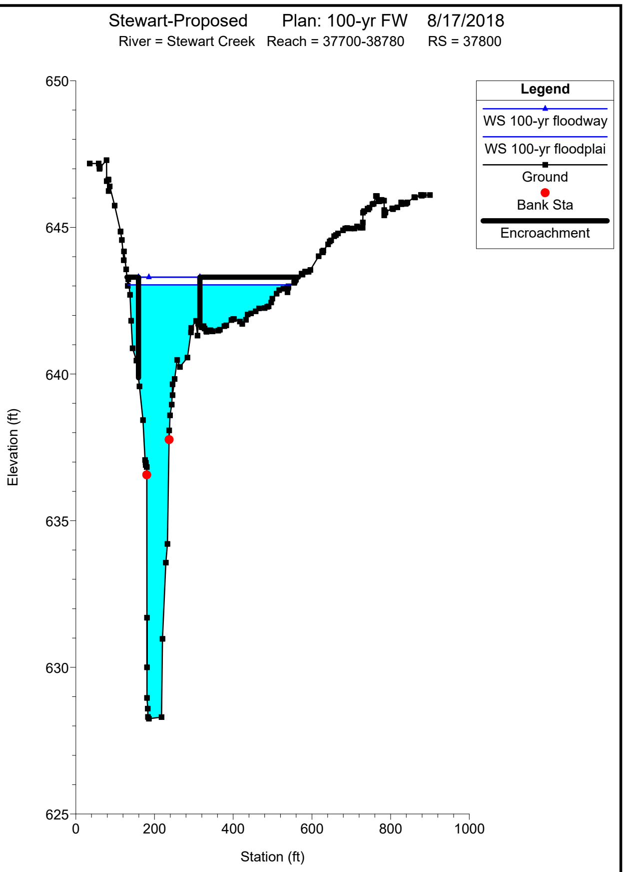

Stewart-Proposed Plan: 100-yr FW 8/17/2018
River = Stewart Creek Reach = 37700-38780 RS = 38300
Legend
WS 100-yr floodway
WS 100-yr floodplai
Ground
Bank Sta
Encroachment
Elevation (ft)
655
650
645
640
635
630
Station (ft)
0
100
200
300
400
500
600
700

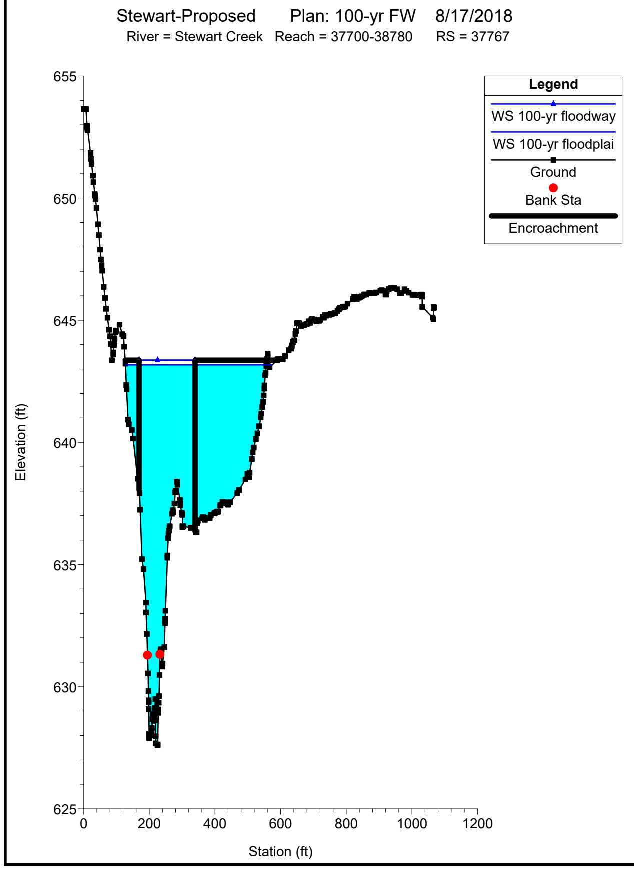

Stewart-Proposed Plan: 100-yr FW 8/17/2018
River = Stewart Creek Reach = 37700-38780 RS = 37860
Legend
WS 100-yr floodway
WS 100-yr floodplai
Ground
Bank Sta
Encroachment
Elevation (ft)
655
650
645
640
635
630
625
Station (ft)
0
200
400
600
800
1000

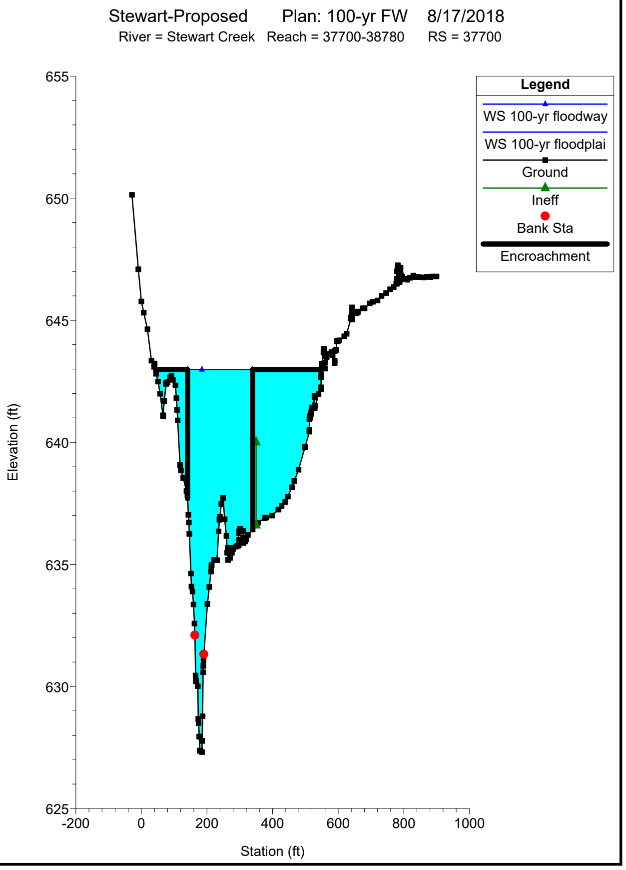

Stewart-Proposed Plan: 100-yr FW 8/17/2018
River = Stewart Creek Reach = 37700-38780 RS = 37820
Legend
WS 100-yr floodway
WS 100-yr floodplai
Ground
Bank Sta
Encroachment
Elevation (ft)
650
645
640
635
630
625
Station (ft)
0
200
400
600
800
1000

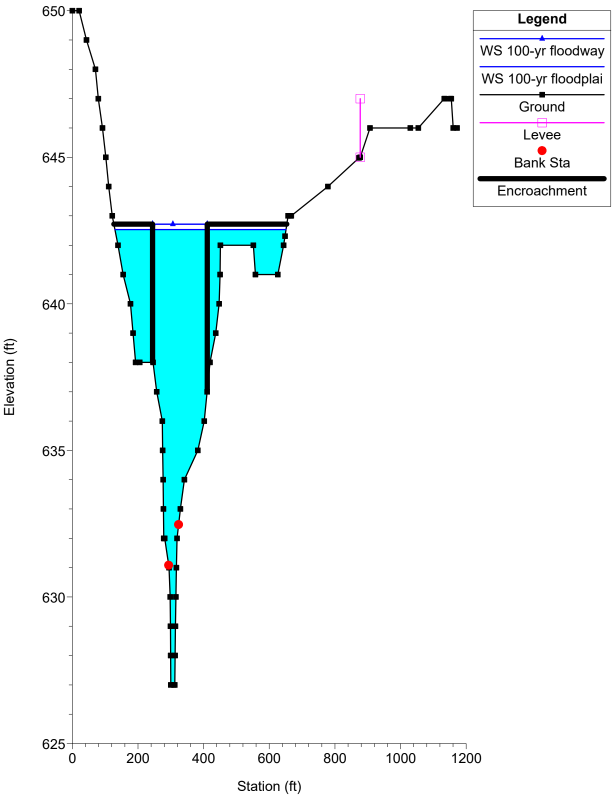

Stewart-Proposed Plan: 100-yr FW 8/17/2018
River = Stewart Creek Reach = 37700-38780 RS = 37819 Culv
Legend
WS 100-yr floodway
WS 100-yr floodplai
Ground
Bank Sta
Encroachment
Elevation (ft)
650
645
640
635
630
625
Station (ft)
0
200
400
600
800
1000

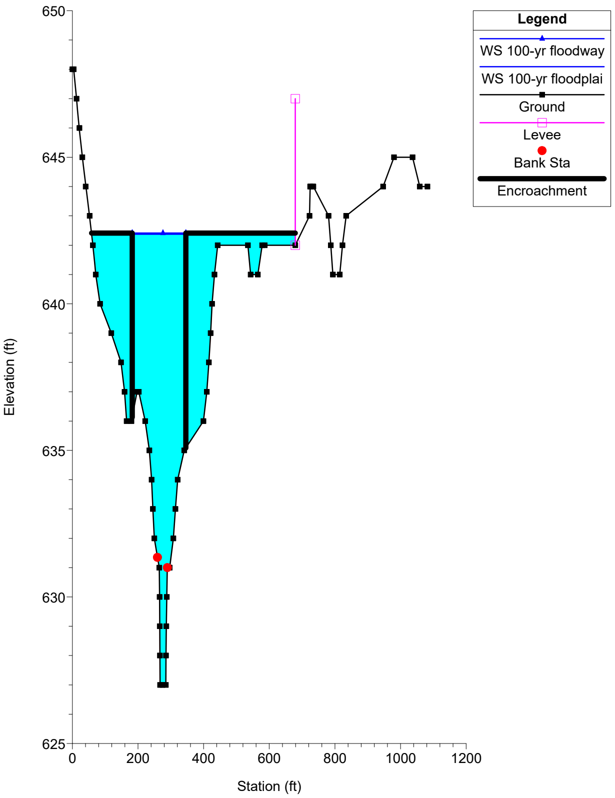

Stewart-Proposed Plan: 100-yr FW 8/17/2018
River = Stewart Creek Reach = 37700-38780 RS = 37819 Culv
Legend
WS 100-yr floodway
WS 100-yr floodplai
Ground
Bank Sta
Encroachment
Elevation (ft)
650
645
640
635
630
625
0
200
400
600
800
1000
Station (ft)

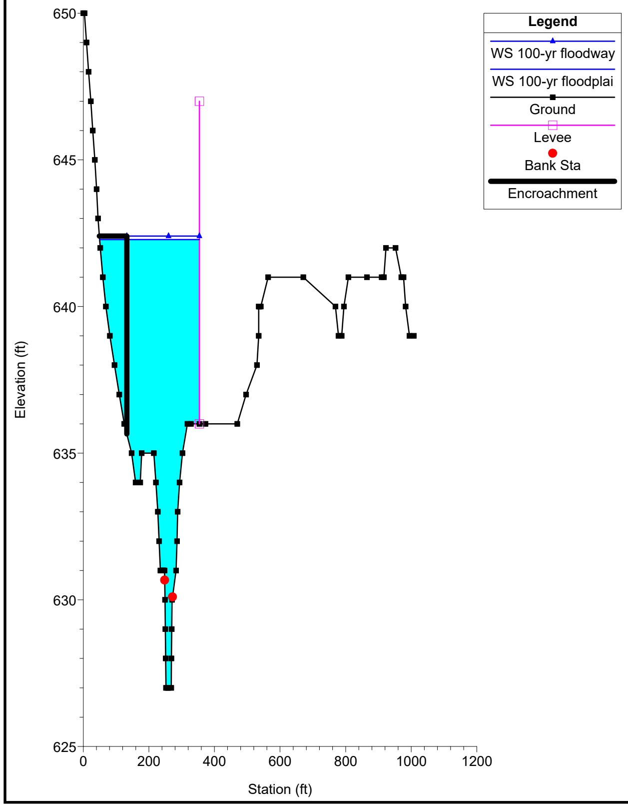

Stewart-Proposed Plan: 100-yr FW 8/17/2018
River = Stewart Creek Reach = 37700-38780 RS = 37800
Legend
WS 100-yr floodway
WS 100-yr floodplai
Ground
Bank Sta
Encroachment
Elevation (ft)
650
645
640
635
630
625
0
200
400
600
800
1000
Station (ft)

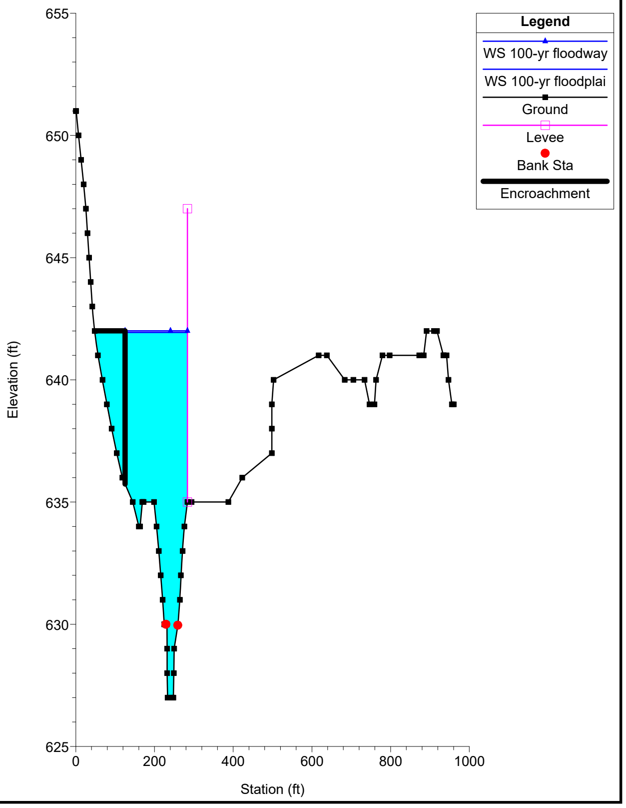

Stewart-Proposed Plan: 100-yr FW 8/17/2018
River = Stewart Creek Reach = 37700-38780 RS = 37767
Legend
WS 100-yr floodway
WS 100-yr floodplai
Ground
Bank Sta
Encroachment
Elevation (ft)
655
650
645
640
635
630
625
0
200
400
600
800
1000
1200
Station (ft)

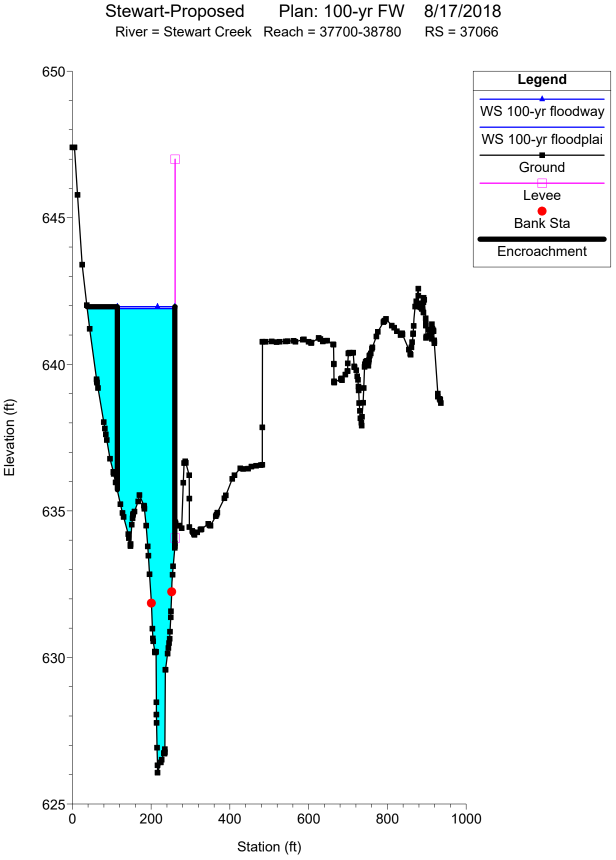

Stewart-Proposed Plan: 100-yr FW 8/17/2018
River = Stewart Creek Reach = 37700-38780 RS = 37700
Legend
WS 100-yr floodway
WS 100-yr floodplai
Ground
Ineff
Bank Sta
Encroachment
Elevation (ft)
655
650
645
640
635
630
625
-200
0
200
400
600
800
1000
Station (ft)

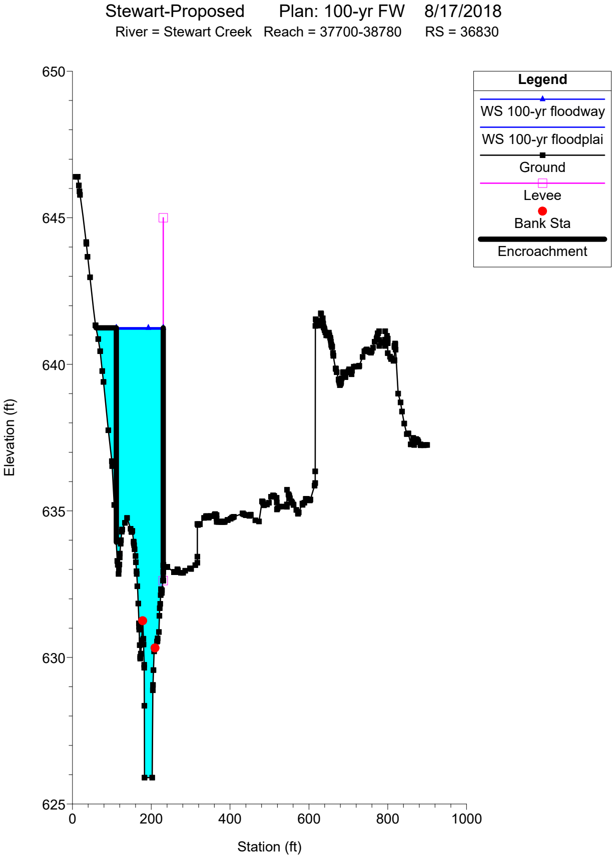

Stewart-Proposed Plan: 100-yr FW 8/17/2018
River = Stewart Creek Reach = 37700-38780 RS = 37483

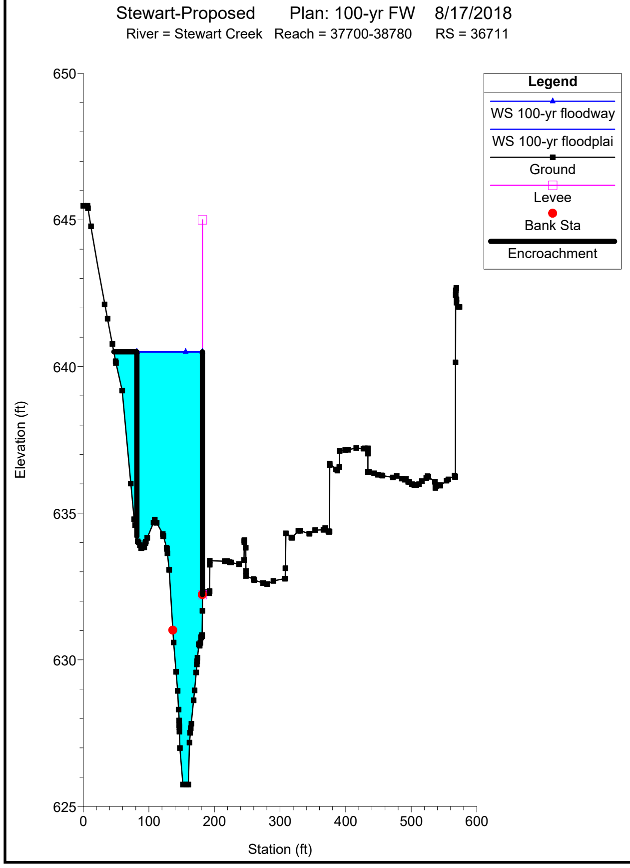

Stewart-Proposed Plan: 100-yr FW 8/17/2018
River = Stewart Creek Reach = 37700-38780 RS = 37291

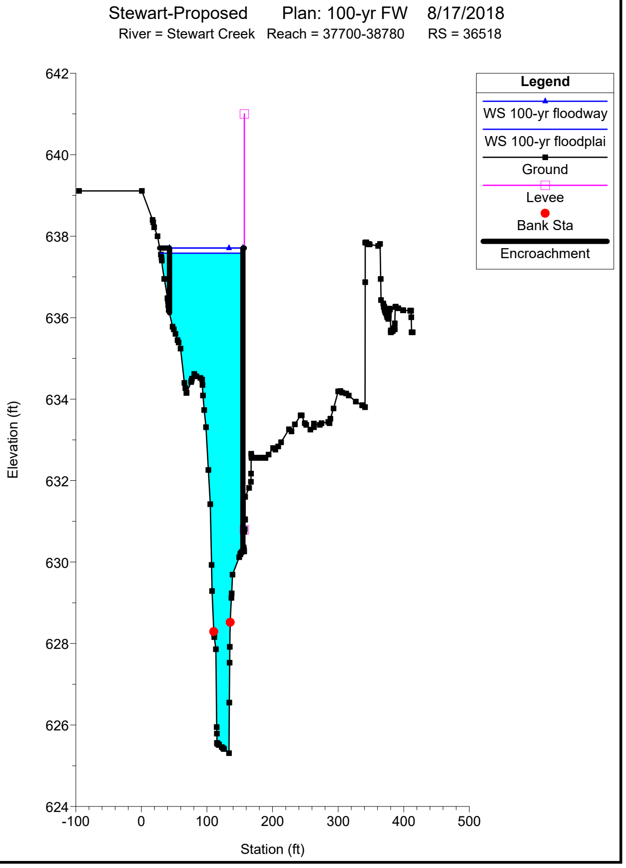

Stewart-Proposed Plan: 100-yr FW 8/17/2018
River = Stewart Creek Reach = 37700-38780 RS = 37164

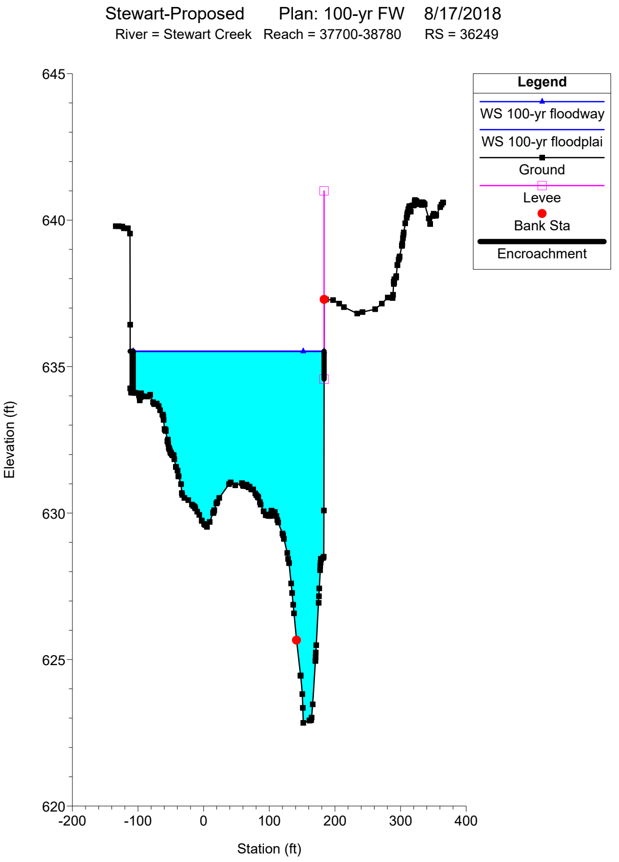

Stewart-Proposed Plan: 100-yr FW 8/17/2018
River = Stewart Creek Reach = 37700-38780 RS = 37091

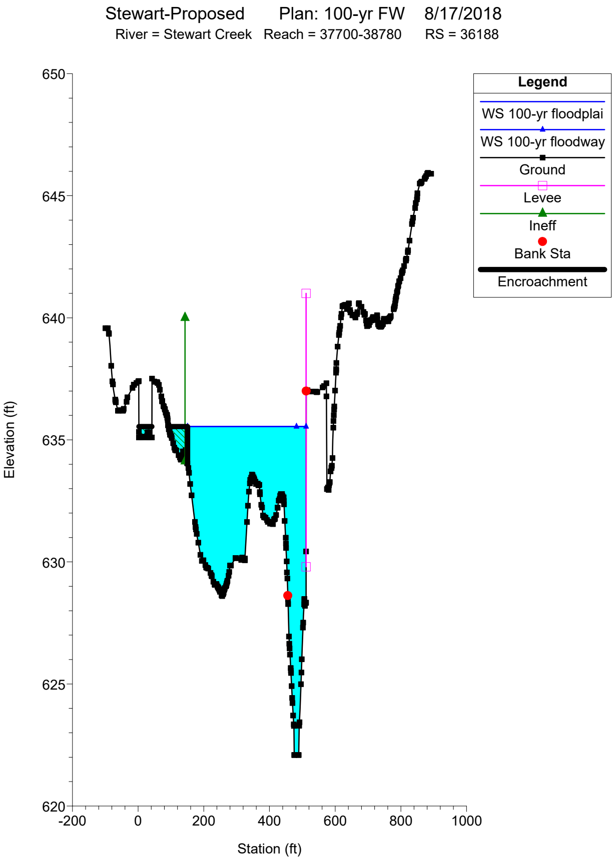

Stewart-Proposed Plan: 100-yr FW 8/17/2018
River = Stewart Creek Reach = 37700-38780 RS = 37066
Legend
WS 100-yr floodway
WS 100-yr floodplai
Ground
Levee
Bank Sta
Encroachment
Elevation (ft)
Station (ft)
650
645
640
635
630
625
0
200
400
600
800
1000

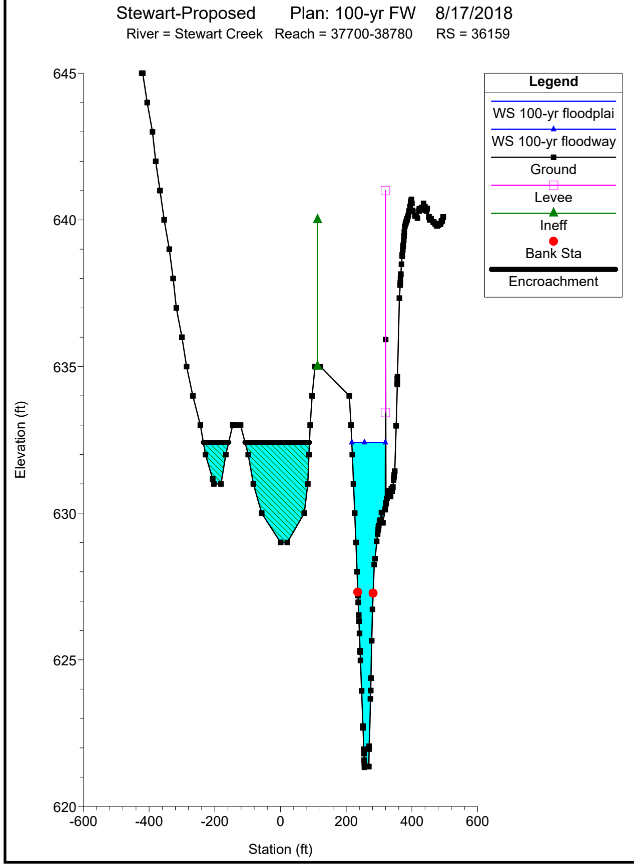

Stewart-Proposed Plan: 100-yr FW 8/17/2018
River = Stewart Creek Reach = 37700-38780 RS = 36830
Legend
WS 100-yr floodway
WS 100-yr floodplai
Ground
Levee
Bank Sta
Encroachment
Elevation (ft)
Station (ft)
650
645
640
635
630
625
0
200
400
600
800
1000

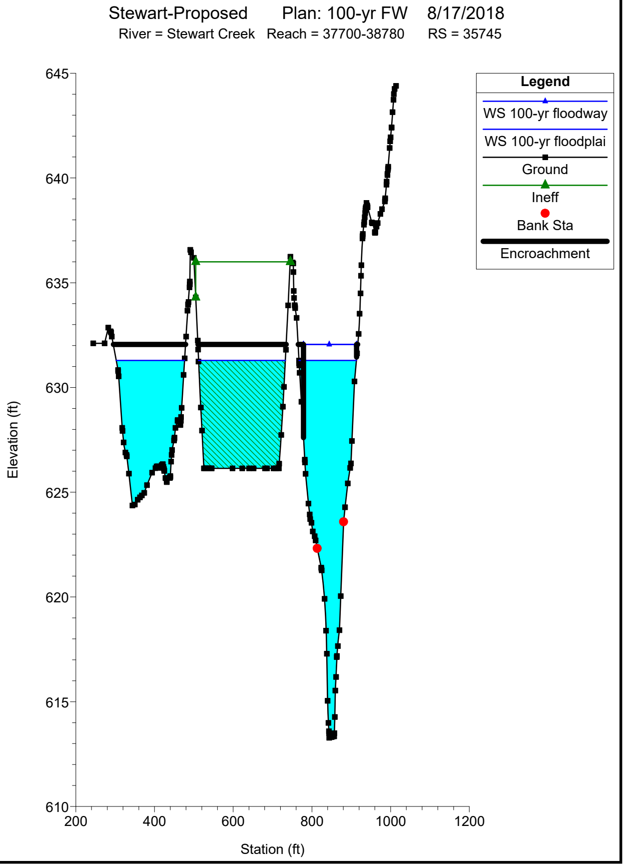

Stewart-Proposed Plan: 100-yr FW 8/17/2018
River = Stewart Creek Reach = 37700-38780 RS = 36711
Legend
WS 100-yr floodway
WS 100-yr floodplai
Ground
Levee
Bank Sta
Encroachment
Elevation (ft)
Station (ft)
650
645
640
635
630
625
0
100
200
300
400
500
600

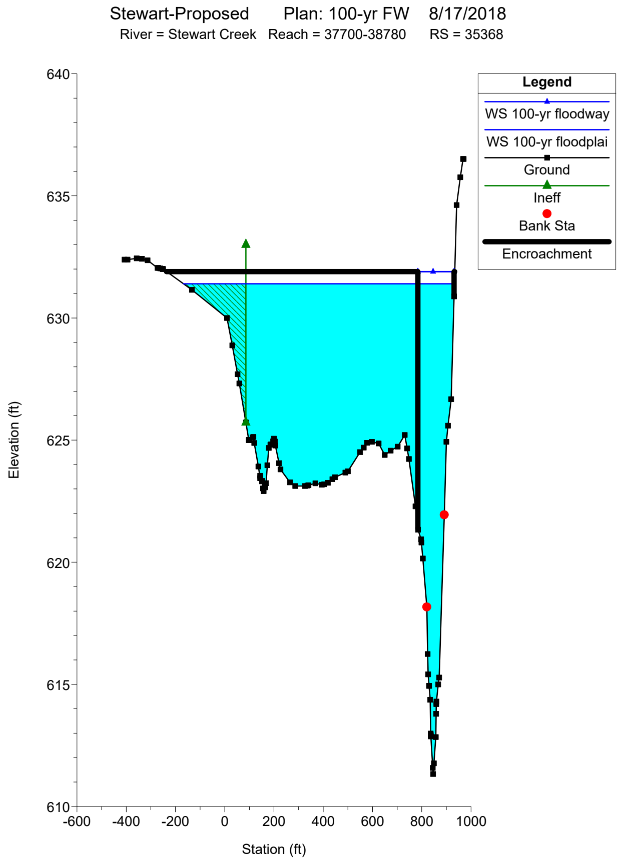

Stewart-Proposed Plan: 100-yr FW 8/17/2018
River = Stewart Creek Reach = 37700-38780 RS = 36518
Legend
WS 100-yr floodway
WS 100-yr floodplai
Ground
Levee
Bank Sta
Encroachment
Elevation (ft)
Station (ft)
642
640
638
636
634
632
630
628
626
624
-100
0
100
200
300
400
500

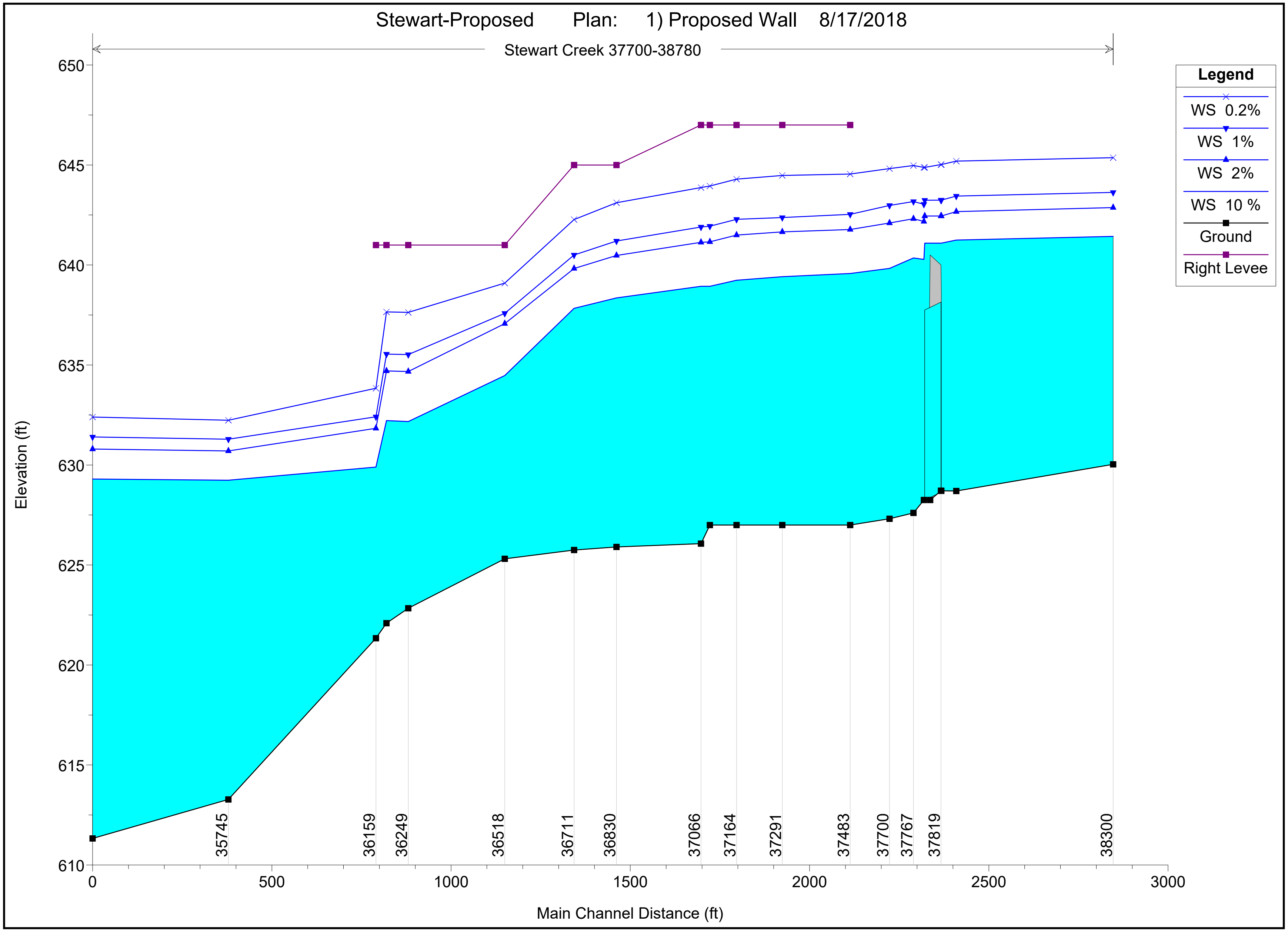

Stewart-Proposed Plan: 100-yr FW 8/17/2018
River = Stewart Creek Reach = 37700-38780 RS = 36249
Legend
WS 100-yr floodway
WS 100-yr floodplai
Ground
Levee
Bank Sta
Encroachment
Elevation (ft)
645
640
635
630
625
620
-200
-100
0
100
200
300
400
Station (ft)


Stewart-Proposed Plan: 100-yr FW 8/17/2018
River = Stewart Creek Reach = 37700-38780 RS = 36188
Legend
WS 100-yr floodplai
WS 100-yr floodway
Ground
Levee
Ineff
Bank Sta
Encroachment
Elevation (ft)
650
645
640
635
630
625
620
-200
0
200
400
600
800
1000
Station (ft)


Stewart-Proposed Plan: 100-yr FW 8/17/2018
River = Stewart Creek Reach = 37700-38780 RS = 36159
Legend
WS 100-yr floodplai
WS 100-yr floodway
Ground
Levee
Ineff
Bank Sta
Encroachment
Elevation (ft)
645
640
635
630
625
620
-600
-400
-200
0
200
400
600
Station (ft)


Stewart-Proposed Plan: 100-yr FW 8/17/2018
River = Stewart Creek Reach = 37700-38780 RS = 35745
Legend
WS 100-yr floodway
WS 100-yr floodplai
Ground
Ineff
Bank Sta
Encroachment
Elevation (ft)
645
640
635
630
625
620
615
610
200
400
600
800
1000
1200
Station (ft)


Stewart-Proposed Plan: 100-yr FW 8/17/2018
River = Stewart Creek Reach = 37700-38780 RS = 35368
Legend
WS 100-yr floodway
WS 100-yr floodplai
Ground
Ineff
Bank Sta
Encroachment
640
635
630
625
620
615
610
-600
-400
-200
0
200
400
600
800
1000
Elevation (ft)
Station (ft)


Stewart-Proposed Plan: 1) Proposed Wall 8/17/2018
Stewart Creek 37700-38780
Legend
WS 0.2%
WS 1%
WS 2%
WS 10 %
Ground
Right Levee
Elevation (ft)
650
645
640
635
630
625
620
615
610
Main Channel Distance (ft)
0
500
1000
1500
2000
2500
3000
35745
36159
36249
36518
36711
36830
37066
37164
37291
37483
37700
37767
37819
38300

HEC-RAS Plan: Proposed Wall River: Stewart Creek Reach: 37700-38780

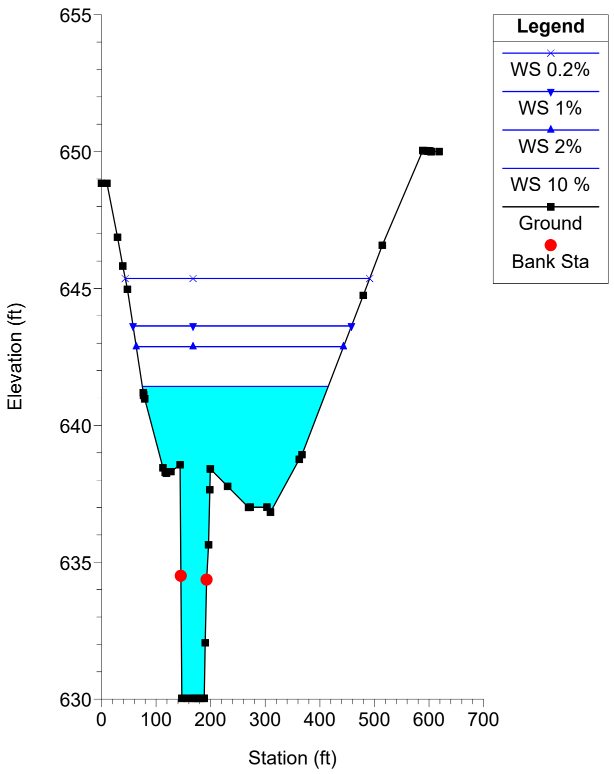
Reach	River Sta	Profile	Q Total	Min Ch El	W.S. Elev	Crit W.S.	E.G. Elev	E.G. Slope	Vel Chnl	Flow Area	Top Width	Froude # Chl	Levee El Right	R. Levee Frbrd
			(cfs)	(ft)	(ft)	(ft)	(ft)	(ft/ft)	(ft/s)	(sq ft)	(ft)		(ft)	(ft)
37700-38780	38300	10 %	2700.00	630.03	641.43	634.99	641.54	0.000567	3.30	1426.77	340.74	0.17		
37700-38780	38300	2%	4000.00	630.03	642.87	636.42	643.00	0.000607	3.70	1946.49	379.65	0.18		
37700-38780	38300	1%	4500.00	630.03	643.63	637.73	643.75	0.000547	3.66	2241.35	400.05	0.18		
37700-38780	38300	0.2%	6000.00	630.03	645.37	639.43	645.48	0.000484	3.73	2976.80	447.71	0.17		
37700-38780	37860	10 %	2700.00	628.70	641.25		641.32	0.000411	2.73	1641.47	344.69	0.15		
37700-38780	37860	2%	4000.00	628.70	642.67		642.76	0.000463	3.16	2162.12	388.42	0.16		
37700-38780	37860	1%	4500.00	628.70	643.44		643.53	0.000419	3.14	2471.23	409.13	0.16		
37700-38780	37860	0.2%	6000.00	628.70	645.20		645.29	0.000379	3.26	3231.27	458.14	0.15		
37700-38780	37820	10 %	2700.00	628.71	641.09	633.15	641.28	0.000390	3.58	1091.70	312.12	0.18		
37700-38780	37820	2%	4000.00	628.71	642.45	634.42	642.70	0.000496	4.34	1568.26	395.96	0.21		
37700-38780	37820	1%	4500.00	628.71	643.24	634.85	643.47	0.000458	4.33	1899.81	444.65	0.20		
37700-38780	37820	0.2%	6000.00	628.71	645.02	636.08	645.23	0.000410	4.44	2795.37	562.37	0.20		
37700-38780	37819		Culvert											
37700-38780	37800	10 %	2700.00	628.25	640.28		640.59	0.000892	4.53	644.85	103.27	0.25		
37700-38780	37800	2%	4000.00	628.25	642.18		642.60	0.001010	5.40	993.29	320.67	0.27		
37700-38780	37800	1%	4500.00	628.25	643.04		643.43	0.000903	5.34	1310.40	411.79	0.26		
37700-38780	37800	0.2%	6000.00	628.25	644.88		645.21	0.000736	5.27	2211.44	563.25	0.24		
37700-38780	37767	10 %	2700.00	627.60	640.35		640.48	0.000413	3.67	1575.85	380.63	0.19		
37700-38780	37767	2%	4000.00	627.60	642.31		642.43	0.000343	3.71	2374.70	420.80	0.18		
37700-38780	37767	1%	4500.00	627.60	643.17		643.27	0.000299	3.61	2739.17	443.19	0.17		
37700-38780	37767	0.2%	6000.00	627.60	644.97		645.09	0.000317	4.01	3683.72	624.53	0.18		
37700-38780	37700	10 %	4000.00	627.31	639.83	637.52	640.32	0.001868	7.33	1105.35	384.59	0.39		
37700-38780	37700	2%	6000.00	627.31	642.10	638.99	642.35	0.001003	6.10	2363.18	457.41	0.30		
37700-38780	37700	1%	6800.00	627.31	642.98	639.37	643.20	0.000873	5.94	2787.92	506.17	0.28		
37700-38780	37700	0.2%	9100.00	627.31	644.82	640.08	645.02	0.000774	6.08	3825.93	618.34	0.27		
37700-38780	37483	10 %	4000.00	627.00	639.58	636.73	640.10	0.002009	7.39	1093.69	262.29	0.40	647.00	7.42
37700-38780	37483	2%	6000.00	627.00	641.77	637.56	642.20	0.001508	7.27	1781.39	394.78	0.36	647.00	5.23
37700-38780	37483	1%	6800.00	627.00	642.53	639.19	643.04	0.001689	8.00	2146.76	521.29	0.38	647.00	4.47
37700-38780	37483	0.2%	9100.00	627.00	644.55	640.07	644.91	0.001189	7.36	3383.24	726.02	0.33	647.00	2.45
37700-38780	37291	10 %	4000.00	627.00	639.42	636.54	639.74	0.001285	6.12	1391.27	318.80	0.32	647.00	7.58
37700-38780	37291	2%	6000.00	627.00	641.65	637.89	641.92	0.000981	6.04	2195.02	409.65	0.29	647.00	5.35
37700-38780	37291	1%	6800.00	627.00	642.37	638.15	642.73	0.001203	6.93	2570.79	620.33	0.33	647.00	4.63
37700-38780	37291	0.2%	9100.00	627.00	644.48	639.05	644.69	0.000739	5.96	3898.23	643.42	0.26	647.00	2.52
37700-38780	37164	10 %	4000.00	627.00	639.24	636.81	639.57	0.001363	6.50	1355.98	276.22	0.34	647.00	7.76
37700-38780	37164	2%	6000.00	627.00	641.50	637.78	641.79	0.001080	6.52	2007.12	298.67	0.31	647.00	5.50
37700-38780	37164	1%	6800.00	627.00	642.28	638.11	642.57	0.001019	6.57	2243.61	304.45	0.30	647.00	4.72
37700-38780	37164	0.2%	9100.00	627.00	644.29	638.94	644.58	0.000905	6.75	2868.04	315.39	0.29	647.00	2.71
37700-38780	37091	10 %	4000.00	627.00	638.93	636.32	639.44	0.001765	7.20	1051.12	203.68	0.39	647.00	8.07
37700-38780	37091	2%	6000.00	627.00	641.16	637.57	641.67	0.001557	7.66	1532.53	228.54	0.37	647.00	5.84
37700-38780	37091	1%	6800.00	627.00	641.94	637.98	642.45	0.001496	7.81	1713.34	235.07	0.37	647.00	5.06
37700-38780	37091	0.2%	9100.00	627.00	643.95	639.06	644.47	0.001363	8.16	2197.39	245.60	0.36	647.00	3.05
37700-38780	37066	10 %	4000.00	626.07	638.94	634.72	639.38	0.001313	5.98	1021.64	192.37	0.33	647.00	8.06

HEC-RAS Plan: Proposed Wall   River: Stewart Creek   Reach: 37700-38780 (Continued)

Reach	River Sta	Profile	Q Total	Min Ch El	W.S. Elev	Crit W.S.	E.G. Elev	E.G. Slope	Vel Chnl	Flow Area	Top Width	Froude # Chl	Levee El Right	R. Levee Frbrd
			(cfs)	(ft)	(ft)	(ft)	(ft)	(ft/ft)	(ft/s)	(sq ft)	(ft)		(ft)	(ft)
37700-38780	37066	2%	6000.00	626.07	641.13	636.73	641.63	0.001238	6.61	1470.92	215.98	0.33	647.00	5.87
37700-38780	37066	1%	6800.00	626.07	641.90	637.25	642.42	0.001214	6.82	1639.52	222.87	0.33	647.00	5.10
37700-38780	37066	0.2%	9100.00	626.07	643.87	638.46	644.43	0.001163	7.33	2095.66	238.29	0.33	647.00	3.13
37700-38780	36830	10 %	4000.00	625.90	638.35	635.37	638.98	0.002102	7.60	869.47	143.67	0.40	645.00	6.65
37700-38780	36830	2%	6000.00	625.90	640.48	636.70	641.23	0.002155	8.65	1191.76	160.24	0.42	645.00	4.52
37700-38780	36830	1%	6800.00	625.90	641.20	637.18	642.01	0.002209	9.07	1310.81	169.82	0.43	645.00	3.80
37700-38780	36830	0.2%	9100.00	625.90	643.11	638.51	644.03	0.002218	9.91	1653.38	187.03	0.44	645.00	1.89
37700-38780	36711	10 %	4000.00	625.75	637.83	635.10	638.68	0.002472	7.95	675.76	116.88	0.45	645.00	7.17
37700-38780	36711	2%	6000.00	625.75	639.82	636.78	640.91	0.002590	9.24	918.20	128.96	0.48	645.00	5.18
37700-38780	36711	1%	6800.00	625.75	640.50	637.31	641.68	0.002655	9.71	1007.37	135.12	0.49	645.00	4.50
37700-38780	36711	0.2%	9100.00	625.75	642.27	638.69	643.68	0.002750	10.82	1260.41	150.40	0.51	645.00	2.73
37700-38780	36518	10 %	4000.00	625.31	634.47	634.47	637.56	0.011611	15.40	357.11	75.93	0.93	641.00	6.53
37700-38780	36518	2%	6000.00	625.31	637.07	637.07	639.91	0.008353	15.61	634.66	123.19	0.83	641.00	3.93
37700-38780	36518	1%	6800.00	625.31	637.58	637.58	640.64	0.008677	16.40	699.54	127.80	0.85	641.00	3.42
37700-38780	36518	0.2%	9100.00	625.31	639.09	639.09	642.59	0.008975	18.09	910.84	155.91	0.88	641.00	1.91
37700-38780	36249	10 %	4000.00	622.84	632.17	631.89	633.35	0.005773	9.89	688.65	235.48	0.64	641.00	8.83
37700-38780	36249	2%	6000.00	622.84	634.67	632.94	635.36	0.003014	8.40	1336.00	295.57	0.47	641.00	6.33
37700-38780	36249	1%	6800.00	622.84	635.52	633.26	636.09	0.002464	7.94	1586.42	295.58	0.43	641.00	5.48
37700-38780	36249	0.2%	9100.00	622.84	637.63	633.88	638.08	0.001747	7.33	2209.80	295.63	0.36	641.00	3.37
37700-38780	36188	10 %	4000.00	622.09	632.22	630.97	632.94	0.003475	7.65	835.04	281.08	0.50	641.00	8.78
37700-38780	36188	2%	6000.00	622.09	634.71	632.17	635.14	0.001845	6.60	1673.73	401.73	0.37	641.00	6.29
37700-38780	36188	1%	6800.00	622.09	635.55	632.51	635.91	0.001515	6.27	1983.80	459.00	0.34	641.00	5.45
37700-38780	36188	0.2%	9100.00	622.09	637.66	633.76	637.95	0.001071	5.82	2762.27	591.40	0.29	641.00	3.34
37700-38780	36159	10 %	4000.00	621.34	629.90	629.90	632.57	0.011488	13.24	329.72	203.71	0.93	641.00	11.10
37700-38780	36159	2%	6000.00	621.34	631.84	631.84	634.78	0.009397	14.30	515.62	336.64	0.88	641.00	9.16
37700-38780	36159	1%	6800.00	621.34	632.41	632.41	635.55	0.009288	14.87	573.80	375.01	0.88	641.00	8.59
37700-38780	36159	0.2%	9100.00	621.34	633.84	633.84	637.53	0.009299	16.43	724.06	467.61	0.90	641.00	7.16
37700-38780	35745	10 %	4000.00	613.28	629.24	622.72	629.46	0.000551	4.19	1503.99	498.05	0.22		
37700-38780	35745	2%	6000.00	613.28	630.70	624.42	631.01	0.000695	5.11	1939.26	525.41	0.25		
37700-38780	35745	1%	6800.00	613.28	631.29	625.22	631.62	0.000725	5.38	2123.00	540.20	0.26		
37700-38780	35745	0.2%	9100.00	613.28	632.24	627.04	632.69	0.000946	6.43	2438.66	594.56	0.30		
37700-38780	35368	10 %	4000.00	611.33	629.30	619.63	629.32	0.000112	1.62	5176.22	904.12	0.08		
37700-38780	35368	2%	6000.00	611.33	630.80	621.45	630.82	0.000134	1.89	6440.23	1020.54	0.08		
37700-38780	35368	1%	6800.00	611.33	631.40	622.02	631.43	0.000137	1.97	6947.59	1099.98	0.09		
37700-38780	35368	0.2%	9100.00	611.33	632.40	624.51	632.44	0.000174	2.31	7795.48	1283.74	0.10		

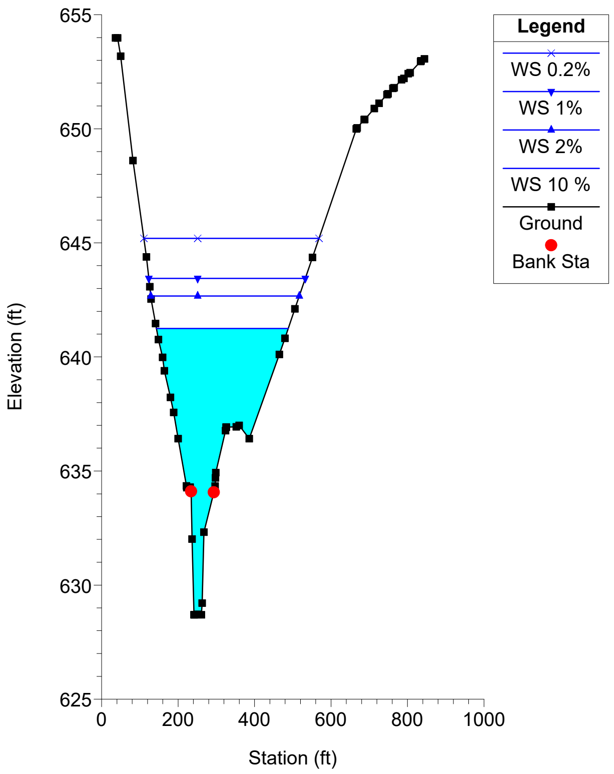
Stewart-Proposed Plan: 1) Proposed Wall 8/17/2018

River = Stewart Creek Reach = 37700-38780 RS = 38300



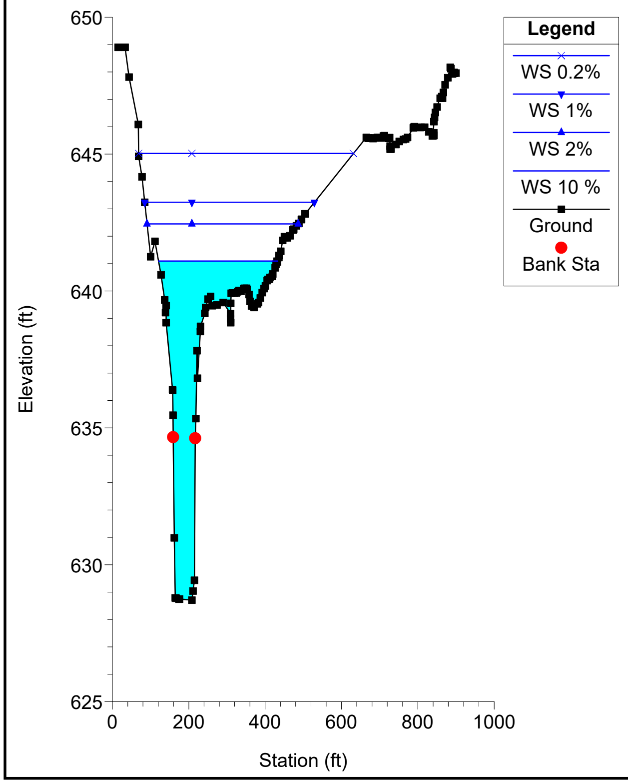
Stewart-Proposed Plan: 1) Proposed Wall 8/17/2018

River = Stewart Creek Reach = 37700-38780 RS = 37860



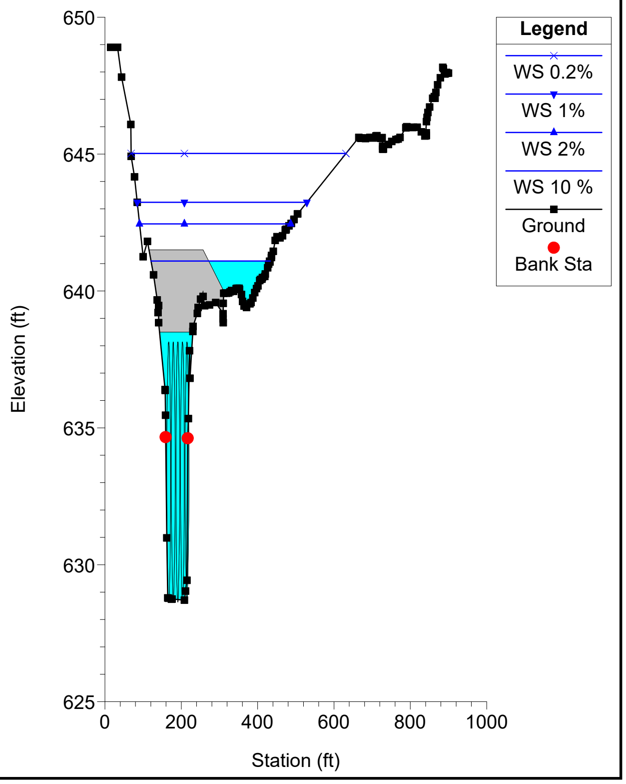
Stewart-Proposed Plan: 1) Proposed Wall 8/17/2018

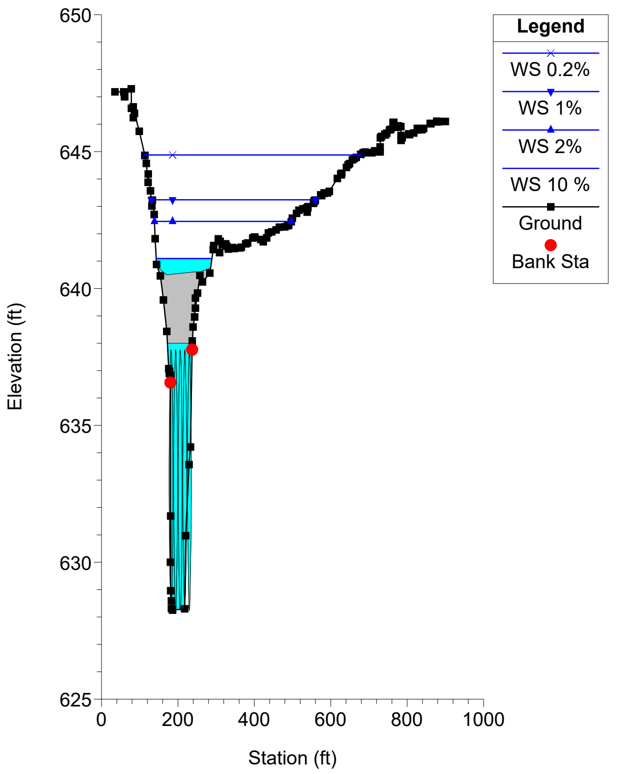
River = Stewart Creek Reach = 37700-38780 RS = 37820



Stewart-Proposed Plan: 1) Proposed Wall 8/17/2018

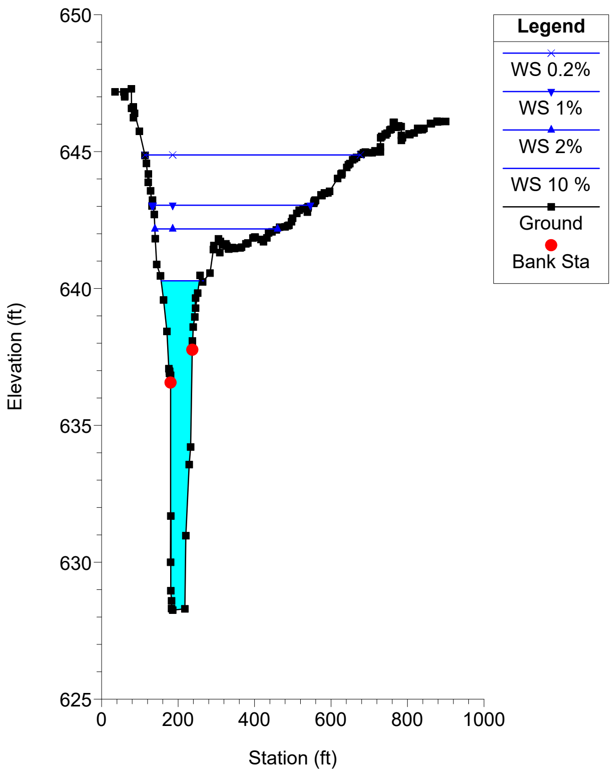
River = Stewart Creek Reach = 37700-38780 RS = 37819 Culv





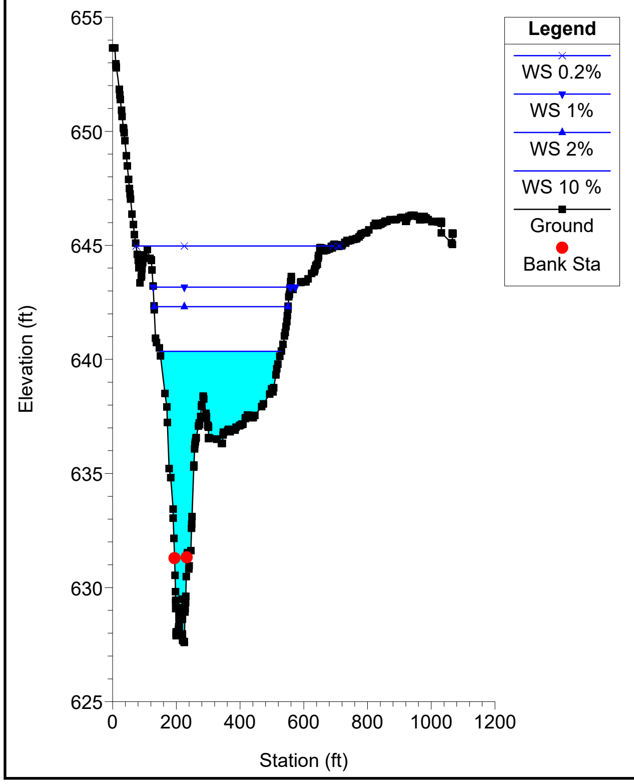
Stewart-Proposed Plan: 1) Proposed Wall 8/17/2018

River = Stewart Creek Reach = 37700-38780 RS = 37819 Culv



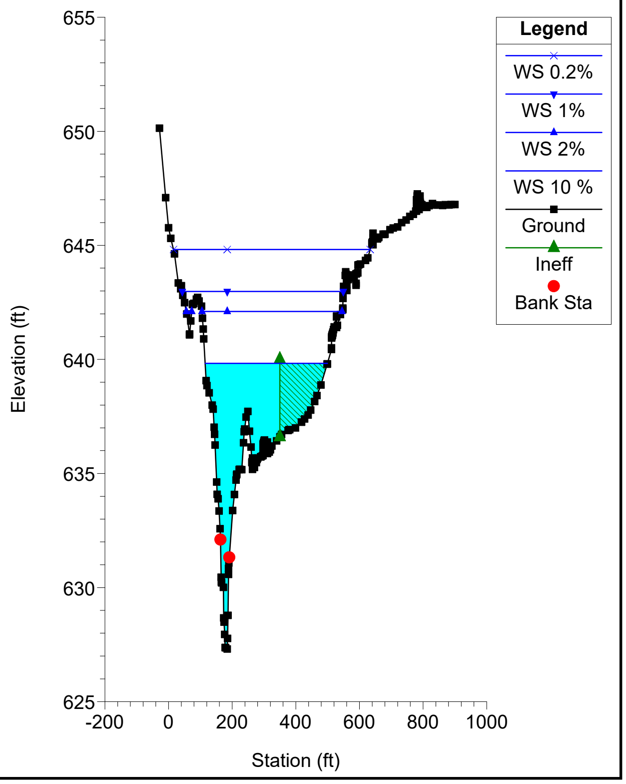
Stewart-Proposed Plan: 1) Proposed Wall 8/17/2018

River = Stewart Creek Reach = 37700-38780 RS = 37800



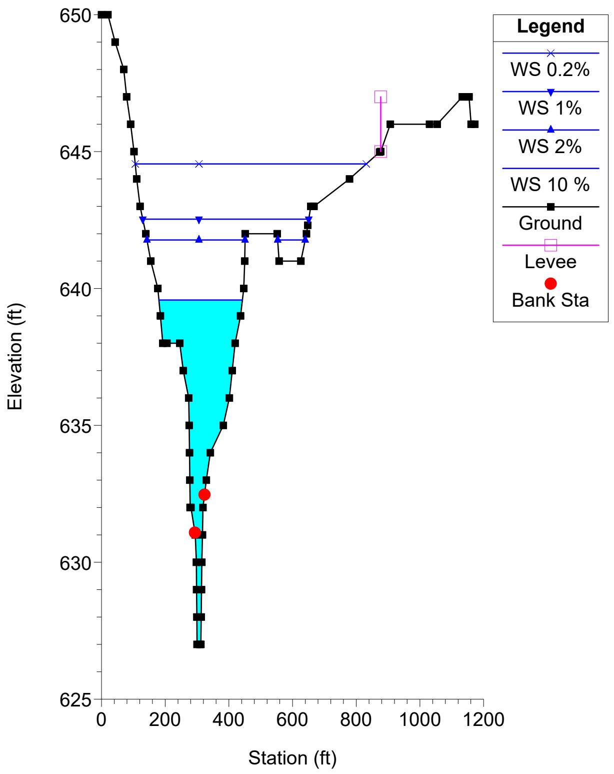
Stewart-Proposed Plan: 1) Proposed Wall 8/17/2018

River = Stewart Creek Reach = 37700-38780 RS = 37767

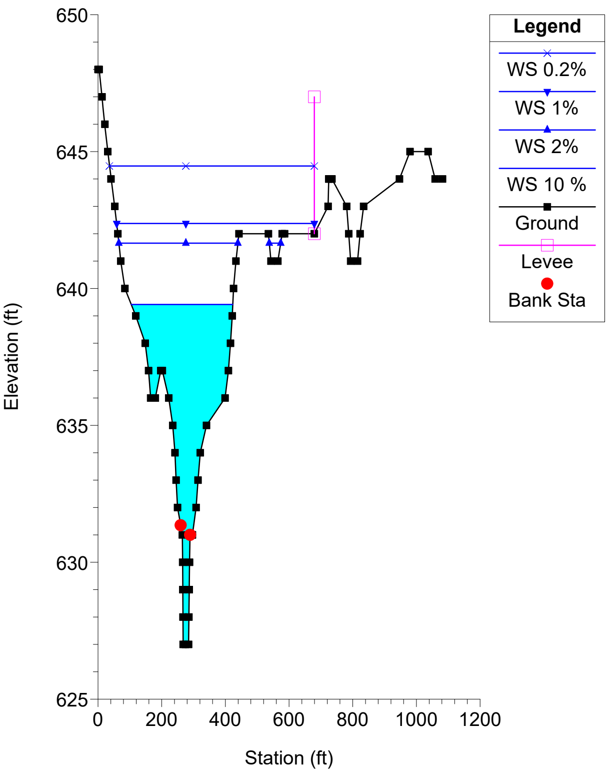


Stewart-Proposed Plan: 1) Proposed Wall 8/17/2018

River = Stewart Creek Reach = 37700-38780 RS = 37700



Stewart-Proposed Plan: 1) Proposed Wall 8/17/2018
River = Stewart Creek Reach = 37700-38780 RS = 37483



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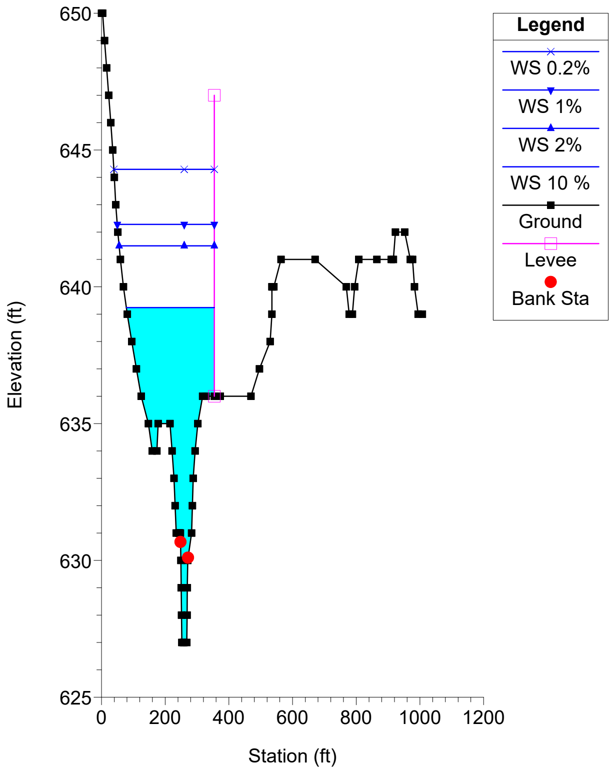
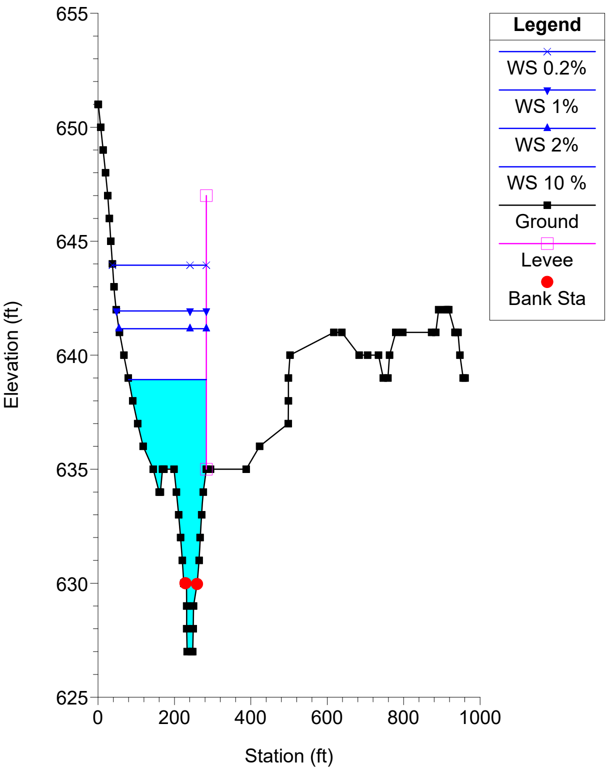
River = Stewart Creek Reach = 37700-38780 RS = 37291



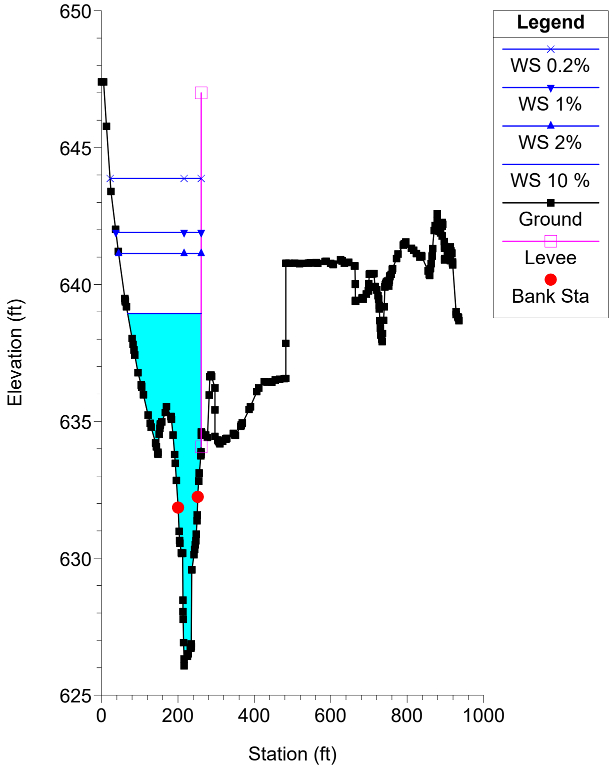
Stewart-Proposed Plan: 1) Proposed Wall 8/17/2018
River = Stewart Creek Reach = 37700-38780 RS = 37164



Stewart-Proposed Plan: 1) Proposed Wall 8/17/2018
River = Stewart Creek Reach = 37700-38780 RS = 37091

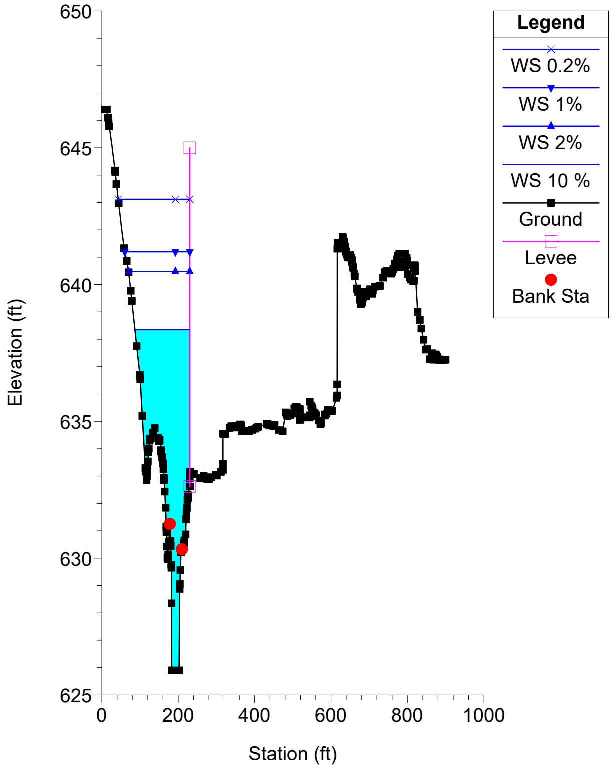
Stewart-Proposed Plan: 1) Proposed Wall 8/17/2018

River = Stewart Creek Reach = 37700-38780 RS = 37066



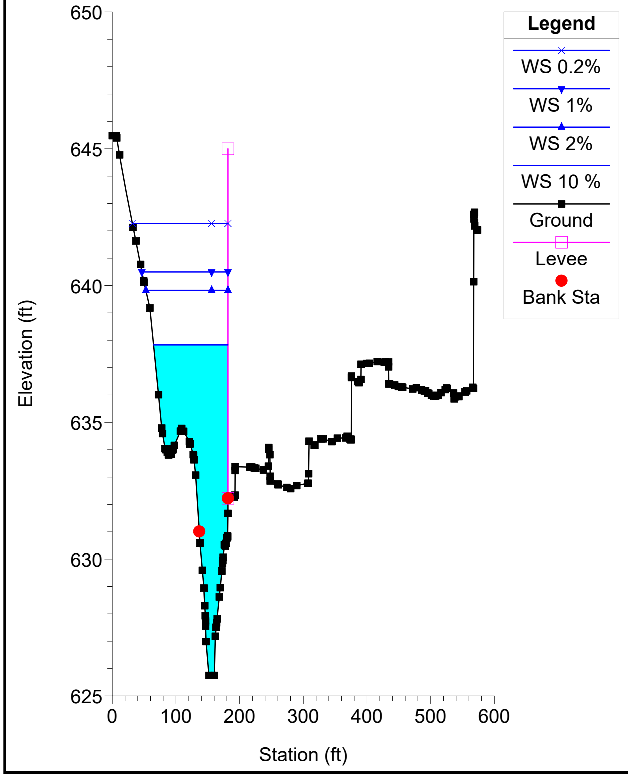
Stewart-Proposed Plan: 1) Proposed Wall 8/17/2018

River = Stewart Creek Reach = 37700-38780 RS = 36830



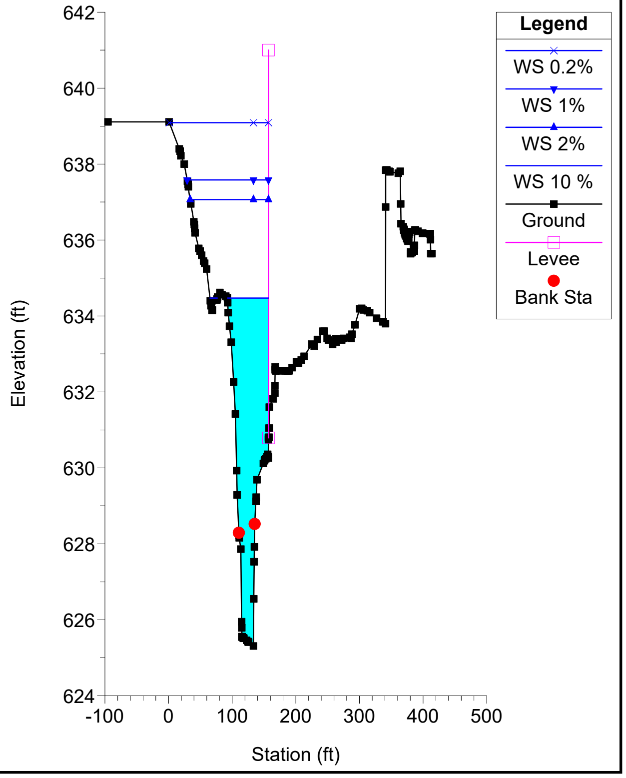
Stewart-Proposed Plan: 1) Proposed Wall 8/17/2018

River = Stewart Creek Reach = 37700-38780 RS = 36711

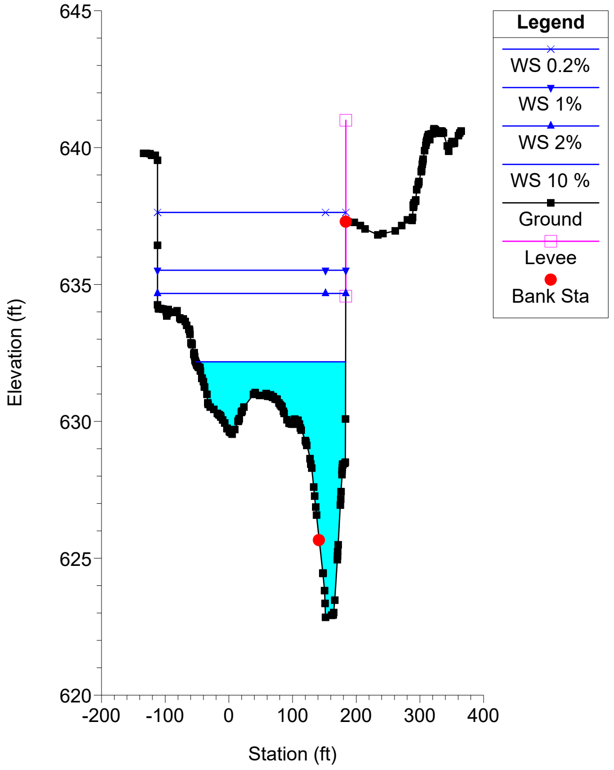


Stewart-Proposed Plan: 1) Proposed Wall 8/17/2018

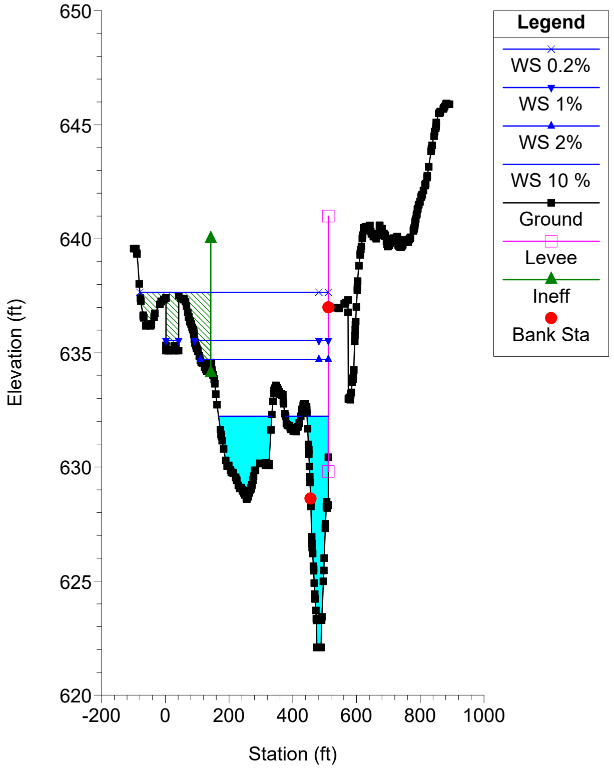
River = Stewart Creek Reach = 37700-38780 RS = 36518



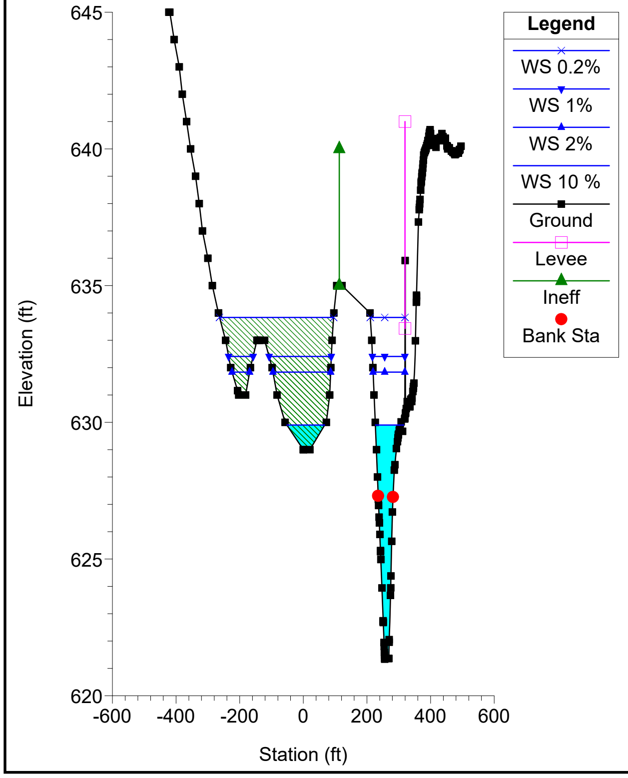
Stewart-Proposed Plan: 1) Proposed Wall 8/17/2018
River = Stewart Creek Reach = 37700-38780 RS = 36249



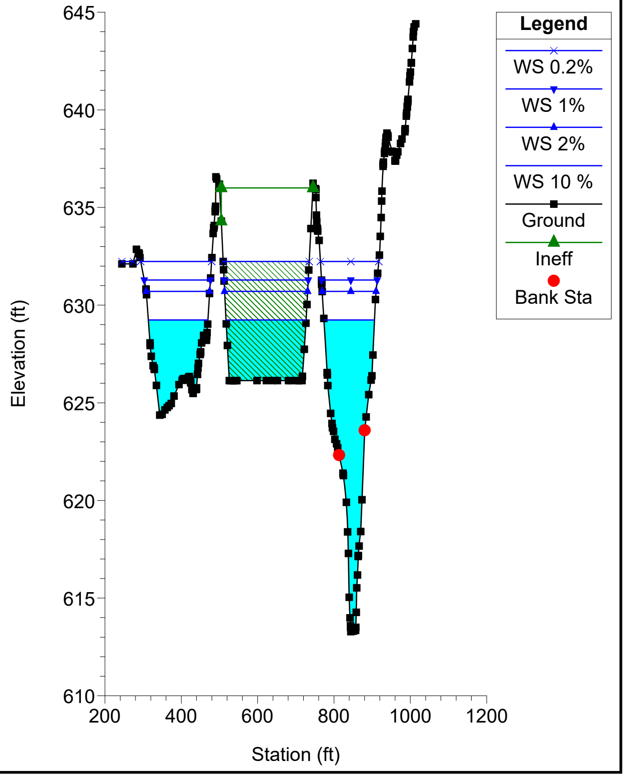
Stewart-Proposed Plan: 1) Proposed Wall 8/17/2018
River = Stewart Creek Reach = 37700-38780 RS = 36188



Stewart-Proposed Plan: 1) Proposed Wall 8/17/2018
River = Stewart Creek Reach = 37700-38780 RS = 36159

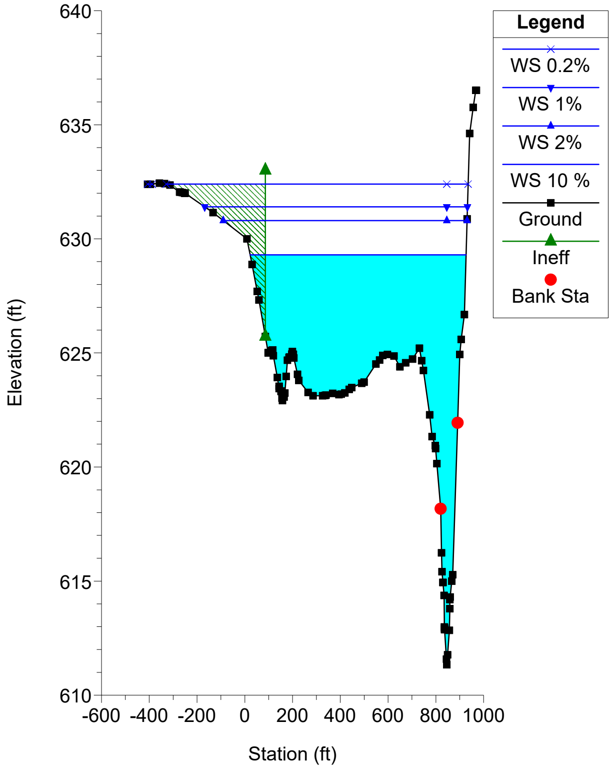


Stewart-Proposed Plan: 1) Proposed Wall 8/17/2018
River = Stewart Creek Reach = 37700-38780 RS = 35745



Stewart-Proposed Plan: 1) Proposed Wall 8/17/2018

River = Stewart Creek Reach = 37700-38780 RS = 35368



APPENDIX F

HEC-RAS Work Maps and Annotated FIRM Panel

EXIDE TECHNOLOGIES
FRISCO RECYCLING CENTER
CONDITIONAL LETTER OF MAP REVISION
STEWART CREEK
465 FEET UPSTREAM OF BNSF RAILROAD
TO 500 FEET EAST OF EAGAN WAY
AUGUST 2018

SITE MAP
SCALE 1" = 250'

NOTE(S)

1. ALL ELEVATIONS AND FLOOD LINES ARE ON NORTH AMERICAN VERTICAL DATUM OF 1988 (NAVD 88)

2. HORIZONTAL COORDINATE SYSTEM FOR THE PROJECT IS TEXAS STATE PLANE, NORTH CENTRAL ZONE, NORTH AMERICAN DATUM OF 1983 (NAD83)

REFERENCE(S)

1. THE EXISTING GROUND SURFACE WAS DEVELOPED BY GOLDER ASSOCIATES FROM THE FOLLOWING FILES:

- Frisco Plant Site_topo.dwg - MARCH 31, 2017 AERIAL SURVEY PROVIDED BY DALLAS AERIAL SURVEY (DAS).

- EXIDE-TOPO-2018.dwg - TOPOGRAPHIC SURFACE PROVIDED BY BRITTAIN & CRAWFORD, LLC, RECEIVED BY GOLDER ON MARCH 27, 2018.

- ExideTopo_USGS10ft_NAD83SP_v2.dwg - 10 ft TOPOGRAPHIC CONTOURS INTERPOLATED BY GOLDER FROM 2003 USGS NATIONAL ELEVATION DATASET 10 m DEM.

REV.	YYYY-MM-DD	DESCRIPTION	DESIGNED	PREPARED	REVIEWED	APPROVED
0	2018-08-28	ISSUED FOR CITY OF FRISCO REVIEW	SPS	JLS	SR	JBF

SEAL
8/28/18
JEFFREY B. FASSETT
85675

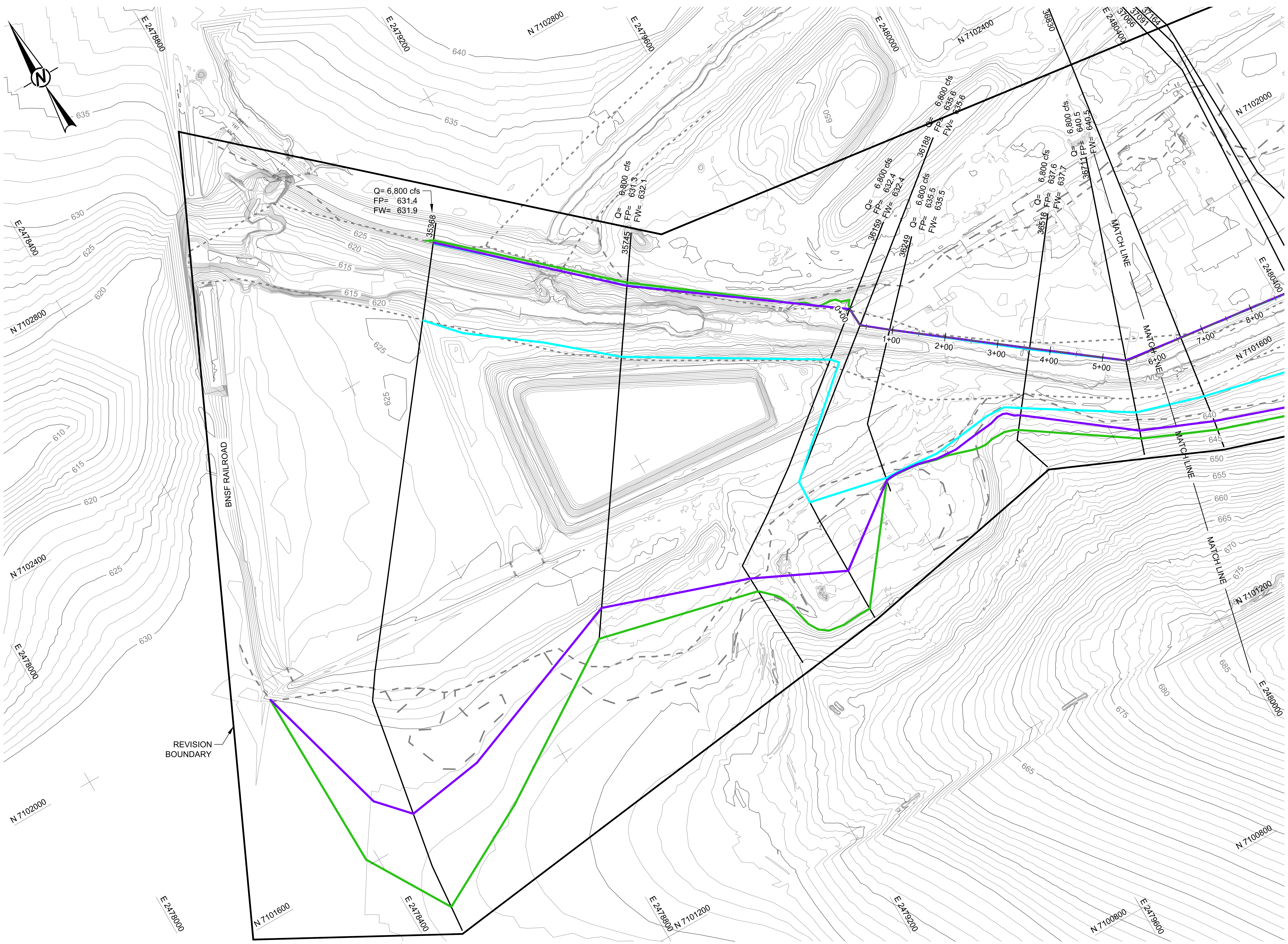
CLIENT
EXIDE TECHNOLOGIES
PO BOX 520, 7471 FIFTH STREET
FRISCO, TEXAS 75034

CONSULTANT
GOLDER
TUCSON OFFICE
4730 N. ORACLE ROAD, SUITE 210
TUCSON, ARIZONA
UNITED STATES OF AMERICA
[+1] (520) 888 8818
www.golder.com

PROJECT
FRISCO RECYCLING CENTER
CONDITIONAL LETTER OF MAP REVISION
STEWART CREEK

TITLE
HEC-RAS WORK MAP GENERAL ARRANGEMENT

PROJECT NO.	CONTROL	REV.		DRAWING
1302086-06	0006	0	1 of 4	G-001



LEGEND

3600	EXISTING GROUND CONTOUR (ft -MSL)
	EXISTING ROADS
X	EXISTING FENCELINE
2423.15	HEC-RAS CROSS SECTIONS
	HEC-RAS RIVER CENTERLINE
	EXISTING 100-YEAR FLOODWAY
	EXISTING 100-YEAR ZONE AE FLOODPLAIN
	EXISTING 500-YEAR ZONE X FLOODPLAIN
	PROPOSED 100-YEAR FLOODWAY
	PROPOSED 100-YEAR ZONE AE FLOODPLAIN
	PROPOSED 500-YEAR ZONE X FLOODPLAIN
	PROPOSED FLOODWALL EXTENSION
	EXISTING FLOODWALL
1+00	FLOODWALL ALIGNMENT AND STATION

NOTE(S)

1. ALL ELEVATIONS AND FLOOD LINES ARE ON TEXAS STATE PLANE, NORTH CENTRAL, NAD 83, NAVD 88.

0 100 200
1" = 100' FEET

REV.	YYYY-MM-DD	DESCRIPTION	DESIGNED	PREPARED	REVIEWED	APPROVED
0	2018-08-28	ISSUED FOR CITY OF FRISCO REVIEW	SPS	JLS	SR	JBF

SEAL

8/28/18

JEFFREY B. FASSETT
85675

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TUCSON, ARIZONA
UNITED STATES OF AMERICA
[+1] (520) 888 8818
www.golder.com

PROJECT
FRISCO RECYCLING CENTER
CONDITIONAL LETTER OF MAP REVISION
STEWART CREEK

TITLE
HEC-RAS WORK MAP (1 OF 2)

PROJECT NO.	CONTROL	REV.		DRAWING
1302086-06	0006	0	2 of 4	X-001

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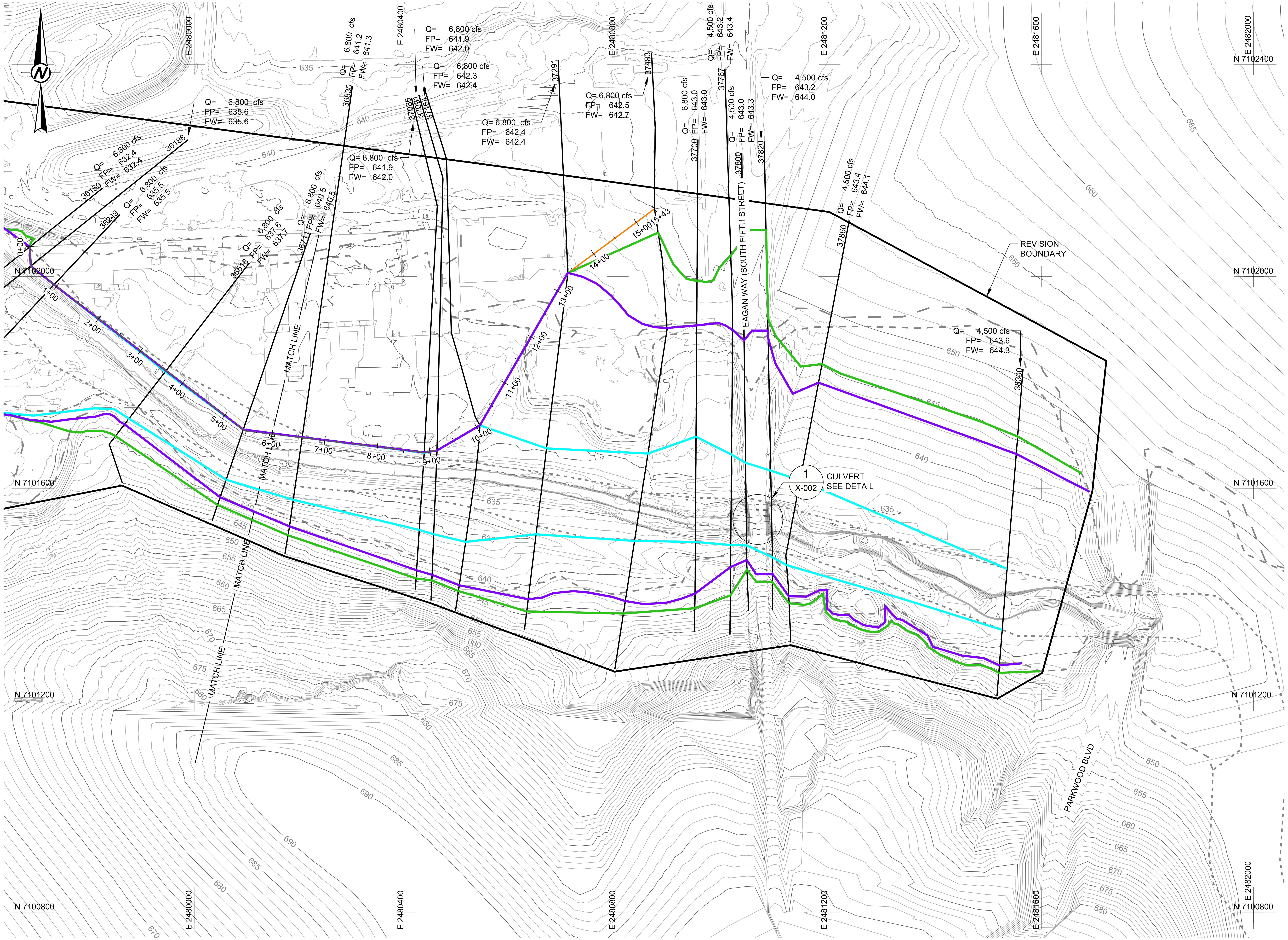


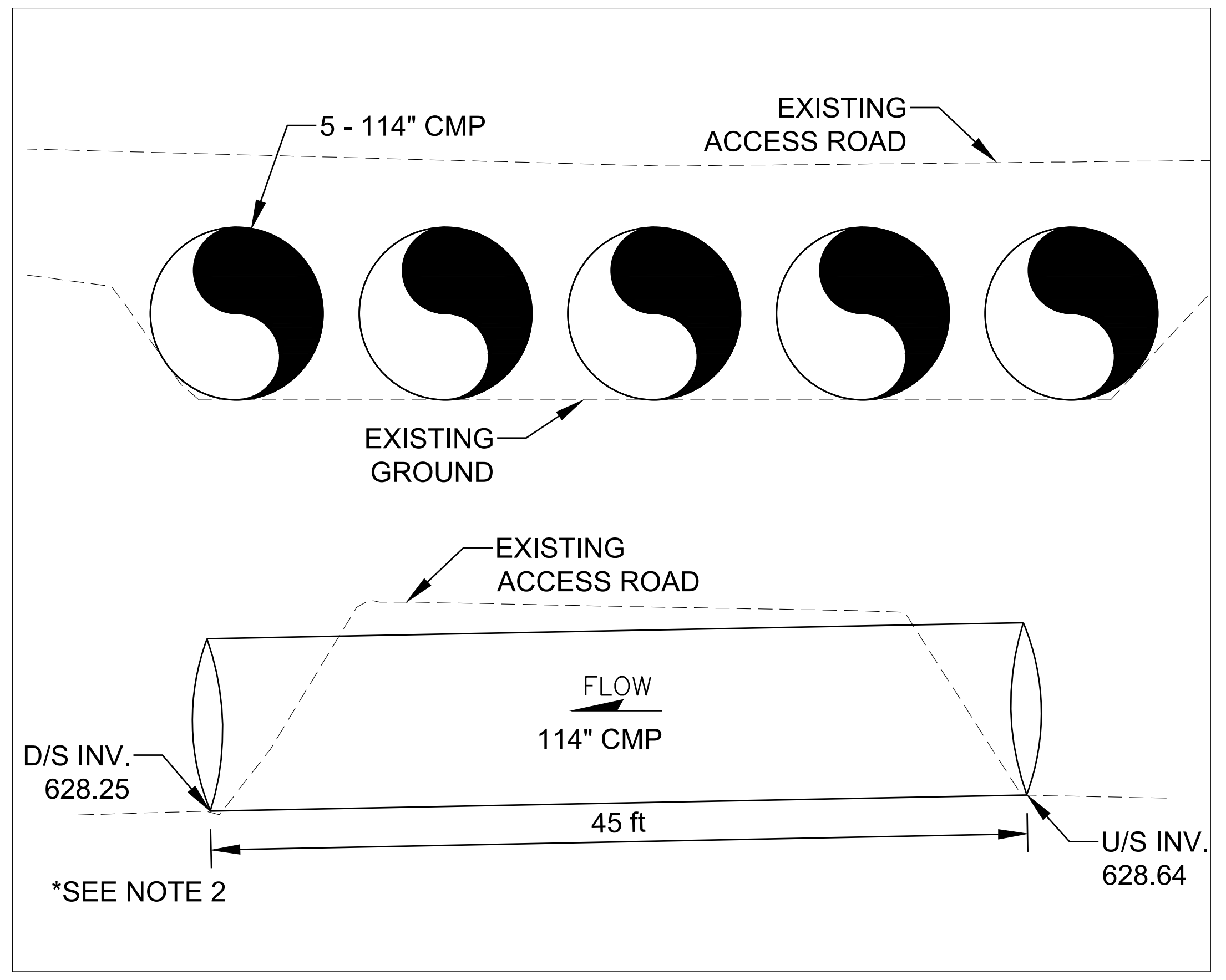
0 100 200
1" = 100' FEET

LEGEND

- 3600 — EXISTING GROUND CONTOUR (ft -MSL)
- EXISTING ROADS
- —X— EXISTING FENCELINE
- 2423.15 — HEC-RAS CROSS SECTIONS
- HEC-RAS RIVER CENTERLINE
- EXISTING 100-YEAR FLOODWAY
- EXISTING 100-YEAR ZONE AE FLOODPLAIN
- EXISTING 500-YEAR ZONE X FLOODPLAIN
- PROPOSED 100-YEAR FLOODWAY
- PROPOSED 100-YEAR ZONE AE FLOODPLAIN
- PROPOSED 500-YEAR ZONE X FLOODPLAIN
- PROPOSED FLOODWALL EXTENSION
- EXISTING FLOODWALL
- 1+00 FLOODWALL ALIGNMENT AND STATION

NOTE(S)

1. ALL ELEVATIONS AND FLOOD LINES ARE ON NORTH AMERICAN VERTICAL DATUM OF 1988, NAVD 88.
2. CULVERT PROFILE INFORMATION DEVELOPED FROM AS-BUILT SURVEY DATA PROVIDED BY BRITTAIN & CRAWFORD, LLC (EXIDE-TOPO-2018.DWG). SEE REFERENCES ON DRAWING G-001.



NOT TO SCALE 1 X-002 EXISTING 5-BARREL 114 in CULVERT DETAIL

REV.	YYYY-MM-DD	DESCRIPTION	DESIGNED	PREPARED	REVIEWED	APPROVED
0	2018-08-28	ISSUED FOR CITY OF FRISCO REVIEW	SPS	JLS	SR	JBF

SEAL

8/28/18
JEFFREY B. FASSETT
85875

CLIENT
EXIDE TECHNOLOGIES
PO BOX 520, 7471 FIFTH STREET
FRISCO, TEXAS 75034

CONSULTANT
GOLDER

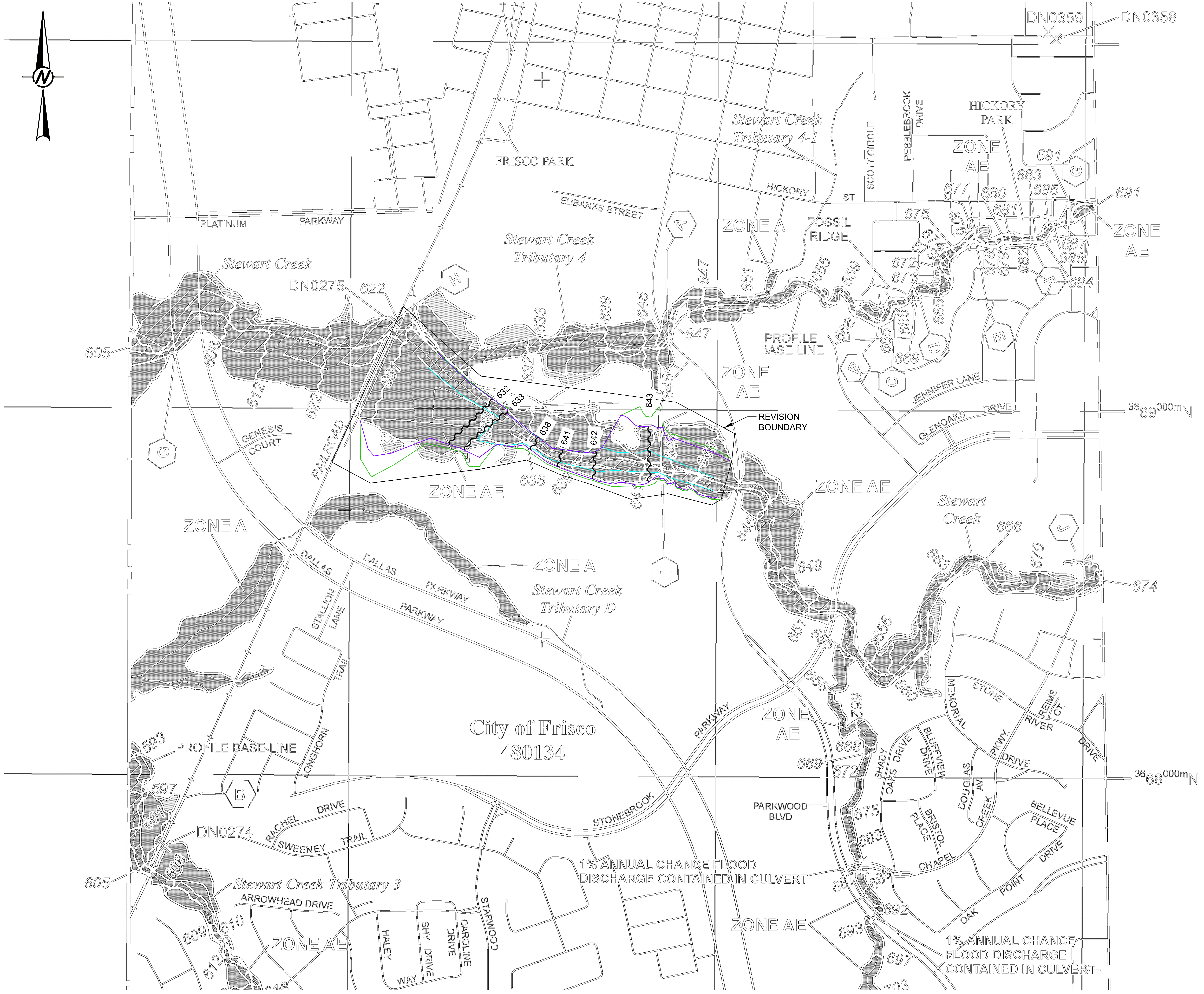
TUCSON OFFICE
4730 N. ORACLE ROAD, SUITE 210
TUCSON, ARIZONA
UNITED STATES OF AMERICA
[+1] (520) 888 8818
www.golder.com

PROJECT
FRISCO RECYCLING CENTER
CONDITIONAL LETTER OF MAP REVISION
STEWART CREEK

TITLE
HEC-RAS WORK MAP (2 OF 2)

PROJECT NO.	CONTROL	REV.		DRAWING
1302086-06	0006	0	3 of 4	X-002

Path: \\tucson\cadd\EXIDE\Frisco\99_PROJECTS\130208606_2018RCRA\0006_CLOMR\02_PRODUCTION\DWG\ | File Name: 130208606_0006_X_002.dwg | Last Edited By: jlsanchez Date: 2018-08-28 Time:3:37:56 PM | Printed By: JLSanchez Date: 2018-08-28 Time:3:40:55 PM



LEGEND

〰 546	100-YEAR BASE FLOOD ELEVATIONS (NAVD 1988)
— · · —	HEC-RAS RIVER CENTERLINE
—	PROPOSED 100-YEAR FLOODWAY
—	PROPOSED 100-YEAR ZONE AE FLOODPLAIN
—	PROPOSED 500-YEAR ZONE X FLOODPLAIN

REFERENCE(S)

1. THE BASE MAP SHOWN REPRESENTS THE FOLLOWING FEMA FLOOD INSURANCE RATE MAPS (FIRM) FROM THE NATIONAL FLOOD INSURANCE PROGRAM (NFIP) FOR COLLIN COUNTY, TEXAS AND INCORPORATED AREAS:
   - MAP No. 48085C0240K - PANEL 0240K, EFFECTIVE DATE JUNE 7, 2017.

0 500 1000
1" = 500' FEET

REV.	YYYY-MM-DD	DESCRIPTION	DESIGNED	PREPARED	REVIEWED	APPROVED
0	2018-08-28	ISSUED FOR CITY OF FRISCO REVIEW	SPS	JLS	SR	JBF

SEAL

JFassett 8/28/18

JEFFREY B. FASSETT
85875

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UNITED STATES OF AMERICA
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www.golder.com

PROJECT
FRISCO RECYCLING CENTER
CONDITIONAL LETTER OF MAP REVISION
STEWART CREEK

TITLE
ANNOTATED FIRM PANEL

PROJECT NO.	CONTROL	REV.	4 of 4	DRAWING
1302086-06	0006	0		X-003

Path: \\tucson\cadd\EXIDE\Frisco\99_PROJECTS\130208606_2018RCRA\0006_CLOMR\02_PRODUCTION\DWG\ | File Name: 130208606_0006_X_003.dwg | Last Edited By: jlsanchez Date: 2018-08-28 Time:3:12:52 PM | Printed By: JLSanchez Date: 2018-08-28 Time:3:41:25 PM

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APPENDIX G

USFWS Endangered Species Act Consultation

From: Small, Brian <brian_small@fws.gov>
Sent: Tuesday, July 31, 2018 9:20 AM
To: Munz, Jeremy <Jeremy_Munz@golder.com>
Subject: Re: [EXTERNAL] RE: Federal Nexus for Exide Recycling Facility

Good morning Jeremy,
We received your letter concerning the Exide Recycling Plant CLOMR, which included a determination of "no effect" to federally listed species. Under Section 7 of the Endangered Species Act, consultation with this office is not required for federal actions determined to have "no effect" on listed species. For this reason, we did not take any action on the letter. We recommend you maintain records supporting your determination and provide your determination of effect to the Federal Emergency Management Agency for their records.

On Tue, Jul 31, 2018 at 8:05 AM, Munz, Jeremy <Jeremy_Munz@golder.com> wrote:

Good Morning Brian,

Just checking to see if the consultation is complete for the Exide Recycling Facility. I never received a concurrence letter. If you have any questions of need any additional information please feel free to contact me either by email or on my cell.

Best Regards,

GOLDER

Jeremy Munz
Project Biologist

500 Century Plaza Drive, Suite 190, Houston, Texas, USA 77073
T: +1 281 821-6868 | **D:** +1 (281) 821-6868 x24832 | **C:** +1 (254) 721-0495 |
golder.com
LinkedIn | Facebook | Twitter

Work Safe, Home Safe

From: Small, Brian <brian_small@fws.gov>
Sent: Friday, May 4, 2018 12:35 PM
To: Munz, Jeremy <Jeremy_Munz@golder.com>
Subject: Re: [EXTERNAL] RE: Federal Nexus for Exide Recycling Facility

Thanks Jeremy. That's all I needed. The determination you provided was well supported.

On Fri, May 4, 2018 at 12:23 PM, Munz, Jeremy <Jeremy_Munz@golder.com> wrote:

Good Afternoon Brian,

The Federal Nexus for the Exide Project is FEMA - Conditional Letter of Map Revision (CLOMR) process. I can send you the request from FEMA for USFWS consultation on Monday if that helps. Hopefully this helps clarify some things if you have any additional questions please do not hesitate to contact me.

Best Regards,

Jeremy Munz
Project Biologist

500 Century Plaza Drive, Suite 190, Houston, Texas, USA 77073
T: +1 281 821-6868 | **D:** +1 (281) 821-6868 x24832 | **C:** +1 (254) 721-0495 |
golder.com
LinkedIn | Facebook | Twitter

Work Safe, Home Safe

From: Small, Brian <brian_small@fws.gov>
Sent: Friday, May 4, 2018 11:58 AM
To: Munz, Jeremy <Jeremy_Munz@golder.com>
Subject: Federal Nexus for Exide Recycling Facility

Good afternoon Mr. Munz,

I'm the wildlife biologist reviewing your informal Section 7 consultation for the Exide Recycling Plant. Quick question, what is the federal nexus for the project?

--

Brian Small

Fish & Wildlife Biologist

U.S. Fish & Wildlife Service

2005 Green Oaks Blvd., Suite 140

Arlington, TX 76006

(817) 277-1100 ext. 2105

--

Brian Small

Fish & Wildlife Biologist

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--
Brian Small
Fish & Wildlife Biologist
U.S. Fish & Wildlife Service
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Arlington, TX 76006
(817) 277-1100 ext. 2105

GOLDER

April 17, 2018

Ms. Debra Bills
Field Supervisor
U.S. Fish and Wildlife Service (Arlington Ecological Services Field Office)
2005 Northeast Green Oaks Blvd, Suite 140
Arlington, Texas 76006

RE: Exide Technologies
Request for Threatened and Endangered Species Concurrence
Exide Recycling Facility Project
Collin County, Texas

Dear Ms. Bills,

On behalf of our client, Exide Technologies (Exide), Golder Associates, Inc. (Golder) submits this letter and the attached information as a request for informal Section 7 consultation with the U.S. Fish and Wildlife Service (USFWS) for the Exide Recycling Facility Project (Project). The Project is located within Frisco in Collin County, Texas and involves the potential modification of an existing floodwall adjacent to Stewart Creek located within the former Exide recycling facility and consolidation and capping of soil and sediment remediation waste within the footprint of the Exide Former Operating Plant (on currently paved areas). Golder conducted a biological resource assessment of an approximate 8.00-acre site (Project area) to identify the presence of suitable habitat for USFWS federally-listed threatened and endangered (T&E) species potentially occurring in the Project area. Mapping exhibits of the Project area are included as Attachment 1 of the biological resource assessment.

The USFWS Information for Planning and Consultation (IPaC) system was utilized to evaluate the potential presence of federally-listed T&E species in the Project area. Based on the results of the IPaC (Attachment 2), four federally-listed species have the potential to occur within the Project area, including least tern (*Sterna antillarum*), piping plover (*Charadrius melodus*), red knot (*Calidris canutus rufa*), and whooping crane (*Grus americana*). The least tern, piping plover and red knot are only considered for wind energy projects and are therefore, not evaluated in this informal consultation request. Golder did however, analyze the Project area for these three species, during the site assessment as due diligence for reporting to Exide.

The Project area is located within the former Exide Recycling Facility and consists of routinely maintained open land with few trees or large shrubs, existing concrete pads, and industrial structures. Photographs documenting the on-site conditions of the Project area are included in Attachment 3.

Due to the location of the Project, lack of suitable habitat, and the absence of the species during the site visit, it is anticipated that the Project would have *No Effect* on the whooping crane. Additionally, avian species protected under the MBTA and BGEPA are not expected to be impacted by the Project. The biological resource assessment included with this letter describes Golder's effect determination in greater detail.

If you have any further questions please contact either Jeremy Munz, Jeremy_Munz@golder.com or Anne Faeth-Boyd, Anne_Faeth-Boyd@golder.com.

Jeremy Munz

Jeremy Munz
Project Biologist

Anne Faeth-Boyd

Anne Faeth-Boyd, R.G., P.E.
Senior Engineer/ Associate

Biological Assessment Report Submitted to Exide Technologies

TECHNICAL MEMORANDUM

Date: April 13, 2018 **Project No.:** 130208606

To: Exide Technologies

From: Golder Associates Inc.

RE: **EXIDE FRISCO RECYCLING FACILITY BIOLOGICAL RESOURCE ASSESSEMT**

Golder Associates Inc. (Golder) issues this technical memorandum to Exide Technologies (Exide) as a summary of the biological resource assessment conducted at the existing Exide recycling facility (Project). The Project survey area (Project area) is located within an approximate 8.00-acre site located in Frisco in Collin County, Texas.

Golder was contracted by Exide to conduct this biological resource assessment along a small section of Stewart Creek to identify the presence of suitable habitat for U.S. Fish and Wildlife Service (USFWS) federally-listed threatened and endangered (T&E) species potentially occurring in the area. The data presented herein serves as Golder's assessment of the Project area.

On behalf of Exide, this material is being provided to support compliance with the federal Endangered Species Act (ESA) of 1973 (87 Stat. 884, as amended; 16 U.S.C. 1531 et seq.) the Migratory Bird Treaty Act (MBTA) of 1918 (16 U.S.C. 703–712), and the Bald and Golden Eagle Protection Act (BGEPA) of 1940 (16 U.S.C. 668-668d).

The purpose of this report is to present field data, habitat descriptions, and other pertinent information to assist the U.S. Fish and Wildlife Service (USFWS) in their review of regulatory compliance.

1.0 METHODS

"Listed species" for the purpose of this report are those species that are:

- Listed as threatened, endangered, or candidate species by the ESA,
- Birds protected by the MBTA, and
- Birds protected by the BGEPA.

1.1 Background Review

In preparation of the site visit Golder reviewed published information for the Project area to gain an understanding of the existing site characteristics, predominant land cover and habitat types, historic use, and to evaluate potential sensitive areas within the Project area. Golder reviewed information from the following sources:

- United States Geologic Survey (USGS) topographic maps;

- Historic aerial photographs; and
- USFWS Information for Planning and Consultation (IPaC) database.

Additionally, Exide provided Golder the Screening Level Ecological Risk Assessment (SERLA) report conducted on Stewart Creek which contained a Habitat Assessment Report for review. Review of these documents helped Golder gain an understanding of the past environmental resources and habitats previously identified within the Project area.

1.2 Field Survey

A qualified biologist completed the biological resource assessment by surveying the entire 8.00-acre Project area on March 29, 2018. A Project overview map detailing the survey area and photo point locations is included as **Attachment A**. Additionally, the USFWS IPaC results and representative photographs documenting the conditions on-site are included as **Attachment B** and **Attachment C**, respectively.

2.0 FINDINGS

2.1 Conditions Documented at Site

Golder conducted the biological resource assessment on March 29, 2018 to document the presence of federally-listed T&E species and identify any potentially suitable habitat within the Project area. Land use within the Project area consists of Industrial Land containing:

- Routinely maintained open land with few trees or large shrubs;
- Existing concrete pads; and
- Industrial structures.

2.1.1 Flora Observed

Golder observed the following vegetative species within the Project area.

Common Name	Scientific Name
Woody Vegetation Observed	
American Elm	*Ulmus americana*
Bur Oak	*Quercus macrocarpa*
Black Willow	*Salix nigra*
Hackberry	*Celtis occidentalis*
Pecan	*Carya illinoiensis*
Green Ash	*Fraxinus pennsylvanica*
Herbaceous Vegetation Observed	
Johnson Grass	*Sorghum halepense*
American Vetch	*Vicia americana*
Queen Anne’s Lace	*Daucus carota*
Henbit	*Lamium amplexicaule*
Shepherd’s Purse	*Capsella bursa-pastoris*

Giant Ragweed	*Ambrosia trifida*
Poison Ivy	*Toxicodendron radicans*
Common Dandelion	*Taraxacum officinale*
Carolina Geranium	*Geranium carolinianum*
Pony's Foot	*Dichondra carolinensis*
Perennial Rye Grass	*Lolium perenne*
Curly Dock	*Rumex crispus*
Canada Goldenrod	*Solidago canadensis*
Southern Dewberry	*Rubus trivialis*

2.1.2 Fauna Observed

Golder observed the following wildlife species within the Project area.

Common Name	**Scientific Name**
Red-Tailed Hawk	*Buteo jamaicensis*
Mallard	*Anas platyrhynchos*
Mourning Dove	*Zenaida macroura*
Common Pigeon	*Columbidae sp*.
Northern Mockingbird	*Mimus polyglottos*
Bluegill Sunfish	*Lepomis macrochirus*

2.2 Listed Species Review

2.2.1 Threatened and/or Endangered Species Effects Determination

According to the USFWS IPaC resource (**Attachment B**), there are four federally-listed species potentially occurring in the Project area. Golder has completed an effect determination for the four-species based on the results of the background and field visit, that information is presented in **Table 1**.

Table 1
Federally-Listed Threatened and Endangered Species Potentially Occurring with the Project.

Species	**Listing**[1]	**Habitat Characteristics/ Assessment**	**Potential Impact**
Least tern *(Sterna antillarum)*	FE	The species utilizes marine or estuarine shores, or on sandbar islands in large rivers. The Project area is located along a small section of Stewart Creek within a highly developed and industrialized area with no suitable sandbars to serve as suitable habitat. Due to lack of suitable habitat the Project is not anticipated to impact the species.	*No Effect*
Piping plover *(Charadrius melodus)*	FT	The species utilizes open sandy habitats such as beaches or lakeshores. The Project area is located along a small section of Stewart Creek within a highly developed and industrialized area with no suitable sandbars	*No Effect*

Table 1
Federally-Listed Threatened and Endangered Species Potentially Occurring with the Project.

Species	Listing[1]	Habitat Characteristics/ Assessment	Potential Impact
		to serve as suitable habitat. Due to lack of suitable habitat the Project is not anticipated to impact the species.	
Red knot *(Calidris canutus rufa)*	FT	The species utilizes intertidal, marine habitats, especially near coastal inlets, estuaries, and bays. The Project area is located along a small section of Stewart Creek within a highly developed and industrialized area with no suitable habitat. Due to lack of suitable habitat the Project is not anticipated to impact the species.	*No Effect*
Whooping crane *(Grus americana)*	FE	The species migrates from nesting habitat in Wood Buffalo National Park in Canada to wintering habitat in the Aransas National Wildlife Refuge in Texas. The species makes stops along its migrations using croplands for feeding. The Project area is located along a small section of Stewart Creek within a highly developed and industrialized area with no suitable stopover habitat. Due to lack of suitable habitat the Project is not anticipated to impact the species.	*No Effect*

[1] **FE** = Federal Endangered; **FT** = Federal Threatened

2.2.2 Species protected by the MBTA and BGEPA

Habitat within the Project area consists of routinely maintained open land with few trees or large shrubs, existing concrete pads and industrial structures. Although there is limited available habitat within the Project area it still may be used for foraging, resting, and nesting habitat or may be utilized only during daily migration within a bird's home range. Nesting season typically occurs between March and August, and some bird species can reproduce multiple times during a nesting season. Avian species are highly mobile and would likely avoid the area due to high amount of development and anthropomorphic activities in the Project area.

3.0 SUMMARY AND CLOSING

Activity from the former Exide facility have reduced the likelihood of listed species being present within the Project area. The riparian area along the small section of Stewart Creek contains no suitable habitat for any federally-listed T&E species. Additionally, each species is highly mobile and would likely avoid the area due to high amount of development and anthropomorphic activities in the Project vicinity.

Therefore, it is Golder's opinion that the proposed Project will have no effect on the least tern, piping plover, red knot, and whooping crane due to lack of suitable habitat within the Project area. In addition, avian species protected under the MBTA and BGEPA are not expected to be impacted.

GOLDER ASSOCIATES INC.

Jeremy Munz

Anne Faeth-Boyd

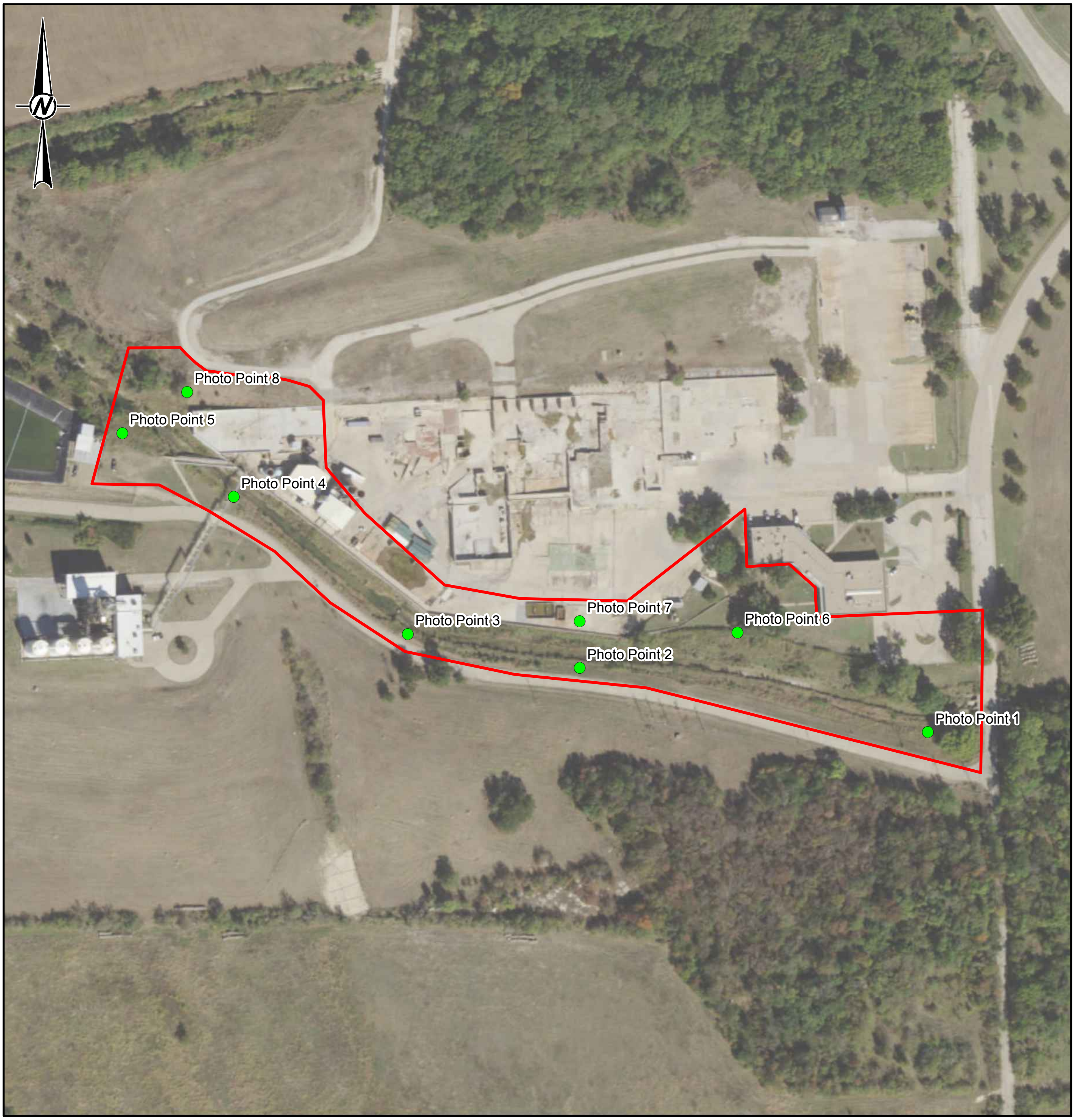
Jeremy Munz
Project Biologist

Anne Faeth-Boyd, R.G., P.E.
Sr. Engineer/Associate

Attachments:

Attachment A - Project Mapping
Attachment B - USFWS IPaC Resource Results
Attachment C - Photo Log

Attachment A
Project Mapping



LEGEND

● Photo Point Locations

▭ Study Area

0 125 250 500

Feet

REFERENCE(S)

1. STUDY AREA, PHOTO POINTS; GOLDER ASSOCIATES INC. 2018
2. COORDINATE SYSTEM: NAD 1983 STATEPLANE TEXAS NORTH CENTRAL FIPS 4202 FEET
PROJECTION: LAMBERT CONFORMAL CONIC
DATUM: NORTH AMERICAN 1983
3. SERVICE LAYER CREDITS: SOURCE: ESRI, DIGITALGLOBE, GEOEYE, EARTHSTAR GEOGRAPHICS, CNES/AIRBUS DS, USDA, USGS, AEROGRID, IGN, AND THE GIS USER COMMUNITY

CLIENT
EXIDE TECHNOLOGIES

PROJECT
CLOMR ESA

CONSULTANT

GOLDER

YYYY-MM-DD	2018-04-06
DESIGNED	JGW
PREPARED	JGW
REVIEWED	JM
APPROVED	JM

TITLE
SITE OVERVIEW MAP

PROJECT NO.	CONTROL	REV.	FIGURE
130208606	A001	0	**1**

PATH: G:\PROJECTS\Exide\130208606\99 PROJECTS\130208606 Exide technologies\CLOMIR ESA\02 PRODUCTION\MXD\130208606 OverviewMap.mxd

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Attachment B
USFWS IPaC Results

IPaC resource list

This report is an automatically generated list of species and other resources such as critical habitat (collectively referred to as *trust resources*) under the U.S. Fish and Wildlife Service's (USFWS) jurisdiction that are known or expected to be on or near the project area referenced below. The list may also include trust resources that occur outside of the project area, but that could potentially be directly or indirectly affected by activities in the project area. However, determining the likelihood and extent of effects a project may have on trust resources typically requires gathering additional site-specific (e.g., vegetation/species surveys) and project-specific (e.g., magnitude and timing of proposed activities) information.

Below is a summary of the project information you provided and contact information for the USFWS office(s) with jurisdiction in the defined project area. Please read the introduction to each section that follows (Endangered Species, Migratory Birds, USFWS Facilities, and NWI Wetlands) for additional information applicable to the trust resources addressed in that section.

Location

Collin County, Texas

Local office

Arlington Ecological Services Field Office

☎ (817) 277-1100
(817) 277-1129

2005 Ne Green Oaks Blvd
Suite 140
Arlington, TX 76006-6247

http://www.fws.gov/southwest/es/arlingtontexas/
http://www.fws.gov/southwest/es/EndangeredSpecies/lists/

Endangered species

This resource list is for informational purposes only and does not constitute an analysis of project level impacts.

The primary information used to generate this list is the known or expected range of each species. Additional areas of influence (AOI) for species are also considered. An AOI includes areas outside of the species range if the species could be indirectly affected by activities in that area (e.g., placing a dam upstream of a fish population, even if that fish does not occur at the dam site, may indirectly impact the species by reducing or eliminating water flow downstream). Because species can move, and site conditions can change, the species on this list are not guaranteed to be found on or near the project area. To fully determine any potential effects to species, additional site-specific and project-specific information is often required.

Section 7 of the Endangered Species Act **requires** Federal agencies to "request of the Secretary information whether any species which is listed or proposed to be listed may be present in the area of such proposed action" for any project that is conducted, permitted, funded, or licensed by any Federal agency. A letter from the local office and a species list which fulfills this requirement can **only** be obtained by requesting an official species list from either the Regulatory Review section in IPaC (see directions below) or from the local field office directly.

For project evaluations that require USFWS concurrence/review, please return to the IPaC website and request an official species list by doing the following:

1. Draw the project location and click CONTINUE.
2. Click DEFINE PROJECT.
3. Log in (if directed to do so).
4. Provide a name and description for your project.
5. Click REQUEST SPECIES LIST.

Listed species

[1] and their critical habitats are managed by the Ecological Services Program of the U.S. Fish and Wildlife Service (USFWS) and the fisheries division of the National Oceanic and Atmospheric Administration (NOAA Fisheries[2]).

Species and critical habitats under the sole responsibility of NOAA Fisheries are **not** shown on this list. Please contact NOAA Fisheries for species under their jurisdiction.

---

1. Species listed under the Endangered Species Act are threatened or endangered; IPaC also shows species that are candidates, or proposed, for listing. See the listing status page for more information.
2. NOAA Fisheries, also known as the National Marine Fisheries Service (NMFS), is an office of the National Oceanic and Atmospheric Administration within the Department of Commerce.

The following species are potentially affected by activities in this location:

Birds

NAME	STATUS
Least Tern *Sterna antillarum* This species only needs to be considered if the following condition applies: • Wind Energy Projects No critical habitat has been designated for this species. https://ecos.fws.gov/ecp/species/8505	Endangered
Piping Plover *Charadrius melodus* This species only needs to be considered if the following condition applies: • Wind Energy Projects There is **final** critical habitat for this species. Your location is outside the critical habitat. https://ecos.fws.gov/ecp/species/6039	Threatened
Red Knot *Calidris canutus rufa* This species only needs to be considered if the following condition applies: • Wind Energy Projects No critical habitat has been designated for this species. https://ecos.fws.gov/ecp/species/1864	Threatened
Whooping Crane *Grus americana* There is **final** critical habitat for this species. Your location is outside the critical habitat. https://ecos.fws.gov/ecp/species/758	Endangered

Critical habitats

Potential effects to critical habitat(s) in this location must be analyzed along with the endangered species themselves.

THERE ARE NO CRITICAL HABITATS AT THIS LOCATION.

Migratory birds

Certain birds are protected under the Migratory Bird Treaty Act

[1] and the Bald and Golden Eagle Protection Act[2].

Any person or organization who plans or conducts activities that may result in impacts to migratory birds, eagles, and their habitats should follow appropriate regulations and consider implementing appropriate conservation measures, as described below.

---

1. The Migratory Birds Treaty Act of 1918.
2. The Bald and Golden Eagle Protection Act of 1940.

Additional information can be found using the following links:

- Birds of Conservation Concern http://www.fws.gov/birds/management/managed-species/birds-of-conservation-concern.php
- Measures for avoiding and minimizing impacts to birds http://www.fws.gov/birds/management/project-assessment-tools-and-guidance/conservation-measures.php
- Nationwide conservation measures for birds http://www.fws.gov/migratorybirds/pdf/management/nationwidestandardconservationmeasures.pdf

MIGRATORY BIRD INFORMATION IS NOT AVAILABLE AT THIS TIME

Tell me more about conservation measures I can implement to avoid or minimize impacts to migratory birds.

Nationwide Conservation Measures describes measures that can help avoid and minimize impacts to all birds at any location year round. Implementation of these measures is particularly important when birds are most likely to occur in the project area. When birds may be breeding in the area, identifying the locations of any active nests and avoiding their destruction is a very helpful impact minimization measure. To see when birds are most likely to occur and be breeding in your project area, view the Probability of Presence Summary. Additional measures and/or permits may be advisable depending on the type of activity you are conducting and the type of infrastructure or bird species present on your project site.

What does IPaC use to generate the migratory birds potentially occurring in my specified location?

The Migratory Bird Resource List is comprised of USFWS Birds of Conservation Concern (BCC) and other species that may warrant special attention in your project location.

The migratory bird list generated for your project is derived from data provided by the Avian Knowledge Network (AKN). The AKN data is based on a growing collection of survey, banding, and citizen science datasets and is queried and filtered to return a list of those birds reported as occurring in the counties which your project intersects, and that have been identified as warranting special attention because they are a BCC species in that area, an eagle (Eagle Act requirements may apply), or a species that has a particular vulnerability to offshore activities or development.

Again, the Migratory Bird Resource list includes only a subset of birds that may occur in your project area. It is not representative of all birds that may occur in your project area. To get a list of all birds potentially present in your project area, please visit the E-bird Explore Data Tool.

What does IPaC use to generate the probability of presence graphs for the migratory birds potentially occurring in my specified location?

The probability of presence graphs associated with your migratory bird list are based on data provided by the Avian Knowledge Network (AKN). This data is derived from a growing collection of survey, banding, and citizen science datasets .

Probability of presence data is continuously being updated as new and better information becomes available. To learn more about how the probability of presence graphs are produced and how to interpret them, go the Probability of Presence Summary and then click on the "Tell me about these graphs" link.

How do I know if a bird is breeding, wintering, migrating or present year-round in my project area?

To see what part of a particular bird's range your project area falls within (i.e. breeding, wintering, migrating or year-round), you may refer to the following resources: The The Cornell Lab of Ornithology All About Birds Bird Guide, or (if you are unsuccessful in locating the bird of interest there), the Cornell Lab of Ornithology Neotropical Birds guide. If a bird entry on your migratory bird species list indicates a breeding season, it is probable that the bird breeds in your project's counties at some point within the timeframe specified. If "Breeds elsewhere" is indicated, then the bird likely does not breed in your project area.

What are the levels of concern for migratory birds?

Migratory birds delivered through IPaC fall into the following distinct categories of concern:

1. "BCC Rangewide" birds are Birds of Conservation Concern (BCC) that are of concern throughout their range anywhere within the USA (including Hawaii, the Pacific Islands, Puerto Rico, and the Virgin Islands);
2. "BCC - BCR" birds are BCCs that are of concern only in particular Bird Conservation Regions (BCRs) in the continental USA; and
3. "Non-BCC - Vulnerable" birds are not BCC species in your project area, but appear on your list either because of the Eagle Act requirements (for eagles) or (for non-eagles) potential susceptibilities in offshore areas from certain types of development or activities (e.g. offshore energy development or longline fishing).

Although it is important to try to avoid and minimize impacts to all birds, efforts should be made, in particular, to avoid and minimize impacts to the birds on this list, especially eagles and BCC species of rangewide concern. For more information on conservation measures you can implement to help avoid and minimize migratory bird impacts and requirements for eagles, please see the FAQs for these topics.

Details about birds that are potentially affected by offshore projects

For additional details about the relative occurrence and abundance of both individual bird species and groups of bird species within your project area off the Atlantic Coast, please visit the Northeast Ocean Data Portal. The Portal also offers data and information about other taxa besides birds that may be helpful to you in your project review. Alternately, you may download the bird model results files underlying the portal maps through the NOAA NCCOS Integrative Statistical Modeling and Predictive Mapping of Marine Bird Distributions and Abundance on the Atlantic Outer Continental Shelf project webpage.

Bird tracking data can also provide additional details about occurrence and habitat use throughout the year, including migration. Models relying on survey data may not include this information. For additional information on marine bird tracking data, see the Diving Bird Study and the nanotag studies or contact Caleb Spiegel or Pam Loring.

What if I have eagles on my list?

If your project has the potential to disturb or kill eagles, you may need to obtain a permit to avoid violating the BGEPA should such impacts occur.

Facilities

Wildlife refuges and fish hatcheries

REFUGE AND FISH HATCHERY INFORMATION IS NOT AVAILABLE AT THIS TIME

Wetlands in the National Wetlands Inventory

Impacts to NWI wetlands and other aquatic habitats may be subject to regulation under Section 404 of the Clean Water Act, or other State/Federal statutes.

For more information please contact the Regulatory Program of the local U.S. Army Corps of Engineers District.

THERE ARE NO KNOWN WETLANDS AT THIS LOCATION.

Data limitations

The Service's objective of mapping wetlands and deepwater habitats is to produce reconnaissance level information on the location, type and size of these resources. The maps are prepared from the analysis of high altitude imagery. Wetlands are identified based on vegetation, visible hydrology and geography. A margin of error is inherent in the use of imagery; thus, detailed on-the-ground inspection of any particular site may result in revision of the wetland boundaries or classification established through image analysis.

The accuracy of image interpretation depends on the quality of the imagery, the experience of the image analysts, the amount and quality of the collateral data and the amount of ground truth verification work conducted. Metadata should be consulted to determine the date of the source imagery used and any mapping problems.

Wetlands or other mapped features may have changed since the date of the imagery or field work. There may be occasional differences in polygon boundaries or classifications between the information depicted on the map and the actual conditions on site.

Data exclusions

Certain wetland habitats are excluded from the National mapping program because of the limitations of aerial imagery as the primary data source used to detect wetlands. These habitats include seagrasses or submerged aquatic vegetation that are found in the intertidal and subtidal zones of estuaries and nearshore coastal waters. Some deepwater reef communities (coral or tuberficid worm reefs) have also been excluded from the inventory. These habitats, because of their depth, go undetected by aerial imagery.

Data precautions

Federal, state, and local regulatory agencies with jurisdiction over wetlands may define and describe wetlands in a different manner than that used in this inventory. There is no attempt, in either the design or products of this inventory, to define the limits of proprietary jurisdiction of any Federal, state, or local government or to establish the geographical scope of the regulatory programs of government agencies. Persons intending to engage in activities involving modifications within or adjacent to wetland areas should seek the advice of appropriate federal, state, or local agencies concerning specified agency regulatory programs and proprietary jurisdictions that may affect such activities.

Attachment C
Photographic Log

PHOTOGRAPHIC LOG

PN: 130208606	**City:** Frisco
Project Name: Exide Technologies CLOMR ESA	**County:** Collin County **State**: Texas

Photograph ID: 1 **Feature:** Stream Photo **Date:** 3.29.2018 **Comments:** Photograph of Stewart Creek facing East.	
Photograph ID: 2 **Feature:** Stream Photo **Date:** 3.29.2018 **Comments:** Photograph of Stewart Creek facing West.	

PHOTOGRAPHIC LOG

Photograph ID: 3 **Feature:** Stream Photo **Date:** 3.29.2018 **Comments:** Photograph of Stewart Creek facing East.	
Photograph ID: 4 **Feature:** Stream Photo **Date:** 3.29.2018 **Comments:** Photograph of Stewart Creek facing West.	

PHOTOGRAPHIC LOG

Photograph ID: 5 **Feature:** Photo Point 1 **Date:** 3.29.2018 **Comments:** Photograph of Photo Point 1 facing West.	
Photograph ID: 6 **Feature:** Photo Point 1 **Date:** 3.29.2018 **Comments:** Photograph of Photo Point 1 facing North	

PHOTOGRAPHIC LOG

Photograph ID: 7 **Feature:** Photo Point 2 **Date:** 3.29.2018 **Comments:** Photograph of Photo Point 2 facing West	
Photograph ID: 8 **Feature:** Photo Point 2 **Date:** 3.29.2018 **Comments:** Photograph of Photo Point 2 facing East	

PHOTOGRAPHIC LOG

Photograph ID: 9 **Feature:** Photo Point 3 **Date:** 3.29.2018 **Comments:** Photograph of Photo Point 3 facing East	
Photograph ID: 10 **Feature:** Photo Point 3 **Date:** 3.29.2018 **Comments:** Photograph of Photo Point 3 facing West	

PHOTOGRAPHIC LOG

Photograph ID: 11 **Feature:** Photo Point 4 **Date:** 3.29.2018 **Comments:** Photograph of Photo Point 4 facing East	
Photograph ID: 12 **Feature:** Photo Point 4 **Date:** 3.29.2018 **Comments:** Photograph of Photo Point 4 facing West	

PHOTOGRAPHIC LOG

Photograph ID: 13 **Feature:** Photo Point 5 **Date:** 3.29.2018 **Comments:** Photograph of Photo Point 5 facing West	
Photograph ID: 14 **Feature:** Photo Point 5 **Date:** 3.29.2018 **Comments:** Photograph of Photo Point 5 facing South	

PHOTOGRAPHIC LOG

Photograph ID:
15

Feature:
Photo Point 6

Date:
3.29.2018

Comments:
Photograph of Photo Point 6 facing West

Photograph ID:
16

Feature:
Photo Point 6

Date:
3.29.2018

Comments:
Photograph of Photo Point 6 facing East

PHOTOGRAPHIC LOG

Photograph ID:
17

Feature:
Photo Point 7

Date:
3.29.2018

Comments:
Photograph of Photo Point 7 facing North

Photograph ID:
18

Feature:
Photo Point 7

Date:
3.29.2018

Comments:
Photograph of Photo Point 7 facing West

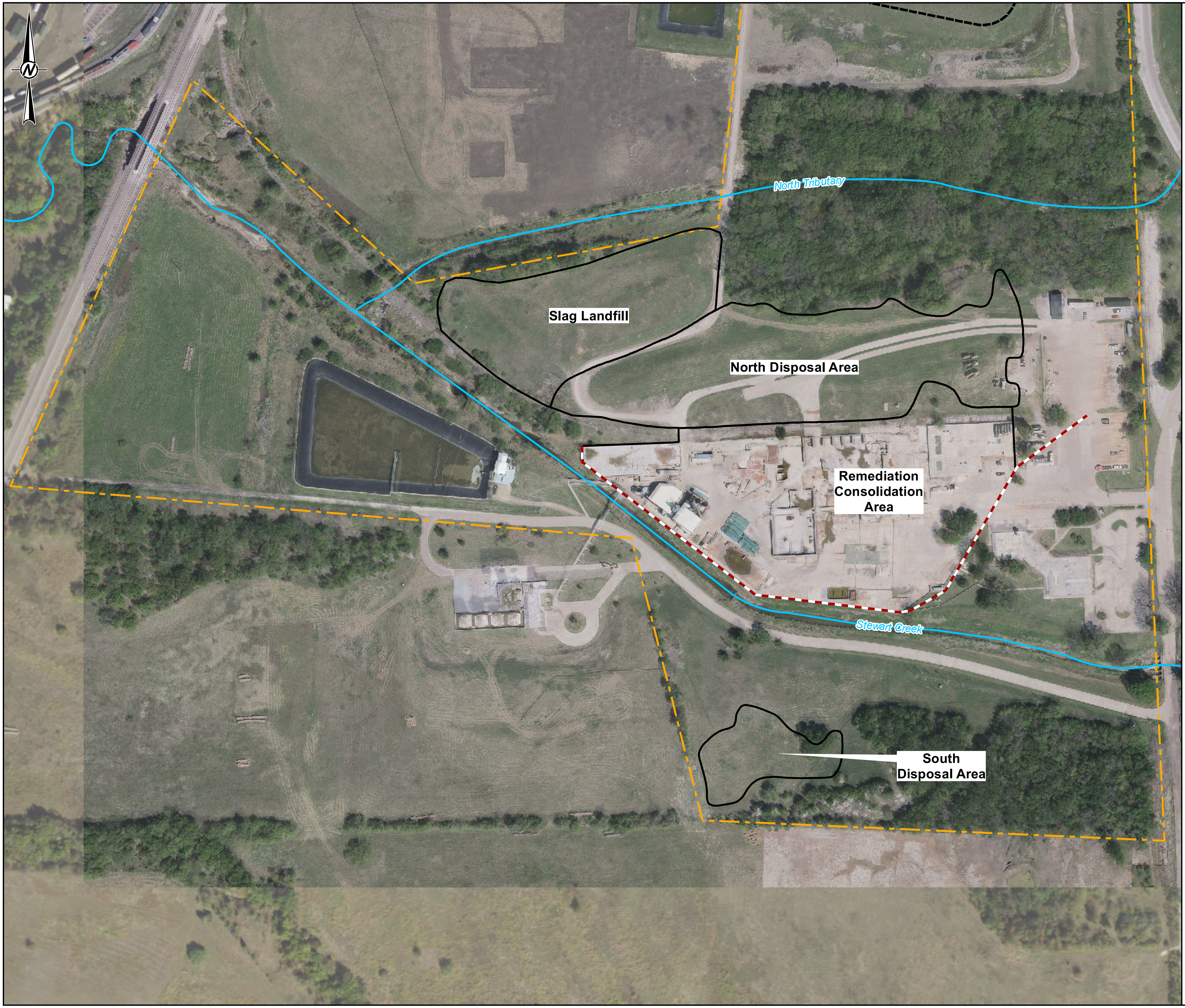
Photograph ID: 19 **Feature:** Photo Point 8 **Date:** 3.29.2018 **Comments:** Photograph of Photo Point 8 facing North	
Photograph ID: 20 **Feature:** Photo Point 8 **Date:** 3.29.2018 **Comments:** Photograph of Photo Point 8 facing South	

APPENDIX H

Floodwall Design

APPENDIX H-1

Floodwall Plans



LEGEND

Surface Water Centerline

Proposed Flood Wall

Disposal Areas

Approximate North CAMU Extent

Former Operating Plant

225 112.5 0 225
Feet

REFERENCE

1. SITE FEATURES - GOLDER, 2014
2. AERIAL IMAGERY - SOURCE: ESRI, DIGITALGLOBE, GEOEYE, EARTHSTAR GEOGRAPHICS, CNES/AIRBUS DS, USDA, USGS, AEROGRID, IGN, AND THE GIS USER COMMUNITY AND AERIAL IMAGERY PROVIDED BY DALLAS AERIAL SURVEY DATED APRIL, 2017

CLIENT
EXIDE TECHNOLOGIES

PROJECT
FRISCO RECYCLING CENTER RCRA PERMIT RENEWAL

TITLE
SITE PLAN VIEW MAP

CONSULTANT
Golder Associates

YYYY-MM-DD 2018-08-14
PREPARED EFT
DESIGN BEF
REVIEW EPW
APPROVED AMF

PROJECT No. 13-0208606
CONTROL 1302086ZF037.mxd
Rev. 0
FIGURE 1

1 in
0
IF THIS MEASUREMENT DOES NOT MATCH WHAT IS SHOWN, THE SHEET HAS BEEN MODIFIED FROM: ANSI B

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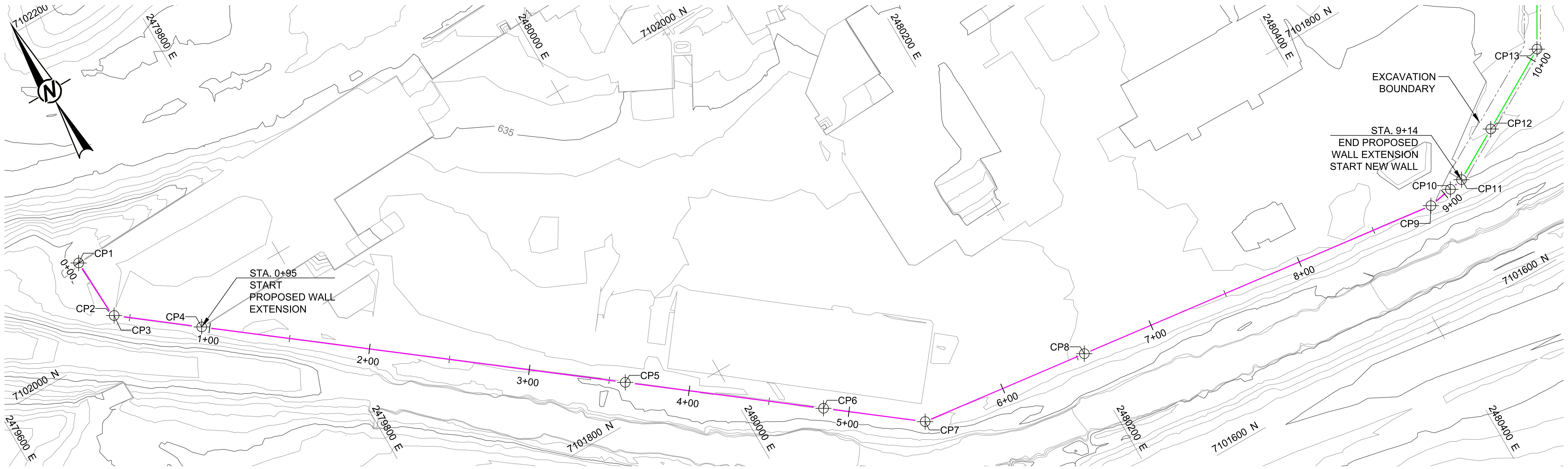
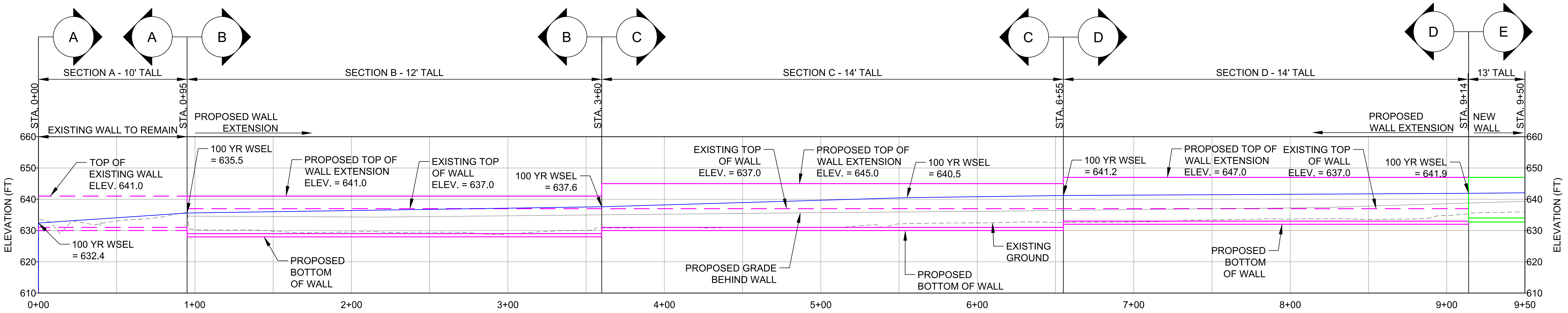


FLOODWALL PLAN

SCALE 1" = 40'



FLOODWALL PROFILE 1

H. SCALE 1" = 40'
V. SCALE 1" = 20'

LEGEND

——3600——	EXISTING GROUND CONTOUR (ft -MSL)
— — —	EXISTING FLOODWALL (SEE DRAWING C-003, NOTE 2)
———	PROPOSED FLOODWALL EXTENSION
———	NEW FLOODWALL
———	100 YR WATER SURFACE ELEVATION (WSEL)
———	PROPOSED GRADE BEHIND WALL
—·—·—	EXCAVATION BOUNDARY

0 40 80
1" = 40' FEET

REV.	YYYY-MM-DD	DESCRIPTION	DESIGNED	PREPARED	REVIEWED	APPROVED
0	2018-08-28	ISSUED FOR CITY OF FRISCO REVIEW	SPS	JLS	JBF	JBF

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8/28/18

JEFFREY B. FASSETT
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UNITED STATES OF AMERICA
[+1] (520) 888 8818
www.golder.com

PROJECT
FRISCO RECYCLING CENTER
CONDITIONAL LETTER OF MAP REVISION
STEWART CREEK

TITLE
FLOODWALL PROFILE
STATION 0+00 TO STATION 9+00

PROJECT NO. 1302086-06
CONTROL 0006
REV. 0
1 of 3
DRAWING C-001

Path: \\tucson\cadd\EXIDE\Frisco\99_PROJECTS\130208606_2018RCRA\0006_CLOMR\02_PRODUCTION\DWG\ | File Name: 130208606_0006_C_001.dwg | Last Edited By: jlsanchez Date: 2018-08-28 Time:2:39:30 PM | Printed By: JLSanchez Date: 2018-08-28 Time:4:27:48 PM

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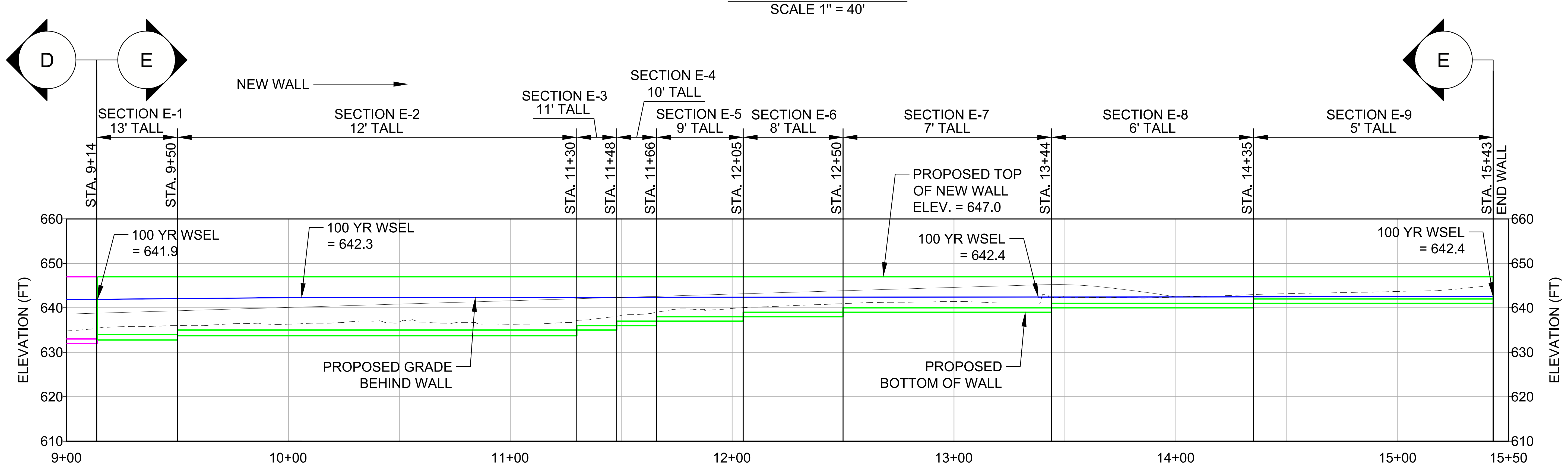
1 in

FLOODWALL PLAN

SCALE 1" = 40'



FLOODWALL PROFILE 2

H. SCALE 1" = 40'
V. SCALE 1" = 20'

LEGEND

- ——3600—— EXISTING GROUND CONTOUR (ft -MSL)
- — — — EXISTING FLOODWALL (SEE DRAWING C-003, NOTE 2)
- —— PROPOSED FLOODWALL EXTENSION
- —— NEW FLOODWALL
- —— 100 YR WATER SURFACE ELEVATION (WSEL)
- —— PROPOSED GRADE BEHIND WALL
- —·—·— EXCAVATION BOUNDARY

0 40 80
1" = 40' FEET

REV.	YYYY-MM-DD	DESCRIPTION	DESIGNED	PREPARED	REVIEWED	APPROVED
0	2018-08-28	ISSUED FOR CITY OF FRISCO REVIEW	SPS	JLS	JBF	JBF

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PROJECT
FRISCO RECYCLING CENTER
CONDITIONAL LETTER OF MAP REVISION
STEWART CREEK

TITLE
FLOODWALL PROFILE
STATION 9+00 TO STATION 15+43

PROJECT NO.	CONTROL	REV.	2 of 3	DRAWING
1302086-06	0006	0		C-002

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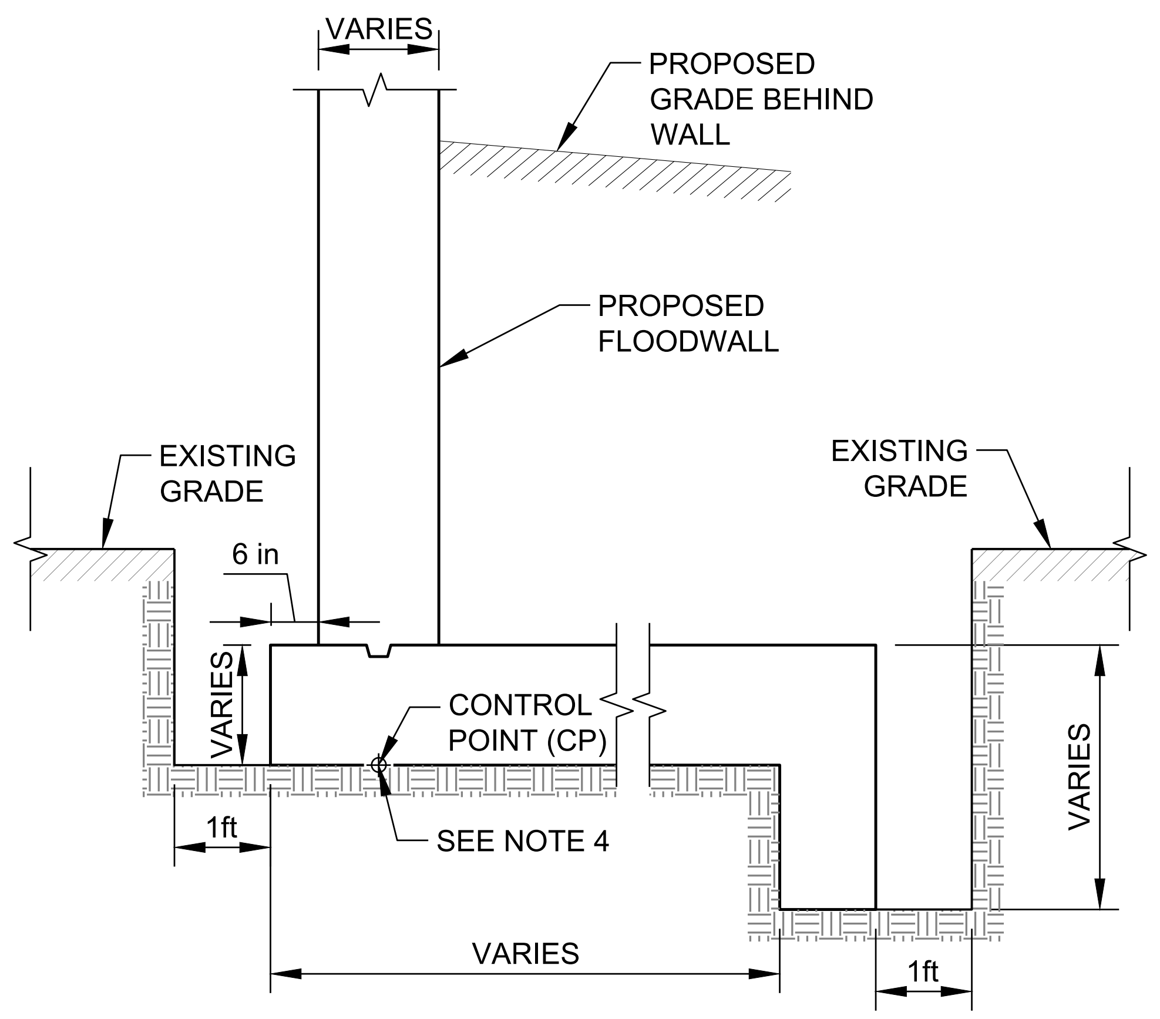
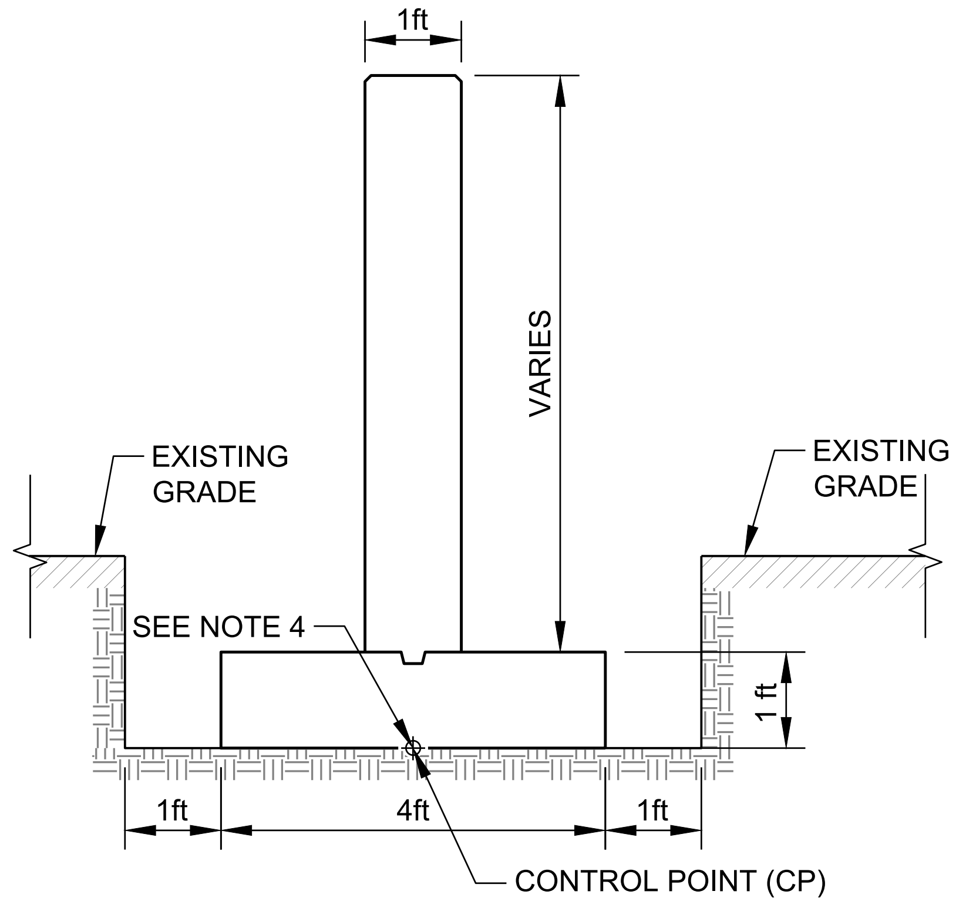


NOT TO SCALE 1 C-003

TYPICAL FLOODWALL EXCAVATION DETAIL FOR NEW WALL (FOOTING WITH KEY)

FOR WALL STATIONS 9+14 TO 13+44
SEE NOTES 3, 4 AND 5



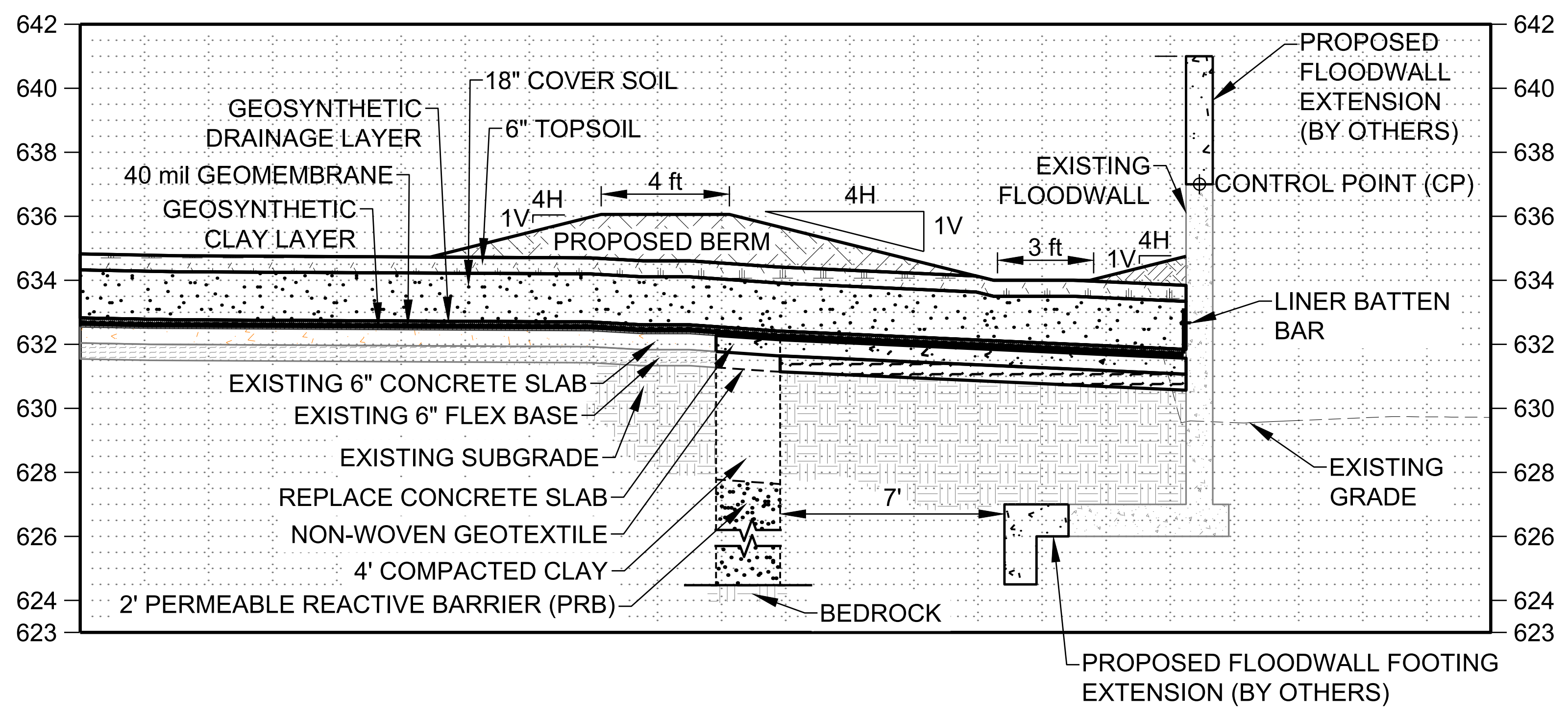
NOT TO SCALE 2 C-003

TYPICAL FLOODWALL EXCAVATION DETAIL FOR NEW WALL (FOOTING WITHOUT KEY)

FOR WALL STATIONS 13+44 TO 15+43
SEE NOTES 3, 4 AND 5

CONTROL POINT TABLE

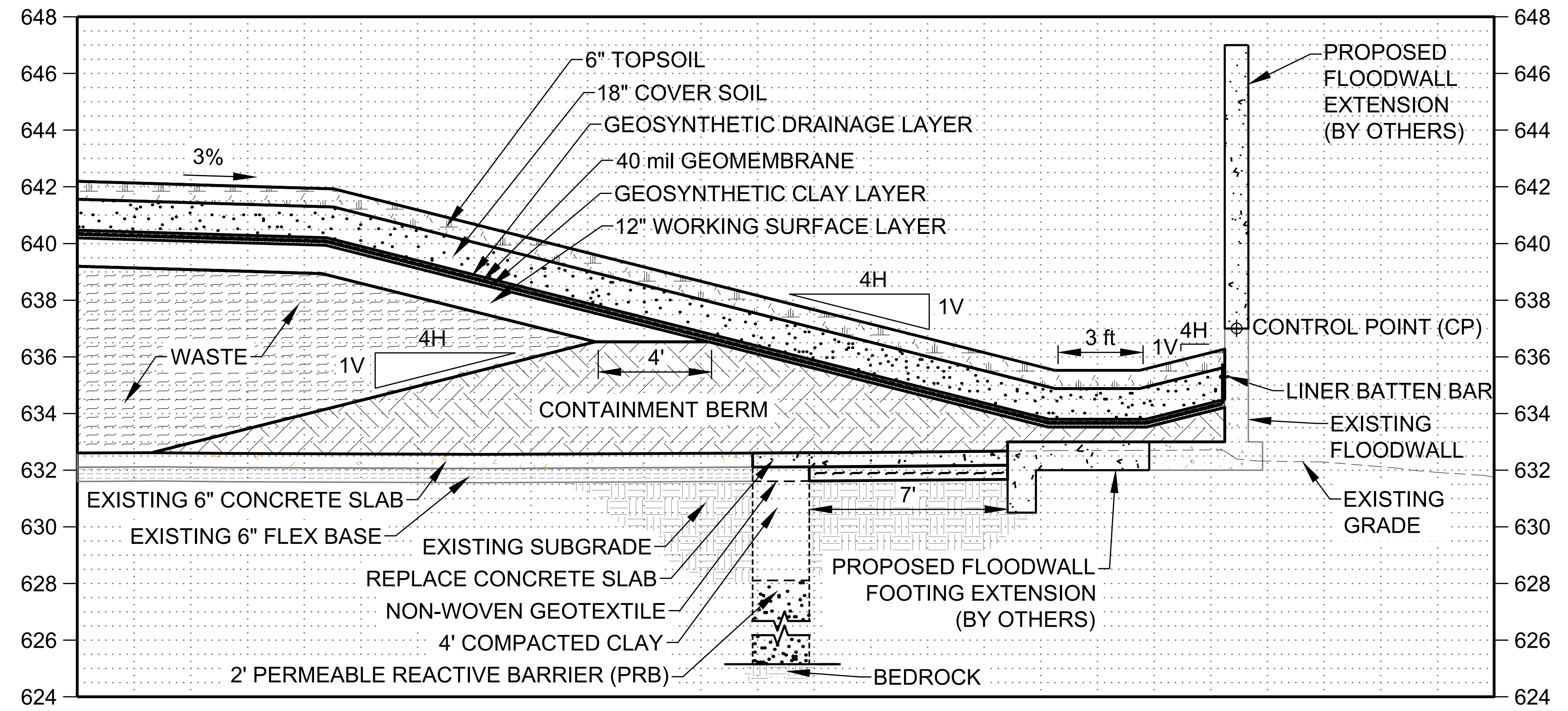
NAME	STATION	NORTHING (FT)	EASTING (FT)	ELEVATION	DESCRIPTION
CP-1	0+00	7102056.50	2479689.56	641.0	BEGIN WALL
CP-2	0+39	7102017.19	2479691.42	641.0	PI
CP-3	0+40	7102017.26	2479692.26	641.0	PI
CP-4	0+95	7101983.96	2479735.80	641.0	WALL TRANSITION
CP-5	3+60	7101822.83	2479946.18	637.0	WALL TRANSITION
CP-6	4+84	7101747.38	2480044.70	637.0	PI
CP-7	5+48	7101708.72	2480095.16	637.0	PI
CP-8	6+55	7101695.83	2480201.73	637.0	WALL TRANSITION
CP-9	8+89	7101667.74	2480433.85	637.0	PI
CP-10	9+05	7101670.53	2480449.34	632.0	PI
CP-11	9+14	7101672.26	2480458.35	632.8	NEW WALL/PI
CP-12	9+50	7101690.35	2480489.78	633.8	WALL TRANSITION
CP-13	10+07	7101718.87	2480539.35	633.8	PI
CP-14	11+30	7101825.22	2480600.77	635.0	WALL TRANSITION
CP-15	11+48	7101840.80	2480609.77	636.0	WALL TRANSITION
CP-16	11+66	7101856.39	2480618.77	637.0	WALL TRANSITION
CP-17	12+05	7101890.17	2480638.28	638.0	WALL TRANSITION
CP-18	12+50	7101929.13	2480660.78	639.0	WALL TRANSTIION
CP-19	13+39	7102006.51	2480705.46	639.0	PI
CP-20	13+44	7102009.27	2480709.20	640.0	WALL TRANSITION
CP-21	14+35	7102063.36	2480782.39	641.0	WALL TRANSITION
CP-22	15+43	7102127.38	2480869.02	641.0	END WALL



NOT TO SCALE 3 C-003

TYPICAL FLOODWALL INSTALLATION DETAIL

FOR WALL STATIONS 0+95 TO 4+20
SEE NOTES 3, 6 AND 7.



NOT TO SCALE 4 C-003

TYPICAL FLOODWALL INSTALLATION DETAIL

FOR WALL STATIONS 4+20 TO 9+14
SEE NOTES 3, 6 AND 7.

NOTE(S)

1. ALL ELEVATIONS AND COORDINATES ARE ON TEXAS STATE PLANE, NORTH CENTRAL, NAD 83, NAVD 88.
2. EXISTING FLOODWALL ELEVATIONS AND SECTION INFORMATION PER AS-BUILT DRAWINGS DEVELOPED BY LAKE ENGINEERS & DEVELOPMENT INC. DATED DECEMBER 1988.
3. SEE GWC ENGINEERING DRAWINGS FOR DETAILED STRUCTURAL DESIGN OF FLOODWALL SECTIONS AND WALL CONSTRUCTION SPECIFICATIONS.
4. CONTROL POINT LOCATED AT CENTERLINE OF WALL STEM AT THE PROPOSED BOTTOM ELEVATION OFF THE FOOTING.
5. TYPICAL WALL EXCAVATION DETAILS AND GRADING LIMITS PROVIDED FOR NEW WALL SECTION (STATION 9+14 TO 15+43)
6. PROPOSED EXTENSION OF EXISTING FLOODWALL (STATION 0+95 TO 9+14) TO BE CONSTRUCTED DURING SITE REMEDIATION.
7. CONTROL POINT LOCATED AT CENTERLINE ALONG TOP OF EXISTING WALL.

REV.	YYYY-MM-DD	DESCRIPTION	DESIGNED	PREPARED	REVIEWED	APPROVED
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8/28/18
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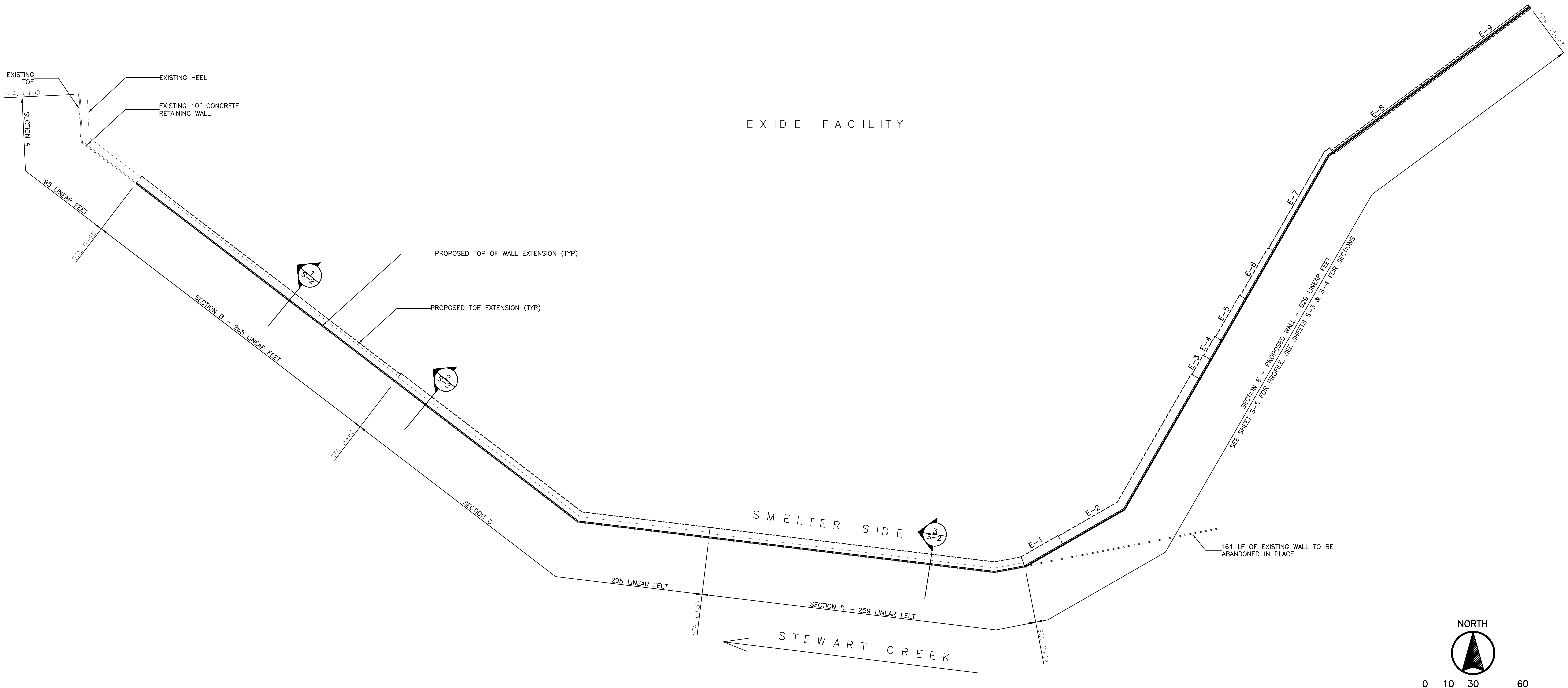
PROJECT
FRISCO RECYCLING CENTER
CONDITIONAL LETTER OF MAP REVISION
STEWART CREEK

TITLE
DETAILS, CONTROL POINTS, GENERAL NOTES

PROJECT NO. 1302086-06
CONTROL 0006
REV. 0
3 of 3
DRAWING C-003

APPENDIX H-2

GWC Design Drawings



PROPOSED WALL EXTENSION PLAN

SCALE: 1" = 30'-0"

THE PROPOSED CONCRETE BARRIER WALL IS LOCATED WEST OF EAGAN WAY IN FRISCO, TEXAS, ALONG THE NORTH SIDE OF STEWART CREEK WHERE IT RUNS IN A WESTERLY DIRECTION ADJACENT TO AND SOUTH OF THE EXIDE FACILITY. THE PROPOSED CONCRETE BARRIER WALL WAS DESIGNED WITH TWO OPTIONS IN MIND:

1. TO UTILIZE THE EXISTING CONCRETE BARRIER WALL FROM STA. 0+95 TO STA. 9+14, EXTENDING THE TOP OF THE WALL UPWARD AND THE HEEL OF THE WALL NORTHWARD TO ACCOMMODATE THE UPDATED HIGHER 100-YEAR FLOOD ELEVATION IN STEWART CREEK ADJACENT TO AND SOUTH OF THE EXISTING CONCRETE BARRIER WALL.
2. TO DEMOLISH AND REMOVE THE EXISTING CONCRETE BARRIER WALL FROM STA. 0+95 TO STA. 9+14, AND REPLACE IT WITH A NEW CONCRETE BARRIER WALL.

BOTH OF THE ABOVE SCENARIOS WOULD INVOLVE DESIGN OF A NEW CONCRETE BARRIER WALL TO THE NORTHEAST OF STEWART CREEK FROM STA. 9+14 TO STA. 15+43.

NOTES:

1. EXISTING CONCRETE RETAINING WALL CONSTRUCTION DRAWINGS BY LAKE ENGINEERING & DEVELOPMENT, INC.; FOR GNB, INC., GNB PROJECT NO. 862-711; DATED 12/15/87.
2. REFER TO EXISTING CONSTRUCTION DRAWINGS FOR EXISTING WALL ALIGNMENT, TYPICAL DETAILS FOR EXISTING CONCRETE WALL AND FOOTINGS, AND ALL AS-BUILT UTILITIES AND OTHER SITE-SPECIFIC STRUCTURES.
3. PROPOSED FLOODWALL ELEVATIONS DETERMINED BY HYDRAULIC ANALYSIS PERFORMED BY GOLDER ASSOCIATES, INC.
4. SEE SHEETS S-3 AND S-4 FOR NEW WALL/WALL REPLACEMENT SECTIONS.
5. SEE SHEET S-5 FOR PROFILE OF WALL IMPROVEMENTS.
6. SEE SHEET S-6 FOR GENERAL NOTES.

PROPOSED FLOODWALL HEIGHT EXTENSION CHART

SECTION ID	EXISTING WALL HEIGHT	PROPOSED WALL HEIGHT	EXISTING ELEVATION	PROPOSED ELEVATION	WALL HEIGHT INCREASE
A	10'	10'	641.0	641.0	NO CHANGE
B	8'	10'	637.0	641.0	4'
C	6'	10'	637.0	645.0	8'
D	4'	10'	637.0	647.0	10'

PROPOSED FLOODWALL LENGTH EXTENSION CHART

SECTION ID	PLAN LENGTH (LINEAR FEET)	PROPOSED WALL HEIGHT	WALL/TOE THICKNESS	B.O.W. ELEVATION	T.O.W. ELEVATION
E-1	36'	13'	1.25'	632.75	647.0
E-2	180'	12'	1.25'	633.75	647.0
E-3	18'	11'	1.25'	634.75	647.0
E-4	18'	10'	1.0'	636.0	647.0
E-5	39'	9'	1.0'	637.0	647.0
E-6	45'	8'	1.0'	638.0	647.0
E-7	94'	7'	1.0'	639.0	647.0
E-8	91'	6'	1.0'	640.0	647.0
E-9	108'	5'	1.0'	641.0	647.0

GOLDER ASSOCIATES INC.
13515 BARRETT PARKWAY DR.
SUITE 260
BALLWIN, MO 63021

ENGINEERING SERVICES FOR
EXIDE TECHNOLOGIES
FLOODWALL EXTENSION
FRISCO, TX

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GWC Engineering, LP
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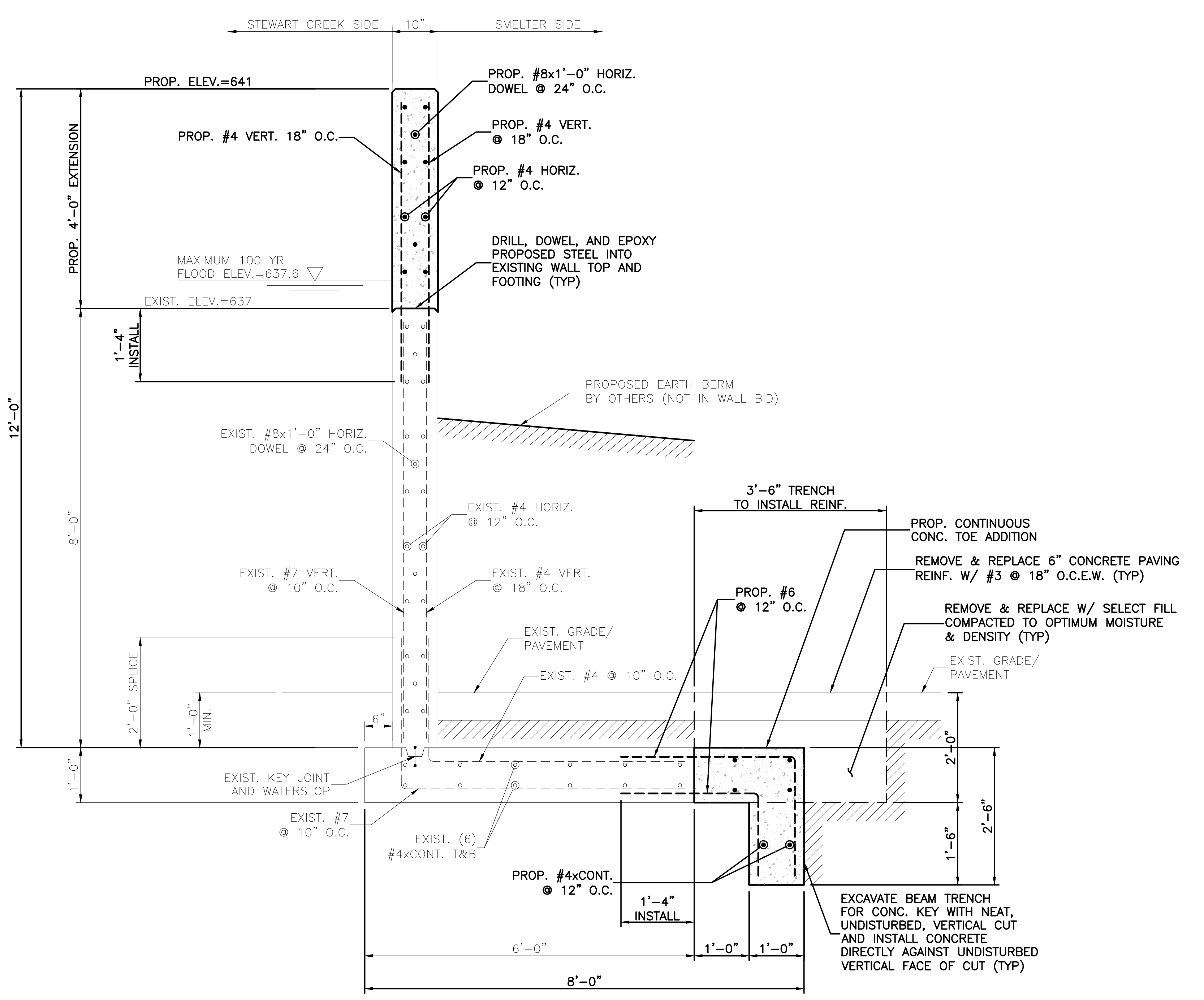
Suite 124
Dallas, TX 75206
T 469-374-0810
F 469-374-0811
www.gwcengineering.com
TX Firm Reg. No. F-1817

FOR REVIEW

GLENN W. CAMPBELL
79683
Glenn Campbell
8/24/2018

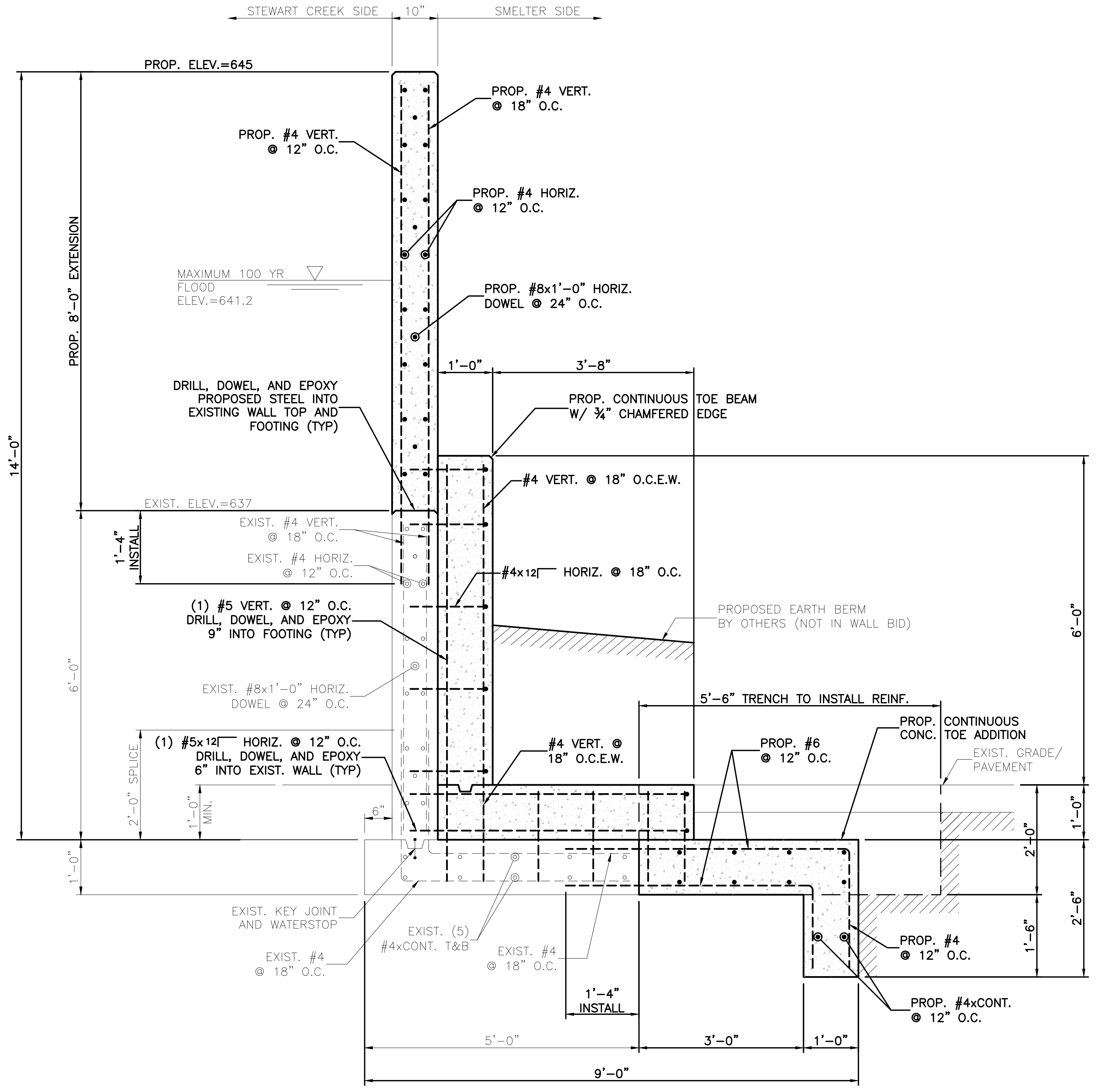
GOLDER:	130208606
JOB NO.	51439
DATE:	AUG 2018
DRAWN:	IMH
CHECKED:	GWC
SCALE:	NOTED

DRAWING NUMBER
S-1



① SECTION B - EXTENSION AT EXISTING 8' HIGH BARRIER WALL - STA. 0+95 TO STA. 3+60

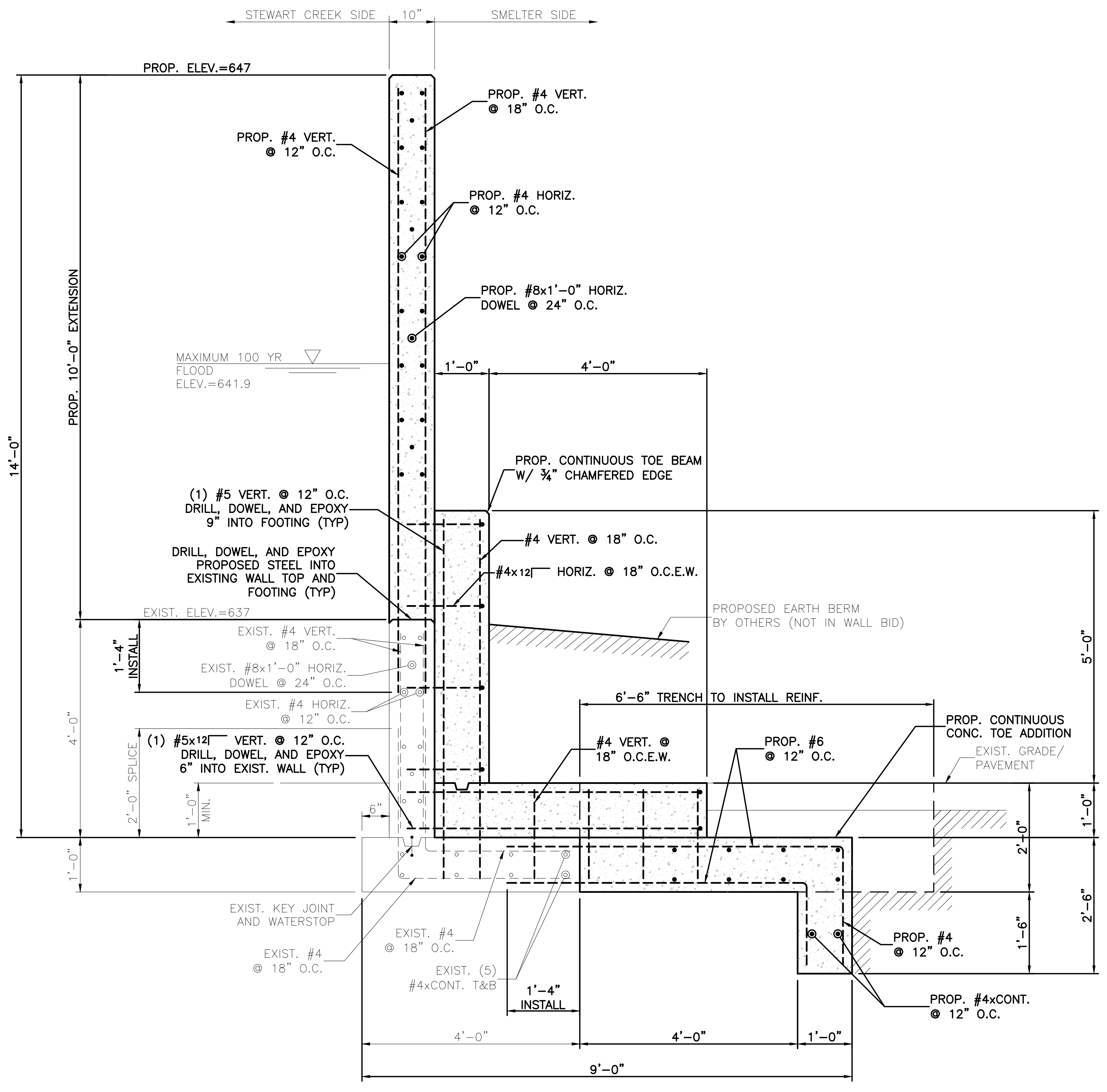
SCALE: 1/2" = 1'-0"



② SECTION C - EXTENSION AT EXISTING 6' HIGH BARRIER WALL - STA. 3+60 TO 6+55

SCALE: 3/4" = 1'-0"

NOTES:
OPTION 1: FOR SECTIONS B, C AND D, MATCH EXPANSION JOINTS OF EXISTING CONCRETE RETAINING WALL (100' O.C.).



③ SECTION D - EXTENSION AT EXISTING 4' HIGH BARRIER WALL - STA. 6+55 TO 9+14

SCALE: 1/2" = 1'-0"

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GOLDER ASSOCIATES INC.
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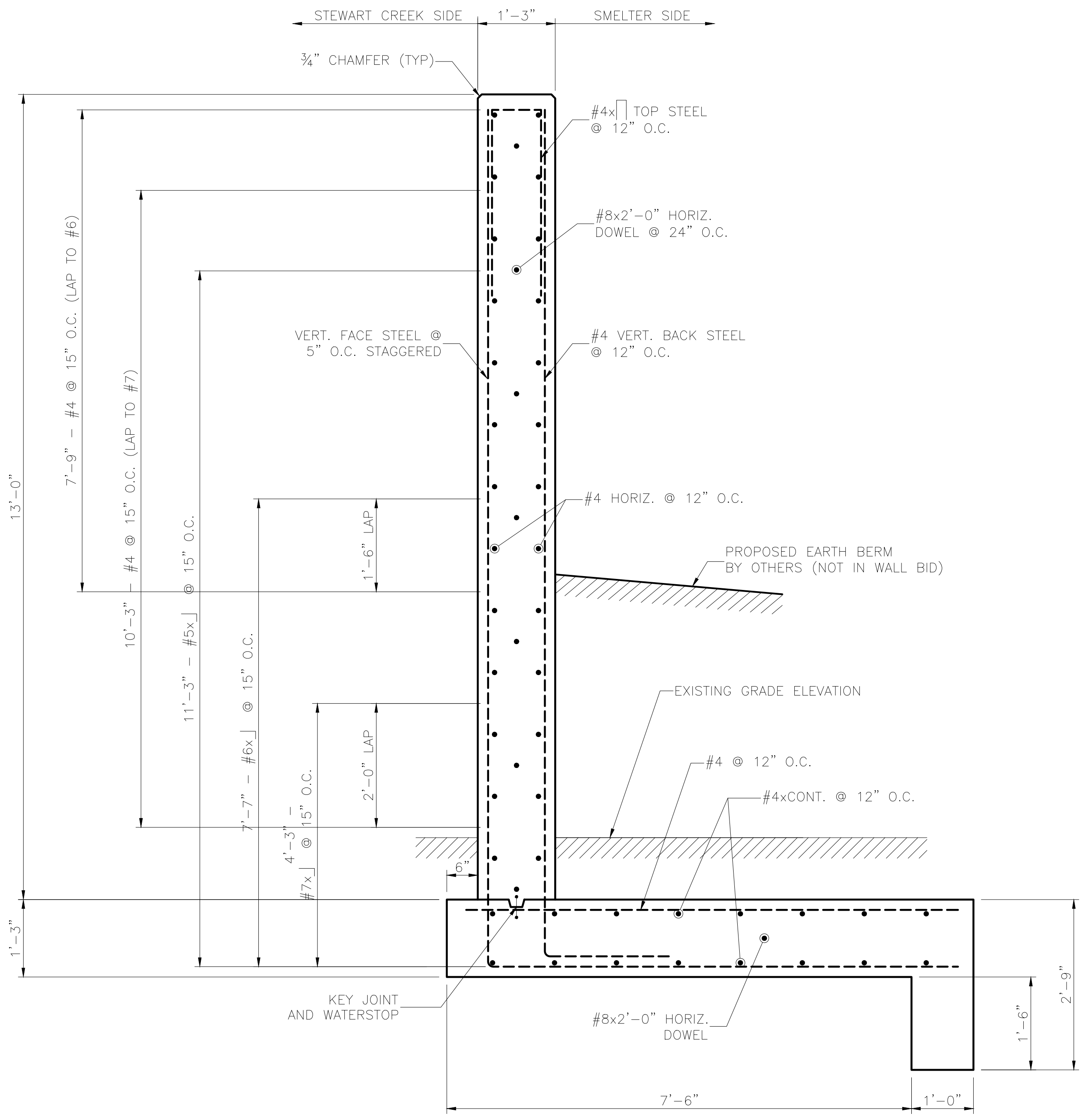
FOR REVIEW

GLENN W. CAMPBELL
79683
8/28/2018

GOLDER: 130208606
JOB NO. 51439
DATE: AUG 2018
DRAWN: IMH
CHECKED: GWC
SCALE: NOTED

DRAWING NUMBER
S-2

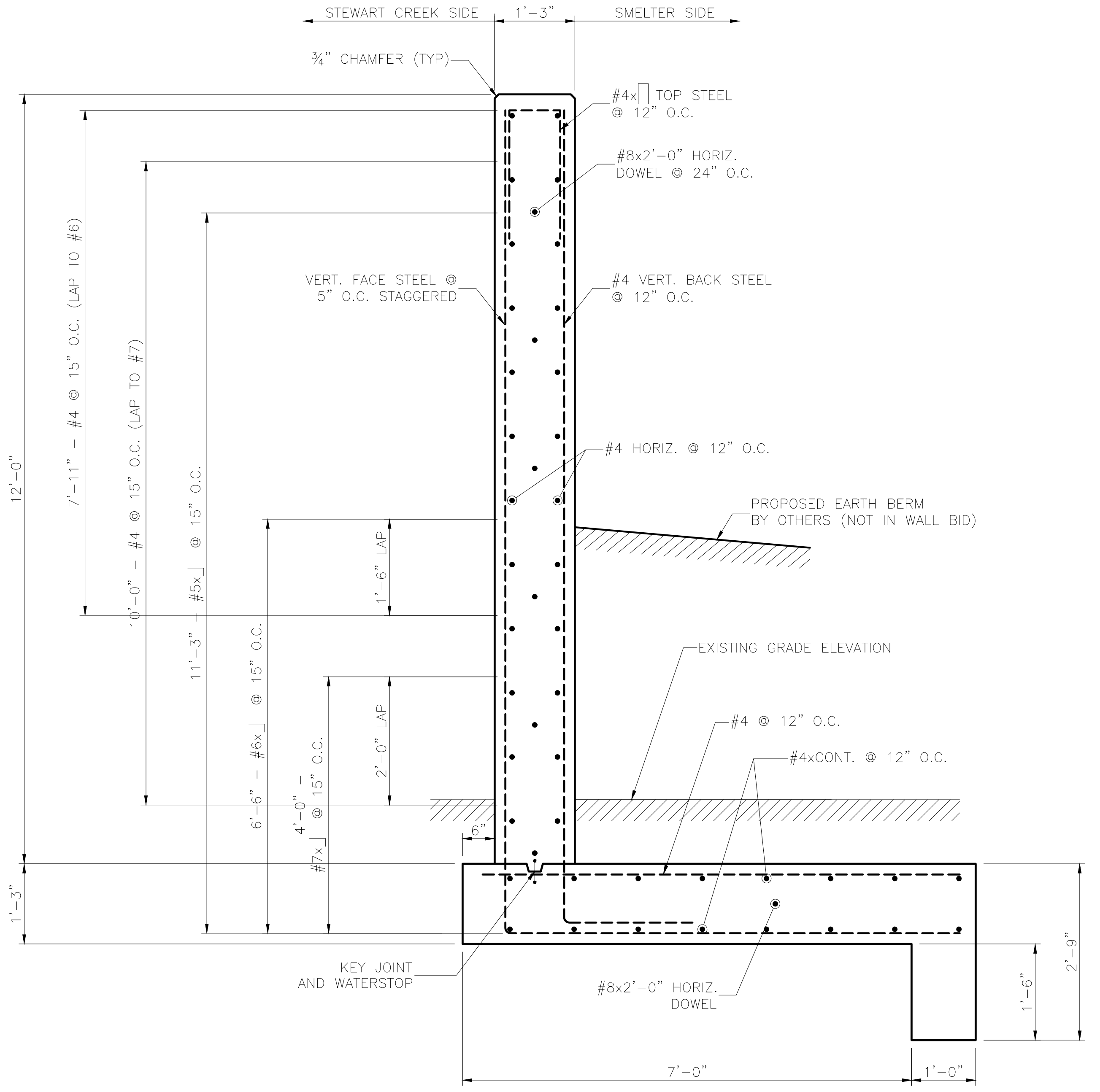


① SECTION E-1 - NEW 13' TALL WALL - STA 9+14 TO 9+50

SCALE: 1/2" = 1'-0"

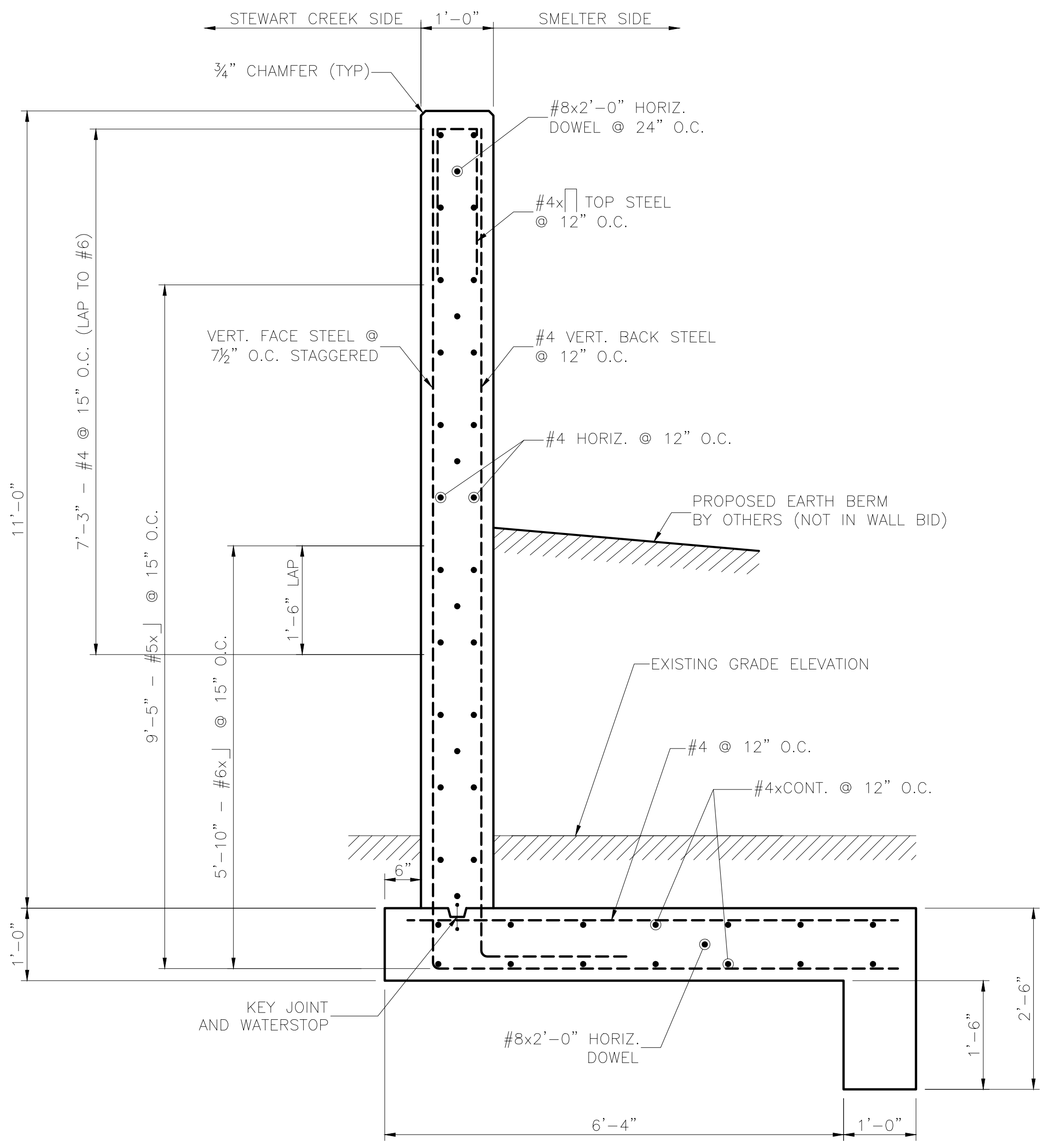
NOTES:

1. FOR SECTIONS B, C AND D, MATCH EXPANSION JOINTS OF EXISTING CONCRETE RETAINING WALL (100' O.C.).



SECTION E-2 - NEW 12' TALL WALL -
② STA. 0+95 TO 3+60 AND 9+50 TO 11+30

SCALE: 1/2" = 1'-0"



③ SECTION E-3 - NEW 11' TALL WALL - STA 11+30 TO 11+48

SCALE: 1/2" = 1'-0"

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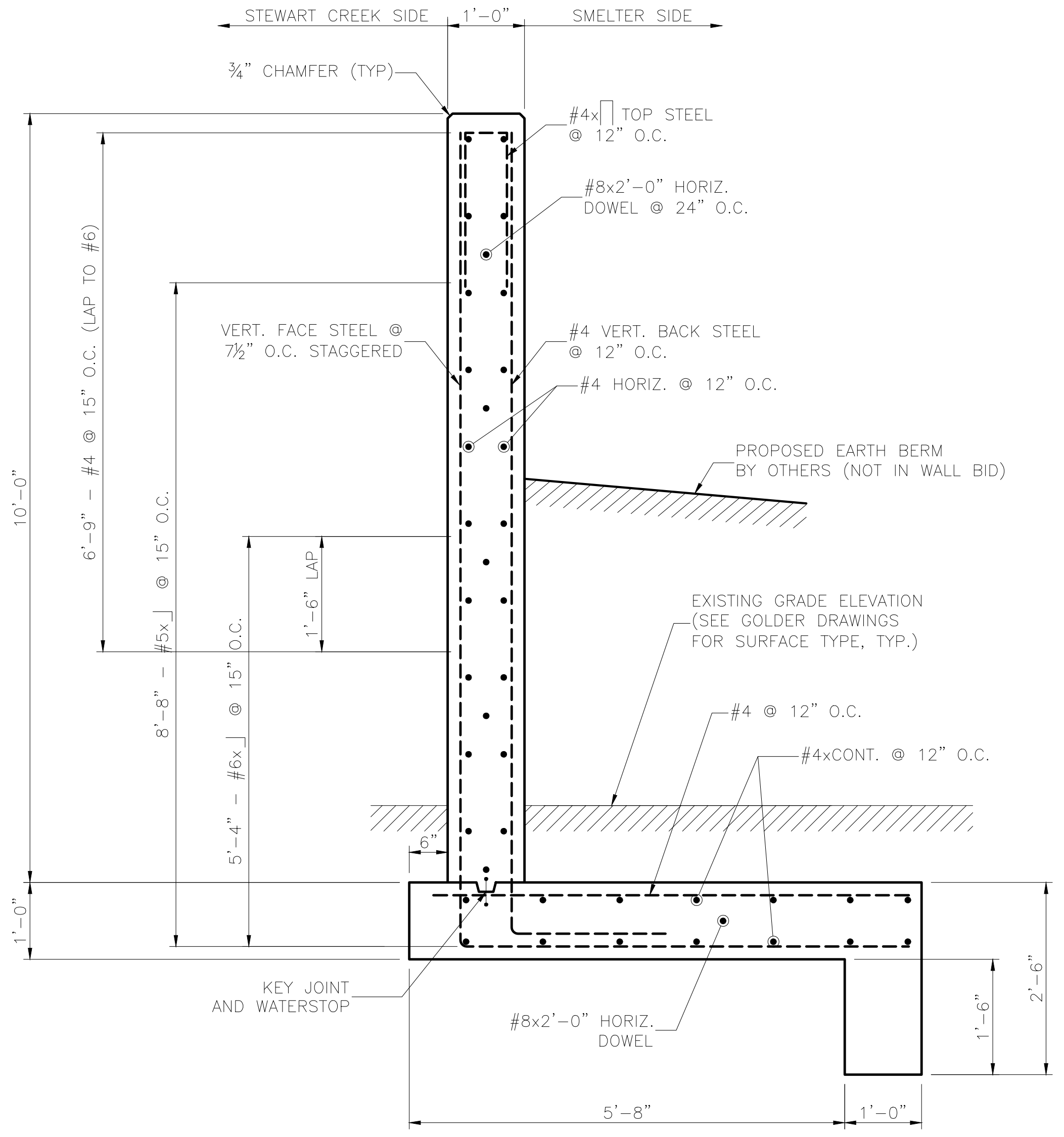
8/24/2018

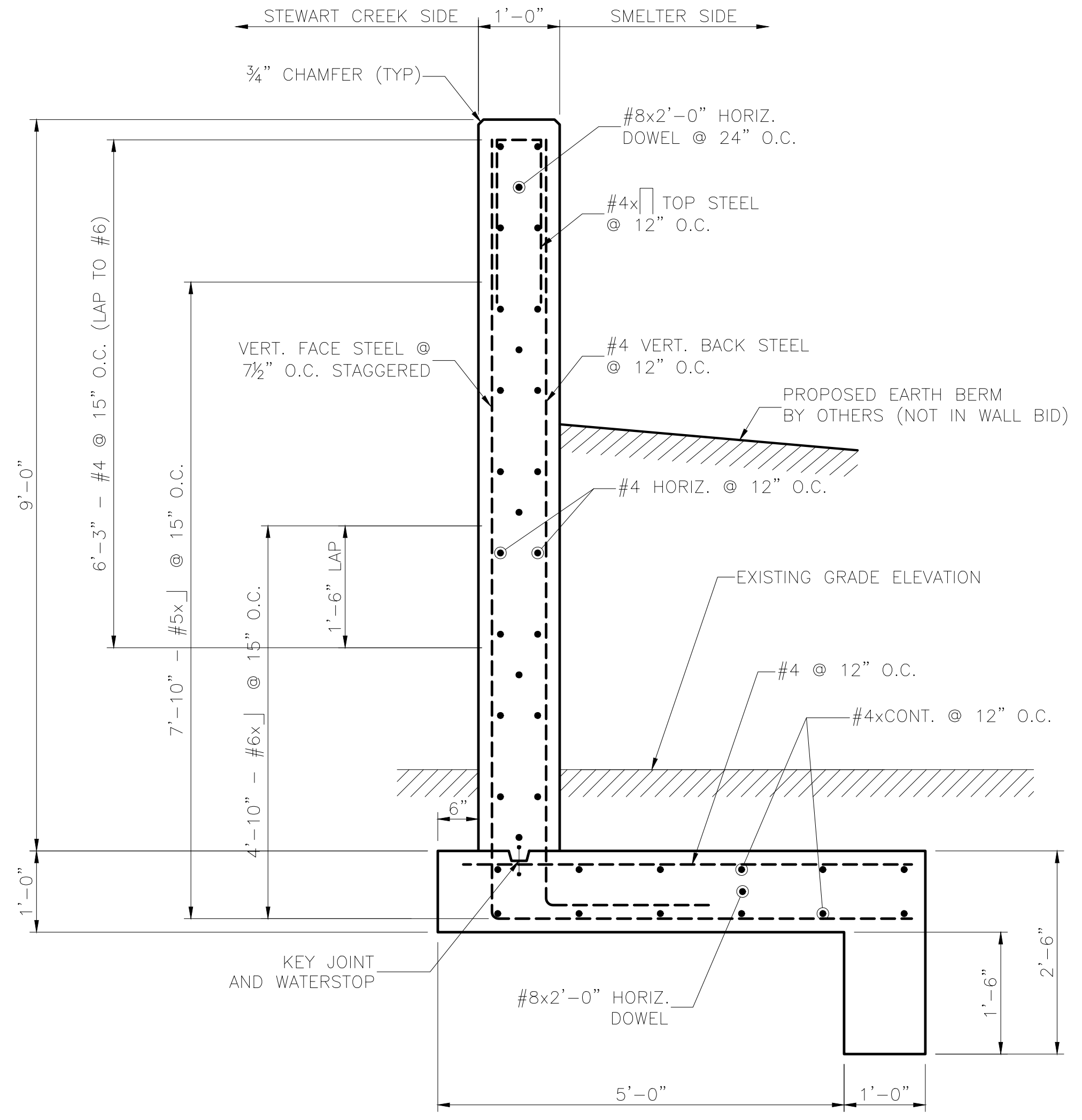
GOLDER: 130208606
JOB NO. 51439
DATE: AUG 2018
DRAWN: IMH
CHECKED: GWC
SCALE: NOTED

DRAWING NUMBER
S-3



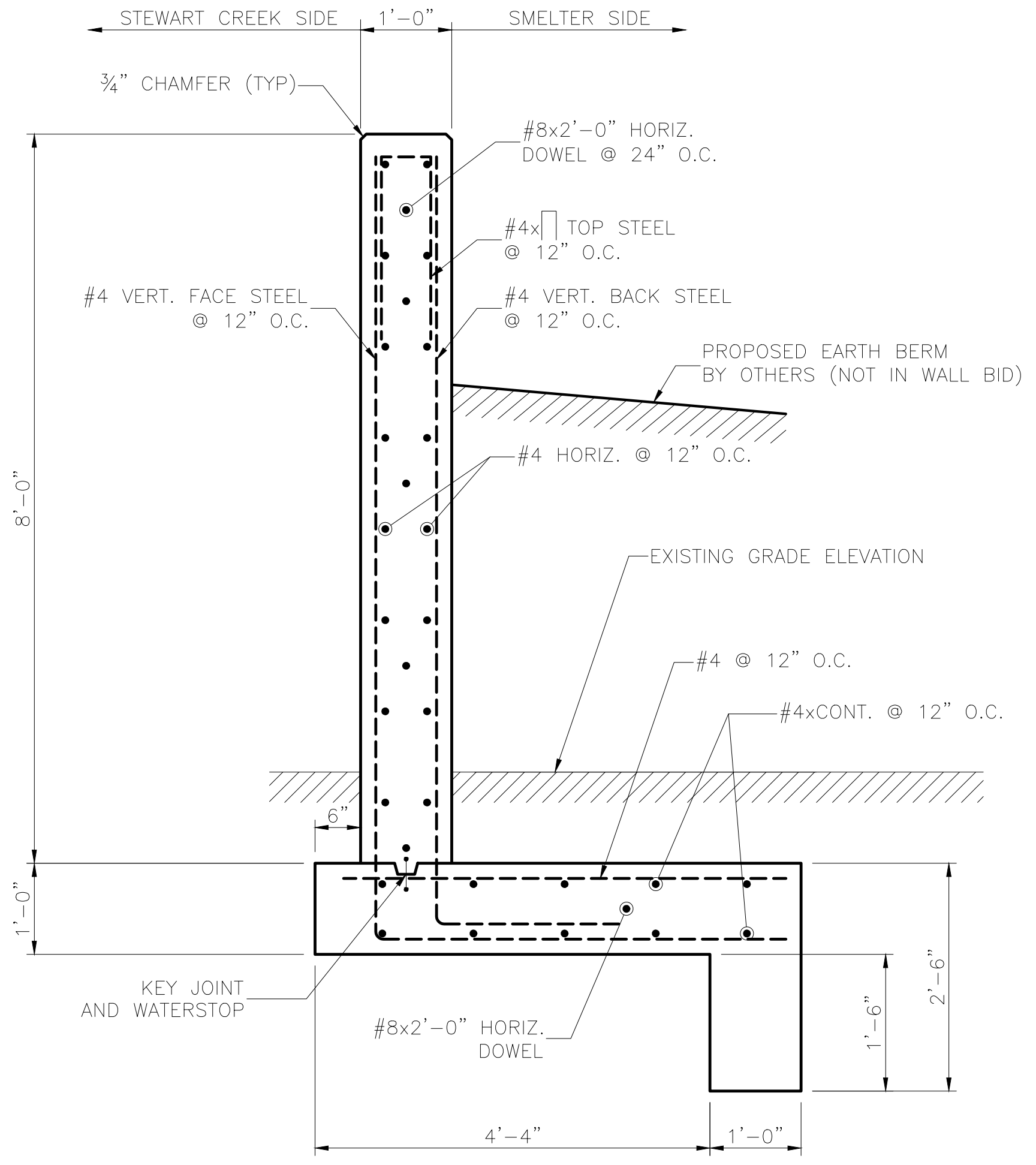
④ SECTION E-4 - NEW 10' TALL WALL - STA 11+48 TO 11+66

SCALE: 1/2" = 1'-0"



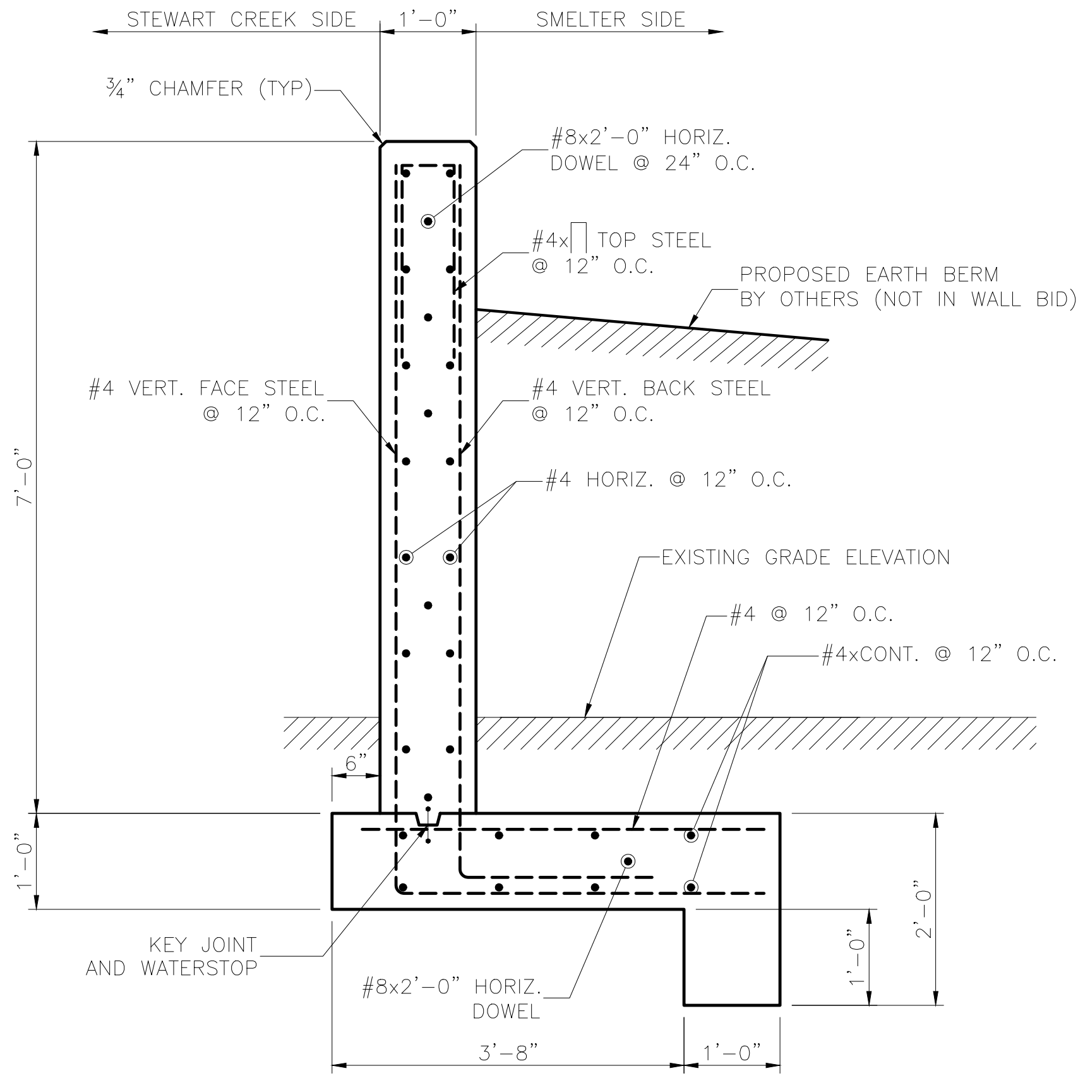
⑤ SECTION E-5 - NEW 9' TALL WALL - STA 11+66 TO 12+05

SCALE: 1/2" = 1'-0"



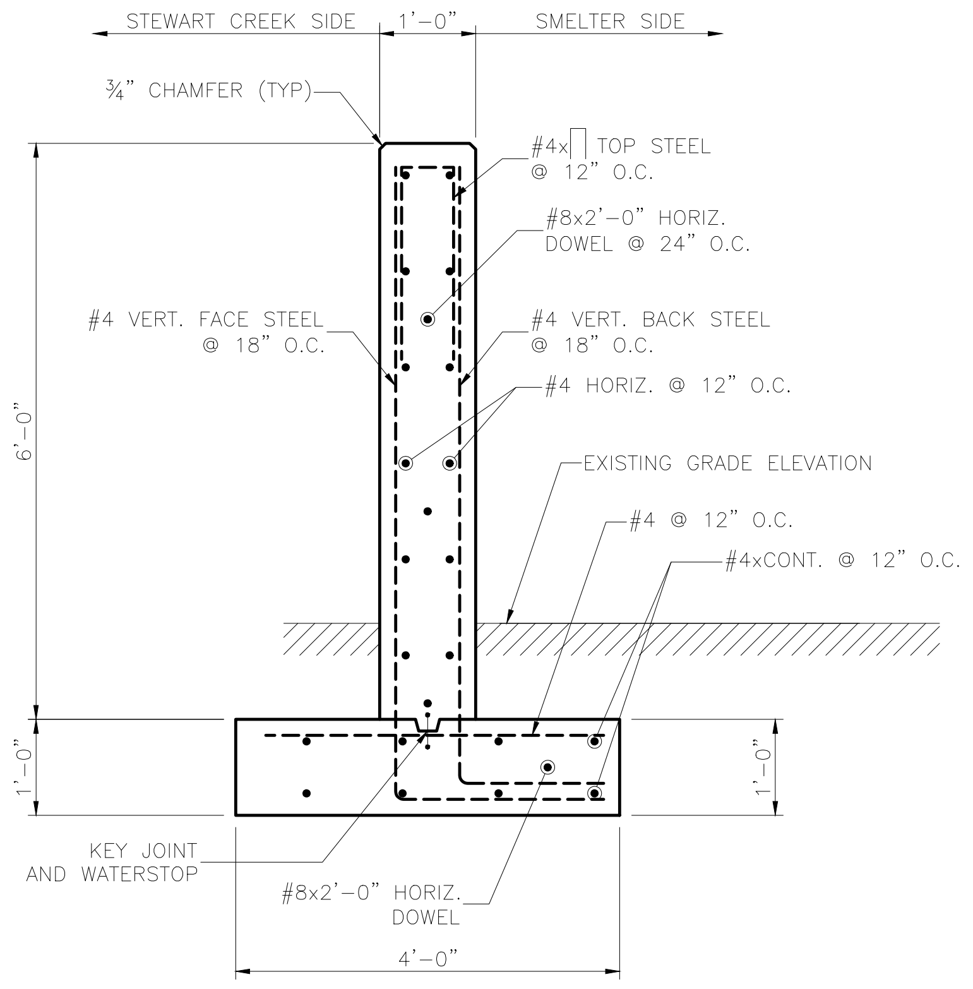
⑥ SECTION E-6 - NEW 8' TALL WALL - STA 12+05 TO 12+50

SCALE: 1/2" = 1'-0"



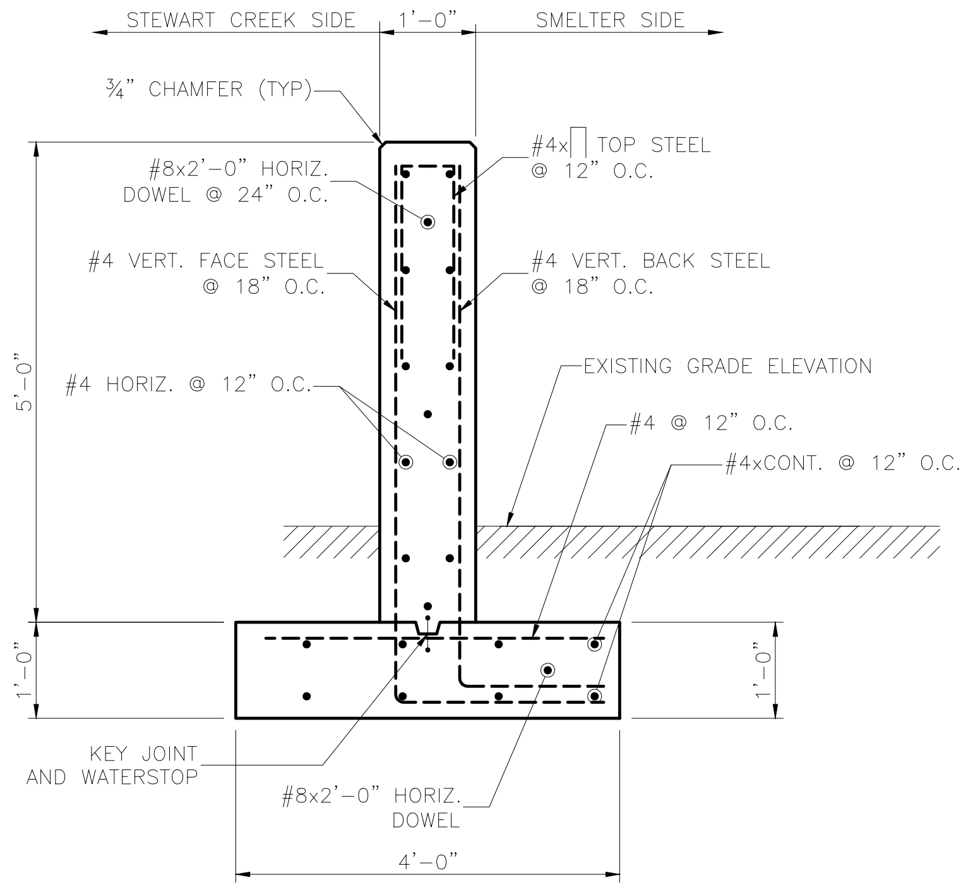
⑦ SECTION E-7 - NEW 7' TALL WALL - STA 12+50 TO 13+44

SCALE: 1/2" = 1'-0"



⑧ SECTION E-8 - NEW 6' TALL WALL - STA 13+44 TO 14+35

SCALE: 1/2" = 1'-0"



⑨ SECTION E-9 - NEW 5' TALL WALL - STA 14+35 TO 15+43

SCALE: 1/2" = 1'-0"

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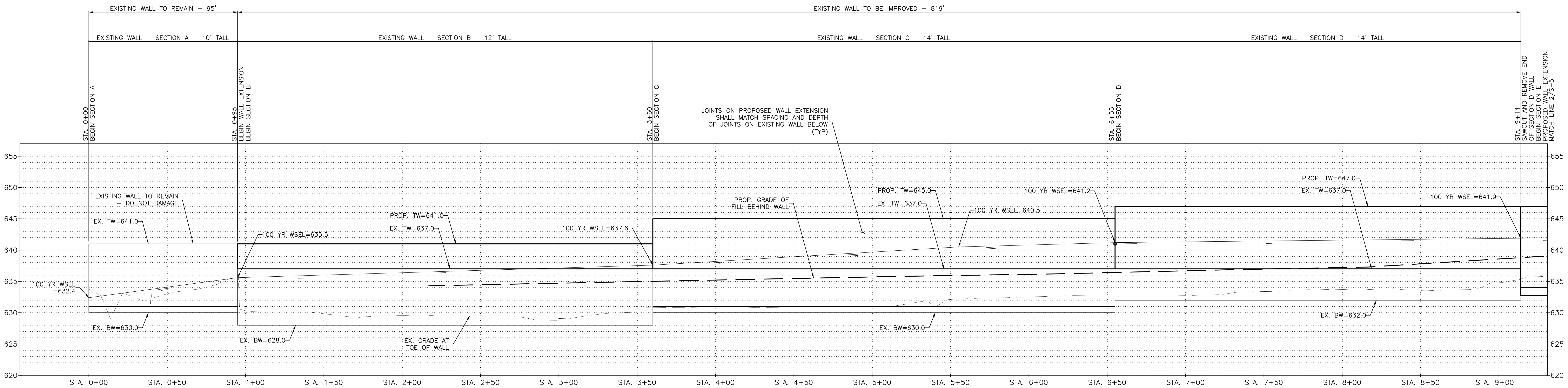
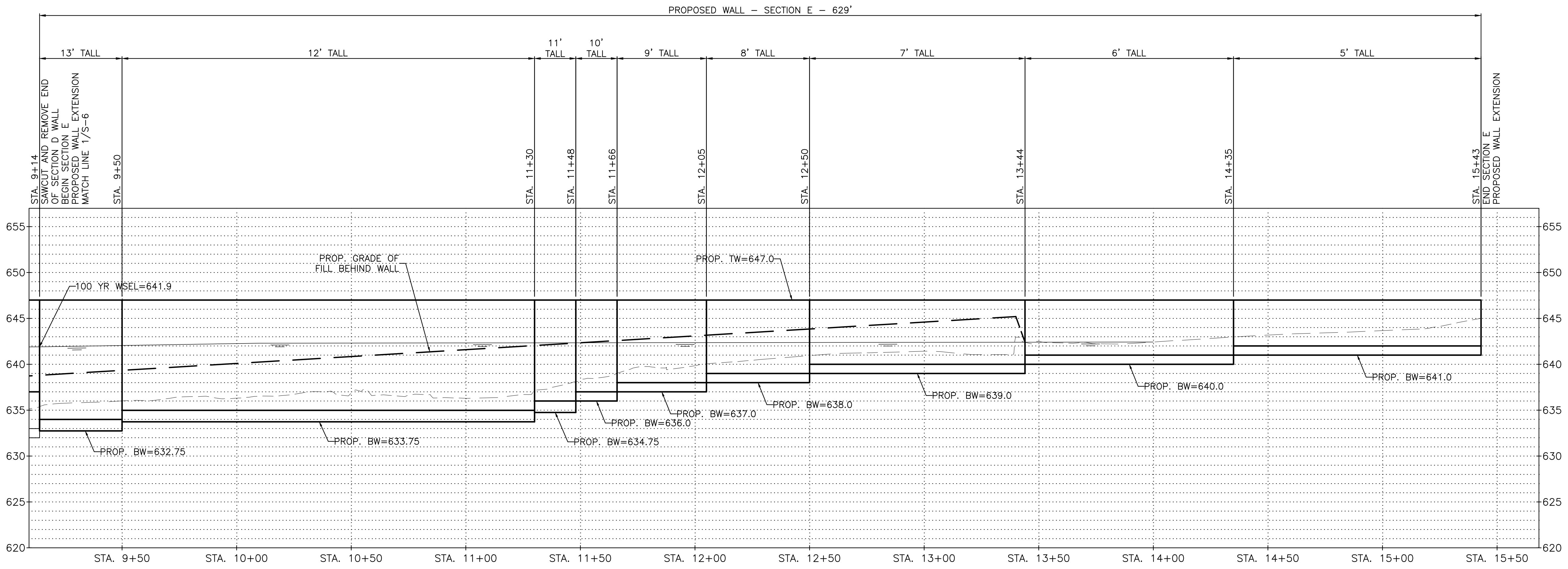
S-4



NOTES:
OPTION 1: FOR SECTIONS B, C AND D, MATCH EXPANSION JOINTS OF EXISTING CONCRETE RETAINING WALL (100' O.C.).
OPTION 2: CONSTRUCTION JOINTS AT 32' MAX SPACING. EXPANSION JOINTS AT STEPS OR AT 100' MAX SPACING.

① PROFILE – PROPOSED RETAINING WALL EXTENSION – SECTIONS A, B, C, AND D
SCALE: 1" = 10'–0"



② PROFILE – PROPOSED RETAINING WALL EXTENSION – SECTION E
SCALE: 1" = 10'–0"

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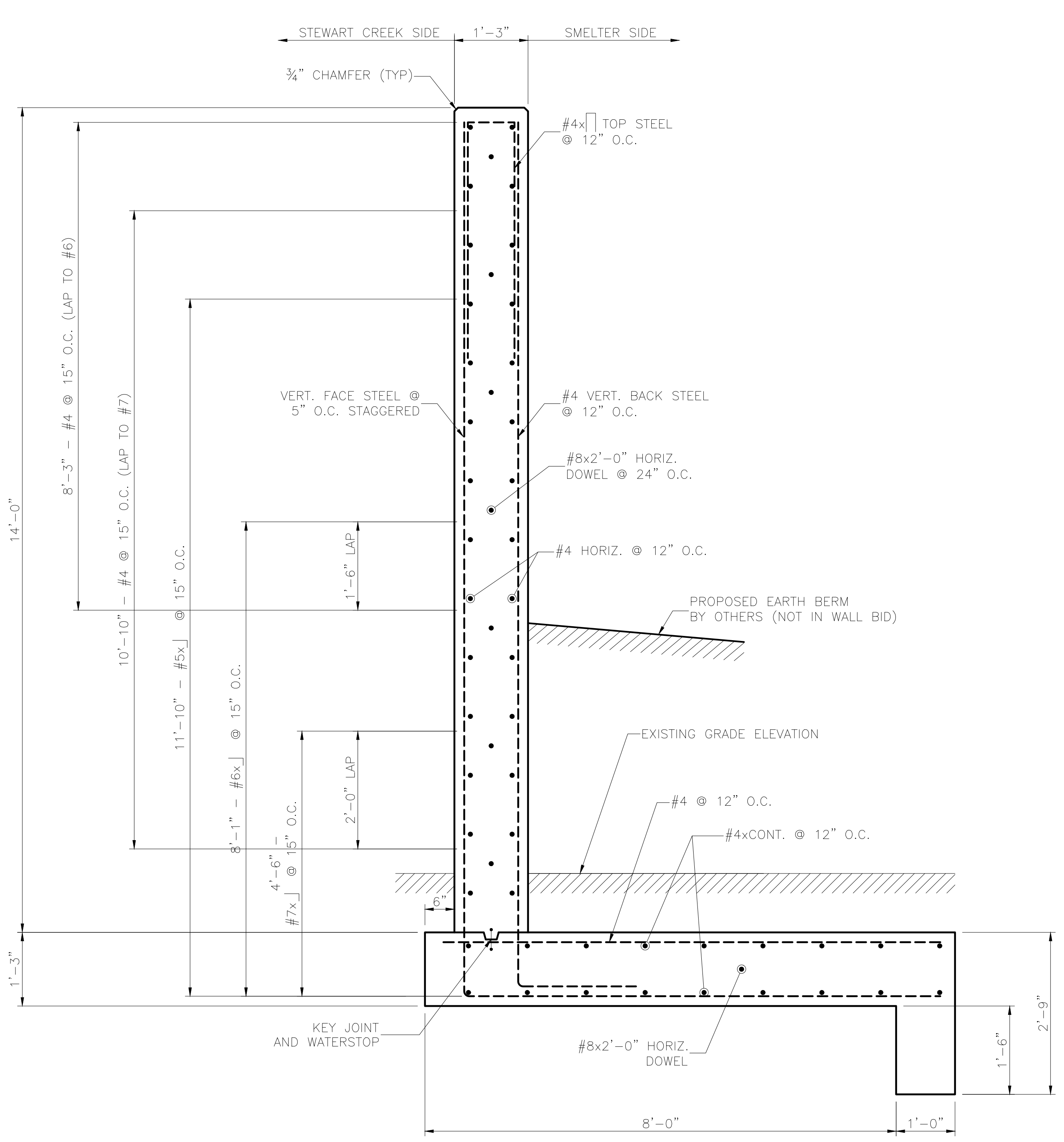
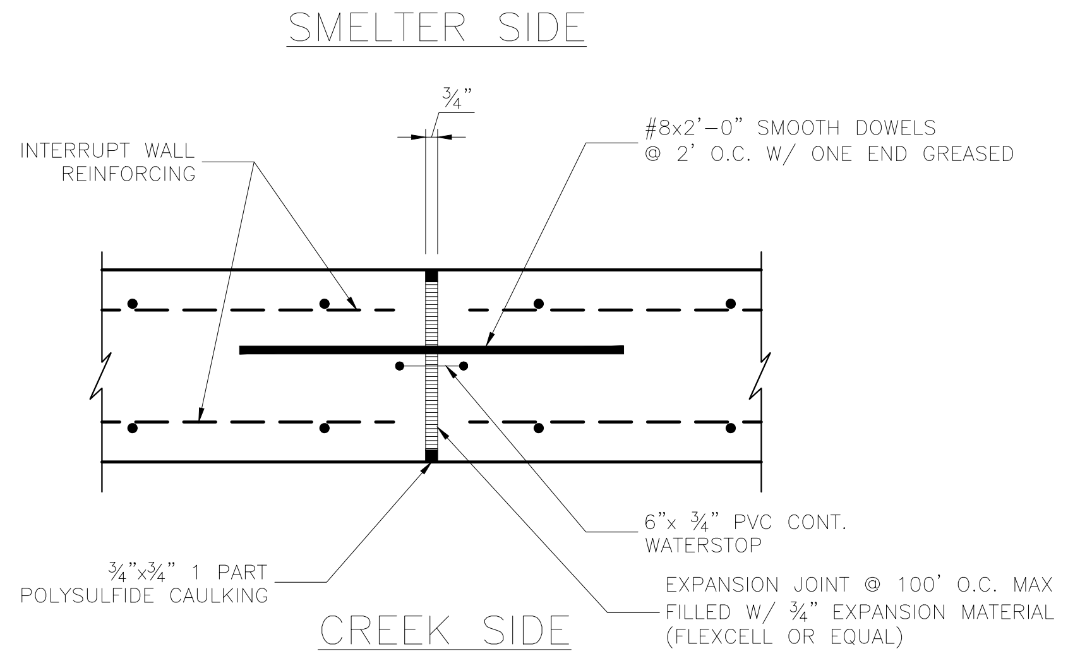
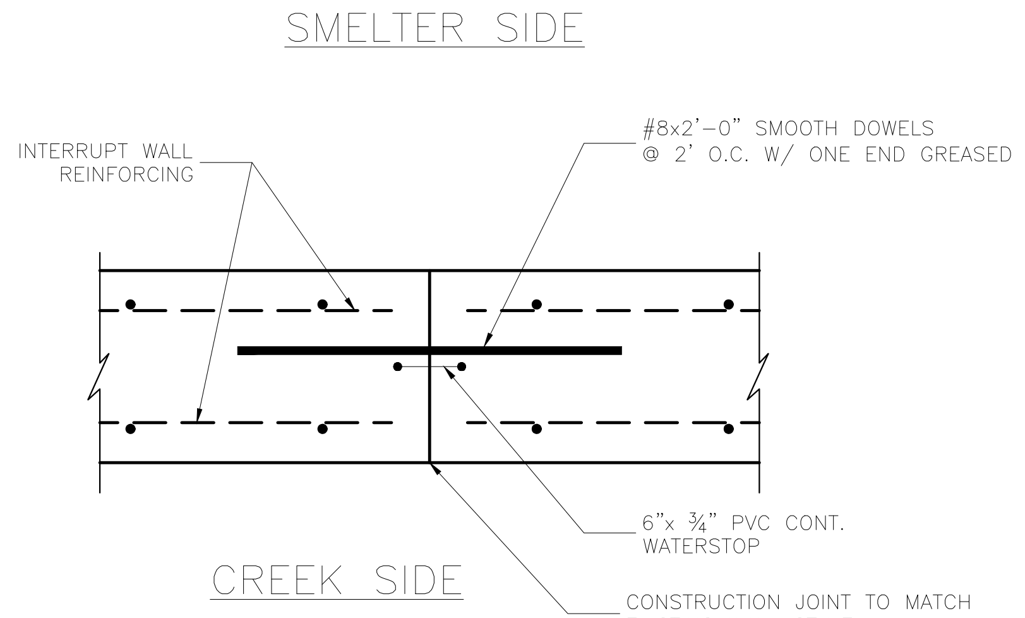
DRAWING NUMBER
S-5



① **SECTION - NEW 14' TALL WALL - STA. 3+60 TO 9+14 (EXIST. WALL REPLACEMENT)**
SCALE: 1/2" = 1'-0"



② **DETAIL - TYPICAL WALL EXPANSION JOINT**
SCALE: 1" = 1'-0"



③ **DETAIL - TYPICAL WALL CONSTRUCTION JOINT**
SCALE: 1" = 1'-0"

GENERAL NOTES

EARTHWORK

1. RETAINING WALL HAS BEEN DESIGNED IN ACCORDANCE WITH GETOTECHNICAL ENGINEERING MEMORANDUM BY KENNETH M. BERRY, P.E. OF GOLDER ASSOCIATES, INC.; 13515 BARRETT PARKWAY DRIVE, SUITE 260; BALLWIN, MO 63021; DATED AUGUST 14, 2018; TEL: 314-984-8800; PROJECT NO. 130208606.

2. ALL VEGETATION AND TOPSOIL WITHIN LIMITS OF CONCRETE WORK CONTAINING ORGANIC MATTER, AND ANY OTHER DEBRIS, SHALL BE CLEARED, GRUBBED AND LEGALLY REMOVED FROM THE SITE AT THE BEGINNING OF EARTHWORK CONSTRUCTION.

3. BACKFILL NORTH OF WALL SHALL BE PLACED IN ACCORDANCE WITH CROSS-SECTION DETAILS OF CONTAINMENT BERM BY GOLDER ASSOCIATES, INC.

CONCRETE FORMWORK

1. ALL CONCRETE FORMWORK SHALL BE SQUARE, PLUMB, AND STRAIGHT WITHOUT SAGS OR BULGES.

2. ALL CONCRETE FORMWORK SHALL BE DESIGNED WITH ADEQUATE SUPPORT FOR THE LOADS, LATERAL PRESSURE AND ALLOWABLE STRESSES AS OUTLINED IN ACI 347, CHAPTER 1 AND 2.

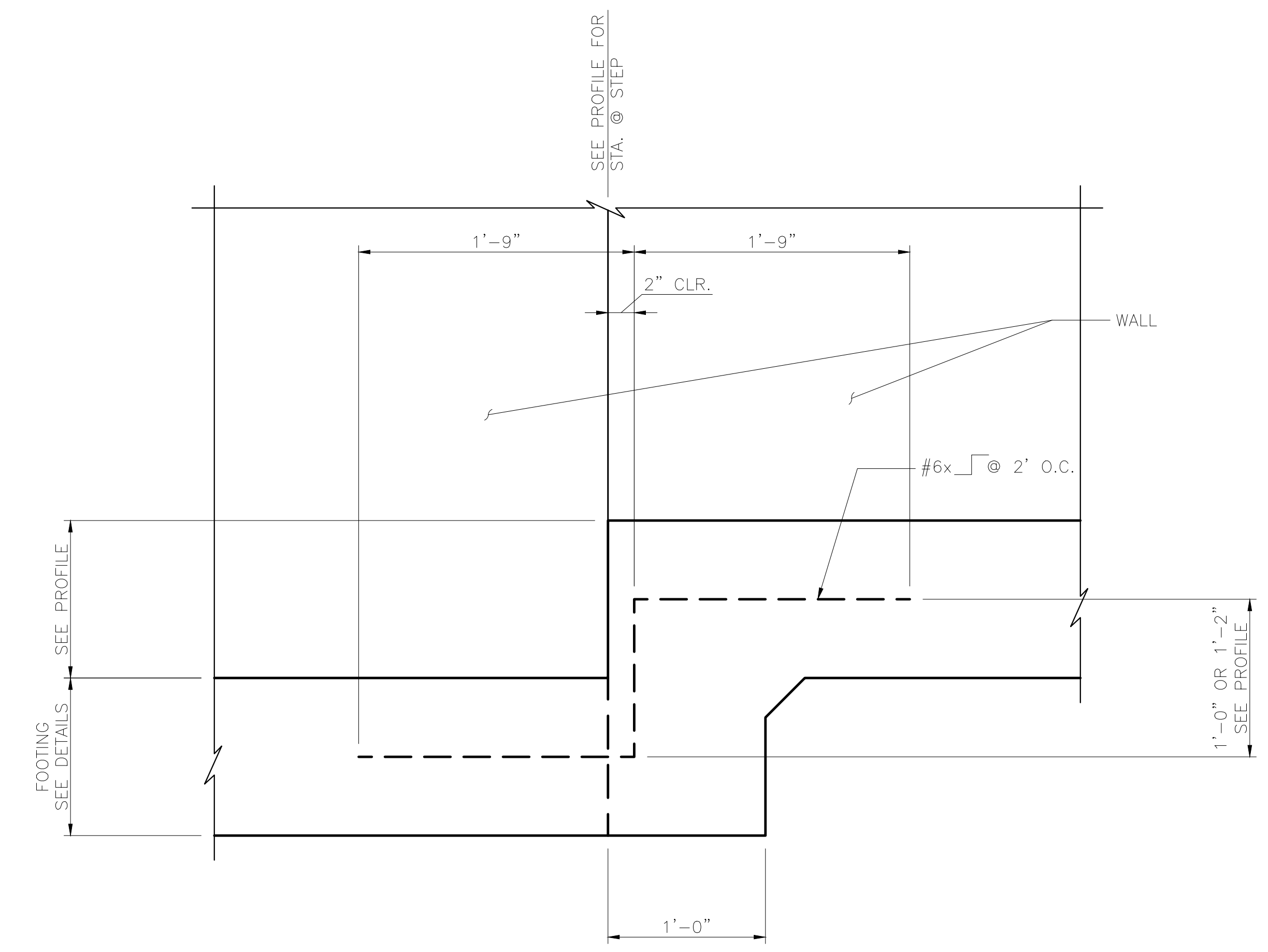
3. ALL EXPOSED FINISH CONCRETE SURFACES SHALL BE SMOOTH WITHOUT FORM MARKS, KNOTS, HOLES, DENTS AND OTHER SURFACE DEFECTS.

4. FORMS SHALL BE SUBSTANTIAL AND SUFFICIENTLY TIGHT TO PREVENT LEAKAGE OF CONCRETE.

5. FORMS SHALL BE BRACED OR TIED TO MAINTAIN DESIRED POSITION, SHAPE AND ALIGNMENT DURING AND AFTER CONCRETE PLACEMENT.

6. CONCRETE FORMS SHALL NOT BE REMOVED OR DISTURBED UNTIL CONCRETE HAS ATTAINED SUFFICIENT STRENGTH TO SUPPORT ALL DEAD AND LIVE LOADS.

7. CARE SHALL BE TAKEN IN FORM REMOVAL TO PREVENT SURFACE GOUGING, CORNER OR EDGE BREAKAGE AND OTHER OTHER DAMAGE TO THE CONCRETE.



④ **DETAIL - TYPICAL FOOTING STEP**
SCALE: 1" = 1'-0"

CONCRETE

1. ALL CONCRETE SHALL UTILIZE CRUSHED LIMESTONE AGGREGATE AND SHALL DEVELOP A MINIMUM COMPRESSIVE STRENGTH OF 3,600 PSI AT 28 DAYS.

2. MAXIMUM SIZE OF COARSE AGGREGATE SHALL BE 1 1/2".

3. ALL CONCRETE SHALL BE DESIGNED, MIXED, TRANSPORTED, AND PLACED IN ACCORDANCE WITH THE LATEST SPECIFICATIONS OF THE AMERICAN CONCRETE INSTITUTE.

4. CONCRETE SLUMP SHALL BE 5" MAXIMUM.

REINFORCEMENT

1. ALL #3 BARS SHALL CONFORM TO ASTM SPECIFICATION A615, GRADE 40. ALL OTHER REINFORCING STEEL SHALL CONFORM TO ASTM A615, GRADE 60. FOREIGN STEEL IS ACCEPTABLE IF MILL CERTIFICATES OF COMPLIANCE WITH ASTM ARE PROVIDED.

2. ALL REINFORCEMENT SHALL BE DESIGNED AND DETAILED IN ACCORDANCE WITH THE LATEST EDITION OF THE ACI "MANUAL OF STANDARD PRACTICE FOR DETAILING CONCRETE STRUCTURES" (ACI 315).

3. ALL REINFORCING BAR BENDS SHALL BE MADE COLD. GRADE 60 BARS MAY BE BENT IN THE FIELD ONE TIME ONLY.

4. WHERE SPLICES ARE REQUIRED IN CONCRETE REINFORCEMENT, BARS SHALL BE SPLICED A MINIMUM OF AN ACI CLASS "C" SPLICE FOR THE SIZE BAR UTILIZED.

5. HOOK ALL BARS AT DISCONTINUOUS ENDS.

6. ALL HOOKS SHALL BE ACI STANDARD 90 DEGREE HOOKS UNLESS DETAILED OTHERWISE.

7. REINFORCEMENT IN CONCRETE SHALL BE SUPPORTED TO PROVIDE THE FOLLOWING MINIMUM CONCRETE COVER:

CAST AGAINST AND PERMANENTLY EXPOSED TO EARTH	3 INCHES
FORMED, EXPOSED TO EARTH OR WEATHER	2 INCHES

8. ALL BAR LENGTH AND DIMENSIONS ARE OUT-TO-OUT AND DO NOT INCLUDE HOOKS AND BENDS.

DESIGN NOTES

1. WALL DESIGN PARAMETERS:
   EFP = 50 PCF
   μ = 0.35
   DENSITY OF EARTH = 125 PCF
   BEARING CAPACITY = 2,000 PSF
   PASSIVE FLUID PRESSURE = 275 PCF

2. FACTORS OF SAFETY:
   SLIDING = 1.5
   OVERTURNING = 2.0
   BEARING = 3.0

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FOR REVIEW

GLENN W. CAMPBELL
79683
8/24/2018

GOLDER:	130208606
JOB NO.	51439
DATE:	AUG 2018
DRAWN:	IMH
CHECKED:	GWC
SCALE:	NOTED

DRAWING NUMBER
S-6

APPENDIX H-3

GWC Design Floodwall Analysis

STRUCTURAL CALCULATIONS

PROPOSED FLOOD BARRIER WALL PROTECTING IMPROVEMENTS ALONG NORTH BANK OF STEWART CREEK
(ADJACENT TO EXIDE FACILITY)
EAGAN WAY
FRISCO, TEXAS

GLENN W. CAMPBELL
79683

Glenn W. Campbell
08/22/2018

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PROPOSED CONCRETE FLOOD BARRIER WALL
PROTECTING IMPROVEMENTS
ALONG NORTH BANK OF STEWART CREEK
(ADJACENT TO EXIDE FACILITY)
EAGAN WAY
FRISCO, TEXAS

DESIGN METHODOLOGY: The proposed concrete barrier wall is located west of Eagan Way in Frisco, Texas, along the north side of Stewart Creek where it runs in a westerly direction adjacent to and south of the Exide Facility. The proposed concrete barrier wall was designed with two options in mind:

1. To utilize the existing concrete barrier wall from Sta. 0+95 to Sta. 9+14, extending the top of the wall upward and the heel of the wall northward to accommodate the updated higher 100-year flood elevation in Stewart Creek adjacent to and South of the existing concrete barrier wall.

2. To demolish and remove the existing concrete barrier wall from Sta. 0+95 to Sta. 9+14, and replace it with a new concrete barrier wall.

Both of the above scenarios would involve design of a new concrete barrier wall to the northeast of Stewart Creek from Sta. 9+14 to Sta. 15+43.

DESIGN PARAMETERS:

Active Equivalent Fluid Pressure for new earth (berm) fill north of wall = 50 pcf
Passive Equivalent Fluid Pressure for new wall key to resist sliding = 275 pcf
Coefficient of Friction = 0.35
Bearing Pressure (capacity) = 2,000 psf
Earth density = 125 pcf
Concrete Density = 145 pcf

FACTORS OF SAFETY:

Sliding = 1.5
Overturning = 2.0
Bearing = 3.0 (by Geotechnical Engineer)

FRISCO FLOOD WALL (STA. 3+50) EXTENSION

$\mu = 0.35$ EFP = 50
passive p = 275 psf

SLIDING:

Forces (Earth): (controls)

$\overleftarrow{F} = \frac{50(7)^2}{2} = 1.23$ klf

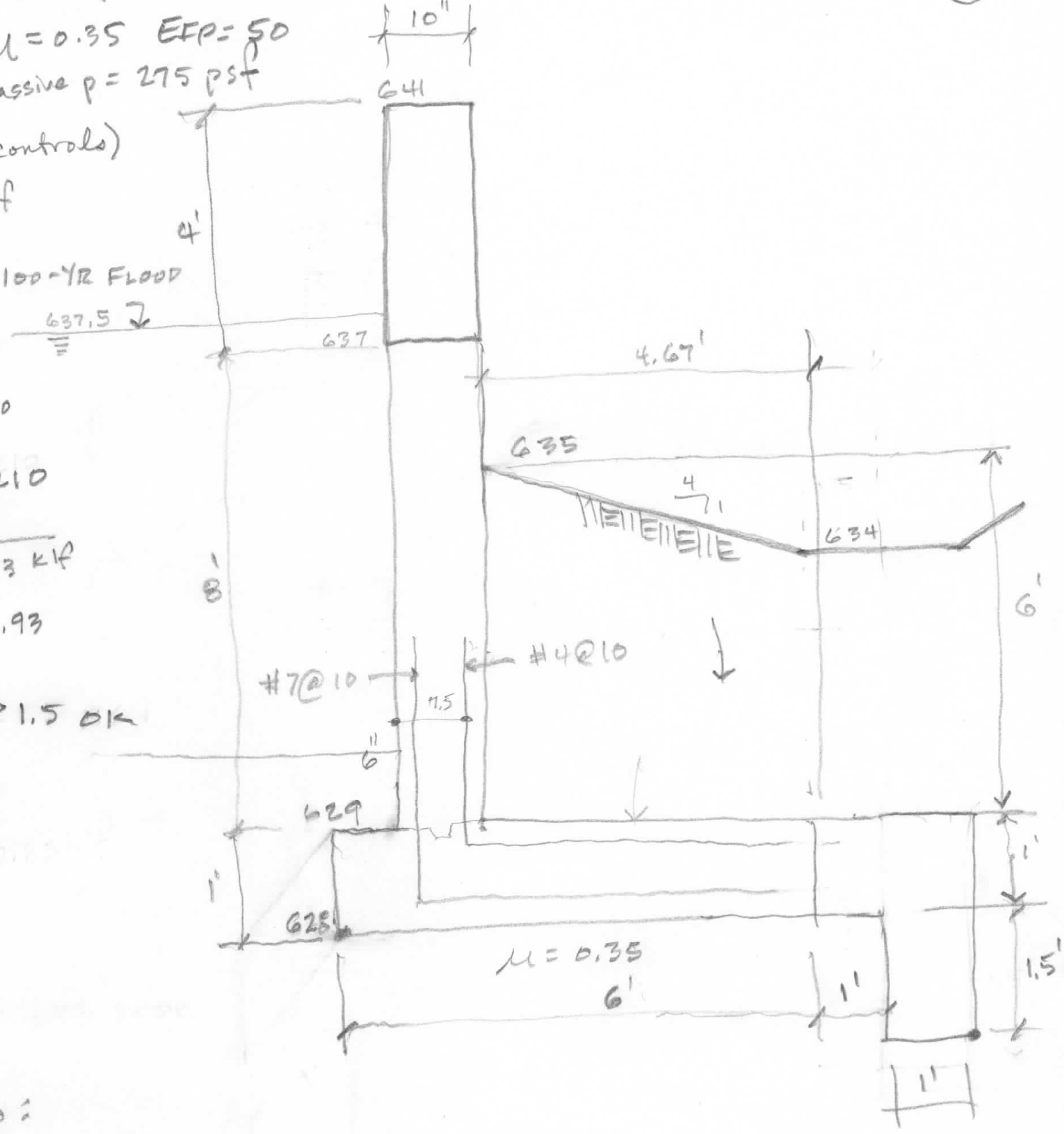
$\overrightarrow{F}_{GRAV:}$

Conc: $6 \times 1 \times 145 = 870$
$12 \times \frac{10}{12} \times 145 = 1450$

Earth: $4.67 \times 6 \times 125 = 3210$
$\left(-\frac{1 \times 4.67 \times 125}{2}\right)$
$\overline{5.53}$ klf

$\overrightarrow{F} = 5.53(0.35) = 1.93$

and $\frac{1.93}{1.23} = 1.57 > 1.5$ OK



OVERTURNING:

Forces (Earth)

$\overleftarrow{F} = \frac{50(7)^2}{2} = 1.23$ so $\overleftarrow{M} = 1.23\left(\frac{7}{3}\right) = 2.87^{\prime\text{-K}/\prime}$

Forces (Earth & Conc)

$\overrightarrow{M}_{conc} = .870(3) = 2.61$
$1450(.5+\frac{5}{12}) = 1.32$

$\overrightarrow{M}_{earth} = 3.21 \times 3.67 = 11.78$

$\frac{15.71}{2.87}$ = FS of $5.47 > 2.0$ OK

MOMENT IN CONCRETE (Earth) (STA 3+50)

$\overset{\curvearrowleft}{M}$ @ Top of Footing $= \frac{50(6)^2}{2} = 0.90^{1-k} \left(\frac{6}{3}\right)' = 1.80^{1-k/1}$

$As_{req'd} = \frac{M(1.6)}{4.02(d)} = \frac{1.80(1.6)}{2.8(7.5)} = .14\ in^2/ft <$ #4@10 $(.24\ in^2/ft)$, OK

$\uparrow$ (Au used by TxDOT)

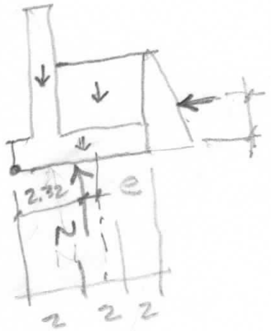
CHECK BEARING:

Determine $N = 145 \times 6 \times 1 = 870$

$145 \times 12 \times \frac{10}{12} = 1450$

Earth $= 3210$

5.53 klf



$\overset{\curvearrowleft}{M} + N(x) = \overset{\curvearrowright}{M}$

$2.87 + 5.53(x) = 15.71$

$x = 2.32$

$e = \left|\frac{B}{2} - x\right| = \left|\frac{6}{2} - 2.32\right| = .68$ So, inside middle third, OK

$P_{max} = \frac{N}{B}\left(1 + \frac{6e}{B}\right)$

$= \frac{5.53}{6}\left(1 + \frac{6(.68)}{6}\right) = 1.55$ ksf < 2.0 ksf OK

WATER (Sta 3+50)

$$\overrightarrow{F}_{water} = \frac{62.4(9.5)^2}{2} = 2.82 \text{ klf}$$

$$\overleftarrow{F}_{Grav:} = \left.\begin{matrix} .87 \\ 1.45 \\ 3.21 \end{matrix}\right\} 5.53 \text{ and } \frac{5.53}{2.82} = 1.96 < 2 \text{ NG., so add } \underline{\text{key}}$$

OVERTURNING (water)

$$\overset{\curvearrowright}{M}_{water} = 2.82\left(\frac{9.5}{3}+1.5\right) = 13.16^{\text{l-k/l}}$$

$$\left.\begin{matrix} \overset{\curvearrowleft}{M}: 145(7)(1) = 1.01 & \times\ 3.5 = 3.54 \\ 145(1.5) = .22 & \times\ .5 = .11 \\ 1.45 & \times\ 6.08 = 8.82 \\ 3.21 & \times\ 2.84 = 9.11 \\ \frac{275(7.5)^2}{2} = 7.73 & \times\ \frac{7.5}{3} = 19.34 \end{matrix}\right\} \frac{40.92}{13.16} = 3.1 > 2.0 \text{ OK}$$

MOMENT IN CONCRETE (water)

$$\overset{\curvearrowright}{M}_{water} = \frac{62.4(8.5)^2}{2} \times \frac{8.5}{3} = 6.39^{\text{l-k/l}}$$

at top of footing

$$A_{s\,req'd} = \frac{6.39(1.6)}{2.8(7.5)} = .49 \text{ in}^2 < \#7 @ 10 \ (.72 \text{ in}^2) \quad \underline{\text{OK}}$$

BEARING (water)

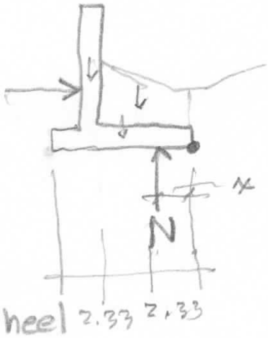
$$N = 5.53, \text{ so } \overset{\curvearrowright}{M} + N(x) = \overset{\curvearrowleft}{M}$$

$$\overset{\curvearrowright}{M} = 2.82\left(\frac{9.5}{3}\right) = 8.93, \text{ so } 8.93 + 5.53x = 21.47$$

$$x = 2.26$$

$$e = \left|\frac{B}{2} - x\right| = \left|\frac{7}{2} - 2.26\right| = 1.24$$

outside middle third, so add $\underline{\text{1' heel}}$



$$P_{max} = \frac{N}{B}\left(1+\frac{6e}{B}\right) = \frac{5.53}{7}\left(1+\frac{6(1.24)}{7}\right) = 1.63 \text{ ksf} < 2000, \text{ OK}$$

STA. 6+50

SLIDING:

Forces (Earth)

$\overleftarrow{F_E} = \frac{50(6.5)^2}{2} = 1.06$ klf

$\overrightarrow{F}_{Grav}$:

Conc. 5×1×145 = .725

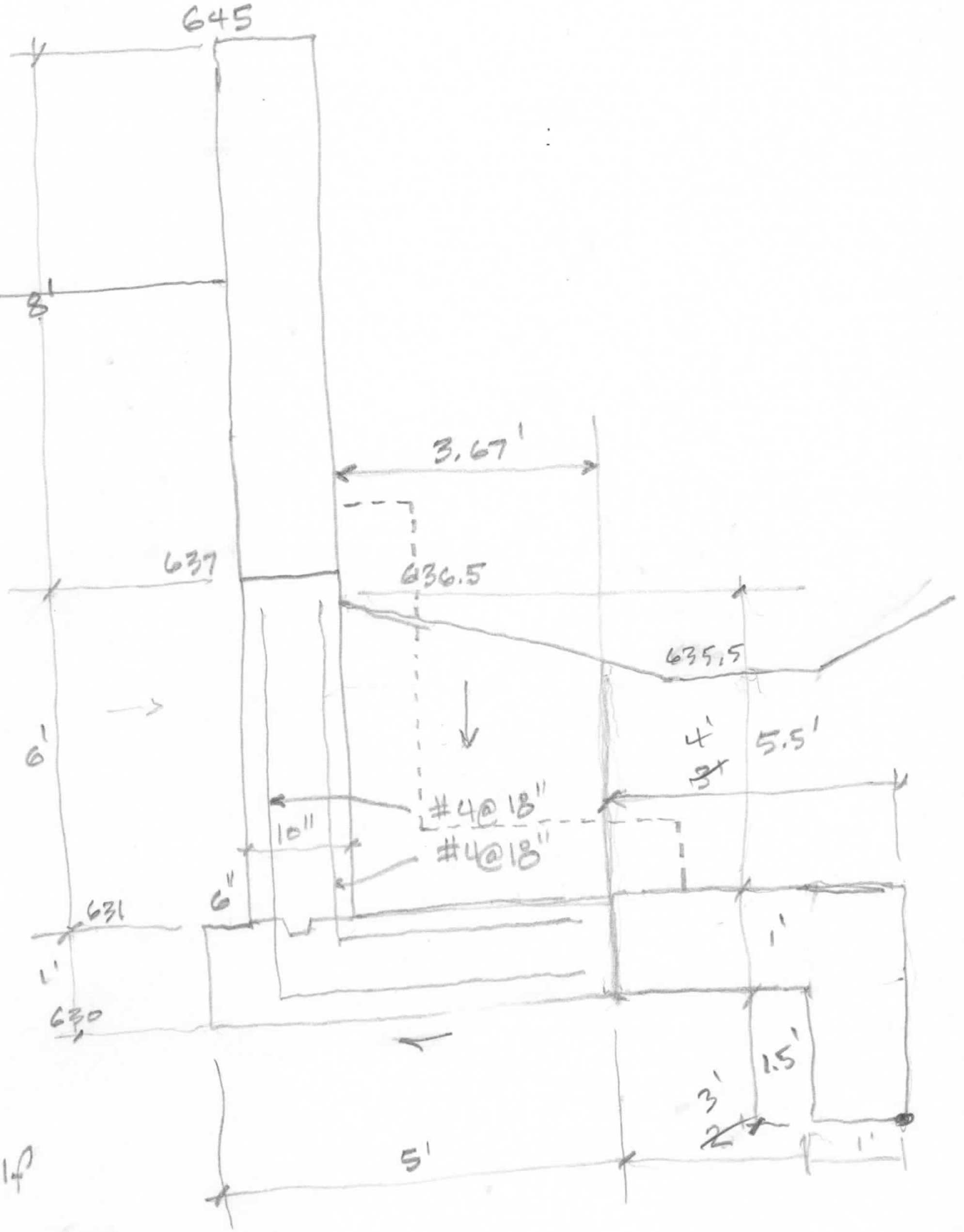
14'×$\frac{10}{12}$×145 = 1.692

Earth: 3.67×5.5×125 $\left(-\frac{1\times3.67\times125}{2}\right)$ = 2294

4710

$\overrightarrow{F_G} = 4.71\ (0.35) = 1.65$ klf

and $\frac{1.65}{1.06} = 1.56 > 1.5$ OK



CHECK WATER PRESSURE:

$\overrightarrow{F_w} = \frac{62.4(11.2)^2}{2} = 3.913$ klf

$\overleftarrow{F_{E_p}} = \frac{275(5.5)^2}{1.2} = 4.16$ klf

$F_G = 1.65$ klf

} 5.81 klf and $\frac{5.81}{3.91} = 1.49 < 2.0$ NG.

Need: $3.91\times2 \underset{FS}{=} 7.82$ & $7.82 - 5.81 = 2.01$

So add key to wall, TRY 1.5'

$\overleftarrow{F_{E_p}} = \frac{275\ (7)^2}{2} = 6.74$

$\overleftarrow{F_G} = 1.65$

} 8.38 and $\frac{8.38}{3.91} = 2.15 > 2$ so OK

OVERTURNING: (Earth) STA 6+50

⑤

$\overleftarrow{F_E} = \frac{50(6.5)^2}{2} = 1.06^{klf}$, so $\overleftarrow{M} = 1.06\left(\frac{6.5}{3}\right) = 2.3^{1-k/1}$

$$\left.\begin{array}{l} \overrightarrow{M}_{conc} = .725(2.5) = 1.81 \\ \quad 1.692(.92) = 1.56 \\ \overrightarrow{M}_{earth} = 2.29(3.17) = 7.26 \end{array}\right\} 10.62 \;\&\; \frac{10.62}{2.3} = 4.62 > 2.0 \text{ OK}$$

OVERTURNING (WATER):

$\overrightarrow{F_w} = \frac{62.4(11.2)^2}{2} = 3.913$, so $\overrightarrow{M} = 3.913\left(\frac{11.2}{3}\right) = 14.61^{1-k/1}$

$$\left.\begin{array}{l} \left.\begin{array}{l} \overleftarrow{M} = .725(2.5) = 1.81 \\ \quad 1.692(4.08) = 6.90 \\ \quad 2.29(1.84) = 4.21 \end{array}\right\} 12.93 \\ \quad \frac{275(5.5)^2}{2} = 4.16 \times \left(\frac{5.5}{3}\right) = 7.6 \end{array}\right\} 20.55 \;\&\; \frac{20.55}{14.61} = 1.4 < 2 \text{ NG}$$

$F_w = 3.913$, so $\overrightarrow{M}_w = 3.913(5.23) = 20.47$

Add 1.5' key and 3' HEEL:

$$\left.\begin{array}{l} \frac{275(7)^2}{2} = 6.74\left(\frac{7}{3}\right) = 15.72 \\ \overleftarrow{M}: 145(8)1 = 1.16 \times 4 = 4.64 \\ \quad 1.5(145) \; .22 \times .5 = .11 = 29.21 \\ \quad 1.69 \times 7.08 = 11.97 \\ \quad 125(4.5)(6.67) = 3.75 \times 3.33 = 12.49 \end{array}\right\} 44.93 \;\&\; \frac{44.93}{20.47} = 2.19 > 2 \text{ OK}$$

MOMENT in CONC (Earth)

$\overleftarrow{M}$ @ Top of Footing: $\frac{50(5.5)^2}{2} = 0.76^{klf} \times \left(\frac{5.5}{3}\right) = 1.39^{1-k/1}$

$As_{req'd} = \frac{1.39(1.6)}{2.8(7.5)} = .11 \text{ in}^2/\text{ft} < $ #4@18 so OK

(.13)

Moment in CONC. (water) (STA. 6+50)

$\overset{\curvearrowright}{M}_{\substack{top\\ of\ footing}} = \frac{62.4(10.2)^2}{2} = 3.25 \times \frac{10.2}{3} = 11.04^{\ 1\text{-}K/1}$

$A_{s\,req'd} = \frac{11.04(1.6)}{2.8(7.5)} = .84\ in^2 > \ \#4@18\ (.13\ in^2)$

need $.84 - .13 = .71\ in^2/ft.$

OR Increase "d" by adding conc. to the back of the wall.

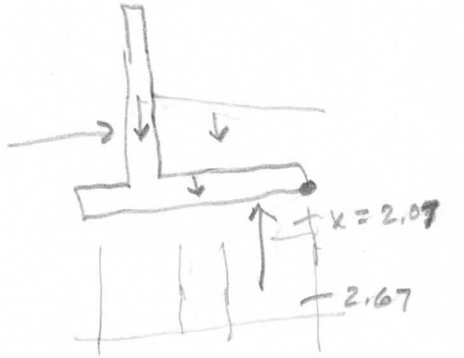
BEARING (water) $N = 4.71 + \overset{1.69}{4.5(3)(125)} + \overset{.65}{4.5(145)} = 7.05$

$\overset{\curvearrowright}{M} + N(x) = \overset{\curvearrowleft}{M}$

$\overset{\curvearrowright}{M} = 3.91\left(\frac{11.2}{3}\right) = 14.61$, so $14.61 + 7.05(x) = 29.21$

$x = 2.07'$

outside middle third,
so add 1' to heel



$e = \left|\frac{B}{2} - x\right| = \left|\frac{8}{2} - 2.07\right| = 1.93$

$P = \frac{N}{B}\left(1 + \frac{6e}{B}\right) = \frac{7.05}{8}\left(1 + \frac{6(1.93)}{8}\right)$

$= 2.15 > 2.0$ so add 1' to heel.

$N = 4.71 + 4.5(4)125 + 5.5(145) = 7.76$

so $14.61 + 7.76\,x = \overset{\curvearrowleft}{M}$: $145(9)1 = 1.31 \times 4.5 = 5.87$
.11
1.69 $\times 8.08 = 13.67$
$125(4.5)7.67 = \ \times 3.83 = 16.55$
} 36.2

2.78 -

so $x = 2.78$, $e = 1.72$

$P = \frac{7.76}{9}\left(1 + \frac{6(1.72)}{9}\right) = 1{,}850 < 2{,}000$ OK

STA 9+00 (Earth)
STA 8+00 (Water)

$$\overleftarrow{F}_{earth} = \frac{50(6.5)^2}{2} = 1.06^{klf}$$

$\overrightarrow{F}_{GRAV}$: $145(4)(1) = .58$

$145(14)(\frac{10}{12}) = 1.69$

$125(5.5)(2.67) = 1.84$

4.11

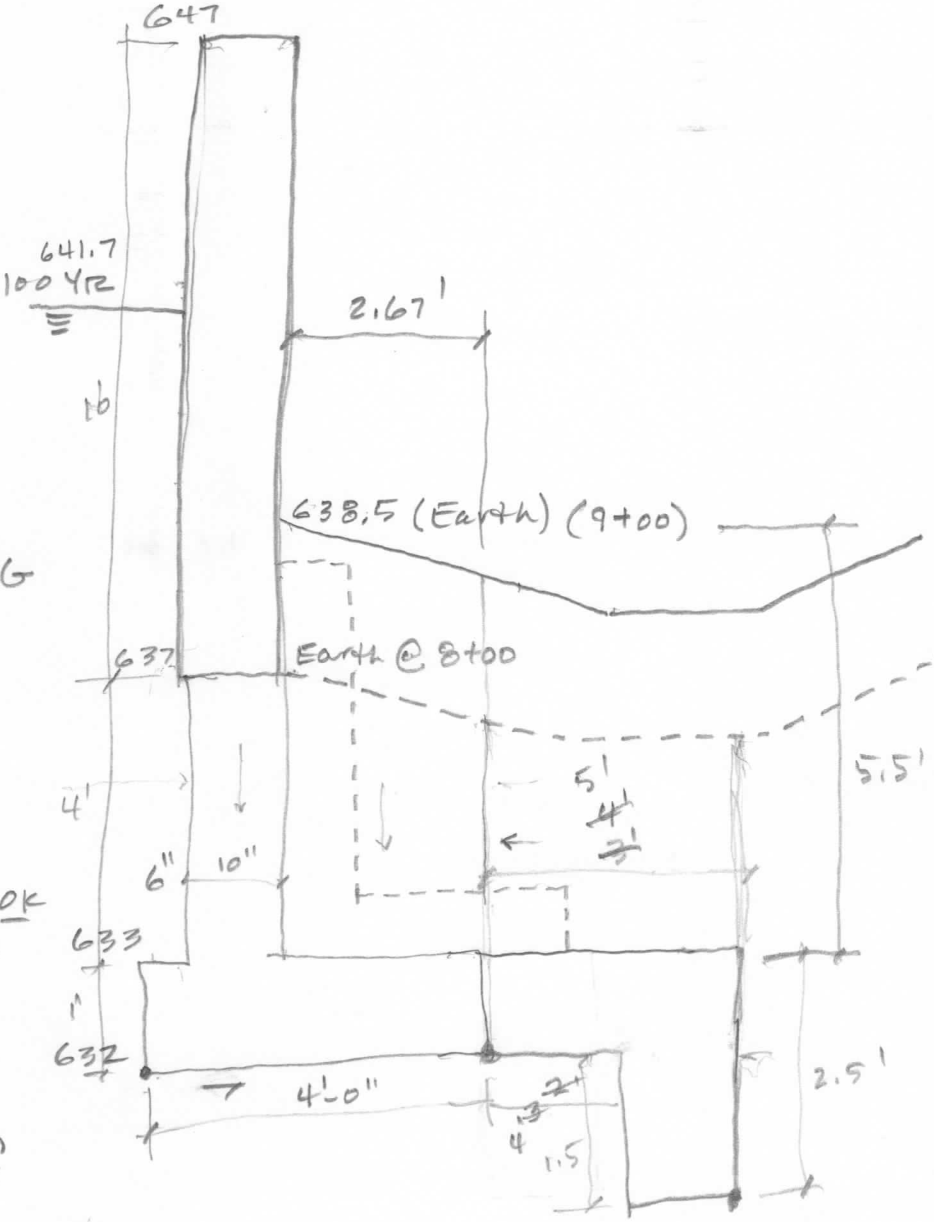
$$\overrightarrow{F} = (0.35)(4.11) = 1.43$$

so $\frac{1.43}{1.06} = 1.36_{FS} < 1.5$ NG

ADD 1.5' KEY

$$\overrightarrow{F} = \frac{275(1.5)^2}{2} = .31$$

$1.36 + .31 = \frac{1.67}{1.06} = 1.57_{FS}$ OK



CHECK WATER

$$\overrightarrow{F}_{water} = \frac{62.4(9.7)^2}{2} = 2.94^{klf}$$

$\overleftarrow{F}_{grav}$: .58

1.69

$125(4)(2.67) = 1.34$

$\overleftarrow{F}_{key} = \frac{275(6.5)^2}{2} = 5.8$

9.41 and $\frac{9.41}{2.94} = 3.2_{FS} > 2.0$, OK

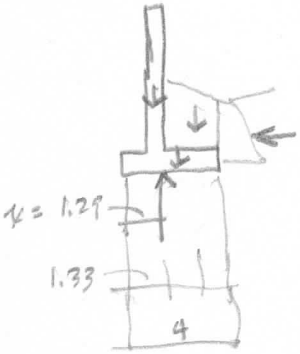
OVERTURING (earth) Sta 9+00

$\overleftarrow{F} = 50(6.5)^2 = 1.06^{klf}$, so $\overset{\curvearrowleft}{M} = 1.06\left(\frac{6.5}{3}\right) = 2.3^{1-k/1}$

$$\left.\begin{aligned}\overset{\curvearrowright}{M} : .58\ (2) &= 1.16\\ 1.69\ (.92) &= 1.55\\ 1.84\ (2{,}67) &= 4.91\end{aligned}\right\}\ 7.62 > 2.3 \text{ by } \frac{7.62}{2.3} = 3{,}31 > 2.0\ \underline{OK}$$

Bearing (earth)

$$\begin{aligned}N = &\ .58\\ &1.69\\ &\underline{1.84}\\ &4.11\end{aligned}$$



$\overset{\curvearrowleft}{M} + N(x) = \overset{\curvearrowright}{M}$

$2.3 + 4.11(x) = 7.62$

$x = 1.29$ outside middle third, $\underline{NG}$ add $\underline{heel}$ to wall.

$e = \left|\frac{B}{2} - x\right| = \frac{4}{2} - 1.29 = .71$

$P_{max} = \frac{N}{B}\left(1 + \frac{6e}{B}\right)$

$= \frac{4.11}{4}\left(1 + \frac{6(.71)}{4}\right) = 1.54^{ksf} < 2.0^{ksf}$ OK

MOMENT IN CONCRETE (earth)

$\overset{\curvearrowleft}{M}$ @ top of Footing $\frac{50(5.5)^2}{2} = .76 \times \frac{5.5}{3} = 1.39^{1-k/1}$

A_s req'd $= \frac{1.39(1.6)}{2.8(7.5)} = .11 < \underset{.13}{\#4@18}$ so $\underline{OK}$

OVERTURNING (water)

$\overset{\curvearrowright}{M} = \frac{62.4(9.7)^2}{2} = 2.94 \times \frac{9.7}{3} = 9.51^{1-k/1}$

$\overset{\curvearrowleft}{M} = \underset{1.16}{.58(2)} + \underset{5.21}{1.69(3.08)} + \underset{1.79}{4(125)(2.67)}^{\times 1.34} + \underset{2.93}{\frac{275(4)^2}{2}}^{\times 1.33} = 11.09 > 9.51$ by $\frac{11.09}{9.51} = 1.17 < 2$

so, $\underline{\text{Add heel \& Key}}$

TRY Heel of 3' and Key of 1.5' (Sta 8+00)

$\overset{\curvearrowright}{M} = 2.94(4.73) = 13.92^{\text{1-K/1}}$

$\overset{\curvearrowleft}{M}$: $7(145)1 = 1.02 \times 3.5 = 3.55$

$1.5(145)1 = .22 \times .5 = .11$

$1.69(\times 6.08 = 10.28$

$3(125)(5.67) = 2.13 \times 2.84 = 6.04$

$\frac{275(5.5)^2}{2} = 4.16 \times 1.33 = 5.53$

$\frac{25.51}{13.92} = 1.83 < 2.0$ NG

so, add 4' Heel

$8(145)1 = 1.16 \times 4 = 4.64$

$.11$

$1.69 \times 7.08 = 11.97$

$3(125)(6.67) = 2.5 \times 3.33 = 8.33$

$4.16 \times 1.33 = 5.53$

$\frac{30.58}{13.92} = 2.2 > 2.0$ OK

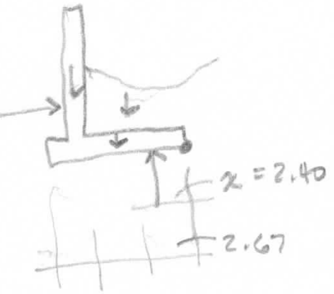
BEARING (water)

$N = 4.11 + 4(\overset{1.5}{3})(125) + 5.5(145) = 6.41$

$\overset{\curvearrowright}{M} + N(x) = \overset{\curvearrowleft}{M}$

$\overrightarrow{M} = 2.94\left(\frac{9.7}{3}\right) = 9.50$ so, $9.50 + 6.41x = 24.94$

$x = 2.40$



outside middle third so add 1' to heel.

$e = \left|\frac{B}{2} - x\right| = \left|\frac{8}{2} - 2.40\right| = 1.6$

$P_{max} = \frac{N}{B}\left(1 + \frac{6e}{B}\right) = \frac{6.41}{8}\left(1 + \frac{6(1.6)}{8}\right) = 1.76$ ksf < 2.0, OK

MOMENT IN CONC. (water) STA 8+00

$$\overrightarrow{M}_{\substack{\text{Top}\\ \text{of footing}}} = \frac{62.4(8.7)^2}{2} \times \frac{8.7}{3} = 6.85^{\text{ 1-K/1}}$$

$$A_{s\,\text{req'd}} = \frac{6.84(1.6_{\text{FS}})}{2.8(7.5)} = .52\text{ in}^2 > \begin{array}{c}\#4 @ 18\\ (.13)\end{array} \quad \underline{\text{NG}}$$

<u>Need</u> $.52 - .13 = .39\text{ in}^2$

STA 6+50 NEW WALL

⑪

SLIDING (Earth), OK

(water), OK

OVERTURNING (Earth) OK

(water) OK

$\overset{\curvearrowleft}{M}_{(earth)} = 1.39^{1\text{-}K/1}$

$A_s req'd = \frac{1.39\,(1.6)}{2.8\,(11")}$

$.07\ in^2/ft$

use #4 @ 12 (.20)

$\overset{\curvearrowright}{M}_{(water)} = 11.04^{1\text{-}K/1}$

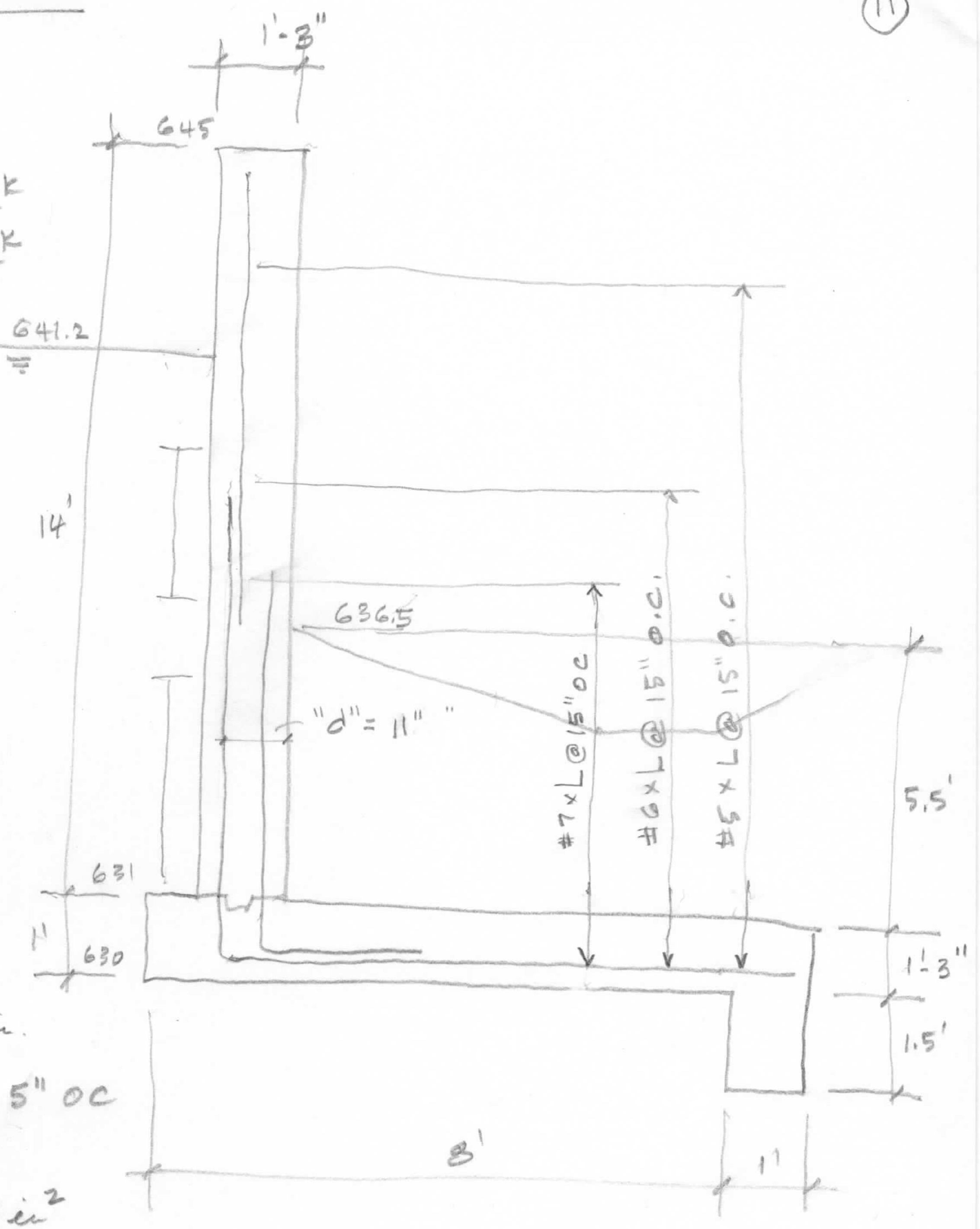
$A_s req'd = \frac{11.04(1.6)}{2.8(11)}$

$= .57\ in^2$

$\times \frac{15}{12} = .72\ sq\ in.$

use #5, #6, #7 @ 5" OC staggered

$.31, .44, .60 = 1.35\ in^2$



APPENDIX H-4

Geotechnical Analysis

GOLDER

TECHNICAL MEMORANDUM

DATE 8/14/2018

Project No. 130208606

TO Brad Weaver, Exide Technologies

CC Anne Faeth-Boyd, Golder; Rick Booth, Golder

FROM Ken Berry, PE; Peter Joplin

EMAIL ken_berry@golder.com

KENNETH M. BERRY
129032

Kenneth M Berry
8/14/2018
GOLDER ASSOCIATES INC.
TEXAS REGISTRATION F-2578

EXIDE FLOOD WALL – GEOTECHNICAL CONSIDERATIONS

Golder Associates Inc. (Golder) is providing this memo to address geotechnical considerations regarding an existing and proposed extension of a flood wall at Exide Technologies former Battery Recycling Facility at 7471 5th Street in Frisco Texas. Glenn Campbell of GWC Engineering is performing the design of the flood wall.

Golder's tasks as related to the project include:

- Check of global slope stability for the flood wall;
- Check of bearing capacity of the flood wall;
- Provide coefficient of friction and passive resistive pressure to wall designer; and
- Provide recommendation for distance of new treatment trench from flood wall due to geotechnical considerations.

Borings

Golder subcontracted West Drilling to perform drilling services at the site. Five borings were drilled to a depth of 25 feet along the alignment of the existing and proposed wall on July 12 and 13, 2018 (see Figure 1 for the locations of the Geotechnical borings). (Representative samples were sent to laboratories for testing. Grain size distribution tests were performed by Tolunay-Wong Engineers, Inc. of Houston, Texas and water content, Atterberg limit, UU triaxial, and permeability tests were performed at Golder's Houston laboratory.

Slope Stability

Slope stability factors of safety design criteria was based on the US Army Corps of Engineers (USACE), Design and Construction of Levees (EM-1110-2-1913). Conditions requiring evaluation include:

- End of Construction (Undrained)
- Sudden Drawdown
- Steady Seepage From Full Flood Stage (Drained)
- Earthquake

It is understood that the design flood event will have a duration of less than one day. The flood wall is basically to address possible flash flooding. Sudden drawdown is when a prolonged flood event occurs and then rapidly recedes. Similarly, steady seepage occurs when prolonged flooding causes a steady seepage to occur through a soil mass. These cases cause changes to pore pressures within soil units and can affect slope stability. Given the limited duration of flooding, the sudden drawdown and stead seepage cases will not occur.

Since the flood wall is located on a slope, calculations were performed for both the normal (sunny day) and flood conditions.

Slope Stability Case	USACE Minimum FS	FS for Normal Conditions	FS for Flood Conditions
End of Construction (Undrained)	1.3	>2.0	>2.0
Sudden Drawdown	1.0 to 1.2	Not Applicable	Not Applicable Due to Short Flood Duration
Steady Seepage (Drained)	1.4	>2.0	Not Applicable Due to Short Flood Duration
Earthquake	1.0 to 1.1	>2.0	Not Applicable Due to Short Flood Duration

Bearing Capacity

Four UU triaxial tests were performed on samples from varying depths. The minimum peak deviator stress of the four tests was 2400 psf. The estimation of allowable bearing capacity is 1200 psf for the Silty Clay. This value is conservative using the minimum UU test value instead of a mean or average value. We understand that the maximum actual bearing pressure is 1000 psf. Therefore, the bearing capacity is satisfactory.

Coefficient of Friction and Passive Resistance

Based on the Naval Facilities Engineering Command, Foundations and Earth Structures (Design Manual 7.02), the appropriate coefficient of friction value is 0.35.

Passive resistance for the wall would be 275 pcf (based upon an estimated effective friction angle of 24 degrees).

Distance of New Treatment Trench From Flood Wall Due to Geotechnical Considerations

For geotechnical purposes, it is recommended that the new treatment trench not be installed immediately adjacent to the flood wall. It is understood that the treatment trench will consist of excavating a trench from the ground surface down to bedrock. Bedrock is approximately 20 to 25 feet below existing grade. The trench will be backfilled with granular material which will be used to treat groundwater which flows through it. The geotechnical concern for the wall is that the granular material installed is assumed to not be compacted. It is recommended that the new granular wall be a minimum of 3 feet from the flood wall. For construction purposes, it should be considered to have the granular 5 feet from the flood wall. Depending on how much of a heel the wall will contain, this may not be necessary. A distance of 5 feet would allow a backhoe or trencher to straddle the trench while it is being excavated.

Attachments:

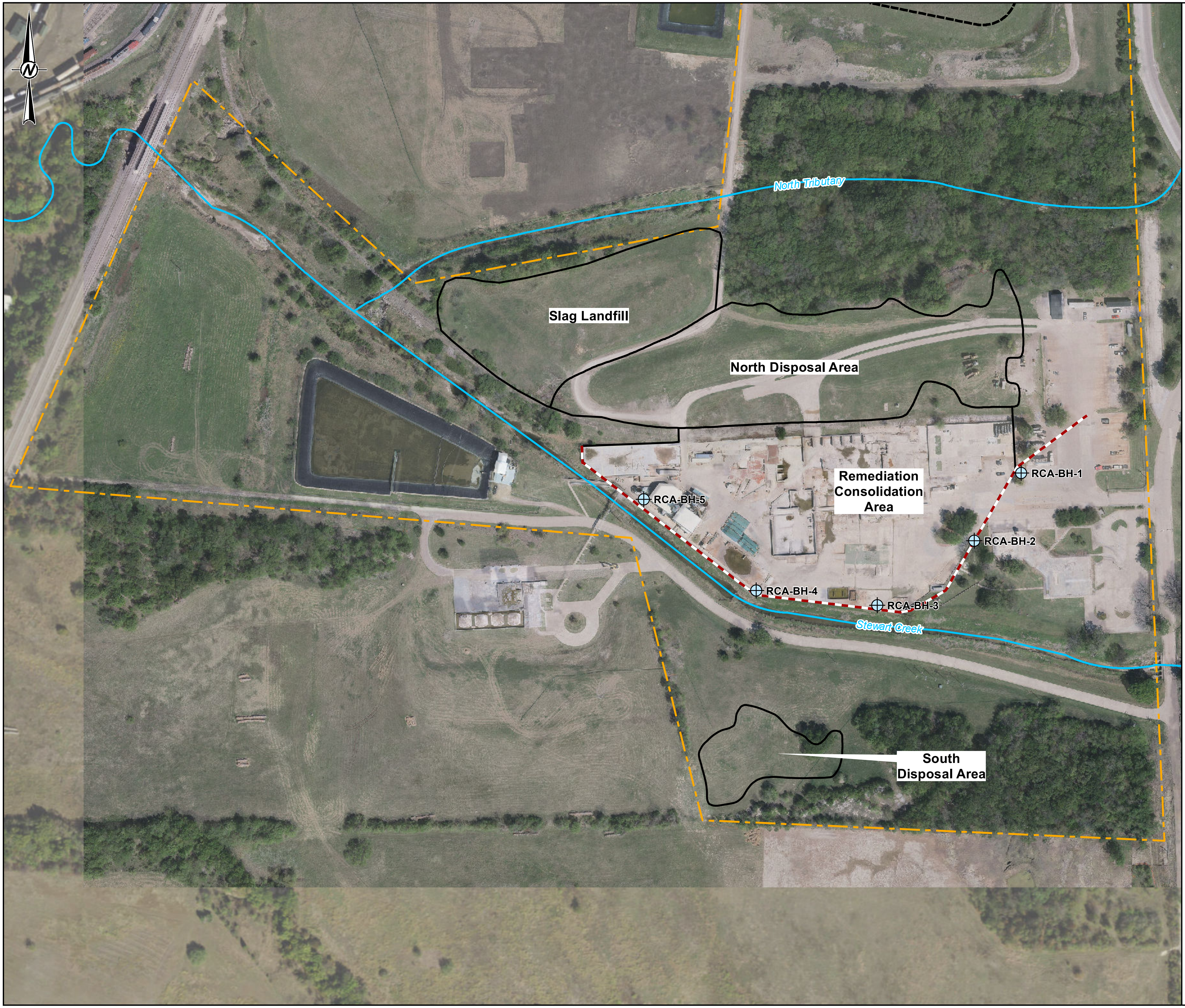
Figure 1 – Geotechnical Boring Location Map

Attachment 1 – Geotechnical Boring Logs

Attachment 2 – Geotechnical Laboratory Data

Attachment 3 – Calculations

Figure 1 – Geotechnical Boring Location Map



LEGEND

⊕	Geotechnical Boring Location
—	Surface Water Centerline
- -	Proposed Flood Wall
☐	Disposal Areas
⬚	Approximate North CAMU Extent
⬚	Former Operating Plant

KENNETH M. BERRY
129032
Kenneth M. Berry
8/14/2018

225 112.5 0 225
Feet

REFERENCE

1. SITE FEATURES - GOLDER, 2014
2. AERIAL IMAGERY - SOURCE: ESRI, DIGITALGLOBE, GEOEYE, EARTHSTAR GEOGRAPHICS, CNES/AIRBUS DS, USDA, USGS, AEROGRID, IGN, AND THE GIS USER COMMUNITY AND AERIAL IMAGERY PROVIDED BY DALLAS AERIAL SURVEY DATED APRIL, 2017

CLIENT
EXIDE TECHNOLOGIES

PROJECT
FRISCO RECYCLING CENTER RCRA PERMIT RENEWAL

TITLE
GEOTECHNICAL BORING LOCATION MAP

CONSULTANT
Golder Associates

YYYY-MM-DD	2018-08-14
PREPARED	EFT
DESIGN	BEF
REVIEW	EPW
APPROVED	AMF

PROJECT No.	CONTROL	Rev.	FIGURE
13-0208606	1302086ZF038.mxd	0	1

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IF THIS MEASUREMENT DOES NOT MATCH WHAT IS SHOWN, THE SHEET HAS BEEN MODIFIED FROM: ANSI B
1 in
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Attachment 1 – Geotechnical Boring Logs

RECORD OF BOREHOLE RCA-BH-1

SHEET 1 of 1

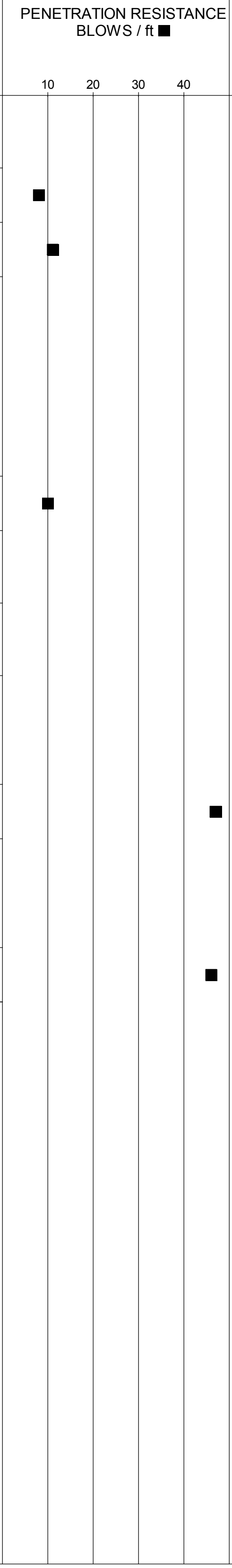
PROJECT: Exide Frisco
PROJECT NUMBER: 130-2086
LOCATION: Inside Wall S of Former Oxide Bldg

DRILLING METHOD:
DRILLING DATE: 07/12/2018
DRILL RIG: Geoprobe 7822DT

DATUM: Local
AZIMUTH: N/A
COORDINATES: N: N/A E: N/A

ELEVATION: N/A
INCLINATION: -90

DEPTH (feet)	BORING METHOD	SOIL PROFILE DESCRIPTION	USCS	ELEV. DEPTH (ft)	SAMPLES NUMBER	TYPE	BLOWS per 6 in 140 lb hammer 30 inch drop	N	REC ATT	REMARKS
0	HSA	(0.0 - 1.0) CONCRETE and GRAVEL								
		(1.0 - 10.5) (CL) SILTY CLAY, low to medium plastic, some fine sand; dark yellowish brown (10YR 4/2); cohesive, w~PL, very stiff. (PP~2.5 tsf)	CL	1.0	1	SPT	2 3 5	8	1.4 1.5	
5		(3.5) Soil color changes to moderate yellowish brown (10YR 5/4).		3.5	2	SPT	2 4 7	11	1.2 1.5	
10		(10.5 - 16.0) (CH) CLAY, high plastic, some nonplastic fines; light brown (5YR 5/6) marbled with moderate yellowish brown (10YR 5/4); cohesive, w~PL, very stiff. (PP~3 tsf)	CH	10.5	3	SPT	2 4 6	10	1.5 1.5	
15					4	SH			1.4 2.0	RCA-BH-1 SH-4: UU = 3,200 psf, Dry Unit Weight = 90.1 pcf
		(16.0 - 25.0) SHALE - (CH) CLAY, high plastic; medium dark gray (N4); cohesive, w<PL, hard. (PP>4.5 tsf)	CH	16.0						
20					5	SPT	15 19 28	47	1.5 1.5	
25					6	SPT	15 23 23	46	1.5 1.5	
30										
35										
40										



SCALE: 1 in = 5 ft
DRILLING CONTRACTOR: WEST Drilling
DRILLER: Bob Williams

LOGGED: PJJ
CHECKED: BCW
REVIEWED: KMB

Golder Associates

RECORD OF BOREHOLE RCA-BH-2

SHEET 1 of 1

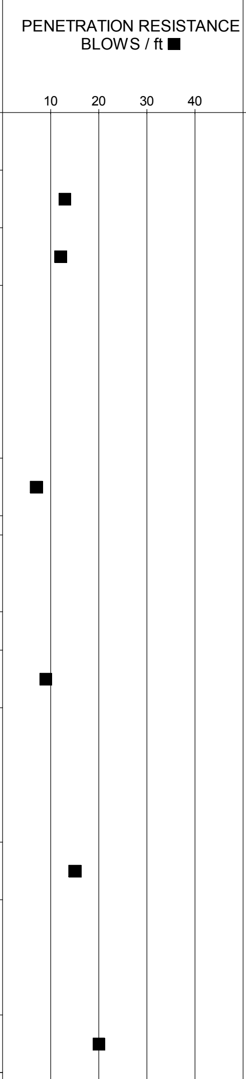
PROJECT: Exide Frisco
PROJECT NUMBER: 130-2086
LOCATION: Inside Wall W of Former Admin

DRILLING METHOD:
DRILLING DATE: 7/12/2018
DRILL RIG: Geoprobe 7822DT

DATUM: Local
AZIMUTH: N/A
COORDINATES: N: N/A E: N/A

ELEVATION: N/A
INCLINATION: -90

BORING METHOD	SOIL PROFILE: DESCRIPTION	USCS	ELEV. / DEPTH (ft)	SAMPLES: NUMBER	TYPE	BLOWS per 6 in (140 lb hammer 30 inch drop)	N	REC / ATT	REMARKS
HSA	(0.0 - 19.0) (CL) SILTY CLAY, low to medium plastic; dusky yellowish brown (10YR 2/2); cohesive, w<PL, firm.	CL		1	SPT	6 6 7	13	0.8 / 1.5	
	(3.0) Trace organics, soil becomes hard. (PP>4.5 tsf)		3.0	2	SPT	7 6 6	12	1.5 / 1.5	
	(9.0 - 19.0) (CH) CLAY, high plastic; dusky yellowish brown (10YR 2/2); cohesive, w~PL, stiff. (PP~1.25 tsf)	CH	9.0	3	SPT	WH 3 4	7	1.5 / 1.5	
				4	SH			1.3 / 2.0	RCA-BH-2 SH-4: UU = 14,200 psf, Dry Unit Weight = 95.6 pcf
				5	SPT	2 4 5	9	0.6 / 1.5	
	(19.0 - 25.0) SHALE - (CH) CLAY, high plastic; medium dark gray (N4); cohesive, w<PL, hard. (PP>4.5 tsf).	CH	19.0	6	SPT	5 6 9	15	1.5 / 1.5	
				7	SPT	7 9 11	20	1.5 / 1.5	



SCALE: 1 in = 5 ft
DRILLING CONTRACTOR: WEST Drilling
DRILLER: Bob Williams

LOGGED: PJJ
CHECKED: BCW
REVIEWED: KMB

Golder Associates

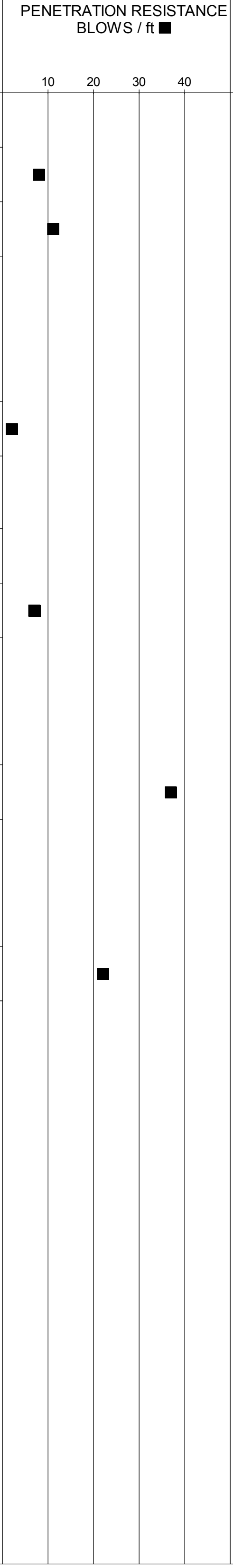
GOLDER STL RECORD OF BOREHOLE MWD 1302086 EXIDE FRISCO.GPJ GLDR_CO.GDT 8/13/18

RECORD OF BOREHOLE RCA-BH-3

SHEET 1 of 1

PROJECT: Exide Frisco
PROJECT NUMBER: 130-2086
LOCATION: Inside Wall E of Former Diesel AST
DRILLING METHOD:
DRILLING DATE: 7/12/2018
DRILL RIG: Geoprobe 7822DT
DATUM: Local
AZIMUTH: N/A
COORDINATES: N: N/A E: N/A
ELEVATION: N/A
INCLINATION: -90

DEPTH (feet)	BORING METHOD	SOIL PROFILE DESCRIPTION	USCS	ELEV. DEPTH (ft)	SAMPLES NUMBER	TYPE	BLOWS per 6 in 140 lb hammer 30 inch drop	N	REC ATT	REMARKS
0	HSA	(0.0 - 1.0) CONCRETE and GRAVEL								
		(1.0 - 8.5) (CH) CLAY, high plastic, some nonplastic fines, some fine sand; olive gray (5Y 4/1); cohesive, w~PL, stiff. (PP~1.5 tsf)	CL	1.0	1	SPT	2 3 5	8	1.5 1.5	
					2	SPT	5 5 6	11	1.3 1.5	
		(8.5 - 13.5) (CL) Sandy SILTY CLAY, low to medium plastic, fine to medium sand; olive gray (5Y 4/1); cohesive, w~PL, soft.	CL	8.5	3	SPT	1 1 1	2	1.5 1.5	
10					4	SH			1.8 2.0	RCA-BH-3 SH-4: Hydraulic Conductivity = 2.94e-8 cm/sec, Dry Unit Weight = 95.5 pcf
		(13.5 - 18.5) (CL) gravelly CLAY, low plastic, fine to medium gravel; light olive gray (5Y 6/1), olive gray gray (5Y 4/1), and yellowish gray (5Y 8/1); cohesive, w~PL, stiff. (PP~2 tsf).	CL	13.5	5	SPT	3 3 4	7	1.5 1.5	
		(18.5 - 23.5) SHALE - (CH) CLAY, high plastic; medium dark gray (N4); cohesive, w<PL, hard. (PP>4.5 tsf)	CH	18.5	6	SPT	7 15 22	37	1.5 1.5	
		(23.5 - 24.8) (SC) CLAYEY SAND, fine sand, low plastic fines; medium dark gray (N4); cohesive, very stiff. (PP~2.5 tsf)	SC	23.5	7	SPT	27 13 9	22	1.5 1.5	
25		(24.8 - 25.0) SHALE - (CH) CLAY, high plastic; medium dark gray (N4); cohesive, w~PL, hard. (PP>4.5 tsf)	CH	24.8						



DEPTH (feet): 0, 5, 10, 15, 20, 25, 30, 35, 40

SCALE: 1 in = 5 ft
DRILLING CONTRACTOR: WEST Drilling
DRILLER: Bob Williams

LOGGED: PJJ
CHECKED: BCW
REVIEWED: KMB

Golder Associates

RECORD OF BOREHOLE RCA-BH-4

SHEET 1 of 1

PROJECT: Exide Frisco
PROJECT NUMBER: 130-2086
LOCATION: Inside Flood Wall and STB

DRILLING METHOD:
DRILLING DATE: 7/13/2018
DRILL RIG: Geoprobe 7822DT

DATUM: Local
AZIMUTH: N/A
COORDINATES: N: N/A E: N/A

ELEVATION: N/A
INCLINATION: -90

BORING METHOD	SOIL PROFILE: DESCRIPTION	USCS	ELEV. / DEPTH (ft)	SAMPLES: NUMBER	TYPE	BLOWS per 6 in (140 lb hammer, 30 inch drop)	N	REC / ATT	REMARKS
HSA	(0.0 - 1.0) CONCRETE and GRAVEL								
	(1.0 - 9.5) (CL) SILTY CLAY, low plastic, high silt content; olive black (5Y 2/1); cohesive, w~PL, very soft, sticky.	CL	1.0	1	SPT	WH WH WH	WH	1.5 / 1.5	
				2	SPT	WH WH 1	1	1.5 / 1.5	
				3	SH			1.3 / 2.0	RCA-BH-4 SH-3: Hydraulic Conductivity = 4.47e-7 cm/sec, Dry Unit Weight = 84.2 pcf
	(9.5 - 10.0) (CL) gravelly CLAY, low plastic fines, fine to medium gravel; olive black (5Y 2/1); cohesive, w~PL, firm, sticky.	CL	9.5	4	SPT	3 3 3	6	1.5 / 1.5	
	(10.0 - 14.0) (CH) CLAY, high plastic; olive black (5Y 2/1); cohesive, w~PL, firm.	CH	10.0	5	SH			2.0 / 2.0	RCA-BH-4 SH-5: UU = 2,400 psf, Dry Unit Weight = 95.3 pcf
	(14.0 - 18.5) (CL) SILTY CLAY, low plastic; light olive gray (5Y 6/1) with light brown (5YR 5/6) marbling; cohesive, w<PL, hard. (PP>4.5 tsf)	CL	14.0	6	SPT	4 8 17	25	1.5 / 1.5	
	(18.5 - 23.5) (CL) SILTY CLAY, low plastic, some fine grained sand; medium dark gray (N4); cohesive, w>PL, very stiff.	CL	18.5	7	SPT	16 28 32	>50	1.5 / 1.5	
	(23.5 - 25.0) SHALE - (CH) CLAY, high plastic; medium dark gray (N4); cohesive, w<PL, hard. (PP>4.5 tsf)	CH	23.5	8	SPT	18 29 50	>50	1.5 / 1.5	

SCALE: 1 in = 5 ft
DRILLING CONTRACTOR: WEST Drilling
DRILLER: Bob Williams

LOGGED: PJJ
CHECKED: BCW
REVIEWED: KMB

Golder Associates

RECORD OF BOREHOLE RCA-BH-5

SHEET 1 of 1

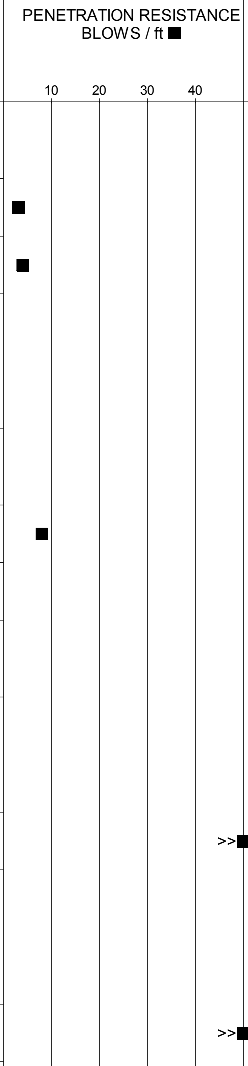
PROJECT: Exide Frisco
PROJECT NUMBER: 130-2086
LOCATION: Inside Flood Wall and WWTP

DRILLING METHOD:
DRILLING DATE: 7/13/2018
DRILL RIG: Geoprobe 7822DT

DATUM: Local
AZIMUTH: N/A
COORDINATES: N: N/A E: N/A

ELEVATION: N/A
INCLINATION: -90

DEPTH (feet)	BORING METHOD	SOIL PROFILE DESCRIPTION	USCS	ELEV. / DEPTH (ft)	SAMPLES NUMBER	TYPE	BLOWS per 6 in (140 lb hammer 30 inch drop)	N	REC / ATT	REMARKS
0	HSA	(0.0 - 1.0) CONCRETE and GRAVEL								
		(1.0 - 10.5) (CL) SILTY CLAY, low plastic; olive black (5Y 2/1); cohesive, w~PL, firm. (PP~1 tsf)	CL	1.0						
					1	SPT	1 1 2	3	1.2 1.5	
		(3.5) Soil color changes to olive black (5Y 2/1) marbled with light olive gray (5Y 5/2)		3.5	2	SPT	2 2 2	4	1.1 1.5	
		(8.5 - 18.5) (CH) CLAY, high plastic; moderate yellowish brown (10YR 5/4); cohesive, w~PL, stiff. (PP~1.5 tsf)	CH	8.5	3	SH			1.1 2.0	RCA-BH-5 SH-3: UU = 5,200 psf, Dry Unit Weight = 107.1 pcf
					4	SPT	2 3 5	8	1.5 1.5	
					5	SH			0.95 2.0	RCA-BH-5 SH-5: Hydraulic Conductivity = 2.42e-8 cm/sec, Dry Unit Weight = 86 pcf
		(18.5 - 25.0) SHALE - (CH) CLAY, high plastic; medium dark gray (N4); cohesive, w<PL, hard. (PP~4.5 tsf)	CH	18.5	6	SPT	15 25 36	>50	1.5 1.5	
					7	SPT	18 27 42	>50	1.5 1.5	



SCALE: 1 in = 5 ft
DRILLING CONTRACTOR: WEST Drilling
DRILLER: Bob Williams

LOGGED: PJJ
CHECKED: BCW
REVIEWED: KMB

Golder Associates

Attachment 2 – Geotechnical Laboratory Data

ATTERBERG LIMITS
ASTM D 4318

PROJECT NAME: Exide Frisco Geotech
PROJECT NUMBER: 130-2086-06
SAMPLE ID: RCA-BH-1, SPT-2
SAMPLE TYPE: Bag
SAMPLE DEPTH (ft): 3.5'-5.0'

SAMPLE PREPARATION
Wet or Dry: Wet
Minus #40 Sieve: N/A

PLASTIC LIMIT

Mass of Wet Soil & Tare (gm)	22.15	27.12
Mass of Dry Soil & Tare (gm)	21.48	26.49
Mass of Tare (gm)	16.62	21.84
Mass of Water (gm)	0.67	0.63
Mass of Dry Soil (gm)	4.86	4.65
Water Content %	13.79	13.55

LIQUID LIMIT

Number of Drops	31	25	16
Mass of Wet Soil & Tare (gm)	32.49	34.87	30.61
Mass of Dry Soil & Tare (gm)	28.83	30.50	25.90
Mass of Tare (gm)	21.44	21.83	16.74
Mass of Water (gm)	3.66	4.37	4.71
Mass of Dry Soil (gm)	7.39	8.67	9.16
Water Content %	49.53	50.40	51.42

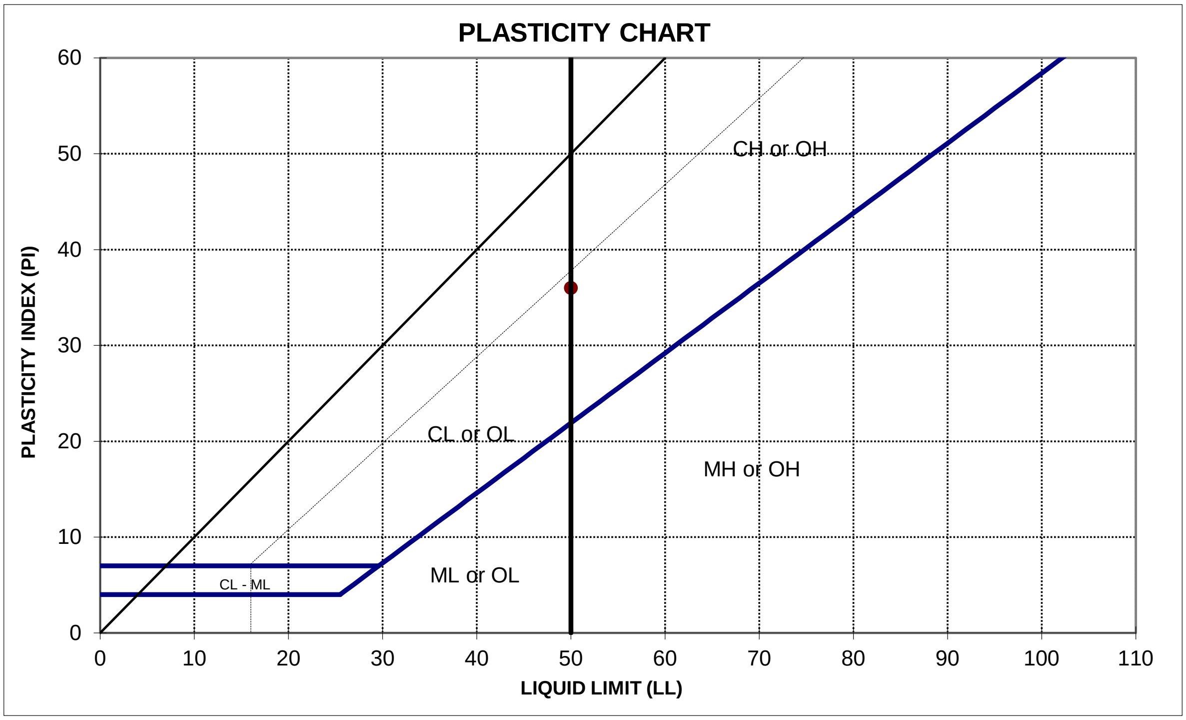
PLASTIC LIMIT (PL)
14

LIQUID LIMIT (LL)
50

PLASTICITY INDEX (PI)
36

Visual Description
Fat Clay, Light Brown

NOTES
Plastic Limit test performed by hand rolling.
Method A Liquid Limit test performed using mechanical device.



TECH: MR
DATE: 7/24/2018
REVIEW: MB

ATTERBERG LIMITS
ASTM D 4318

PROJECT NAME: Exide Frisco Geotech
PROJECT NUMBER: 130-2086-06
SAMPLE ID: RCA-BH-1, SH-4
SAMPLE TYPE: Shelby Tube
SAMPLE DEPTH (ft): 14.0'-16.0'

SAMPLE PREPARATION
Wet or Dry: Wet
Minus #40 Sieve: N/A

PLASTIC LIMIT

Mass of Wet Soil & Tare (gm)	27.19	22.11
Mass of Dry Soil & Tare (gm)	26.04	21.04
Mass of Tare (gm)	21.40	16.72
Mass of Water (gm)	1.15	1.07
Mass of Dry Soil (gm)	4.64	4.32
Water Content %	24.78	24.77

LIQUID LIMIT

Number of Drops	30	25	18
Mass of Wet Soil & Tare (gm)	30.06	30.43	32.77
Mass of Dry Soil & Tare (gm)	25.02	25.07	26.31
Mass of Tare (gm)	16.80	16.74	16.70
Mass of Water (gm)	5.04	5.36	6.46
Mass of Dry Soil (gm)	8.22	8.33	9.61
Water Content %	61.31	64.35	67.22

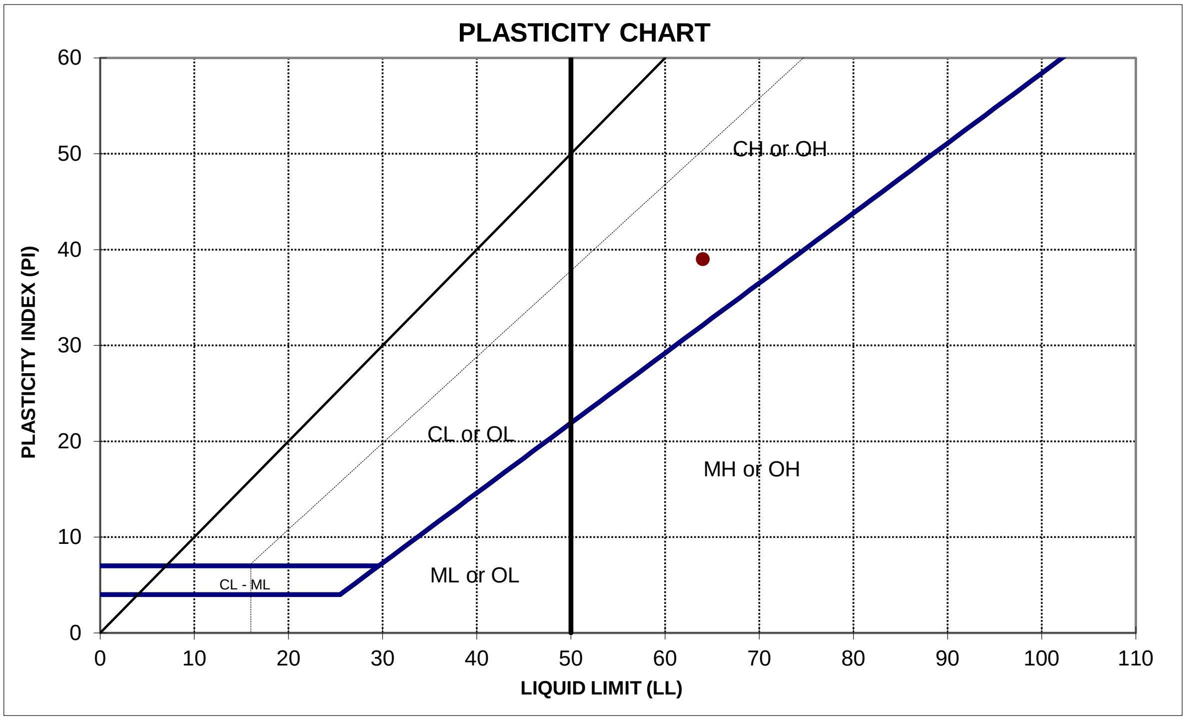
PLASTIC LIMIT (PL)
25

LIQUID LIMIT (LL)
64

PLASTICITY INDEX (PI)
39

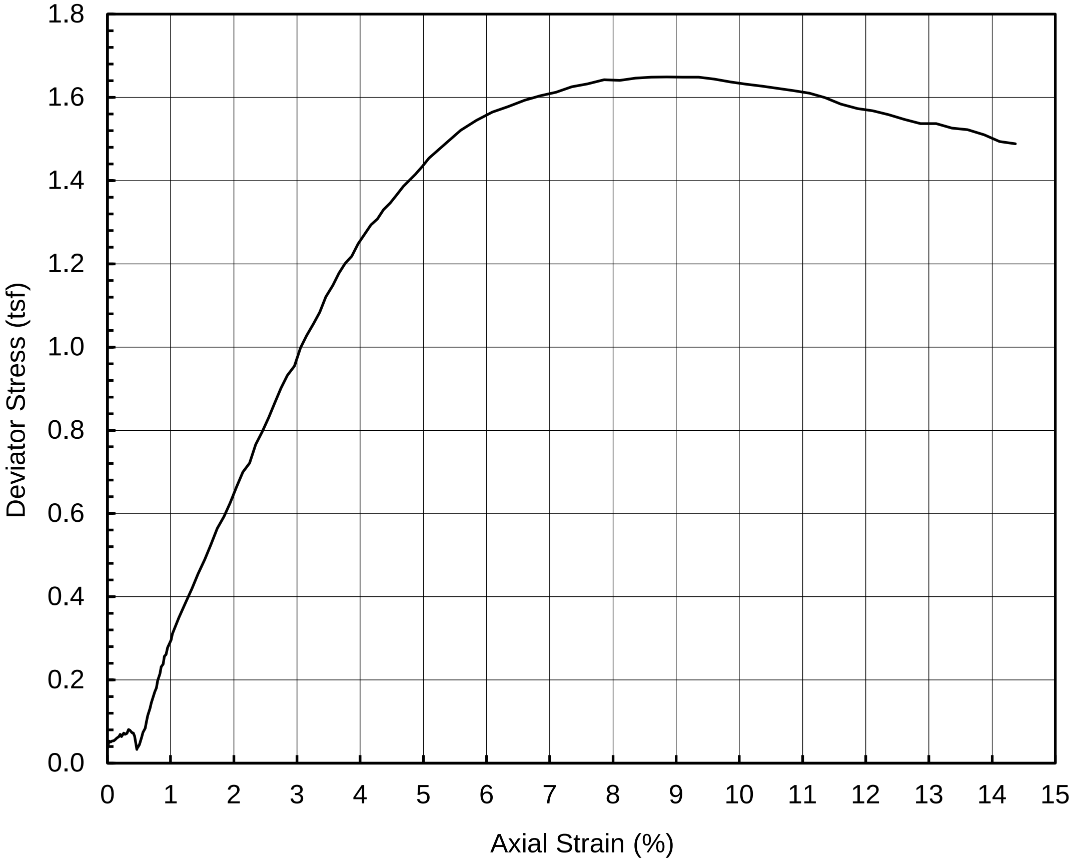
Visual Description
Fat Clay, Gray

NOTES
Plastic Limit test performed by hand rolling.
Method A Liquid Limit test performed using mechanical device.



TECH: MR
DATE: 7/24/2018
REVIEW: MB

UNCONSOLIDATED / UNDRAINED COMPRESSIVE STRENGTH
ASTM D 2850



Specimen Description							
LL	64	PL	25	PI	39.0	USCS	CH

Depth (ft)	14 - 16	Confining Pressure (psi)	9.1
Specimen Height (inch)	5.6	Strain Rate (%/min)	1.0
Specimen Diameter (inch)	2.8	Peak Deviator Stress (tsf)	1.6
Initial Specimen Weight (g)	1001.8	Axial Strain at Peak Stress (%)	8.9
Moist Unit Weight (pcf)	112.5		
Initial Water Content (%)	25		
Initial Dry Unit Weight (pcf)	90.1		

Failure Sketch

Project Title	Exide Frisco Geotech
Project Number	130-2086-06
Sample Type	Shelby Tube
Sample ID	RCA-BH-1 SH-4
Comments	

Golder Associates

Performed by	**MR**
Date	**18-Jul-18**
Check	**JL**
Review	

GOLDER

ATTERBERG LIMITS
ASTM D 4318

PROJECT NAME: Exide Frisco Geotech
PROJECT NUMBER: 130-2086-06
SAMPLE ID: RCA-BH-2, SH-4
SAMPLE DEPTH (ft): 11.0'-13.0'
SAMPLE TYPE: Shelby Tube

SAMPLE PREPARATION
Wet or Dry: Wet
Minus #40 Sieve: N/A

PLASTIC LIMIT

Mass of Wet Soil & Tare (gm)	27.04	25.15
Mass of Dry Soil & Tare (gm)	26.20	24.34
Mass of Tare (gm)	21.45	19.70
Mass of Water (gm)	0.84	0.81
Mass of Dry Soil (gm)	4.75	4.64
Water Content %	17.68	17.46

LIQUID LIMIT

Number of Drops	32	26	19
Mass of Wet Soil & Tare (gm)	32.98	34.58	32.66
Mass of Dry Soil & Tare (gm)	28.54	30.22	28.14
Mass of Tare (gm)	19.44	21.62	19.50
Mass of Water (gm)	4.44	4.36	4.52
Mass of Dry Soil (gm)	9.10	8.60	8.64
Water Content %	48.79	50.70	52.31

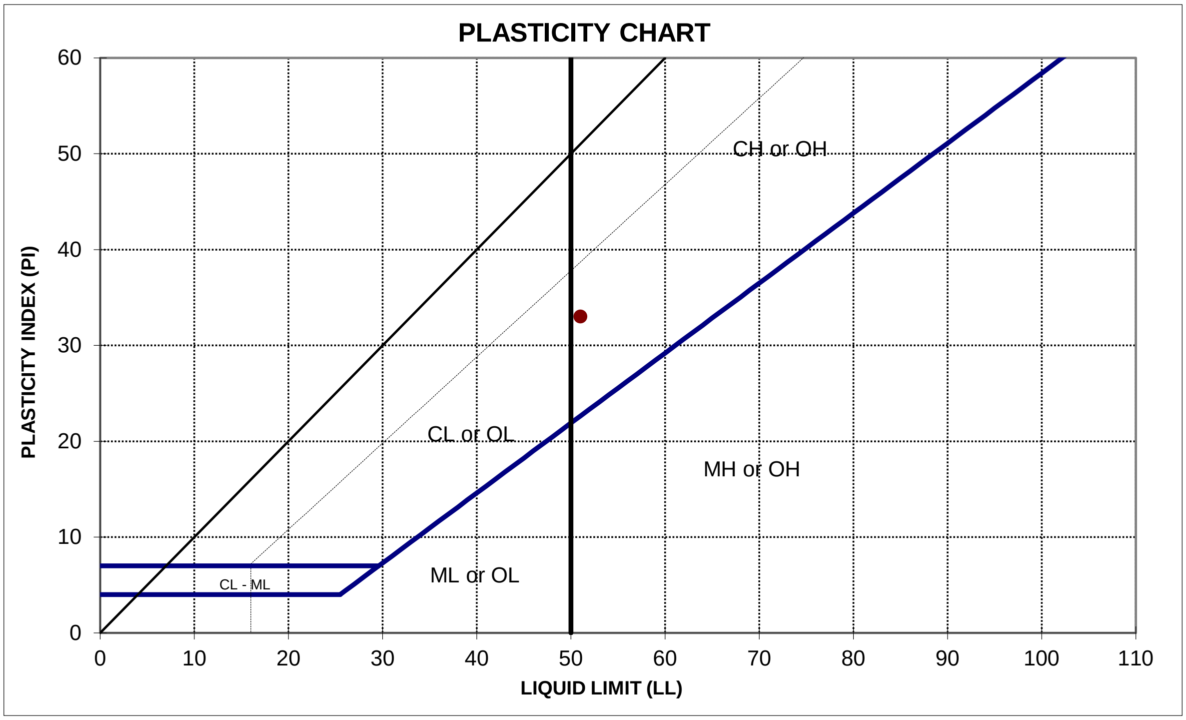
PLASTIC LIMIT (PL)
18

LIQUID LIMIT (LL)
51

PLASTICITY INDEX (PI)
33

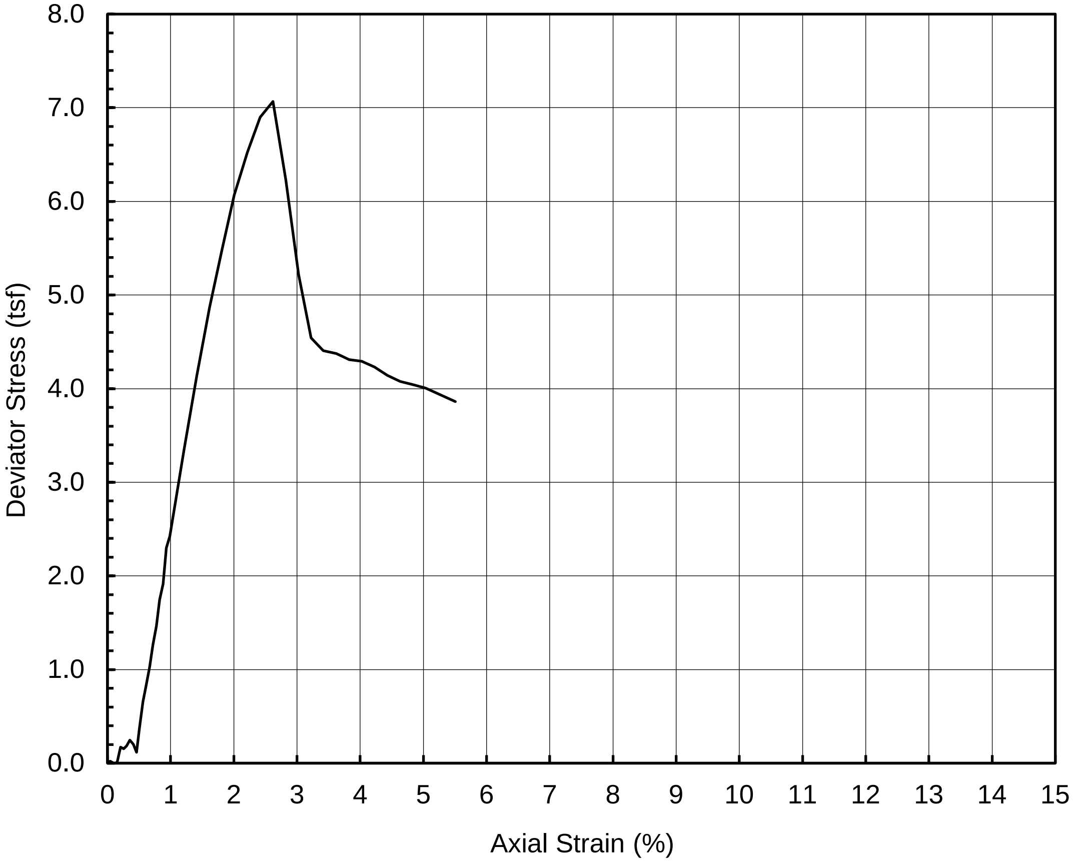
Visual Description
Fat Clay, Gray.

NOTES
Plastic Limit test performed by hand rolling.
Method A Liquid Limit test performed using mechanical device.



TECH: MR
DATE: 7/24/2018
REVIEW: MB

UNCONSOLIDATED / UNDRAINED COMPRESSIVE STRENGTH
ASTM D 2850



Specimen Description							
LL	51	PL	18	PI	33.0	USCS	CH

Depth (ft)	11 - 13	Confining Pressure (psi)	8.3
Specimen Height (inch)	5.6	Strain Rate (%/min)	1.0
Specimen Diameter (inch)	2.8	Peak Deviator Stress (tsf)	7.1
Initial Specimen Weight (g)	1067.9	Axial Strain at Peak Stress (%)	2.6
Moist Unit Weight (pcf)	120.9		
Initial Water Content (%)	26		
Initial Dry Unit Weight (pcf)	95.6		

Failure Sketch

Project Title	Exide Frisco Geotech
Project Number	130-2086-06
Sample Type	Shelby Tube
Sample ID	RCA-BH-2 SH-4
Comments	

Golder Associates

Performed by	**MR**
Date	**19-Jul-18**
Check	**JL**
Review	

ATTERBERG LIMITS
ASTM D 4318

PROJECT NAME: Exide Frisco Geotech
PROJECT NUMBER: 130-2086-06
SAMPLE ID: RCA-BH-3, SPT-2
SAMPLE DEPTH (ft): 3.0'-4.5'
SAMPLE TYPE: Bag

SAMPLE PREPARATION
Wet or Dry: Wet
Minus #40 Sieve: N/A

PLASTIC LIMIT

Mass of Wet Soil & Tare (gm)	23.04	27.13
Mass of Dry Soil & Tare (gm)	22.27	26.42
Mass of Tare (gm)	17.22	21.73
Mass of Water (gm)	0.77	0.71
Mass of Dry Soil (gm)	5.05	4.69
Water Content %	15.25	15.14

LIQUID LIMIT

Number of Drops	30	25	17
Mass of Wet Soil & Tare (gm)	31.29	34.94	30.39
Mass of Dry Soil & Tare (gm)	26.59	29.95	25.05
Mass of Tare (gm)	18.79	21.91	16.80
Mass of Water (gm)	4.70	4.99	5.34
Mass of Dry Soil (gm)	7.80	8.04	8.25
Water Content %	60.26	62.06	64.73

PLASTIC LIMIT (PL): 15

LIQUID LIMIT (LL): 62

PLASTICITY INDEX (PI): 47

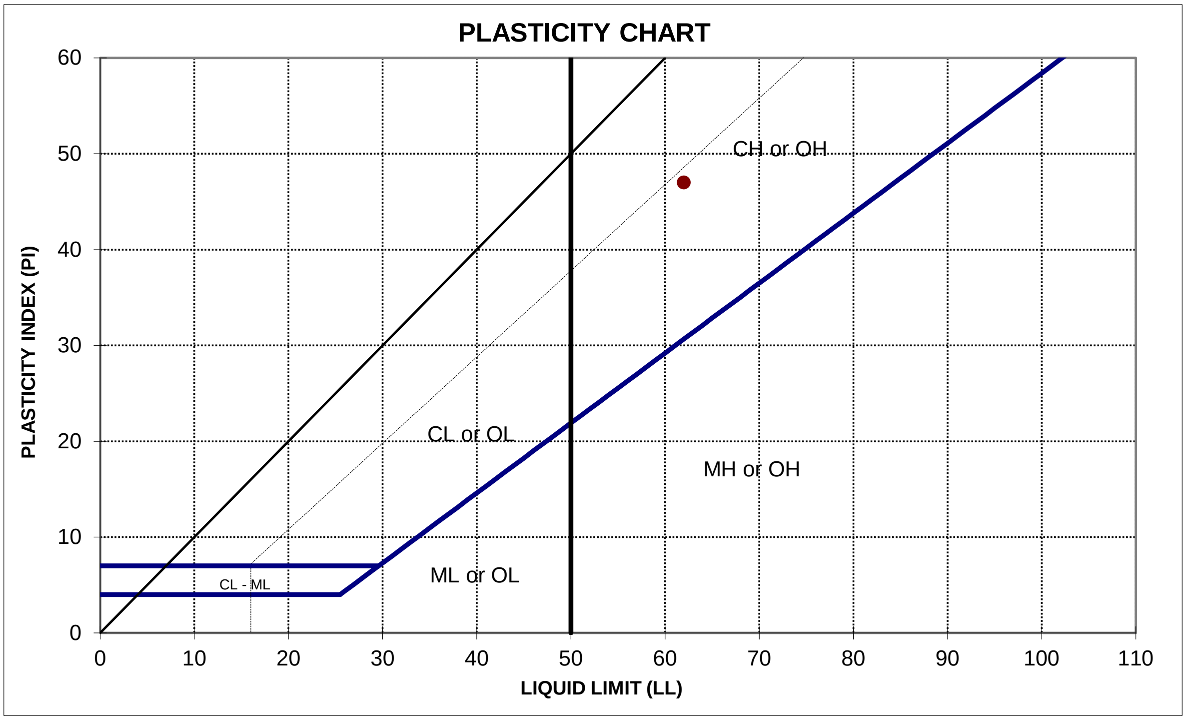
Visual Description

Fat Clay, Grayish Brown

NOTES

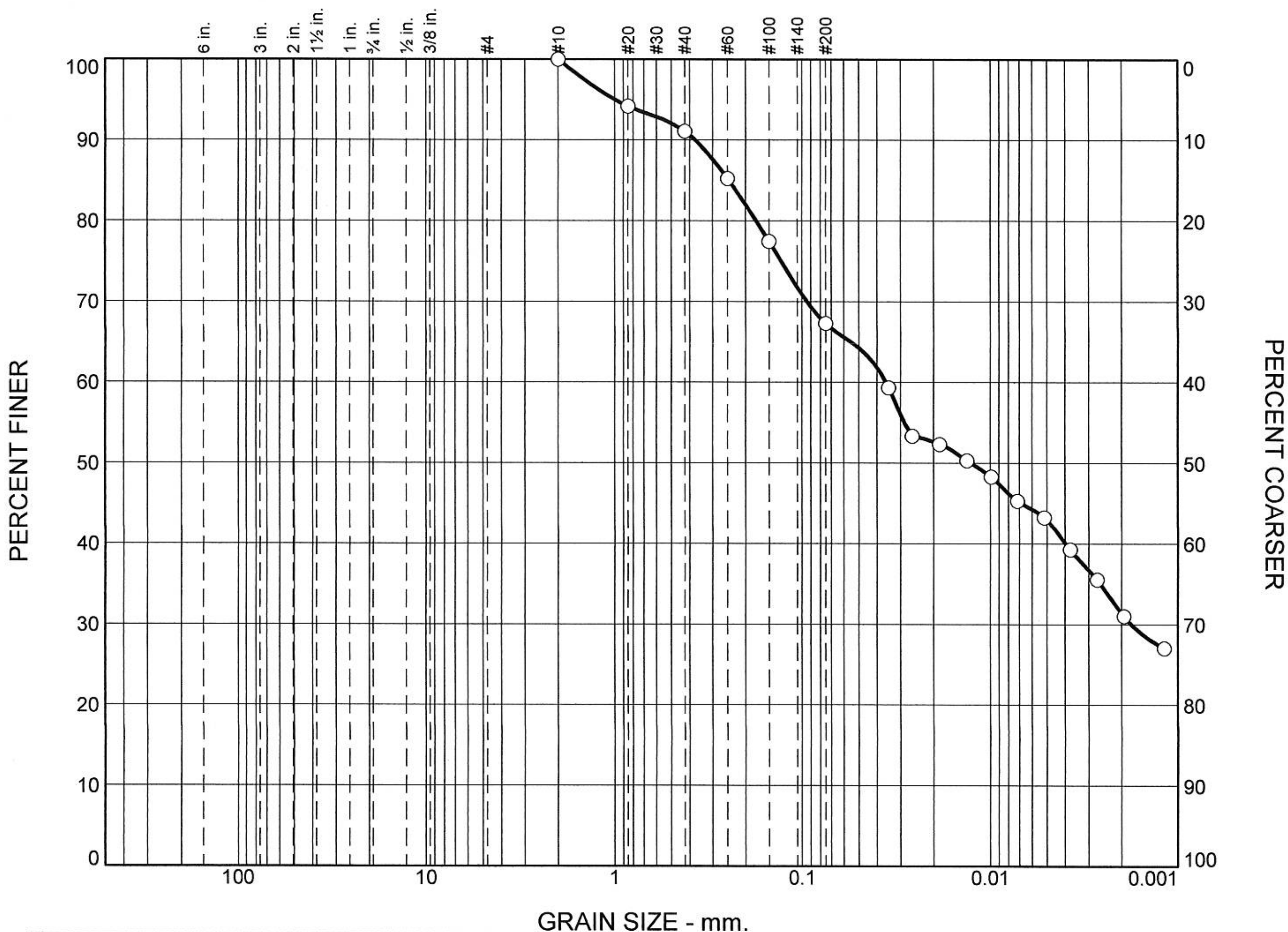
Plastic Limit test performed by hand rolling.
Method A Liquid Limit test performed using mechanical device.

PLASTICITY CHART



TECH: MR
DATE: 7/24/2018
REVIEW: MB

Particle Size Distribution Report



	% +3"	% Gravel		% Sand			% Fines	
		Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
○	0.0	0.0	0.0	0.0	8.9	23.8	35.9	31.4

SOIL DATA

SYMBOL	SOURCE	SAMPLE NO.	DEPTH (ft.)	Material Description	USCS
○	RCA-BH-3	HS18070801-01	8.5-10	Dark gray SANDY LEAN CLAY; calcareous (hydrocarbon odor)	CL

Tolunay-Wong Engineers, Inc.
Houston, Texas

Client: ALS

Project: ALS- HS18070801
COC 9451

Project No.: 18.14.141

Figure

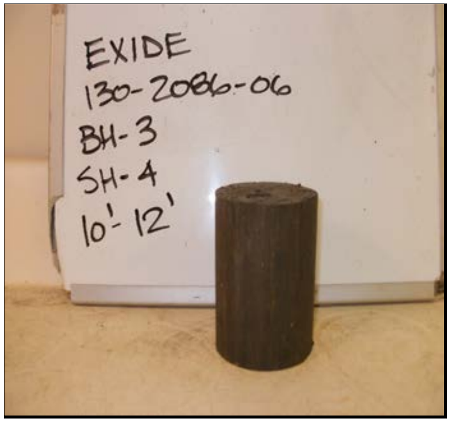
FLEXIBLE WALL TRIAXIAL PERMEABILITY

ASTM D 5084 METHOD F, CONSTANT VOLUME - FALLING HEAD

PROJECT TITLE: Exide
PROJECT NUMBER: 130-2086-06
SAMPLE ID: BH-3, SH-4
LIFT NUMBER: 10'-12'

Cell Pressure = 80 psi
Backwater Pressure = 70 psi
Run Number = 1
Permeant Used= De-Aired Water

Sample Data, Initial		centimeters	**Sample Data, Final**		centimeters
Height, in	3.571	9.07	Height, in	3.584	9.10
Top Diameter, mm	70.630		Top Diameter, mm	70.930	
Middle Diameter, mm	70.630		Middle Diameter, mm	70.810	
Bottom Diameter, mm	70.720		Bottom Diameter, mm	70.750	
Average Diameter, cm	7.066		Average Diameter, cm	7.083	
Area, cm^2	39.21		Area, cm^2	39.40	
Volume, cm^3	355.68		Volume, cm^3	358.70	
Wet Mass, g	694.4		Wet Mass, g	699	
Wt. tare, gm	8.2		Wt. tare, gm	8.2	
Wt. wet soil + tare, gm	464.60		Wt. wet soil + tare, gm	706.8	
Wt. dry soil + tare, gm	365.86		Wt. dry soil + tare, gm	554.4	
Moisture Content, %	27.6%		Moisture Content, %	27.9%	
Dry Density, pcf	95.5		Dry Density, pcf	95.1	
Specific Gravity	2.65	Assumed	Specific Gravity	2.65	
Void Ratio	0.73		Void Ratio	0.74	
Saturation, %	100%		Saturation, %	100%	
Effective Stress, psi	10				



Manometer Constants:

$a_{annulus}$ = 0.76712 cm^2
$a_{center\ pipette}$ = 0.03142 cm^3

Initial Manometer Readings

Pipette = 22.5
Annulus = 0.85

Minutes	Seconds	Δt (sec)	Pipette (cm)	Annulus (cm)	Flowrate (cm^3/s)	Gradient (i)	Hydraulic Conductivity (cm/sec)	Temp. ^oC	rt temp. corr.	Hydraulic Conductivity (cm/sec) @20^oC
0	0	0	22.5	0.85		29.98		23	0.931	
1	15	75	22.3	0.86	8.378E-05	29.44	7.22E-08	23	0.931	6.72E-08
10	50	575	21.3	0.90	5.464E-05	27.42	5.06E-08	23	0.931	4.71E-08
16	6	316	20.9	0.92	3.977E-05	27.28	3.70E-08	23	0.931	3.44E-08
24	51	525	20.3	0.94	3.590E-05	26.28	3.47E-08	23	0.931	3.23E-08
33	2	491	19.8	0.96	3.199E-05	25.63	3.17E-08	23	0.931	2.95E-08
39	58	416	19.4	0.98	3.021E-05	25.13	3.05E-08	23	0.931	2.84E-08
47	22	444	19.0	0.99	2.830E-05	24.56	2.93E-08	23	0.931	2.72E-08

HYDRAULIC CONDUCTIVITY REPORTED AS **2.94E-08** **cm/sec**

TECH: MR
DATE: 7/19/2018

CHECKED: JL
DATE: 7/24/2018

GEOTECHNICAL TESTING LABORATORY
GOLDER ASSOCIATES
HOUSTON, TEXAS

Golder Associates

ATTERBERG LIMITS
ASTM D 4318

PROJECT NAME: Exide Frisco Geotech
PROJECT NUMBER: 130-2086-06
SAMPLE ID: RCA-BH-3, SPT-5
SAMPLE DEPTH (ft): 13.5'-15.0'
SAMPLE TYPE: Bag

SAMPLE PREPARATION
Wet or Dry: Wet
Minus #40 Sieve: N/A

PLASTIC LIMIT

Mass of Wet Soil & Tare (gm)	23.23	22.10
Mass of Dry Soil & Tare (gm)	22.50	21.46
Mass of Tare (gm)	17.02	16.61
Mass of Water (gm)	0.73	0.64
Mass of Dry Soil (gm)	5.48	4.85
Water Content %	13.32	13.20

LIQUID LIMIT

Number of Drops	30	24	16
Mass of Wet Soil & Tare (gm)	32.92	35.00	33.75
Mass of Dry Soil & Tare (gm)	29.49	30.80	29.69
Mass of Tare (gm)	21.77	21.81	21.50
Mass of Water (gm)	3.43	4.20	4.06
Mass of Dry Soil (gm)	7.72	8.99	8.19
Water Content %	44.43	46.72	49.57

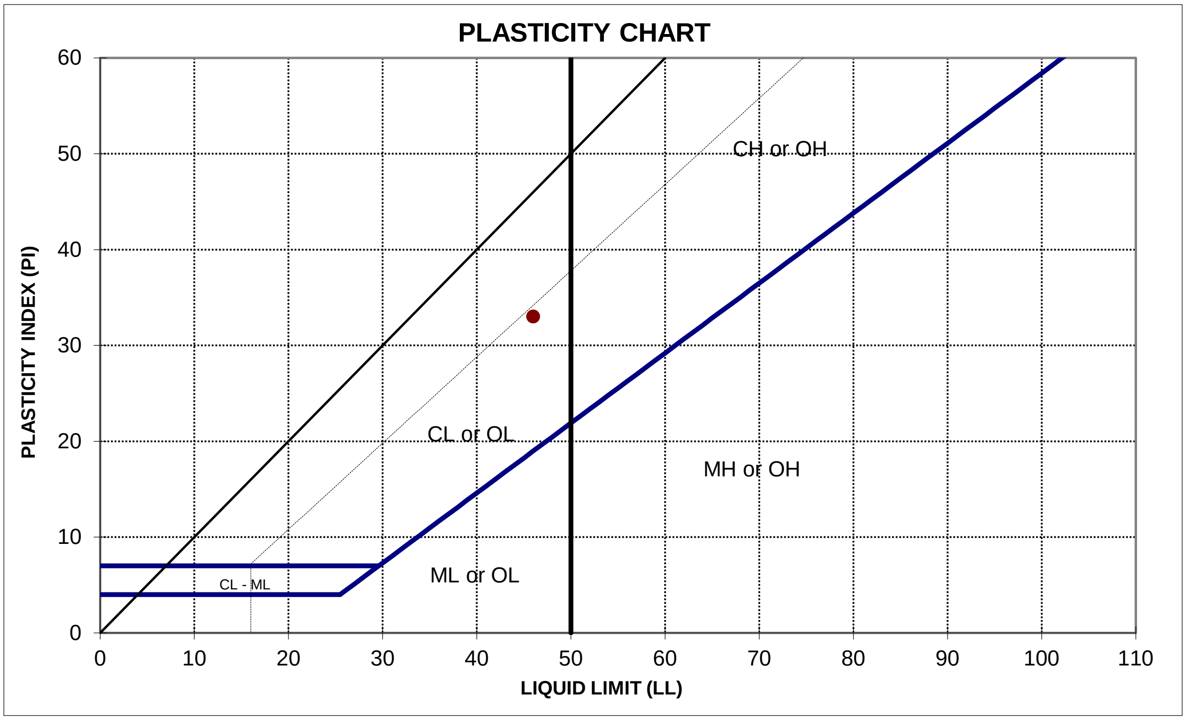
PLASTIC LIMIT (PL)
13

LIQUID LIMIT (LL)
46

PLASTICITY INDEX (PI)
33

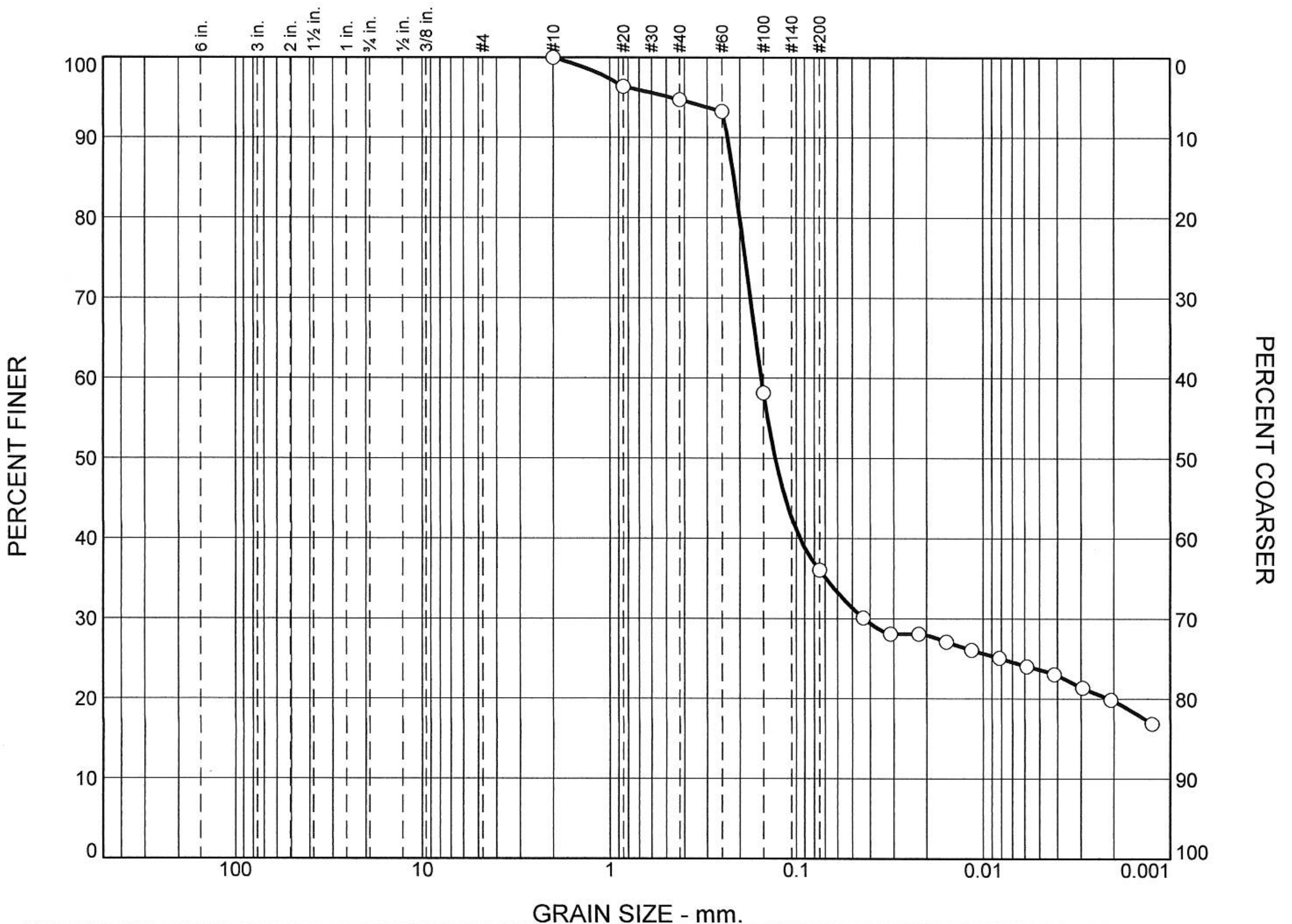
Visual Description
Lean Clay, Light Brown

NOTES
Plastic Limit test performed by hand rolling.
Method A Liquid Limit test performed using mechanical device.



TECH	MR
DATE	7/24/2018
REVIEW	MB

Particle Size Distribution Report



	% +3"	% Gravel		% Sand			% Fines	
		Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
○	0.0	0.0	0.0	0.0	5.3	58.7	16.3	19.7

SOIL DATA

SYMBOL	SOURCE	SAMPLE NO.	DEPTH (ft.)	Material Description	USCS
○	RCA-BH-3	HS18070801-02	23.5-25	Dark gray CLAYEY SAND; calcareous (hydrocarbon odor)	SC

Tolunay-Wong Engineers, Inc.
Houston, Texas

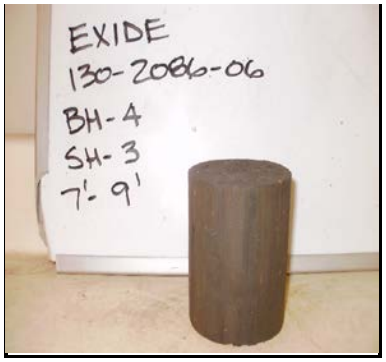
Client: ALS
Project: ALS- HS18070801
COC 9451
Project No.: 18.14.141 **Figure**

FLEXIBLE WALL TRIAXIAL PERMEABILITY

ASTM D 5084 METHOD F, CONSTANT VOLUME - FALLING HEAD

PROJECT TITLE:	Exide	Cell Pressure =	80 psi
PROJECT NUMBER:	130-2086-06	Backwater Pressure =	70 psi
SAMPLE ID:	BH-4, SH-3	Run Number =	1
LIFT NUMBER:	7'-9'	Permeant Used=	De-Aired Water

Sample Data, Initial		centimeters	**Sample Data, Final**		centimeters
Height, in	3.59	9.12	Height, in	3.543	9.00
Top Diameter, mm	72.550		Top Diameter, mm	72.620	
Middle Diameter, mm	72.380		Middle Diameter, mm	72.300	
Bottom Diameter, mm	72.520		Bottom Diameter, mm	72.550	
Average Diameter, cm	7.248		Average Diameter, cm	7.249	
Area, cm²	41.26		Area, cm²	41.27	
Volume, cm³	376.27		Volume, cm³	371.41	
Wet Mass, g	678.2		Wet Mass, g	676.4	
Wt. tare, gm	8.3		Wt. tare, gm	8.3	
Wt. wet soil + tare, gm	356.20		Wt. wet soil + tare, gm	684.4	
Wt. dry soil + tare, gm	268.90		Wt. dry soil + tare, gm	510.5	
Moisture Content, %	33.5%		Moisture Content, %	34.6%	
Dry Density, pcf	84.2		Dry Density, pcf	84.4	
Specific Gravity	2.65	Assumed	Specific Gravity	2.65	
Void Ratio	0.96		Void Ratio	0.96	
Saturation, %	92%		Saturation, %	96%	
Effective Stress, psi	10				



Manometer Constants:

$a_{annulus}$ = 0.76712 cm²

$a_{center\ pipette}$ = 0.03142 cm³

Initial Manometer Readings

Pipette = 22.5

Annulus = 0.85

Minutes	Seconds	Δt (sec)	Pipette (cm)	Annulus (cm)	Flowrate (cm³/s)	Gradient (i)	Hydraulic Conductivity (cm/sec)	Temp. °C	rt temp. corr.	Hydraulic Conductivity (cm/sec) @20°C
0	0	0	22.5	0.85		29.82		23	0.931	
0	22	22	21.5	0.89	1.428E-03	28.03	1.23E-06	23	0.931	1.15E-06
1	1	39	20.5	0.93	8.055E-04	26.58	7.34E-07	23	0.931	6.84E-07
1	48	47	19.5	0.97	6.684E-04	25.12	6.45E-07	23	0.931	6.00E-07
2	42	54	18.5	1.01	5.818E-04	23.67	5.96E-07	23	0.931	5.55E-07
4	14	92	17.0	1.08	5.122E-04	21.12	5.88E-07	23	0.931	5.47E-07
5	26	72	16.0	1.12	4.363E-04	20.04	5.28E-07	23	0.931	4.91E-07
6	47	81	15.0	1.16	3.879E-04	18.58	5.06E-07	23	0.931	4.71E-07
8	13	86	14.0	1.20	3.653E-04	17.13	5.17E-07	23	0.931	4.81E-07
9	50	97	13.0	1.24	3.239E-04	15.68	5.01E-07	23	0.931	4.66E-07
11	30	100	12.0	1.28	3.142E-04	14.22	5.35E-07	23	0.931	4.98E-07
13	28	118	11.0	1.32	2.662E-04	12.77	5.05E-07	23	0.931	4.70E-07
15	44	136	10.0	1.36	2.310E-04	11.31	4.95E-07	23	0.931	4.61E-07
18	24	160	9.0	1.40	1.964E-04	9.86	4.83E-07	23	0.931	4.49E-07
21	33	189	8.0	1.44	1.662E-04	8.40	4.79E-07	23	0.931	4.46E-07
25	8	215	7.0	1.48	1.461E-04	6.95	5.10E-07	23	0.931	4.75E-07
29	59	291	6.0	1.53	1.080E-04	5.49	4.77E-07	23	0.931	4.44E-07
33	40	221	5.4	1.55	8.529E-05	4.92	4.20E-07	23	0.931	3.91E-07
41	32	472	4.4	1.59	6.656E-05	3.14	5.14E-07	23	0.931	4.79E-07

HYDRAULIC CONDUCTIVITY REPORTED AS 4.47E-07 cm/sec

TECH:	MR	CHECKED:	JL
DATE:	7/19/2018	DATE:	7/24/2018

GEOTECHNICAL TESTING LABORATORY
GOLDER ASSOCIATES
HOUSTON, TEXAS

GOLDER

ATTERBERG LIMITS
ASTM D 4318

PROJECT NAME: Exide Frisco Geotech
PROJECT NUMBER: 130-2086-06
SAMPLE ID: RCA-BH-4, SH-5
SAMPLE DEPTH (ft): 12.0'-14.0'
SAMPLE TYPE: Shelby Tube

SAMPLE PREPARATION

Wet or Dry: Wet

Minus #40 Sieve: N/A

PLASTIC LIMIT

Mass of Wet Soil & Tare (gm)	27.02	25.09
Mass of Dry Soil & Tare (gm)	26.10	24.14
Mass of Tare (gm)	21.77	19.66
Mass of Water (gm)	0.92	0.95
Mass of Dry Soil (gm)	4.33	4.48
Water Content %	21.25	21.21

LIQUID LIMIT

Number of Drops	33	25	18
Mass of Wet Soil & Tare (gm)	33.63	31.54	33.49
Mass of Dry Soil & Tare (gm)	29.20	25.95	28.45
Mass of Tare (gm)	21.59	16.80	20.42
Mass of Water (gm)	4.43	5.59	5.04
Mass of Dry Soil (gm)	7.61	9.15	8.03
Water Content %	58.21	61.09	62.76

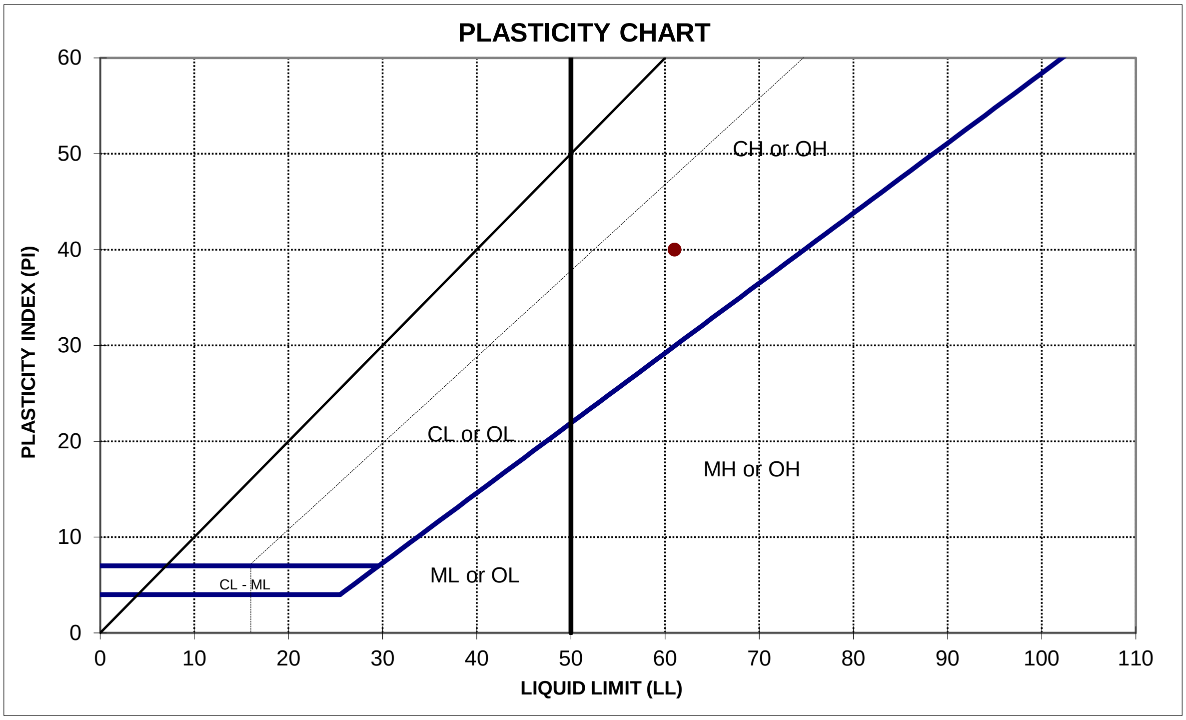
PLASTIC LIMIT (PL)
21

LIQUID LIMIT (LL)
61

PLASTICITY INDEX (PI)
40

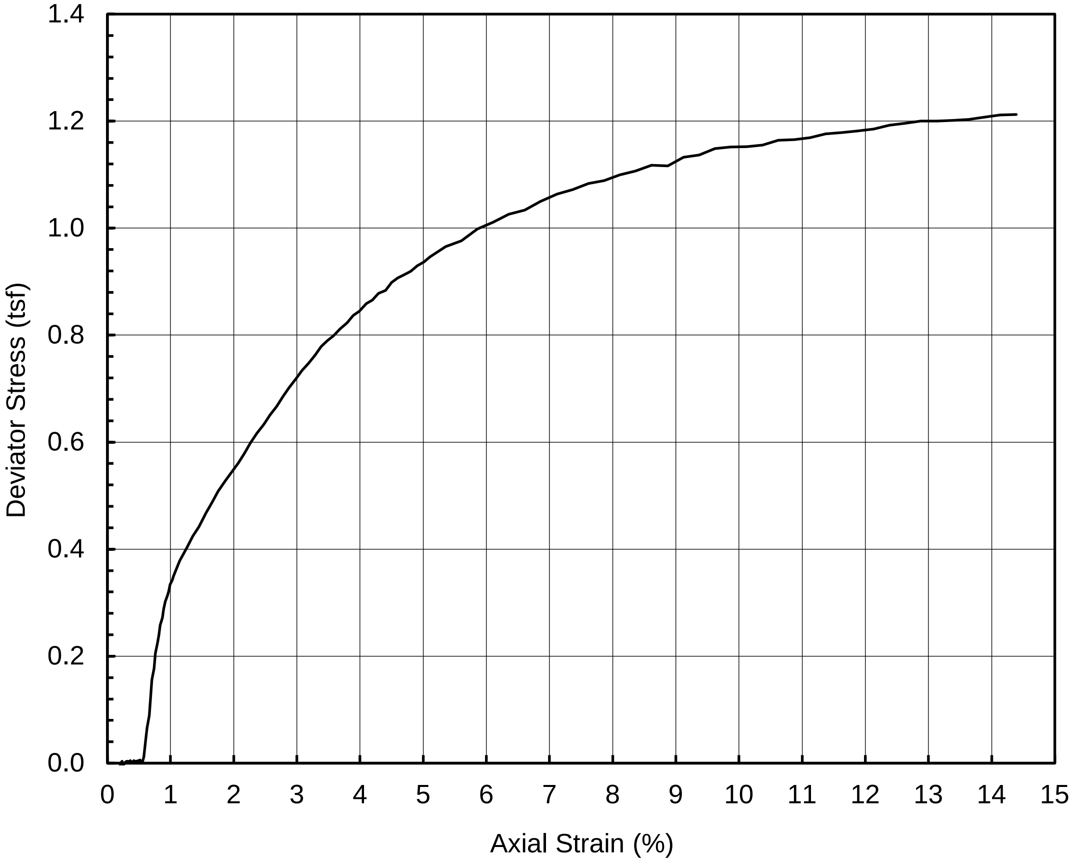
Visual Description
Fat Clay, Gray

NOTES
Plastic Limit test performed by hand rolling.
Method A Liquid Limit test performed using mechanical device.



TECH: MR
DATE: 7/24/2018
REVIEW: MB

UNCONSOLIDATED / UNDRAINED COMPRESSIVE STRENGTH
ASTM D 2850



Specimen Description							
LL	61	PL	21	PI	40.0	USCS	CH

Depth (ft)	12 - 14	Confining Pressure (psi)	9.0
Specimen Height (inch)	5.6	Strain Rate (%/min)	1.0
Specimen Diameter (inch)	2.9	Peak Deviator Stress (tsf)	1.2
Initial Specimen Weight (g)	1119.2	Axial Strain at Peak Stress (%)	14.9
Moist Unit Weight (pcf)	120.2		
Initial Water Content (%)	26		
Initial Dry Unit Weight (pcf)	95.3		

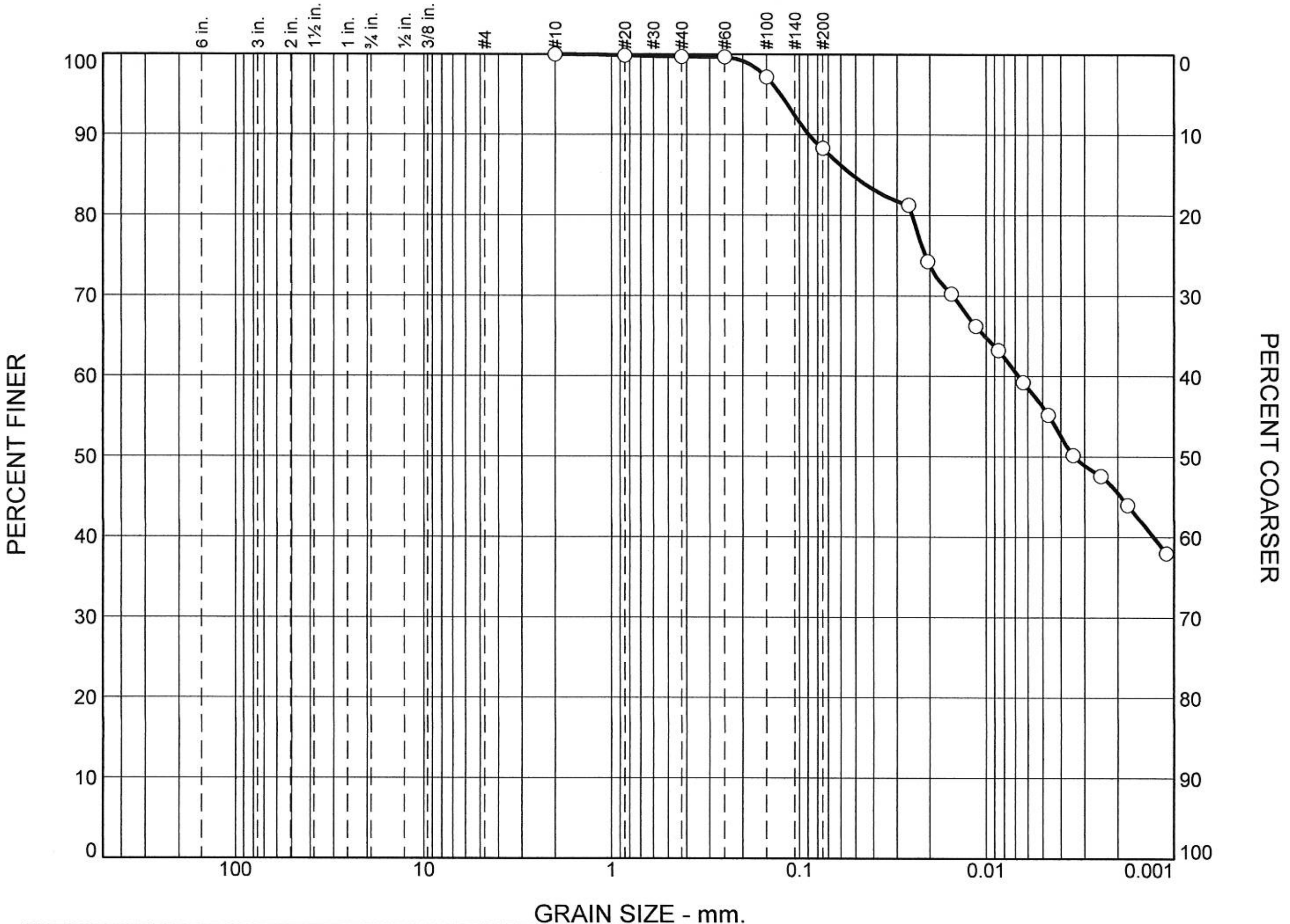
Project Title	Exide Frisco Geotech
Project Number	130-2086-06
Sample Type	Shelby Tube
Sample ID	RCA-BH-4 SH-5
Comments	

Failure Sketch

Golder Associates

Performed by	**MR**
Date	**19-Jul-18**
Check	**JL**
Review	

Particle Size Distribution Report



	% +3"	% Gravel		% Sand			% Fines	
		Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
○	0.0	0.0	0.0	0.0	0.3	11.4	42.8	45.5

SOIL DATA

SYMBOL	SOURCE	SAMPLE NO.	DEPTH (ft.)	Material Description	USCS
○	RCA-BH-4	HS18070801-03	18.5-20	Dark gray LEAN CLAY; calcareous (hydrocarbon odor)	CL

Tolunay-Wong Engineers, Inc.
Houston, Texas

Client: ALS

Project: ALS- HS18070801
COC 9451

Project No.: 18.14.141

Figure

GOLDER

ATTERBERG LIMITS
ASTM D 4318

PROJECT NAME: Exide Frisco Geotech
PROJECT NUMBER: 130-2086-06
SAMPLE ID: RCA-BH-5, SH-3
SAMPLE DEPTH (ft): 8.5'-10.5'
SAMPLE TYPE: Shelby Tube

SAMPLE PREPARATION
Wet or Dry: Wet
Minus #40 Sieve: N/A

PLASTIC LIMIT

Mass of Wet Soil & Tare (gm)	27.12	26.79
Mass of Dry Soil & Tare (gm)	26.48	26.09
Mass of Tare (gm)	21.78	20.88
Mass of Water (gm)	0.64	0.70
Mass of Dry Soil (gm)	4.70	5.21
Water Content %	13.62	13.44

LIQUID LIMIT

Number of Drops	30	23	16
Mass of Wet Soil & Tare (gm)	35.50	33.91	31.65
Mass of Dry Soil & Tare (gm)	30.75	29.56	26.26
Mass of Tare (gm)	21.77	21.77	17.03
Mass of Water (gm)	4.75	4.35	5.39
Mass of Dry Soil (gm)	8.98	7.79	9.23
Water Content %	52.90	55.84	58.40

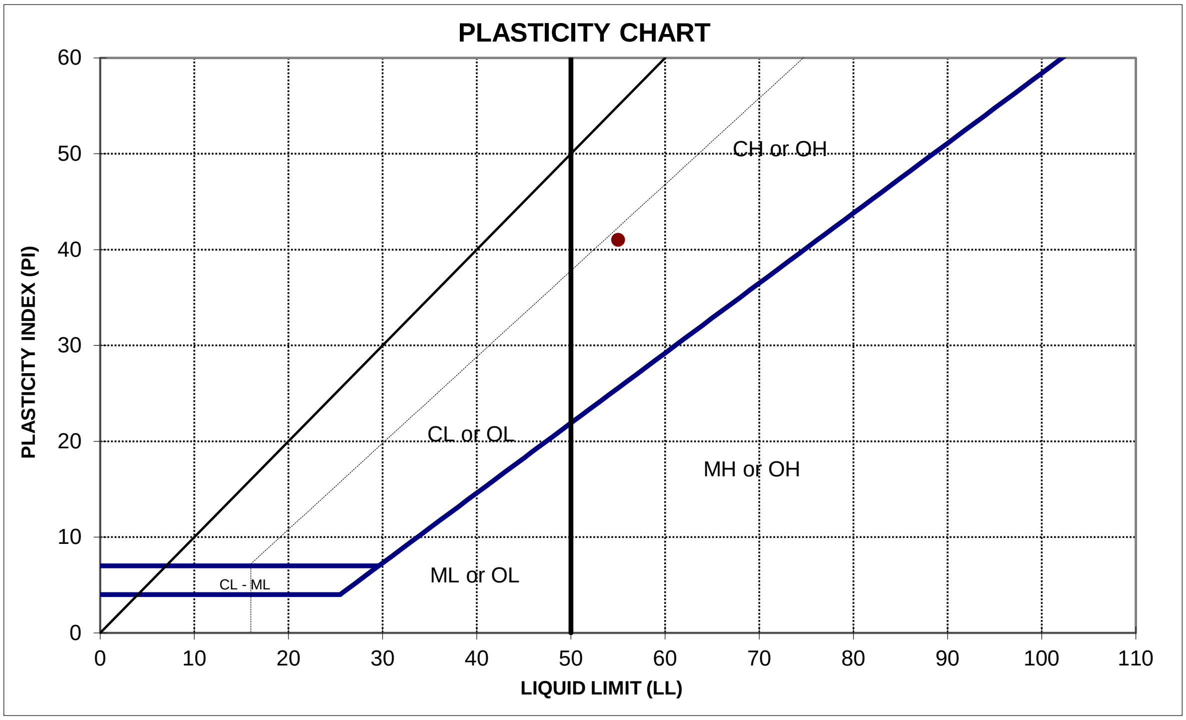
PLASTIC LIMIT (PL)
14

LIQUID LIMIT (LL)
55

PLASTICITY INDEX (PI)
41

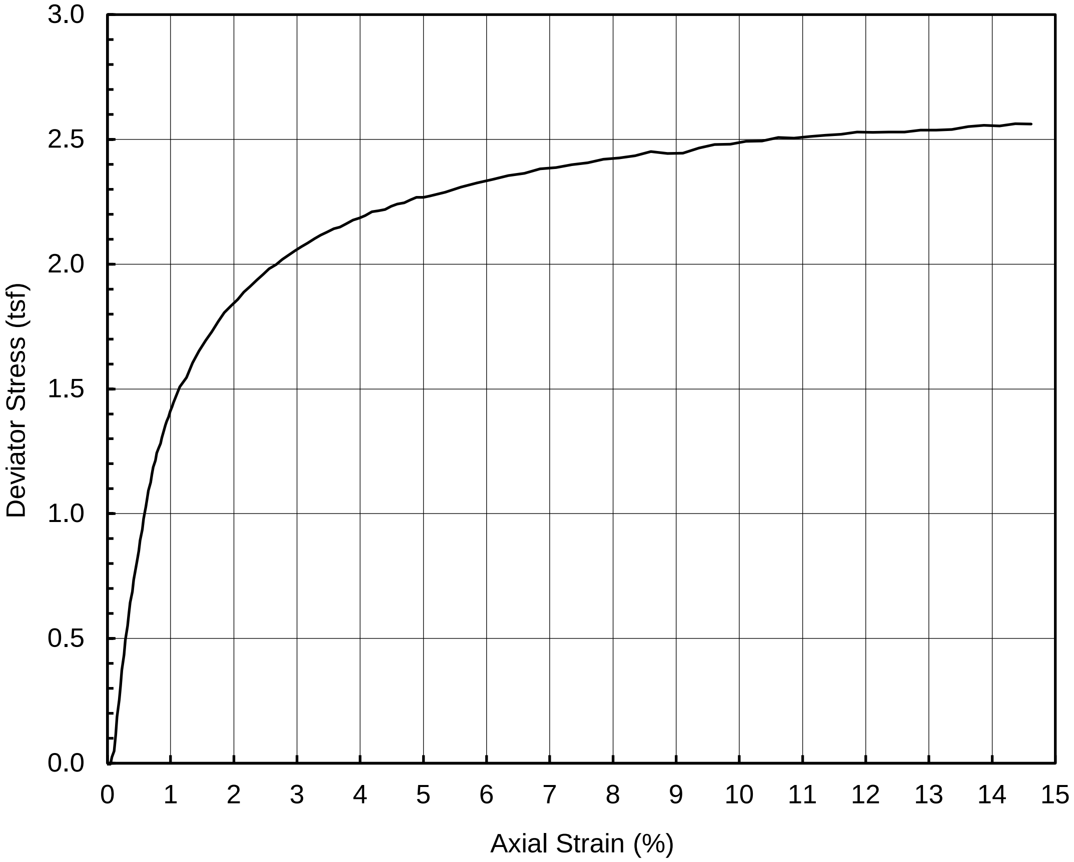
Visual Description
Fat Clay, Light Brown

NOTES
Plastic Limit test performed by hand rolling.
Method A Liquid Limit test performed using mechanical device.



TECH: MR
DATE: 7/24/2018
REVIEW: MB

UNCONSOLIDATED / UNDRAINED COMPRESSIVE STRENGTH
ASTM D 2850



Specimen Description							
LL	55	PL	14	PI	41.0	USCS	CH

Depth (ft)	8.5 - 10.5	Confining Pressure (psi)	6.2
Specimen Height (inch)	5.6	Strain Rate (%/min)	1.0
Specimen Diameter (inch)	2.8	Peak Deviator Stress (tsf)	2.6
Initial Specimen Weight (g)	1149.2	Axial Strain at Peak Stress (%)	14.9
Moist Unit Weight (pcf)	129.3		
Initial Water Content (%)	21		
Initial Dry Unit Weight (pcf)	107.1		


Failure Sketch

Project Title	Exide Frisco Geotech
Project Number	130-2086-06
Sample Type	Shelby Tube
Sample ID	RCA-BH-5 SH-3
Comments	

Golder Associates

Performed by	**MR**
Date	**20-Jul-18**
Check	**JL**
Review	

GOLDER

ATTERBERG LIMITS
ASTM D 4318

PROJECT NAME: Exide Frisco Geotech
PROJECT NUMBER: 130-2086-06
SAMPLE ID: RCA-BH-5, SPT-4
SAMPLE DEPTH (ft): 10.5'-12.0'
SAMPLE TYPE: Bag

SAMPLE PREPARATION
Wet or Dry: Wet
Minus #40 Sieve: N/A

PLASTIC LIMIT

Mass of Wet Soil & Tare (gm)	22.50	27.13
Mass of Dry Soil & Tare (gm)	21.79	26.45
Mass of Tare (gm)	16.66	21.52
Mass of Water (gm)	0.71	0.68
Mass of Dry Soil (gm)	5.13	4.93
Water Content %	13.84	13.79

LIQUID LIMIT

Number of Drops	33	24	18
Mass of Wet Soil & Tare (gm)	35.49	34.66	35.26
Mass of Dry Soil & Tare (gm)	30.84	29.99	30.32
Mass of Tare (gm)	21.89	21.45	21.69
Mass of Water (gm)	4.65	4.67	4.94
Mass of Dry Soil (gm)	8.95	8.54	8.63
Water Content %	51.96	54.68	57.24

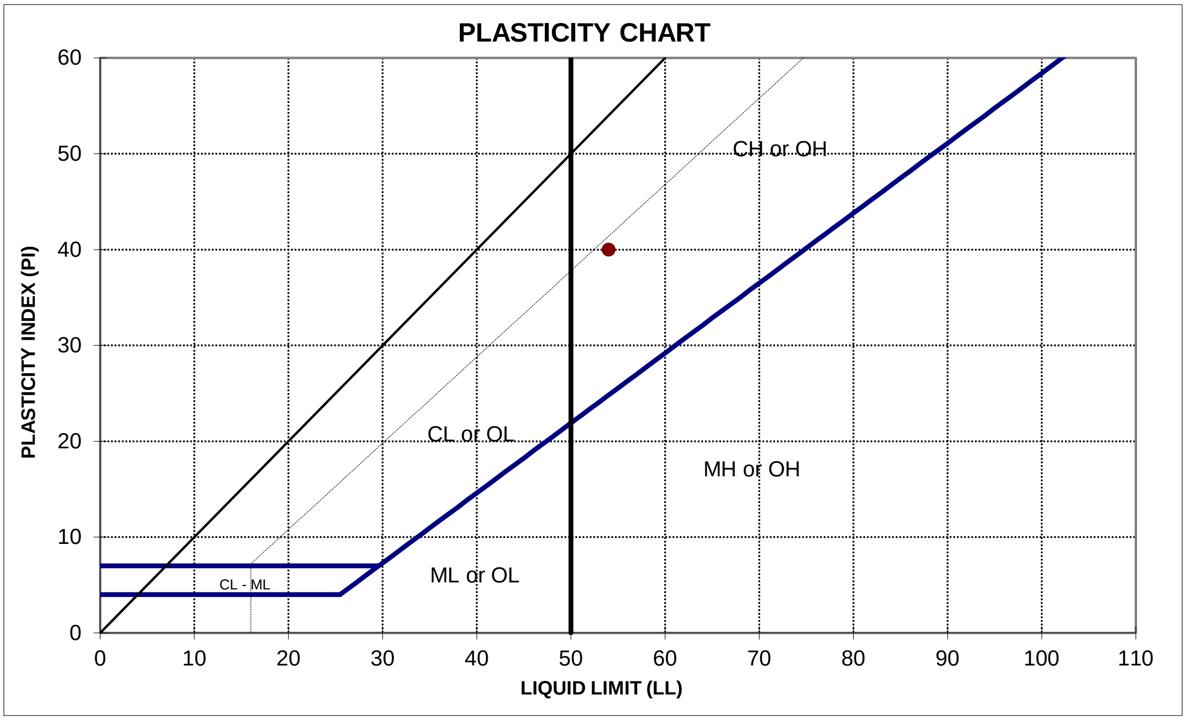
PLASTIC LIMIT (PL)
14

LIQUID LIMIT (LL)
54

PLASTICITY INDEX (PI)
40

Visual Description
Fat Clay, Light Brown

NOTES
Plastic Limit test performed by hand rolling.
Method A Liquid Limit test performed using mechanical device.



TECH: MR
DATE: 7/24/2018
REVIEW: MB

FLEXIBLE WALL TRIAXIAL PERMEABILITY

ASTM D 5084 METHOD F, CONSTANT VOLUME - FALLING HEAD

PROJECT TITLE:	Exide		Cell Pressure =	80 psi
PROJECT NUMBER:	130-2086-06		Backwater Pressure =	70 psi
SAMPLE ID:	BH-5, SH-5		Run Number =	1
LIFT NUMBER:	13.5'-15.5'		Permeant Used=	De-Aired Water

Sample Data, Initial		centimeters	**Sample Data, Final**		centimeters
Height, in	3.625	9.21	Height, in	3.534	8.98
Top Diameter, mm	71.010		Top Diameter, mm	71.220	
Middle Diameter, mm	70.880		Middle Diameter, mm	70.060	
Bottom Diameter, mm	71.300		Bottom Diameter, mm	71.530	
Average Diameter, cm	7.106		Average Diameter, cm	7.094	
Area, cm^2	39.66		Area, cm^2	39.52	
Volume, cm^3	365.19		Volume, cm^3	354.76	
Wet Mass, g	671.6		Wet Mass, g	663.1	
Wt. tare, gm	7		Wt. tare, gm	6.8	
Wt. wet soil + tare, gm	303.50		Wt. wet soil + tare, gm	669.6	
Wt. dry soil + tare, gm	229.10		Wt. dry soil + tare, gm	512.5	
Moisture Content, %	33.5%		Moisture Content, %	31.1%	
Dry Density, pcf	86.0		Dry Density, pcf	89.0	
Specific Gravity	2.65	Assumed	Specific Gravity	2.65	
Void Ratio	0.92		Void Ratio	0.86	
Saturation, %	96%		Saturation, %	96%	
Effective Stress, psi	10				

Manometer Constants:

$a_{annulus}$ = 0.76712 cm^2

$a_{center\ pipette}$ = 0.03142 cm^3

Initial Manometer Readings

Pipette = 22.5

Annulus = 0.85

Minutes	Seconds	Δt (sec)	Pipette (cm)	Annulus (cm)	Flowrate (cm^3/s)	Gradient (i)	Hydraulic Conductivity (cm/sec)	Temp. °C	rt temp. corr.	Hydraulic Conductivity (cm/sec) @20°C
0	0	0	22.5	0.85		29.53		23	0.931	
2	13	133	21.9	0.87	1.417E-04	28.98	1.24E-07	23	0.931	1.15E-07
9	48	455	21.1	0.91	5.524E-05	27.67	5.05E-08	23	0.931	4.70E-08
17	30	462	20.5	0.93	4.080E-05	26.94	3.83E-08	23	0.931	3.57E-08
25	30	480	20.0	0.95	3.273E-05	26.29	3.15E-08	23	0.931	2.93E-08
32	30	420	19.6	0.97	2.992E-05	25.78	2.94E-08	23	0.931	2.73E-08
40	42	492	19.2	0.99	2.554E-05	25.19	2.57E-08	23	0.931	2.39E-08
49	24	522	18.8	1.00	2.407E-05	24.61	2.47E-08	23	0.931	2.30E-08
60	50	686	18.3	1.02	2.290E-05	23.81	2.43E-08	23	0.931	2.27E-08

HYDRAULIC CONDUCTIVITY REPORTED AS **2.42E-08** **cm/sec**

TECH:	MR	CHECKED:	JL
DATE:	7/19/2018	DATE:	7/24/2018

GEOTECHNICAL TESTING LABORATORY
GOLDER ASSOCIATES
HOUSTON, TEXAS

Golder Associates

WATER CONTENT DETERMINATION
ASTM D2216

PROJECT TITLE	Exide Frisco Geotech
PROJECT NUMBER	130-2086-06
REMARKS	

Sample Type	Bag	Bag	Bag	Bag	Bag
Borehole Number	RCA-BH-1	RCA-BH-1	RCA-BH-2	RCA-BH-2	RCA-BH-2
Sample Number	SPT-1	SPT-3	SPT-1	SPT-2	SPT-3
Depth of Sample (ft)	2.0'-3.5'	10.5'-12.0'	1.5'-3.0'	3.0'-4.5'	9.0'-10.5'
Tare Number	101	17	76	410	28
Weight of Tare (gm)	18.82	20.80	19.55	16.92	21.72
Weight of Wet Soil + Tare (gm)	143.24	150.78	110.30	107.76	108.00
Weight of Dry Soil + Tare (gm)	123.21	124.23	97.13	92.53	88.93
Water Content (%)	**19.2**	**25.7**	**17.0**	**20.1**	**28.4**
Sample Type	Bag	Bag	Bag	Bag	Bag
Borehole Number	RCA-BH-2	RCA-BH-3	RCA-BH-4	RCA-BH-4	RCA-BH-4
Sample Number	SPT-5	SPT-1	SPT-1	SPT-2	SPT-4
Depth of Sample (ft)	14.0'-15.5'	1.5'-3.0'	2.0'-3.5'	3.5'-5.0'	9.0'-10.5'
Tare Number	413	61	79	8	14
Weight of Tare (gm)	17.34	22.33	19.87	21.67	20.93
Weight of Wet Soil + Tare (gm)	114.82	104.33	119.62	129.69	143.91
Weight of Dry Soil + Tare (gm)	94.08	87.23	89.19	96.87	111.42
Water Content (%)	**27.0**	**26.3**	**43.9**	**43.6**	**35.9**
Sample Type	Bag	Bag	Bag		
Borehole Number	RCA-BH-4	RCA-BH-5	RCA-BH-5		
Sample Number	SPT-6	SPT-1	SPT-2		
Depth of Sample (ft)	14.0'-15.5'	2.0'-3.5'	3.5'-5.0'		
Tare Number	10	115	43		
Weight of Tare (gm)	21.47	19.54	21.84		
Weight of Wet Soil + Tare (gm)	150.01	136.56	112.25		
Weight of Dry Soil + Tare (gm)	124.70	108.15	91.25		
Water Content (%)	**24.5**	**32.1**	**30.3**		
Sample Type					
Borehole Number					
Sample Number					
Depth of Sample (ft)					
Tare Number					
Weight of Tare (gm)					
Weight of Wet Soil + Tare (gm)					
Weight of Dry Soil + Tare (gm)					
Water Content (%)					

TECH	MR
DATE	7/20/2018
REVIEW	MB

Attachment 3 – Calculations

SUBJECT:	Material Properties of Soil Constituents at Exide Frisco		
Job No.:	130-2086-06	**Prepared:**	PJJ
Ref.:	Exide/Frisco Facility/TX	**Checked:**	MSG
Date:	8/14/2018	**Reviewed:**	KMB

Material Properties of Soil Constituents at the Exide Frisco Facility

Objective:

Evaluate the in-situ and test data to develop representative geotechnical material properties for the soils encountered along the proposed location of the flood wall

Methods:

Golder estimated strength properties for each encountered soil type by using a combination of in-situ testing and logging observations, laboratory testing results on samples obtained during the in-situ testing program, published correlations between in-situ and laboratory testing results (e.g. SPT N value, and plasticity index (PI)) and engineering parameters, and published ranges of typical strength properties for the encountered materials.

Summary of Site Materials:

Based on observations during the in-situ drilling investigation, in-situ testing (e.g. SPT sampling), and soil laboratory testing, Golder divided the site materials into three general material types for the current engineering evaluations as summarized below.

Type	USCS Categories
Silty Clay (CL)	CL
Clay (CH)	CH
SHALE	SHALE

Calculations:

In Situ Unit Weight

The in-situ unit weights (γ) used in the engineering analyses were based on averages of laboratory testing results for the Silty Clay (CL), and the Clay (CH) and the Shale was based on Golder experience.

Material	Calculated Unit Weight (pcf)	Unit Weight Used in Analyses (pcf)
Silty Clay (CL)	117.1	117
Clay (CH)	122.8	123
Shale	150.0	150

Correction of material strength properties from in-situ and index testing results

The N value measured in the field was assumed to be based on an energy ratio of 60%; therefore, measured N is assumed equal to N_{60} (N corrected for an energy ratio of 60%).

$(N_1)_{60}$ value is the N_{60} value corrected for the overburden stress, where: $(N_1)_{60} = C_N N_{60}$ $\quad C_N = \frac{2}{1+\left(\frac{\sigma'_{vo}}{p_a}\right)}$

σ'v = effective overburden pressure = depth x unit weight of soil [US tons/square foot]

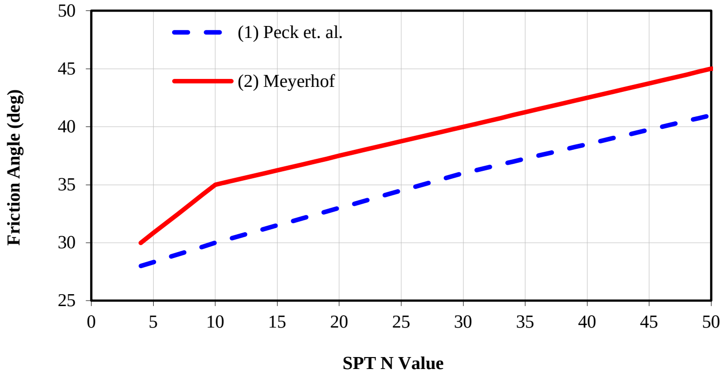
P_a = atmospheric pressure

Effective Friction Angle Based on SPT N Value

Correlations (1) Peck et. al. and (2) Meyerhof, given in source [1] are shown in the table and figure below.

N is assumed equal to N_{60}

N Value (blows/ft)	Approximate ϕ'	
	(1)	(2)
0 to 4	< 28	< 30
4 to 10	28 to 30	30 to 35
10 to 30	30 to 36	35 to 40
30 to 50	36 to 41	40 to 45
> 50	> 41	> 45



Correlation (3) Schmertmann correlation is given as:

$$\Phi' = \tan^{-1}\left[\frac{N}{12.2 + 20.3\left(\frac{\sigma_v'}{p_a}\right)}\right]^{0.34}$$

Correlation (4) Terzaghi, Peck, and Mesri (1996) is shown on Figure 19.6 [2] relating $(N_1)_{60}$ to ϕ'. A quadratic regression equation was fit to the data:

$$\Phi' = -0.0027[(N_1)_{60}]^2 + 0.4271[(N_1)_{60}] + 27.327$$ R^2=0.9998

Effective Friction Angle Based on PI

Correlation (5) Normally consolidated clays $sin\Phi' = 0.8 - 0.094\ln PI$
EPRI (1990)

Correlation (6) Figure 19.7 [2]; PI < 100 $\Phi' = 0.0013(PI)^2 - 0.2717(PI) + 35.876$ R^2 = 0.9972
Terzaghi, Peck, and Mesri (1996)

Correlation (7) Lambe and Whitman (1996) $sin\Phi' = -0.0993\ln(PI) + 0.8064$ R^2 = 1

Correlation (8) Mesri and Shahien (2003) *No closed form relationship, see attached sheets*

Undrained Shear Strength

Undrained shear strength is estimated from correlations with: SPT N and PI.

NAVFAC (1986): The following regression equation was fit to the correlation shown in Figure 4:

Correlation (9) $S_u = 133.33N - 5e^{-13}$ [psf] R^2=1

Lambe and Whitman (1996): The following regression equation was fit to the correlation shown in Figure 29.19:

Correlation (10) $\frac{S_u}{\sigma_v'} = 5 * 10^{-6}\,(PI)^2 - 0.0021(PI) + 0.6626$ [psf] R^2=0.9994

Table D1 summarizes the estimated friction angle from correlations with N and PI.

Results:

The following table summarizes the geotechnical strength properties of the identified soils.

	Shear Strength				In-situ Unit Weight (pcf)
Material	Undrained Parameters		Drained Parameters		
	Effective Friction Angle	Cohesion	Effective Friction Angle	Cohesion	
Silty Clay (CL)	0	1200	24.2	153.0	117
Clay (CH)	0	2100	23.7	137.8	123
SHALE					

The above material properties were based on a combination of: (i) correlations between field (SPT N Value) and laboratory index (PI) tests and engineering properties, the range of observed material densities and consistencies, published ranges of typical engineering property values, laboratory testing, and Golder's experience with similar materials.

SUBJECT:	Material Properties of Soil Constituents at Exide Frisco		
Job No.:	130-2086-06	**Prepared:**	PJJ
Ref.:	Exide/Frisco Facility/TX	**Checked:**	MSG
Date:	8/14/2018	**Reviewed:**	KMB

REFERENCES

[1] Kulhawy, F. H. and Mayne, P.W. (1990). Manual on Estimating Soil Properties for Foundation Design, EL-6800, Electric Power Research Institute.

3 SPT-N correlations: (1) Peck et al.; (2) Meyerhof; (3) Schmertmann
1 PI correlation (5)

[2] Terzaghi, K., Peck, R.B., Mesri, G. (1996). Soil Mechanics in Engineering Practice, 3rd Edition, John Wiley & Sons, New York.

1 SPT-N correlation (4); and 1 PI correlation (6)

[3] Lambe, T.W. and Whitman, R.V. (1969). Soil Mechanics, John Wiley & Sons, New York.

1 PI correlation (7)
1 Undrained Shear Strength correlation (10)

[4] Mesri, G. and Shahien, M. (2003). "Residual Shear Strength Mobilized in First-Time Slope Failures," Journal of Geotechnical and Geoenvironmental Engineering, Vo. 129, No. 1, pp. 12-31.

1 PI correlation (8)

[5] Naval Facilities Engineering Command (NAVFAC) (1986). Design Manual 7.02 Foundations and Earth Structures.

1 Undrained Shear Strength correlation (9)

[6] Lindeburg, M. (2014). Civil Engineering Reference Manul, 14th Edition, Professional Publications Inc., California.

SUBJECT: **TABLE D1 Soil Material Properties**

Job No.:	130-2086-06	**Prepared:**	PJJ
Ref.:	Exide/Frisco Facility/TX	**Checked:**	MSG
Date:	8/14/2018	**Reviewed:**	KMB

																		Effective Friction Angle for Granular Soils (deg)				*Effective Friction Angle for Cohesive Soils (deg)*				*Cohesion (psf)*					*Undrained Shear Strength (psf)*		
Borehole or Test Pit	*Sample Type*	*USCS*	*Soil Category*	*Total Unit Weight (pcf)*	*Depth to Water Table (ft)*	*Depth to Top of Sample (ft)*	*Depth to Bottom of Sample (ft)*	*Depth to Midpoint of Sample (ft)*	*N*	*N_{60} (1)*	*σ_v' (psf)*	*C_N (2)*	*$(N_1)_{60}$ (3)*	*Plastic Limit*	*Liquid Limit*	*Plasticity Index*	*Percent Fines*	*Peck, Hanson, and Thornburn (4)*	*Meyerhof (4)*	*Schmertmann (5)*	*Terzaghi et al. (1996) (6) - Fine Grained*	*EPRI (1990) (7)*	*Terzaghi et al. (1996) (8)*	*Lambe and Whitman (1969) (9)*	*Mesri and Shahien (2003) (10)*		*Moisture (%)*	*Initial Void Ratio (e_0)*	*Hydraulic Conducivity (cm/s)*	*Dry Unit Weight (pcf)*	*NAVFAC from N*	*From UU Test*	*Lambe and Whitman from PI*
RCA-BH-01	SPT	CL	Silty Clay (CL)	107.4	7	2	3.5	2.8	8	10	295	1.74	17					30.0	35.0	41.0	33.9	-	35.9	-			19.2			90.1	1067		
RCA-BH-01	SPT	CL	Silty Clay (CL)	107.8	7	3.5	5	4.3	11	14	458	1.63	22	14	50	36		30.9	35.8	43.2	35.5	27.6	27.8	26.8	24.2	153.0	19.6			90.1	1467		272
RCA-BH-01	SPT	CH	Clay (CH)	113.3	7	10.5	12	11.3	10	13	1009	1.33	17					30.6	35.5	39.6	33.7	-	35.9	-			25.7			90.1	1333		
RCA-BH-01	SH	CH	Clay (CH)	112.5	7	14	16	15.0	0	0	1189	1.25	0	25	64	39		-	-	0.0	27.3	27.1	27.3	26.3	23.8	130.9	24.9	0.84		90.1	0	1600	699
RCA-BH-01	SPT	CH	SHALE	112.5	7	19	20.5	19.8	47	59	1427	1.17	69					41.0	45.0	52.9	43.9	-	35.9	-						90.1	4000		
RCA-BH-01	SPT	CH	SHALE	112.5	7	23.5	25	24.3	46	58	1653	1.10	63					41.0	45.0	51.9	43.5	-	35.9	-						90.1	4000		
RCA-BH-02	SPT	CL	Silty Clay (CL)	111.9	7	1.5	3	2.3	13	16	252	1.78	29					31.8	36.5	46.0	37.4	-	35.9	-			17.0			95.6	1733		
RCA-BH-02	SPT	CL	Silty Clay (CL)	114.8	7	3	4.5	3.8	12	15	431	1.65	25					31.5	36.3	44.2	36.2	-	35.9	-			20.1			95.6	1600		
RCA-BH-02	SPT	CH	Clay (CH)	122.8	7	9	10.5	9.8	7	9	1025	1.32	12					29.3	33.3	36.1	31.9	-	35.9	-			28.4			95.6	933		
RCA-BH-02	SH	CH	Clay (CH)	120.9	7	11	13	12.0	0	0	1139	1.27	0	18	51	33		-	-	0.0	27.3	28.1	28.3	27.3	24.2	153	26.5	0.73		95.6	0		682
RCA-BH-02	SPT	CH	Clay (CH)	121.4	7	14	15.5	14.8	9	11	1307	1.21	14					30.3	35.3	37.4	32.6	-	35.9	-			27.0			95.6	1200		
RCA-BH-02	SPT	CH	SHALE	121.4	7	19	20.5	19.8	15	19	1602	1.11	21					32.4	37.0	41.3	35.0	-	35.9	-						95.6	2000		
RCA-BH-02	SPT	CH	SHALE	121.4	7	23.5	25	24.3	20	25	1868	1.03	26					34.5	38.8	43.2	36.6	-	35.9	-						95.6	2667		
RCA-BH-03	SPT	CL	Silty Clay (CL)	120.6	5	1.5	3	2.3	8	10	271	1.76	18					30.0	35.0	41.2	34.0	-	35.9	-			26.3			95.5	1067		
RCA-BH-03	SPT	CH	Clay (CH)	124.2	5	3	4.5	3.8	11	14	466	1.62	22	15	62	47		30.9	35.8	43.1	35.5	26.0	26.0	25.1	23.2	150	30.1			95.5	1467		268
RCA-BH-03	SPT	CL	Silty Clay (CL)	124.2	5	8.5	10	9.3	2	3	884	1.39	3				67.3	27.3	28.3	26.0	28.8	-	35.9	-						95.5	267		
RCA-BH-03	SH	CL	Silty Clay (CL)	121.9	5	10	12	11.0	0	0	966	1.35	0					-	-	0.0	27.3	-	35.9	-			27.6	0.73	2.94E-08	95.5	0		
RCA-BH-03	SPT	CL	Silty Clay (CL)	119.9	5	13.5	15	14.3	7	9	1132	1.28	11	13	46	33		29.3	33.3	35.7	31.8	28.1	28.3	27.3	24.2	153	25.6			95.5	933		678
RCA-BH-03	SPT	CH	SHALE	119.9	5	18.5	20	19.3	37	46	1420	1.17	54					40.0	44.0	50.6	42.5	-	35.9	-						95.5	4000		
RCA-BH-03	SPT	SC	Silty Clay (CL)	119.9	5	23.5	25	24.3	22	28	1708	1.08	30				36.0	35.1	39.3	44.6	37.6	-	35.9	-						95.5	2933		
RCA-BH-04	SPT	CL	Silty Clay (CL)	121.2	5	2	3.5	2.8	0	0	333	1.71	0					-	-	0.0	27.3	-	35.9	-			43.9			84.2	0		
RCA-BH-04	SPT	CL	Silty Clay (CL)	120.9	5	3.5	5	4.3	1	1	514	1.59	2					27.0	27.5	22.3	28.2	-	35.9	-			43.6			84.2	133		
RCA-BH-04	SH	CL	Silty Clay (CL)	112.4	5	7	9	8.0	0	0	712	1.47	0					-	-	0.0	27.3	-	35.9	-			33.5	0.96	4.47E-07	84.2	0		
RCA-BH-04	SPT	CL	Silty Clay (CL)	114.4	5	9	10.5	9.8	6	8	819	1.42	11					29.0	32.5	35.6	31.6	-	35.9	-			35.9			84.2	800		
RCA-BH-04	SH	CH	Clay (CH)	120.2	5	12	14	13.0	0	0	1063	1.31	0	21	61	40		-	-	0.0	27.3	27.0	27.1	26.1	23.8	130.9	26.1	0.74		95.3	0		624
RCA-BH-04	SPT	CL	Silty Clay (CL)	118.6	5	14	15.5	14.8	25	31	1142	1.27	40					36.3	40.3	47.9	40.0	-	35.9	-			24.5			95.3	3333	1200	
RCA-BH-04	SPT	CL	Silty Clay (CL)	118.6	5	18.5	20	19.3	50	63	1395	1.18	74				88.3	41.0	45.0	53.6	44.1	-	35.9	-						95.3	4000		
RCA-BH-04	SPT	CH	SHALE	118.6	5	23.5	25	24.3	50	63	1676	1.09	68					41.0	45.0	52.6	43.9	-	35.9	-						95.3	4000		
RCA-BH-05	SPT	CL	Silty Clay (CL)	113.6	5	2	3.5	2.8	3	4	312	1.73	6					27.7	29.2	31.9	30.0	-	35.9	-			32.1			86.0	400		
RCA-BH-05	SPT	CL	Silty Clay (CL)	112.1	5	3.5	5	4.3	4	5	476	1.62	8					28.3	30.8	33.5	30.6	-	35.9	-			30.3			86.0	533		
RCA-BH-05	SH	CH	Clay (CH)	145.8	5	8.5	10.5	9.5	0	0	1104	1.29	0	14	55	41		-	-	0.0	27.3	26.8	26.9	26.0	23.8	130.9	36.1	0.54		107.1	0	2600	646
RCA-BH-05	SPT	CH	Clay (CH)	104.5	5	10.5	12	11.3	8	10	786	1.44	14	14	54	40		30.0	35.0	38.4	32.9	27.0	27.1	26.1	23.8	130.9	21.5			86.0	1067		461
RCA-BH-05	SH	CH	Clay (CH)	114.8	5	13.5	15.5	14.5	0	0	1072	1.30	0					-	-	0.0	27.3	-	35.9	-			33.5	0.92	2.42E-08	86.0	0		
RCA-BH-05	SPT	CH	SHALE	114.8	5	18.5	20	19.3	50	63	1321	1.20	75					41.0	45.0	53.8	44.2	-	35.9	-						86.0	4000		
RCA-BH-05	SPT	CH	SHALE	114.8	5	23.5	25	24.3	50	63	1583	1.12	70					41.0	45.0	52.9	44.0	-	35.9	-						86.0	4000		

Silty Clay (CL)	Silty Clay (CL)	**117.1**										**14**	**48**	**35**		**31.1**	**34.6**	**32.2**	**33.0**	**27.9**	**35.0**	**27.1**	**24.2**	**153.0**	**28.5**	**0.85**	**0.0**	**91.1**	**1192.1**	**1200.0**	**474.8**
Max Values for Material Properties	Silty Clay (CL)	121.9										14	50	36		41.0	45.0	53.6	44.1	28.1	35.9	27.3	24.2	153.0	43.9	0.96	0.0	95.6	4000.0	1200.0	677.8
Min Values Material Properties	Silty Clay (CL)	112.4										0	0	0		27.0	27.5	0.0	27.3	27.6	27.8	26.8	0.0	0.0	0.0	0.0	0.0	84.2	0.0	0.0	271.8
Clay (CH)	Clay (CH)	**122.8**										**18**	**58**	**40**		**30.2**	**35.0**	**19.5**	**30.3**	**27.0**	**30.6**	**26.1**	**23.7**	**137.8**	**28.0**	**0.75**	**0.0**	**93.7**	**600.0**	**2100.0**	**563.2**
Max Values for Material Properties	Clay (CH)	145.8										25	64	47		30.9	35.8	43.1	35.5	28.1	35.9	27.3	24.2	153.0	36.1	0.92	0.0	107.1	1466.6	2600.0	699.4
Min Values for Material Properties	Clay (CH)	112.5										0	0	0		29.3	33.3	0.0	27.3	26.0	26.0	25.1	0.0	0.0	21.5	0.0	0.0	86.0	0.0	0.0	267.9
SHALE	SHALE	**-**										**-**	**-**	**-**		**39.0**	**43.1**	**49.9**	**41.7**	**-**	**35.9**	**-**	**-**	**-**	**-**			**91.8**	**3583.3**	**-**	**-**
Max Values for Material Properties	SHALE	-										0	0	0		41.0	45.0	53.8	44.2	0.0	35.9	0.0	0.0	0.0	0.0			95.6	4000.0	0.0	0.0
Min Values for Material Properties	SHALE	-										0	0	0		32.4	37.0	41.3	35.0	0.0	35.9	0.0	0.0	0.0	0.0			86.0	2000.0	0.0	0.0

Estimation of Fully Softened and Residual Clay Strengths from Mesri and Shahien 2003

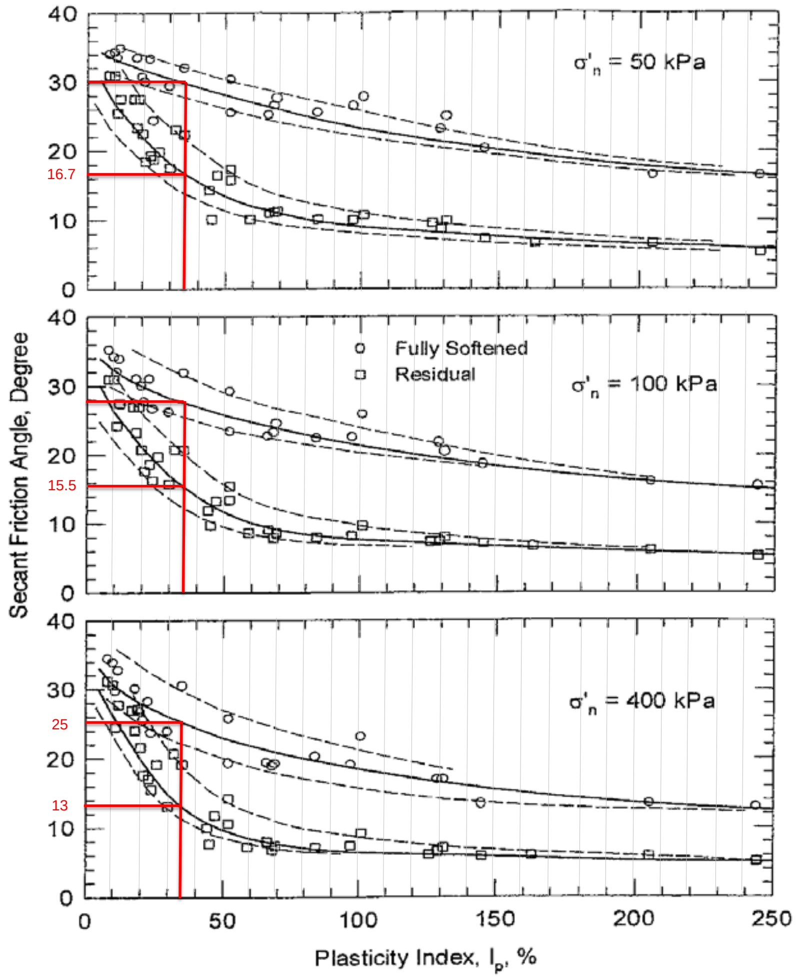


Fig. 2. Empirical information on fully softened strength and residual strength (data from Stark and Eid 1994; Eid 1996; and Stark and Eid 1997)

**Note - Vertical Lines on Figure are Approximate and Not on Original*

Reference - Mesri, G. and Shahien, M. (2003) "Residual Shear Strength Mobilized in First-Time Slope Failures,", JGGE, 129, 1, 12-31.

ENTER SECANT FRICTION ANGLES OBTAINED FROM MESRI & SHAHIEN 2003 FIG. 2

OBTAIN RESULTS FOR M-C PARAMETERS

Effective Normal Stress (kPa)	Fully Softened Secant Friction Angle (º)	Calculated Shear Stress (kPa)
σ'_n	$(\phi'_{fs})_{sec}$	τ_{fs}
50 kPa	30.0	29 kPa
100 kPa	28.0	53 kPa
400 kPa	25.0	187 kPa
Mohr-Coulomb Tangent ϕ' and c' Data		
Fully Softened	**c'**	7.3 kPa
	$(\phi'_{fs})_{tan}$	24.2 º

Effective Normal Stress (kPa)	Residual Secant Friction Angle (º)	Calculated Shear Stress (kPa)
σ'_n	$(\phi'_r)_{sec}$	τ_r
50 kPa	16.7	15 kPa
100 kPa	15.5	28 kPa
400 kPa	13.0	92 kPa
Mohr-Coulomb Tangent ϕ' and c' Data		
Residual	**c'**	4.9 kPa
	$(\phi'_r)_{tan}$	12.4 º

Enter I_P Used	**35**

Estimation of Fully Softened and Residual Clay Strengths from Mesri and Shahien 2003

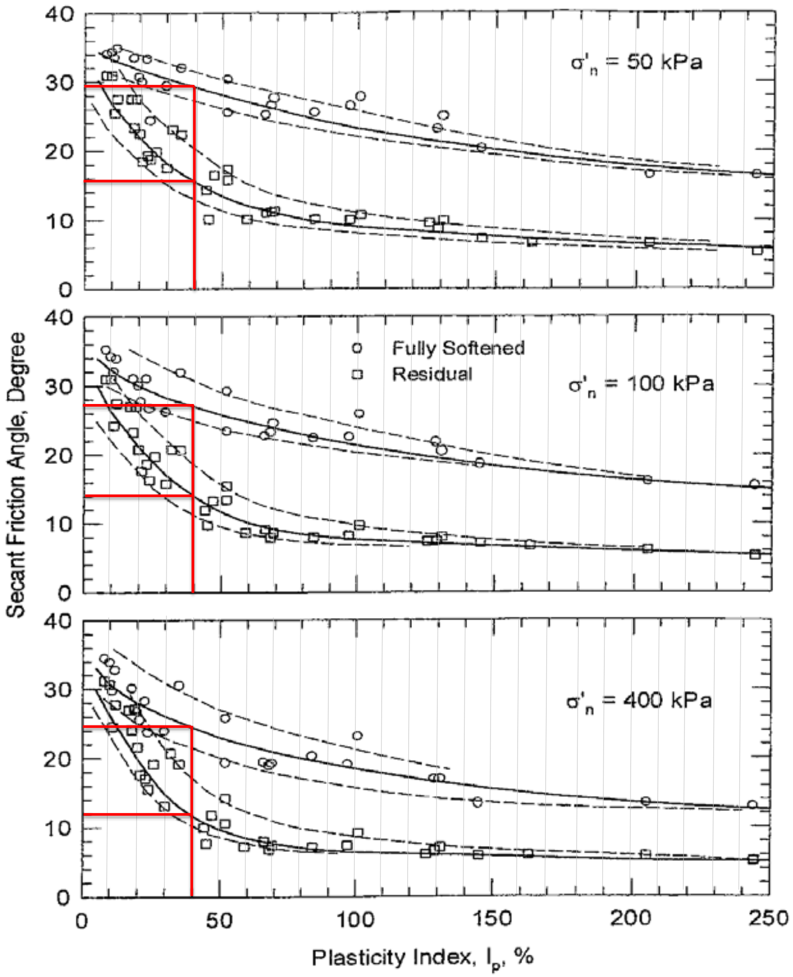


Fig. 2. Empirical information on fully softened strength and residual strength (data from Stark and Eid 1994; Eid 1996; and Stark and Eid 1997)

**Note - Vertical Lines on Figure are Approximate and Not on Original*

ENTER SECANT FRICTION ANGLES OBTAINED FROM MESRI & SHAHIEN 2003 FIG. 2

OBTAIN RESULTS FOR M-C PARAMETERS

Effective Normal Stress (kPa)	**Fully Softened Secant Friction Angle (°)**	**Calculated Shear Stress (kPa)**
σ'_n	$(\phi'_{fs})_{sec}$	τ_{fs}
50 kPa	29.0	28 kPa
100 kPa	27.0	51 kPa
400 kPa	24.5	182 kPa
Mohr-Coulomb Tangent ϕ' and c' Data		
Fully Softened	**c'**	6.3 kPa
	$(\phi'_{fs})_{tan}$	23.8 °

Effective Normal Stress (kPa)	**Residual Secant Friction Angle (°)**	**Calculated Shear Stress (kPa)**
σ'_n	$(\phi'_r)_{sec}$	τ_r
50 kPa	15.5	14 kPa
100 kPa	14.0	25 kPa
400 kPa	12.0	85 kPa
Mohr-Coulomb Tangent ϕ' and c' Data		
Residual	**c'**	4.2 kPa
	$(\phi'_r)_{tan}$	11.4 °

Enter I_P Used	**40**

Reference - Mesri, G. and Shahien, M. (2003) "Residual Shear Strength Mobilized in First-Time Slope Failures,", JGGE, 129, 1, 12-31.

Golder Associates

Estimation of Fully Softened and Residual Clay Strengths from Mesri and Shahien 2003

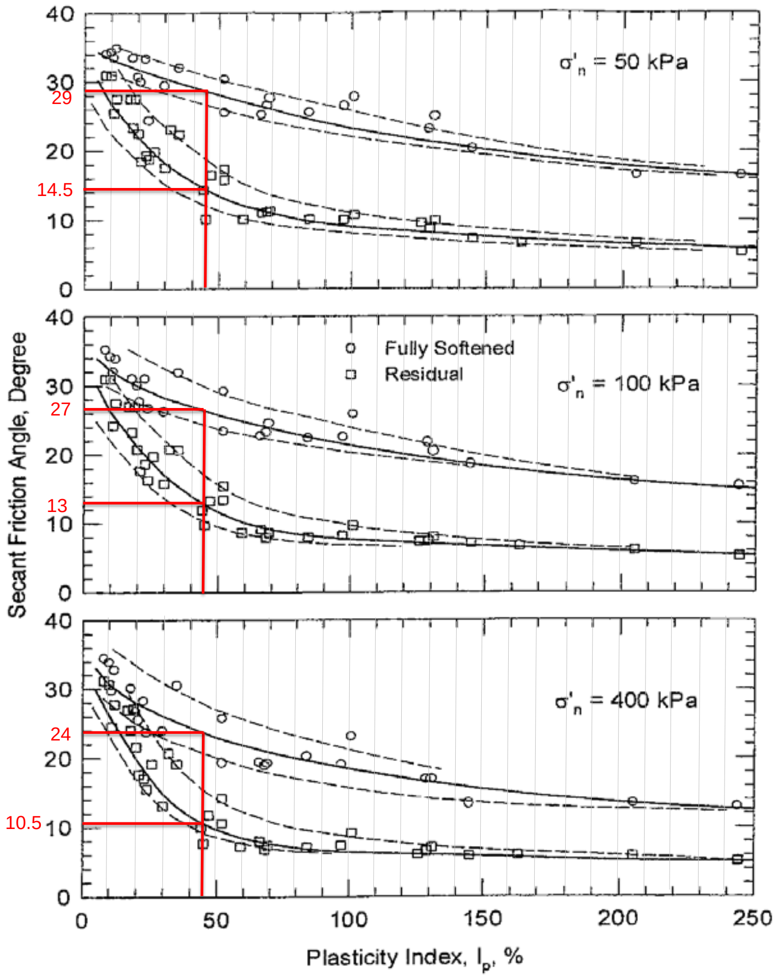


Fig. 2. Empirical information on fully softened strength and residual strength (data from Stark and Eid 1994; Eid 1996; and Stark and Eid 1997)

ENTER SECANT FRICTION ANGLES OBTAINED FROM MESRI & SHAHIEN 2003 FIG. 2		
OBTAIN RESULTS FOR M-C PARAMETERS		
Effective Normal Stress (kPa)	**Fully Softened Secant Friction Angle (º)**	**Calculated Shear Stress (kPa)**
σ'_n	$(\phi'_{fs})_{sec}$	τ_{fs}
50 kPa	29.0	28 kPa
100 kPa	27.0	51 kPa
400 kPa	24.0	178 kPa
Mohr-Coulomb Tangent ϕ' and c' Data		
Fully Softened	**c'**	7.2 kPa
	$(\phi'_{fs})_{tan}$	23.2 º

Effective Normal Stress (kPa)	**Residual Secant Friction Angle (º)**	**Calculated Shear Stress (kPa)**
σ'_n	$(\phi'_r)_{sec}$	τ_r
50 kPa	14.5	13 kPa
100 kPa	13.0	23 kPa
400 kPa	10.5	74 kPa
Mohr-Coulomb Tangent ϕ' and c' Data		
Residual	**c'**	5.0 kPa
	$(\phi'_r)_{tan}$	9.8 º

Enter I_P Used	**45**

**Note - Vertical Lines on Figure are Approximate and Not on Original*

Reference - Mesri, G. and Shahien, M. (2003) "Residual Shear Strength Mobilized in First-Time Slope Failures,", JGGE, 129, 1, 12-3

GOLDER

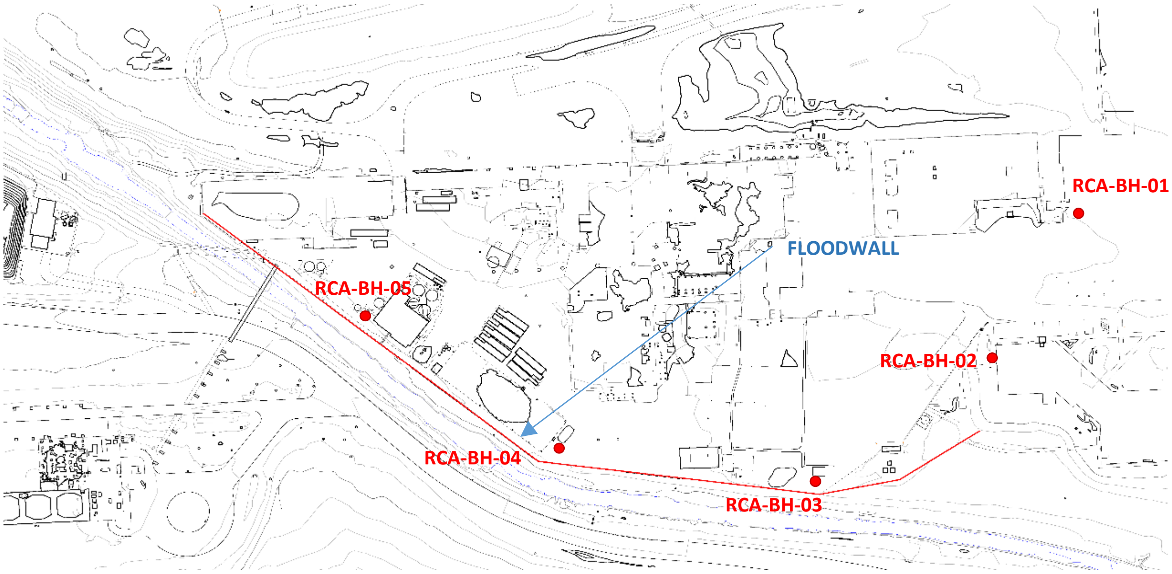
CALCULATIONS

Subject: Exide Flood Wall
Date: 8/14/2018 **Designed:** P. Joplin
Project No.: 130-2086-06 **Checked:** M. Gore
Project Short Title: Exide/Frisco/Geotech **Reviewed:** K. Berry

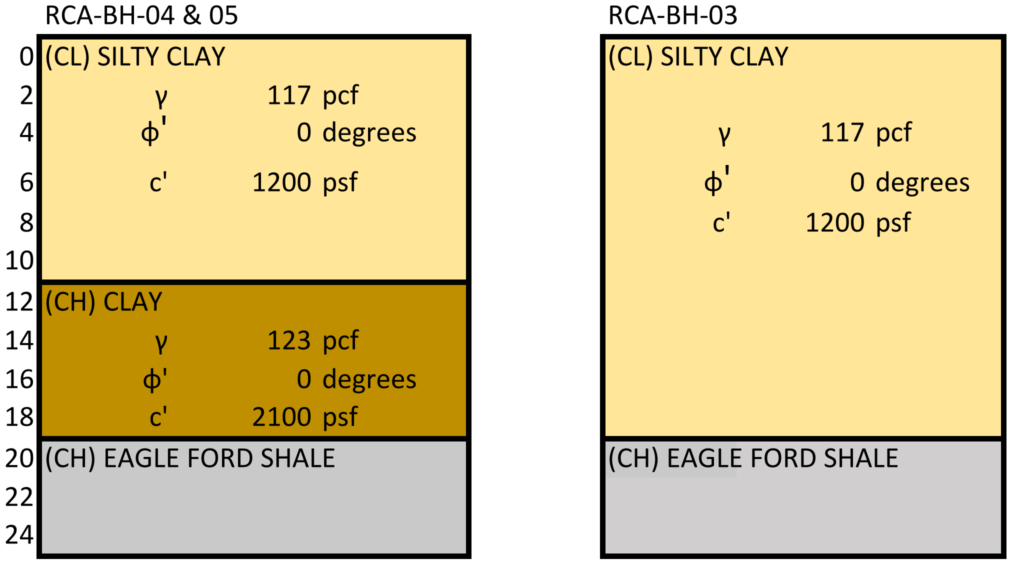
1.0 OBJECTIVE

Determine the geotechnical properties of the soil flood wall at Exide. Properties determined included bearing capacity and passive resistive pressure. In addition Golder performed a global stability analysis using Slide at the critical cross-section.

1.1 Design Location



1.2 Design Stratigraphy



2.0 CALCULATIONS

2.1 Bearing Capacity

Bearing capacity was determined using Terzaghi's Bearing Capacity equations with bear capacity factors as determined by Kumbhojkar (1993). Golder evaluated Bearing Capacity for both Continuous or Strip foundation and for a square foundation. Allowable bearing capacity was determined giving a factor of safety of 3.

Nc: 5.7 Nq: 1 Nγ: 0

2.11 Continuous/Strip Foundation Equation

$$q_u = c'N_c + qN_q + \frac{1}{2}\gamma B N_\gamma$$

(CL) SILTY CLAY

Allowable Bearing Capacity: 2,280 psf *at ground surface

2,358 psf *at depth of 2 feet

(CH) CLAY

Allowable Bearing Capacity: 4,400 psf *at depth of 10 feet

2.12 Square Foundation Equation

$$q_u = 1.3c'N_c + qN_q + 0.4\gamma B N_\gamma$$

(CL) SILTY CLAY

Allowable Bearing Capacity: 2,964 psf *at ground surface

3,042 psf *at depth of 2 feet

(CH) CLAY

Allowable Bearing Capacity: 5,597 psf *at depth of 10 feet

2.2 Passive Resistive Pressure

Passive Earth Pressure was determined using the Rankine method which is calculated using the equation below:

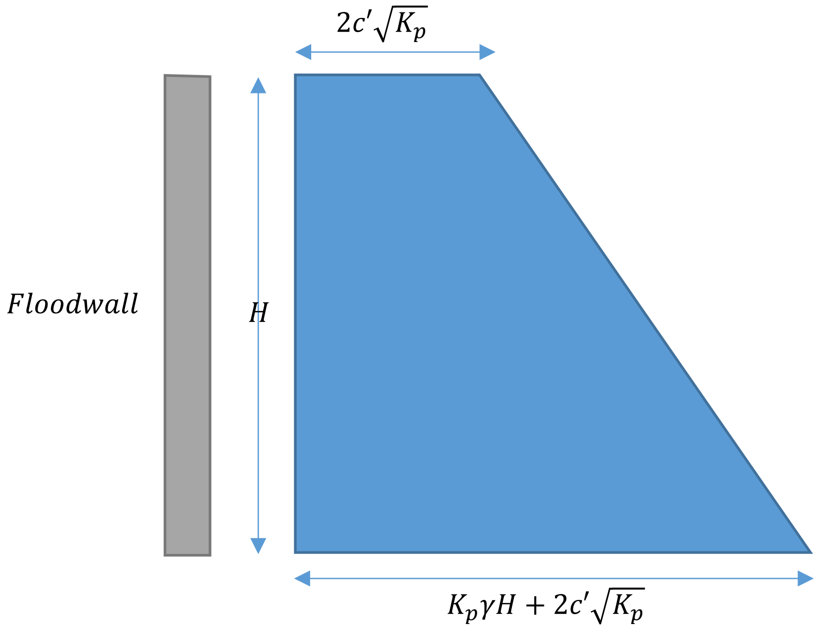
$$\sigma_p' = \sigma_0' K_p + 2c'\sqrt{K_p}$$

Where σ'_p is the major principal stress, σ'_0 is is the minor principal stress, K_p is the Rankine passive earth pressure coefficient, and c' is the cohesion. K_p is determined using the equation below;

$$K_p = \tan^2\left(45 + \frac{\phi'}{2}\right)$$

Rankine Passive Earth Pressure, Kp: 1

The Rankine passive pressure can be seen in the diagram below;



The passive force per unit length of the wall can be determined from the ara of the pressure diagram above or using the equation below;

$$P_p = \frac{1}{2}\gamma H^2 K_p + 2c'H\sqrt{K_p}$$

2.21 Rankine Passive Earth Pressure

Passive Earth Pressure at 5 foot of Depth

Height/Depth, H:	5	feet	
Equation 1:	2400	psf	$2c'\sqrt{K_p}$
Equation 2:	2985	psf	$K_p\gamma H + 2c'\sqrt{K_p}$
Equation 3, Pp:	13,463	lbs	$P_p = \frac{1}{2}\gamma H^2 K_p + 2c'H\sqrt{K_p}$

Passive Earth Pressure at 10 foot of Depth

Height/Depth, H:	10	feet	
Equation 1:	2400	psf	$2c'\sqrt{K_p}$
Equation 2:	3570	psf	$K_p\gamma H + 2c'\sqrt{K_p}$
Equation 3, Pp:	29,850	lbs	$P_p = \frac{1}{2}\gamma H^2 K_p + 2c'H\sqrt{K_p}$

2.3 Consolidation

Golder calculated the estimated consolidation caused by an additional load of 1000 psf which Golder understands to be the largest possible load increase caused by the proposed flood wall. The load was calculated to occur at a depth of 3 feet below the existing soil level.

2.31 Compression Index, Cc

Golder calculated the compression index using correlations with average soil liquid limit and plasticity index. Golder used the three methods below and used the maximum and thus most conservative value.

Kulhawy and Mayne, 1990

$$C_c = \frac{PI(\%)}{74}$$

Nagaraj and Murty, 1985

$$C_c = 0.2343\left[\frac{LL(\%)}{100}\right]G_s$$

Wroth and Wood, 1978

$$C_c = 0.5G_s\left(\frac{PI(\%)}{100}\right)$$

Compression Index, Cc for (CL) Silty Clay

PI: 35
LL: 48

Kulhawy and Mayne: 0.47
Nagaraj and Murty: 0.30
Wroth and Wood: 0.46

Value Used: 0.47

Compression Index, Cc for (CH) Clay

PI: 40
LL: 58

Kulhawy and Mayne: 0.54
Nagaraj and Murty: 0.36
Wroth and Wood: 0.53

Value Used: 0.54

2.32 Recompression Index, Cr

Assumed to be 0.1 of the Cc per Golder's engineering judgement

Recompression Index, Cr for (CL) Silty Clay

Kulhawy and Mayne: 0.05
Nagaraj and Murty: 0.03
Wroth and Wood: 0.05

Value Used: 0.05

Recompression Index, Cr for (CH) Clay

Kulhawy and Mayne: 0.05
Nagaraj and Murty: 0.04
Wroth and Wood: 0.05

Value Used: 0.05

2.33 Primary Consolidation Settlement

Golder calculated an estimated primary consolidation for the flood wall. Golder assumed a 3 foot base on a continous strip foundation with a bearing pressure of 1000 psf. The foundation was assumed to be at a depth of 3 feet below ground surface for the purposes of the calculation and the effect of the water table was not included. Golder also assumed an overconslidation ration of 2. The stress induced by the bearing pressure was calculated using the simplified equation of the Boussinesq equation shown below;

$$\Delta\sigma' = \left[1 - \left(\frac{1}{1 + \left(\frac{B}{2z_f}\right)^2}\right)^{2.60}\right](q - \sigma'_{zD})$$

Where Δσ' is the induced stress from the assumed bearing pressure at a certain depth, B is the width of the base of the flood wall, z_f is the depth to the midpoint of the analyzed layer, q is the bearing pressure (1000 psf) and σ'_{zd} is the vertical effective stress at the midpoint of the analzed layer. Given that the OCR was assumed to be 2 throughout the soil, Golder calculated the preconsolidation pressure using the relationship given below;

$$OCR = \frac{\sigma'_p}{\sigma'_0}$$

Where σ'_p is the preconsolidation pressure and σ'_0 is the average effective vertical stress on the clay layer. Lastly, Golder calculculated the settlement using the equation below which accounts for overconsolidated clays where the bearing stress may cause some consolidation in the recompression curve and some in the virgin compression curve.

$$S_c = \frac{Cr}{1 + e_0} Hlog\left(\frac{\sigma'_p}{\sigma'_0}\right) + \left(\frac{C_c}{1 + e_0}\right) Hlog\left(\frac{\sigma'_0 + \Delta\sigma'}{\sigma'_p}\right)$$

Where C_c is compression index and C_r is the compression index (calculated above), e_0 is the intial void ratio that Golder calculated from laboratory testing and then used the average value for the two soil types. H was length of the analyzed soil layer segment (assuming a single drainage path). Where, the pressure was not greater than the preconsolidation pressure, the equation below was used;

$$S_c = \frac{Cr}{1 + e_0} Hlog\left(\frac{\sigma'_0 + \Delta\sigma'}{\sigma'_0}\right)$$

Depth (feet)	σ'_p (psf)	σ'_0 (psf)	$\Delta\sigma'$ (psf)	e_0	H (feet)	Sc (feet)	ΣSc (feet)	ΣSc (inches)
0.0	0	0.0	0.0	0.85	0	-	-	0.0
1.0	117	58.5	0.0	0.85	1	-	-	0.0
2.0	351	175.5	0.0	0.85	1	-	-	0.0
3.0	585	292.5	0.0	0.85	1	-	-	0.0
4.0	819	409.5	452.7	0.85	1	0.01	0.01	0.2
5.0	1053	526.5	170.6	0.85	1	0.00	0.02	0.2
6.0	1287	643.5	67.0	0.85	1	0.00	0.02	0.2
7.0	1521	760.5	26.9	0.85	1	0.00	0.02	0.2
8.0	1755	877.5	9.1	0.85	1	0.00	0.02	0.2
9.0	1989	994.5	0.3	0.85	1	0.00	0.02	0.2
10.0	2223	1111.5	0.0	0.75	1	-	0.02	0.2
11.0	2457	1228.5	0.0	0.75	1	-	0.02	0.2
12.0	2691	1345.5	0.0	0.75	1	-	0.02	0.2
13.0	2925	1462.5	0.0	0.75	1	-	0.02	0.2
14.0	3159	1579.5	0.0	0.75	1	-	0.02	0.2
15.0	3393	1696.5	0.0	0.75	1	-	0.02	0.2
16.0	3627	1813.5	0.0	0.75	1	-	0.02	0.2
17.0	3861	1930.5	0.0	0.75	1	-	0.02	0.2
18.0	4095	2047.5	0.0	0.75	1	-	0.02	0.2

Total Estimated Settlement: 0.2 inches

2.4 Global Stability

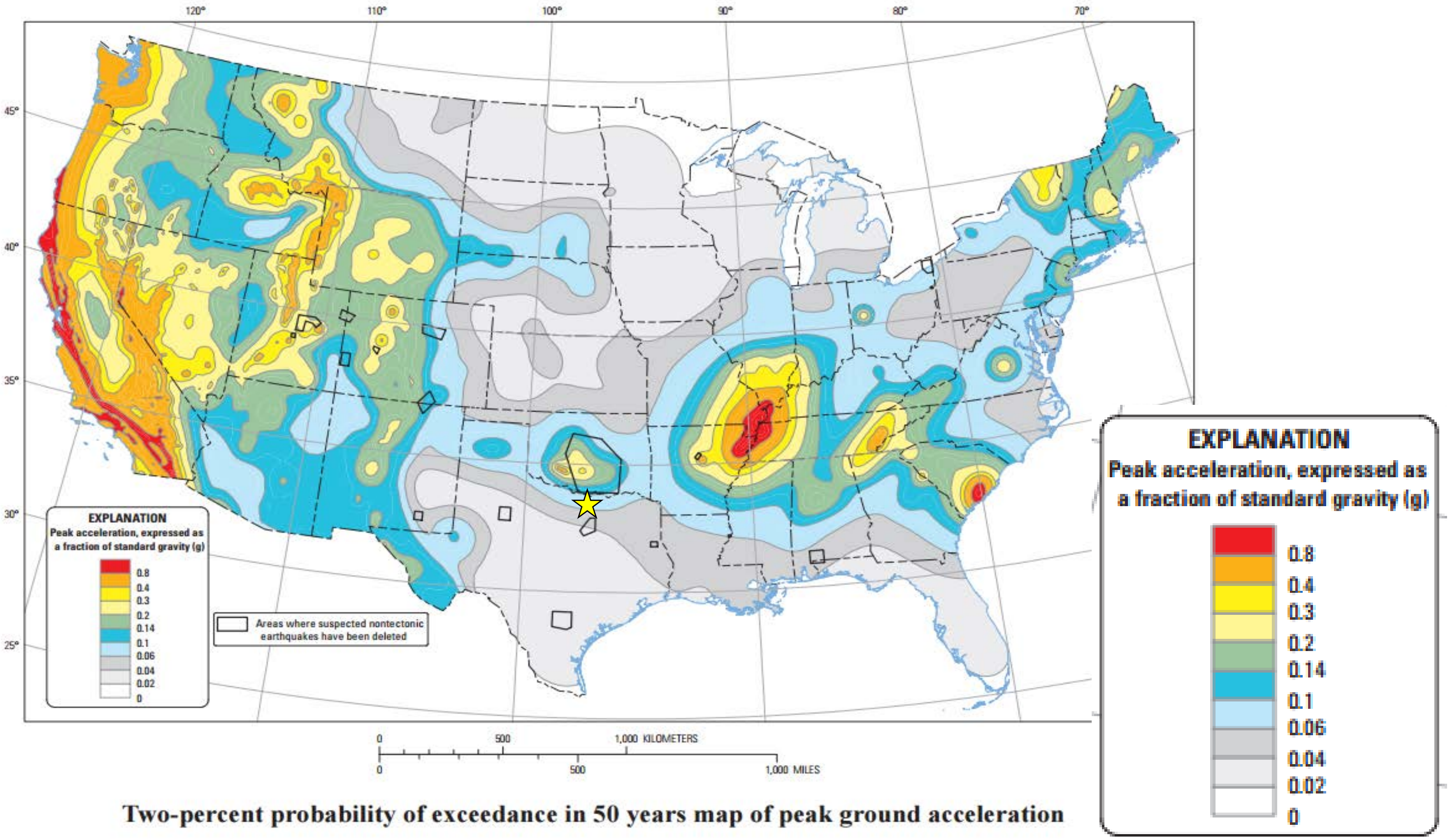
Global slope stability was evaluated using the computer program SLIDE 2018 Version 8.016 64-bit (Rocscience, 2018) using the generalized limit equilibrium method of stability analysis developed by Morgenstern and Price (Abramson et al., 2002). Circular search patterns were used to find the failure surface, which resulted in a minimum calculated factor of safety global stability of the flood wall. Golder analyzed four different scenarios; (1) Undrained conditons, (2) Drained Conditons, (3) Undrained conditions with a pseudo-static load, and (4) Undrained conditions with Stewart Creek at flood stage. Material properties used are included in the Material Properties of Soil Constituents at the Exide Frisco Facility. The results of the analyses are tabulated below; Pseudo-static limit equilibrium analyses were conducted to evaluate the stability of the proposed slope under seismic loads for earthquake hazards. Pseudo-static stability analyses apply a constant horizontal force to the system to represent the forces generated during an earthquake event, with the magnitude of the

Slope Stability Case	Minimum Acceptabl	Calculated Factor	Evaluation	Figure(s)
Undrained	1.5	7.8	Satisfactory	1
Drained	1.5	2.7	Satisfactory	2
Pseudo-Static Seismic	1.0	2.1	Satisfactory	3
Undrained - Flood Stage	1.5	7.6	Satisfactory	4

3.0 References

Hynes-Griffin, M.E. and Franklin, A.G. (1984), "Rationalizing the Seismic Coefficient Method, " Miscellaneous Paper GL-84-13, U.S. Army Engineer Waterways Experiment Station, Vicksbug, Mississippi, 34p.

Horizontal Ground Acceleration for Analysis = (1/2)*0.092g = 0.046 (per Hynes-Griffin & Franklin (1984)



Two-percent probability of exceedance in 50 years map of peak ground acceleration

GOLDER

Golder Associates Inc.

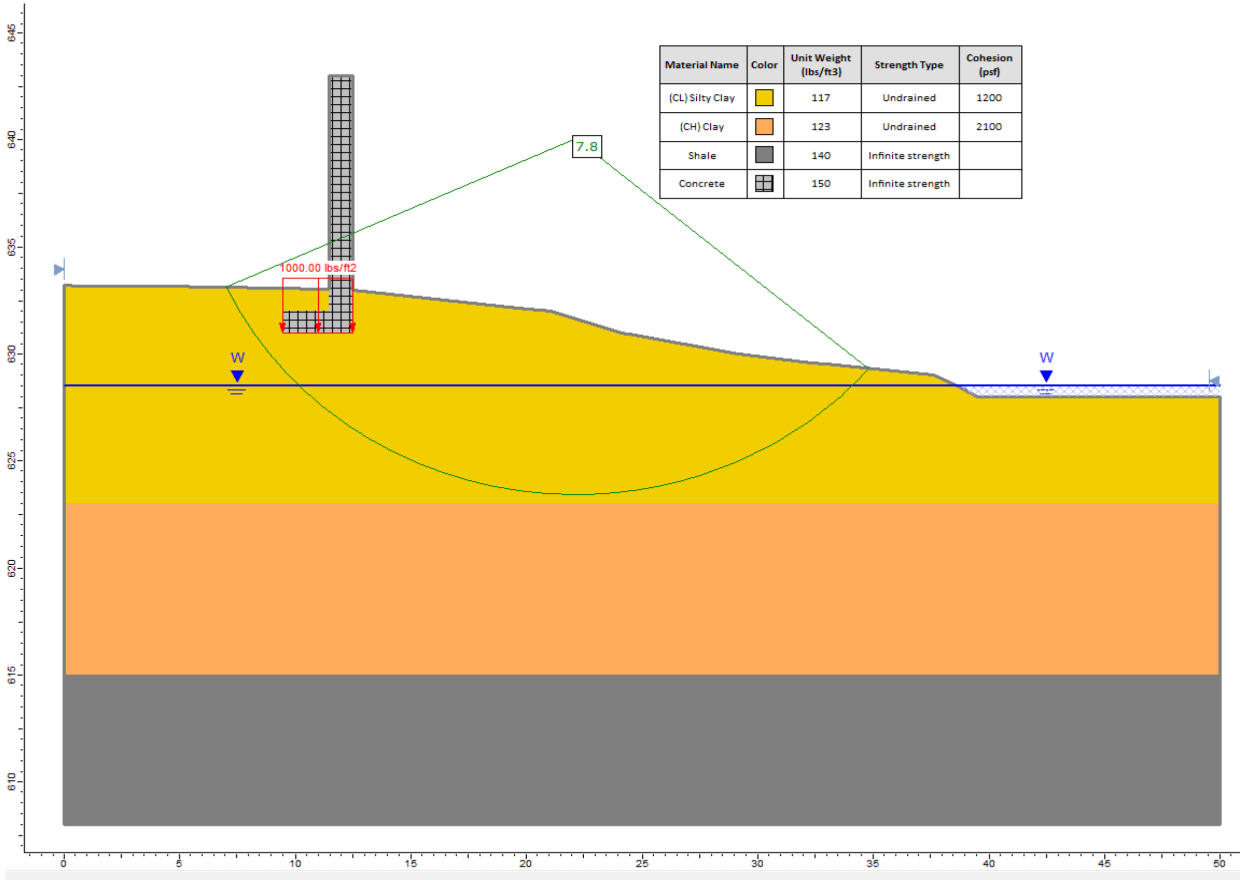
SCALE	As Shown	PROJECT	**Exide Flood Wall**
DATE	8/14/2018	TITLE	**SLOPE USGS Peak Horizontal Ground Acceleration Hazard Assessment (2% in 50 Year Event) (2014)**
MADE BY	P. Joplin		
CAD	P. Joplin		
CHECK	M. Gore	CLIENT	**Exide - Texas**
REVIEW	K. Berry	FIGURE	**A**

FILE Stability

PROJECT No. 130-2086-06

REV. 0

Minimum
FS = 7.8



Material Name	Color	Unit Weight (lbs/ft3)	Strength Type	Cohesion (psf)
(CL) Silty Clay	🟨	117	Undrained	1200
(CH) Clay	🟧	123	Undrained	2100
Shale	⬛	140	Infinite strength	
Concrete	▦	150	Infinite strength	

GOLDER

Golder Associates Inc.

SCALE As Shown
DATE 8/14/2018
MADE BY P. Joplin
CAD P. Joplin
CHECK M. Gore
REVIEW K. Berry

PROJECT **Exide Flood Wall**

TITLE

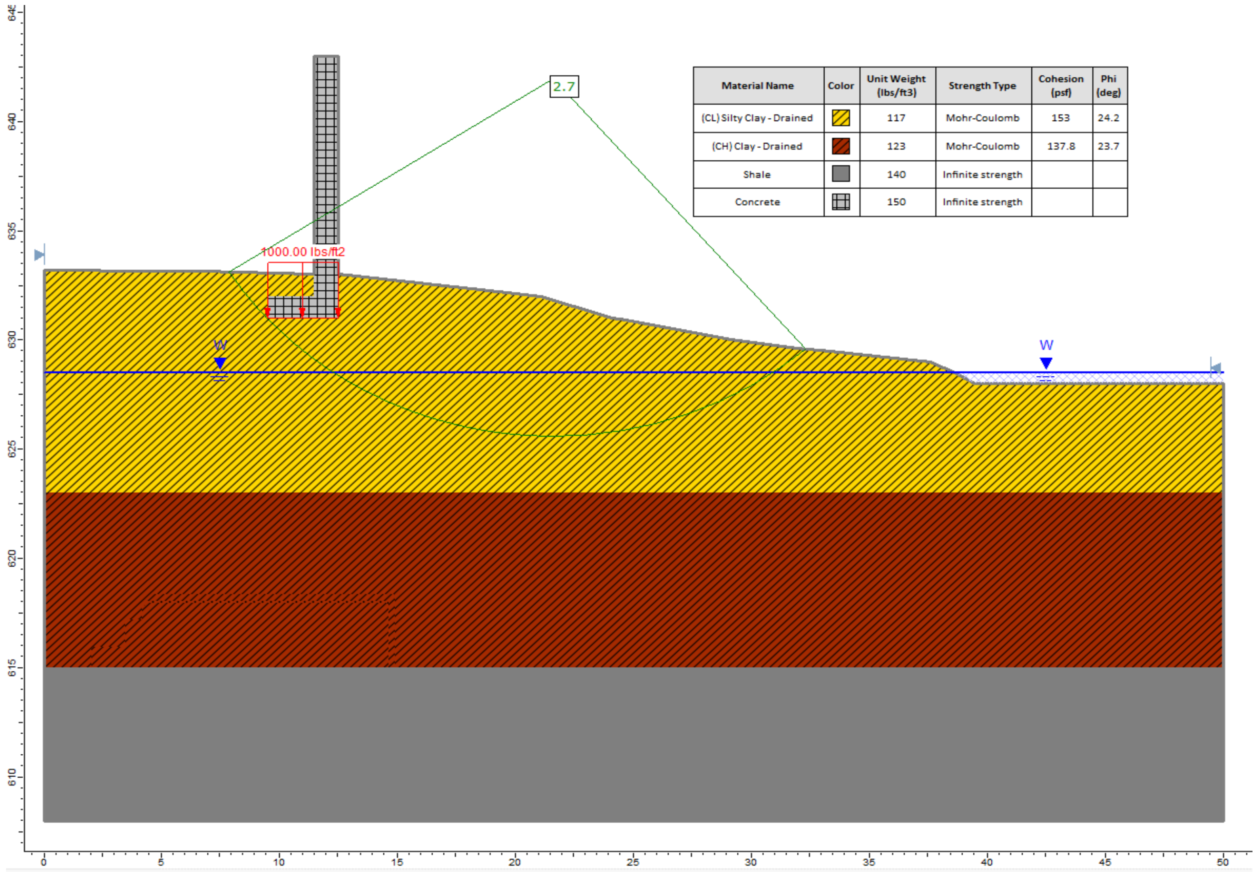
Undrained

CLIENT **Exide - Texas**

FIGURE **1**

FILE Stability
PROJECT No. 130-2086-06
REV.

Minimum
FS = 2.7



Material Name	Color	Unit Weight (lbs/ft3)	Strength Type	Cohesion (psf)	Phi (deg)
(CL) Silty Clay - Drained	▨	117	Mohr-Coulomb	153	24.2
(CH) Clay - Drained	▨	123	Mohr-Coulomb	137.8	23.7
Shale	■	140	Infinite strength		
Concrete	⊞	150	Infinite strength		

GOLDER

Golder Associates Inc.

SCALE	As Shown
DATE	8/14/2018
MADE BY	P. Joplin
CAD	P. Joplin
CHECK	M. Gore
REVIEW	K. Berry

FILE Stability

PROJECT No. 130-2086-06

REV.

PROJECT **Exide Flood Wall**

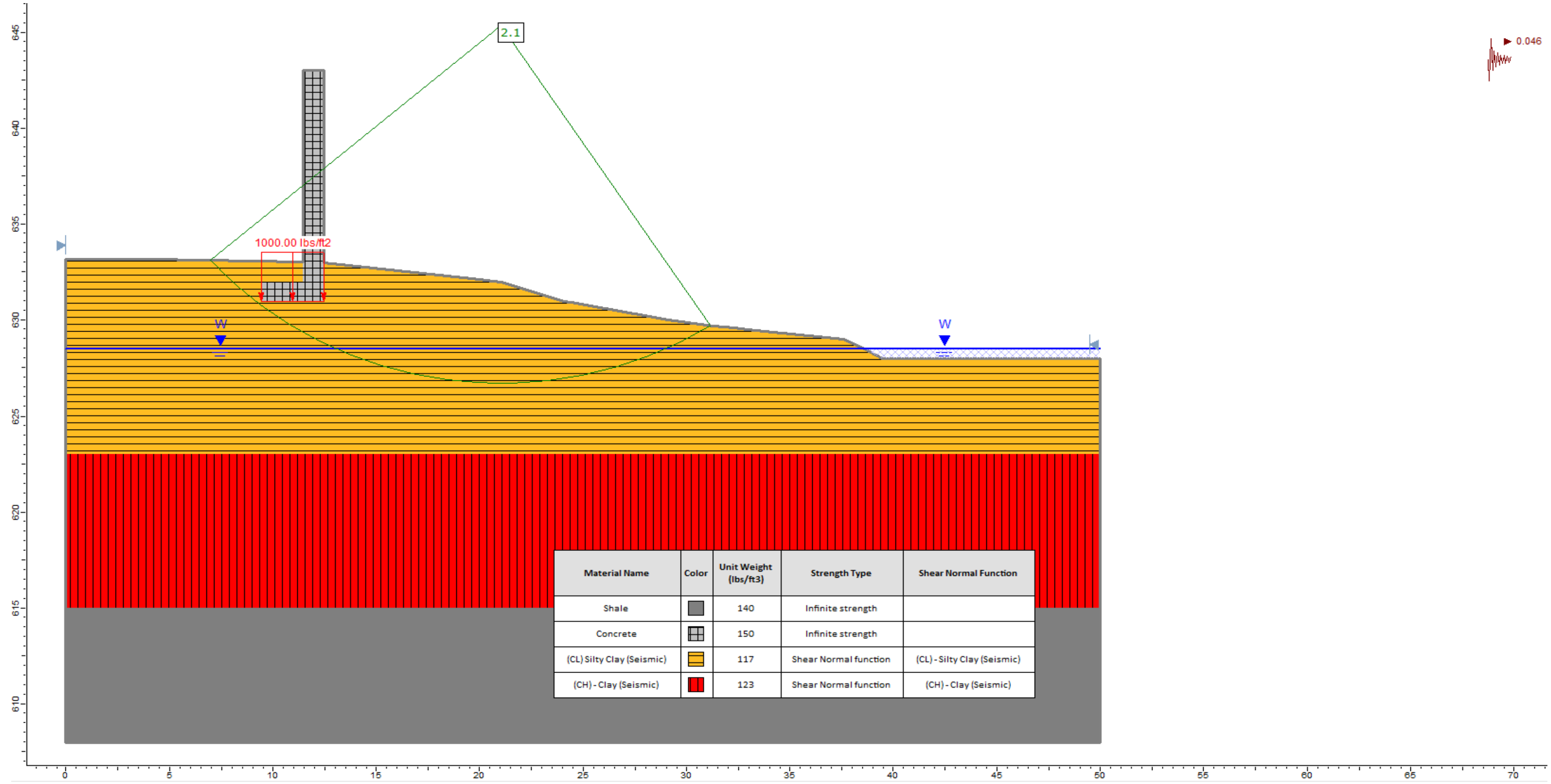
TITLE

Drained

CLIENT **Exide - Texas**

FIGURE **2**

Minimum
FS = 2.1



Material Name	Color	Unit Weight (lbs/ft3)	Strength Type	Shear Normal Function
Shale	■	140	Infinite strength	
Concrete	▦	150	Infinite strength	
(CL) Silty Clay (Seismic)	▤	117	Shear Normal function	(CL) - Silty Clay (Seismic)
(CH) - Clay (Seismic)	▥	123	Shear Normal function	(CH) - Clay (Seismic)

GOLDER

Golder Associates Inc.

SCALE	As Shown
DATE	8/14/2018
MADE BY	P. Joplin
CAD	P. Joplin
CHECK	M. Gore
REVIEW	K. Berry
FILE	Stability
PROJECT No.	130-2086-06
REV.	

PROJECT **Exide Flood Wall**

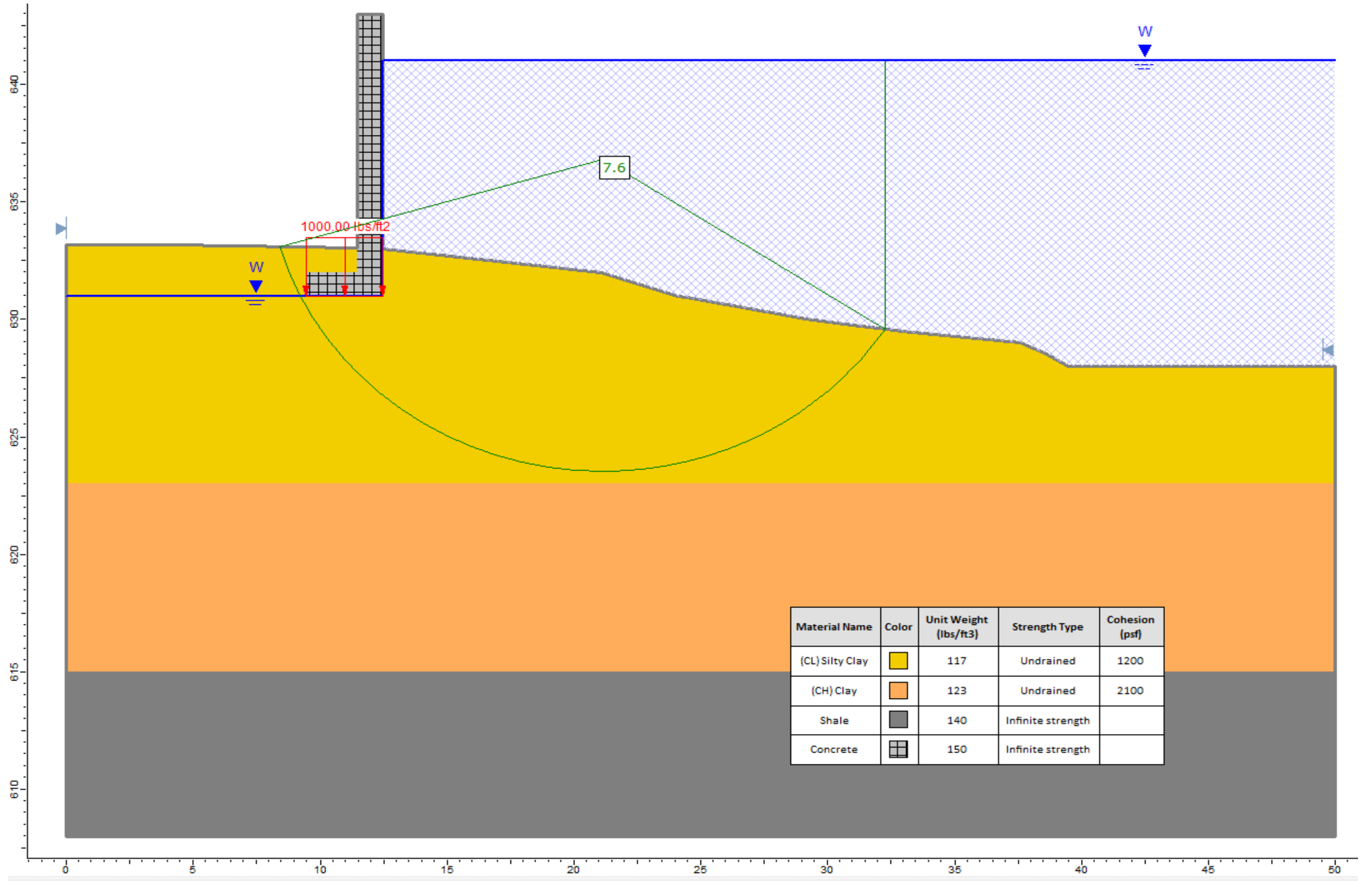
TITLE

Pseudo-Static Seismic

CLIENT **Exide - Texas**

FIGURE **3**

Minimum
FS = 7.6



Material Name	Color	Unit Weight (lbs/ft3)	Strength Type	Cohesion (psf)
(CL) Silty Clay	🟨	117	Undrained	1200
(CH) Clay	🟧	123	Undrained	2100
Shale	⬛	140	Infinite strength	
Concrete	▦	150	Infinite strength	

GOLDER

Golder Associates Inc.

SCALE As Shown
DATE 8/14/2018
MADE BY P. Joplin
CAD P. Joplin
CHECK M. Gore
REVIEW K. Berry

PROJECT **Exide Flood Wall**

TITLE

Undrained - Flood Stage

CLIENT **Exide - Texas**

FIGURE **4**

FILE Stability
PROJECT No. 130-2086-06
REV.

APPENDIX I

Contingency Plan

CONTINGENCY PLAN

Exide Technologies Frisco Recycling Facility
7471 Fifth Street, Frisco, Texas

Submitted To:

Exide Technologies
Mr. Brad Weaver
7471 5th Street
Frisco, Texas 75034

Submitted By:

Golder Associates Inc.
13515 Barrett Parkway Drive, Suite 260
Ballwin, MO 63021

8/8/18

JEFFREY B. FASSETT
85675

August 2018

Project No. 130208606

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JEFFREY B. FASSETT
85675
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1.0 INTRODUCTION AND PURPOSE

1.1 Introduction

The Exide Technologies Frisco Recycling Center is located at 7471 5th Street in Frisco, Texas ("the Facility"). The 89-acre Facility is located near the intersection of Parkwood Drive and Eagan Way/5th Street, approximately 1 mile north of the Frisco Police station and 1 mile south of Main Street. The layout of the Facility is shown on Figure 1. The locations of the Facility's active wastewater, stormwater and waste management units, the North Corrective Action Management Unit (North CAMU), the flood wall, and the Remediation Consolidation Area (RCA), as well as the closed units at the Facility are also shown on Figure 1.

1.2 Purpose

As appropriate, this Contingency Plan was developed to be consistent with 30 Texas Administrative Code §§ 335.152, 335.153 and 40 CFR 264 Subpart C (Preparedness and Prevention) and 40 CFR 265 Subpart D (Contingency Plan). This Contingency Plan describes the actions that personnel will take in response to severe weather, fires, explosions, or any unplanned sudden or non-sudden release of waste constituents to air, soil, or surface water at the Facility. This Contingency plan addresses measures applicable during the active remediation period and, to the extent provisions remain relevant, the post-closure period when the Facility will have limited on-site personnel. This Contingency Plan was also developed to meet the applicable requirements of 44 CFR 65.10(c)(3), which requires that sound emergency practices be included as a part of operating plans and criteria for the flood wall at the Facility.

2.0 EMERGENCY COORDINATORS

At all times, there will be at least one employee either on the Facility premises or on call (i.e., available to respond to an emergency by reaching the Facility within a short period of time) with the responsibility for coordinating all emergency response measures. This emergency coordinator will be thoroughly familiar with all aspects of the Contingency Plan, all operations and activities at the Facility, the location and characteristics of waste, waste handling procedures, the location of all records at the Facility, and the Facility layout. In addition, this person will have the authority to commit the resources needed to carry out the Contingency Plan.

During remediation activities at the Facility, the primary emergency coordinator listed in Appendix A will be at the Facility or on call. If the Facility is inactive and unattended, the primary emergency coordinator will be on call.

There may be changes to the Facility's emergency contact information from time to time and Appendix A will be revised as necessary and kept on file at the Facility to maintain current responsible individuals and updated contact information. Changes to emergency contacts will be revised through a class 1 permit modification with written notification.

If an individual is injured, or a situation is created that could negatively impact the community, the first call made by the emergency coordinator will be to 911.

3.0 CONTINGENCY PLAN IMPLEMENTATION

The Contingency Plan will be implemented whenever the emergency coordinator/alternate determines an imminent or actual hazard exists which could threaten human health or the environment. This section provides the criteria used by the emergency coordinator/alternate in making the decision to implement the Contingency Plan. The Contingency Plan will be implemented in the following situations:

- Any event at the Facility involving fire and/or an explosion
- In the event of tornadoes or severe weather
- In the case of flood events,
    - Adverse weather projections (flood warnings);
    - Observed increased water flows
    - Potential or actual flood wall breaches
- Any spill occurring outside of the active waste disposal management area
- Any spill within the containment system with the potential for leakage or overflow from the containment system
- Any spill which could result in a fire and/or explosion
- Any spill or release that has the potential for damaging human health or the environment.

In no circumstance should an employee or contractor put themselves in danger. Therefore, it is imperative to assess the situation as rapidly and as accurately as possible. Never attempt to act in any emergency situation without first alerting an emergency coordinator, supervisor, or outside emergency responder. The first duty of employees is to remain safe and report the emergency to the emergency coordinator. The emergency coordinator will provide instructions on how to proceed if different than described for each emergency procedure listed in Section 4. In the event of an imminent or actual emergency situation, the emergency coordinator will follow the emergency response procedures as described in Section 4.0, notify all Facility personnel or contractors who may be at the Facility, and notify appropriate state or local agencies with designated response roles if their help is needed. Should an evacuation be required, Figure 1 provides an evacuation route map. (Evacuation procedures are described in Section 6.0). Should any injuries or suspected injuries occur, Figure 2 indicates the route from the Facility to the nearest medical facility.

4.0 EMERGENCY RESPONSE PROCEDURES

The following emergency procedures shall be followed in the event of an imminent or actual emergency situation. Emergency situations and response instructions will be communicated to on-site staff, contractors and visitors in person or using a radio or cellular telephone.

4.1 Notification

In the event of an emergency:

1. The person first noticing the incident will immediately notify the emergency coordinator or the on call alternate. All Facility contractors working at the Facility will be trained to immediately notify other personnel and the emergency coordinator of a potential hazard. Contractors are to be trained annually on the entire content of the Contingency Plan.
2. The emergency coordinator will determine whether or not to implement the Contingency Plan.
3. The Contingency Plan may be implemented for less than the entire Facility area.
4. Upon notification, the emergency coordinator will assess the incident. This assessment will include all of the following:
    A. Materials involved in the incident
    B. Need for evacuation or other actions (e.g. move to higher ground)
    C. Threat to human health or the environment outside the Facility area
    D. “In-house” incident response capabilities
5. If the emergency coordinator determines that evacuation is required, the emergency coordinator will activate the EVACUATION PLAN (see Section 6.0).
6. In the event of an incident that may threaten human health or the environment outside the Facility area, the emergency coordinator will notify the appropriate outside agencies by telephone (see Attachment A). Otherwise, any required notifications will be made after the emergency is under control, according to the protocol outlined in Section 7.0.
7. When notifying any response agency, the following information will be given:
    A. The name and telephone number of the person calling
    B. The name and address of the Facility
    C. The time and type of incident (e.g., release, fire, etc.)
    D. The name and quantity of material(s) involved, to the extent known
    E. The extent of injuries, if any
    F. Any known possible hazards to human health or the environment outside the Facility area

4.2 Identification Of Hazardous Material

In the event of an incident at the Facility, the emergency coordinator will first identify the sources, amount and types(s) of material involved, as well as the area/extent of the release, fire, flood, or explosion. The initial identification will be by visual analysis of the incident location and the materials involved, review of available records and manifests, or, if necessary, by chemical analyses.

With the release information, the emergency coordinator will assess possible hazards to human health, the environment, the Facility, and other materials on-site. The assessment will consider both direct and indirect effects of the release, fire, explosion, flood, or other emergency event. Consideration will be given to the effects of any toxic, irritating, or asphyxiating gases that could be generated and the effects of any hazardous surface water run-offs from water or chemical agents used to control fire and heat induced explosions. Considerations for transport of materials or wastes during flood events will also be considered.

Waste and hazardous materials expected to be at the Facility include the following:

- The following wastes authorized to be contained in the North CAMU:
  - The treated slag that currently exists in cells 1 through 12
  - Remediation waste associated with clean-up activities for VCP No. 2541 (J Parcel) and other remediation waste approved in the final Remediation Action Plan (RAP) for the Facility and/or the final Closure Plan
- The following wastes authorized to be contained in the RCA:
  - Surface soils exceeding applicable protective concentration levels (PCLs) excavated from affected property at the Facility where no cap is planned
  - Sediments and waste materials exceeding applicable PCLs removed from portions of Stewart Creek on or downstream from the Facility
  - Other remediation waste approved in the final RAP and/or the final Closure Plan
- Liquids associated with routine operation of vehicles and power equipment in use by the contractor
- Contact and non-contact storm water
- Wastewater treatment chemicals

4.3 Assessment

The emergency coordinator will first determine the nature of the incident (e.g., flood, fire, explosion, or other release of material). If an explosion or fire occurs that could threaten human health or the environment, the emergency coordinator will attempt to ascertain the immediate cause in order to determine the potential for another explosion or if additional fires could be started. In the event of an explosion or fire that could threaten human health or the environment, the emergency coordinator will first notify the Frisco Fire and Police Departments. Subsequently, the National Response Center (phone numbers listed in Appendix A) will be advised of any reportable release. Upon identifying the material causing the incident, the emergency coordinator will assess the potential and existing hazards through knowledge of hazards posed by individual materials and wastes.

Records for these wastes and materials are available from the following locations:

- Contractors will maintain a book of MSDS sheets at the Facility for any hazardous materials used during the Site remediation and closure process of the North CAMU and the RCA
- Information regarding the typical chemical composition of slag such as that disposed in the North CAMU will be kept along with the MSDS sheets in the Exide trailer or will be available from an Exide representative or designated consultant or on-site contractor
- Sampling results for remediation wastes will be available in the Exide trailer or will be available from an Exide representative or designated consultant or contractor

The emergency coordinator will convey all such information to responding emergency assistance teams.

4.4 Control Procedures

After assessing the extent of the emergency situation and the possible hazards posed, the emergency coordinator will initiate the following type-specific control procedures with the assistance of Facility contractor personnel and/or any necessary outside agencies. In general, these procedures will be consistent with the emergency response procedures outlined above. The initial response priority in any emergency will be to protect human health and safety and then the environment. Identification, containment, treatment, and disposal assessments will be the secondary response. The emergency coordinator will document all control, response, and clean-up procedures.

While the Facility is in operation, the Exide trailer will be used as the Emergency Operations Center, if needed and it is safe to do so. In the event that the Exide trailer is not available or is inaccessible, the Emergency Coordinator will designate an alternate location as the Emergency Operations Center. The Emergency Operations Center will serve as a location where key personnel can coordinate a response.

4.4.1 Fire

No ignitable, corrosive, incompatible, or reactive materials will be accepted in support of the Facility closure. Non-waste related fires from the use of small amounts of these materials (liquids associated with routine operation of vehicles and power equipment in use by the contractor) could occur (vehicle fires, building fires, etc.) and would be responded to as detailed below.

Any fires will be assessed by the Facility contractors. All Facility contractors will be trained to first notify appropriate persons. Any fire will be assessed to determine if it is an incipient stage fire[1]. If so, Facility contractors will be trained to know when it is safe to fight these fires with portable fire extinguishers. If the

---

[1] 29 CFR 1910.155(c)(26) defines "incipient stage fire" as a fire which is in the initial or beginning stage and which can controlled or extinguished by portable fire extinguishers, class II standpipe or small hose systems without the need for protective clothing or breathing apparatus.

fire has passed the incipient stage, Facility personnel will be trained to call 911 immediately. In no case will Facility contractors risk injury or life fighting a fire.

Under no circumstances shall any Facility contractor attempt to fight a fire that cannot readily be extinguished by use of a portable fire extinguisher. Any fire of greater size requires evacuation of the area and notification of the emergency coordinator.

If it possible to do so without risk of injury (following criteria listed above), the Facility contractor will attempt to extinguish the fire with the appropriate fire suppression equipment as described below:

- Do use the PASS technique as described in Fire Extinguisher training.
- Do NOT attempt to extinguish a fire
  - That has become too large for a single extinguisher.
  - Places the fire between you and safe egress.
  - If you cannot see your safe egress.
  - Involves toxics for which you do not have the appropriate respirator.
  - Without alerting others.
  - With an inappropriate extinguisher.

4.4.2 Explosion

Explosive materials are not expected to be used or disposed of at the North CAMU or the RCA or elsewhere at the Facility. The only materials that might be present that represent an explosion hazard are fuels for on-site vehicles and equipment. In the unlikely event of an explosion, the Facility contractor will alert the emergency coordinator and outside emergency personnel.

It is imperative that extreme caution be utilized in assessing emergencies involving an explosion. The Facility contactor will assess the surroundings for the cause of the explosion. The contractor will look specifically for situations where another explosion is imminent or possible. If it is safe to do so, the contractor will remove ignition sources or other causes of explosion.

If there are no signs of further imminent explosions, the fire response will proceed as described above.

4.4.3 Tornadoes / Severe Weather / Flood

The following Severe Weather Sheltering Procedures should be followed when there is potential or confirmed severe weather in the area. The designated location to seek shelter for a tornado is the Frisco Police Department located at 7200 Stonebrook Parkway, approximately one mile to the south of the Facility along Parkwood Boulevard. The location is shown on Figure 1.

- In the event of severe weather (tornado, severe thunderstorm or flood watches/warnings), the emergency coordinator or a designee will monitor the weather status of the area.
- If the local emergency siren blows, or in the event of imminent danger to the Facility, the emergency coordinator or a designee will provide a verbal warning or notify Facility personnel using another means of communication.
- All employees and contractors should immediately stop work and turn off any equipment in the affected area or in the entire Facility if it is safe to do so, as warranted.
- In the event of a flood warning, equipment and materials should be moved to higher ground, if it is safe to do so. The priorities for a flood emergency are: protection of human health, environment and property; communication of hazardous conditions; and restoration of normal operations.
- For a tornado warning, employees and contractors should proceed by vehicle to the severe weather shelter at the Frisco Police Department in a calm and orderly manner. For a severe thunderstorm warning or flood warning, employees and contractors should seek shelters in vehicles or job trailers, or in areas of higher ground (for flood events).
- Employees and contractors should not leave the severe weather shelter until instructed to do so by the emergency coordinator or designee.
- The emergency coordinator or designee shall monitor the current weather situation and local emergency services to determine when it is safe for employees and contractors to leave the severe weather shelter.
- After the all clear signal is given and it is safe to leave the severe weather shelter, the emergency coordinator or designee will perform a Facility walkover and follow the procedures for follow-up actions as indicated in Section 7.0 of this Plan.

4.4.4 Material Spills

For material spills during loading, unloading, or transfer of waste or hazardous substances, the emergency coordinator and/or contractors will don appropriate personal protective equipment, which may include gloves, disposable coveralls, protective boots, face shields/goggles, and respirators. Any nearby electrical power or potential ignition sources will be isolated.

The worst-case spill or release scenario would occur in connection with a release of materials from a truck prepared to dump waste into the North CAMU or RCA. This worst-case spill could involve up to 30 cubic yards of class 2 waste or waste exceeding applicable PCLs. Such quantity would not cause material to spill beyond the unit boundaries and could be readily contained, recovered, and appropriately placed into the appropriate waste management unit.

Spilled remediation wastes (already approved for disposal at the Facility) will be contained, removed, and transferred into the North CAMU or the RCA. Where necessary and as appropriate, the spill area(s) will be decontaminated or excavated to ensure complete cleanup. Surrounding soils will be sampled and analyzed for the presence of appropriate constituents to assure complete cleanup.

It should be noted that no liquid waste will be disposed in the North CAMU or the RCA. Therefore, any potential hazardous liquid spills would be related to maintenance chemicals, fuels, etc. Absorbent may be applied around liquid spills to contain and absorb free-standing liquid. If necessary, appropriate neutralizing agents would be applied prior to clean-up efforts. Any containers near the spill area would be moved to eliminate the possibility of other leaks. The leaking container would be transferred into a new container. Overpack drums would be packed with absorbent or pozzolanic reagents. Once controlled and absorbed, spilled material would be placed into a compatible empty drum.

In the event of a release, waste will be excavated and placed in compatible 55-gallon drums or roll-off boxes for bulk disposal, as appropriate. Surrounding soils will be sampled and analyzed for the presence of appropriate constituents to confirm effective clean-up.

Any drums and material generated from spill clean-up (other than waste already approved for disposal in the North CAMU or RCA as described above) will be properly labeled and sent to an approved off-site treatment and/or disposal facility. In the event materials are shipped off-site, appropriate manifest system, recordkeeping and reporting requirements will be used.

4.5 Prevention of Reoccurrence or Spread of Fires, Explosions or Releases

During an emergency, the emergency coordinator will take all reasonable measures necessary to ensure that fires, explosions, or releases do not occur, recur, or spread. These measures could include stopping processes, traffic, and operations. Additionally, containers will be isolated or removed to prevent further involvement of the emergency event.

If a fire, explosion or release were to occur during loading, unloading or transfer of waste, the subject operations would cease. Trucks and/or other equipment involved would be moved from the incident area as directed by the emergency coordinator. Where necessary and practicable, a trench excavation or a containment berm would be made by the heavy equipment in order to contain the release. If this is not practicable, absorbent booms or pads would be used to contain the release. Equipment used would be decontaminated at the point of the incident to limit any spreading by tires or tracks.

4.6 Wastewater Discharge

Leachate from the North CAMU is directed to a leachate storage tank and contact stormwater is directed to the Solar Evaporation Pond. If there are any releases of reportable quantities within a 24-hour period from the leachate storage tank or Solar Evaporation Pond, the emergency coordinator or alternate will call within 24 hours to report the release. The call should go to both the Texas Commission on Environmental Quality (TCEQ) Region IV office spill reporting hotline (800-832-8224) and the National Response Center (NRC) (800-424-8802). See Attachment A for additional information.

5.0 EMERGENCY EQUIPMENT

A list of potential emergency equipment is provided as Appendix D and will be updated as needed. An up-to-date version of this list will be maintained at the on-site Exide trailer or will be available from an Exide representative or designated consultant or contractor following final closure activities. The list will include the location and a physical description of each item on the list and a brief outline of its capabilities.

Protective clothing and equipment will be provided to protect employees during normal and emergency operations. Such equipment may include, if necessary, first aid kit, gloves, goggles, disposable coveralls, and respirators. Monthly inspections are performed for the Automated External Defibrillators (AED) at the Facility and the eyewash and emergency showers are inspected weekly. Inspections will also be performed after storms or emergency events.

The Frisco Fire Department has its own emergency equipment that is subject to the department's regular inspection and maintenance procedures to respond to any incidents that may occur. The City of Frisco provides fire suppression services for the Facility and has an Insurance Services Office, Inc. (ISO) Public Protection Classification (PPC) of 1 (best public protection on a scale of 1 to 10) based on Classification designated by the State Fire Marshal. Water is provided to the Facility by the City of Frisco and is accessible to City of Frisco emergency responders by hydrants available at the Facility (see Figure 1). The water pressure from the hydrants is sufficient for emergency response needs at the Facility. Fire hydrant flow test data is included in Appendix E.

6.0 EVACUATION PLAN

This Contingency Plan includes an evacuation plan for Facility personnel where there is a possibility that evacuation could be necessary. The following paragraphs describe notification and signals to be used to begin evacuation, evacuation routes, and alternate evacuation routes (in cases where the primary routes could be blocked by releases of hazardous waste or fires).

6.1 Notification

If in the assessment of the emergency event the emergency coordinator determines that evacuation of the Facility or local areas may be advisable, they will immediately notify Facility personnel by telephone or radio and appropriate local authorities by telephone, indicate the extent and type of emergency that exists (fire, spill, etc.), and make themselves available to help appropriate officials with evacuation planning. The foremost local authority is identified as the Frisco Fire Department (911).

In the event of an emergency where environmental contamination associated with reportable releases is imminent, in addition to notifying the Frisco Fire Department (911 emergencies), the following governmental agencies will be notified by the Exide Technologies emergency coordinator or an alternate Exide Technologies contact:

Agency	Emergencies Notified for:	Telephone #
Frisco Fire Department	Any Potential fire or explosion	911 (Emergencies)
Frisco Hazardous Materials Team	Any hazmat Contingency Plan incident	911 (Emergencies)
Police Department	Any potential evacuation, traffic or security control	911 (Emergencies)
Emergency Medical Service	Any medical emergency	911 (Emergencies)
Collin County Local Emergency Planning Committee (Collin County Fire Marshal)	In the event of a reportable release	972-548-5576
TCEQ Region IV (State Emergency Response Commission, SERC)	All reportable spills or release incidents must be reported within 24 hours	800-832-8224 (24 hr)
National Response Center (NRC) Coast Guard	All reportable spills or releases – RQ	800 424-8802 (24 hr)

The emergency coordinator will provide the following information in the notification:

- Name and telephone number of reporter
- Name and address of facility
- Time and type of incident (e.g., release, fire)
- Name and quantity of material(s) involved, to the extent known
- The extent of injuries, if any

- The possible hazards to human health, or the environment, outside the Facility

Upon the determination that a reportable incident has occurred, the responsible person shall notify the appropriate agencies as soon as possible but not later than 24 hours after the discovery of the incident.

In the event of emergencies involving leaks, fire, or explosions (which may require additional assistance), at the direction of the emergency coordinator, a qualified emergency response contractor will be obtained.

6.2 Evacuation Routes

Any evacuation of the Facility will follow the normal emergency evacuation procedures as posted within the Exide trailer.

The primary evacuation Route is included as Figure 1. In general, the evacuation route from the North CAMU is to travel south along the west side of the North CAMU along the road and then to the east, exiting the Facility via Eagan Way. The evacuation routes from the RCA and the Exide trailer also travel east and exit the Facility via Eagan Way.

Any evacuation of the surrounding properties will be coordinated with the local fire and police departments.

7.0 POST-INCIDENT PROCEDURES

7.1 Storage and Treatment of Released Materials

Immediately after an emergency, the emergency coordinator will provide for treating, storing, or disposing of recovered waste, contaminated soil or surface water, or any other material that results from a release, fire, or explosion at the Facility. When the emergency response and cleanup have been completed, all wash waters and disposable cleaning materials need to be contained and packaged as the same waste category as the waste involved in the emergency and disposed of in accordance with the regulations for that class of waste. The emergency coordinator will ensure that, in the affected area(s) of the Facility, no waste that may be incompatible with the released material is treated, stored, or disposed until cleanup procedures are completed.

7.2 Post-Emergency Equipment Maintenance

All emergency equipment listed in this Contingency Plan will be cleaned and fit for its intended use before waste management operations are performed. Non-expendable items such as tools and material handling equipment are to be inspected and cleaned in an appropriate solvent or detergent and placed back in the original location. Inoperable emergency equipment will be serviced, repaired, or replaced.

All tanks and containerized waste will be thoroughly inspected for leaks, pressure build-up and structural integrity by the construction manager (during closure activities) or the emergency coordinator. Any deficiencies will be immediately corrected.

7.3 Restoration

As soon as practical, but no later than 48 hours after an incident is concluded, the restoration process will be initiated. This process may include the following activities (or other activities as appropriate):

- Inspection and repair of waste management unit caps to their original integrity and Closure Plan specifications
- Reseeding of repaired cap surfaces in accordance with the original Closure Plan specifications
- Inspection and repair of any damaged Facility equipment, security fencing, flood wall, drainage structures, etc.

7.4 Required Written Reports

When this Contingency Plan is implemented to address fire, explosion, or release of reportable quantities of constituents, a follow-up notification letter will be delivered by Exide to the Texas Commission on Environmental Quality, Remediation Division, MC225, PO Box 13087, Austin, Texas 78711-3087, as soon as practicable, but no later than 15 days after the incident or within 5 days for unauthorized discharge to waters (per TPDES permit). The follow-up notice will update the following information included in the initial notification and provide information on actual response actions taken and advice regarding medical attention necessary for citizens exposed.

- Name, address, and telephone number of the owner or operator
- Name, address, and telephone number of the facility
- Date, time, and type of incident (e.g., fire, explosion)
- Name and quantity of material(s) involved
- The extent of injuries, if any
- An assessment of actual or potential hazards to human health or the environment, where this is applicable
- Estimated quantity and disposition of recovered material that resulted from the incident

8.0 CONTINGENCY PLAN UPDATE, DISTRIBUTION AND CONTROL

8.1 Distribution and Coordination Agreements

Copies of this plan will be distributed, at a minimum, to the following local authorities and service agencies that may be summoned in the event of an emergency:

FIRE DEPARTMENTT/EMERGENCY MANAGEMENT:
Frisco Fire Department (Central Fire Station)
Mr. Mark Piland (Fire Chief/Emergency Management Coordinator)
Mr. Jason Lane, Deputy Emergency Management Coordinator
8601 Gary Burns Drive
Frisco, TX 75034
972-292-6300

POLICE:
Frisco Police Department
Mr. John Bruce (Chief of Police)
7200 Stonebrook Parkway
Frisco, Texas, 75034
972-292-6100

The Contingency Plan will be provided to these local emergency responders following TCEQ’s approval of the Closure Plan and this Contingency Plan. An offer will also be made to brief these organizations on the type of materials and activities involved at the Facility. Letters of notification and a copy of the Agreement Request to the above organizations are included as Appendix B. If updates are made to the Contingency Plan, revised copies will be submitted to these organizations.

8.2 Updates/Amendments

Updates or amendments will be reviewed and immediately implemented if

- The Final Closure Plan is revised;
- This Plan fails in an emergency;
- The Facility design, construction, operation, maintenance, or other circumstances change to increase the potential for fires, explosions, or releases of hazardous wastes or hazardous waste constituents, or change the response necessary in an emergency;
- Emergency coordinators are changed; or
- Emergency equipment changes.

TABLES

Table 1: Potential Types of Incidents
Exide Technologies Frisco Recycling Facility
Contingency Plan

<table>
<tr><th colspan="2">Fire Incidents</th></tr>
<tr><th>Type of Incident</th><th>Potential Response (See Section 4.4.1)</th></tr>
<tr><td>Vehicle or equipment fire</td><td>Extinguish or notify and evacuate</td></tr>
<tr><td>Brush fire (lightning)</td><td>Extinguish or notify and evacuate</td></tr>
<tr><th colspan="2">Explosion</th></tr>
<tr><th>Type of Incident</th><th>Potential Response (See Section 4.4.2)</th></tr>
<tr><td>Explosion from vehicle or equipment</td><td>Notify</td></tr>
<tr><th colspan="2">Severe Weather</th></tr>
<tr><th>Type of Incident</th><th>Potential Response (See Section 4.4.3)</th></tr>
<tr><td>Tornado or severe thunderstorm watch</td><td>Notify and monitor weather</td></tr>
<tr><td>Tornado or severe thunderstorm warning</td><td>Notify, take cover in designated area of Exide trailer or at Frisco Police Department, and monitor weather</td></tr>
<tr><td>Ice/snow storm</td><td>Notify, monitor weather, and demobilize from Site as needed</td></tr>
<tr><td>Potential Flooding</td><td>Notify, monitor weather, move equipment/materials, and demobilize from Site as needed</td></tr>
<tr><th colspan="2">Material/Waste/Wastewater Spills</th></tr>
<tr><th>Type of Incident</th><th>Potential Response (See Section 4.4.4 and 4.6)</th></tr>
<tr><td>Waste spill (soil, sediment or other approved remediation waste)</td><td>Transfer waste to North CAMU or RCA, characterize and remove impacted surrounding soil (as appropriate)</td></tr>
<tr><td>Release of fuel or fluids from equipment or vehicles</td><td>Deploy spill kits, notify if needed, characterize and remove impacted surrounding soil (as appropriate).</td></tr>
<tr><td>Release of fuel from on-site storage tank (contractor portable tank)</td><td>Deploy spill kits, notify if needed, characterize and remove impacted surrounding soil (as appropriate)</td></tr>
<tr><td>Release from North CAMU leachate storage tank or solar evaporation pond</td><td>Deploy spill kits, notify if needed, characterize and remove impacted surrounding soil (as appropriate).</td></tr>
</table>

Notes:

- **Notify –** Notify emergency coordinator and all on-site personnel (i.e., Exide, contractors, visitors) of potential emergency.
- **Evacuate –** Follow evacuation procedures listed in Section 6.0 of the Contingency Plan.
- **Extinguish –** If fire is small and can be contained using portable fire extinguisher, contractor can attempt to extinguish.

FIGURES

LEGEND

- ▭ Disposal Area
- ▭ Remediation Consolidation Area
- ⬚ Approximate North CAMU Extent
- ⬚ Approximate Boundary of the Former Operating Plant
- ▥ Equipment Staging Area
- — Proposed Flood Wall
- → Evacuation Route
- ✚ Fire Hydrant
- ★ Severe Weather Shelter

8/8/18

STATE OF TEXAS
JEFFREY B. FASSETT
85675
LICENSED PROFESSIONAL ENGINEER

500 250 0 500
Feet

REFERENCE

1. AERIAL IMAGERY - SOURCE: ESRI, DIGITALGLOBE, GEOEYE, EARTHSTAR GEOGRAPHICS, CNES/AIRBUS DS, USDA, USGS, AEROGRID, IGN, AND THE GIS USER COMMUNITY AND PLANT SITE TAKEN 4/1/2017

CLIENT
EXIDE TECHNOLOGIES

PROJECT
RCRA PERMIT RENEWAL

TITLE
SITE LAYOUT AND EVACUATION ROUTE

CONSULTANT
Golder Associates

YYYY-MM-DD	2018-08-07
PREPARED	EFT
DESIGN	EFT
REVIEW	EPW
APPROVED	AMF

PROJECT No.	CONTROL	Rev.	FIGURE
13-0208606	1302086ZF034.mxd	0	**1**

Path: G:\Projects\130 Projects\1302086-06 - Exide Frisco RCRA Permit Mod\800 - FIGURES-DRAWINGS\PRODUCTION\GIS from JAX\ZF - RCRA Permit\map documents\1302086ZF034.mxd

IF THIS MEASUREMENT DOES NOT MATCH WHAT IS SHOWN, THE SHEET HAS BEEN MODIFIED FROM: ANSI B

1 in
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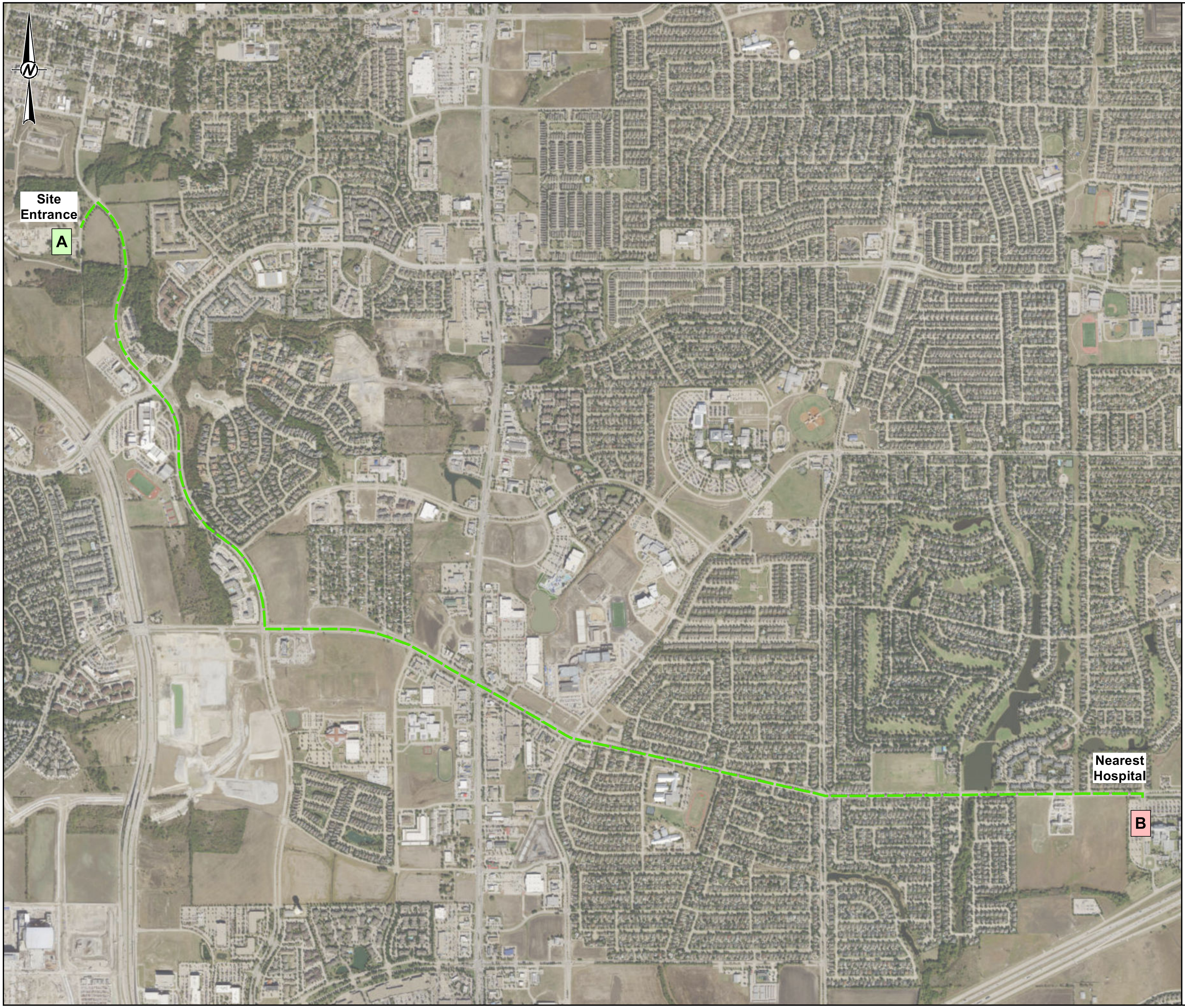

LEGEND

--- Route to Hospital

JBF 8/8/18

STATE OF TEXAS
JEFFREY B. FASSETT
85675
LICENSED PROFESSIONAL ENGINEER

A

↰ Turn left onto Eagan Way

⚠ Restricted usage road

0.2 mi

↱ Turn right onto Parkwood Blvd

1.4 mi

↰ Turn left onto Lebanon Rd

2.7 mi

↱ Turn right at Palmetto Dr

367 ft

B

1,500 750 0 1,500
Feet

REFERENCE

1. AERIAL IMAGERY - SOURCE: ESRI, DIGITALGLOBE, GEOEYE, EARTHSTAR GEOGRAPHICS, CNES/AIRBUS DS, USDA, USGS, AEROGRID, IGN, AND THE GIS USER COMMUNITY AND PLANT SITE TAKEN 4/1/2017

CLIENT
EXIDE TECHNOLOGIES

PROJECT
RCRA PERMIT RENEWAL

TITLE
HOSPITAL ROUTE

CONSULTANT

Golder Associates

YYYY-MM-DD	2018-08-02
PREPARED	EFT
DESIGN	EFT
REVIEW	EPW
APPROVED	AMF

PROJECT No.	CONTROL	Rev.	FIGURE
13-02086-06	1302086ZF035.mxd	0	**2**

Path: G:\Projects\130 Projects\1302086-06 - Exide Frisco RCRA Permit Mod\800 - FIGURES-DRAWINGS\PRODUCTION\GIS from JAX\New Figures\1302086ZF035.mxd

IF THIS MEASUREMENT DOES NOT MATCH WHAT IS SHOWN, THE SHEET HAS BEEN MODIFIED FROM: ANSI B

0
1 in

APPENDIX A
EMERGENCY COORDINATORS AND EMERGENCY RESPONSE CONTACT NUMBERS

EMERGENCY RESPONSE CONTACT INFORMATION

PRIMARY EMERGENCY COORDINATOR

Eduardo Salazar, Health and Safety Supervisor

Office	Home
7471 5th Street	5940 Madison Drive
Frisco, Texas 75034	The Colony, Texas 75056
Cell: (972) 786-5404	
Office: (972) 335-2121	
eduardo.salazar@exide.com	

ALTERNATE EMERGENCY COORDINATOR

Brad Weaver, Remediation Director

Office	Home
7471 5th Street	3718 Bluegrass Drive
Frisco, Texas 75034	Grand Prairie, TX 75052
Cell: (214) 893-4803	
Office: (972) 335-2121	
brad.weaver@exide.com	

OTHER EXIDE EMERGENCY CONTACTS

Office

Billy King, Operations Manager
7471 5th Street
Frisco, Texas 75034
Office: (972) 335-2121
Cell: (214) 674-0197
billy.king@exide.com

EMERGENCY (FIRE/POLICE/AMBULANCE)

911

EMERGENCY RESPONSE CONTACT INFORMATION

FIRE DEPT/EMERGENCY MANAGEMENT

Frisco Fire Department (Central Fire Station)
8601 Gary Burns Drive
Frisco, Texas, 75034
(972) 292-6300

POLICE

Frisco Police Department
7200 Stonebrook Parkway
Frisco, Texas 75034
(972) 292-6000

TCEQ REGIONAL OFFICE

Regional Director: Tony Walker
2309 Gravel Drive
Fort Worth, TX 76118-6951
(817) 588-5800

Spill reporting: (800) 832-8224

LOCAL EMERGENCY PLANNING COMMITTEE

Collin County Fire Marshal's Office
Attn: Collin County LEPC
4690 Community Ave #200
McKinney, TX 75071
(972) 548-5576

HOSPITAL

Centennial Medical Center
12505 Lebanon Road
Frisco, TX 75035
(972) 963-3333

PRIMARY RELEASE RESPONDER/CONTRACTOR:

Qualified release responder/contractor to be identified by Exide as appropriate.

OTHER EMERGENCY NUMBERS

National Response Center	(800) 424-8802
Centennial Medical Center (ER)	(972) 963-3039
Frisco Medical & Surgical (Staff Doctor)	(972) 377-2447
Chemtrek	(800) 424-9300
The Spill Center	(800) 847-0959
National Poison Number	(800) 222-1222
Atmos Energy (gas) emergency number	(866) 322-8667
TXU (electricity) transmission and distribution utility for Lewisville and North Texas	(888) 866-7456
City of Frisco Water Resources Division	(972) 292-5800
Telephone (AT&T)	(800) 499-7928

Phone numbers on this page will be updated as needed and kept on file.

APPENDIX B
NOTIFICATIONS

GOLDER

August 8, 2018 130208606

Jason Lane, Deputy Emergency Management Coordinator
Frisco Central Fire Station
8601 Gary Burns Drive
Frisco, TX 75034

RE: CONTINGENCY PLAN, EXIDE TECHNOLOGIES FRISCO RECYCLING CENTER, FRISCO, TEXAS

Dear Mr. Lane:

Golder Associates Inc. (Golder), on behalf of Exide Technologies (Exide), is providing the enclosed Contingency Plan for the Exide Technologies Frisco Recycling Center at 7471 Fifth Street in Frisco, Texas (Facility), which is in the process of being remediated and closed. The Facility is comprised of 89 acres and is located near the intersection of Parkwood Drive and Eagan Way/5th Street. Exide is requesting that the Frisco Police and Fire Departments agree to be the primary emergency authorities responding to a potential emergency and 911 call from the Facility. We would be happy to meet with you to review the following:

- Layout of the facility
- Properties of materials at the facility and associated hazards
- Places where facility personnel generally work
- Entrances to roads inside the facility
- Possible evacuation routes

Golder Associates Inc.
13515 Barrett Parkway Drive, Suite 260,
Ballwin, Missouri, USA 63021

T: +1 314 984-8800 F: +1 314 984-8770

We are requesting that you review the attached Contingency Plan and sign and return the attached Agreement at your earliest convenience. If a Facility visit is desired, please suggest a date that is convenient for you. If there are any questions or comments regarding the enclosed Contingency Plan or a meeting, please contact Mr. Brad Weaver of Exide at (972) 335-2121.

Sincerely,

GOLDER ASSOCIATES INC.

Anne Faeth-Boyd

Anne M. Faeth-Boyd, R.G., P.E. Missouri
Associate and Senior Engineer

Frederick M. Booth, P.G.
Principal and Program Leader

cc: Mr. Brad Weaver – Exide Technologies
Ms. Aileen Hooks – Baker Botts

Attachments: Contingency Plan, Exide Technologies Frisco Recycling Center, Frisco, Texas

Emergency Coordination Agreement
Exide Technologies
Frisco Recycling Center
7471 Fifth Street
Frisco, Texas 75034

Participating Agency or Organization: City of Frisco, Emergency Management

The following information has been provided or discussed:

- Facility Contingency Plan
- The layout of the facility
- Properties of wastes handled at the facility and their associated hazards
- Places where facility personnel would normally be working
- Entrances to the facility
- Roads inside the facility
- Possible evacuation routes
- Types of injuries that could result from fires, explosions or releases at the Facility

Please state that your agency or organization has received the Contingency Plan and is in agreement to act as the primary emergency authority if an unexpected emergency were to take place.

Signature		Signature	
Title		Title	
Date		Date	

Please return a signed copy of this agreement to:

Anne Faeth-Boyd
Golder Associates
13515 Barrett Parkway Drive
Suite 260
Ballwin, MO 63021

August 8, 2018 Project No. 130208606

Mr. Mark Piland, Fire Chief/Emergency Management Coordinator
Frisco Fire Department
8601 Gary Burns Drive
Frisco, Texas 75034

RE: CONTINGENCY PLAN, EXIDE TECHNOLOGIES FRISCO RECYCLING CENTER, FRISCO, TEXAS

Dear Mr.Piland:

Golder Associates Inc. (Golder), on behalf of Exide Technologies (Exide), is providing the enclosed Contingency Plan for the Exide Technologies Frisco Recycling Center at 7471 Fifth Street in Frisco, Texas (Facility), which is in the process of being remediated and closed. The Facility is comprised of 89 acres and is located near the intersection of Parkwood Drive and Eagan Way/5th Street. Exide is requesting that the Frisco Police and Fire Departments agree to be the primary emergency authorities responding to a potential emergency and 911 call from the Facility. We would be happy to meet with you to review the following:

- Layout of the facility
- Properties of materials at the facility and associated hazards
- Places where facility personnel generally work
- Entrances to roads inside the facility
- Possible evacuation routes

Golder Associates Inc.
13515 Barrett Parkway Drive, Suite 260,
Ballwin, Missouri, USA 63021
T: +1 314 984-8800 F: +1 314 984-8770

We are requesting that you review the attached Contingency Plan and sign and return the attached Agreement at your earliest convenience. If a Facility visit is desired, please suggest a date that is convenient for you. If there are any questions or comments regarding the enclosed Contingency Plan or a meeting, please contact Mr. Brad Weaver of Exide at (972) 335-2121.

Sincerely,

GOLDER ASSOCIATES INC.

Anne Faeth-Boyd

Booth

Anne M. Faeth-Boyd, R.G., P.E. Missouri
Associate and Senior Engineer

Frederick M. Booth, P.G.
Principal and Program Leader

cc: Mr. Brad Weaver – Exide Technologies
Ms. Aileen Hooks – Baker Botts

Attachments: Contingency Plan, Exide Technologies Frisco Recycling Center, Frisco, Texas

Emergency Coordination Agreement
Exide Technologies
Frisco Recycling Center
7471 Fifth Street
Frisco, Texas 75034

Participating Agency or Organization: City of Frisco, Emergency Management

The following information has been provided or discussed:

- Facility Contingency Plan
- The layout of the facility
- Properties of wastes handled at the facility and their associated hazards
- Places where facility personnel would normally be working
- Entrances to the facility
- Roads inside the facility
- Possible evacuation routes
- Types of injuries that could result from fires, explosions or releases at the Facility

Please state that your agency or organization has received the Contingency Plan and is in agreement to act as the primary emergency authority if an unexpected emergency were to take place.

Signature		Signature	
Title		Title	
Date		Date	

Please return a signed copy of this agreement to:

Anne Faeth-Boyd
Golder Associates
13515 Barrett Parkway Drive
Suite 260
Ballwin, MO 63021

GOLDER

August 8, 2018 Project No. 130208606

Mr. John Bruce, Chief of Police
Frisco Police Department
8601 Gary Burns Drive
Frisco, Texas 75034

RE: CONTINGENCY PLAN, EXIDE TECHNOLOGIES FRISCO RECYCLING CENTER, FRISCO, TEXAS

Dear Mr. Bruce:

Golder Associates Inc. (Golder), on behalf of Exide Technologies (Exide), is providing the enclosed Contingency Plan for the Exide Technologies Frisco Recycling Center at 7471 Fifth Street in Frisco, Texas (Facility), which is in the process of being remediated and closed. The Facility is comprised of 89 acres and is located near the intersection of Parkwood Drive and Eagan Way/5th Street. Exide is requesting that the Frisco Police and Fire Departments agree to be the primary emergency authorities responding to a potential emergency and 911 call from the Facility. We would be happy to meet with you to review the following:

- Layout of the facility
- Properties of materials at the facility and associated hazards
- Places where facility personnel generally work
- Entrances to roads inside the facility
- Possible evacuation routes

We are requesting that you review the attached Contingency Plan and sign and return the attached Agreement at your earliest convenience. If a Facility visit is desired, please suggest a date that is convenient for you. If there are any questions or comments regarding the enclosed Contingency Plan or a meeting, please contact Mr. Brad Weaver of Exide at (972) 335-2121.

Sincerely,

GOLDER ASSOCIATES INC.

Anne Faeth-Boyd

Anne M. Faeth-Boyd, R.G., P.E. Missouri
Associate and Senior Engineer

Frederick M. Booth, P.G.
Principal and Program Leader

cc: Mr. Brad Weaver – Exide Technologies
Ms. Aileen Hooks – Baker Botts

Attachments: Contingency Plan, Exide Technologies Frisco Recycling Center, Frisco, Texas

Emergency Coordination Agreement
Exide Technologies
Frisco Recycling Center
7471 Fifth Street
Frisco, Texas 75034

Participating Agency or Organization: City of Frisco, Emergency Management

The following information has been provided or discussed:

- Facility Contingency Plan
- The layout of the facility
- Properties of wastes handled at the facility and their associated hazards
- Places where facility personnel would normally be working
- Entrances to the facility
- Roads inside the facility
- Possible evacuation routes
- Types of injuries that could result from fires, explosions or releases at the Facility

Please state that your agency or organization has received the Contingency Plan and is in agreement to act as the primary emergency authority if an unexpected emergency were to take place.

Signature		Signature	
Title		Title	
Date		Date	

Please return a signed copy of this agreement to:

Anne Faeth-Boyd
Golder Associates
13515 Barrett Parkway Drive
Suite 260
Ballwin, MO 63021

APPENDIX C
INCIDENT REPORT FORM

CONTINGENCY PLAN INCIDENT REPORT

Name, Address and Telephone Number of Owner or Operator:

Name: ______________________________

Address: ______________________________

____

Telephone Number: ______________________________

Name, Address and Telephone Number of the Facility:

Name: ______________________________

Address: ______________________________

____

Telephone Number: ______________________________

Incident Date: ______________________________

Incident Time: ______________________________

Type of Incident: ______________________________

____

Name and Quantity of Materials Involved: ______________________________

____

Extent of Injuries, if any: ______________________________

____

Assessment of actual or potential hazards to human health or the environment, where it applies:

____

____

Estimate quantity and disposition of recovered material that resulted from the incident:

____

____

Brief description of the incident: ____

____

____

____

____

Response Action Taken: ____

____

____

____

____

APPENDIX D
EMERGENCY EQUIPMENT

EMERGENCY EQUIPMENT

Protective clothing and equipment will be provided to protect employees during normal and emergency operations. Such equipment may include, if necessary, first aid kit, gloves, goggles, and disposable coveralls. The following is a list of equipment available at the Site:

Equipment	Location	Physical Description	Capabilities
General tools (i.e., pipe wrenches, screwdrivers, hose clamps, wiring splice kits (for underwater), and electrical tape)	Exide trailer and wastewater treatment plant (WWTP)	Standard hardware and tape	General maintenance and emergency repairs
Fire extinguisher	Exide trailer and WWTP[1]	Standard, cylindrical, red fire extinguishers	Extinguish minor fires
Eye Wash Station and Showers	WWTP and stormwater treatment plant	The eye wash station looks like a water fountain with a faucet on each side. There is a large sign labeled "Emergency Eye Wash" above the station. The facility also has a bottle eye wash station which consists of two bottles of saline solution stored on a dedicated rack on the wall. The shower looks like a free-standing showerhead. A large, triangular handle hangs from the top of the shower. There is a large sign labeled "Emergency Shower" on the piping.	Decontamination of eyes and personnel
First Aid Supplies	Exide trailer	Standard first aid supplies	Bandaids, ointment, gauze, etc.
PPE (leather gloves, nitrile or latex gloves, Tyvek chemical resistant coveralls, safety goggles or glasses, respirators)	Exide trailer	Blue and/or white gloves, plastic-like overalls, clear goggles and glasses, and face masks	Hand, eye, and skin protection and protection from inhalation of hazardous chemicals
AED	Exide trailer	Small case, with handle, labeled "AED"	Cardiac emergency response
Walkie talkies for communication	Exide trailer	Small, hand-held, plastic devices	Communications
Flashlights	Exide trailer	Standard flashlights	Emergency lighting
Spill kits	Exide trailer and WWTP	Yellow bucket with absorbent pads	Small spill response
Water for emergency response	City of Frisco Hydrants	Municipal Water Supply	Extinguish major fires

---

[1] Note: Locations of the WWTP, SWTP and Exide trailer are depicted on Figure 1.

APPENDIX E
FIRE HYDRANT FLOW TEST DATA REPORT

PROGRESS IN MOTION

Fire Hydrant Flow Test Data Report

Address of Test: PARKWOOD BLVD & EAG

Work Order ID: 248961

Location Details: PARKWOOD BLVD & EAG

Date/Time of Test: 8/3/2018 10:30:26AM

Test Performed By: PURDOM, BLAKE A at the City of Frisco

Static and Residual Hydrant

Main Size	Static (PSI)	Residual (PSI)
8	127	98

Flow Hydrant (Pitot)

Main Size	Outlet Size Flowed	Pitot 1 (PSI)	Pitot 2 (PSI)	Coefficient
8	2.5	25	30	0.9

Operating Levels of Nearest Elevated Water Tank

Approximate Site Elevation (feet)	Level at Time of Flow Test (feet)	Water Normal Operating Range (feet)
646	924	921 to 941

Flow (GPM)

1,678

Note: *1. The test result data is for reference only. The system must be designed in accordance with the 2006 International Fire Code with local amendments.*
2. The test data must be modified to adjust the pressure for the lowest normal operating level of the tank with the level of the tank at time of the flow test.
3. The provided hydrant flow test information and the modification data of the hydrant flow test must be shown on the submitted drawings and hydraulic calculation sheets.

Established in 1960, Golder Associates is a global, employee-owned organization that helps clients find sustainable solutions to the challenges of finite resources, energy and water supply and management, waste management, urbanization, and climate change. We provide a wide range of independent consulting, design, and construction services in our specialist areas of earth, environment, and energy. By building strong relationships and meeting the needs of clients, our people have created one of the most trusted professional services organizations in the world.

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Engineering Earth's Development, Preserving Earth's Integrity

APPENDIX J

Operation and Maintenance Plan

RCA O&M PLAN

REMEDIATION CONSOLIDATION AREA OPERATION & MAINTENANCE PLAN

Former Exide Technologies Frisco Recycling Facility
Frisco, Texas

8/15/18

JEFFREY B. FASSETT
85675

Submitted To:

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Golder Associates

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1.0 INTRODUCTION

Golder Associates Inc. (Golder) has prepared this operation and maintenance plan (O&M Plan) for the Remediation Consolidation Area (RCA) at the Former Operating Plant (FOP) of the Exide Technologies (Exide) Frisco Recycling Center in Frisco, Collin County, Texas. A Site Location Map is provided as Figure 1 of the Final Closure Plan, to which this Operations and Maintenance Plan (O&M Plan) is an appendix. The Site Layout is depicted in Figure 2 of the Final Closure Plan. The RCA will be used for the disposal of excavated sediment from Stewart Creek and excavated soil from affected properties at the FOP as well as other remediation waste. An engineered cap will be placed over the RCA once filling is complete.

1.1 Background

The RCA will be constructed over the former operational areas of the Former Operating Plant (FOP), as shown on Figure 2 of the Closure Plan. Per the Response Action Plan (RAP) for the FOP, which is submitted with the August 2018 supplement to the hazardous waste permit renewal application, the RCA will contain a) surface soils exceeding applicable protective concentration levels (PCLs) excavated from affected property at the FOP where no cap is planned, b) sediments and waste materials exceeding applicable PCLs removed from portions of Stewart Creek downstream from the FOP and c) other approved remediation waste.

As described in the RAP, approximately 51,000 cubic yards of soils and/or sediments (in place cubic yards) will be placed in the RCA. An engineered cover will be placed over the consolidated soil and sediment after this response action has been implemented.

1.2 Organization of Report

This O&M Plan provides general instructions to be followed by Site management and operating personnel for operations throughout the operating life of the RCA. This O&M Plan also includes a description of waste management practices to be followed during closure, including removal and decontamination of equipment and devices during RCA closure activities. The operations and maintenance items included in this O&M Plan are as follows:

- Section 2.0 presents the RCA Filling Procedures;
- Section 3.0 presents the Final Closure Procedures;
- Section 4.0 details the specific Storm Water Management Procedures;
- Section 5.0 presents Support Operations Procedures;
- Section 6.0 presents Inspection and Monitoring Procedures;
- Section 7.0 outlines Equipment Descriptions; and
- Section 8.0 discusses Personnel and Training.

Inspections, monitoring, and maintenance protocols during the post-closure period are included in the Final Closure Plan text, to which this O&M Plan is an appendix. Other information previously submitted in existing documents or in the Final Closure Plan is referenced where appropriate.

2.0 ACTIVE RCA OPERATIONS PROCEDURES

This section describes the site-specific procedures for preparation and active RCA filling operations including management objectives, the waste acceptance criteria, working face practices, and placement of waste lifts. Support functions including stormwater management procedures to be followed during the active period are presented in Section 4.0 of this document.

2.1 Preparation for Waste Placement in RCA

Monitoring wells within the RCA will be abandoned prior to waste placement activities (see Figure 3 of the Final Closure Plan as well as the RAP for additional information on well abandonment). Concrete walls and foundations associated with the FOP operations are present within the RCA. To facilitate waste placement, to the extent practical, the walls and above grade foundations will be demolished. The resulting rubble will be spread on the surface of the existing concrete slab.

The Facility's on-site wastewater treatment facility will be demolished prior to waste placement. Remaining concrete walls and foundations will be demolished and spread over the concrete slab prior to extending the waste placement in this area.

A barrier wall to protect against potential flood waters from Stewart Creek was constructed along the southern boundary of the FOP as part of the 1987 Agreed Order with the Texas Water Commission. The steel-reinforced concrete barrier wall effectively forms a new bank to the creek. A vertical extension of the existing barrier wall and a new lateral extension of this wall along the eastern boundary of the RCA has been designed to protect the facility from potential 100-year flood waters. The extended wall sections will also be made of 10-inch thick steel-reinforced concrete. The construction of the flood wall extensions will be completed prior to waste placement in the RCA. Additional information for the design of the flood wall is included in the Engineering Report for the RCA which is included as Attachment F of the August 2018 supplement to the hazardous waste permit renewal application.

A permeable reactive barrier (PRB) will be constructed on the downgradient (south) side of the RCA as part of the Corrective Action Program for the RCA. Construction of the PRB will be completed prior to placement of waste in the RCA. Additional information for the PRB is included in the Engineering Report for the RCA which is included as Attachment F and the Response Action Plan which is included as Attachment M to the August 2018 supplement to the hazardous waste permit renewal application.

A number of utilities are present below the concrete slab in the RCA. These utilities consist of pipes, manholes, and sumps for the sanitary sewer, the storm sewer, and process drains. To prevent liquid from accumulating in the utilities and to remove the potential for collapse, the pipes, sumps, and manholes will be plugged with flowable fill or other low-permeable material prior to final closure of the area. In addition, overhead utilities in and around the RCA will be disconnected and removed.

2.2 Waste Acceptance Limits and Testing

The following wastes are eligible to be placed in the RCA, which is a corrective action management unit (CAMU):

- Excavated soils from affected areas at the FOP
- Excavated sediment from Stewart Creek
- Approved remediation waste

Waste characterization will be performed in accordance with the Waste Analysis Plan (WAP) included as Attachment Q to the August 2018 supplement to the hazardous waste permit renewal application.

Other remediation waste may also be placed in the RCA. These wastes may include soils from surface or subsurface excavation areas, concrete, sediment, or other wastes that meet the criteria for placement in the RCA. Demolition waste that meets the disposal criteria from any remaining demolition activities required at the FOP may also be placed in the RCA.

2.3 Method of Waste Placement

Excavated soils and sediments will be placed in the RCA in lifts. The general operational approach dictates that the lifts be placed with the primary objective of limiting settlement and providing a surface suitable for equipment operation.

A significant rainfall event (determination to be made by the Construction Manager) would stop all loading and transportation activities in the RCA. No waste will be loaded, transported, or placed into the RCA during such an event. Work will resume as soon as possible after the rain stops and conditions allow. The decision to resume work will be the responsibility of the Construction Manager.

The following subsections provide a narrative of how waste placement requirements will be implemented during the filling operations.

As shown on the Site Layout (Figure 1 in Appendix K of the Final Closure Plan), waste hauling vehicles will use existing (or new if needed) roads to access the RCA area, then, once in the RCA area, use access roads established within the RCA, as directed by the Construction Manager. Waste hauling vehicles will unload in the designated drop area. This drop area will be demarcated by use of temporary barriers. Tracked or wheel equipment (loader and dozer) will be stationed within the RCA and will work in tandem to place the waste in lifts as required.

2.3.1 Interim Storage

Interim storage areas are not anticipated to be needed for RCA operations.

2.3.2 Waste Lifts

Waste will be placed in loose lifts compacted to a general thickness of approximately 1 foot. The waste will be compacted by a combination of the tracked dozer and appropriately sized smooth-drum compactor operating on the surface. Following compaction, the soil waste should have sufficient strength to adequately support construction equipment.

2.3.3 Ponded Water

Ponding of water over waste filled areas within the RCA will be prevented using the following techniques:

- Proper grading of interim waste slopes to promote positive water surface drainage toward drainage features (Figure 1 of Appendix K of the Final Closure Plan), then collected contact surface water will be handled as described below;
- Proper grading of final waste slopes to the elevations shown in the design plans (Appendix K of the Final Closure Plan), which provide surface water drainage without depressions or low spots; and
- Installation of upgradient temporary diversion berms as required to minimize the amount of water entering the disposal area.

Waste fill areas will be inspected to identify depressions or other potential ponding locations. If ponded water on the RCA is observed, action will be taken to remedy the problem. If water begins to accumulate in the active portion of the RCA, it will be removed with a small portable pump and transferred to the stormwater retention pond. The area of ponding will be filled with clean soil or waste fill and re-graded within seven days of the occurrence, weather permitting. Water that has been in contact with waste will be disposed of off-site as described in Section 4.0.

2.4 Physical Criteria of Waste

Soil, slag, sediment, and other approved remediation waste to be placed in the RCA shall not contain free water. Putrescible wastes shall not be placed in the RCA. Wastes shall be placed in a manner to minimize formation of bridging or voids and to allow adequate compaction to prevent excessive consolidation or settlement after placement.

2.5 Daily Cover Operations

Daily cover of the active area will not be required because the waste will not attract birds or animals and does not contain material susceptible to being windblown. A Dust Control Plan is included as Appendix I to the Final Closure Plan. The exposed face of the RCA will be limited to the area actively being filled. Other areas of exposed waste may be covered by a spray applied cover or temporary cover.

2.6 Equipment Decontamination

The existing equipment decontamination pad at the Wastewater Treatment Plant (WWTP) is anticipated to be used for equipment decontamination. If this existing pad is not used, an equipment decontamination area will be constructed within or near the RCA. Berms will be constructed around the perimeter. The decontamination area will be large enough to accommodate the largest piece of equipment that will be used during the operation and closure activities. The area will be graded to drain to one corner to allow the fluids generated during decontamination to be removed. A 40-mil high density polyethylene (HDPE) geomembrane will be placed over the graded area extending over the berms. The HDPE geomembrane will be anchored at the bottom of the berms to prevent it from becoming windblown. Timbers will be installed over the HDPE geomembrane to protect it from the tracks and tires of the heavy equipment during the decontamination activities.

The equipment will be decontaminated using potable water and high pressure washers. The decontamination fluids will be pumped out of the lined decontamination area into a tank and transferred to the Facility's on-site wastewater treatment facility or transferred to an off-site treatment facility for treatment and disposal in accordance with applicable regulations. To limit the generation of contact storm water, if an equipment decontamination pad other than the existing pad at the WWTP is used, the decontamination pad will be covered with poly sheeting weighted with sandbags during periods of inactivity and during significant storm events.

During the operation and closure activities, decontamination residue will be containerized and placed in the RCA provided capacity is available for this waste. If the decontamination waste is not placed in the RCA, it will be characterized and disposed off-site in accordance with local, state, and federal requirements. If an equipment decontamination pad other than the existing pad at the WWTP is used, the geomembrane and timbers will be decontaminated using high pressure water which will subsequently be collected and transferred to the facility's on-site wastewater treatment facility or transferred to an off-site facility for treatment and disposal in accordance with applicable regulations. The liner and timbers will be placed in the RCA provided capacity is available for this waste. If not, the liner and timbers will be transferred to a less than 90-day container for characterization, storage and disposal off-site in accordance with local, state and federal requirements.

If the decontamination pad is outside the RCA, following completion of decontamination activities and removal of the decontamination pad, three grab samples will be collected from beneath the decontamination area. The samples will be analyzed for total lead, cadmium, arsenic, antimony, and selenium. Should any of the results exceed applicable Protective Concentration Limits (PCLs) for any of these five metals, a minimum of six (6) inches of material underlying the decontamination area will be removed and placed into a temporary, less than 90-day container meeting applicable standards for waste characterization and analysis. This process will be repeated as required until the grab samples exhibits results that meet the PCLs for these five metals. Material will be transported off-site for disposal in accordance with local, state and federal requirements.

3.0 FINAL RCA CLOSURE PROCEDURES

This section describes the site-specific procedures for Final RCA Closure activities, including placement of final cover. Final closure procedures and specifications are included in the Final Closure Plan and RCA QA/QC Plan and included here for reference. Should the specifications listed within this document differ from the Final RCA Cover System Drawings (Appendix K of the Final Closure Plan) or the RCA QA/QC Plan (Appendix M of the Final Closure Plan), the Engineering Drawings take precedence, followed by the QA/QC Plan and then the Final Closure Plan.

Support functions, including contact water and storm water management procedures during final closure, will be the same as those identified during active operations and summarized in Sections 2.0 and 4.0 of this O&M Plan.

3.1 Working Surface Soil

The final surface of waste will be covered with a minimum 12-inch thick working surface soil layer (see the QA/QC Plan for the RCA which is included as Appendix M to the Final Closure Plan for more detail). The surface will be drum rolled to a smooth condition and surveyed at 100-foot intervals to establish the elevations of the surface prior to placement of a geosynthetic clay liner (GCL). The working surface soil material will be obtained from an on- or off-site source, delivered using haul trucks, and spread with a dozer to prepare a smooth surface for the GCL. The 12-inch working surface soil layer may be composed of waste placed, given the top four inches of the working surface is smooth and free of all sharp, angular objects as described in Appendix M. The surface should provide a firm, unyielding foundation for the GCL with no sudden sharp or abrupt changes or break in grade.

3.2 Geosynthetic Clay Liner

Following the grading and smoothing of the working surface soil, a GCL will be placed directly above the working surface soil as shown on Figure 2 in Appendix K of the Final Closure Plan. The new GCL will extend to the flood wall along the south, will be anchored in a containment berm to the east and will tie in to the existing compacted clay cover of the North Disposal Area as shown on Figure 2 in Appendix K of the Final Closure Plan.

3.3 Geomembrane Barrier

Following the installation of the geosynthetic clay liner, a 40-mil high density polyethylene (HDPE) geomembrane will be installed over the RCA. The geomembrane will be anchored to the flood wall with a batten strip along the south and east and will terminate in an anchor trench outside the RCA perimeter along the northeast. Along the north, the geomembrane will be tie into the geomembrane to be placed over the existing clay cover within the North Disposal Area. These details are shown on Figure 2 in Appendix K of the Final Closure Plan.

3.4 Geotextile/Geocomposite

A nonwoven geotextile layer shall be placed over the 40-mil textured LLDPE geomembrane in areas where the final cover slopes are 5% or less. The geotextile shall be 8-ounce per square yard (oz/sy), nonwoven and needle-punched. In areas with slopes greater than 5%, a 200-mil double-sided geocomposite drainage layer shall be placed over the geomembrane.

3.5 Clean Fill Material

An 18-inch thick layer of general clean fill material will be placed on top of the geotextile/geocomposite layer. The clean fill soil layer will consist of suitable soil obtained from an approved borrow source.

3.6 Vegetative Cover Soil

A 6-inch thick layer of topsoil will then be placed above the general clean fill layer in a loose condition and will be amended as necessary to establish a dense growth of vegetation. Once placement of the vegetative growth layer is completed, the area will be hydroseeded.

4.0 CONTACT WATER AND STORMWATER MANAGEMENT PROCEDURES

This section presents the contact water and stormwater management procedures to be used during the active operations and closure of the RCA as well as during the post-closure period. Inspection and monitoring requirements are presented in Section 6.0.

4.1 Water Management During Active RCA Filling and Closure Operations

4.1.1 RCA Contact Storm Water Management (Flood Wall Interior Drainage)

As described in the Final Closure Plan, the RCA base consists predominantly of a concrete slab. The concrete slab has an existing surface water collection system that collects and directs water to the stormwater retention pond to the southwest of the former operational areas. Sediment dikes or check dams will be maintained at the pipe inlet in order to control sediment transport from the RCA to the stormwater retention pond.

Water infiltrating through the concrete slab is collected in a French Drain System (FDS) located along the flood wall and conveyed to a sump located at the southwest end of the facility where it can be collected and pumped to storage tanks at the WWTP for off-site disposal or treatment and discharge, if authorized. Prior to placement of waste, the FDS will be abandoned and the PRB will be installed at the Site. Water infiltrating through the concrete slab would be captured by the PRB and treated in-situ.

During operations, precipitation coming into contact with exposed waste (i.e., contact water) will be contained using soil berms and either pumped or directed to the stormwater retention pond. A containment berm will be placed north of the flood wall to limit water collecting in the PRB during waste placement.

4.1.2 Exterior RCA Storm Water Management

As shown on Figure 1 in Appendix K of the Final Closure Plan, a containment berm will surround the northern and northeastern perimeter of the RCA and the existing flood wall surrounds the southern, eastern and western perimeter. Surface water will either flow away from the perimeter (as is the case along the flood wall) or the outside toe of the perimeter will be graded to drain (as is the case along the containment berm).

4.1.3 Decontamination Water

Decontamination procedures and protocols to be used at this site are discussed in Section 2.6 above. Decontamination waters will be handled as described in Section 2.6.

4.2 Post-Closure Water Management

After the RCA is filled and the cover system installed, the water volume within the waste is expected to be negligible and only non-contact storm water will be generated, simplifying the associated management procedures.

4.2.1 Storm Water Management

Following final closure, storm water run-off from the RCA will flow radially off the northern portion of the RCA final cover, where it will be directed to Stewart Creek. Storm water on southern and eastern facing slopes will flow to a perimeter channel formed adjacent to the flood wall and/or directed to the existing drainage pipe and directed to the stormwater retention pond as shown on Figure 1 in Appendix K of the Final Closure Plan. Calculations for channel and culvert sizing are included in Appendix O of the Final Closure Plan.

Storm water drainage facilities will be inspected regularly as described in the Final Closure Plan. Fill material, siltation, and excessive plant growth will be removed from drainage waterways to prevent obstruction of flow. Erosion on the sides or bottoms of the drainage waterways will be repaired and reconstructed as necessary.

5.0 SUPPORT OPERATIONS PROCEDURES

This section describes the site-specific support operations procedures for hauling and handling RCA waste.

5.1 Waste Hauling Vehicles and Traffic Control

Vehicles for hauling waste must be suitable for transporting this material from Stewart Creek or FOP areas to the RCA. The waste haulers will not allow waste from their vehicles to impact any roadways on which they travel. In addition, waste haulers will be responsible for observing the speed limits, traffic and safety requirements. Waste hauling vehicles shall be covered to minimize dust migration during transportation. Waste hauling vehicles will follow only those routes designated by the Construction Manager.

Waste hauling vehicles will track each load, documenting the quantity and time loaded. The Construction Manager designee at the entry to the RCA will stop each truck and log its arrival in the RCA records, or the information will be recorded in an equivalent manner. An inventory number will be assigned to each load by the Construction Manager designee. These logs will become part of the final recordkeeping as described in the Final Closure Plan.

5.2 Surveying

As described in the QA/QC Plan, the working surface layer and the soil cover layers will be surveyed by a surveyor or professional engineer licensed in the state of Texas.

5.3 Soil Erosion and Sediment Control

Erosion and sedimentation will be reduced and controlled using best management practices. Erosion control measures at the RCA will include hydroseeding, as appropriate. Erosion calculations, included in Appendix O of the Final Closure Plan, indicate that, once the final cover is installed and vegetation is established, the potential for erosion and sedimentation will be minor.

5.4 Noise Control

RCA operations are expected to occur during daytime hours and will be contained within the FOP boundary; therefore, no special noise controls are needed. However, noise levels for equipment used at the FOP will comply with applicable Occupational Safety and Health Administration (OSHA) requirements as described in each contractor’s Health and Safety Plan (to be prepared prior to the start of work at the Site).

5.5 Odor Control, Air Monitoring and Dust Suppression

Odorous constituents are not expected to be an issue based upon the types of wastes that are approved for acceptance at the RCA. Ambient air monitoring will be performed as described in the Air Monitoring

Plan (included as Appendix P to the Final Closure Plan) and each contractor's health and safety plan, which will be prepared prior to the start of work at the Site. A Dust Control Plan has also been prepared for the RCA and is included as Appendix Q to the Final Closure Plan.

5.6 Site Security

Unauthorized personnel will not be permitted in or near the RCA. The RCA will not be open to the public at any time. Security devices, including chain-link fencing, gates, locks, and signs, will be maintained around the perimeter of the FOP or around the capped areas throughout the post closure care period, unless otherwise approved by TCEQ. A security guard is contracted for the FOP when the FOP is not staffed [during the closure process]. Once closure is complete, the need for security guard will be re-evaluated.

To minimize the possibility that wildlife or unauthorized individuals will enter the RCA, a 6-foot high fence, with a lockable entrance gate, will be installed around the RCA (or entire FOP) perimeter following final closure activities. The fence will reduce the possibility for large wildlife or unauthorized individuals to enter the RCA area and potentially damage liners, interfere with operations, come in contact with waste materials, or track waste materials outside of the RCA area.

During active operations, the Construction Manager designee, located at the entrance to the FOP or the RCA, will stop each vehicle or person to determine whether they are permitted in the RCA area. At other times the gate to the FOP will be locked.

All Site security elements are included in the periodic inspections discussed in Section 6.0 and the Final Closure Plan.

5.7 Fire Protection and Emergency Measures

Only waste which is non-flammable and non-combustible will be placed in the RCA and as such fire hazards are believed to be minimal. A Contingency Plan for the RCA has been prepared and is included as Appendix J to the Final Closure Plan.

6.0 INSPECTIONS AND MONITORING

6.1 Active RCA Operations Site Inspections and Monitoring

During active operations, the RCA will be inspected a minimum of weekly and after each significant storm event to detect evidence of the following:

- Deterioration, malfunction, or improper operation of surface water control features;
- Erosion of RCA cap or berms;
- Signs of seepage, settlement, cracks or other signs of damage to the flood wall;
- Indications of sand boils outside the flood wall;
- The presence of trees or high vegetation growing along the flood wall;
- Procedures followed by operations and maintenance staff; and
- The condition of the operating equipment, including earth moving equipment, alarms and pumps.

An inspection check form with explanations of observations made will document each of these weekly inspections and become part of the RCA records. In addition, inspections of the security system (existing fences, gates, locks, etc.), emergency equipment, and communications equipment will be conducted weekly during active operations. These areas are described in the following subsections and documented on the RCA Inspection Form (Inspection Form), which is included in Attachment A of this O&M Plan. If, during a periodic inspection, damage, deterioration, or malfunction of any of the systems, components, or facilities is observed, steps shall be initiated to rectify the situation. Site personnel, or their designated contractor, will perform minor maintenance activities as described in this O&M Plan. Maintenance and repair actions will be documented on the Repair Report From included in Attachment A of this O&M Plan.

6.1.1 General RCA Conditions and Operating Conditions

The following will be inspected weekly and noted on the Inspection Form:

- Date of inspection;
- Name of inspector;
- Project features that were inspected;
- Overall condition of project features;
- Photographs showing flood damages, deficiencies, and overall project condition;
- Signs of erosion, obstructions, or ponding on the exterior berm slopes and on temporary water control systems, including ditches and culverts;
- Condition of heavy and support equipment, including signs of leaks or other items requiring maintenance;
- Access road conditions (potholes, washouts, ponding, or other deterioration);
- Inventory and condition of emergency and communications equipment (all should be available, stocked, and functioning);

- Conditions of any tanks used on-site for fuel or other material storage;
- Conditions of existing fences, locks, gates, and signs (i.e., note any missing items, damage, or signs of tampering);
- Flood wall conditions;
- Maintenance that has been completed;
- Maintenance that is currently being performed; and
- Maintenance items that need to be accomplished in the future

The FOP access road will be inspected and maintained so that routine inspections can be performed. Any potholes, washouts, or excessive “washboarding” of the road will be repaired and the road will be graded, as needed.

6.1.2 Final Cover

The final cover and any temporary cover will be inspected by walking the RCA to confirm positive drainage from the cover to the perimeter drainage features and assess the condition of the cover. Any subsidence that significantly alters drainage from the cover will be corrected. Any areas that allow water to pond on the cover will be backfilled and revegetated. The inspector will look for evidence of erosion, subsidence, ponded water, animal burrows, cracks along the cover, and loss of soil. Any excessive erosion will be identified and corrected. Erosion over large areas will be backfilled and revegetated. The following should be noted on the inspection form:

- Rills, gullies and crevices 6 inches or deeper in the vegetative soil layer
- Cover settling or subsidence that affects surface water runoff
- Reworked surfaces and areas with sparse or eroded vegetation in excess of 100 square feet cumulatively
- Brush, trees or similar invasive vegetation with tap roots growing in areas not designated for this type of vegetation
- Evidence of burrowing or other cover disturbance by burrowing animals
- Effectiveness of storm water drainage features

The vegetative surface will be mowed after initial establishment of the planted species. Mowing is assumed to occur twice a year. Any areas with rills and gullies greater than 6 inches in depth will be filled with soil and the vegetation re-established. Settlement, subsidence, or displacement of the RCA will be corrected. Temporary erosion and sediment control measures will be employed on steep slopes to enhance restoration of the restored surfaces.

6.2 Post-Closure Inspections, Maintenance and Monitoring

Post-closure inspections, maintenance and monitoring are included in the Final Closure Plan to which this document is an appendix.

7.0 EQUIPMENT

The following section describes the general types of equipment to be used at the RCA, the functions this equipment performs and equipment maintenance requirements. All equipment and tools used in the performance of the work are subject to the approval of the Construction Manager before work is started.

7.1 Heavy Equipment

Heavy equipment available for day-to-day operations of the disposal area may consist of bulldozer, earth moving equipment, waste or soil compactors (as needed), drum rollers, and a water truck, as well as other equipment as needed. When major repairs to heavy equipment are needed, the landfill operator or contractors will make additional equipment of similar size and function available. All heavy equipment shall be fitted with fully enclosed cabs while operating over exposed waste.

7.2 Support Equipment

In addition to the required heavy equipment, miscellaneous pickups, and/or other light utility vehicles, as well as various portable water pumps, instruments, and safety and training equipment will be on-site as necessary. Pickup trucks shall be used to haul landfill personnel within the FOP to conduct site duties. A portable pump shall be used for pumping stormwater from excavations and from ponded areas, as needed.

CAMU support equipment includes mobile and portable equipment used in operating and maintaining the RCA. The support equipment may include

- Trucks (dump, pickup, all-terrain, etc.);
- Portable pumps;
- Portable generator;
- Portable air compressor;
- Temporary light fixtures;
- Roll off containers;
- Tankers;
- Fuel storage tank;
- CQA/testing equipment; and
- Health and safety equipment.

7.3 Stationary Operating Equipment and Tools

Stationary operating equipment will include the equipment installed at the RCA during construction, such as

- Contact storm water storage and treatment tanks (if needed);

- Emergency power generating equipment;
- Piping; and
- Water hoses.

Emergency equipment is discussed in the Contingency Plan included as Appendix J to the Final Closure Plan.

7.4 Equipment Maintenance Requirements

Maintenance is necessary to keep equipment in a condition that assures continuous proper operation of the assigned functions. Maintenance can be divided into three basic categories:

- Preventive Maintenance – routine work that can be accomplished with minimal or no downtime of equipment. These tasks include routine inspections, lubrication, and adjustments.
- Corrective Maintenance – the non-routine repair work that may require some equipment downtime. These tasks include changing belts and replacing work bearings and brushes, etc.
- Major Overhauls – large jobs that usually require extensive downtime. These tasks can involve considerable expenditures of money and may require additional labor.

The heavy equipment maintenance program can be divided into two major categories:

- Equipment maintenance and repair to be performed by the heavy equipment suppliers; and
- Maintenance activities to be performed by RCA operator and/or maintenance personnel.

Maintenance must also be performed on the support and stationary equipment. The frequency and extent of maintenance will be as recommended by the manufacturer.

Each piece of mechanical equipment on the FOP, from personal exposure meters to heavy equipment, will be inspected routinely. All emergency equipment will be regularly inspected to assure that it is present, functional and decontaminated. Whenever a problem is discovered with equipment necessary for safe RCA operations, operations will be curtailed until a satisfactory repair or replacement can be put in place.

8.0 PERSONNEL AND TRAINING

The Site personnel will include at a minimum, a Site manager and/or supervisor (Exide representative or designated Contractor Construction Manager), equipment operators and laborers.

8.1 Personnel

8.1.1 Site Manager

The Site Manager (SM) will be responsible for all activities at the FOP and will be the designated contact person for regulatory compliance matters. The SM or his designated alternate will provide on-site management of the Facility operations and will be responsible for day-to-day operations with applicable regulatory requirements and this O&M Plan. The SM or designated alternate will provide adequate staffing to operate the facility in accordance with applicable regulatory requirements and this O&M Plan. The SM or his designated alternate will be responsible for inspection and/or maintenance of all equipment and operating systems required for the RCA operations and closure activities.

The SM or designated alternate must be an experienced personnel manager, who is familiar with and has the aptitude to implement operational aspects of waste disposal operations including knowledge of relevant regulations and permit requirements, and safe management practices.

Direct operation and maintenance activities, as described throughout this report, are the responsibility of the SM. The major responsibilities of the SM during operation of the RCA include the following:

- Operate and coordinate all disposal of waste into the RCA;
- Ensure that all applicable health and safety protocols are followed in accordance with the approved plan;
- Ensure that all personnel are properly trained for RCA operations;
- Maintain records of methods of placement within the RCA;
- Ensure waste is placed in accordance with procedures described in this O&M Plan;
- Divert storm water away from waste material within the RCA to the extent practical and appropriately manage contact stormwater;
- Maintain records of applicable inspections outlined in this O&M Plan;
- Perform any corrective measures required as a result of these inspections;
- Perform routine maintenance on equipment;
- Attain all required record survey information;
- Control potential traffic congestion at the RCA; and
- Maintain site dust and erosion control throughout the duration of RCA operations.

8.1.2 *Equipment Operators*

Equipment operators will operate vehicles and heavy equipment associated with RCA operations and closure in a safe manner to achieve functions necessary for operation and closure of the Facility. Duties may include spreading waste and final cover materials, maintaining access roads, establishing and maintaining stormwater drainage, and placement of soils.

8.1.3 *Laborers*

Site laborers will have responsibilities as directed by the SM or the designated alternate. These duties may include dust control, inspection and maintenance of gates, perimeter fencing, and other duties as necessary.

8.2 Personnel Training

The SM will be responsible for training operators and laborers on the requirements of this O&M Plan, the Contingency Plan, and other items as needed. Documentation of on-site training will be maintained.

Personnel are trained on

- Procedures for using, inspecting, repairing, and replacing facility emergency and monitoring equipment,
- Key parameters for waste feed (i.e., waste hauling vehicles) cut-off systems,
- Communications or alarm systems,
- Response to fires or explosions,
- Response to groundwater contamination incidents, and
- Shutdown of operations procedures.

Personnel are fully trained on all relevant O&M and safety procedures within six months after the date of their employment or appointment to a new position. Personnel who have not yet been fully trained do not work in unsupervised positions until they have received all necessary training. Exide maintains records at the facility which include each employee’s name, job description, the amount of both introductory and continuing training necessary for the position, and the current status of the employee’s training.

The training program covering the RCA’s O&M and safety procedures is reviewed annually. All RCA personnel are required to participate in the review. Documentation of on-site training will be maintained at the FOP.

8.3 Worker Safety Programs

Operations at the RCA will comply with the health and safety procedures established by the contractor’s site-specific Health and Safety Plan. Each contractor will be responsible for developing a site-specific health and safety plan in accordance with Exide internal requirements as well as applicable regulatory requirements. Exide will use appropriately trained personnel to operate and maintain the RCA. Each contractor will be responsible for providing required health and safety training to their personnel and providing appropriate documentation to Exide. All contractors working at the Site will also attend a health and safety orientation provided by an Exide representative prior to beginning work at the Site.

APPENDIX A
INSPECTION AND MAINTENANCE FORMS

INSPECTION FORM
EXIDE TECHNOLOGIES RCA

Date:________________ Type of Inspection (Storm, Monthly, Quarterly or Semi-Annual):_______________________

Inspector(s):____

Signature(s):____

Instructions: For any items that require maintenance, submit this form and notify the Exide representative of any recommended actions. Schedule remedial actions complete the **REPAIR REPORT FORM** when complete.

Facility Component	**Inspection Item**	**Inspection Frequency**				**Condition**		**Notes or Recommended Repairs**
		Storm	**Monthly**	**Quarterly**	**Semi-Annually**	**Acceptable**	**Maintenance Needed**	
RCA Final Cover	Access road conditions							
	Surface erosion, rills, gullies, and crevasses; minor cover settling or subsidence							
	Major cover settlement							
	Water on unit surface							
	Sparse or eroded vegetation							

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Facility Component	Inspection Item	Inspection Frequency				Condition		Notes or Recommended Repairs
		Storm	Monthly	Quarterly	Semi-Annually	Acceptable	Maintenance Needed	
	Invasive vegetation							
	Cover disturbance by burrowing animals							
	Grass							
RCA Surface Water Management	Ditches							
	Storm Water Pond							
	Erosion and sediment control devices							
	Culverts and conveyance pipes							
	Grass							
	Surface water drainage							
RCA Flood Wall	Flood wall waterstop and joint filters							

Facility Component	Inspection Item	Inspection Frequency				Condition		Notes or Recommended Repairs
		Storm	Monthly	Quarterly	Semi-Annually	Acceptable	Maintenance Needed	
	Seepage, settlement, sand boils, saturated soil areas, cracks, or other damage to flood wall							
	Vegetation (no trees or high vegetation along flood wall)							
	No trash or debris accumulation along flood wall							
	No bank erosion/caving observed that would endanger wall stability							
Groundwater Monitoring System	Protective casing							
	Locks							
	Ground surface seal							
	Accumulation of surface water							
	Concrete pad and bollards							
General Facility Components	Fences							

Facility Component	Inspection Item	Inspection Frequency				Condition		Notes or Recommended Repairs
		Storm	Monthly	Quarterly	Semi-Annually	Acceptable	Maintenance Needed	
	Locks							
	Gates							
	Signs							
	Access Roads							
	Surveyed Benchmarks							
	Safety and Emergency Equipment							

REPAIR REPORT FORM
EXIDE TECHNOLOGIES FRISCO RECYCLING CENTER

Inspector(s):____

Signature(s):____

Instructions: Note the problem(s) identified during the inspection, date the problem(s) was identified, actions performed to address the problem(s), date the problem(s) was addressed, and date the problem(s) was fully addressed.

Deficiency	Date Identified	Action Taken	Date Addressed	Date Completed

Golder Associates

Established in 1960, Golder Associates is a global, employee-owned organization that helps clients find sustainable solutions to the challenges of finite resources, energy and water supply and management, waste management, urbanization, and climate change. We provide a wide range of independent consulting, design, and construction services in our specialist areas of earth, environment, and energy. By building strong relationships and meeting the needs of clients, our people have created one of the most trusted professional services organizations in the world.

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