KENNECOTT GREENS CREEK MINING COMPANY
GENERAL PLAN OF OPERATIONS

APPENDIX 11
PRODUCTION ROCK PILES

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1.0 INTRODUCTION

Underground mining methods require the removal of host or native rock to gain orebody access for the purpose of economic mineral resource extraction. Mine development is the industry term used for activities which access and prepare the orebody for extraction. Mature underground mines conduct development activities in conjunction with mineral recovery operations and surface facilities development and maintenance. Each of these activities generates differing amounts of rock and/or overburden. At Greens Creek, material generated from these combined sources are termed production rock.

The purpose of this document (General Plan of Operations (GPO), Appendix 11) is to define the management objectives and subsequent methods and/or procedures for the development, operation and maintenance of production rock placement areas at the Greens Creek Mine (Figure 1), from initial material placement through the operating life of the mine. Closure requirements for the Greens Creek mine, including temporary and permanent closure, are described in more detail in GPO Appendix 14. Management objectives consider Acid Rock Drainage (ARD) and metals leaching, both of which can potentially create adverse environmental conditions. These potentials are evaluated with respect to local hydrology, climate and geochemistry to ensure the employment of practices best matched to site-specific conditions while providing the operational flexibility to incorporate systems improvement.

This appendix is divided into three sections.

- Section 1.0 provides general information and scope;

- Section 2.0 provides historical references including: governing permits, characterization methods and references, ARD discussion, status definitions and KGCMC production rock site status;

- Section 3.0 provides statement of management objectives and general methods, techniques, and/or procedures common to all production rock placement areas.

In addition, site-specific plans for active (Site 23) and inactive/closed production rock placement areas are included as Attachments B and C.

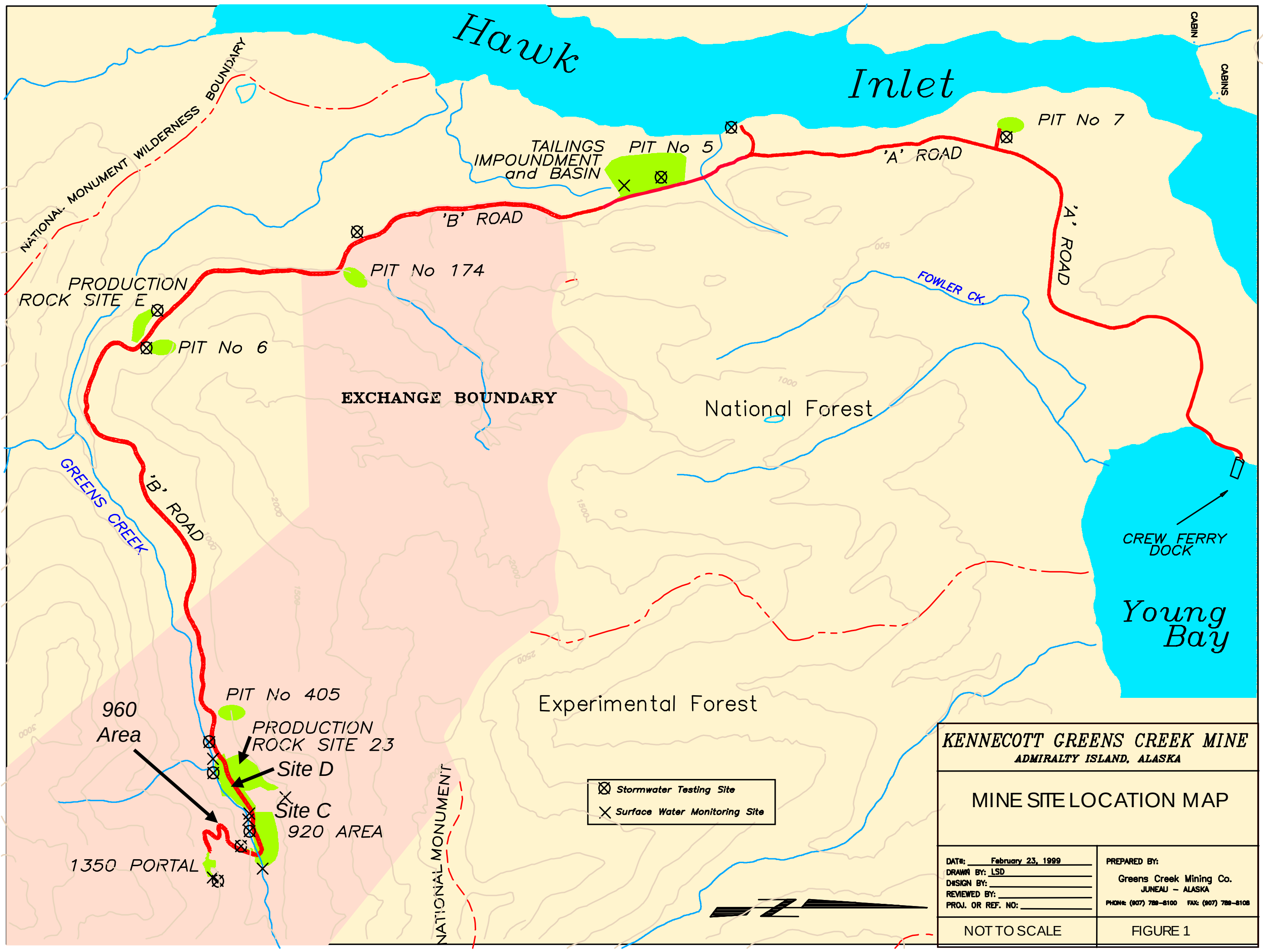


Figure 1. Location of facilities at the Greens Creek Mine.

2.0 BACKGROUND

The understanding of the Greens Creek production rock geochemistry and potential influences on water quality has developed over the life of the project. This section provides a brief narrative of this development.

2.1 Permits

The Forest Service and the Alaska Department of Environmental Conservation (ADEC) regulate production rock placement, monitoring and eventual reclamation. Regulatory references are included in each of the following documents.

2.1.1 Final Environmental Impact Statement (FEIS), 1983

The FEIS for the Greens Creek Project was completed during January 1983. Development of a surface mine service area in close proximity to the orebody was common to all alternatives compared during the EIS review process. Included in the mine service area were 43 acres designated as production (waste) rock storage.

2.1.2 Environmental Assessment for Proposed Changes to the General Plan of Operation for the Development and Operation of the Greens Creek Mine, 1988

The 1988 EA, a review of proposed changes to the Greens Creek General Plan of Operation, is specific to tailings placement methods and impact. No changes to production rock storage capacity were proposed.

2.1.3 Environmental Assessment for Additional Waste (Production) Rock Disposal Capacity at Greens Creek Mine, 1992

The 1992 EA Decision Notice approved and incorporated the use of ten acres in addition to eight remaining acres approved by the 1983 FEIS Record of Decision for the purpose of production rock disposal. The Decision Notice incorporates all aspects of the Operations and Maintenance, Required Improvements, Mitigation, Monitoring and Reclamation components identified within the "Components Common to all Alternatives" section of the EA and those found in "Alternative 3, Technical Considerations".

The EA concluded that the potential for short or long-term generation of acid drainage from production rock was small. The EA required an ongoing assessment of field conditions to verify these conclusions from laboratory studies. The EA Decision Notice required that mitigation measures defined from the ongoing assessment be incorporated into the General Plan of Operations, if necessary.

2.1.4 General Plan of Operations

The General Plan of Operations (GPO) documents regulatory guidelines for management of operational activities at the Greens Creek Project. Appendix 11 of the GPO is specific to the management of production rock. Modification and/or update to the appendix are subject to Forest Service, and ADEC approval.

2.1.5 Solid Waste Permit

Mining wastes are categorically exempt from regulation under the Alaska solid waste program unless they pose a potential "welfare threat or environmental problem associated with the management of the waste". Recently, the state of Alaska made the determination that production rock placed in Site 23 is subject to the chapter 60 solid waste requirements, which include the need to acquire a permit. Mining waste is regulated under the monofill standards 18 Alaska Administrative Code (AAC) section 60.455 which allows the department discretion to incorporate applicable provisions of 18 AAC 60 into a waste disposal permit. A waste that is not specifically addressed in Article 4, such as waste rocks, will be classified by the ADEC and assigned the most applicable waste category

The waste disposal permit will contain applicable provisions of Article 1 and 2 (60.010 to 60.265) that have to do with general standards, limitations, prohibitions and administrative procedures to be followed by every disposal facility regulated under the chapter. Additionally, the waste disposal permit will apply relevant locational, operational, and design related requirements from the monofill standards in Article 4 (18 AAC 60.400 to 60.495) in which the industrial waste standards most closely match the Greens Creek facilities. The monofill requirements also include closure and post-closure care, deed notations, notifications, monitoring and reporting.

Furthermore, the Greens Creek facilities are subject to Article 6 (18 AAC 60.700 to 60.730) which have to do with user fees and Article 7 monitoring and corrective action requirements (18 AAC 60.800 to 60.865). In Article 7 monitoring requirements specify visual, surface water and groundwater requirements. Detection monitoring is required under Article 7. If a significant statistical difference exists between upgradient and downgradient or if the water quality standards are exceeded in detection monitoring, then assessment monitoring will be triggered. Assessment monitoring will require that the plume be identified and that the owner/operator identify and implement remedial corrective measures according to 40 Code of Federal Regulations (CFR) 258.55 to 258.58. Lastly, the facilities at Greens Creek are open to waivers to any provision of the chapter under 18 AAC 60.900 upon adequate demonstration and ADEC discretion.

2.2 Production Rock Characterization

In accordance with the 1992 EA Decision Notice, an ongoing assessment of production rock field conditions has been conducted and continues. This section includes a narrative summary of the rock types found within the Greens Creek district and a status summary of ongoing assessment work.

2.2.1 Physical and Mineralogical Characteristics

The objective of production rock characterization is to define the materials and determine how they behave under weathering conditions. Limiting metals mobility and the potential for development of acid rock drainage are of primary concern. Rocks encountered at the mine are classified into three general categories that have gradational boundaries and show considerable internal variation. The main units: argillite, phyllite and ore are described below using the KGCMC classification system and nomenclature. Refer to the geological database, Weathering

Characteristics of Waste Rock From Admiralty Island Deposit (Vos 1993), results of the 1994 surface drilling program, and the review of ARD and metal leaching risk (SMI 2000) for specific geochemical analyses.

Argillite Units (Structural Footwall/Stratigraphic Hangingwall)

A brief description of each rock type within the Argillite Unit is accompanied by a summary, included in Attachment A, of the abbreviation system utilized at Greens Creek for documenting physical and mineralogical characteristics. (See Table 1)

Slaty Argillite (SA): Light-gray to black, graphitic, variable carbonate content which can be calcareous to dolomitic, variable sericite content; banded, thinly to broadly, bands can be locally ladder-veined, and/or weakly lightning-veined (stockworked); locally shows tectonic fabrics (foliation breccia). This is the most common lithology in the argillite package. It does show considerable mineralogic variation near lithologic contacts as well as elsewhere, but these local variations are not reflected in the name applied unless the variation is interpreted to be the result of alteration associated with mineralization. Sulfide content is typically low (<3%) but can range up to 50% (rare). Higher sulfide contents are usually associated with alteration or proximity to mineralization and generally occur along foliation planes.

Massive Argillite (MA): Light-gray to black, graphitic (weak to strong), variable carbonate content which is calcareous to dolomitic, variable silicic and/or sericitic content (trace to weak); very fine to fine grained to granular (graphitic=vfg, carbonate-more granular), typically variably lightning-veined (stockworked) but can be almost a massive featureless graphitic-carbonate, commonly displays a crude reheated fabric (stylolitic sutures-reflect the generally higher carbonate content of MA relative to SA). Sulfide content is typically low (<3%) but can range up to 50% (very rare). Higher sulfide contents are usually associated with alteration or proximity to mineralization. In some areas massive argillite occurs stratigraphically adjacent and just above the ore horizon. However, in other areas of the mine massive argillite occurs well away from any known ore. At present, no sense of a predictable stratigraphy appears to be present within the SA/MA package.

Dolomitic Slaty Argillite (DSA): Light gray to medium gray, variably graphitic, dolomitic, definitely siliceous (weakly to moderately) with a distinct but weak sericitic composition, distinct (medium to coarse-grained) pyrite content (typically greater then 15% but can range from 1% to localized bands of massive pyrite). "Blocky-sutured" to chaotically banded, broadly to thinly, S3 contributes to complexity. Commonly contains siliceous-clastic-pulse intervals that may be confused with a "siliceous microbreccia" or SRx unit.

Dolomitic Massive Argillite (DMA): Pale to medium gray, granular to pelloidal, non-graphitic, dolomitic to calcareous, can occur with intercalated micaceous sutures/bands composed of white-mica/chlorite/mariposite/talc ± graphite ± pyrite (vfg), and can be fossiliferous. This lithology also encompasses the rock type previously described as limestone. This unit is typically found near the phyllite/argillite contact or near the mineralized zones of argillite in the upper-southwest ore zone.

Chert (CHT): Light-gray to medium-gray to gray-green to olive-brown, major component is cryptocrystalline silica with trace graphite/sericite/carbonate minerals. Usually subtly banded and can show veining (hydrofractures). Also can have a minor component of evenly disseminated fine-grained euhedral carbonate crystals. In some areas chert/siliceous slaty argillite contacts are very gradational and hard to place. Unless the lithology is distinctly a chert the SAs classification takes precedence.

Alteration Types for Slaty/Massive Argillite:

- Elevated Carbonate-cb
- Siliceous-s
- Sericitic-sr

DSA/DMA and CHT are narrowly defined lithologies and are not commonly modified with an alteration type.

Carbonate (cb): Applied mostly to SA and MA for rock which typically appears more bleached and granular and has a distinctly elevated-carbonate (calcareous/dolomitic) content, and a reduced graphitic content with respect to the standard lithologies. Usually has other alterations such as sericitic and rarely silicic but the carbonate alteration is dominant.

Siliceous (s): Applied to SA or MA lithologies that have distinctively elevated silica content above that of normal SA/MA. Elevated silica can be a result of either hydrothermally introduced silica or an increase in the chert content. This is one area where alteration may truly be a lateral facies change. However, since cherts are usually proximal to mineralized contacts, it is felt to be justified. Intense ladder/lightning/bull-quartz veining is not viewed as a siliceous alteration unless the veining reaches the point where it completely disrupts the fabric of the rock.

Sericitic (sr): Applied to SA and rarely MA having a distinctive sericite component which is usually associated with surrounding siliceous and/or carbonate alteration with sericite being the dominate mineralogy. This alteration can also have associated barite and may be a lateral variation of barren WBA zones in the upper south-west. Standard SA can vary to a black, graphitic micaceous "phyllite" but this is interpreted to be a sedimentary variation and is not noted with an "sr" suffix.

Phyllite Units (Structural Hanging Wall/Stratigraphic Footwall)

A brief description of each rock type within the Phyllite Units are accompanied by a summary, found in Attachment A, of the abbreviation system utilized at Greens Creek for documenting physical and mineralogical characteristics. (See Attachment A, Table 2)

Sericitic-Phyllite (SP): Light-gray to dark-gray to green-gray to tan-gray, usually well foliated (evenly/thinly to complexly, commonly shows well developed S3); sericite, quartz, carbonate± chlorite± leucoxene± mariposite± serpentine± trace graphite.

Siliceous Rock (SR): Applied to a unit which is composed of at least 70% wt free SiO_2 (usually as fine-grained quartz). However, the rock usually still contains enough remaining phyllosilicates to have a broadly spaced foliation. Can be associated with medium-grained pyrite and is inferred to be a highly silicified SP. SRcx is used to describe a polymictic-clastic-breccia with rounded to angular chert clasts in a fine-grained siliceous ± sericitic matrix. The latter rock type is almost always found at the contact between readily recognizable phyllite and argillite units and may actually represent a mixed zone. If chert clasts comprise more than 50% of the rock it is classified as a CHTcx even if the matrix is dominantly SR/SP.

Diorite-Gabbro (DG): Dark to light-olive-green mottled with yellow-green, mostly fine-grained chlorite with 2-3 mm black pyroxene, phenocrysts and minor quartz/carbonate and trace -2% fine-grained euhedral pyrite; textures reflect a relict cumulate igneous texture.

Serpentine-Chlorite (SC): Light to dark green to dark gray to gray-brown, massive to sheared and crudely foliated, feels soft and greasy; mineralogy is primarily serpentine/chlorite/talc and typically has pyrite contents of 5-15%. This classification includes soapstone.

Chloritic Rock (CR): Medium-green, moderately to well-foliated (thinly to broadly, predominately evenly) to rarely massive; chlorite± carbonate± leucoxene± white-mica. Weakly magnetic.

Mariposite Phyllite (MP): (a.k.a.-Quartz-Carbonate-Mariposite Rock/QCM) Lavender-gray to green-gray to green to brilliant green, massive to banded to foliated, carbonate+ mariposite± chlorite/sericite± quartz± (leucoxene). Note that the mariposite content can be present in trace quantities and the carbonate± quartz are usually the dominant mineralogies. Typically contains intervals with quartz-carbonate veins/lenses/boudins 1-2 cm wide.

Alteration Types for Sericitic-Phyllite:

- Elevated Carbonate-cb
- Moderately Siliceous-s
- Chloritic-c
- Leucoxene-t

These alteration types are almost exclusively applied to Sericitic-Phyllite with the rest of the phyllite package being narrowly enough defined so as not to need modifiers.

Carbonate (cb): Is applied to SP that contains elevated carbonate (greater than 20%). Typically the carbonate is granular and is present in high enough quantities to disrupt the usual well developed foliation and can range up to massive textures. The more massive textured carbonate-altered SP is differentiated from MP by the lack of mariposite.

Moderately Siliceous (s): Applied to an SP which has distinctly elevated silica but is below 70% (wt) SiO2. Commonly occurs in association with elevated carbonate ± pyrite. If a well developed S3 is present a texture referred to as a foliation-breccia commonly occurs in this rock type. Typically foliation breccias have a siliceous matrix formed by angular to sub-angular, gray/white silica "clasts"/bound in a carbonate/sericite matrix. This fabric should not be confused with a clastic breccia that typically has well-rounded clear/gray silica clasts when found in SPs.

Chloritic(c): Applied to SP where chlorite constitutes greater than 15% of the total phyllosilicate mineralogy but is less than 60% (greater than 60% chlorite and the rock would probably be a CR).

Leucoxene (t): Applied to SP where the rock has a distinct tannish color that is caused by the occurrence of leucoxene. The leucoxene occurs as an accessory mineral localized in thin bands intercalated with more typical grayish SP or in a more widespread disseminated character. Typically, rocks designated as SPt contain greater than 1% TiO_2. Note that standard SP can have trace to accessory leucoxene and the (t) modifier should be reserved for cases where as least 20% of the rock shows a tannish color.

White Ores

The white ores are defined as primary lithologies based on gangue components. These lithologies almost always have associated base metal/precious metal mineralization but can be barren.

White Baritic Ore (WBA): A precious/base metal bearing baritic rock with less than 50% sulfides with barite being the predominant gangue mineral. Typically contains mineralization but doesn't have to have mineralization to be classified as WBA.

White Carbonate Ore (WCA): A carbonate rich rock with less than 50% sulfides that is typically precious/base metal bearing. The carbonate is typically medium to coarse grained and granular. Gangue minerals other than carbonate are not common but accessory components of silica, barite and/or sericite can occur.

White Siliceous Ore (WSI): A siliceous rock with less than 50% sulfides but with precious/base metal minerals. The majority of gangue occurs as free silica but also can contain secondary carbonate, barite or sericite. The free silica may be a massive-crystalline-aggregate or a readily recognizable chert with mineralization.

Veined (v e.g. vWCA, vWBA, vWSI): Applied as a prefix to any white ore that has distinctly remobilized medium-to-coarse-grained sulfides that are typically precious metal rich. Classic examples of this rock type are found in the precious-metal zones of the upper-southwest ore zone.

Massive Ores

For all massive ores the composition must be as least 50% sulfides. The sulfide component may be compositionally banded, intercalated with barren gangue or massive. All of the massive ores may be distinctly foliated with segregation of sulfide intercalated with gangue.

Massive Fine-Grained Base-Metal Sulfide Rich Ore (MFB): Ore contains at least 50% sulfides with base-metal sulfides greater than total pyrite. The ore is usually fine to very-fine grained, medium to dark metallic gray to blue-gray with subordinate quartz-carbonate-mica-barite gangue.

Massive Fine-Grained Pyrite Rich Ore (MFP): Ore contains at least 50% sulfides with pyrite forming the dominate sulfide. The ore is medium fine to fine grained, bronze to metallic-brown colored.

Massive Very-Fine-Grained Base-Metal Sulfide Rich Ore (MVB): Ore contains at least 50% sulfides with base-metal sulfides greater than total pyrite. The ore is very fine grained with the core showing a polished metallic gray to blue-gray color.

Massive Very-Fine-Grained Pyrite Rich Ore (MVP): Ore contains at least 50% sulfides with pyrite forming the dominant sulfide. The ore is very fine grained with the core showing a polished bronze to metallic-brown color

Both varieties of very-fine-grained ore are much more rare than the fine-grained type.

Fabrics

Fabric descriptors or physical rock characteristics are potentially applicable to each of the three major rock classifications within the Greens Creek district. The fabric types are as follows:

Gougy/Rubblized-(g): The prefix g applies to intervals of core that are faulted, highly fractured to rubblized and have greater than 5% Gougy matrix. The g prefix takes precedence over f or x.

Faulted/Broken/Highly Jointed-(f): The prefix F applies to broken or highly jointed core but with less than 5% gouge. Jointing planes may range from graphitically polished S2 surfaces in argillites to aligned open-spaced fractures commonly parallel to S3 which are found in more silicic/carbonate rich lithologies to highly fractured and rubbly core with applicable gouge. The f prefix takes precedence over x.

Tectonic Breccia (x): This suffix is applied to a “rehealed” tectonic breccia with angular to sub-rounded, monolithic to polylithic fragments. Obviously, this could run the gamut from stylolitic solution "breccia textures" (suture banding) to a foliation breccia produced by intense shearing of a siliceous rock to a rehealed fault breccia. This term is only applied to the latter-rehealed breccia where little or no gouge is present. The purpose of this designation is to attempt to trace structures and fabrics associated with flat-shears/(Claus-Type-Faults.)

Clastic Breccia (cx): Gray siliceous matrix, variably-colored polymictic clasts, rounded typically shows fining sequences (although commonly obscured). Is usually massive but can be foliated (massive predominates in the type section). Can be clast supported or matrix supported or a mixture of both. This term implies a primary sedimentary origin based upon grading, color and/or shape of the clasts. In all cases the lithological classification which comprises more than 50% of the rock will be used as the main litho-code modified by the cx suffix.

2.3 Weathering Characteristics and Acid Rock Drainage

When rock is disturbed, it undergoes physical and chemical changes in response to its new environment. The particle size decrease and surface area increase that result from rock extraction exposes some minerals to chemical and physical conditions under which they may not be stable. The unstable minerals break apart, dissolve and/or alter to form other minerals in response to the new conditions. Exposure and weathering of unstable forms of base metal-bearing minerals can liberate elements such as copper, lead and zinc, which are carried away in dissolved form or reprecipitate as more stable mineral species.

Several variables, including pH, control the solubility (stability) of minerals under weathering conditions. In general, minerals are more soluble under acidic (low pH) conditions. As a result, drainage from acidic environments tends to carry a considerably larger dissolved load than drainage from neutral to alkaline environments. It is important to note, however, that some metals, such as zinc, may be released under neutral pH conditions. Some sulfide minerals, predominantly pyrite (FeS_2), react with oxygen and water in the weathering environment to produce sulfuric acid, as illustrated by the following reactions:

$$FeS_2 + 15/4\ O_2 + 7/2\ H_2O \Longrightarrow Fe(OH)_3 + 2\ SO_4^{2-} + 4\ H^+ \qquad 2.1$$

$$2\ H^+ + SO_4^{2-} \Longrightarrow H_2SO_4 \qquad 2.2$$

If the acid is not neutralized by dissolution of neutralizing minerals within the rock (reaction 2.3), acid rock drainage (ARD) can result.

$$CaCO_3 + H^+ <==> Ca^{2+} + HCO_3^- \qquad 2.3$$

Because of its acidity, ARD is able to dissolve minerals with which it is in contact. Although this tends to neutralize the acidity, it also depletes the rock of neutralizing potential and liberates dissolved metals.

The relative amounts of oxygen, water and pyrite that are allowed to chemically interact dictate the rate and volume of ARD production. Limiting the supply of any one of those variables will help to decrease the severity of ARD.

Given the above considerations, it is clear that interaction between many complex variables influences water quality associated with production rock removal and storage. Knowledge of the dynamics is important to meet water quality objectives. ARD unchecked may increase exponentially. Therefore, timely evaluation of significant variables at existing locations is necessary for effective planning and action.

Static tests (acid-base accounting) and kinetic tests (column or humidity cells) allow identification of the potential for acid generation and determination of how materials behave under controlled weathering conditions. These tests are then used in conjunction with physical and mineralogical characterization to determine best management practices for production rock disposal.

2.3.1 Static Tests (Acid-Base Accounting)

The purpose of acid-base accounting (ABA) is to identify the potential for acid generation based on balance between acid forming species and acid neutralizing species within the rock. Net neutralizing potential (NNP) is calculated by subtracting the acid generation potential (AGP) from the acid neutralization potential (ANP) of the rock (ANP-AGP=NNP). A negative NNP indicates the material has the potential to generate acid and a positive NNP indicates the material is potentially a net acid consumer. Although there are several methods of ABA, all are based on the following assumptions:

- Oxidation of pyrite by oxygen is the only source of acid production, (reaction 2.1)
- Pyrite reacts completely; and
- Dissolution of calcite to Ca^{2+} and HCO_3- is the neutralization reaction. (reaction 2.3)

Because the modified Sobek method is currently the most accepted ABA procedure, it has been adopted by KGCMC and is described below.

For the acid-base account, acid generation potential (AGP), maximum acid potential (MAP), and acid potential (AP) are all synonymous for the amount of sulfur within the rock. Depending on the ABA method and mineralogical information, either total sulfur, sulfidic sulfur or pyritic sulfur is used for the acid generation calculation. For the majority of the material at Greens Creek, the amount of sulfidic sulfur (sulfur contributed by sulfide minerals) is within 0.2% of the total sulfur content. Pyritic sulfur is roughly 1.5% lower than total sulfur in the mine's production rock. Because pyrite oxidation is the primary source of acidity, pyritic sulfur content would be the most reliable indicator of acid generation potential. However to be conservative, calculation of acid generation based on total sulfur or sulfidic sulfur is the AGP basis for Greens Greek production rock.

To calculate the AGP of a sample, the percent total sulfur is multiplied by 31.25 to convert to units of tons of Ca CO_3/1000 tons. Use of 31.25 assumes that reactions 2.1 and 2.3 are the only acid generating and neutralizing reactions in progress and that 100% of the pyrite is oxidized. The 31.25 conversion factor relates the stoichiometry of the two reactions. This assumption does not account for the oxidation of pyrite by other species like ferric iron and manganese and would underestimate the AGP of the material if conditions drop below a pH of 3.5. Although the objective is to avoid such conditions, over estimating AGP by using total or sulfidic sulfur instead of pyritic sulfur helps to offset underestimation under these conditions, however unlikely. Because pyrite grains form a skin of oxidation products which isolates the grain from the oxidizing environment, the assumption that 100% of the pyrite is oxidized may also lead to an overestimation of AGP.

The modified Sobek ABA method for determination of neutralization potential (ANP) was developed because previous methods tended to overestimate the ANP of materials by excessive acid titration. The modified method uses only enough acid to reduce the pH of the titrating solution to a range of 1.5-2.0 for 24 hours. After 24 hours, the amount of standardized base that is required to raise the pH to 8.3 is measured and converted to tons Ca CO_3/1000 tons. Although this method does not distinguish between reactive and less reactive species, relatively insoluble species that may have reacted as a result of excessive acid titration will not contribute to the ANP calculation.

For Greens Creek lithologies, the carbonate minerals dolomite, calcite and ferro-dolomite contribute to most of the ANP value. AGP is calculated by using the 31.25 conversion factor which assumes that reaction 2.3 is the only neutralization reaction. Considering molecular weight and stoichiometry, less dolomite and more ankerite (by weight) would be required to achieve the same neutralizing effect as in the calcite reaction. If dissolution of dolomite, the most common carbonate mineral at Greens Creek, were used for the neutralization reaction, the resulting AP value would be lower. However, because the AGP decrease might be offset by the fact that dolomite is less reactive than calcite, the standard, more conservative calcite conversion factor of 31.25 is used.

Because the AGP conversion factor for pH conditions less than 6.0 is half that for conditions above 6.0, AGP may be overestimated for the pH range from 3.5 to 6.0. This results from the formation of H_2CO_3 rather than HCO_3- during the dissolution reaction under lower pH conditions as illustrated by the following reaction.

$$CaCO_3 + 2H^+ = Ca^{2+} + H_2CO_3 \qquad 2.4$$

Given the complex variables involved, the limitations of the ABA methods, and the consequences of overestimating NNP, overestimation of AGP and underestimation of ANP will be incorporated into the interpretation of ABA results. It is important to note that the actual amount and rate of acid production are influenced by factors other than those considered by ABA.

ABA values for lithologies at Greens Creek show a considerable range. Attachment A, Table 3 summarizes the results of 175 ABA analyses.

The data indicate that there is considerable variation in ABA values from samples of the same lithologic unit. This is a result of variations in both carbonate and pyrite content of the samples. Caution must therefore be exercised when dealing with these units. Although there are exceptions, averages suggest that most phyllites are acid generating and argillite units are acid neutralizing. The results from surface production rock disposal sites indicate a moderate acid generating potential (KGCMC 1994.) Limiting flow through these materials will help reduce the likelihood of acid generation.

The net acid generation (NAG) test is another form of static test that enables identification of potentially acid generating materials. It is an eight hour test that involves reaction of the crushed sample with hydrogen peroxide and tracking the pH of the evolving solution with time. The hydrogen peroxide oxidizes available sulfide, liberating hydrogen ions, which in turn reacts with neutralizing phases within the rock. If there is enough available neutralizing material within the rock, the solution will not generate acid. Since this method can substantially reduce ABA data lead times, KGCMC may incorporate this method into its production rock handling and characterization practices if such change may improve the production rock management system and is approved by the Agencies. Development of this method supports the KGCMC objective of visual identification of potential ARD sources.

2.3.2 Kinetic Testing

The purpose of kinetic testing is to evaluate how materials behave under controlled weathering conditions. This enables generalized prediction of whether acidification will occur and to what extent metals are released during the weathering process. There are two basic types of kinetic tests. Humidity cell tests, which involve drawing humidified air through the material followed by successive weekly flushing, are aggressive weathering tests. Column tests require percolation of distilled water through a large column of material under more steady state conditions than the humidity cell tests. The column tests are run for a longer time interval (up to 2 years rather than 20 weeks for the humidity cell tests) and more closely simulate field conditions. Leachate from both tests are analyzed periodically for a range of water quality parameters.

Kinetic tests (column tests) performed by B.C. Research (Vos 1993, 1994) indicate that none of the production rock composites tested produce acidic drainage under conditions modeled in the test. Testing of the phyllite unit was extended and included an attempt to generate acidic leachate by removing 10% of the neutralization potential of the material via temporary acidification and bacterial inoculation. The material did not generate acidic drainage and indicated that under the test conditions the onset of acidic drainage would require more than 10.9 years. Although it is impossible to replicate field conditions exactly, an effort was made to match expected flow parameters. Material used in the kinetic tests was also sieved to match the run-of-mine size distribution of the two inch minus fraction. The materials did liberate zinc in concentrations significant enough to warrant attention with respect to water quality assurance practices. Although the argillite units show significant acid consuming potential, the kinetic test indicates that the material is capable of producing effluent with elevated zinc, sulfate and conductivity. This reflects the presence of readily soluble salts, some of which contain significant quantities of zinc. Limiting water flow through the material is one way to limit zinc mobility as well as acid generation.

Interpretation of the kinetic test results requires an in-depth look at the materials, conditions, methods and assumptions used in the tests. Although such review is recommended, it is beyond the scope of this document, and the reader is referred to the following reports for more information:

"Weathering Characteristics of Waste Rock from Admiralty Island Deposit", Vos, 1993.

"Acidification of Siliceous Waste Rock from Admiralty Island Deposit", Vos, 1994

In 1994 KGCMC drilled and sampled several surface production rock disposal sites to better define site specific material composition and weathering characteristics (KGCMC 1994.) As stated above the results indicate a moderate average net acid generation potential of surface materials deposited on the surface to date. Distribution of potentially acid generating material is not homogeneous as there is a considerable range in NNP values for each site. Local production rock acidification was encountered in areas where significant surface water infiltration into potentially acid generating material occurs.

The amount of readily soluble metals in surface samples was determined via shake flask extraction test. The test involves swirling 200 g of uncrushed material in 400 ml of distilled water for 24 hours and measuring the resulting water quality parameters of the 0.45 micron-filtered effluent. The results indicate that samples that have undergone acidification produce metals, sulfate, conductivity and acidity significantly higher than samples that have not undergone acidification. Less than 15% of the material sampled showed significant signs of acidification. Best management practices should include limiting water infiltration into the material and limiting placement and exposure of large areas of high permeability-high acid generation potential production rock.

3.0 PRODUCTION ROCK MANAGEMENT

Kennecott Greens Creek Mining Company will manage active production rock areas as an operational segment of the Mine Department. Management responsibility will transfer to the Environmental Department upon completion of closure activities.

3.1 Management Objectives

Kennecott Greens Creek Mining Company will manage all Production Rock Areas to maintain pile stability and water quality standards while planning for a return of the land to natural use. The Company will achieve its management objective by employing proven practices, building on methods developed through on-site experience and establishing techniques and/or procedures matched to the unique geochemistry and climatic combination of the local (Greens Creek) environment. The following represents a partial listing of management focus as related to the stated objective:

Management Objective	Approach used to meet objective
Geologic modeling, laboratory work and employee training to support visual identification;	Geological modeling was not useful in classification of headings because of the spatial variability of the system. Modeling will be used to estimate production rock tonnages for new ore zones. For operational production rock management, visual classification and periodic sampling and analysis will be used instead.
Underground visual identification and mechanical sorting to reduce acid generating potential;	Refer to Section 3.2.
Elimination of subsurface water from entering in-place production rock;	Refer to the site-specific management plan, Attachment B, for Site 23.
Elimination of run-on surface water (diversion ditches);	Refer to the site-specific management plan, Attachment B, for Site 23.
Routing of rainfall off the site using compacted, lined bench drainage channels;	Refer to the site-specific management plan, Attachment B, for Site 23.

Placement of production rock to limit localized concentrations of potentially acid generating or metals leaching rock;	Section 3.3.1, subsection titled "Production Rock Numerical Classification System".
Limestone placement and alternative treatment testing to improve geochemical stability through proven encapsulation techniques;	Limestone has been used selectively for controlling acidic conditions. It is not used widely. Refer to Section 3.4.2, subsection titled "Acid Rock Drainage and Metals Leaching Monitoring", on the selective handling and encapsulation techniques used.
Compaction of production rock as it is placed to limit infiltration and enhance stability;	Refer to the site-specific management plan, Attachment B, for Site 23, Section 2.2.6.
Sediment control followed by reclamation efforts including topsoil/till cover placement and a longer term revegetation program;	The sediment control program is described in Appendix 10, and the reclamation program is discussed in Appendix 14.
Sound observational and monitoring procedures to ensure engineering approach;	Refer to Section 3.2 regarding the ID Team.
Planning and placement records to facilitate and improve decision making; and	Records maintained in an orderly fashion and submitted to Agencies in annual reports.
Interdisciplinary technical and operational resources to support production rock management.	Refer to Section 3.2 regarding the ID Team.

3.2 Underground Geochemical Sampling and Classification

Common management practices apply to all active production rock placement areas and sources. KGCMC will utilize an interdisciplinary team (IDT) to support production rock area operations and management. The IDT will have representation from each of the following areas:

- Mine Operations;
- Mine Geology;
- Environmental Geology/Engineering;

- Environmental Regulation;
- Hydrology;
- Geotechnical Engineering;
- Surface/Civil Engineering; and
- Fixed Plant Maintenance.

The IDT will meet on a quarterly basis to review production rock area plans and performance.

Production Rock Source Characterization

Discussion of existing production rock characterization at the Greens Creek Mine is provided in Section 2.2. The purpose of this section is to define the procedures for ongoing characterization of production rock sources. Two kinds of characterization programs are described, one for exploration targets, and one for development headings advanced during mining (Section 3.3.1). For exploration targets, modeling techniques are employed for predictive characterization. Face monitoring procedures are used to classify production rock associated with the active mine headings.

Exploration Targets - Geologic Modeling

Greens Creek utilizes a computer modeling format for definition of in situ mineral inventory. The pedigree of the ore reserve reporting has to meet Securities and Exchange Commission (SEC) requirements and more stringent in-house requirements. The results of modeling the Greens Creek ore deposit with the geologic and economic complexities exhibited at Greens Creek provides the operation the flexibility to change cutoff grades and economic criteria at any time. Greens Creek utilizes several software packages to assist in the modeling process including: Datamine™, AutoCAD, and Microsoft Excel™. Geologic block modeling involves geologic interpretation of a mineralized envelope based on recognizable ore lithologies. Ore lithologies are manually interpreted on 100 ft spaced cross-sections or wider cross-sectional spacings pending drill coverage throughout distinct ore zones. Once the manual geologic crosssection interpretation is complete, the sections are digitized in AutoCAD. From digitized cross-sectional drawings the mineralized envelope is projected to plan sections generated on 10 to 15 ft mining lifts. The geologic mineralized envelope is then reinterpreted and digitized on the mining lift spacing.

Once the digitizing is complete the block modeling process begins. Due to the polymetalic characteristics of the Greens Creek ore and four payable metals in three concentrates, 11 elements are modeled then rolled up into a final net smelter return (NSR) block model for reporting, development and scheduling scenarios. Block modeling methodology will be applied to production rock modeling, acid base accounting and development scheduling.

Based on distinct modeled variables, grades of in situ metal content are interpolated through ordinary kriging in the mineralized envelope to generate NSR roll up sections and plans at certain cutoff grades relative to volume. From this delineation of economic criteria, development design and engineering can commence. The engineered development layouts are drafted in plan and section and scheduled by month and by year. Forecast of development rock volumes can be predicted utilizing historical rates of advance. The resulting mine development schedule can be utilized to account for specific volumes of production rock and the prediction of production rock lithologies based on geologic interpretation. Upon completion of engineered as-builts, the information is projected to section. KGCMC will sample select lithologic intervals of drill core intersecting or in close proximity of proposed mine development. Additionally, an envelope of 50 ft diameter is drawn around the proposed development as a restriction to search ellipsoid and subsequently restrict the kriging to a production rock envelope. The methodology, used to estimate in situ mineral inventory, also applies to production rock chemical characteristics. The only modifications are assay elements, compounds and mathematical derivatives. Results from this geostatistical approach to production rock modeling are derivation of NNP and physicochemical characteristics by distinct lithotype. The forecast information supports forward planning of placement strategies and mitigation of ARD potential.

Refer to Figures 2, 3, and 4 for the following: examples of the geologic interpretation and geometry of distinct ore types; gross geologic interpretations of the contact between stratigraphic footwall rocks (phyllite) and stratigraphic hangingwall rocks (argillite); proposed development in plan and long-section; projections of the development to the geologic cross-sections and visual relationships to the trace of drill holes and lithotype designation.

Exploration Targets - Geologic Sampling, Acid Base Accounting

As stated above, samples for Acid Base Accounting (ABA) analysis and characterization will be selected and composited by lithotype from selected drill core, where proposed development drifting and the 50 foot diameter sphere intersects or is immediately adjacent to diamond drill hole traces.

Samples of whole core (NQTK, 1.88") will be collected from predetermined locations and composited by lithology. Select intersections of core will be taken when representative of global characteristics relative to Greens Creek internal definition of that specific rock type. The objective is to characterize the physiochemical characteristics of distinct lithologic units through qualitative versus quantitative analysis. Static ABA analysis will be performed by reputable and industry acceptable laboratories, such as CESL, B.C. Research and ACME Analytical all of Vancouver B.C., Canada. CESL will be the primary lab for production rock characterization and ABA. Quality control analysis will be performed by an internal Kennecott lab (USEPA Approved) located at Utah Copper Division near Salt Lake City, Utah. KGCMC lab facilities will support qualitative data development. QA/QC procedures will entail backup analysis to visual and chemical spot tests. Correction factors will be applied to original estimates once the data base is of sufficient size to achieve reliable statistics. Data retention and statistical analysis will be downloaded and accessed from a Microsoft Access™ database.

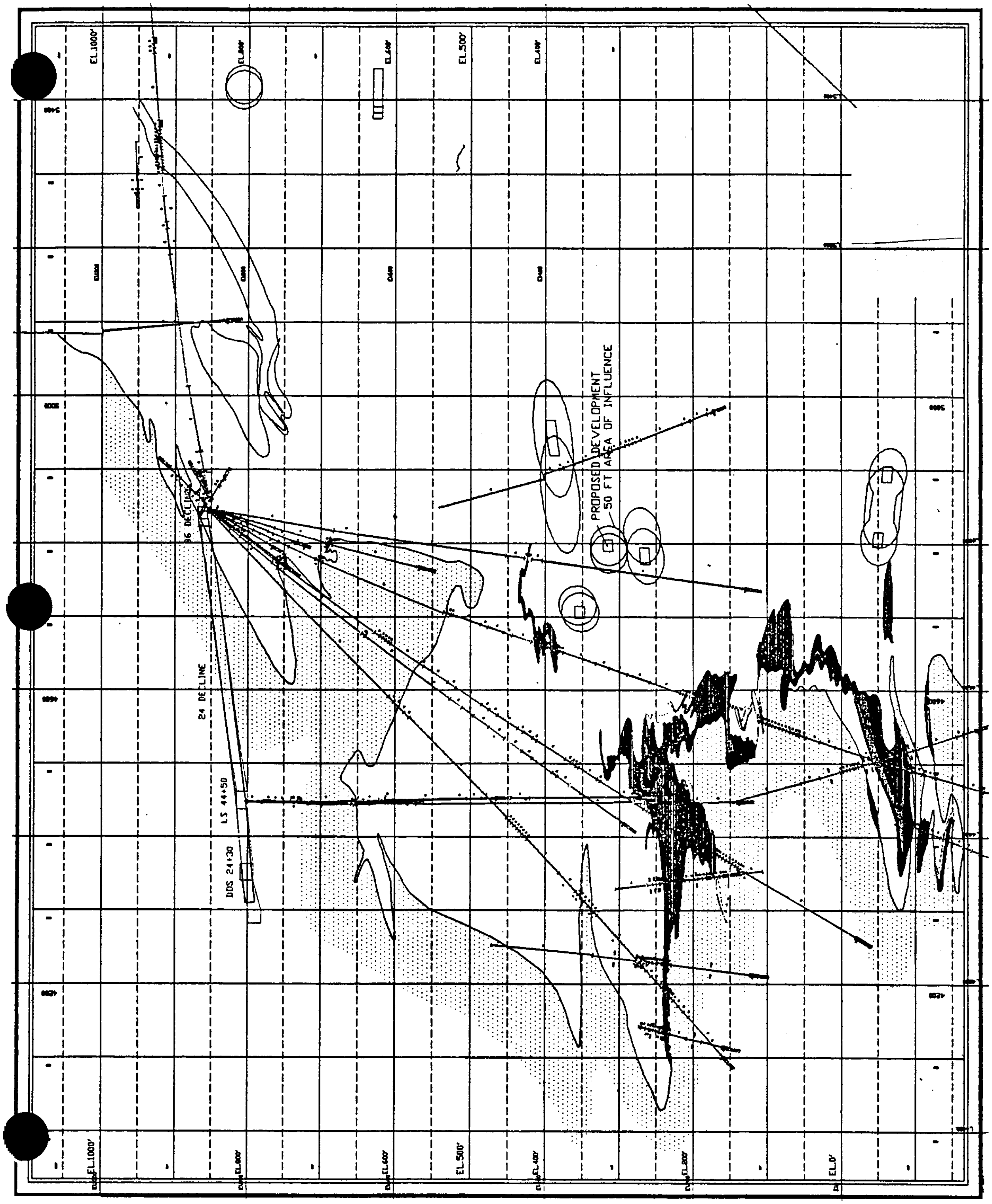


Figure 2. Geologic Interpretation

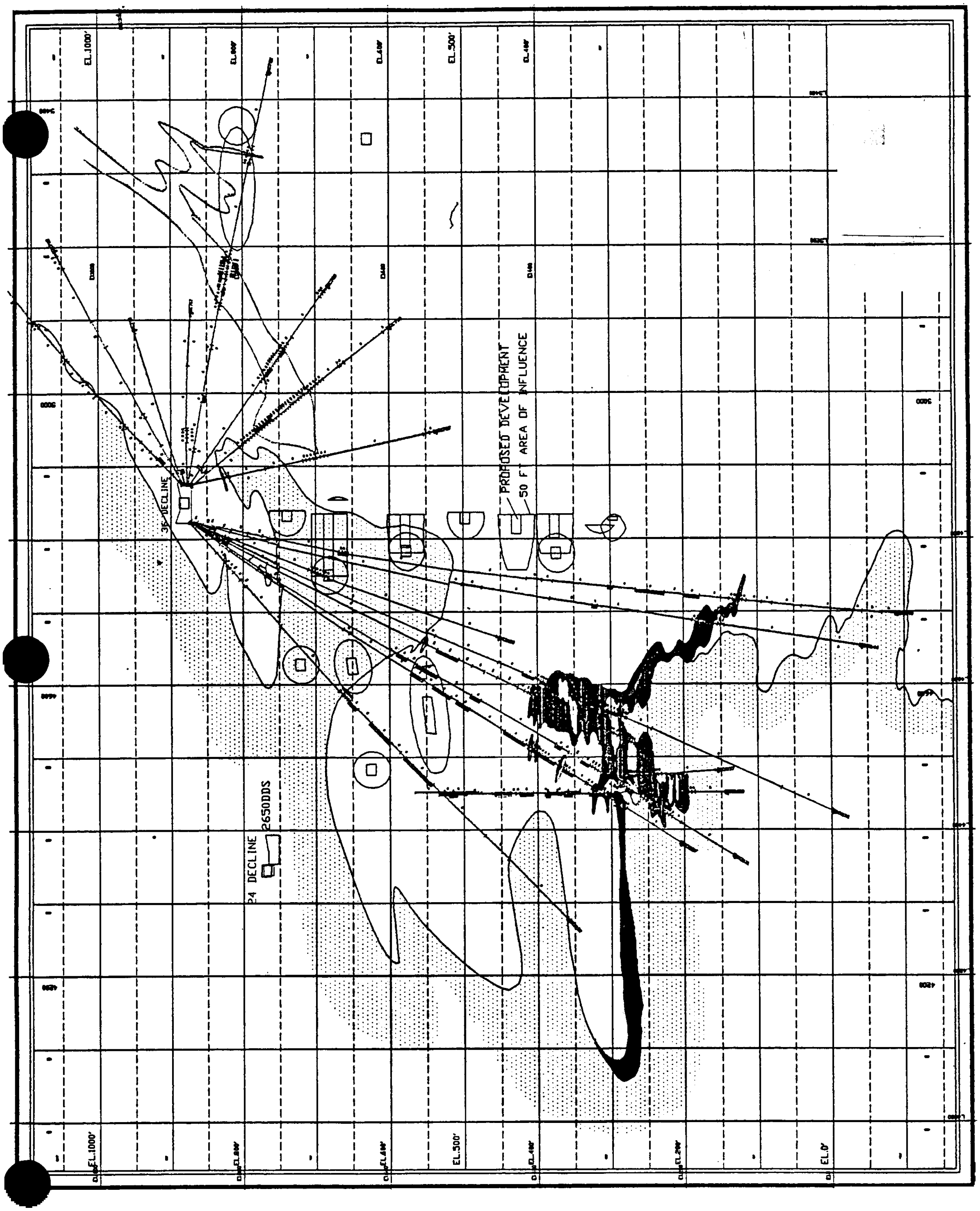


Figure 3. Geologic Interpretation

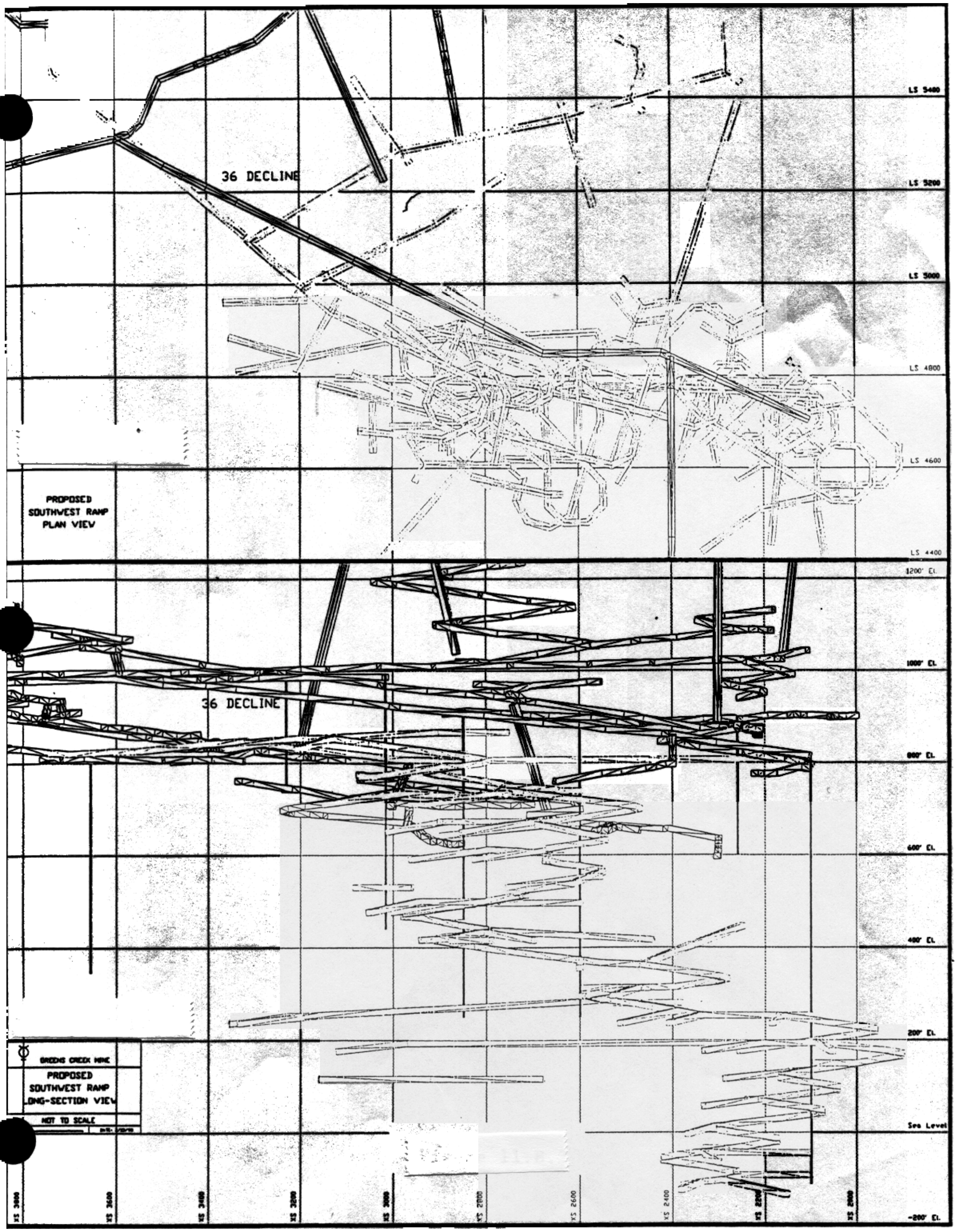


Figure 4. Proposed Development Plan and Section

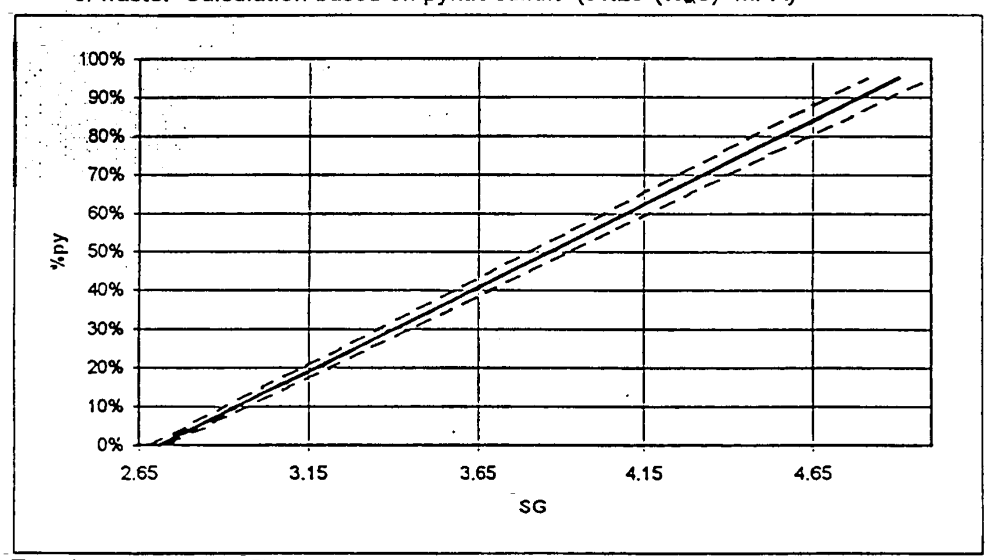
phase	SG
pyrite	5.02
gangue	2.71

Mineral	SG(g/cm³)
	2

Mineral	SG(g/cm³)

Modal%			wt%		wt%		Estimated
%py	%gangue	SG	%py	%gangue	$\%Fe_{py}$	$\%S_{py}$	MPA*
0%	100%	2.71	0%	100%	0%	0%	-
5%	95%	2.83	9%	91%	4%	5%	148
10%	90%	2.94	17%	83%	8%	9%	285
15%	85%	3.06	25%	75%	11%	13%	411
20%	80%	3.17	32%	68%	15%	17%	529
25%	75%	3.29	38%	62%	18%	20%	638
30%	70%	3.40	44%	56%	21%	24%	739
35%	65%	3.52	50%	50%	23%	27%	834
40%	60%	3.63	55%	45%	26%	30%	923
45%	55%	3.75	60%	40%	28%	32%	1,006
50%	50%	3.87	65%	35%	30%	35%	1,085
55%	45%	3.98	69%	31%	32%	37%	1,159
60%	40%	4.10	74%	26%	34%	39%	1,228
65%	35%	4.21	77%	23%	36%	41%	1,294
70%	30%	4.33	81%	19%	38%	43%	1,356
75%	25%	4.44	85%	15%	39%	45%	1,415
80%	20%	4.56	88%	12%	41%	47%	1,472
85%	15%	4.67	91%	9%	43%	49%	1,525
90%	10%	4.79	94%	6%	44%	50%	1,576
95%	5%	4.90	97%	3%	45%	52%	1,624

MPA=Maximum potential acidity in tons $CaCO_3$ equivalent per 1000 tons of waste. Calculation based on pyritic sulfur. (31.25*(%[illegible]S)=MPA)



Error bars based on 5kg sample and a ±20g error in weighing

Figure 5. Estimated Maximum Potential Acidity

3.3 Operations

Operations include all production rock handling activities, from source to placement.

3.3.1 Mine/Geology Operations

The practices outlined for mine and geological operations have been developed to provide greater control of production rock on a classified basis. The underground practices will be common to all active production rock placement areas.

Review of Geologic Classification

During a third party review of the production rock geochemical test results, SMI (2000) suggested that additional samples be collected for analysis of the rock classification scheme. In order to fulfill this requirement, an additional 100 channel samples will be collected underground. For each sample the following information will be recorded: location, date, lithology, alteration, estimated distance from ore zone, estimated pyrite, and estimated classification. Samples will be crushed and submitted for analysis of paste pH, modified Sobek static test (as has been used for 1994 and 1999 grab samples), whole rock assays for total zinc, lead, and iron, and net acid generation pH.

After compilation and review of all existing and new geochemical data, a brief interpretive report will be assembled that considers revision of the production rock classification program so that:

- fewer rock types are classified,
- the sampling and classification program is simplified,
- the secondary shell of Type 2 production rock in Site 23 is eliminated,
- production rock with negative NNP values are retained underground to the extent practical.

The sampling program will be completed by July 1, 2001. A report will be submitted to the USFS and ADEC for review. At the same time that the interpretive report is submitted, a revision of this Appendix that contains modifications to the relevant sections regarding geochemical sampling and classification will also be submitted to the USFS and ADEC for their review, comment and approval.

Development Monitoring Practices

Greens Creek mine geologists will inspect each active development at least weekly when expecting or entering new lithotypes. Data is collected on lithotype, modal percent pyrite, pyrite morphology and textures, basic gangue mineralogy and structures such as foliation planes and faults/shear/joint planes are mapped. Once per week a measurement is taped-off from a surveyed spad point. The data is entered into a database utilizing the software Microsoft Access™. Tonnage estimates for each heading based on haul truck counts and drift as-builts are entered in the database. Formatted excerpts from the database are forwarded to the chief geologist, environmental geologist, surface engineering and are posted outside the mine foremen's office on a daily basis.

Visual Inspection and Drift Sampling

Estimates of pyrite content are based on visual modal percentages. The modal percentages are checked by comparing the hypothetical specific gravity of a rock with X% of pyrite and 100%-X% of gangue with an average specific gravity of 2.71. Figure 5 lists the corresponding wt. % pyrite, pyritic Fe, pyritic sulfur, hypothetical NNP based solely on pyritic sulfur and estimated SG for pyrite contents ranging from 0-95%. Figure 5 also shows a graph of the specific gravity-% pyrite relationship along with estimated possible errors related to sample weight.

Volumetric carbonate abundance is estimated by visual inspection. Weight percent carbonate is estimated by a one-to-one conversion from modal percent estimates since the specific gravities of the typical carbonate species found at Greens Creek range from 2.7 to 2.9. Carbonate chemistry is qualitatively determined by color changes in the dye. With current staining techniques, variations between calcite, dolomite, ferro-dolomite and ankerite are noted. See Hurlbut & Klein (1977) for details on carbonate solid solution chemistry.

On a bimonthly basis representative chip-samples taken from the rib representing monthly development are characterized by lithology are taken for standard ABA, whole rock and ICP analysis. Tonnage estimates are calculated from a polygonal estimate made from a surveyed plan as-built. These tonnage estimates are reconciled with tram tonnages. NNP values are calculated on a monthly basis from the chip sample analysis. The visually estimated AGP and ANP values based on visual classification are reconciled with actual analyzed values and reported to the USFS and ADEC annually.

Mine Geology Reporting

Monthly reports are issued summing total tons of production rock and corresponding NNP values. Active production rock placement areas will be surveyed and plotted on a monthly basis. Actual truck count to each active placement area will be recorded, total truck count will be subdivided into trucks per each of the KGCMC numeric classifications.

Production Rock Numerical Classification System

A numerical production rock classification system, which is based on visual inspection of physical and mineralogical characteristics, is described with placement guidelines below.

Class (1): This material has a NNP > 100 tons $CaCO_3$/1000 tons. No special handling is required.

Class (2): This material has a NNP value between 100 and -100 tons $CaCO_3$/1000 tons and will be placed at least five feet from final pile surfaces.

Class (3): This material has a NNP value between -100 and -300 tons $CaCO_3$/1000 tons. It will be placed at least 10 feet from final pile surfaces.

Class (4): This material has a NNP value less than -300 tons $CaCO_3$/1000 tons and will be kept underground as fill.

Production rock classification will be communicated utilizing a combination of four methods: (1) the mine geologist will physically mark the face or muck pile with the classification number; (2) verbal communication with underground operations foreman, shifters and miners as to production rock classification for each heading inspected; (3) placement of signs on the production rock pile designating appropriate placement areas; and (4) written communication to the surface operations foreman reflecting any changes to documented handling procedures for each classification.

3.4 Monitoring

Monitoring of production rock placement areas will be conducted to confirm the following:

- The site is constructed according to the existing approved construction plans;
- The site is maintained in a stable condition over the short and long term;
- The site is stable;
- Water management system components are effective and maintained in a stable condition;
- Geochemical and hydrologic processes are defined through internal environmental monitoring to consist of measurement of flow and chemistry of internal stations, evaluation of the performance of engineered covers, and formulation of a mass load model for the facility,
- Water quality objectives outlined in the General Plan of Operations - Appendix 1, Freshwater Monitoring Plan are met.

Additional monitoring requirements that are specific to Site 23 or inactive production rock piles are contained in Attachment B and C respectively.

3.4.1 Stability

Monitoring actions will consist of visual observations, piezometer data, and survey data. After the site reaches its final approved design capacity, regular site monitoring will continue by the mine staff or an approved geotechnical consultant until the the site is determined to be stable and monitoring is no longer needed.

Visual Observations

KGCMC will conduct a visual inspection of the active sites once per month looking for cracks, bulges, and signs of stress. When appropriate, photographs of the site will be taken. KGCMC will maintain a written record of inspection findings. In addition, equipment operators working at the site will make frequent, regular visual observations during the course of their work at the site to check for cracks, signs of distress, or production rock and soil movement. Records of these inspections will not be maintained and will be submitted to the USFS and ADEC annually.

3.4.2 Water Quality, Water Management System, Reclamation, and Acid Drainage Monitoring

KGCMC's General Plan of Operations - Appendix 1, Freshwater Monitoring Plan establishes the protocols for freshwater monitoring. The water monitoring objectives for production rock sites include: assurance that appropriate water quality standards are met, ARD activity and management approach are assessed, metals leaching activity and management approach are assessed, and closure plans remain consistent with field conditions/observations. Data trends will assist overall site management plan direction and development. See GPO Appendix 1 for site summary sheets and monitoring requirements.

Acid Rock Drainage and Metals Leaching Monitoring

KGCMC will continue to assess conditions relative to ARD and metals leaching. Programs similar to the 1994 investigations at Area D, the 1994 surface drilling program, global site reconnaissance, the alternative treatment testing approved for the mill backslope in 1995, and the third-party ARD and metals leaching review conducted in 1999 will be developed as specific objectives require. KGCMC will continue to participate in ARD and production rock forums and will retain staff with responsibilities specific to production rock management.

The NNP and paste pH values of production rock will be measured annually to insure that material is placed in the proper zone within the rock pile, and to insure that acidification processes have not been triggered during operations. The operational geochemical sampling program is described in Section 4.2 of Attachment B, the site specific monitoring plan for Site 23, and in the Attachment C, Inactive Site Monitoring and Maintenance Plan.

Monitoring Reports

In April each year, KGCMC will submit an annual report on the production rock sites to the Forest Service, and ADEC. These reports will provide:

- An as-built topographic survey of active sites;
- A running total of production rock placed on active sites and a current remaining volume estimate;
- A summary of piezometer readings from all monitored production rock sites;
- A summary of key observations, problems, and corrective actions resulting from visual inspections, observations, and other monitoring activities;
- A closure status report for each inactive site; and
- Freshwater reports will be as established in the Freshwater Monitoring Plan.

The annual reports will also contain the following information when applicable: a survey of the sediment pond(s) and site maintenance recommendations, including the cleanout of accumulated sediment from the sediment settling pond, estimates for surface production rock placement, underground backfill placement, overburden stripping and capping volume estimates for the upcoming year. Actual and forecast volumes will be reconciled after the first year.

3.5 Site-specific Management Plan

Each production rock placement area is subject to the KGCMC common management practices. In addition each site will have a specific O&M plan to identify protocols, procedures and/or monitoring locations specific to the site (Attachment B and C).

3.5.1 Objectives

Site specific O&M Plans are developed to meet the following objectives:

- Conform to approved construction plan(s)/drawings;
- Development of monitoring frequencies based on individual site performance; and
- Individual construction and reclamation bond maintenance.

3.5.2 Plan Development

Production rock management is an evolving science. Utilization of site specific O&M plans incorporates the ability to modify and/or update individual site procedures to meet site specific objectives within the context of the GPO. Site specific O&M plan updates are subject to Forest Service approval.

3.6 Management Plan Implementation

The achievement of management objectives set forth by KGCMC to minimize ARD and/or metals leaching potentials will depend significantly on employee training and commitment. KGCMC will incorporate ARD awareness in our standard task training format and will require employees to complete the program to be certified as a dump operator.

3.6.1 Training Objectives

Training program objectives include:

- Development of visual identification capabilities;

- Improved communications;
- Understanding of ARD potentials and liabilities; and
- Continual improvement of placement practices.

3.6.2 Training Programs

KGCMC will develop a 4-hour training course for potential production rock dump operators. Employees must complete the course prior to operating equipment on the dump. Dump operators will be required to complete 2 hours of refresher training on an annual basis to maintain certification. The surface foreman will maintain and have training records available for inspection. Records will be retained in the employee's training file. Training program content will focus in the following areas:

- ARD Process;
- GPO - Appendix 11;
- Practical Rock Type Identification; and
- Case Studies (Favorable and Unfavorable).

4.0 FORMS

4.1 Mine Development Face Inspection Form

P.2/2

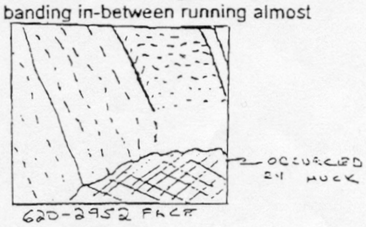
Greens Creek Mining Company
Memorandum

20-Mar-95
SUBJECT: Underground Development Headings
FROM: Geologist -TH / DA / KL

Heading: 37decline
Lith: SP **pyrite:** 4%
Comments: Clean face/RTD. Well foliated, gray, sericite + carbonate ± mariposite ± (leucoxene) phyllite. Pyrite occurs as fine-grained disseminations within sericite rich zones as well as 2-3 cm semi-massive bands and cross-cutting veins. Moderate amount of white-quartz-carbonate veining.

Heading: 37incline
Lith: SP **pyrite:** 6%
Comments: Clean face/ bolting. Well foliated, gray, sericite + carbonate + mariposite + (leucoxene) phyllite. Minor Pb/Zn mineralization present as noted on Friday.

Heading: 620-2952
Lith: SA pyrite: 1%
Comments: Clean face/ RTD. Similar to previous faces with mostly broad-spaced bedding dipping to the west at ~70° W along with several thin slickensides with minor gouge. Also a distinct pair of thin-gougy shears dipping at 65°W with banding in-between running almost horizontally. (See sketch)



Heading: 840-3150
Lith: DSA pyrite: 15%
Comments: Clean face/ RTD. Well banded pyritic-DSA with medium-grained pyrite as disseminations, clots and bands up to 4 cm wide.

Heading: 830-2948
Lith: SA **pyrite:** 3%
Comments: Fresh muck pile. Well banded, graphitic, dolomitic slaty argillite. This lithology has been variously logged as DSA or SAcb in DDC. The is more appropriate here due to the lack of pyrite, sericite and silica. ? SA ?

Heading: 37ramp
Lith: SA **pyrite:** 5%
Comments: Clean face/RTD. Same face as Friday.

11-35

5.0 BIBLIOGRAPHY

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KENNECOTT GREENS CREEK MINING COMPANY
GENERAL PLAN OF OPERATIONS

APPENDIX 11
ATTACHMENT A
TABLES

Table 1. Argillite Units

Argillite Units		
Litho Type	Alterations	Fabrics
SA	Cb	g
MA	S	f
DSA	Sr	x
DMA	Cx	
CHT		

Table 2. Phyllite Units

Phyllite Units		
Litho Type	Alterations	Fabrics
SP	cb	g
SR	s	f
DG	c	x
SC	t	cx
CR		
MP		

Table 3. Summary of ABA Units

	Phyllite Units			Argillite Units			Prod. Rock Sites		
Analyses	52			21			102		
tCa CO_3/kt	AGP	ANP	NNP	AGP	ANP	NNP	AGP	ANP	NNP
Minimum	13	41	-603	31	13	-237	5	8	-631
Maximum	719	535	363	250	651	595	657	529	417
Average	269	161	-109	91	383	292	169	131	-34