PLAN OF OPERATIONS
BUCKHORN MT. PROJECT

Submitted to:

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and

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1.0 INTRODUCTION

1.1 General Information

Crown Resources Corporation (Crown) proposes to develop an underground gold mine on Buckhorn Mountain in the Myers Creek mining district, Okanogan County, in north-central Washington (Figure 1). This proposal will be reviewed by regulatory agencies as described below and will be subject to an environmental impact analysis and study as part of the permitting process. The proposal described in this document in future tense is Crown's preferred project design based on information available at the time of submission. As part of the regulatory review the proposal will be one alternative for future action. However, any and all development on the part of the proponent is contingent upon regulatory approval.

The Buckhorn Mt. deposit was discovered by Crown exploration geologists in 1988 and further delineated by Battle Mountain Gold Corporation (BMG) during the period 1990 – 1992. An economic feasibility study, completed by BMG in 1992, indicated that the deposit was commercially viable as an open pit mine with an on-site milling facility. The deposit was considered one of the largest gold skarns in North America with estimated proven and probable reserves of 1.6 million ounces. In 2000, BMG withdrew from its joint venture with Crown and the project assets reverted to 100 percent Crown ownership. Mine claims owned or controlled by Crown Resources for this project are listed in Appendix A.

Crown proposes to develop the deposit as an underground gold mine on Buckhorn Mt. approximately 3.5 air miles east of Chesaw, Washington with a satellite milling facility two miles south of Chesaw. The majority of the project will be developed on private land with some minor facility components and access roads on public lands. The public lands include lands administered by the U.S. Forest Service (USFS) Okanogan and Wenatchee National Forests (Tonasket Ranger District), and the State of Washington.

Following the protocol of the National Environmental Policy Act (NEPA) and the Washington State Environmental Policy Act (SEPA), this plan of operations (POO) is submitted to the governing agencies for the purpose of review of the project proposal and preparation of environmental documents as required by law as a prerequisite to any application of permits necessary for operation.

This POO presents details of the proposed new project. The document builds in part on the previous work developed by BMG relating to the Crown Jewel Project, a proposed open pit gold/silver mine at Buckhorn Mountain. BMG submitted a POO pertaining to that proposal in 1992 and its subsequent revisions in 1993, 1997, and 1998. This POO is also based in part on studies performed during the environmental review of the BMG proposal. It contains similar information relative to the location, access, topography, surface ownership, and site environmental characteristics. The information has been revised and updated to reflect the significant changes in the proposed mining operations including operating facilities and reclamation, mitigation, and monitoring plans.

1.2 Summary of Previous Work

The Buckhorn Mt. area has a long history of mining. The town of Chesaw was initially developed to service mineral exploration and mining activities in the small mining districts of Myers Creek, Bodie, and Wauconda. Various other companies and individuals explored the Buckhorn Mt. area prior to the discovery of the Buckhorn Mt. deposit by Crown. Crown worked on the Buckhorn Mt. Project for two years defining parts of the mineralization contained within the deposit.

After forming a joint venture with Crown in 1990 and changing the name of the project to Crown Jewel, BMG performed numerous studies on the geologic, hydrogeologic, geotechnical, archeological, wildlife, air, vegetation, soils, visual resources, and threatened and endangered species conditions present at the Buckhorn Mt. Project. These studies and previously projected impacts were evaluated by the USFS/BLM and DOE. The existing environment at the various components of the Buckhorn Mt. Project have been thoroughly described in the Final Environmental Impact Statement (FEIS) completed in 1997 by the Washington Department of Ecology (DOE) and the USFS as lead agencies and assembled by TerraMatrix Engineering and Environmental Services (TerraMatrix).

Substantial differences in the project plan exist between the current project proposal and all of the alternatives studied and assessed in the Crown Jewel permitting process. However, much of the technical information from the earlier studies is relevant for this project, particularly those relating to the existing environment. Extensive baseline work has been compiled and can be reviewed in the selected studies performed by BMG, its contractors and the agencies and contractors who assessed the project as part of the earlier EIS and permitting process. Additionally, new baseline data has been collected by Crown to augment previously collected data and new programs of monitoring are planned where appropriate.

Table 1 (appended) is a reference list of pertinent major submittals associated with the Crown Jewel project. These documents provide an extensive database that is applicable for the environmental and regulatory review of this proposed underground mine.

1.3 Applicant Information

Crown Resources Corporation is incorporated in the State of Washington and is focused on developing the Buckhorn Mt. Project. It also holds an interest in Solitario Resources Corporation, a diversified mineral exploration company with properties in South America.

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1.4 Permits, Approvals, and Regulatory Requirements

In addition to receiving agency approval on the POO, Crown must comply with other federal, state, and local laws and regulations. As part of the scoping process governmental agencies will determine what permits will be required for operation of the mine and which existing or new environmental information will be necessary to review in order to determine any mitigation measures which must be undertaken to address identified impacts. Table 2 lists the likely permits, approvals, and authorizations currently identified as being necessary in connection with the construction, operation, and closure of the Project.

TABLE 2

PERMIT LIST

Federal Government	
U.S. Forest Service	Plan of Operations Special Use Permits (Rights-of-Ways, etc) Plan of Operations Record of Decision Utilities Easement
Environmental Protection Agency	Spill Prevention Control and Countermeasure (SPCC) Plan Notification of Hazardous Waste Activity (Review Only, No Permit Required)
Federal Communications Commission	Radio Authorizations
Dept. of Homeland Security (Department of Alcohol, Tobacco, and Firearms)	Explosives User Permit
Mine Safety and Health Administration	Mine Identification Number (No permit Necessary) Legal Identity Report Miner Training Plan Approval Notice of Start of Operations
State of Washington	
Washington Department of Ecology	National Pollution Discharge Elimination System (NPDES)/Construction Activities Storm Water General Permit and Operational Permit Water Quality Certification (section 401-Federal Clean Water Act) Waste Water Discharge permit EPCRA Sara Title III compliance Dam Safety Permits Notice of Construction Approval (Air Quality) Air Contaminant Source Operation Permit Water Rights/Change of Use
Washington Department of Fish and Wildlife	Hydraulic Project Approvals
Washington Department of Health	Sewage Disposal Permit Public Water Supply Approval
Washington Department of Natural Resources	Road Maintenance and Improvement Mined Land Reclamation Permit Forest Practices Act Burning Permit Right of Way Utilities Easement
Washington Department of Labor and Industries	Explosives License Safety Regulation Compliance (No Permit)
Wash., Dept of Community Development, Office of Archaeology and Historic Preservation	SHIPO/106 Review

Local Government	
Okanogan Planning Department	Conditional Use Permit/Zoning Requirements Building Permits Pipeline Franchise Utilities Easement Shoreline Management Permits Joint Aquatic Resource Permits Maximum Environmental Noise Levels (Compliance Item) Socioeconomic Impact Analysis Approval Growth Management Critical Areas Regulations
Okanogan County Health District	Solid Waste Handling Septic Tanks and Drain Field Approval
Okanogan Public Works Department	Road Construction and/or Realignment
Okanogan Public Utility District	Power Service Contract

2.0 PROJECT OVERVIEW

The proposed project area and facilities are located on private land and on land partially within the boundaries of the Okanogan National Forest and certain lands belonging to the State of Washington, all in Okanogan County, Washington. The proposed underground mine is located on the eastern flank of Buckhorn Mountain approximately 3.5 air miles or nine miles by road to the east of the town of Chesaw. The mineral deposit itself lies under both private and USFS land. The proposed mine site is accessible by paved and unpaved county and USFS roads as shown on Figure 1.

A processing facility (mill) and a tailings disposal facility (TDF) are proposed to be located on private land two miles south of the town of Chesaw.

The ore will be transported from the mine to the mill by road in highway-legal trucks. The majority of underground mined areas will be backfilled upon completion of mining in each area. The backfill will consist of development rock from the mine or gravel from a storage site located at the mill/TDF site. Haul trucks will transport the backfill gravel to the mine.

Water used in the processing facility will be obtained through the use of existing surface and ground water rights controlled by Crown. Water will be conveyed in a buried pipe from the location of the water rights to the mill for process use.

Figure 1 shows the proposed access route for employee and supply transportation from Oroville to Chesaw. The proposed route continues south of Chesaw to the mill and then east to the mine site via county and USFS roads.

2.1 Project Area and Ownership

The mine site will consist of approximately 27 acres of fenced area surrounding surface facilities located above the ore deposit. Parts of the deposit are located on private land with surface and mineral title belonging to Crown. The majority of the ore deposit is located under USFS surface rights. Since 1987, Crown has held the mineral rights to the area of the deposit through unpatented mining claims and fee land. A list of mining and mill site claims in the area of the mine that are owned or controlled by Crown are presented in Appendix A.

The mill/TDF site will occupy approximately 90 acres located exclusively on private land controlled by Crown. A transportation route from the mine to the mill is proposed along a road alignment approximately seven miles long. To utilize this alignment for ore hauling, Crown is proposing to construct or upgrade some portions of the existing roads while other portions will need no improvement. Figure 2 shows the land ownership of the area in relation to the proposed facilities.

2.2 Employee Access

The estimated number of employees is 90 at the peak of construction activities and 150 during operations, including full time contract trucking employees. Most of these employees will likely reside in the areas around Chesaw, Oroville, or Tonasket. Although some shift staggering may occur, it is anticipated that most mine and mill employees will be assigned to one of two daily 10-hour shifts, three 8-hour shifts or two 12-hour shifts.

In order to minimize traffic on local roads, bus or van pooling transportation will be provided by the company for most employees from points in Oroville and Chesaw to the mine and mill sites.

2.3 Project Schedule

After issuance of required permits, the construction of surface facilities at the mine site and collaring of development workings will commence. Approximately eight months of underground development work is required prior to initial ore production. The approximately 88,000 tons of development rock generated during this initial period will be temporarily staged on the surface until placed underground for rock stability purposes.

Concurrent construction of the mill, administrative offices, and the TDF will occur. Initial throughput of ore at the mill will likely occur during the ninth or tenth month following construction commencement. Full-scale production of fifteen hundred tons of ore per day should begin in the eleventh or twelfth month.

Road upgrading will also be initiated soon after permits are obtained. Transport of gravel for use in the mine as backfill will commence based upon scheduled backfill requirements but is not anticipated before the ninth month.

Initially, development workings in the mine will be driven south and west of the portal to establish a ventilation loop near the west end of the Southwest Zone of the deposit (Figure 3). Subsequently, test-mining areas (stopes) will be started to confirm grades and rock characteristics. Shortly after initial stope development in the Southwest Zone, the access drifts to the Gold Bowl area will be driven. Prior to commercial production mining in the Gold Bowl area, underground ore definition drilling may be required from the development drifts to provide information necessary for mining of these ore bodies.

After the initial eight to ten month construction phase, commercial production is projected to continue for approximately 90 months (7.4 years). Active physical decommissioning of the site facilities will continue for two additional years upon mining cessation, followed by three to five additional years of reclamation monitoring and final closure.

3.0 SITE CHARACTERISTICS

3.1 Topography and Physiography

The Buckhorn Mt. deposit is located in north-central Washington State several miles south of the Canadian (British Columbia) border in the northwestern portion of the Okanogan Highlands geomorphic province. The mine site area lies near the top of Buckhorn Mountain on portions of its eastern flank. The region consists of a group of north-south ridges with rounded tops and steeper-walled valleys. The terrain in the mine area commonly has slopes of 2 horizontal (H): 1 vertical (V). The intervening north-south valleys between the ranges are wide and gentle, reflecting their glacial origin. Steeper east-west tertiary drainages flow into the larger secondary drainages of Myers and Toroda Creeks.

Regional elevations range from just over 900 feet above mean sea level (amsl) in the Okanogan River Valley to the west to 5,598 feet amsl at the summit of Buckhorn Mountain (Figure 1). The town of Chesaw and the proposed mill/TDF facility site in the Myers Creek drainage are about 3,000 feet amsl. The proposed portal location lies at an elevation of approximately 5,000 feet amsl.

Buckhorn Mt. and the mine area are drained to the east by Nicholson Creek and Marias Creek. These creeks are third order streams that ultimately drain to Kettle River via Toroda Creek. The proposed mill and TDF sites are located in the Myers Creek drainage west of Buckhorn Mt. Gold Creek and Bolster Creek drain the west side of Buckhorn Mountain and flow into Myers Creek. Myers Creek flows north into British Columbia, where it joins the Kettle River upstream from its confluence with Toroda Creek.

Although Buckhorn Mt. has historically been covered in timber, much of the terrain immediately surrounding the local mine site area has been disturbed by earlier logging in the 1980's associated with part of the Buckhorn Timber Sale. The mill site in the Myers Creek drainage has historically been used as cultivated land and for grazing.

The proposed mine-to-mill access route generally transects timbered terrain in its upper reaches and grassland in the lower portions.

3.2 Land Use

The mine area includes private land and public lands within the Okanogan National Forest (USFS 1989), managed by the Tonasket Ranger District. Current and past land uses include hunting, fishing, gathering, logging, mineral exploration and extraction, agriculture, residential development, timber sale, firewood gathering, grazing, and general recreation.

Logging has been one of the dominant land management uses in the vicinity of this project. Over the past 35 years, about 8,000 acres have been logged in and around the mine site. Approximately 560 acres of timber were harvested during the 1979 USFS's Buckhorn Mountain Sale.

The State of Washington and BLM have harvested their lands within the vicinity of Buckhorn Mt. using both shelterwood and overstory removal methods. Most private lands around the project area have been harvested at some time in the past.

Historically native populations have used the land of the region for traditional uses and continue to reserve rights for hunting, fishing, and gathering on the traditional north half of the Colville Indian Reservation.

Management of the USFS land is guided by a land and resource management plan (RMP) developed by the USFS (USFS 1989). The proposed mine is consistent with the USFS RMP. Additionally the proposed mine is consistent with BLM Spokane Resource Management Plan Record of Decision (ROD) (BLM 1987). The ROD states that all operations associated with mining development shall adhere to 43 CFR 3809 and 3802 which requires reclamation of all mining operations and compliance to air and water quality state and federal standards.

The private land at the mill/TDF site has been dominantly used for livestock grazing and was recently subdivided in recent years.

Although there are no developed recreation facilities in the immediate vicinity of the project, recreation is another land use in the general area. USFS and the BLM-managed lands in the region are used for hunting, hiking, fishing, camping, sightseeing, and picnicking.

3.3 Geology/Seismicity

The mine is situated west of the western margin of the Eocene-aged Toroda Creek Graben and on the northern edge of the Okanogan Metamorphic Core Complex. The rocks within the mine area are comprised of Cretaceous- to Tertiary-aged intrusive rocks and Permian- to Triassic-aged, volcanics, and clastic sediments that have been variably metamorphosed.

Host rocks for the Buckhorn Mt. mineral deposit consist of a sequence of folded and faulted volcanic and volcaniclastic rocks, shallow to deep marine clastic rocks, and carbonate rocks. Locally the volcanic rocks overlie sedimentary, carbonate, and volcaniclastic rocks. The sequence has been intruded by numerous small diorite bodies and the larger Buckhorn Mountain granodiorite pluton. Figure 4 presents a geology map of the mine site area.

The Buckhorn Mt. deposit is a mineralized skarn formed by the hydrothermal interaction of hot silicate magmas and cooler sedimentary rocks. A skarn deposit that can be mined largely for its contained gold is classified as a gold skarn. In most cases gold skarns are of modest size and do not reach economic proportions.

Buckhorn Mt. gold mineralization is directly associated with the skarn alteration which mineralogically includes pyroxene-, garnet-, and magnetite-dominant skarn zones reflecting the varied hydrothermal fluid reaction in host rocks. Skarn fluid pathways included folds, faults, chemically reactive rocks, and permeable hosts. Most faulting and shearing in the area predated skarn development and mineralization. The overprint of early faulting and shearing by skarn minerals has healed the fractures and renders the structures, along with the enclosing host rocks relatively impermeable. Permeability within the rocks within and surrounding the deposits is now controlled by closely-spaced small fractures and by the broken rock within the North Lookout fault zone (Figure 4). This condition is termed secondary permeability. Gold occurs as fine-grained disseminations varying in grade within the skarn mineral assemblages. The geology of the deposit is understood based on surface mapping and detailed examination, analysis, and interpretation of approximately 280,000 feet of reverse circulation drilling and 100,000 feet of diamond drilling core.

Structurally, rocks in the Buckhorn Mt. area near the deposit average a strike of north-northwest and range in dip from 0-20 degrees to the northeast. Northeast trending, southeast dipping, and nearly horizontal sinuous shear zones locally cut all rock types. These sinuous shears have been healed by the overprint of skarn alteration.

Regionally, major faulting after the Jurassic or Cretaceous skarnification event was related to Tertiary volcanism. Geologic structural interpretation, historic seismic records and data on active faults in Washington indicate a lack of active faulting and the lack of moderate to strong seismic activity in the area in recent geologic time. A formal review of local seismicity will update existing information as part of the final TDF design planned for the project.

3.4 Climate

The climate at the Buckhorn Mt. Project is influenced by the topography, elevation, its location relative to the Cascade Mountains and the Pacific Ocean, as well as latitude and longitude. The prevailing westerly winds and weather fronts generally have origins from the Pacific Ocean and the Artic Ocean.

Climatic data was collected from near the top of Buckhorn Mt. from 1989 to 2000. BMG operated sensors for wind speed, wind direction, and temperature at the site beginning in 1991. Precipitation data was collected and analyzed starting in mid-1993. Total average annual precipitation near the summit of Buckhorn Mt. is provided in the Meteorological Data Set, Crown Jewel Project, Chesaw, Washington (ENSR 1996) and updated in the Prefiled Direct Testimony of James M. Wilder (Revised) before the Pollution Control Hearings Board (Wilder, 1998). These data have been statistically correlated and corrected by the use of long-term averages from the nearby monitoring stations of Republic and Molson. Yearly average precipitation at the site is calculated to be 20.0-inches per year using data to 1996, which includes snowfall yielding 7.1 inches of water. Updated values calculated using data through 1998 indicated that yearly average precipitation to be 19.8-inches (Wilder 1998).

Most precipitation between mid-December and mid-February falls as snow, with some snow occurring before and after these dates. Rain can occur at any time, however, and occasionally may be mixed with snow. The months with the highest average precipitation are May and June with 2.3 inches and 2.4 inches, respectively. September and October are the months with the lowest average monthly precipitation at 1.2 inches of water.

Monthly maximum, minimum, and average temperature data were collected continuously at 2.0 and 8.8 meter levels. Wind speed and direction were recorded at the 10-meter level. Average and maximum 1-hour average wind speeds (m/s) were compiled on a monthly and annual basis for both levels. Frequency of occurrence of wind speed by direction were developed graphically (windrose) and in tabular form for each quarter and annually. In addition to precipitation data, other water balance related parameters were collected on site. Relative humidity (2 meter), solar radiation (3 meter) and barometric pressure (1.8 meter) data were all collected on a continuous basis for the site. Monthly, quarterly, and annual evaluations were made for relative humidity (percent, monthly average, monthly 1-hour maximum and minimum), solar radiation (watts/m^2, monthly average, monthly 1-hour maximum) and barometric pressure (in Hg, monthly average, monthly 1-hour maximum, and minimum).

Precipitation data for the mill/TDF and mine site areas for 24-hour storm events at 2-, 10-, 25-, and 100-year frequencies (NOAA Atlas II Precipitation – Frequency Atlas of Western United States, Volume IX – Washington) are listed below in Table 3. This information will be used in the detailed design and sizing of mine and mill/TDF stormwater management structures and channels.

TABLE 3

PRECIPITATION DATA FOR 24-HOUR STORM EVENTS

Storm Recurrence Period (year)	Mine Site Precipitation (inches)	TDF Site Precipitation (inches)
2	1.4	1.2
10	2.0	1.8
25	2.4	2.2
100	2.7	2.6

The climatic conditions at the mill/TDF site are more temperate. Less rainfall and snowfall occur as a result of the lower elevation. Average monthly maximum temperatures at the site range from 21° (F) in January to 74° (F) in August. Average monthly precipitation at the nearby Chesaw site as referenced in Golder (1996) are summarized below in Table 4.

TABLE 4

AVERAGE MONTHLY PRECIPITATION AT CHESAW

Month	(in/month)	(mm/month)
January	1.25	31.8
February	0.90	22.9
March	0.75	19.1
April	1.05	26.7
May	1.54	39.1
June	1.60	40.6
July	0.86	21.8
August	1.31	33.3
September	1.00	25.4
October	0.71	18.0
November	1.29	32.8
December	1.66	42.2
Total Annual	13.92	353.7

Pan evaporation rates for the Buckhorn Mt. mine site were calculated by adjusting historical data that were available from a National Weather Service station in Republic, Washington for the Buckhorn Mt. site (Golder 1996). The adjustments to the Republic evaporation data included modifications for temperature, wind speed, and humidity at the mine site. The estimated average annual pan evaporation for the Buckhorn Mt. mine site using the Priestly and Taylor model was about 38.6 inches (Golder 1996). The average monthly pan evaporation ranges from a maximum of about 7.3 inches in July to a minimum of 0.2 inches in January. Estimated average monthly potential evapotranspiration values for the site were developed by Golder (1996) and are summarized in Table 5, where the potential evapotranspiration is estimated at approximately 0.7 times the pan evaporation. As part of the planned TDF design the climatic information will be updated to support development of a detailed water balance and facility sizing.

TABLE 5

ESTIMATED AVERAGE MONTHLY POTENTIAL EVAPOTRANSPIRATION VALUES FOR THE MINE SITE

Month	(in/month)	(mm/month)
January	0.08	2.03
February	0.12	3.05
March	0.61	15.5
April	1.66	42.2
May	3.17	80.5
June	4.22	107.2
July	5.44	138.2
August	4.39	111.5
September	2.69	68.3
October	1.03	26.2
November	0.00	0.00
December	0.00	0.00
Annual Total	23.41	594.68

3.5 Water Resources

Extensive baseline water resource characterization studies for surface water and groundwater have been conducted at the site. These programs are discussed briefly in the following sections and more extensively in the previous studies shown on Table 1.

3.5.1 Surface Water Hydrology

The Buckhorn Mt. mine site area is drained by Nicholson Creek and Marias Creek that generally flow east to Toroda Creek. On the western side of Buckhorn Mt., Ethel Creek, Thorp Creek, Bolster Creek, and Gold Creek flow west to Myers Creek. Myers Creek is approximately three miles to the west of the proposed Buckhorn Project and flows north into Canada eventually discharging into the Kettle River. Toroda Creek is about six miles east of the project and flows northeast and then east to the Kettle River.

To characterize baseline surface water resources, monitoring stations were established in six principal drainages in or near the area of the mine and related facilities. The drainages were extensively monitored from 1990 to 1996 over a period of six years and included Nicholson Creek, Marias Creek, Bolster Creek, Gold Creek, Ethel Creek, and Myers Creek. A total of eighteen surface water sites were established as part of the baseline water quality characterization program and were sampled for an extensive suite of field and laboratory parameters. Not all eighteen sample sites were monitored the entire period as modifications to the operational program refocused monitoring on certain drainages and sites. However, from 1990 to 1996 the majority of these sites were sampled on a monthly basis. Samples were analyzed for as many as 138 different field and laboratory parameters including trace metals (total, total dissolved, dissolved & total recoverable), major cations and anions, nutrients, radionuclides and physical characteristics. In addition, pH, temperature, conductivity, flow rate, dissolved oxygen (DO) and ferrous iron ($Fe^{2}+$) were also recorded as field parameters at each station at the time of sample collection. Over this time period for the 18 different surface water sites approximately 32,000 individual analyses were performed.

3.5.2 Surface Water Quality

Due to similarities observed in water quality conditions, an overall summary of water quality characteristics on the project area is summarized here instead of a basin by basin description. Based on field analyses surface waters are alkaline and contain measurable oxygen, with field pH values ranging from 6.9 to 9.3. Dissolved oxygen (DO) ranges from 1.5 mg/l to 13.8 mg/l. Surface water temperatures vary seasonally, with measurements ranging from -0.7 ^{o}C (30.7 ^{o}F) during the winter to 16.9 ^{o}C (62.5 ^{o}F) during the summer. Field measurements of ferrous iron in site surface waters were negative.

Laboratory analyses indicate that calcium and bicarbonate are the dominant cation and anion measured, respectively, in site surface waters. The pH range and the predominance of calcium and bicarbonate in solution indicate that the major-ion chemistry and the acid-base conditions of the surface waters at the site are due to dissolution of carbonate minerals. The bicarbonate alkalinity characteristic of the surface water indicates that the system has natural acid buffering capabilities. One exception is the station located at the headwaters of Gold Creek. Sulfate instead of bicarbonate was the dominant anion.

At most stations the total dissolved solids (TDS) ranged from 62 mg/l to 324 mg/l. One station (SW 10) had the highest TDS measurements, ranging from 290 mg/l to 482 mg/l.

Dissolved trace metal concentrations were generally at or below analytical detection limits. Both arsenic and strontium were frequently detected at levels above detection limits. Arsenic concentrations ranged from less than 0.001 mg/l (detection limit) to 0.014 mg/, and averaged

0.002 mg/l. Strontium concentrations ranged from less than 0.01 mg/l (detection limit) to 0.77 mg/l, and averaged 0.3 mg/l. These metals are commonly detected at trace levels in natural waters as a result of the interaction with sediments and bedrock.

Total concentrations of iron and aluminum were higher than associated dissolved concentrations at several stations. This is not uncommon and is attributed to the occurrence of colloidal material and/or suspended solids in the water column which are removed during sample filtration.

Nutrient levels were low in most surface water samples. Ammonia concentrations ranged from below 0.05 mg/l (detection limit) to 0.27 mg/l. The presence of ammonia may be the result of cattle grazing. Average ammonia concentrations were less than 0.05 mg/l. Nitrate plus nitrite concentrations ranged from below 0.02 mg/l (detection limit) to 1.09 mg/l. Average nitrate/nitrite concentrations were 0.1 mg/l.

Analysis of gross alpha and gross beta activities indicates that background radioactivity is generally near detection limits.

Total and WAD cyanide concentrations were generally below analytical detection limit. The highest concentration of total cyanide was 0.029 mg/l. The highest concentration of WAD cyanide was 0.02 mg/l. Cyanide does occur naturally in the environment and its detection during baseline monitoring may indicate a natural source.

3.5.2 Groundwater Hydrogeology

The regional groundwater system in the vicinity of the Buckhorn Mt. project area occurs as three hydrogeologic systems; alluvial sediments, glacial deposits, and bedrock. Bedrock is the primary hydrogeologic unit in the immediate area of the proposed mine. In close proximity to the mine area significant thicknesses of alluvial materials are absent and groundwater flow is limited to glacial deposits and bedrock systems. The water resource data collected and evaluated for the Crown Jewel FEIS is extensive and directly applicable to this project.

Alluvial valley sediments have developed along the valley bottoms of the regional drainages and are generally saturated where the thickness of the sediments is more than approximately ten feet. Unconsolidated sediments along regional streams are typically comprised of clays, silts, sands, and gravel. The alluvial sediments are recharged by precipitation and snowmelt, by stream flow losses, and by discharge from the bedrock groundwater system. The regional surface and groundwater system is interdependent with groundwater contributing to stream baseflows in some areas.

Unconsolidated glacial deposits are saturated with groundwater near their bases in many areas near the project, particularly where the deposits are located in valleys. The glacial deposits exhibit permeability and porosity depending primarily on the gradation and clay content.

Groundwater is present in varying degrees in all bedrock in the mine area. Groundwater flow direction generally mimics topography; however preferential flow may occur on a small scale in the fractured bedrock. The fracture systems are influenced by structural faulting and folding that have affected the ability of the bedrock to store and transmit groundwater

Mine Site Hydrogeology

To evaluate the baseline groundwater resources in the area, nine monitoring wells were installed in 1992 to establish pre-mining groundwater quality conditions for the drainage basin potentially affected by mine development. The location of each well was selected in consultation with DOE and the USFS to provide water quality data within and downgradient of the proposed open pit mine and waste rock disposal areas of the Crown Jewel proposal. Wells were sampled monthly for field and laboratory analytical parameters. Selection of groundwater wells specific for this project will be in conjunction with the DOE and the USFS.

Groundwater monitoring began in November 1990 with the collection of water samples from an existing mine adit, GW-1. The formal baseline groundwater monitoring program began with the installation of nine monitoring wells between March and June 1992. Most of the wells were located in proximity to the proposed Crown Jewel project facilities and each was completed with a dedicated submersible pump to reduce the potential for cross-contamination of samples. Baseline monitoring was performed on a monthly basis, weather, and access permitting, from May 1992 to June 1995; sampling was then conducted on a semi-annual basis. In 1999 seven additional wells were drilled and completed at the request of the state agencies to further evaluate groundwater quality specific to certain proposed facilities for the Crown Jewel project. These wells were sampled monthly for 13 consecutive months. In addition, a series of existing wells were also sampled on a quarterly basis to provide a comparative data-base for these seven new wells. Field parameters such as static water level were routinely recorded during sampling.

In addition to the groundwater monitoring wells, a series of historic adits located within the project area were sampled and analyses conducted. There are a total of four mine adits that make up this component of the overall historic groundwater monitoring efforts on site. Although the number of total analyses performed was much lower for these sites than that of the monitoring wells, the extensive parameter suite was similar (over 100 different parameters analyzed) and over 5,000 individual analyses were analyzed from the four sites from 1990 - 1996.

A number of groundwater investigations in both bedrock and glacial hydrogeologic systems have been completed at the site. A general summary of these data indicate that groundwater fluctuate seasonally by about one to two feet in the glacial system, while seasonal fluctuations ranging from 50 to 200 feet locally occur within the bedrock groundwater system. Permeability and porosity are low within the mine area bedrock system, and groundwater flow is governed by secondary fractures and joints that are closely spaced, indicating that the flow is similar to that of a porous media on a moderate to large scale. Aquifer recharge is via infiltration of precipitation and snowmelt for the bedrock system plus direct infiltration from local streams and flow from bedrock groundwater in the case of glacial till formations. The groundwater flow in the vicinity of the deposit appears to be influenced on a small-scale by the North Lookout Fault which crosses the site from southwest to northeast, dipping 60 to 70 degrees to the southeast. In the general project area, the fractured rock associated with the fault zone is approximately 70 to 200 feet wide at the surface.

A groundwater divide exists along the top of Buckhorn Mountain. This divide is based on groundwater modeling (Hertzman 1996). This divide separates the Toroda Creek groundwater basin to the east from the Myers Creek groundwater basin to the west.

Depths to groundwater are greatest on the ridge tops (generally between 100 and 300 feet below ground level (bgl)) and less in the valley bottoms (less than 50 feet bgl) depending on the season. Groundwater elevations in the bedrock range from 4,700 to over 5,200 feet amsl. Historic data indicate that groundwater levels rise rapidly in the spring in response to snowmelt and spring runoff. Groundwater elevations subsequently decline over a period of several weeks to months in late spring and early summer. And then decline very slowly throughout the remainder of the year.

The mine portal will be situated at an elevation of approximately 5,030 feet amsl. At this location the elevation of the decline portal will be above the high water table elevation. Most of the mine workings will extend below the water table, and as a consequence, groundwater will enter the workings as mining proceeds. Because part of the mine workings in the Southwest Zone extend into the Myers Creek drainage, the workings will intercept some of the upgradient recharge east of the groundwater divide during mining. In addition, it is predicted that drawdown in the vicinity of the workings will result in a migration of the groundwater divide to the west, effectively diverting and capturing some of the groundwater recharge that would otherwise feed the Myers Creek groundwater basin to the west. Preliminary groundwater modeling indicate that potential inflows to the underground workings and the displacement of the groundwater divide associated with the proposed mining operation during and after mining will likely be minimal.

Groundwater modeling work was conducted (May 2, 2003) in order to provide estimates of the potential impacts to the physical groundwater system associated with the proposed underground mining operation on Buckhorn Mountain. Specifically, modeling was conducted to determine the following:

- Estimated groundwater inflows to the underground workings during mining,
- Any change during operation in the location of the groundwater divide between the Myers Creek drainage and the Toroda Creek drainage basins, and
- Any final post-closure impacts to the hydrogeologic system.

The modeling results are presented in Appendix B. The results illustrate that the displacement of the groundwater divide associated with the proposed mining operation during and after mining will be minimal.

The estimated maximum groundwater inflows to the underground workings during the mine life range from an annual average of 15 to 42 gpm. Water collected within the mine and discharged will be returned to the local drainage basins after water quality treatment.

Groundwater Quality

Groundwater quality monitoring wells were completed in both the bedrock units and in glacial deposits. The bedrock units included andesite and/or basalt; clastics and granodiorite; and undifferentiated skarn, garnet skarn, and diorite. Groundwater quality was analyzed for both bedrock and glacial deposit wells and is discussed separately below. Similar to the surface water monitoring program, an extensive parameter suite was evaluated for each well over the period of 1990 - 2000. Over this time period over 113 different analytical parameters were evaluated totaling over 25,000 individual sample analyses. Groundwater analyses included trace metals (total, total dissolved, & dissolved), major cations and anions, nutrients, radionuclides, total petroleum hydrocarbons (TPH), total organic carbon (TOC) and physical characteristics. In addition pH, temperature, conductivity, flow rate, depth to water, dissolved oxygen (DO) and ferrous iron ($Fe^{2}+$) were also recorded as field parameters at each well at the time of sample collection. The average values as discussed below were calculated using one-half the detection limit value for all measurements identified as below the reported detection limit.

Bedrock Wells

Field analyses indicate that the groundwater is near neutral to moderately alkaline. Values of pH ranged from 6.2 to 9.2. Groundwater temperature ranged from 4.0° C (39° F) to 7.9° C (46° F). DO levels ranged from 3.1 mg/l to 12.3 mg/l. Field measurements of ferrous iron in groundwater were negative.

Laboratory analyses indicated that, with the exception of one well, MW-1, calcium, and bicarbonate are the dominant cation and anion measured, respectively, measured in all wells, including the glacial wells. Sodium (rather than calcium) was the dominant cation measured in MW-1. TDS ranged from 92 mg/l to 250 mg/l in the bedrock wells. Average TDS in the glacial wells was 190 mg/l. TDS concentrations in the surface water averaged 235 mg/l. These similar TDS levels between surface water and groundwater suggest a close interrelationship between the two hydrologic systems and between the bedrock and glacial aquifers.

In general, dissolved trace metal concentrations in bedrock groundwater were generally at or below analytical detection limits. However, three trace metals (arsenic, barium, and strontium) were commonly detected at levels above detection limits. Dissolved arsenic concentrations ranged from less than 0.001 mg/l (detection limit) to 0.011 mg/l, and averaged 0.004 mg/l. Dissolved strontium concentrations ranged from less than 0.09 mg/l to 0.8 mg/, and averaged 0.3 mg/l. Dissolved barium concentrations ranged from less than 0.01 mg/l (detection limit) to 0.03 mg/, and averaged 0.01 mg/l.

Total trace metal concentrations were typically higher than associated dissolved concentrations in both bedrock and glacial deposit wells.

Nutrient levels in the bedrock wells were low. Ammonia concentrations ranged from below 0.05 mg/l (detection limit) to 0.12 mg/l. Average ammonia concentrations were less than 0.05 mg/l. Nitrate plus nitrite concentrations ranged from below 0.02 mg/l (detection limit) to 3.5 mg/l and averaged 0.94 mg/l.

TOC concentrations ranged from less than 1 mg/l to 53 mg/l and averaged 3 mg/l. These concentrations may indicate impacts related to organic matter. TPH concentrations were negative in both bedrock and glacial deposit wells.

Hydrogen sulfide concentrations ranged from less than 0.02 mg/l to 0.30 mg/l.

Total and WAD cyanide concentrations were generally below analytical detection limit. Cyanide was occasionally detected in both bedrock and glacial deposit wells. Total cyanide concentrations ranged from less than the detection limit to 0.03 mg/l. WAD cyanide concentrations ranged from less than the detection limit to 0.04 mg/l. Cyanide does occur naturally in the environment and its detection during baseline monitoring may indicate a natural source.

Analysis of gross alpha and gross beta activities indicates that background radioactivity is generally near detection limits.

Glacial Deposit Wells

Field analyses indicate that the groundwater is near neutral to slightly alkaline. Values of pH ranged from 6.0 to 8.3. Groundwater temperature ranged from 3.1 ^{o}C (38 ^{o}F) to 8.5 ^{o}C (47 ^{o}F). DO levels ranged from 2.3 mg/l to 13.3 mg/l. Field measurements of ferrous iron were negative.

Laboratory analyses indicated that calcium and bicarbonate are the dominant cation and anion measured, respectively, measured in all wells, including the glacial wells. TDS ranged from 76 mg/l to 344 mg/l in the bedrock wells. Average TDS was 190 mg/l.

The same trace metals were typically detected at levels above analytical detection limits in the glacial deposit and bedrock wells, except iron and manganese which were below detection limits in the bedrock wells. Iron and manganese concentrations in the glacial wells may be unique to the glacial materials.

Dissolved arsenic concentrations ranged from less than 0.001 mg/l (detection limit) to 0.44 mg/l, and averaged 0.006 mg/l. Dissolved strontium concentrations ranged from less than 0.13 mg/l to 0.54 mg/l, and averaged 0.29 mg/l. Dissolved barium concentrations ranged from less than 0.01 mg/l (detection limit) to 0.04 mg/, and averaged 0.01 mg/l. Iron concentrations ranged from less than 0.02 mg/l to 0.20 mg/l and averaged 0.02 mg/l. Manganese concentrations ranged from less than 0.01 mg/l to 0.70 mg/l and averaged 0.07 mg/l.

Nutrient levels in the glacial deposit wells were low. Ammonia concentrations ranged from below 0.05 mg/l (detection limit) to 0.49 mg/l. Average ammonia concentrations were 0.06 mg/l. Nitrate plus nitrite concentrations ranged from below 0.02 mg/l (detection limit) to 1.53 mg/l and averaged 0.15 mg/l.

TOC concentrations ranged from less than 1 mg/l to 77 mg/l and averaged 3 mg/l. These concentrations may indicate impacts related to organic matter. TPH concentrations were negative in both bedrock and glacial deposit wells.

Hydrogen sulfide concentrations ranged from less than 0.02 mg/l to 0.80 mg/l.

Analysis of gross alpha and gross beta activities indicates that background radioactivity is generally near detection limits. Gross alpha activities measured in the glacial deposit wells ranged from less than 1 pCi/l to 17.4 pCi/l and averaged 4 pCi/l. Gross beta activities ranged from less than 3 pCi/l to 33 pCi/l and averaged 3 pCi/l.

Radium 226 was measured in both bedrock and glacial deposit wells when gross alpha activities exceeded 5 pCi/l. Radium activities ranged from less than 1 pCi/l (detection limit) to 8.6 pCi/l and averaged less than 1 pCi/l. Radium activities were above the detection limit in all but three wells.

Seasonal trends in groundwater quality were noted to occur. TDS and temperature were the only parameters affected. There appeared to be little or no seasonal variability in the levels of nutrients, trace metals, or radionuclides.

Seeps and Springs

A series of springs (30) and seeps (18) were monitored as a component of the overall site groundwater monitoring program. A spring and seep survey was conducted over an area of approximately 10 square miles that was delineated by the Washington DOE. This area includes watersheds that may have been potentially affected by development of the Crown project and adjoining facilities. Groundwater in the glacial deposits discharges into springs and seeps and into the surface water streams in the lower reaches of the local drainages. Springs and seeps within the study area were identified by examining color aerial photographs, geologic maps, and topographic maps, and by physically walking the drainage areas. Springs and seeps were designated based on the presence of observable flow: sources with observable overland flow were classified as springs, while sources characterized as areas of very shallow standing water or saturated soil were classified as seeps. Samples from springs and seeps were analyzed for a wide spectrum of parameters (approximately 120), including trace metals, major cations and anions, nutrients, radionuclides, and physical characteristics. Where possible, flow, temperature, pH, conductivity, DO, and ferrous iron were measured and recorded as field parameters for each spring and seep.

Mill Site Hydrogeology

Groundwater investigations are in progress and have not been completed to date in the area of the proposed mill/TDF. The area is located on glacial deposits in the Myers Creek drainage basin. A program of water quality monitoring of both surface and groundwaters is being formulated and implemented according to recommendations of the DOE. Groundwater hydrology is being studied and characterized by Crown at the time of issuance of this POO. The results of these studies will be appended to the POO when complete.

3.6 Geotechnical Characteristics

The geotechnical rock strength characteristics of the host rocks of the Buckhorn Mt. deposit are favorable for stability during underground mining. Uniaxial rock strengths are summarized below in Table 6 for the rock types that will be encountered in the workings. These strengths are typical of competent lithologies, particularly for the skarn, clastics, and andesite, which are the “hanging wall” rocks of the ore found directly above the most important planned mining stopes. Except in rare local cases, the weaker marble lithology typically comprises the “footwall” of the stopes so its strength is of lesser importance for stability in the workings. Garnet skarn is important only in the Gold Bowl area where large spans of exceptionally competent rock are not critical to ground stability.

TABLE 6

UNIAXIAL ROCK STRENGTHS PARAMETERS

Measured Unconfined Compressive Strengths	
Lithology	**Expected Uniaxial Compressive Strength (psi)**
Andesite	18,000
Clastics	28,000
Skarn	17,000
Marble	7,500
Garnet Skarn	9,600

Engineered backfill placed into stope areas will facilitate stability in the underground workings so that safety standards are met. Additionally, backfill will support the rock mass as a whole and will minimize the amount of normally occurring fracturing, relaxation and subsidence in the rock immediately overlying the mined-out stopes. Surface disturbance caused by subsidence will be prevented by the use of backfill and the appropriate placement of pillars and ground support.

A detailed geotechnical assessment of each stoping area will be completed prior to final design of mining and backfilling. These studies will continue throughout the mine life. Design criteria for the stopes and for backfilling will be based on geotechnical information obtained from drill core and detailed data obtained in the mine workings. This underground information is acquired by mapping of fractures with particular emphasis placed on logging of orientation, spacing, planarity, roughness, alteration, and continuity. These data will be used in conjunction with measurements of uniaxial compressive strengths of the host rock to model the rock strength characteristics of the ore body. The objective for the design performance of the mine backfill specifications will be to achieve insignificant subsidence-related surface disturbance above the mined areas.

The North Lookout Fault crosses the northwestern part of the Southwest Zone of the Buckhorn Mt. Deposit and to the south of the majority of the Gold Bowl ore bodies. This fault is characterized by a zone of broken rock that dips, on average, 65 degrees from vertical to the southeast. Within the uppermost andesite this fault zone is estimated to average about 20 feet in width and is characterized by blocky to rubbly fracturing adjacent to the fault trace itself over variable widths. In the more competent skarn and adjacent mylonite and hornfels lithologies, the zone of broken rock is more confined and less broken. In either case, where workings intercept the North Lookout Fault zone ground support is anticipated to be required to maintain a high degree of safety in the mine workings. This support may take the form of rock bolts, shotcrete, or steel sets, as required.

3.7 Geochemistry Characteristics

The geochemical behavior of the rock to be mined and processed for the Buckhorn Mt. Project has been extensively characterized by BMG (Adrian Smith Consulting Inc. 1992, Kea Pacific 1993a, 1993b, 1993c, BMG 1993, BMG in association with Geochimica and Golder 1996, TerraMatrix 1995, and Geochimica 1996) and in the Crown Jewel FEIS (USFS and DOE 1997). The proposed project will mine and process the same materials but at reduced volumes and without any permanent surface waste rock disposal facilities. As discussed in the project description Section 4.0, there will be a temporary development rock stockpile near the mine and there will be temporary ore stockpiles at the mine and mill. The available geochemical information and analysis conducted previously to support definition of the environmental behavior of the waste rock and tailings is valid and provides adequate characterization information for this proposed project. The proposed new underground mine plan, which incorporates management strategies for the temporary surface ore and development rock stockpiles, significantly reduces, or eliminates any potential environmental issues related to the geochemistry of the materials. These plans have been developed to address and utilize the results of the extensive geochemical characterization for the Crown Jewel project.

3.7.1 Materials Characterized

During the assessment of the Crown Jewel Project geochemical characterization programs were developed to be representative of the geologic materials encountered in the mine and to evaluate the environmental behavior of waste rock, ore and low grade ore, and tailings. Based on these studies the following waste rock groups were identified:

- Altered Andesite
- Unaltered Andesite
- Garnet Skarn
- Magnetite Skarn
- Undifferentiated Skarn
- Altered Clastics
- Unaltered Clastics
- Marble, and
- Intrusives

Ore and low grade ore included:

- Andesite/garnetite skarn
- Magnetite skarn, and
- Undifferentiated skarn
- Tailings developed by bench scale milling of the ore materials were also analyzed.

All of these materials were evaluated by whole rock chemistry (XRF), leachability tests (US EPA Method 1312), acid base accounting (ABA), and humidity cell tests (HCT). Additionally, the tailings had pore water extraction and testing and waste classification testing. These test procedures are consistent with standard of care currently used for the characterization of mine waste materials and are considered appropriate for the analysis of this project.

3.7.2 Geochemical Characterization Results

As summarized in the Crown Jewel FEIS (USFS and DOE 1997), the following key conclusions where reached:

1. Whole rock chemistry identified the presence of trace metals that could be potentially leachable in the environment including arsenic, chromium, cobalt, copper, lead, molybdenum, nickel, strontium, thorium, tin, vanadium, and zinc.

2. However, leachability tests indicated a low potential for short-term leaching. Due to the nature of the test (US EPA Method 1312), this information does not provide specific predictive information for the water quality but merely indicates that the following metals may be leachable: arsenic, iron, and aluminum. The leachability of metals would be facilitated if acidic conditions exist.

3. ABA testing indicated that the overall geologic materials characterized will not be acid generating due to the availability of net acid neutralizing potential. A portion of two individual rock types (magnetite skarn and altered clastics) were identified to be marginally potentially acid generating based on the ABA testing. Likewise a portion of two ore rock types were also identified to be potentially acid generating on the basis of the ABA testing. Tailings were found to have a low potential for acid generation.

4. HCT results for the ore and tailings indicated that these materials are not acid generating.

Management of the temporary ore and development rock stockpiles is discussed below in Section 4.0. However, based on the geochemical characterization and the proposed storm water management plans in Section 4.0, no environmental impacts related to the geochemistry of the rock are anticipated. Also as discussed in Section 4.0, the tailings will be managed as zero-discharge closed facility with lined containment to prevent environmental impacts. The underground mine provides the only other potential concern for environmental impacts related to geochemical interaction with groundwater. Based on the studies completed to date, the mine is expected to be net acid neutralizing. The existing geochemical database is extensive and provides suitable background to support the environmental impact analysis phase.

4.0 PROJECT DESCRIPTION

The Buckhorn Mt. Project proposes to mine and process gold ore from the Buckhorn Mt. deposit located in Okanogan County, Washington approximately 20 miles east of the town of Oroville. During operation the project would employ about 150 people, of which approximately 25 will work directly for a full time trucking contractor. Additional contractors will be retained on an as-needed basis to perform road maintenance, mechanical repair and maintenance, engineering, special mining projects etc. The mine and the mill will operate on a 24-hour basis with transportation limited to a shorter daily schedule.

The proposed project consists of two principal facility locations, one at the mine site and one at the mill/TDF site. These locations will be interconnected by an access (haul) road. Site maps of the two facilities are shown on Figures 5 and 6 respectively and of the overall location of facilities on Figure 7. Cross-sections through the mine and mill/TDF sites are presented as Figures 8, 9, and 10. Surface water diversion for the mill site is on Figure 11. Key Project components at each of the two principal facility sites are introduced below.

Mine Site

- Mine Portal and Underground Workings
- Mine Ventilation Equipment
- Office, Shop and Change Room Building
- Mine Rescue Building
- Substation
- Fuel Storage
- Explosives Storage
- Development Rock Temporary Storage
- Backfill Stockpile and Batch Plant

- Topsoil Stockpile
- Water Tank/Well
- Water Treatment Plant
- Stormwater Diversion, Capture and Infiltration Structures
- Security Fencing

Mill/TDF Site

- Mill Building and Equipment
- Temporary Ore Stockpile
- Backfill Stockpile
- Tailings Disposal Facility/Reclaim Pond
- Freshwater Pond
- Office Building
- First Aid and Training Building
- Change Room / Waiting Building
- Shop and Warehouse
- Reagent Storage
- Equipment Laydown Area
- Substation
- Employee Parking
- Security Fencing

A buried water pipe would convey water to the Mill/TDF site from Crown's ground water-right located on private land owned by Crown four miles north of the site. Additional water would be supplied by surface water-rights located two miles north of the site and conveyed in the same pipe. The point of diversion of the surface water right, currently located on Mary Ann Creek, is proposed to be changed to a point on Myers Creek near the confluence of Mary Ann Creek to be approved by the DOE. Potable water will be provided by installation of a water well or from commercial sources.

4.1 Underground Mining

Commercial ore production at the Buckhorn Mt. Project is proposed to utilize primarily room and pillar and drift and fill underground mining methods combined with extensive use of backfill for ground support. Access to mining areas and drifting (tunneling) in ore will be accomplished by the use of drill jumbos and conventional blasting techniques. A jumbo is a rubber-tire mining machine that drills near-horizontal holes in a mining face to be blasted. The method results in drifts that can be driven on the level or on an incline, either up or down, of up to 15 percent grade. Most ongoing development and mining will be accomplished by this method.

A lesser quantity of ore will be extracted by longhole methods. The primary machine used for preparing blast holes is the longhole drill that drills vertical or near vertical holes to excavate vertical slices of rock.

Prior to commercial mining development, drifting will be done to provide access to the areas for production. A primary access ramp will be developed to the south of the mine portal which will split to access the Southwest Zone and the Gold Bowl mining areas (Figure 3). Development access will continue throughout the mine life as new areas are selected for mining.

Certain mining practices will always be followed regardless of the specific mining method used. The injection of water or water mist is necessary during drilling of the blast holes to cool the drill bit, suppress dust and to wash the drilled rock from the blast hole. This water will be obtained from sumps located throughout the mine. No drilling additives will be used with this water.

The holes will be loaded with an ammonium nitrate-based explosive such as ANFO, water gel, or emulsion. It is anticipated that ANFO will be the most appropriate primary explosive material based on existing ground conditions and the relatively dry rock conditions anticipated. Approximately

1.2 lb of ANFO per ton of ore will be required for mining. Non-electric blasting caps will be the detonation devices for the explosives. Safety precautions will be taken in the handling of explosive materials to optimize safety of workers and minimize spillage of bulk materials.

After blasting and prior to reentry, the mining area will be ventilated to meet air standards prescribed by the Mining Safety and Health Administration (MSHA). Water spray will be applied to the ore pile after blasting to control dust in the mine air.

Cross-sections through the ore body illustrating pre-mining topography, pre-mining groundwater elevations, post-mining topography and post-mining groundwater elevations are presented on Figure 8. Cross-sections through mine site area illustrating the pre-mining, mine operations, and post-reclamation topography for facilities and underground access are shown on Figure 9.

4.1.1 Underground Mining Method in Near-Horizontal Bodies

Mining in near-horizontal ore zones such as in most of the Southwest Zone will be done with a room-and-rib-pillar, cut, and fill technique or by long hole open stoping. Once an initial drift (tunnel) of up to 14 x 16 feet is established through the ore zone, extraction of the walls of the drift will be facilitated using a drill jumbo to achieve a full maximum stope width of up to 32 feet. Commonly, however, the design width of the stope will not exceed 16 feet. Further definition drilling will then be completed both up and down to determine the full height of the ore zone. Extraction of ore below the drift level (if necessary) will be followed by filling of the opening by cemented backfill which will provide a solid floor on which to mine additional ore above the initial drift level, if present. Cemented backfill will ultimately be placed in the mined out stope as tightly as feasible to provide rock support to the overlying rock mass.

When complete, another stope will be mined parallel to the initial stope leaving a pillar of ore between these two primary stopes. When the cemented backfill in these stopes has fully hardened, the extraction of the pillar will be done in the same manner as previously described and filled as before but with unconsolidated (uncemented) fill to provide ground support in the secondary stope.

Where vertical ore thicknesses exceed about sixty feet the ore may be removed by a longhole open stoping technique. This method utilizes blast holes collared in one drift in the ore (sublevel) and drilled upwards or downwards toward the adjacent sublevel. These holes are loaded with explosives and the ore between the levels is blasted and falls into the lower level of the active stope where it is removed.

Filling of stopes by cemented backfill will be accomplished in a similar manner to thinner zones and intervening secondary stopes will be filled by unconsolidated fill where required.

In some areas it may be possible to fill the primary stopes with a core of uncemented fill armored with cemented fill on either side and above.

4.1.2 Underground Mining Method in Inclined Ore Zones

Mining in steeply dipping bodies is accomplished in much the same way as described above. Initial drifts of up to 14 x 16 feet will be established through the ore and drilling will be done to locate the limit of the ore laterally. Slashing (ore extraction) to the maximum full ore width of thirty feet will be followed by stoping of the ore above the drift and by filling where needed. Where vertical ore thicknesses are sufficient, long hole open stoping can be used to more efficiently extract the ore. In all cases, filling of the open stopes will be done where appropriate to minimize natural stoping (or caving) resulting in surface subsidence.

Production drill hole configuration in the longhole method is determined by stope width. In narrower stopes, parallel long hole drilling and blasting would be completed. In wider stopes where spans are too great for full width sublevels, ring drilling patterns may be designed.

It is anticipated that stope boundaries in the majority of the inclined ore zones of the Gold Bowl area will be determined and engineered prior to initial cuts in the ore. This definition of ore boundaries can be accomplished by close spaced drilling of the body from a development drift outside of the ore. While this is more expensive and time consuming than boundary definition drilling from the interior of the stope, this method gives the highest degree of confidence in the stope engineering and layout for more complex geometries of individual ore bodies.

4.1.3 Ore and Development Rock Transfer Procedures

Broken development rock and ore will be loaded into low profile diesel powered underground haul trucks at or near the face (end) of the working stopes or at draw points designed for this purpose.

Low profile diesel powered front-end loaders will load the rock into the mine trucks. Development rock will be transported to the surface and deposited into the development rock temporary storage areas near the mine as shown on Figure 5. Construction design of the storage areas is discussed in Section 4.2.1. All of the development rock will ultimately be transported underground and used as backfill material as described in Section 4.1.4.

Mined ore by the longhole method will be loaded and hauled from the ore face or at draw points at the lowest level of an active longhole stope. The ore will then be transported to the temporary ore stockpile area on the surface as shown on Figure 5. Where required, underground loading of rock will be done using remote controlled equipment to reduce human exposure to falling rock.

Transportation of ore from the stockpile to the mill is described in Section 4.2.

4.1.4 Backfilling

The voids produced during mining will be selectively backfilled after stoping is completed. Backfilling will promote rock stability and prevent surface disturbance by minimizing subsidence of the rock immediately overlying the stopes. Backfill will consist of either development rock from other parts of the mine or of gravel transported from the backfill storage site. Some of the backfill will contain up to 6 percent (average 5 percent) cement that will bind the unconsolidated rock and provide additional strength to support load. Uncemented development rock used as backfill may be brought directly from another working area within the mine or from the development rock storage area on the surface.

In the case of cemented gravel backfill, underground trucks will load the backfill at the underground backfill facility by an automated system as shown on Figure 12. The unconsolidated gravels for cemented backfill will be transported from the backfill storage area near the mill to the mine site by the haul trucks when they return to the mine from the mill/TDF. The gravel will be stored on the surface at the temporary backfill storage location shown on Figure 5. The gravel is dumped by a loader into the backfill pass where it falls by gravity onto a conveyor underground and is carried to a rotating mixer. Cement is added directly onto the conveyor from a screw feed mechanism fed from cement storage silos located on the surface. The gravel with cement is conveyed directly to underground trucks as required and is hauled to a mining area.

The use of cemented backfill will be determined based on the requirement for stope stability depending on stope geometry, size, depth from surface, and mine sequencing.

Approximately 1.6 million yd^3 of total backfill will be required during the mine life. Of this amount, about 900,000 yd^3 will be uncemented fill and 700,000 yd^3 will require cement additive. All of the cemented backfill will be composed of glacial gravel. Of the uncemented fill, approximately 300,000 to 400,000 yd^3 will come from development rock.

4.2 Ore Processing

The processing of ore at the Buckhorn Mt. Project will follow procedures developed for the Crown Jewel Plan of Operations. The nature of the Buckhorn Mt. ore from the standpoint of mineralogy and metallurgical process is identical. The only difference is that the volumes mined for the underground mine plan are less but the contained gold grade will be of a higher concentration. The estimated head (mined) grade is an average of approximately 0.34 ounces per ton. However, detailed mine planning will refine the mine life grade and the scheduling of grade to the mill. A simplified flow sheet of the mill process is shown on Figure 13.

The processing of the ore will occur within a closed system where water used for gold extraction and tailings conveyance will be recirculated and reused in the process.

After primary crushing, ore will be transported by truck from the mine temporary ore storage to the mill temporary ore storage. Generally these storage sites will contain from 0 to 20,000 tons of ore. However, during the spring thaw period when road conditions restrict truck traffic, the mine site ore stockpile will be allowed to expand to 50,000 tons. Similarly, prior to spring thaw the mill temporary stockpile will be augmented to allow for continuous processing during periods when ore cannot be delivered to the mill.

4.2.1 Mill Ore Stockpile

The mill site ore stockpile will be located adjacent to the mill building as shown in Figure 6. This stockpile will be placed on a compacted pad comprised of neutralizing gravel or similar material. As discussed in Section 3.7, the ore is not predicted to be acid generating. Also the stockpiled materials will not reside in place long enough to be oxidized to any significant degree. However, metals leaching is a potential concern and surface water controls will be installed to prevent run-on of storm water and to minimize the potential for contact surface water. Contact water due to direct precipitation will be routed to a sedimentation basin and infiltrated. A program of sampling and analysis will monitor the chemistry of the water.

4.2.2 Crushing

The ore hauled from underground will be fed directly into a jaw crusher and stockpiled at the mine site temporary ore stockpile prior to transport to the mill. The jaw crusher is designed to reduce the ore size to fragments of maximum dimension of six inches.

4.2.3 Grinding

The crushed ore will be transferred by loader or conveyor from the temporary mill ore stockpile to the mill building where it will be fed directly into the semi-autogenous grinding (SAG) circuit. The SAG mill reduces the size of ore particles using steel balls and the rock itself through tumbling action within a large rotating drum. Water will be added to the SAG mill to assist in grinding as well as cement or lime to prepare the ore for the cyanidization process.

From the SAG mill, ore will be transferred to the ball mill for further size reduction. The ball mill utilizes steel balls in a rotating drum to produce the very finely ground rock required for the gold and silver recovery process. Following grinding, a gravity separation circuit may be used to concentrate some of the gold into a heavy fraction which can then be subjected to further grinding to better facilitate gold extraction in the carbon-in-leach process.

4.2.4 Carbon-in-Leach Process

Finely ground ore in slurry will be pumped from the ball mill circuit to a thickener tank where flocculent is added to aid in settling the solids to create a thickened slurry. The thickened slurry will be pumped from the bottom of the thickener tank to the leach circuit. Water will be decanted from the top of the thickener and recycled back to the grinding circuit.

From the thickener, the slurry will flow through a series of agitated tanks. Gold and silver will be extracted from the ore by a conventional process known as carbon-in-leach or CIL. Compressed air or oxygen is bubbled through the slurry in a dilute cyanide solution that is used to dissolve gold and silver. At all times, strict pH control is maintained to keep the cyanide in solution. A small amount of lead nitrate is also added to enhance the recovery process. This cyanide leaching process takes place in steel tanks. The tanks are located within cement containment structures sized to hold in excess of the entire volume of liquid in the tanks.

Granular carbon will be present in the CIL tanks. The gold and silver in solution are adsorbed onto this carbon. Screens allow the slurry to flow through a series of CIL tanks while prohibiting carbon from flowing between the tanks. Periodically, the carbon is advanced countercurrent to the slurry flow and fresh or reactivated carbon is added to the last tank. From the CIL circuit, carbon is screened and transferred to the acid wash system for further processing. The barren slurry (tailings) from the CIL tanks report to the cyanide detoxification system.

4.2.5 Cyanide Detoxification

Crown will use the INCO/SO_2/O_2 (INCO) process to detoxify cyanide contained in the tailings. This process employs a sulfur dioxide (SO_2) and air or oxygen injection system for detoxification. The process has a well-documented and proven track record of detoxification in cyanide bearing tailings for similar ores.

The INCO process occurs in a vessel and uses SO_2 in combination with air or oxygen in the presence of a small amount of copper catalyst in the form of a copper sulfate solution to detoxify (oxidize) the cyanide. Since the process also oxidizes the SO_2, slaked lime is added to the vessel to neutralize the solution, maintaining the pH at approximately 8.5. The INCO process will target neutralization of cyanide in the tailings to less than an average of 10 mg/L WAD cyanide.

Following detoxification, the tailing slurry will be pumped to the TDF for disposal. At the TDF, solids settle from the slurry and the liquid fraction is recycled to the mill for reuse.

4.2.6 Gold and Silver Recovery from Carbon

The gold- and silver-bearing (loaded) carbon from the CIL circuit is transferred to the acid wash vessel. A dilute acid solution is circulated through the loaded carbon to remove calcium carbonate scale. This step improves gold and silver recovery in subsequent processing steps. Following the acid wash, the acid solution is neutralized and circulated through the carbon to wash residual acid from the carbon.

The acid-washed carbon is pumped to the stripping vessel. A heated solution containing dilute sodium hydroxide and sodium cyanide is used to strip gold and silver from the loaded carbon. This resulting gold- and silver-bearing solution (pregnant solution) is passed through an electrowinning cell, which plates the metals onto cathodes through an electrolysis procedure. The solution is recycled through the stripping vessel until metal recovery is complete.

The final step in this process is to reactivate the carbon by passing it through a heated kiln for thermal reactivation. The reactivated carbon is returned to the leach tanks.

Periodically, gold and silver are removed from the cathodes in the electrowinning circuit and smelted in a furnace. Most impurities are removed in the smelting process, and dore bullion is produced containing gold and silver and minor amounts of other trace metals. Dore bullion is shipped offsite for further refining.

4.3 Tailings Management

4.3.1 General Site Description

The Buckhorn Mt. project will use a geomembrane lined tailings disposal facility (TDF) for permanent disposal of the detoxified mill tailings. The facility will also have a small reclaim pond. An extensive analysis of possible sites for the TDF was made and the most appropriate is located at the Dry Gulch site as shown on Figure 2. A plan layout of the TDF is provided on Figure 6. The site is located within a basin-shaped hanging valley dissected in glacial gravels. No surface water drainage or wetlands occur within the footprint of the site and it has virtually no surface water catchment upgradient. Groundwater flow beneath the site surfaces a short distance to the north and contributes to the drainage catchment and recharge area which supplies water to a small unnamed tributary of Myers Creek. This tributary headwaters to the east and southeast on the western slopes of Buckhorn Mt. and has been blocked by road construction fill on County Road 9480, forming a small pond and associated wetland referred to as the Pine Chee wetlands in BMG environmental permitting and documentation.

Detailed geotechnical investigations have not yet been conducted to date at the site to characterize the foundation materials and their suitability for earthworks construction borrow sources. However, based upon the sediments encountered in similar glacial deposits, it is anticipated that the sandy and gravely materials should provide highly suitable materials for founding and constructing an impoundment, with lesser quantities of low permeability fine grained deposits suitable for a soil liner and impoundment core material as required. Necessary geotechnical studies of the foundation and potential construction materials are scheduled for completion in 2003. If additional fine grained materials are needed for liner or core materials are found to be required, it will be sourced from a separate location.

Cross-sections through the TDF showing the pre-mining, end-of-operations and, post-reclamation topography are presented on Figure 10. Current groundwater elevations as estimated by seismic refraction geophysical survey methods has been included.

4.3.2 General Design Considerations

The Buckhorn Mt. Project plan has several significant changes from that previously proposed by BMG, which control the viability and suitability of tailing disposal sites. The most significant is that the volumetric requirement for tailings disposal has been reduced from 9.1 Mt to approximately 4 Mt. This reduced tailings volume allows for the adaptation of a smaller and more compact TDF site such as Dry Gulch. Additionally, a mine plan emphasizing minimal surface disturbance and wetland avoidance makes this proposed plan and location a more desirable alternative to the previously proposed Marias Creek site. Ore will be transported from the mine to a mill located adjacent to the TDF (Figures 6 and 7). Following milling and gold extraction, the tailings stream will be subjected to the INCO cyanide destruction process and then conveyed via a pipeline to the lined impoundment.

The tailings slurry will be thickened to a density of approximately 45 percent to 50 percent solids and deposited using thin-layer rotational subaerial deposition techniques to develop a stable, high density, low permeability deposit. An additional advantage of thickening the tailings prior to deposition is to maximize the amount of water that is recycled back to the mill, thereby minimizing the water entrained in the tailings. In addition to removal of water at the mill from the tailings stream, the supernatant waters that form a pond above the tailings solids will be reclaimed and returned to the process system to complete the closed circuit. In order to minimize the size of the supernatant pond and maximize the consolidation and density of the tailings following deposition, the supernatant waters will be decanted and will flow by gravity to the reclaim pond. Water collected from the overdrain and underdrain will also drain by gravity to the reclaim pond. Makeup water will be pumped on an as-needed basis from the fresh water pond. Both the detoxified tailings slurry pipeline and the return water pipeline will be located within a geomembrane lined channel.

4.3.3 Tailings Impoundment Design

The TDF has been designed for permanent disposal of the detoxified mill tailings. The conceptual design includes a double geomembrane composite liner system. The TDF is designed to contain approximately 4 million tons, at a tailings density (dry) of 95 pounds per cubic foot (pcf). The preliminary design plan layout with a typical design sections are illustrated on Figures 6 and 10 with TDF liner details on Figure 14. Staging of construction will occur so that backfill gravel requirements from the footprint of the TDF can be generated on an as-needed basis and incrementally stored at the backfill storage site as discussed in Section 4.12. The preliminary design and design concepts discussed herein will be advanced during detailed engineering to optimize the facility design for the site conditions and meet standards required by regulatory agencies.

As illustrated on Figure 6, the TDF will be constructed with a down-gradient retention embankment. The downgradient reclaim pond will also be a double composite lined geomembrane facility. A single geomembrane-lined freshwater pond will be located on private property owned by Crown south of Chesaw in Dry Gulch in the area of the TDF. Water will be pumped from a well owned by Crown to the freshwater pond at the site for use in the closed circuit of the mill/TDF. Existing surface water rights will augment the groundwater source. The point of diversion of surface waters under the existing right is on Mary Ann Creek near the town of Chesaw. A point of diversion for use under the proposed action will require approval by the DOE. Surface water will be routed into the fresh water pipeline shown on Figure 7. Both surface and groundwater will be stored at the fresh water pond at the mill site.

The construction will provide for a cut/fill using scrapers and/or loaders and trucks to excavate cut from within the impoundment to construct the embankment. An excess of 1.2m yd^3 will be excavated and stockpiled for use as backfill at the mine site. The construction of the TDF will be staged with excavation occurring intermittently throughout the construction of the TDF. This staging will allow for backfill production to be used at the mine site. A storage area located as shown on Figure 6 will be used to temporarily store backfill at the mill/TDF site prior to transport to the mine site. Detailed design of the stages will be fully developed in the final engineering of the facility.

The design provides for embankment side slopes of 2.0(H):1(V) downstream and 2.5 (H):1(V) upstream. The design also provides a 3-foot freeboard. The TDF crest width has been designed at 30 feet for compatibility with construction via scrapers. The preliminary design provides for a final stage maximum embankment height of approximately 165 feet in the northwest corner. Both the embankment volume and heights are conservative estimates, as future optimizations are expected to reduce these quantities. The TDF will be designed to conform to DOE's Division of Dam Safety Guidelines. Construction materials for the embankment will be borrowed from the footprint of the TDF. These materials will be further characterized for geotechnical properties during the TDF field and laboratory characterization and design phases. The embankment material and construction specifications will be defined based on the field characterization, detailed geotechnical testing, and the dam safety requirements. It is anticipated based on surface interpretation and geophysical surveys that the foundation materials in the area of the TDF will be reworked gravels and sandy silts of glacial origin.

4.3.4 TDF Liner System

The liner system is designed to meet or exceed the criteria of the Washington Metals Mining and Milling Act (RCW 78.56). Liner details are presented on Figure 14. The TDF will be constructed with a multi-layered engineered liner-drainage layer system with the following separate components:

1. A leak detection and collection system constructed between two synthetic liners (60-mil HDPE primary liner and 40-mil HDPE secondary liner);

2. A low permeability 1-foot thick soil liner constructed beneath the primary liner, to create a composite liner system; and,

3. An overdrain located immediately beneath the deposited tailings on top of the liner system to collect tailings solution and convey it to the reclaim pond for reuse in the mill process.

These engineered liners have been designed to prevent degradation of groundwater or surface water resources. In the event that any springs or seeps are intercepted during construction within the disposal area limits, the water will be conveyed beneath the liner system by means of an underdrain system.

The bottom-most liner of the TDF (which overlies any underdrain) consists of a 12-inch thick layer of compacted soil with a permeability of less that $1x10^{-6}$ cm/sec. A 40-mil HDPE synthetic liner (secondary liner) will be constructed on top of the soil liner.

4.3.4.1 Reclaim Pond

The Reclaim Pond is designed to collect waters from the overdrain system and the leak detection and collection systems of the TDF. The Reclaim Pond will be constructed north-northwest of the TDF. Flows from the TDF will be transmitted via gravity to the Reclaim Pond in a HDPE pipeline that is contained within a geomembrane lined channel. The Reclaim Pond will be sized with appropriate freeboard to store reclaim and overdrain solution along with some limited storm water surge capacity. The overflow prevention plan for the Reclaim Pond will be specified in the facility design and dam safety permit application. Flow volumes from the TDF to the Reclaim Pond will be controlled at the TDF decant system. Excess water storage capacity for extreme storm event and temporary process water storage will occur on the TDF and minimum freeboard levels in the Reclaim Pond will be maintained at all times. The freeboard storage capacity for the Reclaim Pond will be sized to address extreme storm events and temporary loss of pump capacity to prevent overtopping as defined in the approved dam safety permit.

The Reclaim Pond will be lined with two separate 60-mil HDPE liners with a drainage net leak collection and removal system between the liners. The lower liner will be constructed on top of a 1-foot-thick compacted soil liner.

Shutoff valves will be installed to temporarily stop flows into the pond for routine maintenance.

4.3.4.2 TDF Operation

High density thickened tailings will be delivered to the TDF continuously and deposited using thin layer rotational deposition subaerial techniques. Tailings will be deposited from a series of drop bars that tee off the main tailings distribution line. The main tailings distribution line will encircle the impoundment. To the extent possible, tailings will be deposited in thin layers to take advantage of the benefits of subaerial deposition. This will be done by using two to four spigots simultaneously, and leaving each spigot in operation for approximately 24 hours. The spigoted distribution points will be rotated allowing each deposition area to dry for approximately six to 12 days while tailings are being discharged in other portions of the TDF. This controlled cyclic rotation of the tailings discharge enhances liquid-solid separation during deposition and maximizes subsequent air drying and consolidation of the tailings, forming an unsaturated stable impoundment.

4.3.4.3 Tailings Water Collection and Recycling

As tailings are deposited and settle in the TDF, the liquid fraction of the slurry (supernatant) will flow toward the north end of the facility, creating a water pool. An inclined decant constructed on the inboard embankment slope will be used to remove the supernatant from the TDF for reuse in the mill operation. The supernatant water will flow by gravity to the reclaim pond. In general, the operating objective will be to maintain a constant pool volume that is as small as technically feasible. A small pool will enhance desiccation of the tailings and the associated densification. However, a minimum pool depth is required in order to avoid sucking tailings into the decant line. Pool levels will be managed by continually decanting water to the reclaim pond prior to pumping to the mill.

The pool volume will typically be controlled by regulating the amount of fresh makeup water introduced from the freshwater pond. By minimizing the introduction of makeup water to the TDF, the pool will be reduced in size as water is recycled to the mill, or lost to tailings voids and to evaporation.

4.3.5 Freshwater Pond

As shown on Figures 6 and 8, a freshwater pond is planned near the TDF on property controlled by Crown Resources. Stored water will be used primarily to provide the process water for the mill. The volume of this pond has been sized from the water balance model discussed in the following section. Water uses are discussed more thoroughly in Section 4.9. The development concept provides for pumping water from a well two miles north of Chesaw (Figure 7) and diverting flows from Myers Creek in accordance with Crown's existing water rights, for use during the dry season. Currently these water rights are being used for agricultural purposes during the growing season. No new water rights will be required to supply water to the freshwater pond.

Water would be pumped along the county road easement in a buried pipe from the most distal point at the well to the freshwater pond. The freshwater pond will be lined with a single geomembrane liner to prevent leakage.

A detailed water use and water handling plan will be developed to append to this Plan of Operations.

4.3.5.1 Water Balance

The water management plan for the TDF consists of a closed solution circuit with storage and recycling of solutions back into the process circuit. The lined TDF is designed as a closed thin layer deposition system with no discharge of solutions. System losses include evaporation and permanent loss of solution as pore water in the deposited tailings. The water balance calculation was based on the assumptions and data in Table 7 below.

TABLE 7

WATER BALANCE CALCULATION DATA

Dry Tailings Production Rate	1,500 tons per day
Tailings Solids Content	45% - 50% range
Area of Supernatant Pond (avg.)	30% of impoundment area
Deposited Density (avg. at closure)	95 pounds per cubic foot
Deposited Density (avg. operational)	70 pounds per cubic foot
Average Monthly Precipitation from Chesaw data	From Golder 1996
Average Monthly Evaporation from corrected data	From Golder 1996
Upgradient Flows	None

Based upon the above input, a preliminary water balance simulation has been completed for the TDF water management circuit on an average monthly basis. The results indicate that make-up water will be required as the fluid losses are larger than the inflows over the 12 month period. The total volume of water required to process the tailings slurry, the make-up water required for each of the various slurry densities to maintain a constant pond volume, and the percent of water that can be recycled to maintain a constant pond volume are below in Table 8.

TABLE 8

MAKE-UP WATER REQUIREMENTS FOR THE TAILINGS DISPOSAL FACILITY

Tailings Slurry Density	Recycled Water Required at Process Plant (acre-ft/year)	Net Loss (Total Make-up)	
		(acre-ft /year)	(gpm / cfs)
50%	403	193	120 / 0.27

Based upon a monthly simulation, the minimum freshwater pond storage volume is equivalent to the annual solution make-up required. Therefore, over the course of one year the makeup volume required is estimated to be 193 acre-ft. As a result, the freshwater pond is designed to contain 200 acre-ft to provide a level of contingency and to provide for other water requirements on the site.

A detailed water balance will be presented as part of the detailed TDF design and included in the water supply plan to be prepared in 2003.

4.4 Equipment Requirements/Consumables

Table 9 lists the mine site mobile equipment requirements for the Buckhorn Mt. Project during production. Some substitutions for comparable items may occur based on availability. During preproduction development of the underground workings, the mine equipment requirements will be less. Initially only one scoop, one truck, and one jumbo are required. The fleet will gradually be augmented as additional headings are commenced to ultimately achieve the full complement shown in Table 9.

TABLE 9

MINE SITE MOBIL EQUIPMENT LIST

Mobile Equipment List	
Mine Site	
30 ton Underground Haul Trucks	5
6 yd Scoop (underground loader)	5
4 yd Scoop	2
2 boom Jumbo	4

Underground Pickups	4
Scissor lift	1
D6 Dozer UG and surface	1
Light Surface Vehicles	4
Surface Loaders	2
Mill Site	
D6 Dozer	1
Loader	2
Light Surface Vehicles	5
Bus	1
Ambulance	1
Transportation	
Haul Trucks (contract)	6 average
Road Maintenance (contract)	As needed

During construction of the surface facilities at the mill site, mine site, and TDF, all mobile construction equipment will be contracted. The contractor will determine exact fleet requirements.

Table 10 lists typical quantities of major consumable materials delivered by truck and consumed by the Buckhorn Mt. Project during full operation. Table 11 presents the estimated project consumable usage on an annual basis and anticipated maximum storage requirements at the mine and mill sites. The Material Safety Data Sheets (MSDS's) are provided for those consumables requiring MSDS's in Appendix C.

TABLE 10

MAJOR CONSUMABLES DELIVERY ESTIMATE

Consumables Delivery Estimate	
Mine Site	
Material	**Trucks per Month**
Explosives	4
Cement	0-75 (depending on usage)
Fuel	15
Miscellaneous Supplies	About 5
Mill Site	
Sodium Cyanide	2 or 3
Sulfur Dioxide	2
Oxygen	0-2
Fuel	1
Lime	2

Areas containing mine and mill consumables will require security clearance for entry. Explosives will be stored at the mine site and stored as required by federal regulations with security controlled access as discussed in Section 4.6. Potentially toxic materials such as sodium cyanide will be stored in a locked cage within the mill complex and can be accessed only by employees with training in use of the material and with security clearance and safety training relating to its handling. No unauthorized personnel will be given access to restricted areas containing potentially dangerous materials. Additional security of consumables is provided by the limited access to the sites overseen by the security department screening of all persons upon entry.

TABLE 11

CONSUMABLE USAGE AND SITE STORAGE REQUIREMENTS

Reagent/Substance	Buckhorn Mt Est. Annual Use	Buckhorn Mt. Est. Maximum Storage Requirements	Use
Activated Carbon	55 Tons	10 Tons	Gold Adsorption
Anhydrous Borax	8 Tons	1 Ton	Furnace Flux
Cement	10,000 Tons	750 Tons	Mine Backfill
Copper Sulfate	27 Tons	6 Tons	Mill Reagent
Descalant	17 Tons	6 Tons	Mill Reagent
Flocculent	34 Tons	6 Tons	Mill Reagent
Grinding Balls	1500 Tons	125 Tons	Mill
Steel Wool	270 lbs	250 lbs	Mill
Hydrochloric Acid	125 Tons	20 Tons	Mill Reagent
Lead Nitrate	86 Tons	10 Tons	Mill Reagent
Diesel Fuel	630,000 gal	75,000 gal	Mine Equipment
Gasoline	4000 gal	1000 gal	Surface Vehicles
Motor Oil	3000 gal	400 gal	Mine/Surface Vehicles
Transmission Fluid	1000 gal	200 gal	Mine/Surface Vehicles
Anti Freeze	400 gal	200 gal	Mine/Surface Vehicles
Propane	2500 gal	500 gal	Furnace
Silica Sand	4 Tons	1000 lbs	Furnace Flux
Soda Ash (Dense)	4 Tons	1000 lbs	Furnace Flux
Sodium Cyanide	850 Tons	60 Tons	Mill Reagent
Lime	400Tons	50 Tons	Mill Reagent
Sodium Nitrate	1.5 Ton	1000 lbs	Mill Reagent
Sulfur Dioxide	770 Tons	85 Tons	Mill Reagent
Ammonium Nitrate	330 Tons	30 Tons	Mine Explosive

4.5 Mine Ventilation

Electric fans will provide the principal ventilation of the mine. The fans will draw air into the primary portal and will exhaust air from the upper ventilation portal and ventilation raise. The difference in elevation of the primary portal and the exhaust ventilation openings will aid air movement by natural effects. The ventilation portal will be located on Forest Service land. Development of the portal will create minimal surface disturbance (less than 0.5 acre) and is located on an existing road (Figure 5). The portal will be surrounded by a perimeter fence and a steel door installed that will be locked on the outside at all times except when in use. This door and the surrounding fence will be able to be opened from the inside as this is a secondary escapeway for the mine workings. A ventilation raise (also a secondary escapeway) will be located in the northern part of the mine site infrastructure (Figure 5) within the mine site fencing and security. Road access to both the ventilation portal and raise will provide the ability to service electric fans.

The routing of air to specific areas underground is facilitated by the use of strategically placed barriers to direct airflow. Moveable 60 to 125 horsepower (hp) fans will blow air through ventilation tubing or bag to working areas. As the configuration of the underground workings changes, so does the configuration of the airflow. The Mining Safety and Health Administration (MSHA) regulates the air quality in underground workings and requires an updated ventilation design and layout at all times. Periodic inspections of the mine by MSHA inspectors address the adequacy of the ventilation plan along with measured air quality and safety issues. An updated mine ventilation map will be posted at the mine site office at all times.

4.6 Explosives Storage and Handling

Explosives are to be stored in an above-ground locked magazine approved by and permitted by MSHA. All personnel who handle explosives or are involved in blasting are directly supervised by an employee with a blasting license issued by MSHA. Weekly and monthly safety meetings will be held with all operations personnel. Safety in explosives handling is a regular topic of these meetings. Also covered in these meetings are the best management procedures for handling explosives so as to prevent spillage at the working face.

Access to the explosives magazine will be strictly regulated by the safety and security department. The magazine itself will be locked and will be contained within a fenced locked enclosure under separate key. Only security personnel and mining personnel with security clearance and training will have access to the keys to the enclosure and the magazine.

4.7 Fire Fighting Equipment/Emergency Response

All light vehicles on site will be equipped with an axe, shovel, bucket, and fire extinguisher during fire season. In addition, all vehicles and other internal combustion engines will have adequate spark arresters. There will be telephone service at the mine and mill sites for communication in case of fire or other emergencies.

Phones will also be located underground for communication with the surface. All underground personnel are awareness trained in the location of these phones and of emergency escape-way locations. A map showing emergency escape routes and telephones is posted at the sites and routes are clearly marked underground.

Crown will promptly comply with any emergency directives by the USFS or the State and will obey any fire precautions imposed on operations during the summer fire season. Also, existing water sources at the mine site will be available to fire fighting efforts in the area.

An ambulance will be present on site at the mine during production. Trained emergency medical technicians employed by Crown will be available to respond to emergencies at any time.

A trained mine rescue team is on call at all times to respond to underground mine emergencies. Trained emergency medical technicians are members of this team.

4.8 Power Requirements

It is currently anticipated that electrical power will be purchased from the Public Utilities District of Okanogan County (PUD). A power supply agreement will be negotiated with PUD that could include upgrading the power distribution by PUD to Chesaw. An express line could be continued along existing PUD easements to the mill/TDF site under a Special Use Agreement with PUD. Power required at the mine site could also be strung along existing easements and construction to the end of the existing service near the junction of County Road 4895 and USFS easements (USFS 120). In order to minimize surface disturbance, the new line to the mine is proposed to be buried along the road easements. This, however, would not prevent local land owners from benefiting from the extension of service.

Power consumption at the mill is estimated at 4.5 megawatts (Mw) Power requirement at the mine site is projected to be approximately 1.6 Mw of installed capacity averaging 1.2 Mw usage.

4.9 Water Requirements

4.9.1 Mine Site

Water will be needed at the mine site for mining and for potable uses. Uses in the mine will include drilling water, ore washing water for particulate suppression, and water for general cleaning of equipment. The water entering the mine through natural seepage will be used for these purposes. All use will occur underground prior to any treatment and discharge. After initial startup, excess water entering the underground workings will be collected in sumps and discharged to a water treatment plant for treatment of elevated nitrates as required. The treated water will be infiltrated in engineered infiltration structures returning the water to the groundwater system.

Potable water will be required for showers, toilets, and human consumption. Potable water is proposed to be obtained from an on-site water supply well. Containerized water for human consumption will be brought on site.

Additionally, water may be needed at the mine site from time to time to augment dust suppression on the roads around and to the mine site. It is planned to use water from the freshwater pond at the Mill/TDF site for this purpose.

4.9.2 Mill/TDF Site

The largest water requirements at the mill site will be makeup water for the closed circuit mill/TDF facility. Water in this circuit is used primarily for grinding and reagent mixing. Reclaim water is recirculated for this purpose from the supernatant water in the TDF and is lost primarily through evaporation and entrainment in the tailings. Makeup water required in the zero-discharge closed circuit facility is calculated to average 120 gallons per minute (gpm) on a seasonally adjusted basis. This makeup water will come from storage in the off-site freshwater pond having a capacity of approximately 200 acre-feet. The source of this water will be seasonal withdrawals from a well and from Myers Creek. Adequate water rights controlled by Crown are available to provide water supply to the mill/TDF site. These water rights are currently being utilized and the use will be temporarily changed during mining operations. Any water rights not used at the Mill/TDF will be temporarily deeded to instream flows of Myers Creek during mining. A summary of calculation for the preliminary estimated water requirement is found in Appendix D.

Water at the mill will also be required for showers, toilets, cleaning, and vegetation. Containerized water for human consumption will be brought on site.

From time to time water may also be required to augment dust suppression at the mine, the mill, and the access road although dust suppression agents will be used as the primary fugitive dust control on roads around the project. The selection of the specific additives to be used will be coordinated and approved by the county, DOE and the USFS.

Table 12 summarizes the water requirements for the different sites seasonally adjusted to gallons per minute.

TABLE 12

PROJECT WATER USE FOR MILL AND MINE

Project Water Use	
Mine Site	
Consumptive Use	**Average Amount**
Potable	4 gpm
Drilling	4 gpm
Ore Wetting	2 gpm
Miscellaneous Washing	1 gpm
Mill Site	
Potable	4 gpm
Equipment Cleaning, Miscellaneous	1 gpm
Makeup Water	120 gpm
Contingency	
Road Watering	
Fire Fighting	
Mitigation	

Water balance is discussed in Section 4.3. A Water Supply Plan detailing water handling and consumption for the project will be prepared in conjunction with water rights and change applications. The Plan will further refine water balance calculations and incorporate water conservation measures.

4.10 Stormwater and Sediment Control

Crown will minimize or eliminate any impact to area streams from stormwater runoff entering or originating within the mine and mill/TDF site boundaries during the construction and operational phases. Stormwater control will be implemented primarily through construction of channels to divert flow around mine facilities. Culverts will be used to convey flow beneath access roads. Catchment ditches will control stormwater flow originating on the sites themselves. Stormwater will be directed through sediment control structures and traps that will be designed to detain flows originating from disturbed surfaces to allow sedimentation to occur behind the structures prior to proposed infiltration into specially designed infiltration structures. Sediment controls and diversions will be constructed and made fully operational prior to beginning other surface disturbance activities.

Figures 5 and 8 show the location of diversion ditches, sediment traps, and the flow direction of diverted waters at the mine site, the mill site and the fresh water pond. At the mill site the stormwater that comes in contact with mill facilities and the ore stockpile will be diverted to the TDF. Water caught on the mine site will be routed to the sedimentation structure east of the site.

A detailed Stormwater Pollution and Prevention/Erosion and Sediment Control Plan utilizing Best Management Practices will be developed for the project construction and production phases as required by the Clean Water Act, in conjunction with and to be approved by the appropriate regulatory agencies.

4.11 Development Rock Temporary Storage Area

Prior to use as backfill mined rock from development workings will be stored temporarily on the surface at the mine site as shown on Figure 5. The exact layout of the development rock stockpiles may vary slightly from that shown based on site conditions of the bedrock surface.

Development rock can be non-mineralized or sub-ore grade material, and is mined to gain access to the ore. The primary access to the Southwest Zone is the largest individual contributor to the development rock storage area. Additionally, rock from shorter accesses to some of the early stopes in the Southwest Zone and local development in the Gold Bowl area may be stored on the surface. As discussed Section 4.1.4, approximately 1,600,000 yd^3 of backfill will be required during mining. Whenever possible, as development rock is mined, it will be placed as backfill in another part of the mine. When no development rock is being generated, then development rock fill will be sourced from the temporary surface stockpile for use as backfill. When all the development rock has been consumed as backfill, gravel from the mill site backfill storage site will be used.

A preliminary mine sequencing plan has been prepared that outlines the quantity and lithologies of the development rock that will be generated. This plan will be adjusted as conditions require during the mine life. However, the early development mine plan is well understood. It is during this time period that the rock that makes up the temporary development rock stockpile will be mined.

The lithologies of development rock to be stored on the surface are classified by on-site geologists as andesite, undifferentiated skarn, clastics, and marble. All the rocks to be stored have low acid generating potential which is exceeded by the neutralizing potential. And, although the rock will be exposed to atmospheric conditions for only a short time frame, consideration is given to development rock handling and stormwater management methods to minimize the potential of acid rock drainage (ARD) and leaching of metals.

The sequence of placing of the development rock in the storage area will be designed to layer and blend the relatively more acid generating materials with more neutralizing rock. The initial lift of the storage area will be of a neutralizing rock type. This geometry will minimize the potential for ARD during the brief period the stockpile is in use.

Table 13 presents a summary of the development rock volumes to be temporarily stockpiled. Table 14 presents a summary of the geochemical characteristics determined by TerraMatrix in the EIS (USFS and DOE 1997) for waste rock acid generation potential (AGP) and acid neutralization potential (ANP) for each major lithology. These results were developed as part of the verification program conducted by the third-party EIS contractor. Each of these lithologies corresponds to materials expected in the stockpile. As can be seen from these data, all of the rock types have excess neutralizing capability based on the mean expected values. The marble and andesite rock will be the predominant rock types expected during the early development phase.

All development rock that is initially stored in the temporary stockpile will be placed underground within the first two and one-half to three years of the mine life. Based on the short resident time of rock on the pile, the low overall AGP of all rock types and the high ANP of the lower and admixed andesite and marble lithologies, the ARD potential for the storage piles is extremely low and no impacts are expected. However, appropriate storm water controls will be constructed to minimize contact of surface water with the stockpile to the degree possible.

TABLE 13

SEQUENCE OF INITIAL DEVELOPMENT ROCK FOR TEMPORARY STORAGE

Rock Type	Tons Placed
Andesite - Unaltered	13,000
Undifferentiated Skarn	22,000
Andesite - Unaltered	14,000
Undifferentiated Skarn	4,000
Marble	28,000
Clastics	7,000

TABLE 14

SUMMARY OF ACID GENERATION POTENTIAL FOR DEVELOPMENT ROCK

Rock Type	Mean Values of Total Sulfur by Wt. %	Mean Acid Generation Potential (Ton CaCO3/Ktons)	Mean Acid Neutralizing Potential (Ton CaCO3/Ktons)
Andesite - Altered	0.45	14.0	72.4
Andesite – Unaltered	0.32	10.1	38.6
Undifferentiated Skarn	0.97	30.4	86.4
Marble	0.19	5.87	667.2
Clastics	0.38	12.0	60.2

4.12 Backfill Storage Site

Backfill for the mine openings will consist of both development rock and glacial gravel. The glacial gravel will contain, in part, cement additive to enhance its support characteristics. The glacial gravel will be sourced from the TDF footprint during the staged construction of the storage facility. After excavation, the gravel may be transported directly to the mine site backfill storage site or will be temporarily stored at the mill backfill storage site (Figure 5). This mill storage site will vary in size from the size shown on Figure 5 to lesser amounts depending on the timing with respect to staging of construction of the TDF. The detailed engineering of the excavation and scheduling of impoundment construction of the TDF will be developed in conjunction with the DOE according to Dam Safety requirements. Trucks which transport ore from the mine to the mill will transport backfill on the return trip, as required.

4.13 Project Transportation Plan

Ore stockpiled at the mine site will be loaded into highway-legal haul trucks by a front-end loader or directly by conveyor for transportation to the mill. As required, the backfill will be transported from the backfill storage site to the mine site by the same trucks which transport ore to the mill. The ore transportation will be contracted to a company specializing in highway haulage. The trucks will probably be rated at a twenty- or twenty five-ton capacity and will trail likely a ten-ton or fifteen-ton tandem trailer. The number of round trips will therefore average about forty per day. All trucks and trucking procedures will conform to all requirements of the Washington State Dept. of Transportation, the Okanogan County Road Department, and the USFS and will be permitted by the agencies if and as required. The contractor will have latitude to select the equipment based on seasonal conditions so long as permitted requirements and agency regulations are followed.

Ore transport is proposed to be limited to a daily schedule of 8:00 a.m. to 6:00 p.m. Deliveries to the mill and mine sites are proposed to be limited to a schedule of 8:00 a.m. to 5:00 p.m. Monday through Friday, excluding holidays, excepting unusual requirements.

The proposed access route from the mill to the mine incorporates the shortest possible alignment using existing roads. Certain portions of the existing route will require realignment and the entire USFS route will require widening to provide an appropriate margin of safety and to facilitate adequate stormwater control and proper maintenance. The route following existing roads is identical to that reviewed by the agencies for the Crown Jewel Project. Figure 2 shows the land status and alignment of the proposed route from the mine to the mill illustrating those portions of the alignment that require new construction or upgrading. Those parts of the route using County Roads 9480 and 4895 are judged to require minimal widening or no new construction or upgrading. The more extensive road widening anticipated on the USFS road will benefit local landholders who use this route for access to their properties. All of the upgraded portions of the proposed alignment along county roads and the USFS road 120 will conform to plans previously submitted and reviewed by the county and the USFS under the Crown Jewel proposal. New construction of road from USFS 120 to the mine site will require approximately 4,300 feet of new road of which part will use existing disturbance of earlier constructed drill road.

Crown will enter into an agreement with the USFS, Okanogan County, and the State for the construction and upgrading necessary and for maintenance requirements year-round during operation.

Regional access to the mill site will be by public County Roads 9480 from Oroville to Chesaw and continuing on 9480 from Chesaw to the mill/TDF site (Figure 15). Crown proposes to supply regularly scheduled transportation for the majority of workers at the mine and mill from Oroville and Chesaw. Deliveries of materials are proposed to follow the same route as access to the mill site. Deliveries to the mine will follow the access route to the mine site so as to minimize traffic on other local unimproved roads.

4.14 Site Construction Methods

Much of the mine site area was logged in the 1980's and will require little clearing of timber for site construction. To the extent possible, existing timbered areas will be left intact. Only a minor amount of timber requires removal. The mine site layout is shown in Figure 5. The facilities are arranged to allow for one way traffic on the site eliminating the need for two lane roads and minimizing traffic. The location of building foundations may vary slightly from the layout indicated in order to accommodate local irregularities in the configuration of the bedrock. Most or all of construction at the site will be possible using cut and fill of overburden.

At the mill/TDF site approximately ten acres of sparsely to moderately timbered ground would require clearing.

The proposed access road alignment will require some construction and widening of the roadbed and realignment so tree cutting will be required. Generally, Crown will propose a detailed design for the access route that addresses safety concerns, while at the same time minimizing impacts to vegetation, wildlife, and water quality. All road upgrades and new construction will conform to county and/or USFS regulations as required including the proper construction of ditches and water control structures. A short stretch of blasting of a road cut is required along the new alignment near the mine site.

Prior to construction at the mine site, diversion ditches and stormwater catchment structures will be constructed so as to control sedimentation from the beginning of construction activities. Concurrent with road construction, water control structures will be installed. Lesser stormwater controls and no diversion ditches are anticipated at the mill/TDF site as there is no catchment area upstream and the topography on the permeable glacial gravels is subdued. A Stormwater Pollution Prevention/Erosion Sediment Control Plan will be developed as discussed in Section 4.10.

Topsoil of all planned areas of disturbance at the mine, and mill/TDF sites will be removed prior to construction of facilities. This soil will be stockpiled for use in reclamation at the end of the mine life. The soil stockpiles will be seeded and revegetated as soon as practical after placement in order to prevent erosion during the period they reside in stockpile and to maintain nutrient capabilities of the soil.

5.0 ALTERNATIVES

As part of the Crown Jewel Project permitting process a detailed analysis of project alternatives was made and presented in the Crown Jewel FEIS (USFS and DOE 1997). These alternatives were developed utilizing engineering, reclamation, and environmental studies performed specifically for the alternative analysis or in association with the Crown Jewel permitting process. Seven alternatives were evaluated in detail. These alternatives comprised variations in project components such as mining methods, waste rock disposal, tailings disposal, ore processing, reclamation, etc.

During Crown's development of this plan of operations, various project components, options, and alternatives were considered for the proposed Buckhorn Mt. project. These variations were analyzed to select the combination of practical project alternatives that best fit Crown's objective of minimizing project-related impacts. The following presents several of the most important proposed project components that have been considered for the Buckhorn Mt. project as compared with earlier studied alternatives. More detailed analysis of alternatives will be completed as part of the environmental impact analysis. Supporting technical data will be supplied by Crown on an ongoing basis to the agencies in response to requests for background information required for analysis of identified alternatives.

5.1 Underground Mining

The underground mining plan proposed by Crown will greatly reduce mine related impacts in comparison to impacts associated with previously evaluated open pit mining alternatives (Crown Jewel Alternatives B, D, E, F, and G). The open pit mining alternatives analyzed would have resulted in: 1) larger areas of surface disturbance from the mine pit and waste rock areas; 2) permanent reconfiguration of the topography at the mine site related to the open pit and waste rock disposal areas; 3) the requirement for long-term monitoring of surface and groundwater downgradient from permanent waste rock disposal areas; 4) monitoring of pit lake chemistry and discharge; 5) potential for long-term remediation of water quality relating to 3 and 4 above; 6) relatively larger water usage due to larger amounts of ore treated and the necessary use of water for dust suppression, and; 7) a permanent reconfiguration of groundwater system in the vicinity of the pit which was to be mitigated by conveyance of pit water from the Toroda Creek drainage to the Myers Creek drainage.

All of the issues above are addressed by the current plan proposed by Crown for underground mining.

Crown's proposed plan also differs substantially from the previously evaluated underground Alternative C in the Crown Jewel FEIS. Alternative C, like the open pit alternatives, proposed surface waste rock disposal, permanent mine discharge and the resultant changes in groundwater flow. Alternative C also was judged to have resulted in possible surface disturbance related to subsidence, as no structural backfilling was included in the plan. The backfilling proposed in the Buckhorn Mt. plan addresses the issue of subsidence.

An alternative considered but rejected in the Crown Jewel FEIS was proposed by the EPA in comments to the draft EIS. This plan would have mined the deposit by a combination of open pit and underground techniques and would have used development rock as backfill for the underground workings. Thirty million tons of waste rock from the open pit would be used to backfill the surface mine on completion.

Crown's proposed underground mine plan will significantly reduce the surface disturbance during operations by temporarily placing limited amounts of development rock on the surface; ultimately transporting all of it to underground workings to avoid surface disturbance due to subsidence. Likewise, the placement of the mine portal above the groundwater table will eliminate post-closure mine drainage and long-term impacts to regional groundwater flow and surface water quality. Final reclamation will recontour and revegetate the mine site in its entirety.

Crown believes that this proposed plan of operations for an underground mine addresses the environmental concerns raised during the Crown Jewel EIS relating to surface disturbance, land ownership, habitat conservation, wetlands preservation and water quality and usage.

5.2 Tailings Disposal Facility Siting

A number of Alternatives were evaluated and presented in the Crown Jewel FEIS including off-site upland and side-hill sites analyzed by TerraMatrix as part of the Crown Jewel permitting process (TerraMatrix 1996). Options were evaluated for environmental suitability, social impacts, and economics. While these studies provided insights into many of the local and regional options, Crown's lesser tailings storage requirements lend more flexibility in the site selection process than for the larger open pit mine plan of Crown Jewel. Because of the substantially reduced tailings disposal volumes additional options were available to Crown for assessment.

An evaluation was made by Crown of potential TDF sites within a reasonable transportation distance of the Buckhorn Mt. ore deposit. Based on a review of land status, topography, upgradient, and downgradient catchments, availability of construction materials, access, and surrounding land uses, Crown proposes the Dry Gulch site as the most desirable and technically appropriate location. Crown's proposed TDF site differs from all of the Alternatives evaluated in the Crown Jewel FEIS in the following important ways:

- The Dry Gulch site would not require construction on an active stream course or wetlands.
- The Dry Gulch site will require lesser impact to timbered forest lands thereby reducing impact to prime habitat.
- The Dry Gulch site is on private land.
- The volume of tailings contained in the proposed TDF is less than half of the volume proposed in the open pit alternatives, minimizing area of disturbance, water consumption, and closure requirements.

Because the location of the proposed mill/TDF site is seven miles from the mine, the ore will necessarily be trucked from the mine to the mill. This will result in higher traffic on the access route during the life of the project and higher operating costs. BMG considered haulage of ore to a mill only with large tonnage off-road trucks. The current proposal suggests usage of only highway legal vehicles to eliminate the potential safety hazards associated with interaction between haul trucks and local traffic. Also, the use of smaller trucks allows for the reduction of the access route footprint and impacts and provides for a permanent upgraded route which potentially benefits local land holders after mine closure.

The construction cost of the Dry Gulch site will be higher than the previously evaluated Alternatives in the Crown Jewel FEIS.

5.3 Off-Site Milling

There is one existing off-site operational gold mill within economically viable transportation distance that would be appropriate for treatment of Buckhorn Mt. ores. The mill and tailings impoundment are at the Kettle River Operations site located approximately fifty miles by road east of the Buckhorn Mt.

deposit. The Kettle River mill is not under ownership by Crown and therefore was eliminated from further consideration as an alternative milling option.

5.4 Gravel Backfill

Crown proposes to use gravel sourced from the excavation of the TDF site on private land for the underground mine backfilling operation. Gravel backfill provides an advantage over development rock for the cemented portion of the backfill requirement due to its wider range of grain size in its matrix. This results in a higher strength of the hardened backfill.

The underground mining alternative analyzed in the Crown Jewel EIS considered a surface rock quarry near the top of Buckhorn Mt. to provide rock needed for partial backfill during mine operations. The rock quarry would have also included a crushing and screening operation for sizing the backfill material. Rock fill can also be effectively used as a cemented backfill material but care must be exercised in proper sizing of the material.

6.0 MANAGEMENT AND MITIGATION OF AFFECTED ENVIRONMENT

Management and mitigation practices at the mine site and its surrounding environs are based on Crown's policy to minimize environmental impacts and are guided by the requirements of local, state, and federal laws and regulations, best management practices (BMP)s, and current technology. The goals of the management and mitigation practices are to avoid, reduce, or minimize adverse operational impacts to the environment and to provide for superior reclamation of disturbed areas. Implementation of management and mitigation measures is the primary responsibility of Crown. Oversight and, if necessary, enforcement of the permitted measures are the responsibility of the agencies issuing permits and approvals to the company.

The mining and environmental control activities also are designed such that the site will be reclaimed to a productive use following closure and decommissioning. Implementation of the measures discussed in this section has been developed to allow the Project to operate in an environmentally responsible manner. The management and mitigations measures proposed or to be developed by Crown in all cases either exceed or meet requirements of state or federal regulations.

6.1 Air Quality

As part of the DOE air quality permit, Crown will be required to meet all applicable state and federal air quality standards. The use of Best Available Control Technology (BACT) is required to meet these standards. The following practices and design features will be employed during construction and operations to control fugitive dust emissions and mitigate impacts to air quality:

- The rock crushing system will be enclosed thus eliminating air quality concerns.
- The ore to be crushed will generally be wet so as to further eliminate air quality issues relating to crushing.
- Baghouse type dust collectors will be installed and operated at the lime bins, cement bins, and the refinery furnace.
- Dust-inhibiting agents approved by the appropriate agencies will be used to control fugitive dust on the access roads. These agents are the first line of defense for dust suppression.

- Watering of mine-related roads will be conducted to reduce fugitive dust at such times as are necessary when dust suppressants are not effective.

- Vehicle speed on the access roads will be restricted as necessary to reduce the amount of fugitive dust caused by traffic.

- Mining underground will eliminate dust emissions from blasting.

- Burning of slash during land clearing operations will adhere to DNR burning permit restrictions.

- Busing or van pooling will be arranged for the majority of employees to reduce traffic to and between the mine and mill sites. Busing or van pooling is discussed in more detail in Section 6.12.

- Dust suppressants will be applied to the access road between the mill/TDF and the mine site as well as roads internal to each of the sites. As required, water will be required to augment dust control on roads. The selection of the dust suppressant will be coordinated with state, local and federal agencies consistent with climatic and road use considerations as well as other environmental factors. It is anticipated that a contractor will apply and maintain the dust suppressant for the project.

6.2 Topography/Physiography

The mine site will be constructed so as to minimize surface disturbance. Upon mine closure, the site will be recontoured to pre-mining condition and revegetated as described in Section 7, Reclamation Plan.

The access route to the mine will be constructed using existing alignments wherever practical. Any widening or improvements will be done to address safety issues but will also be designed to minimize surface disturbance and impact to vegetation.

The mill site will also be designed to minimize impacts to existing topography. However, the construction of the TDF site will result in significant modification to the pre-operational topography. Slopes on the embankment will be rounded and revegetated to blend into the natural topography to the extent possible.

Estimated Summary of Areas of Disturbance	
Mine Site	20 acres
Mill Site	90 acres
Road Improvement	10 acres
Road New Construction	8 acres
Other (Monitoring Wells, Diversions etc.)	5 acres

6.3 Geology and Geotechnical Considerations

All facilities involved with construction and operations of the project will be constructed and maintained to be geotechnically stable during operations and in the long-term following decommissioning and reclamation of the project. Facility design and engineering plans will be submitted to the USFS as part of the POO approval process, and to the DNR and DOE as part of the permitting process. Of particular importance is the design and operation of the TDF with respect to geotechnical considerations. The approval process for all impoundment structures requires rigorous review of detailed design engineering.

6.4 Soils

Crown recognizes that soil resources, particularly topsoil materials, are a valuable resource at the site. Soil horizons will be removed from facility sites prior to construction assuring that viable, handling and stockpiling of those soils will be completed to promote microbial activity upon redistribution to the degree practical. Temporary soil stockpiles will be reseeded with noxious weed-free mixed cover vegetation containing native species and with an emphasis on the ability to root quickly.

6.5 Water Management

Surface water control and management and protection of groundwater resources are critical elements of the operation. Controls include control of sediment and erosion and diversion and entrapment of surface runoff flows from disturbed areas. Process water controls include management of chemicals and reagents at the mill, fuel storage, and containment and tailings management. The TDF is operated as a closed system, but destruction of cyanide and maintenance of low levels of cyanide in the TDF and containment of tailings within the TDF further reduce risk to the environment. These topics are discussed in more detail below.

6.5.1 Storm Water Management and Sedimentation Controls

Storm water management will be completed in accordance with the approved storm water pollution prevention/erosion control plan. This plan will be part of the site wide water management plan and fall under the jurisdiction of the DOE. Minimization of erosion and sedimentation of disturbed areas may include the following techniques:

- Vegetation will be removed only from those areas to be directly disturbed.
- Primary soil removal will be scheduled for the dry months.
- Cut and fill slopes for service and access roads will be designed to prevent soil erosion. Drainage ditches with cross drains will be constructed where necessary.
- Road embankment slopes will be graded and revegetated as practicable.
- Runoff from roads, buildings, and other structures will be handled through BMPs.
- Stream crossings will be minimized.
- Diversions will be constructed around affected areas during construction and operation of the TDF, mill site, and mine site.
- The tailings pipeline berms will be revegetated after pipeline installation.
- The water supply pipeline and the power supply corridors will be revegetated after their installations.
- Incidental precipitation falling on disturbed areas at the mine and mill/TDF sites will be collected in basins or traps.
- Management practices such as check dams, dispersion terraces, and filter fences will be used during construction and operations.
- Permanent diversion channels will be designed for long-term stability.
- Reclamation will be implemented as soon as practical.

The design events (i.e., peak flows) for storm water management and sedimentation control will vary according to the size of the facility and possible consequences of failure, in general accordance with standard engineering practice. The TDF represents the only structure that falls into a high risk category and will be designed in accordance with the Dam Safety permit requirements. Other storm water management structures will sized according to the potential consequence of failure and likely range from a 24-hr, 100-year reoccurrence storm events for medium risk structures such as settlement basins above wetland areas to 6-hr, 2-year reoccurrence storm events for non-critical structures. Culverts will sized to meet Okanagan County and USFS road requirements.

Surface water channels. Channels will be located on natural ground where possible and will not be lined for infiltration control. Channels with velocities above prescribed limiting velocities will be protected with riprap.

6.5.2 Process Water Controls

Issues pertinent to cyanide use, destruction via the INCO process, residual cyanide levels within the TDF, and design and operation of the TDF as a closed facility are discussed in Section 4.0.

Crown proposes to use the INCO process to detoxify cyanide contained in the tailings. As part of the previous Crown Jewel permitting process, a testing program (Crown Jewel FEIS, Appendix F) using ore material was conducted by independent laboratories to determine toxicity of the ore processing stream and tailings from the operation and to determine whether the INCO process would reduce residual cyanide levels below the threshold for designation as a Dangerous Waste. Samples were prepared at varying cyanide concentrations and pH values to simulate a range of process slurry conditions and process tailings conditions. Static acute fish toxicity testing (Part A: Method 80-12) was performed on 24 separate samples representing four ore composites selected from the Crown Jewel ore deposit representing the same material as the ore types to be mined at Buckhorn Mt. deposit.

None of the 24 samples subjected to toxicity testing showed any indication of statistically significant toxicity. The test results confirmed that a threshold of Dangerous Waste designation under Washington regulations (WAC 173-303) will be neither approached nor reached in the ore processing circuit prior to cyanide destruction or in the tailings.

Crown proposes to use the INCO process to detoxify tailings to limit the concentration of weak acid dissociable (WAD) cyanide in the TDF to 10mg/l or less. The target WAD cyanide content of the tailings discharge to the TDF would also be below 10mg/lor less. However, normal variations in the chemistry of the reaction normally results in some short-term variability of the discharge levels in similar systems elsewhere. Crown will work with DOE to ensure that the design, construction, and operation of the permitted detoxification method meet these standards.

The Buckhorn Mt. Project is designed to meet all State of Washington and federal water quality standards.

6.6 Mine Water Quantity/Quality

Water will be encountered in the subsurface workings of the mine. Modeled estimates of mine water inflow have been prepared and are summarized in Appendix B. Assuming the maximum estimated recharge rate of 5.4 in/yr (Hertzman 1996); total maximum estimated annualized inflows to the southern workings are calculated at 7.25 gpm at the end of mining and maximum extent of ore extraction. Total annualized inflows into the entire workings at the end of mining are expected to be from 15 to 42 gpm, based on the range of estimated recharge values (1.9 inches/year minimum; 5.4 inches /year maximum). Seasonal changes in recharge and local rock permeability conditions will affect inflows.

Nearly all of this groundwater entering the mine would be from recharge intercepted within the Toroda Creek drainage during mining. Since the portal will not discharge following closure and flooding of the mine, no long term discharge of groundwater will occur and the hydrogeologic conditions will return to near pre-mining conditions. After mine flooding, the regional groundwater divide in the area of the mine is predicted to move slightly eastward to near the pre-mining divide location, potentially reducing net recharge to the Myers Creek basin on the order of 0.5 gpm (Appendix B).

Water used underground during operation for drilling, wetting of ore, cleaning of equipment and other uses underground will be taken from sumps designed to temporarily store mine inflow of water. Water will need to be discharged from the mine during operation to facilitate mining activities. This water will be treated to ensure that nitrate derived from explosives is reduced to standards required by the DOE. Treated water will be infiltrated in the infiltration pond, the proposed location of which is shown on Figure 7. The exact final location and engineering of the infiltration structure(s) will be determined in consultation with the DOE and USFS. Water will be collected in sumps in the mine prior to discharge. These sumps will be inspected for any petroleum residues which will be collected and removed as required. Should other potential pollutants be encountered in the mine discharge, water handling or the treatment plant will be modified as necessary. The water treatment method and detailed plant design will be determined by the DOE in consultation with other agencies.

As discussed in Section 3.7 development rock stored on the surface will have a net neutralizing character thereby minimizing the potential for acid generation and metals leaching while temporarily present on the surface. Nevertheless, development rock storage will be constructed in a manner as if there were potential for acid generation within the storage area. Temporary ore storage will be constructed on a compacted pad of net neutralizing material. Layering of different rock types will further ensure the neutralizing character of the stockpile. Storm water draining these temporary storage areas will be managed in sediment control structures for infiltration and or discharge as appropriate. Storm water will be managed in accordance with the approved storm water pollution protection plan.

The development rock stored on the surface will ultimately be placed underground as backfill in stopes along with other development rock that was generated underground but which never reported to the temporary surface stockpile. Any acid generation potential of this placed development rock is effectively eliminated by:

- The relatively small proportion of placed development rock fill in relation to the encapsulating neutralizing mine rocks.
- The interlayering of the development rock fill with much larger quantities of inert to neutralizing glacial gravels and, more importantly, cemented backfill having very high neutralizing potential.
- Inundation of most backfilled areas effectively diminishing the oxidation of rock-forming minerals.

6.7 Water Supply Resources and Water Rights

Water use will occur at both the mine site and the mill/TDF site. It is the policy of Crown to minimize the use of water in Project operations to the degree practical. Water rights controlled by

Crown are adequate to provide resources for the necessary water consumption at the mill/TDF based on current Project plans. Despite adequate water resources, careful water management will allow for its optimized use. Crown will work with DOE and local authorities to ensure that the consumptive use of water in no way impairs the water rights of others. A groundwater right can fulfill part of the needed water for the milling process subject to approval of a change in beneficial use and change in place of use. Additionally, existing water rights controlled by Crown for surface water in the Myers Creek drainage will augment the groundwater appropriation on site. Water seasonally withdrawn from ground or surface waters will be stored in an onsite freshwater storage pond as shown on Figure 6. This pond will be lined in order to prevent water loss.

The groundwater right owned by Crown Resources, located in Section 9, T40N, R30E is exercisable from April 1 to October 1 annually. Surface water rights, located in Section 28, T40N, R30E are exercisable from April 15 to October 1. An application for a change in beneficial use and place of use will be required prior to use of these rights by the proposed operation.

Application for water appropriation has been filed with DOE for the mine site consumptive uses shown in Table 12. The majority of the requested appropriation relates to the groundwater removed from the mine to permit underground work. Excess water discharged from the mine is proposed to be treated and returned to the groundwater by infiltration and will therefore not result in a net loss of water in the groundwater system of the Toroda Creek drainage.

Some consumptive use in the mine during mining will result in a small net loss to the groundwater system. Water will be lost from the mine through ore transported to the mill for processing. Water removed related to the ore moisture will not have any net affect on the groundwater recharge to the system as this moisture is equivalent to the naturally retained moisture in the rock.

Water will also be used for potable/domestic uses in toilets, showers and for human consumption. This water is proposed to come from an on-site water well.

A water supply plan will be prepared and submitted to the DOE in conjunction with water rights applications. This plan will detail uses and mitigations of water appropriated and used in both the Myers Creek and Toroda Creek drainage basins.

6.8 Vegetation

Mitigation and management issues regarding vegetation resources include avoidance of surface impacts, timber salvage, and sales, noxious weed control, use of noxious weed-free mulch and seed in reclamation, and interim revegetation. These are discussed in the Reclamation Plan in Section 7.0.

The project design is tailored to minimize the amount of timber that is required for removal. Timber on areas scheduled for disturbance by the Project will be sold and cleared in accordance with the USFS and DNR management requirements for timber harvesting. Negotiated contracts for timber harvest will be entered into with the appropriate agency where appropriate. Timber to be removed will be designated by agency representatives prior to removal.

As applicable to the surface ownership, plans for clearing and disposal of vegetation will be submitted prior to beginning operations. The areas to be cleared will be delineated on the ground to facilitate USFS and DNR review, as appropriate in order to specify the measures that will be needed to ensure proper utilization of the timber, disposal of slash, and protection of surface resources.

6.9 Wetlands

It is the objective of the project design to result in no net loss of wetlands. If existing wetland resources are affected or filled by mandated changes in the proposed development of the project, permits would necessarily be obtained from the DOE and/or United States Army Corps of Engineers (USACE). Final mitigation measures would be detailed in these permits. Final wetland mitigation measures on USFS administered land must be agreed to by the USFS prior to their implementation though none are expected based on the current plan.

Water intercepted in the underground workings of the mine will be infiltrated or released as directed by the DOE and USFS. It is anticipated that this infiltration or release will accommodate local groundwater conditions in the protection of wetlands and surface waters in the area surrounding the mine. Crown will work with these agencies to ensure that ground and surface water quality and quantity are protected.

The area covered by the proposed TDF will intercept rainfall during operation and will decrease the water available for infiltration to the groundwater within the catchment of a small unnamed tributary to Myers Creek. Dry Gulch supplies a minor portion of the water to the Pine Chee wetlands located downgradient from the TDF. Potential indirect impacts to the Pine Chee wetland will be assessed as part of future permitting.

6.11 Wildlife

The project is designed to avoid impacts to wildlife resources. By minimizing surface disturbance, the use of existing access roads where possible and reclamation of the mine site and mill/TDF sites, impacts to wildlife resources are mitigated. The goals of the project design are:

- Avoid impacts to wildlife and sensitive habitats.
- Minimize impacts to wildlife when impacts cannot be avoided.

The following specific wildlife management and mitigation steps will be employed by Crown.

- Perimeter fencing at the mine site will exclude cattle but allow for deer movement.
- Deer-proof fencing will be installed around the TDF.
- At least 15 percent of the species mix selected to provide immediate soil stabilization during reclamation will be species with higher palatability to wildlife.
- Any required new power poles will be designed to eliminate risk of electrocution of raptors.
- Wildlife run-outs will be created along both sides of access roads during winter when snow banks exceed two feet in height.
- Speed limits will be instituted in areas of high wildlife density to minimize wildlife injuries or mortalities from vehicles.
- Bird mortality rates related to the TDF will be negligible due to the cyanide destruction system and low cyanide concentrations in the tailings.

A Biological Assessment (B.A.) (Cedar Creek 1996) was completed for the area of the Crown Jewel mine site and transportation corridor as required under the Endangered Species Act of 1973. A determination of effects was developed for the Gray Wolf, Grizzly Bear, Northern Bald Eagle, and American Peregrine Falcon.

The B.A. determined that the previously proposed Crown Jewel Project would not adversely affect existing populations of Gray Wolves primarily because no viable wolf population occurs in the area.

The study area of the B.A. was found to be unsuitable critical habitat for the establishment of Grizzly Bears though occasional travels through the area are possible. Population centers exist in Canada within forty miles.

No suitable breeding or wintering habitat exists for Bald Eagles and the Project was judged to have no adverse affect on Peregrine Falcons.

6.12 Noise

Noise generated at the mine site will consist of several elements. Local traffic, including ore transport trucks and underground mobile mine equipment entering and exiting the portal will contribute to noise at the mine site. Given the location of the mine site in the Gold Bowl drainage basin, the prime direction of noise will be upward and to the east. It is unlikely that any operational noise from the mine site could be heard within populated areas. A possible exception may be during the initial several blasts in the development of the adit. These noise impacts detected from the local sparsely populated areas will be very low given the distance. In any case the impacts would be of very short duration.

The fans at the portal and the other ventilation openings will also contribute to local noise levels. In all cases, fans will be used which minimize noise by design. In the cases of the ventilation raise and secondary ventilation ramp, existing vegetation near the noise sources will be left in place to the extent possible to shield noise. In both of these sites the direction of the highest noise will be engineered so that the peak direction is upward and away from the population centers. It is highly unlikely that ventilation fan noise will be heard from populated areas under even the most adverse wind and climatic conditions. However, testing of detectable noise at different locations will be done subsequent to installation of the fans to confirm this and, should noise be detected in or around Chesaw in populated areas, further mitigation measures for noise control will be installed.

Increased noise will occur along the access route as a result of increased traffic associated with ore transport, employee traffic, and deliveries. All company or contractor vehicles will observe the following noise reduction measures:

- Truck traffic and deliveries by truck are proposed to be limited to a schedule of no longer than 8 a.m. to 6 p.m.
- Contractor and company owned vehicles will have maintained exhaust systems in good condition.
- Vehicle operators will observe company instituted speed limits.
- Trucks will not use engine brakes in areas designated as noise sensitive areas.

Operations at the mill/TDF site will increase the local noise levels. However, noise increases are proposed to be mitigated in a number of ways. As with the mine to mill access route, traffic noise can be reduced through good management practices. The noise associated with the mill operation itself will be greatly mitigated by housing the principal equipment inside the mill structure. The interior of the mill building will be insulated with sound abatement materials specifically designed to minimize detectible noise from a reasonable distance outside the structure.

The period of highest noise during the life of the mine will be during construction activities. In particular, the heavy equipment used for TDF construction and grading of the mill site will result in a noticeable increase in local noise levels

The use of a loader at the backfill storage site will increase the background noise in that area. The intermittent use of a dozer approximately one day per week will also increase noise generation. The loader and dozer are also proposed for use on a limited schedule

Both Washington State and MSHA regulate noise on construction and operational sites. Crown will comply with all State of Washington, MSHA, and Okanogan County health and safety requirements relative to noise generation.

6.13 Scenic Resources

Crown will employ several general measures to minimize the visual intrusion of the project. As discussed previously, vegetation will be left undisturbed where feasible as a screening element. Construction cuts and fills will be rounded and blended with the surrounding topography to the degree possible. Buildings will be painted with non-reflective, earth-tone paints.

Exterior lighting will be reduced to the minimum required for safe operations and to maintain site security. Such exterior lights will be directed inward and down toward the center of the area to be illuminated to minimize views from offsite. Permanently mounted lights will be sodium or a similar type of spectrum and intensity.

The mine site is not known to be visible from any population centers nor from public roads. The mill site is clearly visible from both public roads and from the surrounding sparsely populated area. Design plans for the layout of mill facilities will be finalized in cooperation with county authorities and interested parties in order to address visual impacts. However, it is proposed to use the topsoil stockpiles to aid is shielding the site from the county road as shown on Figure 11. The backfill storage site, freshwater pond, and mill buildings may be partially shielded by the topsoil stockpiles. The topsoil stockpiles will be planted with groundcover as interim reclamation. Nevertheless, the mill and associated infrastructure will be visible from County Road 9480 and from elevated locations to the west and east.

The TDF site is also visible from several locations. Though the TDF site was selected specifically for its partially shielded location, the upper parts (later stages) of the impoundment structure will be visible from the north along the county road and the overall footprint from higher locations in the vicinity. Trees which are not required to be removed for operational purposes will be preserved to aid in mitigating visual impacts especially north of the impoundment location where shielding can effectively obscure most of the impoundment structure. Additionally, the impoundment will be constructed with rounded edges so as to conform to the local topography to the extent possible. Ground cover vegetation will be planted on the slopes to aid in the blending of the impoundment with local topographic conditions

6.14 Heritage Resources

Various cultural resource studies were conducted from 1993 to 1995 as part of the Crown Jewel permitting process. Within the immediate area of the mine site, heritage and cultural resources identified as significant or potentially significant were identified. Four intact structures of the old Gold Axe mining camp remain. Crown believes that these structures represent a valuable resource to be preserved. All four occur within the area of proposed site construction. Of these, three occur on USFS land and the fourth on private property owned by Crown. Crown intends to isolate these resources within the site so that they will be left undisturbed and preserved. Vegetation immediately surrounding these sites will be enhanced. Crown will consult with agencies and interested parties regarding the enhancement of these historic sites and their preservation during and after operation

No other sites previously identified as culturally significant will be impacted by Crown's proposed operations. However, if newly undiscovered cultural resources are identified during new cultural resource surveys or during construction or operations the site will be protected or documented, and, depending on which agency has authority over the specific area, the USFS, or DNR will be notified for determination of future action, if any. If cultural sites of importance to native cultures are located, tribal authorities of the Colville Indian Reservation will be contacted and coordination of the disposition of the site will be made.

6.15 Tribal Rights

The Colville Confederated Tribes retain hunting, fishing, and gathering rights to the region surrounding the Buckhorn Mt. Project as part of the traditional north half of the Colville Reservation. Many of the impact avoidance strategies that address general environmental issues similarly protect tribal rights in the area. The minimization of impacts to surface water quality and quantity ensures protection of existing aquatic habitat in the surrounding streams. The minimization of the area of disturbance, especially on Buckhorn Mt., reduces impacts to wildlife habitat. The use almost exclusively of previously disturbed areas at the mine site further minimizes new impacts.

However, approximately 12 acres of USFS land within the fence of the mine site is proposed to be withdrawn from hunting during the operating life of the mine site. For security reasons, hunting is not a compatible activity within the portal and office area at the mine site.

No known Native American archeological sites within the area of disturbance were located in previous surveys. However, if resources are identified appropriate action will be coordinated with the Colville Confederated Tribe.

6.16 Transportation

Issues pertaining to transportation have been discussed in Section 4.13. Additional details, regarding road maintenance, winter road maintenance, supply delivery, a USFS Road Use Permit, road closures, and other issues relating to transportation will be identified in a proposed joint agreement between the County Road Department, USFS and DNR.

Crown understands that it must obtain agency approval for road improvements on existing USFS routes, DNR routes and along county easements. New road construction must also be permitted through the appropriate landholding agency.

6.16 Land Use/Reclamation

Land use considerations include land and vegetation disturbances, existing livestock leases and water sources, fencing, and noxious weed control during construction operations. Additionally, the federal land at the mine site impacted during the mine life will be fenced and entry will be limited for safety and security purposes to those with business at the mine site. This area of approximately 12 acres will therefore be withdrawn temporarily from recreational purposes such as hunting and hiking.

Crown will minimize land and vegetation disturbances by maintaining a compact operation. Timber and vegetation will be left where feasible to serve as facility screening and for wildlife habitat. Erosion will be controlled at all times during construction and operation.

As discussed previously, the mine site will be fenced to exclude livestock using standard USFS four strand barbed wire fence. A small amount of USFS land within the Cedar Allotment will fall within the fence line. All stock fencing will be maintained by Crown during operations and until reclamation and successful revegetation of the site is established (up to five years from closure).

It is important to prevent the establishment or spread of noxious weeds. All earth-moving and other mobile equipment entering the site for the first time will be cleaned (washed) of soil and noxious weed seeds with particular attention to the undercarriage area. While spraying will be used to control noxious weeds on site and on the access road as necessary, preventative measures of vehicle cleaning are an important defense against the spread of noxious weeds. Company vehicles that have traveled off of paved highways in areas of noxious weed infestations will be cleaned prior to traveling on the accesses to the site and on the haul road. Spraying of areas on or adjacent to federal or state land will be conducted only as approved by the jurisdictional agency. All spraying will be conducted in accordance with county guidelines.

6.17 Socioeconomics

Crown's corporate philosophy will be to employ personnel from the local communities surrounding its mine site when feasible. Every effort will be made to maximize local hires. Such local hiring practices include use of local contractors and contract personnel. Worker training would be available, particularly to support local hiring practices. The mine construction, operations, and reclamation will provide a beneficial revenue and tax base increase for the county and state for a minimum of ten years. State and local taxes are projected to exceed \$3,000,000 annually during operation. The capital investment during construction and development is estimated to exceed \$55,000,000.

Socioeconomic impacts related to the mine construction are expected to be both beneficial and adverse in relation to housing a temporary workforce consisting of local and outside contractors. Crown will stage the construction to consider the impacts of the contractor work force to the degree possible.

The operations will result in the creation of a high percentage of skilled labor and technical jobs of which a large percentage could be transferred to other potential employment opportunities upon closure of mining operations. Reclamation and post-closure monitoring will employ a reduced number of employees and, after physical reclamation, contractors.

Local expenditures made directly by the mine and by mine personnel would result in an increased demand for goods and services in the project area. Some of this demand would be met by existing residents working in stores, real estate offices, and other businesses. However, the new demands generated by the mine would be expected to create new jobs in the service, retail, or other non-mine sectors of the economy to support the project and its employees.

6.18 Solid Waste (Garbage and Trash) Management

Solid refuse, trash, and general garbage generated during construction of the facilities will be consolidated and contained and transported offsite to the county land fill or other disposal sites as appropriate. Portable toilet facilities will be used during construction and during operations at certain locations. Solid wastes such as wood debris and concrete may be buried onsite during the reclamation phase contingent upon approval by the appropriate authorities and land management agencies. Should burial not be approved, solid waste will be transported to appropriate land fill disposal locations. Spills of oil, fuel, grease, and other materials will be cleaned up immediately and disposed of appropriately. An emergency spill and response plan will be developed as required prior to construction and operation.

The handling of human waste during operation and the closure will be coordinated with the State of Washington at the mine and mill sites.

6.19 Hazardous Substances

At the mine site explosives will be handled and stored for blasting use in mining of ore and development rock. It is anticipated that most or all of the primary explosives used will be ammonium nitrate fuel oil (ANFO). This explosive is particularly safe to handle and poses less risk of danger or theft than other dynamite-based explosives. Nevertheless dynamite-based explosives may be stored on site as will detonation cord and other explosive devices requiring high security measures. Storage of explosives is discussed in Section 4.6 and the security of explosives on site and in transit will be subject to a security plan which will be approved by MSHA and prepared in coordination with the County and other interested agencies.

Reagents at the mill site which pose risk of release will also be stored and handled in accordance with MSHA standards and federal Emergency Planning and Community Right-to-Know Act (EPCRA) regulations as well as other federal and state regulatory programs. A plan will be developed in conjunction with interested agencies to address all EPCRA compliance issues. Of particular interest is the gold leaching agent, sodium cyanide which will be delivered and stored in solid or liquid form. Only trained authorized personnel will be permitted to handle potentially toxic reagents. An emergency response and control plan will be developed prior to operation which will address potential spill events for all reagents on the property and all mill and administrative personnel will be required to undergo response training. A security program to prevent theft of explosives and sodium cyanide will be developed in cooperation with local and county security professionals.

Sodium cyanide will be stored inside, segregated from acids, weak alkalis, and strong oxidizing materials such as nitrates. The cyanide will also be stored away from flammables and combustibles to minimize the chance of cyanide-water runoff as a result of firefighting. Where local regulations permit, sodium cyanide containers should not be stored under sprinklers, because sodium cyanide will not burn in ordinary fires and runoff must be avoided. Storage with food or intermediates for human or animal products will be avoided.

Security will be maintained and only authorized personnel will have access to the cyanide. Only the quantity required for immediate use will be removed from storage. Sodium cyanide will be stored in tightly closed, air tight containers which are clearly identified as containing hazardous materials. The cyanide will be stored in a dry place and protected against corrosion and damage. Areas in which sodium cyanide are stored and processed will be well ventilated and will have secondary containment Detailed procedures will be developed and implemented for handling and mixing sodium cyanide. The transporter will be required to have emergency response capability which is able to interface with local governmental agencies. Spill response plans will be required of suppliers and will be a matter of public record. Security plans for transportation of substances by suppliers to the site will also be developed.

The transportation of potentially hazardous or dangerous substances to the site by contractors will be in accordance with the provisions of 49 CFR Part 107 and, in the case of cyanide, the newly formulated International Cyanide Management Code for the Manufacture, Transport, and Use of Cyanide in the Production of Gold May 2002 (Code). The basic principles and standards of practices outlined in the Code and which will be followed for the project include:

- Purchase cyanide from manufacturers employing appropriate practices and procedures to limit exposure of their workforce to cyanide and to prevent releases of cyanide to the environment.

- Establish clear lines of responsibility for safety, security, release prevention, training and emergency response in written agreements with producers, distributors, and transporters.

- Require that cyanide transporters implement appropriate emergency response plans and capabilities, and employ adequate measures for cyanide management.

- Design and construct unloading, storage and mixing facilities consistent with sound, accepted engineering practices and quality control and quality assurance procedures, spill prevention and spill containment measures.

- Operate unloading, storage and mixing facilities using inspections, preventive maintenance, and contingency plans to prevent or contain releases and control and respond to worker exposures.

- Implement management and operating systems designed to protect human health and the environment including contingency planning and inspection and preventive maintenance procedures.

- Introduce management and operating systems to minimize cyanide use, thereby limiting concentrations of cyanide in mill tailings.

- Implement a comprehensive water management program to protect against unintentional releases.

- Implement measures to protect birds, other wildlife, and livestock from adverse effects of cyanide process solutions.

- Implement measures to protect fish and wildlife from direct and indirect discharges of cyanide process solutions to surface water.

- Implement measures designed to manage seepage from cyanide facilities to protect the beneficial uses of ground water.

- Provide spill prevention or containment measures for process tanks and pipelines.

- Implement quality control/quality assurance procedures to confirm that cyanide facilities are constructed according to accepted engineering standards and specifications.

- Implement monitoring programs to evaluate the effects of cyanide use on wildlife, surface, and ground water quality.

- Plan and implement procedures for effective decommissioning of cyanide facilities to protect human health, wildlife, and livestock.

- Establish an assurance mechanism capable of fully funding cyanide-related decommissioning activities.

- Identify potential cyanide exposure scenarios and take measures as necessary to eliminate, reduce, and control them.
- Operate and monitor cyanide facilities to protect worker health and safety and periodically evaluate the effectiveness of health and safety measures.
- Develop and implement emergency response plans and procedures to respond to worker exposure to cyanide.
- Prepare detailed emergency response plans for potential cyanide releases.
- Develop procedures for internal and external emergency notification and reporting.
- Incorporate into response plans monitoring elements and remediation measures that account for the additional hazards of using cyanide treatment chemicals.
- Periodically evaluate response procedures and capabilities and revise them as needed.
- Train workers to understand the hazards associated with cyanide use.
- Train appropriate personnel to operate the facility according to systems and procedures that protect human health, the community, and the environment.
- Train appropriate workers and personnel to respond to worker exposures and environmental releases of cyanide.

A list of substances to be consumed on site is shown in Table 11.

7.0 RECLAMATION PLAN

This section presents an overview of the key components of the reclamation planning. Details of the reclamation plan are presented in Appendix E.

Historic and current land uses include hunting, fishing, gathering, mineral exploration and extraction, logging, agriculture, residential development, timber sale, firewood gathering, grazing, and recreation. Management of the USFS land in the vicinity of the project is guided by a land and resource management plan (RMP) developed by the USFS (USFS 1989). The ROD states that all operations associated with mining development shall adhere to 43 CFR 3809 and 3802 which requires reclamation of all mining operations and compliance to air and water quality state and federal standards. Reclamation plans presented here are, to the extent applicable and appropriate, based on recommendations contained in the BLM Solid Minerals Reclamation Handbook (BLM 1992). Additionally, reclamation will conform to WA DNR Title 78 governing mines, minerals and petroleum.

The goal of reclamation is to return the site to a productive post-mining condition following closure and decommissioning. Reclamation will be completed on both private and public lands. Key facilities to be reclaimed include:

- Mine portal area
- Ventilation openings
- Mill/TDF area
- Access roads
- Any new power line corridors
- Water pipeline
- Water supply wells
- Monitor wells
- Freshwater pond

Reclamation activities will be scheduled to occur as soon as practical after the mining activities are completed, thus minimizing erosion and sedimentation problems. In general, reclamation will be timed to take advantage of optimal climatic conditions. Final grading, drainage, and sediment control establishment will occur over the late spring and summer months. Seedbeds will be prepared in later summer or early fall just prior to seeding. Seeding will be completed in mid-late fall in order to take advantage of winter and spring moisture.

Many of the reclamation activities can not occur until near the time of final mine closure. Areas such as the underground workings and surface facilities will remain active until mine closure. However, during the anticipated life of the project, interim and concurrent reclamation will occur to reduce erosion and the potential for off-site degradation.

Interim reclamation refers to reclamation efforts on lands disturbed and reclaimed during the course of a project. To reduce erosion and sedimentation during the life of the operations, disturbed areas will be temporarily revegetated. Topsoil will not be applied to temporarily revegetated areas. Topsoil will generally be conserved for final reclamation activities. These temporarily vegetated areas will be broadcast seeded with an interim seed mixture. Mulch and fertilizer may be added if initial seeding is unsuccessful. The topsoil stockpiles, tailings pipeline berm, and access road embankment will require interim reclamation.

Concurrent reclamation refers to reclamation activities which can be carried on at the same time as ongoing mining activities. Concurrent reclamation can be advantageously employed on disturbed areas that have served their purpose and are ready to be graded to final reclamation contours. Such areas will include disturbances associated with diversion ditches, exploration drill pads, and any access roads that will not be needed for future activities. Reclamation of temporary development rock staging areas will occur upon final use as interim reclamation. Where possible during the life of the project, disturbed lands will be reclaimed with ongoing mining operations.

Extensive reclamation has already been completed and is ongoing at the mine site. Exploration drilling roads constructed by Crown and, more extensively by BMG, are being reclaimed by BMG (now Newmont Mining) in 2002 and 2003. At the end of 2002 physical recontouring and reseeding has been completed on 55 acres of USFS land and 32 acres on private land. Lesser area remains to be reclaimed in 2003 on USFS, private and BLM land. Roads used by Crown in a recent drilling program will also be reclaimed in 2003.

Most reclamation activities will take place at the time of mine closure and will be considered "final" reclamation. The areas to undergo reclamation at mine closure include underground workings, the portal and general mine site area, the final tailings embankment face and tailings surface, the sediment control ponds, mill area and associated surface facilities, water supply pipeline route, freshwater pond and access roads. Final reclamation will be implemented upon the completion of mining and exploration. Detailed final reclamation procedures are discussed in Appendix E.

8.0 MONITORING MEASURES

Monitoring programs will be developed by Crown through discussions with and input from Okanogan County, DOE and DNR, and the USFS and required by permit conditions. These programs will be designed to detect and quantify any environmental impacts from construction through post-closure reclamation activities at the site. All monitoring programs will comply with any required local, state, and federal permit and approval stipulations.

Extensive monitoring data exists as documented in the Crown Jewel Project FEIS and subsequent monitoring activities conducted by BMG. These baseline data provide background for the proposed Buckhorn Mt. Project. It is anticipated that much of the existing monitoring data and baseline studies will be utilized during the future regulatory analysis of the Buckhorn Mt. Project. Based on Crown's current understanding of the existing data and where data gaps may exist for the new project, the following table summarizes the expected monitoring programs.

TABLE 15

MONITORING MEASURES

Resource Area	Baseline Monitoring Measures	Operational Monitoring Measures	Post-Closure Monitoring
Water Resources	Use existing data, add stations for mill/TDF and augment existing mine site data	Select appropriate stations from baseline program	Reduced number of stations
Air Quality	Use existing data, add station for mill/TDF site	Use existing data and select appropriate stations	None or to be determined
Geochemistry	Use existing data, add stations at mill/TDF	Develop operational sampling and testing program to verify baseline results	To be determined
Reclamation	Use existing data	Use existing data and develop operational monitoring program	Develop post-closure monitoring program

Water resource monitoring is believed to be the most critical resource area for characterizing baseline and establishing appropriate monitoring for the operational conditions. Extensive baseline monitoring of groundwater and surface water geochemistry and of surface water flows in the vicinity of the mine site has been completed for the Crown Jewel project and will provide the basis and starting point for the Buckhorn Mt. Project monitoring. Continued baseline water quality monitoring of surface and ground waters at and near the mine site will be reinitiated in 2003. Continued surface water flow and ground water level data is currently being collected.

Monitoring of groundwater and surface water at the proposed mill/TDF site is planned to begin in the spring/summer of 2003 when monitor wells will be installed at locations coordinated with the DOE. The objective of baseline monitoring is to characterize existing ground and surface water quality and quantity so that comparisons can be made with earlier results, both during operation and after closure. A program of monitoring of the underdrain system to the TDF and discharge to the TDF will be developed for operation in conjunction with parameters required by a waste water discharge permit.

Monitoring parameters and locations during operation and post-closure may be different from initial baseline studies as information is gathered and assessed. The monitoring programs, whether baseline, operational or post-closure will be developed in cooperation with appropriate regulatory agencies. It is anticipated that specific programs will be modified as the project moves forward to meet identified needs.

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TABLES

TABLE 1

PERTINENT MAJOR STUDIES/SUBMITTALS PERFORMED FOR THE PROJECT

Year	Subject	Author
1990	A Cultural Resources Survey of the Crown Jewel Exploration Project, Okanogan County, Washington	Archaeological and Historical Services
1992	Plan of Operations	Battle Mountain Gold
1992	Soils Technical Memorandum, Crown Jewel Project	Cedar Creek Assoc.
1992	Report on the Waste Rock Geochemical Testing Program: Crown Jewel Project, Chesaw, WA.	Adrian Smith Consulting Inc
1992	Supplements to the Plan of Operations	Battle Mountain Gold
1993	Integrated Plan of Operation	Battle Mountain Gold
1993	Reclamation Plan.	Battle Mountain Gold
1993	Report on Geochemical Testing of Ore and Low Grade Ore Crown Jewel Project	Battle Mountain Gold
1993	Baseline Noise Monitoring Report. Proposed Crown Jewel Mine Site. Chesaw, Washington	Hart Crowser
1993	Report on the Waste Rock Geochemical Testing Program, Crown Jewel Project	Kea Pacific Holdings Inc. and Golder Associates Inc.
1993	Report on the Waste Rock Geochemical Testing Program, Crown Jewel Project, Responses to Agency Comments	Kea Pacific Holdings Inc. and Golder Associates Inc
1993	Report on Geochemical Testing of: Ore and Low Grade Ore, Crown Jewel Project	Kea Pacific Holdings Inc. and Golder Associates Inc
1993	Aquatic Resources for Sections of Myers, Gold, Nicholson, and Marias Creeks in the Okanogan National Forest	Pentec Environmental Inc.
1993	Aquatic Resources for Sections of Myers, Gold, Nicholson, and Marias Creeks in the Okanogan National Forest	Pentec Environmental, Inc.
1993	Wetland Delineation, Crown Jewel Project, Okanogan County, Washington	Pentec Environmental, Inc.
1993	All Known Available and Reasonable Technology (AKART) Evaluation for Cyanide Detoxification, Battle Mountain Gold Company, Crown Jewel Project, Okanogan County WA.	Knight Piesold & Company
1994	Cultural Resources Investigations of the Crown Jewel Mine Project, Okanogan County, Washington	Archaeological and Historical Services
1994	Summary Report Confirmation Geochemistry Program, Crown Jewel Project	Terra Matrix Inc.
1994	Technical Memorandum on Groundwater Supply Evaluation of Lost Creek Ranch Irrigation Well	Golder Associates Inc.
1995	Crown Jewel Project, Wildlife Technical Report	Beak Consultants, Limited
1995	*Draft Environmental Impact Statement: Crown Jewel Mine, Okanagon County Washington*, assembled by TerraMatrix	U.S. Forest Service
1995	National Register of Historic Places Registration Form determination of Eligibility: Buckhorn Mountain Mining Properties	Eastern Washington University

Year	Subject	Author
1995	Crown Jewel Project Economic and Fiscal Impact Analysis	Huckell / Weinmam Assoc.
1996	Tailings Geochemical Testing Program, Crown Jewel Project, Okanogan County, Washington, Addendum 1	Battle Mountain Gold
1996	Reclamation Plan	Battle Mountain Gold
1996	Biological Assessment for the Crown Jewel Mine Project	Cedar Creek Associates, Inc. and Beak Consultants Inc.
1996	Affected Socioeconomic Environmental Background Report (1996 Update) Crown Jewel Project	E.D. Hovee and Company
1996	Existing Socioeconomic Environmental Conditions Baseline Report (1996 Update) Crown Jewel Project	E.D. Hovee and Company
1996	Report on Waste Rock Geochemical Testing Program, Crown Jewel Project, Phase IV, Additional Humidity Cell Tests	Geochimica, Inc.
1996	Final Report: Tailings Disposal Facility, Final Design Report	Golder Associates Inc.
1996	Crown Jewel Project Conceptual Wetland Mitigation Plan.	Parametrix, Inc.
1996	Noxious Weed Management Plan, Crown Jewel Mine	Parametrix, Inc
1996	All Known Available and Reasonable Technology (AKART) Evaluation for Cyanide Detoxification, Battle Mountain Gold Company, Crown Jewel Project	Knight Piesold LLC
1996	Report on Packer Injection Tests at the Proposed Crown Jewel Mine, Okanogan County, WA.	Golder Associates Inc.
1996	Meteorological Data Set, Crown Jewel Project, Chesaw WA	ENSR
1996	Myers Creek Project Fisheries & Instream Flow Studies, Final Report	Cascade Environmental Services Inc. & Caldwell & Assoc.
1997	*Final Environmental Impact Statement: Crown Jewel Mine, Okanagon County Washington*, assembled by TerraMatrix	U.S. Forest Service
1997	Crown Jewel Mine Plan of Operations, Battle Mountain Gold Company	Battle Mountain Gold Company
1997	Results of Static Acute Fish Toxicity Testing for Designation of Dangerous Waste	Battle Mountain Gold Company
1997	Engineering Report INCO SO2/O2 Wastewater Treatment Unit	AGRA Earth and Environmental Inc.
2000	Crown Jewel Surface Water and Groundwater Data Validation and Preliminary Analysis	Shepherd Miller Inc.