WHARF BOSTON EXPANSION LARGE-SCALE MINE PERMIT APPLICATION

REVISION 2

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ABA	Acid-Base Accounting
ADB	Air-Dry Basis
AGP	acid-generating potential
ANP	acid-neutralization potential
APE	area of potential effect
ARD	acid rock drainage
ARSD	Administrative Rules of South Dakota
ATV	all-terrain vehicle
BHM	Black Hills Meridian
BKS	BKS Environmental Associates, Inc.
BOD	biological oxygen demand
C&A	Chadwick & Associates, Inc.
CEC	Chadwick Ecological Consultants, Inc.
CUP	Conditional Use Permit
dB	decibel
EXNI	Exploration Notice of Intent
GEI	GEI Consultants, Inc.
gpm	gallons per minute
GWD	groundwater discharge
Ha	hectare
hivol	high volume
mg/L	milligrams per liter
mL	milliliters
MSHA	Mine Safety and Health Administration
MT	million tons
MW	monitoring wells
MWMT	Meteoric Water Mobility Testing
NAG	net acid generation
NNP	net neutralization potential
NP	neutralization potential
NPDES	National Pollutant Discharge Elimination System
NRCS	Natural Resources Conservation Service
NRHP	National Register of Historic Places
PAG	potential acid generating
pls/acre	pure live seed per acre
POP	perimeter of pollution
ppm	parts per million
PPSA	Ponderosa Pine-Common Snowberry
PTSE	Quaking Aspen Series
QA	quality assurance
SARC	State Archaeological Research Center
SDCL	South Dakota Codified Law

SD DANR	South Dakota Department of Agriculture and Natural Resources
SDGFP	South Dakota Game, Fish, and Parks
SDNHP	South Dakota Natural Heritage Program
SHM	special handling material
SHPO	State Historic Preservation Office
SWD	Surface Water Discharge
TDS	total dissolved solids
TSP	total suspended particulates
T&E	threatened and endangered
USFWS	U.S. Fish and Wildlife Services
USGS	U.S. Geological Survey
VP	Vantage Points
WAD	weak acid dissociable
$\mu g/m^3$	micrograms per cubic meter
yd^3	cubic yards
°F	degrees Fahrenheit

1.0 INTRODUCTION

1.1 STATEMENT OF PROCEDURAL COMPLETENESS AND COMPLIANCE

This permit application includes items required under South Dakota Codified Law (SDCL) 45-6B and Administrative Rules of South Dakota (ARSD) 74:29. Tables 1-1 and 1-2 list the applicable South Dakota Codified Laws and Administrative Rules of South Dakota along with the section of this permit application that fulfills the statute and regulations. Permit application forms are provided in Appendix A.

No part of the proposed Boston Expansion mining operation, reclamation plan, or proposed future use is contrary to the laws or regulations of the State of South Dakota or the United States (SDCL-45-6B-32(3)). A disclosure of all notices of violation and enforcement actions issued to Wharf during the life of the mine are also included in Appendix A.

SDCL 45-6B-32 Compliance

Wharf has paid the required application fees. The application is complete and the surety bond for the Boston Expansion is covered by the current bond. No part of the proposed expansion mining operation, the reclamation program, or the proposed future use is in violation to the laws and regulation of the State of South Dakota or the United States.

The mining operation will not adversely affect the stability of any significant, valuable, or permanent man-made structures located within 200 feet of the affected land, as no structures occur within 200 ft. A one call was completed, and no underground utilities or pipelines were found within the proposed area to effect of the permit application.

The mining operation will not be in violation of any county zoning or subdivision regulations. The proposed mining operation and reclamation will be carried out in conformance with the requirements of statue SDCL 45-6B-35.

Wharf is currently investigating the source of elevated selenium and testing potential treatment methods for False Bottom Spring located on the far northern border of the existing Wharf Mine. This spring is located on Wharf property immediately below the historic Bald Mountain Mill tailings repository, which was operated from approximately 1905 through just after WWII. Pilot testing of two potential treatment options is currently underway, and geochemical modeling of the upgradient area to better identify the source is nearly complete. Findings from these studies are anticipated to result in a formal compliance schedule to be incorporated in the forthcoming National Pollutant Discharge Elimination System (NPDES) permit renewal for Wharf, which is currently being drafted by the DANR Surface Water group.

The proposed affected land is suitable for mining operation, as determined pursuant to SDCL 45-6B-33.

SDCL 45-6B-33 Compliance

The proposed affected land is suitable for mining operation, as determined pursuant to SDCL 45-6B-33. It is both physically and economically feasible to reclam land to be affected by the proposed Boston Expansion (SDCL 45-6B-33(1)). Disposition of sediment in stream or lake beds, landslides, or water pollution are not anticipated and can feasibly be prevented (SDCL 45-6B-33(2)). The land to be affected does not include land that is special, exceptional, critical, or unique (SDCL 45-6B-33(3), see Section 2.5). The proposed project will not result in the loss or reduction in productivity of an aquifer, wells, watershed lands, aquifer recharge areas, or significant agricultural areas (SDCL 45-6B-33(4)). Temporary mining activities would not affect the biological productivity of the land nor would it jeopardize threatened or endangered wildlife (SDCL 45-6B-33(5)). Adverse socioeconomic impacts are not anticipated and probable beneficial impacts of the operation are noted in Chapter 4.0 (SDCL 45-6B-33(6)).

1.2 PROJECT OVERVIEW

The project area (Boston Expansion) is located approximately 4 miles west of Lead, South Dakota, in the Bald Mountain Mining District (see Exhibit 1 in Appendix B). The existing Wharf Mine is located in Sections 1, 2, 3, and 4, Township 4 North, Range 2 East (T4N, R2E), and Sections 25, 26, 33, 34, 35, and 36, T5N, R2E of the Black Hills Meridian (BHM), Lawrence County, South Dakota. The Golden Reward Mine is located in Sections 1 and 12, T4N, R2E, and Sections 6 and 7, T4N, R3E of the BHM. As of January 1, 2022, the permitted affected acreage is 1,480 acres with 1,278.41 acres disturbed and 333.39 acres reclaimed.

The proposed Boston Expansion area is located south of, and immediately adjacent to, the existing Wharf Mine. The Wharf Mine property is accessed by Wharf Road and State Highway 473 (Nevada Gulch Road), which leads west from Lead to the Wharf Mine. The proposed Boston Expansion area encompasses approximately 47.4 acres of private land owned by Wharf, including portions in Sections 2 and 3, T4N, R2E of the BHM (see Exhibit 2 in Appendix B).

Mining in the Boston Expansion area will be an open-pit, truck-and-shovel operation, which is the same method used in the ongoing operations at the Wharf Mine. Current facilities are shown on Exhibit 3 in Appendix B. Total production is estimated to be approximately 32 million tons of rock (see Section 3.1 and Chapter 5.0), and both gold and silver will be produced. Mining in the expansion area is anticipated to increase the mine life by 1 to 3 years, thus extending the total mine life until approximately 2030.

The proposed project will involve open-pit mining and overburden disposal. Ore extracted from the Boston Expansion area will be trucked to the existing permitted Wharf Mine heap-leaching facility for processing. The operation will not modify any public roads or highways, and the proposed project does not require moving or relocating any processing equipment. Processing gold and silver at the Wharf Mine processing plant will not change as a result of the Boston Expansion project. Ore will continue to be milled at Wharf's on-site crusher, and gold will be heap-leached on the existing heap-leach pads. The process solution, percolated through the leach pad that is designed to dissolve the gold, will be a liquid sodium cyanide, as is currently used.

As mining operations continue at the Wharf Mine, waste rock and additional overburden material will be used to backfill previously mined areas within the Boston Expansion area. Neutralized spent ore will be

deposited in previously permitted localities. No spent ore is currently scheduled to be deposited within the new Boston Expansion area. Wharf's legal right to dispose of spent ore is evidenced by State Mine Permits 356, 434, 435, 450, 464, and 476 and Groundwater Discharge (GWD) Permits GWD 1-88, GWD 1-94, GWD 1-98, GWD 5-88, and GWD 1-11.

Table 1-1. South Dakota Codified Law (Page 1 of 4)

Statute	Information Required	Permit Application Reference
SDCL-45-6B-4	Local government permits	Sections 1.3 and 2.3
SDCL-45-6B-5 (1)	Application for permit–form/copy	Appendix A
SDCL-45-6B-5 (2)	Reclamation Plan	Chapter 6.0
SDCL-45-6B-5 (3)	Map of affected land	Exhibits 1,3, and 4 in Appendix B
SDCL-45-6B-5 (4)	Application fee	Submitted with application
SDCL-45-6B-5 (5)	Postclosure Plan	Section 6.10.2
SDCL-45-6B-6 (1)	Legal description and area of affected land	Appendix A; Chapter 2.0; Appendix C
SDCL-45-6B-6 (2)	Owner of the surface area of affected land	Appendix A; Section 2.3; Appendix C
SDCL-45-6B-6 (3)	Owner of the substance to be mined	Appendix A; Section 2.4; Appendix C
SDCL-45-6B-6 (4)	Applicant's legal right to enter and mine	Appendix A; Section 2.4; Appendix C
SDCL-45-6B-6 (5)	Applicant's legal right to dispose of tailings	Appendix A; Section 5.4
SDCL-45-6B-6 (6)	Address and telephone number of the general office and local address and telephone number of applicant	Application form in Appendix A
SDCL-45-6B-6 (7)	Minerals to be extracted and milled	Section 1.2; application form in Appendix A
SDCL-45-6B-6 (8)	Description of method of mining and milling	Sections 5.2 through 5.6, Exhibits 24 and 25
SDCL-45-6B-6 (8) a	Contour basis of mining operation	Section 5.4; Exhibit 23 in Appendix B
SDCL-45-6B-6 (8) b	Depth and direction of mining	Section 5.3.4
SDCL-45-6B-6 (8) c	Disposition of mine spoil and tailings	Sections 5.3.7 and 5.4
SDCL-45-6B-6 (8) d	Method of blasting and control thereof	Section 5.3.5
SDCL-45-6B-6 (9)	Size of the area to be worked at one time	Appendix A; Section 5.2
SDCL-45-6B-6 (10)	Timetable of proposed duration of mining operation	Appendix A; Section 5.1 and Table 5-1
SDCL-45-6B-6 (11)	Written consent to grant access to the Board of Minerals and Environment	Application form in Appendix A
SDCL-45-6B-7	Reclamation Plan	Chapter 6.0
SDCL-45-6B-7 (1)	Description of reclamation types	Section 6.2
SDCL-45-6B-7 (2)	Standard soil survey	Section 3.2; Appendix E
SDCL-45-6B-7 (3)	Vegetative survey	Section 3.6; Appendix I
SDCL-45-6B-7 (4)	Preliminary wildlife study	Section 3.7; Appendix J
SDCL-45-6B-7 (5)	Characteristics of affected land of historic, archaeological, geologic, scientific, or recreational significance	Sections 2.5, 3.1, 3.9, and 4.6
SDCL-45-6B-7 (6)	Description of implementation plan of Reclamation Plan to meet requirements of SDCL 45-6B-37 to SDCL 45-6B-46	Chapter 6.0

Table 1-1. South Dakota Codified Law (Page 2 of 4)

Statute	Information Required	Permit Application Reference
SDCL-45-6B-7 (7)	Description of how the Reclamation Plan will rehabilitate the affected land	Section 6.2
SDCL-45-6B-7 (8) (a) and (b)	Map of all the proposed affected land	Exhibits 31-37 in Appendix B
SDCL-45-6B-7 (9) (a–mm)	Baseline water quality and level of aquifers	Sections 3.3 and 3.4, Appendices F and G
SDCL-45-6B-7 (10)	Location of proposed reservoirs, tailings ponds, tailings disposal sites, dams, dikes, and diversion canals	Section 5.0
SDCL-45-6B-7 (11)	Provisions for stripping, storage, and replacement of overburden and topsoil	Sections 5.3.3 and 6.4
SDCL-45-6B-7 (12)	Estimated cost of implementing and completing the proposed reclamation	Section 6.11.1
SDCL-45-6B-8	Identification of previous surface mined land	Section 3.1.2
SDCL-45-6B-9	Reclamation not required for underground mining before July 1, 1980	Section 3.1.2 and 6.2.1.6; Exhibit 5 in Appendix B
SDCL-45-6B-10	Accurate map of affected area	See below
SDCL-45-6B-10 (1)	Identify the area corresponding with application	Exhibit 4A and 4B
SDCL-45-6B-10 (2)	Show adjoining surface owners of record	Exhibit 4A
SDCL-45-6B-10 (3)	Map scale not more than 1:25,000	Scale in range
SDCL-45-6B-10 (4)	Show water wells, creeks, roads, buildings, pipelines, and power and communication lines on and within 200 feet of all boundaries of affected land	Exhibits 18,19, 20, 22, and 24 in Appendix B; maps in Appendix F; maps in Appendix G
SDCL-45-6B-10 (5)	Show total area involved in operation	Exhibit 4A
SDCL-45-6B-10 (6)	Indicate on map or by statement the general type, thickness, and distribution of soil	Section 3.2; Appendix E
SDCL-45-6B-12	Instrument of consultation from the surface landowner if different from mineral owner (permission to enter and commence operations and written receipt of operating and Reclamation Plans)	Section 2.4; Appendix C
SDCL-45-6B-14	Application fee	Included
SDCL-45-6B-15	Copy of application with the South Dakota Department of Agriculture and Natural Resources (SD DANR) and Lawrence County Register of Deeds	Appendix A, proof of submission will be forwarded upon receipt
SDCL-45-6B-19	Confidential information	Appendix L
SDCL-45-6B-20.1	Cyanide surety	Section 6.11.3
SDCL-45-6B-32	Compliance with this chapter	Chapter 1.0
SDCL-45-6B-32(1)	Complete Application and Posted Surety	Appendix A

Table 1-1. South Dakota Codified Law (Page 3 of 4)

Statute	Information Required	Permit Application Reference
SDCL-45-6B-32(2)	Application Fee	Submitted
SDCL-45-6B-32(3)	Proposed Operation in Compliance with Laws and Regulations of State and US	Section 1.1
SDCL-45-6B-32(4)	No adverse effects to structures within 200-ft	Section 5.3.5
SDCL-45-6B-32(5)	Mining Operation not in violation with county zoning	Section 2.3
SDCL-45-6B-32(6)	Mining Operation and Reclamation in conformance with 45-6B-35	Sections 5.0 and 6.9, Table 5-1
SDCL-45-6B-32(7)	Violations of the provisions of this chapter	Section 1.1, Appendix A
SDCL-45-6B-32(8)	Land is Suitable for Mining	Section 1.1
SDCL-45-6B-33	Statement land is suitable for mining	Section 1.1
SDCL-45-6B-33(1)	Reclamation of the affected land pursuant to the requirements of this chapter is not physically or economically feasible	Section 1.1
SDCL-45-6B-33(2)	Substantial disposition of sediment in stream or lake beds, landslides, or water pollution cannot feasibly be prevented	Section 1.1
SDCL-45-6B-33(3)	The land to be affected by a proposed mining operation includes land that is special, exceptional, critical, or unique as defined in § 45-6B-33.3 and satisfactory mitigation is not possible	Section 1.1
SDCL-45-6B-33(4)	The proposed mining operation will result in the loss or reduction of long-range productivity of aquifer, public and domestic water wells, watershed lands, aquifer recharge areas, or significant agricultural areas	Section 1.1
SDCL-45-6B-33(5)	The biological productivity of the land is such that the loss would jeopardize threatened or endangered species of wildlife indigenous to the area; or	Section 1.1
SDCL-45-6B-33(6)	The board finds that any probable adverse socioeconomic impacts of the proposed mining operation outweigh the probable beneficial impacts of the operation.	Section 1.1
SDCL-45-6B-33.1	Socioeconomic impact study	Chapter 4.0; Appendix O
SDCL-45-6B-37	Grading final topography appropriate to final land use	Sections 6.8.1 and 6.10.2; Exhibits 31-37 in Appendix B
SDCL-45-6B-38	Disposal of refuse	Sections 5.3.7, 6.2.1, and 6.7
SDCL-45-6B-39	Revegetation	Sections 6.6 and 6.10.1, Appendix Q
SDCL-45-6B-40	Overburden removal and topsoil storage and protection	Section 5.3.3

Table 1-1. South Dakota Codified Law (Page 4 of 4)

Statute	Information Required	Permit Application Reference
SDCL-45-6B-41	Minimize disturbance to prevailing hydrologic balance	Sections 3.3 and 3.4, Appendix F and G
SDCL-45-6B-42	Protection of areas outside of affected land	Sections 5.2, 5.3.1, and 6.7.1
SDCL-45-6B-43	Stabilization of affected land-control erosion and air and water pollution—noxious weed control	Sections 5.3.3 and 6.6, Appendix Q
SDCL-45-6B-44	Reclamation Plan developed by the operator, department, and landowner	Chapter 6.0; Appendix Q
SDCL-45-6B-45	Choices of reclamation	Sections 6.2.2, 6.2.1.7
SDCL-45-6B-46	Time for completion of reclamation	Section 6.6, Table 5-1
SDCL-45-6B-46(1)	Plantings on affected land not required until after cessation of operations	Section 6.6
SDCL-45-6B-46((2)	Plantings not required on affected land with characteristics that inhibit growth and cannot be remedied	Section 6.6
SDCL-45-6B-91	Detailed Postclosure Plan	Section 6.11.2
SDCL-45-6B-91 (1)	Treatment of tailings	Sections 5.4 and 6.11.2.1
SDCL-45-6B-91 (2)	Operation of monitoring systems	Section 6.11.2
SDCL-45-6B-91 (3)	Inspection and maintenance activities to ensure compliance with reclamation design and operating criteria	Section 6.11.2
SDCL-45-6B-91 (4)	Procedures for maintaining the final cover, erosion, and fugitive dust	Section 6.11.2
SDCL-45-6B-92	Description of all critical resources	See below
SDCL-45-6B-92 (1)	Wildlife	Section 3.12.5; Appendix J
SDCL-45-6B-92 (2)	Aquatic resources	Section 3.12.6; Appendix K
SDCL-45-6B-92 (3)	Vegetation	Section 3.12.4; Appendix I
SDCL-45-6B-92 (4)	Water: direct or indirect sources of drinking water	Section 3.12.2; Appendices F and G
SDCL-45-6B-92 (5)	Visual resources	Section 3.12.9; Appendix N
SDCL-45-6B-92 (6)	Soils	Section 3.12.1; Appendix E
SDCL-45-6B-92 (7)	Cultural resources	Section 3.12.7; Appendix L
SDCL-45-6B-92 (8)	Air quality	Section 3.12.3
SDCL-45-6B-92 (9)	Noise	Section 3.12.8; Appendix M
SDCL-45-6B-92 (10)	Special, exceptional, critical, or unique lands	Sections 2.5 and 3.12.10
SDCL-45-6B-96	Mine permit history	Section 1.3
SDCL-45-6B-104	Spearfish Canyon—surface mining prohibition	Not applicable

Table 1-2. Administrative Rules of South Dakota (Page 1 of 5)

Regulation	Information Required	Permit Application Reference
ARSD 74:29:01:03	Presubmission meeting	December 21, 2010
ARSD 74:29:01:04	Proof of submission of application to Register of Deeds; SD DANR; South Dakota Game, Fish and Parks (SDGFP); Department of Agriculture; Department of Education and Cultural Affairs; Bureau of Land Management; Department of Health	Appendix A, proof of submission will be forwarded upon receipt
ARSD 74:29:01:17	Permit area boundaries	Exhibit 3 in Appendix B
ARSD 74:29:01:17 (1)	County Conditional Use Permit (CUP) area boundary	Exhibit 4A in Appendix B
ARSD 74:29:01:17 (2)	Legal right to mine	Section 2.4
ARSD 74:29:01:17 (3)	Location of permit boundary in relation to scenic and unique land	Section 2.5
ARSD 74:29:01:17 (4)	Ratio of proposed permit area to affected land	Chapter 2.0
ARSD 74:29:02:02	Local zoning requirements	Section 2.2
ARSD 74:29:02:03	Surface and mineral owners	Sections 2.3 and 2.4; Exhibit 4A an 4B in Appendix B; Appendix C
ARSD 74:29:02:04	Mining and milling methods	Sections 5.2 through 5.3.4, 5.5, 5.6
ARSD 74:29:02:04 (1)	Mining and milling methods	Sections 5.2 through 5.3.4, 5.5, 5.6
ARSD 74:29:02:04 (2)	Description and maps of premining and postmining contours	Sections 2.1, 5.3.4, and 5.4; Exhibits 2 and 31 in Appendix B
ARSD 74:29:02:04 (3)	Description of proposed depth and direction of mining and representative cross sections	Section 5.3.4; Exhibits 7 through 10 and 32 through 37in Appendix B
ARSD 74:29:02:04 (4)	Map of proposed spent-ore disposal, waste facilities, ore stockpiles, and other mine spoil	Exhibits 3, 23 (waste rock will be placed in the pit within the proposed Boston Expansion), 27, 28, and 38 in Appendix B
ARSD 74:29:02:04 (5)	Stability analysis for all critical earth structures	Sections 5.2 and 6.10.2, Appendix P
ARSD 74:29:02:04 (6)	Description of proposed blast procedures and mitigation program for fugitive dust, noise, and potential structural or stability damage outside the permit area	Sections 3.10.2, 3.10.3, and 5.3.5; Appendix M
ARSD 74:29:02:05	Timetable with narrative description of existing plans for future exploration and mining in the area of the proposed operation	Section 3.1.3; Table 5-1
ARSD 74:29:02:06	Historic or archaeologic significance	Section 3.9, Appendix L
ARSD 74:29:02:07	Water quality and water level data	Sections 3.3 and 3.4; Appendices F and G
ARSD 74:29:02:08	Reclamation costs	Section 6.10.1 and Table 6-4
ARSD 74:29:02:09	Permit area boundary—map requirements	Appendix B
ARSD 74:29:02:10	Revegetation	Sections 6.6 and 6.10.1
ARSD 74:29:02:11	Effect on hydrologic balance on surface and groundwater	Sections 3.3 and 3.4; Appendices F and G
ARSD 74:29:02:11 (1)	Baseline surface and groundwater reports	Appendices F and G

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Regulation	Information Required	Permit Application Reference
ARSD 74:29:02:11 (2)	Representative geologic cross sections	Exhibits 6 through 10 in Appendix B
ARSD 74:29:02:11 (3)	Surface-water inventory map	Appendix G (Figure 2-1 and Appendix H), Appendix F (sub-Appendix J)
ARSD 74:29:02:11 (4)	Well location inventory map	Appendix F (Exhibit 20)
ARSD 74:29:02:11 (5)	Potentiometric surface map	Appendix F (Figure 2-4)
ARSD 74:29:02:11 (6)	Geochemical characterization of ore and waste rock	Section 3.1.4; Appendix D, Exhibits 11-19
ARSD 74:29:02:11 (7)	Surface and groundwater monitoring plan for life of mine	Sections 3.3.2 and 3.4.1
ARSD 74:29:02:11 (8)	Meteorologic monitoring plan	Section 3.5.6
ARSD 74:29:02:11 (9)	Drainage, erosion, and sedimentation control plan	Section 5.3.6
ARSD 74:29:02:11 (10)	Chemicals in the milling process – proposed methods to monitor and collect leaks and spills and a spill contingency plan	Sections 5.4 and 5.6; Appendix P
ARSD 74:29:02:11 (11)	Estimate of project water requirements	Section 5.7
ARSD 74:29:02:11 (12)	Chemical characteristics of process solutions	Section 5.6
ARSD 74:29:02:11 (13)	Pollution control facilities	Section 5.0
ARSD 74:29:02:12	Map requirements for large-scale mining operations	Appendix B
ARSD 74:29:05:01	Reclamation of millsites	Sections 5.2 and 5.5
ARSD 74:29:05:02	Choice of reclamation	Section 6.8.3. See approved reclamation plan for the process area covered under other permits.
ARSD 74:29:05:03	Process pond reclamation	Sections 5.2 and 5.5
ARSD 74:29:05:04	Removal of equipment and buildings	Sections 5.2 and 6.7.3
ARSD 74:29:05:05 (1–6)	Reclamation of tailings impoundments	Sections 5.2, 5.4, and 5.5
ARSD 74:29:05:06	Treatment of tailings	Sections 5.4
ARSD 74:29:06:02	Determination of reclamation type	Section 6.2
ARSD 74:29:06:02 (1)	Land has capability of meeting reclamation criteria	Sections 3.2.2 and 3.12.1
ARSD 74:29:06:02 (2)	Postmining land use compatible with surrounding land uses	Section 6.2.1
ARSD 74:29:06:02 (3)	Support and maintenance activities	Sections 6.7 and 6.10
ARSD 74:29:06:02 (4)	Postmining land use is obtainable, practicable, has a schedule, is consistent with land use plans, and is of beneficial use	Chapter 6.0
ARSD 74:29:07:01	General requirements for all reclamation types	Section 6.2.1
ARSD 74:29:07:01(3)	Reclamation completed prior to full bond release	Section 6.11
ARSD 74:29:07:02	Minimizing of adverse impacts	See below
ARSD 74:29:07:02 (1)	Design of facilities to minimize surface disturbance	Sections 5.5 and 6.2.1
ARSD 74:29:07:02 (2)	Clearing of land in small sections	Sections 5.3.2 and 6.3
ARSD 74:29:07:02 (3)	Visual screening	Section 3.11.2, Exhibit 29

Table 1-2. Administrative Rules of South Dakota (Page 3 of 5)

Regulation	Information Required	Permit Application Reference
ARSD 74:29:07:02 (4)	Minimize impacts to surface and groundwater	Sections 3.3.5, 3.4.3, 3.4.4, and 5.3.6
ARSD 74:29:07:02 (5)	Control of access	Section 5.3.1
ARSD 74:29:07:02 (6)	Preventative measures to minimize harmful impacts to wildlife	Sections 3.7.10 and 3.12.5
ARSD 74:29:07:02 (7)	Location of waste facilities, spoil piles, and topsoil stockpiles to facilitate implementation of reclamation and to minimize environmental impacts	Sections 5.3.3 and 6.2.1; Exhibits 23 and 27 in Appendix B
ARSD 74:29:07:02 (8)	Minimizing the production of mine waste and spoil	Section 5.2
ARSD 74:29:07:02 (9)	Design and location of facilities so they are compatible with surrounding land uses (i.e., waste facility and haul road)	Section 6.2
ARSD 74:29:07:02 (10)	Integration of mine operations planning with the Reclamation Plan	Sections 5.1 and 6.8; Table 5-1
ARSD 74:29:07:03	Grading and backfilling—necessity	Section 6.8.1
ARSD 74:29:07:04	Grading and backfilling—criteria	Section 6.8.1
ARSD 74:29:07:04 (1a–1d)	Grading and backfilling requirements	Sections 6.2.1.1 and 6.8.1
ARSD 74:29:07:04 (2)	Detailed plans—erosion control	Sections 5.3.6, 6.2.1.1, and 6.11.2.5
ARSD 74:29:07:04 (3)	Timetable—grading and backfilling	Section 6.2.1.1; Table 5-1
ARSD 74:29:07:04 (4)	Depressions for accumulation of water	Section 6.2.1.1
ARSD 74:29:07:04 (5)	Original drainage preserved as much as possible	Section 6.2.1.1
ARSD 74:29:07:04 (6)	Highwall reduction impractical	Section 6.8.1
ARSD 74:29:07:04 (7)	Blending in landforms	Sections 3.11.1, 3.11.2, 3.12.9, and 6.2.1.1
ARSD 74:29:07:05	Disposal of refuse	Sections 5.3.7, 6.2.1.2, and 6.7
ARSD 74:29:07:06 (1)	Vegetative species and composition—postmining land use	Section 6.5; Tables 6-1 and 6-2, Appendix Q
ARSD 74:29:07:06 (2)	Methods and procedures for revegetation	Sections 6.2.1.3, 6.6, 6.10.1, Appendix Q
ARSD 74:29:07:06 (3)	Vegetative success—reference areas	Section 6.10.1, Appendix Q
ARSD 74:29:07:06 (4)	Seeding and planting	Section 6.6, Appendix Q, Exhibit 30
ARSD 74:29:07:07 (1)	Salvageable topsoil	Section 5.3.3
ARSD 74:29:07:07 (2)	Temporary distribution of topsoil during interim reclamation	Section, 6.4
ARSD 74:29:07:07 (3)	Determination of fertilizer need	Sections 3.12.1 and 6.2.1.3
ARSD 74:29:07:07 (4)	Signing of topsoil stockpiles	Section 5.3.3

Table 1-2. Administrative Rules of South Dakota (Page 4 of 5)

Regulation	Information Required	Permit Application Reference
ARSD 74:29:07:07 (5)	Estimate of topsoil to complete reclamation	Section 5.3.3
ARSD 74:29:07:07 (6)	Excess topsoil usage	Section 5.3.3
ARSD 74:29:07:07 (7)	Separation of rocks and trees from topsoil	Section 5.3.3
ARSD 74:29:07:07 (8a)	Segregation of topsoil substitutes	Section 5.3.3
ARSD 74:29:07:07 (8b)	Suitability of topsoil substitutes	Section 5.3.3
ARSD 74:29:07:08	Hydrologic balance—water quality	Sections 3.3.2, 3.3.4, 3.4.2, 3.4.3, 3.4.4, 5.3.6, and 6.2.1
ARSD 74:29:07:08(1)	Compliance with SD water rights	Section 6.2.1.4, Appendix F
ARSD 74:29:07:08(2)	Compliance with water quality laws	Section 6.2.1.4
ARSD 74:29:07:08(3)	Dredge and fill laws of Clean Water Act	Section 3.4
ARSD 74:29:07:08(4)	Removal of temporary or large sediment control structures	Section 6.11.1.1
ARSD 74:29:07:08(5)	Permanent diversion structures	Sections 5.3.6 and 6.2.1.4
ARSD 74:29:07:08(6)	Unchannelized surface water	Section 5.3.6
ARSD 74:29:07:09	Surface runoff diversions	Sections 3.4.4, 5.3.6, and 6.2.1.4
ARSD 74:29:07:09(1)	Construction and stabilization of diversion ditches	Sections 5.3.6 and 6.2.1.4
ARSD 74:29:07:09(2)	Diversions in rock must be stable	Sections 5.3.6 and 6.2.1.4
ARSD 74:29:07:09(3)	Methods to prevent erosion of diversion ditches	Sections 5.3.6 and 6.2.1.4
ARSD 74:29:07:09(4)	Culverts and bridges	Sections 5.3.6 and 6.2.1.4
ARSD 74:29:07:09(5)	Diversion hazard minimization	Sections 5.3.6 and 6.2.1.4
ARSD 74:29:07:09(6)	Diversions around milling and processing facilities	Sections 5.3.6 and 6.2.1.4
ARSD 74:29:07:09(7)	Diversion capacity	Sections 5.3.6 and 6.2.1.4
ARSD 74:29:07:09(8)	Diversion ditches may not discharge on stockpiles	Sections 5.3.6 and 6.2.1.4
ARSD 74:29:07:10	Diversions of intermittent and perennial streams	Sections 3.4, 5.3.6, and 6.2.1.4
ARSD 74:29:07:11	Tailings impoundments	Section 6.2.1.4
ARSD 74:29:07:12	Roads and railroad spurs—riparian zones	Sections 3.12.4 and 5.3.6
ARSD 74:29:07:13	Buildings and structures	Section 6.8.3
ARSD 74:29:07:14 (1)	Spoil location	Section 6.2.1.5; Exhibit 23 in Appendix B
ARSD 74:29:07:14 (2)	Stability analysis of spoil	Section 5.2
ARSD 74:29:07:14 (3 and 4)	Potential toxic or acid-forming spoil	Sections 3.1.4.7, 3.3.5, 3.4.3, and 3.4.4
ARSD 74:29:07:15	Noxious weed control plan	Section 6.7, Appendix Q
ARSD 74:29:07:16	Subsidence from mining activities—prevent or minimize	Section 6.8.1

Table 1-2. Administrative Rules of South Dakota (Page 5 of 5)

Regulation	Information Required	Permit Application Reference
ARSD 74:29:07:17	Underground mines—sealed during reclamation	Sections 3.1.2 and 6.2.1
ARSD 74:29:07:18	Reclamation plan developed by competent individuals	Section 6.1
ARSD 74:29:07:20	Rangeland	Section 6.2.2.1
ARSD 74:29:07:20(1)	Livestock carrying capacity	Sections 6.2.1.7 and 6.2.2, and Appendix Q
ARSD 74:29:07:20(2)	Slopes not to exceed 3:1	Sections 6.2.2 and 6.8.1
ARSD 74:29:07:20(3)	Fencing if necessary to preclude livestock	Section 6.2.1.7
ARSD 74:29:07:20(4)	Reclamation complete upon 2 years of stocking	Section 6.2.1.7
ARSD 74:29:07:27	Permanent surface impoundments	Section 5.3.6
ARSD 74:29:08:01	Requirements for concurrent reclamation	Sections 5.1, 5.3.4 , 6.2.1, and 6.8; Table 5-1
ARSD 74:29:08:02	Requirements for interim reclamation	Sections 5.3.3, 6.4, 6.6.1
ARSD 74:29:08:03	Requirements for final reclamation	Chapter 6.0; Sections 6.6.2, 6.8, 6.9, and 6.10

The planned postmining land use is rangeland. Wharf Resources (U.S.A.), Inc. (Wharf) has previously reclaimed land for use as rangeland, which has provided beneficial uses including habitat for many species. Disturbed areas will be reclaimed by recontouring, resoiling, and revegetating the land according to accepted reclamation techniques. Although the current approved postmine land use in adjacent areas to the Boston Expansion is rangeland and homesites, homesites are not proposed for this expansion due to steep topography that is not well suited for homesites. Further reclamation details are provided in Chapter 6.0 of this application.

1.3 PERMITTING HISTORY

Wharf's active state and county mining permits are listed in chronological order in Table 1-3.

1.4 PROJECT DESCRIPTION PER SDCL 45-6B-96

SDCL 45-6B-96 allows mine extension of up to 200 acres of surface mining disturbed land for each Large-Scale Mine Permit held as of January 1, 1992. Wharf Resources has maintained four active mine permits (No. 356, 434, 435, and 450) that allow up to 800 acres of total expansion. The haul road, other roads, and the topsoil stockpile are not considered surface-mining disturbed lands under SDCL 45-6B-96. The total allowable expansion limit (not including reclamation credits) is approximately 102.01 acres, which is higher than the proposed surface mining disturbance of only 48.2 acres. As of January 1, 2022, 666.71 acres of land at Wharf and Golden Reward have been reclaimed and are available to be applied to the expansion limit of surface mine disturbed land (the reclaimed acres include lands at the Wharf Mine and the Golden Reward Mine). As shown on Table 1-4, that total expansion allowable under SDCL 45-6B-96 and 45-6B-97 is 768.72 acres.

Table 1-3. Chronology of Wharf's State and County Mining Permits (Page 1 of 2)

Date	County Conditional Use Permit	State Permit Number	Comments
12/07/82		Annie Creek # 356	Mining and milling of gold ores by open-pit methods, 400,000 tons per year, $732,000 cash bond
12/08/82	CUP #63 Annie Creek		Mining and milling operation
12/09/83	CUP #63 Annie Creek		Mining and milling operation
02/17/83		Amendment to #356	Included three additional mining claims, relocating plant facilities, developing a haul road, and building a leach pad
07/20/83		Amendment to #356	Included 18 additional mining claims and relocating proposed overburden facility
08/10/83	CUP #70 Annie Creek		Mining and milling
09/20/84		Amendment to #356	Increased production to 800,000 tons per year, added 14 acres for low-grade ore stockpile, modified stripping/stockpiling method, and allowed for developmental drilling of up to 230 holes up to 100 feet deep
12/20/84		Amendment to #356	Extended duration of leach season from 180 to 365 days per year
12/11/85	CUP #99A Foley Ridge		Mining and related activities, subject to conditions
02/12/86	CUP #100B Foley Ridge		Mining and related activities, subject to conditions
03/12/86	CUP #102 (Amend–Annie Creek)		Amended CUP #63 to correct original application
03/12/86		Foley Ridge #434	Amended CUP #63 to correct original application, subject to conditions
03/21/86		Foley Ridge #434	Mining permit for 800,000 tons per year each rock/ore, $141,000 cash for reclamation bond
03/31/86		Annie Arm #435	Mining permit for 800,000 tons per year each rock/ore, $47,955 cash for reclamation bond
11/05/86	Amend CUPs #99A and #100B		Conditions 7 and 10 amended clarifying requirements
05/21/87		Amendment to #434	Increased annual ore production to 1.5 million tons per year
09/14/87	CUP #122		Amended CUP #63 and CUP #102 for expanding Annie Arm mine area, revised the CUP boundary
03/16/88		Amendment to #356	Approved pad #4 and load, unload
04/16/88		Amendment to #356	Plant expansion
05/11/88	CUP #126		Golden Reward
05/19/88		Permits #356, 434, and 435	Mine boundary established
06/30/88		Golden Reward #450	Golden Reward
09/01/88	CUP #132		All CUPs combined

Table 1-3. Chronology of Wharf's State and County Mining Permits (Page 2 of 2)

Date	County Conditional Use Permit	State Permit Number	Comments
11/17/88		Amendment to #356, 434, and 435	Mine expansion amendment, Annie Arm extension
08/21/89		Amendment to #356, 434, and 435	Reliance rock disposal, land application
11/12/91		Amendment to #356, 434, and 435	Increased ore production to 3.5 million tons
08/18/92		Mining License #90 to #400	Foley Gravel Pit license expired 5/3/2011
03/01/93		Amendment to #356, 434, and 435	Increased ore production to 4.5 million tons
03/01/94		Permit #SD-0025852	Surface Water Discharge Permit
03/04/96		Amendment to #356, 434, and 435	South Dakota Department of Transportation Project (Altering State Highway 473)
04/07/98	CUP #224		Mining and milling operations for Clinton project for 8 additional years of mine life
06/18/98		Clinton Expansion #464	Clinton Expansion area
12/06/98		Amendment to #356	Clinton Expansion adding 616 acres under permit with two pits
09/17/07		Amendment to #464	American Eagle Expansion
04/06/10		Amendment to #464	Mine expansion amendment, American Eagle pushback (added 18 acres to existing permit)
06/14/11	CUP #398		Green Mountain and Golden Reward expansion (added 600 acres with 250 acres new disturbance)
01/29/12		Permit #476	Green Mountain and Golden Reward expansion (added 600 acres with 250 acres new disturbance)
1/25/22	CUP #470		Boston Expansion along Portland ridgeline adding 47.4 acres to the CUP/mine boundary.

Table 1-4. Expansion Acres Allowed Under SDCL 45-6B-96 and 45-6B-97

Expansion Acres Allowed Under SDCL 45-6B-96	Acres
Permit No. 356	200.00
Permit No. 434	200.00
Permit No. 435	200.00
Permit No. 450	200.00
Total Expansion Allowed Under SDCL 45-6B-96	**800.00**
Less Acres since 1/1/92	
New Mine Permit Expansions	–502.00
Permit Amendment Expansions	–58.00
Technical Revisions	–137.99
Total Expansion Acres	**–697.99**
Total Surface Mine Expansion Remaining for New Permits	**102.01**
Reclamation Credits Under SDCL 45-6B-97	
Golden Reward Reclamation – Permit No. 450	408.44
Less Disturbance Under Permit 476	–75.12
Wharf Reclamation – Permit Nos. 356, 434, 435, 464, and 476	333.29
Total Surface Mine Expansion as Reclamation Credit	**666.71**
Grand Total Expansion Acres Allowable Under SDCL 45-6B-96 and 45-6B-97	**768.72**

2.0 PROPERTY DESCRIPTION

Wharf is proposing to expand its existing gold mine operations in the area known as the Boston Expansion, which is located on the southern edge of the Wharf Mine along the Portland Ridgeline. The Boston Expansion area is located approximately 4 miles west of Lead, South Dakota, in the Bald Mountain Mining District (see Exhibit 1 in Appendix B). The proposed Boston Expansion is located south of, and immediately adjacent to, the existing Wharf Mine, and access to the Wharf Mine area is from State Highway 473 (Nevada Gulch Road).

The existing Wharf Mine is located in Sections 1, 2, 3, and 4, T4N, R2E, and Sections 25, 26, 33, 34, 35, and 36, T5N, R2E of the BHM, Lawrence County, South Dakota. The Golden Reward Mine is located in Sections 1 and 12, T4N, R2E, and Sections 6 and 7, T4N, R3E of the BHM. The property is accessed by Wharf Road and State Highway 473 (Nevada Gulch Road), which leads west from Lead to the Wharf Mine.

The Boston Expansion area, which consists of portions of 15 patented lode mining claims and two government lots, is located in Lawrence County, South Dakota. The proposed Boston Expansion area encompasses approximately 47.4 acres of private land, including portions in Sections 2 and 3, T4N, R2E of the BHM (see Exhibit 2 in Appendix B). The proposed permit boundary and ownership is shown on Exhibits 2, 3, and 4 in Appendix B. The Boston Expansion project has a permit boundary area estimated to be 47.4 acres in size. A total of 48.2 acres of new permitted affected acreage (disturbance) are proposed, including 40.6 acres within the proposed Boston Expansion permit boundary and outside the existing Wharf Mine permit boundary and 7.6 acres of new affected acreage (disturbance) that is within the existing Wharf Mine permit boundary but outside the current approved permitted affected acreage boundary. Undisturbed areas are reserved for potential expansion of operations, vegetation buffer zones, site continuity, and visual screening. The permit boundary (47.4 acres) to permitted affected acreage (40.6 acres) ratio for lands within the Boston Expansion is 1:1.17.

2.1 TOPOGRAPHY

The proposed Boston Expansion area lies along the southern edge of the existing Wharf Mine in the northern Black Hills in western South Dakota. Elevations within the Boston Expansion area range from 6,320 to 6,560 feet above mean sea level. Currently, the westernmost portion of the expansion area slopes to the southwest while the eastern half slopes and drains northward toward the existing Portland/American Eagle Pits. The topography of the surrounding area is characterized by moderate to steep-sloping hills intersected by narrow drainages. Terry Peak, which has an elevation of 7,064 feet, lies approximately 1 mile southeast of the proposed project. The Boston Expansion area occurs within the Annie creek, Lost Camp Gulch, and Nevada Gulch Creek drainages. The expansion area's topography does not have significant features and is similar to the topography of the north-central Black Hills. A topographic contour map of the area is presented on Exhibit 2 in Appendix B.

2.2 ADJACENT LAND USE

The Boston Expansion area is surrounded by patented and unpatented mining claims and adjoins the southern margin of the existing Wharf Mine. The predominant uses of those lands are open-pit gold

mining and mineral exploration. Other adjacent land uses include logging, wildlife habitat, rural residential housing, and recreation (including skiing).
Land within the vicinity of the Boston Expansion area is zoned Park Forest (PF), Highway Service Commercial (HSC), Recreation Commercial (RC), and Suburban-Residential (SRD) districts under terms set forth by the Lawrence County Zoning Ordinance, District Regulations. The project will not require a zoning change because mining activity is allowed in all zoning districts, subject to the acquisition of a CUP (which was approved on January 25, 2022), as described in Chapter 19 CUP, Section § II-19.002 Application of the Lawrence County Zoning Ordinances. The proposed post-reclamation land use is rangeland (see Section 6.2.2).

2.3 COUNTY CONDITIONAL USE PERMIT BOUNDARY/ZONING

The Boston Expansion area is located solely on private land owned by Wharf. The CUP boundary is coincident with the proposed mine permit boundary and is shown on Exhibit 4A in Appendix B.

The Lawrence County Comprehensive Plan requires that all large-scale mines implement a 500-foot minimum buffer zone between the disturbed land and any adjacent landowner. An exception to this requirement occurs when an operator secures a waiver from the landowners. An ownership listing of those lands within and adjoining the proposed expansion mine permit area is provided on Exhibit 4A in Appendix B and in Appendix C. Landowners within this buffer zone include Paul Akrop; Ross and Amber Determan; Terry Valley Trojan Water Project District; and Western Communications, Inc.

As stated previously, the proposed expansion does not include new mining practices or equipment from those currently employed at the Wharf Mine, and little to no interference is anticipated for using or enjoying other property within 500 feet of the proposed disturbance area. All landowners within 500 feet of the disturbance boundary have been contacted and all landowners have signed buffer waivers to waive their right to a buffer zone.

Wharf submitted a Conditional Use Permit (CUP) to Lawrence County Planning and Zoning and County Commissioners for mining in the Boston Expansion. The permit was approved on January 25, 2022. A copy of the CUP permit and conditions is provided in Appendix A.

2.4 LEGAL RIGHT TO ENTER AND MINE

Wharf has the legal right to conduct mining within the proposed permit area boundary (SDCL 45-6B-6(4) and ARSD 74:29:02:03). Wharf owns or controls all of the mineral rights and surface rights within the Boston Expansion area. The Homestake Mining Company is a 50 percent mineral owner of the Precambrian minerals, although no Precambrian rock is proposed to be mined. Appendix C provides information on mineral and surface ownership and Exhibits 4A and 4B show surface owner and mineral claims boundaries, respectively.

2.5 DETERMINATION OF SPECIAL, EXCEPTIONAL, CRITICAL, OR UNIQUE LANDS

Per South Dakota regulations, a Large-Scale Mine Permit is required for operations that mine and disturb more than 10 acres of land and extract more than 25,000 tons annually and for any operation that uses cyanide or other chemical or biological leaching agents. A prospective mining operator must

request the SD DANR to determine whether or not the lands included in the proposed mining operation constitute special, exceptional, critical, or unique lands by submitting a Notice of Intent to Operate to the department. To fulfill the requirement, SDCL 45-6B-33.3 and ARSD 74:29:10:02 require the operator to submit a Request for Determination of Special, Exceptional, Critical, or Unique Lands.
For the purposes of § 45-6B-33, land is special, exceptional, critical, or unique if it possesses one or more of the following characteristics:

- The land is so ecologically fragile that, once it is adversely affected, it could not return to its former ecological role in the reasonably foreseeable future.
- The land has such a strong influence on the total ecosystem of which it is a part that even temporary effects felt by it could precipitate a system-wide ecological reaction of unpredictable scope or dimension.
- The land has scenic, historic, archaeologic, topographic, geologic, ethnologic, scientific, cultural, or recreational significance.

A Notice of Intent to Operate and a Request for Determination of Special, Exceptional, Critical, or Unique Lands were submitted to the SD DANR on February 17, 2022. The SD DANR conducted on-site inspections of the project area on October 19, 2021. A second inspection of the western portion of the proposed Boston Expansion was conducted on November 3, 2021. On May 6, 2022, the DANR determined that lands described in the Notice of Intent to Operate do not constitute special, exceptional, critical, or unique lands and are cleared in accordance with ARSD 74:29:10:15 (notice of determination include in Appendix A). The proposed permit boundary is entirely within the scenic and unique land study area as shown on Exhibit 4A in Appendix B (ARSD 74:29:01:17(3)). No restrictions or limitations were enacted by the board (SDCL 45-6B-33.5) and Wharf does not intend to appeal the decision (SDCL 45-6B-33.7). No underground mining is planned as part of the Boston Expansion (SDCL 45-6B-33.8).

Environmental and cultural resource studies have been conducted within the proposed Boston Expansion area to determine if the affected land has historic, archaeologic, geologic, scientific, or recreational significance. These items were included in Wharf Resource's Request for Determination of Special, Exceptional, Critical, or Unique Lands [Wharf Resources, 2021]. Characteristics of the affected land of historic, archaeological, geologic, scientific, or recreational significance that are known to the applicant are summarized as follows (SDCL 45-6B-7(5)):

- No significant historic or cultural resources were identified. Although a portion of site 39LA0376 occurs within the Boston Expansion area, the southern portion of the site located within the Boston Expansion area was designated as noncontributing.
- No threatened or endangered plant species exist within the Boston Expansion area.
- One sensitive plant species (mountain huckleberry) was identified within the west side of the Boston Expansion area.
- No raptor nests were discovered within the Boston Expansion area. The broad-winged hawk, which is a rare species designated by the South Dakota Natural Heritage Program (SDNHP) was observed.

- Five bat species are listed by the SDNHP as species of concern: Townsend's big-eared bat, silver-haired bat, long-eared myotis, fringe-tailed myotis, and northern long-eared bat. The northern long-eared bat is a listed threatened species by the U.S. Fish and Wildlife Services (USFWS).
- No geologic, scientific, or recreational features of significance occur within the Boston Expansion area.
- No other special, exceptional, critical, or unique features exist within the Boston Expansion area.

3.0 BASELINE

This chapter provides summaries of existing monitoring programs and baseline data studies for the Boston Expansion area. Detailed information and analysis reports are included as attachments to this permit. Baseline reports may include data that are not relevant to the Boston Expansion but was collected as part of Wharf's ongoing environmental program.

3.1 GENERAL GEOLOGY AND DEPOSITIONAL ENVIRONMENT

The Wharf Mine and proposed Boston Expansion area are located in the north-central portion of the Black Hills uplift in western South Dakota. The geology consists of Precambrian metamorphic rocks overlain by sediments of the Cambrian Deadwood Formation. These rocks have been intruded by Tertiary-age igneous dikes and sills. Mineralization is primarily within the Deadwood Formation but also in and along the Tertiary intrusions.

A geochemical analysis of the affected rock units has been conducted on samples collected within the Boston Expansion during the exploration phase of this project as described in Section 3.1.4. This geochemical analysis includes Acid-Base Accounting (ABA) testing, Meteoric Water Mobility testing (MWMT), whole-rock analysis, humidity cells, and nitrates. More than 10,000 geochemical samples have been collected. Based on the results from historical geochemical analyses of similar rock, the potential for acid-rock drainage appears to be minor. Wharf does not plan to mine acid-generating material, and existing mitigation plans approved by the SD DANR will be followed if acid-generating material is encountered. Historical mine workings and stopes are shown on Exhibit 5. Surface geology around the Wharf Mine, and geologic cross sections are shown on Exhibits 6 through 10 in Appendix B.

3.1.1 GENERAL GEOLOGY

Within the Boston Expansion area, the geology consists of Precambrian metamorphic rocks overlain by sediments of the Cambrian Deadwood Formation. All of these rocks have been intruded by Tertiary-age igneous stocks, sills, dikes, and porphyry breccias. Mineralization in the Boston Expansion area is primarily within the Deadwood Formation but also in and along the Tertiary intrusions. A general geologic plan map is shown on Exhibit 6, and cross sections are shown on Exhibits 7 through 10 in Appendix B. Additional details about the geology of each of the major formations in the Boston Expansion are provided in the following text.

The Precambrian Ellison Formation is the dominant rock unit within the area and underlies the entire project at depth. The formation consists of interbedded quartzites and phyllites that are strongly folded and foliated. Foliation dips near vertically and strikes approximately north-south. Groundwater flow is anisotropic and oriented in the direction of foliation. Surface exposures can be found along the western edge of the Bald Mountain area and in Nevada Gulch on the south flank of Green and Bald Mountains. Exploration work performed in the Precambrian to date has been extremely limited.

The Cambrian deadwood Formation unconformably overlies the Precambrian and consists of quartz and limestone conglomerate, sandstone, quartzite, siltstone, shale, and limestone. Locally, a pebble conglomerate is present at the basal unconformity. The Deadwood Formation is informally divided into

the lower, middle, and upper members based on stratigraphy and preference for hosting mineralization. Within the Boston Expansion area, the dominant ore host is the lower member. This member generally consists of sandy dolomite interbedded with calcareous siltstone, sandstone, quartzite, limestone, limestone conglomerate, and shale.

The Deadwood Formation in the Wharf Mine area is approximately 400 feet thick and dips southwesterly at 6 to 15 degrees [J. M. Montgomery Engineers, Inc., 1996]. Ore localization in the Deadwood Formation is primarily controlled by north-northeast-trending, subvertical fractures called "verticals." Ore zones are best described as hydrothermal replacement deposits adjacent to the fractures in favorable horizons such as carbonate-rich units with high permeability. In areas of closely spaced fractures, extensive deposits occur with intense silicification and decarbonization.

The Ordovician-age Winnipeg Shale consists of friable, green shale. Within the project area, the Winnipeg Shale (specifically the Icebox Shale Member) occurs under the Tertiary intrusive cap on the Portland Ridgeline.

All rock units within the project area have been intruded by a variety of igneous dikes and sills considered Tertiary in age (40 to 60 million years). The intrusions are locally subdivided into monzonite porphyry, phonolite porphyry, porphyry breccia, and trachyte. These rocks primarily intrude the Precambrian and Deadwood as sills, although dikes and stocks are also present within the area. The sills are typically more than 20 feet thick; local thicknesses may be 100 feet or greater. Ore grade mineralization within porphyry units is normally restricted to portions of the thick (20 to 100 feet) monzonite porphyry sill. This sill is located near the top of the lower member of the Deadwood Formation.

3.1.2 HISTORICAL MINE WORKINGS

Historical mine workings within the proposed Boston Expansion consist of random underground mining features such as stopes, drifts, and shafts that intersect the Cambrian Deadwood sediments and porphyry igneous rocks (SDCL 45-6B-8, SDCL 45-6B-9, and ARSD 74:29:07:17). Specific examples of historical mine workings within the Deadwood sediments include room-and-pillar, shrinkage stopes, and exploratory drifts. The room-and-pillar features are within the upper and lower Deadwood sediments and span up to 10 feet high and up to 40 feet wide. Shrinkage stopes are located within the intermediate Deadwood sediments and are narrow (typically up to 8 feet wide and up to 80 feet high).

No historical surface mining operations prior to 1971 exist within the Boston Expansion area that Wharf staff are aware of.

At active mining areas, measures exist to limit contact with this mine's historical workings. Maps depicting the location and dimensions of these historical mine workings have been created and are used to anticipate contact with active mining (Exhibit 5). With drilling and current mining activities, technology is used to simultaneously navigate active mining and assist with safe demolition. During the past 30 years, Wharf has located historical shafts and drifts to safeguard the public with fencing and signs. Remaining openings and workings will be sealed during reclamation.

Three underground mining collapse features present within the Boston Expansion were filled in September 2022. There is not expected to be any reclamation potential of underground workings in the Boston Expansion area given the entire working mine disturbance will be backfilled.

3.1.3 FUTURE EXPLORATION POTENTIAL

Future exploration work will include drilling and operations similar to present-day activities (ARSD 74:29:02:05). Future exploration or expansion plans are minimal because of geological change and previously mined areas adjacent to the mine boundary. Any exploration within the proposed Boston Expansion area will likely be concentrated in the southwest corner, where little exploration work has been conducted to date, or at the pit perimeter and bottom to further define economic mineralization. After mining in the Boston Expansion is complete, there are no planned exploration activities in or immediately adjacent to the Boston Expansion because of the close proximity of housing and infrastructure.

The Precambrian rocks that underlie the proposed expansion area could host an economic deposit, such as those deposits found within the overlying Paleozoic sediments. Currently, subsurface data are limited for identifying if future expansion of any area is planned. The lower unit of the Cambrian-aged Deadwood Formation and the porphyry host mineralization and are located below the pit bottom of the Portland Ridgeline area. This area has the potential for deeper mineralization at the western perimeter of the current pit design.

3.1.4 GEOCHEMICAL CHARACTERIZATION OF ORE AND WASTE ROCK

Geochemical samplings throughout the Boston Expansion area were completed to analyze geochemical characterization of ore and waste rock for the project (ARSD 74:29:02:11(6)). The Boston Expansion area geochemical database analysis consists of the following: over 5,000 ABA samples, 104 whole rock samples, 37 MWMT samples, and 10 humidity cell samples. The physical locations of the geochemical samples are plotted on Exhibits 11 through 15 in Appendix B. As indicated on these maps, the samples were initially randomly selected throughout the Boston Expansion area based on a grid pattern. The samples represent intervals of 10 feet in length.

The historic ABA and nitrate samples were analyzed by Energy Laboratories, Inc. of Rapid City, South Dakota and Billings, Montana. New ABA samples were analyzed by Bureau Veritas of Burnaby, British Columbia, and new nitrate samples were analyzed by Inter-Mountain Labs (now Pace Analytical Services, LLC) of Sheridan, Wyoming. The historic whole rock analysis and humidity cell testing were completed by ALS Laboratory Group of Reno, Nevada. New humidity cell tests are being conducted by McClelland Laboratories of Sparks, Nevada. The MWMT were completed by Inter-Mountain Laboratories of Sheridan, Wyoming. Appendix D contains the procedural methods for the analysis and the analysis results for all geochemical testing.

The Boston Expansion project involves moving approximately 31,912,000 tons of rock, including 6,694,000 tons of ore. The various rock types and corresponding tonnage of rock and ore-bearing rock that will be encountered over the life of the project are shown in Table 3-1.

Table 3-1. Tonnages of Rock and Ore-Bearing Rock

Rock Type	Tonnage of Rock	Tonnage of Ore	Tonnage of Waste Rock
Deadwood (upper and intermediate)	14,479,000	3,738,000	10,741,000
Porphyry	15,570,000	2,859,000	12,711,000
Lower Deadwood	278,000	97,000	181,000
Rehandle	1,585,000	—	1,585,000
Total	31,912,000	6,694,000	25,218,000

3.1.4.1 ACID-BASE ACCOUNTING TEST RESULTS

Samples were collected on approximately a 100-foot × 100-foot grid every 40 feet down the hole (with varying starting intervals) with greater spacing depending on the rock unit. More samples were collected within the lower Deadwood because the unit is thinner and not well-represented in the Boston Expansion area. This spacing provided over 5,000 ABA samples and represented the affected rock units with over 2,000 samples located within proposed Boston Expansion. ABA sample locations are shown on Exhibit 11 in Appendix B.

The ABA testing results are listed in Appendix D (Tables D-1 to D-9). Mitigation plans for any potential acid-generating material are detailed in Section 3.1.4.7 and include special handling, encapsulation, or leaving the material in place and undisturbed in accordance with Wharf's existing waste rock management plan. A summary of the number of ABA samples by rock unit type and those that are categorized as moderate to high acid-generating potential (AGP) are provided in Table 3-2a. A list of specific samples with high AGP are included in Table 3-2b. The following sections detail the results of ABA test work by rock unit.

The California standard ratio of 3 to 1 (3:1) is used as an industry standard in predicting AGP. If a sample has an acid-neutralization potential (ANP)/AGP ratio that is above 3:1, then the sample has a very low potential for acid production. This standard is used for interpretating all rock types. These standards categorize the ARD potential into three categories using the following variables: ANP = acid neutralizing potential, AGP = acid generation potential, NNP = net neutralizing potential. The percent sulfur content calculated from the ABA testing for each sample was also considered. The industry standardizes the ABA data into three groups that categorize the potential for ARD as follows:

Low AGP = 3:1 ANP:AGP ratio, with an NNP > 20

Moderate/Unclear AGP = 2:1 ANP:AGP ratio, with 20 > NNP > –20

High AGP = 1:1 ANP:AGP ratio, with NNP < –20

Table 3-2a. Summary of ABA Samples

Rock Unit	Approximate Number of ABA Samples in Boston Expansion	Number of Samples With Moderate to High AGP	Number of Samples With Moderate or High AGP Within the Pit (Ore + Waste)
Icebox Shale	64	17	14
Upper Deadwood	903	164	95
Intermediate Deadwood	1230	130	112
Lower Deadwood	220	31	3
Porphyry (monzonite)	1747	393	256
Porphyry (phonolite)	442	14	12

3.1.4.1.1 **Icebox Shale.** The Icebox Shale comprises a negligible amount of the Expansion Project discard rock production. The data in Appendix D (Tables D-1A and D-1B) indicate that the Icebox Shale unit has a very low percentage of nonsulfate sulfur (an average of less than 0.001 percent for both ore and discard) overall for a rock unit.

Fourteen samples within the Icebox Shale found within the pit limits resulted in a NP:AGP ratio less than 3:1 and NNP less than 20 that categorize these Icebox Shale samples of having an acid rock drainage (ARD) potential. Approximately 80 percent of ABA samples from this unit have a low AGP and a high neutralization potential (NP) (ratio significantly greater than 3:1) with very low nonsulfate sulfur content; therefore, this unit will not have an AGP.

3.1.4.1.2 **Upper and Intermediate Deadwood.** As indicated in Table 3-1, the Cambrian Deadwood Formation upper contact and intermediate units represent 43 percent (or 10,741,000 tons) of the total expansion area discard rock production and 56 percent of expansion ore. The current data in Appendix D (Tables D-2A and D-2B) indicate that this unit has a very low percentage of nonsulfate sulfur. Ninety-five samples within the Deadwood upper contact found within the pit limits resulted in an NP:AP ratio less than 3:1 and NNP values less than 20; thus, these samples are categorized as having an ARD potential. Based on review of all ABA test results on this unit (including a review of the number of samples, range in NNP values, and mean values), the upper Deadwood has a low AGP and a high NP. The average NNP value is much greater than 20 with very low nonsulfate sulfur content; therefore, this unit will not have an acid generating potential and may actually have a significant neutralizing capacity. The upper Deadwood unit has a low acid generation potential and a high NP. These values will add to the NP of any area where rock is deposited.

The intermediate unit of the Deadwood Formation consists of carbonate-rich shale, siltstone, and limestone. The data for the intermediate Deadwood Formation is in Appendix D (Tables D-3A and D-3B). Of more than 1,200 ABA samples within the intermediate Deadwood, there are 112 samples found within the pit limits resulted in an NP:AP ratio less than 3:1 and NNP value less than 20; these samples are categorized as having an ARD potential. However, because nearly 90 percent of ABA samples are neutralizing, this unit as a whole has a low AGP and a high NP. The average NNP value is much greater

than 20 with very low nonsulfate sulfur content; therefore, this unit will not have an acid generation potential, and may actually have a significant neutralizing capacity.

3.1.4.1.3 **Lower Contact Unit of the Deadwood Formation**. The Cambrian Deadwood Formation lower contact unit comprises 0.7 percent (or 181,000 tons) of the total expansion area discard rock production and 1.5 percent of ore material. The data in Table 3-2 and Tables D-4A and D-4B in Appendix D show the results of the ABA analysis. Overall, the Cdlc rock unit has very low nonsulfate sulfur content and a good NP:AP ratio in barren rock.

Only three samples within the pit limits of the Boston Expansion (or 1 percent of all lower Deadwood ABA samples) are categorized as having an ARD potential. On average, this unit has a low AGP and a high NP. The NNP value is much greater than 20 with very low nonsulfate sulfur content; therefore, this unit will not have an acid generation potential and may actually have a significant neutralizing capacity. The lower Deadwood unit has a low acid generation potential and a high NP. These values will add to the NP of any area where rock is deposited.

3.1.4.1.4 **Porphyry**. Porphyry (both monzonite and phonolite) comprises 12,711,000 tons or 50 percent of the expansion area discard rock production and 43 percent ore production. The data in Appendix D (Tables D-5A and D-5B) indicate that the monzonite porphyry rock units have a very low percentage of nonsulfate sulfur overall for a rock unit and will not behave as an acid material when mined. Two hundred and fifty-six samples within the monzonite porphyry found within the pit limits resulted in an NP:AP ratio less than 3:1 and NNP value less than 20; thus, these samples are categorized as having an ARD potential. However, for the over 1,700 samples analyzed for the monzonite unit, in all combinations of ore versus waste and in pit versus outside pit, the unit has a low AGP and a high NP (ratio significantly greater than 3:1) with very low nonsulfate sulfur content; therefore, this unit will not have an AGP.

Sample results for the phonolite porphyry are summarized in Appendix D (Tables D-6A and D-6B). Twelve samples within the phonolite porphyry found within the pit limits (or 3 percent of all phonolite ABA samples) resulted in an NP:AP ratio a less than 3:1 and less than 20 NNP values; thus, these samples are categorized as having an ARD potential. However, this unit, in all combinations of ore versus waste and in pit versus outside pit, has a low acid generation potential and a high NP (ratio significantly greater than 3:1). The NNP value is much greater than 20 with very low nonsulfate sulfur content; therefore, this unit will not have an AGP and may actually have a significant neutralizing capacity.

Table 3-3b. Summary of High Acid Rock Drainage Potential Samples

Unit	Material	In Pit	Outside Pit
Upper Deadwood	Ore	FX3865 (160'-170') FX3876 (80'-90') FX3877 (150'-160') FX3879 (90'-100' & 100'-110')	FX3877 (200'-210')
	Waste	FX3866 (100'-110' & 110'-120')	W21R-4780 (110'-120')
Intermediate Deadwood	Ore	FX3067 (180'-190') FX3088 (190'-200') FX3351 (240'-250') FX3859 (80'-90') FX3866 (90'-100',160'-170', & 200'-210') FX3867 (90'-100') FX3875 (100'-110') FX3876 (60'-70') FX3902 (100'-110')	None
	Waste	FX3067 (220'-230') FX3071 (190'-200') FX3074 (90'-100') FX3075 (180'-190') FX3078 (140'-150') FX3079 (210'-220') FX3085 (260'-270') FX3849 (140'-150') FX3875 (120'-130')	None
Lower Deadwood	Ore	None	None
	Waste	FX4417 (350'-360' & 360'-370') FX4425 (440'-450')	None
Monzonite	Ore	None	None
	Waste	FX3909 (400'-410') FX4409 (350'-360')	None
Phonolite	Ore	FX3834 (200'-210')	None
	Waste	None	None

Note: FX3868 (80'-90'), which is an in-pit, ore sample, without a rock-type designation, also qualifies as a high ARD potential.

3.1.4.1.5 **Trachyte, Fill, Colluvium, and Others.** The results from trachyte, fill, colluvium, and samples with undesignated units are included in Appendix D (Tables D-7, D-8, and D-9).

3.1.4.1.6 **Acid Rock Drainage Potential by Area**. As Tables 3-2a and 3-2b indicate, the NP:AP ratio, NNP, and low nonsulfate sulfur values for material being mined within each rock type show a low ARD potential and sufficient neutralizing material adjacent to the random samples. As a result, the ARD potential will be blended out during the normal mining sequence.

Overall, the Boston Expansion ABA samples indicate little ARD potential except for four unique areas marked as special handling material (SHM) SHM#1 to SHM#4 all located in the Flossie West expansion area. From the ABA tests, only 37 of the 10,217 samples qualified for a "high ARD potential" based on the industry standard (less than 1:1 NP:AP ratio with NNP less than –20). These 37 samples are summarized in Table 3-2 and indicated in Appendix D (Tables D-1 through D-9). The 37 high ARD potential samples correspond to 27 unique hole identification numbers that are dominantly clustered in the Flossie Pit area, an area mined out in 2020 and 2021. The material mined was managed under the current ARD management plan which includes quarterly reporting including testing summaries, maps, and blending calculations. The Flossie Pit was a continuation of the Portland Pit and is located on the farthest most western edge of the Portland Pit. This area consists of a high-grade structure that continues from the previous mined-out Maria Pit from the late 1990s and early 2000s. The Flossie West area has been split into 4 discreet zones based upon current ABA data, and test results indicate a potential for ARD. Humidity cell testing was conducted along the perimeter of the Flossie Pit area and the Boston Expansion area and are summarized in the following text.

3.1.4.2 WHOLE ROCK ANALYSIS RESULTS

Samples for whole rock analysis were collected at locations spaced approximately 450 feet apart. A total of 104 whole rock samples representing the affected rock units were analyzed. Whole rock sample locations are shown on Exhibit 12 in Appendix B.

Data for the whole rock analysis are listed in Tables D-10 through D-12 in Appendix D. The results for individual elements are somewhat variable, and the data indicate enrichment in semimetals that appear to be associated with gold values. The elements that are enriched with gold values for all rock types are predominantly arsenic. Elevated levels of semimetals and metals are common within the Tertiary gold deposits of the Northern Black Hills. This enrichment probably occurred because the Deadwood Formation basal quartzite unit was the first cool aquifer that the Tertiary hydrothermal fluids encountered. As a result, the elements precipitated out of solution and become deposited in that unit. As the fluids flowed up through the Deadwood Formation, the fluids cooled even further and precipitated more elements out of solution. The concentrations of the elements are very consistent with similar rock units found in the Northern Black Hills.

In reviewing whole rock analysis results (Appendix D), ore-grade values are all samples with gold grades greater than 0.010 ounce per ton. This ore-grade material will be processed at the existing Wharf processing facilities. All samples with gold grades of less than 0.010 ounce per ton generally indicate rock material that will not be processed and will be placed in one of the rock facilities as pit backfill.

3.1.4.3 METEORIC WATER MOBILITY TEST RESULTS

A total of 37 samples were taken throughout the Boston Expansion area, and the sample locations are shown on Exhibit 13 in Appendix B. The results from the MWMT analysis are listed in Table D-13 of Appendix D, and the MWMT procedure is also located in Appendix D.

The effluent is not filtered, so the results for each element are presented as total. This data is compared to drinking water standards, and results outside of the standard, if any, are determined. The results can be somewhat misleading because the MWMT effluent test results represent the total amount of each element in the water whereas the drinking water standards are for dissolved amounts.

No MWMT samples were completed on the Precambrian unit or the lower contact unit of the Deadwood Formation. As stated previously, the current pit design and mine plan excludes mining any Precambrian material.

Fifteen MWMT samples were run from the Tertiary igneous rock units (monzonite porphyry and phonolite porphyry). The results showed arsenic values that exceeded the drinking water standards (10 µg/L) in 12 of the 13 monzonite porphyry samples but in neither of the phonolite porphyry samples. Elevated fluoride was also found in three of the samples (two monzonite porphyry samples and one phonolite porphyry sample); the drinking water standard for fluoride is 4 mg/L.

Ten MWMT samples were run on the intermediate unit of the Deadwood Formation. Elevated levels of arsenic were found in six of the samples and one sample had elevated fluoride.

Twelve MWMT samples were run on the upper contact and glauconitic sandstone units, and all had elevated levels of arsenic with two sample having elevated fluoride. The arsenic was derived from the natural enrichment of arsenic in these two units associated with ore deposition processes.

As would be expected, the ore grade and waste samples contain enrichments from hydrothermal solutions related to the original ore deposition processes. The test results indicate that arsenic is elevated in the rock from the Boston Expansion project.

3.1.4.4 HUMIDITY CELL TEST RESULTS

Ten humidity cell tests were completed on the upper unit of the Deadwood Formation, the monzonite porphyry, and trachyte. Two tests began in 2011 and eight tests began in 2021. The data for the humidity cells are listed in Tables D-14 through D-23 in Appendix D. Humidity cell sample locations are shown on Exhibit 14 in Appendix B. The data presented are the analysis of the leachate of the humidity cells. Approximately 1,000 milliliters (mL) of water were used weekly for the leaching of the solids. The starting solids for each of these six cells are approximately 2 kilograms when dry. All samples were processed within the recommended holding times.

Seven of the ten humidity cell tests, all originating on the border between the Flossie West area and the Boston Expansion area, have shown a stable-to-dropping pH, a stable-to-dropping acidity generation (approaching and reaching 0), and decreasing sulfate over time. One of the humidity cell tests (W21R-4767), which falls outside of the proposed Boston Expansion area but within the property boundary, has shown a decreasing pH (from 7.94 to 5.94), an increasing acidity (from 0 mg/L to 4.7 mg/L), and a decreasing sulfate (from 56.2 mg/L to as low as 5.8 mg/L). The two samples that originate from within the Flossie Pit area ran for a 25-week duration with weekly measurements showing fairly stable pH (between 7 and 8), stable acidity (between 1.4 and 5.4 milligrams per liter [mg/L] as CaCO3), decreasing alkalinity, decreasing sulfate, and increasing iron content. Section 3.1.4.7 contains alternative mitigation effort associated with the identified materials that may generate acid drainage.

3.1.4.5 NITRATE TEST RESULTS

A total of 108 samples were analyzed for nitrate concentrations. The sample locations are shown on Exhibit 15 in Appendix B, and the results are provided in Table D-24 of Appendix D. Nitrate samples

were analyzed by Energy Laboratories and Inter-Mountain Labs (Pace Analytical Services, LLC) using procedures described by Page et al. [1982] (provided in Appendix D).

All nitrate samples analyzed had values less than 3 mg/L. The highest nitrate value of 2.8 mg/L was analyzed from a sample in the upper Deadwood Formation. The mean average value among all samples is less than 0.16 mg/L (nitrate in 102 of the samples was not detected, with a limit of detection of 0.1 mg/L).

3.1.4.6 CONCLUSIONS AND ADDITIONAL TESTING

The ABA sample results indicate that the vast majority of the rock units for the expansion area are nonreactive and will not generate acid. Most of the rock types present, comprising a large percentage of the unmineralized rock, have a large neutralization capacity.

The Flossie West area contains a cluster of samples with ARD potential, based on ABA testing; however, all of the humidity cell results from samples collected along the shared border between the Flossie West area and the Boston Expansion area indicate that no acid generation occurs along the perimeter. Given the cluster of ARD potential samples and the continuity of mineralization into this area, SHM zones have been established.

The select few samples that show a potential for ARD are outweighed by adjacent neutralizing potential material. In addition, the ARD Management Plan at Wharf Resources is a proactive procedure/system that delineates the mining bodies in advance of mining, and this process is successful.

The whole rock analysis results indicate that individual elements are variable in concentrations and the results are geochemically similar to related rock types found currently in the American Eagle Pit, Deep Portland Pit, Trojan Pit, Portland area, and Golden Reward. All of the rock units are elevated in arsenic in varied degrees but at a wide range of variability. These elements are elevated because of association with the gold in the original mineralized hydrothermal fluids.

The MWMT results for the rock units indicate elevated arsenic levels in samples from each rock type, which is normal for this area. Six samples hade elevated fluoride above the groundwater standard.

The upper contact and glauconitic sandstone units contain elevated levels of arsenic. The arsenic is derived from natural enrichment by the hydrothermal processes that were responsible for the deposition of gold. These rock units are identical to the rock units currently being mined and because the rock depository will be constructed in a similar fashion to the current backfill areas, no exceedances of drinking water standards are expected in the groundwater.

All of the rock units found in the Boston Expansion area are also found in the Foley, American Eagle, and Trojan Pits. These rock units are chemically similar and were placed in existing discard dumps. The Boston Expansion area discard facilities will be constructed in the same fashion and, since there are no elevated levels of contaminants, none are expected within the Boston Expansion area.

3.1.4.7 ACID-GENERATING POTENTIAL ROCK ANALYSIS AND MITIGATION PLAN

The mitigation plan detailed in this section provides for identifying potential ARD material before mining and handling and defines the blending protocol. Operational plans for mitigating exposed AGP rock in the final pit surfaces are also included. This mitigation plan is identical to current practices used across the Wharf Mine but may be lengthier than Wharf's 2002 Acid Rock Drainage Prevention Management Plan that is included in Appendix D.

Identifying any potential acid-generating material will use a combination of historical and future data, including geological interpretation of the rock types, drillhole information, geochemical testing, and computer modeling. This information will determine whether or not special handling and blending procedures are necessary to ensure that the material will contain a net neutralizing capacity. The plan will address identifying, handling, blending, and placing acid-forming rock throughout the life of the Boston Expansion. The plan includes set criteria to determine AGP material based on historical and future drillhole data; geochemical data; visual identification of material; and if needed, future geochemical data.

Wharf maintains a master drillhole database that contains exploration and developmental drillholes, monitor well holes, water well holes, and specific deep production blast holes. In addition, the drillhole database contains all muckface mapping and quality assurance (QA) information that is collected. The drilling was completed by one of the following techniques: percussion, reverse circulation, down-the-hole hammer, and diamond core. The database contains the following information for each drillhole: location, azimuth, dip and lithology (rock type) information, geochemical data, and mineral logging information.

The drilling within the current permit area and the Boston Expansion area has yielded a high density of drill coverage. Hole spacing has been designed to cover an area 100 feet along strike and 50–100 feet across strike of the orebody. This coverage provides the information needed to develop the reserve model. Annual drilling campaigns are completed to continually refine the reserve model for possible gains and for additional geological information.

The geochemical data include any geochemical testing that was completed on a drillhole (e.g., a single sample interval, multiple sample intervals, or a rock material sample). The type of testing conducted can include humidity cells, ABA, meteoric water mobility pathway, nitrates, and net acid generation (NAG) pH.

The drillholes logging data include geological and mineral information on the samples from each hole. Sample size is typically a 10-foot composite sample. The information includes items such as rock type, color, percentage of clay, sericite, quartz veining, silicification, iron oxide, manganese oxide, copper oxide, calcite, pyrite, and sulfide veins.

A two-phased approach is used to collect samples for the ABA testing. The first phase uses a grid system so that a sufficient number of samples are collected to represent each rock type per area of interest. The second phase of sampling is based on targeting areas and/or samples that show a potential for ARD based on the first phase of the ABA results.

The sulfur content helps to further classify samples that fall in the moderate/unclear potential for ARD. Samples can also be recategorized as having low or high ARD potential, depending on the sulfur content, NNP values, pH data, and other pertinent information (e.g., geological characteristics and geochemical information). For samples that cannot be recategorized, further testing may be needed either on the individual samples or a selected area. Samples that fall into the high potential ARD category are reviewed, using all information from testing and geological data, to verify the ARD potential.

The sample procedure for ABA geochemical testing was to select samples that sufficiently covered each rock type area in a grid-like fashion so that a representative number of samples per rock type collected. The ABA geochemical testing completed on selected samples resulted in a significant amount of information on each rock type and area as to the potential to create acid rock drainage. All rock types were focused on within the Boston Expansion area to ensure that all areas of mining would be covered and analyzed. Additional ABA testing will continue to fill in gaps within the expansion for each rock type and on samples that showed a potential for ARD. This testing helped in determining any areas that would require special handling during mining.

The combination of all of the geochemical testing indicated that the rock types to be mined in the Boston Expansion pits have little to no potential to produce acid rock drainage except within the Flossie West area. The majority of the Deadwood sediments of all three distinct groupings (Cdu, Cdi, and Cdlc) have a very high neutralizing capacity compared to the acid-generating potential.

In addition, the mapping, observations, geochemical testing, and the known geology from past mining in adjacent pits of Trojan, Deep Portland, and Foley Pits have realized no significant ARD zones. Although minor amounts of sulfides have been identified, they are principally small, isolated pods that are of blendable size. Moreover, the majority of the geochemical testing (such as ABA and humidity cells) have not had results that indicated a potential to generate ARD.

In the almost 40 years of mining, the adjacent Trojan, Foley, and Portland Pits at Wharf Resources have not had any ARD issues. The exposed highwalls subjected to the natural elements for more than 20 years have given no indication of acid generation and are basically identical to those found in the Boston Expansion pits. The high-grade zone of the Flossie area within the Portland Pit resulted in increased awareness and sampling. The material was blended following the existing ARD management plan where it is worth noting that the blended tonnage was significantly less than what was estimated before blasting and mining.

3.1.4.7.1 **Flossie West ARD Management Plan.** The management plan for potential acid-generating material will be based on sufficient volume of neutralizing material and ample material blending. The mine plan is based on mining areas of the eastern Portland Pit at the same time as Flossie West to facilitate availability of blend material, if needed. The ARD management plan provides for identifying potential acid-generating material before mining and defines the blending protocol. No material will be blasted or moved unless suitable base amendment is immediately available for blending or capping.

The identification of any potential acid-generating (PAG) material will be based on a combination of historical and future data, including geological interpretation of the rock types, drillhole information,

geochemical testing, and computer modeling. This information will determine whether or not special handling and blending procedures are necessary to ensure that the material will contain a net neutralizing capacity.

Through ABA testing in the Flossie West area, potential ore and waste special-handling areas have been outlined. These shapes have an estimated tonnage and average NNP value using the currently available data. Subsequent testing will refine the shape and estimated NNP values to ensure that adequate blend material is available. These potential special-handling areas are outlined on Exhibit 16 with the Portland Pit area where the blend material will be sourced. The specific estimated blend tonnages are summarized in Table 3-3. Cross-sections E, F, and G (Exhibits 17, 18, and 19A, and 19B respectively) show the potential special handling and base amendment areas with the current NNP values downhole.

Table 3-4. Blending Calculations for Potential Special Handling Zones

Potential Special Handling				Portland Ridgeline Base Amendment		
Zone	RockType	Tons	NNP	Rock Type	Tons	NNP
SH-01	Intrusive Waste	380,619	–3	Dw gray shale	2,302,671	221
SH-02	Intrusive Waste	1,375,115	–4			
SH-03	Intrusive Waste	260,601	–3			
Sh-04	Upper Dw Waste	397,604	–5			
Total Waste		**2,413,939**	**–4**	**Blend Tons Needed**	**131,074**	
SH-04	Upper Dw Ore	791,789	–5	Int. Dw	145,846	299
				Lower DW	205,725	242
Total Ore		**791,789**	**–5**	**Total**	**351,571**	**270.5**
				Blend Tons Needed	**65,437**	

Wharf will continue to infill on a 100-foot grid through exploration as well as completing a 50-foot × 50-foot × 20-foot grid on the production benches before blasting and mining. NAG pHs will be completed on the production holes in this smaller grid, and an NNP will be calculated in accordance with the existing 2002 Acid Rock Drainage Prevention Management Plan (Appendix D). All blending procedures will follow the established methods outlined in Sections 3.1.4.7.4 and 3.1.4.7.5.

3.1.4.7.2 General Blending of Mined Material.

The mine plan for the remainder of the planned mine life is based on simultaneously mining several phases and areas. This method will expose several different rock types that can be used in blending any AGP material that is identified to ensure that a sufficient amount of NNP material will always be available for blending purposes. The final blending ratio for ore is 4:1 per the 2002 Acid Rock Drainage Prevention Management Plan (Appendix D).

The ARD Management Plan will begin with a standard blending procedure for the material mined. The blending procedure will help to ensure a positive NNP through the normal mining procedures for blasting, mucking, crushing, and loading of the material.

Material blending begins with blasting the material. For the average shot, approximately 12 feet of movement occurs at the crest of a 20-foot bench shot with less at the toe; thus, blending is created. The next step in blending is mucking the material using front-end loaders and 150-ton haul trucks. Blending is enhanced by the angle of the muckface and the constant material slumping off the crest as well as mucking and loading the material by the loaders to the haul trucks. After the material is loaded, it is transported to the crusher. The material is dumped either directly into the crusher hopper or to the crusher stockpile. Material is again blended as it is dumped, and additional material is dumped on top as the material is worked to maintain a manageable stockpile. The stockpile will usually maintain a blend of Deadwood sediments and monzonite porphyry to maximize the crushing and leaching efficiency. Ore material is again blended when mucked from the stockpile to the crusher hopper and again in the crushing process. The crushed ore also has lime added to maintain an alkaline pH for processing. After the rock goes through the crushing procedure, it is dumped from a conveyor belt into piles of approximately 10,000 tons in the form of cones, and the material is again blended as the cones are formed. From the crushed piles, the crushed ore is blended as it is loaded into the haul trucks for dumping on the leach pads. Once on the leach pad, the material is blended for the final time as it is dozed to create 20-foot lifts to be dripped and leached.

3.1.4.7.3 **Pad Off-Load Management Plan.** It is highly unlikely and not expected that any material will have the ability to generate acid when the material unloading process begins. Constant monitoring of the ore material, from the pit to the crusher to the pad load, and through the leaching process, will ensure that all the material is sufficiently blended and has neutralizing capacity.

Unloading the pads will begin another step in blending the material through normal mining practices. This process begins with mucking and loading the spent ore from the pads. The mucking procedure begins by cutting material out of the pad from the bottom lift to establish a loading area. The established muckface will range in height from one to several lifts exposed, and each lift is 20 feet high. A dozer is used to push material from the top lift over the muckface to the loading area, where the loader will begin loading the trucks. This standard practice creates blending by constantly moving and loading the material. After the material is loaded, it is transported to the designated spent-ore depository. The depositories are designed to have the material dumped over a dump face, which creates an advancing face. This process finishes the blending and reworking of the spent-ore material.

3.1.4.7.4 **Ore Management Plan.** Ore material that is identified as having the potential to generate ARD will be segregated at the time of mucking. Material blending will ensure that the net neutralizing capacity is adequate to suppress any acid generation. The material selected for blending will be based on geological knowledge of the rock types and can include the ABA modeling, rock types, NP, AP, ratio, and NAG pH testing. The final blending ratio for ore is 4:1 per the 2002 Acid Rock Drainage Prevention Management Plan (Appendix D).

3.1.4.7.5 **Non-Ore Management Plan.** The management plan for non-ore material that shows a potential to generate acid will go through the standard blending that results from normal mining procedures, except the material will go to a backfill or depository area. Additional blending will occur as the material is deposited over the dump embankment. The material is then dozed to maintain an advancing dump face where additional blending will occur. Identified PAG material will undergo additional blending at the backfill/depository area or at the active mining area with material of an NNP

value to ensure an NNP blend and 3:1 NP:AP ratio for all of the material. The material used for blending will be stockpiled either at the depository or at the active mining area. This material will be identified with sufficient NNP to maintain proper blending with PAG material. The PAG material will be thoroughly blended at the site with the use of a dozer to spread the material and work in additional NNP material. There are hundreds of millions of tons of NNP material onsite at Wharf rock dumps available for blending.

3.1.4.7.6 **Highwall and Pit Floor Management Plan.** Highwalls and pit floors that have identified PAG material exposed will be covered with material that has a net neutralizing capacity to ensure no acid is generated. The neutralizing material will either come directly from the active mine area where identified NNP material is available or from a net neutralizing potential material stockpile. Pit floors and highwalls with PAG will be covered with neutralizing material immediately prior to backfilling. The information combined with computer modeling will ensure that the mitigation plan for any identified PAG material is properly implemented.

3.2 SOILS

3.2.1 INTRODUCTION

The Boston Expansion project was evaluated by BKS Environmental Associates, Inc. (BKS) of Gillette, Wyoming, in August and October 2010 as part of the Wharf 2010 Expansion project [BKS, 2010a]. Approximately 600 acres were included in the final soil mapping of which 50 mapped acres comprise the Boston Expansion soils study area. A detailed report on the soils study (Appendix E) characterizes the project area soils in terms of topsoil salvage depths and related physical and chemical properties (SDCL 45-6B-7(2) and 45-6B-92(6)).

Baseline soils inventories for the 2010 area consisted of refining the current Natural Resources Conservation Service (NRCS) mapping for Lawrence County, South Dakota. The 2010 soil mapping included descriptions of 32 soil profiles and 2 road cuts [BKS, 2010a]. Of the soil profiles mapped in 2010, three soil profiles are within the Boston Expansion project. Four road cuts are currently visible on the 2020 aerial photography; only two road cuts were visible in 2010. The 2010 soils mapping is applicable to the Boston Expansion project because no change has occurred in the land use; however, logging- and exploration-related disturbances have occurred.

General topography surrounding the Wharf Boston Expansion project ranges from valleys to very steep hills and mountainous slopes, and the proposed project is primarily located along the Portland Ridgeline. The soils occurring in the Wharf 2010 Expansion area were generally loamy with deep and rocky soils. Soils within the Boston Expansion project are also loamy with several coarse fragments that would be considered skeletal loamy [BKS, 2021a].

Soils within the proposed Boston Expansion project are not remarkably different from soils within other areas permitted for the Wharf Mine. The three soil map units that are present in the Boston Expansion project include Goldmine loam, Hisega loam, and Grizzly very gravelly silt loam. These soil mapping units comprise approximately 50 acres (100 percent) of the Boston Expansion project [BKS, 2010a]. The soils map is provided in Appendix E.

Soils in the Boston Expansion area are typical for soils formed under a mixed coniferous and deciduous forest occurring on the mountainous hillslopes of the Black Hills. Parent material included colluvium, residuum, and alluvium. Soil map units for the Boston Expansion project are similar to those identified during the 2010 evaluation. Soils were classified taxonomically as Typic Palecryolls, Haplic Glossudalfs, and Pachic Hapludolls.

All soils have at least some suitable topsoil and/or subsoil except for rock outcrops and rubbleland. The primary limiting factor within the Boston Expansion project is coarse fragments. Rocks inhibited soil augering on every hole except for one in 2010 and is still the case for the Boston Expansion project. The soils within the Boston Expansion project are typical of the surrounding region and sufficient for reclamation. An estimated 28,383 cubic yards (yd^3) of salvageable topsoil (an average of 4.38-inches over 48.2 acres of proposed new disturbance) will be available to be recovered from the project area.

3.2.2 DISCUSSION

Soils in the Boston Expansion project consists of Goldmine loam (55 percent of the total area and 25 percent of the total topsoil volume), Hisega loam (36 percent of the total area and 75 percent of the total topsoil volume), and Grizzly very gravelly silt loam (9 percent of the total area and 0 percent of the total topsoil volume) map units [BKS, 2021a].

The Goldmine loam map unit consists of very deep, well-drained soils that formed in colluvium and residuum derived from igneous rocks. Slopes range from 3 to 75 percent. The Goldmine soil occurs on mountain hillslopes at elevations between 5,100 and 7,000 feet. Permeability within the Goldmine soil is moderate, available water capacity is moderate, and surface runoff is high. The effective rooting depth is greater than 60 inches, and the hazard of water or wind erosion is slight. The Goldmine loam map unit is a fair source of topsoil to 5 inches based on average 2010 sample locations [BKS, 2021b].

The Hisega loam map unit consists of deep and very deep, well-drained soils formed in residuum from micaceous metamorphic rocks. Slopes for the Hisega map unit range from 15 to 65 percent and occur on mountains at elevations between 3,600 and 6,300 feet. Permeability within the Hisega soil is moderate, available water capacity is low, and surface runoff is medium to very high. The effective rooting depth is greater than 60 inches, and the hazard of water or wind erosion is slight. The Hisega loam map unit is a fair source of topsoil to 8 inches based on an average 2010 sample locations [BKS, 2021b].

The Grizzly very gravelly silt loam consists of very deep, well-drained soils formed in residuum from igneous rocks. Slopes for this map unit range from 6 to 80 percent, and the Grizzly soil occurs on mountains at elevations between 4,400 and 6,400 feet. Permeability within the Grizzly soil is moderately low to moderately high, available water capacity is moderate, and surface runoff is medium to very rapid. The effective rooting depth is greater than 60 inches, and the hazard of water or wind erosion is negligible. The Grizzly very gravelly silt loam map unit is a fair source of topsoil to 2 inches based on average sample locations within the 2010 expansion area; but, based on sample locations falling within the smaller Boston Expansion area, the Grizzly series has a topsoil salvage depth of 0 inches [BKS, 2021b].

The proposed topsoil salvage depths are based on field observations of soil profiles (SDCL 45-6B-10(6)). Approximate salvage depths of each map unit series ranged from 0 to 9 inches. Based on field observations, the recommended topsoil average salvage depth for the study area is 4.38 inches. Approximate salvage depths of each soil map unit identified within the Boston Expansion area ranged from 0 to 9 inches. Within the 2010 Wharf Expansion area, suitability of soil as a plant growth medium was generally affected by the physical factor of coarse fragments.

During exploration activities, all of the topsoil, where possible, was piled near the end of access trails or adjacent to trails and drill pads. Wharf has added inorganic dirt and rocks to several existing topsoil stockpiles and has not seeded these temporary piles. Topsoil is not actively moved from the exploration areas to a separate soil stockpile during exploration. As a result, the topsoil volume calculations provided in Section 5.3.3 will not be notably impacted. Trails and drill pads outside of the proposed mining activity will be reclaimed with adjacent material in berms and piles near the disturbance.

Wharf acknowledges that soil windrows produced during the creation of temporary exploration access roads could have the potential for minor localized erosion under significant storm events and tries to balance limiting additional disturbance during exploration by utilizing these windrows rather than constructing access to and hauling to larger stockpile areas elsewhere. During salvage of soil across the Boston Expansion area, any topsoil windrows from recent exploration will be incorporated into the entire Boston topsoil grubbing effort and placed in stockpiles as per normal operating practices. During this process, large boulders, trees, and rootballs will be segregated as much as possible and removed. Final segregation of any remaining large, non-soil components occurs during the dozer application of the topsoil veneer to reclaimed slopes, where the approximate 6-inch depth application forces any larger components out to the side.

Chemical-limiting factors such as electrical conductivity and sodium adsorption ratio were not considered to be an issue because no salts were noted within the profiles. The pH levels were assumed to be strongly acidic to moderately alkaline. Calcium carbonate was only noted in two profiles within the Winetti soil series in 2010; this map unit is not within the Boston Expansion area. Similar physical and chemical factors exist in the Boston Expansion area for those soil map units and soil series appliable to this specific area [BKS, 2021b].

Topsoil and suitable subsoil will be salvaged wherever possible. This material will be stockpiled, stabilized through erosion-control measures, revegetated, surveyed, and labeled in the field for future use in the final reclamation phases of the project.

All soils within the Boston Expansion project have at least some suitable topsoil and/or subsoil except for rock outcrops and rubbleland. The primary limiting factor within the Boston Expansion project is coarse fragments because rocks inhibited soil augering on every hole except for one in 2010. Topsoil will be unsalvageable in certain areas because of circumstances such as rocky conditions, the safety concerns for the operator or equipment from excessively steep slopes, “near-surface” underground workings, or open cuts. Every attempt will be made to salvage topsoil wherever possible.

3.3 GROUNDWATER

The groundwater environment was characterized for the proposed Boston Expansion area based on available hydrogeologic and water quality data and is provided in Appendix F. Identifying baseline groundwater conditions is critical to understanding the groundwater system, including any potential impacts to the actual mining operation and any associated impacts to subsurface water quality and quantity.

Numerous historical studies were conducted for the area, including a study for the Clinton Expansion by J. M. Montgomery Engineers, Inc. [1996] and review of more recent data by RESPEC. The J. M. Montgomery Engineers, Inc. report included a complete hydrogeological investigation in a 4-square-mile area around the Clinton project, including areas now considered as part of this expansion. The aquifers in the Wharf area are similar to those throughout the central Black Hills and principally include the Deadwood Formation and the Precambrian Aquifer.

Groundwater well data were reviewed by combining Wharf's location information with SD DANR well-completion report information. Numerous wells are located within the Wharf Mine and surrounding area. The majority of these wells are monitoring wells (MW) or other wells owned and operated by Wharf. No water supply wells are located within the Boston Expansion area, and recent drilling within the Boston Expansion area indicates that water is not present at the depths projected for surface mining [Sarratt, 2021]. Groundwater uses in the area are related to mining, housing development, and snow making. A map of all Wharf monitoring and private wells in the area is shown on Exhibit 20 in Appendix B and Appendix F.

Impacts to groundwater hydrology, water quality, and local water supply wells would be minimal as a result of mining in the Boston Expansion area (Appendix F). Potential impacts are anticipated to be similar to those experienced in previously mined areas of the Wharf and Golden Reward Mines.

No spent ore is planned to be disposed of in the Boston Expansion area. Only minor, if any, impacts on groundwater chemistry are predicted in association with extracting material and waste rock disposal. The presence of mine pits exposes additional rock surfaces to infiltrating water. Similar to the rest of the Wharf and Golden Reward Mine areas, the ore being mined in the Boston Expansion area has low concentrations of sulfide minerals and will not likely impact water quality.

Impacts on groundwater quality resulting from waste rock disposal may be similar to the groundwater impacts in nearby areas that have previously been mined and backfilled with waste rock. Examples of these impacts include increased nitrate concentrations in shallow wells within the Wharf permit boundary. Given these experiences, an increase in nitrate may occur below the Boston Expansion area. Based on historic observations and modeling of groundwater impacts from backfill at the Wharf Mine, RESPEC infers that the increase in nitrate from blasting and waste rock disposal is not expected to exceed the groundwater standard of 10 parts per million (ppm) outside the proposed Boston Expansion area [Hocking and Meuzelaar, 2021].

Mining of the proposed Boston Expansion area will occur above the water table near the top of a regional hydrographic divide. No water supply wells are located within the Boston Expansion area, and the majority of active wells in the nearby region are owned by Wharf or the Black Hills Chairlift Company.

General water uses are related to housing development, mining, and snow making. The expansion project is not anticipated to adversely affect water supply or water quality for Terry Peak snow making or local drinking water wells. Because no additional groundwater usage is required for the Boston Expansion project beyond what is currently used as part of Wharf's ongoing mining operations, no impacts to groundwater quantity are anticipated. No pollution control facilities are planned for the Boston Expansion.

3.3.1 GROUNDWATER OCCURRENCE

Groundwater depth in the Boston Expansion area was evaluated by drilling and through records of historical underground and surface workings in the Wharf area. All evaluations of historical records and the results of recent drilling programs along the Portland Ridgeline indicate that this region is devoid of any significant water at the depths projected for surface mining. The groundwater elevation, based on the potentiometric map, could range from 5,800 to 6,250 feet and the mine plan indicates the deepest pit floor will be at an elevation of 6,260 feet. This results in a potential of only 10 feet of difference between the groundwater elevation and the pit bottom and a conclusion that groundwater is not anticipated to be encountered within the proposed Boston Expansion pit. Again, the regional potentiometric map is approximate and may vary, but no exploration borings in the area have encountered the groundwater table.

Mining of the proposed Boston Expansion area will occur above the water table near the top of a regional hydrographic divide. No water supply wells are located within the Boston Expansion area, and the majority of active wells in the nearby region are owned by Wharf or the Black Hills Chairlift Company. Three private groundwater wells are within 1 mile of the Boston Expansion area. These wells are primarily shallow domestic water supply wells located hydraulically upgradient or side gradient to the Boston Expansion area and are therefore not expected to be hydraulically impacted by the Boston Expansion area. A map of private wells was created based on well-completion reports available from the SD DANR's online database. A map of all of the private wells (and Wharf monitoring wells) is provided in Exhibit 20 of Appendix F. The well locations outside the permit area must be considered approximate because the state well-completion reports list wells only to the nearest section or quarter section. Wells within close proximity of the Boston Expansion area were field-checked to verify their presence/location.

Historical records show that underground workings in the Wharf area are dry [J. M. Montgomery Consulting Engineers, Inc., 1996]. None of the exploration borings in the Boston Expansion encountered quantifiable groundwater. Following the requirements of Wharf's Exploration Notice of Intent (EXNI) permits, "Wharf Resources shall notify the department, in writing, when exploration drilling penetrates an aquifer." Wharf has not completed any such report for exploration holes. Drillers who have conducted operations on Wharf property in and around the expansion area have stated that no drillhole was producing water or encountered notable water. The maximum drill depth was approximately 800 feet with holes being slightly deviated, which results in a true depth of approximately 775 feet [Sarratt, 2021]. Recent exploration drilling information from the Boston Expansion, which indicates that current groundwater levels are below the anticipated pit bottom at 6,260 feet.

Depth to water has been periodically collected from more than 40 monitoring wells surrounding the Wharf Mine. Water levels are measured immediately before water quality sampling and measured quarterly or monthly (depending on sampling schedule) using a water-level meter.

The water table or potentiometric surface was updated as part of recent groundwater modeling [Hocking and Minnick, 2019]. Because seasonal fluctuations and abnormal data points can skew a potentiometric surface based on a single point in time, an average water table or potentiometric surface was used to provide a more accurate surface for model calibration. The average (calculated mean) water table elevation map, shown in Figure 3-1 and Appendix F, was created using monitoring well data from 2000 through August 2017 and excluded obvious erroneous data points. Based on this potentiometric map, groundwater level in the Boston Expansion may range from 5,800- to 6,250-foot elevation. The potentiometric map is based on monitoring well data.

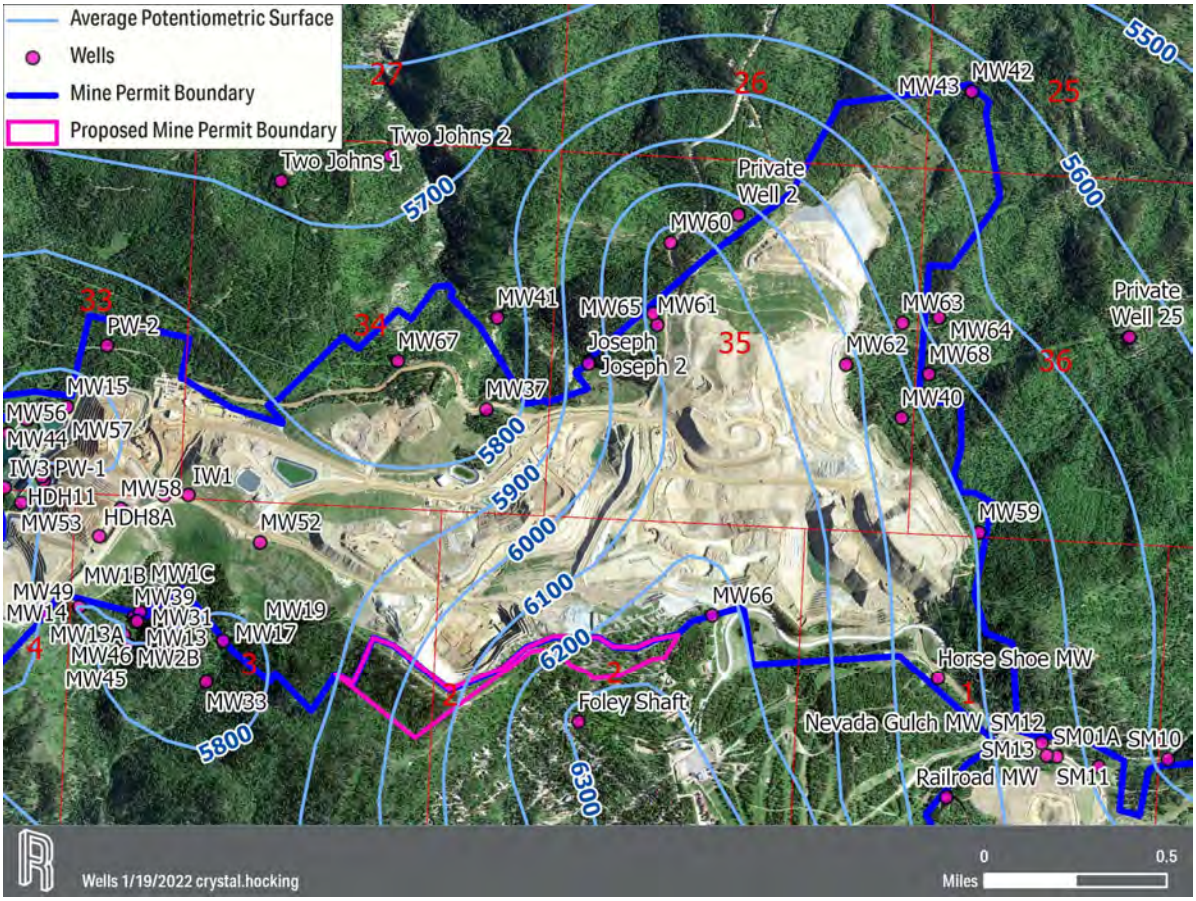

Figure 3-1. Average Potentiometric Surface (Feet Above Mean Sea Level).

Two major flow regimes exist within the model domain: shallow and deep groundwater flow. The shallow flow is predominantly influenced by recharge in the unsaturated zone, and the pressure gradient that occurs perpendicular to the water-table elevation contours. Solute transport is influenced by shallow groundwater flow as recharge moves through high-permeability pit fill. The pit fill is isotropic, so the flow direction depends on pressure gradients. A deeper flow regime in the fractured Precambrian bedrock is predominantly influenced by the north-south-trending, anisotropic, fracture-controlled flow. When the solutes reach the Precambrian bedrock, fracture-controlled, anisotropic hydraulic

conductivity dominates the flow-direction factor and results in a general northern flow that is influenced primarily by the anisotropic flow and secondarily by the pressure gradient.

3.3.2 PROPOSED GROUNDWATER MONITORING PROGRAM

Well locations in the existing Wharf groundwater monitoring plan are included in Appendix F. Wells used as baseline for this expansion project are depicted in Figure 3-2 and Appendix F. Available well completion reports for Wells MW-19, MW-33, and MW-66 are also provided in Appendix F.

Figure 3-2. Baseline Groundwater Sampling Sites for the Boston Expansion Area.

Groundwater monitoring for the proposed Boston Expansion area will continue at those sites used for baseline sampling (MW-19, MW-33, and MW-66). Sampling these monitoring sites is proposed to continue on a similar schedule as other monitoring sites at Wharf. Wharf is currently proposing to continue its current monitoring program throughout operations at the Boston Expansion area unless otherwise directed by the SD DANR.

MW-19 was chosen as a baseline well for the Boston Expansion because of its close proximity to the project area in the Annie Creek drainage. MW-17 and MW-18 are located within 10 feet of each other and approximately 630 feet west-southwest of MW-19. If groundwater impacts were to be measured because of the Boston Expansion, MW-19 would likely display those impacts sooner. MW-17 and MW-18 were also not chosen because they have shallow completions with total depths of 125 feet and 73 feet, respectively. All three wells were installed in the late 1980s and have water quality data dating

back to December 1988. Wharf continues monitoring all three of these wells, and the results of the chemical analyses and statistics for baseline groundwater monitoring sites are included in Appendix F.

The Foley Shaft was originally proposed to be included as a baseline well for the Boston Expansion in Wharf's December 2000 environmental sampling plan for the Boston Expansion because of its location upgradient of the expansion. The Foley Shaft is not part of Wharf's regular groundwater monitoring program and is not technically a well but rather an open shaft that contains water. At the request of Wharf, LifeCycleGeo, LLC. Prepared a technical memorandum that summarized the evaluation of historical water quality within the Foley Shaft with the goal to assess if the water within Foley Shaft can be used as a future compliance point at the Wharf Mine. The primary analysis tool consisted of Piper plots of more than 1,670 water quality samples from around the Wharf site. The results suggest that the Foley Shaft water is not influenced by current mine activity, nor is it hydraulically connected to the groundwater system but rather is influenced from surface water. A copy of LifeCycleGeo's memorandum is included in Appendix F. After reviewing LifeCycleGeo's memorandum, the SD DANR agreed that the site could be removed from the baseline monitoring plan [Hudson, 2021].

The current operational groundwater monitoring schedule and parameter lists are provided in Appendix F. Wharf will review the groundwater monitoring program with the SD DANR upon request and determine any changes to the sampling program that may be necessary (ARSD 74:29:02:11(7)).

3.3.3 GROUNDWATER QUALITY

Water quality and water level monitoring programs have been in place at the Wharf Mine since 1985 and at that Golden Reward Mine since 1987. At the Wharf Mine, 55 groundwater monitoring wells are being sampled for water quality and water level, and two additional wells are monitored for water level only. At the Golden Reward Mine, 21 wells are part of the ongoing monitoring effort.

Three wells (MW-19, MW-33, and MW-66) are considered baseline wells that may be representative of groundwater for the Boston Expansion area. Because these wells are part of Wharf's ongoing sampling program, MW-19 and MW-33 were monitored on their scheduled frequency or four times per year (ARSD 74:29:02:07). MW-66 has been monitored periodically since its completion, and the full suite of parameters has been sampled monthly since May 2021. Parameters analyzed for the baseline sampling program are the same parameters as those required for the existing Wharf water quality program and those required by SDCL 45-6B-7(9). Additional information regarding the baseline and existing groundwater monitoring programs are included in the baseline groundwater report (Appendix F).

The groundwater quality results at the three baseline sampling sites are similar to those from other sampling sites and are representative of mineralized groundwater in the region. Field pH values range from 7.06 to 8.22, and the median value among baseline wells is 7.86. MW-66 has the highest pH values that range from 7.76 to 8.27. Conductivity and total dissolved solids (TDS) values are highest at MW-19 and lowest at MW-66; MW-33 lies between MW-19 and MW-66. For many parameters, including conductivity, TDS, dissolved arsenic, dissolved gold, sodium, bicarbonate, nitrate, and sulfate, MW-19 appears to fluctuate more notably than MW-33 and MW-66.

Most dissolved metals concentrations are generally at or below the detection limit. Nitrate values show minor fluctuations in MW-19 and relatively steady concentrations in MW-33 and MW-66; however, in

the past 5 years of data reviewed for the baseline groundwater study, nitrate concentrations above 10 mg/L have been observed in MW-19. (Note, nitrates were also above 10 mg/L in MW-19 several times from 2002 through 2005 and 2011 through 2013.) All nitrate detections in MW-33 and MW-66 over the last 5 years are less than 1 mg/L. Arsenic values have been above the detection limit in all three baseline wells, which is a common occurrence in gold-hosted mineralized rock in the region. MW-66 has the highest arsenic levels (including total arsenic concentrations greater than advisory levels), MW-33 has one detection of dissolved arsenic, and MW-19 has concentrations that vary from 0.009 to 0.019 mg/L. MW-66 was the only baseline well sampled for total arsenic over the last 5 years. Sodium values have had minor fluctuations. The increases and decreases at MW-33 and MW-19 mirror each other. Field and laboratory pH values have minor fluctuations for most of the wells.

Impacts on groundwater quality that result from waste rock disposal may be similar to the groundwater impacts in nearby areas that have previously been mined and backfilled with waste rock. Examples of these historical impacts include increased nitrate concentrations in shallow wells within the Wharf permit boundary. The next groundwater fate and transport model that is submitted to SD DANR in support of a new or amended GWD permit will include proposed waste rock disposal in the Boston Expansion.

3.3.4 SPRINGS

No springs or seeps are located within the proposed Boston Expansion area. Several springs are located around the Wharf Mine area and are provided in Appendix F. Because these springs are fed by groundwater sources, they are discussed in this groundwater section. A few springs may be the result of perched water zones while others may be the expression of the regional water table.

As part of the Boston Expansion and at the request of the SD DANR, Wharf conducted a field inventory for springs in May 2021. The inventory involved walking up the Lost Camp drainage from its confluence with Annie Creek to search for a water source. A small spring (Lost Camp Headwaters) was identified. The Lost Camp Headwaters spring was sampled while flowing in May 2021, but the site was dry between June and September 2021. The field inventory also identified a stormwater outfall from the subdivision, which was contributing flow to the drainage. Wharf acknowledges that another source of flow to Lost Camp Creek may exist but has yet to be identified, including but not limited to additional springs or gaining stream conditions. Wharf contracted a hydrologist, and a spring survey was conducted on Lost Camp Creek during May 24 and 25, 2022, to identify additional sources of flow within the drainage. No springs or seeps are located within the proposed Boston Expansion area. At the time of the survey, local streams and creeks had higher flow than Wharf observed in 2021, which was likely a result of spring melt and runoff from recent precipitation events. Twenty-two potential spring or seep locations were identified along Lost Camp Creek during the survey. Sites consisted of a single seep or spring, although a few locations consisted of two or more visibly separate springs or seeps. Flow and physical measurements were taken along with representative photographs of springs and seeps.

The headwater springs identified by Wharf in 2021 and observed during this survey were the only springs where traditional streamflow measurements could be collected outside the main creek channel. All other springs and seeps observed were either too shallow, too narrow, or too disparate to collect flow measurements with a top-setting wading rod; therefore, flow measurements were collected

directly within the Lost Camp Creek channel where the cross section had a depth greater than 0.2 foot. Based on the hydrologist's understanding of the local surface-water hydrology, most of these springs and seeps are likely to be intermittent; springs are more likely to be dry during late summer and fall and more significant following precipitation events. More detailed information about the 2022 spring survey can be found in the Appendix F, sub-Appendix J.

Seven spring localities are currently sampled as part of Wharf's ongoing water quality monitoring program: False Bottom Spring, Ross Spring, Beaver Springs, War Eagle, Annie Creek II, Ross Valley French Drain, and Lost Camp Headwaters (see Figure 3-3). Measured flows at these seven springs range from 1 to 2,010 gallons per minute (gpm) with higher flows occurring in the spring and early summer and low to no flows occurring in the later summer and fall. False Bottom Spring is located at the headwaters of False Bottom Creek, War Eagle is located on Cleopatra Creek, Lost Camp Headwaters is at the upper reach of Lost Camp Gulch, and the other four monitored springs are located on tributaries of Annie Creek.

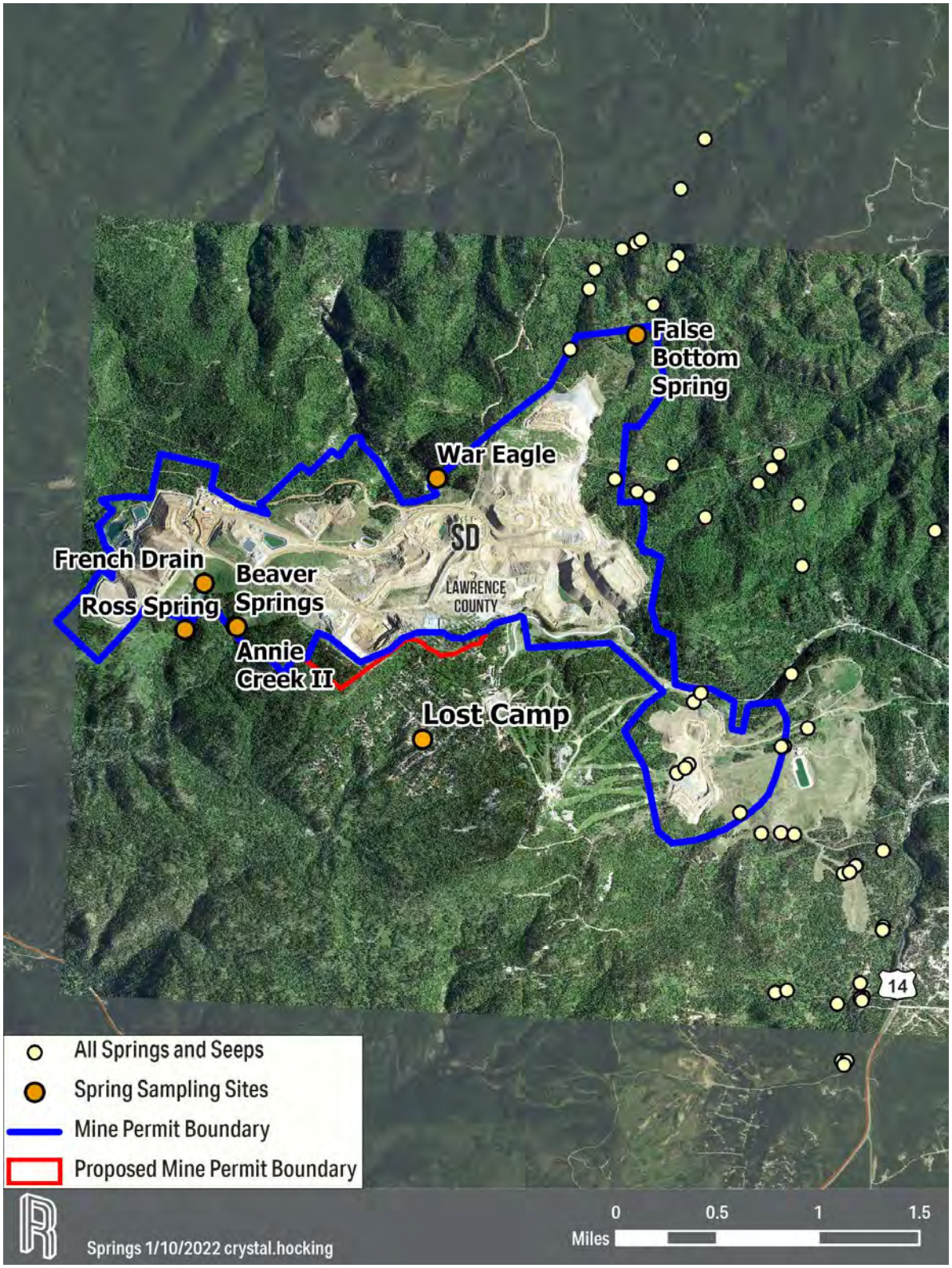

Figure 3-3. Springs and Spring Sampling Sites Map.

The majority of the area springs and seeps identified in previous investigations are typically dry with intermittent periods of low flows. Based on historical surveys presented in the Golden Reward Mining Permit application [Hydrometrics, Inc., 1988] and Wharf's Clinton application [Wharf Resources (USA) Inc., 1997], other minor, unnamed springs in the area are located in drainages of False Bottom Creek, Deadwood Creek, Nevada Gulch, Fantail Creek, and Stewart Gulch. A map of springs is presented in Figure 3-3. The majority of these springs produce only a few gallons of water per minute during the wet springtime of the year.

3.3.5 GROUNDWATER QUALITY IMPACTS OF WASTE ROCK AND SPENT ORE DISPOSAL

Waste rock that is mined to remove overburden will be used to fill previously mined areas to create slopes that are functionally and visually compatible with the surrounding area. Spent ore offloaded from heap-leach pads will continue to be placed within a perimeter of pollution (POP) zone; spent ore generated from the Boston Expansion will tentatively be placed within the existing American Eagle POP. All material paced to the respective areas and POP zones will meet the required off-load criteria before off-loading. Wharf will continue treating spent ore before offload, including reducing nitrate levels in pore water through bacteriological denitrification, thus reducing the amount of nitrate off-loaded to the facilities and any potential impact on groundwater quality.

Meteoric water has the potential to infiltrate through backfilled waste rock in the Boston Expansion and into the bottom of the pit and seep out into surrounding aquifers. Potential impacts to groundwater quality are minimal as discussed in the Boston Expansion groundwater characterization study (Appendix F).

3.4 SURFACE WATER

The surface-water condition in the vicinity of the proposed Boston Expansion project is discussed in this section. The information in this section is from a more detailed surface-water report by Krajewski and McCutcheon [2022a] and is provided in Appendix G. A site drainage map is provided on Exhibit 21 in Appendix B.

Three small tributaries (Annie Creek, Lost Camp Gulch, and Nevada Gulch Creek) are adjacent to the Boston Expansion. The Boston Expansion occurs in the Middle Spearfish Creek and Upper Whitewood Creek subwatersheds that are situated within the Spearfish Creek and the Middle Belle Fourche River Watersheds, respectively. Annie Creek and Lost Camp Gulch drain into Spearfish Creek, which drains into Redwater Creek before entering the Belle Fourche River approximately 23 miles north of the Boston Expansion. Nevada Gulch Creek drains into Whitetail Creek, which drains into Whitewood Creek, before entering the Belle Fourche River approximately 30 miles northeast of the Boston Expansion.

As part of the Boston Expansion project and at the request of the SD DANR, Wharf conducted a field inventory for springs in May 2021. The inventory involved walking up the Lost Camp drainage from its confluence with Annie Creek to search for a source of water. A small spring, Lost Camp Headwaters, was identified. The Lost Camp Headwaters spring was sampled while flowing in May 2021, but the site was dry in June and July 2021. The field inventory also identified a stormwater outfall from the subdivision, which was contributing flow to the drainage. And in 2022, Wharf contracted a hydrologist to

complete a spring survey in the Lost Camp drainage, which is summarized in Section 3.3.4 and included in Appendix F, sub-Appendix J and Appendix G, sub-Appendix H.

The proposed affected acreage (i.e., surface disturbance) would occur within the drainages of Annie Creek (approximately 27.3 acres), Lost Camp Gulch (approximately 18.1 acres), and a small area within Nevada Gulch Creek (approximately 2 acres). Surface disturbances within the Boston Expansion will not directly overlie any streams or drainages and are not expected to impact surface-water flow or water quality in the Annie Creek, Lost Camp, and Nevada Gulch Creek drainages because the pit area would capture the precipitation within the Boston Expansion area. Also, no springs, seeps, or surface-water impoundments are located within the proposed Boston Expansion. Proposed disturbance is not expected to impact the overall surface-water flow or quality in these drainages. Precipitation will be captured by the pit and available for recharge.

The Boston Expansion project does not entail the dredging or filling of material in wetlands or other surface water bodies. A permit from the U.S. Army Corp of Engineers is not required for this project.

3.4.1 PROPOSED SURFACE WATER MONITORING PROGRAM

Surface-water quality and flow monitoring programs have been in place near the Wharf Mine since the early 1980s. It is proposed to continue existing surface water monitoring programs. Currently, 18 surface-water monitoring sites are being sampled at Wharf. The existing Wharf surface-water monitoring programs were evaluated to determine which sites were applicable to the proposed Boston Expansion project. Seven existing surface-water monitoring sites were chosen as baseline sites based on proximity to the Boston Expansion area and SD DANR recommendations.

Annie Creek is a perennial stream that flows southwest into Spearfish Creek. Annie Creek has four baseline sampling sites: (1) Annie Creek II, which is located approximately 0.4 mile east of the Boston Expansion area; (2) Annie Creek at U.S. Geological Survey (USGS) located approximately 1.9 miles southwest of the Boston Expansion area and near the USGS 06430800 gage station; (3) CP001; and (4) CP005 located along middle Annie Creek. Lost Camp Gulch is a perennial stream that flows northwest to its confluence with Annie Creek. Lost Camp Gulch has one surface-water monitoring site (Lost Camp) located approximately 0.75 mile southwest of the Boston Expansion area. Nevada Gulch Creek flows east of the Boston Expansion area to its confluence with Whitetail Creek. Nevada Gulch Creek is a perennial stream with two surface-water monitoring sites SS-20 and SS-04 located approximately 0.9 and 1.2 miles east of the Boston Expansion area, respectively. Surface-water monitoring sites are typically sampled four times per year but depends on whether or not the stream has flow or is frozen. The National Pollutant Discharge Elimination System (NPDES) compliance points are sampled 26 times per year.

The locations of baseline surface-water monitoring sites as well as the current operational groundwater and surface-water monitoring schedule and parameter lists are provided in Appendix G. Wharf will review the surface-water monitoring program with the SD DANR upon request and determine any changes to the sites or sample parameters that may be necessary (ARSD 74:29:02:11(7)).

Surface disturbances within the Boston Expansion will not directly overlie any streams and are not expected to impact surface-water flow or water quality in drainages because precipitation within the

area would be captured by the existing and proposed expanded pit. Further, because the Boston Expansion is relatively small and Wharf has an existing surface-water quality sampling program, only a small number of sites were selected as baseline for this project. While Wharf recognizes that other existing surface-water quality sites are available, the sites chosen adequately characterize current surface-water quality and meet the requirements of ARSD 74:29:02:07. Wharf will continue monitoring surface-water sites, and data are available for SD DANR's review.

3.4.2 SURFACE WATER QUALITY

Baseline data for evaluating surface-water quality in potentially disturbed drainages were obtained at eight existing surface-water monitoring sites and were chosen based on their proximity to the Boston Expansion area and the SD DANR recommendations. In addition to these seven Wharf monitoring sites, Monitoring Site 46MN31 (Annie Creek near Elmore), which is sampled by the SD DANR, was selected for evaluation. These sites will continue to be sampled on an established schedule. Any changes to the sites or sample parameters will be established in conjunction with the SD DANR.

Parameters analyzed for the baseline sampling program are the same parameters as those required for the existing Wharf water quality program and those required by SDCL 45-6B-7(9). The SD DANR specified required chemical parameters as well as sampling frequency. Between 11 and 23 set chemical parameters were analyzed at each site. The required frequency of sampling events varies from site to site. The required chemical parameters, the frequency of sampling events, and the results of the chemical analysis are included in the surface-water report in Appendix G.

Water quality sample results from 2015 through 2021 were analyzed from eight surface-water monitoring sites. An analysis of field parameters compared to the South Dakota state criteria showed that less than 0.6 percent of the more than 500 samples exceeded the dissolved oxygen, pH, and total suspended solids (TSS) criteria for the cold-water marginal fish life propagation use. All the samples collected and analyzed were below the South Dakota and/or Environmental Protection Agency (EPA) criteria for conductivity, water temperature, nitrate, arsenic, cyanide, and total dissolved solids (TDS), and no exceedances of the criteria were detected at the eight surface-water quality sites within the past 6 years. Analyses of field and laboratory results from eight surface water monitoring sites were compared to the state and federal water quality criteria for samples collected from 2015 through 2021. The water quality results at these surface water monitoring sites are similar to the Wharf baseline water quality results from 2006 through 2010 analyzed as part of the existing permit.

3.4.3 SURFACE WATER QUALITY IMPACTS OF WASTE ROCK AND SPENT ORE DISPOSAL

Waste rock that is mined to remove overburden will be used to fill previously mined areas to create slopes that are functionally and visually compatible with the surrounding area. Valley fill approach where waste rock is deposited on bedrock within a valley (such as the Reliance rock facility) is not planned. Meteoric water flowing through waste rock deposited in mined-out areas flows toward the bedrock groundwater.

The pit within the Boston Expansion will be backfilled with waste rock only. Water that has contacted waste rock backfill in the expansion area is not anticipated to interact with surface water given Wharf's continued use of stormwater best management practices, but groundwater or meteoric water that

comes into contact with waste rock in the expansion area has the potential to enter into surface waters through downstream springs. The surface-water standards for biological oxygen demand (BOD), ammonia, chlorides, dissolved oxygen, hydrogen sulfide, pH, TSS, temperature, or toxic pollutants will not be exceeded as a result of this project (ARSD 74:51:01:32, 45, 46, and 55, as well as in Wharf's NPDES permits). Sediment, erosion, and drainage-control structures are discussed in Section 5.3.6.

3.4.4 POTENTIAL OF WATER POOLING IN PITS

Water pooling in the final pit floor could occur for a minimal time as the pit approaches final mining, but because of the concurrent reclamation practices, the time in which the final pit floor is exposed is minimal. The final pit floor will not be mined to the point where large quantities of Precambrian rock are exposed for any extended period (less than 1 month). All efforts will be made to cover any exposed Precambrian rock immediately so that exposure to the elements (i.e., weather) is minimized to prevent potential ARD generation. The minimal occurrences of pooled water at the pit bottom would be a result of meteoric events. If the pooled water does not readily infiltrate into the ground, it would be pumped out if necessary or as required. If water did pool, pumping would be necessary so that mining is not hampered at the lower levels, undue wear of consumables does not occur, and to avoid increases of the chance to generate ARD.

Wharf does not anticipate there to be any impound water in the Boston Expansion area, therefore no water rights permitting is required. The Boston Expansion project does not entail the dredging or filling of material in wetlands or other surface water bodies. A permit from the U.S. Army Corp of Engineers is not required for this project. Wharf is, and will continue to remain, consistent with the site storm water pollution prevention plan (SWPPP).

3.4.5 PROPOSED METEOROLOGICAL MONITORING PROGRAM

The Wharf meteorological station used in this analysis is located at the processing plant at the Wharf Mine and is 0.9 mile northwest of the Boston Expansion. Historically, the Wharf meteorological station collected daily minimum, maximum, and 7 a.m. temperatures, as well as total daily precipitation.

During continued operations associated with the Boston Expansion, meteorological data from the Lead meteorological station and the Wharf station will continue to be collected and reviewed. Wharf's data will be summarized in annual reports to the SD DANR Air Quality Program if requested. The current meteorological monitoring is anticipated to continue providing adequate meteorologic information in monitoring effects on hydrologic balance for the proposed Boston Expansion. Wharf proposes that no additional monitoring will be needed to monitor meteorological data during mining operations in the Boston Expansion area (ARSD 74:29:02:11(8)).

3.5 AIR QUALITY

3.5.1 INTRODUCTION

Operational air quality was monitored near Wharf's surface-mining operation to determine localized source-generated concentrations of airborne particulates and their trends of dispersal periodically since 1985 (SDCL 45-6B-92(8)). Based on conversations with staff from the SD DANR, no additional baseline air-quality monitoring is required for the baseline studies of the Boston Expansion. Specific emission types measured at the operation are primarily rock dusts generated during handling and

transporting mined ore and rock. Off-site emissions, including dust from an adjacent county road and wood smoke from forest fires and local home heating units, also contribute airborne particulates.

In addition to monitoring air quality, meteorological data were collected and recorded at the mine from 1985 until early 2008; at that time, the station became dysfunctional and meteorology was no longer required to be monitored by the Air Quality Permit and Technical Revision to the Mine Permit. For current baseline investigations, meteorological parameters measured at nearby weather stations were analyzed. A complete analysis of meteorological conditions near the expansion area is provided in Appendix H.

3.5.2 HISTORICAL SAMPLING PROGRAM

High volume (hivol) air samplers were used for measuring source emissions from the mine (primarily rock and road dusts) from several locations, including upwind and downwind sites, from 1985 until 1992. Samplers measured total suspended particulates (TSP). In 1988, a PM-10 air sampler, which measures total inhalable particulates, was incorporated into the sampling network to establish a general correlation between TSP and PM-10 particulate concentrations. In August 1992, all hivol samplers were dismantled and the upwind site known as Preston was brought up to federal air-quality monitoring standards by installing a PM-10 air sampler. A PM-10 sampler at the downwind site (known as the Micro-Tower) was in operation from 1988 through 2007. A PM-10 air sampler was also installed near the Clinton Expansion area in 1993 to record baseline emission levels. All PM-10 sampling was discontinued in early 2007 under the discretion of the SD DANR Air Quality Program.

3.5.3 EXISTING SAMPLING PROGRAM

Existing monitoring activities conducted by Wharf Resources personnel consisted of EPA Method 9 visible emission evaluations at the two permitted sources and the seven fugitive sources. Wharf completes and submits a monthly visible emissions form and an annual air summary form. Based on yearly data submitted, the SD DANR calculates yearly emissions. No additional baseline air-quality monitoring was required by the South Dakota air quality and mining programs for the baseline studies.

3.5.4 AIR-SAMPLING RESULTS

During 2006, which was the last full year of PM-10 data, the maximum 24-hour PM-10 concentration for the compliance monitors (Micro-Tower, Preston, and DN-1) was 28.7 micrograms per cubic meter ($\mu g/m^3$), which occurred at Preston. This value is compared to the South Dakota 24-hour PM-10 standard of 150 $\mu g/m^3$. The maximum annual arithmetic average PM-10 concentration for the compliance monitors was 10.9 $\mu g/m^3$, which occurred at the Micro-Tower site. This value is compared to the South Dakota and Federal PM-10 standard of 50 $\mu g/m^3$. Individual results of the last PM-10 suspended particulate data collected in 2006 is found in the 2006 annual air-quality report [Wharf Resources, 2007].

During all periods of air-quality monitoring at Wharf, all particulate levels were well within both federal and South Dakota PM-10 air-quality standards. Ambient air-quality standards are provided in Table 3-4. The results indicate that the air quality has not significantly deteriorated because of the current operation since 1985. Annual air-quality data summary reports by Wharf contain additional information.

Table 3-5. Ambient Air-Quality Standards for Total Suspended Particulates and PM-10 Suspended Particulates

Time Period	TSP	South Dakota PM-10	Federal PM-10
24-Hour	150[(a)]	150[(a)]	150[(a)]
Annual	60[(b)]	50[l]	50[(c)]

(a) Not to be exceeded more than once per year.
(b) Geometric average, not to be exceedel(c) Arithmetic average of quarterly averages, not to be exceeded.
Note: Values in micrograms per cubic meter.

3.5.5 METEOROLOGICAL STATIONS

The Wharf Mine and Lead meteorological stations in the vicinity of the proposed Boston Expansion are discussed in this section. The information in this section is from a more detailed meteorological report by Krajewski and McCutcheon [2021b] and is provided in Appendix H.

Meteorological data collected and recorded at the Wharf Mine and Lead meteorological stations near the proposed Boston Expansion were analyzed and summarized (ARSD, 74:29:02:11(8)). The Wharf meteorological station is located at the processing plant at the Wharf Mine and is 0.9 mile northwest of the Boston Expansion. The Lead meteorological station is located in Lead, South Dakota, and is approximately 5 miles east of the Boston Expansion project.

Meteorological data at the Wharf meteorological station for observed 7 a.m. temperature and daily precipitation from 2015 through 2020 were obtained from Wharf [Allen, 2021]. In addition to the Wharf meteorological station data, available temperature, precipitation, and snowfall data for the Lead meteorological station from 2015 through 2020 were obtained from the High Plains Regional Climate Center [High Plains Regional Climate Center, 2021]. Wind speed and wind gust data are not recorded at the Wharf Mine and Lead meteorological stations. Therefore, gridded wind vector data were obtained and analyzed for wind speed and direction patterns for the 7.5-mile grid containing the Wharf Mine and Boston Expansion from the North American Land Data Assimilation System.

From 2015 through 2020, the Lead meteorological station had an average historical temperature of 46.4 degrees Fahrenheit (°F) and an average precipitation accumulation of 28.8 inches per year. During 2020, the average annual temperature was 46.1°F and the average precipitation accumulation was 23.6 inches. The Wharf meteorological station had an average 7 a.m. observed temperature of 36.8°F and an average precipitation accumulation of 30.1 inches per year from 2015 through 2020. During 2020, the average 7 a.m. observed temperature was 38.4°F and the average precipitation was 27.4 inches. The historical yearly average wind speed at Wharf from 2015 through 2020 was approximately 9.9 miles per hour. A complete analysis of meteorological data is presented in Appendix H.

3.5.6 PROPOSED AIR-QUALITY MONITORING PROGRAM

As per conversations with the SD DANR, the current monitoring is anticipated to continue providing adequate air quality safeguards for the proposed Boston Expansion. The current air-quality monitoring

will continue to provide information regarding visible emissions. Wharf proposes that no additional monitoring will be needed to monitor ambient air-quality or meteorological data during mining operations in the Boston Expansion area (ARSD 74:29:02:11(8)).

3.5.7 AIR-QUALITY—IMPACTS TO TERRY PEAK, BAREFOOT CONDOMINIUM, AND LOST CAMP AREAS

As described in Section 3.5, air quality has not significantly deteriorated in the area because of mining operations at Wharf or Golden Reward. Therefore, air-quality impacts from the Boston Expansion project to Terry Peak, Barefoot Condominium, Lost Camp Subdivision, or the other surrounding areas are not anticipated. However, Wharf has monitored and will continue to monitor visible emissions and work with the state air-quality personnel to ensure that adequate monitoring needs are met.

Fugitive dust from blasting operations or haul road dust at the existing Wharf Mine has not been an issue to date as evidenced by historical air-quality data. If weather conditions (e.g., temperature inversions, wind, or cloud cover) are unfavorable, blasts will be rescheduled as much as is safely or operationally feasible until more favorable conditions are present. Additional discussion on dust from blasting is discussed in Section 5.3.5. Haul roads are sprayed with water and a chemical treatment (magnesium chloride) to maintain acceptable dust levels; the normal road-watering season runs from May through October.

3.6 VEGETATION

3.6.1 INTRODUCTION

A baseline vegetation study for the proposed Boston Expansion area was conducted by BKS in June and August 2021 to support the SD DANR Large-Scale Mine Permit application as is provided in Appendix I [BKS, 2021b]. The baseline vegetation report meets SDCL 45-6B-92 by addressing critical resources potentially affected by the proposed mine expansion, including critical riparian zones, mountain meadows, wetlands, USFWS threatened-and-endangered (T&E) species, and SDNHP rare plant species [BKS, 2021b]. The proposed Boston Expansion area is located entirely within Wharf's 2010 Expansion area, which was investigated for baseline vegetation information by BKS [2010b]. Information from the 2010 baseline study was included in the 2021 baseline vegetation report.

The 2021 bas51mount51egetation field study was conducted on June 8, August 21, and August 25, 2021, and followed the *Baseline Vegetation Sample Plan for Coeur Wharf 2021 Proposed Boston Expansion* submitted by BKS to the SD DANR and SDGFP in June 2021 [BKS, 2021c] as well as supplemental information submitted in July 2021 [BKS, 2021d]. Vegetation communities within the proposed expansion area were mapped using aerial photography. Field surveys consisted of establishing linear transects within each community type and conducting plant cover, species diversity and composition, shrub density, and tree density surveys along each transect, as well as establishing a comprehensive species list for the area [BKS, 2021c]. Special status plant species studies were also conducted as part of the field surveys [BKS, 2021e].

3.6.2 VEGETATION COMMUNITIES

Two native vegetation community types were identified within the proposed Boston Expansion area during the 2021 baseline surveys: Ponderosa Pine-Common Snowberry (PPSA), which covered 11 acres, and Quaking Aspen Series (PTSE), which covered 8 acres. Both community types also had

areas within the proposed expansion area that were disturbed by logging, and these areas were mapped as separate community types: PPSA Log, which covered 7 acres, and PTSE Log, which covered 14 acres. The remaining area (approximately 10 acres) within the proposed expansion area consisted of disturbed land, with disturbance primarily associated with exploration such as access roads, sumps, and drill pads [BKS, 2021b].

The PPSA vegetation community type occlrred in the western portion of the proposed expansion area. The overstory of this community type was dominated by ponderosa pine (*Pinus ponderosa*). Dominant shrubs in the understory included shinyleaf spirea (*Spiraea lucida*), grouse whortleberry (*Vaccinium scoparium*), kinnikinnick (*Arctostaphylos uva-ursi*), common snowberry (*Symphoricarpos albus*), Oregon grape (*Mahonia repens*), creeping juniper (*Juniperus horizontalis*), and bunchberry dogwood (*Cornus canadensis*). Common grasses included Kentucky bluegrass (*Poa pratensis*) and timothy (*Phleum pratense*). Common forbs included wild bergamot (*Monarda fistulosa*) and western yarrow (*Achillea millefolium*) [BKS, 2021b].

The PPSA Log vegetation community type was also located within the western portion of the proposed expansion area. This community had a lower absolute total vegetation cover than the undisturbed PPSA community and a higher percentage of ground covered by plant litter. Understory vegetation within the PPSA Log community was less dense and accounted for less total cover than in the PPSA community; however, the overall species diversity was higher in the PPSA Log community. Tree density was higher in the PPSA Log community, but trees were generally smaller and less mature than those in the PPSA community [BKS, 2021b].

The PTSE vegetation community occurred along the southwestern border of the proposed expansion area. The overstory of this community type was dominated by quaking aspen (*Populus tremuloides*). Dominant shrubs included grouse whortleberry, shinyleaf spirea, kinnikinnick, bunchberry dogwood, and common snowberry. Common grasses included Kentucky bluegrass, timothy, and smooth brome (*Bromus inermis*). Common forbs included spreading dogbane (*Apocynum androsaemifolium*) and western bracken fern (*Pteridium aquilinum*) [BKS, 2021b].

The PTSE Log vegetation community type was the dominant community type within the proposed expansion area and occurred in most of the eastern half and a portion of the western half of the area. This community type had a similar species composition to the PTSE community type; however, total cover, species diversity, tree density, and shrub density were all lower in the disturbed PTSE Log community compared to the undisturbed PTSE community [BKS, 2021b].

3.6.3 CRITICAL HABITAT AND SPECIAL STATUS PLANT SPECIES

BKS conducted two rare plant species surveys in 2021 within the Boston Expansion. The first survey was conducted in June 2021 and the second was conducted in August 2021 in conjunction with the quantitative vegetation sampling. The special status plan species surveys generally followed the approach of the timed meander methodology of Goff et al. [1982] recommended by the SDGFP, though the methodology was not an exact replication of the Goff et al. methodology. Timed meander species point data, species list, and species effort curve are included in the 2021 Critical Habitat and Special Status Plant Species Report provided in Appendix I.

Based on the 2010 and 2021 baseline vegetation surveys, riparian zones, mountain meadows, and wetlands are not present within the proposed Boston Expansion [BKS, 2021d]. Two federally listed threatened plant species, Leedy's roseroot (*Rhodiola integrifolia* spp. *Leedyi*) and western prairie fringed orchid (*Platanthera praeclara*), occur in South Dakota. Neither species was observed during the 2010 or 2021 baseline vegetation surveys, and no suitable habitat for either species is present within the proposed Boston Expansion area [BKS, 2021e].

One plant species identified as rare by the SDNHP [2018a] was found within the proposed expansion area during the 2021 baseline vegetation survey: mountain huckleberry (*Vaccinium membranaceum* also called thinleaf huckleberry) [BKS, 2021d]. One population of approximately ten individual plants was found on the western boundary of the proposed expansion area on a steep south-facing slope within the PTSE vegetation community type. The plants were in a vegetative state at the time of the survey and appeared to be in good health [BKS, 2021e].

General reconnaissance surveys for mountain huckleberry conducted by Wharf in 1992 and 1996 around the Annie Creek Mine and adjacent areas indicated that mountain huckleberry was intolerant of disturbance that opened the canopy [BKS, 1996]. According to the earlier surveys, isolated individuals of mountain huckleberry were found in previously disturbed habitats with open canopies, but no large patches were observed. Areas devoid of any past mining, logging, recreation, residential, agricultural, or exploration activity were most suitable for mountain huckleberry according to the earlier surveys.

Lands within much of the Boston Expansion have been significantly impacted by multiple types of historical disturbance and do not represent highly suitable habitats for large populations of mountain huckleberry [BKS, 2021a]. The isolated and limited population found within the Boston Expansion area during the 2021 survey is reflective of the 1996 survey findings where only isolated individual plants were found in previously disturbed habitats [BKS, 2021b].

Wharf will continue to provide results of all future surveys to the SDNHP database to enhance the current understanding of mountain huckleberry populations. Because more suitable habitat in the general vicinity is present [BKS Environmental Associates, Inc., 1996], the loss of this small group of mountain huckleberry is unlikely to change the S2 status of mountain huckleberry in South Dakota. The huckleberry populations are rhizomatous and lack a central root system; thus, this species is difficult to transplant. However, Wharf will attempt to transplant the mountain huckleberry population using a "tree pod" type of transplant in which the mountain huckleberry and adjacent understory vegetation will be removed by a tree spade or front-end loader, and the pod will be transplanted to an area with favorable conditions (see mountain huckleberry transplant recommendation memorandum in Appendix I).

Wharf employees indicate that logging in the Boston Expansion occurred in early summer 2015. Aerial photography from 2013 and 2015 confirms logging took place in that time frame; however, an aerial photograph of that area was not acquired in 2014. Logging in the Flossie Pit/Flossie Dump area (northwest of the Boston Expansion) occurred in fall 2018. Logging just east of the Boston Expansion took place in early 2019 before mining started in the current phase of the Portland Ridgeline Pit. Exploration activities within the Boston Expansion area have occurred from 2010 to present.

3.7 WILDLIFE

3.7.1 INTRODUCTION

Annual wildlife monitoring has been conducted at the Wharf Mine since 1982, and ICF of Gillette, Wyoming and conducted all of the annual monitoring since 1994. Various wildlife baseline studies have also been conducted for Wharf on adjacent lands during this time. The monitoring program has consistently included monitoring known raptor nests, combined with searching for new raptor nests throughout the mine permit area and a 0.2- to 0.6-mile perimeter [ICF, 2020]. Annual surveys also include documenting incidental sightings of all wildlife species observed during raptor surveys. Between 1994 and 2003, the monitoring program included surveys for non-raptor avian species, including upland game birds and songbirds. Surveys for upland game birds were also conducted between 2006 and 2010.

As part of the SD DANR Large-Scale Mine Permit application process, a baseline wildlife study was required for the proposed Boston Expansion [ICF, 2021a]. Wildlife reports are included in Appendix J. The proposed Boston Expansion area is located entirely within the study areas of both the annual wildlife monitoring and Wharf's 2010 baseline wildlife study. Because of this overlap, the only specific wildlife surveys required for the Boston Expansion baseline wildlife study were those for bat habitat and nesting raptors [ICF, 2021a]. Initial wildlife surveys were conducted in May and June 2021 and followed the *Baseline Wildlife Plan for Coeur Wharf 2021 Proposed Boston Expansion* [ICF, 2021b]. A supplemental bat habitat and use survey was conducted in fall 2021 [ICF 2021a]. The study area consisted of the proposed Boston Expansion area and a 0.5-mile buffer for raptor nest surveys. In addition to the bat habitat and raptor nest surveys, incidental observations of all other wildlife species (e.g., mammals and songbirds) were recorded and combined with historic data to create a comprehensive species list for the area [ICF, 2021a].

3.7.2 WILDLIFE INVENTORIES

Wildlife surveys in the proposed Boston Expansion area were conducted in May and June 2021, and follow-up bat surveys were conducted in late-summer and fall 2021. The study area is located on private land in Sections 2 and 3 of T4N, R2E, adjacent to the southern edge of the existing Wharf Mine permit boundary. Surveys were conducted in accordance with applicable SDGFP guidelines [ICF, 2021a]. Bat habitat assessment and surveys followed the recommended guidelines detailed in the South Dakota Bat Management Plan [Dowd-Stukel, 2001]. Raptor nest surveys were conducted through visual observations and call-back surveys using tape-recorded raptor calls. Data recorded for incidental wildlife observations include species, number of individuals, location, behavior, and habitat association [ICF, 2021a]. Historic data, including annual wildlife monitoring reports and the 2010 expansion baseline wildlife study, were also reviewed and incorporated into this baseline study.

Seven wildlife species were observed within the Boston Expansion wildlife study area during the 2021 baseline wildlife survey: yellow-bellied marmot (*Marmota flaviventris*), white-tailed deer (*Odocoileus virginianis*), turkey vulture (*Cathartes aura*), broad-winged hawk (*Buteo platypterus*), black-capped chickadee (*Parus atricapillus*), yellow warbler (*Setophaga petechia*), and boreal chorus frog (*Pseudacris triseriata*) [ICF, 2021a]. Mammals documented in the area during past baseline surveys and previous years' monitoring include but are not limited to big game such as pronghorn (*Antilocapra americana*), deer (*Odocoileus spp.*), and elk (*Cervus canadensis*); predators and furbearers such as mountain lions

(*Puma concolor*), coyotes (*Canis latrans*), raccoons (*Procyon lotor*); weasels (*Mustela spp.*) and striped skunks (*Mephitis*); and small and medium-sized mammals such as porcupines (*Erethizon dorsatum*), rabbits, and several small rodent species. A wide variety of common avian species are also present in the area either as seasonal or year-long residents or as migrants passing through the area. Avian species include but are not limited to various raptors such as hawks, owls, eagles, and vultures; woodpeckers, waterfowl, and shorebirds; wild turkeys (*Meleagris gallopavo*), and mourning doves (*Zenaida macroura*); and numerous songbirds.

3.7.3 BATS

Bats have been identified as a critical wildlife resource by SDGFP (SDCL 45-6B-92). In 2021, bat studies were conducted within the Boston Expansion that included habitat, passive presence/absence surveys, and hibernacula emergence surveys. Bat habitat surveys were conducted in June and August 2021 to identify and assess potential bat habitat. Eight potential summer roost and winter hibernacula locations were identified including historic mine features, rock outcrops, and tree snags. However, no evidence of roosting or hibernacula was detected at any of these site locations based on observations during these surveys. The presence of existing disturbances (both mine and non-mine related) near the Boston Expansion has likely reduced the quality of bat roost and hibernacula habitat in the Boston Expansion. Habitat found within the Boston Expansion are only marginal and higher quality habitat is found elsewhere [ICF, 2021a].

A bat presence/absence survey was conducted to identify general bat usage in the area. The survey involved four passive bat echolocation detectors over the period from September 7 to 14, 2021. Software and manual identification of recordings were used to identify bat species. An additional survey was conducted with passive monitoring from October 6 through 18. During a visual nocturnal emergence/hibernaculum survey on October 6 and 7, no bats were visually observed emerging from the collapse mine features and none were observed via infrared video footage during the survey. Based on data from September and October 2021, 11 bat species were identified in the area based on data from the passive echolocation detectors. Of these species, 5 are listed by the SDNHP as species of concern: Townsend's big-eared bat, silver-haired bat, long-eared myotis, fringe-tailed myotis, and northern long-eared bat. The northern long-eared bat is also a federally listed threatened species by the USFWS. While survey results indicate that bats use the Boston Expansion, it is most likely for foraging based on the lack of bats observed emerging from the collapse features [ICF, 2021a].

A conference call with Wharf, the USFWS, SD DANR, and SDGFP was held in December 2021 to discuss bats. Because no bat hibernacula or maternity roots had been confirmed in the study area, the USFWS indicated that they would not require Wharf to complete additional surveys for the species at potential suitable habitat sites. Furthermore, the USFWS said it would not need to be involved with the project further unless additional surveys were conducted, and the species was confirmed emerging from the sites. However, SDGFP and SD DANR required that emergence surveys be conducted again in spring 2022 to verify the findings of the fall 2021 surveys. Wharf's contractor ICF prepared a bat minimization plan and conducted bat emergence surveys at the three collapsed mine shafts in May and June 2022.

Though no bats were visually observed during emergence surveys in 2022, the shafts nonetheless remained potential habitat. To minimize potential impacts to bats, it was essential to seal the shafts so that no bats could access the workings and become impacted before or during mining of the Boston

Expansion. After emergence surveys were completed, temporary physical exclusion barriers (tarps) were installed to prevent bats from re-entering the site; these temporary closures remained in place for at least 1 week before permanent closure to allow any bats within the shafts opportunity to escape. Closure or infilling took place in September 2022 under observation by SDGFP and SD DANR staff.

3.7.4 RAPTORS

No active raptor nests were observed within the proposed Boston Expansion area or 0.5-mile buffer during the baseline study. Nine historic nests were known to occur within 0.5 mile of the proposed Boston Expansion area, including seven broad-winged hawk nests located within the proposed expansion area, but all of these nests have been destroyed by natural causes; the most recent nest was destroyed in 2018 [ICF, 2021a]. One broad-winged hawk was observed during the baseline study in the western portion of the proposed expansion area but did not appear to be nesting, and no active nest was found in the area [ICF, 2021a]. A total of 16 raptor species have been observed during previous wildlife surveys, including 12 species listed as rare by the SDNHP [2018b]. The broad-winged hawk was the only species observed in 2021 Ind is included on the SDNHP list of rare species.

Resource recovery in the Boston Expansion area would not result in impacts on regional raptor populations; however, individual birds or pairs may be affected. Mining activity could cause raptors to abandon nest sites near disturbance areas, particularly if activities encroach on active nests during a given breeding season, although no current nests have been observed intact in the area [ICF, 2021a]. Many of the historic nest sites are located near active mining areas and other areas impacted by human development, which suggests that nesting raptors are at least somewhat tolerant of these activities. Other potential direct impacts would be injury or mortality caused by collisions with mine-related vehicular traffic [ICF, 2021a]. Construction activities that occur within or near active raptor territories could also cause indirect impacts such as reduced or avoided foraging habitats for nesting birds. However, 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 Boston Expansion area [ICF, 2021a].

3.7.5 BIG GAME

No specific surveys targeting big-game species were required as part of the baseline survey; however, incidental sightings of white-tailed deer were noted during the 2021 survey, and mule deer (*Odocoileus hemionus*) were observed during the 2020 wildlife surveys [ICF, 2020; 2021a]. Other ungulate species observed during previous surveys include elk, pronghorn, and bighorn sheep [ICF, 2021a]. Carnivore species observed during previous surveys include coyote, mountain lion, and raccoon. Suitable habitat for these species exists immediately adjacent to the proposed Boston Expansion area, and impacts to any big-game species as a result of this expansion are unlikely.

3.7.6 GAME BIRDS

No specific surveys targeting upland game birds were required as part of the baseline survey, and no upland game bird species were observed during the survey [ICF, 2021a]. Species observed during previous surveys at Wharf include wild turkey, mourning dove, and ruffed grouse (*Bonasa umbellus*) [ICF, 2021a]. While the expansion area may be used by game birds, these species do not appear to concentrate in the area in great numbers, and impacts from mining activities are not expected.

3.7.7 SONGBIRDS AND SMALL MAMMALS

No specific surveys targeting songbird species were required as part of the baseline survey; however, incidental sightings of black-capped chickadees and yellow warblers were noted during the survey. Numerous other songbird species have been observed during previous surveys, including sparrows, swallows, chickadees, thrushes, and warblers [ICF, 2021a].
No small mammal surveys were required as part of the baseline survey, and no small mammal observations were recorded in 2021. Small mammal species observed during previous surveys include squirrels, chipmunks, mice, and voles [ICF, 2021a].

Several SDNHP rare songbird and small mammal species have been observed near the Wharf Mine during previous surveys. Many of these species have the potential to occur in the Boston Expansion area and may experience direct and/or indirect impacts from increased travel and noise in the area during project construction and operation. However, the presence of potential alternate nesting and foraging habitat in the immediate vicinity, as well as the mobility of these species, combine to reduce impacts on most species of interest [ICF, 2021a].

3.7.8 REPTILES AND AMPHIBIANS

No specific surveys targeting reptile or amphibian species were required as part of the baseline survey. One amphibian species (the boreal chorus frog) was observed during the 2021 survey, and no reptile species were observed. A small number of snake, lizard, and frog species have been observed during previous surveys [ICF, 2021a]. The relatively low number of observations indicates that reptiles and amphibians are probably not numerous in the Boston Expansion area and are unlikely to be impacted.

3.7.9 SPECIES OF STATE AND FEDERAL INTEREST

One federally listed threatened species (the northern long-eared bat) has been documented during passive acoustic monitoring using echolocation detectors in the survey area during September and October 2021 and has been observed during previous surveys [ICF, 2021a]. No other state or federally listed or proposed T&E wildlife species were documented within the survey area during the 2021 baseline survey [ICF, 2021a]. Two state-listed bird species have been observed during previous surveys: the peregrine falcon (*Falco peregrinus*) (endangered) and the American dipper (*Cinclus mexicanus*) (threatened) [SDGFP, 2016; ICF, 2021a].

One SDNHP-listed rare raptor species (the broad-winged hawk) was observed during the 2021 baseline survey. One individual hawk was observed in the western portion of the proposed expansion area and did not appear to be nesting [ICF, 2021a]. Five SDNHP-listed rare bat species were detected during passive acoustic surveys in September and October 2021, which included the Townsend's big-eared bat, silver-haired bat, long-eared myotis, fringe-tailed myotis, and northern long-eared bat [ICF, 2021a]. A total of 47 SDNHP rare wildlife species have been observed during past wildlife surveys at Wharf or are thought to occur near the proposed expansion area. This list includes five species of bats and twelve species of raptors, as well as numerous mammals, songbirds, owls, and waterfowl [ICF, 2021a].

In summary, one federally listed species, the northern long-eared bat, was detected within the study area during the 2021 baseline survey. No other state or federal listed or proposed T&E wildlife species were documented in the study area during the baseline survey. Six SDNHP rare species were

documented in the study area during the 2021 baseline survey and included five bat species and one raptor species.

3.7.10 PREVENTATIVE MEASURES TO PREVENT WILDLIFE IMPACTS

Pursuant to ARSD 74:29:07:02(6), preventative measures to minimize harmful impacts to wildlife at the Wharf Mine include active communication between the mine operators and on-site environmental personnel, a big-game fence enclosure around the process area, and frequent inspections of the process ponds. Cyanide levels in process solutions are maintained at low levels (less than 50 ppm weak acid dissociable [WAD] cyanide) at locations where ponds are open, and these practices will continue for the Boston Expansion project. Wharf personnel will work closely with SDGFP personnel and wildlife consultants to address any potential harmful impacts to wildlife.

3.8 AQUATIC RESOURCES

3.8.1 INTRODUCTION

Annual aquatic species and habitat surveys have been conducted by GEI Consultants, Inc. (GEI) (formerly Chadwick Ecological Consultants, Inc. [CEC]) and Chadwick & Associates, Inc. (C&A) since the early 1990s on streams that flow through or have drainages within the Wharf and Golden Reward Mines as required in their NPDES Permit [GEI, 2021]. In 2020, the aquatic study evaluated habitat, fish, benthic macroinvertebrates, and periphyton in Annie Creek, Ross Valley, Lost Camp Gulch, Deadwood Creek, False Bottom Creek, McKinley Gulch, Cleopatra Creek, Fantail Creek, Nevada Gulch, Stewart Gulch, Reno Creek, and Labrador Gulch [GEI, 2021]. No aquatic sites are located within the proposed Boston Expansion, although several sites (Annie Creek, Ross Valley, and Lost Camp Gulch) should be considered in the baseline analysis because these sites are downstream of the existing mine and the proposed expansion area.

The results of the 2021 aquatic monitoring are presented in Appendix K. Fifteen monitoring sites were sampled in 2021. Downstream and to the southwest of the proposed expansion area, three sites are located on Annie Creek, one site on Ross Valley just above the confluence with Annie Creek, and one site on Lost Camp Gulch also above the confluence with Annie Creek. Sites on Annie Creek include one near the headwaters, one downstream of the confluences of Ross Valley and Lost Camp Gulch, and one downstream of Annie Creek Falls near the confluence with Spearfish Creek. Sites on Labrador Gulch to the north and Reno Creek to the east serve as reference sites for comparison to sites downgradient of mining activities [GEI, 2022].

All surveys were conducted in August 2021 and followed the 2018 *A*quatic Biological Sampling and Analysis *Plan for Streams in the Vicinity of the Wharf Mine* [GEI [2018]. A 100-meter transect was established at each sample location, and data were collected beginning at the downstream end. Surveys involved collecting, identifying, counting, weighing, and measuring fish and collecting and identifying aquatic macroinvertebrates and periphyton that inhabit the streams. Several stream habitat variables, including water depth, channel width, streambank vegetation, and substrate composition, were measured to determine the habitat quality for fish, macroinvertebrates, and periphyton [GEI, 2022].

Aquatic monitoring in 2021 on streams near the Wharf Mine and proposed expansion area indicates overall healthy fish, benthic macroinvertebrate, and periphyton communities. The absence of fish in some streams is related to low flows and migration barriers, and sedimentation from nearby roads has led to decreased macroinvertebrate and periphyton population metrics in some streams. However, the 2021 aquatic report concludes that mining activities at the Wharf Mine are not directly impacting aquatic resources in the study streams [GEI, 2022].

3.8.2 AQUATIC HABITAT

All of the sample sites on Annie Creek, Ross Valley, and Lost Camp Gulch were impacted to some degree by tornado activity in July 2020. The lower Annie Creek site was heavily disturbed by downed trees, and the majority of biomonitoring tasks were not practicable in 2020 and 2021. On Lost Camp Gulch, approximately 43 ft (13 meters) of the stream reach were covered in downfall, and this section was excluded from the habitat assessment in 2020 [GEI, 2021].

All of the Annie Creek, Ross Valley, and Lost Camp Gulch sites were dominated by fast-water habitat types such as riffles and runs, with some pools occurring in Annie Creek and Lost Camp Gulch. Each site contained diverse substrate types. Fine sediments were found in Ross Valley and lower Annie Creek, and larger substrate types such as boulders and rubble were found in Lost Camp Gulch and Upper Annie Creek. These fine sediments in Ross Valley and lower Annie Creek are believed to be coming from the nearby Annie Creek Road and are not believed to be the result of mining activities. All sites included abundant gravel, rubble, and boulders/bedrock, which are considered desirable substrate size classes for benthic macroinvertebrates and fish [GEI, 2022]. Banks at each site appeared stable with little to no erosion observed. Overall, habitat quality was determined to be high at each site [GEI, 2022].

3.8.3 FISH

Limited sampling began on Annie Creek in 1990. In 1992, habitat was measured and fish and benthic macroinvertebrates were extensively sampled for the Annie Creek/Reliance Tailings Project [C&A, 1993]. Brook trout (*Salvelinus fontinalis*) and brown trout (*Salmo trutta*) were limited to the lower portion of Annie Creek, just upstream of the confluence with Spearfish Creek and downstream of the falls on Annie Creek. The continued absence of trout in the upper portion is caused by the falls, which act as a barrier to upstream fish movement. Annie Creek historically supported a population of mountain suckers (*Catostomus platyrhynchus*). Mountain suckers are not a species of concern in South Dakota but are listed as a rare species by the SDNHP [2018b]. Further discussion of mountain suckers and impacts from those releases is provided by GEI [2022] and included in the following text.

Biological Monitoring Site AC-1-BIO on Annie Creek is immediately downgradient of the Wharf Mine. At the site, Annie Creek is narrow, has low discharge, and has multiple small bedrock features that create small cascades and falls that would act as barriers to fish movement [GEI, 2021b]. No fish were observed at the uppermost Annie Creek site in a 1990 survey [Mariah Associates, Inc., 1990], and no fish have been observed by GEI since they began annual surveys in 2006.

In 1990 and 1992, a few individual mountain suckers were found in Annie Creek above the confluence with Lost Camp Gulch and in the vicinity of the confluence with Ross Valley, but none were found further

upstream at Site AC-1-BIO or within Lost Camp Gulch [C&A, 1993]. The absence of fish at Site AS-1-BIO reflects its headwater location upstream of perennial fish habitat [C&A, 1993]. Also, small waterfalls that either impede or prevent upstream fish migration are common in this section of Annie Creek. C&A [1993] concluded that Annie Creek is too small for year-round fish populations upstream of the confluence with Lost Camp Gulch, and the rockslide near Annie Creek Falls likely acts as a barrier to upstream fish movement.

Site AC-2-BIO is located further downstream, beyond the confluence with Ross Valley and downstream of the confluence with Lost Camp Gulch, and upstream of Annie Creek Falls. Historically, mountain suckers were present at the middle Annie Creek Site AC-2-BIO [Mariah Associates, Inc., 1990]; however, no fish have been collected since 2010 following an accidental cyanide release from the Wharf Mine in 1995, an ammonia release in 2002, and an accidental release of high BOD water from the Wharf Mine in 2007, which was subsequently cleaned up in 2008. No other fish species have been collected at Site AC-2-BIO. In 1990 and 1992, 380 and 127 mountain suckers were collected, respectively [C&A, 1993]. In 1995, an ammonia and cyanide release occurred via Ross Valley into Annie Creek, and mountain sucker and macroinvertebrate numbers were reduced [CEC, 1996a; 1996b]. Only three live mountain suckers (density estimate: 102 mountain suckers per hectare [ha]) were collected at Site AC-2-BIO, and 68 dead mountain suckers were observed [CEC, 1996a; 1996b]. Complete details of the effects of this event and sampling for recovery patterns were presented in CEC [1996c]. However, no mountain suckers were found during the 1998 and 1999 surveys, which indicates that populations still had not recovered from the ammonia and cyanide release in 1995 [CEC, 2001]. From 2001 to 2006, annual electrofishing surveys found 8–18 mountain suckers at Site AC-2-BIO.

In 2007, BOD water that exceeded standards was inadvertently released into upper Annie Creek. Ammonia and cyanide standards were exceeded in Annie Creek in 2007 [GEI, 2008a]. No mountain suckers were collected from Site AC-2-BIO in 2007, where a population had existed in past years [GEI, 2008b]. As a result of the absence of mountain suckers in August 2007 and the failure to meet water quality permit limits, Wharf Resources, Inc. was ordered to clean up the biomass accumulations. The cleanup effort was conducted on July 15 and 16, 2008, and supervised by GEI personnel. The cleanup process included using a vacuum truck to collect the biomass and affected sediments from the surface of the riparian areas and the streambed in Annie Creek.

Aquatic biological populations were sampled in June 2008, before the cleanup activities, and in August 2008, after the cleanup activities. Overall, annual monitoring data collected in August 2008 indicated that Site AC-1-BIO was not fully recovered from the release of high BOD water into Annie Creek, while Site AC-2-BIO appeared largely recovered. Four mountain suckers were collected at Site AC-2-BIO during June 2008 and two were collected in August 2008. During the August 2009 survey, no mountain suckers were collected [GEI, 2010]. One mountain sucker was collected during the 2010 survey [GEI, 2011], and since 2011, no mountain suckers have been observed in the middle to upper portion of Annie Creek (AC-2-BIO) or its tributaries [GEI, 2012; 2013; 2014; 2015; 2016; 2017; 2018; 2019; 2020]. This absence of mountain suckers at AC-2-BIO is attributed to the water quality disturbances in 2007 plus the fact that there are no upstream sources of fish, and the movement of fish into this site from downstream is prevented by Annie Creek Falls. Based on the data collected, mountain suckers are now absent from Annie Creek upstream of Annie Creek Falls.

Site AC-3-BIO is located furthest downstream in Annie Creek, just upstream of US Highway 14 that parallels Spearfish Creek. During the water quality upset in upper Annie Creek, the lowermost Annie Creek site (Site AC-3-BIO) appeared healthy in 2008 and was similar to 2007 conditions. Only a small section (approximately 65 feet or 20 meters) of the lower Annie Creek site was sampled in 2020 and 2021 because of heavy deadfall from a July 8, 2020, tornado. Only sections of the upper reach were sampled with electrofishing, though population size was not estimated based on the fish that were retained for tissue analysis. Brook trout and brown trout have been consistently observed at this location since 1992. Brown trout densities increased, and brook trout densities decreased in recent years. Mountain suckers are occasionally found at Site AC-3-BIO.

Site LC-1-BIO is located on Lost Camp Gulch and is a short distance upstream of the confluence with Annie Creek. Because of low flows, fish have never been observed at the Ross Valley or Lost Camp Gulch sample sites [GEI, 2022].

3.8.4 MACROINVERTEBRATES

Similar to impacts from spills and discharges affecting fish in Annie Creek in 1995, 2002, and 2007 (as discussed previously), those same spills also negatively impacted macroinvertebrate and periphyton populations. Biomass accumulations were observed on the stream bottom. Benthic invertebrate communities in both the middle and upper Annie Creek aquatic monitoring sites were stressed. Continued monitoring has shown improvement in the aquatic habitat and benthic macroinvertebrate conditions at Sites AC-1-BIO and AC-2-BIO since 2007 [GEI, 2021]. Macroinvertebrate monitoring from 1996 through 2001 indicated that the benthic community had recovered from the 1995 ammonia and cyanide release [CEC 1997; 1998; 1999; 2000; 2001; 2002]. Benthic invertebrate communities in middle and upper Annie Creek appeared stressed in August 2007, which is typical of communities tolerant of low dissolved oxygen [GEI, 2008b]. Macroinvertebrate population metrics in upper and middle Annie Creek have generally improved in recent years following improvements in habitat and water quality after the high BOD water cleanup in 2008.

Most metrics, including species richness, composition, tolerance, trophic habitat, and life history, had values that ranged from moderate to excellent in 2020. The lower Annie Creek site was not sampled for macroinvertebrates in 2020 or 2021, but macroinvertebrate population metrics have generally declined in recent years. The reason for this decline is unknown but seems to be isolated to the lower sampling site on Annie Creek and is not believed to be caused by mining activities. Macroinvertebrate metrics in Ross Valley had values ranging from moderate to excellent in 2020 and have largely stayed consistent over time. Macroinvertebrate metrics in Lost Camp Gulch were generally favorable in 2020 but vary widely from year to year related to variable and often very low flows in the summer months [GEI, 2021]. No state-listed sensitive, threatened, or rare aquatic macroinvertebrates have been sampled in streams near the Wharf Mine.

3.8.5 PERIPHYTON

Periphyton population metrics in the upper and middle Annie Creek sites were generally favorable in 2021. The upper site generally had higher metric values than the middle site, but both sites meet the threshold for overall diversity and appear to support healthy populations. Since sampling began at the Annie Creek aquatic sampling sites, periphyton populations showed only very minor changes, though periphyton communities have been influenced by increased siltation in recent years. Periphyton

population metrics at both the Ross Valley and Lost Camp Gulch sites were favorable in 2021 and have shown few changes over time, although the Lost Camp Gulch site shows signs of sedimentation from the nearby dirt road that impacts periphyton assemblages [GEI, 2021].

3.9 CULTURAL RESOURCES

Cultural resources are sites or areas of use or modification by people in either prehistory or historic times. Upon their discovery, cultural resources are evaluated as to their significance as defined by criteria of the National Register of Historic Places (NRHP). To be considered NRHP eligible, an archaeological site must retain sufficient historic or physical integrity to convey its significance. Mining-related resources often lack the traditional aspects of integrity because of the passage of time, exposure to a harsh environment, abandonment, vandalism, and neglect. Although individual components appear to lack distinction, the combination of multiple components could enable the property to be labeled as a historically significant mining operation eligible to the NRHP. A property eligible to the NRHP that is threatened by mining operations will be assigned a treatment plan or mitigation plan to recover any data that make the property significant [Wharf Resources, 1998]. Considerable cultural resources research has been conducted in the vicinity of the Wharf Mine. The majority of historical items are related to historical mining activities, railroad transportation, and community development. Per SDCL 45-6B-92(7), a summary of previous investigations as well as new surveys are provided in the following sections. Complete cultural resource reports for the expansion area are provided in Appendix L and were submitted to the state archaeologist's office (ARSD 74:29:02:06). Cultural resource reports are considered confidential and not available to the general public. However, a summary of the regional ethnology is included in Appendix L.

3.9.1 PREVIOUS INVESTIGATIONS

Cultural resources research was conducted in the vicinity of the Wharf and Golden Reward Mines in association with historic mining activities since the 1980s. A brief historic overview of the area is provided by Luoma and Lowe [2010] below

> *The discovery of gold in the Black Hills during the 1874 reconnaissance by the Custer expedition heralded the beginning of Euroamerican settlement in the Black Hills of South Dakota—settlement based exclusively on the search for gold and the profitable commercial enterprises that supported the subsequent mining operations. The town of Portland developed a few years later in 1880 near Terry Peak in the Northern Black Hills, resulting in the Bald Mountain Mining District. The community expanded with the mining operations, and a second town, Trojan, developed approximately 0.5 mile (0.8 kilometer) south. Trojan was named for the reorganized gold mining company that played a prominent role in the area during the early twentieth century. The two towns appeared to be inexplicably linked, sharing the same school, while the working populace was employed in several nearby mines. The distinction and identity of each townsite seems to correlate to two distinct periods of mining activity; Portland, from the inception of the Portland Company and its mill, which closed in the late 1890s; and Trojan, following the creation of the Trojan Mining Company in 1911 [Lowe and Schneider, 1996]. Currently, both towns are extinct. The Bald Mountain Mining District including this project area is replete with old mining claims and mineral exploration activities.*

The majority of the Boston Expansion area had been covered by previous cultural resource surveys. Previously recorded sites within proximity of the expansion area were researched and summarized in Quality Services Inc. [2021a; 2021b]. Approximately 39 historic surveys occurred within a 1-mile radius of the Boston Expansion area. The majority of historical items identified in the project vicinity (but outside of the area of potential effect [APE]) are generally related to historical mining activities, railroad transportation, and community development. Within 1 mile of the cultural resources inventory area (but outside the APE), historical surveys have identified five Native American artifact scatters, which includes a hearth [Quality Services Inc., 2021a]. While a small potential for Native American features or artifacts exists within the Boston Expansion, no such features were identified within the expansion area during current or historical archaeological surveys.

A preliminary list of previously recorded archaeological sites and historic structures located within the Boston Expansion area is provided in Table 3-5. Additional previously recorded sites within proximity of the expansion area are listed by Quality Services Inc. [2021a] and are included in Appendix L.

Table 3-5. Previously Recorded Archaeological Sites and Historic Structures Within the Boston Expansion Area

Site No.	Site Type	Cultural Affiliation	NRHP Status
39LA0376	Townsite	Euroamerican	Eligible
39LA0475	Mine; artifact scatter	Euroamerican	Not Eligible

One previously recorded site (Site 39LA0376) was both in the APE and NRHP eligible. This site once served as a residence for mine workers and their families. The area was abandoned around 1959 after the Bald Mountain Mining Company closed [Lowe and Schneider, 1996]. Numerous archaeological work was performed at the site since 1973. In 1985, the site was originally recorded by Jeffrey Buechler, who recorded nine features including standing structures, stone foundations, and several artifact scatters. Site updates were conducted in 1991, 1993, 1996, 2010, and 2016. State Historic Preservation Office (SHPO) concurrence in 1995 stated that the site was still eligible for NRHP.

3.9.2 CURRENT INVESTIGATIONS

Boston Expansion areas that were not previously surveyed, as well as those cultural sites already identified, were included in the 2021 Level III resource evaluations conducted by Quality Services, Inc. [2021a; 2021b]. A preliminary records search at the State Archaeological Research Center (SARC) in Rapid City, South Dakota, was conducted, and two separate field surveys were performed within the Boston Expansion. The first survey covered 15 acres and was in support of Wharf's EXNI where exploration drilling would occur within the Boston Expansion area, and the second survey was within the remaining areas of the Boston Expansion that had not been previously surveyed and included 5.8 acres. These surveys entailed pedestrian surveys of areas identified by SARC as needing inventory, including additional inventory and site evaluation of Site 39LA0376.

The northern and southern portions of Site 39LA0376 were visited. The northern portion is outside the Boston Expansion and will not be impacted by the proposed project; however, the northern portion of the site is considered contributing to NRHP listing. The southern portion of Site 39LA0376 is located

within the Boston Expansion but was designated as noncontributing to NRHP eligibility because the site has been impacted from historic mining activities, lacks sufficient historic integrity, and/or post-dates the site's period of significance [Quality Services, Inc., 2021a].

A newly recorded site was identified (Site 39LA1728). This site consists of two small mine shafts within a trench. No artifacts were observed within the vicinity, and the shafts are not unique to this area and lack distinction. Therefore, the site was recommended as not eligible for the NRHP. During the second survey of 2021, only a single prospecting pit was located in the inventory area and a determination of no historic properties affected was recommended [Quality Services, Inc., 2021b].

Overall, the SHPO determined that the proposed project will not encroach upon, damage, or destroy historical property listed in the NRHP or SHPO. Furthermore, a qualified archaeologist will monitor surface disturbance related project activities within the southern portion of Site 39LA0376.

3.10 NOISE

3.10.1 PREVIOUS NOISE INVESTIGATIONS

Noise impacts of the Wharf mining operation in the area were analyzed. Observed sounds generated by mining activities mainly included blasting, general mine activity, backup alarms, and traffic. Several pertinent baseline sound-level studies have been performed near the Wharf Mine. The most recent historic study was performed in 2010 by Dr. Charles Kliche, and two studies were performed by MartyAnn Apa in 1987 and 1992. A study was also conducted by Erickson and Apa in 1988–1989. A summary of the studies is as follows:

- **1987** – A sound study was conducted for the Golden Reward Mine by Apa [1987]. Sound measurements were obtained at 12 locations in and around Golden Reward's proposed open pit. The report concluded "average background noise levels from all sites fall within or near environmental levels for rural areas." Noise levels were highest at sites along roadways where vehicle traffic contributed to the overall sound levels.
- **1988–1989** – The study conducted by Erickson [1988] aimed to quantify sound from mine operations regarding receptors outside of the mine boundary. A subsequent report by Apa [1989] analyzed Erickson's 1988 data. These reports concluded that mine-related sound (excluding blasting) was 35-50 decibels (dB) and would be expected to have minimal effect on nearby dwellings.
- **1992** – The 1992 sound study conducted by Apa was for the Clinton Expansion. For this study, sound measurements were taken at ten locations around the proposed Clinton Expansion. The report concluded that sound levels at eight of the ten sites were typical for rural areas. At the other two sites, sound readings 10–15 dB higher than background noise were caused by high winds and local and highway traffic noise [Apa, 1993].
- **2010** – A baseline sound study was conducted in 2010 for the Wharf 2010 Expansion. Measurements were taken at 11 locations on four dates in July and August 2010 (some of these locations coincided with monitoring locations in Apa [1993]). The results from this study indicated that most sound levels were typical for rural area forests. Most higher levels of sound were from wind, wildlife (i.e., birds), or traffic. The only verifiable mine activity sounds were

related to a backup alarm, water truck, lowboy trailer, and general shift changes in mine traffic [Kliche, 2010].

3.10.2 BOSTON EXPANSION NOISE STUDIES

Pursuant to SDCL 45-6B-92, baseline sound-level measurements were taken by Wharf and RESPEC in 2021-2022 to measure the current noise and infer possible noise levels from the proposed Boston Expansion area. Background sound levels were recorded at multiple sites near the Boston Expansion area to establish a baseline for future comparison.

To evaluate current sound or noise conditions as work progressed along the Portland Ridgeline and the Flossie Pit, Wharf installed two automated, remote sound meters in April 2021. These meters are located at the Terry Peak Ski area overflow parking lot and south of the closest residence. The installation locations were selected with respect to proximity to the Lost Camp housing development and Wharf-owned properties. Beginning on April 20, 2021, data have been collected at 5-minute-average intervals. When readings over 60 dB are measured, sound clips are automatically recorded.

RESPEC reviewed Wharf sound data collected over the following four time periods

- April 20, 2021, through July 27, 2021
- October 1-15, 2021
- January 1-15, 2022
- April 24, 2022, through May 8, 2022.

Note, meter 1249 was offline from April 23 through 30, 2021, because the 3G data connector was not properly transmitting data. Sound data from over the review period are plotted in Appendix C; additional Wharf data from during the period of record are available in electronic format upon request. Wharf's sound meters record a sound clip for each measurement over 60 dBA. RESPEC's staff listened to a selection of sound clips with a focus on the events with the highest readings and those that coincided with the time period in which Wharf typically conducts blasts.

A summary of sound data collected by Wharf between April 20 through July 27, 2021, was analyzed and is presented in Appendix M. Over this time period, sound levels ranged from 22.87 to 103.03 dB at Meter 1248. Sixty 5-minute intervals recorded sound levels exceeding 85 dBA. More than one-half of these recordings occurred during the late afternoon or evening hours; few, if any, records were triggered during times typical of blast events (12 p.m. to 4 p.m.). Based on the review of sound clips of events exceeding 85 dBA, most high-sound levels are associated with thunderstorms, wind, wildlife, voices, or vehicles. Sound levels at meter 1249 were generally similar. Sound readings ranged from 22.78 to 101.73 dBA, and 49 readings exceeded 85 dBA.

RESPEC also reviewed data from the 2-week period of April 24 through May 8, 2022. During this time period, sound levels ranged from 24.0 to 97.2 dBA at meter 1248. Nine 5-minute intervals recorded sound levels exceeding 85 dBA. Sound levels at meter 1249 were generally similar, with sound readings that ranged from 22.66 to 97.44 dBA and 25 readings exceeded 85 dBA. The majority of these high-sound recordings occurred during midday hours with a few night readings, and all recordings RESPEC

listened to were associated with weather events (i.e., wind, rain, and thunder) that occurred on April 24 and 29, 2022.

In general, Wharf sound data for 2-week periods in October 2021 and January 2022 are relatively similar in magnitude and sources of sound compared to sound data collected at the periods that were chosen for review as overlapping RESPEC's data.

RESPEC also conducted a supplemental sound study with handheld instruments at seven noise receptors on four separate days (July 13, July 20, and July 28, 2021, and May 3, 2022). The locations of RESPEC sound-monitoring sites were established to provide paired locations with the two Wharf sound-monitoring stations and several of the same locations measured by Kliche [2010]. Location SND-07 was added based on SD DANR comments on April 13, 2022; this location provides additional spatial coverage within the Lost Camp subdivision, and the added May 2022 data provide additional temporal data.

The original dates for RESPEC's sound survey (July 2021) were chosen based on RESPEC staff availability and site access, and to coincide with periods of mine activity, including a blast event. A summer survey also was suspected to represent the noisiest time of the year because of increased tourist traffic and ATV usage. Based on production, most mine noises are likely similar year-round, though may also be increased during summer months due to increased reclamation activities in the summer. Further, the last sound survey by Kliche [2010] was performed over the summer months. The additional survey in May 2022 was conducted as soon as feasible after DANR staff requested an additional survey location in Lost Camp be added to the study.

The sound measurements collected by RESPEC ranged from 31.7 to 86.9 dB [Hocking 2022]. LA_{eq} values ranged from 39.4 to 61.5 dB, which are equivalent to the sound levels found in a typical living room to a busy office setting The maximum sound levels were brief momentary highs and related to local traffic in almost every instance. Much of the noise in 2021-2022 was attributed to all-terrain vehicles (ATVs) and vehicle traffic. Other observed sounds were related to wind, wildlife, aircraft, thunder, construction, and mining activities. The only verified mine activities recorded during RESPEC's sound monitoring included a blast (as well as pre- and post-blast sirens) and trucks. Based on the noise observed at Site SND-05, homes closest to the mine in the northwestern area of the Lost Camp Subdivision are likely to hear noise from the mine under current conditions. No noises attributable to the mine were observed on Last Chance Trail at sites SND-02 or SND-07.

Under the proposed Boston Expansion, the existing pit highwall will be pushed back to the south approximately 400 feet and trees will be removed. Noise is expected to temporarily increase for initial blasts at the top of the Portland Ridgeline and will then likely return to current baseline levels after the upper benches are complete. Sound is greatest with a line of sight, and there are minimal areas south of Wharf where there is a line of sight to the Boston Expansion area.

3.10.3 NOISE MITIGATION STRATEGIES

Sound resulting from mining activities may be mitigated by leaving some natural screening such as trees and topographic features in place as long as possible without disrupting the mining sequence. Because tree clearing will be limited to the area necessary for pit construction, the remaining trees will

provide a screen and reduce noise. In addition to natural topography, an 8-foot berm around a large portion of the expansion will provide some noise reduction.

The proposed noise mitigation plan includes the following:

- Continue operating automated sound meters from points outside the disturbance limit.
- Incorporate minimal disturbance of the natural topography and use existing vegetation for sound buffering.
- Blast only during daylight hours on weekdays except during special circumstances, such as weather or unforeseen delays.

Most residents can expect mining noises to continue at present levels and the Boston Expansion will not increase their current noise levels. The closest few residents in the northwestern-most corner of the subdivision nearest the Boston Expansion could expect temporary increases in mining noise associated with vegetation removal, berm construction, and initial blasts at the top of the ridgeline in the Boston Expansion area. After the upper benches are complete noise levels are expected to return to near-present conditions.

3.11 VISUAL ASSESSMENT

A visual resources assessment was conducted to illustrate the current, maximum disturbance and post-reclamation view of the landscape at several vantage points. The proposed Boston Expansion will push back into the Portland Ridgeline and allow for minor increased visibility from public areas. Compared to visual impacts of existing mining disturbance, visual impacts of the Boston Expansion area will be low. The Boston Expansion area may be slightly visible from Perkins Road but will not be visible from State Highway 34 or Interstate 90. The residence areas consist of the Barefoot Condominium area and the Lost Camp Subdivision. Both of these residence areas are close to the existing Wharf operation and the Boston Expansion; however, the Boston Expansion area should not be visible from the housing development because topography and vegetation currently provide visual screening. Visual screening measures will not be feasible for all views of the Boston Expansion area.

3.11.1 VISUAL SIMULATION

A visual simulation analysis for the Boston Expansion was performed and is included in Appendix N. Nine Vantage Points (VPs) were chosen to show the progress of the mine construction, including current permitted operations and reclamation as well as proposed operations and reclamation. VPs were collaboratively chosen by Stantec, Wharf, and RESPEC based on public access points where the view of the existing mine and proposed expansion operations may exist. VPs are typically chosen based on areas of high public use, residences, and public facilities. The VPs chosen had the highest probability of public visibility of the Boston Expansion; the direction of view was also selected using the same criteria.

Because of the exact location of the expansion and local topography, most VPs evaluated by Stantec do not show public views of the expansion but, rather, show views of the general Wharf Mine and views seen by residents and visitors as they approach the mine. The VP locations are shown in Figure 3-4.

Images from all VPs are included in Appendix N and illustrate existing conditions, computer-simulated post-build (or end of mining), and simulated reclaimed views. VPs that were considered most relevant to the Boston Expansion include the following sites:

- VP 1 NW – Terry Peak Summit overlooking Wharf
- VP 3 W – Approaching top of Nevada Gulch Road
- VP 4 NNW – Top of Nevada Gulch Road and intersection of Stewart Road
- VP 7 N – Antelope and Last Chance intersection
- VP 8 NW – Toward Wharf/Thaler house
- VP 8 NE – Moose Trial and Last Chance intersection
- VP 9 S – Perkins Road.

The VPs that demonstrated the most changes were VPs 1, 4, and 9. The rest of the VPs oriented toward the Boston Expansion showed minimal changes. The visual impacts of mining will become greater as mining occurs and the elevation of the Portland Ridgeline is reduced.

VP 1 is located at the top of the Terry Peak ski resort and has a large field of view. The biggest visual change at VP 1 is the land cover between post-build and post-reclamation of existing permitted disturbance. The majority of the Boston Expansion is not visible from VP 1, though small areas may be visible depending upon exact viewing location and vegetation screening.

Vantage Points VP 3 and VP 4 are located on Highway 473 (Nevada Gulch Road). VP 4 and is higher in elevation with a clear view of the Green Mountain Pit area and Deep Portland area. These areas also show a bigger change in land cover as opposed to topography. At VP 4 looking north-northwest, tree removal along the ridgeline may be noticeable, but overall visual impacts from the Boston Expansion will be minimal. The Boston Expansion is not explicity visible from VP 3 W.

Views from within the Lost Camp Subdivision (VP 7 and VP 8) were from public roads rather than private residences, which is industry standard. These VPs coincidentally face residences and demonstrate the amount of current vegetation and topography blocking visibility in these areas. The difference in view and visual impacts from VP 8 and the nearest residences is not anticipated to vary greatly. VP 9 is located on Perkins Road, looking south toward the American Eagle Pit. Visual changes are most apparent associated with changes permitted under an existing mine permit; however, depending on the exact viewpoint on Perkins Road, the change along the Portland Ridgeline as a result of mining within the Boston Expansion may be visible to residents or ATV users on the road.

Spearfish Canyon is several miles from the proposed Boston Expansion and is not an applicable viewpoint because of the lower elevation and significant vegetation; therefore, the expansion is not visible from Spearfish Canyon.

The closest residences in the Lost Camp Subdivision can presently view the edge of the Wharf property from the back of their properties and have historically been able to see Wharf's logging and exploration activities in the vicinity. To supplement the visual assessment conducted by Stantec and assist in understanding the visual changes that may occur as a result of the proposed Boston Expansion, Stantec expanded its visual assessment to include oblique aerial views of the Boston Expansion

topography. Wharf took photographs from the southern edge of its property looking toward the residences as well as toward the mine (see Appendix N). These photographs provide insight into the current view and discuss potential changes that may be visible as a result of the Boston Expansion.

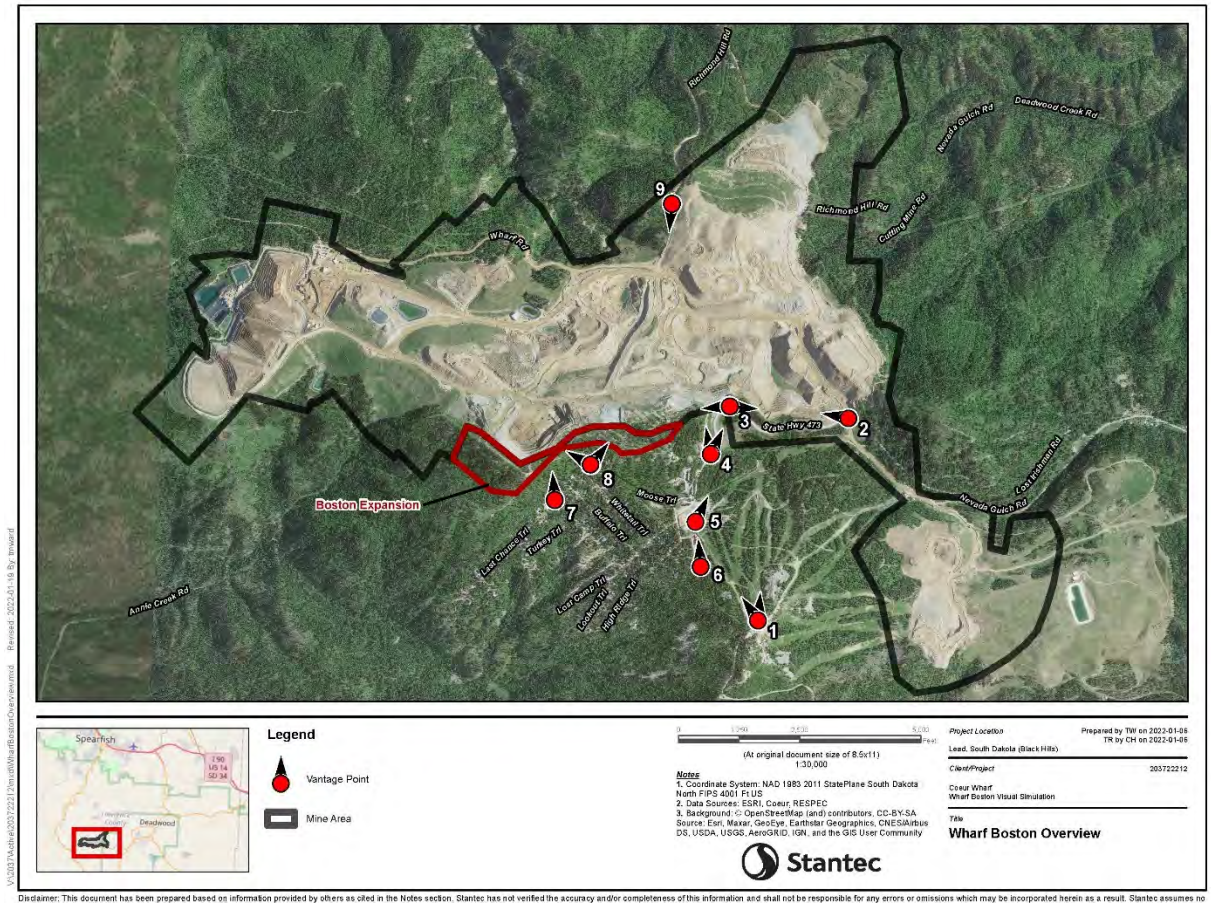

Figure 3-4. Visual Simulation Vantage Point Locations.

3.11.2 VISUAL SCREENING OF AFFECTED LANDS

To the extent possible, visual screening of affected lands will be used to minimize visual impacts (ARSD 74:29:07:02(3)). During pit reclamation, land shaping will occur that will enhance the reclamation so that the land ties in with the current surrounding (ARSD 74:29:07:04 (7)). The land that requires reclaiming will include undulation and shaping so as to break up the contour of the land and blend the land with the surrounding area.

The Portland Ridgeline provides a topographical and vegetative screen that effectively minimizes the visibility concerns from the main public access areas; however, intermittent views of the mining operation (including currently permitted operations) will exist at several locations. Visual screening along the southern boundary of the affected mining land will include a buffer zone of approximately 10 to 40 feet wide with existing vegetation that will include trees, shrubs, and grasses. When the mining progresses to lower benches, the mining will be screened because of elevation and will no longer be visible from these locations. Located between the buffer zone and the southern border of the pit will be a security berm of approximately 8 feet tall along with a security fence and signage, which will be

situated south of the berm. The size and standard of the security fence will be typical of what is currently used on the Wharf Mine access road (approximately 6 feet high and either chain-link type or game-fence type with approximately 4-inch-square wire spacing).

3.12 INFORMATION ON CRITICAL RESOURCES

Environmental and cultural resource studies have been conducted within the proposed Boston Expansion area to determine if the affected land has critical resources including resources with historic, archaeologic, geologic, scientific, or recreational significance. These critical resources of the affected land, which are known to the applicant, are summarized in the following sections and in Section 2.5.

3.12.1 SOILS—SOILS WITH HIGH-EROSION AND LOW-REVEGETATION POTENTIAL

The proposed Boston Expansion area does not have soils with a high-erosion or low-revegetation potential. Based on the soil mapping conducted by BKS, the hazard for soil erosion based on soil type varies from negligible to slight, with the loam soils on the proposed Boston Expansion area being more susceptible to erosion from water than wind [BKS, 2021a]. Soils have the ability to meet reclamation criteria. To minimize soil erosion, the topsoil stockpile will be seeded as soon as reasonably possible in a time frame not to exceed past the spring or fall seeding schedule immediately following placement of the topsoil stockpile (SDCL 45-6B-40) (Section 6.3). Reclaimed slopes will also be graded and shaped at 3H:1V or regraded to a stable configuration, bermed, and seeded. Interim seeding will use the same seed mixture as the final seeding mixture provided in Section 6.5.2 to ensure that all interim reclamation is compatible with the final reclamation. Additional erosion-control measures are described in Section 5.3.6. Project area soils are also suitable as a plant-grown medium with revegetation potential affected mostly by rock fragments. Prior to placement, topsoil analysis will be conducted to determine soil nutrient levels and appropriate additional fertilization requirements.

3.12.2 WATER—DIRECT OR INDIRECT SOURCES OF DRINKING WATER

No drinking water wells exist within the Boston Expansion area, and three private wells are located within 1-mile of the Boston Expansion. The locations of these wells are available in Appendix F.

Proposed mining is not predicted to have an overall influence on groundwater flow or quality outside the Boston Expansion and POP boundaries. Impacts to groundwater quality resulting from waste rock disposal may be similar to the groundwater impacts in nearby areas that have previously been mined and backfilled with waste rock. Examples of these impacts include temporary increased nitrate concentrations in shallow wells immediately adjacent to backfilled areas within the Wharf permit boundary. Because of these experiences, a temporary increase in nitrate may occur below the proposed Boston Expansion as backfill is flushed by recharge precipitation. The increase in nitrate from blasting and disposal of waste rock is not expected to exceed the groundwater standard of 10 ppm outside permitted POP boundaries based on historical groundwater water quality results and fate and transport modeling. The geochemical characterization of the ore and overburden material (Section 3.1) does not indicate a risk of developing ARD.

3.12.3 AIR QUALITY—IMPACTS TO TERRY PEAK, BAREFOOT CONDOMINIUM, AND LOST CAMP AREAS

As described in Section 3.5, no significant deterioration of air quality has occurred in the area because of mining operations at Wharf. Therefore, air-quality impacts from the Boston Expansion to Terry Peak, Barefoot Condominium, Lost Camp Subdivision, or the other surrounding areas are not anticipated. However, Wharf has and will continue to monitor visible emissions and work with the state air-quality personnel to ensure that adequate monitoring needs are met.

3.12.4 VEGETATION—WETLAND AND RIPARIAN VEGETATION

Vegetation studies, as described in Section 3.6 and Appendix I of this application, were conducted by BKS. No wetland or riparian species or communities were observed within the Boston Expansion area. Wharf will attempt to mitigate impacts to the mountain huckleberry population using a "tree pod" type of transplant in which the mountain huckleberry and adjacent understory vegetation will be removed by a tree spade or front-end loader, and the pod will be transplanted to an area with favorable conditions (see mountain huckleberry transplant recommendation memorandum in Appendix I).

3.12.5 WILDLIFE—SPECIES ON THE SOUTH DAKOTA NATIONAL HERITAGE PROGRAM LIST (INCLUDING RAPTORS) AND CRITICAL DEER WINTER RANGE

Pursuant to ARSD 74:29:07:02(6), preventative measures to minimize harmful impacts to wildlife at the Wharf Mine include active communication between the mine operators and on-site environmental personnel, a big-game fence enclosure around the process area, and frequent inspections of the process ponds. Cyanide levels in process solutions are maintained at low levels (less than 50 ppm WAD cyanide) at locations where ponds are open. These practices will continue for the Boston Expansion. Wharf personnel will also work closely with SDGFP personnel and wildlife consultants to address any potential harmful impacts to wildlife.

Species of federal and state concern, including those listed on the SDNHP list, are discussed in Section 3.7.9. Although several avian species, including raptors, have been observed during historic wildlife surveys within and near the proposed Boston Expansion area, no active raptor nest sites were documented within the proposed permit area. These avian species have and continue to use the area around Wharf where historic and current mining have occurred. Wharf does not propose any mitigation measures for these avian species but will continue to work with the SDGFP to address any necessary mitigation measures.

Five bat species identified in the area are listed by the SDNHP as species of concern: Townsend's big-eared bat, silver-haired bat, long-eared myotis, fringe-tailed myotis, and northern long-eared bat. The northern long-eared bat is also a federally listed threatened species by the USFWS. Wharf's contractor ICF prepared a bat minimization plan and conducted bat emergence surveys at the three collapsed mine shafts in May and June 2022 (ARSD 74:29:07:2(6)). After emergence surveys were completed, temporary physical exclusion barriers (i.e., tarps) were installed to prevent bats from re-entering the site, and these temporary closures remained in place for at least 1 week prior to permanent closure. Closure or infilling took place in September 2022 under observation by SDGFP and SD DANR staff.

Big-game species were not specifically surveyed in the Boston Expansion area in 2021; however, based on historical surveys, several incidental sightings of mule and white-tailed deer occurred. Both species were observed in forested habitats and open meadows including reclaimed grassland areas of Golden

Reward. Although this Wharf area serves as winter range for deer, habitat is abundant on surrounding lands and no additional mitigation measures are necessary at this time.

3.12.6 AQUATIC RESOURCES—COLD-WATER FISH LIFE PROPAGATION WATER

The Boston Expansion is located within the Annie Creek, Lost Camp, and Nevada Gulch drainages. According to ARSD 74:51:03:01, all streams in South Dakota are listed as having the beneficial use as fish wildlife propagation; thus, water quality standards must be maintained for such use. As streams near the Wharf Mine are classified as coldwater fisheries, ARSD 74:51:01:32, relating to effluent limits for discharges to coldwater fishery waters, is also applicable and will be adhered to for the Boston Expansion. The surface-water standards for BOD, ammonia, chlorides, dissolved oxygen, hydrogen sulfide, pH, TSS, temperature, or toxic pollutants will not be exceeded within any drainage as a result of mining operations at the Boston Expansion (Section 3.4) (ARSD 74:51:01:32, 45, 46, and 55, as well as in Wharf's NPDES permits). No water from the Boston Expansion is anticipated to impact surface water or aquatic resources, including coldwater fisheries. Efforts to mitigate effects on surface-water quality and aquatic resources include sedimentation-, erosion-, and drainage-control structures (described in Section 5.3.6).

3.12.7 CULTURAL RESOURCES—SUMMARY OF SITES ELIGIBLE FOR NATIONAL REGISTER OF HISTORIC PLACES

Cultural resource surveys have been conducted within the Boston Expansion (see Section 3.9 and Appendix L). Site 39LA0376 is eligible for the National Register of Historic Places. The southern portion of Site 39LA0376 is located within the Boston Expansion area but was designated as noncontributing to NRHP eligibility of the overall site because the site has been impacted from historic mining activities, lacks sufficient historic integrity, and/or post-dates the site's period of significance [Quality Services, Inc., 2021a]. A newly recorded site, identified as Site 39LA1728, is recommended as not eligible for the NRHP. The SHPO determined that the proposed project will not encroach upon, damage, or destroy historical property listed in the National or State Registers of Historic Places (see Appendix L). Furthermore, a qualified archaeologist will monitor project activities related to surface disturbance within the southern portion of Site 39LA0376.

3.12.8 NOISE—IMPACTS TO TERRY PEAK, BAREFOOT CONDOMINIUM, AND LOST CAMP AREAS

A recent baseline study was conducted to determine the current sound levels at several areas around Wharf's current operation and the proposed Boston Expansion (Section 3.10 and Appendix M). Sound-measuring points included continuous monitors at the Terry Peak Ski area overflow parking lot and south of the closest residence as well as additional monitoring at two points along Last Chance Trail (the intersection of Last Chance Trail and Whitetail Trail and along Last Chance Trail), the Barefoot Condominiums, and the Terry Valley Road District storage shop along Nevada Gulch Road.

The maximum sound levels were brief momentary highs and related to local traffic in almost every instance (including ATVs). The only verified mine activities recorded during RESPEC's sound monitoring included a blast (as well as pre- and post-blast sirens) and trucks. Operations at the expansion areas are not anticipated to greatly increase noise levels. The greatest impacts to these areas of concern will likely be during blasting events. Wharf's noise mitigation plan, as described in Section 3.10.3, includes continued monitoring of noise, incorporating topography and vegetation for natural sound buffering,

and blasting only during daylight hours on weekdays. Noise impacts directly related to the Boston Expansion are expected to be low overall.

3.12.9 VISUAL RESOURCES—VISUAL IMPACTS TO BAREFOOT CONDOMINIUM AND LOST CAMP AREAS

Visual assessment and screening of affected lands are described in Section 3.11. The Barefoot Condominium area and the Lost Camp Subdivision are located near the proposed Boston Expansion adjacent to the existing mine. Visual impacts from these areas will be minimal because topography and vegetation currently provide visual screening when viewing the operation from the Barefoot Condominium and Lost Camp Subdivision. Visual screening along the southern boundary of the affected mining land will include an 8-foot berm and a buffer zone of approximately 10 to 40 feet wide with existing vegetation that will include trees, shrubs, and grasses.

3.12.10 LAND DESIGNATED AS SPECIAL, EXCEPTIONAL, CRITICAL, OR UNIQUE

Environmental and cultural resource studies have been conducted within the proposed Boston Expansion area to determine if the affected land has historic, archaeologic, geologic, scientific, or recreational significance. These items were included in Wharf Resource's Request for Determination of Special, Exceptional, Critical, or Unique Lands [Wharf Resources, 2021]. As discussed in Section 2.5, the DANR determined that lands described in the Notice of Intent to Operate do not constitute special, exceptional, critical, or unique lands and are cleared in accordance with ARSD 74:29:10:15 (notice of determination include in Appendix A).

4.0 SOCIOECONOMIC ASSESSMENT

Wharf's proposed Boston Expansion qualifies as a large-scale mine under Lawrence County's Zoning Ordinance and the South Dakota Codified Laws (SDCL). Under these statutes, applicants seeking to develop a large-scale mine are required to file a socioeconomic assessment. The statutes identify the basic factors to be addressed in such an assessment, which generally include demographic factors (population impacts), economic issues (employment and income/expenditures), social considerations (education, public safety, and utility services), and quality-of-life issues (health, parks, and recreation). This assessment outlines the economic, fiscal, and social impacts likely to be associated with the Boston Expansion.

Socioeconomic studies are different when a given permit is associated with an entirely new operation than when a permit only extends the life of a project. In this case, the proposed mining permit is extending the life of the mining operation. The total number of employees at the Wharf Mine and annual spending by Wharf is not projected to significantly change from the past 10–15 years. Adverse socioeconomic impacts would be more likely to occur if the proposed Boston Expansion was not permitted (i.e., the mine would close earlier without additional permitted acres).

The following sections summarize the socioeconomic findings of the study that was conducted to assess the impacts of the proposed expansion. The entire socioeconomic assessment, completed by Dr. Michael Madden [2021], is located in Appendix O.

4.1 KEY PROJECT PARAMETERS

Under the current permit, mine operations are expected to end by 2028. Approval of the proposed Boston Expansion permit would extend the mine life and operations to 2030. Extending the mine life would not impact or require additional public infrastructure or public services, such as fire protection, solid-waste disposal, road maintenance, or health service [Madden, 2021].

4.2 FISCAL TRENDS AFFECTING LAWRENCE COUNTY

The community of Lead, Lawrence County, and other communities where Wharf employees reside may be subject to fiscal impacts from Wharf's mining operation. Legalized gambling, tourism, and consumerism are a few economic sectors that have grown within Lawrence County since the 1990s [Madden, 2021]. Private employment has increased with these growing economic sectors as mining has fluctuated.

Wharf invests at the local and county levels for its operations and spends an average of $1.8 million solely in Lawrence County each year. Average yearly wages per employee at Wharf are $66,537, and total payroll and benefits are valued at $24.3 million. In 2020, mining-sector wages were 69 percent higher than the overall average Lawrence County wages within the private sector. The mining sector has provided significant impacts to Lawrence County in the form of income, employment, and spending [Madden, 2021].

4.3 WHARF'S CONTRIBUTIONS TO LOCAL AND REGIONAL ECONOMIES

Wharf began mining in Lawrence County in 1974 and has been a major employer since 1982 [Madden, 2021]. The majority of Wharf's employees reside within Lawrence and Meade Counties, and some employees reside in Butte, Pennington, and Custer Counties [Madden, 2021].

Positive economic impacts at the city, county, and state levels include operational-related purchases (e.g., goods and services) from South Dakota vendors, employment provided by all vendors used by Wharf, taxes (e.g., sales, property, severance, income) paid by Wharf, taxes paid by Wharf Mine employees (e.g., property, sales, income), earnings spent by Wharf Mine employees, and community involvement. Community involvement includes directly contributing time or monetary donations as well as indirectly through taxes paid. Wharf donates approximately $170,000 annually to local charities and not-for-profit organizations in addition to $75,000 annually that is awarded for multiple scholarships.

Wharf provides full-time jobs to approximately 257 employees, 98 percent of whom reside within the Black Hills. In 2020, Wharf's payroll (including benefits) was $24.3 million, and Wharf's purchases within South Dakota exceeded $24 million.

4.4 TAX PAYMENTS

Local governments benefit directly from property and sales taxes paid by Wharf. A majority of property taxes collected by Wharf support the Lead-Deadwood School District. The average amount of annual state sales and use taxes paid by Wharf from 2016 to 2020 was $195,332. The average amount of annual local and property taxes for the same time period was $593,575, and the majority of this amount was property taxes. The average state severance tax paid between 2016 and 2020 was $5.8 million. Approving the proposed Boston Expansion would ensure continued tax contributions at the city, county, and state levels [Madden, 2021].

4.4.1 SALES TAX

Sales tax is a tax on goods and services purchased in South Dakota. Local governments (both city and county levels) and school districts depend on sales tax. Wharf and its employees pay sales taxes on purchases. State sales and use taxes paid by Wharf in 2020 was $157,742 and averaged approximately $195,332 from 2016 to 2020 [Madden, 2021].

4.4.2 PROPERTY TAX

Similar to sales tax, property taxes paid by Wharf supports Lawrence County government and the Lead-Deadwood School District. The property tax amount depends on the county assessment or levy rate.

4.4.3 SEVERANCE TAX

The severance tax on gold, which is levied by the state of South Dakota, involves two components. The first component is a $4-per-ounce production tax for all gold produced. However, when the price of gold is above $800 per ounce, the severance tax increases to $8 per ounce. The price of gold and production levels affect severance taxes. Ten percent of net company profits is also charged as net income tax. From 2016 to 2019, severance taxes paid varied from approximately $7 million in 2016 to approximately $3 million in 2019, as a result of production fluctuations. In 2020, almost $9 million in

severance taxes was paid to South Dakota and is the largest amount paid by Wharf in a year. The average annual severance tax amount paid between 2016 and 2020 was approximately $5.8 million [Madden, 2021].

4.5 EFFECT ON NEARBY RESIDENTIAL DEVELOPMENT AND PROPERTY VALUES

The number of Wharf Mine employees will remain the same if the proposed Boston Expansion is approved; therefore, housing impacts will likely remain unchanged. Because the number of employees is not expected to increase or decrease, the existing housing market and property values are not expected to fluctuate as a result of the expansion.

The presence of Wharf Mine and its mining activities has not historically affected nearby development or property values. The Lost Camp Subdivision has doubled in size over the past 20 years, as shown in Figure 4-1. In the past 3 years, 22 building permits for new house construction have been filed with Lawrence County. The demand for housing in the area remains high. Property values in Lawrence County, including within the Lost Camp Subdivision, have generally increased over the last 10 years. As shown in Figure 4-2, home sales from the Lost Camp Subdivision over the last 5 years demonstrate notable increases in value, which indicates that mining has not adversely impacted property values.

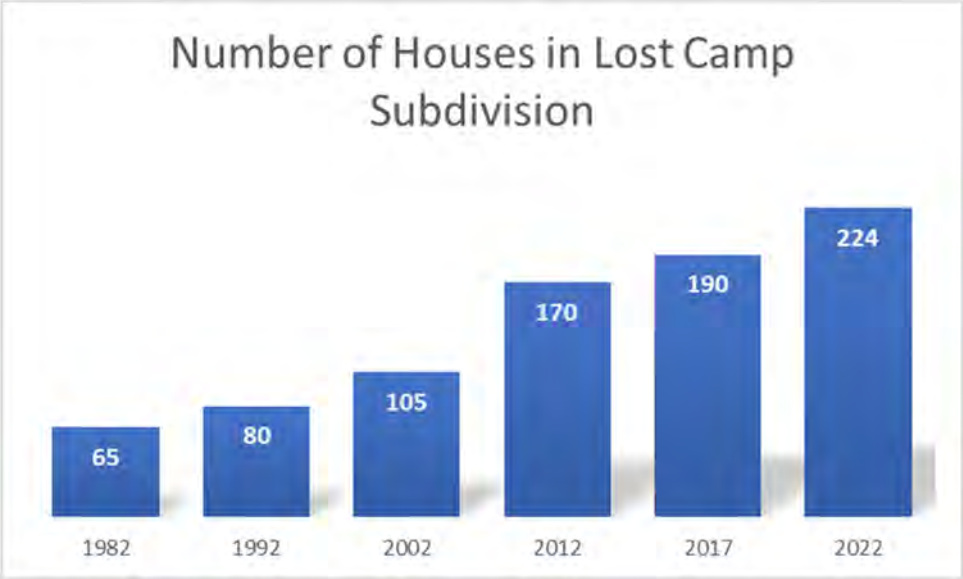

Figure 4-1. Total Number of Houses in the Lost Camp Subdivision by Year.

4.6 EFFECT ON RECREATION AND SKIING

Recreational opportunities near the Wharf Mine and the proposed Boston Expansion include many activities, such as hiking, biking, hunting, skiing, ATV use, and camping. Trail rides occur within Wharf property but outside disturbance areas, and snowmobile trails at Golden Reward are used in the winter. These activities are not permitted on Wharf property within the permitted mining disturbance boundary at Wharf Mine, and no existing recreational activities will be impacted by the Boston Expansion.

Figure 4-2. Home Sale Values in the Lost Camp Subdivision by Year.

Nearby major recreation areas include Black Hills National Forest, Spearfish Canyon, and Terry Peak [Madden, 2021]. Commercial recreation in the area is limited primarily to Terry Peak ski area, which is south of the proposed Boston Expansion area. Terry Peak is unique to the area in that it is one of two local ski areas and plays a role in winter recreation opportunities and the region's economy. For this reason, the potential for adverse impacts was a concern in the past. An investigation into the impact of mining activity on skiing was prepared during the 1997 Clinton Expansion permit application [Hammer, Siler, George Associates, 1996] and was considered as part of the 2010 and 2021 socioeconomic assessments [Madden, 2010; 2021]. Hammer, Siler, George Associates [1996] concluded that the number of skiers is associated more with weather than mining activity and that these numbers rise when snow conditions are better and fall when snow conditions are poor. The resulting conclusion is that overall winter recreation activity in the northern Black Hills continues to grow [Hammer, Siler, George Associates, 1996]. Terry Peak management indicated that snow-making ability was also a significant factor in the number of skiers [Madden, 2010]. The last 30 years confirm that ski recreation and nearby gold mining operations can coexist, and the visual impact of mining activity does not interfere with skiers' participation in the sport. Actual disturbance will not affect recreational use,77mounthe amount of snowfall is known to have a greater impact on the number of skiers.

As a partner of the Black Hills Chairlift Company (located at Terry Peak), Wharf has provided material contributions for the parking lots and financial contributions for artificial snow-making equipment and a chair lift. Approving the proposed Boston Expansion at the Wharf Mine would not affect nearby skiing or outdoor recreational activities.

The estimated number of individuals partaking in recreational activities in the Black Hills, including snowmobiling, skiing, hiking, and ATV usage are not readily available (ARSD 74:29:07:23b). However, Terry Peak management indicates that the demand continues for outdoor winter recreational opportunities [Madden, 2010; 2021]. In previous years, improved facilities and snow-making facilities have increased winter recreational activities [Madden, 2010; 2021]. The number of snowmobile licenses sold in Lawrence County slowly increased from approximately 300 per year in the 1990s, 820 in 2010,

and 925 in 2020 [South Dakota Department of Revenue and Regulation, 2021]. Recreational use (hiking and biking) on the nearby Mickelson Trail has steadily increased over the past decade. The 2021 pass counts (including daily and annual passes) totaled approximately 26,102, which is an increase from 16,000 in 2010 [Reiprich, 2021; Garry, 2011]. Michelson Trail usage is also estimated to be several times greater than the number of passes sold because the purchaser may have used the trail multiple times and children 11 years of age and younger are not required to obtain a trail pass [Reiprich, 2021].

4.7 EFFECT ON POPULATION AND FUTURE TRENDS IN MINING EMPLOYMENT

As of 2019, the total population of South Dakota was estimated at 884,659, continuing an annual increasing trend since 2010 [U.S. Census Bureau, 2019a]. Lawrence County's 5-year estimated population in 2019 was 25,478 [U.S. Census Bureau, 2019b], and the 5-year estimated population of Lead, South Dakota, in 2019 was 2,985 [U.S. Census Bureau, 2019c]. The population in Lead and within Lawrence County is not anticipated to change in connection with permit approval of the proposed Boston Expansion. Post-reclamation land use at previously permitted areas of the Wharf and Golden Reward Mines includes commercial and residential development, which would accommodate a population increase and economic growth.

Extending mine operations by approving the proposed Boston Expansion will allow continued employment for approximately 257 employees. Wharf and its employees contribute to their respective communities with payroll earnings, community involvement (e.g., contribution of time and goods), and taxes. Taxes from Wharf Mine, as well as taxes paid by employees, broadly benefit the state of South Dakota, Lawrence County, and the city of Lead.

5.0 MINE PLAN

The Boston Expansion will consist of expanding to the south of existing mine pits, as shown on Exhibits 22 and 23 in Appendix B. The area will be mined concurrently with the Portland Pit from approximately 2022 through 2029. The proposed method of operation in the Boston Expansion area will be truck-and-loader operation and is similar to existing operations at the Wharf Mine. Mining operations will be in an open-pit setting with overburden disposal. Ore extracted from the expansion area will be transported by haul trucks to the existing, permitted Wharf Mine heap-leaching facility for processing. No new pollution control facilities are planned for the Boston Expansion (ARSD 74:29:02:11.13). No new reservoirs, tailings ponds, tailings disposal sites, dams, dikes, or other such facilities will be constructed in the Boston Expansion (SDCL 45-6B-7(10)). Wharf will continue to operate 24 hours a day, 7 days per week with the exception of major holidays.

County roads are not in the vicinity of the proposed project. The Wharf Mine is accessed from Lead by State Highway 473. Wharf Road is an all-weather, gravel road that is maintained from State Highway 473 to the Wharf security gate [Nelson et al., 2018]. Unpaved roads on the Wharf Mine property and around the mine property are maintained by Wharf to accommodate light vehicle and heavy equipment traffic required for daily mine operations [Nelson et al., 2018]. Public roads are not anticipated to be impacted with this proposed expansion. No public traffic roads will be located within the proposed Boston Expansion (only temporary haul roads), and current access roads will not need to be rerouted to accommodate the Boston Expansion (Exhibit 22). The access road will be rerouted back to its original location as part of the currently permitted mine plan. The traffic level will be similar to the current level. Daily traffic includes approximately 10 semitrucks, 10 small trucks or vehicles for miscellaneous deliveries, and 50 to 120 employee vehicles. Public traffic also occurs via the access road to Preston Road and Preston Trail. In 2020, the mine employed 257 individuals. The mine maintains 172 parking spaces, including 1 handicap space.

Potable water is supplied to the Wharf Mine by Well PW-2, which is completed in the Madison Limestone Aquifer. Following chlorination treatment, water is stored in two 5,000-gallon concrete reservoirs before being distributing to various mine facilities [Nelson et al., 2018]. This treated, potable water is also sent to a fill station where portable tanks are filled for drilling purposes [Nelson et al., 2018]. No change in water usage or disposal is currently anticipated with the proposed Boston Expansion. Structures at the Wharf Mine are served by its own wastewater treatment system, and solid waste is collected by private contractors and transported to the state-approved landfills [Madden, 2021]. No change to the mine's wastewater treatment system or the solid waste generated/disposal is expected with the proposed Boston Expansion. Existing signage along the road to the mine informs and directs the public, deliveries, and personnel to the site [Nelson et al., 2018].

Per SDCL 45-6B-36, Wharf will submit deviations to the originally approved operating and reclamation plans, reclamation accomplished, a map, and an annual fee on an annual basis.

5.1 CONSTRUCTION PHASE

The approximate timeline for the site preparation, mining, and reclamation phases of the Boston Expansion area is shown in Table 5-1 and will be adjusted based on the approval date of the CUP and Large-Scale Mine Permit. The following activities for the Boston Expansion are planned:

- 2023: Site preparation, including tree clearing and soil salvage will begin in 2023 but will be concurrent throughout the life of the mine.
- 2023–2029: Active mining, with mining the west side of the Boston Pit first and the east side last.
- 2023–2030. Reclamation will be conducted concurrent with mining. Reclamation of the west side of the Boston Pit will be initiated after mining in that area is complete (2023–2024), and the east side of the Boston area would be one of the last places reclaimed.

Table 5-1. Wharf Expansion Project Mine and Reclamation Schedule

Task	2023	2024	2025	2026	2027	2028	2029	2030
Site Preparation								
Active Mining Boston Pit								
Grading During Concurrent Reclamation								
Reclamation Boston Pit								

Because the Boston Expansion area is so small (especially in comparison to the Green Mountain expansion in 2011), there are not separate "phases" of mining for the Boston Expansion as it's merely incorporated into the existing mine phase of mining the Portland Ridgeline.

Mining the Boston Expansion area involves changes to utility system locations. The proposed changes shown on Exhibit 24 in Appendix B are preliminary, and the location of the rerouted lines will depend on utility company input. Water, telephone, gas, and power lines will need to be relocated. The power and water lines service the public; however, the gas and telephone lines to be rerouted only service Wharf. Black Hills Power, Inc. would reroute the power line, Montana-Dakota Utilities Company would reroute the gas line, and Vast Broadband would reroute the telephone line. Wharf will hire a private third party to reroute the water line.

5.2 GENERAL MINE PLANNING AND DESIGN

Mining of the Boston Expansion area will coincide with mining and reclamation in the current permitted areas. During the majority of the mine life, ore and rock will be extracted from the Boston Pit within the Boston Expansion to produce a uniform ore grade for processing.

The size of a given area to be worked at any given time will vary because of the diversity of the deposit and the need to maintain a reasonably constant grade and level of rock production. Each individual mine working area will generally range from 15 to 30 acres. However, the total area of mining,

backfilling, dumping, and reclaiming can be expected to approach the proposed affected acreage at certain times.

Also inherent to the mining industry is the natural tendency to minimize the amount of unmineralized rock and spoil produced. Before permitting a pit, the projected production costs are incorporated into a computer mining model that also contains the exploration drilling data. This model runs iterations of mine development until the model is optimized into a final pit configuration. The final configuration represents a pit that maximizes the profitability, thus minimizing the overall costs. Unmineralized rock represents no economic viability; therefore, the unmineralized rock will be minimized through the modeling and pit design process.
RESPEC conducted a slope-stability analysis of the ultimate (or maximum) pit for expanding the Portland Pit in the Boston Expansion area and the Green Mountain Pit [Fritch and Haugen, 2021]. A copy of this report is included in Appendix P. Based on those results, Wharf's experience in nearby pits (e.g., the Foley, Trojan, Harmony, Liberty, American Eagle, and Green Mountain Pits), and data from exploration drilling, the highwalls in the Boston Pit will be constructed in a similar manner. The highwalls will be constructed with overall pit slopes between 45 and 52 degrees, depending upon rock type. Typical pit design consists of a 40-foot wall with a 20-ft catch bench. Any fill material will have a maximum slope of 34 degrees. As the pit is being developed, significant fracture systems will be mapped and monitored, and highwalls will be adjusted accordingly to provide long-term stability.

During mining, the orientation of the southern Boston Pit highwalls and rock types will be the same as the current walls found along this section of Portland Ridgeline but will be pushed back a few hundred feet to the south. These areas are initially identified from past mining of this area and previous and historical exploration drilling programs, which were then incorporated into the pit designs. As the mine areas are developed, detailed mapping of altered zones and fractures are incorporated into the pit designs and adjustments made to maintain a stable highwall configuration.

The predominant fracture systems are near vertical and trend north to northeast within these rock types. The regional dip within this area is approximately 5 degrees to the south, which enhances the stability to the predominantly northeast-trending highwall. Measures will be taken to maximize highwall coverage during backfill sequencing, and no highwalls are anticipated to remain within the Boston Expansion area at closure.

The Deadwood Formation within the Portland Ridgeline area was mined sporadically by underground methods in the past by room-and-pillar-type stopes, which parallel the northeast-trending fracture systems. During normal mining practices, these stopes will be collapsed to provide safe mine access. Highwall and catch-bench configurations are adjusted based on the exact position of these workings to maintain a stable configuration within the collapsed zones. The similar fracture, stope, and highwall orientations within the Trojan, Foley, or American Eagle pits have not caused significant stability problems to date.

No additional mill sites, process ponds, or buildings will be constructed in conjunction with the Boston Expansion project. Existing facilities and ponds covered under existing mine permits will be used to process ore from the Boston Expansion. Flow diagrams for the crusher and process plant are provided on Exhibits 25 and 26 in Appendix B.

5.3 MINE DEVELOPMENT

5.3.1 SITE PREPARATION

The boundaries of all disturbed areas will be surveyed and physically marked before the onset of construction. Initial site preparation will begin with harvesting merchantable timber and other usable wood products. Topsoil and other suitable growth medium will be salvaged and stockpiled for use in the final property reclamation (Exhibits 27 and 28). The pit disturbance limits will be adequately fenced to limit access and provide primary security and safety.

To maintain access control to the Boston Expansion, a fence will be constructed that will surround all of the affected acres. No new gates will be installed along the perimeter fencing. Signs that warn of pit areas, active mine traffic, and blasting activity will be posted intermittently along the fence. The fence and warning signs will be constructed in a manner to prevent inadvertent entry.

As per MSHA requirements, a berm will be constructed between the Boston Expansion and the majority of the Last Chance subdivision to decrease noise and visibility of mining activity. The berm will be approximately 8 feet high, 12-14 feet wide at the base, with sides at the angle of repose and no steeper than 3:1, and constructed from pit waste material, covered with topsoil, and seeded (Exhibit 29). There may be minor variability in the berm due to terrain.

5.3.2 TREE CLEARING

Site preparation, including tree clearing and soil salvage will begin in 2023 but will be concurrent throughout the life of the mine. The affected lands within the Boston Expansion would be cleared in small increments to match the mine production needs. Tree clearing and mining will proceed from west to east in the Flossie area, initially beginning in early 2023. After the Flossie area is mined, tree clearing and mining will then commence at the east end of the project by Green Mountain and be directed west. Table 5-1 details the timing of the various activities associated with the Boston Expansion.

Undisturbed areas within the Boston Expansion may have trees and shrubs salvaged and transplanted as feasible. Potential areas for tree salvaging are shown on Exhibit 30. The timber not salvaged will be removed after an area is marked. If feasible, the marketable timber will be logged and sold. Any remaining trees or large slash will be grubbed and either piled and burned or disposed of in an existing rock depository. Disposed slash in the rock depository will be piled without creating "nests" to reduce the potential of subsidence problems. While removing all debris is difficult, the vast majority of native debris-type material will be hauled to a separate site for controlled burning or systematic burial.

5.3.3 SOIL SALVAGE HANDLING PLAN

All efforts will be made to salvage as much topsoil as possible in all areas. All salvageable soil within the clearing areas will be stripped using mine equipment and stockpiled at the existing Juno topsoil stockpile location. When possible, Wharf will directly haul topsoil to a targeted reclamation site. If surplus topsoil is available after these measures have been implemented, topsoil will be stockpiled on designated areas. The general location of the soil stockpile is shown on Exhibit 27 in Appendix B. The stockpile will be built at a stable grade (usually 3H:1V or shallower), bermed, and labeled with a placard saying "topsoil" per normal mine practices.

Any debris (e.g., large boulders, trees, and rootballs) that would hinder redistributing topsoil will be segregated as much as possible and removed and disposed of in an existing rock facility. Final segregation of any remaining large, non-soil components occurs during the dozer application of the topsoil veneer to reclaimed slopes, where the approximate 6-inch depth application forces any larger components out to the side. A suitable amount of topsoil is available from the Boston Expansion for reclamation; therefore, additional subsoil or a topsoil substitute is not anticipated for reclamation in the Boston area (ARSD 74:29:07:07(8)). No subsoil stockpiles are planned.

The topsoil stockpile will be regraded to a stable configuration, bermed, and seeded as soon as reasonably possible in a time frame not to exceed past the spring or fall seeding schedule immediately following placement of the topsoil stockpile (SDCL 45-6B-40).

Achieving 4 inches of cover over the 48.2 proposed disturbed acres of pit, road, and dumps within the Boston Expansion area will require approximately 25,921 yd^3 of topsoil. Approximately 28,383 yd^3 of topsoil were determined salvageable from the disturbed areas of the Boston Expansion area during topsoil salvaging (an average of 4.38-inches over 48.2 acres of proposed new disturbance); thus, approximately 2,462 yd^3 of surplus would remain. The current mine area will require approximately 606,392 yd^3 of topsoil for reclamation for a 5-inch coverage. Currently, 717,285 yd^3 of topsoil are stockpiled, which leaves a surplus of 110,893 yd^3. The total soil surplus from the Wharf Mine and the new Boston Expansion is approximately 113,355 yd^3. This anticipated surplus ensures that all areas will have adequate topsoil coverage after final reclamation with surplus soil used to increase coverage depth as available. Wharf understands the Board may approve of use of excess topsoil elsewhere at the mine (ARSD 74:29:07:07(6)).

5.3.4 PIT DEVELOPMENT AND SEQUENCING

Mining and reclamation will then be conducted along the Portland Ridgeline beginning in early 2023 through 2029 as provided in Table 5-1. The depth and direction of mining is shown on representative cross sections on Exhibits 7 through 10 of Appendix B. Because the Boston Expansion area is so small (especially in comparison to the Green Mountain expansion in 2011), there are not separate "phases" of mining for the Boston Expansion as it's merely incorporated into the existing mine phase of mining the Portland Ridgeline.

Pre-mining elevations within the Boston Expansion area range from 6,320 to 6,560 feet above mean sea level. Currently, the westernmost portion of the expansion area slopes to the southwest while the eastern half slopes and drains northward toward the existing Portland/American Eagle Pits. The projected final mine design pit elevation is shown on Exhibit 23 in Appendix B. The contours in Exhibit 23 show the final elevation of the pit within the Boston Expansion, which ranges from approximately 6,260 (deepest part of the pit) to 6,640 ft elevation. The contours also show the adjacent mining area elevations.The maximum pit depth of approximately 320 feet will occur in the Flossie area (south of Sunshine/Portland).

Mining of the Boston Expansion will begin in 2023 upon permit approval and continue through approximately 2029, as Wharf mines the pit and pushes back the current highwall along the Portland Ridgeline. The Boston Expansion area will begin to be prepared inearly 2023 with concentration on

clearing trees, grubbing, removing topsoil, and prestripping. Mining will proceed from west to east in the Flossie area, initially beginning in early 2023. After the Flossie area is mined, mining will then commence at the east end of the Boston Expansion by Green Mountain and be directed west. The majority of the prestrip waste will be hauled to the Green Mountain area for backfill material during the first year of production in this area and later for backfilling the far east end of the Boston Pit for final reclamation. All proposed haul roads will be contained within the new pit (see Exhibit 22 in Appendix B), and these haul road configurations are expected to change frequently.

The majority of the Boston Expansion area will be mined concurrently with Portland (because it is a highwall pushback) so the last section of the Boston Expansion area will be mined out in 2029 (the end of mine life). Backfill would be concurrent with mining, following shortly behind the areas that have been mined out. For example, West Flossie is scheduled to be mined out in October 2023 and backfill would begin soon after that in approximately November 2023. Waste rock will be placed within the entire full pit extent within the Boston Expansion shown on Exhibit 23 and labeled as backfill on cross-sections in Exhibits 32 through 37. No spent ore will be placed in the Boston Expansion; spent ore derived from the Boston Expansion project will be placed in the American Eagle POP as shown on new Exhibit 38.

5.3.5 BLASTING AND VIBRATION

Wharf will continue to use blasting agents (an ammonium nitrate and fuel oil based bulk explosive), storage, and blasting techniques in the Boston Expansion that are standard for the mining industry and are currently in practice at the Wharf Mine and within the established industry standards (RI-8507, Siskind, et al., 1980) (SDCL 45-6B-6(8)). Blasting will be conducted by a local licensed contractor.

In accordance with federal regulation, blasting will only occur during daylight hours. Representative blasts within all mine areas will be monitored for noise and ground vibration at the nearest or appropriate structures. Based on the monitoring results, blast designs (which include hole depths, hole sizes, hole spacing, stemming depths, explosive used, row orientations, timing and delay systems, and blast size) will be adjusted to prevent excessive dust, noise, and vibrations that could cause structural damage to buildings adjacent to the mine area by using industry and U.S. Bureau of Mines standards (ARSD 74:29:02:04(6)). No structures exist within 200 feet of the proposed affected acreage for the Boston Expansion (SDCL 45-6B-32(4)).

Wharf's current blasting procedures do not generate excessive dust, noise, and vibration beyond safe standards recognized by the U.S. Bureau of Mines. Current blasts at the existing Wharf Mine are drilled on approximately 16-foot × 16-foot patterns with 6.5-inch-diameter holes drilled 23 feet deep. Each blast contains from 50,000 to 100,000 tons of rock. Typically, 2–3 holes are shot per delay. Stemming height, blasting agent, timing between delays and rows, and the initiation row are adjusted to control shot movement, hole cutoffs, air blast, fragmentation, and vibration. Good housekeeping procedures to avoid spillage of blasting agent and misfire prevention systems are in place to minimize excess nitrates within rock facilities.

The spill plan for undetonated or spilled blasting agent is use a shovel and 5-gallon buckets to clean up small quantities of approximately 10–15 gallons in size; larger spills will require small loader and dump trucks or vacuum trucks to clean up the material. Material will then be used immediately back in an unshot blast to be detonated or mixed back in within the blasting agent holding tank or truck for later

use. Any soil or subsoil that is contaminated by the blasting agent will be excavated and placed in the contaminated soil storage bin to be disposed of at an appropriate contaminated soil disposal site.

Wharf will use blast procedures within the Boston Expansion that are similar to the rest of the permitted Wharf Mine operation; because the Boston Expansion is a small expansion adjacent to existing, ongoing operations, Wharf expects noise and vibration levels at adjacent properties to be minimal and similar to present conditions. Wharf is also committed to the trial and use of new technologies. Sound and vibration levels associated with blasting can potentially be further reduced by using new procedures or products that may be developed in the future. Wharf will comply with federal and industry standards for ground vibration and air noise when blasting in proximity to residential structures.

Wharf has historically monitored blast vibration with seismographs along the southern permit boundary and actively monitors blast vibrations and effects on the surrounding area resulting from blasting activities to ensure that the maximum allowable criteria are not exceeded. The maximum accepted level for ground vibration before structural damage could occur is 2 inches per second peak particle velocity at 40 Hz, though Wharf plans to target 0.75 inches per second at the Wharf property boundary as the threshold for potential drywall damage The maximum accepted level for air blast before damage could occur is 136 dB [Siskind et al., 1980].

RESPEC reviewed and analyzed the blasting documentation and blast vibration data for Wharf to predict blast vibrations at structures near the limits of the proposed Boston Expansion. A total of 105 data points were reviewed for blasting operations in the Flossie, Sunshine, and Portland Pits and verified by RESPEC to have been collected according to industry standards. RESPEC's review of collected data determined that the blast vibrations resulting from active operations and the current blast plan and design used by Wharf were within the established industry standard blast vibration limits as determined in RI-8507 [Siskind, et al., 1980]. All future risk will be significantly mitigated through detailed design and planning of blasting operations. Wharf will continue to monitor, predict, and review blast vibration as the mining operations progress to the south. The blast design/plan will be designed and managed by Wharf to maintain resulting blast vibrations below any potential damage thresholds. Currently and historically, Wharf has followed this procedure (which includes shot direction and lower powder factor) so that structures that fall within a close radius (usually less than 500 feet) do not sustain structural damage.

Seismographs will be placed at the Wharf property boundary at locations between the closest structures and mining operations. The seismographs will monitor active blast vibrations, help predict the blast vibration levels at the nearby structures and be used to maintain blast vibrations below set limits. These actions will allow Wharf to effectively ensure the safety of the public and protect nearby structures.

Typically, Wharf will blast only during daylight hours on weekdays. However, special circumstances because of weather or other unforeseen delays may require very limited weekend blasting. According to Mine Safety and Health Administration (MSHA) Regulation 30 CFR 56.6306(d), all blasts must be detonated within 72 hours of being loaded; blasts can be delayed longer only if MSHA is notified. If weather conditions (e.g., temperature inversions or cloud cover) are unfavorable to maintain a minimum

air blast, the blast will be rescheduled as much as is safely or operationally feasible until more favorable conditions are present.

Fugitive dust or residual blasting agents from blasting operations at the existing Wharf Mine has not been a problem to date, as evidenced by historic air-quality data. Blasts being of short duration, sufficient moisture content of the rocks (approximately 4 percent from crusher samples), and particle size generally do not generate excessive dust. Mitigation plans to reduce fugitive dust include visually monitoring blasts to determine if excessive dust is being generated and reviewing and adjusting blasting procedures to minimize fugitive dust. Selective blasting occurs only under favorable wind and weather conditions to ensure dust from blasting is not directed toward nearby landowners. (Prevailing wind direction is from the northwest to southeast (see meteorology report in Appendix H).) Additionally, DANR is notified of shots on a daily basis so that they may independently monitor the blasts.

Blasting fumes are also a potential hazard associated with blasting operations. When an ammonium nitrate based bulk explosive detonates completely or ideally, the primary gases produced are water in the form of steam (H_2O), carbon dioxide (CO_2) and nitrogen (N_2). If a non-ideal detonation or deflagration occurs, toxic gases are created, including nitrogen dioxide (NO_2), nitric oxide (NO) and carbon monoxide (CO). Of all these gases produced from blasting, NO_2 is the only blast fume that has color and can be more readily identified by its yellow to dark orange color depending on concentration and temperature. It should be understood that all nitrate based bulk explosives performance and the amount of toxic fumes produced are adversely affected by, for example, changes in pressure, temperature, confinement, diameter, and exposure to water.

The use of appropriate priming and bulk explosive loading techniques can help to control fumes. All bulk explosives begin to degrade once they have been loaded into the blastholes. The amount of degradation depends on the explosive quality, water conditions and the loading technique used. In ground that is known to produce excessive fumes, it is recommended that the blast be shot the day of loading. This may not always be possible due to wind conditions or production constraints, but is set as a performance goal. Because the blasthole conditions at the Wharf operation are anticipated to be dry, it is not likely that excessive fumes will be produced, as long as explosive products that meet manufacturer and design specifications continue to be used.

5.3.6 WATER MANAGEMENT AND EROSION CONTROL DURING MINING

During mining operations, no permanent erosion-control structures, diversions, or permanent impoundments are planned because all precipitation will drain into the pit. Temporary sediment-control structures (e.g., hay bales, wattles, and silt fencing) will be constructed upgradient or downgradient of disturbed grounds as necessary to control runoff from leaving the property and is a continuation of existing methods. These sediment-control devices are highly effective during the early stages of site disturbance and has been demonstrated before reestablishing vegetation at the active Wharf Mine.

Following ground disturbance, disturbed areas will be prepared and seeded with an appropriate seed mixture (see Section 6.5) to accelerate land rehabilitation and further reduce the potential for soil erosion. The haul road disturbance will be limited to within the active pit. Wharf will stabilize temporary topsoil windrows and stockpiles associated within exploration in the Boston Expansion area by

interim seeding, weed control, and temporary erosion control measures (straw bales and waddles) as needed.

As the Boston Expansion area is above and an extension of the existing Portland Ridgeline Pits, there are not stand-alone stormwater features planned in the Boston expansion area. It will, however, as part of the active Wharf Mine, still be subject to the site SWPPP. As such, standard BMPs such as silt fence, straw bales, straw wattles, or water bars may be employed periodically if operational access and safety warrant. Wharf does not plan any permanent diversions, including storm water diversions, for the Boston Expansion area.

The SWPPP addresses active and inactive mining areas, including: sedimentation ponds, Ross Valley Spent Ore Facility, Juno/Foley Spent Ore and Rock Facility, Reliance Rock and Spent Ore Facility, Cleopatra Rock Facility, Trojan Rock Facility, Bald Mountain Reclaimed Tailings Area, Annie Creek Mine, Foley Ridge/Annie Arm Mine, Clinton Extension, Portland Mine Area (including the Boston Expansion), Plant Area in McKinley Gulch, Nevada Gulch Reclaimed Tailings/Mine Site, American Eagle Pit Rock and Spent Ore Facility, Green Mountain and Bald Mountain Pit Rock Facilities, Golden Reward Pits and Rock Facilities, inter connecting haul roads, EXNI drill trails, and storage areas.

There are areas which due to topography, activities, or other factors that may have potential for soil erosion. These include areas of the rock and spent ore facilities which have not yet been re-graded, re-contours and seeded; and parking and work areas around the processing buildings, office, and crushing area. Structural, vegetative, and/or stabilization measures which may be used to reduce erosion and sediment load, will include construction of diversion channels, lining channels with natural materials to reduce channel flow, grading areas to reduce rate of runoff, placing silt fences, straw bales, and re-seeding and mulching as appropriate.

The SWPPP contains a narrative consideration of the appropriateness of traditional storm water management practices (practices other than those which control the source of pollutants) used to divert, infiltrate, reuse, or otherwise manage storm water runoff in a manner that reduces pollutants in storm water discharge from the site. The SWPPP provides that measures determined to be reasonable and appropriate shall be implemented and maintained. The potential of various sources at the facility to contribute pollutants to storm water discharges associated with industrial activity shall be considered when determining reasonable and appropriate measures. Appropriate measures may include: vegetative swales, diversion to potential wildlife habitat, and reuse of collected storm water (such as for a process or as an irrigation source).

5.3.7 RUBBLE SITE CONDITIONS

Wharf maintains a Construction and Demolition Debris permit through the SD DANR (permit number GPCD 17-34-011, valid through April 6, 2027). Wharf proposes to continue placing mining-related rubble/construction and demolition debris in the permitted rock disposal areas of the Wharf Mine. Acceptable materials for disposal include rubble/construction, demolition debris, and other waste-building materials that result from construction, remodeling, repair, and demolition operations on pavements, houses, commercial buildings, and other structures. Other disposable materials include slash from tree-clearing activities and ash from slash burned under the regulation of Forest Service burn permits.

Unacceptable material would consist of regulated asbestos-containing material as defined in the National Emissions Standards for Hazardous Air Pollutants 40 CFR part 61, petroleum-contaminated soils, herbicide/pesticide containers, car batteries, tires, putrescible waste, yard wastes, and hazardous or special wastes, as defined by ARSD 74:27:07:01.

Self-imposed restrictions regarding the disposal of the above-listed acceptable materials are as follows:

1. No rubble/construction and demolition debris shall be accepted from an outside source. Only the above-listed acceptable materials generated at the Wharf Mine will be placed in the rock depositories.
2. All slash and burned material disposed of in the rock depositories will be pushed so as not to create a "pocket" of rubble.
3. All rubble/construction and demolition material will be covered by the rock disposed of in the site.
4. The disposal sites will not be located within 300 feet of surface water as defined by ARSD 74:27:07:01.
5. The disposal sites will not be located within 1,000 feet of any occupied dwellings.
6. The active disposal sites will not be located within 200 feet of the mine permit boundaries without written approval of the adjacent property owner/owners.
7. The disposal sites will not be within 500 feet of any private or public well that supplies drinking water for human consumption.
8. The disposal sites will not be located in a 100-year flood plain.
9. The disposal site will not be located in a wetland as defined by ARSD 74:27:07:01.
10. The site will not be located within the incorporated limits of any municipality.
11. The site will not be located where the depth to an aquifer (as defined by ARSD 74:03:16:01 (1)) is less than 10 feet.

Records shall be maintained and include, at a minimum, the following:

- A copy of the permit approval letter from the SD DANR.
- The date on which the disposal of rubble/construction and demolition debris commenced.
- Names, dates, and nature of any complaints received concerning the disposal of rubble/construction and demolition debris.
- Dates when open burning occurs.
- A description of the debris, the estimated tonnage, and the sources.

All refuse not defined in this section will be disposed of in an approved landfill that complies with the South Dakota solid-waste regulations. Any potential acid-forming material mined from the pit area will be disposed of according to Wharf's Mitigation Plan for AGP rock. All other hazardous wastes will be handled in accordance with South Dakota hazardous waste regulations.

5.4 PIT BACKFILLING

The entire proposed Boston Expansion pit area will be backfilled with barren waste rock. Spent ore currently on the pads and that associated with the Boston Expansion will be off-loaded to an approved area within a designated POP.

Wharf owns or controls all surface and mineral rights within all proposed spent ore disposal areas. Currently Wharf holds five GWD permits (GWD 1-88, GWD 1-94, GWD 1-98, GWD 5-88, and GWD 1-11) that include four at Wharf and one at Golden Reward. The Wharf Mine is currently permitted to place spent ore from the leach pads in Ross Valley, the Juno Cut, Reliance Depository, the Foley Pit, and the American Eagle Pit as part of current mine permits and GWD permits. These permits address such information as the following:

- The treatment method proposed
- The reasons for selection of the proposed treatment method
- The plans and specifications for the existing facilities used to treat the spent ore
- The plan of operation for the treatment of spent ore
- Sampling and chemical characterization of effluent before initiation of treatment (neutralization) (ARSD 74:29:05:06)
- Sampling and chemical characterization during treatment (neutralization) to meet off-load standards, including solids and effluent sampling
- The standards (groundwater and/or surface water) to be met before offload
- Locations for spent ore disposal
- Reclamation Plans for all areas scheduled for spent ore disposal.

Storage of the treatment reagents at the Wharf Mine is addressed in Wharf's Spill Prevention Control and Countermeasure Plan (provided in Appendix P) (ARSD 74:29:02:11(10)).

The rock production throughout the mine life will be prioritized as pit backfill whenever operationally feasible. Backfilling pits with discard rock and spent ore aid in reclamation through the means of concurrent reclamation. As pit areas are mined to completion, dump areas are begun in the finalized pit area to meet the reclamation plan. This minimizes the amount of area at any time being unreclaimed and ensures continued backfill and land reclamation. With this practice, the environmental impact is reduced by returning the land to an atheistically pleasing design that fits in with the surrounding undisturbed land. Included in the final backfill of the Boston Pit and immediately adjacent pits will be approximately 66.5 million tons (MT) of barren waste rock.

Mining in the Boston Expansion area will include approximately 6.5 MT of ore that will be processed for gold. The material will be neutralized and denitrified on the heap-leach liners and be disposed within one of Wharf's POP boundaries under a GWD permit. The spent ore will meet the required pad off-load criteria set within the GWD permit. Beginning in 2021, approximately 34 MT of ore remain within the current permitted area and the Boston Expansion area. Of this amount, 27.5 MT are within the current permitted area and approximately 6.5 MT are within the new Boston Expansion area. The 34 MT and the approximate 10 MT of ore currently on the heap-leach pads will be unloaded to an approved disposal location or POP. The spent-ore unload and deposit schedule is shown in Table 5-2.

The final heap-leach pads are anticipated to be unloaded in 2029 after final recovery is met and the pads have completed neutralization and denitrification (in-place) and met the required off-load standards.

Table 5-2. Spent-Ore Unload Schedule

Year	Tonnage (MT)	Pad Unload
2022	3.4	Pads 1 and 2
2023	3.5	Pads 1 and 4
2024	5.4	Pads 3 and 5
2025	4.8	Pads 1 and 2
2026	5.6	Pads 4 and 5
2027	3.8	Pads 2 and 3
2028	5.0	Pads 1 and 4
2029	2.3	Pad 5
Total	34	

Concerning ARSD 74:29:05:05 through 12, all spent ore that is planned to be off-loaded to an unlined area will meet the necessary off-load criteria and will be unloaded within a designated POP boundary. All spent ore subject to the above will be treated by in situ treatment through bio-denitrification within the heap-leach pad system before unload. Treatment of the spent ore will occur during the neutralization cycle of the pad before offload. Treatment by this process (in situ) has been successful on current denitrification pads; Wharf's operation is set up for this type of process and is most feasible. All treatment reagents for this process are currently stored and used on site; the storage facilities for the reagents pass all applicable storage laws. When the pad has been determined neutralized/denitrified, the effluent solution from the treated pads will undergo off-load sampling protocol to ensure that the solution passes groundwater discharge standards. After the spent ore has been cleared for off-load, the material will be suitable for use in backfill of pits for reclamation. The final pads to be off-loaded will be used to help cover the remaining highwalls within the Portland Ridgeline area along with waste material in the backfill.

Before initiating treatment (neutralization/denitrification), the pad will undergo the required effluent sampling of pore water for the required parameters and will be monitored throughout the treatment process. Off-load of each pad in treatment will be determined by the final off-load sampling protocol set and approved by the SD DANR. If any pad(s) cannot meet treatment standards, the pad(s) will need to be evaluated on how to prepare for final reclamation, and a plan set and agreed upon with the SD DANR will be implemented so that the material will not negatively affect the environment.

Highwall areas within the Boston Expansion will be backfilled and sloped to 3H:1V or shallower. The Boston Expansion will be completely backfilled with waste rock, and no highwalls will remain.

Conceptual configurations of postmine land use of the affected pits are shown on Exhibits 31 through 37 of Appendix B.

5.5 GOLD PROCESSING PHASE

Processing of gold will not change at the Wharf Mine process plant as a result of the Boston Expansion. Ore from the Boston Expansion area will still be crushed at the Wharf crushing plant (Exhibit 25), and gold will be heap leached on each of the five existing process pads. No additional surface disturbance from facilities will occur (ARSD 74:29:07:02:1). The impact to the process end of the gold recovery circuit will not be affected by the rate of mining in the Boston Expansion or the specific geology of the ores; both of which are nearly identical to the current mining operation.

5.6 PROCESS SOLUTIONS

The process solutions will remain the same as current operations. The leaching of gold and silver uses several chemicals in the overall process flow sheet (see Exhibit 26 of Appendix B). A general chemical description of the process solution includes high alkalinity (pH = 10.0), a relatively high level of dissolved solids, a generally even distribution of anions and cations, and a number of metals. The majority of these chemicals are below drinking water standards.

Lime is added to the ore during the crushing stage to buffer the process solution and maintain a basic pH of approximately 10. Liquid sodium cyanide is added to the process solution before being applied to the leach pads. Typical cyanide values range from 50 to 60 ppm in the solution. The pH of 10 in the process solutions prevents hydrogen cyanide (HCN) gas from forming.

The process solution is percolated through the leach pad to dissolve gold and silver. The gold- and silver-laden process solution is then routed through and adsorbed onto activated carbon. The carbon is then removed and put through a high-pressure stripping process. This stripping process removes the gold and silver from the carbon and then electroplates the gold and silver onto steel wool cathodes. Liquid sodium cyanide and sodium hydroxide (caustic) are used in stripping process solutions.

Before the carbon is put back into the main process stream, the carbon is thermally reactivated. Antiscalent is also used in the process solutions to reduce the amount of carbonate and scale growth.

To off-load spent ore from the heaps, the material must be neutralized to meet several groundwater parameters. This is accomplished by adding hydrogen peroxide to the neutralization pond, which oxidizes the cyanide. The solution is then streamed through a series of carbon columns which removes particular metals to the required levels for discharge.

Nitrate is removed from the neutralization solution by a biodenitrification plant or through batch treatment within a pond using denitrifying bacteria. The bacteria lower the nitrate level within the solution to meet the groundwater standard so that it may be discharged (if necessary). Spent ore may also be placed onto a denitrification liner where denitrifying bacteria in solution is applied to the spent ore to lower the nitrate levels.

Spent ore may also be unloaded into pits for backfill if the material meets the necessary off-load requirements or within a designated POP boundary with specified criteria for groundwater discharge and the appropriate GWD permits. Before initiating treatment (neutralization/denitrification), the pad will undergo the required effluent sampling of pore water for the required parameters and will be monitored throughout the treatment process. Off-load of each pad in treatment will be determined by the final off-load sampling protocol set and approved by the SD DANR. If any pad(s) cannot meet treatment standards, the pad(s) will need to be evaluated on how to prepare for final reclamation, and a revised plan set and agreed upon with the SD DANR will be implemented so that the material will not negatively affect the environment.

Per ARSD 74:29:02:11(12), average concentrations or consumption rates for the major chemicals used in the processing of ore are shown in Table 5-3. Other parameters monitored in the process solution include sulfates, chlorides, nitrogen species, and several required metals. The current spill contingency plan for Wharf Mine and the Expansion Project is provided in Appendix P.

Table 5-3. Average Chemical Concentration or Consumption Rates

Chemical	Consumption Rate
Cyanide	~50–60 ppm
Lime	0.9–1.5 pounds per ton (lbs/ton) ore
Caustic	20 lbs/ton strip solution
Antiscalent	2–4 ppm
Hydrochloric Acid	25,000 gallons per year
Ammonia	0.4 lbs./ton solution
Hydrogen Peroxide	15 ppm
pH of Leach Solution	9.5–10.5

5.7 PROJECT WATER REQUIREMENTS

Water requirements for the Boston Expansion will be similar to current water usage. Water requirements related to the open-pit, heap-leaching process are limited to a few basic areas. Water is needed in the leaching process to leach fresh ore on the pads. A majority of this water requirement is achieved through natural precipitation. Approximately 60 million gallons of water per year are required for leaching new ore. Of this amount, roughly 50 to 55 million gallons are provided by precipitation. Other makeup water is available from the pad draindown. During the hotter summer months, makeup water is required for dust control. Although a chemical treatment (magnesium chloride) is used during these months, an average of 65,000 gallons per day (45 gpm) of water is required to maintain acceptable dust levels, although water usage for dust control depends on season and weather. Up to 100,000 gallons per day can be used during the hottest and driest portions of the month.

The normal road-watering season runs from May through October. Water is also needed throughout the mine site for general purpose needs, such as personnel hygiene, plant operations, equipment washing, crusher dust control, and building cleanup and maintenance.

Per ARSD 74:29:02:11(11), a summary of the approximate average annual water requirements is shown in Table 5-4 along with the location of the water source. At times throughout the year, this rate can range from 0 to higher than the average.

Table 5-4. Average Wharf Water Requirements

Requirement	Consumption (gpm)	Location
Process Make-up Water	25	PW-1 & PW-2 Wells
Process Treatment Water	150	PW-1 & PW-2 Wells
Dust Control	45	Precipitation and Treated Water
Fresh Ore	100	Precipitation and Pad Draindown
General Use	5	HDH-8A & PW-2

5.8 SPENT ORE DISPOSAL

Spent ore is scheduled to be deposited within the American Eagle POP boundary (Exhibit 38). The approximate location of spent ore disposal of material specifically from the Boston Expansion is shown in Exhibit 38. Denitrification pads will also be used for treating and disposing spent ore. In situ treatment of nitrates within the leach pads will be implemented to reduce or deplete nitrates in the spent ore before unloading (ARSD 74:29:05:05, ARSD 74:29:07:11, SDCL 45-6B-91). This practice will help in disposing spent ore and protecting the groundwater.

6.0 RECLAMATION PLAN

6.1 INTRODUCTION

The initial and most critical goal of reclaiming mined land is to stabilize the primary disturbance to reduce off-site impacts. The overall long-term objective of mine reclamation is to return future and past areas of disturbance to a beneficial land use after mining activities have ceased. During the period of active mining, disturbed lands will be managed through revegetation techniques, sediment control, dust and noise suppression, and management of noxious weeds to minimize impacts to land, water, air, wildlife, and humans. As mining is completed within various portions of the permit area, long-term reclamation treatments will be implemented to ensure that a stable and environmentally sound postmining land base is created. Pursuant to ARSD 74:29:07:18, the staff at Wharf that helped develop this reclamation plan have significant experience in developing and executing mine reclamation plans, as demonstrated by the well-established reclamation at Golden Reward as well as portions of the active Wharf Mine above Annie Creek and Ross Valley.

6.2 POSTMINING RECLAMATION PLAN

The formal land uses selected as the objective of this Reclamation Plan after projection completion is rangeland. This Reclamation Plan aligns with land-use objectives for the adjacent properties and will provide a beneficial use of the property at closure. This specific reclamation type was chosen because it will support the existing uses of the surrounding area. The conceptual proposed postmine land use and estimated acreage are outlined on Exhibits 31A and 31B in Appendix B. These maps are in the conceptual stage and will likely be modified as the Mine Plan progresses or opportunities to enhance the plan become available. The postmine topography and revegetation plan (shown on Exhibits 31 through 37 in Appendix B) will produce structural and biological diversity within a rolling mountainous and forested landscape.

ARSD 74:29:06:02
General Requirements for the Determination of Reclamation Type

The regulatory assessment submitted with this permit demonstrates that the affected land has the capability of meeting reclamation criteria of ARSD 74:29:07. All land surrounding the purposed mine expansion is currently used for mining, rangeland, and homesites, which demonstrates that the post mining land use of rangeland is compatible with surrounding land uses. The Reclamation Plan found in Chapter 6.0 of this permit details support and maintenance activities required for successful implementation. There are no critical earthen structures that require a stability analysis.

Wharf has had successful reclamation operations in similar conditions throughout other parts of the Wharf Mine. The primary land use on the proposed expansion permit has been rangeland for several years and this will be the postmining land use. There are no public agency interests in the proposed mine expansion lands.

The outline of bond costs found attached to the Reclamation Plan in Section 6.11 shows that the proposed operation is practicable on the basis of private financial capability of completion. The schedule found in Table 5-1 of Section 5.1 of this permit integrates mining operation with the

postmining reclamation and land use. The proposed rangeland land use is consistent with county land use plans and is of beneficial use to the owner.

6.2.1 MINIMIZING ADVERSE IMPACTS OF THE MINING OPERATION

Pursuant to ARSD 74:29:06:02, general requirements for determining reclamation type, and ARSD 74:29:07:02—, minimum reclamation standards, Wharf submits the following Reclamation Plan information.

The affected land has the capability of meeting reclamation criteria as stated in ARSD 74:29:07. Wharf's reclamation success is validated by the fact that the SD DANR already approved the release of reclaimed acreage at the Golden Reward Mine, which the Board of Minerals and Environment released Wharf from reclamation liability under Mine Permit 450 in 2009. The proposed reclamation type of rangeland (ARSD 74:29:07:20) is achievable for the areas affected by mining as outlined in the details of this Reclamation Plan (per ARSD 74:29:07:01).

Concurrent, interim, and final reclamation are being performed at the Wharf and Golden Reward Mines and will continue. Interim reclamation includes the seeding of the temporary topsoil stockpile. Examples of concurrent reclamation are applying topsoil and seed to partially backfilled and sloped areas of the Harmony Pit at Golden Reward and the American Eagle facility at Wharf while other portions of these same areas were still being backfilled and sloped. Recent examples of final reclamation being completed are the single lane area leading into the Golden Reward Mine and the American Eagle slope adjacent to Perkins Road at the Wharf Mine. Mining activities are now complete at Golden Reward Mine and final reclamation areas are evaluated annually by SD DANR.

In accordance with ARSD 74:29:07:02, the environmental impacts of mining will be minimized because surface disturbance will be phased to match mine production needs. For example, under ARSD 74:29:07:02(1), the mine operation will minimize surface disturbance through conducting concurrent reclamation. Lands will be cleared as mining progresses (ARSD 74:29:07:02(2). Visual screening of the Boston Expansion includes construction of a berm along the southern boundary of the expansion area and leaving vegetation to the extent practicable (ARSD 74:29:07:02(3)).

The construction of the mine pit, and location of waste dumps, spoil piles, and the topsoil stockpile have been located to minimize impacts to surface water and groundwater as the expansion is not within a perennial surface water drainage and no spent ore will be placed as backfill within the expansion (ARSD 74:29:07:02(4)). Only minor, if any, impacts on groundwater chemistry are predicted in association with extracting material and waste rock disposal [Hocking and Meuzelaar, 2021]. The presence of mine pits exposes additional rock surfaces to infiltrating water. Similar to the rest of the Wharf and Golden Reward Mine areas, the ore being mined in the Boston Expansion area has low concentrations of sulfide minerals and will not likely impact water quality.

Impacts on groundwater quality resulting from waste rock disposal may be similar to the groundwater impacts in nearby areas that have previously been mined and backfilled with waste rock. Examples of these impacts include increased nitrate concentrations in shallow wells within the Wharf permit boundary. Given these experiences, an increase in nitrate may occur below the Boston Expansion area. Based on historic observations and modeling of groundwater impacts from backfill at the Wharf Mine,

RESPEC infers that the increase in nitrate from blasting and waste rock disposal is not expected to exceed the groundwater standard of 10 ppm outside the proposed Boston Expansion permit area [Hocking and Meuzelaar, 2021].

Access to active mining areas will be controlled via fencing (ARSD 74:29:07:02(5) and SDCL 45-6B-42). As with the existing wildlife program at Wharf, monitoring raptor nest sites will continue with an emphasis on reducing or mitigating impacts to these sites during breeding season (ARSD 74:29:07:02(6)). The topsoil stockpile will be located on previously disturbed areas of the Wharf Mine to facilitate reclamation and minimize environmental impacts and waste rock will be used to backfill the expansion pit (ARSD 74:29:07:02(7)). The production of waste rock will be minimized to the extent practical to reduce economic and environmental impacts of the expansion (ARSD 74:29:07:02(8)).

No new facilities are associated with the Boston Expansion and mining plans have been designed so that they are compatible with the surrounding land uses including mining that is occurring immediately adjacent north of the expansion (ARSD 74:29:07:02(9)), and mine operations planning has been integrated with the Reclamation Plan (ARSD 74:29:07:02(10)). The expansion mine plan was designed to include a buffer between Wharf's property boundary and active mining operations as well as a berm so that once the upper mining bench is complete, visual and noise impacts to Lost Camp subdivision will be reduced. The expansion will have little to no impact, including visual impact, to recreation opportunities including the Terry Peak ski area.

6.2.1.1 GRADING AND EROSION CONTROL MEASURES

Grading and backfilling will be completed to achieve visually and functionally compatible contours with the surrounding area and enhance public safety and welfare (SDCL 45-6B-37 and ARSD 74:29:07:03). Grading will be performed to minimize surface runoff and reduce pollution potential as well as to ensure that the final topography is appropriate to the final land use of rangeland. Grading will occur after backfilling with waste rock. Grading is primarily completed with dozers and in a manner similar to established successful reclamation at other areas of the Wharf and Golden Reward Mines.

In accordance with SDCL 45-6B-42 and ARSD 74:29:07:04, all reclaimed slopes will be visually and functionally compatible to the surrounding area. As shown on the post-reclamation contours in Exhibit 31B compared to the current topography in Exhibit 2, the topography or landforms created during final grading of the Boston Expansion will closely mimic pre-mining topography, and as such will be compatible with surrounding areas. The western portion of the Boston Expansion that will be disturbed will be regraded to a similar pre-mining slope towards the southwest. The eastern portion of the Boston Expansion also currently slopes towards the southwest and will have a similar slope and drainage after reclamation.

Slope combinations will be suitable for the postmining land use of rangeland and structurally stable. Fill slopes will not exceed the angle of repose and final backfill slope angles will not exceed 3H:1V, making them functional and structurally stable. During final grading, minor undulations in topography will be randomly created on the landscape to promote the accumulation of water, which will in turn promote vegetation diversity and reduce runoff.

Topographic reconstruction will control erosion and sedimentation, protect areas outside the affected land from slides or other damage, and minimize the need for long-term maintenance. Erosion-control measures will be implemented during all phases of construction, operation, reclamation, and closure. Per the existing Wharf and Golden Reward SWPPP that is updated annually, erosion control measures within the proposed Boston Expansion will include sediment controls (BMPs) in place to reduce sediment in storm water runoff (see Section 5.3.6).

No new permanent sediment- or erosion-control structures are planned as part of the Boston Expansion. If erosion and sedimentation in any area become an issue during the reclamation period, temporary surface runoff diversions and erosion control structures (e.g., hay bales, wattles, and silt fencing) will be constructed in soils or unconsolidated materials and seeded as soon as practical. Were appropriate, temporary sedimentation and erosion control structures would be removed after affected lands have been revegetated and stabilized; small temporary structures such as hay bales may remain if they are degraded or removal would cause increased erosion.

The topographic grading itself will help reduce erosion because the original drainages will be preserved. No perennial, intermittent, or ephemeral streams occur in the Boston Expansion. However, the southwestern edge of the expansion currently has a draw that is oriented northwest in the Annie Creek watershed; this draw will not be disturbed or impacted during mining operations.

Berms are standard on all mine roadways per MSHA requirements, and Wharf also utilizes standard stormwater BMPs such as shallow water bars in roadways and small cutouts in berms as needed along haul roads, with somewhat flexible locations given their interim and temporary nature. The location of these BMPs is often season dependent, with snow removal and surface grading the usual drivers for small location changes to these BMPs over the course of a year. Straw wattles and/or bales are also utilized when and where needed as BMPs to help further slow flow and remove sediment.

Due to the fluid nature of these BMPs, Wharf requests the ability to make open-ended modifications to these sediment control BMPs in the field as per the existing site SWPPP. The ability to make routine modifications as needed will allow for operational safety, efficiency, and flexibility and ensure the ability to adapt sediment controls to best perform their intended function. These erosion control measures, BMPs, and grading, along with revegetation, will minimize the need for long term maintenance.

For the Boston Expansion, reclamation including grading, will generally occur from west to east as the pit expansion occurs and mining progresses. Backfilling and recontouring will be conducted concurrently with mining or as soon as practical, as specified in the mining schedule shown in Table 5-1. No highwalls will remain in the Boston Expansion area, and slopes will be stabilized and constructed to minimize negative visual impacts (ARSD 74:29:07:04(6)). No slides or earth movement are anticipated because the backfilled slopes would be graded at 3:1 or less and backfilled material has proven stable in other areas of the mine. Additional information on final pit bench and backfill reclamation methods are discussed in Section 6.8.1.

6.2.1.2 REFUSE DISPOSAL

All refuse from the mining operation, including garbage and rubbish, will be disposed of in an approved landfill according to SDCL 45-6B-38 and ARSD 74:29:07:05. Wharf maintains a Construction and

Demolition Debris permit through the SD DANR (permit number GPCD 17-34-011, valid through April 6, 2027). Only the allowable rubble and construction demolition debris will be disposed of at the permitted facility on site.

All hazardous wastes must be handled in accordance with South Dakota hazardous waste regulations in ARSD 74:28. The expansion is not anticipated to directly result in petroleum, cyanide, or other contaminated soil. Should any hydrocarbon spills occur in the Boston Expansion, Wharf will follow its established spill practice and remove any contaminated soil from the spill site and conduct confirmation testing as well as SD DANR reporting as required. Although, Wharf currently disposes of petroleum contaminated soil in a designated dumpster which is then tested and disposed of in the Belle Fourche landfill. Other contaminated soils are either neutralized in place or depending upon the type of contamination may be placed on one of the heap leach pads.

The combination of all of the geochemical testing indicated that the rock types to be mined in the Boston Expansion pits have little to no potential to produce acid rock drainage except within the Flossie West area. If encountered, acid-forming materials that have been mined will be handled and disposed of in a manner that is consistent with the existing Wharf Acid Rock Drainage Prevention and Management Plan as summarized in Section 3.1.4.7 of this application.

6.2.1.3 REVEGETATION

Initial revegetation will focus on meeting the needs for the rangeland postmine land use. Vegetation species, seed mixtures, and seeding rates are described in Section 6.6 of this Reclamation Plan and follow guidance of SDCL 45-6B-39 and ARSD 74:29:07:06. This seed mix is presently used on the Wharf Mine site and has been developed in consultation with the local Lawrence County Conservation District. During past consultations with the Lawrence County CD and the NRCS on the Wharf seed mix, the reclamation timeline occurring during the fall was acceptable, however NRCS has indicated that the best planting time would be in early spring before May 15 for a cool-season and warm-species species mix. Other seeding date options include a dormant seeding after November 1 or late spring from May 15 to June 15 or late summer from August 1 to September 1, and are dependent on conditions such as soil temperature and moisture, weed control and management, seedbed preparation and tillage equipment, and residue cover. At the mine site, seeding dates vary with soil temperatures, moisture conditions, and fluctuate annually up to two weeks depending on weather patterns and climatic conditions.

As with the existing Wharf and Golden Reward Mine sites, an active noxious weed-control plan will continue to be implemented. Section 6.6 of this plan describes the weed-control program in place at the Wharf Mine (ARSD 74:29:07:15).

Topsoil is a critical component to successful revegetation. Wharf has always endeavored to salvage as much native soil as possible. Topsoil management and seed bed preparation are described in Section 6.4 of this Reclamation Plan (SDCL 45-6B-40 and ARSD 74:29:07:07).

Wharf has successfully reclaimed overburden on areas such as the Trojan, Portland, Reliance, and Foley Pits as well as the Golden Reward Mine. The success of revegetation in subsoil is also evident in the Bald Mountain Historic Tailings Revegetation Survey [BarrXX Environmental Service, 1995]. The

historical tailings were covered in 1993 with rock overburden from two borrow areas. Little to no subsoil was used to cover the tailings because the subsoil was not available in the borrow area. Soil tests were completed after the tailings were covered with the rock overburden. As indicated by BarrXX Environmental Service [1995], the frequency of seeded species was especially good at all locations surveyed after 2 years of growth. The results also indicated that the established plants varied, as evidenced by the cover values. Since the 1995 vegetative survey, one more fertilizer application was applied in fall 1995. Select areas of limited vegetative establishment were also reseeded in 1995. Vegetative growth on the tailings was visually inspected in 1996 and appeared healthy and self-sustaining; some of the reclaimed grasses were producing viable seed. No other soil amendments and vegetative treatments are currently recommended at Bald Mountain. Noxious weeds (Canada thistle and tansy) have been identified in small communities on the upper and lower tailings. Wharf has and will continue to conduct an herbicide program at this site.

6.2.1.4 HYDROLOGIC BALANCE

All water rights and water quality laws will be adhered to during and after mining (SDCL 45-6B-41 and ARSD 74:29:07:08). There are no planned diversions of perennial or intermittent streams or channels and floodplain diversions that will affect area streams (ARSD 74:29:07:10). No permanent diversion structures or ditches are planned for the Boston Expansion. No permanent surface impoundments or water depressions are planned within the Boston Expansion project (ARSD 74:29:07:04 (4) and 74:29:07:11). Spoil topsoil or unconsolidated material will not be pushed or placed within 10 feet of any perennial or intermittent streams.

Unchanneled surface water will be controlled to the extent possible using temporary erosion control structures (e.g., hay bales, wattles, and silt fencing) and seeding soils or unconsolidated materials as soon as practical. Temporary sedimentation and erosion-control structures will be removed when no longer needed. See Section 6.2.1.1, Grading and Erosion Control Measures. Wharf is, and will continue to remain, consistent with the site SWPPP.

6.2.1.5 SPOIL PILES AND WEEDS

There will be no spoil piles other than waste rock piles within the pit that are used to backfill the pit within the Boston Expansion. Waste rock will be placed within the entire full pit extent shown on Exhibit 23 and labeled as backfill on cross-sections in Exhibits 32 through 37. Waste rock will not be placed in areas that block perennial, intermittent, or ephemeral drainages (SDCL 45-6B-43 and ARSD 74:29:07:14). Permanent waste rock depositories will be constructed to be stable, and the existing Wharf ARD Management Plan will be used to ensure that the depositories are not a potential source of water pollution. Noxious weeds infestations shall be controlled during all phases of the mining operation and reclamation.

6.2.1.6 SUBSIDENCE

Subsidence is not anticipated; however, measures will be taken to minimize damage to property and loss of property value and minimize hazards to livestock, wildlife, and humans (SDCL 45-6B-42 and ARSD 74:29:07:16). Historic workings within the Boston Expansion and general Wharf area are shown on Exhibit 5 in Appendix B. In the event any underground mine openings and workings or previously existing underground mine workings are intercepted by surface-mining activities, they will be sealed during reclamation as per ARSD 74:29:07:17. Two open mine surface features/collapses within the

expansion will be addressed prior to mining to mitigate potential bat habitat (see Section 3.7.3 and Appendix J).

6.2.1.7 FINAL RECLAMATION AND POST-MINING LAND USE

Final reclamation will commence as mining, rock deposition, and pit backfilling are progressively completed (see Section 6.7). The project schedule (Table 5-1) is provided in Section 5.1 of this permit application. This type of reclamation scheduling allows for concurrent reclamation costs; thus, the majority of reclamation costs subsequent to mining completion is reduced. As discussed in Section 6.10, the affected land areas will be bonded.

As per ARSD 74:29:07:20, reclamation will be completed when the affected land can support a livestock-carrying capacity that is equivalent to the surrounding area. As described in Section 6.2.2 Rangeland, Wharf has developed criterion states that useable forage production shall be at least 190 pounds per acre air-dry basis (ADB) during a dry-year, at least 275 pounds per acre during a normal-year, and at least 330 pounds per acre in a wet-year [Cedar Creek Associates, Inc., 2008]. Final reclamation will be complete when the reclaimed range is determined to be capable of withstanding proper stocking rates for 2 consecutive years. As per ARSD 74:29:07:23, reclamation will be complete when the affected land has been vegetated to control erosion. If determined necessary, newly seeded areas will be fenced to preclude livestock or wildlife (ARSD 74:29:07:20(3)).

Land within the vicinity of the Boston Expansion project is zoned Park Forest (PF), Highway Service Commercial (HSC), Recreation Commercial (RC), and Suburban-Residential (SRD). Extractive industries are allowed in all zoning districts by Lawrence County, subject to the acquisition of a CUP; CUP No. 470 for the Boston Expansion was approved in January 2022. The post-reclamation land use of rangeland has been reviewed by Lawrence County in the permitting process. All of the uses proposed in the postmine land use are options identified as minimum reclamation standards pursuant to ARSD 74:29:07. All of the proposed uses will benefit the local area, South Dakota, and the region in general.

Per SDCL 45-6B-44, Wharf consulted with the NRCS on the seed mix proposed for Wharf's 2010 Expansion and will use that same seed mix for the Boston Expansion area.

6.2.2 SPECIFIC POSTMINING LAND-USE TYPES

Surrounding land uses include mining, woodland grazing, residential development, tourist industry, recreational skiing, and snowmobiling. This permit proposes a multiuse Reclamation Plan for the areas proposed to be mined with this permit application (ARSD 74:29:07:18 and SDCL 45-6B-7(1)). The proposed specific type of reclamation is rangeland (woodland grazing).

A postmine land use of rangeland (woodland grazing) and homesites is currently approved for the adjoining Portland area of the Wharf Mine to the north of the expansion. The socioeconomic effects of the proposed postmining land-use options are described in Madden [2021] and provided in Appendix O.

Rangeland reclamation will follow guidelines established in ARSD 74:29:07:20. Most of the reclamation type currently in place at the Wharf Mine is rangeland or woodland grazing, and Wharf has developed reclamation practices to ensure that the requirements for reclaiming the land to rangeland are

accomplished by consulting with Cedar Creek Associates, Inc., the Lawrence County Conservation District, and SD DANR. Monitoring as per the recommendations outlined in Wharf Resources' Reclamation Performance Criteria document [Cedar Creek Associates, Inc., 2008] will determine reclamation success to ensure that the land has the capability to support a livestock-carrying capacity equivalent to the surrounding area. Note, the Reclamation Performance Criteria plan was part of a technical revision which was approved on April 7, 2008.

Appendix Q includes Wharf's site-specific procedures and protocols for revegetation monitoring and determination of successful revegetation. In order to determine success, Wharf has developed, in consultation with Cedar Creek Associates, Inc., the Lawrence County Conservation District, and the NRCS, a "Vegetative Ground Cover Criterion" that must have at least 40 percent live vegetative ground cover, excluding noxious weeds and a "Useable Forage Production Criterion" to determine useable livestock forage production during below average, average, and above average precipitation conditions to ensure that the rangeland postmine land use supports the livestock carrying capacity equivalent to the surrounding area [Cedar Creek Associates, Inc., 2008]. This criterion states that useable forage production shall be at least 190 pounds per acre ADB during years of below precipitation (dry-year), at least 275 pounds per acre during years of average precipitation (normal-year), and at least 330 pounds per acre in years of above average precipitation (wet-years) [Cedar Creek Associates, Inc., 2008]. Reclamation for this land-use type will be considered complete when the reclaimed range is capable of withstanding proper stocking rates for 2 consecutive years before bond release.

Slopes will not exceed 3H:1V unless the Minerals and Environment Board approves steeper slopes for areas to be used as rangeland. Newly seeded areas will be fenced, if necessary, to prevent livestock or wildlife from impairing establishment of the required vegetation.

6.3 CONCURRENT RECLAMATION

In accordance with ARSD 74:29:08:01, Wharf will conduct concurrent reclamation during all phases of the mining operation. In general, Wharf's concurrent reclamation plan and procedures are identical to the final reclamation plan described throughout Section 6.0 of this document.

Lands will be cleared and stripped in small increments as mining progresses to minimize surface disturbance (ARSD 74:29:07:02(2). After mining a section of the pit is completed, concurrent reclamation will include backfilling with waste rock, applying topsoil, and seeding. Concurrent reclamation will commence as mining, rock deposition, and pit backfilling are progressively completed. Concurrent reclamation and temporary sediment-control structures (e.g., hay bales, wattles, and silt fencing) will be the primary means of controlling erosion and sedimentation during mining.

A conceptual projected mining and reclamation schedule for features located within the Boston Expansion area as well as those remaining within the Wharf Mine is provided in Table 5-1. The sequence of reclamation within these various areas depends on the mining progress and may vary somewhat. Concurrent reclamation will be initiated on the west side of the Boston Pit after mining in that area is complete (2023–2024), and the east side of the Boston area would be one of the last places reclaimed.

6.4 INTERIM RECLAMATION

Interim reclamation is the process of temporarily stabilizing grounds that are scheduled to be re-disturbed before mining is completed by regrading and revegetation (ARSD 74:29:08). Portions of the project area that will receive interim reclamation treatments include the topsoil stockpile, exploration drilling areas, and all suitable peripheral areas (i.e., pit perimeters, fence, and power corridors) of disturbance. A minimal amount of interim reclamation work is anticipated. Interim reclamation methods will entail direct seeding areas without importing supplemental topsoil whenever suitable substrates exist. This method of revegetation has proven to be effective at the Wharf Mine such as on temporary exploration trails and portions of utility corridors. In accordance with ARSD 74:29:07:07(2), a portion of stockpiled topsoil may be used during interim reclamation; the productive capabilities will not be diminished, the soil will be protected from erosion by seeding, and the topsoil will be available for final reclamation. Straw mulch and/or fertilizer amendments may be applied at the time of seeding to further improve and accelerate planting success; however, such applications will be site specific and based on soil nutrient levels. Straw mulch additive can help retain moisture in drier years, so that option is retained for the Boston Expansion area.

The topsoil stockpile will be regraded to a stable configuration, bermed, and seeded in a short enough time span to prevent contamination and deterioration of the topsoil; the stockpile will be seeded as soon as reasonably possible in a time frame not to exceed past the spring or fall seeding schedule immediately following placement of the topsoil stockpile (SDCL 45-6B-40). Interim seeding will use the same seed mixture as the final seeding mixture provided in Section 6.5.2 to ensure that all interim reclamation is compatible with the final reclamation.

Seed mix for exploration reclamation were approved by the NRCS as included in Appendix Q.

6.5 SOIL REPLACEMENT AND SEEDBED CONSTRUCTION

6.5.1 SOIL REPLACEMENT

As soil is being salvaged, operators who are trained to recognize soil and suitable subsoils sort the soil materials as much as possible from the unwanted rock and debris. Achieving 4 inches of cover over the 48.2 proposed disturbed acres of pit, road, and dumps within the Boston Expansion area will require approximately 25,921 yd^3 of soil as described in Section 5.3.3. An estimated 28,383 yd^3 of salvageable soil will be available to be recovered from the project disturbance area (an average of 4.38-inches over 48.2 acres of proposed new disturbance); this amount is sufficient and results in a small surplus. The proposed topsoil stockpile is shown on Exhibits 27 and 28 in Appendix B.

6.5.2 SEEDBED CONSTRUCTION

Critical to establishing adequate vegetative cover is the initial condition of the seedbed. Based on Wharf's experience, revegetation is enhanced by creating a firm but irregular seedbed and is accomplished during the cover soil application by a dozer working on a slope.

A typical farmland seedbed is not possible to construct, nor is it a good analogy to Black Hills landscape soils, in these situations because of the terrain's steepness, available cover soil quality, and the amount of natural debris present in the material (e.g., small brush and rocks). Small trees, brush, stumps, and a lot of small to large rocks are often encountered and unavoidable during grubbing. Wharf does it's best

to avoid rocks and brush when stockpiling soil, but due to the large equipment used for soil removal this is not always practical. Larger debris are removed when stockpiling soil, and the majority of debris 6-inch or larger are effectively filtered out during topsoil placement due to the blade distance from the ground surface.

Wharf has found that after cover soil has been placed on the reclaimed area, the rough seedbed accelerates initial vegetative establishment, reduces runoff, and promotes the establishment of unique microclimates at the soil surface. The specialized microclimates provide different niches for the variety of plant species seeded into the cover soil. Ultimately, these niches provide for establishing a diverse plant cover and small mammal habitat.

6.6 SEEDING

Seeding can commence after cessation of mining and disposal of refuse and after the soil in an area is prepared (SDCL 45-6B-46.1). The Boston Expansion area has no areas with chemical or physical characteristics of the soil material that would be unsuitable for plantings or seriously inhibit growth that cannot be remedied by chemical treatment, fertilization, or replacement of overburden (SDCL 45-6B-46.2)

Seed will be sewn via the broadcast method or hydroseeding as soon as possible after the seedbed becomes available. A nurse crop seed mix will be used before or in combination with the final seed mix to attain a quick initial cover. The reclamation seed mixture is the same seed mixture approved by the NRCS under the 2010 expansion and used at Wharf in the past. Supporting documentation on seed mix, fertilizer, and weed management are included in Appendix Q.

6.6.1 NURSE CROP SEED MIX

The primary purpose of the nurse crop seed mix is to provide the disturbed area with a rapid initial vegetative cover that does not need to persist. Therefore, annual grasses are usually preferred to most other species. These plants provide a quick initial cover and rapid growth during the first year, which is imperative to controlling the erosion rate on newly regraded slopes. Because the plants are annuals, they do not persist in the revegetated landscape beyond the first year; however, the soil-anchoring characteristic will provide a benefit for a few years to come. The nurse crop seeding will be combined or followed with a more permanent seeding.

Inventorying the seed to assess its purity is also critical. The agricultural seed species are generally closely regulated for the amount of weed seed present in any particular seed lot. Table 6-1 outlines the nurse crop seed mix used at the Wharf Mine.

6.6.2 FINAL SEED MIX

The seed mixture chosen for the final vegetative landscape must meet the criteria for the designated postmining land use. In this case, the final use will merge with the adjacent reclaimed landscape at the Wharf Mine and fit into the rangeland/woodland grazing scenario. Therefore, the seed mix for this project will be very similar to that of the existing approved Wharf final reclamation seed mix, as shown in Table 6-2 and included Appendix Q. The final seed mix was developed from consultation with the

Lawrence County Conservation District and the NRCS and was based on soil types and range/woodland ecological sites present at Wharf to provide adequate cover for the proposed site reclamation.

This seed mixture was selected to provide the revegetated area with a variety of species—either native, adapted, or introduced. The goal in designing the seed mixture was to provide a mixture of species that would give the revegetated landgenetic, phenotypic, and structural diversity. Some species such as wildrye are tall erect species, while clover and hard fescue are low-growing plants. Such diversity provides a tiered approach to the vegetation and allows variable animal use while protecting the soil from water or wind erosion. Because of the elevation and climate, all species that appear in the mix are cool-season plants that will green up early and mature rapidly early in the season, which is critical because the growing season is generally less than 90 days.

Table 6-1. Nurse Crop Seed Mixture

Species	Pounds (pls/acre)[(a)]
Spring Wheat	15
Annual Ryegrass	2
Total	**17**

(a) pls/acre = pure live seed per acre.

Table 6-2. Final Reclamation Seed Mix

Species	Pounds (pls/acre)
Alsike Clover	1.00
Slender Wheatgrass	5.00
Western Wheatgrass	6.25
Thickspike Wheatgrass	6.00
Hard Fescue	2.50
Pubescent Wheatgrass	4.00
Big Bluestem	3.00
Canada Wildrye	1.00
Western Yarrow	0.50
Purple Praire Clover	0.50
Total	**29.75**

6.6.3 WOODY SPECIES REVEGETATION

Although the primary postmining land use for the Wharf Mine and the proposed Boston Expansion area is rangeland/woodland grazing, which do not require woody species revegetation (see ARSD 74:29:07:20), Wharf will include select woody species components to the vegetative community seed mix if natural encroachment of these species is not observed. The purpose of the eventual establishment of woody species in the final landscape is to provide visual diversity and hiding and consumptive cover diversity for domestic and wildlife grazing.

Woody species in the postmining environment will be planted in clumps and interspersed in groups of species rather than evenly spaced throughout the landscape. Some reclaimed acres will incorporate tree and shrub clumps while other acres will not. This technique allows using large expanses of forage-based areas while still providing breaks in the landscape provided by shrubs and trees. Trees and shrubs that have thrived in the Northern Black Hills will be planted in the best location suited for survival. Potential tree and shrub locations have not yet been determined but will determined based on timing of the grubbing activity and status of nearby disturbance suitable at that time.

Specific tree and shrub areas will be identified during the mine planning and reclamation development process. The trees and shrubs listed in Table 6-3 may be used in these areas. Tree pods of existing native vegetation will also be transplanted during the concurrent mining and reclamation process if practical based on abundance of juvenile plants and location of source and proposed transplant areas. Typically, juvenile plants have a higher chance of survival and adapting. Locations for planting tree pods will be determined after adequate slope reclamation has occurred, with tree pods transplanted close to nearby source locations being ideal. Exhibit 30 in Appendix B provides tentative tree transplant source locations from within the proposed Boston Expansion. In the Boston Expansion, woody species will be planted or transplanted in areas where snow drifts and precipitation accumulate following final grading.

Table 6-3. Reclamation Woody Species

Common Name	Species Name
Black Hills Spruce	*Picea glauca* (Moench)
Ponderosa Pine	*Pinus ponderosas*
Bur Oak	*Quercus macrocarpa*
Chokecherry	*Prunus virginiana*
Woods Rose	*Rosa woodsii*
Currant	*Ribus rubrum*
Quaking Aspen	*Populus tremuloides*

6.7 WEED CONTROL AND REFUSE MANAGEMENT

Wharf maintains an active weed-control program to control noxious weeds occurring on the property. Appendix Q includes an example of the weed control and reporting at Wharf. The program has the following objectives:

- Conduct a yearly property inspection.
- Identify locations of weed growth.

- Treat weeds annually through chemical control.

Weeds are typically sprayed during spring green up and when weeds become visible, typically in late spring or early summer depending upon precipitation. Locations are spot-checked as necessary throughout the summer months. Exact chemicals used are based upon weed type as well as the current Lawrence County approved list.

Weed control and refuse management are part of a much larger program of "housekeeping." Wharf's goal has always been to maintain the area disturbed by mining operations in an as-organized condition as possible. Wharf consulted with the Lawrence County Conservation District Board of Supervisors and the Lawrence County Invasive Species Management Department during previous mine permitting efforts and will continue this practice for the Boston Expansion project. Along with the weed-control program, Wharf manages refuse according to state and federal requirements.

6.8 FINAL RECLAMATION METHODS

The areas to be mined and reclaimed will be surrounded by a naturally hilly topography. Most of the hills surrounding the reclaimed pits and rock facilities are steeper than the reclaimed 3H:1V slopes proposed in this permit application. However, past reclamation at the existing Wharf Mine has used similar criteria and has proven to be visually and functionally compatible with the surrounding area. All slopes are designed at 3H:1V or shallower and will be seeded with the approved seed mix described in Section 6.5.

During reclamation, temporary erosion and sediment control on backfilled and sloped areas will be conducted as necessary to control runoff from leaving the property. Concurrent reclamation and temporary sediment-control structures (e.g., hay bales, wattles, and silt fencing) will be the primary means of controlling erosion and sedimentation during mining. There are no planned permanent sediment control structures associated with the Boston Expansion that will remain after reclamation is complete. Vegetation, in addition to the 3H:1V slopes, has proven successful in stabilizing the rock faces and controlling sedimentation for the long-range reclamation. The silt fences and other synthetic structures will be removed after vegetation is established and interim sediment-control structures are no longer needed; however, hay bales will remain. Wharf does not anticipate needing permanent sediment controls because reclamation earthwork will be sloped and revegetated to prevent erosion. Wharf requests the ability to make open-ended modifications to these sediment control BMPs in the field as per the existing site SWPPP. The ability to make routine modifications as needed will allow for operational safety, efficiency, and flexibility and ensure the ability to adapt sediment controls to best perform their intended function. These erosion control measures, BMPs, and grading, along with revegetation, will minimize the need for long term maintenance.

Final reclamation will commence as mining, rock deposition, and pit backfilling are progressively completed. Table 5-1 shows a conceptual projected mining and reclamation schedule for features located within the project area as well as those remaining within the Wharf Mine property. Modifications to this plan would result from developing improved reclamation or mining method strategies, mitigating unseen geologic landform situations, redesigning the Mine Plan, identifying new reserves, or other unforeseen factors. Major modifications to the Reclamation Plan would be presented to the SD DANR for approval before implementation.

6.8.1 PIT BENCH AND BACKFILL RECLAMATION

As shown on Exhibit 31B in Appendix B, the mine areas proposed as part of this application will be completely backfilled and recontoured to provide a stable and functional postmining landform that is compatible with surrounding land uses. The reclamation plan does not propose leaving pit benches. Final reclamation will entail reapplying cover soil and seeding with the final reclamation seed mix shown in Table 6-2.

The pit will be regraded to a stable configuration and final backfill slope angles will not exceed 3H:1V. The broad flattened or gently rolling nature of the planned backfilled configuration will serve as excellent grazing and loafing areas for livestock and ungulate wildlife. The topography or landforms created during grading of the Boston Expansion will be similar in slope and orientation as current, pre-mining topography, and as such will be compatible with surrounding areas. During final grading, minor undulations in topography will be randomly created on the landscape to promote the accumulation of water which will promote vegetation diversity and reduce runoff. No highwalls will remain within the Boston Expansion.

6.8.2 ROAD RECLAMATION

After mining is completed, all nonfunctional roads leading from the Boston Expansion area to other on-site access roads will be reclaimed to blend with the existing topography. Compacted road surfaces will be ripped, soil will be reapplied, and the area will be seeded with the final reclamation seed mix. Trees and shrubs will be transplanted where appropriate. The existing access road leading from State Highway 473 through the Wharf property tying into the Perkins Road will remain open with a public right-of-way.

6.8.3 BUILDINGS AND STRUCTURES

No new structures are planned to be constructed at this time. All buildings and structures to be used are existing, and reclamation of these buildings and structures is covered in previous approved state mining permits (ARSD 74:29:05:02).

6.9 RECLAMATION TIMETABLE

A conceptual projected mining and reclamation schedule for features located within the Boston Expansion area as well as those remaining within the Wharf Mine is provided in Table 5-1. The sequence of reclamation within these various areas depends on the mining progress and may vary somewhat. Final reclaimed areas will be submitted to the SD DANR yearly in the Wharf Annual Report.

6.10 RECLAMATION MONITORING

Monitoring is essential for determining reclamation success and eventual bond release. Specific concerns relative to the postmine landscape are addressed in the following sections. All reclamation monitoring proposed is similar to that stated in previous state mining permits.

6.10.1 VEGETATION

Seeded areas will be qualitatively monitored by a consultant after revegetation of the Boston Expansion to determine changes in plant species composition and production as well as vegetative trends. The

results of early vegetative trend analyses will be used to determine revegetation success and changes in species composition if warranted. These studies will be incorporated into reclamation seed mixes to ultimately determine the species best suited to the reclaimed environment. The relative absence of similar physiography within an acceptable ecological region makes the use of reference areas unfeasible. As per ARSD 74:29:07:20, reclamation will be complete when the reclaimed range is capable of withstanding proper stocking rates for 2 consecutive years before bond release. Stocking rates will be determined as per NRCS guidelines.

Wharf worked with Cedar Creek Associates, Inc. to establish monitoring criteria for the vegetation within Wharf's existing permitted areas. The monitoring methods and criteria are described in the Wharf Resources Reclamation Performance Criteria document and specifically referenced in Section II, Part 4 Revegetation Evaluation Procedures [Cedar Creek Associates, Inc. 2008]. The following monitoring criteria are consistent with the existing Wharf permit area and will be used to monitor vegetation for this reclamation project.

Representative monitoring transects will be established in the reclaimed area using the point intercept method to determine percent cover. Vegetative monitoring and casual pedestrian surveys will be conducted to identify the species composition in the reclaimed area to document seed or rhizome production. The mean current annual forage production (excluding noxious weeds) will be compared against the appropriate standard depending on whether or not the sampling year is determined to be a dry year, normal year, or wet year with regard to incident precipitation. The comparison will be made on an Air-Dry Basis (ADB) to one of the following standards:

- Dry Year – 190 pounds of production (ADB)
- Normal Year – 275 pounds of production (ADB)
- Wet Year – 330 pounds of production (ADB).

6.10.2 MINE BENCHES AND ROCK FACILITY SLOPES

Slope stability is critical to assessing the reclamation success on the non-backfilled areas of the reclaimed landscape. Using selective land shaping, potentially unstable areas will be manipulated to yield a safe and functional landform. Following backfilling, no highwalls will remain within the Boston Expansion area, thus stability concerns are minimal.

6.10.3 FINAL RECLAMATION REVIEW

The overall appearance of the reclaimed area is paramount to evaluating reclamation success in the Boston Expansion. An important component to establishing this goal is contour blending. Much of the final blending will be conducted using selective blasting or localized backfill along the Portland ridgeline in the Boston Expansion. Final review criteria will incorporate the results from the previously mentioned topics over time. At the time that the bond release is requested, the overall reclamation product will be presented to the SD DANR for review. The general reclamation concept is presented on Exhibits 31 through 37 of Appendix B.

6.11 BONDING

All reclamation required under the approved reclamation plan will be completed prior to final and full bond release (ARSD 74:29:07:01(3)).

6.11.1 ESTIMATED BOND CALCULATIONS

Table 6-4 shows the estimated reclamation cost for each component of the proposed affected lands for the Boston Expansion and Wharf Mine; details of the Boston Expansion earthmoving and revegetation costs are provided in Table 6-5. Calculations for each component, as well as for the operation being performed, are summarized. The final cost estimate was derived by first developing a Mine Plan that exhausted the reserve base established on January 1, 2021. After establishing the material characterization quantities within the Mine Plan, the material destination was determined by means of economics as well as maximizing reclamation areas available.

Because the Boston Expansion is a pit layback verses a separate new pit, reclamation costs are a small add-on to the Portland Pit reclamation bond. There would be no backfilling or sloping at the time of final reclamation because those steps will have been done prior as concurrent reclamation. Therefore, the majority of final reclamation costs are associated with topsoiling and seeding. The cost breakdown for the Boston Expansion reclamation is provided in Table 6-5.

Upon establishing a final land configuration, costs were developed assuming that dumped material would be dozed to the final slopes shown on Exhibits 31A and 31B in Appendix B, the heaps would be neutralized and land shaped, and the pond liners will be folded and covered with material from the heaps or other pit sources. These areas would be topsoiled and seeded as described in Section 6.6. The costs for all activities will be developed using the Wharf Mine equipment costs, and total equipment hours necessary to complete the tasks were generated using the Caterpillar™ Equipment Fleet Analysis computer model. All general assumptions for the bond calculations were taken from the annual bond update.

Table 6-4. Wharf 2022 Bond Update Summary (Page 1 of 4)

Item	Cost ($)
Earthmoving and Revegetation	
Wharf Mine	
Leach Pads and Process Ponds	
Offload 10 Million Tons Spent Ore from Leach Pads	11,727,406
Reclaim Process Area	937,046
Upper Ross Valley Spent Ore Depository	
Reclaim Upper Portion of Ross Valley Depository	375,729
Cap Rock for Regraded Upper Ross Valley Depository	138,935
Trojan/Green Mountain Pit	3,279,193
Flossie Pit	
Backfill Flossie Pit	3,364,109
Reclaim Flossie Pit	1,209,800
Flossie Waste Rock Depository	88,267
Portland Area	382,470
Boston Area	102,846
Denitrification Pads	
Reclaim Denitrification Pads	853,181
Cap Rock for Regraded Denitrification Pads	383,315
Reliance Spent Ore Depository	205,900
Reliance Spent Ore Cap Rock	120,812
New Ruby Dump	143,410
New Trojan Waste Rock Facility	217,216
Land App/Juno/Low Grade	94,511
Office/Crusher	73,714
New Access Road	0
Golden Reward Mine	
Harmony/W Liberty Pit	509,685
Haul Additional Topsoil from Wharf Mine	28,591
Golden Reward Haul Road	88,993
Remove Haul Road Fills	139,274

Table 6-4. Wharf 2022 Bond Update Summary (Page 2 of 4)

Item	Cost ($)
Other Earthmoving	
Minimum Impact (Reclaimed Areas)	100,900
Building Demolition	657,337
Support Staff Payroll	
Project Manager	637,000
Construction Manager	473,200
Field Engineer	312,000
Water Sampler/Laborer	277,883
Mechanic	279,085
Security/Safety	67,200
Road Maintenance	2,848,556
Sediment Basin Maintenance	25,000
Weed Control	100,000
Lab Waste Disposal	5,000
Shop Wash Water Disposal	20,000
Petroleum Contaminated Soil Disposal	20,000
Boneyard Cleanup	10,000
Partial Fence Removal	24,692
Fence and Gate Installation	15,178
Pipeline Removal & Plugging	168,161
Well Plugging	6,544
Site Survey	207,105
Subtotal Earthmoving	**$30,719,246**
Mobilization (3%)	921,577
Contractor Overhead (8%)	2,457,5470
State Excise Tax (2%)	614,385
Contractor Profit (10%)	3,071,925
Contingency (5 %)	1,535,962
Insp., Adm., & Maint. (5%)	1,535,962
Engineering & Consulting (2%)	614,385
Scope and Bid Contingency (5%)	1,535,962
Total Earthmoving and Revegetation	**$43,006,944**
Water Treatment	
Leach Pad Neutralization and Denitrification	
Cyanide Neutralization for Five Leach Pads	361,670
Clean Water Plant Denitrification for Five Leach Pads	775,005
Total Leach Pad Neutralization and Denitrification	**$1,136,675**

Table 6-4. Wharf 2022 Bond Update Summary (Page 3 of 4)

Item	Cost ($)
Process Pond Neutralization and Denitrification	
Cyanide Neutralization and Denitrification for Five Ponds	189,947
Total Process Pond Neutralization and Denitrification	**$189,947**
Denitrification Pad	
Remaining Pad and Sump Denitrification	**$1,357,625**
RV Nitrate Water Treatment Complex (Blue Water Plant)	
Plant Chemicals & Nutrients (includes sales tax)	1,001,544
Electricity ($0.092/Kwh)	856,176
Natural Gas	1,440,912
Plant Operation & Maintenance	252,000
Assay Analysis Lab Supplies	17,940
Total RV Water Treatment Complex Denitrification	**$3,568,572**
Labor	
Plant Operators	777,779
Security/Safety	67,200
Vehicle Purchase (every 10 years)	64,000
Vehicle Fuel & Maintenance	83,000
Liner Repair	10,000
Subtotal Water Treatment	**$7,254,797**
Mobilization (5%)	160,869
Contractor Overhead (8%)	580,384
State Excise Tax (2%)	145,097
Contractor Profit (10%)	725,481
Contingency (15%)	1,088,220
Insp., Adm., & Maint. (5%)	362,739
Engineering & Consulting (2%)	64,348
Scope and Bid (5%)	160,869
Total Water Treatment	**$10,542,804**
Monitoring	
Water Quality Sample Collection Equipment	65,622
Aquatic/Biological Monitoring	340,500
Subtotal Monitoring	**$406,122**
Contractor Overhead (8%)	32,490
State Excise Tax (2%)	8,122
Contractor Profit (10%)	40,612
Contingency (3%)	12,184
Scope and Bid (5%)	20,306
Total Monitoring	**$519,836**

Table 6-4. Wharf 2022 Bond Update Summary (Page 4 of 4)

Item	Cost ($)
Water Quality Sample Lab Analysis Costs	695,231
RV Plant Assay Analytical Work	297,600
Total Monitoring and Analysis	**$1,512,667**
Miscellaneous	
Computer	1,500
Office Supplies	9,000
Insurance	50,000
Utilities	
Electricity	40,000
Phone & Internet	5,000
Propane	6,000
Subtotal Utilities & Miscellaneous	**$111,500**
Contingency (10%)	11,150
Insp., Adm., & Maint. (1%)	1,115
Total Utilities & Miscellaneous	123,765
Total Earthmoving, Water Treatment, Misc, & Utilities	**$55,186,181**
Inflation Cost Adjustment @ 3% Per Year for One Year	**$1,655,585**
Total Reclamation Bond	**$56,841,766**
ROUND TO:	**$56,842,000**
CURRENT BOND	**$58,246,100**
ADDITIONAL BOND REQUIRED	**-$1,404,100**

Table 6-5. Boston Expansion Reclamation Cost Details (Page 1 of 4)

Item	Cost ($)
GRADING TOPSOIL ON FLATS	
Grader Type:	Cat 16M
Blade Width (ft):	16
Man. Time (min):	0.35
Avg. Pass (ft):	500
Avg. Speed (mph):	3
# of passes over area:	2
Acreage (acres):	49.9
Cost for Grader ($/hr):	$49.20
Cost for Oper. ($/hr):	$28.15
Travel Distance (ft)=	271627
Number of Passes =	543
Total Time @ 80% eff = (hrs)	25.4
Cost =	$1,965
RIPPING ROADS & COMPACTED AREAS PRIOR TO TOPSOIL PLACEMENT	
Dozer Type:	Cat D9T
Ripper Spacing (ft):	10
Avg. Speed (mph):	1
Avg. Pass (ft):	100
Man. Time (min):	0.25
Acreage (acres):	49.9
Cost for Dozer ($/hr):	$112.50
Cost for Oper. ($/hr):	$28.15
Travel Distance (ft) =	217302
Number of Passes =	2173
Total Time @ 80% eff = (hrs)	62.8
Cost =	$8,833
MATERIAL MOVING WITH DOZER (Reducing backfill to 3:1 slope)	
Cost =	$0

Table 6-5. Boston Expansion Reclamation Cost Details (Page 2 of 4)

Item	Cost ($)
GRADING TOPSOIL ON SLOPES WITH DOZER	
Dozer Type:	Cat D9T
Blade Type:	Universal
Avg. Doze Dist. (ft.):	50
Acreage (acres):	49.9
Mat. Thickness (ft.):	0.33
Cost for Dozer ($/hr):	$112.50
Cost for Oper. ($/hr):	$28.15
Production = (cy/hr)	2200
Total Time @ 80% Eff. = (hrs)	15.1
Cost =	$2,124
TOPSOIL REAPPL. (SCRAPER)	
Cost =	$0
TOPSOIL REAPPL. (FRONT END LOADER)	
Cost =	$0
MATERIAL MOVING (Truck & Front End Loader)	
(Replacing topsoil)	
Unit Wt. Mat. (lb/cu ft):	80
Vol. of Material (cy):	26559
Loader Type(1:988,2:993)	2
Bucket Capacity (cy):	17
Load-Dump-Man. Time(min):	0.51
Cost for Loader ($/hr):	$110.00
Cost for Oper. ($/hr):	$28.15
Truck Type (1:50T,2:100T):	2
Truck Capacity (cy):	60
Avg. Truck Speed (mph):	25
Man. & Dump Time (min):	0.75
Avg. Haul Dist. (ft):	1500
Cost for Truck ($/hr):	$61.95
Cost for Oper. ($/hr):	$28.15

Table 6-5. Boston Expansion Reclamation Cost Details (Page 3 of 4)

Item	Cost ($)
# Buckets to Fill Truck =	4
Loader Time/Truckload = (min/truck)	2.04
No. of Truckloads =	443
Time per Truckload = (min)	4.2
Optimum No. of Trucks =	2
Time/Truck @ 80% Eff. = (hrs/truck)	19.4
F.E.L. Time @ 80% Eff. = (hrs)	19.4
Cost =	$6,176
SEED COSTS (MIXTURE #1)	
SEED TYPE	APPL. Rate (lbs/acre)
Alfalfa	0.50
White Dutch Clover	0.50
Slender Wheatgrass	7.00
Thickspike Wheatgrass	7.00
Hard Fescue	1.50
Timothy	1.00
Western Wheatgrass	8.00
Russian Wildrye	3.00
Canada Bluegrass	0.50
Pubescent Wheatgrass	2.50
Blanket Flower	0.30
Black-Eyed Susan	0.10
Rocky Mt. Pestemon	0.10
Seed Mix 1 total cost per acre	$272.00
Acreage (acres):	49.9
Cost =	$13,569
SEED COSTS (MIXTURE #2, NURSE CROP)	
SEED TYPE	APPL. Rate (lbs/acre)
Spring Wheat (nurse crop)	40.00
Siberian Millet (nurse crop)	7.00
Annual Ryegrass (nurse crop)	4.00
total	51.00
Seed Mix 2 total cost per acre	$18.00
Acreage (acres):	49.9
Cost =	$898

Table 6-5. Boston Expansion Reclamation Cost Details (Page 4 of 4)

Item	Cost ($)
FORB COSTS	
Cost =	$0
SEEDING COSTS	
Acreage (acres):	49.9
Cost ($/acre):	500
Total Cost =	$24,943
HYDROMULCH (WOOD FIBER)	
Acreage (acres):	49.9
Cost ($/acre):	679.9
Total Cost =	$33,917
FERTILIZER	
Acreage (acres):	49.9
cost per acre	57
Total Cost =	$2,843
FUEL COSTS	
Cost of fuel ($/gal):	$3.29
EQUIPMENT	HOURS / CONSUMP. (gal/hr)
Cat D9T Dozer	77.9/12
Cat 637E Scraper	0/11.5
Cat 16M Grader	25.4/5.0
Cat 988 Loader	0/16
Cat 993 Loader	19.4/30
Cat 777 Truck	38.8/17
Cat 773 Truck	0/14.5
Total Cost =	$7,578
TOTAL COST =	**$102,845.9**

6.11.2 POSTCLOSURE PLAN

6.11.2.1 INTRODUCTION TO THE POSTCLOSURE PLAN

After the mining process is completed and reclamation is in the final stages of establishing vegetation, Wharf will inspect and maintain activities to ensure permit compliance and potential environmental impacts are reduced. No new environmental impacts are anticipated to be identified after mining in the Boston Expansion has been completed, Wharf does not anticipate the need for treatment of spent ore from the Boston Expansion during post closure.

All depositories within the Boston Expansion will be constructed to a 3H:1V final slope, which has proven to be stable. No residual highwalls are proposed under the Boston Expansion. Possibly of more critical interest is properly evaluating the reclamation success in relation to the chemical environment. The long-term impacts to surface and groundwater sources will be well-known in all affected areas before the request for bond release. The primary areas of hydrology interest associated with this project are in the Lost Camp, Annie Creek, and Nevada Gulch drainages. A postclosure monitoring plan for the Boston Expansion will be submitted to the SD DANR before closure.

Wharf currently has a Surface Water Discharge (SWD) permit for all of the drainages associated with the Wharf Mine. The permit includes the drainages associated with this project and details long-term monitoring conditions for these drainages. The monitoring program will provide definition of specific surface-water concerns relevant to the issue of long-term monitoring. The postclosure surface-water program will dovetail with the SWD permit.

Groundwater monitoring after the mining and processing operations are complete is regulated by state statutes that control the impacts to groundwater. Wharf currently has four GWD permits for disposal of spent ore at Wharf, and one GWD permit is in place at the Golden Reward Mine site. Wharf developed a groundwater monitoring program associated with the existing GWD permits, existing Wharf Large-Scale Mine permit, and Golden Reward Postclosure Mining permit. Additional wells have been added and will continue to be added as needed and per SD DANR requirements. Wharf will develop a long-term monitoring plan in conjunction with the SD DANR for the areas included in the GWD permits as well as those areas associated with the process facility.

The following sections provide a detailed description of the proposed postmining monitoring plan. If the affected area is found to be stable and free of hazards, has established and self-regenerated vegetation as specified in the Reclamation Plan, has minimal hydrologic impacts, has minimal air-quality impacts, or is maintenance free to the extent practicable, the operator may submit an application to reduce the monitoring requirements or shorten the postclosure plan period to the Board of Minerals and Environment.

6.11.2.2 WATER QUALITY MONITORING

Postclosure water quality monitoring will be performed quarterly at the majority of the currently active surface-water and groundwater monitoring sites listed in Table 6-6. The sites include areas permitted under Permit Nos. 356, 434, 435, 450, 464, 476 and proposed with this project. During postclosure, the

Table 6-6. Groundwater and Surface-Water Monitoring Sites (Page 1 of 4)

Site	Purpose	Location/Description
Annie Creek @ USGS	Wharf Surface-Water Quality – Boston Expansion Baseline	Annie Creek
Annie Creek II	Wharf Surface-Water Quality – Boston Expansion Baseline	Annie Creek
Beaver Springs	Wharf Surface-Water Quality	Reliance
BMT-1	Wharf Surface-Water Quality	Deadwood
DM01	Golden Reward Groundwater Quality	Well just south of Stewart Gulch
DM14A	Golden Reward Groundwater Quality	Located in the central portion of Golden Reward between Fantail and Stewart Gulch
DM16	Golden Reward Groundwater Quality	On eastern Golden Reward boundary between Fantail and Stewart Gulch
DWD-1	Wharf Surface-Water Quality	Deadwood
FB Spring	Wharf Surface-Water Quality	False Bottom
FB-1 (EFB)	Wharf Surface-Water Quality	False Bottom
FB-2 (WFB)	Wharf Surface-Water Quality	False Bottom
GWAC6	Wharf Groundwater Quality	Reliance
HDH-8A	Wharf Groundwater Quality	Ross Valley
HDH-10A	Wharf Groundwater Quality	McKinley Gulch
HDH-11	Wharf Groundwater Quality	McKinley Gulch
HDH-12	Wharf Groundwater Quality	Downgradient of the process facility
HDH-12A	Wharf Groundwater Quality	McKinley Gulch
Horse Shoe MW	Wharf Groundwater Quality	Well located in Nevada Gulch parking lot
Joseph Well 2	Wharf Groundwater Quality	Well near headwaters of Cleopatra Creek
Lost Camp	Wharf Surface-Water Quality – Boston Expansion Baseline	Lost Camp
McKinley Gulch	Wharf Surface-Water Quality	McKinley Gulch
MM03	Golden Reward Groundwater Quality	Along Stewart Gulch
MM04A	Golden Reward Groundwater Quality	Well located east of Terry Peak inside Golden Reward
MW-1	Wharf Groundwater Quality	Ross Valley
MW-1A	Wharf Groundwater Quality	Ross Valley
MW-1B	Wharf Groundwater Level	
MW-2	Wharf Groundwater Quality	Deep groundwater below the toe of the Ross Valley rock facility
MW-2A	Wharf Groundwater Quality	Shallow groundwater below the toe of the Ross Valley rock facility
MW-2B	Wharf Groundwater Level	
MW-9	Wharf Groundwater Quality	McKinley Gulch

Table 6-6. Groundwater and Surface-Water Monitoring Sites (Page 2 of 4)

Site	Purpose	Location/Description
MW-9A	Wharf Groundwater Quality	McKinley Gulch
MW-10	Wharf Groundwater Quality	McKinley Gulch
MW-10A	Wharf Groundwater Quality	McKinley Gulch
MW-13	Wharf Groundwater Quality	Ross Valley
MW-13A	Wharf Groundwater Quality	Ross Valley
MW-14	Wharf Groundwater Quality	Ross Valley
MW-15	Wharf Groundwater Quality	Upgradient of the Process Facility
MW-17	Wharf Groundwater Quality	Reliance
MW-18	Wharf Groundwater Quality	Reliance
MW-19	Wharf Groundwater Quality – Boston Expansion Baseline	Well in Annie Creek drainage downgradient of Reliance
MW-31	Wharf Groundwater Quality	Ross Valley
MW-33	Wharf Groundwater Quality – Boston Expansion Baseline	Below the toe of the Reliance rock facility
MW-37	Wharf Groundwater Quality	Cleopatra Creek
MW-40	Wharf Groundwater Quality	Well located just east of Trojan Pit
MW-41	Wharf Groundwater Quality/Proposed for GWD Permit	Below the toe of the Cleopatra Creek rock facility and downgradient of the proposed Foley rock facility and the northern portion of the Reliance rock facility
MW-42	Wharf Groundwater Quality	Below the north toe of the Trojan rock facility; headwaters of False Bottom Creek
MW-43	Wharf Groundwater Quality	Below the north toe of the Trojan rock facility; headwaters of False Bottom Creek
MW-44	Wharf Groundwater Quality	McKinley Gulch
MW-45	Wharf Groundwater Quality	Ross Valley
MW-47	Wharf Groundwater Quality	McKinley Gulch
MW-48	Wharf Groundwater Quality	McKinley Gulch
MW-49	Wharf Groundwater Quality	McKinley Gulch
MW-50	Wharf Groundwater Quality	McKinley Gulch
MW-51	Wharf Groundwater Quality	McKinley Gulch
MW-52	Wharf Groundwater Quality	Reliance
MW-53	Wharf Groundwater Quality	McKinley Gulch
MW-54	Wharf Groundwater Quality	McKinley Gulch
MW-55	Wharf Groundwater Quality	McKinley Gulch
MW-56	Wharf Groundwater Quality	McKinley Gulch
MW-57	Wharf Groundwater Quality	McKinley Gulch

Table 6-6. Groundwater and Surface-Water Monitoring Sites (Page 3 of 4)

Site	Purpose	Location/Description
MW-58	Wharf Groundwater Quality	McKinley Gulch
MW-59	Wharf Groundwater Quality	Dry well located near head of Deadwood Creek at Bald Mountain
MW-60	Wharf Groundwater Quality	Deep groundwater north and west of the proposed American Eagle/Portland spent-ore disposal facility
MW-61	Wharf Groundwater Quality	Deep groundwater north and west of the proposed American Eagle/Portland spent-ore disposal facility
MW-62	Wharf Groundwater Quality	Deep groundwater north and east of the proposed American Eagle/Portland spent-ore disposal facility
MW-63	Wharf Groundwater Quality	Deep groundwater north and east of the proposed American Eagle/Portland spent-ore disposal facility
MW-64	Wharf Groundwater Quality	Deep groundwater north and east of the proposed American Eagle/Portland spent-ore disposal facility
MW-65	Wharf Groundwater Quality	Deep groundwater north and west of the proposed American Eagle/Portland spent-ore disposal facility
MW-66	Wharf Groundwater Quality – Boston Expansion Baseline	Groundwater south of the American Eagle
MW-67	Wharf Groundwater Quality	Deep groundwater north of Juno
MW-68	Wharf Groundwater Quality	Deep groundwater north and east of the proposed American Eagle/Portland spent-ore disposal facility
Nevada Gulch MW	Expansion Groundwater Quality	Terry Peak water well at the Nevada Gulch Lodge; at Dark Horse
OM05	Golden Reward Groundwater Quality	Well located in Stewart Gulch
PW02	Golden Reward Groundwater Quality	Along Stewart Gulch at the eastern Golden Reward boundary
PW04	Golden Reward Groundwater Quality	Along Stewart Gulch upstream of the mine boundary
PW-2	Wharf Groundwater Quality	Well located north of Pad No. 4
Railroad MW	Wharf Groundwater Quality	Well located on the railroad grade (Liberty)
Ross Springs	Wharf Surface-Water Quality	Ross Valley
RV French Drain	Wharf Surface-Water Quality	Ross Valley
RVLC Pond	Wharf Surface-Water Quality	Ross Valley
RVSO Discharge	Wharf Surface-Water Quality	Ross Valley
Site 001	SWD Permit	Below the toe of Reliance rock facility; headwaters of Annie Creek
Site 002	SWD Permit	Below the toe of the Ross Valley rock facility; Ross Creek above the Confluence with Annie Creek
Site 003	SWD Permit	Downgradient of the Process Facility; McKinley Gulch (dry drainage)
Site 004	SWD Permit	Below the toe of Cleopatra Creek rock facility; headwaters of Cleopatra Creek

Table 6-6. Groundwater and Surface-Water Monitoring Sites (Page 4 of 4)

Site	Purpose	Location/Description
Site 005 (In-stream Monitoring Site)	SWD Permit	Below the confluence of Ross Creek and Lost Camp drainages; at the stream classification change in Annie Creek
Site 006	SWD Permit	Discharge of treated water from either biological treatment facility or the carbon treatment facility to either Ross Valley or Annie Creek
Site 007	Proposed SWD Permit	Below the toe of the Trojan rock facility in False Bottom Creek; site to be determined in conjunction with the SWD Program
Site 008	Proposed SWD Permit	Below the toe of any rock facilities in Deadwood Creek; site to be determined in conjunction with the SWD Program
Site 009	Proposed SWD Permit	(Formerly Golden Reward's National Pollutant Discharge Elimination System [NPDES] 001) Discharge of precipitation and infiltration from rock and spent-ore areas in Stewart drainage
Site 010	Proposed SWD Permit	(Formerly Golden Reward's NPDES 003) Discharge of precipitation and infiltration from rock and spent-ore areas in Fantail drainage
Site 011	Golden Reward Surface-water Quality	(Golden Reward's Surface Site SS05) Discharge of precipitation and infiltration from rock and spent-ore areas in Nevada Gulch drainage
SM01B	Golden Reward Groundwater Quality	Near Nevada Gulch south of Bald Mountain
SM02A	Golden Reward Groundwater Quality	Near Fantail Creek
SM03A	Golden Reward Groundwater Quality	At eastern Golden Reward boundary near Fantail Creek
SM06	Golden Reward Groundwater Quality	At Golden Reward boundary near Stewart Gulch
SM08	Golden Reward Groundwater Quality	
SM09	Golden Reward Groundwater Quality	Near Nevada Gulch south of Bald Mountain
SM10	Golden Reward Groundwater Quality	Near Nevada Gulch southeast of Bald Mountain
Spearfish Falls	Wharf Surface-Water Quality	Little Spearfish
War Eagle	Wharf Surface-Water Quality	Cleopatra
SS-01	Golden Reward Surface-Water Quality	Stewart Gulch
SS-04	Golden Reward Surface-Water Quality	Nevada Gulch
SS-06	Golden Reward Surface-Water Quality	Fantail Gulch
SS-12	Golden Reward Surface-Water Quality	Stewart Gulch
SS-14A	Golden Reward Surface-Water Quality	Fantail Gulch
SS-17	Golden Reward Surface-Water Quality	No Name Gulch
SS-20	Wharf Surface-Water Quality – Boston Expansion Baseline	Nevada Gulch

water quality samples will be analyzed on a site-specific basis unless (similar to those parameters listed in Table 6-7) otherwise specified through surface water discharge permit or ground water discharge plans. In general, no changes to the site postclosure groundwater monitoring plan is anticipated to be needed as a result of the Boston Expansion due to the small size, nature, and location of this expansion.

Table 6-7. List of Water Quality Monitoring Parameters

Groundwater Parameters	Surface-Water Parameters
Water Level	Flow
Field pH	Field pH
Field Conductivity	Field Conductivity
Field Temperature	Field Temperature
Hardness	Hardness
Total Dissolved Solids	Total Dissolved Solids
Sulfate	Total Suspended Solids
Total and Weak Acid Dissociable Cyanide	Total and Weak Acid Dissociable Cyanide
Nitrite	Nitrite
Nitrate	Nitrate
Ammonia	Ammonia
Arsenic (Dissolved)	Aluminum (Total Recoverable)
Cadmium (Dissolved)	Arsenic (Total Recoverable)
Copper (Dissolved)	Beryllium (Total Recoverable)
Gold (Dissolved)	Cadmium (Total Recoverable)
Lead (Dissolved)	Chromium (Total Recoverable)
Selenium (Dissolved)	Copper (Total Recoverable)
Silver (Dissolved)	Iron (Total Recoverable)
Zinc (Dissolved)	Lead (Total Recoverable)
Mercury (Total)	Manganese (Total Recoverable)
	Nickel (Total Recoverable)
	Selenium (Total Recoverable)
	Silver (Total Recoverable)
	Zinc (Total Recoverable)
	Mercury (Total)

6.11.2.3 AIR-QUALITY MONITORING

No postclosure air-quality monitoring is currently required or proposed for the Boston Expansion area mining activities.

6.11.2.4 VEGETATION MONITORING

During post-closure, reclaimed lands within the Boston Expansion meeting success standards will be inspected annually by a contractor and coincide with the growing season to ensure continued compliance with postmining land use. If vegetation is not maintaining postmining land use requirements (as discussed in Section 6.9.1), steps will be taken to correct or mitigate the situation such as re-seeding and topical fertilizer application. Changes to the seed mixture (as described in Section 6.5), if necessary to ensure vegetative success, will be submitted to the pertinent agencies for approval.

6.11.2.5 SEDIMENT- AND EROSION-CONTROL STRUCTURES

No new permanent sediment- or erosion-control structures are planned as part of the Boston Expansion. If erosion and sedimentation in any area become an issue during the term of the postclosure period, new structures will be installed to adequately address any problems.

6.11.2.6 MISCELLANEOUS MAINTENANCE AND CARE

All fence lines and warning signs to restrict access to the open pit within the Boston Expansion will be inspected semiannually. Maintenance work to keep the fence line and warning signs in good repair will be performed as necessary.

6.11.2.7 POSTCLOSURE SURETY

After the reclamation bond is released by the state of South Dakota, a portion of the reclamation surety will be dedicated to the existing postclosure bond. Before the reclamation bond is released, a detailed bond calculation for postclosure activities will be updated and will be submitted to the state of South Dakota for approval. At this time, no changes to the post closure bond are anticipated as there are no projections for treatment or additional monitoring for the Boston Expansion.

6.11.3 CYANIDE BOND

As part of a recommendation from the Cumulative Environmental Evaluation Task Force, in 1991 the Board of Minerals and Environment issued an order requiring each large scale gold mine that uses cyanide to identify scenarios and develop costs to respond to and remediate releases. The heap-leach mining industry was reviewed in 1992 for the issue of bonding for large and potentially catastrophic cyanide spills (SDCL 45-6B-20.1). In conjunction with the SD DANR, various scenarios were developed in an attempt to address costs associated with each scenario. For example, a hypothetical scenario of a slow chronic release of cyanide at Wharf was determined to be more costly than an accidental release. As a result of these reviews, each mine was assessed a cost for abatement and mitigation of potential cyanide spills that could affect surface water and groundwater. Wharf is currently assessed a value of $731,300, which is reviewed by SD DANR on an annual basis and adjusted for inflation if necessary. The Boston Expansion area will not increase the relative amount of cyanide used annually because the rate of ore processed will not significantly differ from current levels.

7.0 PROPOSED TECHNICAL REVISION PERMIT CONDITIONS

To address ARSD 74:29:03:16, Wharf proposes the following technical revision categories for consideration with this Boston Expansion permit.

WHARF RESOURCES (USA) INC.
PROPOSED BOSTON EXPANSION
LARGE SCALE MINING PERMIT

The Board of Minerals and Environment (Board), pursuant to ARSD 74:29:03:16, hereby authorizes the Department of Agriculture and Natural Resources (Department) to approve proposed technical revisions to Wharf Resources (Wharf) Boston Expansion mining permit for the following subject areas when the scope of the proposed change is of substantive nature beyond basic operational adjustments or a minor modification that does not increase the potential for adverse environmental effects:

1. Modifying monitoring plans, locations, parameters, and time frames;
2. Modifying compliance limits for chemical parameters as allowed within the mining laws and mine permit, including spent ore off-load criteria ;
3. Submitting and modifying plans and use specifications for permitted facilities;
4. Adding contiguous, affected land within the permit boundary with the total of additions not to exceed twenty (20) percent of the permitted affected area of 48.2 acres for this permit. The maximum expansion allowed (20% of 48.2 acres) is 9.6 acres;
5. Modifying or relocating erosion, sedimentation, or drainage control structures other than in accordance with the existing site Stormwater Protection Plan;
6. Modifying reclamation seed mixes or rates beyond substituting a variety of a species based on seed availability;
7. Modifying freshwater manner of use and source as allowed by water rights permits;
8. Modifying dust control methods;
9. Modifying blasting methods and procedures beyond simple adjustments for safety or efficiency;
10. Adding or modifying ancillary facilities within the permit boundary, including equipment and chemical storage areas, parking lots, office buildings, septic systems, perimeter fencing, utilities (phone lines, natural gas lines, power lines, water lines), crushing areas, sludge ponds, and stockpiles;
11. Modifying pit and rock facility configurations within permitted disturbance limits consistent with geotechnical considerations;
12. Modifying and relocating state, county, and private roads and haulage routes within the permit boundary when not within the active mine pit areas;
13. Modifying topsoil stripping plans and storage areas;
14. Modifying the reclamation plan within the constraints of ARSD 74:29:03;
15. Modifying the mine operating plan within the constraints of ARSD 74:29:03;
16. Implementing new surface mining techniques or types of equipment;

17. Modifying the gold recovery methodology to improve performance, recovery, or environmental aspects;
18. Modifying action leakage response schedules and leakage response action plans;
19. Providing for or modifying long-term active water treatment;
20. Modifying postclosure plans and monitoring time frames;
21. Modifying handling procedures for potential acid generating rock;
22. Modifying reclamation or vegetation success standards;
23. Modifying spent ore backfilling plans to include the American Eagle, Portland, and Trojan pit areas subject to obtaining the necessary Groundwater Discharge Permits;
24. Modifying mine designs and disturbance areas to include contiguous areas of potential ore;
25. Expanding the leach pad footprint for better drainage, rinsing, and production or convert existing leach pad from removable to permanent;
26. Building lined spent ore impoundment for environmental purposes to provide additional water treatment;
27. Adding water storage capacity when it entails building new ponds;
28. Changing, modifying, developing, enhancing, or increasing water treatment technology and water treatment regimes;
29. Modifying pad parameters to enhance leaching or draindown characteristics;
30. Developing and implementing other mineral processing technologies that would improve both economic and environmental aspects;
31. Modifying reporting procedures and parameters as allowed within the mining laws and mine permit;
32. Allowing use of Contingency Pond or other ponds as batch ponds, temporary process, or neutralization ponds;
33. Changing the slope angle for final reclamation of specific sites where visually and functionally compatible or to add aesthetic;
34. Modifying stocking guidelines and reclamation success standards to reflect climatic conditions; and
35. Modifying aspects of the recreational, homesite, and industrial (commercial) land uses based on market conditions that do not conflict with statutes or regulations.

Technical revisions must comply with ARSD 74:29:03:03 and must be submitted to the department in writing. The department shall approve, disapprove, conditionally approve, or request additional information deemed necessary to approve technical revisions within thirty days of receipt.

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