RECEIVED
JAN 13 2022
MINERALS & MINING PROGRAM

January 5, 2022

Mr. Eric Holm
Engineer Manager III
Department of Agriculture and Natural Resources
Minerals and Mining Program
523 E Capitol Ave.
Pierre, SD 57501

RE: Loring Quarry Large Scale Mine Permit Application Submission

Mr. Holm:

On behalf of Simon Contractors of South Dakota Inc. (Simon), H2E, Inc. would like to submit the enclosed Large Scale Mining/Milling Permit Application. The application package includes:

- Application Form;
- Legal Right to Enter;
- Certification of Applicant Form;
- Wildlife Consultant Approval Letter;
- Map of the Affected Area pursuant to SDCL 45-6B-10(1-5)
    - Simon owns the surface and mineral rights for both parcels (006251 & 006252) that comprise the Loring Quarry. Landowners are displayed on the map referenced above.
    - Maps depicting general type, thickness, and distribution of soil can be found in Appendix E of the Reclamation Plan;
- Operating Plan;
- Reclamation Plan;
- Technical Revisions List;
- A fee of $1,000;
- Proof of compliance with all local and county zoning ordinance requirements (included as Appendix B in the Operating Plan);
- USB Drive containing an electronic copy of the permit application package.

A copy of the Reclamation Plan will be submitted to adjacent landowners once the Minerals and Mining Program has finished its review and determined the plan to be complete. Similarly, a copy of the permit application will be filed with the Custer County Register of Deeds once the application package is deemed complete. Certified mail receipts and proof of filing will be submitted to the Minerals and Mining Program once received.

If you have any questions or concerns, please feel free to contact me via email at bmorris@h2eincorporated.com or by phone 307-696-7007.

Sincerely,
H2E, Inc.

Becky Morris

Becky Morris, Ph.D.
Senior Environmental Scientist

Enclosure

SIMON

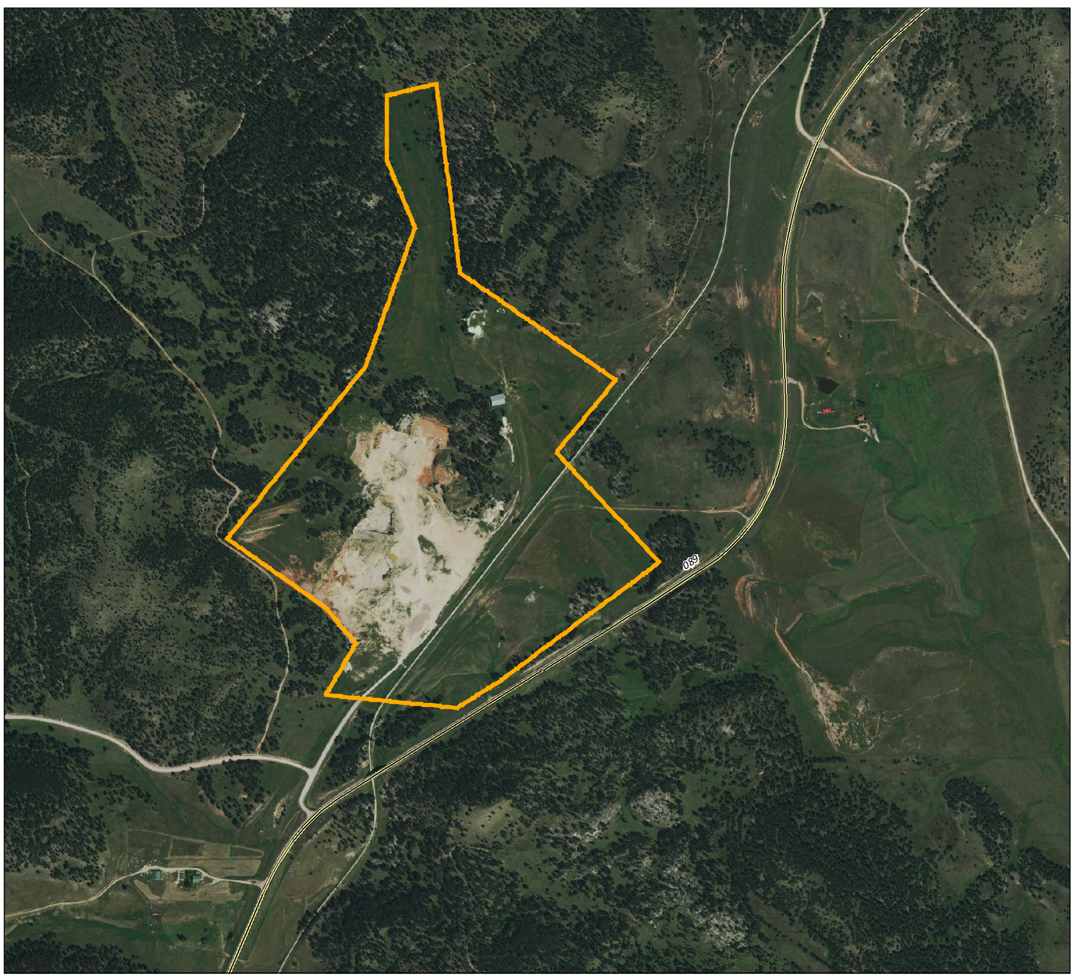
LARGE SCALE MINE PERMIT APPLICATION

Loring Quarry
Sections 33 & 34; T5S-R4E
Custer County, SD

SIMON

LARGE SCALE MINE PERMIT APPLICATION

Loring Quarry
Sections 33 & 34; T5S-R4E
Custer County, SD



Contents

REGULATORY CROSS-REFERENCE

Large Scale Permit Application Form

Loring Quarry

Department of Agriculture and Natural Resources
Minerals and Mining Program
523 East Capitol Avenue
Pierre, South Dakota 57501-3182
605 773-4201; Fax: 605 773-5286

RECEIVED
JAN 13 2022
MINERALS & MINING PROGRAM

LARGE SCALE MINING/MILLING PERMIT
Pursuant to SDCL 45-6B and ARSD 74:29

Relating to The Extraction and Processing of Minerals in Operations Affecting More Than 10 Acres and/or Removing over 25,000 Tons Per Year or For Operations Utilizing Cyanide Leaching or Other Chemical or Biological Leaching Agents

Operator's name:

Simon Contractors of SD, Inc.

General office address:

3975 Sturgis Road
Rapid City, SD 57702

Telephone: 605-394-3300

Local mailing address:

Same as above.

Telephone: Same as above.

Resident agent (if out-of-state corporation):

Resident agent address: NA

Resident agent telephone: NA

Legal description of affected land:

Sections 33 and 34, Township 5S, Range 4E

County:

Custer

Name and address of surface owner:

Same as Operator information above.

Name and address of mineral owner:

Same as Operator information above.

Minerals to be extracted or milled, or both:

Limestone

Proposed starting date: Activities to begin once permit is granted.

Proposed completion date: 2150

Size of area (acres) to be worked at any one time: 80
Estimated working days per year: 60-120

Estimated tons of ore per year: +/-150,000

Estimated overburden/waste tons per year: Once initial topsoil stripping is completed, no additional overburden will be produced. See operating plan for details.

Estimated total tonnage per year: +/-165,000

Include a copy of your source of legal right to enter and initiate operations: ____ Lease ____ Letter ____ USFS Permit Deed

Include a copy of your source of legal right to dispose of tailings: ____ Lease ____ Letter ____ USFS Permit NA

INSTRUCTIONS:

Please reference SDCL 45-6B and ARSD 74:29. This large scale mining/milling permit must be accompanied by:

1. A narrative description of the methods of mining and milling to be employed per Section 6(8).
2. A reclamation plan pursuant to Section 7.
3. A map of the affected area pursuant to Section 10.
4. A fee of $1,000 payable to the Department of Agriculture and Natural Resources pursuant to Section 14. For precious metals, coal, or uranium, a fee of $50,000 payable to the Department of Agriculture and Natural Resources is required.
5. A map clearly depicting all surface and mineral owners of the affected land pursuant to Section 10 and ARSD 74:29:02:03.
6. Proof of compliance with all local and county zoning ordinance requirements pursuant to Section 4 and ARSD 74:29:02:02.

Before a hearing on this large scale mining/milling permit can be conducted by the SD Board of Minerals and Environment, the operator must submit the following:

1. Certified mail receipts confirming mailing of notice to all surface owners and lessees pursuant to Section 17.
2. A copy of the affidavit of publication of notice pursuant to Section 16.
3. Proof of filing a copy of the large scale mining/milling permit with the Register of Deeds pursuant to Section 15.
4. A surety in an amount to be determined by the department pursuant to Section 20.
5. A copy of instruments of consultation from all surface landowners, if different than the owner of the minerals, including written receipt of the operating and reclamation plans pursuant to Section 12 and 13.

Applicant affirms that the mining or milling will be conducted pursuant to SDCL 45-6B or any regulations promulgated thereunder, that he will grant access to the SD Board of Minerals and Environment or its agents to the area under this large scale mining/milling permit from the date of application and during the life of the permit as necessary to assure compliance with SDCL 45-6B.

I declare and affirm under the penalties of perjury that this claim (petition, application, information) has been examined by me, and to the best of my knowledge and belief, is in all things true and correct.

T. Scott Ol
Signature

Date: January 4, 2022

Title: Regional Manager

STATE OF South Dakota

COUNTY OF Pennington

On this 4th day of January, 20 22, before me personally appeared T. Scott Olsen, who acknowledged himself to be the Regional Manager (Title) for Simon Contractors of SD, Inc. (Operator) and that he is authorized to execute the Large Scale Mining/ Milling Permit for the purposes contained therein.

Tamara C Achtien
Notary Public:

My Commission Expires: August 5, 2022

SEAL:

TAMARA C. ACHTIEN NOTARY SEAL PUBLIC STATE OF SOUTH DAKOTA

FOR DEPARTMENT USE ONLY

DATE APPROVED: BOND AMOUNT: PERMIT NUMBER:

Chairman, SD Board of Minerals & Environment

PAID
JAN 13 2022
Ck#
$1,000.00

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JAN 13 2022
MINERALS & MINING PROGRAM

Application Fee

Lg Scale Mine
Permit Fee
Simon Cont. of
SD Inc.

RECEIVED
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MINERALS & MINING PROGRAM

Legal Right to Enter

Loring Quarry

Confidential

Certification of Applicant Form

Loring Quarry

SD EForm - 2088LD V1

RECEIVED
JAN 13 2022
MINERALS & MINING PROGRAM

STATE OF SOUTH DAKOTA

BEFORE THE SECRETARY OF

THE DEPARTMENT OF ENVIRONMENT AND NATURAL RESOURCES

IN THE MATTER OF THE APPLICATION OF	)	
Loring Quarry Large Scale Mine Permit	)	**CERTIFICATION OF**
	)	**APPLICANT**
STATE OF South Dakota	)	
COUNTY OF Custer	)	

I, T. Scott Olsen, the applicant in the above matter after being duly sworn upon oath hereby certify the following information in regard to this application:

I have read and understand South Dakota Codified Law Section 1-40-27 which provides:

"The secretary may reject an application for any permit filed pursuant to Titles 34A or 45, including any application by any concentrated swine feeding operation for authorization to operate under a general permit, upon making a specific finding that:

(1) The applicant is unsuited or unqualified to perform the obligations of a permit holder based upon a finding that the applicant, any officer, director, partner, or resident general manager of the facility for which application has been made:

(a) Has intentionally misrepresented a material fact in applying for a permit;

(b) Has been convicted of a felony or other crime involving moral turpitude;

(c) Has habitually and intentionally violated environmental laws of any state or the United States which have caused significant and material environmental damage;

(d) Has had any permit revoked under the environmental laws of any state or the United States; or

(e) Has otherwise demonstrated through clear and convincing evidence of previous actions that the applicant lacks the necessary good character and competency to reliably carry out the obligations imposed by law upon the permit holder; or

(2) The application substantially duplicates an application by the same applicant denied within the past five years which denial has not been reversed by a court of competent jurisdiction. Nothing in this subdivision may be construed to prohibit an applicant from submitting a new application for a permit previously denied, if the new application represents a good faith attempt by the applicant to correct the deficiencies that served as the basis for the denial in the original application.

All applications filed pursuant to Titles 34A and 45 shall include a certification, sworn to under oath and signed by the applicant, that he is not disqualified by reason of this section from obtaining a permit. In the absence of evidence to the contrary, that certification shall constitute a prima facie showing of the suitability and qualification of the applicant. If at any point in the application review, recommendation or hearing process, the secretary finds the applicant has intentionally made any material misrepresentation of fact in regard to this certification, *consideration of the application may be suspended and the application may be rejected as provided for under this section.*

Applications rejected pursuant to this section constitute final agency action upon that application and may be appealed to circuit court as provided for under chapter 1-26."

I certify pursuant to 1-40-27, that as an applicant, officer, director, partner, or resident general manager of the activity or facility for which the application has been made that I; a) have not intentionally misrepresented a material fact in applying for a permit; b) have not been convicted of a felony or other crime of moral turpitude; c) have not habitually and intentionally violated environmental laws of any state or the United States which have caused significant and material environmental damage; (d) have not had any permit revoked under the environmental laws of any state or the United States; or e) have not otherwise demonstrated through clear and convincing evidence of previous actions that I lack the necessary good character and competency to reliably carry out the obligations imposed by law upon me. I also certify that this application does not substantially duplicate an application by the same applicant denied within the past five years which denial has not been reversed by a court of competent jurisdiction. Further;

"I declare and affirm under the penalties of perjury that this claim (petition, application, information) has been examined by me, and to the best of my knowledge and belief, is in all things true and correct."

Dated this 4th day of January, 20 22 .

T. Scott Olsen
Applicant (print)

T. Scott Ol
Applicant (signature)

Subscribed and sworn before me this 4th day of January, 20 22 .

Tamara C Achtien
Notary Public (signature)

My commission expires: August 5, 2022

(SEAL)

TAMARA C. ACHTIEN
NOTARY
SEAL
PUBLIC
STATE OF SOUTH DAKOTA

PLEASE ATTACH ANY ADDITIONAL INFORMATION NECESSARY TO DISCLOSE ALL FACTS AND DOCUMENTS PERTAINING TO SDCL 1-40-27 (1) (a) THROUGH (e). ALL VIOLATIONS MUST BE DISCLOSED, BUT WILL NOT AUTOMATICALLY RESULT IN THE REJECTION OF AN APPLICATION

Map of Affected Area

Loring Quarry

SIMON

Loring Quarry
Map of Affected Area
SDCL 45-6B-10
ARSD 74:29:02:03

0 0.1 0.2 0.4

Miles

N W E S

Scale: 1:9,000

Date Produced: 12/22/2021

Designed to be printed at 11" x 17"

Prepared by:

H2E

Editor: RGilson

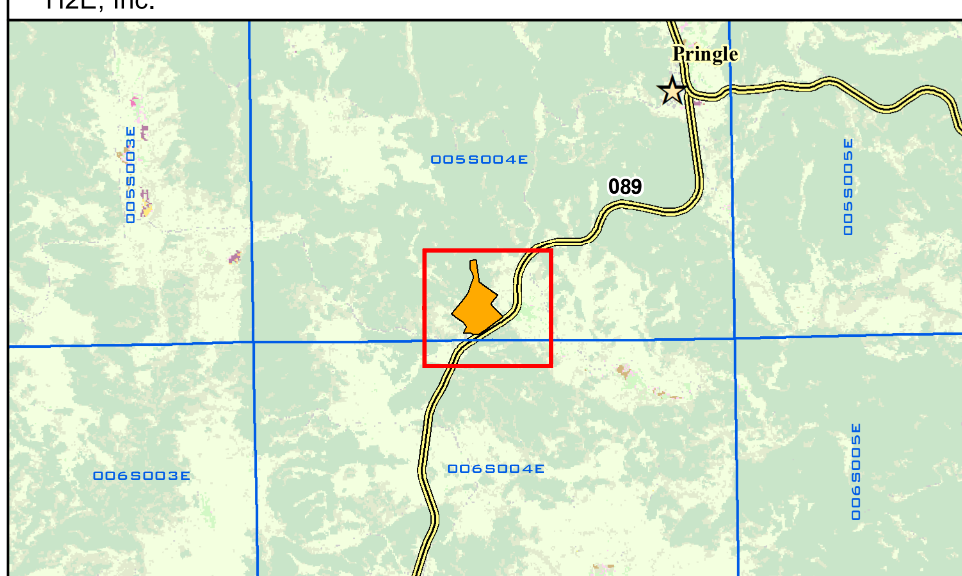
Mickelson Trail	Township/Range
Overhead Power	Section
SD Highways	EUDY SHERI L
200 ft Buffer	KIRK CATTLE & LAND
Loring Quarry Property Boundary	SD DOT Interest
Access Road	SIMON CONTRACTORS OF SD, INC
Permit Boundary 200ft Buffer	STEIER KENNETH R
SD Counties	USA - USDA - BHNF

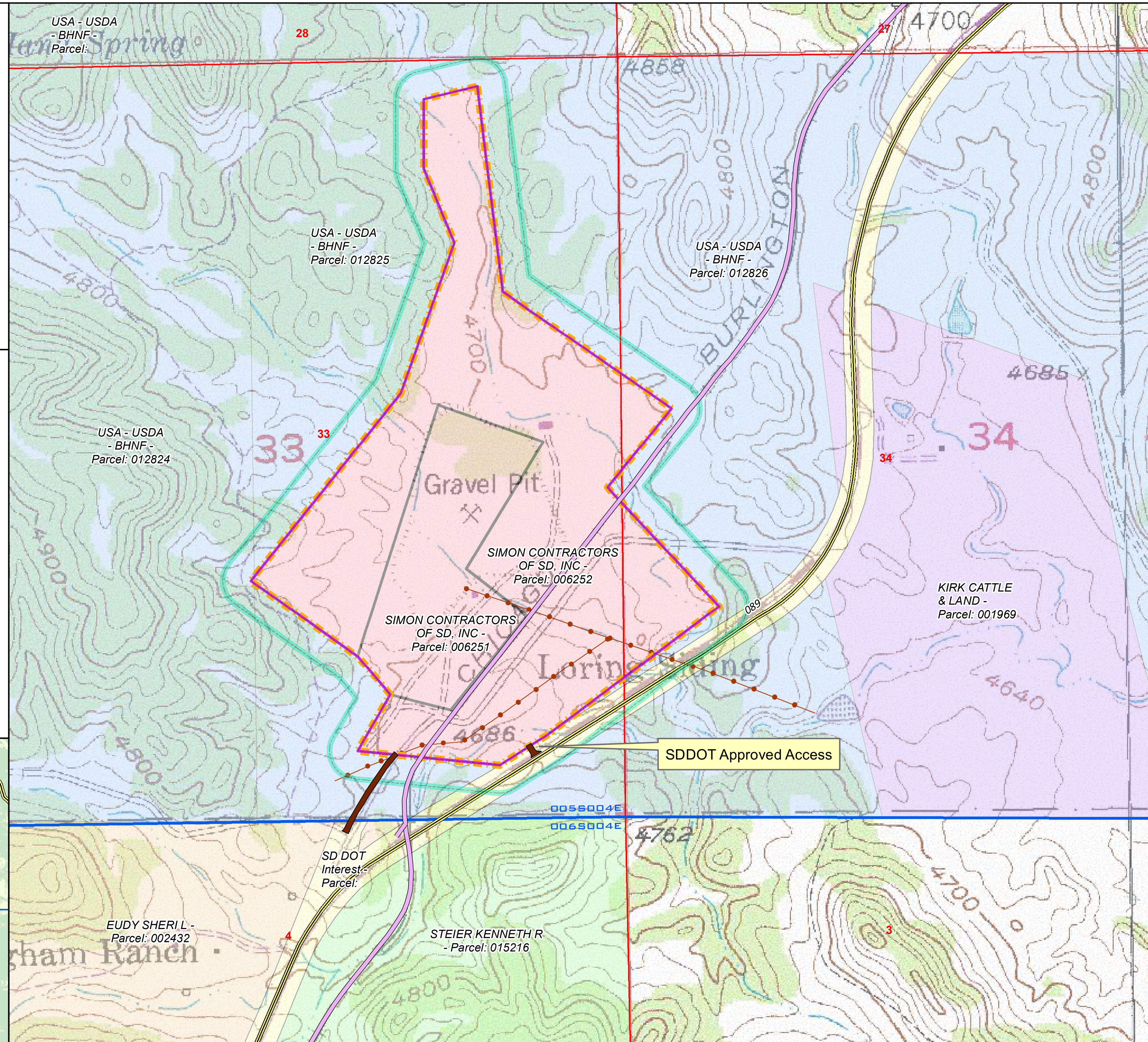
Note: Simon Contractors of SD, Inc. is the surface and mineral owner of the affected land.

Note: There are no oil and gas wells or pipelines in the area of affected land or within 200' of the affected land.

Note: Base map is a U.S. geological survey seven-and-one-half-minute quadrangle map in accordance with ARSD 74:29:02:12.

Prepared By:
Robert Gilson
Environmental Professional
H2E, Inc.





Wildlife Consultant Approval Letter

Loring Quarry

DEPARTMENT OF GAME, FISH, AND PARKS
Division of Wildlife – Regional Office
4130 Adventure Trail
Rapid City, South Dakota 57702-0303

July 16, 2020

ICF Jones & Stokes
ATTN. Stephanie Kane
405 W Boxelder Road, Suite A-5,
Gillette, WY 82718

Subject: Approval of ICF Jones & Stokes wildlife consultants

Dear Stephanie,

This letter represents South Dakota Department of Game, Fish and Parks approving the qualifications of the wildlife consultants, provided by ICF Jones & Stokes, conducting wildlife evaluations at the Loring Quarry Project.

Please contact me with any questions regarding this letter.

Sincerely

Stan Michals
Energy and Minerals Coordinator
Office (605) 394-2589
E-mail stan.michals@state.sd.us

cc: E. Holm (SD/DENR)

Operting Plan

Loring Quarry

SIMON

OPERATING PLAN

Loring Quarry
Sections 33 & 34; T5S-R4E
Custer County, SD

Table of Contents

APPENDICES

1. GENERAL DESCRIPTION

Simon Contractors of SD, Inc. (Simon) currently owns and operates the Loring Quarry under a mine license. The quarry is located approximately five miles south of Pringle, South Dakota in Sections 33 and 34 of Township 5S, Range 4E in Custer County. The quarry is comprised of two parcels both owned by Simon. Parcel 006251 (~45 acres) and parcel 006252 (~126 acres). Simon also owns the mineral rights. The quarry is currently accessed via County Road CS 316.

The quarry was purchased from J. Erpelding by Northwest Engineering (Hills Materials) in 1963 and was already a quarry at that time. In 2015, Simon acquired Hills Materials and has continued to operate the quarry. The quarry is an open pit limestone quarry with reserves estimated to last up to 65 years or more.

Although Simon is applying for a large scale mine permit, the actual mining operations currently conducted under the existing mine license will not change. Approval of the large scale mine permit will provide the ability to sell limestone products to an agricultural consumer base.

This mine plan was prepared and will be implemented to meet the applicable statues and regulations of SCDL 45-6B and ARSD 74:29.

2. MINING METHOD AND TYPE

SDCL 45-6B-6(7)(8), SCDCL 45-6B-7(10) and ARSD 74:29:02:04

Simon will mine limestone for commercial processing and sales by stripping the mining area of any topsoil, or overburden, above the limestone deposit using appropriate construction equipment such as but not limited to dozers, track excavators, scrapers, etc., depending on the layout. Typically, only enough area is stripped to allow for one to three years of sales volumes. Topsoil is stockpiled or placed according to the reclamation plan. A total disturbance of approximately 80 acres is anticipated west of the George S. Michelson Trail, with the potential to disturb another 30 acres east of the trail in the long term (40 plus years out). All potential disturbance will be contained within the quarry boundary and a working/vegetative buffer, of no less than 50 ft, will be maintained from the George S. Michelson Trail.

Once topsoil and/or overburden are removed, drilling and blasting operations begin. Drilling is conducted by Simon, while blasting operations are contracted out to a third party. Blasting only occurs during production/crushing. Drilling and blasting operations will utilize a long-hole benching method. Blasting will be conducted using ammonium nitrate/fuel oil explosives detonated with a PETN (pentaerythritol tetranitrate) cast booster. Blasting will not occur on low overcast days to minimize reflection of noise and air blast back to the ground. Blasting will be monitored as necessary with a seismograph to measure, record and document ground accelerations to ensure blasts are below standard thresholds to prevent any property damage to adjacent landowners. Dust mitigation will include watering the highwall face and pit floor prior to blasting and watering the muck pile after detonation of the shot. After blasting, material is loaded into the crusher where it is sized into difference products. No tailings are produced during mining operations. The only spoil produced would be the removed overburden. At this time there are no proposed reservoirs, tailings ponds, tailings disposal sites, dams, dikes or diversion canals. There will be no tailings dams, waste dumps or ore stockpiles. A wash plant and washing ponds could be added in the future to remove limestone fines from specific products to meet customer specifications. Location of the wash plant and ponds would be determined at that time.

Once the material has been processed by the crusher, it is stockpiled onsite via conveyors and or loaders. Agricultural use products are of a separate, distinct specification from the construction products and will be stockpiled, sold, and tracked separate from the construction products. When sold, the product is loaded onto trucks using a loader, weighed on a scale, ticketed, and shipped to customers. Limestone is used as a crushed stone for road base, railroad ballast, coarse aggregate in ready mix concrete, coarse and fine aggregates in hot mix asphalt, and as a component in the manufacture of Portland cement. Limestone (ag-lime) from this mine will be sold for use in agricultural applications such as soil amendments or feed supplements. Additional limestone rock products will be used in the processing of other agricultural related products and operations.

Reclamation occurs as soon as practical after the mining process. Reclamation is on-going and may be concurrent with mining activities. Usually topsoil and overburden are placed in their final resting place designated by the reclamation plan, and this is done where reserves have been exhausted and where it won't prohibit continued mining processes. All overburden stockpiles will be utilized during reclamation, so stockpile stability analysis will not be necessary. Once mining is complete, highwalls will be reduced to the natural angle of repose or a 3:1 slope, unless it is determined they should remain for bat habitat. Simon shall seek input from South Dakota Game, Fish and Parks regarding leaving highwalls for bat habitat. A stability analysis will be conducted should any of the highwalls remain after final reclamation.

Existing areas within the permit boundaries were historically mined by other entities prior to July 1, 1971. Disturbance was primarily within parcel 006251. These "Pre-Law" mining areas were not reclaimed, and the proposed mining and reclamation is likely to enhance the productivity of the land from its current condition.

Maps in Appendix A depict pre-mining and proposed postmining topography along with four profile centerline contours. Since this is an existing quarry, true pre-mining contours do not exist. Pre-mining contours are from August 8, 2021, but do show contours of the unaffected portions of the area. Topography in the northeastern portion of the area (along the Cold Brook drainage) will remain relatively unchanged. Pre-mining centerline A ranges from 4609 to 4669 ft., centerline B ranges from 4608 to 4666 ft., centerline C ranges from 4597 to 4666 ft and centerline D ranges from 4586 to 4678 ft. Post-mining centerline A ranges from 4555 to 4669 ft., centerline B ranges from 4586 to 4666 ft., centerline C ranges from 4555 to 4666 ft and centerline D ranges from 4540 to 4678 ft.

Depth of mining will range from 0 ft. to 100 ft. depending on depth to the limestone. In general, mining will occur from south to north. The direction of mining is illustrated on the mine sequence maps in Appendix A.

The mine permit and mine license (14-977) acreages are one in the same and cannot be spatially separated. Approximately, 70% of the limestone products would be sold as construction aggregate and 30% would go to agricultural use. Using those percentages approximately 56 acres west of the trail would be under the mine license and 24 acres would be under the mine permit. Similarly, approximately 21 acres east of the trail would be under the mine license and 9 acres would be under the mine permit.

3. LOCAL, STATE AND FEDERAL LAWS

ARSD 74:29:02:02 and SDCL 45-6B-32(3)(5)(7)

The operating plan, reclamation plan and proposed future use is not contrary to the laws or regulations of the State of South Dakota or the United States. Simon is not currently in violation of the provisions of Chapter 45-6B with respect to other mining operations in the State. Custer County does not have any zoning, ordinances or permitting requirements that would impact a large scale mining operation. Correspondence is provided in Appendix B.

4. UNSUITABLE AND PREVIOUSLY MINED LAND

SDCL 45-6B-7(5), SDCL 45-6B-8, SDCL 45-6B-32(8) and SDCL 45-6B-33(1)(3)(6)

Environmental baseline surveys do not indicate that the quarry area is special, exceptional, critical or unique. The land is not ecologically fragile and can return to its former ecological role in the reasonably foreseeable future. The land does not have a unique or strong influence on the total ecosystem of which it is a part. The Department of Agriculture and Natural Resources determined the lands within the proposed Loring Quarry mine permit boundary do not constitute special, exceptional, critical or unique lands. A copy of the Notice of Determination can be found in Appendix C. Reclamation of the affected land is economically and physically feasible.

No adverse socioeconomic impacts were identified that would outweigh the probable beneficial impacts of the large scale mine operation. The socioeconomic study can be found in Appendix E of the Reclamation Plan.

The Loring Quarry was purchased from J. Erpelding by Northwest Engineering (Hills Materials) in 1963, and was already a quarry at that time. Simon then acquired Hills Materials in 2015, which included the Loring Quarry. Surface mining disturbance prior to July 1, 1971 was primarily within parcel 006251. Areas mined prior to July 1, 1971 have been affected under the current mine license.

5. MINIMIZING ADVERSE IMPACTS

ARSD 74:29:07:02, SDCL 45-6B-32(6), SDCL 45-6B-33(2)(3)(4)(5), SDCL 45-6B-92 and ARSD 74:29:07:12

The mining operation is designed to minimize surface disturbance by clearing land in small sections; typically enough to allow for one to three years of sales volumes. There will be no waste dumps or tailings piles, and topsoil will be stockpiled for future reclamation. Reclamation occurs as soon as possible behind mining, and is an on-going process during mining activities. Usually topsoil and overburden are placed in their final resting place designated by the reclamation plan, and is done where reserves have been exhausted and where it won't prohibit continued mining processes. Pits/quarry and Rapidcreek cobbly loam comprised the majority of the project area, and these soil map units are not considered to be unusual or unique although moderate to high erosion hazards require best management practices during reclamation and revegetation.

Surrounding land uses include recreation, forest and private. The quarry has been designed so that the recreational trail running through the area will not be disturbed. Private landowners and forest access will not be impacted by the continued operation of the quarry. Mining operations and reclamation will be carried out in conformance with SDCL 45-6B-35; see below for further discussion.

Mining operations are not expected to impact surface or groundwater, and no disturbance to the hydrologic balance is anticipated. No adverse impacts to aquifer productivity, public/domestic water wells, watershed land, aquifer recharge areas or agricultural areas is anticipated. There are no direct or indirect sources of drinking water. Cold Brook (an intermittent drainage) will not be disturbed during operations and will not need to be diverted. A vegetative buffer will be maintained around the drainage to prevent sediment deposition. Cold Brook was an area of focus for the soil and vegetation surveys and those results were submitted to the U.S. Army Corps of Engineers (USACE) as part of a Request for Corps Jurisdictional Determination (JD). The approved JD found that the review area was comprised entirely of dry land (i.e., there are no waters or water features, including wetlands, of any kind in the entire review area). They determined that the drainage noted as Cold Brook consisted of an upland swale, with vegetation and soil results confirming that no wetlands were present.

The Loring Quarry is currently covered under South Dakota's General Permit for Storm Water Discharges Associated with Industrial Activities (Permit No. SDR00A294). A Storm Water Pollution Prevention Plan (SWPPP) has been prepared for mining activities as is required for overage under the general permit to discharge. The SWPPP lists Best Management Practices (BMPs) that Simon will utilize to prevent potential adverse impacts to the upland swale feature described above. The SWPPP is included in Appendix D of this Operating Plan. There are no wetlands or working groundwater wells located within the quarry boundaries. Groundwater was not encountered during exploratory drilling.

Some quarry activities are visible to occasional motorists traveling on State Highway 89, just east of the property boundary. The quarry has been in existence since the 1960's and should not have any new impact on the scenic nature of the area. The viewshed from the nearby residence should not be impacted by continued mining based on viewshed modeling. The need for visual screening is not anticipated. The quarry property is fenced and access is limited by a locked gate.

Access to and from the quarry is already established and no new haul roads will be constructed and no roads cross the trail. Access to the east side of the quarry will be from a SD Department of Transportation approved access off Highway 89 that is already in place. Access to the west side of the trail is off of 18 Mile Road (County Road 316) and across a small portion of US Forest Service. This road may be used by cavers to access the grotto, Black Hills Power or a rancher should grazing be occurring. This access will be maintained during the mining operation.

The project area is already an operating quarry with some rangeland pasture. No threatened and endangered or SD Natural Heritage vegetative species were identified during the baseline vegetative survey. This area is similar to surrounding lands and does not exhibit unique scenic or aesthetic qualities.

Baseline surveys and onsite visits conducted at the quarry resulted in the identification of two critical resources, as defined in SDCL 45-6B-2. Approximately 0.4 miles of the George S. Mickelson Trail crosses the eastern side of the property. This was identified as a critical resource and as such precautions will be taken so as not to disturb the trail. A 50 ft buffer will be maintained between mining operations and the trail at all times. No access roads will cross the trail. Access to the east side of the quarry will be from a SD Department of Transportation approved access off Highway 89 that is already in place. No other sites were recommended as eligible for the National Register of Historic Places.

Bats were the second critical resource identified and included four SDNHP sensitive bat species (Townsend's big-eared bat, silver-haired bat, long-eared myotic and fringe-tailed bat) and associated highwall habitat. Bat species were identified acoustically during spring and fall surveys.

The grotto located beneath the quarry pit, and associated entrances, were evaluated as potential bat hibernaculum habitat. Two rounds of surveys were conducted at this location and no bats were observed emerging from either the highwall or nearby man-made (capped) grotto entrances. It is likely species recorded during the surveys were using the area for foraging, as there is suitable roost and hibernacula habitat present beyond the quarry property.

While there was no indication that bats were using the grotto and associated entrances during the hibernaculum surveys, mitigation efforts will be employed during the roosting and hibernation periods to minimize adverse impacts to this critical resource. Mitigation measures will include:

- Seasonal restriction on tree cutting, and
- Seasonal restriction on blasting near the vuggy highwall and pit area with grotto entrances.

To avoid or minimize disturbance to roosting bats, tree removal (live or dead) will only occur between September 15th and May 15th. Ongoing mining activity will likely preclude bats from using the vuggy highwall for roosting habitat. Bats utilizing the vuggy highwall will be displaced by mining operations such as drilling and blasting.

To avoid and/or minimize impacts to hibernating bats using the vuggy highwall and main pit area (with grotto entrances) blasting in this area may be restricted. If mining in this area has not occurred during the preceding month(s), blasting may not begin between October 1st and March 15th. If blasting at the vuggy highwalls has been continual throughout the summer, it can continue into November. The continued disturbance and disrupted highwalls should minimize impacts to bats by discouraging use of the area for hibernation. Blasting into October and/or November is not a common occurrence, but is needed occasionally. To preclude bats from accessing the grotto, the manmade entrances are and will remain covered.

No significant impacts to other wildlife species are anticipated from continued mining and reclamation activities at the quarry. The quarry was not identified as critical deer winter range, and no coldwater fisheries exist on the property. No threatened or endangered wildlife species depend on the biological productivity of the land, and the majority of habitats found within the quarry boundaries are typical of the region, and no unique or unusual wildlife features are present. Activities that could cause impacts to wildlife have been present, continuous and ongoing for several decades.

Appendix A:

Maps

LORING QUARRY

Sections 33 & 34; T5S-R4E
Custer County, SD

Simon Contractors
Pre-mining Contour Plan View

Prepared 8-9-2021
Prepared by: Nathan Oliver

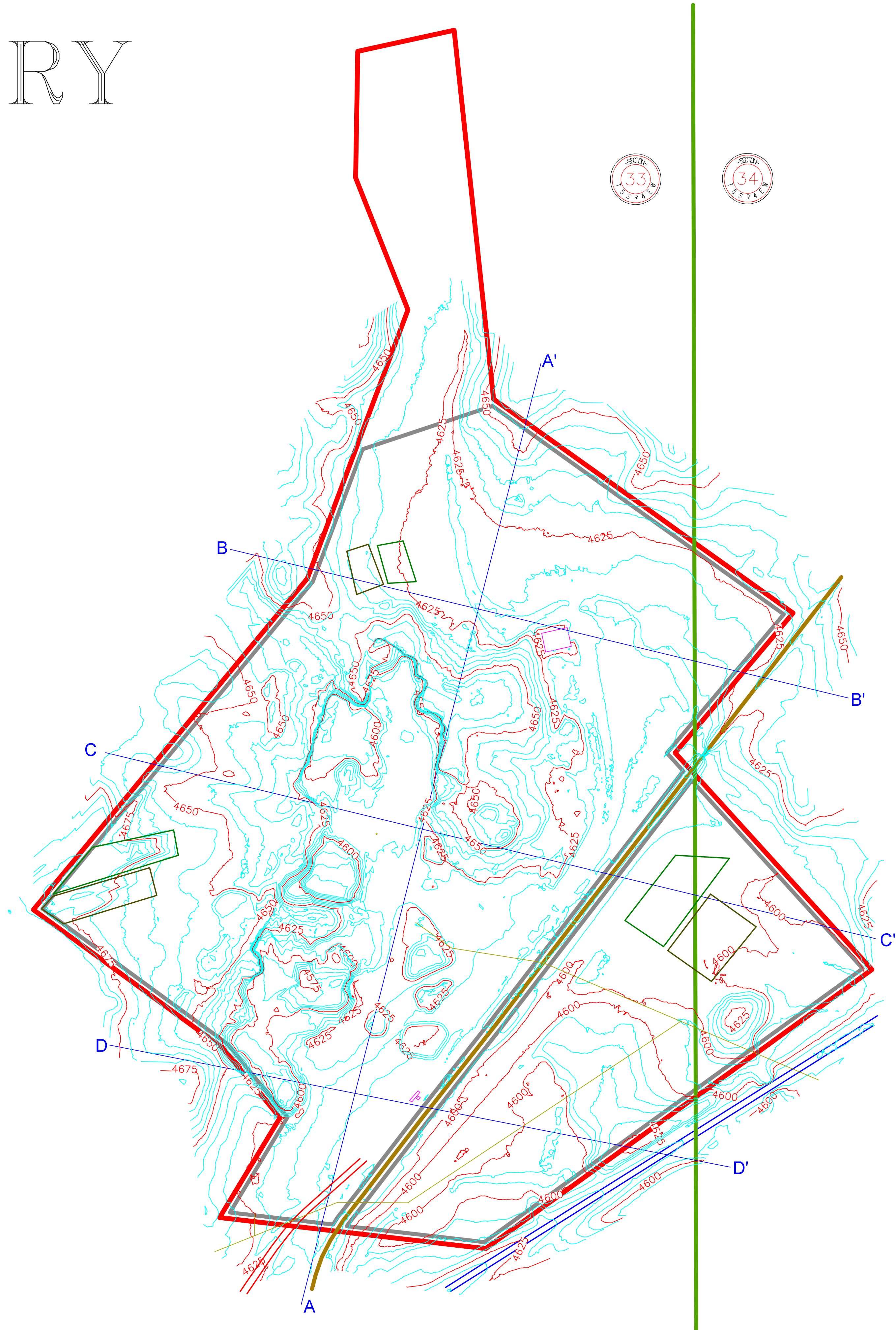
N

250 0 125 250 500 1000

Scale: 1"=250'
Contours: 5 ft

SECTION LINE
PROPOSED LORING QUARRY MINE PERMIT BOUNDARY
SD HWY 89
QUARRY ACCESS ROAD
STRUCTURES
MICKELSON TRAIL
PROPOSED DISTURBANCE AREA
OVERHEAD ELECTRICAL
TOPSOIL STOCKPILES
OVERBURDEN STOCKPILES
A—A' PROFILE CENTERLINE "A"
B—B' PROFILE CENTERLINE "B"
C—C' PROFILE CENTERLINE "C"
D—D' PROFILE CENTERLINE "D"

ARSD 74:29:02:04(2)
SDCL 45-6B-6(8)(a)
SDCL 45-6B-10(1)
SDCL 45-6B-10(3)
SDCL 45-6B-10(5)



LORING QUARRY

Sections 33 & 34; T5S–R4E
Custer County, SD

Simon Contractors
Pre–mining Contour Profile A–A'

Prepared 8–9–2021
Prepared by: Nathan Oliver

Scale: 1"=125'

ARSD 74:29:02:04(3)
SDCL 45-6B-6(8)(b)

LORING QUARRY

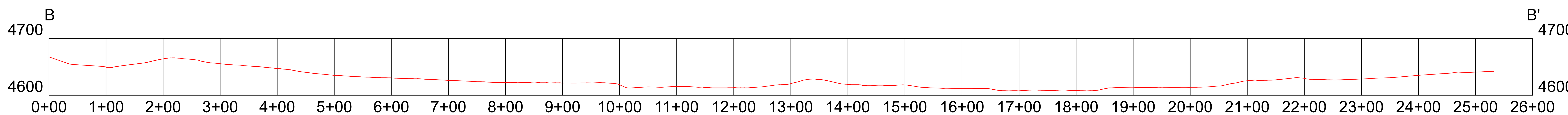
Sections 33 & 34; T5S-R4E
Custer County, SD

Simon Contractors
Pre-mining Contour Profile B-B'

Prepared 8-9-2021
Prepared by: Nathan Oliver

Scale: 1"=100'

ARSD 74:29:02:04(3)
SDCL 45-6B-6(8)(b)



LORING QUARRY

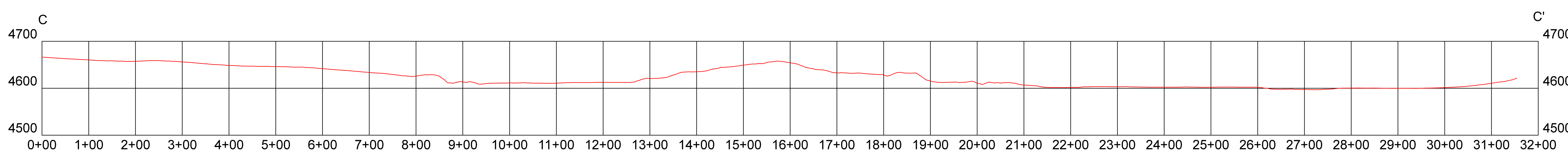
Sections 33 & 34; T5S–R4E
Custer County, SD

Simon Contractors
Pre–mining Contour Profile C–C'

Prepared 8–9–2021
Prepared by: Nathan Oliver

Scale: 1"=125'

ARSD 74:29:02:04(3)
SDCL 45-6B-6(8)(b)



LORING QUARRY

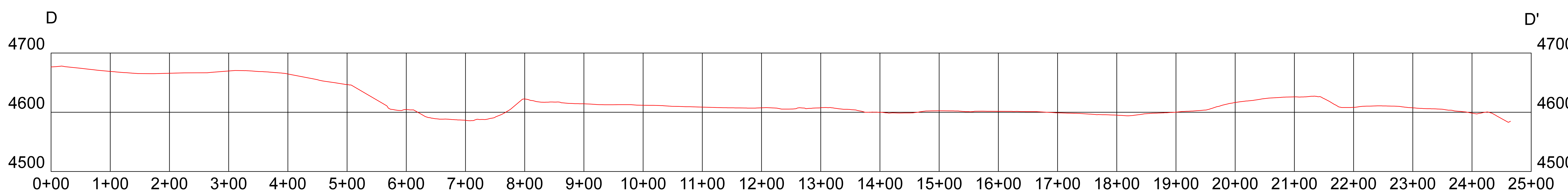
Sections 33 & 34; T5S-R4E
Custer County, SD

Simon Contractors
Pre-mining Contour Profile D-D'

Prepared 8-9-2021
Prepared by: Nathan Oliver

Scale: 1"=100'

ARSD 74:29:02:04(3)
SDCL 45-6B-6(8)(b)



LORING QUARRY

Sections 33 & 34; T5S-R4E
Custer County, SD

Simon Contractors
Post-mining Contour Plan View

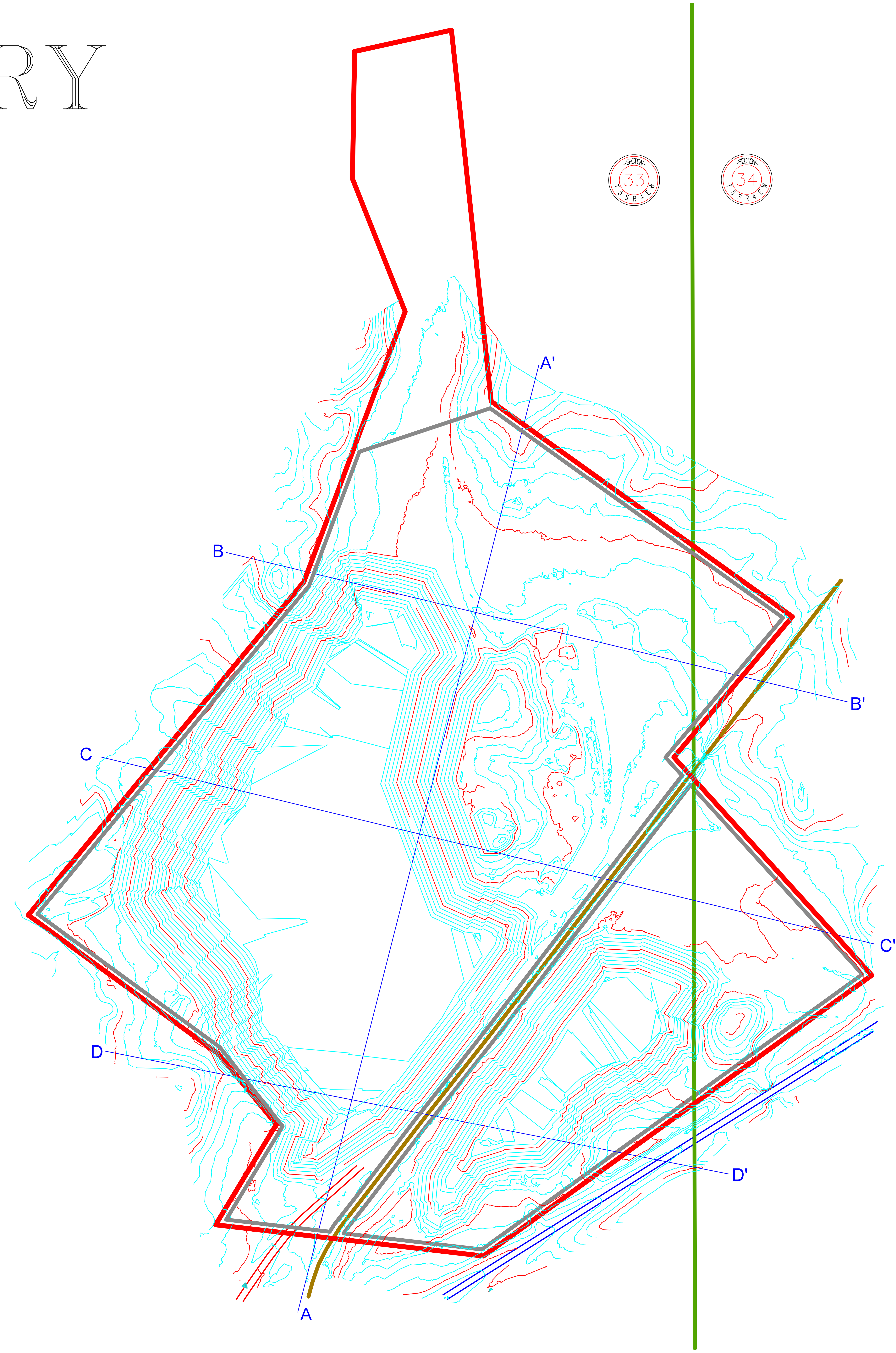
Prepared 8-17-2021
Prepared by: Nathan Oliver

N

250 0 125 250 500 1000

Scale: 1"=250'
Contours: 5 ft

SECTION LINE
PROPOSED LORING QUARRY PERMIT BOUNDARY
SD HWY 89
QUARRY ACCESS ROAD
MICKELSON TRAIL
PROPOSED DISTURBANCE AF
A — A' PROFILE CENTERLINE "A"
B — B' PROFILE CENTERLINE "B"
C — C' PROFILE CENTERLINE "C"
D — D' PROFILE CENTERLINE "D"



ARSD 74:29:02:04(2)
SDCL 45-6B-6(8)(a)

LORING QUARRY

Sections 33 & 34; T5S-R4E
Custer County, SD

Simon Contractors
Post-mining Contour Profile A-A'

Prepared 8-17-2021
Prepared by: Nathan Oliver

Scale: 1"=125'

ARSD 74:29:02:04(3)
SDCL 45-6B-6(8)(b)

LORING QUARRY

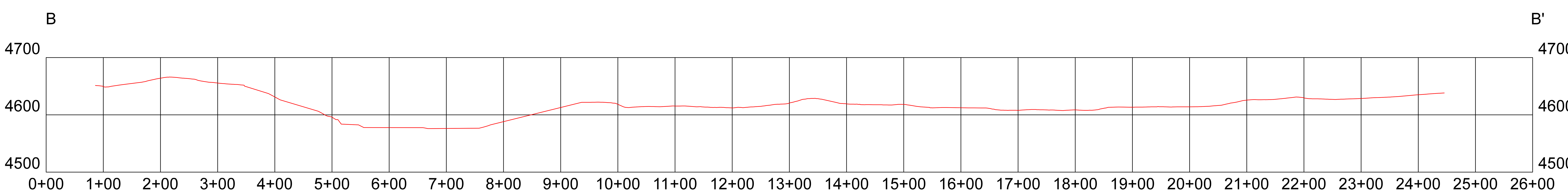
Sections 33 & 34; T5S-R4E
Custer County, SD

Simon Contractors
Post-mining Contour Profile B-B'

Prepared 8-17-2021
Prepared by: Nathan Oliver

Scale: 1"=100'

ARSD 74:29:02:04(3)
SDCL 45-6B-6(8)(b)



LORING QUARRY

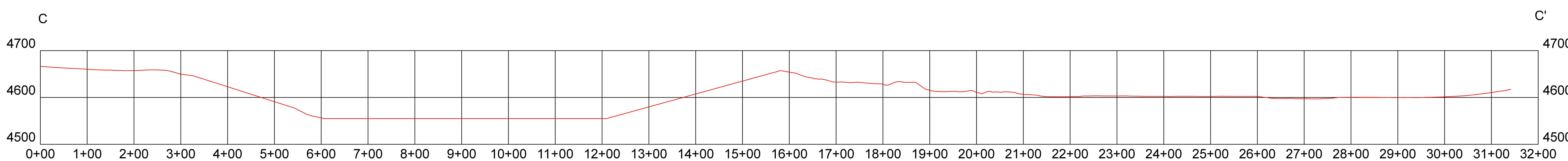
Sections 33 & 34; T5S-R4E
Custer County, SD

Simon Contractors
Post–mining Contour Profile C–C'

Prepared 8–17–2021
Prepared by: Nathan Oliver

Scale: 1"=125'

ARSD 74:29:02:04(3)
SDCL 45-6B-6(8)(b)



LORING QUARRY

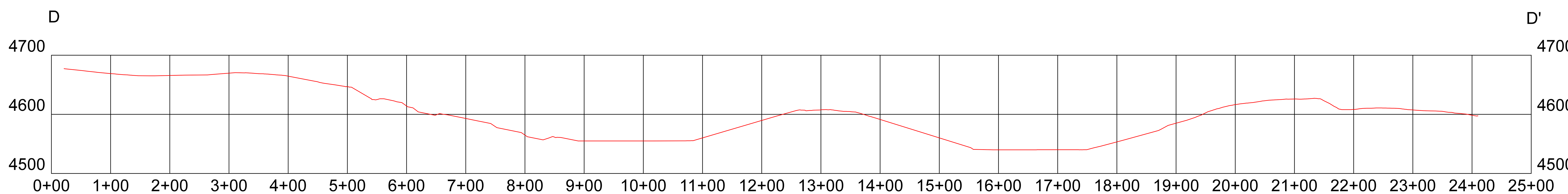
Sections 33 & 34; T5S-R4E
Custer County, SD

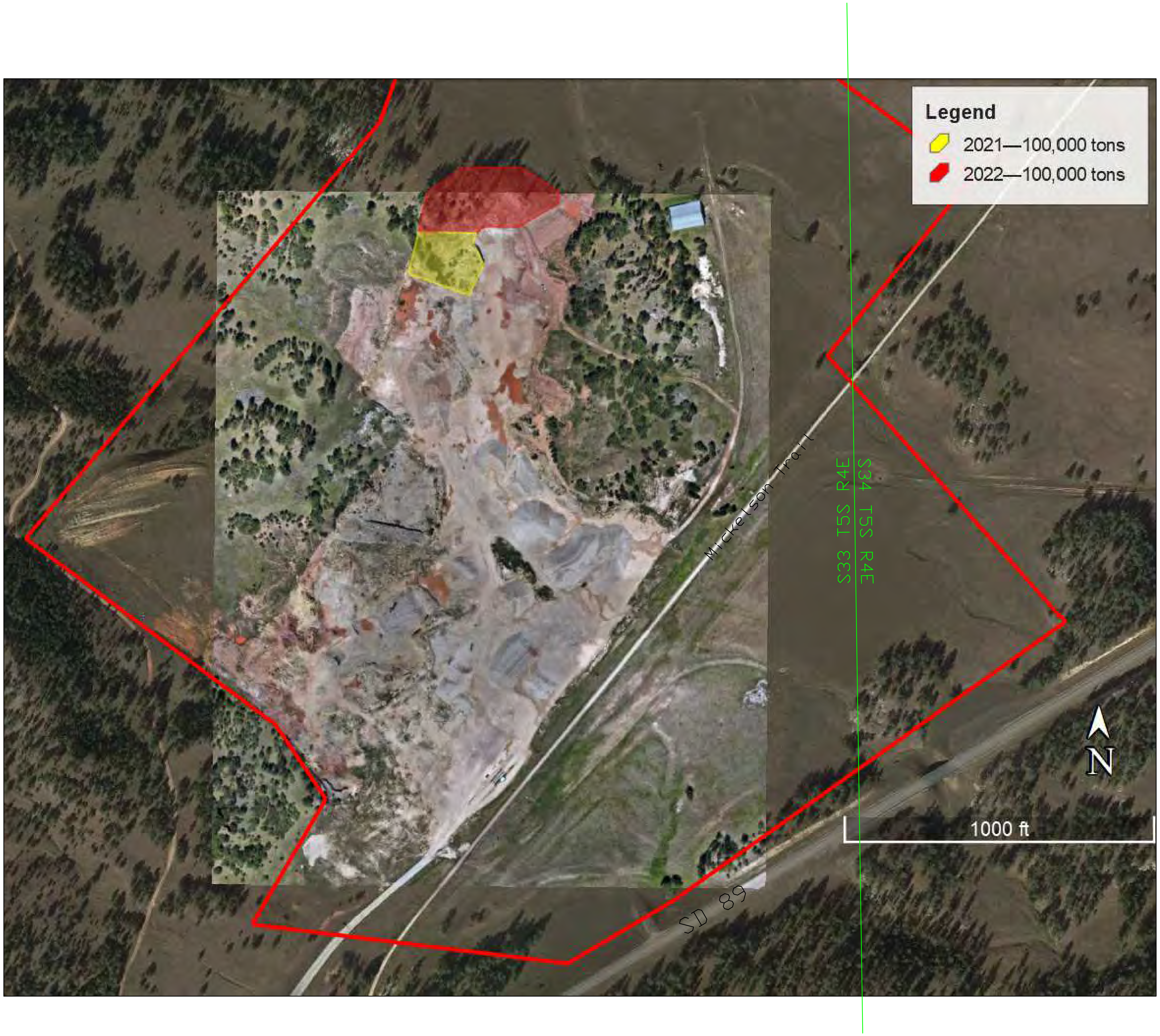
Simon Contractors
Post-mining Contour Profile D-D'

Prepared 8-17-2021
Prepared by: Nathan Oliver

Scale: 1"=100'

ARSD 74:29:02:04(3)
SDCL 45-6B-6(8)(b)





Simon Contractors

ARSD 74:29:02:04(3)
SDCL 45-6B-6(8)(b)

Proposed Loring Quarry Mine Permit Boundary

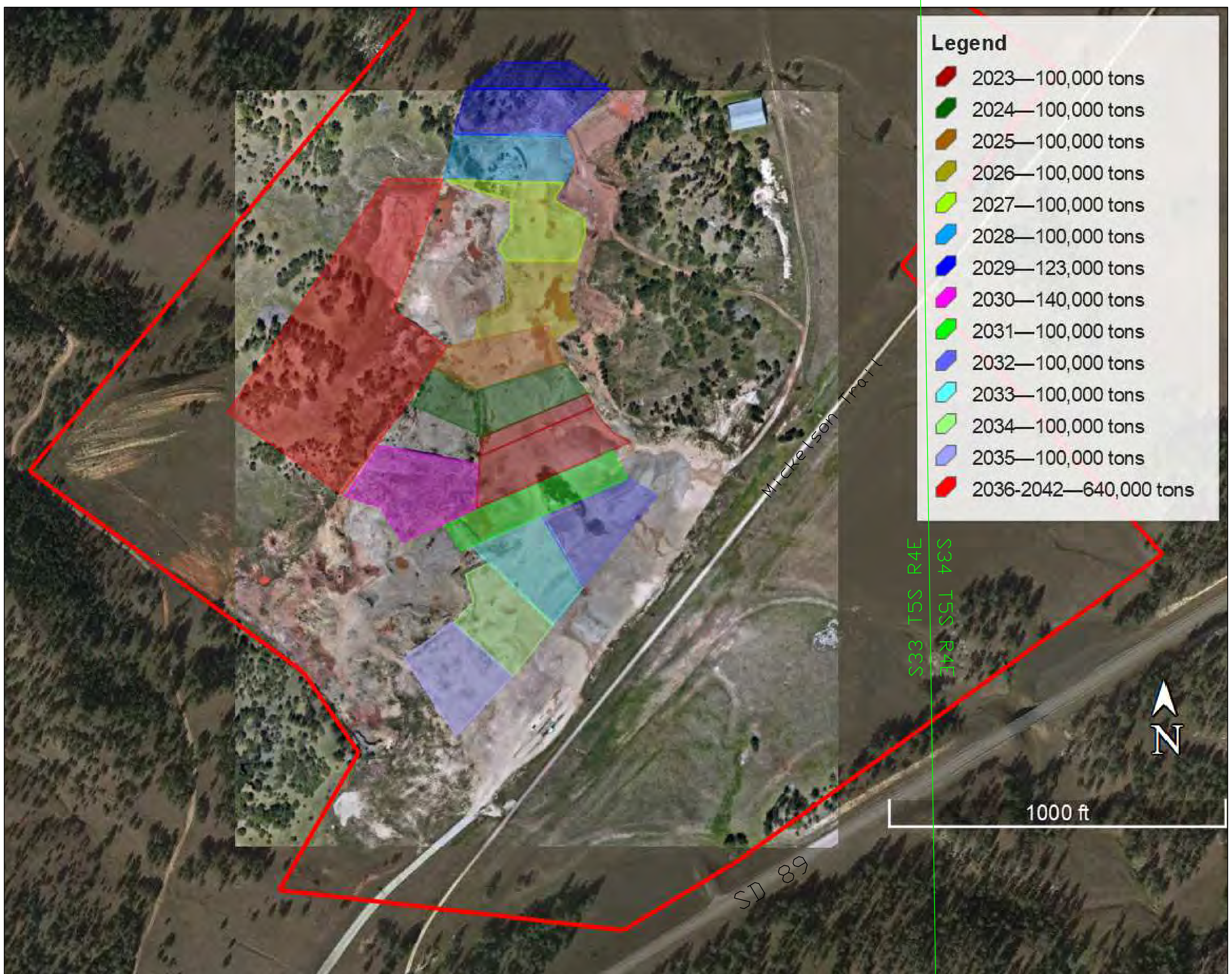
Section Boundary

N
S

0 500 1000

Loring Quarry Mine Sequence 2021-2022

Drawn by Nathan Oliver
4/7/2021



Simon Contractors

ARSD 74:29:02:04(3)
SDCL 45-6B-6(8)(b)

Proposed Loring Quarry Mine Permit Boundary

Section Boundary

N
S

0 500 1000

Loring Quarry Mine Sequence 2023-2042

Drawn by Nathan Oliver
4/7/2021

Simon Contractors

ARSD 74:29:02:04(3)
SDCL 45-6B-6(8)(b)

Proposed Loring Quarry Mine Permit Boundary

Section Boundary

0 500 1000

Loring Quarry Mine Sequence ~2042-2085+

Drawn by Nathan Oliver
4/7/2021

Appendix B:

Custer County Zoning Communication

From:	Terri Kester
To:	Becky Morris
Subject:	FW: Custer County Ordinances for Limestone Mining
Date:	Thursday, February 6, 2020 4:32:00 PM
Attachments:	image001.png

Terri Kester

From: James Kor
Sent: Thursday, February 06, 2020 4:00 PM
To: Bmorris@h2eincorpotrated.com
Subject: RE: Custer County Ordinances for Limestone Mining

Becky,

Custer County does not have any zoning, ordinances or permitting requirements that would impact a Large Scale Mining operation. We do not foresee the County having any opposition to the permit.

Jim Kor, PE

Staff Engineer

Custer County Planning Department

From: Becky Morris <BMorris@h2eincorporated.com>
Date: February 6, 2020 at 2:27:17 PM MST
To: Kimberly Kerkvliet <kkerkvliet@custercountysd.com>
Subject: Custer County Ordinances for Limestone Mining

Hello Kimberly-

Hi my name is Becky Morris with H2E, Inc. I am helping Simon prepare a Large Scale Mine Permit application for submission to SD DENR. Simon currently operates the Loring Quarry (limestone) under a mine license, but due to changes in the operation will need to apply for a Large Scale Mine Permit. As part of the mine permit application, the SD DENR wants to know that the company applying for the mining permit is complying with any county zoning, ordinances and permitting requirements the county may have.

Does Custer County have any zoning, ordinances or permitting requirements that would impact a limestone quarry?

Please respond in writing so that I may include the response in the permit application.

Thank you for your time!
Becky

Becky Morris, Ph.D.
Environmental Scientist
H2E, Inc.
801 East 4th Street, Suite 5
Gillette, WY 82716
Cell: 307-696-7007
bmorris@h2eincorporated.com

Appendix C:

Department of Agriculture and Natural Resources Notice of Determination

DEPARTMENT of AGRICULTURE and NATURAL RESOURCES
JOE FOSS BUILDING
523 E CAPITOL AVE
PIERRE SD 57501-3182
danr.sd.gov

**NOTICE OF DETERMINATION OF
SPECIAL, EXCEPTIONAL, CRITICAL, OR UNIQUE LANDS
SIMON CONTRACTORS OF SD, INC.**

The Department of Agriculture and Natural Resources has made its determination regarding a Notice of Intent to Operate and Request for Determination of Special, Exceptional, Critical, or Unique Lands from Simon Contractors of SD, Inc., 3975 Sturgis Road, Rapid City, South Dakota 57702. The Notice of Intent to Operate was submitted as required under ARSD 74:29:10 for purposes of requesting the department to determine whether the lands potentially affected by the mining operation are eligible for inclusion on the preliminary list of special, exceptional, critical, or unique lands.

The proposed operation involves the expansion of the Loring Limestone Quarry located approximately four miles southwest of Pringle, South Dakota which is currently mined under Simon Contractors' mine license. The mine permit will allow Simon Contractors to mine limestone for uses other than construction aggregate and cement, such as agricultural applications, including, but not limited to feed and soil supplements and food processing. Topsoil and overburden will be stripped from portions of the expansion area every one to three years to match production. The stripped area will be drilled and blasted, and limestone will be removed and hauled to an on-site crusher where it will be sized into different products. After the limestone is processed, it will be stockpiled until it is loaded onto trucks and shipped to customers. Reclamation will occur concurrently with the mining operation.

In accordance with ARSD 74:29:10:08 and 74:29:10:09, the department has determined that the lands described in the Notice of Intent to Operate do not constitute special, exceptional, critical, or unique lands. This determination is based on the on-site inspection of the proposed lands to be affected, examination of the established preliminary list, consultation with other agencies, and evaluating information provided with the Notice of Intent to Operate. In addition, no nominating petitions pertaining to the lands described in the Notice of Intent were filed with the department.

The lands described in the Notice of Intent to Operate are considered cleared from special, exceptional, critical, or unique characteristics in accordance with ARSD 74:29:10:15. This clearance will remain in effect for seven years. If a mine permit application is not submitted within the seven-year period, the Board of Minerals and Environment may declare the clearance void and the lands may be reevaluated.

Simon Contractors of SD, Inc. may appeal the department's determination by filing a petition for a contested case hearing pursuant to SDCL 1:26 within seven days after receipt of the determination. The hearing on the appeal shall be confined to the determination of the lands as special exceptional, critical, or unique and whether an environmental impact statement and socioeconomic study will be required.

Persons desiring further information may contact Eric Holm, Minerals and Mining Program, at (605) 773-4201.

Hunter Roberts
Secretary
Department of Agriculture and Natural Resources

July 14, 2021

Appendix D:

Storm Water Pollution Prevention Plan

Loring Pit Storm Water Pollution Prevention Plan (SWP3)

Prepared by: Mike Lee, Environmental Manager

Date: 5/2/2019
Last Updated: May 2019
Next Scheduled Review: May 2022

Certification:

"I T. Scott Olsen (responsible corporate official) certify that this document and all attachments were prepared under my direction or supervision in accordance with a system designed to assure that qualified personnel properly gather and evaluate the information submitted. Based upon my inquiry of the person or persons who manage the system, or those persons directly responsible for gathering the information, the information submitted is, to the best of my knowledge and belief, true, accurate, and complete. I am aware that there are significant penalties for submitting false information, including the possibility of fine and imprisonment for knowing violation."

T. Scott Olsen – Regional Manager	605-394-3300
(Name/Official Title)	(Telephone)
T. Scott Ol	10/31/19
(Signature)	(Date)

Table of Contents

1.0 General Facility Information

Mailing Address:	**Location:**
Simon P.O. Box 2720 Rapid City, SD 57709	Simon Loring Quarry 12066 18 Mile Rd Custer, SD 57730

Emergency Contact: Francis Zeimet	**Work Phone:** (605) 745-5206
Title: Superintendent	**Emergency Phone:** (605)890-5206
Secondary Contact: Mike Lee	**Work Phone:** (605)394-3320
Title: Environmental Manager	**Emergency Phone:** (605) 390-8439
Type of Facility: Construction sand and gravel mining	**SIC Code:** 1442 **NAICS Code:** 212321
Number of Storm Water Outfalls: 1	**Receiving Waters:** Carroll Creek
NPDES Permit Number: SDR00A294	

1.1 Site Assessment

The Loring Siding Quarry is located five miles south of Pringle, SD, on Highway 89. The actual quarry encompasses approximately 50 acres with an additional 100 acres of undisturbed property surrounding the quarry, which is also part of this site. This quarry is used infrequently and is not regularly staffed.

On-site, there is one 10' x 12' scale house. A loader is kept on-site as needed. No fuel tanks are kept on-site, so a fuel truck on an as needed basis fuels the loader. Several stockpiles of crushed rock and fines are stored on-site and used as needed. There is no paving on-site and areas not disturbed are vegetated with trees and natural grasses.

The portable crusher is moved on-site intermittently. When it is on site a 1000-gallon fuel tank and 55-gallon waste oil tank are moved on site also. These tanks are contained inside a secondary containment. The runoff that results from the crushing operation is retained on-site in retention ponds.

There is a possibility that the portable hot plant would be moved on-site as well. This has not occurred yet but if a job warranted it, then it would be placed on this site. If the hot plant were to be moved on-site, then hot plant's SWPPP would be used to prevent pollution of storm water runoff.

The storm water is either retained in the quarry or drains off the site via a grass lined ditch by an old railroad grade. The water then drains under the grade and eventually into Carroll Creek about 1 mile east of the site. The old railroad grade is abandoned and has been converted into a hiking and biking trail.

2.0 Overview

2.1 Introduction

This storm water pollution prevention plan (SWPPP) has been prepared for Simon - Loring Pit, located 12066 18 Mile Rd, Custer, SD 57730. It has been developed as required under Part 4.4 of the South Dakota Surface Water Discharge Program's General Permit for Storm Water Discharges Associate with Industrial Activity. This SWPPP describes this facility, recommends appropriate best management practices (BMPs) or pollution control measures to reduce the discharge of pollutants in storm water runoff, gives a materials inventory, gives a description of materials exposed to storm water, and provides for periodic review of this SWPPP.

2.2 Objectives

The goal of the storm water permit program is to improve the quality of surface waters by reducing the amount of pollutants potentially contained in the storm water runoff being discharged. Industrial facilities subject to storm water permit requirements must prepare and implement a SWPPP for their facility.

The objective for this SWPPP is three-fold:

1. To identify potential sources of pollution at Loring Pit,
2. To describe best management practices (BMPs) which are to be used at Loring Pit, and
3. To provide other elements such as, but not limited to, a facility inspection program, site compliance evaluation program, record keeping and reporting program that will help Loring Pit comply with the terms and conditions of their storm water discharge permit.

3.0 Plan Coordinator Duties and Pollution Prevention Team

The SWPPP coordinator for the facility is: Mike Lee, Environmental Manager, (605) 394-3320. The coordinators duties include:

- Create a SWPPP team to aid in the implementation of the SWPPP,
- Implement the SWPPP,
- Oversee maintenance practices identified as BMPs in the SWPPP,
- Implement and oversee employee training,
- Conduct or provide for inspection or monitoring activities,
- Identify other potential pollutant sources and make sure they are corrected,
- Prepare and submit reports, and
- Ensure that any changes in facility operation are addressed and incorporated in the revisions of the SWPPP.

The following team people will be part of the Pollution Prevention Team and jointly responsible for implementation of identified BMP's in this SWPPP.

Team Member: Francis Zeimet
Title: Superintendent
Office Phone: (605) 745-5206
Emergency Phone: (605) 890-5206
Responsibilities: Promote good housekeeping and maintenance of storm water pollution prevention activities as outlined in this plan.

Team Member: Mike Lee
Title: Environmental Manager
Office Phone: (605)394-3320
Emergency Phone: (605)390-8439
Responsibilities: Support Team Leader in promoting good housekeeping and providing manpower and equipment necessary to implement and maintain storm water pollution prevention activities, as outlined in this plan.

4.0 Potential Sources of Pollutants

4.1 Site Map

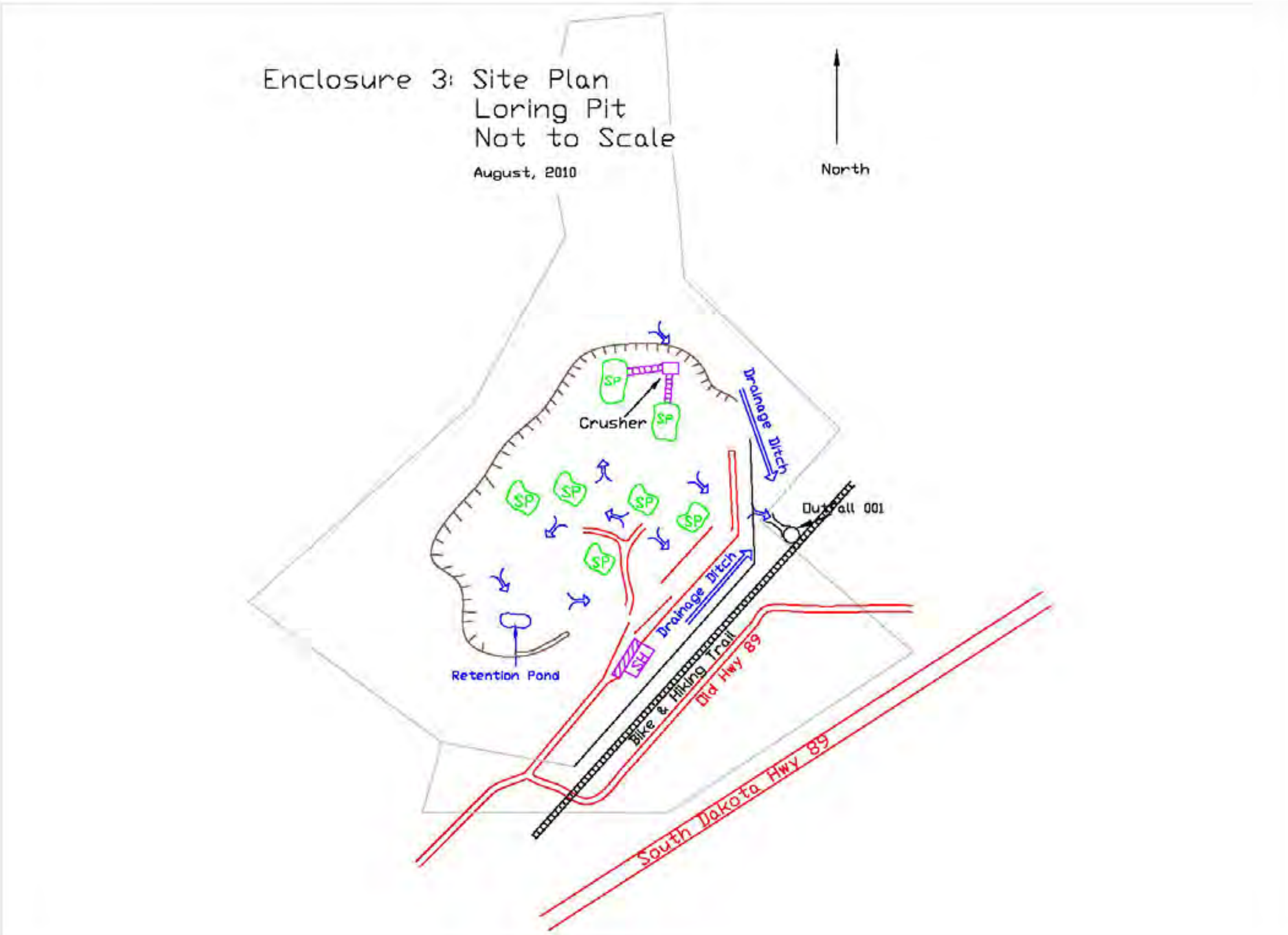
Figure 1 presents a site map of the facility showing the following features:

- Property boundaries,
- Buildings and other permanent structures,
- Storage or disposal areas for significant materials,
- Storm water discharge outfalls (locations where storm water is, or may be, discharged),
- Location of Storm Water inlets contributing to each outfall,
- Outlines of drainage areas contribution to each outfall,
- Structural runoff controls and storm water treatment facilities,
- Areas of vegetation,
- Areas of exposed and/or erodible soils,
- Impervious surfaces (roof tops, asphalt, concrete)
- Names and locations of receiving waters,
- Areas of known or suspected spills or leaks,
- Locations where the following activities are exposed to storm water:
    - Fueling stations,
    - Vehicle and equipment maintenance and/or cleaning areas,
    - Waste storage, treatment, or disposal areas,
    - Liquid storage tanks,
    - Equipment operating areas,
    - Processing areas,
    - Storage areas,
- Any other areas deemed appropriate.

LEGEND

	EXPOSED FACE
	PAVED AREA
— X — X —	*FENCE*
SS	*STORAGE SHED*
	DIRECTION OF RUNOFF
	DIRECTION OF DRAINAGE DITCH
	ROAD (GRAVEL OR DIRT)
	PAVED ROAD
OB	*OVERBURDEN PILE*
TS	*TOPSOIL PILE*
SP	*GRAVEL OR ROCK STOCK PILE*
F	*FUEL TANK*
SH	*SCALE HOUSE*
	CONVEYOR
	RAILROAD
	SITE BOUNDARY
	CULVERT
B	*STORAGE BIN/LOADING BIN*
	CREEK (WET OR DRY)
	BERM
	POND

Figure 1. Simon - Loring Pit located at 12066 18 Mile Rd, Custer, SD 57730.



4.2 Inventory of Materials

Table 1 contains an inventory of the types of materials handled at Loring Pit that have potential to cause pollution to storm water.

Table 1

Area/Process	Material(s)	Method of Exposure	Outfall	Controls
Stock piles	Coarse & Fine Aggregates	Rainfall	none	Drainage to retention areas
Equipment Parking area	Oil/other fluid drips	Rainfall	none	Daily equipment walk-arounds, sorbent materials on site

4.3 Spill Incidents

Significant spills are listed in Table 2. According to facility records there have been no "significant" spills on site.

A significant spill includes, but is not limited to releases of oil or hazardous substances in excess of reportable quantities under section 311 of the Clean Water Act (40 CFR 110.10 and CFR 117.21) or section 102 of CERCLA (40 CFR 302.4).

Table 2

Date	Material	Volume	Location	Actions Taken
None	None	None	None	

4.4 Existing Monitoring Data

Monitoring and sampling will be done as often as deemed necessary by the permit or the Plan Coordinator. Results of sampling and testing are in Table 3.

Table 3

Date	Location	Parameter	Non-Storm Water Discharge detected	Initials	Additional Information
None	None	None	None	None	

5.0 Best Management Practices

Storm water management controls, or best management practices (BMPs), will be implemented to reduce the amount of pollutants in storm water discharged from Loring Pit. The BMP's in this SWPPP include:

- Good Housekeeping,
- Preventative Maintenance,
- Spill Prevention and Response,
- Sediment and Erosion Control,
- Management of Runoff,
- Employee Training, and
- Security.

5.1 Good Housekeeping

Good housekeeping practices are reinforced throughout the facility. Employees are trained and reminded of good housekeeping practices. The following practices are included in our good housekeeping routine:

- Maintain a clean and orderly facility (grounds and floors) by sweeping, shoveling, or vacuuming debris accumulated within our property,
- Institute a "clean as you go" mentality in all areas of operation,
- Remove debris, trash, and waste materials to be collected on a regular basis to eliminate the chance from entering storm water conveyance points,
- Cover trash cans and/or collection municipal drop boxes to eliminate storm water contamination,
- Store drums away from storm water drains and high vehicle traffic areas,
- Remove all unused containers and drums from the property as soon as possible,
- Inspect materials storage areas and clean any spills on a regular basis,
- The systematic elimination of aggregate and material handling spill points, and
- Spill absorption materials readily available at fueling and/or oil storage areas.

5.2 Preventive Maintenance

Preventive Maintenance involves the regular inspection, testing, and cleaning of storm water management devices and facility equipment. These inspections will help prevent conditions that could cause breakdowns or failures resulting in discharges of pollutants.

Table 4 includes the equipment/activities that will be included in the preventative maintenance program.

Table 4

Equipment/Activity	Perform Maintenance	Frequency
Daily Walk Arounds on all equipment	Walk arounds include looking for drips of oil or other fluids, checking hoses etc.	Daily for all equipment

5.3 Spill Prevention and Response

Areas where potential spills can occur and their adjacent drainage points are identified in the facility site map included in Figure 1. Minor spills and leaks are addressed under the housekeeping section of this plan and are cleaned accordingly.

All facility personnel are responsible for the following:

- Identify spills, leaks or potential problem areas,
- Perform initial containment, if possible, of leak or spill,
- Report all incidents to supervisor or designated Emergency Response Person and/or SWPPP Coordinator,
- If applicable contact Fire and/or Police department by dialing 911.

The SWPPP Coordinator or a designated supervisor is responsible for the following:

- Report releases in excess of the reportable quantities to the local emergency response center at: (605)773-3296 or after hours at (605)773-3231.
- Report releases in excess of the reportable quantities to the National Response Center (NRC) at: **(800)424-8802** or **www.nrc.uscg.mil/online.htm**
- Prepare and submit any necessary regulatory report.

5.4 Sediment and Erosion Control

The facility site map in Figure 1 identifies any bare areas that due to location, topography, and activity have a higher potential for erosion and sediment runoff. This map also identifies the controls utilized for stabilization and control of such areas. Below in Table 5 is a list of areas prone to soil erosion.

Table 5

Area of Concern	Control Measures
None	

5.5 Management of Runoff

The storm water at Loring Pit is contained on site by using berms and the slope of the property.

5.6 Employee Training

All Employees are trained and informed of the goals and responsibilities associated with this SWPPP. As a minimum, SWPPP training occurs once a year for all employees regardless of their responsibility within the facility and is covered additionally in monthly Toolbox Talks. In addition, employees should receive new hire environmental training and site-specific environmental training as part of their operator training.

Training will include, but is not limited to: an overview of the SWPPP, good housekeeping procedures, preventative maintenance procedures, material storage procedures, spill prevention, and response procedures, location of any storm water drains, the location of raw materials, and waste with identified pollution potential. Training records are kept in the back of the binder for 3 years.

5.7 Security

There is a fence that completely surrounds the Loring Quarry. All entrances are locked when not in use.

6.0 Inspections

6.1 Comprehensive Site Compliance Evaluation (CSCE)

At a minimum the SWPPP Coordinator, or other qualified personnel, shall evaluate the entire facility for overall compliance with the storm water permit once per year. Comprehensive Site Compliance Evaluations are included in **Appendix 2.**

6.2 Periodic Inspections

In addition to the Comprehensive Site Compliance Evaluations (CSCE) described above, periodic visual inspections will also be done monthly. These monthly inspections should include at least one inspection that was done during or immediately after a significant rain event. These inspections will assure the proper operation of the equipment and all storm water controls.

Simon will take appropriate and prompt actions in response to inspections that require follow-up procedures.

Attachment 2 Comprehensive Site Compliance Evaluation

Facility:	Date/Time:	Retain until (5 years):
Personnel Conducting Inspection:		

Overall Drainage: ☐ **Good** ☐ **Needs Improvement – (Make Comments)**

Look at overall drainage plan, is it performing as planned. Are the separate areas working together to contain and control stormwater runoff for the entire site? Comments:____

____

____

Petroleum **Storage:** ☐ **Good** ☐ **Needs Improvement – (Make Comments)**

Look at containment. Look for housekeeping, any signs of spillage, and secondary containment. Is the secondary containment large enough to contain the largest tank if it were to rupture and any water that might be standing in it?

Comments:____

____

Drainage Systems: ☐ **Good** ☐ **Needs Improvement – (Make Comments)**

Look at drainage ditches and anything that is used to direct the flow of runoff. Look for any signs of erosion. Look at visible piping for signs of leakage. Check retention ponds for storage capacity. Can the ponds hold the amount of runoff flowing into them? Check the housekeeping in all the areas for any trash and clutter. Comments:_____________________________

____

____

Hazardous Materials Storage: ☐ **Good** ☐ **Needs Improvement – (Make Comments)**

Look at the containment used to store this type of material. Are there any signs of leakage? Check the secondary containment for this type of storage. Will it contain the largest tank if it were to spill and also allow for freeboard? A good rule of thumb is at least at least 110% of largest tank capacity. Check for signage to make sure this storage area is marked. Check records to make sure that an accurate accountability is kept. Check security of area to make sure no unauthorized use is occurring.

Comments:____

____

Vehicle Parking & Haul Roads: ☐ **Good** ☐ **Needs Improvement – (Make Comments)**

Check the Drainage off the parking lots and haul roads. Is there a lot of sediment flowing off these areas? Check the overall conditions of the surface. Is there rutting and potholes? Is it flowing where it can be controlled or contained? Check the surface for spillage. Are vehicles leaking on the surface, which in turn can get into the runoff? Check the vehicle inspection records to make sure routine maintenance is kept up and daily walkarounds are being performed. Comments:__________________

____

____

I certify under penalty of law that this document and all attachments are prepared under my direction or supervision in accordance with a system designed to assure that qualified personnel gather and evaluate the information submitted. Based on my inquiry of the person or persons directly responsible for gathering information, the information submitted is, to the best of my knowledge and belief, true, accurate, and complete. I am aware that there are significant penalties for submitting false information, including the possibility of fine and imprisonment for knowing violations.

INSPECTOR'S Signature:______________________________Date:____________________

7.0 Non-Storm Water Discharges

There are no non-storm water discharges currently present at this site.

Certification of Evaluation of Non-Storm Water Discharges

I (responsible corporate official) certify under penalty of law that the storm water drainage system in this SWPPP has been tested or evaluated for the presence of non-storm water discharges either by me, or under my direction and supervision. To the best of my knowledge and belief, the information submitted is true, accurate, and complete. And at the time this plan was completed no unauthorized discharges were present. I am aware that there are significant penalties for submitting false information, including the possibility of fine of imprisonment for knowing violations.

______________________________	_______________________
(Signature)	(Date)
_T. Scott Olsen______________________	__Regional Manager_______
(Printed Name)	(Title)

8.0 Record Keeping and Reporting

8.1 Storm Water Pollution Prevention Plan

The permit requires that the SWPPP plan be reviewed for its effectiveness and that changes be made as needed. A record shall be kept of any changes that have been made and the reason for the changes. Facility records will also include information pertaining to significant spills, what actions were taken as result of the spill, facility inspections, unauthorized discharges, training, and site evaluations will be kept in the facility files along with this SWPPP.

Table 6. Plan Review/Amendment Log.

Activity	Who & Date	PE Cert	Comments
3-year Scheduled Review	Clint Allen 6/1/12	No	Re-wrote entire SWPPP. Changes made to responsible person and team members. Added shingles, fuel discharge info., and other minor changes to site plan. Format changed but other information stayed the same
Updated certification pages to reflect change of General Manager	Clint Allen 6/1/2014	No	Updated certification pages to reflect change of General Manager
Administrative Update	Mike Lee	No	

9.0 Inspections and Memos

Inspection reports and memo are all kept in a separate tab near the back of the binder.

STORM WATER BEST MANAGEMENT PRACTICES MANUAL

Compiled by:

www.h2eincorporated.com

The following manual is a collection of manufacture specific designs and good engineering practices intended to minimize impacts to storm water. Included are standard designs, installation specifications, and maintenance requirements for plan approved BMPs.

References

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Table of Contents

Check Dams (CD)

Description

Check dams (ditch checks) are small, temporary dams constructed across a diversion or roadside ditch. Check dams can be constructed using rock, sandbags, gravel bags, earth with erosion control blanketing, or synthetic materials to slow the velocity of concentrated flow in a channel and reduce in channel erosion. A secondary benefit of check dams is sediment trapping upstream of the individual check dams.

Uses

● Meets full use/application; ○ meets use/application under certain circumstances; and no symbol indicates not appropriate/applicable.

●	Erosion Control		Good Housekeeping
●	Sediment Control		Snow Management
	Chemical/Pollutant Control		

Applications

	Cut/Fill Transitions		Pollution/Material Sources
●	Ditches		Sediment Traps/Basins
	Exposed Areas		Site Perimeter
○	Inlets and Outlets		Slopes
	Near Water/Wetlands		Toe of Slopes

Soils

●	Clay	●	Rocky Subgrade
○	Sand		
●	Loam		

Check dams can be used on mild or moderately steep slopes and in the following applications:

- Used to intercept and filter concentrated flows and dissipate erosive energy;
- In diversion or roadside ditches where seeding has been implemented but vegetation has not been established;
- Along temporary channels, ditches, or swales that need protection where construction of non-erodible lining is not practicable;
- Can be installed on soil or hard surface channels; and
- In areas subject to high flow velocities, provided that reinforced check dams are used.

Selection Considerations

- Generally, check dams should not be used in live streams;
- Use only in open channels that receive runoff from an area OF 10 acres or less; and
- Not for use in wetland areas or areas where vegetation has been established.

Design and Installation

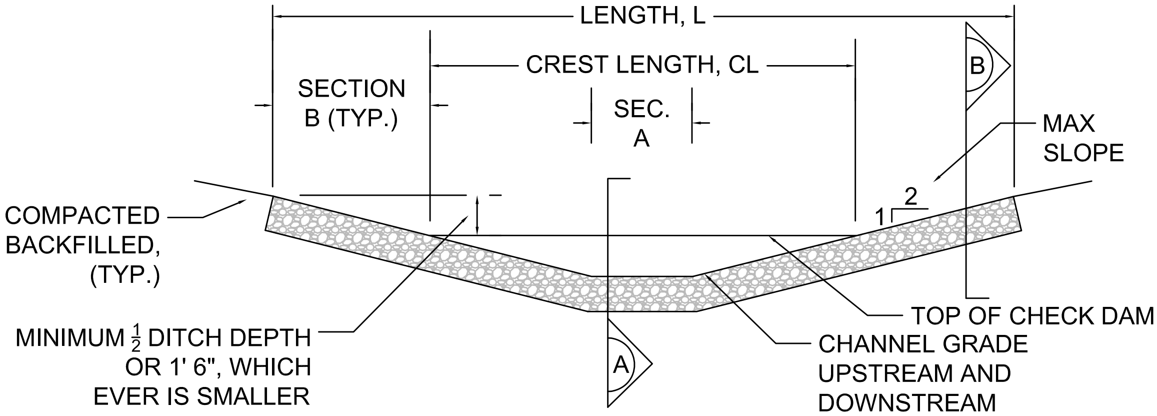
- Check dams shall be placed at regular intervals along swales or ditches;
- Check dams should be installed with careful placement of the construction material (do not simply dump rocks);
- Where multiple check dams are used, the top of the lower dam should be at the same elevation as the toe of the upper dam;
- Typical construction materials:
    - Crushed rock;
    - Sediment control log/wattles;
    - Sand/gravel bags; and
    - Reinforced crushed rock.
- All check dams should have sufficient space up slope from the check dam to allow ponding and to provide room for sediment storage; and
- Check dams are most effective when installed perpendicular to relatively straight sections of a ditch or open channel.

Maintenance and Removal

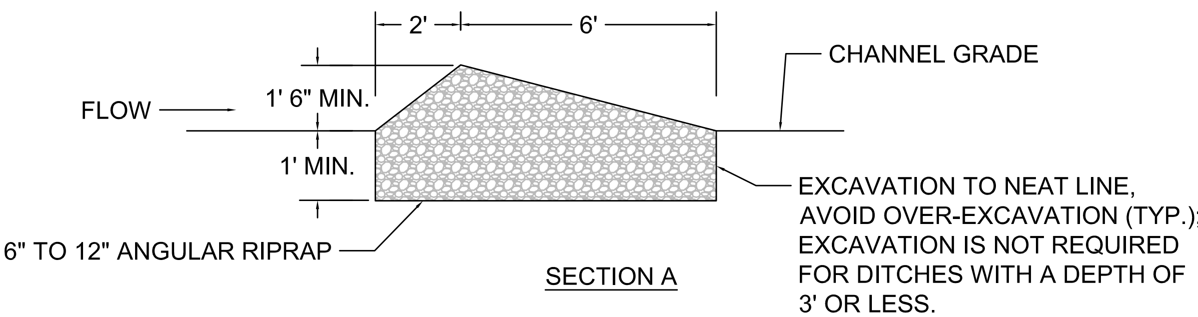
The frequency of inspections shall be in accordance with the Storm Water Plan. Inspect for sediment, trash, or other debris accumulations and visually inspect for erosion around the edges of the structure. Repair and replace as required to maintain functional check dams in accordance with the installation designs. Remove sediment accumulations reaching half or greater of the upslope crest height. Remove accumulated sediment prior to mulching, seeding or chemical soil stabilization.

The removal of check dams is optional when removal will have a negative impact on surrounding vegetated areas and/or when landowner approval is obtained. If removing a check dam, all accumulated sediment should be removed. Removal of a check dam should be completed only after the contributing drainage area has been completely stabilized. Permanent vegetation should replace areas from which rock or other material has been removed.

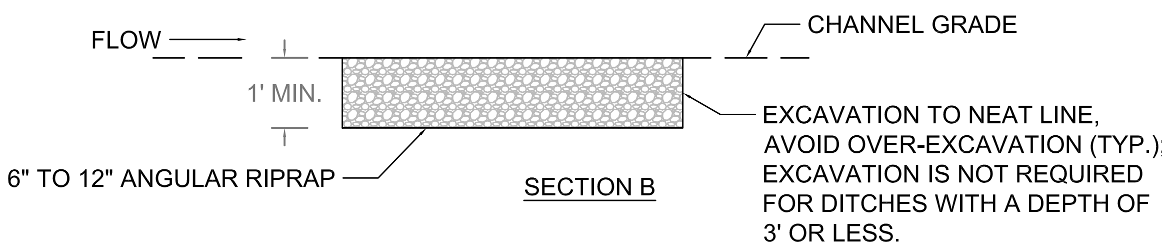
CHECK DAM FIGURES



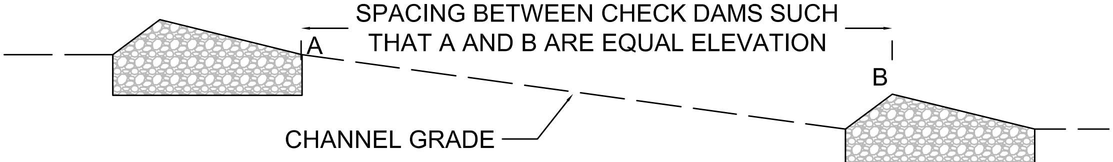
CHECK DAM ELEVATION VIEW



SECTION A



SECTION B



PROFILE

NOTE: DESIGN MODIFIED TO ACCOMIDATE INSTALLATION OF ROCK CHECK DAMS IN DITCHES <3' DEEP.

CHECK DAM NOTES

CHECK DAM INSTALLATION

1. SEE PLAN VIEW FOR:
   1.1. LOCATION OF CHECK DAMS
   1.2. CHECK DAM TYPE
   1.3. LENGTH (L), CREST LENGTH (CL), AND DEPTH (D).
2. CHECK DAMS SHALL BE INSTALLED AFTER PERIMETER CONTROLS, BUT PRIOR TO ANY UPSTREAM LAND DISTURBING ACTIVITIES.
3. RIPRAP UTILIZED FOR CHECK DAMS SHOULD BE OF APPROPRIATE SIZE FOR THE APPLICATION. CHECK DAMS WILL BE CONSTRUCTED OF 6" TO 12" ANGULAR ROCK.
4. RIPRAP PAD SHALL BE TRENCHED INTO THE GROUND A MINIMUM OF 1' FOR DITCHES WITH A DEPTH OF 3' OR GREATER.
5. THE ENDS OF THE CHECK DAM SHALL BE A MINIMUM OF 1/2 THE DITCH DEPTH, OR 1' 6", WICH EVER IS SMALLER.

CHECK DAM MAINTENANCE

1. INSPECT BMPS ACCORDING TO THE APPLICABLE STORM WATER PLAN SCHEDULE AND MAINTAIN THEM IN EFFECTIVE OPERATING CONDITION. MAINTENANCE OF BMPS IN A PROACTIVE MANNER, NOT REACTIVE. INSPECT BMPS AS SOON AS POSSIBLE FOLLOWING APPLICABLE STORM EVENTS AND PERFORM NECESSARY MAINTENANCE.
2. FREQUENT OBSERVATIONS AND MAINTENANCE ARE NECESSARY TO MAINTAIN BMPS IN EFFECTIVE OPERATING CONDITION. INSPECTION AND CORRECTIVE MEASURES SHOULD BE DOCUMENTED.
3. WHERE BMPS HAVE FAILED, REPAIR OR REPLACEMENT SHOULD BE INITIATED UPON DISCOVERY OF THE FAILURE.
4. SEDIMENT ACCUMULATED UPSTREAM OF THE CHECK DAMS SHALL BE REMOVED WHEN THE SEDIMENT DEPTH IS WITHIN 1/2 OF THE HEIGHT OF THE CREST.
5. CHECK DAMS ARE TO REMAIN IN PLACE UNTIL THE UPSTREAM DISTURBED AREA IS STABILIZED.
6. WHEN CHECK DAMS ARE REMOVED, EXCAVATIONS SHALL BE FILLED WITH SUITABLE COMPACTED BACKFILL. DISTURBED AREA SHALL BE SEEDED AND MULCHED OR OTHERWISE STABILIZED AS PROJECT APPROPRIATE.

Culvert (C)

Description

Culverts are a means of subsurface storm water conveyance where surface transport is not feasible. Culverts are most often used to convey water under a roadway without impeding use of the road.

Uses

● Meets full use/application; ○ meets use/application under certain circumstances; and no symbol indicates not appropriate/applicable.

●	Erosion Control		Good Housekeeping
	Sediment Control		Snow Management
	Chemical/Pollutant Control		

Applications

	Cut/Fill Transitions		Pollution/Material Sources
●	Ditches		Sediment Traps/Basins
	Exposed Areas		Site Perimeter
●	Inlets and Outlets		Slopes
	Near Water/Wetlands		Toe of Slopes

Soils

●	Clay		Rocky Subgrade
●	Sand		
●	Loam		

Culverts may be used as:

- Ditch relief culverts to periodically relieve the roadside ditch by piping water to the opposite side of the road where the flow can be dispersed away from the roadway;
- Drainage crossings in streams and small channels typically under access roads; and
- A means of conveying storm water where surface transport is not feasible.

Selection Considerations

- Culverts can be utilized in crossings of major waterways, but require site specific design and may require additional permitting with state and federal agencies;
- Undersized culverts may cause flooding/ponding above inlet which may lead to erosion if water overtops or failure/washout of the culvert;
- As a general rule, culverts should be oversized rather than undersized to help mitigate future problems;
- If a location has limited height for installation of a culvert, consider installation of a “squash pipe” or arch pipes and box culverts (these maximize capacity while minimizing height);
- Culverts may fill with sediment and debris and require periodic cleanout; and

- Culverts may become crushed/damaged and require periodic maintenance.

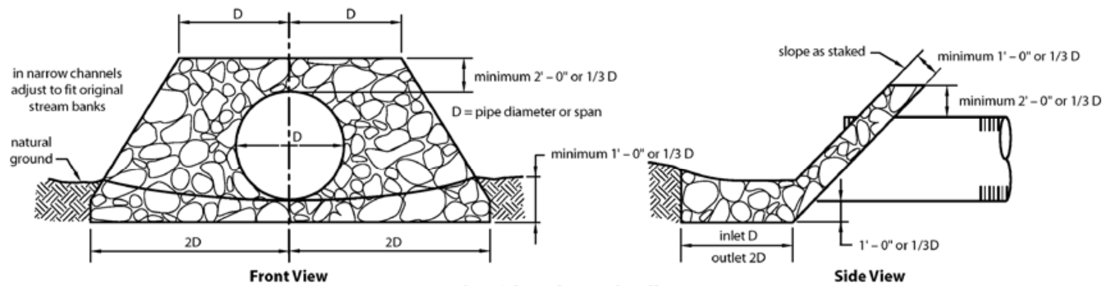
Design and Installation

- In the absence of site-specific designs or manufacture specific designs, this standard culvert installation design may be used, provided the design is appropriate for the situation;
- Culverts should have a minimum diameter of 18 in. or as site-specific hydrologic analysis indicates;
- The culvert outlet should extend at least 1 ft beyond the toe of any slope and discharge on grade;
- Ensure culvert discharges into a stabilized area (stabilization can be achieved with culvert outlet protection, erosion control blankets, or other similar stabilization BMPs);
- It may be necessary to install riprap or other energy dissipation devices at the inlet and outlet end of the culvert;
- Culverts may be constructed of concrete, corrugated metal pipe, corrugated plastic pipe (when properly bedded and backfilled);
- Inspect culverts for damage prior to installation (including any protective coatings such as Zinc);
- Culverts must be buried to a sufficient depth to ensure protection of the culvert and prevent lifting;
- When installing ditch relief culverts, try to install with an entrance angle of 45-60 degrees with the side of the ditch for better flow;
- Ditch relief culverts should have a greater gradient (at least 2% steeper) than the ditch for improved flow;
- Ditch relief culvert spacing is dependent on road grade and soils erosivity (reference Recommended Culvert Spacing Table for specifics);
- Most soils are satisfactory for use as bedding or backfill if free from obstructions such as roots or rocks (larger than 7.5 cm in backfill or larger than 3.8 cm in bedding) and do not have excessive moisture;
- Ideal backfill is moist, well graded granular or sandy gravel soil with up to 10% fines and free of rocks;
- Backfill needs to be well compacted (must match background compaction or a density of 90-95%);
- Uniform compaction is best achieved by backfilling in layers and compacting each layer individually; and
- Avoid the use of fine sand and silt rich soils for bedding material.

Maintenance and Removal

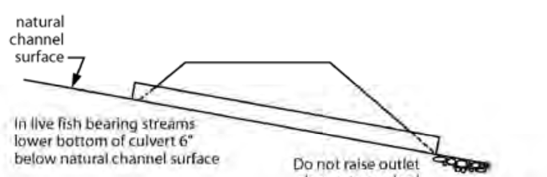
Inspections should be conducted in accordance with the Storm Water Plan. Inspect for damage, sediment buildup, or obstructed flow to culvert, inlet/outlet protection and promptly repair. Culverts are typically designed for permanent installation. If a culvert is removed, the disturbed area must be recontoured to match surrounding grade and stabilized. A culvert should only be removed when upslope concentrated flow is no longer directed to the culvert location.

CULVERT FIGURES

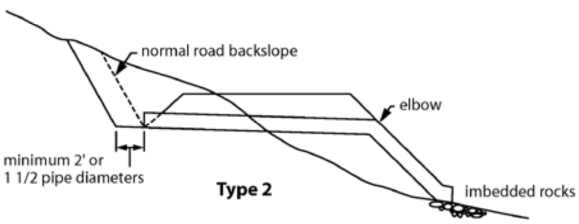


Hand–Laid Rock Headwalls

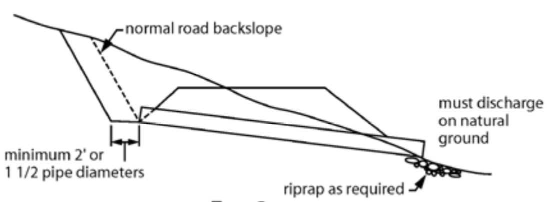
Culvert Construction Details



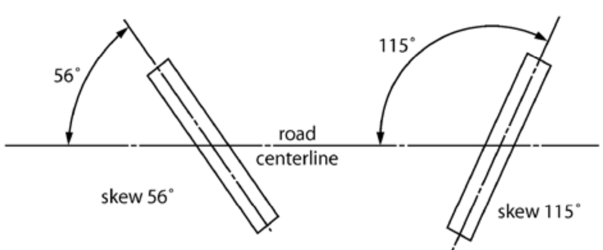
Type 1



Type 2

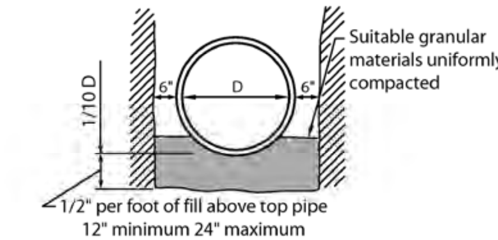


Type 3

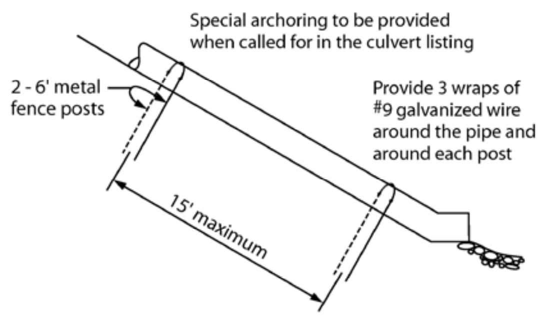


Skew Diagram

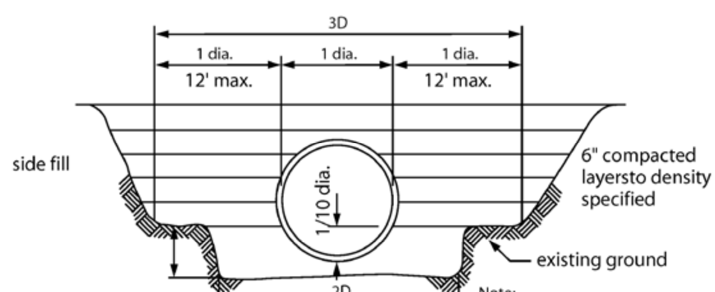
Typical Bedding Details



Rock Foundation



Special Anchoring Type 2 Downdrains



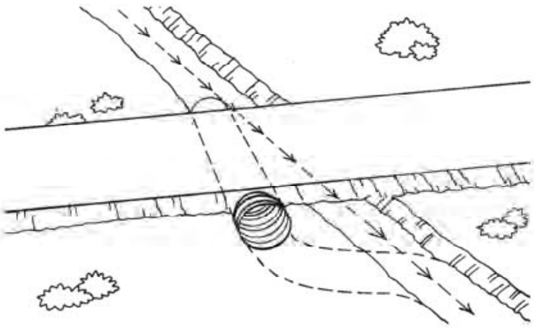
Note:
Bedding blanket to be suitable granular material roughly shaped to fit bottom of pipe

Sidefill

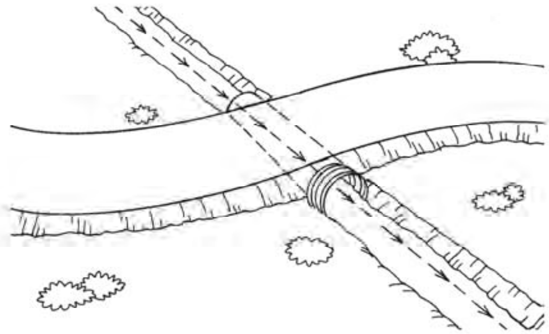
Note:
Minimum cover for paved surface is 12" minimum cover for dirt surface is 18"

Compiled by H2E, Inc.	Updated: 12/2020	Not to Scale	Culvert Figures	SHEET 1 OF 2

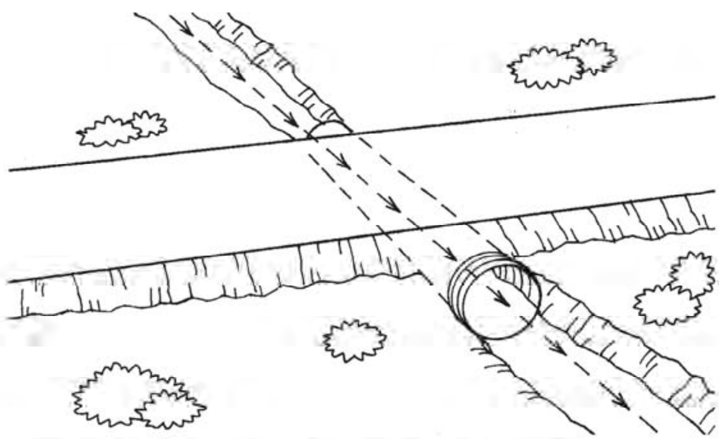
CULVERT FIGURES



Poor – Requires a stream channel modification.



Adequate – No channel modifications but requires a curve in the road.



Best – No channel modification, and the road is perpendicular to the culvert without a curve in the road alignment.

GENERAL CULVERT SIZING

DRAINAGE AREA (ACRES)	STEEP SLOPES LIGHT VEGETATION C=0.7	GENTLE SLOPES HEAVY VEGETATION C=0.2	NOTES:
	ROUND PIPE (IN)	ROUND PIPE (IN)	1. IF PIPE SIZE IS NOT AVAILABLE, USE THE NEXT LARGER PIPE SIZE. FOR INTERMEDIATE TERRAIN, INTERPOLATE BETWEEN PIPE SIZES.
0 - 10	30"	18"	2. PIPE SIZE IS BASED ON THE RATIONAL FORMULA AND CAPACITY CURVES. RAINFALL INTENSITY OF 3"/HR TO 4"/HR. VALUES OF "C" ARE THE RUNOFF COEFFICIENTS FOR THE TERRAIN.
10 - 20	42"	24"	
20 - 37	48"	30"	
37 - 74	72"	42"	

NOTE: CULVERT SIZING IS IDEALLY BASED UPON SITE-SPECIFIC HYDROLOGIC ANALYSIS.

DITCH RELIEF CULVERT SPACING

SOIL TYPE	ROAD GRADE 2 - 4%	ROAD GRADE 5 - 8%	ROAD GRADE 9 - 12%
HIGHLY EROSIVE GRANITIC OR SANDY	240'	180'	140'
INTERMEDIATE EROSIVE CLAY OR LOAD	310'	260'	200'
INTERMEDIATE EROSIVE CLAY OR LOAD	400'	325'	250'
	MAXIMUM RECOMMENDED CULVERT SPACING		

Dewatering (DW)

Description

Dewatering applications typically involve the use of pumps to move water from an inundated area to an area suitable for discharge. The discharge point must have a sediment control BMP (e.g. dewatering bag, sediment basin/trap) prior to storm water moving downslope to a well vegetated area or other applicable storm water control. Typical dewatering operations have multiple inline BMPs to prevent erosion and control sediment movement.

Dewatering requirements will vary by project and site-specific features (soils, topography, discharge location, proximity to waterways, and anticipated water volume) will dictate the BMPs required.

Uses

● Meets full use/application; ○ meets use/application under certain circumstances; and no symbol indicates not appropriate/applicable.

○	Erosion Control		Good Housekeeping
●	Sediment Control		Snow Management
	Chemical/Pollutant Control		

Applications

	Cut/Fill Transitions		Pollution/Material Sources
	Ditches		Sediment Traps/Basins
●	Exposed Areas	●	Site Perimeter
	Inlets and Outlets		Slopes
●	Near Water/Wetlands	●	Toe of Slopes

Soils

●	Clay	●	Rocky Subgrade
●	Sand		
●	Loam		

Selection Considerations

- State and local jurisdictions may have additional criteria (e.g. dewatering must be retained on location) and/or permitting requirements;
- Dewatering of groundwater or water sources other than storm water may be prohibited by state and/or local regulations; and
- Dewatered storm water must be free of chemicals, hydrocarbons, and other contaminants.

Design and Installation

Dewatering operations must be continually manned to ensure proper function of the storm water controls and prevent off-site discharge of sediments.

Dewatering Bag:

- Size dewatering bag according to anticipated volume/pressure requirements;
- Ensure dewatering bag is firmly attached to discharge hose and that manufacture specific pressures/flow rates are followed;
- Place dewatering bag on relatively flat and stable ground (e.g. rock pad) or on strawbales; and
- Locate dewatering bag and/or install additional downslope controls to ensure dewatering bag does not cause erosion or uncontrolled downslope sediment movement.

Sediment Basin/Trap:

- Inspect existing sediment basin/trap for compliance with basin/trap design prior to use in dewatering;
- Monitor storm water leaving sediment basin/trap for evidence of sediment and modify controls/process if sediment is found to be discharging;
- Ensure discharge point into sediment basin/trap is at the opposite end of the control from the outlet; and
- Discharge into sediment basin/trap using preexisting stabilized inlet or add additional stabilization (e.g. riprap) to prevent erosion at discharge point.

Maintenance and Removal

Inspect all inline BMPs for proper function and stop dewatering operations if damaged or ineffective controls are identified.

If discharging directly into a dewatering bag:

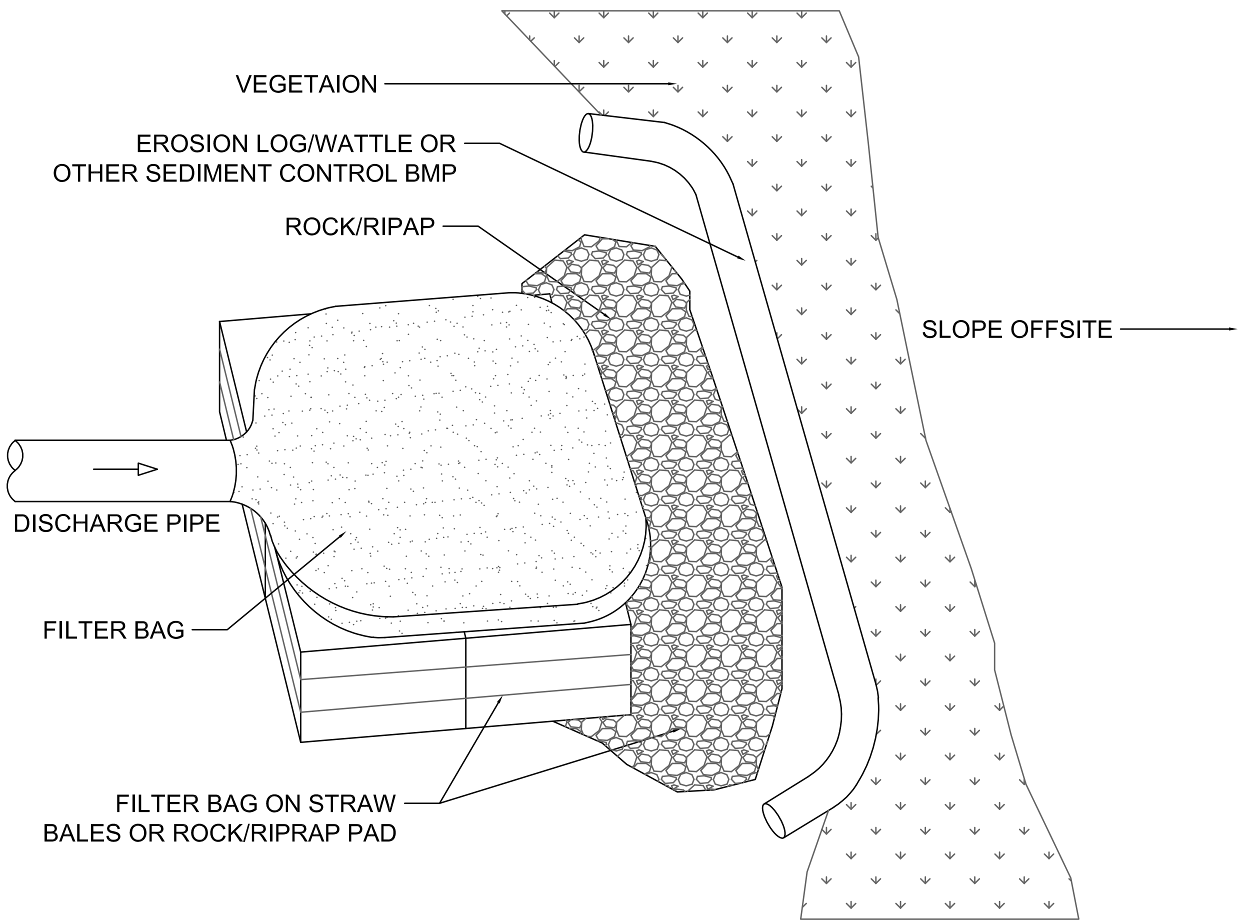
- Ensure bag is properly attached to hose;
- Inspect bag for tears/damage and replace as applicable;
- Monitor bag throughout dewatering operations for reduced flow caused by sediment buildup within the bag; and
- Cleanout or replace bag as necessary to maintain proper function or in accordance with manufacturer specifications.

If discharging directly into a sediment basin/trap:

- Remove sediment prior to the control reaching half filled;
- Monitor storm water leaving sediment basin/trap for evidence of sediment and modify controls/process if sediment is found to be discharging; and
- Follow all sediment basin/trap guidelines.

Remove dewatering bag and collected sediment once dewatering operations are complete. Collected sediment can be redistributed within origin area. Ensure waste dewatering bags are removed from location and disposed of properly.

DEWATERING FIGURES



DEWATERING FILTER BAG

Ditch/Drainage Swale (D/DS)

Description

A ditch or drainage swale is a drainage with a parabolic, trapezoidal, or V-shaped cross-section and may include a dike/berm on the lower side that is constructed across the slope. The purpose of a ditch is to prevent off-site storm water runoff (run-on) from entering a disturbed area, to prevent sediment laden storm runoff from leaving the construction site or disturbed area, to prevent flows from eroding slopes, and to direct sediment laden flows to a trapping device.

Uses

● Meets full use/application; ○ meets use/application under certain circumstances; and no symbol indicates not appropriate/applicable.

●	Erosion Control		Good Housekeeping
○	Sediment Control		Snow Management
	Chemical/Pollutant Control		

Applications

	Cut/Fill Transitions		Pollution/Material Sources
●	Ditches	●	Sediment Traps/Basins
○	Exposed Areas	●	Site Perimeter
○	Inlets and Outlets	●	Slopes
	Near Water/Wetlands	●	Toe of Slopes

Soils

●	Clay		Rocky Subgrade
○	Sand		
●	Loam		

Ditches may be designed for temporary or permanent use. Regardless of timeframe, a ditch should be sufficiently constructed throughout to minimize the potential for failure. Ditches may be used for, but are not limited to:

- Up slope of cut or fill slopes to convey or divert flows away from disturbed areas;
- Down slope of cut or fill slopes to divert on-site runoff to a stabilized outlet or sediment trapping device;
- At the outer edge of a location to ensure that runoff remains on the pad and is diverted to a designated water collection system, such as a sediment trap, pond, etc. (if applicable);
- Where runoff from higher areas has the potential to cause erosion or interfere with the establishment of vegetation on lower areas;
- Where the slope lengths need to be reduced in order to keep soil loss to a minimum; and
- At the perimeter of a site or disturbed area.

Selection Considerations

- The area around a ditch, that is disturbed by its construction, must be stabilized (with vegetation or other erosion control);
- Overburden needs to be sufficiently compacted upon initial ditch construction;
- Ditches must be directed into a stabilized outlet, a well-vegetated area, or a sediment trapping device where sediment can be settled out of the runoff before being discharged into surface waters;
- Temporary ditches should be designed to avoid crossing vehicle pathways but if a ditch needs to cross a vehicle pathway, a culvert and or similar BMPs must be utilized; and
- Ditches should be used with caution on soils subject to slippage.

Design and Installation

- All ditches shall have uninterrupted positive grade to an outlet and shall be parabolic, trapezoidal, or V-shaped;
- Parabolic and trapezoidal shapes are preferred over V-shaped to minimize concentration of flow in center of ditch and limit erosion;
- The ditches shall be excavated or shaped to line, grade, and cross section as required to meet the specific criteria, depending on ditch design;
- All ditches must be cut to a minimum depth of 15 in. from the top of the ditch to the bottom center;
- The side slopes must be 3:1 (H:V) to ensure ease of maintenance, minimize erosion, and allow the ditch to adequately disperse flow;
- In the event of an excavated ditch and berm, all overburden needs to be sufficiently compacted along the ditch edge;
- All trees, brush, stumps, obstructions, and other objectionable material shall be removed and disposed of so as not to interfere with the proper functioning of the ditch. Ideally, the ditch will be cut in a location that avoids obstructions and or objects as to avoid additional disturbance;
- All earth that is removed and not needed in the construction process shall be spread or disposed of on the construction project so it will not interfere with the functioning of the ditch;
- Stabilization BMPs shall be incorporated into all ditches immediately after the channel is constructed in order to minimize erosion, degradation, and sediment deposition from the ditch;
- Permanent ditches must be seeded and mulched, hydroseeded, or covered with erosion control blanketing;
- Diverted runoff from a disturbed area shall be conveyed to a sediment trapping device; and
- Diverted runoff from an undisturbed area shall outlet to a sediment trapping device or into an undisturbed stabilized area at non-erosive velocities. Vegetative outlets shall be installed before ditch construction, if needed, to ensure establishment of vegetative cover in the outlet channel.

Ditches are usually located above or below cut or fill slopes. Exact ditch location shall be determined by considering outlet conditions, topography, land use, soil type, length of slope, and the development layout. Where possible on shallow slopes, a vegetative buffer strip should be left between the edge of the cut or fill slope and the ditch.

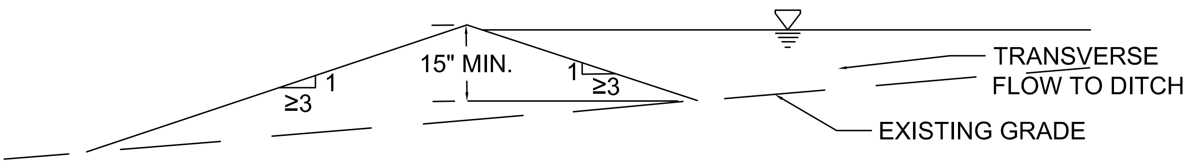
Ditches are usually not applicable below high sediment producing areas unless structural measures, designed to prevent damaging accumulations of sediment in the channels, are installed with or before the ditch.

Maintenance and Removal

The frequency of inspections shall be in accordance with the Storm Water Plan. Ditches should be cleared of sediment and repaired when necessary. Redistribute the sediment as necessary to maintain the capacity of the ditch and berm.

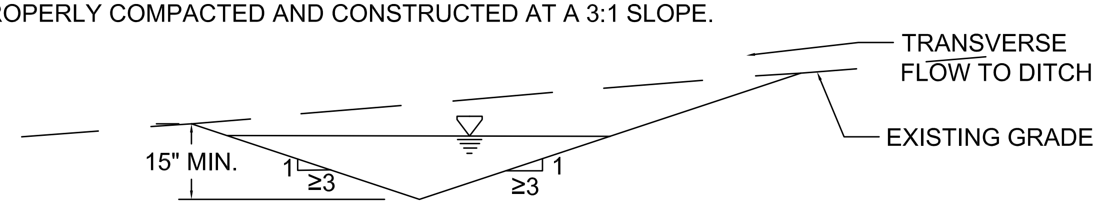
Ditches should remain in place and in good condition until the disturbed areas are permanently stabilized. If the ditches are not permanent, remove ditches once the overall facility is stabilized. Areas where ditches are removed should be stabilized with vegetation or other permanent stabilization methods.

DITCH/DRAINAGE SWALE FIGURES

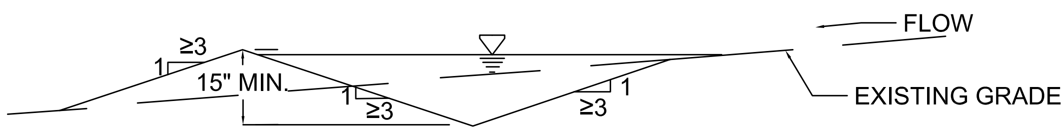


COMPACTED UNLINED EARTH DITCH FORMED BY BERM

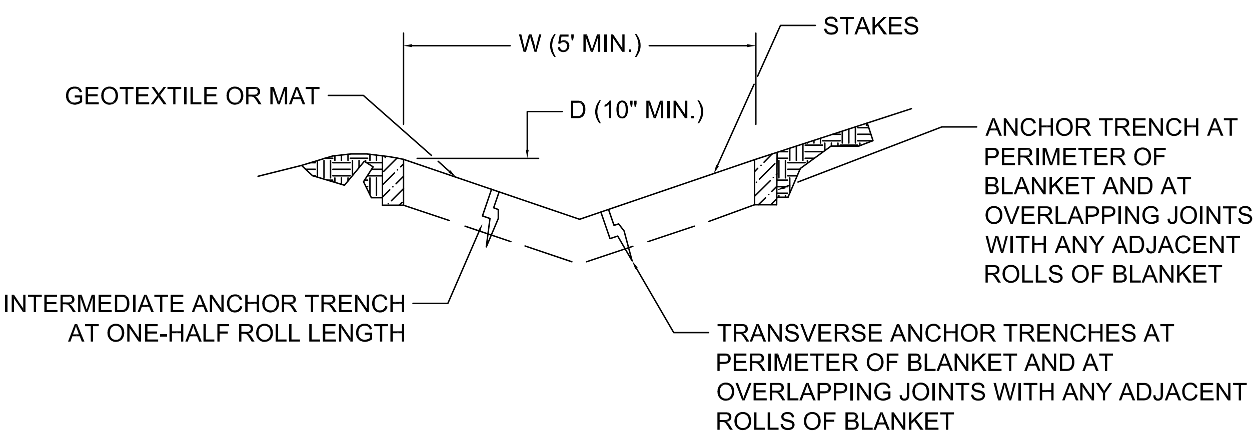
OPTIONAL: AN INTERIOR BERM IS OPTIONAL IF ALL OVERBURDEN GENERATED DURING THE CONSTUCTION PHASE IS REMOVED AND PROPERLY STORED ON LOCATION. ALL OVERBURDEN THAT REMAINS ALONG THE SIDES OF AN EXCAVATED DITCH (EXTERIOR & INTERIOR) MUST BE PROPERLY COMPACTED AND CONSTRUCTED AT A 3:1 SLOPE.



COMPACTED UNLINED EXCAVATED DITCH/SWALE



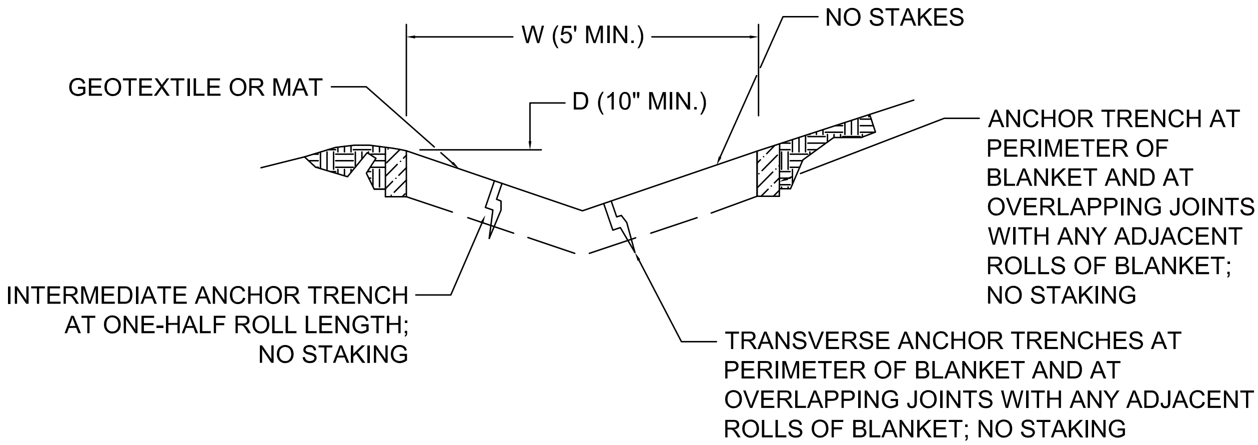
COMPACTED UNLINED EXCAVATED DITCH/SWALE FORMED BY CUT AND FILL



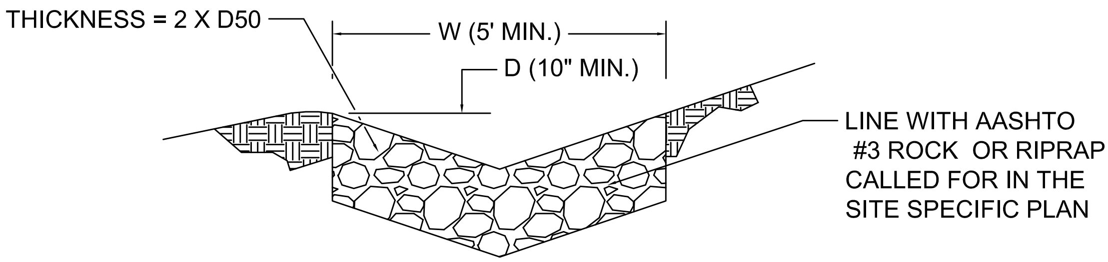
LINED DITCH/SWALE (CUT AND FILL OR BERM)

1. EXCAVATED OR FILL MATERIAL USED TO CREATE A DITCH/SWALE AND BERM MUST BE COMPACTED.
2. LOCATIONS WITH SITE-SPECIFIC ENGINEERED DITCH AND BERM DESIGNS WILL BE FOLLOWED IN LIEU OF THIS STANDARD DESIGN AND WILL BE DOCUMENTED IN THE SITE-SPECIFIC STORM WATER PLAN.

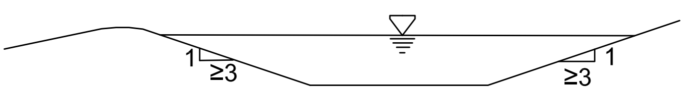
DITCH/DRAINAGE SWALE FIGURES



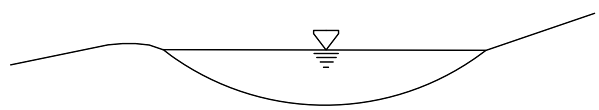
SYNTHETIC LINED DITCH/SWALE



RIPRAP LINED DITCH/SWALE



Trapezoidal Shape



Parabolic Shape

1. DITCH/SWALE SHOULD BE INSTALLED PRIOR TO LAND DISTURBING ACTIVITIES IN PROXIMITY.
2. EMBANKMENT AND BERMS SHOULD BE COMPACTED TO 90% OF MAXIMUM DENSITY AND WITHIN 2% OF OPTIMUM MOISTURE CONTENT ACCORDING TO ASTM D698.
3. SWALES SHALL DRAIN TO A STABILIZED OUTLET AND/OR SEDIMENT CONTROL BMP.
4. FOR LINED DITCHES, INSTALLATION OF EROSION CONTROL/SOIL RETENTION BLANKETS SHALL CONFORM TO THE EROSION CONTROL/SOIL RETENTION BLANKET REQUIREMENTS.
5. WHEN CONSTRUCTION TRAFFIC MUST CROSS A DIVERSION SWALE, INSTALL A TEMPORARY CULVERT WITH A MINIMUM DIAMETER OF 12 INCHES.
6. TRAPEZOIDAL OR PARABOLIC SHAPED DITCH/SWALES ARE PREFERRED SO THAT FLOW IS NOT CONCENTRATED IN THE BOTTOM CENTER OF A V DITCH. V DITCHES ARE EASIER TO CONSTRUCT AND MORE COST EFFECTIVE TO CONSTRUCT THEREFORE BETTER SUITED FOR TEMPORARY INSTALLATIONS.

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Compiled by H2E, Inc.	Updated: 12/2020	Not to Scale	DITCH/DRAINAGE SWALE FIGURES	SHEET 2 OF 2

Ditch Turnout (DT)

Description

Ditch turnouts (diversion ditch) are used to disperse concentrated ditch flows (typically associated with roadways) into well vegetated areas. Ditch turnouts reduce flow volumes and velocities, therefore reducing erosion potential. Ditch turnouts are important for stability of unpaved roads.

Uses

● Meets full use/application; ○ meets use/application under certain circumstances; and no symbol indicates not appropriate/applicable.

●	Erosion Control		Good Housekeeping
	Sediment Control		Snow Management
	Chemical/Pollutant Control		

Applications

	Cut/Fill Transitions		Pollution/Material Sources
●	Ditches	●	Sediment Traps/Basins
	Exposed Areas		Site Perimeter
●	Inlets and Outlets		Slopes
	Near Water/Wetlands		Toe of Slopes

Soils

●	Clay	○	Rocky Subgrade
●	Sand		
●	Loam		

Selection Considerations

- Ditch turnouts should be installed where long continuous roadside ditches and steep slopes combine to produce increased flow volume and velocities which may result in erosion;
- Ditch turnouts should only be installed where they will direct flows away from the road and roadside ditch into a well vegetated and stable area (typically in areas of gradual slopes); and
- If not properly installed/constructed, ditch turnouts can become another source of sediment.

Design and Installation

- Ditch turnouts should have a draining slope of ~3% and drain into a well vegetated area;
- Angle ditch turnouts at 20-40 degrees;
- Ensure that the receiving area will maintain its natural contour and that channelization does not develop;
- A ditch turnout should maintain the contour elevation without any sharp drops or changes in contour;
- A ditch turnout should typically only service an area of 2 acres or less;

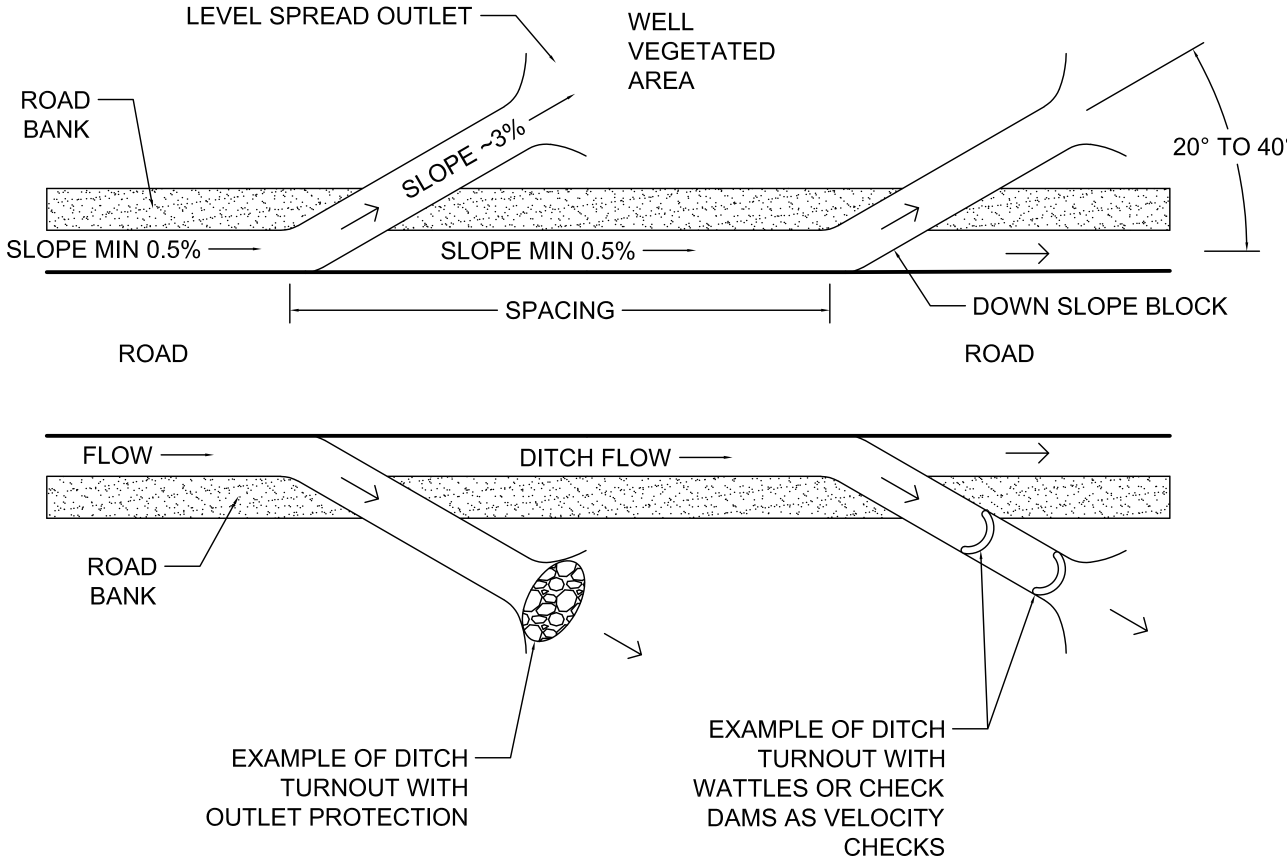
- Ditch turnout should be stabilized with vegetation, rolled erosion control products, riprap, or other applicable controls;
- Optional - outlet protection can be installed at the ditch turnout termination point;
- Optional - rock or wattle checks can be installed in ditch turnouts to control velocity and as sediment control; and
- Space ditch turnouts based on the grade and natural topography.

Maintenance and Removal

Inspections should be conducted in accordance with the Storm Water Plan. Inspect ditch turnouts for signs of erosion, sediment buildup, bypass, and overall stabilization. Repair all erosion and implement additional BMPS as needed to address cause of erosion. Remove and redistribute sediment in its original source location.

Ditch turnouts are typically installed as a permanent control and do not require removal. In the event that a ditch turnout is removed, ensure the area is regraded to match the natural terrain and that the area is stabilized with alternative controls.

DITCH TURNOUT FIGURES



DITCH TURNOUT SPACING	
GRADE OF ROAD %	**DISTANCE BETWEEN DITCH TURNOUTS**
<2%	INSTALLER DISCRETION
2%	~200'
3-5%	~150'
5-10%	~100'
>10%	~80' OR LESS

1. TOPOGRAPHY, EXPECTED FLOW AND OTHER SITE SPECIFIC FACTORS MAY REQUIRE DEVIATIONS FROM SUGGESTED SPACING.
2. SPACING DITCH TURNOUTS CLOSER TOGETHER IS MORE EFFECTIVE THAN WIDER SPACING.

Earth Dike/Berm (ED/B)

Description

An earth dike (berm) is a temporary or permanent ridge of compacted soil located at the top or base of a sloping disturbed area to intercept and divert surface runoff away from areas not yet stabilized. It can also be installed around a pollutant source to prevent storm water and pollutants from leaving the location. Berms will typically be constructed from compactable subsoils which are sufficiently impermeable to retain water. Berms may be combined with lined or unlined drainage swales/ditches to divert storm water to additional sediment control BMPs prior to discharge from a site.

Uses

● Meets full use/application; ○ meets use/application under certain circumstances; and no symbol indicates not appropriate/applicable.

●	Erosion Control		Good Housekeeping
○	Sediment Control		Snow Management
●	Chemical/Pollutant Control		

Applications

	Cut/Fill Transitions	●	Pollution/Material Sources
●	Ditches	●	Sediment Traps/Basins
	Exposed Areas	●	Site Perimeter
○	Inlets and Outlets	●	Slopes
	Near Water/Wetlands	●	Toe of Slopes

Soils

●	Clay	○	Rocky Subgrade
○	Sand		
●	Loam		

With regular maintenance, the life span of earthen berms can last throughout the construction project. Berms can be used in, but not limited to, the following applications:

- Constructed across roadways (transverse berm) at a slight angle with respect to the centerline;
- Constructed along the top edge of cut/fill slopes to divert flows away from disturbed areas;
- Constructed along the toe of exposed and erodible slopes to divert on-site runoff into a stabilized outlet or sediment control BMP;
- Constructed mid-slope of a disturbed area to intercept runoff and reduce the effective slope length;
- May be used on relatively flat slopes to capture surface runoff to shorten the overall slope length before it has a chance to concentrate and cause erosion; or
- As secondary containment around pollutant sources.

Selection Considerations

- Berms may erode if not properly maintained, compacted, and or stabilized;
- Berms which intercept high velocity concentrate flows may be susceptible to erosion and may require additional means of stabilization;
- Must use a secondary erosion control device when sediment control is an objective; and
- If a berm is installed across a vehicle roadway or entrance, the berm shall be compacted and widened to prevent impediment to traffic while maintaining function as a berm.

Design and Installation

- Construct berms using subsoils or other material that can be compacted to be sufficiently impervious. Top soil **may not** be used to construct this BMP;
- Berms must be compacted manually or by mechanical means;
- Berms should be constructed prior to commencement of major land disturbance activities; and
- Berms used as secondary containment must be lined or compacted and sufficiently impervious to retain liquids until the next routine inspection.

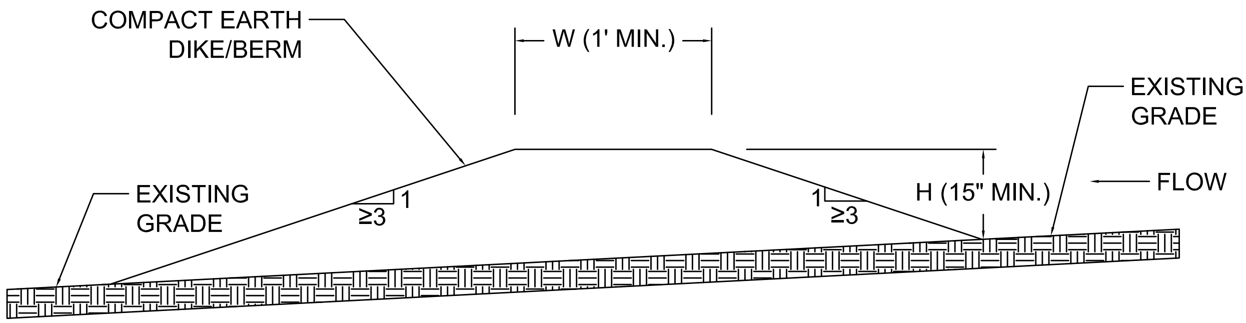
Maintenance and Removal

The frequency of inspections shall be in accordance with the Storm Water Plan. Berms should be inspected for signs of erosion, stability, and compaction. Any areas of damage or erosion should be repaired as necessary. If intensive or repeated maintenance is required to keep the control functional, then alternative or additional controls may be necessary.

When using berms, they should be maintained at or above the minimum required height.

Berms should remain in place and in good condition until the disturbed areas are permanently stabilized. If the berms are not permanent, remove berms once the overall facility is stabilized. Areas where berms are removed should be stabilized with vegetation or other permanent stabilization methods.

EARTH DIKE/BERM FIGURE



1. SOIL MUST BE COMPACTABLE AND SUFFICIENTLY IMPERVIOUS TO RETAIN/DEFLECT STORM WATER.
2. TOPSOIL SHALL NOT BE USED FOR THE CONSTRUCTION OF EARTHEN DIKE/BERMS.
3. MUST BE COMPACTED MANUALLY OR BY MECHANICAL MEANS.
4. BERMS USED AS SECONDARY CONTAINMENT MUST BE LINED OR COMPACTED AND SUFFICIENTLY IMPERVIOUS TO RETAIN LIQUIDS UNTIL THE NEXT ROUTINE INSPECTION.

Compiled by H2E, Inc.	Updated: 12/2020	Not to Scale	EARTH DIKE/BERM FIGURES	SHEET 1 OF 1

Erosion Logs/Wattles (EL/W)

Description

Erosion logs/wattles are temporary sediment controls shaped as linear rolls and constructed of a combination of excelsior, straw, coconut fibers, wood chips, or compost. Erosion logs are typically trenched in and secured in place using stakes. When properly installed, erosion logs form a sediment barrier to intercept sheet flow runoff from the disturbed area. This results in the velocity of sheet flows being reduced thus allowing sediment to be captured before the runoff is released as sheet flow by the control.

Uses

● Meets full use/application; ○ meets use/application under certain circumstances; and no symbol indicates not appropriate/applicable.

○	Erosion Control		Good Housekeeping
●	Sediment Control		Snow Management
	Chemical/Pollutant Control		

Applications

●	Cut/Fill Transitions		Pollution/Material Sources
	Ditches		Sediment Traps/Basins
●	Exposed Areas	●	Site Perimeter
	Inlets and Outlets	●	Slopes
●	Near Water/Wetlands	●	Toe of Slopes

Soils

●	Clay	○	Rocky Subgrade
○	Sand		
●	Loam		

Typical uses include:

- To intercept surface runoff, reduce flow velocities and capture sediment;
- On disturbed slopes to shorten flow lengths;
- As check dams in small drainage ditches (low flow);
- As perimeter control for stockpiles and disturbance boundaries; and
- As inlet protection.

Selection Considerations

- Not recommended for use in ditches, swales, or channels where continuous flows or high-volume flows are anticipated;
- Not to be used below the high-water mark in stream applications;
- Only intended as a temporary control and will degrade with time;

- Function will degrade as sediment builds up in and behind the control; and
- Erosion logs are prone to undercutting when used on sandy soils.

Design and Installation

- Should be installed on contour (perpendicular to flow) when used to intercept sheet flows or as check dams;
- The typical maximum allowable tributary area is 0.25 acres with up to 150 ft of disturbed slope (no steeper than 3:1 (H:V)) for every 100 linear feet of erosion log installed;
- When used as perimeter control or other similar use, install in a manner that will minimize concentrated flows (e.g. J-hook ends);
- Ensure proper spacing based on flow line gradient and erosion log dimensions;
- Erosion logs must be trenched and staked if lighter than 8 lb/ft;
- Recommend stakes at ends of erosion logs/wattles be placed at a 90 degree angle from each other to prevent lifting of ends; and
- When used at the toe of a slope, place 5-10 ft beyond the toe of the slope to allow room for ponding behind the control.

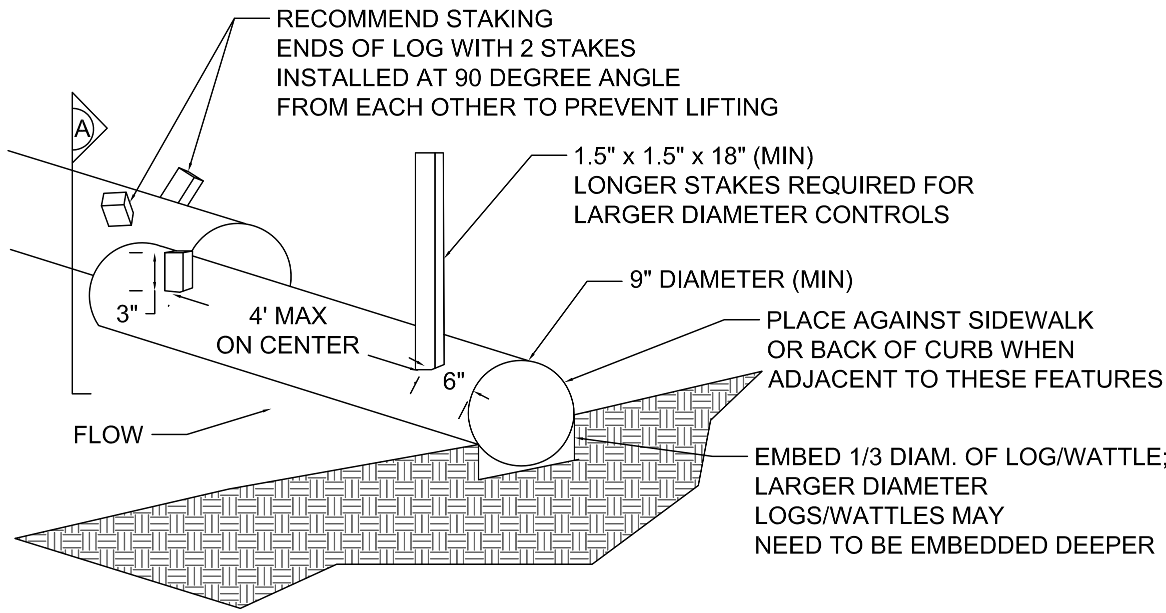
Maintenance and Removal

Inspections should be conducted in accordance with the Storm Water Plan. Inspect erosion control logs for damage, missing stakes, undercutting, improper installation, and sediment accumulation of 1/2 the height of the erosion log or greater. Initiate repairs, replacement or sediment removal as soon as possible.

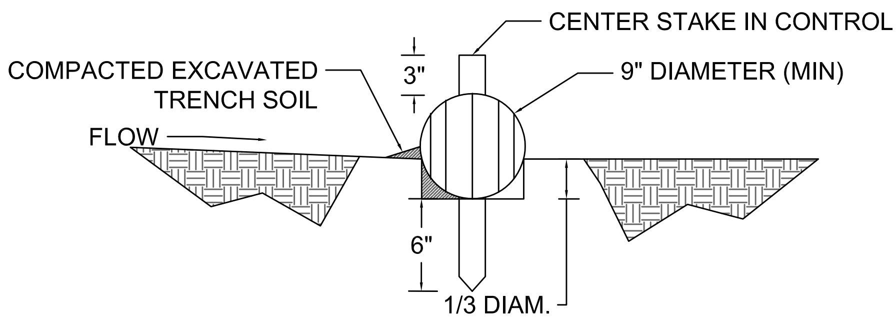
Erosion logs may be removed once the surrounding areas are stabilized. Areas disturbed under the controls may need seed/mulch. Erosion logs constructed of biodegradable materials may be left in place, especially when installed in difficult to reach or remote locations.

EROSION LOGS/WATTLE FIGURES

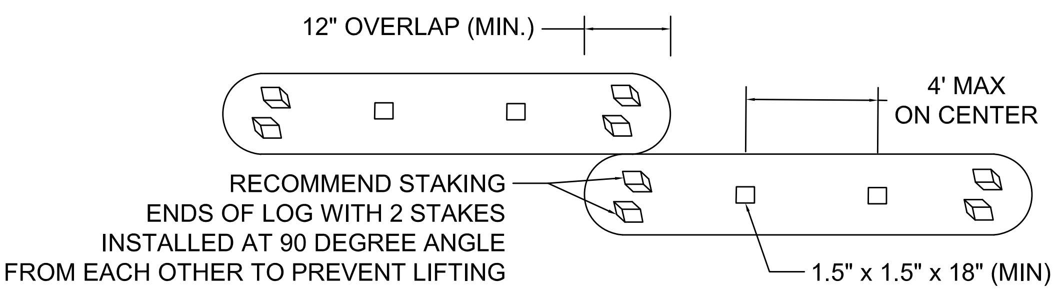
TRENCHED EROSION LOG/WATTLE DESIGN



TRENCHED SEDIMENT CONTROL LOG



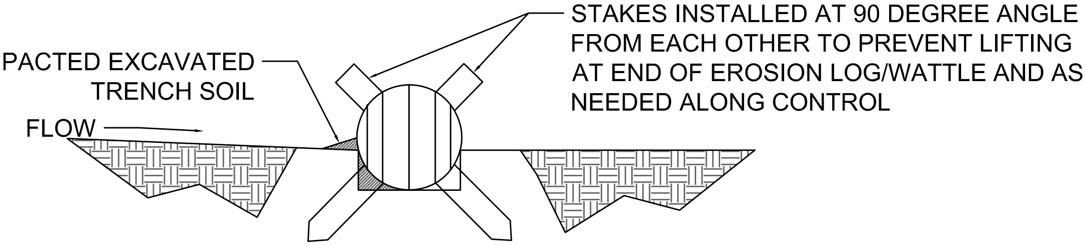
SECTION A TRENCHED SEDIMENT CONTROL LOG



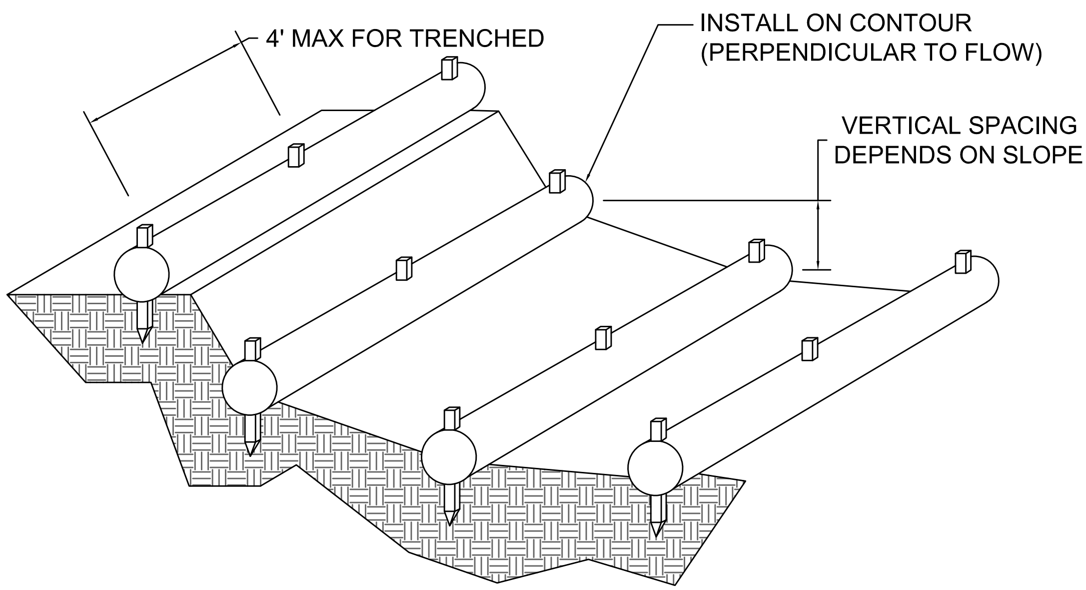
LOG JOINTS

Compiled by H2E, Inc.	Updated: 12/2020	Not to Scale	EROSION LOGS/WATTLE FIGURES	SHEET 1 OF 2

EROSION LOGS/WATTLE FIGURES



SECTION A TRENCHED SEDIMENT CONTROL LOG WITH CROSS STAKED END



EROSION LOGS/WATTLES TO CONTROL SLOPE LENGTH

FLOW LINE GRADIENT	**MAXIMUM SPACING BASED ON NOMINAL LOG DIAMETER (FEET)**		
	8" TO 9"	**12"**	**18" TO 20"**
0% TO 2%	30'	55'	75'
2% TO 5%	25'	40'	55'
5% TO 10%	15'	30'	40'
10% TO 33%	10'	15'	20'
33% TO 50%	5'	10'	15'

Good Housekeeping Practices (GH)

Description

Good housekeeping practices must be implemented in order to prevent storm water contamination with solid and liquid wastes generated in the construction process. Good housekeeping practices include but are not limited to employee and contactor training, designating material storage/staging areas, implementing spill prevention procedures, and developing spill response and cleanup procedures.

Uses

● Meets full use/application; ○ meets use/application under certain circumstances; and no symbol indicates not appropriate/applicable.

	Erosion Control	●	Good Housekeeping
	Sediment Control		Snow Management
●	Chemical/Pollutant Control		

Applications

	Cut/Fill Transitions	●	Pollution/Material Sources
	Ditches		Sediment Traps/Basins
●	Exposed Areas	●	Site Perimeter
	Inlets and Outlets		Slopes
	Near Water/Wetlands		Toe of Slopes

Soils

●	Clay	●	Rocky Subgrade
●	Sand		
●	Loam		

Selection Considerations

Good housekeeping practices will be project specific and depend on the identified pollutant sources. The selected good housekeeping practices must be discussed in the storm water plan and, when applicable, identified on the site-specific diagrams/maps.

Design and Installation

Include a discussion of the following good housekeeping practices in the storm water plan and, as applicable, identify on the site-specific diagrams/maps. Incorporate the following as applicable to the project:

Training

- Is key to ensuring all employees and contractors understand the importance of good housekeeping and the protection of storm water from pollutant sources;
- Ensures all employees and contractors understand the requirements of the storm water plan and associated BMPs;

- Ensures all employees and contractors are prepared to identify and respond to an uncontrolled pollutant source; and
- Facilitates discussion between the owner/construction manager and their employees and contractors.

Material Handling and Storage/Staging

- Retain all Safety Data Sheets (SDS) in an accessible location for all stored materials, chemicals, and hydrocarbons;
- Do not remove original manufacturer labels;
- Keep stored materials, chemicals, and hydrocarbons in original containers or properly designated containers;
- Keep bagged and boxed materials on pallets or similar elevated storage area (do not place directly on ground);
- Provide appropriately sized secondary containment or storage containers for applicable materials, chemicals, and hydrocarbons;
- Clearly designate delivery and storage areas;
- Routinely inspect storage for damaged, leaking, or improperly stored materials, chemicals, or hydrocarbons;
- Storage sheds/containers must be leak free;
- Minimize storage of materials, chemicals, and hydrocarbons on location (limit to anticipated need in a timely manner); and
- Keep well organized and leave adequate room between stored products to facilitate inspection, cleanup, or emergency response actions.

Waste Management

- Provide designated containers for trash disposal and recycling (if applicable);
- Ensure all waste containers are covered to prevent storm water contact or wind movement;
- Segregate wastes by type for proper disposal;
- Ensure all employees and contractors working on location are routinely cleaning the construction site of trash;
- Locate waste collection containers near waste sources or at the construction entrance; and
- Routinely empty waste containers to prevent overfilling.

Hazardous Materials and Waste

- If applicable, designate hazardous waste collection area(s);
- Provide adequately sized secondary containment for all hazardous waste storage;
- Properly label and handle all hazardous wastes; and
- Follow company specific waste management guidelines.

Sanitary and Septic Waste

- Provide onsite toilet facilities while construction is ongoing;
- Locate toilet facilities in convenient locations but away from waterways, wetlands, or other sensitive areas;
- All portable toilets must be staked, tied, or otherwise secured to prevent tipping; and
- Routinely dispose of sanitary and septic waste in accordance with state or local regulations.

Equipment/Vehicle Fueling and Maintenance

- Minimize the fueling and maintenance of equipment and vehicles on the construction site;
- Only minor unscheduled maintenance should be conducted on location, provided it can be done while protecting storm water;
- Routine and major maintenance should be conducted off location;
- Keep spill kits/materials on location near on-site fueling and maintenance areas;
- Routinely inspect vehicles and equipment for leaks;
- All chemical and fuel transfer operations shall be continuously monitored to minimize the risk of spills; and
- Use absorbent pads, drip pans, or other fluid control measures when drips or spills are possible.

Equipment/Vehicle Washing

- Minimize on-site vehicle and equipment washing;
- Use off-site dedicated washing facilities when possible;
- Keep wash water on location and treat with applicable BMPs; and
- Do not allow wash water to discharge off of the construction location.

Spill Prevention and Response Plan

- Develop a written spill prevention and response plan (may incorporate SPCC plan(s));
- Identify employees and/or contractors responsible for spill prevention and response;
- All employees and contractors shall adhere to company specific environmental, health, and safety plans, rules, and programs;
- Prioritize employee, contractor, and public safety followed by stopping the source of a spill and containing on-site;
- Keep an ample supply of spill cleanup materials and equipment near storage, loading/unloading, and refueling areas;
- Adhere to all federal, state, and local rules and regulations for response, cleanup, reporting, and disposal.

Hydraulically Applied Mulch (HM)

Description

Hydraulically applied mulch is a temporary stabilization control measure that facilitates long term stabilization by promoting vegetation establishment. Hydroseeding equipment is used to apply a layer of natural and biodegradable fibers, along with an adhesive-like material, uniformly over disturbed soil areas. The combination of natural fibers and adhesive-like material protects the soil from rainfall impacts, channeling, wind erosion, and protects seed until permanent vegetation is established. Seed and other enhancements such as fertilizer may be applied in the hydromulch solution in certain circumstances.

Uses

● Meets full use/application; ○ meets use/application under certain circumstances; and no symbol indicates not appropriate/applicable.

●	Erosion Control		Good Housekeeping
○	Sediment Control		Snow Management
	Chemical/Pollutant Control		

Applications

●	Cut/Fill Transitions		Pollution/Material Sources
●	Ditches	●	Sediment Traps/Basins
●	Exposed Areas		Site Perimeter
●	Inlets and Outlets	●	Slopes
●	Near Water/Wetlands	●	Toe of Slopes

Soils

●	Clay	○	Rocky Subgrade
●	Sand		
●	Loam		

- Provides immediate but temporary stabilization once applied;
- Can be used as temporary stabilization where dirt work is complete or temporarily stopped and not anticipated to begin again for more than 14 days;
- Can be used as interim stabilization when season does not facilitate seeding operations;
- Helps to retain moisture, aid seed germination, and moderate soil temperatures facilitating vegetation establishment.

Selection Considerations

- Seed must be applied before or during hydromulch application when stabilizing in preparation for final stabilization;
- Application typically requires at least 24 hours drying time before exposure to precipitation;

- Livestock and wildlife can have a detrimental impact on the function and longevity of the application;
- Not recommended for areas of channelized or concentrated flows;
- Recommended for application on dry slopes of 2:1 (H:V) or flatter; and
- Application is not effective on saturated soils, areas with seeps, or seasonal springs.

Design and Installation

- Follow manufacturer recommended application rates or in the absence of manufacturer information, apply at a rate of no less than 1,500 lb/acre (1425 lb of fiber mixed with 75 lb of tackifier; for steeper slopes, up to 3000 lb/acre may be required);
- Recommend using maximum rate when applied to critical areas;
- Application must be uniform across exposed soils;
- Apply with a hydro-mulcher;
- Underapplication or “thin” applications are prone to failure when uniform coverage is not achieved;
- Avoid applications to roads, waterways, sidewalks, lined drainage channels and existing vegetation;
- Test a small area with hydraulically applied mulch prior to large scale application; and
- Recommend applying from multiple angles to ensure uniform distribution.

Maintenance and Removal

Inspections should be conducted in accordance with the Storm Water Plan. Inspect for damaged areas typically resulting from human, wildlife, or livestock impacts. If small areas are found requiring repair, spread and hydrate granular hydraulic mulch products over the repair areas.

Hydromulch is biodegradable and does not need removal.

Mulching (M)

Description

Mulching is a temporary erosion control used to stabilize exposed soils while waiting for vegetation to establish. Mulch protects soils from rain impacts and wind erosion, increases infiltration, and helps regulate soil temperatures. Typically, agricultural straw or hay is mechanically applied and crimped in or wood splinters/fibers are surface applied by hand or machinery. Tackifiers may be sprayed over the applied mulch to enhance stabilization.

Uses

● Meets full use/application; ○ meets use/application under certain circumstances; and no symbol indicates not appropriate/applicable.

●	Erosion Control		Good Housekeeping
	Sediment Control		Snow Management
	Chemical/Pollutant Control		

Applications

●	Cut/Fill Transitions		Pollution/Material Sources
	Ditches		Sediment Traps/Basins
●	Exposed Areas	●	Site Perimeter
	Inlets and Outlets	●	Slopes
●	Near Water/Wetlands	●	Toe of Slopes

Soils

●	Clay		Rocky Subgrade
●	Sand		
●	Loam		

Selection Considerations

- Typically applied as a stabilizer before or promptly following seed application;
- Can be applied to disturbed areas as a stabilization strategy when dirt work is temporarily stopped for 14 days or more;
- Material availability can impact use of this control;
- Long strand straw/hay is more effective when crimped into soil as compared to shorter strands which tend to resist crimping;
- Mulch has the potential to introduce weeds or other non-desirable species (only weed free);
- Wood splinter/fibers are inherently less susceptible to wind and water movement than other forms of mulch;
- Wood splinter bales used as sediment controls can be repurposed and spread as wood splinter mulch thus helping to reduce costs;
- Agricultural hay or straw can clog downslope inlets of other controls; and

- Works best when applied to slopes of 3:1 (H:V) or flatter, steeper slopes should consider using rolled erosion control products.

Design and Installation

- Projects adjacent to sensitive areas must use certified weed free agricultural straw or hay;
- For areas to be seeded, soil shall be prepared (with topsoil reapplied for final stabilization) and free of rocks, woody debris or soil clumps prior to mulch application;
- Straw mulch should be applied at a rate of 1.5-2 tons per acre;
- Mechanically apply straw or hay mulch over the entire area;
- Avoid creating areas of thick mulch application (over 3 in. deep) as this can impair germination of vegetation;
- Evenly apply mulch;
- Do not apply straw or hay mulch during windy conditions;
- Straw and hay mulch must be stabilized in place by crimping, application of tackifier, or netting;
- Tackifiers are suitable for small areas with gentle slopes sheltered from the wind and heavy runoff; and
- Crimpers must be capable of tucking the straw and hay mulch fibers into the soil to a depth of 3 in. without cutting the fibers.

Mulch Material	Quality Standards	Application Rates		Depth of Application	Anchoring Methods	Remarks
		Per 1000 ft2	Per Acre			
ORGANIC MULCHES						
Grass hay or cereal grain straw	Air dried, weed free. Should be at least 2/3 grass species	75-100 lb 2-3 bales	1.5-2.5 tons 90-120 bales	Lightly cover 75-90 % of the surface.	Mulch Anchoring tool or disk, wood cellulose fiber, tackifier, netting	Good to use where mulch is needed for up to 3 months. Prone to blowing if not properly disked or stabilized.
REGULAR MULCHES						
Wood Excelsior	Wood fibers 4" long	90 lb 1 bale	2 tons		Netting, Peg and Twine, Slit	Anchoring required only on critical areas or sites subjected to high winds.
Wood Splinters or Bark Shavings	Green or air dried. Hardwood species are preferred.	500-900 lb	10-20 tons	2-4"	(Optional) Netting, Peg and Twine, Slit	Recommend applying 20-25 lb Nitrogen/ton wood to prevent Nitrogen deficiency during decay. Resists wind movement.

Maintenance and Removal

Inspections should be conducted in accordance with the Storm Water Plan. Inspect for areas of excessive mulch buildup or areas of minimal coverage and redistribute as required to achieve even coverage.

Mulch is biodegradable and does not require removal.

Riprap (R)

Description

Riprap is a layer of loose stone installed to stabilize and protect the underlying soils from erosion or movement. When properly sized and installed, riprap can be resistant to high velocity concentrated flows.

Uses

● Meets full use/application; ○ meets use/application under certain circumstances; and no symbol indicates not appropriate/applicable.

●	Erosion Control		Good Housekeeping
	Sediment Control		Snow Management
	Chemical/Pollutant Control		

Applications

	Cut/Fill Transitions		Pollution/Material Sources
●	Ditches	●	Sediment Traps/Basins
	Exposed Areas		Site Perimeter
●	Inlets and Outlets		Slopes
●	Near Water/Wetlands		Toe of Slopes

Soils

●	Clay	○	Rocky Subgrade
●	Sand		
●	Loam		

Selection Considerations

- Common uses of riprap include the stabilization of cut and fill slopes, channels, inlets and outlets of culverts or other discharge structures, and slope drains;
- Slopes of 1.5:1 (H:V)or steeper may not be suitable for riprap alone as the stones may be unstable and prone to movement;
- Displacement of riprap may occur if a slope is too steep or if the installed riprap is too small;
- Typically used where erosive forces exceed the soil or vegetative covers ability to resist erosion; and
- Riprap lined channels must be designed for the installation of riprap as it reduces the flow capacity of the channel once installed.

Design and Installation

- Follow site specific or engineered designs when available;
- Riprap should be hard, durable, and not prone to breakdown when exposed to the weathering;
- Riprap can be sourced from the field or a quarry;
- Stones should be rough and angular;
- Riprap shall be a well graded mixture of stone size so that 50% by weight, shall be larger than the d50 size;
- A well graded mixture means a mixture of mostly larger stones, but with sufficient other sizes to fill in the gaps/voids between the larger stones (diameter of the largest stone size in the mixture shall be 1.5 times the d50 size and the smallest sizes shall be 1 in.);
- Minimum riprap thickness shall be 1.25 times the maximum stone diameter or 6 in, whichever is greater;
- Riprap stone size shall be selected based on the application (slope stabilization, channel stabilization, outlet protection, etc.);
- Any fill material should be compacted to a density approximating the undisturbed soils;
- The toe of the riprap should consist of larger rocks and be entrenched;
- In situations where groundwater is not an issue, a nonwoven geotextile filter fabric (type of rolled erosion control product) can be placed directly on the soil surface as a filter blanket and then covered with 3 in. of gravel;
- In situations where groundwater is an issue or if more protection is required, provide the riprap with 6 in. of granular fill underlayment covered with a nonwoven geotextile filter fabric as a drainage layer;
- When using stones of 12 in. or greater, provide a 3-4 in. deep layer of gravel (3/4 in. washed stone) to distribute the load and protect the granular fill underlayment and/or nonwoven geotextile filter fabric;
- No filter fabric should have an equivalent opening size (EOS) of less than No. 100 (intended for soils with fine-grained silts and clays) nor should the filter fabric have less than 4% open area;
- Filter fabric with EOS No. 70 is appropriate for most soils; and
- Riprap should not be layered or simply dumped into place during installation as this may cause the various stone sizes to be separated or may cause damage to the underlayment.

Slope Stabilization

- Stone size shall be selected to ensure that the natural angle of repose of the stone is less than the slope of the installation location;
- Angle of repose does not take into consideration other factors such as vibrations (adjacent to roadway); and
- Slope stabilization does not add significant resistance to slope failure and should not be used as a retaining wall or on naturally unstable soils.

Outlet Protection

See Culvert (C) and Velocity Dissipation Devices (VDD) designs for details.

Filter Blanket

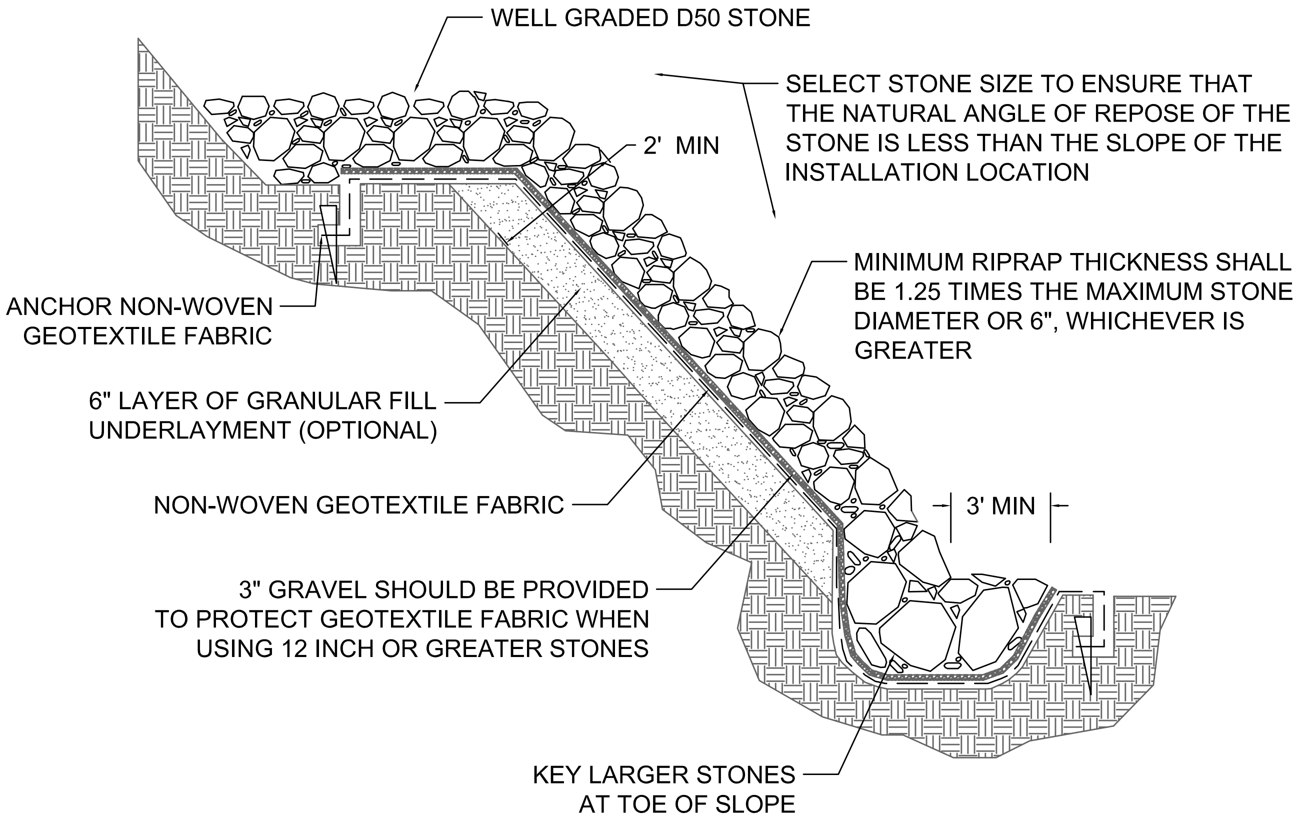
- Is a layer of material that may be placed between the underlying soil and the riprap to help prevent erosion and help support the riprap layer;
- Although not required, it is recommended that rolled erosion control products (and/or a well graded gravel or sand-gravel layer) be used as a filter blanket.
- For stabile design of a gravel filter blanket:
    - $\frac{d_{15}\, filter}{d_{85}\, base} < 5$
    - $5 < \frac{d_{15}\, filter}{d_{50}\, base} \leq 40$
    - $\frac{d_{50}\, filter}{d_{50}\, base} \leq 40$
        - Filter is the overlying material and base is the underlayment material;
        - These 3 relationships should hold between the base and filter and the filter and riprap to prevent migration of the material;
- Filter fabric thickness 20-60 mils; and
- Grab strength 90-120 lb.

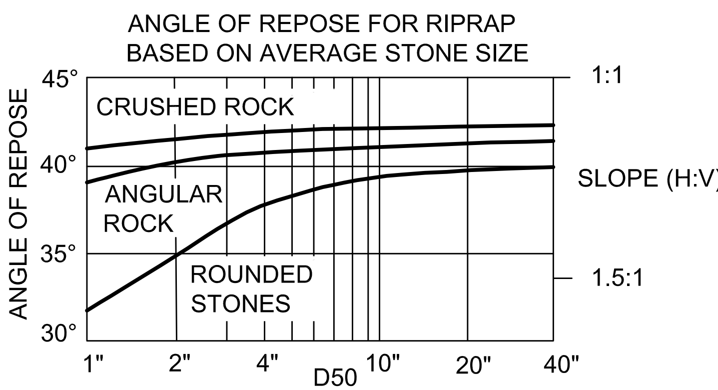
Maintenance and Removal

Inspections should be conducted in accordance with the Storm Water Plan. Inspect for stone movement, scour, or sediment buildup at toe. Repair/replace in accordance with installation instructions. Additionally, inspect for establishment of weeds/invasive vegetation and control as applicable.

Riprap is typically a long term or permanent control and does not need removed. In the event that riprap is removed, ensure all stones and synthetic filter blankets/liners are removed and that the area is stabilized with alternative controls.

RIPRAP FIGURES





Sediment Basin (SB)

Description

Sediment basins are used to temporarily pond and capture eroded soil transported in storm water runoff. Sediment basins are designed to capture runoff in a large pool or pond and allow sediment to fall out of suspension prior to discharge. Sediment basins work by ponding storm water thereby dissipating enough energy for sediment to fall out of suspension. This process will only occur if storm water is retained in the pond for a sufficient amount of time.

Uses

● Meets full use/application; ○ meets use/application under certain circumstances; and no symbol indicates not appropriate/applicable.

	Erosion Control		Good Housekeeping
●	Sediment Control		Snow Management
○	Chemical/Pollutant Control		

Applications

	Cut/Fill Transitions	○	Pollution/Material Sources
●	Ditches	●	Sediment Traps/Basins
●	Exposed Areas	●	Site Perimeter
	Inlets and Outlets		Slopes
●	Near Water/Wetlands	●	Toe of Slopes

Soils

○	Clay	●	Rocky Subgrade
●	Sand		
●	Loam		

Selection Considerations

- Typically installed at projects disturbing a minimum of 2 acres or at smaller projects near sensitive habitats;
- Sediment basins are typically not suitable for long, linear projects (see sediment traps or other applicable BMPs);
- Sediment basins work best as a final storm water control with other erosion and sediment controls installed upslope;
- Sediment basins should be installed before disturbing upslope areas; and
- Sediment basins will typically need to be designed to fit the site-specific needs and topography.

Design and Installation

Storage Volume

- Must have a minimum storage volume of 3,600 cubic per acre of drainage area;
- Minimize project run-on from undisturbed areas to avoid unnecessary storm water being directed to the sediment basin; and
- For undisturbed but stable undeveloped areas that cannot be diverted away from the sediment basin, provide a minimum of 500 cubic feet per acre of additional storage above the minimum 3,600 cubic feet per acre of disturbed area.

Geometry

- Sediment basins must be designed with a minimum length to width ratio of 2:1 (L:W) to ensure sufficient retention time of storm water;
- If a 2:1 (L:W) length is not achievable due to space limitations, baffles may be installed within the sediment pond to increase the distance between inlet and outlet points; and
- Embankment slopes should be kept to 4:1 (H:V) or flatter with no location's steeper than 3:1 (H:V).

Inlet/Outlet

- Provide energy dissipation at inflow when sediment basin receives concentrated flow;
- Extend the outlet pipe through the embankment at a minimum slope of 0.5%;
- Typical outlet design for basins treating 15 acres or less is the riser pipe;
    - Alternative outlet designs may include an orifice plate or floating skimmer which will require site specific designs;
- Provide outlet protection for all outlet flow paths;
- A riprap apron or other means of stabilization will be required when discharge velocities may cause erosion;
- Provide a stabilized emergency spillway for sediment basins; and
- Emergency spillway should be well stabilized with riprap or other stabilizing BMPs.

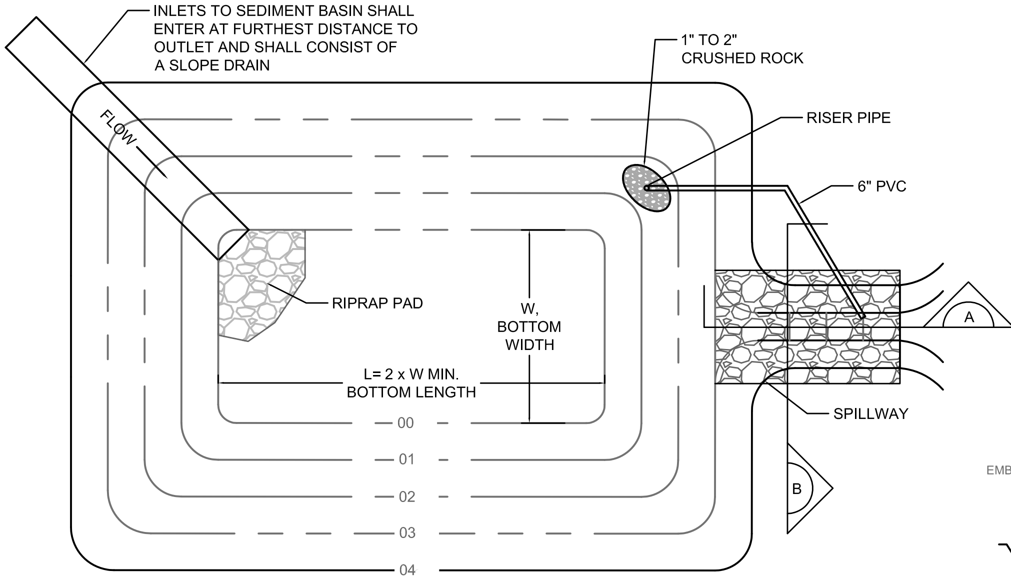
Maintenance and Removal

Inspections should be conducted in accordance with the Storm Water Plan. Inspect the sediment basin inlet and outlet for signs of erosion, debris, or sediment buildup. Inspect the embankment for signs of erosion, damage, settling, stability, and signs of seepage. Inspect the basin for sediment buildup and initiate sediment removal when the design storage volume is no more than 1/3 filled (Typically 1 ft deep for this standard design).

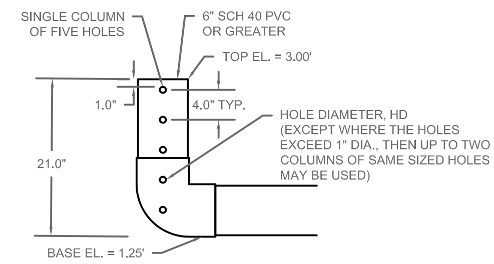
Repair all damage as soon as possible with emphasis on repairs being completed before the next precipitation event. Clean out all debris or sediment from the inlet, outlet, and basin.

Sediment basins may be a temporary or long-term BMP depending on the site-specific requirements. Sediment basins can only be removed once the upslope area has reached final stabilization or been permanently stabilized by other means. Check with local jurisdictions before removal of a sediment basin that requires dewatering as additional permits may be required. Ensure that all riprap, piping, rolled erosion control products, and other materials are removed from the location prior to filling the basin area with soil. Stabilize the reclaimed basin area with vegetation or other permanent stabilization methods.

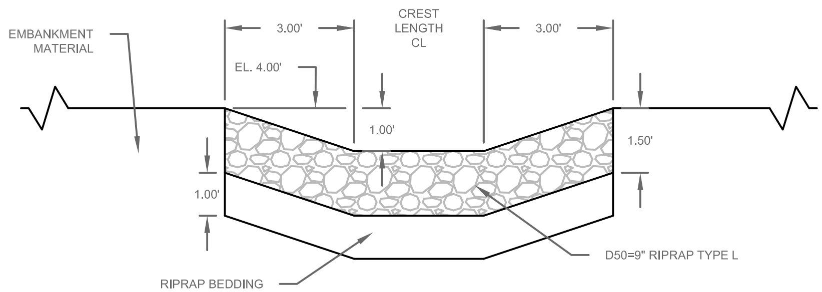
SEDIMENT BASIN FIGURES



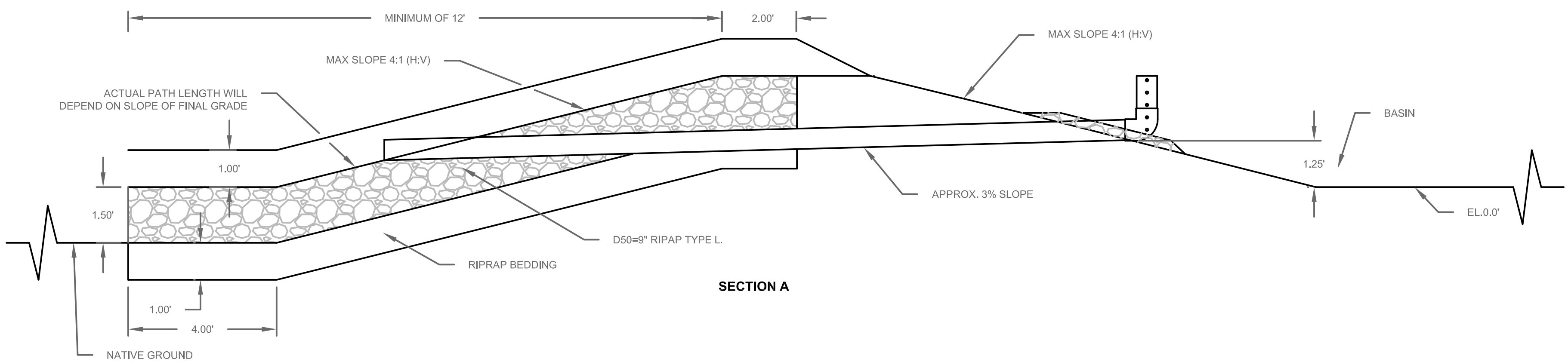
SEDIMENT BASIN PLAN



RISER PIPE



SECTION B



SECTION A

Compiled by H2E, Inc.	Updated: 12/2020	Not to Scale	SEDIMENT BASIN FIGURES	SHEET 1 OF 2

SEDIMENT BASIN FIGURES

SIZING INFORMATION FOR STANDARD SEDIMENT BASIN			
UPSTREAM DRAINAGE AREA (ROUNDED TO NEAREST ACRE), (AC)	BASIN BOTTOM WIDTH (W), (FT)	SPILLWAY CREST LENGTH (CL), (FT)	HOLE DIAMETER (HD), (IN)
1	12 1/2	2	9/32
2	21	3	13/16
3	28	5	1/2
4	33 1/2	6	9/16
5	38 1/2	8	21/32
6	43	9	21/32
7	47 1/4	11	25/32
8	51	12	27/32
9	55	13	7/8
10	58 1/4	15	15/16
11	61	16	31/32
12	64	18	1
13	67 1/2	19	1 1/16
14	70 1/2	21	1 1/8
15	73 1/4	22	1 3/16

IMPERVIOUSNESS (%)	ADDITIONAL STORAGE VOLUME (FT^3) PER ACRE OF TRIBUTARY AREA
UNDEVELOPED	500
10	800
20	1230
30	1600
40	2030
50	2470
60	2980
70	3560
80	4360
90	5300
100	6460

1. FOR STANDARD BASIN, BOTTOM DIMENSION MAY BE MODIFIED AS LONG AS BOTTOM AREA IS NOT REDUCED.
2. SEDIMENT BASIN SHALL BE INSTALLED PRIOR TO ANY OTHER LAND-DISTURBING ACTIVITY THAT RELIES ON BASINS AS A STORM WATER CONTROL.
3. EMBANKMENT MATERIAL SHALL CONSIST OF SOIL FREE OF DEBRIS, ORGANIC MATERIAL, AND ROCKS OR CONCRETE GREATER THAN 3 INCHES AND SHALL HAVE A MINIMUM OF 15 PERCENT BY WEIGHT PASSING A NO. 200 SIEVE.
4. EMBANKMENT MATERIAL SHALL BE COMPACTED TO AT LEAST 95 PERCENT OF MAXIMUM DENSITY IN ACCORDANCE WITH ASTM D698.
5. PIPE SCH 40 OR GREATER SHALL BE USED.
6. THE DETAILS SHOWN PERTAIN TO STANDARD SEDIMENT BASIN(S) FOR DRAINAGE AREAS LESS THAN 15 ACRES. INDIVIDUAL SITE SPECIFIC DESIGNS ARE REQUIRED FOR ALL SEDIMENT BASINS DESIGNED FOR DRAINAGE AREAS LARGER THAN 15 ACRES.
7. CHECK LOCAL JURISDICTIONS FOR BMP DETAILS THAT VARY FROM THIS DESIGN.

Sediment Trap (ST)

Description

Sediment traps are temporary sediment control BMPs constructed by excavating a depression or by placing an earthen berm across a low area or drainage swale. Sediment traps slow and temporarily detain sediment laden runoff. The reduction in velocity (energy) allows sediment to fall out of suspension and collect in the sediment trap before the runoff is discharged into a stabilized area. This process will only occur if storm water is retained in the trap for a sufficient amount of time.

Uses

● Meets full use/application; ○ meets use/application under certain circumstances; and no symbol indicates not appropriate/applicable.

	Erosion Control		Good Housekeeping
●	Sediment Control		Snow Management
○	Chemical/Pollutant Control		

Applications

	Cut/Fill Transitions	○	Pollution/Material Sources
●	Ditches	●	Sediment Traps/Basins
●	Exposed Areas	●	Site Perimeter
	Inlets and Outlets		Slopes
●	Near Water/Wetlands	●	Toe of Slopes

Soils

○	Clay	●	Rocky Subgrade
●	Sand		
●	Loam		

Selection Considerations

- Sediment traps should be installed before disturbance of upslope areas;
- Use sediment traps in areas of concentrated flow or at discharge points;
- Sediment traps may require frequent cleanout and/or maintenance;
- Should only be used to control sediment from small drainage areas (typically less than 1 acre);
- Sediment traps can be combined with other sediment traps in series to increase effectiveness;
- Sediment traps can be used with other sediment control measures to increase effectiveness; and
- Sediment traps are not as effective at settling fine particles, such as clay or silt, compared to heavier particles like sand.

Design and Installation

- Excavate a depression or install a berm to construct a detention area;

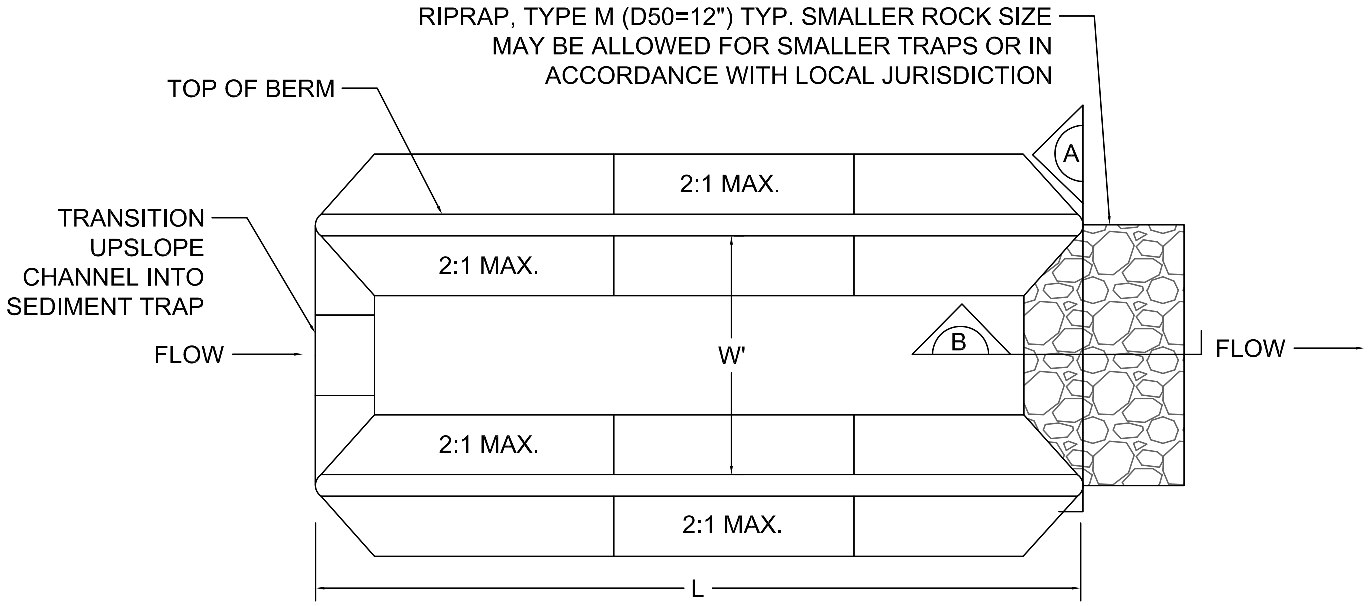
- Sediment traps are most effective when the length is greater than the width (optimal size is $L \geq 2 \times W$);
- Compact berms to 95% of the maximum density;
- Depression walls or berms shall have maximum slopes of 2:1 (H:V);
- Provide a stabilized outlet using riprap or other stabilization controls;
- If using riprap for outlet stabilization; see the riprap specification for details;
- Typical riprap size for sediment trap outlets is $D50 = 12$ in.;
- Construct the top of the earthen berm so that it is a minimum of 6 in. higher than the top of the riprap outlet; and
- Construct the ends of the riprap outlet structure so that they are a minimum of 6 in. higher than the outlet structure center.

Maintenance and Removal

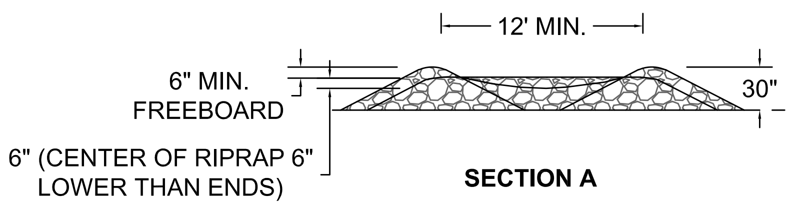
Inspections should be conducted in accordance with the Storm Water Plan. Inspect sediment traps for damage or failure and for sediment and debris buildup. Sediment traps need to be cleaned out when sediment has built up to 1/2 of the height of the riprap outlet.

Sediment traps are temporary and shall be removed when the upslope disturbed areas are stabilized with vegetation or other permanent stabilization measures. Ensure that all riprap, rolled erosion control products, and other materials are removed from the location prior to filling the sediment trap depression or spreading the earthen berm. Stabilize the reclaimed basin area with vegetation or other permanent stabilization methods.

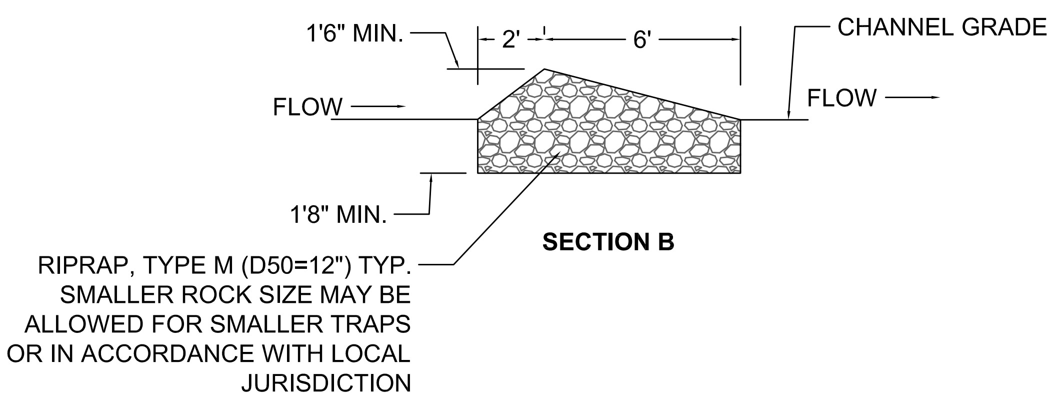
SEDIMENT TRAP FIGURES



SEDIMENT TRAP PLAN



SECTION A



SECTION B

Seeding (S)

Description

Seeding, to establish perennial vegetative cover following construction, is the best long term stabilization control for areas not stabilized with other permanent controls (pavement, concrete, road base, etc.). Establishing perennial vegetation stabilizes the soil, reduces wind and water erosion, minimizes sheet flow, increases infiltration, and reduces overall runoff volumes.

Seeding can be used to establish temporary stabilization when dirt moving activities have ceased and will not resume for an extended period of time (30 days or longer). Typically, a quick growing annual cover crop will be planted, provided that the time of year is conducive to germination and growth.

Uses

● Meets full use/application; ○ meets use/application under certain circumstances; and no symbol indicates not appropriate/applicable.

●	Erosion Control		Good Housekeeping
○	Sediment Control		Snow Management
	Chemical/Pollutant Control		

Applications

●	Cut/Fill Transitions		Pollution/Material Sources
●	Ditches		Sediment Traps/Basins
●	Exposed Areas	●	Site Perimeter
	Inlets and Outlets	●	Slopes
●	Near Water/Wetlands	●	Toe of Slopes

Soils

●	Clay	○	Rocky Subgrade
○	Sand		
●	Loam		

Selection Considerations

- Seeding must be combined with other temporary stabilization BMPs to prevent erosion while waiting for vegetation germination and maturation;
- Select a seed mix (species and seeding rates) that is applicable to the climate, region, and site-specific soils;
- Seeding for permanent stabilization must be applied only after all dirt work is complete and topsoil has been redistributed;
- Soil amendments may be required on a site-specific basis;
- Planting technique can greatly impact success of seed germination;
- Seeding is typically combined with mulch or rolled erosion control products; and

- Topsoil must be properly conserved, handled, and stored for use in reclamation.

Design and Installation

- Ensure all grading, soil preparation, topsoil distribution (permanent seeding only), and amendment applications are complete before seeding;
- If soil quality is a concern, soil testing may be beneficial to identify limiting factors and recommend amendments;
- The ground surface should be rough and firm, but not compacted or too loose (rip or roto-till if needed);
- Seed to soil contact is vital for germination;
- Ensure that poor quality subsoils are not mixed with topsoil during dirt work;
- Select native and/or desirable species based on preexisting or background vegetation communities and/or in accordance with landowner or jurisdictional requirements;
- Ensure the seed mix has a combination of warm and cool season species;
- Drill seeding is the preferred method but hydroseeding or hand seeding can be used where steep slopes prevent use of drill seeding equipment;
- If hand seeding or broadcast seeding, application rates should be doubled;
- Seeding for final stabilization should commence within 14 days following construction completion, provided that seasonal conditions are favorable (e.g. ground is not frozen, not in the dry, hot part of summer, etc.);
- Seeding is most effective when conducted in the spring, between late March and mid-May, and in the fall, between early September and when the ground freezes; and
- Cover seeded areas with mulch (can be applied before seeding) or other temporary stabilization BMPs to prevent erosion while waiting for vegetation germination and maturation.

Maintenance and Removal

Inspections should be conducted in accordance with the Storm Water Plan. Inspect seeded areas for erosion, soil impacts (vehicle traffic or disturbance), and the condition of associated BMPs. Implement repairs or install additional temporary BMPs as needed to stabilize the areas until vegetation can be established. Inspect seeded areas for even germination and vegetative health following the first growing season. Spot seed and/or add additional mulch as identified by inspections. Monitor seeded areas for invasive, noxious, or other undesirable species of vegetation and implement mechanical or chemical controls as necessary to control.

Typically, it only takes one growing season for seed to germinate and establish an even cover. Yearly variations in precipitation and temperature can influence the results and should be considered when evaluating reclamation success. Areas of poor or no growth may require reseeding.

Once vegetation is well established, the associated temporary BMPs can be removed if applicable.

Silt Fence (SF)

Description

Silt fence is a temporary sediment control designed to intercept storm water runoff from disturbed areas. Silt fence works by ponding storm water which allows sediment to fall from suspension. Silt fence is typically constructed of a woven geotextile fabric attached to or stretched across supporting stakes. The fabric is trenched into the ground to prevent water from bypassing the control.

Uses

● Meets full use/application; ○ meets use/application under certain circumstances; and no symbol indicates not appropriate/applicable.

	Erosion Control		Good Housekeeping
●	Sediment Control		Snow Management
	Chemical/Pollutant Control		

Applications

●	Cut/Fill Transitions		Pollution/Material Sources
	Ditches		Sediment Traps/Basins
●	Exposed Areas	●	Site Perimeter
	Inlets and Outlets		Slopes
●	Near Water/Wetlands	●	Toe of Slopes

Soils

○	Clay		Rocky Subgrade
●	Sand		
●	Loam		

Selection Considerations

- The effective lifespan is between 5 and 8 months;
- Should be installed down gradient of disturbed areas;
- Can be installed as perimeter control for the construction project or for receiving waters;
- Can be installed around temporary stockpiles;
- Can be installed at the toe of exposed slopes prone to erosion;
- Not intended for intercepting concentrated flows or as flow diversion;
- Does not work in areas of continuous ponding;
- Has an increased risk of failure/damage when installed in high wind areas; and
- Should not be used as mid slope protection when slopes are steeper than 4:1 (H:V).

Design and Installation

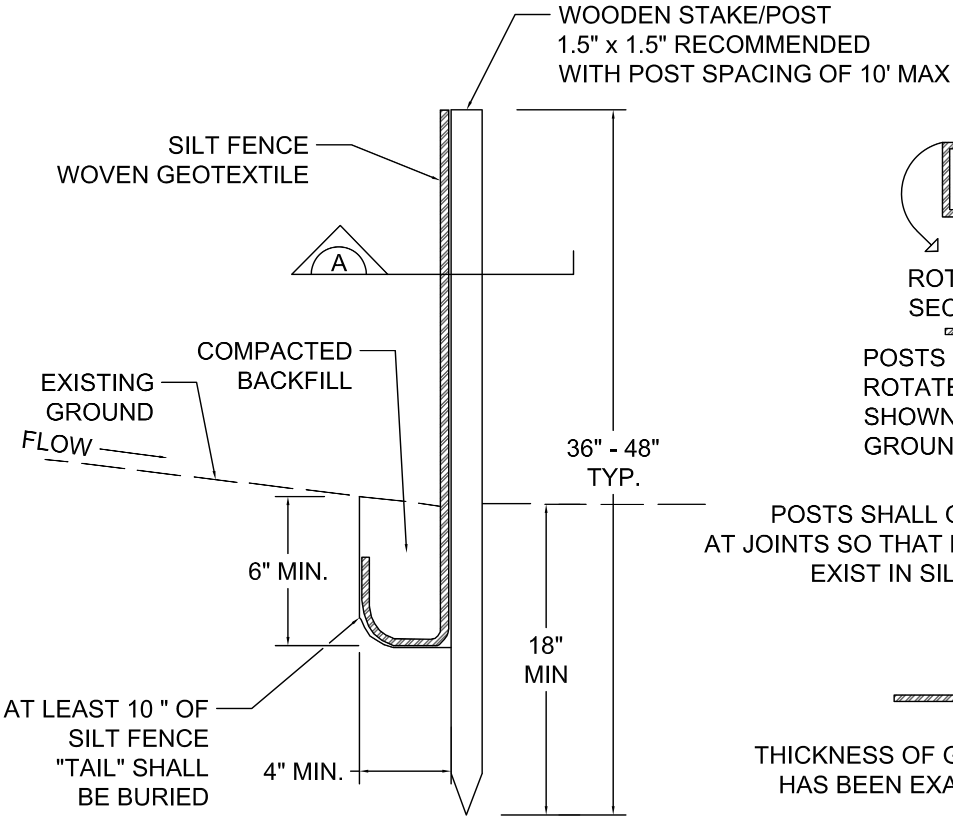
- Works best when installed on relatively flat terrain or when installed on contour (perpendicular to flow) to intercept sheet flows;
- The typical maximum allowable tributary area is 0.25 acre with up to 150 ft of disturbed slope (no steeper than 3:1 (H:V)) for every 100 linear feet of silt fence installed;
- When used as perimeter control or other similar use, install in a manner that will minimize concentrated flows (e.g. J-hook ends);
- Reinforced silt fence with wire backing may be selected where site conditions necessitate increased durability and strength (areas with rock or heavy soil dislodgement);
- Storm water flows reaching the silt fence should be limited to 0.5 cubic feet per linear foot or less;
- Ensure proper stake/pole spacing;
- Silt fence must be trenched with no gaps between the fabric and the ground;
- Anchor fabric at least 6 in. deep in the ground;
- When used at the toe of a slope, place 5-10 ft beyond the toe of the slope to allow room for ponding behind the control; and
- Avoid runs of silt fence greater than 500 ft in length.

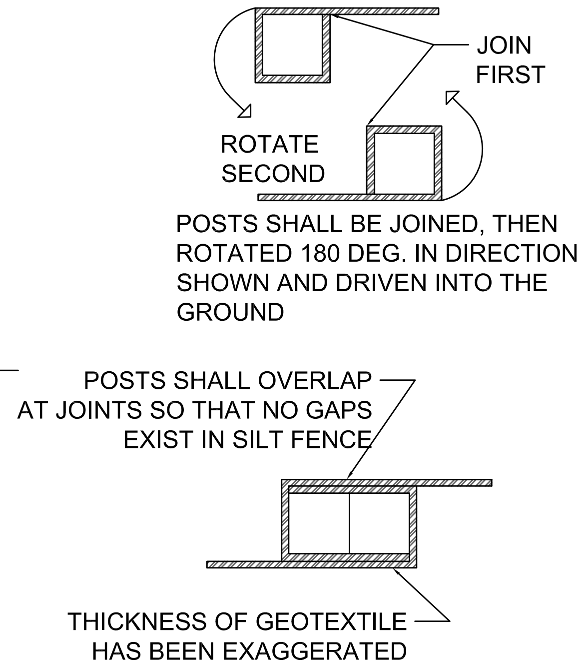
Maintenance and Removal

Inspections should be conducted in accordance with the Storm Water Plan. Inspect silt fence for damage (tears/holes), slumping, undercutting, bypass, and sediment buildup. When silt fence is damaged, the damaged section typically requires replacement. As sediment builds up along the silt fence, it needs to be removed before it reaches 6 in. or greater in depth.

Silt fence may be removed once the upslope area has been stabilized with vegetation or other control measures. Ensure all removed silt fence is disposed of appropriately.

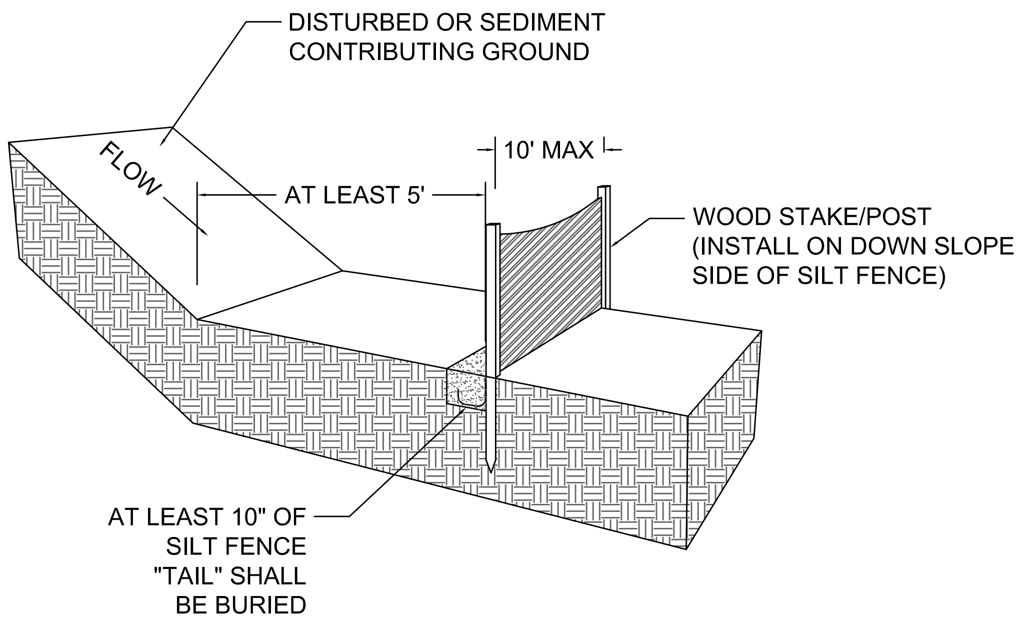
SILT FENCE FIGURES





SECTION A

SILT FENCE



Compiled by H2E, Inc.	Updated: 12/2020	Not to Scale	SILT FENCE FIGURES	SHEET 1 OF 1

Surface Roughening (SR)

Description

Surface roughening is a temporary stabilization method designed to minimize erosion by reducing runoff velocity, decreasing wind exposure, increasing infiltration, and to a minor extent, trapping sediment. Surface roughening is typically installed on steep slopes and implemented using tracked equipment or equipment capable of scarifying or tilling exposed soils to create variations in the surface.

Uses

● Meets full use/application; ○ meets use/application under certain circumstances; and no symbol indicates not appropriate/applicable.

●	Erosion Control		Good Housekeeping
○	Sediment Control		Snow Management
	Chemical/Pollutant Control		

Applications

●	Cut/Fill Transitions		Pollution/Material Sources
	Ditches		Sediment Traps/Basins
●	Exposed Areas		Site Perimeter
	Inlets and Outlets	●	Slopes
	Near Water/Wetlands	●	Toe of Slopes

Soils

●	Clay		Rocky Subgrade
	Sand		
●	Loam		

Selection Considerations

- Surface roughening is a temporary erosion control measure and may require frequent reapplication;
- Surface roughening may be effective for up to 30 days, provided a major rain event or series of minor rain events have not reduced functionality;
- Installation requires heavy machinery (which makes reapplication difficult if heavy machinery is removed from location);
- Tracking using heavy machinery will result in soil compaction and therefore should not be used on topsoil or areas planned for vegetation establishment;
- Tilling, ripping, or similar techniques are better surface roughening options for topsoil or areas planned for vegetation establishment;
- Surface roughening is intended to be used in conjunction with other erosion and sediment control BMPs; and

- Surface roughening is not effective on sandy soils and alternative stabilization methods should be implemented.

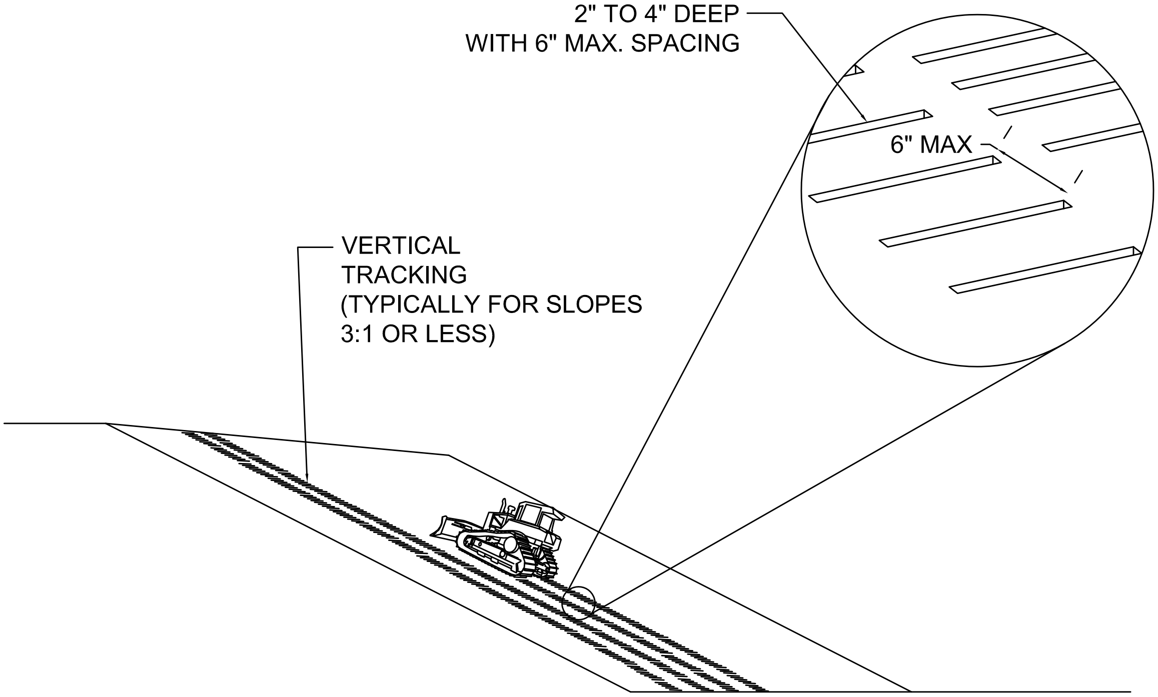
Design and Installation

- Install surface roughening as temporary stabilization in active construction areas that will remain inactive for a short period of time or after final grading;
- Surface roughening should create impressions or channels that are 2-6 in. deep and approximately 6 in. spacing; and
- Impressions or channels should run perpendicular to the slope (flow of water).

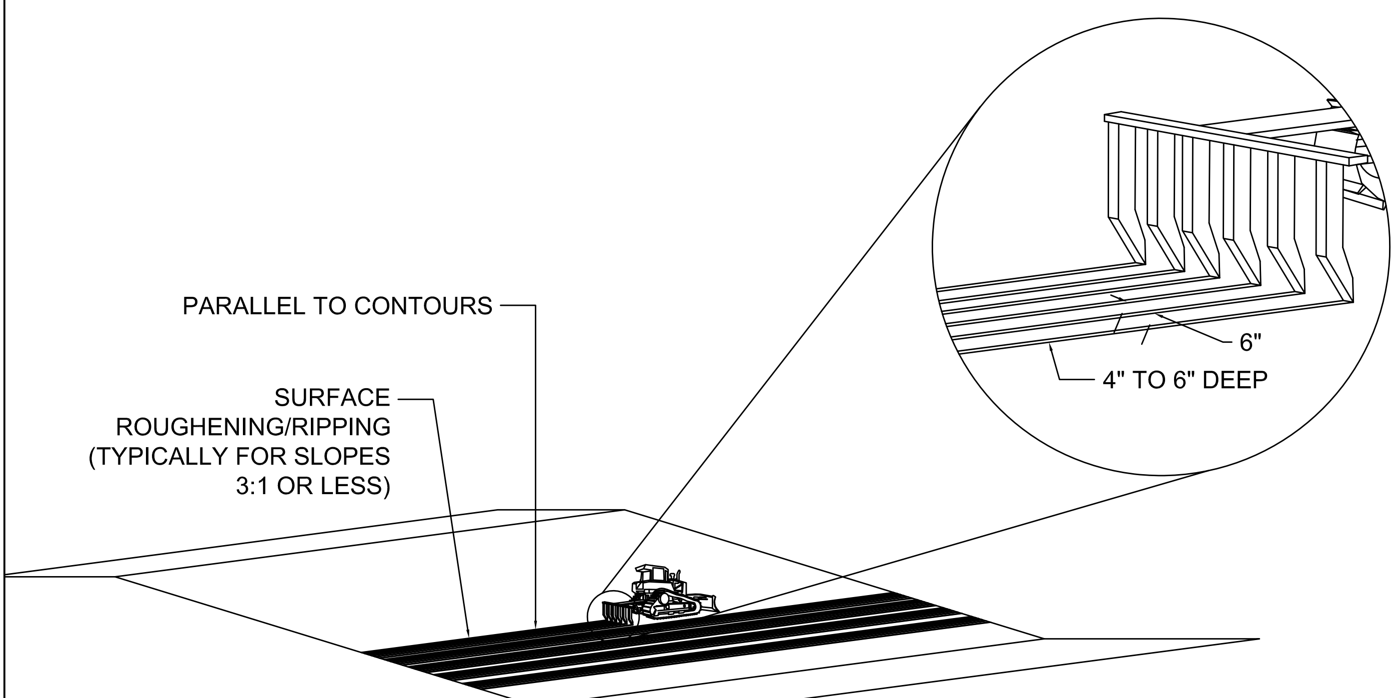
Maintenance and Removal

Inspections should be conducted in accordance with the Storm Water Plan. Inspect surface roughening for signs of smoothing, erosion, or impacts from vehicles. Wind and precipitation events will smooth out the roughened surface reducing effectiveness. If no longer effective, reapplication or alternative stabilization methods may need to be implemented.

SURFACE ROUGHENING FIGURES



SURFACE ROUGHENING



Compiled by H2E, Inc.	Updated: 12/2020	Not to Scale	SURFACE ROUGHENING FIGURES	SHEET 1 OF 1

Stockpile Management (SP)

Description

Stockpile management is the protection of stockpiled erodible materials through structural and nonstructural practices.

Uses

● Meets full use/application; ○ meets use/application under certain circumstances; and no symbol indicates not appropriate/applicable.

	Erosion Control		Good Housekeeping
●	Sediment Control		Snow Management
	Chemical/Pollutant Control		

Applications

●	Cut/Fill Transitions		Pollution/Material Sources
	Ditches		Sediment Traps/Basins
●	Exposed Areas	●	Site Perimeter
	Inlets and Outlets		Slopes
●	Near Water/Wetlands	●	Toe of Slopes

Soils

○	Clay	○	Rocky Subgrade
●	Sand		
●	Loam		

Selection Considerations

- Stockpiles of erodible materials should be located away from drainages, waterways, or other sensitive areas;
- Stockpile management typically requires the use of multiple erosion and sediment control BMPs;
- Requires a combination of stabilization and sediment control practices;
- Avoid stockpiling contaminated soils on location when possible; and
- The anticipated storage timeframe will typically dictate the selected stockpile management practices.

Design and Installation

- Locate stockpiles in areas that will remain largely undisturbed or in areas that work best in the phasing of construction;
- Recommend installing perimeter sediment controls (e.g. silt fence, wattles, etc.) around stockpiles, although not required when stockpiles are located on the interior of the construction project and where other down slope sediment controls are installed;

- Perimeter sediment controls should be installed 5-10 ft off the toe of the stockpile (do not install directly next to stockpile);
- If soils will be stockpiled less than 30 days, recommend surface roughening the stockpile (reapply as needed);
- If soils will be stockpiled between 30 and 60 days, recommend surface roughening and/or mulching the stockpile;
- If soils will be stockpiled longer than 60 days, recommend using seed and mulch, rolled erosion control products, or similar stabilization methods;
- If stockpiling contaminated soils, install a perimeter berm/dike around the stockpile;
- Installation of a liner may be required for stockpiling of contaminated soils depending on the type of contaminate; and
- Recommend installing signage to indicate material type, especially for topsoil storage.

Maintenance and Removal

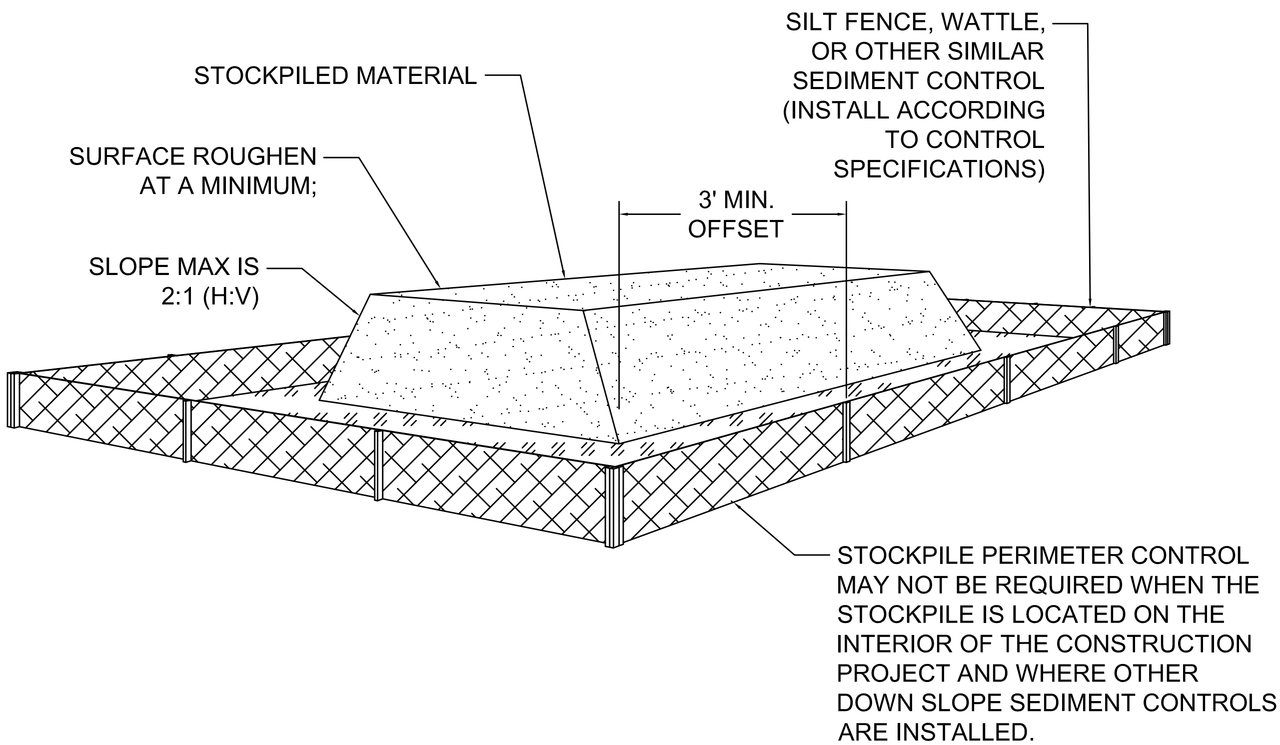
Inspections should be conducted in accordance with the Storm Water Plan. Inspect stockpiles for signs of erosion and sediment buildup along perimeter sediment controls. Signs of erosion indicate additional stabilization methods may be needed, especially in longer term storage applications. Recover sediment build up from perimeter controls and return to stockpile.

If using vegetation or other long term stabilization methods, inspect for function and repair or maintain as outlined in the installation details.

If temporary removal of the perimeter controls is required for access, ensure proper reinstallation once access is complete.

Once the stockpile is no longer required, remove or disperse excess material. Areas where stockpiles are removed should be stabilized with vegetation or other permanent stabilization methods.

STOCKPILE MANAGEMENT FIGURES



IN ADDITION TO PERIMETER SEDIMENT CONTROLS, IT IS RECOMMENDED THE FOLLOWING BE APPLIED:

1. IF SOILS WILL BE STOCKPILED LESS THAN 30 DAYS, RECOMMEND SURFACE ROUGHENING THE STOCKPILE (REAPPLY AS NEEDED).
2. IF SOILS WILL BE STOCKPILED BETWEEN 30 AND 60 DAYS, RECOMMEND SURFACE ROUGHENING AND/OR MULCHING THE STOCKPILE.
3. IF SOILS WILL BE STOCKPILED FOR MORE THAN 60 DAYS, RECOMMEND USING SEED AND MULCH, ROLLED EROSION CONTROL PRODUCTS, OR SIMILAR STABILIZATION METHODS.

Surface Armor (SA)

Description

Surface armor is a combination of various materials (e.g. clay, concrete, dirt, rock, etc.) used to stabilize a surface on location where erosion could occur. The armor reduces erosion caused by runoff and/or raindrop impact, and provides a stable working surface for various construction related activities. Surface armor is often utilized throughout the life of a location and can be incorporated on access roads, tank battery locations, and well head locations.

Uses

● Meets full use/application; ○ meets use/application under certain circumstances; and no symbol indicates not appropriate/applicable.

●	Erosion Control		Good Housekeeping
	Sediment Control		Snow Management
	Chemical/Pollutant Control		

Applications

	Cut/Fill Transitions		Pollution/Material Sources
	Ditches		Sediment Traps/Basins
●	Exposed Areas		Site Perimeter
	Inlets and Outlets		Slopes
	Near Water/Wetlands		Toe of Slopes

Soils

●	Clay	●	Rocky Subgrade
●	Sand		
●	Loam		

Surface armor is applicable to all construction locations (excluding plugged & abandoned and final reclamation locations where material is removed). Armoring material is appropriate in areas where all aspects of construction and vehicular traffic are expected, as well as areas where long term surface stabilization is required and vegetation cannot be used. Surface armor is not designed to control and/or manage concentrated storm water runoff and should not be used as a filtering media.

Selection Considerations

Materials utilized for surface armor may be limited or ineffective on slopes greater than 3:1 (H:V). Scraping/re-contouring and/or removal of snow may affect functionality and unwanted distribution of surface armor materials. Some other concerns with surface armor are compaction and tilling, which warrants a refreshing of the material and/or additional applications, and the possibility of material being tracked off-site following a significant precipitation or melting event.

Design and Installation

Locations are generally designed for the use of:

- Class 5 road base; or
- Class 5 road base with 10% Portland cement mix (typically around well heads and areas where additional stabilization is needed).

Surface armor use and type can vary between phases at a given location.

Construction Phase

During the construction phase, surface armor will be applied intermittently and where applicable. This includes, but is not limited to, the working surface of a location, access roads, and any relating surfaces requiring a means of stabilization in the event that construction and vehicular traffic is anticipated.

Drilling Phase

Drilling specific surface armor will be applied to the area(s) around the well heads. A mixture of concrete, generally 10% Portland mix and road base material, will be used to create an apron around the wells and serve as both a stabilization method and additional support for a drilling rig. The concrete apron also serves as dust mitigation, vehicle tracking control, and sediment pollution control, as the area is solidified upon installation of the apron.

Completions Phase

Surface armor during the completions phase will consist of road base throughout the location and any additional stabilization material required for equipment and vehicular traffic.

Interim Phase

Once all construction related activities are complete on location (e.g., drilling, completions, etc.), road base will be applied throughout to serve as surface armor during the expected life of the location. Road base will be applied to working areas around the tank battery and well heads, as well as the access road where applicable. Generally, the location undergoes a pullback and reduction phase, also known as interim reclamation, after which road base will be applied and periodically maintained and/or re-applied as necessary. Concrete aprons around the well heads are expected to remain around the well heads throughout the life of the location.

Maintenance and Removal

The frequency of inspections should be in accordance with the Storm Water Plan. Inspect all surface armor to ensure there are no erosional issues or off-site movement as it relates to day-to-day operations. All erosional issues shall be addressed with equipment and/or additional armoring material as needed. If off-site deposition is discovered, recovery of all material shall be conducted immediately. Maintenance activities including grading and/or snow removal have the potential to impact the surface armor. Care shall be taken to minimize the impacts to existing surface armor during other maintenance activities. If surface armor effectiveness is reduced, additional applications of surface armor material may be required.

Remove surface armor from areas anticipated to be reclaimed and or turned back to agricultural practices as necessary. In the event of pad reduction/reclamation, follow all final reclamation practices as described in the SWMP.

Vehicle Tracking Control/Tracking Pad (VTC/TP)

Description

Vehicle tracking control (tracking pad) is a temporary stabilized entrance to the construction location that helps minimize off-site tracking of sediment onto public roads. Tracking pads help remove sediment from vehicles by providing a stabilized area where sediment can be tracked, shaken, and/or washed off before leaving the location.

Uses

● Meets full use/application; ○ meets use/application under certain circumstances; and no symbol indicates not appropriate/applicable.

	Erosion Control		Good Housekeeping
●	Sediment Control		Snow Management
	Chemical/Pollutant Control		

Applications

	Cut/Fill Transitions		Pollution/Material Sources
	Ditches		Sediment Traps/Basins
●	Exposed Areas	●	Site Perimeter
	Inlets and Outlets		Slopes
	Near Water/Wetlands		Toe of Slopes

Soils

●	Clay	●	Rocky Subgrade
●	Sand		
●	Loam		

Selection Considerations

- Tracking pads should be installed at each construction site entrance/exit to a paved public road or other road of concern;
- Tracking pads are particularly important during wet periods when tracking of sediment is increased;
- Tracking pads help reduce traffic dust during dry weather;
- A properly installed tracking pad will reduce the likelihood of ruts forming near the entrance; and
- May require periodic street sweeping to control fines that track onto paved roadways.

Design and Installation

- When selecting a location to install a track pad, site grades, sight distances, and curves on public roads must be considered for safe placement;
- Consider the turning radius of construction vehicles when installing a tracking pad;

- If storm water flows towards a track pad, use berms/dikes, ditches or other storm water routing controls to redirect flows away from the track pad;
- Construction fence, silt fence or other visual indicators may be required to ensure vehicle traffic does not bypass the tracking pad when entering or exiting the construction site;
- If required, install signage to indicate entrance/exit locations and direct traffic;
- A non-woven geotextile fabric is recommended between the trackpad aggregate and the compacted subgrade;
- The tracking pad area will need to be excavated approximately 9 in. to ensure level grade with the public road once aggregate is installed (except when using construction, woven, or reinforcement mats); and
- If using pre-fabricated vehicle tracking pads, follow all manufacturer specifications.

Vehicle Tracking Control with Wheel Wash

- If using equipment to wash wheels and wheel wells prior to vehicles entering the public road, ensure that all state and local rules and permitting requirements are followed;
- Recommend using only clean wash water;
- Soaps and other wash chemical may require additional permitting;
- Install a ditch to direct wash water away from the tracking pad and into a sediment control device; and
- Retention of wash waters on location may be required by state, county or local jurisdictions.

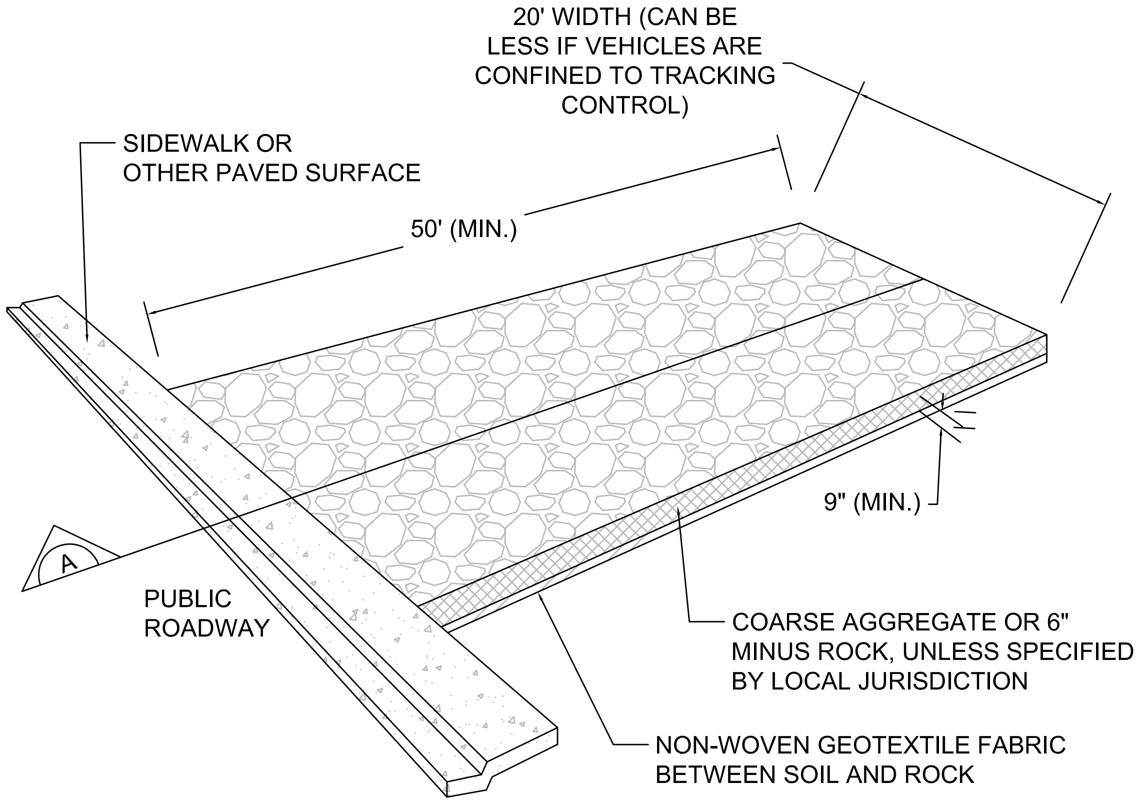
Maintenance and Removal

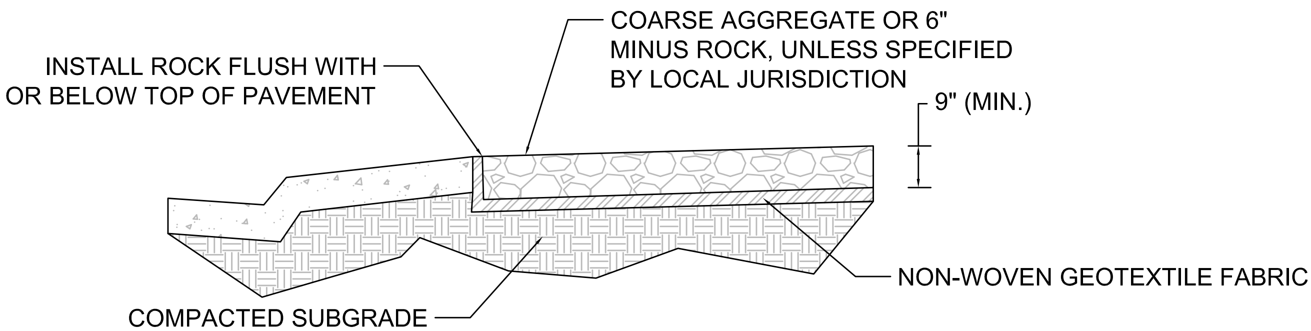
Inspections should be conducted in accordance with the Storm Water Plan. Inspect tracking pads for sediment buildup on/in the tracking pad. If sediment build up has occurred, cleanup and refreshing of the track pad may be required. Also, inspect for damage to the tracking pad or underlayment. Maintain or repair in accordance with installation design. Inspect roadway for sediment tracking and initiate street sweeping when required.

The use of pre-fabricated tracking pads may require more frequent maintenance than aggregate based tracking pads.

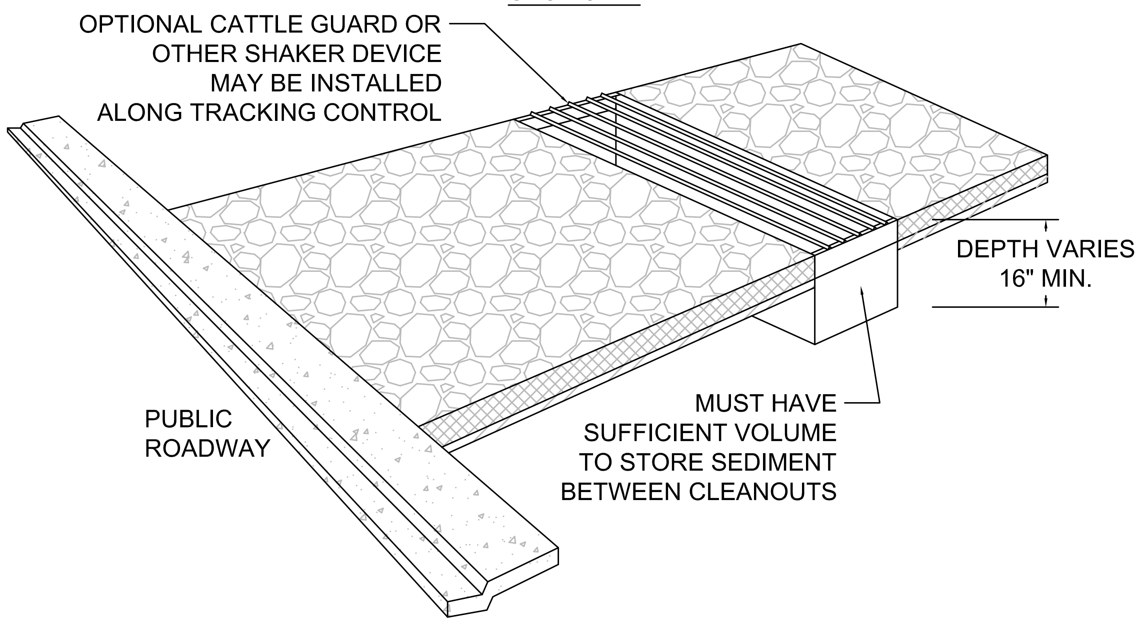
Vehicle tracking pads should only be removed once the site is stabilized and the risk of off-site tracking is eliminated. The aggregate may be washed and repurposed on location or removed from location and recycled. Ensure that all liner material is removed and properly disposed of at an approved facility. Regrade the excavated area and stabilize with vegetation or other permanent stabilization methods.

VEHICLE TRACKING CONTROL FIGURES

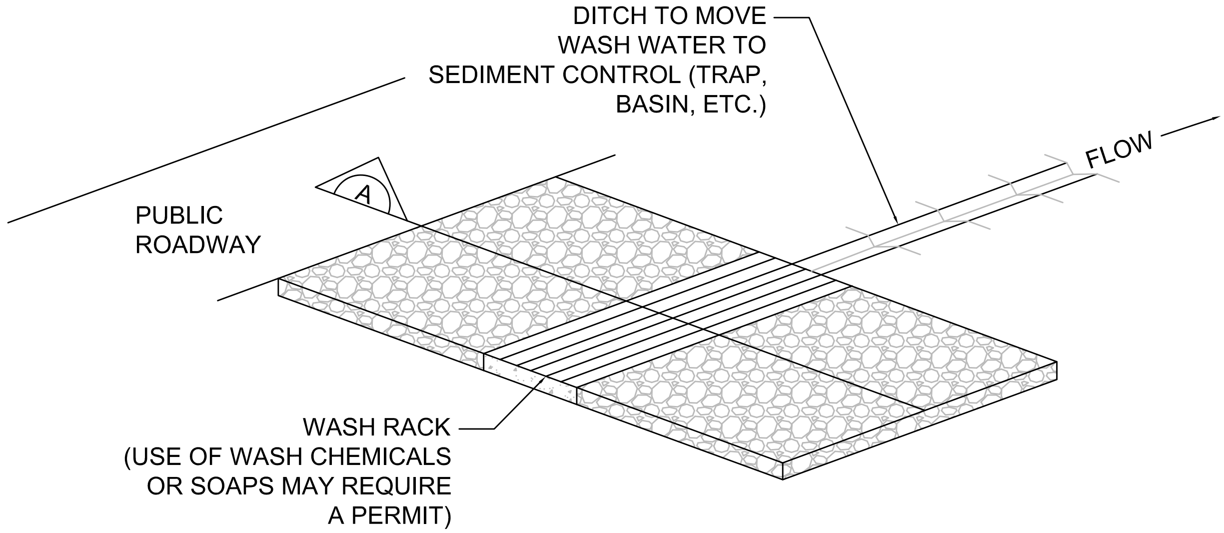


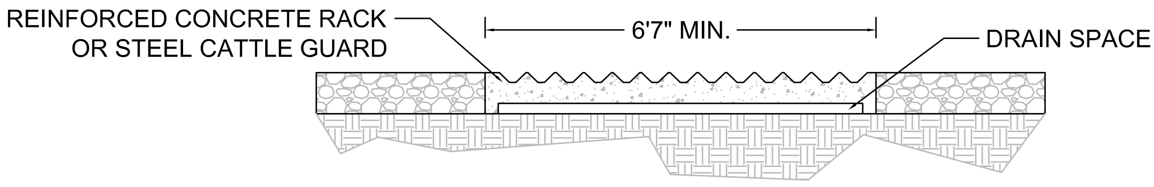


SECTION A



VEHICLE TRACKING CONTROL FIGURES

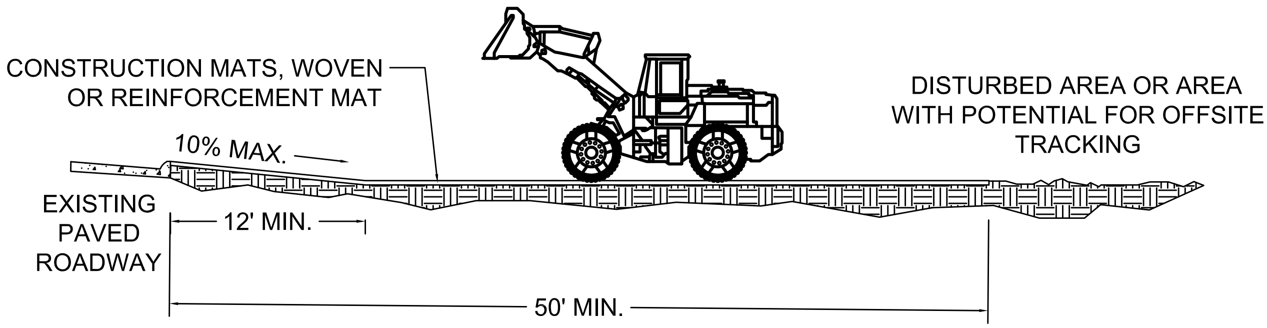


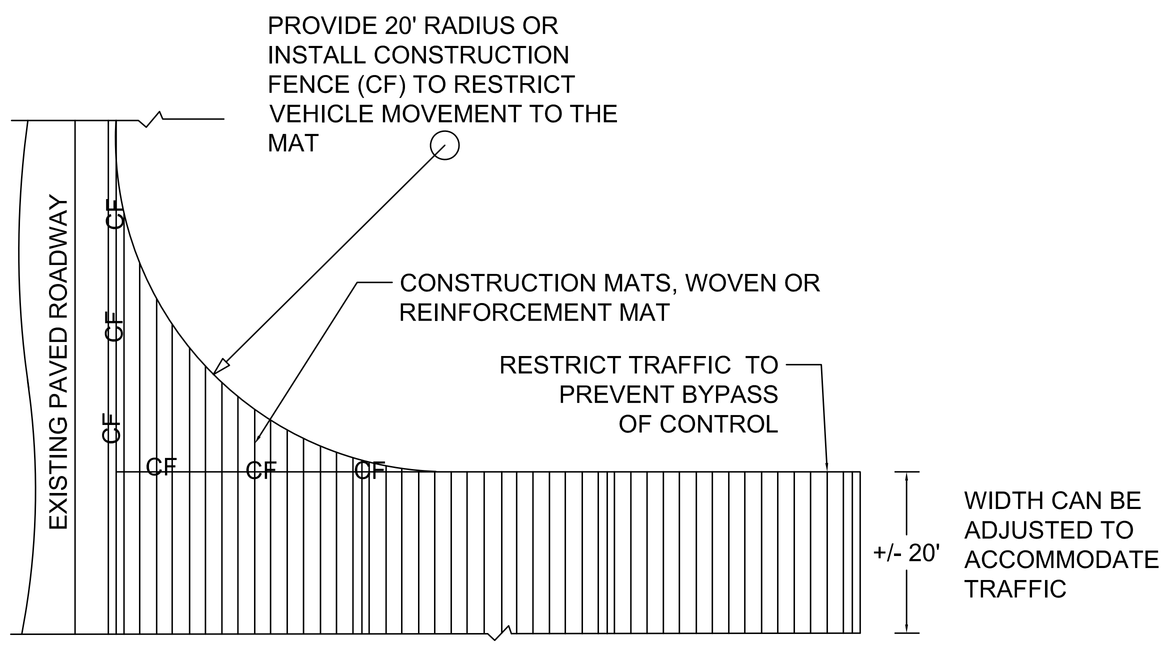


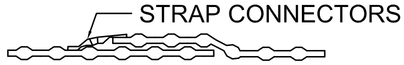
SECTION A

Compiled by H2E, Inc.	Updated: 12/2020	Not to Scale	VEHICLE TRACKING CONTROL FIGURES	SHEET 2 OF 3

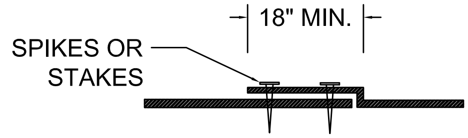
VEHICLE TRACKING CONTROL FIGURES







CONSTRUCTION MAT END OVERLAP INTERLOCK WITH STRAP CONNECTORS



REINFORCED MAT

Compiled by H2E, Inc.	Updated: 12/2020	Not to Scale	VEHICLE TRACKING CONTROL FIGURES	SHEET 3 OF 3

Water Bar (WB)

Description

Water bars are a temporary or permanent control designed to effectively shorten uninterrupted flow paths into shorter sections and direct flows into stable well vegetated areas. Water bars are typically constructed of berms or berms with swales installed diagonally across linear disturbances. Water bars are generally used on narrow, linear projects such as a utility right-of-way or pipeline.

Uses

● Meets full use/application; ○ meets use/application under certain circumstances; and no symbol indicates not appropriate/applicable.

●	Erosion Control		Good Housekeeping
○	Sediment Control		Snow Management
	Chemical/Pollutant Control		

Applications

	Cut/Fill Transitions		Pollution/Material Sources
	Ditches		Sediment Traps/Basins
●	Exposed Areas		Site Perimeter
	Inlets and Outlets	●	Slopes
	Near Water/Wetlands		Toe of Slopes

Soils

●	Clay		Rocky Subgrade
	Sand		
●	Loam		

Selection Considerations

- Install on long, narrow (typically 100 ft wide or less) continuous slopes susceptible to erosion;
- Can be installed on grades ranging from 2% to over 20%; and
- Water bars are not typically effective on sandy soils or rocky subgrade.

Design and Installation

- Water bars shall be installed perpendicular to the slope;
- A slope of 2% or less (crossing angle of 60 degrees is preferred) shall be applied to the water bar (swale and berm) in order for storm water to flow across the control and into an adjacent well vegetated area;
- Water bars shall have an installed height (from the swale bottom to the berm top) of at least 12 in.;
- The typical water bar width shall be between 6 ft and 12 ft;
- The berm is typically constructed using the excavated swale material;

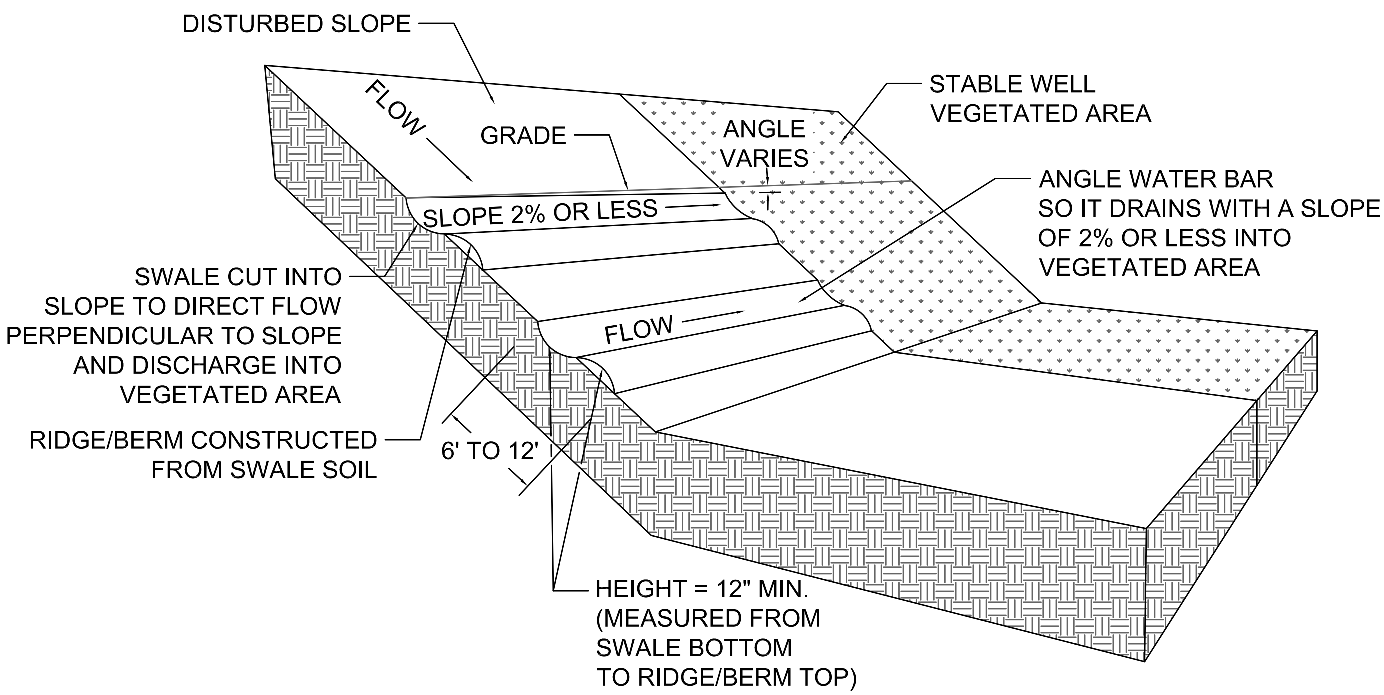
- The berm must be compacted;
- Space water bars according to the slope and the soils susceptibility to erosion (a minimum and maximum spacing is provided); and
- Optional stabilized outlets may be installed at the discharge end of each water bar.

Maintenance and Removal

Inspections should be conducted in accordance with the Storm Water Plan. Inspect water bars for signs of erosion, damage, and sediment buildup. If erosion is identified above or along the water bar, repair the eroded areas and install additional stabilization BMPs to address the cause of erosion. Remove and redistribute sediment in the area of origin or stabilize sediment in place (if removal will have a detrimental effect on reclamation).

Temporary water bars will typically be removed as part of final grading. Once removed, stabilize the impacted area using other erosion and sediment control BMPs.

WATER BAR FIGURES



WATER BAR SPACING		
GRADE (%)	MIN. SPACING (FT)	MAX SPACING (FT)
2	250	415
4	230	380
6	205	350
8	185	320
10	160	285
12	140	250
14	115	220
16	95	185
18	70	150
20	50	120

Reclamation Plan

Loring Quarry

SIMON

RECLAMATION PLAN

Loring Quarry
Sections 33 & 34; T5S-R4E
Custer County, SD

Table of Contents

APPENDICES

1. GENERAL DESCRIPTION

ARSD 74:29:07:18

Simon Contractors of SD, Inc. (Simon) currently owns and operates the Loring Quarry under a mine license. The quarry is located approximately 5 miles south of Pringle, South Dakota in Sections 33 and 34 of Township 5S, Range 4E in Custer County. The quarry is comprised of two parcels both owned by Simon. Parcel 006251 (~45 acres) and parcel 006252 (~126 acres). The quarry is an open pit limestone quarry with reserves estimated to last up to 30 years or more. A total disturbance of approximately 80 acres is anticipated west of the Michelson Trail, with the potential to disturb another 30 acres east of the trail in the long term (40 plus years out). The disturbance to the west of the trail will be partially reclaimed (~75%) when operations begin to the east of the trail. Reclamation operations will continue concurrently until completed.

This reclamation plan was prepared and will be implemented in order to meet the reclamation standards as outlined in SDCL 45-6B, ARSD 74:29:02 and ARSD 74:29:05 through ARSD 74:29:08. This plan was prepared by individuals from Simon Contractors of SD, Inc. and H2E, Inc. with experience in developing reclamation plans.

2. PREVIOUSLY MINED LAND

SDCL 45-6B-8, SDCL 45-6B-9 and ARSD 74:29:07:17

The Loring Quarry was purchased from J. Erpelding by Northwest Engineering (Hills Materials) in 1963, and was already a quarry at that time. Simon then acquired Hills Materials in 2015, which included the Loring Quarry. Surface mining disturbance prior to July 1, 1971 was primarily within parcel 006251. Areas mined prior to 1971 have been affected by operations under the mine license and would also be affected by the continued mining operation. This is an open pit limestone quarry and, as such, no underground mining has occurred within the quarry.

3. GRADING

SDCL 45-6B-37, ARSD 74:29:07:03 and ARSD 74:29:07:04(1)(2)(3)(4)(5)(6)(7)

Grading will be done so as to create a final topography appropriate to the final land use of forest; see Reclamation Contours Map (Appendix A). Highwalls will be blasted and regraded to a 3:1 slope, unless it is determined they should remain for bat habitat. Simon will seek input from South Dakota Department of Game, Fish and Parks regarding leaving highwalls for bat habitat prior to blasting and regrading. In the event that highwalls remain for bat habitat, the amount of available fill material will be reduced. If 3:1 slopes are not feasible in some areas due to a lack of fill material, Simon will ensure that slopes blend with surrounding native and reclaimed lands and that the slopes are stable and no steeper than 2.5:1. By grading slopes to 2.5:1 or flatter, slopes will blend into the surrounding area. This will also result in stable slopes well below the angle of repose.

Backfilling will not occur, apart from what is required to properly recontour the highwalls. Backfilling to return the pit area to its original elevation and contour would require approximately 5 million cubic yards of material. It would not be economically feasible to import this amount of material for reclamation purposes. This would also remove all highwalls resulting in the loss of potential bat habitat.

The Cold Brook drainage will be maintained throughout the life of the quarry and final reclamation. A vegetative buffer will be maintained around the drainage to prevent sediment deposition, and the drainage will not be diverted. No depressions for the accumulation of water will remain. It is not anticipated that any unchannelized surface water will need to be diverted around the operation.

All finished and graded slopes will be considerably less than the angle of repose. In most cases the finished slopes will be 2.5:1 or less. Grading will be down to bedrock and the finished slopes will be graded into the mine property protecting land outside the affected area from slides. Slopes will be tracked and seeded upon completion to reduced and eliminate soil erosion. Silt fence, rock dams and other standard best management practices will be installed should erosion issues be identified.

Concurrent reclamation on the west side of the quarry will begin once mining is complete and operations have moved to the east side. Reclamation on the west side will include all areas, with the exception of the crusher area, which will still be utilized.

4. REFUSE DISPOSAL

SDCL 45-6B-38, ARSD 74:29:07:05

Disposal of refuse will not occur at the site during mining or reclamation activities. A privately contracted dumpster will be located on-site at all times and be emptied as needed for proper off-site disposal. Additional smaller receptacles will be available when crushing operations are in progress. Any refuse produced onsite will be removed in a timely manner, so as not to create any unsightliness or unproductive areas, and will not pollute surface or groundwater. Petroleum contaminated soil would be hauled to a proper offsite disposal facility. There should be no refuse to remove once the mine enters the reclamation phase.

There are no circumstances in which any equipment would be abandoned at the quarry. Used mobile equipment parts will be removed from the site by maintenance personnel at the time of replacement. Used crushing equipment parts may be stored on site while the crusher is operating, but would be moved off location when the crusher is moved out. No waste or reject materials are anticipated at this time. If, at some in the future, there is rejected material from the crusher it will be stockpiled for use during reclamation.

The calcium dust shed and scale will be removed during reclamation. Building materials from the shed will be discarded at an appropriate off-site disposal facility.

5. REVEGETATION

SDCL 45-6B-39, ARSD 74:29:02:10, ARSD 74:29:07:06, ARSD 74:29:07:19(1)

Reclaimed areas will be reseeded using native grass species adapted to the location and similar to the surrounding landscape. Seeding will be conducted using either hydraulic application or drill seeding as deemed appropriate at time of reclamation. Typically seeding is conducted in the early spring or late fall/winter. Additional amendments (mulching, fertilizer, etc.) may be required as deemed necessary at time of reclamation. Soil amendments are not anticipated to be needed, but fertilizer may be applied at the time of seeding. The U.S. Department of Agriculture Natural Resource Conservation Service (NRCS) in Rapid City was consulted, and their recommended final seed mix can be found in Appendix C. This mix is physiologically suited for this area. After grasses are established, ponderosa pine seedlings will be planted. The NRCS does not have planting rates for ponderosa pines, and noted that they will typically move into a site from nearby areas without trouble. To speed the reclamation process it was noted that up to 100 seedlings per acre would be sufficient. Ponderosa pine will be the only woody species planted.

6. TOPSOIL SALVAGE

SDCL 45-6B-7(11), SDCL 45-6B-40 and ARSD 74:29:07:07

All salvageable topsoil and overburden will be removed using scrapers, bulldozer and truck/loader methods. Stockpiles will remain on location, but be placed outside the active and future planned mining areas. Trees, large rocks or other waste material will be separated from topsoil, if present. Stockpiles will initially be stabilized using surface roughening to protect from wind and water erosion. A long term perennial seed mixture of native species will be used to stabilize the stockpiles when kept long term (6+ months); see Table 1 below. The seed mix is a native grass mixture that adheres to the South Dakota Department of Transportation and South Dakota Seed Laws and is generally used in the Black Hills area where projects are adjacent to United States Forest Service, National Park Service or South Dakota Department of Game, Fish, and Parks lands. Topsoil stockpiles will be seeded using hydraulic or drill seed methods and identified by signs mounted on posts.

Table 1. Stockpile Seed Mix SDDOT Type E

Common Name	Scientific Name	Total Lbs./Acre
Western Wheatgrass	*Agropyron smithii*	7.0
Green Needlegrass	*Stipa virdula*	4.0
Sideoats Grama	*Bouteloua curtipendula*	3.0
Blue Grama	*Bouteloua gracilis*	2.0
Canada Wildrye	*Elymus canadensis*	2.0
Dotted Gayfeather	*Liatris punctata*	0.5
Black-eyed Susan	*Rudbeckia hirta*	0.5
Blue Flax	*Linum lewisii*	0.5
Pale Purple Coneflower	*Echinacia angustifolia*	0.5

* Seed at a rate of 20 Lbs./Acre

Topsoil will be stored in the easternmost corner of the property, south of the current topsoil and overburden stockpiles, and to the north of the northernmost area of proposed mining activity; see Pre-Mining Contour Plan View Map (Appendix A). Overburden will be stored separately from topsoil and stabilized so as to effectively control erosion.

During reclamation, overburden and topsoil will be moved to its final location using a truck/loader. A bulldozer will be used for final placement. The redistributed topsoil may be graded, but will always be left in a roughened condition to provide additional protection from wind and water erosion. Simon will always conduct operations to limit excessive compaction of the redistributed topsoil. This will be one of the final reclamation activities, occurring approximately 2050 or later.

Approximately 10,000 cubic yards of topsoil is estimated to be needed for reclamation west of the trail. An estimated 6,000 cubic yards of topsoil will be needed for reclamation east of the trail. There will be adequate topsoil for reclamation and the replacement topsoil depth is estimated to be 3 to 4 inches for both sides of the quarry. This depth may increase depending on the actual future stripped quantities.

Reclamation, including replacement of topsoil, west of the trail will begin once mining operations on that side are completed, and will occur concurrently with mining activities east of the trail. When mining in an area is complete and the highwalls have been re-sloped, if not leaving for bat habitat, topsoil will be replaced. Reclamation will then proceed in a similar sequence all the way around the pit until reclamation is complete. Due to the nature of the construction activity and the constraints on working space, scale and stockpile areas will remain on the west side until all mining activities are completed.

7. HYDROLOGIC BALANCE

SDCL 45-6B-41, ARSD 74:29:02:11, ARSD 74:29:07:08 through ARSD 74:29:07:11 and ARSD 74:29:07:27

Mining operations are not expected to impact surface, and no disturbances to the hydrologic balance are anticipated. Cold Brook (an intermittent drainage) runs roughly from north to south across the northern portion of the Loring Quarry. The drainage will not be disturbed during mining operations and will not be diverted. Cold Brook was an area of focus for the soil and vegetation surveys and those results were submitted to the U.S. Army Corps of Engineers (USACE) as part of a Request for Corps Jurisdictional Determination (JD). The approved JD found that the review area was comprised entirely of dry land (i.e., there are no waters or water features, including wetlands, of any kind in the entire review area). They determined that the drainage noted as Cold Brook consisted of an upland swale, with vegetation and soil results confirming that no wetlands were present. The approved JD can be found in Appendix E.

Cold Brook was also monitored for surface water flow after precipitation events greater than 0.25 in. and was also checked for flow during soil, vegetation and wildlife surveys. Precipitation was tracked using a weather station (Meso Wet PRIS2) located in Pringle, SD. Precipitation tracking began April 27, 2020 and multiple events greater than 0.25 in. were recorded. Cold Brook was consistently visited following these events and no surface water flow was ever observed. Visits were recorded and photo documented and are available for review. Monitoring of Cold Brook for surface flow is ongoing at this time.

No well records were found within the quarry property, but an old shallow well is present in the southern portion of the quarry. The windmill is no longer onsite and the well has not been pumped for several years. The functional status of the well is unknown at this time. No groundwater was encountered during exploratory drilling. A search of the SD DENR database (https://apps.sd.gov/nr68welllogs/) identified 2 wells (1 stock; and 1 domestic water well) within ½ mile of the quarry boundary; see Water Resources Map (Appendix A). According to the well log, the domestic well is 100 ft. deep with a static water level of 17 ft. The stock well is 167 ft. deep with a static water level of 16 ft. Both wells were sampled on July 21, 2020 along with a spring fed well that was identified by one of the landowners.

Upon resuming sampling in March 2021, the owner of the domestic and spring fed wells, requested the domestic well be sampled from a different tap. From March through August this tap was sampled assuming it was drawing from the domestic well. Unfortunately, while going through the process of listing and selling the property the owner discovered that the tap was actually connected to the spring-fed well. The September and October samples were collected from the original location sampled July 21, 2020, which is drawing from the domestic well. The owner of the stock well declined to allow continued sampling. Results from groundwater monitoring are provided in Appendix B.

Mining operations are not expected to impact groundwater, and no disturbances to the hydrologic balance are anticipated. Groundwater was not encountered during exploratory drilling. The Loring Quarry is located on a dome of Madison limestone, near Minnelusa formation and alluvial deposits along Cold Brook. Generally groundwater flow in the Minnelusa is radially outward from the core of the Black Hills. The quarry does not contain Minnelusa formation, but nearby wells are completed in this formation. Groundwater flow in the Madison also occurs radially outward from the core of the Black Hills. There are no potentiometric contour lines for the Madison in the quarry area. Both aquifers recharge from precipitation infiltrates at outcrops. The area receives an average of 19.0 inches of annual precipitation and has an average annual snowfall of 56.0 inches. Given that no groundwater has been encountered at the mine, groundwater results were all below drinking water standards and that no complaints regarding water quality have been noted, no other groundwater monitoring is planned at this time. Refer to Appendix B for a representative geologic cross section map of the Black Hills as well as potentiometric maps and a map showing the geology, structure and geophysics of the area.

The mining operation anticipates only requiring the use of water for dust control. Approximately 6,000 gallons per 10 hour day are used to control dust at the crusher drop points. Dust palliatives will be used to control dust as needed and to conserve water. Water is hauled from Hot Springs and a water rights permit will not be required at this time. No ponds, dams or pollution control facilities will be required.

The only use of chemicals onsite would be herbicides for noxious weed control and potentially soil amendments if required during reclamation. Herbicides will be applied on an as needed basis by a licensed and reputable third party contractor following all applicable regulations and best management practices.

An Oil Spill Contingency Plan is not required for this mining operation as there is less than 1,320 gallons of bulk storage on location. Equipment is refueled using mobile refuelers, which are not parked or stored on location.

The Loring Quarry is currently covered under South Dakota's General Permit for Storm Water Discharges Associated with Industrial Activities (Permit No. SDR00A294). A Storm Water Pollution Prevention Plan (SWPPP) has been prepared for mining activities as is required for coverage under the general permit to discharge. The SWPPP is included in the Operating Plan. The SWPPP lists Best Management Practices (BMP's) that Simon will utilize to prevent potential adverse impacts to the hydrologic features described above. As part of the monthly storm water inspections, drainages at the quarry will be monitored to ensure no sediment deposition has occurred. All reclaimed areas will be inspected for erosion and revegetation issues in order to comply with the terms and conditions of the mine permit. Inspections will also be conducted should a precipitation event of 1.0 inch or more occur. Precipitation events will be monitored using the same weather station described above. No other surface water monitoring is planned at this time.

8. SLIDES, SUBSIDENCE OR DAMAGE PROTECTION, FENCING

SDCL 45-6B-32(4), SDCL 45-6B-42 and ARSD 74:29:07:16

Areas outside the project boundary, as well as the Mickelson Trail, will be protected from slides, subsidence or damage occurring during mining or reclamation activities via a working and vegetative buffer of no less than 50 ft.

There are no significant, valuable or permanent man-made structures located within 200 ft of the mining operation that will be adversely affected. There are no known underground utility lines or pipelines within 200 ft. of the mining operation.

Once mining is complete, highwalls will be reduced to the natural angle of repose or a 3:1 slope, unless it is determined they should remain for bat habitat. Simon shall seek input from South Dakota Game, Fish and Parks regarding leaving highwalls for bat habitat.

Access to the quarry is currently limited by a locked gate on the access road, perimeter fencing, and signage. When not active the highwall crest is bermed, and during active mining the highwall crest is marked with yellow reflective markers.

9. SPOILS PILES, WEEDS

SDCL 45-6B-43 and ARSD 74:29:07:14 and ARSD 74:29:07:15

No tailings will be generated during the mining process. The only spoils produced will be the removed overburden. All mined limestone will be sized into various products and sold. The portable crusher has an onboard water dust suppression system to control airborne particulates. Overburden will be stockpiled in locations where any water runoff will be captured on site. Erosive runoff from any other areas will be identified and captured on site.

Topsoil and overburden stockpiles will be stabilized using applicable best management practices and vegetated for erosion control. Simon will use certified weed-free seed and standard agricultural practices to minimize the introduction of listed or noxious weeds. If weed control is required, a licensed third party contractor shall be contracted for herbicide application following all applicable regulations and best practices. Weed control may be required during all phases of the mining operation and initial reclamation. Herbicides to be used, application rates and application times will depend on the weed species and location. Recommendations from the Custer County Conservation District regarding weed control can be found in Appendix D. Custer County Weed and Pest Department was consulted by phone and provided the South Dakota State University Extension 2020 Weed Control document. This document lists noxious weeds along with recommended herbicides, application rates and any restrictions. It can be found at the Extension website below. Field bindweed, a local noxious weed, was identified during the vegetation survey. Per Extension recommendations, herbicides should be applied at the beginning of flowering or to regrowth in the fall. Several herbicides are listed for control of field bindweed and herbicide specific application rates can be found in the Extension document.

https://extension.sdstate.edu/sites/default/files/2020-02/P-00144.pdf.

10. LANDOWNER CONSULTATION

SDCL 45-6B-12, SDCL 45-6B-44, ARSD 74:29:06:01, ARSD 74:29:06:02

Simon is the surface landowner as well as owner of the mineral interest; therefore the instrument of consultation is not applicable.

After conferring with the Department of Agriculture and Natural Resources the post-mine land use will be forest. The post-mine land use of forest is compatible with the surrounding land use. The quarry is surrounded by USDA Black Hills National Forest. Support and maintenance activities are discussed throughout this plan and include storm water inspections, noxious weed control and vegetation monitoring. Returning the quarry to forest is obtainable, of beneficial use, and Simon has the financial capability to complete this reclamation. No commitments from public agencies are required, but as discussed in Section 3 South Dakota Department of Game, Fish and Parks will be consulted regarding leaving highwalls for bat habitat prior to blasting and regrading. Reclamation is planned pursuant to the mine sequence schedule. There are no known land use plans/programs that include the quarry area.

11. RECLAMATION CHOICES, OPERATOR REQUIREMENTS

SDCL 45-6B-7(1), SDCL 45-6B-45, ARSD 74:29:06:02 through ARSD 74:29:06:05, ARSD 74:29:07:01 and ARSD 74:29:07:18 through ARSD 74:29:07:26

Simon will restore a stable, non-erosive post-mining surface which promotes a post-mining land use of forest. The estimated area to be reclaimed is approximately 80 acres west of the trail and 30 acres east of the trail. This post-mine land use is typical of the surrounding region. Reforestation and revegetation practices will establish cover sufficient to prevent undue erosion as well as establish species diversity and composition which supports the intended land use.

Reclamation success will be determined by comparing post-mine vegetation to results from the baseline vegetation survey. Methods for collecting vegetation data will follow the baseline survey; see Appendix E for details. Reclamation will be considered successful when the reclaimed areas reach 70% desirable perennial vegetation as compared to the undisturbed woodland and upland grassland locations in the baseline survey.

In order to successfully implement and reclaim the disturbed area, storm water inspections will continue until final bond release as outlined in the SWPPP provided with the Operating Plan. Inspections will not only allow for the monitoring of storm water issues, but will allow for ongoing monitoring of vegetation establishment as well as presence of invasive species.

Vegetation similar to the natural pre-mining vegetation will be seeded using hydraulic and/or drill seed application methods. Typical forest usage in the surrounding would be grazing and potentially recreation. As such, slopes will not be too steep for livestock to traverse. Simon will ensure that slopes blend with surrounding native and reclaimed lands and that the slopes are stable. No livestock grazing will be allowed on reclaimed land until the plant community is firmly established. Once grasses are established, final reclamation will include forest planting.

Forest planting will consist of ponderosa pine seedlings. Planting methods and care of stock will follow good planting practices. Reclamation is anticipated to be completed 4-5 years after cessation of mining operations.

It is anticipated that some highwalls may remain as part of the reclaimed area for bat habitat. Evaluation of habitat would be coordinated with the South Dakota Department Game, Fish, and Parks. If a highwall is determined not to be suitable bat habitat, it will be reduced to a 3:1 slope or less and be reclaimed.

Simon has no intended plan for future industrial, homesite or mineral exploration after the life of the quarry. Simon has the financial capability to perform the required reclamation, which is planned pursuant to the mine sequence schedule.

12. RECLAMATION TIME TABLE

SDCL 45-6B-46

Simon will complete the reclamation described above with all reasonable diligence and estimates reclamation will be completed approximately 4-5 years after cessation of mining. There will be no unsuitable land, roads, permanent pools or lakes or other features in which revegetation will not be feasible.

13. CONCURRENT AND INTERIM RECLAMATION

ARSD 74:29:08

The disturbance to the west of the trail will be partially reclaimed (~75%) when operations begin to the east of the trail. Due to the nature of the construction activity and the constraints on working space, scale and stockpile areas will remain on the west side until all mining activities are completed. Reclamation operations will continue concurrently until completed. If other areas are identified in the future that can be reclaimed concurrent to mining operations, reclamation will be initiated in accordance with this plan.

14. POSTCLOSURE PLAN

SDCL 45-6B-5(5) and SDCL 45-6B-91

After the reclamation bond is released, post closure monitoring will consist of annual visits to the location to identify any erosion issues, noxious weeds or required fencing maintenance. There will be no treatment of tailings or monitoring systems at this location. Should any erosion, fugitive dust, weeds or other maintenance be required it will be carried out with all reasonable diligence. Vegetation will be qualitatively monitored during the annual inspections to ensure establishment of a self-sustaining vegetative community.

15. CRITICAL RESOURCES

SDCL 45-6B-92

Baseline surveys and onsite visits conducted at the quarry resulted in the identification of two critical resources. Approximately 0.4 miles of the George S. Mickelson Trail crosses the eastern side of the property. This was identified as a critical resource and as such precautions will be taken so as not to disturb the trail. A 50 ft. buffer will be maintained between mining operations and the trail at all times. No access roads will cross the trail. Access to the east side of the quarry will be from a SD Department of Transportation approved access off Highway 89 that is already in place.

Bats were the second critical resource identified and included four SDNHP sensitive bat species (Townsend's big-eared bat, silver-haired bat, long-eared myotic and fringe-tailed bat) and associated highwall habitat. Bat species were identified acoustically during spring and fall surveys. The grotto located beneath the quarry pit, and associated entrances, were evaluated as potential bat hibernaculum habitat. Two rounds of surveys were conducted at this location and no bats were observed emerging from either the highwall or nearby man-made (capped) grotto entrances. It is likely species recorded during the surveys were using the area for foraging, as there is suitable roost and hibernacula habitat present beyond the quarry property.

While there was no indication that bats were using the grotto and associated entrances during the hibernaculum surveys, mitigation efforts will be employed during the roosting and hibernation periods to minimize adverse impacts to this critical resource. Mitigation measures will include:

- Seasonal restriction on tree cutting, and
- Seasonal restriction on blasting near the vuggy highwall and pit area with grotto entrances.

These measures, described in detail in the Operating Plan, will be in effect during reclamation operations. As previously noted, it is anticipated that some highwalls may remain as part of the reclaimed area for bat habitat. Evaluation of habitat would be coordinated with the South Dakota Department of Game, Fish, and Parks. If a highwall is determined not to be suitable bat habitat, it will be reduced to a 3:1 slope or less and be reclaimed. A stability analysis will be conducted should any of the highwalls remain after final reclamation.

No other critical resources were identified in the baseline surveys and the area was considered cleared from special, exceptional, critical or unique characteristics.

16. RECLAMATION OF MILL SITES

ARSD 74:29:05

No mill sites will be constructed in conjunction with this mining operation.

17. MAPS

SDCL 45-6B-7(8) and ARSD 74:29:02:12

Post reclamation maps showing the anticipated physical appearance and final contours of the reclaimed mine as well as an outline of the proposed final land areas can be found in Appendix A.

18. BONDING

SDCL 45-6B-20, SDCL 45-6B-20.1 and ARSD 74:29:02:08

Estimated reclamation cost is approximately $4,946 per acre. Total disturbance west of the trail is estimated to be approximately 80 acres, with an additional ~30 acres east of the trail. This cost includes the placement of overburden and topsoil, finishing topsoil for seeding and cost to seed, fertilize and mulch. This also includes the cost to plant ponderosa pine seedlings once grasses have established. Phased bonding will not be requested, please see Table 2 below for a detailed reclamation cost analysis.

Table 2. Loring Quarry Reclamation Cost Estimate

Work Description	Reclaim Acres	Quantity CY/Acre	Cost per CY	Cost Per Acre	Cost for 110 Acres
Place Overburden at 0 inches[a]	-	807	$2.50	$2,018	-
Place Topsoil at 6 inches[a]	110	807	$2.50	$2,018	$221,925
Finish Topsoil for Seeding[b]	110			$510	$56,100
Seed, Fertilize and Mulch[c]	110			$1,100	$121,000
Demo Scale & Building[d]					$20,000
Drill, Shoot and Slope Highwalls[d]					$125,000
Total Cost to Reclaim					$544,025
Cost to Reclaim per Acre					$4,946

[a]Scraper cost.
[b]D8 and operator at $170 per hour at 3 hours per acre.
[c]Subcontractor cost.
[d]Lump Sum.

Appendix A

Maps

LORING QUARRY

Sections 33 & 34; T5S-R4E
Custer County, SD

Simon Contractors
Pre-mining Contour Plan View

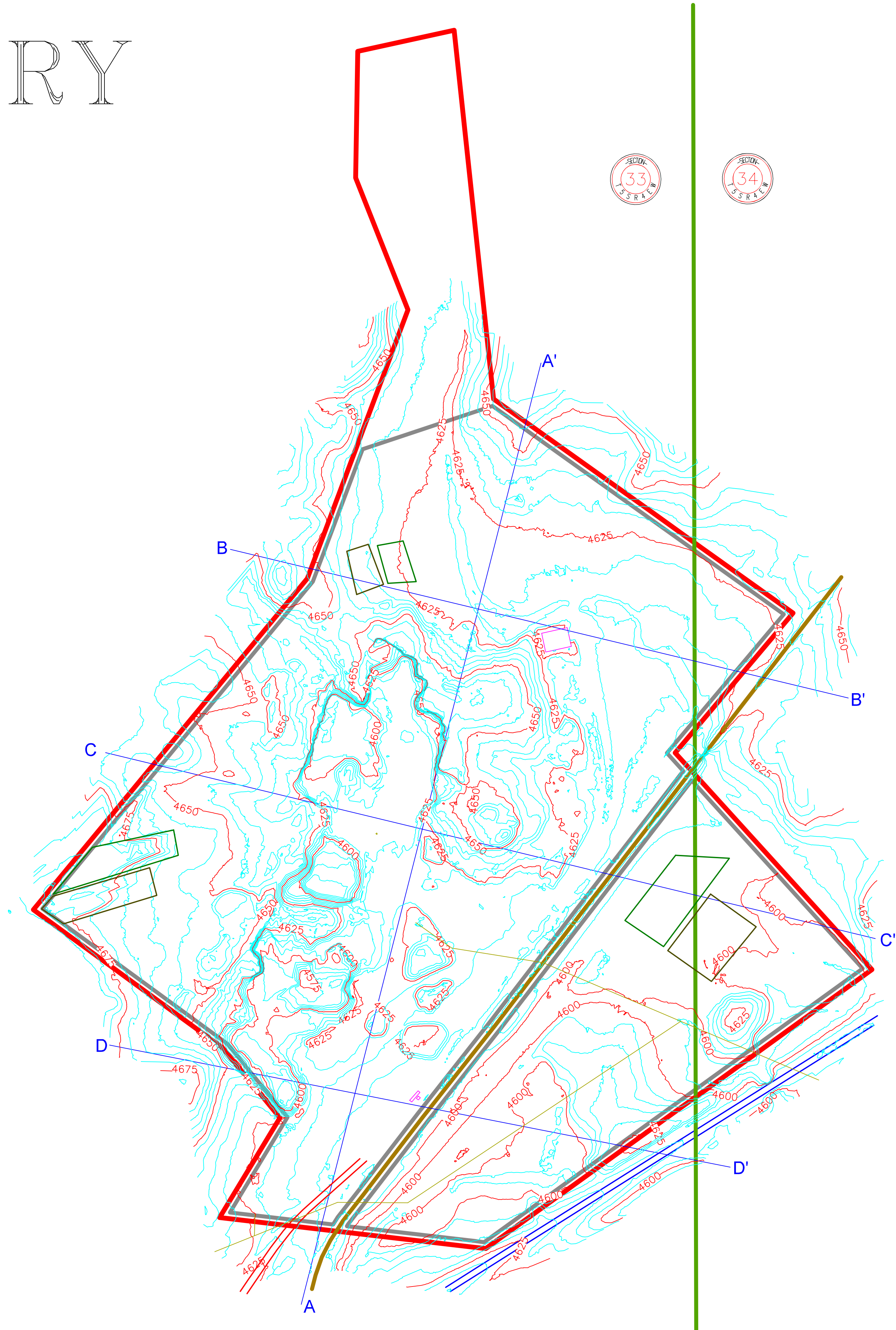
Prepared 8-9-2021
Prepared by: Nathan Oliver

N

250 0 125 250 500 1000

Scale: 1"=250'
Contours: 5 ft

SECTION LINE
PROPOSED LORING QUARRY MINE PERMIT BOUNDARY
SD HWY 89
QUARRY ACCESS ROAD
STRUCTURES
MICKELSON TRAIL
PROPOSED DISTURBANCE AREA
OVERHEAD ELECTRICAL
TOPSOIL STOCKPILES
OVERBURDEN STOCKPILES
A — A' PROFILE CENTERLINE "A"
B — B' PROFILE CENTERLINE "B"
C — C' PROFILE CENTERLINE "C"
D — D' PROFILE CENTERLINE "D"



ARSD 74:29:02:04(2)
SDCL 45-6B-6(8)(a)
SDCL 45-6B-10(1)
SDCL 45-6B-10(3)
SDCL 45-6B-10(5)

LORING QUARRY

Sections 33 & 34; T5S–R4E
Custer County, SD

Simon Contractors
Pre–mining Contour Profile A–A'

Prepared 8–9–2021
Prepared by: Nathan Oliver

Scale: 1"=125'

ARSD 74:29:02:04(3)
SDCL 45-6B-6(8)(b)

LORING QUARRY

Sections 33 & 34; T5S-R4E
Custer County, SD

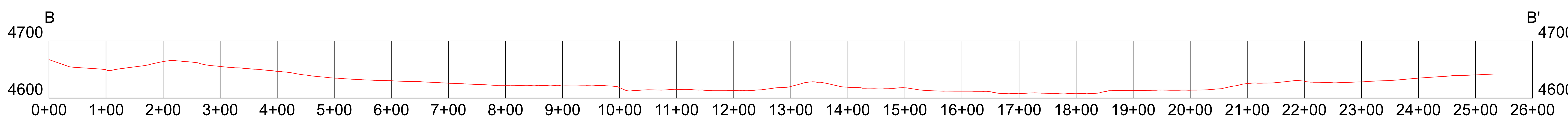
Simon Contractors
Pre-mining Contour Profile B-B'

Prepared 8-9-2021
Prepared by: Nathan Oliver

Scale: 1"=100'

100 0 50 100 200 400

ARSD 74:29:02:04(3)
SDCL 45-6B-6(8)(b)



LORING QUARRY

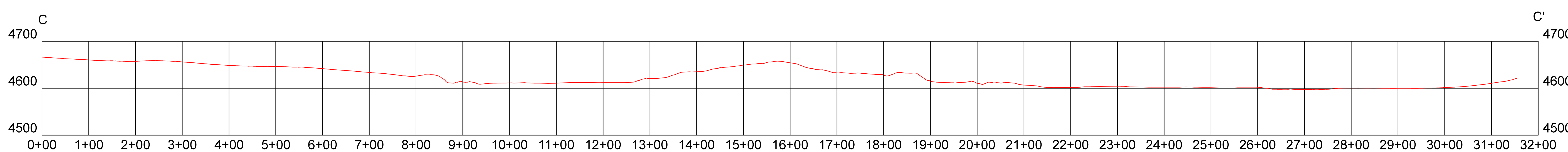
Sections 33 & 34; T5S–R4E
Custer County, SD

Simon Contractors
Pre–mining Contour Profile C–C'

Prepared 8–9–2021
Prepared by: Nathan Oliver

Scale: 1"=125'

ARSD 74:29:02:04(3)
SDCL 45-6B-6(8)(b)



LORING QUARRY

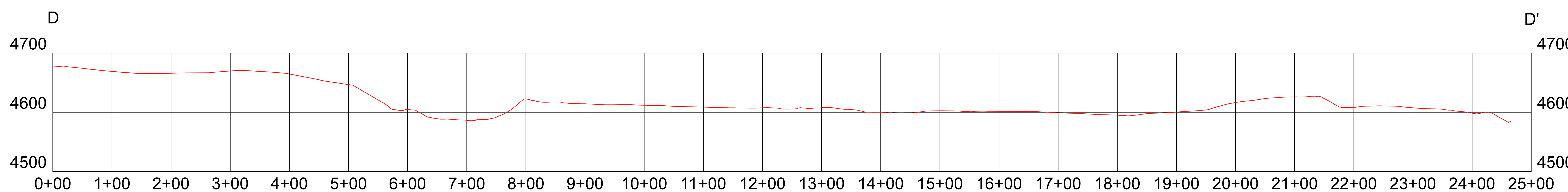
Sections 33 & 34; T5S-R4E
Custer County, SD

Simon Contractors
Pre-mining Contour Profile D-D'

Prepared 8-9-2021
Prepared by: Nathan Oliver

Scale: 1"=100'

ARSD 74:29:02:04(3)
SDCL 45-6B-6(8)(b)



LORING QUARRY

Sections 33 & 34; T5S-R4E
Custer County, SD

Simon Contractors
Post-mining Contour Plan View

Prepared 8-17-2021
Prepared by: Nathan Oliver

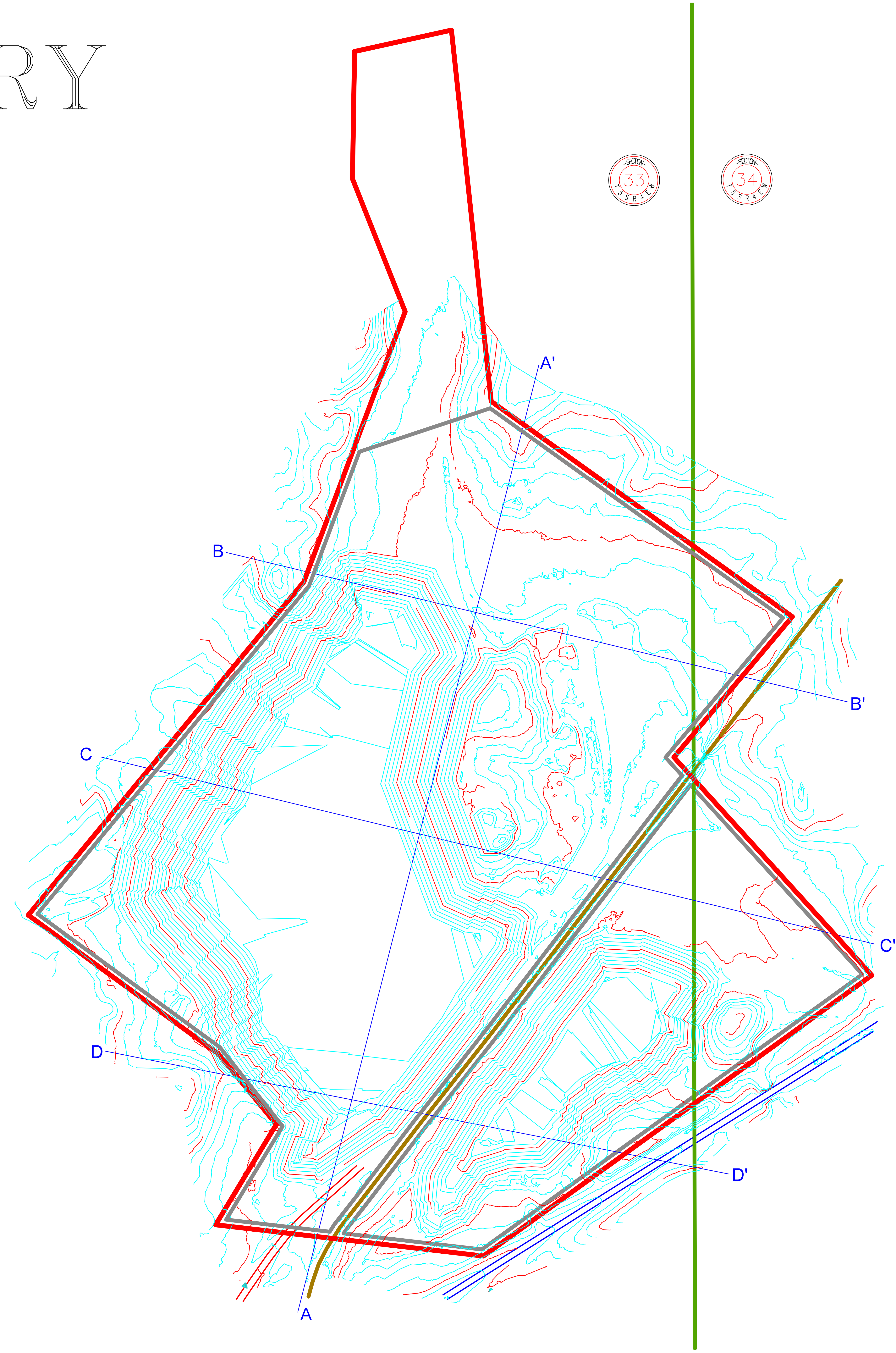
N

250 0 125 250 500 1000

Scale: 1"=250'
Contours: 5 ft

SECTION LINE
PROPOSED LORING QUARRY PERMIT BOUNDARY
SD HWY 89
QUARRY ACCESS ROAD
MICKELSON TRAIL
PROPOSED DISTURBANCE AF
A—A' PROFILE CENTERLINE "A"
B—B' PROFILE CENTERLINE "B"
C—C' PROFILE CENTERLINE "C"
D—D' PROFILE CENTERLINE "D"

ARSD 74:29:02:04(2)
SDCL 45-6B-6(8)(a)



LORING QUARRY

Sections 33 & 34; T5S-R4E
Custer County, SD

Simon Contractors
Post-mining Contour Profile A-A'

Prepared 8-17-2021
Prepared by: Nathan Oliver

Scale: 1"=125'

ARSD 74:29:02:04(3)
SDCL 45-6B-6(8)(b)

LORING QUARRY

Sections 33 & 34; T5S-R4E
Custer County, SD

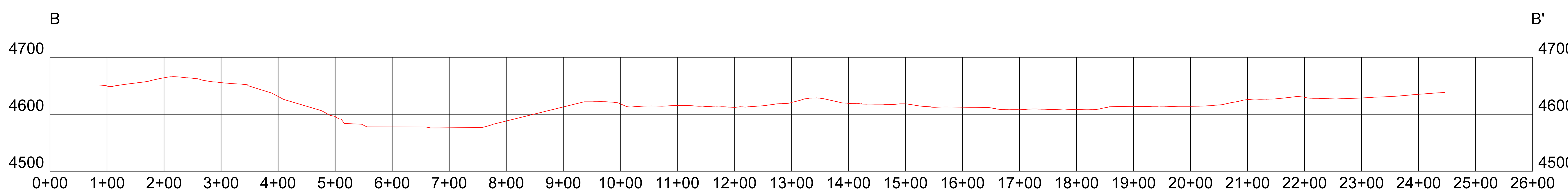
Simon Contractors
Post-mining Contour Profile B-B'

Prepared 8-17-2021
Prepared by: Nathan Oliver

Scale: 1"=100'

100 0 50 100 200 400

ARSD 74:29:02:04(3)
SDCL 45-6B-6(8)(b)



LORING QUARRY

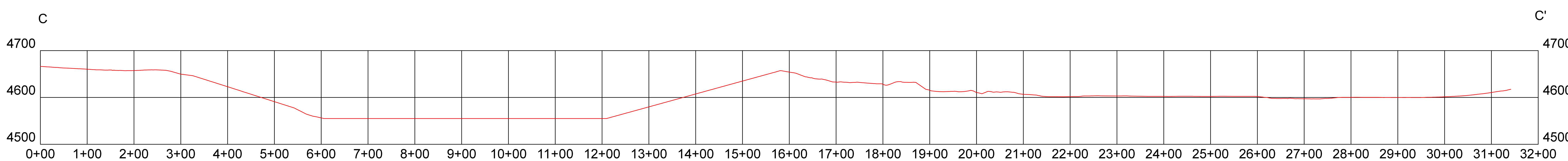
Sections 33 & 34; T5S-R4E
Custer County, SD

Simon Contractors
Post-mining Contour Profile C-C'

Prepared 8-17-2021
Prepared by: Nathan Oliver

Scale: 1"=125'

ARSD 74:29:02:04(3)
SDCL 45-6B-6(8)(b)



LORING QUARRY

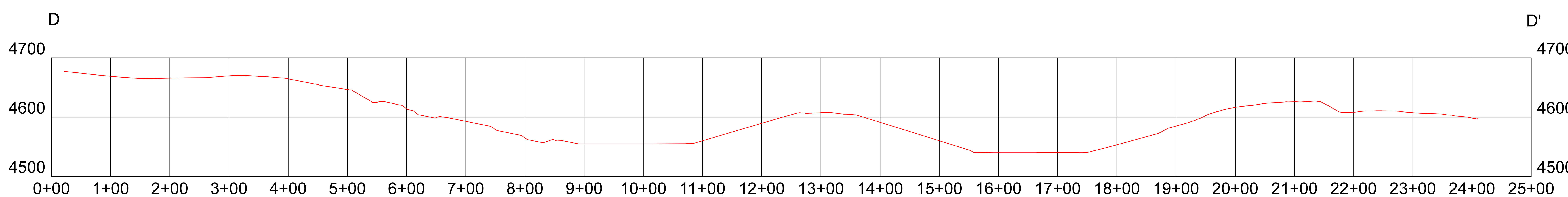
Sections 33 & 34; T5S-R4E
Custer County, SD

Simon Contractors
Post-mining Contour Profile D-D'

Prepared 8-17-2021
Prepared by: Nathan Oliver

Scale: 1"=100'

ARSD 74:29:02:04(3)
SDCL 45-6B-6(8)(b)



Loring Quarry
Water Resources
ARSD 74:29:02:11(3)(4)

0 0.1 0.2 0.4
Miles

N W E S

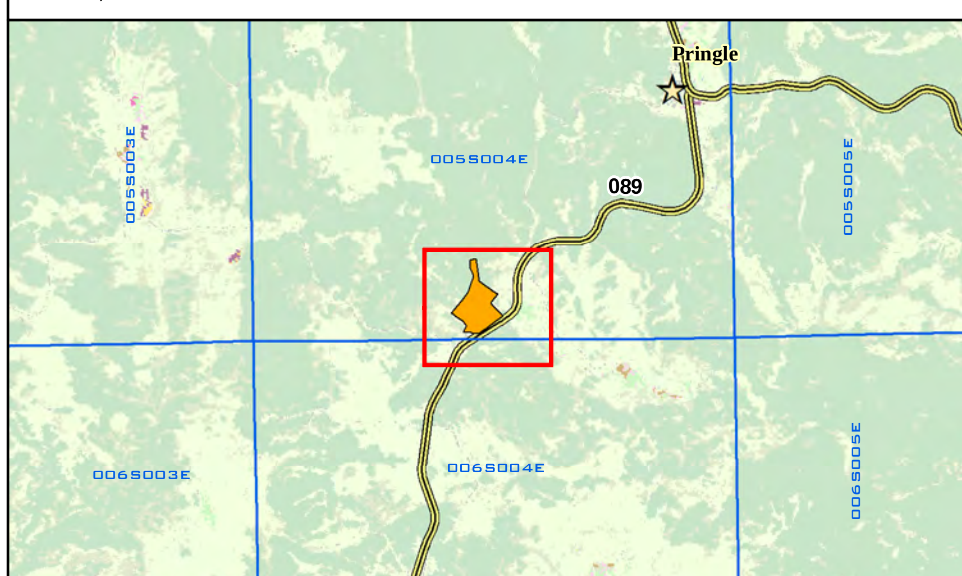
Scale: 1:9,000
Date Produced: 12/14/2021
Designed to be printed at 11" x 17"

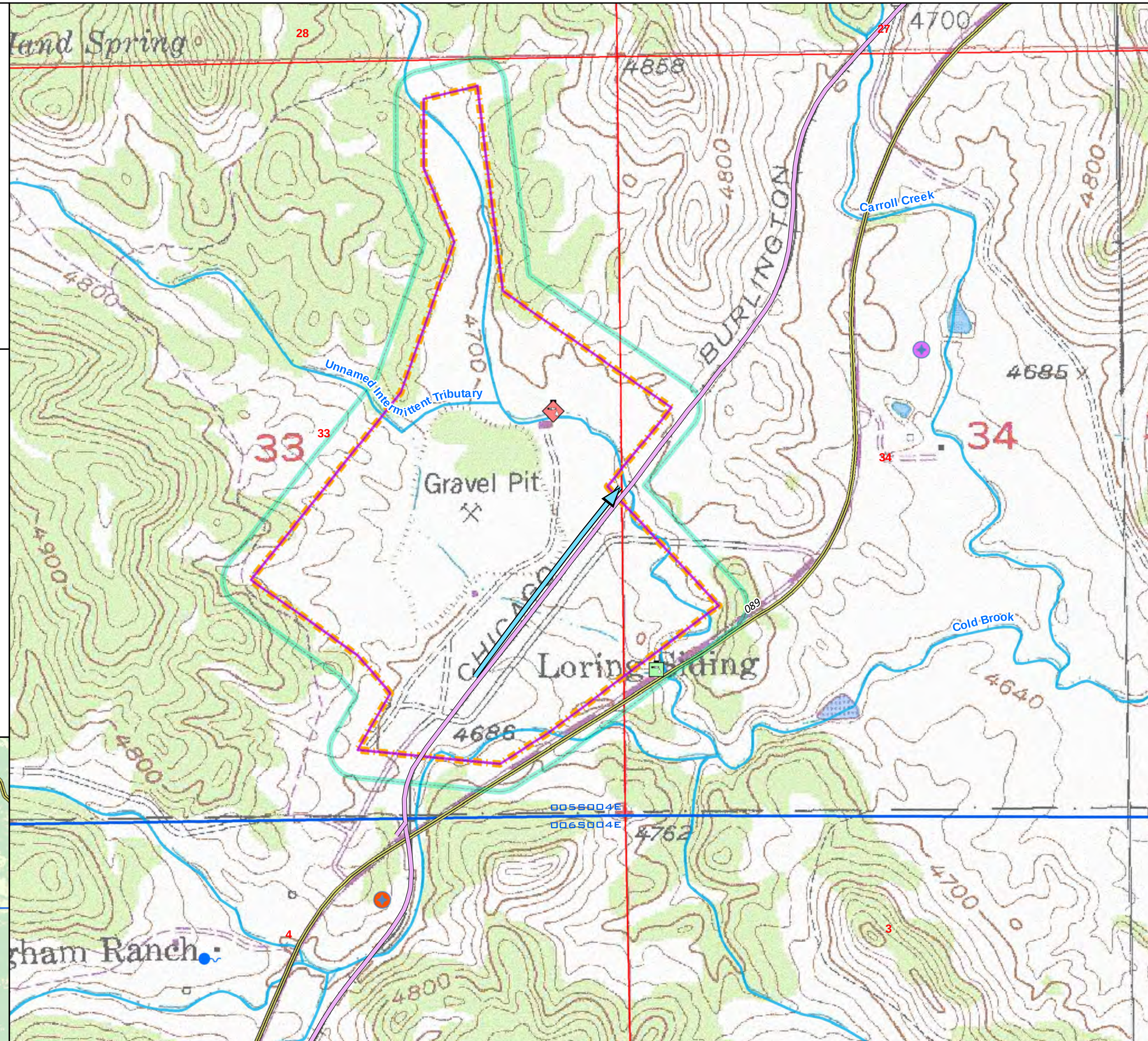
Prepared by:
Editor: RGilson

- SPRING
- Domestic
- Stock
- Sample - Upstream
- Sample - Downstream
- Grass Lined Ditch
- Mickelson Trail
- SD Highways
- NHD Flowline
- Proposed Loring Quarry Mine Permit Boundary
- Loring Quarry Property Boundary
- Permit Boundary 200ft Buffer
- Lake/Pond/Reservoir
- SD Counties
- Township/Range
- Section

Note: There are no oil and gas wells or pipelines in the area of affected land or within 200' of the affected land.
Note: Base map is a U.S. geological survey seven-and-one-half-minute quadrangle map in accordance with ARSD 74:29:02:12.

Prepared By:
Robert Gilson
Environmental Professional
H2E, Inc.





Document Name: Mine_Permit_Water Resources_v1

Appendix B

Groundwater Monitoring Results

Spring

Parameter	7/21/2020	3/30/2021	4/27/2021	5/27/2021	6/17/2021	7/29/2021	8/19/2021	9/28/2021	10/11/2021
TDS (mg/L)	365	324	281	324	335	431	408	395	380
TSS (mg/L)	< 10.0	< 4.0	< 4.0	< 4.0	< 4.0	< 4.0	< 4.0	< 4.0	< 4.0
Chloride (Cl-) (mg/L)	na	10.7	11.2	12.5	19.4	25.1	27.8	25.5	21.0
Nitrogen, Nitrate (NO3) (mg/L)	4.82	1.98	2.29	3.01	5.66	6.64	7.8	6.6	5.76
Fecal Coliform (CFU/100 mL)	na	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0
Field Conductivity (umhos/cm)	302	232	594	588	639	704	763	768	697
Field pH (S.U.)	7.46	7.85	7.19	7.8	7.43	7.52	7.59	7.59	7.66

67605 Domestic Well

Parameter	7/21/2020	3/30/2021	4/27/2021	5/27/2021	6/17/2021	7/29/2021	8/19/2021	9/28/2021	10/11/2021
TDS (mg/L)	375	301	301	325	338	417	400	364	371
TSS (mg/L)	< 10.0	< 4.0	< 4.0	< 4.0	< 4.0	< 4.0	< 4.0	< 4.0	< 4.0
Chloride (Cl-) (mg/L)	na	10.6	11.2	12.1	19.6	24.2	28.7	17.3	17.3
Nitrogen, Nitrate (NO3) (mg/L)	6.11	1.98	2.3	3.14	5.91	6.58	7.43	4.31	4.45
Fecal Coliform (CFU/100 mL)	na	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0	2.0	< 2.0	< 2.0
Field Conductivity (umhos/cm)	355	263	594	589	646	718	738	715	701
Field pH (S.U.)	7.53	7.74	7.34	7.87	7.45	7.53	7.57	7.69	7.75

*Hilighted cells indicate the time period where the spring-fed well was inadvertantly sampled rather than the domestic well.

61831 Stock Well

Parameter	7/21/2020
TDS (mg/L)	442
TSS (mg/L)	< 10.0
Chloride (Cl-) (mg/L)	na
Nitrogen, Nitrate (NO3) (mg/L)	3.66
Fecal Coliform (CFU/100 mL)	na
Field Conductivity (umhos/cm)	434
Field pH (S.U.)	7.72

MIDCONTINENT
TESTING LABORATORIES, INC.

2381 South Plaza Drive P.O. Box 3388 Rapid City, SD 57709
(605) 348-0111 -- www.thechemistrylab.com

Sample Site: Spring
Project Name: Loring Quarry
Sampled: 07/21/20 at 09:27 AM
by John Jarding
Sample Matrix: Water

Lab ID#: 20200722306
Received: 07/21/20 at 12:30 PM
by Dean Aurand
Account: 9511 - Simon Contractors

BOB ROBERTS
SIMON CONTRACTORS
3975 STURGIS RD.
RAPID CITY, SD 57702

Parameter	Result	Units	DF	MDL	PQL	Method	Analyst/Date	
Physical Properties								
Total Dissolved Solids	365	mg/L	100ml	14.7	50.0	SM 2540 C	JNM	07/22/20
Total Suspended Solids	< 10.0	mg/L	100ml	3.49	10.0	SM 2540 D	JNM	07/22/20
Non-Metallics								
Nitrogen, Nitrate (NO3)	4.82	mg/L	5	0.045	0.250	SM 4500-NO3 F	BLL	07/22/20

Notes:
Copy to: Becky Morris bmorris@H2Eincorporated.com

Report Approved By:

Report Approved On: 7/23/2020 12:33:03 PM

MIDCONTINENT
TESTING LABORATORIES, INC.

2381 South Plaza Drive P.O. Box 3388 Rapid City, SD 57709
(605) 348-0111 -- www.thechemistrylab.com

Sample Site: Domestic Well
Project Name: Loring Quarry
Sampled: 07/21/20 at 09:48 AM
by John Jarding
Sample Matrix: Water

Lab ID#: 20200722307
Received: 07/21/20 at 12:30 PM
by Dean Aurand
Account: 9511 - Simon Contractors

BOB ROBERTS
SIMON CONTRACTORS
3975 STURGIS RD.
RAPID CITY, SD 57702

Parameter	Result	Units	DF	MDL	PQL	Method	Analyst	Date
Physical Properties								
Total Dissolved Solids	375	mg/L	100ml	14.7	50.0	SM 2540 C	JNM	07/22/20
Total Suspended Solids	< 10.0	mg/L	100ml	3.49	10.0	SM 2540 D	JNM	07/22/20
Non-Metallics								
Nitrogen, Nitrate (NO3)	6.11	mg/L	5	0.045	0.250	SM 4500-NO3 F	BLL	07/22/20

Notes:
Copy to: Becky Morris bmorris@H2Eincorporated.com

Report Approved By:

Report Approved On: 7/23/2020 12:33:03 PM

MIDCONTINENT
TESTING LABORATORIES, INC.

2381 South Plaza Drive P.O. Box 3388 Rapid City, SD 57709
(605) 348-0111 -- www.thechemistrylab.com

Sample Site:	Stock Tank
Project Name:	Loring Quarry
Sampled:	07/21/20 at 10:29 AM by John Jarding
Sample Matrix:	Water
Lab ID#:	20200722308
Received:	07/21/20 at 12:30 PM by Dean Aurand
Account:	9511 - Simon Contractors

BOB ROBERTS
SIMON CONTRACTORS
3975 STURGIS RD.
RAPID CITY, SD 57702

Parameter	Result	Units	DF	MDL	PQL	Method	Analyst/Date	
Physical Properties								
Total Dissolved Solids	442	mg/L	100ml	14.7	50.0	SM 2540 C	JNM	07/22/20
Total Suspended Solids	< 10.0	mg/L	100ml	3.49	10.0	SM 2540 D	JNM	07/22/20
Non-Metallics								
Nitrogen, Nitrate (NO3)	3.66	mg/L	5	0.045	0.250	SM 4500-NO3 F	BLL	07/22/20

Notes:
Copy to: Becky Morris bmorris@H2Eincorporated.com

Report Approved By:

Report Approved On: 7/23/2020 12:33:03 PM

MIDCONTINENT
TESTING LABORATORIES, INC.

2381 South Plaza Drive P.O. Box 3388 Rapid City, SD 57709
(605) 348-0111 -- www.thechemistrylab.com

Sample Site: Spring
Project Number: Loring Quarry
Sampled: 03/30/21 at 09:25 AM
by J. Jarding
Sample Matrix: Water

BOB ROBERTS
SIMON CONTRACTORS
3975 STURGIS RD.
RAPID CITY, SD 57702

Lab ID#: 20210330907
Received: 03/30/21 at 12:24 PM
by Dean Aurand
Account: 9511
Simon Contractors

Parameter	Result	Units	DF	MDL	PQL	Method	Analyst/Date	
Physical Properties								
Total Dissolved Solids	324	mg/L	100ml	13.0	50.0	SM 2540 C	JNM	04/01/21
Total Suspended Solids	< 4.00	mg/L	250ml	0.949	4.00	SM 2540 D	JNM	04/01/21
Non-Metallics								
Chloride (Cl-)	10.7	mg/L	1	0.275	0.500	SM 4500-Cl E	BLL	04/01/21
Nitrogen, Nitrate (NO3)	1.98	mg/L	5	0.045	0.250	SM 4500-NO3 F	BLL	03/31/21
Bacteria								
Fecal Coliform	< 2.00	CFU/100mL	1			SM 9222 D	SAA	03/30/21
Field Test								
Field Conductivity	232	µmhos/cm	1			Field Conductivity	SYS	03/31/21
Field pH	7.85	S.U.	1			Field pH	SYS	03/31/21

Approved By: Steve Ristau

Approved On: 4/7/2021 2:05:08 PM

MIDCONTINENT
TESTING LABORATORIES, INC.

2381 South Plaza Drive P.O. Box 3388 Rapid City, SD 57709
(605) 348-0111 -- www.thechemistrylab.com

Sample Site: 67605 Domestic
Project Number: Loring Quarry
Sampled: 03/30/21 at 10:05 AM
by J. Jarding
Sample Matrix: Water

Lab ID#: 20210330908
Received: 03/30/21 at 12:24 PM
by Dean Aurand
Account: 9511
Simon Contractors

BOB ROBERTS
SIMON CONTRACTORS
3975 STURGIS RD.
RAPID CITY, SD 57702

Parameter	Result	Units	DF	MDL	PQL	Method	Analyst/Date	
Physical Properties								
Total Dissolved Solids	301	mg/L	100ml	13.0	50.0	SM 2540 C	JNM	04/01/21
Total Suspended Solids	< 4.00	mg/L	250ml	0.949	4.00	SM 2540 D	JNM	04/01/21
Non-Metallics								
Chloride (Cl-)	10.6	mg/L	1	0.275	0.500	SM 4500-Cl E	BLL	04/01/21
Nitrogen, Nitrate (NO3)	1.98	mg/L	5	0.045	0.250	SM 4500-NO3 F	BLL	03/31/21
Bacteria								
Fecal Coliform	< 2.00	CFU/100mL	1			SM 9222 D	SAA	03/30/21
Field Test								
Field Conductivity	263	µmhos/cm	1			Field Conductivity	SYS	03/31/21
Field pH	7.74	S.U.	1			Field pH	SYS	03/31/21

Approved By: Steve Ristau

Approved On: 4/7/2021 2:05:08 PM

MIDCONTINENT
TESTING LABORATORIES, INC.

2381 South Plaza Drive P.O. Box 3388 Rapid City, SD 57709
(605) 348-0111 -- www.thechemistrylab.com

Sample Site: Spring
Project Number: Loring Quarry
Sampled: 04/27/21 at 09:29 AM
by John Jarding
Sample Matrix: Water

Lab ID#: 20210427920
Received: 04/27/21 at 12:14 PM
by Dean Aurand
Account: 9511
Simon Contractors

BOB ROBERTS
SIMON CONTRACTORS
3975 STURGIS RD.
RAPID CITY, SD 57702

Parameter	Result	Units	DF	MDL	PQL	Method	Analyst/Date	
Physical Properties								
Electrical Conductivity	588	µmhos/cm	1	0.153	5.00	SM 2510B	JAM	04/28/21
Total Dissolved Solids	281	mg/L	100ml	13.0	50.0	SM 2540 C	JNM	04/28/21
Total Suspended Solids	< 4.00	mg/L	250ml	0.949	4.00	SM 2540 D	JNM	04/28/21
Non-Metallics								
Chloride (Cl-)	11.2	mg/L	1	0.186	0.500	SM 4500-Cl E	BLL	04/28/21
Nitrogen, Nitrate (NO3)	2.29	mg/L	2	0.016	0.100	SM 4500-NO3 F	BLL	04/28/21
Bacteria								
Fecal Coliform	< 2.00	CFU/100mL	1			SM 9222 D	SAA	04/27/21
Field Test								
Field Conductivity	594	µmhos/cm	1			Field Conductivity	JMH	04/28/21
Field pH	7.19	S.U.	1			Field pH	JMH	04/28/21

Approved By: Steve Pistau

Approved On: 4/29/2021 1:06:04 PM

MIDCONTINENT
TESTING LABORATORIES, INC.

2381 South Plaza Drive P.O. Box 3388 Rapid City, SD 57709
(605) 348-0111 -- www.thechemistrylab.com

Sample Site:	67605 Domestic
Project Number:	Loring Quarry
Sampled:	04/27/21 at 09:53 AM by John Jarding
Sample Matrix:	Water
Lab ID#:	20210427921
Received:	04/27/21 at 12:14 PM by Dean Aurand
Account:	9511 Simon Contractors

BOB ROBERTS
SIMON CONTRACTORS
3975 STURGIS RD.
RAPID CITY, SD 57702

Parameter	Result	Units	DF	MDL	PQL	Method	Analyst	Date
Physical Properties								
Electrical Conductivity	588	µmhos/cm	1	0.153	5.00	SM 2510B	JAM	04/28/21
Total Dissolved Solids	301	mg/L	100ml	13.0	50.0	SM 2540 C	JNM	04/28/21
Total Suspended Solids	< 4.00	mg/L	250ml	0.949	4.00	SM 2540 D	JNM	04/28/21
Non-Metallics								
Chloride (Cl-)	11.2	mg/L	1	0.186	0.500	SM 4500-Cl E	BLL	04/28/21
Nitrogen, Nitrate (NO3)	2.30	mg/L	2	0.016	0.100	SM 4500-NO3 F	BLL	04/28/21
Bacteria								
Fecal Coliform	< 2.00	CFU/100mL	1			SM 9222 D	SAA	04/27/21
Field Test								
Field Conductivity	594	µmhos/cm	1			Field Conductivity	JMH	04/28/21
Field pH	7.34	S.U.	1			Field pH	JMH	04/28/21

Approved By: Steve Ristau

Approved On: 4/29/2021 1:06:04 PM

MIDCONTINENT
TESTING LABORATORIES, INC.

2381 South Plaza Drive P.O. Box 3388 Rapid City, SD 57709
(605) 348-0111 -- www.thechemistrylab.com

Sample Site: Spring
Project Number: Loring Quarry
Sampled: 05/27/21 at 09:30 AM
by John Jarding
Sample Matrix: Water

Lab ID#: 20210527906
Received: 05/27/21 at 12:07 PM
by Dean Aurand
Account: 9511
Simon Contractors

BOB ROBERTS
SIMON CONTRACTORS
3975 STURGIS RD.
RAPID CITY, SD 57702

Parameter	Result	Units	DF	MDL	PQL	Method	Analyst	Date
Physical Properties								
Total Dissolved Solids	324	mg/L	100ml	13.0	50.0	SM 2540 C	JNG	05/28/21
Total Suspended Solids	< 4.00	mg/L	250ml	0.949	4.00	SM 2540 D	JNG	05/28/21
Non-Metallics								
Chloride (Cl-)	12.5	mg/L	1	0.186	0.500	SM 4500-Cl E	BLL	05/28/21
Nitrogen, Nitrate (NO3)	3.01	mg/L	5	0.039	0.250	SM 4500-NO3 F	BLL	05/28/21
Bacteria								
Fecal Coliform	< 2.00	CFU/100mL	1			SM 9222 D	SAA	05/27/21
Field Test								
Field Conductivity	588	µmhos/cm	1			Field Conductivity	JMH	05/28/21
Field pH	7.80	S.U.	1			Field pH	JMH	05/28/21

Approved By: Steve Ristau

Approved On: 6/2/2021 1:24:46 PM

MIDCONTINENT
TESTING LABORATORIES, INC.

2381 South Plaza Drive P.O. Box 3388 Rapid City, SD 57709
(605) 348-0111 -- www.thechemistrylab.com

Sample Site: 67605 Domestic
Project Number: Loring Quarry
Sampled: 05/27/21 at 09:50 AM
by John Jarding
Sample Matrix: Water

Lab ID#: 20210527907
Received: 05/27/21 at 12:07 PM
by Dean Aurand
Account: 9511
Simon Contractors

BOB ROBERTS
SIMON CONTRACTORS
3975 STURGIS RD.
RAPID CITY, SD 57702

Parameter	Result	Units	DF	MDL	PQL	Method	Analyst	Date
Physical Properties								
Total Dissolved Solids	325	mg/L	100ml	13.0	50.0	SM 2540 C	JNG	05/28/21
Total Suspended Solids	< 4.00	mg/L	250ml	0.949	4.00	SM 2540 D	JNG	05/28/21
Non-Metallics								
Chloride (Cl-)	12.1	mg/L	1	0.186	0.500	SM 4500-Cl E	BLL	05/28/21
Nitrogen, Nitrate (NO3)	3.14	mg/L	5	0.039	0.250	SM 4500-NO3 F	BLL	05/28/21
Bacteria								
Fecal Coliform	< 2.00	CFU/100mL	1			SM 9222 D	SAA	05/27/21
Field Test								
Field Conductivity	589	µmhos/cm	1			Field Conductivity	JMH	05/28/21
Field pH	7.87	S.U.	1			Field pH	JMH	05/28/21

Approved By: Steve Ristau

Approved On: 6/2/2021 1:24:46 PM

MIDCONTINENT
TESTING LABORATORIES, INC.

2381 South Plaza Drive P.O. Box 3388 Rapid City, SD 57709
(605) 348-0111 -- www.thechemistrylab.com

Sample Site:	Spring
Project Number:	Loring Quarry
Sampled:	06/17/21 at 09:22 AM by John Jarding
Sample Matrix:	Water
Lab ID#:	20210617909
Received:	06/17/21 at 12:00 PM by Tanya Nelsen
Account:	9511 Simon Contractors

BOB ROBERTS
SIMON CONTRACTORS
3975 STURGIS RD.
RAPID CITY, SD 57702

Parameter	Result	Units	DF	MDL	PQL	Method	Analyst	Date
Physical Properties								
Total Dissolved Solids	335	mg/L	100ml	13.0	50.0	SM 2540 C	JNG	06/18/21
Total Suspended Solids	< 4.00	mg/L	250ml	0.949	4.00	SM 2540 D	JNG	06/18/21
Non-Metallics								
Chloride (Cl-)	19.4	mg/L	1	0.186	0.500	SM 4500-Cl E	BLL	06/21/21
Nitrogen, Nitrate (NO3)	5.66	mg/L	5	0.039	0.250	SM 4500-NO3 F	BLL	06/18/21
Bacteria								
Fecal Coliform	< 2.00	CFU/100mL	1			SM 9222 D	SAA	06/17/21
Field Test								
Field Conductivity	639	µmhos/cm	1			Field Conductivity	JMH	06/18/21
Field pH	7.43	S.U.	1			Field pH	JMH	06/18/21

Approved By: Steve Ristau

Approved On: 6/21/2021 2:59:23 PM

MIDCONTINENT
TESTING LABORATORIES, INC.

2381 South Plaza Drive P.O. Box 3388 Rapid City, SD 57709
(605) 348-0111 -- www.thechemistrylab.com

Sample Site: 67605 Domestic
Project Number: Loring Quarry
Sampled: 06/17/21 at 09:44 AM
by John Jarding
Sample Matrix: Water

Lab ID#: 20210617910
Received: 06/17/21 at 12:00 PM
by Tanya Nelsen
Account: 9511
Simon Contractors

BOB ROBERTS
SIMON CONTRACTORS
3975 STURGIS RD.
RAPID CITY, SD 57702

Parameter	Result	Units	DF	MDL	PQL	Method	Analyst/Date	
Physical Properties								
Total Dissolved Solids	338	mg/L	100ml	13.0	50.0	SM 2540 C	JNG	06/18/21
Total Suspended Solids	< 4.00	mg/L	250ml	0.949	4.00	SM 2540 D	JNG	06/18/21
Non-Metallics								
Chloride (Cl-)	19.6	mg/L	1	0.186	0.500	SM 4500-Cl E	BLL	06/21/21
Nitrogen, Nitrate (NO3)	5.91	mg/L	5	0.039	0.250	SM 4500-NO3 F	BLL	06/18/21
Bacteria								
Fecal Coliform	< 2.00	CFU/100mL	1			SM 9222 D	SAA	06/17/21
Field Test								
Field Conductivity	646	µmhos/cm	1			Field Conductivity	JMH	06/18/21
Field pH	7.45	S.U.	1			Field pH	JMH	06/18/21

Approved By: Steve Ristau

Approved On: 6/21/2021 2:59:23 PM

MIDCONTINENT
TESTING LABORATORIES, INC.

2381 South Plaza Drive P.O. Box 3388 Rapid City, SD 57709
(605) 348-0111 -- www.thechemistrylab.com

Sample Site:	Spring
Project Number:	Loring Quarry
Sampled:	07/29/21 at 09:28 AM by John Jarding
Sample Matrix:	Water
Lab ID#:	20210729907
Received:	07/29/21 at 12:01 PM by Eric Fuehrer
Account:	9511 Simon Contractors

BOB ROBERTS
SIMON CONTRACTORS
3975 STURGIS RD.
RAPID CITY, SD 57702

Parameter	Result	Units	DF	MDL	PQL	Method	Analyst/Date	
Physical Properties								
Total Dissolved Solids	431	mg/L	100ml	13.0	50.0	SM 2540 C	JNG	07/30/21
Total Suspended Solids	< 4.00	mg/L	100ml	2.37	10.0	SM 2540 D	JNG	07/30/21
Non-Metallics								
Chloride (Cl-)	25.1	mg/L	1	0.186	0.500	SM 4500-Cl E	BLL	07/30/21
Nitrogen, Nitrate (NO3)	6.64	mg/L	5	0.039	0.250	SM 4500-NO3 F	BLL	07/30/21
Bacteria								
Fecal Coliform	< 2.00	CFU/100mL	1			SM 9222 D	SAA	07/29/21
Field Test								
Field Conductivity	704	µmhos/cm	1			Field Conductivity	JMH	07/30/21
Field pH	7.52	S.U.	1			Field pH	JMH	07/30/21

Approved By: Steve Ristau

Approved On: 8/3/2021 9:33:42 AM

MIDCONTINENT
TESTING LABORATORIES, INC.

2381 South Plaza Drive P.O. Box 3388 Rapid City, SD 57709
(605) 348-0111 -- www.thechemistrylab.com

Sample Site:	67605 Domestic
Project Number:	Loring Quarry
Sampled:	07/29/21 at 09:46 AM by John Jarding
Sample Matrix:	Water
Lab ID#:	20210729908
Received:	07/29/21 at 12:01 PM by Eric Fuehrer
Account:	9511 Simon Contractors

BOB ROBERTS
SIMON CONTRACTORS
3975 STURGIS RD.
RAPID CITY, SD 57702

Parameter	Result	Units	DF	MDL	PQL	Method	Analyst	Date
Physical Properties								
Total Dissolved Solids	417	mg/L	100ml	13.0	50.0	SM 2540 C	JNG	07/30/21
Total Suspended Solids	< 4.00	mg/L	100ml	2.37	10.0	SM 2540 D	JNG	07/30/21
Non-Metallics								
Chloride (Cl-)	24.2	mg/L	1	0.186	0.500	SM 4500-Cl E	BLL	07/30/21
Nitrogen, Nitrate (NO3)	6.58	mg/L	5	0.039	0.250	SM 4500-NO3 F	BLL	07/30/21
Bacteria								
Fecal Coliform	< 2.00	CFU/100mL	1			SM 9222 D	SAA	07/29/21
Field Test								
Field Conductivity	718	µmhos/cm	1			Field Conductivity	JMH	07/30/21
Field pH	7.53	S.U.	1			Field pH	JMH	07/30/21

Approved By: Steve Ristau

Approved On: 8/3/2021 9:33:42 AM

MIDCONTINENT
TESTING LABORATORIES, INC.

2381 South Plaza Drive P.O. Box 3388 Rapid City, SD 57709
(605) 348-0111 -- www.thechemistrylab.com

Sample Site: Spring
Project Name: Loring Quarry
Sampled: 08/19/21 at 09:08 AM
by John Jarding
Sample Matrix: Water

Lab ID#: 20210819920
Received: 08/19/21 at 11:36 AM
by Dean Aurand
Account: 9511 - Simon Contractors

IVY FOSTER
SIMON CONTRACTORS
3975 STURGIS RD.
RAPID CITY, SD 57702

Parameter	Result	Units	DF	MDL	PQL	Method	Analyst	Date
Physical Properties								
Total Dissolved Solids	408	mg/L	100ml	13.0	50.0	SM 2540 C	JNG	08/20/21
Total Suspended Solids	< 4.00	mg/L	250ml	0.949	4.00	SM 2540 D	JNG	08/20/21
Non-Metallics								
Chloride (Cl-)	27.8	mg/L	1	0.186	0.500	SM 4500-Cl E	BLL	08/27/21
Nitrogen, Nitrate (NO3)	7.80	mg/L	4	0.032	0.200	SM 4500-NO3 F	EJF	08/20/21
Bacteria								
Fecal Coliform	< 2.00	CFU/100mL	1			SM 9222 D	SAA	08/19/21
Field Test								
Field Conductivity	763	µmhos/cm	1			Field Conductivity	JMH	08/20/21
Field pH	7.59	S.U.	1			Field pH	JMH	08/20/21

Report Approved By:

Steve Distau

Report Approved On: 8/27/2021 11:48:32 AM

MIDCONTINENT
TESTING LABORATORIES, INC.

2381 South Plaza Drive P.O. Box 3388 Rapid City, SD 57709
(605) 348-0111 -- www.thechemistrylab.com

Sample Site: 67605 Domestic
Project Name: Loring Quarry
Sampled: 08/19/21 at 09:26 AM
by John Jarding
Sample Matrix: Water

Lab ID#: 20210819921
Received: 08/19/21 at 11:36 AM
by Dean Aurand
Account: 9511 - Simon Contractors

IVY FOSTER
SIMON CONTRACTORS
3975 STURGIS RD.
RAPID CITY, SD 57702

Parameter	Result	Units	DF	MDL	PQL	Method	Analyst/Date	
Physical Properties								
Total Dissolved Solids	400	mg/L	100ml	13.0	50.0	SM 2540 C	JNG	08/20/21
Total Suspended Solids	< 4.00	mg/L	250ml	0.949	4.00	SM 2540 D	JNG	08/20/21
Non-Metallics								
Chloride (Cl-)	28.7	mg/L	1	0.186	0.500	SM 4500-Cl E	BLL	08/27/21
Nitrogen, Nitrate (NO3)	7.43	mg/L	4	0.032	0.200	SM 4500-NO3 F	EJF	08/20/21
Bacteria								
Fecal Coliform	2.00	CFU/100mL	1			SM 9222 D	SAA	08/19/21
Field Test								
Field Conductivity	738	µmhos/cm	1			Field Conductivity	JMH	08/20/21
Field pH	7.57	S.U.	1			Field pH	JMH	08/20/21

Report Approved By:

Steve Distau

Report Approved On: 8/27/2021 11:48:32 AM

MIDCONTINENT
TESTING LABORATORIES, INC.

2381 South Plaza Drive P.O. Box 3388 Rapid City, SD 57709
(605) 348-0111 -- www.thechemistrylab.com

Sample Site: Spring
Project Number: Loring Quarry
Sampled: 09/28/21 at 09:46 AM
by John Jarding
Sample Matrix: Water

Lab ID#: 20210928905
Received: 09/28/21 at 12:25 PM
by Dean Aurand
Account: 9511
Simon Contractors

IVY FOSTER
SIMON CONTRACTORS
3975 STURGIS RD.
RAPID CITY, SD 57702

Parameter	Result	Units	DF	MDL	PQL	Method	Analyst/Date	
Physical Properties								
Total Dissolved Solids	395	mg/L	100ml	13.0	50.0	SM 2540 C	JNG	09/29/21
Total Suspended Solids	< 4.00	mg/L	250ml	0.949	4.00	SM 2540 D	JNG	09/29/21
Non-Metallics								
Chloride (Cl-)	25.5	mg/L	1	0.186	0.500	SM 4500-Cl E	BLL	09/30/21
Nitrogen, Nitrate (NO3)	6.60	mg/L	4	0.032	0.200	SM 4500-NO3 F	BLL	10/19/21
Bacteria								
Fecal Coliform	< 2.00	CFU/100mL	1			SM 9222 D	SAA	09/28/21
Field Test								
Field Conductivity	768	µmhos/cm	1			Field Conductivity	JMH	09/29/21
Field pH	7.59	S.U.	1			Field pH	JMH	09/29/21

Approved By: Dean Aurand

Approved On: 10/21/2021 5:10:58 PM

MIDCONTINENT
TESTING LABORATORIES, INC.

2381 South Plaza Drive P.O. Box 3388 Rapid City, SD 57709
(605) 348-0111 -- www.thechemistrylab.com

Sample Site: 67605 Domestic
Project Name: Loring Quarry
Sampled: 09/28/21 at 09:18 AM
by John Jarding
Sample Matrix: Water

Lab ID#: 20210928906
Received: 09/28/21 at 12:25 PM
by Dean Aurand
Account: 9511 - Simon Contractors

IVY FOSTER
SIMON CONTRACTORS
3975 STURGIS RD.
RAPID CITY, SD 57702

Parameter	Result	Units	DF	MDL	PQL	Method	Analyst/Date	
Physical Properties								
Total Dissolved Solids	364	mg/L	100ml	13.0	50.0	SM 2540 C	JNG	09/29/21
Total Suspended Solids	< 4.00	mg/L	250ml	0.949	4.00	SM 2540 D	JNG	09/29/21
Non-Metallics								
Chloride (Cl-)	17.3	mg/L	1	0.186	0.500	SM 4500-Cl E	BLL	09/30/21
Nitrogen, Nitrate (NO3)	4.31	mg/L	10	0.079	0.500	SM 4500-NO3 F	BLL	09/29/21
Bacteria								
Fecal Coliform	< 2.00	CFU/100mL	1			SM 9222 D	SAA	09/28/21
Field Test								
Field Conductivity	715	µmhos/cm	1			Field Conductivity	JMH	09/29/21
Field pH	7.69	S.U.	1			Field pH	JMH	09/29/21

Report Approved By:

Steve Dirksen

Report Approved On: 10/5/2021 4:18:45 PM

MIDCONTINENT
TESTING LABORATORIES, INC.

2381 South Plaza Drive P.O. Box 3388 Rapid City, SD 57709
(605) 348-0111 -- www.thechemistrylab.com

Sample Site: Spring
Project Number: Loring Quarry
Sampled: 10/12/21 at 09:26 AM
by Luke Paulson
Sample Matrix: Water

Lab ID#: 20211012901
Received: 10/12/21 at 12:07 PM
by Dean Aurand
Account: 9511
Simon Contractors

IVY FOSTER
SIMON CONTRACTORS
3975 STURGIS RD.
RAPID CITY, SD 57702

Parameter	Result	Units	DF	MDL	PQL	Method	Analyst/Date	
Physical Properties								
Total Dissolved Solids	380	mg/L	100ml	13.0	50.0	SM 2540 C	JNG	10/13/21
Total Suspended Solids	< 4.00	mg/L	250ml	0.949	4.00	SM 2540 D	JNG	10/13/21
Non-Metallics								
Chloride (Cl-)	21.0	mg/L	1	0.186	0.500	SM 4500-Cl E	BLL	10/15/21
Nitrogen, Nitrate (NO3)	5.76	mg/L	10	0.079	0.500	SM 4500-NO3 F	BLL	10/13/21
Bacteria								
Fecal Coliform	< 2.00	CFU/100mL	1			SM 9222 D	SAA	10/12/21
Field Test								
Field Conductivity	697	µmhos/cm	1			Field Conductivity	JMH	10/13/21
Field pH	7.66	S.U.	1			Field pH	JMH	10/13/21

Approved By: Steve Ristau

Approved On: 10/18/2021 3:02:28 PM

MIDCONTINENT
TESTING LABORATORIES, INC.

2381 South Plaza Drive P.O. Box 3388 Rapid City, SD 57709
(605) 348-0111 -- www.thechemistrylab.com

Sample Site:	67605 Domestic
Project Number:	Loring Quarry
Sampled:	10/12/21 at 10:00 AM by Luke Paulson
Sample Matrix:	Water
Lab ID#:	20211012902
Received:	10/12/21 at 12:07 PM by Dean Aurand
Account:	9511 Simon Contractors

IVY FOSTER
SIMON CONTRACTORS
3975 STURGIS RD.
RAPID CITY, SD 57702

Parameter	Result	Units	DF	MDL	PQL	Method	Analyst/Date	
Physical Properties								
Total Dissolved Solids	371	mg/L	100ml	13.0	50.0	SM 2540 C	JNG	10/13/21
Total Suspended Solids	< 4.00	mg/L	250ml	0.949	4.00	SM 2540 D	JNG	10/13/21
Non-Metallics								
Chloride (Cl-)	17.3	mg/L	1	0.186	0.500	SM 4500-Cl E	BLL	10/15/21
Nitrogen, Nitrate (NO3)	4.56	mg/L	5	0.039	0.250	SM 4500-NO3 F	BLL	10/13/21
Bacteria								
Fecal Coliform	< 2.00	CFU/100mL	1			SM 9222 D	SAA	10/12/21
Field Test								
Field Conductivity	701	µmhos/cm	1			Field Conductivity	JMH	10/13/21
Field pH	7.75	S.U.	1			Field pH	JMH	10/13/21

Approved By: Steve Ristau

Approved On: 10/18/2021 3:02:28 PM

MIDCONTINENT
TESTING LABORATORIES, INC.

2381 South Plaza Drive P.O. Box 3388 Rapid City, SD 57709
(605) 348-0111 -- www.thechemistrylab.com

Sample Site: Spring
Project Number: Loring Quarry
Sampled: 11/02/21 at 09:11 AM
by Luke Paulson
Sample Matrix: Water

Lab ID#: 20211102913
Received: 11/02/21 at 11:35 AM
by Dean Aurand
Account: 9511
Simon Contractors

IVY FOSTER
SIMON CONTRACTORS
3975 STURGIS RD.
RAPID CITY, SD 57702

Parameter	Result	Units	DF	MDL	PQL	Method	Analyst	Date
Physical Properties								
Total Dissolved Solids	365	mg/L	100ml			SM 2540 C	JNG	11/03/21
Total Suspended Solids	< 4.00	mg/L	100ml			SM 2540 D	JNG	11/03/21
Non-Metallics								
Chloride (Cl-)	15.3	mg/L	1	0.186	0.500	SM 4500-Cl E	BLL	11/04/21
Nitrogen, Nitrate (NO3)	3.83	mg/L	5	0.039	0.250	SM 4500-NO3 F	BLL	11/03/21
Bacteria								
Fecal Coliform	< 2.00	CFU/100mL	1			SM 9222 D	SAA	11/02/21
Field Test								
Field Conductivity	672	µmhos/cm	1			Field Conductivity	JMH	11/03/21
Field pH	7.78	S.U.	1			Field pH	JMH	11/03/21

Approved By: Steve Ristau

Approved On: 11/8/2021 1:20:10 PM

MIDCONTINENT
TESTING LABORATORIES, INC.

2381 South Plaza Drive P.O. Box 3388 Rapid City, SD 57709
(605) 348-0111 -- www.thechemistrylab.com

Sample Site: 67605 Domestic
Project Number: Loring Quarry
Sampled: 11/02/21 at 09:34 AM
by Luke Paulson
Sample Matrix: Water

Lab ID#: 20211102914
Received: 11/02/21 at 11:35 AM
by Dean Aurand
Account: 9511
Simon Contractors

IVY FOSTER
SIMON CONTRACTORS
3975 STURGIS RD.
RAPID CITY, SD 57702

Parameter	Result	Units	DF	MDL	PQL	Method	Analyst	Date
Physical Properties								
Total Dissolved Solids	382	mg/L	100ml			SM 2540 C	JNG	11/03/21
Total Suspended Solids	< 4.00	mg/L	100ml			SM 2540 D	JNG	11/03/21
Non-Metallics								
Chloride (Cl-)	19.8	mg/L	1	0.186	0.500	SM 4500-Cl E	BLL	11/04/21
Nitrogen, Nitrate (NO3)	4.45	mg/L	5	0.039	0.250	SM 4500-NO3 F	BLL	11/03/21
Bacteria								
Fecal Coliform	< 2.00	CFU/100mL	1			SM 9222 D	SAA	11/02/21
Field Test								
Field Conductivity	730	µmhos/cm	1			Field Conductivity	JMH	11/03/21
Field pH	7.75	S.U.	1			Field pH	JMH	11/03/21

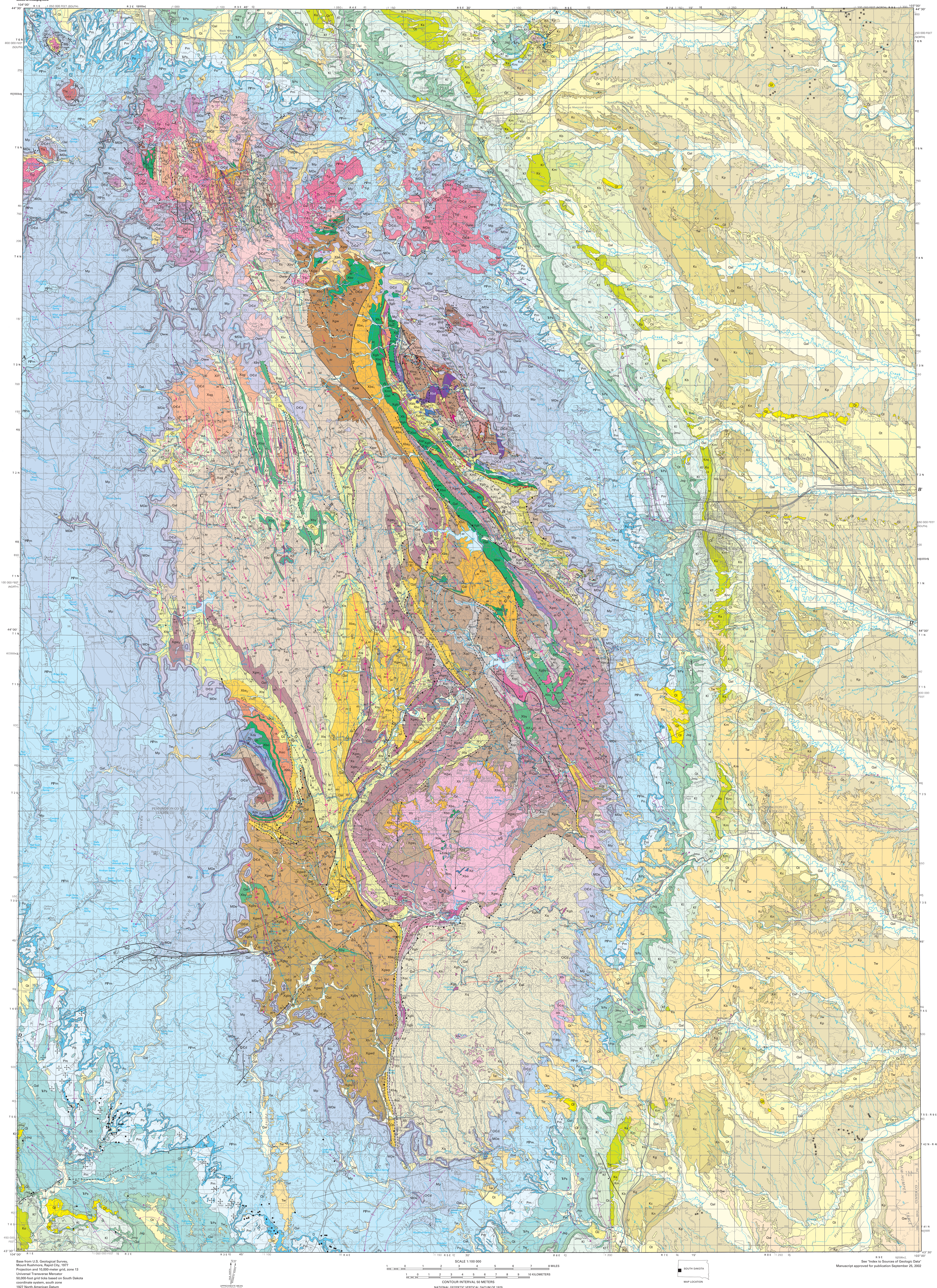
Approved By: Steve Ristau

Approved On: 11/8/2021 1:20:10 PM

U.S. DEPARTMENT OF THE INTERIOR
U.S. GEOLOGICAL SURVEY

Prepared in cooperation with the
SOUTH DAKOTA SCHOOL OF MINES AND TECHNOLOGY FOUNDATION

SCIENTIFIC INVESTIGATIONS MAP 2777
SHEET 1 OF 2
Pamphlet accompanies map



Base from U.S. Geological Survey, Mount Rushmore, Rapid City, 1977
Projection and 10,000-meter grid, zone 13
Universal Transverse Mercator
50,000-foot grid ticks based on South Dakota coordinate system, south zone
1927 North American Datum

APPROXIMATE MEAN DECLINATION, 1977

SCALE 1:100 000

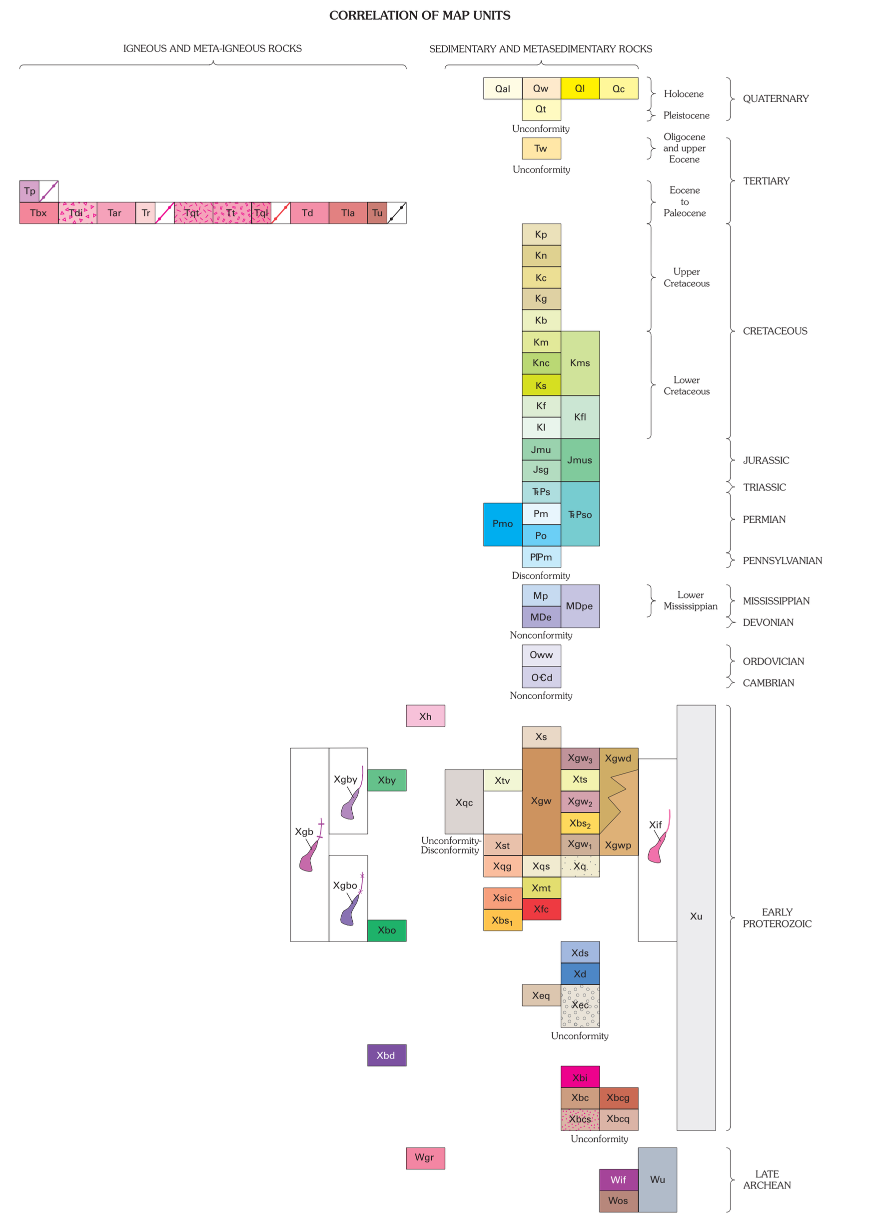
CONTOUR INTERVAL 50 METERS
NATIONAL GEODETIC VERTICAL DATUM OF 1929

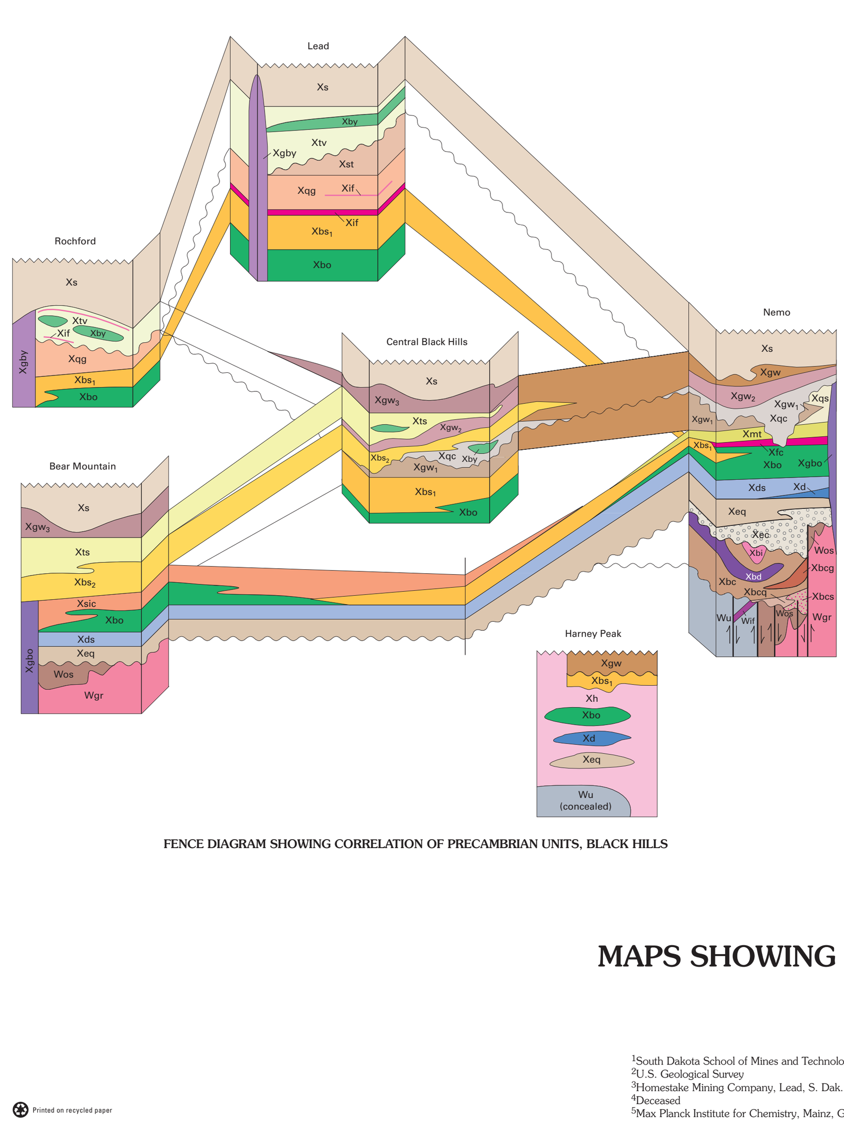
MAP LOCATION

See "Index to Sources of Geologic Data"
Manuscript approved for publication September 25, 2002

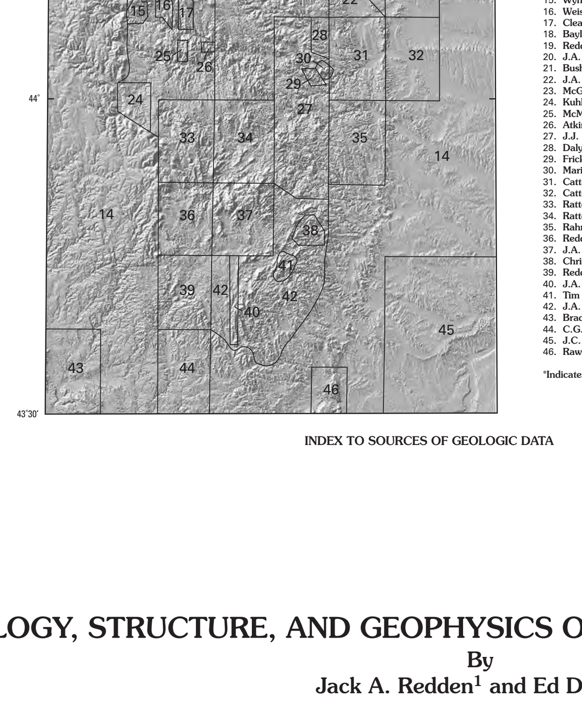
MAP A. GEOLOGIC MAP OF THE CENTRAL BLACK HILLS

CORRELATION OF MAP UNITS





FENCE DIAGRAM SHOWING CORRELATION OF PRECAMBRIAN UNITS, BLACK HILLS



INDEX TO SOURCES OF GEOLOGIC DATA

1. Lisenbee (1991a)*
2. Lisenbee (1991b)*
3. Lisenbee (1991c)*
4. Redden and Lisenbee (1991)*
5. Lisenbee and Redden (1991b)*
6. DeWitt (1973)
7. Lisenbee (1991d)*
8. Lisenbee (1991e)*; J.A. Redden, unpub. mapping in Precambrian, 1989–90.
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12. Lisenbee (1991f)*
13. Lisenbee (1991g)*
14. J.A. Redden, photogeology and field checking, 1980–84
15. Wynn (1992)
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17. Cleath (1986)
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19. Redden (1980)
20. J.A. Redden, unpub. mapping, 1979–81
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22. J.A. Redden and A.L. Lisenbee, unpub. mapping 1982–92
23. McGregor and Cattermole (1973)
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25. McMillan (1977)
26. Atkinson (1976)
27. J.J. Norton, unpub. mapping, 1947–85
28. Daly (1981)
29. Fricke (1982)
30. Marin (1983)
31. Cattermole (1969)
32. Cattermole (1972)
33. Ratté (1986)
34. Ratté and Wayland (1969)
35. Rahn (1987)
36. Redden (1968)
37. J.A. Redden, unpub. mapping, 1972–75
38. Christiansen (1984)
39. Redden (1963)
40. J.A. Redden, unpub. mapping, 1985–92
41. Tim Lincoln, unpub. mapping, 1990–94
42. J.A. Redden, reconnaissance mapping, 1982–94
43. Braddock (1963)
44. C.G. Bowles, unpub. mapping, 1956(?)
45. J.C. Harksen, unpub. mapping, 1968–69
46. Rawlins (1978)

*Indicates compilation source

EXPLANATION OF MAP SYMBOLS

Contact—Dashed and queried where indeterminate

Fault—Dashed where approximately located or inferred; dotted where concealed by younger units. Bar and ball on downthrown side; arrows indicate relative lateral displacement

Probable thrust fault—Dashed where approximately located; dotted where concealed. Sawteeth on upthrown side

PHANEROZOIC STRUCTURAL FEATURES
[Only representative structures shown; see map B]

Anticline—Showing trace of axial surface and direction of plunge. Dashed where approximately located; dotted where concealed

Syncline—Showing trace of axial surface and direction of plunge. Dashed where approximately located; dotted where concealed

Monocline

Upper flexure—Dotted where concealed. Short arrow indicates steep limb

Lower flexure—Dotted where concealed. Short arrow indicates steep limb

Dome—Size of symbol arbitrary for most domes. Asymmetry indicated by length of arrow for the Lead dome (51) and the Brownsville dome (56). Dashed where approximately located; dotted where concealed

PROTEROZOIC STRUCTURAL FEATURES
[Only larger structures shown; see map C]

Folds of uncertain age—Probably between F_2 and F_4 in age; shown predominantly east of Custer

Generalized trace of axial surface of fold where stratigraphic younging unknown—Dotted where concealed; queried where indeterminate. Based on photogeology and reconnaisance mapping in unit Kgs east of Custer

Overturned anticline—Showing generalized trace of axial surface and direction of dip of limbs. Dotted where concealed; queried where indeterminate

Inverted anticline—Showing generalized trace of axial surface and direction of dip of limbs. Queried where indeterminate

Overturned syncline—Showing generalized trace of axial surface and direction of dip of limbs. Queried where indeterminate

15 **Minor fold of F_5 age**—Showing trend and plunge. Restricted to area west of Rochford

F_4 folds

Elongate dome related to emplacement of Harney Peak Granite—Dotted where concealed

Minor fold—Showing trend and plunge. Folds associated with emplacement of Harney Peak Granite

11 **Plunging**

Horizontal

Minor antiform or synform of F_3 age—Showing generalized trace of axial surface. Dotted where concealed

F_2 folds

Major antiform—Showing generalized trace of axial surface. Dotted where concealed; queried where indeterminate

Major synform—Showing generalized trace of axial surface. Dotted where concealed

Minor antiform or synform—Showing generalized trace of axial surface. Dotted where concealed. May be anticlinal, synclinal, or both, depending on stratigraphic sequence in F_1 fold. Shown only in limited areas to indicate deformational pattern

Overturned anticline—Showing generalized trace of axial surface and direction of dip of limbs. Dotted where concealed

Syncline—Showing generalized trace of axial surface. Dotted where concealed

Overturned syncline—Showing generalized trace of axial surface and direction of dip of limbs. Dotted where concealed

Minor fold of probable F_2 age—Showing trend and plunge

30 **Plunging**

Horizontal

F_1 folds

Anticline—Showing generalized trace of axial surface. Dotted where concealed; queried where indeterminate

Overturned anticline—Showing generalized trace of axial surface and direction of dip of limbs. Dotted where concealed; queried where indeterminate

Inverted anticline—Showing generalized trace of axial surface and direction of dip of limbs

Syncline—Showing generalized trace of axial surface. Dotted where concealed; queried where indeterminate

Overturned syncline—Showing generalized trace of axial surface and direction of dip of limbs. Dotted where concealed; queried where indeterminate

PHANEROZOIC AND PROTEROZOIC PLANAR STRUCTURES

Strike and dip of beds—Attitudes in Phanerozoic areas are generally calculated from dip slopes or subsurface data. Beds in Proterozoic rocks may be overturned. Attitudes in unit Xh are for inclusions too small to be shown on map. May be shown combined with foliation where parallel

40 **Inclined**

Vertical

Strike and dip of S_5 foliation

10 **Inclined**

Vertical

Strike and dip of S_4 foliation—May be shown combined with bedding where parallel

10 **Inclined**

Strike and dip of S_2 foliation—May be shown combined with bedding where parallel

10 **Inclined**

Vertical

Strike and dip of bedding where top of bed undetermined—Bedding symbols in Harney Peak Granite are on inclusions too small to be shown

63 **Inclined**

Vertical

OTHER FEATURES

Form line—Shown only in cross sections (in black) and on map B (in red)

B/G **Metamorphic isograd**—First appearance of index mineral noted on side of isograd. B, biotite; G, garnet; K, kyanite; S, sillimanite; sS, second sillimanite; St, staurolite. Dotted through outcrops of Harney Peak Granite and where covered by surficial deposits

Line indicating outer limit of small pegmatite bodies related to Harney Peak Granite

Top of bed—Indicated by sedimentary structure

Collapse breccia pipe

Mine dump or tailings area

Teepee butte in Cretaceous shale

Minor dome—Related to possible conversion of anhydrite to gypsum in underlying rocks. Size of symbol arbitrary

DESCRIPTION OF MAP UNITS

PHANEROZOIC UNITS

Qal **Alluvial deposits (Holocene and Pleistocene)**—Stream-laid deposits of mud, silt, sand, and gravel. Narrow deposits not shown. Maximum thickness 10 m

Qw **Windblown sand or loess deposit (Holocene and Pleistocene)**—Forms small dunes and covers flat surfaces. Restricted to southeast corner of map area. Thickness in individual areas is as much as 10 m

Ql **Landslide deposits (Holocene and Pleistocene)**—Small deposits typically along escarpments of Pierre Shale. Localized, very small slumps in Jurassic rocks not shown

Qc **Colluvium or talus (Holocene and Pleistocene)**—Angular blocks and debris masking bedrock. Many small deposits not shown. Thickness as much as 10 m

Qt **Terrace gravel and alluvial-fan deposits (Pleistocene)**—Gravel, sand, silt, and soil. Maximum thickness about 30 m. Some higher elevation terrace deposits could be of Pliocene age

Tw **White River Group (Oligocene and Upper Eocene)**—Silty claystone and poorly indurated sandstone, arkose, and conglomerate. Gravel at higher elevations. Thickness as much as 120 m

Tp **Phonolitic intrusive rocks (Eocene to Paleocene)**—Greenish gray, phaneritic. Typically, fresh exposures contrast with weathered intermediate-composition rocks. Forms laccolithic bodies, sills, and dikes

Tbx **Tertiary intrusion breccia (Eocene to Paleocene)**—Fragments of igneous rock, wallrock, and overlying or underlying rocks in dikes or small pipes

Tdt **Breccia and layered tuffaceous unit (Eocene to Paleocene)**—Foundered coherent blocks of sedimentary rocks in diatremes and pipes

Tar **Alkali rhyolitic intrusive rocks (Eocene to Paleocene)**—Tan to gray, containing phenocrysts of alkali feldspar and quartz. Forms sills

Tr **Rhyolitic intrusive rocks (Eocene to Paleocene)**—Tan to ivory, containing sparse phenocrysts of quartz, feldspar, and biotite. Forms dikes, sills, and laccolithic bodies, including probable feeder pipes

Tqt **Quartz trachytic intrusive rocks (Eocene to Paleocene)**—Tan to gray and porphyritic or phaneritic. Locally sanidine-bearing. Forms laccolithic bodies and sills

Tt **Trachytic intrusive rocks (Eocene to Paleocene)**—Gray to brown, weathered, commonly aegerine-bearing. Forms sills and laccolithic bodies

Tql **Quartz latitic intrusive rocks (Eocene to Paleocene)**—Gray to brown, commonly hornblende-bearing, and phaneritic. Forms laccolithic bodies, sills, dikes, and small stocks

Td **Dacitic intrusive rocks (Eocene to Paleocene)**—Typically shades of gray and commonly hornblende-bearing and phaneritic. Forms laccolithic bodies and sills

Tla **Lati-andesite intrusive rocks (Eocene to Paleocene)**—Resembles latitic rocks. Forms laccolithic bodies and sills

Tu **Tertiary intrusive rocks, undivided (Eocene to Paleocene)**—Aphanitic to phaneritic. Includes trachyandesite and other compositions

Kp **Pierre Shale (Upper Cretaceous)**—Dark-gray to black shale containing concretions and bentonite beds. Maximum thickness about 500 m within map area. Teepee buttes underlain by fossiliferous limestone formed by methane-rich spring deposits

Kn **Niobrara Formation (Upper Cretaceous)**—Gray to yellowish-tan, thin-bedded limestone and calcareous shale. Contains bentonite beds. Thickness 60–100 m

Kc **Carlile Shale (Upper Cretaceous)**—Gray shale and a few tan siltstone and resistant sandstone beds. Thickness 100–200 m

Kg **Greenhorn Limestone (Upper Cretaceous)**—Light-gray to tan, thin-bedded limestone and calcareous shale. Bentonite beds. Thickness 70–120 m

Kb **Belle Fourche Shale (Upper Cretaceous)**—Gray to black bentonitic shale containing small concretions and thin bentonite beds. Thickness 70–200 m

Km **Mowry Shale (Lower Cretaceous)**—Dark-gray shale, locally somewhat siliceous. Contains minor thin bentonite beds. Thickness 40–70 m

Knc **Newcastle Sandstone (Lower Cretaceous)**—Tan to white sandstone and minor siltstone. Locally abundant carbonaceous fragments. Shown in combination with Mowry Shale in cross sections. Thickness 0–20 m

Ks **Skull Creek Shale (Lower Cretaceous)**—Dark-gray to black shale. Thickness 55–80 m. Underlies minor valleys where Newcastle Sandstone is present

Kms **Mowry Shale (Lower Cretaceous), Newcastle Sandstone (Lower Cretaceous), and Skull Creek Shale (Lower Cretaceous), undivided**—Shown combined in Bear Butte area

Kf **Fall River Formation (Lower Cretaceous)**—Sandstone interbedded with gray to dark-gray shale near top. Thickness 35–70 m

Kl **Lakota Formation (Lower Cretaceous)**—Sandstone, mudstone, and shale. Upper part is hard siltstone. Thickness 85–150 m

Kfl **Fall River and Lakota Formations (Lower Cretaceous), undivided**—Shown combined in Bear Butte area

Jmu **Morrison Formation and Unkpapa Sandstone, undivided (Upper Jurassic)**

Morrison Formation—Shale and sandstone; minor limestone. Thickness as much as 50 m

Unkpapa Sandstone—Fine-grained eolian sandstone. Lenses out to the west. Thickness as much as 85 m

Jsg **Sundance (Upper and Middle Jurassic) and Gypsum Spring Formations (Middle Jurassic), undivided**

Sundance Formation—Interbedded shale, siltstone, and sandstone. Thickness 70–160 m

Gypsum Spring Formation—Gypsum and shale. Thickness as much as 25 m

Jmus **Morrison Formation and Unkpapa Sandstone (Upper Jurassic) and Sundance (Upper and Middle Jurassic) and Gypsum Spring Formations (Middle Jurassic), undivided**—Shown combined in Bear Butte area

TRPs **Spearfish Formation (Triassic and Upper Permian)**—Red shale and siltstone; minor limestone and gypsum. Thickness 70–275 m

Pm **Minnekahta Limestone (Lower Permian)**—Pinkish-gray, thin-bedded limestone. Thickness 10–18 m

Po **Opeche Shale (Lower Permian)**—Maroon shale and siltstone. Thickness 20–40 m

TRPso **Spearfish Formation (Triassic and Upper Permian), Minnekahta Limestone (Lower Permian), and Opeche Shale (Lower Permian), undivided**—Shown combined in Bear Butte area

Pmo **Minnekahta Limestone and Opeche Shale (Lower Permian), undivided**

PPm **Minnelusa Formation (Lower Permian and Pennsylvanian), undivided**—Sandstone, limestone, and minor shale. Thickness 120 to about 350 m

Mp **Pahasapa Limestone (Lower Mississippian)**—Mainly thick-bedded dolomitic limestone. Reef-like, bluish limestone in uppermost part. Includes Englewood Limestone (unit MDe) in areas of steep terrain. Thickness 80–210 m

MDe **Englewood Limestone (Lower Mississippian and Upper Devonian)**—Lavender, impure limestone. Shown in combination with Pahasapa Limestone in areas of steep terrain. Thickness 10–20 m

MDpe **Pahasapa Limestone (Lower Mississippian) and Englewood Limestone (Lower Mississippian and Upper Devonian), undivided**—Shown only in cross sections

Oww **Whitewood Dolomite (Upper Ordovician) and Winnipeg Formation (Middle Ordovician), undivided**

Whitewood Dolomite—Gray to tan, massive dolomite. Thickness 0–45 m

Winnipeg Formation—Green shale and siltstone. Thickness 0–35 m

OЄd **Deadwood Formation (Lower Ordovician and Upper Cambrian)**—Glauconitic sandstone, shale, siltstone, and conglomerate. Thickness 0–200 m

PRECAMBRIAN UNITS

Xh **Harney Peak Granite (Early Proterozoic)**—Layered granite, pegmatitic granite, and pegmatite. Leucocratic, peraluminous, plagioclase-microcline-quartz-muscovite S-type granite. Tourmaline and biotite common, but biotite mainly in inner part of central mass. Central mass consists of hundreds of intrusions. More than 24,000 separate bodies of pegmatite and granite are known between the central mass and the line defining the outer limit of pegmatite and granite bodies (map A). Several hundred zoned pegmatites in a peripheral zone contain deposits of feldspar, mica, beryl, and other rare-element minerals. Emplacement age of 1,715±3 Ma for the main granite based on concordant U-Pb date for monazite (Redden and others, 1990), but the emplacement of some pegmatite bodies may have continued for ~10 million years

Xu **Early Proterozoic rocks, undivided**—Shown only in areas where virtually no outcrop is present and below Phanerozoic rocks in cross sections

Xs **Metamorphosed shale (Early Proterozoic)**—Gray to black slate, phyllite, or schist. In part, garnetiferous at higher metamorphic grade. Locally carbon-rich and contains sulfide minerals. Includes Grizzly Formation (Dodge, 1942), part of Swede Gulch Formation (Bayley, 1972c), and part of Oreville Formation (Ratté and Wayland, 1969). Thickness poorly known due to homogeneity and intense folding, but estimated to be at least 2,000 m

Xgb **Metagabbro (Early Proterozoic)**—Dark-green amphibolite, actinolite schist, or greenstone. Small bodies and margins of larger bodies well foliated. Predominantly sill-like bodies. Minor chemical differences in selected samples indicate at least two distinct types of probable different ages. Types are not lithologically distinct and are shown as a single unit where age is uncertain. Thin dikes cutting unit Xgw_2 a few kilometers northwest of Rockerville have rafted inclusions of metabasalt and metachert apparently derived from units Xby and Xqc. Minor bodies not shown

Xgby **Younger metagabbro (Early Proterozoic)**—Lithologically similar to unit Xgb. Sills and dikes spatially distributed with or near shale, tuff, and volcaniclastic rock (unit Xtv). Compositions of selected bodies are alkalic gabbro. Emplaced about 1,900 Ma. Differentiated sill intruding quartzite and pelite (unit Xqs) in Prairie Creek area (T. 1 N., R. 5 E.) has U-Pb zircon age of 1,883±5 Ma (Redden and others, 1990)

Xgw **Metagraywacke (Early Proterozoic)**—Greenish-gray to grayish-tan siliceous schist. Minor chlorite, garnet, staurolite, or sillimanite in pelitic interbeds at various metamorphic grades. Protoliths are turbidite deposits having readily recognizable Bouma sequences. Calc-silicate ellipsoidal structures develop from carbonate-rich concretions near the garnet isograd. Local discordances within units probably indicate penecontemporaneous slump, but a disconformity is inferred to exist in lower part of unit. Subdivided into units Xgw_1, Xgw_2, and Xgw_3 where possible. Subunits pinch out northwest of Pactola Lake. Includes part of Oreville Formation in Hill City 7.5-minute quadrangle (Ratté and Wayland, 1969). Thickness possibly as much as 2,200 m

Xgw_3 **Metagraywacke unit 3 (Early Proterozoic)**—Upper part of unit Xgw. Gray to tan siliceous schist containing minor chlorite, garnet, or staurolite in pelitic parts of Bouma sequences or in thin shale subunits at various metamorphic grades. Protoliths are turbidite deposits. Unit overlies mica schist (unit Xts) in central part of map area but pinches out or is lensoid to the northwest and west. Shown as unit Xgw where unit Xts pinches out north of Pactola Lake. Maximum thickness is about 700 m

Xgwd **Distal metagraywacke (Early Proterozoic)**—Grayish-tan schist and siliceous schist containing considerable garnet, staurolite, and sillimanite. Calc-silicate lenses developed from former concretions. Restricted to area southwest of Grand Junction fault. Includes Mayo Formation and middle part of Bugtown Formation (Redden, 1963). Correlation of Mayo Formation uncertain due to faulting but may be equivalent to upper graywacke (unit Xgw_3). Thickness of Mayo part of unit about 3,600 m

Xif **Metamorphosed carbonate-facies iron-formation (Early Proterozoic)**—Banded metachert containing ankerite and siderite, and schist. Present at various stratigraphic levels including both younger and older Early Proterozoic units. Contains cummingtonite-grunerite and garnet at higher metamorphic grade. Locally sulfide-rich and carbon-rich, such as at Bluelead Mountain (T. 1 S., R. 6 E.). In areas where unit is thick, includes considerable biotite-garnet schist and lenses of massive metachert. Commonly associated with metabasalt, volcaniclastic rocks, or conglomerate and quartzite (unit Xqc); rarely as lenses in metagraywacke. Includes thin lensoid bodies between basaltic flows not shown on map A. In Lead area, includes the Homestake Formation (Hosted and Wright, 1923), which separates the Ellison and Poorman Formations (units Xqg and Xbs_1). In Rochford area, includes the Rochford and Montana Mine Formations (Bayley, 1972c) and unnamed subunits. Locally transitional to thin-bedded chert and dark phyllite or schist. Poor exposures are typical in areas of low metamorphic grade, and unit mapped largely on metachert float. Some units may contain iron-poor strata. Lensoid distribution, composition, and associated rocks suggest deposition by thermal springs. Laterally continuous units apparently represent larger trough ponding of similar springs. Thickness highly variable; average thickness about 25 m

Xby **Metamorphosed younger alkalic basalt, tuff, and volcaniclastic rocks (Early Proterozoic)**—Pillowed chloritic greenstone or amphibolite, and layered amphibole schist and amphibole-bearing or biotite-rich schist. Thin interflow deposits include various dark-gray and black schists, typically containing some sulfide minerals or carbon-rich strata, and lenses of massive metachert and banded siderite-metachert or cummingtonite-rich beds. In Lead area this unit is part of the Flag Rock Group (Hosted and Wright, 1923) and in Rochford area it is equivalent to the Rapid Creek Greenstone of the Flag Rock Group (Bayley, 1972b). In Mount Rushmore quadrangle, unit represents two apparent separate volcanic centers largely within unit Xqc. Correlated with the Crow Formation west of Custer (Redden, 1963), which has flows and agglomerate having generally similar trace-element abundances and is locally enriched in niobium and cesium, suggestive of alkalic volcanism. In Rochford area, unit intertongues with tuffaceous shale, tuff, and volcaniclastic rocks (unit Xtv) that have U-Pb zircon age of 1,884±29 Ma (Redden and others, 1990). Maximum thickness about 1,000 m

Xqc **Metamorphosed quartzite, debris flow conglomerate, pelite, and graywacke (Early Proterozoic)**—Heterogeneous, gray to tan quartzite, metaconglomerate, and phyllite or schist. Garnet-, staurolite-, andalusite-, and sillimanite-bearing at different metamorphic grades. Contains local lenses of unit Xif and massive metachert (not shown everywhere). Matrix-supported metaconglomerate clasts range from quartzite to pelitic schist. Amphibole-schist clasts noted locally in Bitter Creek area (T. 1 S., R. 6 E.) adjacent to exposures of unit Xby. Easternmost exposures in Pactola Dam quadrangle include clast-supported metaconglomerate apparently derived from adjacent older units Xqs and Xfc. Locally contains thick, lensoid, structureless quartzite beds. Unsorted, typically paraconglomerate, locally containing giant boulders, has pelitic matrix characteristic of debris flows. Unit decreases in thickness to the northwest and southwest from north half of Mount Rushmore 7.5-minute quadrangle. Quartzite and thin metagabbro sills are widespread east of a north-south line through Pactola Lake dam and extending south to middle of the Harney Peak Granite. Metagraywacke interbeds are more numerous west of this line, and unit not recognized north of Silver City fault in Pactola Lake area. The lower contact is unconformable in much of the Pactola Lake quadrangle and possibly in part of the Mount Rushmore quadrangle. Elsewhere the lower contact is apparently concordant with adjacent graywacke and the contact is inferred to be a disconformity separating younger from older packages of Early Proterozoic rocks. Because of facies changes to deeper water turbidites to the west and north, the disconformity may lie within or along graywacke units that are lateral equivalents of unit Xqc. Unit Xqc in Hill City area may be at a somewhat different stratigraphic level than elsewhere. Thickness 30–700 m

Xtv **Metamorphosed tuffaceous shale, tuff, and volcaniclastic rocks (Early Proterozoic)**—Biotite or muscovite-biotite schist containing local interbeds of amphibole-bearing schist. Unit is agglomerate near Rochford. Lenses of massive metachert and banded metachert transitional to carbonate-facies iron-formation (unit Xif) and associated carbon-rich and sulfur-rich subunits. Distribution of unit is poorly known in Long Draw area west of Rochford. Schistose, alkalic ash-fall tuff north of Rochford has U-Pb zircon age of 1,884±29 Ma (Redden and others, 1990). Includes most of Flag Rock Group (Hosted and Wright, 1923) in Lead area where lower contact is believed to be an unconformity. In Rochford area, includes the Irish Gulch Slate, Nahant Schist of Flag Rock Group, and Poverty Gulch Slate (Bayley, 1972c). Unit is approximate lateral equivalent of tuff and shale (unit Xts). Maximum thickness in Rochford area but poorly known due to refolding and enclosed lenses of unit Xby. Maximum thickness probably about 1,200 m

Xts **Metamorphosed tuff and shale (Early Proterozoic)**—Greenish-gray to tan phyllite and muscovite-biotite schist. At higher metamorphic grades, muscovite schist may contain andalusite, sillimanite, garnet, staurolite, or cordierite. Manganese-rich garnet coticle, magnetite octahedra, and traces of chalcopyrite are distinctive components in Berne, Hill City, Silver City, Medicine Mountain, and Deerfield 7.5-minute quadrangles. Subunits rich in magnetite and ilmenite produce strong magnetic anomalies. Included as part of Oreville Formation in Hill City area by Ratté and Wayland (1969). Unit includes increasing number of metagraywacke beds to the northeast and loses distinctive identity a few kilometers north of Pactola Lake. East of Mystic (T. 1 N., R. 3 E.), unit includes thin alkalic metabasalt (unit Xby). West toward Rochford, unit is equivalent to tuffaceous shale, tuff, and volcaniclastic rocks (unit Xtv), in which tuff within the volcaniclastic rocks has a U-Pb zircon age of 1,883±5 Ma (Redden and others, 1990). Thickness as much as 700 m

Xgwp **Proximal metagraywacke (Early Proterozoic)**—Light-tan, thick-bedded quartzose schist southwest of Grand Junction fault. Predominantly thick Bouma beds of turbidite deposits. Calc-silicate lenses developed from former concretions. Includes lower and upper part of Bugtown Formation (Redden, 1963). Correlation of Bugtown Formation uncertain due to truncation by Grand Junction fault. Total thickness about 2,200 m

Xgw_2 **Metagraywacke unit 2 (Early Proterozoic)**—Middle part of unit Xgw. Lithologically similar to unit Xgw_3. Pelitic parts may contain sillimanite near Harney Peak Granite. Unit underlies mica schist unit (unit Xts) in Pactola Lake area but is shown as Xgw where Xts pinches out to the north. Overlies unit Xqc to the southeast in the Rockerville-Keystone area, where unit may be as much as 2,000 m thick and is largely proximal turbidites. North of Hill City, unit apparently pinches out

Xbs_2 **Metamorphosed black shale (Early Proterozoic)**—Thin-bedded, dark phyllite, biotite schist, or garnet schist, depending on metamorphic grade. Resembles unit Xbs_1 but contains thin units of metagraywacke. Equivalent to part of Oreville Formation (Ratté and Wayland, 1969). Interpreted to be stratigraphically higher than unit Xbs_1 in central Black Hills but pinches out north of Pactola Lake. Thickness as much as 700 m in Hill City 7.5-minute quadrangle

Xst **Metamorphosed shale and tuff (Early Proterozoic)**—Mica phyllite and schist containing minor garnet. Equivalent to Northwestern Formation (Hosted and Wright, 1923) in Lead area. Disappears to the south due to unconformably overlying shale, tuff, and volcaniclastic rocks (unit Xtv). Thickness as much as 500 m

Xgw_1 **Metagraywacke unit 1 (Early Proterozoic)**—Lower part of unit Xgw. Lithologically similar to unit Xgw_3 but contains higher metamorphic grade minerals such as sillimanite near the Harney Peak Granite. In Hill City and Sheridan Lake areas, unit is largely proximal turbidites having thick Bouma A units. A disconformity is inferred within or at top of unit. Maximum thickness probably about 1,500 m, but unit pinches out or is removed by erosion to the west

Xgbo **Older metagabbro (Early Proterozoic)**—Lithologically similar to unit Xgb. Sills and dikes in and peripheral to Nemo area. Thin dikes along faults cutting Boxelder Creek Formation (unit Xbc) are extensively altered. Unaltered sill on north side of Bogus Jim Creek (east edge of T. 3 N., R. 5 E.) has U-Pb zircon age of 1,964±15 Ma (Redden and others, 1990). General chemical composition similar to that of tholeiitic basaltic rocks (unit Xbo), which are inferred to be comagmatic

Xqg **Metamorphosed quartzite, pelite, and graywacke (Early Proterozoic)**—Gray to tan quartzite, metagraywacke, and quartzose schist. Includes Ellison Formation (Hosted and Wright, 1923) in Lead area and Moonshine Gulch Quartzite (Bayley, 1972c) in Rochford area. Large area west of Nahant is mainly metagraywacke that contains subgraywacke or quartzite in upper part. Tuffaceous bed in Ellison Formation at Lead has a U-Pb zircon age of 1,974±8 Ma (Redden and others, 1990). Shallow-water shelf sandstone and thin carbonate beds in Lead area change laterally toward the Nahant area to deeper water, coarser clastic beds. Thickness uncertain due to extreme deformation in Lead area but probably ranges from about 200 m to more than 1,000 m in Nahant area

Xqs **Metamorphosed quartzite and pelite (Early Proterozoic)**—Interbedded quartzite, grayish-tan schist, and phyllite. Massive, thick-bedded quartzite subunits as much as 70 m thick underlie major ridges north of Rockerville and are interbedded with thin-bedded phyllite. Sizable areas of predominantly phyllite are probable in larger fold noses. Thick, ripple-structured quartzite indicates shelf depositional environment. Northern part equivalent to most of Buck Mountain Quartzite (Bayley, 1972b). Correlated with higher metamorphic grade quartzite and sillimanite schist east and southeast of Custer. Unit decreases in thickness to the north and may pinch out near Crystal Mountain. Thickness as much as 1,200 m in eastern and northeastern parts of map area

Xq **Metamorphosed quartzite (Early Proterozoic)**—Tan quartzite and quartzose schist lacking interbedded phyllite or graywacke. Exposed south and east of Custer. Correlation with other Early Proterozoic units in Black Hills poorly known. Thickness may be in thousands of meters

Xmt **Metamorphosed impure mafic tuff (Early Proterozoic)**—Green to tan, thin-bedded, fine-grained, chlorite-biotite phyllite and schist. Equivalent to Gingrass Draw Slate (Bayley, 1972b). Near Rapid Creek, unit is less chloritic and contains quartzite and silt beds, thus making it difficult to distinguish from the younger quartzite and pelite (unit Xqs). Locally intruded by abundant metagabbro sills, which exaggerate outcrop width. Thickness about 200 m

Xsic **Metamorphosed shale, siltstone, carbonate-facies iron-formation, and chert (Early Proterozoic)**—Grayish-tan schist and phyllite, banded recrystallized chert and iron-rich carbonate units, and lenses of massive iron-stained metachert near Benchmark where unit may be a facies variation of unit Xmt. In Bear Mountain area, unit consists of biotite-garnet (± staurolite) schist, banded cummingtonite iron-formation, and associated iron-stained, massive metachert lenses of upper Vanderlehr Formation (Ratté, 1986). Bedded sulfide minerals associated with massive metachert. Associated biotite-feldspar schist derived from tuffaceous beds. A thin basalt (unit Xbo) unit separates the unit at Bear Mountain into two parts whose combined thickness is about 400 m

Xfc **Metamorphosed ferruginous chert (Early Proterozoic)**—Banded, reddish- to yellowish-brown ferruginous metachert. Massive, color-banded metachert outcrops characterize the upper part, and more ferruginous and more easily weathered outcrops characterize the lower part in exposures along the tholeiitic basalt (unit Xbo) west of Nemo area. Locally, there may be thin flows above the unit and farther west the unit may be equivalent to some thin interflow unit within unit Xbo. Locally indistinguishable from carbonate-facies iron-formation (unit Xif). Possibly correlative with Homestake Formation at Lead. Thickness 15–75 m

Xbs_1 **Metamorphosed black shale (Early Proterozoic)**—Dark, thin-bedded slate, phyllite, or schist, and local thin beds of metachert. Generally biotite-rich and contains thin garnet-rich beds at higher metamorphic grade. Carbon-rich and sulfide-rich locally. Equivalent to Reausaw Slate (Bayley, 1972b) and upper part of Poorman Formation in Lead area. Interfingers with individual metabasalt flows (unit Xbo) north-northwest of Pactola Lake. Thickness estimated to range from about 30 m to possibly 1,000 m

Xbo **Metamorphosed older basaltic rocks (Early Proterozoic)**—Greenschist- to amphibolite-facies pillowed tholeiitic basalt flows equivalent to the Hay Creek Greenstone (Bayley, 1972c). Interflows contain gray and black schist or phyllite and lensoid carbonate-facies iron-formation, all commonly carbon-rich or sulfide-rich. Unit repeated by folds west of Nemo area but farther to the west individual flows end in laterally equivalent black shale (unit Xbs_1) north of Pactola Lake. Small flows repeated near top of unit Xbs_1 south of Pactola Lake. Correlated with chemically similar basalt in Lead area in lower part of Poorman Formation (Hosted and Wright, 1923). Tuff in overlying Ellison Formation at Lead has U-Pb zircon age of 1,974±8 Ma (Redden and others, 1990). Metagabbro sill (Xgbo) along Bogus Jim Creek has U-Pb zircon age of 1,964±15 Ma (Redden and others, 1990) and is inferred to be comagmatic with unit Xbo. Present at two different levels in Bear Mountain dome. Inliers in Harney Peak Granite (unit Xh) are clinopyroxene-bearing amphibole schist. Maximum thickness about 700 m

Xds **Metamorphosed dolomite and silty pelite (Early Proterozoic)**—Light-tan, locally schistose, generally impure dolomite and minor graphitic phyllite units in Nemo area where unit is part of the Roberts Draw Formation (Redden, 1980). At Bear Mountain, it includes a relatively thin unit of tremolite marble, phlogopitic schist, and thicker biotite garnet (±) staurolite schist and graphitic schist of the middle part of the Vanderlehr Formation (Ratté, 1986). Amphibole schist (unit Xbo) overlies the section. Includes coarse-grained marble and skarn in screens within Harney Peak Granite (unit Xh). Original thickness ~300 m

Xd **Metamorphosed dolomite (Early Proterozoic)**—Siliceous, fine-grained, gray to yellowish-tan dolomitic marble. Shown in Nemo area, where it is part of Roberts Draw Formation (Redden, 1980), and in Harney Peak area, where it is a coarse-grained marble and skarn. Widest exposures in fold noses contain minor conglomerate beds similar to those of underlying Estes Formation (unit Xec). Thickness about 50 m

Metamorphosed conglomerate and quartzite (Early Proterozoic)—Includes the Estes Formation in Nemo area, which is subdivided into the following units

Xeq **Quartzite (Early Proterozoic)**—Predominantly thick bedded quartzite and minor meta-arkose, both grading distally to quartzose phyllite. Near Nemo, units Xeq and Xec intertongue in three fans. Combined thickness of units Xec and Xeq in the well-exposed middle fan ranges from about 500 m to 3,300 m. In Bear Mountain area, unit Xeq is arkosic quartzite that contains a local, very thin basal metaconglomerate equivalent to arkosic part of the Vanderlehr Formation (Ratté, 1986). Thickness near Bear Mountain about 100 m. In Harney Peak area, unit Xeq includes quartzite and gneissic metaconglomerate inliers within Harney Peak Granite (unit Xh)

Xec **Metamorphosed conglomerate and quartzite (Early Proterozoic)**—Composed of pebble to massive boulder metaconglomerate, minor quartzite, and thin (20 m thick) doloarenite, which grades proximally into doloconglomerate. Deposited in three separate fans along growth faults. Clasts virtually all derived from underlying quartzite (unit Xbc) and oxide-facies banded iron-formation (unit Xbi). Two olistoliths, one quartzite (unit Xbc), and another oxide-facies iron-formation unit (Xif) shown in middle fan. In Nemo area, unit is equivalent to Estes Formation as mapped by Redden (1980)

Xbd **Blue Draw Metagabbro (Early Proterozoic)**—Greenish serpentinite, hornblendite, metagabbro, and minor quartz-biotite granophyre. Major unit is an overturned, 1,000-m-thick, gravity-differentiated sill intruding sandstone (unit Xbc) of the Boxelder Creek Formation in Nemo area (Redden, 1980). Original U-Pb zircon age of 2,170±110 Ma (Redden and others, 1990) redetermined as 2,480±6 Ma (Dahl and others, 2006)

Xbi **Benchmark Iron-formation (Early Proterozoic)**—Metamorphosed oxide-facies banded iron-formation. Thin, recrystallized chert beds and lenses and silvery-gray specular hematite beds. Preserved as synclinal noses along unconformity below quartzite (unit Xeq) and conglomerate and quartzite (unit Xec, Estes Formation) in Nemo area. Maximum thickness about 70 m

Boxelder Creek Formation (Early Proterozoic)—Metamorphosed sandstone, conglomerate, and siltstone. Subdivided in Nemo area (Redden, 1980) into the following units

Xbc **Quartzite**—Thick-bedded, locally schistose, tan to gray quartzite. Cross bedding and sparse pebbles indicate mainly fluvial origin. Maximum thickness at least 3,050 m

Xbcg **Metagrit and iron-stained metaconglomerate**—Intertongues with or underlies unit Xbc. Local quartzite beds and an upper, thin phyllite unit. Contains pebbles of metachert, quartzite, and vein quartz. Conglomerate and grit moderately radioactive and enriched in pyrite and gold. Diagnostic accessory chromite and fuchsite. Mapped informally as "Tomahawk Tongue" of Boxelder Creek Formation (Redden, 1980). Fluvial origin. Thickness as much as 150 m

Xbcs **Chloritic biotite phyllite**—Contains a few thin dolomite and pebble beds. Distal (northeast) equivalent of unit Xbcq and part of informal "Greenwood Tongue" of Boxelder Creek Formation (Redden, 1980). Units Xbcs and Xbcq are fan deposits believed to have been deposited unconformably on Archean basement

Xbcq **Impure chlorite quartzite and metaconglomerate**—Generally underlies unit Xbcg. Clasts are oxide-facies banded iron-formation, chert, and quartzite. Conglomerate beds pinch out to the northeast. Magnetite a common accessory. Part of "Greenwood Tongue" of Boxelder Creek Formation (Redden, 1980). Lower contact concealed by Phanerozoic rocks. Locally at least 1,000 m thick

Wgr **Granite (Late Archean)**—Includes the Little Elk Granite (T. 3 N., R. 5 E.) and pegmatitic granite and trondhjemite at Bear Mountain (T. 2 S., R. 3 E.). Little Elk Granite is a coarse-grained, pinkish microcline augen granite that locally contains blue quartz. The I-type biotite granite is metaluminous to slightly peraluminous and has U-Pb zircon age of 2,549±11 Ma (Gosselin and others, 1988). The medium-grained granite and trondhjemite at Bear Mountain are typically leucocratic, muscovite-bearing, and peraluminous. Pegmatitic phases are clearly deformed. U-Pb zircon upper intercept age of 2,392±230 Ma (Gosselin and others, 1988) is considered a minimum age for the granite

Wu **Late Archean rocks, undivided**—Shown in cross sections and in the largely concealed area adjacent to unit Wif along Little Elk Creek and in Nemo area. Samples of float from unit are chloritic and arkosic schist. Unit is in fault contact with unit Wos

Wif **Iron-formation (Late Archean?)**—Grayish-black, massive, banded iron-formation containing interbedded hematite and sugary quartz layers. Protolith includes oxide-facies banded iron-formation and ferruginous shale. Informally named the "Nemo iron-formation" (Redden, 1980) to distinguish it from the Benchmark Iron-formation of Bayley (1972b). Thickness about 20 m. Where shown at greater widths, unit includes one or more banded iron-formation beds separated and enclosed by thin-bedded chloritic schist typically containing recrystallized chert laminae and disseminated magnetite. Inferred Archean age is based on this iron-formation's being the probable source for oxide-facies iron-formation clasts in oldest Early Proterozoic rocks of Boxelder Creek Formation. Unit produces a strong magnetic high traceable below the Phanerozoic cover

Wos **Older metasedimentary rocks (Late Archean)**—Quartz-biotite-plagioclase schist (± garnet, staurolite, and kyanite) at Bear Mountain. Protolith probably derived from siltstone and graywacke. Quartz-feldspar-biotite gneiss and schist (locally metaconglomeratic) and minor bedded, amphibole-bearing rocks contact the Little Elk Granite north-northeast of Nemo. Protoliths predominantly arkosic sandstone. Thickness about 600 m

MAPS SHOWING GEOLOGY, STRUCTURE, AND GEOPHYSICS OF THE CENTRAL BLACK HILLS, SOUTH DAKOTA

By
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Including contributions by
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2008

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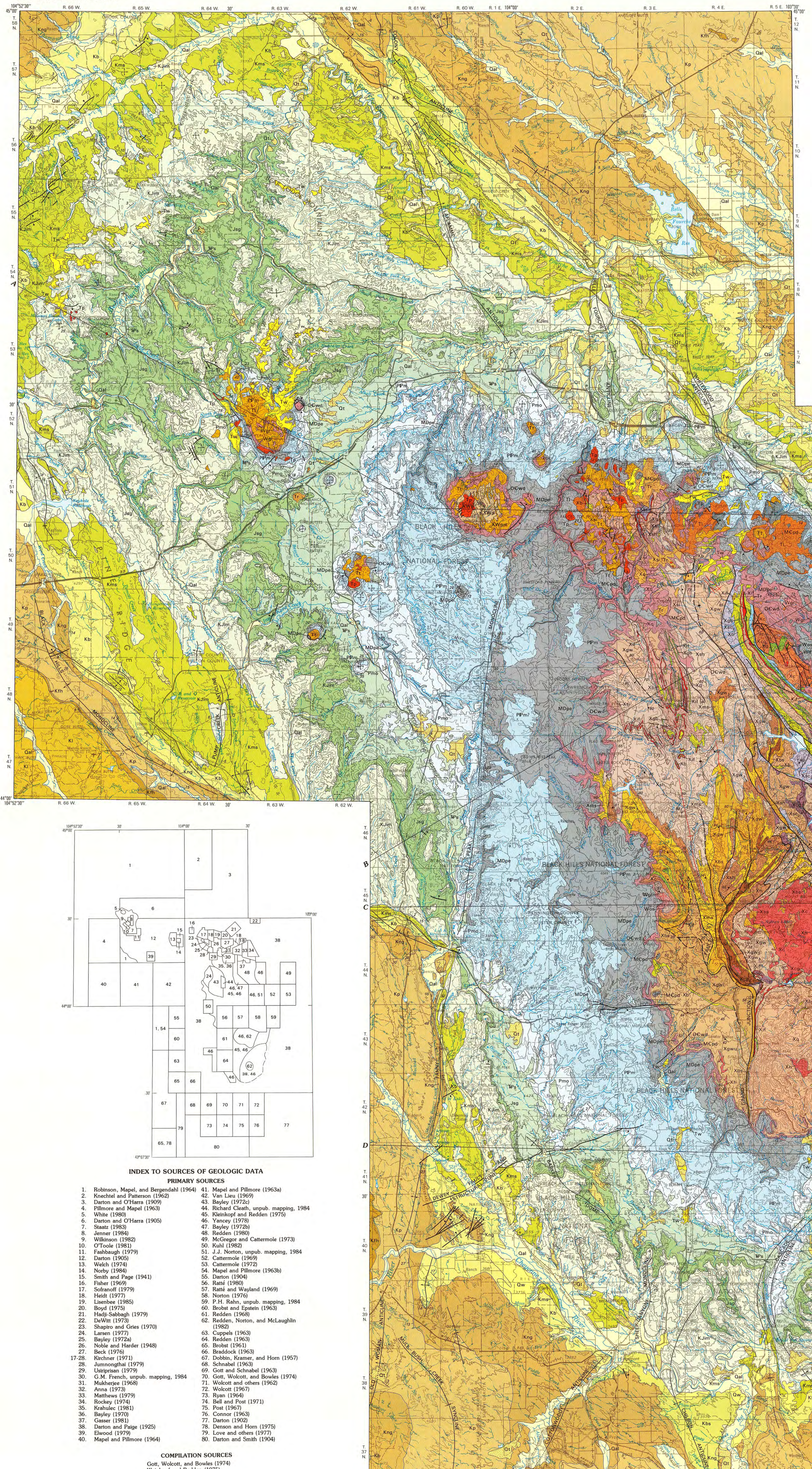
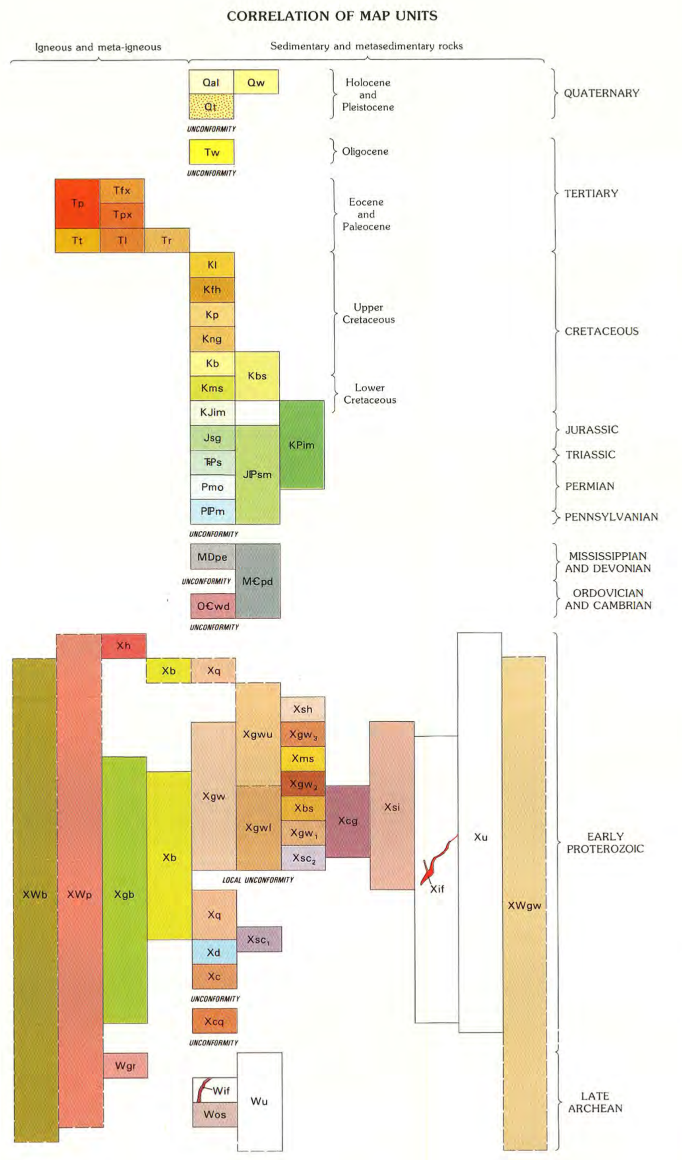


CORRELATION OF MAP UNITS



DESCRIPTION OF MAP UNITS

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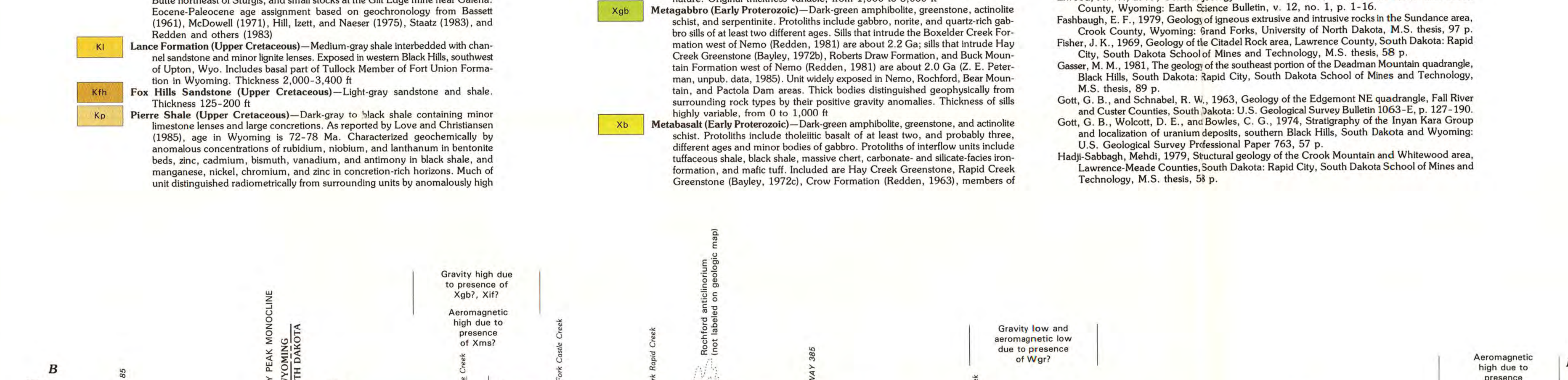
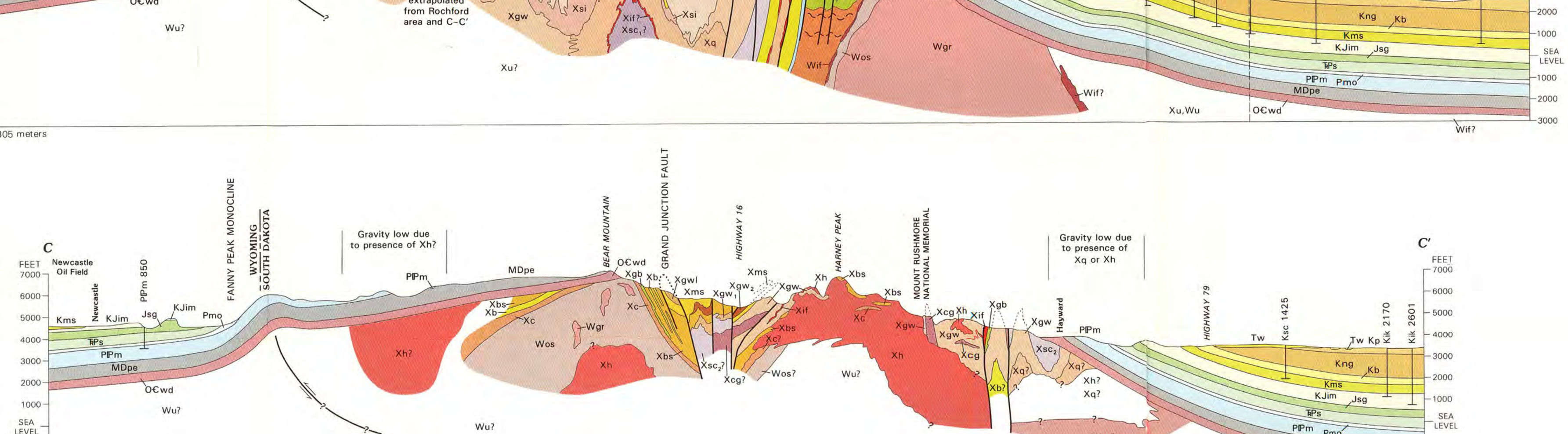
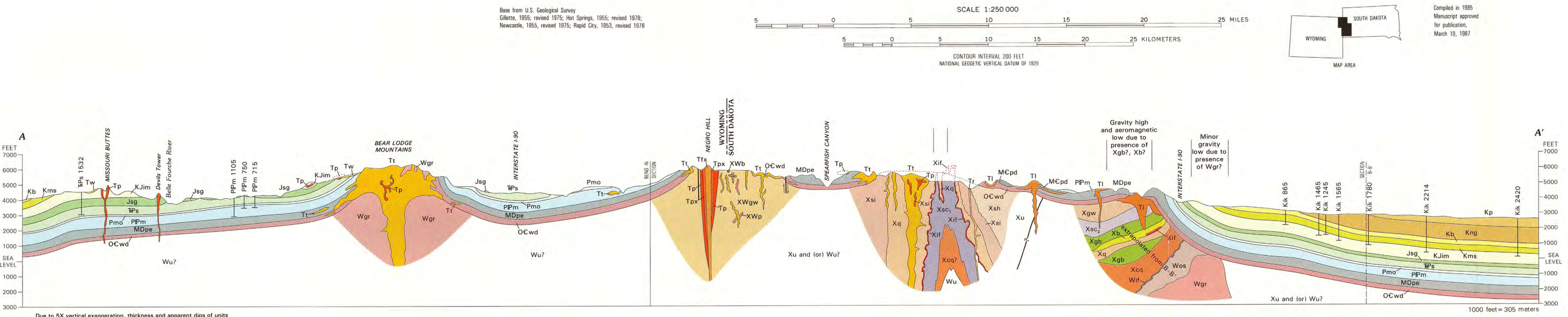
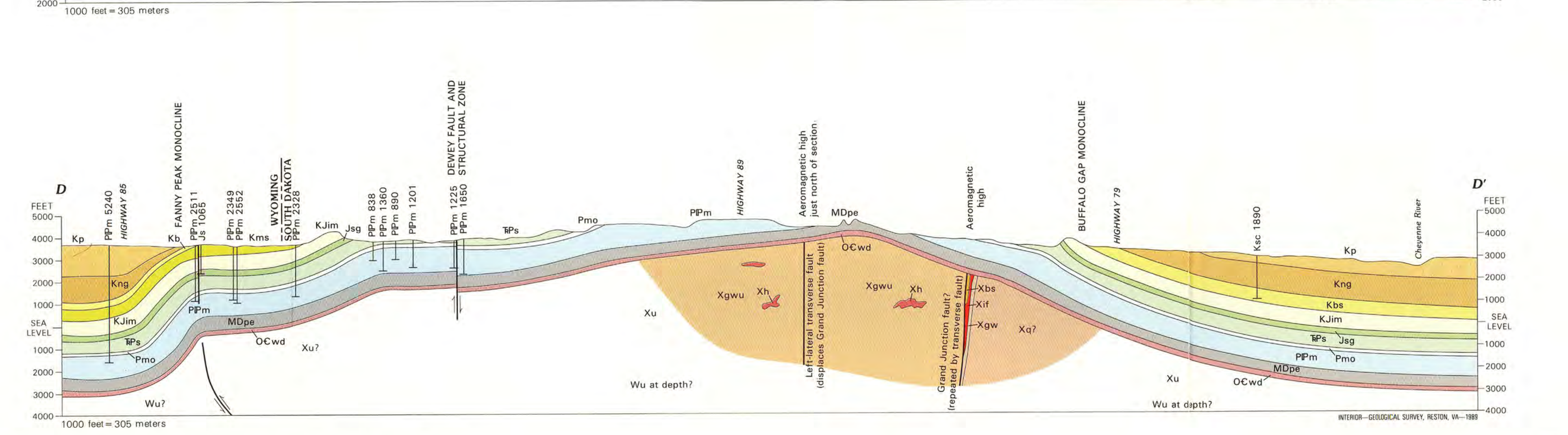
DISCUSSION









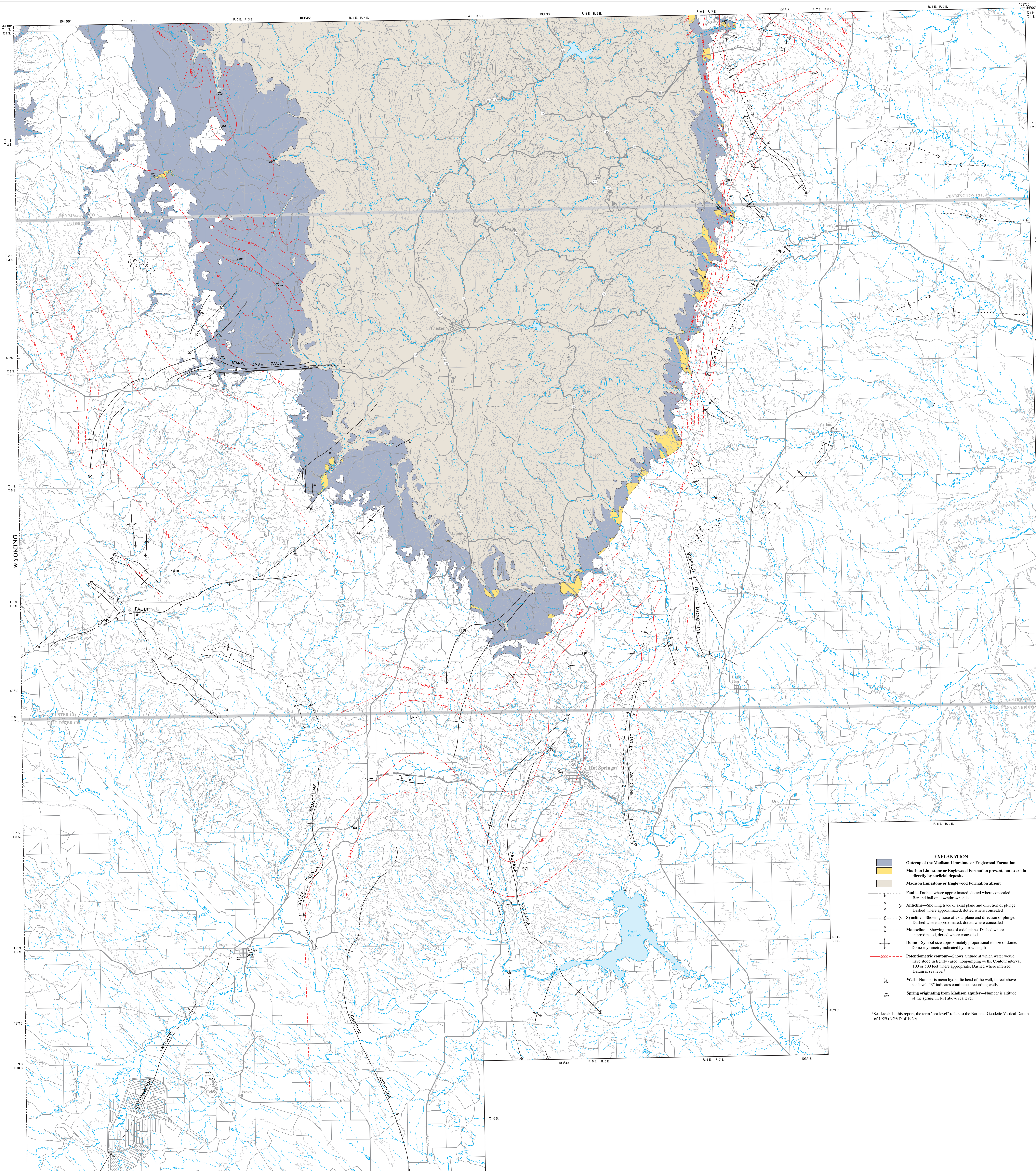
GEOLOGIC MAP OF THE BLACK HILLS AREA, SOUTH DAKOTA AND WYOMING

By
Ed DeWitt, J. A. Redden, David Buscher, and Anna Burack Wilson
1989

USGS science for a changing world
U.S. DEPARTMENT OF THE INTERIOR
U.S. GEOLOGICAL SURVEY

PREPARED IN COOPERATION WITH THE
SOUTH DAKOTA DEPARTMENT OF ENVIRONMENT AND NATURAL RESOURCES
AND THE WEST DAKOTA WATER DEVELOPMENT DISTRICT

HYDROLOGIC INVESTIGATIONS ATLAS HA-745-D
Southern part of area —SHEET 2 OF 2
Strobel, M.L., Galloway, J.M., Hamade, G.R., and Jarrell, G.J., 2000,
Potentiometric Surface of the Madison Aquifer in the Black Hills Area, South Dakota



EXPLANATION

Outcrop of the Madison Limestone or Englewood Formation

Madison Limestone or Englewood Formation present, but overlain directly by surficial deposits

Madison Limestone or Englewood Formation absent

Fault—Dashed where approximated, dotted where concealed. Bar and ball on downthrown side

Anticline—Showing trace of axial plane and direction of plunge. Dashed where approximated, dotted where concealed

Syncline—Showing trace of axial plane and direction of plunge. Dashed where approximated, dotted where concealed

Monocline—Showing trace of axial plane. Dashed where approximated, dotted where concealed

Dome—Symbol size approximately proportional to size of dome. Dome asymmetry indicated by arrow length

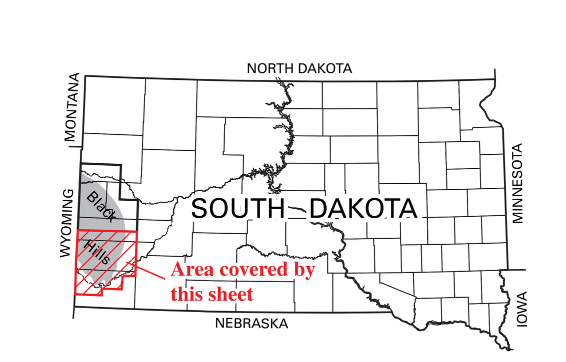
5000 **Potentiometric contour**—Shows altitude at which water would have stood in tightly cased, nonpumping wells. Contour interval 100 or 500 feet where appropriate. Dashed where inferred. Datum is sea level[1]

R 3586 **Well**—Number is mean hydraulic head of the well, in feet above sea level. "R" indicates continuous recording wells

5380 **Spring originating from Madison aquifer**—Number is altitude of the spring, in feet above sea level

[1]Sea level: In this report, the term "sea level" refers to the National Geodetic Vertical Datum of 1929 (NGVD of 1929)

Planimetric base from U.S. Geological Survey digital data, 1:100,000: Hot Springs, 1985; Lance Creek, 1981; Mt. Rushmore, 1977; Newcastle, 1979
Topographic base modified from U.S. Geological Survey digital data, 1:24,000, from maps dated 1950-84
Universal Transverse Mercator projection
Zone 13
North American Horizontal Datum 1927



SCALE 1:100,000
2 0 2 4 6 8 10 MILES
2 0 2 4 6 8 10 KILOMETERS
LAND SURFACE CONTOUR INTERVAL 200 FEET
NATIONAL GEODETIC VERTICAL DATUM OF 1929

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Potentiometric Surface of the Madison Aquifer in the Black Hills Area, South Dakota

By
Michael L. Strobel, Joel M. Galloway, Ghaith R. Hamade, and Gregory J. Jarrell
2000

Appendix C

NRCS Seeding Plan

Instructions

SEEDING PLAN

Producer	Loring Quarry	Conservation District:	Custer	MLRA 62
Program	CTA	Practice No.	550	Practice Name: Range Planting
CI or Referral No.		Contract #		

Resource Concern (CPPE Impact)	Purpose:

PLANNED

		Seedbed Preparation
Tract		
Field		
Acres	1.00	
Group or Site	Ecological Site	
Site [Web Soil Survey]		
Date to be Planted [TechNote4]	Early Spring Prior to 5/15	
Alternative planting dates		Protection Provided
Alternative planting dates		
Seeding Equipment		
Companion Crop		

PLANNED

Species * **	1/ Select Improved Variety (recommended) or select common seed (see note below)	Percent in Mixture 100	Pure Live Seeds (PLS) per square foot 27.85	Pure Live Seed (PLS) lbs/ac Needed	Acres to Seed	Pure Live Seed (PLS) lbs Required
Big bluestem	Common	15.0	4.50	1.11	1.00	1.11
Green needlegrass	Common	15.0	4.50	1.09	1.00	1.09
Little bluestem	Common	15.0	4.50	0.69	1.00	0.69
Prairie dropseed	Common	5.0	1.25	0.24	1.00	0.24
Slender wheatgrass	Common	15.0	3.75	1.05	1.00	1.05
Virginia wildrye	Common	10.0	3.00	1.36	1.00	1.36
Western wheatgrass	Common	20.0	5.00	1.94	1.00	1.94
American vetch	Common	1.0	0.25	0.36	1.00	0.36
Purple prairie clover	Common	1.0	0.25	0.04	1.00	0.04
White prairie clover	Common	1.0	0.25	0.04	1.00	0.04
Leadplant	Common	1.0	0.30	0.07	1.00	0.07
Western snowberry	Common	1.0	0.30	0.18	1.00	0.18

To meet SD NRCS Standards Please Note:

1/ Improved varieties recommended above have no restrictions on their origin.
1/ Origin of Common grass seed must be ND, SD, NE, MT, WY, MN, or IA. Exception: Smooth Bromegrass any locale.
1/ Common Native forbs and legumes will originate or be grown in (USA): ND, SD, NE, MT, IA, WY, ID, WA, OR, MN, WI, and (CAN): AB, BC, MB, ON, SK.
- Seed test must be completed according to SD Seed laws (see link below) and no more than 9 months prior to the date planted. Producer will provide all seed tags to NRCS
- Tetrazolium (TZ) tests may be used as a substitute for germination tests ONLY for Green Needlegrass
  - For Alfalfa Salinity tolerence use F or G from https://www.alfalfa.org/varietyLeaflet

* Pubescent wheatgrass and Intermediate wheatgrass are the same species and can be substituted for one another at any time.
** Thickspike wheatgrass may be substituted for western wheatgrass if the later is not available but only west of the Missouri River. To calculate the amount needed multiply the western wheatgrass seeding rate by .72

SD Seed Laws: Codified_Laws Statute 38-12A   Seed testing: SD state seed-lab

LOCATION MAP

Tract
N
S.
T.
R.

Planning Assistance By: J. Reid (Name) 9/30/201 (Date)

Plan Meets SD Standards (if no explain) Yes ☑ No ☐

Reclamation Mix

Appendix D

Custer County Conservation District
Weed Control

CUSTER COUNTY CONSERVATION DISTRICT
25363 US Hwy 385
Custer, SD 57730
Phone: 605-673-5680

September 9, 2021

Simon Contractors of South Dakota, Inc.
3975 Sturgis Rd
Rapid City, SD 57702

Simon Contractors of South Dakota, Inc.:

This letter is to acknowledge receipt of your letter dated 8-30-2021, regarding your mining permit for the Loring Quarry property. We have several general comments that may already be addressed in your reclamation plan. Our comments are as follows:

1) Treat noxious weeds ensuring that these treatments are kept concurrent with mining operations. Ore removal, transport, and processing can be a vector for weed spread, if not controlled at the source. When reseeding, a seed mix native to the area, should help reduce weed establishment and spread. The Natural Resources Conservation Service (NRCS) offices in Rapid City and Hot Springs can provide specific seed recommendations.

2) Ensure that any surface run-off from the mining area or access road is minimized and adequately treated before leaving the mining area.

3) Provide for safety of the facility so that people or livestock are not endangered by operations or land/mine slopes or drop-offs.

4) Follow any reclamation standards that have been established and approved, as well as requirements for posting reclamation bonds. During reclamation, reshape to the natural character of the land.

Thank you for considering these comments. We appreciate your diligence in caring for soil and water resources while providing important mineral resources.

Sincerely,

Mike Baldwin
CCCD Office Manager

CC: SD DANR
SD Dept. of Agriculture & Natural Resources
Minerals and Mining Program
523 East Capitol Ave.
Pierre, SD 57501

Appendix E

Jurisdictional Determination and Baseline Surveys

Cultural Resources Survey
Socioeconomic Study
Soil Survey
Vegetation Survey
Wildlife Survey

U.S. ARMY CORPS OF ENGINEERS
REGULATORY PROGRAM
APPROVED JURISDICTIONAL DETERMINATION FORM (INTERIM)
NAVIGABLE WATERS PROTECTION RULE

I. ADMINISTRATIVE INFORMATION

Completion Date of Approved Jurisdictional Determination (AJD): 10/26/2020
ORM Number: NWO-2020-01738-PIE
Associated JDs: N/A
Review Area Location[1]: State/Territory: SD City: N/A County/Parish/Borough: Custer
Center Coordinates of Review Area: Latitude 43.57459 Longitude -103.64079

II. FINDINGS

A. Summary: Check all that apply. At least one box from the following list MUST be selected. Complete the corresponding sections/tables and summarize data sources.

- ☒ The review area is comprised entirely of dry land (i.e., there are no waters or water features, including wetlands, of any kind in the entire review area). Rationale: The feature evaluated consisted of an upland swale. A vegetation survey and a soils survey confirmed that no wetlands are present.
- ☐ There are “navigable waters of the United States” within Rivers and Harbors Act jurisdiction within the review area (complete table in Section II.B).
- ☐ There are “waters of the United States” within Clean Water Act jurisdiction within the review area (complete appropriate tables in Section II.C).
- ☐ There are waters or water features excluded from Clean Water Act jurisdiction within the review area (complete table in Section II.D).

B. Rivers and Harbors Act of 1899 Section 10 (§ 10)[2]

§ 10 Name	§ 10 Size		§ 10 Criteria	Rationale for § 10 Determination
N/A.	N/A.	N/A	N/A.	N/A.

C. Clean Water Act Section 404

Territorial Seas and Traditional Navigable Waters ((a)(1) waters):[3]				
(a)(1) Name	(a)(1) Size		(a)(1) Criteria	Rationale for (a)(1) Determination
N/A.	N/A.	N/A.	N/A.	N/A.

Tributaries ((a)(2) waters):				
(a)(2) Name	(a)(2) Size		(a)(2) Criteria	Rationale for (a)(2) Determination
N/A.	N/A.	N/A.	N/A.	N/A.

Lakes and ponds, and impoundments of jurisdictional waters ((a)(3) waters):				
(a)(3) Name	(a)(3) Size		(a)(3) Criteria	Rationale for (a)(3) Determination
N/A.	N/A.	N/A.	N/A.	N/A.

Adjacent wetlands ((a)(4) waters):				
(a)(4) Name	(a)(4) Size		(a)(4) Criteria	Rationale for (a)(4) Determination
N/A.	N/A.	N/A.	N/A.	N/A.

[1] Map(s)/figure(s) are attached to the AJD provided to the requestor.
[2] If the navigable water is not subject to the ebb and flow of the tide or included on the District’s list of Rivers and Harbors Act Section 10 navigable waters list, do NOT use this document to make the determination. The District must continue to follow the procedure outlined in 33 CFR part 329.14 to make a Rivers and Harbors Act Section 10 navigability determination.
[3] A stand-alone TNW determination is completed independently of a request for an AJD. A stand-alone TNW determination is conducted for a specific segment of river or stream or other type of waterbody, such as a lake, where upstream or downstream limits or lake borders are established. A stand-alone TNW determination should be completed following applicable guidance and should NOT be documented on the AJD Form.

D. Excluded Waters or Features

Excluded waters ((b)(1) – (b)(12)):[4]				
Exclusion Name	Exclusion Size		Exclusion[5]	Rationale for Exclusion Determination
N/A.	N/A.	N/A.	N/A.	N/A.

III. SUPPORTING INFORMATION

A. Select/enter all resources that were used to aid in this determination and attach data/maps to this document and/or references/citations in the administrative record, as appropriate.

☒ Information submitted by, or on behalf of, the applicant/consultant: SIMON CONTRACTORS LORING QUARRY VEGETATION SURVEY SITE SUMMARY and SIMON CONTRACTORS LORING QUARRY SOIL SURVEY SITE SUMMARY, Prepared by ICF, September 2020.

This information is sufficient for purposes of this AJD.

Rationale: N/A

☐ Data sheets prepared by the Corps: Title(s) and/or date(s).

☒ Photographs: Aerial and Other: Google Earth various years, 2020 Site Photos from the consultant.

☐ Corps site visit(s) conducted on: Date(s).

☐ Previous Jurisdictional Determinations (AJDs or PJDs): ORM Number(s) and date(s).

☐ Antecedent Precipitation Tool: *provide detailed discussion in Section III.B*.

☒ USDA NRCS Soil Survey: See file for Soils Hydric Rating Map/Report.

☐ USFWS NWI maps: Title(s) and/or date(s).

☒ USGS topographic maps: Argyle 24K.

Other data sources used to aid in this determination:

Data Source (select)	Name and/or date and other relevant information
USGS Sources	N/A.
USDA Sources	N/A.
NOAA Sources	N/A.
USACE Sources	N/A.
State/Local/Tribal Sources	N/A.
Other Sources	N/A.

B. Typical year assessment(s): N/A

C. Additional comments to support AJD: The upland swale shows no evidence of surface water flow.

[4] Some excluded waters, such as (b)(2) and (b)(4), may not be specifically identified on the AJD form unless a requestor specifically asks a Corps district to do so. Corps districts may, in case-by-case instances, choose to identify some or all of these waters within the review area.

[5] Because of the broad nature of the (b)(1) exclusion and in an effort to collect data on specific types of waters that would be covered by the (b)(1) exclusion, four sub-categories of (b)(1) exclusions were administratively created for the purposes of the AJD Form. These four sub-categories are not new exclusions, but are simply administrative distinctions and remain (b)(1) exclusions as defined by the NWPR.

Addendum 2-1. Figure 2-1. Loring Quarry Soil Map Units and Sample Locations

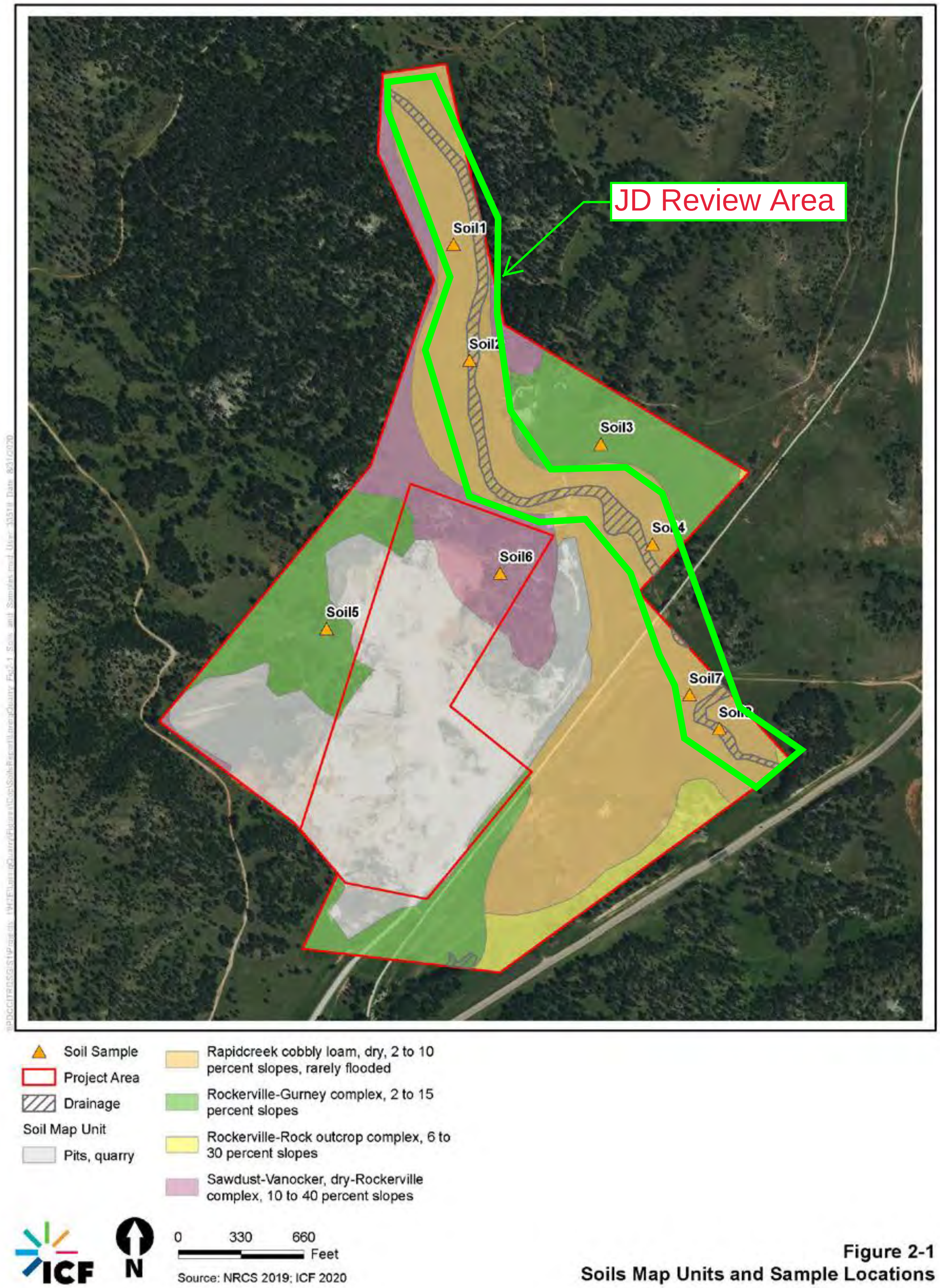

Figure 2-1
Soils Map Units and Sample Locations

A Class III Cultural Resources Survey of Simon Contractors Loring Quarry, Custer County, South Dakota

PREPARED FOR:

H2E, Inc.
801 East 4th Street, Suite 5
Gillette, WY 82716
Contact: Becky Morris, Ph.D.
(307) 696-7007

PREPARED BY:

ICF
405 West Boxelder Road, Suite A-5
Gillette, WY 82718
Contact: Lauran R. Switzer M.A., RPA
864-901-8280

September 2020

For Official Use Only: Disclosure of site locations prohibited (43 CFR 7.18)

Confidential

LIMITED SOCIOECONOMIC ASSESSMENT

LARGE SCALE MINE PERMIT

LORING QUARRY

CUSTER COUNTY, SOUTH DAKOTA

SIMON CONTRACTORS OF SOUTH DAKOTA

Prepared by:

Dr. Michael K. Madden

Business and Economic Research

Buffalo, Wyoming

August 2020

CONTENTS

TABLES

SECTION I
INTRODUCTION

This research is prepared for the purpose of documenting the socioeconomic characteristics of Custer County, South Dakota and to identify any impacts that may be associated with the expansion of the scope of an existing quarry operation located in that county. Technically the expansion is referred to as large scale mine in conformance to South Dakota Codified Laws. These statutes include the need for a limited socioeconomic assessment. The information that is contained below conforms to SDCS 45-6B-33.1.

The existing mine, known as the Loring Quarry is presently an operation under a mine license owned and operated by Simon Contractors of South Dakota. The Loring Quarry is one of many Simon quarrying and mining operations located in the four state region. It, along with other similar operations, produces aggregate for asphalt and concrete, buildings. base courses and gravel roads throughout their service area. The quarry is located about 5 miles southwest of the community of Pringle and just west of SD Highway 89. It's present scope of operation is limited primarily to the need for aggregate in connection with various construction projects contracted by the Simon companies. The proposed permit application is intended to allow for a substantial increase in mine output. Upon approval of the Large Scale Mine Permit, the products from the mine will be marketed to other firms

Simon Contractors was formed in the mind 1950s and has grown substantially over its sixty five year life. Beginning in Nebraska, the company has expanded in geographical coverage, as well as a diversification of services offered. The company has undertaken acquisitions of other operations through time and today maintains significant construction activity primarily in Nebraska, Wyoming, Colorado, and South Dakota.

This document focuses on the Loring Quarry in Custer County, South Dakota. When examining regional socioeconomic factors, it is observed that currently and in the recent past the workers at this facility reside primarily in Custer County with occasional workers living in adjacent Fall River County. On average approximately three employees are involved with the current operation depending on the time of the year. Upon approval of the expanded operation which will be afforded by the Large Scale Permit, another two employees on average will be required.

Demographic baseline factors and trends will be discussed in the next section of this report. Characteristics such as population, age distribution, households by type and housing patterns will be examined. Section III will involve basic economic data for Custer County such as employment and income. Section IV will involve fiscal impacts surrounding the Loring Quarry operation. An assortment of other socioeconomic considerations including housing, transportation, and other public service requirements will identified in Section V.

SECTION II
POPULATION DEMOGRAPHICS

The following table provides a demographic snapshot of Custer County as of the 2019 census estimates. Actual census data for 2020 will not be available until sometime in late 2021.

TABLE 1

SELECTED DEMOGRAPHIC STATISTICS - CUSTER COUNTY, SD		
	Number	Percent of Total
Total Population (2018)	8,972	
Under 18 years	1,328	14.8%
65 years and over	2,844	31.7%
Median Age	54.3	
Households (2018)	3,941	
Family Households	2,743	69.6%
Non Family Households	1,198	30.4%
Total Housing Units (2018)	5,322	
Owner Occupied	4,385	82.4%
Renter Occupied	937	17.6%

Source: US Decennial Census and 2019 Estimate

In comparison, Custer County is significantly different from South Dakota in general. The population is comprised by far fewer young people aged under 18 and far more county residents are above age 65. Similarly, the median age in Custer County is more than seventeen years older than for the state of South Dakota's 37.2 median age.

The population has experienced only moderate fluctuations in Custer County over the past nearly fifty years. The lowest rate of growth took place during the decade of the nineteen eighties with a growth rate of 3 percent. This is largely accounted for by the sluggish national economy and was accentuated by the accelerated growth in retail and business activity in Black Hills counties north of the Custer County.

Compared to most other South Dakota counties, Custer County is noted as being one of the few that has never experienced negative growth from one decade to the next. In the nineteen nineties substantial population growth took place in Custer County. Actual population statistics in ten and five year intervals appear in Table 2.

TABLE 2

POPULATION TRENDS - CUSTER COUNTY		
1970	4,698	Percent Change
1980	6,000	27.74%
1990	6,179	3.0%
1995	6,737	9.0%
2000	7,275	8.0%
2005	7,785	7.0%
2010	8,276	6.3%
2018	8,972	8.4%

Source: Bureau of the Census and intra year census data

Custer County Communities

Custer County has historically been comprised of a vast majority of it's population residing outside of any town or city. In fact, an estimated 6,200 of the 2018 population or 69 percent live outside an incorporated city or town. The towns of Buffalo Gap, Fairburn, Hermosa and Pringle together add up to only 641 residents of the entire county.

Among the incorporated towns and cities of Custer County, the county seat of Custer contains the largest population. However, as of 2018, only 2,172 of the total county population of 8,972 residents live in the City of Custer. A significant additional number are located in the immediate environs on rural acreages and within subdivisions outside of Custer and other areas of the county that are convenient to population centers beyond Custer County such as Rapid City.

SECTION III
EMPLOYMENT AND INCOME

Employment

A snapshot of the distribution of employment can be gained in the following table.

TABLE 3

NON FARM EMPLOYMENT- CUSTER COUNTY 2019		
	Number	Ave. Weekly Wage
Construction	176	642
Manufacturing	21	400
Retail trade	324	444
Transportation and warehousing	52	460
Information	31	554
Finance and insurance	39	1,283
Real estate and rental and leasing	36	417
Administrative and waste services	76	807
Educational services	15	495
Health care and social assistance	229	1,109
Arts, entertainment, and recreation	181	655
Accommodation and food services	949	432
Other services, except public	99	509
TOTAL	2,227	

Source: Quarterly Census of Employment and Wage Bureau of Economic Analysis, Dept. of Commerce. data.bls.gov/cew/apps/data_views/data_views.htm#tab=Tables

These employment numbers point to the well known fact that Custer County employment is heavily dominated within those sectors that provide goods and services to the vacation travel industry. A major reason for this factor is that Custer State Park lies within it boundary. However, there are many other facets of vacation travel in the county as well.

Sectors impacted by tourism include retail trade, arts, entertainment and accommodation and food service. Together, these three sectors account for 1,545 of total non farm employment in the county. It is also observed that the total amount of employment relative to population is quite low, reflecting the large component of the population over 65 years of age which was noted in Table 1. Since this data is expressed in terms of the place of work, it also must be recognized that many of the employment positions cited in the table are likely filled by those outside of Custer County.

Earnings

Average earnings are relatively low in Custer County relative to the balance of the state of South Dakota. In Custer County in 2119, non farm average weekly wages approximated $572. In contrast the statewide average wage was $836 over the same time frame. Most of this large difference is due to the employment composition of the labor force with respect to industry mix within the county. Leisure and hospitality sectors which are dominate in Custer County are generally characterized with lower wages than other sectors such as manufacturing and financial sectors. However lower wages are present in each sector for Custer County when specific sectors are compared to the entire state.

Quarrying in the Black Hills

Numerous aggregate quarrying facilities and gravel pits are found in Custer County as well as other counties in and near the Black Hills region. There is a preponderance of these quarries near the periphery of the Black Hills so that they can be accessed for projects in and near the Black Hills.

Because of the relative low unit cost of the product in conjunction with relatively high cost as a proportion of value of transporting materials, quarries have been spatially developed throughout the area so as to control transportation costs. High volumes of rock products are inherently required for road construction and other construction projects making nearby sources of material highly advantageous.

The nature of quarry operations today is characterized by high levels of mechanization and correspondingly a relatively low need for labor inputs. The Loring Quarry and the manner in which it operates is typical of this pattern.

Only three employees are currently utilized on average - the number varying according to seasonal demand for the product. In addition, subcontractors will be utilized for project-specific tasks such as blasting services and reclamation on an as-needed basis.

In 2019, earnings received by these three employees totaled about $145,000 in 2019. The cost of added benefits amounted to an additional $62,400 for a total labor compensation expense of $208,000. The output of the quarry under its current mine license is limited to 25,000 tons annually. Long run plans for the quarry include expanding the types of material produced to include products for agricultural use. These products include sugar rock which is used in the processing of sugar beets and limestone dust used in the feeding of livestock and as a soil supplement. Upon receiving a South Dakota large scale mine permit, it is anticipated that output will significantly grow beyond its current production levels. In the long run, it is possible that production could reach 250,000 tons per year. The life of the mine is estimated to be about 60 years.

Moderate increases in labor requirements will accompany the transition to a large scale mine facility. It is expected to require two additional employees. Rough estimates of the changes in selected economic variables are summarized in the following table.

TABLE 4

SELECTED ECONOMIC VARIABLES PRESENTLY, NEAR TERM TRANSITION AND LONG RUN POTENTIAL			
Variable	Present	Near Term	Long Run Potential
Employment	3	3-5	5
Earnings/Benefits	$208,000	$208,000 to $346,667	$390,000
Other Expenditures	$160,000	$160,000 +	$160,000
Subcontracting	$76,000	$76,000 +	$270,000
Output	20,000 tons	80,000 to 90,000 tons	up to 250,000 tons
Sales Tax - Product*	$8,100	$36,500	$101,000
Property Taxes	$5,600	$5,600 +	$5.600 +

*Assumes average selling price of $9 per ton. See Section IV.

Induced Economic Impacts

Additional economic impacts are often equally important when analyzing a basic industry such as mining. These are impacts that are often termed induced impacts because they are created in the region because of the initial economic activity generated in the basic industry. An example this phenomenon is in the case of input requirements that are purchased by the mining operation itself and the resulting additional business volume generated within other industries. In turn, new workers are required by these supplying industries. Another example of induced impacts is traced to the additional jobs generated in local businesses as employees in the mining industry dispense their earnings throughout the regional economy. Since wages and salaries in the mining industry are substantially higher than regional wages in general, the multiplier effect of mining activity can be quite significant.

The Regional Input-Output Modeling System developed by the Bureau of Economic Analysis suggests that the earnings multiplier applicable to the type of mining taking place at the Loring Quarry is equal to 1.546. The employment multiplier is equal to 2.027. These multipliers are applicable to the Black Hills region.

This means that for every direct dollar of earnings generated by the mining industry another .546 dollars are generated in households employed in other industries within this four county region. Similarly, every employment position in the mining industry supports an additional 1.027 employment positions in other industries.

Currently there are an average of 3 workers employed at the quarry in the Custer County area. This means that another three workers are estimated to be employed in other industries induced as a result of the three quarry workers. This is due to added economic activity that is induced by the spending of their wages and the expenditure for other inputs that take place by the quarry itself on conjunction with the expanded operation. Examples include employees of service industries and workers that are hired by subcontractors and others. Similarly, it was discussed above that workers engaged at the Loring Quarry were paid a total of $208,000 the recently ended year of 2019. An earnings multiplier of 1.546 suggests that and additional $113,000 in wages and benefits are paid to the induced labor and is traced to the Loring Quarry operation.

Thus, when direct and induced impacts are added together, it is estimated that there is a regional impact of 6 employees and $321,000 in total earnings supported by the quarry in the Black Hills region.

As quarry output increases and employees are added, there will be additional economic benefits to the region through the same process as described in the previous paragraphs. For example if the added output generated results in the Loring Quarry hiring two more workers eventually, additional employees and additional earnings will be dispersed into the region.

SECTION IV
FISCAL ENVIRONMENT

South Dakota local governments rely primarily on sales or excise taxes and property taxes for financing public services. School districts are also heavily dependent on property taxes, but also finance a significant part of their budgets from state school aid.

The following table summarizes the allocation of property taxes by political subdivision for Custer County. The data is for 2018, latest year for which data is available.

TABLE 5

CUSTER COUNTY PROPERTY TAXES COLLECTED BY SUBDIVISION 2018

	Collected	Percent of Total
County	$4,203,000	29%
School	8,564,000	59%
Other	1,746,000	12%
Total	14,513,000	

Source: Property Tax Statistical Report, SD Department of Revenue, 2018.

Excluding municipal levies, nearly 60 percent of all local property taxes collected from parcels located within the county were directed to school districts in the county. The second largest user of property taxes is the county government with 29% of all property taxes collected.

Municipalities collectively account for additional property tax collections, but on only from levies upon those parcels located within a city or town.

Currently property associated with the Loring Quarry paid a total $5,600 of property taxes in 2019. As the quarry operation expands, annual property taxes are expected to increase. It is also the case that quarry employees who own and/or rent housing and other real estate in the county also pay property taxes. It is beyond the scope of this study to arrive at estimates of this component of the property tax impact.

Sales and Gross Receipts Taxes

Municipal governments in South Dakota have become increasingly dependent on sales taxes as a means of financing municipal services. The City of Custer, as do the majority of South Dakota cities and towns, imposes a two percent general sales tax applicable to the majority of goods and services sold within the city boundaries. An additional gross receipts tax of 1 percent is levied on purchases of prepared food, beverages and lodging in addition to a few other minor items. (Source: South Dakota Sales and Use Tax Reports, SD Department of Revenue and Regulation.)

Many business purchases made by the Loring Quarry are subject to municipal as well as state sales taxes because significant purchases are made by the quarry in the City of Custer as well as other Black Hills communities for materials, parts, lodging and prepared meals. An undetermined, but undoubtedly substantial, amount of sales taxes were due in connection with these purchases. Company subcontractors also pay municipal sales and use taxes according to their respective input needs.

State Taxes

Because the South Dakota state sales tax system is designed to be broad, a majority of company purchases within South Dakota or used within the state, as well as employee purchases are assessed the 4.5% state sales tax. The state benefits fiscally from sales made both in conjunction with purchases of goods and services required by the quarry and also via the sale of aggregate products to their customers.   A further benefit accrues to the state through the sale of the processed aggregate products at the point of production or in later in the production chain with the 2 percent contractor’s excise tax.

Cited earlier in this document were estimates of contracted services and also the purchase of other goods and services by the quarry together totaling $336,000. It is not possible to determine the proportion of these would be subject to the South Dakota sales and use tax. Given the broad nature of the South Dakota sales tax, it is clear that the vast majority of these annual purchases would be subject to that tax. This means that up to $15,000 would be received as state revenue. Depending on wether or not some of these purchases are sourced within a municipality, additional sales taxes would accrue to towns and cities in the region as well.

The more significant amount of sales and use tax receipts is traced to the sale of processed quarry materials. It is estimated that the sales price of processed aggregate ranges between $8.00 and $10 per ton based on local regional conditions found in South Dakota and Wyoming. As a benchmark, if a production level of 90,000 tons is attained, state sales and use taxes due would total in the range of $32,400 to $40,500. When tonnage of material increases, revenue to the state will increase proportionately. Should production reach 250,000 tons state this revenue source would range from $90,000 to $112,500. These revenue estimates should be viewed as maximums, since it is likely that a portion of the product would be subject to the 2 percent contractors excise tax rather than the 4.5 percent sales tax.

It is also noted that the portion of processed aggregate purchased for resale is not subject to the sales tax by the quarry operation itself. However, when this product is later sold to final users of the material, the sales tax would apply at that point.

An additional benefit to the state is generated through spending by employees whose incomes are directly or indirectly traced to quarry production in South Dakota.

SECTION V
OTHER SOCIOECONOMIC FACTORS

Housing

Negligible market impacts can be anticipated in the housing industry since the level of employment is not projected to change appreciably. However, the life of the quarry operation is expected to be extended, allowing workers directly and indirectly related to the Loring quarry to perhaps make longer term housing plans. These plans may involve the shift from rental to owner occupied housing or the upgrade of housing among households benefitting from assurances of an extended life of the business.

The median house value as of 2019 was equal to about $144,000 compared to a statewide median of $159,100. Median contract rent amounted to $764 per month, about $40 higher than the average state-wide housing rental rate. (Source: Towncharts.com, an authoritative compilation of community housing profiles in the United States

Basically, the housing market in Custer County gives all indications of being stable with ample opportunities to renting or purchasing housing. Prices are favorable relative to other communities in the state, and no impact can be expected as a result of the pending large scale mine permit being approved.

Recreation

Nearly surrounded by national forest land, recreation activity regarding the pending permit area is comprised of hunting, hiking, biking and other similar activities. Because the Loring Quarry has been in existence for decades, the approval of a large scale mining permit would not appear to change adjacent land uses. During periods of mining activity on the site environmental standards of various types will need to be adhered to and access to the quarry area is expected to be prevented for safety reasons. There are no other recreation opportunities known to be affected either on the premises or elsewhere in the county.

Highways and Roads

The quarry is basically adjacent to U.S. Highway 89. Product will be transported either south on SD 89 toward US Highway 18 or north probably to US Highway 16. Among all of the socioeconomic impacts considered in this document road challenges appear to be the only issues of significance.

The process of processing aggregate materials and the expectations of growth in output is expected to increase traffic on SD Highway 89. Material from the proposed permit areas and transporting it from the Loring processing facilities is expected to necessarily bear an impact on this state road. In addition to the obvious impact of transport trucks carrying material from the site, there are also additional marginal impacts due to transporting equipment to and from the quarry and the commuting of workers during days of operation.

Public Services

Examples of community services considered here include public education fire and police protection, solid waste disposal, water and sanitary sewer. As discussed in this document only two or three additional individuals are expected to be added to the Loring Quarry operation. These community services provided by units of government are not expected to experience any measurable change in demand as a result of the approval of a large scale mine permit.

VICINITY MAP

FINAL

SIMON CONTRACTORS LORING QUARRY SOIL SURVEY SITE SUMMARY

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September 2020

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Contents

Tables, Figures, Photos, Laboratory Analysis, and Raw Soils Data

Tables

Figures

Photos

Addendum Photos **Page**

Laboratory Analysis

Addendum Laboratory Analysis **Page**

Raw Soils Data

Addendum Raw Soils Data **Page**

Resume of Personnel

Addendum Resumes of Personnel **Page**

Introduction

Simon Contractors of SD, Inc. (Simon) is in need of applying for a large-scale mine permit for its Loring Quarry (limestone) from the state of South Dakota. The project area is located approximately 4 miles south of Pringle along highway 89 in Custer County, South Dakota and occurs on land privately held by Simon. The mine includes approximately 162 acres throughout portions of Section 33 and 34, T5S:R4E. This area encompasses the current mine parcel (45 acres) in Section 33, a large portion of which (approximately 40 acres, 89%) is currently disturbed by the existing quarry or other man-made features.

Simon will be applying for a large scale mine permit with the South Dakota Department of Environment and Natural Resources (SD DENR) Minerals and Mining Program. H2E, Inc (H2E), on behalf of Simon, awarded and contracted the baseline soil survey to ICF in June 2020. The baseline soil survey report detailing survey data and results will be included with the permit documents compiled and submitted by H2E.

This report presents baseline information regarding Natural Resource Conservation Service (NRCS) soil series, soil map units and ecological site characteristics within the project area. The information gathered from field sampling will be used by the applicant and the SD DENR to develop the reclamation plan for the project area.

Methods

Soil survey and sampling procedures were modeled after the National Soil Survey Handbook (USDA 2019), Soil Survey Manual (USDA 2017), Field Book for Describing and Sampling Soils (USDA 2012) and Wyoming Department of Environmental Quality (WDEQ) Guideline No. 1A (WDEQ 2015). An Order 3 soil survey was conducted within the project area. The sampling methods were determined by ICF prior to on-site sampling. One team of two biologists from ICF completed field sampling at the project area between June 29 and 30, 2020. The majority of sample locations were accessed by foot.

Prior to fieldwork the project area was reviewed using aerial imagery and existing Natural Resources Conservation Service (NRCS) soil map units, soil series, and ecological site descriptions.

Soil profiles (hereafter, soil pedon or pedon) were described in a total of eight soil pits, all excavated by hand using a 72.0-inch-long by 3.0-inch-diameter soil bucket auger. The soil pits established the range and variability of soil types and depths of suitable soil for reclamation for each map unit. A photo was taken at each soil pit and a photo board was used to label the pictures; this included site name, sample location, and date. Latitude and longitude data were collected using an iPad with ArcGIS Collector software at each soil sample location.

Soil pedon descriptions, methods, and nomenclature followed the Soil Survey Manual (USDA 2017) and the Keys to Soil Taxonomy Edition 12 (USDA 2014) was used for soil classification. Soil color was determined visually in the field. Profile characteristics such as horizon arrangement and depth, texture, structure, color, consistence, course fragments, reaction to 10% hydrochloric acid, and other diagnostic characteristics were recorded on a soils form. Other soil and nonsoil observations were made and noted at most soil sample locations.

Each soil pedon sample location was collected for laboratory analysis to characterize the chemical and physical properties of the soils. Soil sampling collection followed guidelines according to Field Book for Describing and Sampling Soils (USDA 2012). Samples were collected from each soil pedon and separated by field determined horizon. Samples were placed in Ziploc bags, and the sample ID, depth interval, and date were written on each bag. The samples were hand delivered by ICF to Pace Analytics, in Gillette, Wyoming for transmittal to the laboratory in Sheridan, Wyoming for analysis.

Based on the interpretation of aerial imagery, soil descriptions, laboratory analysis, and classification of soil pedons observed during the field survey, present soil series and map units were verified, and their major components described. Classification activities were not performed to the degree that is carried out by the NRCS and formal correlation or the development of new soil series was not undertaken. The main emphasis of the soil survey was to define, describe, and delineate suitable soils in the survey area for use as plant growth medium during reclamation.

Twenty eight samples from eight soil pedons were submitted to Pace Analytics to determine physical and chemical properties of soils within the project area. The results of the laboratory analysis and case narrative are provided in Addendum 4.

Soil suitability for use in reclamation was determined for each soil type in the project area according to criteria in WDEQ Guideline No. 1A (see Table 1). In some instances, the field interpretations were adapted based on professional judgement of site-specific conditions. Selenium and boron were not analyzed, and therefore were not used for evaluating soil suitability. Laboratory analysis of coarse fragments were not analyzed; however, field observations of coarse fragments within the soil pedon were noted.

Surveys for critical soil resources within the project boundary were also completed. Critical soil resources include high erosion and low revegetation potentials.

Table 1. WDEQ Guideline 1A: Criteria to Establish Suitability of Soil or Soil Substitutes

Parameter	Suitable	Marginal [1/]	Unsuitable
pH	5.5-8.5	5.0-5.5 8.5-9.0	<5.0 >9.0
EC (mmhos/cm)	0-8	8-12	>12
Saturation Percent	25-80	<25 >80	
Texture		c, sic, s [2/]	
SAR 3/	0-10	10-12 [4/] 10-15	>12 [4/]
Selenium (ppm)	<0.3	>0.3-0.8 [5/]	
Boron (ppm) [6/]	<5.0		>5.0
Coarse Fragments (% Vol.)	<25	25-35	>35

Source: WDEQ Guideline 1A 2015.
1/ Evaluated on an individual basis for suitability;
2/ Clay (c), sic (silty clay), s (sand);
3/ As an alternative to SAR calculations, ESP (exchangeable sodium percentage) can be determined;
4/ For fine textured soils (clay >40%);
5/ Preferred extraction is with AB-DPTA which extracts water soluble and exchangeable species of Se (However, hot water extractable methods are acceptable for coal mines that have historical data collected using this procedure). These marginally suitable values of 0.3 to 0.8 ppm in the regraded spoil are keyed to sampling vegetation at bond release. Vegetation >5 ppm Se is considered unsuitable. Generally, selenium is more pervasive in the spoil material compared to the soil. Please refer to Guideline 1B for specifics on sampling intensity of regraded spoils;
6/ Boron analysis is recommended for mining operations in Sweetwater County and for bentonite operations.

Results

General

Twenty-eight samples from eight soil pedons were collected for laboratory analysis. See Addendum 1 for Results Tables and Official Soil Series Descriptions, Addendum 2 for Figures of the project area and sample locations, Addendum 3 for Photos of the soil samples, and Addendum 4 for Laboratory Analysis.

The project area is in the Black Hills region of South Dakota. It is located within the Major Land Resource Area (MLRA) 62 – Black Hills (USDA 2006). The area ranges in elevation from 3,600 to 6,565 feet with moderately sloping hills and ridges. Annual average precipitation is between 16 and 37 inches and increases or decreases with the elevation from west to east and north to south. The annual snowfall ranges from about 60 inches at the lower elevations to as much as 140 inches at the higher elevations. The average annual temperature is 36 to 48 degrees F. The freeze free period averages 125 days and ranges from 85 to 165 days (USDA 2006).

The project area supports open areas to dense forest vegetation and pine and spruce species grow at higher elevations. Cool and warm season grasses are the most common under open forest stands along with forb and subshrub/shrub species. The project area is primarily used as a limestone quarry and pasture for cattle grazing with incidental use for wildlife habitat.

The center of the Black Hills is a plutonic mass of granite with steeply dipping metamorphic rocks, primarily slate and schist, directly surrounding it. A plateau of Mississippian limestone surrounds the igneous and metamorphic rock center. This Pahasapa (Madison) limestone is broken around the outer edges of the uplifted area. The Permian Minnekahta limestone forms the outermost boundary of the area. Many other tilted sandstone, shale, and limestone units are exposed like a bathtub ring inside the steeply dipping Pahasapa limestone (USDA 2006).

The dominant soil orders in this MLRA are Alfisols and Mollisols. The soils in the area dominantly have a frigid or cryic soil temperature regime, a udic or ustic soil moisture regime, and mixed, micaceous, or smectitic mineralogy. They are shallow to very deep, generally well drained, and loamy or clayey. Hapludalfs (Buska, Citadel, Pactola, Vanocker, and Virkula series), Haplocryalfs (Stovho and Trebor series), and Ustorthents (Sawdust series) formed in residuum on mountains. In some areas the residuum is mixed with alluvium or colluvium. Haplustalfs (Mocmont series) formed in colluvium or alluvium on fans, hills, and mountains. Haplustolls formed in alluvium on fan aprons and piedmonts (Cordeston series) and in residuum on mesas and hills (Paunsaugunt series). Rock outcrop is common throughout this area (USDA 2006).

Table 2 illustrates the soil sample name, latitude and longitude. Table 3 illustrates the soil map unit symbols and names along with acreage and percentage of each within the project area. Table 4 illustrates the soil series, ecological site, and taxonomic class of the soils within the project area.

Descriptions of the soil map units occurring within the project area are found below. Soil salvage suitability depths and reasoning along with soil critical resources are found in the Discussion section.

Table 2. Loring Quarry Project Area Summary of Soil Sample Locations

Soil Sample Name	Latitude/Longitude	Map Unit	Field Identified Soil Series
Soil1	43.575975, -103.64304	Rapidcreek cobbly loam, dry, 2 to 10 percent slopes rarely flooded	Colombo
Soil2	43.574301, -103.642753	Rapidcreek cobbly loam, dry, 2 to 10 percent slopes rarely flooded	Rapidcreek
Soil3	43.573064, -103.640182	Rockerville-Gurney complex, 2 to 15 percent slopes	Gurney
Soil4	43.571607, -103.639194	Rapidcreek cobbly loam, dry, 2 to 10 percent slopes rarely flooded	Barnum
Soil5	43.570466 -103.645679	Rockerville-Gurney complex, 2 to 15 percent slopes	Rockerville
Soil6	43.571225, -103.642223	Sawdust-Vanocker, dry-Rockerville complex, 10 to 40 percent slopes	Vanocker, dry
Soil7	43.569425, -103.638506	Rapidcreek cobbly loam, dry, 2 to 10 percent slopes rarely flooded	Colombo
Soil8	43.568931, -103.637931	Rapidcreek cobbly loam, dry, 2 to 10 percent slopes rarely flooded	Rapidcreek

Table 3. Loring Quarry Project Area Soil Map Units, Ecological Site, and Acres

Map Unit Symbol	Map Unit Name	Ecological Site	Acres in Project Area	Percent of Project Area
Q0645C	Rapidcreek cobbly loam, dry, 2 to 10 percent slopes rarely flooded	R062XC020SD – Loamy Overflow 17-22	59.2	36.6%
Q0658D	Rockerville-Gurney complex, 2 to 15 percent slopes	R062XC010SD – Loamy 62C	29.2	18.0%
Q0659E	Rockerville-Rock outcrop complex, 6 to 30 percent slopes	R062XC024SD – Shallow Loamy 62C	5.9	3.6%
Q0665E	Sawdust-Vanocker, dry-Rockerville complex, 10 to 40 percent slopes	R062XY012SD – Thin Upland	16.9	10.4%
Q0702F	Pits, quarry	N/A	50.7	31.4%
Total			161.8	100.0%

Table 4. Loring Quarry Project Area Soil Series and Taxonomic Class

Soil Series	Taxonomic Class
Barnum	Fine-loamy, mixed, superactive, calcareous, mesic Ustic Torrifluvents
Colombo	Fine-loamy, mixed, mesic Torrifluventic Haplustolls
Gurney	Fine-loamy, mixed, superactive, frigid Typic Argiustolls
Rapidcreek	Loamy-skeletal over sandy or sandy-skeletal, mixed, superactive, calcareous, frigid Typic Udifluvents
Rockerville	Loamy-skeletal, mixed, superactive, frigid Lithic Calciustolls
Sawdust*	Loamy-skeletal, mixed, superactive, calcareous, frigid Typic Ustorthents
Vanocker	Loamy-skeletal, mixed, superactive, frigid Inceptic Hapludalfs
Pits	---
Rock outcrop	---

Source: USDA NRCS 2020

Map Unit Descriptions (USDA 2020a)

Q0645C – Rapidcreek cobbly loam, dry, 2 to 10 percent slopes rarely flooded

This map unit consists of shallow, somewhat excessively drained soils formed on alluvial flood plains, stream terraces, and terraces. This map unit is found at elevations of 3,640 to 5,600 feet with slopes typically from 2 to 10 percent. Mean annual precipitation is 17 to 24 inches and the mean annual air temperature is 37 to 46 degrees F. Map unit is not within prime farmland.

Permeability within the Rapidcreek cobbly loam is moderately high to high. The available water capacity is low (4.6 inches). Runoff class is low and frequency of flooding is rare, none. The hazard of water erosion is moderate and wind erosion hazard is moderate.

This map unit composition consists of approximately 85% Rapidcreek, rarely flooded, and similar soils, and 15% minor components (8% Barnum, cool and 7% Colombo, cool).

Q0658D – Rockerville-Gurney complex, 2 to 15 percent slopes

This map unit is found at elevations of 3,700 to 5,800 feet with slopes typically from 2 to 15 percent. Mean annual precipitation is 17 to 22 inches and the mean annual air temperature is 41 to 45 degrees F. Map unit is not within prime farmland.

Rockerville consists of shallow, somewhat excessively drained soils formed on residuum weathered from limestone on ridges and knolls. Gurney consists of moderately deep, well drained soils formed on residuum weathered from sedimentary rock on mountain slopes.

Permeability within Rockerville is very low to moderately low. The available water capacity is very low (1.2 inches). Runoff class is medium and frequency of flooding is none. The hazard of water erosion is moderate and wind erosion hazard is low. Permeability within Gurney is very low to moderately high. The available water capacity is low (5.1 inches). Runoff class is medium and frequency of flooding is none. The hazard of water erosion is moderate and wind erosion hazard is low.

This map unit complex consists of approximately 50% Rockerville and similar soils, 35% Gurney and similar soils, and 15% minor components (4% Ziggy, cool, moist, 4% Hilger, cobbly, 4% Sawdust, and 3% Rock outcrop, sandstone).

Q0659E – Rockerville-Rock outcrop complex, 6 to 30 percent slopes

This map unit is found at elevations of 3,610 to 5,000 feet with slopes typically from 6 to 30 percent. Mean annual precipitation is 16 to 22 inches and the mean annual air temperature is 39 to 48 degrees F. Map unit is not within prime farmland.

Rockerville consists of shallow, somewhat excessively drained soils formed on loamy residuum weathered from limestone on dip slopes. Rock outcrop is excessively drained formed on hard limestone on dip slopes.

Permeability within Rockerville is moderately low to high. The available water capacity is very low (1.9 inches). Runoff class is very high and frequency of flooding is none. The hazard of water erosion is moderate and wind erosion hazard is low. Permeability within Rock outcrop is very low to high. The available water capacity is very low (0.0 inches). Runoff class is very high. The hazard of water erosion is moderate and wind erosion hazard is low.

This map unit complex consists of approximately 50% Rockerville and similar soils, 35% Rock outcrop, and 15% minor components (8% Sawdust, and 7% Tilford, cool).

Q0665E – Sawdust-Vanocker, dry-Rockerville complex, 10 to 40 percent slopes

This map unit is found at elevations of 3,700 to 5,800 feet with slopes typically from 10 to 40 percent. Mean annual precipitation is 17 to 22 inches and the mean annual air temperature is 41 to 45 degrees F. Map unit is not within prime farmland.

Sawdust consists of shallow, well drained soils formed on gravelly colluvium derived from limestone and sandstone on mountain slopes. Vanocker, dry consists of moderately deep to deep well drained soils formed on residuum weathered from limestone and sandstone on mountain slopes. Rockerville consists of shallow, somewhat excessively drained soils formed on residuum weathered from limestone on mountain slopes.

Permeability within Sawdust is moderately high to high. The available water capacity is low (4.4 inches). Runoff class is high and frequency of flooding is none. The hazard of water erosion is moderate and wind erosion hazard is moderate. Permeability within Vanocker, dry is very low to moderately high. The available water capacity is low (5.4 inches). Runoff class is high and frequency of flooding is none. The hazard of water erosion is moderate and wind erosion hazard is moderate. Permeability within Rockerville is very low to moderately low. The available water capacity is very low (1.8 inches). Runoff class is high and frequency of flooding is none. The hazard of water erosion is moderate and wind erosion hazard is moderate.

This map unit complex consists of approximately 40% Sawdust and similar soils, 25% Vanocker, dry and similar soils, 15% Rockerville and similar soils, and 20% minor components (5% Rock outcrop, limestone, 5% Citadel, dry, 5% Hickok, dry, and 5% Gurney).

Q0702F – Pits, quarry

This map unit is found at elevations of 3,440 to 6,890 feet. Mean annual precipitation is 16 to 31 inches and the mean annual air temperature is 37 to 48 degrees F. Map unit is not within prime farmland. This map unit formed on igneous and sedimentary rock on mountain slopes. The hazard of water erosion is moderate and wind erosion hazard is low.

This map unit composition consists of approximately 90% pits and 10% minor components (5% Rock outcrop, sedimentary and 5% Rock outcrop, igneous).

Discussion

Soil suitability limiting factors across all soil map units were coarse fragments and gravel noted within the soil pedon. Field cutoff determinations were made based on this factor as well as visually observed soil color and effervescence reaction to 10% hydrochloric acid.

Map units Rapidcreek cobbly loam, dry, 2 to 10 percent slopes rarely flooded and Sawdust-Vanocker, dry-Rockerville complex, 10 to 40 percent slopes were rated as moderate in the wind erosion group (WEG) (USDA 2020a). Ratings range from low, moderate, and high. All map units were rated as moderate with pits, quarry rated as moderate/high for water erosion potential using the K factor (Kf) in the Revised Universal Soil Loss Equation, Version 2 (RUSLE2) (USDA 2020a). Ratings range from low, moderate, and high.

Map units with rock outcropping (Q0659E Rockerville-Rock outcrop complex, 6 to 30 percent slopes) or pits, quarry (Q0702F (Pits, quarry) were noted to have low revegetation potential due to the lack of available suitable salvage soil.

<u>Q0645C – Rapidcreek cobbly loam, dry, 2 to 10 percent slopes rarely flooded</u>

Soil samples Soil1, Soil2, Soil4, Soil7, and Soil8 were sampled within this map unit. Soil samples Soil1 and Soil7 were identified as soil series Colombo. Soil samples Soil2 and Soil8 were identified as soil series Rapidcreek, and soil sample Soil4 was identified as soil series Barnum.

- Soil1 – Colombo – suitable soil salvage depth = 60.00 inches
- Soil2 – Rapidcreek – suitable soil salvage depth = 16.00 inches
- Soil4 – Barnum – suitable soil salvage depth = 4.00 inches
- Soil7 – Colombo – suitable soil salvage depth = 62.00 inches
- Soil8 – Rapidcreek – suitable soil salvage depth = 24.00 inches

This map unit can be split into two subsets Rapidcreek cobbly loam and Rapidcreek cobbly loam – drainage). Please see Figure 2-1 for the drainage inclusion identified during the field survey. This map unit is a suitable source of soil salvage to a weighted average of 5.08 feet outside of the drainage and 1.22 feet within the drainage. One marginal parameter for Soil2 was noted. Saturation percent was recorded at 81.2%, 1.2% over the parameter to be suitable. No unsuitable parameters were noted in the laboratory analysis based on WDEQ Guideline 1A.

<u>Q0658D – Rockerville-Gurney complex, 2 to 15 percent slopes</u>

Soil samples Soil3 and Soil5 were sampled within this map unit. Soil sample Soil3 was identified as soil series Gurney. Soil sample Soil5 was identified as soil series Rockerville.

- Soil3 – Colombo – suitable soil salvage depth = 40.00 inches
- Soil5 – Rockerville – suitable soil salvage depth = 14.00 inches

This map unit is a suitable source of topsoil to a weighted average of 2.25 feet. Soil sample Soil3 within the soil series Colombo has more salvageable material than Soil5 within the Rockerville soil series. Discretion and operator judgment should be used during the topsoil and subsoil stripping activity. No marginal or unsuitable parameters were noted in the laboratory analysis based on WDEQ Guideline 1A.

Q0659E – Rockerville-Rock outcrop complex, 6 to 30 percent slopes

No soil samples were collected in this map unit. An attempt was made, during the field survey by ICF biologists, to extract a soil sample from this map unit, however, ground conditions were too rocky to collect material.

This map unit is an unsuitable source of soil salvage due to its rock outcropping and has a weighted average of 0.00 feet.

Q0665E – Sawdust-Vanocker, dry-Rockerville complex, 10 to 40 percent slopes

Soil samples Soil6 was sampled within this map unit. Soil sample Soil6 was identified as soil series Vanocker.

- Soil6 – Vanocker – suitable soil salvage depth = 4.00 inches

This map unit is a marginally suitable source of topsoil to a weighted average of 0.33 feet. No marginal or unsuitable parameters were noted in the laboratory analysis based on WDEQ Guideline 1A.

Q0702F – Pits, quarry

This map unit is an unsuitable source of soil salvage due to its existing surface disturbance and has a weighted average of 0.00 feet.

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Addendum 1
Result Tables and Official Soil Series Descriptions

Addendum 1-1. Loring Quarry Soils Laboratory Analysis Suitability Summary based on WDEQ Guideline 1A

Sample ID	Sampled	Depth	pH s.u.	Sat. %	EC dS/m	OM %	CaCO3 %	Ca meq/L	Mg meq/L	Na meq/L	SAR	Sand %	Silt %	Clay %	Texture
Soil #1	6/29/20	0-4	6.3	71.7	0.80	6.3	0.7	4.42	1.33	0.22	0.13	35.0	49.0	16.0	Loam
Soil #1	6/29/20	4-18	7.1	52.5	0.87	3.4	13.1	5.50	1.29	0.18	0.10	29.0	47.0	24.0	Loam
Soil #1	6/29/20	18-26	7.7	45.9	0.50	2.2	14.1	2.13	1.82	0.40	0.28	22.0	52.0	26.0	Silty Loam
Soil #1	6/29/20	26-42	7.9	48.1	1.04	1.7	14.9	2.31	4.16	1.88	1.04	29.0	49.0	22.0	Loam
Soil #1	6/29/20	42-60	7.9	42.2	2.78	1.3	7.5	2.98	6.19	13.4	6.26	24.0	57.0	19.0	Silty Loam
Soil #2	6/29/20	0-8	6.6	81.2	1.65	8.6	1.5	8.81	2.23	0.27	0.12	28.0	47.0	25.0	Loam
Soil #2	6/29/20	8-16	7.1	60.0	2.41	4.4	10.3	14.6	2.59	0.45	0.15	40.0	38.0	22.0	Loam
Soil #3	6/29/20	0-6	7.1	54.4	1.41	5.1	7.5	9.55	1.15	0.10	<0.05	41.0	41.0	18.0	Loam
Soil #3	6/29/20	6-12	7.1	46.3	1.55	3.8	16.2	10.0	1.25	0.21	0.09	41.0	37.0	22.0	Loam
Soil #3	6/29/20	12-18	7.5	31.3	0.78	1.6	37.2	4.80	1.00	0.23	0.13	62.0	22.0	16.0	Sandy Loam
Soil #3	6/29/20	18-26	7.6	30.7	1.06	1.1	26.6	4.62	1.63	0.31	0.17	56.0	30.0	14.0	Sandy Loam
Soil #3	6/29/20	26-35	7.8	43.7	0.85	1.6	8.7	2.37	2.49	1.40	0.90	29.0	47.0	24.0	Loam
Soil #3	6/29/20	35-40	8.1	50.8	0.67	2.4	9.0	1.08	1.43	2.82	2.52	22.0	48.0	30.0	Clay Loam
Soil #3	6/29/20	40-46	8.2	46.3	0.67	1.6	12.0	0.77	1.16	3.78	3.84	33.0	41.0	26.0	Loam
Soil #4	6/29/20	0-4	7.2	68.2	1.03	7.8	16.6	7.07	0.78	0.13	0.06	25.0	51.0	24.0	Silty Loam
Soil #5	6/29/20	0-3	7.1	72.2	1.68	8.3	21.6	12.1	0.75	0.19	0.07	42.0	36.0	22.0	Loam
Soil #5	6/29/20	3-8	7.1	65.3	1.05	5.8	23.2	7.75	0.52	0.12	0.06	31.0	39.0	30.0	Clay Loam
Soil #5	6/29/20	8-14	7.1	60.4	1.37	4.7	38.4	9.41	0.53	0.17	0.08	18.0	51.0	31.0	Silty Clay Loam
Soil #6	6/30/20	0-4	7.1	56.9	1.32	5.8	24.3	10.4	0.59	0.18	0.08	42.0	38.0	20.0	Loam
Soil #7	6/30/20	0-4	7.3	63.5	1.08	5.9	5.6	7.10	0.99	0.11	0.05	35.0	49.0	16.0	Loam
Soil #7	6/30/20	4-10	7.2	55.8	1.05	3.7	5.5	6.54	1.11	0.20	0.10	32.0	48.0	20.0	Loam
Soil #7	6/30/20	10-18	7.4	51.1	1.56	3.0	17.4	8.29	2.93	0.37	0.16	35.0	45.0	20.0	Loam
Soil #7	6/30/20	18-50	7.9	41.7	0.73	1.8	21.8	2.45	2.64	0.59	0.37	40.0	40.0	20.0	Loam
Soil #7	6/30/20	50-62	8.7	58.0	2.84	1.9	9.6	1.01	4.78	15.3	8.99	24.0	52.0	24.0	Silty Loam
Soil #8	6/30/20	0-3	7.1	75.6	1.22	7.8	11.6	8.28	1.00	0.28	0.13	36.0	47.0	17.0	Loam
Soil #8	6/30/20	3-12	7.2	46.9	1.24	3.4	23.4	7.97	0.91	0.18	0.09	53.0	31.0	16.0	Sandy Loam
Soil #8	6/30/20	12-20	7.5	43.2	0.76	3.1	23.7	4.81	0.74	0.18	0.11	52.0	34.0	14.0	Sandy Loam

Sample ID	Sampled	Depth	pH s.u.	Sat. %	EC dS/m	OM %	CaCO3 %	Ca meq/L	Mg meq/L	Na meq/L	SAR	Sand %	Silt %	Clay %	Texture
Soil #8	6/30/20	20-24	7.6	40.5	0.72	2.3	23.3	4.51	0.65	<0.05	<0.05	52.0	34.0	14.0	Sandy Loam

Marginal suitability per WDEQ Guideline 1A
Unsuitable per WDEQ Guideline 1A
Coarse fragments, selenium and boron not analyzed.

Addendum 1-2. Loring Quarry Project Area Approximate Soil Suitability Salvage Depths and Volume

Map Unit Symbol	Map Unit Name	Soil Series	Acres in Project Area	Percent of Project area (acres)	Suitability Salvage Depth (Average) (feet)	Total Volume of Salvageable Soil (acre-feet)
Q0645C	Rapidcreek cobbly loam, dry, 2 to 10 percent slopes rarely flooded	Colombo	59.20	4.14	5.08	21.07
		Barnum Rapidcreek		4.74 50.32	1.22	67.29
Q0658D	Rockerville-Gurney complex, 2 to 15 percent slopes	Gurney Rockerville	29.20	14.60 14.60	3.33 1.17	48.67 17.03
Q0665E	Sawdust-Vanocker, dry-Rockerville complex, 10 to 40 percent slopes	Vanocker	16.90	16.90	0.33	5.58
Q0659E	Rockerville-Rock outcrop complex, 6 to 30 percent slopes	---	5.90	5.90	0.00	0.00
Q0702F	Pits, quarry	---	50.70	40.70	0.00	0.00
Total			161.80		2.23	159.63[1]

[1] 159.63 acre-feet of salvageable soil = 257,536 cubic yards

Addendum 1-3. Loring Quarry Project Area Soil Restoration Potential

Map Unit Symbol	Map Unit Name	Soil Restoration Potential[1]
Q0645C	Rapidcreek cobbly loam, dry, 2 to 10 percent slopes rarely flooded	High
Q0658D	Rockerville-Gurney complex, 2 to 15 percent slopes	Moderate
Q0659E	Rockerville-Rock outcrop complex, 6 to 30 percent slopes	Moderate
Q0665E	Sawdust-Vanocker, dry-Rockerville complex, 10 to 40 percent slopes	High
Q0702F	Pits, quarry	High

[1]This interpretation rates each soil for its inherent ability to recover from degradation, which is often referred to as soil resilience. The ability to recover from degradation means the ability to restore functional and structural integrity after a disturbance. "High potential" indicates that the soil has features that are very favorable for recovery. Good performance can be expected. "Moderate potential" indicates that the soil has features that are generally favorable for recovery. Fair performance can be expected. "Low potential" indicates that the soil has one or more features that are unfavorable for recovery. Poor performance can be expected. (USDA NRCS 2020a).

Addendum 1-4. Loring Quarry Project Area Wind and Water Erosion Hazards

Map Unit Symbol	Map Unit Name	Wind Erosion Group (WEG) Rating[1]	Water Erosion Hazard (RUSLE2) Kf[2]
Q0645C	Rapidcreek cobbly loam, dry, 2 to 10 percent slopes rarely flooded	5 (moderate)	Rapidcreek, rarely flooded: 0.28 (moderate)
Q0658D	Rockerville-Gurney complex, 2 to 15 percent slopes	7 (low)	Rockerville: 0.37 (moderate) Gurney: 0.24 (moderate)
Q0659E	Rockerville-Rock outcrop complex, 6 to 30 percent slopes	7 (low)	Rockerville: 0.32 (moderate) Rock outcrop: NA
Q0665E	Sawdust-Vanocker, dry-Rockerville complex, 10 to 40 percent slopes	5 (moderate)	Sawdust: 0.28 (moderate) Vanocker, dry: 0.28 (moderate) Rockerville: 0.37 (moderate)
Q0702F	Pits, quarry	8 (low)	Pits, quarry: 0.43 (moderate/high)

[1]WEG Rating: Low: 6-8; Moderate: 3-5; High: WEG 1-2 (USDA 2020a)

[2]The K Factor (Kf) is an index which quantifies the relative susceptibility of the soil to sheet and rill erosion. Kf is used in the RUSLE2 soil loss prediction equation. Values range from 0.02 for the least erodible soils to 0.64 for the most erodible. (USDA 2020a).

Addendum 1-5. Loring Quarry Project Area Official Soil Series Descriptions (NRCS 2020)

Official Series Description - BARNUM Series

LOCATION BARNUM WY+SD UT

Established Series
Rev. PSD/MCS
11/2005

BARNUM SERIES

The Barnum series consists of very deep, well drained soils formed in calcareous alluvium from red bed sediments. Barnum soils are on flood plains and alluvial terraces. Slopes are simple and range from 0 to 8 percent. The mean annual precipitation is about 12 inches, and the mean annual temperature is about 47 degrees F.

TAXONOMIC CLASS: Fine-loamy, mixed, superactive, calcareous, mesic Ustic Torrifluvents

TYPICAL PEDON: Barnum very fine sandy loam-rangeland. (Colors are for dry soil unless otherwise stated.)

A--0 to 4 inches; reddish brown (5YR 5/4) very fine sandy loam, reddish brown (5YR 4/4) moist; moderate very fine granular structure; soft, very friable; slightly effervescent, calcium carbonate disseminated; moderately alkaline (pH 8.2); clear smooth boundary. (3 to 6 inches thick)

C--4 to 60 inches; reddish brown (2.5YR 5/5) loam stratified with thin lenses of fine sandy loam and light clay loam, reddish brown (2.5YR 4/5) moist; massive with lenses of unaltered parent sediment; slightly hard, very friable; strongly effervescent, calcium carbonate disseminated and as soft masses in some lenses; moderately alkaline (pH 8.4).

TYPE LOCATION: Johnson County, Wyoming; NW1/4, NE1/4 of sec. 6, T. 41 N., R. 83 W. 43 degrees 33 minutes 22 seconds north latitude and 106 degrees 51 minutes 34 seconds west longitude.

RANGE IN CHARACTERISTICS: These soils typically contain free carbonates throughout but may be leached a few inches in some pedons. Organic carbon ranges from .6 to 3 percent in the upper 10 inches and decreases irregularly with depth. The mean annual soil temperature is about 47 to 53 degrees F. The particle size control section is highly stratified and typically averages loam or light clay loam with 18 to 35 percent clay and more than 15 percent fine or coarser sand. Strata of sandy loam, silt loam, silty clay loam, and fine sandy loam are common. Rock fragments are variable between strata but average from 0 to 10 percent pebbles. Exchangeable sodium ranges from 4 to 15 percent throughout the soil. EC typically ranges from

2 to 8 mmhos throughout under natural conditions but may range to 16 mmhos where poorly irrigated.

The A horizon has hue of 7.5YR through 2.5YR, value of 4 through 6 dry, 3 through 5 moist, and chroma of 2 through 6. Reaction is slightly through strongly alkaline.

The C horizon has hue of 5YR through 10R, value of 4 through 7 dry, 3 through 5 moist, and chroma of 2 through 6. Some strata have visual accumulations of salts and carbonates which are typically discontinuous throughout the extent of the pedon. Reaction is slightly through strongly alkaline. Some pedons may have buried horizons below 40 inches.

COMPETING SERIES: These are the Haverdad, Haverson, Haysham, Manikan, Panitchen, San Mateo, and Suwanee soils. Haverdad, Haverson, and San Mateo soils have hue of 10YR or yellower throughout. Hysham soils are very strongly alkaline and have compact subsurface horizons with hard consistence. Manikan and Suwanee soils are intermittently moist in July through September, and December through February. Panitchin soils have hues of 5Y through 7.5YR in the C horizon.

GEOGRAPHIC SETTING: Barnum soils are on flood plains and alluvial terraces. These soils formed in calcareous alluvium derived from red beds containing siltstone, shale, and sandstone. Slopes are 0 to 8 percent. Elevations are 4,000 to 6,600 feet. The mean annual precipitation is about 12 inches and ranges from 10 to 14 inches with about half falling as snow or rain in April, May, and early June. The mean annual temperature is about 43 to 49 degrees F. The frost-free season is estimated to range from 110 to 135 days depending upon elevation, aspect, and air drainage.

GEOGRAPHICALLY ASSOCIATED SOILS: These are the Neville and Redbank soils and the competing Haverdad soils. Neville soils have uniform textures and a uniform decrease in organic carbon. Redbank soils are coarse-loamy.

DRAINAGE AND PERMEABILITY: Well drained; medium and low runoff; permeability is moderate or moderately slow because of stratification.

USE AND VEGETATION: Rangeland, wildlife habitat, and irrigated farming. Native vegetation consists of basin wildrye, green needlegrass, western wheatgrass, blue grama, rubber rabbitbrush, and silver sagebrush.

DISTRIBUTION AND EXTENT: Central Wyoming, western South Dakota, and eastern Utah. The series is of moderate extent.

MLRA SOIL SURVEY REGIONAL OFFICE (MO) RESPONSIBLE: Denver, Colorado

SERIES ESTABLISHED: Butte County, South Dakota; 1970.

REMARKS: Diagnostic horizons and features recognized in this pedon are:

Ochric epipedon - 0 to 4 inches (A)

MLRR- G

SIRs- WY0004, WY0865

National Cooperative Soil Survey
U.S.A.

Official Series Description - COLOMBO Series

LOCATION COLOMBO CO+SD WY

Established Series
Rev. JC/RHM
8/89

COLOMBO SERIES

The Colombo series consists of deep, well drained soils that formed in calcareous loamy alluvium. Colombo soils are on flood plains and terraces and have slopes of 0 to 6 percent. The mean annual precipitation is about 12 inches and the mean annual air temperature is about 48 degrees F.

TAXONOMIC CLASS: Fine-loamy, mixed, mesic Torrifluventic Haplustolls

TYPICAL PEDON: Colombo clay loam - irrigated cropland. (Colors are for dry soil unless otherwise noted.)

Ap--0 to 14 inches; dark grayish brown (10YR 4/2) clay loam, very dark grayish brown (10YR 3/2) moist; weak medium granular structure; slightly hard, friable, slightly effervescent; moderately alkaline; clear smooth boundary. (10 to 20 inches thick)

C1--14 to 21 inches; pale brown (10YR 6/3) stratified clay loam and loam, brown (10YR$ 5/3) moist; weak coarse subangular blocky structure grading to massive; slightly hard, friable; strongly effervescent; moderately alkaline; gradual smooth boundary. (4 to 12 inches thick)

C2--21 to 60 inches; very pale brown (10YR 7/3) loam stratified with thin lenses of fine sandy loam, fine sand, medium sand and clay loam, pale brown (10YR 6/3) moist; massive; slightly hard, friable; strongly effervescent; moderately alkaline.

TYPE LOCATION: Weld County, Colorado; 2,350 feet north, 2,000 feet east of the SW corner of Sec. 4, T. 5 N., R. 64 W.

RANGE IN CHARACTERISTICS: Usually these soils are calcareous throughout, but may be leached to a depth of 10 to 18 inches. The control section lacks continuous subhorizons of secondary calcium carbonate and/or sulfate but some pedons have some visible accumulation. The mollic epipedon ranges from 8 to 16 inches thick. The 10- to 40- inch control section is usually loam or light clay loam stratified with thin lenses of sand and clay loam. It averages 18 to 35 percent clay, 15 to 50 percent silt, and 20 to 60 percent sand. Rock fragments range from 0 to 15 percent by volume and are mainly 1/2 to 10 inches in diameter.

The A horizon has hue of 2.5YR through 7.5YR, value of 4 or 5 dry, 2 or 3 moist, and chroma of 1 through 3. It is mildly or moderately alkaline.

The C horizon has hue of 2.5Y through 7.5YR. It is moderately or strongly alkaline.

COMPETING SERIES: These are the Haverson, Mill, and Uncom series. Haverson soils lack a mollic epipedon. Mill soils are coarse-loamy and have hue of 5YR or redder in a majority of subhorizons. Uncom soils are coarse-loamy and have the lower part of their moisture control section moistened by a fluctuating water table or its capillary fringe.

GEOGRAPHIC SETTING: Colombo soils are on flood plains, terraces, and drainageways. Slopes range from 0 to 6 percent. The soils formed in thick, stratified, calcareous, predominantly medium to moderately fine textured, mixed alluvium. At the type location, the mean annual precipitation is about 12 inches with peak periods of precipitation occurring in the spring and early summer. Mean annual temperature is 48 degrees F, mean summer temperature is 70 degrees F. The frost-free season is about 130 to 160 days.

GEOGRAPHICALLY ASSOCIATED SOILS: These are the Glenberg soils and the competing Haverson soils. Glenberg soils lack a mollic epipedon.

DRAINAGE AND PERMEABILITY: Well drained; slow to medium runoff; moderate permeability.

USE AND VEGETATION: These soils are used as grazing land, cropland, and native meadow. Native vegetation is sagebrush, blue grama, and native bluegrass.

DISTRIBUTION AND EXTENT: Northeastern and western Colorado. This series is of moderate extent.

MLRA SOIL SURVEY REGIONAL OFFICE (MO) RESPONSIBLE: Denver, Colorado

SERIES ESTABLISHED: Weld County, Colorado, 1976.

REMARKS: Last updated by the state 7/76.

National Cooperative Soil Survey
U.S.A.

Official Series Description - GURNEY Series

LOCATION GURNEY SD

Established Series
Rev. EHE-DDH-KEC
10/98

GURNEY SERIES

The Gurney series consists of moderately deep, well drained soils formed in residuum weathered from sedimentary rocks on open prairies in mountains. Permeability is moderate. Slopes range from 0 to 25 percent. Mean annual precipitation is about 18 inches, and mean annual temperature is about 40 degrees F.

TAXONOMIC CLASS: Fine-loamy, mixed, superactive, frigid Typic Argiustolls

TYPICAL PEDON: Gurney silt loam - on a south-facing slope of 7 percent under native grassland at 5380 feet elevation. When described, the soil was moist to 9 inches and dry below. (Colors are for dry soil unless otherwise noted.)

A--0 to 5 inches; dark brown (10YR 4/3) loam, very dark grayish brown (10YR 3/2) moist; moderate fine and medium granular structure; soft, very friable; slightly acid; clear smooth boundary. (4 to 8 inches thick)

Bt1--5 to 9 inches; brown (7.5YR 4/4) loam, dark reddish brown (5YR 3/4) moist; moderate fine and medium subangular blocky structure; soft, very friable; neutral; clear smooth boundary.

Bt2--9 to 16 inches; brown (7.5YR 5/4) clay loam, dark brown (7.5YR 4/3) moist; weak medium prismatic structure parting to moderate medium blocky; hard, friable; neutral; abrupt wavy boundary. (Combined Bt horizons is 6 to 16 inches thick.)

Bk1--16 to 22 inches; light yellowish brown (10YR 6/4) clay loam, dark yellowish brown (10YR 4/4) moist; moderate medium subangular blocky structure; very hard, friable; few fine and medium accumulations of carbonates; strong effervescence; slightly alkaline; gradual wavy boundary. (4 to 10 inches thick)

Bk2--22 to 28 inches; light yellowish brown (10YR 6/4) channery clay loam, dark yellowish brown (10YR 4/4) moist; weak medium subangular blocky structure; very hard, friable; 20 percent by volume of fragments of rock; common fine accumulations of carbonates; violent effervescence; moderately alkaline; abrupt smooth boundary. (0 to 10 inches thick)

R--28 to 60 inches; red (2.5YR 5/6) indurated sandstone; strong effervescence.

TYPE LOCATION: Custer County, South Dakota; about 9 miles west and 7 miles south of Custer; 2100 feet north and 1300 feet east of southwest corner sec. 32, T. 4 S., R. 3 E.

RANGE IN CHARACTERISTICS:
Depth to carbonates typically is 12 to 18 inches, but ranges from 10 to 24 inches. Rock fragments which are dominantly channers or flagstones. Depth to consolidated limestone or sandstone typically is from 24 to 32 inches, but ranges from 20 to 40 inches.

The A horizon has hue of 5YR, 7.5YR, or 10YR; value of 3 or 4 and 2 or 3 moist; and chroma of 1 to 3. It is silt loam, loam, channery silt loam, or channery loam. It ranges from moderately acid to neutral.

The Bt horizon has hue of 2.5YR to 7.5YR, value of 4 to 6 and 3 or 4 moist, and chroma of 3 or 4. It is silt loam, loam, silty clay loam or clay loam and contains up to 20 percent by volume of rock fragments. It averages between 20 to 35 percent clay. It is slightly acid or neutral.

The Bk horizon has hue of 2.5YR to 10YR, value of 5 to 8 and 4 to 7 moist, and chroma of 3 or 4. It is silt loam, loam, clay loam, or channery clay loam and contains up to 35 percent by volume of rock fragments. It has few to many accumulations of carbonates. It is slightly or moderately alkaline.

Some pedons have a C horizon.

COMPETING SERIES: These are the Bullflat, Dooley, Empedrado, Fairfield, Farnuf, Felor, Greenway, Hangdo, Lefor, Lininger, Livona, Martinsdale, Moen, Reeder, Trag, Vida, Watrous, Wemple, Williams, and Yegen in the same family. Bookcliff soils have hard bedrock at depths of 40 to 60 inches. Bullflat, Dooley, Empedrade, Fairfield, Farnuf, Felor, Greenway, Hangdo, Livona, Martinsdale, Trag, Vida, Wemple, Williams, and Yegen do not have bedrock within a depth of 60 inches. In addition, Dooley soils contain more sand and formed in glacial till; Fairfield soils have carbonates within 10 inches of the surface; Felor soils contain more sand; Hangdo soils have carbonates below depths of 40 inches; Trag soils do not have carbonates; Vida and Williams formed in glacial till and Legen soils contain more sand. Lefor, Lininger, and Reeder soils have soft bedrock within depths of 20 to 40 inches. Moen soils do not have carbonates and overlie granite. Watrous soils have yellower hue in the argillic horizon.

GEOGRAPHIC SETTING: Gurney soils are nearly level to moderately steep on open prairies in mountains at elevations of 3600 to 6200 feet. Slope gradients range from 0 to 25 percent. These soils formed in residuum or colluvial sediments weathered from sedimentary rock. Mean annual temperature ranges from 37 to 45 degrees F. Mean annual precipitation ranges from 18 to 26 inches.

GEOGRAPHICALLY ASSOCIATED SOILS: These are the competing Bullflat series and the Hilger, Paunsaugunt, Vanocker, and Sawdust series. The Bullflat soils are on the lower parts of the landscape. The Hilger soils are skeletal and are on outer margins of broad terraces. The Paunsaugunt soils are shallow to bedrock and are on higher convex parts of the landscape. The Vanocker and Sawdust soils are skeletal and are on forested ridges and side slopes.

DRAINAGE AND PERMEABILITY: Well drained. Permeability is moderate. Runoff is medium or high.

USE AND VEGETATION: Used mainly for grazing, wildlife and recreation. Native vegetation is primarily prairire junegrass, western wheatgrass, needleandthread, blue grama and sedges.

DISTRIBUTION AND EXTENT: Mountainous areas of the Black Hills in South Dakota and Wyoming especially on the sedimentary formations. The series is of small extent.

MLRA SOIL SURVEY REGIONAL OFFICE (MO) RESPONSIBLE: Denver, Colorado

SERIES ESTABLISHED: Custer County, South Dakota, 1985.

REMARKS: Diagnostic horizons and features recognized in this pedon are: mollic epipedon - the zone from the surface of the soil to a depth of about 5 inches (A horizon); argillic horizon - the zone from about 5 to 16 inches (Bt1, Bt2 horizons).

ADDITIONAL DATA: Laboratory data NSSL 83T7230-31.

National Cooperative Soil Survey
U.S.A.

Official Series Description - RAPIDCREEK Series

LOCATION RAPIDCREEK SD+WY

Established Series
JWW/DJB
09/2011

RAPIDCREEK SERIES

The Rapidcreek series consists of very deep, well or somewhat excessively drained soils that formed in mixed alluvium derived from sedimentary and igneous sources. Rapidcreek soils are on flood plains and terraces. Slopes range from 1 to 10 percent. Mean annual precipitation is about 560 mm (22 inches) and the mean annual temperature is about 6 degrees C (43 degrees F).

TAXONOMIC CLASS: Loamy-skeletal over sandy or sandy-skeletal, mixed, superactive, calcareous, frigid Typic Udifluvents

TYPICAL PEDON: Rapidcreek gravelly loam, on a southwest facing, linear slope of 2 percent in mixed forest-grassland vegetation at an elevation of about 1,345 meters. (Colors are for moist soil unless otherwise noted.) When described on July 9, 2004 the soil was moist throughout.

A--0 to 4 cm (0 to 2 inches); very dark grayish brown (10YR 3/2) gravelly loam, dark grayish brown (10YR 4/2) dry; weak medium and moderate fine granular structure; soft, very friable, slightly sticky; many very fine, common fine and medium roots; about 15 percent subrounded limestone gravel and subangular channers; slight effervescence; slightly alkaline; abrupt smooth boundary. (2 to 15 cm thick [0.8 to 6 inches])

C1--4 to 20 cm (2 to 8 inches); about 80 percent stratified dark grayish brown (10YR 4/2) very gravelly loam, light brownish gray (10YR 6/2) dry, and 20 percent grayish brown (10YR 5/2) fine sandy loam, light brownish gray (10YR 6/2) dry; weak medium platy structure; slightly hard, friable, moderately sticky and moderately plastic; many very fine, common fine and medium roots; about 40 percent subangular and subrounded gravel, 2 percent subrounded cobble; strong effervescence; moderately alkaline; clear wavy boundary.

C2--20 to 38 cm (8 to 15 inches); about 80 percent brown (10YR 4/3), pale brown (10YR 6/3) dry, and 20 percent dark brown (10YR 3/3), brown (10YR 5/3) dry very gravelly fine sandy loam; massive; slightly hard, friable, slightly sticky and slightly plastic; many very fine, common fine and medium roots; about 43 percent subangular and subrounded gravel and 2 percent subrounded cobbles; strong effervescence; moderately alkaline; clear wavy boundary. (Combined thickness of the C horizon is 25 to 51 cm [10 to 20 inches])

2C3--38 to 53 cm (15 to 21 inches); dark grayish brown (10YR 4/2) very gravelly loamy coarse sand, light brownish gray (10YR 6/2) dry; massive; soft, very friable, nonsticky and nonplastic; common very fine and fine and few medium roots; about 50 percent subangular and subrounded gravel; violent effervescence; moderately alkaline; clear wavy boundary.

2C4--53 to 157 cm (21 to 62 inches); brown (10YR 4/3) extremely cobbly loamy coarse sand, pale brown (10YR 6/3) dry; single grain; loose; common very fine and few fine and medium roots; about 70 percent mixed sedimentary fragments, of which 35 percent are rounded cobbles, 30 percent subrounded and rounded gravel, and 5 percent rounded stones; strong effervescence; moderately alkaline; clear wavy boundary.

3C5--157 to 173 cm (62 to 68 inches); 60 percent dark grayish brown (10YR 4/2) gravelly fine sandy loam, grayish brown (10YR 5/2) dry, and 40 percent very dark grayish brown (10YR 3/2) gravelly very fine sandy loam, dark grayish brown (10YR 4/2) dry; massive; soft, very friable; few very fine and fine roots; 30 percent mixed sedimentary fragments, of which 20 percent are subrounded gravel and 10 percent rounded cobble; violent effervescence; moderately alkaline; clear wavy boundary. (0 to 20 cm [0 to 8 inches] thick)

2C4'--173 to 200 cm (68 to 80 inches); brown (10YR 4/3) extremely cobbly loamy coarse sand, pale brown (10YR 6/3) dry; single grain; loose; few very fine roots; 60 percent mixed sedimentary fragments, of which 40 percent are rounded cobble and 20 percent rounded gravel; strong effervescence; moderately alkaline. (Combined thickness of the 2C horizon is 102 to 171 cm [20 to 67 inches])

TYPE LOCATION: Lawrence County, South Dakota; about 0.5 miles north of Maurice, between Highway 14A and Spearfish Creek; about 1,000 feet north and 1,700 feet west of the southeast corner of Sec. 8, T. 5 N., R. 2 E.; Maurice USGS topographic quadrangle, South Dakota; GPS 44 degrees 24 minutes 20.3 seconds north latitude and 103 degrees 53 minutes 53.2 seconds west longitude; NAD 83.

RANGE IN CHARACTERISTICS:
Depth to effervescence: 0 to 15 cm (0 to 6 inches)
Depth to contrasting particle-size class or lithologic discontinuity: 30 to 60 cm (12 to 24 inches)

A horizon:
Hue: 5YR to 10YR
Value: 3 or 4, 4 to 6 dry
Chroma: 2 to 4
Texture: GR-L, CB-L
Clay content: 18 to 27 percent
Rock fragments: 15 to 35 percent gravel and/or cobble
Reaction: neutral or slightly alkaline

C horizon:
Hue: 5YR to 10YR
Value: 3 to 6, 5 to 7 dry
Chroma: 2 to 6
Texture: stratified LS, SL, FSL, VFSL, L, SIL, CL (fine-earth fraction)
Clay content: 15 to 27 percent horizon average; individual strata may contain more or less

Rock fragments: 35 to 60 percent rounded and subrounded, mixed sedimentary and igneous fragments; 20 to
45 percent gravel and 2 to 40 percent cobble
Calcium carbonate equivalent: 2 to 15 percent
Reaction: slightly alkaline or moderately alkaline

2C horizon:
Hue: 7.5YR or 10YR
Value: 4 or 5, 5 or 6 dry
Chroma: 2 to 4
Texture: stratified LS, S, LCOS, COS (fine-earth fraction)
Clay content: 3 to 10 percent horizon average
Rock fragments: 50 to 80 percent rounded and subrounded, mixed sedimentary and igneous fragments; 20 to
50 percent cobble, 10 to 40 percent gravel, and 0 to 10 percent stones
Calcium carbonate equivalent: 1 to 5 percent
Reaction: slightly alkaline to moderately alkaline

3C horizon (when present):
Hue: 10YR
Value: 3 or 4, 4 or 5 dry
Chroma: 2 or 3
Texture: L, FSL, VFSL (fine-earth fraction)
Clay content: 15 to 25 percent
Rock fragments: 15 to 35 percent rounded and subrounded gravel and/or cobble
Calcium carbonate equivalent: 2 to 10 percent
Reaction: moderately alkaline or strongly alkaline

COMPETING SERIES: There are no competing series in this taxonomic class.

GEOGRAPHIC SETTING:
Parent material: Alluvium derived primarily from mixed sedimentary sources, but also including minor components of igneous- and metamorphic-derived material
Landform: flood plains and low terraces in mountain valleys and canyon floors
Slopes: 1 to 10 percent
Elevation: 1,158 to 1,830 meters (3,799 to 6,004 feet)
Mean annual air temperature: 6 to 9 degrees C (43 to 48 degrees F)
Mean annual precipitation: 455 to 710 mm (18 to 28 inches)
Precipitation pattern: Over half of the average annual precipitation falls as rain and snow from March through July
Frost-free period: 100 to 140 days.

GEOGRAPHICALLY ASSOCIATED SOILS:
Bullflat, Cordeston, and Marshbrook - have mollic epipedons and are fine-loamy. In addition, Bullflat soils have an argillic horizon, Cordeston soils have a cumulic mollic epipedon, and Marshbrook soils have a aquic moisture regime. Bullflat soils occur on higher landscape

positions and Cordeston soils occur on slightly higher and Marshbrook soils on slightly lower landscape positions than Rapidcreek soils.

DRAINAGE AND SATURATED HYDRAULIC CONDUCTIVITY: Well to somewhat excessively drained; saturated hydraulic conductivity is high over very high; low to medium runoff; rarely to occasionally flooded for very brief to brief periods during the months of April through August.

USE AND VEGETATION: Rapidcreek soils have a riparian or mixed woodland and grassland ecological community and are utilized for livestock grazing, wildlife habitat, recreation, and limited homesite development. Common vegetation present on most areas includes Timothy, Kentucky bluegrass, smooth brome, sedges, cottonwood, boxelder, green ash, and occasional ponderosa pine and Black Hills spruce.

DISTRIBUTION AND EXTENT: Rapidcreek soils occur in valleys and canyons on the Limestone Plateau physiographic area in the Black Hills of South Dakota and Wyoming; LRR G, MLRA 62; the series is of small extent.

MLRA SOIL SURVEY REGIONAL OFFICE (MO) RESPONSIBLE: Denver, Colorado

SERIES PROPOSED: Update Soil Survey of Lawrence County, South Dakota, 2006. The name is taken from Rapid Creek.

REMARKS:
Diagnostic horizons and features recognized in this pedon are:
Particle-size control section: The zone from 25 to 100 cm (10 to 39 inches) (C2, C3, and 2C4 horizons)
Ochric epipedon: The zone from 0 to 4 cm (0 to 2 inches) (A horizon)
Strongly contrasting particle-size classes: At the lower boundary of the C2 horizon
Lithologic discontinuity: At the upper boundary of the 2C3 horizon and at the upper boundary of the 3C5 horizon.

Other features: Fluventic suborder, an irregular decrease in organic matter

The assignment of the cation-exchange activity class is derived from lab data from the typical pedon.

Taxonomic Version: Keys to Soil Taxonomy, Eleventh Edition, 2010

ADDITIONAL DATA:

National Cooperative Soil Survey
U.S.A.

Official Series Description - ROCKERVILLE Series

LOCATION ROCKERVILLE SD+WY

Established Series
Rev. JWW
09/2011

ROCKERVILLE SERIES

The Rockerville series consists of shallow, well drained soils that formed in residuum derived from sedimentary rocks. Rockerville soils are on mountain and ridges. Slopes range from 2 to 60 percent. Mean annual precipitation is about 510 mm (20 inches) and the mean annual air temperature is about 7 degrees C (45 degrees F).

TAXONOMIC CLASS: Loamy-skeletal, mixed, superactive, frigid Lithic Calciustolls

TYPICAL PEDON: Rockerville channery silt loam, on a northeast facing, slightly convex slope of 20 percent, in a vegetative community consisting of an overstory of ponderosa pine and an understory of mixed grasses, forbs, and low shrubs, at an elevation of about 1,180 meters (3,871). (Colors are for dry soil unless otherwise noted.) When described on June 3, 2004 the soil was slightly moist throughout.

Oi--0 to 2 cm (0 to 0.8 inches); slightly decomposed forest litter consisting of ponderosa pine needles, cones, twigs, and detached roots. (0 to 4 cm [0 to 2 inches] thick)

A1--2 to 9 cm (0.8 to 4 inches); dark gray (10YR 4/1) channery silt loam, very dark gray (10YR 3/1) moist; weak medium and moderate very fine and fine granular structure; soft, very friable, slightly sticky and slightly plastic; many very fine, common fine, and few medium roots; about 20 percent subangular limestone fragments; slight effervescence; slightly alkaline; clear smooth boundary.

A2--9 to 18 cm (4 to 7 inches); dark gray (10YR 4/1) channery silt loam, very dark gray (10YR 3/1) moist; weak fine and medium subangular blocky structure parting to moderate very fine and fine granular; soft, very friable, slightly sticky and moderately plastic; common very fine and fine and few medium roots; about 25 percent subangular limestone fragments; about 7 percent calcium carbonate equivalent; strong effervescence; slightly alkaline; clear smooth boundary. (Combined thickness of the A horizon is 2 to 23 cm [0.8 to 9 inches])

ABk--18 to 37 cm (7 to 15 inches); dark grayish brown (10YR 4/2) extremely flaggy silt loam, very dark grayish brown (10YR 3/2) moist; moderate fine and very fine granular structure; soft, very friable, slightly sticky and moderately plastic; common very fine, few fine roots; about 85 percent limestone fragments, of which 60 percent are subangular flagstones and 25 percent are subangular channers; calcium carbonate disseminated throughout; thin continuous calcium carbonate coatings on the bottom of rock fragments; about 16 percent calcium carbonate equivalent; violent effervescence; slightly alkaline; clear smooth boundary. (0 to 20 cm [0 to 8 inches] thick)

R--37 to 200 cm (15 to 79 inches); very pale brown (10YR 7/3) to white (10YR 8/1) hard, fractured limestone bedrock; fractures are typically about 0.5 cm wide at the narrowest part; distance between fractures ranges from about 40 to more than 90 cm (16 to 35 inches).

TYPE LOCATION: Meade County, South Dakota; about 0.5 miles southwest of Tilford; located about 1,450 feet south and 2,250 feet east of the northwest corner of Sec. 19, T. 4 N., R. 6 E.; Tilford USGS quadrangle; 44 degrees 17 minutes 49 seconds north latitude and 103 degrees 26 minutes 35 seconds west longitude; NAD 83

RANGE IN CHARACTERISTICS:
Soil moisture: ustic moisture regime bordering on udic
Depth to calcic horizon: 12 to 35 cm (5 to 14 inches)
Thickness of the mollic epipedon: 18 to 38 cm (7 to 15 inches) and constitutes over one-third the thickness of the soil above bedrock

Particle-size control section (weighted average):
Clay content: 15 to 27 percent
Sand content: 10 to 20 percent fine sand and coarser
Rock fragments: 35 to 85 percent limestone rock fragments

A horizon:
Hue: 7.5YR or 10YR
Value: 3 to 5, 2 or 3 moist
Chroma: 1 to 3
Texture: L, SIL (fine-earth fraction)
Rock fragments: 5 to 35 percent angular and subangular limestone channers or subrounded gravel
Reaction: neutral or slightly alkaline

ABk horizon:
Hue: 7.5YR to 10YR
Value: 4 or 5, 3 or 4 moist
Chroma: 2 or 3
Texture: L, SIL (fine-earth fraction)
Rock fragments: 20 to 50 percent subangular channers or subrounded gravel; 0 to 50 percent subangular cobbles; 0 to 60 percent angular or subangular flagstones; fragments typically consist of hard limestone and/or calcareous sandstone
Calcium carbonate equivalent: 15 to 25 percent
Reaction: slightly alkaline

Bk and/or Ck horizon (when present):
Hue: 5YR to 10YR
Value: 5 to 7, 4 or 5 moist

Chroma: 2 to 4
Texture: Loam or silt loam (fine-earth fraction)
Clay content: 15 to 27 percent
Rock fragments: 20 to 50 percent subangular channers or subrounded gravel; 0 to 50 percent subangular cobbles; 0 to 60 percent angular or subangular flagstones; fragments typically consist of hard limestone and/or calcareous sandstone
Calcium carbonate equivalent: 15 to 25 percent
Reaction: slightly alkaline or moderately alkaline

R horizon:
Hue: 5YR to 2.5Y
Value: 6 to 8
Chroma: 1 to 4
Texture: Hard fractured limestone or calcareous sandstone; fractures typically contain fine-earth material in the upper 20 to 50 cm (8 to 20 inches); fine-earth material consists of less than 5 percent of the total volume of this horizon

COMPETING SERIES:
Tyzak and Tyzut - are at elevations above 2440 meters (8,005 feet) and have Typic-Ustic and Aridic-Ustic soil moisture regimes, respectfully.

GEOGRAPHIC SETTING:
Parent material: Typically residuum derived from limestone or, less commonly, calcareous sandstone
Landform: Bedrock-controlled dipslopes and ridges in mountains
Slopes: 2 to 60 percent
Elevation: 1,160 to 1,830 meters (3,806 to 6,004 feet)
Mean annual temperature: 5 to 7 degrees C (42 to 45 degrees F)
Mean annual precipitation: 430 to 660 mm (17 to 26 inches)
Precipitation pattern: In most years, half or more of the normal annual precipitation falls as rain and/or snow in the spring and early summer.
Frost-free period: 110 to 140 days.

GEOGRAPHICALLY ASSOCIATED SOILS:
Gurney and Pesowyo - are moderately deep and occur below Rockerville soils. Additionally the Gurney soils have an argillic horizon and are fine-loamy.
Hopdraw, Sawdust, and Vanocker - are deep or very deep and occur below the Rockerville soils. Additionally, Hopdraw soils are sandy-skeletal; Sawdust lack a mollic epipedon and a calcic horizon; and Vanocker soils have an argillic horizon.

DRAINAGE AND SATURATED HYDRAULIC CONDUCTIVITY: Well drained; saturated hydraulic conductivity is moderately high to high; runoff is slow to very rapid, depending on slope.

USE AND VEGETATION: Rockerville soils are used for livestock grazing and wildlife habitat. Vegetation consists of light to moderate stands of ponderosa pine, with an understory of little bluestem, sedge, bluegrass, bearberry, ground juniper, and snowberry. The site index for ponderosa pine is less than 50.

DISTRIBUTION AND EXTENT: Rockerville soils occur on the Low Limestone Plateau physiographic area of the Black Hills of South Dakota and Wyoming; LRR G, MLRA 62; the series is extensive.

MLRA SOIL SURVEY REGIONAL OFFICE (MO) RESPONSIBLE: Denver, Colorado

SERIES PROPOSED: Lawrence County, South Dakota.

REMARKS:
Diagnostic horizons and features recognized in this pedon are:
Particle-size control section: The zone from 18 to 37 cm (ABk horizon)
Mollic epipedon: The zone from 2 to 37 cm (0.8 to 15 inches) (A1, A2, ABk horizons)
Calcic horizon: The zone from 18 to 37 cm (7 to 15 inches) (ABk horizon)
Lithic contact: The contact with hard limestone bedrock at 37 cm (15 inches) (R horizon)

The assignment of the cation-exchange activity class is inferred from lab data from similar soils in the surrounding area.

The Rockerville series is established to replace the Paunsaugunt series previously correlated in the Black Hills, MLRA 62

Taxonomic Version: Keys to Soil Taxonomy, Eleventh Edition, 2010

ADDITIONAL DATA:

National Cooperative Soil Survey
U.S.A.

Official Series Description - SAWDUST Series

LOCATION SAWDUST SD

Established Series
Rev. LDZ-EHE-KEC
11/98

SAWDUST SERIES

The Sawdust series consists of very deep, well drained soils formed in residuum and colluvial sediments from calcareous sandstone and limestone on mountain slopes. Permeability is moderate. Slopes range from 6 to 80 percent. Mean annual precipitation is about 18 inches, and mean annual air temperature is about 40 degrees F.

TAXONOMIC CLASS: Loamy-skeletal, mixed, superactive, calcareous, frigid Typic Ustorthents

TYPICAL PEDON: Sawdust channery loam - on a south-facing slope of 34 percent under sparse pine and native grass at 5460 feet elevation. When described, the soil was dry throughout. (Colors are for dry soil unless otherwise noted).

A--0 to 4 inches; dark grayish brown (10YR 4/2) channery loam, very dark brown (10YR 2/2) moist; weak fine granular structure; soft, very friable; 30 percent coarse fragments; strong effervescence; slightly alkaline; gradual wavy boundary. (2 to 10 inches thick)

AC--4 to 8 inches; pale brown (10YR 6/3) very channery loam, brown (10YR 4/3) moist; weak medium subangular blocky structure; soft, friable; 50 percent coarse fragments; strong effervescence; moderately alkaline; gradual wavy boundary. (0 to 8 inches thick)

C1--8 to 15 inches; light yellowish brown (10YR 6/4) very channery loam, dark yellowish brown (10YR 4/4) moist; massive; soft, friable; 60 percent coarse fragments; many partially weathered limestone pebbles; strong effervescence; moderately alkaline; gradual wavy boundary.

C2--15 to 26 inches; very pale brown (10YR 7/4) extremely channery loam, light yellowish brown (10YR 6/4) moist; massive; soft, friable; 70 percent coarse fragments; strong effervescence; moderately alkaline; gradual wavy boundary.

C3--26 to 60 inches; yellow (10YR 7/6) extremely channery sandy loam, brownish yellow (10YR 6/6) moist; massive; soft, friable; 85 percent coarse fragments; strong effervescence; moderately alkaline.

TYPE LOCATION: Custer County, South Dakota; about 9 miles west and 5 miles south of Custer; 2600 feet north and 1900 feet east of southwest corner sec. 20, T. 4 S., R. 3 E.

RANGE IN CHARACTERISTICS: The Sawdust soils typically have carbonates to the surface but some pedons are leached to a depth of 4 inches. The depth to bedrock is more than 40 inches. Rock fragments which are dominantly pebbles and channers range from 5 to 45 percent by volume in the upper 10 inches.
They range from 35 to 90 percent by volume in the control section and are dominantly channers and flagstones. Some pedons have a thin O horizon.

The A horizon has 7.5YR or 10YR hue, value of 3 to 6 dry and 2 to 4 moist, and chroma of 1 to 3. It typically is gravelly loam, gravelly silt loam or channery loam, but is loam or silt loam, channery silt loam, very channery loam, very gravelly loam or very gravelly silt loam in some pedons. It is neutral or slightly alkaline.
When the A horizon is thicker than 6 inches, the lower part has value of 5 or 6 dry and 4 moist.

The AC horizon has 5 YR, 7.5YR, or 10YR hue; value of 5 to 7 dry and 4 or 5 moist; and chroma of 2 to 5. It is loam or silt loam and contains up to 50 percent coarse fragments of rock. It is slightly or moderately alkaline.

The C horizon has 2.5YR through 10YR hue, value of 5 to 8 dry and 4 to 7 moist, and chroma of 3 to 6. It is sandy loam, silt loam, silty clay loam, loam or clay loam and contains 35 to 90 percent coarse fragments. It is slightly or moderately alkaline.

COMPETING SERIES: These are the Pathead series that have bedrock at depths of 20 to 40 inches.

GEOGRAPHIC SETTING: The Sawdust soils are on moderately sloping to very steep mountain side slopes at elevations of 3600 to 6200 feet. Slope gradients range from 6 to 80 percent. These soils formed in colluvial or residuum weathered from calcareous limestone or sandstone. Mean annual temperature ranges from 37 to 45 degrees F. Mean annual precipitation ranges from 18 to 26 inches.

GEOGRAPHICALLY ASSOCIATED SOILS: These are the Gurney, Hopdraw, Paunsaugunt and Vanocker soils. The Gurney soils have bedrock at depths between 20 and 40 inches and have an argillic horizon and are in open areas. The Hopdraw soils contain more sand and are on similar landscapes. The Paunsaugunt soils are shallow to bedrock and are on higher convex areas in the landscape. The Vanocker soils have an argillic horizon and are on similar landscapes with a more dense cover of trees.

DRAINAGE AND PERMEABILITY: Well drained. Permeability is moderate. Runoff is medium or high.

USE AND VEGETATION: Used mainly for grazing, timber production, wildlife and recreation. Native vegetation is sparse stand of ponderosa pine with an understory of little bluestem, big bluestem, needlegrass, sideoats grama, junegrass, western wheatgrass, stiff sunflower, prairie clover, juniper, snowberry, rose and sedges.

DISTRIBUTION AND EXTENT: Mountainous areas of the Black Hills in South Dakota and Wyoming especially on the sedimentary formations. The series is of moderate extent.

MLRA SOIL SURVEY REGIONAL OFFICE (MO) RESPONSIBLE: Denver, Colorado

SERIES ESTABLISHED: Custer County, South Dakota, 1985.

National Cooperative Soil Survey
U.S.A.

Official Series Description - VANOCKER Series

LOCATION VANOCKER SD+WY

Established Series
Rev. TJO-KEC-JWW
06/2011

VANOCKER SERIES

The Vanocker series consists of deep to very deep, well drained soils formed in residuum and colluvium from sedimentary rocks. Vanocker soils are on gently sloping to very steep ridges and hillslopes in mountains. They have moderately low and moderately high saturated hydraulic conductivity. Slopes range from 2 to 80 percent. The mean annual precipitation is about 585 mm (23 inches) and the mean annual temperature is about 6 degrees C (43 degrees F).

TAXONOMIC CLASS: Loamy-skeletal, mixed, superactive, frigid Inceptic Hapludalfs

TYPICAL PEDON: Vanocker gravelly silt loam, on a west-facing, linear slope of 38 percent under ponderosa pine forest at an elevation of 1,432 meters. When described on June 1, 1976 the soil was dry throughout. (Colors are for moist soil unless otherwise noted).

0e--0 to 2.5 cm (0 to 1 inches); forest litter and partially decomposed forest litter consisting of mixed coniferous and deciduous residue. (1 to 6 cm [0.4 to 3 inches] thick)

A--2.5 to 7.5 cm (1 to 3 inches); black (10YR 2/1) and very dark grayish brown (10YR 3/2) gravelly silt loam, very dark grayish brown (10YR 3/2) and dark grayish brown (10YR 4/2) dry; weak very fine granular structure; soft, very friable, slightly sticky and slightly plastic; many fine, medium, and coarse roots; 30 percent by volume subangular limestone gravel; neutral; abrupt wavy boundary. (0 to 8 cm [0 to 3 inches] thick)

Bt--7.5 to 18 cm (3 to 7 inches); brown (10YR 4/3) very gravelly silty clay loam, brown (10YR 5/3) dry; moderate fine subangular blocky structure; slightly hard, friable, moderately sticky and moderately plastic; many fine, medium and coarse roots; many faint continuous clay films on faces of peds; 40 percent by volume subangular limestone gravel; disseminated calcium carbonate throughout; very slight effervescence; slightly alkaline; clear wavy boundary. (7 to 25 cm [3 to 10 inches] thick)

Btk--18 to 40 cm (7 to 16 inches); brown (10YR 4/3) very gravelly clay loam, brown (10YR 5/3) dry; moderate ffine and medium subangular blocky structure; slightly hard, friable, slightly sticky and slightly plastic; common fine, medium, and coarse roots; 55 percent by volume subangular limestone gravel; common medium and coarse accumulations of calcium carbonate throughout and on the bottom of rock fragments; slight effervescence; slightly alkaline; clear wavy boundary. (0 to 38 cm [0 to 15 inches] thick)

Bk1--40 to 104 cm (16 to 41 inches); brown (10YR 5/3) very gravelly loam, light gray (10YR 7/2) dry; weak fine and medium subangular blocky structure; slightly hard, friable, slightly sticky and slightly plastic; few medium and coarse roots; 55 percent by volume subangular limestone gravel; few (3 percent) fine threads of calcium carbonate in soil matrix and medium and coarse calcium carbonate coatings on the bottom of rock fragments; strong effervescence; moderately alkaline; gradual wavy boundary. (10 to 76 cm [4 to 30 inches] thick)

Bk2--104 to 152 cm (41 to 60 inches); brown (10YR 4/3) extremely gravelly silt loam, brown (10YR 5/3) dry; weak fine and medium subangular blocky structure; slightly hard, friable, slightly sticky and nonplastic; few medium and coarse roots; 65 percent by volume subangular limestone gravel; few (3 percent) fine threads of calcium carbonate in matrix and continuous calcium carbonate coatings on faces of peds; violent effervescence; moderately alkaline.

TYPE LOCATION: Meade County, South Dakota; about 4 miles south and 2 miles west of Sturgis; about 1,500 feet east and 100 feet south of the northwest corner of Sec. 5, T. 4 N., R. 5 E.; Deadman Mountain USGS quadrangle; 44 degrees 20 minutes 37 seconds north latitude, and 103 degrees 32 minutes 49 seconds west longitude; NAD 83.

RANGE IN CHARACTERISTICS:
Soil moisture: Typic-udic soil moisture regime.
Depth to secondary calcium carbonate: 10 to 38 cm (4 to 15 inches)

Particle-size control section (weighted average):
Clay content: 18 to 35 percent
Sand content: typically 5 to 15 percent fine and coarser sand; ranges to 35 percent in some pedons

A horizon:
Hue: 7.5YR or 10YR
Value: 3 to 6, 2 to 4 moist
Chroma: 2 or 3
Texture: L, SIL, FSL, VFSL (fine-earth fraction)
Clay content: 8 to 27 percent
Rock fragments: 5 to 35 percent total volume of non-flat subangular or subrounded gravel, or flat subangular or subrounded channers, and 0 to 5 percent cobble
Reaction: moderately acid to neutral

An E horizon is present in place of the A in a few pedons; it has properties similar to the A except that moist and dry colors are one value lighter.

Bt horizon:
Hue: 2.5YR, 5YR, 7.5YR, 10YR, or 2.5Y
Value: 5 to 7, 4 to 6 moist
Chroma: 2 to 4
Texture: CL, SICL, SCL (fine-earth fraction)

Clay content: 25 to 35 percent
Rock fragments: 30 to 45 percent total volume of non-flat subangular or subrounded gravel or flat, subangular or subrounded channers, and 0 to 15 percent cobble
Calcium carbonate equivalent: 0 to 10 percent
Reaction: moderately acid to slightly alkaline

Btk horizon:
Hue: 2.5YR, 5YR, 7.5YR, 10YR, or 2.5Y
Value: 5 to 7, 4 to 6 moist
Chroma: 2 to 6
Texture: L, SIL, CL, SICL, SCL (fine-earth fraction)
Clay content: 20 to 35 percent
Rock fragments: 30 to 45 percent total volume of non-flat subangular or subrounded gravel or flat ,subangular or subrounded channers, and 0 to 15 percent cobble
Calcium carbonate equivalent: 10 to 20 percent
Reaction: slightly alkaline

Bk horizon:
Hue: 2.5YR, 5YR, 7.5YR, 10YR, or 2.5Y
Value: 5 to 8, 4 to 7 moist
Chroma: 2 to 6
Texture: L, CL, SIL, SICL, SL, FSL, SCL (fine-earth fraction)
Clay content: 15 to 35 percent
Rock fragments: 20 to 55 percent total volume of non-flat subangular or subrounded gravel, or flat subangular or subrounded channers, 5 to 30 percent cobble, and/or 0 to 20 percent flagstones
Calcium carbonate equivalent: 15 to 40 percent
Reaction: slightly alkaline or moderately alkaline

Some pedons contain a C horizon

COMPETING SERIES:
Marquette - have fine-earth textures of fine sandy loam or coarser throughout; additionally they formed in glacial outwash

GEOGRAPHIC SETTING:
Parent material: colluvium and/or residuum derived primarily from limestone and/or calcareous sandstone
Landform: ridges, ridge shoulders, and hillslopes of mountains
Slopes: 2 to 80 percent
Elevation: 1,095 to 1,890 meters (3,583 to 6,200 feet)
Mean annual temperature: 4 to 7 degrees C (39 to 45 degrees F)
Mean annual precipitation: 510 to 760 mm (20 to 30 inches)
Precipitation pattern: over one-half the mean annual precipitation falls as snow and rain during the period
March through July
Frost-free season: 60 to 110 days

GEOGRAPHICALLY ASSOCIATED SOILS: These are the Citadel, Hopdraw, Rockerville(T), Sawdust, and Tollflat (T) soils.
Citadel and Tollflat (T) - are fine-textured; they generally occur below Vanocker soils on the landscape
Hopdraw - are sandy-skeletal and lack argillic horizons; they occur on similar landscape positions as Vanocker soils
Rockerville(T) - are shallow to a lithic contact; they generally occur above Vanocker soils on the landscape
Sawdust - lack argillic horizons; on similar landscape positions as Vanocker

DRAINAGE AND SATURATED HYDRAULIC CONDUCTIVITY: Well drained; medium to very high runoff, depending on slope; moderately low to moderately high hydraulic conductivity.

USE AND VEGETATION: Used for timber production, recreation and wildlife habitat, and for grazing. Native vegetation is dominantly ponderosa pine with lesser amounts of aspen, birch, and bur oak. Understory species include Kentucky bluegrass, needlegrass, timber oatgrass, roughleaf ricegrass, and little bluestem. Shrubs include bearberry, oregon-grape, common juniper, buffaloberry, and snowberry.

DISTRIBUTION AND EXTENT: Low Limestone Plateau physiographic area of the Black Hills in western South Dakota and northeastern Wyoming; LRR G, MLRA 62. The series is extensive.

MLRA SOIL SURVEY REGIONAL OFFICE (MO) RESPONSIBLE: Denver, Colorado

SERIES ESTABLISHED: Meade County, South Dakota, Southern Part, 1974.

REMARKS: Diagnostic horizons and features recognized in this pedon are:
Ochric epipedon - 2.5 to 7.5 cm (1 to 3 inches) (A horizon)
Argillic horizon - 7.5 to 40 cm (3 to 16 inches) (Bt and Btk horizons)

The classification of the series was revised from Typic Eutroboralfs to Inceptic Hapludalfs due to changes in Soil Taxonomy (02/1999).

Taxonomic Version: Keys to Soil Taxonomy, Eleventh Ed., 2006

ADDITIONAL DATA:

National Cooperative Soil Survey
U.S.A.

Addendum 2
Figures

Addendum 2-1. Figure 2-1. Loring Quarry Soil Map Units and Sample Locations

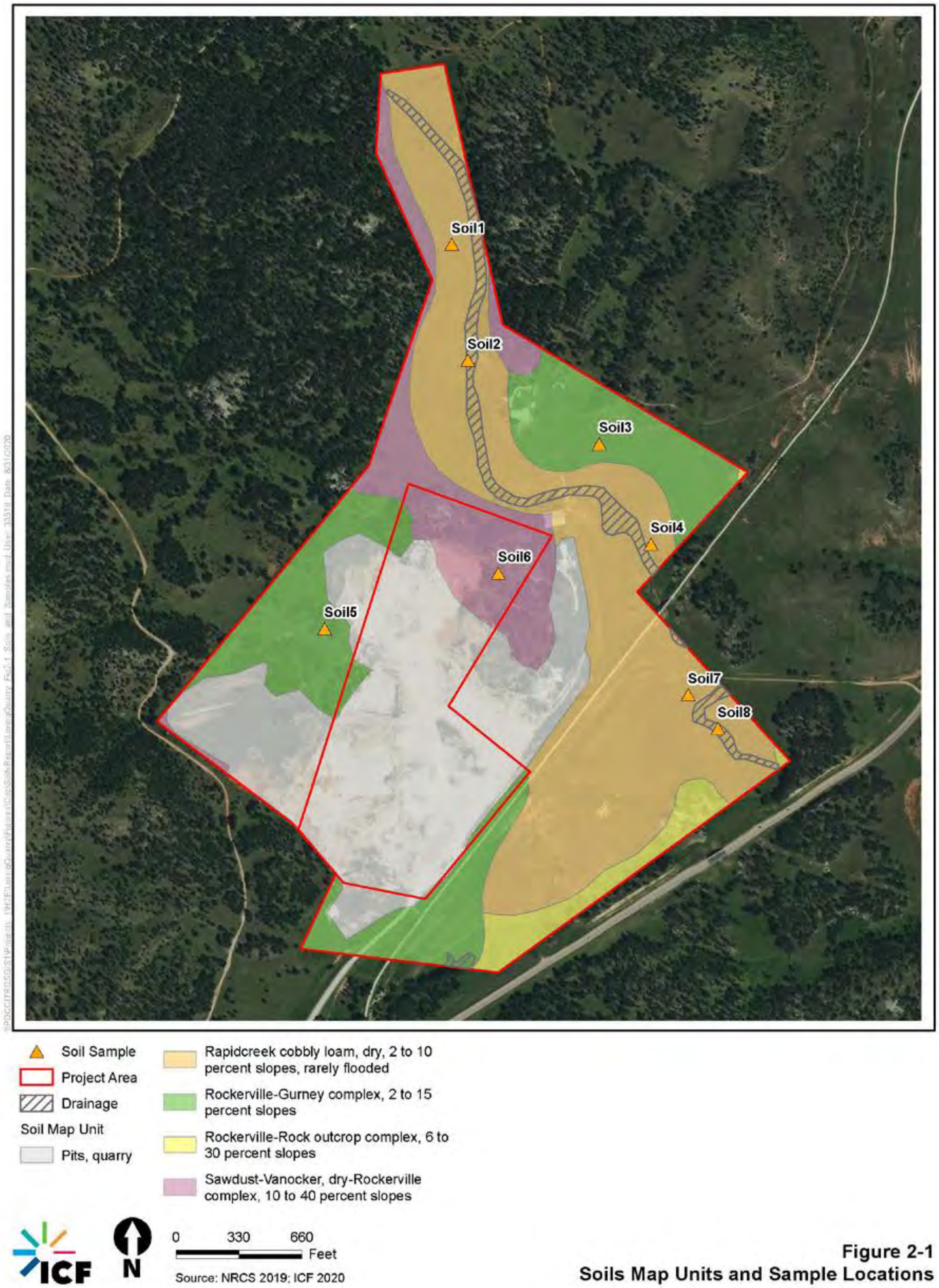

Figure 2-1
Soils Map Units and Sample Locations

Addendum 2-2. Figure 2-1. Loring Quarry Ecological Sites and Soil Sample Locations

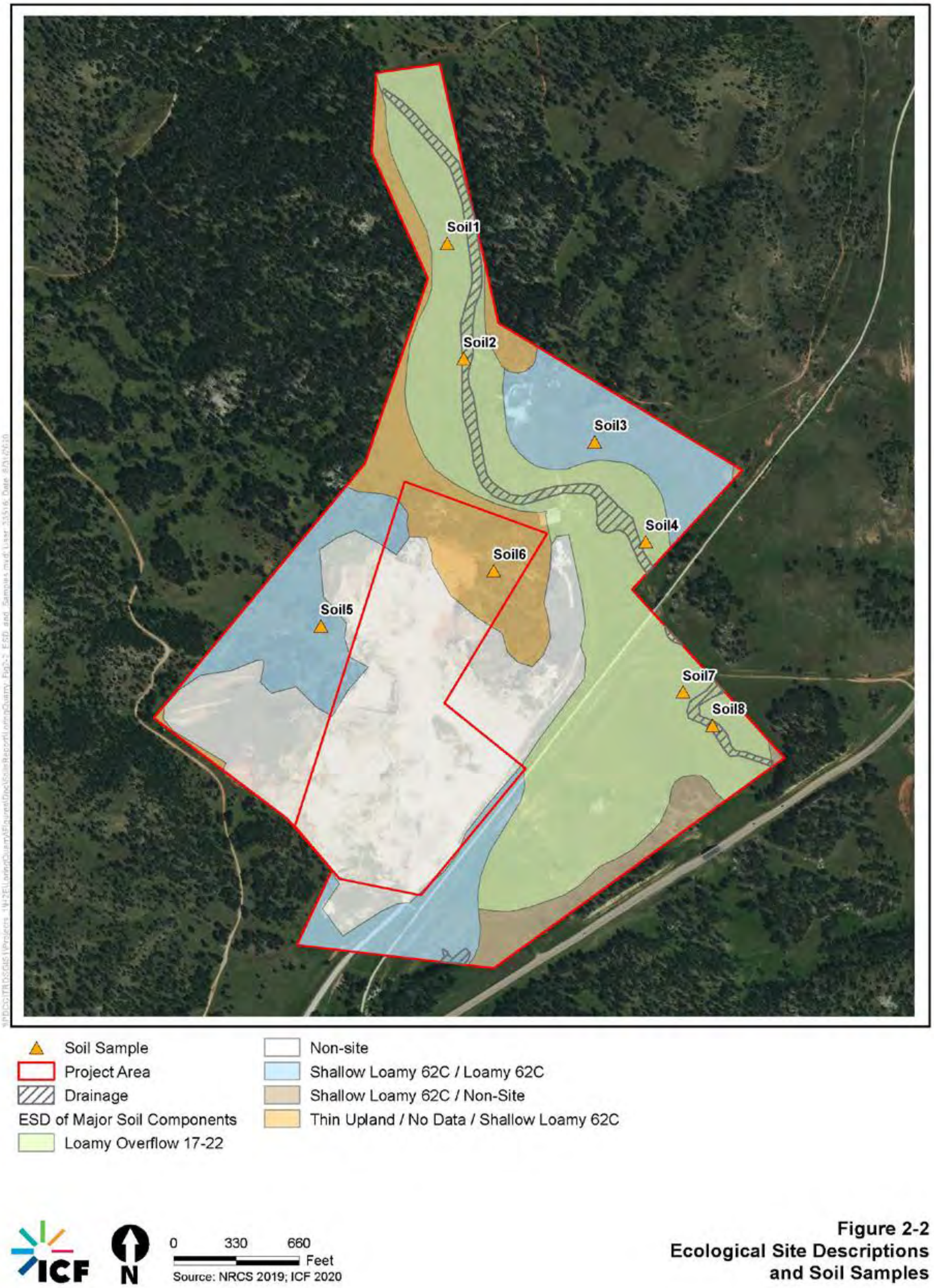

Figure 2-2
Ecological Site Descriptions
and Soil Samples

Addendum 3
Photos

Addendum 3-1. Loring Quarry Soil Sample Pedon Photos

Photo 1. Soil1; Date: 6/29/20; Colombo series; Described to 60 inches

Photo 2. Soil2; Date: 6/29/20; Rapidcreek series; Described to 20 inches

Photo 3. Soil3; Date: 6/29/20; Gurney series; Described to 48 inches

Photo 4. Soil4; Date: 6/29/20; Barnum series; Described to 4 inches

Photo 5. Soil5; Date: 6/29/20; Rockerville series; Described to 38 inches

Photo 6. Soil6; Date: 6/30/20; Vanocker, dry series; Described to 13 inches

Photo 7. Soil7; Date: 6/30/20; Colombo series; Described to 62 inches

Photo 8. Soil8; Date: 6/30/20; Rapidcreek series; Described to 24 inches

Addendum 4
Laboratory Analysis

Addendum 4-2. Loring Quarry Laboratory Analysis

PaceAnalytical® Formerly Inter-Mountain Laboratories

1673 Terra Avenue Sheridan, WY 82801 ph: (307) 672-8945

Date: 7/31/2020

CLIENT: H2E, Inc.
Project: Loring Quarry
Lab Order: S2007178

CASE NARRATIVE

Report ID: S2007178001

Samples Soil #1, Soil #2, Soil #3, Soil #4, Soil #5, Soil #6, Soil #7 and Soil #8 were received on July 1, 2020.

Samples were analyzed using the methods outlined in the following references:

U.S.E.P.A. 600/2-78-054 "Field and Laboratory Methods Applicable to Overburden and Mining Soils", 1978
American Society of Agronomy, Number 9, Part 2, 1982
USDA Handbook 60 "Diagnosis and Improvement of Saline and Alkali Soils", 1969
Wyoming Department of Environmental Quality, Land Quality Division, Guideline No. 1, 1984
New Mexico Overburden and Soils Inventory and Handling Guideline, March 1987
State of Utah, Division of Oil, Gas, and Mining: Guidelines for Management of Topsoil and Overburden for Underground and Surface Coal Mining, April 1988
Montana Department of State Lands, Reclamation Division: Soil, Overburden, and Regraded Spoil Guidelines, December 1994
State of Nevada Modified Sobek Procedure
Test Methods for Evaluating Solid Waste, Physical/Chemical Methods, SW846, 3rd Edition

All Quality Control parameters met the acceptance criteria defined by EPA and Pace Analytical (Formerly Inter-Mountain Laboratories) except as indicated in this case narrative.

Qualifiers by sample

S2007178-018 - Saturated Paste Cations by EPA 200.7/Magnesium - RPD outside accepted recovery limits

Reviewed by: Crystal Herman

Crystal Herman, Soil Analyst

Page 1 of 1

Pace Analytical Formerly Inter-Mountain Laboratories
1673 Terra Avenue Sheridan, WY 82801 ph: (307) 672-8945

Soil Analysis Report

H2E, Inc.
405 West Boxelder Road, Suite A5
Gillette, WY 82718

Report ID: S2007178001

Project: Loring Quarry
Date Received: 7/1/2020

Date Reported: 7/31/2020
Work Order: S2007178

Lab ID	Sample ID	Depths Inches	pH s.u.	Saturation %	Electrical Conductivity dS/m	Organic Matter %	CaCO3 %	Calcium PE meq/L	Magnesium PE meq/L	Sodium PE meq/L	SAR
S2007178-001	Soil #1	0-4	6.3	71.7	0.80	6.3	0.7	4.42	1.33	0.22	0.13
S2007178-002	Soil #1	4-18	7.1	52.5	0.87	3.4	13.1	5.50	1.29	0.18	0.10
S2007178-003	Soil #1	18-26	7.7	45.9	0.50	2.2	14.1	2.13	1.82	0.40	0.28
S2007178-004	Soil #1	26-42	7.9	48.1	1.04	1.7	14.9	2.31	4.16	1.88	1.04
S2007178-005	Soil #1	42-60	7.9	42.2	2.78	1.3	7.5	2.98	6.19	13.4	6.26
S2007178-006	Soil #2	0-8	6.6	81.2	1.65	8.6	1.5	8.81	2.23	0.27	0.12
S2007178-007	Soil #2	8-16	7.1	60.0	2.41	4.4	10.3	14.6	2.59	0.45	0.15
S2007178-008	Soil #3	0-6	7.1	54.4	1.41	5.1	7.5	9.55	1.15	0.10	<0.05
S2007178-009	Soil #3	6-12	7.1	46.3	1.55	3.8	16.2	10.0	1.25	0.21	0.09
S2007178-010	Soil #3	12-18	7.5	31.3	0.78	1.6	37.2	4.80	1.00	0.23	0.13
S2007178-011	Soil #3	18-26	7.6	30.7	1.06	1.1	26.6	4.62	1.63	0.31	0.17
S2007178-012	Soil #3	26-35	7.8	43.7	0.85	1.6	8.7	2.37	2.49	1.40	0.90
S2007178-013	Soil #3	35-40	8.1	50.8	0.67	2.4	9.0	1.08	1.43	2.82	2.52
S2007178-014	Soil #3	40-46	8.2	46.3	0.67	1.6	12.0	0.77	1.16	3.78	3.84
S2007178-015	Soil #4	0-4	7.2	68.2	1.03	7.8	16.6	7.07	0.78	0.13	0.06
S2007178-016	Soil #5	0-3	7.1	72.2	1.68	8.3	21.6	12.1	0.75	0.19	0.07
S2007178-017	Soil #5	3-8	7.1	65.3	1.05	5.8	23.2	7.75	0.52	0.12	0.06
S2007178-018	Soil #5	8-14	7.1	60.4	1.37	4.7	38.4	9.41	0.53	0.17	0.08
S2007178-019	Soil #6	0-4	7.1	56.9	1.32	5.8	24.3	10.4	0.59	0.18	0.08
S2007178-020	Soil #7	0-4	7.3	63.5	1.08	5.9	5.6	7.10	0.99	0.11	0.05

These results apply only to the samples tested.

Abbreviations for extractants: PE= Saturated Paste Extract, H20Sol= water soluble,AB-DTPA= Ammonium Bicarbonate-DTPA, AAO= Acid Ammonium Oxalate
Abbreviations used in acid base accounting: T.S.= Total Sulfur, AB= Acid Base, ABP= Acid Base Potential, PyrS= Pyritic Sulfur, Pyr+Org= Pyritic Sulfur + Organic Sulfur, Neutral. Pot.= Neutralization Potential
Miscellaneous Abbreviations: SAR= Sodium Adsorption Ratio, CEC= Cation Exchange Capacity, ESP= Exchangeable Sodium Percentage, TOC=Total Organic Carbon

Reviewed by: Crystal Herman
Crystal Herman, Soil Analyst

Page 1 of 4

Pace Analytical Formerly Inter-Mountain Laboratories
1673 Terra Avenue Sheridan, WY 82801 ph: (307) 672-8945

Soil Analysis Report
H2E, Inc.
405 West Boxelder Road, Suite A5
Gillette, WY 82718

Report ID: S2007178001

Project: Loring Quarry
Date Received: 7/1/2020

Date Reported: 7/31/2020
Work Order: S2007178

Lab ID	Sample ID	Depths Inches	Sand %	Silt %	Clay %	Texture
S2007178-001	Soil #1	0-4	35.0	49.0	16.0	Loam
S2007178-002	Soil #1	4-18	29.0	47.0	24.0	Loam
S2007178-003	Soil #1	18-26	22.0	52.0	26.0	Silty Loam
S2007178-004	Soil #1	26-42	29.0	49.0	22.0	Loam
S2007178-005	Soil #1	42-60	24.0	57.0	19.0	Silty Loam
S2007178-006	Soil #2	0-8	28.0	47.0	25.0	Loam
S2007178-007	Soil #2	8-16	40.0	38.0	22.0	Loam
S2007178-008	Soil #3	0-6	41.0	41.0	18.0	Loam
S2007178-009	Soil #3	6-12	41.0	37.0	22.0	Loam
S2007178-010	Soil #3	12-18	62.0	22.0	16.0	Sandy Loam
S2007178-011	Soil #3	18-26	56.0	30.0	14.0	Sandy Loam
S2007178-012	Soil #3	26-35	29.0	47.0	24.0	Loam
S2007178-013	Soil #3	35-40	22.0	48.0	30.0	Clay Loam
S2007178-014	Soil #3	40-46	33.0	41.0	26.0	Loam
S2007178-015	Soil #4	0-4	25.0	51.0	24.0	Silty Loam
S2007178-016	Soil #5	0-3	42.0	36.0	22.0	Loam
S2007178-017	Soil #5	3-8	31.0	39.0	30.0	Clay Loam
S2007178-018	Soil #5	8-14	18.0	51.0	31.0	Silty Clay Loam
S2007178-019	Soil #6	0-4	42.0	38.0	20.0	Loam
S2007178-020	Soil #7	0-4	35.0	49.0	16.0	Loam

These results apply only to the samples tested.

Abbreviations for extractants: PE= Saturated Paste Extract, H20Sol= water soluble,AB-DTPA= Ammonium Bicarbonate-DTPA, AAO= Acid Ammonium Oxalate
Abbreviations used in acid base accounting: T.S.= Total Sulfur, AB= Acid Base, ABP= Acid Base Potential, PyrS= Pyritic Sulfur, Pyr+Org= Pyritic Sulfur + Organic Sulfur, Neutral. Pot.= Neutralization Potential
Miscellaneous Abbreviations: SAR= Sodium Adsorption Ratio, CEC= Cation Exchange Capacity, ESP= Exchangeable Sodium Percentage, TOC=Total Organic Carbon

Reviewed by: Crystal Herman
Crystal Herman, Soil Analyst

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1673 Terra Avenue Sheridan, WY 82801 ph: (307) 672-8945

Soil Analysis Report

H2E, Inc.
405 West Boxelder Road, Suite A5
Gillette, WY 82718

Report ID: S2007178001

Project: Loring Quarry
Date Received: 7/1/2020

Date Reported: 7/31/2020
Work Order: S2007178

Lab ID	Sample ID	Depths Inches	pH s.u.	Saturation %	Electrical Conductivity dS/m	Organic Matter %	CaCO3 %	Calcium PE meq/L	Magnesium PE meq/L	Sodium PE meq/L	SAR
S2007178-021	Soil #7	4-10	7.2	55.8	1.05	3.7	5.5	6.54	1.11	0.20	0.10
S2007178-022	Soil #7	10-18	7.4	51.1	1.56	3.0	17.4	8.29	2.93	0.37	0.16
S2007178-023	Soil #7	18-50	7.9	41.7	0.73	1.8	21.8	2.45	2.64	0.59	0.37
S2007178-024	Soil #7	50-62	8.7	58.0	2.84	1.9	9.6	1.01	4.78	15.3	8.99
S2007178-025	Soil #8	0-3	7.1	75.6	1.22	7.8	11.6	8.28	1.00	0.28	0.13
S2007178-026	Soil #8	3-12	7.2	46.9	1.24	3.4	23.4	7.97	0.91	0.18	0.09
S2007178-027	Soil #8	12-20	7.5	43.2	0.76	3.1	23.7	4.81	0.74	0.18	0.11
S2007178-028	Soil #8	20-24	7.6	40.5	0.72	2.3	23.3	4.51	0.65	<0.05	<0.05

These results apply only to the samples tested.

Abbreviations for extractants: PE= Saturated Paste Extract, H20Sol= water soluble,AB-DTPA= Ammonium Bicarbonate-DTPA, AAO= Acid Ammonium Oxalate
Abbreviations used in acid base accounting: T.S.= Total Sulfur, AB= Acid Base, ABP= Acid Base Potential, PyrS= Pyritic Sulfur, Pyr+Org= Pyritic Sulfur + Organic Sulfur, Neutral. Pot.= Neutralization Potential
Miscellaneous Abbreviations: SAR= Sodium Adsorption Ratio, CEC= Cation Exchange Capacity, ESP= Exchangeable Sodium Percentage, TOC=Total Organic Carbon

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Lab ID	Sample ID	Depths Inches	Sand %	Silt %	Clay %	Texture
S2007178-021	Soil #7	4-10	32.0	48.0	20.0	Loam
S2007178-022	Soil #7	10-18	35.0	45.0	20.0	Loam
S2007178-023	Soil #7	18-50	40.0	40.0	20.0	Loam
S2007178-024	Soil #7	50-62	24.0	52.0	24.0	Silty Loam
S2007178-025	Soil #8	0-3	36.0	47.0	17.0	Loam
S2007178-026	Soil #8	3-12	53.0	31.0	16.0	Sandy Loam
S2007178-027	Soil #8	12-20	52.0	34.0	14.0	Sandy Loam
S2007178-028	Soil #8	20-24	52.0	34.0	14.0	Sandy Loam

These results apply only to the samples tested.

Abbreviations for extractants: PE= Saturated Paste Extract, H20Sol= water soluble,AB-DTPA= Ammonium Bicarbonate-DTPA, AAO= Acid Ammonium Oxalate
Abbreviations used in acid base accounting: T.S.= Total Sulfur, AB= Acid Base, ABP= Acid Base Potential, PyrS= Pyritic Sulfur, Pyr+Org= Pyritic Sulfur + Organic Sulfur, Neutral. Pot.= Neutralization Potential
Miscellaneous Abbreviations: SAR= Sodium Adsorption Ratio, CEC= Cation Exchange Capacity, ESP= Exchangeable Sodium Percentage, TOC=Total Organic Carbon

Reviewed by: Crystal Herman
Crystal Herman, Soil Analyst

Page 4 of 4

Addendum 5
Raw Soil Survey Data

Addendum 5-3. Loring Quarry Raw Soils Data

Site	Plot	Pit Label	Total Soil I	Pit Notes
LQ	Lowland	Soil2	20	Color dark brown; 0-2 inch organic layer.
LQ	Lowland	Soil4	6	Soil color brown. Rock at bottom of profile. Initial sample was moved due to rocks.
LQ	Lowland	Soil8	24	Soil color brown. Rock at 24", prevented further digging.
LQ	Upland	Soil1	60	Area used for pasture, possibly tilled.
LQ	Upland	Soil3	48	Upland area, grazing
LQ	Upland	Soil7	62	Hay meadow; likely cultivated. Color
LQ	Woodland	Soil5	38	Soil color red; red/white at bottom of pedon.
LQ	Woodland	Soil6	13	Soil color brown/red. Rock prevented further digging.

Site	Plot	Pit Label	Upper Depth	Lower Depth	Horizon	Color	Texture	Frag Type 1	Frag Vol 1	Frag Type 2	Frag Vol 2	Total Rock Fragments (vol)	Effervescence	Struct
LQ	Lowland	Soil2	0	2	A	Dry	C					0	NE	GR
LQ	Lowland	Soil2	2	8	A	Dry	C					0	NE	GR
LQ	Lowland	Soil2	8	16	BC	Dry	C	Gravel	10			10	SL	GR
LQ	Lowland	Soil2	16	20	C	Dry	C	Gravel	70			70	ST	GR
LQ	Lowland	Soil4	0	4	A	Dry	SIC					0	SL	GR
LQ	Lowland	Soil4	4	6	CA	Dry	SIC	Gravel	60			60	VE	GR
LQ	Lowland	Soil8	0	3	A	Dry	SIL					0	NE	ABK
LQ	Lowland	Soil8	3	12	A	Dry	SL					0	SL	GR
LQ	Lowland	Soil8	12	20	B/C	Dry	SC	Gravel	20			20	ST	GR
LQ	Lowland	Soil8	20	24	B/C	Dry	SC	Gravel	20			20	SL	GR
LQ	Upland	Soil1	0	4	A	Dry	C					0	NE	GR
LQ	Upland	Soil1	4	18	B	Dry	SIC					0	VE	ABK
LQ	Upland	Soil1	18	26	B	Dry	SIC					0	VE	ABK
LQ	Upland	Soil1	26	42	B	Dry	SIC					0	ST	ABK
LQ	Upland	Soil1	42	60	B	Dry	C					0	ST	GR
LQ	Upland	Soil3	0	1	O	Dry	SIC					0	NE	ABK
LQ	Upland	Soil3	1	6	A	Dry	SIC					0	NE	GR
LQ	Upland	Soil3	6	12	B	Dry	SIC					0	VS	GR
LQ	Upland	Soil3	12	18	B/C	Dry	C	Gravel	25	Cobble	20	45	ST	GR
LQ	Upland	Soil3	18	26	B/C	Dry	SIC					0	VE	SBK
LQ	Upland	Soil3	26	35	B	Dry	SIC					0	ST	ABK
LQ	Upland	Soil3	35	40	B	Dry	C					0	SL	ABK
LQ	Upland	Soil3	40	46	BC	Dry	C	Gravel	10			10	ST	GR
LQ	Upland	Soil3	46	48	B/C	Dry	C	Cobble	40			40	ST	GR
LQ	Upland	Soil7	0	4	A	Dry	SICL					0	NE	GR
LQ	Upland	Soil7	4	10	B	Dry	SICL	Gravel	10			10	VS	GR
LQ	Upland	Soil7	10	18	B	Dry	C					0	VE	GR
LQ	Upland	Soil7	18	50	B	Dry	C					0	ST	GR
LQ	Upland	Soil7	50	62	B	Dry	C					0	SL	GR
LQ	Woodland	Soil5	0	3	A	Dry	C	None	0			0	SL	GR
LQ	Woodland	Soil5	3	8	AB	Dry	C	Gravel	10			10	ST	GR
LQ	Woodland	Soil5	8	14	C/B	Dry	C					0	VE	ABK
LQ	Woodland	Soil5	14	28	C	Dry	C					0	VE	ABK
LQ	Woodland	Soil5	28	38	C	Dry	C	Gravel	40			40	VE	GR
LQ	Woodland	Soil6	0	4	A	Dry	SIC	Gravel	2	Cobble	8	10	NE	GR
LQ	Woodland	Soil6	4	13	BC	Dry	SIC	Gravel	30	Cobble	10	40	VE	GR

Texture: C=clay, SIC=silty clay, SICL= silty clay loam, SC=sandy clay, SIL=silty loam, SL=sandy loam
Effervescence: NE=non, VS=very slightly, SL=slight, ST=strong, VS=violent
Structure: ABK=angular blocky, SBK=subangular blocky, GR=granular

Addendum 6
Resumes of Personnel

JEFFREY ABPLANALP

Wildlife Biologist

Jeff Abplanalp is a wildlife biologist with 10 years of experience. He specializes in providing terrestrial and aquatic wildlife and habitat mitigation consulting to the oil, natural gas, coal mining, wind farm, and uranium industries. He has extensive experience conducting ground based and aerial surveys for sage grouse, raptors, big game, and threatened and endangered species. He has contributed to several largescale oil and gas projects conducting pre-construction baseline wildlife and habitat inventory surveys. Jeff also has extensive experience in wildlife conflict, disease, and population management.

Years of Experience

- Professional start date: 05/2008
- ICF start date: 04/2013

Education

- BS, Wildlife and Fisheries Management and Biology, University of Wyoming, 2009

Professional Memberships

- Wildlife Society, 2007-2009
- American Fisheries Society, 2007-2009

Certifications/Other

- Site-Specific Hazard Training (Surface Coal, Metal, Non-metal, Mine Safety and Health Administration

Area of Expertise

- Terrestrial and aquatic wildlife and habitat baseline surveys

Project Experience

Oil and Natural Gas

Moneta Divide—Aethon Energy/Encana Oil and Gas and Burlington Resources, Fremont and Natrona Counties, WY, 04/2013 – 06/2013, 04/2014 – 06/2014

Field Biologist. Conduct ground based and aerial wildlife and habitat baseline inventory surveys for proposed natural gas project. Primary species surveyed include Greater sage-grouse, raptors, mountain plovers, big game, herptiles, and white-tailed prairie dog colonies.

Powder River Basin North—EOG Resources, Campbell and Johnson Counties, WY, 04/2019 – 06

Field Biologist. Conduct ground based and aerial wildlife and habitat surveys for proposed natural gas project. Primary species surveyed include greater sage-grouse, raptors, herptiles, and black-tailed prairie dog colonies.

Leavitt-Underwood—Devon Energy Corporation, Campbell County, WY, 04/2019 – Present

Field Biologist. Conduct ground-based wildlife surveys as part of plan of development. Primary species surveyed included raptors, mountain plovers, and black-tailed prairie dog colonies.

Cosner Fuller TLE—Devon Energy Corporation, Campbell County, WY, 04/2019 – Present

Field Biologist. Conduct ground-based wildlife surveys as part of plan of development. Primary species surveyed included raptors, mountain plovers, and black-tailed prairie dog colonies.

Mines and Quarries

Surface Coal Mine Wildlife Monitoring and Reporting—Navajo Transitional Energy Company, Antelope Mine, Campbell and Converse Counties, WY, 01/2020 – Present

Field Biologist. Conduct wildlife monitoring as part of mine and state DEQ monitoring and mitigation plan. Primary surveys conducted include golden eagle nest monitoring, bald eagle winter roost surveys, big game, lagomorph, and prairie dog colony surveys. Helped with drafting an avian mitigation plan and annual monitoring and conducted analysis of field data.

Surface Coal Mine Wildlife Monitoring and Reporting—Eagle Specialty Materials, Eagle Butte & Belle Ayr Mines, Campbell County, WY. 09/2020--Present

Field Biologist. Conduct wildlife monitoring as part of mine and state DEQ monitoring and mitigation plan. Primary surveys conducted include golden eagle nest monitoring, bald eagle winter roost surveys, big game, aquatic, lagomorph, and prairie dog colony surveys. Helped with drafting an avian mitigation plan and annual monitoring and conducted analysis of field data.

Willow Creek Uranium ISR Project Annual Wildlife Monitoring—Uranium One, Campbell and Johnson Counties, WY. 04/2019 – 06/2019

Field Biologist. Conduct wildlife monitoring as part of mine and state DEQ monitoring and mitigation plan. Primary surveys included Greater sage-grouse lek and raptor nest surveys. Helped with drafting annual monitoring and conducted analysis of field data.

Wind Energy Development

Maestro Wind Project—BayWa, Carbon County, WY. 08/2019-Present

Field Biologist. Conduct baseline wildlife surveys prior to wind farm development. Primary species surveyed included raptors, black-footed ferrets, and swift foxes.

Employment History

ICF. Wildlife Biologist. Gillette, WY. 04/2019 – Present.

Wyoming Game and Fish Department. Wildlife Damage Technician. Cody, WY. 05/2011 – 01/2019.

Big Horn Environmental Consultants. On-call Wildlife Biologist. Sheridan, WY. 04/2017 – 06/2017, 04/2018 – 06/2018.

Wyoming Game and Fish Department. Bird Farm Technician. Yoder, WY. 4/2015.

ICF. On-call Wildlife Biologist. Gillette, WY. 04/2013 – 06/2013, 04/2014 – 06/2014.

Wyoming Game and Fish Department. Aquatic Invasive Species Technician. Casper, WY. 5/2010 – 9/2010.

Wyoming Game and Fish Department. Fish Hatchery Technician. Boulder, WY. 05/2009 – 08/2009.

University of Wyoming. Fisheries Technician. Laramie, WY. 05/2008 – 10/2008.

KATIE WILSON

Project Role: Senior Biologist

Katie Wilson is a senior biologist specializing in wetland and vegetation assessments. She performs natural resource-based fieldwork to include field sampling, map review, global positioning systems (GPS) data collection, and technical report completion. Her fieldwork experience includes baseline vegetation, soil and wetland assessments, threatened and endangered (vegetation) surveys and habitat assessments, reclamation monitoring, and wetland delineations. Katie is responsible for data analysis and report writing for all aspects of fieldwork. She works extensively with different stakeholders to include: U.S. Bureau of Land Management (BLM), USDA Forest Service (Forest Service), Wyoming Department of Environmental Quality (WDEQ), U.S. Army Corps of Engineers (USACE); oil, gas, coal, and uranium mine operators; and private landowners to assess and mitigate the potential impacts of activities on regional flora, including federally threatened and endangered species and other species of management concern.

Prior to joining ICF, Katie spent 11 years as a wetland specialist and vegetation ecologist, as well as operations manager at a consulting firm in Gillette, Wyoming. Her duties included project management, managing budgets, client correspondence, data gathering, map review, field surveys, results analysis, data presentation, and report compilation. She has worked extensively on projects to conduct special-status plant surveys, floristic inventories, baseline assessments, reclamation monitoring, vegetation community mapping, wetland delineations, and soil map unit mapping and sampling.

Selected Project Experience

Moneta Divide Biological Assessment—Fremont, Natrona, and Sweetwater Counties, Wyoming. 12/2019.

Senior Biologist. Katie completed a biological assessment for Ute ladies'-tresses for proposed oil and gas development in south-central Wyoming. She completed the biological assessment document for submittal to the Lander BLM Field Office.

Coeur Wharf Mine Rare Plant Survey—Lawrence County, South Dakota. 08/2019.

Senior Biologist. Katie complete a rare plant inventory for proposed development at the Wharf Mine located within the Black Hills. As project manager, she performed fieldwork per the direction of the South Dakota Department of Game, Fish, and Parks. Additionally, she completed a report summary of the field survey findings.

Years of Experience

- Professional start date: 05/2005
- ICF start date: 03/2017

Education

- BS, Biology, Bemidji State University, 2005
- AA, Liberal Arts, Thief River Falls, Minnesota, 2002

Professional Membership

- Society for Wetland Science

Training Certificates

- MSHA Annual Refresher, 2019
- OSHA General Industry 10 hr., 2014
- Safeland USA, 2010

Professional Development

- Assessment, Inventory, and Monitoring (AIM) Terrestrial Field Methods, U.S. Department of the Interior (DOI)
- Phase I and Phase II Environmental Site Assessment, ASTM International
- Wetland Delineation Training and Certification, USACE
- Emphasis on Soil and Hydrology, Wetland Training Institute (WTI)
- Federal Wetland/Waters Regulatory Policy, WTI

Transmission and Wind Facility Projects—Various Companies Wyoming. 07/2018 – 09/2019.

Vegetation Ecologist. As the field manager, Katie developed scopes of work to conduct baseline evaluations using the Assessment, Inventory, and Monitoring (AIM) program on BLM administered lands for proposed plans of development. She managed and coordinated a team of field biologists, served as field surveyor, and primary author of technical reports.

Katie also developed weed management plans for submittal to Albany and Carbon County Weed and Pest Offices along with reclamation plans to the Industrial Siting Council for the Wyoming Department of Environmental Quality and the Rawlins BLM Field Office.

Vegetation Assessments for Various Oil and Gas Projects—Various Clients, Wyoming. 05/2005 – 08/2016.

Vegetation Ecologist. While employed by BKS Environmental, Katie developed scopes of work and project budgets to conduct special-status plant species surveys and vegetation assessments for proposed plans of development. Her responsibilities included overall management of client contracts, safety compliance, and correspondence with clients and applicable state or federal agencies. She managed a team of field biologists, and served as field surveyor, primary author and/or reviewer of technical reports.

Threatened and Endangered Plant Surveys for Various Coal Mines—Various Clients, Northeastern Wyoming. 05/2005 – 08/2013.

Senior Vegetation Ecologist. While employed by BKS Environmental, Katie completed Ute ladies'-tresses (*Spiranthes diluvialis*) and Barr's milkvetch (*Astragalus barrii*) habitat and species surveys on the U.S. Forest Service in the Thunder Basin National Grasslands for various coal mine locations. Her responsibilities included overall management of client contracts, safety compliance, and correspondence with clients and applicable state or federal agencies. She developed scopes of work and project budgets to conduct special-status plant species surveys and assessments for proposed plans of development. Katie also managed a team of field biologists and was primary author and/or reviewer of technical reports and biological assessments/biological evaluations (BAs/Bes).

Bear Lodge and Upton Plant Site Wetland Delineation—Rare Earth Elements, Crook and Weston Counties, Wyoming. 05/2012 – 12/2015.

Project Manager and Senior Wetland Specialist. While employed by BKS Environmental, Katie developed scope of work and project budget for the completion of an aquatic resource inventory for proposed rare earth mine and plant development located on the U.S. Forest Service in the Black Hills National Forest. She performed fieldwork in compliance with Section 404 federal permitting process and state and local regulations for jurisdictional wetlands. Katie completed nationwide permit process for submission to the USACE. Responsibilities for this project also included management of the client contract, safety compliance, and correspondence with client and federal agencies. Katie also prepared a PowerPoint presentation for the client and USFS staff regarding the vegetation, soils, and wetlands surveyed at the project area.

FINAL

SIMON CONTRACTORS LORING QUARRY VEGETATION SURVEY SITE SUMMARY

PREPARED FOR:

H2E, Inc.
801 East 4th Street, Suite 5
Gillette, WY 82716
Contact: Becky Morris, Ph.D.
(307) 696-7007

PREPARED BY:

ICF
405 West Boxelder Road, Suite A-5
Gillette, WY 82718
Contact: Katie Wilson
(307) 687-4770

March 2021

ICF. 2021. *Simon Contractors Loring Quarry Vegetation Survey Site Summary*. Final. March. (ICF 00374.20) Gillette, WY. Prepared for H2E, Inc. Gillette, WY.

Contents

Tables, Figures, and Photos

Tables

Figures

Photos

Introduction

Simon Contractors of SD, Inc. (Simon) is in need of applying for a large-scale mine permit for its Loring Quarry (limestone) from the state of South Dakota. The project area is approximately 4 miles south of Pringle along Highway 89 in Custer County, South Dakota and occurs on land privately held by Simon. The mine includes approximately 162 acres throughout portions of Section 33 and 34, T5S:R4E. This area encompasses the current mining parcel (45 acres) in Section 33, a large portion of which (approximately 40 acres, 89 percent) is currently disturbed by the existing quarry or other man-made features.

Simon will be applying for a large-scale mine permit with the South Dakota Department of Environment and Natural Resources (SD DENR) Minerals and Mining Program. H2E, Inc (H2E), on behalf of Simon, awarded and contracted the baseline vegetation survey to ICF in June 2020. The baseline vegetation survey report detailing survey data and results will be included with the permit documents compiled and submitted by H2E.

This report presents baseline information regarding vegetation and ecological site characteristics within the project area. The information gathered from field sampling will be used by the applicant and the SD DENR to develop the reclamation plan for the project area.

Methods

Vegetation sampling procedures were modeled after the Bureau of Land Management (BLM) Assessment, Inventory, and Monitoring (AIM) Strategy (USDA-ARS 2017). The sampling methods were determined by ICF prior to the on-site survey. One team of two biologists from ICF completed the vegetation surveys at the project area between June 29 and 30, 2020. The majority of sample points were accessed by foot.

Prior to fieldwork the project area was mapped with aerial imagery to delineate vegetation communities. The mapped vegetation communities were field verified prior to sampling. Existing Natural Resources Conservation Service (NRCS) soil map units and descriptions of the ecological sites were available and reviewed for the project area prior to the on-site survey. Based on mapping from aerial imagery, field verification, and existing ecological site descriptions, the following vegetation communities were determined to be present: Upland Grassland, Lowland Grassland, and Woodland. Transects were selected within each vegetation type that best represented the community and were within the proposed project area boundary. Three transects were collected within each vegetation community.

Sample points consisted of three 25.0-meter transects orientated at random compass directions but within the mapped vegetation community and proposed project area boundary. Collected along each transect were data from a line-point intercept at 0.5-meter intervals for a total of 50 hits. Top layer (first hit), lower layers (second and third hits), basal hits, and soil surface were recorded at each interval. A species inventory was completed within 0.5-meters on either side of the vegetation transect to create a 25.0-meter square belt. Site characterizations and observations at each sample point were recorded.

A photo was taken at each transect. A photo board was used at each transect to label the pictures; this included the site name, date, transect name, and degree orientation. Latitude and longitude data were collected using an iPad with ArcGIS Collector software at each transect location.

All field data collected were entered into the Database for Inventory, Monitoring, and Assessment (DIMA), a customizable software tool for data collection, management, and interpretation. DIMA reports were generated to interpret the field data collected.

During the transect data collection, critical vegetation resources were surveyed for within the project area boundary. Critical vegetation resources include riparian zones, mountain meadows, wetlands, and threatened or endangered species.

General

Nine plots within three vegetation communities were collected for vegetation site information. Three plots were collected in the Upland Grassland (UPL1, UPL2, UPL3), three plots in the Lowland Grassland (LL1, LL2, LL3), and three plots in the Woodland (WL1, WL2, WL3). See Addendum 1 for the result tables, Addendum 2 for figures of the project area and sample locations, and Addendum 3 for photos of the transects and general views.

The project area is in the Black Hills region of South Dakota. It is within the Major Land Resource Area (MLRA) 62 – Black Hills (USDA NRCS 2006). The area ranges in elevation from 3,600 to 6,565 feet with moderately sloping hills and ridges. Annual average precipitation is between 16 and 37 inches and increases or decreases with the elevation from west to east and north to south. The annual snowfall ranges from about 60 inches at the lower elevations to as much as 140 inches at the higher elevations. The average annual temperature is 36 to 48 degrees Fahrenheit. The freeze free period averages 125 days and ranges from 85 to 165 days (USDA NRCS 2006).

The project area supports open areas to dense forest vegetation and pine and spruce species grow at higher elevations. Cool and warm season grasses are the most common under open forest stands along with forb and shrub species (USDA NRCS 2006). The project area is primarily used as a quarry and pasture for cattle grazing with incidental use for wildlife habitat.

Table 1 illustrates the transect name, latitude and longitude, and azimuth. Table 2 shows each vegetation community type and disturbance and acreage of each. Table 3 illustrates the ecological sites within the project area and the associated acreages.

Table 1. Loring Quarry Project Area Summary of Transects

Area Description	Transect Name	Latitude/Longitude	Azimuth
Lowland Grassland	LL1	43.574311, -103.642752	180
	LL2	43.571603, -103.639276	320
	LL3	43.568923, -103.637903	158
Upland Grassland	UPL1	43.575852, -103.643091	325
	UPL2	43.573026, -103.640071	120
	UPL3	43.5704, -103.643962	242
Woodland	WL1	43.570009, -103.64532	292
	WL2	43.571224, -103.642221	60
	WL3	43.567473, -103.638751	4

Table 2. Loring Quarry Project Area Acreages by Vegetation Type and Disturbance

Area Description	Acreages	Percent
Lowland Grassland	5.2	3
Upland Grassland	82.5	51
Woodland	24.0	15
Disturbed Grassland	4.1	2
Disturbed – Infrastructure, gravel piles	15.9	10
Disturbed – Pit	15.7	10
Disturbed – Spoil, topsoil, etc.	14.4	9
Total	161.8	

Table 3. Loring Quarry Project Area Acreages by Ecological Site

Area Description	Acreages
Loamy Overflow 17-22	59.2
Shallow Loamy 62C / Loamy 62C	29.2
Shallow Loamy 62C / Non-Site	5.9
Thin Upland / No Data / Shallow Loamy 62C	17.4
Non-site (disturbed area)	50.7
Total	161.8

Lowland Grassland

Line-point intercept sampling was carried out at three transects within the Lowland Grassland vegetation community. Vegetation cover was recorded at 89 percent of the first hits along the transects. Smooth brome (*Bromus inermis*) represented the majority (47%) of vegetated first hits along the three transects followed by Kentucky bluegrass (*Poa pratensis*) (21%). No bare ground hits were recorded.

Lowland transects, LL1, LL2, and LL3 are identified within the Loamy Overflow 17-22 ecological site as mapped by the NRCS. The Loamy Overflow ecological site for the project area (MLRA 60 – Black Hills) is incomplete or has not undergone quality control and quality assurance review (NRCS 2020). However, Overflow ecological site, adjacent to the project area (MLRA 61 –Black Hills Foot Slopes), was available. These sites are located on nearly level lowlands and drainageways. The soils are moderately well to well drained and formed in alluvium with a surface layer of 4 to 10 inches thick of silt loam to fine sandy loam. Vegetation changes are subject to weather deviations, management actions (such as grazing) and impacts of native and or foreign plant and animal species to the site (NRCS 2020).

Upland Grassland

Line-point intercept sampling was carried out at three transects within the Upland Grassland vegetation community. Vegetation cover was recorded at 79 percent of the first hits along the transects. Crested wheatgrass (*Agropyron cristatum*) represented the majority (58 percent) vegetated first hits along the three transects followed by western wheatgrass (*Pascopyrum smithii*) (11 percent). No bare ground hits were recorded.

Upland transects UPL1 and UPL3 are identified within the Loamy Overflow 17-22 ecological site and UPL2 was identified within the Shallow Loamy 62C / Loamy 62C ecological site as mapped by the NRCS. The Shallow Loamy ecological sites are located on upland landscapes with shallow soils and have a loamy surface layer ranging from 2 to 6 inches in depth. Slopes range from 2 to 60 percent and the site does not receive additional water from runoff or overflow. Vegetation is generally warm season grass species with cool season species also present. Forbs are common and diverse but never dominant. Ponderosa pine (*Pinus ponderosa*) can be found scattered throughout these sites (NRCS 2020).

The Loamy ecological sites are located on upland landscapes. The site has a loamy surface layer with a thickness less than 15 inches in depth. Most soils have calcium carbonates in the profile and are typically located 12 inches or greater in depth. Slopes range from 0 to 15 percent and the site does not receive additional water from runoff or overflow. Vegetation generally consists of both cool and warm season grasses. Forbs are common and diverse but never dominant and shrubs are often present in the vegetation community. The site is vulnerable to pine encroachment from adjacent areas (NRCS 2020).

Woodland

Line-point intercept sampling was carried out at three transects within the Woodland vegetation community. Vegetation cover was recorded at 74 percent of the first hits along the transects. Ponderosa pine represented the majority (30 percent) vegetated first hits along the three transects followed by blue grama (*Bouteloua gracilis*) (10 percent). One bare ground hit was recorded (2 percent).

Figure 3-3 in Addendum 3 illustrates tree canopy cover within the Woodland vegetation type found within the project area. Tree canopy cover in the project area was calculated by using United States Geological Survey (USGS) Landscape Fire and Resource Management Planning Tools (LANDFIRE) Remap Forest Canopy Cover. The forest canopy cover shows the vertical projections of tree canopy onto an imaginary horizonal surface that represents the ground surface (USGS 2020).

Woodland transect WL1 was identified within Shallow Loamy 62C / Loamy 62C ecological, WL2 was identified within Thin Upland / No Data / Shallow Loamy 62C ecological site, and WL3 was identified within the Shallow Loamy 62C / Non-Site ecological site as mapped by the NRCS.

The Thin Upland ecological sites are located on upland landscapes with shallow soils and have a loamy surface layer ranging from 2 to 6 inches in depth. Slopes range from 2 to 60 percent and the site does not receive additional water from runoff or overflow. Vegetation is generally warm season grass species with cool season species also present. Forbs are common and diverse but never dominant. Ponderosa pine can be found scattered throughout these sites (NRCS 2020).

Disturbed Grassland

An area to the west and south of the pit is classified by ecological site mapping as a Non-Site. Aerial imagery and the on-site field visit confirmed that that area had previously been disturbed by mining. Upland vegetation is present at the site with scattered ponderosa pine saplings. The area appears to have been stripped and overburden was piled to the west of the area. The overburden pile is also vegetated with perennial and annual grasses, forbs to include wavyleaf thistle (*Cirsium undulatum*), upright prairie cone flower (*Ratibida columnifera*), curlycup gumweed (*Grindelia squarrosa*), and ponderosa pine saplings.

Threatened, Endangered, and Rare Plant Species and Critical Vegetation Resources

No threatened, endangered, and rare plant species were observed during the field survey. A search of the South Dakota Natural Heritage Database did not find any documented records for threatened, endangered, or rare plants species within the project area boundary. No observations of critical vegetation resources were noted during the field survey.

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Addendum 1
Result Tables and Raw Data

Addendum 1-1. Loring Quarry Line-Point Intercept Summary by Vegetation Type and Transect

Vegetation Type	Line	Foliar Cover	Bare Ground	Basal Cover	Total Ground Cover	Ground Cover Between-Plant Cover	Ground Cover Under-Plant Cover	Total Litter	Litter Between-Plant Cover	Litter Under-Plant Cover
Lowland	1	41	0	0	50	9	41	49	8	41
Lowland	2	45	0	0	50	5	45	50	50	45
Lowland	3	48	0	0	50	2	48	50	2	48
	Average:	45	0	0	50	5	45	50	5	45
Upland	1	31	0	0	50	19	31	49	19	30
Upland	2	39	0	1	48	10	38	47	10	37
Upland	3	48	0	0	50	2	48	50	2	48
	Average:	39	0	0	49	10	39	49	10	38
Woodland	1	40	0	0	50	10	40	50	10	40
Woodland	2	39	0	0	50	11	39	50	11	39
Woodland	3	32	1	1	42	17	25	34	12	22
	Average:	37	0	0	47	13	35	45	11	34

Foliar Cover - # of hits with a “real plant code” in the top layer
Bare Ground - # of hits with “none” in top layer and no subsequent layer hits.
Basal Cover - # of hits with a “real plant code” as the soil surface.
Ground Cover - # of hits with litter, rock, and/or basal.
Count, N=50 total points

Ground Cover Between Plant Cover – # of hits between ground cover and layer hits
Ground Cover Under Plant Cover - # of hits noted under the top layer hit
Total Litter - # of hits with either “litter” or “woody litter”
Litter Between Plant Cover – # of hits with litter under top layer and ground cover
Litter Under Plant Cover - # of hits with litter under top layer hit

Addendum 1-2. Loring Quarry Line-Point Intercept Summary Percentage by Vegetation Type and Transect

Vegetation Type	Line	% Foliar Cover	% Bare Ground	% Basal Cover	% Total Ground Cover	% Ground Cover Between-Plant Cover	% Ground Cover Under-Plant Cover	% Total Litter	% Litter Between-Plant Cover	% Litter Under-Plant Cover
Lowland	1	82	0	0	100	18	82	98	16	82
Lowland	2	90	0	0	100	10	90	100	10	90
Lowland	3	96	0	0	100	4	96	100	4	96
	Average:	89	0	0	100	11	89	99	10	89
Upland	1	62	0	0	100	38	62	98	38	60
Upland	2	78	0	2	96	20	76	94	20	74
Upland	3	96	0	0	100	4	96	100	4	96
	Average:	79	0	1	99	21	78	97	21	77
Woodland	1	80	0	0	100	20	80	10	20	80
Woodland	2	78	0	0	100	22	78	100	22	78
Woodland	3	64	2	2	84	34	50	68	24	44
	Average:	74	1	1	95	25	69	89	22	67

Foliar Cover - # of hits with a "real plant code" in the top layer
Bare Ground - # of hits with "none" in top layer and no subsequent layer hits.
Basal Cover - # of hits with a "real plant code" as the soil surface.
Ground Cover - # of hits with litter, rock, and/or basal.
Count, N=50 total points

Ground Cover Between Plant Cover – # of hits between ground cover and layer hits
Ground Cover Under Plant Cover - # of hits noted under the top layer hit
Total Litter - # of hits with either "litter" or "woody litter"
Litter Between Plant Cover – # of hits with litter under top layer and ground cover
Litter Under Plant Cover - # of hits with litter under top layer hit

Addendum 1-3. Loring Quarry Lowland Grassland Species Inventory

Species Code	Scientific Name	Common Name	Lifeform	Transect
AF05	---	Unknown forb	Annual forb	1, 2, 3
ACHY	*Achnatherum hymenoides*	Indian ricegrass	Perennial grass	1
ACMI2	*Achillea millefolium.*	Common yarrow	Perennial forb	2
AGCR	*Agropyron cristatum*	Crested wheatgrass	Perennial grass	2, 3
APAN2	*Apocynum androsaemifolium*	Spreading dogbane	Perennial forb	2
ARLU	*Artemisia ludoviciana*	White sagebrush	Perennial subshrub	1, 2, 3
BRAR5	*Bromus arvensis*	Field brome	Annual grass	1, 2, 3
BRIN2	*Bromus inermis*	Smooth brome	Perennial grass	1, 3
BRTE	*Bromus tectorum*	Cheatgrass	Annual grass	2, 3
CAREX	*Carex*	Carex	Grass-like	1
CHLE4	*Chenopodium leptophyllum*	Narrowleaf goosefoot	Annual forb	1, 2, 3
COAR4*	*Convolvulus arvensis*	Field bindweed	Biennial forb	1, 2, 3
ECAN2	*Echinacea angustifolia*	Blacksamson echinacea	Perennial forb	3
IRMI	*Iris missouriensis*	Rocky Mountain iris	Perennial forb	1, 2, 3
MELU	*Medicago lupulina*	Black medick	Annual forb	3
MESA	*Medicago sativa*	Alfalfa	Perennial forb	1, 2, 3
NAVI4	*Nassella viridula*	Green needlegrass	Perennial grass	2, 3
PASM	*Pascopyrum smithii*	Western wheatgrass	Perennial grass	1, 2, 3
PEAR6	*Pediomelum argophyllum*	Silverleaf Indian breadroot	Perennial forb	1, 3
POPR	*Poa pratensis*	Kentucky bluegrass	Perennial grass	1, 2, 3
ROWO	*Rosa woodsia*	Woods' rose	Perennial subshrub	1, 2, 3
RACO3	*Ratibida columnifera*	Upright prairie coneflower	Perennial forb	3
RUAQ	*Rumex aquaticus*	Western dock	Perennial forb	1
SILA21	*Silene latifolia*	Bladder campion	Biennial forb	3
THAR5	*Thlaspi arvense*	Field pennycress	Annual forb	2
THRH	*Thermopsis rhombifolia*	Prairie thermopsis	Perennial forb	1
VEST	*Verbena stricta*	Hoary verbena	Annual forb	1, 2, 3

*Local Noxious Weed
Total Species Observed Transect 1 – 17
Total Species Observed Transect 2 – 17
Total Species Observed Transect 3 – 20

Addendum 1-4. Loring Quarry Upland Grassland Species Inventory

Species Code	Scientific Name	Common Name	Lifeform	Transect
AF05	---	Unknown forb	Annual forb	2
AF19	---	Unknown forb	Annual forb	2
AGCR	*Agropyron cristatum*	Crested wheatgrass	Perennial grass	1, 2, 3
ARFR4	*Artemisia frigida.*	Prairie sagewort	Perennial subshrub	1, 2
BRAR5	*Bromus arvensis*	Field brome	Annual grass	1
BRTE	*Bromus tectorum*	Cheatgrass	Annual grass	1
COAR4*	*Convolvulus arvensis*	Field bindweed	Perennial forb	1, 2, 3
DEPI	*Descurainia pinnata*	Western tansymustard	Biennial forb	1
ECAN2	*Echinacea angustifolia*	Blacksamson echinacea	Perennial forb	1, 2
ERST3	*Erigeron strigosus*	Prairie fleabane	Biennial forb	2
GRSQ	*Grindelia squarrosa*	Curlycup gumweed	Biennial forb	2
GUSA2	*Gutierrezia sarothrae*	Broom snakeweed	Perennial shrub	2
HECO26	*Hesperostipa comata*	Needle and thread	Perennial grass	2
IRMI	*Iris missouriensis*	Rocky Mountain iris	Perennial forb	2
MELU	*Medicago lupulina*	Black medic	Annual forb	1, 2, 3
MESA	*Medicago sativa*	Alfalfa	Perennial forb	1, 2, 3
PASM	*Pascopyrum smithii*	Western wheatgrass	Perennial grass	1, 3
PEAR6	*Pediomelum argophyllum*	Silverleaf Indian breadroot	Perennial forb	1, 2
POPR	*Poa pratensis*	Kentucky bluegrass	Perennial grass	1, 2, 3
RACO3	*Ratibida columnifera*	Upright prairie coneflower	Perennial forb	2
SILA21	*Silene latifolia*	Bladder compion	Biennial forb	1
SPCO	*Sphaeralcea coccinea*	Scarlet globemallow	Biennial forb	1, 2
TRDU	*Tragopogon dubius.*	Yellow salsify	Biennial forb	1
VIAM	*Vicia americana*	American vetch	Perennial forb	1

*Local Noxious Weed
Total Species Observed Transect 1 – 16
Total Species Observed Transect 2 – 17
Total Species Observed Transect 3 – 6

Addendum 1-5. Loring Quarry Woodland Species Inventory

Species Code	Scientific Name	Common Name	Lifeform	Transect
AF05	---	Unknown forb	Annual forb	2, 3
AF10	---	Unknown forb	Annual forb	1
AF11	---	Unknown forb	Annual forb	1
AF14	---	Unknown forb	Annual forb	2
AF17	---	Unknown forb	Annual forb	3
AF18	---	Unknown forb	Annual forb	3
AF19	---	Unknown forb	Annual forb	3
ACMI2	*Achillea millefolium*	Common yarrow	Perennial forb	2
APAN2	*Apocynum androsaemilfolium*	Spreading dogbane	Perennial forb	2, 3
ARFR4	*Artemisia frigida*	Prairie sagewort	Perennial subshrub	2, 3
ARLU	*Artemisia ludoviciana*	White sagebrush	Perennial subshrub	2, 3
BOGR2	*Bouteloua gracilis*	Blue grama	Perennial grass	3
BRAR5	*Bromus arvensis*	Field brome	Annual grass	3
BRIN2	*Bromus inermis*	Smooth brome	Perennial grass	1, 2, 3
CAFI	*Carex filifolia*	Threadleaf sedge	Grass-like	3
CARO2	*Campanula rotundifolia*	Bluebell bellflower	Perennial forb	3
CHLE4	*Chenopodium leptophyllum*	Narrowleaf goosefoot	Annual forb	1, 2
CIUN	*Circium undulatum*	Wavyleaf thistle	Biennial forb	3
DEPI	*Descurainia pinnata*	Western tansymustard	Annual forb	2
ECAN2	*Echinacea angustifolia*	Blacksamson echinacea	Perennial forb	2
ERSTS3	*Erigeron strigosus*	Prairie fleabane	Biennial forb	1, 2
ERFL4	*Eriogonum flavum*	Alpine golden buckwheat	Perennial forb	3
HECO26	*Hesperostipa comate*	Needle and thread	Perennial grass	2, 3
KOMA	*Koeleria macrantha*	Prairie Junegrass	Perennial grass	2
MELU	*Medicago lupulina*	Black medick	Annual forb	2, 3
NAVAR	*Navarretia*	Pincushion plant	Annual forb	3
NAVI4	*Nassella viridula*	Green needlegrass	Perennial grass	1, 2, 3
OPPO	*Opuntia polyacantha*	Plains pricklypear	Perennial shrub	3
PASM	*Pascopyrum smithii*	Western wheatgrass	Perennial grass	1, 2, 3
PEAR6	*Pediomelum argophyllum*	Silverleaf Indian breadroot	Perennial forb	1, 2, 3
PHHO	*Phlox hoodia*	Spiny phlox	Perennial forb	3
PIPO	*Pinus ponderosa*	Ponderosa pine	Tree	1, 2, 3
PLPA2	*Plantago patagonica*	Wooly plantain	Annual forb	3
POAL4	*Polgala alba*	White milkwort	Perennial forb	2
POPR	*Poa pratensis*	Kentucky bluegrass	Perennial grass	1, 2, 3
RHAR4	*Rhus aromatic*	Fragrant sumac	Perennial shrub	2, 3
RIOX	*Ribes oxyacanthoides*	Canadian gooseberry	Perennial shrub	2, 3
ROWO	*Rosa woodsia*	Woods' rose	Perennial subshrub	1, 3
SCSC	*Schizachyrium scoparium*	Little bluestem	Perennial grass	3

Species Code	Scientific Name	Common Name	Lifeform	Transect
SILA21	*Silene latifolia*	Bladder campion	Biennial forb	1, 2, 3
SPCO	*Sphaeralcea coccinea.*	Scarlet globemallow	Biennial forb	2
TEAC	*Tetraneuris acaulis*	Stemless four-nerve daisy	Perennial forb	3
VIAM	*Vicia Americana*	American vetch	Perennial forb	1, 2
LICHEN*	*Lichen*	Lichen	Nonvascular	3

Total Species Observed Transect 1 – 13
Total Species Observed Transect 2 – 25
Total Species Observed Transect 3 – 32
*LICHEN – not included in raw data.

Addendum 1-6. Loring Quarry Lowland Grassland Line-Point Intercept Transect Data

Species Code	Average Number of 1st Hits	% of 1st Hits	Average Number of Overall Hits	Relative % of Overall Hits
AF05	0.013	1%	0.033	3%
AGCR	0.033	3%	0.040	4%
APAN2	0.027	3%	0.040	4%
ARLU	0.007	1%	0.020	2%
BRAR5	0.007	1%	0.007	1%
BRIN2	0.497	47%	0.513	51%
BRTE	0.007	1%	0.013	1%
CHLE4	0.007	1%	0.033	3%
COAR4	0.007	1%	0.027	3%
IRMI	0.013	1%	0.020	2%
MELU	0.007	1%	0.013	1%
MESA	0.007	1%	0.007	1%
NAVI4	0.020	2%	0.020	2%
PASM	0.053	5%	0.080	8%
PEAR6	0.007	1%	0.007	1%
POPR	0.207	21%	0.320	32%
ROWO	0.007	1%	0.007	1%
Ave Total Foliar Hits	0.893	89%	0.913	91%
Ave Total Litter Hits	0.000	0%	0.993	99%
Ave Total Non-veg Litter Hits	0.000	0%	0.007	1%
Ave Total Rock Hits	0.000	0%	0.027	3%
Ave Total Bare Soil	0.000	0%	0.000	0%
Ave Total Ground Cover	0.000	0%	1.000	100%

1st Hit Ave. – sum of line averages where X indicator occurred only in the top layer for all the lines in the plot / total number of lines

Any Hit Ave. – sum of line averages where X indicator occurred in any layer once for all the lines in the plot / total number of lines

Addendum 1-7. Loring Quarry Upland Grassland Line-Point Intercept Transect Data

Species Code	Average Number of 1st Hits	% of 1st Hits	Average Number of Overall Hits	Relative % of Overall Hits
AGCR	0.580	58%	0.647	65%
ARFR4	0.013	1%	0.033	3%
BRAR5	0.007	1%	0.007	1%
BRTE	0.000	0%	0.007	1%
COAR4	0.027	3%	0.033	3%
MELU	0.020	2%	0.060	6%
MESA	0.013	1%	0.020	2%
PASM	0.107	11%	0.187	19%
POPR	0.020	2%	0.027	3%
SPCO	0.000	0%	0.013	1%
VIAM	0.000	0%	0.007	1%
Ave Total Foliar Hits	0.787	79%	0.920	92%
Ave Total Litter Hits	0.000	0%	0.967	97%
Ave Total Non-veg Litter Hits	0.000	0%	0.020	2%
Ave Total Duff Hits	0.000	0%	0.007	1%
Ave Total Rock Hits	0.000	0%	0.027	3%
Ave Total Basal Hits	0.000	0%	0.007	1%
Ave Total Bare Soil	0.000	0%	0.000	0%
Ave Total Ground Cover	0.000	0%	1.000	100%

1st Hit Ave. – sum of line averages where X indicator occurred only in the top layer for all the lines in the plot / total number of lines

Any Hit Ave. – sum of line averages where X indicator occurred in any layer once for all the lines in the plot / total number of lines

Addendum 1-8. Loring Quarry Woodland Line-Point Intercept Transect Data

Species Code	Average Number of 1st Hits	% of 1st Hits	Average Number of Overall Hits	Relative % of Overall Hits
AF05	0.000	0%	0.007	1%
AF14	0.007	1%	0.013	1%
AF17	0.007	1%	0.007	1%
APAN2	0.013	1%	0.020	2%
ARFR4	0.013	1%	0.020	2%
BOGR2	0.100	10%	0.107	11%
BRIN2	0.040	4%	0.100	10%
HECO26	0.027	3%	0.047	5%
MELU	0.000	0%	0.007	1%
NAVI4	0.047	5%	0.053	5%
PASM	0.040	4%	0.100	10%
PIPO	0.300	30%	0.300	30%
POPR	0.073	7%	0.173	17%
ROWO	0.000	0%	0.007	1%
SCSC	0.067	7%	0.073	7%
SILA21	0.007	1%	0.007	1%
TEAC	0.000	0%	0.007	1%
Ave Total Foliar Hits	0.740	74%	0.780	78%
Ave Total Litter Hits	0.000	0%	0.893	89%
Ave Total Woody Litter Hits	0.000	0%	0.033	3%
Ave Total Rock Hits	0.000	0%	0.087	1%
Ave Total Basal Hits	0.000	0%	0.007	1%
Ave Total Bare Soil	0.000	0%	0.007	1%
Ave Total Ground Cover	0.000	0%	0.947	95%

1st Hit Ave. – sum of line averages where X indicator occurred only in the top layer for all the lines in the plot / total number of lines

Any Hit Ave. – sum of line averages where X indicator occurred in any layer once for all the lines in the plot / total number of lines

Addendum 1-9. Loring Quarry Raw Line-Point Intercept Transect Data

Site	Plot	Line	Date	PointLoc	PointNbr	TopCanopy	Lower1	Lower2	Lower3	Lower4	SoilSurface
LQ	Lowland	1	6/29/2020	0.5	1	IRMI	BRIN2	PASM	L		S
LQ	Lowland	1	6/29/2020	1	2	BRIN2	L				S
LQ	Lowland	1	6/29/2020	1.5	3	BRIN2	L				S
LQ	Lowland	1	6/29/2020	2	4	CHLE4	L				S
LQ	Lowland	1	6/29/2020	2.5	5	None	L				S
LQ	Lowland	1	6/29/2020	3	6	BRIN2	L				S
LQ	Lowland	1	6/29/2020	3.5	7	None	L				S
LQ	Lowland	1	6/29/2020	4	8	BRIN2	POPR	L			S
LQ	Lowland	1	6/29/2020	4.5	9	BRIN2	POPR	L			S
LQ	Lowland	1	6/29/2020	5	10	BRIN2	L				S
LQ	Lowland	1	6/29/2020	5.5	11	None	L				S
LQ	Lowland	1	6/29/2020	6	12	BRIN2	POPR	L			S
LQ	Lowland	1	6/29/2020	6.5	13	None	L	BRIN2	L		S
LQ	Lowland	1	6/29/2020	7	14	BRIN2	COAR4	L			S
LQ	Lowland	1	6/29/2020	7.5	15	AF05	L				S
LQ	Lowland	1	6/29/2020	8	16	BRIN2	L				S
LQ	Lowland	1	6/29/2020	8.5	17	BRIN2	L				S
LQ	Lowland	1	6/29/2020	9	18	BRIN2	L				S
LQ	Lowland	1	6/29/2020	9.5	19	POPR	L				S
LQ	Lowland	1	6/29/2020	10	20	APAN2	PASM	POPR	L		S
LQ	Lowland	1	6/29/2020	10.5	21	BRIN2	L				S
LQ	Lowland	1	6/29/2020	11	22	BRIN2	L				S
LQ	Lowland	1	6/29/2020	11.5	23	BRIN2	L				S
LQ	Lowland	1	6/29/2020	12	24	POPR	L				S
LQ	Lowland	1	6/29/2020	12.5	25	BRIN2	L				S
LQ	Lowland	1	6/29/2020	13	26	BRIN2	L				S
LQ	Lowland	1	6/29/2020	13.5	27	BRIN2	L				S
LQ	Lowland	1	6/29/2020	14	28	BRIN2	L				S
LQ	Lowland	1	6/29/2020	14.5	29	BRIN2	POPR	L			S
LQ	Lowland	1	6/29/2020	15	30	BRIN2	L				S
LQ	Lowland	1	6/29/2020	15.5	31	BRIN2	L				S
LQ	Lowland	1	6/29/2020	16	32	None	NL				S
LQ	Lowland	1	6/29/2020	16.5	33	POPR	L				S
LQ	Lowland	1	6/29/2020	17	34	BRIN2	L				S
LQ	Lowland	1	6/29/2020	17.5	35	None	L				BY
LQ	Lowland	1	6/29/2020	18	36	POPR	L				S
LQ	Lowland	1	6/29/2020	18.5	37	POPR	L				S
LQ	Lowland	1	6/29/2020	19	38	POPR	L				S
LQ	Lowland	1	6/29/2020	19.5	39	PASM	POPR	L			S
LQ	Lowland	1	6/29/2020	20	40	None	BRIN2	L			S
LQ	Lowland	1	6/29/2020	20.5	41	BRIN2	L				S
LQ	Lowland	1	6/29/2020	21	42	POPR	L				S
LQ	Lowland	1	6/29/2020	21.5	43	POPR	L				S
LQ	Lowland	1	6/29/2020	22	44	POPR	L				S
LQ	Lowland	1	6/29/2020	22.5	45	APAN2	POPR	L			S
LQ	Lowland	1	6/29/2020	23	46	PASM	POPR	L			S
LQ	Lowland	1	6/29/2020	23.5	47	None	L				S
LQ	Lowland	1	6/29/2020	24	48	None	L				BY
LQ	Lowland	1	6/29/2020	24.5	49	POPR	COAR4	L			ST
LQ	Lowland	1	6/29/2020	25	50	BRIN2	L				ST

LQ	Lowland	2	6/29/2020	0.5	1	BRAR5	AF05	L		S
LQ	Lowland	2	6/29/2020	1	2	PASM	L			S
LQ	Lowland	2	6/29/2020	1.5	3	None	L			S
LQ	Lowland	2	6/29/2020	2	4	PASM	POPR	L		S
LQ	Lowland	2	6/29/2020	2.5	5	ROWO	ARLU	POPR	L	S
LQ	Lowland	2	6/29/2020	3	6	POPR	L			S
LQ	Lowland	2	6/29/2020	3.5	7	PASM	AF05	L		S
LQ	Lowland	2	6/29/2020	4	8	BRIN2	POPR	L		S
LQ	Lowland	2	6/29/2020	4.5	9	POPR	BRIN2	L		S
LQ	Lowland	2	6/29/2020	5	10	AF05	POPR	L		S
LQ	Lowland	2	6/29/2020	5.5	11	None	L	PASM	L	S
LQ	Lowland	2	6/29/2020	6	12	IRMI	AGCR	L		S
LQ	Lowland	2	6/29/2020	6.5	13	AGCR	L			S
LQ	Lowland	2	6/29/2020	7	14	PASM	BRTE	L		S
LQ	Lowland	2	6/29/2020	7.5	15	BRTE	L			S
LQ	Lowland	2	6/29/2020	8	16	AGCR	L			S
LQ	Lowland	2	6/29/2020	8.5	17	None	L			S
LQ	Lowland	2	6/29/2020	9	18	AGCR	L			S
LQ	Lowland	2	6/29/2020	9.5	19	POPR	L			S
LQ	Lowland	2	6/29/2020	10	20	AGCR	POPR	L		S
LQ	Lowland	2	6/29/2020	10.5	21	POPR	L			S
LQ	Lowland	2	6/29/2020	11	22	BRIN2	L			S
LQ	Lowland	2	6/29/2020	11.5	23	None	L			S
LQ	Lowland	2	6/29/2020	12	24	AGCR	L			S
LQ	Lowland	2	6/29/2020	12.5	25	ARLU	BRIN2	L		S
LQ	Lowland	2	6/29/2020	13	26	POPR	ARLU	CHLE4	L	S
LQ	Lowland	2	6/29/2020	13.5	27	POPR	CHLE4	L		S
LQ	Lowland	2	6/29/2020	14	28	POPR	L			S
LQ	Lowland	2	6/29/2020	14.5	29	POPR	L			S
LQ	Lowland	2	6/29/2020	15	30	POPR	L			S
LQ	Lowland	2	6/29/2020	15.5	31	COAR4	L			S
LQ	Lowland	2	6/29/2020	16	32	POPR	CHLE4	L		S
LQ	Lowland	2	6/29/2020	16.5	33	NAVI4	L			S
LQ	Lowland	2	6/29/2020	17	34	NAVI4	L			S
LQ	Lowland	2	6/29/2020	17.5	35	POPR	L			S
LQ	Lowland	2	6/29/2020	18	36	POPR	L			S
LQ	Lowland	2	6/29/2020	18.5	37	POPR	PASM	L		S
LQ	Lowland	2	6/29/2020	19	38	None	L			S
LQ	Lowland	2	6/29/2020	19.5	39	POPR	AF05	L		S
LQ	Lowland	2	6/29/2020	20	40	POPR	L			S
LQ	Lowland	2	6/29/2020	20.5	41	POPR	APAN2	POPR	L	S
LQ	Lowland	2	6/29/2020	21	42	POPR	COAR4	L		S
LQ	Lowland	2	6/29/2020	21.5	43	NAVI4	APAN2	POPR	L	S
LQ	Lowland	2	6/29/2020	22	44	APAN2	IRMI	POPR	L	S
LQ	Lowland	2	6/29/2020	22.5	45	POPR	BRIN2	L		S
LQ	Lowland	2	6/29/2020	23	46	POPR	L			S
LQ	Lowland	2	6/29/2020	23.5	47	PASM	POPR	L		S
LQ	Lowland	2	6/29/2020	24	48	PASM	CHLE4	L		S
LQ	Lowland	2	6/29/2020	24.5	49	APAN2	L			S
LQ	Lowland	2	6/29/2020	25	50	POPR	L			S

LQ	Lowland	3	6/30/2020	1	2	BRIN2	L		S
LQ	Lowland	3	6/30/2020	1.5	3	BRIN2	L		S
LQ	Lowland	3	6/30/2020	2	4	BRIN2	L		S
LQ	Lowland	3	6/30/2020	2.5	5	MESA	L		S
LQ	Lowland	3	6/30/2020	3	6	BRIN2	L		S
LQ	Lowland	3	6/30/2020	3.5	7	BRIN2	L		S
LQ	Lowland	3	6/30/2020	4	8	BRIN2	L		S
LQ	Lowland	3	6/30/2020	4.5	9	BRIN2	L		S
LQ	Lowland	3	6/30/2020	5	10	BRIN2	L		S
LQ	Lowland	3	6/30/2020	5.5	11	BRIN2	L		S
LQ	Lowland	3	6/30/2020	6	12	BRIN2	L		S
LQ	Lowland	3	6/30/2020	6.5	13	BRIN2	L		S
LQ	Lowland	3	6/30/2020	7	14	BRIN2	L		S
LQ	Lowland	3	6/30/2020	7.5	15	BRIN2	L		S
LQ	Lowland	3	6/30/2020	8	16	BRIN2	L		S
LQ	Lowland	3	6/30/2020	8.5	17	BRIN2	L		S
LQ	Lowland	3	6/30/2020	9	18	POPR	L		S
LQ	Lowland	3	6/30/2020	9.5	19	BRIN2	L		S
LQ	Lowland	3	6/30/2020	10	20	BRIN2	L		S
LQ	Lowland	3	6/30/2020	10.5	21	None	L		S
LQ	Lowland	3	6/30/2020	11	22	BRIN2	L		S
LQ	Lowland	3	6/30/2020	11.5	23	BRIN2	POPR	L	S
LQ	Lowland	3	6/30/2020	12	24	MELU	L		S
LQ	Lowland	3	6/30/2020	12.5	25	BRIN2	L		S
LQ	Lowland	3	6/30/2020	13	26	BRIN2	L		S
LQ	Lowland	3	6/30/2020	13.5	27	BRIN2	L		S
LQ	Lowland	3	6/30/2020	14	28	BRIN2	L		S
LQ	Lowland	3	6/30/2020	14.5	29	BRIN2	MELU	L	S
LQ	Lowland	3	6/30/2020	15	30	BRIN2	L		S
LQ	Lowland	3	6/30/2020	15.5	31	None	L		S
LQ	Lowland	3	6/30/2020	16	32	BRIN2	L		S
LQ	Lowland	3	6/30/2020	16.5	33	BRIN2	L		S
LQ	Lowland	3	6/30/2020	17	34	BRIN2	L		S
LQ	Lowland	3	6/30/2020	17.5	35	BRIN2	L		S
LQ	Lowland	3	6/30/2020	18	36	BRIN2	L		S
LQ	Lowland	3	6/30/2020	18.5	37	BRIN2	L		S
LQ	Lowland	3	6/30/2020	19	38	BRIN2	L		S
LQ	Lowland	3	6/30/2020	19.5	39	BRIN2	L		S
LQ	Lowland	3	6/30/2020	20	40	BRIN2	L		S
LQ	Lowland	3	6/30/2020	20.5	41	BRIN2	L		S
LQ	Lowland	3	6/30/2020	21	42	BRIN2	L		S
LQ	Lowland	3	6/30/2020	21.5	43	BRIN2	L		S
LQ	Lowland	3	6/30/2020	22	44	BRIN2	L		S
LQ	Lowland	3	6/30/2020	22.5	45	BRIN2	L		S
LQ	Lowland	3	6/30/2020	23	46	BRIN2	L		S
LQ	Lowland	3	6/30/2020	23.5	47	BRIN2	L		S
LQ	Lowland	3	6/30/2020	24	48	BRIN2	L		S
LQ	Lowland	3	6/30/2020	24.5	49	PEAR6	BRIN2	L	S
LQ	Lowland	3	6/30/2020	25	50	BRIN2	L		S

Site	Plot	Line	Date	PointLoc	PointNbr	TopCanopy	Lower1	Lower2	Lower3	Lower4	SoilSurface
LQ	Upland	1	6/29/2020	0.5	1	AGCR	NL				S
LQ	Upland	1	6/29/2020	1	2	PASM	L				S
LQ	Upland	1	6/29/2020	1.5	3	None	L	PASM			S
LQ	Upland	1	6/29/2020	2	4	None	L				S
LQ	Upland	1	6/29/2020	2.5	5	None	L	PASM			S
LQ	Upland	1	6/29/2020	3	6	None	L				S
LQ	Upland	1	6/29/2020	3.5	7	PASM	L				S
LQ	Upland	1	6/29/2020	4	8	None	L				S
LQ	Upland	1	6/29/2020	4.5	9	PASM	BRTE	L			S
LQ	Upland	1	6/29/2020	5	10	BRAR5	L				S
LQ	Upland	1	6/29/2020	5.5	11	None	L	PASM	L		S
LQ	Upland	1	6/29/2020	6	12	None	L	PASM	L		S
LQ	Upland	1	6/29/2020	6.5	13	None	L	PASM			S
LQ	Upland	1	6/29/2020	7	14	None	L	PASM	L		S
LQ	Upland	1	6/29/2020	7.5	15	PASM	L				S
LQ	Upland	1	6/29/2020	8	16	None	L	PASM	L		S
LQ	Upland	1	6/29/2020	8.5	17	None	L	PASM	L		S
LQ	Upland	1	6/29/2020	9	18	None	L	AGCR	L		S
LQ	Upland	1	6/29/2020	9.5	19	None	L				S
LQ	Upland	1	6/29/2020	10	20	MELU	L				S
LQ	Upland	1	6/29/2020	10.5	21	AGCR	L				S
LQ	Upland	1	6/29/2020	11	22	PASM	MELU	L			S
LQ	Upland	1	6/29/2020	11.5	23	AGCR	L				S
LQ	Upland	1	6/29/2020	12	24	PASM	L				S
LQ	Upland	1	6/29/2020	12.5	25	None	L	PASM	L		S
LQ	Upland	1	6/29/2020	13	26	None	L	PASM	L		S
LQ	Upland	1	6/29/2020	13.5	27	PASM	L				S
LQ	Upland	1	6/29/2020	14	28	PASM	L				S
LQ	Upland	1	6/29/2020	14.5	29	AGCR	MELU	L			S
LQ	Upland	1	6/29/2020	15	30	None	L	PASM	AGCR	L	S
LQ	Upland	1	6/29/2020	15.5	31	None	L	AGCR	L		S
LQ	Upland	1	6/29/2020	16	32	AGCR	L				S
LQ	Upland	1	6/29/2020	16.5	33	AGCR	L				S
LQ	Upland	1	6/29/2020	17	34	AGCR	VIAM	L			S
LQ	Upland	1	6/29/2020	17.5	35	AGCR	L				S
LQ	Upland	1	6/29/2020	18	36	AGCR	L				S
LQ	Upland	1	6/29/2020	18.5	37	AGCR	L				S
LQ	Upland	1	6/29/2020	19	38	PASM	L				S
LQ	Upland	1	6/29/2020	19.5	39	AGCR	L				S
LQ	Upland	1	6/29/2020	20	40	POPR	L				S
LQ	Upland	1	6/29/2020	20.5	41	AGCR	L				S
LQ	Upland	1	6/29/2020	21	42	AGCR	L				S
LQ	Upland	1	6/29/2020	21.5	43	PASM	L				S
LQ	Upland	1	6/29/2020	22	44	PASM	L				S
LQ	Upland	1	6/29/2020	22.5	45	None	L	POPR	L		S
LQ	Upland	1	6/29/2020	23	46	PASM	L				S
LQ	Upland	1	6/29/2020	23.5	47	PASM	L				S
LQ	Upland	1	6/29/2020	24	48	None	L	PASM			S
LQ	Upland	1	6/29/2020	24.5	49	AGCR	L				S
LQ	Upland	1	6/29/2020	25	50	PASM	L				S

LQ	Upland	2	6/29/2020	0.5	1	None	L		S
LQ	Upland	2	6/29/2020	1	2	None	L		S
LQ	Upland	2	6/29/2020	1.5	3	AGCR	L		S
LQ	Upland	2	6/29/2020	2	4	AGCR	L		S
LQ	Upland	2	6/29/2020	2.5	5	AGCR	ARFR4	L	S
LQ	Upland	2	6/29/2020	3	6	AGCR	L		S
LQ	Upland	2	6/29/2020	3.5	7	None	L		S
LQ	Upland	2	6/29/2020	4	8	AGCR	L		S
LQ	Upland	2	6/29/2020	4.5	9	AGCR	L		S
LQ	Upland	2	6/29/2020	5	10	None	L		S
LQ	Upland	2	6/29/2020	5.5	11	None	L		S
LQ	Upland	2	6/29/2020	6	12	None	L	AGCR L	S
LQ	Upland	2	6/29/2020	6.5	13	None	L		S
LQ	Upland	2	6/29/2020	7	14	AGCR	L		S
LQ	Upland	2	6/29/2020	7.5	15	AGCR	L		S
LQ	Upland	2	6/29/2020	8	16	AGCR	L		S
LQ	Upland	2	6/29/2020	8.5	17	COAR4	L		S
LQ	Upland	2	6/29/2020	9	18	POPR	ARFR4		ARFR4
LQ	Upland	2	6/29/2020	9.5	19	AGCR	L		S
LQ	Upland	2	6/29/2020	10	20	AGCR	SPCO	L	S
LQ	Upland	2	6/29/2020	10.5	21	COAR4	L		S
LQ	Upland	2	6/29/2020	11	22	None	L		S
LQ	Upland	2	6/29/2020	11.5	23	AGCR	SPCO	NL NL	S
LQ	Upland	2	6/29/2020	12	24	AGCR	L		S
LQ	Upland	2	6/29/2020	12.5	25	None	AGCR	NL NL	S
LQ	Upland	2	6/29/2020	13	26	POPR	L		S
LQ	Upland	2	6/29/2020	13.5	27	AGCR	L		S
LQ	Upland	2	6/29/2020	14	28	AGCR	L		S
LQ	Upland	2	6/29/2020	14.5	29	AGCR	L		S
LQ	Upland	2	6/29/2020	15	30	AGCR	MELU	L	S
LQ	Upland	2	6/29/2020	15.5	31	ARFR4			D
LQ	Upland	2	6/29/2020	16	32	COAR4	L		S
LQ	Upland	2	6/29/2020	16.5	33	AGCR	L		S
LQ	Upland	2	6/29/2020	17	34	AGCR	L		S
LQ	Upland	2	6/29/2020	17.5	35	AGCR	L		S
LQ	Upland	2	6/29/2020	18	36	None	L		S
LQ	Upland	2	6/29/2020	18.5	37	AGCR	L		S
LQ	Upland	2	6/29/2020	19	38	None	L	AGCR L	S
LQ	Upland	2	6/29/2020	19.5	39	AGCR	L		S
LQ	Upland	2	6/29/2020	20	40	AGCR	MESA	L	S
LQ	Upland	2	6/29/2020	20.5	41	AGCR	L		S
LQ	Upland	2	6/29/2020	21	42	AGCR	L		S
LQ	Upland	2	6/29/2020	21.5	43	MELU	L		S
LQ	Upland	2	6/29/2020	22	44	MELU	L		S
LQ	Upland	2	6/29/2020	22.5	45	COAR4	AGCR	L	S
LQ	Upland	2	6/29/2020	23	46	AGCR	L		S
LQ	Upland	2	6/29/2020	23.5	47	MESA	AGCR	L	S
LQ	Upland	2	6/29/2020	24	48	AGCR	L		S
LQ	Upland	2	6/29/2020	24.5	49	ARFR4	COAR4	L	S
LQ	Upland	2	6/29/2020	25	50	AGCR	ARFR4	L	S

LQ	Upland	3	6/30/2020	1	2	AGCR	L			S
LQ	Upland	3	6/30/2020	1.5	3	AGCR	L			S
LQ	Upland	3	6/30/2020	2	4	AGCR	L			S
LQ	Upland	3	6/30/2020	2.5	5	AGCR	L			S
LQ	Upland	3	6/30/2020	3	6	AGCR	L			S
LQ	Upland	3	6/30/2020	3.5	7	AGCR	L			S
LQ	Upland	3	6/30/2020	4	8	AGCR	L			S
LQ	Upland	3	6/30/2020	4.5	9	AGCR	MELU	L		S
LQ	Upland	3	6/30/2020	5	10	AGCR	L			S
LQ	Upland	3	6/30/2020	5.5	11	AGCR	L			S
LQ	Upland	3	6/30/2020	6	12	AGCR	L			S
LQ	Upland	3	6/30/2020	6.5	13	PASM	L			S
LQ	Upland	3	6/30/2020	7	14	AGCR	L			S
LQ	Upland	3	6/30/2020	7.5	15	AGCR	L			S
LQ	Upland	3	6/30/2020	8	16	AGCR	L			S
LQ	Upland	3	6/30/2020	8.5	17	AGCR	L			S
LQ	Upland	3	6/30/2020	9	18	PASM	MELU	L		S
LQ	Upland	3	6/30/2020	9.5	19	AGCR	L			S
LQ	Upland	3	6/30/2020	10	20	AGCR	L			S
LQ	Upland	3	6/30/2020	10.5	21	AGCR	L			S
LQ	Upland	3	6/30/2020	11	22	AGCR	L			S
LQ	Upland	3	6/30/2020	11.5	23	AGCR	L			S
LQ	Upland	3	6/30/2020	12	24	AGCR	L			S
LQ	Upland	3	6/30/2020	12.5	25	AGCR	L			S
LQ	Upland	3	6/30/2020	13	26	AGCR	L			S
LQ	Upland	3	6/30/2020	13.5	27	AGCR	L			S
LQ	Upland	3	6/30/2020	14	28	AGCR	L			S
LQ	Upland	3	6/30/2020	14.5	29	AGCR	L			S
LQ	Upland	3	6/30/2020	15	30	MESA	L			S
LQ	Upland	3	6/30/2020	15.5	31	AGCR	L			S
LQ	Upland	3	6/30/2020	16	32	AGCR	L			S
LQ	Upland	3	6/30/2020	16.5	33	AGCR	L			S
LQ	Upland	3	6/30/2020	17	34	None	L	AGCR	L	S
LQ	Upland	3	6/30/2020	17.5	35	AGCR	L			S
LQ	Upland	3	6/30/2020	18	36	AGCR	L			S
LQ	Upland	3	6/30/2020	18.5	37	AGCR	L			S
LQ	Upland	3	6/30/2020	19	38	AGCR	MELU	L		S
LQ	Upland	3	6/30/2020	19.5	39	AGCR	L			S
LQ	Upland	3	6/30/2020	20	40	AGCR	L			S
LQ	Upland	3	6/30/2020	20.5	41	AGCR	L			S
LQ	Upland	3	6/30/2020	21	42	AGCR	L			S
LQ	Upland	3	6/30/2020	21.5	43	None	L	AGCR	L	S
LQ	Upland	3	6/30/2020	22	44	AGCR	L			S
LQ	Upland	3	6/30/2020	22.5	45	AGCR	L			S
LQ	Upland	3	6/30/2020	23	46	AGCR	L			S
LQ	Upland	3	6/30/2020	23.5	47	AGCR	L			S
LQ	Upland	3	6/30/2020	24	48	AGCR	L			S
LQ	Upland	3	6/30/2020	24.5	49	AGCR	L			S
LQ	Upland	3	6/30/2020	25	50	AGCR	L			S

Site	Plot	Line	Date	PointLoc	PointNbr	TopCanopy	Lower1	Lower2	Lower3	Lower4	SoilSurface
LQ	Woodland	1	6/29/2020	0.5	1	None	POPR	L			S
LQ	Woodland	1	6/29/2020	1	2	PASM	L				S
LQ	Woodland	1	6/29/2020	1.5	3	None	L				S
LQ	Woodland	1	6/29/2020	2	4	None	L	WL			S
LQ	Woodland	1	6/29/2020	2.5	5	None	L				S
LQ	Woodland	1	6/29/2020	3	6	PASM	L				S
LQ	Woodland	1	6/29/2020	3.5	7	POPR	L				S
LQ	Woodland	1	6/29/2020	4	8	None	L				S
LQ	Woodland	1	6/29/2020	4.5	9	NAVI4	L				ST
LQ	Woodland	1	6/29/2020	5	10	BRIN2	POPR	L			S
LQ	Woodland	1	6/29/2020	5.5	11	None	L				S
LQ	Woodland	1	6/29/2020	6	12	SILA21	L				S
LQ	Woodland	1	6/29/2020	6.5	13	POPR	L				S
LQ	Woodland	1	6/29/2020	7	14	POPR	L				S
LQ	Woodland	1	6/29/2020	7.5	15	POPR	L				S
LQ	Woodland	1	6/29/2020	8	16	None	L				S
LQ	Woodland	1	6/29/2020	8.5	17	BRIN2	L				S
LQ	Woodland	1	6/29/2020	9	18	BRIN2	L				S
LQ	Woodland	1	6/29/2020	9.5	19	PIPO	BRIN2	POPR	L		S
LQ	Woodland	1	6/29/2020	10	20	PIPO	POPR	L			S
LQ	Woodland	1	6/29/2020	10.5	21	PIPO	BRIN2	PASM	L		S
LQ	Woodland	1	6/29/2020	11	22	PIPO	L				S
LQ	Woodland	1	6/29/2020	11.5	23	PIPO	POPR	L			S
LQ	Woodland	1	6/29/2020	12	24	PIPO	BRIN2	BRIN2	L		S
LQ	Woodland	1	6/29/2020	12.5	25	PIPO	L				S
LQ	Woodland	1	6/29/2020	13	26	PIPO	L	BRIN2	L		S
LQ	Woodland	1	6/29/2020	13.5	27	POPR	L				S
LQ	Woodland	1	6/29/2020	14	28	POPR	L				S
LQ	Woodland	1	6/29/2020	14.5	29	POPR	L				S
LQ	Woodland	1	6/29/2020	15	30	POPR	L				S
LQ	Woodland	1	6/29/2020	15.5	31	PIPO	L				S
LQ	Woodland	1	6/29/2020	16	32	PIPO	POPR	L			S
LQ	Woodland	1	6/29/2020	16.5	33	PIPO	L				S
LQ	Woodland	1	6/29/2020	17	34	PIPO	PIPO	PASM	L		S
LQ	Woodland	1	6/29/2020	17.5	35	PIPO	PIPO	POPR	L		S
LQ	Woodland	1	6/29/2020	18	36	PIPO	PIPO	L			S
LQ	Woodland	1	6/29/2020	18.5	37	PIPO	L				S
LQ	Woodland	1	6/29/2020	19	38	PIPO	L				S
LQ	Woodland	1	6/29/2020	19.5	39	PIPO	L				S
LQ	Woodland	1	6/29/2020	20	40	PIPO	ROWO	L			S
LQ	Woodland	1	6/29/2020	20.5	41	PIPO	PASM	L			S
LQ	Woodland	1	6/29/2020	21	42	PIPO	PASM	POPR	L		S
LQ	Woodland	1	6/29/2020	21.5	43	PIPO	L				S
LQ	Woodland	1	6/29/2020	22	44	PIPO	L				S
LQ	Woodland	1	6/29/2020	22.5	45	None	L				S
LQ	Woodland	1	6/29/2020	23	46	None	L				S
LQ	Woodland	1	6/29/2020	23.5	47	None	L				S
LQ	Woodland	1	6/29/2020	24	48	PIPO	PASM	L			S
LQ	Woodland	1	6/29/2020	24.5	49	PIPO	PIPO	L			S
LQ	Woodland	1	6/29/2020	25	50	PIPO	POPR	L			S

LQ	Woodland	2	6/30/2020	0.5	1	None	WL	L		S
LQ	Woodland	2	6/30/2020	1	2	BRIN2	L			S
LQ	Woodland	2	6/30/2020	1.5	3	BRIN2	L			S
LQ	Woodland	2	6/30/2020	2	4	APAN2	L			S
LQ	Woodland	2	6/30/2020	2.5	5	PIPO	L	WL		S
LQ	Woodland	2	6/30/2020	3	6	PIPO	BRIN2	L		S
LQ	Woodland	2	6/30/2020	3.5	7	PIPO	POPR	L		S
LQ	Woodland	2	6/30/2020	4	8	PIPO	BRIN2	POPR	L	S
LQ	Woodland	2	6/30/2020	4.5	9	PIPO	L	PASM	L	S
LQ	Woodland	2	6/30/2020	5	10	PIPO	PASM	L		S
LQ	Woodland	2	6/30/2020	5.5	11	PIPO	L			S
LQ	Woodland	2	6/30/2020	6	12	PIPO	NAVI4	APAN2	L	S
LQ	Woodland	2	6/30/2020	6.5	13	PIPO	L			S
LQ	Woodland	2	6/30/2020	7	14	PIPO	L			S
LQ	Woodland	2	6/30/2020	7.5	15	POPR	L			S
LQ	Woodland	2	6/30/2020	8	16	None	L	POPR	L	S
LQ	Woodland	2	6/30/2020	8.5	17	POPR	L			S
LQ	Woodland	2	6/30/2020	9	18	None	L			S
LQ	Woodland	2	6/30/2020	9.5	19	APAN2	L			S
LQ	Woodland	2	6/30/2020	10	20	NAVI4	L			S
LQ	Woodland	2	6/30/2020	10.5	21	PASM	L			S
LQ	Woodland	2	6/30/2020	11	22	PASM	L			S
LQ	Woodland	2	6/30/2020	11.5	23	HECO26	L			S
LQ	Woodland	2	6/30/2020	12	24	AF14	HECO26	L		S
LQ	Woodland	2	6/30/2020	12.5	25	None	L			S
LQ	Woodland	2	6/30/2020	13	26	HECO26	L			S
LQ	Woodland	2	6/30/2020	13.5	27	HECO26	AF05	L		S
LQ	Woodland	2	6/30/2020	14	28	None	L			S
LQ	Woodland	2	6/30/2020	14.5	29	POPR	AF14	L		S
LQ	Woodland	2	6/30/2020	15	30	HECO26	L			S
LQ	Woodland	2	6/30/2020	15.5	31	PASM	L			S
LQ	Woodland	2	6/30/2020	16	32	NAVI4	L			S
LQ	Woodland	2	6/30/2020	16.5	33	None	L	POPR	L	S
LQ	Woodland	2	6/30/2020	17	34	None	L	HECO26	L	S
LQ	Woodland	2	6/30/2020	17.5	35	PASM	HECO26	L		S
LQ	Woodland	2	6/30/2020	18	36	NAVI4	L			S
LQ	Woodland	2	6/30/2020	18.5	37	None	L			S
LQ	Woodland	2	6/30/2020	19	38	None	L	POPR	L	S
LQ	Woodland	2	6/30/2020	19.5	39	None	L	PASM	L	S
LQ	Woodland	2	6/30/2020	20	40	None	L			S
LQ	Woodland	2	6/30/2020	20.5	41	PIPO	PASM	L		ST
LQ	Woodland	2	6/30/2020	21	42	PIPO	BRIN2	L		S
LQ	Woodland	2	6/30/2020	21.5	43	PIPO	L			S
LQ	Woodland	2	6/30/2020	22	44	PIPO	L			S
LQ	Woodland	2	6/30/2020	22.5	45	PIPO	BRIN2	L		S
LQ	Woodland	2	6/30/2020	23	46	PIPO	BRIN2	L		S
LQ	Woodland	2	6/30/2020	23.5	47	PIPO	L			S
LQ	Woodland	2	6/30/2020	24	48	PIPO	L			S
LQ	Woodland	2	6/30/2020	24.5	49	PIPO	L			S
LQ	Woodland	2	6/30/2020	25	50	PIPO	L			S
LQ	Woodland	3	6/30/2020	0.5	1	BOGR2	L			S

LQ	Woodland	3	6/30/2020	1	2	BOGR2	WL		BY
LQ	Woodland	3	6/30/2020	1.5	3	NAVI4	L		S
LQ	Woodland	3	6/30/2020	2	4	None			GR
LQ	Woodland	3	6/30/2020	2.5	5	None	L		S
LQ	Woodland	3	6/30/2020	3	6	BOGR2	L		S
LQ	Woodland	3	6/30/2020	3.5	7	NAVI4			S
LQ	Woodland	3	6/30/2020	4	8	NAVI4	TEAC	L	S
LQ	Woodland	3	6/30/2020	4.5	9	None	L		S
LQ	Woodland	3	6/30/2020	5	10	None	L		S
LQ	Woodland	3	6/30/2020	5.5	11	SCSC	L		S
LQ	Woodland	3	6/30/2020	6	12	None	L		CB
LQ	Woodland	3	6/30/2020	6.5	13	BOGR2			S
LQ	Woodland	3	6/30/2020	7	14	AF17	L		S
LQ	Woodland	3	6/30/2020	7.5	15	None			S
LQ	Woodland	3	6/30/2020	8	16	BOGR2	L		S
LQ	Woodland	3	6/30/2020	8.5	17	SCSC	L		S
LQ	Woodland	3	6/30/2020	9	18	ARFR4	L		S
LQ	Woodland	3	6/30/2020	9.5	19	SCSC	MELU	L	S
LQ	Woodland	3	6/30/2020	10	20	BOGR2	L		S
LQ	Woodland	3	6/30/2020	10.5	21	BOGR2	L		S
LQ	Woodland	3	6/30/2020	11	22	SCSC			SCSC
LQ	Woodland	3	6/30/2020	11.5	23	SCSC	POPR	L	S
LQ	Woodland	3	6/30/2020	12	24	None	WL		S
LQ	Woodland	3	6/30/2020	12.5	25	SCSC	BOGR2		S
LQ	Woodland	3	6/30/2020	13	26	BOGR2	L		S
LQ	Woodland	3	6/30/2020	13.5	27	None	L		S
LQ	Woodland	3	6/30/2020	14	28	None	L		S
LQ	Woodland	3	6/30/2020	14.5	29	SCSC	ARFR4	L	S
LQ	Woodland	3	6/30/2020	15	30	SCSC	L		GR
LQ	Woodland	3	6/30/2020	15.5	31	None	L		GR
LQ	Woodland	3	6/30/2020	16	32	SCSC	L		S
LQ	Woodland	3	6/30/2020	16.5	33	BRIN2	L		S
LQ	Woodland	3	6/30/2020	17	34	None			BY
LQ	Woodland	3	6/30/2020	17.5	35	None	L		LC
LQ	Woodland	3	6/30/2020	18	36	None			GR
LQ	Woodland	3	6/30/2020	18.5	37	SCSC			GR
LQ	Woodland	3	6/30/2020	19	38	None	L		LC
LQ	Woodland	3	6/30/2020	19.5	39	None	L		GR
LQ	Woodland	3	6/30/2020	20	40	ARFR4	SCSC	L	S
LQ	Woodland	3	6/30/2020	20.5	41	BOGR2	L		S
LQ	Woodland	3	6/30/2020	21	42	BOGR2			GR
LQ	Woodland	3	6/30/2020	21.5	43	BOGR2	L		S
LQ	Woodland	3	6/30/2020	22	44	None			BY
LQ	Woodland	3	6/30/2020	22.5	45	None			LC
LQ	Woodland	3	6/30/2020	23	46	BOGR2			S
LQ	Woodland	3	6/30/2020	23.5	47	BOGR2			S
LQ	Woodland	3	6/30/2020	24	48	BOGR2			S
LQ	Woodland	3	6/30/2020	24.5	49	None	L		M
LQ	Woodland	3	6/30/2020	25	50	BOGR2			S

Notes: BY=boulder CB=cobble; D=duff; GR=gravel; L=herbaceous litter; LC=Lichen; M=moss; R=rock S=soil; ST=stone

Addendum 1-10. Loring Quarry Raw Species Richness Belt Transect Data

SiteID	SiteName	PlotID	FormDate	LineID	SubPlotID	SubPlotDesc	SpeciesCount
LQ	**Loring Quarry**	**Lowland**	**06/29/20**	**1**	**1**	**Belt Transect 1**	**17**
ACHY	Achnatherum hymenoides (Roem. & Schult.) Barkworth						
AF05							
ARLU	Artemisia ludoviciana Nutt.						
BRAR5	Bromus arvensis L.						
BRIN2	Bromus inermis Leyss.						
CAREX	Carex L.						
CHLE4	Chenopodium leptophyllum (Moq.) Nutt. ex S. Watson						
COAR4	Convolvulus arvensis L.						
IRMI	Iris missouriensis Nutt.						
MESA	Medicago sativa L.						
PASM	Pascopyrum smithii (Rydb.) Ã�LÃ¶ve						
PEAR6	Pediomelum argophyllum (Pursh) J. Grimes						
POPR	Poa pratensis L.						
ROWO	Rosa woodsii Lindl.						
RUAQ	Rumex aquaticus L.						
THRH	Thermopsis rhombifolia (Nutt. ex Pursh) Nutt. ex Richardson						
VEST	Verbena stricta Vent.						
LQ	**Loring Quarry**	**Lowland**	**06/29/20**	**2**	**1**	**Belt Transect 2**	**17**
ACMI2	Achillea millefolium L.						
AF05							
AGCR	Agropyron cristatum (L.) Gaertn.						
APAN2	Apocynum androsaemifolium L.						
ARLU	Artemisia ludoviciana Nutt.						
BRAR5	Bromus arvensis L.						
BRTE	Bromus tectorum L.						
CHLE4	Chenopodium leptophyllum (Moq.) Nutt. ex S. Watson						
COAR4	Convolvulus arvensis L.						
IRMI	Iris missouriensis Nutt.						
MESA	Medicago sativa L.						
NAVI4	Nassella viridula (Trin.) Barkworth						
PASM	Pascopyrum smithii (Rydb.) Ã�LÃ¶ve						
POPR	Poa pratensis L.						
ROWO	Rosa woodsii Lindl.						
THAR5	Thlaspi arvense L.						
VEST	Verbena stricta Vent.						
LQ	**Loring Quarry**	**Lowland**	**06/30/20**	**3**	**1**	**Belt Transect 3**	**20**
AF05							
AGCR	Agropyron cristatum (L.) Gaertn.						
ARLU	Artemisia ludoviciana Nutt.						
BRAR5	Bromus arvensis L.						
BRIN2	Bromus inermis Leyss.						
BRTE	Bromus tectorum L.						
CHLE4	Chenopodium leptophyllum (Moq.) Nutt. ex S. Watson						
COAR4	Convolvulus arvensis L.						
ECAN2	Echinacea angustifolia DC.						
IRMI	Iris missouriensis Nutt.						
MELU	Medicago lupulina L.						
MESA	Medicago sativa L.						
NAVI4	Nassella viridula (Trin.) Barkworth						
PASM	Pascopyrum smithii (Rydb.) Ã�LÃ¶ve						
PEAR6	Pediomelum argophyllum (Pursh) J. Grimes						
POPR	Poa pratensis L.						
RACO3	Ratibida columnifera (Nutt.) Wooton & Standl.						
ROWO	Rosa woodsii Lindl.						
SILA21	Silene latifolia Poir.						
VEST	Verbena stricta Vent.						

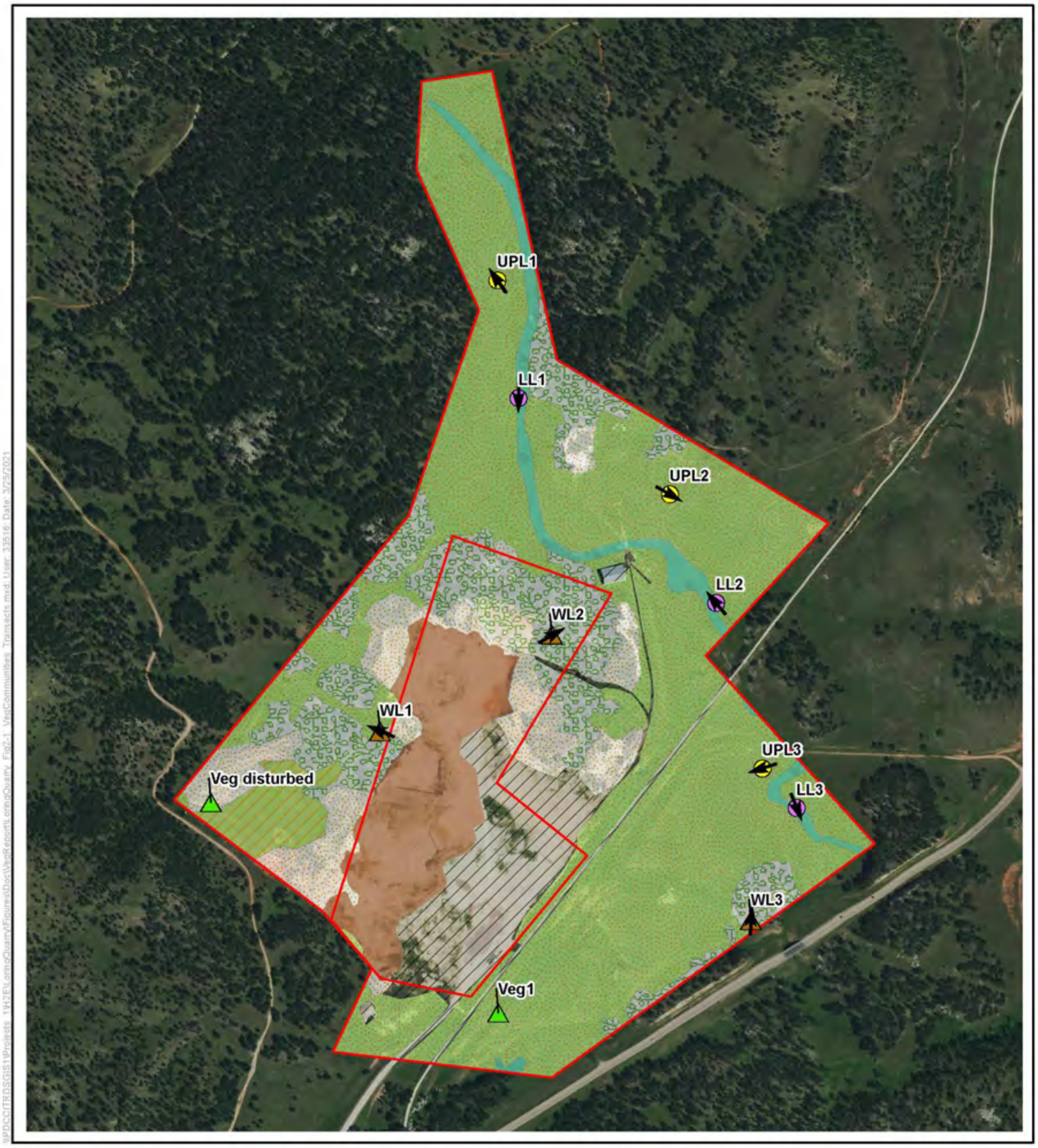
SiteID	SiteName	PlotID	FormDate	LineID	SubPlotID	SubPlotDesc	SpeciesCount
LQ	**Loring Quarry**	**Upland**	**06/29/20**	**1**	**1**	**Belt Transect 1**	**16**
AGCR	Agropyron cristatum (L.) Gaertn.						
ARFR4	Artemisia frigida Willd.						
BRAR5	Bromus arvensis L.						
BRTE	Bromus tectorum L.						
COAR4	Convolvulus arvensis L.						
DEPI	Descurainia pinnata (Walter) Britton						
ECAN2	Echinacea angustifolia						
MELU	Medicago lupulina L.						
MESA	Medicago sativa L.						
PASM	Pascopyrum smithii (Rydb.) Ã□LÃ¶ve						
PEAR6	Pediomelum argophyllum (Pursh) J. Grimes						
POPR	Poa pratensis L.						
SILA21	Silene latifolia Poir.						
SPCO	Sphaeralcea coccinea (Nutt.) Rydb.						
TRDU	Tragopogon dubius Scop.						
VIAM	Vicia americana Muhl. ex Willd.						
LQ	**Loring Quarry**	**Upland**	**06/29/20**	**2**	**1**	**Belt Transect 2**	**17**
AF05							
AF19							
AGCR	Agropyron cristatum (L.) Gaertn.						
ARFR4	Artemisia frigida Willd.						
COAR4	Convolvulus arvensis L.						
ECAN2	Echinacea angustifolia DC.						
ERST3	Erigeron strigosus Muhl. ex Willd.						
GRSQ	Grindelia squarrosa (Pursh) Dunal						
GUSA2	Gutierrezia sarothrae (Pursh) Britton & Rusby						
HECO26	Hesperostipa comata (Trin. & Rupr.) Barkworth						
IRMI	Iris missouriensis Nutt.						
MELU	Medicago lupulina L.						
MESA	Medicago sativa L.						
PEAR6	Pediomelum argophyllum (Pursh) J. Grimes						
POPR	Poa pratensis L.						
RACO3	Ratibida columnifera (Nutt.) Wooton & Standl.						
SPCO	Sphaeralcea coccinea (Nutt.) Rydb.						
LQ	**Loring Quarry**	**Upland**	**06/30/20**	**3**	**1**	**Belt Transect 3**	**6**
AGCR	Agropyron cristatum (L.) Gaertn.						
COAR4	Convolvulus arvensis L.						
MELU	Medicago lupulina L.						
MESA	Medicago sativa L.						
PASM	Pascopyrum smithii (Rydb.) Ã□LÃ¶ve						
POPR	Poa pratensis L.						

SiteID	SiteName	PlotID	FormDate	LineID	SubPlotID	SubPlotDesc	SpeciesCount
LQ	**Loring Quarry**	**Woodland**	**06/29/20**	**1**	**1**	**Belt Transect 1**	**13**
AF11							
BRIN2	Bromus inermis Leyss.						
CHLE4	Chenopodium leptophyllum (Moq.) Nutt. ex S. Watson						
ERSTS2	Erigeron strigosus Muhl. ex Willd. var. strigosus						
NAVI4	Nassella viridula (Trin.) Barkworth						
PASM	Pascopyrum smithii (Rydb.) ÃLÃ¶ve						
PEAR6	Pediomelum argophyllum (Pursh) J. Grimes						
PIPO	Pinus ponderosa Lawson & C. Lawson						
POPR	Poa pratensis L.						
ROWO	Rosa woodsii Lindl.						
SILA21	Silene latifolia Poir.						
VIAM	Vicia americana Muhl. ex Willd.						
LQ	**Loring Quarry**	**Woodland**	**06/30/20**	**2**	**1**	**Belt Transect 2**	**25**
ACMI2	Achillea millefolium L.						
AF05							
AF14							
APAN2	Apocynum androsaemifolium L.						
ARFR4	Artemisia frigida Willd.						
ARLU	Artemisia ludoviciana Nutt.						
BRIN2	Bromus inermis Leyss.						
CARO2	Campanula rotundifolia L.						
CHLE4	Chenopodium leptophyllum (Moq.) Nutt. ex S. Watson						
DEPI	Descurainia pinnata (Walter) Britton						
ECAN2	Echinacea angustifolia DC.						
HECO26	Hesperostipa comata (Trin. & Rupr.) Barkworth						
KOMA	Koeleria macrantha (Ledeb.) Schult.						
MELU	Medicago lupulina L.						
NAVI4	Nassella viridula (Trin.) Barkworth						
PASM	Pascopyrum smithii (Rydb.) ÃLÃ¶ve						
PEAR6	Pediomelum argophyllum (Pursh) J. Grimes						
PIPO	Pinus ponderosa Lawson & C. Lawson						
POAL4	Polygala alba Nutt.						
POPR	Poa pratensis L.						
RHAR4	Rhus aromatica Aiton						
RIOX	Ribes oxyacanthoides L.						
SILA21	Silene latifolia Poir.						
SPCO	Sphaeralcea coccinea (Nutt.) Rydb.						
VIAM	Vicia americana Muhl. ex Willd.						

LQ	**Loring Quarry**	**Woodland**	**06/30/20**	**3**	**1 Belt Transect 3**	**31**
AF05						
AF17						
AF18						
AF19						
APAN2	Apocynum androsaemifolium L.					
ARFR4	Artemisia frigida Willd.					
ARLU	Artemisia ludoviciana Nutt.					
BOGR2	Bouteloua gracilis (Willd. ex Kunth) Lag. ex Griffiths					
BRAR5	Bromus arvensis L.					
BRIN2	Bromus inermis Leyss.					
CAFI	Carex filifolia Nutt.					
CARO2	Campanula rotundifolia L.					
CIUN	Cirsium undulatum (Nutt.) Spreng.					
ERFL4	Eriogonum flavum Nutt.					
HECO26	Hesperostipa comata (Trin. & Rupr.) Barkworth					
MELU	Medicago lupulina L.					
NAVAR	Navarretia Ruiz & Pav.					
NAVI4	Nassella viridula (Trin.) Barkworth					
OPPO	Opuntia polyacantha Haw.					
PASM	Pascopyrum smithii (Rydb.) Ã̈LÃ¶ve					
PEAR6	Pediomelum argophyllum (Pursh) J. Grimes					
PHHO	Phlox hoodii Richardson					
PIPO	Pinus ponderosa Lawson & C. Lawson					
PLPA2	Plantago patagonica Jacq.					
POPR	Poa pratensis L.					
RHAR4	Rhus aromatica Aiton					
RIOX	Ribes oxyacanthoides L.					
ROWO	Rosa woodsii Lindl.					
SCSC	Schizachyrium scoparium (Michx.) Nash					
SILA21	Silene latifolia Poir.					
TEAC	Tetraneuris acaulis (Pursh) Greene					

Addendum 2
Figures

Addendum 2-1. Figure 2-1. Loring Quarry Vegetation Communities and Transects



Field Point
- Lowland
- Upland
- Vegetation
- Woodland
- Transect Direction

Project Area

Vegetation Communities
- Disturbed - Infrastructure, gravel piles
- Disturbed - Pit
- Disturbed - Spoil, topsoil,etc
- Disturbed Grassland
- Upland Grassland
- Lowland Grassland
- Woodland

N

0 330 660 Feet

Source: H2E 2020; ICF 2020

Figure 2-1
Vegetation Communities and Transect Locations

Addendum 2-2. Figure 2-2. Loring Quarry Ecological Site Descriptions and Transect Locations

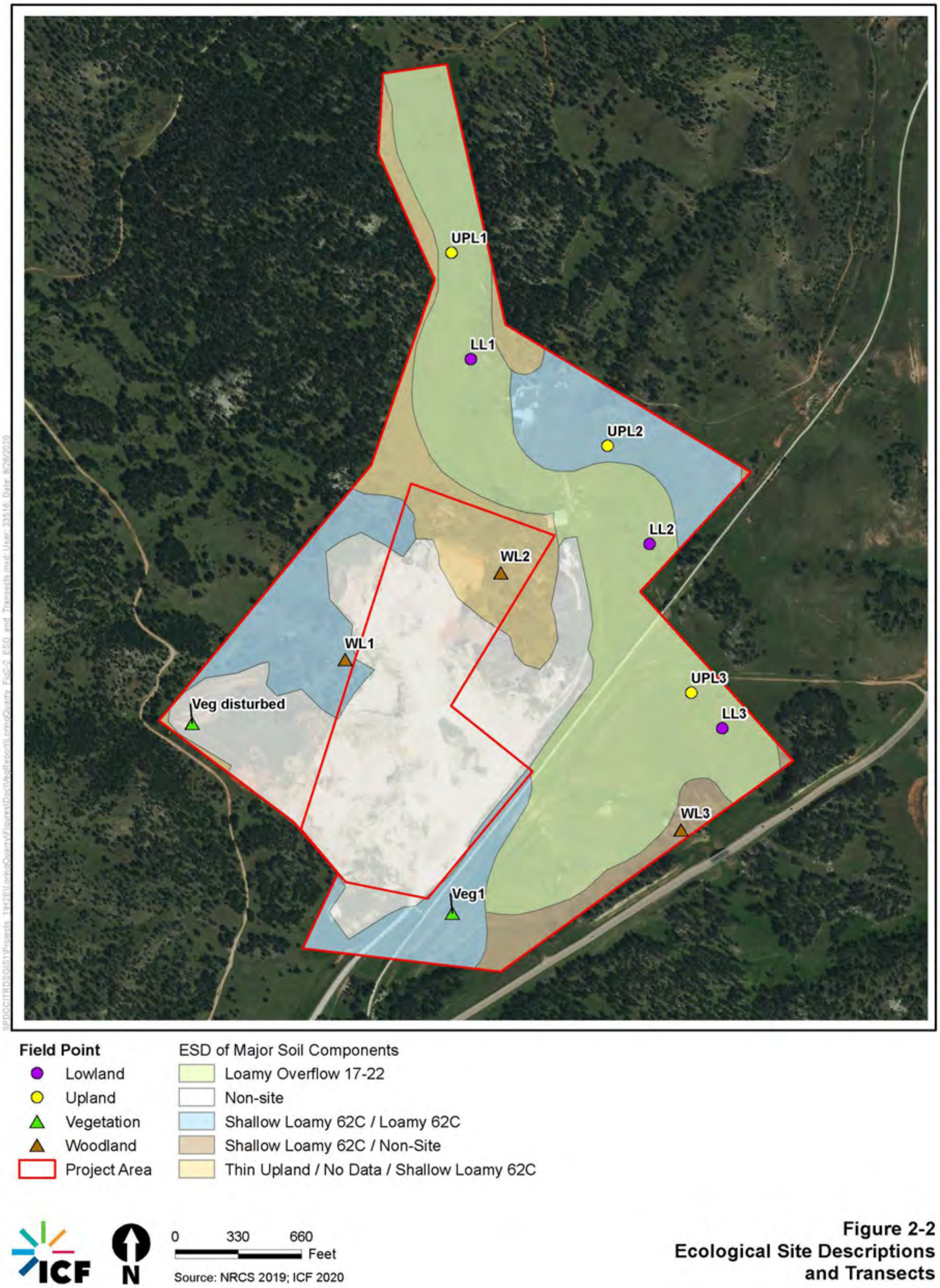


Figure 2-2
Ecological Site Descriptions and Transects

Addendum 2-3. Figure 2-3. Loring Quarry Tree Canopy Cover

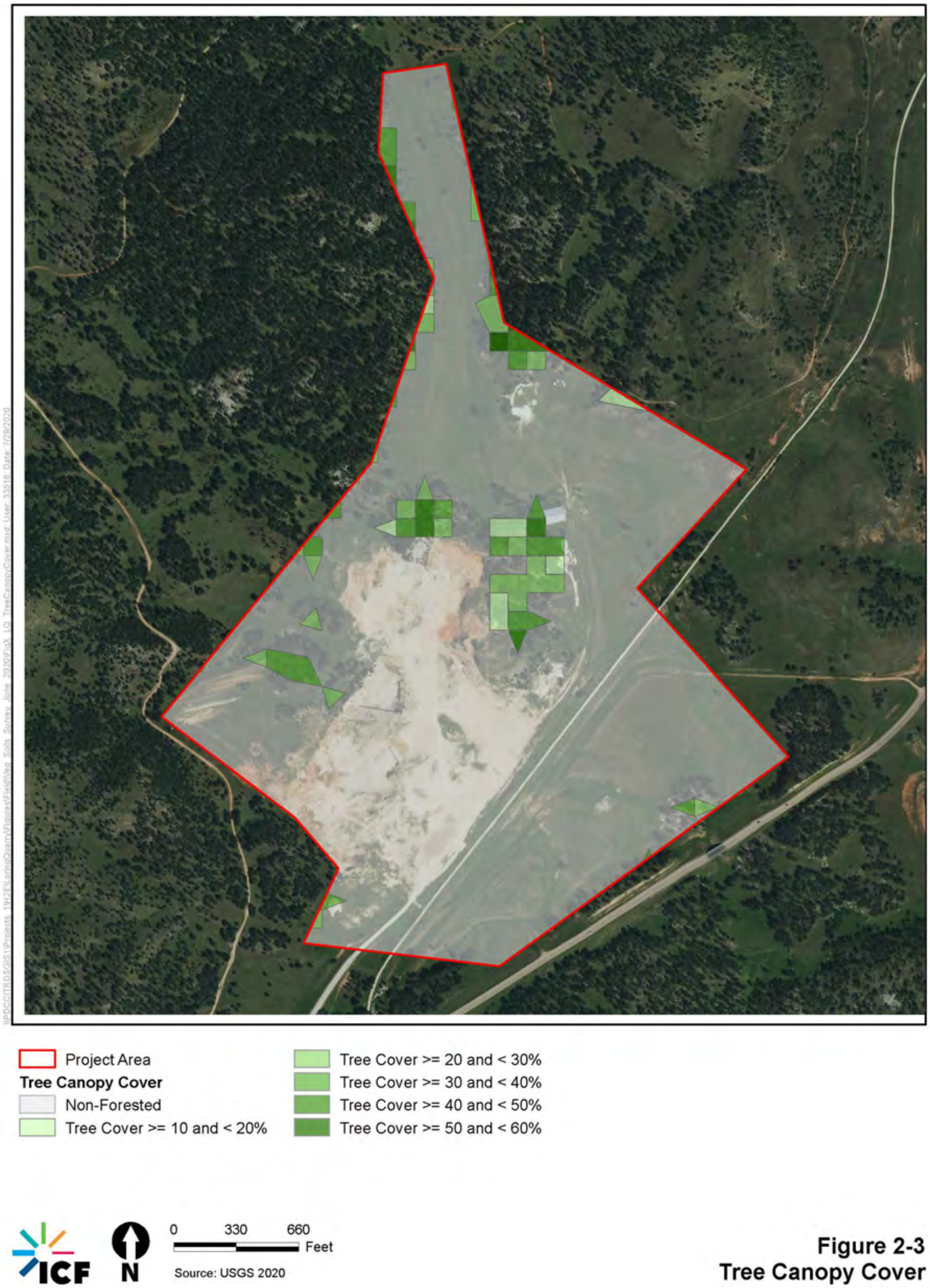


Figure 2-3
Tree Canopy Cover

Addendum 3
Photos

Addendum 3-1. Loring Quarry Lowland Grassland Transects and General View

Photo 1. Transect: LL1, Date: 6/29/20

Photo 2. Transect LL1- General view northeast

Photo 3. Transect LL1- General view southeast

Photo 4. Transect: LL2, Date: 6/29/20

Photo 5. Transect LL2 –General view west

Photo 6. Transect LL2 –General view southeast

Photo 7. Transect: LL3, Date: 6/30/20

Photo 8. Transect LL3 –General view southwest

Addendum 3-2. Loring Quarry Upland Grassland Transects and General View

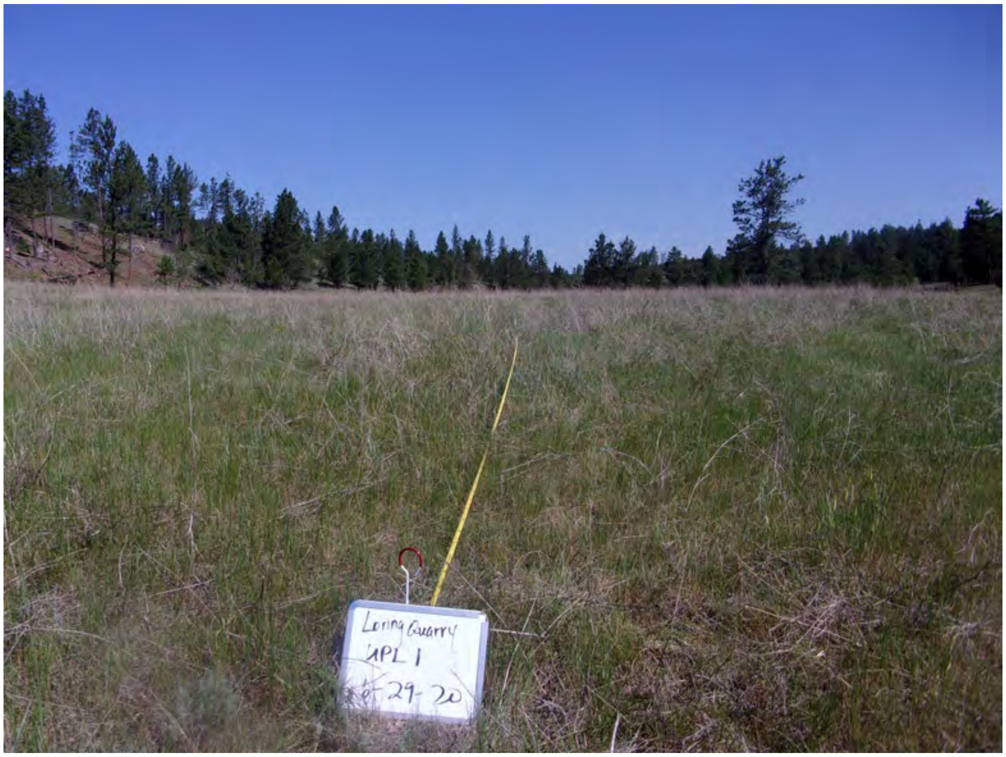


Photo 1. Transect: UPL1, Date: 6/29/20

Photo 2. Transect UPL1 – General view north.

Photo 3. Transect UPL1 – General view south

Photo 4. Transect: UPL2, Date: 6/29/20

Photo 5. Transect UPL2 – General view north

Photo 6. Transect UPL2 – General view west

Photo 7. Transect UPL2 – General view south

Photo 8. Transect: UPL3, Date: 6/30/20

Addendum 3-3. Loring Quarry Woodland Transects and General Views

Photo 1. Transect: WL1, Date: 6/29/20

Photo 2. Transect WL1- General view north

Photo 3. Transect WL1- General view south

Photo 4. Transect: WL2, Date: 6/30/20

Photo 5. Transect WL2- General view north

Photo 6. Transect WL2- General view south

Photo 7. Transect WL3, Date: 6/30/20

Photo 8. Site: Transect WL3 – General view south

Addendum 3-4. Loring Quarry General Views

Photo 1. Waypoint Vegetation 1, General view north, upland grassland

Photo 2. Waypoint Vegetation 1, General view south, upland grassland

Photo 3. Waypoint Disturbed Vegetation 1, General view southeast, disturbed area upland grassland

Photo 4. Waypoint Disturbed Vegetation 1, General view west, disturbed area upland grassland

Photo 5. Waypoint Disturbed Vegetation 1, General view northwest, disturbed area upland grassland

Addendum 4
Resumes

JEFFREY ABPLANALP

Wildlife Biologist

Jeff Abplanalp is a wildlife biologist with 10 years of experience. He specializes in providing terrestrial and aquatic wildlife and habitat mitigation consulting to the oil, natural gas, coal mining, wind farm, and uranium industries. He has extensive experience conducting ground based and aerial surveys for sage grouse, raptors, big game, and threatened and endangered species. He has contributed to several largescale oil and gas projects conducting pre-construction baseline wildlife and habitat inventory surveys. Jeff also has extensive experience in wildlife conflict, disease, and population management.

Years of Experience

- Professional start date: 05/2008
- ICF start date: 04/2013

Education

- BS, Wildlife and Fisheries Management and Biology, University of Wyoming, 2009

Professional Memberships

- Wildlife Society, 2007-2009
- American Fisheries Society, 2007-2009

Certifications/Other

- Site-Specific Hazard Training (Surface Coal, Metal, Non-metal, Mine Safety and Health Administration

Area of Expertise

- Terrestrial and aquatic wildlife and habitat baseline surveys

Project Experience

Oil and Natural Gas

Moneta Divide—Aethon Energy/Encana Oil and Gas and Burlington Resources, Fremont and Natrona Counties, WY, 04/2013 – 06/2013, 04/2014 – 06/2014

Field Biologist. Conduct ground based and aerial wildlife and habitat baseline inventory surveys for proposed natural gas project. Primary species surveyed include Greater sage-grouse, raptors, mountain plovers, big game, herptiles, and white-tailed prairie dog colonies.

Powder River Basin North—EOG Resources, Campbell and Johnson Counties, WY, 04/2019 – 06

Field Biologist. Conduct ground based and aerial wildlife and habitat surveys for proposed natural gas project. Primary species surveyed include greater sage-grouse, raptors, herptiles, and black-tailed prairie dog colonies.

Leavitt-Underwood—Devon Energy Corporation, Campbell County, WY, 04/2019 – Present

Field Biologist. Conduct ground-based wildlife surveys as part of plan of development. Primary species surveyed included raptors, mountain plovers, and black-tailed prairie dog colonies.

Cosner Fuller TLE—Devon Energy Corporation, Campbell County, WY, 04/2019 – Present

Field Biologist. Conduct ground-based wildlife surveys as part of plan of development. Primary species surveyed included raptors, mountain plovers, and black-tailed prairie dog colonies.

Mines and Quarries

Surface Coal Mine Wildlife Monitoring and Reporting—Navajo Transitional Energy Company, Antelope Mine, Campbell and Converse Counties, WY, 01/2020 – Present

Field Biologist. Conduct wildlife monitoring as part of mine and state DEQ monitoring and mitigation plan. Primary surveys conducted include golden eagle nest monitoring, bald eagle winter roost surveys, big game, lagomorph, and prairie dog colony surveys. Helped with drafting an avian mitigation plan and annual monitoring and conducted analysis of field data.

Surface Coal Mine Wildlife Monitoring and Reporting—Eagle Specialty Materials, Eagle Butte & Belle Ayr Mines, Campbell County, WY. 09/2020--Present

Field Biologist. Conduct wildlife monitoring as part of mine and state DEQ monitoring and mitigation plan. Primary surveys conducted include golden eagle nest monitoring, bald eagle winter roost surveys, big game, aquatic, lagomorph, and prairie dog colony surveys. Helped with drafting an avian mitigation plan and annual monitoring and conducted analysis of field data.

Willow Creek Uranium ISR Project Annual Wildlife Monitoring—Uranium One, Campbell and Johnson Counties, WY. 04/2019 – 06/2019

Field Biologist. Conduct wildlife monitoring as part of mine and state DEQ monitoring and mitigation plan. Primary surveys included Greater sage-grouse lek and raptor nest surveys. Helped with drafting annual monitoring and conducted analysis of field data.

Wind Energy Development

Maestro Wind Project—BayWa, Carbon County, WY. 08/2019-Present

Field Biologist. Conduct baseline wildlife surveys prior to wind farm development. Primary species surveyed included raptors, black-footed ferrets, and swift foxes.

Employment History

ICF. Wildlife Biologist. Gillette, WY. 04/2019 – Present.

Wyoming Game and Fish Department. Wildlife Damage Technician. Cody, WY. 05/2011 – 01/2019.

Big Horn Environmental Consultants. On-call Wildlife Biologist. Sheridan, WY. 04/2017 – 06/2017, 04/2018 – 06/2018.

Wyoming Game and Fish Department. Bird Farm Technician. Yoder, WY. 4/2015.

ICF. On-call Wildlife Biologist. Gillette, WY. 04/2013 – 06/2013, 04/2014 – 06/2014.

Wyoming Game and Fish Department. Aquatic Invasive Species Technician. Casper, WY. 5/2010 – 9/2010.

Wyoming Game and Fish Department. Fish Hatchery Technician. Boulder, WY. 05/2009 – 08/2009.

University of Wyoming. Fisheries Technician. Laramie, WY. 05/2008 – 10/2008.

KATIE WILSON

Project Role: Senior Biologist

Katie Wilson is a senior biologist specializing in wetland and vegetation assessments. She performs natural resource-based fieldwork to include field sampling, map review, global positioning systems (GPS) data collection, and technical report completion. Her fieldwork experience includes baseline vegetation, soil and wetland assessments, threatened and endangered (vegetation) surveys and habitat assessments, reclamation monitoring, and wetland delineations. Katie is responsible for data analysis and report writing for all aspects of fieldwork. She works extensively with different stakeholders to include: U.S. Bureau of Land Management (BLM), USDA Forest Service (Forest Service), Wyoming Department of Environmental Quality (WDEQ), U.S. Army Corps of Engineers (USACE); oil, gas, coal, and uranium mine operators; and private landowners to assess and mitigate the potential impacts of activities on regional flora, including federally threatened and endangered species and other species of management concern.

Prior to joining ICF, Katie spent 11 years as a wetland specialist and vegetation ecologist, as well as operations manager at a consulting firm in Gillette, Wyoming. Her duties included project management, managing budgets, client correspondence, data gathering, map review, field surveys, results analysis, data presentation, and report compilation. She has worked extensively on projects to conduct special-status plant surveys, floristic inventories, baseline assessments, reclamation monitoring, vegetation community mapping, wetland delineations, and soil map unit mapping and sampling.

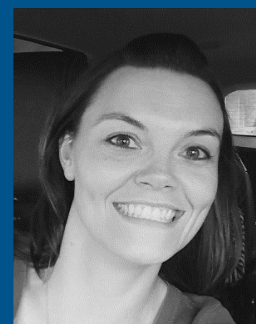
Selected Project Experience

Moneta Divide Biological Assessment—Fremont, Natrona, and Sweetwater Counties, Wyoming. 12/2019.

Senior Biologist. Katie completed a biological assessment for Ute ladies'-tresses for proposed oil and gas development in south-central Wyoming. She completed the biological assessment document for submittal to the Lander BLM Field Office.

Coeur Wharf Mine Rare Plant Survey—Lawrence County, South Dakota. 08/2019.

Senior Biologist. Katie complete a rare plant inventory for proposed development at the Wharf Mine located within the Black Hills. As project manager, she performed fieldwork per the direction of the South Dakota Department of Game, Fish, and Parks. Additionally, she completed a report summary of the field survey findings.



Years of Experience

- Professional start date: 05/2005
- ICF start date: 03/2017

Education

- BS, Biology, Bemidji State University, 2005
- AA, Liberal Arts, Thief River Falls, Minnesota, 2002

Professional Membership

- Society for Wetland Science

Training Certificates

- MSHA Annual Refresher, 2019
- OSHA General Industry 10 hr., 2014
- Safeland USA, 2010

Professional Development

- Assessment, Inventory, and Monitoring (AIM) Terrestrial Field Methods, U.S. Department of the Interior (DOI)
- Phase I and Phase II Environmental Site Assessment, ASTM International
- Wetland Delineation Training and Certification, USACE
- Emphasis on Soil and Hydrology, Wetland Training Institute (WTI)
- Federal Wetland/Waters Regulatory Policy, WTI

Transmission and Wind Facility Projects—Various Companies Wyoming. 07/2018 – 09/2019.

Vegetation Ecologist. As the field manager, Katie developed scopes of work to conduct baseline evaluations using the Assessment, Inventory, and Monitoring (AIM) program on BLM administered lands for proposed plans of development. She managed and coordinated a team of field biologists, served as field surveyor, and primary author of technical reports.

Katie also developed weed management plans for submittal to Albany and Carbon County Weed and Pest Offices along with reclamation plans to the Industrial Siting Council for the Wyoming Department of Environmental Quality and the Rawlins BLM Field Office.

Vegetation Assessments for Various Oil and Gas Projects—Various Clients, Wyoming. 05/2005 – 08/2016.

Vegetation Ecologist. While employed by BKS Environmental, Katie developed scopes of work and project budgets to conduct special-status plant species surveys and vegetation assessments for proposed plans of development. Her responsibilities included overall management of client contracts, safety compliance, and correspondence with clients and applicable state or federal agencies. She managed a team of field biologists, and served as field surveyor, primary author and/or reviewer of technical reports.

Threatened and Endangered Plant Surveys for Various Coal Mines—Various Clients, Northeastern Wyoming. 05/2005 – 08/2013.

Senior Vegetation Ecologist. While employed by BKS Environmental, Katie completed Ute ladies'-tresses (*Spiranthes diluvialis*) and Barr's milkvetch (*Astragalus barrii*) habitat and species surveys on the U.S. Forest Service in the Thunder Basin National Grasslands for various coal mine locations. Her responsibilities included overall management of client contracts, safety compliance, and correspondence with clients and applicable state or federal agencies. She developed scopes of work and project budgets to conduct special-status plant species surveys and assessments for proposed plans of development. Katie also managed a team of field biologists and was primary author and/or reviewer of technical reports and biological assessments/biological evaluations (BAs/Bes).

Bear Lodge and Upton Plant Site Wetland Delineation—Rare Earth Elements, Crook and Weston Counties, Wyoming. 05/2012 – 12/2015.

Project Manager and Senior Wetland Specialist. While employed by BKS Environmental, Katie developed scope of work and project budget for the completion of an aquatic resource inventory for proposed rare earth mine and plant development located on the U.S. Forest Service in the Black Hills National Forest. She performed fieldwork in compliance with Section 404 federal permitting process and state and local regulations for jurisdictional wetlands. Katie completed nationwide permit process for submission to the USACE. Responsibilities for this project also included management of the client contract, safety compliance, and correspondence with client and federal agencies. Katie also prepared a PowerPoint presentation for the client and USFS staff regarding the vegetation, soils, and wetlands surveyed at the project area.

Final

Simon Contractors Loring Quarry Baseline Wildlife Survey report

Prepared for:

H2E, Inc.
801 East 4th Street, Suite 5
Gillette, WY 82716
Contact: Becky Morris, Ph.D.
307.696.7007

Prepared by:

ICF
405 West Boxelder Road, Suite A-5
Gillette, WY 82718
Contact: Stephanie Kane
307.687-4771

December 2020
(Rev. April 2021)

ICF. 2020. Simon Contractors Loring Quarry Baseline Wildlife Survey Report. Draft. December. (ICF 374.20.) Gillette, WY. Prepared for H2E, Inc, Gillette, WY.

Contents

Acronyms and Abbreviations

ACOs	artificial cover objects
E	East
ESA	Endangered Species Act of 1973
GPS	global positioning system
H2E	H2E, Inc
IPaC	Information Planning and Conservation
OMNRF	Ontario Ministry of Natural Resources and Forestry
Pd	*Pseudogymnoascus destructans*
project area	Entire proposed permit area (current as of December 2020) with additional surveys conducted on adjacent lands for certain species of concern
R	Range
S	South
SD DENR	South Dakota Department of Environment and Natural Resources
SDGFP	South Dakota Game, Fish and Parks
SDNHP	South Dakota Natural Heritage Program's
Simon	Simon Contractors of SD, Inc.
T&E	threatened and endangered
T	Township
USFWS	U.S. Fish and Wildlife Service
UTM	Universal Transverse Mercator
VE	visual encounter
WNS	White-Nose Syndrome

Introduction

Simon Contractors of SD, Inc. (Simon) is planning to submit an application for a large-scale mine permit for its current small-scale mine operation, Loring Quarry (limestone). The Loring Quarry project area is approximately 4.0 miles south of Pringle along Highway 89 in Custer County, South Dakota and is on land privately held by Simon. The mine permit plan includes approximately 162 acres throughout portions of Section 33 and 34, T5S:R4E. This area encompasses the current mining parcel (45 acres) in Section 33, a large portion of which (approximately 40 acres, 89 percent) is currently disturbed by the existing quarry or other man-made features.

Simon will be applying for a large-scale mine permit with the South Dakota Department of Environment and Natural Resources (SD DENR) Minerals and Mining Program. H2E, Inc (H2E), on behalf of Simon, awarded and contracted the baseline vegetation survey to ICF in June 2020. The baseline wildlife survey report detailing survey data and results will be included with the permit documents compiled and submitted by H2E.

This report presents baseline information regarding wildlife observations and habitat characteristics within the project area. The information gathered from field sampling will be used by the applicant and the SD DENR to develop the reclamation plan for the project area.

Ecological baseline studies for fauna were conducted in accordance with applicable SD DENR, South Dakota Game, Fish and Parks (SDGFP), and U.S. Fish and Wildlife Service (USFWS) guidelines. Appropriate agencies were consulted prior to initiating field studies to ensure that adequate objectives, survey methodologies, and data collection techniques were employed.

ICF conducted the baseline wildlife inventories for this project. The objectives of the study were to: describe wildlife habitats within the proposed permit area; collect data on faunal diversity, abundance, and habitat affinity; and determine the potential impacts of Simon operations on terrestrial wildlife. Baseline information was collected for the project from April 2020 through December 2020. The project area included the entire proposed permit area (current as of December 2020) with additional surveys conducted on adjacent lands for certain species of concern. Per the SDGFP-approved study plan (ICF 2020), specific surveys were conducted for threatened and endangered species and their habitats, raptors, bats, amphibians, and reptiles. Information on other animal groups (big game, gamebirds, passerine birds, wading birds, waterfowl and shorebirds, mammal species not previous listed, and aquatic invertebrates and fish) was obtained primarily through opportunistic observation in and near the project area. Available wildlife habitats within the proposed permit area were also delineated.

Survey methods and results are presented by animal group, below. S. Kane supervised all wildlife surveys for the Loring Quarry baseline inventory and conducted a portion of them. J. Abplanalp and A. Harris conducted the field surveys. L. Allen analyzed the bat echolocation data. S. Kane, and J. Abplanalp, and L. Allen drafted the baseline report. All work for ICF and staff resumes are provided as an attachment to this report.

Permit Area Description

Simon is proposing to expand the permit area of their Loring Quarry, a surface limestone quarry in southwestern South Dakota near the town of Pringle in Custer County. The proposed expansion includes 162 acres (0.25 mile) throughout portions of Sections 33 and 34, Township (T) 5 South (S): Range (R) 4 East (E). This area encompasses the current permit parcel (45 acres) in Section 33, T5S:R4E, a large portion of which (approximately 40 acres, 89%) is currently disturbed by the existing quarry or other man-made features.

The permit area is in the Black Hills region of South Dakota. The elevation within the area ranges from approximately 3,600 feet to 6,565 feet with moderately sloping hills and ridges. Annual average precipitation is between 16 and 37 inches and increases or decreases with the elevation from west to east and north to south. The annual snowfall ranges from about 60 inches at the lower elevations to as much as 140 inches at the higher elevations. The average annual temperature is 36 to 48 degrees Fahrenheit. The freeze-free period averages 125 days and ranges from 85 to 165 days (USDA NRCS 2006).

The Loring Quarry survey area (permit area and a surrounding half-mile perimeter) supports open areas to dense forest vegetation, and pine and spruce species grow at higher elevations. Cool and warm season grasses are the most common under open forest stands, along with forb and shrub species (USDA NRCS 2006). The permit area is composed of a seven main habitat types: Upland Grassland, Lowland Grassland, Woodland, Disturbed Grassland, Disturbed – infrastructure and gravel piles, Disturbed – pit, and Disturbed – spoil, topsoil, etc. Four habitat types (Upland Grassland, Lowland Grassland, Woodland, and Disturbed Grassland) were defined during the baseline vegetation assessment conducted by ICF in June 2020 (Figure 1). That assessment is included as a separate report in the permit application package for the Loring Quarry Project.

Ponderosa pine *(Pinus ponderosa)* dominates the higher elevation hilltops and breaks along the edges and central portion of the permit area, and it was the only tree species documented in the permit area. The only recorded shrub species was Wood's rose (*Rosa woodsii)*; it was documented in the shallow drainage in the northern and east portions of the permit area.

The permit area is composed entirely of private lands owned by Simon but is adjacent to the Black Hills National Forest. Land use in the area includes a limestone quarry and ranch lands managed primarily for livestock (cattle) grazing. Several unimproved (two-track) roads pass through the permit area and surrounding perimeter. One improved bike path (the Mickelson Trail) currently runs through the southeastern portion of the permit area from northeast to southwest. South Dakota Highway 89 runs roughly parallel to the bike path through the survey area.

Methods

Wildlife baseline surveys were conducted by ICF, of Gillette, Wyoming. All baseline wildlife monitoring protocols were based on the guidelines required for permitting and environmental analysis through state and federal agencies (primarily SDGFP). Each wildlife baseline survey included the proposed Loring Quarry project area and up to a 0.5-mile survey perimeter.

Prior to initiating field surveys, a comprehensive effort was made to gather information about the occurrence, abundance, and natural history of all terrestrial vertebrate species that could occur in the project area. This included data requests through the South Dakota Natural Heritage Program's (SDNHP) Resource Information System, and the USFWS's Information Planning and Conservation (IPaC) tool. A potential species list was developed for the project area that included those species recorded during the field visits conducted throughout the baseline survey period.

Current baseline wildlife information was collected for the project from April 2020 through December 2020 to meet agency requirements for one year (i.e., four seasons) of baseline data. Survey protocols and timing were developed collaboratively with SDGFP to meet species-specific requirements. Surveys and documentation of occurrence conducted in the project area included other vertebrate species of concern tracked by the SDNHP, as well as bats and reptiles. In addition to these targeted efforts, incidental observations of all vertebrate wildlife species seen within the permit area were recorded during each site visit during the baseline survey period.

All surveys were conducted by qualified biologists using standard field equipment and appropriate field guides. Most terrestrial data were collected from vantage points during pedestrian or vehicular surveys to avoid disturbing wildlife. Raptor nests and other features or points of special interest were mapped in the field using a hand-held global positioning system (GPS) receiver to record the Universal Transverse Mercator (UTM) coordinates.

The project area was visited a minimum of once each season (i.e., spring, summer, fall, winter) to assess wildlife use during the year. Biologists conducted habitat assessments over a course of 11 days: 6 visits in spring and summer, 4 in fall, and 1 in winter. Habitat assessments were completed concurrently with or on the same day as other surveys. All surveys were conducted during favorable weather conditions (no precipitation with little or no wind).

Habitat Mapping

General wildlife habitats within the proposed permit area were outlined in the field with the aid of ESRI ArcGIS aerial maps. Habitats were described in terms of physical and vegetative characteristics, in keeping with classifications identified by ICF staff during their baseline vegetation assessment. Special emphasis was placed on documenting any high value, unusual, or critical wildlife habitats.

Mammals

Big Game

SDGFP did not require big game surveys for the Loring Quarry Project. Therefore, big game use of the permit area was largely determined through biologists recording all observations made during site visits from April through December 2020. Data recorded typically included the species and number of animals seen, location in UTMs, behavior, and habitat association. Personnel also noted herd activity, and sex and age composition, when possible.

Small Mammals

SDGFP did not require small mammal trapping for the Loring Quarry Project. Therefore, biologists watched for and recorded sightings of all mammals and their sign during wildlife baseline surveys and seasonal habitat assessments. Observation notes included species, number, habitat association, and location in UTMs.

Surveys for sensitive bats species were conducted concurrently with surveys for northern long-eared bats (*Myotis septentrionalis*). Survey methods for these species are discussed in the *Northern Long-eared Bat* section.

Lagomorphs

SDGFP did not require lagomorph surveys for the Loring Quarry Project. Occurrence of lagomorphs within the project area was documented through incidental observation. Observation notes included species, number, habitat association, and location in UTMs.

Medium and Large-Sized Mammals

The occurrence of mammals such as predators and furbearers within the Loring Quarry project area was documented through incidental observation. Formal surveys for these species were not required by the SDGFP. Biologists watched for and recorded sightings of all mammals and their sign. All large burrows encountered were examined closely to determine if they were used recently. Large predators (e.g., cougar, bobcat, and bear) were opportunistically documented when conditions presented themselves (e.g., observation or tracks in mud/snow). Observation notes included species, number, habitat association, and location in UTMs.

Avifauna

Game Birds

SDGFP did not require game bird surveys for the Loring Quarry Project. Biologists watched for and recorded sightings of all gamebirds and their sign during wildlife baseline surveys. Observation notes included species, number, age and sex if possible, habitat association, and location in UTMs.

Raptors

Ground-based searches for raptor nests were conducted on at least 3 days from late April through June 2020 within the survey area and within line of site of the permit area. New nests were located by examining typical nesting habitat (trees, cliffs, man-made structures, etc.) and watching for breeding behavior (territory defense, courtship flights, prey deliveries, etc.) during all site visits. All active nests were monitored from the ground to assess productivity, and monitoring followed guidelines contained in Rosenfield et al. (2007) to prevent nest abandonment and injury to eggs or young. Nest productivity checks were conducted throughout June 2020 for all active nests located during the previous surveys. All nest observations included species, substrate, location in UTMs, and distance and line-of-sight to the proposed project boundary.

Bald and Golden Eagles

No targeted surveys were conducted for Bald Eagles (*Haliaeetus leucocephalus*) or Golden Eagles (*Aquila chrysaetos*) during baseline surveys. Any incidental sightings of this species were recorded, including notes on the number of individuals, location, habitat, and activity.

Breeding Birds

No breeding bird surveys were required by SDGFP for the Loring Quarry wildlife baseline assessment. Biologists watched for and recorded sightings of all passerine birds and their sign during wildlife baseline surveys. Biologists were permitted to use call playbacks to aid in detection of SDGFP sensitive woodpecker species if stands of burned or beetle-killed trees were encountered.

Wading Birds, Shorebirds, and Waterfowl

No water features (i.e., ponds, lakes, or streams) occur within the project area. Regardless, wildlife biologist watched for and recorded waterfowl, wading birds, and shorebirds during all wildlife surveys. Any incidental observations of waterfowl and shorebirds included species, number, habitat association, and location in UTMs.

Amphibians and Reptiles

Amphibians

No water features (i.e., ponds, lakes, or streams) occurred within the project area; therefore, no targeted surveys for such species were proposed. Any incidental observations of amphibians included species, number, habitat association, and location in UTMs.

Reptiles

Artificial cover objects (ACOs) and visual encounter (VE) surveys were conducted for reptiles over the course of 7 days, starting in late April. Surveys were conducted throughout the permit area and occurred in April through June, and September 2020. ACOs were made of 2.0-foot by 2.0-foot plywood that was 0.75 inch thick, as recommended by the Ontario Ministry of Natural Resources and Forestry (OMNRF) (2016). ACO placement was based on guidelines established by the Iowa Department of Natural Resources (2016) for surveying amphibians and reptiles. ACOs were placed in five identified microhabitats (disturbed – pit, disturbed – other, woodland, grassy-riparian drainages, and grassland) and spaced approximately 200 meters apart, when possible. ACOs were not placed in roads or trails but were placed in a vegetated unused parking area and near gravel piles. Placement in representative habitats took priority over ACO spacing, so spacing was adjusted as needed. However, there was still a minimum of seven ACOs/26 acres of surveyed habitat (as stipulated in the Iowa guidelines). ACOs were placed 2 weeks prior to beginning surveys and were checked twice a month in May, June, and September (Iowa Department of Natural Resources 2016; OMNRF 2016).

Targeted VE surveys were conducted with every ACO survey as biologists moved between ACO sites. VE protocols followed those established by the OMNRF's *Survey Protocol for Ontario's Species at Risk Snakes* (2016). Biologists walked slowly through suitable habitat in the area watching for snakes or snake shed skins. Areas such as woodpiles and exposed rock outcrops were searched, and biologists checked under logs, rocks and other locations that could provide shelter. On colder sunny days biologists looked to places where the sun had warmed the ground, and on hotter days and cloudy days biologists focused on areas that provide thermal cover.

VE surveys also occurred during habitat assessments and other species surveys. Suitable habitat for other reptile species (i.e., lizards) was searched as they were encountered. All reptile species encountered during habitat assessments were recorded, and observations included species, number, habitat association, and location in UTMs.

Aquatic Invertebrates and Fish

No water features (i.e., ponds, lakes, or streams) occurred within the project area.

Federally Listed and State Sensitive Species

Throughout the course of all field surveys, biologists watched for species that are listed as endangered or threatened under the Endangered Species Act of 1973 (ESA), or species that are proposed or candidates for listing under the ESA. Habitats in or within the survey area that could support those species were also documented. As of December 2020, a three targeted species were listed under the ESA, as amended, 16 U.S.C 1531 *et seq*., for Custer County, South Dakota (USFWS 2020a and 2020b): black-footed ferret (*Mustela nigripes*), Rufa Red Knot (*Calidris canutus rufa*), and Whooping Crane (*Grus americana*).

The proposed surveys targeted a variety of taxa, combined with comprehensive listing of detected species throughout the baseline survey period. This approach was determined to be adequate to detect the occurrence of species of special concern defined by the SDNHP, SDGFP, and USFWS.

Appropriate habitat does not occur for most species listed by the SDGFP (2016) or USFWS (2017 and 2020a) as threatened or endangered in Custer County or the project area. However, wildlife biologists watched for and recorded all listed species if they were encountered during other wildlife baseline surveys.

Black-Footed Ferret

No targeted surveys were conducted for the black-footed ferret during baseline surveys, as they are no longer required by the USFWS throughout most of the species range (USFWS 2013). Any incidental sightings of this species were recorded, including notes on the number of individuals, location, habitat, and activity.

Red Knot

No targeted surveys were conducted for red knot (*Calidris canutus*) during base line surveys. Any incidental sightings of this species were recorded, including notes on the number of individuals, location, habitat, and activity.

Whooping Crane

No targeted surveys were conducted for whooping crane (*Grus americana*) during baseline surveys. Any incidental sightings of this species were recorded, including notes on the number of individuals, location, habitat, and activity.

Northern Long-Eared Bat

Northern long-eared bats (*Myotis septentrionalis*) are known to occur in Custer County, SD (USFWS 2020a), and hibernacula with confirmed White-Nose Syndrome (WNS)/ *Pseudogymnoascus destructans* (Pd) also occur in that county (USFWS 2020c). As such, the Loring Quarry Project falls within the WNS Zone per the northern long-eared bat Final 4(d) Rule that accompanied the species listing (80 FR 17674).

Habitats in the project area consisted of a few small stands of ponderosa pine forest, open grassland, and a quarry pit with exposed rock highwalls, one of which has holes and crevices. Two man-made entrances to a grotto located beneath the quarry occur on the eastern edge of the quarry pit. While no perennial creeks or ponds exist in the project area, water present seasonally in drainages or in pools in the quarry pit may provide a water source for a least a portion of the year.

The survey protocols were based on guidelines recommended by the SDGFP, the USFWS's *Range-wide Indiana Bat Survey Guidelines* (hereafter, USFWS *Guidelines*; 2020d), the USFWS *Northern Long-eared Bat Interim Conference and Planning Guidance* (hereafter, USFWS *Interim Guidance*; 2014), or the USFWS's *Indiana Bat* (Myotis sodalis) *Survey Protocol for Assessing Use of Potential Hibernacula* (2019).

Habitat Assessments and Summer Presence/Absence Surveys

Habitat assessments for maternity roost and winter hibernacula sites occurred June 2020. Two biologists conducted the surveys on 1 day. Habitats within 150 feet of the permit area (hereafter bat survey area) were searched for potential roost and hibernacula sites (i.e., cavities, crevices located in rock outcrops or trees). Any potential sites were marked using flagging, and UTM NAD83 (North American Datum 83, Zone 13N) coordinates were recorded using a GPS unit. Qualitative descriptions, including substrate and distances from the permit area, were recorded. Photographs of the sites were also taken.

Passive acoustic surveys were conducted for summer presence/absence near identified potential roost sites and near any open bodies of water in appropriate habitat. Wildlife Acoustics SM4BAT full-spectrum bat echolocation detectors equipped with single omni-directional ultrasonic microphones (*Wildlife Acoustics*, MA) were placed throughout the bat survey area near potential bat roost locations, including an abandoned barn, near tree snags, and in the quarry pit near the vuggy highwall on the north end of the pit.

Detector units were mounted to t-posts, and microphones were positioned 3 meters above ground level. Specific detector locations were chosen in accordance with recommendations made in the USFWS *Guidelines*.

Detectors were deployed for 7 consecutive nights, which satisfied SDGFP recommendations (Michals pers. comm. April 7, 2020) and exceeded recommendations by the *Guidelines*. This was to account for potential poor weather conditions (e.g., prolonged precipitation, low temperatures, and sustained winds) while detectors were deployed. Extended weather forecasts were consulted prior to deployment in an attempt to reduce the chance of poor weather during surveys. Recording periods began 30 minutes before sunset and conclude the following morning at sunrise. Calls were recorded directly to media cards located within the detector units.

Potential Hibernaculum Surveys

Pre-survey assessments (i.e., communication with Simon) and the June habitat assessment indicated the holes and crevices located in the quarry pit wall and/or the grotto entrances have suitable characteristics to be a hibernaculum entrance. Therefore, ICF conducted potential winter hibernaculum surveys at these sites. A combination of passive acoustic surveys and active count monitoring were used, per USFWS *Indiana Bat* (Myotis sodalis) *Survey Protocol for Assessing Use of Potential Hibernacula*. Studies by Lemen et al. (2016a and 2016b) indicate that passive acoustic detection is a reliable method of detecting long-eared bats emerging from hibernaculum. One Wildlife Acoustics SM4BAT full-spectrum bat echolocation detector equipped with single omni-directional ultrasonic microphones (*Wildlife Acoustics*, MA) was placed according to the USFWS *Guidelines* near the potential hibernacula entrances. Detector units were mounted to t-posts and microphones were positioned 3 meters above ground level.

Two rounds of surveys were conducted in September and October 2020, and each round was separated by a minimum of 2 weeks (USFWS *Interim Guidance*). Detectors were deployed for two consecutive nights during each round, which exceeds the USFWS *Interim Guidance* minimum of two nights total per site. Recording began 30 minutes before sunset and concluded the following morning at sunrise. Calls were recorded directly to media cards located within the detector unit.

One night per each round, a wildlife biologist monitored the potential hibernaculum entrance, using a heterodyne bat detector and/or a night-vision/infrared video recording device to record bats entering and exiting openings. The monitoring period began 30 minutes before sunset and lasted 5 hours. The biologist followed protocols established by USFWS *Indiana Bat* (*Myotis sodalis*) *Survey Protocol for Assessing Use of Potential Hibernacula*. The biologist was in a position such that they did not interfere with the passive acoustic detector. Data recorded included the number of bat passes per hour during the period, the frequency peak of each pass, and notes describing the bat activity throughout the period.

Data Analysis

Recordings of bat echolocation calls were downloaded from each monitor and processed using Sonobat version 4.2.2. Each recording was initially processed through the Sonobat program using the vetting function which identified calls recording to species when possible. There are generally three types of echolocation sequences: search phase, approach phase, and terminal phase. Search phase calls are used when searching for prey (i.e., insects) which are longer, lower frequency calls. Approach phase and terminal phase calls used when approaching and closing in on prey, respectively, become much more frequent and higher frequency. As a bat gets nearer to an insect the calls become shorten to detect the quick movements of the insect (Feldhamer et. al. 2007). Due to the variation in approach and terminal phase calls, echolocation calls are identified to species best by the search phase recordings. These types of calls generally have a consistent structure throughout the call sequence and usually have species-specific characteristics (Fenton and Bell 1981; O'Farrell et al. 1999 as cited by Murray et al.).

Each of the calls Sonobat identified to species were then manually assessed to determine if the identification to species was accurate. Although search phase calls are typically consistent in structure, species within the same frequency range can be similar in the different echolocation phases and can be misidentified within the program automation identification. Species that were identified by Sonobat as only a "high frequency" call where briefly assessed and determine to be exclusively myotis calls; however, they quality was too poor to determine to a specific species.

Aquatic Resources

The Loring Quarry project area does not contain any perennial water sources; therefore, no aquatic surveys were required.

Appendix I lists all species observed that could reside in the vicinity of the Loring Quarry permit area or pass through during migration. Species recorded in or adjacent to the property are noted. Appendix II lists Federal and State listed that could occur in the vicinity (Custer County, SD) of the permit area. Appendix III provides representative photographs of the project area and wildlife species observed there during the baseline survey period. Appendix IV includes resumes for the biologists who completed surveys for the project.

Habitat Mapping

Prior to fieldwork the project area was mapped with aerial imagery to delineate vegetation communities and habitat types. The mapped vegetation communities and habitat types were field verified prior to sampling. ICF biologists classified seven primary habitat types within the Loring Quarry project area: Upland Grassland, Lowland Grassland, Woodland, Disturbed Grassland, Disturbed-infrastructure and gravel pits, Disturbed – pit, and Disturbed – spoil, topsoil, etc. A general description of the extent and characteristics of each habitat type is described below.

Upland Grassland

Upland grassland covers approximately 82.5 acres and comprises approximately 51.0 percent of the total acreage of the permit area. Grassland areas are characterized by moderately dense cover with little bare ground. Various native short-to mid-grass species dominate this habitat type, with numerous forbs scattered throughout the area. Grass species commonly encountered during field surveys included crested wheatgrass *(Agropyron cristatum)* and western wheatgrass *(Pascopyrum smithii).*

Woodland

Approximately 24.0 acres of the permit area is comprised of woodland habitat. This habitat type covers approximately 14.8 percent of the permit area. Ponderosa pine *(Pinus ponderosa)* is the dominant tree species of the woodland habitat within the project area. The grass species most encountered in woodland habitat was blue grama (*Bouteloua gracilis).*

Lowland Grassland

Lowland grassland habitat covered approximately 5.2 acres, which comprised 3.2 percent of the total acreage of the permit area. The most common grasses found in lowland grassland habitat were smooth brome *(Bromus inermis)* and Kentucky bluegrass *(Poa pratensis).*

Disturbed Grassland

Approximately 2.5 percent of the permit area is comprised of disturbed grassland habitat. This habitat type comprises approximately 4.1 acres of the permit area. The area appears to have been stripped and overburden was piled to the west of the area. Upland vegetation is present at the site with scattered ponderosa pine saplings. The overburden pile is also vegetated with perennial and annual grasses, forbs to include wavyleaf thistle (*Cirsium undulatum*), upright prairie cone flower (*Ratibida columnifera*), curlycup gumweed (*Grindelia squarrosa*), and ponderosa pine saplings.

Disturbed – Other

Three other disturbed habitat types occurred at Loring Quarry. These types included infrastructure and gravel piles (15.9 acres/9.8% of permit area), pit (15.7 acres/9.7% of permit area), and spoil, topsoil, etc. (14.4 acres/1.9% of permit area). Each of these disturbed habitat types contained primarily bare ground and sparse vegetation.

Mammals

Big Game

No crucial big game habitats or migration corridors are recognized by the SDGFP in the Loring Quarry permit area or surrounding one-mile perimeter (Michals pers. comm. December 30, 2020). Crucial range is defined as any particular seasonal range or habitat component that has been documented as the determining factor in a population's ability to maintain and reproduce itself at a certain level.

Mule deer *(Odocoileus hemionus)* and white-tailed deer *(Odocoileus virginianus)* regularly occur in the Loring Quarry project area, and both are considered year-round residents. Elk *(Cervus elaphus)* are also present in the survey area, but only in small herds. All three species can be seen in the survey area year-round but may be more common during certain seasons.

Mule deer use nearly all habitats, but prefer sagebrush-grassland, rough breaks, and riparian bottomland (Jones et al. 1983). Browse is an important component of the mule deer's diet throughout the year, comprising as much as 60 percent of total intake during autumn, while forbs and grasses typically make up the rest of their diet (Fitzgerald et al. 2011). In the project area, mule deer were observed as individuals or in small herds in ponderosa pine habitat along the northern reaches of the project area, and in the grassland habitat in northern region of the permit area. Fresh tracks and droppings were found throughout all habitats of the permit area and adjacent ponderosa pine habitats. They are considered year-round residents in the survey area.

By nature, elk are shy animals that are less accepting of human disturbance than pronghorn (Fitzgerald et al. 2011) or deer. No elk were observed during the baseline survey period, but multiple fresh tracks and droppings were observed in the grassland habitat of the northern reaches of the permit area and ponderosa pine habitat just outside the permit area.

White-tailed deer are typically associated with forests, woodlands, and treed galleries along streams (Fitzgerald et al. 2011). Small numbers of white-tailed deer were observed in the project area during the baseline survey period. White-tailed deer were primarily observed in the grassland and pine habitat of the western and northern sections of the permit area.

Small Mammals

Small mammals were not systemically surveyed as part of the Loring Quarry baseline inventory surveys. However, three species of small mammals were observed incidentally during baseline surveys: black-tailed prairie dog (*Cynomys ludovicianus*), least chipmunk (*Tamias minimus*) and red squirrel (*Sciurus vulgaris*). One active black-tailed prairie dog colony was discovered on September 15, 2020 in the grassland habitat of the northern permit area (Figure 3, Photo 11). Least chipmunks and red squirrels were found throughout the ponderosa pine habitat of the project area. Least chipmunks were also observed in the blasting pit area of the quarry.

Bats

Habitat Assessments and Presence/Absence Surveys

Habitat assessments for all bat species occurred throughout the baseline surveys, with targeted searched for roost and hibernacula occurring on June 5, 2020. Potential roost and hibernacula habitat are present in the abandoned barn, tree snags in the woodland habitat, and crevices in the vuggy highwall on the north end of the quarry pit. Tree snags were limited within the permit area, with only one present, but more prevalent in the survey area where woodland habitat is more predominant.

Target presence/absence surveys for bats occurred in June. Five Wildlife Acoustics SM4BAT full-spectrum bat echolocation detectors equipped with single omni- directional ultrasonic microphones (*Wildlife Acoustics*, MA) were placed throughout the bat survey area (Figure 2), starting on June 5. The five locations included:

- One near an unused barn located northeast of the current quarry pit (SE NE Section 33, T5S:R4E; Monitor 5-Spring)
- One near the two grotto entrances and the vuggy rock highwall with holes and crevices located at the north end of the quarry pit (NW SE Section 33, T5S:R4E; Monitor 4-Spring); all locations were within 100 yards of each other
- Two detectors in the south half of NE Section 33 in or near forest habitat, both near a pine snag with roost characteristics (i.e., loose bark and cavities) (Monitors 1-Spring and 5-Spring)
- One detector near some partially filled cattle stock tanks (NW SW Section 34, T5S:R4E; Monitor 3-Spring).

Detectors were placed for a span of 7 days, and audio data downloaded for later analysis.

Two rounds of targeted presence/absence surveys were also conducted during the 2020 fall surveys, one round from September 21 through 23 and one round from October 12 through 14. Detectors were located near the vuggy rock highwall in the north end of the quarry pit (NW SE Section 33, T5S:R4E; Monitors 1 and 2-Fall, Figure 2).

A total of eight bat species were identified acoustically during both the spring and the fall surveys: Townsend's big-eared bat (*Corynorhinus townsendii*), big brown bat (*Eptesicus fuscus*), hoary bat (*Lasiurus cinereus*), silver-haired bat (*Lasionycteris noctivagans*), western small-footed bat (*Myotis ciliolabrum*), long-eared myotis (*Myotis evotis*), little brown bat (*Myotis lucifugus*), and fringe-tailed bat (*Myotis thysanodes*). Of these species, four are listed by the SDNHEP has species of concern: Townsend's big-eared bat, silver-haired bat, long-eared myotis, and fringe-tailed bat. Table 1. describes the general habitat and current state and federal status of each species.

Table 1. Status and Habitat Description of Species Detected During Spring and Fall Surveys

Scientific Name Common Name	Status[1]	General Habitat Description
Townsend's big-eared bat *Corynorhinus townsendii*	G4, S2S3	Typical habitat is arid western desert scrub and pine forest regions. Maternity colonies form in mines, caves, or buildings, but males roost individually.[1] Roost sites and hibernacula are selected in areas with minimal human intervention and relatively stable, cool temperatures. Hibernacula also occur in mines and caves. Foraging primarily occurs along forested edges or in the canopy. [2]
Big brown bat *Eptesicus fuscus*		Found in a variety of habitats ranging from timberline meadows to lowland deserts, though it is most abundant in deciduous forest areas. Typically form maternity colonies beneath loose bark and in small cavities of pine, oak, and other trees. Maternity roosts also occur in buildings and bridges[1], and have been documented in buildings, trees, railway tunnels, mines, caves, and at least one metal electrical fuse box within the Black Hills. Found in a variety of hibernacula with varying microclimates, in caves, mines and in buildings[3].
Hoary bat *Lasiurus cinereus*		Solitary roosting species, except during the maternity season when females roost with young in foliage along forest edges or in fencerows, generally 12 to 40 feet above ground. Occurs in arid deserts and ponderosa pine forests of the western U.S., most abundant on the edges of croplands and deciduous forests of the Plains States. It is a fast flier that commonly feeds at treetop level above the forest canopy.[4]
Silver-haired bat *Lasionycteris noctivagans*	G3G4, S4	Dependent upon roosts in Old Growth areas. Form maternity colonies almost exclusively in tree cavities or small hollows and will switch roosts throughout the maternity season. Typical hibernation roosts include small tree hollows, beneath exfoliating bark, in wood piles, and in cliff faces. Occasionally silver-haired bats will hibernate in cave entrances, especially in northern regions of their range. Feed predominantly in disturbed areas, sometimes at tree-top level, but often in small clearings and along roadways or water courses.[1]
Myotis ciliolabrum Western small-footed bat		Located in arid habitats with cliffs, talus fields, and prairies containing clay buttes and steep banks along rivers[2]. Maternity roosts in cliff-face crevices, erosion cavities, and beneath rocks on the ground. Some females care for their pups alone, while others form small groups. These bats can also be found hibernating in caves or mines.[1] Foraging occurs 1 to 3 m above ground over cliffs or clay buttes. [2]

Long-eared myotis *Myotis evotis*	G5, S1	Located in coniferous forests, typically only at higher elevations in southern areas (between 7,000 and 8,500 feet)[1] or arid badlands of the Great Plains.[2] Roost sites include live or dead trees (beneath bark), abandoned buildings, mines or caves, sinkholes, or cliff fissures. Winter hibernacula include primarily caves or mines. Foraging typically occurs over tree canopy, ponds, or streams.[2]
Little brown bat *Myotis lucifugus*		Mainly in mountainous and riparian areas in a wide variety of forest habitats; from tree-lined xeric-scrub to aspen meadows. Maternity colonies often form in buildings, attics, and other man-made structures. Also roosts in tree cavities and crevices[1] as well as caves and mines.[2] Main prey consists of aquatic insects, and typical foraging habitat is over water. Will also feed over forest trails, cliff faces, meadows, and farmland.[1]
Fringe-tailed bat *Myotis thysanodes*	G5, S1	Mostly found in dry habitats where open areas (e.g., grasslands and deserts) are interspersed with mature forests (usually ponderosa pine, pinyon-juniper, or oak), creating complex mosaics with ample edges and abundant snags[5]. Day roosts include caves, mines, and buildings (typically abandoned). Hibernacula include caves and buildings, but not much is known about their wintering whereabouts[1,6].

[1]Status as listed by the South Dakota Natural Heritage Program. 2018. https://gfp.sd.gov/rare-animals/. Accessed December 29, 2020. A description of rankings can be found in Appendix II.

[2]Bat Conservation International 2020

[3]South Dakota Bat Working Group 2004

[4]Tigner and Stukel 2003

[5]Tuttle 1995

[6]Keinath 2004

Big brown bat, hoary bat, and silver-haired bat were detected at all locations during both the springs and fall surveys. Long-eared myotis was detected at the fewest locations and was the only species not detected during both spring and fall surveys. Myotis species with ranges which occur within the vicinity of the project area emit echolocation calls generally within the same frequency range. Species specific call characteristics can be difficult to determine with poor quality calls. At most locations, high frequency calls were recorded; however, due to the poor quality of the recording, species could not be identified. All species recorded during spring and fall surveys, and their locations are depicted in Table X. In some cases, species identification could not definitively be made, for the reasons previously discussed. However, if characteristics were present that pointed to one species over another this was noted as most likely that species.

Additionally, the number of echolocation calls recorded cannot be used to correlate the number of bats of that species in the area or the recordings. Each time a call is emitted within range of the detector, a recording is created. Therefore, it is possible for a single bat can be recorded multiple times if it is foraging for an extended period within range of the detector.

Monitor 1-Spring was placed in a sparsely forested are near a snag (Figure 2, Photo 1). Big brown bat and silver-haired bat, recorded at this location, are both species known to roost in tree cavities, crevices and under exfoliating bark. This location could be a potential roost site for these species and emergence (or out flight) surveys would determine if these species are using this snag. The remaining two species recorded at this site, fringe-tailed bat and hoary bat, were not likely roosting at these locations but rather utilizing this area for foraging.

Monitor 2-Spring occurred in an area near an abandoned barn(Figure 2, Photo 2). Three of the species detected at this location, Townsend's big-eared bat, big brown bat, and little brown bat, are all know to roost within manmade structures. Townsend's big-eared bat are sensitive to disturbance and are typically only found in buildings within little to no human activity. Since this building as long since been abandoned, it is possible for this species to be roosting inside.

Monitor 3-Spring was placed in an open field adjacent to stock tanks (Figure 2, Photo 3). This location recorded foraging species, though it is possible that some species have roosts within the vicinity. This location produced poor quality calls, making species identification more difficult. Myotis species were recorded and the most likely species included western small-footed bat, long-eared myotis, and little brown bat. Similarly, poor quality lower frequency bat calls were also recorded at this location. These calls exhibited characteristics that represent Townsend's big-eared bat, but due to the quality of the call this is only a likely determination and not definitive.

Monitor 4-Spring was placed near a treed are with water in the northwest corner of the quarry pit. (Figure 2, Photo 4). This was also in the vicinity of cave openings that potentially connect to an underground grotto (Photo 5). Seven of the eight species detected during the spring surveys were detected at this location. Big brown bat, western small-footed bat, long-eared myotis, little brown bat, and fringe-tailed bat are known to roost within caves and mines. This location could be a roost for these species and emergence surveys would confirm the presence of roosting bats.

Table 1. Species Recorded at each monitoring location during both Spring and Fall Surveys[1].

Species Recorded	Monitors						
	1-Spring	2-Spring	3-Spring	4-Spring	5-Spring	1-Fall	2-Fall
Townsend's big-eared bat *Corynorhinus townsendii*		X	X*			X	X
Big brown bat *Eptesicus fuscus*	X	X	X	X	X	X	X
Hoary bat *Lasiurus cinereus*	X	X	X	X	X	X	X
Silver-haired bat *Lasionycteris noctivagans*	X	X	X	X	X	X	X
Western small-footed bat *Myotis ciliolabrum*		X	X*	X	X*	X	X
Long-eared myotis *Myotis evotis*				X	X*		
Little brown bat *Myotis lucifugus*		X	X*	X	X	X	X
Fringe-tailed bat *Myotis thysanodes*	X		X*	X	X	X	

[1] The long-eared myotis was the only bat species not detected during both spring and fall surveys.

* Likely the species recorded, but due to the poor quality of the recording definitive identification could not be made

Monitor 5-Spring was placed near a single tree snag in a dry creek bed (Figure 2, Photo 6). Five positively identified species were recorded at this location and two myotis species, western small-footed bat and long-eared myotis, are likely to have been recorded. This location provides potentially suitable roosting habitat for big brown bat, silver-haired bat, long-eared myotis, and fringe-tailed bat. Additionally, species are likely foraging within the vicinity.

Fall Monitors 1 and 2 were placed in the same location, with Monitor 1 data collection occurring in September and Monitor 2 in October. The placement of the monitors occurred within close proximity of the mine where suitable roost features were present (Figure 2, Photo 7). These surveys occurred following the maternity season, when young are presumably all volant, or capable of flight, and prior to the hibernation period. Surveyors were present at these locations conducting emergence surveys in conjunction with the acoustic surveys. Townsend's big-eared bat, big brown bat, hoary bat, silver-haired bat, and little brown bat were recorded during both surveys. Additionally, fringe-tailed bat was recorded during the September survey and western small-footed bat in October. This location has roosting potential for Townsend's big-eared bat, big brown bat, little brown bat and fringe-tailed bat; however, no bats were observed exiting this location during the surveys. It is likely species recorded during the surveys were using the area for foraging.

The avoidance and minimization measures presented in Appendix IV would avoid direct impacts to roosting bat species at this location.

Potential Hibernaculum Surveys

One area within the Loring Quarry permit area was identified as potential bat hibernaculum habitat, the grotto located beneath the quarry pit and its associated entrances (Photos 8 and 14). Two rounds of acoustic monitoring surveys were conducted in the fall, one from September 21 through 23, and one from October 12 through 14. Emergence surveys were conducted at the vuggy highwall on September 15 and October 13, and at the northern man-made grotto entrance on October 12. To aid with active bat detection after sundown, a Elekon Heterodyne BatScanner (*Elekon*, Switzerland) and infrared-capable videorecorder were used. To aid with species identification, a Wildlife Acoustics SM4BAT full-spectrum bat echolocation detector equipped with single omni- directional ultrasonic microphones (*Wildlife Acoustics*, MA) was set-up near the vuggy highwall for two nights during each acoustic monitoring survey round. Results of these surveys are presented in Table 1 and discussed in the Habitat Assessments and Presence/Absence Survey results.

No bats were observed emerging from either the highwall or man-made grotto entrance during the surveys. One bat was observed flying along the highwall during the September 15 survey, but was not observed entering or exiting any of the crevices in the highwall. The site was surveyed again on October 13; one bat was seen flying in front of the highwall, but no bats were observed entering or exiting the crevices. The northern man-made grotto entrance also fits the characteristics of potential hibernaculum opening and was surveyed October 12. No bats were observed using the entrance.

The highest number of bat passes (bat echolocations) recorded occurred during the September 15 survey, with a total of 340 passes recorded. In contrast, only 1 bat was detected during the October 13 survey of the same location. Fourteen bat passes were recorded during the October 12 survey of the north man-made grotto entrance. It is important to note that the number of bat passes recorded cannot be used to correlate the number of bats of in the area. Each time a call is emitted within range of the detector, the BatScanner picks up the echolocation and translates it into a sound. Therefore, it is possible for a single bat can be recorded multiple times if it is foraging for an extended period within range of the scanner. As no bats were observed exiting this location during the surveys. It is likely species recorded during the surveys were using the area for foraging.

Lagomorphs

Lagomorphs were not systemically targeted as part of the Loring Quarry baseline inventory survey. Although mountain cottontail (*Sylvilagus nuttallii*), desert cottontail (*Sylvilagus audubonii*), and white-tailed jackrabbit (*Lepus townsendii*) potentially occur in the region, none were recorded in the project area.

Medium and Large-sized Mammals

A variety of medium-sized mammalian species have the potential to occur in the Loring Quarry survey area. These potential species include a variety of common predators and furbearers such as the coyote (*Canis latrans*), red fox (*Vulpes vulpes*), raccoon (*Procyon lotor*), bobcat (*Lynx rufus*), badger (*Taxidea taxus*), striped skunk (*Mephitis mephitis*), and porcupine (*Erethizon dorsatum*). Large carnivores such as black bear (*Ursus americanus*) and mountain lion (Felis concolor) may potentially be found in the region as well. The only medium-sized mammal documented was coyote, which was observed on September 14, 2020 in grassland habitat of the permit area. Coyote scat was also periodically found on site. A complete list of the mammalian species that were observed during surveys in and near the Loring Quarry property during the baseline survey period can be found in Appendix 1.

Avifauna

Game Birds

The Wild Turkey *(Meleagris gallopavo)* was the only upland game bird species observed in the Loring Quarry survey area during baseline inventories. Three hens with 20 chicks were recorded in grassland habitat in the western edge of the permit area on June 30, 2020. No other game birds were recorded during baseline surveys. The woodland habitat in the area is suitable to host Ruffed Grouse (*Bonasa umbellus*).

Raptors

Raptor species observed during the Loring Quarry baseline wildlife surveys included Red-tailed Hawk *(Buteo jamaicensis),* Golden Eagle (*Aquila chrysaetos*), Merlin (*Falco columbarius*), American Kestrel (*Falco sparverius*), Bald Eagle, and Turkey Vulture (*Cathartes aura*). Other raptor species (Appendix 1) could also occur in the survey area, particularly as seasonal migrants, but were not seen during the baseline survey.

Raptor sightings were recorded most often in ponderosa pine and grassland habitats. Red-tailed Hawk observations were the most common and occurred along the eastern edge and northern reaches of the permit area over grassland and pine habitat during multiple surveys. A variety of behavior was recorded, including hunting, perching in trees, on power poles, tending nests, incubating eggs, and exhibiting nest defense behavior. Multiple American Kestrels were observed perched on power lines in the grassland of the southeast region of the permit area. One Merlin was recorded on September 15, 2020 perched on a wooden post in grassland within the permit area (SE SE Section 33, T5S:R4E). Turkey vultures were also observed during multiple surveys flying over pine and grassland habitats.

One occupied and previously undocumented Red-tailed Hawk nest (Photo 9) was found in the Loring Quarry project area during the baseline survey period (Figure 3) The nest was discovered on May 13, 2020 in a ponderosa pine approximately 85 feet east (and within line-of-site) of the southeastern permit boundary. One adult Red-tailed Hawk was observed incubating in nest while another adult soared around nest site exhibiting defensive behavior. Both adults would exhibit defensive behavior during subsequent surveys. On June 30, 2020, one chick was observed in the nest. No other raptor nests were recorded within the project area during baseline surveys.

Bald and Golden Eagles

The USFWS removed (delisted) the Bald Eagle from protection under the ESA in July 2007 (Federal Register, July 9, 2007), and the ruling became effective that August. However, both species continue to be protected under the Bald and Golden Eagle Protection Act and the Migratory Bird Treaty Act, as well as any applicable state regulations. No targeted Bald or Golden Eagle surveys were required for the Loring Quarry Project. One Golden Eagle was observed on May 13, 2020 soaring along the eastern edge of the survey area (E½ Section 33, T5S:R4E) over grassland and agricultural habitats. One Bald Eagle was recorded flying north over the permit area (NE NE Section 33, T5S:R4E) on December 22, 2020 during the winter habitat and wildlife survey. The Bald Eagle did not land in or near the permit area and was not observed again during the survey.

Breeding Birds

Breeding birds were not systematically surveyed as part of the Loring Quarry baseline inventory surveys. However, several species that are potential occupants in the region (Appendix 1) were recorded incidentally. The most common species recorded in grassland habitat included the Western Meadowlark (*Sturnella neglecta*), Vesper Sparrow (*Pooecetes gramineus*), Grasshopper Sparrow (*Ammodramus savannarum*) and Mountain Bluebird (*Sialia currucoides*). Multiple species were also found in pine habitat such as American Robin (*Turdus migratorius*), Blue jay (*Cyanocitta cristata*), Northern Flicker (*Colaptes auratus*), and Black-capped Chickadee (*Poecile atricapillus*). The disturbed and pit areas also contained multiple species such as Cliff Swallow (*Petrochelidon pyrrhonota*), Rock Wren (*Salpinctes obsoletus*), and Rock Dove (*Columba livia*).

Other Avian Observations

Targeted surveys for waterfowl and shorebirds were not required for the Loring Quarry Project. Nevertheless, biologists recorded all birds seen during the survey period. No waterfowl species were documented within the project area. Killdeer (*Charadrius vociferus*), a shorebird species, was recorded on multiple surveys in disturbed ground near the quarry entrance in the southern portion of the permit area.

Amphibians and Reptiles

Potential habitat for amphibian species is limited in the permit area. No perennial water sources occur in the area. Potential intermittent water could occur in the drainages during higher precipitation events, but these were dry during the 2020 baseline surveys. A small seasonal wet area was located in the northwest end of the pit during surveys, and while it had shallow water in the spring and summer surveys it was dry by September. Stock tanks present in the could also provide temporary mesic habitat. Habitat for reptile species is more prevalent throughout the area, and included slash piles, grassy slopes, and mine spoil piles.

Artificial coverage objects were placed at 41 locations across the 5 initial identified habitat types in the area. While multiple species of amphibians and reptiles potentially occur in the region (Appendix 1), only one species was recorded. On June 30, 2020 one plains spadefoot toad (*Spea bombifrons*) (Photo 10) was found underneath the artificial cover object placed in the northwest corner of the quarry pit.

Federally Listed and State Sensitive Species

Prior to initiating field surveys, biologists reviewed the list of rare, threatened, or endangered (T&E) vertebrate species tracked by the SDNHP that could occur as permanent or seasonal residents on or within the vicinity of the Loring Quarry project area, based on each species' range and the habitats present in that area. As expected, the SDNHP database includes State- and Federally listed threatened and endangered species. However, many SDNHP species are not actually rare; some are merely at the edge of their natural range. A listing by the SDNHP is often an indication of possible concern, and the need for more information on a species' range and habitat requirements within the state of South Dakota.

Appendix II presents a summary of current Federal (USFWS) and State (SDGFP) vertebrate species of concern that potentially reside in Custer County, SD. No federally listed species were observed during surveys. Seven vertebrate sensitive species or species of local concern were documented within the Loring Quarry project area during the baseline survey period: Townsend's big-eared bat (*Corynorhinus townsendii*), silver-haired bat (*Lasionycteris noctivagans*), long-eared myotis (*Myotis evotis*), fringe-tailed bat (*Myotis thysanodes*), Merlin, Bald Eagle, and Golden Eagle. The three raptor species were previously discussed in the Raptors results section, while the bat species were discussed in the Small Mammal – Bat results.

Black-Footed Ferret

The USFWS initially listed the black-footed ferret under the ESA in 1967 (32 FR 4001). The agency later issued a block clearance for black-footed ferrets surveys in black-tailed prairie dog colonies throughout most of South Dakota prior to 2007, and throughout most of the species range in 2013 (USFWS 2013). Consequently, ferret surveys are no longer recommended statewide in South Dakota, including the Loring Quarry permit area in Custer County. No surveys were required for the Loring Quarry Project and no ferrets or evidence of their presence (e.g., trenching, tracks, or scat) were observed during the Loring Quarry survey period. While one black-tailed prairie dog colony does occur within the project area, its small size and relative isolation precludes it from being considered adequate black-footed ferret habitat.

Red Knot

The USFWS listed the Rufa Red Knot as Threatened on December 11, 2014 (79 FR 73706) and indicates it as a possible migrant for South Dakota (USFWS 2020a). Targeted surveys were not required for Red Knot (*Calidris canutus*) during baseline surveys. This species has not been documented in the Loring Quarry project area. The Red Knot feeds primarily on hard-shelled aquatic invertebrates, and as such tends to utilize marine habitats such as salt marshes, lagoons, coastal impoundments, sandy or gravel shorelines, mudflats, or tidal zones during migration (USFWS 2015). No red knots were recorded in the project area and no adequate habitat for this species occurs in the permit area.

Whooping Crane

The USFWS recognized the Whooping Crane as endangered on March 11, 1967 (32 FR 4001) and indicates it as a possible migrant for South Dakota (USFWS 2020a). In addition, the SDGFP lists the species as a State Endangered Species (SDGFP 2016). Targeted surveys were not required for Whooping Crane (*Grus americana*) during baseline surveys. This species has not been documented in the Loring Quarry project area. The Whooping Crane's preferred habitats include wet/moist meadows and marshes where it feeds upon fish, small mammals, crustaceans, insects, roots, berries, and grain (Orabona et al. 2012). No whooping cranes were recorded in the project area, and no adequate habitat for this species occurs in the permit area.

Northern Long-eared Bat

The final rule listing the northern long-eared bat as threatened was published on April 2, 2015 (80 FR 17974). While this species has been documented in Custer County (USFWS 2020a), it has not been documented in the Loring Quarry project area. Potential adequate habitat for northern long-eared bat maternal roost and hibernacula occurs both within the Loring Quarry permit area and within the surrounding survey area. One large ponderosa pine snag occurs in the central portion of the permit area north of the quarry pit, and two other smaller snags occur in the permit area could be used as maternal roosts in the summer (Photos 1 and 6). Crevices in the vuggy highwall could also potentially provide roost and hibernacula habitat, especially if they connect to the grotto beneath the quarry (Photos 5 and 7). An abandoned barn just northeast of the pit also provides adequate bat roosting habitat (Photo 2). Suitable maternal roost habitat in the form of tree snags is also located throughout the woodland habitat in the areas beyond the permit area.

No northern long-eared bats were observed or identified during the 2020 baseline surveys. Myotis species with ranges which occur within the vicinity of the project area emit echolocation calls generally within the same frequency range. Species specific call characteristics can be difficult to determine with poor quality calls. At most locations, high frequency calls were recorded; however, due to the poor quality of the recording, species could not be identified.

Aquatic Resources

Benthic Invertebrates

Aquatic resource surveys were not required by the SDGFP. The drainages within the permit area were dry during surveys and no sign of water was observed.

Conclusions

The Loring Quarry permit area encompasses approximately 162 contiguous acres and has been operating since at least 1963. Because much of the area has existing disturbance and is small, topsoil stripping and other habitat impacts are reduced to relatively small areas needed for the quarry expansion, access roads, and other supporting infrastructure. Despite the relatively limited surface disturbance associated with a project of this size, operations can have direct and indirect impacts on local wildlife populations. These impacts are both short-term (until successful reclamation is achieved) and long-term (persisting beyond successful completion of reclamation). However, the latter category is not expected to be substantial due to the relatively limited habitat disturbance associated with the permitted disturbance area.

The direct impacts of a quarry on wildlife include: 1) injuries and mortalities caused by collisions with project-related traffic and infrastructure, or habitat removal actions, such as topsoil stripping, particularly for smaller species with limited mobility, such as some rodents and herptiles; and 2) restrictions on wildlife movement due to construction of fences. The likelihood for the impacts resulting in injury or mortality is greatest during the construction and topsoil stripping phases due to increased levels of traffic and physical disturbance during those periods. Overall traffic will increase from current levels and will persist during production, but should occur at a reduced, and possibly more predictable level than during the construction phase. Speed limits would be enforced during all construction and maintenance operations to reduce impacts on wildlife throughout the year, but particularly during the breeding season.

As indicated, most of the habitat disturbance associated with the quarry operation will consist of removal of topsoil or with creation of topsoil and overburden piles, as is the case with other surface mining operations. Therefore, most indirect impacts would relate to the displacement of wildlife due to increased noise, traffic, or other disturbances associated with the development and operation of the Loring Quarry Project, as well as from small reductions in existing or potential cover and forage due to habitat alteration, fragmentation, or loss. Indirect impacts typically persist longer than direct impacts. However, because smaller quarry mine operations result in fewer large-scale habitat alterations, the need for reclamation actions that may result in dramatic differences between pre-construction and post-construction vegetative communities is also reduced.

No significant impacts on wildlife are anticipated from the construction of infrastructure, mining, and reclamation of these lands. The majority of habitats in the proposed permit area are typical of the region, and no unique or unusual wildlife features are present. The site currently is subject to regular human activity beyond normal ranching operations, as the area is still accessed by construction personnel picking up gravel. Occasional bike traffic on the Mickelson Trail, vehicular traffic associated with either the quarry or ranch, and cattle do occur in the area. Multiple site visits and targeted surveys conducted over the last year, combined with existing agency databases that encompass the project area, indicate that the Loring Quarry permit area and surrounding vicinity are occupied by a wide variety of common wildlife species, with only a few species of concern occurring in the area.

The most notable SDNHP species of interest were the four species of bat recorded during targeted acoustic surveys. Three additional SDNHP sensitive species were documented in or within 0.5 mile of the permit area during baseline surveys. However, most of those observations consisted of limited observations of birds perched in or flying over the permit area, or sightings made in the surrounding survey perimeter.

As indicated, suitable nesting habitat (trees and native uplands) for some SDNHP species is present in the permit area. However, the location of the quarry permit area and the presence of apparently suitable alternate nesting habitat (due to low density of other nesting individuals) throughout the permit area and perimeter combine to minimize the potential for both direct and indirect impacts for species of concern, and others that require similar habitats.

Other wildlife species of concern, such as other nesting raptors, that occur in the area may also experience direct and/or indirect impacts from increased travel and noise in the area during project construction and operation. The presence of potential alternate nesting and foraging habitat in the immediate vicinity, the mobility of those species, and the location of most relative to planned and existing disturbance combine to reduce impacts on most nesting SDNHP birds as well as other species of interest.

The vegetative communities (Upland Grassland and Woodland) with the greatest species richness baseline surveys will experience physical impacts from construction or operation of the proposed Loring Quarry Project. These two communities account for 51% and 15% of available habitat, respectively. Some vegetation communities, such as the Woodland type, can be difficult to reestablish through artificial planting, and natural re-seeding of those species could take many years. While physical impacts on these areas cannot be avoided, the ample availability of both habitat types throughout the region will help mitigate the habitat loss. The low density of nesting efforts relative to habitat presence in that area (based on observations during surveys) suggests that species' populations as a whole will experience minimal negative impacts from the Loring Quarry Project. Advanced planning of construction activities in concert with continued monitoring can further reduce impacts and assist with the development of mitigation options, if necessary. Adjusting activities associated with topsoil disturbance to periods outside of breeding seasons will further reduce potential impacts.

Big game could be displaced from portions of the Loring Quarry project area to adjacent habitats when disturbance activities would be greatest (e.g., during topsoil stripping and blasting activities). Disturbance levels would decrease resource recovery and processing and would consist primarily of vehicular traffic on new and existing improved and unimproved (two-track) roads throughout the project area. Similar disturbance is already present in the area due to existing haulage of aggregate materials from the site, ranching operations, and traffic on the nearby highway. Mule deer, white-tailed deer, and elk would not be substantially affected given their somewhat limited use of these lands, and the availability of suitable habitat in adjacent areas. The SDGFP does not consider the project area to be within the crucial habitat range of mule deer or any other big game species. Sightings of other species in that vicinity are often seasonal and less common.

Medium-sized mammals (such as prairie dogs, lagomorphs, canids, and badgers) may be temporarily displaced to other habitats during topsoil disturbance activities. Direct losses of some small mammal species (e.g., voles, ground squirrels, mice) may be higher than for other wildlife due to their more limited mobility and likelihood that they would retreat into burrows when disturbed, and thus potentially experience impacts from topsoil scraping or staging activities. However, given the incremental disturbance pattern and relatively small and limited area of impact from the Loring Quarry Project, such effects would not be expected to result in major changes or reductions in mammalian populations for small or medium-sized animals in the area. Most mammalian species known to be, or potentially be, present in the project area have shown an ability to adapt to human disturbance in varying degrees, as evidenced by their continued presence in other mining and residential areas of similar, or greater, disturbance levels elsewhere in the region. Additionally, small mammal species in the area have a high reproductive potential and tend to reoccupy and adapt to altered and/or reclaimed areas quickly. Advanced planning for topsoil stripping activities, such as timing them in the fall after the young are weaned and mobile, could reduce impacts to these species.

Bat species may be displaced to other habitats during quarry expansion. Several potential summer roost and winter hibernacula locations were identified during surveys. These included tree snags, an abandoned barn, and crevices in the quarry highwall, particularly in the northern portion. Bat species, including SDNHP sensitive species, were recorded at or near each of the selected survey sites that were placed near these locations. Expansion of the quarry could directly impact potential bats, including SDNHP listed species, and their summer roost and winter hibernacula locations for the bat species identified in the area. Such effects could be minimized by implementing avoidance and impact mitigation measures like those recommended in Appendix IV. Suitable roost and hibernacula habitat are present beyond the permit area, providing alternate habitat for displaced individuals. Advanced planning of construction activities in concert with continued monitoring can further reduce impacts and assist with the development and implementation of impact avoidance and mitigation options.

Resource recovery in the Loring Quarry project area would not result in impacts on regional raptor populations, though individual birds or pairs may be affected. Mining activity could cause raptors to abandon nest sites near disturbance, particularly if activities encroach on active nests during a given breeding season. Other potential direct impacts would be injury or mortality due to collisions with mine-related vehicular traffic. Construction activities that occur within or near active raptor territories could also cause indirect impacts such as reduction or avoidance of foraging habitats for nesting birds. However, surface disturbance will only occur in a small percentage of the overall permit area at any given time, and the low density of nesting raptors relative to the apparent availability of suitable habitat suggests that alternate nesting habitat is available for all known nesting raptor species in the Loring Quarry project area. Advanced planning of topsoil disturbance and blasting activities in concert with continued monitoring can further reduce impacts and assist with the development of mitigation or monitoring options, if necessary.

While Ruffed Grouse and other upland game birds may be displaced to other habitats during topsoil disturbance activities, resource recovery in the Loring Quarry project area would not impact regional populations. Mining activity could cause upland birds to abandon mating territories or nest sites proximate to disturbance, particularly if activities encroach on active nests during a given breeding season. Other potential direct impacts would be injury or mortality due to collisions with mine-related vehicular traffic. Construction activities that occur within or near occupied habitat could also cause indirect impacts such as reduction or avoidance of mating, nesting, or foraging habitats. However, the presence of ample suitable year-round habitat for these species in the region provides alternatives for displace individuals. Advanced planning of topsoil disturbance and blasting activities can reduce impacts.

Construction and operation of the Loring Quarry Project would have no effect on migrating and breeding waterfowl and shorebirds. Existing habitat for these species does not occur in the project area, so these species will rarely, if ever, use the area. Habitat disturbance in drainages or other potential water sources would be reclaimed once productive operations have ceased.

As with waterfowl, potential habitat for aquatic and semi-aquatic amphibians is limited within the proposed Loring Quarry permit area and is associated with mobile stock tanks in the area. Those herptile species residing in rocky outcrops located in potential disturbance area could experience impacts from construction and maintenance operations. However, no non-aquatic herptile species were observed in the permit area and surrounding perimeter. Any impacts that might occur would affect individuals but would not likely affect the population as a whole.

As described in the preceding sections of this document, no federally listed vertebrate species were documented in the Loring Quarry survey area (permit area and 0.5-mile perimeter) during the survey period. Additionally, the USFWS has issued a block clearance for black-footed ferrets in all black-tailed prairie dog colonies in South Dakota (except northern Custer County). That clearance indicates that ferrets do not currently and are not expected to occupy the Loring Quarry project area. Only one occupied black-tailed prairie dog colony was present within the permit area itself during the 2020 baseline surveys. Consequently, licensing the Loring Quarry Project will have no direct, indirect, or cumulative effects on black-footed ferrets.

Mining within the Loring Quarry Project is not likely to adversely affect eagle species. Only two eagles were documented during baseline surveys for this project, and they were recorded flying over the area. While no eagles were recorded utilizing the project area, direct impacts on eagles could include the potential for injury or mortality to individual birds foraging in the project area due to collisions with mine-related equipment during construction or operation of the Loring Quarry Project, or due to electrocutions on new or current overhead power lines.

Given the low number of wintering and nesting eagle, SDNHP sensitive and other raptor species in the project area, potential negative direct impacts of the proposed project would be limited to individuals rather than a large segment of the population. The use of existing or overlapping right-of-way corridors, along with current Avian Power Line Interaction Committee (APLIC 2006) recommendations for new power line construction, would help minimize potential direct impacts associated with overhead power lines. If necessary, the majority of other potential direct impacts could be mitigated if construction activities were conducted outside the breeding season and/or winter roosting months, or outside the daily roosting period, should raptors or eagles be present within 1.0 mile of construction. Any Bald or Golden Eagles, merlins, or other raptors that might roost or nest in the area once the mine is operational would be doing so despite continuous and ongoing human disturbance, indicating a tolerance for such activities.

Indirect impacts to SDNHP sensitive and other raptor species, such as area avoidance, could result from increased noise and human presence associated with mine-related operations. Potential winter foraging habitat could be further fragmented by linear disturbances such as overhead power lines and new roads associated with the project. Given the size of the proposed project, those disturbances would occur within narrow corridors over relatively short distances. Nevertheless, the use of common right-of-way corridors to consolidate new infrastructure would help reduce these potential indirect impacts. Three avian species tracked by the SDNHP were recorded during baseline surveys for the Loring Quarry Project

(Merlin, Bald Eagle, and Golden Eagle). While only the Merlin was recorded within the permit area, all three species are highly mobile, and likely would utilize the permit area.

While habitats within the Loring Quarry Project area are adequate to host several of the species listed by the SDNHP, only seven were recorded. SDNHP-listed species that utilize these habitats could potentially experience the same type of direct and/or indirect impacts from activities associated with the proposed mining operation as those described previously for other similar species (e.g., injury, mortality, avoidance, displacement, and increased competition for resources). Those potential impacts would be minimized by the timing, extent, and duration of the quarry operations and associated activities. Animals occurring in the area have indicated a tolerance for such activities due to their presence during continued operations at the quarry, which began at least 57 years ago. Once resource recovery activities increase, animals remaining in the project area would be demonstrating an acclimation and tolerance to those disturbances.

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Personal Communication

Michals, Stan, Energy and Minerals Coordinator. South Dakota Game, Fish, and Parks. April 7, 2020—Letter to Stephanie Kane, Biologist, ICF, Gillette, Wyoming.

Michals, Stan, Energy and Minerals Coordinator. South Dakota Game, Fish, and Parks. December 30, 2020—Email to Stephanie Kane, Biologist, ICF, Gillette, Wyoming.

Figures

Figure 1. Wildlife Habitat Communities

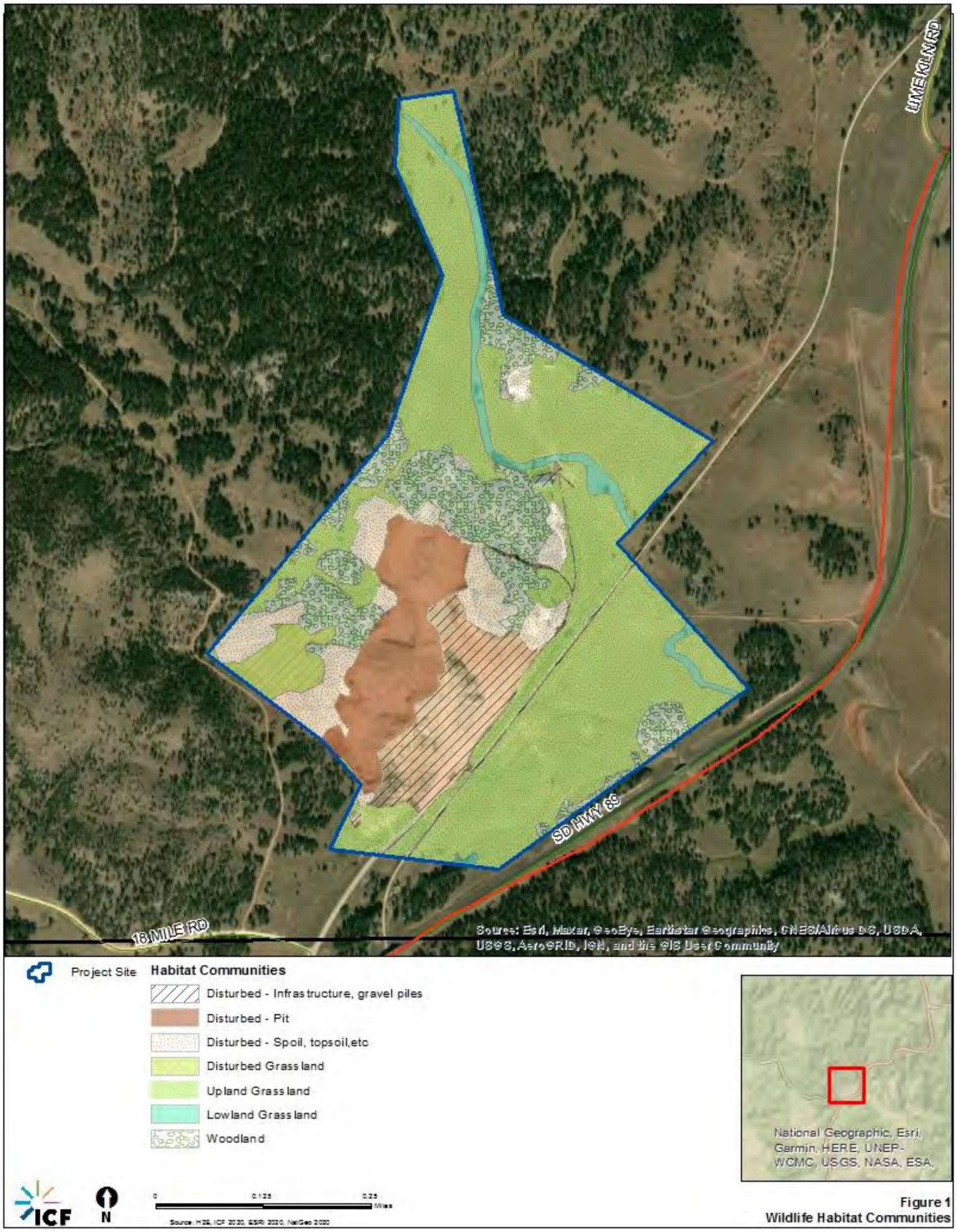


Figure 2. Herptile and Bat Survey Locations

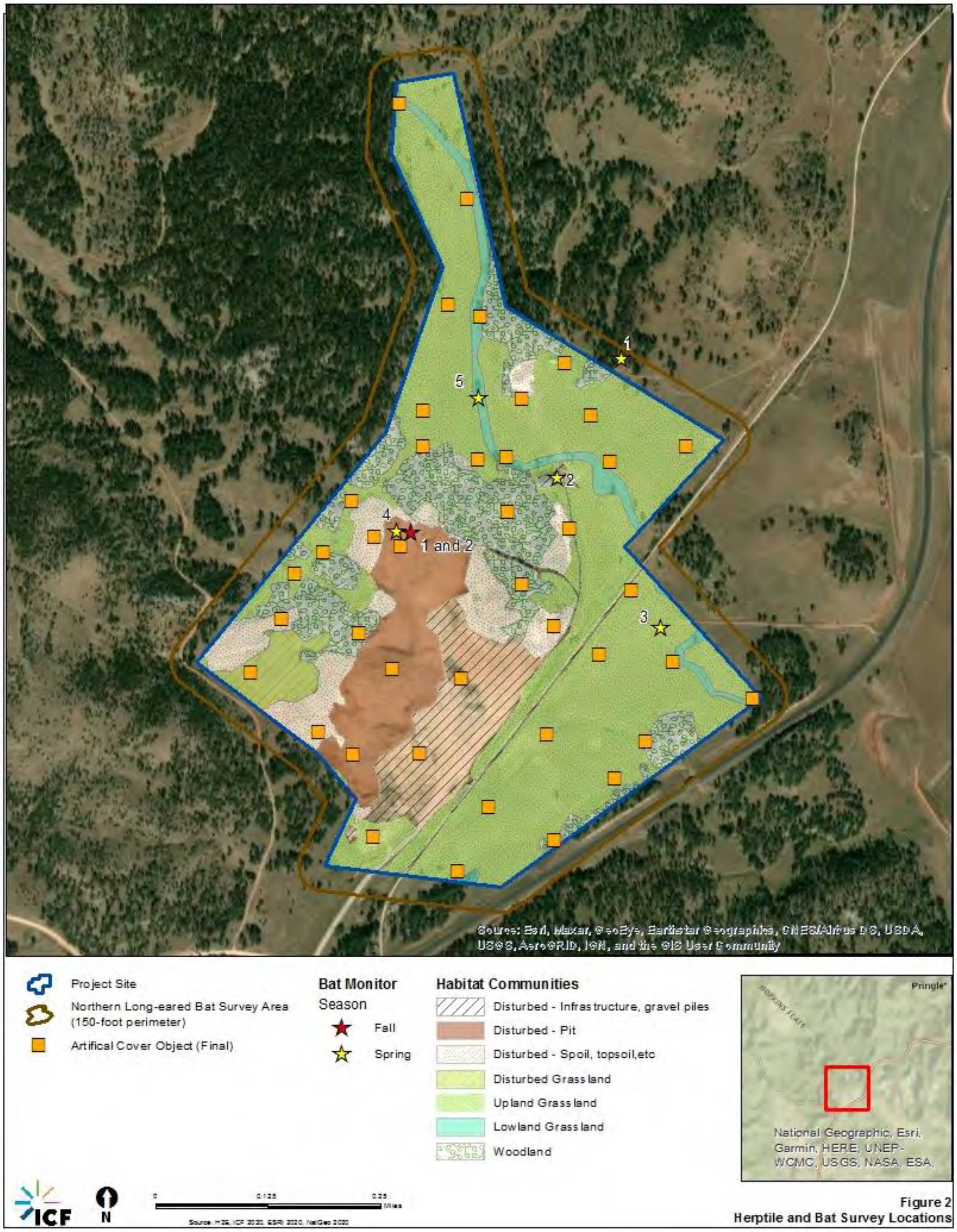
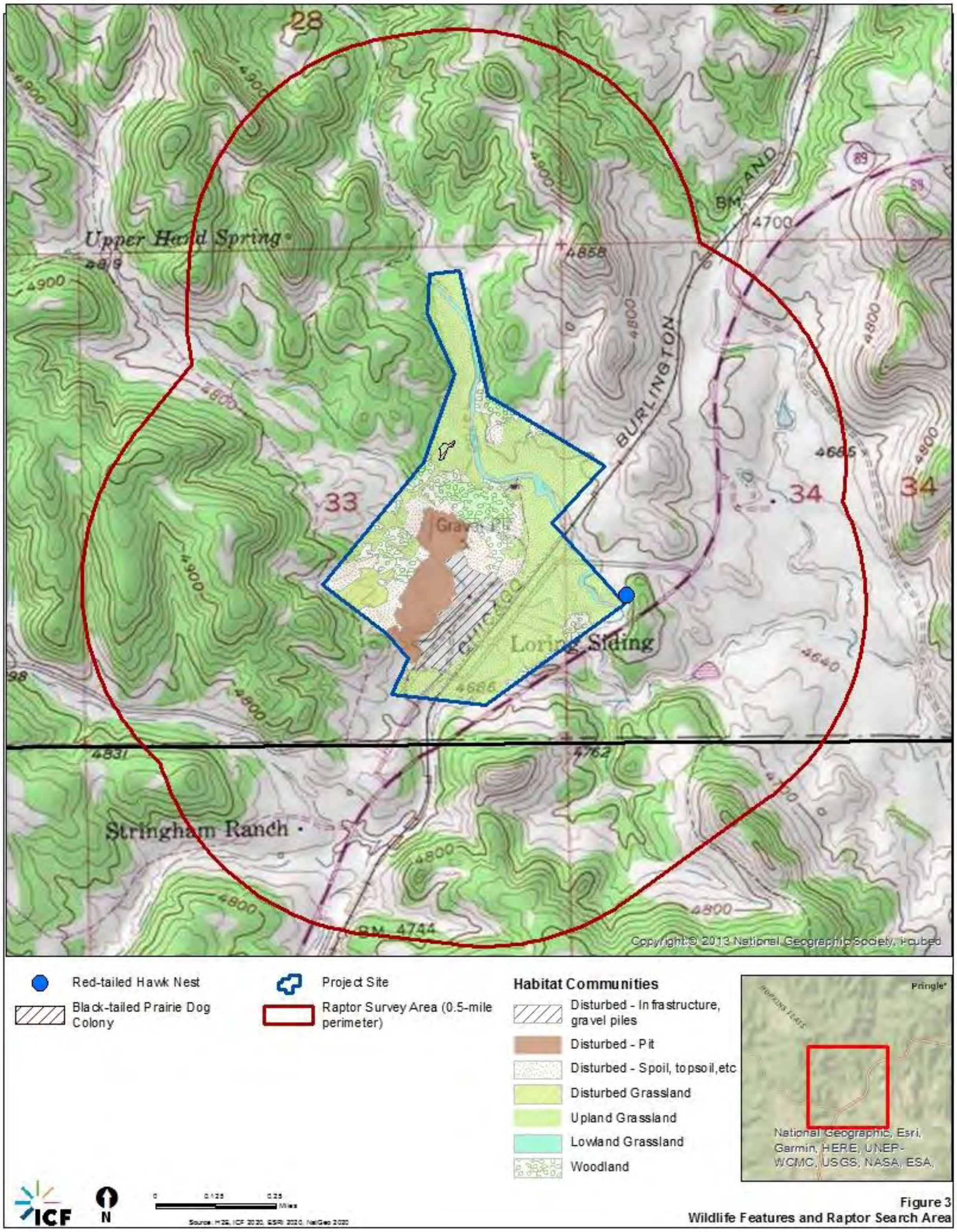


Figure 3. Wildlife Features and Raptor Search Area



Appendix I

Potential and Observed Terrestrial Species List in the Loring Quarry Wildlife Baseline Study Area

Table I-1. Potential[1] and Observed Mammalian Species in the Loring Quarry Wildlife Survey Area

Common Name[2]	Latin Name	Recorded in Permit Area	Recorded in Vicinity [3]
Insectivores			
Hayden's shrew	*Sorex haydeni*	---	---
Masked shrew	*Sorex cinereus*	---	---
Merriam's shrew	*Sorex merriami*	---	---
Bats			
Big brown bat	*Eptesicus fuscus*	X	---
Fringe-tailed bat	*Myotis thysanodes*	X	---
Hoary bat	*Lasiurus cinereus*	X	---
Keen's myotis	*Myotis keenii*	---	---
Little brown bat	*Myotis lucifugus*	X	---
Long-eared myotis	*Myotis evotis*	X	---
Long-legged myotis	*Myotis volans*	---	---
Northern long-eared bat	*Myotis septentrionalis*	---	---
Red bat	*Lasiurus borealis*	---	---
Silver-haired bat	*Lasionycteris noctivagans*	X	---
Western small-footed bat	*Myotis ciliolabrum*	X	---
Townsend's big-eared bat	*Plecotus townsendii*	X	---
Unknown bat species		X	---
Hares and Rabbits			
Desert cottontail	*Sylvilagus audubonii*	---	---
Mountain cottontail	*Sylvilagus nuttallii*	---	---
White-tailed jackrabbit	*Lepus townsendii*	---	---
Cottontail species	*Sylvilagus spp.*	---	---
Rodents			
Black-tailed prairie dog	*Cynomys ludovicianus*	X	---
Bushy-tailed woodrat	*Neotoma cinerea*	---	---
Deer mouse	*Peromyscus maniculatus*	---	---
House mouse	*Mus musculus*	---	---
Least chipmunk	*Tamias minimus*	X	X
Long-tailed vole	*Microtus longicaudus*	---	---
Meadow jumping mouse	*Zapus hudsonius*	---	---
Meadow vole	*Microtus pennsylvanicus*	---	---
Northern flying squirrel	*Glaucomys sabrinus*	---	---
Northern pocket gopher	*Thomomys talpoides*	---	---
Norway rat	*Rattus norvegicus*	---	---
Porcupine	*Erethizon dorsatum*	---	---
Prairie vole	*Microtus ochrogaster*	---	---
Red squirrel	*Tamiasciurus hudsonicus*	X	---
Southern red-backed vole	*Clethrionomys gapperi*	---	---

Common Name[2]	Latin Name	Recorded in Permit Area	Recorded in Vicinity [3]
Thirteen-lined ground squirrel	*Spermophilus tridecemlineatus*	---	---
Vole species	*Microtus* spp.	---	---
White-footed mouse	*Peromyscus leucopus*	---	---
Yellow-bellied marmot	*Marmota flaviventris*	---	---
Carnivores			
Badger	*Taxidea taxus*	---	---
Black bear	*Ursus americanus*	---	---
Bobcat	*Lynx rufus*	---	---
Coyote	*Canis latrans*	X	---
Eastern spotted skunk	*Spilogale putorius*	---	---
Ermine	*Mustela erminea*	---	---
Gray fox	*Urocyon cinereoargenteus*	---	---
Long-tailed weasel	*Mustela frenata*	---	---
Lynx	*Lynx canadensis*	---	---
Mink	*Mustela vison*	---	---
Mountain lion	*Felis concolor*	---	---
Pine marten	*Martes americana*	---	---
Raccoon	*Procyon lotor*	---	---
Red fox	*Vulpes*	---	---
Striped skunk	*Mephitis*	---	---
Weasel species	*Mustela spp.*	---	---
Ungulates			
Elk	*Cervus elaphus*	X	X
Mule deer	*Odocoileus hemionus*	X	X
Pronghorn	*Antilocapra americana*	---	---
White-tailed deer	*Odocoileus virginianus*	X	X
Bighorn Sheep	*Ovis canadensis*	---	---

1 POTENTIAL OCCURRENCE—list derived from range and habitat information in South Dakota Game Fish and Parks (2016), Sharps and Benzon (1984), Jones et al. (1983), Clark and Stromberg (1987), and Burt and Grossenheider (1976).

2 Species in **bold** indicate rare species tracked by the South Dakota Natural Heritage Program (2018).

3 RECORDED IN VICINITY-animal or sign observed within 0.5-mile of the proposed permit area by ICF biologists or during baseline surveys.

Table I-2. Potential[1] and Observed Avian Species in the Loring Quarry Survey Area

Common Name[2]	Latin Name	Recorded in Permit Area	Recorded in Vicinity
Loons and Grebes			
Common loon	*Gavia immer*	---	---
Eared grebe	*Podiceps nigricollis*	---	---
Horned grebe	*Podiceps auritus*	---	---
Pied-billed grebe	*Podilymbus podiceps*	---	---
Herons and Bitterns			
American bittern	*Botaurus lentiginosus*	---	---
Black-crowned night heron	*Nycticorax*	---	---
Great blue heron	*Ardea herodias*	---	---
Ibises			
White-faced ibis	*Plegadis chihi*	---	---
Swans, Geese, and Ducks			
American wigeon	*Anas Americana*	---	---
Blue-winged teal	*Anas discors*	---	---
Bufflehead	*Bucephala albeola*	---	---
Canada goose	*Branta Canadensis*	---	---
Canvasback	*Aythya valisineria*	---	---
Cinnamon teal	*Anas cyanoptera*	---	---
Common merganser	*Mergus merganser*	---	---
Gadwall	*Anas strepera*	---	---
Green-winged teal	*Anas crecca*	---	---
Lesser scaup	*Aythya affinis*	---	---
Mallard	*Anas platyrhynchos*	---	---
Northern pintail	*Anas acuta*	---	---
Northern shoveler	*Anas clypeata*	---	---
Redhead	*Aythya Americana*	---	---
Ring-necked duck	*Aythya collaris*	---	---
Ruddy duck	*Oxyura jamaicensis*	---	---
Snow goose	*Chen caerulescens*	---	---
Vultures			
Turkey vulture	*Cathartes aura*	X	X
Diurnal Raptors			
American kestrel	*Falco sparverius*	X	---
Bald eagle	*Haliaeetus leucocephalus*	X	---
Broad-winged Hawk	*Buteo platypterus*	---	---
Cooper's Hawk	*Accipiter cooperii*	---	---
Ferruginous hawk	*Buteo regalis*	---	---
Golden eagle	*Aquila chrysaetos*	---	X
Merlin	*Falco columbarius*	X	---
Northern Goshawk	*Accipiter gentilis*	---	---

Common Name[2]	Latin Name	Recorded in Permit Area	Recorded in Vicinity
Northern harrier	*Circus cyaneus*	---	---
Osprey	*Pandion haliaetus*	---	---
Peregrine falcon	*Falco peregrines*	---	---
Prairie falcon	*Falco mexicanus*	---	---
Red-tailed Hawk	*Buteo jamaicensis*	X	X
Rough-legged hawk	*Buteo lagopus*	---	---
Sharp-shinned hawk	*Accipiter striatus*	---	---
Swainson's hawk	*Buteo swainsoni*	---	---
Gallinaceous Birds			
Ruffed grouse	*Bonasa umbellus*	---	---
Sharp-tailed grouse	*Tympanuchus phasianellus*	---	---
Wild turkey	*Meleagris gallopavo*	X	---
Cranes			
Sandhill crane	*Grus canadensis*	---	--
Whooping crane	*Grus americana*	---	---
Coots, Gallinules, and Rails			
American coot	*Fulica americana*	---	---
Sora	*Porzana carolina*	---	---
Virginia rail	*Rallus limicola*	---	---
Shorebirds, Gulls, and Terns			
American avocet	*Recurvirostra americana*	---	---
Common snipe	*Gallinago*	---	---
Greater yellowlegs	*Tringa melanoleuca*	---	---
Killdeer	*Charadrius vociferus*	X	---
Lesser yellowlegs	*Tringa flavipes*	---	---
Solitary sandpiper	*Tringa solitaria*	---	---
Spotted sandpiper	*Actitis macularia*	---	---
Upland sandpiper	*Bartramia longicauda*	---	---
Willet	*Catoptrophorus semipalmatus*	---	---
Wilson's phalarope	*Phalaropus tricolor*	---	---
Pigeons and Doves			
Mourning dove	*Zenaida macroura*	---	---
Rock dove	*Columba livia*	X	---
Cuckoos			
Black-billed cuckoo	*Coccyzus erythropthalmus*	---	---
Yellow-billed cuckoo	*Coccyzus americanus*	---	---
Owls			
Eastern screech owl	*Otus asio*	---	---
Great Horned Owl	*Bubo virginianus*	---	---
Long-eared owl	*Asio otus*	---	---
Northern saw-whet owl	*Aegolius acadicus*	---	---

Common Name[2]	Latin Name	Recorded in Permit Area	Recorded in Vicinity
Goatsuckers			
Common nighthawk	*Chordeiles minor*	X	---
Common poorwill	*Phalaenoptilus nuttallii*	---	---
Swifts			
White-throated swift	*Aeronautes saxatalis*	---	---
Hummingbirds			
Broad-tailed hummingbird	*Selasphorus platycercus*	---	---
Calliope hummingbird	*Selasphorus calliope*	---	---
Rufous hummingbird	*Selasphorus rufus*	---	---
Kingfishers			
Belted kingfisher	*Megaceryle alcyon*	---	---
Woodpeckers			
Black-backed woodpecker	*Picoides arcticus*	---	---
Downy woodpecker	*Picoides pubescens*	---	---
Hairy woodpecker	*Picoides villosus*	---	---
Lewis' woodpecker	*Melanerpes lewis*	---	---
Northern flicker	*Colaptes auratus*	X	X
Red-headed woodpecker	*Melanerpes erythrocephalus*	---	---
Red-naped sapsucker	*Sphyrapicus nuchalis*	---	---
Three-toed woodpecker	*Picoides tridactylus*	---	---
Yellow-bellied sapsucker	*Sphyripicus varius*	---	---
Flycatchers			
Cordilleran flycatcher	*Empidonax occidentalis*	---	---
Dusky flycatcher	*Empidonax oberholseri*	---	---
Least flycatcher	*Empidonax minimus*	---	---
Eastern kingbird	*Tyrannus*	---	---
Eastern phoebe	*Sayornis phoebe*	---	---
Hammond's flycatcher	*Empidonax hammondii*	---	---
Olive-sided flycatcher	*Contopus cooperi*	---	---
Say's phoebe	*Sayornis saya*	---	---
Western kingbird	*Tyrannus verticalis*	---	---
Western wood pewee	*Contopus sordidulus*	X	---
Larks			
Horned lark	*Eremophila alpestris*	X	---
Swallows			
Barn swallow	*Hirundo rustica*	---	---
Cliff swallow	*Hirundo pyrrhonota*	X	---
Tree swallow	*Tachycineta bicolor*	---	---
Violet-green swallow	*Tachycineta thalassina*	---	---
Jays, Magpies, and Crows			
American crow	*Corvus brachyrhynchos*	X	---

Common Name[2]	Latin Name	Recorded in Permit Area	Recorded in Vicinity
Black-billed magpie	*Pica*	---	---
Blue jay	*Cyanocitta cristata*	X	---
Clark's nutcracker	*Nucifraga columbiana*	---	---
Common Raven	*Corvus corax*	---	---
Gray jay	*Perisoreus canadensis*	---	---
Pinyon jay	*Gymnorhinus cyanocephalus*	---	---
Chickadees			
Black-capped chickadee	*Parus atricapillus*	X	---
Pygmy nuthatch	*Sitta pygmaea*	---	---
Red-breasted nuthatch	*Sitta canadensis*	X	---
White-breasted nuthatch	*Sitta carolinensis*	---	---
Creepers			
Brown creeper	*Certhia americana*	---	---
Wrens			
Canyon wren	*Catherpes mexicanus*	---	---
House wren	*Troglodytes aedon*	X	---
Rock wren	*Salpinctes obsoletus*	X	---
Winter wren	*Troglodytes*	---	---
Dippers			
American dipper	*Cinclus mexicanus*	---	---
Gnatcatchers and Kinglets			
Blue gray Gnatcatcher	*Polioptila caerulea*	---	---
Golden-crowned kinglet	*Regulus satrapa*	---	---
Ruby-crowned kinglet	*Regulus calendula*	---	---
Thrushes			
American robin	*Turdus migratorius*	X	X
Eastern bluebird	*Sialia sialis*	---	---
Mountain bluebird	*Sialia currucoides*	X	---
Swainson's thrush	*Catharus ustulatus*	---	---
Townsend's solitaire	*Myadestes townsendi*	---	---
Veery	*Catharus fuscescens*	---	---
Mimic Thrushes			
Brown thrasher	*Toxostoma rufum*	---	---
Gray catbird	*Dumetella carolinensis*	---	---
Northern Mockingbird	*Mimus polyglottos*	---	---
Wagtails and Pipits			
American pipit	*Anthus rubescens*	---	---
Sprague’s pipit	*Anthus spragueii*	---	---
Waxwings			
Bohemian waxwing	*Bombycilla garrulus*	---	---

Common Name[2]	Latin Name	Recorded in Permit Area	Recorded in Vicinity
Cedar waxwing	*Bombycilla cedrorum*	---	---
Shrikes			
Northern shrike	*Lanius excubitor*	---	---
Loggerhead shrike	*Lanius ludovicianus*	---	---
Starlings			
European starling	*Sturnus vulgaris*	---	---
Vireos			
Bell’s vireo	*Vireo bellii*	---	---
Red-eyed vireo	*Vireo olivaceus*	---	---
Plumbeous Vireo	*Vireo plumbeus*	---	---
Solitary vireo	*Vireo solitarius*	---	---
Warbling vireo	*Vireo gilvus*	---	---
Warblers			
American redstart	*Setophaga ruticilla*	---	---
Black-and-white warbler	*Mniotilta varia*	---	---
Blackburnian warbler	*Dendroica fusca*	---	---
Blackpoll warbler	*Dendroica striata*	---	---
Common yellowthroat	*Geothlypis trichas*	X	---
MacGillivray's warbler	*Oporornis tolmiei*	---	---
Orange-crowned warbler	*Vermivora celata*	---	---
Ovenbird	*Seiurus aurocapillus*	---	---
Tennessee warbler	*Vermivora peregrina*	---	---
Townsend’s warbler	*Dendroica townsendi*	---	---
Wilson's warbler	*Wilsonia pusilla*	---	---
Yellow warbler	*Setophaga petechia*	---	---
Yellow-breasted chat	*Icteria virens*	---	---
Yellow-rumped warbler	*Dendroica coronata*	---	---
Tanagers			
Western tanager	*Piranga ludoviciana*	---	---
Grosbeaks and Buntings			
Black-headed grosbeak	*Pheucticus melanocephalus*	---	---
Blue grosbeak	*Guiraca caerulea*	---	---
Dickcissel	*Spiza americana*	---	---
Indigo bunting	*Passerina cyanea*	---	---
Lazuli bunting	*Passerina amoena*	---	---
Rose-breasted grosbeak	*Pheucticus ludovicianus*	---	---
Towhees, Sparrows, Juncos, and Longspurs			
American tree sparrow	*Spizella arborea*	---	---
Baird’s sparrow	*Ammodramus bairdii*	---	---
Chestnut-collared longspur	*Calcarius ornatus*	---	---
Chipping sparrow	*Spizella passerina*	X	---

Common Name[2]	Latin Name	Recorded in Permit Area	Recorded in Vicinity
Clay-colored sparrow	*Spizella pallida*	---	---
Dark-eyed junco	*Junco hyemalis*	X	---
Field sparrow	*Spizella pusilla*	---	---
Grasshopper sparrow	*Ammodramus savannarum*	X	---
Harris' sparrow	*Zonotrichia querula*	---	---
Lark bunting	*Calamospiza melanocorys*	---	---
Lark sparrow	*Chondestes grammacus*	X	---
Snow bunting	*Plectrophenax nivalis*	---	---
Song sparrow	*Melospiza melodia*	---	---
Spotted towhee	*Pipilo maculatus*	X	---
Vesper sparrow	*Pooecetes gramineus*	X	---
White-crowned sparrow	*Zonotrichia leucophrys*	---	---
White-throated sparrow	*Zonotrichia albicollis*	---	---
Blackbirds, Meadowlarks, and Orioles			
Brewer's blackbird	*Euphagus cyanocephalus*	X	---
Brown-headed cowbird	*Molothrus ater*	X	---
Common grackle	*Quiscalus quiscula*	---	---
Northern oriole	*Icterus galbula*	---	---
Orchard oriole	*Icterus spurius*	X	---
Red-winged blackbird	*Agelaius phoeniceus*	---	---
Western meadowlark	*Sturnella neglecta*	X	---
Finches			
American goldfinch	*Carduelis tristis*	X	---
Cassin's finch	*Carpodacus cassinii*	---	---
Common redpoll	*Carduelis flammea*	---	---
Evening grosbeak	*Coccothraustes vespertinus*	---	---
House finch	*Carpodacus mexicanus*	---	---
Pine grosbeak	*Pinicola enucleator*	---	---
Pine siskin	*Carduelis pinus*	---	---
Purple finch	*Carpodacus purpureus*	---	---
Red crossbill	*Loxia curvirostra*	---	---
Rosy finch	*Leucosticte arctoa*	---	---
White-winged crossbill	*Loxia leucoptera*	---	---
Weaver Finches			
House sparrow	*Passer domesticus*	---	---

[1] POTENTIAL OCCURRENCE—list derived from range and habitat information in South Dakota Game Fish and Parks (2016), Peterson (2020), Robbins et al. (2001), Stokes et al. (2013).

[2] Species in **bold** indicate rare species tracked by the South Dakota Natural Heritage Program (2018).

[3] RECORDED IN VICINITY-animal or sign observed within 0.5-mile of the proposed permit area by ICF biologists or during baseline surveys.

Table I-3. Potential[1] and Observed Avian Species in the Loring Quarry Survey Area

Common Name[2]	Latin Name	Recorded in Permit Area	Recorded in Vicinity
Salamanders			
Tiger salamander	*Ambystoma tigrinum*	---	---
Frogs and Toads			
Boreal chorus frog	*Pseudacris triseriata*	---	---
Plains spadefoot toad	*Spea bombifrons*	X	---
Northern leopard frog	*Rana pipiens*	---	---
Lizards			
Northern sagebrush lizard	*Sceloporus graciousus*	---	---
Short-horned lizard	*Phrynosoma hernandesi*	---	---
Snakes			
Black hills redbelly snake	*Storeria occipitomaculata pahasapae*	---	---
Bullsnake	*Pituophis melanoleucas sayi*	---	---
Common garter snake	*Thamnophis sirtalis*	---	---
Eastern yellowbelly racer	*Coluber constrictor*	---	---
Pale milk snake	*Lampropeltis triangulum multistriata*	---	---
Smooth green snake	*Liochlorophis vernalis*	---	---
Western terrestrial (wandering) garter snake	*Thamnophis elegans*	---	---

[1] POTENTIAL OCCURRENCE—list derived from range and habitat information in South Dakota Game Fish and Parks (2016), Kiesow (2006).

[2] Species in **bold** indicate rare species tracked by the South Dakota Natural Heritage Program (2018).

[3] RECORDED IN VICINITY-animal or sign observed within 0.5-mile of the proposed permit area by ICF biologists or during baseline surveys.

References for Potential and Observed Species Lists (Appendix I)

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Appendix II
Vertebrate Wildlife Species Federal and State Species of Concern

Table II-1. Current Federal (U.S. Fish and Wildlife Service Listing within Custer County, SD [SDGFP 2016]), Loring Quarry IPaC Report (USFWS 2020a), State Vertebrate Species of Concern that potentially occur in Custer County, SD[1]

Common Name (Latin Name)	Federal Status, State Status, State Rank†
BIRDS	
American Dipper (*Cinclus mexicanus*)	ST, S2B
American Three-toed Woodpecker (*Picoides dorsalis*)	S2B
Baird's sparrow (*Ammodramus bairdii*)	S2B
Bald eagle (*Haliaeetus leucocephalus*)	S4B
Black and White Warbler (*Mniotilta varia*)	S1B
Black-backed woodpecker (*Picoides arcticus*)	S2B
Blue-gray Gnatcatcher (*Polioptila caerulea*)	S2B
Brown Creeper (*Certhia americana*)	S2B
Cassin's Finch (*Haemorhous cassinii*)	S1B
Clark's Nutcracker (*Nucifraga columbiana*)	S2B
Common Poorwill (*Phalaenoptilus nuttallii*)	S1B
Ferruginous Hawk (*Buteo regalis*)	S3B
Golden Eagle (*Aquila chrysaetos*)*	O, S3B
Great Blue Heron (*Ardea herodias*)	S4B
Lark bunting (*Calamospiza melanocorys*)	C
Lewis's woodpecker (*Melanerpes lewis*)	S2B
Long-eared Owl (*Asio otus*)	S3B
Merlin (*Falco columbarius*)*	SUB
Northern Goshawk (*Accipiter gentilis*)	S3B
Northern Mockingbird (*Mimus polyglottos*)	S1B
Northern Saw-whet Owl (*Aegolius acadicus*)	S2B
Osprey (*Pandion haliaetus*)	S3B
Prairie falcon (*Falco mexicanus*)	S3S4B
Pygmy Nuthatch (*Sitta pygmaea*)	S1B
Red-headed Woodpecker (*Melanerpes erythrocephalus*)	O
Rufa Red Knot (*Calidris canutus rufa*)	FT
Ruffed Grouse (*Bonasa umbellus*)	C
Sharped-shinned Hawk (Accipiter striatus)	S3B
Whooping crane (*Grus americana*)	FE, SE, SZA
MAMMALS	
Black bear (*Ursus americanus*)	C
Black-footed ferret (*Mustela nigripes*)	FE, SE, S1
Fringe-tailed bat (*Myotis thysanodes pahasapensis*)*	S2
Northern Long-eared bat (*Myotis septentrionalis*)	FT, S3
Northern river otter (*Lontra canadensis*)	S2
Silver-haired bat (*Lasionycteris noctivagans*)*	S4
Swift fox (*Vulpes velox*)	ST, S3

Townsend's big-eared bat (*Corynorhinus townsendii*)*	S2S3
AMPHIBIANS AND REPTILES	
Black Hills redbelly snake (*Storeria occipitomaculata pahasapae*)	S3
Sagebrush lizard (*Sceloporus graciosus*)	S2
Smooth green snake (*Opheodrys vernalis*)	S4
FISHES	
Blacknose shiner (*Notropis heterolepis*)	SE, S1
Longnose sucker (*Catostomus catostomus*)	ST, S1
Sturgeon chub (*Macrhybopsis gelida*)	ST, S2

*Species recorded during the 2020 baseline surveys.

[1] Michals, Stan, Energy and Minerals Coordinator. South Dakota Game, Fish, and Parks. February 14, 2020—Letter to Katie Wilson, Biologist, ICF, Gillette, Wyoming.

C Species listed at county level

FC Federally listed (for Custer County, SD), candidate

FE Federally listed (for Custer County, SD), endangered

FT Federally listed (for Custer County, SD), threatened

O Listed for the area in the USFWS IPaC report (2020), due to species listing in the Breeding Birds of Conservation Concern Report for the region (2008).

SE State Endangered

ST State Threatened

† State Rank: Separate rank given for breeding (B) and non-breeding (N) seasons (if different).

S1 Critically imperiled because of extreme rarity (five or fewer occurrences or very few remaining individuals) or because of some factor(s) making it especially vulnerable to extinction within South Dakota.

S2 Imperiled because of rarity (six to 20 occurrences or few remaining individuals) or because of some factor(s) making it very vulnerable to extinction throughout its range within South Dakota.

S3 Either very rare and local throughout its range within South Dakota or found locally (even abundantly at some of its locations in a restricted range) or vulnerable to extinction throughout its range because of other factors (in the range of 21 to 100 occurrences).

S4 Apparently secure within South Dakota, though it may be quite rare in parts of its range, especially at the periphery; cause for long-term concern.

SZ No definable occurrences for conservation purposes, usually assigned to migrants.

Appendix III
Representative Photographs from the Loring Quarry Project Area

2020 Loring Quarry Photos

Photo 1

Bat Monitor 1 near potential tree snag roost site.

Photo 2

Bat Monitor 2 near potential roost site at old barn.

Photo 3

Bat Monitor 3 near stock tanks filled with water.

Photo 4

Bat Monitor 4 near wet area in west side of blasting pit.

Photo 5

Bat Monitor 4's location in relation to the vuggy highwall in blasting pit.

Photo 6

Potential bat roost snag where Bat Monitor 5 was placed.

Photo 7

Crevices in highwall in blasting pit. Bat monitor site for Fall surveys was located in the lower left of the photo.

Photo 8

North man-made grotto entrance in blasting pit.

Photo 9

Occupied Red-tailed Hawk nest in ponderosa pine near east edge of permit area (center of photo, just up from fork in tree).

Photo 10

Plains spadefoot toad (*Spea bombifrons*) discovered underneath artificial cover object (ACO) placed in blasting pit.

Photo 11

Black-tailed prairie dog colony in grassland habitat in central portion of proposed permit area.

Photo 12

Typical woodland habitat in and near the Loring Quarry permit area.

Photo 13

South pit area.

Photo 14

North pit area looking towards highwall with crevices and north man-made grotto entrance.

Appendix IV
Bat Avoidance and Mitigation Measures

MM-1: Conduct Emergence Surveys Prior to Construction Activities

If identified suitable day roost habitat would be affected by construction activities presence/absence surveys will be conducted for bats prior to the start of construction. The survey will consist of a daytime search for potential roosting habitat and evening emergence surveys to determine if the structure is being used as a roost. Work will be performed by qualified biologists who have knowledge of the natural history of the bat species that could occur in the project area and experience conducting emergence surveys and using full spectrum acoustic equipment. During evening emergence surveys, biologists will avoid unnecessary disturbance of occupied roosts. Evening (i.e., dusk) emergence surveys will consist of at least one biologist stationed on at different vantage points from the structure, watching for emerging bats from a half hour before sunset to 1-2 hours after sunset or until visibility is no longer optimal. All emergence surveys will be conducted during favorable weather conditions (no rain or high winds, night temperatures above 55° F).

If surveys are positive for roosting bats and will be impacted by construction, installation of exclusion devices or tree removal may occur outside of the maternity and hibernating period (i.e., during September 16-October 15 and March 16-April 30) to preclude bats from occupying structure/feature. Exclusionary devices will only be installed by or under the supervision of an experienced bat biologist.

MM-2: Removal of Potential Bat Tree and Snag Roost Habitat

If trees, including snags, with bat roost potential require removal or trimming during the maternity season (May 1-September 15), a qualified bat biologist will conduct a one night emergence survey during acceptable weather conditions (no rain or high winds, night temperatures above 55° F) or if conditions permit, physically examine the roost for presence or absence of bats (such as with lift equipment) before the start of construction/removal. If the roost is determined to be occupied during this time, the tree will be avoided until after the maternity season when young are self-sufficiently volant. If trees with bat roost potential require removal during the winter months when bats are torpor or hibernation (October 16-March 15, but is dependent on specific weather conditions), a qualified bat biologist will physically examine the roost if conditions permit for presence or absence of bats (such as with lift equipment) before the start of construction. If the roost is determined to be occupied during this time, the tree will be avoided until after the winter season when bats are once again active.

If trees with a potential bat roost require trimming or removal it will be conducted following a two-day process, in coordination with any necessary permits or ordinances. On Day 1, for trees with cavities, crevices, and exfoliating bark, removal of branches and limbs with no cavities will be removed by hand (e.g., using chainsaws). This will create a disturbance (noise and vibration) and physically alter the tree. Bats already roosting in the tree, which may not have been detected during the preconstruction survey, will either abandon the roost immediately (rarely) or, after emergence, avoid returning to the roost. For foliage roosting bats, such as hoary bats, Day 1 would be to remove adjacent, smaller, or non-habitat trees to create noise and vibration disturbance that would cause abandonment. On Day 2 under the supervision of a qualified biological monitor, the tree may be removed. Trees that are only to be trimmed and not removed would be processed in the same manner; if a branch with a potential roost must be removed, all surrounding branches would be trimmed on Day 1 under supervision of a qualified bat biologist and then the limb with the potential roost would be removed on Day 2. All downed roost trees shall be searched for dead and injured bats. If any bat species of special concern are dead or injured then the biologist shall report the find to South Dakota Game and Fish (SDGFP) and/or U.S. Department of Fish and Wildlife (USFWS).

If it is determined that trees or structures in the project area are being used by bats as roost sites, the following protective measures shall be implemented:

Disturbance of active roosting structures or trees (e.g., structure removal, construction equipment operation near roosts, tree trimming or removal) will not occur between the maternity period (May 15 and the following September 15) or hibernation period (October 15-March 15). This will avoid impacts on reproductively active females and active maternity roosts (whether colonial or solitary) and hibernating bats. The roosts will remain undisturbed from the time it is located until outside the maternity or hibernation period (as applicable) or a qualified biologist has determined the roost is no longer active. No construction work will occur at the roost or within a 100-foot-wide buffer zone (or an alternative width, as determined in consultation with NDGF) until it is outside those periods.

MM-3: Removal and Eviction of Potential Bat Cave and Mine Roost Habitat-

If potential cave and mine bat roost habitat will be impacted, a qualified bat biologist will conduct a one-night emergence survey during acceptable weather conditions (no rain or high winds, night temperatures above 55° F) or if conditions permit, physically examine the roost for presence or absence of bats. Qualified bat biologist will conduct a one-night emergence survey during acceptable weather conditions (no rain or high winds, night temperatures above 55° F) or if conditions permit, physically examine the roost for presence or absence of bats (such as with lift equipment) before the start of construction/removal. If the roost is determined to be occupied during this time, it will be avoided until after the maternity season when young are self-sufficiently volant. If a mine or cave with bat roost potential require will be impacted during the winter months when bats are torpor or hibernation (October 15- March 15, but is dependent on specific weather conditions), a qualified bat biologist will physically examine the roost if conditions permit for presence or absence of bats (such as with lift equipment) before the start of construction. If the roost is determined to be occupied during this time, impacts will be avoided until after the winter season when bats are once again active.

If surveys are positive for roosting bats and will be impacted by construction, exclusion devices may be installed outside of the maternity (i.e., during March 16-April 30) and hibernating period (i.e., during September 16-October 15) to preclude bats from occupying structure/feature Exclusion devices may be installed outside of the maternity period (i.e., between September 16 and April 14) to preclude bats from occupying mines/features during construction. Exclusionary devices will only be installed by or under the supervision of an experienced bat biologist and in consultation with NDGF. If bat roosts need to be impacted during the hibernation period (October 15- March 15), emergence surveys should occur during September 1 through October 15, when successful eviction is feasible. Exclusionary devices should only be installed by or under the supervision of an experienced bat biologist. Once in the hibernation period, seasonally torpid bats and hibernating bats are not active, therefore eviction methodologies would not be successful or feasible. Emergence surveys conducted between October 15 and March 15, during heavy rains, and when day and/or night temperatures drop below 52 degrees Fahrenheit (° F) cannot definitively determine if potential day roost habitat is unoccupied. Once temperatures fall below 52° F and/or there is rainfall, bats may enter torpor very quickly and may not emerge. The October 15 date may be extended or the March 15 date reduced if rains are absent and night temperatures remain above 52° F. If a feature cannot be visually inspected and confirmed to be unoccupied, the potential roost will be avoided until weather permits to conduct an accurate emergence survey.

Appendix V
Resumes

- Stephanie Kane
- Lisa Allen
- Jeff Abplanalp
- Ashlynn Harris

STEPHANIE KANE

Project Role: Senior Wildlife Biologist

Stephanie Kane is a project manager and wildlife biologist with more than 10 years of experience. She provides environmental consulting expertise to regional coal, coal bed methane, and oil companies, providing wildlife surveys and related reports to the companies on a contract basis. Stephanie manages both surface coal mine and coal bed natural gas/petroleum projects for northeastern Wyoming and southern Montana and helps with surveys for utilities/transmission line projects. She has managed utilities/transmission and rock quarry projects. As project manager, she manages the majority of tasks associated with contracted projects: providing yearly cost estimates for each project; conducting necessary wildlife surveys and making sure the surveys meet federal and state wildlife and environment regulations; ensuring the project stays on schedule and within budget; providing written reports of wildlife survey findings; and solving any problems encountered during the project. Her mine projects also include writing raptor nest mitigation plans and activities associated with the physical mitigation of the nests.

Years of Experience

- Professional start date: 08/2003
- ICF start date: 03/2013

Education

- MS, Biology, Fort Hays State University, 2011
- BS, Zoology, Colorado State University, 2005

Professional Memberships

- Kansas, Cooper and Wilson Ornithological Societies, Student Member
- The Association of Field Ornithologists
- Society for Range Management, 2010

Certifications

- Chapter 10, Wyoming Game and Fish Department (WGFD)
- Chapter 33, WGFD
- Wetland Delineations, WTI 2019
- Projects WET & WILD, Kansas, 2011

Selected Project Experience

Surface Gold Mine Wildlife Monitoring and Reporting—Coeur Wharf Resources (USA) Inc., Wharf Mine, Lawrence County, South Dakota. 2016 - Present.

Senior Biologist and Project Director. As senior biologist manages annual monitoring at the Wharf Mine, helps with field surveys, and provides area expertise. Surveys encompass a variety of terrestrial vertebrates, including threatened and endangered (T&E) and Sensitive Species (USFWS and SDNHP species), raptors and songbirds. As project director, manages staff, ensures the project is on task, schedule and budget, and meets with client, and coordinates with SDWFP.

Surface Coal Mine Wildlife Monitoring and Reporting—Navajo Transitional Energy Company, Antelope Mine, Campbell and Converse County, Wyoming. 2016 - Present.

Lead biologist and project manager. As lead biologist, designs, manages, and conducts annual monitoring at the Antelope Mine. Surveys encompass a variety of terrestrial vertebrates, including (T&E) and Sensitive Species (USFWS, BLM, and WGFD species), big game, lagomorphs, aquatics, raptors, upland game birds, waterfowl, shorebirds, and songbirds. Helped draft the current *Avian Species of Management Concern and Raptor Monitoring and Mitigation Plan*. Regularly works with the USFWS on an ongoing golden eagle nest monitoring project, and on lease modifications. As project manager, creates and manages annual budgets, meets with client, and coordinates field surveys.

Surface Coal Mine Wildlife Monitoring and Reporting—Eagle Specialty Materials, Eagle Butte & Belle Ayr Mines, Campbell County, Wyoming. 2014 - Present.

Lead biologist and project manager. As lead biologist, designs, manages, and conducts annual monitoring at the Eagle Butte and Belle Ayr Mines. Surveys encompass a variety of terrestrial vertebrates, including T&E and Sensitive Species (USFWS, BLM, and WGFD species), big game, lagomorphs, aquatics, raptors, upland game birds, waterfowl, shorebirds, and songbirds. Helped draft the current *Avian Species of Management Concern and Raptor Monitoring and Mitigation Plan*. As project manager, creates and manages annual budgets, meets with client, and coordinates field surveys.

Decker Mine Annual Wildlife Monitoring and Amendment Baseline Biological Surveys—Lighthouse Resources, Decker Coal Company, Big Horn County, Montana. 2015 - Present.

Lead biologist and project manager. As lead biologist, designed, managed, and conducted baseline inventory surveys at existing mines and baseline inventories for expansions of existing properties. Surveys encompassed a variety of terrestrial vertebrates, including threatened and endangered and Sensitive Species (USFWS, BLM, and MFWP species), big game, lagomorphs, raptors, upland game birds, waterfowl, shorebirds, reptiles and amphibians, songbirds, prairie dogs, and aquatics/fishery surveys. Prepared baseline and species of special interest reports to be submitted to multiple federal and state agencies as part of permit application packages. As project manager, created and manages project budget, meets with client, consults with agencies, and coordinates field surveys. Annual wildlife monitoring and reporting for the mine are on-going.

Hondo Federal 11-15 Northern Long-eared Bat Surveys and Big Jake 13-7 Greater Sage-Grouse Surveys—Stephens Production Company, Campbell County, Wyoming. 2019.

Project Manager and Field Biologist. As a field biologist for the Hondo Federal 11-15 (Campbell County, Wyoming), Stephanie planned and coordinated maternity roost searches and set-up bat monitoring surveys as required by the BLM Buffalo Field Office and U.S. Fish and Wildlife Service prior to project construction. Tasks as a project manager included: coordinating with federal agencies prior to surveys, developing a survey plan for agency approval, creating a project budget and scope of work, coordinating project staff, and submitting a technical report of the survey results.

Rawhide Mine Wildlife Monitoring—Peabody Energy, Campbell County, Wyoming. 2017.

Lead biologist and project manager. Designs, manages, and conducts annual monitoring; Surveys include T&E and Sensitive Species (USFWS, BLM, and WGFD species), big game, lagomorphs, raptors, upland game birds, waterfowl, shorebirds, and song birds; Prepares and reviews annual wildlife reports, raptor mortality reports, mitigation plan supplemental letters, and USFWS permit annual reports; GIS/AutoCAD mapping; Implements raptor nest mitigation activities including raptor nest monitoring and relocation; Handles wildlife emergencies including raptor mortalities and injuries; Creates and manages annual budgets and meets with client.

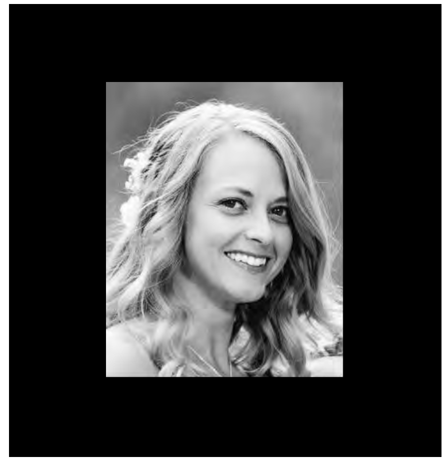
State 36 Scoria Pit—Earth Works Solutions, LLC, Campbell County, Wyoming. 2016.

Field Biologist. As a field biologist, designed and conducted baseline inventory surveys for a proposed expansion to a scoria pit. Surveys encompassed T&E and Sensitive Species (USFWS, BLM, and WGFD species), raptors, upland game birds, and songbirds. Prepared baseline study plan and wrote baseline report to be submitted to federal and state agencies as part of the permit application package.

LISA ALLEN

Project Role: Senior Wildlife Biologist/Bats

Lisa has ten years of experience as a wildlife biologist. She has completed focused surveys for nesting birds, as well as special status species including burrowing owl, least Bell's vireo, and coastal California gnatcatcher. She has conducted other biological surveys for small mammals, southwestern pond turtle, desert tortoise, Mojave fringe-toed lizard, Nelson's bighorn sheep, Lane Mountain milk-vetch, and desert cymopterus. Lisa has also conducted habitat assessments and emergence surveys for bat in southern California in additional to attending field workshops for survey techniques, handling of bats, and for acoustic monitoring using Sonobat software. She is familiar with ArcPad and QGIS. Lisa has written an avian monitoring plan for the National Training Center at Fort Irwin, California, as well as several habitat assessments, focused survey reports, and biological sections for Environmental Impact Reports, Environmental Impact Statements, and Natural Environmental Study (Caltrans NES) reports. She has project management experience as well as managing and coordinating large field efforts and data collection and organization.



Years of Experience

- Professional start date: 11/2009
- ICF start date: 07/2010

Education

- BS, Wildlife Management and Conservation, Humboldt State University, California, 2009

Professional Memberships

- Bat Conservation International
- The Wildlife Society

Certifications/Other

- California of Fish and Wildlife (CDFW) Scientific Collecting Permit, No. SC-11914
- U.S. Fish and Wildlife Service (USFWS) 10(a)(1)(A) Permit, for least Bell's vireo nest monitoring, California gnatcatcher presence/absence surveys, No. TE-601151B-0 *(Expires 3/2021)*
- Letter of Concurrence for Flat-tailed Horned Lizard, CDFW, Issued August 20, 2012

Training

Southwestern Desert Bats 2014, Dr. Pat Brown, Anza-Borrego Foundation, Borrego Springs, CA, April 11-13, 2014

Discussion of desert species biology, ecology, and conservation efforts. Discussion of habitat assessments and survey techniques, including setting mist and acoustic equipment.

Conservation and Ecology of California Bats, Dr. Szewczak, San Francisco State University Sierra Nevada Field Campus, CA, August 5-9, 2013.

Learned the biology, ecology, and conservation efforts for California bats. Learned survey techniques for bats including mist netting, acoustic monitoring, assessing habitat and roosts, and passive emergence surveys. Identified and handled 15 individuals of 6 species including *Myotis evotis, Myotis californicus, Myotis thysanodes, Myotis yumanenis, Myotis volans, Antrozous pallidus,* and *Lasionycteris noctivagans*. Also observed maternity roost for *Corynorhinus townsendii* and identified *Euderma maculatum* in flight.

Noninvasive Acoustic Monitoring and Species Identification of Bats with SonoBat software, Dr. Szewczak, Field Techniques Workshop, Davenport, CA, May 14-18, 2012.

Learned to use acoustic recording equipment to record echo location calls of a variety of bat species. Used Sonobat software to positively identify species.

Selected Project Experience

Restoration

Tehachapi Renewable Transmission Project (TRTP)—Southern California Edison (SCE), California, 07/2010 – 12/2015

Biologist and Assistant to Work Package Manager. In addition to assisting the work package manager in daily duties, was tasked with managing preconstruction surveys, including general preconstruction surveys, as well as focused surveys (burrowing owls and bat assessments). Bat habitat assessments consisted of mapping potential day roosting habitat in various habitats along the right of way.

Water and Wastewater

Machado Lake Ecosystem Rehabilitation Project—City of Los Angeles Bureau of Engineering, Los Angeles, California, 2013–2014

Lead Bat and Lead Avian Biologist. Independently conducted bat roost habitat assessment and mapping of the project area. Lead biologist conducting emergence surveys for bats with acoustic monitoring. Led nesting bird surveys and in charge of keeping track of all surveys, active nests, and coordinating with GIS. All species were recorded based on visual and auditory detections. Authoring the survey methodology and habitat assessment results reports.

Wilmington Drain Construction Biological Compliance Services—City of Los Angeles Bureau of Engineering/Arcadis US, Los Angeles, California, 2013 –2014

Lead Bat and Lead Avian Biologist. Conducted preconstruction focused bat habitat assessment and emergence surveys for the restoration of Wilmington Drain. All species were recorded based on visual and auditory detections. Authored the preconstruction nesting bird and roosting bat survey results report.

Transportation—Roads, Bridges, and Highways

Monte Vista Avenue Grade Separation Project— Caltrans, City of Monclare, California— 9/2017-10/2017

Bat Biologist. Analyzed acoustic data collected from two Pettersson D500X units. A single poor-quality call was retrieved from the detectors and could not be definitely identified.

San Diego Freeway (I-405) Improvement Project — OC 405 Partners, Santa Ana, California—08/2017-09/2017

Bat Biologist. Analyzed acoustic data collected using Pettersson D500X units at five separate locations. Yuma myotis (*Myotis yumanensis*) was positively identified using Sonobat. Some Myotis calls were of poor quality and could not be identified. Calls in the lower range of Mexican free-tailed bat (*Tadarida* *brasiliensis*), silver-haired bat (*Lasionycteris noctivagans*; tree roosting species), and big brown bat (*Eptesicus fuscus*) were also recorded but were of poor quality and could not be definitively identified.

Hamner Avenue Bridge Replacement Project—Caltrans, City of Norco, Riverside County, California—09/2017

Bat Biologist. Analyzed acoustic data collected using Pettersson D500X units at four separate locations. Calls were of poor quality and definitive identification could not be made. Almost all calls were within the frequency of myotis species, specifically Yuma myotis (*Myotis yumanensis*) and California myotis (*M. californicus*), with the clearer calls making Yuma myotis the most likely bat observed. Several lower range calls were picked up as well but were also of low quality, not allowing for exact identification. These lower calls where in the range of Mexican-free tailed bat (*Tadarida brasiliensis*) and western yellow bat (*Lasiurus xanthinus*).

Cajalco Road Widening and Safety Enhancement Project—Caltrans, Riverside, California, 08/2012 – 10/2017

Lead Bat Biologist. Assisted in authoring the Natural Environmental Statement (NES). Served as a lead bat biologist. Coordinated and led habitat assessment for project alternatives. Located one active roost and documented several rock outcrops that are suitable roost habitat. Led emergence surveys for suitable roosting habitat. Also deployed acoustic monitoring equipment. Analyzed acoustic data identifying the following species: western yellow bat (*Lasiurus xanthinus*), canyon bat (*Parastrellus hesperus*), Mexican free-tailed bat (*Tadarida brasiliensis*), Yuma myotis (*Myotis yumanensis*), and hoary bat (*Lasiurus cinereus*).

State Route (SR) 91 Santa Ana River Bridge Widening Project—Caltrans, Orange County, California, 2013 –2016

Project Manager and Biologist. Conducted emergence and count surveys for bats within suitable features of the bridge for California Department of Transportation. Over 500 Mexican free-tailed bats (*Tadarida brasiliensis*) bats were observed emerging from the bridge. Conducted follow-up surveys for night roosting of bats on the bridge. Conducted weekly nesting bird surveys. Ongoing project management.

SR 74 Shoulder Widening Safety Improvement Project—Caltrans, San Juan Capistrano, California, 2014

Lead Biologist. Supported bat expert conducting evening emergence surveys for day roosts as well as night roosts. Assisted in acoustic analysis of echolocation calls using Sonobat. Scheduled support biologist and coordinated with Caltrans biologist.

Mount Vernon Grade Separation Project—Caltrans, Colton, California, 2014

Biologist. Conducting habitat assessment for bats including special status species within the Project limits. Documented potential roosting features within the bridge and surrounding habitat.

North First Avenue Grade Separation and Bridge Replacement Project—City of Barstow and Caltrans, Barstow, California, 2014

Biologist. Conducting habitat assessment for bats including special status species. Lead bat biologist conducting emergence surveys and acoustic monitoring. Identified emerging bats from the

habitat. Conducted emergence surveys for features determined to be suitable for roosting bats.

Employment History

ICF International. Senior Biologist. 07/2010–Present.
QinetiQ North America. Natural Resource Specialist. Fort Irwin, California. 11/2009–06/2010.

JEFFREY ABPLANALP

Wildlife Biologist

Jeff Abplanalp is a wildlife biologist with 10 years of experience. He specializes in providing terrestrial and aquatic wildlife and habitat mitigation consulting to the oil, natural gas, coal mining, wind farm, and uranium industries. He has extensive experience conducting ground based and aerial surveys for sage grouse, raptors, big game, and threatened and endangered species. He has contributed to several largescale oil and gas projects conducting pre-construction baseline wildlife and habitat inventory surveys. Jeff also has extensive experience in wildlife conflict, disease, and population management.

Years of Experience

- Professional start date: 05/2008
- ICF start date: 04/2013

Education

- BS, Wildlife and Fisheries Management and Biology, University of Wyoming, 2009

Professional Memberships

- Wildlife Society, 2007-2009
- American Fisheries Society, 2007-2009

Certifications/Other

- Site-Specific Hazard Training (Surface Coal, Metal, Non-metal, Mine Safety and Health Administration

Area of Expertise

- Terrestrial and aquatic wildlife and habitat baseline surveys

Project Experience

Oil and Natural Gas

Moneta Divide—Aethon Energy/Encana Oil and Gas and Burlington Resources, Fremont and Natrona Counties, WY, 04/2013 – 06/2013, 04/2014 – 06/2014

Field Biologist. Conduct ground based and aerial wildlife and habitat baseline inventory surveys for proposed natural gas project. Primary species surveyed include Greater sage-grouse, raptors, mountain plovers, big game, herptiles, and white-tailed prairie dog colonies.

Powder River Basin North—EOG Resources, Campbell and Johnson Counties, WY, 04/2019 – 06

Field Biologist. Conduct ground based and aerial wildlife and habitat surveys for proposed natural gas project. Primary species surveyed include greater sage-grouse, raptors, herptiles, and black-tailed prairie dog colonies.

Leavitt-Underwood—Devon Energy Corporation, Campbell County, WY, 04/2019 – 12/2020

Field Biologist. Conduct ground-based wildlife surveys as part of plan of development. Primary species surveyed included raptors, mountain plovers, and black-tailed prairie dog colonies.

Cosner Fuller TLE—Devon Energy Corporation, Campbell County, WY, 04/2019 – 12/2020

Field Biologist. Conduct ground-based wildlife surveys as part of plan of development. Primary species surveyed included raptors, mountain plovers, and black-tailed prairie dog colonies.

Mines and Quarries

Surface Coal Mine Wildlife Monitoring and Reporting—Navajo Transitional Energy Company, Antelope Mine, Campbell and Converse Counties, WY, 01/2020 – Present

Field Biologist. Conduct wildlife monitoring as part of mine and state DEQ monitoring and mitigation plan. Primary surveys conducted include golden eagle nest monitoring, bald eagle winter roost surveys, big game, lagomorph, and prairie dog colony surveys. Helped with drafting an avian mitigation plan and annual monitoring and conducted analysis of field data.

Surface Coal Mine Wildlife Monitoring and Reporting—Eagle Specialty Materials, Eagle Butte & Belle Ayr Mines, Campbell County, WY. 09/2020--Present

Field Biologist. Conduct wildlife monitoring as part of mine and state DEQ monitoring and mitigation plan. Primary surveys conducted include golden eagle nest monitoring, bald eagle winter roost surveys, big game, aquatic, lagomorph, and prairie dog colony surveys. Helped with drafting an avian mitigation plan and annual monitoring and conducted analysis of field data.

Willow Creek Uranium ISR Project Annual Wildlife Monitoring—Uranium One, Campbell and Johnson Counties, WY. 04/2019 – 06/2019

Field Biologist. Conduct wildlife monitoring as part of mine and state DEQ monitoring and mitigation plan. Primary surveys included Greater sage-grouse lek and raptor nest surveys. Helped with drafting annual monitoring and conducted analysis of field data.

Wind Energy Development

Maestro Wind Project—BayWa, Carbon County, WY. 08/2019-Present

Field Biologist. Conduct baseline wildlife surveys prior to wind farm development. Primary species surveyed included raptors, black-footed ferrets, and swift foxes.

Employment History

ICF. Wildlife Biologist. Gillette, WY. 04/2019 – Present.
Wyoming Game and Fish Department. Wildlife Damage Technician. Cody, WY. 05/2011 – 01/2019.
Big Horn Environmental Consultants. On-call Wildlife Biologist. Sheridan, WY. 04/2017 – 06/2017, 04/2018 – 06/2018.
Wyoming Game and Fish Department. Bird Farm Technician. Yoder, WY. 4/2015.
ICF. On-call Wildlife Biologist. Gillette, WY. 04/2013 – 06/2013, 04/2014 – 06/2014.
Wyoming Game and Fish Department. Aquatic Invasive Species Technician. Casper, WY. 5/2010 – 9/2010.
Wyoming Game and Fish Department. Fish Hatchery Technician. Boulder, WY. 05/2009 – 08/2009.
University of Wyoming. Fisheries Technician. Laramie, WY. 05/2008 – 10/2008.

Ashlynn Koral Harris

54 Corthell Road Laramie, Wyoming 82070
Phone: 307-460-1691
E-mail: aharri42@uwyo.edu

Education

December 2019 Bachelor of Science: Wildlife Fisheries Biology and Management, University of Wyoming, Laramie, WY (Cumulative GPA 3.199)

May 2016 High School Diploma: Cienega High School, Vail, AZ (Weighted GPA 5.058)

Experience

- **Field Technician – ICF:** Conduct ground based and aerial wildlife and habitat surveys for proposed natural gas projects in northeastern Wyoming. Primary species surveyed include greater sage-grouse, raptors, herptiles, and black-tailed prairie dog colonies.

- **Disease/Biologist Technician for Wyoming Game and Fish Department:** In charge of raising 3 pronghorn fawns and five bighorn sheep lambs at the Tom Thorne and Beth Williams Wildlife Research Facility. Followed a set protocol and feeding schedule. Experience working in a remote area mostly alone, dosing and giving antibiotics, treating injuries, making decisions in emergency situations, keeping records of health, including food, mineral, and antibiotic intake. Participated in sampling elk and bighorn sheep for on going wildlife research projects specifically taking fecal, blood, tear, and saliva samples from elk. As well as sampling fecal matter, blood, and taking swabs of the nose, tonsils, and ears of bighorn sheep. Assisted with facility maintenance (repairing and making improvements to wildlife enclosures, general facility upkeep such as cleaning buildings and mowing) and daily feedings to meet nutritional requirements for adult resident species at the facility (including elk, bison, and bighorn sheep). (April 2019- December 2019)

- **University of Wyoming's Wildlife Society**: Participated in conducting biannual river otter surveys as a team. Searching for signs of river otters (scat, tracks, latrine sites, etc), collecting data in riparian areas (location, incline of slope used by otters, width of river, percent cover of overstory, general description of area), and navigating riparian areas. Hiking over 8 hours on uneven terrain (including marshy areas, crossing rivers, over logs, rocky areas, and inclines at elevations greater than 7,000 feet). Use of Garmin GPS Units, forest densiometer, portable transmitter and receiver. (April 2018-December 2019)

- **Wyoming Game and Fish Department Volunteer:** Volunteered to assist Wyoming Game and Fish Department biologists with sampling hunter kills for chronic wasting disease, entering and recording data into a database with the check station app, checking hunting licenses, and talking to hunters. (October 2019)

- **University of Wyoming Chipmunk Project:** Chipmunk trapping, tracking, and handling for the University of Wyoming PHD student research. Experience setting up small mammal trap grids and flagging in remote areas. Experience using and communicating with team members over handheld transmitter and receivers. Setting, securing, and baiting small mammal traps for chipmunks (tomahawk and havahart traps). Recording data on trapped chipmunks in the field including weight, sex, age, sexual reproduction status, and pit tag number. Setting up trail cameras for capturing chipmunk activity at trap sites. Utilizing radio telemetry to track chipmunks with GPS collars through dense forest terrain and sage brush. (September 2019-October 2019)

- **Summer Moose Day:** Assisted with biannual moose surveys for the University of Wyoming Biodiversity Institute and Wyoming Cooperative Fish and Wildlife Research Unit. Participated in a training for surveying moose. Survey involved searching for signs of moose in the snowy range (bed sites, tracks, scat, actual moose sightings.), recording, identifying, and measuring signs of moose. Furthermore Aging, identifying sex, and apparent health (making note of ticks, ear cropping, and blood in tracks or feces) of moose. (July 2019)

- **Legends Ranch**: Worked with a team to raise 78 bottle-fed white tail fawns. Assisted with handling wildlife, collecting data and keeping records of health, food intake, and medication administered as well as amount administered. Participated in administering medication, loading and giving syringes (under the skin and in the muscle), drenches, in feed/water/milk, fluids (lactated ringer), vaccinations. Assisted with cleaning wounds and removal of antlers and broken tines, and safely tube fed fawns under supervision. Performed kennel maintenance, regularly checked feed and water, met dietary needs of white tail fawns as they aged. Sticking with a schedule, checking/ assessing health of deer. Observed use of all-terrain vehicles and tractors. Instructed members of the general public and answering questions on how to safely interact with and feed fawns. (May 2018- August 2018)

- **Montana Fish, Wildlife, and Parks:** Assisted in trapping, handling, locating and collecting data on tagged snapping and spiny softshell turtles with telonics telemetry systems. Aided in collecting measurements and data for vegetation at points on GPS for overgrazed land. Utilized VHS telemetry to locate tagged sage grouse. Worked over 8-hour days in the field starting at various times in the day with changing schedules. (May 2017-August 2017)

- **Montana Fish, Wildlife, and Parks:** Assisted in checking vitals during a bear immobilization clinic, and in relocating a successfully rehabilitated bear. Checked for production rate success and activity at peregrine falcon nest sites. (June 2015)

Training

- Introductory Wildlife Handling and Chemical Immobilization Training with Wyoming Game and Fish Department: experience using dart guns, blow darts, calculating doses of appropriate drugs to immobilize wildlife, taking samples of immobilized wildlife and recording data, and walking through immobilization and capture scenarios.
- Introductory Disease and Necropsy Training with Wyoming Game and Fish: experience performing a necropsy on deceased wildlife, recognizing signs of parasites, and identifying different mammalian diseases on deceased wildlife.
- Summer Moose Day Survey Training

Technical Revisions

Loring Quarry

Simon Contractors of SD, Inc.
Large Scale Mine Permit – Loring Quarry
Technical Revisions

Pursuant to ARSD 74:29:03:16 Simon Contractors of SD, Inc. proposes the following technical revisions:

1. Monitoring plans or parameters;
2. Seeding mixtures or rates;
3. Modification or relocation of erosion, sedimentation, or drainage control;
4. Topsoil stripping or storage;
5. Implementing new or improved reclamation techniques as they are developed;
6. Modification of dust control measures;
7. Modification of the size of area to be worked at any one time;
8. Modification of operating time tables for proposed operations;
9. Location or modification of ancillary facilities within the permit boundary, including equipment storage areas, perimeter fencing and stockpiles;
10. Modification of the reclamation plan;
11. Addition of a wash plant and washing ponds to remove limestone fines from specific products to meet customer specifications;
12. Modification of the acreage split (adjusting the designated acres under the mine license and mine permit) may be necessary depending on future customer demand.