J&T Consulting, Inc.

April 8, 2024

Mr. Rob Zuber
Environmental Protection Specialist
State of Colorado
Division of Reclamation, Mining, and Safety
Physical Address:
1313 Sherman Street, Room 215
Denver, CO 80203
Mailing Address:
Division of Reclamation, Mining and Safety, Room 215
1001 East 62nd Avenue
Denver, CO 80216

RE: Bernhardt Sand and Gravel Pit, File No. M-2023-025,
112c Permit Application, Preliminary Adequacy Review

Dear Mr. Zuber,

WW Clyde & Co. (WW Clyde) has received the Division's Preliminary Adequacy Review letter dated September 29, 2023, Groundwater Adequacy Review dated October 23, 2023, Preliminary Adequacy Review Memo for Geotechnical Exhibit dated November 14, 2023, and Adequacy Review Related To Name Change letter dated November 21, 2023. Below are the comments and the corresponding responses that we have provided to address the comments.

Comments

1) The Division received comments from three State agencies. The letters from these agencies are included as enclosures with this adequacy review letter. Please review the letters and provide responses accordingly.
a. History Colorado
b. The Division of Water Resources
c. Colorado Parks and Wildlife.

Response: a. History Colorado – See attached e-mail correspondence with History Colorado.

b. Division of Water Resources – WW Clyde commits to pursuing a well permit prior to mining; a well permit will be applied for immediately after approval of the DRMS permit for the gravel pit. WW Clyde commits to pursuing a Substitute Supply Plan in concert with the well permit and this will occur prior to mining and immediately after approval of the DRMS permit. WW Clyde commits to conducting a field inspection of the site and documenting locations of all wells within 600 feet of the permit area. This field inspection will be completed prior to mining and immediately after approval of the DRMS permit. If there are wells within 600 feet the well owners will be contacted to obtain a waiver of objection. If a waiver of objection cannot be obtained then a hearing will be requested from WW Clyde to the Division of Water Resources and the State Engineer.

c. Colorado Parks and Wildlife – See attached response from ERC for the CPW comments.

1.6 Public Notice

2) Pursuant to Rule 1.6.2(e), please submit proof of the notice to all owners of record of surface and mineral rights of the affected land and the owners of record of all land surface within 200 feet of the boundary of the affected land including all easement holders located on the affected land and within 200 feet of the boundary of the affected land. Proof of notice may be return receipts of a Certified Mailing or by proof of personal service.

Response: Public notice letters to all owners of record within 200 feet of the permit boundary were mailed via certified mail. Copies of the letters, certified mail receipts, and certified mail return receipts were provided to the DRMS (e-mailed to Mr. Rob Zuber on October 16, 2023).

6.4 Specific Exhibit Requirements - Regular 112 Operations

The following adequacy items must be addressed by the Applicant to satisfy the "Mineral Rules and Regulations of the Mined Land Reclamation Board for the Extraction of Construction Materials." For items without specific rule citations, the requirement is based on the general intent of the rules, especially Rule 3.1 (Reclamation Performance Standards) and Rule 6.4.

6.4.3 Exhibit C - Pre-Mining and Mining Plan Maps of Affected Land

3) The South Platte River must be shown and labeled on maps C-1 and C-2, per Rule 6.4.3(b).

Response: Acknowledged. The maps C-1 and C-2 have been revised to show the South Platte River labels.

6.4.4 Exhibit D - Mining Plan

4) Please discuss if processing will entail washing of the product and if a pond or ponds will be included in the process area. If so, add a discussion to the text of Exhibit D and to Map C-2.

Response: Discussion has been added to the text of Exhibit D (See highlighted text in the attached updated mining plan) for the location of sediment ponds where the water is recaptured from washing product. The location is also shown on the revised map C-2.

5) The Mining Plan should state that topsoil should be stripped and salvaged from areas where overburden material will be stockpiled (Rule 3.1.9(1)).

Response: The mining plan has been updated to include this statement. See highlighted text in the attached updated mining plan.

6) Exhibit D needs to include a discussion of stabilization of topsoil stockpiles (Rule 3.1.9(3)).

Response: Discussion has been added to the text of Exhibit D (See highlighted text in the attached updated mining plan) for the stabilization of topsoil stockpiles.

7) Exhibit D should include a discussion of the structures that will be constructed for the mining operation, including buildings and roads. The discussion must include dimensions and general construction methods. (For example, will foundations include rebar reinforcement?)

Response: Discussion has been added to the text of Exhibit D (See highlighted text in the attached updated mining plan) for the structures constructed for the mining operation, including buildings and roads.

8) This exhibit needs to include an appendix that includes a detailed slurry wall design report.

Response: We discussed with Mr. Michael Cunningham and a detailed slurry wall design will be completed for the pit, however at this point in the permitting process one is not necessary as the gravel investigation borings provide enough information to establish a bedrock surface and square footage of slurry wall can be calculated from the preliminary profiles to establish quantities necessary for establishing bond calculations for the slurry wall construction cost.

6.4.5 Exhibit E - Reclamation Plan

9) The text states that reclamation will be concurrent with mining. Exhibit E should provide a commitment to a maximum un-reclaimed disturbance area and length of un-reclaimed highwall.

Response: The text is correct because the mining slope is a 2:1 slope and not a high wall. The reclaimed slope is a 4.5:1 slope where the excess overburden will be used to construct the reclamation slope. WW Clyde commits to a maximum un-reclaimed slope of 3,000 lineal feet (See highlighted text in the attached updated Exhibit E reclamation plan).

10) The text states that auger holes will not be left on the property. Please clarify if there are/were auger holes and add a discussion on how these holes will be filled or were filled in the past (Rule 3.1.5(6)).

Response: The text is correct as the auger holes for the gravel investigation were backfilled with native gravel and soil cuttings from the drilling. The auger holes that were not backfilled were the four monitor wells that were constructed and permitted as permanent monitoring wells to monitor groundwater at the north, east, west, and south sides of the permit boundary (See highlighted text in the attached updated Exhibit E reclamation plan).

11) The text should state that no structural fill shall be imported from outside the permit area, or the Reclamation Plan must include all of the requirements of Rule 3.1.5(9).

Response: No structural fill shall be imported from outside the permit area. The text has been updated (See highlighted text in the attached updated Exhibit E

reclamation plan).

12) The text should state that topsoil will be re-handled as little as possible and that a Technical Revision will be submitted before topsoil stockpiles are relocated (per Rule 3.1.9(4)).

Response: The text has been updated to state that topsoil will be re-handled as little as possible and that a Technical Revision will be submitted prior to re-locating topsoil stockpiles (See highlighted text in the attached updated Exhibit E reclamation plan).

13) The text should state that topsoil will be placed in a way to prevent erosion of this resource (per Rule 3.1.9(5)) and a discussion added regarding the practices to stabilize slopes. One option is to roughen slopes prior to placement of topsoil.

a. The text for revegetation needs to include details for seed bed preparation and the time of seeding (Rule 6.4.5(2)(f)).

Response: The text has been updated to state that topsoil will be placed in a way to prevent erosion of the resource and discussion for stabilizing slopes. The text for revegetation has also been updated to include details for seed bed preparation and timing of seeding (See highlighted text in the attached updated Exhibit E reclamation plan).

14) The weed control paragraph should reference a more detailed plan in Exhibit J.

Response: The text has been updated to reference a more detailed plan in Exhibit J (See highlighted text in the attached updated Exhibit E reclamation plan).

6.4.7 Exhibit G – Water Information

15) The text must include a discussion regarding the use of water for processing gravel. If no products will be washed onsite, this should be stated in Exhibit G.

Response: The text has been updated to include water for processing (i.e. wash water for wash plant to process concrete rock and sand). (See highlighted text in the attached updated Exhibit G)

16) The McGrane report and associated conclusions will be reviewed by a groundwater hydrologist with the Division, and an additional adequacy letter will be sent in October or November 2023.

Response: Acknowledged (See responses specific to the ground water modeling comments later in this response letter).

17) To ensure that the Bernhardt Pit does not impact the hydrologic balance of the river, the application needs to include a water quality monitoring plan, specifically for the alluvium. The groundwater monitoring plan should be developed in accordance with Rule 3.1.7(7)(b) and should include a Quality Assurance Project Plan (QAPP) for the collection of groundwater samples. The plan should provide mitigation steps if there is an exceedance at a groundwater or surface water monitoring location. Potential impacts to quality and/or quantity of nearby domestic wells should also be addressed. A copy of

the Division's "Groundwater Monitoring and Protection Technical Bulletin" has been included as an enclosure to this letter for your reference**.**
Response: A water quality monitoring plan has been included the text of Exhibit G. (See highlighted text in the attached updated Exhibit G).

18) For protection of the riverbank, perform one of the following:
1. Revise the extraction and reclamation plans to include a 400-foot setback from the top of the riverbanks to the top of the pit side slope of the planned pit. This size of setback is based on guidance from the Mile High Flood District (MHFD). The document, "Technical Review Guidelines for Gravel Mining and Water Storage Activities Within or Adjacent to 100-year Floodplains," is available upon request. A smaller setback will be considered by the Division if rationale from this guideline (or similar reference) is given. 2. Design inlet and outlet structures (aka, side-channel spillways) that will allow floodwaters to pass through the site with considerably less risk of destroying the banks (aka, riverside berms). The design should include any necessary analysis to illustrate that the structures will prevent the loss of riverside berms during a 100-year flood.
3. Perform an analysis to illustrate that riverside berm failure is unlikely during a 100-year flood event. This analysis should be done using standard methodology, such as a two-dimensional HEC-RAS model.

Response: The mining and reclamation plans have been updated to provide a 400-foot setback from the top of the river bank to the pit side slope/mining limit. (See the attached updated maps for the mining plan and reclamation plan).

6.4.8 Exhibit H – Wildlife Information

19) The applicant must address the comments of the Colorado Parks and Wildlife Division (CPW), which are enclosed with this review letter. Each of the comments must be directly addressed in your response letter, and, as applicable, comments must also be addressed by revising Exhibit H. Where necessary, add commitments for future studies or other actions. Note that CPW recommends a setback from the river of 500 feet. While this would be preferable in the context of wildlife protection, the Division believes that the 400-foot setback described in Exhibit G, above, is sufficient. Please consider the 400-foot option to protect wildlife as well as protect the riverbanks from erosion.

Response: The mining and reclamation plans have been updated to provide a 400-foot setback from the top of the river bank to the pit side slope/mining limit. (See the attached updated maps for the mining plan and reclamation plan). The responses to CPW are included in the attached response from ERC and these have also been included with the updated Exhibit H. (See highlighted text in updated Exhibit H)

20) In the body of Exhibit H, the applicant should discuss the presence of (or lack of) critical habitat for such things as elk calving or other activities that require special consideration (per Rule 3.1.8(1)).

Response: The body of the text in Exhibit H has been revised to include discussion provided by ERC. Responses to CPW are included in the attached response from ERC and these have also been included with the updated Exhibit H. (See highlighted

text in updated Exhibit H)

21) In the body of Exhibit H, the applicant should discuss seasonal use of the permit area. For example, is the permit area used for winter habitat by deer or other species? Also, will noise from the operation impact any wildlife? These items are required per Rule 6.4.8(1).

Response: The body of the text in Exhibit H has been revised to include discussion provided by ERC. Responses to CPW are included in the attached response from ERC and these have also been included with the updated Exhibit H. (See highlighted text in updated Exhibit H)

6.4.10 Exhibit J – Vegetation Information

22) Per Rule 3.1.10(6), a Weed Management Plan should be included in this exhibit, and it should discuss the list of State of Colorado noxious weeds and should state that List A species will be eradicated, and List B Species will be controlled. The plan should also describe the efforts that will be made to control List C species, including field bindweed, a focus in Weld County.

Response: The body of the text in Exhibit J has been revised to include discussion on the weed management plan. (See highlighted text in updated Exhibit J)

6.4.19 Exhibit S - Permanent Man-made Structures

23) The Division requires the Applicant to demonstrate that they attempted to obtain notarized structure agreements with all owners of the structures within 200 feet of the affected area of the proposed mine site, pursuant to Rule 6.4.19. This attempt must be made prior to the Division's consideration of a stability analysis. Please provide this demonstration; this can be in the form of certified mailing receipts or similar documentation.

Response: The structure agreements that have been signed are attached. The certified mail receipts are attached for the agreements that were delivered via certified mail. The e-mails are attached for the agreements that were delivered via e-mail.

6.5 Geotechnical Stability Exhibit

DRMS is reviewing the geotechnical analysis and our comments will be sent in October or November 2023.

Response: Acknowledged (See responses specific to the slope stability exhibit comments later in this response letter).

Groundwater Review Memo

1) The proposed operation has the potential to negatively affect the prevailing hydrologic balance, both the quantity and quality of groundwater, of the affected land and of the surrounding area. The applicant is required to develop a groundwater monitoring and sampling and analysis plan (SAP). This SAP will establish, through five quarters of monitoring, what the baseline conditions are at the site to enable the Division to assess the impacts of mining on the hydrologic balance. A copy of the Division's Groundwater

Monitoring: Sampling and Analysis Plan Guidance for Construction Materials and Hard Rock Sites was provided to the applicant, in the Division's adequacy letter dated September 29, 2023, and should be referenced in developing a sampling and analysis plan. Please provide a sampling and analysis plan for the proposed operation.

Response: The sampling plan has been updated and is included in Exhibit G (See highlighted text in the updated Exhibit G).

2) Please commit to providing the Division with a copy of the Substitute Water Supply Plan once it is approved by the Division of Water Resources.

Response: WW Clyde commits to providing the Division with a copy of the approved Substitute Water Supply Plan by the Division of Water Resources.

3) Please update the groundwater elevation table found at the end of Exhibit G with groundwater level measurements through October 2023. Additionally, the groundwater elevations calculated for JT MW-3 have been incorrectly calculated and need to be updated.

Response: The groundwater elevation table has been updated and the elevations for JT MW-3 have been corrected as the formula was referencing the wrong cell. The measurements included are through the month of January 2024.

4) The Pre-Mining, Mining, and Reclamation Plan maps need to be updated to show the monitoring well locations associated with the proposed permit.

Response: The Pre-Mining, Mining, and Reclamation Plan maps have been updated to show the monitoring well locations. (See attached updated maps)

5) Please provide the locations of each monitoring well (MW-1 through MW-4) in decimal degrees.

Response: The Pre-Mining, Mining, and Reclamation Plan maps have been updated to show the monitoring well locations with the decimal degrees and these are also included in Exhibit G in the monitor well measurements table. (See attached updated maps and updated Exhibit G)

6) In review of Figure 10A along with the predicted mounding of ~2.5 feet on the upstream side of the proposed permit boundary it appears the predicted mounding combine with high groundwater levels seen in July 2023 will bring groundwater elevations to within 0.5 feet of ground surface at MW-3. Additionally, extrapolating the potential mounding groundwater elevations during high groundwater levels away from the permit boundary in the southwestern area it appears that the mounding will result in groundwater being exposed at the surface.
Please update the groundwater model using the highest groundwater elevations to evaluate the potential of groundwater being exposed at the surface along the boundary of the permit. It should be noted that groundwater elevations approaching the surface can cause offsite land user issues due to saturated ground conditions.
When updating the groundwater model figures please label the individual well location I.D.'s.

Response: The figures have been updated for the groundwater model. (See attached updated figures)

7) Please provide a groundwater model analysis to demonstrate how effective installing the proposed underdrain will be to mitigate the predicted groundwater mounding on the upstream side of the proposed slurry wall.

Response: The analysis has been updated and figures have been updated for the proposed drain in the groundwater model. The Exhibit G text has been updated to discuss the design/construction drawings being provided for the proposed drain when the design/construction drawings for the slurry wall are provided to the DRMS prior to construction and installation of the drain and slurry wall (See attached updated figures).

8) A discussion about plugging and abandoning the monitoring wells needs to be included in the Reclamation Plan Exhibit E.

Response: A discussion was provided in Exhibit E for how the investigation holes were filled in with cuttings and how the monitor wells have been permitted as permanent monitor wells and will remain in place through the mining and after reclamation is complete for the water storage owner to continue to utilize for groundwater monitoring for their own use.

9) The Reclamation Cost Estimate, Exhibit L, needs to be updated to account for plugging and abandoning the monitoring wells.

Response: See answer to number 8). The monitor wells were permitted as permanent monitor wells and will remain in place for use for the water storage owner after reclamation is completed so there is no need to include in the reclamation cost estimate.

Geotechnical Slope Stability Exhibit Review Memo

1) Soil Properties – On p. 1 of the Slope Stability Report, under “Geotechnical Data” it states, “estimated soil strength parameters based on the information from the boring and monitor well logs and other stability analyses that have been performed on gravel mining operations along the Front Range.” When comparing the soil properties in Table 1 with standard references (e.g., Houk and Bray 1977), the selected properties differ significantly in some cases. Please provide rationale for the selected soil properties consistent with the boring logs in Appendix D.

Response: The strength parameters have been updated and these are based on properties at other front range locations in Weld County where Cesare/CMT Technical services provided these values in their slurry wall design investigation reports and stability analysis. (See the updated Table 1).

2) Slurry Wall Properties – Please provide rationale for the slurry wall soil parameters listed in Table 1.

Response: The strength parameters are based on properties at other front range

locations in Weld County on the slurry wall backfill that was placed. Typically the range on the backfill unit weight is anywhere from 95 lbs per cubic foot to 120 lbs per cubic foot depending on the number of fines passing the number 200 sieve. We used the lower range for the dry density at 100 lbs per cubic foot and 110 lbs per cubic foot for the saturated density. (These were all samples of soil/bentonite backfill and test results of samples that were tested for permeability).

3) Bedrock Properties – The Galena models use "weathered bedrock" and "stable bedrock". Whereas the borehole logs reference either sandstone or claystone. Please provide rationale for the different bedrock properties and explain whether there is any correlation between the selected bedrock properties and whether the bedrock encountered was sandstone or claystone.

Response: The strength parameters are based on properties at other front range locations in Weld County. The borelogs are correct and we have updated the models with the sandstone or claystone bedrock properties for the different locations to match the section. The weathered sandstone and claystone bedrock properties as well as the stable sandstone and claystone bedrock properties are updated in the table in the report and the analysis sheets in the report appendices.

4) Reclamation Phreatic Surface – The phreatic surface shown on the Galena graphic for Case SS-5, Reclamation shows a slight drop across the slurry wall and a near horizontal phreatic surface in the sand and gravel layer on the left side of the slurry wall, then sloping down to the toe of the backfill zone of clay. If the slurry wall is effective, the groundwater elevation on either side should be independent of one another. Please explain what post reclamation condition this phreatic surface represents.

Response: The phreatic surface shown for Case SS-5 is for the scenario where the reclaimed reservoir was filled with water and then dewatered where water is trapped between the slurry wall and the backfilled reclaimed clay slope.

Adequacy Review Related to Name Change

1) Please update all references in your exhibits (including the maps in Exhibits C and F) to reflect the name W.W. Clyde & Co.

Response: All references in the exhibits and maps have been updated to reflect the name change from IHC Scott to W.W. Clyde & Co.

WW Clyde appreciates your consideration of this adequacy review response.

Please feel free to contact me with any questions or comments.

Sincerely,

J.C. York

J.C. York, P.E.
J&T Consulting, Inc.

Attachments:

1. History Colorado Emails and Letters
2. Letter Report Update from SWCA for History Colorado
3. ERC Response for CPW Comments
4. Updated Exhibit C-1 and C-2 Maps
5. Updated Exhibit D
6. Updated Exhibit E
7. Updated Exhibit F Maps
8. Updated Exhibit G
9. Groundwater Monitor Well Readings
10. Groundwater Quality Testing Readings
11. McGrane Groundwater Model Update and Responses
12. Updated Exhibit H
13. Updated Exhibit J
14. Signed Structure Agreements
15. Structure Agreements Sent by Email
16. Structure Agreements Sent by Certified Mail
17. Structure Agreements Hand Delivered
18. Updated Slope Stability Report

History Colorado

Robert D. Zuber, P.E.
Division of Reclamation, Mining and Safety
1313 Sherman Street, Room 215
Denver, Colorado 80203

Re: Bernhardt Sand and Gravel Pit, File No. M-2023-025 (HC#83573)

Dear Mr. Zuber:

Thank you for your correspondence dated September 14, 2023 and received by our office on September 15, 2023 requesting comment for the referenced permit application notification.

Based on the search area indicated in the maps that our office received on September 19, 2023, a search of our database indicates 0 sites and 0 surveys were located within or adjacent to the search area. If any site, district, building, structure, object, or survey area was identified within the search area, a list of sites is attached to this letter. No National or State Register listed or nominated properties were identified within the proposed permit area. Please note, as most of Colorado has not been inventoried for cultural resources, our files contain incomplete information. Consequently, there is the possibility that as yet unidentified cultural resources exist within the proposed permit amendment area. The requirements under CRS 24-80 part 13 apply and must be followed if human remains are discovered during ground disturbing activities.

Please note that our comments should not be interpreted as concurrence under the National Historic Preservation Act or any other environmental law or regulation. It is the responsibility of any federal agency involved to meet the requirements of Section 106 as set forth in 36 CFR Part 800 titled "Protection of Historic Properties". This includes not only reasonable and good faith identification efforts of any historic properties located within the area of potential effects, but determining whether the undertaking will have an effect upon such properties. The State Historic Preservation Office, Native American tribes, representatives of local governments, and applicants for federal permits are entitled to consultative roles in this process.

If you have any questions or if we may be of further assistance, please contact Holly McKee-Huth, Cultural Resource Information/Section 106 Compliance Specialist at (303) 866-4670 or holly.mckee@state.co.us.

Sincerely,

Patrick A. Eidman Digitally signed by Patrick A. Eidman
Date: 2023.09.26 12:10:37 -06'00'

Dawn DiPrince
State Historic Preservation Officer

JC York

From: Mckee-Huth - HC, Holly <holly.mckee@state.co.us>
Sent: Friday, November 17, 2023 12:18 PM
To: JC York
Cc: Holly Norton - HC
Subject: Bernhardt Sand and Gravel Pit, File No. M-2023-025

Hello Mr. York:

I have just sent our letter regarding the referenced subject matter to Ms. Medeiros at SWCA and I cc'd you on the correspondence. Our State Archaeologist and Deputy SHPO, Dr. Holly Norton, would also like to extend an invitation to you to further discuss our comments and the importance of the archaeological resources in the surrounding area. I have cc'd her on this email as an introduction.

We would like to thank you again for getting this information to us, and we look forward to working with you in the future.

Sincerely,

Holly McKee-Huth
Holly McKee-Huth

GIS Manager | Section 106 and Cultural Resource Information Specialist, Archaeology

Pronouns: she/her/hers

History Colorado | Office of Archaeology and Historic Preservation

303/866-4670 | holly.mckee@state.co.us

History Colorado Center |1200 Broadway | Denver, Colorado 80203 | HistoryColorado.org

We acknowledge that the land currently known as Colorado has been the traditional homelands of Indigenous peoples since time immemorial. We are grateful to work in partnership with the 48 sovereign nations who continue to call this land home. Together, we plan exhibits; collect, preserve, and interpret artifacts; do archaeological work; and create educational programs to share the history of Colorado.

SWCA
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TECHNICAL MEMORANDUM

To: J. C. York
J-T Consulting, Inc.
305 Denver Avenue, Suite D
Fort Lupton, Colorado 80621

From: Ryan Cline, M.A., SWCA Cultural Resources Specialist
Melanie Medeiros, M.A., RPA, SWCA Cultural Resources Principal Investigator

Date: February 19, 2024

Re: **Addendum to Cultural Resource Support for the IHC Scott Proposed Bernhardt Gravel Mining Pit in Weld County, Colorado / SWCA Project No. 78991 / HC Project No. 83746**

J-T Consulting, Inc. contracted SWCA Environmental Consultants (SWCA) to conduct a cultural resource review and reconnaissance survey to support the proposed Bernhardt Gravel Mining Pit project. The project consists of the new construction of a gravel mining pit on an approximately 132-acre lot (Parcel No. 105924000023, hereafter referred to as the project area), southeast of Milliken, Colorado, on agricultural land owned by IHC Scott, now W.W. Clyde and Co. (Figures 1 and 2). Development of the proposed gravel mining pit will be subject to permitting through both Weld County and the State of Colorado.

In February and March 2023, SWCA archaeologists Mindy Burkitt and Nick Simpson completed a file search, literature review, and reconnaissance survey of the project area to identify cultural resources and potential impacts the project may have on those resources. SWCA also excavated three shovel tests to evaluate the subsurface depositional setting and assess the project area for the potential to contain buried cultural material. The original survey identified three new cultural resources: one segment of a historic levee system (5WL9625.1), one precontact isolated find (IF) (5WL9626), and one historic IF (5WL9627), all of which are recommended not eligible for the National Register of Historic Places (NRHP). The reconnaissance survey found that most of the project area has been subject to agricultural practices for at least the last 40 years, with plowing extending into the gravelly alluvium effectively removing stable topsoil, and that no to few soil horizons remain within the cultivated field could support intact subsurface archaeological materials. However, the corners of the project area outside the agricultural field and disturbance areas exhibit clear alluvial bedding and have the potential to retain cultural horizons.

On November 17, 2023, the Colorado State Historic Preservation Office (SHPO) requested that SWCA conduct a Class III cultural resource survey and shovel testing specifically focusing on the northeast and southwest corners of the project area, and north of the road that transects the northwest portion of the project area, areas that have not been subject to agriculture. The Colorado SHPO requested this additional effort to assess potentially undisturbed portions of the project area for the presence of archaeologically and potentially sensitive cultural areas due to a lack of previous intensive survey of the project area and the proximity of the nearby Dent Site (5WL269), an NRHP-eligible mamoth kill site that like the project area, is located on the T3 terrace of the South Platte River. This technical memorandum provides a description of the project area and land use, a description of field methods, a summary of the results of the additional survey, and recommendations as they relate to the proposed project.

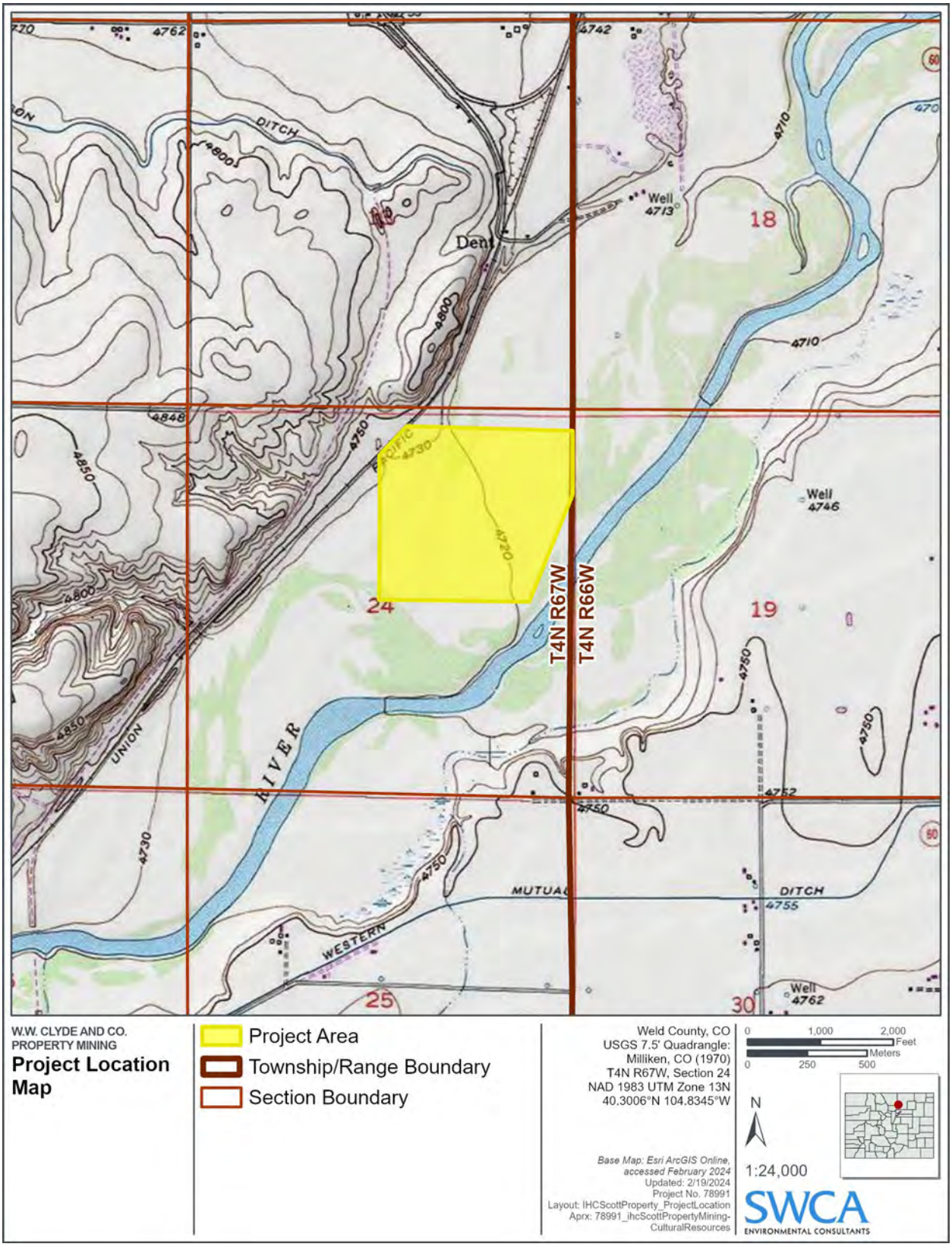

Figure 1. Project location.

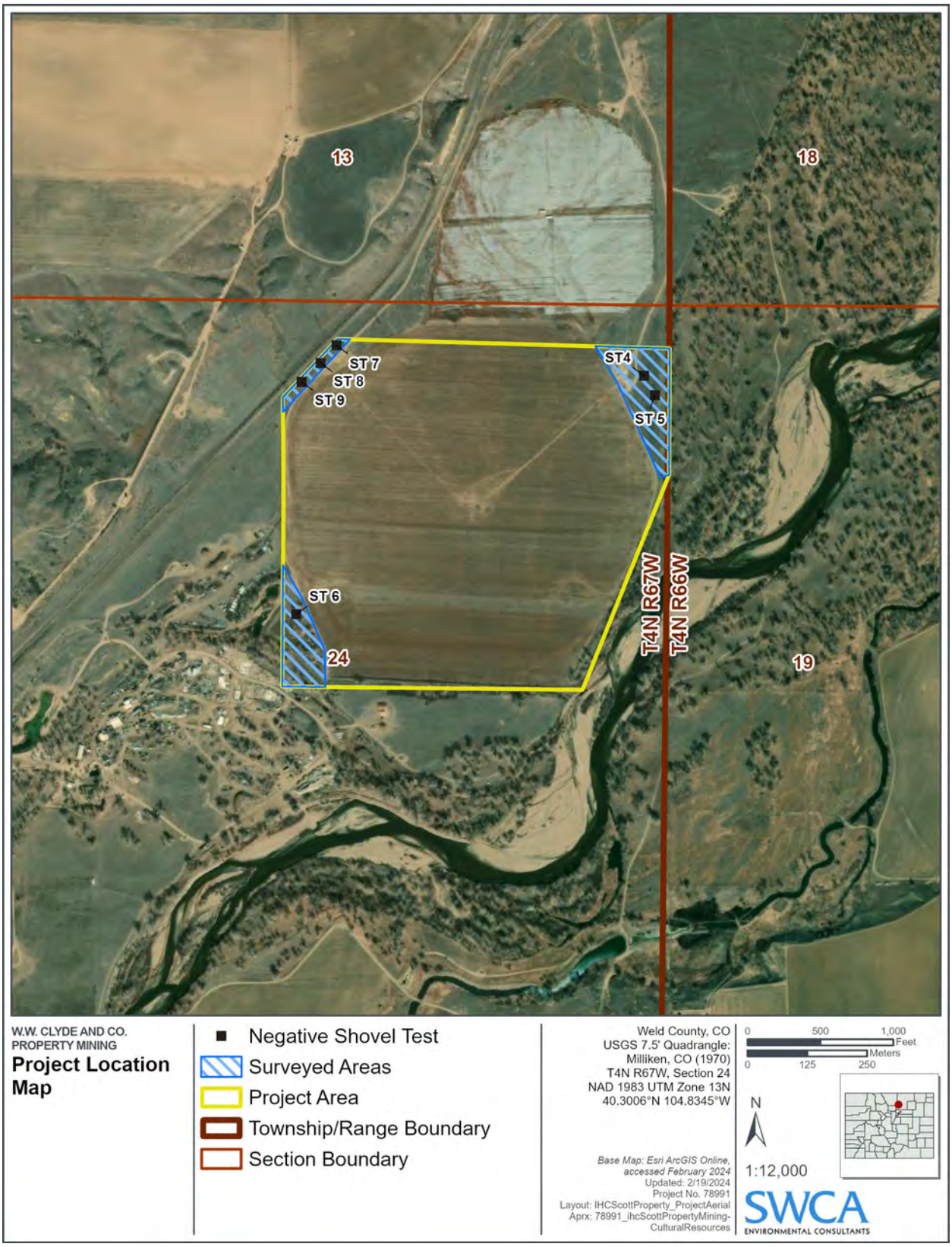

Figure 2. Project area, showing additional shovel tests excavated to examine deposition in potentially undisturbed portions of the project area.

PROJECT AREA AND LAND USE

The project area is located 2 miles southeast of Milliken, Weld County, Colorado, in the northeast quadrant of Section 24, Township 4 North, Range 67 West, as depicted on the 1970 U.S. Geological Survey (USGS) Milliken, Colorado, 7.5-minute quadrangle (see Figures 1 and 2). The majority of the parcel is a roughly circular, tilled and fallow agricultural field on the T3 terrace of the South Platte River. An earthen levee system (5WL9625.1) surrounds the eastern, southern, and half of the western edges of the agricultural field and a prominent, dissected, northeast-trending terrace or ridge system is northwest of the project area. Additional fallow agricultural fields and reclaimed well pads are north of the project area.

The areas identified by the SHPO for additional survey and shovel testing are the uncultivated portions northeast, northwest, and southwest of the agricultural field (see Figure 2). The southwest corner of the project area is characterized by a graded lot that is currently being used to store a variety of modern industrial and farming materials; this area, particularly the southwest corner of the project area, is heavily disturbed and has clearly been impacted by modern mechanical excavations, tree removal, and soil transportation (Figure 3). The northeast corner of the project area is predominantly undisturbed and is close to both the river and the earthen levee. The northwest corner of the site between the unpaved access road and the project boundary is moderately disturbed, most likely from activities relating to the construction and maintenance of the unpaved access road and the nearby Dent Branch of the Union Pacific Railroad (Figure 4). Numerous pipelines cross through and border the project area. Vegetation is entirely invasive and noxious weeds, allowing for between 0 and 90 percent bare ground visibility, averaging 70 percent.

Figure 3. Example of the southwest corner of the project area showing the disturbed nature of the soil; view to the west.

Figure 4. Overview of the northwest corner of the project area, between unpaved access road and railroad; view to the northeast.

One of the highest terraces in the Platte River system is termed T3 by geomorphologists because it is the third terrace above the modern level of the river. This terrace is known as the Kersey Terrace on the south side of the river and as the Pleasant Valley Terrace on the north side. This terrace is notable for the large amount of glacial gravels mixed with the alluvial sediments deposited during the Pleistocene Pinedale Monarch Glaciation, about 12,000 years before present (McFaul et al. 1994). According to Holliday (1987) and McFaul et al. (1994), among others, the surface of the T3 is characterized by gravel ridges and channels, a result of braided channels of the South Platte River as it deposited glacial outwash materials. Much of this landscape has been flattened by historical agricultural activities. Of note, the Kersey Terrace has yielded several of the earliest sites in Weld County, including the Frazier Site (Agate Basin) (5WL268), the Klein site (Clovis) (5WL1368), the Jurgens Site (Cody complex) (5WL53), and the Powars site (Folsom) (5WL1369), all of which are within 0.75 mile of the proposed project area. Soils in the project area are predominantly (99 percent) Aquolls and Aquents, gravelly substratum. This map unit is common on swales, floodplains, and streams; consists of loam overlying gravelly sand; and is poorly drained, deep, and derived from recent alluvium (Natural Resources Conservation Service 2023).

Figure 5. Overview of the northeast corner of the project area; view to the south from the levee.

METHODS

As requested by the SHPO in the letter dated November 17, 2023, on January 14, 2024, SWCA archaeologists Nick Simpson and Ryan Cline conducted an intensive survey in the northeast, northwest, and southwestern corners of the project area and excavated six additional shovel tests in these areas to evaluate the subsurface depositional setting and assess the potential for intact buried cultural material. The intensive survey followed the methods outlined in the Colorado Office of Archaeology and Historic Preservation (OAHP) guidelines for conducting cultural resource inventories in Colorado (Colorado OAHP 2007). Field personnel inspected the survey area using a series of parallel, 20-meter (m)-wide transects across the survey area; however, survey transects were adjusted, when necessary, to ensure full coverage of the survey area. Archaeologists examined the ground surface for artifacts, features, and other prehistoric or historic material evidence, such as charcoal-stained sediments, as well as aboveground features and structures. Special attention was paid to animal burrows to assess the potential for subsurface archaeological deposits. If cultural resources had been encountered, they would have been recorded and assessed for the NRHP following the methods outlined in the Colorado Office of Archaeology and Historic Preservation (OAHP) guidelines (OAHP n.d., 2007; Horn and Norton 2021).

RESULTS

Intensive Survey

On January 14, 2024, SWCA completed an intensive survey of the northeast, northwest, and southwest corners of the project area. The survey found that the southwest corner of the project area was heavily disturbed from modern mechanical excavations, tree removal, and soil transportation (see Figure 3).

Similarly, the northwest corner of the project area is moderately disturbed from transportation-related activities (see Figure 4). The northeast corner of the project area is predominantly undisturbed (see Figure 5). Intensive survey of these areas did not identify any additional cultural resources on the ground surface.

Shovel Tests

In March 2023, three shovel tests were excavated across the project area as part of the reconnaissance survey to assess the deposition and the potential for buried cultural material (Table 4; Figure 6). Shovel Test (ST) 1 was placed in the northeast corner of the project area, outside the tilled agricultural field and near the river and levee. ST2 was placed in the northwestern portion of the project area, near the center of newly recorded precontact IF 5WL9626; more specifically, the test was placed upslope of a metate, near the transition from T3 to T4. ST3 was placed in the south-central portion of the project area, in sediment representative of the majority of the matrix observed across the project area.

During the January 2024 survey, ST4 and ST5 were placed in the northeast corner of the project area, north of ST1, because of the area's relatively undisturbed nature and proximity to the South Platte River, to confirm the results of ST1. ST4 and ST5 both contain a deep layer of laminated soils, indicating frequent flooding events, likely before the construction of the historic levee. ST6 was placed in the southwest corner of the project area, outside the tilled agricultural field in an area that appears undisturbed in aerial imagery. However, survey confirmed that the southwest corner of the project area is heavily disturbed with evidence of modern mechanical excavations, tree removal, and the transport and deposition of outside soils. ST6 was placed here in an area with the least amount of disturbance. ST7, ST8, and ST9 were placed in the far northwestern corner of the project area between the unpaved access road and the railroad. The reason for multiple shovel tests in this area is its relatively close proximity to IF 5WL9626.

The survey and associated shovel tests confirm the field has been affected by plowing into the gravelly alluvium, effectively removing stable topsoil. No to few soil horizons remain within the cultivated field that could support intact subsurface archaeological materials. The corners of the project area outside the agricultural field and disturbance areas exhibit clear alluvial bedding and have the potential to retain cultural horizons, although none have been identified through shovel testing.

Table 4. Shovel Test Results

ST No.	Depth Using Shovel (cmbs)	Soil Profile	Artifacts
1	0–86	0–9 cmbs: semicompact brown fine sandy loam with rootlets and poorly sorted subrounded gravels 9–15 cmbs: semicompact brown-yellow sand with small subrounded gravels 15–24 cmbs: semicompact brown sandy clay loam mottled with 20% pale yellow sandy loam; small subrounded gravels throughout 24–29 cmbs: loose pale yellow sand with small subrounded gravels 29–55 cmbs: loose pale brown sandy loam with small subrounded gravels 55–86 cmbs: loose, coarse-grained, pale yellow riverbed sand with ample subrounded gravels	None
2	0–55	0–32 cmbs: semicompact pale brown sandy loam with few small subrounded gravels 32–45 cmbs: compact pale yellow-brown silty loam with 20% subrounded to subangular gravels 45–55 cmbs: compact pale gray silty loam with 20% small, subrounded gravels and calcium carbonates	0–13 cmbs: 1 quartzite FAR less than 5 cm (in plow zone)
3	0–40	0–22 cmbs: semicompact dark brown sandy loam with 30% poorly sorted, subrounded gravels 22–40 cmbs: very compact dark gray-brown clay loam with 20% poorly sorted, subrounded gravels and some calcium carbonate lacing on peds	None
4	0–97	0-35 cmbs: gray-brown sandy loam with 10% fine roots 35-60 cmbs: dark gray-brown sandy clay loam laminated with 2- to 3-cm-thick pale yellow-brown silt loam 60-97 cmbs: pale yellow-brown riverbed sand with numerous small subrounded gravels	None
5	0–101	0-31 cmbs: gray-brown sandy loam with 10% fine roots 31-61 cmbs: dark gray-brown sandy clay loam laminated with 2- to 3-cm-thick pale yellow-brown silt loam 61-101 cmbs: pale yellow-brown riverbed sand with numerous small subrounded gravels	None
6	0–60	0-60 cmbs: pale yellow-brown riverbed sand with numerous small subrounded gravels	None
7	0–100	0-100 cmbs: brown sandy loam with 5% subrounded gravels	None
8	0–100	0-100 cmbs: brown sandy loam with 5% subrounded gravels	None
9	0–100	0-100 cmbs: brown sandy loam with 5% subrounded gravels, 50% medium to large rounded cobbles in top 50 cm.	None

Note: cmbs = centimeters below surface, FAR = fire-altered rock.

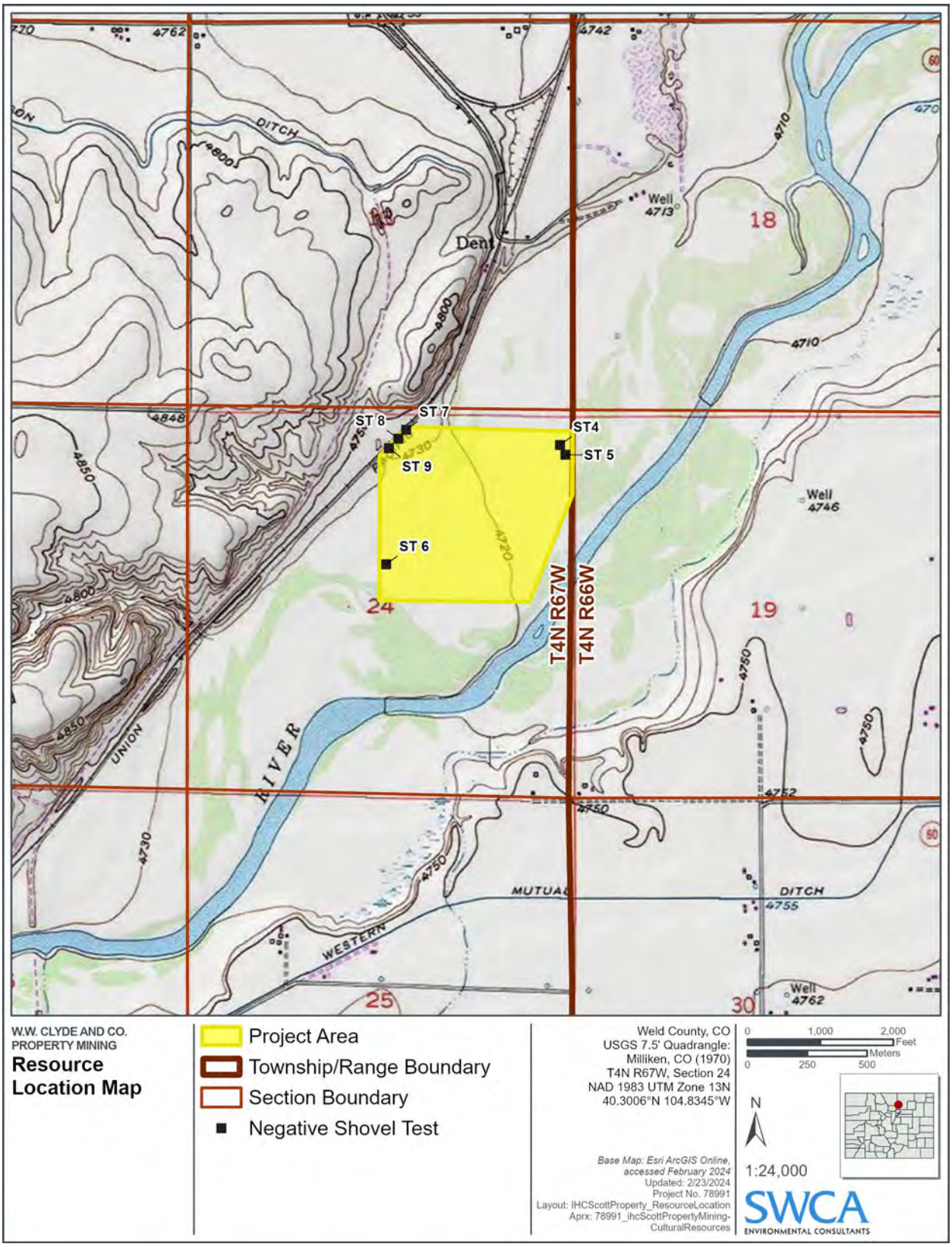

Figure 6. Shovel test locations.

CONCLUSIONS AND RECOMMENDATIONS

Given the level of higher energy flooding and modern agricultural use occurring within the project area, confirmed by the 2023 reconnaissance survey and shovel tests as well as the 2024 intensive survey and shovel tests, either shallow or no native sediments that could retain precontact or early historic archaeological sites remain in the agricultural portion of the project area. Therefore, no additional archaeological assessment is recommended in the cultivated field. The northeastern portion of the project area, outside the cultivated field, shows evidence of frequent flooding events and riverbed deposits, and does not have potential for intact subsurface archaeological deposits. Furthermore, intensive survey and shovel testing of the northwestern portion of the project area, north of the unpaved access road, indicate that no buried cultural materials are present. The southwestern corner of the project area was found to be heavily disturbed and has no potential for the presence of intact archaeological materials. Therefore, SWCA recommends no further work regarding archaeological investigations for this project.

REFERENCES CITED

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2007 *Colorado Cultural Resource Survey Manual.* Available at: https://www.historycolorado.org/sites/default/files/media/document/2017/1527.pdf. Accessed March 2023.

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History Colorado

Melanie Medeiros, M.A., RPA
Senior Cultural Resource Team Lead – Principle Investigator
SWCA Environmental Consultants
295 Interlocken Boulevard, Suite 300
Broomfield, Colorado 80021

Re: Addendum to Cultural Resources Support for the IHC Scott Proposed Bernhardt Gravel Minning Pit in Weld County, Colorado/SWCA Project No. 78991 (HC#83746)

Dear Ms. Medeiros:

We received your correspondence dated February 22, 2024 on February 28, 2024 continuing consultation with our office on the subject action pursuant to the Colorado State Register Act – Colorado Revised Statute (CRS) 24-80.1 et. seq.

Our office understands that there is no federal involvement for this project and Section 106 of the National Historic Preservation Act does not apply. We also understand that the construction of the new gravel mining pit, on land owned by IHC Scott, is subject to state permitting through the Division of Reclamation, Mining and Safety. As such, continued consultation with our office under the State Register Act has been requested.

Per our office's request, SWCA Environmental Consultants conducted additional testing and survey northeast and southwest corners of the project area that appeared to be undisturbed. Based on the additional information provided, we still concur that site 5WL.9625.1, a segment of a levee in Weld County, and isolates 5WL.9626 and 5WL.9627, are not eligible for listing to the State Register of Historic Properties. In addition, we have determined that the proposed action will result in no effect to properties of historical significance that are included or nominated for inclusion to the Colorado State or National Registers of Historic Places.

Please note that the requirements under CRS 24-80 part 13 apply and must be followed if human remains are discovered during ground disturbing activities. In addition, our comments should not be interpreted as concurrence under the National Historic Preservation Act or any other federal law or regulation.

If you have any questions or if we may be of further assistance, please contact Holly McKee-Huth, Cultural Resource Information/Section 106 Compliance Specialist at (303) 866-4670 or holly.mckee@state.co.us.

Sincerely,

Dawn DiPrince
State Historic Preservation Officer

Ecological Resource Consultants, LLC
2820 Wilderness Place, Suite A~ Boulder, CO 80301~ (303) 679-4820

December 1, 2023

Prepared by: Ecological Resource Consultants, LLC
David J. Blauch, Senior Ecologist

RE: Bernhardt Sand and Gravel Pit, File No. M-2023-025
112c Permit Application, Preliminary Adequacy Review
Response to 6.4.8 Exhibit H Wildlife Information
Colorado Parks and Wildlife Comments

This information provides specific response to comments provided by DRMS (September 29, 2023) in regard to the project specified above and specific to Section 6.4.8. Exhibit H Wildlife Information. Ecological Resource Consultants (ERC) previously prepared for the Property a Screening Report for Federal-State Listed Threatened and Endangered Species and General Wildlife for the Bernhardt Site, February 3, 2023 (ERC 2023). ERC 2023 was included as part of Exhibit H in the Application.

DRMS Comment 19 specifies the applicant must address the comments provided by Colorado Parks and Wildlife (CPW) (Email dated September 21, 2023). The following provides a summary of the comment (numbered and italicized) and a bullet item response.

1. *Construction Timing-Presence of prairie dogs and burrowing owls related to seasonal restriction*.
   - ERC 2023 did not identify any prairie dogs or burrowing owl habitat within the Permit Area, therefore no burrowing owl survey is required and operations will not be restricted by seasonal closures.
2. *Construction Timing-raptor nests and migratory birds*.
   - ERC 2023 did not identify any raptor nests (active or inactive) within CPW recommend buffers from the Permit Area. A documented destroyed eagle nest was confirmed and is not considered active. Therefore, the Permit Area is not subject to CPW recommended raptor buffers and timing limitation. Active non-raptor active migratory bird nests will not be disturbed.
3. *Construction Timing-Mule Deer*.
   - Refer to number 10 below.
4. *Fencing.*
   - No new fencing is proposed as part of the project. Existing fencing will remain. Any future new fencing will consider CPW recommended guidelines where appropriate.
5. *Noxious Weeds and Native Reseeding*.
   - A weed management plan will be developed and provided as part of Application Exhibit J.
   - Reclamation seeding will incorporate native species as part of Exhibit F2.

6. *Tree Replacement*

   - The Permit Area does not contain trees/shrubs that will be disturbed. Therefore, no replacement compensation is required or proposed.

7. *Wildlife Escape Ramps*

   - During open pit operations side slopes will be initially cut to a maximum slope of 2:1 and reclaimed to 4.5:1. In addition, operations will always maintain a minimum of one equipment access ramp typically no steeper than 5:1. These measures will provide adequate escape routes for any wildlife entering the pit.

8. *Retention Pond-islands and shorelines for wildlife improvement*.

   - The proposed post-mining use is not intended as wildlife habitat, but rather defined as water storage. The shoreline perimeter does incorporate some level of variability. Creation of islands within the water surface area is not considered appropriate for this project.

9. *Aquatic Species.*

   - Standard stormwater BMPs will be employed and routinely inspected/maintained in accordance with permits to protect water quality in the South Platte River.

   - Plans will be revised to maintain a 400' no disturbance buffer from the ordinary high water mark of the South Platte River. 400' has been considered adequate for this project and per DRMS comments.

10. *Mule Deer Severe Winter Range.*

    - Per CPW recommendations, no initial (first year of construction and vegetation removal) ground disturbance will occur between December 1 to April 30.

    - Year-around operations will commence after the initial year.

    - A 400' riparian corridor (400' from the ordinary high water mark of the South Platte River) will be maintained to preserve migrations corridor along the south Platte River.

DRMS Comment 20 and 21 requests discussion, in the body of Exhibit H of critical habitat that requires special consideration (per Rule 3.1.8(1)) and winter habitat use by wildlife species as well as potential wildlife disruptions (per Rule 6.4.8(1).

- ERC 2023 provided a detailed evaluation of potential critical wildlife habitat and use within the Permit Area. The Permit Area was determined to be comprised of 100% ruderal grassland and disturbed lands which is generally considered low-value wildlife habitat. No federal or state listed threatened and endangered species/habitat were identified. Following the preparation of ERC 2023, CPW issued (~March 2023) new wildlife Species Activity Mapping (polygons) that depict the Permit Area within Mule Deer High Priority Habitat (HPH). This CPW polygon encompasses more than 955 square miles (~611,000 acres) acres along the South Platte and Big Thompson Rivers (refer to Figure 1). The Permit Area represents less than 0.02 % of this entire HPH polygon. In order to minimize potential disturbances to the HPH, the project will implement CPW recommendations addressed in Item 10 above.
- No other critical habitat or seasonal wildlife use has been identified within the Permit Area.
- It is not anticipated that operations (increased traffic, noise, light) will have a significant effect on wildlife in the area.
- Refer to ERC 2023 for further explanation.

Figure 1. CPW High Priority Habitat (Purple Shade) in Relation to the Property (Red Outline)

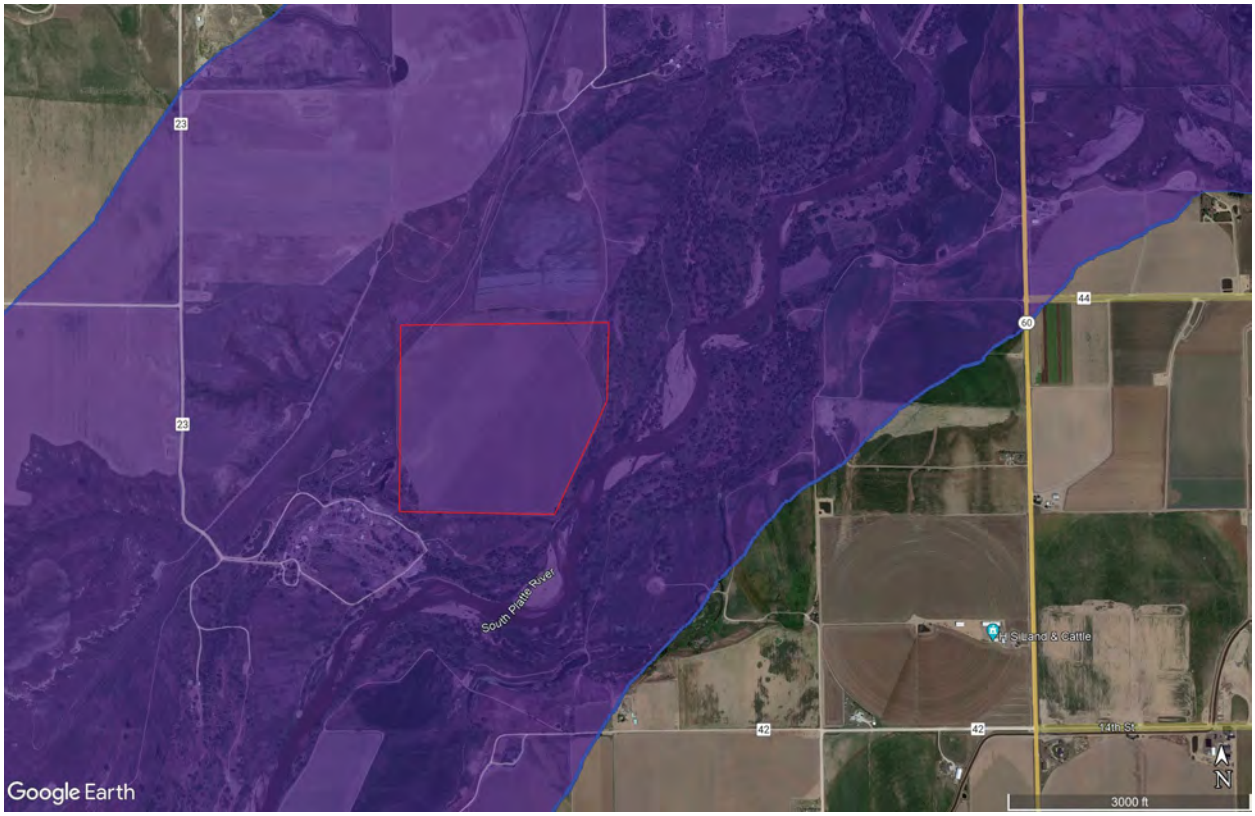
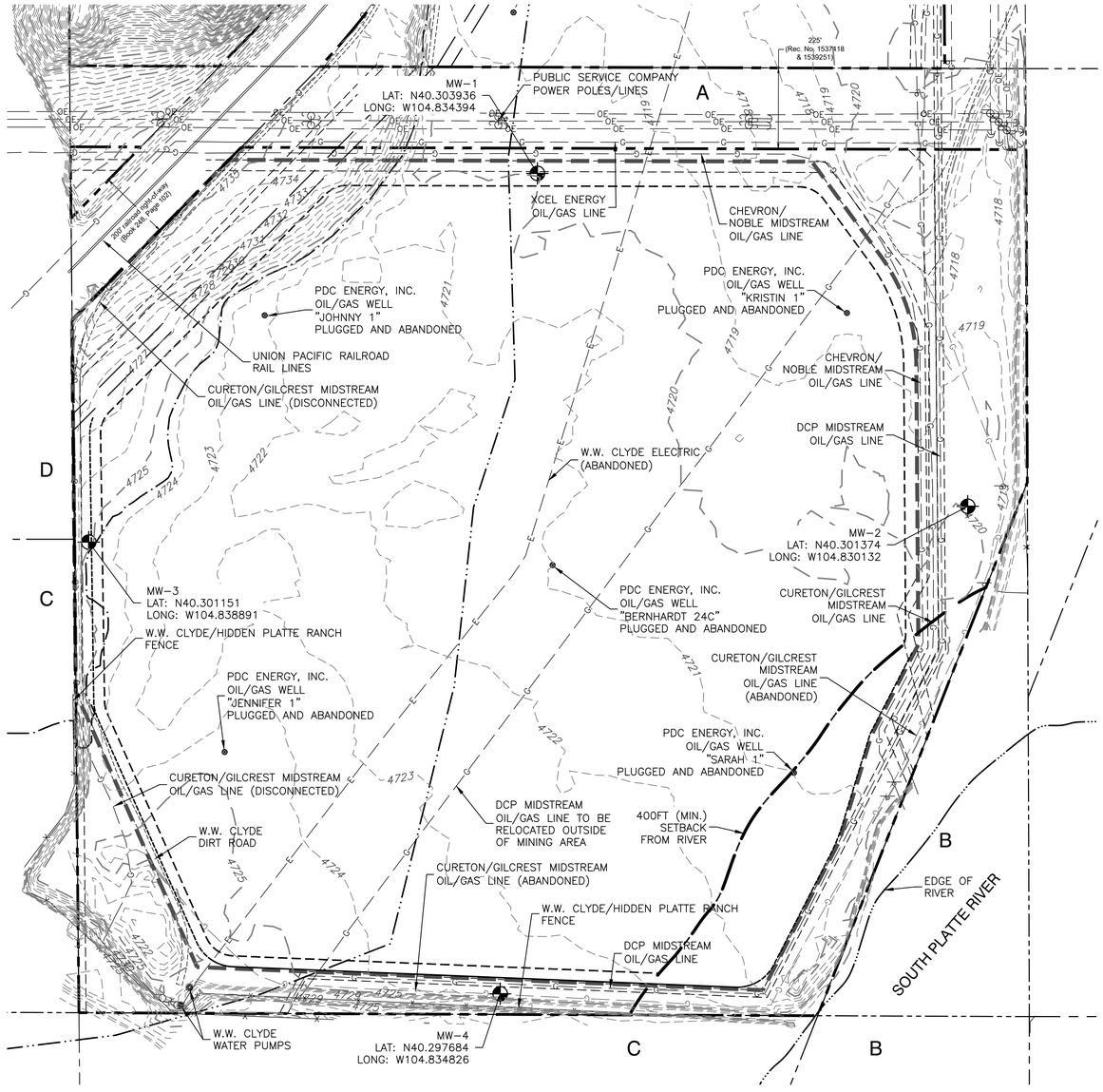
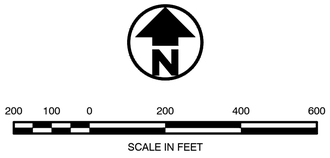


EXHIBIT C

Pre-Mining/Mining Plan Maps

See attached maps.





LEGEND:

EXISTING CONTOURS	SECTION LINE
PROPERTY LINE	EXISTING 100 YR FLOODPLAIN
EXISTING FENCE	EXISTING 100 YR FLOODWAY
EXISTING ROADS	PERMIT BOUNDARY
EXISTING OVERHEAD ELECTRIC	MINING LIMIT
EXISTING UNDERGROUND ELECTRIC	SLURRY WALL
EXISTING POWER POLE	STOCKPILE AREA
EXISTING OIL/GAS LINE	A PROPERTY OWNER MAP ID
EXISTING RIGHT-OF-WAY	

PROPERTY OWNERS WITHIN 200 FEET

MAP ID	NAME/ADDRESS	ASSESSORS ID NO.
A	PUBLIC SERVICE COMPANY OF COLORADO TAX SERVICE DEPARTMENT PO BOX 1979 DENVER, CO 80201-1979	105924000019
B	HALFLIGHT LAND & MINERALS, LLC 4420 SUMAC LANE LITTLETON, CO 80123-2743	105729100002
C	HIDDEN PLATTE RANCH, LLC PO BOX 331 MILLIKEN, CO 80543-0331	105924000039
D	CHERYL KASTEN KAREN CURRIER CARLENE STROH 511 N SHOLDT DRIVE PLATTEVILLE, CO 80651-7583	105924000036

VEGETATION:

ALL AREAS WITHIN THE PERMIT BOUNDARY ARE CURRENTLY AGRICULTURAL CROP AND PASTURE LAND.

NOTE:
W.W. CLYDE & CO. IS THE SURFACE AND SUBSURFACE OWNER WITHIN THE PERMIT AREA.

J&T Consulting, Inc.
305 Denver Avenue - Suite D
Fort Lupton, CO 80621
Ph: 303-857-6222
www.jtconsulting.com

Bernhardt Sand And Gravel Pit

Exhibit C1 - Pre-Mining Plan Map

W.W. Clyde & Co.

REVISIONS

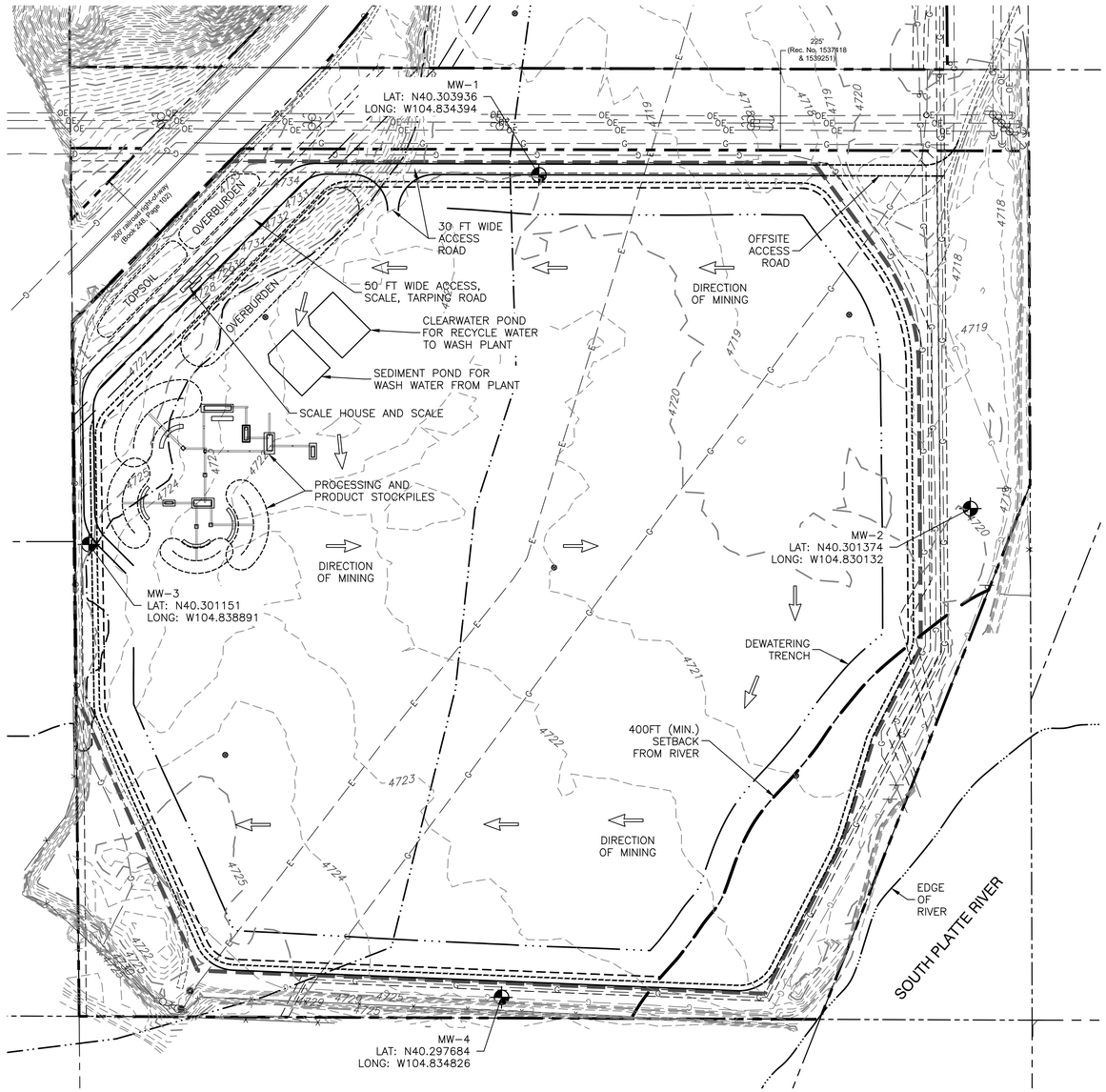
No	Date	By	Chk	Description

J&T Consulting, Inc.

J.C. York

Job #	22036
Date	11.27.23
Drawn By	TPY
Designed By	TPY
Checked By	JCY
File	JT-IHCS Bernhardt Mining.dwg
Scale	As Shown

Sheet: 1 Of: 2

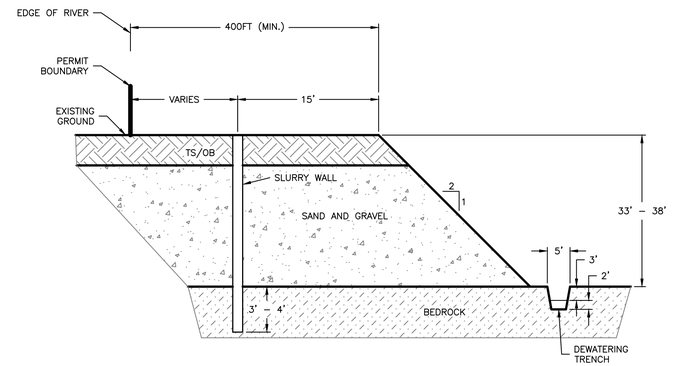


PERMIT AREA = 111.01 AC
MINING AREA = 98.24 AC

200 100 0 200 400 600
SCALE IN FEET

LEGEND:

- EXISTING CONTOURS
- PROPERTY LINE
- EXISTING FENCE
- EXISTING ROADS
- EXISTING OVERHEAD ELECTRIC
- EXISTING UNDERGROUND ELECTRIC
- EXISTING POWER POLE
- EXISTING OIL/GAS LINE
- EXISTING RIGHT-OF-WAY
- SECTION LINE
- EXISTING 100 YR FLOODPLAIN
- EXISTING 100 YR FLOODWAY
- PERMIT BOUNDARY
- MINING LIMIT
- SLURRY WALL
- STOCKPILE AREA
- A — PROPERTY OWNER MAP ID



TYPICAL MINING SECTION
N.T.S.

J&T Consulting, Inc.
305 Denver Avenue - Suite D
Fort Lupton, CO 80621
Ph: 303-857-6222
www.j-tconsulting.com

Bernhardt Sand And Gravel Pit

Exhibit C2 - Mining Plan Map

W.W. Clyde & Co.

REVISIONS

No	Date	By	Chk	Description

J&T Consulting, Inc.

J.C. York

Job #	22036
Date	11.27.23
Drawn By	TPY
Designed By	TPY
Checked By	JCY
File	JT-IHCS Bernhardt Mining.dwg
Scale	As Shown

Sheet: 2 Of: 2

EXHIBIT D

Mining Plan

Mining Limits

WW Clyde proposes to mine in the land located in the parcel of land situated in the northeast 1/4 of Section 24, Township 4 North, Range 67 West of the 6th Principal Meridian, in Weld County, Colorado.

The proposed mining site is located within the Town of Milliken. CR 46 is north of the property and an access road from the property connects to CR 46 near the intersection of CR 46 and CR 25. The South Platte River is adjacent to the property and approximately 880 feet south of the site on the south side of the permit boundary and 140 feet from the east side of the permit boundary. The dominant land use surrounding the property is agricultural use and industrial use.

An aggregate processing plant will be located in Phase 1. These areas will contain stockpiles, portable equipment, storage bins, and silos as necessary to support the plant operations. Mining will start from the northeast corner of the mining limit then moving south approximately to one third of the property then west, then moving south to another third of the property back to the east, then moving south to the final third of the property to the west to complete mining and reclamation.

All local, State, and Federal rules and regulations will be followed for the storage and handling of any petroleum products.

The permit boundary will encompass approximately 111.01 acres which will all be affected acreage, and approximately 98.24 acres being mined. The remaining area will consist of access roads and disturbed land. The following table depicts the different affected acreage:

Affected Acreage	**Mining Plan Area (acres)**
Mined Area	98.24
Access Roads	2.36
Disturbed Land	10.41
TOTAL	**111.01**

Various setbacks from adjacent roads, adjacent structures, and oil and gas infrastructure will be maintained as mining occurs. The final executed agreements are expected to be obtained in the near future and will be forwarded to the Division when they are available. A minimum 200-foot setback from any existing oil/gas facility will be maintained until that time. See Exhibit C, Mining Plan Map, and the Slope Stability Report for the mining limit configuration and information on setbacks and their locations. The abandoned wells would be cutoff after mining has reached the bedrock surface or the reclaimed slope surface where a new cap and any additional concrete for the existing plug would be needed. Petroleum Development Corporation (PDC) is the leaseholder and operator of the existing abandoned wells. Discussions with PDC have indicated they would cut down the existing casings as mining occurs. We have also worked with McCarty Engineering, LLC to provide this service at other mining permit locations for other operators. If PDC does not want to perform this work then McCarty Engineering, LLC would be contacted to do it. They are

licensed and bonded to obtain approvals from the COGCC to do these types of re-plug services on abandoned oil and gas wells.

Products

Sand and gravel will be the primary product produced from the Bernhardt Sand and Gravel Pit. The principal intended use for the sand and gravel is for road base and construction aggregates.

Subsurface drilling and testing have verified that the Bernhardt Sand and Gravel Pit property contains a significant commercial deposit of sand and gravel. The depth of clay, interbedded sandy clays and clayey to silty sands at the surface range from 1 to 8 feet. The thickness of the aggregate material ranges from 4 to 37 feet where bedrock contact occurs.

Mining Methods

The deposit will be dry mined and a slurry wall will be constructed around the perimeter of the mining area for Phase 1. Mining will not expose groundwater prior to the slurry wall being constructed around the perimeter of Phase 1. Design specifications for the slurry wall and quality control procedures used during construction will ensure that the reclaimed reservoir meets State Engineer's Office (SEO) performance standards. Dewatering trenches will be excavated around the perimeter of each mining area prior to mining operations commencing. The depth of the ditches will vary as the mining progresses deeper into the alluvium in order to maintain the groundwater level below the active mining bottom surface, and therefore minimize the exposed groundwater surface area. The dewatering ditches will flow to a collection pond, from which the water will be pumped and discharged into recharge areas where overflow will reach a ditch that flows to the South Platte River.

The equipment and facilities may include, but are not limited to the following:

Scaling Equipment

A scale house and scale will be used to weigh trucks and product leaving the pit. The dimensions of the scale house are 40’ x 12’ and the scale will be 70’ by 10’. The scale house will be founded on typical trailer type jacks and tiedowns on top of concrete pads with minimal rebar to provide reinforcement. The scale will also be founded on concrete pads with reinforcement where load cells are located for the scale. These foundations would be removed once the pit is fully mined.

Processing Equipment

Screens, wash plant, crusher, conveyors, stackers, and other miscellaneous processing equipment. All processing equipment will be mobile and temporary without fixed foundations. Washing will occur at the wash plant and excess water from the washing will be recycled to the wash water ponds within the processing area, there will be a sedimentation pond that will receive the excess water first and then and overflow from the sedimentation pond to the clear water pond for re-using the water and pumping back to the wash plant.

Earth Moving Equipment

Dozers, loaders, scrapers, excavators, and compactors will be used for mining and earth moving operations.

Haul Roads and Access Roads

Haul roads will be graded and constructed using the existing pit run where needed outside the processing area in order to move material from the mine using haul trucks, loaders, or scrapers. These roads will be mined and removed as the mining is completed.

Access roads to the processing plant will be constructed with aggregates made at the site where the entrance to the permit boundary is located to the scale house and through the scaling area until the access reaches the stockpile locations. The roads around the stockpiles will be constructed from the existing pit run similar to the haul roads.

Miscellaneous Equipment

Dewatering pumps, electrical trailer, generator trailer, small portable generators and watering trucks will be used as needed.

As mining progresses, topsoil and overburden will be stripped to expose the aggregate product below. Topsoil will be stripped and salvaged from areas where overburden material will be stockpiled. All soil and overburden material will be used on-site for reclamation; so long-term stockpiling of these materials is not anticipated. Overburden stockpiles will be located within the proposed mining area. The stockpiles will be placed parallel to the floodplain to mitigate impacts to the floodplain.

Mining of the aggregate will progress down to the underlying bedrock. Since reclamation will occur concurrently with mining, it is not anticipated that overburden material will be stockpiled long-term prior to use in the slope reclamation and also the production of road base. During mining the mining face for Phase 1 will have a 2H:1V slope to bedrock or the bottom of the future reclaimed reservoir and the reclamation slope will be constructed using the excess overburden to a 4.5H:1V slope. The processed aggregate material will be temporarily stockpiled near the portable processing plant.

Recommendations for monitoring of slope stability, including, conducting a visual inspection of the excavated slopes on a weekly basis for the duration of mining, conducting a visual inspection after a major precipitation event that has saturated the ground using the same procedures, contacting qualified personnel to evaluate and recommend remediation work to stabilize the area in the event a visual inspection detects signs of potential slope failure, and if no visible signs of slope failures are detected during mining, reducing visual inspections to once every six months after mining completion, or after every major precipitation event.

All local, State, and Federal rules and regulations will be followed for the storage and handling of any fuel for the facilities.

Topsoil Handling Plan

As stated previously the topsoil will be stripped to expose the aggregate product underlying the topsoil. The topsoil will be stripped using scrapers and stockpiled in the topsoil stockpile as depicted in Exhibit C. Topsoil will be stripped and salvaged from areas where overburden material will be stockpiled. The volume of topsoil for all the mining phases is approximately 13,000 cubic yards. The depth of the topsoil is approximately six inches over the majority of the mining area. The topsoil will be stripped and stockpiled during each phase of mining where topsoil will only be removed for Phase 1 as Phase 1 is mined. Mining will start from the northeast corner then moving south approximately to one third of the property then west, then moving south to another third of

the property back to the east, then moving south to the final third of the property to the west to complete mining and reclamation. The height of the topsoil stockpile will be approximately 15 feet to 20 feet.

Mine Phasing

WW Clyde anticipates mining and reclaiming the Bernhardt Sand and Gravel Pit in 1 phase, progressing through this phase as shown on the Mining Plan Map. The overall time required to complete the mining and reclamation is estimated to be 11 years based on an average rate of 650,000 tons per year. The initial production is expected to be 300,00 tons per year with the maximum production expected to be 1,000,000 tons per year. However, it is possible that due to demand fluctuations, mining could progress slower than anticipated and additional time may be required for mining and reclamation of the site.

Phase 1 is 98.24 acres and the estimated time for mining Phase 1 is approximately 11 years.

The mining will progress beginning at the outer edge of the phase where material will be moved toward the interior of the phase such that the mining slope can be established. The mining slope will be established for the entire perimeter of the phase in 3 to 6 feet intervals.

Dewatering

Dewatering trenches will be placed along the perimeter of Phase 1. The dewatering trench around the perimeter of the phase being mined will be placed at the toe of the mining slope. As the phase is mined deeper the dewatering trench will be lowered and moved laterally along the mining slope toward the center of that phase. A slurry wall is anticipated to be installed around the perimeter of Phase 1 prior to exposing groundwater and mining will continue to commence and it is expected minimal dewatering will be required after the slurry wall is installed due to the slurry wall cutting off groundwater infiltration into the pit. WW Clyde will have an approved substitute water supply plan and well permit prior to exposing groundwater. The substitute supply plan will be updated annually to account for water that is consumed due to exposing groundwater by the mining operation.

Explosives

Explosives will not be used during mining.

EXHIBIT E

Reclamation Plan

A lined water storage reservoir will be the final reclaimed use for the Bernhardt Sand and Gravel Pit. Portions of mining area will be reclaimed as "native" areas, which will be re-seeded with native vegetation. The majority of the mining areas will be reclaimed as a water storage reservoir. The remaining area within the proposed permit boundary will consist of reservoir shoreline, unimproved access roads around the reservoirs, and reclaimed vegetated land.

Final Land Use	Reclamation Plan Area (acres)
Reservoir Water Surface	92.35
Access Roads	3.59
Reclaimed Vegetated Land (Disturbed Land and Slopes above Reservoir Water Surface)	15.07
TOTAL	**111.01**

Water Storage Reservoir

In general, the mining limits will be mined down to the shale/claystone/sandstone bedrock. The relatively impermeable bedrock will make the bottom of the reservoir. The reservoir will be separated from the surrounding alluvial aquifer by the slurry wall liner system as detailed in the cross-section shown on the Reclamation Plan Map. The slurry wall liner will be keyed into the bedrock material and extend upward through the height of the alluvium as depicted in the mining plan. Design specifications and quality control procedures used during the construction of the slurry wall liner will ensure that the reservoir meets the State Engineer's Office (SEO) performance standards for permeability.

All reservoir slopes will be reclaimed to at least 4.5H:1V final grade Since reclamation will be concurrent with mining, most soil, overburden, and bedrock material excavated during mining will be used almost immediately. The miner commits to having a maximum un-reclaimed slope of 3,000 lineal feet. Scrapers and dozers and compactors will be used to shape the reclaimed slope material along the reservoir perimeters to achieve the final grade. Upon placing the backfill material, 95 percent compaction will be achieved to ensure adequate integrity of the reclaimed slope, backfilled areas for haul/access roads and recharge pond areas that are not within the future water storage/reservoir footprint. Final reclamation by capping with topsoil and re-vegetating above the expected reservoir water level will follow grading operations as well as backfilled areas that will not be haul/access roads to minimize the amount of disturbance at any one time.

Recommendations for monitoring of slope stability, including, conducting a visual inspection of the excavated slopes on a weekly basis for the duration of mining, conducting a visual inspection after a major precipitation event that has saturated the ground using the same procedures, contacting qualified personnel to evaluate and recommend remediation work to stabilize the area in the event a visual inspection detects signs of potential slope failure, and if no visible signs of

slope failure are detected during mining, reducing visual inspections to once every six months after mining completion, or after every major precipitation event.
During reclamation activities, inlet and outlet facilities for the reservoir will be designed and installed once the operational criteria of the proposed reservoir have been identified by an end user.

Reclamation Measures/Materials Handling

Backfilling will be done to provide stabilized shorelines around the reservoir and to minimize erosion. The backfill material will consist of gravel, overburden, clay, and topsoil from on-site materials. No structural fill will be imported from outside the permit area. There will not be known toxic or hazardous materials in the backfill material. Additionally, it is not likely that acid forming or toxic materials will be encountered during mining. The mining will not leave high walls on the property. In addition, there will be no auger holes, excavations, or shafts left on the property. The auger holes for the gravel investigation were backfilled with native gravel and soil cuttings from the drilling. The auger holes that were not backfilled were the four monitor wells that were constructed and permitted as permanent monitoring wells to monitor groundwater at the north, east, west, and south sides of the permit boundary. Monitor wells will remain on the property so the end user may continue to monitor levels of the groundwater elevations.

Topsoil will be placed to finalize the grading such that seeding can occur. The topsoil will be placed at all disturbed areas and on the mining slope to an elevation matching the expected reservoir water level.

Topsoiling

Approximately the top six inches of soil on the property is classified as topsoil. This layer includes the root zone of grasses and crops, which will be stripped and stockpiled separately. Topsoil will be re-handled as little as possible and a Technical Revision will be submitted prior to re-locating topsoil stockpiles. By using concurrent reclamation techniques, the topsoil is not expected to remain in stockpiles for more than one to five years. If the stockpile remains more than one growing season, it will be seeded with a fast-growing vegetative cover to prevent erosion. All topsoil will be retained on-site to reclaim the reservoir shoreline, and other areas disturbed by mining activities. Where required, topsoil will be replaced to a depth of twelve inches. Prior to placing topsoil uneven areas and low spots will be graded to subgrade elevation, in addition debris, roots, branches, stones, in excess of 2 inch in size will be removed. Scarify surface to depth of 8 inches where topsoil is to be placed for a roughened condition to assist in eliminating erosion. Scarify/cultivate in areas where equipment used for hauling and spreading topsoil has compacted subsoil. Place topsoil during dry weather and on dry unfrozen subgrade. Remove vegetable matter and foreign non-organic material from topsoil while spreading. Grade topsoil to eliminate rough, low or soft areas.

Revegetation

As mining operations are completed, areas for reclamation will be graded and shaped for revegetation. Runoff or excess water from adjacent areas will not be allowed to flow over slopes being graded and seeded. If needed, berms or channels will be constructed to divert excess water and convey it in a safe and non-erosive manner.

For disturbed areas, the reclamation plan includes re-vegetating with appropriate seed mixes to minimize erosion and re-establish natural terrain. A proper seedbed is firm and free of competing vegetation. Correct firmness is when an adult footprint is only slightly visible on the prepared bed prior to the seeding operation. The seedbed can be firmed, if needed, by pulling a commercial or homemade packer or roller. A firm seedbed is essential for proper seeding depth prior to using the mechanical seeder or broadcasting seed. Apply seed evenly in two intersecting directions. Rake in lightly. Apply seed at the vendor's recommended bulk seed rate/acre according to the quantity of PLS contained in their bulk seed to achieve the specified PLS/acre rate utilizing a mechanical seeder. Where access is limited and seed is applied by hand broadcasting, apply the seed mix at twice the PLS rate per acre and rake in once broadcasting in completed. Do not seed areas in excess of that which can be mulched on same day. Do not sow immediately following rain, when ground is too dry, or when winds are over 10 mph. Immediately following seeding, apply mulch to thickness of 1/4 inch.

The seed mixture below was selected as recommended by the DRMS for this climate zone (Dryland Quick Establishment, elevation less than 8,000 feet). Reservoir side slopes below the anticipated reservoir water level will not be seeded. The proposed seed mix is shown in the following table.

Reclamation and Temporary Stockpile Seed Mix

Seed Mix	Species	Scientific Name	Application Rate * (#PLS/acre)
Grasses	Intermediate Wheatgrass	*Thinopyrum intermedium*	2.50
	Slender Wheatgrass	*Elymus trachycaulus,*	2.00
	Pubescent Wheatgrass	*Thinopyrum intermedium*	3.00
	Russian Wildrye	*Psathyrostachys juncea*	3.00
	Western Wheatgrass	*Pascoprum smithii*	2.00
	Sand Dropseed	*Sporobolus cryptandrus*	0.25
*Application rate is for drilling the seed. If seed is to be broadcast, the application rate will be doubled.			

The seed mix for final reclamation as described above does not require fertilizer per the information provided by the DRMS. The seeded areas will be covered with dead crop litter from sorghum or milo crop forage, or with straw mulch at a rate of 2,000 pounds per acre. Ideal seeding dates for Colorado are November 1 to May 1, when the soil is not frozen. Grasses should be seeded when soil moisture and temperature are optimum for germination. Grasses are designated either "cool" or "warm" season based on their growth cycle. Cool-season grasses can be planted when temperatures are cooler and day lengths are short. Warm-season grasses need warmer temperatures and longer day lengths to grow. Refer to Weld County's seeding recommendations as a resource for time frames outside of the ideal seeding times at www.weld.gov/Government/Departments/Public-Works/Weed-Management/Controlling-Weeds/Reseeding.

If a significant invasion of noxious weeds occurs after seeding, the weeds will be mowed before they can go to seed. The areas will be mowed periodically for additional control as needed.

Mechanical control will be used as a first priority. Chemical methods will only be used if no other alternative produces acceptable results. See Exhibit J for specifics of the weed control plan.

For temporary earthen stockpiles, the reclamation plan includes re-vegetating with appropriate seed mixes to minimize erosion and establish more rapidly to stabilize the stockpiles. If a temporary earthen stockpile remains more than one growing season, it will be seeded with the seed mix above to prevent erosion.

Water – General Requirement

To minimize the effect on the prevailing hydrologic balance, WW Clyde will:

a. Comply with all applicable Colorado water laws.
b. Comply with all applicable Federal and State water quality laws and regulations.
c. Comply with all Federal and State requirements for dredge and fill.
d. Re-grade and backfill all sediment and siltation structures after mining is completed.
e. Monitor groundwater levels adjacent to the site and mitigate any damage to adjacent wells that dewatering activities may have. (See Exhibit G)

Groundwater – Specific Requirements

The operation will not affect groundwater quality on or off the site. The operation will comply with State groundwater quality standards.

The mining and reclamation may affect the groundwater table surrounding the mine site. The proposed mitigation efforts to minimize these impacts are recharge ponds or ditches in necessary areas to maintain groundwater levels during the mining, and a perimeter drain if needed to convey groundwater around the lined reservoir after the pit side liner is installed. A ground water model by McGrane Water Engineering, LLC has also been provided and the results indicate that water levels will be affected by +/-0.5 to +/-1 ft and there are 5 wells (2 are owned by WW Clyde) within the predicted water level change so the overall impact of the slurry wall will be insignificant. WW Clyde proposes that they monitor groundwater levels through both interior (within the mining) and exterior (outside the slurry wall lining) monitoring wells that they have installed, or have access to before, during, and after the mining and reclamation is complete so that impacts to the groundwater table, from this mining operation, can be identified and addressed. It is the intent of WW Clyde to operate responsibly and to mitigate any damage to wells that is directly attributable to the mining and reclamation of this site.

Reclamation – Approximate Time Table

The initial proposed rate of production for the mine is 300,000 tons per year and the maximum proposed rate of production for the mine is 1,000,000 tons per year. The total time frame to mine all phases assuming an average production rate of 650,000 tons per year is approximately 12 years. The following table shows the approximate time frame to finish each phase of mining assuming an average production rate of 650,000 tons per year:

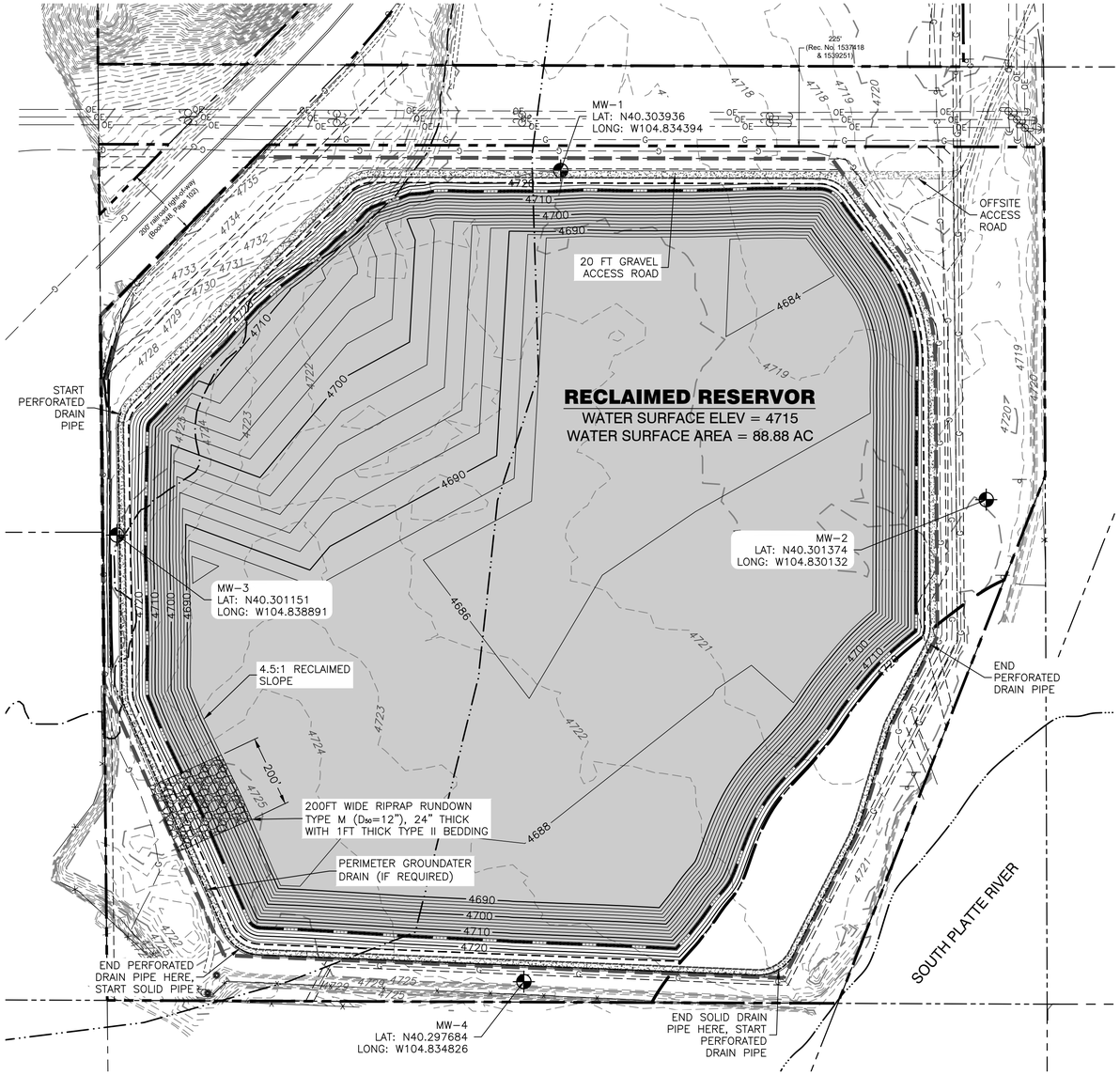
Mine Phase and Acreage	Time Frame to Complete and Reclaim Phase
Phase 1 – 98.24 acres	11 years

The assumed annual production rate is 300,000 tons initially to 1,000,000 tons maximum for processed material leaving the mine each year. The size and area of reclamation generally consists of the outside mining slope (mined at a 2H:1V slope) in in Phase 1 being reclaimed at a 4.5H:1V slope with the addition of clay, overburden, topsoil, and revegetation. For more information on sequencing and size of the reclamation activities refer to Exhibit L financial warranty calculations.

EXHIBIT F

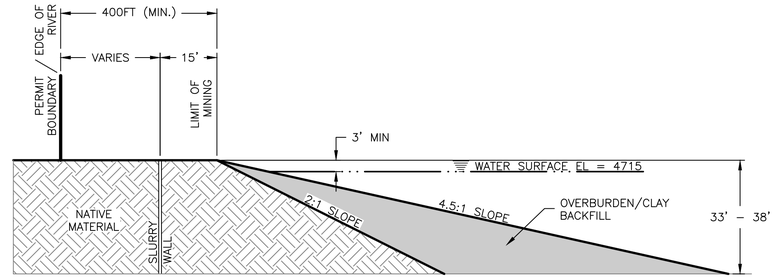
Reclamation Plan Map

See attached maps.

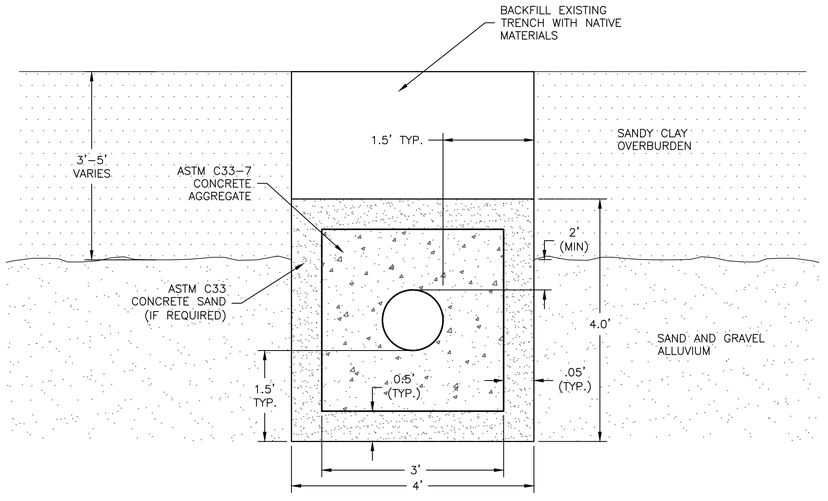


LEGEND:

- EXISTING CONTOURS
- PROPOSED CONTOURS
- PROPERTY LINE
- EXISTING FENCE
- EXISTING ROADS
- EXISTING OVERHEAD ELECTRIC
- EXISTING UNDERGROUND ELECTRIC
- EXISTING POWER POLE
- EXISTING GAS LINE
- EXISTING RIGHT-OF-WAY
- SECTION LINE
- EXISTING 100 YR FLOODPLAIN
- EXISTING 100 YR FLOODWAY
- PERMIT BOUNDARY
- SLURRY WALL
- RESERVOIR WATER SURFACE
- PERIMETER DRAIN (IF NEEDED)



TYPICAL RECLAMATION SECTION
N.T.S.



PERIMETER GROUNDWATER DRAIN (TYPICAL SECTION IF REQUIRED)
N.T.S.

J&T Consulting, Inc.
305 Denver Avenue - Suite D
Fort Lupton, CO 80621
Ph: 303-857-6222
www.jtconsulting.com

Bernhardt Sand And Gravel Pit

Exhibit F1 - Reclamation Plan Map

W.W. Clyde & Co.

REVISIONS

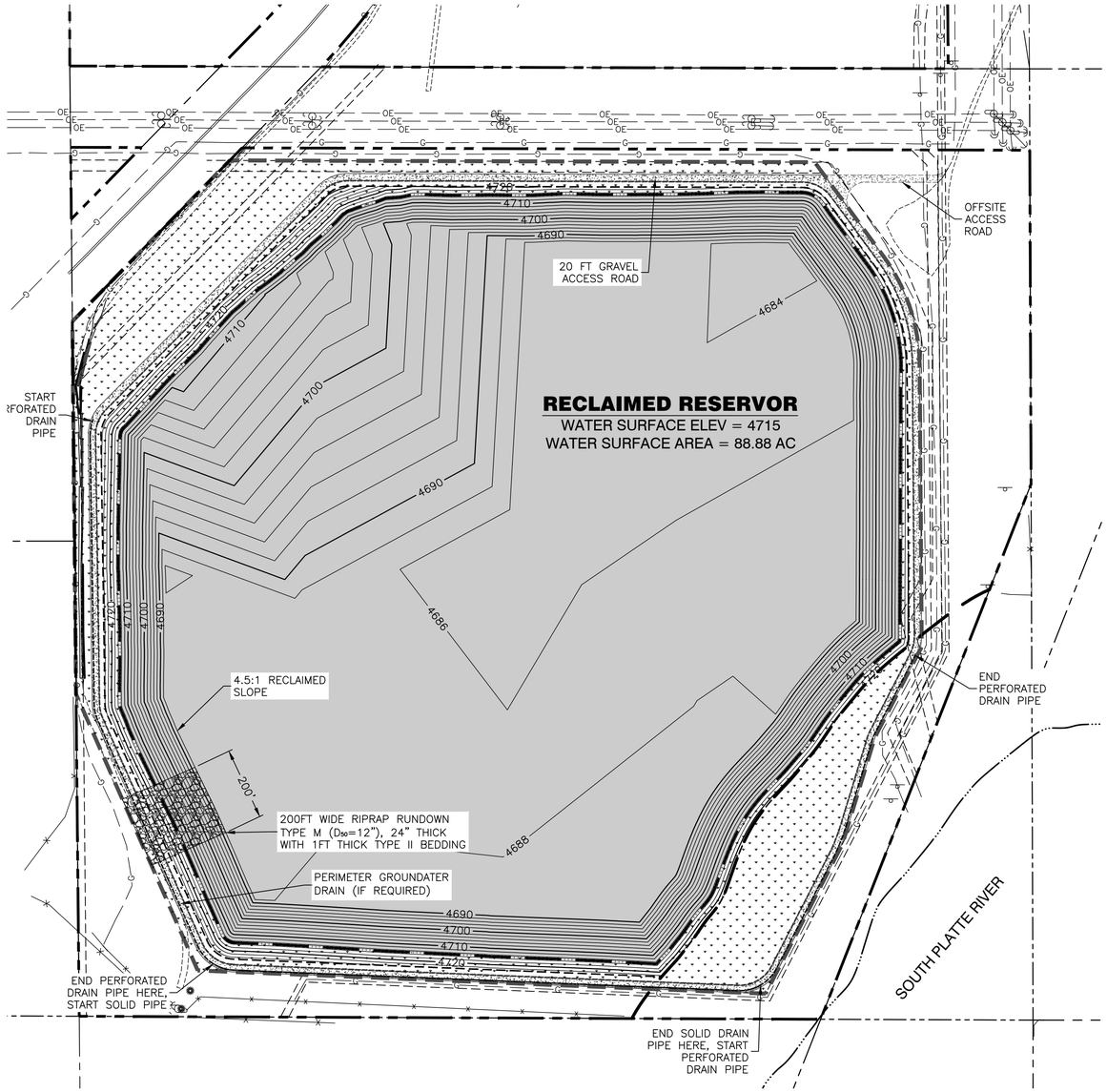
No	Date	By	Chk	Description

J&T Consulting, Inc.

J.C. York

Job #	22036
Date	03.12.24
Drawn By	TPY
Designed By	TPY
Checked By	JCY
File	JT-IHCS Bernhardt Rec.dwg
Scale	As Shown

Sheet: 1 Of: 2



LEGEND:

- EXISTING CONTOURS
- PROPOSED CONTOURS
- PROPERTY LINE
- EXISTING FENCE
- EXISTING ROADS
- EXISTING OVERHEAD ELECTRIC
- EXISTING UNDERGROUND ELECTRIC
- EXISTING POWER POLE
- EXISTING GAS LINE
- EXISTING RIGHT-OF-WAY
- SECTION LINE
- EXISTING 100 YR FLOODPLAIN
- EXISTING 100 YR FLOODWAY
- PERMIT BOUNDARY
- SLURRY WALL
- RESERVOIR WATER SURFACE
- PERIMETER DRAIN (IF NEEDED)
- SCARIFY, TOPSOIL, SEED AREA

NOTE:

ALL DISTURBED AREAS OUTSIDE OF THE WATER SURFACE WILL BE SEEDED AND MULCHED, WITH THE EXCEPTION OF THE ACCESS ROAD, WHICH WILL BE GRAVEL SURFACED.

RECLAIMED AREA TABULATION:

WATER SURFACE = 92.35 AC
GRAVEL ACCESS ROAD = 3.59 AC
SCARIFY, TOPSOIL, SEED AREA = 15.07 AC
TOTAL AREA = 111.01 AC

N

200 100 0 200 400 600

SCALE IN FEET

J&T Consulting, Inc.
305 Denver Avenue - Suite D
Fort Lupton, CO 80621
Ph: 303-857-6222
www.jtconsulting.com

Bernhardt Sand And Gravel Pit

Exhibit F2 - Reclamation Seeding Map

W.W. Clyde & Co.

REVISIONS

No	Date	By	Chk	Description

J&T Consulting, Inc.

J.C. York

Job #	22036
Date	03.12.24
Drawn By	TPY
Designed By	TPY
Checked By	JCY
File	JT-IHCS Bernhardt Rec.dwg
Scale	As Shown

Sheet: 2 Of: 2

EXHIBIT G

Water Information

Introduction

WW Clyde proposes to mine in the land located in the parcel of land situated in the northeast 1/4 of Section 24, Township 4 North, Range 67 West of the 6th Principal Meridian, in Weld County, Colorado.

The proposed mining site is located within the Town of Milliken town limits. CR 46 is north of the property and an access road from the property connects to CR 46 near the intersection of CR 46 and CR 25. The South Platte River is adjacent to the property and approximately 880 feet south of the site on the south side of the permit boundary and 180 feet from the east side of the permit boundary. The operation will consist of sand and gravel production and will impact the South Platte River in the form of depletions due to evaporation and operational losses associated with mining. Mining of the Bernhardt Sand and Gravel Pit mining site will last for approximately 11 years. Once reclamation is complete a reservoir will be created with a total surface area being 92.35 acres.

The depth to groundwater ranges from 3 to 7 feet seasonally within the permit boundary (measured in MW-1 through MW-4, See the attached piezometer measurements table). The site will be mined down to a depth of 37 feet at the deepest depth thus exposing groundwater to the atmosphere. This exposed groundwater, along with the operational losses associated with the extraction of sand and gravel deposits, will impact the South Platte alluvial aquifer. These impacts will cause river depletions that must be augmented. Groundwater will be exposed during the mining once the mining depths reach an elevation of approximately 4713.8.

To enable dry mining at the Bernhardt Sand and Gravel Pit mining site, there will be dewatering trenches around the perimeter of Phase 1. These dewatering trenches will change in length throughout mining. The maximum length will occur when Phase 1 is completely mined. The maximum size of dewatering trench will be 5,430 feet long and 5 feet wide, or 0.62 acres of exposed surface area. water will be pumped into dewatering ditch, which traverses the site, and ultimately into the South Platte River.

As mining progresses, the dewatering trenches will shift as mining slopes are reclaimed. The gravel pit will have a slurry wall liner being constructed as mining commences in Phase 1.

Water Requirements

Water use at the Bernhardt Sand and Gravel Pit mining site will include evaporation from exposed groundwater, dust control of haul roads and stockpiles, water for the wash plant (i.e. wash screen for concrete rock and sand) and water retained in material removed from the site.

Evaporative Loss

Evaporative losses are dependent on the exposed water surface area, which may shift throughout the mining operation, but will not exceed the maximum. Exposed surface area at the Bernhardt Sand and Gravel mining site will include groundwater exposed in the dewatering trenches. The

maximum exposed surface area at the site during mining is estimated at 1.80 acres. WW Clyde plans to keep the site dewatered throughout the life of the mine.

Evaporation data was taken from NOAA Technical Report NWS 33, Evaporation Atlas for the 48 Contiguous United States. The annual gross evaporation was determined to be 45 inches for this location. Monthly evaporation percentages are established by guidelines set by the State Engineer's Office. To determine precipitation, data from the National Weather Service for Greeley, CO (UNC) (1967-2022) was used. The long-term average precipitation at the Bernhardt Sand and Gravel Pit mining site is estimated at 14.26 inches. Effective precipitation is calculated as 70% of the total precipitation. The net evaporation is the difference between gross annual evaporation and effective precipitation. The resulting net evaporation is 2.56 feet.

The maximum evaporative loss from the 1.80 acres is 4.61 ac-ft.

Operational Loss

The average annual production from the Bernhardt Sand and Gravel Pit mining site is estimated at 650,000 tons. Using 4% moisture content (2% for moisture in the product and 2% for water used to wash), the total associated consumptive use for water retained in the material mined and water used for washing is 19.13 ac-ft.

Dust control and water use is 10,000 gal/day, 6 days/week, 4 weeks/month for 10 months of the year. This equates to 7.4 ac-ft.

Maximum annual operational loss is estimated to be 26.53 ac-ft for Phase 1.

Consumptive Use

The maximum annual consumptive use (operational loss + evaporation loss) at this site during the mining operation is estimated to be 31.14 ac-ft for Phase 1.

Replacement Water

The replacement of consumptive uses at the site is will be accounted for in a substitute water supply plan (SWSP) approved by the State Engineer. The SWSP will be obtained prior to any mining activities occurring that expose groundwater.

Surrounding Water Rights

The attached Figure A-1 Well Permits in the Bernhardt Sand and Gravel Pit – Groundwater Evaluation by McGrane Engineering, LLC shows the permitted wells within 600 feet of the mining limits and permitted wells within the boundaries of the groundwater model/evaluation. The well information and locations were obtained from the Division of Water Resources online mapping well permit locator. This well and water rights information was cross checked with the State's CDSS. Between the sources, all permitted and decreed wells are included. Table G-1 below is a corresponding list of wells as numbered in the Bernhardt Sand and Gravel Pit – Groundwater Evaluation by McGrane Engineering, LLC that is attached that are within 600 feet of the mining limits.

Table G-1 - Permitted and Decreed Wells Within 600 Feet of Mining Limits								
No.	**Permit No**	**WDID**	**Well Name**	**Owner**	**Address**	**City**	**State**	**Zip Code**
1	14477-F-R (Replaced 014477F Shows Expired on DWR Website)	0208226	Stroh Well (Irrigation)	Cheryl L. Kasten, Carlene M. Stroh, Karen S. Currier	511 North Sholdt Drive	Platteville	CO	80651
2	42519-F	0205536	Bernhardt Well (Irrigation)	WW Clyde (Purchased Property in 2022)	10303 E. Dry Creek Road, Suite 300	Englewood	CO	80112
3	85-R-R	0205392	Bernhardt Well #5 (Irrigation)	WW Clyde (Purchased Property in 2022)	10303 E. Dry Creek Road, Suite 300	Englewood	CO	80112
4	5-WCB	No WDID	CWCB Well	Violet Montgomery	No Street Address Provided on Permit	Eagle	CO	No Zip Code Provided on Permit
5	13701-F (Red Tag in Photos Showing Do Not Divert dated 2019)	0205393	Bernhardt Well #6 (Irrigation)	Herbert B. Bernhardt	500 Broad Street	Milliken	CO	80543

At the time of SWSP application/approval, a new gravel pit well permit will be applied for/obtained to include the evaporative and operational losses from the property. If the proposed use of groundwater at the Bernhardt Sand and Gravel Pit mining site results in material injury to surrounding wells, WW Clyde will ensure that all necessary measures are taken to address the issues.

Water Quality

An NPDES permit will be obtained from the Water Quality Control Division at the Colorado Department of Public Health & Environment for the Bernhardt Sand and Gravel Pit mining site prior to discharging any groundwater that is dewatered from the site. This permit will be kept current and amended as necessary to ensure that any water discharged from the site will meet the permitted water quality standards.

Impacts to Groundwater/Hydrologic Balance

WW Clyde will monitor the groundwater levels surrounding the site and provide groundwater recharge if necessary via a groundwater drain as shown on the reclamation plan. The groundwater drain size will be provided with the groundwater drain plan and profiles prior to

installation of the slurry wall at the same time that the slurry wall design/construction drawings are provided to the DRMS prior to installation of the slurry wall. WW Clyde will discharge dewatering flows into existing adjacent irrigation laterals where possible to limit the disturbance to the surrounding land or obtain an agreement with one of the adjacent land owners to discharge the dewatering flows directly to the South Platte River. A slurry wall liner is proposed around the individual phase and will likely be installed prior to mining starting.

To summarize the mitigation process, as each phase of mining/dewatering occurs, WW Clyde will monitor the groundwater levels adjacent to mine as each phase progresses. If groundwater levels drop to a level that prevents an adjacent well from performing acceptably, according to that well's owner, WW Clyde will either implement a groundwater recharge ditch/pond near the well in order to raise the groundwater level in the vicinity of the well and hence return it's operation to acceptable standards, or will negotiate an agreement with that well owner to replace the well or provide replacement water via other means until the mining and reclamation activities are concluded but it is not anticipated that any groundwater levels will drop since the slurry wall will be installed prior to exposing groundwater.

Groundwater wells that are not owned by WW Clyde (Table G-1) are potentially located within 600 feet of the mining limits. The exact physical location of these wells will be determined during the SWSP and well permit application processes. If wells are found to be within 600 feet of the mining limits, WW Clyde will either obtain a well waiver from the owner of the well, or provide an agreement with the well owner that WW Clyde will mitigate any material damage to the well that is directly attributable to the mining and reclamation of the site.

All other wells within 600 feet of the mining limits are either owned by WW Clyde, or are monitoring wells therefore groundwater impacts to these wells do not need to be addressed.

See the attached Piezometer Location Map, and Piezometer Data Summary, which show the locations of monitoring wells around the perimeter of the site that WW Clyde has either installed or has access to, and the groundwater level data that has been collected for each well. The groundwater monitoring data will be provided for what has been done to date with this permit application/adequacy review and then submitted in the annual report for the pit to the DRMS after approval of the permit application.

Groundwater Quality Monitoring Plan

The majority of the mining operations at this site will be within the slurry wall lined area. The areas outside of the slurry wall will be limited to the scale house and haul roads for trucks coming into and out of the pit, which are not likely to affect groundwater quality.

To establish pre-mining groundwater quality at the site WW Clyde will have two monitor wells sampled quarterly. The upgradient monitor well that will be sampled is MW-3 and the downgradient monitor well that will be sampled is MW-2. The samples will be taken by a qualified consultant and then tested by SGS Laboratories for the analytes listed in Tables 1-4 of the "Basic Standards for Groundwater."

The quarterly sampling will continue until 5 quarters of data has been established. Once the baseline has been established we would recommend annual sampling to monitor the groundwater quality. The groundwater quality sampling data will be provided for what has been done to date with this permit application/adequacy review and then submitted in the annual

report for the pit to the DRMS after approval of the permit application. WW Clyde will notify the DRMS within 7 days of receiving a lab report that indicates any of the standards set forth in Tables 1-4 have been exceeded. If a lab report shows an exceedance, a new sample will be taken to verify exceedance or discount potential lab contamination.

Bernhardt Pit - Monitor Well Readings

Well Designation	JT MW-1			JT MW-2			JT MW-3			JT MW-4		
Description	North Side			East Side			West Side			South Side		
Top of Well Elevation (ft)	4722.96			4723.15			4727.70			4726.65		
Ground Elevation (ft)	4719.92			4720.09			4724.78			4723.56		
Date	Depth to Groundwater from Top of Well (ft)	Depth to Groundwater from Ground (ft)	Elevation of Groundwater (ft)	Depth to Groundwater from Top of Well (ft)	Depth to Groundwater from Ground (ft)	Elevation of Groundwater (ft)	Depth to Groundwater from Top of Well (ft)	Depth to Groundwater from Ground (ft)	Elevation of Groundwater (ft)	Depth to Groundwater from Top of Well (ft)	Depth to Groundwater from Ground (ft)	Elevation of Groundwater (ft)
March 29, 2023	7.46	4.42	4715.50	9.27	6.21	4713.88	10.92	8.00	4716.78	10.38	7.29	4716.28
April 21, 2023	7.60	4.56	4715.36	8.10	5.04	4715.05	10.02	7.10	4717.68	9.02	5.93	4717.63
May 18, 2023	6.29	3.25	4716.67	6.04	2.98	4717.11	8.54	5.62	4719.16	6.58	3.49	4720.07
June 12, 2023	5.67	2.63	4717.29	6.00	2.94	4717.15	7.50	4.58	4720.20	6.33	3.24	4720.32
July 14, 2023	5.00	1.96	4717.96	5.92	2.86	4717.23	6.58	3.66	4721.12	6.21	3.12	4720.44
August 14, 2023	5.75	2.71	4717.21	6.92	3.86	4716.23	7.33	4.41	4720.37	8.58	5.49	4718.07
September 13, 2023	7.67	4.63	4715.29	8.17	5.11	4714.98	9.92	7.00	4717.78	9.00	5.91	4717.65
October 16, 2023	7.83	4.79	4715.13	8.33	5.27	4714.82	10.17	7.25	4717.53	9.17	6.08	4717.48
November 17, 2023	7.50	4.46	4715.46	7.83	4.77	4715.32	10.00	7.08	4717.70	8.58	5.49	4718.07
December 22, 2023	7.50	4.46	4715.46	8.00	4.94	4715.15	9.83	6.91	4717.87	8.00	4.91	4718.65
January 20, 2024	7.83	4.79	4715.13	8.38	5.32	4714.78	10.17	7.25	4717.53	9.08	5.99	4717.57
February 25, 2024	7.67	4.63	4715.29	8.13	5.07	4715.03	10.02	7.10	4717.68	8.92	5.83	4717.73
March 30, 2024	6.58	3.54	4716.38	7.29	4.23	4715.86	9.63	6.70	4718.08	8.13	5.04	4718.53

Monitor Well Locations in decimal degrees
MW -1 - LAT N40.303936, LONG W104.834394
MW -2 - LAT N40.301374, LONG W104.830132
MW - 3 - LAT N40.301151, LONG W104.838891
MW - 4 - LAT N40.297684, LONG W104.834826

SGS Engage --- Analysis Crosstab

Job:DA60116				Analysis:	General Chemistry - SW846 9056A	Regulation 41 Table Value Standard
Description:				Analyte:	pH - from field sample information	pH
				Unit:		
Client Name	Client Sample ID	Lab Sample ID	Matrix	Sample Date:		
J&T Consulting (Fort Lupton, CO)	BERNHARDT PIT MW-2	DA60116-5	Ground Water	11/17/2023 2:45 PM	7.8	6.5-8.5
J&T Consulting (Fort Lupton, CO)	BERNHARDT PIT MW-2	DA60116-5F	Groundwater Filtered	11/17/2023 2:45 PM		
J&T Consulting (Fort Lupton, CO)	BERNHARDT PIT MW-3	DA60116-6	Ground Water	11/17/2023 2:25 PM	7.5	6.5-8.5
J&T Consulting (Fort Lupton, CO)	BERNHARDT PIT MW-3	DA60116-6F	Groundwater Filtered	11/17/2023 2:25 PM		
J&T Consulting (Fort Lupton, CO)	BERNHARDT SAND AND GRAVEL PIT (MW-2)	DA62542-3	Ground Water	3/1/2024 12:40 PM	7.31	6.5-8.5
J&T Consulting (Fort Lupton, CO)	BERNHARDT SAND AND GRAVEL PIT (MW-2)	DA62542-3F	Groundwater Filtered	3/1/2024 12:40 PM		
J&T Consulting (Fort Lupton, CO)	BERNHARDT SAND AND GRAVEL PIT (MW-2)	DA62542-3FC	Groundwater Filtered	3/1/2024 12:40 PM		
J&T Consulting (Fort Lupton, CO)	BERNHARDT SAND AND GRAVEL PIT (MW-3)	DA62542-4	Ground Water	3/1/2024 12:30 PM	7.41	6.5-8.5
J&T Consulting (Fort Lupton, CO)	BERNHARDT SAND AND GRAVEL PIT (MW-3)	DA62542-4F	Groundwater Filtered	3/1/2024 12:30 PM		
J&T Consulting (Fort Lupton, CO)	BERNHARDT SAND AND GRAVEL PIT (MW-3)	DA62542-4FC	Groundwater Filtered	3/1/2024 12:30 PM		

Result Comments						
Footnote						
a	Calculated as: (Nitrogen, Nitrate) + (Nitrogen, Nitrite)					
b	Elevated detection limit due to matrix interference.					

General Chemistry - SW846 9056A	Regulation 41 Table Value Standard	General Chemistry - SW846 9056A	Regulation 41 Table Value Standard	General Chemistry - SW846 9056A	Regulation 41 Table Value Standard
TDS	TDS (mg/L, unless other units	Chloride	Chloride (mg/L, unless other units	Fluoride	Flouride (mg/L, unless other units
mg/l	given)	mg/l	given)	mg/l	given)
Not Tested	400	77	250	0.71	2
Not Tested	400	116	250	0.81	2
888		135	250	0.8	2
	400				
655	400	77.6	250	0.77	2

General Chemistry - SW846 9056A	Regulation 41 Table Value Standard	General Chemistry - SW846 9056A	Regulation 41 Table Value Standard	General Chemistry - SW846 9056A
Nitrogen, Nitrate	Nitrogen, Nitrate	Nitrogen, Nitrate + Nitrite	Nitrate + Nitrite as Nitrogen	Nitrogen, Nitrite
mg/l	(mg/L, unless other unitsgiven)	mg/l	(mg/L, unless other unitsgiven)	mg/l
0.38 [a]	10	0.41	10	0.027
3.3 [a]	10	3.3	10	0.028
5.7	10	5.8	10	0.11
0.54	10	0.54	10	<0.040

Regulation 41 Table Value Standard	General Chemistry - SM 2540D-2011	General Chemistry - SW846 9056A	Regulation 41 Table Value Standard	Metals Analysis - SW846 6010C
Nitrogen, Nitrite (mg/L, unless other units	Solids, Total Suspended	Sulfate	Sulfate Dissolved (mg/L, unless other units	Aluminum
given)	mg/l	mg/l	given)	ug/l (1,000 ug/l = 1 mg/L)
1	111	258	250	
				<100
1	69.7	276	250	
				<100
1	Not Tested	320	250	
				<100
1	Not Tested	237	250	
				<100

Regulation 41 Table Value Standard	Metals Analysis - SW846 6010C	Regulation 41 Table Value Standard	Metals Analysis - SW846 6010C	Regulation 41 Table Value Standard	Metals Analysis - SW846 6010C
Aluminum Dissolved	Antimony	Antimony Dissolved	Arsenic	Arsenic Dissolved	Barium
(mg/L, unless other units given)	ug/l (1,000 ug/l = 1 mg/L)	(mg/L, unless other units given)	ug/l (1,000 ug/l = 1 mg/L)	(mg/L, unless other units given)	ug/l (1,000 ug/l = 1 mg/L)
5	<30	0.006	<25	0.01	33
5	<30	0.006	<25	0.01	45.2
5	<30	0.006	<25	0.01	55.7
5	<30	0.006	<25	0.01	32.9

Regulation 41 Table Value Standard	Metals Analysis - SW846 6010C	Regulation 41 Table Value Standard	Metals Analysis - SW846 6010C	Regulation 41 Table Value Standard	Metals Analysis - SW846 6010C
Barium Dissolved	Beryllium	Beryllium Dissolved	Boron	Boron Dissolved	Cadmium
(mg/L, unless other units given)	ug/l (1,000 ug/l = 1 mg/L)	(mg/L, unless other units given)	ug/l (1,000 ug/l = 1 mg/L)	(mg/L, unless other units given)	ug/l (1,000 ug/l = 1 mg/L)
2	<10	0.004	133	0.75	<10
2	<10	0.004	151	0.75	<10
2	<10	0.004	206	0.75	<10
2	<10	0.004	202	0.75	<10

Regulation 41 Table Value Standard	Metals Analysis - SW846 6010C	Regulation 41 Table Value Standard	Metals Analysis - SW846 6010C	Regulation 41 Table Value Standard	Metals Analysis - SW846 6010C
Cadmium Dissolved	Chromium	Chromium Dissolved	Cobalt	Cobalt Dissolved	Copper
(mg/L, unless other units given)	ug/l (1,000 ug/l = 1 mg/L)	(mg/L, unless other units given)	ug/l (1,000 ug/l = 1 mg/L)	(mg/L, unless other units given)	ug/l (1,000 ug/l = 1 mg/L)
0.005	<10	0.1	<5.0	0.05	<10
0.005	<10	0.1	<5.0	0.05	<10
0.005	<10	0.1	<5.0	0.05	<10
0.005	<10	0.1	<5.0	0.05	<10

Regulation 41 Table Value Standard	Metals Analysis - SW846 6010C	Regulation 41 Table Value Standard	Metals Analysis - SW846 6010C	Regulation 41 Table Value Standard	Metals Analysis - SW846 6010C
Copper Dissolved	Iron	Iron Dissolved	Lead	Lead Dissolved	Lithium
(mg/L, unless other units given)	ug/l (1,000 ug/l = 1 mg/L)	(mg/L, unless other units given)	ug/l (1,000 ug/l = 1 mg/L)	(mg/L, unless other units given)	ug/l (1,000 ug/l = 1 mg/L)
0.2	<70	0.3	<50	0.05	9.5
0.2	<70	0.3	<50	0.05	13.7
0.2	<70	0.3	<50	0.05	
					18.9
0.2	<70	0.3	<50	0.05	
					10.5

Regulation 41 Table Value Standard	Metals Analysis - SW846 6010C	Regulation 41 Table Value Standard	Metals Analysis - SW846 7470A	Regulation 41 Table Value Standard	Metals Analysis - SW846 6010C
Lithium Dissolved	Manganese	Manganese Dissolved	Mercury	Mercury Dissolved	Molybdenum
(mg/L, unless other units given)	ug/l (1,000 ug/l = 1 mg/L)	(mg/L, unless other units given)	ug/l (1,000 ug/l = 1 mg/L)	(mg/L, unless other units given)	ug/l (1,000 ug/l = 1 mg/L)
2.5	1120	0.05	<0.10	0.002	<10
2.5	821	0.05	<0.10	0.002	19
	322	0.05	<0.10	0.002	<10
2.5					
	582	0.05	<0.10	0.002	<10
2.5					

Regulation 41 Table Value Standard	Metals Analysis - SW846 6010C	Regulation 41 Table Value Standard	Metals Analysis - SW846 6010C	Regulation 41 Table Value Standard	Metals Analysis - SW846 6010C
Molybedenum Dissolved	Nickel	Nickel Dissolved	Selenium	Selenium Dissolved	Silver
(mg/L, unless other units given)	ug/l (1,000 ug/l = 1 mg/L)	(mg/L, unless other units given)	ug/l (1,000 ug/l = 1 mg/L)	(mg/L, unless other units given)	ug/l (1,000 ug/l = 1 mg/L)
0.21	<30	0.1	<50	0.02	<30
0.21	<30	0.1	<50	0.02	<30
0.21	<30	0.1	<50	0.02	<30
0.21	<30	0.1	<50	0.02	<30

Regulation 41 Table Value Standard	Metals Analysis - SW846 6010C	Regulation 41 Table Value Standard	Metals Analysis - SW846 6010C	Regulation 41 Table Value Standard	Metals Analysis - SW846 6010C
Silver Dissolved	Thallium	Thallium Dissolved	Uranium	Uranium Dissolved	Vandium
(mg/L, unless other units given)	ug/l (1,000 ug/l = 1 mg/L)	(mg/L, unless other units given)	ug/l (1,000 ug/l = 1 mg/L)	(mg/L, unless other units given)	ug/l (1,000 ug/l = 1 mg/L)
0.05	<10	0.002	<50	0.03	<10
0.05	<10	0.002	<50	0.03	<10
0.05	<10	0.002	<50	0.03	<10
0.05	<15	0.002	<50	0.03	<10

Regulation 41 Table Value Standard	Metals Analysis - SW846 6010C	Regulation 41 Table Value Standard
Vandium Dissolved	Zinc	Zinc Dissolved
(mg/L, unless other units given)	ug/l (1,000 ug/l = 1 mg/L)	(mg/L, unless other units given)
0.1	<30	2
0.1	<30	2
0.1	<30	2
0.1	<30	2

EXHIBIT H

Wildlife Information

The project area was surveyed for general wildlife habitat by Ecological Resource Consultants (ERC). The Screening Report for Federal and State Listed Threatened and Endangered Species from ERC is attached which describes the wildlife habitat present on the site and the common species that may be found in the habitat area.

ERC conducted this screening for federal and state threatened, endangered and species of concern for the approximately 134-acre survey area. The following provides key items identified as part of the report:

1. Two primary land use class/vegetation cover type exists within the survey area. Habitat within the survey area is characterized as the Great Plains Ruderal Grassland and Shrubland (98%) and disturbed (2%). Historic land use for agricultural practices has led to degradation of the native vegetation community.

2. Generally, there are features on the survey area and the surrounding area that provide general habitat for local songbirds, raptors, and small to mid-size mammals. However, habitat within the survey area is somewhat degraded and of lower ecological value from a wildlife perspective due to historic and current land use for agriculture, which has restricted overall growth and establishment of vegetation. The South Platte River and adjacent eastern cottonwood floodplain and woodland, provides suitable habitat for wildlife species and MBTA species. The South Platte River and associated vegetative community will not be impacted by the proposed project.

3. Non-raptor birds
   No non-raptor migratory bird nests were observed within the survey area. However, prior to vegetation removal a nest survey should be completed to ensure that no nests have become established within the survey area and active nests, if any, are not disturbed.
   Non-eagle Raptors
   No non-eagle raptor nests were observed and no CPW mapped non-eagle raptor nest protection zones are located within the survey area (CPW 2023a). However, nest activity status can vary seasonally and from year-to-year. Future land use changes may require additional nest surveys (generally between February 1 and September 15 (CPW 2020)) to determine activity status within ½ to ¼ mile of the survey area to ensure compliance with CPW recommendations.
   Eagles
   CPW SAM data identifies a bald eagle nest listed as “destroyed” being directly northeast of the survey area. Per CPW monitoring logs, the eagle nest has been inactive from 2019-2021, and destroyed in 2022. A field visit by ERC on January 25, 2023 confirmed the identified nest no longer exists and the nest area is no longer being utilized with no efforts by eagles to rebuild the nest. Therefore, the nest site and the survey area is not subject to any restriction per CPW protective buffer zone recommendations or USFWS Bald Eagle Protection Act.

4. No federally listed threatened and endangered species and/or habitat protected under the ESA were identified within the survey area. The survey area is not within designated critical habitat of any federally listed species. The vegetation community and features

within the survey area were investigated as potential habitat for federally listed species. Any future land use changes will result in No Take on any federal listed species, their habitats, or proposed or designated critical habitat.

5. No State listed threatened or endangered species and/or habitat protected by CPW under Colorado Statute Title 33 were identified within the survey area. The vegetation communities within the survey area were investigated as potential habitat for state listed species. Any future land use changes will have no effect on any state listed species, their habitats, or proposed or designated critical habitat.

ERC 2023 provided a detailed evaluation of potential critical wildlife habitat and use within the Permit Area. The Permit Area was determined to be comprised of 100% ruderal grassland and disturbed lands which is generally considered low-value wildlife habitat. No federal or state listed threatened and endangered species/habitat were identified.

Following the preparation of ERC 2023, CPW issued (~March 2023) new wildlife Species Activity Mapping (polygons) that depict the Permit Area within Mule Deer High Priority Habitat (HPH). This CPW polygon encompasses more than 955 square miles (~611,000 acres) acres along the South Platte and Big Thompson Rivers (refer to Figure 1 in ERC's Adequacy Review Responses to CPW below). The Permit Area represents less than 0.02 % of this entire HPH polygon. In order to minimize potential disturbances to the HPH, the project will implement CPW recommendations addressed in Item 10 of their comment e-mail to DRMS also attached below.

No other critical habitat or seasonal wildlife use has been identified within the Permit Area.
It is not anticipated that operations (increased traffic, noise, light) will have a significant effect on wildlife in the area.

Refer to ERC 2023 for further explanation.

Attached are ERC's Adequacy Review Responses to CPW's comments and the Screening Report for Federal and State Listed Threatened and Endangered Species.

EXHIBIT J

Vegetation Information

The project site was surveyed for both general vegetation and for the presence of possible wetland areas by Ecological Resource Consultants (ERC). The site is currently agricultural crop and pasture land. ERC's wetland delineation report is attached which includes descriptions of the general vegetation found on the site and wetlands found in the area. Note that WW Clyde received a jurisdictional determination (JD) from the Army Corps of Engineers and the JD is attached. The wetlands found in the area are not going to be disturbed based on the mining and reclamation plans.

The weed control plan for the site will be as follows and will be discussed and revised if needed by meeting with Tina Booton who is with Weld County's Weed Division:

Mechanical and Chemical Control – Mowing will occur throughout the growing season in order to keep the plants from going to seed. Mowing will be terminated in late August followed by a herbicide treatment during late September through October – before a hard frost. Where controls cause vegetation to be removed, re-seeding will occur with native grass specified for the area per Weld County's recommendations and the re-seeding will occur the season after the weed control measures have been implemented.

Chemical Control Only – A herbicide application will be applied from rosette to bud stage. This will be followed up with a fall application, if needed. The applicator (licensed if required by law for the type of herbicide) must read the label and use a herbicide labeled for the weeds present at the site.

Noxious weed species to be managed are defined as those plant species currently identified by the Colorado State Department of Agriculture (CDA) as noxious under the Colorado Noxious Weed Act. The list is often updated and available at:

https://www.colorado.gov/pacific/agconservation/noxious-weed-species

Management efforts will be directed to those species identified under List A or List B by the CDA. List A species are required to be eradicated, while List B species will be controlled. Efforts to address List C species will follow guidelines of the Weld County Public Works Weed Management Division.

An example Structure Agreement which meets the requirements of the Statutes is shown below.
****

Structure Agreement

This letter has been provided to you as the owner of a structure on or within two hundred (200) feet of a proposed mine site. The State of Colorado, Division of Reclamation, Mining and Safety ("Division") requires that where a mining operation will adversely affect the stability of any significant, valuable and permanent man-made structure located within two hundred (200) feet of the affected land, the Applicant shall either:

a) Provide a notarized agreement between the Applicant and the Person(s) having an interest in the structure, that the Applicant is to provide compensation for any damage to the structure; or

b) Where such an agreement cannot be reached, the Applicant shall provide an appropriate engineering evaluation that demonstrates that such structure shall not be damaged by activities occurring at the mining operation; or

c) Where such structure is a utility, the Applicant may supply a notarized letter, on utility letterhead, from the owner(s) of the utility that the mining and reclamation activities, as proposed, will have "no negative effect" on their utility. (*Construction Materials Rule 6.3.12 and Rule 6.4.19 & Hard Rock/Metal Mining Rule 6.3.12 and Rule 6.4.20)*

The Colorado Mined Land Reclamation Board ("Board") has determined that this form, if properly executed, represents an agreement that complies with Construction Materials Rule 6.3.12(a), Rule 6.4.19(a), and C.R.S. § 34-32.5-115(4)(e) and with Hard Rock/Metal Mining Rule 6.3.12(a), Rule 6.4.20(a), and C.R.S. § 34-32-115(4)(d). This form is for the sole purpose of ensuring compliance with the Rules and Regulations and shall not make the Board or Division a necessary party to any private civil lawsuit to enforce the terms of the agreement or create any enforcement obligations in the Board or the Division.

The following structures are located on or within 200 feet of the proposed affected area:

1. Oil/Gas Lines _____
2. _____
3. _____
4. _____
5. _____

(*Please list additional structures on a separate page*)

CERTIFICATION

The Applicant, W.W. Clyde & Co. (print applicant/company name), by Andy Carpenter (print representative's name), as Area Manager, Aggregates (print representative's title), does hereby certify that DCP Midstream (structure owner) shall be compensated for any damage from the proposed mining operation to the above listed structure(s) located on or within 200 feet of the proposed affected area described within Exhibit A, of the Reclamation Permit Application for Bernhardt Sand and Gravel Pit (operation name), File Number M-2023-025.

This form has been approved by the Colorado Mined Land Reclamation Board pursuant to its authority under the Colorado Land Reclamation Act for the Extraction of Construction Materials and the Colorado Mined Land Reclamation Act for Hard Rock, Metal, and Designated Mining Operations. Any alteration or modification to this form shall result in voiding this form.

NOTARY FOR PERMIT APPLICANT

ACKNOWLEGED BY:

Applicant W.W. Clyde & Co. Representative Name [signature]

Date 10/3/2023 Title Area Manager, Aggregates

STATE OF Colorado)
) ss.
COUNTY OF Weld)

The foregoing was acknowledged before me this 3rd day of October, 2023, by Andy Carpenter as W.W. Clyde & Co. Area Manager PS of W.W. Clyde & Co.

[signature] My Commission Expires: 12/30/2023
Notary Public

Peggy L Sherman
NOTARY PUBLIC
STATE OF COLORADO
NOTARY ID 20044011484
MY COMMISSION EXPIRES December 30, 2023

NOTARY FOR STRUCTURE OWNER

ACKNOWLEGED BY:

Structure Owner DCP Operating Company, LP Name [signature]

Date November 8, 2023 Title Attorney In Fact

STATE OF Colorado)
) ss.
COUNTY OF Weld)

The foregoing was acknowledged before me this 8th day of November, 2023, by Lewis D. Hagenlock as Attorney-in-Fact of DCP Operating Company, LP.

[signature] My Commission Expires: 2/11/2025
Notary Public

NICOLAS D. HAGENLOCK
NOTARY PUBLIC
STATE OF COLORADO
NOTARY ID 20094004084
MY COMMISSION EXPIRES FEBRUARY 11, 2025

JC York

From: JC York
Sent: Tuesday, November 7, 2023 3:27 PM
To: Mason Clark; Corey Ward
Cc: Todd Yee; Acarpenter
Subject: RE: Cureton Gas Lines - Property South of CR 46 Adjacent to South Platte River
Attachments: Structure Agreement Cureton Midstream 11.7.23.pdf; 22036 IHCS Bernhardt Stability Report 5.11.23 SIGNED.pdf

Mason –

Attached is the structure agreement and the slope stability report for reference. We had a delay in getting this to you as IHC Scott changed their name to WW Clyde so that is who the agreement would be with. Let me know if you have any questions.

For the roadway crossing we have the following anticipated truck weights for your information:

Gravel Hauling – Semi-truck – 97,000 lbs total weight on 5 axles
Low Boy Equipment Hauling – Semi-truck – 200,000 lbs total weight on 7 axles
Gravel Hauling – Super Tandem Truck – 110,000 lbs total weight on 4 axles

Regards,

J.C.

J.C. York, P.E.

J&T Consulting, Inc.
305 Denver Avenue, Suite D
Fort Lupton, CO 80621

Office: (303) 857-6222
Mobile: (970) 222-9530
FAX: (303) 857-6224

From: Mason Clark <mason.clark@curetonmidstream.com>
Sent: Monday, September 25, 2023 12:06 PM
To: JC York <jcyork@j-tconsulting.com>; Corey Ward <corey.ward@curetonmidstream.com>
Cc: Todd Yee <toddyee@j-tconsulting.com>; Andy Carpenter <acarpenter@ihcscott.com>
Subject: RE: Cureton Gas Lines - Property South of CR 46 Adjacent to South Platte River

Hey JC-

We are okay with you guys removing the abandoned segment of pipeline for the slurry wall. We will need to do a little diligence first on our end to verify it is safe to remove, but don't foresee it being an issue. For the roadway crossing, we will need a little more information on the anticipated load to determine how high the road will need to built-up. We will also need to pothole the pipeline to determine the exact depth at that particular point.

Mason Clark
GIS Manager
C: (913) 963-3026
mason.clark@curetonmidstream.com

From: JC York <jcyork@j-tconsulting.com>
Sent: Wednesday, September 20, 2023 12:53 PM
To: Mason Clark <mason.clark@curetonmidstream.com>; Corey Ward <corey.ward@curetonmidstream.com>
Cc: Todd Yee <toddyee@j-tconsulting.com>; Andy Carpenter <acarpenter@ihcscott.com>
Subject: RE: Cureton Gas Lines - Property South of CR 46 Adjacent to South Platte River

Mason –

Attached is a drawing showing some more detail on the locations of the crossings for the slurry wall and where we will have truck traffic crossing the gas lines. Will send over the structure agreement and stability analysis in a separate e-mail.

Regards,

J.C.

J.C. York, P.E.

J&T Consulting, Inc.
305 Denver Avenue, Suite D
Fort Lupton, CO 80621

Office: (303) 857-6222
Mobile: (970) 222-9530
FAX: (303) 857-6224

From: JC York
Sent: Monday, September 18, 2023 11:44 AM
To: Mason Clark <mason.clark@curetonmidstream.com>; Corey Ward <corey.ward@curetonmidstream.com>
Cc: Todd Yee <toddyee@j-tconsulting.com>; Andy Carpenter <acarpenter@ihcscott.com>
Subject: RE: Cureton Gas Lines - Property South of CR 46 Adjacent to South Platte River

Mason –

Thanks for the reply back. I will get some more information to you on the areas where we are showing crossing one of the abandoned lines with the proposed slurry wall (likely would want to see if we can remove the abandoned line for a

certain length in this location) as well as sending over the location where we would have truck traffic crossing the active gas line (would want to see what the existing depth is here to determine if we need to add fill to mound over so there is not any issues with crossing with semi-trucks). We will also send over the structure agreement and the stability analysis in regard to the mining slopes that would be offset from the easement and pipeline locations.

Regards,

J.C.

J.C. York, P.E.

J&T Consulting, Inc.
305 Denver Avenue, Suite D
Fort Lupton, CO 80621

Office: (303) 857-6222
Mobile: (970) 222-9530
FAX: (303) 857-6224

From: Mason Clark <mason.clark@curetonmidstream.com>
Sent: Thursday, September 14, 2023 1:39 PM
To: JC York <jcyork@j-tconsulting.com>; Corey Ward <corey.ward@curetonmidstream.com>
Cc: Todd Yee <toddyee@j-tconsulting.com>; Andy Carpenter <acarpenter@ihcscott.com>
Subject: RE: Cureton Gas Lines - Property South of CR 46 Adjacent to South Platte River

Hey JC- We reviewed the mining plan relative to our assets and it looks like you have them plotted correctly. Would you mind sending over the structure agreement and further details regarding activity that would impact our pipelines? We will review internally.

Thanks

Mason Clark
GIS Manager
C: (913) 963-3026
mason.clark@curetonmidstream.com

From: JC York <jcyork@j-tconsulting.com>
Sent: Tuesday, September 12, 2023 9:02 AM
To: Mason Clark <mason.clark@curetonmidstream.com>; Corey Ward <corey.ward@curetonmidstream.com>
Cc: Todd Yee <toddyee@j-tconsulting.com>; Andy Carpenter <acarpenter@ihcscott.com>
Subject: Cureton Gas Lines - Property South of CR 46 Adjacent to South Platte River

Mason / Corey –

I left a voicemail on Mason's mobile and wanted to send over some drawings for the proposed gravel mine that IHC Scott is proposing on its property. We wanted to discuss locations where we will have truck traffic crossing the active gas lines and some locations where the slurry wall will cross some of the abandoned or soon to be abandoned gas lines. Let me know when you may have some time to discuss or meet as we will also be requesting a structure agreement for the mining as we have on other mining projects based on our slope stability analysis which I will also send over once we have had a chance to discuss and review the drawings attached.

Regards,

J.C.

J.C. York, P.E.

J&T Consulting, Inc.
305 Denver Avenue, Suite D
Fort Lupton, CO 80621

Office: (303) 857-6222
Mobile: (970) 222-9530
FAX: (303) 857-6224

JC York

From: JC York
Sent: Tuesday, November 7, 2023 3:45 PM
To: Corey Ward; Mason Clark
Cc: Todd Yee; Acarpenter
Subject: RE: Cureton Gas Lines - Property South of CR 46 Adjacent to South Platte River
Attachments: Structure Agreement Cureton Gilcrest LLC 11.7.23.pdf

Attached is the corrected agreement. Let us know if you need anything else.

Regards,

J.C.

J.C. York, P.E.

J&T Consulting, Inc.
305 Denver Avenue, Suite D
Fort Lupton, CO 80621

Office: (303) 857-6222
Mobile: (970) 222-9530
FAX: (303) 857-6224

From: JC York
Sent: Tuesday, November 7, 2023 3:41 PM
To: 'Corey Ward' <corey.ward@curetonmidstream.com>; Mason Clark <mason.clark@curetonmidstream.com>
Cc: Todd Yee <toddyee@j-tconsulting.com>; Acarpenter <acarpenter@wwclyde.net>
Subject: RE: Cureton Gas Lines - Property South of CR 46 Adjacent to South Platte River

Ok we will change that. Sorry about that.

Regards,

J.C.

J.C. York, P.E.

J&T Consulting, Inc.
305 Denver Avenue, Suite D
Fort Lupton, CO 80621

Office: (303) 857-6222
Mobile: (970) 222-9530
FAX: (303) 857-6224

From: Corey Ward <corey.ward@curetonmidstream.com>
Sent: Tuesday, November 7, 2023 3:36 PM
To: JC York <jcyork@j-tconsulting.com>; Mason Clark <mason.clark@curetonmidstream.com>
Cc: Todd Yee <toddyee@j-tconsulting.com>; Acarpenter <acarpenter@wwclyde.net>
Subject: RE: Cureton Gas Lines - Property South of CR 46 Adjacent to South Platte River

I will get with Mason for review, however noting one item requiring revision, is that the 'Structure Owner' in this case will be "Cureton Gilcrest, LLC" rather than "Cureton Midstream".

Thakns,

Corey

Corey Ward
O: (720) 390-4509
C: (720) 227-1946
corey.ward@curetonmidstream.com

From: JC York <jcyork@j-tconsulting.com>
Sent: Tuesday, November 7, 2023 3:27 PM
To: Mason Clark <mason.clark@curetonmidstream.com>; Corey Ward <corey.ward@curetonmidstream.com>
Cc: Todd Yee <toddyee@j-tconsulting.com>; Acarpenter <acarpenter@wwclyde.net>
Subject: RE: Cureton Gas Lines - Property South of CR 46 Adjacent to South Platte River

Mason –

Attached is the structure agreement and the slope stability report for reference. We had a delay in getting this to you as IHC Scott changed their name to WW Clyde so that is who the agreement would be with. Let me know if you have any questions.

For the roadway crossing we have the following anticipated truck weights for your information:

Gravel Hauling – Semi-truck – 97,000 lbs total weight on 5 axles
Low Boy Equipment Hauling – Semi-truck – 200,000 lbs total weight on 7 axles
Gravel Hauling – Super Tandem Truck – 110,000 lbs total weight on 4 axles

Regards,

J.C.

J.C. York, P.E.

J&T Consulting, Inc.
305 Denver Avenue, Suite D
Fort Lupton, CO 80621

Office: (303) 857-6222
Mobile: (970) 222-9530
FAX: (303) 857-6224

From: JC York
Sent: Monday, September 18, 2023 11:44 AM
To: Mason Clark <mason.clark@curetonmidstream.com>; Corey Ward <corey.ward@curetonmidstream.com>
Cc: Todd Yee <toddyee@j-tconsulting.com>; Andy Carpenter <acarpenter@ihcscott.com>
Subject: RE: Cureton Gas Lines - Property South of CR 46 Adjacent to South Platte River

Mason –

Thanks for the reply back. I will get some more information to you on the areas where we are showing crossing one of the abandoned lines with the proposed slurry wall (likely would want to see if we can remove the abandoned line for a certain length in this location) as well as sending over the location where we would have truck traffic crossing the active gas line (would want to see what the existing depth is here to determine if we need to add fill to mound over so there is not any issues with crossing with semi-trucks). We will also send over the structure agreement and the stability analysis in regard to the mining slopes that would be offset from the easement and pipeline locations.

Regards,

J.C.

J.C. York, P.E.

J&T Consulting, Inc.
305 Denver Avenue, Suite D
Fort Lupton, CO 80621

Office: (303) 857-6222
Mobile: (970) 222-9530
FAX: (303) 857-6224

From: Mason Clark <mason.clark@curetonmidstream.com>
Sent: Thursday, September 14, 2023 1:39 PM
To: JC York <jcyork@j-tconsulting.com>; Corey Ward <corey.ward@curetonmidstream.com>
Cc: Todd Yee <toddyee@j-tconsulting.com>; Andy Carpenter <acarpenter@ihcscott.com>
Subject: RE: Cureton Gas Lines - Property South of CR 46 Adjacent to South Platte River

Hey JC- We reviewed the mining plan relative to our assets and it looks like you have them plotted correctly. Would you mind sending over the structure agreement and further details regarding activity that would impact our pipelines? We will review internally.

Thanks

Mason Clark
GIS Manager
C: (913) 963-3026
mason.clark@curetonmidstream.com

An example Structure Agreement which meets the requirements of the Statutes is shown below.
****

Structure Agreement

This letter has been provided to you as the owner of a structure on or within two hundred (200) feet of a proposed mine site. The State of Colorado, Division of Reclamation, Mining and Safety ("Division") requires that where a mining operation will adversely affect the stability of any significant, valuable and permanent man-made structure located within two hundred (200) feet of the affected land, the Applicant shall either:

a) Provide a notarized agreement between the Applicant and the Person(s) having an interest in the structure, that the Applicant is to provide compensation for any damage to the structure; or

b) Where such an agreement cannot be reached, the Applicant shall provide an appropriate engineering evaluation that demonstrates that such structure shall not be damaged by activities occurring at the mining operation; or

c) Where such structure is a utility, the Applicant may supply a notarized letter, on utility letterhead, from the owner(s) of the utility that the mining and reclamation activities, as proposed, will have "no negative effect" on their utility. (*Construction Materials Rule 6.3.12 and Rule 6.4.19 & Hard Rock/Metal Mining Rule 6.3.12 and Rule 6.4.20)*

The Colorado Mined Land Reclamation Board ("Board") has determined that this form, if properly executed, represents an agreement that complies with Construction Materials Rule 6.3.12(a), Rule 6.4.19(a), and C.R.S. § 34-32.5-115(4)(e) and with Hard Rock/Metal Mining Rule 6.3.12(a), Rule 6.4.20(a), and C.R.S. § 34-32-115(4)(d). This form is for the sole purpose of ensuring compliance with the Rules and Regulations and shall not make the Board or Division a necessary party to any private civil lawsuit to enforce the terms of the agreement or create any enforcement obligations in the Board or the Division.

The following structures are located on or within 200 feet of the proposed affected area:

1. Oil/Gas Lines _____
2. _____
3. _____
4. _____
5. _____

(*Please list additional structures on a separate page*)

CERTIFICATION

The Applicant, W.W. Clyde & Co. (print applicant/company name), by Andy Carpenter (print representative's name), as Area Manager, Aggregates (print representative's title), does hereby certify that Cureton Gilcrest, LLC (structure owner) shall be compensated for any damage from the proposed mining operation to the above listed structure(s) located on or within 200 feet of the proposed affected area described within Exhibit A, of the Reclamation Permit Application for Bernhardt Sand and Gravel Pit (operation name), File Number M-2023-025.

This form has been approved by the Colorado Mined Land Reclamation Board pursuant to its authority under the Colorado Land Reclamation Act for the Extraction of Construction Materials and the Colorado Mined Land Reclamation Act for Hard Rock, Metal, and Designated Mining Operations. Any alteration or modification to this form shall result in voiding this form.

NOTARY FOR PERMIT APPLICANT

ACKNOWLEGED BY:

Applicant W.W. Clyde & Co. Representative Name [signature]

Date 10/3/2023 Title Area Manager, Aggregates

STATE OF Colorado)
) ss.
COUNTY OF Weld)

The foregoing was acknowledged before me this 3rd day of October, 2023 by Andy Carpenter as Area Manager of W.W. Clyde & Co.

[signature] My Commission Expires: 12/30/2023
Notary Public

Peggy L Sherman
NOTARY PUBLIC
STATE OF COLORADO
NOTARY ID 20044011484
MY COMMISSION EXPIRES December 30, 2023

NOTARY FOR STRUCTURE OWNER

ACKNOWLEGED BY:

Structure Owner _____ Name _____

Date _____ Title _____

STATE OF _____)
) ss.
COUNTY OF_____)

The foregoing was acknowledged before me this____ day of _____, 20___, by _____ as _____ of _____.

_____ My Commission Expires:_____
Notary Public

JC York

From: JC York
Sent: Tuesday, November 7, 2023 2:30 PM
To: Van Decar, Erik; Tabor, Jon
Cc: Acarpenter; Todd Yee
Subject: RE: Noble Midstream Gas Lines - Property South of CR 46 Adjacent to South Platte River
Attachments: Structure Agreement Chevron Pipeline and Power 11.7.23.pdf; 22036 IHCS Bernhardt Stability Report 5.11.23 SIGNED.pdf

Erik –

Attached is the structure agreement and it will be with WW Clyde instead of IHC Scott as they changed the name of the company to WW Clyde. Let me know if you have any questions. I also attached the slope stability report for reference that we turned into the DRMS with our permit application.

Regards,

J.C.

J.C. York, P.E.

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305 Denver Avenue, Suite D
Fort Lupton, CO 80621

Office: (303) 857-6222
Mobile: (970) 222-9530
FAX: (303) 857-6224

From: Van Decar, Erik <erik.vandecar@chevron.com>
Sent: Thursday, October 26, 2023 2:09 PM
To: JC York <jcyork@j-tconsulting.com>; Tabor, Jon <jon.tabor@chevron.com>
Cc: Andy Carpenter <acarpenter@ihcscott.com>; Todd Yee <toddyee@j-tconsulting.com>
Subject: RE: Noble Midstream Gas Lines - Property South of CR 46 Adjacent to South Platte River

JC,
Thank you for the follow up. I actually just sent a reminder yesterday to a couple of folks that I'm waiting on info from. The surveyor is going to get me some as-built depths on that route & then our PM is going to do the load calcs to see where we are.

Here is the contact at Xcel that I know:
Brian Bolton
Xcel Energy | Responsible By Nature
Senior Agent, Siting and Land Rights
1800 Larimer Street, 4th Floor, Denver, CO 80202
P: 303-571-7353 **C:** 303-810-6253
E: Brian.A.Bolton@xcelenergy.com

Thank you,

Erik

Erik T. Van Decar
Senior Land Representative
erik.vandecar@chevron.com

Chevron Pipeline & Power
Black Diamond Rockies Midstream
2001 16th Street, Suite 900
Denver, Colorado 80202
Tel 970.556.9476

From: JC York <jcyork@j-tconsulting.com>
Sent: Thursday, October 26, 2023 1:52 PM
To: Van Decar, Erik <erik.vandecar@chevron.com>; Tabor, Jon <jon.tabor@chevron.com>
Cc: Andy Carpenter <acarpenter@ihcscott.com>; Todd Yee <toddyee@j-tconsulting.com>
Subject: [**EXTERNAL**] RE: Noble Midstream Gas Lines - Property South of CR 46 Adjacent to South Platte River

Eric –

Just wanted to touch base with you on the information we provided you and make sure you have everything you need. Did you find out how much cover you have on the pipes based on your as-built information? I know we will need to confirm but just wanted to check. Also you mentioned you may have a contact at Xcel Energy for their land person and I wanted to see if you could provide that to me as well.

Regards,

J.C.

J.C. York, P.E.

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Office: (303) 857-6222
Mobile: (970) 222-9530
FAX: (303) 857-6224

From: Van Decar, Erik <erik.vandecar@chevron.com>
Sent: Wednesday, October 4, 2023 2:55 PM
To: JC York <jcyork@j-tconsulting.com>; Tabor, Jon <jon.tabor@chevron.com>
Cc: Andy Carpenter <acarpenter@ihcscott.com>; Todd Yee <toddyee@j-tconsulting.com>
Subject: RE: Noble Midstream Gas Lines - Property South of CR 46 Adjacent to South Platte River

JC,
Thank you for that. Do you have time for a Teams meeting in the next week or so to discuss? I will run traps with folks on the CPP side & see if anyone else on our end needs/wants to attend.
Regards,

Erik

Erik T. Van Decar
Senior Land Representative
erik.vandecar@chevron.com

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Black Diamond Rockies Midstream
2001 16th Street, Suite 900
Denver, Colorado 80202
Tel 970.556.9476

From: JC York <jcyork@j-tconsulting.com>
Sent: Wednesday, October 4, 2023 2:22 PM
To: Van Decar, Erik <erik.vandecar@chevron.com>; Tabor, Jon <jon.tabor@chevron.com>
Cc: Andy Carpenter <acarpenter@ihcscott.com>; Todd Yee <toddyee@j-tconsulting.com>
Subject: [**EXTERNAL**] RE: Noble Midstream Gas Lines - Property South of CR 46 Adjacent to South Platte River

Erik –

Attached is the agreement. I can send a check out tomorrow. We make it payable to Chevron Pipeline Company correct? I will include a hard copy with the check and send to the address on the agreement.

Regards,

J.C.

J.C. York, P.E.

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Fort Lupton, CO 80621

Office: (303) 857-6222
Mobile: (970) 222-9530
FAX: (303) 857-6224

From: Van Decar, Erik <erik.vandecar@chevron.com>
Sent: Thursday, September 14, 2023 4:19 PM
To: JC York <jcyork@j-tconsulting.com>; Tabor, Jon <jon.tabor@chevron.com>
Cc: Andy Carpenter <acarpenter@ihcscott.com>; Todd Yee <toddyee@j-tconsulting.com>
Subject: RE: Noble Midstream Gas Lines - Property South of CR 46 Adjacent to South Platte River

JC,
Thank you for the email. I believe there are Black Diamond lines on the subject property. These are managed by Chevron Pipeline & Power (Chevron Pipe Line Company), and they require the attached encroachment application to be completed before we can further engage. Can you please complete the attached form & email back to me? We can discuss where to send the application fee as well.
Thank you,

Erik

Erik T. Van Decar
Senior Land Representative
erik.vandecar@chevron.com

Chevron Pipeline & Power
Black Diamond Rockies Midstream
2001 16th Street, Suite 900
Denver, Colorado 80202
Tel 970.556.9476

From: JC York <jcyork@j-tconsulting.com>
Sent: Thursday, September 14, 2023 3:45 PM
To: Van Decar, Erik <erik.vandecar@chevron.com>; Tabor, Jon <jon.tabor@chevron.com>
Cc: Andy Carpenter <acarpenter@ihcscott.com>; Todd Yee <toddyee@j-tconsulting.com>
Subject: [**EXTERNAL**] Noble Midstream Gas Lines - Property South of CR 46 Adjacent to South Platte River

Erik / Jon –

I spoke to one of your coworkers this morning and he sent me your e-mail address and I wanted to send over some drawings for the proposed gravel mine that IHC Scott is proposing on its property. We wanted to discuss locations where we will have truck traffic crossing the active gas lines. Let me know when you may have some time to discuss or meet as we will also be requesting a structure agreement for the mining as we have on other mining projects based on our slope stability analysis which I will also send over once we have had a chance to discuss and review the drawings attached.

Regards,

J.C.

J.C. York, P.E.

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Fort Lupton, CO 80621

Office: (303) 857-6222
Mobile: (970) 222-9530
FAX: (303) 857-6224

JC York

From: Van Decar, Erik <erik.vandecar@chevron.com>
Sent: Tuesday, December 19, 2023 11:34 AM
To: JC York
Subject: RE: Noble Midstream Gas Lines - Property South of CR 46 Adjacent to South Platte River

Follow Up Flag: Follow up
Due By: Thursday, January 4, 2024 5:00 PM
Flag Status: Flagged

I got some info from our engineering group:

Sorry for the delay. There are a few inputs regarding the soil conditions and with a conservative assessment and with the weights provided previously we would require 5.5' of cover on our line for the crossings. They are close to that in the proposed are at ~4.6' so we'd require an additional foot or matting in the crossing areas.

Is that helpful?
Thank you,
Erik

Erik T. Van Decar
Senior Land Representative
erik.vandecar@chevron.com
Chevron Pipeline & Power
Black Diamond Rockies Midstream
1099 18th Street, Suite 1500
Denver, Colorado 80202
Tel 970.556.9476

From: JC York <jcyork@j-tconsulting.com>
Sent: Friday, December 1, 2023 8:17 AM
To: Van Decar, Erik <erik.vandecar@chevron.com>
Subject: [**EXTERNAL**] RE: Noble Midstream Gas Lines - Property South of CR 46 Adjacent to South Platte River

Erik –

I may be able to make something work but I will be out of town next week and the following week. I could probably do some type of virtual meeting.

Let me know what you are thinking. I will be back the week of December 18th.

Regards,

J.C.

J.C. York, P.E.

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305 Denver Avenue, Suite D
Fort Lupton, CO 80621

Office: (303) 857-6222
Mobile: (970) 222-9530
FAX: (303) 857-6224

From: Van Decar, Erik <erik.vandecar@chevron.com>
Sent: Friday, December 1, 2023 6:58 AM
To: JC York <jcyork@j-tconsulting.com>
Subject: RE: Noble Midstream Gas Lines - Property South of CR 46 Adjacent to South Platte River

Do you have some time next week for a meeting?

Erik T. Van Decar
Senior Land Representative
erik.vandecar@chevron.com

Chevron Pipeline & Power
Black Diamond Rockies Midstream
2001 16th Street, Suite 900
Denver, Colorado 80202
Tel 970.556.9476

From: JC York <jcyork@j-tconsulting.com>
Sent: Tuesday, November 7, 2023 2:30 PM
To: Van Decar, Erik <erik.vandecar@chevron.com>; Tabor, Jon <jon.tabor@chevron.com>
Cc: Acarpenter <acarpenter@wwclyde.net>; Todd Yee <toddyee@j-tconsulting.com>
Subject: [**EXTERNAL**] RE: Noble Midstream Gas Lines - Property South of CR 46 Adjacent to South Platte River

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Regards,

J.C.

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Fort Lupton, CO 80621

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FAX: (303) 857-6224

From: Van Decar, Erik <erik.vandecar@chevron.com>
Sent: Thursday, October 26, 2023 2:09 PM
To: JC York <jcyork@j-tconsulting.com>; Tabor, Jon <jon.tabor@chevron.com>
Cc: Andy Carpenter <acarpenter@ihcscott.com>; Todd Yee <toddyee@j-tconsulting.com>
Subject: RE: Noble Midstream Gas Lines - Property South of CR 46 Adjacent to South Platte River

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Brian Bolton
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1800 Larimer Street, 4th Floor, Denver, CO 80202
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E: Brian.A.Bolton@xcelenergy.com

Thank you,
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Subject: [**EXTERNAL**] RE: Noble Midstream Gas Lines - Property South of CR 46 Adjacent to South Platte River

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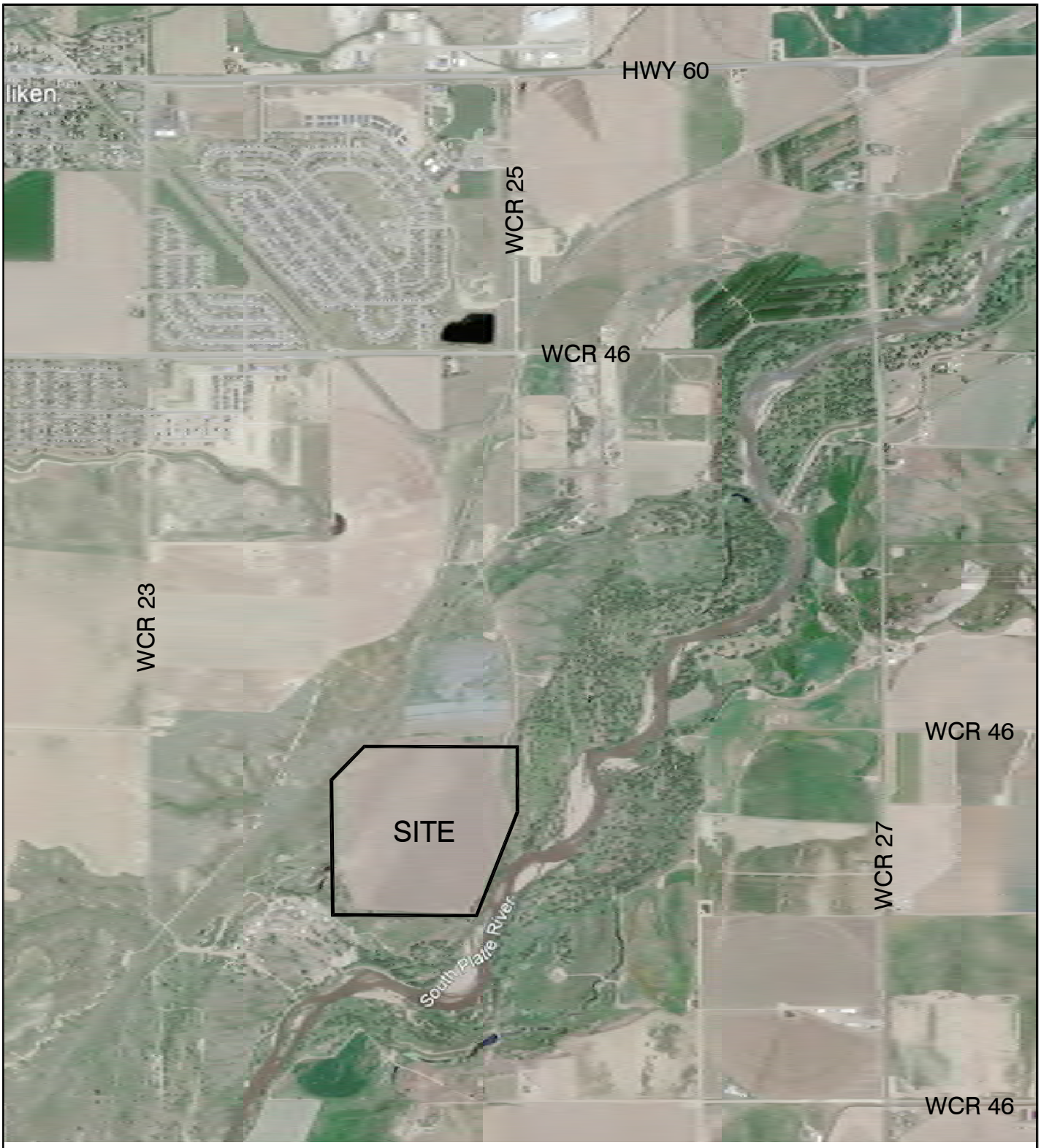


2000 1000 0 2000

SCALE IN FEET

N

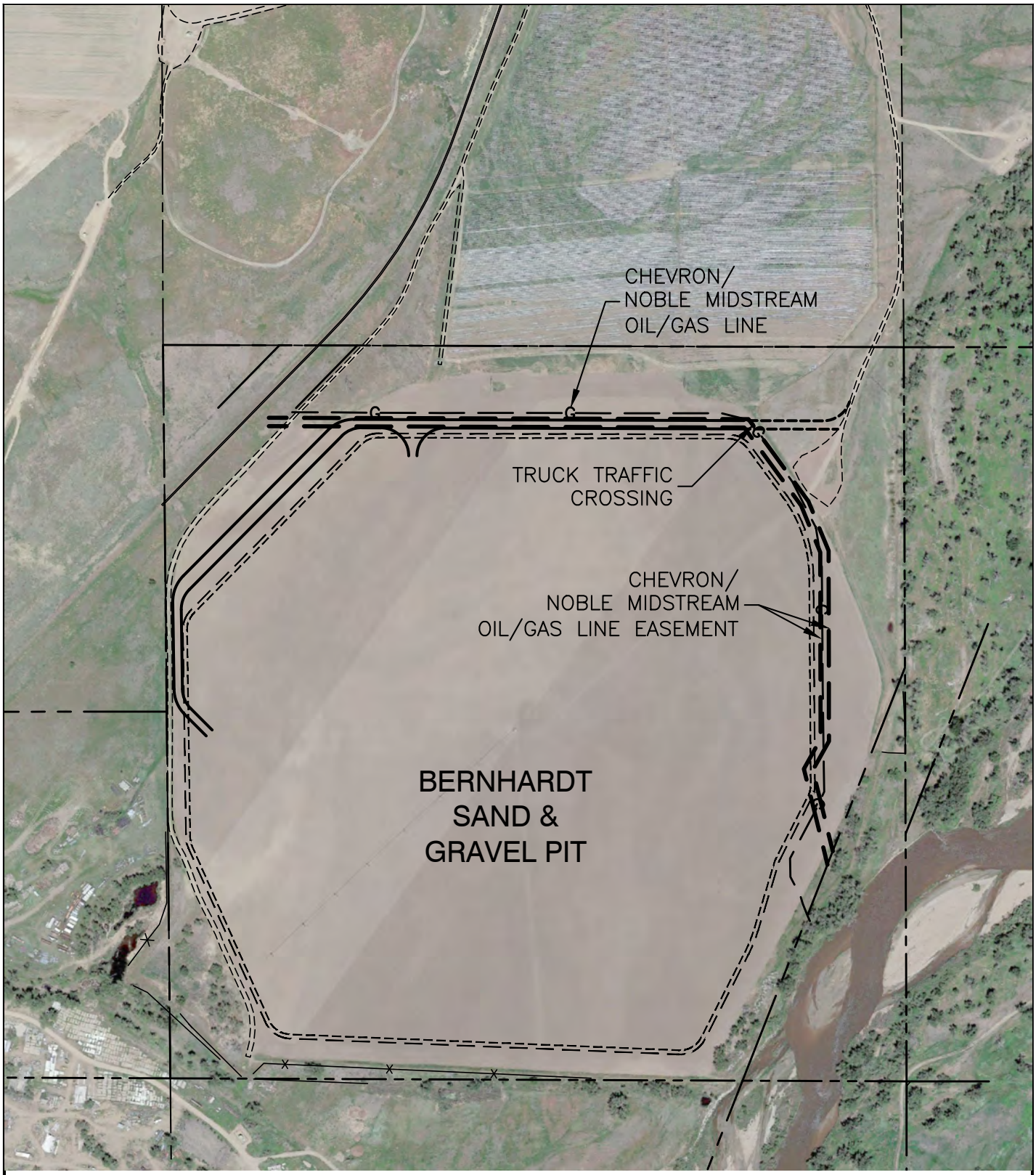
J&T Consulting, Inc.

305 Denver Avenue - Suite D
Fort Lupton, CO 80621
303-857-6222

IHC Scott
Bernhardt Sand and Gravel Pit
Exhibit B - Index Map

Date:	5.18.23
Job No:	22036
Drawn:	TPY
Scale:	1" = 2000'
Sheet: 1	Of: 1

P:\22036 IHC Scott Milliken Property\Drawings\Xref\jt-ihcs milliken base.dwg, Vicinity, 5/18/2023 11:00:48 AM



500 250 0 500

SCALE IN FEET

N

J&T Consulting, Inc.

305 Denver Avenue - Suite D
Fort Lupton, CO 80621
303-857-6222

IHC Scott, Inc.
Bernhardt Sand & Gravel Pit
Chevron Pipeline Crossings Map

Date:	10.4.23
Job No:	22036
Drawn:	TPY
Scale:	1"=500'
Sheet: 1	Of: 2

P:\22036 IHC Scott Milliken Property\Drawings\Plan Sheets\Oil-Gas Crossings\JT-IHCS Bernhardt Oil-Gas Crossings-CHEVRON.dwg, Chevron Overall, 10/4/2023 3:49:36 PM

An example Structure Agreement which meets the requirements of the Statutes is shown below.
****

Structure Agreement

This letter has been provided to you as the owner of a structure on or within two hundred (200) feet of a proposed mine site. The State of Colorado, Division of Reclamation, Mining and Safety ("Division") requires that where a mining operation will adversely affect the stability of any significant, valuable and permanent man-made structure located within two hundred (200) feet of the affected land, the Applicant shall either:

a) Provide a notarized agreement between the Applicant and the Person(s) having an interest in the structure, that the Applicant is to provide compensation for any damage to the structure; or

b) Where such an agreement cannot be reached, the Applicant shall provide an appropriate engineering evaluation that demonstrates that such structure shall not be damaged by activities occurring at the mining operation; or

c) Where such structure is a utility, the Applicant may supply a notarized letter, on utility letterhead, from the owner(s) of the utility that the mining and reclamation activities, as proposed, will have "no negative effect" on their utility. (*Construction Materials Rule 6.3.12 and Rule 6.4.19 & Hard Rock/Metal Mining Rule 6.3.12 and Rule 6.4.20)*

The Colorado Mined Land Reclamation Board ("Board") has determined that this form, if properly executed, represents an agreement that complies with Construction Materials Rule 6.3.12(a), Rule 6.4.19(a), and C.R.S. § 34-32.5-115(4)(e) and with Hard Rock/Metal Mining Rule 6.3.12(a), Rule 6.4.20(a), and C.R.S. § 34-32-115(4)(d). This form is for the sole purpose of ensuring compliance with the Rules and Regulations and shall not make the Board or Division a necessary party to any private civil lawsuit to enforce the terms of the agreement or create any enforcement obligations in the Board or the Division.

The following structures are located on or within 200 feet of the proposed affected area:

1. Oil/Gas Lines _____
2. _____
3. _____
4. _____
5. _____

(*Please list additional structures on a separate page*)

CERTIFICATION

The Applicant, W.W. Clyde & Co. (print applicant/company name), by Andy Carpenter (print representative's name), as Area Manager, Aggregates (print representative's title), does hereby certify that Chevron Pipeline and Power Black Diamond Rockies Midstream (structure owner) shall be compensated for any damage from the proposed mining operation to the above listed structure(s) located on or within 200 feet of the proposed affected area described within Exhibit A, of the Reclamation Permit Application for Bernhardt Sand and Gravel Pit (operation name), File Number M-2023-025.

This form has been approved by the Colorado Mined Land Reclamation Board pursuant to its authority under the Colorado Land Reclamation Act for the Extraction of Construction Materials and the Colorado Mined Land Reclamation Act for Hard Rock, Metal, and Designated Mining Operations. Any alteration or modification to this form shall result in voiding this form.

NOTARY FOR PERMIT APPLICANT

ACKNOWLEGED BY:

Applicant W.W. Clyde & Co. Representative Name [signature]

Date 10/3/2023 Title Area Manager, Aggregates

STATE OF Colorado)
) ss.
COUNTY OF Weld)

The foregoing was acknowledged before me this 3rd day of October, 2023, by Andy Carpenter as Area Manager of W.W. Clyde & Co.

[signature] My Commission Expires: 12/30/2023
Notary Public

Peggy L Sherman
NOTARY PUBLIC
STATE OF COLORADO
NOTARY ID 20044011484
MY COMMISSION EXPIRES December 30, 2023

NOTARY FOR STRUCTURE OWNER

ACKNOWLEGED BY:

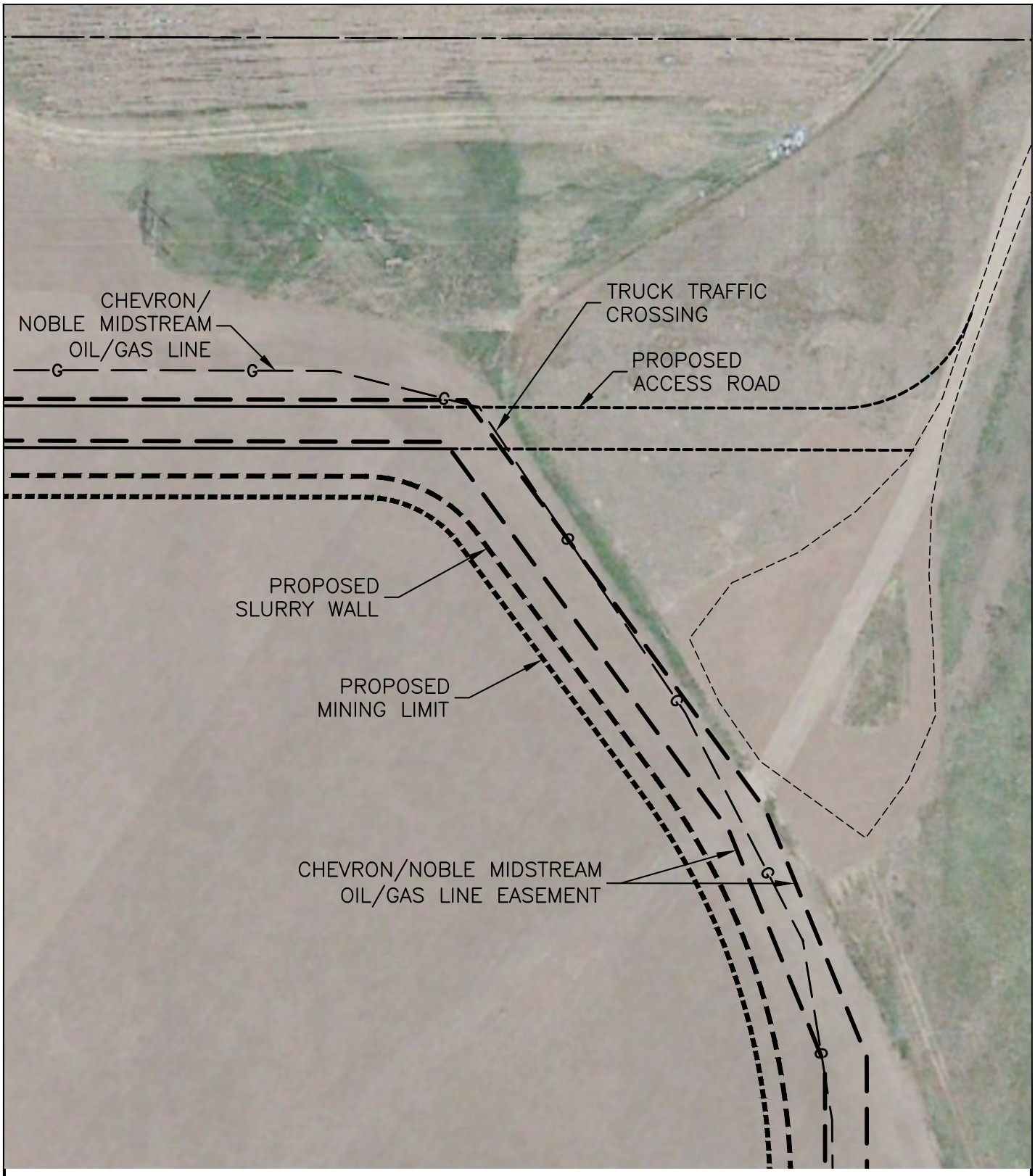
Structure Owner _____ Name _____

Date _____ Title _____

STATE OF _____)
) ss.
COUNTY OF_____)

The foregoing was acknowledged before me this____ day of _____, 20___, by _____ as _____ of _____.

_____ My Commission Expires:_____
Notary Public



100 50 0 100

SCALE IN FEET

N

J&T Consulting, Inc.

305 Denver Avenue - Suite D
Fort Lupton, CO 80621
303-857-6222

IHC Scott, Inc.
Bernhardt Sand & Gravel Pit
Chevron Pipeline Crossing 1

Date:	10.4.23
Job No:	22036
Drawn:	TPY
Scale:	1"=100'
Sheet: 2	Of: 2

P:\22036 IHC Scott Milliken Property\Drawings\Plan Sheets\Oil-Gas Crossings\JT-IHCS Bernhardt Oil-Gas Crossings-CHEVRON.dwg, Chevron 1, 10/4/2023 3:49:40 PM

EASEMENT ENCROACHMENT OR RELEASE APPLICATION FORM

SUBMIT TO: CHEVRON PIPE LINE COMPANY
CPL LAND DEPARTMENT
1400 SMITH STREET, 38 FLOOR
HOUSTON, TX 77002

APPLICATION DATE: 9/29/23 **PROPERTY ADDRESS:** MILLIKEN 22430 NE4 24 4 67 EXC N225' ALSO EXC BEG E4 COR SEC TH WLY ALG E-W C/L 588.23' T H NELY 1568.1' TH SLY 1483.57' ALG E LN SEC TO BEG EXC OG&M (4RR)

NAME OF APPLICANT: (PRINT OR TYPE)

Andy Carpenter	**Area Manager, Aggregates**	**IHC Scott, Inc.**	
Name	Title	Company	
801 8th Street, Suite 130	Greeley	CO	80631
Address	City	State	Zip Code

APPLICANT CONTACT INFORMATION:

J.C. York	**J&T Consulting, Inc.**	**(970) 222-9530**	**jcyork@j-tconsulting.com**
Name		Phone Number	Email
305 Denver Avenue, Suite D	Fort Lupton	CO	80621
Address	City	State	Zip Code

THE FOLLOWING MUST BE INCLUDED WITH THIS APPLICATION:

1. A **non-refundable** application fee of $500.00 made payable to Chevron Pipe Line Company (CPL)
2. A survey or drawing with the easement highlighted
3. A Google Earth screenshot or map of general area
4. Property deed and Tax Assessor parcel number
5. A written description/explanation of the requested encroachment or release

Please note: The purpose of this application is for CPL to determine whether it or another affiliated legal entity managed within Chevron's pipeline business unit currently owns the easement and which pipeline system is associated with the easement. If it is determined that a legal entity managed within Chevron's pipeline business unit is the owner, then the steps below are applicable; otherwise, your request will need to be directed elsewhere.

AFTER CPL HAS COMPLETED THE INITIAL APPLICATION REVIEW:

If it is determined that a legal entity managed within Chevron's pipeline business unit is the confirmed owner, processing can proceed on Applicant's request as described in the steps below:

1. If CPL deems it necessary to conduct additional surveys, the cost of any additional survey is the responsibility of the Applicant. CPL will provide an estimate to the Applicant and payment is required before the survey will be completed. Applicant may be required to pay other processing costs as directed by CPL.
2. If CPL deems it necessary to perform any construction or engineering work to protect the pipeline, the cost of any construction or engineering work is the responsibility of the Applicant. CPL will provide an estimate to the Applicant and payment is required before the construction will be completed. Applicant may be required to pay other processing costs as directed by CPL.

APPLICANT ACKNOWLEDGES THAT APPLICANT'S SUBMISSION OF AND CPL'S PROCESSING OF THIS APPLICATION DOES NOT GUARANTEE APPROVAL OF APPLICANT'S REQUEST FOR AN ENCROACHMENT OR RELEASE. APPLICANT FURTHER ACKNOWLEDGES THAT AT ANY TIME DURING THE PROCESSING OF ITS APPLICATION, APPLICANT'S REQUEST MAY BE DENIED FOR ANY BUSINESS, COMMERCIAL, ENVIRONMENTAL OR OTHER REASON, AND ALL FEES PAID AND COSTS INCURRED (INCLUDING BUT NOT LIMITED TO THE $500.00 APPLICATION FEE) BY APPLICANT ARE NON-REFUNDABLE.

_____
Signature of Requestor/Applicant

JC York

From: JC York
Sent: Tuesday, November 7, 2023 2:23 PM
To: Ted Schultz
Cc: Andy Carpenter; Todd Yee; Brian DeRose
Subject: RE: [EXTERNAL] :PDC Plugged and Abandoned Wells - Property South of CR 46 Adjacent to South Platte River
Attachments: Structure Agreement PDC Energy 11.7.23.pdf

Ted –

Sorry for the delay. Attached is the structure agreement. We had to wait on this because IHC Scott is now WW Clyde so the agreement will be with WW Clyde. Let me know if you have any questions.

Regards,

J.C.

J.C. York, P.E.

J&T Consulting, Inc.
305 Denver Avenue, Suite D
Fort Lupton, CO 80621

Office: (303) 857-6222
Mobile: (970) 222-9530
FAX: (303) 857-6224

From: Ted Schultz <Ted.Schultz@pdce.com>
Sent: Wednesday, September 20, 2023 10:30 AM
To: JC York <jcyork@j-tconsulting.com>
Cc: Andy Carpenter <acarpenter@ihcscott.com>; Todd Yee <toddyee@j-tconsulting.com>; Brian DeRose <Brian.Derose@pdce.com>
Subject: RE: [EXTERNAL] :PDC Plugged and Abandoned Wells - Property South of CR 46 Adjacent to South Platte River

J.C.-

Good morning. As a follow up to your email and our call, would you mind sending over the structure agreement for mining that you will be requesting. As I work with our Team on this end, I wanted to be able to have us all look at this agreement as well.

Thanks J.C.

Ted Schultz
Surface Landman - Agent for PDC Energy, Inc.
Office: 970-506-9272
Mobile: 303-522-4043
Ted.Schultz@pdce.com

From: JC York <jcyork@j-tconsulting.com>
Sent: Thursday, September 14, 2023 10:49 AM
To: Ted Schultz <Ted.Schultz@pdce.com>
Cc: Andy Carpenter <acarpenter@ihcscott.com>; Todd Yee <toddyee@j-tconsulting.com>
Subject: [EXTERNAL] :PDC Plugged and Abandoned Wells - Property South of CR 46 Adjacent to South Platte River

Ted –

I left a voicemail on your mobile number and wanted to send over some drawings for the proposed gravel mine that IHC Scott is proposing on its property. We wanted to discuss locations where PDC has plugged and abandoned oil/gas wells that are within the mining limits and see if those casings can be cut and capped as the mining progresses down to bedrock. Let me know when you may have some time to discuss or meet as we will also be requesting a structure agreement for the mining as we have on other mining projects which I will also send over once we have had a chance to discuss and review the drawings attached.

Regards,

J.C.

J.C. York, P.E.

J&T Consulting, Inc.
305 Denver Avenue, Suite D
Fort Lupton, CO 80621

Office: (303) 857-6222
Mobile: (970) 222-9530
FAX: (303) 857-6224

Regards,

J.C.

J.C. York, P.E.

J&T Consulting, Inc.
305 Denver Avenue, Suite D
Fort Lupton, CO 80621

Office: (303) 857-6222
Mobile: (970) 222-9530
FAX: (303) 857-6224

An example Structure Agreement which meets the requirements of the Statutes is shown below.
****

Structure Agreement

This letter has been provided to you as the owner of a structure on or within two hundred (200) feet of a proposed mine site. The State of Colorado, Division of Reclamation, Mining and Safety ("Division") requires that where a mining operation will adversely affect the stability of any significant, valuable and permanent man-made structure located within two hundred (200) feet of the affected land, the Applicant shall either:

a) Provide a notarized agreement between the Applicant and the Person(s) having an interest in the structure, that the Applicant is to provide compensation for any damage to the structure; or

b) Where such an agreement cannot be reached, the Applicant shall provide an appropriate engineering evaluation that demonstrates that such structure shall not be damaged by activities occurring at the mining operation; or

c) Where such structure is a utility, the Applicant may supply a notarized letter, on utility letterhead, from the owner(s) of the utility that the mining and reclamation activities, as proposed, will have "no negative effect" on their utility. (*Construction Materials Rule 6.3.12 and Rule 6.4.19 & Hard Rock/Metal Mining Rule 6.3.12 and Rule 6.4.20)*

The Colorado Mined Land Reclamation Board ("Board") has determined that this form, if properly executed, represents an agreement that complies with Construction Materials Rule 6.3.12(a), Rule 6.4.19(a), and C.R.S. § 34-32.5-115(4)(e) and with Hard Rock/Metal Mining Rule 6.3.12(a), Rule 6.4.20(a), and C.R.S. § 34-32-115(4)(d). This form is for the sole purpose of ensuring compliance with the Rules and Regulations and shall not make the Board or Division a necessary party to any private civil lawsuit to enforce the terms of the agreement or create any enforcement obligations in the Board or the Division.

The following structures are located on or within 200 feet of the proposed affected area:

1. Abandoned Oil/Gas Wells _____
2. _____
3. _____
4. _____
5. _____

(*Please list additional structures on a separate page*)

CERTIFICATION

The Applicant, W.W. Clyde & Co. (print applicant/company name), by Andy Carpenter (print representative's name), as Area Manager, Aggregates (print representative's title), does hereby certify that PDC Energy (structure owner) shall be compensated for any damage from the proposed mining operation to the above listed structure(s) located on or within 200 feet of the proposed affected area described within Exhibit A, of the Reclamation Permit Application for Bernhardt Sand and Gravel Pit (operation name), File Number M-2023-025.

This form has been approved by the Colorado Mined Land Reclamation Board pursuant to its authority under the Colorado Land Reclamation Act for the Extraction of Construction Materials and the Colorado Mined Land Reclamation Act for Hard Rock, Metal, and Designated Mining Operations. Any alteration or modification to this form shall result in voiding this form.

NOTARY FOR PERMIT APPLICANT

ACKNOWLEGED BY:

Applicant W.W. Clyde Representative Name [signature]

Date 10/3/2023 Title Area Manager, Aggregates

STATE OF Colorado)
) ss.
COUNTY OF Weld)

The foregoing was acknowledged before me this 3rd day of October, 2023, by Andy Carpenter as Area Manager of W.W. Clyde.

[signature] My Commission Expires: 12/30/2023
Notary Public

Peggy L Sherman
NOTARY PUBLIC
STATE OF COLORADO
NOTARY ID 20044011484
MY COMMISSION EXPIRES December 30, 2023

NOTARY FOR STRUCTURE OWNER

ACKNOWLEGED BY:

Structure Owner _____ Name _____

Date _____ Title _____

STATE OF _____)
) ss.
COUNTY OF_____)

The foregoing was acknowledged before me this____ day of _____, 20___, by _____ as _____ of _____.

_____ My Commission Expires:_____
Notary Public

JC York

From: Muncy, Lynette L <Lynette.Muncy@xcelenergy.com>
Sent: Thursday, October 26, 2023 2:22 PM
To: Holloway, Sean A; JC York
Cc: Todd Yee; Andy Carpenter
Subject: RE: Public Service ROW and Xcel Power Transmission Line and Xcel Gas Line - Property South of CR 46 Adjacent to South Platte River

Hi Sean:

I am the person of contact. I have not had a chance to research, my apology. I have a priority project I am working on writing up and thereafter I will research this to have a full understanding and know how to reply back.
I should have something tomorrow afternoon.

Thank you for your patience.

From: Holloway, Sean A <Sean.A.Holloway@xcelenergy.com>
Sent: Thursday, September 14, 2023 10:51 AM
To: Muncy, Lynette L <Lynette.Muncy@xcelenergy.com>
Subject: FW: Public Service ROW and Xcel Power Transmission Line and Xcel Gas Line - Property South of CR 46 Adjacent to South Platte River

Good morning Lynette,

Please see the email below, could you point me in the right direction for this request?

Sean Holloway
Xcel Energy
Design Supervisor – Pike Engineering
Design Contractor for Xcel Energy
5245 Ronald Reagan Blvd
Suite 104
Johnstown, CO 80534
Cell: 970-806-9194 Office: 970-654-2921
Email: Sean.A.Holloway@xcelenergy.com
Direct Supervisor: Jeremy.jensen@xcelenergy.com

From: JC York <jcyork@j-tconsulting.com>
Sent: Tuesday, September 12, 2023 9:27 AM
To: Holloway, Sean A <Sean.A.Holloway@xcelenergy.com>
Cc: Todd Yee <toddyee@j-tconsulting.com>; Andy Carpenter <acarpenter@ihcscott.com>
Subject: Public Service ROW and Xcel Power Transmission Line and Xcel Gas Line - Property South of CR 46 Adjacent to South Platte River

Sean –

Per our phone conversation this morning I wanted to send over some drawings for the proposed gravel mine that IHC Scott is proposing on its property. We wanted to discuss locations where we will have truck traffic crossing the Public Service ROW. Let me know when you may have some time to discuss or meet as we will also be requesting a structure agreement for the mining as we have on other mining projects based on our slope stability analysis which I will also send over once we have had a chance to discuss and review the drawings attached.

Previously when the area was farmed they used an existing dirt road (gravel surfaced) that crossed into and out of the Public Service ROW (see proposed truck route drawing attached. We wanted to figure out who we needed to talk to in order to get a formalized agreement with Public Service/Xcel Energy.

Regards,

J.C.

J.C. York, P.E.

J&T Consulting, Inc.
305 Denver Avenue, Suite D
Fort Lupton, CO 80621

Office: (303) 857-6222
Mobile: (970) 222-9530
FAX: (303) 857-6224

JC York

From: Muncy, Lynette L <Lynette.Muncy@xcelenergy.com>
Sent: Monday, October 30, 2023 5:08 PM
To: Swanson, Tyler J
Cc: Holloway, Sean A; JC York
Subject: RE: Structure Agreement - Ewing Mine - #2023-336
Attachments: PSCo High Pressure Gas Encroachment Guidelines_JAN2021 (004).pdf; FW: Public Service ROW and Xcel Power Transmission Line and Xcel Gas Line - Property South of CR 46 Adjacent to South Platte River

Importance: High

Hello,

I received several emails regarding a gravel mine operation wanting an agreement to be able to cross PSCo's ROW which I believe to be OH Electric Transmission and I see that there may be encroachment on our HP gas lines that are also in part of that area. It is my opinion that you will need to apply for a License from both electric transmission and HP gas which are two separate applications. Tyler Swanson handles electric transmission and he will send you a link for his department application. Tyler, I don't believe you received all the documentation I got for review, attached. The below link is for HP gas application. Once applications are received the locations will need to be Investigated to determine the ROW and how it is affected by truck, equipment crossings, if any. Agreements, License can be discussed at that time.

==========

HP Link for Application

Thanks for your notification of construction work planned near Xcel Energy high pressure gas pipeline. To initiate review, an encroachment request must first be completed at the following link:

Below is a summary of the HP Gas encroachment application process along with supporting design guidelines which outline Xcel HP pipeline construction crossing methods, clearances and safe pipe bedding practices.

1. Applicant initiates an HP gas encroachment request at the following hyperlink after selecting CO as the appropriate state from the website:
   - encroachment requests (xcelenergy.com)

2. Applicants information is captured in a text file and an auto-generated e-mail is submitted to encroachments@xcelenergy.com where it is logged and assigned to an HP engineer for review.
3. Assigned HP Engineer works with Siting & Land Rights agent to determine whether impacted area falls within Xcel easement, coordinates with Community Relations Area Mgr. for relevant customer specific information.
4. HP Engineer completes design review and recommends clearance requirements, maximum axle loading requirements and engineering related items as applicable.
5. If Xcel easement applies, Siting & Land Rights issues a license agreement along with engineering criteria; if outside of easement, HP Engineer communicates design restrictions and watch and protect requirements by HP Operations to monitor upcoming site construction.
6. HP encroachment applications typically take 3 to 4 weeks for the above process to be fully executed for a standard license agreement before site excavation is scheduled to start. In rare instances where a HP pipeline must be

relocated due to easement conflicts or customer requests, allow up to 12 months advanced notice for pipeline relocations prior to site construction, depending upon the scope of the project.

Thank you,

Lynette Muncy
Xcel Energy | You. Us. Together.
Public Service Company of Colorado, PSCo
Northern and Weld | Division Agent
Right of Way & Permits Department
Electric & Gas Distribution, HP Gas
1123 West 3rd Ave., Denver, CO 80223
C: 720-838-0960
E: Lynette.Muncy@xcelenergy.com
Direct Supervisor: Adam.R.Pena@xcelenergy.com

xcelenergy.com

From: Swanson, Tyler J <Tyler.J.Swanson@xcelenergy.com>
Sent: Wednesday, October 4, 2023 10:34 AM
To: Muncy, Lynette L <Lynette.Muncy@xcelenergy.com>
Subject: Structure Agreement - Ewing Mine - #2023-336

Hi Lynette,

I've got a structure agreement request for S30, T2N, R66W in Weld County. See the map on the last page of the attachment. I'm not sure if this is something for you or someone else. I don't see any transmission facilities here though. Please take a look and hopefully we can find the right person to handle it.

Thank you,

Tyler J. Swanson
Xcel Energy
Senior Siting & Land Rights Agent
1800 Larimer Street, Suite 400, Denver, CO 80202
P: 303.571.7294 C: 303.889.9505
E: tyler.j.swanson@xcelenergy.com

JC York

From: JC York
Sent: Monday, November 27, 2023 1:23 PM
To: Swanson, Tyler J
Cc: Holloway, Sean A; 'Muncy, Lynette L'; 'Andy Carpenter'
Subject: RE: Bernhardt Sand and Gravel Pit - WW Clyde Owns Property (formerly IHC Scott)
Attachments: Encroachment-Application-Electric-Transmission-Line.pdf; IHC Scott, Inc. Bernhardt Pit Haul Route.pdf; JT IHCS Location Map for Bernhardt Pit 3.13.23.pdf; 1 Exhibit F1 - Reclamation Plan Map 6.7.23.pdf; 1 Exhibit C1 - Pre-Mining Plan Map 6.7.23.pdf; 2 Exhibit C2 - Mining Plan Map 6.7.23.pdf

Tyler –

Attached is the encroachment form for electrical transmission and the maps for the locations we are talking about encroaching. Let me know if you need anything else and also where I should send the $500 check to for the review.

Regards,

J.C.

J.C. York, P.E.

J&T Consulting, Inc.
305 Denver Avenue, Suite D
Fort Lupton, CO 80621

Office: (303) 857-6222
Mobile: (970) 222-9530
FAX: (303) 857-6224

From: Muncy, Lynette L <Lynette.Muncy@xcelenergy.com>
Sent: Monday, October 30, 2023 5:08 PM
To: Swanson, Tyler J <Tyler.J.Swanson@xcelenergy.com>
Cc: Holloway, Sean A <Sean.A.Holloway@xcelenergy.com>; JC York <jcyork@j-tconsulting.com>
Subject: RE: Structure Agreement - Ewing Mine - #2023-336
Importance: High

Hello,

I received several emails regarding a gravel mine operation wanting an agreement to be able to cross PSCo's ROW which I believe to be OH Electric Transmission and I see that there may be encroachment on our HP gas lines that are also in part of that area. It is my opinion that you will need to apply for a License from both electric transmission and HP gas which are two separate applications. Tyler Swanson handles electric transmission and he will send you a link for his department application. Tyler, I don't believe you received all the documentation I got for review, attached. The below link is for HP gas application. Once applications are received the locations will need to be Investigated to determine the ROW and how it is affected by truck, equipment crossings, if any. Agreements, License can be discussed at that time.

==========
HP Link for Application

Thanks for your notification of construction work planned near Xcel Energy high pressure gas pipeline. To initiate review, an encroachment request must first be completed at the following link:

Below is a summary of the HP Gas encroachment application process along with supporting design guidelines which outline Xcel HP pipeline construction crossing methods, clearances and safe pipe bedding practices.

1. Applicant initiates an HP gas encroachment request at the following hyperlink after selecting CO as the appropriate state from the website:
   - encroachment requests (xcelenergy.com)

2. Applicants information is captured in a text file and an auto-generated e-mail is submitted to encroachments@xcelenergy.com where it is logged and assigned to an HP engineer for review.
3. Assigned HP Engineer works with Siting & Land Rights agent to determine whether impacted area falls within Xcel easement, coordinates with Community Relations Area Mgr. for relevant customer specific information.
4. HP Engineer completes design review and recommends clearance requirements, maximum axle loading requirements and engineering related items as applicable.
5. If Xcel easement applies, Siting & Land Rights issues a license agreement along with engineering criteria; if outside of easement, HP Engineer communicates design restrictions and watch and protect requirements by HP Operations to monitor upcoming site construction.
6. HP encroachment applications typically take 3 to 4 weeks for the above process to be fully executed for a standard license agreement before site excavation is scheduled to start. In rare instances where a HP pipeline must be relocated due to easement conflicts or customer requests, allow up to 12 months advanced notice for pipeline relocations prior to site construction, depending upon the scope of the project.

Thank you,

Lynette Muncy
Xcel Energy | You. Us. Together.
Public Service Company of Colorado, PSCo
Northern and Weld | Division Agent
Right of Way & Permits Department
Electric & Gas Distribution, HP Gas
1123 West 3rd Ave., Denver, CO 80223
C: 720-838-0960
E: Lynette.Muncy@xcelenergy.com
Direct Supervisor: Adam.R.Pena@xcelenergy.com

xcelenergy.com

From: Swanson, Tyler J <Tyler.J.Swanson@xcelenergy.com>
Sent: Wednesday, October 4, 2023 10:34 AM
To: Muncy, Lynette L <Lynette.Muncy@xcelenergy.com>
Subject: Structure Agreement - Ewing Mine - #2023-336

Hi Lynette,

I've got a structure agreement request for S30, T2N, R66W in Weld County. See the map on the last page of the attachment. I'm not sure if this is something for you or someone else. I don't see any transmission facilities here though. Please take a look and hopefully we can find the right person to handle it.

Thank you,

Tyler J. Swanson
Xcel Energy
Senior Siting & Land Rights Agent
1800 Larimer Street, Suite 400, Denver, CO 80202
P: 303.571.7294 C: 303.889.9505
E: tyler.j.swanson@xcelenergy.com

JC York

From: Muncy, Lynette L <Lynette.Muncy@xcelenergy.com>
Sent: Tuesday, November 7, 2023 4:23 PM
To: Hoffmeyer, Kaela
Cc: Vallejos, Jesse M; JC York
Subject: New encroachment project

Importance: High

Hi Kaela:

Could you contact JC York from J&T Consulting Inc and help him get an encroachment application submitted. He indicated he cannot get the application to go through.

Will you let me know that you were able to speak with JC and help him with the application. Thank you.

J&T Consulting, Inc.
305 Denver Avenue, Suite D
Fort Lupton, CO 80621
JC York jcyork@j-tconsulting.com

Office: (303) 857-6222
Mobile: (970) 222-9530

Thank you,

Lynette Muncy
Xcel Energy | You. Us. Together.
Public Service Company of Colorado, PSCo
Northern and Weld | Division Agent
Right of Way & Permits Department
Electric & Gas Distribution, HP Gas
1123 West 3rd Ave., Denver, CO 80223
C: 720-838-0960
E: Lynette.Muncy@xcelenergy.com
Direct Supervisor: Adam.R.Pena@xcelenergy.com

JC York

From: Shorr, Austin E <Austin.E.Shorr@xcelenergy.com>
Sent: Thursday, February 1, 2024 10:46 AM
To: JC York
Cc: ashorr@entrustsol.com; Dan Marshall; acarpenter@wwclyde.net
Subject: RE: #698 - CR 25 and CR 46 - Encroachment request

Good morning,

Thank you for taking the time to discuss your gas encroachment request. I appreciate the clarification on the road surface being gravel and details about the semi-truck, weighing 200,000lb including the maximum load. Considering that there are no plans to construct any buildings at the mine or near an easement, I believe construction plans may not be necessary for approval.

As discussed, kindly coordinate with a Hydrovac company for the potholing data. The Hydrovac company should contacts 811 for locates and requests an Xcel representative to be present during the potholing process.

Should you have any further inquiries or require additional assistance, please do not hesitate to reach out.

Best Regards,

Austin E. Shorr
Xcel Energy
Design Engineer, Contractor for Xcel Energy
9777 Pyramid Court Ste. 300
Englewood, CO 80112
P: 720-501-5657 Xcel Customer Call line: 720-457-6039
E: Austin.E.Shorr@xcelenergy.com

From: JC York <jcyork@j-tconsulting.com>
Sent: Thursday, February 1, 2024 9:06 AM
To: Shorr, Austin E <Austin.E.Shorr@xcelenergy.com>
Cc: ashorr@entrustsol.com; Dan Marshall <dmarshall@enengineering.com>; acarpenter@wwclyde.net
Subject: RE: #698 - CR 25 and CR 46 - Encroachment request

Austin –

Below should also help with the types of trucks below. Sorry I forgot to include this in my last e-mail.
Gravel Hauling – Semi-truck – 97,000 lbs total weight on 5 axles
Low Boy Equipment Hauling – Semi-truck – 200,000 lbs total weight on 7 axles
Gravel Hauling – Super Tandem Truck – 110,000 lbs total weight on 4 axles

Regards,

J.C.

J.C. York, P.E.

J&T Consulting, Inc.
305 Denver Avenue, Suite D
Fort Lupton, CO 80621

Office: (303) 857-6222
Mobile: (970) 222-9530
FAX: (303) 857-6224

From: JC York
Sent: Thursday, February 1, 2024 7:23 AM
To: 'Shorr, Austin E' <Austin.E.Shorr@xcelenergy.com>
Cc: 'ashorr@entrustsol.com' <ashorr@entrustsol.com>; 'Dan Marshall' <dmarshall@enengineering.com>; 'acarpenter@wwclyde.net' <acarpenter@wwclyde.net>
Subject: RE: #698 - CR 25 and CR 46 - Encroachment request

Austin –

Attached is an updated map showing the overall area where the encroachment would occur on public service ROW in regard to the existing road that would be used. Please let me know that you received this e-mail. The expected truck weights that would be accessing the roadway to get to and from the proposed Bernhardt Gravel mine are as follows:

97,000 lbs – 5 axle semi truck/trailer

110,000 lbs – 4 axle tandem truck with booster axle

200,000 lbs – 7 axle semi truck/trailer with booster axle

We would also like to see what we may need to do to schedule some potholing to determine the actual depth of your gas lines but wanted to see how we should go about doing that as well.

Regards,

J.C.

J.C. York, P.E.

J&T Consulting, Inc.
305 Denver Avenue, Suite D
Fort Lupton, CO 80621

Office: (303) 857-6222
Mobile: (970) 222-9530
FAX: (303) 857-6224

From: JC York
Sent: Tuesday, January 23, 2024 2:08 PM
To: Shorr, Austin E <Austin.E.Shorr@xcelenergy.com>
Cc: ashorr@entrustsol.com; Dan Marshall <dmarshall@enengineering.com>
Subject: RE: #698 - CR 25 and CR 46 - Encroachment request

Austin –

I am sending over some general information for you and once you have received I wanted to discuss further where we can figure out what areas I need to send you information on. Give me a call to discuss once you receive the maps and have a chance to review. Also since we created these maps IHC Scott changed their name to W.W. Clyde & Co. so we will be able to provide updated maps once I have had a chance to discuss more with you. Sorry for the delay in getting back to you.

Regards,

J.C.

J.C. York, P.E.

J&T Consulting, Inc.
305 Denver Avenue, Suite D
Fort Lupton, CO 80621

Office: (303) 857-6222
Mobile: (970) 222-9530
FAX: (303) 857-6224

From: Shorr, Austin E <Austin.E.Shorr@xcelenergy.com>
Sent: Thursday, December 21, 2023 10:21 AM
To: JC York <jcyork@j-tconsulting.com>
Cc: ashorr@entrustsol.com; Dan Marshall <dmarshall@enengineering.com>
Subject: RE: #698 - CR 25 and CR 46 - Encroachment request

Good morning,

I wanted to follow up on the requested information below.

Please let me know if you have any questions.

Best Regards,

Austin E. Shorr
Xcel Energy
Design Engineer, Contractor for Xcel Energy
9777 Pyramid Court Ste. 300
Englewood, CO 80112
P: 720-501-5657 **Xcel Customer Call line:** 720-457-6039
E: **Austin.E.Shorr@xcelenergy.com**

Visit our website for more information about installing and connecting service with Xcel Energy.-

---

From: Shorr, Austin E
Sent: Thursday, December 7, 2023 11:15 AM
To: jcyork@j-tconsulting.com
Cc: ashorr@entrustsol.com; Dan Marshall <dmarshall@enengineering.com>
Subject: #698 - CR 25 and CR 46 - Encroachment request

Good morning,

Thank you for submitting your encroachment request online.

In order for the review process to begin, the following information needs to be included in engineered drawings PDF:

1. The location of the proposed encroachment on the right-of-way and/or easement
2. The edges of the right-of-way or easement
3. The nearest poles, towers, or other PSCo facilities
4. Tied into a section corner (bearing and distance)
5. Where appropriate, roads, streets, streams, creeks, etc.
6. Construction access routes
7. Heaviest tracked and wheeled equipment (Make and Model) if crossing over the pipeline
8. Location of heavy equipment crossing above PSCo gas transmission lines
9. Grading plans (Including temporary cut/fill and permanent grading)
10. Landscaping plans
11. Underground structure dimensions
12. Aboveground structure dimensions
13. Distances from the proposed structures to both the pipeline and ROW
14. Depth of pipeline with SUE Level A quality locates
15. Anticipated construction start date

The review process will begin only after all applicable items above have been submitted in a PDF.

If there are omissions of applicable items listed above in the engineered drawings, you will be asked to re-submit with the needed information.

The high pressure gas engineer that has been assigned to your request is Austin Shorr, contact info below.

Best Regards,

Austin E. Shorr
Xcel Energy
Design Engineer, Contractor for Xcel Energy
9777 Pyramid Court Ste. 300
Englewood, CO 80112
P: 720-501-5657 **Xcel Customer Call line:** 720-457-6039
E: Austin.E.Shorr@xcelenergy.com

HIGHWAY 60

HAUL ROUTE FROM PIT TO COUNTY ROAD 46 (~1.0 MILE)

North ¼, Section 18, Township 4 North, Range 66 West 3.25" aluminum cap marked PLS 24305 (2011)

COUNTRY ROAD 46

SOUTH PLATTE RIVER

EXISTING OVERHEAD POWER LINE(s) (TYP.)

Southeast corner, Section 13, Township 4 North, Range 67 West 3.25" aluminum cap marked PLS 16154 (1999)

East ¼, Section 13, Township 4 North, Range 67 West 3.25" aluminum cap marked PLS 10855 (1997)

EXISTING POWER POLE LOCATION (TYP.)

East ¼, Section 24, Township 4 North, Range 67 West 2.5" aluminum cap marked PLS 16154 (1999)

HAUL ROUTE CONNECTION

N89° 13' 39.08"E 137.902'

Weld County Road 25

19.53'

S 1°15'42" W 1.21'

Northeast corner, Section 13, Township 4 North, Range 67 West 3.25" aluminum cap marked PLS 31159 (2016)

Weld County Road 46 (60' right-of-way)

Rec. No. 2109488

Lot B Amended Recorded Exemption #1059-13-1-RE948

HAUL ROUTE FROM PIT TO COUNTY ROAD 46 (~1.2 MILES)

BERNHARDT SAND AND GRAVEL PIT

S Dumont Lane

North ¼, Section 13, Township 4 North, Range 67 West 3.25" aluminum cap marked PLS 37067 (2017)

Site Benchmark (NAVD88) 4793.05'

4508.65'

SCALE IN FEET: 400 200 0 400 800 1,200

J&T Consulting, Inc.
305 Denver Avenue - Suite D
Fort Lupton, CO 80621
Ph: 303-857-6222
www.jtconsulting.com

Bernhardt Sand And Gravel Pit

Exhibit F2 - Reclamation Seeding Map

W.W. Clyde & Co.

REVISIONS					
No	Description	Date	By	Chk	

J&T Consulting, Inc.

Job #	22036
Date	11.27.23
Drawn By	TPY
Designed By	TPY
Checked By	JCY
File	IHCS Encroachment Exhibit.dwg
Scale	As Shown

Sheet: 2 Of: 2

An example Structure Agreement which meets the requirements of the Statutes is shown below.
****

Structure Agreement

This letter has been provided to you as the owner of a structure on or within two hundred (200) feet of a proposed mine site. The State of Colorado, Division of Reclamation, Mining and Safety ("Division") requires that where a mining operation will adversely affect the stability of any significant, valuable and permanent man-made structure located within two hundred (200) feet of the affected land, the Applicant shall either:

a) Provide a notarized agreement between the Applicant and the Person(s) having an interest in the structure, that the Applicant is to provide compensation for any damage to the structure; or

b) Where such an agreement cannot be reached, the Applicant shall provide an appropriate engineering evaluation that demonstrates that such structure shall not be damaged by activities occurring at the mining operation; or

c) Where such structure is a utility, the Applicant may supply a notarized letter, on utility letterhead, from the owner(s) of the utility that the mining and reclamation activities, as proposed, will have "no negative effect" on their utility. (*Construction Materials Rule 6.3.12 and Rule 6.4.19 & Hard Rock/Metal Mining Rule 6.3.12 and Rule 6.4.20)*

The Colorado Mined Land Reclamation Board ("Board") has determined that this form, if properly executed, represents an agreement that complies with Construction Materials Rule 6.3.12(a), Rule 6.4.19(a), and C.R.S. § 34-32.5-115(4)(e) and with Hard Rock/Metal Mining Rule 6.3.12(a), Rule 6.4.20(a), and C.R.S. § 34-32-115(4)(d). This form is for the sole purpose of ensuring compliance with the Rules and Regulations and shall not make the Board or Division a necessary party to any private civil lawsuit to enforce the terms of the agreement or create any enforcement obligations in the Board or the Division.

The following structures are located on or within 200 feet of the proposed affected area:

1. Gas Lines _____
2. Power Lines _____
3. ROW _____
4. _____
5. _____

(*Please list additional structures on a separate page*)

CERTIFICATION

The Applicant, W.W. Clyde & Co. (print applicant/company name), by Andy Carpenter (print representative's name), as Area Manager, Aggregates (print representative's title), does hereby certify that Public Service / Xcel Energy (structure owner) shall be compensated for any damage from the proposed mining operation to the above listed structure(s) located on or within 200 feet of the proposed affected area described within Exhibit A, of the Reclamation Permit Application for Bernhardt Sand and Gravel Pit (operation name), File Number M-2023-025.

This form has been approved by the Colorado Mined Land Reclamation Board pursuant to its authority under the Colorado Land Reclamation Act for the Extraction of Construction Materials and the Colorado Mined Land Reclamation Act for Hard Rock, Metal, and Designated Mining Operations. Any alteration or modification to this form shall result in voiding this form.

NOTARY FOR PERMIT APPLICANT

ACKNOWLEGED BY:

Applicant W.W. Clyde + Co. Representative Name [signature]

Date 10/3/2023 Title Area Manager, Aggregates

STATE OF Colorado)
) ss.
COUNTY OF Weld)

The foregoing was acknowledged before me this 3rd day of October, 2023, by Andy Carpenter as Area Manager of W.W. Clyde + Co.

[signature] My Commission Expires: 12/30/2023
Notary Public

Peggy L Sherman
NOTARY PUBLIC
STATE OF COLORADO
NOTARY ID 20044011484
MY COMMISSION EXPIRES December 30, 2023

NOTARY FOR STRUCTURE OWNER

ACKNOWLEGED BY:

Structure Owner _____ Name _____

Date _____ Title _____

STATE OF _____)
) ss.
COUNTY OF_____)

The foregoing was acknowledged before me this____ day of _____, 20___, by _____ as _____ of _____.

_____ My Commission Expires:_____
Notary Public

SENDER: COMPLETE THIS SECTION

- Complete items 1, 2, and 3.
- Print your name and address on the reverse so that we can return the card to you.
- Attach this card to the back of the mailpiece, or on the front if space permits.

1. Article Addressed to:

Union Pacific Railroad
Attn: Nathan Anderson
650 Davis Road
Salt Lake City, Utah 84119

9590 9402 6444 0346 7377 38

2. Article Number *(Transfer from service label)*

COMPLETE THIS SECTION ON DELIVERY

A. Signature

X CAMD-CA ☐ Agent ☐ Addressee

B. Received by *(Printed Name)*

C. Date of Delivery 3-4-24

D. Is delivery address different from item 1? ☐ Yes
If YES, enter delivery address below: ☐ No

3. Service Type

- ☐ Adult Signature
- ☐ Adult Signature Restricted Delivery
- ☐ Certified Mail®
- ☐ Certified Mail Restricted Delivery
- ☐ Collect on Delivery
- ☐ Collect on Delivery Restricted Delivery
- ☐ Insured Mail
- ☐ Insured Mail Restricted Delivery (over $500)
- ☐ Priority Mail Express®
- ☐ Registered Mail™
- ☐ Registered Mail Restricted Delivery
- ☐ Signature Confirmation™
- ☐ Signature Confirmation Restricted Delivery

PS Form 3811, July 2020 PSN 7530-02-000-9053 Domestic Return Receipt

7020 1290 0000 0718 8313

U.S. Postal Service™
CERTIFIED MAIL® RECEIPT
Domestic Mail Only

For delivery information, visit our website at *www.usps.com®*.

West Valley City, UT 84119

OFFICIAL USE

Certified Mail Fee $4.40	0392
$ $3.65	25
Extra Services & Fees *(check box, add fee as appropriate)* $0.00	
☐ Return Receipt (hardcopy) $ $0.00	
☐ Return Receipt (electronic) $ $0.00	
☐ Certified Mail Restricted Delivery $ $0.00	
☐ Adult Signature Required $	
☐ Adult Signature Restricted Delivery $	
Postage $1.63	Postmark Here
$	FORT LUPTON CO FEB 28 2024 80621
Total Postage and Fees $4.68	02/28/2024
$	

Sent To Union Pacific Railroad
Street and Apt. No., or PO Box No. 650 Davis Road
City, State, ZIP+4® Salt Lake City, Utah 84119

PS Form 3800, April 2015 PSN 7530-02-000-9047 See Reverse for Instructions

An example Structure Agreement which meets the requirements of the Statutes is shown below.
****

Structure Agreement

This letter has been provided to you as the owner of a structure on or within two hundred (200) feet of a proposed mine site. The State of Colorado, Division of Reclamation, Mining and Safety ("Division") requires that where a mining operation will adversely affect the stability of any significant, valuable and permanent man-made structure located within two hundred (200) feet of the affected land, the Applicant shall either:

a) Provide a notarized agreement between the Applicant and the Person(s) having an interest in the structure, that the Applicant is to provide compensation for any damage to the structure; or

b) Where such an agreement cannot be reached, the Applicant shall provide an appropriate engineering evaluation that demonstrates that such structure shall not be damaged by activities occurring at the mining operation; or

c) Where such structure is a utility, the Applicant may supply a notarized letter, on utility letterhead, from the owner(s) of the utility that the mining and reclamation activities, as proposed, will have "no negative effect" on their utility. (*Construction Materials Rule 6.3.12 and Rule 6.4.19 & Hard Rock/Metal Mining Rule 6.3.12 and Rule 6.4.20)*

The Colorado Mined Land Reclamation Board ("Board") has determined that this form, if properly executed, represents an agreement that complies with Construction Materials Rule 6.3.12(a), Rule 6.4.19(a), and C.R.S. § 34-32.5-115(4)(e) and with Hard Rock/Metal Mining Rule 6.3.12(a), Rule 6.4.20(a), and C.R.S. § 34-32-115(4)(d). This form is for the sole purpose of ensuring compliance with the Rules and Regulations and shall not make the Board or Division a necessary party to any private civil lawsuit to enforce the terms of the agreement or create any enforcement obligations in the Board or the Division.

The following structures are located on or within 200 feet of the proposed affected area:

1. Rail Road _____
2. ROW _____
3. _____
4. _____
5. _____

(*Please list additional structures on a separate page*)

CERTIFICATION

The Applicant, W.W. Clyde & Co. (print applicant/company name), by Andy Carpenter (print representative's name), as Area Manager, Aggregates (print representative's title), does hereby certify that Union Pacific Rail Road (structure owner) shall be compensated for any damage from the proposed mining operation to the above listed structure(s) located on or within 200 feet of the proposed affected area described within Exhibit A, of the Reclamation Permit Application for Bernhardt Sand and Gravel Pit (operation name), File Number M-2023-025.

This form has been approved by the Colorado Mined Land Reclamation Board pursuant to its authority under the Colorado Land Reclamation Act for the Extraction of Construction Materials and the Colorado Mined Land Reclamation Act for Hard Rock, Metal, and Designated Mining Operations. Any alteration or modification to this form shall result in voiding this form.

NOTARY FOR PERMIT APPLICANT

ACKNOWLEGED BY:

Applicant W.W. Clyde & Co. Representative Name [signature]

Date 10/3/2023 Title Area Manager, Aggregates

STATE OF Colorado)
) ss.
COUNTY OF Weld)

The foregoing was acknowledged before me this 3rd day of October, 2023 by Andy Carpenter as Area Manager of W.W. Clyde & Co

[signature] My Commission Expires: 12/30/2023
Notary Public

Peggy L Sherman
NOTARY PUBLIC
STATE OF COLORADO
NOTARY ID 20044011484
MY COMMISSION EXPIRES December 30, 2023

NOTARY FOR STRUCTURE OWNER

ACKNOWLEGED BY:

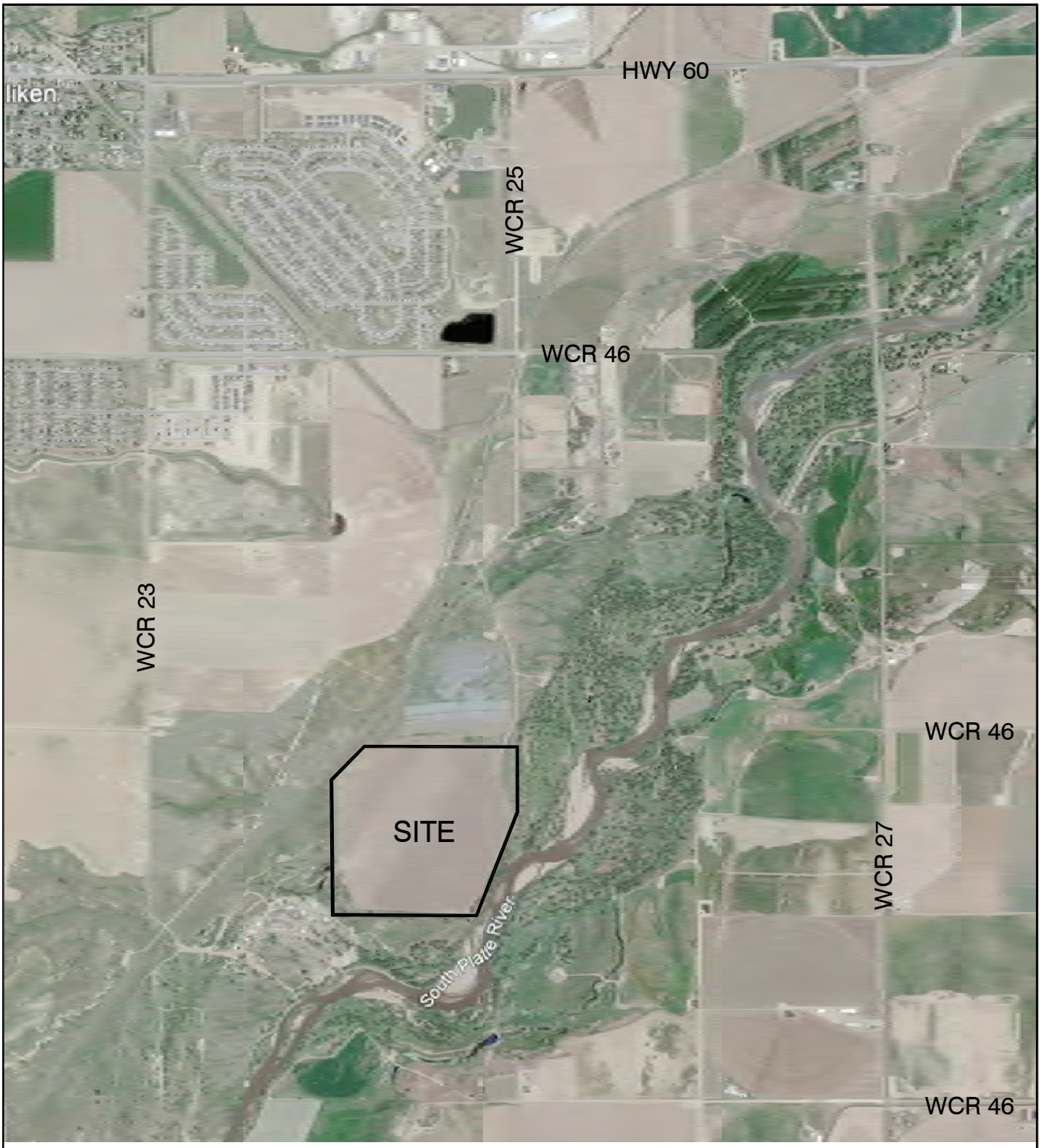
Structure Owner _____ Name _____

Date _____ Title _____

STATE OF _____)
) ss.
COUNTY OF_____)

The foregoing was acknowledged before me this____ day of _____, 20___, by _____ as _____ of _____.

_____ My Commission Expires:_____
Notary Public



2000 1000 0 2000

SCALE IN FEET

N

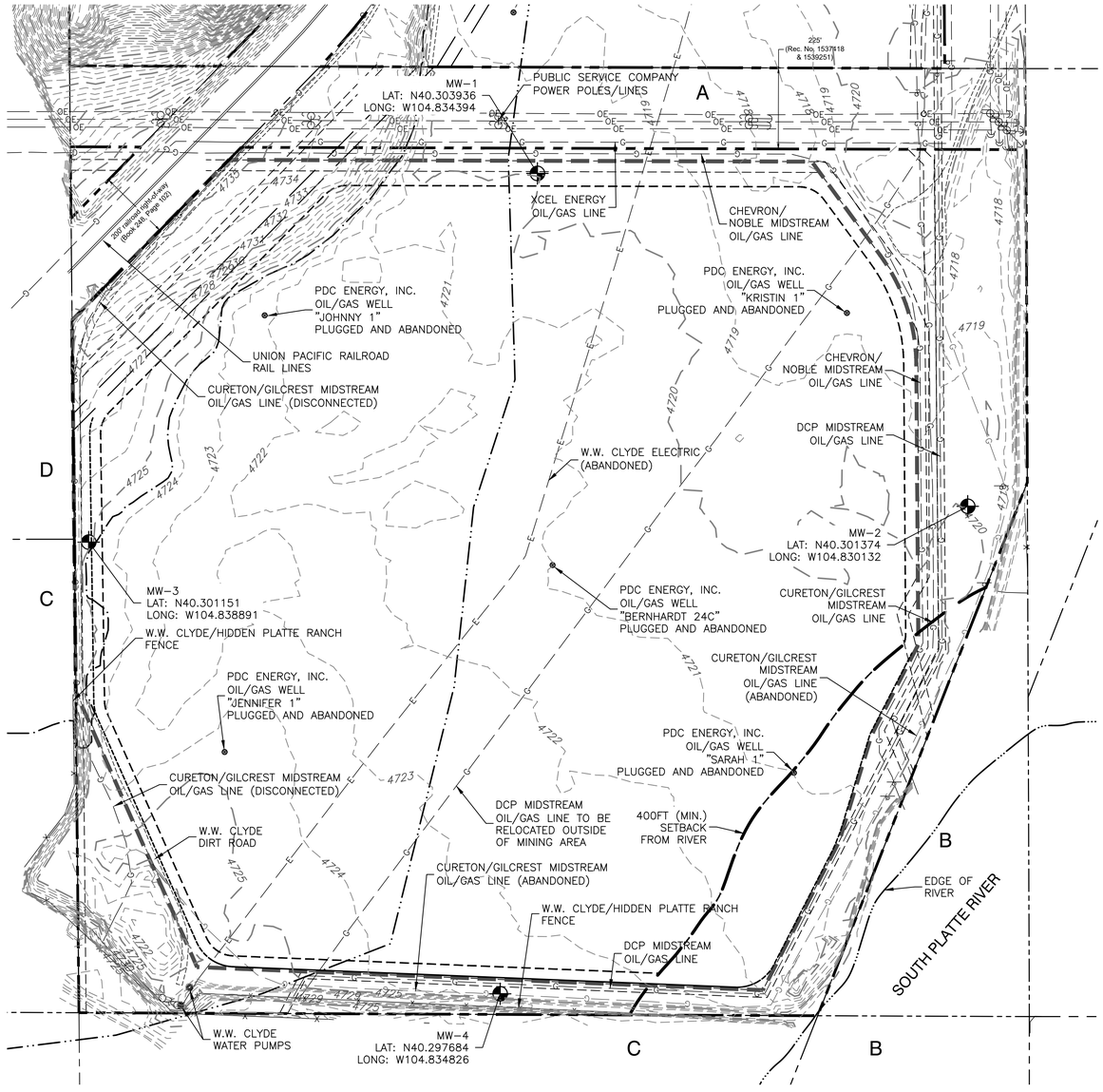
J&T Consulting, Inc.

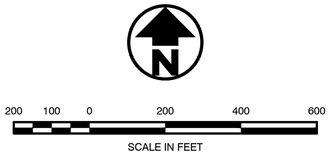
305 Denver Avenue - Suite D
Fort Lupton, CO 80621
303-857-6222

IHC Scott
Bernhardt Sand and Gravel Pit
Exhibit B - Index Map

Date:	5.18.23
Job No:	22036
Drawn:	TPY
Scale:	1" = 2000'
Sheet: 1	Of: 1

P:\22036 IHC Scott Milliken Property\Drawings\Xref\jt-ihcs milliken base.dwg, Vicinity, 5/18/2023 11:00:48 AM





LEGEND:

EXISTING CONTOURS	SECTION LINE
PROPERTY LINE	EXISTING 100 YR FLOODPLAIN
EXISTING FENCE	EXISTING 100 YR FLOODWAY
EXISTING ROADS	PERMIT BOUNDARY
EXISTING OVERHEAD ELECTRIC	MINING LIMIT
EXISTING UNDERGROUND ELECTRIC	SLURRY WALL
EXISTING POWER POLE	STOCKPILE AREA
EXISTING OIL/GAS LINE	A PROPERTY OWNER MAP ID
EXISTING RIGHT-OF-WAY	

PROPERTY OWNERS WITHIN 200 FEET

MAP ID	NAME/ADDRESS	ASSESSORS ID NO.
A	PUBLIC SERVICE COMPANY OF COLORADO TAX SERVICE DEPARTMENT PO BOX 1979 DENVER, CO 80201-1979	105924000019
B	HALFLIGHT LAND & MINERALS, LLC 4420 SUMAC LANE LITTLETON, CO 80123-2743	105729100002
C	HIDDEN PLATTE RANCH, LLC PO BOX 331 MILLIKEN, CO 80543-0331	105924000039
D	CHERYL KASTEN KAREN CURRIER CARLENE STROH 511 N SHOLDT DRIVE PLATTEVILLE, CO 80651-7583	105924000036

VEGETATION:

ALL AREAS WITHIN THE PERMIT BOUNDARY ARE CURRENTLY AGRICULTURAL CROP AND PASTURE LAND.

NOTE:
W.W. CLYDE & CO. IS THE SURFACE AND SUBSURFACE OWNER WITHIN THE PERMIT AREA.

J&T Consulting, Inc.
305 Denver Avenue - Suite D
Fort Lupton, CO 80621
Ph: 303-857-6222
www.jtconsulting.com

Bernhardt Sand And Gravel Pit

Exhibit C1 - Pre-Mining Plan Map

W.W. Clyde & Co.

REVISIONS

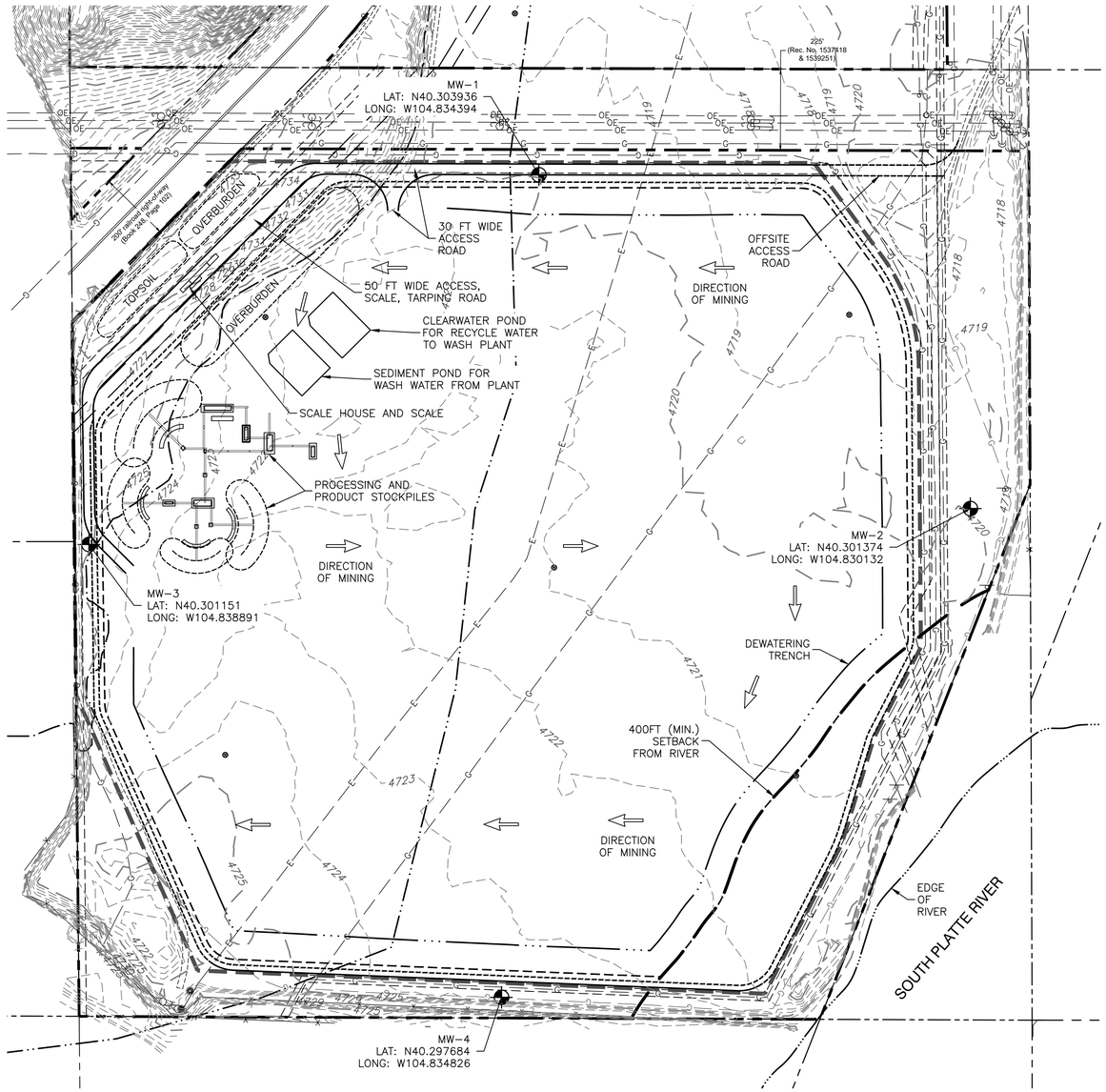
No	Date	By	Chk	Description

J&T Consulting, Inc.

J.C. York

Job #	22036
Date	11.27.23
Drawn By	TPY
Designed By	TPY
Checked By	JCY
File	JT-IHCS Bernhardt Mining.dwg
Scale	As Shown

Sheet: 1 Of: 2

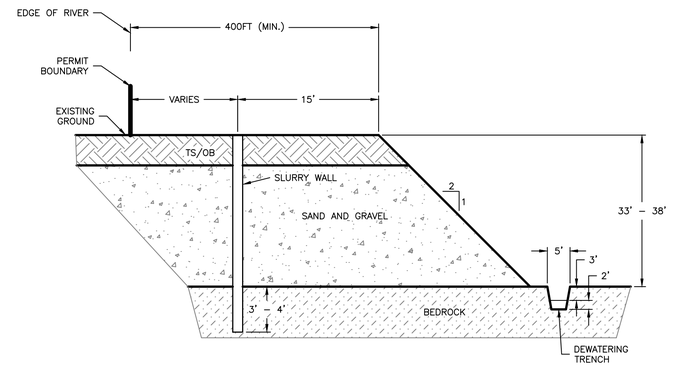


PERMIT AREA = 111.01 AC
MINING AREA = 98.24 AC

200 100 0 200 400 600
SCALE IN FEET

LEGEND:

- EXISTING CONTOURS
- PROPERTY LINE
- EXISTING FENCE
- EXISTING ROADS
- EXISTING OVERHEAD ELECTRIC
- EXISTING UNDERGROUND ELECTRIC
- EXISTING POWER POLE
- EXISTING OIL/GAS LINE
- EXISTING RIGHT-OF-WAY
- SECTION LINE
- EXISTING 100 YR FLOODPLAIN
- EXISTING 100 YR FLOODWAY
- PERMIT BOUNDARY
- MINING LIMIT
- SLURRY WALL
- STOCKPILE AREA
- A — PROPERTY OWNER MAP ID



TYPICAL MINING SECTION
N.T.S.

J&T Consulting, Inc.
305 Denver Avenue - Suite D
Fort Lupton, CO 80621
Ph: 303-857-6222
www.j-tconsulting.com

Bernhardt Sand And Gravel Pit

Exhibit C2 - Mining Plan Map

W.W. Clyde & Co.

REVISIONS

No	Date	By	Chk	Description

J&T Consulting, Inc.

J.C. York

Job #	22036
Date	11.27.23
Drawn By	TPY
Designed By	TPY
Checked By	JCY
File	JT-IHCS Bernhardt Mining.dwg
Scale	As Shown

Sheet: 2 Of: 2

An example Structure Agreement which meets the requirements of the Statutes is shown below.
****

Structure Agreement

This letter has been provided to you as the owner of a structure on or within two hundred (200) feet of a proposed mine site. The State of Colorado, Division of Reclamation, Mining and Safety ("Division") requires that where a mining operation will adversely affect the stability of any significant, valuable and permanent man-made structure located within two hundred (200) feet of the affected land, the Applicant shall either:

a) Provide a notarized agreement between the Applicant and the Person(s) having an interest in the structure, that the Applicant is to provide compensation for any damage to the structure; or

b) Where such an agreement cannot be reached, the Applicant shall provide an appropriate engineering evaluation that demonstrates that such structure shall not be damaged by activities occurring at the mining operation; or

c) Where such structure is a utility, the Applicant may supply a notarized letter, on utility letterhead, from the owner(s) of the utility that the mining and reclamation activities, as proposed, will have "no negative effect" on their utility. (*Construction Materials Rule 6.3.12 and Rule 6.4.19 & Hard Rock/Metal Mining Rule 6.3.12 and Rule 6.4.20)*

The Colorado Mined Land Reclamation Board ("Board") has determined that this form, if properly executed, represents an agreement that complies with Construction Materials Rule 6.3.12(a), Rule 6.4.19(a), and C.R.S. § 34-32.5-115(4)(e) and with Hard Rock/Metal Mining Rule 6.3.12(a), Rule 6.4.20(a), and C.R.S. § 34-32-115(4)(d). This form is for the sole purpose of ensuring compliance with the Rules and Regulations and shall not make the Board or Division a necessary party to any private civil lawsuit to enforce the terms of the agreement or create any enforcement obligations in the Board or the Division.

The following structures are located on or within 200 feet of the proposed affected area:

1. Fence/Property Line _____
2. Stored Materials _____
3. _____
4. _____
5. _____

(*Please list additional structures on a separate page*)

CERTIFICATION

The Applicant, W.W. Clyde & Co. (print applicant/company name), by Andy Carpenter (print representative's name), as Area Manager, Aggregates (print representative's title), does hereby certify that Hidden Platte Ranch, LLC (structure owner) shall be compensated for any damage from the proposed mining operation to the above listed structure(s) located on or within 200 feet of the proposed affected area described within Exhibit A, of the Reclamation Permit Application for Bernhardt Sand and Gravel Pit (operation name), File Number M-2023-025.

This form has been approved by the Colorado Mined Land Reclamation Board pursuant to its authority under the Colorado Land Reclamation Act for the Extraction of Construction Materials and the Colorado Mined Land Reclamation Act for Hard Rock, Metal, and Designated Mining Operations. Any alteration or modification to this form shall result in voiding this form.

NOTARY FOR PERMIT APPLICANT

ACKNOWLEGED BY:

Applicant W.W. Clyde & Co. Representative Name [signature]

Date 10/3/2023 Title Area Manager, Aggregates

STATE OF Colorado)
) ss.
COUNTY OF Weld)

The foregoing was acknowledged before me this 3rd day of October, 2023 by Andy Carpenter as Area Manager of W.W. Clyde + Co.

[signature] My Commission Expires: 12/30/2023
Notary Public

Peggy L Sherman
NOTARY PUBLIC
STATE OF COLORADO
NOTARY ID 20044011484
MY COMMISSION EXPIRES December 30, 2023

NOTARY FOR STRUCTURE OWNER

ACKNOWLEGED BY:

Structure Owner _____ Name _____

Date _____ Title _____

STATE OF _____)
) ss.
COUNTY OF_____)

The foregoing was acknowledged before me this____ day of _____, 20___, by _____ as _____ of _____.

_____ My Commission Expires:_____
Notary Public

An example Structure Agreement which meets the requirements of the Statutes is shown below.
****

Structure Agreement

This letter has been provided to you as the owner of a structure on or within two hundred (200) feet of a proposed mine site. The State of Colorado, Division of Reclamation, Mining and Safety ("Division") requires that where a mining operation will adversely affect the stability of any significant, valuable and permanent man-made structure located within two hundred (200) feet of the affected land, the Applicant shall either:

a) Provide a notarized agreement between the Applicant and the Person(s) having an interest in the structure, that the Applicant is to provide compensation for any damage to the structure; or

b) Where such an agreement cannot be reached, the Applicant shall provide an appropriate engineering evaluation that demonstrates that such structure shall not be damaged by activities occurring at the mining operation; or

c) Where such structure is a utility, the Applicant may supply a notarized letter, on utility letterhead, from the owner(s) of the utility that the mining and reclamation activities, as proposed, will have "no negative effect" on their utility. (*Construction Materials Rule 6.3.12 and Rule 6.4.19 & Hard Rock/Metal Mining Rule 6.3.12 and Rule 6.4.20)*

The Colorado Mined Land Reclamation Board ("Board") has determined that this form, if properly executed, represents an agreement that complies with Construction Materials Rule 6.3.12(a), Rule 6.4.19(a), and C.R.S. § 34-32.5-115(4)(e) and with Hard Rock/Metal Mining Rule 6.3.12(a), Rule 6.4.20(a), and C.R.S. § 34-32-115(4)(d). This form is for the sole purpose of ensuring compliance with the Rules and Regulations and shall not make the Board or Division a necessary party to any private civil lawsuit to enforce the terms of the agreement or create any enforcement obligations in the Board or the Division.

The following structures are located on or within 200 feet of the proposed affected area:

1. Fence/Property Line _____
2. _____
3. _____
4. _____
5. _____

(*Please list additional structures on a separate page*)

CERTIFICATION

The Applicant, W.W. Clyde & Co. (print applicant/company name), by Andy Carpenter (print representative's name), as Area Manager, Aggregates (print representative's title), does hereby certify that Halflight Land & Minerals, LLC (structure owner) shall be compensated for any damage from the proposed mining operation to the above listed structure(s) located on or within 200 feet of the proposed affected area described within Exhibit A, of the Reclamation Permit Application for Bernhardt Sand and Gravel Pit (operation name), File Number M-2023-025.

This form has been approved by the Colorado Mined Land Reclamation Board pursuant to its authority under the Colorado Land Reclamation Act for the Extraction of Construction Materials and the Colorado Mined Land Reclamation Act for Hard Rock, Metal, and Designated Mining Operations. Any alteration or modification to this form shall result in voiding this form.

NOTARY FOR PERMIT APPLICANT

ACKNOWLEGED BY:

Applicant W.W. Clyde & Co. Representative Name [signature]

Date 10/3/2023 Title Area Manager, Aggregates

STATE OF Colorado)
) ss.
COUNTY OF Weld)

The foregoing was acknowledged before me this 3rd day of October, 2023 by Andy Carpenter as Area Manager of W.W. Clyde & Co.

[signature] My Commission Expires: 12/30/2023
Notary Public

Peggy L Sherman
NOTARY PUBLIC
STATE OF COLORADO
NOTARY ID 20044011484
MY COMMISSION EXPIRES December 30, 2023

NOTARY FOR STRUCTURE OWNER

ACKNOWLEGED BY:

Structure Owner _____ Name _____

Date _____ Title _____

STATE OF _____)
) ss.
COUNTY OF_____)

The foregoing was acknowledged before me this____ day of _____, 20___, by _____ as _____ of _____.

_____ My Commission Expires:_____
Notary Public

An example Structure Agreement which meets the requirements of the Statutes is shown below.
****

Structure Agreement

This letter has been provided to you as the owner of a structure on or within two hundred (200) feet of a proposed mine site. The State of Colorado, Division of Reclamation, Mining and Safety ("Division") requires that where a mining operation will adversely affect the stability of any significant, valuable and permanent man-made structure located within two hundred (200) feet of the affected land, the Applicant shall either:

a) Provide a notarized agreement between the Applicant and the Person(s) having an interest in the structure, that the Applicant is to provide compensation for any damage to the structure; or

b) Where such an agreement cannot be reached, the Applicant shall provide an appropriate engineering evaluation that demonstrates that such structure shall not be damaged by activities occurring at the mining operation; or

c) Where such structure is a utility, the Applicant may supply a notarized letter, on utility letterhead, from the owner(s) of the utility that the mining and reclamation activities, as proposed, will have "no negative effect" on their utility. (*Construction Materials Rule 6.3.12 and Rule 6.4.19 & Hard Rock/Metal Mining Rule 6.3.12 and Rule 6.4.20)*

The Colorado Mined Land Reclamation Board ("Board") has determined that this form, if properly executed, represents an agreement that complies with Construction Materials Rule 6.3.12(a), Rule 6.4.19(a), and C.R.S. § 34-32.5-115(4)(e) and with Hard Rock/Metal Mining Rule 6.3.12(a), Rule 6.4.20(a), and C.R.S. § 34-32-115(4)(d). This form is for the sole purpose of ensuring compliance with the Rules and Regulations and shall not make the Board or Division a necessary party to any private civil lawsuit to enforce the terms of the agreement or create any enforcement obligations in the Board or the Division.

The following structures are located on or within 200 feet of the proposed affected area:

1. Fence/Property Line _____
2. _____
3. _____
4. _____
5. _____

(*Please list additional structures on a separate page*)

CERTIFICATION

The Applicant, W.W. Clyde & Co. (print applicant/company name), by Andy Carpenter (print representative's name), as Area Manager, Aggregates (print representative's title), does hereby certify that Ms. Cheryl Kasten, Ms. Karen Currier, Ms. Carlene Stroh (structure owner) shall be compensated for any damage from the proposed mining operation to the above listed structure(s) located on or within 200 feet of the proposed affected area described within Exhibit A, of the Reclamation Permit Application for Bernhardt Sand and Gravel Pit (operation name), File Number M-2023-025.

This form has been approved by the Colorado Mined Land Reclamation Board pursuant to its authority under the Colorado Land Reclamation Act for the Extraction of Construction Materials and the Colorado Mined Land Reclamation Act for Hard Rock, Metal, and Designated Mining Operations. Any alteration or modification to this form shall result in voiding this form.

NOTARY FOR PERMIT APPLICANT

ACKNOWLEGED BY:

Applicant W.W. Clyde & Co Representative Name [signature]

Date 10/3/2023 Title Area Manager, Aggregates

STATE OF Colorado)
) ss.
COUNTY OF Weld)

The foregoing was acknowledged before me this 3rd day of October, 2023, by Andy Carpenter as Area Manager of W.W. Clyde + Co.

[signature] My Commission Expires: 12/30/2023
Notary Public

Peggy L Sherman
NOTARY PUBLIC
STATE OF COLORADO
NOTARY ID 20044011484
MY COMMISS ON EXPIRES December 30, 2023

NOTARY FOR STRUCTURE OWNER

ACKNOWLEGED BY:

Structure Owner _____ Name _____

Date _____ Title _____

STATE OF _____)
) ss.
COUNTY OF_____)

The foregoing was acknowledged before me this____ day of _____, 20___, by _____ as _____ of _____.

_____ My Commission Expires:_____
Notary Public

SLOPE STABILITY REPORT

FOR THE
BERNHARDT SAND AND GRAVEL PIT
WELD COUNTY, COLORADO

MAY 2023
REVISED JANUARY 2024

PREPARED FOR:

WW CLYDE®

10303 EAST DRY CREEK ROAD, #300
ENGLEWOOD, CO 80112
(303) 790-9100

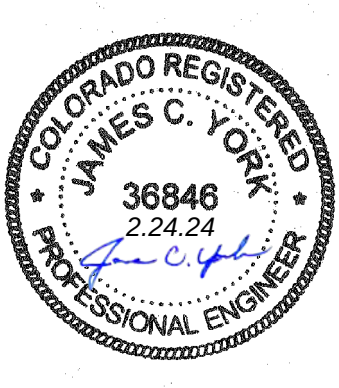
PREPARED BY:

J&T Consulting, Inc.

305 DENVER AVENUE – SUITE D
FORT LUPTON, CO 80621
PHONE: 303-857-6222

CERTIFICATION:

I hereby certify this slope stability analysis for W.W. Clyde & Co. the Bernhardt Sand and Gravel Pit, located in Weld County, Colorado was prepared by me or under my direct supervision.



James C. York
Registered Professional Engineer
State of Colorado No. 36846

Table of Contents

INTRODUCTION

W.W. Clyde & Co. (WW Clyde), proposes to mine the property located in the northeast 1/4 of Section 24, Township 4 North, Range 67 West of the 6th Principal Meridian, in Weld County, Colorado. The property is bounded by the private property on all sides, with the South Platte River being adjacent to the southeast boundary of the property. The proposed mining operation will extract gravel reserves from locations adjacent to man-made structures. The rules and regulations of the Division of Reclamation, Mining, and Safety (DRMS) require that any mining within a 200-foot setback of a man-made structure show thorough engineering analysis that the proposed mining will not cause damage to the structure. The accepted method of demonstrating this is through a slope stability analysis. This report contains an overview of the methodology used in the analysis of the mining slopes and their estimated effects on all man-made structures. Recommendations regarding acceptable setbacks from man-made structures have also been included.

OVERVIEW

The DRMS mining plan proposes that the property will be mined in a single pit, and reclaimed as a water storage reservoir. The mining will occur at 2H:1V slopes. The reservoir will be reclaimed by backfilling the mining slopes with overburden/clay soils at 4.5H:1V slopes, and will cover an estimated 88.88 surface acres when full. The actual surface area will depend on the final configuration of the reservoir after reclamation is complete.

GEOTECHNICAL DATA

Exploratory borings and monitoring wells were done on the site by Cesare Inc./CMT Technical Services. Logs of the borings and monitoring wells used to estimate the soil types and thicknesses for this study are included in Appendix D. J&T Consulting, Inc. (JT) estimated soil strength parameters based on the information from the boring and monitor well logs and other stability analyses that have been performed on gravel mining operations along the Front Range as well as recommendations from Cesare/CMT. Table 1, on the following page, represents a summary of the soil strength parameters that were used in this stability analysis.

Table 1 – Soil Properties

Description	Max dry density (pcf)	Saturated Density (pcf)	Cohesion (psf)	Internal Friction Angle
Clay	100	115	50	25
Sand and Gravel	115	130	10	35
Weathered Sandstone Bedrock	105	115	1000	0
Weathered Claystone Bedrock	110	120	1000	0
Stable Sandstone Bedrock	115	128	3000	0
Stable Claystone Bedrock	120	135	3000	0
Slurry Wall	100	110	0	45

DESIGN ANALYSIS AND CRITERIA

The proposed mining slopes were analyzed using Clover Technologies Galena Slope Stability Analysis System, version 7.2. Galena was designed to analyze the slope stability of earth embankments subjected to several critical situations that may occur during the life of the embankment. For this project, five cases were identified as critical during the mining operation. Static and pseudo-static conditions were analyzed in each case.

Pseudo-static peak acceleration factors (peak horizontal acceleration, or PHA) were taken from USGS information for the western United States. The 2% probability of exceedance in 50 years (the most conservative) was used. The USGS peak acceleration map is included in Appendix E. A peak acceleration factor of 0.10 x gravity was taken from this data. A conservative earthquake loading coefficient of 0.50 x PHA is often used for slope stability analyses (50% of PHA). We used an even more conservative approach and used 70% of the PHA for this area for our earthquake loading coefficient. Hence, 0.70 x 0.10 = 0.07.

All mining side slopes will be 2H:1V, and all reclaimed slopes will be 4.5H:1V.

The locations of the cases are shown on the case location map included in Appendix A.

Case SS-1 – Gas Line West of Pit.
The mining operation is adjacent to a gas line on the west side of the pit. The proposed setback for mining is 53 feet from the gas line. The mining depth was assumed to be 38 feet in this area based on bore log information.

Case SS-2 – Gas Line North of Pit.
The mining operation is adjacent to a gas line on the north side of the pit. The proposed setback for mining is 91 feet from the power poles/lines. The mining depth was assumed to be 34 feet in this area based on bore log information.

Case SS-3 – Gas Line Northeast of Pit.
The mining operation is adjacent to a gas line on the northeast side of the pit. The proposed setback for mining is 61 feet from the gas line. The mining depth was assumed to be 34 feet in this area based on bore log information.

Case SS-4 – Gas Line East of Pit.
The mining operation is adjacent to a gas line on the east side of the pit. The proposed setback for mining is 46 feet from the gas line. The mining depth was assumed to be 35 feet in this area based on bore log information.

Case SS-5 – Gas Line South of Pit
The mining operation is adjacent to a gas line on the south side of the pit. The proposed setback for mining is 45 feet from the irrigation ditch bank. The mining depth was assumed to be 36 feet in this area based on bore log information.

The cross-sections located in Appendix B show the estimated phreatic surface associated with each case, the geometry used in the mining/reclamation, and the locations of the man-made structures adjacent to the mining slopes.

METHODOLOGY

The mining embankment configuration shown in the computer analysis represents the estimated conditions for this site. If mining conditions differ from the estimated conditions, the slope stability will need to be re-evaluated on a case-by-case basis. The Bishop Method was used in the computer analysis for determining safety factors. The procedure searches for circular shear failures and automatically searches for the lowest safety factor. 20,000 separate failure surfaces were analyzed for each case. The required minimum safety factors are based on the policy of the Mined Land Reclamation Board (MLRD) for Factors of Safety for Slope Stability / Geotechnical Analyses.

All cases were analyzed using mining condition geometry to determine the factor of safety for each case with the steeper mining slopes. Case SS-5, which is the location that is closest to a critical structure (45 feet from the gas line), was analyzed to determine the minimum factor of safety for all reclaimed slopes.

SLOPE STABILITY RESULTS

When estimated soil strength parameters are used, the MLRB requires minimum safety factors of 1.50 for static condition analyses and 1.30 for pseudo-static (earthquake loading) condition analyses for embankments adjacent to critical structures. The calculated factors of safety are within the design criteria specified for this project and can be considered indicators of the mining slope performance under the various conditions. The results of the static condition and pseudo-static condition slope stability analyses are shown in Tables 2, 3, & 4 below.

Table 2: Mining Conditions
Static Condition Slope Stability Analysis Results

Description	Calculated Factor of Safety	Required Minimum Factor of Safety
Case SS-1 – Gas Line West of Pit – Static	2.03	1.50
Case SS-2 – Gas Line North of Pit – Static	2.14	1.50
Case SS-3 – Gas Line Northeast of Pit – Static	2.08	1.50
Case SS-4 – Gas Line East of Pit – Static	2.21	1.50
Case SS-5 – Gas Line South of Pit – Static	2.14	1.50

Table 3: Mining Conditions
Pseudo-Static Condition Slope Stability Analysis Results

Description	Calculated Factor of Safety	Required Minimum Factor of Safety
Case SS-1 – Gas Line West of Pit – EQ	1.61	1.30
Case SS-2 – Gas Line North of Pit – EQ	1.55	1.30
Case SS-3 – Gas Line Northeast of Pit – EQ	1.59	1.30
Case SS-4 – Gas Line East of Pit – EQ	1.73	1.30
Case SS-5 – Gas Line South of Pit – EQ	1.70	1.30

Table 3: Reclaimed Conditions
Static & Pseudo-Static Condition Slope Stability Analysis Results

Description	Calculated Factor of Safety	Required Minimum Factor Of Safety
Case SS-5 – Gas Line West of Pit – Static	2.41	1.50
Case SS-5 – Gas Line West of Pit – EQ	1.72	1.30

The Galena analysis output files are included in Appendix C for all cases.

CONCLUSIONS AND RECOMMENDATIONS

Mining Conditions:

Case SS-1 – At a setback of 53 feet, the lowest resulting static condition safety factor of 2.01 exceeds the MLRB minimum requirement of 1.50 for an embankment adjacent to a critical structure. The lowest resulting pseudo-static condition safety factor of 1.61 exceeds the MLRB minimum requirement of 1.30 for an embankment adjacent to a critical structure subject to earthquake loading. The proposed setback of 53 feet from the gas line is satisfactory.

Case SS-2 – At a setback of 91 feet, the lowest resulting static condition safety factor of 2.14 exceeds the MLRB minimum requirement of 1.50 for an embankment adjacent to a critical structure. The lowest resulting pseudo-static condition safety factor of 1.55 exceeds the MLRB minimum requirement of 1.30 for an embankment adjacent to a critical structure subject to earthquake loading. The proposed setback of 91 feet from the gas line is satisfactory.

Case SS-3 – At a setback of 61 feet, the lowest resulting static condition safety factor of 2.08 exceeds the MLRB minimum requirement of 1.50 for an embankment adjacent to a critical structure. The lowest resulting pseudo-static condition safety factor of 1.59 exceeds the MLRB minimum requirement of 1.30 for an embankment adjacent to a critical structure subject to earthquake loading. The proposed setback of 61 feet from the gas line is satisfactory.

Case SS-4 – At a setback of 46 feet, the lowest resulting static condition safety factor of 2.21 exceeds the MLRB minimum requirement of 1.50 for an embankment adjacent to a critical structure. The lowest resulting pseudo-static condition safety factor of 1.73 exceeds the MLRB minimum requirement of 1.30 for an embankment adjacent to a critical structure subject to earthquake loading. The proposed setback of 46 feet from the gas line and lift station is satisfactory.

Case SS-5 – At a setback of 45 feet, the lowest resulting static condition safety factor of 2.14 exceeds the MLRB minimum requirement of 1.50 for an embankment adjacent to a critical structure. The lowest resulting pseudo-static condition safety factor of 1.70 exceeds the MLRB minimum requirement of 1.30 for an embankment adjacent to a critical structure subject to earthquake loading. The proposed setback of 45 feet from the gas line is satisfactory.

CONCLUSIONS AND RECOMMENDATIONS (Continued)

Reclaimed Conditions:

Case SS-5 – At a setback of 45 feet, the lowest resulting static condition safety factor of 2.41 exceeds the MLRB minimum requirement of 1.50 for an embankment adjacent to a critical structure. The lowest resulting pseudo-static condition safety factor of 1.72 exceeds the MLRB minimum requirement of 1.30 for an embankment adjacent to a critical structure subject to earthquake loading. The proposed setback of 45 feet from the gas line is satisfactory.

The following recommendations for monitoring of slope stability should be followed:

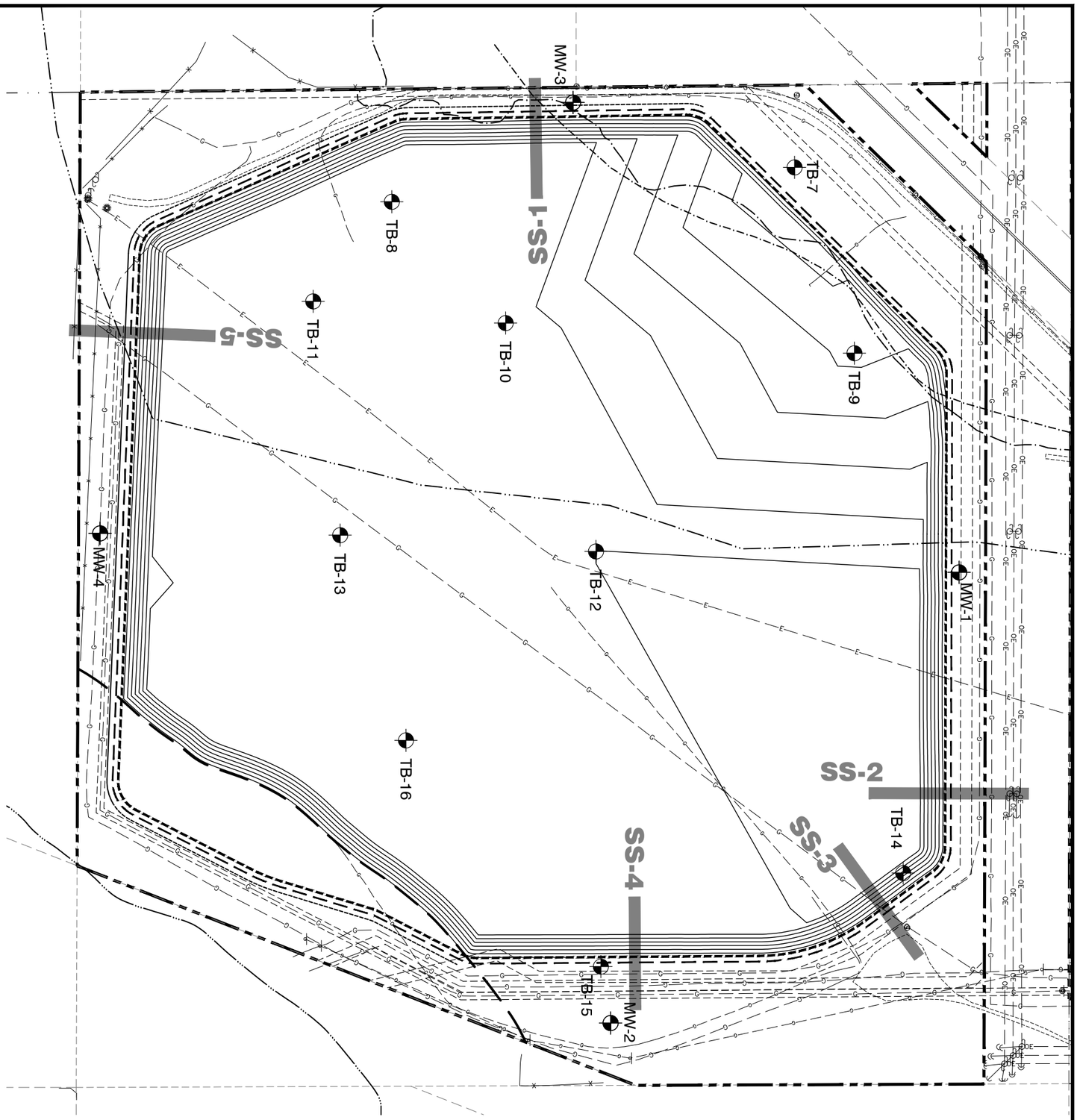
1. A visual inspection of the excavated slopes should be done on a weekly basis for the duration of mining. This inspection should consist of walking the existing ground and looking for any signs of stress cracks or other potential signs of slope failure. Some minor sloughing of slopes is expected on any mine site. The intent of this inspection is to locate potential major slope failures that could potentially extend back into a structure.

2. A visual inspection should be done after a major precipitation event that has saturated the ground using the same procedures. A major precipitation event would be defined as a storm that produces an intensity level reached once in 50 years on the average.

3. If a visual inspection detects signs of a potential slope failure, qualified personnel should be contacted to evaluate and recommend remediation work to stabilize the area.

4. If no visible signs of slope failure are detected during mining, then the inspection period could be reduced to once per 6 months after mining completion, or after every major precipitation event.

APPENDIX A



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Drawn By	TPY				
Designed By	TPY				
Checked By	JCY				
File	JT Bernhardt SS				
Scale	1" = 150'				
Sheet:	1 Of: 1				

W.W. Clyde & Co.

Bernhardt Sand and Gravel Pit

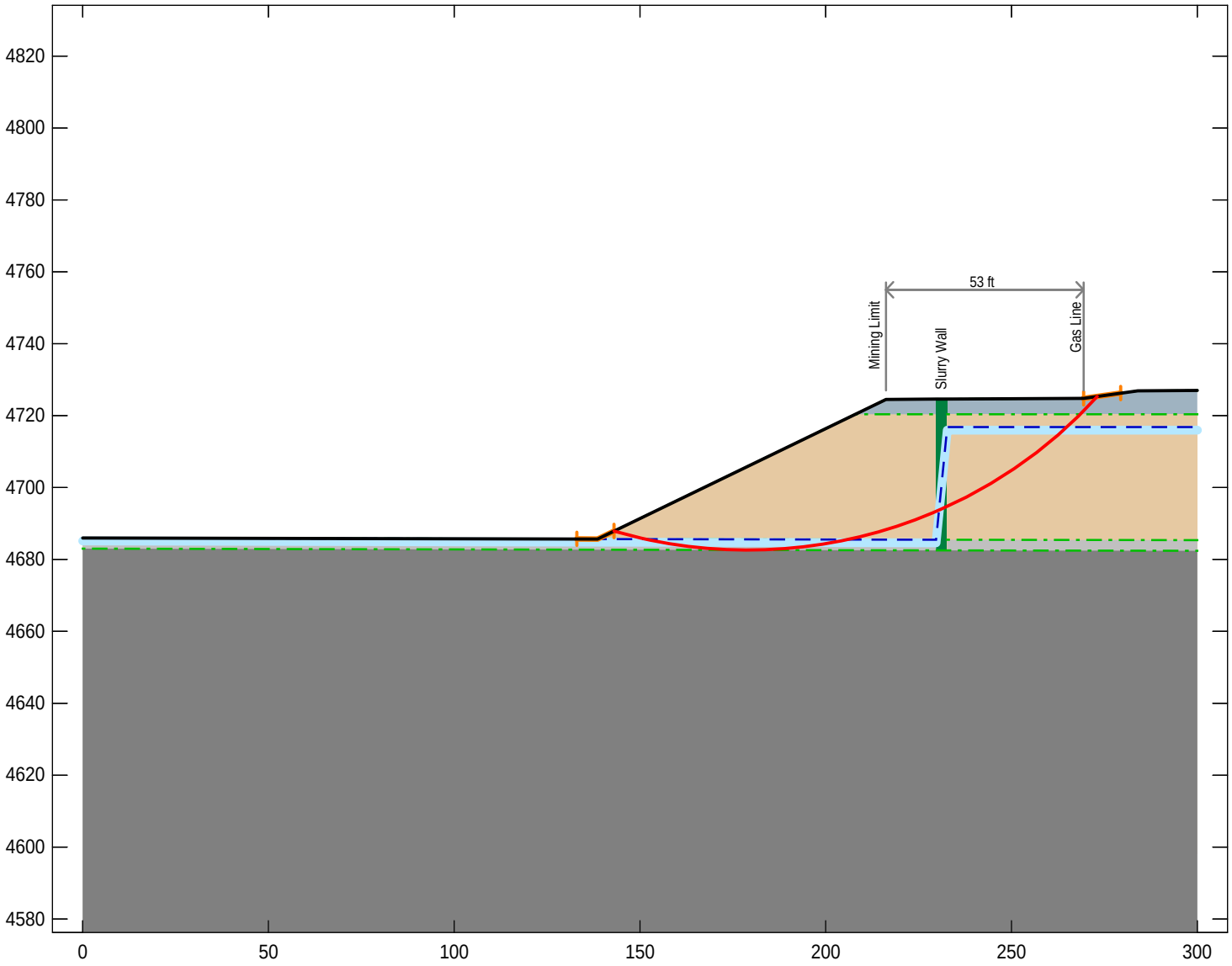
Slope Stability Case Location Map

J&T Consulting, Inc.

305 Denver Avenue - Suite D
Fort Lupton, CO 80621
Ph: 303-857-6222 Fax: 303-857-6224
www.j-tconsulting.com

APPENDIX B

Mining Conditions



GALENA Version 7.2

Licensed to: J & T Consulting

Material Keys

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2: Weathered Claystoe Bedrock (c:1000 ø:0 g:110) Sat Đ

3: Stable Claystone Bedrock (c:3000 ø:0 g:120) Sat Đ

4: Slurry Wall (c:0 ø:45 g:100) Sat Đ

5: Clay (c:50 ø:25 g:100) Sat Đ

Analysis 1

Multiple Stability Analysis

Method: Bishop Simplified

Surface: Circular

Results

Critical Factor of Safety: 2.03

Project Bernhardt Sand and Gravel Pit
Case SS-1 - Static

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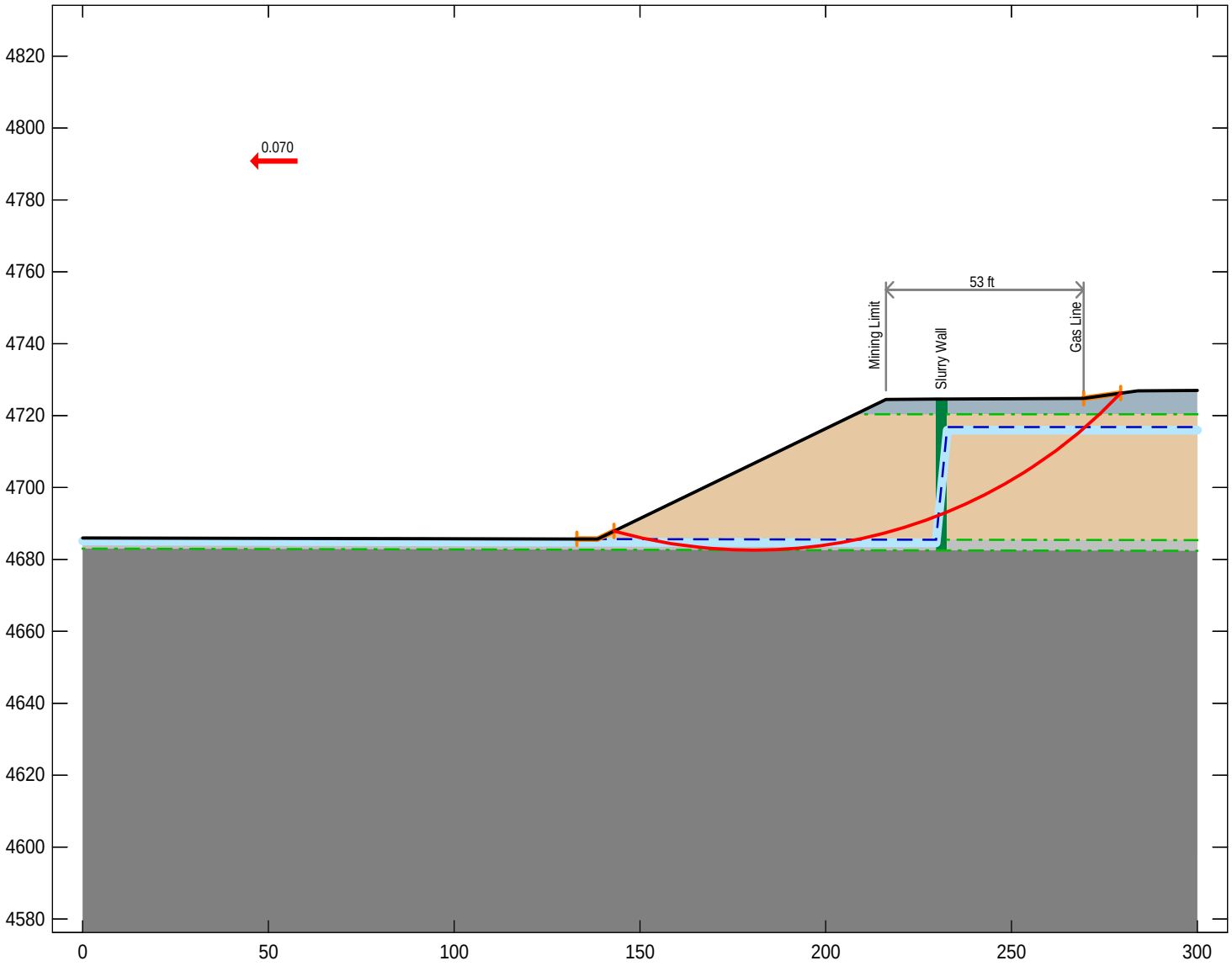
Edited: 23 Feb 2024
Processed: 23 Feb 2024

J&T Consulting, Inc.



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Analysis 1

Multiple Stability Analysis

Method: Bishop Simplified

Surface: Circular

Results

Critical Factor of Safety: 1.61

Project Bernhardt Sand and Gravel Pit
Case SS-1 - Pseudo-Static

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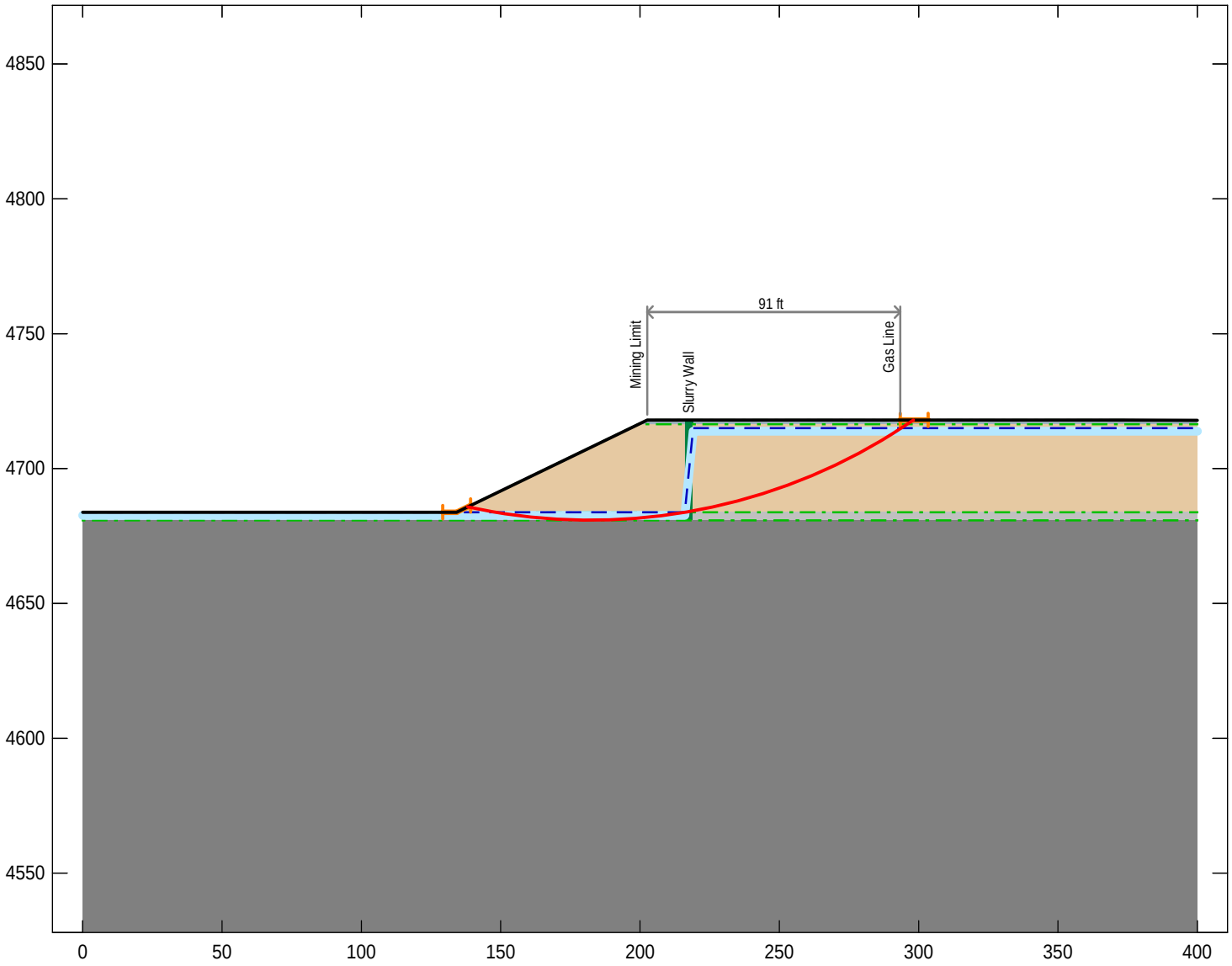
Edited: 27 Jan 2024
Processed: 23 Feb 2024

J&T Consulting, Inc.



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Analysis 1

Multiple Stability Analysis

Method: Bishop Simplified

Surface: Circular

Results

Critical Factor of Safety: 2.14

Project Bernhardt Sand and Gravel Pit
Case SS-2 - Static

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Processed: 23 Feb 2024

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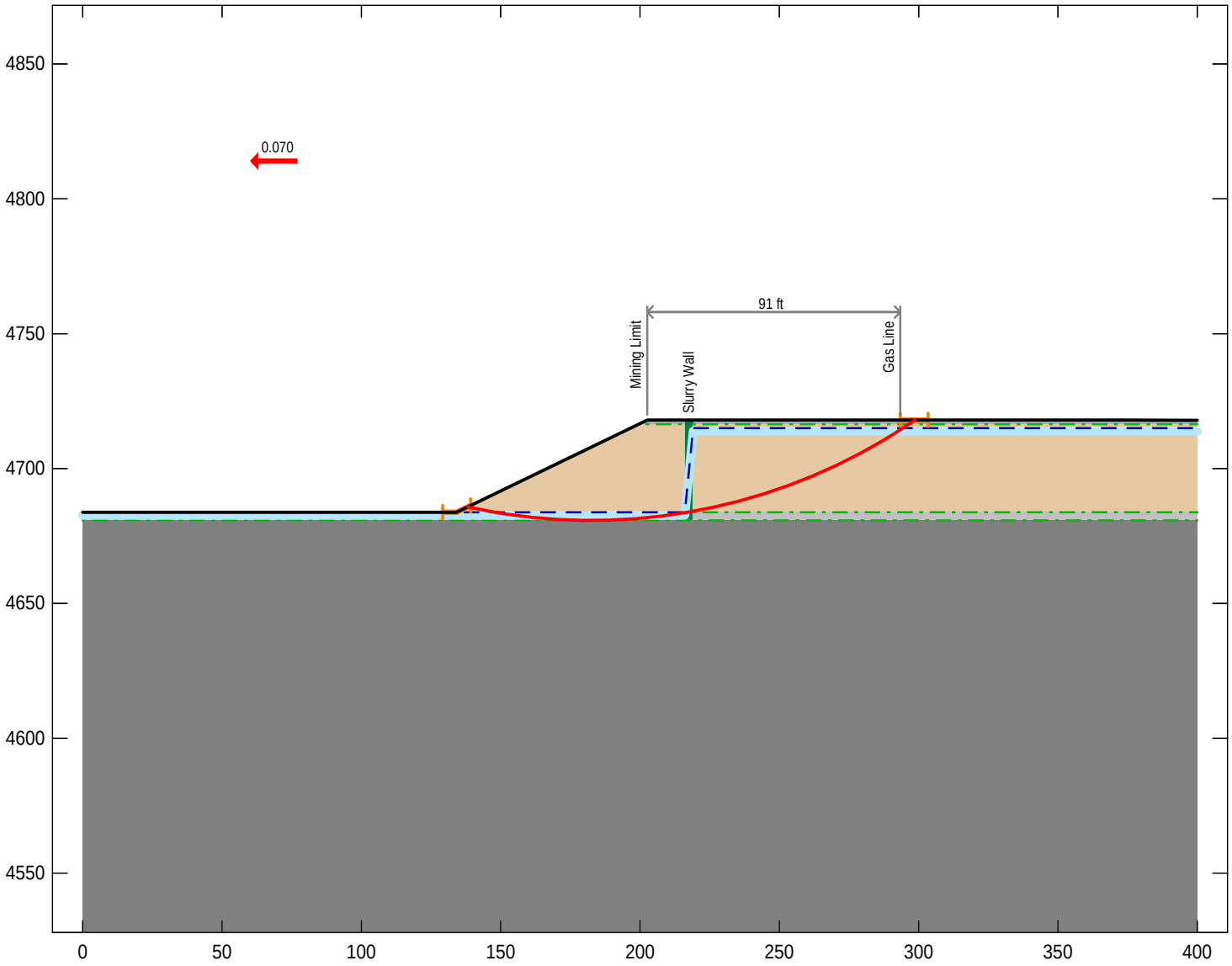

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4: Slurry Wall (c:0 ø:45 g:100) Sat Đ

5: Clay (c:50 ø:25 g:100) Sat Đ

Analysis 1

Multiple Stability Analysis

Method: Bishop Simplified

Surface: Circular

Results

Critical Factor of Safety: 1.55

Project Bernhardt Sand and Gravel Pit
Case SS-2 - Pseudo-Static

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Edited: 27 Jan 2024
Processed: 23 Feb 2024

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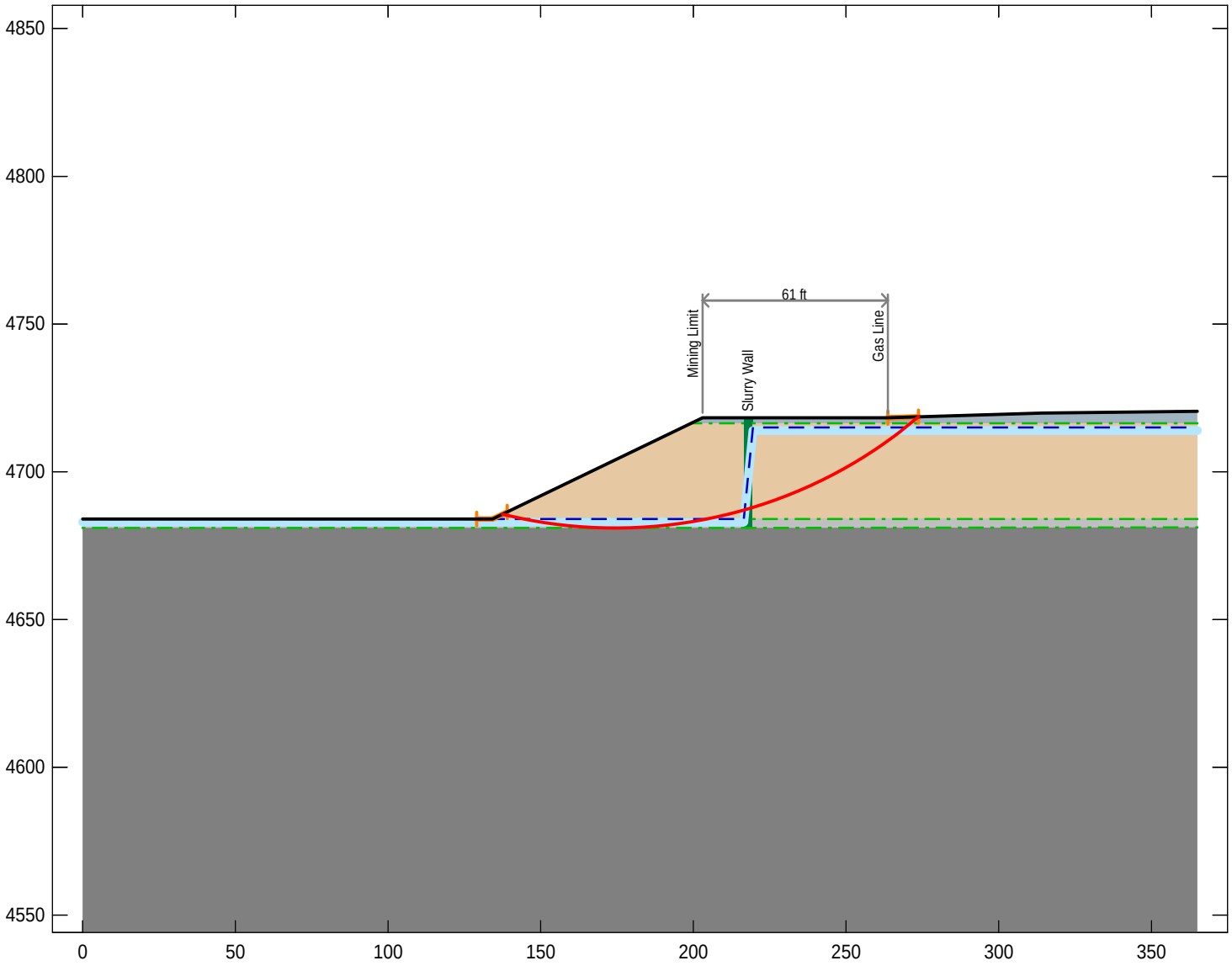

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Analysis 1

Multiple Stability Analysis

Method: Bishop Simplified

Surface: Circular

Results

Critical Factor of Safety: 2.08

Project Bernhardt Sand and Gravel Pit
Case SS-3 - Static

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Edited: 28 Jan 2024
Processed: 24 Feb 2024

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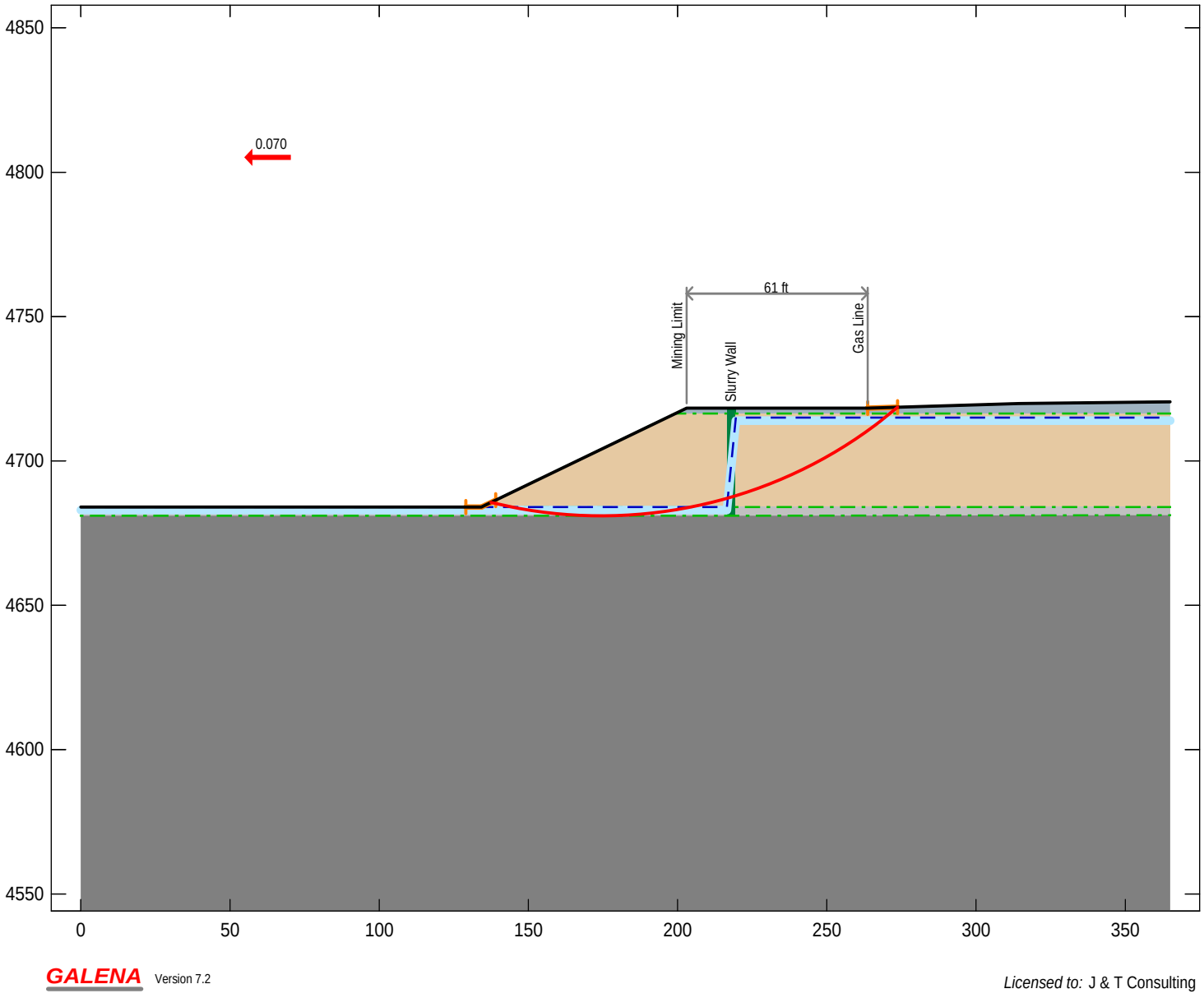

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Analysis 1

Multiple Stability Analysis

Method: Bishop Simplified

Surface: Circular

Results

Critical Factor of Safety: 1.59

Project Bernhardt Sand and Gravel Pit
Case SS-3 - Pseudo-Static

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Edited: 28 Jan 2024
Processed: 24 Feb 2024

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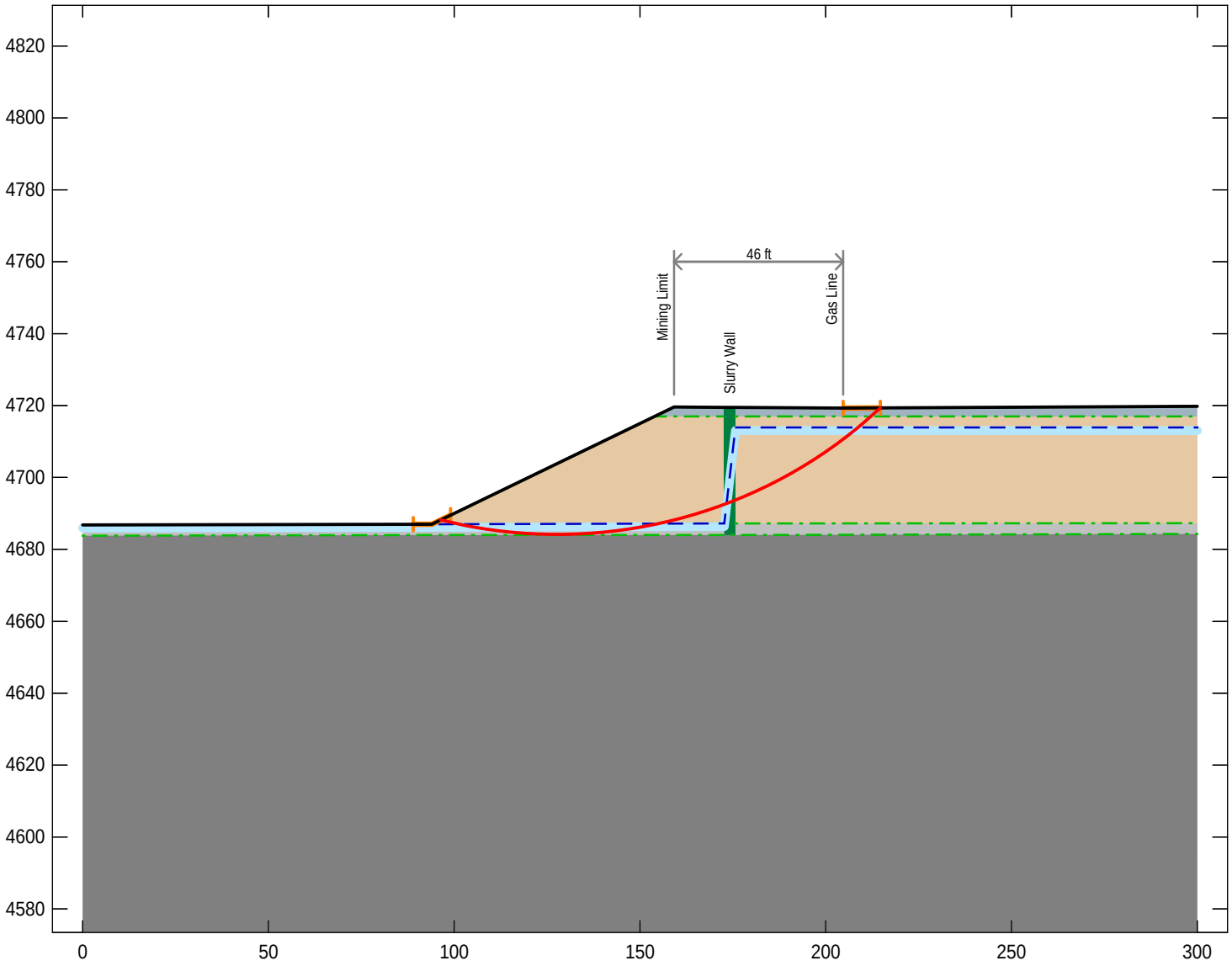

GALENA Version 7.2

Licensed to: J & T Consulting

Material Keys

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5: Clay (c:50 ø:25 g:100) Sat Đ

Analysis 1

Multiple Stability Analysis

Method: Bishop Simplified

Surface: Circular

Results

Critical Factor of Safety: 2.21

Project Bernhardt Sand and Gravel Pit
Case SS-4 - Static

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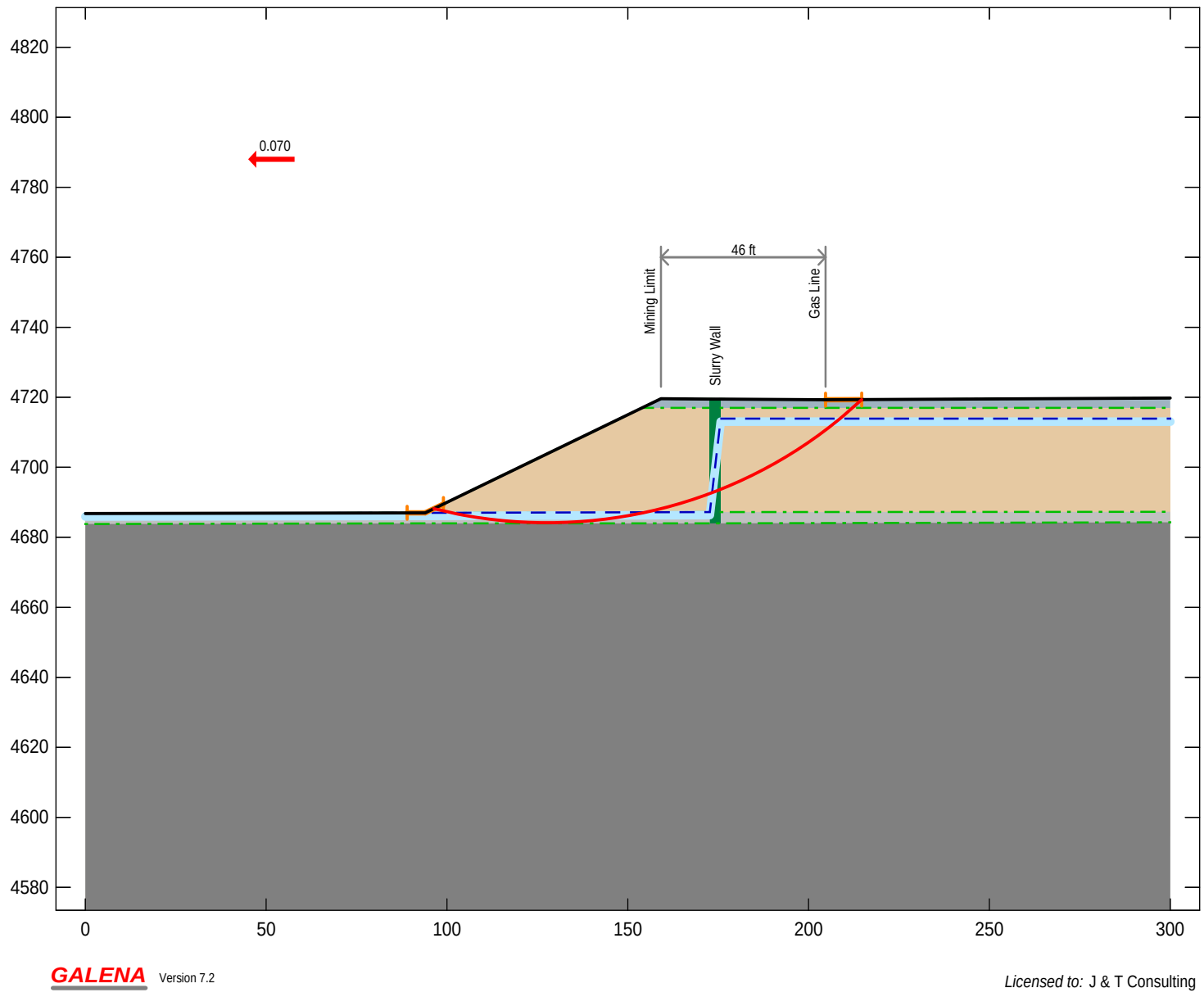
Edited: 28 Jan 2024
Processed: 24 Feb 2024

J&T Consulting, Inc.



GALENA Version 7.2

Licensed to: J & T Consulting

Material Keys

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4: Slurry Wall (c:0 ø:45 g:100) Sat Đ

5: Clay (c:50 ø:25 g:100) Sat Đ

Analysis 1

Multiple Stability Analysis

Method: Bishop Simplified

Surface: Circular

Results

Critical Factor of Safety: 1.73

Project Bernhardt Sand and Gravel Pit
Case SS-4 - Pseudo-Static

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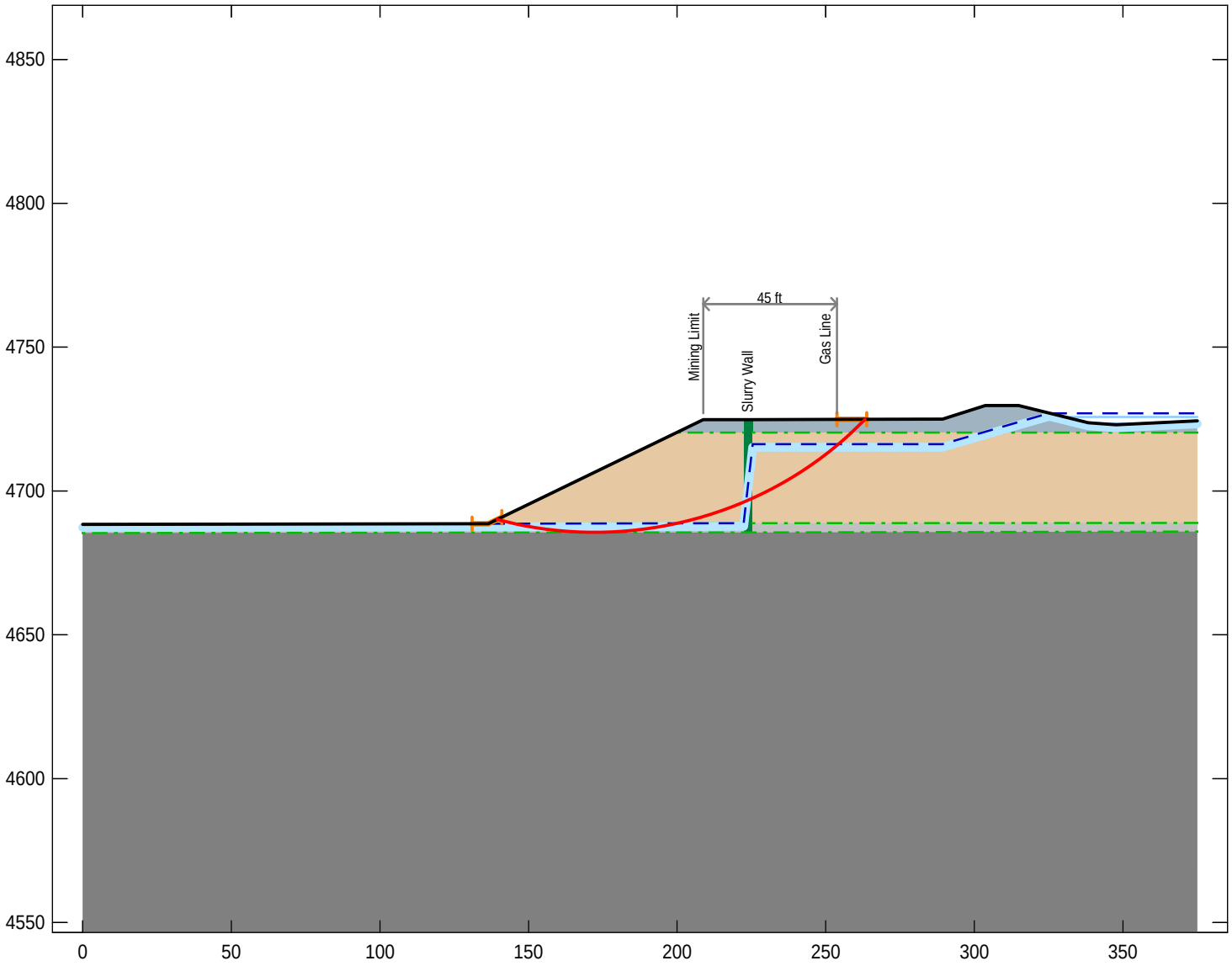
Edited: 28 Jan 2024
Processed: 24 Feb 2024

J&T Consulting, Inc.



GALENA Version 7.2

Licensed to: J & T Consulting

Material Keys

1: Sand and Gravel (c:10 ø:35 g:115) Sat Đ

2: Weathered Claystone Bedrock (c:1000 ø:0 g:110) Sat Đ

3: Stable Claystone Bedrock (c:3000 ø:0 g:120) Sat Đ

4: Slurry Wall (c:0 ø:45 g:100) Sat Đ

5: Clay (c:50 ø:25 g:100) Sat Đ

Analysis 1

Multiple Stability Analysis

Method: Bishop Simplified

Surface: Circular

Results

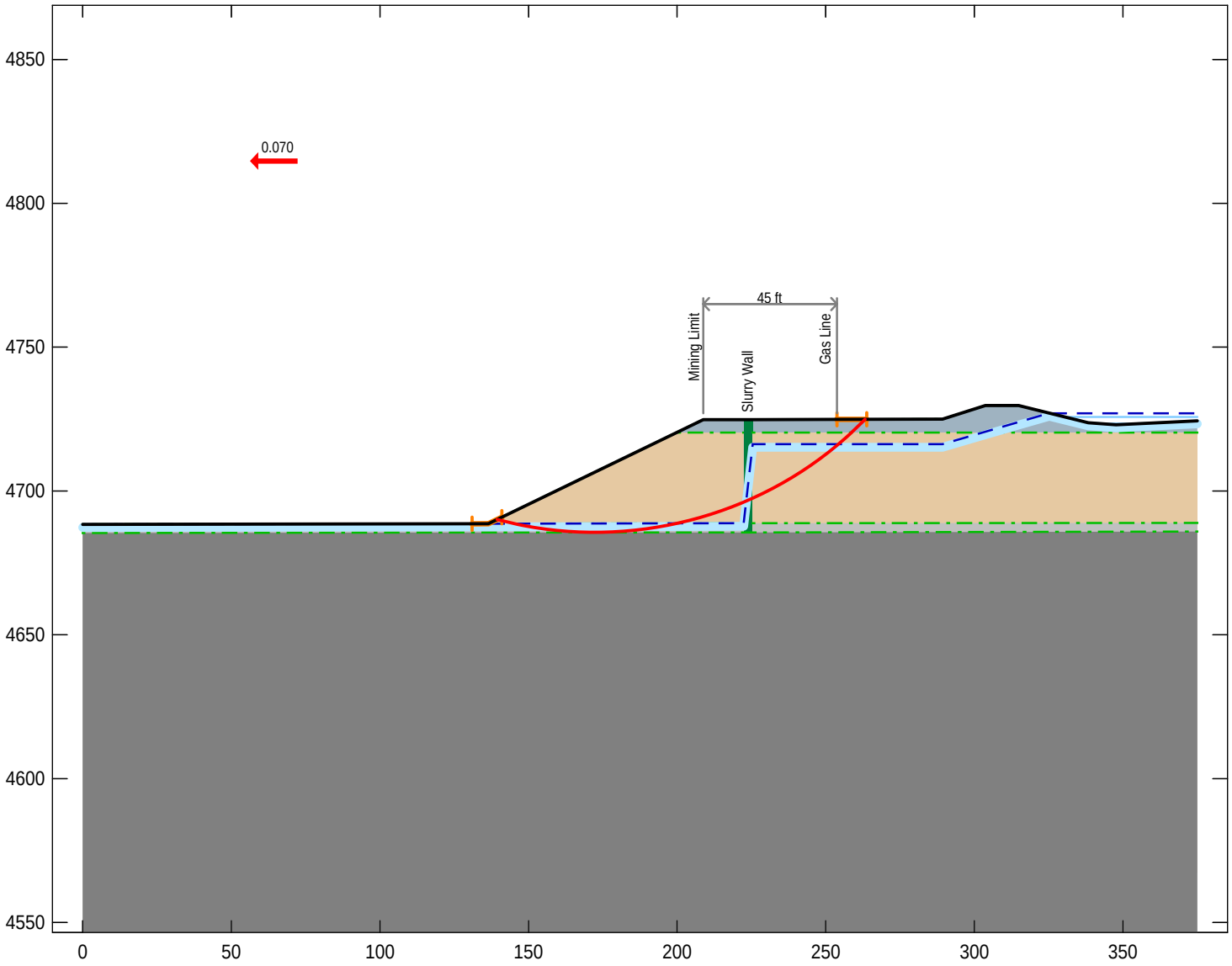
Critical Factor of Safety: 2.14

Project Bernhardt Sand and Gravel Pit
Case SS-5 - Static

File: P:\22036 IHC Scott Milliken Property\Slope Stability\Galena\Bernhardt SS5.gmf

Edited: 28 Jan 2024
Processed: 24 Feb 2024

J&T Consulting, Inc.



GALENA Version 7.2

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Material Keys

1: Sand and Gravel (c:10 ø:35 g:115) Sat Đ

2: Weathered Claystone Bedrock (c:1000 ø:0 g:110) Sat Đ

3: Stable Claystone Bedrock (c:3000 ø:0 g:120) Sat Đ

4: Slurry Wall (c:0 ø:45 g:100) Sat Đ

5: Clay (c:50 ø:25 g:100) Sat Đ

Analysis 1

Multiple Stability Analysis

Method: Bishop Simplified

Surface: Circular

Results

Critical Factor of Safety: 1.70

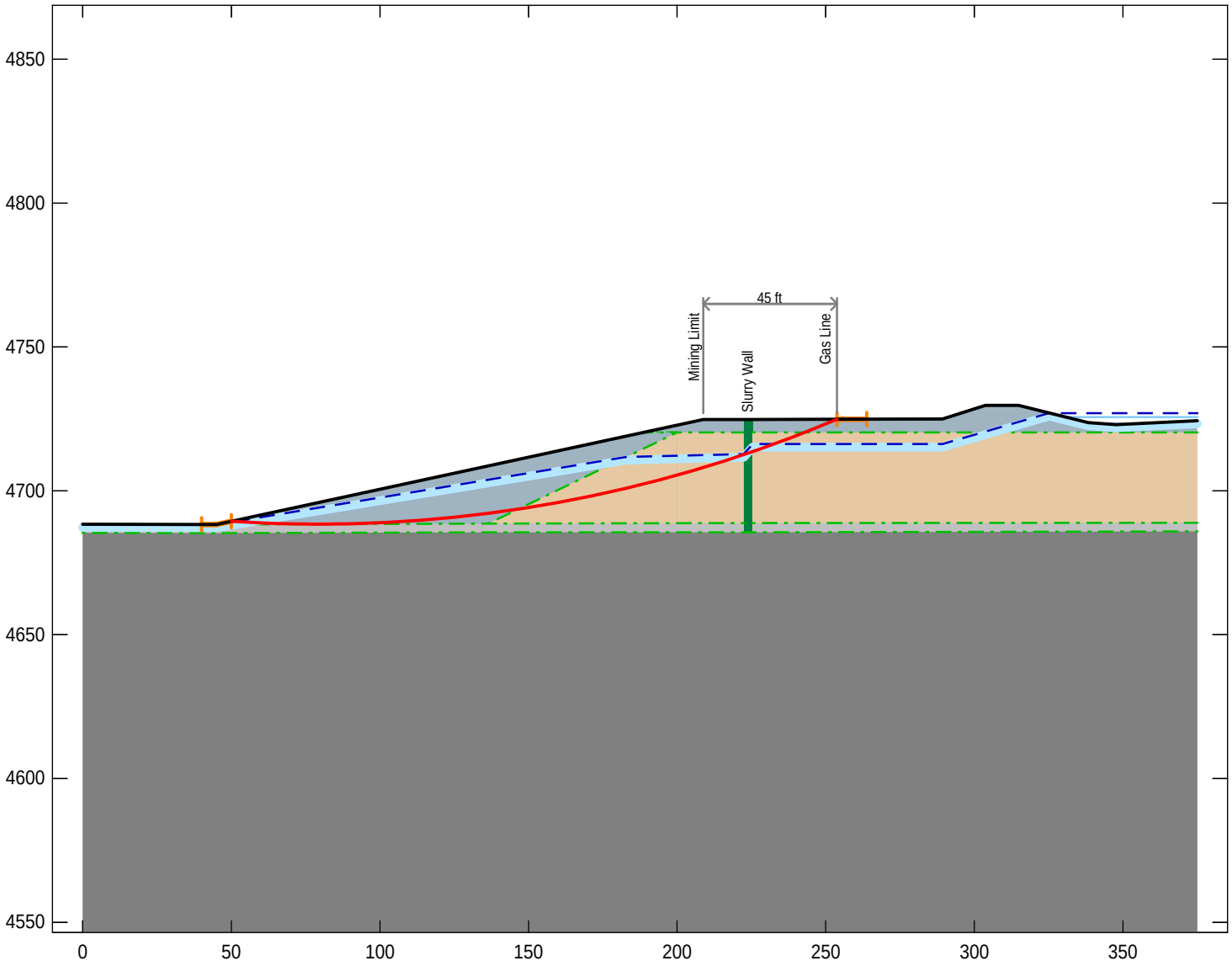
Project Bernhardt Sand and Gravel Pit
Case SS-5 - Pseudo-Static

File: P:\22036 IHC Scott Milliken Property\Slope Stability\Galena\Bernhardt SS5-EQ.gmf

Edited: 28 Jan 2024
Processed: 24 Feb 2024

J&T Consulting, Inc.

Reclamation Conditions



GALENA Version 7.2

Licensed to: J & T Consulting

Material Keys

1: Sand and Gravel (c:10 ø:35 g:115) Sat Đ

2: Weathered Claystone Bedrock (c:1000 ø:0 g:110) Sat Đ

3: Stable Claystone Bedrock (c:3000 ø:0 g:120) Sat Đ

4: Slurry Wall (c:0 ø:45 g:100) Sat Đ

5: Clay (c:50 ø:25 g:100) Sat Đ

Analysis 1

Multiple Stability Analysis

Method: Bishop Simplified

Surface: Circular

Results

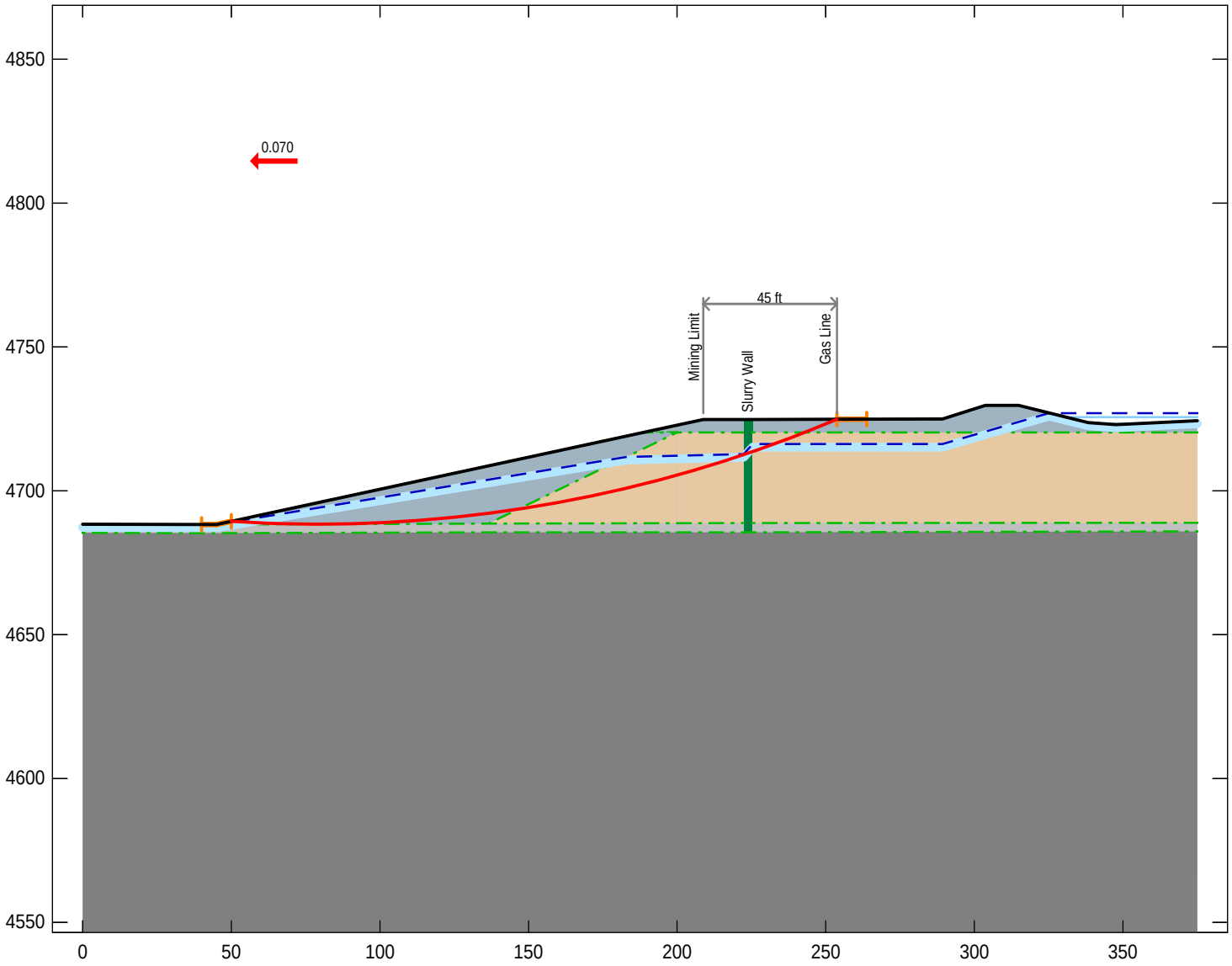
Critical Factor of Safety: 2.41

Project Bernhardt Sand and Gravel Pit
Case SS-5 - Reclamation - Static

File: P:\22036 IHC Scott Milliken Property\Slope Stability\Galena\Bernhardt SS5-REC.gmf

Edited: 24 Feb 2024
Processed: 24 Feb 2024

J&T Consulting, Inc.



GALENA Version 7.2

Licensed to: J & T Consulting

Material Keys

1: Sand and Gravel (c:10 ø:35 g:115) Sat Đ

2: Weathered Claystone Bedrock (c:1000 ø:0 g:110) Sat Đ

3: Stable Claystone Bedrock (c:3000 ø:0 g:120) Sat Đ

4: Slurry Wall (c:0 ø:45 g:100) Sat Đ

5: Clay (c:50 ø:25 g:100) Sat Đ

Analysis 1

Multiple Stability Analysis

Method: Bishop Simplified

Surface: Circular

Results

Critical Factor of Safety: 1.72

Project Bernhardt Sand and Gravel Pit
Case SS-5 - Reclamation - Pseudo-Static

File: P:\22036 IHC Scott Milliken Property\Slope Stability\Galena\Bernhardt SS5-REC-EQ.gmf

Edited: 28 Jan 2024
Processed: 24 Feb 2024

J&T Consulting, Inc.

APPENDIX C

Mining Conditions

Project: Bernhardt Sand and Gravel Pit
File: P:\22036 IHC Scott Milliken Property\Slope Stability\Galena\Bernhardt SS1.gmf
Processed: 23 Feb 2024 09:42:28

DATA: Analysis 1 - Case SS-1 - Static

Material Properties (5 materials)

Material: 1 (Mohr-Coulomb Isotropic) - Sand and Gravel

	Cohesion	Phi	UnitWeight	Ru
Unsaturated:	10.00	35.0	115.00	Auto
Saturated:	10.00	35.0	130.00	Auto

Material: 2 (Mohr-Coulomb Isotropic) - Weathered Claystoe Bedrock

	Cohesion	Phi	UnitWeight	Ru
Unsaturated:	1000.00	0.0	110.00	Auto
Saturated:	1000.00	0.0	120.00	Auto

Material: 3 (Mohr-Coulomb Isotropic) - Stable Claystone Bedrock

	Cohesion	Phi	UnitWeight	Ru
Unsaturated:	3000.00	0.0	120.00	Auto
Saturated:	3000.00	0.0	135.00	Auto

Material: 4 (Mohr-Coulomb Isotropic) - Slurry Wall

	Cohesion	Phi	UnitWeight	Ru
Unsaturated:	0.00	45.0	100.00	Auto
Saturated:	0.00	45.0	110.00	Auto

Material: 5 (Mohr-Coulomb Isotropic) - Clay

	Cohesion	Phi	UnitWeight	Ru
Unsaturated:	50.00	25.0	100.00	Auto
Saturated:	50.00	25.0	115.00	Auto

Water Properties

Unit weight of water: 62.400 Unit weight of water/medium above ground: 62.400

Material Profiles (7 profiles)

Profile: 1 (2 points) Material beneath: 5 - Clay
0.00 4728.00 300.00 4728.00

Profile: 2 (2 points) Material beneath: 1 - Sand and Gravel
0.00 4720.40 229.70 4720.40

Profile: 3 (2 points) Material beneath: 4 - Slurry Wall

```
    229.70     4724.70         232.70     4724.70
Profile:  4 (2 points)   Material beneath:  1 - Sand and Gravel
    232.70     4720.40         300.00     4720.40
Profile:  5 (3 points)   Material beneath:  2 - Weathered Claystoe Bedrock
      0.00     4686.00         138.60     4685.70         229.70     4685.50
Profile:  6 (2 points)   Material beneath:  2 - Weathered Claystoe Bedrock
    232.70     4685.50         300.00     4685.40
Profile:  7 (4 points)   Material beneath:  3 - Stable Claystone Bedrock
      0.00     4683.00         138.60     4682.70         229.70     4682.50         300.00     4682.40

Slope Surface (8 points)
-------------
      0.00     4686.00         138.60     4685.70         216.20     4724.50         229.70     4724.60         232.70
4724.60
    269.40     4724.80         284.00     4726.90         300.00     4727.00

Phreatic Surface (5 points)
----------------
      0.00     4686.00         138.60     4685.70         229.70     4685.50         232.70     4716.80         300.00
4716.80

Failure Surface
---------------
Initial circular surface for critical search defined by: XL,XR,R
  Intersects:  XL:     138.00      YL:    4685.70      XR:     274.40      YR:    4725.52
      Centre:  XC:     153.81      YC:    4885.08                  Radius:  R:     200.00

Variable Restraints
-------------------
Parameter descriptor:              XL         XR         R
Range of variation:             10.00      10.00     150.00
Trial positions within range:      20         20         50

-  --  --  --  --  --  --  --  --  --  --  --  --  --  --  --  --  --  --  --  --  --  --  --  --  --  --  --  --  --  --
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RESULTS: Analysis  1 - Case SS-1 - Static

Bishop Simplified Method of Analysis - Circular Failure Surface
------------------------------------------------------------
Critical Failure Surface Search using Multiple Circle Generation Techniques

Initial failure surface approximation - Factor of Safety:   2.554

Analysis Summary
```

==========
There were: 18041 successful analyses from a total of 20001 trial failure surfaces
             1960 analyses terminated due to unacceptable geometry

Critical (minimum) Factor of Safety: 2.03
==========

Results Summary - Lowest 99 Factor of Safety circles

Circle	X-Left	Y-Left	X-Right	Y-Right	X-Centre	Y-Centre	Radius	FoS	
1	143.00	4687.90	273.08	4725.33	178.98	4807.61	125.00	2.032	<-- Critical Surface
2	143.00	4687.90	275.19	4725.63	179.44	4810.67	128.06	2.034	
3	143.00	4687.90	277.29	4725.94	179.90	4813.72	131.12	2.039	
4	142.47	4687.64	271.51	4725.10	177.60	4807.60	125.00	2.041	
5	141.95	4687.37	269.93	4724.88	176.21	4807.59	125.00	2.043	
6	143.00	4687.90	279.40	4726.24	180.36	4816.78	134.18	2.044	
7	142.47	4687.64	273.61	4725.41	178.05	4810.66	128.06	2.044	
8	143.00	4687.90	272.56	4725.25	178.62	4807.72	125.00	2.044	
9	143.00	4687.90	274.66	4725.56	179.07	4810.78	128.06	2.048	
10	142.47	4687.64	270.98	4725.03	177.23	4807.71	125.00	2.051	
11	143.00	4687.90	276.77	4725.86	179.54	4813.83	131.12	2.051	
12	142.47	4687.64	273.08	4725.33	177.69	4810.76	128.06	2.053	
13	141.95	4687.37	269.40	4724.80	175.84	4807.69	125.00	2.054	
14	143.00	4687.90	278.87	4726.16	180.00	4816.88	134.18	2.054	
15	142.47	4687.64	275.19	4725.63	178.15	4813.81	131.12	2.055	
16	143.00	4687.90	272.03	4725.18	178.25	4807.83	125.00	2.056	
17	141.95	4687.37	271.51	4725.10	176.29	4810.74	128.06	2.059	
18	141.95	4687.37	275.72	4725.71	177.22	4816.84	134.18	2.060	
19	143.00	4687.90	274.14	4725.48	178.71	4810.88	128.06	2.060	
20	142.47	4687.64	270.45	4724.95	176.86	4807.81	125.00	2.060	
21	141.95	4687.37	273.61	4725.41	176.76	4813.79	131.12	2.061	
22	141.42	4687.11	269.93	4724.88	174.90	4810.72	128.06	2.062	
23	142.47	4687.64	277.29	4725.94	178.62	4816.86	134.18	2.062	
24	142.47	4687.64	275.72	4725.71	178.51	4813.71	131.12	2.062	
25	143.00	4687.90	276.24	4725.78	179.17	4813.93	131.12	2.063	
26	142.47	4687.64	279.40	4726.24	179.09	4819.91	137.24	2.064	
27	142.47	4687.64	272.56	4725.25	177.32	4810.87	128.06	2.064	
28	141.95	4687.37	277.82	4726.01	177.70	4819.88	137.24	2.066	
29	143.00	4687.90	278.35	4726.09	179.64	4816.98	134.18	2.066	
30	141.42	4687.11	272.03	4725.18	175.36	4813.77	131.12	2.066	
31	141.42	4687.11	276.24	4725.78	176.30	4819.85	137.24	2.067	
32	143.00	4687.90	271.51	4725.10	177.89	4807.93	125.00	2.067	
33	142.47	4687.64	274.66	4725.56	177.78	4813.92	131.12	2.068	
34	141.42	4687.11	274.14	4725.48	175.83	4816.81	134.18	2.069	

35	142.47	4687.64	276.77	4725.86	178.25	4816.96	134.18	2.070
36	142.47	4687.64	269.93	4724.88	176.50	4807.92	125.00	2.070
37	140.89	4686.85	270.45	4724.95	173.96	4813.73	131.12	2.071
38	143.00	4687.90	273.61	4725.41	178.35	4810.99	128.06	2.071
39	141.42	4687.11	278.35	4726.09	176.78	4822.89	140.31	2.072
40	141.42	4687.11	269.40	4724.80	174.53	4810.82	128.06	2.072
41	141.95	4687.37	273.08	4725.33	176.39	4813.89	131.12	2.072
42	142.47	4687.64	278.87	4726.16	178.73	4820.01	137.24	2.073
43	141.95	4687.37	270.98	4725.03	175.93	4810.85	128.06	2.074
44	140.89	4686.85	272.56	4725.25	174.43	4816.77	134.18	2.074
45	143.00	4687.90	275.72	4725.71	178.81	4814.04	131.12	2.075
46	141.95	4687.37	275.19	4725.63	176.86	4816.94	134.18	2.075
47	142.47	4687.64	272.03	4725.18	176.95	4810.97	128.06	2.075
48	141.95	4687.37	272.03	4725.18	176.66	4810.64	128.06	2.075
49	141.95	4687.37	277.29	4725.94	177.33	4819.98	137.24	2.077
50	143.00	4687.90	277.82	4726.01	179.28	4817.09	134.18	2.078
51	143.00	4687.90	270.98	4725.03	177.52	4808.04	125.00	2.078
52	141.95	4687.37	279.40	4726.24	177.82	4823.02	140.31	2.078
53	142.47	4687.64	274.14	4725.48	177.42	4814.02	131.12	2.079
54	141.95	4687.37	270.45	4724.95	175.56	4810.95	128.06	2.079
55	141.42	4687.11	273.61	4725.41	175.46	4816.90	134.18	2.079
56	142.47	4687.64	269.40	4724.80	176.13	4808.02	125.00	2.080
57	140.89	4686.85	269.93	4724.88	173.59	4813.83	131.12	2.080
58	141.42	4687.11	271.51	4725.10	174.99	4813.86	131.12	2.080
59	141.42	4687.11	275.72	4725.71	175.94	4819.94	137.24	2.081
60	142.47	4687.64	276.24	4725.78	177.89	4817.06	134.18	2.081
61	143.00	4687.90	273.08	4725.33	177.98	4811.09	128.06	2.082
62	141.42	4687.11	277.82	4726.01	176.42	4822.98	140.31	2.082
63	143.00	4687.90	275.19	4725.63	178.45	4814.14	131.12	2.083
64	141.95	4687.37	272.56	4725.25	176.02	4813.99	131.12	2.083
65	142.47	4687.64	278.35	4726.09	178.36	4820.11	137.24	2.084
66	142.47	4687.64	277.82	4726.01	178.98	4816.76	134.18	2.085
67	141.95	4687.37	274.66	4725.56	176.49	4817.03	134.18	2.086
68	141.42	4687.11	270.98	4725.03	174.63	4813.96	131.12	2.086
69	140.89	4686.85	274.14	4725.48	174.54	4819.91	137.24	2.086
70	140.89	4686.85	272.03	4725.18	174.06	4816.87	134.18	2.087
71	140.89	4686.85	276.24	4725.78	175.02	4822.94	140.31	2.088
72	141.95	4687.37	276.77	4725.86	176.97	4820.08	137.24	2.088
73	140.89	4686.85	278.35	4726.09	175.50	4825.97	143.37	2.089
74	143.00	4687.90	277.29	4725.94	178.92	4817.19	134.18	2.089
75	140.37	4686.58	270.45	4724.95	172.66	4816.83	134.18	2.089
76	141.42	4687.11	273.08	4725.33	175.10	4817.00	134.18	2.089
77	141.95	4687.37	278.87	4726.16	177.45	4823.11	140.31	2.090
78	141.42	4687.11	275.19	4725.63	175.57	4820.04	137.24	2.091
79	143.00	4687.90	279.40	4726.24	179.39	4820.23	137.24	2.092

80	141.42	4687.11	277.29	4725.94	176.05	4823.08	140.31	2.093
81	141.95	4687.37	269.93	4724.88	175.19	4811.04	128.06	2.093
82	141.42	4687.11	279.40	4726.24	176.54	4826.11	143.37	2.094
83	140.37	4686.58	272.56	4725.25	173.13	4819.86	137.24	2.095
84	142.47	4687.64	271.51	4725.10	176.59	4811.07	128.06	2.095
85	140.89	4686.85	269.40	4724.80	173.22	4813.92	131.12	2.096
86	141.42	4687.11	270.45	4724.95	174.26	4814.06	131.12	2.096
87	143.00	4687.90	272.56	4725.25	177.62	4811.19	128.06	2.097
88	141.95	4687.37	272.03	4725.18	175.66	4814.09	131.12	2.098
89	142.47	4687.64	275.72	4725.71	177.52	4817.16	134.18	2.098
90	143.00	4687.90	270.45	4724.95	177.16	4808.14	125.00	2.098
91	142.47	4687.64	273.61	4725.41	177.05	4814.12	131.12	2.098
92	142.47	4687.64	270.98	4725.03	176.22	4811.17	128.06	2.099
93	142.47	4687.64	273.08	4725.33	176.69	4814.22	131.12	2.099
94	141.42	4687.11	272.56	4725.25	174.73	4817.09	134.18	2.099
95	141.95	4687.37	269.40	4724.80	174.82	4811.14	128.06	2.100
96	143.00	4687.90	274.66	4725.56	178.08	4814.24	131.12	2.100
97	143.00	4687.90	269.93	4724.88	176.79	4808.25	125.00	2.100
98	140.89	4686.85	271.51	4725.10	173.69	4816.96	134.18	2.100
99	141.95	4687.37	276.24	4725.78	176.61	4820.17	137.24	2.100

Critical Failure Surface (circle 1)

Intersects: XL: 143.00 YL: 4687.90 XR: 273.08 YR: 4725.33
Centre: XC: 178.98 YC: 4807.61 Radius: R: 125.00

Generated failure surface: (20 points)

143.00	4687.90	150.27	4685.95	157.65	4684.44	165.10	4683.38	172.60	4682.77
180.13	4682.61	187.65	4682.91	195.14	4683.66	202.57	4684.85	209.91	4686.50
217.15	4688.58	224.24	4691.09	231.17	4694.03	237.92	4697.37	244.45	4701.12
250.74	4705.25	256.77	4709.76	262.52	4714.62	267.96	4719.81	273.08	4725.33

Slice Geometry and Properties - Critical Failure Surface (circle 1, 45 slices)

Slice	X-S	Base						PoreWater	Normal Test
	X-Left	Area	Angle	Width	Length	Matl	Cohesion	Phi	Weight	Force	Stress	Factor
1	143.00	5.07	-15.0	3.64	3.76	1	10.00	35.0	583.62	0.00	178.33	1.14
2	146.64	15.22	-15.0	3.64	3.76	1	10.00	35.0	1750.65	0.00	532.00	1.14

3	150.27	8.31	-11.6	1.37	1.40	1	10.00	35.0	955.81	0.00	751.62	1.10
4	151.64	22.84	-11.6	3.00	3.06	2	1000.00	0.0	2630.81	58.08	976.85	1.02
5	154.64	29.19	-11.6	3.00	3.06	2	1000.00	0.0	3370.08	174.13	1223.08	1.02
6	157.65	44.62	-8.1	3.73	3.76	2	1000.00	0.0	5159.02	346.55	1454.66	1.01
7	161.37	53.54	-8.1	3.73	3.76	2	1000.00	0.0	6194.56	469.24	1732.52	1.01
8	165.10	62.48	-4.7	3.75	3.76	2	1000.00	0.0	7230.48	565.33	1967.54	1.00
9	168.85	70.66	-4.7	3.75	3.76	2	1000.00	0.0	8176.79	635.06	2219.80	1.00
10	172.60	78.67	-1.2	3.76	3.76	2	1000.00	0.0	9101.63	678.41	2429.18	1.00
11	176.36	86.05	-1.2	3.76	3.76	2	1000.00	0.0	9951.07	694.92	2654.86	1.00
12	180.13	92.94	2.3	3.76	3.76	2	1000.00	0.0	10743.35	684.94	2837.38	1.00
13	183.89	99.46	2.2	3.76	3.76	2	1000.00	0.0	11489.66	648.24	3035.89	1.00
14	187.65	105.09	5.7	3.75	3.76	2	1000.00	0.0	12132.56	585.06	3190.57	1.00
15	191.39	110.71	5.7	3.75	3.76	2	1000.00	0.0	12771.05	495.39	3360.98	1.00
16	195.14	114.97	9.1	3.72	3.76	2	1000.00	0.0	13251.06	379.22	3487.01	1.01
17	198.85	119.65	9.2	3.72	3.76	2	1000.00	0.0	13778.17	236.80	3628.79	1.01
18	202.57	103.87	12.6	3.12	3.20	2	1000.00	0.0	11950.35	70.39	3716.78	1.02
19	205.69	78.51	12.6	2.31	2.37	1	10.00	35.0	9029.12	0.00	3630.58	0.95
20	208.00	66.24	12.6	1.91	1.96	1	10.00	35.0	7603.87	0.00	3686.13	0.95
21	209.91	110.61	16.1	3.14	3.27	1	10.00	35.0	12637.50	0.00	3657.17	0.95
22	213.06	112.70	16.0	3.14	3.27	1	10.00	35.0	12804.67	0.00	3705.74	0.95
23	216.20	34.19	16.1	0.95	0.99	1	10.00	35.0	3874.00	0.00	3715.61	0.95
24	217.15	125.28	19.5	3.55	3.76	1	10.00	35.0	14188.13	0.00	3562.65	0.95

25	220.70	120.92	19.5	3.55	3.76	1	10.00	35.0	13684.91	0.00	3436.38
0.95											
26	224.24	89.76	23.0	2.73	2.96	1	10.00	35.0	10151.70	0.00	3245.46
0.95											
27	226.97	86.66	23.0	2.73	2.96	1	10.00	35.0	9794.61	0.00	3131.05
0.95											
28	229.70	24.50	23.0	0.79	0.86	4	0.00	45.0	2449.75	0.00	2567.77
0.90											
29	230.49	21.05	22.9	0.69	0.74	4	0.00	45.0	2128.88	159.30	2607.70
0.90											
30	231.17	46.05	26.4	1.53	1.70	4	0.00	45.0	4825.41	1534.19	2719.53
0.90											
31	232.70	76.10	26.4	2.61	2.91	1	10.00	35.0	9423.33	3883.03	3277.63
0.95											
32	235.31	72.76	26.4	2.61	2.91	1	10.00	35.0	8987.87	3647.70	3123.29
0.95											
33	237.92	85.93	29.9	3.26	3.76	1	10.00	35.0	10580.17	4342.18	2894.31
0.96											
34	241.18	79.88	29.9	3.26	3.76	1	10.00	35.0	9791.06	3902.18	2673.17
0.96											
35	244.45	70.83	33.3	3.15	3.76	1	10.00	35.0	8634.84	3439.39	2404.54
0.98											
36	247.59	64.38	33.3	3.15	3.76	1	10.00	35.0	7795.04	2954.21	2162.96
0.98											
37	250.74	55.26	36.8	3.02	3.76	1	10.00	35.0	6631.33	2447.08	1879.21
0.99											
38	253.75	48.51	36.8	3.02	3.76	1	10.00	35.0	5753.05	1917.96	1618.78
0.99											
39	256.77	39.56	40.2	2.87	3.76	1	10.00	35.0	4613.98	1368.06	1321.99
1.01											
40	259.64	32.63	40.2	2.87	3.76	1	10.00	35.0	3710.81	797.68	1044.40
1.01											
41	262.52	20.71	43.7	2.29	3.16	1	10.00	35.0	2269.44	215.10	760.37
1.04											
42	264.80	20.46	43.7	3.16	4.37	1	10.00	35.0	2145.37	0.00	507.46
1.04											
43	267.96	2.55	47.1	0.54	0.80	1	10.00	35.0	257.04	0.00	341.17
1.07											
44	268.50	3.51	47.1	0.90	1.32	5	50.00	25.0	350.59	0.00	292.76
1.18											
45	269.40	6.33	47.1	3.68	5.41	5	50.00	25.0	633.05	0.00	116.56
1.18											

X-S Area:	2819.24	Path Length:	143.02	X-S Weight:	325970.22

Project: Bernhardt Sand and Gravel Pit
File: P:\22036 IHC Scott Milliken Property\Slope Stability\Galena\Bernhardt SS1-EQ.gmf
Processed: 23 Feb 2024 09:50:58

DATA: Analysis 1 - Case SS-1 - Pseudo-Static

Material Properties (5 materials)

Material: 1 (Mohr-Coulomb Isotropic) - Sand and Gravel

	Cohesion	Phi	UnitWeight	Ru
Unsaturated:	10.00	35.0	115.00	Auto
Saturated:	10.00	35.0	130.00	Auto

Material: 2 (Mohr-Coulomb Isotropic) - Weathered Claystone Bedrock

	Cohesion	Phi	UnitWeight	Ru
Unsaturated:	1000.00	0.0	110.00	Auto
Saturated:	1000.00	0.0	120.00	Auto

Material: 3 (Mohr-Coulomb Isotropic) - Stable Claystone Bedrock

	Cohesion	Phi	UnitWeight	Ru
Unsaturated:	3000.00	0.0	120.00	Auto
Saturated:	3000.00	0.0	135.00	Auto

Material: 4 (Mohr-Coulomb Isotropic) - Slurry Wall

	Cohesion	Phi	UnitWeight	Ru
Unsaturated:	0.00	45.0	100.00	Auto
Saturated:	0.00	45.0	110.00	Auto

Material: 5 (Mohr-Coulomb Isotropic) - Clay

	Cohesion	Phi	UnitWeight	Ru
Unsaturated:	50.00	25.0	100.00	Auto
Saturated:	50.00	25.0	115.00	Auto

Water Properties

Unit weight of water: 62.400 Unit weight of water/medium above ground: 62.400

Material Profiles (7 profiles)

Profile: 1 (2 points) Material beneath: 5 - Clay
0.00 4728.00 300.00 4728.00

Profile: 2 (2 points) Material beneath: 1 - Sand and Gravel
0.00 4720.40 229.70 4720.40

Profile: 3 (2 points) Material beneath: 4 - Slurry Wall

```
    229.70     4724.70         232.70     4724.70
Profile:  4 (2 points)   Material beneath:  1 - Sand and Gravel
    232.70     4720.40         300.00     4720.40
Profile:  5 (3 points)   Material beneath:  2 - Weathered Claystone Bedrock
      0.00     4686.00         138.60     4685.70         229.70     4685.50
Profile:  6 (2 points)   Material beneath:  2 - Weathered Claystone Bedrock
    232.70     4685.50         300.00     4685.40
Profile:  7 (4 points)   Material beneath:  3 - Stable Claystone Bedrock
      0.00     4683.00         138.60     4682.70         229.70     4682.50         300.00     4682.40

Slope Surface (8 points)
-------------
      0.00     4686.00         138.60     4685.70         216.20     4724.50         229.70     4724.60         232.70
4724.60
    269.40     4724.80         284.00     4726.90         300.00     4727.00

Phreatic Surface (5 points)
-----------------
      0.00     4686.00         138.60     4685.70         229.70     4685.50         232.70     4716.80         300.00
4716.80

Failure Surface
---------------
Initial circular surface for critical search defined by: XL,XR,R
  Intersects:  XL:     138.00      YL:    4685.70      XR:     274.40      YR:    4725.52
      Centre:  XC:     153.81      YC:    4885.08                  Radius:  R:     200.00

Earthquake Force
----------------
Pseudo-static earthquake (seismic) coefficient:  0.070

Variable Restraints
-------------------
Parameter descriptor:              XL         XR         R
Range of variation:             10.00      10.00     150.00
Trial positions within range:      20         20         50

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RESULTS: Analysis  1 - Case SS-1 - Pseudo-Static

Bishop Simplified Method of Analysis - Circular Failure Surface
---------------------------------------------------------------
Critical Failure Surface Search using Multiple Circle Generation Techniques
```

Initial failure surface approximation - Factor of Safety: 2.042

Analysis Summary
================
There were: 18041 successful analyses from a total of 20001 trial failure surfaces
             1960 analyses terminated due to unacceptable geometry

Critical (minimum) Factor of Safety: 1.61
==

Results Summary - Lowest 99 Factor of Safety circles

Circle	X-Left	Y-Left	X-Right	Y-Right	X-Centre	Y-Centre	Radius	FoS	
1	143.00	4687.90	279.40	4726.24	180.36	4816.78	134.18	1.608	<-- Critical Surface
2	143.00	4687.90	277.29	4725.94	179.90	4813.72	131.12	1.609	
3	143.00	4687.90	275.19	4725.63	179.44	4810.67	128.06	1.610	
4	143.00	4687.90	273.08	4725.33	178.98	4807.61	125.00	1.614	
5	143.00	4687.90	278.87	4726.16	180.00	4816.88	134.18	1.618	
6	143.00	4687.90	276.77	4725.86	179.54	4813.83	131.12	1.621	
7	143.00	4687.90	274.66	4725.56	179.07	4810.78	128.06	1.623	
8	142.47	4687.64	273.61	4725.41	178.05	4810.66	128.06	1.623	
9	143.00	4687.90	272.56	4725.25	178.62	4807.72	125.00	1.625	
10	142.47	4687.64	271.51	4725.10	177.60	4807.60	125.00	1.625	
11	142.47	4687.64	279.40	4726.24	179.09	4819.91	137.24	1.626	
12	142.47	4687.64	275.19	4725.63	178.15	4813.81	131.12	1.629	
13	143.00	4687.90	278.35	4726.09	179.64	4816.98	134.18	1.629	
14	142.47	4687.64	277.29	4725.94	178.62	4816.86	134.18	1.629	
15	143.00	4687.90	276.24	4725.78	179.17	4813.93	131.12	1.631	
16	142.47	4687.64	273.08	4725.33	177.69	4810.76	128.06	1.631	
17	141.95	4687.37	269.93	4724.88	176.21	4807.59	125.00	1.632	
18	141.95	4687.37	277.82	4726.01	177.70	4819.88	137.24	1.632	
19	141.95	4687.37	275.72	4725.71	177.22	4816.84	134.18	1.632	
20	143.00	4687.90	274.14	4725.48	178.71	4810.88	128.06	1.633	
21	142.47	4687.64	275.72	4725.71	178.51	4813.71	131.12	1.633	
22	142.47	4687.64	278.87	4726.16	178.73	4820.01	137.24	1.634	
23	142.47	4687.64	270.98	4725.03	177.23	4807.71	125.00	1.635	
24	143.00	4687.90	272.03	4725.18	178.25	4807.83	125.00	1.635	
25	142.47	4687.64	276.77	4725.86	178.25	4816.96	134.18	1.637	
26	141.42	4687.11	278.35	4726.09	176.78	4822.89	140.31	1.637	
27	141.95	4687.37	273.61	4725.41	176.76	4813.79	131.12	1.638	
28	141.42	4687.11	276.24	4725.78	176.30	4819.85	137.24	1.638	
29	141.95	4687.37	279.40	4726.24	177.82	4823.02	140.31	1.639	
30	143.00	4687.90	277.82	4726.01	179.28	4817.09	134.18	1.639	

31	142.47	4687.64	274.66	4725.56	177.78	4813.92	131.12	1.640
32	141.95	4687.37	271.51	4725.10	176.29	4810.74	128.06	1.641
33	143.00	4687.90	275.72	4725.71	178.81	4814.04	131.12	1.642
34	141.95	4687.37	269.40	4724.80	175.84	4807.69	125.00	1.642
35	142.47	4687.64	272.56	4725.25	177.32	4810.87	128.06	1.642
36	141.95	4687.37	277.29	4725.94	177.33	4819.98	137.24	1.642
37	142.47	4687.64	270.45	4724.95	176.86	4807.81	125.00	1.643
38	143.00	4687.90	273.61	4725.41	178.35	4810.99	128.06	1.644
39	141.42	4687.11	274.14	4725.48	175.83	4816.81	134.18	1.644
40	142.47	4687.64	278.35	4726.09	178.36	4820.11	137.24	1.644
41	141.95	4687.37	275.19	4725.63	176.86	4816.94	134.18	1.645
42	143.00	4687.90	271.51	4725.10	177.89	4807.93	125.00	1.646
43	143.00	4687.90	279.40	4726.24	179.39	4820.23	137.24	1.647
44	142.47	4687.64	277.82	4726.01	178.98	4816.76	134.18	1.647
45	141.42	4687.11	272.03	4725.18	175.36	4813.77	131.12	1.647
46	141.42	4687.11	277.82	4726.01	176.42	4822.98	140.31	1.647
47	142.47	4687.64	276.24	4725.78	177.89	4817.06	134.18	1.647
48	141.95	4687.37	273.08	4725.33	176.39	4813.89	131.12	1.648
49	141.42	4687.11	269.93	4724.88	174.90	4810.72	128.06	1.648
50	141.95	4687.37	278.87	4726.16	177.45	4823.11	140.31	1.649
51	143.00	4687.90	275.19	4725.63	178.45	4814.14	131.12	1.649
52	143.00	4687.90	277.29	4725.94	178.92	4817.19	134.18	1.650
53	142.47	4687.64	274.14	4725.48	177.42	4814.02	131.12	1.650
54	141.42	4687.11	275.72	4725.71	175.94	4819.94	137.24	1.650
55	142.47	4687.64	272.03	4725.18	176.95	4810.97	128.06	1.652
56	140.89	4686.85	278.35	4726.09	175.50	4825.97	143.37	1.652
57	141.95	4687.37	276.77	4725.86	176.97	4820.08	137.24	1.652
58	141.42	4687.11	279.40	4726.24	176.54	4826.11	143.37	1.652
59	142.47	4687.64	269.93	4724.88	176.50	4807.92	125.00	1.653
60	140.89	4686.85	272.56	4725.25	174.43	4816.77	134.18	1.653
61	141.42	4687.11	273.61	4725.41	175.46	4816.90	134.18	1.653
62	141.95	4687.37	272.03	4725.18	176.66	4810.64	128.06	1.653
63	141.95	4687.37	270.98	4725.03	175.93	4810.85	128.06	1.654
64	143.00	4687.90	273.08	4725.33	177.98	4811.09	128.06	1.654
65	141.95	4687.37	274.66	4725.56	176.49	4817.03	134.18	1.655
66	140.89	4686.85	270.45	4724.95	173.96	4813.73	131.12	1.655
67	140.89	4686.85	276.24	4725.78	175.02	4822.94	140.31	1.656
68	143.00	4687.90	270.98	4725.03	177.52	4808.04	125.00	1.656
69	141.42	4687.11	277.29	4725.94	176.05	4823.08	140.31	1.656
70	141.42	4687.11	269.40	4724.80	174.53	4810.82	128.06	1.657
71	141.95	4687.37	272.56	4725.25	176.02	4813.99	131.12	1.658
72	143.00	4687.90	278.87	4726.16	179.03	4820.33	137.24	1.658
73	141.42	4687.11	271.51	4725.10	174.99	4813.86	131.12	1.659
74	140.89	4686.85	274.14	4725.48	174.54	4819.91	137.24	1.659
75	141.95	4687.37	270.45	4724.95	175.56	4810.95	128.06	1.659

76	141.42	4687.11	275.19	4725.63	175.57	4820.04	137.24	1.660
77	142.47	4687.64	277.82	4726.01	178.00	4820.20	137.24	1.660
78	142.47	4687.64	279.40	4726.24	178.12	4823.34	140.31	1.661
79	143.00	4687.90	276.77	4725.86	178.55	4817.29	134.18	1.661
80	142.47	4687.64	275.72	4725.71	177.52	4817.16	134.18	1.661
81	142.47	4687.64	269.40	4724.80	176.13	4808.02	125.00	1.662
82	141.95	4687.37	278.35	4726.09	177.09	4823.21	140.31	1.662
83	141.42	4687.11	273.08	4725.33	175.10	4817.00	134.18	1.663
84	141.42	4687.11	278.87	4726.16	176.18	4826.20	143.37	1.663
85	141.95	4687.37	276.24	4725.78	176.61	4820.17	137.24	1.664
86	142.47	4687.64	277.29	4725.94	177.64	4820.30	137.24	1.664
87	143.00	4687.90	274.66	4725.56	178.08	4814.24	131.12	1.664
88	140.89	4686.85	269.93	4724.88	173.59	4813.83	131.12	1.664
89	140.89	4686.85	272.03	4725.18	174.06	4816.87	134.18	1.665
90	141.42	4687.11	270.98	4725.03	174.63	4813.96	131.12	1.665
91	141.42	4687.11	276.77	4725.86	175.69	4823.17	140.31	1.666
92	140.89	4686.85	279.40	4726.24	175.27	4829.18	146.43	1.666
93	142.47	4687.64	273.61	4725.41	177.05	4814.12	131.12	1.666
94	143.00	4687.90	272.56	4725.25	177.62	4811.19	128.06	1.667
95	142.47	4687.64	275.19	4725.63	177.16	4817.26	134.18	1.667
96	140.89	4686.85	277.82	4726.01	175.14	4826.06	143.37	1.668
97	141.95	4687.37	274.14	4725.48	176.13	4817.13	134.18	1.668
98	142.47	4687.64	273.08	4725.33	176.69	4814.22	131.12	1.669
99	142.47	4687.64	271.51	4725.10	176.59	4811.07	128.06	1.669

Critical Failure Surface (circle 1)

Intersects: XL: 143.00 YL: 4687.90 XR: 279.40 YR: 4726.24
Centre: XC: 180.36 YC: 4816.78 Radius: R: 134.18

Generated failure surface: (20 points)

143.00	4687.90	150.60	4685.94	158.31	4684.42	166.09	4683.35	173.93	4682.75
181.78	4682.60	189.63	4682.91	197.44	4683.68	205.20	4684.91	212.88	4686.59
220.44	4688.72	227.86	4691.28	235.12	4694.28	242.20	4697.69	249.06	4701.51
255.69	4705.73	262.06	4710.33	268.14	4715.29	273.93	4720.60	279.40	4726.24

Slice Geometry and Properties - Critical Failure Surface (circle 1, 42 slices)

Slice	X-S	Base						PoreWater	Normal Test
	X-Left	Area	Angle	Width	Length	Matl	Cohesion	Phi	Weight	Force	Stress Factor

1	143.00	5.48	-14.5	3.80	3.93	1	10.00	35.0	630.31	0.00	188.58
1.16											
2	146.80	16.45	-14.5	3.80	3.93	1	10.00	35.0	1891.56	0.00	562.34
1.16											
3	150.60	8.37	-11.1	1.34	1.37	1	10.00	35.0	962.40	0.00	785.60
1.11											
4	151.95	24.86	-11.1	3.18	3.24	2	1000.00	0.0	2863.95	62.75	1022.33
1.02											
5	155.13	31.92	-11.1	3.18	3.24	2	1000.00	0.0	3685.47	188.06	1280.46
1.02											
6	158.31	48.16	-7.8	3.89	3.93	2	1000.00	0.0	5567.79	367.85	1515.89
1.01											
7	162.20	57.80	-7.8	3.89	3.93	2	1000.00	0.0	6686.65	496.00	1803.35
1.01											
8	166.09	67.44	-4.4	3.92	3.93	2	1000.00	0.0	7803.73	596.28	2041.09
1.00											
9	170.01	76.30	-4.4	3.92	3.93	2	1000.00	0.0	8827.50	668.44	2302.54
1.00											
10	173.93	81.72	-1.1	3.78	3.78	2	1000.00	0.0	9452.65	686.42	2509.84
1.00											
11	177.71	89.14	-1.1	3.78	3.78	2	1000.00	0.0	10307.76	701.07	2735.83
1.00											
12	181.49	103.69	2.0	4.07	4.07	2	1000.00	0.0	11983.66	744.39	2924.20
1.00											
13	185.56	111.30	2.3	4.07	4.07	2	1000.00	0.0	12855.82	701.10	3136.02
1.00											
14	189.63	113.68	5.6	3.91	3.93	2	1000.00	0.0	13121.18	607.29	3295.80
1.00											
15	193.54	119.81	5.6	3.91	3.93	2	1000.00	0.0	13818.62	510.60	3474.24
1.00											
16	197.44	124.52	9.0	3.88	3.93	2	1000.00	0.0	14350.92	386.03	3601.13
1.01											
17	201.32	129.67	9.0	3.88	3.93	2	1000.00	0.0	14930.01	233.46	3750.41
1.01											
18	205.20	96.44	12.3	2.80	2.86	2	1000.00	0.0	11095.24	59.40	3831.13
1.02											
19	208.00	85.87	12.3	2.44	2.50	1	10.00	35.0	9852.67	0.00	3688.15
0.93											
20	210.44	87.54	12.3	2.44	2.50	1	10.00	35.0	10000.37	0.00	3743.43
0.93											
21	212.88	121.69	15.7	3.32	3.45	1	10.00	35.0	13830.94	0.00	3706.00
0.93											
22	216.20	154.24	15.7	4.24	4.40	1	10.00	35.0	17476.06	0.00	3672.43
0.93											

23	220.44	130.62	19.1	3.71	3.93	1	10.00	35.0	14790.95	0.00	3461.69
0.92											
24	224.15	125.97	19.1	3.71	3.93	1	10.00	35.0	14253.71	0.00	3335.89
0.92											
25	227.86	60.51	22.4	1.84	1.99	1	10.00	35.0	6843.63	0.00	3155.33
0.92											
26	229.70	21.16	22.4	0.65	0.71	4	0.00	45.0	2115.93	0.00	2581.03
0.86											
27	230.35	74.67	22.4	2.35	2.54	4	0.00	45.0	7742.97	1863.55	2775.21
0.86											
28	232.70	74.74	22.4	2.42	2.62	1	10.00	35.0	9279.60	3767.34	3461.83
0.92											
29	235.12	104.32	25.8	3.54	3.93	1	10.00	35.0	12922.70	5310.90	3251.50
0.92											
30	238.66	98.35	25.8	3.54	3.93	1	10.00	35.0	12144.52	4892.55	3051.20
0.92											
31	242.20	89.26	29.1	3.43	3.93	1	10.00	35.0	10980.47	4449.27	2793.99
0.92											
32	245.63	82.77	29.1	3.43	3.93	1	10.00	35.0	10134.56	3980.76	2572.38
0.92											
33	249.06	73.33	32.5	3.31	3.93	1	10.00	35.0	8927.34	3488.59	2299.35
0.93											
34	252.37	66.41	32.5	3.31	3.93	1	10.00	35.0	8024.90	2971.53	2057.61
0.93											
35	255.69	56.86	35.8	3.18	3.93	1	10.00	35.0	6805.78	2431.57	1770.81
0.94											
36	258.87	49.59	35.8	3.18	3.93	1	10.00	35.0	5859.53	1868.18	1510.42
0.94											
37	262.06	40.19	39.2	3.04	3.93	1	10.00	35.0	4661.30	1282.49	1211.88
0.95											
38	265.10	32.69	39.2	3.04	3.93	1	10.00	35.0	3684.46	674.40	934.54
0.95											
39	268.14	11.21	42.5	1.26	1.70	1	10.00	35.0	1224.19	99.44	709.55
0.97											
40	269.40	28.88	42.5	4.32	5.86	1	10.00	35.0	3015.84	0.00	495.23
0.97											
41	273.72	10.75	45.6	2.84	4.07	5	50.00	25.0	1075.44	0.00	267.35
1.10											
42	276.56	3.58	45.9	2.84	4.08	5	50.00	25.0	358.44	0.00	72.40
1.11											

X-S Area:	2991.97	Path Length:	149.24	X-S Weight:	346841.59

Project: Bernhardt Sand and Gravel Pit
File: P:\22036 IHC Scott Milliken Property\Slope Stability\Galena\Bernhardt SS2.gmf
Processed: 23 Feb 2024 11:25:08

DATA: Analysis 1 - Case SS-2 - Static

Material Properties (5 materials)

Material: 1 (Mohr-Coulomb Isotropic) - Sand and Gravel

	Cohesion	Phi	UnitWeight	Ru
Unsaturated:	10.00	35.0	115.00	Auto
Saturated:	10.00	35.0	130.00	Auto

Material: 2 (Mohr-Coulomb Isotropic) - Weathered Sandstone Bedrock

	Cohesion	Phi	UnitWeight	Ru
Unsaturated:	1000.00	0.0	105.00	Auto
Saturated:	1000.00	0.0	115.00	Auto

Material: 3 (Mohr-Coulomb Isotropic) - Stable Sandstone Bedrock

	Cohesion	Phi	UnitWeight	Ru
Unsaturated:	3000.00	0.0	115.00	Auto
Saturated:	3000.00	0.0	128.00	Auto

Material: 4 (Mohr-Coulomb Isotropic) - Slurry Wall

	Cohesion	Phi	UnitWeight	Ru
Unsaturated:	0.00	45.0	100.00	Auto
Saturated:	0.00	45.0	110.00	Auto

Material: 5 (Mohr-Coulomb Isotropic) - Clay

	Cohesion	Phi	UnitWeight	Ru
Unsaturated:	50.00	25.0	100.00	Auto
Saturated:	50.00	25.0	115.00	Auto

Water Properties

Unit weight of water: 62.400 Unit weight of water/medium above ground: 62.400

Material Profiles (7 profiles)

Profile: 1 (2 points) Material beneath: 5 - Clay
0.00 4719.00 400.00 4719.00

Profile: 2 (2 points) Material beneath: 1 - Sand and Gravel
0.00 4716.40 216.10 4716.40

Profile: 3 (2 points) Material beneath: 4 - Slurry Wall

```
    216.10     4718.10         219.10     4718.10
Profile:  4 (2 points)   Material beneath:  1 - Sand and Gravel
    219.10     4716.40         400.00     4716.40
Profile:  5 (3 points)   Material beneath:  2 - Weathered Sandstone Bedrock
      0.00     4683.80         134.20     4683.80         216.10     4683.80
Profile:  6 (2 points)   Material beneath:  2 - Weathered Sandstone Bedrock
    219.10     4683.80         400.00     4683.80
Profile:  7 (4 points)   Material beneath:  3 - Stable Sandstone Bedrock
      0.00     4680.80         134.20     4680.80         216.10     4680.80         400.00     4680.80

Slope Surface (8 points)
-------------
      0.00     4683.80         134.21     4683.80         202.60     4718.00         216.10     4718.00         219.10
4718.00
    293.40     4718.00         373.50     4718.00         400.00     4717.90

Phreatic Surface (5 points)
----------------
      0.00     4683.80         134.20     4683.80         216.10     4683.80         219.10     4715.00         400.00
4715.00

Failure Surface
---------------
Initial circular surface for critical search defined by: XL,XR,R
  Intersects:  XL:     134.20      YL:    4683.80      XR:     298.40      YR:    4718.00
      Centre:  XC:     147.01      YC:    5033.57                  Radius:  R:     350.00

Variable Restraints
-------------------
Parameter descriptor:             XL         XR         R
Range of variation:            10.00      10.00     300.00
Trial positions within range:     20         20         50

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RESULTS: Analysis  1 - Case SS-2 - Static

Bishop Simplified Method of Analysis - Circular Failure Surface
-------------------------------------------------------------
Critical Failure Surface Search using Multiple Circle Generation Techniques

Initial failure surface approximation - Factor of Safety:   3.106

Analysis Summary
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==========
There were: 17005 successful analyses from a total of 20001 trial failure surfaces
2996 analyses terminated due to unacceptable geometry

Critical (minimum) Factor of Safety: 2.14
==========

Results Summary - Lowest 99 Factor of Safety circles

Circle	X-Left	Y-Left	X-Right	Y-Right	X-Centre	Y-Centre	Radius	FoS	
1	138.15	4685.77	298.14	4718.00	182.08	4880.88	200.00	2.138	<-- Critical Surface
2	138.15	4685.77	298.66	4718.00	182.48	4880.79	200.00	2.140	
3	137.62	4685.51	296.56	4718.00	180.47	4880.86	200.00	2.143	
4	137.09	4685.24	294.98	4718.00	178.85	4880.83	200.00	2.149	
5	138.15	4685.77	297.61	4718.00	181.68	4880.97	200.00	2.153	
6	136.57	4684.98	293.40	4718.00	177.23	4880.80	200.00	2.156	
7	137.09	4685.24	297.61	4718.00	179.53	4886.95	206.12	2.157	
8	137.62	4685.51	299.19	4718.00	181.15	4886.98	206.12	2.158	
9	138.67	4686.03	299.19	4718.00	183.29	4880.99	200.00	2.159	
10	137.62	4685.51	296.03	4718.00	180.07	4880.95	200.00	2.162	
11	136.57	4684.98	296.03	4718.00	177.90	4886.91	206.12	2.164	
12	137.09	4685.24	294.45	4718.00	178.45	4880.92	200.00	2.164	
13	138.15	4685.77	300.24	4718.00	182.37	4887.09	206.12	2.165	
14	138.67	4686.03	299.72	4718.00	183.68	4880.90	200.00	2.166	
15	138.67	4686.03	300.24	4718.00	184.08	4880.81	200.00	2.169	
16	138.15	4685.77	297.08	4718.00	181.28	4881.06	200.00	2.169	
17	137.62	4685.51	298.66	4718.00	180.75	4887.06	206.12	2.169	
18	138.15	4685.77	300.77	4718.00	182.77	4887.00	206.12	2.172	
19	137.09	4685.24	300.24	4718.00	180.23	4893.06	212.24	2.172	
20	137.09	4685.24	297.08	4718.00	179.13	4887.03	206.12	2.173	
21	138.67	4686.03	298.66	4718.00	182.89	4881.08	200.00	2.173	
22	139.20	4686.30	299.72	4718.00	184.09	4881.19	200.00	2.178	
23	137.62	4685.51	301.82	4718.00	181.86	4893.09	212.24	2.178	
24	137.62	4685.51	301.29	4718.00	181.45	4893.17	212.24	2.178	
25	138.15	4685.77	299.72	4718.00	181.97	4887.18	206.12	2.179	
26	136.57	4684.98	295.51	4718.00	177.50	4887.00	206.12	2.179	
27	137.09	4685.24	293.93	4718.00	178.04	4881.01	200.00	2.180	
28	137.09	4685.24	299.72	4718.00	179.83	4893.14	212.24	2.180	
29	137.62	4685.51	295.51	4718.00	179.66	4881.04	200.00	2.182	
30	138.67	4686.03	298.14	4718.00	182.49	4881.17	200.00	2.182	
31	139.20	4686.30	300.24	4718.00	184.49	4881.10	200.00	2.185	
32	137.09	4685.24	302.35	4718.00	180.55	4899.24	218.37	2.185	
33	138.15	4685.77	296.56	4718.00	180.88	4881.15	200.00	2.185	
34	136.57	4684.98	298.14	4718.00	178.19	4893.10	212.24	2.186	

35	137.62	4685.51	298.14	4718.00	180.35	4887.15	206.12	2.186
36	136.04	4684.72	293.93	4718.00	175.86	4886.96	206.12	2.187
37	137.09	4685.24	302.87	4718.00	180.95	4899.16	218.37	2.187
38	138.67	4686.03	301.29	4718.00	183.58	4887.20	206.12	2.190
39	137.09	4685.24	296.56	4718.00	178.72	4887.12	206.12	2.191
40	136.57	4684.98	300.77	4718.00	178.91	4899.20	218.37	2.191
41	137.62	4685.51	294.98	4718.00	179.26	4881.12	200.00	2.193
42	139.20	4686.30	300.77	4718.00	184.89	4881.01	200.00	2.193
43	136.04	4684.72	296.56	4718.00	176.55	4893.06	212.24	2.193
44	137.62	4685.51	300.77	4718.00	181.05	4893.26	212.24	2.194
45	136.57	4684.98	294.98	4718.00	177.09	4887.08	206.12	2.194
46	138.67	4686.03	300.77	4718.00	183.18	4887.29	206.12	2.195
47	138.15	4685.77	299.19	4718.00	181.57	4887.27	206.12	2.195
48	137.09	4685.24	293.40	4718.00	177.63	4881.09	200.00	2.195
49	137.09	4685.24	299.19	4718.00	179.42	4893.22	212.24	2.195
50	138.15	4685.77	301.29	4718.00	183.17	4886.91	206.12	2.196
51	136.57	4684.98	303.40	4718.00	179.64	4905.30	224.49	2.196
52	137.62	4685.51	297.08	4718.00	180.87	4880.77	200.00	2.197
53	138.15	4685.77	302.35	4718.00	182.68	4893.29	212.24	2.197
54	139.20	4686.30	299.19	4718.00	183.70	4881.28	200.00	2.198
55	138.67	4686.03	301.82	4718.00	183.98	4887.11	206.12	2.198
56	138.67	4686.03	297.61	4718.00	182.09	4881.26	200.00	2.198
57	136.04	4684.72	299.19	4718.00	177.26	4899.16	218.37	2.199
58	139.20	4686.30	301.82	4718.00	185.68	4880.82	200.00	2.200
59	136.57	4684.98	298.66	4718.00	178.60	4893.02	212.24	2.200
60	138.15	4685.77	296.03	4718.00	180.48	4881.24	200.00	2.201
61	139.20	4686.30	301.29	4718.00	185.28	4880.91	200.00	2.201
62	136.57	4684.98	297.61	4718.00	177.78	4893.18	212.24	2.201
63	137.09	4685.24	301.82	4718.00	180.14	4899.32	218.37	2.201
64	136.04	4684.72	293.40	4718.00	175.45	4887.04	206.12	2.202
65	137.62	4685.51	297.61	4718.00	179.94	4887.24	206.12	2.202
66	135.52	4684.45	294.98	4718.00	174.90	4893.01	212.24	2.203
67	138.15	4685.77	302.87	4718.00	183.08	4893.20	212.24	2.204
68	137.62	4685.51	294.45	4718.00	178.85	4881.21	200.00	2.205
69	138.67	4686.03	302.35	4718.00	184.38	4887.02	206.12	2.205
70	136.57	4684.98	300.24	4718.00	178.50	4899.28	218.37	2.206
71	136.57	4684.98	302.87	4718.00	179.24	4905.38	224.49	2.207
72	137.62	4685.51	303.40	4718.00	181.78	4899.36	218.37	2.208
73	136.04	4684.72	296.03	4718.00	176.14	4893.14	212.24	2.208
74	136.57	4684.98	294.45	4718.00	176.68	4887.16	206.12	2.208
75	138.67	4686.03	300.24	4718.00	182.78	4887.38	206.12	2.209
76	138.15	4685.77	301.82	4718.00	182.27	4893.38	212.24	2.209
77	137.09	4685.24	296.03	4718.00	178.31	4887.20	206.12	2.210
78	137.62	4685.51	300.24	4718.00	180.65	4893.34	212.24	2.210
79	138.15	4685.77	298.66	4718.00	181.16	4887.35	206.12	2.210

80	137.09	4685.24	298.66	4718.00	179.02	4893.31	212.24	2.210
81	138.15	4685.77	303.40	4718.00	183.48	4893.12	212.24	2.211
82	138.67	4686.03	302.87	4718.00	184.77	4886.93	206.12	2.213
83	139.20	4686.30	301.82	4718.00	184.39	4887.40	206.12	2.213
84	136.04	4684.72	298.66	4718.00	176.85	4899.24	218.37	2.213
85	137.62	4685.51	297.08	4718.00	179.54	4887.32	206.12	2.214
86	138.67	4686.03	297.08	4718.00	181.69	4881.35	200.00	2.215
87	139.20	4686.30	298.66	4718.00	183.30	4881.37	200.00	2.215
88	138.15	4685.77	301.29	4718.00	181.87	4893.46	212.24	2.215
89	137.09	4685.24	301.29	4718.00	179.74	4899.41	218.37	2.216
90	136.04	4684.72	301.29	4718.00	177.59	4905.33	224.49	2.217
91	135.52	4684.45	294.45	4718.00	174.49	4893.09	212.24	2.217
92	137.09	4685.24	295.51	4718.00	177.91	4887.28	206.12	2.218
93	138.15	4685.77	295.51	4718.00	180.07	4881.33	200.00	2.218
94	136.57	4684.98	297.08	4718.00	177.37	4893.26	212.24	2.219
95	138.67	4686.03	302.87	4718.00	183.50	4893.49	212.24	2.219
96	137.62	4685.51	293.93	4718.00	178.45	4881.29	200.00	2.220
97	139.20	4686.30	302.35	4718.00	184.79	4887.31	206.12	2.220
98	136.57	4684.98	299.72	4718.00	178.09	4899.36	218.37	2.221
99	137.62	4685.51	299.72	4718.00	180.24	4893.43	212.24	2.221

Critical Failure Surface (circle 1)

Intersects: XL: 138.15 YL: 4685.77 XR: 298.14 YR: 4718.00
Centre: XC: 182.08 YC: 4880.88 Radius: R: 200.00

Generated failure surface: (20 points)

138.15	4685.77	146.82	4684.02	155.56	4682.65	164.35	4681.67	173.18	4681.08
182.03	4680.88	190.87	4681.08	199.70	4681.66	208.49	4682.63	217.23	4684.00
225.91	4685.74	234.49	4687.87	242.98	4690.38	251.34	4693.26	259.57	4696.51
267.65	4700.11	275.56	4704.07	283.29	4708.38	290.82	4713.03	298.14	4718.00

Slice Geometry and Properties - Critical Failure Surface (circle 1, 43 slices)

Slice	X-S	Base						PoreWater	Normal Test
	X-Left	Area	Angle	Width	Length	Matl	Cohesion	Phi	Weight	Force	Stress	Factor
1	138.15	6.60	-11.4	4.34	4.42	1	10.00	35.0	759.16	0.00	188.50	1.09
2	142.48	19.80	-11.4	4.34	4.42	1	10.00	35.0	2277.48	0.00	563.50	1.09

3	146.82	9.05	-8.9	1.38	1.40	1	10.00	35.0	1040.94	0.00	793.83	1.07
4	148.20	30.18	-8.9	3.68	3.72	2	1000.00	0.0	3471.19	66.82	1016.72	1.01
5	151.88	39.07	-8.9	3.68	3.72	2	1000.00	0.0	4492.67	200.46	1294.40	1.01
6	155.56	57.90	-6.4	4.40	4.42	2	1000.00	0.0	6659.06	385.07	1566.76	1.01
7	159.96	69.72	-6.4	4.40	4.42	2	1000.00	0.0	8018.32	520.25	1875.88	1.01
8	164.35	81.45	-3.8	4.41	4.42	2	1000.00	0.0	9366.66	628.34	2153.37	1.00
9	168.77	92.49	-3.8	4.41	4.42	2	1000.00	0.0	10636.84	709.75	2441.15	1.00
10	173.18	103.32	-1.3	4.42	4.42	2	1000.00	0.0	11881.49	763.94	2697.09	1.00
11	177.60	113.54	-1.3	4.42	4.42	2	1000.00	0.0	13056.85	791.44	2962.86	1.00
12	182.03	123.32	1.3	4.42	4.42	2	1000.00	0.0	14182.04	791.70	3196.58	1.00
13	186.45	132.67	1.3	4.42	4.42	2	1000.00	0.0	15257.57	765.01	3439.77	1.00
14	190.87	136.40	3.8	4.26	4.27	2	1000.00	0.0	15686.54	688.66	3647.08	1.00
15	195.14	144.30	3.8	4.26	4.27	2	1000.00	0.0	16594.18	613.39	3859.90	1.00
16	199.40	113.26	6.1	3.20	3.22	2	1000.00	0.0	12985.94	400.60	4008.65	1.01
17	202.60	105.62	6.3	2.95	2.96	2	1000.00	0.0	12076.03	306.05	4047.45	1.01
18	205.55	104.66	6.3	2.95	2.96	2	1000.00	0.0	11965.37	245.63	4009.96	1.01
19	208.49	131.15	8.9	3.74	3.78	2	1000.00	0.0	14992.41	206.28	3936.61	1.01
20	212.23	128.97	8.9	3.74	3.78	2	1000.00	0.0	14742.13	68.84	3869.67	1.01
21	215.97	43.08	8.9	1.26	1.28	4	0.00	45.0	4372.23	408.43	3248.01	0.94
22	217.23	63.12	11.4	1.87	1.90	4	0.00	45.0	6706.20	2508.12	3396.71	0.93
23	219.10	113.27	11.4	3.40	3.47	1	10.00	35.0	14490.58	6560.50	4110.44	0.96
24	222.50	110.94	11.4	3.40	3.47	1	10.00	35.0	14187.07	6411.70	4024.22	0.96

25	225.91	136.21	13.9	4.29	4.42	1	10.00	35.0	17410.64	7928.54	3884.06	0.95
26	230.20	131.64	13.9	4.29	4.42	1	10.00	35.0	16816.45	7634.69	3751.09	0.95
27	234.49	125.15	16.5	4.24	4.42	1	10.00	35.0	15976.53	7314.87	3578.36	0.95
28	238.74	119.83	16.5	4.24	4.42	1	10.00	35.0	15285.54	6969.02	3422.95	0.95
29	242.98	112.52	19.0	4.18	4.42	1	10.00	35.0	14338.38	6597.03	3230.42	0.95
30	247.16	106.49	19.0	4.18	4.42	1	10.00	35.0	13555.46	6199.82	3053.03	0.95
31	251.34	98.47	21.5	4.11	4.42	1	10.00	35.0	12516.60	5777.08	2841.46	0.95
32	255.46	91.79	21.5	4.11	4.42	1	10.00	35.0	11648.36	5329.07	2643.02	0.95
33	259.57	83.17	24.1	4.04	4.42	1	10.00	35.0	10533.84	4855.90	2413.41	0.96
34	263.61	75.89	24.1	4.04	4.42	1	10.00	35.0	9586.73	4358.02	2194.49	0.96
35	267.65	66.83	26.6	3.96	4.42	1	10.00	35.0	8414.99	3835.66	1947.89	0.96
36	271.61	59.00	26.6	3.96	4.42	1	10.00	35.0	7396.58	3288.98	1709.29	0.96
37	275.56	49.65	29.1	3.86	4.42	1	10.00	35.0	6187.43	2718.60	1446.78	0.97
38	279.43	41.32	29.1	3.86	4.42	1	10.00	35.0	5105.54	2123.95	1189.28	0.97
39	283.29	31.84	31.7	3.76	4.42	1	10.00	35.0	3879.39	1506.28	912.06	0.98
40	287.06	23.09	31.7	3.76	4.42	1	10.00	35.0	2742.55	865.19	636.48	0.98
41	290.82	10.57	34.2	2.58	3.12	1	10.00	35.0	1195.85	213.38	388.97	0.99
42	293.40	5.74	34.2	2.38	2.88	1	10.00	35.0	603.08	0.00	204.42	0.99
43	295.78	1.88	34.2	2.35	2.85	5	50.00	25.0	188.40	0.00	55.85	1.05
		--------			-------				----------			
X-S Area:		3444.98	Path Length:		168.10		X-S Weight:		413281.25			

Project: Bernhardt Sand and Gravel Pit
File: P:\22036 IHC Scott Milliken Property\Slope Stability\Galena\Bernhardt SS2-EQ.gmf
Processed: 23 Feb 2024 11:31:06

DATA: Analysis 1 - Case SS-2 - Pseudo-Static

Material Properties (5 materials)

Material: 1 (Mohr-Coulomb Isotropic) - Sand and Gravel

	Cohesion	Phi	UnitWeight	Ru
Unsaturated:	10.00	35.0	115.00	Auto
Saturated:	10.00	35.0	130.00	Auto

Material: 2 (Mohr-Coulomb Isotropic) - Weathered Sandstone Bedrock

	Cohesion	Phi	UnitWeight	Ru
Unsaturated:	1000.00	0.0	105.00	Auto
Saturated:	1000.00	0.0	115.00	Auto

Material: 3 (Mohr-Coulomb Isotropic) - Stable Sandstone Bedrock

	Cohesion	Phi	UnitWeight	Ru
Unsaturated:	3000.00	0.0	115.00	Auto
Saturated:	3000.00	0.0	128.00	Auto

Material: 4 (Mohr-Coulomb Isotropic) - Slurry Wall

	Cohesion	Phi	UnitWeight	Ru
Unsaturated:	0.00	45.0	100.00	Auto
Saturated:	0.00	45.0	110.00	Auto

Material: 5 (Mohr-Coulomb Isotropic) - Clay

	Cohesion	Phi	UnitWeight	Ru
Unsaturated:	50.00	25.0	100.00	Auto
Saturated:	50.00	25.0	115.00	Auto

Water Properties

Unit weight of water: 62.400 Unit weight of water/medium above ground: 62.400

Material Profiles (7 profiles)

Profile: 1 (2 points) Material beneath: 5 - Clay
0.00 4719.00 400.00 4719.00

Profile: 2 (2 points) Material beneath: 1 - Sand and Gravel
0.00 4716.40 216.10 4716.40

Profile: 3 (2 points) Material beneath: 4 - Slurry Wall

```
    216.10     4718.10         219.10     4718.10
Profile:  4 (2 points)   Material beneath:  1 - Sand and Gravel
    219.10     4716.40         400.00     4716.40
Profile:  5 (3 points)   Material beneath:  2 - Weathered Sandstone Bedrock
      0.00     4683.80         134.20     4683.80         216.10     4683.80
Profile:  6 (2 points)   Material beneath:  2 - Weathered Sandstone Bedrock
    219.10     4683.80         400.00     4683.80
Profile:  7 (4 points)   Material beneath:  3 - Stable Sandstone Bedrock
      0.00     4680.80         134.20     4680.80         216.10     4680.80         400.00     4680.80

Slope Surface (8 points)
-------------
      0.00     4683.80         134.21     4683.80         202.60     4718.00         216.10     4718.00         219.10
4718.00
    293.40     4718.00         373.50     4718.00         400.00     4717.90

Phreatic Surface (5 points)
----------------
      0.00     4683.80         134.20     4683.80         216.10     4683.80         219.10     4715.00         400.00
4715.00

Failure Surface
---------------
Initial circular surface for critical search defined by: XL,XR,R
  Intersects:  XL:     134.20      YL:    4683.80      XR:     298.40      YR:    4718.00
      Centre:  XC:     147.01      YC:    5033.57                  Radius:  R:     350.00

Earthquake Force
----------------
Pseudo-static earthquake (seismic) coefficient:  0.070

Variable Restraints
-------------------
Parameter descriptor:              XL         XR         R
Range of variation:             10.00      10.00     300.00
Trial positions within range:      20         20         50

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RESULTS: Analysis  1 - Case SS-2 - Pseudo-Static

Bishop Simplified Method of Analysis - Circular Failure Surface
------------------------------------------------------------
Critical Failure Surface Search using Multiple Circle Generation Techniques
```

Initial failure surface approximation - Factor of Safety: 2.287

Analysis Summary
================
There were: 17005 successful analyses from a total of 20001 trial failure surfaces
             2996 analyses terminated due to unacceptable geometry

Critical (minimum) Factor of Safety: 1.55
==

Results Summary - Lowest 99 Factor of Safety circles

Circle	X-Left	Y-Left	X-Right	Y-Right	X-Centre	Y-Centre	Radius	FoS	
1	138.15	4685.77	298.66	4718.00	182.48	4880.79	200.00	1.549	<-- Critical Surface
2	138.15	4685.77	298.14	4718.00	182.08	4880.88	200.00	1.549	
3	138.67	4686.03	299.19	4718.00	183.29	4880.99	200.00	1.558	
4	137.62	4685.51	296.56	4718.00	180.47	4880.86	200.00	1.561	
5	138.67	4686.03	299.72	4718.00	183.68	4880.90	200.00	1.562	
6	138.15	4685.77	297.61	4718.00	181.68	4880.97	200.00	1.562	
7	138.67	4686.03	300.24	4718.00	184.08	4880.81	200.00	1.562	
8	138.15	4685.77	300.24	4718.00	182.37	4887.09	206.12	1.562	
9	137.62	4685.51	299.19	4718.00	181.15	4886.98	206.12	1.563	
10	138.15	4685.77	300.77	4718.00	182.77	4887.00	206.12	1.566	
11	139.20	4686.30	299.72	4718.00	184.09	4881.19	200.00	1.568	
12	137.62	4685.51	301.82	4718.00	181.86	4893.09	212.24	1.569	
13	137.09	4685.24	297.61	4718.00	179.53	4886.95	206.12	1.570	
14	138.67	4686.03	298.66	4718.00	182.89	4881.08	200.00	1.571	
15	137.62	4685.51	301.29	4718.00	181.45	4893.17	212.24	1.571	
16	139.20	4686.30	300.24	4718.00	184.49	4881.10	200.00	1.571	
17	137.09	4685.24	294.98	4718.00	178.85	4880.83	200.00	1.573	
18	137.09	4685.24	300.24	4718.00	180.23	4893.06	212.24	1.573	
19	137.62	4685.51	298.66	4718.00	180.75	4887.06	206.12	1.573	
20	138.15	4685.77	299.72	4718.00	181.97	4887.18	206.12	1.574	
21	138.67	4686.03	301.29	4718.00	183.58	4887.20	206.12	1.574	
22	137.09	4685.24	302.87	4718.00	180.95	4899.16	218.37	1.575	
23	137.09	4685.24	302.35	4718.00	180.55	4899.24	218.37	1.575	
24	138.15	4685.77	297.08	4718.00	181.28	4881.06	200.00	1.575	
25	139.20	4686.30	300.77	4718.00	184.89	4881.01	200.00	1.576	
26	137.62	4685.51	296.03	4718.00	180.07	4880.95	200.00	1.576	
27	139.20	4686.30	301.82	4718.00	185.68	4880.82	200.00	1.577	
28	138.67	4686.03	301.82	4718.00	183.98	4887.11	206.12	1.578	
29	138.15	4685.77	302.35	4718.00	182.68	4893.29	212.24	1.579	
30	138.67	4686.03	298.14	4718.00	182.49	4881.17	200.00	1.579	

31	139.20	4686.30	301.29	4718.00	185.28	4880.91	200.00	1.579
32	138.67	4686.03	300.77	4718.00	183.18	4887.29	206.12	1.579
33	137.09	4685.24	299.72	4718.00	179.83	4893.14	212.24	1.580
34	138.15	4685.77	301.29	4718.00	183.17	4886.91	206.12	1.581
35	138.67	4686.03	302.35	4718.00	184.38	4887.02	206.12	1.582
36	138.15	4685.77	302.87	4718.00	183.08	4893.20	212.24	1.582
37	136.57	4684.98	303.40	4718.00	179.64	4905.30	224.49	1.583
38	136.57	4684.98	296.03	4718.00	177.90	4886.91	206.12	1.583
39	137.09	4685.24	297.08	4718.00	179.13	4887.03	206.12	1.583
40	137.62	4685.51	300.77	4718.00	181.05	4893.26	212.24	1.584
41	139.20	4686.30	299.19	4718.00	183.70	4881.28	200.00	1.585
42	138.67	4686.03	302.87	4718.00	184.77	4886.93	206.12	1.585
43	138.15	4685.77	303.40	4718.00	183.48	4893.12	212.24	1.585
44	137.62	4685.51	303.40	4718.00	181.78	4899.36	218.37	1.585
45	136.57	4684.98	293.40	4718.00	177.23	4880.80	200.00	1.586
46	137.09	4685.24	294.45	4718.00	178.45	4880.92	200.00	1.586
47	139.20	4686.30	301.82	4718.00	184.39	4887.40	206.12	1.586
48	137.62	4685.51	298.14	4718.00	180.35	4887.15	206.12	1.587
49	138.15	4685.77	299.19	4718.00	181.57	4887.27	206.12	1.587
50	136.57	4684.98	300.77	4718.00	178.91	4899.20	218.37	1.588
51	138.15	4685.77	296.56	4718.00	180.88	4881.15	200.00	1.589
52	137.09	4685.24	301.82	4718.00	180.14	4899.32	218.37	1.589
53	138.15	4685.77	301.82	4718.00	182.27	4893.38	212.24	1.589
54	139.20	4686.30	302.35	4718.00	184.79	4887.31	206.12	1.590
55	138.67	4686.03	302.87	4718.00	183.50	4893.49	212.24	1.590
56	138.67	4686.03	300.24	4718.00	182.78	4887.38	206.12	1.592
57	138.67	4686.03	303.40	4718.00	183.89	4893.40	212.24	1.592
58	136.57	4684.98	298.14	4718.00	178.19	4893.10	212.24	1.592
59	136.57	4684.98	302.87	4718.00	179.24	4905.38	224.49	1.592
60	138.67	4686.03	297.61	4718.00	182.09	4881.26	200.00	1.593
61	137.62	4685.51	295.51	4718.00	179.66	4881.04	200.00	1.593
62	137.09	4685.24	299.19	4718.00	179.42	4893.22	212.24	1.593
63	139.20	4686.30	302.87	4718.00	185.19	4887.22	206.12	1.593
64	138.15	4685.77	301.29	4718.00	181.87	4893.46	212.24	1.596
65	136.57	4684.98	295.51	4718.00	177.50	4887.00	206.12	1.596
66	139.20	4686.30	303.40	4718.00	185.58	4887.13	206.12	1.596
67	137.62	4685.51	300.24	4718.00	180.65	4893.34	212.24	1.598
68	139.20	4686.30	301.29	4718.00	184.00	4887.49	206.12	1.598
69	137.09	4685.24	296.56	4718.00	178.72	4887.12	206.12	1.598
70	139.20	4686.30	298.66	4718.00	183.30	4881.37	200.00	1.599
71	137.09	4685.24	293.93	4718.00	178.04	4881.01	200.00	1.599
72	137.62	4685.51	302.87	4718.00	181.37	4899.44	218.37	1.600
73	137.62	4685.51	297.08	4718.00	180.87	4880.77	200.00	1.600
74	136.57	4684.98	300.24	4718.00	178.50	4899.28	218.37	1.600
75	138.15	4685.77	298.66	4718.00	181.16	4887.35	206.12	1.601

76	136.04	4684.72	299.19	4718.00	177.26	4899.16	218.37	1.601
77	137.62	4685.51	297.61	4718.00	179.94	4887.24	206.12	1.601
78	136.57	4684.98	298.66	4718.00	178.60	4893.02	212.24	1.602
79	137.09	4685.24	301.29	4718.00	179.74	4899.41	218.37	1.602
80	138.15	4685.77	296.03	4718.00	180.48	4881.24	200.00	1.602
81	138.67	4686.03	302.35	4718.00	183.10	4893.58	212.24	1.603
82	137.62	4685.51	294.98	4718.00	179.26	4881.12	200.00	1.603
83	138.67	4686.03	299.72	4718.00	182.38	4887.47	206.12	1.605
84	136.57	4684.98	297.61	4718.00	177.78	4893.18	212.24	1.605
85	136.04	4684.72	296.56	4718.00	176.55	4893.06	212.24	1.606
86	137.09	4685.24	298.66	4718.00	179.02	4893.31	212.24	1.606
87	137.62	4685.51	302.35	4718.00	180.97	4899.53	218.37	1.606
88	138.67	4686.03	297.08	4718.00	181.69	4881.35	200.00	1.607
89	136.57	4684.98	302.35	4718.00	178.83	4905.45	224.49	1.607
90	138.15	4685.77	303.40	4718.00	182.20	4899.65	218.37	1.607
91	136.04	4684.72	301.29	4718.00	177.59	4905.33	224.49	1.608
92	137.62	4685.51	299.72	4718.00	180.24	4893.43	212.24	1.608
93	136.57	4684.98	294.98	4718.00	177.09	4887.08	206.12	1.609
94	137.09	4685.24	303.40	4718.00	180.07	4905.58	224.49	1.609
95	136.04	4684.72	293.93	4718.00	175.86	4886.96	206.12	1.610
96	138.15	4685.77	300.77	4718.00	181.47	4893.54	212.24	1.611
97	139.20	4686.30	300.77	4718.00	183.60	4887.58	206.12	1.611
98	137.62	4685.51	297.08	4718.00	179.54	4887.32	206.12	1.611
99	137.09	4685.24	293.40	4718.00	177.63	4881.09	200.00	1.612

Critical Failure Surface (circle 1)

Intersects: XL: 138.15 YL: 4685.77 XR: 298.66 YR: 4718.00
Centre: XC: 182.48 YC: 4880.79 Radius: R: 200.00
Generated failure surface: (20 points)

138.15 4685.77 146.85 4683.99 155.61 4682.61 164.43 4681.61 173.29 4681.00
182.16 4680.79 191.04 4680.98 199.90 4681.55 208.72 4682.52 217.49 4683.88
226.20 4685.63 234.81 4687.76 243.33 4690.27 251.72 4693.16 259.98 4696.42
268.08 4700.04 276.02 4704.02 283.77 4708.34 291.33 4713.00 298.66 4718.00

Slice Geometry and Properties - Critical Failure Surface (circle 1, 44 slices)

Slice	X-S	Base						PoreWater	Normal Test
X-Left	Area	Angle	Width	Length	Matl	Cohesion	Phi	Weight	Force	Stress Factor

1	138.15	6.66	-11.5	4.35	4.44	1	10.00	35.0	765.80	0.00	195.44
1.12											
2	142.50	19.98	-11.5	4.35	4.44	1	10.00	35.0	2297.41	0.00	583.43
1.12											
3	146.85	7.98	-9.0	1.22	1.24	1	10.00	35.0	917.37	0.00	809.56
1.09											
4	148.07	30.83	-9.0	3.77	3.82	2	1000.00	0.0	3545.35	71.11	1041.80
1.01											
5	151.84	40.20	-9.0	3.77	3.82	2	1000.00	0.0	4623.04	213.45	1327.53
1.01											
6	155.61	58.43	-6.4	4.41	4.44	2	1000.00	0.0	6719.83	399.75	1596.60
1.01											
7	160.02	70.36	-6.4	4.41	4.44	2	1000.00	0.0	8091.09	537.69	1907.52
1.01											
8	164.43	82.20	-3.9	4.43	4.44	2	1000.00	0.0	9452.86	648.58	2178.80
1.00											
9	168.86	93.34	-3.9	4.43	4.44	2	1000.00	0.0	10734.43	732.29	2468.21
1.00											
10	173.29	100.99	-1.4	4.30	4.30	2	1000.00	0.0	11613.78	764.69	2713.88
1.00											
11	177.59	110.69	-1.4	4.30	4.30	2	1000.00	0.0	12729.29	792.11	2973.15
1.00											
12	181.90	127.78	1.0	4.57	4.57	2	1000.00	0.0	14695.00	845.80	3203.25
1.00											
13	186.47	137.80	1.2	4.57	4.57	2	1000.00	0.0	15847.00	818.96	3453.54
1.00											
14	191.04	134.41	3.7	4.18	4.19	2	1000.00	0.0	15457.57	702.57	3655.47
1.00											
15	195.22	142.02	3.7	4.18	4.19	2	1000.00	0.0	16331.78	631.47	3864.51
1.00											
16	199.40	113.67	5.9	3.20	3.22	2	1000.00	0.0	13034.10	426.72	4007.14
1.01											
17	202.60	110.13	6.3	3.06	3.08	2	1000.00	0.0	12591.02	342.42	4043.02
1.01											
18	205.66	109.10	6.3	3.06	3.08	2	1000.00	0.0	12472.55	277.77	4004.43
1.01											
19	208.72	129.84	8.8	3.69	3.73	2	1000.00	0.0	14843.18	231.15	3923.09
1.01											
20	212.41	127.73	8.8	3.69	3.73	2	1000.00	0.0	14600.52	97.94	3857.33
1.01											
21	216.10	47.69	8.8	1.39	1.41	4	0.00	45.0	4869.92	639.71	3218.88
0.92											
22	217.49	54.56	11.4	1.61	1.64	4	0.00	45.0	5819.29	2311.43	3367.95
0.90											

23	219.10	118.65	11.4	3.55	3.62	1	10.00	35.0	15179.82	6874.12	4079.09	0.94
24	222.65	116.12	11.4	3.55	3.62	1	10.00	35.0	14851.15	6713.21	3990.49	0.94
25	226.20	137.18	13.9	4.31	4.44	1	10.00	35.0	17535.46	7987.12	3840.05	0.93
26	230.50	132.58	13.9	4.31	4.44	1	10.00	35.0	16938.37	7691.67	3708.82	0.93
27	234.81	126.05	16.4	4.26	4.44	1	10.00	35.0	16093.04	7370.17	3529.23	0.92
28	239.07	120.70	16.4	4.26	4.44	1	10.00	35.0	15397.77	7021.99	3375.98	0.92
29	243.33	113.34	19.0	4.20	4.44	1	10.00	35.0	14444.71	6648.39	3178.15	0.92
30	247.52	107.28	19.0	4.20	4.44	1	10.00	35.0	13656.66	6248.37	3003.53	0.92
31	251.72	99.19	21.5	4.13	4.44	1	10.00	35.0	12610.11	5823.00	2788.35	0.91
32	255.85	92.47	21.5	4.13	4.44	1	10.00	35.0	11736.07	5371.77	2593.38	0.91
33	259.98	83.79	24.1	4.05	4.44	1	10.00	35.0	10613.20	4895.53	2361.89	0.91
34	264.03	76.46	24.1	4.05	4.44	1	10.00	35.0	9659.69	4394.45	2147.08	0.91
35	268.08	67.33	26.6	3.97	4.44	1	10.00	35.0	8478.65	3868.19	1900.43	0.91
36	272.05	59.44	26.6	3.97	4.44	1	10.00	35.0	7453.04	3317.54	1666.77	0.91
37	276.02	50.01	29.2	3.88	4.44	1	10.00	35.0	6234.38	2742.73	1406.12	0.91
38	279.90	41.63	29.2	3.88	4.44	1	10.00	35.0	5144.68	2143.91	1154.39	0.91
39	283.77	32.07	31.7	3.78	4.44	1	10.00	35.0	3909.10	1521.56	880.95	0.92
40	287.55	23.27	31.7	3.78	4.44	1	10.00	35.0	2764.01	875.47	612.15	0.92
41	291.33	8.90	34.2	2.07	2.51	1	10.00	35.0	1013.73	201.90	389.18	0.93
42	293.40	2.82	34.2	0.86	1.04	1	10.00	35.0	307.23	18.83	275.39	0.93
43	294.26	4.73	34.2	2.06	2.49	1	10.00	35.0	494.54	0.00	180.54	0.93
44	296.31	1.88	34.2	2.35	2.84	5	50.00	25.0	188.00	0.00	48.15	1.00
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X-S Area: 3472.27 Path Length: 168.66 X-S Weight: 416755.56

Project: Bernhardt Sand and Gravel Pit
File: P:\22036 IHC Scott Milliken Property\Slope Stability\Galena\Bernhardt SS3.gmf
Processed: 24 Feb 2024 13:42:29

DATA: Analysis 1 - Case SS-3 - Static

Material Properties (5 materials)

Material: 1 (Mohr-Coulomb Isotropic) - Sand and Gravel

	Cohesion	Phi	UnitWeight	Ru
Unsaturated:	10.00	35.0	115.00	Auto
Saturated:	10.00	35.0	130.00	Auto

Material: 2 (Mohr-Coulomb Isotropic) - Weathered Claystone Bedrock

	Cohesion	Phi	UnitWeight	Ru
Unsaturated:	1000.00	0.0	110.00	Auto
Saturated:	1000.00	0.0	120.00	Auto

Material: 3 (Mohr-Coulomb Isotropic) - Stable Claystone Bedrock

	Cohesion	Phi	UnitWeight	Ru
Unsaturated:	3000.00	0.0	120.00	Auto
Saturated:	3000.00	0.0	135.00	Auto

Material: 4 (Mohr-Coulomb Isotropic) - Slurry Wall

	Cohesion	Phi	UnitWeight	Ru
Unsaturated:	0.00	45.0	100.00	Auto
Saturated:	0.00	45.0	110.00	Auto

Material: 5 (Mohr-Coulomb Isotropic) - Clay

	Cohesion	Phi	UnitWeight	Ru
Unsaturated:	50.00	25.0	100.00	Auto
Saturated:	50.00	25.0	115.00	Auto

Water Properties

Unit weight of water: 62.400 Unit weight of water/medium above ground: 62.400

Material Profiles (7 profiles)

Profile: 1 (2 points) Material beneath: 5 - Clay
0.00 4721.00 365.00 4721.00

Profile: 2 (2 points) Material beneath: 1 - Sand and Gravel
0.00 4716.40 216.50 4716.40

Profile: 3 (2 points) Material beneath: 4 - Slurry Wall

```
    216.50     4718.40         219.50     4718.40
Profile:  4 (2 points)   Material beneath:  1 - Sand and Gravel
    219.50     4716.40         365.00     4716.40
Profile:  5 (3 points)   Material beneath:  2 - Weathered Claystone Bedrock
      0.00     4684.00         134.30     4684.00         216.50     4684.00
Profile:  6 (2 points)   Material beneath:  2 - Weathered Claystone Bedrock
    219.50     4684.00         365.00     4684.00
Profile:  7 (4 points)   Material beneath:  3 - Stable Claystone Bedrock
      0.00     4681.00         134.20     4681.00         216.50     4681.00         365.00     4681.20

Slope Surface (8 points)
-------------
      0.00     4684.00         134.20     4684.00         203.00     4718.30         216.50     4718.30         219.50
4718.30
    263.70     4718.30         314.40     4719.90         365.00     4720.50

Phreatic Surface (5 points)
----------------
      0.00     4684.00         134.20     4684.00         216.50     4684.00         219.50     4715.00         365.00
4715.00

Failure Surface
---------------
Initial circular surface for critical search defined by: XL,XR,R
  Intersects:  XL:     134.00      YL:    4684.00      XR:     268.70      YR:    4718.46
      Centre:  XC:     141.84      YC:    4933.88                  Radius:  R:     250.00

Variable Restraints
-------------------
Parameter descriptor:             XL         XR         R
Range of variation:            10.00      10.00     200.00
Trial positions within range:     20         20        50

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RESULTS: Analysis  1 - Case SS-3 - Static

Bishop Simplified Method of Analysis - Circular Failure Surface
-----------------------------------------------------------
Critical Failure Surface Search using Multiple Circle Generation Techniques

Initial failure surface approximation - Factor of Safety:   2.702

Analysis Summary
```

==========
There were: 16605 successful analyses from a total of 20001 trial failure surfaces
             3396 analyses terminated due to unacceptable geometry

Critical (minimum) Factor of Safety: 2.08
==========

Results Summary - Lowest 99 Factor of Safety circles

Circle	X-Left	Y-Left	X-Right	Y-Right	X-Centre	Y-Centre	Radius	FoS	
1	137.42	4685.61	273.70	4718.62	174.34	4830.99	150.00	2.075	<-- Critical Surface
2	137.42	4685.61	273.17	4718.60	173.95	4831.09	150.00	2.095	
3	136.89	4685.34	271.59	4718.55	172.41	4831.08	150.00	2.103	
4	136.89	4685.34	272.12	4718.57	172.81	4830.98	150.00	2.107	
5	136.89	4685.34	273.70	4718.62	172.91	4835.16	154.08	2.109	
6	137.42	4685.61	272.65	4718.58	173.55	4831.19	150.00	2.109	
7	137.95	4685.87	273.70	4718.62	174.69	4831.30	150.00	2.113	
8	136.37	4685.08	270.02	4718.50	170.87	4831.06	150.00	2.119	
9	136.37	4685.08	272.12	4718.57	171.36	4835.14	154.08	2.120	
10	136.89	4685.34	271.07	4718.53	172.01	4831.17	150.00	2.121	
11	136.89	4685.34	273.17	4718.60	172.51	4835.25	154.08	2.125	
12	137.42	4685.61	272.12	4718.57	173.16	4831.29	150.00	2.125	
13	137.95	4685.87	273.17	4718.60	174.30	4831.40	150.00	2.129	
14	135.84	4684.82	268.44	4718.45	169.32	4831.04	150.00	2.134	
15	136.89	4685.34	270.54	4718.52	171.62	4831.27	150.00	2.136	
16	136.37	4685.08	269.49	4718.48	170.47	4831.15	150.00	2.137	
17	136.37	4685.08	271.59	4718.55	170.96	4835.23	154.08	2.137	
18	135.84	4684.82	272.65	4718.58	170.32	4839.18	158.16	2.137	
19	136.89	4685.34	272.65	4718.58	172.11	4835.35	154.08	2.140	
20	136.37	4685.08	273.70	4718.62	171.47	4839.30	158.16	2.140	
21	137.42	4685.61	271.59	4718.55	172.76	4831.38	150.00	2.141	
22	137.95	4685.87	272.65	4718.58	173.90	4831.50	150.00	2.145	
23	137.42	4685.61	273.70	4718.62	173.26	4835.46	154.08	2.146	
24	135.84	4684.82	270.54	4718.52	169.81	4835.11	154.08	2.148	
25	135.84	4684.82	267.91	4718.43	168.92	4831.13	150.00	2.148	
26	136.37	4685.08	268.96	4718.47	170.07	4831.25	150.00	2.148	
27	135.84	4684.82	272.12	4718.57	169.91	4839.27	158.16	2.149	
28	135.32	4684.56	266.86	4718.40	167.76	4831.00	150.00	2.150	
29	135.84	4684.82	270.02	4718.50	169.41	4835.20	154.08	2.151	
30	136.89	4685.34	270.02	4718.50	171.22	4831.36	150.00	2.151	
31	138.47	4686.13	273.70	4718.62	175.04	4831.60	150.00	2.152	
32	135.32	4684.56	268.96	4718.47	168.25	4835.08	154.08	2.153	
33	136.37	4685.08	270.54	4718.52	171.27	4830.96	150.00	2.153	
34	136.89	4685.34	272.12	4718.57	171.71	4835.44	154.08	2.155	

35	136.37	4685.08	273.17	4718.60	171.07	4839.39	158.16	2.155
36	136.37	4685.08	271.07	4718.53	170.56	4835.32	154.08	2.156
37	135.32	4684.56	271.07	4718.53	168.75	4839.14	158.16	2.157
38	137.95	4685.87	272.12	4718.57	173.51	4831.59	150.00	2.160
39	136.37	4685.08	268.44	4718.45	169.66	4831.34	150.00	2.162
40	137.42	4685.61	271.07	4718.53	172.36	4831.48	150.00	2.162
41	135.32	4684.56	266.33	4718.38	167.36	4831.09	150.00	2.162
42	137.42	4685.61	273.17	4718.60	172.86	4835.56	154.08	2.162
43	135.84	4684.82	267.38	4718.42	168.51	4831.22	150.00	2.163
44	135.84	4684.82	269.49	4718.48	169.00	4835.29	154.08	2.165
45	136.89	4685.34	269.49	4718.48	170.82	4831.46	150.00	2.166
46	136.37	4685.08	270.54	4718.52	170.16	4835.41	154.08	2.166
47	136.89	4685.34	271.59	4718.55	171.31	4835.53	154.08	2.167
48	135.32	4684.56	268.44	4718.45	167.85	4835.17	154.08	2.167
49	135.84	4684.82	271.59	4718.55	169.51	4839.36	158.16	2.168
50	136.37	4685.08	272.65	4718.58	171.76	4835.04	154.08	2.168
51	138.47	4686.13	273.17	4718.60	174.65	4831.70	150.00	2.168
52	135.32	4684.56	270.54	4718.52	168.35	4839.23	158.16	2.169
53	135.84	4684.82	273.70	4718.62	170.03	4843.42	162.24	2.170
54	135.32	4684.56	272.65	4718.58	168.87	4843.29	162.24	2.172
55	137.42	4685.61	270.54	4718.52	171.96	4831.57	150.00	2.173
56	136.89	4685.34	273.70	4718.62	171.83	4839.60	158.16	2.173
57	135.84	4684.82	266.86	4718.40	168.11	4831.31	150.00	2.174
58	135.32	4684.56	265.81	4718.37	166.95	4831.18	150.00	2.175
59	137.95	4685.87	271.59	4718.55	173.11	4831.69	150.00	2.175
60	136.37	4685.08	272.65	4718.58	170.67	4839.48	158.16	2.175
61	136.37	4685.08	267.91	4718.43	169.26	4831.43	150.00	2.176
62	135.84	4684.82	268.96	4718.47	168.60	4835.38	154.08	2.178
63	134.79	4684.29	264.75	4718.33	165.79	4831.06	150.00	2.179
64	136.89	4685.34	268.96	4718.47	170.41	4831.55	150.00	2.179
65	136.37	4685.08	270.02	4718.50	169.76	4835.50	154.08	2.180
66	136.37	4685.08	272.12	4718.57	170.27	4839.57	158.16	2.181
67	137.95	4685.87	273.70	4718.62	173.61	4835.76	154.08	2.181
68	135.32	4684.56	267.91	4718.43	167.44	4835.25	154.08	2.181
69	135.84	4684.82	271.07	4718.53	169.11	4839.44	158.16	2.182
70	134.79	4684.29	266.86	4718.40	166.28	4835.12	154.08	2.183
71	135.32	4684.56	270.02	4718.50	167.94	4839.32	158.16	2.183
72	136.89	4685.34	271.07	4718.53	170.91	4835.62	154.08	2.184
73	135.84	4684.82	273.17	4718.60	169.63	4843.51	162.24	2.184
74	137.42	4685.61	270.02	4718.50	171.56	4831.67	150.00	2.184
75	135.32	4684.56	272.12	4718.57	168.46	4843.38	162.24	2.185
76	137.42	4685.61	272.65	4718.58	172.47	4835.65	154.08	2.186
77	135.84	4684.82	266.33	4718.38	167.70	4831.40	150.00	2.186
78	134.79	4684.29	268.96	4718.47	166.78	4839.19	158.16	2.187
79	135.32	4684.56	265.28	4718.35	166.54	4831.27	150.00	2.187

80	137.95	4685.87	271.07	4718.53	172.71	4831.78	150.00	2.187
81	136.89	4685.34	273.17	4718.60	171.43	4839.69	158.16	2.187
82	134.79	4684.29	271.07	4718.53	167.29	4843.25	162.24	2.188
83	136.37	4685.08	267.38	4718.42	168.86	4831.52	150.00	2.188
84	137.42	4685.61	272.12	4718.57	172.07	4835.74	154.08	2.189
85	135.32	4684.56	273.17	4718.60	169.27	4843.21	162.24	2.189
86	134.79	4684.29	264.23	4718.32	165.38	4831.14	150.00	2.191
87	136.89	4685.34	268.44	4718.45	170.01	4831.64	150.00	2.192
88	135.84	4684.82	268.44	4718.45	168.20	4835.47	154.08	2.192
89	136.37	4685.08	269.49	4718.48	169.36	4835.59	154.08	2.193
90	139.00	4686.39	273.70	4718.62	175.39	4831.91	150.00	2.194
91	135.84	4684.82	272.65	4718.58	169.23	4843.59	162.24	2.195
92	138.47	4686.13	272.65	4718.58	174.25	4831.80	150.00	2.195
93	137.95	4685.87	273.17	4718.60	173.22	4835.86	154.08	2.195
94	135.84	4684.82	270.54	4718.52	168.70	4839.53	158.16	2.195
95	135.32	4684.56	269.49	4718.48	167.54	4839.40	158.16	2.195
96	134.79	4684.29	266.33	4718.38	165.87	4835.21	154.08	2.195
97	136.37	4685.08	271.59	4718.55	169.87	4839.66	158.16	2.197
98	136.89	4685.34	270.54	4718.52	170.51	4835.71	154.08	2.197
99	135.32	4684.56	267.38	4718.42	167.03	4835.34	154.08	2.197

Critical Failure Surface (circle 1)

Intersects: XL: 137.42 YL: 4685.61 XR: 273.70 YR: 4718.62
Centre: XC: 174.34 YC: 4830.99 Radius: R: 150.00

Generated failure surface: (20 points)

137.42	4685.61	144.91	4683.91	152.47	4682.59	160.10	4681.67	167.76	4681.14
175.43	4680.99	183.11	4681.25	190.76	4681.89	198.37	4682.93	205.91	4684.35
213.37	4686.16	220.74	4688.35	227.97	4690.91	235.07	4693.83	242.01	4697.12
248.77	4700.76	255.34	4704.74	261.69	4709.05	267.82	4713.68	273.70	4718.62

Slice Geometry and Properties - Critical Failure Surface (circle 1, 42 slices)

Slice	X-S	Base						PoreWater	Normal Test
	X-Left	Area	Angle	Width	Length	Matl	Cohesion	Phi	Weight	Force	Stress	Factor
1	137.42	4.54	-12.8	3.54	3.63	1	10.00	35.0	522.52	0.00	161.05	1.11
2	140.96	13.63	-12.8	3.54	3.63	1	10.00	35.0	1567.77	0.00	480.82	1.11

3	144.50	25.90	-10.2	3.99	4.05	2	1000.00	0.0	2986.32	93.06	835.35
1.02											
4	148.49	36.59	-9.9	3.99	4.05	2	1000.00	0.0	4229.02	267.81	1144.37
1.01											
5	152.47	44.58	-6.9	3.81	3.84	2	1000.00	0.0	5158.41	392.33	1411.96
1.01											
6	156.29	53.59	-6.9	3.81	3.84	2	1000.00	0.0	6202.59	503.10	1685.87
1.01											
7	160.10	62.54	-4.0	3.83	3.84	2	1000.00	0.0	7239.39	590.37	1923.77
1.00											
8	163.93	70.88	-4.0	3.83	3.84	2	1000.00	0.0	8203.24	654.36	2175.50
1.00											
9	167.76	75.86	-1.1	3.69	3.69	2	1000.00	0.0	8777.67	667.84	2386.41
1.00											
10	171.45	82.91	-1.0	3.69	3.69	2	1000.00	0.0	9589.08	683.47	2606.13
1.00											
11	175.14	97.02	1.7	3.98	3.99	2	1000.00	0.0	11215.55	733.56	2801.29
1.00											
12	179.12	104.40	1.9	3.98	3.99	2	1000.00	0.0	12062.71	700.97	3012.18
1.00											
13	183.11	106.84	4.8	3.83	3.84	2	1000.00	0.0	12336.40	620.90	3184.11
1.00											
14	186.93	112.91	4.8	3.83	3.84	2	1000.00	0.0	13027.53	543.69	3364.77
1.00											
15	190.76	117.91	7.7	3.80	3.84	2	1000.00	0.0	13594.58	443.10	3508.12
1.01											
16	194.56	123.15	7.8	3.80	3.84	2	1000.00	0.0	14187.74	318.99	3663.98
1.01											
17	198.37	27.28	10.7	0.82	0.84	2	1000.00	0.0	3141.79	51.95	3730.79
1.02											
18	199.19	129.22	10.7	3.81	3.88	2	1000.00	0.0	14816.51	135.06	3797.04
1.02											
19	203.00	36.25	10.7	1.05	1.07	2	1000.00	0.0	4139.38	6.67	3837.05
1.02											
20	204.05	63.42	10.7	1.86	1.89	1	10.00	35.0	7240.34	0.00	3661.82
0.96											
21	205.91	124.99	13.6	3.73	3.84	1	10.00	35.0	14267.25	0.00	3533.86
0.95											
22	209.64	121.62	13.6	3.73	3.84	1	10.00	35.0	13879.43	0.00	3437.63
0.95											
23	213.37	99.00	16.6	3.13	3.26	1	10.00	35.0	11295.79	0.00	3283.72
0.95											
24	216.50	92.30	16.6	3.00	3.13	4	0.00	45.0	9589.31	2337.22	2889.54
0.91											

25	219.50	37.22	16.6	1.24	1.29	1	10.00	35.0	4742.77	2157.93	3641.25
0.95											
26	220.74	106.10	19.5	3.62	3.84	1	10.00	35.0	13510.57	6232.07	3506.41
0.95											
27	224.35	101.47	19.5	3.62	3.84	1	10.00	35.0	12908.18	5925.37	3349.20
0.95											
28	227.97	94.63	22.4	3.55	3.84	1	10.00	35.0	12024.54	5596.69	3150.50
0.95											
29	231.52	89.43	22.4	3.55	3.84	1	10.00	35.0	11349.09	5245.99	2972.28
0.95											
30	235.07	82.04	25.3	3.47	3.84	1	10.00	35.0	10393.99	4873.81	2755.91
0.95											
31	238.54	76.33	25.4	3.47	3.84	1	10.00	35.0	9652.51	4480.22	2557.44
0.95											
32	242.01	68.53	28.3	3.38	3.84	1	10.00	35.0	8644.79	4065.36	2324.56
0.96											
33	245.39	62.38	28.3	3.38	3.84	1	10.00	35.0	7845.38	3629.39	2107.05
0.96											
34	248.77	54.33	31.2	3.28	3.84	1	10.00	35.0	6806.33	3173.33	1858.94
0.97											
35	252.06	47.79	31.2	3.28	3.84	1	10.00	35.0	5957.03	2696.48	1623.14
0.97											
36	255.34	39.66	34.2	3.18	3.84	1	10.00	35.0	4908.51	2200.23	1361.23
0.98											
37	258.52	32.82	34.1	3.18	3.84	1	10.00	35.0	4018.50	1683.89	1108.27
0.98											
38	261.69	17.04	37.1	2.01	2.51	1	10.00	35.0	2058.53	814.89	880.56
1.00											
39	263.70	25.72	37.1	4.12	5.16	1	10.00	35.0	3014.09	927.50	616.57
1.00											
40	267.82	6.48	40.0	1.57	2.06	1	10.00	35.0	712.15	84.74	358.43
1.02											
41	269.39	4.68	40.0	1.67	2.18	1	10.00	35.0	485.33	0.00	223.66
1.02											
42	271.06	2.81	40.0	2.64	3.45	5	50.00	25.0	281.26	0.00	72.65
1.10											

X-S Area: 2776.78 Path Length: 145.89 X-S Weight: 328583.91

Project: Bernhardt Sand and Gravel Pit
File: P:\22036 IHC Scott Milliken Property\Slope Stability\Galena\Bernhardt SS3-EQ.gmf
Processed: 24 Feb 2024 13:46:58

DATA: Analysis 1 - Case SS-3 - Pseudo-Static

Material Properties (5 materials)

Material: 1 (Mohr-Coulomb Isotropic) - Sand and Gravel

	Cohesion	Phi	UnitWeight	Ru
Unsaturated:	10.00	35.0	115.00	Auto
Saturated:	10.00	35.0	130.00	Auto

Material: 2 (Mohr-Coulomb Isotropic) - Weathered Claystoe Bedrock

	Cohesion	Phi	UnitWeight	Ru
Unsaturated:	1000.00	0.0	110.00	Auto
Saturated:	1000.00	0.0	115.00	Auto

Material: 3 (Mohr-Coulomb Isotropic) - Stable Claystone Bedrock

	Cohesion	Phi	UnitWeight	Ru
Unsaturated:	3000.00	0.0	120.00	Auto
Saturated:	3000.00	0.0	135.00	Auto

Material: 4 (Mohr-Coulomb Isotropic) - Slurry Wall

	Cohesion	Phi	UnitWeight	Ru
Unsaturated:	0.00	45.0	100.00	Auto
Saturated:	0.00	45.0	110.00	Auto

Material: 5 (Mohr-Coulomb Isotropic) - Clay

	Cohesion	Phi	UnitWeight	Ru
Unsaturated:	50.00	25.0	100.00	Auto
Saturated:	50.00	25.0	115.00	Auto

Water Properties

Unit weight of water: 62.400 Unit weight of water/medium above ground: 62.400

Material Profiles (7 profiles)

Profile: 1 (2 points) Material beneath: 5 - Clay
0.00 4721.00 365.00 4721.00

Profile: 2 (2 points) Material beneath: 1 - Sand and Gravel
0.00 4716.40 216.50 4716.40

Profile: 3 (2 points) Material beneath: 4 - Slurry Wall

```
    216.50     4718.40         219.50     4718.40
Profile:  4 (2 points)   Material beneath:  1 - Sand and Gravel
    219.50     4716.40         365.00     4716.40
Profile:  5 (3 points)   Material beneath:  2 - Weathered Claystoe Bedrock
      0.00     4684.00         134.30     4684.00         216.50     4684.00
Profile:  6 (2 points)   Material beneath:  2 - Weathered Claystoe Bedrock
    219.50     4684.00         365.00     4684.00
Profile:  7 (4 points)   Material beneath:  3 - Stable Claystone Bedrock
      0.00     4681.00         134.20     4681.00         216.50     4681.00         365.00     4681.20

Slope Surface (8 points)
-------------
      0.00     4684.00         134.20     4684.00         203.00     4718.30         216.50     4718.30         219.50
4718.30
    263.70     4718.30         314.40     4719.90         365.00     4720.50

Phreatic Surface (5 points)
----------------
      0.00     4684.00         134.20     4684.00         216.50     4684.00         219.50     4715.00         365.00
4715.00

Failure Surface
---------------
Initial circular surface for critical search defined by: XL,XR,R
  Intersects:  XL:     134.00      YL:    4684.00      XR:     268.70      YR:    4718.46
      Centre:  XC:     141.84      YC:    4933.88                  Radius:  R:     250.00

Earthquake Force
----------------
Pseudo-static earthquake (seismic) coefficient:  0.070

Variable Restraints
-------------------
Parameter descriptor:              XL         XR         R
Range of variation:             10.00      10.00     200.00
Trial positions within range:      20         20         50

-  --  --  --  --  --  --  --  --  --  --  --  --  --  --  --  --  --  --  --  --  --  --  --  --  --  --  --  --  --  --
--  --  --  -

RESULTS: Analysis  1 - Case SS-3 - Pseudo-Static

Bishop Simplified Method of Analysis - Circular Failure Surface
---------------------------------------------------------------
Critical Failure Surface Search using Multiple Circle Generation Techniques
```

Initial failure surface approximation - Factor of Safety: 2.102

Analysis Summary
================
There were: 16605 successful analyses from a total of 20001 trial failure surfaces
             3396 analyses terminated due to unacceptable geometry

Critical (minimum) Factor of Safety: 1.59
==

Results Summary - Lowest 99 Factor of Safety circles

Circle	X-Left	Y-Left	X-Right	Y-Right	X-Centre	Y-Centre	Radius	FoS	
1	137.42	4685.61	273.70	4718.62	174.34	4830.99	150.00	1.588	<-- Critical Surface
2	137.42	4685.61	273.17	4718.60	173.95	4831.09	150.00	1.606	
3	137.95	4685.87	273.70	4718.62	174.69	4831.30	150.00	1.616	
4	136.89	4685.34	273.70	4718.62	172.91	4835.16	154.08	1.616	
5	137.42	4685.61	272.65	4718.58	173.55	4831.19	150.00	1.618	
6	136.89	4685.34	271.59	4718.55	172.41	4831.08	150.00	1.619	
7	136.89	4685.34	272.12	4718.57	172.81	4830.98	150.00	1.621	
8	137.95	4685.87	273.17	4718.60	174.30	4831.40	150.00	1.630	
9	136.89	4685.34	273.17	4718.60	172.51	4835.25	154.08	1.630	
10	137.42	4685.61	272.12	4718.57	173.16	4831.29	150.00	1.632	
11	136.37	4685.08	272.12	4718.57	171.36	4835.14	154.08	1.632	
12	136.89	4685.34	271.07	4718.53	172.01	4831.17	150.00	1.634	
13	136.37	4685.08	270.02	4718.50	170.87	4831.06	150.00	1.637	
14	136.37	4685.08	273.70	4718.62	171.47	4839.30	158.16	1.642	
15	137.42	4685.61	273.70	4718.62	173.26	4835.46	154.08	1.643	
16	136.89	4685.34	272.65	4718.58	172.11	4835.35	154.08	1.644	
17	137.95	4685.87	272.65	4718.58	173.90	4831.50	150.00	1.644	
18	138.47	4686.13	273.70	4718.62	175.04	4831.60	150.00	1.644	
19	135.84	4684.82	272.65	4718.58	170.32	4839.18	158.16	1.646	
20	137.42	4685.61	271.59	4718.55	172.76	4831.38	150.00	1.646	
21	136.37	4685.08	271.59	4718.55	170.96	4835.23	154.08	1.647	
22	136.89	4685.34	270.54	4718.52	171.62	4831.27	150.00	1.647	
23	136.37	4685.08	269.49	4718.48	170.47	4831.15	150.00	1.653	
24	135.84	4684.82	268.44	4718.45	169.32	4831.04	150.00	1.655	
25	136.37	4685.08	273.17	4718.60	171.07	4839.39	158.16	1.655	
26	135.84	4684.82	272.12	4718.57	169.91	4839.27	158.16	1.657	
27	136.89	4685.34	272.12	4718.57	171.71	4835.44	154.08	1.657	
28	137.95	4685.87	272.12	4718.57	173.51	4831.59	150.00	1.657	
29	137.42	4685.61	273.17	4718.60	172.86	4835.56	154.08	1.657	
30	138.47	4686.13	273.17	4718.60	174.65	4831.70	150.00	1.658	

31	135.84	4684.82	270.54	4718.52	169.81	4835.11	154.08	1.660
32	136.89	4685.34	270.02	4718.50	171.22	4831.36	150.00	1.661
33	136.37	4685.08	271.07	4718.53	170.56	4835.32	154.08	1.663
34	136.37	4685.08	270.54	4718.52	171.27	4830.96	150.00	1.663
35	136.37	4685.08	268.96	4718.47	170.07	4831.25	150.00	1.664
36	137.42	4685.61	271.07	4718.53	172.36	4831.48	150.00	1.664
37	135.84	4684.82	270.02	4718.50	169.41	4835.20	154.08	1.664
38	136.89	4685.34	273.70	4718.62	171.83	4839.60	158.16	1.666
39	135.32	4684.56	271.07	4718.53	168.75	4839.14	158.16	1.667
40	135.84	4684.82	273.70	4718.62	170.03	4843.42	162.24	1.667
41	137.95	4685.87	273.70	4718.62	173.61	4835.76	154.08	1.668
42	136.89	4685.34	271.59	4718.55	171.31	4835.53	154.08	1.668
43	135.84	4684.82	267.91	4718.43	168.92	4831.13	150.00	1.668
44	136.37	4685.08	272.65	4718.58	171.76	4835.04	154.08	1.669
45	137.95	4685.87	271.59	4718.55	173.11	4831.69	150.00	1.670
46	135.32	4684.56	268.96	4718.47	168.25	4835.08	154.08	1.671
47	135.84	4684.82	271.59	4718.55	169.51	4839.36	158.16	1.672
48	136.37	4685.08	270.54	4718.52	170.16	4835.41	154.08	1.673
49	136.37	4685.08	272.65	4718.58	170.67	4839.48	158.16	1.673
50	136.89	4685.34	269.49	4718.48	170.82	4831.46	150.00	1.673
51	139.00	4686.39	273.70	4718.62	175.39	4831.91	150.00	1.674
52	137.42	4685.61	270.54	4718.52	171.96	4831.57	150.00	1.674
53	135.32	4684.56	266.86	4718.40	167.76	4831.00	150.00	1.675
54	135.32	4684.56	272.65	4718.58	168.87	4843.29	162.24	1.675
55	136.37	4685.08	268.44	4718.45	169.66	4831.34	150.00	1.675
56	135.84	4684.82	269.49	4718.48	169.00	4835.29	154.08	1.677
57	137.42	4685.61	272.65	4718.58	172.47	4835.65	154.08	1.678
58	135.32	4684.56	270.54	4718.52	168.35	4839.23	158.16	1.679
59	136.89	4685.34	273.17	4718.60	171.43	4839.69	158.16	1.679
60	136.37	4685.08	272.12	4718.57	170.27	4839.57	158.16	1.679
61	135.84	4684.82	273.17	4718.60	169.63	4843.51	162.24	1.680
62	138.47	4686.13	272.65	4718.58	174.25	4831.80	150.00	1.680
63	137.95	4685.87	273.17	4718.60	173.22	4835.86	154.08	1.681
64	137.42	4685.61	272.12	4718.57	172.07	4835.74	154.08	1.681
65	135.84	4684.82	267.38	4718.42	168.51	4831.22	150.00	1.681
66	137.95	4685.87	271.07	4718.53	172.71	4831.78	150.00	1.682
67	136.89	4685.34	271.07	4718.53	170.91	4835.62	154.08	1.683
68	135.32	4684.56	268.44	4718.45	167.85	4835.17	154.08	1.683
69	137.42	4685.61	270.02	4718.50	171.56	4831.67	150.00	1.684
70	138.47	4686.13	272.12	4718.57	173.86	4831.90	150.00	1.684
71	135.84	4684.82	271.07	4718.53	169.11	4839.44	158.16	1.685
72	136.37	4685.08	270.02	4718.50	169.76	4835.50	154.08	1.685
73	135.32	4684.56	272.12	4718.57	168.46	4843.38	162.24	1.686
74	136.89	4685.34	268.96	4718.47	170.41	4831.55	150.00	1.686
75	135.32	4684.56	266.33	4718.38	167.36	4831.09	150.00	1.686

76	135.32	4684.56	273.17	4718.60	169.27	4843.21	162.24	1.687
77	136.37	4685.08	267.91	4718.43	169.26	4831.43	150.00	1.688
78	135.84	4684.82	268.96	4718.47	168.60	4835.38	154.08	1.688
79	136.37	4685.08	273.70	4718.62	170.39	4843.72	162.24	1.688
80	137.42	4685.61	273.70	4718.62	172.19	4839.90	158.16	1.690
81	135.84	4684.82	272.65	4718.58	169.23	4843.59	162.24	1.690
82	135.32	4684.56	270.02	4718.50	167.94	4839.32	158.16	1.691
83	136.89	4685.34	272.65	4718.58	171.03	4839.78	158.16	1.691
84	135.84	4684.82	266.86	4718.40	168.11	4831.31	150.00	1.692
85	135.32	4684.56	273.70	4718.62	168.59	4847.52	166.33	1.692
86	136.37	4685.08	271.59	4718.55	169.87	4839.66	158.16	1.693
87	134.79	4684.29	271.07	4718.53	167.29	4843.25	162.24	1.694
88	139.00	4686.39	273.17	4718.60	175.00	4832.01	150.00	1.695
89	136.89	4685.34	270.54	4718.52	170.51	4835.71	154.08	1.695
90	138.47	4686.13	273.70	4718.62	173.97	4836.07	154.08	1.695
91	135.32	4684.56	267.91	4718.43	167.44	4835.25	154.08	1.696
92	135.84	4684.82	270.54	4718.52	168.70	4839.53	158.16	1.697
93	136.37	4685.08	269.49	4718.48	169.36	4835.59	154.08	1.697
94	138.47	4686.13	271.59	4718.55	173.46	4831.99	150.00	1.697
95	137.95	4685.87	272.65	4718.58	172.82	4835.95	154.08	1.697
96	136.89	4685.34	268.44	4718.45	170.01	4831.64	150.00	1.697
97	135.32	4684.56	265.81	4718.37	166.95	4831.18	150.00	1.698
98	135.32	4684.56	271.59	4718.55	168.06	4843.46	162.24	1.698
99	134.79	4684.29	273.17	4718.60	167.82	4847.31	166.33	1.698

Critical Failure Surface (circle 1)

Intersects: XL: 137.42 YL: 4685.61 XR: 273.70 YR: 4718.62
Centre: XC: 174.34 YC: 4830.99 Radius: R: 150.00

Generated failure surface: (20 points)

137.42	4685.61	144.91	4683.91	152.47	4682.59	160.10	4681.67	167.76	4681.14
175.43	4680.99	183.11	4681.25	190.76	4681.89	198.37	4682.93	205.91	4684.35
213.37	4686.16	220.74	4688.35	227.97	4690.91	235.07	4693.83	242.01	4697.12
248.77	4700.76	255.34	4704.74	261.69	4709.05	267.82	4713.68	273.70	4718.62

Slice Geometry and Properties - Critical Failure Surface (circle 1, 42 slices)

Slice	X-S	Base						PoreWater	Normal Test
X-Left	Area	Angle	Width	Length	Matl	Cohesion	Phi	Weight	Force	Stress Factor

1	137.42	4.54	-12.8	3.54	3.63	1	10.00	35.0	522.52	0.00	165.62
1.14											
2	140.96	13.63	-12.8	3.54	3.63	1	10.00	35.0	1567.77	0.00	493.72
1.14											
3	144.50	25.90	-10.2	3.99	4.05	2	1000.00	0.0	2978.98	93.06	859.96
1.02											
4	148.49	36.59	-9.9	3.99	4.05	2	1000.00	0.0	4207.88	267.81	1164.71
1.01											
5	152.47	44.58	-6.9	3.81	3.84	2	1000.00	0.0	5127.20	392.33	1421.68
1.01											
6	156.29	53.59	-6.9	3.81	3.84	2	1000.00	0.0	6162.57	503.10	1693.26
1.01											
7	160.10	62.54	-4.0	3.83	3.84	2	1000.00	0.0	7192.20	590.37	1921.73
1.00											
8	163.93	70.88	-4.0	3.83	3.84	2	1000.00	0.0	8150.93	654.36	2172.13
1.00											
9	167.76	75.86	-1.1	3.69	3.69	2	1000.00	0.0	8724.17	667.84	2374.63
1.00											
10	171.45	82.91	-1.0	3.69	3.69	2	1000.00	0.0	9534.33	683.47	2593.99
1.00											
11	175.14	97.02	1.7	3.98	3.99	2	1000.00	0.0	11156.80	733.56	2782.23
1.00											
12	179.12	104.40	1.9	3.98	3.99	2	1000.00	0.0	12006.57	700.97	2993.24
1.00											
13	183.11	106.84	4.8	3.83	3.84	2	1000.00	0.0	12286.83	620.90	3158.71
1.00											
14	186.93	112.91	4.8	3.83	3.84	2	1000.00	0.0	12984.12	543.69	3340.98
1.00											
15	190.76	117.91	7.7	3.80	3.84	2	1000.00	0.0	13559.40	443.10	3478.78
1.01											
16	194.56	123.15	7.8	3.80	3.84	2	1000.00	0.0	14162.41	318.99	3637.22
1.01											
17	198.37	27.28	10.7	0.82	0.84	2	1000.00	0.0	3137.70	51.95	3697.93
1.02											
18	199.19	129.22	10.7	3.81	3.88	2	1000.00	0.0	14805.88	135.06	3766.41
1.02											
19	203.00	36.25	10.7	1.05	1.07	2	1000.00	0.0	4138.86	6.67	3808.71
1.02											
20	204.05	63.42	10.7	1.86	1.89	1	10.00	35.0	7240.34	0.00	3595.64
0.94											
21	205.91	124.99	13.6	3.73	3.84	1	10.00	35.0	14267.25	0.00	3453.63
0.93											
22	209.64	121.62	13.6	3.73	3.84	1	10.00	35.0	13879.43	0.00	3359.54
0.93											

23	213.37	99.00	16.6	3.13	3.26	1	10.00	35.0	11295.79	0.00	3194.15
0.92											
24	216.50	92.30	16.6	3.00	3.13	4	0.00	45.0	9589.31	2337.22	2810.34
0.88											
25	219.50	37.22	16.6	1.24	1.29	1	10.00	35.0	4742.77	2157.93	3587.43
0.92											
26	220.74	106.10	19.5	3.62	3.84	1	10.00	35.0	13510.57	6232.07	3446.38
0.92											
27	224.35	101.47	19.5	3.62	3.84	1	10.00	35.0	12908.18	5925.37	3291.62
0.92											
28	227.97	94.63	22.4	3.55	3.84	1	10.00	35.0	12024.54	5596.69	3088.91
0.92											
29	231.52	89.43	22.4	3.55	3.84	1	10.00	35.0	11349.09	5245.99	2913.83
0.92											
30	235.07	82.04	25.3	3.47	3.84	1	10.00	35.0	10393.99	4873.81	2695.12
0.92											
31	238.54	76.33	25.4	3.47	3.84	1	10.00	35.0	9652.51	4480.22	2500.52
0.92											
32	242.01	68.53	28.3	3.38	3.84	1	10.00	35.0	8644.79	4065.36	2267.01
0.92											
33	245.39	62.38	28.3	3.38	3.84	1	10.00	35.0	7845.38	3629.39	2054.19
0.92											
34	248.77	54.33	31.2	3.28	3.84	1	10.00	35.0	6806.33	3173.33	1807.19
0.92											
35	252.06	47.79	31.2	3.28	3.84	1	10.00	35.0	5957.03	2696.48	1576.93
0.92											
36	255.34	39.66	34.2	3.18	3.84	1	10.00	35.0	4908.51	2200.23	1317.91
0.93											
37	258.52	32.82	34.1	3.18	3.84	1	10.00	35.0	4018.50	1683.89	1071.36
0.93											
38	261.69	17.04	37.1	2.01	2.51	1	10.00	35.0	2058.53	814.89	847.11
0.94											
39	263.70	25.72	37.1	4.12	5.16	1	10.00	35.0	3014.09	927.50	590.13
0.94											
40	267.82	6.48	40.0	1.57	2.06	1	10.00	35.0	712.15	84.74	337.43
0.95											
41	269.39	4.68	40.0	1.67	2.18	1	10.00	35.0	485.33	0.00	208.58
0.95											
42	271.06	2.81	40.0	2.64	3.45	5	50.00	25.0	281.26	0.00	64.31
1.05											

X-S Area: 2776.78 Path Length: 145.89 X-S Weight: 327992.78

GALENA 7.2 Analysis Results Version: 7.2.3.05 Licensee: J & T Consulting

Project: Bernhardt Sand and Gravel Pit
File: P:\22036 IHC Scott Milliken Property\Slope Stability\Galena\Bernhardt SS4.gmf
Processed: 24 Feb 2024 13:50:51

DATA: Analysis 1 - Case SS-4 - Static

Material Properties (5 materials)

Material: 1 (Mohr-Coulomb Isotropic) - Sand and Gravel

	Cohesion	Phi	UnitWeight	Ru
Unsaturated:	10.00	35.0	115.00	Auto
Saturated:	10.00	35.0	130.00	Auto

Material: 2 (Mohr-Coulomb Isotropic) - Weathered Sandstone Bedrock

	Cohesion	Phi	UnitWeight	Ru
Unsaturated:	1000.00	0.0	105.00	Auto
Saturated:	1000.00	0.0	115.00	Auto

Material: 3 (Mohr-Coulomb Isotropic) - Stable Sandstone Bedrock

	Cohesion	Phi	UnitWeight	Ru
Unsaturated:	3000.00	0.0	115.00	Auto
Saturated:	3000.00	0.0	128.00	Auto

Material: 4 (Mohr-Coulomb Isotropic) - Slurry Wall

	Cohesion	Phi	UnitWeight	Ru
Unsaturated:	0.00	45.0	100.00	Auto
Saturated:	0.00	45.0	110.00	Auto

Material: 5 (Mohr-Coulomb Isotropic) - Clay

	Cohesion	Phi	UnitWeight	Ru
Unsaturated:	50.00	25.0	100.00	Auto
Saturated:	50.00	25.0	115.00	Auto

Water Properties

Unit weight of water: 62.400 Unit weight of water/medium above ground: 62.400

Material Profiles (7 profiles)

Profile: 1 (2 points) Material beneath: 5 - Clay
0.00 4721.00 300.00 4721.00

Profile: 2 (2 points) Material beneath: 1 - Sand and Gravel
0.00 4717.00 172.70 4717.00

Profile: 3 (2 points) Material beneath: 4 - Slurry Wall

```
    172.70     4719.50         175.70     4719.50
Profile:  4 (2 points)   Material beneath:  1 - Sand and Gravel
    175.70     4717.00         300.00     4717.00
Profile:  5 (3 points)   Material beneath:  2 - Weathered Sandstone Bedrock
      0.00     4686.80          94.00     4687.00         172.70     4687.20
Profile:  6 (2 points)   Material beneath:  2 - Weathered Sandstone Bedrock
    175.70     4687.20         300.00     4687.30
Profile:  7 (4 points)   Material beneath:  3 - Stable Sandstone Bedrock
      0.00     4683.80          94.00     4684.00         172.70     4684.00         300.00     4684.30

Slope Surface (7 points)
-------------
      0.00     4686.80          94.00     4687.00         159.20     4719.60         172.70     4719.50         175.70
4719.50
    204.70     4719.30         300.00     4719.80

Phreatic Surface (5 points)
----------------
      0.00     4686.80          94.00     4687.00         172.70     4687.20         175.70     4713.90         300.00
4713.90

Failure Surface
---------------
Initial circular surface for critical search defined by: XL,XR,R
  Intersects:  XL:      94.00      YL:    4687.00      XR:     209.70      YR:    4719.33
      Centre:  XC:     100.52      YC:    4886.89                  Radius:  R:     200.00

Variable Restraints
-------------------
Parameter descriptor:              XL         XR         R
Range of variation:             10.00      10.00     150.00
Trial positions within range:      20         20         50

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RESULTS: Analysis  1 - Case SS-4 - Static

Bishop Simplified Method of Analysis - Circular Failure Surface
------------------------------------------------------------
Critical Failure Surface Search using Multiple Circle Generation Techniques

Initial failure surface approximation - Factor of Safety:   2.671

Analysis Summary
```

==========
There were: 16823 successful analyses from a total of 20001 trial failure surfaces
             3178 analyses terminated due to unacceptable geometry

Critical (minimum) Factor of Safety: 2.21
==========

Results Summary - Lowest 99 Factor of Safety circles

Circle	X-Left	Y-Left	X-Right	Y-Right	X-Centre	Y-Centre	Radius	FoS	
1	96.37	4688.18	214.70	4719.35	127.77	4809.18	125.00	2.214	<-- Critical Surface
2	95.84	4687.92	213.65	4719.35	126.62	4809.07	125.00	2.217	
3	95.32	4687.66	212.59	4719.34	125.46	4808.97	125.00	2.219	
4	95.32	4687.66	214.17	4719.35	125.81	4812.04	128.06	2.225	
5	95.84	4687.92	213.12	4719.34	126.20	4809.18	125.00	2.232	
6	96.37	4688.18	214.17	4719.35	127.36	4809.28	125.00	2.232	
7	95.84	4687.92	214.70	4719.35	126.55	4812.25	128.06	2.234	
8	95.32	4687.66	212.07	4719.34	125.05	4809.07	125.00	2.234	
9	95.32	4687.66	213.65	4719.35	125.39	4812.14	128.06	2.240	
10	94.79	4687.39	212.59	4719.34	124.23	4812.03	128.06	2.245	
11	95.84	4687.92	212.59	4719.34	125.79	4809.28	125.00	2.247	
12	96.37	4688.18	213.65	4719.35	126.94	4809.39	125.00	2.247	
13	95.32	4687.66	211.54	4719.34	124.63	4809.17	125.00	2.249	
14	94.79	4687.39	214.17	4719.35	124.58	4815.09	131.12	2.250	
15	96.89	4688.45	214.70	4719.35	128.10	4809.49	125.00	2.250	
16	95.84	4687.92	214.17	4719.35	127.03	4808.97	125.00	2.251	
17	95.84	4687.92	214.17	4719.35	126.13	4812.35	128.06	2.253	
18	95.32	4687.66	213.12	4719.34	124.97	4812.24	128.06	2.255	
19	94.79	4687.39	210.49	4719.33	123.46	4809.06	125.00	2.259	
20	94.79	4687.39	212.07	4719.34	123.81	4812.12	128.06	2.260	
21	95.32	4687.66	214.70	4719.35	125.33	4815.30	131.12	2.261	
22	95.84	4687.92	212.07	4719.34	125.37	4809.38	125.00	2.261	
23	96.89	4688.45	214.17	4719.35	127.68	4809.60	125.00	2.261	
24	96.37	4688.18	213.12	4719.34	126.53	4809.49	125.00	2.262	
25	95.32	4687.66	211.02	4719.33	124.21	4809.27	125.00	2.263	
26	94.79	4687.39	213.65	4719.35	124.16	4815.19	131.12	2.265	
27	96.37	4688.18	214.70	4719.35	126.88	4812.56	128.06	2.266	
28	94.79	4687.39	209.96	4719.33	123.04	4809.16	125.00	2.267	
29	95.84	4687.92	213.65	4719.35	125.72	4812.45	128.06	2.268	
30	95.32	4687.66	212.59	4719.34	124.55	4812.34	128.06	2.269	
31	94.79	4687.39	211.54	4719.34	123.38	4812.22	128.06	2.274	
32	94.26	4687.13	208.91	4719.32	121.88	4809.04	125.00	2.274	
33	95.32	4687.66	214.17	4719.35	124.91	4815.40	131.12	2.275	
34	95.84	4687.92	211.54	4719.34	124.95	4809.48	125.00	2.275	

35	96.37	4688.18	212.59	4719.34	126.11	4809.59	125.00	2.276
36	94.79	4687.39	213.12	4719.34	123.74	4815.28	131.12	2.279
37	96.89	4688.45	213.65	4719.35	127.27	4809.70	125.00	2.280
38	94.79	4687.39	209.44	4719.32	122.62	4809.26	125.00	2.280
39	95.32	4687.66	210.49	4719.33	123.79	4809.37	125.00	2.280
40	94.26	4687.13	210.49	4719.33	122.21	4812.10	128.06	2.280
41	95.84	4687.92	213.12	4719.34	125.30	4812.55	128.06	2.282
42	97.42	4688.71	214.70	4719.35	128.43	4809.80	125.00	2.283
43	95.32	4687.66	212.07	4719.34	124.13	4812.43	128.06	2.283
44	96.37	4688.18	214.17	4719.35	126.46	4812.66	128.06	2.283
45	94.79	4687.39	214.70	4719.35	124.11	4818.34	134.18	2.284
46	94.26	4687.13	212.07	4719.34	122.57	4815.16	131.12	2.286
47	94.26	4687.13	208.38	4719.32	121.45	4809.14	125.00	2.287
48	95.84	4687.92	211.02	4719.33	124.53	4809.58	125.00	2.288
49	95.84	4687.92	214.70	4719.35	125.66	4815.61	131.12	2.288
50	95.32	4687.66	209.96	4719.33	123.36	4809.47	125.00	2.288
51	93.74	4687.00	207.86	4719.32	120.82	4809.03	125.00	2.289
52	95.32	4687.66	213.65	4719.35	124.49	4815.49	131.12	2.289
53	96.37	4688.18	212.07	4719.34	125.69	4809.70	125.00	2.289
54	94.79	4687.39	211.02	4719.33	122.96	4812.32	128.06	2.289
55	94.26	4687.13	213.65	4719.35	122.93	4818.22	134.18	2.291
56	94.79	4687.39	208.91	4719.32	122.20	4809.35	125.00	2.292
57	94.79	4687.39	212.59	4719.34	123.32	4815.38	131.12	2.293
58	94.26	4687.13	209.96	4719.33	121.79	4812.20	128.06	2.293
59	96.89	4688.45	213.12	4719.34	126.85	4809.80	125.00	2.294
60	97.42	4688.71	214.17	4719.35	128.01	4809.91	125.00	2.294
61	95.84	4687.92	212.59	4719.34	124.88	4812.65	128.06	2.295
62	93.21	4687.00	207.33	4719.31	120.29	4809.03	125.00	2.295
63	93.74	4687.00	209.44	4719.32	121.15	4812.09	128.06	2.295
64	95.32	4687.66	211.54	4719.34	123.71	4812.53	128.06	2.296
65	96.37	4688.18	213.65	4719.35	126.05	4812.76	128.06	2.296
66	94.79	4687.39	214.17	4719.35	123.68	4818.43	134.18	2.298
67	94.26	4687.13	207.86	4719.32	121.02	4809.23	125.00	2.299
68	94.79	4687.39	210.49	4719.33	122.54	4812.41	128.06	2.299
69	96.89	4688.45	214.70	4719.35	127.21	4812.87	128.06	2.300
70	95.32	4687.66	209.44	4719.32	122.94	4809.57	125.00	2.300
71	94.79	4687.39	211.02	4719.33	123.88	4808.96	125.00	2.300
72	94.26	4687.13	211.54	4719.34	122.14	4815.26	131.12	2.301
73	95.84	4687.92	214.17	4719.35	125.24	4815.70	131.12	2.301
74	93.74	4687.00	211.02	4719.33	121.50	4815.15	131.12	2.301
75	93.74	4687.00	207.33	4719.31	120.39	4809.12	125.00	2.301
76	95.32	4687.66	213.12	4719.34	124.07	4815.59	131.12	2.302
77	96.37	4688.18	211.54	4719.34	125.28	4809.80	125.00	2.302
78	95.84	4687.92	210.49	4719.33	124.11	4809.68	125.00	2.302
79	93.21	4687.00	208.91	4719.32	120.63	4812.09	128.06	2.303

80	94.79	4687.39	208.38	4719.32	121.77	4809.45	125.00	2.304
81	92.68	4687.00	206.81	4719.31	119.77	4809.03	125.00	2.304
82	94.26	4687.13	213.12	4719.34	122.51	4818.31	134.18	2.304
83	94.79	4687.39	212.07	4719.34	122.89	4815.47	131.12	2.305
84	94.26	4687.13	209.44	4719.32	121.36	4812.29	128.06	2.306
85	93.74	4687.00	212.59	4719.34	121.87	4818.20	134.18	2.306
86	95.84	4687.92	212.07	4719.34	124.46	4812.74	128.06	2.307
87	95.32	4687.66	214.70	4719.35	124.44	4818.64	134.18	2.307
88	93.74	4687.00	208.91	4719.32	120.73	4812.18	128.06	2.308
89	96.89	4688.45	212.59	4719.34	126.44	4809.91	125.00	2.308
90	95.32	4687.66	211.02	4719.33	123.29	4812.63	128.06	2.309
91	94.26	4687.13	214.70	4719.35	122.88	4821.36	137.24	2.309
92	93.21	4687.00	210.49	4719.33	120.98	4815.15	131.12	2.309
93	93.21	4687.00	206.81	4719.31	119.86	4809.12	125.00	2.309
94	97.42	4688.71	213.65	4719.35	127.60	4810.01	125.00	2.309
95	96.37	4688.18	213.12	4719.34	125.63	4812.86	128.06	2.309
96	93.74	4687.00	206.81	4719.31	119.96	4809.22	125.00	2.309
97	92.68	4687.00	208.38	4719.32	120.10	4812.09	128.06	2.310
98	93.74	4687.00	214.17	4719.35	122.24	4821.25	137.24	2.310
99	94.26	4687.13	207.33	4719.31	120.60	4809.33	125.00	2.310

Critical Failure Surface (circle 1)

Intersects: XL: 96.37 YL: 4688.18 XR: 214.70 YR: 4719.35
Centre: XC: 127.77 YC: 4809.18 Radius: R: 125.00

Generated failure surface: (20 points)

96.37	4688.18	102.92	4686.67	109.55	4685.51	116.23	4684.71	122.95
4684.27								
129.68	4684.19	136.40	4684.47	143.10	4685.12	149.75	4686.12	156.34
4687.48								
162.85	4689.20	169.26	4691.26	175.54	4693.66	181.69	4696.40	187.68
4699.47								
193.50	4702.85	199.12	4706.54	204.54	4710.53	209.74	4714.80	214.70
4719.35								

Slice Geometry and Properties - Critical Failure Surface (circle 1, 43 slices)

Slice	X-S	Base						PoreWater	Normal Test
	X-Left	Area	Angle	Width	Length	Matl	Cohesion	Phi	Weight	Force	Stress	Factor
1	96.37	2.33	-13.0	2.52	2.59	1	10.00	35.0	267.51	0.00	115.56	1.11
2	98.89	6.97	-13.0	2.52	2.59	1	10.00	35.0	802.11	0.00	344.23	1.11

3	101.41	6.41	-13.0	1.51	1.55	2	1000.00	0.0	737.57	17.12	592.02
1.03											
4	102.92	19.59	-9.9	3.31	3.36	2	1000.00	0.0	2253.19	135.94	758.82
1.02											
5	106.24	27.01	-9.9	3.31	3.36	2	1000.00	0.0	3105.74	259.37	1016.12
1.02											
6	109.55	34.42	-6.8	3.34	3.36	2	1000.00	0.0	3957.89	364.13	1238.89
1.01											
7	112.89	41.34	-6.8	3.34	3.36	2	1000.00	0.0	4753.64	450.05	1477.15
1.01											
8	116.23	48.21	-3.8	3.36	3.36	2	1000.00	0.0	5543.97	517.09	1680.89
1.00											
9	119.59	54.58	-3.8	3.36	3.36	2	1000.00	0.0	6277.13	565.06	1899.27
1.00											
10	122.95	60.79	-0.7	3.36	3.36	2	1000.00	0.0	6990.32	594.08	2082.99
1.00											
11	126.31	66.58	-0.7	3.36	3.36	2	1000.00	0.0	7656.27	604.02	2280.93
1.00											
12	129.68	72.00	2.4	3.36	3.36	2	1000.00	0.0	8280.30	595.10	2444.15
1.00											
13	133.04	77.18	2.4	3.36	3.36	2	1000.00	0.0	8875.14	567.02	2621.03
1.00											
14	136.40	81.73	5.5	3.35	3.36	2	1000.00	0.0	9398.87	520.16	2762.92
1.00											
15	139.75	86.26	5.5	3.35	3.36	2	1000.00	0.0	9919.61	454.15	2918.34
1.00											
16	143.10	89.87	8.6	3.33	3.36	2	1000.00	0.0	10334.66	369.36	3038.20
1.01											
17	146.43	93.73	8.6	3.33	3.36	2	1000.00	0.0	10778.71	265.62	3171.67
1.01											
18	149.75	61.71	11.7	2.12	2.17	2	1000.00	0.0	7096.17	108.46	3249.19
1.02											
19	151.88	63.03	11.7	2.12	2.17	2	1000.00	0.0	7248.33	49.87	3320.84
1.02											
20	154.00	22.43	11.7	0.74	0.76	2	1000.00	0.0	2576.91	3.62	3366.41
1.02											
21	154.74	48.70	11.7	1.60	1.63	1	10.00	35.0	5581.71	0.00	3275.37
0.96											
22	156.34	88.61	14.8	2.86	2.95	1	10.00	35.0	10109.83	0.00	3266.32
0.95											
23	159.20	112.71	14.8	3.65	3.78	1	10.00	35.0	12819.45	0.00	3240.10
0.95											
24	162.85	95.59	17.8	3.20	3.36	1	10.00	35.0	10870.17	0.00	3078.99
0.95											

25	166.05	92.22	17.8	3.20	3.36	1	10.00	35.0	10482.96	0.00	2969.41	0.95
26	169.26	95.01	20.9	3.44	3.69	1	10.00	35.0	10796.73	0.00	2795.85	0.96
27	172.70	16.92	20.9	0.63	0.68	4	0.00	45.0	1692.00	0.00	2285.06	0.91
28	173.33	58.05	20.9	2.21	2.37	4	0.00	45.0	6013.41	1390.59	2406.04	0.91
29	175.54	77.27	24.0	3.07	3.36	1	10.00	35.0	9673.03	4104.87	2907.51	0.96
30	178.62	73.00	24.0	3.07	3.36	1	10.00	35.0	9119.38	3817.41	2739.07	0.96
31	181.69	66.74	27.1	3.00	3.36	1	10.00	35.0	8316.31	3512.66	2533.22	0.97
32	184.68	62.08	27.1	3.00	3.36	1	10.00	35.0	7713.33	3191.09	2346.56	0.97
33	187.68	55.54	30.2	2.91	3.36	1	10.00	35.0	6874.39	2852.57	2125.87	0.98
34	190.59	50.56	30.2	2.91	3.36	1	10.00	35.0	6229.03	2497.46	1922.06	0.98
35	193.50	43.87	33.3	2.81	3.36	1	10.00	35.0	5372.75	2126.05	1687.81	0.99
36	196.31	38.63	33.3	2.81	3.36	1	10.00	35.0	4692.41	1738.81	1467.70	0.99
37	199.12	31.95	36.3	2.71	3.36	1	10.00	35.0	3838.44	1335.64	1221.31	1.01
38	201.83	26.50	36.4	2.71	3.36	1	10.00	35.0	3130.60	916.96	985.88	1.01
39	204.54	16.25	39.4	2.05	2.65	1	10.00	35.0	1875.86	418.44	756.19	1.03
40	206.59	12.82	39.4	2.05	2.65	1	10.00	35.0	1429.25	139.51	561.50	1.03
41	208.64	5.47	39.4	1.10	1.42	1	10.00	35.0	590.28	0.00	423.09	1.03
42	209.74	8.21	42.5	2.39	3.25	1	10.00	35.0	860.94	0.00	275.51	1.05
43	212.14	3.00	42.5	2.56	3.48	5	50.00	25.0	299.96	0.00	80.66	1.14

X-S Area:	2195.84	Path Length:	127.86	X-S Weight:	255236.25

Project: Bernhardt Sand and Gravel Pit
File: P:\22036 IHC Scott Milliken Property\Slope Stability\Galena\Bernhardt SS4-EQ.gmf
Processed: 24 Feb 2024 13:54:48

DATA: Analysis 1 - Case SS-4 - Pseudo-Static

Material Properties (5 materials)

Material: 1 (Mohr-Coulomb Isotropic) - Sand and Gravel

	Cohesion	Phi	UnitWeight	Ru
Unsaturated:	10.00	35.0	115.00	Auto
Saturated:	10.00	35.0	130.00	Auto

Material: 2 (Mohr-Coulomb Isotropic) - Weathered Sandstone Bedrock

	Cohesion	Phi	UnitWeight	Ru
Unsaturated:	1000.00	0.0	105.00	Auto
Saturated:	1000.00	0.0	115.00	Auto

Material: 3 (Mohr-Coulomb Isotropic) - Stable Sandstone Bedrock

	Cohesion	Phi	UnitWeight	Ru
Unsaturated:	3000.00	0.0	115.00	Auto
Saturated:	3000.00	0.0	128.00	Auto

Material: 4 (Mohr-Coulomb Isotropic) - Slurry Wall

	Cohesion	Phi	UnitWeight	Ru
Unsaturated:	0.00	45.0	100.00	Auto
Saturated:	0.00	45.0	110.00	Auto

Material: 5 (Mohr-Coulomb Isotropic) - Clay

	Cohesion	Phi	UnitWeight	Ru
Unsaturated:	50.00	25.0	100.00	Auto
Saturated:	50.00	25.0	115.00	Auto

Water Properties

Unit weight of water: 62.400 Unit weight of water/medium above ground: 62.400

Material Profiles (7 profiles)

Profile: 1 (2 points) Material beneath: 5 - Clay
0.00 4721.00 300.00 4721.00

Profile: 2 (2 points) Material beneath: 1 - Sand and Gravel
0.00 4717.00 172.70 4717.00

Profile: 3 (2 points) Material beneath: 4 - Slurry Wall

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    172.70     4719.50         175.70     4719.50
Profile:  4 (2 points)   Material beneath:  1 - Sand and Gravel
    175.70     4717.00         300.00     4717.00
Profile:  5 (3 points)   Material beneath:  2 - Weathered Sandstone Bedrock
      0.00     4686.80          94.00     4687.00         172.70     4687.20
Profile:  6 (2 points)   Material beneath:  2 - Weathered Sandstone Bedrock
    175.70     4687.20         300.00     4687.30
Profile:  7 (4 points)   Material beneath:  3 - Stable Sandstone Bedrock
      0.00     4683.80          94.00     4684.00         172.70     4684.00         300.00     4684.30

Slope Surface (7 points)
-------------
      0.00     4686.80          94.00     4687.00         159.20     4719.60         172.70     4719.50         175.70
4719.50
    204.70     4719.30         300.00     4719.80

Phreatic Surface (5 points)
----------------
      0.00     4686.80          94.00     4687.00         172.70     4687.20         175.70     4713.90         300.00
4713.90

Failure Surface
---------------
Initial circular surface for critical search defined by: XL,XR,R
  Intersects:  XL:      94.00      YL:    4687.00      XR:     209.70      YR:    4719.33
      Centre:  XC:     100.52      YC:    4886.89                  Radius:  R:     200.00

Earthquake Force
----------------
Pseudo-static earthquake (seismic) coefficient:  0.070

Variable Restraints
-------------------
Parameter descriptor:              XL         XR         R
Range of variation:             10.00      10.00     150.00
Trial positions within range:      20         20         50

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RESULTS: Analysis  1 - Case SS-4 - Pseudo-Static

Bishop Simplified Method of Analysis - Circular Failure Surface
---------------------------------------------------------------
Critical Failure Surface Search using Multiple Circle Generation Techniques
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Initial failure surface approximation - Factor of Safety: 2.119

Analysis Summary
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There were: 16823 successful analyses from a total of 20001 trial failure surfaces
             3178 analyses terminated due to unacceptable geometry

Critical (minimum) Factor of Safety: 1.73
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Results Summary - Lowest 99 Factor of Safety circles

Circle	X-Left	Y-Left	X-Right	Y-Right	X-Centre	Y-Centre	Radius	FoS	
1	96.37	4688.18	214.70	4719.35	127.77	4809.18	125.00	1.734	<-- Critical Surface
2	95.84	4687.92	213.65	4719.35	126.62	4809.07	125.00	1.742	
3	95.32	4687.66	214.17	4719.35	125.81	4812.04	128.06	1.748	
4	95.32	4687.66	212.59	4719.34	125.46	4808.97	125.00	1.749	
5	96.37	4688.18	214.17	4719.35	127.36	4809.28	125.00	1.750	
6	95.84	4687.92	214.70	4719.35	126.55	4812.25	128.06	1.751	
7	95.84	4687.92	213.12	4719.34	126.20	4809.18	125.00	1.755	
8	96.89	4688.45	214.70	4719.35	128.10	4809.49	125.00	1.760	
9	95.32	4687.66	213.65	4719.35	125.39	4812.14	128.06	1.762	
10	95.32	4687.66	212.07	4719.34	125.05	4809.07	125.00	1.763	
11	96.37	4688.18	213.65	4719.35	126.94	4809.39	125.00	1.764	
12	95.84	4687.92	214.17	4719.35	127.03	4808.97	125.00	1.768	
13	95.84	4687.92	214.17	4719.35	126.13	4812.35	128.06	1.768	
14	95.84	4687.92	212.59	4719.34	125.79	4809.28	125.00	1.769	
15	94.79	4687.39	214.17	4719.35	124.58	4815.09	131.12	1.769	
16	94.79	4687.39	212.59	4719.34	124.23	4812.03	128.06	1.771	
17	96.89	4688.45	214.17	4719.35	127.68	4809.60	125.00	1.771	
18	95.32	4687.66	214.70	4719.35	125.33	4815.30	131.12	1.774	
19	96.37	4688.18	214.70	4719.35	126.88	4812.56	128.06	1.775	
20	95.32	4687.66	213.12	4719.34	124.97	4812.24	128.06	1.775	
21	95.32	4687.66	211.54	4719.34	124.63	4809.17	125.00	1.776	
22	96.37	4688.18	213.12	4719.34	126.53	4809.49	125.00	1.777	
23	95.84	4687.92	213.65	4719.35	125.72	4812.45	128.06	1.782	
24	95.84	4687.92	212.07	4719.34	125.37	4809.38	125.00	1.782	
25	94.79	4687.39	213.65	4719.35	124.16	4815.19	131.12	1.783	
26	97.42	4688.71	214.70	4719.35	128.43	4809.80	125.00	1.784	
27	94.79	4687.39	212.07	4719.34	123.81	4812.12	128.06	1.785	
28	96.89	4688.45	213.65	4719.35	127.27	4809.70	125.00	1.787	
29	95.32	4687.66	214.17	4719.35	124.91	4815.40	131.12	1.787	
30	95.32	4687.66	212.59	4719.34	124.55	4812.34	128.06	1.788	

31	95.32	4687.66	211.02	4719.33	124.21	4809.27	125.00	1.789
32	94.79	4687.39	210.49	4719.33	123.46	4809.06	125.00	1.789
33	96.37	4688.18	214.17	4719.35	126.46	4812.66	128.06	1.790
34	96.37	4688.18	212.59	4719.34	126.11	4809.59	125.00	1.790
35	95.84	4687.92	214.70	4719.35	125.66	4815.61	131.12	1.793
36	94.79	4687.39	214.70	4719.35	124.11	4818.34	134.18	1.794
37	95.84	4687.92	213.12	4719.34	125.30	4812.55	128.06	1.794
38	97.42	4688.71	214.17	4719.35	128.01	4809.91	125.00	1.795
39	95.84	4687.92	211.54	4719.34	124.95	4809.48	125.00	1.795
40	94.79	4687.39	213.12	4719.34	123.74	4815.28	131.12	1.796
41	94.79	4687.39	211.54	4719.34	123.38	4812.22	128.06	1.797
42	94.79	4687.39	209.96	4719.33	123.04	4809.16	125.00	1.798
43	96.89	4688.45	214.70	4719.35	127.21	4812.87	128.06	1.799
44	95.32	4687.66	213.65	4719.35	124.49	4815.49	131.12	1.800
45	96.89	4688.45	213.12	4719.34	126.85	4809.80	125.00	1.800
46	95.32	4687.66	212.07	4719.34	124.13	4812.43	128.06	1.801
47	96.37	4688.18	213.65	4719.35	126.05	4812.76	128.06	1.802
48	96.37	4688.18	212.07	4719.34	125.69	4809.70	125.00	1.802
49	95.32	4687.66	210.49	4719.33	123.79	4809.37	125.00	1.804
50	94.26	4687.13	213.65	4719.35	122.93	4818.22	134.18	1.805
51	95.84	4687.92	214.17	4719.35	125.24	4815.70	131.12	1.806
52	95.84	4687.92	212.59	4719.34	124.88	4812.65	128.06	1.807
53	95.84	4687.92	211.02	4719.33	124.53	4809.58	125.00	1.807
54	94.79	4687.39	214.17	4719.35	123.68	4818.43	134.18	1.807
55	94.26	4687.13	212.07	4719.34	122.57	4815.16	131.12	1.807
56	97.95	4688.97	214.70	4719.35	128.75	4810.12	125.00	1.808
57	97.42	4688.71	213.65	4719.35	127.60	4810.01	125.00	1.808
58	94.26	4687.13	210.49	4719.33	122.21	4812.10	128.06	1.809
59	94.79	4687.39	212.59	4719.34	123.32	4815.38	131.12	1.809
60	94.26	4687.13	208.91	4719.32	121.88	4809.04	125.00	1.809
61	94.79	4687.39	209.44	4719.32	122.62	4809.26	125.00	1.810
62	96.37	4688.18	214.70	4719.35	126.00	4815.92	131.12	1.811
63	95.32	4687.66	214.70	4719.35	124.44	4818.64	134.18	1.811
64	94.79	4687.39	211.02	4719.33	122.96	4812.32	128.06	1.812
65	95.32	4687.66	213.12	4719.34	124.07	4815.59	131.12	1.812
66	95.32	4687.66	211.54	4719.34	123.71	4812.53	128.06	1.813
67	95.32	4687.66	209.96	4719.33	123.36	4809.47	125.00	1.813
68	96.89	4688.45	212.59	4719.34	126.44	4809.91	125.00	1.813
69	96.89	4688.45	214.17	4719.35	126.79	4812.97	128.06	1.814
70	96.37	4688.18	213.12	4719.34	125.63	4812.86	128.06	1.814
71	96.37	4688.18	211.54	4719.34	125.28	4809.80	125.00	1.814
72	94.26	4687.13	214.70	4719.35	122.88	4821.36	137.24	1.816
73	95.84	4687.92	213.65	4719.35	124.82	4815.80	131.12	1.818
74	95.84	4687.92	212.07	4719.34	124.46	4812.74	128.06	1.818
75	94.26	4687.13	213.12	4719.34	122.51	4818.31	134.18	1.818

76	94.79	4687.39	213.65	4719.35	123.26	4818.52	134.18	1.819
77	97.95	4688.97	214.17	4719.35	128.34	4810.22	125.00	1.820
78	95.84	4687.92	210.49	4719.33	124.11	4809.68	125.00	1.820
79	97.42	4688.71	213.12	4719.34	127.18	4810.12	125.00	1.820
80	93.74	4687.00	214.17	4719.35	122.24	4821.25	137.24	1.821
81	94.79	4687.39	212.07	4719.34	122.89	4815.47	131.12	1.821
82	94.26	4687.13	209.96	4719.33	121.79	4812.20	128.06	1.821
83	97.42	4688.71	214.70	4719.35	127.54	4813.18	128.06	1.821
84	94.26	4687.13	211.54	4719.34	122.14	4815.26	131.12	1.821
85	94.26	4687.13	208.38	4719.32	121.45	4809.14	125.00	1.821
86	94.79	4687.39	210.49	4719.33	122.54	4812.41	128.06	1.822
87	94.79	4687.39	208.91	4719.32	122.20	4809.35	125.00	1.822
88	94.79	4687.39	211.02	4719.33	123.88	4808.96	125.00	1.822
89	95.32	4687.66	214.17	4719.35	124.02	4818.74	134.18	1.823
90	93.74	4687.00	212.59	4719.34	121.87	4818.20	134.18	1.823
91	95.32	4687.66	212.59	4719.34	123.65	4815.68	131.12	1.824
92	95.32	4687.66	209.44	4719.32	122.94	4809.57	125.00	1.824
93	93.74	4687.00	211.02	4719.33	121.50	4815.15	131.12	1.825
94	95.32	4687.66	211.02	4719.33	123.29	4812.63	128.06	1.825
95	93.74	4687.00	209.44	4719.32	121.15	4812.09	128.06	1.826
96	93.74	4687.00	207.86	4719.32	120.82	4809.03	125.00	1.826
97	95.84	4687.92	214.70	4719.35	124.78	4818.95	134.18	1.828
98	94.26	4687.13	214.17	4719.35	122.46	4821.45	137.24	1.828
99	96.89	4688.45	212.07	4719.34	126.02	4810.01	125.00	1.829

Critical Failure Surface (circle 1)

Intersects: XL: 96.37 YL: 4688.18 XR: 214.70 YR: 4719.35
Centre: XC: 127.77 YC: 4809.18 Radius: R: 125.00

Generated failure surface: (20 points)

96.37	4688.18	102.92	4686.67	109.55	4685.51	116.23	4684.71	122.95
4684.27								
129.68	4684.19	136.40	4684.47	143.10	4685.12	149.75	4686.12	156.34
4687.48								
162.85	4689.20	169.26	4691.26	175.54	4693.66	181.69	4696.40	187.68
4699.47								
193.50	4702.85	199.12	4706.54	204.54	4710.53	209.74	4714.80	214.70
4719.35								

Slice Geometry and Properties - Critical Failure Surface (circle 1, 43 slices)

Slice	X-S	Base						PoreWater	Normal Test
	X-Left	Area	Angle	Width	Length	Matl	Cohesion	Phi	Weight	Force	Stress Factor

1	96.37	2.33	-13.0	2.52	2.59	1	10.00	35.0	267.51	0.00	118.45
1.13											
2	98.89	6.97	-13.0	2.52	2.59	1	10.00	35.0	802.11	0.00	352.23
1.13											
3	101.41	6.41	-13.0	1.51	1.55	2	1000.00	0.0	737.57	17.12	620.93
1.03											
4	102.92	19.59	-9.9	3.31	3.36	2	1000.00	0.0	2253.19	135.94	780.69
1.02											
5	106.24	27.01	-9.9	3.31	3.36	2	1000.00	0.0	3105.74	259.37	1038.01
1.02											
6	109.55	34.42	-6.8	3.34	3.36	2	1000.00	0.0	3957.89	364.13	1253.88
1.01											
7	112.89	41.34	-6.8	3.34	3.36	2	1000.00	0.0	4753.64	450.05	1492.17
1.01											
8	116.23	48.21	-3.8	3.36	3.36	2	1000.00	0.0	5543.97	517.09	1689.10
1.00											
9	119.59	54.58	-3.8	3.36	3.36	2	1000.00	0.0	6277.13	565.06	1907.48
1.00											
10	122.95	60.79	-0.7	3.36	3.36	2	1000.00	0.0	6990.32	594.08	2084.44
1.00											
11	126.31	66.58	-0.7	3.36	3.36	2	1000.00	0.0	7656.27	604.02	2282.38
1.00											
12	129.68	72.00	2.4	3.36	3.36	2	1000.00	0.0	8280.30	595.10	2438.88
1.00											
13	133.04	77.18	2.4	3.36	3.36	2	1000.00	0.0	8875.14	567.02	2615.74
1.00											
14	136.40	81.73	5.5	3.35	3.36	2	1000.00	0.0	9398.87	520.16	2750.88
1.00											
15	139.75	86.26	5.5	3.35	3.36	2	1000.00	0.0	9919.61	454.15	2906.29
1.00											
16	143.10	89.87	8.6	3.33	3.36	2	1000.00	0.0	10334.66	369.36	3019.30
1.01											
17	146.43	93.73	8.6	3.33	3.36	2	1000.00	0.0	10778.71	265.62	3152.78
1.01											
18	149.75	61.71	11.7	2.12	2.17	2	1000.00	0.0	7096.17	108.46	3223.35
1.02											
19	151.88	63.03	11.7	2.12	2.17	2	1000.00	0.0	7248.33	49.87	3295.00
1.02											
20	154.00	22.43	11.7	0.74	0.76	2	1000.00	0.0	2576.91	3.62	3340.58
1.02											
21	154.74	48.70	11.7	1.60	1.63	1	10.00	35.0	5581.71	0.00	3220.39
0.94											
22	156.34	88.61	14.8	2.86	2.95	1	10.00	35.0	10109.83	0.00	3197.89
0.93											

23	159.20	112.71	14.8	3.65	3.78	1	10.00	35.0	12819.45	0.00	3172.24	0.93
24	162.85	95.59	17.8	3.20	3.36	1	10.00	35.0	10870.17	0.00	3001.78	0.93
25	166.05	92.22	17.8	3.20	3.36	1	10.00	35.0	10482.96	0.00	2894.96	0.93
26	169.26	95.01	20.9	3.44	3.69	1	10.00	35.0	10796.73	0.00	2714.32	0.93
27	172.70	16.92	20.9	0.63	0.68	4	0.00	45.0	1692.00	0.00	2195.41	0.88
28	173.33	58.05	20.9	2.21	2.37	4	0.00	45.0	6013.41	1390.59	2334.77	0.88
29	175.54	77.27	24.0	3.07	3.36	1	10.00	35.0	9673.03	4104.87	2851.23	0.93
30	178.62	73.00	24.0	3.07	3.36	1	10.00	35.0	9119.38	3817.41	2685.53	0.93
31	181.69	66.74	27.1	3.00	3.36	1	10.00	35.0	8316.31	3512.66	2477.38	0.93
32	184.68	62.08	27.1	3.00	3.36	1	10.00	35.0	7713.33	3191.09	2294.09	0.93
33	187.68	55.54	30.2	2.91	3.36	1	10.00	35.0	6874.39	2852.57	2072.56	0.94
34	190.59	50.56	30.2	2.91	3.36	1	10.00	35.0	6229.03	2497.46	1872.80	0.94
35	193.50	43.87	33.3	2.81	3.36	1	10.00	35.0	5372.75	2126.05	1639.20	0.95
36	196.31	38.63	33.3	2.81	3.36	1	10.00	35.0	4692.41	1738.81	1423.84	0.95
37	199.12	31.95	36.3	2.71	3.36	1	10.00	35.0	3838.44	1335.64	1179.63	0.96
38	201.83	26.50	36.4	2.71	3.36	1	10.00	35.0	3130.60	916.96	949.71	0.96
39	204.54	16.25	39.4	2.05	2.65	1	10.00	35.0	1875.86	418.44	723.05	0.97
40	206.59	12.82	39.4	2.05	2.65	1	10.00	35.0	1429.25	139.51	533.20	0.97
41	208.64	5.47	39.4	1.10	1.42	1	10.00	35.0	590.28	0.00	399.43	0.97
42	209.74	8.21	42.5	2.39	3.25	1	10.00	35.0	860.94	0.00	258.52	0.99
43	212.14	3.00	42.5	2.56	3.48	5	50.00	25.0	299.96	0.00	72.60	1.09

X-S Area:	2195.84	Path Length:	127.86	X-S Weight:	255236.25

Project: Bernhardt Sand and Gravel Pit
File: P:\22036 IHC Scott Milliken Property\Slope Stability\Galena\Bernhardt SS5.gmf
Processed: 24 Feb 2024 13:58:24

DATA: Analysis 1 - Case SS-5 - Static

Material Properties (5 materials)

Material: 1 (Mohr-Coulomb Isotropic) - Sand and Gravel

	Cohesion	Phi	UnitWeight	Ru
Unsaturated:	10.00	35.0	115.00	Auto
Saturated:	10.00	35.0	130.00	Auto

Material: 2 (Mohr-Coulomb Isotropic) - Weathered Claystone Bedrock

	Cohesion	Phi	UnitWeight	Ru
Unsaturated:	1000.00	0.0	110.00	Auto
Saturated:	1000.00	0.0	120.00	Auto

Material: 3 (Mohr-Coulomb Isotropic) - Stable Claystone Bedrock

	Cohesion	Phi	UnitWeight	Ru
Unsaturated:	3000.00	0.0	120.00	Auto
Saturated:	3000.00	0.0	135.00	Auto

Material: 4 (Mohr-Coulomb Isotropic) - Slurry Wall

	Cohesion	Phi	UnitWeight	Ru
Unsaturated:	0.00	45.0	100.00	Auto
Saturated:	0.00	45.0	110.00	Auto

Material: 5 (Mohr-Coulomb Isotropic) - Clay

	Cohesion	Phi	UnitWeight	Ru
Unsaturated:	50.00	25.0	100.00	Auto
Saturated:	50.00	25.0	115.00	Auto

Water Properties

Unit weight of water: 62.400 Unit weight of water/medium above ground: 62.400

Material Profiles (7 profiles)

Profile: 1 (2 points) Material beneath: 5 - Clay
0.00 4730.00 375.00 4730.00

Profile: 2 (2 points) Material beneath: 1 - Sand and Gravel
0.00 4720.30 222.40 4720.30

Profile: 3 (2 points) Material beneath: 4 - Slurry Wall

```
    222.40     4724.90         225.40     4724.90
Profile:  4 (2 points)   Material beneath:  1 - Sand and Gravel
    225.40     4720.30         375.00     4720.30
Profile:  5 (3 points)   Material beneath:  2 - Weathered Claystone Bedrock
      0.00     4688.40         136.50     4688.60         222.40     4688.80
Profile:  6 (2 points)   Material beneath:  2 - Weathered Claystone Bedrock
    225.40     4688.80         375.00     4688.90
Profile:  7 (4 points)   Material beneath:  3 - Stable Claystone Bedrock
      0.00     4685.40         136.50     4685.60         222.40     4685.60         375.00     4685.90

Slope Surface (12 points)
-------------
      0.00     4688.40         136.50     4688.60         208.80     4724.80         222.40     4724.80         225.40
4724.80
    253.80     4724.90         289.30     4725.00         303.70     4729.70         314.90     4729.70         338.30
4723.70
    347.70     4723.00         375.00     4724.40

Phreatic Surface (7 points)
----------------
      0.00     4688.40         136.50     4688.60         222.40     4688.80         225.40     4716.30         289.30
4716.30
    325.00     4727.00         375.00     4727.00

Failure Surface
---------------
Initial circular surface for critical search defined by: XL,XR,R
  Intersects:  XL:     136.00      YL:    4688.60      XR:     258.80      YR:    4724.91
      Centre:  XC:     143.67      YC:    4888.45                  Radius:  R:     200.00

Variable Restraints
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Parameter descriptor:             XL         XR         R
Range of variation:             10.00      10.00     150.00
Trial positions within range:     20         20         50

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RESULTS: Analysis  1 - Case SS-5 - Static

Bishop Simplified Method of Analysis - Circular Failure Surface
---------------------------------------------------------------
Critical Failure Surface Search using Multiple Circle Generation Techniques
```

Initial failure surface approximation - Factor of Safety: 2.581

Analysis Summary
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There were: 16505 successful analyses from a total of 20001 trial failure surfaces
             3496 analyses terminated due to unacceptable geometry

Critical (minimum) Factor of Safety: 2.14
==

Results Summary - Lowest 99 Factor of Safety circles

Circle	X-Left	Y-Left	X-Right	Y-Right	X-Centre	Y-Centre	Radius	FoS	
1	139.42	4690.06	263.27	4724.93	172.31	4810.66	125.00	2.141	<-- Critical Surface
2	138.89	4689.80	263.80	4724.93	171.45	4813.65	128.06	2.148	
3	138.37	4689.54	260.64	4724.92	169.60	4810.57	125.00	2.150	
4	138.89	4689.80	261.69	4724.92	170.75	4810.67	125.00	2.151	
5	139.42	4690.06	262.75	4724.93	171.89	4810.77	125.00	2.154	
6	139.95	4690.33	263.80	4724.93	173.03	4810.87	125.00	2.159	
7	138.37	4689.54	262.22	4724.92	169.89	4813.66	128.06	2.160	
8	138.89	4689.80	263.27	4724.93	171.03	4813.76	128.06	2.161	
9	138.37	4689.54	260.12	4724.92	169.18	4810.68	125.00	2.162	
10	137.84	4689.27	259.06	4724.91	168.03	4810.57	125.00	2.162	
11	138.89	4689.80	261.17	4724.92	170.32	4810.78	125.00	2.164	
12	138.37	4689.54	263.80	4724.93	170.18	4816.74	131.12	2.168	
13	139.42	4690.06	262.22	4724.92	171.47	4810.88	125.00	2.170	
14	137.84	4689.27	260.64	4724.92	168.31	4813.66	128.06	2.172	
15	138.37	4689.54	261.69	4724.92	169.46	4813.76	128.06	2.172	
16	137.84	4689.27	258.54	4724.91	167.60	4810.68	125.00	2.173	
17	138.37	4689.54	259.59	4724.92	168.75	4810.79	125.00	2.174	
18	139.95	4690.33	263.27	4724.93	172.61	4810.98	125.00	2.174	
19	138.89	4689.80	260.64	4724.92	169.90	4810.89	125.00	2.176	
20	138.89	4689.80	262.75	4724.93	170.61	4813.87	128.06	2.176	
21	138.89	4689.80	262.22	4724.92	171.17	4810.56	125.00	2.177	
22	139.42	4690.06	263.80	4724.93	171.76	4813.97	128.06	2.178	
23	139.42	4690.06	261.69	4724.92	171.05	4810.99	125.00	2.180	
24	137.84	4689.27	262.22	4724.92	168.61	4816.73	131.12	2.181	
25	137.84	4689.27	258.01	4724.91	167.17	4810.78	125.00	2.181	
26	138.37	4689.54	263.27	4724.93	169.76	4816.84	131.12	2.182	
27	137.84	4689.27	260.12	4724.92	167.88	4813.76	128.06	2.183	
28	138.37	4689.54	261.17	4724.92	169.04	4813.87	128.06	2.183	
29	138.37	4689.54	259.06	4724.91	168.33	4810.89	125.00	2.185	
30	137.32	4689.01	259.06	4724.91	166.73	4813.65	128.06	2.185	
31	138.89	4689.80	262.22	4724.92	170.19	4813.98	128.06	2.186	

32	137.32	4689.01	256.96	4724.91	166.02	4810.67	125.00	2.187
33	138.89	4689.80	260.12	4724.92	169.48	4811.00	125.00	2.187
34	139.95	4690.33	262.75	4724.93	172.19	4811.10	125.00	2.188
35	140.47	4690.59	263.80	4724.93	173.34	4811.19	125.00	2.189
36	137.84	4689.27	263.80	4724.93	168.92	4819.81	134.18	2.189
37	139.42	4690.06	263.27	4724.93	171.34	4814.08	128.06	2.190
38	139.42	4690.06	261.17	4724.92	170.63	4811.10	125.00	2.191
39	137.84	4689.27	261.69	4724.92	168.18	4816.84	131.12	2.192
40	137.84	4689.27	259.59	4724.92	167.46	4813.86	128.06	2.194
41	137.32	4689.01	260.64	4724.92	167.02	4816.72	131.12	2.194
42	137.32	4689.01	258.54	4724.91	166.30	4813.75	128.06	2.194
43	137.84	4689.27	257.48	4724.91	166.75	4810.88	125.00	2.194
44	138.37	4689.54	260.64	4724.92	168.61	4813.97	128.06	2.195
45	138.37	4689.54	258.54	4724.91	167.90	4811.00	125.00	2.195
46	138.89	4689.80	263.80	4724.93	170.50	4817.06	131.12	2.195
47	137.32	4689.01	256.43	4724.91	165.59	4810.77	125.00	2.197
48	138.89	4689.80	261.69	4724.92	169.77	4814.08	128.06	2.197
49	139.95	4690.33	262.22	4724.92	171.78	4811.21	125.00	2.197
50	138.89	4689.80	259.59	4724.92	169.06	4811.11	125.00	2.198
51	138.37	4689.54	262.75	4724.93	169.34	4816.95	131.12	2.198
52	140.47	4690.59	263.27	4724.93	172.92	4811.31	125.00	2.202
53	136.79	4688.75	255.38	4724.90	164.43	4810.65	125.00	2.202
54	139.42	4690.06	262.75	4724.93	170.92	4814.19	128.06	2.202
55	139.42	4690.06	260.64	4724.92	170.21	4811.21	125.00	2.202
56	137.32	4689.01	262.22	4724.92	167.33	4819.79	134.18	2.203
57	137.84	4689.27	261.17	4724.92	167.75	4816.94	131.12	2.203
58	138.37	4689.54	258.01	4724.91	167.48	4811.10	125.00	2.204
59	138.37	4689.54	262.22	4724.92	168.92	4817.05	131.12	2.204
60	137.84	4689.27	259.06	4724.91	167.03	4813.96	128.06	2.204
61	137.32	4689.01	260.12	4724.92	166.59	4816.82	131.12	2.205
62	138.37	4689.54	260.12	4724.92	168.19	4814.08	128.06	2.205
63	137.84	4689.27	263.27	4724.93	168.49	4819.91	134.18	2.205
64	137.32	4689.01	258.01	4724.91	165.87	4813.85	128.06	2.206
65	139.95	4690.33	263.80	4724.93	172.07	4814.29	128.06	2.207
66	137.84	4689.27	256.96	4724.91	166.32	4810.99	125.00	2.207
67	138.89	4689.80	263.27	4724.93	170.07	4817.16	131.12	2.207
68	138.89	4689.80	259.06	4724.91	168.63	4811.21	125.00	2.208
69	138.89	4689.80	261.17	4724.92	169.35	4814.19	128.06	2.208
70	136.79	4688.75	256.96	4724.91	164.70	4813.73	128.06	2.211
71	137.32	4689.01	255.91	4724.91	165.16	4810.87	125.00	2.211
72	137.84	4689.27	262.75	4724.93	168.07	4820.01	134.18	2.212
73	138.37	4689.54	263.80	4724.93	169.23	4820.12	134.18	2.213
74	137.32	4689.01	261.69	4724.92	166.90	4819.89	134.18	2.213
75	139.42	4690.06	260.12	4724.92	169.78	4811.32	125.00	2.213
76	137.84	4689.27	260.64	4724.92	167.33	4817.04	131.12	2.214

77	137.32	4689.01	263.80	4724.93	167.65	4822.86	137.24	2.214
78	138.37	4689.54	261.69	4724.92	168.49	4817.15	131.12	2.215
79	138.37	4689.54	259.59	4724.92	167.76	4814.18	128.06	2.215
80	137.84	4689.27	258.54	4724.91	166.60	4814.06	128.06	2.215
81	137.32	4689.01	259.59	4724.92	166.16	4816.92	131.12	2.215
82	136.79	4688.75	258.54	4724.91	164.99	4816.80	131.12	2.215
83	137.84	4689.27	256.43	4724.91	165.89	4811.09	125.00	2.216
84	136.26	4688.60	254.33	4724.90	163.35	4810.63	125.00	2.217
85	138.37	4689.54	257.48	4724.91	167.05	4811.20	125.00	2.217
86	136.79	4688.75	254.85	4724.90	163.99	4810.75	125.00	2.217
87	137.32	4689.01	255.38	4724.90	164.72	4810.97	125.00	2.218
88	135.74	4688.60	253.80	4724.90	162.83	4810.63	125.00	2.219
89	138.89	4689.80	260.64	4724.92	168.92	4814.29	128.06	2.219
90	139.95	4690.33	261.17	4724.92	170.93	4811.42	125.00	2.219
91	137.32	4689.01	257.48	4724.91	165.44	4813.94	128.06	2.219
92	138.89	4689.80	258.54	4724.91	168.21	4811.31	125.00	2.221
93	140.47	4690.59	262.75	4724.93	172.50	4811.42	125.00	2.221
94	137.84	4689.27	258.01	4724.91	166.17	4814.16	128.06	2.221
95	137.32	4689.01	263.27	4724.93	167.22	4822.96	137.24	2.222
96	139.95	4690.33	261.69	4724.92	171.36	4811.32	125.00	2.222
97	136.26	4688.60	255.91	4724.91	163.63	4813.70	128.06	2.222
98	137.84	4689.27	262.22	4724.92	167.64	4820.11	134.18	2.223
99	137.32	4689.01	261.17	4724.92	166.47	4819.99	134.18	2.224

Critical Failure Surface (circle 1)

Intersects: XL: 139.42 YL: 4690.06 XR: 263.27 YR: 4724.93
Centre: XC: 172.31 YC: 4810.66 Radius: R: 125.00

Generated failure surface: (20 points)

139.42	4690.06	146.33	4688.39	153.33	4687.11	160.39	4686.23	167.48	4685.75
174.60	4685.68	181.70	4686.01	188.78	4686.75	195.80	4687.89	202.74	4689.42
209.59	4691.35	216.31	4693.66	222.90	4696.35	229.32	4699.42	235.55	4702.84
241.58	4706.61	247.39	4710.72	252.95	4715.15	258.25	4719.89	263.27	4724.93

Slice Geometry and Properties - Critical Failure Surface (circle 1, 42 slices)

Slice	X-S	Base						PoreWater	Normal Test
X-Left	Area	Angle	Width	Length	Matl	Cohesion	Phi	Weight	Force	Stress	Factor

1	139.42	3.29	-13.6	2.97	3.06	1	10.00	35.0	377.97	0.00	139.24
1.12											
2	142.40	9.86	-13.6	2.97	3.06	1	10.00	35.0	1134.09	0.00	415.34
1.12											
3	145.37	4.60	-13.6	0.96	0.99	2	1000.00	0.0	530.02	7.31	663.23
1.03											
4	146.33	22.15	-10.4	3.50	3.56	2	1000.00	0.0	2557.11	124.17	816.38
1.02											
5	149.83	30.52	-10.4	3.50	3.56	2	1000.00	0.0	3530.38	267.96	1094.60
1.02											
6	153.33	38.90	-7.1	3.53	3.56	2	1000.00	0.0	4504.00	389.53	1334.53
1.01											
7	156.86	46.68	-7.1	3.53	3.56	2	1000.00	0.0	5407.37	488.89	1590.46
1.01											
8	160.39	54.43	-3.8	3.55	3.56	2	1000.00	0.0	6304.37	565.93	1808.14
1.00											
9	163.94	61.57	-3.8	3.55	3.56	2	1000.00	0.0	7130.60	620.53	2040.94
1.00											
10	167.48	68.52	-0.6	3.56	3.56	2	1000.00	0.0	7932.46	652.83	2235.45
1.00											
11	171.04	74.98	-0.6	3.56	3.56	2	1000.00	0.0	8676.10	662.69	2444.56
1.00											
12	174.60	80.99	2.7	3.55	3.56	2	1000.00	0.0	9366.26	650.11	2614.85
1.00											
13	178.15	86.72	2.7	3.55	3.56	2	1000.00	0.0	10022.15	615.01	2799.41
1.00											
14	181.70	91.68	5.9	3.54	3.56	2	1000.00	0.0	10588.08	557.59	2944.80
1.01											
15	185.24	96.65	5.9	3.54	3.56	2	1000.00	0.0	11152.54	477.73	3104.45
1.01											
16	188.78	100.47	9.2	3.51	3.56	2	1000.00	0.0	11583.57	375.67	3224.04
1.01											
17	192.29	104.64	9.2	3.51	3.56	2	1000.00	0.0	12053.66	251.27	3358.03
1.01											
18	195.80	120.58	12.5	3.90	3.99	2	1000.00	0.0	13875.06	106.14	3457.88
1.02											
19	199.69	97.31	12.5	3.05	3.12	1	10.00	35.0	11158.16	0.00	3412.44
0.96											
20	202.74	99.00	15.7	3.03	3.15	1	10.00	35.0	11283.79	0.00	3409.27
0.95											
21	205.77	101.01	15.7	3.03	3.15	1	10.00	35.0	11446.21	0.00	3458.53
0.95											
22	208.80	26.42	15.7	0.79	0.82	1	10.00	35.0	2985.04	0.00	3471.18
0.95											

23	209.59	110.55	19.0	3.36	3.56	1	10.00	35.0	12485.71	0.00	3336.02
0.95											
24	212.95	106.66	19.0	3.36	3.56	1	10.00	35.0	12038.57	0.00	3216.50
0.95											
25	216.31	92.88	22.2	3.04	3.29	1	10.00	35.0	10475.71	0.00	3034.18
0.95											
26	219.36	89.09	22.2	3.04	3.29	1	10.00	35.0	10040.07	0.00	2907.93
0.95											
27	222.40	14.16	22.2	0.50	0.54	4	0.00	45.0	1415.81	0.00	2397.31
0.91											
28	222.90	69.74	25.5	2.50	2.77	4	0.00	45.0	7170.71	1362.89	2431.28
0.91											
29	225.40	103.07	25.5	3.92	4.34	1	10.00	35.0	12634.65	4823.07	2939.64
0.96											
30	229.32	76.53	28.8	3.12	3.56	1	10.00	35.0	9338.64	3556.66	2689.81
0.97											
31	232.43	71.22	28.8	3.12	3.56	1	10.00	35.0	8648.41	3177.11	2485.77
0.97											
32	235.55	63.50	32.0	3.02	3.56	1	10.00	35.0	7662.78	2778.15	2240.10
0.98											
33	238.57	57.84	32.0	3.02	3.56	1	10.00	35.0	6926.70	2359.38	2017.50
0.98											
34	241.58	50.00	35.3	2.90	3.56	1	10.00	35.0	5928.63	1922.27	1757.42
0.99											
35	244.48	44.07	35.3	2.90	3.56	1	10.00	35.0	5156.25	1466.33	1517.25
0.99											
36	247.39	36.31	38.5	2.78	3.56	1	10.00	35.0	4171.37	992.59	1244.52
1.01											
37	250.17	30.18	38.5	2.78	3.56	1	10.00	35.0	3372.92	500.90	988.20
1.01											
38	252.95	7.97	41.8	0.85	1.14	1	10.00	35.0	868.17	54.77	796.66
1.04											
39	253.80	17.79	41.8	2.23	2.99	1	10.00	35.0	1892.50	0.00	654.80
1.04											
40	256.03	13.38	41.8	2.23	2.99	1	10.00	35.0	1384.76	0.00	478.28
1.04											
41	258.25	9.46	45.1	2.51	3.56	5	50.00	25.0	945.81	0.00	289.88
1.16											
42	260.76	3.15	45.1	2.51	3.56	5	50.00	25.0	315.19	0.00	83.79
1.16											
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	X-S Area:	2488.51	Path Length:		135.14		X-S Weight:		286472.31		

Project: Bernhardt Sand and Gravel Pit
File: P:\22036 IHC Scott Milliken Property\Slope Stability\Galena\Bernhardt SS5-EQ.gmf
Processed: 24 Feb 2024 14:03:34

DATA: Analysis 1 - Case SS-5 - Pseudo-Static

Material Properties (5 materials)

Material: 1 (Mohr-Coulomb Isotropic) - Sand and Gravel

	Cohesion	Phi	UnitWeight	Ru
Unsaturated:	10.00	35.0	115.00	Auto
Saturated:	10.00	35.0	130.00	Auto

Material: 2 (Mohr-Coulomb Isotropic) - Weathered Claystone Bedrock

	Cohesion	Phi	UnitWeight	Ru
Unsaturated:	1000.00	0.0	110.00	Auto
Saturated:	1000.00	0.0	120.00	Auto

Material: 3 (Mohr-Coulomb Isotropic) - Stable Claystone Bedrock

	Cohesion	Phi	UnitWeight	Ru
Unsaturated:	3000.00	0.0	120.00	Auto
Saturated:	3000.00	0.0	135.00	Auto

Material: 4 (Mohr-Coulomb Isotropic) - Slurry Wall

	Cohesion	Phi	UnitWeight	Ru
Unsaturated:	0.00	45.0	100.00	Auto
Saturated:	0.00	45.0	110.00	Auto

Material: 5 (Mohr-Coulomb Isotropic) - Clay

	Cohesion	Phi	UnitWeight	Ru
Unsaturated:	50.00	25.0	100.00	Auto
Saturated:	50.00	25.0	115.00	Auto

Water Properties

Unit weight of water: 62.400 Unit weight of water/medium above ground: 62.400

Material Profiles (7 profiles)

Profile: 1 (2 points) Material beneath: 5 - Clay
0.00 4730.00 375.00 4730.00

Profile: 2 (2 points) Material beneath: 1 - Sand and Gravel
0.00 4720.30 222.40 4720.30

Profile: 3 (2 points) Material beneath: 4 - Slurry Wall

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    222.40     4724.90         225.40     4724.90
Profile:  4 (2 points)   Material beneath:  1 - Sand and Gravel
    225.40     4720.30         375.00     4720.30
Profile:  5 (3 points)   Material beneath:  2 - Weathered Claystone Bedrock
      0.00     4688.40         136.50     4688.60         222.40     4688.80
Profile:  6 (2 points)   Material beneath:  2 - Weathered Claystone Bedrock
    225.40     4688.80         375.00     4688.90
Profile:  7 (4 points)   Material beneath:  3 - Stable Claystone Bedrock
      0.00     4685.40         136.50     4685.60         222.40     4685.60         375.00     4685.90

Slope Surface (12 points)
-------------
      0.00     4688.40         136.50     4688.60         208.80     4724.80         222.40     4724.80         225.40
4724.80
    253.80     4724.90         289.30     4725.00         303.70     4729.70         314.90     4729.70         338.30
4723.70
    347.70     4723.00         375.00     4724.40

Phreatic Surface (7 points)
-----------------
      0.00     4688.40         136.50     4688.60         222.40     4688.80         225.40     4716.30         289.30
4716.30
    325.00     4727.00         375.00     4727.00

Failure Surface
---------------
Initial circular surface for critical search defined by: XL,XR,R
  Intersects:  XL:     136.00      YL:    4688.60      XR:     258.80      YR:    4724.91
      Centre:  XC:     143.67      YC:    4888.45                  Radius:  R:     200.00

Earthquake Force
----------------
Pseudo-static earthquake (seismic) coefficient:  0.070

Variable Restraints
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Parameter descriptor:              XL         XR         R
Range of variation:             10.00      10.00     150.00
Trial positions within range:      20         20         50

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RESULTS: Analysis  1 - Case SS-5 - Pseudo-Static
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Bishop Simplified Method of Analysis - Circular Failure Surface

Critical Failure Surface Search using Multiple Circle Generation Techniques

Initial failure surface approximation - Factor of Safety: 2.071

Analysis Summary

There were: 16505 successful analyses from a total of 20001 trial failure surfaces
3496 analyses terminated due to unacceptable geometry

Critical (minimum) Factor of Safety: 1.70

Results Summary - Lowest 99 Factor of Safety circles

Circle	X-Left	Y-Left	X-Right	Y-Right	X-Centre	Y-Centre	Radius	FoS	
1	139.42	4690.06	263.27	4724.93	172.31	4810.66	125.00	1.696	<-- Critical Surface
2	138.89	4689.80	263.80	4724.93	171.45	4813.65	128.06	1.701	
3	139.95	4690.33	263.80	4724.93	173.03	4810.87	125.00	1.707	
4	139.42	4690.06	262.75	4724.93	171.89	4810.77	125.00	1.708	
5	138.89	4689.80	261.69	4724.92	170.75	4810.67	125.00	1.710	
6	138.89	4689.80	263.27	4724.93	171.03	4813.76	128.06	1.713	
7	138.37	4689.54	260.64	4724.92	169.60	4810.57	125.00	1.714	
8	138.37	4689.54	262.22	4724.92	169.89	4813.66	128.06	1.717	
9	138.37	4689.54	263.80	4724.93	170.18	4816.74	131.12	1.719	
10	139.95	4690.33	263.27	4724.93	172.61	4810.98	125.00	1.721	
11	138.89	4689.80	261.17	4724.92	170.32	4810.78	125.00	1.722	
12	139.42	4690.06	262.22	4724.92	171.47	4810.88	125.00	1.722	
13	139.42	4690.06	263.80	4724.93	171.76	4813.97	128.06	1.723	
14	138.37	4689.54	260.12	4724.92	169.18	4810.68	125.00	1.725	
15	138.89	4689.80	262.75	4724.93	170.61	4813.87	128.06	1.727	
16	138.37	4689.54	261.69	4724.92	169.46	4813.76	128.06	1.728	
17	138.89	4689.80	262.22	4724.92	171.17	4810.56	125.00	1.730	
18	140.47	4690.59	263.80	4724.93	173.34	4811.19	125.00	1.730	
19	137.84	4689.27	259.06	4724.91	168.03	4810.57	125.00	1.730	
20	138.37	4689.54	263.27	4724.93	169.76	4816.84	131.12	1.731	
21	139.42	4690.06	261.69	4724.92	171.05	4810.99	125.00	1.732	
22	137.84	4689.27	260.64	4724.92	168.31	4813.66	128.06	1.733	
23	138.89	4689.80	260.64	4724.92	169.90	4810.89	125.00	1.733	
24	139.95	4690.33	262.75	4724.93	172.19	4811.10	125.00	1.734	
25	139.42	4690.06	263.27	4724.93	171.34	4814.08	128.06	1.735	
26	137.84	4689.27	262.22	4724.92	168.61	4816.73	131.12	1.735	
27	138.37	4689.54	259.59	4724.92	168.75	4810.79	125.00	1.736	

28	138.89	4689.80	262.22	4724.92	170.19	4813.98	128.06	1.736
29	137.84	4689.27	263.80	4724.93	168.92	4819.81	134.18	1.737
30	138.89	4689.80	263.80	4724.93	170.50	4817.06	131.12	1.739
31	138.37	4689.54	261.17	4724.92	169.04	4813.87	128.06	1.739
32	137.84	4689.27	258.54	4724.91	167.60	4810.68	125.00	1.741
33	140.47	4690.59	263.27	4724.93	172.92	4811.31	125.00	1.742
34	139.95	4690.33	262.22	4724.92	171.78	4811.21	125.00	1.743
35	139.42	4690.06	261.17	4724.92	170.63	4811.10	125.00	1.743
36	137.84	4689.27	260.12	4724.92	167.88	4813.76	128.06	1.744
37	138.89	4689.80	260.12	4724.92	169.48	4811.00	125.00	1.744
38	139.95	4690.33	263.80	4724.93	172.07	4814.29	128.06	1.745
39	138.37	4689.54	262.75	4724.93	169.34	4816.95	131.12	1.746
40	137.84	4689.27	261.69	4724.92	168.18	4816.84	131.12	1.746
41	139.42	4690.06	262.75	4724.93	170.92	4814.19	128.06	1.746
42	138.37	4689.54	259.06	4724.91	168.33	4810.89	125.00	1.747
43	138.89	4689.80	261.69	4724.92	169.77	4814.08	128.06	1.747
44	137.84	4689.27	258.01	4724.91	167.17	4810.78	125.00	1.749
45	138.37	4689.54	260.64	4724.92	168.61	4813.97	128.06	1.750
46	138.89	4689.80	263.27	4724.93	170.07	4817.16	131.12	1.750
47	137.32	4689.01	259.06	4724.91	166.73	4813.65	128.06	1.750
48	137.84	4689.27	263.27	4724.93	168.49	4819.91	134.18	1.751
49	137.32	4689.01	260.64	4724.92	167.02	4816.72	131.12	1.752
50	138.37	4689.54	262.22	4724.92	168.92	4817.05	131.12	1.752
51	139.42	4690.06	260.64	4724.92	170.21	4811.21	125.00	1.753
52	137.84	4689.27	259.59	4724.92	167.46	4813.86	128.06	1.754
53	138.89	4689.80	259.59	4724.92	169.06	4811.11	125.00	1.754
54	137.32	4689.01	262.22	4724.92	167.33	4819.79	134.18	1.754
55	138.37	4689.54	263.80	4724.93	169.23	4820.12	134.18	1.755
56	138.37	4689.54	258.54	4724.91	167.90	4811.00	125.00	1.757
57	137.84	4689.27	261.17	4724.92	167.75	4816.94	131.12	1.757
58	138.89	4689.80	261.17	4724.92	169.35	4814.19	128.06	1.758
59	137.32	4689.01	256.96	4724.91	166.02	4810.67	125.00	1.758
60	137.32	4689.01	263.80	4724.93	167.65	4822.86	137.24	1.758
61	140.47	4690.59	262.75	4724.93	172.50	4811.42	125.00	1.759
62	137.84	4689.27	262.75	4724.93	168.07	4820.01	134.18	1.759
63	137.32	4689.01	258.54	4724.91	166.30	4813.75	128.06	1.759
64	141.00	4690.85	263.80	4724.93	173.65	4811.51	125.00	1.759
65	138.37	4689.54	260.12	4724.92	168.19	4814.08	128.06	1.760
66	137.84	4689.27	257.48	4724.91	166.75	4810.88	125.00	1.761
67	139.95	4690.33	263.27	4724.93	171.65	4814.40	128.06	1.761
68	138.37	4689.54	261.69	4724.92	168.49	4817.15	131.12	1.763
69	137.32	4689.01	260.12	4724.92	166.59	4816.82	131.12	1.763
70	139.95	4690.33	261.69	4724.92	171.36	4811.32	125.00	1.764
71	139.95	4690.33	261.17	4724.92	170.93	4811.42	125.00	1.764
72	139.42	4690.06	260.12	4724.92	169.78	4811.32	125.00	1.764

73	137.84	4689.27	259.06	4724.91	167.03	4813.96	128.06	1.764
74	138.89	4689.80	259.06	4724.91	168.63	4811.21	125.00	1.764
75	137.32	4689.01	261.69	4724.92	166.90	4819.89	134.18	1.765
76	140.47	4690.59	262.22	4724.92	172.08	4811.53	125.00	1.765
77	138.37	4689.54	258.01	4724.91	167.48	4811.10	125.00	1.766
78	139.42	4690.06	263.80	4724.93	170.81	4817.37	131.12	1.766
79	137.32	4689.01	263.27	4724.93	167.22	4822.96	137.24	1.766
80	137.84	4689.27	260.64	4724.92	167.33	4817.04	131.12	1.767
81	138.37	4689.54	263.27	4724.93	168.81	4820.22	134.18	1.767
82	139.42	4690.06	262.22	4724.92	170.50	4814.29	128.06	1.767
83	137.32	4689.01	256.43	4724.91	165.59	4810.77	125.00	1.768
84	141.00	4690.85	263.27	4724.93	173.23	4811.63	125.00	1.768
85	139.95	4690.33	262.75	4724.93	171.23	4814.51	128.06	1.768
86	138.89	4689.80	260.64	4724.92	168.92	4814.29	128.06	1.768
87	139.42	4690.06	261.69	4724.92	170.08	4814.40	128.06	1.768
88	137.84	4689.27	262.22	4724.92	167.64	4820.11	134.18	1.769
89	140.47	4690.59	263.80	4724.93	172.39	4814.61	128.06	1.769
90	138.37	4689.54	259.59	4724.92	167.76	4814.18	128.06	1.769
91	138.89	4689.80	262.75	4724.93	169.65	4817.26	131.12	1.770
92	137.32	4689.01	258.01	4724.91	165.87	4813.85	128.06	1.770
93	138.89	4689.80	262.22	4724.92	169.23	4817.36	131.12	1.771
94	139.42	4690.06	263.27	4724.93	170.39	4817.48	131.12	1.771
95	137.84	4689.27	263.80	4724.93	167.96	4823.17	137.24	1.772
96	137.32	4689.01	259.59	4724.92	166.16	4816.92	131.12	1.772
97	138.37	4689.54	261.17	4724.92	168.06	4817.25	131.12	1.773
98	137.84	4689.27	256.96	4724.91	166.32	4810.99	125.00	1.773
99	138.89	4689.80	263.80	4724.93	169.55	4820.44	134.18	1.774

Critical Failure Surface (circle 1)

Intersects: XL: 139.42 YL: 4690.06 XR: 263.27 YR: 4724.93
Centre: XC: 172.31 YC: 4810.66 Radius: R: 125.00

Generated failure surface: (20 points)

139.42 4690.06 146.33 4688.39 153.33 4687.11 160.39 4686.23 167.48 4685.75
174.60 4685.68 181.70 4686.01 188.78 4686.75 195.80 4687.89 202.74 4689.42
209.59 4691.35 216.31 4693.66 222.90 4696.35 229.32 4699.42 235.55 4702.84
241.58 4706.61 247.39 4710.72 252.95 4715.15 258.25 4719.89 263.27 4724.93

Slice Geometry and Properties - Critical Failure Surface (circle 1, 42 slices)

Slice		X-S	---------- Base ----------							PoreWater	Normal	Test
	X-Left	Area	Angle	Width	Length	Matl	Cohesion	Phi	Weight	Force	Stress	Factor
1	139.42	3.29	-13.6	2.97	3.06	1	10.00	35.0	377.97	0.00	142.79	1.14
2	142.40	9.86	-13.6	2.97	3.06	1	10.00	35.0	1134.09	0.00	425.28	1.14
3	145.37	4.60	-13.6	0.96	0.99	2	1000.00	0.0	530.02	7.31	692.94	1.03
4	146.33	22.15	-10.4	3.50	3.56	2	1000.00	0.0	2557.11	124.17	838.80	1.02
5	149.83	30.52	-10.4	3.50	3.56	2	1000.00	0.0	3530.38	267.96	1117.03	1.02
6	153.33	38.90	-7.1	3.53	3.56	2	1000.00	0.0	4504.00	389.53	1349.82	1.01
7	156.86	46.68	-7.1	3.53	3.56	2	1000.00	0.0	5407.37	488.89	1605.73	1.01
8	160.39	54.43	-3.8	3.55	3.56	2	1000.00	0.0	6304.37	565.93	1816.38	1.00
9	163.94	61.57	-3.8	3.55	3.56	2	1000.00	0.0	7130.60	620.53	2049.15	1.00
10	167.48	68.52	-0.6	3.56	3.56	2	1000.00	0.0	7932.46	652.83	2236.70	1.00
11	171.04	74.98	-0.6	3.56	3.56	2	1000.00	0.0	8676.10	662.69	2445.81	1.00
12	174.60	80.99	2.7	3.55	3.56	2	1000.00	0.0	9366.26	650.11	2609.12	1.00
13	178.15	86.72	2.7	3.55	3.56	2	1000.00	0.0	10022.15	615.01	2793.67	1.00
14	181.70	91.68	5.9	3.54	3.56	2	1000.00	0.0	10588.08	557.59	2932.04	1.01
15	185.24	96.65	5.9	3.54	3.56	2	1000.00	0.0	11152.54	477.73	3091.70	1.01
16	188.78	100.47	9.2	3.51	3.56	2	1000.00	0.0	11583.57	375.67	3204.17	1.01
17	192.29	104.64	9.2	3.51	3.56	2	1000.00	0.0	12053.66	251.27	3338.18	1.01
18	195.80	120.58	12.5	3.90	3.99	2	1000.00	0.0	13875.06	106.14	3430.77	1.02
19	199.69	97.31	12.5	3.05	3.12	1	10.00	35.0	11158.16	0.00	3352.84	0.94
20	202.74	99.00	15.7	3.03	3.15	1	10.00	35.0	11283.79	0.00	3335.12	0.93

21	205.77	101.01	15.7	3.03	3.15	1	10.00	35.0	11446.21	0.00	3383.35	0.93
22	208.80	26.42	15.7	0.79	0.82	1	10.00	35.0	2985.04	0.00	3395.68	0.93
23	209.59	110.55	19.0	3.36	3.56	1	10.00	35.0	12485.71	0.00	3249.37	0.93
24	212.95	106.66	19.0	3.36	3.56	1	10.00	35.0	12038.57	0.00	3132.94	0.93
25	216.31	92.88	22.2	3.04	3.29	1	10.00	35.0	10475.71	0.00	2942.60	0.92
26	219.36	89.09	22.2	3.04	3.29	1	10.00	35.0	10040.07	0.00	2820.14	0.92
27	222.40	14.16	22.2	0.50	0.54	4	0.00	45.0	1415.81	0.00	2300.51	0.87
28	222.90	69.74	25.5	2.50	2.77	4	0.00	45.0	7170.71	1362.89	2342.69	0.86
29	225.40	103.07	25.5	3.92	4.34	1	10.00	35.0	12634.65	4823.07	2876.60	0.93
30	229.32	76.53	28.8	3.12	3.56	1	10.00	35.0	9338.64	3556.66	2624.34	0.93
31	232.43	71.22	28.8	3.12	3.56	1	10.00	35.0	8648.41	3177.11	2424.03	0.93
32	235.55	63.50	32.0	3.02	3.56	1	10.00	35.0	7662.78	2778.15	2177.21	0.94
33	238.57	57.84	32.0	3.02	3.56	1	10.00	35.0	6926.70	2359.38	1959.10	0.94
34	241.58	50.00	35.3	2.90	3.56	1	10.00	35.0	5928.63	1922.27	1699.53	0.95
35	244.48	44.07	35.3	2.90	3.56	1	10.00	35.0	5156.25	1466.33	1464.62	0.95
36	247.39	36.31	38.5	2.78	3.56	1	10.00	35.0	4171.37	992.59	1194.09	0.96
37	250.17	30.18	38.5	2.78	3.56	1	10.00	35.0	3372.92	500.90	943.85	0.96
38	252.95	7.97	41.8	0.85	1.14	1	10.00	35.0	868.17	54.77	753.88	0.98
39	253.80	17.79	41.8	2.23	2.99	1	10.00	35.0	1892.50	0.00	617.27	0.98
40	256.03	13.38	41.8	2.23	2.99	1	10.00	35.0	1384.76	0.00	450.66	0.98
41	258.25	9.46	45.1	2.51	3.56	5	50.00	25.0	945.81	0.00	272.03	1.11
42	260.76	3.15	45.1	2.51	3.56	5	50.00	25.0	315.19	0.00	75.21	1.11
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X-S Area: 2488.51 Path Length: 135.14 X-S Weight: 286472.31

Reclamation Conditions

Project: Bernhardt Sand and Gravel Pit
File: P:\22036 IHC Scott Milliken Property\Slope Stability\Galena\Bernhardt SS5-REC.gmf
Processed: 24 Feb 2024 14:08:05

DATA: Analysis 1 - Case SS-5 - Reclamation - Static

Material Properties (5 materials)

Material: 1 (Mohr-Coulomb Isotropic) - Sand and Gravel

	Cohesion	Phi	UnitWeight	Ru
Unsaturated:	10.00	35.0	115.00	Auto
Saturated:	10.00	35.0	130.00	Auto

Material: 2 (Mohr-Coulomb Isotropic) - Weathered Claystone Bedrock

	Cohesion	Phi	UnitWeight	Ru
Unsaturated:	1000.00	0.0	110.00	Auto
Saturated:	1000.00	0.0	120.00	Auto

Material: 3 (Mohr-Coulomb Isotropic) - Stable Claystone Bedrock

	Cohesion	Phi	UnitWeight	Ru
Unsaturated:	3000.00	0.0	120.00	Auto
Saturated:	3000.00	0.0	135.00	Auto

Material: 4 (Mohr-Coulomb Isotropic) - Slurry Wall

	Cohesion	Phi	UnitWeight	Ru
Unsaturated:	0.00	45.0	100.00	Auto
Saturated:	0.00	45.0	110.00	Auto

Material: 5 (Mohr-Coulomb Isotropic) - Clay

	Cohesion	Phi	UnitWeight	Ru
Unsaturated:	50.00	25.0	100.00	Auto
Saturated:	50.00	25.0	115.00	Auto

Water Properties

Unit weight of water: 62.400 Unit weight of water/medium above ground: 62.400

Material Profiles (9 profiles)

Profile: 1 (2 points) Material beneath: 5 - Clay
0.00 4730.00 375.00 4730.00

Profile: 2 (2 points) Material beneath: 1 - Sand and Gravel
0.00 4720.30 222.40 4720.30

Profile: 3 (2 points) Material beneath: 4 - Slurry Wall

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    222.40     4724.90         225.40     4724.90
Profile:  4 (2 points)   Material beneath:  1 - Sand and Gravel
    225.40     4720.30         375.00     4720.30
Profile:  5 (3 points)   Material beneath:  5 - Clay
     45.00     4688.30         188.60     4720.30         200.00     4720.30
Profile:  6 (2 points)   Material beneath:  1 - Sand and Gravel
    136.50     4688.60         200.00     4720.30
Profile:  7 (4 points)   Material beneath:  2 - Weathered Claystone Bedrock
      0.00     4688.40          45.00     4688.30         136.50     4688.60         222.40     4688.80
Profile:  8 (2 points)   Material beneath:  2 - Weathered Claystone Bedrock
    225.40     4688.80         375.00     4688.90
Profile:  9 (5 points)   Material beneath:  3 - Stable Claystone Bedrock
      0.00     4685.40          45.00     4685.30         136.50     4685.60         222.40     4685.60         375.00
4685.90

Slope Surface (12 points)
-------------
      0.00     4688.40          45.00     4688.30         208.80     4724.80         222.40     4724.80         225.40
4724.80
    253.80     4724.90         289.30     4725.00         303.70     4729.70         314.90     4729.70         338.30
4723.70
    347.70     4723.00         375.00     4724.40

Phreatic Surface (8 points)
-----------------
      0.00     4688.40          45.00     4688.30         182.90     4711.80         222.40     4712.80         225.40
4716.30
    289.30     4716.30         325.00     4727.00         375.00     4727.00

Failure Surface
---------------
Initial circular surface for critical search defined by: XL,XR,R
  Intersects:  XL:      45.00      YL:    4688.30      XR:     258.80      YR:    4724.91
      Centre:  XC:      69.51      YC:    5187.70                  Radius:  R:     500.00

Variable Restraints
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Parameter descriptor:              XL         XR         R
Range of variation:             10.00      10.00     300.00
Trial positions within range:      20         20         50

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RESULTS: Analysis  1 - Case SS-5 - Reclamation - Static
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Bishop Simplified Method of Analysis - Circular Failure Surface

Critical Failure Surface Search using Multiple Circle Generation Techniques

Initial failure surface approximation - Factor of Safety: 3.223

Analysis Summary

There were: 18956 successful analyses from a total of 20001 trial failure surfaces
1045 analyses terminated due to unacceptable geometry

Critical (minimum) Factor of Safety: 2.41

Results Summary - Lowest 99 Factor of Safety circles

Circle	X-Left	Y-Left	X-Right	Y-Right	X-Centre	Y-Centre	Radius	FoS	
1	50.00	4689.41	253.80	4724.90	79.29	5124.14	435.71	2.408	<-- Critical Surface
2	48.95	4689.18	253.80	4724.90	75.44	5142.49	454.08	2.412	
3	49.47	4689.30	253.80	4724.90	76.83	5136.42	447.96	2.413	
4	50.00	4689.41	253.80	4724.90	78.21	5130.35	441.84	2.414	
5	48.95	4689.18	253.80	4724.90	74.36	5148.68	460.20	2.415	
6	48.95	4689.18	254.33	4724.90	75.90	5142.46	454.08	2.416	
7	49.47	4689.30	254.33	4724.90	77.29	5136.39	447.96	2.417	
8	48.42	4689.06	253.80	4724.90	72.98	5154.74	466.33	2.418	
9	50.00	4689.41	254.33	4724.90	78.67	5130.32	441.84	2.418	
10	50.00	4689.41	253.80	4724.90	77.13	5136.55	447.96	2.420	
11	47.89	4688.94	253.80	4724.90	70.51	5166.98	478.57	2.420	
12	49.47	4689.30	253.80	4724.90	75.75	5142.62	454.08	2.420	
13	49.47	4689.30	254.85	4724.90	77.74	5136.36	447.96	2.421	
14	48.42	4689.06	253.80	4724.90	71.90	5160.93	472.45	2.421	
15	48.95	4689.18	254.33	4724.90	74.83	5148.66	460.20	2.421	
16	48.42	4689.06	254.33	4724.90	73.44	5154.72	466.33	2.422	
17	49.47	4689.30	253.80	4724.90	74.67	5148.81	460.20	2.422	
18	50.00	4689.41	254.85	4724.90	79.12	5130.29	441.84	2.422	
19	49.47	4689.30	254.33	4724.90	76.21	5142.59	454.08	2.423	
20	47.89	4688.94	254.33	4724.90	70.98	5166.96	478.57	2.423	
21	47.37	4688.83	253.80	4724.90	68.05	5179.21	490.82	2.424	
22	50.00	4689.41	254.33	4724.90	77.59	5136.52	447.96	2.424	
23	48.95	4689.18	253.80	4724.90	73.28	5154.87	466.33	2.425	
24	47.89	4688.94	253.80	4724.90	69.43	5173.16	484.69	2.426	
25	48.95	4689.18	254.85	4724.90	75.29	5148.63	460.20	2.426	
26	50.00	4689.41	255.38	4724.90	79.58	5130.26	441.84	2.427	

27	49.47	4689.30	254.85	4724.90	76.67	5142.56	454.08	2.427
28	48.42	4689.06	253.80	4724.90	70.82	5167.11	478.57	2.427
29	50.00	4689.41	253.80	4724.90	76.05	5142.75	454.08	2.428
30	50.00	4689.41	254.85	4724.90	78.05	5136.49	447.96	2.428
31	48.95	4689.18	253.80	4724.90	72.21	5161.06	472.45	2.429
32	49.47	4689.30	254.33	4724.90	75.13	5148.79	460.20	2.429
33	48.95	4689.18	254.33	4724.90	73.75	5154.85	466.33	2.429
34	47.37	4688.83	253.80	4724.90	66.97	5185.38	496.94	2.430
35	48.42	4689.06	254.33	4724.90	71.29	5167.09	478.57	2.430
36	48.95	4689.18	255.38	4724.90	75.75	5148.60	460.20	2.430
37	47.89	4688.94	254.33	4724.90	69.90	5173.14	484.69	2.430
38	50.00	4689.41	254.33	4724.90	76.51	5142.72	454.08	2.430
39	48.42	4689.06	254.85	4724.90	72.83	5160.88	472.45	2.431
40	50.00	4689.41	253.80	4724.90	74.98	5148.94	460.20	2.431
41	47.89	4688.94	253.80	4724.90	68.35	5179.33	490.82	2.431
42	49.47	4689.30	255.38	4724.90	77.13	5142.54	454.08	2.431
43	48.95	4689.18	254.85	4724.90	74.21	5154.82	466.33	2.432
44	48.42	4689.06	254.33	4724.90	72.37	5160.90	472.45	2.432
45	49.47	4689.30	255.91	4724.91	77.58	5142.51	454.08	2.432
46	50.00	4689.41	255.38	4724.90	78.50	5136.47	447.96	2.433
47	48.42	4689.06	253.80	4724.90	69.74	5173.29	484.69	2.433
48	49.47	4689.30	254.85	4724.90	75.59	5148.76	460.20	2.433
49	46.84	4688.71	253.80	4724.90	64.50	5197.59	509.18	2.433
50	49.47	4689.30	253.80	4724.90	73.59	5155.00	466.33	2.433
51	50.00	4689.41	255.91	4724.91	78.96	5136.44	447.96	2.434
52	47.37	4688.83	254.33	4724.90	67.44	5185.36	496.94	2.434
53	50.00	4689.41	254.85	4724.90	76.97	5142.69	454.08	2.434
54	48.42	4689.06	255.38	4724.90	73.30	5160.86	472.45	2.434
55	48.95	4689.18	253.80	4724.90	71.13	5167.24	478.57	2.434
56	47.37	4688.83	253.80	4724.90	65.89	5191.55	503.06	2.435
57	48.95	4689.18	255.91	4724.91	75.14	5154.77	466.33	2.435
58	47.89	4688.94	254.33	4724.90	68.83	5179.31	490.82	2.436
59	48.95	4689.18	255.38	4724.90	74.67	5154.80	466.33	2.436
60	49.47	4689.30	253.80	4724.90	72.51	5161.18	472.45	2.436
61	47.37	4688.83	254.85	4724.90	67.92	5185.34	496.94	2.436
62	50.00	4689.41	254.33	4724.90	75.44	5148.91	460.20	2.436
63	47.89	4688.94	254.85	4724.90	70.37	5173.12	484.69	2.436
64	47.89	4688.94	253.80	4724.90	67.28	5185.51	496.94	2.437
65	48.95	4689.18	254.33	4724.90	71.60	5167.21	478.57	2.437
66	46.32	4688.59	253.80	4724.90	62.03	5209.78	521.43	2.437
67	49.47	4689.30	255.38	4724.90	76.05	5148.73	460.20	2.437
68	48.42	4689.06	254.33	4724.90	70.21	5173.27	484.69	2.437
69	49.47	4689.30	254.33	4724.90	74.06	5154.98	466.33	2.437
70	49.47	4689.30	255.91	4724.91	76.51	5148.71	460.20	2.438
71	46.84	4688.71	254.33	4724.90	64.98	5197.57	509.18	2.438

72	48.95	4689.18	254.85	4724.90	73.14	5161.01	472.45	2.438
73	50.00	4689.41	255.38	4724.90	77.43	5142.67	454.08	2.438
74	46.84	4688.71	253.80	4724.90	63.42	5203.75	515.31	2.438
75	48.42	4689.06	253.80	4724.90	68.66	5179.46	490.82	2.439
76	48.42	4689.06	255.91	4724.91	73.76	5160.83	472.45	2.439
77	49.47	4689.30	254.85	4724.90	74.52	5154.95	466.33	2.439
78	49.47	4689.30	256.43	4724.91	78.04	5142.48	454.08	2.439
79	47.37	4688.83	254.33	4724.90	66.37	5191.53	503.06	2.439
80	50.00	4689.41	255.91	4724.91	77.89	5142.64	454.08	2.439
81	48.42	4689.06	254.85	4724.90	71.76	5167.06	478.57	2.440
82	48.95	4689.18	254.33	4724.90	72.67	5161.03	472.45	2.440
83	48.95	4689.18	253.80	4724.90	70.05	5173.41	484.69	2.440
84	50.00	4689.41	254.85	4724.90	75.90	5148.89	460.20	2.440
85	47.37	4688.83	253.80	4724.90	64.81	5197.71	509.18	2.440
86	48.42	4689.06	255.38	4724.90	72.22	5167.04	478.57	2.441
87	50.00	4689.41	253.80	4724.90	73.90	5155.13	466.33	2.441
88	50.00	4689.41	256.43	4724.91	79.41	5136.41	447.96	2.441
89	48.95	4689.18	255.91	4724.91	74.07	5160.96	472.45	2.441
90	47.89	4688.94	254.33	4724.90	67.75	5185.49	496.94	2.441
91	46.32	4688.59	254.33	4724.90	62.52	5209.77	521.43	2.441
92	47.89	4688.94	255.38	4724.90	70.84	5173.10	484.69	2.441
93	48.95	4689.18	255.38	4724.90	73.60	5160.98	472.45	2.442
94	49.47	4689.30	253.80	4724.90	71.44	5167.36	478.57	2.442
95	46.84	4688.71	254.85	4724.90	65.46	5197.55	509.18	2.442
96	47.89	4688.94	253.80	4724.90	66.20	5191.67	503.06	2.442
97	48.95	4689.18	256.43	4724.91	75.60	5154.74	466.33	2.442
98	46.32	4688.59	253.80	4724.90	60.96	5215.94	527.55	2.442
99	48.42	4689.06	254.33	4724.90	69.14	5179.44	490.82	2.443

Critical Failure Surface (circle 1)

Intersects: XL: 50.00 YL: 4689.41 XR: 253.80 YR: 4724.90
Centre: XC: 79.29 YC: 5124.14 Radius: R: 435.71

Generated failure surface: (20 points)

50.00	4689.41	60.98	4688.81	71.96	4688.49	82.96	4688.44	93.95	4688.67
104.93	4689.18	115.89	4689.97	126.83	4691.03	137.74	4692.37	148.62	4693.98
159.45	4695.86	170.22	4698.02	180.94	4700.45	191.60	4703.15	202.18	4706.12
212.69	4709.35	223.11	4712.85	233.44	4716.61	243.67	4720.62	253.80	4724.90

Slice Geometry and Properties - Critical Failure Surface (circle 1, 45 slices)

Slice		X-S	---------- Base ----------							PoreWater	Normal	Test
	X-Left	Area	Angle	Width	Length	Matl	Cohesion	Phi	Weight	Force	Stress	Factor
1	50.00	0.19	-3.1	1.16	1.17	5	50.00	25.0	18.82	0.00	17.49	1.01
2	51.16	4.92	-3.1	4.91	4.91	5	50.00	25.0	533.13	169.30	110.62	1.01
3	56.07	11.60	-3.1	4.91	4.91	5	50.00	25.0	1282.24	507.92	264.22	1.01
4	60.98	20.54	-1.7	5.49	5.50	5	50.00	25.0	2281.53	945.82	417.30	1.01
5	66.47	28.16	-1.7	5.49	5.50	5	50.00	25.0	3133.28	1322.27	572.84	1.01
6	71.96	35.41	-0.2	5.50	5.50	5	50.00	25.0	3943.25	1675.28	717.88	1.00
7	77.46	42.26	-0.2	5.50	5.50	5	50.00	25.0	4708.30	2004.35	857.15	1.00
8	82.96	48.73	1.2	5.49	5.50	5	50.00	25.0	5428.13	2309.79	985.10	1.00
9	88.45	54.82	1.2	5.49	5.50	5	50.00	25.0	6105.11	2591.29	1108.02	1.00
10	93.95	60.49	2.6	5.49	5.50	5	50.00	25.0	6732.69	2849.07	1219.03	0.99
11	99.44	65.80	2.7	5.49	5.50	5	50.00	25.0	7320.67	3082.69	1325.54	0.99
12	104.93	70.64	4.1	5.48	5.50	5	50.00	25.0	7852.99	3292.27	1419.62	0.99
13	110.41	75.18	4.1	5.48	5.50	5	50.00	25.0	8352.41	3478.35	1509.92	0.99
14	115.89	79.18	5.5	5.47	5.50	5	50.00	25.0	8788.44	3640.11	1587.13	0.99
15	121.36	82.94	5.5	5.47	5.50	5	50.00	25.0	9198.02	3777.77	1661.08	0.99
16	126.83	86.08	7.0	5.46	5.50	5	50.00	25.0	9536.67	3891.46	1721.53	0.98
17	132.29	89.06	7.0	5.46	5.50	5	50.00	25.0	9856.10	3980.89	1779.10	0.98
18	137.74	75.14	8.4	4.48	4.53	5	50.00	25.0	8306.66	3332.56	1819.33	0.98
19	142.22	76.64	8.4	4.48	4.53	5	50.00	25.0	8463.00	3360.53	1853.44	0.98
20	146.71	33.13	8.4	1.91	1.93	1	10.00	35.0	3664.88	1441.11	1869.30	0.97

21	148.62	94.99	9.9	5.41	5.50	1	10.00	35.0	10596.80	4104.99	1898.02
0.97											
22	154.03	96.42	9.9	5.41	5.50	1	10.00	35.0	10881.18	4098.11	1947.96
0.97											
23	159.45	97.00	11.3	5.39	5.50	1	10.00	35.0	11062.58	4067.13	1979.71
0.96											
24	164.83	97.66	11.3	5.39	5.50	1	10.00	35.0	11245.67	4012.04	2011.26
0.96											
25	170.22	97.40	12.8	5.36	5.50	1	10.00	35.0	11317.13	3932.68	2024.12
0.96											
26	175.58	97.30	12.8	5.36	5.50	1	10.00	35.0	11399.63	3829.36	2037.39
0.96											
27	180.94	35.42	14.2	1.96	2.02	1	10.00	35.0	4172.91	1376.40	2033.27
0.96											
28	182.90	102.57	14.2	5.70	5.88	1	10.00	35.0	12114.04	3743.67	2022.15
0.96											
29	188.60	53.59	14.2	3.00	3.09	1	10.00	35.0	6339.99	1778.91	2006.70
0.96											
30	191.60	74.32	15.7	4.20	4.36	1	10.00	35.0	8802.26	2268.30	1975.97
0.96											
31	195.80	73.31	15.7	4.20	4.36	1	10.00	35.0	8691.48	1976.92	1946.50
0.96											
32	200.00	37.73	15.7	2.18	2.27	1	10.00	35.0	4459.33	913.00	1916.57
0.96											
33	202.18	111.98	17.1	6.62	6.92	1	10.00	35.0	13024.11	2261.55	1832.74
0.96											
34	208.80	62.44	17.1	3.89	4.07	1	10.00	35.0	7136.93	953.33	1701.69
0.96											
35	212.69	71.05	18.5	4.85	5.12	1	10.00	35.0	8020.99	782.90	1517.68
0.96											
36	217.55	63.14	18.6	4.85	5.12	1	10.00	35.0	7001.96	301.75	1318.04
0.96											
37	222.40	35.00	19.7	3.00	3.19	4	0.00	45.0	3542.12	281.38	1039.62
0.92											
38	225.40	37.68	20.0	3.60	3.83	1	10.00	35.0	4196.56	469.57	1064.81
0.96											
39	229.00	33.02	20.0	3.60	3.83	1	10.00	35.0	3588.19	156.48	904.16
0.96											
40	232.60	7.07	20.0	0.84	0.90	1	10.00	35.0	755.35	0.00	808.02
0.96											
41	233.44	34.35	21.4	4.70	5.05	1	10.00	35.0	3630.50	0.00	691.54
0.96											
42	238.14	25.75	21.4	4.70	5.05	1	10.00	35.0	2640.05	0.00	502.49
0.96											

43	242.85	3.64	21.4	0.83	0.89	5	50.00	25.0	364.39	0.00	401.36
1.00											
44	243.67	16.10	22.9	5.06	5.50	5	50.00	25.0	1609.74	0.00	285.78
1.00											
45	248.74	5.37	22.9	5.06	5.50	5	50.00	25.0	536.75	0.00	89.89
1.00											

X-S Area: 2505.20 Path Length: 208.85 X-S Weight: 282636.97

Project: Bernhardt Sand and Gravel Pit
File: P:\22036 IHC Scott Milliken Property\Slope Stability\Galena\Bernhardt SS5-REC-EQ.gmf
Processed: 24 Feb 2024 14:11:31

DATA: Analysis 1 - Case SS-5 - Reclamation - Pseudo-Static

Material Properties (5 materials)

Material: 1 (Mohr-Coulomb Isotropic) - Sand and Gravel

	Cohesion	Phi	UnitWeight	Ru
Unsaturated:	10.00	35.0	115.00	Auto
Saturated:	10.00	35.0	130.00	Auto

Material: 2 (Mohr-Coulomb Isotropic) - Weathered Claystone Bedrock

	Cohesion	Phi	UnitWeight	Ru
Unsaturated:	1000.00	0.0	110.00	Auto
Saturated:	1000.00	0.0	120.00	Auto

Material: 3 (Mohr-Coulomb Isotropic) - Stable Claystone Bedrock

	Cohesion	Phi	UnitWeight	Ru
Unsaturated:	3000.00	0.0	120.00	Auto
Saturated:	3000.00	0.0	135.00	Auto

Material: 4 (Mohr-Coulomb Isotropic) - Slurry Wall

	Cohesion	Phi	UnitWeight	Ru
Unsaturated:	0.00	45.0	100.00	Auto
Saturated:	0.00	45.0	110.00	Auto

Material: 5 (Mohr-Coulomb Isotropic) - Clay

	Cohesion	Phi	UnitWeight	Ru
Unsaturated:	50.00	25.0	100.00	Auto
Saturated:	50.00	25.0	115.00	Auto

Water Properties

Unit weight of water: 62.400 Unit weight of water/medium above ground: 62.400

Material Profiles (9 profiles)

Profile: 1 (2 points) Material beneath: 5 - Clay
0.00 4730.00 375.00 4730.00

Profile: 2 (2 points) Material beneath: 1 - Sand and Gravel
0.00 4720.30 222.40 4720.30

Profile: 3 (2 points) Material beneath: 4 - Slurry Wall

```
    222.40     4724.90         225.40     4724.90
Profile:  4 (2 points)   Material beneath:  1 - Sand and Gravel
    225.40     4720.30         375.00     4720.30
Profile:  5 (3 points)   Material beneath:  5 - Clay
     45.00     4688.30         188.60     4720.30         200.00     4720.30
Profile:  6 (2 points)   Material beneath:  1 - Sand and Gravel
    136.50     4688.60         200.00     4720.30
Profile:  7 (4 points)   Material beneath:  2 - Weathered Claystone Bedrock
      0.00     4688.40          45.00     4688.30         136.50     4688.60         222.40     4688.80
Profile:  8 (2 points)   Material beneath:  2 - Weathered Claystone Bedrock
    225.40     4688.80         375.00     4688.90
Profile:  9 (5 points)   Material beneath:  3 - Stable Claystone Bedrock
      0.00     4685.40          45.00     4685.30         136.50     4685.60         222.40     4685.60         375.00
4685.90

Slope Surface (12 points)
-------------
      0.00     4688.40          45.00     4688.30         208.80     4724.80         222.40     4724.80         225.40
4724.80
    253.80     4724.90         289.30     4725.00         303.70     4729.70         314.90     4729.70         338.30
4723.70
    347.70     4723.00         375.00     4724.40

Phreatic Surface (8 points)
----------------
      0.00     4688.40          45.00     4688.30         182.90     4711.80         222.40     4712.80         225.40
4716.30
    289.30     4716.30         325.00     4727.00         375.00     4727.00

Failure Surface
---------------
Initial circular surface for critical search defined by: XL,XR,R
  Intersects:  XL:      45.00      YL:    4688.30      XR:     258.80      YR:    4724.91
      Centre:  XC:      69.51      YC:    5187.70                  Radius:  R:     500.00

Earthquake Force
----------------
Pseudo-static earthquake (seismic) coefficient:  0.070

Variable Restraints
-------------------
Parameter descriptor:              XL         XR         R
Range of variation:             10.00      10.00     300.00
Trial positions within range:      20         20         50
```

- -

RESULTS: Analysis 1 - Case SS-5 - Reclamation - Pseudo-Static

Bishop Simplified Method of Analysis - Circular Failure Surface

Critical Failure Surface Search using Multiple Circle Generation Techniques

Initial failure surface approximation - Factor of Safety: 2.312

Analysis Summary

There were: 18956 successful analyses from a total of 20001 trial failure surfaces
1045 analyses terminated due to unacceptable geometry

Critical (minimum) Factor of Safety: 1.72

Results Summary - Lowest 99 Factor of Safety circles

Circle	X-Left	Y-Left	X-Right	Y-Right	X-Centre	Y-Centre	Radius	FoS	
1	50.00	4689.41	253.80	4724.90	79.29	5124.14	435.71	1.720	<-- Critical Surface
2	49.47	4689.30	253.80	4724.90	76.83	5136.42	447.96	1.723	
3	48.95	4689.18	253.80	4724.90	75.44	5142.49	454.08	1.723	
4	50.00	4689.41	253.80	4724.90	78.21	5130.35	441.84	1.724	
5	48.95	4689.18	254.33	4724.90	75.90	5142.46	454.08	1.725	
6	49.47	4689.30	254.33	4724.90	77.29	5136.39	447.96	1.725	
7	48.95	4689.18	253.80	4724.90	74.36	5148.68	460.20	1.726	
8	50.00	4689.41	254.33	4724.90	78.67	5130.32	441.84	1.726	
9	48.42	4689.06	253.80	4724.90	72.98	5154.74	466.33	1.727	
10	49.47	4689.30	254.85	4724.90	77.74	5136.36	447.96	1.727	
11	50.00	4689.41	254.85	4724.90	79.12	5130.29	441.84	1.728	
12	50.00	4689.41	253.80	4724.90	77.13	5136.55	447.96	1.728	
13	49.47	4689.30	253.80	4724.90	75.75	5142.62	454.08	1.729	
14	48.95	4689.18	254.33	4724.90	74.83	5148.66	460.20	1.729	
15	47.89	4688.94	253.80	4724.90	70.51	5166.98	478.57	1.729	
16	48.42	4689.06	254.33	4724.90	73.44	5154.72	466.33	1.729	
17	49.47	4689.30	254.33	4724.90	76.21	5142.59	454.08	1.730	
18	48.42	4689.06	253.80	4724.90	71.90	5160.93	472.45	1.730	
19	49.47	4689.30	253.80	4724.90	74.67	5148.81	460.20	1.730	
20	47.89	4688.94	254.33	4724.90	70.98	5166.96	478.57	1.730	
21	50.00	4689.41	255.38	4724.90	79.58	5130.26	441.84	1.730	
22	50.00	4689.41	254.33	4724.90	77.59	5136.52	447.96	1.730	

23	48.95	4689.18	254.85	4724.90	75.29	5148.63	460.20	1.731
24	49.47	4689.30	254.85	4724.90	76.67	5142.56	454.08	1.732
25	47.37	4688.83	253.80	4724.90	68.05	5179.21	490.82	1.732
26	48.95	4689.18	253.80	4724.90	73.28	5154.87	466.33	1.732
27	50.00	4689.41	254.85	4724.90	78.05	5136.49	447.96	1.732
28	48.95	4689.18	255.38	4724.90	75.75	5148.60	460.20	1.733
29	47.89	4688.94	253.80	4724.90	69.43	5173.16	484.69	1.733
30	49.47	4689.30	255.91	4724.91	77.58	5142.51	454.08	1.733
31	49.47	4689.30	255.38	4724.90	77.13	5142.54	454.08	1.734
32	49.47	4689.30	254.33	4724.90	75.13	5148.79	460.20	1.734
33	48.42	4689.06	253.80	4724.90	70.82	5167.11	478.57	1.734
34	50.00	4689.41	253.80	4724.90	76.05	5142.75	454.08	1.734
35	48.95	4689.18	254.33	4724.90	73.75	5154.85	466.33	1.734
36	50.00	4689.41	255.38	4724.90	78.50	5136.47	447.96	1.734
37	50.00	4689.41	255.91	4724.91	78.96	5136.44	447.96	1.734
38	50.00	4689.41	254.33	4724.90	76.51	5142.72	454.08	1.735
39	48.42	4689.06	254.85	4724.90	72.83	5160.88	472.45	1.735
40	48.95	4689.18	253.80	4724.90	72.21	5161.06	472.45	1.735
41	48.95	4689.18	254.85	4724.90	74.21	5154.82	466.33	1.735
42	48.42	4689.06	254.33	4724.90	71.29	5167.09	478.57	1.735
43	47.89	4688.94	254.33	4724.90	69.90	5173.14	484.69	1.735
44	49.47	4689.30	254.85	4724.90	75.59	5148.76	460.20	1.736
45	48.95	4689.18	255.91	4724.91	75.14	5154.77	466.33	1.736
46	47.37	4688.83	253.80	4724.90	66.97	5185.38	496.94	1.736
47	48.42	4689.06	255.38	4724.90	73.30	5160.86	472.45	1.736
48	48.42	4689.06	254.33	4724.90	72.37	5160.90	472.45	1.736
49	50.00	4689.41	253.80	4724.90	74.98	5148.94	460.20	1.736
50	50.00	4689.41	254.85	4724.90	76.97	5142.69	454.08	1.737
51	48.95	4689.18	255.38	4724.90	74.67	5154.80	466.33	1.737
52	47.89	4688.94	253.80	4724.90	68.35	5179.33	490.82	1.737
53	49.47	4689.30	256.43	4724.91	78.04	5142.48	454.08	1.737
54	49.47	4689.30	255.91	4724.91	76.51	5148.71	460.20	1.737
55	49.47	4689.30	255.38	4724.90	76.05	5148.73	460.20	1.738
56	48.42	4689.06	253.80	4724.90	69.74	5173.29	484.69	1.738
57	48.42	4689.06	255.91	4724.91	73.76	5160.83	472.45	1.738
58	47.37	4688.83	254.33	4724.90	67.44	5185.36	496.94	1.738
59	49.47	4689.30	253.80	4724.90	73.59	5155.00	466.33	1.738
60	50.00	4689.41	256.43	4724.91	79.41	5136.41	447.96	1.738
61	50.00	4689.41	255.91	4724.91	77.89	5142.64	454.08	1.738
62	50.00	4689.41	255.38	4724.90	77.43	5142.67	454.08	1.739
63	46.84	4688.71	253.80	4724.90	64.50	5197.59	509.18	1.739
64	47.89	4688.94	254.85	4724.90	70.37	5173.12	484.69	1.739
65	47.37	4688.83	254.85	4724.90	67.92	5185.34	496.94	1.739
66	48.95	4689.18	253.80	4724.90	71.13	5167.24	478.57	1.739
67	50.00	4689.41	254.33	4724.90	75.44	5148.91	460.20	1.739

68	47.89	4688.94	254.33	4724.90	68.83	5179.31	490.82	1.739
69	48.95	4689.18	254.85	4724.90	73.14	5161.01	472.45	1.739
70	49.47	4689.30	254.33	4724.90	74.06	5154.98	466.33	1.740
71	48.95	4689.18	256.43	4724.91	75.60	5154.74	466.33	1.740
72	48.95	4689.18	254.33	4724.90	71.60	5167.21	478.57	1.740
73	48.95	4689.18	255.91	4724.91	74.07	5160.96	472.45	1.740
74	49.47	4689.30	254.85	4724.90	74.52	5154.95	466.33	1.740
75	47.37	4688.83	253.80	4724.90	65.89	5191.55	503.06	1.740
76	49.47	4689.30	253.80	4724.90	72.51	5161.18	472.45	1.740
77	48.42	4689.06	254.33	4724.90	70.21	5173.27	484.69	1.740
78	48.42	4689.06	255.38	4724.90	72.22	5167.04	478.57	1.740
79	50.00	4689.41	256.96	4724.91	79.87	5136.38	447.96	1.741
80	50.00	4689.41	254.85	4724.90	75.90	5148.89	460.20	1.741
81	48.42	4689.06	254.85	4724.90	71.76	5167.06	478.57	1.741
82	46.84	4688.71	254.33	4724.90	64.98	5197.57	509.18	1.741
83	47.89	4688.94	253.80	4724.90	67.28	5185.51	496.94	1.741
84	49.47	4689.30	256.43	4724.91	76.97	5148.68	460.20	1.741
85	48.95	4689.18	255.38	4724.90	73.60	5160.98	472.45	1.741
86	47.89	4688.94	255.38	4724.90	70.84	5173.10	484.69	1.741
87	49.47	4689.30	255.91	4724.91	75.45	5154.90	466.33	1.741
88	47.89	4688.94	255.91	4724.91	71.31	5173.07	484.69	1.741
89	48.95	4689.18	254.33	4724.90	72.67	5161.03	472.45	1.742
90	46.32	4688.59	253.80	4724.90	62.03	5209.78	521.43	1.742
91	49.47	4689.30	255.38	4724.90	74.98	5154.93	466.33	1.742
92	47.37	4688.83	254.33	4724.90	66.37	5191.53	503.06	1.742
93	48.42	4689.06	253.80	4724.90	68.66	5179.46	490.82	1.742
94	48.42	4689.06	255.91	4724.91	72.69	5167.02	478.57	1.742
95	50.00	4689.41	256.43	4724.91	78.35	5142.61	454.08	1.742
96	50.00	4689.41	255.91	4724.91	76.82	5148.84	460.20	1.742
97	48.42	4689.06	256.43	4724.91	73.16	5166.99	478.57	1.742
98	46.84	4688.71	253.80	4724.90	63.42	5203.75	515.31	1.742
99	50.00	4689.41	255.38	4724.90	76.36	5148.86	460.20	1.743

Critical Failure Surface (circle 1)

Intersects: XL: 50.00 YL: 4689.41 XR: 253.80 YR: 4724.90

Centre: XC: 79.29 YC: 5124.14 Radius: R: 435.71

Generated failure surface: (20 points)

50.00 4689.41 60.98 4688.81 71.96 4688.49 82.96 4688.44 93.95 4688.67

104.93 4689.18 115.89 4689.97 126.83 4691.03 137.74 4692.37 148.62 4693.98

159.45 4695.86 170.22 4698.02 180.94 4700.45 191.60 4703.15 202.18 4706.12

212.69 4709.35 223.11 4712.85 233.44 4716.61 243.67 4720.62 253.80 4724.90

Slice Geometry and Properties - Critical Failure Surface (circle 1, 45 slices)

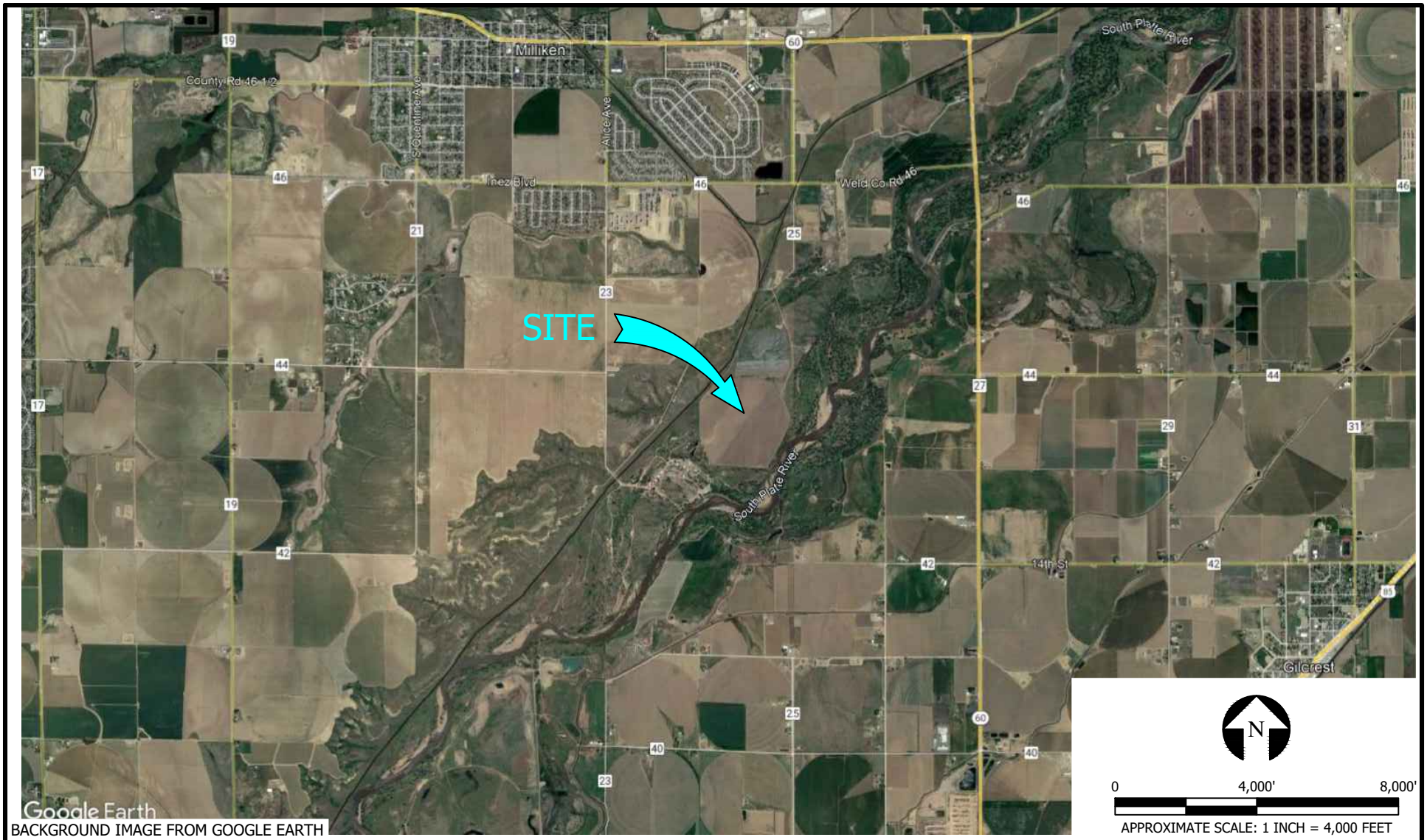
Slice	X-S	Base							PoreWater	Normal	Test
	X-Left	Area	Angle	Width	Length	Matl	Cohesion	Phi	Weight	Force	Stress	Factor
1	50.00	0.19	-3.1	1.16	1.17	5	50.00	25.0	18.82	0.00	18.03	1.02
2	51.16	4.92	-3.1	4.91	4.91	5	50.00	25.0	533.13	169.30	111.40	1.02
3	56.07	11.60	-3.1	4.91	4.91	5	50.00	25.0	1282.24	507.92	265.37	1.02
4	60.98	20.54	-1.7	5.49	5.50	5	50.00	25.0	2281.53	945.82	418.11	1.01
5	66.47	28.16	-1.7	5.49	5.50	5	50.00	25.0	3133.28	1322.27	573.85	1.01
6	71.96	35.41	-0.2	5.50	5.50	5	50.00	25.0	3943.25	1675.28	718.05	1.00
7	77.46	42.26	-0.2	5.50	5.50	5	50.00	25.0	4708.30	2004.35	857.35	1.00
8	82.96	48.73	1.2	5.49	5.50	5	50.00	25.0	5428.13	2309.79	984.01	0.99
9	88.45	54.82	1.2	5.49	5.50	5	50.00	25.0	6105.11	2591.29	1106.82	0.99
10	93.95	60.49	2.6	5.49	5.50	5	50.00	25.0	6732.69	2849.07	1216.17	0.99
11	99.44	65.80	2.7	5.49	5.50	5	50.00	25.0	7320.67	3082.69	1322.45	0.99
12	104.93	70.64	4.1	5.48	5.50	5	50.00	25.0	7852.99	3292.27	1414.58	0.98
13	110.41	75.18	4.1	5.48	5.50	5	50.00	25.0	8352.41	3478.35	1504.56	0.98
14	115.89	79.18	5.5	5.47	5.50	5	50.00	25.0	8788.44	3640.11	1579.57	0.98
15	121.36	82.94	5.5	5.47	5.50	5	50.00	25.0	9198.02	3777.77	1653.16	0.98
16	126.83	86.08	7.0	5.46	5.50	5	50.00	25.0	9536.67	3891.46	1711.24	0.98
17	132.29	89.06	7.0	5.46	5.50	5	50.00	25.0	9856.10	3980.89	1768.43	0.98
18	137.74	75.14	8.4	4.48	4.53	5	50.00	25.0	8306.66	3332.56	1806.18	0.97

19	142.22	76.64	8.4	4.48	4.53	5	50.00	25.0	8463.00	3360.53	1839.99	0.97
20	146.71	33.13	8.4	1.91	1.93	1	10.00	35.0	3664.88	1441.11	1850.81	0.95
21	148.62	94.99	9.9	5.41	5.50	1	10.00	35.0	10596.80	4104.99	1875.98	0.95
22	154.03	96.42	9.9	5.41	5.50	1	10.00	35.0	10881.18	4098.11	1924.95	0.95
23	159.45	97.00	11.3	5.39	5.50	1	10.00	35.0	11062.58	4067.13	1952.71	0.94
24	164.83	97.66	11.3	5.39	5.50	1	10.00	35.0	11245.67	4012.04	1983.37	0.94
25	170.22	97.40	12.8	5.36	5.50	1	10.00	35.0	11317.13	3932.68	1992.19	0.94
26	175.58	97.30	12.8	5.36	5.50	1	10.00	35.0	11399.63	3829.36	2004.69	0.94
27	180.94	35.42	14.2	1.96	2.02	1	10.00	35.0	4172.91	1376.40	1996.83	0.94
28	182.90	102.57	14.2	5.70	5.88	1	10.00	35.0	12114.04	3743.67	1984.77	0.94
29	188.60	53.59	14.2	3.00	3.09	1	10.00	35.0	6339.99	1778.91	1968.09	0.94
30	191.60	74.32	15.7	4.20	4.36	1	10.00	35.0	8802.26	2268.30	1932.95	0.93
31	195.80	73.31	15.7	4.20	4.36	1	10.00	35.0	8691.48	1976.92	1902.37	0.93
32	200.00	37.73	15.7	2.18	2.27	1	10.00	35.0	4459.33	913.00	1871.85	0.93
33	202.18	111.98	17.1	6.62	6.92	1	10.00	35.0	13024.11	2261.55	1784.39	0.93
34	208.80	62.44	17.1	3.89	4.07	1	10.00	35.0	7136.93	953.33	1654.56	0.93
35	212.69	71.05	18.5	4.85	5.12	1	10.00	35.0	8020.99	782.90	1470.33	0.93
36	217.55	63.14	18.6	4.85	5.12	1	10.00	35.0	7001.96	301.75	1274.31	0.93
37	222.40	35.00	19.7	3.00	3.19	4	0.00	45.0	3542.12	281.38	992.89	0.88
38	225.40	37.68	20.0	3.60	3.83	1	10.00	35.0	4196.56	469.57	1029.54	0.93
39	229.00	33.02	20.0	3.60	3.83	1	10.00	35.0	3588.19	156.48	871.81	0.93
40	232.60	7.07	20.0	0.84	0.90	1	10.00	35.0	755.35	0.00	777.71	0.93

41	233.44	34.35	21.4	4.70	5.05	1	10.00	35.0	3630.50	0.00	663.74
0.93											
42	238.14	25.75	21.4	4.70	5.05	1	10.00	35.0	2640.05	0.00	482.15
0.93											
43	242.85	3.64	21.4	0.83	0.89	5	50.00	25.0	364.39	0.00	387.38
0.97											
44	243.67	16.10	22.9	5.06	5.50	5	50.00	25.0	1609.74	0.00	274.25
0.97											
45	248.74	5.37	22.9	5.06	5.50	5	50.00	25.0	536.75	0.00	84.11
0.97											
		---			---				---		
	X-S Area:	2505.20	Path Length:		208.85			X-S Weight:	282636.97		

APPENDIX D

W:\2023\Frederick\23.3020.A Bernhardt Property Wells\ACAD new template 1.16.23\TEMPLATE_2013.dwg 3/24/2023 12:36 PM



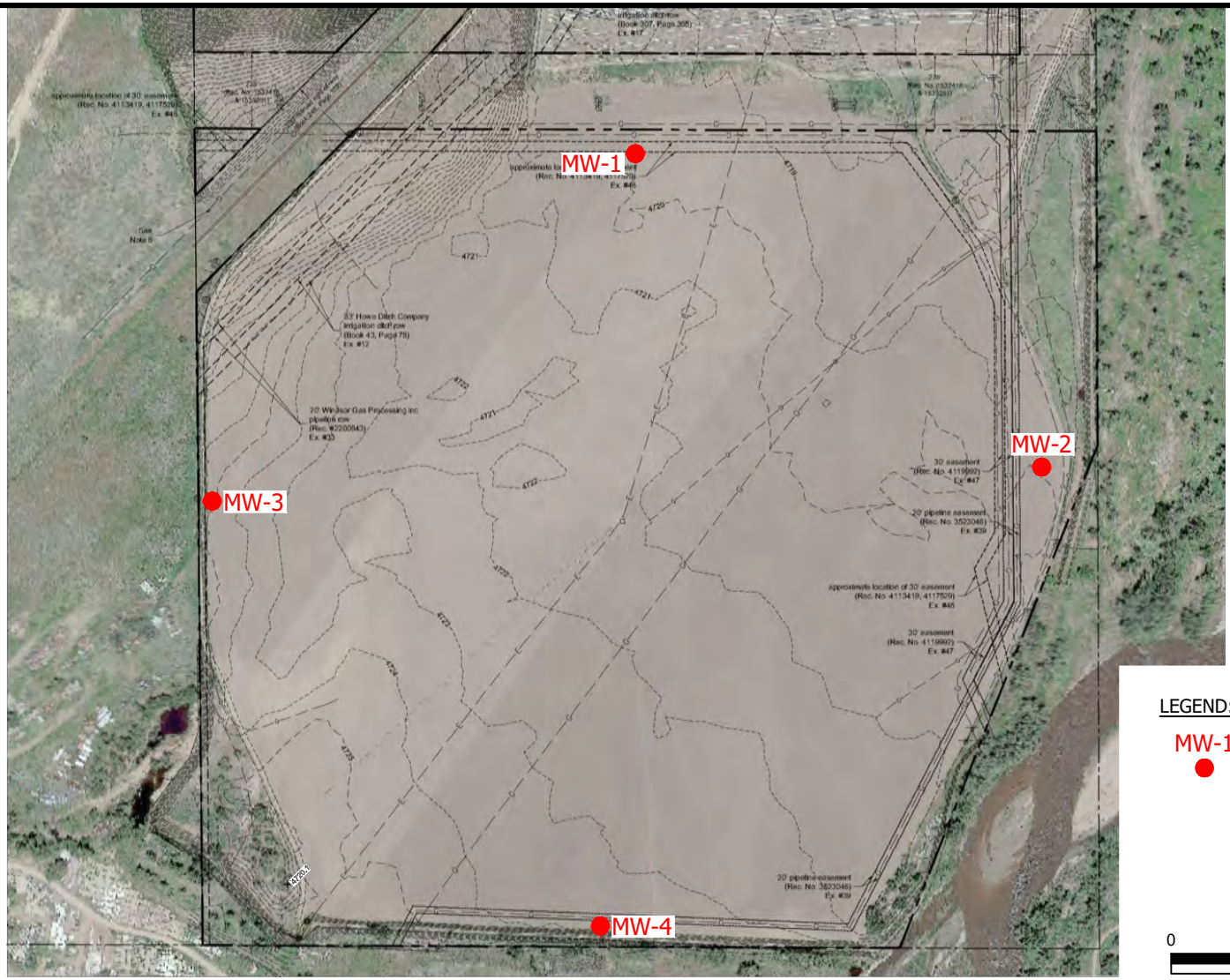
BACKGROUND IMAGE FROM GOOGLE EARTH

PROJECT NO:	23.3020		
PROJECT NAME:	Bernhardt Property Monitor Wells		
DRAWN BY:	JBE	CHECKED BY:	---
DWG DATE:	03.24.23	REV. DATE:	--

FIGURE 1
Vicinity Map

CMT TECHNICAL SERVICES

W:\2023\Frederick\23.3020.A Bernhardt Property Wells\ACAD new template 1.16.23\TEMPLATE_2013.dwg 3/24/2023 12:37 PM



LEGEND:

MW-1 — MONITOR WELL NUMBER AND APPROXIMATE LOCATION

N

0 500' 1,000'

APPROXIMATE SCALE: 1 INCH = 500 FEET

SITE PLAN PROVIDED BY CLIENT

PROJECT NO:	23.3020		
PROJECT NAME:	Bernhardt Property Monitor Wells		
DRAWN BY:	JBE	CHECKED BY:	---
DWG DATE:	03.24.23	REV. DATE:	--

FIGURE 2
Site Plan and Monitor Well Locations

CMT TECHNICAL SERVICES

PROJECT NAME	Bernhardt Property Monitor Wells	PROJECT NUMBER	23.3020
BORING LOCATION	See Figure 2	BORING ELEVATION	
DRILLING COMPANY/RIG	Dakota Drilling/CME-55	CMTTS REP.	J. Edwards
DRILLING METHOD	7in. Diameter HSA	DATE STARTED	3/23/2023
HAMMER SYSTEM	Rope & Cathead	DATE COMPLETED	3/23/2023

MW-1

DEPTH (ft)	BLOW COUNT	SAMPLE DRIVE	SAMPLE BULK	GRAPHIC LOG	ELEVATION (ft)	MATERIAL DESCRIPTION	DEPTH (ft)	WELL DIAGRAM	Water Level and Depth of Cave (ft)
						CLAY, sandy, moist, dark brown.	1	Concrete pad with 3' steel stickup	
						SAND, with silt, moist, brown.	3	Bentonite	
						SAND, well graded, with gravel, typical gravels 1-2" in dimension max, estimated 2-3" in dimension from 27' to 35', very moist to wet, brown.		2" S40 PVC Riser	
								2" S40 PVC .01" Slotted Screen	
							35	Natural "cave-in" sand pack to 6.0'	

LEGEND

- WATER LEVEL AT TIME OF DRILLING
- SPLIT SPOON
- #: WATER LEVEL # DAYS AFTER DRILLING
- #: DEPTH OF CAVE # DAYS AFTER DRILLING
- DEPTH OF REFUSAL

CMT TECHNICAL SERVICES

PROJECT NAME	Bernhardt Property Monitor Wells	PROJECT NUMBER	23.3020	MW-1	
BORING LOCATION	See Figure 2	BORING ELEVATION			
DRILLING COMPANY/RIG	Dakota Drilling/CME-55	CMTTS REP.	J. Edwards		
DRILLING METHOD	7in. Diameter HSA	DATE STARTED	3/23/2023		
HAMMER SYSTEM	Rope & Cathead	DATE COMPLETED	3/23/2023		

DEPTH (ft)	BLOW COUNT	SAMPLE DRIVE	SAMPLE BULK	GRAPHIC LOG	ELEVATION (ft)	MATERIAL DESCRIPTION	DEPTH (ft)	WELL DIAGRAM	Water Level and Depth of Cave (ft)
						SANDSTONE, fine grained, silty, very hard, wet, gray.			
	50/5	☒					39.42		
						Boring terminated at 39.42 feet			

LEGEND

- ▼ WATER LEVEL AT TIME OF DRILLING
- ☒ SPLIT SPOON
- ▽# WATER LEVEL # DAYS AFTER DRILLING
- →# DEPTH OF CAVE # DAYS AFTER DRILLING
- ↑ DEPTH OF REFUSAL

CMT TECHNICAL SERVICES

PROJECT NAME	Bernhardt Property Monitor Wells	PROJECT NUMBER	23.3020
BORING LOCATION	See Figure 2	BORING ELEVATION	
DRILLING COMPANY/RIG	Dakota Drilling/CME-55	CMTTS REP.	J. Edwards
DRILLING METHOD	7in. Diameter HSA	DATE STARTED	3/22/2023
HAMMER SYSTEM	Rope & Cathead	DATE COMPLETED	3/22/2023

MW-2

DEPTH (ft)	BLOW COUNT	SAMPLE DRIVE	SAMPLE BULK	GRAPHIC LOG	ELEVATION (ft)	MATERIAL DESCRIPTION	DEPTH (ft)	WELL DIAGRAM	Water Level and Depth of Cave (ft)
						SAND, clayey, to CLAY, sandy, moist, dark brown.		Concrete pad with 3' steel stick up	
							2		
						SAND, silty, moist, brown.			
							3	Bentonite	
						SAND, with gravel, gravels typically 1" or less in dimension, very moist to wet, brown.			
5									
								2" S40 PVC Riser	
10								Natural "cave-in" sand pack to 5.0'	
15									
								2" S40 PVC .01" Slotted Screen	
20									
25									
30									
							33		
						SANDSTONE, fine grained, silty, very moist to wet, brown to gray.			
	50/7	☒							

LEGEND

- ▼ WATER LEVEL AT TIME OF DRILLING
- ☒ SPLIT SPOON
- ▽# WATER LEVEL # DAYS AFTER DRILLING
- →# DEPTH OF CAVE # DAYS AFTER DRILLING
- ↑ DEPTH OF REFUSAL

CMT TECHNICAL SERVICES

PROJECT NAME	Bernhardt Property Monitor Wells	PROJECT NUMBER	23.3020
BORING LOCATION	See Figure 2	BORING ELEVATION	
DRILLING COMPANY/RIG	Dakota Drilling/CME-55	CMTTS REP.	J. Edwards
DRILLING METHOD	7in. Diameter HSA	DATE STARTED	3/22/2023
HAMMER SYSTEM	Rope & Cathead	DATE COMPLETED	3/22/2023

MW-2

DEPTH (ft)	BLOW COUNT	SAMPLE DRIVE	SAMPLE BULK	GRAPHIC LOG	ELEVATION (ft)	MATERIAL DESCRIPTION	DEPTH (ft)	WELL DIAGRAM	Water Level and Depth of Cave (ft)
							39		

Boring terminated at 39 feet

LEGEND

- WATER LEVEL AT TIME OF DRILLING
- SPLIT SPOON
- #: WATER LEVEL # DAYS AFTER DRILLING
- #: DEPTH OF CAVE # DAYS AFTER DRILLING
- DEPTH OF REFUSAL

CMT TECHNICAL SERVICES

PROJECT NAME	Bernhardt Property Monitor Wells	PROJECT NUMBER	23.3020
BORING LOCATION	See Figure 2	BORING ELEVATION	
DRILLING COMPANY/RIG	Dakota Drilling/CME-55	CMTTS REP.	J. Edwards
DRILLING METHOD	7in. Diameter HSA	DATE STARTED	3/23/2023
HAMMER SYSTEM	Rope & Cathead	DATE COMPLETED	3/23/2023

MW-3

DEPTH (ft)	BLOW COUNT	SAMPLE DRIVE	SAMPLE BULK	GRAPHIC LOG	ELEVATION (ft)	MATERIAL DESCRIPTION	DEPTH (ft)	WELL DIAGRAM	Water Level and Depth of Cave (ft)
						CLAY, sandy, moist, dark brown.		Concrete pad with 3' steel stickup	
							3		
						SAND, silty, fine-grained, moist, light brown.		Bentonite	
5							6		
						SAND, poorly graded, with silt, moist, brown.		2" S40 PVC Riser	
							9		
						SAND, well-graded, with gravel, gravels typically 1" or less in dimension, wet, brown.			
10									
15									
20								Natural "cave-in" sand pack to 8.0'	
25									
								2" S40 PVC .01" Slotted Screen	
30									

LEGEND

- WATER LEVEL AT TIME OF DRILLING
- SPLIT SPOON
- #: WATER LEVEL # DAYS AFTER DRILLING
- #: DEPTH OF CAVE # DAYS AFTER DRILLING
- DEPTH OF REFUSAL

CMT TECHNICAL SERVICES

PROJECT NAME	Bernhardt Property Monitor Wells	PROJECT NUMBER	23.3020	MW-3	
BORING LOCATION	See Figure 2	BORING ELEVATION			
DRILLING COMPANY/RIG	Dakota Drilling/CME-55	CMTTS REP.	J. Edwards		
DRILLING METHOD	7in. Diameter HSA	DATE STARTED	3/23/2023		
HAMMER SYSTEM	Rope & Cathead	DATE COMPLETED	3/23/2023	Page 2 of 2	

DEPTH (ft)	BLOW COUNT	SAMPLE DRIVE	SAMPLE BULK	GRAPHIC LOG	ELEVATION (ft)	MATERIAL DESCRIPTION	DEPTH (ft)	WELL DIAGRAM	Water Level and Depth of Cave (ft)
						driller felt cobbles (estimated 3-4" in dimension) 37'-40'			
40							40		
						CLAYSTONE, with interbedded SANDSTONE lenses, fine-grained sand, very hard, very moist, gray.			
	50/6	☒					44.5		
						Boring terminated at 44.5 feet			

LEGEND

- ▼ WATER LEVEL AT TIME OF DRILLING
- ☒ SPLIT SPOON
- ▽# WATER LEVEL # DAYS AFTER DRILLING
- →# DEPTH OF CAVE # DAYS AFTER DRILLING
- ↑ DEPTH OF REFUSAL

CMT TECHNICAL SERVICES

PROJECT NAME	Bernhardt Property Monitor Wells	PROJECT NUMBER	23.3020	**MW-4**	
BORING LOCATION	See Figure 2	BORING ELEVATION			
DRILLING COMPANY/RIG	Dakota Drilling/CME-55	CMTTS REP.	J. Edwards		
DRILLING METHOD	7in. Diameter HSA	DATE STARTED	3/22/2023		
HAMMER SYSTEM	Rope & Cathead	DATE COMPLETED	3/22/2023		

DEPTH (ft)	BLOW COUNT	SAMPLE DRIVE	SAMPLE BULK	GRAPHIC LOG	ELEVATION (ft)	MATERIAL DESCRIPTION	DEPTH (ft)	WELL DIAGRAM	Water Level and Depth of Cave (ft)
						CLAY, sandy, moist, dark brown.		Concrete pad with 3' steel stickup	
							2		
						SAND, gravelly, 1-2" gravels, with silt, moist, brown.		Bentonite	
5									
							6		
						SAND, with gravel, gravels typically less than 1" in dimension, wet, brown.		2" S40 PVC Riser	
								10/20 Washed Silica Sand to 6'	
10									
15								Natural "cave-in" sand pack to 11.0'	
								2" S40 PVC .01" Slotted Screen	
20									
25									
30							33		
						CLAYSTONE, with interbedded SANDSTONE lenses, fine-grained sand, silty, very hard, very moist, gray.			

LEGEND

- WATER LEVEL AT TIME OF DRILLING
- SPLIT SPOON
- #: WATER LEVEL # DAYS AFTER DRILLING
- #: DEPTH OF CAVE # DAYS AFTER DRILLING
- DEPTH OF REFUSAL

CMT TECHNICAL SERVICES

PROJECT NAME	Bernhardt Property Monitor Wells		PROJECT NUMBER	23.3020	MW-4
BORING LOCATION	See Figure 2		BORING ELEVATION		
DRILLING COMPANY/RIG	Dakota Drilling/CME-55		CMTTS REP.	J. Edwards	
DRILLING METHOD	7in. Diameter HSA		DATE STARTED	3/22/2023	
HAMMER SYSTEM	Rope & Cathead		DATE COMPLETED	3/22/2023	

DEPTH (ft)	BLOW COUNT	SAMPLE DRIVE	SAMPLE BULK	GRAPHIC LOG	ELEVATION (ft)	MATERIAL DESCRIPTION	DEPTH (ft)	WELL DIAGRAM	Water Level and Depth of Cave (ft)
	50/5	☒				Boring terminated at 39.42 feet	39.42		

LEGEND

- ▼ WATER LEVEL AT TIME OF DRILLING
- ☒ SPLIT SPOON
- ▽# WATER LEVEL # DAYS AFTER DRILLING
- →# DEPTH OF CAVE # DAYS AFTER DRILLING
- ↑ DEPTH OF REFUSAL

CMT TECHNICAL SERVICES

W:\2022\Frederick\22.3007.A Bernhardt Property Aggregate Exploration\ACAD\Boring Location Map(1).dwg 1/19/2022 2:49 PM

LEGEND:

TB-13 BORING NUMBER AND APPROXIMATE LOCATION

APPROXIMATE FIELD BOUNDARY

N

0 400' 800'

APPROXIMATE SCALE: 1 INCH = 400 FEET

BACKGROUND IMAGE FROM GOOGLE EARTH

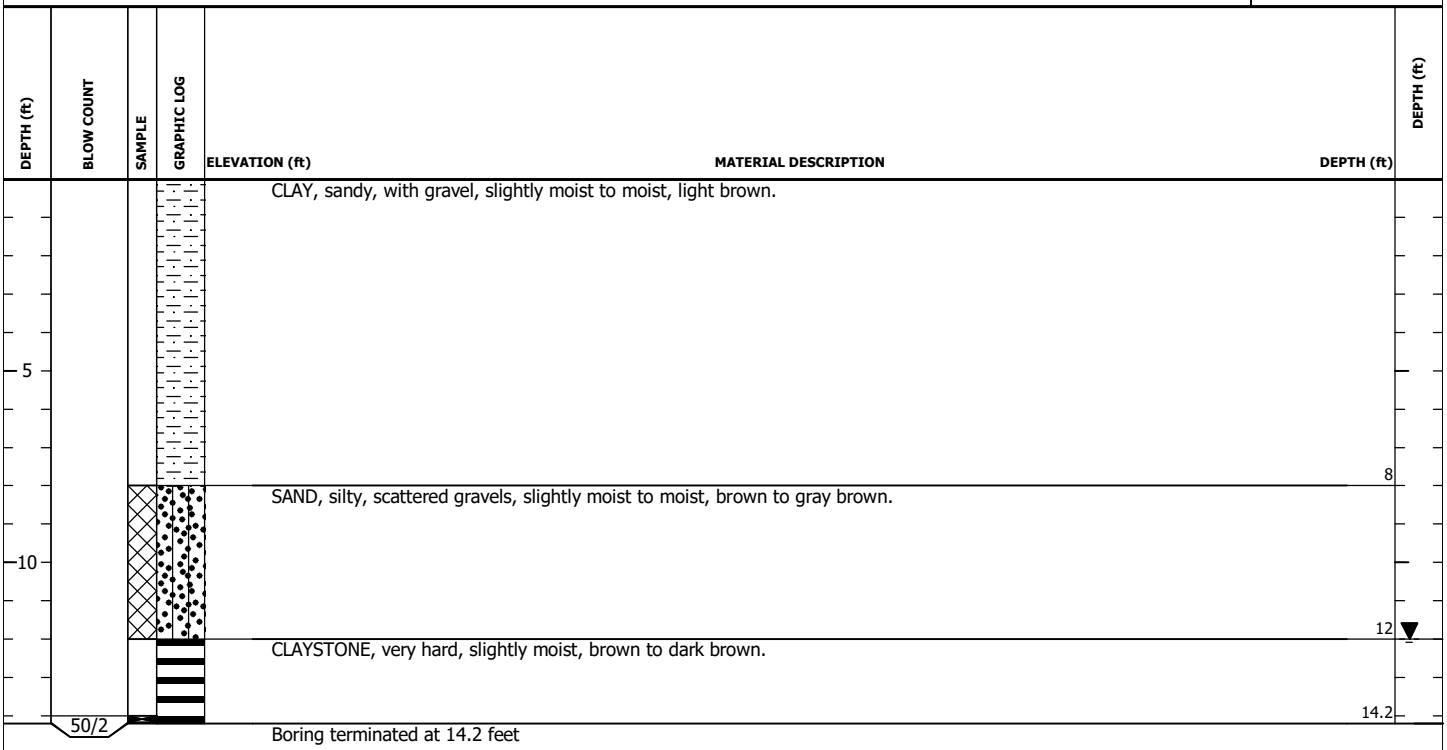
FIGURE 2.2
Field 2 Boring Location Plan

PROJECT NO:	22.3007		
PROJECT NAME:	Bernhardt Property		
DRAWN BY:	ZLM	CHECKED BY:	JBE
DWG DATE:	01.19.21	REV. DATE:	--

CESARE, INC.
Geotechnical Engineers & Construction Materials Consultants

PROJECT NAME	Bernhardt Property Aggregate Exploration	PROJECT NUMBER	22.3007
BORING LOCATION	40.30249 / -104.83856	BORING ELEVATION	
LOCATION NOTES	40.30249/-104.83856	CESARE REP.	Z. Moore
DRILLING COMPANY/RIG	Dakota Drilling/CME-55	DATE STARTED	1/10/2022
DRILLING METHOD	6in. Diameter SSA	DATE COMPLETED	1/10/2022

TB-7



CLAY, sandy, with gravel, slightly moist to moist, light brown.

8

SAND, silty, scattered gravels, slightly moist to moist, brown to gray brown.

12

CLAYSTONE, very hard, slightly moist, brown to dark brown.

14.2

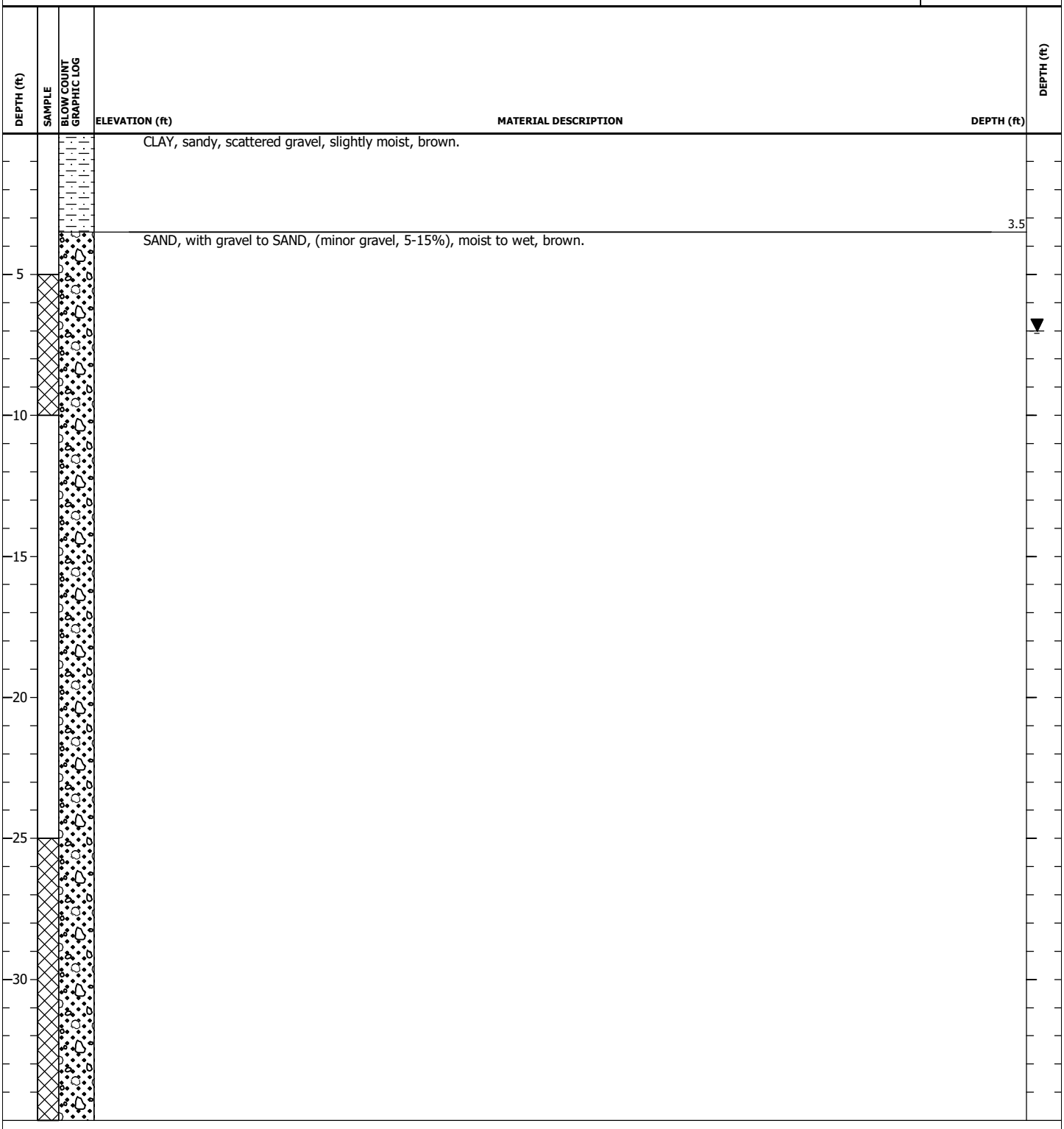
Boring terminated at 14.2 feet

LEGEND

- WATER LEVEL AT TIME OF DRILLING
- # WATER LEVEL # DAYS AFTER DRILLING
- # DEPTH OF CAVE # DAYS AFTER DRILLING
- DEPTH OF REFUSAL

CESARE, INC.
Geotechnical Engineers & Construction Materials Consultants

PROJECT NAME	Bernhardt Property Aggregate Exploration	PROJECT NUMBER	22.3007	TB-8
BORING LOCATION	40.29969 / -104.83811	BORING ELEVATION		
LOCATION NOTES	40.29969/-104.83811	CESARE REP.	Z. Moore	
DRILLING COMPANY/RIG	Dakota Drilling/CME-55	DATE STARTED	1/10/2022	
DRILLING METHOD	6in. Diameter SSA	DATE COMPLETED	1/10/2022	Page 1 of 2



LEGEND

- WATER LEVEL AT TIME OF DRILLING
- #WATER LEVEL # DAYS AFTER DRILLING
- #DEPTH OF CAVE # DAYS AFTER DRILLING
- DEPTH OF REFUSAL

CESARE, INC.
Geotechnical Engineers & Construction Materials Consultants

PROJECT NAME	Bernhardt Property Aggregate Exploration		PROJECT NUMBER	22.3007	
BORING LOCATION	40.29969 / -104.83811		BORING ELEVATION		
LOCATION NOTES	40.29969/-104.83811		CESARE REP.	Z. Moore	
DRILLING COMPANY/RIG	Dakota Drilling/CME-55		DATE STARTED	1/10/2022	
DRILLING METHOD	6in. Diameter SSA		DATE COMPLETED	1/10/2022	

TB-8

DEPTH (ft)	SAMPLE	BLOW COUNT GRAPHIC LOG	ELEVATION (ft)	MATERIAL DESCRIPTION	DEPTH (ft)	DEPTH (ft)
					36	
				CLAYSTONE, moist, gray.		
					39	

Boring terminated at 39 feet

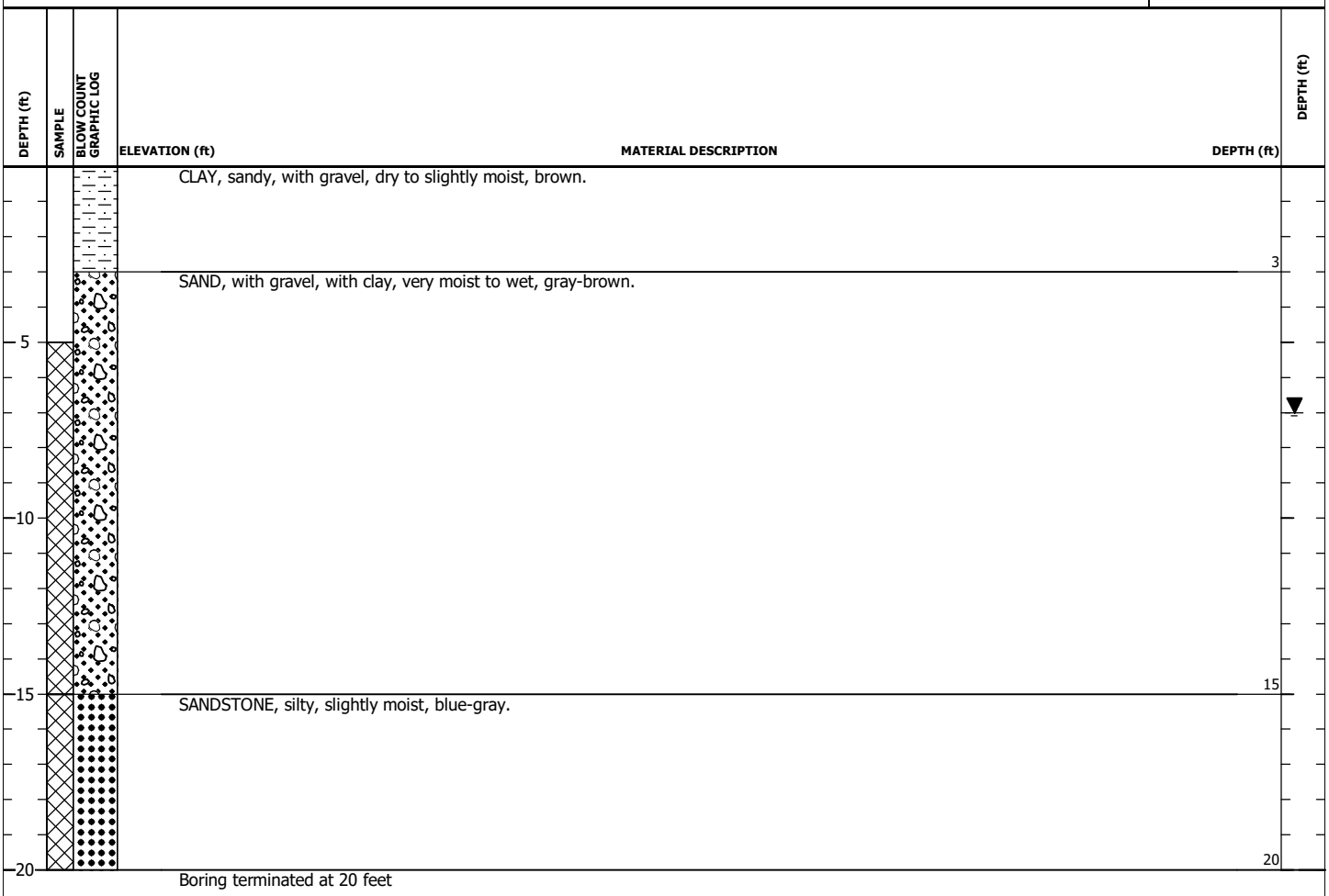
LEGEND

- WATER LEVEL AT TIME OF DRILLING
- # WATER LEVEL # DAYS AFTER DRILLING
- # DEPTH OF CAVE # DAYS AFTER DRILLING
- DEPTH OF REFUSAL

CESARE, INC.
Geotechnical Engineers & Construction Materials Consultants

PROJECT NAME	Bernhardt Property Aggregate Exploration		PROJECT NUMBER	22.3007	
BORING LOCATION	40.30285 / -104.83679		BORING ELEVATION		
LOCATION NOTES	40.30285/-104.83679		CESARE REP.	Z. Moore	
DRILLING COMPANY/RIG	Dakota Drilling/CME-55		DATE STARTED	1/10/2022	
DRILLING METHOD	6in. Diameter SSA		DATE COMPLETED	1/10/2022	

TB-9



LEGEND

- WATER LEVEL AT TIME OF DRILLING
- #WATER LEVEL # DAYS AFTER DRILLING
- →#DEPTH OF CAVE # DAYS AFTER DRILLING
- DEPTH OF REFUSAL

CESARE, INC.
Geotechnical Engineers & Construction Materials Consultants

PROJECT NAME	Bernhardt Property Aggregate Exploration	PROJECT NUMBER	22.3007	TB-10
BORING LOCATION	40.30036 / -104.83708	BORING ELEVATION		
LOCATION NOTES	40.30036/-104.83708	CESARE REP.	Z. Moore	
DRILLING COMPANY/RIG	Dakota Drilling/CME-55	DATE STARTED	1/10/2022	
DRILLING METHOD	6in. Diameter SSA	DATE COMPLETED	1/10/2022	Page 1 of 2

DEPTH (ft)	SAMPLE	BLOW COUNT GRAPHIC LOG	ELEVATION (ft)	MATERIAL DESCRIPTION	DEPTH (ft)
				CLAY, sandy, moist, brown.	
					2.5
				SAND, with gravel, with clay, moist to wet, light brown.	
5					
10					
15					
20					
25					
30					

DEPTH (ft)

LEGEND

- ▼ WATER LEVEL AT TIME OF DRILLING
- ▽# WATER LEVEL # DAYS AFTER DRILLING
- →# DEPTH OF CAVE # DAYS AFTER DRILLING
- ↑ DEPTH OF REFUSAL

CESARE, INC.
Geotechnical Engineers & Construction Materials Consultants

PROJECT NAME	Bernhardt Property Aggregate Exploration		PROJECT NUMBER	22.3007	
BORING LOCATION	40.30036 / -104.83708		BORING ELEVATION		
LOCATION NOTES	40.30036/-104.83708		CESARE REP.	Z. Moore	
DRILLING COMPANY/RIG	Dakota Drilling/CME-55		DATE STARTED	1/10/2022	
DRILLING METHOD	6in. Diameter SSA		DATE COMPLETED	1/10/2022	

TB-10

DEPTH (ft)	SAMPLE	BLOW COUNT GRAPHIC LOG	ELEVATION (ft)	MATERIAL DESCRIPTION	DEPTH (ft)	DEPTH (ft)
					36	
				CLAYSTONE, slightly moist, gray.		
					39	
				Boring terminated at 39 feet		

LEGEND

- WATER LEVEL AT TIME OF DRILLING
- # WATER LEVEL # DAYS AFTER DRILLING
- # DEPTH OF CAVE # DAYS AFTER DRILLING
- DEPTH OF REFUSAL

CESARE, INC.
Geotechnical Engineers & Construction Materials Consultants

PROJECT NAME	Bernhardt Property Aggregate Exploration	PROJECT NUMBER	22.3007
BORING LOCATION	40.29903 / -104.83722	BORING ELEVATION	
LOCATION NOTES	40.29903/-104.83722	CESARE REP.	Z. Moore
DRILLING COMPANY/RIG	Dakota Drilling/CME-55	DATE STARTED	1/10/2022
DRILLING METHOD	6in. Diameter SSA	DATE COMPLETED	1/10/2022

TB-11

DEPTH (ft)	SAMPLE	BLOW COUNT GRAPHIC LOG	ELEVATION (ft)	MATERIAL DESCRIPTION	DEPTH (ft)	DEPTH (ft)
				CLAY, with sand to sandy, moist, brown.		
					4	
5				SAND, (minor gravel, 5-15%), moist to wet, light brown.		
10						
15						
20						
25						
30						

LEGEND

- WATER LEVEL AT TIME OF DRILLING
- #: WATER LEVEL # DAYS AFTER DRILLING
- →#: DEPTH OF CAVE # DAYS AFTER DRILLING
- DEPTH OF REFUSAL

CESARE, INC.
Geotechnical Engineers & Construction Materials Consultants

PROJECT NAME	Bernhardt Property Aggregate Exploration		PROJECT NUMBER	22.3007	
BORING LOCATION	40.29903 / -104.83722		BORING ELEVATION		
LOCATION NOTES	40.29903/-104.83722		CESARE REP.	Z. Moore	
DRILLING COMPANY/RIG	Dakota Drilling/CME-55		DATE STARTED	1/10/2022	
DRILLING METHOD	6in. Diameter SSA		DATE COMPLETED	1/10/2022	

TB-11

DEPTH (ft)	SAMPLE	BLOW COUNT GRAPHIC LOG	ELEVATION (ft)	MATERIAL DESCRIPTION	DEPTH (ft)	DEPTH (ft)
					37	
				CLAYSTONE, slightly moist to moist, gray.	39	

Boring terminated at 39 feet

LEGEND

- WATER LEVEL AT TIME OF DRILLING
- # WATER LEVEL # DAYS AFTER DRILLING
- # DEPTH OF CAVE # DAYS AFTER DRILLING
- DEPTH OF REFUSAL

CESARE, INC.
Geotechnical Engineers & Construction Materials Consultants

PROJECT NAME	Bernhardt Property Aggregate Exploration	PROJECT NUMBER	22.3007
BORING LOCATION	40.30109 / -104.83478	BORING ELEVATION	
LOCATION NOTES	40.30109/-104.83478	CESARE REP.	Z. Moore
DRILLING COMPANY/RIG	Dakota Drilling/CME-55	DATE STARTED	1/10/2022
DRILLING METHOD	6in. Diameter SSA	DATE COMPLETED	1/10/2022

TB-12

DEPTH (ft)	SAMPLE	BLOW COUNT GRAPHIC LOG	ELEVATION (ft)	MATERIAL DESCRIPTION	DEPTH (ft)	DEPTH (ft)
				CLAY, with sand, moist, brown.		
					3	
				SAND, with gravel, moist to wet, brown.		
5						
10						▼
15						
20						
25						
30						

LEGEND

▼ WATER LEVEL AT TIME OF DRILLING

▽# WATER LEVEL # DAYS AFTER DRILLING

→# DEPTH OF CAVE # DAYS AFTER DRILLING

↑ DEPTH OF REFUSAL

CESARE, INC.
Geotechnical Engineers & Construction Materials Consultants

PROJECT NAME	Bernhardt Property Aggregate Exploration		PROJECT NUMBER	22.3007	
BORING LOCATION	40.30109 / -104.83478		BORING ELEVATION		
LOCATION NOTES	40.30109/-104.83478		CESARE REP.	Z. Moore	
DRILLING COMPANY/RIG	Dakota Drilling/CME-55		DATE STARTED	1/10/2022	
DRILLING METHOD	6in. Diameter SSA		DATE COMPLETED	1/10/2022	

TB-12

DEPTH (ft)	SAMPLE	BLOW COUNT GRAPHIC LOG	ELEVATION (ft)	MATERIAL DESCRIPTION	DEPTH (ft)	DEPTH (ft)
					36.5	
				CLAYSTONE, slightly moist, gray.		
					39	
				Boring terminated at 39 feet		

LEGEND

- WATER LEVEL AT TIME OF DRILLING
- #: WATER LEVEL # DAYS AFTER DRILLING
- →#: DEPTH OF CAVE # DAYS AFTER DRILLING
- DEPTH OF REFUSAL

CESARE, INC.
Geotechnical Engineers & Construction Materials Consultants

PROJECT NAME	Bernhardt Property Aggregate Exploration	PROJECT NUMBER	22.3007
BORING LOCATION	40.29914 / -104.83508	BORING ELEVATION	
LOCATION NOTES	40.29914/-104.83508	CESARE REP.	Z. Moore
DRILLING COMPANY/RIG	Dakota Drilling/CME-55	DATE STARTED	1/10/2022
DRILLING METHOD	6in. Diameter SSA	DATE COMPLETED	1/10/2022

TB-13

DEPTH (ft)	SAMPLE	BLOW COUNT GRAPHIC LOG	ELEVATION (ft)	MATERIAL DESCRIPTION	DEPTH (ft)	DEPTH (ft)
				CLAY, with sand to sandy, scattered gravel, slightly moist, brown.		
5					5	
				SAND, with gravel, wet, brown.		
10						▼
15						
20						
25						
30						

LEGEND

▼ WATER LEVEL AT TIME OF DRILLING

▽# WATER LEVEL # DAYS AFTER DRILLING

→# DEPTH OF CAVE # DAYS AFTER DRILLING

↑ DEPTH OF REFUSAL

CESARE, INC.
Geotechnical Engineers & Construction Materials Consultants

PROJECT NAME	Bernhardt Property Aggregate Exploration		PROJECT NUMBER	22.3007	
BORING LOCATION	40.29914 / -104.83508		BORING ELEVATION		
LOCATION NOTES	40.29914/-104.83508		CESARE REP.	Z. Moore	
DRILLING COMPANY/RIG	Dakota Drilling/CME-55		DATE STARTED	1/10/2022	
DRILLING METHOD	6in. Diameter SSA		DATE COMPLETED	1/10/2022	

TB-13

DEPTH (ft)	SAMPLE	BLOW COUNT GRAPHIC LOG	ELEVATION (ft)	MATERIAL DESCRIPTION	DEPTH (ft)	DEPTH (ft)
					36	
				CLAYSTONE, moist, blue-gray.		
					39	
				Boring terminated at 39 feet		

LEGEND

- WATER LEVEL AT TIME OF DRILLING
- #: WATER LEVEL # DAYS AFTER DRILLING
- →#: DEPTH OF CAVE # DAYS AFTER DRILLING
- DEPTH OF REFUSAL

CESARE, INC.
Geotechnical Engineers & Construction Materials Consultants

PROJECT NAME	Bernhardt Property Aggregate Exploration	PROJECT NUMBER	22.3007	TB-14
BORING LOCATION	40.30327 / -104.83175	BORING ELEVATION		
LOCATION NOTES	40.30327/-104.83175	CESARE REP.	Z. Moore	
DRILLING COMPANY/RIG	Dakota Drilling/CME-55	DATE STARTED	1/10/2022	
DRILLING METHOD	6in. Diameter SSA	DATE COMPLETED	1/10/2022	Page 1 of 2

DEPTH (ft)	SAMPLE	BLOW COUNT GRAPHIC LOG	ELEVATION (ft)	MATERIAL DESCRIPTION	DEPTH (ft)	DEPTH (ft)
				SAND, clayey, with gravel, slightly moist, brown.	2	
				SAND, with gravel, wet, brown.		▼
5						
10						
15						
20						
25						
30					35	

LEGEND

▼ WATER LEVEL AT TIME OF DRILLING

▽# WATER LEVEL # DAYS AFTER DRILLING

→# DEPTH OF CAVE # DAYS AFTER DRILLING

↑ DEPTH OF REFUSAL

CESARE, INC.
Geotechnical Engineers & Construction Materials Consultants

PROJECT NAME	Bernhardt Property Aggregate Exploration		PROJECT NUMBER	22.3007	
BORING LOCATION	40.30327 / -104.83175		BORING ELEVATION		
LOCATION NOTES	40.30327/-104.83175		CESARE REP.	Z. Moore	
DRILLING COMPANY/RIG	Dakota Drilling/CME-55		DATE STARTED	1/10/2022	
DRILLING METHOD	6in. Diameter SSA		DATE COMPLETED	1/10/2022	

TB-14

DEPTH (ft)	SAMPLE	BLOW COUNT GRAPHIC LOG	ELEVATION (ft)	MATERIAL DESCRIPTION	DEPTH (ft)	DEPTH (ft)
				CLAYSTONE, slightly moist, gray.		
					39	
				Boring terminated at 39 feet		

LEGEND

- WATER LEVEL AT TIME OF DRILLING
- #: WATER LEVEL # DAYS AFTER DRILLING
- →#: DEPTH OF CAVE # DAYS AFTER DRILLING
- DEPTH OF REFUSAL

CESARE, INC.
Geotechnical Engineers & Construction Materials Consultants

PROJECT NAME	Bernhardt Property Aggregate Exploration	PROJECT NUMBER	22.3007
BORING LOCATION	40.30108 / -104.83095	BORING ELEVATION	
LOCATION NOTES	40.30108/-104.83095	CESARE REP.	Z. Moore
DRILLING COMPANY/RIG	Dakota Drilling/CME-55	DATE STARTED	1/10/2022
DRILLING METHOD	6in. Diameter SSA	DATE COMPLETED	1/10/2022

TB-15

DEPTH (ft)	SAMPLE	BLOW COUNT GRAPHIC LOG	ELEVATION (ft)	MATERIAL DESCRIPTION	DEPTH (ft)
				CLAY, with sand, slightly moist, brown.	
					3
				SAND, with silt, (minor gravel, 5-15%), moist to wet, light brown to brown to gray brown.	
5					
10					
15					
20					
25					
30					
					32
				CLAYSTONE, slightly moist, gray.	
					34
				Boring terminated at 34 feet	

LEGEND

- ▼ WATER LEVEL AT TIME OF DRILLING
- ▽# WATER LEVEL # DAYS AFTER DRILLING
- →# DEPTH OF CAVE # DAYS AFTER DRILLING
- ↑ DEPTH OF REFUSAL

CESARE, INC.
Geotechnical Engineers & Construction Materials Consultants

PROJECT NAME	Bernhardt Property Aggregate Exploration	PROJECT NUMBER	22.3007	TB-16
BORING LOCATION	40.29987 / -104.83309	BORING ELEVATION		
LOCATION NOTES	40.29987/-104.83309	CESARE REP.	Z. Moore	
DRILLING COMPANY/RIG	Dakota Drilling/CME-55	DATE STARTED	1/10/2022	
DRILLING METHOD	6in. Diameter SSA	DATE COMPLETED	1/10/2022	Page 1 of 1

DEPTH (ft)	SAMPLE	BLOW COUNT GRAPHIC LOG	ELEVATION (ft)	MATERIAL DESCRIPTION	DEPTH (ft)	DEPTH (ft)
				CLAY, sandy, with gravel, slightly moist, brown.		
					4	
				SAND, with gravel, moist to wet, brown.		
5						
						▼
10						
15						
20						
25						
30						
					33	
				CLAYSTONE, slightly moist, gray.	34	
				Boring terminated at 34 feet		

LEGEND

▼ WATER LEVEL AT TIME OF DRILLING

▽# WATER LEVEL # DAYS AFTER DRILLING

→# DEPTH OF CAVE # DAYS AFTER DRILLING

↑ DEPTH OF REFUSAL

CESARE, INC.
Geotechnical Engineers & Construction Materials Consultants

APPENDIX E

Peak Acceleration (%g) with 2% Probability of Exceedance in 50 Years
USGS Map, Oct. 2002rev