Initial Safety Factor Assessment
Jeffrey Energy Center
Inactive Bottom Ash Pond

Prepared for:

Westar Energy

Jeffrey Energy Center

St. Marys, Kansas

Prepared by:

APTIM Environmental & Infrastructure, Inc.

April 2018

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Plan Review/Amendment Log §257.73(e)

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CCR Regulatory Requirements

USEPA CCR Rule Criteria 40 CFR 257.73	Jeffrey Energy Center (JEC) Safety Factor Assessment
§257.73(e)(1)(i-iv) stipulates: *(e) Periodic safety factor assessments. (1) The owner or operator must conduct an initial and periodic safety factor assessments for each CCR unit and document whether the calculated factors of safety for each CCR unit achieve the minimum safety factors specified in paragraphs (e)(1)(i) through (iv) of this section for the critical cross section of the embankment. The critical cross section is the cross section anticipated to be the most susceptible of all cross sections to structural failure based on appropriate engineering considerations, including loading conditions. The safety factor assessments must be supported by appropriate engineering calculations:* *(i) The calculated static factor of safety under long-term, maximum storage pool loading condition must equal or exceed 1.50;* *(ii) The calculated safety factor of safety under the maximum surcharge pool loading condition must equal or exceed 1.40;* *(iii)The calculated seismic factor of safety must equal or exceed 1.00;* *(iv) For dikes constructed of soils that have susceptibility to liquefaction, the calculated liquefaction factor of safety must equal or exceed 1.20;*	Section 4.0

USEPA CCR Rule Criteria 40 CFR 257.73	Jeffrey Energy Center (JEC) Safety Factor Assessment
§257.73(e)(2) stipulates: *(2) The owner or operator of the CCR unit must obtain a certification from a qualified professional engineer stating that the initial assessment and each subsequent periodic assessment specified in paragraph (e)(1) of this section meets the requirements of this section.*	Section 6.0
§257.73(f)(1) stipulates: *(f) Timeframes for periodic assessments –* *(1) Initial Assessments. Except as provided by paragraph (f)(2) of this section, the owner or operator of the CCR unit must complete the initial assessments required by paragraphs (a)(2), (d), and (e) of this section no later than October 17, 2016. The owner or operator has completed an initial assessment when the owner or operator has placed the assessment required by paragraphs (a)(2), (d), and (e) of this section in the facility's operating record as required by §257.105(f)(5), (10), (12).*	Not applicable. See §257.100
§257.73(f)(2) stipulates: *(2) Use of a previously completed assessment(s) in lieu of the initial assessment(s). The owner or operator of the CCR unit may elect to use a previously completed assessment ot serve as the initial assessment required by paragraphs (a)(2), (d), and (e) of this section provided that the previously completed assessments(s):* *(i) Was completed no earlier than 42 months prior to October 17, 2016; and* *(ii) Meets the applicable requirements of paragraphs (a)(2), (d) and (e) of this section.*	Not Applicable for this Report.

USEPA CCR Rule Criteria 40 CFR 257.73	Jeffrey Energy Center (JEC) Safety Factor Assessment
§257.73(f)(3) stipulates: *(3) Frequency for conducting periodic assessments. The owner or operator of the CCR unit must conduct and complete the assessments required by paragraphs (a)(2), (d), (e) of this section every five years. The date of completing the initial assessment is the basis for establishing the deadline to complete the first subsequent assessment. If the owner or operator elects to use a previously completed assessment(s) in lieu of the initial assessment as provided by paragraph (f)(2) of this section, the date of the report for the previously completed assessment is the basis for establishing the deadline to complete the first subsequent assessment. The owner or operator may complete any required assessment prior to the deadline provided the owner or operator places the completed assessment(s) into the facility's operating record within a reasonable amount of time. In all cases, the deadline for completing subsequent assessments is based on the date of completing the previous assessment. For purposes of this paragraph (f)(3), the owner or operator has completed an assessment when the relevant assessment(s) required by paragraphs (a)(2), (d), and (e) of this section has been placed in the facility's operating record as required by §257.105(f)(5), (10), and (12).*	An assessment will be completed every five years and placed into the operating record.
§257.73 (g) stipulates: *(g) The owner or operator of the CCR unit must comply with the recordkeeping requirements specified in §257.105(f), the notification requirements specified in §257.106(f), and the internet requirements specified in §257.107(f).*	Section 5.0

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USEPA CCR Rule Criteria 40 CFR 257.73	Jeffrey Energy Center (JEC) Safety Factor Assessment
§257.100 stipulates (a): *(a) Inactive CCR surface impoundments are subject to all of the requirements of this subpart applicable to existing CCR surface impoundments.*	Section 5.0
§257.100 stipulates (e)(1): *(e) Timeframes for certain inactive CCR surface impoundments. (1) An inactive CCR surface impoundment for which the owner or operator has completed the actions by the deadlines specified in paragraphs (e)(1)(i) through (iii) of this section is eligible for the alternative timeframes specified in paragraphs (e)(2) through (6) of this section. The owner or operator of the CCR unit must comply with the applicable recordkeeping, notification, and internet requirements associated with these provisions. For the inactive CCR surface impoundment:* *(i) The owner or operator must have prepared and placed in the facility's operating record by December 17, 2015, a notification of intent to initiate closure of the inactive CCR surface impoundment pursuant to §257.105(i)(1);* *(ii) The owner or operator must have provided notification to the State Director and/or appropriate Tribal authority by January 19, 2016, of the intent to initiate closure of the inactive CCR surface impoundment pursuant to §257.106(i)(1); and* *(iii) The owner or operator must have placed on its CCR Web site by January 19, 2016, the notification of intent to initiate closure of the inactive CCR surface impoundment pursuant to §257.107(i)(1).*	Section 5.0

USEPA CCR Rule Criteria 40 CFR 257.73	Jeffrey Energy Center (JEC) Safety Factor Assessment
§257.100(e)(3) stipulates: (e)(3) Design criteria. The owner or operator of the inactive CCR surface impoundment must: (v) No later than April 17, 2018, complete the initial hazard potential classification, structural stability, and safety factor assessments as set forth by §257.73(a)(2), (b), (d), (e), and (f).	Report completed by April 17, 2018.

1.0 INTRODUCTION

APTIM Environmental and Infrastructure, Inc. (APTIM, f/k/a CB&I Environmental & Infrastructure, Inc., CB&I) has prepared this initial safety factor assessment (Assessment) at the request of Westar Energy (Westar) for the inactive Bottom Ash Pond (Pond) located at Jeffrey Energy Center (JEC) in St. Marys, Kansas. JEC is a coal-fired power plant that has been in operation since 1980.

On July 26, 2016 the United States Environmental Protection Agency (USEPA) extended the requirements of the Disposal of Coal Combustion Residuals from Electric Utilities Final Rule (CCR Rule) 40 CFR §257 and §261, for certain inactive CCR surface impoundments. The Pond has been determined to be inactive by 40 CFR §257.53 and therefore has been deemed to be a regulated, inactive CCR unit by the USEPA through the CCR Rule. Westar is currently in the process of closing the Pond in-place in accordance with §257.100(d) of the CCR Rule and intends to complete closure of the Pond in 2018.

In support of compliance with the CCR Rule, APTIM has conducted an Assessment of the Pond and reviewed the relevant portions of the facility's operating record, permit application, and previous stability analyses and inspections. This Assessment meets the requirements set forth within 40 CFR §257.73(e) and §257.100(a) and (e) based on the review of available information and visual observation.

2.0 POND OVERVIEW

Westar owns and operates all waste management units at JEC in St. Marys, Pottawatomie County, Kansas. JEC is located approximately 4.5 miles north of Belvue, Kansas and approximately 4.3 miles west of Highway 63 and resides in Sections 1, 2, 11, and 12, Township 9 South, Range 11 East and Sections 6 and 7, Township 9 South, Range 12 East. At JEC the Pond is located southeast of Fly Ash Area 1, north of the FGD Landfill, west of Bottom Ash Area 1, and east of the Tower Hill Lake. The location of the Pond is depicted in **Figure 1**.

2.1 Design and Construction History

2.1.1 Original Design

A Type C fly ash berm and overflow was constructed in the early 1990's by JEC plant staff to separate the Pond and Tower Hill Lake. The fly ash was deposited in lifts of approximately 9 to 15-inches, processed to a desired moisture content, and compacted. The embankment foundation and abutment materials primarily consists of the native underlying geologic materials. The Pond was not constructed with an engineered pond liner system. There are no drawings or documents available for review for the original design/construction of the berm.

2.1.2 Design Modifications

In 2000 the berm was expanded by raising the embankment to its current elevation to provide for additional CCR material storage volume and to add an emergency spillway and instrumentation devices. These modifications were designed by Black & Veatch and were approved and stamped by the Kansas Department of Agriculture, Department of Water Resources (KSDWR) Chief Engineer on June 29, 2000. With the modifications, the berm became a permitted dam (Pond Dam) under permit DPT-0160.

2.1.3 Pond Closure

The Pond has not received CCR material prior to October 2015 and is in the process of being dewatered for closure. Historically the Pond received CCR material from the plant, stormwater, decant water from Bottom Ash Area 1, and site runoff. The final cover design and construction of the Pond will meet 40 CFR §257.100(b)(3)(i) and (ii).

2.2 Current Dimensions and Capacities

The following dimensions of the Pond, Pond Dam, and spillway structures were determined based on the most recent survey of the Pond, estimates from the Coal Ash Impoundment – Specific Site Assessment Report conducted in September 2009 by GEI Consultants, Inc. (GEI), and the Jeffrey Energy Center - CCR Impoundment Closure Design 100% Design submitted in February 2017:

- ❑ Pond
    - Surface area of 72.1 acres
    - Normal operating pool water level of 1,164 feet mean seal level (ft MSL)
    - Maximum water level elevation of 1,165 ft MSL, based on the spillway crest design elevation
    - Minimum elevation in Pond is 1,160 ft MSL based on 2016 survey

    - Maximum water depth of approximately 5 feet (at the deepest portion of the Pond at maximum water elevations)
- Pond Dam
    - 1,050-feet long
    - 30-foot wide crest
    - 3H:1V sideslopes
    - Crest elevation of 1,170 ft MSL
- Spillway Structures
    - South Outlet Structure
        - Open-channel spillway
        - 450-feet long
        - 40-feet wide
        - 3H:1V sideslopes
        - Rock control crest at 1,165 ft MSL
        - Upstream side lined with 1.5-foot thick layer of limestone riprap
    - North Outlet Structure
        - Concrete-lined box culvert
        - 271-feet long
        - 12-feet wide
        - 6-feet tall
        - Downstream side lined with riprap

The Pond is currently undergoing closure and has been dewatered. Historically, the typical impounded water volume within the Pond was determined to be approximately 62,680 cubic yards (cy), as described in the 2017 Annual Inspection Report. The CCR depths within the Pond have varied through time due to the continual deposit and discharge of water and CCR materials, and whether the fines have settled out in the alluvial fan/ravine (elevation higher than 1,164 ft MSL). The remaining CCR material storage capacity within the Pond was calculated in the 2017 Annual Inspection Report and was determined to be approximately 138,232 cy. The total CCR volume is unknown due to a range of ash material sources historically being routed to the Pond. Site topography prior to closure is depicted in **Figure 2**.

2.3 Instrumentation

As part of the 1999 Pond Dam Study, five borings (WR-1 through WR-5) were drilled along the crest of the Pond Dam and three piezometers (at WR-2, -3, -4) were installed.

Currently the Pond Dam has a standpipe piezometer (WR-3) which is located on the eastern edge of the spillway. This is used to monitor the water level within the Pond Dam and is sampled every 30 days per the CCR Rule. Potentiometric elevations within this piezometer generally shows the upper water surface to be located near the water elevation of the pond.

3.0 REVIEW OF PREVIOUS INVESTIGATIONS/INSPECTIONS

The available information for the Pond was provided to and reviewed by APTIM for this Assessment:

- Annual Inspection Report Jeffrey Energy Center Inactive Bottom Ash Pond, CB&I Environmental & Infrastructure, Inc., June 2017.
- Coal Ash Impoundment – Specific Site Assessment Report, GEI Consultants, Inc., September 2009.
- Fines Containment Dam-Stability Report, Black & Veatch, April 14, 1999.
- JEC Survey, Professional Engineering Consultants (PEC), April 2016.
- NPDES Permit No. I-KS67-PO06.
- Volume I and II of the Industrial Landfill Permit No. 0359, August 2009.

Based on our review of the information and observations during the inspection conducted on May 16, 2017, the following Assessment has been conducted in accordance with 40 CFR §257.73(e).

3.1 Summary of Previous Assessment

A stability assessment was conducted in 1999 by Black & Veatch in order to secure Dam Permit DPT-0160. The stability assessment evaluated if the structure was capable of containing water and CCR material. The analysis included a visual inspection and a model using SLOPE/W Version 3, by GEO-SLOPE International.

3.1.1 Visual Inspection

A site visit was conducted prior to modeling. Based on the recorded visual observations, it was determined there were no signs of structural deficiencies on the Pond Dam. This includes cracking along the crest and embankments, seepage of water from the downstream face, severe erosional features, and distress in and around piping. Visual observations confirmed that the downstream toe materials are being broken down by wave action from Tower Hill Lake.

3.1.2 Geotechnical Site Assessment

A subsurface investigation was conducted as part of the 1999 stability assessment of the Pond Dam by Black & Veatch. This included drilling five borings (WR-1 through WR-5) along the crest of the Pond Dam and installing three piezometers in WR-2, -3, and -4. The depths of borings WR-1 through WR-5 range from 41.5 to 80.0 feet.

From the borings it was determined that the main components of the Pond Dam consist of compacted fly ash, foundation soils, and bedrock. The profiles created from the borings demonstrate that the Pond Dam is founded on weathered bedrock at the abutments (WR-1 and -5) with soil under the main Dam section. The foundation soils under the main portion of the dam include an upper layer comprised of a soft alluvial clay with variable amounts of sands and silts and a low density and strength. The second layer is a stiff clay and silty clay till with a variable thickness. The abutments were founded directly on bedrock which is Neva Limestone. From the borings it was determined the ash lift thicknesses of the Pond Dam were between 9 and 15 inches with the maximum Pond Dam thickness varying between 25 and 28 feet. Lab testing on the borings determined that the upper portions of the Pond Dam were of high compressive strength and the lower 3 to 8 feet of the embankment exhibited properties more consistent with a stiff or hard soil.

Piezometers were installed at Borings WR-2, -3, and -4. Piezometer WR-3 was screened within the Pond Dam and WR-2 and 4 were screened below the fly ash in the natural soils. The water level at WR-3 is 1158.1 feet, WR-4 is 1156.5 feet and WR-2 is 1153.1 feet.

3.1.3 Stability Assessment Model

The cross section used in the Black & Veatch model was based on the profile of the Pond Dam from Boring WR-3 in 1999. The model was analyzed for normal pool elevation and maximum flood stage pool elevation. The upstream water surface in the normal pool elevation scenario was raised from the existing elevation (1,158 ft MSL) to 1,163 ft MSL in order to account for the estimated maximum height of fines storage (i.e. 5 feet). The maximum flood stage pool scenario assumed the upstream water level rises to the height of the emergency spillway. The phreatic surface was assumed to be linear connection between the upstream and downstream elevations.

The normal pool scenario was analyzed using a slip circle and sliding block modes of failure, and the maximum flood stage pool scenario was analyzed for sliding block failure. Both scenarios were analyzed in static and seismic conditions. A seismic acceleration of 0.05g was applied based on the USGS ground motion applicable to low hazard dams in Pottawattamie County.

The material and strength properties used in the analysis were based on lab results from the material samples obtained from the borings. Testing included Atterberg limits, moisture content, dry density, grain size analysis, hydrometer, unconfined compression, and unconsolidated-undrained triaxial compression tests.

The required factors of safety were determined to be 1.5 and 1.1 for static and seismic conditions, respectively. The computed factors of safety computed for the normal pool elevation scenario ranged from 1.35 to 2.45 and or the maximum flood stage pool elevation scenario ranged from 1.17 to 1.81. Therefore, the calculated factors of safety were determined to meet the required factors of safety of 1.1 and 1.5. It was concluded from this assessment that the Pond Dam, was capable of performing its intended function of trapping ash fines sluiced into the facility from JEC. It was recommended that downstream slope protection be added to prevent erosion due to wave action, and that the Pond Dam be put on periodic inspection program.

3.2 Summary of Previous Visual Inspection Reports

In addition to the visual inspection conducted by Black & Veatch in 1999 for the stability assessment, the 2009 annual inspection conducted by GEI and 2017 annual inspection conducted by APTIM were reviewed.

3.2.1 2009 Annual Inspection

GEI conducted a site visit on May 19, 2009 with KDHE being present. They walked the dam crest, upstream and downstream slopes, and the spillway. There were no recorded signs of settlement, displacement, adverse seepage, leakage, cracking, uplift, or deterioration that would affect the stability of the Pond Dam. The upstream slope was protected by riprap and was in good condition with no signs of vegetation. The downstream slope was in good condition with no signs of slumping or instability. The only recorded issues during the field assessment were:

- Several locations on the downstream slope of the Pond Dam that showed signs of surface erosion (i.e. small erosion rills).

The spillway was in good condition with riprap running the entire length. It was recommended that if the erosion of the downstream slope of the Pond Dam continue that the slope be repaired and riprap slope protection installed.

3.2.2 2017 Annual Inspection

An inspection of the Pond was completed by APTIM personnel on May 16, 2017. During the 2017 annual inspection, slope appearance, slope stability, and overall site conditions were assessed. No erosion or sloughing was observed along the Surface Impoundment perimeter berm. At the time of inspection, stormwater conveyance systems such as the Pond stormwater drainage channels and the Pond Dam spillway were operating as designed. It was noted that erosion rills were observed on the Pond Dam's western side (downstream slope), which separates the Pond from Tower Hill Lake. This was consistent with the findings of the 2009 inspection. Photographs 12 through 15 in **Appendix A** depict the observed erosion rills on the downstream slope of the Pond Dam. Recommendations were provided to repair these rills and install rip-rap slope protection. The rills are intended to be repaired during the construction of the cap that is currently being completed. It was anticipated that the rills will be repaired as part of the final stages of construction of the cap and that the Pond Dam will remain stable until that moment. Once capping commences, the rills should be filled and regraded to remove preferential pathways for stormwater. After grading, rip-rap will be placed to minimize the potential for future erosion.

At the time of inspection, stormwater conveyance systems such as the Pond stormwater drainage channels and the Pond Dam spillway were operating as designed with no observed deficiencies. Photographs 3 through 5 in **Appendix A**, depict the spillway's location with discharge appropriately moving from the Pond to Tower Hill Lake. No signs of erosion or malfunction were detected in these features.

4.0 INITIAL SAFETY FACTOR ASSESSMENT (§257.73(e))

An initial and periodic safety factor assessment is required to be conducted for CCR impoundments per §257.73(e)(1). This includes determining if the factor of safety for a critical cross section of the Pond Dam is greater than the required factor of safety for each of the four loading conditions shown in **Table 1** below.

Table 1
Initial Safety Factor Assessment Requirements

Analysis	Required Minimum Factor of Safety (§257.73(e))
Long-term, maximum storage pool loading	≥1.50
Maximum surcharge pool loading	≥1.40
Seismic Loading	≥1.00
Soil Liquefaction[1]	≥1.20

Notes:
(1) Soil liquefaction must be analyzed for dikes constructed of soils susceptible to liquefaction

APTIM performed a safety factor analysis to ensure the stability of the Pond Dam during operating conditions (see **Table 1**). A critical cross section was developed and used to determine the minimum factor of safety for each scenario in SLIDE – 2D Limit Equilibrium Slope Stability Analysis (SLIDE), version 6.038, developed by Rocscience, Inc. See **Appendix B** for each model result and see Section 4.4 for the summary table.

4.1 Critical Cross-Section Location

Cross section A-A' is a schematic, critical cross-section which incorporates the section of the Pond Dam most susceptible to structural failure, as required by §257.73(e)(1). It conservatively captures the area with the highest potential for failure based on the embankment geometry, water levels, and subsurface soil conditions. The cross-section is based on the cross-section used in the 1999 stability assessment and updated with current elevations and conditions. The cross-section is characterized by the following features:

- Peak Pond Dam crest of 1,170 ft MSL;
- Pond Dam side slopes of 3H:1V;
- Downstream toe elevation of 1123 ft MSL; and
- Upstream toe elevation of 1160 ft MSL.

See **Figure 4** for the approximate cross-section location.

4.2 Layer Properties

APTIM reviewed the material and strength properties for the Pond Dam system previously used in the 1999 B&V assessment. It was concluded that the values previously used were conservative and appropriately determined from lab data, therefore the same properties were used in this analysis. The property values can be seen in the summary **Table 2** below.

Table 2 SLIDE Model Material Properties			
Material Layer	**Unit Weight (pcf)**	**Cohesion (psf)**	**Friction Angle (degrees)**
Upstream Fines	85	50	10
Pond Dam (compacted fly ash)	112	2,000	5
Foundation Upper Layer (Soft Clay and Silt)	94	200	5
Foundation Lower Layer (Clay Till)	128	1,300	5

The settled out upstream fines were modeled having a unit weight of 85 pcf, a cohesion of 50 psf, and a friction angle of 10 degrees. These are typical values assigned to dredge material containment facilities and dams with large silt deposits on the upstream side. These deposits add additional load to the structures and have minimum strength properties. The compacted fly ash within the Pond Dam were modeled having a unit weight of 112 pounds per cubic foot (pcf), a cohesion of 2,000 pounds per square foot (psf), and a friction angle of 5 degrees. It should be noted that the strength properties were concluded by the lab results to be highly variable. The main portion of the embankment is founded on soil with the outer portions on weathered bedrock. The portions founded on soil is comprised of two layers: an upper layer of soft alluvial clay and a lower portion of stiff to very still clay till. The upper clay was modeled with a unit weight of 94 pcf, a cohesion of 200 psf, and a friction angle of 5 degrees. The lower clay was modeled with a unit weight of 128 pcf, a cohesion of 1,300 psf, and a friction angle of 5 degrees, as determined by the laboratory results. It should be noted the upper clay had highly variable strength properties. The minimum strength was determined to be 330 psf, which was reduced to 200 psf to be conservative.

4.3 Model Analyses

Safety factor analyses were performed using the critical cross-section and material properties previously described in the SLIDE software for the following modeled scenarios required by §257.73(e)(1):

- ❑ Long-term Maximum Storage Loading;
- ❑ Maximum Surcharge Loading;
- ❑ Seismic Conditions; and
- ❑ Drawdown conditions.

Even though the Pond is inactive and has not received CCR material since 2015, some scenarios were run under operating conditions to fulfill the CCR Rule Requirements.

The limit equilibrium analysis methods used in the SLIDE model analyses included the Bishop Simplified Method, the Janbu Corrected Method, the Spencer Method, and the GLE (Generalized Limit Equilibrium) / Morgenstern-Price Method. The lowest factor of safety from the four methods used is reported on the SLIDE plot for each modeled scenario (see **Appendix B**) and on the summary table in Section 4.4.4. Additional information regarding each scenario is described in the following subsections.

4.3.1 Long-Term Maximum Storage Loading

According to Section E.3.b.ii.b of the preamble in the CCR Rule, the maximum storage pool loading is “the maximum water level that can be maintained that will result in full development of a steady-state seepage condition.” As stated previously, the current spillway structure includes a rock control crest at 1,165 ft MSL, and therefore the long-term maximum storage pool loading surface elevation was modeled at this elevation. The water surface elevation for Tower Hill Lake was conservatively assumed to be 1142 ft MSL. A linear connection connecting the water surface in the Pond and Tower Hill Lake was used as the phreatic surface within the Pond Dam.

The minimum factor of safety determined by SLIDE for this scenario is 1.727, which is greater than the required factor of safety of 1.50 as stated in §257.73(e)(1)(i).

4.3.2 Maximum Surcharge Loading

The maximum surcharge pool loading condition is meant to ensure that the impoundment can withstand a temporary rise in the pool elevation above the maximum storage pool elevation under inflow design flood stage. Therefore this scenario was modeled with upstream water elevation during the 100-year flood event for the impoundment.

The Pond Dam has a spillway at 1,165 ft MSL and has been designed to pass a 100-year, 6-hour storm event while maintaining a minimum design freeboard of three feet, as required by the Kansas Department of Agriculture – Division of Water Resources. The spillway is capable of passing a flood that produces a reservoir peak inflow rate of 2,100 cfs which generates a maximum reservoir water surface elevation of 1,166.3 ft MSL. This leaves approximately 3.7 feet of freeboard available based on a Pond Dam crest elevation of 1,170 ft MSL. Based on this information, it was conservatively assumed that at least 3 feet of freeboard will be maintained under surge conditions. Therefore it was assumed the water surface in the Pond is 1,167 ft MSL.

The calculated static factor of safety is 1.738 for the Pond Dam and meets the requirement for the maximum surcharge pool condition (1.40), per §257.73(e)(1)(ii).

4.3.3 Seismic Loading

As discussed in the preamble of the CCR Rule, all CCR surface impoundments must also be capable of withstanding a design earthquake without damage to the foundation or embankment that would cause a discharge of its contents. Specifically, it must be assessed to withstand “a seismic loading event with a 2% probability of exceedance in 50 years, equivalent to a return period of approximately 2,500 years, based on the USGS seismic hazard maps for seismic events with this return period for the region where the CCR unit is located”. Therefore the long-term maximum loading scenario was analyzed under a peak ground acceleration of 0.0485 g. The seismic acceleration is based on the USGS seismic hazard map for a 2 percent probability of exceedance in 50 years (see **Figure 5**).

The calculated static factor of safety is 1.426 for the Pond Dam and meets the requirement for the seismic loading (1.0), per §257.73(e)(1)(iii).

4.3.4 Soil Liquefaction

Based on 40 CFR §257.73(e)(1)(iv), a soil liquefaction analysis must be conducted for dikes constructed of soils that have a susceptibility to liquefaction. Liquefaction of soils typically occurs in loose, saturated, sandy soils that undergo a loss of strength during a seismic event. The Pond Dam is constructed of compacted fly ash and the foundation soils are comprised of clayey or silty soils. These materials and soils are not typically susceptible to liquefaction and therefore a liquefaction analysis was not conducted.

4.3.5 Drawdown Conditions

40 CFR §257.73 does not require that drawdown conditions are modeled. However for CCR units with downstream slopes which can be inundated by the pool of an adjacent water body (i.e. Tower Hill Lake) it is required that the slopes that will maintain structural integrity in events of drawdown of the adjacent water body. Therefore, a drawdown scenario was created where the stabilizing force of the water from Tower Hill Lake is removed and the Pond is operating at maximum water level (1,165 ft MSL). The calculated static factor of safety is 1.664 for the Pond Dam, which is determined to be acceptable by industry standards.

4.4 Summary of Findings

Table 3 below summarizes the initial safety factor assessment results for the Pond Dam and confirms that the calculated factors of safety meet or exceed the required factors of safety by 40 CFR §257.73(e). All four cases were calculated for both circular and block slip surfaces.

The Pond is currently undergoing closure and is in the process of being dewatered and capped. During dewatering and closure conditions, the Pond will be empty and Tower Hill Lake will remain at normal operating conditions. The Pond is not required by the CCR Rule to be assessed during closure conditions.

Table 3
Initial Safety Factor Assessment Results

Analysis	Calculated Minimum Factor of Safety		Required Minimum Factor of Safety (§257.73(e))
	Circular	Block	
Long-term, maximum storage pool loading	1.897	1.727	≥1.50
Maximum surcharge pool loading	1.878	1.738	≥1.40
Seismic Loading	1.578	1.426	≥1.00
Soil Liquefaction	N/A[1]	N/A[1]	≥1.20
Drawdown Conditions	1.881	1.664	N/A[2]

Notes:
(1) Pond Dam is not constructed of soils that are susceptible to liquefaction (i.e. typically saturated granular soils).
(2) Analysis not required and therefore there is no minimum factor of safety that needs to be met, however it has been assumed that a factor of safety of 1.3 should be met based on industry standards.

5.0 RECORDS RETENTION AND MAINTENANCE (§257.100(g))

5.1 Incorporation of Assessment into Operating Record

§257.105(g) of 40 CFR Part 257 provides record keeping requirements to ensure that the Assessment must be placed in the facility's operating record. Specifically, §257.105(f) stipulates:

> §257.105(f) stipulates*: "(f) Design Criteria. The owner or operator of a CCR unit subject to this subpart must place the following information, as it becomes available, in the facility's operating record: (5)The initial and periodic hazard potential classification assessments as required by §§257.73(a)(2) and 257.74(a)(2)."*

This Assessment will be placed within the Facility Operating Record upon Westar's review and approval.

5.2 Notification Requirements

§257.106(f) of 40 CFR Part 257 provides guidelines for the notification of the availability of the initial and periodic Assessment. Specifically, §257.106(f) stipulates:

> §257.106(f) stipulates: "*(f) Design criteria. The owner or operator of a CCR unit subject to this subpart must notify the State Director and/or appropriate Tribal authority when information has been placed in the operating record and on the owner or operator's publicly accessible internet site. The owner or operator must: (4) Provide notification of the availability of the initial and periodic hazard potential classification assessments specified under §257.05(f)(5)"*

The State Director and appropriate Tribal Authority will be notified upon placement of this Assessment in the Facility Operating Record.

§257.107(f) of 40 CFR Part 257 provides publicly accessible Internet site requirements to ensure that the Assessment is accessible through the Westar webpage. Specifically, §257.107(f) stipulates:

> §257.107(f) stipulates: *"(f) Design criteria. The owner or operator of a CCR unit subject to this subpart must place the following information on the owner or operator's CCR Web site: (4) The initial and periodic hazard potential classification assessments specified under §257.105(f)(5)."*

This Assessment will be uploaded to Westar's CCR compliance reporting website upon Westar's review and approval.

6.0 PROFESSIONAL ENGINEER CERTIFICATION (§257.73(e)(2))

The undersigned registered professional engineer is familiar with the requirements of the CCR Rule and has visited and examined JEC or has supervised examination of JEC by appropriately qualified personnel. The undersigned registered professional engineer attests that this Assessment has been prepared in accordance with good engineering practice, including consideration of applicable industry standards and meets the requirements of §257.73 and §257.100. This certification was prepared as required by §257.73(e)(2).

Name of Professional Engineer: Richard Southorn

Company: APTIM

Signature: ______________________

Date: 04/16/18

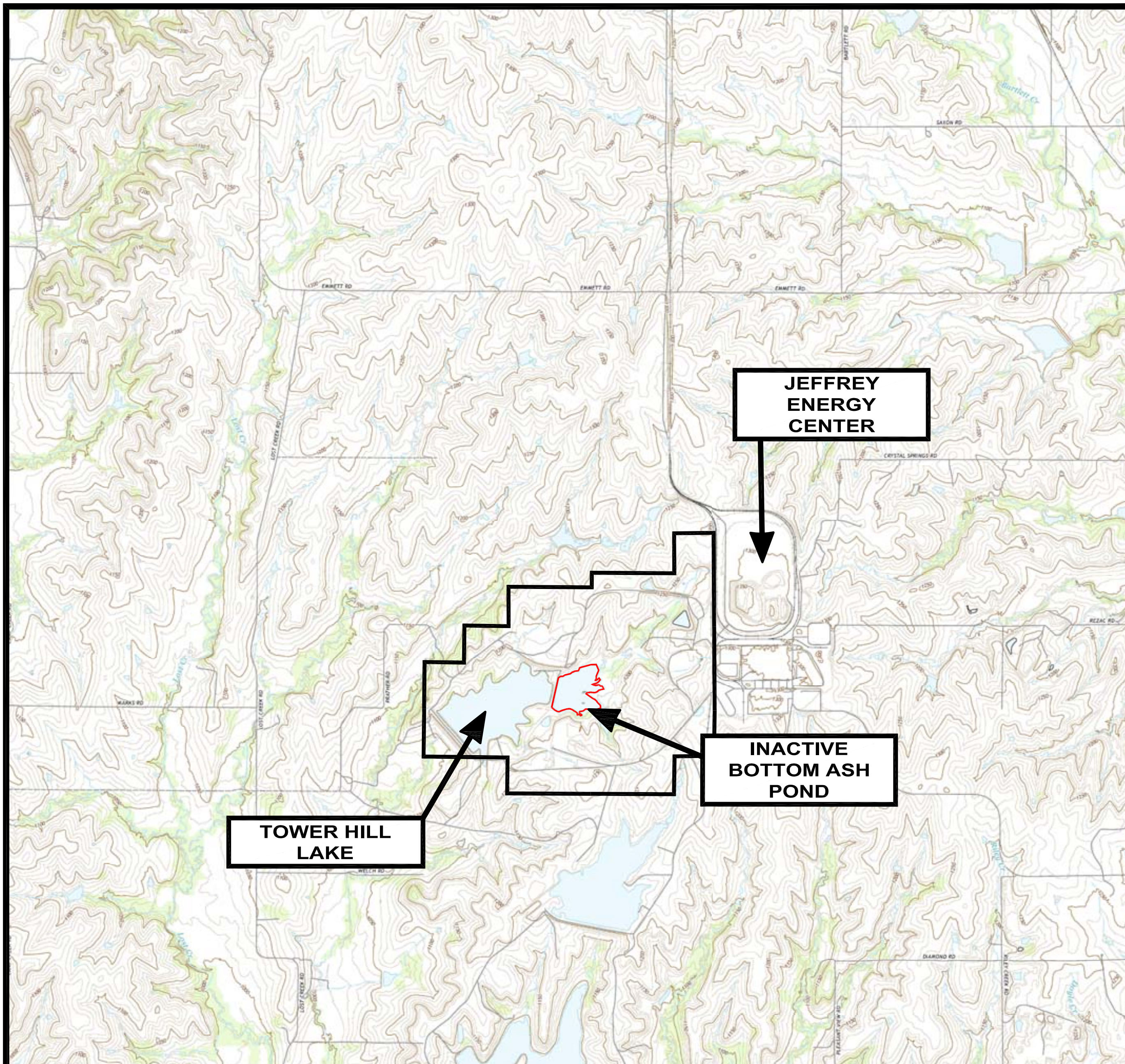
PE Registration State: Kansas

PE Registration Number: PE25201

Professional Engineer Seal:

FIGURES

APTIM



LEGEND

CCR UNIT BOUNDARY

KDHE-BWM INDUSTRIAL LANDFILL PERMIT NO. 0359 BOUNDARY

N

0 5000'

GRAPHIC SCALE

NOTES

1. AERIAL TOPO OBTAINED FROM USGS 7.5-MINUTE SERIES, EMMETT AND LACLEDE QUADRANGLE, KANSAS, 2014.
2. ALL BOUNDARIES ARE APPROXIMATE.

APTIM Environmental & Infrastructure, Inc.

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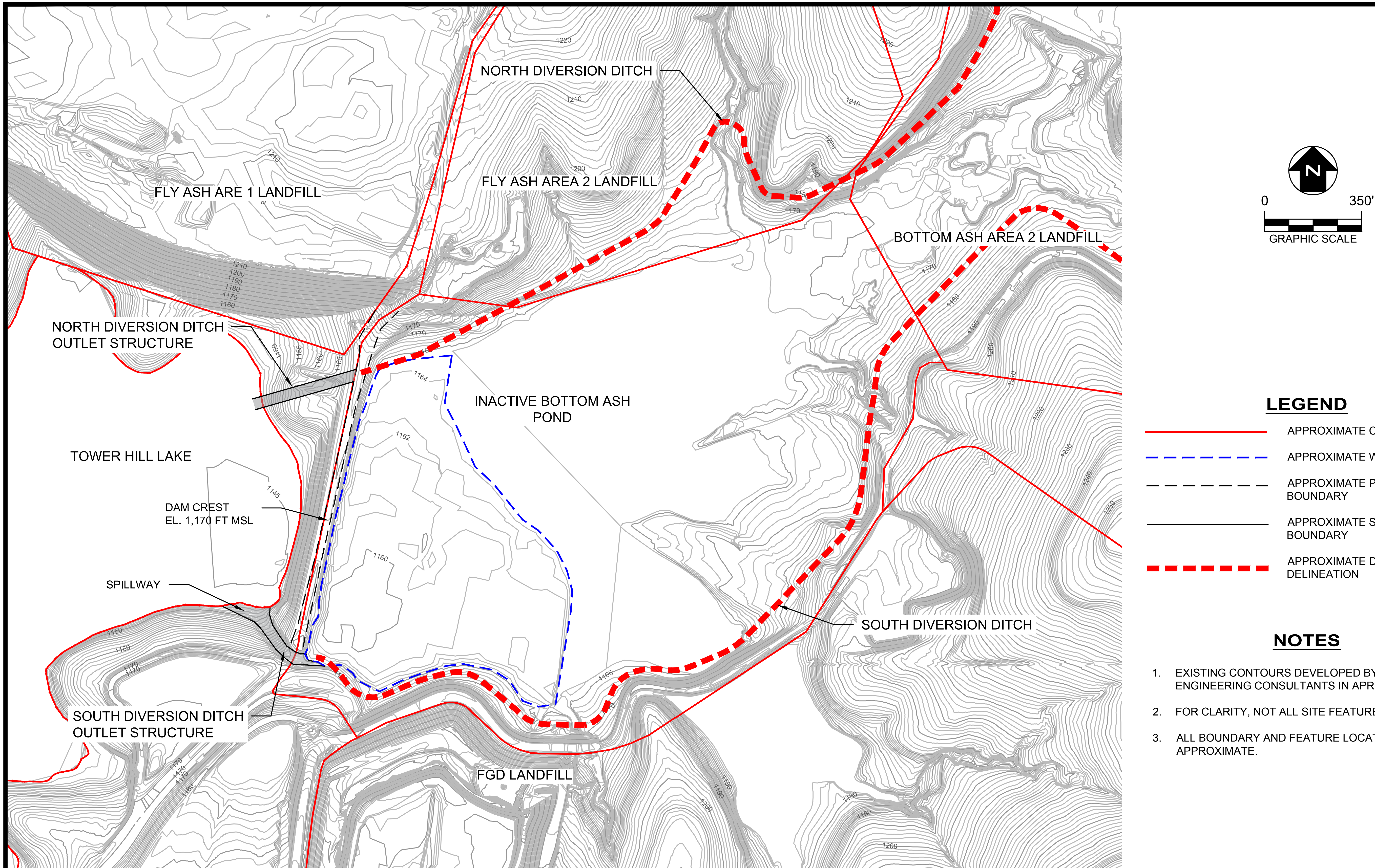
25905 JEFFREY RD., ST. MARYS, KS

FIGURE 1
FGD LANDFILL
SITE LOCATION PLAN

APPROVED BY:	RDS	PROJ. NO.:	631232565	DATE:	APRIL 2018



LEGEND

- APPROXIMATE CCR UNIT BOUNDARY
- APPROXIMATE WATER ELEVATION
- APPROXIMATE POND DAM BOUNDARY
- APPROXIMATE SPILLWAY BOUNDARY
- APPROXIMATE DIVERSION DITCH DELINEATION

NOTES

1. EXISTING CONTOURS DEVELOPED BY PROFESSIONAL ENGINEERING CONSULTANTS IN APRIL 2016.
2. FOR CLARITY, NOT ALL SITE FEATURES MAY BE SHOWN.
3. ALL BOUNDARY AND FEATURE LOCATIONS ARE APPROXIMATE.

REV. NO.	DATE	DESCRIPTION

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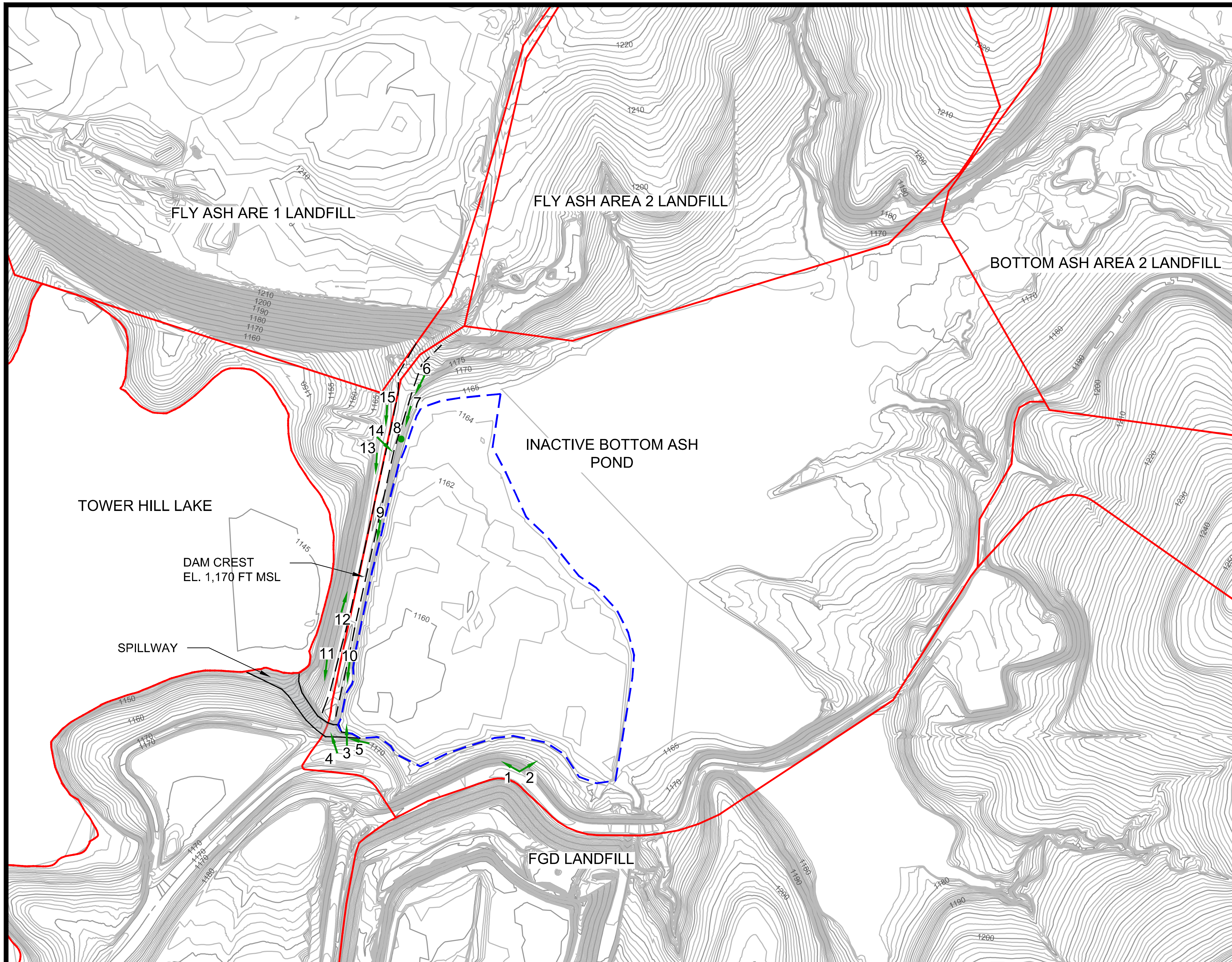
FIGURE 2
INACTIVE BOTTOM ASH POND
SITE TOPOGRAPHY PRIOR TO CLOSURE

DRAWN BY:	ORC	APPROVED BY:	MMS	PROJ. NO.:	631232565	DATE:	APRIL 2018

T:\AutoCAD\Projects\Westar Energy\Jeffrey\Compliance Reports\Inactive BAP\Inactive Bottom Ash Pond Figures 2 and 3.dwg, DWG To PDF.pc3



N

0 350'

GRAPHIC SCALE

LEGEND

- APPROXIMATE CCR UNIT BOUNDARY
- APPROXIMATE WATER ELEVATION
- APPROXIMATE POND DAM BOUNDARY
- APPROXIMATE SPILLWAY BOUNDARY

NOTES

1. EXISTING CONTOURS DEVELOPED BY PROFESSIONAL ENGINEERING CONSULTANTS IN APRIL 2016.
2. FOR CLARITY, NOT ALL SITE FEATURES MAY BE SHOWN.
3. ALL BOUNDARY AND FEATURE LOCATIONS ARE APPROXIMATE.

REV. NO.	DATE	DESCRIPTION

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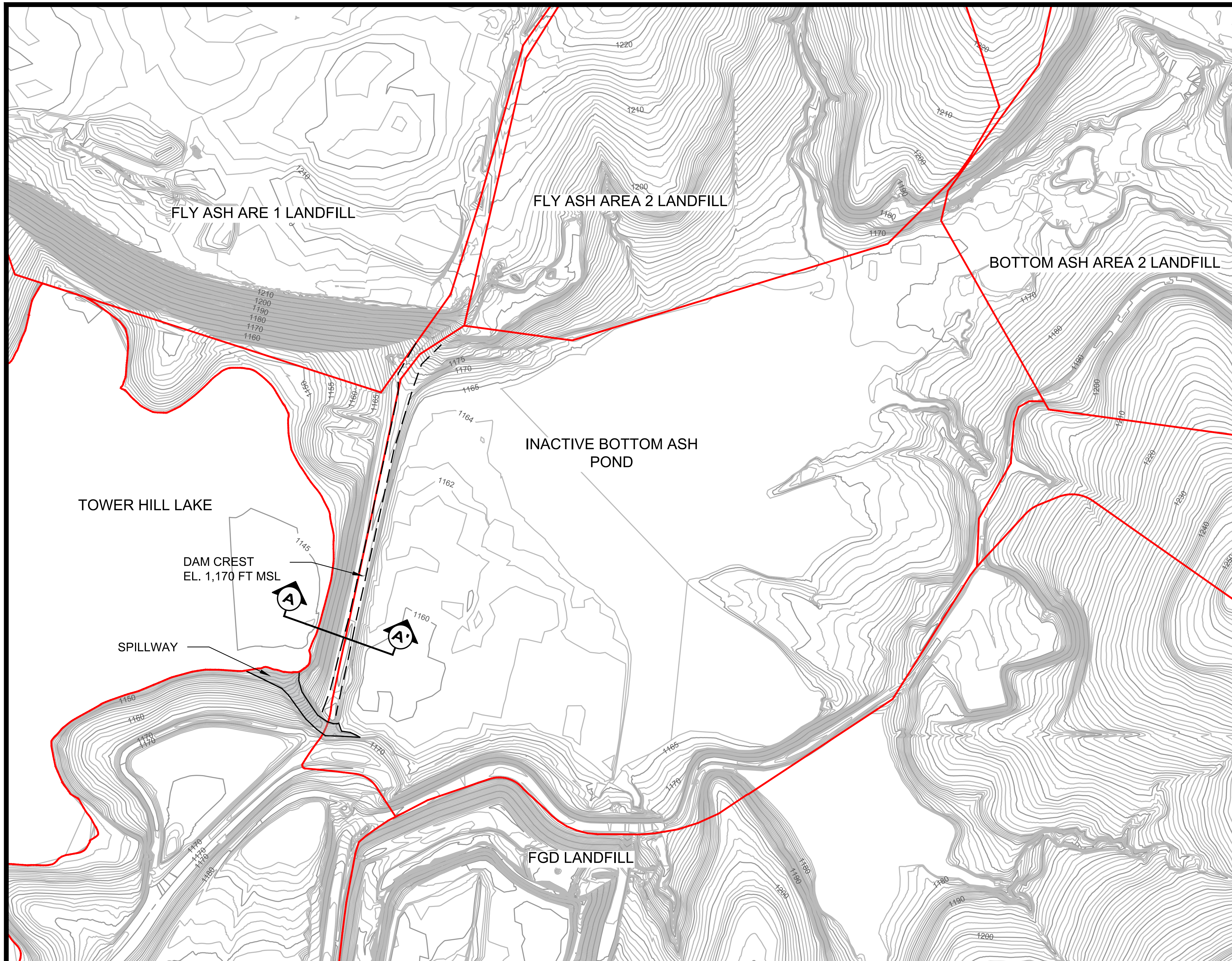
FIGURE 3
INACTIVE BOTTOM ASH POND
PHOTO LOG

DRAWN BY: ORC	APPROVED BY: MMS	PROJ. NO.: 631232565	DATE: APRIL 2018



LEGEND

- APPROXIMATE CCR UNIT BOUNDARY
- APPROXIMATE POND DAM BOUNDARY
- APPROXIMATE SPILLWAY BOUNDARY

NOTES

1. EXISTING CONTOURS DEVELOPED BY PROFESSIONAL ENGINEERING CONSULTANTS IN APRIL 2016.
2. FOR CLARITY, NOT ALL SITE FEATURES MAY BE SHOWN.
3. ALL BOUNDARY AND FEATURE LOCATIONS ARE APPROXIMATE.

REV. NO.	DATE	DESCRIPTION

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FIGURE 4
INACTIVE BOTTOM ASH POND
APPROXIMATE CROSS-SECTION LOCATION

DRAWN BY: ORC	APPROVED BY: MMS	PROJ. NO.: 631232565	DATE: APRIL 2018

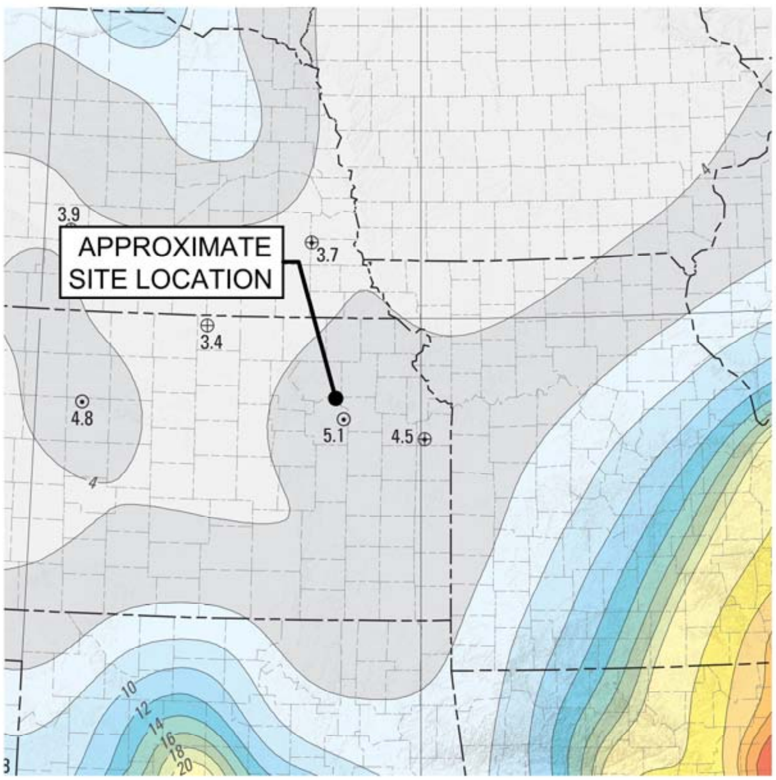
USGS
science for a changing world
Earthquake Hazards Program

LOCATION 39.283 Lat. -96.141 Long.

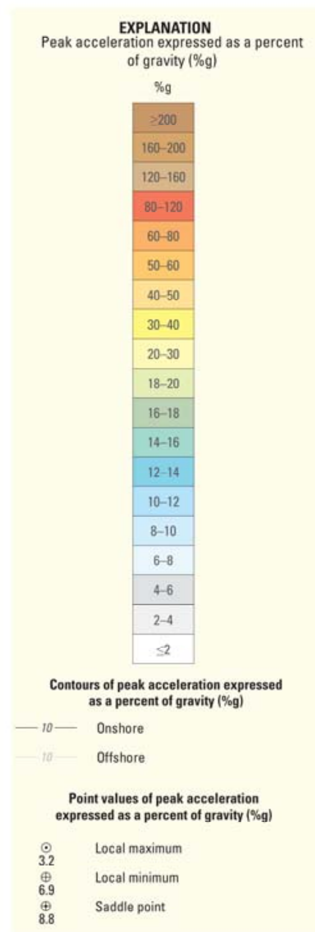
The interpolated probabilistic ground motion values, in %g, at the requested point are:

P.E. %	Exp. Time (years)	Ground Motion (g)
2	50	0.0485

U.S. NATIONAL SEISMIC HAZARD MAPS: Peterson, M.D., et al, 2014



Peak Horizontal Acceleration with 2% Probability of Exceedance in 50 Years



NOTES

1. Information obtained from the United States Geological Survey website.

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FIGURE 5
INACTIVE BOTTOM ASH POND
MAP OF HORIZONTAL ACCELERATION

APPROVED BY:	RDS	PROJ. NO.:	631232565	DATE:	APRIL 2018

APPENDICES

APPENDIX A

2017 Photo Log

APTIM

Photograph No. 1 **Date:** May 16, 2017 **Direction:** Northwest **Description:** Observing Bottom Ash Pond and the surrounding vegetation on the south slope.	

Photograph No. 2 **Date:** May 16, 2017 **Direction:** Northeast **Description:** Observing the eastern edge of the Bottom Ash Pond. Vegetation is well established.	

Photograph No. 3 **Date:** May 16, 2017 **Direction:** North	
Description: Looking at spillway and dam between the Bottom Ash Pond and Tower Hill Lake. Slopes are rip-rap lined. Some vegetation. No noticeable erosion.	

Photograph No. 4 **Date:** May 16, 2017 **Direction:** Northwest	
Description: Looking at spillway from Bottom Ash Pond to Tower Hill Lake. No evidence of erosion or malfunction.	

Photograph No. 5 **Date:** May 16, 2017 **Direction:** Northwest	
Description: Looking at spillway from Bottom Ash Pond to Tower Hill Lake. No evidence of erosion or malfunction. Some vegetation present.	

Photograph No. 6 **Date:** May 16, 2017 **Direction:** Southwest	
Description: Looking at the dam from the access road crossing. No evidence of erosion or distress. Established vegetation present.	

Photograph No. 7	
Date: May 16, 2017 **Direction:** Southwest	
Description: Observing the upstream side of the dam separating the Bottom Ash Pond and Tower Hill Lake. No significant erosion. Established vegetation present.	

Photograph No. 8	
Date: May 16, 2017 **Direction:** -	
Description: Observing rip-rap present on the upstream slope of the dam.	

Photograph No. 9 **Date:** May 16, 2017 **Direction:** Southwest	
Description: Observing the dam separating the Bottom Ash Pond and Tower Hill Lake on the downstream slope. No significant erosion present. Established vegetation present.	

Photograph No. 10 **Date:** May 16, 2017 **Direction:** Southwest	
Description: Observing the berm separating the Bottom Ash Pond and Tower Hill Pond on the upstream slope. No significant erosion present. Established vegetation present.	

Photograph No. 11 **Date:** May 16, 2017 **Direction:** Southwest	
Description: Observing the downstream slope of the dam separating the Bottom Ash Pond and Tower Hill Lake. No erosion in this location.	

Photograph No. 12 **Date:** May 16, 2017 **Direction:** Northeast	
Description: Observing minor erosion of the dam separating the Bottom Ash Pond and Tower Hill Lake on the downstream slope. Established vegetation present.	

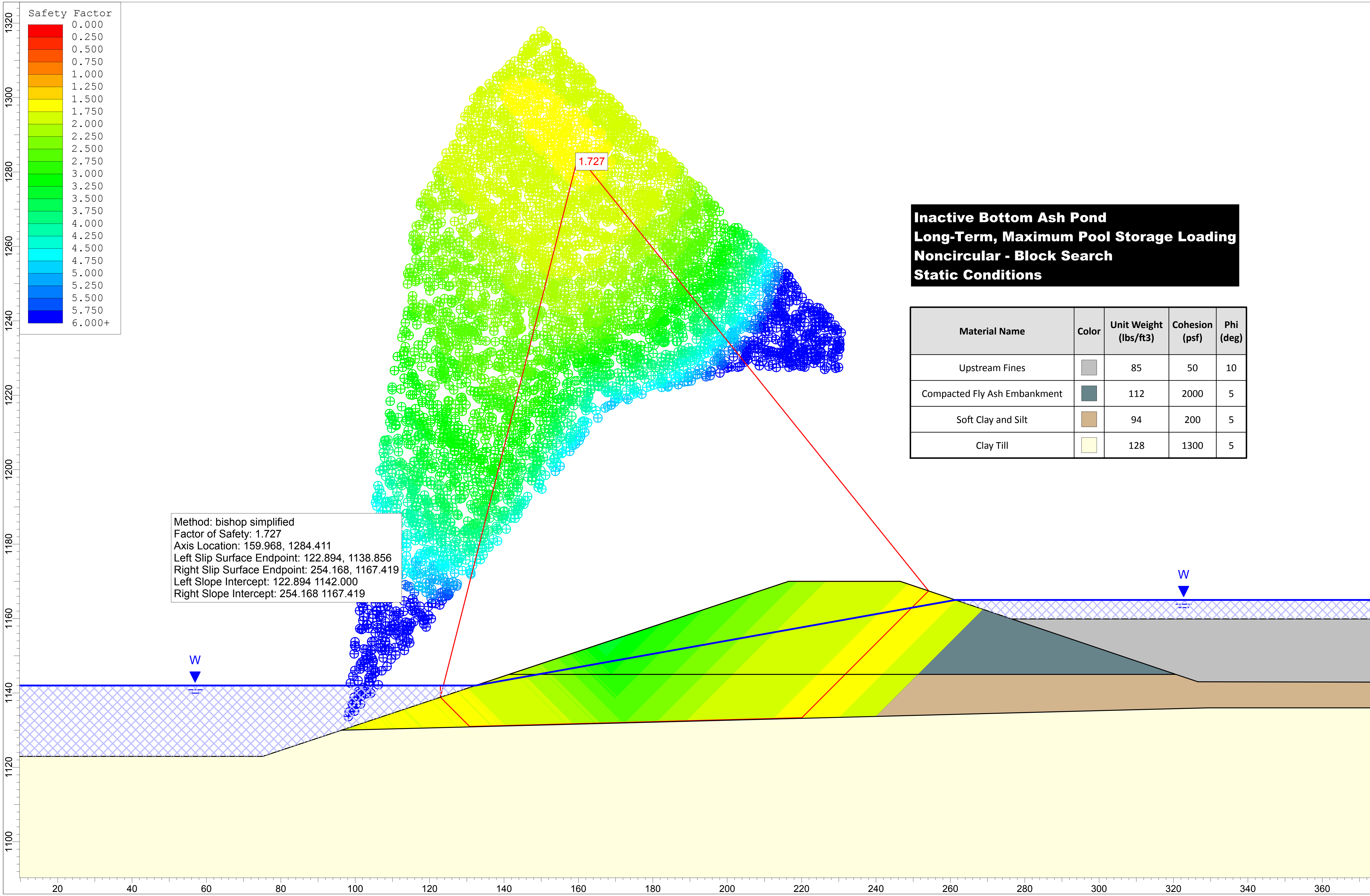
Photograph No. 13 **Date:** May 16, 2017 **Direction:** South	
Description: Observing erosion rills on the dam separating the Bottom Ash Pond and Tower Hill Lake on the downstream slope.	

Photograph No. 14 **Date:** May 16, 2017 **Direction:** Southeast	
Description: Observing the erosion rills on the dam separating the Bottom Ash Pond and Tower Hill Lake on the downstream slope.	

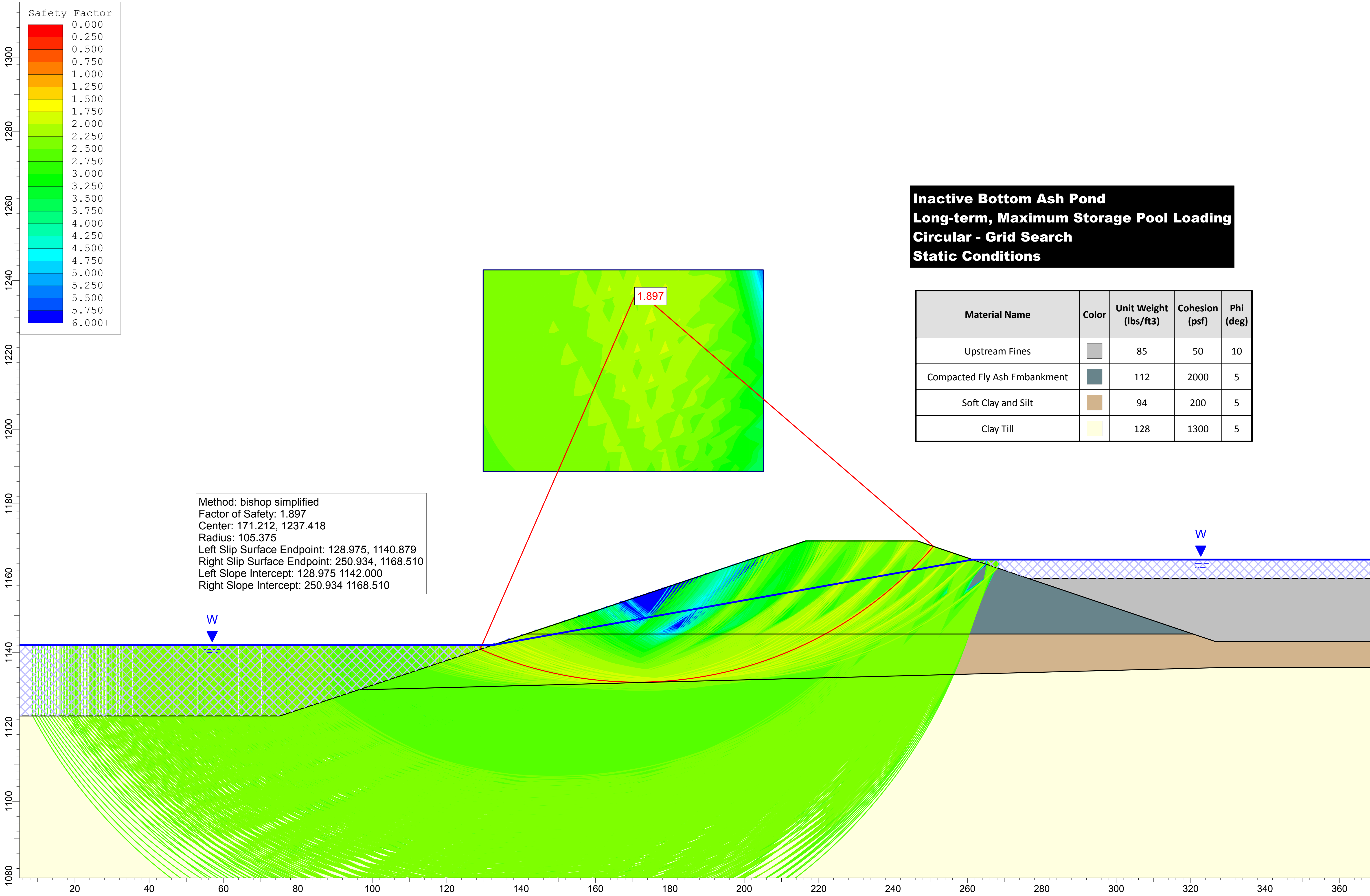
Photograph No. 15 **Date:** May 16, 2017 **Direction:** Southwest	
Description: Observing the dam that separates the Bottom Ash Pond from Tower Hill Lake. Erosion rills on downstream slope.	

APPENDIX B

Safety Factor Assessment Models

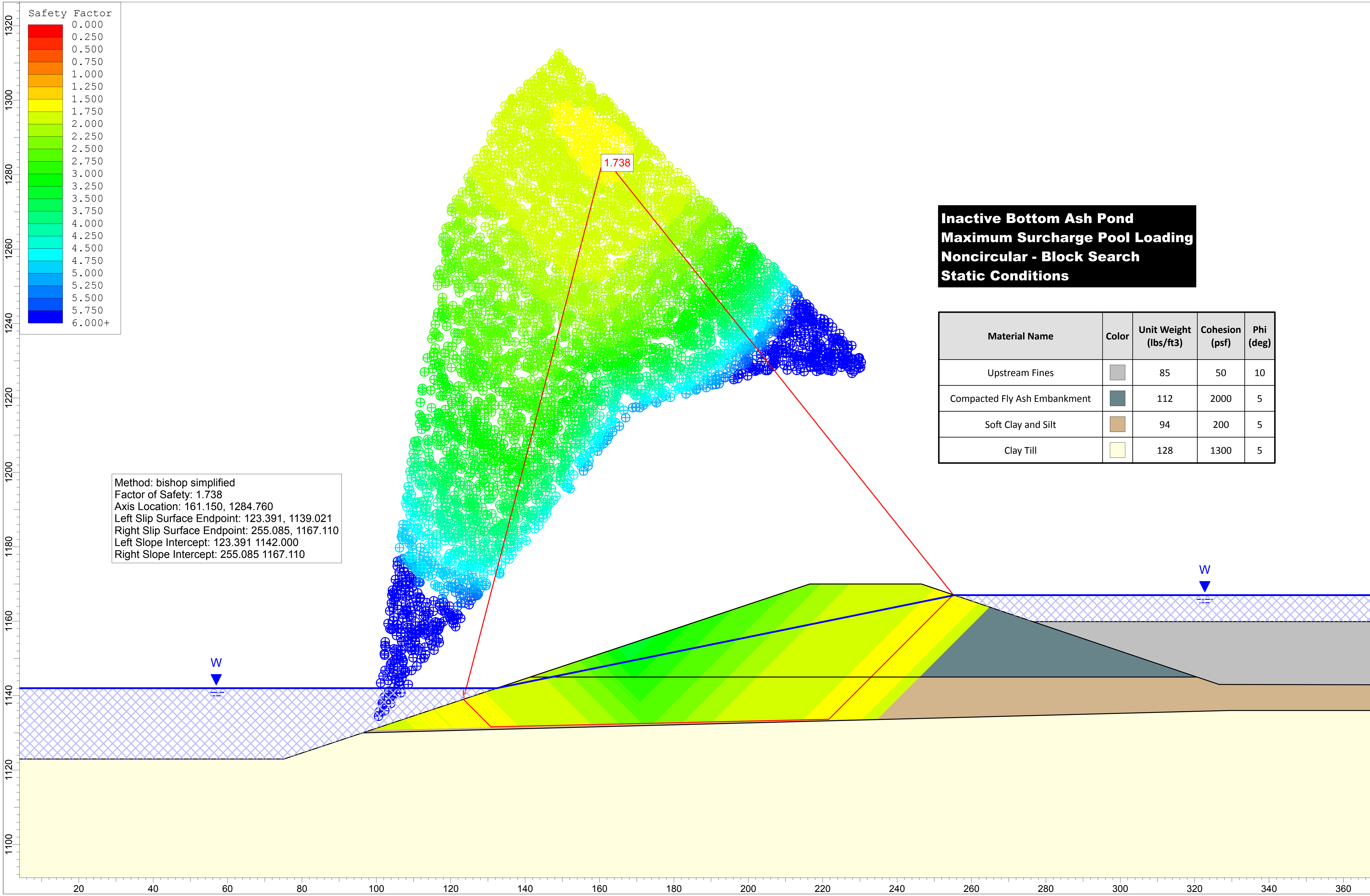


Material Name	Color	Unit Weight (lbs/ft3)	Cohesion (psf)	Phi (deg)
Upstream Fines		85	50	10
Compacted Fly Ash Embankment		112	2000	5
Soft Clay and Silt		94	200	5
Clay Till		128	1300	5

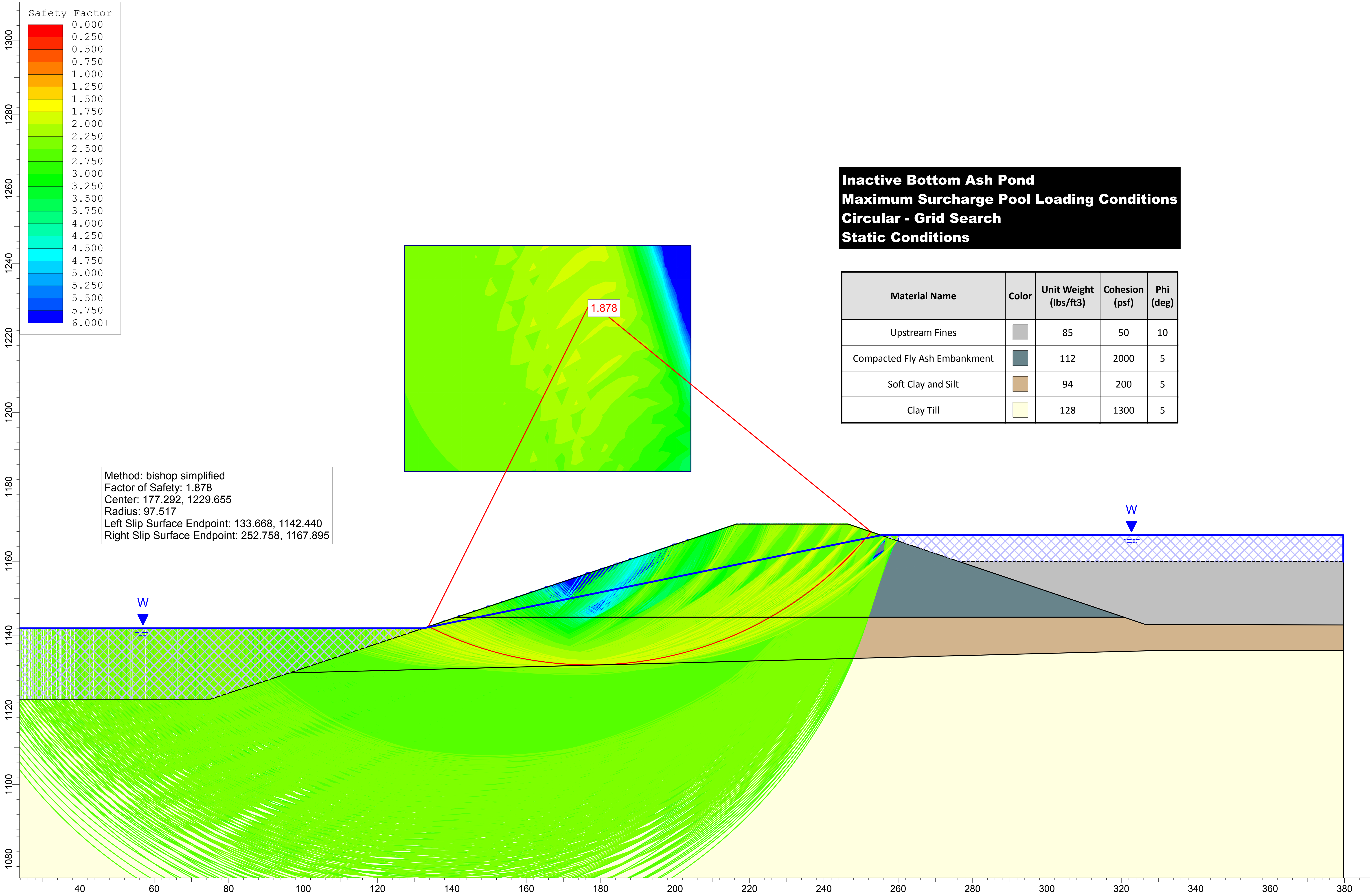


Inactive Bottom Ash Pond
Long-term, Maximum Storage Pool Loading
Circular - Grid Search
Static Conditions

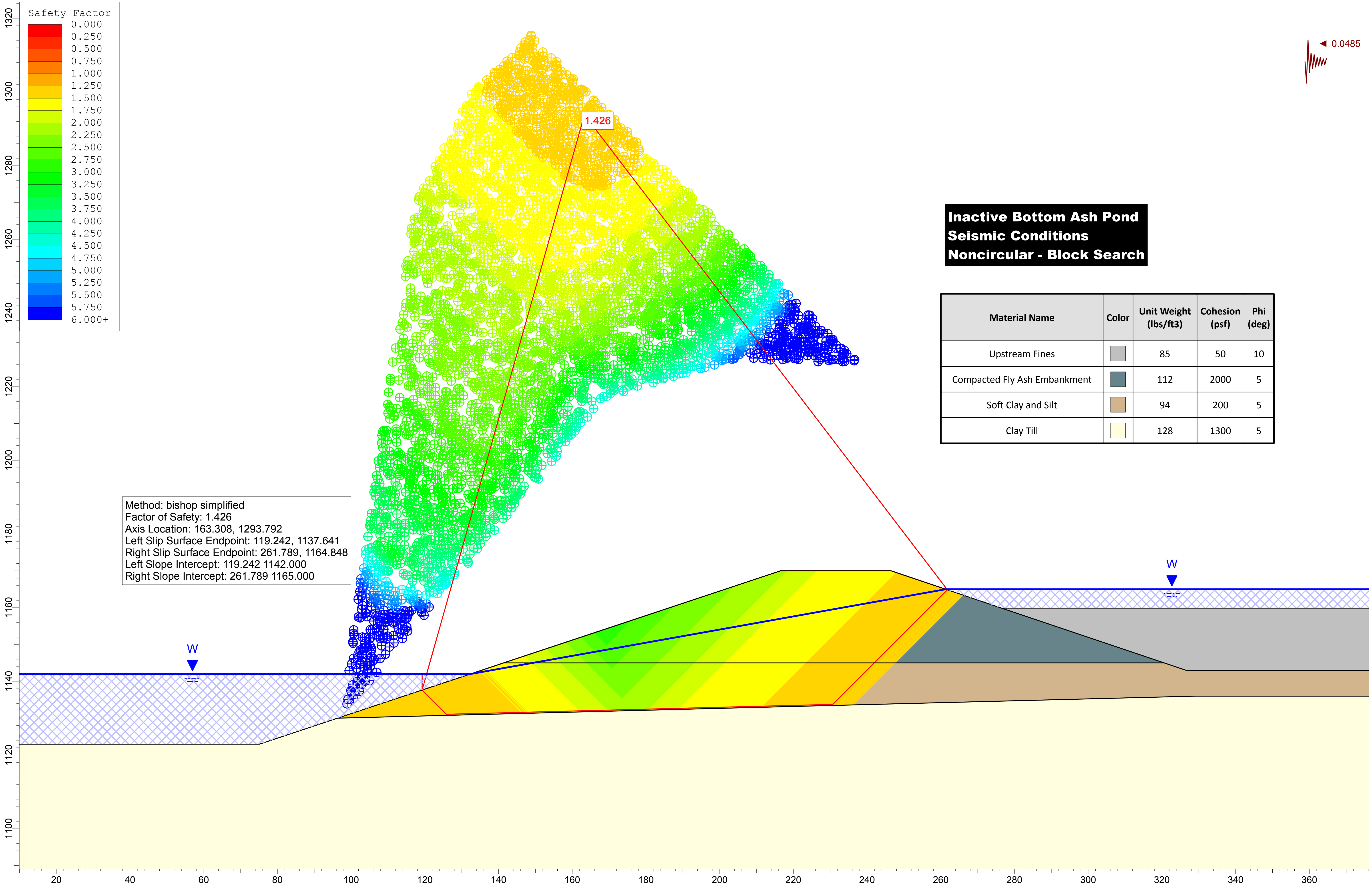
Material Name	Color	Unit Weight (lbs/ft3)	Cohesion (psf)	Phi (deg)
Upstream Fines		85	50	10
Compacted Fly Ash Embankment		112	2000	5
Soft Clay and Silt		94	200	5
Clay Till		128	1300	5



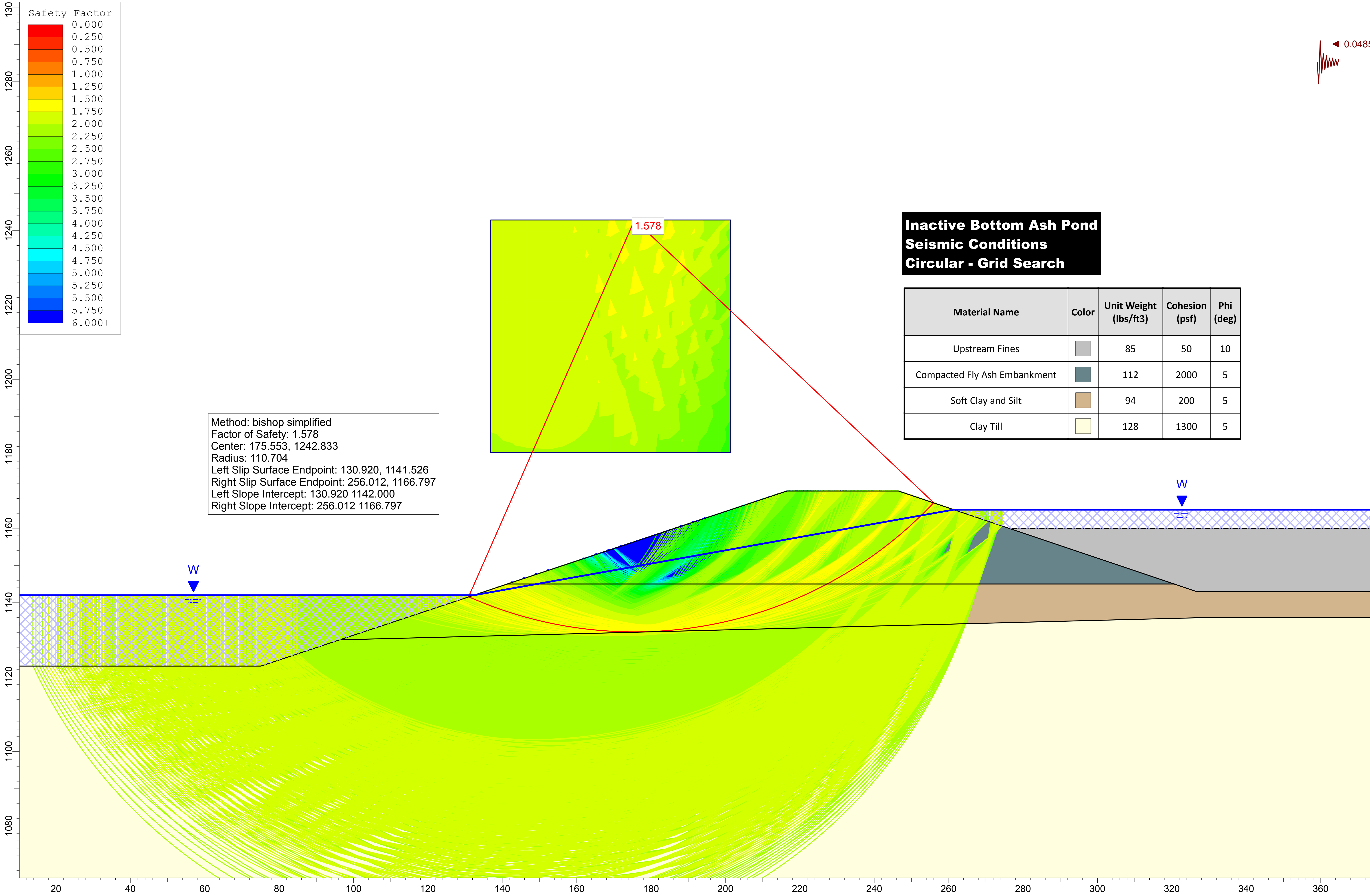
Material Name	Color	Unit Weight (lbs/ft3)	Cohesion (psf)	Phi (deg)
Upstream Fines		85	50	10
Compacted Fly Ash Embankment		112	2000	5
Soft Clay and Silt		94	200	5
Clay Till		128	1300	5



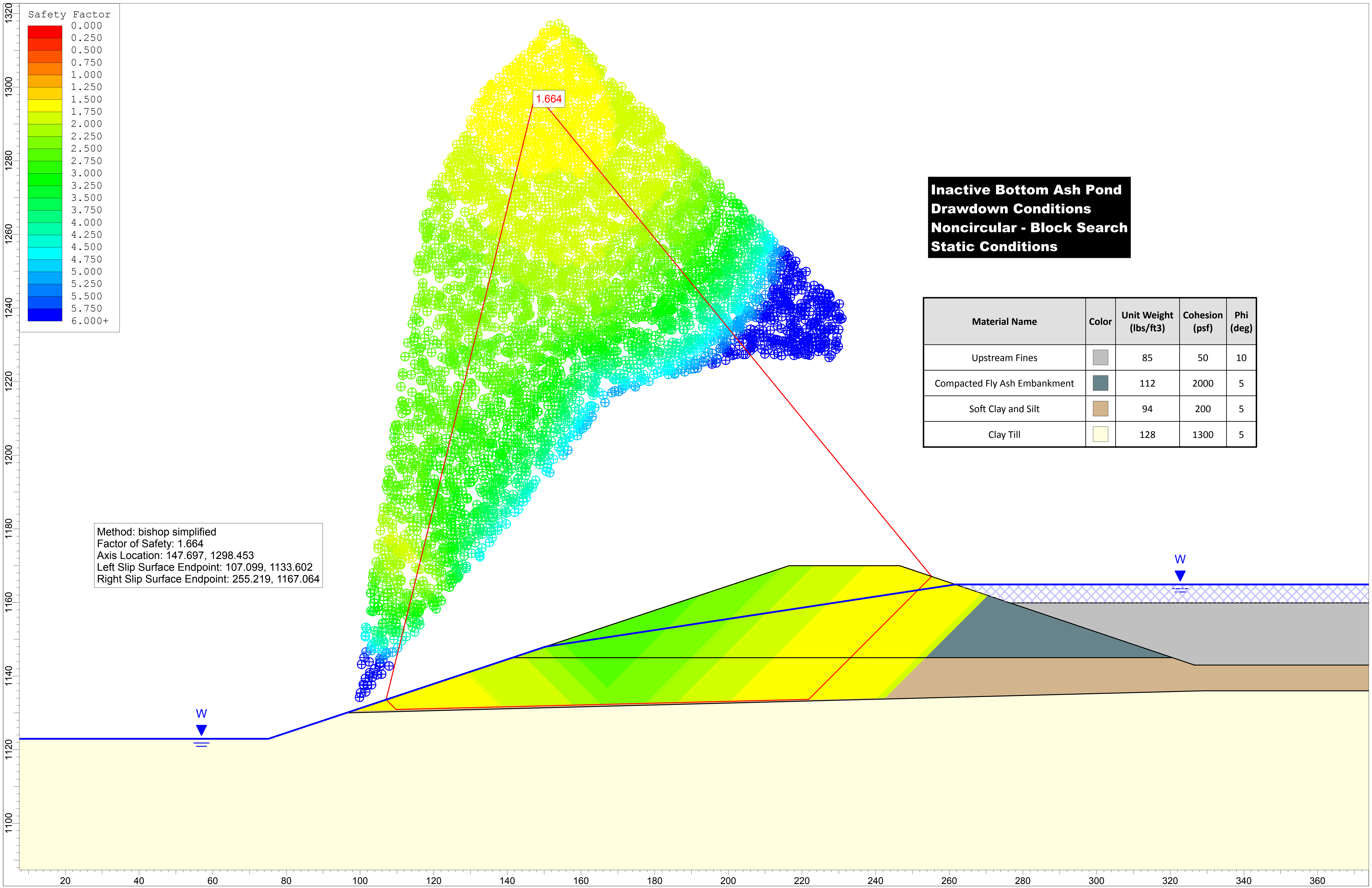
Material Name	Color	Unit Weight (lbs/ft3)	Cohesion (psf)	Phi (deg)
Upstream Fines		85	50	10
Compacted Fly Ash Embankment		112	2000	5
Soft Clay and Silt		94	200	5
Clay Till		128	1300	5



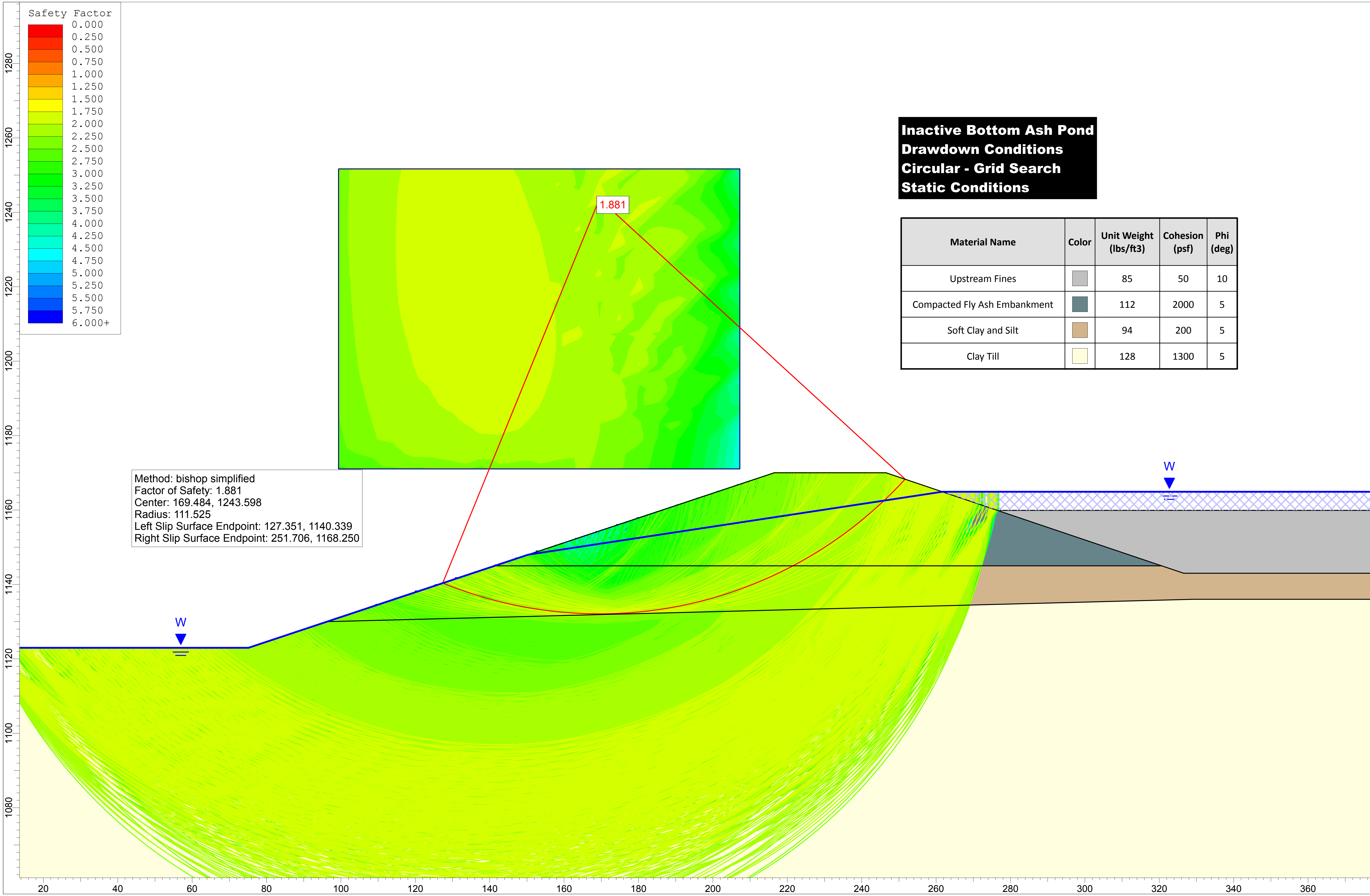
Material Name	Color	Unit Weight (lbs/ft3)	Cohesion (psf)	Phi (deg)
Upstream Fines		85	50	10
Compacted Fly Ash Embankment		112	2000	5
Soft Clay and Silt		94	200	5
Clay Till		128	1300	5



Material Name	Color	Unit Weight (lbs/ft3)	Cohesion (psf)	Phi (deg)
Upstream Fines		85	50	10
Compacted Fly Ash Embankment		112	2000	5
Soft Clay and Silt		94	200	5
Clay Till		128	1300	5



Material Name	Color	Unit Weight (lbs/ft3)	Cohesion (psf)	Phi (deg)
Upstream Fines		85	50	10
Compacted Fly Ash Embankment		112	2000	5
Soft Clay and Silt		94	200	5
Clay Till		128	1300	5



Material Name	Color	Unit Weight (lbs/ft3)	Cohesion (psf)	Phi (deg)
Upstream Fines		85	50	10
Compacted Fly Ash Embankment		112	2000	5
Soft Clay and Silt		94	200	5
Clay Till		128	1300	5