Design Report

Daniels Sand Wash Fines Pond Embankment Dam Raise

Colorado Springs, Colorado

Submitted to:
Holcim
999 W 52nd Ave
Denver, CO 80221

Submitted by:
GEI Consultants, Inc.
350 Indiana Street, Suite 750
Golden, CO 80401
303.625.9502

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Project No. 2400434

COLORADO LICENSED
STEVEN C. KUEHR
24369
PROFESSIONAL ENGINEER

Steven Kuehr, P.E.
Senior Consultant

Sarah Myers
Project Professional

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1. Purpose and Project Description

The operating Daniels Sand wash fines pond has a current capacity of 375 acre-feet. The pond is nearly full; therefore, a raise in the embankment dam is required to allow for additional storage. The site is located in Colorado Springs, Colorado as shown in Figures 1 and 2. This report presents the subsurface conditions, embankment dam design, construction recommendations and specifications.

The proposed expanded silt fines pond will have an increase in capacity of 484 acre-feet after completing the 22.5-foot raise contemplated by this report.

2. Subsurface Conditions

2.1. Previous Site Work

2.1.1. Field and Laboratory Investigation

Brierley Associates conducted a geotechnical investigation in 2016 within the pond footprint as shown in Figure 3. Eolian deposits, coarse alluvium, bedrock, and groundwater were encountered. Boring logs and laboratory testing results are presented in Appendix A.

2.1.2. Initial Construction

The existing embankment dam was constructed in 2017 with a top width of 15 feet and final slopes of 2.5H:1V. Borrow for the embankment dam was obtained from the existing mine floor within the footprint of the pond. The borrow material was on-site eolian sand (silty sand, clayey sand, lean clay). The embankment dam was keyed-in to the mine floor and had a depth of approximately ten feet and a width of 12 feet. The embankment dam is approximately 22.5 feet high at present.

The Fountian Mutual Ditch is located above and to the north of the wash fines pond. A buttress was installed in 2022 to flatten the existing steep mine slope below the ditch to 3H:1V. The buttress footprint extended into the wash fines pond. Recycled concrete (12-inch minus) was pushed into the pond along the toe of the mine slope until it daylighted above the water level. The upper 18 inches (in contact with the geotextile) was 6-inch minus recycled concrete. A needle punched nonwoven geotextile (Winfab 450n) was installed over the recycled concrete with adjacent panels overlapping approximately two feet. On-site sand was placed in 12-inch-thick horizontal loose lifts. Bi-annual monitoring of the buttress slope is currently occurring as required by DRMS.

2.2. Geologic Setting

The project site is situated in the southern Front Range located on the western-most flank of the Colorado Piedmont section of the Great Plains Physiographic Province. The Colorado Piedmont is defined as a north/south trending, asymmetrical basin that formed during the uplift of the Rocky Mountains to the west and was later incised by streams and rivers. The area is generally lower than the Great Plains Province to the east and characterized by broad alluvial and pediment deposits over dipping and flat lying bedrock. The subject site is mapped at a 1:24,000 scale in the Geologic Map of the Colorado Springs Quadrangle (Carroll and Crawford, 2000). Eolian sands (Unit Qes) are mapped as the surficial deposits across the site and are described as “silt sand to coarse-grained sand deposited by wind”. The eolian deposits overly the Pierre Shale (Unit Kp) described as "gray shale that includes numerous bentonite beds; weathers to an olive-green clay, with curvilinear fractures filled with sulfate salts; particularly susceptible to slope instability in steep areas”.

2.3. Geologic Hazards

In Colorado, the following are recognized geologic hazards: abandoned mines, avalanches, collapsible soils, debris flows, seismic induced hazards, erosion, fires, floods, heaving bedrock, expansive soils, landslides, mudslides, rockfall, and subsidence. Geologic hazards for the project area are discussed below. In general, the Project site has low potential for geologic hazards.

2.3.1. General Site Hazards

According to the Colorado Division of Reclamation, Mining and Safety's AUGER Map, the Project location is geographically close to mines, though only sand and gravel sources similar to the current operations are listed, and no abandoned coal mines. The Project site is outside of the avalanche ratings according to the Colorado Avalanche Information Center. According to the USGS National Landslide Hazards Map, the Project site has low landslide susceptibility. The Colorado Geological Survey Landslide inventory has not mapped landslide deposits at the site, and the closest mapped deposits are 1.5 miles to the southwest. The project site has a low wildfire intensity risk intensity according to the Colorado Wildfire Risk Assessment Portal. The Project site is outside of FEMA's FIRM mapping limits indicating the location has no special flood hazard areas. The Colorado Geological Survey does not have any reported rockfall events in the site vicinity. Mudslides are debris flows that are triggered by storms in the mountains and therefore can be dismissed due to the location of the project site.

2.4. Collapsible Soils

Collapsible soils are relatively low-density materials that shrink in volume when they become wet, and/or are subjected to increased overburden pressure such as from a building or road fill. The process of collapse with the addition of water is also known as hydrocompaction. Large ground displacements caused by collapsing soils can damage structures and alter surface drainage. According to geologic maps, the Project site is located within a zone of collapsible soils composed of windblown eolian deposits. The depositional process resulted in a soil structure with low density, high porosity, and a meta-stable open skeletal fabric. Because most of the eolian soils in the vicinity of the embankment dam was removed by mining, the risk of collapsible soils at the Project is low.

2.4.1. Expansive Soils and Bedrock

Swelling soil and bedrock is widespread throughout the Front Range of Colorado and in some mountain valleys. The phenomenon occurs when certain types of clay minerals undergo a change in moisture content. Historically, structures and other infrastructure underlain by dipping and expansive bedrock have experienced differential movement due to the geologic mechanism known as heaving bedrock (Colorado Geological Survey, 1997). Heaving bedrock is the result of steeply-dipping bedrock with hydration-induced expansion properties, confined by non-expansive bedrock. The result of heaving bedrock is heterogeneous, differential movement. Conversely, expansive soils are typically horizontal beds that exhibit relatively homogeneous swelling behavior. The project site is outside of the areas mapped as susceptible to differential heave.

2.4.2. Seismic Induced Hazards

Earthquakes cause ground motions that can cause structures to fail either through structural collapse or loss of ground support. The nearest active fault to the property according to the US Geological Survey Earthquake Hazards Program is the Ute Pass fault approximately 5.23 miles southwest of the project site. The Ute Pass fault has a slip rate of less than 0.2 mm/year. We anticipate a minimal seismic risk potential for the embankment dam.

2.4.2.1. Liquefaction Evaluation

Loose saturated granular soils such as wind deposited (eolian) sand, silty sand or clayey sand, and non-plastic silts within 50 feet of the surface and below the water table can be susceptible to liquefaction during cyclic loading such as exhibited during seismic events. The average blow count for the embankment dam foundation is 23 blows per foot which indicates a medium dense material. Based on medium dense blow counts and the material classifications in the foundation there is a minimal risk of liquefaction for in-place undisturbed materials at the site.

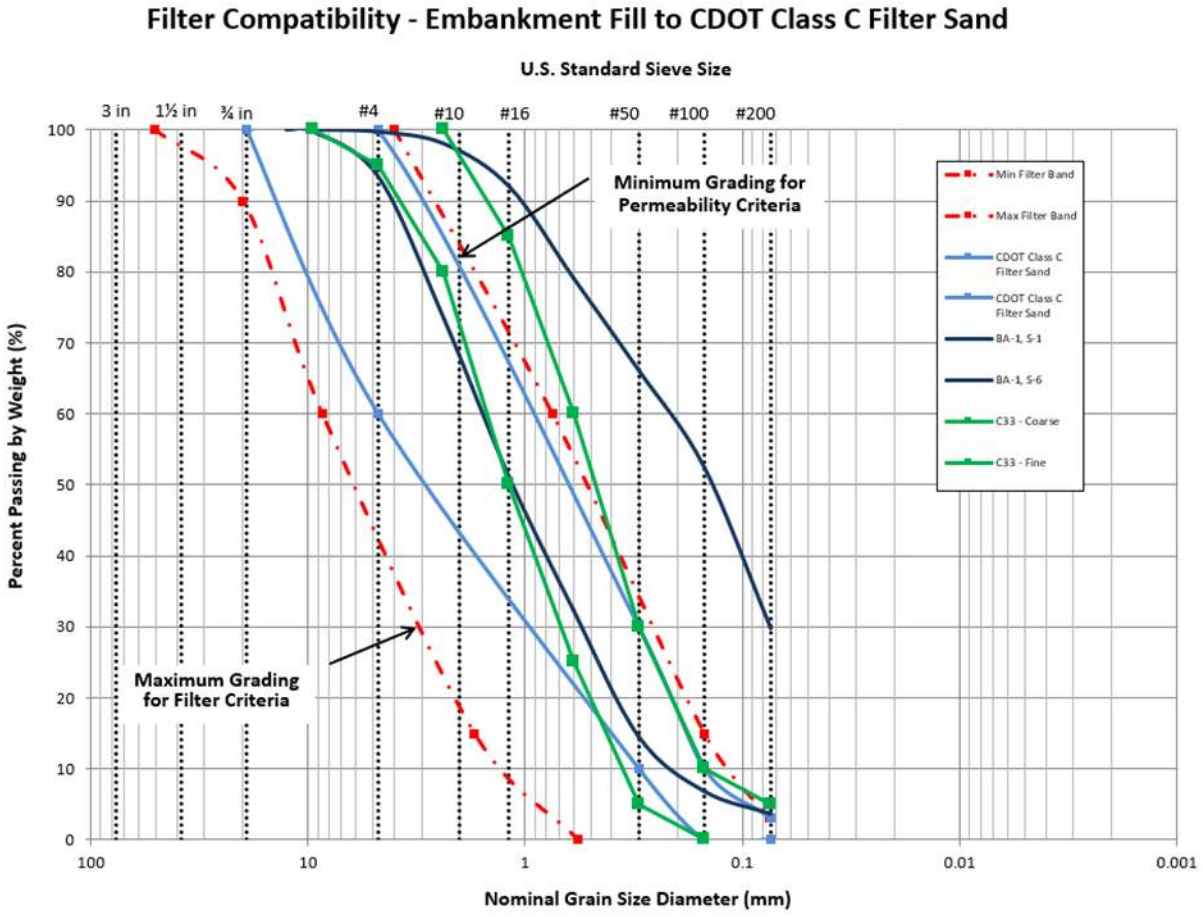
Each lift in the existing embankment dam and proposed embankment dam raise was/will be compacted to at least 95 percent relative compaction. The borrow material consists of the eolian sands with USCS classifications of SM, SC, or CL. Laboratory test results for the percent gravel, percent sand, percent fines, and Atterberg Limits were evaluated based on several literature criteria to characterize the liquefaction susceptibility. The analysis indicated a low potential for liquefaction for the embankment dam.

3. Design Recommendations

The embankment dam should have a design top width of 15 feet. The haul road and embankment dam grading plans are shown on Figures 4 and 5, respectively. Embankment dam sections, benching details, and toe drain details are presented on Figure 6. After removal of any vegetation and debris on the face of the existing mine highwalls, haul road sidewalls and Fountain Mutal Ditch buttress which will form the abutments of the embankment dam, all new fills should be benched into place by cutting steps into the existing slope. The pond slope reclamation plan is shown on Figure 7. We recommend borrow for the embankment dam construction be obtained from the onsite mined eolian soils with the USCS classifications of SM, SC, or CL. The coarse alluvium encountered beneath the eolian deposits should not be utilized.

A hydrology study was conducted for two potential embankment dam height increases and is presented in Appendix B. The purpose of the evaluation was to estimate the flood stage of the settling pond due to runoff generated from the 100-year and 200-year storm and the one-half probable maximum precipitation (PMP) events, assuming no outflow during the storm event. It was determined that if a minimum freeboard of 3 feet was maintained for the proposed increase, none of the four storm events are expected to overtop the embankment dam. Accordingly, we recommend that the level of wash fines/supernatant accumulation in the pond be limited to an elevation of 5,833 feet corresponding to a minimum of three feet below the crest of the proposed embankment dam. We understand that Holcim intends to maintain this minimum freeboard by decanting the supernatant after fines have settled out. This is consistent with Holcim's current operations.

As shown on the design drawings, a blanket drain is required to meet the required slope stability factor of safety. To prevent internal erosion or piping within the blanket drain, filter material gradation requirements were determined using the procedures outlined in the USDA National Engineering Handbook Part 633 Chapter 26 as shown in the following graph. Based on the grain size distributions presented in the graph, filter material meeting the requirements of CDOT Class C filter material will be sufficient to meet USDA requirements. Gradation requirements for CDOT Class C filter material are included in Specification Section 31 00 00 Earthwork provided in Appendix D.


Filter Compatibility - Embankment Fill to CDOT Class C Filter Sand
U.S. Standard Sieve Size
3 in
1½ in
¾ in
#4
#10
#16
#50
#100
#200
Percent Passing by Weight (%)
Nominal Grain Size Diameter (mm)
Minimum Grading for Permeability Criteria
Maximum Grading for Filter Criteria
Min Filter Band
Max Filter Band
CDOT Class C Filter Sand
CDOT Class C Filter Sand
BA-1, S-1
BA-1, S-6
C33 - Coarse
C33 - Fine

4. Slope Stability Analysis

GEI conducted a slope stability analysis on the Daniels Sand wash fines engineered embankment dam. Slope stability was analyzed using the computer program SLOPE/W, developed by GEO-SLOPE International (GeoStudio). SLOPE/W utilizes limit equilibrium principles to analyze potential failure surfaces within a user defined two-dimensional geometry. Slip surface ranges can be defined using a variety of methods. Scenarios analyzed in this report defined failure surface locations over a range of entry and exit points. The Morgenstern-Price Method was used to calculate critical slip surfaces and associated safety factors. Using this methodology the factor of safety for a given geometry is determined by calculating the ratio of resisting forces to driving forces on a particular trial failure surface. The slip surface with the lowest factor of safety against sliding is described as the minimum factor of safety for the defined conditions.

Two stability cases were analyzed for the embankment dam: 1) Long-Term Steady-State, and 2) Long-Term Pseudo-static. Long Term Steady State considers the extended term stability of the embankment dam at the design elevation (full wash fines pond and steady state seepage condition) and the soil strength is characterized by the effective stress parameters in drained conditions. Pseudo-static introduces seismic loading to the long-term steady state model. Pseudo-static loading approximates a typical earthquake load by applying a user defined horizontal load to the model, approximating the equivalent peak ground acceleration from the design earthquake. Per the State guidelines, for a significant hazard dam, the dam shall be designed for a 2% chance of exceedance in 50 years (approximately 2,500-year return frequency). Using the USGS unified hazard tool, the peak ground acceleration for the required return period was determined to be 0.107g. Using the peak ground acceleration, a horizontal seismic coefficient (k_h) of 0.053 was chosen for use in the pseudo-static analysis in accordance with State requirements and work by Hynes-Griffin and Franklin concluding that earth dams with pseudo-static factors of safety greater than 1.0 using $k_h=0.5a_{max}/g$ would not develop dangerously large deformations.

For the slope stability analysis, the phreatic surface was generated using SEEP/W. The analysis considered the maximum reservoir pool. The embankment dam and foundation soil properties are based on conditions encountered during Brierley's subsurface investigation and laboratory results. Mohr-Coulomb strength criterion framework was utilized to define soil strengths and bedrock strengths were defined using undrained strength parameters ($\phi=0$). Mohr-Coulomb assumes an inherent cohesion in over-consolidated fine-grained or cemented soils and bedrock. The strength properties used in each analysis are based on available soil classification laboratory test results and engineering judgement and experience.

Colorado DRMS requires specific minimum safety factors for slope stability of embankment dams. Slope stability results based on modeling of the above conditions along with the associated minimum factors of safety according to the Colorado DRMS are provided in Table 4-1 below. The modeling results are presented in Appendix C.

Table 4-1. Slope Stability Results

Loading Condition	Colorado DRMS Minimum Recommended Factor of Safety	Computed Factor of Safety
Long Term Steady State Seepage	1.5	1.88
Pseudo-Static Seismic Loading	1.3	1.54

5. Construction Procedures and Recommendations

5.1. Site Preparation

The volume of material required to build the embankment dam raise is approximately 160,000 cubic yards. Modifications to site operations (access roads, haul road, stockpiles, Fountain Mutual Ditch buttress) will be required. The existing haul road on the south end of the embankment dam will have to be substantially removed prior to embankment dam construction. A grading plan for the haul road removal is shown in Figure 4 and the embankment dam grading plan is shown in Figure 5.

The Fountain Mutual Ditch buttress is located north of the pond. We recommend any erosion gullies be reconstructed and that vegetation only be stripped where the embankment dam ties into this slope. Only minimal earthwork is anticipated along the remainder of the buttress. However, the east and south sides of the pond should be reclaimed to 3H:1V slopes as shown on Figure 6.

Care should be exercised during the earthwork operations at the site. The earthwork should be done during a dry season. The Contractor should account for potential shrinkage and bulking of borrow material which are defined as the change in volume of the soil from its in-situ condition following excavation, moisture conditioning, placement, and compaction.

5.2. Fill Material

Individual particles up to six inches in diameter are acceptable. Fine and coarse material should be blended to achieve a homogenous fill across the embankment dam without lenses, pockets, or zones of different materials.

5.3. Compaction Testing and Inspection

We recommend that technical or engineering personnel be present to provide monitoring and geotechnical engineering services during construction. It is recommended that the engineering representative review the prepared surface to be filled and the fill material to be used prior to placing any fill. The engineering representative can also review density, moisture, and other laboratory testing results.

Field density tests should be performed on each lift as necessary to verify that adequate compaction is being achieved. Density and moisture testing should be carried out as specified in the earthwork specification provided in Appendix D.

6. Regulatory Environment

This report is intended to meet the requirements of the Colorado Division of Water Reclamation and Mining Safety (DRMS) and Mine Safety and Health Administration (MSHA). John Hunyadi from the Colorado Division of Water Resources, Dam Safety Branch answered our inquiry regarding jurisdiction by his email dated June 4, 2024. John stated, “Rule 14.4 Dams or other water impounding structures regulated by other State agencies (e.g., COGCC, CDPHE, DRMS, etc.) may be exempt from these Rules to avoid dual regulation. The State Engineer may provide technical consultation as necessary for the permitting of such structures”.

7. Limitations

This study was conducted in accordance with generally accepted geotechnical engineering and engineering geologic practices and principles; no warranty, express or implied is made. The subsurface conditions described in this report were based on data obtained from others.

This report has been prepared exclusively for our client for design purposes for the subject project. GEI is not responsible for technical interpretations by others of the data presented in this report or use of this report by others for the subject project or other projects. If differing site conditions are encountered during further evaluation of the subsurface conditions by others or during construction, GEI should be notified immediately to determine if any changes to our recommendations presented in this report are warranted.

The recommendations presented in this report are only intended for the proposed design and construction as understood by GEI at the time of issuing this report. If the proposed design and construction changes, GEI should be notified immediately and given the opportunity to review the proposed changes and if necessary, modify our recommendations presented herein.

Figures

Figure 1. Site Location Map

Figure 2. Pond Topographic Overlay

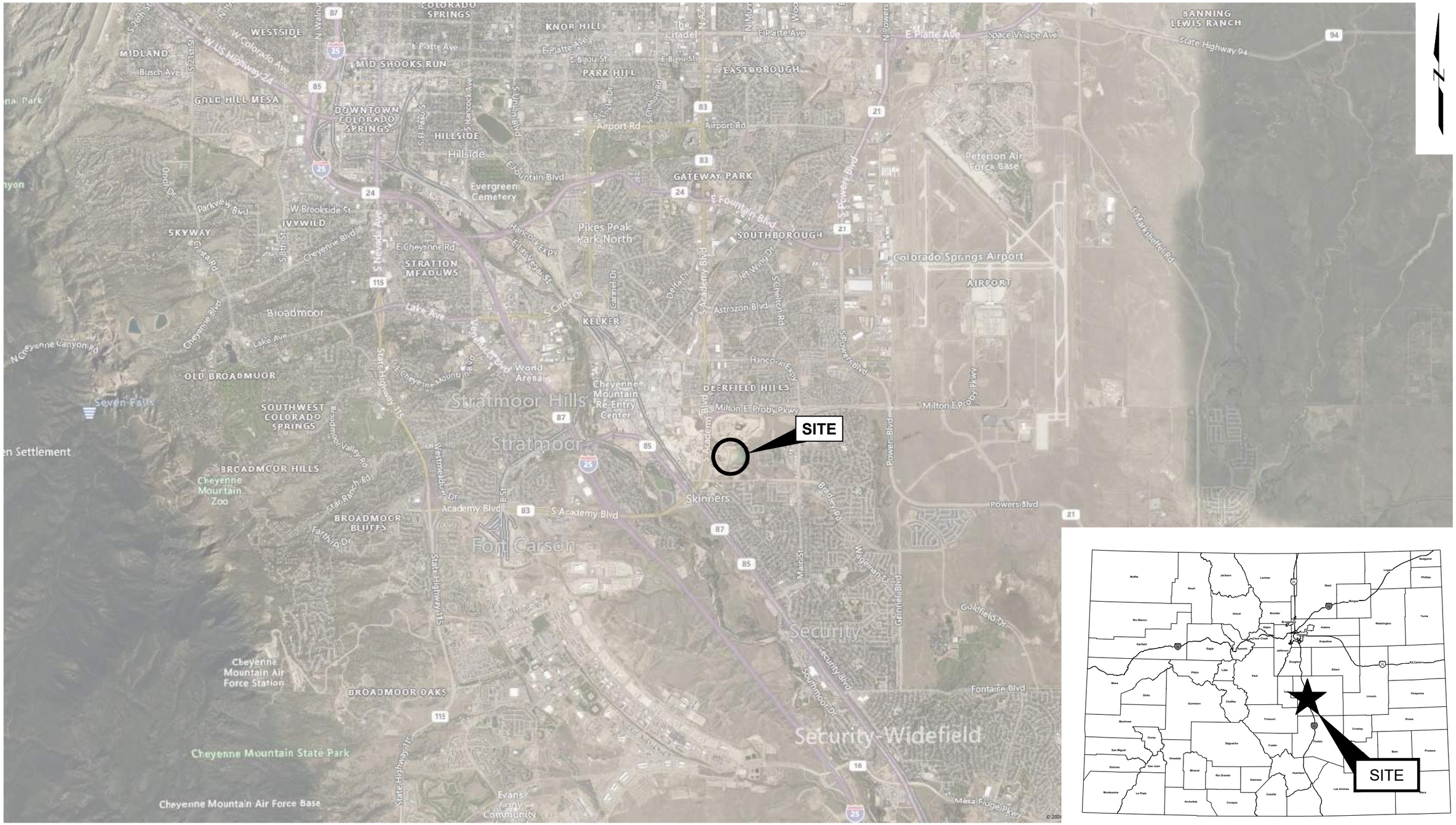
Figure 3. Existing Site Conditions

Figure 4. Haul Road Grading Plan

Figure 5. Embankment Dam Grading Plan

Figure 6. Embankment Dam Section and Details

Figure 7. Pond Slope Reclamation Plan

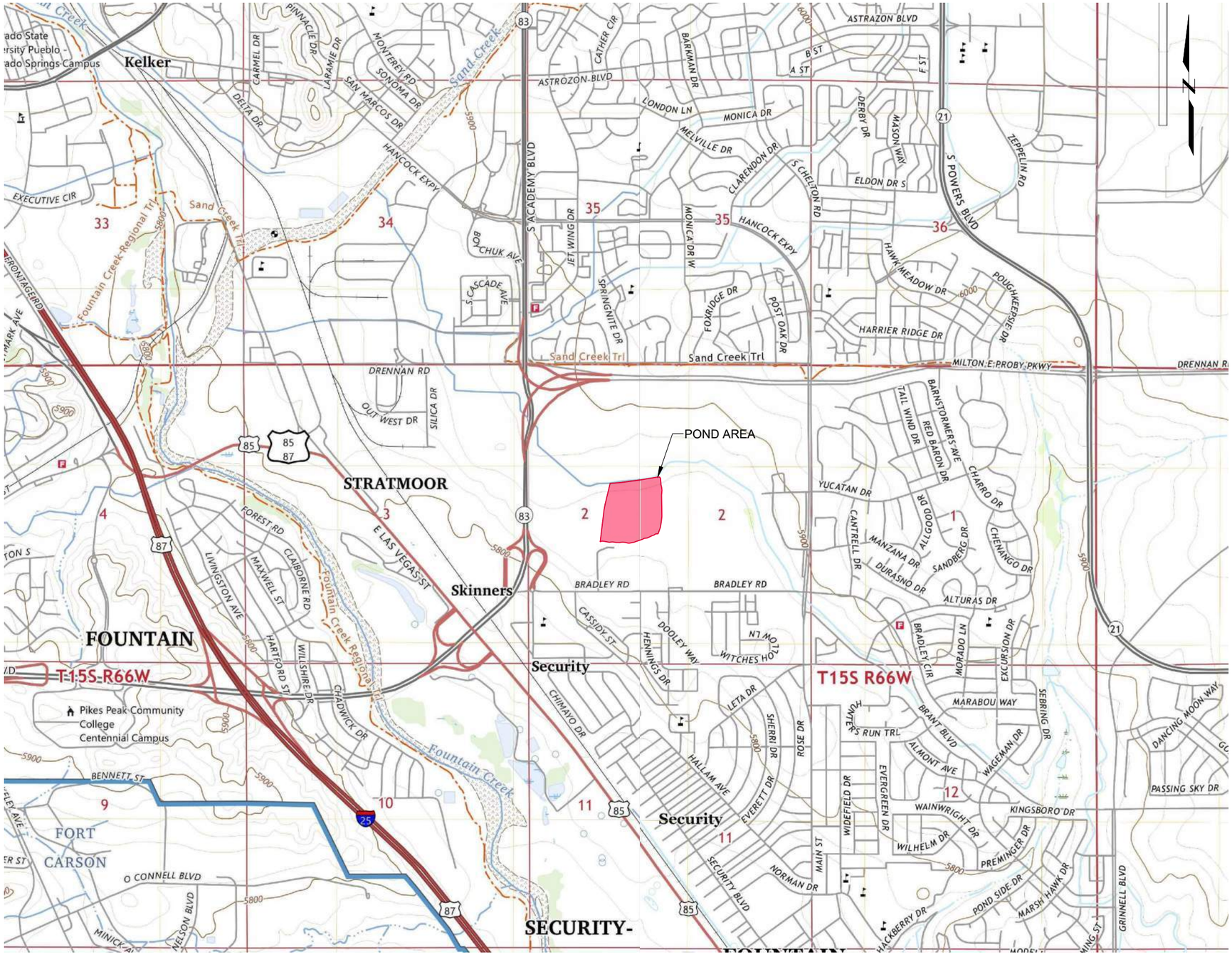


0 1 2

SCALE, MILES

Construction Drawings Daniels Sand Wash Fines Pond Embankment Dam Raise El Paso County, Colorado	GEI Consultants	SITE LOCATION MAP
Holcim Denver, Colorado	Project 2400434	November 2024 Fig. 1

JOHANSON, ROBERT B:\Working\HOLCIM\2400434 Daniels Sand Wash Fines Pit Raise\00_CAD\Design\Working\Daniels_Sand_Construction_Drawings.dwg - 11/22/2024



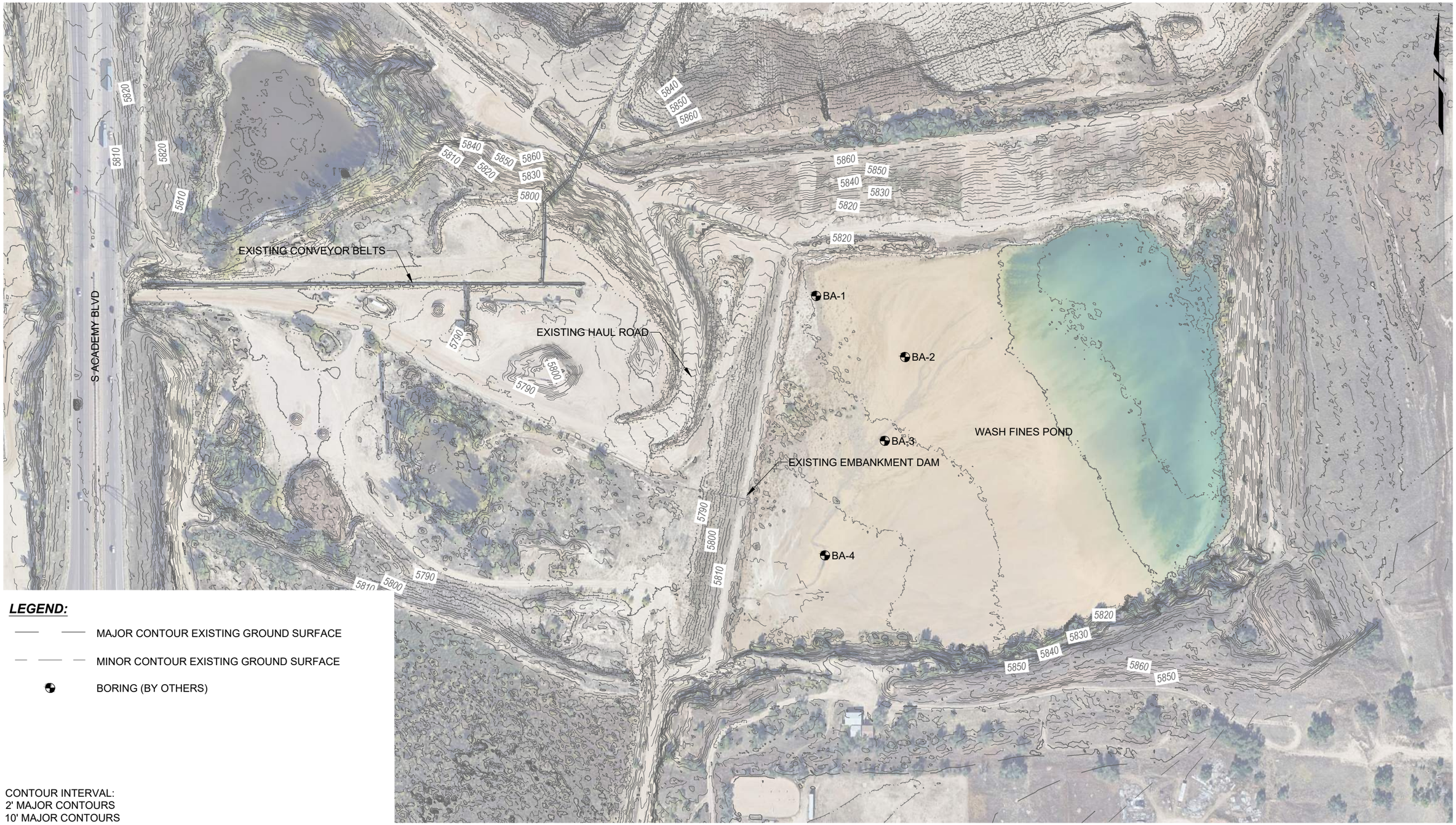
NOTES:

1. USGS TOPOGRAPHIC MAPS USED IN THIS FIGURE INCLUDE THE FOLLOWING:
   - 1.1. COLORADO SPRINGS QUADRANGLE, COLORADO - EL PASO COUNTY, 7.5 MINUTE SERIES, U.S. GEOLOGICAL SURVEY, 2023
   - 1.2. ELSMERE QUADRANGLE, COLORADO - EL PASO COUNTY, 7.5 MINUTE SERIES, U.S. GEOLOGICAL SURVEY, 2022

0 2000 4000

SCALE, FEET

Construction Drawings Daniels Sand Wash Fines Pond Embankment Dam Raise El Paso County, Colorado	GEI Consultants	POND TOPOGRAPHIC OVERLAY
Holcim Denver, Colorado	Project 2400434	November 2024 Fig. 2



LEGEND:

MAJOR CONTOUR EXISTING GROUND SURFACE

MINOR CONTOUR EXISTING GROUND SURFACE

BORING (BY OTHERS)

CONTOUR INTERVAL:
2' MAJOR CONTOURS
10' MAJOR CONTOURS

NOTES:

1. BORINGS COMPLETED BY BRIERLEY ASSOCIATES (2016). BORING LOCATIONS ARE APPROXIMATE.

0 200 400

SCALE, FEET

Construction Drawings
Daniels Sand Wash Fines Pond Embankment Dam Raise
El Paso County, Colorado

Holcim
Denver, Colorado

GEI Consultants

EXISTING SITE CONDITIONS

Project 2400434 | November 2024 | Fig. 3

JOHANSON, ROBERT B:\Working\HOLCIM\2400434 Daniels Sand Wash Fines Pit Raise\00_CAD\Design\Working\Daniels_Sand_Construction_Drawings.dwg - 11/22/2024

LEGEND:

- MAJOR CONTOUR PROPOSED GRADING
- MINOR CONTOUR PROPOSED GRADING
- MAJOR CONTOUR EXISTING GROUND SURFACE
- MINOR CONTOUR EXISTING GROUND SURFACE

CONTOUR INTERVAL:
2' MAJOR CONTOURS
10' MAJOR CONTOURS

NOTES:

1. GRADE HAUL ROAD SUCH THAT EXISTING EMBANKMENT DAM SLOPE IS NOT DISTURBED.
2. EXISTING CONVEYOR BELTS MAY NEED TO BE RELOCATED TO ACHIEVE REQUIRED GRADING.

0 100 200
SCALE, FEET

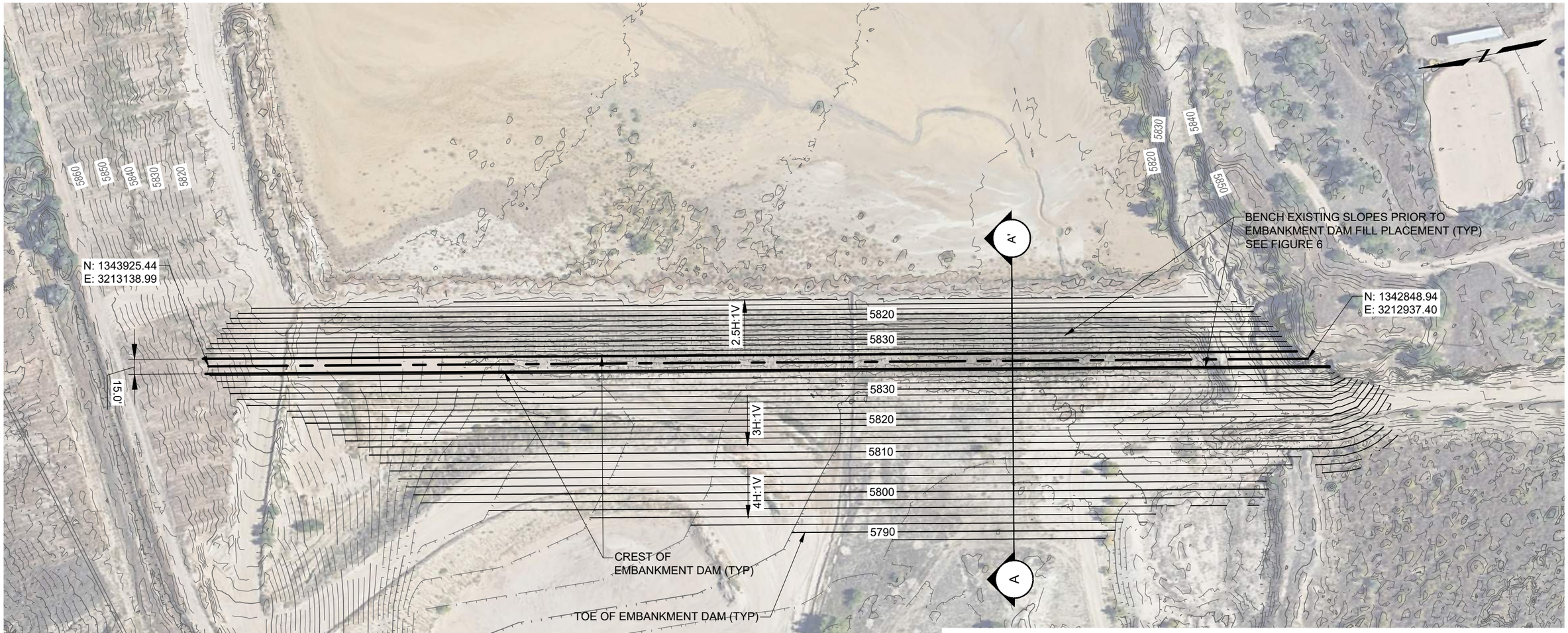
Construction Drawings
Daniels Sand Wash Fines Pond Embankment Dam Raise
El Paso County, Colorado

Holcim
Denver, Colorado

GEI Consultants

HAUL ROAD GRADING PLAN

Project 2400434 | November 2024 | Fig. 4



LEGEND:

- CREST OF EMBANKMENT DAM
- CENTERLINE OF EMBANKMENT DAM
- MAJOR CONTOUR PROPOSED GRADING
- MINOR CONTOUR PROPOSED GRADING
- MAJOR CONTOUR EXISTING GROUND SURFACE
- MINOR CONTOUR EXISTING GROUND SURFACE

CONTOUR INTERVAL:
2' MAJOR CONTOURS
10' MAJOR CONTOURS

NOTES:

1. EXISTING SLOPES SHALL BE BENCHED PRIOR TO EMBANKMENT DAM FILL PLACEMENT. SEE BENCHING DETAIL ON FIGURE 6 FOR BENCHING REQUIREMENTS.

CONSTRUCTION SEQUENCE:

1. REMOVE EXISTING HAUL ROAD LOCATED WEST OF EXISTING EMBANKMENT DAM AND GRADE SLOPE NORTH OF HAUL ROAD AT A MAXIMUM SLOPE OF 2H:1V PER FIGURE 4.
2. GRUB AND STRIP ALL VEGETATION, TOPSOIL, RUBBISH, OR OTHER UNSUITABLE MATERIALS FROM PROPOSED EMBANKMENT DAM FOUNDATION AND ABUTMENT LOCATIONS. REMOVE ALL DEBRIS, ORGANIC MATERIALS, AND PARTICLES GREATER THAN 6 INCHES, THEN SCARIFY, MOISTURE CONDITION, AND RE-COMPACT FOUNDATION MATERIALS PRIOR TO FILL PLACEMENT PER SPECIFICATION SECTION 31 00 00.
3. EXCAVATE TOE DRAIN TRENCH AT THE TOE OF THE PROPOSED EMBANKMENT DAM AND CONSTRUCT TOE DRAIN PER DETAIL 3 ON FIGURE 6. PLACE BLANKET DRAIN MATERIALS IN LOOSE LIFTS NOT EXCEEDING 8 INCHES IN THE GEOMETRY SPECIFIED IN DETAIL 1 ON SHEET 6 THEN MOISTURE CONDITION AND COMPACT EACH LIFT. CONTINUE PLACING LIFTS UNTIL REQUIRED BLANKET DRAIN THICKNESS IS ACHIEVED.
4. PLACE EMBANKMENT DAM FILL ACCORDING TO SLOPE GEOMETRY SHOWN IN DETAIL 1 ON FIGURE 6 IN LOOSE LIFTS NOT EXCEEDING 8 INCHES AND MOISTURE CONDITION AND COMPACT PER SPECIFICATION SECTION 31 00 00 PRIOR TO PLACEMENT OF EACH SUBSEQUENT LIFT. CUT BENCHES IN EXISTING EMBANKMENT DAM AND ABUTMENT SLOPES PER DETAIL 2 ON FIGURE 6 AS FILL PLACEMENT PROGRESSES. DO NOT LEAVE BENCHES UNSUPPORTED FOR GREATER THAN 12 HOURS.
5. RE-VEGETATE EMBANKMENT DAM AND ABUTMENT SLOPES FOLLOWING EMBANKMENT DAM CONSTRUCTION.

0 100 200
SCALE, FEET

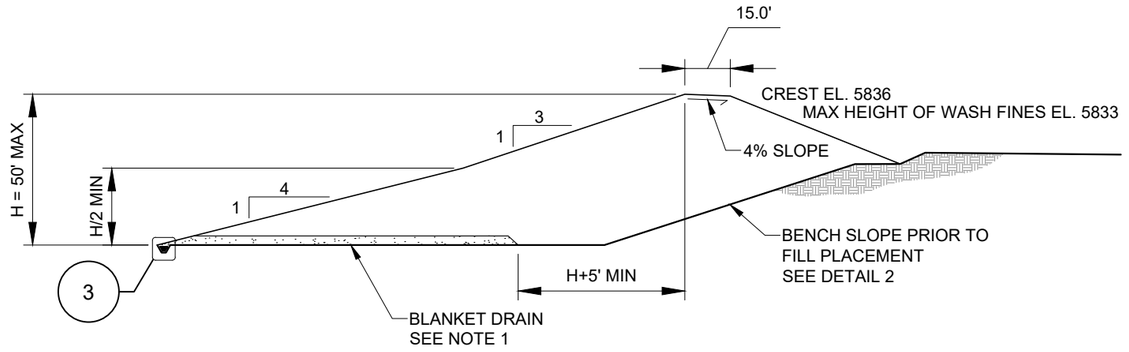
Construction Drawings
Daniels Sand Wash Fines Pond Embankment Dam Raise
El Paso County, Colorado

Holcim
Denver, Colorado

GEI Consultants

EMBANKMENT DAM GRADING PLAN

Project 2400434 | November 2024 | Fig. 5

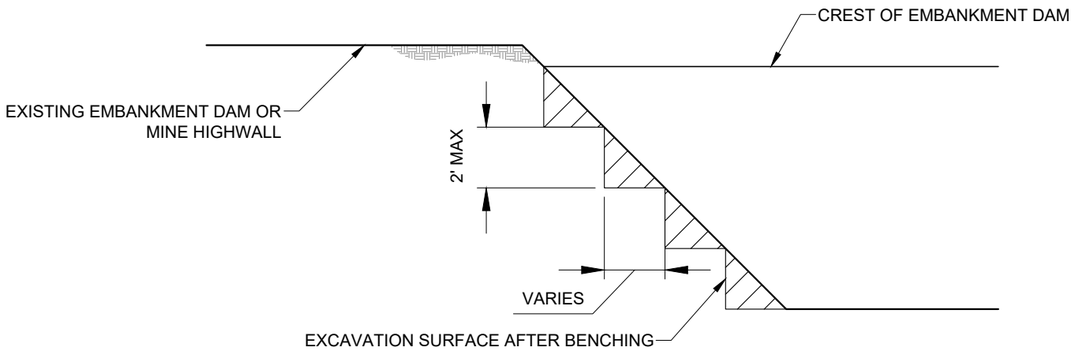


1 MAXIMUM SECTION A-A'

NO SCALE

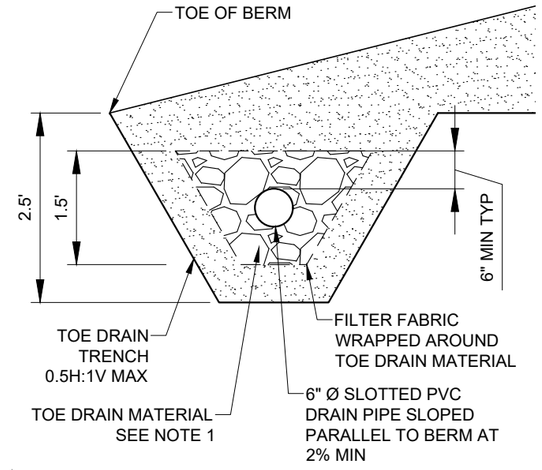
NOTES:

1. SEE SPECIFICATION SECTION 31 00 00 EARTHWORK FOR BLANKET DRAIN AND TOE DRAIN GRAIN SIZE DISTRIBUTION REQUIREMENTS.
2. CONSTRUCT BENCHES FOR NEW FILL PLACED AGAINST EXISTING SLOPES.
3. BENCHES TO BE CUT AS CONSTRUCTION PROGRESSES. BENCHES SHALL NOT REMAIN UNSUPPORTED FOR MORE THAN 12 HOURS.
4. PRIOR TO PLACEMENT OF FILL, ORIGINAL GROUND SURFACE SHALL BE SCARIFIED WITH A DISC OR SIMILAR EQUIPMENT AND MOISTURE CONTOLLED TO FACILITATE BONDING WITH NEW FILL.



2 BENCHING DETAIL TYPICAL

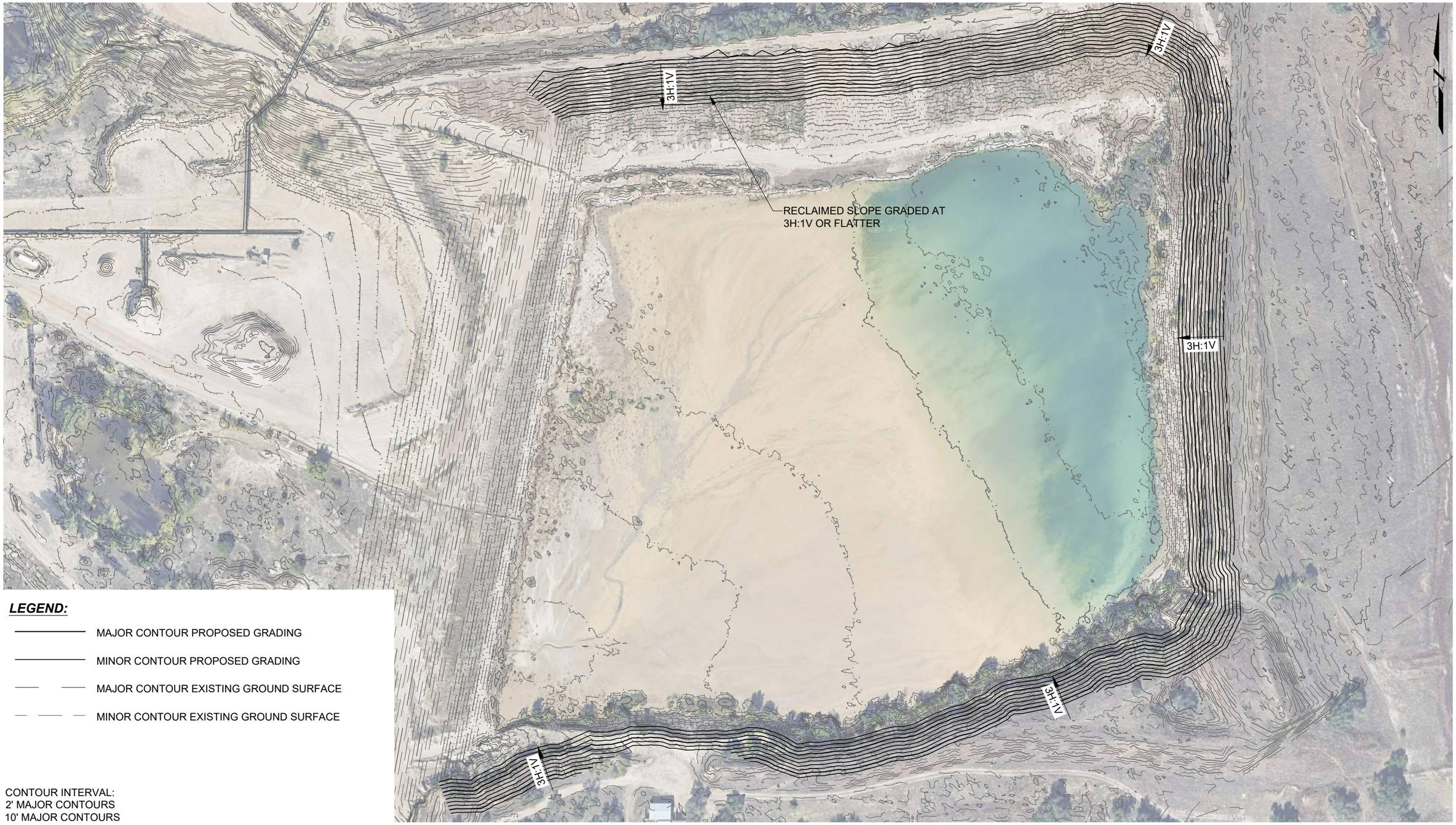
NO SCALE



3 TOE DRAIN DETAIL

NO SCALE

Construction Drawings Daniels Sand Wash Fines Pond Embankment Dam Raise El Paso County, Colorado	GEI Consultants	EMBANKMENT DAM SECTION AND DETAILS
Holcim Denver, Colorado	Project 2400434	November 2024 Fig. 6



LEGEND:

- MAJOR CONTOUR PROPOSED GRADING
- MINOR CONTOUR PROPOSED GRADING
- MAJOR CONTOUR EXISTING GROUND SURFACE
- MINOR CONTOUR EXISTING GROUND SURFACE

CONTOUR INTERVAL:
2' MAJOR CONTOURS
10' MAJOR CONTOURS

0 150 300
SCALE, FEET

Construction Drawings
Daniels Sand Wash Fines Pond Embankment Dam Raise
El Paso County, Colorado

Holcim
Denver, Colorado

GEI Consultants

Project 2400434

POND SLOPE RECLAMATION PLAN

November 2024 Fig. 7

Appendix A Previous Boring Logs and Laboratory Test Results

G:\Templates\CAD Stds\BA Test Boring Key.dwg

DESCRIPTION AND CLASSIFICATION OF SUBSURFACE MATERIALS

SOIL

Soil description on logs of subsurface explorations are based on Standard Penetration Test results, visual-manual examination of exposed soil and soil samples, and the results of laboratory tests on selected samples. The criteria, descriptive terms and definitions are as follows:

DENSITY OR CONSISTENCY

Density of Cohesionless Soils	SPT (Blows per ft)	Modified CA Sampler (Blows per ft)
Very Loose	0-4	0-4
Loose	5-10	5-12
Medium	11-30	13-35
Dense	31-50	36-60
Very Dense	over 50	over 60

Consistency of Cohesive Soils	SPT (Blows per ft)
Very Soft	0-2
Soft	3-4
Medium	5-8
Stiff	9-15
Very Stiff	16-30
Hard	over 30

PENETRATION RESISTANCE

Standard Penetration Test (ASTM D-1586) - Number of blows required to drive a standard 2 in. O.D. split spoon sampler 6 in. with a 140 lb. weight falling freely through 30 in. Penetration values (N-values) are generally counted over the lower 12 in. of sampler penetration.

COLOR: Basic colors and combinations: black, brown, gray, yellow-brown, etc.

MOISTURE CONTENT:

Dry	- Absence of moisture, dusty, dry to the touch
Moist	- Damp but no visible water
Wet	- Visible free water, usually soil is below water table

SUPPLEMENTAL SOIL TERMINOLOGY:

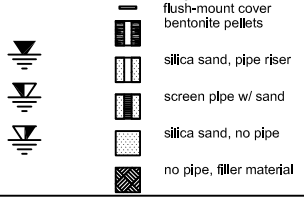
Bed	- A sedimentary layer bounded by depositional surfaces
Blocky	- A characteristic in which cohesive soil can be broken down into small angular lumps which resist further breakdown
Bonded	- Attached or adhering
Fissured	- Broken along definite planes of fracture
Foliated	- Planar arrangement of textural or structural features
Frequent	- More than one per 12 in. of thickness
Homogeneous	- Same color and appearance throughout
Interbedded	- Alternating soil layers of differing composition
Lamina	- 0 to 1/16 in. thick (cohesive)
Layer	- 1/2 to 12 in. thick
Lens	- Lenticular deposit larger than a pocket
Mottled	- Variation of color
Occasional	- One or less per 12 in. of thickness
Parting	- 0 to 1/16 in. thick (granular)
Pocket	- Small, erratic deposit less than 12 in. size
Seam	- 1/16 to 1/2 in. thick
Stratified	- Alternating layers of varying material or color
Stratum	- > 12 in. thick
Varved	- Annually alternating thin seams of silt and clay

FIELD GRADATION OBSERVATIONS

Trace	< 5%
Few	5 TO 10%
Little	15 TO 25%
Some	30 TO 45%
Mostly	50 TO 100%

Groundwater Level

Monitoring Well Details



GEOLOGIC INTERPRETATION

Deposit type - GLACIAL TILL, ALLUVIUM, FILL.....

The natural soils are identified by criteria of Unified Soil Classification System (USCS), with appropriate group symbol in parenthesis for each soil description. Fill materials may not be classified by USCS criteria.

U.S. Standard Series Sieve — Clear Square Sieve Openings

12"	3"	3/4"	4	10	40	200
Boulders	Cobbles	Gravel: Coarse / Fine		Sand: Coarse / Medium / Fine		Silts and Clays
305 mm	76 mm	19 mm	4.75 mm	2.00 mm	0.43 mm	0.074 mm

ROCK

Rock descriptions noted on logs of subsurface explorations are based on visual-manual examination of exposed rock outcrops and core samples. The criteria, descriptive terms and definitions used are as follows:

RQD: Rock Quality Designation-Sum of the length of recovered core pieces greater than or equal to 4 inches divided by the theoretical length of rock cored.

REC: Recovery Ratio-length of core recovered divided by the theoretical length of rock cored.

FIELD HARDNESS:

A measure of resistance to scratching.

Very Hard	Cannot be scratched with a knife point or sharp pick.
Hard	Can be scratched with a knife point or pick only with difficulty.
Medium Hard	Can be grooved or gouged 1/16 in. deep by firm pressure on knife or pick point.
Soft	Can be grooved or gouged easily with a knife or pick point.
Very Soft	Can be carved with a knife and excavated with a pick point. Can be scratched by fingernail.

WEATHERING:

The action of organic and inorganic and chemical and physical processes resulting in alteration of color, texture and composition.

Fresh-FR	No visible sign of alteration, except perhaps slight discoloration on major discontinuity surfaces.
Slight-SL	Discoloration of rock material and discontinuity surfaces.
Moderate-MOD	Less than half the rock material decomposed to soil. Fresh or discolored rock is present either as "framework" or as corestones.
High-HIGH	More than half the rock material decomposed and/or disintegrated to soil. Fresh or discolored rock is present as discontinuous "framework" or as corestones.
Complete-COMP	All rock material disintegrated to soil, but mass still intact.
Residual Soil	All rock material converted to soil. Volume of mass changed, but material has not been significantly transported.

COLOR: Basic colors and combinations: gray, light gray, brown, red-brown.

TEXTURE: Size, shape and arrangements of constituents.

Very Fine-grained	Individual grains invisible (igneous/metamorphic only).
Fine-grained	Grains barely visible to the unaided eye, up to 1/16 in. diameter.
Medium-grained	Grains between 1/16 and 3/16 in. diameter
Coarse-grained	Grains between 3/16 and 1/4 in. diameter
Very Coarse-grained	Grains larger than 1/4 in.

BEDDING:

Term	Inches
Extremely thin	< 0.75
Very thin	0.75-2.5
Thin	> 2.5-8
Medium	> 8-24
Thick	> 24

APERTURE:

Term	Width(in)
Tight	< 0.04
Partly Open	> 0.04 to 0.4
Open	> 0.4 to 2.0
Wide	>2.0

DISCONTINUITIES:

Natural breaks separating the intact rock material into discrete units.

Joint	Break of geologic origin in the continuity of a body of rock along which there has been no visible displacement. A group of parallel joints is called a set and joint sets intersect to form a joint system. Joints frequently form parallel to bedding planes, foliation and cleavage and may be termed bedding plane joints, foliation joints and cleavage joints accordingly.
Shear	Discontinuity in which differential movement has taken place parallel to the discontinuity surface, sufficient to produce slickensides (i.e. striations and polishing). Shear discontinuities may be accompanied by a zone of fractured rock up to a few inches wide.

ORIENTATION:

Relative to the horizontal

Term	Dip Angle (Degrees)
Horizontal	0-5
Low Angle	5-35
Moderately dipping	35-55
High Angle	55-85
Vertical	85-90

SPACING:

Distance between discontinuities

Term	Inches
Extremely close	Less than 3/4
Very close	3/4 to 2-1/2
Close	2-1/2 to 8
Moderate	8-24
Wide	24-80
Very Wide	> 80

GENERAL NOTES

1. Logs of subsurface explorations depict soil, rock and groundwater conditions only at the locations specified on the dates indicated. Subsurface conditions may vary at other locations and at other times.
2. The stratification lines designating the interface between soil types on the logs of borings and on the subsurface profile represent approximate boundaries. The transition between material may be gradual.
3. Water levels noted on the logs were measured at the times and under the conditions indicated. During test borings, these water levels could have been affected by the introduction of water into the borehole, extraction of tools or other procedures and thus may not reflect actual groundwater level at the test boring location. Groundwater level fluctuations may also occur as a result of variations in precipitation, temperature, season, adjacent construction activities and pumping of water supply wells and construction dewatering systems.
4. Solid lines represent change in geologic unit, dashed lines represents change in USCS classification within same geologic unit.
5. BR in the USCS classification column indicates bedrock.

BRIERLEY ASSOCIATES
Creating Space Underground

TEST BORING KEY

TEST BORING REPORT

Boring No. BA-1
Sheet No. 1 of 2

BRIERLEY ASSOCIATES
Creating Space Underground

990 S. Broadway
Suite 222
Denver, Colorado 80209

Project: Daniels Sand Wash Fines Pit
Client: Transit Mix
Drilling Contractor: Vine Laboratories, Inc.

File No. 516051-000
Start: 06/09/2016
Finish: 06/09/2016
Driller: Alex, Renee, Juan
BA Rep.: D. Kwietnewski

	Casing	Sampler	Barrel	Drilling Equipment and Procedures
Type	HSA	SS, CA		Rig Make & Model: CME 750 Buggy Rig
Inside Diameter (in.)	4.25"	1 3/8", 2"		Hoist/Hammer: Automatic
Hammer Weight (lb.)				Drill Method: Hollow Stem Auger
Hammer Fall (in.)				Bit Type: Cutting Head
				Casing: Hollow Stem Auger

Elevation:

Location: North side of the haul road, north of BA-2.

Water Level Data

Water Level	Date mm/dd/yy	Time	Elapsed Time	Bottom of Casing	Bottom of Hole	Depth to Water
▼	06/09/16		None	10'	10'	7.5'
▼						
▼						

Sample Identification

C California Barrel
CS Continuous Sampler
R Core
S Split Spoon
B Bulk
G Geoprobe
T Thin Wall Tube

Notes

Visual-Manual Identification and Description

Soil: Density/consistency, color, GROUP NAME, max. particle size, structure, odor, moisture,optional descriptions, geologic interpretation
Rock: Hardness, weathering, color, LITHOLOGY, texture, joint spacing, drilling rate (min./ft.)

Laboratory Results

Depth (ft.)	Elevation (ft.)	ID Depth (ft.) Rec.(in. or %)/RQD(%)	Blows/6 in.	Water Level	Stratigraphy	Visual-Manual Identification and Description	Well Diagram	Moisture (%)	Gravel (%)	Sand (%)	Fines (%)	LL (%)	PI (%)	UCS (ksf)	Swell/Collapse (%)	Swell Pressure (ksf)
0																
5		S-1 4.0-5.5 17"	6 7 8			Medium dense, medium brown, SILTY SAND (SM), trace gravel, mostly sand, some silt, some orange iron-oxide staining, moist.			0.3	69.9	29.8					
						-EOLIAN-										
						4.5 ft.										
				▼		3" lense of POORLY-GRADED SAND with SILT (SP-SM).										
						4.75 ft.										
						9 ft.										
10		S-2 9.0-10.5 17"	1 2 3			Medium stiff, brown, sandy, SILTY CLAY (CL-ML), some clay, some silt, little sand, moist.										
						-EOLIAN-										
						14 ft.										
15		S-3 14.0-15.5 16"	4 17 19			Top 8": dense, brown, SILTY SAND (SM), mostly fine sand with some silt.										
						14.7 ft.										
						Bottom 8": dense, orange-brown, POORLY- GRADED SAND (SP), mostly coarse sand, wet.										
						-EOLIAN-										
20		S-4 19.0-20.5 12"	5 5 7			Medium dense, orange-brown, POORLY-GRADED SAND (SP), mostly coarse sand.										
						19.67 ft.										
						Bottom 4": brown, SILTY SAND (SM), orange iron-oxide staining, mostly fine sand with some silt, wet, discolored.										
						-EOLIAN-										
						24 ft.										
25		S-5 24.0-25.5 12"	10 14 14			Dense, brown with red brown, WELL-GRADED SAND (SW), less than 5% fines, wet, visible frequent interbeds of 1/2 to 2" thick of varying color and gradations of sand.										
						-COARSE ALLUVIUM-										

Maximum particle size is determined by direct observation within the limitations of the sampler.

NOTE: Soil and rock identification based on visual-manual methods of the USCS as practiced by Brierley Associates.

TEST BORING REPORT

Boring No. BA-1
Sheet No. 2 of 2

BRIERLEY ASSOCIATES
Creating Space Underground

990 S. Broadway
Suite 222
Denver, Colorado 80209

Project: Daniels Sand Wash Fines Pit
Client: Transit Mix
Drilling Contractor: Vine Laboratories, Inc.

File No. 516051-000
Start: 06/09/2016
Finish: 06/09/2016
Driller: Alex, Renee, Juan
BA Rep.: D. Kwietnewski

	Casing	Sampler	Barrel	Drilling Equipment and Procedures
Type	HSA	SS, CA		Rig Make & Model: CME 750 Buggy Rig
Inside Diameter (in.)	4.25"	1 3/8", 2"		Hoist/Hammer: Automatic
Hammer Weight (lb.)				Drill Method: Hollow Stem Auger
Hammer Fall (in.)				Bit Type: Cutting Head
				Casing: Hollow Stem Auger

Elevation:

Location: North side of the haul road, north of BA-2.

Water Level Data

Water Level	Date mm/dd/yy	Time	Elapsed Time	Bottom of Casing	Bottom of Hole	Depth to Water
	06/09/16		None	10'	10'	7.5'

Sample Identification

C California Barrel
CS Continuous Sampler
R Core
S Split Spoon
B Bulk
G Geoprobe
T Thin Wall Tube

Notes

Depth (ft.)	Elevation (ft.)	ID Depth (ft.) Rec.(in. or %)/RQD(%)	Blows/6 in.	Water Level	Stratigraphy	Visual-Manual Identification and Description	Well Diagram	Moisture (%)	Gravel (%)	Sand (%)	Fines (%)	LL (%)	PI (%)	UCS (ksf)	Swell/Collapse (%)	Swell Pressure (ksf)
						Soil: Density/consistency, color, GROUP NAME, max. particle size, structure, odor, moisture,optional descriptions, geologic interpretation Rock: Hardness, weathering, color, LITHOLOGY, texture, joint spacing, drilling rate (min./ft.)			Laboratory Results								
30		S-6 29.0-30.5 12"	7 12 14			29 ft. Medium dense, brown, POORLY-GRADED SAND (SP), few gravel, mostly sand, trace fines, wet. -COARSE ALLUVIUM-			6.5	89.9	3.6					
						33.5 ft. Driller noted possible bedrock at 33.5'. Very soft, slightly weathered, dark-gray, CLAYSTONE (BR), mostly clay, dry, some slough in the top of the sampler. -PIERRE SHALE-										
35		C-7 34.0-35 12"	23 50/6"													
40		C-8 39.0-40 5"	50/5"			As above, except fresh. 39.42 ft.										
45																
50																
55																

TEST BORING REPORT

Boring No. BA-2
Sheet No. 1 of 2

BRIERLEY ASSOCIATES
Creating Space Underground
990 S. Broadway
Suite 222
Denver, Colorado 80209

Project: Daniels Sand Wash Fines Pit
Client: Transit Mix
Drilling Contractor: Vine Laboratories, Inc.

File No. 516051-000
Start: 06/09/2016
Finish: 06/09/2016
Driller: Alex, Renee, Juan
BA Rep.: D. Kwietnewski

	Casing	Sampler	Barrel
Type	HSA	SS	
Inside Diameter (in.)	4.25"	1 3/8"	
Hammer Weight (lb.)			
Hammer Fall (in.)			

Drilling Equipment and Procedures:
Rig Make & Model: CME 750 Buggy Rig
Hoist/Hammer: Automatic
Drill Method: Hollow Stem Auger
Bit Type: Cutting Head
Casing: Hollow Stem Auger

Elevation:

Location:
North side of the haul road, north of BA-3.

Water Level Data

Water Level	Date mm/dd/yy	Time	Elapsed Time	Bottom of Casing	Bottom of Hole	Depth to Water
▼	06/09/16		None	20'	20'	19'
▼						
▼						

Sample Identification

C California Barrel
CS Continuous Sampler
R Core
S Split Spoon
B Bulk
G Geoprobe
T Thin Wall Tube

Notes

Visual-Manual Identification and Description

Soil: Density/consistency, color, GROUP NAME, max. particle size, structure, odor, moisture,optional descriptions, geologic interpretation
Rock: Hardness, weathering, color, LITHOLOGY, texture, joint spacing, drilling rate (min./ft.)

Depth (ft.)	Elevation (ft.)	ID Depth (ft.) Rec.(in. or %)/RQD(%)	Blows/6 in.	Water Level	Stratigraphy	Visual-Manual Identification and Description	Well Diagram	Moisture (%)	Gravel (%)	Sand (%)	Fines (%)	LL (%)	PI (%)	UCS (ksf)	Swell/Collapse (%)	Swell Pressure (ksf)
0						Pit sand/Lt. Vegetation.										
5		S-1 4.0-5.5 18"	1 2 2			Loose, brown, POORLY-GRADED SAND with SILT (SP-SM), mostly fine to medium sand, some silt, moist. -EOLIAN-										
						9 ft.										
10		S-2 9.0-10.5 18"	7 4 5			Stiff, brown to gray, some mix of color, sandy LEAN CLAY (CL), mostly clay, moist, approximately 40% fines. -EOLIAN-										
						14 ft.										
15		S-3 14.0-15.5 18"	1 2 4			Medium stiff, brown, SILTY CLAY with sand (CL-ML), moist. -EOLIAN-										
				▼		19 ft.										
20		S-4 19.0-20.5 7"	4 3 3			Loose, tan-brown to brown, SILTY SAND (SM), few gravel, mostly sand, some silt, some iron-oxide staining, wet. -EOLIAN-			5.6	66.5	27.9					
						24 ft.										
25		S-5 24.0-25.5 17"	2 7 14			Top 9": stiff, brown, sandy SILTY CLAY (CL-ML). 24.75 ft. Bottom 8": medium dense, tan-brown, SILTY SAND (SM), wet. -EOLIAN-										

Maximum particle size is determined by direct observation within the limitations of the sampler.

NOTE: Soil and rock identification based on visual-manual methods of the USCS as practiced by Brierley Associates.

TEST BORING REPORT

Boring No. BA-2
Sheet No. 2 of 2

BRIERLEY ASSOCIATES
Creating Space Underground

990 S. Broadway
Suite 222
Denver, Colorado 80209

Project: Daniels Sand Wash Fines Pit
Client: Transit Mix
Drilling Contractor: Vine Laboratories, Inc.

File No. 516051-000
Start: 06/09/2016
Finish: 06/09/2016
Driller: Alex, Renee, Juan
BA Rep.: D. Kwietnewski

	Casing	Sampler	Barrel
Type	HSA	SS	
Inside Diameter (in.)	4.25"	1 3/8"	
Hammer Weight (lb.)			
Hammer Fall (in.)			

Drilling Equipment and Procedures:
Rig Make & Model: CME 750 Buggy Rig
Hoist/Hammer: Automatic
Drill Method: Hollow Stem Auger
Bit Type: Cutting Head
Casing: Hollow Stem Auger

Elevation:

Location:
North side of the haul road, north of BA-3.

Water Level Data

Water Level	Date mm/dd/yy	Time	Elapsed Time	Bottom of Casing	Bottom of Hole	Depth to Water
▼	06/09/16		None	20'	20'	19'
▼						
▼						

Sample Identification

C California Barrel
CS Continuous Sampler
R Core
S Split Spoon
B Bulk
G Geoprobe
T Thin Wall Tube

Notes

Visual-Manual Identification and Description

Soil: Density/consistency, color, GROUP NAME, max. particle size, structure, odor, moisture,optional descriptions, geologic interpretation
Rock: Hardness, weathering, color, LITHOLOGY, texture, joint spacing, drilling rate (min./ft.)

Depth (ft.)	Elevation (ft.)	ID Depth (ft.) Rec.(in. or %)/RQD(%)	Blows/6 in.	Water Level	Stratigraphy	Visual-Manual Identification and Description	Well Diagram	Moisture (%)	Gravel (%)	Sand (%)	Fines (%)	LL (%)	PI (%)	UCS (ksf)	Swell/Collapse (%)	Swell Pressure (ksf)
30		S-6 29.0-30.5 10"	4 9 12			29 ft. Medium dense, tan-brown, WELL-GRADED GRAVEL (GW), mostly gravel, less than 5% fines, wet, sampler stuck/heaving sands. -COARSE ALLUVIUM-										
35		S-7 34.0-35.5 17"	3 8 12			34 ft. Medium dense, brown, POORLY-GRADED SAND (SP), trace gravel, mostly sand, few fines, wet. -COARSE ALLUVIUM- Heaving sands/hard to get center bit back into position. Pulled back approximately 5' and redrilled. Keeping HSA charged with water.			4.1	90.9	5					
40		C-8 39.0-40 5"	50/5"			37.5 ft. *Driller indicated possible bedrock at 37.5'. -PIERRE SHALE- Very soft, fresh, dark gray, CLAYSTONE (BR), mostly clay, dry.										
45		C-9 44.0-45 3"	50/3"			Very soft, fresh, as above. 44.25 ft.										
50																
55																

Laboratory Results

TEST BORING REPORT

Boring No. BA-3
Sheet No. 1 of 2

BRIERLEY ASSOCIATES
Creating Space Underground

990 S. Broadway
Suite 222
Denver, Colorado 80209

Project: Daniels Sand Wash Fines Pit
Client: Transit Mix
Drilling Contractor: Vine Laboratories, Inc.

File No. 516051-000
Start: 06/03/2016
Finish: 06/03/2016
Driller: Owen Potter
BA Rep.: S. Bailey

	Casing	Sampler	Barrel
Type	HSA	SS, CA	
Inside Diameter (in.)	4.25"	1 3/8", 2"	
Hammer Weight (lb.)			
Hammer Fall (in.)			

Drilling Equipment and Procedures:
Rig Make & Model: CME 750 Buggy Rig
Hoist/Hammer: Automatic
Drill Method: Hollow Stem Auger
Bit Type: Cutting Head
Casing: Hollow Stem Auger

Elevation:

Location:
North side of the haul road.

Water Level Data

Water Level	Date mm/dd/yy	Time	Elapsed Time	Bottom of Casing	Bottom of Hole	Depth to Water
▼	06/03/16	9:21	None	25'	25'	20'
▼						
▼						

Sample Identification

C California Barrel
CS Continuous Sampler
R Core
S Split Spoon
B Bulk
G Geoprobe
T Thin Wall Tube

Notes

Depth (ft.)	Elevation (ft.)	ID Depth (ft.) Rec.(in. or %)/RQD(%)	Blows/6 in.	Water Level	Stratigraphy	Visual-Manual Identification and Description	Well Diagram	Moisture (%)	Gravel (%)	Sand (%)	Fines (%)	LL (%)	PI (%)	UCS (ksf)	Swell/Collapse (%)	Swell Pressure (ksf)
0						Soil: Density/consistency, color, GROUP NAME, max. particle size, structure, odor, moisture,optional descriptions, geologic interpretation Rock: Hardness, weathering, color, LITHOLOGY, texture, joint spacing, drilling rate (min./ft.)										
5		S-1 4.0-5.5 18"	5 5 6			Medium dense, brown, SILTY CLAYEY SAND (SC-SM), mostly fine to medium sand, some silt and clay, no odor, moist. -EOLIAN-										
						9 ft.										
10		S-2 9.0-10.5 13"	4 5 7			Very stiff, gray/orange, sandy LEAN CLAY (CL), mostly clay, little fine sand, no odor, moist, medium plasticity, iron-oxide staining. -EOLIAN-					71.1	32	15			
						14 ft.										
15		S-3 14.0-15.5 18"	7 8 10			Medium dense, brown/orange, SILTY CLAYEY SAND (SC-SM), mostly fine to medium sand, some silt and clay, no odor, moist, trace of coarse sand and gravel, slight iron-oxide staining. -EOLIAN-										
20		S-4 19.0-20.5 18"	4 4 7	▼		Medium dense, brown, no coarse sand or gravel, as above.										
						24 ft.										
25		S-5 24.0-25.5 18"	3 4 7			Stiff, brown/gray, FAT CLAY with sand (CH), mostly clay, little fine to medium sand, no odor, wet, highly plastic, trace of coarse sand. -EOLIAN-										

Laboratory Results

Maximum particle size is determined by direct observation within the limitations of the sampler.

NOTE: Soil and rock identification based on visual-manual methods of the USCS as practiced by Brierley Associates.

TEST BORING REPORT

Boring No. BA-3
Sheet No. 2 of 2

BRIERLEY ASSOCIATES
Creating Space Underground

990 S. Broadway
Suite 222
Denver, Colorado 80209

Project: Daniels Sand Wash Fines Pit
Client: Transit Mix
Drilling Contractor: Vine Laboratories, Inc.

File No. 516051-000
Start: 06/03/2016
Finish: 06/03/2016
Driller: Owen Potter
BA Rep.: S. Bailey

	Casing	Sampler	Barrel
Type	HSA	SS, CA	
Inside Diameter (in.)	4.25"	1 3/8", 2"	
Hammer Weight (lb.)			
Hammer Fall (in.)			

Drilling Equipment and Procedures:
Rig Make & Model: CME 750 Buggy Rig
Hoist/Hammer: Automatic
Drill Method: Hollow Stem Auger
Bit Type: Cutting Head
Casing: Hollow Stem Auger

Elevation:

Location:
North side of the haul road.

Water Level Data

Water Level	Date mm/dd/yy	Time	Elapsed Time	Bottom of Casing	Bottom of Hole	Depth to Water
▼	06/03/16	9:21	None	25'	25'	20'

Sample Identification

C California Barrel
CS Continuous Sampler
R Core
S Split Spoon
B Bulk
G Geoprobe
T Thin Wall Tube

Notes

Depth (ft.)	Elevation (ft.)	ID Depth (ft.) Rec.(in. or %)/RQD(%)	Blows/6 in.	Water Level	Stratigraphy	Visual-Manual Identification and Description	Well Diagram	Moisture (%)	Gravel (%)	Sand (%)	Fines (%)	LL (%)	PI (%)	UCS (ksf)	Swell/Collapse (%)	Swell Pressure (ksf)
30		S-6 29.0-30.5 6"	0 0 1			Soil: Density/consistency, color, GROUP NAME, max. particle size, structure, odor, moisture,optional descriptions, geologic interpretation Rock: Hardness, weathering, color, LITHOLOGY, texture, joint spacing, drilling rate (min./ft.)										
						29 ft. Very loose, brown, WELL-GRADED SAND with CLAY (SW-SC), mostly fine to medium sand, little coarse sand, little clay, no odor, wet. -COARSE ALLUVIUM-											
35		S-7 34.0-35.5 18"	7 14 18			34 ft. Dense, tan, WELL-GRADED SAND (SW), mostly fine to medium sand, little to some coarse sand, trace to few fine gravel, trace of fines, no odor, wet. -COARSE ALLUVIUM-											
40		S-8 39.0-40.5 13"	7 11 15			Top 6": as above. 39.5 ft. Bottom 7": very soft, highly weathered, dark-gray, CLAYSTONE (BR), blocky, mostly clay, no odor, dry, highly plastic, iron-oxide staining. -PIERRE SHALE-										
45		C-9 44.0-45 5"	50/4"			Very soft, fresh, dark-gray, as above.										
50		C-10 49.0-50 4"	50/3"			As above. 49.25 ft.										
55																

Laboratory Results

TEST BORING REPORT

Boring No. BA-4
Sheet No. 1 of 2

BRIERLEY ASSOCIATES
Creating Space Underground

990 S. Broadway
Suite 222
Denver, Colorado 80209

Project: Daniels Sand Wash Fines Pit
Client: Transit Mix
Drilling Contractor: Vine Laboratories, Inc.

File No. 516051-000
Start: 06/09/2016
Finish: 06/09/2016
Driller: Alex, Renee, Juan
BA Rep.: D. Kwietnewski

	Casing	Sampler	Barrel
Type	HSA	SS, CA	
Inside Diameter (in.)	4.25"	1 3/8", 2"	
Hammer Weight (lb.)			
Hammer Fall (in.)			

Drilling Equipment and Procedures:
Rig Make & Model: CME 750 Buggy Rig
Hoist/Hammer: Automatic
Drill Method: Hollow Stem Auger
Bit Type: Cutting Head
Casing: Hollow Stem Auger

Elevation:

Location:
South side of the haul road.

Water Level Data

Water Level	Date mm/dd/yy	Time	Elapsed Time	Bottom of Casing	Bottom of Hole	Depth to Water
▼	06/09/16		None	20'	20'	18'
▼						
▼						

Sample Identification

C California Barrel
CS Continuous Sampler
R Core
S Split Spoon
B Bulk
G Geoprobe
T Thin Wall Tube

Notes

Depth (ft.)	Elevation (ft.)	ID Depth (ft.) Rec.(in. or %)/RQD(%)	Blows/6 in.	Water Level	Stratigraphy	Visual-Manual Identification and Description	Well Diagram	Moisture (%)	Gravel (%)	Sand (%)	Fines (%)	LL (%)	PI (%)	UCS (ksf)	Swell/Collapse (%)	Swell Pressure (ksf)
0						Soil: Density/consistency, color, GROUP NAME, max. particle size, structure, odor, moisture,optional descriptions, geologic interpretation Rock: Hardness, weathering, color, LITHOLOGY, texture, joint spacing, drilling rate (min./ft.)										
5		S-1 4.0-5.5 18"	5 6 7			Medium dense, light-brown, POORLY-GRADED SAND (SP), mostly fine to medium sand, with less than 5% of fines. -EOLIAN-										
						9 ft.										
10		S-2 9.0-10.5 18"	1 4 4			Medium stiff, orange brown, sandy SILTY CLAY (CL-ML), mostly clay with some fine sand and silt, moist. -EOLIAN-										
						14 ft.										
15		S-3 14.0-15.5 17"	2 3 4			Medium stiff, brown and orange brown, LEAN CLAY (CL), mostly clay, slightly plastic, moist. -EOLIAN-					69.8	28	12			
				▼												
20		C-4 19.0-20 12"	4 6			Stiff, moddled brown/red/gray, LEAN CLAY with sand (CL), mostly clay with some fine sand and little silt, moist.										
						24 ft.										
25		S-5 24.0-25.5 18"	4 4 7			Medium dense, tan-brown, SILTY CLAYEY SAND (SC-SM), mostly well graded sand with some silt and clay. -EOLIAN-										

Maximum particle size is determined by direct observation within the limitations of the sampler.

NOTE: Soil and rock identification based on visual-manual methods of the USCS as practiced by Brierley Associates.

TEST BORING REPORT

Boring No. BA-4
Sheet No. 2 of 2

BRIERLEY ASSOCIATES
Creating Space Underground

990 S. Broadway
Suite 222
Denver, Colorado 80209

Project: Daniels Sand Wash Fines Pit
Client: Transit Mix
Drilling Contractor: Vine Laboratories, Inc.

File No. 516051-000
Start: 06/09/2016
Finish: 06/09/2016
Driller: Alex, Renee, Juan
BA Rep.: D. Kwietnewski

	Casing	Sampler	Barrel
Type	HSA	SS, CA	
Inside Diameter (in.)	4.25"	1 3/8", 2"	
Hammer Weight (lb.)			
Hammer Fall (in.)			

Drilling Equipment and Procedures:
Rig Make & Model: CME 750 Buggy Rig
Hoist/Hammer: Automatic
Drill Method: Hollow Stem Auger
Bit Type: Cutting Head
Casing: Hollow Stem Auger

Elevation:

Location:
South side of the haul road.

Water Level Data

Water Level	Date mm/dd/yy	Time	Elapsed Time	Bottom of Casing	Bottom of Hole	Depth to Water
	06/09/16		None	20'	20'	18'

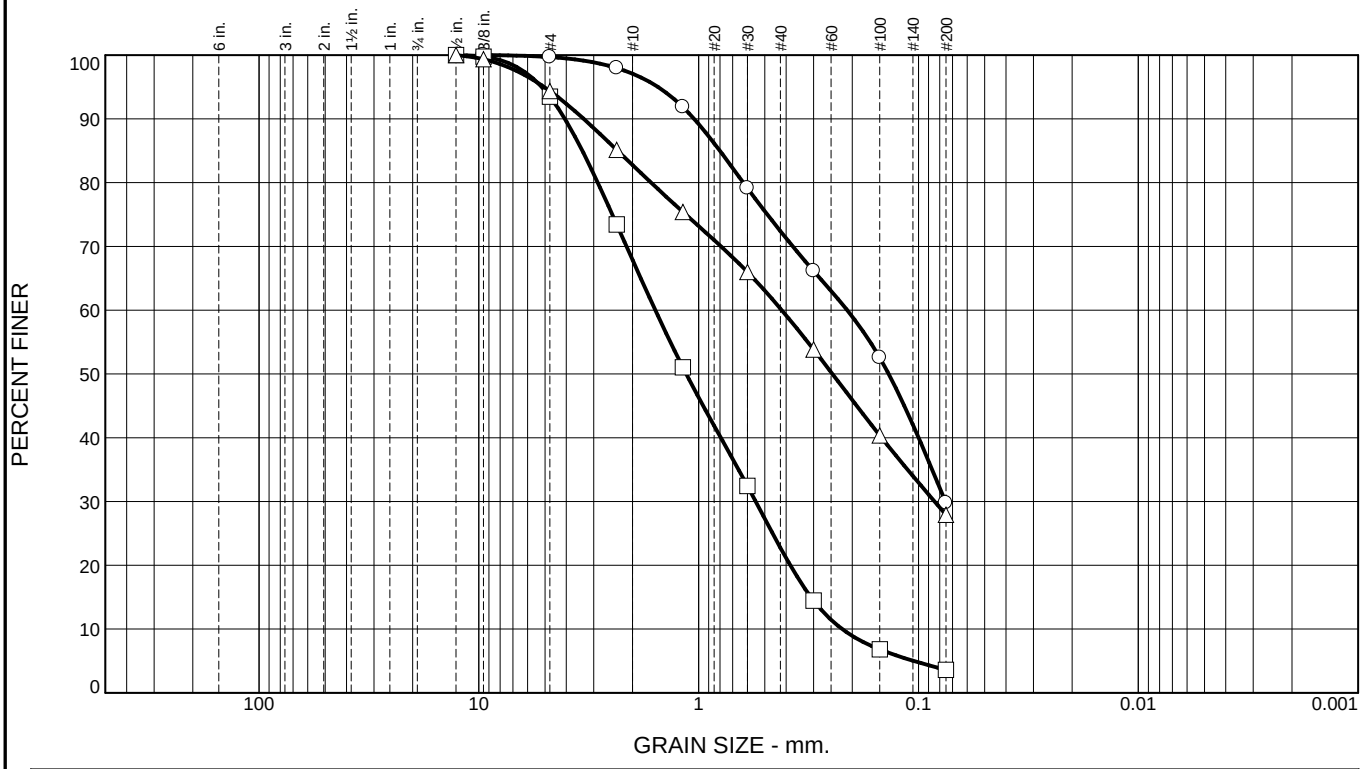
Sample Identification

C California Barrel
CS Continuous Sampler
R Core
S Split Spoon
B Bulk
G Geoprobe
T Thin Wall Tube

Notes

Depth (ft.)	Elevation (ft.)	ID Depth (ft.) Rec.(in. or %)/RQD(%)	Blows/6 in.	Water Level	Stratigraphy	Visual-Manual Identification and Description	Well Diagram	Moisture (%)	Gravel (%)	Sand (%)	Fines (%)	LL (%)	PI (%)	UCS (ksf)	Swell/Collapse (%)	Swell Pressure (ksf)
						Soil: Density/consistency, color, GROUP NAME, max. particle size, structure, odor, moisture,optional descriptions, geologic interpretation Rock: Hardness, weathering, color, LITHOLOGY, texture, joint spacing, drilling rate (min./ft.)			Laboratory Results								
30		S-6 29.0-30.5 18"	9 11 7			29 ft. Medium dense, orange-brown, SILTY SAND (SM), mostly coarse sand, trace gravel, some silt. -COARSE ALLUVIUM-			1.8	68.9	29.3					
35		S-7 34.0-35.5 14"	5 9 13			34 ft. Medium dense, brown to orange-brown, POORLY-GRADED SAND with SILT (SP-SM), few gravel, mostly sand, few silt, wet. -COARSE ALLUVIUM-			5.9	86	8.1					
40		S-8 39.0-40.5 19"	8 15 22			39 ft. Dense, POORLY-GRADED SAND (SP), mostly fine sand from 39-39.75', mostly medium to coarse sand from 39.75-40.5'. -COARSE ALLUVIUM-										
45		C-9 44.0-45 8"	32 50/4"			44 ft. Very soft, slightly weathered, dark-gray, CLAYSTONE (BR), mostly clay. -PIERRE SHALE-										
50			50/2"			Very soft, fresh, as above. 49.2 ft.										
55																

Particle Size Distribution Report



	+3"	% GRAVEL	% SAND	% SILT	% CLAY	USCS	LL	PL	PI
○	0.0	0.3	69.9	29.8					
□	0.0	6.5	89.9	3.6		SP			
△	0.0	5.6	66.5	27.9					

SIEVE inches size	PERCENT FINER ○	□	△
1/2		100.0	100.0
3/8	100.0	99.8	99.4
GRAIN SIZE			
D_{60}	0.2109	1.5745	0.4186
D_{30}	0.0755	0.5501	0.0845
D_{10}		0.2226	
COEFFICIENTS			
C_c		0.86	
C_u		7.07	

SIEVE number size	PERCENT FINER ○	□	△
#4	99.7	93.5	94.4
#8	98.0	73.4	85.1
#16	91.9	51.0	75.4
#30	79.1	32.4	66.0
#50	66.1	14.5	53.8
#100	52.5	6.8	40.4
#200	29.8	3.6	27.9

Material Description
○
□
△

REMARKS:
○
□
△

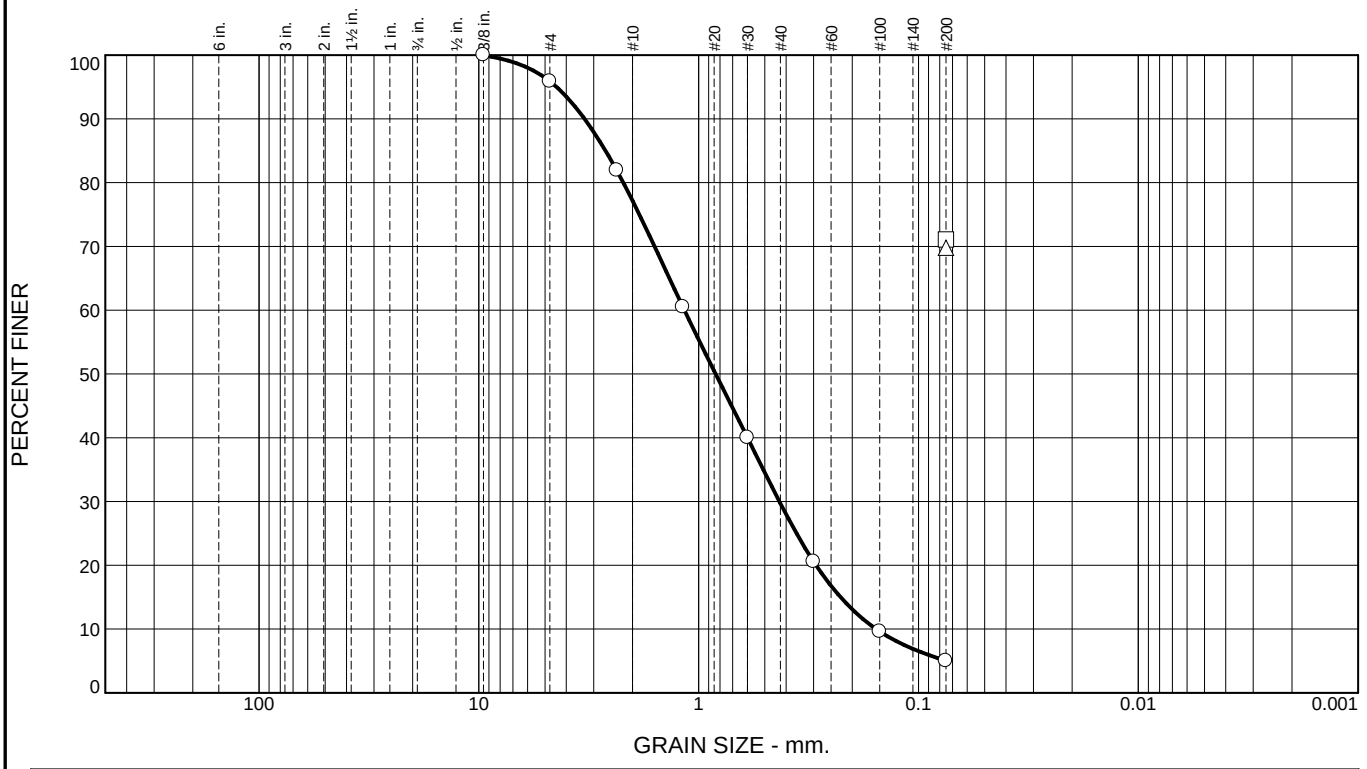
○ Location: BA-1 S-1 Depth: 5' Sample Number: 4780
□ Location: BA-1 S-6 Depth: 30' Sample Number: 4781
△ Location: BA-2 S-4 Depth: 20' Sample Number: 4782

Martinez Associates

Client: Brierley Associates, Inc. BA # 516051-000
Project: Daniels Sand Wash Fines Pit
Project No.: 16-0079 Figure

Tested By: WS Greer **Checked By:** K. Runner

Particle Size Distribution Report



	+3"	% GRAVEL	% SAND	% SILT	% CLAY	USCS	LL	PL	PI
○	0.0	4.1	90.9	5.0					
□							32	17	15
△							28	16	12

SIEVE inches size	PERCENT FINER ○	□	△
3/8	100.0		
	GRAIN SIZE		
D_{60}	1.1609		
D_{30}	0.4291		
D_{10}	0.1558		
	COEFFICIENTS		
C_c	1.02		
C_u	7.45		

SIEVE number size	PERCENT FINER ○	□	△
#4	95.9		
#8	81.9		
#16	60.5		
#30	40.0		
#50	20.6		
#100	9.6		
#200	5.0	71.1	69.8

Material Description
○
□
△

REMARKS:
○
□
△

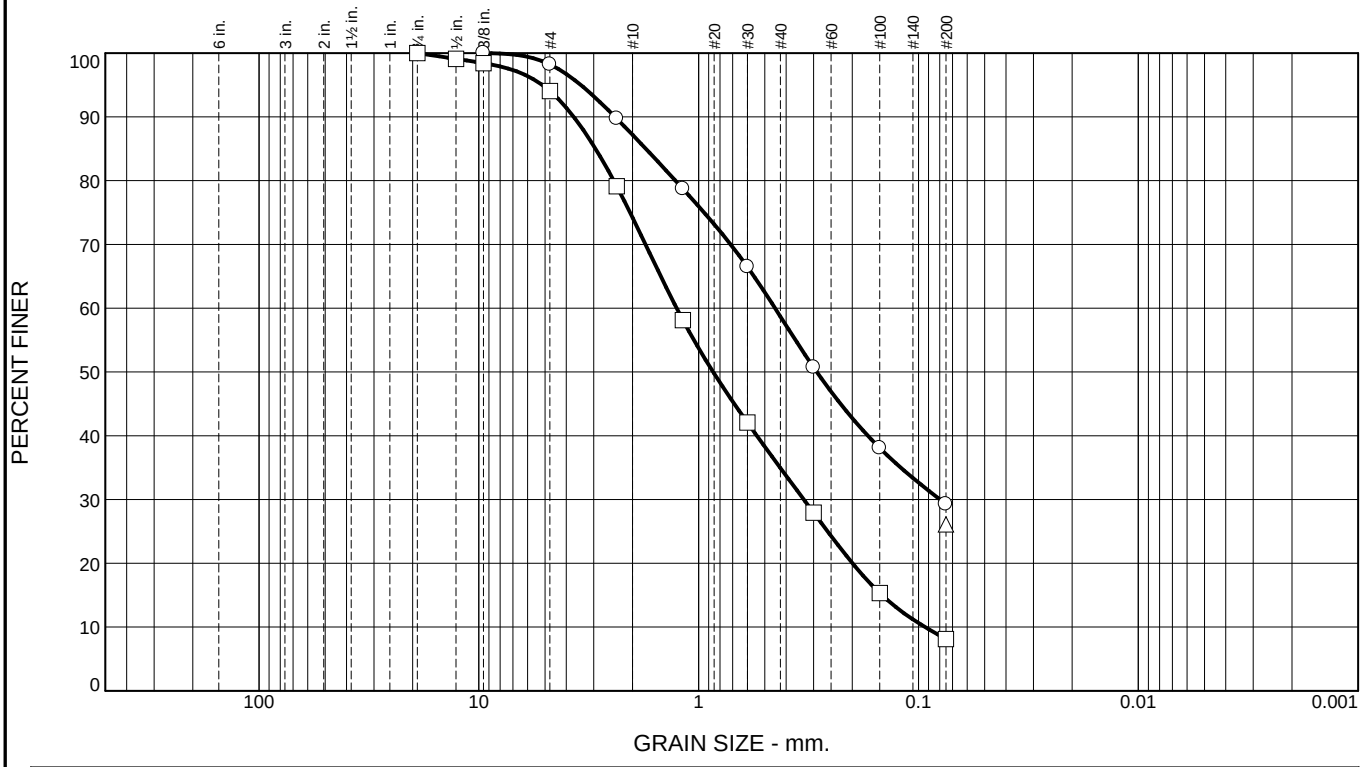
○ Location: BA-2 S-7 Depth: 35' Sample Number: 4783
□ Location: BA-3 S-2 Depth: 10' Sample Number: 4784
△ Location: BA-4 S-3 Depth: 15' Sample Number: 4785

Martinez Associates

Client: Brierley Associates, Inc. BA # 516051-000
Project: Daniels Sand Wash Fines Pit
Project No.: 16-0079 Figure

Tested By: WS Greer **Checked By:** K. Runner

Particle Size Distribution Report



	+3"	% GRAVEL	% SAND	% SILT	% CLAY	USCS	LL	PL	PI
○	0.0	1.8	68.9	29.3					
□	0.0	5.9	86.0	8.1					
△							23	18	5

SIEVE inches size	PERCENT FINER ○	□	△
3/4		100.0	
1/2		99.1	
3/8	100.0	98.4	
	GRAIN SIZE		
D_{60}	0.4493	1.2595	
D_{30}	0.0799	0.3324	
D_{10}		0.0933	
	COEFFICIENTS		
C_c		0.94	
C_u		13.50	

SIEVE number size	PERCENT FINER ○	□	△
#4	98.2	94.1	
#8	89.7	79.1	
#16	78.7	58.1	
#30	66.5	42.1	
#50	50.7	27.9	
#100	38.1	15.3	
#200	29.3	8.1	26.1

Material Description
○
□
△

REMARKS:
○
□
△

○ Location: BA-4 S-6 Depth: 30' Sample Number: 4786
□ Location: BA-4 S-7 Depth: 35' Sample Number: 4787
△ Location: BULK 1 Sample Number: 4788

Martinez Associates

Client: Brierley Associates, Inc. BA # 516051-000
Project: Daniels Sand Wash Fines Pit
Project No.: 16-0079 Figure

Tested By: WS Greer **Checked By:** K. Runner

COMPACTION TEST REPORT

Curve No.: 4801

Project No.: 16-0079 **Date:** 6-24-16

Project: Daniels Sand Wash Fines Pit

Client: Brierley Associates, Inc. BA # 516051-000

Location: Site Stockpile

Sample Number: 4801

Remarks:

MATERIAL DESCRIPTION

Description:

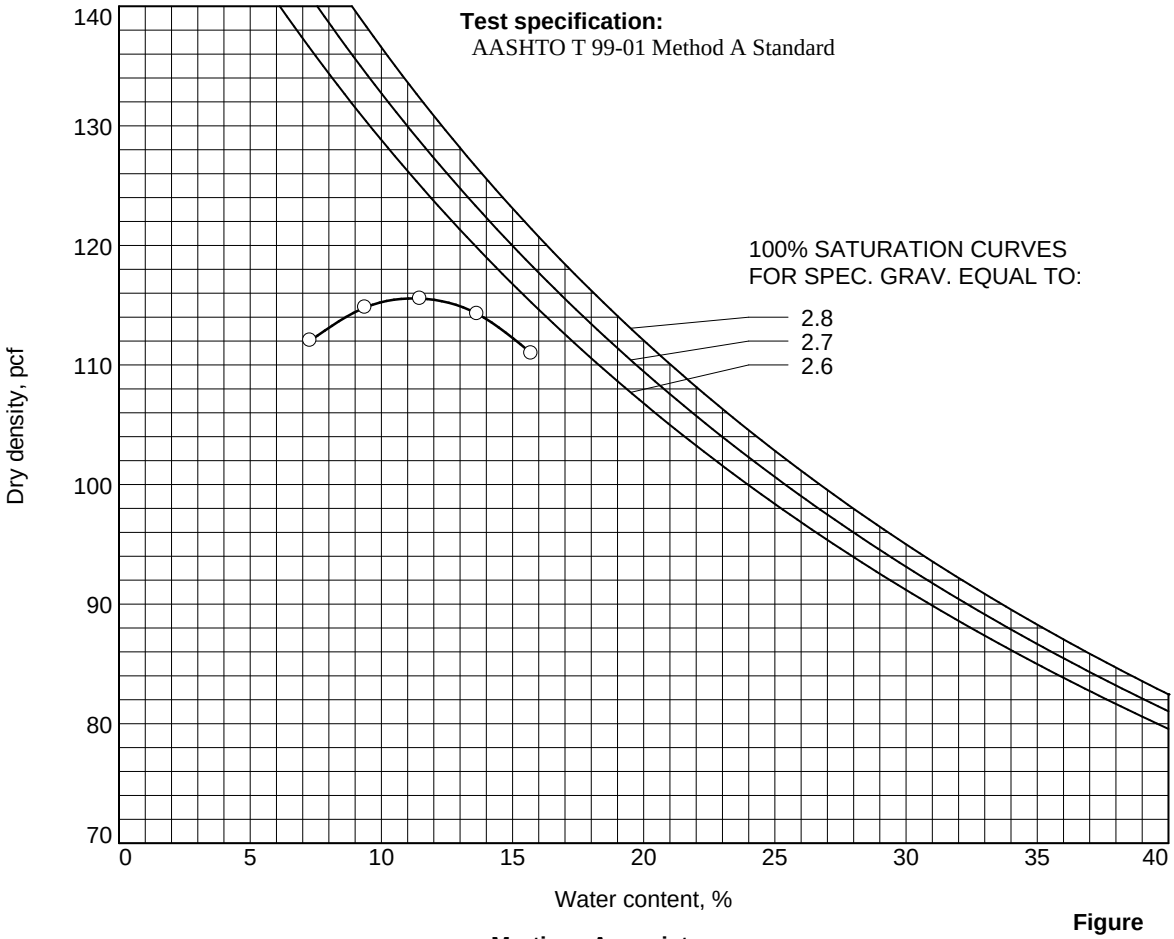
Classifications - **USCS:** **AASHTO:**

Nat. Moist. = **Sp.G. =**

Liquid Limit = **Plasticity Index =**

% < No.200 =

TEST RESULTS
Maximum dry density = 115.6 pcf
Optimum moisture = 11.2 %



Figure

Martinez Associates

Tested By: T. Abel **Checked By:** K. Runner

Appendix B Hydrology Report

GEI Consultants	**Client**	Holcim			**Page**	1 of 2
	Project	Daniels Sand Wash Fines Pit			**Rev.**	0
	By	KDS	**Chk.**	CEF	**App.**	
	Date	8/15/2024	**Date**	8/16/2024	**Date**	
GEI Project No.	2301310	**Document No.**	N/A			
Subject	Stormwater Calculations for DSWFP					

Purpose:

The purpose of this calculation is to estimate the flood stage of the settling pond due to runoff generated from the 100-year and 200-year storm and the one-half Probable Maximum Precipitation (PMP) events, (both HMR 55A and CO-NM REPS) assuming no outflow via an emergency overflow spillway or return water pumping system. The tailings basin was assumed to store all runoff from these large storm events until it can be safely discharged through the return water pumping system.

Design Criteria and Assumptions:

1. The contributing watershed is approximately 29 acres (0.5 square miles) and is limited to the area of the fines pit and side slopes. The land uses are as follows:
    a. A settling pond of approximately 22 acres.
    b. Approximately 7 acres of sloped wall.
2. The maximum normal operating settling pond elevation was assumed to be approximately +5,818 feet for a dam elevation of +5,821 feet for the 2 year buildout plan.
3. The maximum normal operating settling pond elevation was assumed to be approximately +5,833 feet for a dam elevation of +5,836 feet for the 7 year buildout plan.
4. HydroCAD 10.10 was used to model the stormwater at Daniels Sand Wash Fines Pit.
5. The storm events include: (calculations are included in an attached calc package)
    a. 100-Year Storm: 5.15 inches of rainfall, 24-hour duration
    b. 200-Year Storm: 6.01 inches of rainfall, 24-hour duration
    c. One-Half PMP (HMR 55A): 17.5 inches of rainfall, 24-hour duration
    d. One-Half PMP (CO-NM REPS): 14.9 inches of rainfall, 24-hour duration
6. Reservoir Elevation-Storage Relationship: The stage-storage relationships are based upon estimated topographical information for the planned tailings beach contours. Figures 1 and 2 illustrate the estimated surface elevations that were used to determine the available storage volume of the basin.
7. Wind induced wave estimates included in attached calculation package.

Results:

The attached HydroCAD report includes input and output for the stormwater model developed for the Daniels Sand Wash Fines Pit. The table below is a summary of the waves and pond rise due to the analyzed storm events. Based on the anticipated tailings contours and HydroCAD modeling, it is anticipated that if the ½ PMP (HMR 55A) is realized and wave run up is considered, the containment dam may overtop under the current 2-Year planned buildout. A minimum freeboard of 3.0 feet will contain the ½ PMP (CO-NM REPS), 100-Year, and 200-Year storm events. If the minimum freeboard of 3.0 feet is maintained after the 7-Year buildout, all four storm events are not expected to overtop the dam.

2-Year Buildout Storm Events Water Elevations

Summary:

Storm Event	(A) Pond Starting Elevation* (feet)	(B) Wave Run-up (feet)	(C) Wind Set-up (feet)	(D) Approximate Rise of Pond Due to Storm (feet)	(E) Maximum Water Surface Elevation (A+B+C+D) (feet)	(F) Minimum Crest of Water Retention Dam (feet)	(G) Available Freeboard (F-E) (feet)
100 Year	5818.00	0.72	0.35	0.62	5819.69	5821.00	1.31
200-Year	5818.00	0.72	0.35	0.73	5819.80	5821.00	1.20
1/2PMP (CO-NM REPS)	5818.00	0.72	0.35	1.85	5820.92	5821.00	0.08
½ PMP (HMR55A)	5818.00	0.72	0.35	2.16	5821.23	5821.00	-0.23

*Assumes a maximum pond elevation of +5,818 feet for a Water Retention Dam elevation of +5,821 feet.

7-Year Buildout Storm Events Water Elevations

Summary:

Storm Event	(A) Pond Starting Elevation* (feet)	(B) Wave Run-up (feet)	(C) Wind Set-up (feet)	(D) Approximate Rise of Pond Due to Storm (feet)	(E) Maximum Water Surface Elevation (A+B+C+D) (feet)	(F) Minimum Crest of Water Retention Dam (feet)	(G) Available Freeboard (F-E) (feet)
100 Year	5833.00	0.72	0.35	0.52	5834.59	5836.00	1.41
200-Year	5833.00	0.72	0.35	0.62	5834.69	5836.00	1.31
1/2PMP (CO-NM REPS)	5833.00	0.72	0.35	1.61	5835.68	5836.00	0.32
½ PMP (HMR55A)	5833.00	0.72	0.35	1.89	5835.96	5836.00	0.04

*Assumes a maximum pond elevation of +5,833 feet for a dam elevation of +5,836 feet.

GEI Consultants	**Client**	Holcim			**Page**	
	Project	Daniels Sand Wash Fines Pit			**Rev.**	
	By	KDS	**Chk.**	CEF	**App.**	
	Date	8/15/2024	**Date**	8/16/2024	**Date**	
GEI Project No.	2400434	**Document No.**	N/A			
Subject	Stormwater Calculations for DSWFP					

Attachments:

- HydroCAD Summary Report
- Precipitation Calculations
- Wind Induced Wave Calculations

GEI Consultants	**Client**	Holcim			**Page**	
	Project	Daniels Sand Wash Fines Pit			**Rev.**	
	By	KDS	**Chk.**	CEF	**App.**	
	Date	8/15/2024	**Date**	8/16/2024	**Date**	
GEI Project No.	2400434	**Document No.**	N/A			
Subject	Design Precipitation Estimates for Daniels Sand Wash Fines Pit					

Purpose:

The purpose of this analysis is to estimate the precipitation quantity for selected storm events which will be utilized in other calculations to estimate that Daniels Sand Wash Fines Pit can safely store runoff associated with the analyzed storm events. The analyzed storm events include the 100/200-year, 24-hour, and the ½ PMP, 24-hour probable maximum precipitation (PMP) events.

Procedure:

100/200-year, 24-hour Storm Event:

The rainfall depth estimation for the 100/200-year, 24-hour event follows the procedures outlined in Precipitation-Frequency (PF) Atlas of the United States (Atlas 14, Volume 8, Version 2: Colorado). As instructed in Atlas 14, the user is referred to the NOAA Precipitation Frequency Data Server (PFDS) http://hdsc.nws.noaa.gov/hdsc/pfds/index.html. The approximate center of Daniels Sand Wash Fines Pit was input into the PFDS and the PF estimates were returned.

Daniels Sand Wash Fines Pit Coordinates

38.7739°, -104.7507°

GEI Consultants	**Client**	Holcim			**Page**	
	Project	Daniels Sand Wash Fines Pit			**Rev.**	
	By	KDS	**Chk.**	CEF	**App.**	
	Date	8/15/2024	**Date**	8/16/2024	**Date**	
GEI Project No.	2400434	**Document No.**	N/A			
Subject	Design Precipitation Estimates for Daniels Sand Wash Fines Pit					

Tabular Output from the PFDS:

PDS-based precipitation frequency estimates with 90% confidence intervals (in inches)[1]

Duration	Average recurrence interval (years)									
	1	2	5	10	25	50	100	200	500	1000
5-min	0.244 (0.201-0.298)	0.293 (0.242-0.359)	0.380 (0.312-0.468)	0.459 (0.374-0.567)	0.575 (0.455-0.748)	0.671 (0.517-0.884)	0.774 (0.573-1.05)	0.884 (0.625-1.23)	1.04 (0.703-1.49)	1.16 (0.762-1.69)
10-min	0.357 (0.295-0.437)	0.429 (0.354-0.526)	0.557 (0.458-0.685)	0.672 (0.548-0.830)	0.842 (0.667-1.10)	0.983 (0.757-1.30)	1.13 (0.839-1.53)	1.29 (0.914-1.80)	1.52 (1.03-2.19)	1.70 (1.12-2.48)
15-min	0.435 (0.359-0.533)	0.524 (0.432-0.642)	0.679 (0.558-0.835)	0.819 (0.668-1.01)	1.03 (0.813-1.34)	1.20 (0.923-1.58)	1.38 (1.02-1.87)	1.58 (1.12-2.20)	1.86 (1.26-2.67)	2.08 (1.36-3.02)
30-min	0.648 (0.535-0.794)	0.779 (0.643-0.956)	1.01 (0.830-1.24)	1.22 (0.994-1.51)	1.53 (1.21-1.99)	1.78 (1.37-2.35)	2.06 (1.52-2.79)	2.35 (1.66-3.28)	2.77 (1.87-3.98)	3.10 (2.03-4.51)
60-min	0.848 (0.700-1.04)	0.996 (0.821-1.22)	1.27 (1.05-1.57)	1.54 (1.26-1.90)	1.95 (1.56-2.56)	2.31 (1.78-3.06)	2.70 (2.00-3.68)	3.13 (2.22-4.39)	3.75 (2.54-5.42)	4.26 (2.79-6.20)
2-hr	1.05 (0.870-1.27)	1.21 (1.01-1.48)	1.54 (1.27-1.88)	1.86 (1.53-2.28)	2.37 (1.91-3.12)	2.83 (2.21-3.75)	3.34 (2.50-4.53)	3.90 (2.80-5.46)	4.74 (3.24-6.81)	5.43 (3.58-7.84)
3-hr	1.15 (0.957-1.39)	1.31 (1.09-1.59)	1.64 (1.36-2.00)	1.98 (1.64-2.43)	2.56 (2.08-3.37)	3.08 (2.42-4.08)	3.66 (2.77-4.98)	4.33 (3.12-6.06)	5.32 (3.67-7.65)	6.15 (4.08-8.85)
6-hr	1.31 (1.10-1.58)	1.48 (1.24-1.78)	1.84 (1.54-2.22)	2.23 (1.85-2.71)	2.89 (2.38-3.80)	3.50 (2.77-4.62)	4.19 (3.20-5.68)	4.99 (3.63-6.94)	6.18 (4.30-8.83)	7.18 (4.80-10.3)
12-hr	1.46 (1.23-1.75)	1.67 (1.41-2.00)	2.10 (1.76-2.52)	2.54 (2.12-3.07)	3.27 (2.70-4.25)	3.93 (3.14-5.14)	4.68 (3.59-6.28)	5.52 (4.04-7.62)	6.78 (4.74-9.61)	7.82 (5.28-11.1)
24-hr	1.63 (1.39-1.94)	1.90 (1.61-2.26)	2.41 (2.04-2.88)	2.90 (2.44-3.48)	3.69 (3.05-4.72)	4.39 (3.51-5.66)	5.15 (3.97-6.83)	6.01 (4.42-8.20)	7.25 (5.11-10.2)	8.28 (5.63-11.7)
2-day	1.86 (1.60-2.20)	2.18 (1.87-2.58)	2.77 (2.36-3.29)	3.32 (2.82-3.96)	4.17 (3.46-5.27)	4.90 (3.94-6.26)	5.70 (4.41-7.47)	6.57 (4.86-8.87)	7.82 (5.54-10.9)	8.84 (6.06-12.4)
3-day	2.04 (1.75-2.40)	2.39 (2.06-2.82)	3.04 (2.60-3.59)	3.63 (3.09-4.31)	4.53 (3.76-5.68)	5.30 (4.27-6.72)	6.12 (4.76-7.98)	7.02 (5.22-9.43)	8.30 (5.91-11.5)	9.35 (6.44-13.0)
4-day	2.19 (1.89-2.57)	2.56 (2.21-3.01)	3.24 (2.79-3.82)	3.87 (3.30-4.58)	4.81 (4.00-6.00)	5.60 (4.53-7.07)	6.45 (5.02-8.37)	7.37 (5.49-9.86)	8.68 (6.20-12.0)	9.75 (6.74-13.6)
7-day	2.57 (2.23-3.00)	2.97 (2.58-3.47)	3.70 (3.20-4.33)	4.36 (3.74-5.13)	5.35 (4.48-6.63)	6.19 (5.03-7.77)	7.08 (5.55-9.14)	8.05 (6.04-10.7)	9.43 (6.78-12.9)	10.5 (7.34-14.6)
10-day	2.89 (2.52-3.36)	3.32 (2.89-3.87)	4.09 (3.54-4.77)	4.78 (4.12-5.61)	5.82 (4.88-7.17)	6.68 (5.45-8.34)	7.60 (5.98-9.76)	8.60 (6.47-11.4)	10.0 (7.22-13.6)	11.1 (7.79-15.4)
20-day	3.77 (3.31-4.36)	4.32 (3.79-5.00)	5.26 (4.60-6.10)	6.08 (5.28-7.09)	7.26 (6.10-8.82)	8.21 (6.73-10.1)	9.20 (7.27-11.7)	10.2 (7.75-13.4)	11.7 (8.48-15.8)	12.8 (9.03-17.5)
30-day	4.51 (3.97-5.18)	5.18 (4.55-5.96)	6.29 (5.51-7.26)	7.22 (6.29-8.38)	8.53 (7.18-10.3)	9.55 (7.85-11.7)	10.6 (8.40-13.3)	11.7 (8.85-15.1)	13.1 (9.54-17.6)	14.2 (10.1-19.4)
45-day	5.45 (4.82-6.25)	6.28 (5.55-7.20)	7.61 (6.70-8.76)	8.70 (7.62-10.1)	10.2 (8.58-12.1)	11.3 (9.30-13.7)	12.4 (9.85-15.5)	13.5 (10.3-17.4)	14.9 (10.9-19.9)	16.0 (11.4-21.7)
60-day	6.28 (5.57-7.17)	7.24 (6.41-8.28)	8.76 (7.74-10.0)	9.98 (8.76-11.5)	11.6 (9.79-13.8)	12.8 (10.6-15.5)	14.0 (11.1-17.3)	15.1 (11.5-19.3)	16.5 (12.1-21.9)	17.5 (12.5-23.8)

[1] Precipitation frequency (PF) estimates in this table are based on frequency analysis of partial duration series (PDS).

Numbers in parenthesis are PF estimates at lower and upper bounds of the 90% confidence interval. The probability that precipitation frequency estimates (for a given duration and average recurrence interval) will be greater than the upper bound (or less than the lower bound) is 5%. Estimates at upper bounds are not checked against probable maximum precipitation (PMP) estimates and may be higher than currently valid PMP values.

Please refer to NOAA Atlas 14 document for more information.

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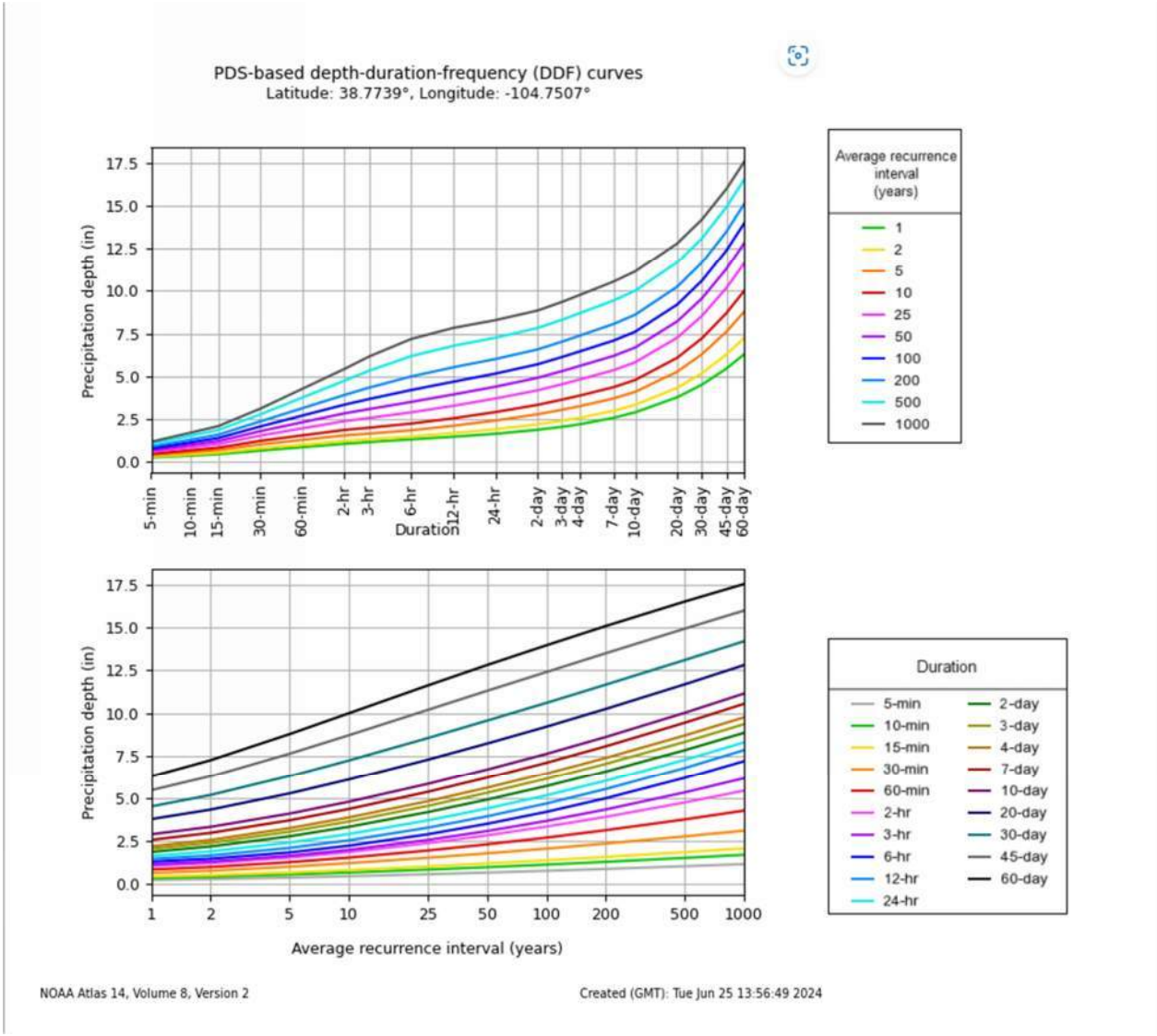
Graphical Output from the PFDS:



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<u>One-half Probable Maximum Precipitation (PMP) event:</u>

There are serveral references that were used to estimate the precipiaton depth for the PMP event at Daniels Sand Wash Fines Pit. Historically, Hydrometerological Report No. 55A (NOAA HMR 55A 1988) was most commonly used to determine the depths for the PMP event. Alternatively, in 2018 the Colorado Department of Water Resources, along with Applied Weather Associates (AWA) and the New Mexico Dam Safety Bureau, performed a study for Colorado and New Mexico that refined the PMP event and reduced the precipitation depths from HMR 55A by up to 15%. The PMP results gathered from the study performed by AWA have been accepted and used by numerous organizations, including Colorado and New Mexico dam safety groups.

The one-half PMP from HMR 55A was taken from an all-season PMP for 24-hour 10 square mile plate and then halved (see figure below).

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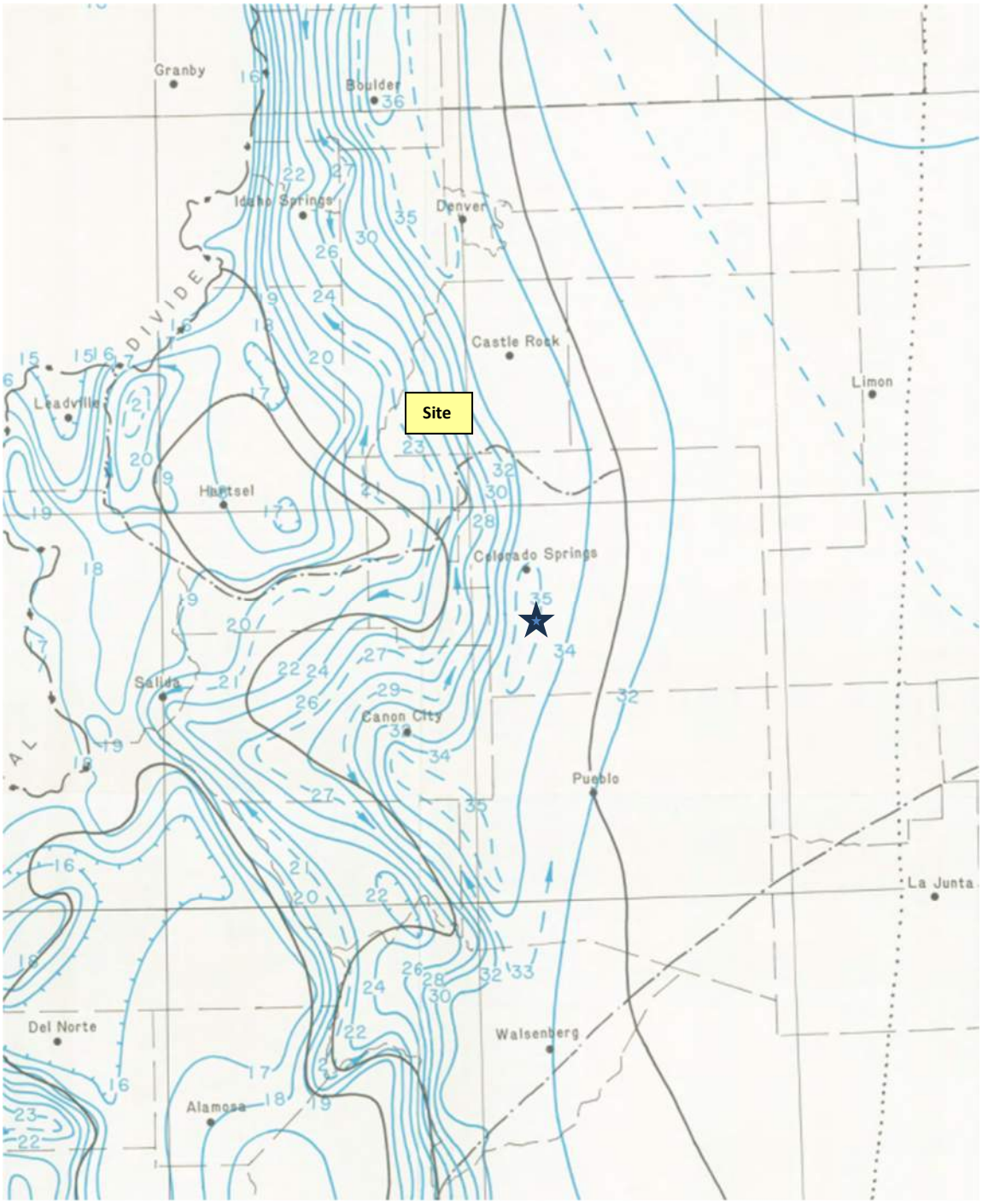
HMR 55A, 24-Hour PMP Values on 10 square mile plate:



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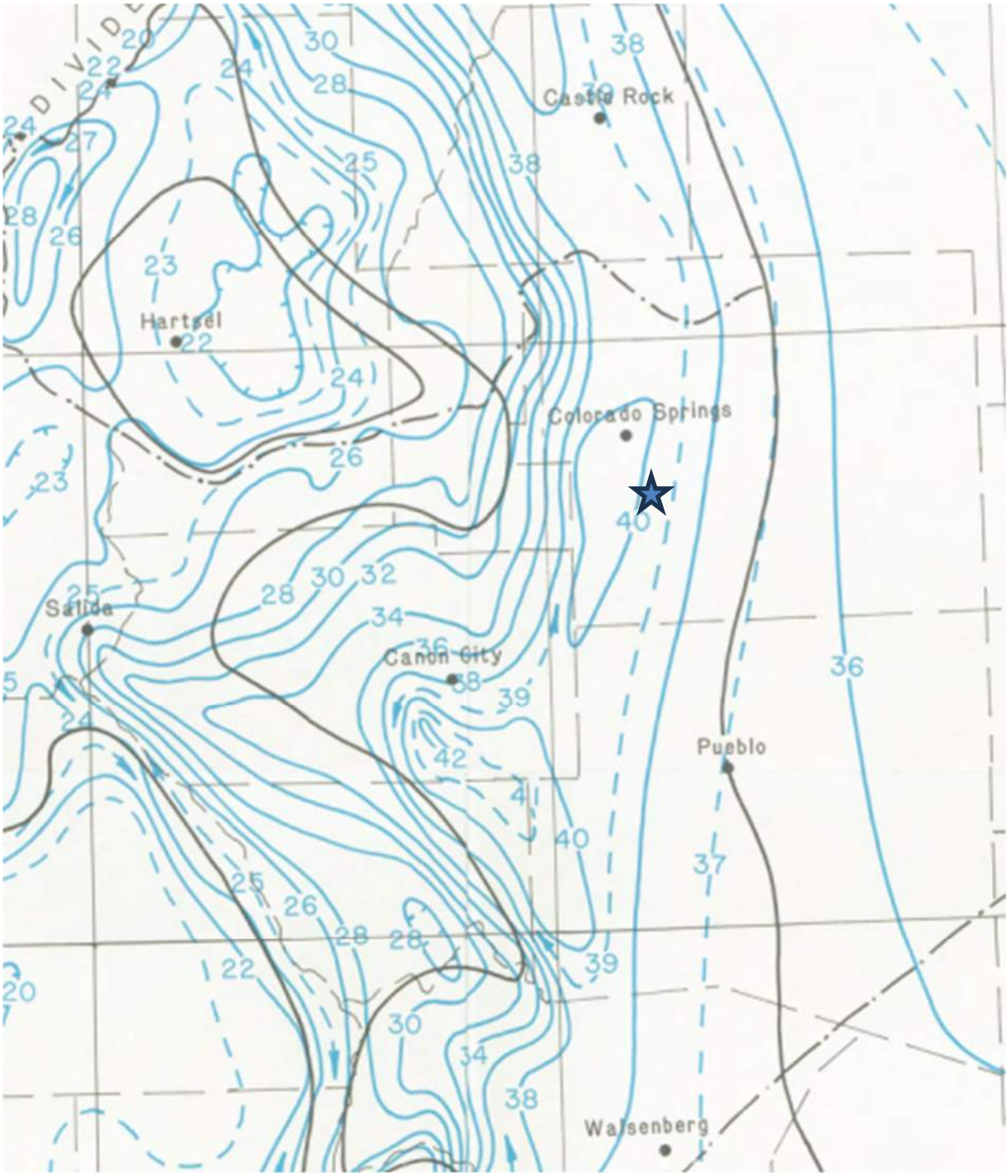
HMR 55A, 72-Hour PMP Values on 10 square mile plate:



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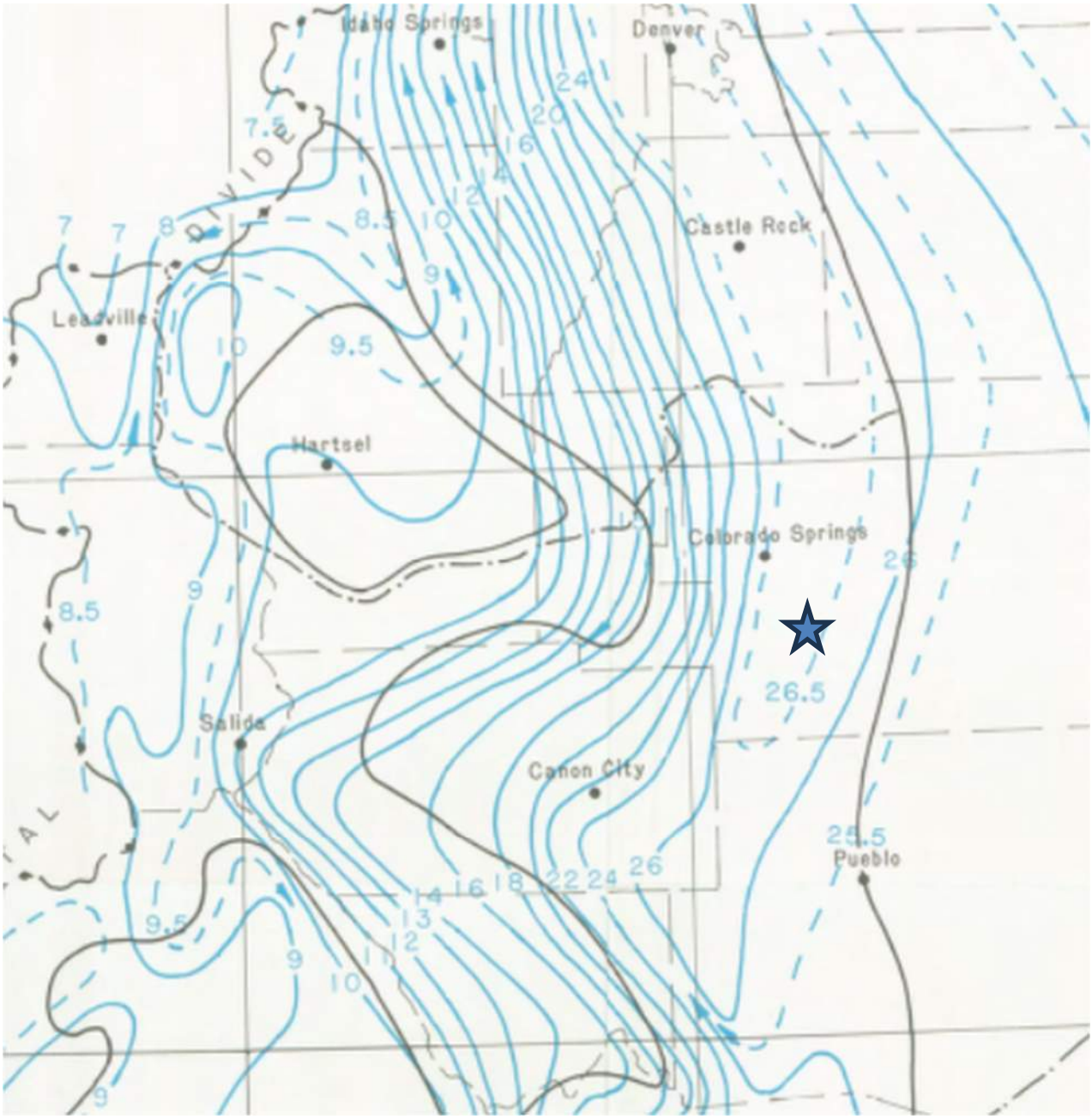
HMR 55A, 6-hour PMP values on a 10 square mile plate.



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Climate Change Considerations:

When determining the ½ PMP depth, GEI considered the effect of climate change. The correlation between climate change and rainfall events is not clear. An atmosphere that is subject to warmer weather may be more susceptible to an increase in atmospheric moisture; however, the relationship between a warming climate and the dynamics of a storm is not known. An increase in temperature may affect the frequency or intensity of a storm, but the evidence that has been gathered does not show a significant trend in data in regards to PMP depth. Climate change should not be considered when estimating the rainfall depths for PMP events (WMO 2009, Section 1.1.1). Similar climate change conclusions were recently discussed in the report "*Site-Specific Probable Maximum Precipitation Study For Tittabawasse River Basin, Michigan Final Report*" by Applied Weather Associates (AWA).

Results:

The 100-yr and 200-yr, 24-hour storms are 5.15 inches and 6.01 inches, respectively, for the Daniels Sand Wash Fine Pit, with the ½ PMP storm event being 17.5 inches from HMR 55A and 14.9 inches from CO-NM REPS (2018), as summarized in the table below. These values will be utilized in the stormwater model (under a separate calculation package).

Table 1: Design Precipitation Events

Frequency	Depth	Reference
100-year, 24-Hour	5.15 inches	NOAA Atlas 14
200-yr, 24-Hour	6.01 inches	NOAA Atlas 14
½ PMP, 24-Hour	17.5 inches	HMR 55A (NOAA 1988)
½ PMP, 24-Hour	14.9 inches	CO-NM REPS (2018)

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References:

Applied Weather Associates (AWA). (2021). (rep.). *Site-Specific Probable Maximum Precipitation Study For Tittabawasse River Basin, Michigan Final Report (pp. 1–57).* Monument , CO.

Applied Weather Associates (AWA). (2018). (rep.). *Colorado – New Mexico Regional Extreme Precipitation Study, Summary Report Volume II,* Monument , CO.

NOAA (National Oceanic and Atmospheric Administration). 1988. *Probable Maximum Precipitation Estimates, United States Between the Continental Divide and the 103rh Meridian, Hydrometeorological Report 55A (HMR55A).* Silver Spring, MD.

NOAA. 2013. National Weather Service Atlas 14, Volume 8, Version 2.0: Midwestern States. Precipitation Frequency Atlas of the United States.

NOAA, Precipitation Frequency Data Server (PFDS). https://hdsc.nws.noaa.gov/hdsc/pfds/. Accessed 2/28/23.

World Meteorological Organization, 2009: Manual for Estimation of Probable Maximum Precipitation, *Operational Hydrology Report No 1045,* WMO, Geneva, 259 pp.

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Subject	Wave Run Up Calculation 2-yr					

Purpose: Determine the maximum water surface elevation due to wind induced waves.

Procedure: Follow procedures as described in ACER Technical Memorandum No. 2 (USBR 1981, based on ETL 1110-2-221)

References: ACER Technical Memorandum No. 2, Freeboard Criteria and Guidelines for Computing Freeboard Allowances for Storage Dams, U.S. Department of Interior Bureau of Reclamation, 1981.

Effective Fetch Calculation (See Attached Site Plan, Figure 3.)

α Degrees	Cos (α)	Xi (feet)	Xi (miles)	Xi * Cos(α)
35	0.819	790.2	0.15	0.123
30	0.866	940.2	0.18	0.154
25	0.906	980.4	0.19	0.168
20	0.940	1040	0.20	0.185
15	0.966	1111.2	0.21	0.203
10	0.985	1202.3	0.23	0.224
5	0.996	1307.6	0.25	0.247
0	1.000	1446	0.27	0.274
5	0.996	1277.8	0.24	0.241
10	0.985	1201.4	0.23	0.224
15	0.966	1166.65	0.22	0.213
20	0.940	1133.1	0.21	0.202
25	0.906	1060.9	0.20	0.182
30	0.866	973	0.18	0.160
35	0.819	917.8	0.17	0.142
40	0.766	871.7	0.17	0.126
45	0.707	808.8	0.15	0.108
Sum =	15.429		Sum =	3.18

$$Feff = \sum (Xi\cos(\alpha)) \Big/ \sum \cos(\alpha)$$

Effective Fetch = 0.21 miles

Design Wave Height

Feff =	0.2	miles	
Wind Velocity =	60	mph	
Duration =	5.1	mins	(Figure 9 USBR 1981)

* From Figure 9 (USBR 1981) design wave	Hs =	1.3	ft
* From Figure 10 (USBR 1981) wave period	T =	1.95	sec
* Wave Length Lo = $5.12(T)^2$	Lo =	19.5	ft
* Hmax (Highest 1% of waves) = 1.67(Hs)	Hmax =	2.2	ft

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Subject	Wave Run Up Calculation 2-yr					

Wind Setup

* Assume a uniform depth = 4 ft

Wind Setup $Zs = \frac{Vwind^2 * F}{1400 * d}$

Vwind =	60	mph
Feff =	0.21	miles
F = 2*Feff =	0.41	miles
d =	3	ft
Zs =	0.35	ft

Wind Runup

* East Dams have 2H:1V slopes with riprap lining

Design Wave, Hs =	1.3	ft	
Period, T =	1.95	sec	
Design Depth, ds =	3	ft	(depth at toe of impoundment)
ds/Hs =	2.31		
Hs = H'o H'o/(g*T^2) =	0.011		

From Figure 11 (USBR 1981)

R/H'o =	0.55	
R =	0.72	ft

Summary:

Storm Event	(A) Pond Starting Elevation* (feet)	(B) Wave Run-up (feet)	(C) Wind Set-up (feet)	(D) Approximate Rise of Pond Due to Storm (feet)	(E) Maximum Water Surface Elevation (A+B+C+D) (feet)	(F) Minimum Crest of Water Retention Dam (feet)	(G) Available Freeboard (F-E) (feet)
100 Year	5818.00	0.72	0.35	0.62	5819.69	5821.00	1.31
200-Year	5818.00	0.72	0.35	0.73	5819.80	5821.00	1.20
1/2PMP (CO-NM REPS)	5818.00	0.72	0.35	1.85	5820.92	5821.00	0.08
½ PMP (HMR55A)	5818.00	0.72	0.35	2.16	5821.23	5821.00	-0.23

*Assumes a maximum pond elevation of +5,818 feet for a Water Retention Dam elevation of +5,821 feet.

Attachments:

Figure 3.
USBR Referenced Figures

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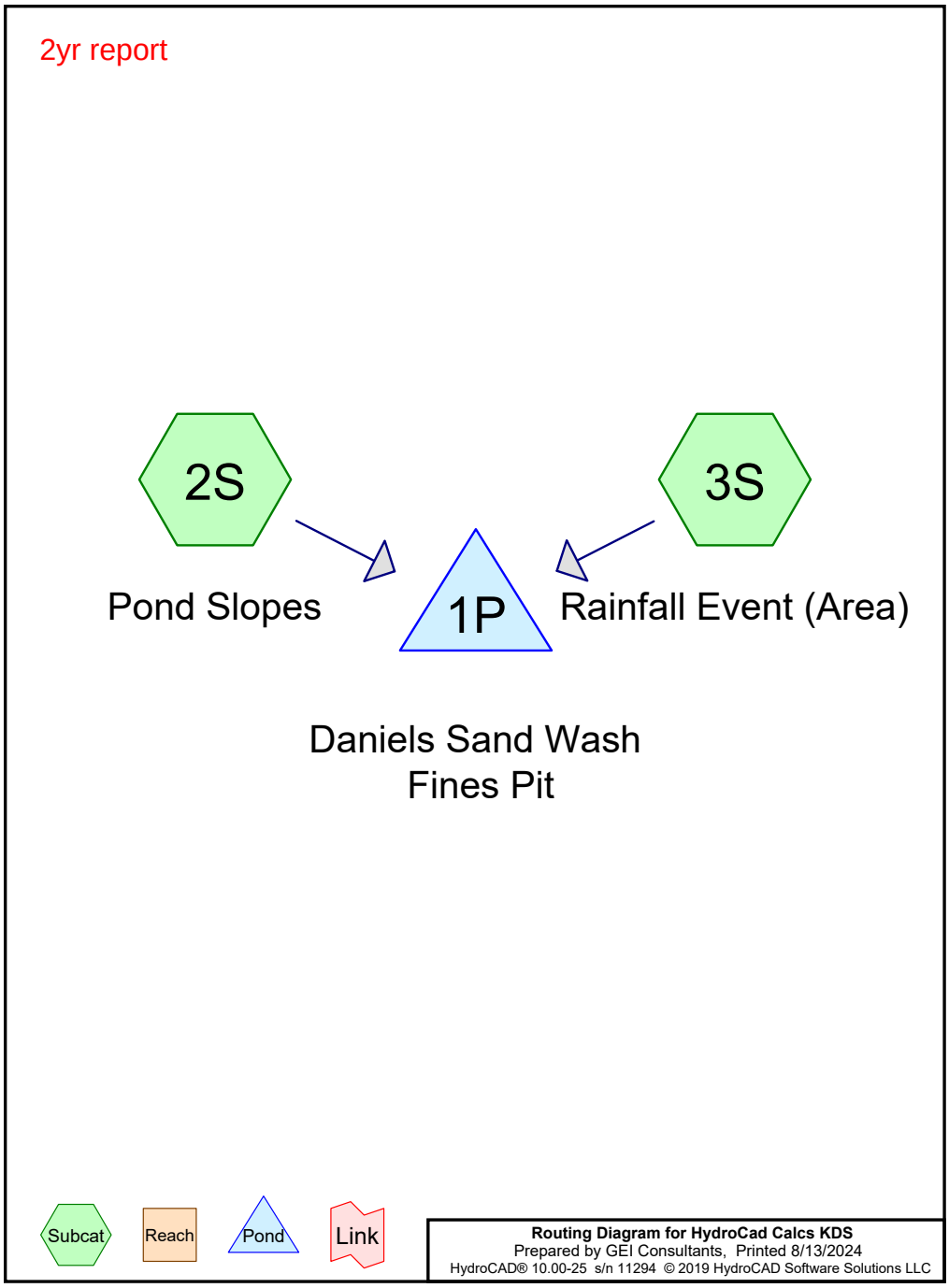
2yr report



Area Listing (all nodes)

Area (acres)	CN	Description (subcatchment-numbers)
7.000	77	Fallow, bare soil, HSG A (2S)
21.700	98	Water Surface, HSG A (3S)
28.700	**93**	**TOTAL AREA**

Soil Listing (all nodes)

Area (acres)	Soil Group	Subcatchment Numbers
28.700	HSG A	2S, 3S
0.000	HSG B	
0.000	HSG C	
0.000	HSG D	
0.000	Other	
28.700		**TOTAL AREA**

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Ground Covers (all nodes)

HSG-A (acres)	HSG-B (acres)	HSG-C (acres)	HSG-D (acres)	Other (acres)	Total (acres)	Ground Cover	Subcatchment Numbers
7.000	0.000	0.000	0.000	0.000	7.000	Fallow, bare soil	2S
21.700	0.000	0.000	0.000	0.000	21.700	Water Surface	3S
28.700	**0.000**	**0.000**	**0.000**	**0.000**	**28.700**	**TOTAL AREA**	

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Subject	Wave Run Up Calculation 2-yr					

Time span=0.00-72.00 hrs, dt=0.05 hrs, 1441 points
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN
Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

Subcatchment2S: Pond Slopes Runoff Area=7.000 ac 0.00% Impervious Runoff Depth=14.36"
Flow Length=140' Slope=0.3330 '/' Tc=0.7 min CN=77 Runoff=183.70 cfs 8.379 af

Subcatchment3S: Rainfall Event (Area) Runoff Area=21.700 ac 100.00% Impervious Runoff Depth=17.26"
Tc=0.0 min CN=98 Runoff=610.14 cfs 31.207 af

Pond 1P: Daniels Sand Wash Fines Pit Peak Elev=5,820.16' Storage=39.586 af Inflow=792.99 cfs 39.586 af
Outflow=0.00 cfs 0.000 af

Total Runoff Area = 28.700 ac Runoff Volume = 39.586 af Average Runoff Depth = 16.55"
24.39% Pervious = 7.000 ac 75.61% Impervious = 21.700 ac

Summary for Subcatchment 2S: Pond Slopes

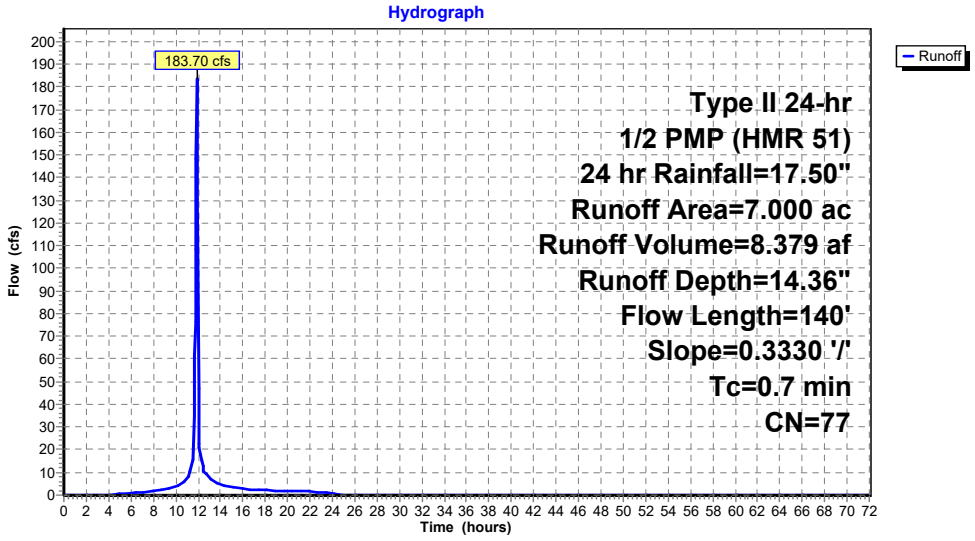
Runoff = 183.70 cfs @ 11.89 hrs, Volume= 8.379 af, Depth=14.36"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs
Type II 24-hr 1/2 PMP (HMR 51), 24 hr Rainfall=17.50"

Area (ac)	CN	Description
7.000	77	Fallow, bare soil, HSG A
7.000		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
0.7	140	0.3330	3.49		**Sheet Flow, Slopes** Smooth surfaces n= 0.011 P2= 1.90"

Subcatchment 2S: Pond Slopes



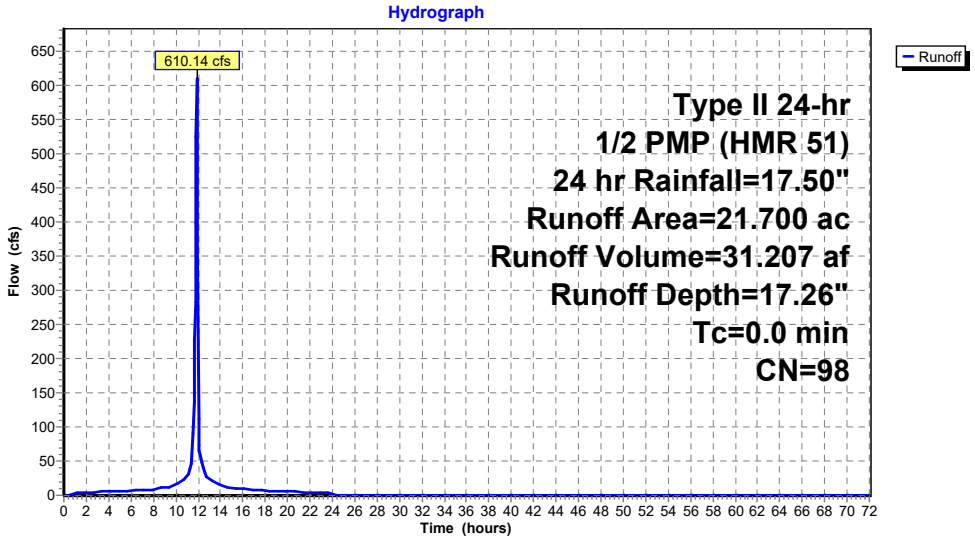
Summary for Subcatchment 3S: Rainfall Event (Area)

Runoff = 610.14 cfs @ 11.89 hrs, Volume= 31.207 af, Depth=17.26"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs
Type II 24-hr 1/2 PMP (HMR 51), 24 hr Rainfall=17.50"

Area (ac)	CN	Description
21.700	98	Water Surface, HSG A
21.700		100.00% Impervious Area

Subcatchment 3S: Rainfall Event (Area)



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Subject	Wave Run Up Calculation 2-yr					

Summary for Pond 1P: Daniels Sand Wash Fines Pit

Inflow Area = 28.700 ac, 75.61% Impervious, Inflow Depth = 16.55" for 1/2 PMP (HMR 51), 24 hr event
Inflow = 792.99 cfs @ 11.89 hrs, Volume= 39.586 af
Outflow = 0.00 cfs @ 0.00 hrs, Volume= 0.000 af, Atten= 100%, Lag= 0.0 min

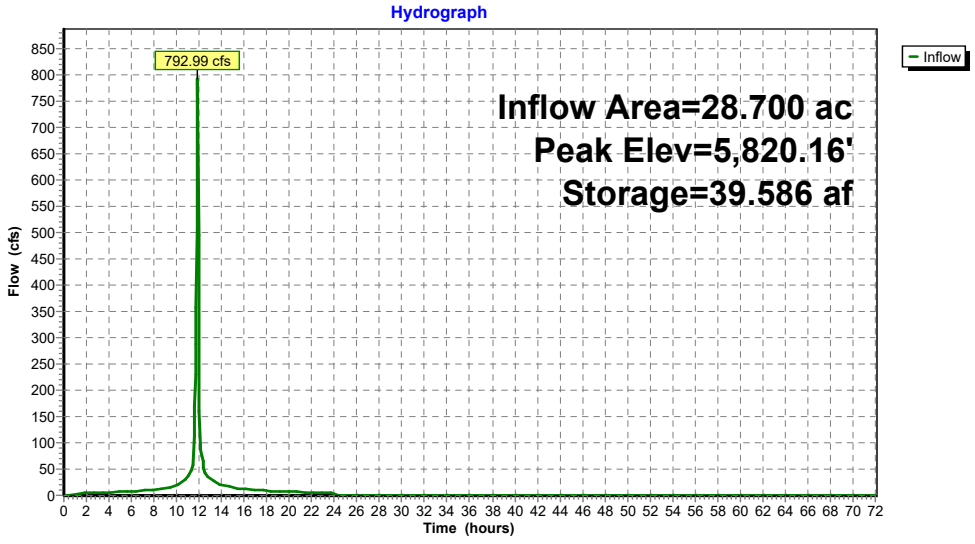
Routing by Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs
Peak Elev= 5,820.16' @ 24.10 hrs Surf.Area= 20.557 ac Storage= 39.586 af

Plug-Flow detention time= (not calculated: initial storage exceeds outflow)
Center-of-Mass det. time= (not calculated: no outflow)

Volume	Invert	Avail.Storage	Storage Description
#1	5,818.00'	57.250 af	**Custom Stage Data (Prismatic)** Listed below

Elevation (feet)	Surf.Area (acres)	Inc.Store (acre-feet)	Cum.Store (acre-feet)
5,818.00	15.960	0.000	0.000
5,819.00	18.080	17.020	17.020
5,820.00	20.340	19.210	36.230
5,821.00	21.700	21.020	57.250

Pond 1P: Daniels Sand Wash Fines Pit



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Time span=0.00-72.00 hrs, dt=0.05 hrs, 1441 points
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN
Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

Subcatchment2S: Pond Slopes Runoff Area=7.000 ac 0.00% Impervious Runoff Depth=11.83"
Flow Length=140' Slope=0.3330 '/' Tc=0.7 min CN=77 Runoff=153.39 cfs 6.902 af

Subcatchment3S: Rainfall Event (Area) Runoff Area=21.700 ac 100.00% Impervious Runoff Depth=14.66"
Tc=0.0 min CN=98 Runoff=519.41 cfs 26.506 af

Pond 1P: Daniels Sand Wash Fines Pit Peak Elev=5,819.85' Storage=33.408 af Inflow=672.03 cfs 33.408 af
Outflow=0.00 cfs 0.000 af

Total Runoff Area = 28.700 ac Runoff Volume = 33.408 af Average Runoff Depth = 13.97"
24.39% Pervious = 7.000 ac 75.61% Impervious = 21.700 ac

Summary for Subcatchment 2S: Pond Slopes

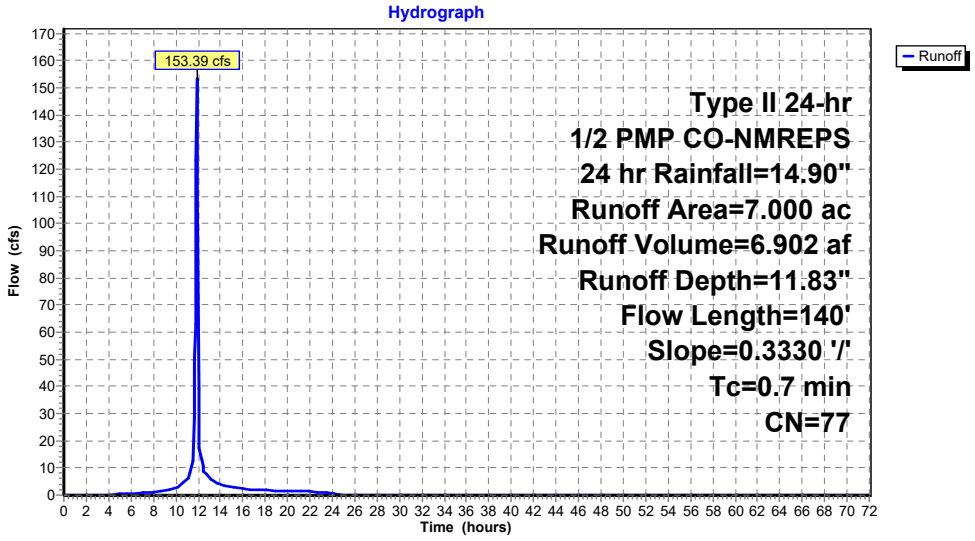
Runoff = 153.39 cfs @ 11.90 hrs, Volume= 6.902 af, Depth=11.83"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs
Type II 24-hr 1/2 PMP CO-NMREPS, 24 hr Rainfall=14.90"

Area (ac)	CN	Description
7.000	77	Fallow, bare soil, HSG A
7.000		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
0.7	140	0.3330	3.49		**Sheet Flow, Slopes** Smooth surfaces n= 0.011 P2= 1.90"

Subcatchment 2S: Pond Slopes



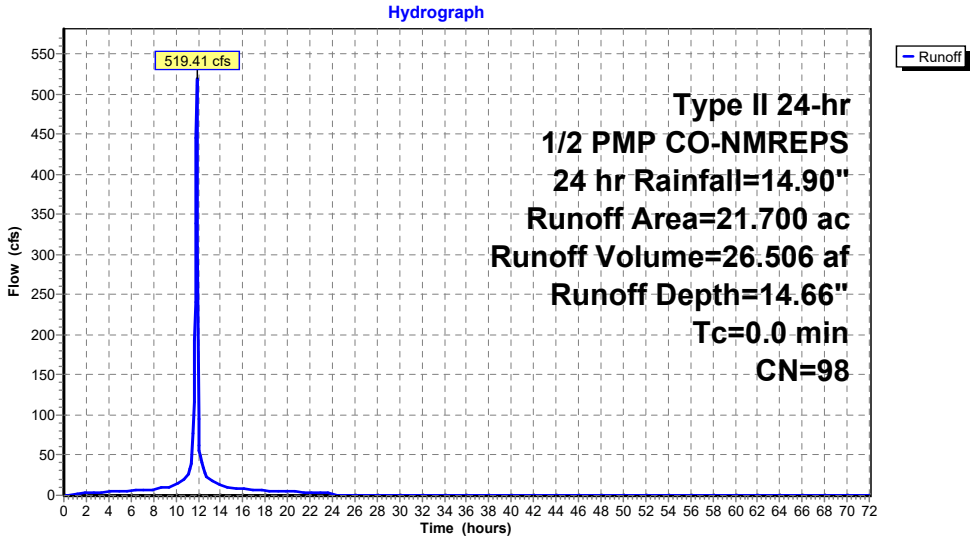
Summary for Subcatchment 3S: Rainfall Event (Area)

Runoff = 519.41 cfs @ 11.89 hrs, Volume= 26.506 af, Depth=14.66"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs
Type II 24-hr 1/2 PMP CO-NMREPS, 24 hr Rainfall=14.90"

Area (ac)	CN	Description
21.700	98	Water Surface, HSG A
21.700		100.00% Impervious Area

Subcatchment 3S: Rainfall Event (Area)



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Subject	Wave Run Up Calculation 2-yr					

Summary for Pond 1P: Daniels Sand Wash Fines Pit

Inflow Area = 28.700 ac, 75.61% Impervious, Inflow Depth = 13.97" for 1/2 PMP CO-NMREPS, 24 hr event
Inflow = 672.03 cfs @ 11.89 hrs, Volume= 33.408 af
Outflow = 0.00 cfs @ 0.00 hrs, Volume= 0.000 af, Atten= 100%, Lag= 0.0 min

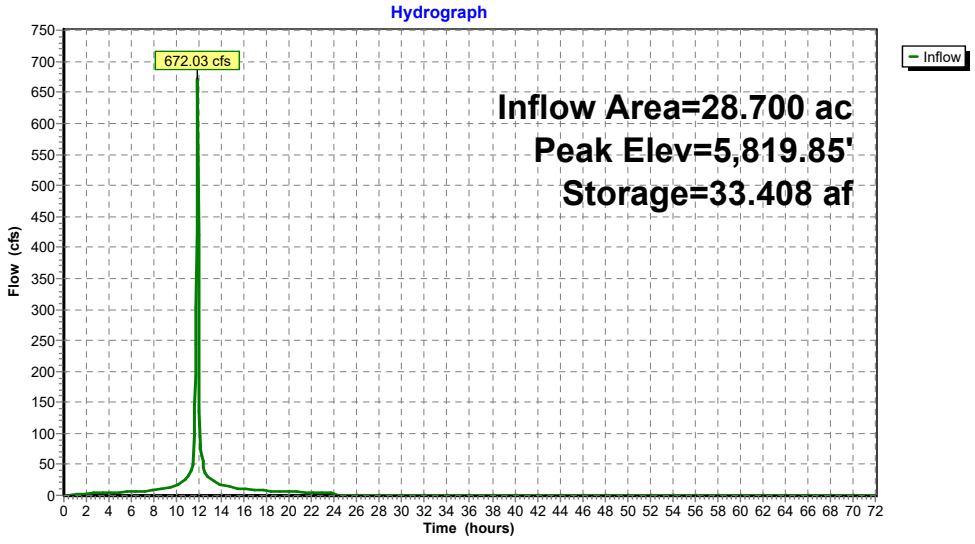
Routing by Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs
Peak Elev= 5,819.85' @ 24.10 hrs Surf.Area= 20.008 ac Storage= 33.408 af

Plug-Flow detention time= (not calculated: initial storage exceeds outflow)
Center-of-Mass det. time= (not calculated: no outflow)

Volume	Invert	Avail.Storage	Storage Description
#1	5,818.00'	57.250 af	**Custom Stage Data (Prismatic)** Listed below

Elevation (feet)	Surf.Area (acres)	Inc.Store (acre-feet)	Cum.Store (acre-feet)
5,818.00	15.960	0.000	0.000
5,819.00	18.080	17.020	17.020
5,820.00	20.340	19.210	36.230
5,821.00	21.700	21.020	57.250

Pond 1P: Daniels Sand Wash Fines Pit



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Subject	Wave Run Up Calculation 2-yr					

Time span=0.00-72.00 hrs, dt=0.05 hrs, 1441 points
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN
Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

Subcatchment2S: Pond Slopes Runoff Area=7.000 ac 0.00% Impervious Runoff Depth=2.75"
Flow Length=140' Slope=0.3330 '/' Tc=0.7 min CN=77 Runoff=38.68 cfs 1.604 af

Subcatchment3S: Rainfall Event (Area) Runoff Area=21.700 ac 100.00% Impervious Runoff Depth=4.91"
Tc=0.0 min CN=98 Runoff=178.80 cfs 8.884 af

Pond 1P: Daniels Sand Wash Fines Pit Peak Elev=5,818.62' Storage=10.488 af Inflow=217.01 cfs 10.488 af
Outflow=0.00 cfs 0.000 af

Total Runoff Area = 28.700 ac Runoff Volume = 10.488 af Average Runoff Depth = 4.39"
24.39% Pervious = 7.000 ac 75.61% Impervious = 21.700 ac

Summary for Subcatchment 2S: Pond Slopes

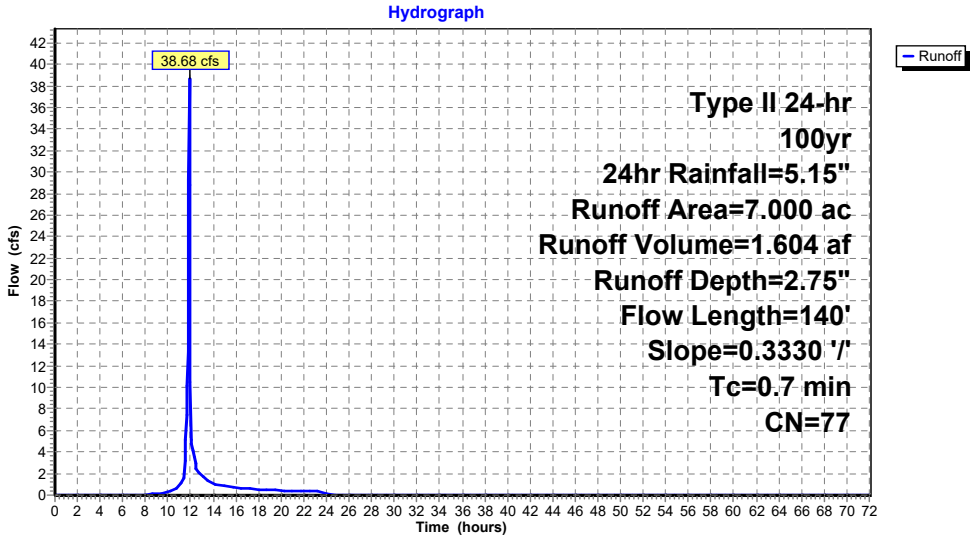
Runoff = 38.68 cfs @ 11.90 hrs, Volume= 1.604 af, Depth= 2.75"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs
Type II 24-hr 100yr, 24hr Rainfall=5.15"

Area (ac)	CN	Description
7.000	77	Fallow, bare soil, HSG A
7.000		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
0.7	140	0.3330	3.49		**Sheet Flow, Slopes** Smooth surfaces n= 0.011 P2= 1.90"

Subcatchment 2S: Pond Slopes



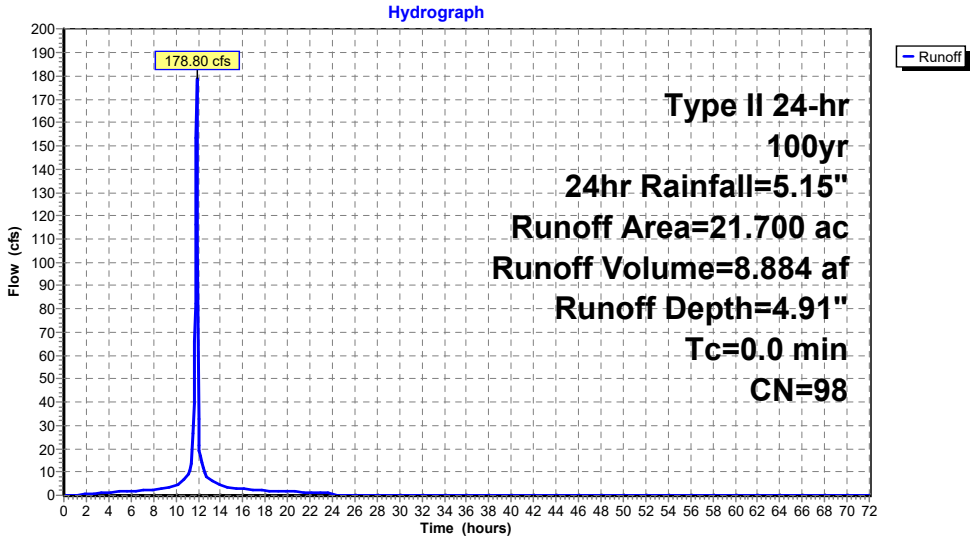
Summary for Subcatchment 3S: Rainfall Event (Area)

Runoff = 178.80 cfs @ 11.89 hrs, Volume= 8.884 af, Depth= 4.91"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs
Type II 24-hr 100yr, 24hr Rainfall=5.15"

Area (ac)	CN	Description
21.700	98	Water Surface, HSG A
21.700		100.00% Impervious Area

Subcatchment 3S: Rainfall Event (Area)



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Subject	Wave Run Up Calculation 2-yr					

Summary for Pond 1P: Daniels Sand Wash Fines Pit

Inflow Area = 28.700 ac, 75.61% Impervious, Inflow Depth = 4.39" for 100yr, 24hr event
Inflow = 217.01 cfs @ 11.89 hrs, Volume= 10.488 af
Outflow = 0.00 cfs @ 0.00 hrs, Volume= 0.000 af, Atten= 100%, Lag= 0.0 min

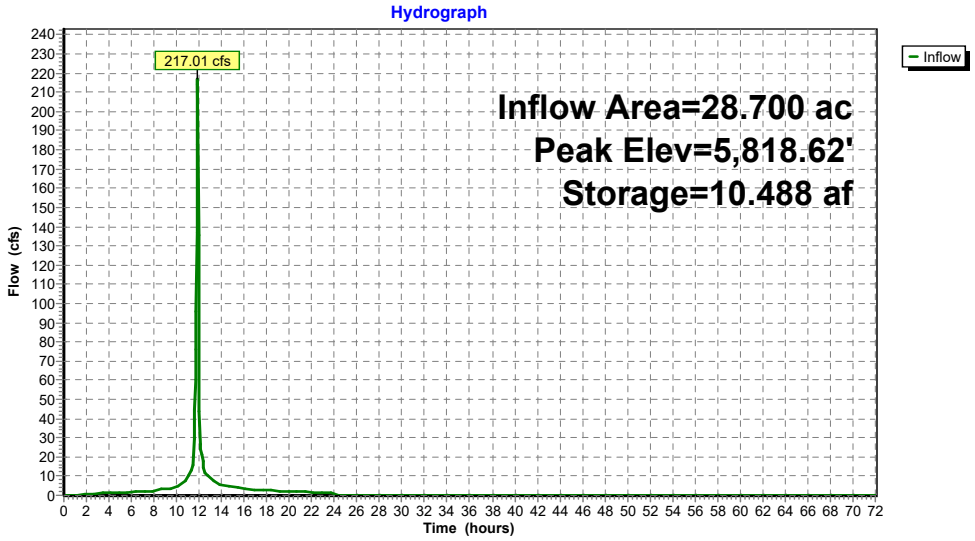
Routing by Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs
Peak Elev= 5,818.62' @ 24.10 hrs Surf.Area= 17.266 ac Storage= 10.488 af

Plug-Flow detention time= (not calculated: initial storage exceeds outflow)
Center-of-Mass det. time= (not calculated: no outflow)

Volume	Invert	Avail.Storage	Storage Description
#1	5,818.00'	57.250 af	**Custom Stage Data (Prismatic)** Listed below

Elevation (feet)	Surf.Area (acres)	Inc.Store (acre-feet)	Cum.Store (acre-feet)
5,818.00	15.960	0.000	0.000
5,819.00	18.080	17.020	17.020
5,820.00	20.340	19.210	36.230
5,821.00	21.700	21.020	57.250

Pond 1P: Daniels Sand Wash Fines Pit



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	Project	Daniels Sand Wash Fines Pit			Pg. Rev.	
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Subject	Wave Run Up Calculation 2-yr					

Time span=0.00-72.00 hrs, dt=0.05 hrs, 1441 points
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN
Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

Subcatchment2S: Pond Slopes Runoff Area=7.000 ac 0.00% Impervious Runoff Depth=3.49"
Flow Length=140' Slope=0.3330 '/' Tc=0.7 min CN=77 Runoff=48.64 cfs 2.035 af

Subcatchment3S: Rainfall Event (Area) Runoff Area=21.700 ac 100.00% Impervious Runoff Depth=5.77"
Tc=0.0 min CN=98 Runoff=208.91 cfs 10.437 af

Pond 1P: Daniels Sand Wash Fines Pit Peak Elev=5,818.73' Storage=12.472 af Inflow=257.05 cfs 12.472 af
Outflow=0.00 cfs 0.000 af

Total Runoff Area = 28.700 ac Runoff Volume = 12.472 af Average Runoff Depth = 5.21"
24.39% Pervious = 7.000 ac 75.61% Impervious = 21.700 ac

Summary for Subcatchment 2S: Pond Slopes

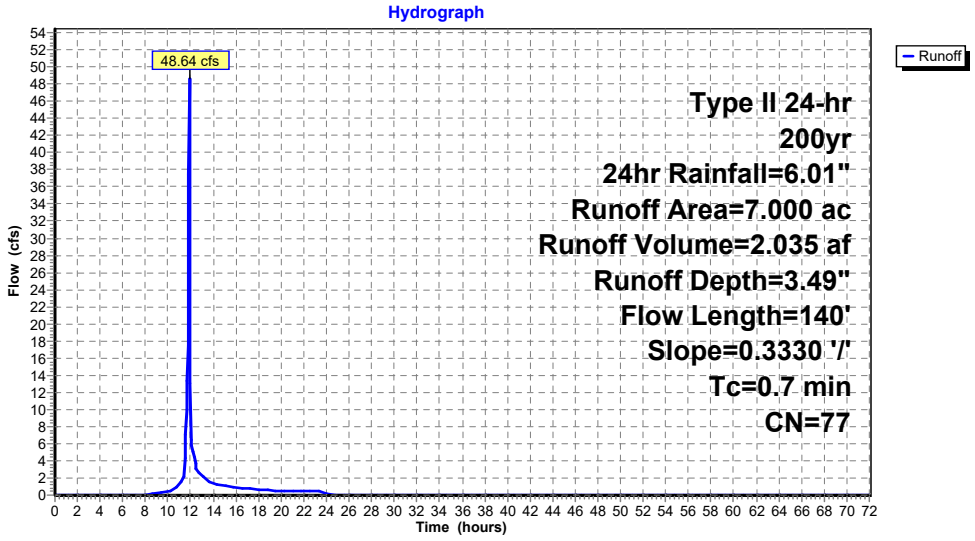
Runoff = 48.64 cfs @ 11.90 hrs, Volume= 2.035 af, Depth= 3.49"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs
Type II 24-hr 200yr, 24hr Rainfall=6.01"

Area (ac)	CN	Description
7.000	77	Fallow, bare soil, HSG A
7.000		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
0.7	140	0.3330	3.49		**Sheet Flow, Slopes** Smooth surfaces n= 0.011 P2= 1.90"

Subcatchment 2S: Pond Slopes



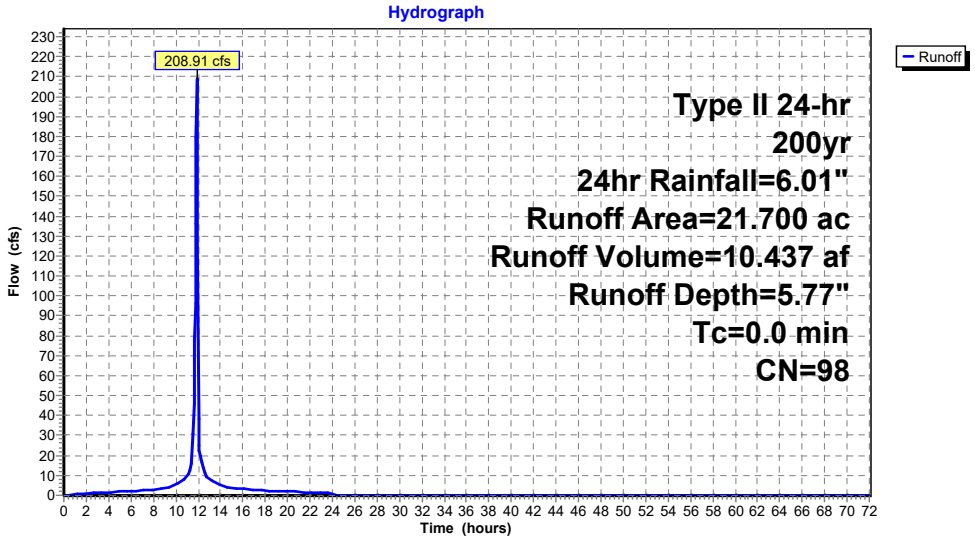
Summary for Subcatchment 3S: Rainfall Event (Area)

Runoff = 208.91 cfs @ 11.89 hrs, Volume= 10.437 af, Depth= 5.77"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs
Type II 24-hr 200yr, 24hr Rainfall=6.01"

Area (ac)	CN	Description
21.700	98	Water Surface, HSG A
21.700		100.00% Impervious Area

Subcatchment 3S: Rainfall Event (Area)



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Summary for Pond 1P: Daniels Sand Wash Fines Pit

Inflow Area = 28.700 ac, 75.61% Impervious, Inflow Depth = 5.21" for 200yr, 24hr event
Inflow = 257.05 cfs @ 11.89 hrs, Volume= 12.472 af
Outflow = 0.00 cfs @ 0.00 hrs, Volume= 0.000 af, Atten= 100%, Lag= 0.0 min

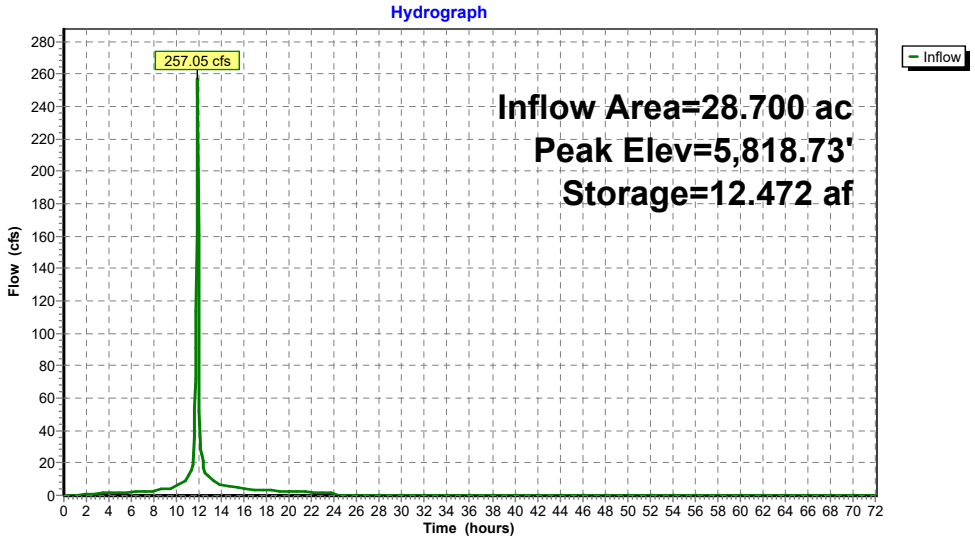
Routing by Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs
Peak Elev= 5,818.73' @ 24.10 hrs Surf.Area= 17.514 ac Storage= 12.472 af

Plug-Flow detention time= (not calculated: initial storage exceeds outflow)
Center-of-Mass det. time= (not calculated: no outflow)

Volume	Invert	Avail.Storage	Storage Description
#1	5,818.00'	57.250 af	**Custom Stage Data (Prismatic)** Listed below

Elevation (feet)	Surf.Area (acres)	Inc.Store (acre-feet)	Cum.Store (acre-feet)
5,818.00	15.960	0.000	0.000
5,819.00	18.080	17.020	17.020
5,820.00	20.340	19.210	36.230
5,821.00	21.700	21.020	57.250

Pond 1P: Daniels Sand Wash Fines Pit



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Purpose: Determine the maximum water surface elevation due to wind induced waves.

Procedure: Follow procedures as described in ACER Technical Memorandum No. 2 (USBR 1981, based on ETL 1110-2-221)

References: ACER Technical Memorandum No. 2, Freeboard Criteria and Guidelines for Computing Freeboard Allowances for Storage Dams, U.S. Department of Interior Bureau of Reclamation, 1981.

Effective Fetch Calculation (See Attached Site Plan, Figure 3.)

α Degrees	Cos (α)	Xi (feet)	Xi (miles)	Xi * Cos(α)
35	0.819	790.2	0.15	0.123
30	0.866	940.2	0.18	0.154
25	0.906	980.4	0.19	0.168
20	0.940	1040	0.20	0.185
15	0.966	1111.2	0.21	0.203
10	0.985	1202.3	0.23	0.224
5	0.996	1307.6	0.25	0.247
0	1.000	1446	0.27	0.274
5	0.996	1277.8	0.24	0.241
10	0.985	1201.4	0.23	0.224
15	0.966	1166.65	0.22	0.213
20	0.940	1133.1	0.21	0.202
25	0.906	1060.9	0.20	0.182
30	0.866	973	0.18	0.160
35	0.819	917.8	0.17	0.142
40	0.766	871.7	0.17	0.126
45	0.707	808.8	0.15	0.108
Sum =	15.429		Sum =	3.18

$$Feff = \sum(Xi\cos(\alpha)) \Big/ \sum\cos(\alpha)$$

Effective Fetch = 0.21 miles

Design Wave Height

Feff =	0.2	miles	
Wind Velocity =	60	mph	
Duration =	5.1	mins	(Figure 9 USBR 1981)

* From Figure 9 (USBR 1981) design wave	Hs =	1.3	ft
* From Figure 10 (USBR 1981) wave period	T =	1.95	sec
* Wave Length Lo = $5.12(T)^2$	Lo =	19.5	ft
* Hmax (Highest 1% of waves) = 1.67(Hs)	Hmax =	2.2	ft

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Wind Setup

* Assume a uniform depth = 4 ft

Wind Setup $Zs = \frac{Vwind^2 * F}{1400 * d}$

Vwind =	60	mph
Feff =	0.21	miles
F = 2*Feff =	0.41	miles
d =	3	ft
Zs =	0.35	ft

Wind Runup

* East Dams have 2H:1V slopes with riprap lining

Design Wave, Hs =	1.3	ft	
Period, T =	1.95	sec	
Design Depth, ds =	3	ft	(depth at toe of impoundment)
ds/Hs =	2.31		
Hs = H'o H'o/(g*T^2) =	0.011		

From Figure 11 (USBR 1981)

R/H'o =	0.55	
R =	0.72	ft

Summary:

Storm Event	(A) Pond Starting Elevation* (feet)	(B) Wave Run-up (feet)	(C) Wind Set-up (feet)	(D) Approximate Rise of Pond Due to Storm (feet)	(E) Maximum Water Surface Elevation (A+B+C+D) (feet)	(F) Minimum Crest of Water Retention Dam (feet)	(G) Available Freeboard (F-E) (feet)
100 Year	5833.00	0.72	0.35	0.52	5834.59	5836.00	1.41
200-Year	5833.00	0.72	0.35	0.62	5834.69	5836.00	1.31
1/2PMP (CO-NM REPS)	5833.00	0.72	0.35	1.61	5835.68	5836.00	0.32
½ PMP (HMR55A)	5833.00	0.72	0.35	1.89	5835.96	5836.00	0.04

*Assumes a maximum pond elevation of +5,833 feet for a dam elevation of +5,836 feet.

Attachments:

Figure 3.
USBR Referenced Figures

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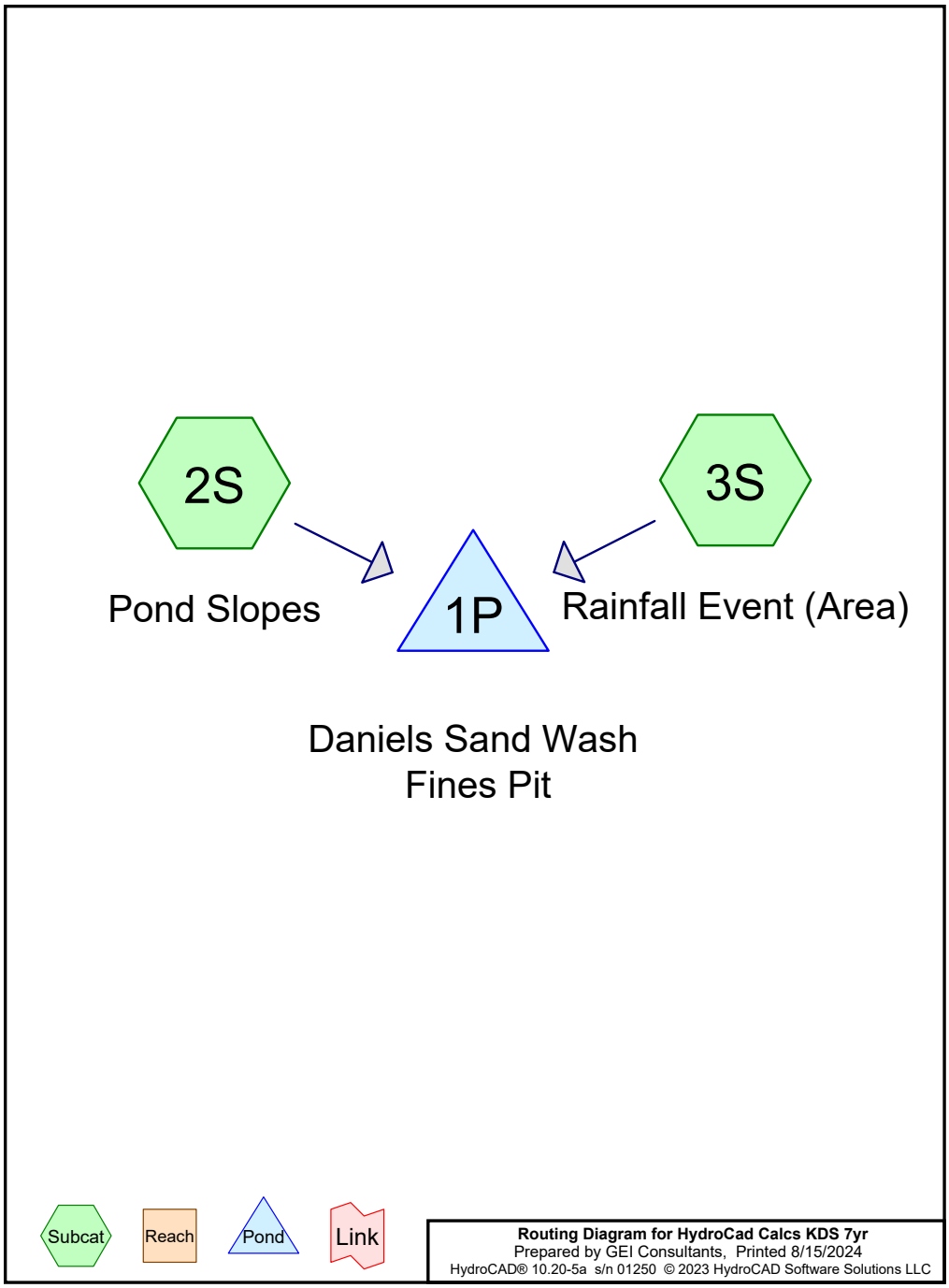

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Subject	Wave Run Up Calculation 7-yr					

Rainfall Events Listing

Event#	Event Name	Storm Type	Curve	Mode	Duration (hours)	B/B	Depth (inches)	AMC
1	1/2 PMP (HMR 51), 24 hr	Type II 24-hr		Default	24.00	1	17.50	2
2	1/2 PMP CO-NMREPS, 24 hr	Type II 24-hr		Default	24.00	1	14.90	2
3	100yr, 24hr	Type II 24-hr		Default	24.00	1	5.15	2
4	200yr, 24hr	Type II 24-hr		Default	24.00	1	6.01	2

Area Listing (all nodes)

Area (acres)	CN	Description (subcatchment-numbers)
6.400	77	Fallow, bare soil, HSG A (2S)
25.070	98	Water Surface, HSG A (3S)
31.470	**94**	**TOTAL AREA**

Soil Listing (all nodes)

Area (acres)	Soil Group	Subcatchment Numbers
31.470	HSG A	2S, 3S
0.000	HSG B	
0.000	HSG C	
0.000	HSG D	
0.000	Other	
31.470		**TOTAL AREA**

HydroCad Calcs KDS 7yr
Prepared by GEI Consultants Printed 8/15/2024

Ground Covers (all nodes)

HSG-A (acres)	HSG-B (acres)	HSG-C (acres)	HSG-D (acres)	Other (acres)	Total (acres)	Ground Cover	Subcatchment Numbers
6.400	0.000	0.000	0.000	0.000	6.400	Fallow, bare soil	2S
25.070	0.000	0.000	0.000	0.000	25.070	Water Surface	3S
31.470	**0.000**	**0.000**	**0.000**	**0.000**	**31.470**	**TOTAL AREA**	

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Subject	Wave Run Up Calculation 7-yr						

Time span=0.00-72.00 hrs, dt=0.05 hrs, 1441 points
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN
Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

Subcatchment2S: Pond Slopes Runoff Area=6.400 ac 0.00% Impervious Runoff Depth=14.36"
Flow Length=140' Slope=0.3330 '/' Tc=2.2 min CN=77 Runoff=157.48 cfs 7.661 af

Subcatchment3S: Rainfall Event (Area) Runoff Area=25.070 ac 100.00% Impervious Runoff Depth=17.26"
Tc=0.0 min CN=98 Runoff=704.90 cfs 36.054 af

Pond 1P: Daniels Sand Wash Fines Pit Peak Elev=5,834.89' Storage=43.715 af Inflow=855.33 cfs 43.715 af
Outflow=0.00 cfs 0.000 af

Total Runoff Area = 31.470 ac Runoff Volume = 43.715 af Average Runoff Depth = 16.67"
20.34% Pervious = 6.400 ac 79.66% Impervious = 25.070 ac

Summary for Subcatchment 2S: Pond Slopes

[49] Hint: Tc<2dt may require smaller dt

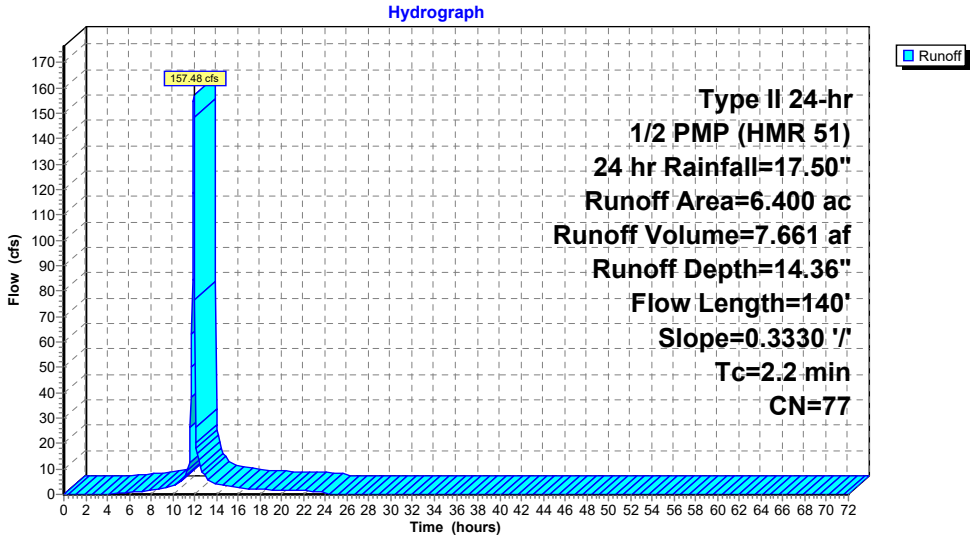
Runoff = 157.48 cfs @ 11.92 hrs, Volume= 7.661 af, Depth=14.36"
Routed to Pond 1P : Daniels Sand Wash Fines Pit

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs
Type II 24-hr 1/2 PMP (HMR 51), 24 hr Rainfall=17.50"

Area (ac)	CN	Description
6.400	77	Fallow, bare soil, HSG A
6.400		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
2.2	140	0.3330	1.04		**Sheet Flow, Pond Slopes** Fallow n= 0.050 P2= 1.90"

Subcatchment 2S: Pond Slopes



Summary for Subcatchment 3S: Rainfall Event (Area)

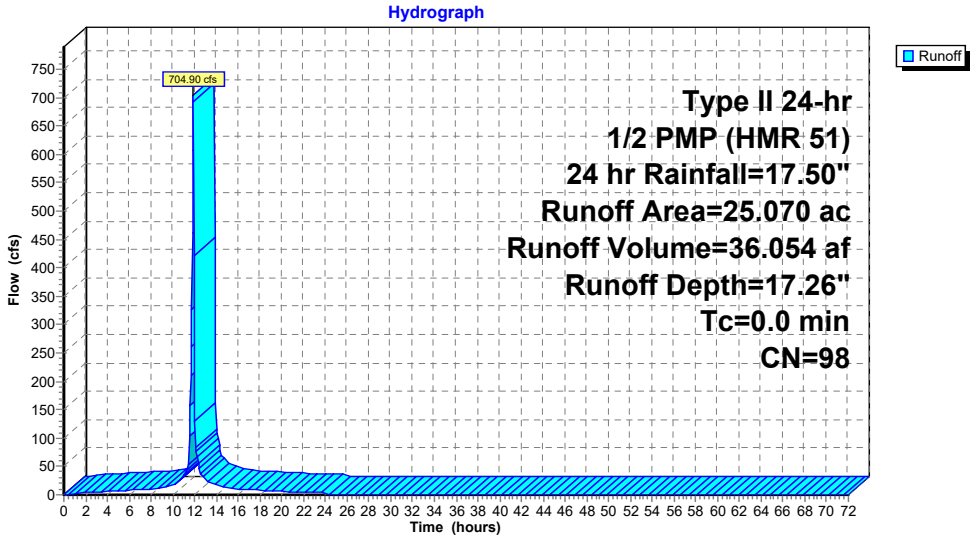
[46] Hint: Tc=0 (Instant runoff peak depends on dt)

Runoff = 704.90 cfs @ 11.89 hrs, Volume= 36.054 af, Depth=17.26"
Routed to Pond 1P : Daniels Sand Wash Fines Pit

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs
Type II 24-hr 1/2 PMP (HMR 51), 24 hr Rainfall=17.50"

Area (ac)	CN	Description
25.070	98	Water Surface, HSG A
25.070		100.00% Impervious Area

Subcatchment 3S: Rainfall Event (Area)



Summary for Pond 1P: Daniels Sand Wash Fines Pit

Inflow Area = 31.470 ac, 79.66% Impervious, Inflow Depth = 16.67" for 1/2 PMP (HMR 51), 24 hr event
Inflow = 855.33 cfs @ 11.89 hrs, Volume= 43.715 af
Outflow = 0.00 cfs @ 0.00 hrs, Volume= 0.000 af, Atten= 100%, Lag= 0.0 min

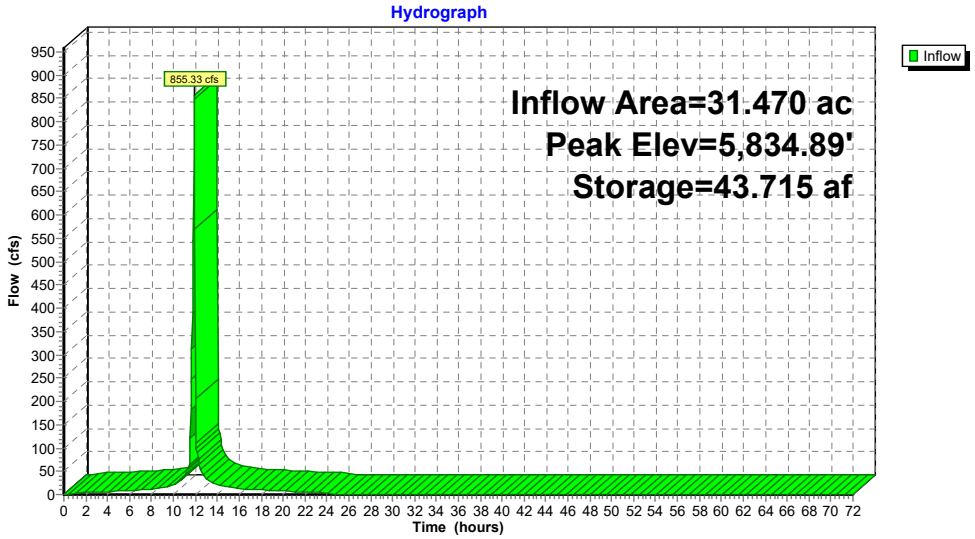
Routing by Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs
Peak Elev= 5,834.89' @ 24.20 hrs Surf.Area= 24.083 ac Storage= 43.715 af

Plug-Flow detention time= (not calculated: initial storage exceeds outflow)
Center-of-Mass det. time= (not calculated: no outflow)

Volume	Invert	Avail.Storage	Storage Description
#1	5,833.00'	70.920 af	**Custom Stage Data (Prismatic)** Listed below

Elevation (feet)	Surf.Area (acres)	Inc.Store (acre-feet)	Cum.Store (acre-feet)
5,833.00	21.830	0.000	0.000
5,834.00	23.290	22.560	22.560
5,835.00	24.180	23.735	46.295
5,836.00	25.070	24.625	70.920

Pond 1P: Daniels Sand Wash Fines Pit



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Subject	Wave Run Up Calculation 7-yr						

Time span=0.00-72.00 hrs, dt=0.05 hrs, 1441 points
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN
Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

Subcatchment2S: Pond Slopes Runoff Area=6.400 ac 0.00% Impervious Runoff Depth=11.83"
Flow Length=140' Slope=0.3330 '/' Tc=2.2 min CN=77 Runoff=131.45 cfs 6.310 af

Subcatchment3S: Rainfall Event (Area) Runoff Area=25.070 ac 100.00% Impervious Runoff Depth=14.66"
Tc=0.0 min CN=98 Runoff=600.07 cfs 30.623 af

Pond 1P: Daniels Sand Wash Fines Pit Peak Elev=5,834.61' Storage=36.933 af Inflow=725.39 cfs 36.933 af
Outflow=0.00 cfs 0.000 af

Total Runoff Area = 31.470 ac Runoff Volume = 36.933 af Average Runoff Depth = 14.08"
20.34% Pervious = 6.400 ac 79.66% Impervious = 25.070 ac

Summary for Subcatchment 2S: Pond Slopes

[49] Hint: Tc<2dt may require smaller dt

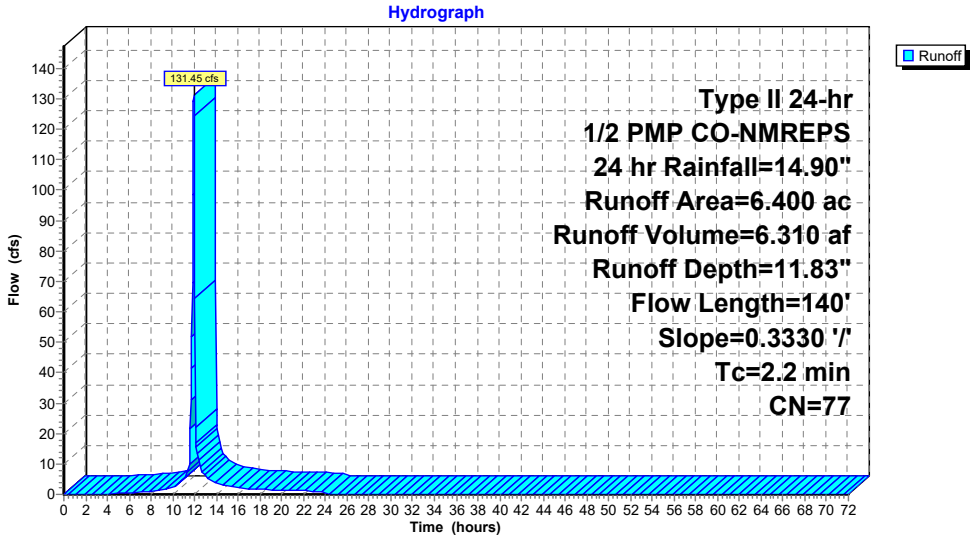
Runoff = 131.45 cfs @ 11.92 hrs, Volume= 6.310 af, Depth=11.83"
Routed to Pond 1P : Daniels Sand Wash Fines Pit

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs
Type II 24-hr 1/2 PMP CO-NMREPS, 24 hr Rainfall=14.90"

Area (ac)	CN	Description
6.400	77	Fallow, bare soil, HSG A
6.400		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
2.2	140	0.3330	1.04		**Sheet Flow, Pond Slopes** Fallow n= 0.050 P2= 1.90"

Subcatchment 2S: Pond Slopes



Summary for Subcatchment 3S: Rainfall Event (Area)

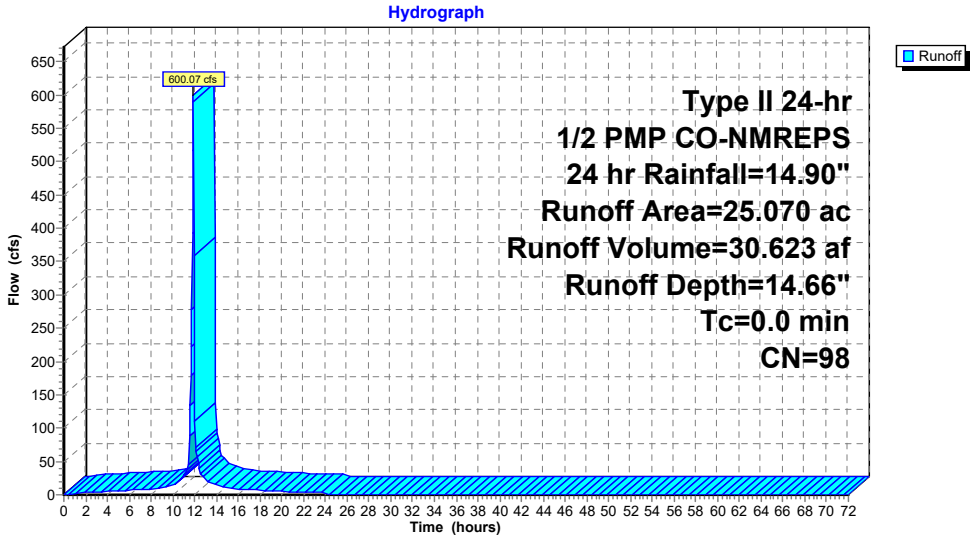
[46] Hint: Tc=0 (Instant runoff peak depends on dt)

Runoff = 600.07 cfs @ 11.89 hrs, Volume= 30.623 af, Depth=14.66"
Routed to Pond 1P : Daniels Sand Wash Fines Pit

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs
Type II 24-hr 1/2 PMP CO-NMREPS, 24 hr Rainfall=14.90"

Area (ac)	CN	Description
25.070	98	Water Surface, HSG A
25.070		100.00% Impervious Area

Subcatchment 3S: Rainfall Event (Area)



GEI Consultants							
	Client	Holcim				Page	
	Project	Daniels Sand Wash Fines Pit				Pg. Rev.	
	By	KDS	Chk.	CEF		App.	
	Date	8/15/2024	Date	8/16/2024		Date	
Project No.	2400434	Document No.	N/A				
Subject	Wave Run Up Calculation 7-yr						

Summary for Pond 1P: Daniels Sand Wash Fines Pit

Inflow Area = 31.470 ac, 79.66% Impervious, Inflow Depth = 14.08" for 1/2 PMP CO-NMREPS, 24 hr event
Inflow = 725.39 cfs @ 11.89 hrs, Volume= 36.933 af
Outflow = 0.00 cfs @ 0.00 hrs, Volume= 0.000 af, Atten= 100%, Lag= 0.0 min

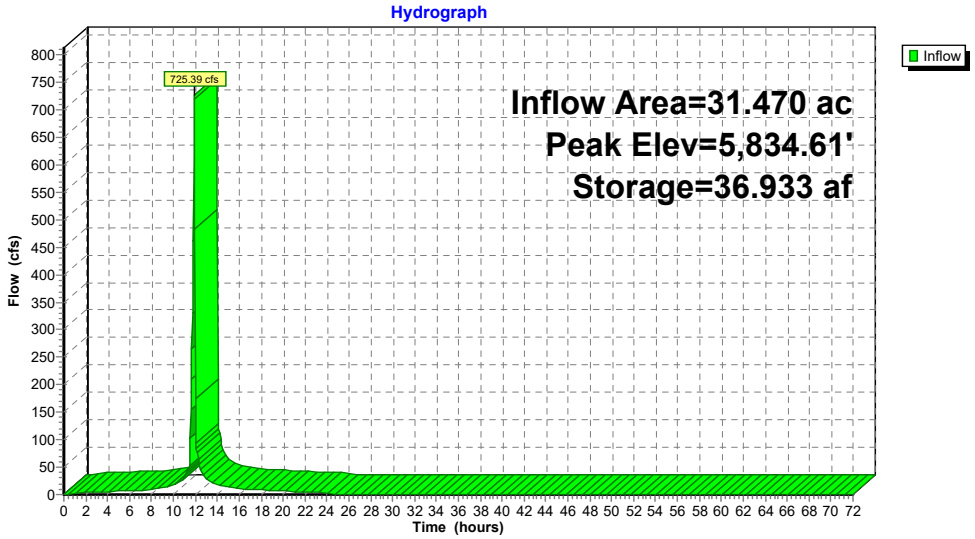
Routing by Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs
Peak Elev= 5,834.61' @ 24.20 hrs Surf.Area= 23.829 ac Storage= 36.933 af

Plug-Flow detention time= (not calculated: initial storage exceeds outflow)
Center-of-Mass det. time= (not calculated: no outflow)

Volume	Invert	Avail.Storage	Storage Description
#1	5,833.00'	70.920 af	**Custom Stage Data (Prismatic)** Listed below

Elevation (feet)	Surf.Area (acres)	Inc.Store (acre-feet)	Cum.Store (acre-feet)
5,833.00	21.830	0.000	0.000
5,834.00	23.290	22.560	22.560
5,835.00	24.180	23.735	46.295
5,836.00	25.070	24.625	70.920

Pond 1P: Daniels Sand Wash Fines Pit



GEI Consultants	Client	Holcim			Page	
	Project	Daniels Sand Wash Fines Pit			Pg. Rev.	
	By	KDS	Chk.	CEF	App.	
	Date	8/15/2024	Date	8/16/2024	Date	
Project No.	2400434	Document No.	N/A			
Subject	Wave Run Up Calculation 7-yr					

Time span=0.00-72.00 hrs, dt=0.05 hrs, 1441 points
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN
Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

Subcatchment2S: Pond Slopes Runoff Area=6.400 ac 0.00% Impervious Runoff Depth=2.75"
Flow Length=140' Slope=0.3330 '/' Tc=2.2 min CN=77 Runoff=33.91 cfs 1.466 af

Subcatchment3S: Rainfall Event (Area) Runoff Area=25.070 ac 100.00% Impervious Runoff Depth=4.91"
Tc=0.0 min CN=98 Runoff=206.57 cfs 10.264 af

Pond 1P: Daniels Sand Wash Fines Pit Peak Elev=5,833.52' Storage=11.730 af Inflow=237.11 cfs 11.730 af
Outflow=0.00 cfs 0.000 af

Total Runoff Area = 31.470 ac Runoff Volume = 11.730 af Average Runoff Depth = 4.47"
20.34% Pervious = 6.400 ac 79.66% Impervious = 25.070 ac

GEI Consultants	Client	Holcim			Page	
	Project	Daniels Sand Wash Fines Pit			Pg. Rev.	
	By	KDS	Chk.	CEF	App.	
	Date	8/15/2024	Date	8/16/2024	Date	
Project No.	2400434	Document No.	N/A			
Subject	Wave Run Up Calculation 7-yr					

Summary for Subcatchment 2S: Pond Slopes

[49] Hint: Tc<2dt may require smaller dt

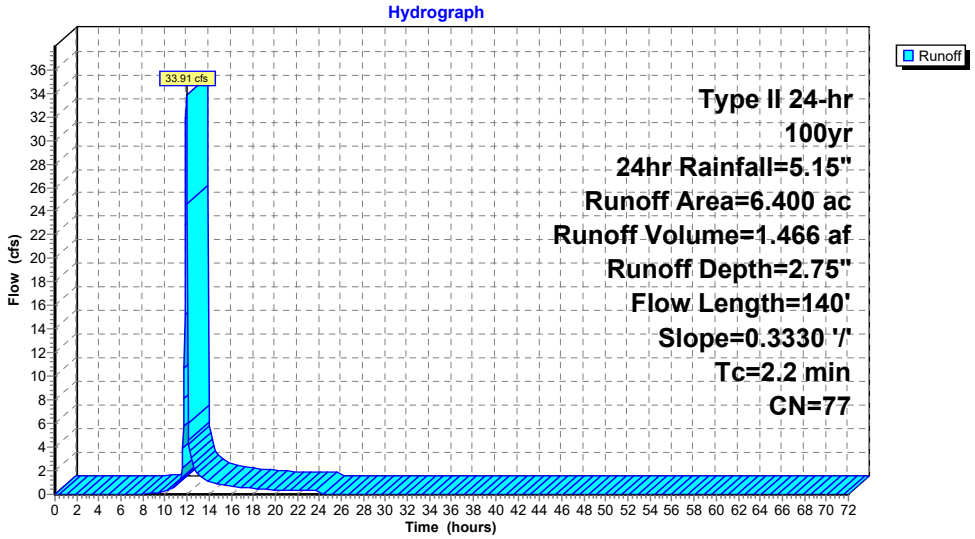
Runoff = 33.91 cfs @ 11.93 hrs, Volume= 1.466 af, Depth= 2.75"
Routed to Pond 1P : Daniels Sand Wash Fines Pit

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs
Type II 24-hr 100yr, 24hr Rainfall=5.15"

Area (ac)	CN	Description
6.400	77	Fallow, bare soil, HSG A
6.400		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
2.2	140	0.3330	1.04		**Sheet Flow, Pond Slopes** Fallow n= 0.050 P2= 1.90"

Subcatchment 2S: Pond Slopes



Summary for Subcatchment 3S: Rainfall Event (Area)

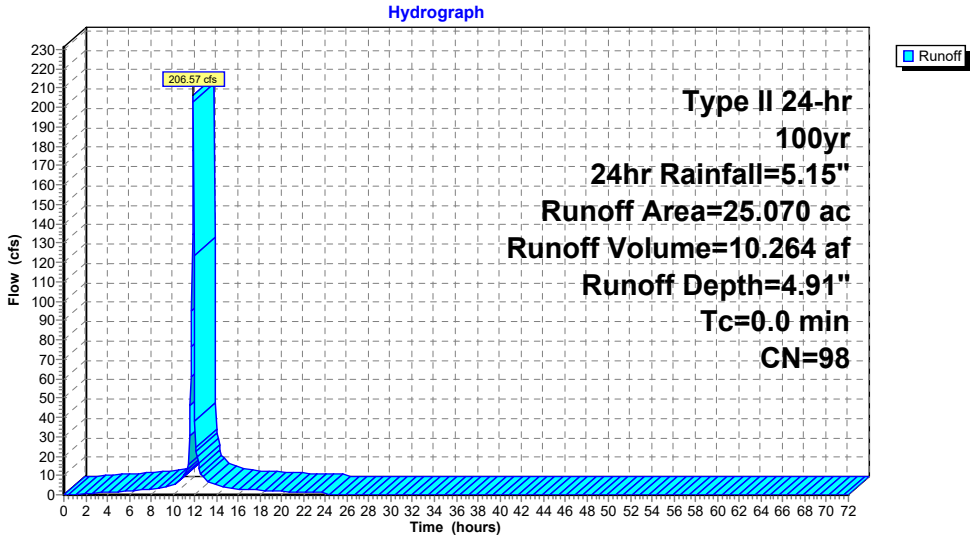
[46] Hint: Tc=0 (Instant runoff peak depends on dt)

Runoff = 206.57 cfs @ 11.89 hrs, Volume= 10.264 af, Depth= 4.91"
Routed to Pond 1P : Daniels Sand Wash Fines Pit

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs
Type II 24-hr 100yr, 24hr Rainfall=5.15"

Area (ac)	CN	Description
25.070	98	Water Surface, HSG A
25.070		100.00% Impervious Area

Subcatchment 3S: Rainfall Event (Area)



GEI Consultants	Client	Holcim				Page	
	Project	Daniels Sand Wash Fines Pit				Pg. Rev.	
	By	KDS	Chk.	CEF		App.	
	Date	8/15/2024	Date	8/16/2024		Date	
Project No.	2400434	Document No.	N/A				
Subject	Wave Run Up Calculation 7-yr						

Summary for Pond 1P: Daniels Sand Wash Fines Pit

Inflow Area = 31.470 ac, 79.66% Impervious, Inflow Depth = 4.47" for 100yr, 24hr event
Inflow = 237.11 cfs @ 11.89 hrs, Volume= 11.730 af
Outflow = 0.00 cfs @ 0.00 hrs, Volume= 0.000 af, Atten= 100%, Lag= 0.0 min

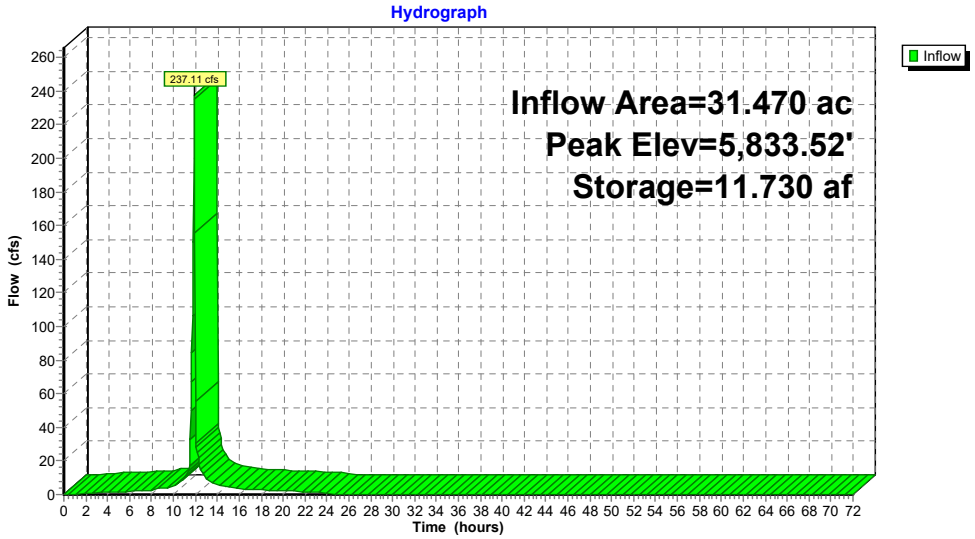
Routing by Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs
Peak Elev= 5,833.52' @ 24.20 hrs Surf.Area= 22.589 ac Storage= 11.730 af

Plug-Flow detention time= (not calculated: initial storage exceeds outflow)
Center-of-Mass det. time= (not calculated: no outflow)

Volume	Invert	Avail.Storage	Storage Description
#1	5,833.00'	70.920 af	**Custom Stage Data (Prismatic)** Listed below

Elevation (feet)	Surf.Area (acres)	Inc.Store (acre-feet)	Cum.Store (acre-feet)
5,833.00	21.830	0.000	0.000
5,834.00	23.290	22.560	22.560
5,835.00	24.180	23.735	46.295
5,836.00	25.070	24.625	70.920

Pond 1P: Daniels Sand Wash Fines Pit



GEI Consultants	Client	Holcim			Page	
	Project	Daniels Sand Wash Fines Pit			Pg. Rev.	
	By	KDS	Chk.	CEF	App.	
	Date	8/15/2024	Date	8/16/2024	Date	
Project No.	2400434	Document No.	N/A			
Subject	Wave Run Up Calculation 7-yr					

Time span=0.00-72.00 hrs, dt=0.05 hrs, 1441 points
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN
Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

Subcatchment2S: Pond Slopes Runoff Area=6.400 ac 0.00% Impervious Runoff Depth=3.49"
Flow Length=140' Slope=0.3330 '/' Tc=2.2 min CN=77 Runoff=41.59 cfs 1.860 af

Subcatchment3S: Rainfall Event (Area) Runoff Area=25.070 ac 100.00% Impervious Runoff Depth=5.77"
Tc=0.0 min CN=98 Runoff=241.35 cfs 12.058 af

Pond 1P: Daniels Sand Wash Fines Pit Peak Elev=5,833.62' Storage=13.919 af Inflow=280.06 cfs 13.919 af
Outflow=0.00 cfs 0.000 af

Total Runoff Area = 31.470 ac Runoff Volume = 13.919 af Average Runoff Depth = 5.31"
20.34% Pervious = 6.400 ac 79.66% Impervious = 25.070 ac

Summary for Subcatchment 2S: Pond Slopes

[49] Hint: Tc<2dt may require smaller dt

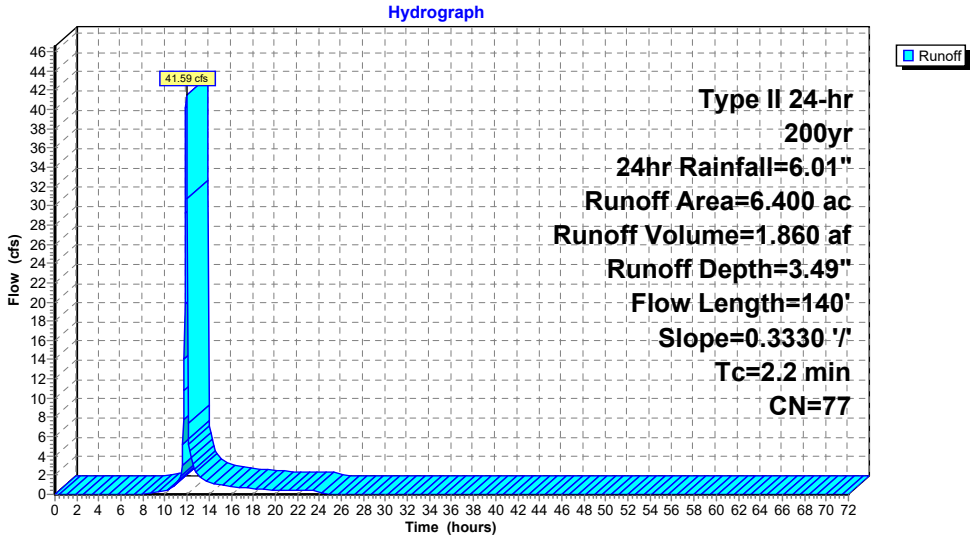
Runoff = 41.59 cfs @ 11.92 hrs, Volume= 1.860 af, Depth= 3.49"
Routed to Pond 1P : Daniels Sand Wash Fines Pit

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs
Type II 24-hr 200yr, 24hr Rainfall=6.01"

Area (ac)	CN	Description
6.400	77	Fallow, bare soil, HSG A
6.400		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
2.2	140	0.3330	1.04		**Sheet Flow, Pond Slopes** Fallow n= 0.050 P2= 1.90"

Subcatchment 2S: Pond Slopes



Summary for Subcatchment 3S: Rainfall Event (Area)

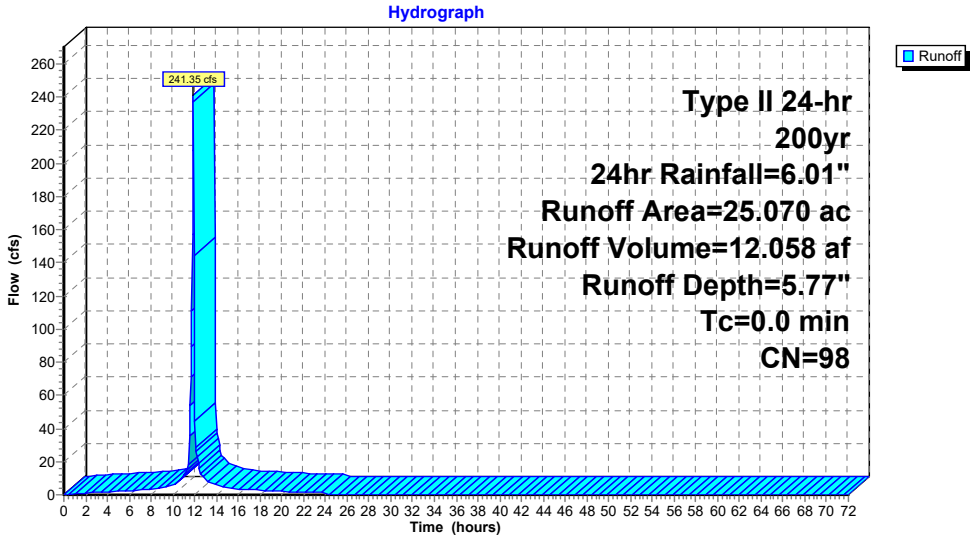
[46] Hint: Tc=0 (Instant runoff peak depends on dt)

Runoff = 241.35 cfs @ 11.89 hrs, Volume= 12.058 af, Depth= 5.77"
Routed to Pond 1P : Daniels Sand Wash Fines Pit

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs
Type II 24-hr 200yr, 24hr Rainfall=6.01"

Area (ac)	CN	Description
25.070	98	Water Surface, HSG A
25.070		100.00% Impervious Area

Subcatchment 3S: Rainfall Event (Area)



GEI Consultants	Client	Holcim				Page	
	Project	Daniels Sand Wash Fines Pit				Pg. Rev.	
	By	KDS	Chk.	CEF		App.	
	Date	8/15/2024	Date	8/16/2024		Date	
Project No.	2400434	Document No.	N/A				
Subject	Wave Run Up Calculation 7-yr						

Summary for Pond 1P: Daniels Sand Wash Fines Pit

Inflow Area = 31.470 ac, 79.66% Impervious, Inflow Depth = 5.31" for 200yr, 24hr event
Inflow = 280.06 cfs @ 11.89 hrs, Volume= 13.919 af
Outflow = 0.00 cfs @ 0.00 hrs, Volume= 0.000 af, Atten= 100%, Lag= 0.0 min

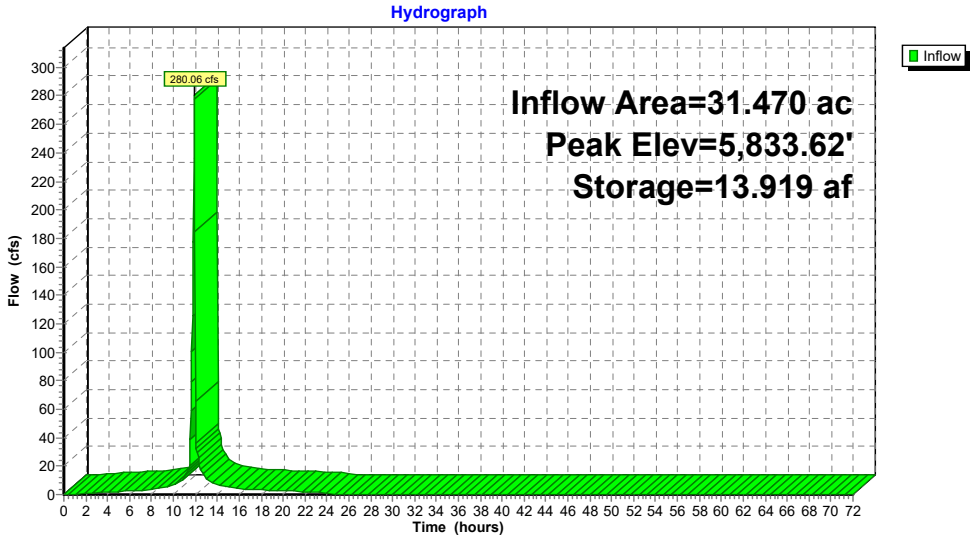
Routing by Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs
Peak Elev= 5,833.62' @ 24.20 hrs Surf.Area= 22.731 ac Storage= 13.919 af

Plug-Flow detention time= (not calculated: initial storage exceeds outflow)
Center-of-Mass det. time= (not calculated: no outflow)

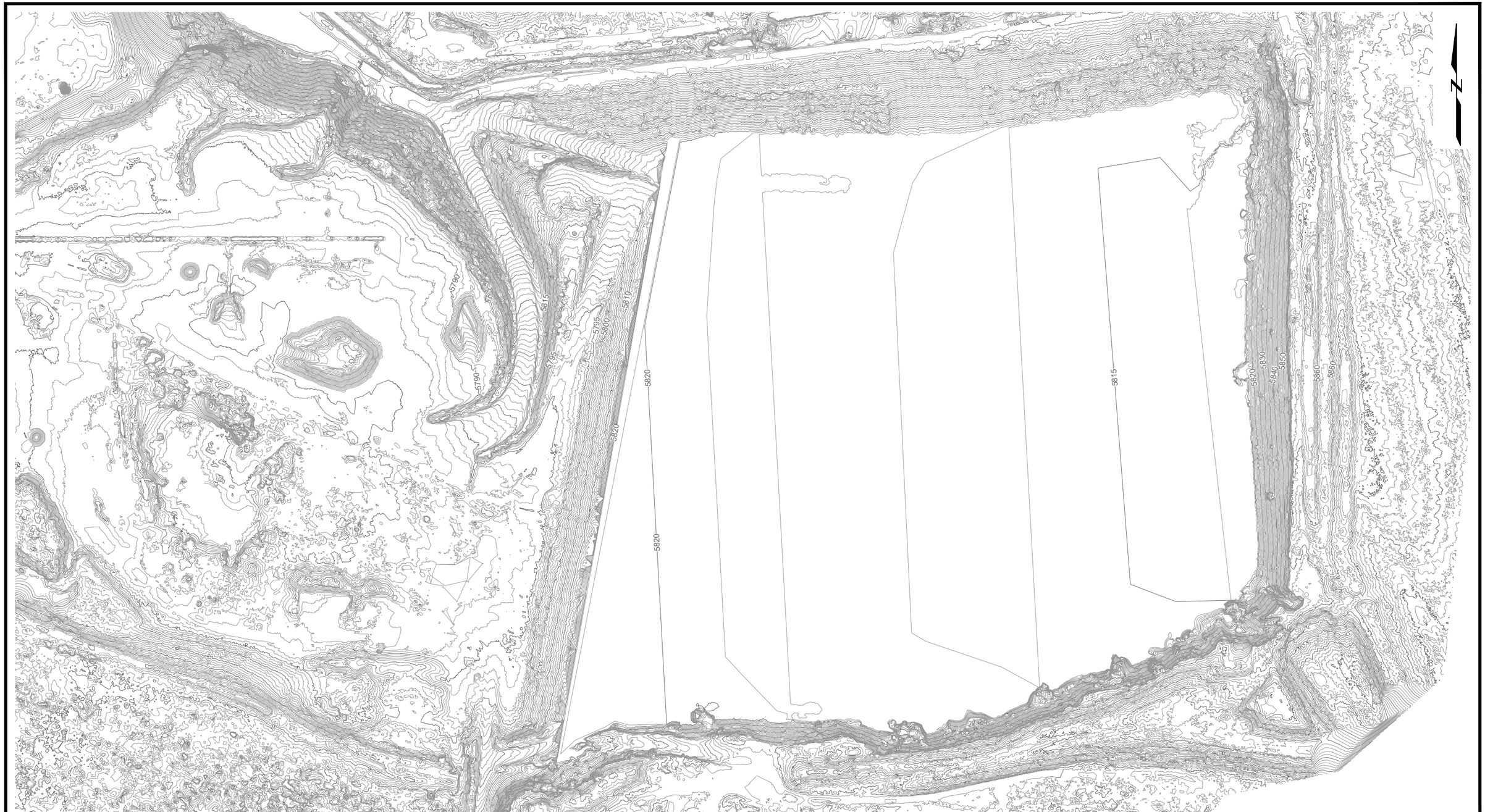
Volume	Invert	Avail.Storage	Storage Description
#1	5,833.00'	70.920 af	**Custom Stage Data (Prismatic)** Listed below

Elevation (feet)	Surf.Area (acres)	Inc.Store (acre-feet)	Cum.Store (acre-feet)
5,833.00	21.830	0.000	0.000
5,834.00	23.290	22.560	22.560
5,835.00	24.180	23.735	46.295
5,836.00	25.070	24.625	70.920

Pond 1P: Daniels Sand Wash Fines Pit



Appendix A – Figures

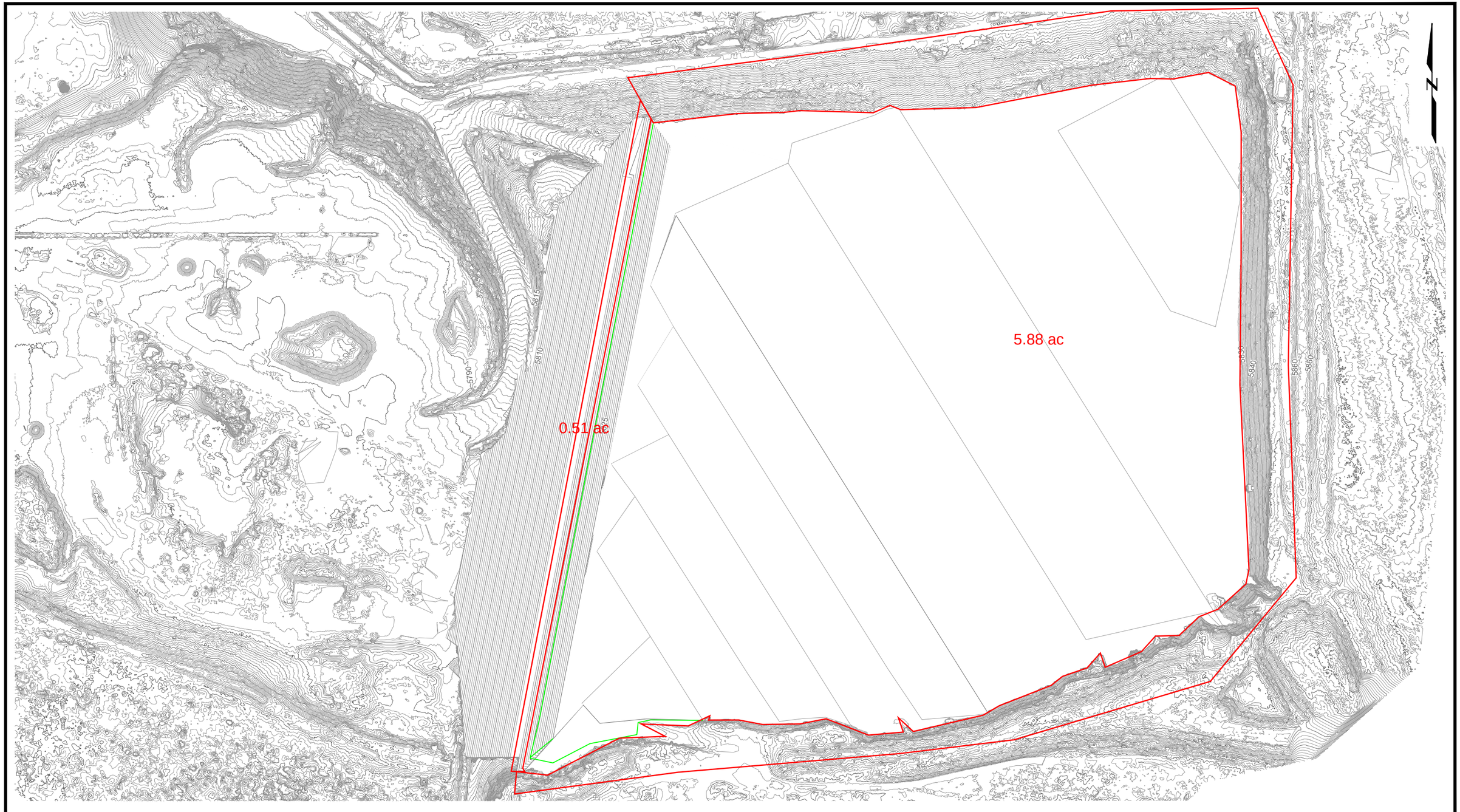


0 75 150 300

SCALE, FEET

DANIELS SAND PIT RAISE	GEI Consultants	2 YEAR PLANNED BUILD OUT	
COLORADO SPRINGS, COLORADO	Project 2400434	July 2024	Fig. 1

BURGER, DAVE B:\Working\HOLCIM\2400434 Daniels Sand Wash Fines Pit Raise\00_CAD\Topo 2 Year\Fig 1 FG_2yrtails DAB.dwg - 7/31/2024

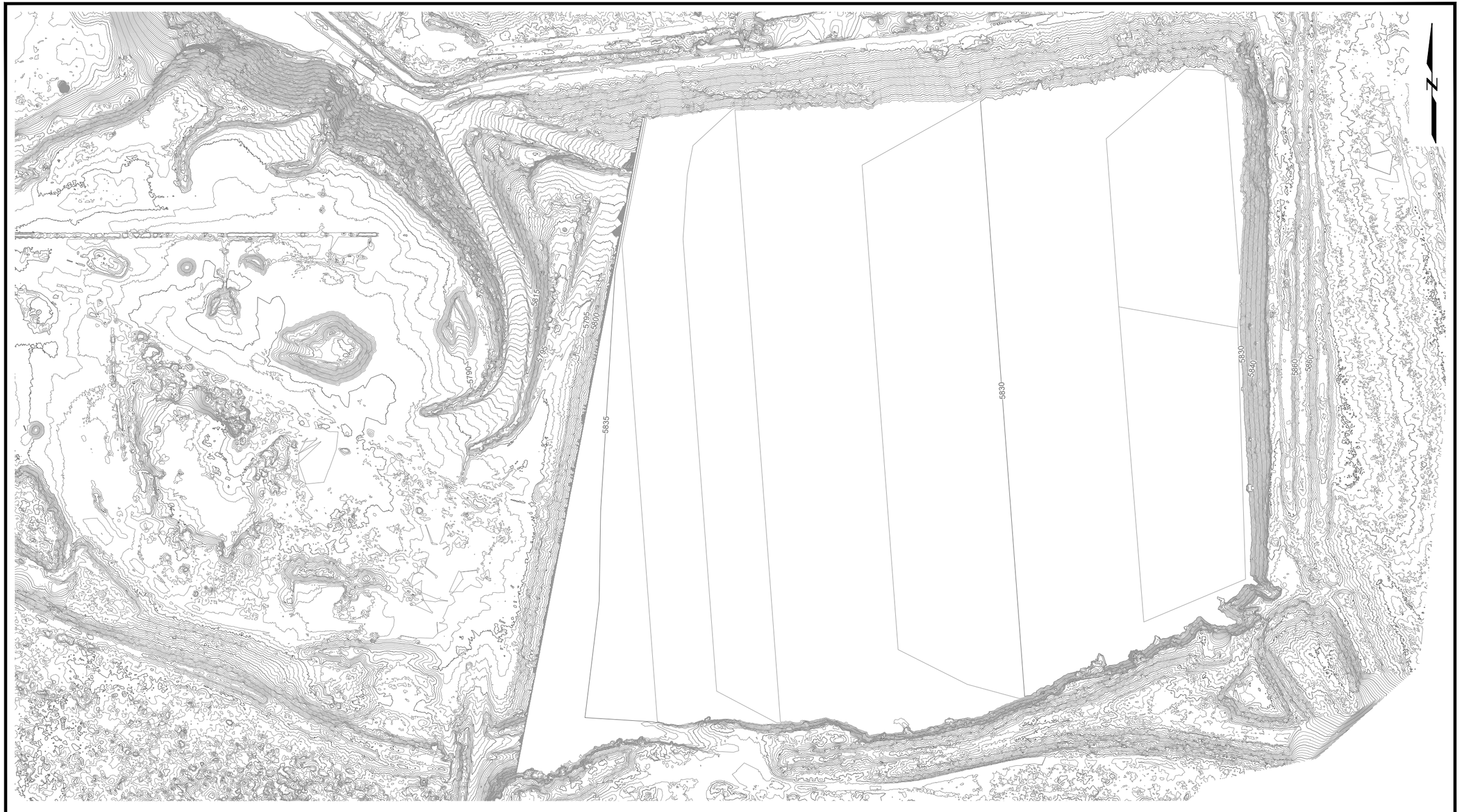


0 75 150 300

SCALE, FEET

DANIELS SAND PIT RAISE	GEI Consultants	7 YEAR PLANNED BUILD OUT
COLORADO SPRINGS, COLORADO	Project 2400434	July 2024 Fig. 2

SPERRY, KRIS B:\Working\HOLCIM\2400434 Daniels Sand Wash Fines Pit Raise\00_CAD\Topo 7 Year\Fig 1 FG_7yrtails DAB with Berm.dwg - 8/15/2024

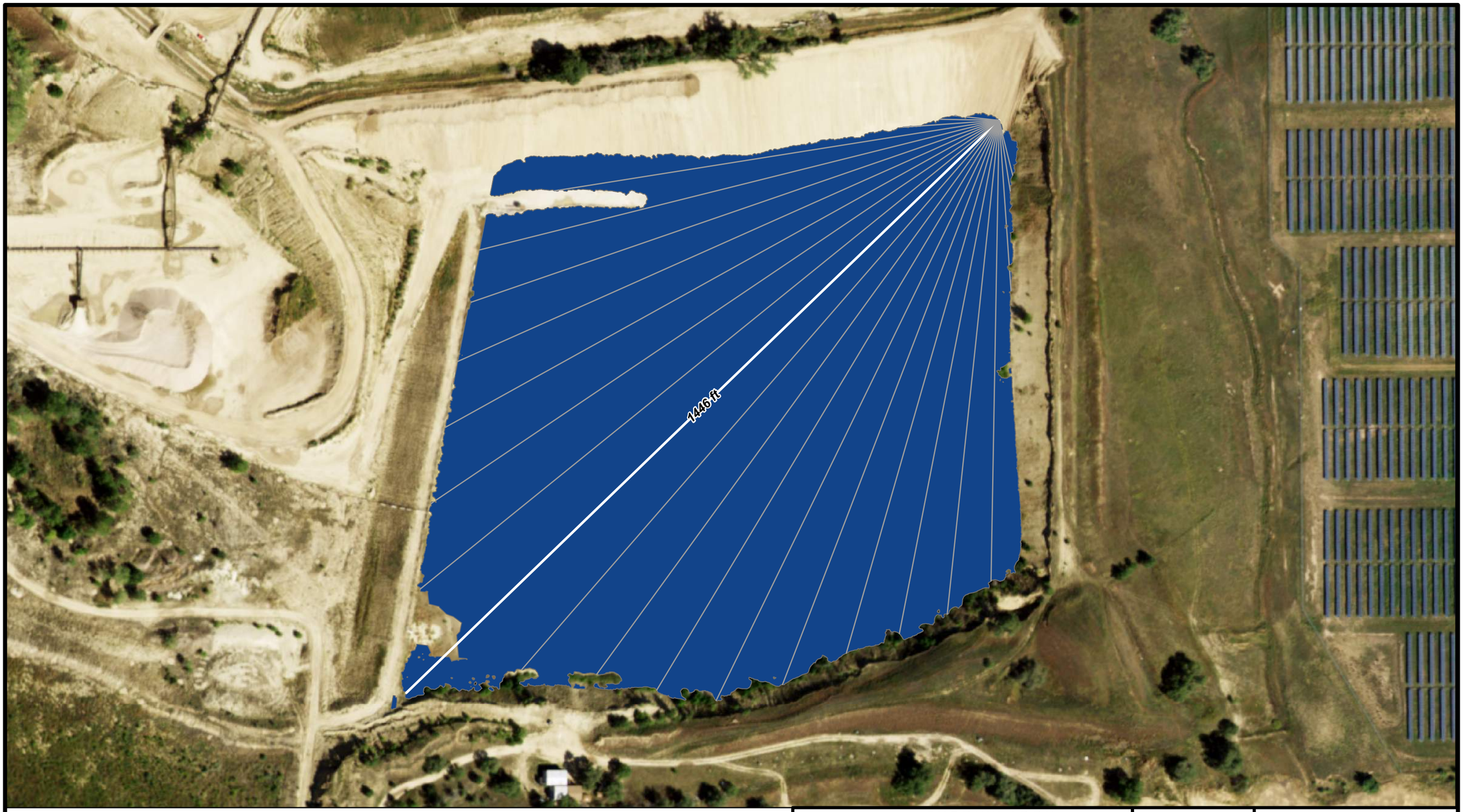


0 75 150 300

SCALE, FEET

DANIELS SAND PIT RAISE	GEI Consultants	7 YEAR PLANNED BUILD OUT 2
COLORADO SPRINGS, COLORADO	Project 2400434	July 2024 Fig. 3

BURGER, DAVE B:\Working\HOLCIM\2400434 Daniels Sand Wash Fines Pit Raise\00_CAD\Topo 7 Year\Fig 1 FG_7yrtails2 DAB.dwg - 7/31/2024



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NOTES:

+LJKZDWHU IW IUHHERDUG VXUIDFH GHULYHG IURP~VLWH WRSR 'DWD UHSUHVHQWV K\SRWKHWLFDO PRGHO FRQGLWLRQV 6LWH FRQGLWLRQV PD\ FKDQJH RYHU WLPH DFFXUDF\ LV QRW JXDUDQWHHG XQG QRW EH XVHG IRU PHDVXUHPHQW)HHW

5HSRUW 1DPH 6LWH 1DPH 3URMHFW /RFDWLRQ &LW\ 6WDWH	GEI Consultants	:$9(581 2)) 6&+(0$7 & 6,7(7232 +,*+:$7(5)7)5((%2$5' &21',7,21
&OLHQW 1DPH &OLHQW &LW\ 6WDWH	3URMHFW	-XQH)LJ

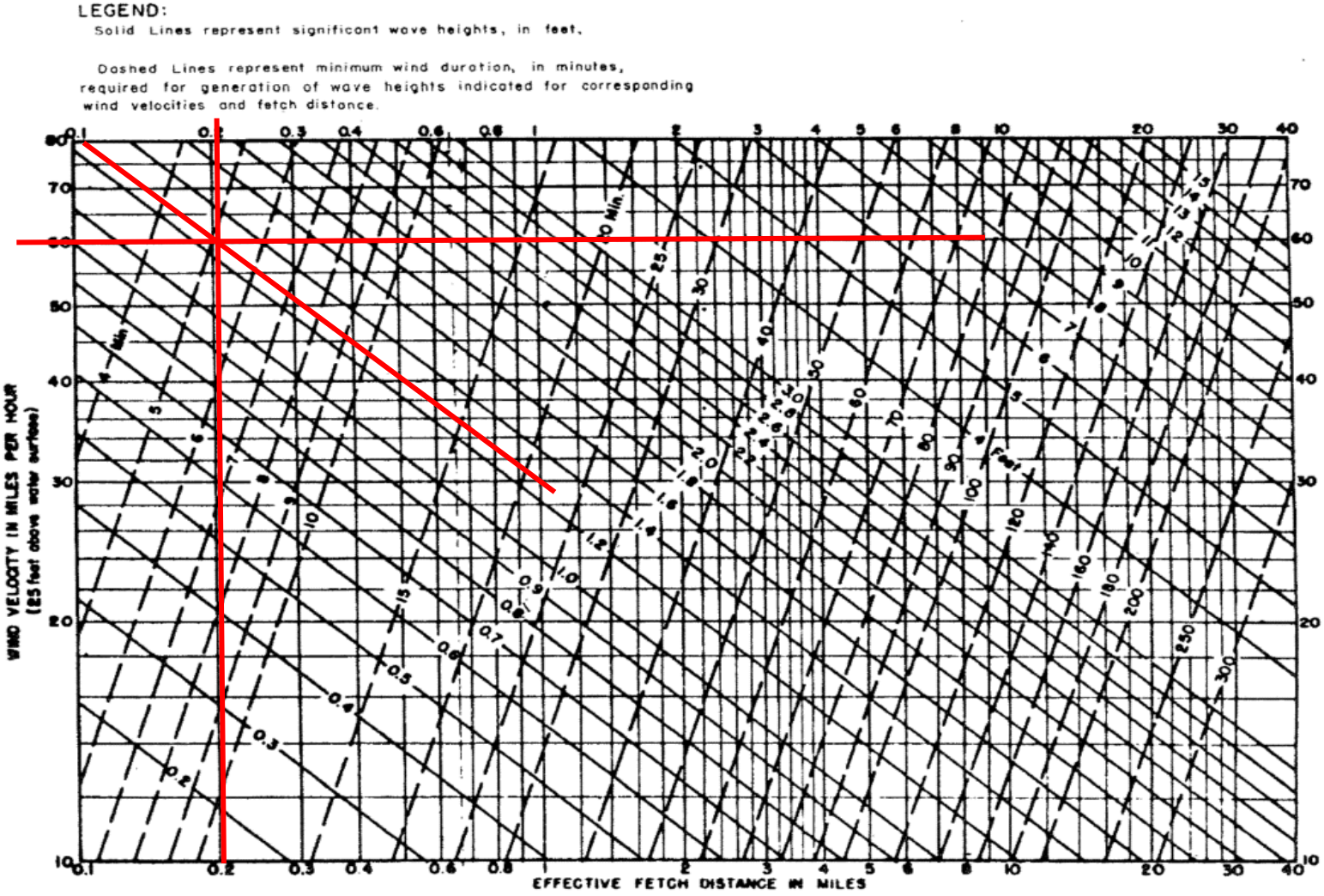


FIGURE 9. - **GENERALIZED CORRELATIONS OF SIGNIFICANT WAVE HEIGHTS (H_s) WITH RELATED FACTORS** -DEEP WATER CONDITIONS (FROM FIGURE 11, REF. 3)

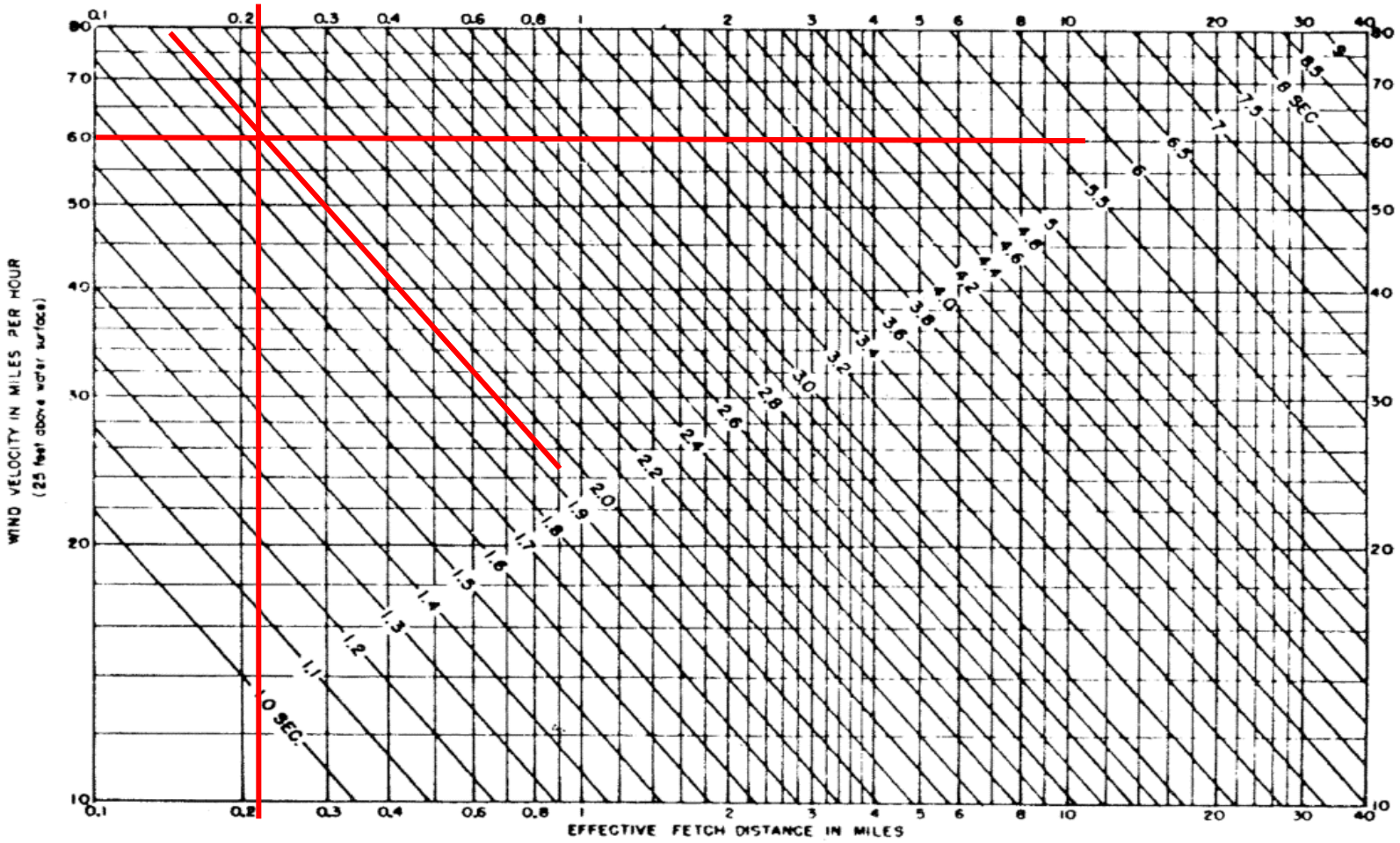


FIGURE 10.- **GENERALIZED RELATIONS BETWEEN WAVE PERIODS AND RELATED FACTORS** -DEEP WATER CONDITIONS (FROM FIGURE 12, REF. 3)

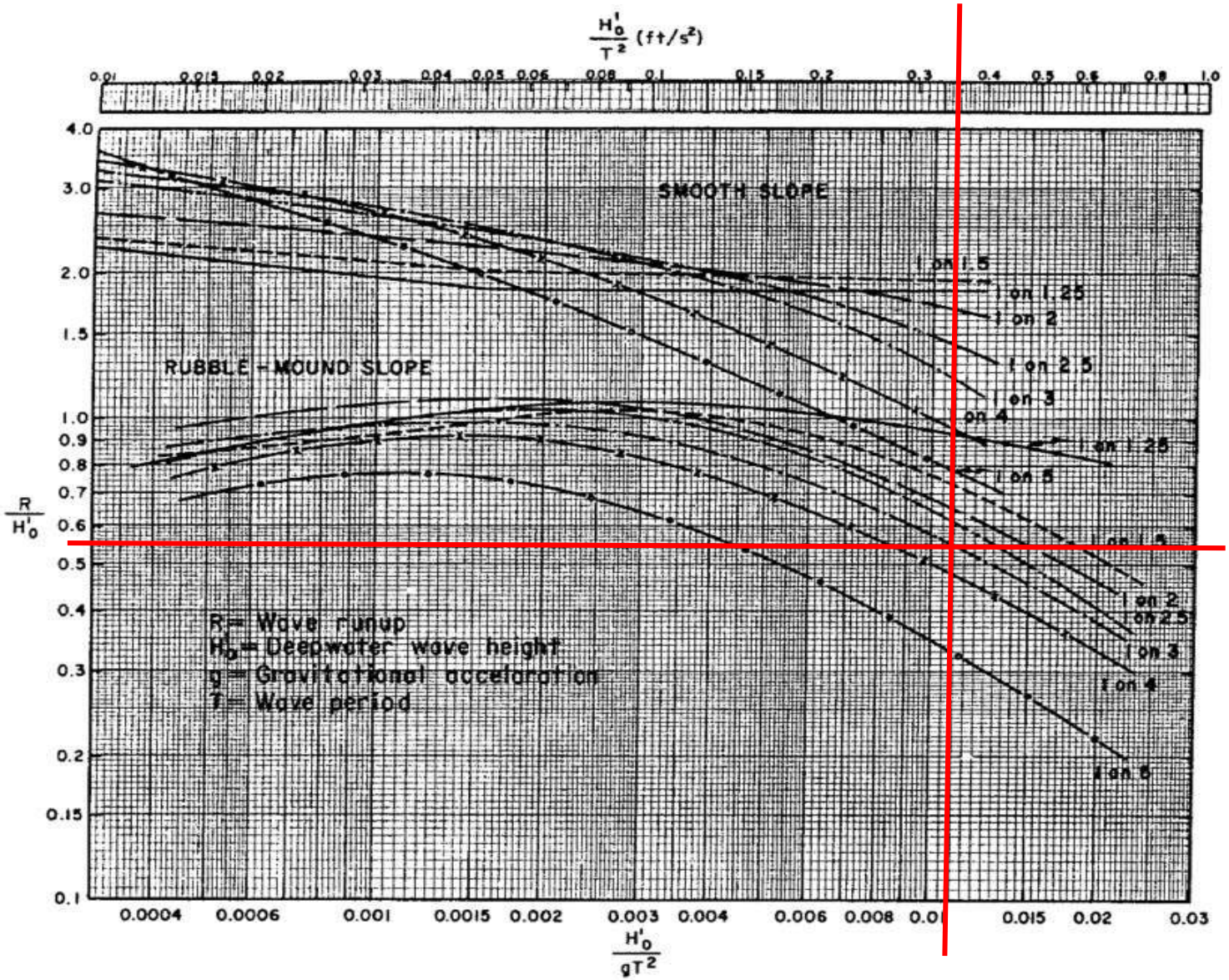


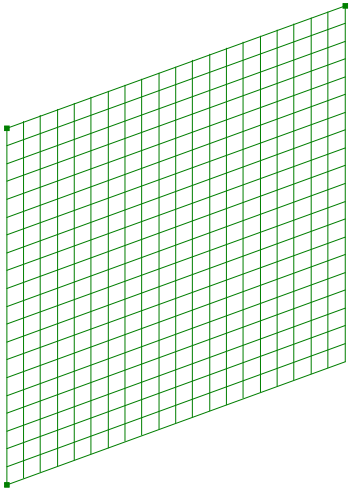
FIGURE 11.- COMPARISON OF WAVE RUNUP ON SMOOTH SLOPES WITH RUNUP ON PERMEABLE RUBBLE SLOPES (DATA FOR $d_s/H'_0 > 3.0$) (FROM FIGURE 7-20, REF. 6)

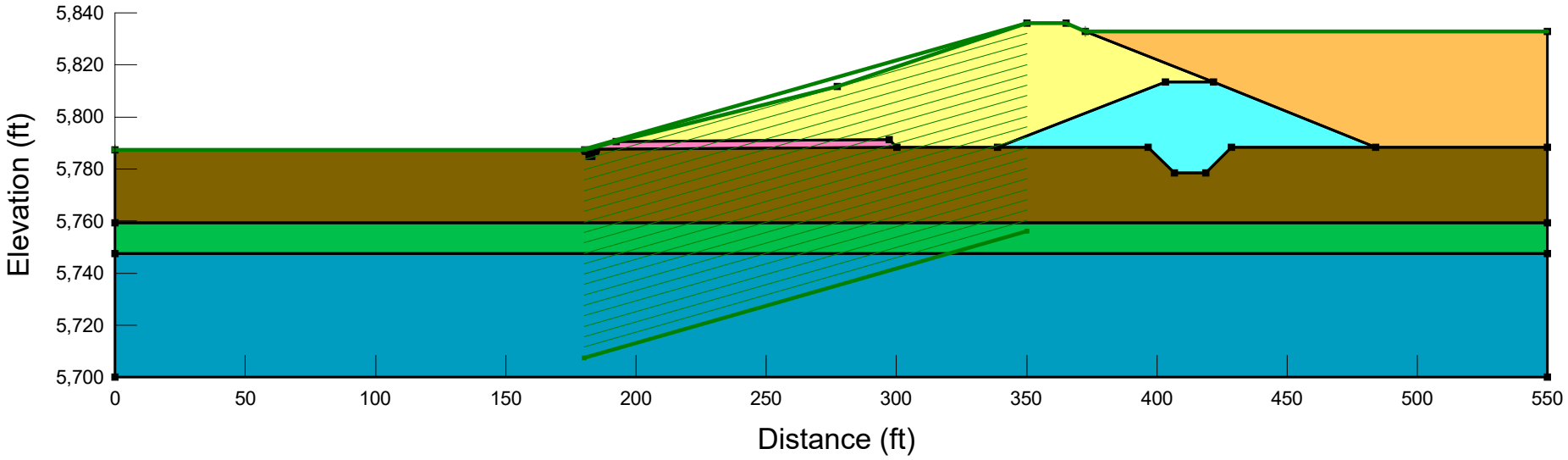
Appendix C Slope Stability Analysis

Daniels Sand Wash Fines Pond Embankment Dam Raise
Slope Stability Analysis

Drawn By: RDJ
Designed By: RDJ
Checked By: SCK
Date: 11/22/2024

Color	Name	Slope Stability Material Model	Unit Weight (pcf)	Total Cohesion (psf)	Effective Cohesion (psf)	Effective Friction Angle (°)
	Graded Gravel Envelope	Mohr-Coulomb	135		0	40
	Native Coarse Alluvium	Mohr-Coulomb	135		0	35
	Native Eolian Deposits	Mohr-Coulomb	125		100	32
	New Embankment Fill	Mohr-Coulomb	130		100	35
	Old Embankment Fill	Mohr-Coulomb	130		100	35
	Pierre Shale Bedrock	Undrained (Phi=0)	135	2,000		
	Sand Drain	Mohr-Coulomb	135		0	38
	Wash Fines	Mohr-Coulomb	90		0	10

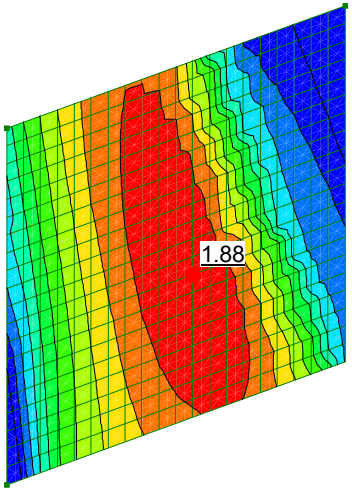


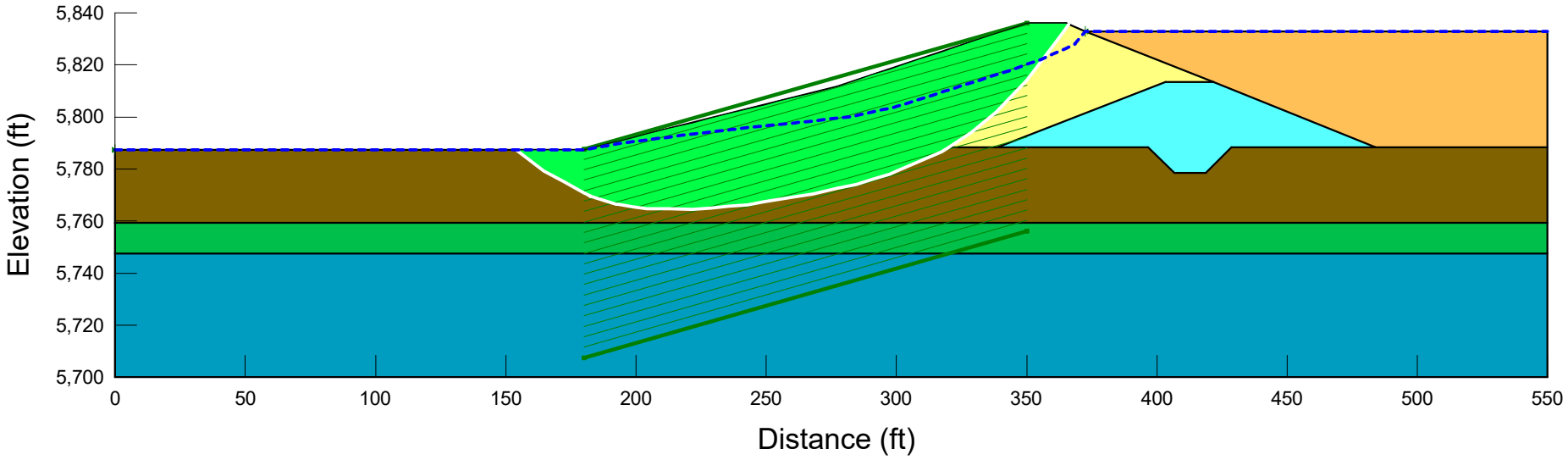


Daniels Sand Wash Fines Pond Embankment Dam Raise
Slope Stability Analysis

Drawn By: RDJ
Designed By: RDJ
Checked By: SCK
Date: 11/21/2024

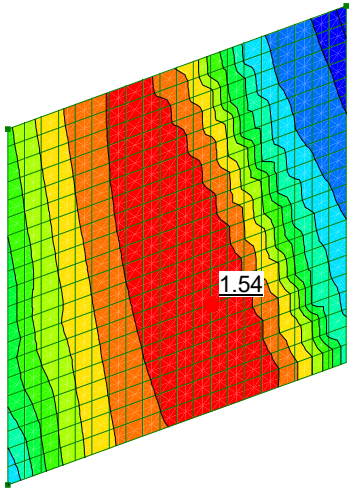
Color	Name	Slope Stability Material Model	Unit Weight (pcf)	Total Cohesion (psf)	Effective Cohesion (psf)	Effective Friction Angle (°)
	Graded Gravel Envelope	Mohr-Coulomb	135		0	40
	Native Coarse Alluvium	Mohr-Coulomb	135		0	35
	Native Eolian Deposits	Mohr-Coulomb	125		100	32
	New Embankment Fill	Mohr-Coulomb	130		100	35
	Old Embankment Fill	Mohr-Coulomb	130		100	35
	Pierre Shale Bedrock	Undrained (Phi=0)	135	2,000		
	Sand Drain	Mohr-Coulomb	135		0	38
	Wash Fines	Mohr-Coulomb	90		0	10





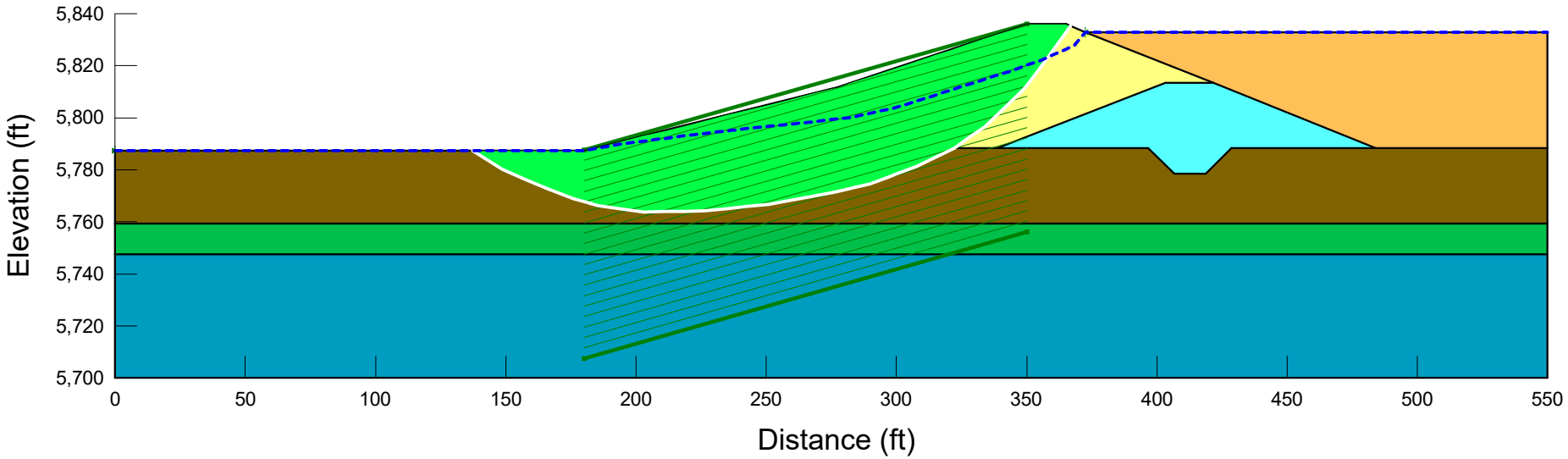
Daniels Sand Wash Fines Pond Embankment Dam Raise
Slope Stability Analysis - Pseudo-Static

Drawn By: RDJ
Designed By: RDJ
Checked By: SCK
Date: 11/21/2024



Color	Name	Slope Stability Material Model	Unit Weight (pcf)	Total Cohesion (psf)	Effective Cohesion (psf)	Effective Friction Angle (°)
	Graded Gravel Envelope	Mohr-Coulomb	135		0	40
	Native Coarse Alluvium	Mohr-Coulomb	135		0	35
	Native Eolian Deposits	Mohr-Coulomb	125		100	32
	New Embankment Fill	Mohr-Coulomb	130		100	35
	Old Embankment Fill	Mohr-Coulomb	130		100	35
	Pierre Shale Bedrock	Undrained (Phi=0)	135	2,000		
	Sand Drain	Mohr-Coulomb	135		0	38
	Wash Fines	Mohr-Coulomb	90		0	10

Horz Seismic Coef.: 0.053



Appendix D Specifications

SECTION 31 00 00

EARTHWORK

PART 1 SCOPE

1.01 WORK INCLUDED

A. This Section includes construction of earth embankments and placement of embankment fills to construct final slopes to the established lines and grades at the locations shown on the Contract Drawings and as directed by the Engineer.

1.02 DEFINITIONS

A. RELATIVE COMPACTION: “Relative compaction" is defined as the ratio, in percent, of the as-compacted field dry density to the laboratory maximum dry density as determined by ASTM D 698. Corrections for oversize material may be applied to either the as-compacted field dry density or the maximum dry density, as determined by the Engineer.

B. OPTIMUM MOISTURE CONTENT: "Optimum moisture content" shall be determined by the ASTM D 698 to determine the maximum dry density for relative compaction. Field moisture content shall be determined on the basis of the fraction passing the ¾ inch sieve.

C. ENGINEER: The licensed engineer in the State of Colorado designated to perform construction inspection services and administrative functions on behalf of Holcim.

1.03 SUBMITTALS

A. All submittals, including drawings and calculations, shall be required for the sole purpose of providing Engineer sufficient details to confirm that the Contractor’s planned work and work in progress is in accordance with Contract Documents. Engineer’s review shall not be construed to relieve Contractor in any way of responsibilities under the Contract. Do not begin work on any item requiring a submittal until the required relevant submittals have been reviewed and approved by the Engineer. All structural designs and other engineered components shall be signed and sealed by a professional engineer licensed in the State of Colorado.

B. Preconstruction Submittals – Submit to the Engineer the following a minimum of three weeks before the scheduled start of the applicable activity:

1. A work plan for the earthwork that describes equipment means and methods anticipated for this project.

1.04 TESTING

A. All testing, including field and laboratory services, will be completed by the Owner.

1.05 CODES, ORDINANCES AND STATUTES: The Constructor shall be familiar with, and comply with, all applicable codes, ordinances, statutes, and bear sole responsibility for the penalties imposed for noncompliance.

1.06 TOLERANCES: All material limits shall be constructed within a tolerance of 0.1 foot except where dimensions or grades are shown or specified as minimum. All grading shall be performed to maintain slopes as shown.

PART 2 EQUIPMENT AND MATERIALS

2.01 EMBANKMENT FILL: Embankment fill shall consist of on-site material free from roots, organic matter, debris, and other deleterious material. Peat and organic clay are not acceptable as embankment fill. Individual particles up to six inches in diameter are acceptable. When compacted, embankment fill shall result in a fill without visible voids between particles, and all particles larger than ¼ inch shall be completely surrounded by a continuous soil matrix. Embankment fill is anticipated to come from the mining operation stockpiles.

2.02 BLANKET DRAIN FILTER MATERIAL: Filter Sand for the blanket drain shall consist of a free-draining sandy material meeting the requirements of a CDOT Class C Filter Material with gradation requirements presented in the following table:

Sieve Size	Mass Percent Passing Square Mesh Sieves
$^{3}/_{4}$”	100
No. 4	60-100
No. 50	10-30
No. 100	0-10
No. 200	0-3

2.03 TOE DRAIN MATERIAL: The material surrounding the toe drain shall consist of a free-draining coarse aggregate material meeting the requirements of a CDOT No. 4 Coarse Aggregate with gradation requirements presented in the following table:

Sieve Size	Mass Percent Passing Square Mesh Sieves
2”	100
1 $^{1}/_{2}$”	90-100
1”	20-55
$^{3}/_{4}$”	0-15
$^{3}/_{8}$”	0-5

2.04 TOE DRAIN FILTER FABRIC: Geotextile filter fabric surrounding the toe drain material shall consist of an AASHTO M288 Class 2 non-woven geotextile filter fabric with a minimum permittivity of 0.5 sec^{-1} and a maximum average apparent opening size of 0.43 mm.

2.05 COMPACTION EQUIPMENT: Provide compaction, watering, and aerating equipment of suitable type to achieve the specified compaction moisture content and relative compaction.

PART 3 EXECUTION

3.01 SUBGRADE PREPARATION

A. The entire surface to be covered with embankment shall be grubbed and stripped of all grass, vegetation, topsoil, rubbish, or other unsuitable materials before any embankment fill is placed.

1. Topsoil shall be stockpiled or placed as designated.

2. Other grubbed and stripped materials shall be removed as spoil.

B. Existing slopes shall be "benched" to prevent the development of a potential sliding surface.

C. Stripped or excavated surfaces on which embankment fill is to be placed shall be compacted to the required density of the embankment prior to any fill being placed.

D. Prior to placement of fill, subgrade shall be scarified with a disc or similar equipment and moisture conditioned to facilitate bonding with the new fill.

E. Surfaces to receive fill shall not have ponded water, snow or ice, nor be desiccated or cracked.

3.02 FILL SURFACE PREPARATION: Immediately before embankment fill is added to the existing surface.

A. Surfaces to receive fill shall be free of debris, organic materials, particles larger than six inches, and other deleterious materials.

B. Previous fill surfaces to receive additional fill shall be compacted to the required relative density of 95 percent relative compaction (standard Proctor) with moisture content within a range of -2 to +2 percent of the optimum moisture content.

C. Prior to placement of subsequent lifts, previous fill surfaces shall be scarified with a disc or similar equipment and moisture conditioned to facilitate bonding with the new fill.

D. Surfaces to receive fill shall not have ponded water, snow or ice, nor be desiccated or cracked.

3.03 PLACEMENT AND COMPACTION

A. Materials shall be placed in lifts not greater than 8 inches of thickness unless greater thicknesses are allowed by the Engineer upon demonstration by the Contractor that the materials and compaction efforts are adequate to obtain the required density.

B. Material shall be placed in a uniform lift and thoroughly compacted by compaction equipment suitable for the material encountered to obtain the required density prior to the placement of succeeding lift.

1. Each lift shall be tested for proper compaction before successive lifts are applied.

C. Stone shall be defined as rock material either in its natural or broken state. Stones shall not exceed 6 inches in greatest dimension and shall be well distributed throughout the soil mass.

D. Stones not well mixed with soil material shall not be used in earth embankments unless the stone material is sufficiently deteriorated or friable so as to be compactible to achieve minimum voids and required density.

E. If the required density is not obtained, compaction of the embankment shall continue until specified densities are obtained, before any additional embankment is placed. Improperly compacted embankment shall be removed.

F. Where required, the Contractor shall, at his/her expense, add sufficient water during the compaction effort to assure proper density. If, due to rain or other causes, the material exceeds the optimum moisture content for satisfactory compaction, it shall be allowed to dry, assisted by discing or harrowing, if necessary, before compaction or filling effort is resumed.

G. Compaction or consolidation achieved by traveling trucks, machines and other equipment will not be accepted unless such procedures are approved by the Engineer and proper compaction density is achieved.

H. Embankments shall be constructed to such elevations as to make allowance for any settlement that may occur. Prior to the construction of any structure, roadway or other ground feature and before final acceptance of the Contract, the Contractor shall regrade the embankments to conform to the established lines and grades.

3.04 PROTECTION OF COMPLETED LIFT AND PREPARED GROUND SURFACE: After completion of a lift or ground surface preparation, all unnecessary traffic shall be kept off. Should it be found necessary to haul over the completed lift or prepared ground surface, the Contractor shall drag and roll the traveled way as frequently as may be necessary to remove ruts, cuts, and breaks in the surface. All cuts, ruts, and breaks in the lift or surface that are not removed by the above operations shall be repaired. Winter earthwork operations are common therefore can be performed satisfactorily by adopting certain procedures and taking prudent precautions.

A. Generally, earthwork operations can be conducted whenever the water being used to moisture condition the fill does not freeze prior to being mixed with the fill and, after mixing, the moisture-conditioned fill does not freeze prior to compaction or prior to placing the next lift. These conditions can obviously be met when temperatures are above freezing and can even be met when temperatures are below freezing due to direct sunshine and/or due to the fill material being warmer than the ambient temperature. The exact temperature and weather limitations can be determined by the Contractor and the Engineer as winter operations progress.

B. At the end of each work day, the exposed active fill area should be covered with a minimum six-inch thick, loose, dry lift of soil which will serve as an insulating layer to limit freezing.

C. At the beginning of each work day, the loose lift form the night before should be inspected for evidence of freezing. If any frozen soil exists, it should be removed to the full depth of freezing, even if frozen soil extends beneath the loose lift and into previously compacted soil. After removing frozen soil, the exposed surface should be scarified with a disk or pulvamixer. Earthwork operations can then proceed as normal. If the loose lift does not contain any frozen soil, then it can be moisture conditioned and compacted in place without the need for removing it.

D. Any portion of the fill which is not being actively worked but becomes subject to freeze/thaw cycles should be scarified and re-compacted prior to placing additional fill even if it is not frozen at the time work is resumed in that area.

E. Also at the beginning of each work day, the borrow source should be inspected for evidence of freezing. All frozen materials should be stripped from the borrow source and not used in the fill. Pre-wetting the borrow source is not desirable for winter construction.

F. Earthwork can be conducted after snowstorms providing that the snow is removed from the borrow source and from the active fill area and providing that the other conditions outlined above are met.

3.05 FILL

A. Obtain the Engineer's review of the surface to be filled and the fill material to be used prior to placing any fill.

B. Do not place frozen fill, or fill mixed with snow or ice.

C. Embankment fill shall be placed in horizontal lifts and each lift compacted to the specified relative compaction for the full width. Borrow area fill shall be blended to achieve a homogenous fill across the embankment without lenses, pockets, or zones of different materials.

D. All embankment fill shall be moisture conditioned to the specified range.

E. All surfaces shall be finished to provide adequate drainage. Any softening or loosening due to the collection of water shall be corrected by overexcavation and replacement. The finished surface shall be reasonably smooth, compacted, free from irregular surface changes, and comparable to the smoothness obtained by bladegrader operations.

3.06 COMPACTION REQUIREMENTS

A. General: Compact all materials by mechanical means. Flooding or jetting will not be permitted. If compaction tests indicate that compaction or moisture content is not as specified, material placement shall be terminated and the Constructor shall take corrective action prior to continued placement. Hand tamping shall be required around buried utility lines or other subsurface features that could be damaged by mechanical compaction equipment.

B. Fill: Place fill in loose lifts not exceeding 8 inches. Compact each lift to at least 95 percent relative compaction within moisture content of -2 to +3 percent of optimum. A kneading compactor such as a pad foot roller or equivalent is required for embankment fill compaction. Rubber tired rollers are specifically excluded. Do not attempt to compact fill material that contains excess or insufficient moisture. If the fill contains insufficient moisture, add water by sprinkling and thoroughly disking the fill. If the fill contains excess moisture, aerate the material by blading, disking, harrowing, or other methods, to accelerate the drying process.

1. Compaction curves for the full range of soil materials to be used in the embankment shall be provided by the Owner.

3.07 FIELD DENSITY AND MOISTURE TESTING: Density and moisture testing will be carried out by the Owner as specified herein and as specified at the end of this section to determine if adequate compaction of the embankment material is being achieved.

3.08 SITE GRADING: Perform all earth work to the lines and grades as shown. Shape, trim, and finish slopes to conform to the lines, grades, and cross sections shown. Make slopes free of all exposed roots and stones exceeding 6-inch diameter. Finished site grading will be reviewed by

the Engineer. Blend new embankment fill into existing topography. Perform grading such that ponding or channeling of water is avoided.

3.09 MINIMUM TESTING FREQUENCY FOR MATERIAL AND QUALITY EVALUATION

	Grain Size Distribution (ASTM D 422)	**Atterberg Limit (ASTM D 4318)**	**Proctor (ASTM D 698)**	**Moisture Content & Density (ASTM D 3017 & D 2922)**
Minimum frequency required	One per 5,000 cubic yards	One per 5,000 cubic yards	One per 5,000 cubic yards	One per 500 cubic yards or 1 per lift placed

END OF SECTION