SECTION 23

ROADS

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SECTION 23

ROADS

LIST OF TABLES

TABLE NUMBER	TABLE TITLE
23.2-1	Primary Roads

SECTION 23

ROADS

LIST OF EXHIBITS

EXHIBIT NUMBER	EXHIBIT TITLE
23.2-1	Location Map – Roads, Culverts and Watersheds
23.2-2	West Haul Road – Plan, Profile, and Section
23.3-1	Typical Ancillary Roads – Typical Section and Profile

SECTION 23

ROADS

LIST OF APPENDICES

APPENDIX NUMBER	APPENDIX TITLE
23.A	Slope Stability Analysis

SECTION 23

ROADS

LIST OF REVISIONS DURING PERMIT TERM

REV. NUMBER	REVISION DESCRIPTION	DATE APPROVED

SECTION 23 ROADS

Navajo Transitional Energy Company (NTEC) will utilize both primary and ancillary roads in its mining operations for the No Name Permit (NNP). Roads classified as primary consist of roads used to transport coal and spoil, the main access roads to the mining areas used by small and heavy equipment, and the access roads to the support facilities. Roads classified as ancillary consist of roads used infrequently by small vehicles for accessing environmental monitoring stations, accessing ponds/water control structures, surveying, and power line service/inspections. The haul roads to topsoil stockpiles and the temporary roads used during the construction of support facilities are also classified as ancillary roads. Ramps leading from the bottom of the pits to the intersection with the haul roads and roads in the active or immediate mining areas are not classified as either primary or ancillary roads.

23.1 Existing Roads

The use of existing roads will be limited to some two-track roads that will be used to access environmental monitoring stations for collection of data. The locations of these roads will be presented on Exhibit 23.2-1 as they are developed. They are classified as ancillary roads. Their existing conditions are suitable for the intended use, so no modification or reconstruction is anticipated. The profiles of these roads closely follow the existing topography with no significant cuts or fills. To minimize additional disturbance and adverse environmental impacts, maintenance will be limited to occasional light blading, particularly after heavy precipitation events that may cause damages.

Some of these roads will eventually be disturbed or blocked due to construction of mine support facilities and mining activities. As construction of new mine roads is completed they will be reconnected to the newly constructed roads. The mine permit will be revised accordingly.

23.2 Primary Roads

All primary roads will be designed, constructed, and maintained in a manner to minimize adverse environmental impacts. Adequate drainage and erosion control structures will be incorporated into the road designs. Information on each primary road segments is presented on Table 23.2-1 and their locations are presented on Exhibit 23.2-1.

23.2.1 Design Criteria

Primary roads are typically designed to meet the applicable performance standards of CFR 30 Subchapter K and the Mine Safety and Health Administration (MSHA) standards and requirements for roads.

Geometric Design

The geometric design of primary roads will be done in a manner to ensure the safe operation of small vehicles and heavy equipment. The layout of the vertical and horizontal curves is for safe sight and stopping distances of the vehicles using the road. The geometric design (i.e., width, vertical/horizontal curves, crown, safety barriers, etc.) will comply with the design criteria to adhere to MSHA regulations.

At elevated roadways, MSHA regulations requires a safety barrier along the edge of the road that is capable of deflecting the largest vehicle back onto the road or prevent it from leaving the roadway. An acceptable barrier is an earth berm having a height equal to or greater than the axle height of the largest vehicle using the road. NTEC uses an earth safety berm in road designs at its Navajo Mine operations, and will adopt the same concept for use at NNP. On roads used by heavy mining equipment, whenever the road is elevated 4 ft or more, a 6-ft high safety berm is incorporated into the design template. On roads used by only small vehicles, a 3-ft high safety berm is used.

A 2% crown will be incorporated into the design template to divert surface runoff from the roadway into side ditches or to the toe of safety berms.

Cut and Fill Side Slopes

The steepness of cut and embankment slopes shall be as follows:

1. Cut slopes will not be steeper than 2 horizontal:1vertical (2h:1v) in unconsolidated material and not steeper than 1h:1v in consolidated material.
2. Embankment slopes will be 4h:1v when the embankment height is less than 4 feet and 2h:1v with a safety berm when the embankment height is equal to or greater than 4 feet.

Embankment Slope Stability

The minimum static safety factor for road embankments shall be 1.3. To demonstrate this, slope stability analysis was performed on two worst-case scenarios (i.e., maximum embankment height and cut slope). Since all the embankments are to be constructed with similar soils, a worst-case analysis should be sufficient. Slope stability analyses are presented in Appendix 23.A.

Design Storm

All required drainage and sediment control structures (i.e., culverts, side ditches, relief ditches, downdrains, etc.) will be designed to pass the peak flow from the 10yr-6hr storm event or larger event.

Design Loads

Culverts and other buried structures within the roadway will be designed to withstand the dead load plus the maximum live surcharge load imposed upon it.

23.2.2 Construction

Road construction will not commence until the regulatory authority approves the designs. Prior to commencing construction, 1 ft of topsoil will be salvaged along the roadways. The salvaged topsoil will be removed and placed either in a stockpile or hauled directly onto a regraded area. If mining activities encroach onto a road and the road needs to be removed, the remaining topsoil beneath the road will be salvaged. Fugitive dust emitted from construction areas will be controlled by watering or by other proven means. The fugitive dust control plan is discussed in Section 40 (Environmental Protection).

Excavation

Excavation or cuts for roads shall conform to the following:

1. To keep surface disturbance to a minimum, the excavation will be limited to the lines and grades indicated on the design drawings.
2. Rock excavation may require blasting; appropriate permits will be obtained prior to commencing blasting activities.

Embankments

The construction of the embankments shall conform to the following:

1. Prior to beginning placement of fill material, the fill area will be cleared of trees, stumps, roots, boulders, vegetation, and rubbish.
2. Only approved suitable fill material free of debris, organic material, frozen matter, and excessive moisture or dryness will be used.
3. Fill material shall be placed in lifts and compacted before placing the next lift. The geotechnical engineer will specify the degree of compaction required and the thickness of the lifts. No additional lifts will be placed until the specified degree of compaction is achieved.

Installation of Culverts

To ensure that the design strength of the culvert is developed, selected fill material shall be placed in lifts around the culvert and compacted. No additional lifts will be placed until the specified degree of compaction is achieved.

23.2.3 Drainage and Sediment Control

Primary roads are designed, constructed and maintained in such a manner to minimize the contribution of additional suspended solids to surface runoff leaving the permit area. The primary roads will be located with minimal impact upon existing drainage channels.

Culverts will be used unless site conditions or other factors dictate otherwise. At topographical lows or areas where roads intersect drainage channels, surface flows will be routed through road embankments with culverts. The placement and orientation of culverts will be in a manner to minimize the alteration of the stream channel. If the stream channel is to be significantly altered, appropriate mitigation measures will be incorporated into the design to minimize the impacts. The inlet and outlet of culverts will be riprapped when required to prevent erosion.

All primary road culverts will be designed to safely pass the peak discharge from a 10yr-6hr event or larger event. The watersheds for all the culverts will be delineated from contour mapping. Soil curve numbers determined using data from the Natural Resources Conservation Service soil surveys (Keetch 1980). The curve numbers assigned to the hydrologic groups are: A 65, B 78, C 87, and D 93. Using this data, a weighted curve number was calculated for the watersheds. The precipitation values for the design storm were obtained from the National Oceanic and Atmospheric Administration (NOAA) Atlas IV-New Mexico (NOAA 2006). The watersheds and culverts will be modeled in SEDCAD to determine the peak flows and the culvert sizes required. If the results from the hydraulic analysis indicate the potential for erosion to occur at the inlet or outlet, riprap rock or other forms of protective lining will be installed.

At transitions from cut to fill a relief ditch is constructed to direct flows along the toe of the road embankment. Additional relief ditches may be needed at the safety berm termination points on the downstream end. The gradient of the relief ditches varies depending on the adjacent topography. The road crown, side ditches, and safety berms direct the surface flows into the relief ditches. The safety berms minimize uncontrolled flows down the slopes of road embankment. The relief ditch watersheds and geometric configuration of the ditches will be modeled in SEDCAD to determine the peak flow and if any protective lining will be required in the ditch to control erosion. Only the relief ditches with steep grades and sufficient watershed area are analyzed.

The availability of rock size greater than D_{50} equal to 9 in is very limited in the local area. Therefore, if results from the hydraulic analysis specify riprap size of D_{50} equal to 12 in or greater, wire-enclosed riprap will be used in lieu of the size specified. D_{50} equal to 6-in rock will be placed and enclosed with wire.

23.2.4 Operation and Maintenance

Routine road maintenance consists of surface repairs; blading of side ditches and roadway surfaces; application of water and chemical road stabilizers; maintaining drainage control structures to design standards; and maintaining safety berms. Periodic inspections will be conducted to ensure proper maintenance and safe operating conditions.

For description of fugitive dust control and the removal and reclamation of primary roads, refer to Section 40 (Environmental Protection) and Section 32 (Temporary Structures and Facilities Removal and Reclamation), respectively.

23.2.5 Removal and Reclamation

Refer to Section 32 (Temporary Structures and Facilities Removal and Reclamation) for removal and reclamation of primary roads.

23.3 Ancillary Roads

Ancillary roads are roads that are used infrequently by small vehicles for accessing environmental monitoring stations, accessing ponds/water control structures, surveying, and servicing/inspecting power lines. The haulroads to topsoil stockpiles and temporary roads used during the construction of the mine support facilities are also classified as ancillary roads; these are utilized infrequently during periods of topsoil removal and construction. They are designed, constructed, and maintained in a manner to minimize adverse environmental impacts.

23.3.1 Design, Construction, and Maintenance

New ancillary roads will be constructed to the typical cross section presented on Exhibit 23.3-1. The road width is typically built for safe passage for small vehicles and approximately 72 ft wide for topsoil haulage roads. Their profile will closely traverse the existing topography to minimize cuts and fills or surface disturbance. At topographic lows or where drainages are intersected, the road profile will be constructed flush with the flow line to prevent ponding and restriction of flows in existing drainage channels. In badland areas, it is not unusual to encounter minor drainages (small watersheds) with deeply incised channels. When the road alignment crosses this type of drainage, a culvert is installed to minimize the excavation and surface disturbance. If the results from the hydraulic analysis indicate the potential for erosion to occur at the inlet or outlet, riprap rock or other forms of protective lining will be installed. Culverts and other drainage or required erosion control structures will be designed to pass the peak flow from the 2yr-6hr storm event. Typical road profiles at drainage crossings are presented on Exhibit 23.3-1.

Ancillary roads constructed as described above and to the typical section do not require approval prior to construction. After construction, the actual alignment will be surveyed and added to Exhibit 23.2-1. The

revised exhibit will be certified and submitted to the regulatory authority within 60 days after completion of construction.

Ancillary roads will be maintained in a manner to minimize adverse environmental impacts. To minimize additional surface disturbance, the maintenance is limited to occasional light blading particularly after heavy precipitation that may cause damage. The drainage control structures (i.e., culverts, riprap channels, etc.) will be properly maintained. Periodic inspections will be conducted to ensure proper maintenance and safe operating conditions.

Fugitive dust emitted from ancillary roads is expected to be minimal since these roads will be infrequently used. Therefore, they will not be treated or watered to control dust.

For information on the removal and reclamation of ancillary roads, refer to Section 32 (Temporary Structures and Facilities Removal and Reclamation).

If deviations from the typical design, such as significant cuts and fills and the crossing of perennial or intermittent stream channels are required, a site-specific design will be developed for the road in order to demonstrate compliance with performance standards. The road design will be submitted to the regulatory authority for approval. Construction will not commence until the design is approved.

23.4 Information Collection and Analysis

Certified as-built drawings will be kept on file at the mine site and made available upon request.

References

Kaufman, Walter W., and James C. Ault. 1977. Design of Surface Mine Haulage Roads – A Manual. Information Circular 8758. U.S. Department of the Interior, Bureau of Mines, Washington D.C.

Keetch, C. Wesley. 1980. Soil Survey of San Juan County, New Mexico, Eastern Part. U.S. Department of Agriculture, Soil Conservation Service, Washington, D.C.

NOAA 2006. Precipitation-Frequency Atlas of the United States, Volume 1, Version 4.0: Semiarid Southwest (Arizona, Southeast California, Nevada, New Mexico, Utah). NOAA Atlas 14. U.S. Department of Commerce, Washington D.C.

Table 23.2-1 Primary Roads

Road ID	Purpose	Length (ft)	Width (ft)	Maximum grade (%)	Surface material	Construction date	Removal or reclamation date	Design Data
West Haulroad	Haulage	774	72	8.4	Gravel/ Dirt	TBD	TBD	Exhibit 23.2-2

LEGEND

- × 5338.5 — SPOT ELEVATION
- 5300 — INDEX CONTOUR
- INTERMEDIATE CONTOUR
- 218 / 5422.45 — HORIZ. & VERT. CONTROL
- LEASE BOUNDARY
- MONITORING WELLS
- PRIMARY ROAD

Well 5214
5228
5345
CHACO
Pinabete Arroyo
×5328
5350
×5375
Cottonwood Arroyo
Chaco River
WEST HAULROAD
Pinabete Arroyo
Well 5244
5252
×5352
No Name Arroyo
5338
×5505
×5662
No Name Arroyo
No Name Arroyo
×5456
×5444
5615×

600 0 600 1200
CONTOUR INTERVAL: 10'

Topo Revised by
Aero-Graphics, Inc.
2930 South West Temple
Salt Lake City, Utah 84115

Notes:

1. The design data for primary roads are referenced on Table 23.3-1 of the NNP PAP.
2. The hydrology and supporting desgn data for the drainage control structures are referenced on Table 23.2-2 of the NNP PAP.

Original certified signed exhibits are maintained at the mine site and at OSM.

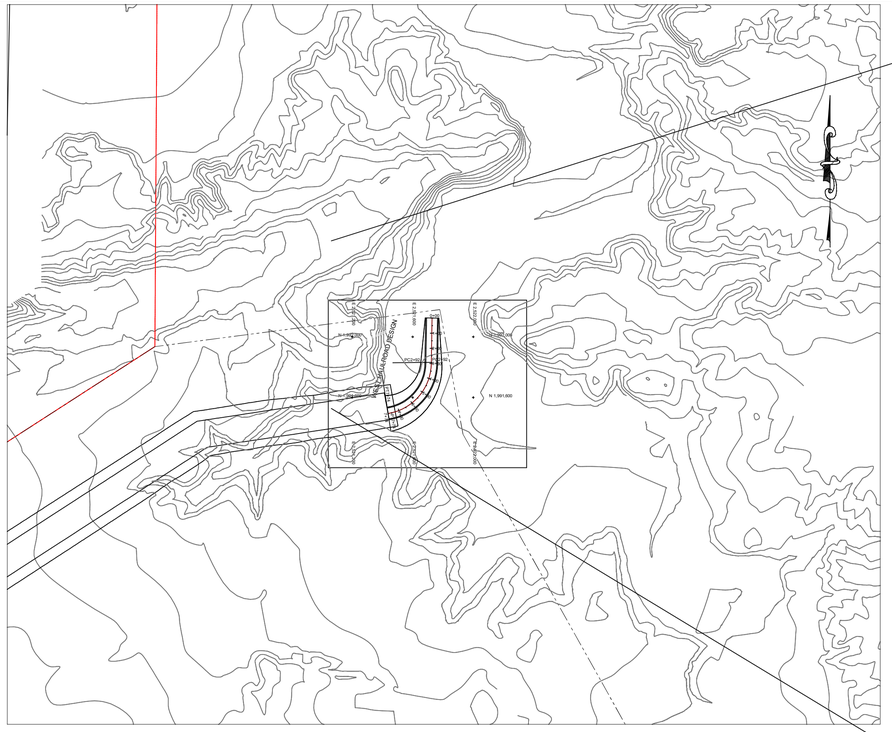
REV. No.	DATE	DRAFT. BY	REVISION DESCRIPTION	PREP'D BY	E.Q.	P.E.	DATE CERTIFIED
				APPROVALS			

Navajo Transitional Energy Company

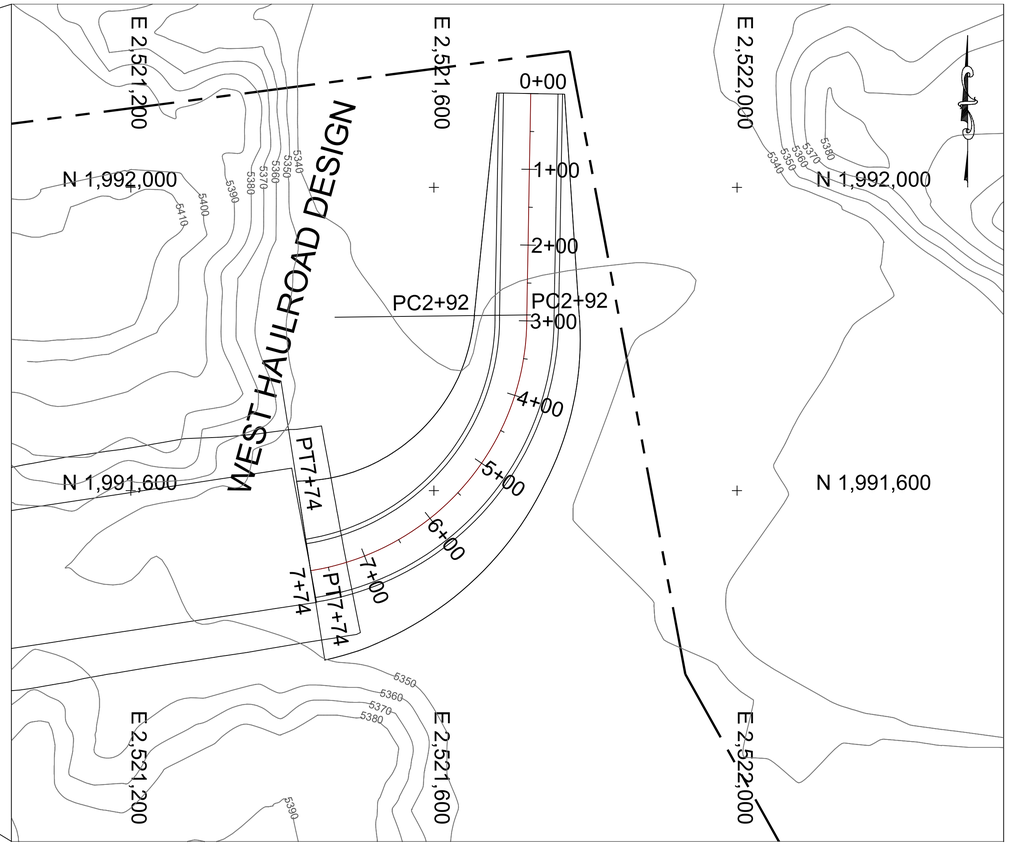
EXHIBIT 23.2-1

NAVAJO MINE NO NAME PERMIT
LOCATION MAP ROADS, CULVERTS AND WATERSHEDS

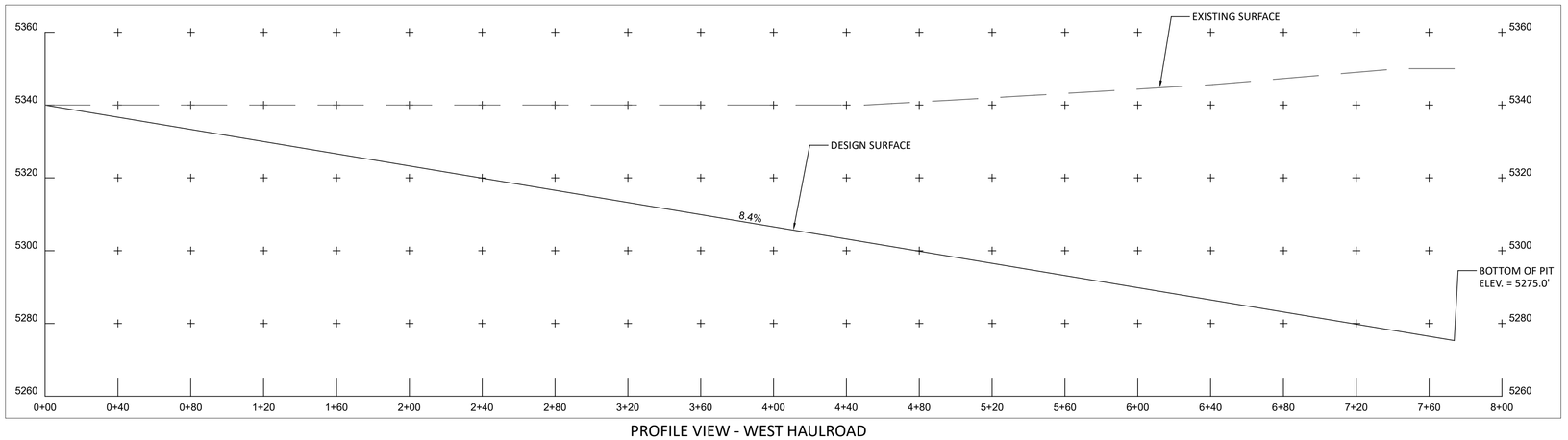
PREPARED BY RY	DRAWN BY RY	SCALE: 1" = 600'
APPROVED BY	DATE 09/08/25	



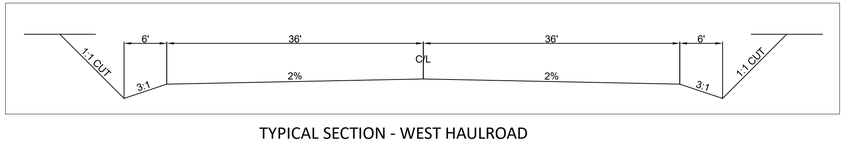
PLAN VIEW - WEST HAULROAD
SCALE 1" = 500'



PLAN VIEW - WEST HAULROAD
SCALE 1" = 100'



PROFILE VIEW - WEST HAULROAD
H. SCALE 1" = 40' V. SCALE 1" = 20'



TYPICAL SECTION - WEST HAULROAD
NTS

LEGEND

- RAILROAD
- INDEX CONTOUR (5300)
- INTERMEDIATE CONTOUR
- LEASE CORNER (218 N422.45 L-30)
- LEASE/PERMIT BOUNDARY

Certification Statement

I, Ramsey Yazzie, hereby certify that this drawing was reviewed by me and that the information shown is complete and accurate to the best of my knowledge.

RAMSEY R. YAZZIE
NEW MEXICO
23571
PROFESSIONAL ENGINEER

0' 500' 1000' 1500'
Scale: 1" = 500'

NOTES:

1. FOR HYDROLOGY AND DESIGN INFORMATION REFER TO APPENDIX 23.B.
2. THE WATERSHED AREA FOR CULVERTS ARE SHOWN ON EXHIBIT 23.2-1.
3. ADDITIONAL MINE STRUCTURES, INCLUDING ROADS, RAILROAD, PONDS, IMPOUNDMENTS AND CULVERTS, ALTHOUGH PRESENT ON THIS EXHIBIT AS PART OF AERIAL BASE MAPPING, ARE NOT INTENDED TO BE CURRENT OR ACCURATE ON THIS EXHIBIT.
4. PLEASE REFER TO THE APPROPRIATE P.A.P. TEXT SECTION FOR A MINE STRUCTURE EXHIBIT REFERENCE.

DATE	DRAFT. BY	REVISION DESCRIPTION	ENG.	E.G.	P.E.
8/5/25	RY	SUBMITTED TO OSM FOR APPROVAL	RY	TH	RY

APPROVALS

EXHIBIT 23.2-2

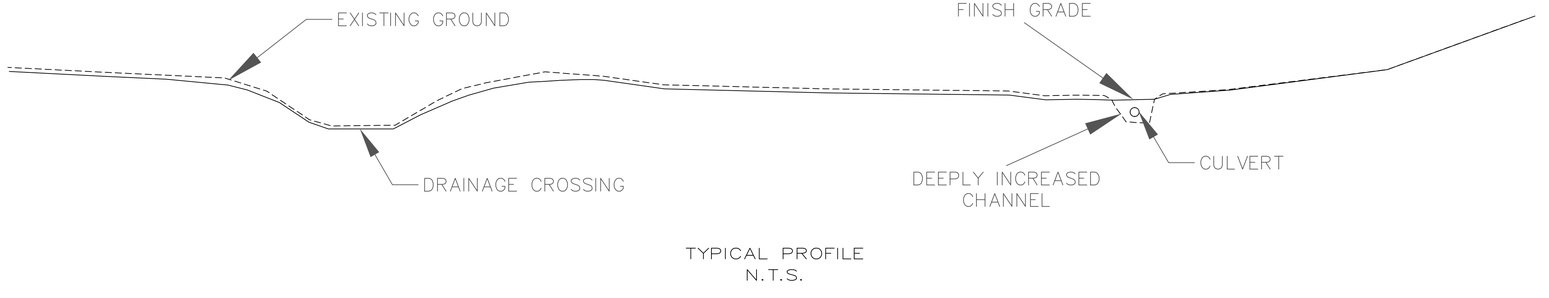
Navajo Transitional Energy Company

Navajo Mine

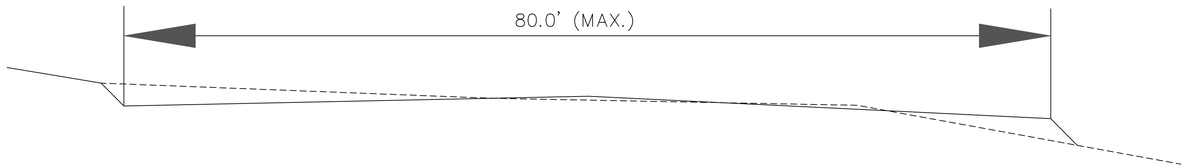
WEST HAULROAD DESIGN
PLAN, PROFILE, AND TYP. SECTION
SHEET 1 OF 1

Prepared By:	Drawn By: CS	Scale:
Approved By: SS	Plot Date: 07/30/2021	

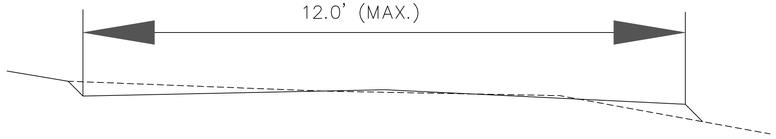
Dwg. Path: N:\Engr\Users\Interns\AEaton\No Name Project_050125\Section 23 Roads\West Haulroad Design
Drawing: Exh 23.2-3 West Haulroad Design_080425.dwg



TYPICAL PROFILE
N.T.S.



NEW ANCILLARY ROAD
FOR TOPSOIL HAULAGE
TYPICAL SECTION
N.T.S.



NEW ANCILLARY ROAD
FOR SMALL VEHICLES
TYPICAL SECTION
N.T.S.

EXISTING TWO TRACK ROADS
CLASSIFIED AS ANCILLARY ROADS
TYPICAL SECTION
N.T.S.

LEGEND

- ROAD
- BUILDING
- FENCE
- CULVERT
- DRAINAGE
- POWERLINE
- 5300 INDEX CONTOUR
- 5298 INTERMEDIATE CONTOUR
- PERMIT/LEASE BOUNDARY

NOTES

1. For location of roads,drainage structures and watersheds refer to Exhibit 23.2-1
2. The location map for mine structures and support facilities, are presented on Exhibit 22.1-1
3. In the fill areas construct a 6-foot high berm along the crest of the fill to retain surface runoff within the stockpile area and divert the flows to the ponds.
4. In the cut areas construct a 4-foot high berm along the crest of the cut to divert flows from the undisturbed areas away from the stockpile area.
5. For the design and details of the ponds refer to section 26 of PAP.

DATE CHECKED
REVISION

PROJECT MANAGER:
ENGR. of RECORD: REG. NO. 6600
SRVYR of RECORD: REG. NO.

Navajo Transitional Energy Company

PROJECT: NMEP
DATE: June 2025
DESIGNED BY:
DRAWN BY:
CHECKED BY:
APPROVED BY:

TYPICAL SECTIONS AND PROFILE

EXHIBIT 23.3-1
TYPICAL
ANCILLARY ROADS
DESIGN

DRAWING

SHEET 1
OF 1

Appendix 23.A

Slope Stability Analysis

GEOMAT INC
2060 Afton Place ◆ Farmington, NM 87401 ◆ Tel (505) 327-7928 ◆ Fax (505) 326-5721

October 16, 2008

Leonard Raymond, P.E.
BHP Billiton
BHP Navajo Coal Company
P.O. Box 1717
Fruitland, New Mexico 87416

RE: Slope Stability Evaluation
Navajo Mine Area 4 Ash Haulage Road
Fruitland, New Mexico
GEOMAT Project No. 82-0728

As you requested, GEOMAT Inc. has completed geotechnical engineering analyses to evaluate the stability of selected cut and full slopes of the proposed ash haulage road to be constructed in Area 4 at Navajo Mine. Our analyses were based on the following understandings:

- Cut and Fill slopes: generally 2:1 Horizontal:Vertical (H:V), except that the slopes of the shoulders of the haul road will be 4:1 H:V,
- Slope of the roadway: 2 % to the shoulders from the center of the roadway
- Roadway and existing grade elevations: based on the roadway profile drawings Sheets 11 and 12 titled West Haulroad and Conveyor Corridor and dated July 07.
- As requested, the cut slope used in the analysis is at station 460+00, where the cut will be approximately 57 ft,
- As requested, the fill slope used in the analysis is at station 520+90, where the fill will be approximately 60 ft,
- Where coal exists in the cut slope, for fire control purposes, the coal will be removed for an approximate horizontal distance of 20 feet and replaced with compacted fill,
- Strength properties of the native soils and the compacted fill material were based on information from the geotechnical engineering reports by Converse (Soil and Foundation Investigation Report, Converse Project No. 07-53190-01 dated July 10, 2008) and GEOMAT (Preliminary Geotechnical Engineering Report-BHP Navajo Mine Extension Project, GEOMAT Project No. 72-0466 and dated May 18, 2007)
- Strengths of the coal were estimated based on properties of the coal indicated in the above-referenced geotechnical engineering reports,
- A pseudo static seismic force of 0.1g was used in the analyses,
- The embankments were not considered to retain water or to be submerged,
- The loaded weight of the haul trucks (CAT 777F) was simulated by dividing the weight of the truck over the area of the wheel base of the truck.
- OSM regulations require a minimum static safety factor of 1.3 for primary road embankments.

Selection, placement and compaction of the fill soils should be as recommended in the aforementioned Converse report.

Slope stability analyses were performed with Galena Slope Stability Analysis System software, v4.02. Properties of the soil and rock materials that are expected to exist in the cut and fill sections are noted on the slope stability analysis sheets that are attached to this report.

The results of the analyses are summarized in the following table. Individual sheets showing the details of the calculations and the configuration of the slope used in the calculations are attached.

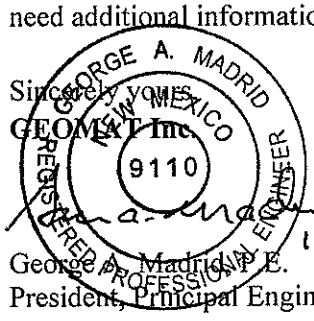
Slope	Pseudo Static Earthquake (%g)	Calculated Factor of Safety
Fill Slope w/o haul truck	0.1	1.5
Fill Slope w/ haul truck	0.1	1.5
Cut Slope w/o haul truck	0.1	1.6
Cut Slope w/ haul truck	0.1	1.5

As shown in the table, the calculated factors of safety for both the cut and fill slopes are approximately 1.5. Based on the required factor of safety of 1.3, both the cut and fill slopes are considered to have adequate factors of safety for the conditions analyzed.

The nature and variation of materials may not become evident until construction. If variations then appear, it will be necessary to reevaluate the information in this report. Likewise, in the event that any changes in the nature, design, or location of the cut or fill slopes are made, the recommendations contained in this report shall not be considered valid unless the changes are reviewed and the recommendations of this report modified or verified in writing.

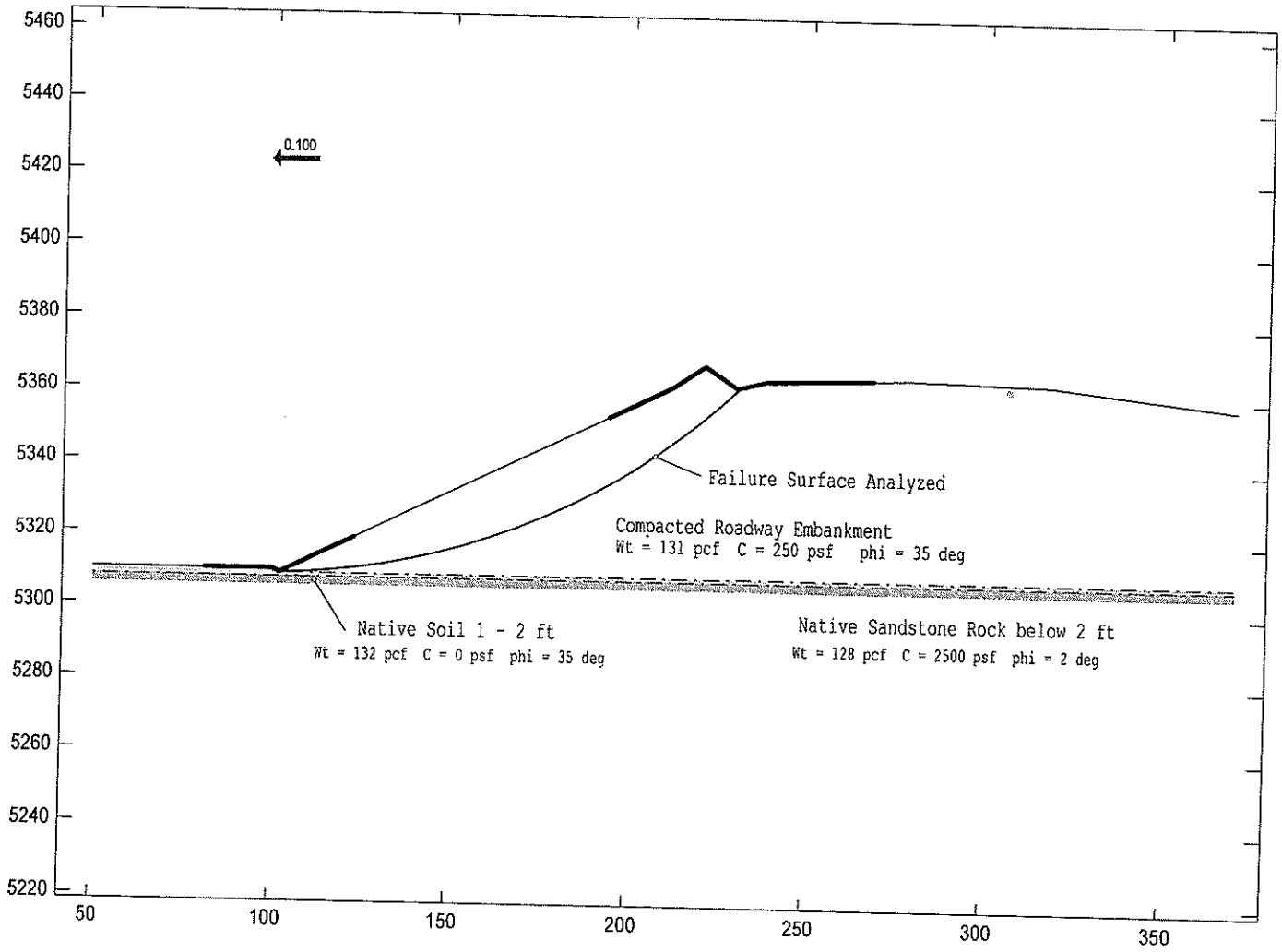
Thank you for the opportunity to work with you on this project. If you have any questions or need additional information, please let us know.

Sincerely yours,
GEOMAT Inc.



10-16-08

George A. Madrid, P.E.
President, Principal Engineer



GALENA Version 4.02

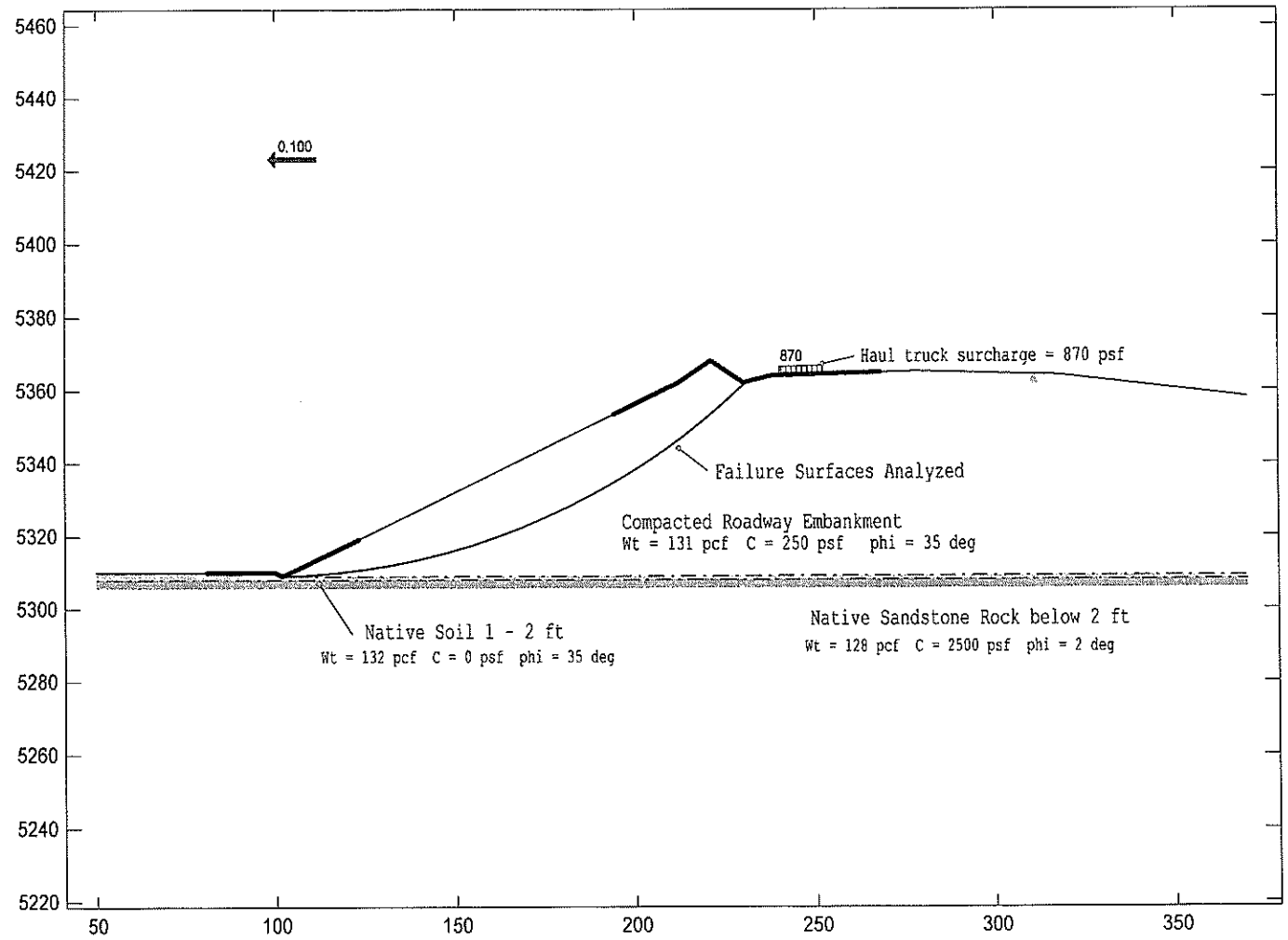
Analysis: 1
Multiple Stability Analysis
Method: Bishop Simplified
Surface: Circular

Results
Critical (minimum)
Factor of Safety: 1.54

Project: BHP Haul Road Cut and Fill Slopes
BHP Roadway Embankment Fill Slope without the haul truck load

File: C:\Program Files\Galena\BHP Haul Roadway - Fill Section - left part of slope and roadway.gmf

LMT Engineering, Inc.



GALENA Version 4.02

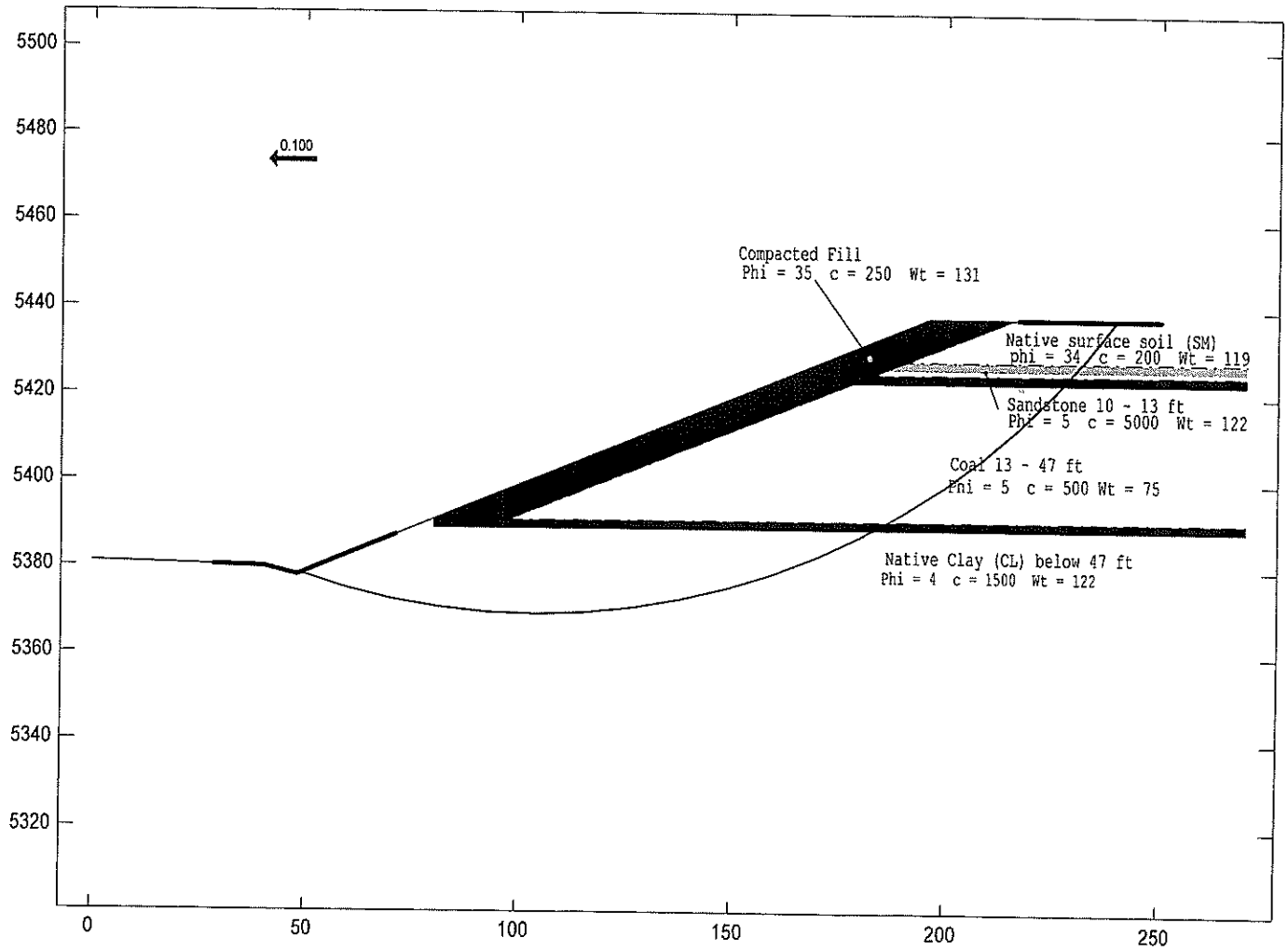
Analysis: 1
Multiple Stability Analysis
Method: Bishop Simplified
Surface: Circular

Results
Critical (minimum)
Factor of Safety: 1.54

Project: BHP Haul Road Cut and Fill Slopes
BHP Roadway Embankment Fill Slope with the haul truck load

File: C:\Program Files\Galena\BHP Haul Roadway - Fill Section - left part of slope and roadway.gmf

LMT Engineering, Inc.



GALENA Version 4.02

Analysis: 1

Multiple Stability Analysis

Method: Bishop Simplified

Surface: Circular

Results

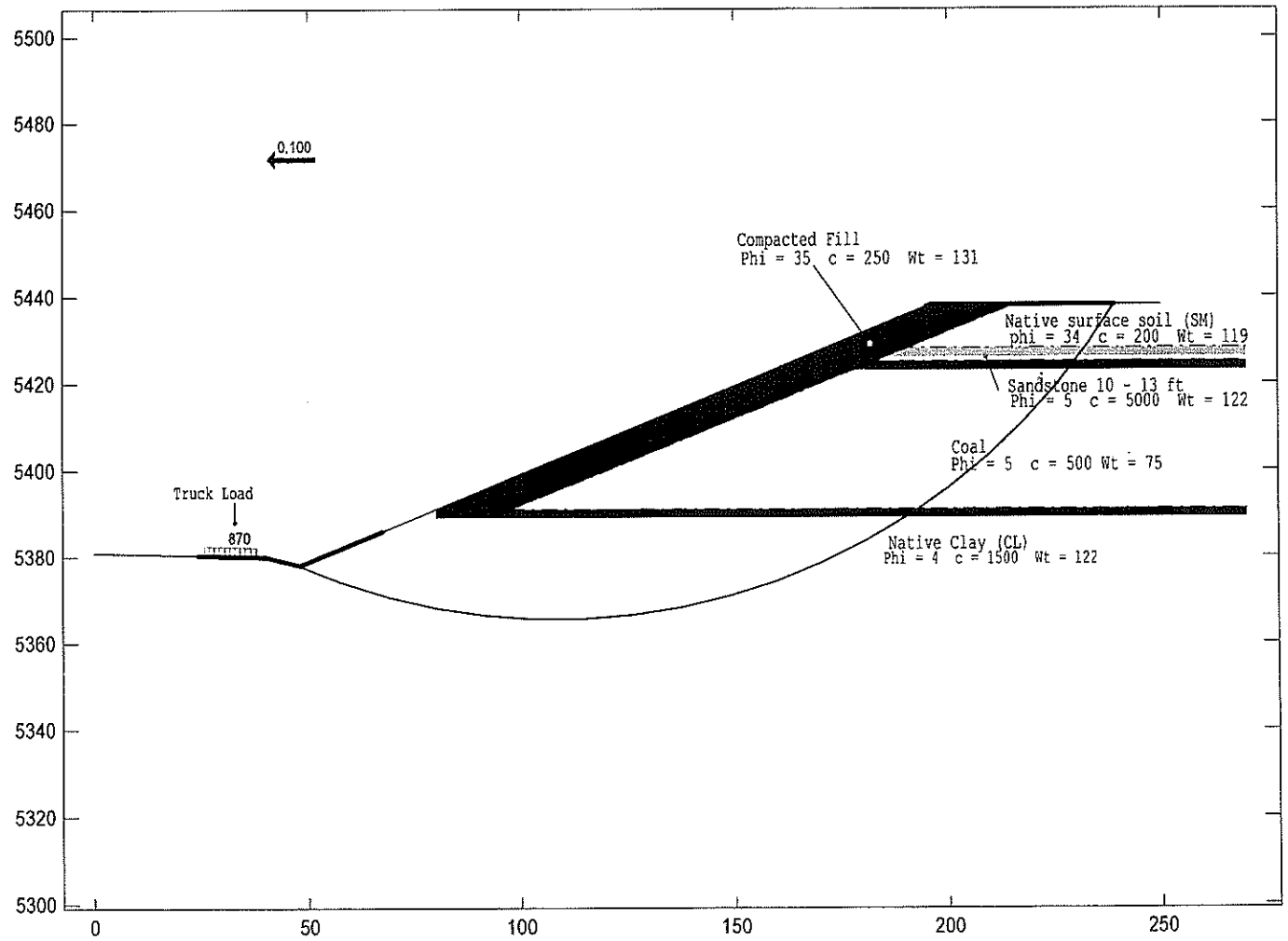
Critical (minimum)
Factor of Safety: 1.51

Project: BHP Haul Road Slope Analysis
BHP Haul rd. Cut Slope Analysis without Haul Truck Load

File: C:\Program Files\Galena\BHP Haul Rd Cut Slope w- Compacted Fill 10-12.gmf

LMT Engineering, Inc.

GALENA Version 4.02



Analysis: 1
Multiple Stability Analysis
Method: Spencer-Wright
Surface: Circular

Results

Critical (minimum) Factor of Safety:	1.48
Final Angle of Interslice Forces:	10.7°

Project: BHP Haul Road Slope Analysis with Haul Truck Load
BHP Haul rd. Cut Slope Analysis with Haul Truck Load

File: C:\Program Files\Galena\BHP Haul Rd Cut Slope w- Compacted Fill 10-12.gmf

LMT Engineering, Inc.