Klohn Crippen Berger

Resolution Copper Mining LLC

Resolution Copper Project

DEIS Design for Alternative 3A
Near West Modified Proposed Action
(Modified Centerline Embankment - "wet")

Doc. # CCC.03-26000-EX-REP-00002 - Rev. 0

M09441A20.734

June 2018

Klohn Crippen Berger

June 8, 2018

Resolution Copper Mining LLC
P.O. Box 1944
Superior, Arizona
85273

Ms. Vicky Peacey
Senior Manager – Permitting and Approvals

Dear Ms. Peacey:

Resolution Copper Project
DEIS Design for Alternative 3A - Near West Modified Proposed Action
(Modified Centerline Embankment - "wet")
Doc. # CCC.03-26000-EX-REP-00002 – Rev. 0

We are pleased to provide the Environmental Impact Statement (DEIS) Design for the Tailings Storage Facility (TSF) Alternative 3A - Near West Modified Proposed Action (Modified Centerline Embankment) for the Resolution Copper Project.

Yours truly,

KLOHN CRIPPEN BERGER LTD.

Kate Patterson, P.E., P.Eng., M.Eng.
Associate, Project Manager

KP:dl/jc

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M09441A20.734

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Near West Modified Proposed Action
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Doc. # CCC.03-26000-EX-REP-00002 - Rev. 0

EXECUTIVE SUMMARY

Resolution Copper Mining LLC (RC) is proposing to develop the Resolution Copper project (the Project), an underground copper mine, using the block cave mining method. The mine site is approximately two miles east of the town of Superior in the Pioneer Mining District, Pinal County, Arizona. The project mine plan includes generation of approximately 1.37 billion tons (Bt) of tailings over a 41-year mine life.

The Tonto National Forest (the Forest) is currently in the "alternatives development" portion of the NEPA process which the Forest will use as a component of the Project's environmental impact statement (EIS). A number of tailings storage facility (TSF) alternatives are currently being assessed and will be included in the draft EIS (DEIS). This report presents Alternative 3A – Near West Modified Proposed Action (Modified Centerline Embankment – "wet").

Key elements of Alternative 3A are summarized below. East Plant Site infrastructure, panel cave mining, West Plant Site ore processing, slurry copper concentrate delivery to the filter plant, and other utility corridors would remain the same as currently described in the General Plan of Operations (GPO), which was submitted in 2016.

- The TSF would be located at the Near West site which is located within the Superior Basin entirely on Forest land, approximately 4 miles southwest of the town of Superior, and 4 miles south of the Superstition Wilderness Area. It is founded primarily on bedrock with localized deposits of unconsolidated alluvium confined to ephemeral drainages. The site is primarily used for livestock grazing, ranching, and road access to recreational areas. The Arizona Trail passes approximately ¾ mile east of where it follows Rice Water and Whitford Canyons into Reevis Canyon. Vegetation comprises mainly desert shrubs and cacti. The TSF would occupy the area of land bounded by Potts Canyon to the east, Roblas Canyon to the west and Queen Creek to the south.
- Alternative 3A would use a modified centerline raised compacted cycloned sand embankment, to enhance geotechnical resiliency and ability to handle operational upsets. The non-potentially acid generating (NPAG) scavenger (scavenger) tailings stream would be cycloned to create two products: cycloned (underflow) sand used to construct the embankment; and finer overflow tailings deposited into the TSF.
- Potentially acid generating (PAG) pyrite (pyrite) tailings would be discharged subaqueously from a floating barge or pipelines directly into the reclaim pond, to maintain pyrite tailings saturation during operations for the benefit of water quality.
- A pyrite tailings starter cell with an engineered low-permeability layer would be constructed for start-up, in order to maintain pyrite tailings saturation and limit seepage.
- Outside of the pyrite starter cell, a layer of low permeability tailings would develop along the foundation surface due to tailings self-weight consolidation. This would limit seepage into the foundation, supplemented with additional mitigation measures discussed below, as required.

- A series of mitigation measures intended to reduce downstream water quality impacts would be utilized, potentially including: selective engineered low-permeability layers; additional seepage collection dams; lined seepage collection ponds; slurry walls; pump back systems; stream diversion systems and cut-off walls. These mitigation measures and environmental protections will be refined between the DEIS and final EIS if this is the selected alternative.
- To reduce the potential for tailings spills, a modified tailings corridor utilizing a gently sloping route with no drop boxes would be incorporated into the design. There would also be no tunnels or at-grade crossings along the route. A cable stay bridge would be utilized to cross Potts Canyon and the Arizona Scenic Trail. A separate report is included for the Tailings Corridor design (RC 2016b).
- Pyrite tailings would be pumped to the TSF rather than flow by gravity to increase reliability and reduce potential for pipeline upsets (i.e. sanding of the lines) and associated spills.

The main benefits of Alternative 3A are:

- The use of a compacted cycloned sand embankment provides greater operational flexibility, robustness and geotechnical resiliency by creating a free-draining, compacted, non-liquefiable structural shell.
- Dust would be reduced by managing the scavenger beach “wet” via rotation of spigots.
- The adoption of a series of seepage mitigation measures further reduces impacts on downstream receptors.

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1 INTRODUCTION

1.1 General

Resolution Copper Mining LLC (RC) is proposing to develop the Resolution Copper project (the Project), an underground copper mine, using the block cave mining method. The mine site is approximately two miles east of the town of Superior in the Pioneer Mining District, Pinal County, Arizona. The project mine plan includes generation of approximately 1.37 billion tons (Bt) of tailings over a 41-year mine life.

RC submitted a General Plan of Operations (GPO) (RC 2016a) for the Project to the Tonto National Forest (the Forest). The subsequent issue of a Notice of Intent by the Forest (GPO 2016) triggered the beginning of the Forest's environmental analysis of the Project, in accordance with the National Environmental Policy Act (NEPA). The analysis will ultimately lead to the issuance of a Record of Decision on the Project by the Forest.

The Forest is currently in the "alternatives development" portion of the NEPA process which the Forest will use as a component of the Project's environmental impact statement (EIS). Klohn Crippen Berger Ltd. (KCB) has been commissioned by RC to prepare select tailings storage facility (TSF) designs to support the alternatives development process and the draft EIS (DEIS). The alternatives being considered are:

- Alternative 1 – No Action;
- Alternative 2 – Near West GPO Proposed Action (not to be considered further in the DEIS, but included for comparison);
- Alternative 3A – Near West Modified Proposed Action (Modified Centerline Embankment – "wet");
- Alternative 3B – Near West Modified Proposed Action (High-density thickened NPAG[1] Scavenger and Segregated PAG[2] Pyrite Cell);
- Alternative 4 – Silver King Filtered;
- Alternative 5 – Peg Leg Lined;
- Alternative 6 – Peg Leg Unlined;

Two additional Alternatives for review and consideration by the Forest are:

- Alternative 7 – Peg Leg, Combined; and
- Alternative 8 – Skunk Camp.

[1] The Forest use the term (Non-Potentially Acid Generating) NPAG tailings to refer to scavenger tailings described in the GPO (RC 2016a).
[2] The Forest uses (Potentially Acid Generating) PAG tailings to refer to cleaner tailings described in the GPO (RC 2016a), also referred to as pyrite tailings.

The scope of the Alternative 3A DEIS design is to provide a basis for comparing impacts from TSF alternatives. The design and report is tailored to meet the Forest's requirements for the EIS comparisons.

1.2 Key Elements of Alternative 3A

Key elements of Alternative 3A are summarized below. East Plant Site infrastructure, panel cave mining, West Plant Site ore processing, slurry copper concentrate delivery to the filter plant, and other utility corridors would remain the same as currently described in the GPO (RC 2016a), refer to Figure 1.1.

- The TSF would be located at the Near West site which is located within the Superior Basin, entirely on Forest land, approximately 4 miles southwest of the town of Superior, and 4 miles south of the Superstition Wilderness Area. After removal of recent sediments during site preparation, it will be founded on bedrock. The site is primarily used for livestock grazing, ranching, and road access to recreational areas. The Arizona Trail passes approximately ¾ mile east of where it follows Rice Water and Whitford Canyons into Reevis Canyon. Vegetation comprises mainly desert shrubs and cacti. The TSF would occupy the area of land bounded by Potts Canyon to the east, Roblas Canyon to the west and Queen Creek to the south.
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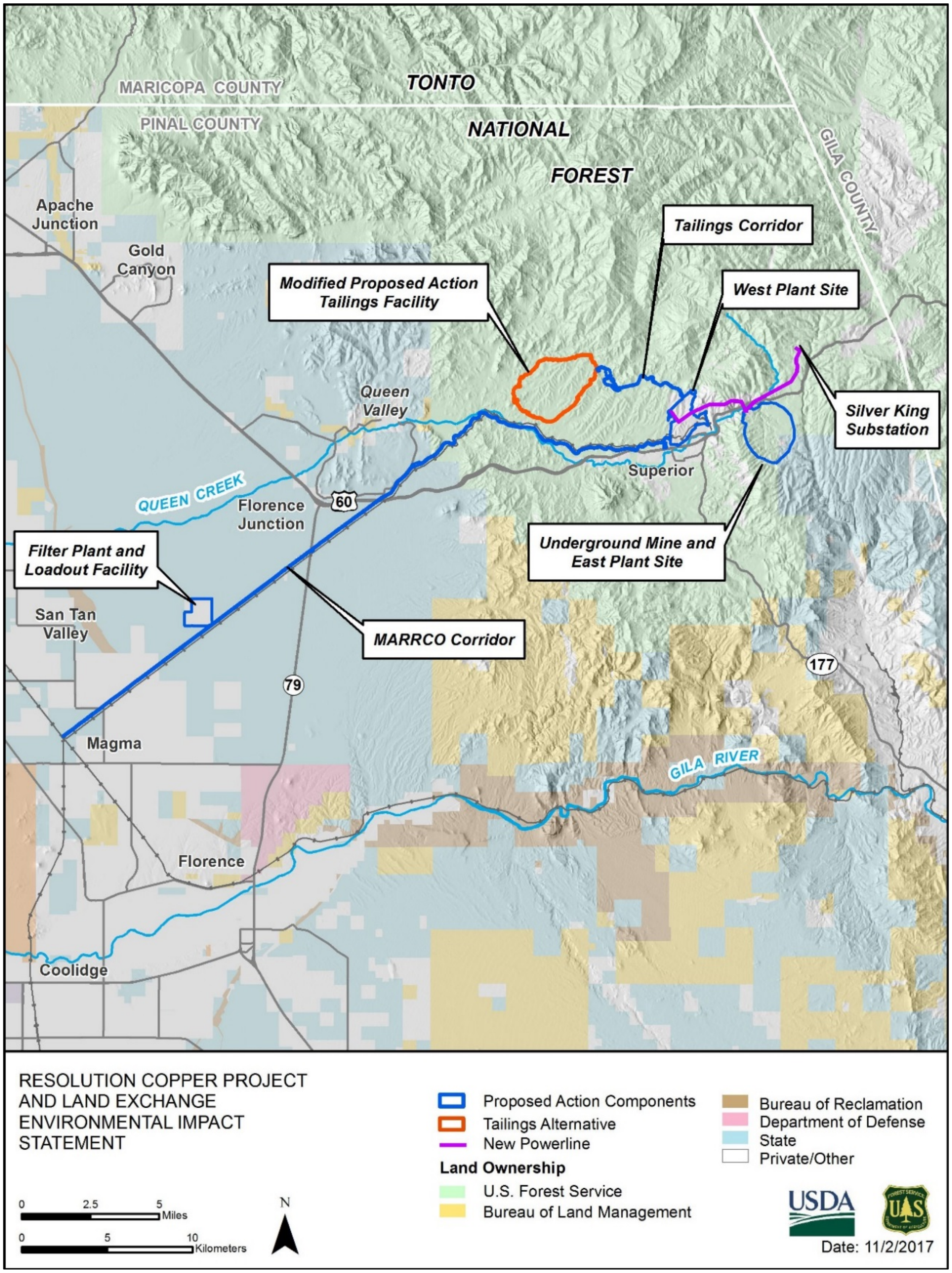
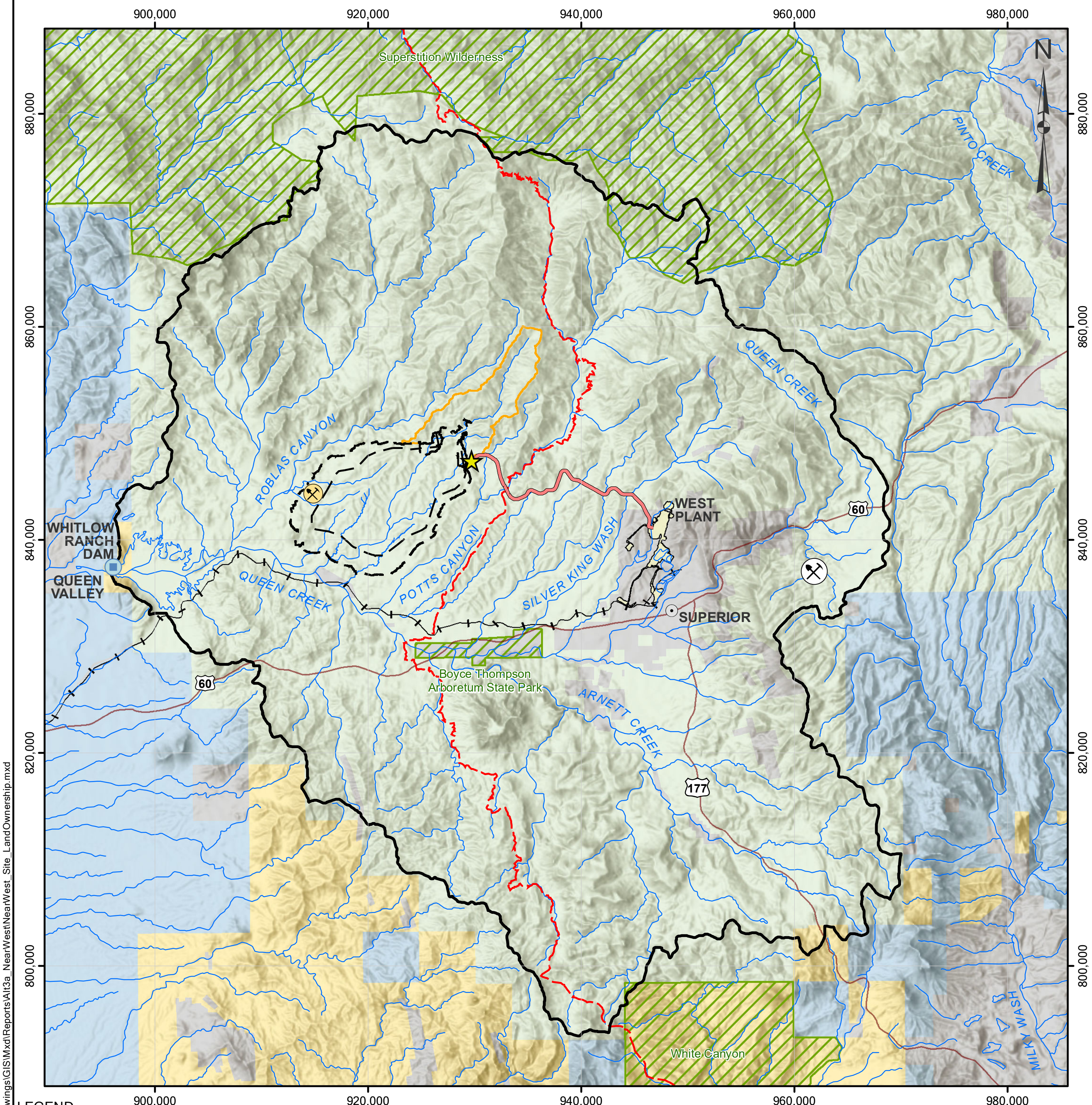
Potts Canyon and the Arizona Scenic Trail. A separate report is included for the Tailings Corridor design (RC 2016b).

- Pyrite tailings would be pumped to the TSF rather than flow by gravity to increase reliability and reduced potential for pipeline upsets (i.e. sanding of the lines) and associated spills.

Figure 1.1 Site Location and Land Ownership Overview





LEGEND

RESOLUTION OREBODY
ALTERNATIVE 3A: NEAR WEST TSF
TSF - WEST PLANT ACCESS ROUTE
SUPERIOR BASIN
TSF UPSTREAM CATCHMENT
WEST PLANT
CYCLONE HOUSE AND ACCESS ROUTE TIE-IN POINT
WILDERNESS AREA OR STATE PARK
ARIZONA NATIONAL SCENIC TRAIL (ARIZONA TRAIL)

WHITLOW RANCH DAM
OLD BOMBOY MINE
TOWN
HIGHWAY
RAILWAY
RIVER OR MAJOR DRAINAGE

LAND OWNERSHIP

BUREAU OF LAND MANAGEMENT
BUREAU OF RECLAMATION
COUNTY
INDIAN RESERVATION
LOCAL OR STATE PARKS
MILITARY
NATIONAL PARKS
PRIVATE
STATE TRUST LAND
STATE WILDLIFE AREA
UNITED STATES FOREST SERVICE

NOTES:
1. NAD83, ARIZONA STATE PLANE CENTRAL
2. HILLSHADE PROVIDED BY ESRI
3. LANDUSE FROM THE ARIZONA BUREAU OF LAND MANAGEMENT (1:100,000) CURRENT AS OF DEC 19TH, 2012.

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PROJECT
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DEIS DESIGN FOR ALTERNATIVE 3A - NEAR WEST MODIFIED PROPOSED ACTION (MODIFIED CENTERLINE EMBANKMENT)

TITLE
SITE LOCATION AND LAND OWNERSHIP DETAILS

PROJECT No.	FIG No.
M09441A20	1.2

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1.3 Previous Studies

There are several previous studies that are relevant to, and utilized in, the Alternative 3A design which include:

- The Alternative Portfolio for Alternative 3A (KCB 2018a) provides a high-level overview of the conceptual design. This document was produced before much of the modeling or analysis presented in this report were complete.
- An embankment design alternatives trade-off to identify the preferred embankment design (KCB 2017a).
- A subsurface site investigation (SI) that included drilling and pit trenches was completed at the Near West site in 2016/2017.
  - KCB prepared a geotechnical site characterization (KCB 2017b) based on the geotechnical information collected during the SI and subsequent laboratory testing
  - Montgomery and Associates (M&A) observed and documented the hydrogeological SI (M&A 2017a) and prepared a hydrogeological site characterization report (M&A 2017b).
  - Duke Hydrochem collected samples of foundation rock units from the SI and tested them for geochemical characterization to support solute transport modeling (Duke 2017a).
- Geochemical characterization of scavenger and pyrite tailings (Duke Hydrochem 2016 and 2017b).
- Site-specific seismic hazard assessment conducted by Lettis Consultants International, Inc. (LCI) in 2017 (LCI 2017).

Aspects of these studies are discussed in this report. Reference should be made to the original reports for further information.

2 SITE CHARACTERIZATION

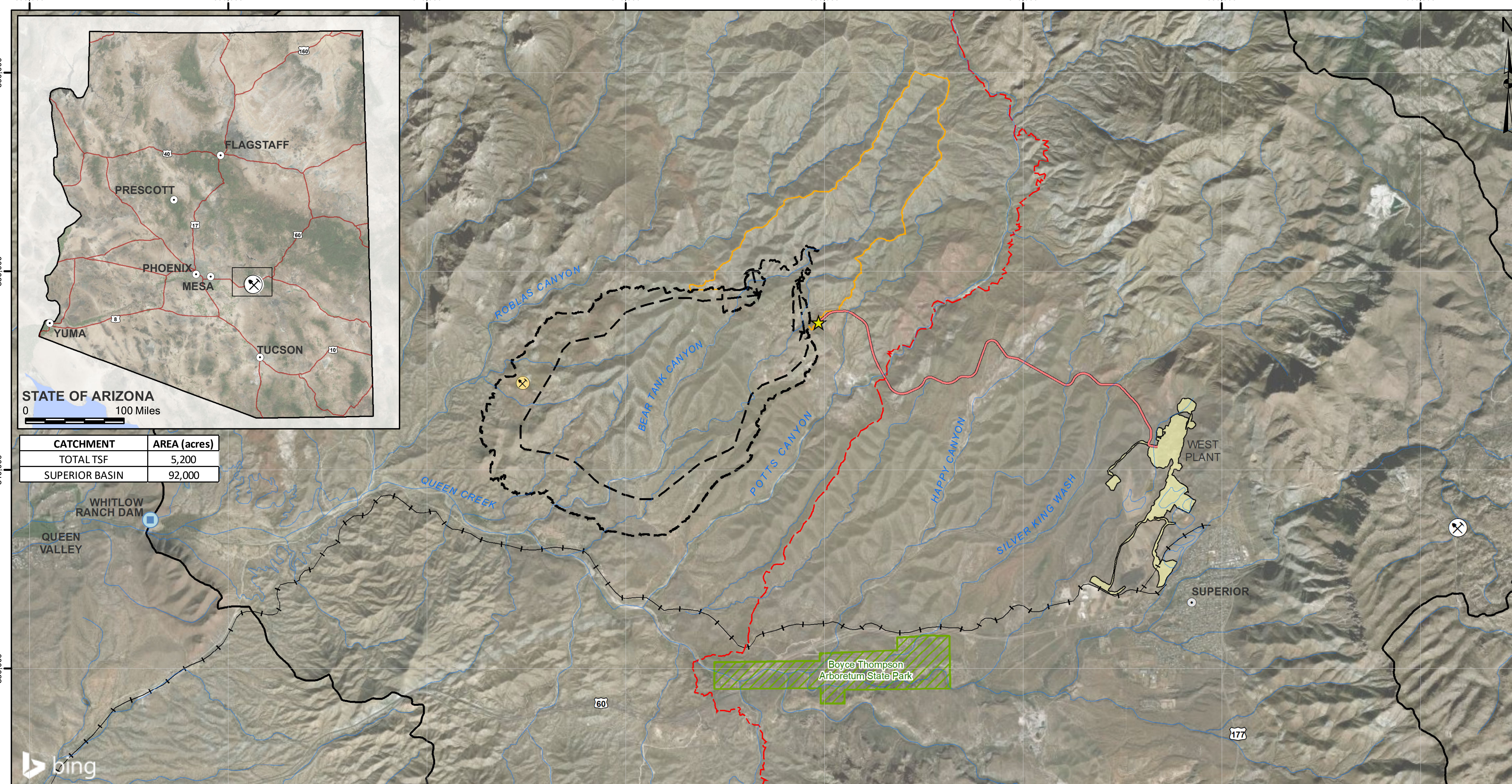
2.1 Setting & Topography

The Near West site is in the Superior Basin, which is drained by Queen Creek to the Whitlow Ranch Dam, refer to Figure 1.1 and Figure 2.1. The Superstition Mountains to the north of the site separate the site from the Superstition Wilderness Area.

The site is within the Basin and Range physiographic zone of Arizona (see Figure 2.2), near its northern boundary with the Central Highlands Transition physiographic zone, marked by the southern edge of the Superstition Mountains (Trapp and Reynolds 1995). The Basin and Range province is characterized by broad basins trending northwest-southeast, bounded by isolated mountain ranges composed of fault-block mountains formed during extensional faulting and crustal thinning (Rasmussen 2012). The Central Highlands Transition zone is a northwest trending escarpment marking the transition from the Colorado Plateau to the north with the Basin and Range province to the south. The Superior area is the northernmost extent of the Basin and Range province (Trapp and Reynolds 1995).

The Near West site is founded on a series of bedrock ridges and valleys up to 250 ft high, running north-south. The main valleys from east to west are Benson Canyon, Bear Tank Canyon and East Fork Roblas Canyon. The base elevation of the TSF area is approximately at 2,300 ft, and the northern extents rise up to 2,800 ft. The site is bounded on the east and west by Potts Canyon and Roblas Canyon, respectively, which reduces the size of the catchment area reporting to the TSF.

Within the TSF area, the valleys are ephemeral drainages, the bases of which are infilled with thin sand and gravel alluvial deposits. These streams flow north to south with slopes ranging typically from 3% to 5% and discharge to Queen Creek.



CATCHMENT	AREA (acres)
TOTAL TSF	5,200
SUPERIOR BASIN	92,000

LEGEND

- RESOLUTION OREBODY
- ALTERNATIVE 3A: NEAR WEST TSF
- TSF - WEST PLANT ACCESS ROUTE
- TSF UPSTREAM CATCHMENT
- WEST PLANT
- CYCLONE HOUSE AND ACCESS ROUTE TIE-IN POINT
- SUPERIOR BASIN
- WILDERNESS AREA AND STATE PARK
- WHITLOW RANCH DAM
- OLD BOMBOY MINE
- TOWN
- HIGHWAY
- ARIZONA NATIONAL SCENIC TRAIL (ARIZONA TRAIL)
- RAILWAY
- RIVER OR MAJOR DRAINAGE

0 2 Mile

NOTES:
1. NAD83, ARIZONA STATE PLANE CENTRAL
2. IMAGERY PROVIDED BY ESRI/BING AERIAL IMAGERY
3. WATERSHEDS PROVIDED BY NATURAL RESOURCE CONSERVATION SERVICE.

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PROJECT
RESOLUTION COPPER PROJECT
DEIS DESIGN FOR ALTERNATIVE 3A - NEAR WEST MODIFIED PROPOSED ACTION (MODIFIED CENTERLINE EMBANKMENT)

TITLE
SITE LOCATION DETAILS

PROJECT No.
M09441A20

FIG No.
2.1

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2.2 Land Use

The land management status for Near West and the surrounding area is shown on Figure 1.1 and Figure 1.2. The site is entirely on Forest land. Other key aspects of the Near West site, with respect to land-use, include the following:

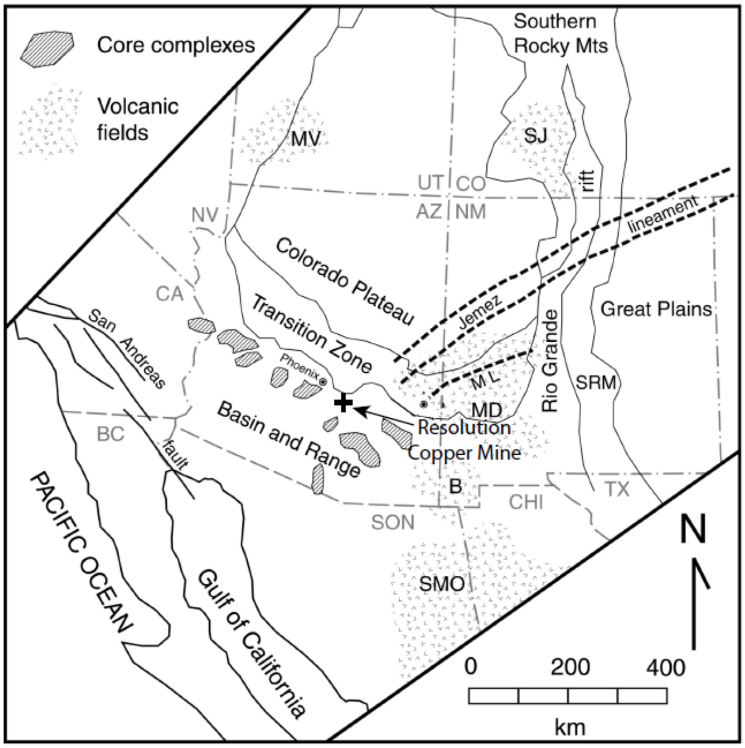
- The abandoned Bomboy Mine is located in the southwest corner of the site (see Figure 2.1). The mine consisted primarily of two tunnels and an upraise of 175 feet, connecting the back of the Main Tunnel to the ore vein cropping. In all, nearly 1,000 linear feet of mine development was completed between 1916 and 1971 (USGS 2018).
- The Arizona Trail passes approximately 3/4 mile east of the site through Rice Water Canyon and Whitford Canyon (see Figure 2.1).
- The site is bordered on the south by a section of private land and a railroad (which is owned by RC), beyond which lies Queen Creek and Highway 60 (both approximately 1/4 mile to 1/2 mile south of the site).
- The site is currently used primarily for livestock grazing, ranching and road access to recreational areas. Vegetation comprises mainly desert shrubs and cacti.
- There is one known cave present northwest of the site called Hawks Claw Cave (see Figure 2.3).

2.3 Seismicity

The Near West site is located in an area of low historic seismicity; 17 earthquakes within 124 miles are part of the seismic record that dates back to 1830. Only five of the recorded earthquakes have had a moment magnitude greater than 5. None of the recorded earthquakes have had a moment magnitude greater than 6.

A site-specific seismic hazard assessment was completed for the Near West site in 2017 (LCI 2017). That study calculated peak ground acceleration (PGA) and spectral acceleration at return periods up to 10,000-years and provided both uniform hazard spectra (UHS) and conditional mean spectra (CMS). The results indicated that the hazard from short period ground motions is controlled by the background seismicity (seismicity not associated with known faults) close to the site, whereas the distant San Andreas Fault (~250 miles from Near West, see Figure 2.2) influences the hazard for longer periods, similar to the period of most large earthfill structures. Earthquake design ground motions would be selected for appropriate return period events.

Figure 2.2 Regional Seismic Zone (URS 2013)



Modified from: Drewes *et al.* (1985)

2.4 Regional Geology

The oldest rocks exposed in the area of the Near West site are facies of the early Proterozoic Pinal Schist (1.7 Ga) that forms the regional basement (Spencer and Richard 1995). Northeast of the site, most of the schist is pelitic, with compositional banding reflecting a combination of metamorphic differentiation and original bedding. This banding is tightly folded (isoclinal) at a small scale with fold axes parallel to the overall foliation plane (dips ~30 degrees to 60 degrees to the southeast) with granular differentiation of minerals. Southwest of the TSF, most of the schist is psammite facies, which transitions from an isoclinal folded and crenulated fabric in the west to a relatively planar fabric in the southeast due to complete transposition of the older fabric (Spencer and Richard 1995). The planar fabric also dips between 30 degrees and 60 degrees to the southeast.

Pinal Schist is disconformably overlain by the middle Proterozoic Apache Group (1.4 Ga to 1.1 Ga), comprising Pioneer Shale, Dripping Spring Quartzite, and Mescal Limestone. Apache Group rocks are highly fractured and in places brecciated as a result of distributed extensional deformation during the Tertiary (Spencer and Richard 1995). During the middle Proterozoic (1.1 Ga), the Apache Group was intruded by a diabase unit, causing contact metamorphism. Diabase generally intrudes along sills; however, it is extensive throughout the Apache Group (Hammer and Webster 1962). The Apache Group is depositionally overlain by Paleozoic rocks including Cambrian Bolsa Quartzite (500 Ma) and

Mississippian Escabrosa Limestone (350 Ma) as well as other limestone units (Spencer and Richard 1995). No rocks with ages between the Mississippian (350 Ma) and the middle Tertiary (34 Ma) are found in the area except Laramide granitic intrusives that are not present within the footprint of the TSF.

Tertiary age extensional faulting was accompanied by the deposition of middle Tertiary age volcanic tuffs and flows, including Apache Leap Tuff (21 Ma to 19 Ma: Dickinson 1991), poorly welded Tuff, Rhyolite, and Basalt. Tertiary Gila Conglomerate and sandstone overlie the volcanics, except at the contact of these units, where they are locally interbedded.

2.5 Site Geology

The foundation of the Near West site is primarily underlain by bedrock of different age and origin incised by narrow drainage channels infilled with alluvial, colluvial and undifferentiated sediments. The early-Proterozoic Pinal Schist brackets the north and south ends of the site, and is exposed between the embankment and Queen Creek, in the south. The schist is overlain by the middle Proterozoic aged Apache Group which consists of siltstone, quartzite, limestone and minor conglomerate and basalt. The Apache group is often intruded by similarly aged diabase. Younger, Paleozoic limestone and quartzite units overlie the Apache Group near the western edge and northwest corner of the site. Tertiary volcanic units include tuff, basalt, and perlitic rhyolite, the last of which forms steep cliffs and ridges in the northeast corner of site. The central and eastern portions of the TSF are dominated by Tertiary aged Gila Conglomerate which forms ridges oriented north to south, separated by creek channels; the Gila Conglomerate covers approximately 55% of the TSF footprint. The Gila Conglomerate grades downslope into bedded sandstone in the southeast corner near Potts Canyon. Bedrock is generally exposed at the surface, with the exception of alluvial sediments in stream channels, and “Old Alluvium” deposits concentrated at the south end of the site at lower elevations.

A summary of the primary bedrock and overburden units at the Near West site are summarized below, arranged in order of age (youngest to oldest). Their distribution across the site is shown on Figure 2.3. A more detailed characterization of each unit is provided in the site characterization report (KCB 2017b), and the engineering significance of each is discussed in Section 6.

Quaternary Deposits

The quaternary deposits are unconsolidated soil deposits, and comprise the following:

- Recent Alluvium (Qal): Found in active drainage channels throughout the TSF footprint. Comprised mostly of sand and gravel derived from various rock units. Some clean deposits but fines content can range up to 40% in some areas.
- Old Alluvium (Qoa): Present throughout the TSF footprint on raised terraces adjacent to active channels. Comprised mainly of gravel, sand and fines, and may include intermediate and high plasticity clay deposits.

- Old Lacustrine (Qoa-Lu): Present in the SE corner of the TSF footprint, adjacent to Potts Canyon. Similar in composition to the Qoa but with higher clay content. Clay layers can be 2 ft to 4 ft in thickness.
- Undifferentiated Quaternary Deposits (Qs). Found in low relief areas and in relatively small drainages within the TSF footprint. The composition of this unit is similar to the Qal but typically with higher fines content, ranging from approximately 30% to 50%.

Gila Sandstone (Tss)

The Gila Sandstone is located in the southeast corner of the TSF footprint adjacent to Potts Canyon. Dominantly fine grained, sub-horizontally bedded fine to medium grained sandstone, with some bentonitic clay layers up to 3 mm thick present in the upper 30 ft of the unit.

Gila Conglomerate (Tcg)

Gila Conglomerate is the most widely distributed rock unit on site covering approximately 55% of the TSF footprint. The unit is comprised of sub-horizontal beds of variable composition, ranging from thin silty sand beds to thick massive beds comprised of a wide range of particle sizes from boulders to fines. The dominant grain size of the Tcg coarsens from south to north across the site. Rock quality designation (RQD) in the Tcg is typically high. Structural discontinuities in the Tcg are comprised of open or eroded sub-horizontal bedding planes and rarely observed sub-vertical joints.

Weathering is typically shallow and limited to the upper 30 ft based on drill hole results, although only a few feet of weathering was observed in test trenches.

Tertiary Basalt (Tb)

Tertiary Basalt outcrops at the southeast corner of site where it forms a tabular flow interbedded with Gila Conglomerate. It is a light to dark grey fine grained basalt with some zones of flow breccia. Weathering varies from fresh to moderate with no obvious correlation with depth. RQD ranges from 0% to 50% in the top 60 ft, increasing to 80% to 100% below 60 ft. The Tb is variably described as weak to strong rock (R2 – R4).

Rhyolite (Tp)

Exposed Rhyolite at the northeast corner of site forms prominent bluffs and escarpments. It is predominantly glassy, aphyric perlitic rhyolite with zones of flow brecciation, fracturing and vesicles, and zones of flow banding. It ranges from slightly to moderately weathered. RQD is highly variable, typically ranging from 15% to 80% in the top 100 ft. Below 100 ft it is typically 100% but can be as low as 30%. Intact rock classifies as very weak to medium-strong (R1 to R3).

Tuff (Tt and Tal)

Tertiary tuffs (Apache Leap – Tal and Poorly Welded Tuff – Tt) are widely distributed across the north and south sides of the site. The Tal is exposed in areas of high relief and forms prominent bluffs and escarpments, whereas the Tt is exposed in areas of low relief. The tuffs are dominantly strongly welded and crystalline and show only moderate weathering, however local examples of Tt completely weathered to hard clay were observed outside of the TSF footprint in drill core. RQD is typically greater than 50%, and in most cases it is 100%. Joints vary from open to closed. The tuffs classify as strong rock (R3 to R4) for samples tested within the TSF footprint.

Escabrosa Limestone (Me)

This unit is not exposed within the TSF footprint and was not encountered during the drilling programs. However, it may be present at depth based on the geologic sequence and is therefore included in this summary.

Martin Limestone (Dm)

Exposed along the west side of the site, within the TSF footprint, this unit is exposed in steep bluffs or ridges. It was not encountered during the drilling program, but observations of outcrops indicate that the rock is fresh, comprised of dipping beds and is closely jointed, parallel to bedding and sub-vertical and is medium strong to very strong (R3-R5).

Bolsa Quartzite (Cb)

Exposed along the west side of the site, within the TSF footprint, this unit is exposed in steep bluffs or ridges. It was not encountered during the drilling program, but observations of outcrops indicate that the rock is fresh and generally comprised of medium to coarse grained quartzite rich sandstone in massive or crudely graded beds interbedded with medium to fine grained, cross bedded and planar bedded sandstone with dark tan to brown laminations. The unit is very closely fractured, parallel to bedding and sub-vertical, and medium strong (R2-R3).

Diabase (Yd)

Exposed in the northwest, north, and northeast portions of the TSF footprint, this unit forms the majority of faulted blocks of Apache Group rocks. At surface the unit is weathered to a regolith and is highly weathered and closely fractured to a depth of up to 60 ft. RQD varies from 0% to 100% from surface to 140 ft. Below 140 ft RQD is typically greater than 50% and often 100%. Below the upper weathered zone, rock strength is weak to medium strong rock (R2-R3).

Mescal Limestone (Ym)

Exposed in the western edge of the TSF, and in fault blocks in the northern portion of the TSF footprint, this unit is composed of massive to laminated calcareous siltstone, with prominent zones of healed brecciation and silicification. RQD is generally greater than 60%, but less than 100%. It is typically fresh, with rare zones of highly weathered rock, especially at contacts with diabase, where zones of dissolution may occur. Core descriptions of strength found medium strong to strong rock (R3-R4).

Dripping Spring Quartzite (Yds)

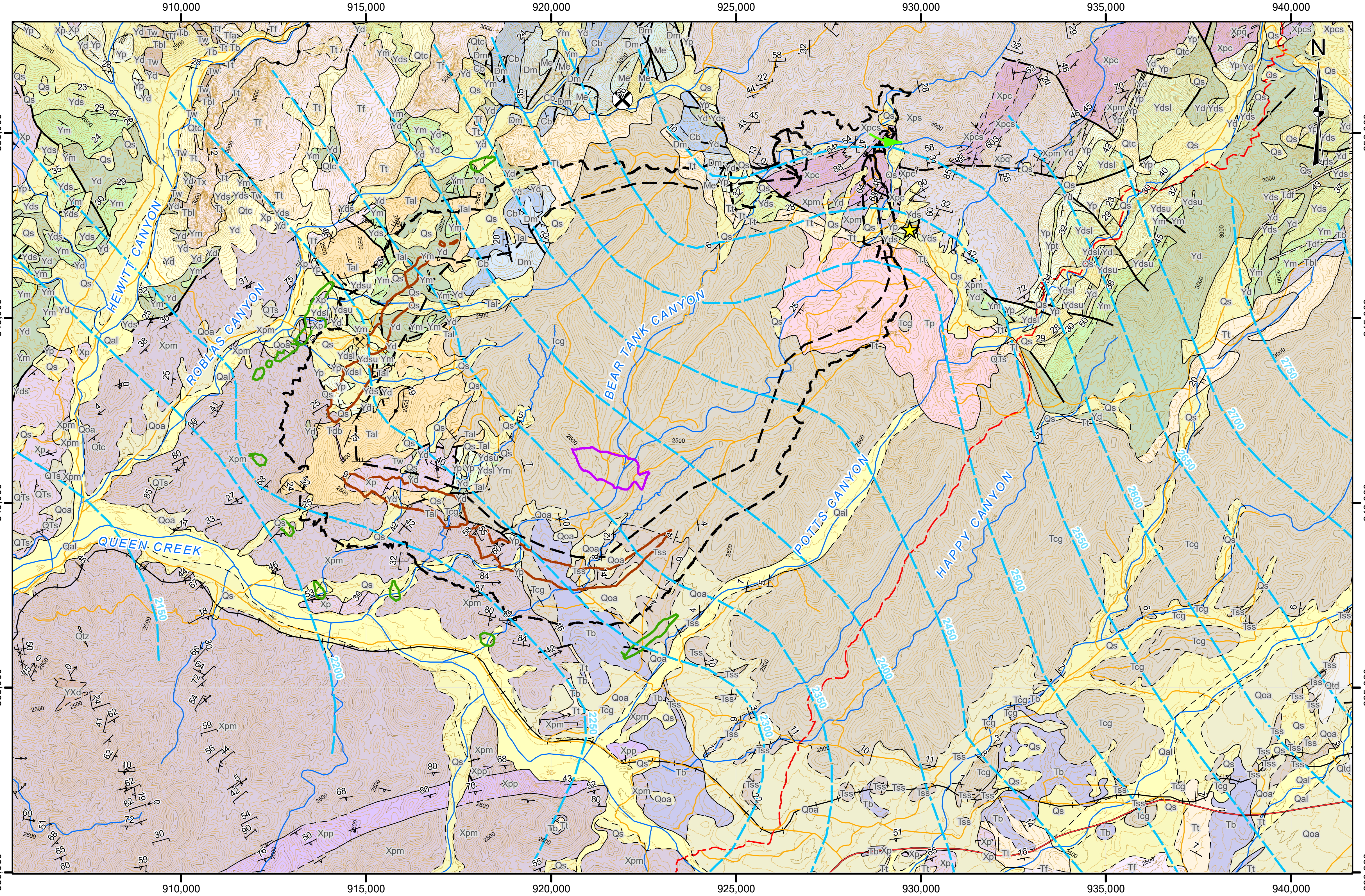
This unit is exposed within fault blocks on the western, southwestern, and northern edge of the TSF footprint. It is composed of laminated siltstone grading downwards into very fine grained sandstone and coarse grained quartzite. Prominent zones of brecciation are observed at the surface and in drill holes. RQD is variable between 40% and 90%, with occasional zones as low at 0%. Core descriptions classify intact Yds as weak to medium strong rock (R2-R3). Yds is typically moderately weathered.

Pioneer Shale (Yp)

This unit is exposed within fault blocks on the western, southwestern, and northern edge of the TSF and is typically recessive and forms relatively flat areas with little exposed rock or moderate talus slopes. Pioneer shale is composed of deep reddish brown siltstone and fine grained sandstone. RQD is low, and typically 0% to 100 ft depth; below that RQD is variable between 20% and 80%. Strength is very weak to weak rock (R1-R2).

Pinal Schist (Xp)

Pinal Schist is widespread at the surface along the southern and northern margins of the TSF footprint. Along the southern margin of the proposed TSF, areas underlain by Pinal Schist are low rolling ridges and broad drainages. To the north, schist underlies the foothills of the Superstition Mountains with steep canyons and ridges. Schist is medium to fine grained, low to moderate grade metamorphic rock. Generally, Pinal Schist is very closely fractured and broken with common zones of gouge and crushed rock in core samples. RQD is typically low (often zero) with alternating zones of very closely fractured rock, and zones of more widely fractured rock, with no clear trend with depth. Foliation-parallel defects are dominant, and persistence is variably low to high (1 m to 20 m). Joint surfaces are rough to smooth, with some slickensided, highly weathered surfaces with clay gouge. Intact zones of Pinal Schist are medium strong to strong rock (R3-R4) however much of the core is very weak rock (R1) that was too weak to test.



GEOLOGICAL UNITS

Qs	Undivided Surficial Deposits (Quaternary)
Qtd	Disturbed Surficial Deposits (Holocene)
Qtc	Talus and Colluvium (Quaternary)
Qal	Unconsolidated Alluvium (Quaternary)
Qoa	Old Alluvium (Quaternary)
QTs	Older Alluvium (Early Quaternary to Late Tertiary)
Tcg	Conglomerate (Pliocene to Late Miocene)
Tss	Sandstone (Pliocene to late Miocene)
Tb	Basalt (Mid-Miocene to Early Miocene)
Tp	Perlitic Aphyric Rhyolite (Middle Tertiary)
Tal	Apache Leap Tuff (Early Miocene)
Tt	Tuff (poorly welded) (Miocene)
Tf	Felsic Volcanic Rocks, undivided (Middle Tertiary)
Tbl	Lower Basalt (Middle Tertiary)
Tx	Rock Avalanche or Talus Brecchia (Middle Tertiary)
Tw	Whitetail Conglomerate
Tdb	Basaltic Dikes (Middle Tertiary)
Kd	Quartz Diorite (Latest Cretaceous)
Me	Escabrosa Limestone (Mississippian)
Dm	Martin Limestone (Devonian)
Cb	Bolsa Quartzite (Cambrian)
Yd	Diabase (Middle Proterozoic)
Ym	Mescal Limestone (Middle Proterozoic)
Yds	Dripping Spring Quartzite, undivided (Middle Proterozoic)
Ydsu	Dripping Spring Quartzite, Upper Unit (Middle Proterozoic)
Ydsl	Dripping Spring Quartzite, Lower Unit (Middle Proterozoic)
Yp	Pioneer Shale (Middle Proterozoic)
Ypt	Pioneer Shale, Tuff Unit (Middle Proterozoic)
YXd	Diorite (Early or Middle Proterozoic)
Xp	Pinal Schist, undivided (Early Proterozoic)
Xpc	Pinal Schist, Calc-silicate Facies (Early Proterozoic)
Xpcs	Pinal Schist, Calc-silicate and Schist Facies (Early Proterozoic)
Xpm	Pinal Schist, Psammite Facies (Early Proterozoic)
Xpp	Pinal Sctist, Phyllite Facies (Early Proterozoic)
Xpq	Pinal Schist, Quartzite Layers (Early Proterozoic)
Xps	Pinal Schist, Pelitic Schist (Early Proterozoic)

LEGEND

- ALTERNATIVE 3A: NEAR WEST TSF
- CYCLONE HOUSE AND ACCESS ROUTE TIE-IN POINT
- SCAVENGER STARTER DAM
- PRIMARY SEEPAGE COLLECTION DAMS
- PYRITE STARTER DAM
- CLOSURE SPILLWAY
- HAWKS CLAW CAVE
- OLD BOMBOY MINE

TRANSPORTATION
- ROAD
- HIGHWAY
- RAILROAD
- ARIZONA NATIONAL SCENIC TRAIL (ARIZONA TRAIL)

- FELSIC DYKE
- FAULT
- FAULT - APPROXIMATE
- FAULT - CONCEALED
- MARKER HORIZON (LOCAL)

- CONTACT (BETWEEN GEOLOGIC UNITS)
- CONTACT - APPROXIMATE
- CONTACT - INFERRED
- GROUNDWATER LEVEL CONTOURS
- CONTOUR (20ft)
- CONTOUR (100ft)

NOTES:
1. NAD83, ARIZONA STATE PLANE CENTRAL
2. REFER TO REPORT FOR SOURCE OF GEOLOGY
3. PACKER TESTS WERE CONDUCTED IN THE GEOTECH DRILLHOLES
4. GROUNDWATER CONTOURS ACQUIRED APRIL, 2017. PROVIDED BY MONTGOMERY & ASSOCIATES. DEPTH BASED ON STABALIZED GROUNDWATER LEVELS IN THE AREA

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PROJECT
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DEIS DESIGN FOR ALTERNATIVE 3A - NEAR WEST MODIFIED PROPOSED ACTION (MODIFIED CENTERLINE EMBANKMENT)

TITLE
SITE GEOLOGY

PROJECT No. M09441A20
FIG No. 2.3

2.6 Site Hydrogeology

M&A completed a conceptual hydrogeologic model for the Superior Basin with a focus on the Near West site (M&A 2017b). The following elements of the conceptual model have been taken directly from the hydrogeological conceptual model report (M&A 2017b):

- The Superior Basin is drained by Upper Queen Creek from its headwaters to an earthen dam known as Whitlow Ranch Dam. Land surface in the basin ranges from 5,560 ft above mean sea level (amsl) in the mountainous terrain north of Superior to 2,056 ft amsl at the inlet of Whitlow Ranch Dam. The proposed TSF facility is in the lowlands of the basin adjacent to an ephemeral reach of Queen Creek. Groundwater leaving the basin is forced to land surface at Whitlow Ranch Dam by a truncation of shallow unconsolidated deposits and narrowing of the bedrock geometry.
- Tests conducted in Gila Conglomerate and Pinal Schist indicate a negative correlation between hydraulic conductivity and test interval depth. Below a depth of 100 ft, the geomean of hydraulic conductivity for all tests in Gila Conglomerate decreases from 7.3×10^{-6} cm/s to 7.9×10^{-7} cm/s; the geomean for all tests in Pinal Schist decreases from 2.6×10^{-5} cm/s to 2.7×10^{-6} cm/s. In both cases, the geomean of tests conducted above 100 ft versus below 100 ft differs by approximately an order of magnitude.
- Preliminary results of aquifer testing in the Quaternary alluvial deposits indicate that the hydraulic conductivity of the alluvium is on the order of 1.0×10^{-1} cm/s, several orders of magnitude greater than the hydraulic conductivity of the bedrock units. Consequently, the alluvial deposits represent relatively more conductive pathways for groundwater movement through the Superior Basin.
- Measured groundwater levels within the basin approximately mimic the shape of the topography, decreasing in elevation from the highlands around the northern, eastern, and southern boundaries of the basin toward Whitlow Ranch Dam in the west.
- Horizontal hydraulic gradients vary across the site. The gradient is notably reduced along the Queen Creek alluvium and within the perlite near the northeastern corner of the proposed TSF. The flattening of gradients in these two areas is caused by higher hydraulic conductivities in these two hydrogeologic units.
- With few exceptions, existing vertical hydraulic gradients in the proposed TSF foundation are upward which is understood to be indicative of recharge, occurring in the uplands, flowing along deeper groundwater flow paths until reaching the higher conductivity alluvial sediments in drainages.
- Groundwater evapotranspiration occurs in stream channels where deep-rooted riparian vegetation draws water from shallow groundwater within the stream channel alluvial deposits.
- A broad range of water chemistries exist in the Superior Basin. This is attributed to the complex and varied hydrogeology in the basin.

- Waters sampled from the alluvial units are of calcium-bicarbonate composition.
- Water sampled from the upper 100 ft of the Gila Conglomerate, Apache Group, Pinal Schist and alluvials have similar chemistry. Isotopic analyses indicate that water sampled from a shallower depth are younger than water sampled from depths greater than 100 ft. The test data support that shallower waters are more active which is consistent with the vertical distribution of hydraulic conductivities.
- Based on a groundwater balance for the basin, prepared by M&A (2017b), precipitation-derived recharge makes up 95% of the inflow to the basin, the remaining 5% is treated effluent from the Superior Waste Water Treatment Plant. Treated water is sourced from outside the basin. Groundwater evapotranspiration (42%) and discharge through Whitlow Ranch Dam (43%) are the primary groundwater outflows from the basin. Groundwater pumping accounts for the remaining 15%.

2.7 Climate and Hydrology

The Near West site is within a semi-arid climate zone with low average annual precipitation (18 inches) and high estimated average annual potential evapotranspiration, or PET (72 inches). The annual average temperature is 69°F and daily temperatures typically range from 40°F to 100°F.

The region experiences three seasonal types of precipitation event (Applied Weather Associates 2013), comprising the following:

- Winter storms that occur during October through March. These are typically long duration, low intensity events.
- Summer monsoonal storms that occur during June through September. These are typically short duration, high intensity thunderstorms, and are common throughout the monsoon season.
- Tropical storms that occur during August through October. These are rare events but produce the most extreme rainfalls in southern Arizona. They are the dying remnants of oceanic tropical storms and typhoons and are typically moderate duration (~24 hrs), high intensity events.

Refer to the design basis memorandum (DBM) in Appendix I for details on design storm events.

In its current state, drainage at the site occurs through a series of roughly north-south oriented valleys (or canyons) that report to Queen Creek in the south. These drainage valleys are ephemeral streams that are typically dry, but are locally fed by springs.

There are numerous springs and seeps that have been identified within Superior Basin (M&A 2017b). The springs located within the Near West site (Bear Tank Canyon Spring and Benson Spring) have flows less than 2 gpm, and are often dry. There is no evidence to suggest the Perlite Spring located in the perlitic rhyolite in the northeast is a natural spring. It is formed by an impoundment located at the base of a former perlite quarry.

3 TAILINGS CHARACTERIZATION

3.1 Tailings Types

The Resolution project will generate two physically, mineralogically and geochemically discrete tailings streams known as scavenger tailings and pyrite tailings; scavenger tailings will account for approximately 84% of tailings produced by weight and pyrite tailings the remaining 16%.

KCB (2018b) has summarized the existing geotechnical laboratory testing data for the tailings and geotechnical characterization for the DEIS design.

Duke HydroChem (2016 and 2017b) summarized the tailings geochemical laboratory data and characterization for the DEIS design (Duke Hydrochem 2016 and 2017b).

3.2 Geochemical

The scavenger tailings contain a very low percentage of pyrite (with a mean sulfide content of less than 0.1% by weight) and low neutralization potential. Additionally, the release of acidity, sulfate and metal/metalloids from the scavenger tailings are limited by the very low sulfide and residual metal contents (Duke HydroChem 2016).

The pyrite tailings contain a much higher percentage of pyrite (>20% by weight) and are classified as PAG (Duke HydroChem 2016). The pyrite tailings specific gravity ranges from 3.23 to 4.33, with an average of 3.87, which reflects the variability in high-density pyrite content of the samples.

3.3 Geotechnical

Geotechnical properties of the tailings for the DEIS were characterized based on laboratory testing, literature review and comparison with similar projects, refer to Table 3.1 and Table 3.2. Key comments regarding the tailings geotechnical characterization are as follows:

- Properties (particle size distributions, plasticity, specific gravity, consolidation behavior, and hydraulic conductivity) of the pyrite tailings and scavenger "total" tailings were measured in the laboratory. The same suite of testing was performed on the scavenger "beach" and scavenger "fines" tailings, except for consolidation.
- Properties of the cycloned sand and cyclone overflow were estimated from numerical cyclone simulations, pilot-scale cyclone tests, and comparison of scavenger and pyrite tailings index properties with those at other sites.
- The scavenger beach "composite" is not a discrete tailings type, rather an interlayered deposit of scavenger tailings and cyclone overflow that will form the tailings beach. Properties of the composite beach were guided by the characterization of the other tailings types, with consideration for the method of deposition and experience on other projects.
- Shear strength values were estimated based on similar materials at other mines including Bingham Canyon Mine (Kennecott), Pinto Valley Operations and a literature review.

- Average consolidated tailings densities for slurry tailings were selected based on large-strain consolidation testing and KCB experience on similar projects.
- The compacted density of cycloned sand was estimated using the specific gravity of the tailings and a typical void ratio for compacted sand with a similar gradation.

Further details on tailings characterization and engineering design property selection are reported in KCB (2018b).

Ranges or “base case” values are provided for engineering design properties based on laboratory testing and case histories.

Engineering design properties based on the tailings characterization are summarized in Table 3.1. Ranges of values are specified for hydrogeological properties (Table 3.2). Engineering properties have been selected from available characterization data with specific consideration to the objectives of the analysis.

Table 3.1 Summary of Tailings Engineering Properties used in Design Assessments

Material	Specific Gravity[1]	Atterberg Limits[1,4]	USCS Class	Particle Size Distribution[2]		Deposition Method	Dry Unit Weight for Tailings Staging (pcf)[3]	Effective Friction Angle (ϕ')	Peak Undrained Shear Strength Ratio (Su-p/σ'v)	Liquefied Undrained Shear Strength Ratio (Su-LIQ/σ'v)
				% fines <74 micron	% clay <2 micron					
Pyrite Tailings	3.87	LL: 18% PI: 3%	ML	80	<20	Subaqueous deposition at 50% solids content	106	27°	0.2	0.05
Scavenger "Total" Tailings	2.78	LL: 20% PI: 1%	ML	50	<10	Subaerial or subaqueous deposition at 65% solids content	87	32°	0.25	0.1 (base case); 0.05 (sensitivity)
Scavenger "Beach" Tailings			SM	25	2					
Scavenger "Fines" Tailings			ML	94	7		81			
Cyclone Overflow			ML	90	15	Subaerial or subaqueous deposition at 50% to 60% solids content				
Scavenger Beach "Composite"			-	-	-	Mixture of spigotted scavenger tailings and cyclone overflow				
Cycloned Sand			SP-SM	<20	0	Discharged to hydraulic cells at 60% solids content and compacted	113	34°	N/A	N/A

Notes:

1. Represent averages from the tailings tested or cyclone numerical simulations.
2. "Beach" and "Fines" values directly measured from laboratory testing. For rationale behind values selected for other materials refer to the DBM (Appendix I)
3. For long-term, consolidated dry density estimates to be used in other analyses, refer to KCB (2018b).
4. LL = Liquid Limit; PI = Plasticity Index.
5. Su-p = peak undrained strength; Su-LIQ = liquefied undrained strength; and σ'v = vertical effective stress.

Table 3.2 Summary of Hydraulic Parameters

Material	Horizontal Saturated Hydraulic Conductivity k_h (cm/s)	Anisotropy Ratio k_h/k_v	Total Porosity n_{total}	Effective Porosity $n_{effective}$	Specific Yield S_y
Pyrite Tailings	1×10^{-6} to 1×10^{-7}	1 to 10	0.40 to 0.50	0.25 to 0.50	0.20 to 0.30
Scavenger "Total" Tailings	5×10^{-5} to 5×10^{-6}	1 to 10	0.30 to 0.40	0.25 to 0.40	0.20 to 0.30
Scavenger "Beach" Tailings	5×10^{-4} to 5×10^{-5}	1 to 10	0.30 to 0.40	0.25 to 0.40	0.25 to 0.35
Scavenger "Fines" Tailings	1×10^{-6} to 1×10^{-7}	1 to 10	0.40 to 0.50	0.25 to 0.50	0.20 to 0.30
Scavenger Beach "Composite"	5×10^{-5} to 5×10^{-6}	10 to 100	0.40 to 0.50	0.25 to 0.50	0.20 to 0.30
Cyclone Overflow	1×10^{-6} to 1×10^{-7}	1 to 10	0.40 to 0.50	0.25 to 0.50	0.20 to 0.30
Cycloned Sand	5×10^{-2} to 1×10^{-3}	1 to 10	0.30	0.30	0.30

3.4 Tailings Deposition Slopes

Tailings deposition slopes are a function of particle size distribution, percent solids of discharged slurry, specific gravity, spigot design/arrangement, distance from deposition point and whether tailings will be deposited subaerially or subaqueously. Slopes should be monitored regularly during operations and the tailings deposition plan adjusted as required. Deposition slopes for discharged slurry tailings adopted for deposition modeling are summarized in Table 3.3. They were chosen based on review of case history data from operating cycloned sand tailings impoundments and subaqueous pyrite tailings facilities.

Table 3.3 Tailings Slopes

Tailings Type	Tailings Slopes	Justification
Scavenger Beach "Composite"	Above Water: 1% for the first 1,500 ft, 0.5% after 1,500 ft. Below Water: 2.5% for the first 1,000 ft, 1.0% after 1,000 ft.	Based on topography and bathymetry surveys from two large, cycloned sand impoundment beaches and slopes below water. These facilities have long exposed beaches, up to five miles.
Pyrite Tailings	Below Water: 10.0% for the first 100 ft, 0.5% after 100 ft.	Based on topography and bathymetry surveys of subaqueous disposal of high-pyrite tailings from floating barges.

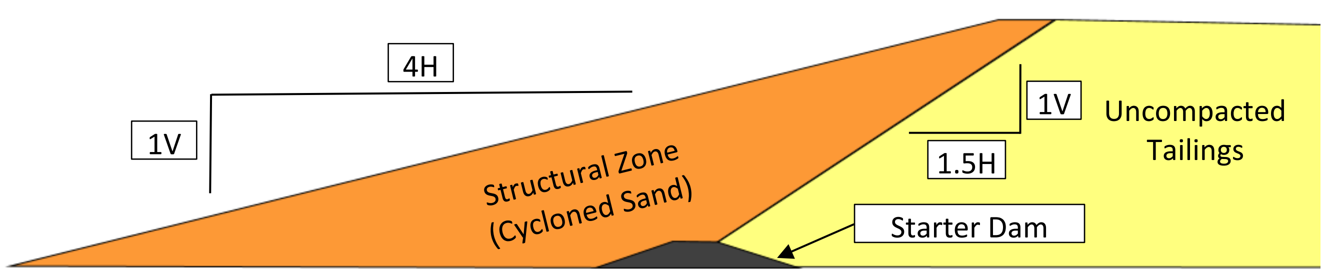
4 DESIGN BASIS

4.1 General

The DBM, refer to Appendix I, was developed with input and agreement from RC. A summary of key design basis and objectives are outlined below; however, the DBM (Appendix I) should be referenced for further details.

- The pyrite tailings are to be deposited subaqueously from a floating barge and remain saturated throughout operations. This is done to reduce potential for acid rock drainage (ARD) and metal leaching (ML) that can be triggered by pyrite tailings exposure to water and oxygen (Duke 2017b).
- For stability analysis, all potentially liquefiable contractive tailings are assumed to liquefy regardless of the triggering mechanism.
- The design cross section for the perimeter embankment includes an outer compacted cycloned sand structural zone that is raised using a modified-centerline approach (Figure 4.1).
    - The modified-centerline approach was found to be preferred based on a trade-off study of several cross sections and raise methods (KCB 2017a) because of the design resiliency, and benefits for progressive reclamation.
- The downstream slope of the cycloned sand embankment was set to 4H:1V. A trade-off was conducted assessing the impact of steepening the slope to 3H:1V, refer to Section 5.2.2.
- Available "best practice" management methods to reduce seepage as much as practical are included in the DEIS design at this preliminary stage.

Figure 4.1 Modified Centerline Schematic



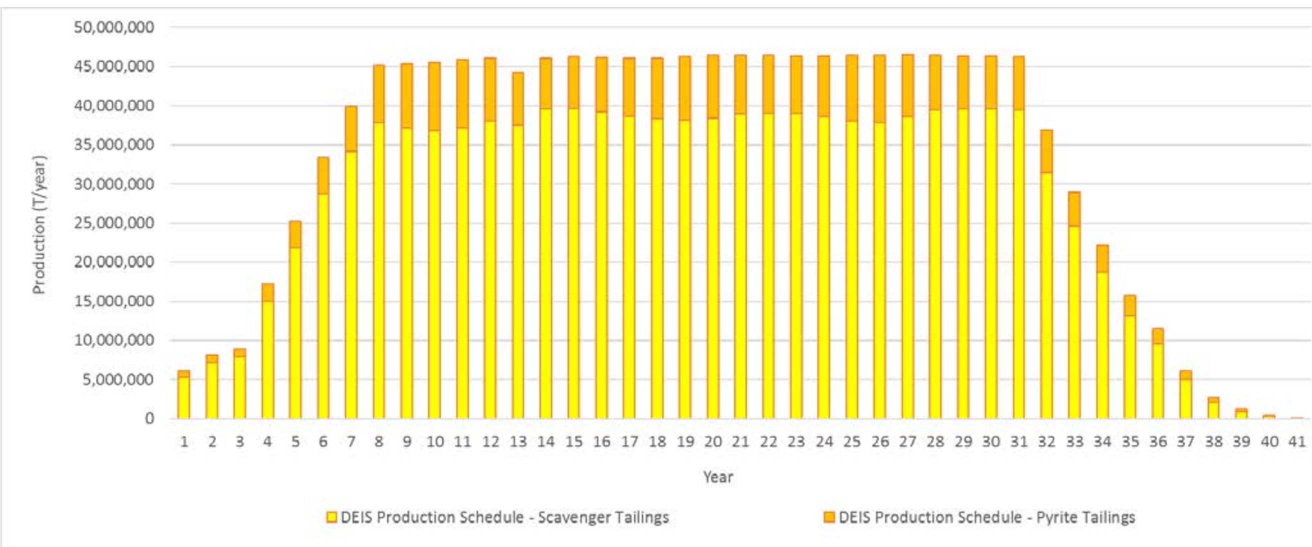
4.2 Tailings Production Rate

The tailings production schedule is summarized in Table 4.1 and illustrated on Figure 4.2.

Table 4.1 Production Schedule Summary

Item	Production Schedule
Scavenger Tailings	1,151 Mtons
Pyrite Tailings	220 Mtons
Total Tailings (Scavenger and Pyrite)	1,371 Mtons
Percentage of Pyrite Tailings by Mass	16%
Number of Production Years	41

Figure 4.2 Annual Tailings Production Schedule



4.3 BADCT Approach

The TSF would apply for an Aquifer Protection Permit (APP) with an "individual" Best Available Demonstrated Control Technology (BADCT) approach, which is performance based, and allows the applicant to select from all available Demonstrated Control Technologies (DCTs) that constitute BADCT. This process considers site specific characteristics, operational controls, and other DCTs.

Under the individual BADCT approach, the TSF is considered a "tailings impoundment" and will be designed in accordance with Section 3.5 of the BADCT manual (ADEQ 2005). The seepage dams are considered to be "surface ponds" and will be designed in accordance with Section 3.6 of the BADCT manual (ADEQ 2005) and the regulations pertaining to water dams (A.A.C. R12-15).

5 TAILINGS MANAGEMENT PLAN

5.1 TSF Features

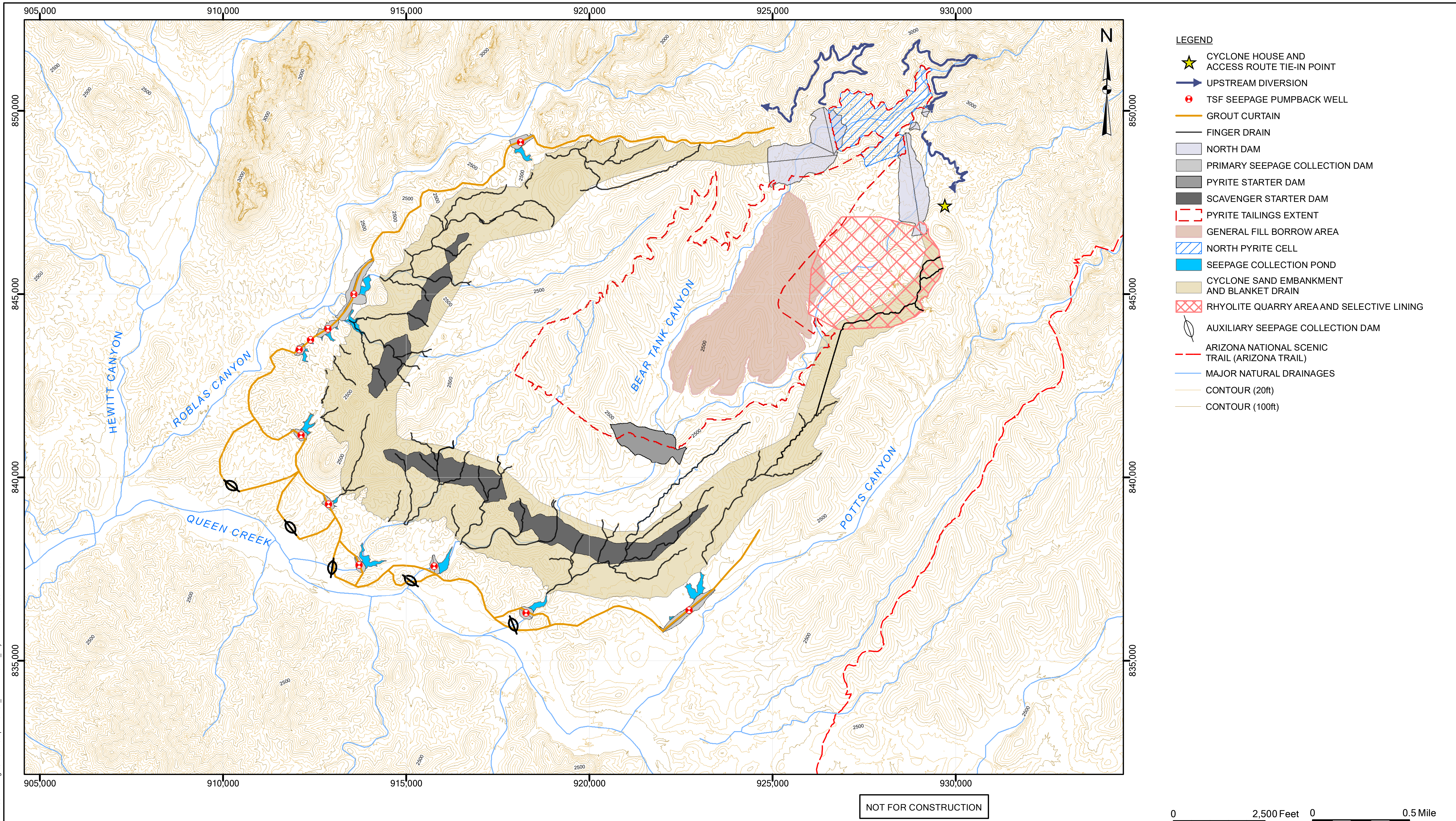
Key features of the TSF during start-up and operations include the following:

- A general fill borrow area and rhyolite quarry developed within the TSF footprint to provide a construction fill source for starter dams, drains and erosion protection.
- A compacted, cycloned sand embankment that forms the perimeter of the impoundment.
- Earthfill starter dams to facilitate tailings placement before the cycloned sand embankment is established.
- Earthfill North Dams constructed at the north end of facility to retain the tailings and reclaim pond and provide containment for the North Pyrite Cell.
- A North Pyrite Cell which stores pyrite tailings in the final years of operations in preparation for closure.
- An underdrain system comprised of a sand and gravel blanket drain and rockfill finger drains that underlies the cycloned sand embankment and a portion of the tailings beach.
- Diversion channels upslope of the impoundment to divert non-contact water around the facility.
- A tailings delivery system that delivers scavenger total tailings and pyrite tailings to the TSF for deposition.
- A reclaim pond maintained within the impoundment to provide water for the cyclone system, dust management, pyrite tailings saturation and reclaim to the West Plant.
- Pond transfer and pond reclaim systems that comprise floating pump barges and the mechanical and electrical infrastructure to transfer water between ponds within the TSF and to the West Plant.
- A pyrite tailings deposition barge and associated pipelines and support systems located within the reclaim pond to facilitate subaqueous deposition of pyrite tailings.
- A cyclone system that receives scavenger total tailings at a cyclone house and processes it to produce cyclone underflow (cycloned sand) for embankment construction. A by-product of this operation is cyclone overflow which is thickened and then deposited into the TSF impoundment.
- Tailings thickeners at the TSF for the cyclone overflow prior to deposition in the TSF.
- A seepage management system, comprising the items listed below. These features combined represent the highest level of seepage control (Level 1 to Level 4), refer to discussion on seepage management in Section 8:

- Eleven primary seepage collection dams (SCDs) and five auxiliary seepage collection dams (ASCDs) constructed in natural valleys downstream of the cycloned sand embankment and their associated seepage collection ponds (SCPs).
- Foundation treatment and, potentially, an engineered low-permeability layer[3] placed over more permeable portions of the foundation.
- A grout curtain installed around the perimeter of the TSF, between the SCDs.
- Associated mechanical and electrical infrastructure required to return collected seepage water to the reclaim pond.

The majority of the features summarized above are shown on Figure 5.1. The potential areas of the foundation that could be treated (that may include engineered low-permeability layers) are shown on Figure 8.1.

[3] The engineered low-permeability layer could be comprised of one or more of the following: compacted fine tailings, geomembrane liner, asphalt, slurry bentonite and/or cemented paste tailings.



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PROJECT

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DEIS DESIGN FOR ALTERNATIVE 3A - NEAR WEST MODIFIED PROPOSED ACTION (MODIFIED CENTERLINE EMBANKMENT)

TITLE

TSF LAYOUT AND KEY FEATURES

PROJECT No.	FIG No.
M09441A20	5.1

NOTES:
1. NAD83, ARIZONA STATE PLANE CENTRAL
2. KEY COMPONENTS OF "LEVELL 5" SEEPAGE MANAGEMENT ARE SHOWN, REFER TO SECTION 7 OF THE REPORT

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5.2 Embankment Design

5.2.1 Overview

The TSF embankment would be constructed of borrow material then raised using compacted cycloned sand by a modified centerline approach. Key components of the design include the following:

- Cycloned sand shell to provide structure support which is compacted to a specified density required to achieve a dilative behavior.
- Underdrain system comprising a sand and gravel blanket drain with gravel primary drains along main drainages and some are extended into the TSF footprint, to maintain a low phreatic surface in the tailings embankment, intercept and direct seepage from the impoundment and hydraulic placement to the downstream SCDs.

The ultimate embankment layout is shown on Figure 5.2. Typical cross sections through the embankment are shown on Figure 5.3.

5.2.2 Downstream Embankment Slope

The cycloned sand embankment for Alternative 3A is assumed to have a downstream slope of 4H:1V and an upstream slope of 1.5H:1V, refer to Figure 5.3. Localized flattening or excavation of weak foundation layers may be required to meet stability criteria in select areas.

A slope trade-off assessment was performed to determine the impact of steepening the downstream embankment slope to 3H:1V and modifying the upstream slope to 1H:1V on: embankment height; amount of cycloned sand required; and forecasted time when progressive reclamation of the embankment slopes can begin. Table 5.1 is a summary of the assessment, refer to Appendix III for additional information.

Table 5.1 Comparison of Cycloned Sand Requirements and Availability

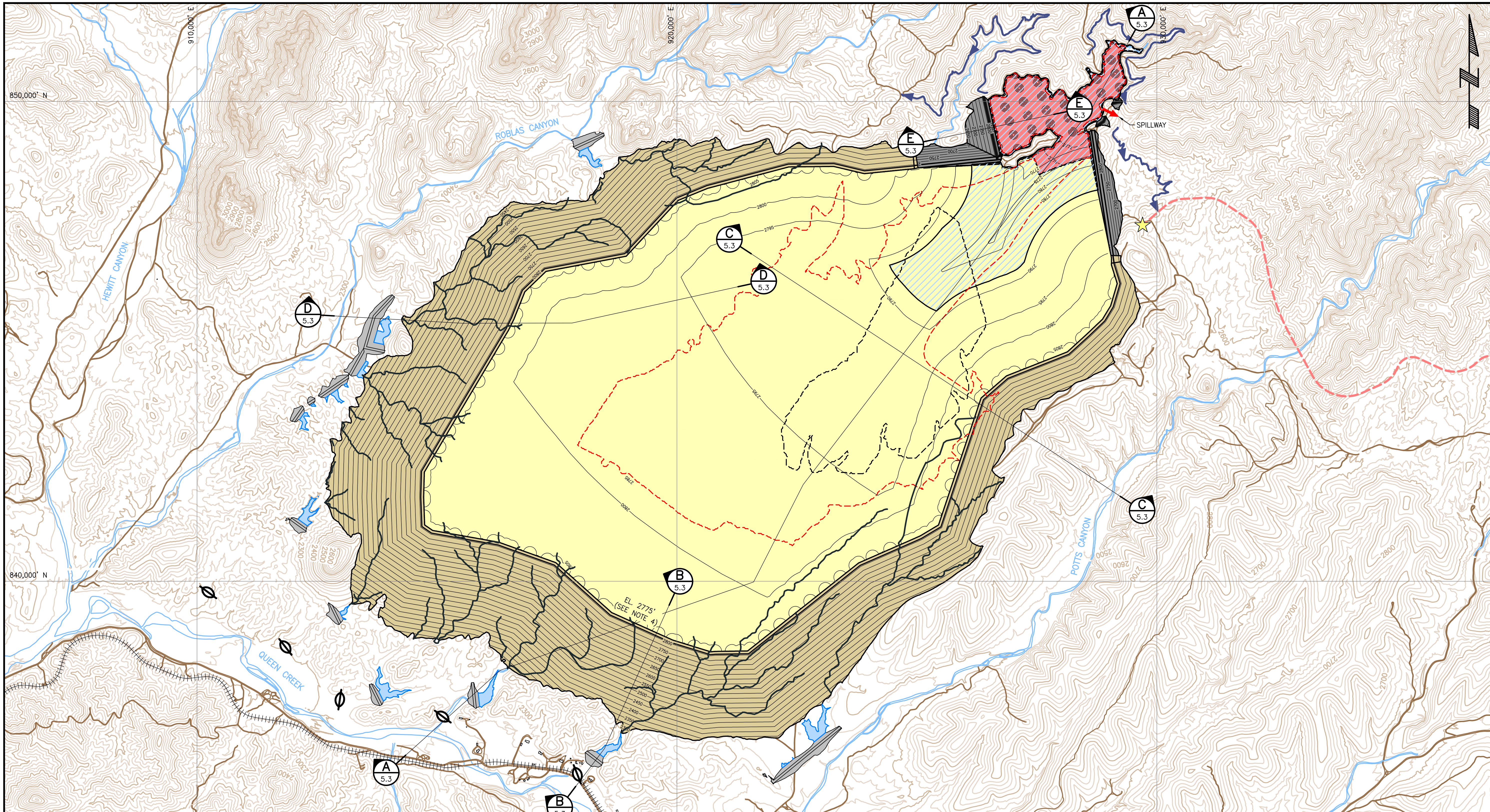
Embankment Slope Configuration	Embankment Elevation (fasl)	Maximum Embankment Height (ft)	Cycloned Sand Volume Required (Myd^3)	Maximum Cycloned Sand Volume Available (Myd^3)[1]	Cycloned Sand Surplus (Myd^3)	Operations "Year" At Which Progressive Reclamation Could Begin
d/s - 4H:1V u/s – 1.5H:1V	2,773	521	204	243	39	28
d/s - 3H:1V u/s – 1H:1V	2,760	504	164	243	79	22

Notes:
1. Refer to Appendix II for information on cycloned sand availability assumptions.
2. d/s = downstream
3. u/s = upstream

The 3H:1V embankment configuration offers an opportunity to reduce the amount of cycloned sand required for construction and potentially allow for progressive reclamation to start earlier. An additional benefit is faster development of large horizontal cycloned sand placement surfaces which are preferred for dust management and constructability. Local foundation conditions, validation of the simplified assumptions and potential challenges with operating equipment on the steeper slope for reclamation may preclude this optimization,

5.2.3 Stability

The embankment section (see Figure 5.3) is assumed to meet DEIS design stability criteria with typical foundation conditions and the preliminary stability analysis presented in KCB (2017a).



LEGEND

- DIVERSION CHANNEL
- RAILWAY
- EXISTING ROAD
- MAJOR NATURAL DRAINAGE
- PRIMARY SEEPAGE COLLECTION DAM (SCD)
- AUXILIARY SEEPAGE COLLECTION DAM (ASCD)
- CYCLONE HOUSE AND ACCESS ROUTE TIE–IN POINT
- FINGER DRAINS
- ACCESS ROUTE TO WEST PLANT
- BORROW AREA
- SCAVENGER CYCLONED SAND EMBANKMENT
- NORTH DAM
- SCAVENGER TAILINGS (CYCLONED OVERFLOW / TOTAL SCAVENGER COMPOSITE)
- PYRITE TAILINGS
- PYRITE TAILINGS EXTENT
- TSF RECLAIM POND
- SCD POND

NOTES

1. PROJECTION AND DATUM: ARIZONA STATE PLANE CENTRAL NAD 83 – INTERNATIONAL FOOT.
2. TOPOGRAPHY BASED ON LIDAR 2013 SURVEY.
3. PIPELINE TO WEST PLANT DESIGNED BY OTHERS.
4. EMBANKMENT ELEVATION SHOWN IS 2806 FASL BASED ON THE GPO TAILINGS PRODUCTION SCHEDULE. EL. 2775 FASL IS THE ANTICIPATED EMBANKMENT CREST ELEVATION BASED ON THE DEIS TAILINGS PRODUCTION SCHEDULE.

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1000 0 1000 FT

CLIENT: RESOLUTION COPPER

Klohn Crippen Berger

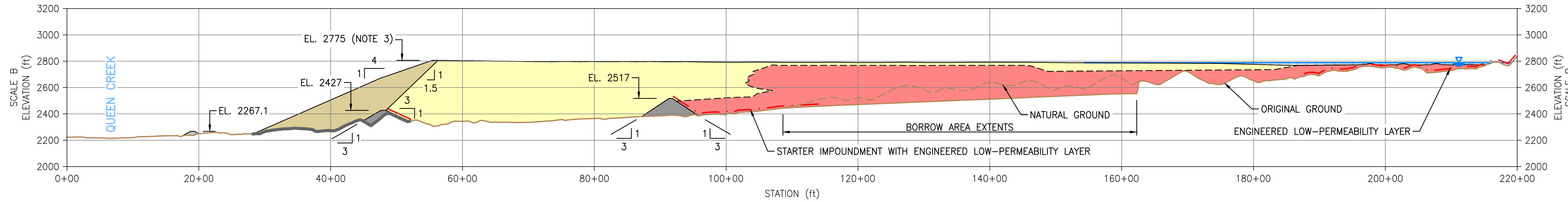
PROJECT: RESOLUTION COPPER PROJECT
DEIS DESIGN FOR ALTERNATIVE 3A – NEAR WEST MODIFIED PROPOSED ACTION (MODIFIED CENTERLINE EMBANKMENT)

TITLE: ULTIMATE EMBANKMENT LAYOUT

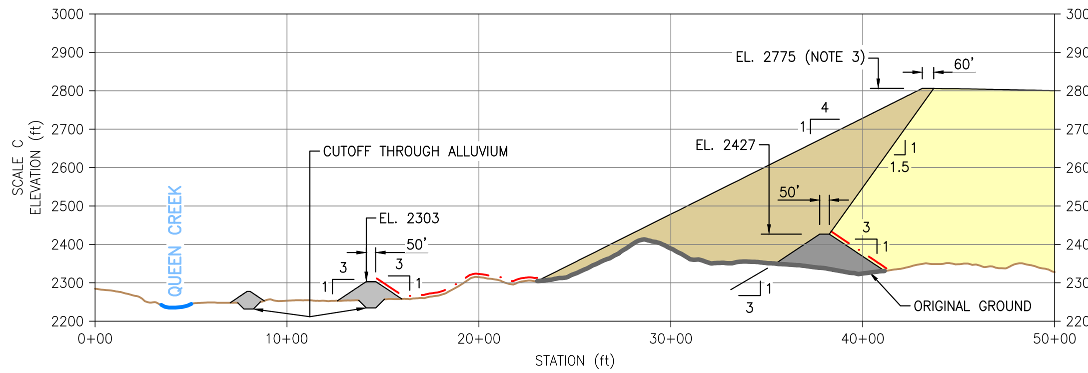
SCALE	PROJECT No.	FIG. No.
AS SHOWN	M09441A20	5.2

KCB–FIG–D–L

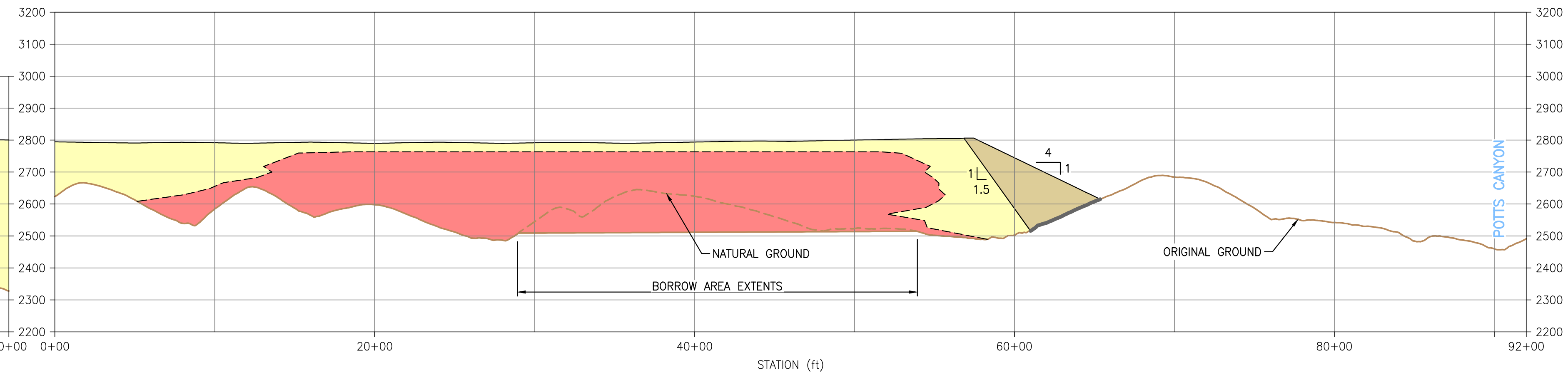
Date: 2018–05–30 Time: 11:00 AM
Drawing File: Z:\M\VCR\M09441A20 – RES–Near West PFS–PES\400 Drawings\CAD\Alt 3A Near West Wet TSF\DEIS\FIG_5.2.dwg – FIG (jbokic)



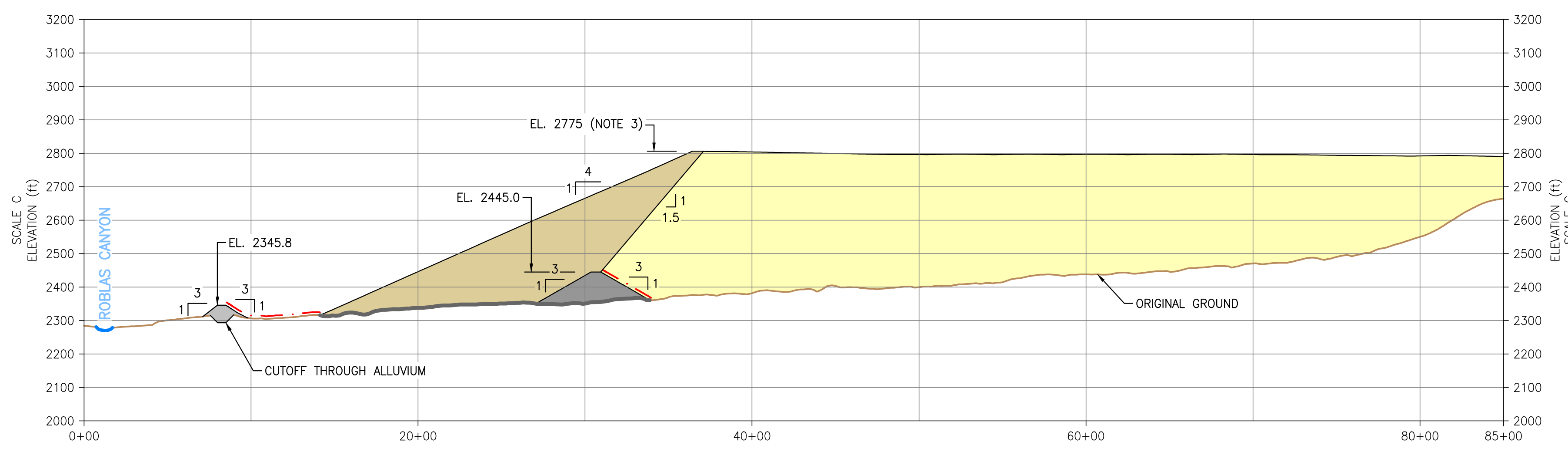
SECTION A
SCALE A
5.2



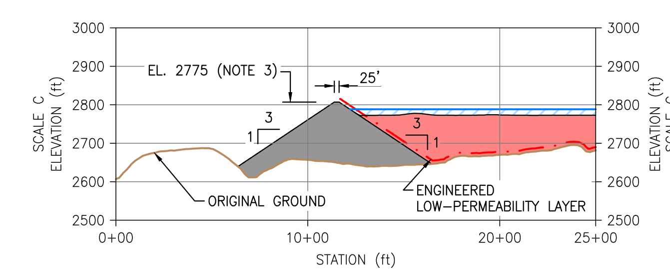
SECTION B
SCALE B
5.2



SECTION C
SCALE B
5.2



SECTION D
SCALE B
5.2



SECTION E
SCALE B
5.2

LEGEND

- SEEPAGE COLLECTION DAM (SCD)
- CYCLONED SAND EMBANKMENT
- STARTER/NORTH DAMS
- SCAVENGER TAILINGS (CYCLONED OVERFLOW / TOTAL SCAVENGER COMPOSITE)
- PYRITE TAILINGS
- TSF RECLAIM POND
- ENGINEERED LOW-PERMEABILITY LAYER (NOTE 4)
- BLANKET DRAIN

NOTES

1. PROJECTION AND DATUM: ARIZONA STATE PLANE CENTRAL NAD 83 – INTERNATIONAL FOOT.
2. TOPOGRAPHY BASED ON LIDAR 2013 SURVEY.
3. EMBANKMENT ELEVATION SHOWN IS 2806 FASL BASED ON THE GPO TAILINGS PRODUCTION SCHEDULE. EL. 2775 FASL IS THE ANTICIPATED EMBANKMENT CREST ELEVATION BASED ON THE DEIS TAILINGS PRODUCTION SCHEDULE.
4. SELECTIVELY LINED AREAS WOULD INCLUDE FOUNDATION TREATMENT AND/OR APPLICATION OF AN ENGINEERED LOW-PERMEABILITY LAYER. DETAILS ON THE TREATMENT OF THESE AREAS ARE TO BE DETERMINED IN FUTURE DESIGN STAGES BUT AN ENGINEERED LOW-PERMEABILITY LAYER COULD COMPRISE OF ONE OR MORE OF THE FOLLOWING: GEOMEMBRANE LINER, COMPACTED FINE TAILINGS, ASPHALT, SLURRY BENTONITE, CEMENTED PASTE TAILINGS, ETC.

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SCALE A 1000 0 1000 FT
SCALE B 500 0 500 FT
SCALE C 250 0 250 FT

CLIENT: RESOLUTION COPPER	PROJECT: RESOLUTION COPPER PROJECT DEIS DESIGN FOR ALTERNATIVE 3A – NEAR WEST MODIFIED PROPOSED ACTION (MODIFIED CENTERLINE EMBANKMENT)
Klohn Crippen Berger	TITLE: ULTIMATE EMBANKMENT LAYOUT SECTIONS
SCALE: AS SHOWN	PROJECT No. M09441A20 — FIG. No. 5.3

Date: 2018-05-30 Time: 11:00 AM
Drawing File: Z:\M\VCR\M09441A20 – RES-Near West PFS-PES\400 Drawings\CAD\Alt 3A Near West Wet TSF\DEIS\FIG_5.3.dwg – FIG (jbokic)

KCB-FIG-D-L

5.3 Tailings Management Strategy

Figure 5.5 and Figure 5.9 present the proposed layout of the Near West TSF at start-up and ultimate (end of mine life). The overall tailings management strategy for Alternative 3A is as follows:

- Scavenger tailings and pyrite tailings earthfill starter dams would be constructed to store tailings at start-up before the cycloned sand embankment is established. The pyrite starter cell would include a low permeability layer and flooded for subaqueous deposition of pyrite tailings.
- During operations, a portion of scavenger tailings would be cycloned and the coarser underflow by-product (cycloned sand) would be used as embankment fill which would be placed in hydraulic placement cells.
- Scavenger tailings that are not cycloned and the finer cyclone overflow by-product would be thickened from the cycloned sand embankment crest to maintain a pond in the center portion of the impoundment. The cyclone overflow would be thickened at the TSF prior to deposition.
- After the pyrite starter dam is buried by tailings (post Year 9), pyrite tailings would be subaqueously discharged into the pond surrounded by the scavenger tailings beaches to keep them saturated to prevent the onset of acid-generation, refer to Section 5.4.
- A floating barge would be used to recycle excess water from the pond to the mill for ore processing.
- The perimeter cycloned sand embankment would be raised progressively to maintain adequate capacity for tailings, pond and flood storage.
- A transition to a “dry-cover” facility would be made for closure to minimize the amount of water that is ponded on the TSF surface and reduce infiltration over the long-term.

The overall strategy is discussed further herein including information regarding the supplementary structures necessary to meet project requirements.

5.4 Tailings Delivery and Process Facilities

Scavenger and pyrite tailings slurry would be thickened at the West Plant to 65% and 50% solids, respectively, and delivered to a “tie-in” point at the northeast corner of the TSF (see Figure 5.1). Downstream of the tie-in point, the scavenger tailings would either be distributed along the embankment crest and discharged from spigots for beaching, or sent to a cyclone house. Pyrite tailings would be sent directly to a deposition barge located within the impoundment.

The key facilities located at the tie-in point are summarized below:

- a cyclone separation plant (“cyclone house”) which houses slurry dilution tanks, storage tanks, pumps and cyclones;
- cyclone overflow thickeners;
- substation;

- vehicle maintenance and fueling shop;
- warehouse for spares along with outside storage areas;
- administration and locker room facilities; and
- parking facilities.

Downstream of the tie-in point would be the following:

- cycloned sand distribution pipelines to hydraulic cells for embankment construction;
- scavenger tailings ("total" tailings and cyclone overflow) distribution pipelines to the embankment crest;
- pyrite distribution pipeline to the deposition barge and/or floating pipelines; and
- return water line from the reclaim pond.

Further details on the tailings delivery and process facilities is provided in the Tailings Corridor study report (RC 2016b).

5.5 Pyrite Tailings Management

Pyrite tailings would be deposited subaqueously from a floating barge throughout operations. No design has been prepared for the barge but the concept is for the barge to be moved frequently around the pond (to minimize pond volumes) to develop a roughly horizontal subaqueous tailings surface.

The primary advantages of this management approach are related to mitigating potential water quality impacts:

- Pyrite tailings would be maintained in a saturated state throughout operations to prevent or reduce oxidation and potential acid generation until they can be covered and encapsulated with scavenger tailings.
- The finer fraction of scavenger tailings that have a lower hydraulic conductivity than beach tailings, would deposit around and in the reclaim pond encapsulating the pyrite tailings.
- Placing pyrite tailings within the center of the facility increases the horizontal flow pathway length resulting in the longer lag time for seepage to reach the receptors, thus increasing potential for attenuation.
- Pyrite tailings to be stored primarily on the Gila Conglomerate foundation, which has lower bulk permeability compared to some other bedrock units on site.
- Pyrite tailings would be capped for closure to reduce infiltration and oxygen ingress over the long-term.

5.6 Tailings Staging Plan

Tailings deposition has been sub-divided into five major stages, as described below.

- Stage I – Years 0 to 2 (1% of total tailings volume) – see Figure 5.5:

  - Scavenger and pyrite tailings are deposited behind their respective starter dams within Bear Tank Canyon.
  - Pyrite tailings deposition into the pyrite reclaim pond from a floating barge.
  - Operation of separate scavenger and pyrite reclaim ponds. Water in the scavenger pond is pumped to the pyrite pond for reclaim to the cyclone house.
  - Cycloning of scavenger tailings to produce fill for embankment construction.
- Stage II – Years 3 to 4 (2% of total tailings volume) – see Figure 5.6:
  - As Stage I, except another scavenger starter dam (Scavenger Starter Stage II) is commissioned in the valley west of Bear Tank Canyon and scavenger deposition commences there. Commissioned scavenger tailings starter dams are raised with cycloned sand.
  - Pyrite tailings deposition into the pyrite reclaim pond from a floating barge.
- Stage III – Years 5 to 9 (14% of total tailings volume) – see Figure 5.7:
  - As Stage II, except another scavenger starter dam (Scavenger Starter Stage III) is commissioned in the western most valleys and scavenger deposition commences there. Commissioned starter dams are raised with cycloned sand.
  - Pyrite tailings deposition into the pyrite reclaim pond from a floating barge.
- Stage IV – Years 10 to 34 (80% of total tailings volume) – see Figure 5.8:
  - Scavenger deposition from the perimeter of the cycloned sand embankment as the embankment is raised.
  - Scavenger and pyrite ponds are merged and operated as one.
  - Pyrite tailings deposition into the reclaim pond in the central portion of the impoundment from a floating barge.
  - Northern Containment Dams are commissioned to retain tailings and the encroaching reclaim pond.
  - Cycloning of scavenger tailings to produce fill for embankment construction.
- Stage V – Years 35 to 41 (3% of total tailings volume) – see Figure 5.9:
  - Scavenger tailings are deposited along the perimeter of the cycloned sand embankment, from pipes further down the beach and/or mechanical placement to fill in the low spot at the center of the facility and promote grading of the beach towards the North Containment Dams and North Pyrite Cell.
  - Pyrite tailings subaqueous deposition within a separate cell, the North Pyrite Cell, north of the main impoundment.
  - Note that the Stage V layout shown on Figure 5.9 still incorporates a tailings production schedule of 45 years, and although final elevations and layout would be slightly different

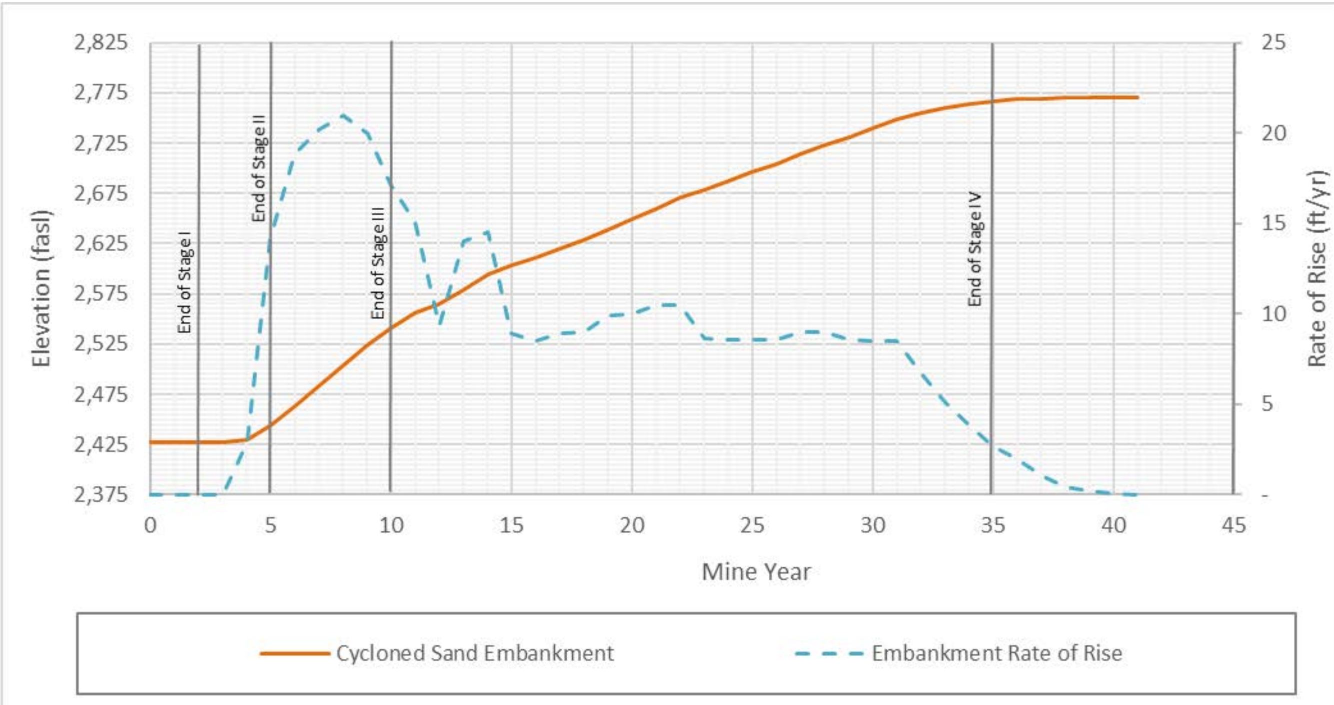
for the actual 41 year production schedule, the changes are not material and the tailings management concept would remain unchanged.

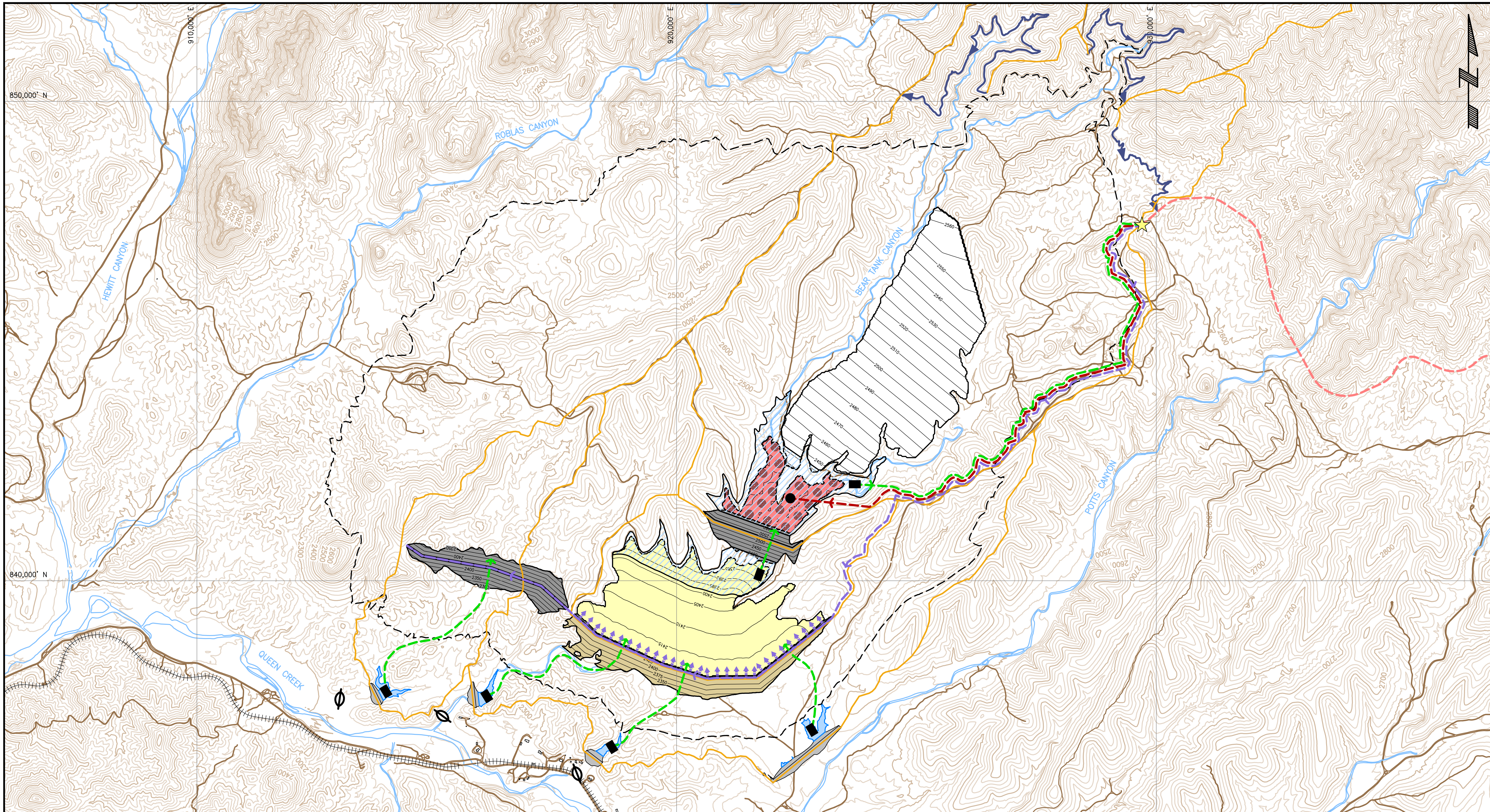
The tailings staging plan described above was modeled using the software program MUCK3D (MineBridge Software Inc., version 1.0.5). A detailed discussion on the modeling approach, key assumptions and results are summarized in Appendix IV.

Key observations from the tailings deposition models include the following:

- Pyrite tailings can be deposited subaqueously at all stages to maintain saturation.
- The impoundment layout can store the required tailings and flood storage volumes.
- There is precedent in the industry for compacted cycloned sand embankments to the height predicted (520 ft).
- Long beaches (>400 ft) are maintained even when storing the inflow design flood (PMF) for all years except Year 3 when the beach width would be 200 ft.
- The forecasted rate of embankment rise, above the initial starter dam crests, is shown on Figure 5.4. Rates of rise between 15 ft/yr and 21 ft/yr are expected in the first 14 years before leveling out to less than 11 ft/yr for the remainder of operations, which is within the range for facilities of this type.
- The total cycloned sand volume required to build the embankment is approximately 40 Myd^3 less than the total cycloned sand available (243 Myd^3), based on the assumed density and cycloned sand availability assumptions provided in the DBM (Appendix I) and discussed in Appendix II. The surplus in cycloned sand could potentially be used for other construction activities to reduce the borrow requirements (e.g. road construction, liner bedding, starter and north dam construction).

Figure 5.4 Embankment Rate of Rise





LEGEND

- DIVERSION CHANNEL
- RAILWAY
- EXISTING ROAD
- MAJOR NATURAL DRAINAGE
- PRIMARY SEEPAGE COLLECTION DAM (SCD)
- AUXILIARY SEEPAGE COLLECTION DAM (ASCD)
- SCAVENGER TAILINGS DISCHARGE
- CATCHMENT BOUNDARY
- CYCLONE HOUSE AND ACCESS ROUTE TIE–IN POINT
- RECLAIM BARGE
- FLOATING PYRITE TAILINGS DEPOSITION BARGE
- SCAVENGER PIPELINE
- PYRITE PIPELINE
- WATER PIPELINE
- ACCESS ROUTE TO WEST PLANT
- ULTIMATE TSF FOOTPRINT
- BORROW AREA
- CYCLONED SAND EMBANKMENT
- STARTER DAM
- SCAVENGER TAILINGS (CYCLONED OVERFLOW / TOTAL SCAVENGER COMPOSITE)
- PYRITE TAILINGS
- TSF RECLAIM POND
- SCD POND

NOTES

1. PROJECTION AND DATUM: ARIZONA STATE PLANE CENTRAL NAD 83 – INTERNATIONAL FOOT.
2. TOPOGRAPHY BASED ON LIDAR 2013 SURVEY.

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1000 0 1000 FT

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Klohn Crippen Berger

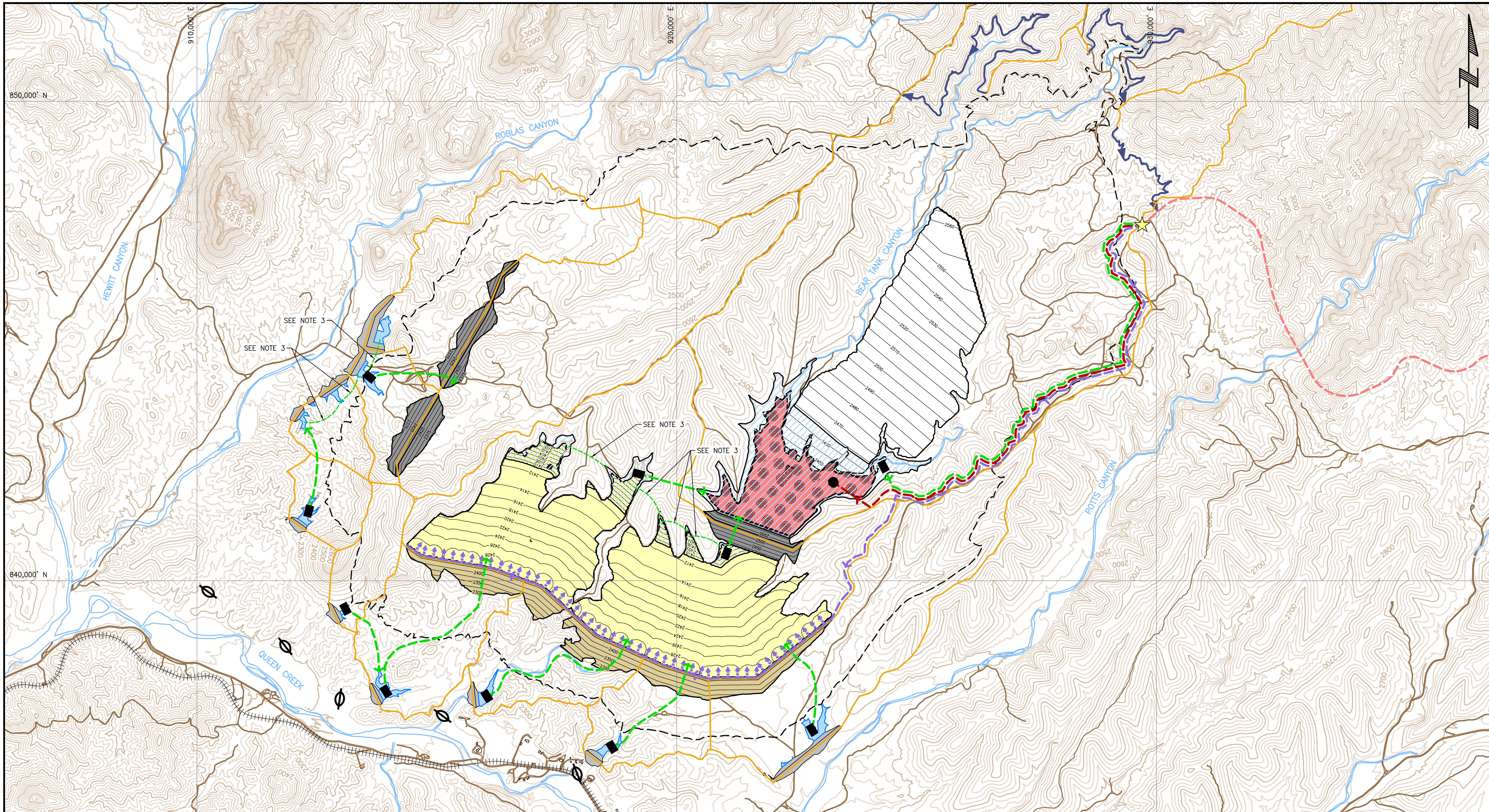
PROJECT: RESOLUTION COPPER PROJECT
DEIS DESIGN FOR ALTERATNATIVE 3A – NEAR WEST MODIFIED PROPOSED ACTION (MODIFIED CENTERLINE EMBANKMENT)

TITLE: TAILINGS STAGING END OF STAGE I (YEAR 2)

SCALE	PROJECT No.	FIG. No.
AS SHOWN	M09441A20	5.5

Date: 2018-05-30 Time: 11:00 AM
Drawing File: Z:\M\VCR\M09441A20 – RES-Near West PFS-PES\400 Drawings\CAD\Alt 3A Near West Wet TSF\DEIS\FIG_5.5.dwg – FIG (persyem)

KCB-FIG-D-L



LEGEND

DIVERSION CHANNEL
RAILWAY
EXISTING ROAD
MAJOR NATURAL DRAINAGE
PRIMARY SEEPAGE COLLECTION DAM (SCD)
AUXILIARY SEEPAGE COLLECTION DAM (ASCD)
SCAVENGER TAILINGS DISCHARGE
CATCHMENT BOUNDARY
CYCLONE HOUSE AND ACCESS ROUTE TIE-IN POINT
RECLAIM BARGE
FLOATING PYRITE TAILINGS DEPOSITION BARGE
SCAVENGER PIPELINE
PYRITE PIPELINE
WATER PIPELINE
ACCESS ROUTE TO WEST PLANT
ULTIMATE TSF FOOTPRINT
BORROW AREA
CYCLONED SAND EMBANKMENT
STARTER DAM
SCAVENGER TAILINGS (CYCLONED OVERFLOW / TOTAL SCAVENGER COMPOSITE)
PYRITE TAILINGS
TSF RECLAIM POND
SCD POND

NOTES

1. PROJECTION AND DATUM: ARIZONA STATE PLANE CENTRAL NAD 83 – INTERNATIONAL FOOT.
2. TOPOGRAPHY BASED ON LIDAR 2013 SURVEY.
3. POTENTIAL EXCAVATION (TO FILL) OR PUMP AND PIPELINE.

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CLIENT: RESOLUTION COPPER	PROJECT: RESOLUTION COPPER PROJECT DEIS DESIGN FOR ALTERNATIVE 3A – NEAR WEST MODIFIED PROPOSED ACTION (MODIFIED CENTERLINE EMBANKMENT)
Klohn Crippen Berger	TITLE: TAILINGS STAGING END OF STAGE II (YEAR 4)
SCALE: AS SHOWN	PROJECT No.: M09441A20 — FIG. No.: 5.6

Date: 2018-05-30 Time: 11:00 AM
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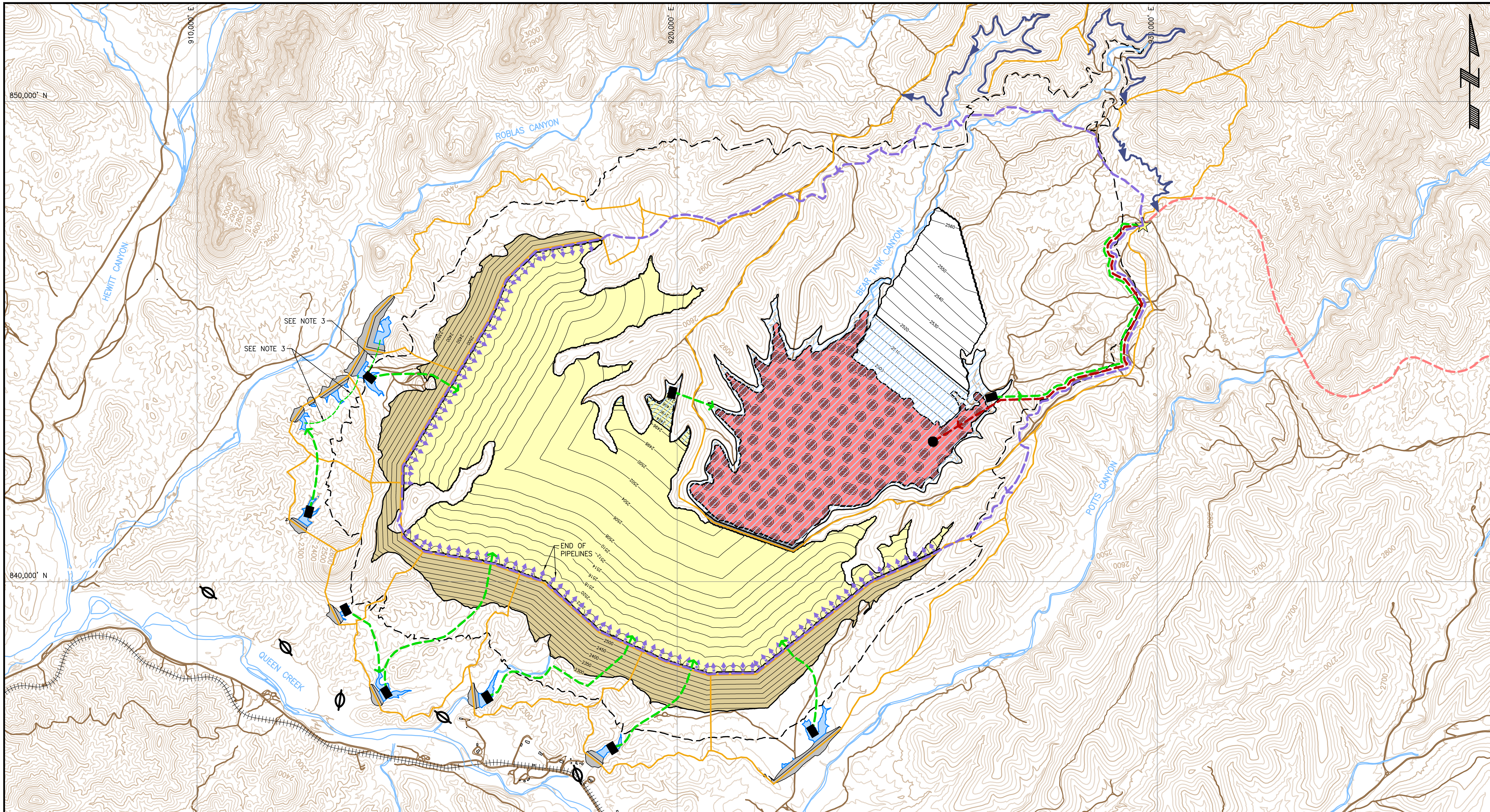
KCB-FIG-D-L



LEGEND

- DIVERSION CHANNEL
- RAILWAY
- EXISTING ROAD
- MAJOR NATURAL DRAINAGE
- PRIMARY SEEPAGE COLLECTION DAM (SCD)
- AUXILIARY SEEPAGE COLLECTION DAM (ASCD)
- SCAVENGER TAILINGS DISCHARGE
- CATCHMENT BOUNDARY
- CYCLONE HOUSE AND ACCESS ROUTE TIE-IN POINT
- RECLAIM BARGE
- FLOATING PYRITE TAILINGS DEPOSITION BARGE
- SCAVENGER PIPELINE
- PYRITE PIPELINE
- WATER PIPELINE
- ACCESS ROUTE TO WEST PLANT
- ULTIMATE TSF FOOTPRINT
- BORROW AREA
- CYCLONED SAND EMBANKMENT
- STARTER DAM
- SCAVENGER TAILINGS (CYCLONED OVERFLOW / TOTAL SCAVENGER COMPOSITE)
- PYRITE TAILINGS
- TSF RECLAIM POND
- SCD POND

NOTES

1. PROJECTION AND DATUM: ARIZONA STATE PLANE CENTRAL NAD 83 – INTERNATIONAL FOOT.
2. TOPOGRAPHY BASED ON LIDAR 2013 SURVEY.
3. POTENTIAL EXCAVATION (TO FILL) OR PUMP AND PIPELINE.

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CLIENT: RESOLUTION COPPER

Klohn Crippen Berger

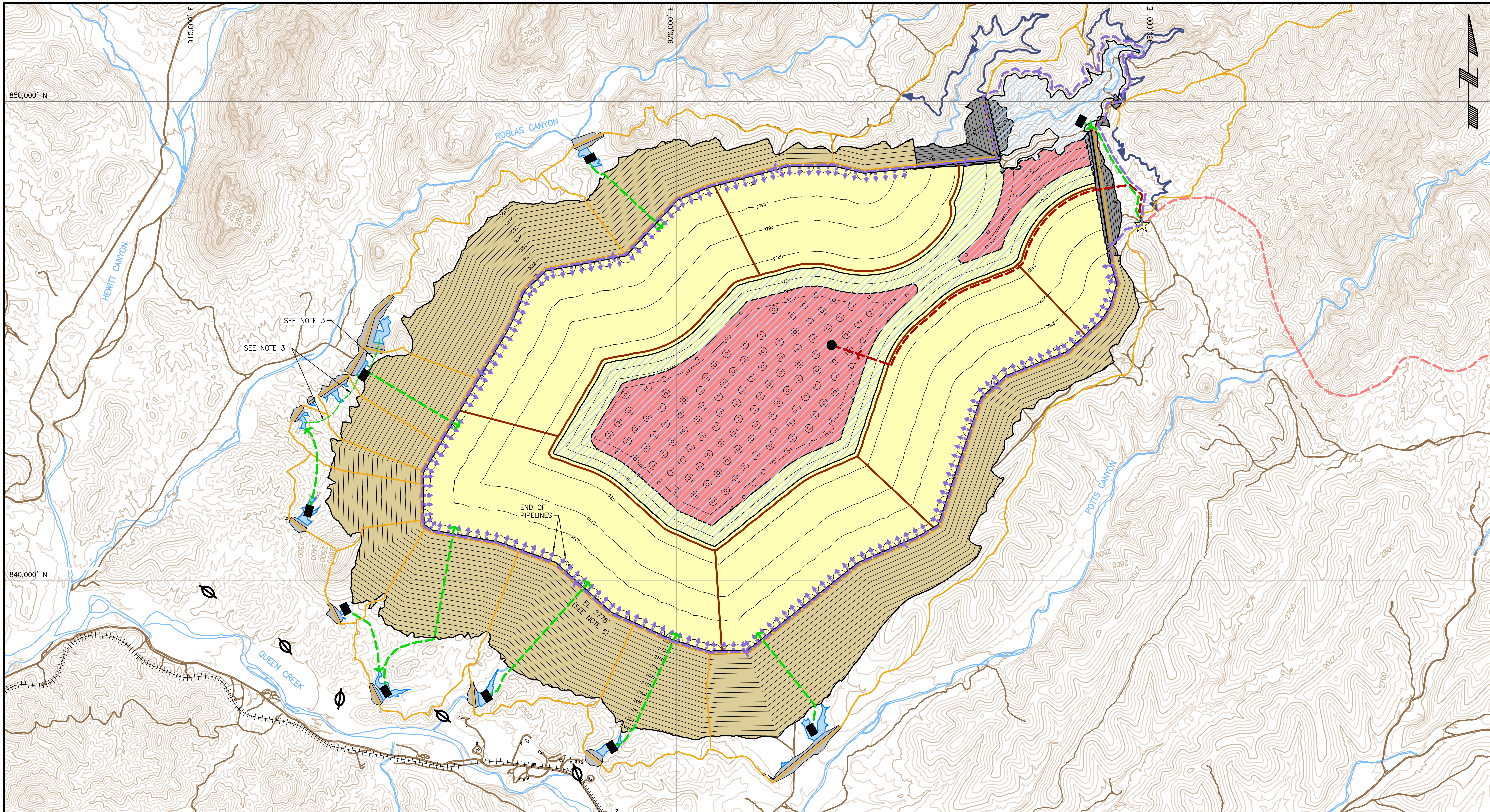
PROJECT: RESOLUTION COPPER PROJECT
DEIS DESIGN FOR ALTERNATIVE 3A – NEAR WEST MODIFIED PROPOSED ACTION (MODIFIED CENTERLINE EMBANKMENT)

TITLE: TAILINGS STAGING END OF STAGE III (YEAR 9)

SCALE	PROJECT No.	FIG. No.
AS SHOWN	M09441A20	5.7

KCB-FIG-D-L

Date: 2018-05-30 Time: 11:00 AM
Drawing File: Z:\M\VCR\M09441A20 – RES-Near West PFS-PES\400 Drawings\CAD\Alt 3A Near West Wet TSF\DEIS\FIG_5.7.dwg – fig (persyem)



LEGEND

- DIVERSION CHANNEL
- RAILWAY
- EXISTING ROAD
- MAJOR NATURAL DRAINAGE
- PRIMARY SEEPAGE COLLECTION DAM (SCD)
- AUXILIARY SEEPAGE COLLECTION DAM (ASCD)
- SCAVENGER TAILINGS DISCHARGE
- CATCHMENT BOUNDARY
- CYCLONE HOUSE AND ACCESS ROUTE TIE-IN POINT
- RECLAIM BARGE
- FLOATING PYRITE TAILINGS DEPOSITION BARGE
- SCAVENGER PIPELINE
- PYRITE PIPELINE
- WATER PIPELINE
- ACCESS ROUTE TO WEST PLANT
- CYCLONED SAND EMBANKMENT
- NORTH DAM
- SCAVENGER TAILINGS (CYCLONED OVERFLOW / TOTAL SCAVENGER COMPOSITE)
- PYRITE TAILINGS
- TSF RECLAIM POND
- SCD POND
- RECLAIM POND ACCESS BERMS

NOTES

1. PROJECTION AND DATUM: ARIZONA STATE PLANE CENTRAL NAD 83 – INTERNATIONAL FOOT.
2. TOPOGRAPHY BASED ON LIDAR 2013 SURVEY.
3. POTENTIAL EXCAVATION (TO FILL) OR PUMP AND PIPELINE.
4. EMBANKMENT ELEVATION SHOWN IS 2806 FASL BASED ON THE GPO TAILINGS PRODUCTION SCHEDULE. EL. 2775 FASL IS THE ANTICIPATED EMBANKMENT CREST ELEVATION BASED ON THE DEIS TAILINGS PRODUCTION SCHEDULE.

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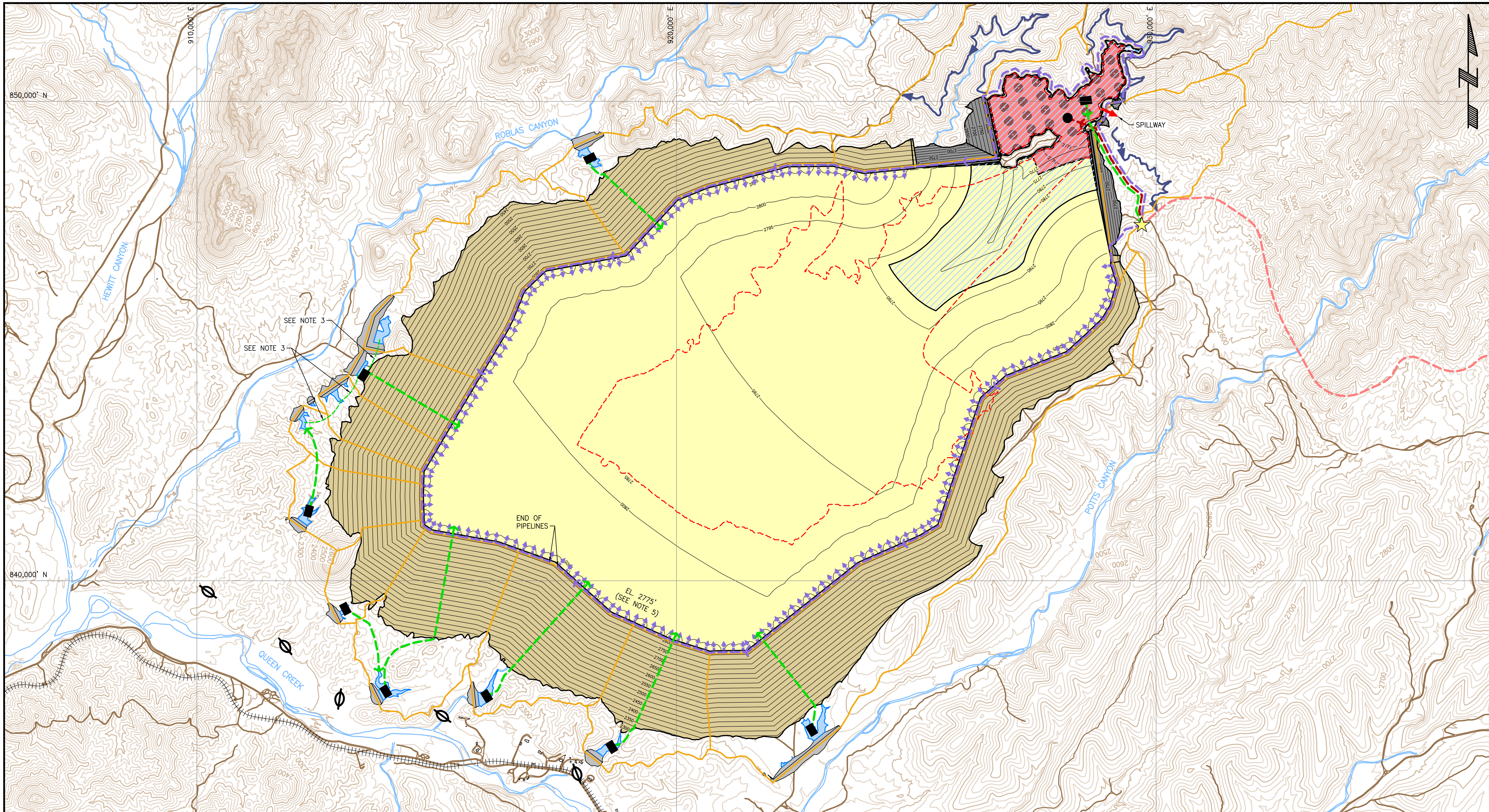
1000 0 1000 FT

CLIENT: RESOLUTION COPPER	PROJECT: RESOLUTION COPPER PROJECT DEIS DESIGN FOR ALTERNATIVE 3A – NEAR WEST MODIFIED PROPOSED ACTION (MODIFIED CENTERLINE EMBANKMENT)
Klohn Crippen Berger	TITLE: TAILINGS STAGING END OF STAGE IV (YEAR 34)
SCALE: AS SHOWN	PROJECT No.: M09441A20 — FIG. No.: 5.8

Date: 2018-05-30 Time: 11:00 AM
Drawing File: Z:\M\VCR\M09441A20 – RES-Near West PFS-PES\400 Drawings\CAD\Alt 3A Near West Wet TSF\DEIS\FIG_5.8.dwg – FIG (persyem)

KCB-FIG-D-L



LEGEND

- DIVERSION CHANNEL
- RAILWAY
- EXISTING ROAD
- MAJOR NATURAL DRAINAGE
- PRIMARY SEEPAGE COLLECTION DAM (SCD)
- AUXILIARY SEEPAGE COLLECTION DAM (ASCD)
- SCAVENGER TAILINGS DISCHARGE
- CATCHMENT BOUNDARY
- CYCLONE HOUSE AND ACCESS ROUTE TIE-IN POINT
- RECLAIM BARGE
- FLOATING PYRITE TAILINGS DEPOSITION BARGE
- SCAVENGER PIPELINE
- PYRITE PIPELINE
- WATER PIPELINE
- ACCESS ROUTE TO WEST PLANT
- CYCLONED SAND EMBANKMENT
- NORTH DAM
- SCAVENGER TAILINGS (CYCLONED OVERFLOW / TOTAL SCAVENGER COMPOSITE)
- PYRITE TAILINGS
- PYRITE TAILINGS EXTENT
- TSF RECLAIM POND
- SCD POND

NOTES

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2. TOPOGRAPHY BASED ON LIDAR 2013 SURVEY.
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1000 0 1000 FT

CLIENT: RESOLUTION COPPER	PROJECT: RESOLUTION COPPER PROJECT DEIS DESIGN FOR ALTERNATIVE 3A – NEAR WEST MODIFIED PROPOSED ACTION (MODIFIED CENTERLINE EMBANKMENT)
Klohn Crippen Berger	TITLE: TAILINGS STAGING END OF STAGE V (YEAR 41)

SCALE	PROJECT No.	FIG. No.
AS SHOWN	M09441A20	5.9

KCB-FIG-D-L

6 FOUNDATION CHARACTERIZATION AND DESIGN SECTOR DEFINITION

6.1 General

The foundation of the TSF has been divided into "design sectors", each of which encompasses a region of broadly similar foundation geology and embankment geometry, and therefore, requires similar foundation treatment and seepage control measures, refer to Figure 6.1. These design sectors are referenced throughout this report in connection to seepage management, particularly in Section 8, where the seepage management plan is described per sector.

Key details on the design sectors are summarized in Table 6.1 and further discussion on the environmental, safety and mitigation measures is provided in the following subsections.

Table 6.1 Design Sectors

Sector Name	Primary Foundation Geology	Key Design Considerations
Northeast	Rhyolite (Tp) and Tuff (Tt)	Relatively high hydraulic conductivity of the foundation rock units providing a pathway for seepage. Potential for low-strength layers in the foundation.
East	Gila Conglomerate (Tcg)	Potential for reduced foundation strength resulting from Gila Conglomerate saturation, and potential seepage through the Gila Conglomerate into Potts Canyon
Southeast	Gila Sandstone (Tss)	Potential for low-strength layers (montmorillonite clay) in the foundation. The existing site investigation information indicate these layers are potentially present within 30 ft of surface (KCB 2017b).
South	Pinal Schist (Xp) and Tertiary Basalt (Tb)	Control of seepage through the bedrock to prevent flow into Queen Creek, and the potential for low-strength layers within the Pinal Schist.
West	"Mixed" Bedrock Geology	Potential for low-strength or collapsible layers within the Apache Leap tuff, dissolution of the limestone units, and seepage into Roblas Canyon. Limited occurrence of these were observed during the site investigation (KCB 2017b). Existing workings from the abandoned Bomboy Mine may present a collapse risk and pathway for seepage.
Northwest	Gila Conglomerate (Tcg)	Similar considerations to the East Design Sector; however, in this region, the potential seepage and stability considerations are less pronounced because the embankment height is lower and seepage flow is against the regional gradient.
North	"Mixed" Bedrock Geology	Potential for seepage through the foundation towards Potts Canyon.

6.2 Northeast Design Sector

The Northeast design sector encompasses a region of Tertiary rhyolite (Tp), and a narrow strip of Tertiary tuff (Tt) at the southern boundary of the design sector. This design sector forms part of a ridge leading to Potts Canyon to the east of the TSF. The main design considerations for this design sector relate to the high hydraulic conductivity and potential for low strength layers in the foundation units.

The hydraulic conductivity of these units is typically in the range of 10^{-5} cm/s to 10^{-6} cm/s; however, zones up to 3 x 10^{-1} cm/s and 2 x 10^{-3} cm/s were recorded in tuff and rhyolite, respectively, during packer testing in the 2016/2017 SI (KCB 2017b). The water level in this region is also lower than the regional trend. These observations imply a potential for seepage to pass through these units into Potts Canyon; seepage management is discussed in Section 8.

There has been a suggestion that low strength layers may exist in these units based on observations of weathered tuff layers in boreholes outside the embankment footprint during the 2016/2017 SI as well as observations of montmorillonite clay-rich weathered layers within the rhyolite. It is currently assumed that rhyolite would form one of the main borrow sources for granular fill required for drains (see Section 10); therefore, blasting/excavation of this unit is already accounted for within the design. If these layers are found to be pervasive and/or persistent in the tuff, it is assumed they could be managed by excavation of a shear key or flattening of the embankment slope, without significantly the overall TSF design.

6.3 East Design Sector

The East design sector extends along a ridge of Gila Conglomerate (Tcg), which separates the TSF from Potts Canyon. The main design considerations for this sector include the potential for reduced foundation strength resulting from Gila Conglomerate saturation, and potential seepage through the Gila Conglomerate into Potts Canyon.

The Gila Conglomerate at the Near West site has an average unconfined compressive strength (UCS) of roughly 1800 psi, classifying as a very weak to weak rock. This strength is significantly higher than that of the tailings and does not impact the stability of the TSF; however, an additional consideration for Gila Conglomerate is that this unit can lose strength during saturation. This potential was assessed in the geotechnical site characterization (KCB 2017b) and a reduced strength of $\phi' = 26°$ has been selected for the upper 10 ft of Gila Conglomerate in this DEIS design to account for this possible strength reduction.

It is currently assumed that weathered Gila Conglomerate will not be susceptible to strength loss during undrained loading or liquefaction because there is no reported evidence of this occurring in the region. Samples of crushed Gila Conglomerate tested in the 2017 site characterization (KCB 2017b) were also found to contain between 13 % and 19 % montmorillonite clay in the total mass of the sample, suggesting that the weathered soil will be clay-like and unlikely to liquefy.

The hydraulic conductivity of the Gila Conglomerate at the Near West site varies widely between 1 x 10^{-2} cm/s to 1 x 10^{-8} cm/s (based on packer testing) with the higher values being associated with localized discontinuities. These discontinuities will be treated, where identified, during foundation preparation. Other seepage control measures to limit the potential for flow through the Gila Conglomerate into Potts Canyon are discussed in Section 8.

6.4 Southeast Design Sector

The Southeast design sector encompasses a region of Gila sandstone (Tss), which was found to contain montmorillonite clay layers with a drained residual friction angle as low as $\phi' = 10°$ in the upper 30 ft of this unit. If these layers are persistent and continuous, they would impact the stability of the TSF in this region. Since these layers were observed in two boreholes during the 2016/2017 SI, a shear key trench may be required through this unit in this design sector to remove these layers from the upper 30 ft.

Limited data are available for the hydraulic conductivity of the Tss compared with the Tcg; however, the available data typically plot in the same range. Therefore, it is assumed that similar seepage control measures will be required for this design sector as for the East design sector (see Section 8).

6.5 South Design Sector

The South design sector covers an area dominated by Pinal Schist (Xp) located along the southern perimeter of the TSF, which separates the TSF from the Queen Creek aquifer. The Pinal Schist in this area is intersected by several alluvial drainage channels, and the eastern boundary of the design sector is underlain by Tertiary basalt (Tb). The main design considerations in this region relate to controlling seepage through the bedrock to prevent flow into Queen Creek, and the potential for weak layers within the Pinal Schist. Flow through the alluvial sediments is not a concern since the design incorporates excavation and removal of all alluvium within the footprint of the TSF and SCDs for use as drain material.

The hydraulic conductivity of the basalt ranges from 5×10^{-5} cm/s to 9×10^{-8} cm/s and the Pinal Schist varies between 2×10^{-3} cm/s and 6×10^{-8} cm/s.

Due to the importance of controlling seepage towards Queen Creek, a preliminary layout of several levels of seepage control has been included in this design, as discussed in Section 8. The need for, and extent of, each of these layers of seepage control will be evaluated during hydrogeological modeling and additional site characterization before construction.

Pinal Schist commonly has reduced strength along foliation planes. The orientation of foliation along the south design sector is typically favorable to stability.

Gouge filled foliations with a friction angle of $\phi' = 32°$ and c' = 14,400 psf have been identified in the Pinal Schist at Near West. Observations at other facilities have found lower strengths (in the order of $\phi' = 27°$) on a scale that is large enough to impact stability are possible in this unit. As a result, a strength of $\phi' = 27°$ and c' = 1000 psf has been selected for this unit.

6.6 West Design Sector

The West design sector encompasses a region of variable geology, referred to in previous design assessments at Near West as the ‘mixed geology’ area. This mixed geology area separates the TSF from Roblas Canyon to the west. Examples of the units in this area include Apache Leap tuff (Tal), Mescal Limestone (Ym), Martin Limestone (Dm), Dripping Spring Quartzite (Ydsl/ Ydsu), Bolsa Quartzite (Cb) and diabase (Yd).

The main design considerations in this area relate to the potential for weak or collapsible layers in the Apache Leap tuff, dissolution of the limestone units, and seepage into Roblas Canyon. Packer testing in these units identified hydraulic conductivities ranging widely between 6 x 10^{-3} cm/s and 5 x 10^{-8} cm/s, and observations of fluid losses during drilling suggest there are discrete zones within these units where the hydraulic conductivity is significantly higher than other areas in the rock mass. To mitigate the potential for seepage through these layers reaching Roblas Canyon, and/or causing dissolution of the limestone layers, selective lining of this area has been included together with other seepage control measures in this design, as discussed in Section 8.

Based on the limited observations of weathered material in the 2017 SI, it is assumed that any weathered material will be located close to the surface (i.e. within the upper 10 ft to 20 ft) and would be excavated as part of site preparation; however, deeper zones of weathered tuff (up to roughly 60 ft) were observed in drill holes located outside of the facility footprint, implying that deeper zones of weathering could exist. If these layers are found to be pervasive and/or persistent in the tuff, they could be managed by excavation of a shear key or flattening of the embankment slope, without significantly the overall TSF design.

A 3 ft deep void was observed in the televiewer profile of a highly fractured area of Mescal Limestone in one of the drill holes, which implies that localized dissolution of the limestone units may have occurred in this region. Packer testing found low hydraulic conductivity (10^{-7} cm/s) across the zone where the potential voids were observed suggesting this void is limited in extent.

Due to limited observations and extent of these features, and the site and regional geology, the current design assumption is that any existing dissolution features are minor and localized and would not affect the integrity of the TSF. Because dissolution features could be a potential seepage pathway, the implementation of seepage mitigation measures discussed in Section 8 would treat areas to prevent seepage flows where dissolution features are discovered in the future.

An abandoned underground mine and shafts called Bomboy Mine is located in this design sector. These mine workings could potentially impact the TSF by providing a preferential flow path for seepage, or by collapsing under the embankment causing deformation of the embankment and/or seepage control measures. The extent of these mine workings and whether they have collapsed/partially collapsed will be investigated with geophysical methods. It is currently assumed that these workings are intact and the design will incorporate treatment by grouting or removing the hill that they are in.

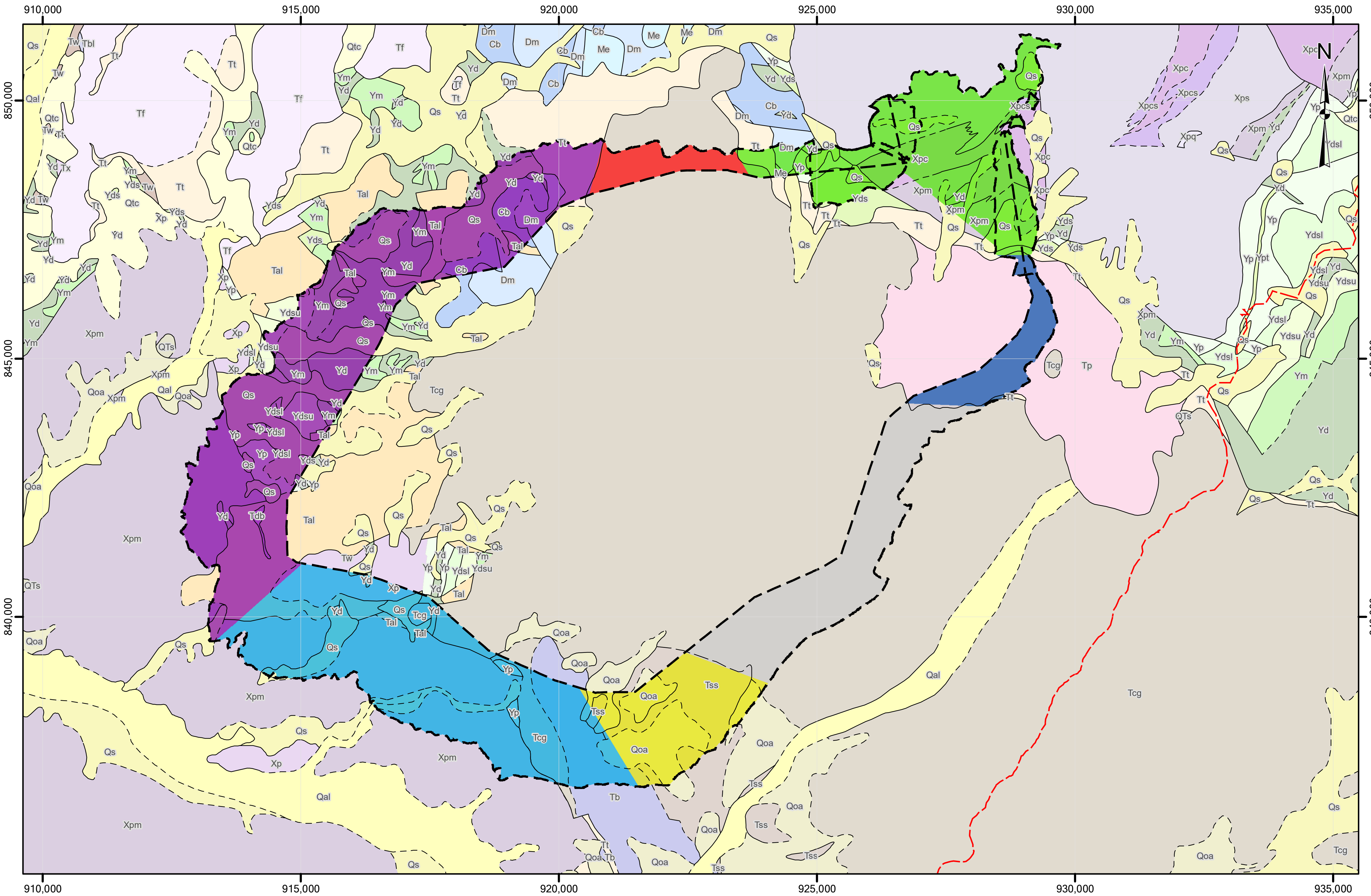
6.7 Northwest Design Sector

The Northwest design sector covers a region of Gila Conglomerate. The design considerations in this region are similar to those discussed for the East design sector; however, in this region, the potential seepage and stability considerations are less pronounced because the embankment height of this area (up to 200 ft) is lower than in the East design sector (up to 350 ft) and the seepage flow is against the regional gradient.

The current design assumption is that seepage could develop through this region towards Roblas Canyon, if it is not mitigated, due to potential changes to the groundwater flow regime because of groundwater mounding beneath the TSF. Therefore, an allowance for grouting surface bedrock fracture zones in this region has been included in the seepage control measures (see Section 8); however, the need for this grouting will be reviewed using hydrogeological modeling and additional site characterization in advance of construction.

6.8 North Design Sector

The North design sector includes a similar range of geological units as the West design sector; however, the embankment height in this sector (up to 150 ft) is less than all other sectors because the natural ground elevation is the highest. Therefore, the main design consideration in this area is the potential for seepage through the foundation towards Potts Canyon. As with the Northeast design sector, the embankments in this design sector will impound the pyrite tailings with a consistent water cover over the pyrite tailings.



GEOLOGICAL UNITS

Qs	Undivided Surficial Deposits (Quaternary)
Qtd	Disturbed Surficial Deposits (Holocene)
Qtc	Talus and Colluvium (Quaternary)
Qal	Unconsolidated Alluvium (Quaternary)
Qoa	Old Alluvium (Quaternary)
QTs	Older Alluvium (Early Quaternary to Late Tertiary)
Tcg	Conglomerate (Pliocene to Late Miocene)
Tss	Sandstone (Pliocene to late Miocene)
Tb	Basalt (Mid-Miocene to Early Miocene)
Tp	Perlitic Aphyric Rhyolite (Middle Tertiary)
Tal	Apache Leap Tuff (Early Miocene)
Tt	Tuff (poorly welded) (Miocene)
Tf	Felsic Volcanic Rocks, undivided (Middle Tertiary)
Tbl	Lower Basalt (Middle Tertiary)
Tx	Rock Avalanche or Talus Breccia (Middle Tertiary)
Tw	Whitetail Conglomerate
Tdb	Basaltic Dikes (Middle Tertiary)
Kd	Quartz Diorite (Latest Cretaceous)
Me	Escabrosa Limestone (Mississippian)
Dm	Martin Limestone (Devonian)
Cb	Bolsa Quartzite (Cambrian)
Yd	Diabase (Middle Proterozoic)
Ym	Mescal Limestone (Middle Proterozoic)
Yds	Dripping Spring Quartzite, undivided (Middle Proterozoic)
Ydsu	Dripping Spring Quartzite, Upper Unit (Middle Proterozoic)
Ydsl	Dripping Spring Quartzite, Lower Unit (Middle Proterozoic)
Yp	Pioneer Shale (Middle Proterozoic)
Ypt	Pioneer Shale, Tuff Unit (Middle Proterozoic)
YXd	Diorite (Early or Middle Proterozoic)
Xp	Pinal Schist, undivided (Early Proterozoic)
Xpc	Pinal Schist, Calc-silicate Facies (Early Proterozoic)
Xpcs	Pinal Schist, Calc-silicate and Schist Facies (Early Proterozoic)
Xpm	Pinal Schist, Psammite Facies (Early Proterozoic)
Xpp	Pinal Sctist, Phyllite Facies (Early Proterozoic)
Xpq	Pinal Schist, Quartzite Layers (Early Proterozoic)
Xps	Pinal Schist, Pelitic Schist (Early Proterozoic)

0 1 Mile

LEGEND

ALTERNATIVE 3A: NEAR WEST TSF

CONTACT (BETWEEN GEOLOGIC UNITS)

CONTACT - APPROXIMATE

CONTACT - INFERRED

ARIZONA NATIONAL SCENIC TRAIL (ARIZONA TRAIL)

DESIGN SECTORS

- EAST
- NORTH
- NORTHEAST
- NORTHWEST
- SOUTH
- SOUTHEAST
- WEST

NOTES:
1. NAD83, ARIZONA STATE PLANE CENTRAL
2. REFER TO GEOTECHNICAL SITE CHARACTERIZATION REPORT FOR SOURCE OF GEOLOGY

NOT FOR CONSTRUCTION

TO BE READ WITH KLOHN CRIPPEN BERGER REPORT DATED: JUNE 2018

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PROJECT

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TITLE

DESIGN SECTORS

PROJECT No. M09441A20

FIG No. 6.1

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7 WATER MANAGEMENT PLAN

7.1 Surface Water Management System

The objectives of the operational water management plan are to:

- divert non-contact water around the TSF to keep separate from contact water;
- minimize water losses and maximize contact water recycled back to the West Plant for ore processing;
- intercept embankment toe seepage and surface runoff from the TSF and recycle the water to the reclaim pond;
- maintain a reclaim pond to keep pyrite tailings saturated;
- store the inflow design flood within the impoundment with adequate freeboard; and
- protect the TSF and diversion structures from erosion from flood events.

The water management concept is shown schematically on Figure 7.1, water management features are shown on Figure 5.1, Figure 5.9, Figure 8.4 and Figure 8.5. The surface water management system includes the following components:

Upstream Water Diversions

Alternative 3A would have the same upstream diversions as Alternative 2 (Near West GPO Proposed Action), as presented in KCB (2014).

The three diversion channels would be constructed north of the TSF to route the upstream catchment around the facility. The diversion channel general layouts are shown on Figure 5.1. They are sized to convey the peak PMF flow, which is the greater peak flow of the 6-hr to 72-hr

Reclaim Pond

The TSF reclaim ponds are sized based on the following:

- Scavenger starter reclaim pond (Year 1 to Year 9) – minimum operating pond is sized with a depth of 20 ft (at the deepest point in the pond) to allow for settling of tailings and operation of the reclaim barge.
- Pyrite starter reclaim pond (Year 1 to Year 9) – minimum water cover over pyrite tailings of 10 ft, which is a conservative depth for reclaim barge and pyrite deposition barge draft.
- Combined reclaim pond (Year 10 to Year 41) – minimum water cover over the pyrite tailings cone peaks of 5 ft, for reclaim barge and pyrite deposition barge draft. The reclaim barge will be located to reclaim clarified water.

Downstream Embankment Runoff Collection Ditches

Lined collection ditches would be constructed along the embankment toe and at underdrain discharges to convey water to the SCDs.

Seepage Collection Dams (SCDs)

Eleven SCDs would be built to collect seepage water from the tailings embankment underdrain system and surface runoff from the embankment slope. The staging of the seepage dams is shown on Figure 5.5 to Figure 5.9 and a typical section is shown on Figure 8.5.

Water from the SCDs will be pumped back into the TSF. The design criteria for the SCD sizing is included in the DBM (Appendix I). The storage capacity will have allowance for the minimum operating volume, maximum seasonal volume (for an average climatic year), volume required for operational upset, volume for critical duration storm even including sediment (Environmental Design Flood and Inflow Design Flood) and minimum freeboard above peak flood level.

The toe of the tailings embankment will be armored to convey seepage that daylights along ridges to the SCDs. The toe of the SCDs will be armored to protect the TSF from flooding in Queen Creek, Roblas Canyon and Potts Canyon.

Seepage collections dams may also be used to manage fines that are suspended in excess surface water from cycloned sand hydraulic placement cells.

Auxiliary Seepage Collection Dams (ASCD)

As part of the staged seepage management plan (see Section 8), Level 3 of the plan includes the construction of additional 'auxiliary' SCDs (ASCD) downstream of the SCDs.

The assumption at this design stage is that the ASCDs would include similar elements as the SCDs, but would be a maximum of approximately 15 ft high. This reduced height compared with the SCDs is because these ASCDs would not collect surface runoff from the TSF and would not be defined as a jurisdictional dam under the Arizona Department of Water Resources (ADWR).

Water Reclaim Systems

Pumping systems (e.g. floating barges, pump stations, siphons) would be utilized to move impounded contact water to central areas where it can be recycled back to the West Plant or used for some other beneficial purpose (e.g. dust management).

The water reclaim systems include the following:

- Pond Reclaim System (PRS) – recovers water from the TSF pyrite reclaim pond and delivers it to the cyclone house at the northeast corner of the facility and from the combined TSF reclaim pond after Year 9.
- Pond Transfer Reclaim System (PTRS) – during Year 1 to Year 9, transfers water from the scavenger pond to the pyrite pond.
- Seepage Reclaim System (SRS) – returns seepage and embankment runoff to the TSF. Includes the SCDs and the additional seepage mitigation infrastructure discussed in Section 8.
- TSF Thickeners – overflow water from the TSF thickeners (for cyclone overflow) would be used to dilute cyclone feed stream and surplus would be reclaimed to the West Plant.

- Dust Management – pumps water from the reclaim pond around the embankment to sprinklers.

7.2 Water Balance

A start-up, operational and post-closure contact water balance was completed for monthly average inflows and outflows, the assumptions and results are summarized in Appendix IV. The main objectives of the water balance were to:

- provide an understanding of monthly average inflows and outflows of the TSF system;
- estimate when the TSF system is in a state of "loss" (defined as having less water available than the West Plant requires, not including the other West Plant inflows) or "surplus" (i.e. defined as having more water than the West Plant requires, not including the other West Plant inflows);
- preliminary estimate of seasonal fluctuations of pond water for the sizing of water collection ponds; and
- provide a basis for further water quality and downstream solute transport assessments (completed by others).

The operational TSF water balance is represented schematically on Figure 7.1 and is focused around the water ponds (i.e. seepage collection ponds, TSF reclaim pond). The West Plant water requirements and TSF reclaim rates are shown on Figure 7.2. A summary of the TSF system losses and surpluses are given in Table 7.1 and Table 7.2.

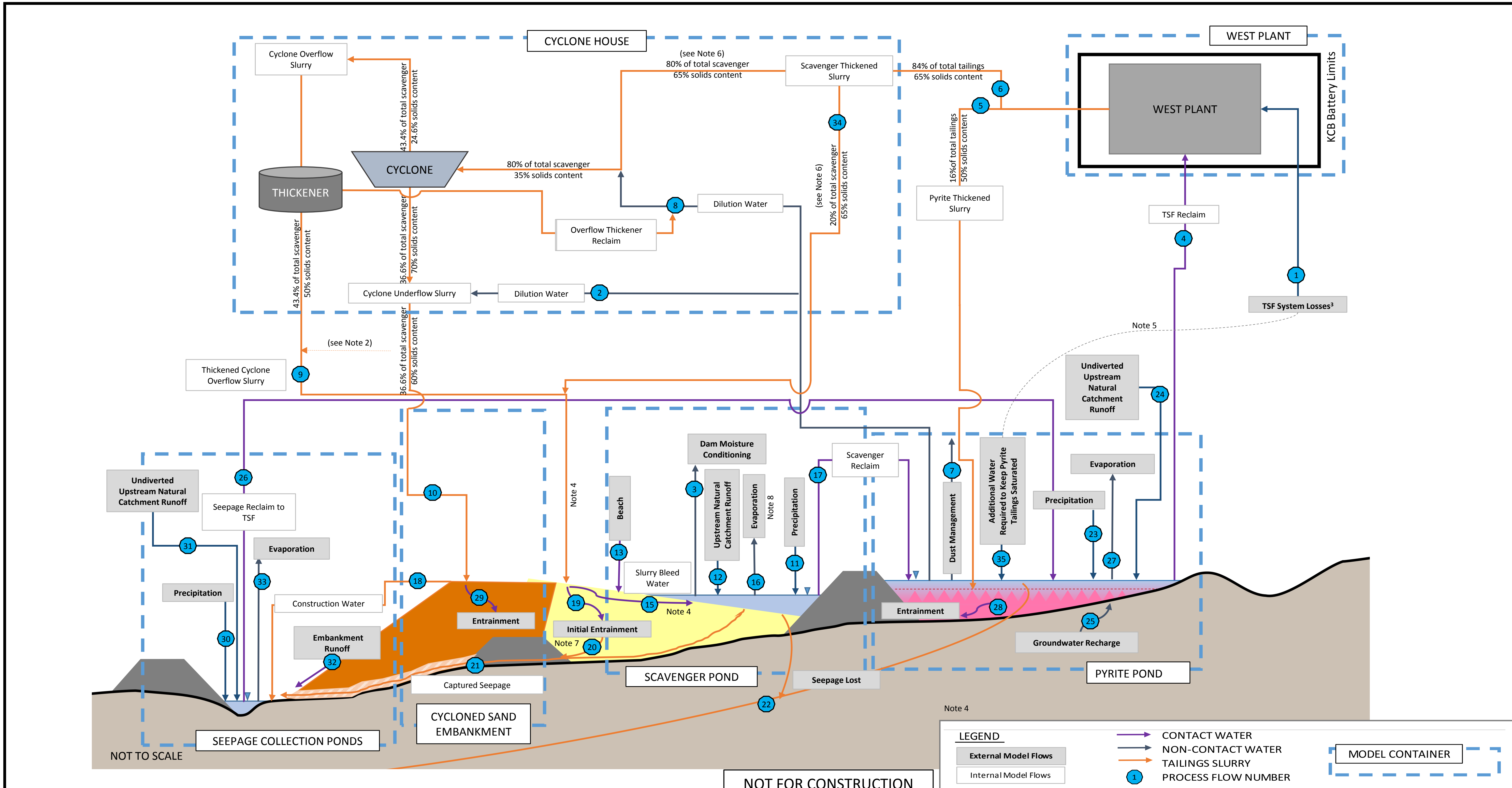
Table 7.1 Summary of TSF System Water Requirements from Other Sources

Flow Description	Operations (acre-ft)	Post-Closure Phase 1 (acre-ft)	Post-Closure Phase 2 (acre-ft)
Additional water required for Pyrite Pond (to maintain saturation)	2,000 (Years 2 to 5)	0	n/a
TSF system loss (water required for the West Plant from other sources)	531,000	0	0

Table 7.2 Summary of TSF Active Water Management Requirements (System Surplus)

Flow Description	Operations (acre-ft)	Post-Closure Phase 1 (acre-ft)	Post-Closure Phase 2 (acre-ft)
TSF Reclaim Pond	1,500 (Years 39 to 41)	0	n/a
Seepage Collection Ponds	0	0	4,400

Notes:
Active water management is required when the storage pond does not have capacity to evaporate inflows on an annual basis. Active water management could include pumping water to different locations or using spray evaporators for additional evaporation capacity and/or treating and releasing.



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Notes:

1. All percentages reported are by weight.
2. For staging/planning a 3% loss of the cyclone underflow mass in the embankment during hydraulic cell placement was assumed. This has not been taken into account in the water balance.
3. KCB does not account for water balance flows upstream of the tailings facility (i.e. ore processing facility, block cave dewatering etc.)
4. Bleed Water = Slurry Water - Entrainment
5. Total TSF system deficit includes the TSF system deficit (the difference between what the West Plant sends to the TSF and what is reclaimed from the TSF pond) and additional water required to keep pyrite tailings saturated.
6. Scavenger mass flow percentages shown are based on 80% of Scavenger tailings through the Cyclone. This value varies over the mine life.
7. A portion of the water initially entrained in tailings pore space (process flow 19) is released as tailings consolidate and draindown (process flow 20).

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PROJECT

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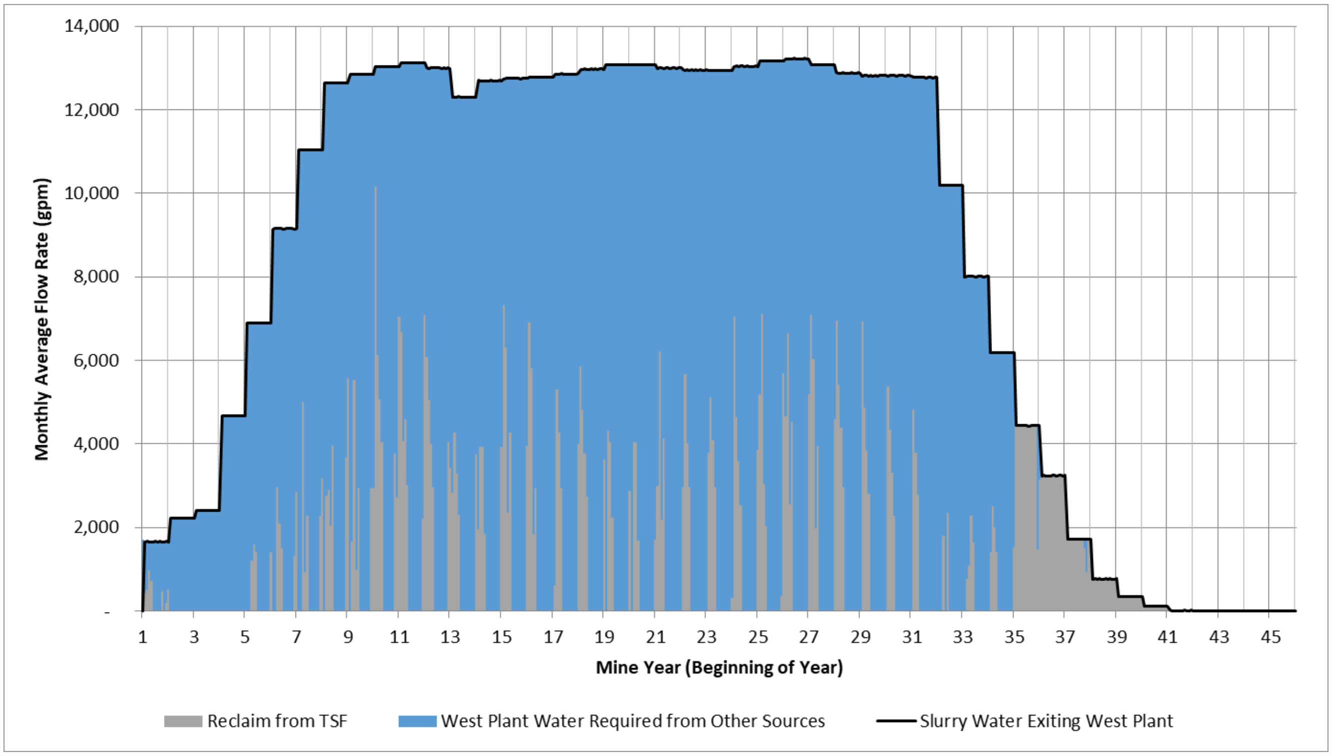
DEIS DESIGN FOR ALTERNATIVE 3A - NEAR WEST MODIFIED PROPOSED ACTION (MODIFIED CENTERLINE EMBANKMENT)

TITLE

WATER BALANCE SCHEMATIC

SCALE	PROJECT No.	FIG No.
AS SHOWN	M09441A20	7.1

Figure 7.2 West Plant Water Requirements from TSF and Other Sources



8 SEEPAGE MANAGEMENT PLAN

Available "best practice" management methods to reduce seepage as much as practical are included in the DEIS design at this stage. Seepage mitigation measures would be refined and optimized between the DEIS and final EIS if this was the selected alternative. In line with ADEQ requirements, assumed groundwater points of compliance are shown on Figure 8.1 to Figure 8.4.

The seepage management plan described below is shown on Figure 8.1 to Figure 8.5, and summarized in Table 8.1. Seepage mitigations are roughly sequenced in an upstream (nearest to TSF) to downstream (nearest to downstream receptor) direction:

- Level 1– Foundation Treatment and Primary Seepage Collection Measures;
- Level 2 – Grout Curtain Extension;
- Level 3 – Auxiliary Seepage Collection Dams (ASCDs); and
- Level 4 – Downstream Pumping Wells.

Level 1 (Figure 8.1 and Figure 8.5) – Foundation Treatment and Primary Seepage Collection Measures

Level 1 includes foundation treatment (dental concrete, cut-offs, grouting) or selective engineered low permeability layers[4] to decrease infiltration in the foundation and a primary layer of seepage collection (underdrainage, SCDs, pumpback system). Specific treatments would be reviewed for each design sectors.

Underdrainage would include the following:

- The scavenger starter dams would be constructed above the embankment blanket drain. The intention is that the blanket and finger drains would collect water from the tailings and convey it beneath the starter dams to a series of lined channels located within the drainage channels downstream of the TSF. The lined channels would then convey the collected seepage water to lined SCDs.
- Underdrains would be extended into the impoundment to intercept seepage from the scavenger beach area.

SCDs are included in Level 1 of the seepage control. These dams are located in the drainage valleys and would include the following elements:

- Excavation of all alluvial soil beneath the crest of the dam until competent foundation material is reached and replacement with compacted granular fill.
- An engineered low-permeability layer placed on the upstream face.

[4] The engineered low-permeability layer could be comprised of one or more of the following: compacted fine tailings, geomembrane liner, asphalt, slurry bentonite and/or cemented paste tailings.

- A cementitious grout curtain that extends to a depth of 100 ft into the foundation, and roughly 100 ft into each abutment.
- Pumpback wells installed in the granular fill beneath the SCD on the upstream side of the grouted core.

Level 2 (Figure 8.2 and Figure 8.5) – Grout Curtain Extension

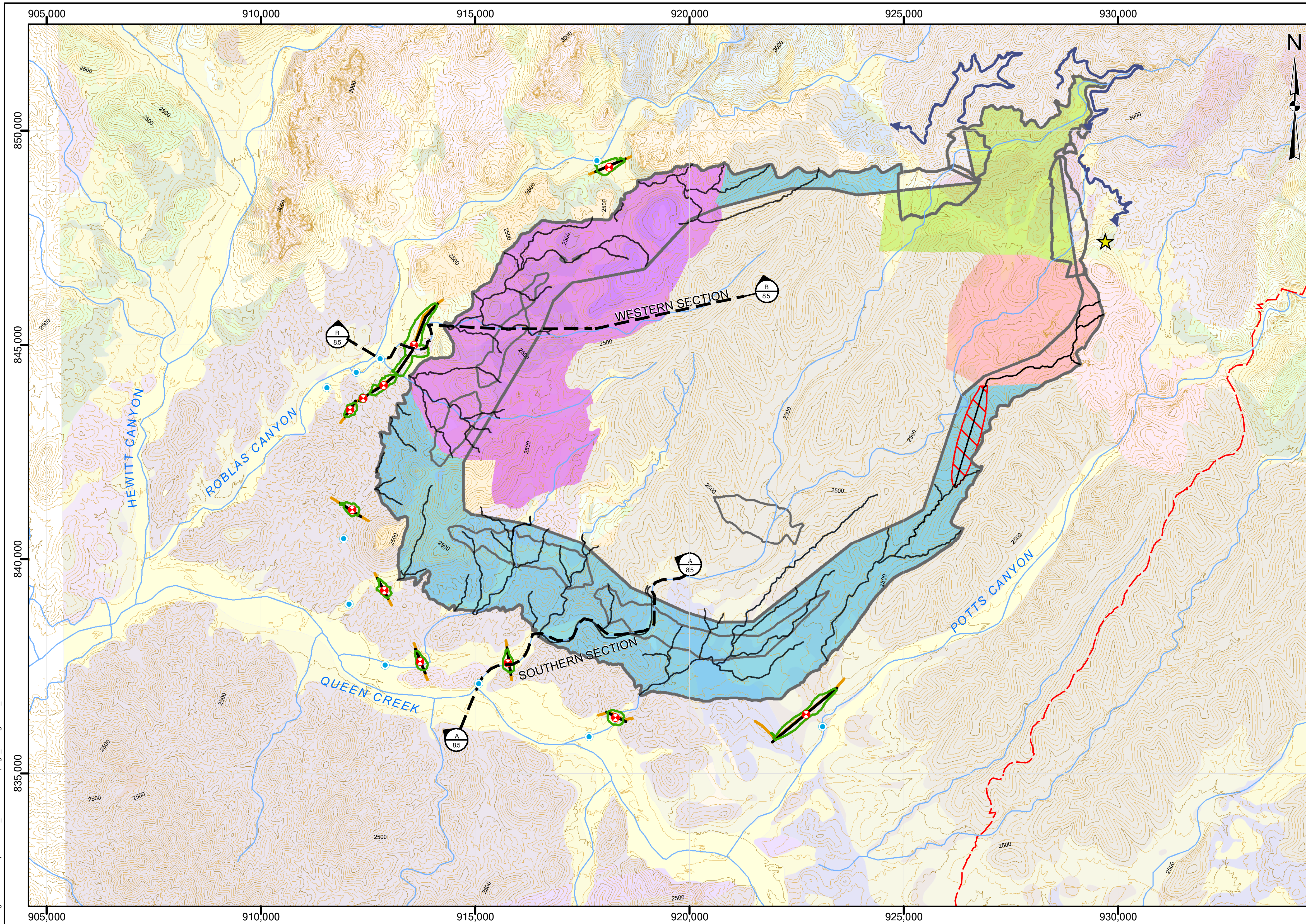
Level 2 measures include extending the grout curtain installed at the SCDs along the bedrock ridges between the SCDs. This grouting would be completed in a phased manner after additional SI's to identify potential high permeability zones, in which the extent of the first phase would be specified based on monitoring data and groundwater modeling results, which would be reviewed and updated as the grouting progressed and be used to guide any additional grouting.

Level 3 (Figure 8.3 and Figure 8.5) – Auxiliary Seepage Collection Dams

Level 3 measures include the construction of additional 'auxiliary' SCDs (ASCD) downstream of the SCDs. The intent from these ASCDs would be to capture any seepage that bypasses the Level 1 and/or Level 2 controls, either through the bedrock ridges or beneath the grout curtains. The assumption behind these Level 3 ASCDs is that the flow through the bedrock ridges or beneath the grout curtains will ultimately report to drainage channels. Therefore, the ASCDs would be located as far downstream along the drainage channels as feasible to maximize opportunity for seepage capture. The current assumption is that these ASCDs would be located up to a maximum of roughly 750 ft from Queen Creek.

Level 4 (Figure 8.4 and Figure 8.5) – Downstream Pumping Wells

Level 4 measures are intended to be deployed if there are indicators that seepage could or is currently bypassing Level 1 to 3 measures. Level 4 measures include installation and operation of a series of pumping wells in the identified seepage pathways.



LEGEND

- ALTERNATIVE 3A: NEAR WEST TSF (INCLUDING STARTER DAMS)
- CYCLONE HOUSE AND ACCESS ROUTE TIE-IN POINT
- CONCEPTUAL SECTION LOCATIONS
- UPSTREAM DIVERSION
- POINT OF COMPLIANCE (POC) TO BE LOCATED A MAXIMUM OF 750 ft DOWNSTREAM OF POLLUTION MANAGEMENT AREA (PMA)
- ARIZONA NATIONAL SCENIC TRAIL (ARIZONA TRAIL)
- MAJOR NATURAL DRAINAGES
- CONTOUR (20ft)
- CONTOUR (100ft)

SEEPAGE MANAGEMENT

LEVEL 1

- TSF SEEPAGE PUMPBACK WELL
- FINGER DRAINS
- GROUT CURTAIN
- CUT-OFF WALL
- PRIMARY SEEPAGE COLLECTION DAM
- EXCAVATION (TO FILL) AND REGRADING (SEE NOTE 3)
- SELECTIVE LINED NORTH AREA (SEE NOTE 4)
- BLANKET DRAIN
- RHYOLITE QUARRY AREA AND SELECTIVE LINING (SEE NOTE 4)
- SELECTIVE LINED WESTERN MIXED GEOLOGY AREA (SEE NOTE 4)

GEOLOGICAL UNITS

- Undivided Surficial Deposits (Quatenary)
- Disturbed Surficial Deposits (Holocene)
- Talus and Colluvium (Quaternary)
- Unconsolidated Alluvium (Quaternary)
- Old Alluvium (Quaternary)
- Older Alluvium (Early Quaternary to Late Tertiary)
- Conglomerate (Pliocene to Late Miocene)
- Sandstone (Pliocene to late Miocene)
- Basalt (Mid-Miocene to Early Miocene)
- Perlitic Aphyric Rhyolite (Middle Tertiary)
- Apache Leap Tuff (Early Miocene)
- Tuff (poorly welded) (Miocene)
- Felsic Volcanic Rocks, undivided (Middle Tertiary)
- Lower Basalt (Middle Tertiary)
- Rock Avalanche or Talus Brecchia (Middle Tertiary)
- Whitetail Conglomerate
- Basaltic Dikes (Middle Tertiary)
- Quartz Diorite (Latest Cretaceous)
- Escabrosa Limestone (Mississippian)
- Martin Limestone (Devonian)
- Bolsa Quartzite (Cambrian)
- Diabase (Middle Proterozoic)
- Mescal Limestone (Middle Proterozoic)
- Dripping Spring Quartzite, undivided (Middle Proterozoic)
- Dripping Spring Quartzite, Upper Unit (Middle Proterozoic)
- Dripping Spring Quartzite, Lower Unit (Middle Proterozoic)
- Pioneer Shale (Middle Proterozoic)
- Pioneer Shale, Tuff Unit (Middle Proterozoic)
- Diorite (Early or Middle Proterozoic)
- Pinal Schist, undivided (Early Proterozoic)
- Pinal Schist, Calc-silicate Facies (Early Proterozoic)
- Pinal Schist, Calc-silicate and Schist Facies (Early Proterozoic)
- Pinal Schist, Psammite Facies (Early Proterozoic)
- Pinal Sctist, Phyllite Facies (Early Proterozoic)
- Pinal Schist, Quartzite Layers (Early Proterozoic)
- Pinal Schist, Pelitic Schist (Early Proterozoic)

NOTES:
1. NAD83, ARIZONA STATE PLANE CENTRAL
2. REFER TO REPORT FOR SOURCE OF GEOLOGY
3. EXCAVATION DONE TO PROMOTE DRAINAGE INTO UNDERDRAINS
4. SELECTIVELY LINED AREAS WOULD INCLUDE FOUNDATION TREATMENT AND/OR APPLICATION OF AN ENGINEERED LOW-PERMEABILITY LAYER. DETAILS ON THE TREATMENT OF THESE AREAS ARE TO BE DETERMINED IN FUTURE DESIGN STAGES BUT AN ENGINEERED LOW-PERMEABILITY LAYER COULD COMPRISE OF ONE OR MORE OF THE FOLLOWING: GEOMEMBRANE LINER, COMPACTED FINE TAILINGS, ASPHALT, SLURRY BENTONITE, CEMENTED PASTE TAILINGS, ETC.

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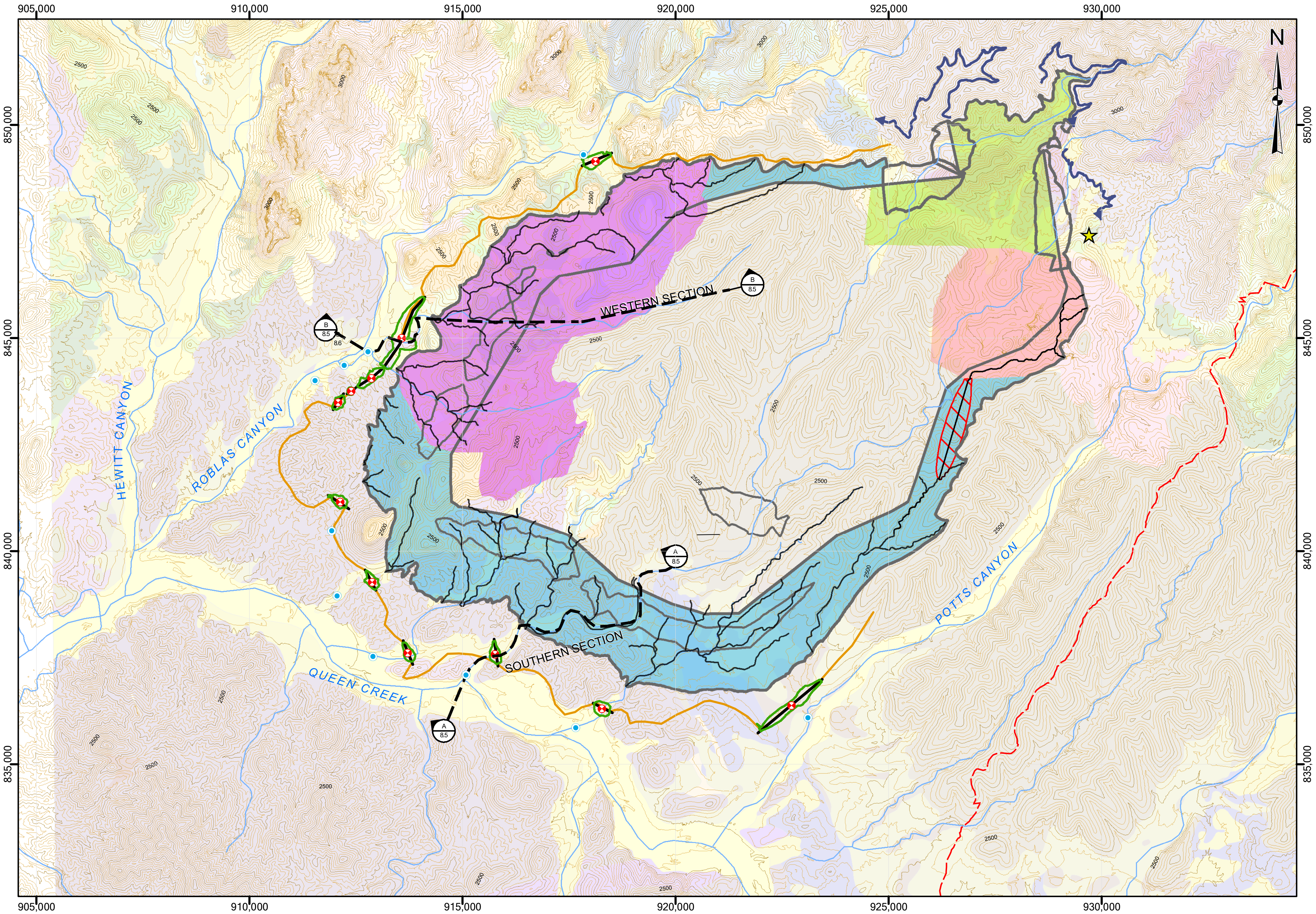
TITLE
SEEPAGE MANAGEMENT
LEVEL 1

PROJECT No.
M09441A20

FIG No.
8.1



LEGEND

- ALTERNATIVE 3A: NEAR WEST TSF (INCLUDING STARTER DAMS)
- CYCLONE HOUSE AND ACCESS ROUTE TIE-IN POINT
- CONCEPTUAL SECTION LOCATIONS
- UPSTREAM DIVERSION
- POINT OF COMPLIANCE (POC) TO BE LOCATED A MAXIMUM OF 750 ft DOWNSTREAM OF POLLUTION MANAGEMENT AREA (PMA)
- ARIZONA NATIONAL SCENIC TRAIL (ARIZONA TRAIL)
- MAJOR NATURAL DRAINAGES
- CONTOUR (20ft)
- CONTOUR (100ft)

SEEPAGE MANAGEMENT

LEVEL 1

- TSF SEEPAGE PUMPBACK WELL
- FINGER DRAINS
- GROUT CURTAIN
- CUT-OFF WALL
- PRIMARY SEEPAGE COLLECTION DAM
- EXCAVATION (TO FILL) AND REGRADING (SEE NOTE 3)
- SELECTIVE LINED NORTH AREA (SEE NOTE 4)
- BLANKET DRAIN
- RHYOLITE QUARRY AREA AND SELECTIVE LINING (SEE NOTE 4)
- SELECTIVE LINED WESTERN MIXED GEOLOGY AREA (SEE NOTE 4)

LEVEL 2

- GROUT CURTAIN EXTENSION

GEOLOGICAL UNITS

- Undivided Surficial Deposits (Quatenary)
- Disturbed Surficial Deposits (Holocene)
- Talus and Colluvium (Quaternary)
- Unconsolidated Alluvium (Quaternary)
- Old Alluvium (Quaternary)
- Older Alluvium (Early Quaternary to Late Tertiary)
- Conglomerate (Pliocene to Late Miocene)
- Sandstone (Pliocene to late Miocene)
- Basalt (Mid-Miocene to Early Miocene)
- Perlitic Aphyric Rhyolite (Middle Tertiary)
- Apache Leap Tuff (Early Miocene)
- Tuff (poorly welded) (Miocene)
- Felsic Volcanic Rocks, undivided (Middle Tertiary)
- Lower Basalt (Middle Tertiary)
- Rock Avalanche or Talus Brecchia (Middle Tertiary)
- Whitetail Conglomerate
- Basaltic Dikes (Middle Tertiary)
- Quartz Diorite (Latest Cretaceous)
- Escabrosa Limestone (Mississippian)
- Martin Limestone (Devonian)
- Bolsa Quartzite (Cambrian)
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- Pioneer Shale, Tuff Unit (Middle Proterozoic)
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- Pinal Schist, Psammite Facies (Early Proterozoic)
- Pinal Sctist, Phyllite Facies (Early Proterozoic)
- Pinal Schist, Quartzite Layers (Early Proterozoic)
- Pinal Schist, Pelitic Schist (Early Proterozoic)

NOTES:
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0 2,500 Feet 0 0.5 Mile

CLIENT
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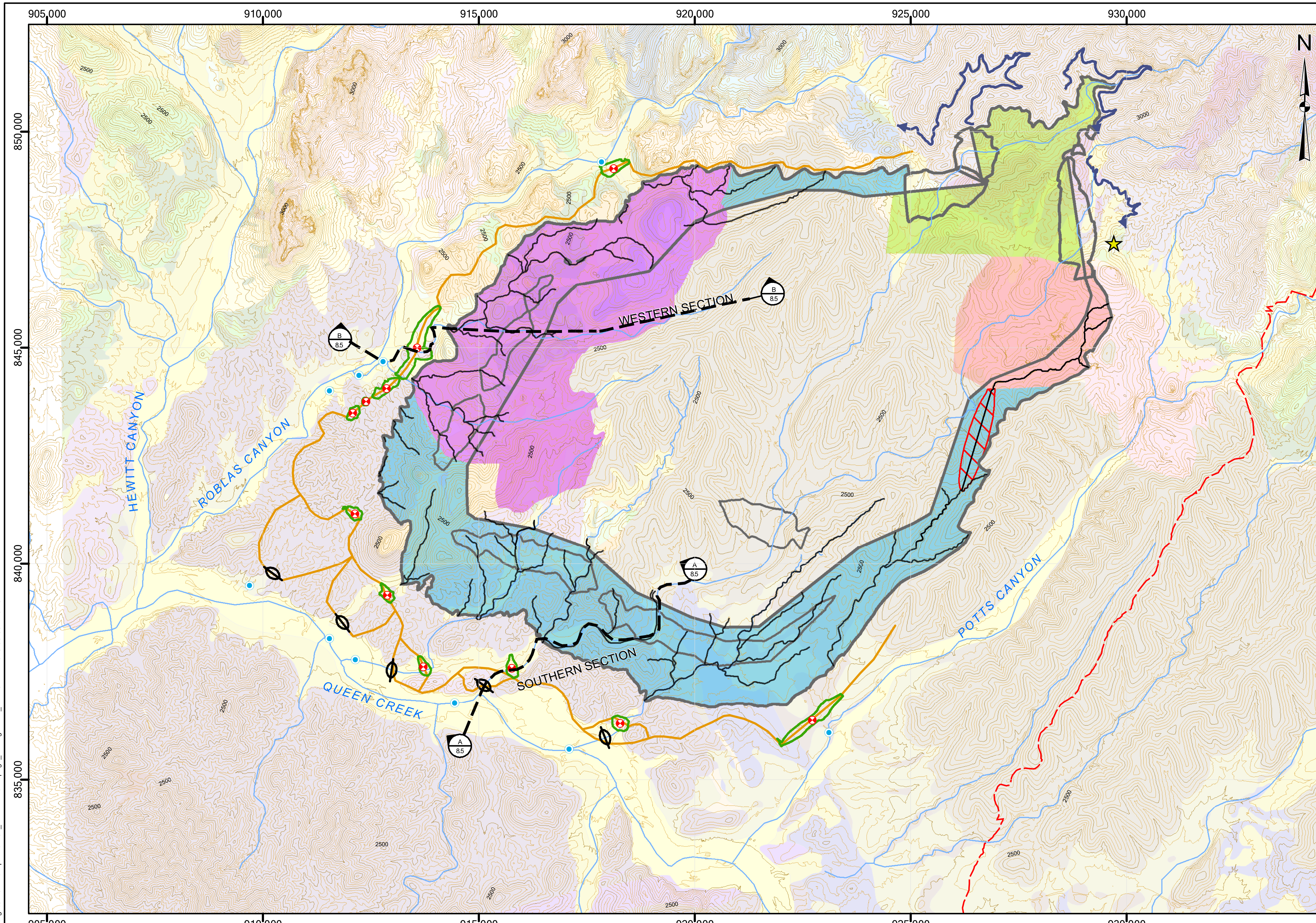
Klohn Crippen Berger

PROJECT
RESOLUTION COPPER PROJECT
DEIS DESIGN FOR ALTERNATIVE 3A - NEAR WEST MODIFIED PROPOSED ACTION (MODIFIED CENTERLINE EMBANKMENT)

TITLE
SEEPAGE MANAGEMENT
LEVEL 2

PROJECT No.	FIG No.
M09441A20	8.2



LEGEND

- NEAR WEST TSF (INCLUDING STARTER DAMS)
- CYCLONE HOUSE AND ACCESS ROUTE TIE-IN POINT
- CONCEPTUAL SECTION LOCATIONS
- UPSTREAM DIVERSION
- POINT OF COMPLIANCE (POC) TO BE LOCATED A MAXIMUM OF 750 ft DOWNSTREAM OF POLLUTION MANAGEMENT AREA (PMA)
- ARIZONA NATIONAL SCENIC TRAIL (ARIZONA TRAIL)
- MAJOR NATURAL DRAINAGES
- CONTOUR (20ft)
- CONTOUR (100ft)

SEEPAGE MANAGEMENT

LEVEL 1

- TSF SEEPAGE PUMPBACK WELL
- FINGER DRAINS
- GROUT CURTAIN
- CUT-OFF WALL
- PRIMARY SEEPAGE COLLECTION DAM
- EXCAVATION (TO FILL) AND REGRADING (SEE NOTE 3)
- SELECTIVE LINED NORTH AREA (SEE NOTE 4)
- BLANKET DRAIN
- RHYOLITE QUARRY AREA AND SELECTIVE LINING (SEE NOTE 4)
- SELECTIVE LINED WESTERN MIXED GEOLOGY AREA (SEE NOTE 4)

LEVEL 2

- GROUT CURTAIN EXTENSION

LEVEL 3

- AUXILIARY SEEPAGE COLLECTION DAM
- GROUT CURTAIN EXTENSION

GEOLOGICAL UNITS

- Undivided Surficial Deposits (Quatenary)
- Disturbed Surficial Deposits (Holocene)
- Talus and Colluvium (Quaternary)
- Unconsolidated Alluvium (Quaternary)
- Old Alluvium (Quaternary)
- Older Alluvium (Early Quaternary to Late Tertiary)
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- Pinal Schist, Quartzite Layers (Early Proterozoic)
- Pinal Schist, Pelitic Schist (Early Proterozoic)

NOTES:
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0 2,500 Feet 0 0.5 Mile

CLIENT
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Klohn Crippen Berger

PROJECT
RESOLUTION COPPER PROJECT
DEIS DESIGN FOR ALTERNATIVE 3A - NEAR WEST MODIFIED PROPOSED ACTION (MODIFIED CENTERLINE EMBANKMENT)

TITLE
SEEPAGE MANAGEMENT
LEVEL 3

PROJECT No.	FIG No.
M09441A20	8.3

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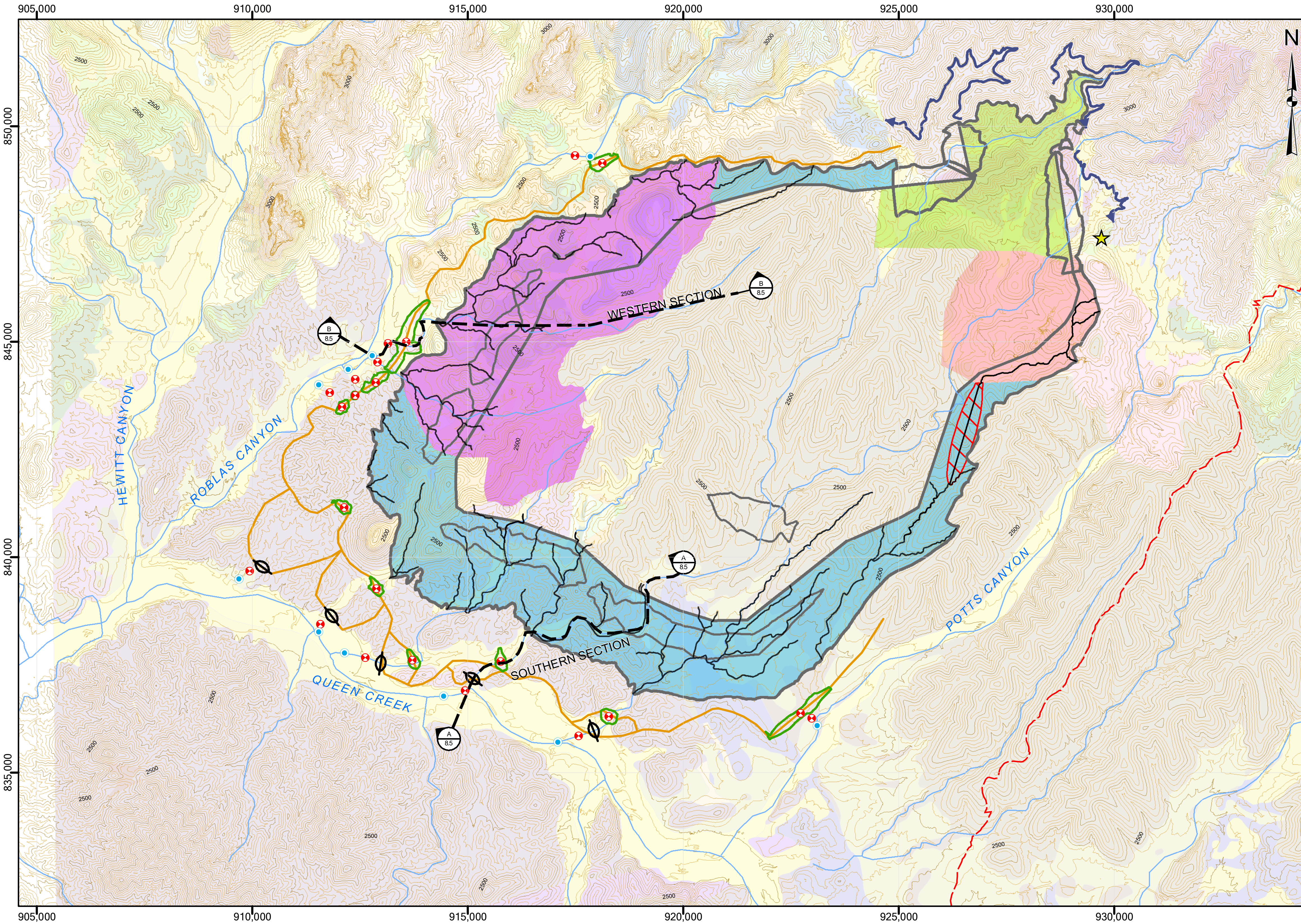

LEGEND

- NEAR WEST TSF (INCLUDING STARTER DAMS)
- CYCLONE HOUSE AND ACCESS ROUTE TIE-IN POINT
- CONCEPTUAL SECTION LOCATIONS
- UPSTREAM DIVERSION
- POINT OF COMPLIANCE (POC) TO BE LOCATED A MAXIMUM OF 750 ft DOWNSTREAM OF POLLUTION MANAGEMENT AREA (PMA)
- ARIZONA NATIONAL SCENIC TRAIL (ARIZONA TRAIL)
- MAJOR NATURAL DRAINAGES
- CONTOUR (20ft)
- CONTOUR (100ft)

SEEPAGE MANAGEMENT

LEVEL 1

- TSF SEEPAGE PUMPBACK WELL
- FINGER DRAINS
- GROUT CURTAIN
- CUT-OFF WALL
- PRIMARY SEEPAGE COLLECTION DAM
- EXCAVATION (TO FILL) AND REGRADING (SEE NOTE 3)
- SELECTIVE LINED NORTH AREA (SEE NOTE 4)
- BLANKET DRAIN
- RHYOLITE QUARRY AREA AND SELECTIVE LINING (SEE NOTE 4)
- SELECTIVE LINED WESTERN MIXED GEOLOGY AREA (SEE NOTE 4)

LEVEL 2

- GROUT CURTAIN EXTENSION

LEVEL 3

- AUXILIARY SEEPAGE COLLECTION DAM
- GROUT CURTAIN EXTENSION

LEVEL 4

- TSF SEEPAGE PUMPBACK WELL

GEOLOGICAL UNITS

- Undivided Surficial Deposits (Quatenary)
- Disturbed Surficial Deposits (Holocene)
- Talus and Colluvium (Quaternary)
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0 2,500 Feet 0 0.5 Mile

CLIENT

RESOLUTION COPPER

Klohn Crippen Berger

PROJECT

RESOLUTION COPPER PROJECT
DEIS DESIGN FOR ALTERNATIVE 3A - NEAR WEST MODIFIED PROPOSED ACTION (MODIFIED CENTERLINE EMBANKMENT)

TITLE

SEEPAGE MANAGEMENT
LEVEL 4

PROJECT No.	FIG No.
M09441A20	8.4

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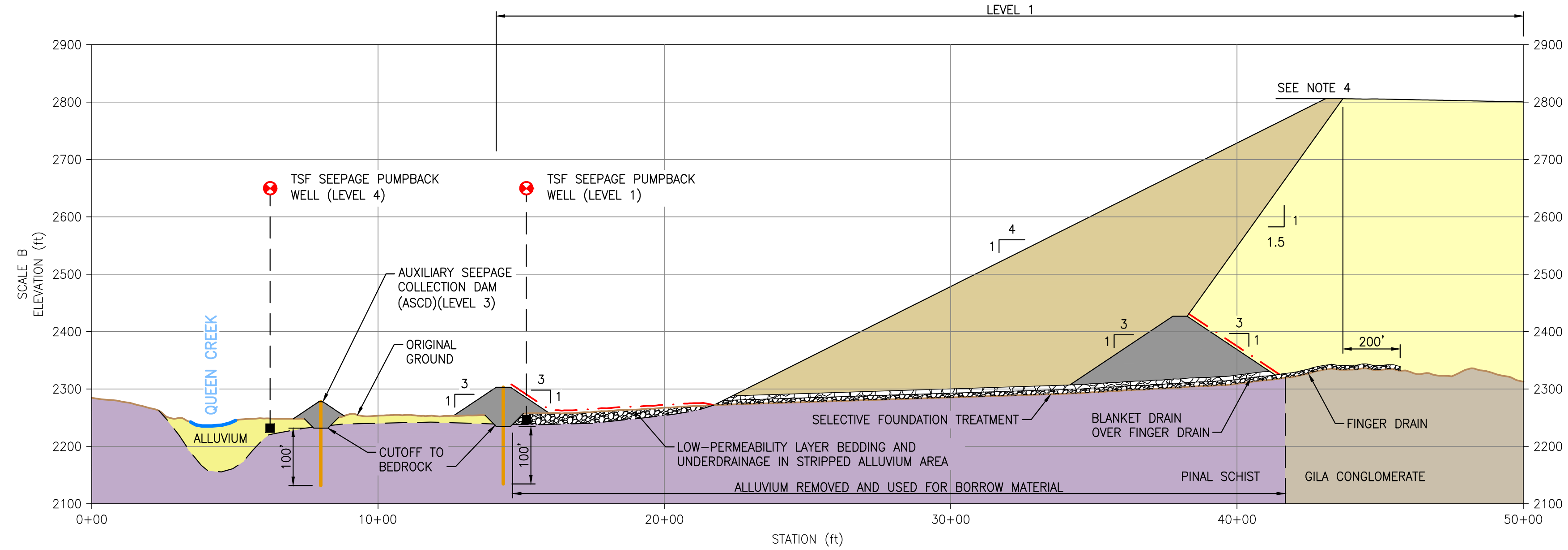
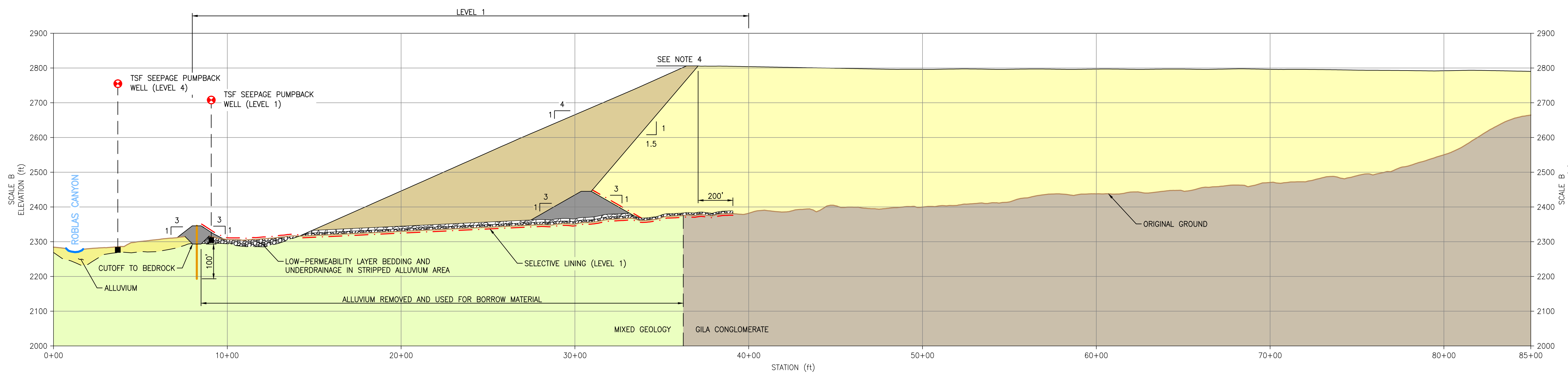


SECTION A SOUTHERN SECTION

SCALE A 8.1–8.4



SECTION B WESTERN SECTION

SCALE A 8.1–8.4

LEGEND

- CYCLONED SAND EMBANKMENT
- SCAVENGER TAILINGS (CYCLONED OVERFLOW / TOTAL SCAVENGER COMPOSITE)
- GENERAL FILL
- ENGINEERED LOW–PERMEABILITY LAYER (NOTE 5)
- GROUT CURTAIN

GEOLOGY UNITS

- QUATERNARY ALLUVIUM
- GILA CONGLOMERATE
- MIXED GEOLOGY
- PINAL SCHIST

NOTES

1. PROJECTION AND DATUM: ARIZONA STATE PLANE CENTRAL NAD 83 – INTERNATIONAL FOOT.
2. TOPOGRAPHY BASED ON LIDAR 2013 SURVEY.
3. GEOLOGY EXTENTS ARE CONCEPTUALIZED SCHEMATICS.
4. EMBANKMENT ELEVATION SHOWN IS 2806 FASL BASED ON THE GPO TAILINGS PRODUCTION SCHEDULE. EL. 2775 FASL IS THE ANTICIPATED EMBANKMENT CREST ELEVATION BASED ON THE DEIS TAILINGS PRODUCTION SCHEDULE.
5. SELECTIVELY LINED AREAS WOULD INCLUDE FOUNDATION TREATMENT AND/OR APPLICATION OF AN ENGINEERED LOW–PERMEABILITY LAYER. DETAILS ON THE TREATMENT OF THESE AREAS ARE TO BE DETERMINED IN FUTURE DESIGN STAGES BUT AN ENGINEERED LOW–PERMEABILITY LAYER COULD COMPRISE OF ONE OR MORE OF THE FOLLOWING: GEOMEMBRANE LINER, COMPACTED FINE TAILINGS, ASPHALT, SLURRY BENTONITE, CEMENTED PASTE TAILINGS, ETC.

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SCALE A: 250 0 250 FT
SCALE B: 125 0 125 FT

CLIENT: RESOLUTION COPPER	PROJECT: RESOLUTION COPPER PROJECT DEIS DESIGN FOR ALTERNATIVE 3A – NEAR WEST MODIFIED PROPOSED ACTION (MODIFIED CENTERLINE EMBANKMENT)
Klohn Crippen Berger	TITLE: SEEPAGE MANAGEMENT SCHEMATICS
SCALE: AS SHOWN	PROJECT No.: M09441A20
FIG. No.: 8.5	

KCB–FIG–D–L

Table 8.1 Alternative 3A Seepage Management Plan

Level	Applicable Design Sectors	Applicable Geology Units	Receiving Waterbody	Mitigation	Purpose
1 (Figure 8.1 and Figure 8.5)	South and Southwest	Pinal Schist, Gila Conglomerate/ Sandstone, and Alluvium	Queen Creek and Roblas Canyon in the southwest corner	▪ Foundation preparation and treatment (e.g. grouting or dental concrete) beneath embankment ▪ Finger drains extending 200 ft upstream of the ultimate embankment crest ▪ SCD with engineered low-permeability layer and cutoff trench ▪ Drainage layer below SCD low-permeability layer and pumpback well to collect flow bypassing blanket drain ▪ Grout curtain below SCD and in SCD abutments ▪ Pyrite starter pond with engineered low-permeability layer	▪ Decrease foundation permeability ▪ Collect and direct seepage to SCDs ▪ Collect seepage and return to TSF ▪ Decrease foundation permeability and limit seepage bypassing collection systems
	East and Northwest	Gila Conglomerate	Potts Canyon and Roblas Canyon	▪ Excavation (for borrow) and re-shaping/smoothing ▪ Selective foundation treatment/placement of engineered low-permeability layer ▪ Blanket drain beneath main embankment	▪ Promote positive drainage of seepage ▪ Decrease foundation permeability ▪ Collect and direct seepage to SCDs
	West	Paleozoic units (e.g. Bolsa Quartzite, Apache Leap Tuff, Escabrosa Limestone), and Alluvium	Roblas Canyon	▪ Foundation treatment/placement of engineered low-permeability layer	▪ Decrease foundation permeability
	Northeast	Perlitic Rhyolite	Potts Canyon	▪ Foundation treatment/placement of engineered low-permeability layer	▪ Decrease foundation permeability
	North	Pinal Schist and Mixed Geology	Potts Canyon	▪ Selective foundation treatment/placement of engineered low-permeability layer	▪ Decrease foundation permeability
2 (Figure 8.2 and Figure 8.5)	South, Southeast, East, Northwest, and West	All	Queen Creek, Potts Canyon, Roblas Canyon	▪ Grouting the perimeter of the TSF through the ridges between SCDs	▪ Decrease foundation permeability and limit seepage bypassing collection systems
3 (Figure 8.3 and Figure 8.5)	South and Southwest	Pinal Schist and Alluvium	Queen Creek and Roblas Canyon in the southwest corner	▪ Construction of ASCD downstream of SCD	▪ Additional seepage collection
4 (Figure 8.4 and Figure 8.5)	South, Southeast, and West	Alluvium, Pinal Schist and Paleozoic units (e.g. Bolsa Quartzite, Apache Leap Tuff, Escabrosa Limestone)	Queen Creek and Roblas Canyon	▪ Pumpback wells downstream of SCD and ASCD	▪ Additional seepage collection

9 DUST MANAGEMENT PLAN

The key considerations for dust management of the Alternative 3A TSF are:

- the surface area of the impoundment;
- susceptibility of beach tailings to wind erosion, when dry;
- susceptibility of cycloned sand to wind erosion, when dry;
- embankment slopes that cannot be progressively reclaimed until the later stages of operations; and
- proximity of the Near West site to sensitive receptors (the town of Superior (4 miles northeast), community of Queen Valley (4 miles southwest), Boyce Thompson Arboretum State Park (1.5 miles east) and the Superstition Wilderness Area (4 miles north)).

The conceptual dust management plan for the Alternative 3A is based on the following approach to manage wind erosion of the TSF surface.

- Cycloned sand embankment slope:
  - The embankment would be constructed to establish the ultimate downstream slope as soon as practical to allow progressive reclamation of the slope with an erosion resistant cover. Progressive reclamation is forecast to start after Year 12, ramping up to Year 30 at which point the embankment can be raised horizontally (see Appendix III and Appendix IV).
  - Active hydraulic placement cells would be wetted through construction water and would not need additional dust suppression.
  - Areas that would be exposed for an extended period (inactive areas that have not been progressively reclaimed) would have temporary erosion controls, such as: polymers, wind fences, and/or temporary sand and gravel erosion protection layer.
- Tailings beach:
  - Tailings deposition spigot locations would frequently rotate to keep as much of the beach as wet as practical.
  - Tailings beaches undergoing active tailings deposition are considered wetted and resistant to dust erosion.
  - Inactive tailings beaches are considered to be dry and if left for extended periods, may be wetted by sprinklers or sprayed with polymer, if necessary.
  - Relative to the cycloned sand embankment, tailings beaches are expected to have higher erosion resistance due to suction and formation of a crust at the surface.
- Reclaim pond:
  - Tailings submerged in the reclaim pond would not be exposed to wind erosion.

In addition, service roads would be regularly watered or sprayed with a dust suppressant, as required.

10 BORROW PLAN

Earthfill construction materials are required for the following purposes:

- general fill for dam construction;
- sand and gravel for underdrains, blanket drains and dam zones; and
- riprap for erosion protection.

Based on the Near West foundation characterization (refer to Section 2.5), the most likely general fill borrow source of sufficient quantity is the Gila Conglomerate (Tcg), which outcrops over approximately 55% of the TSF footprint. Experience at the West Plant site indicates a surface layer of the material can be ripped with a dozer but below approximately 5 ft to 10 ft drilling and blasting may be required. All of the material must be processed to varying degrees to produce a well graded 12 in. minus fill material. A preliminary borrow area has been identified within the TSF impoundment near Bear Tank Canyon, upstream of the Pyrite Starter Dam to provide the added benefit of increased tailings storage, see Figure 5.5.

The preferred source of sand and gravel for the blanket drains and underdrains is the alluvial sediments located within the active channels supplemented with processed rock. Based on the volume estimates prepared for the GPO design (KCB 2014), it is expected that roughly 180,000 yd^3 of 0.8 inch minus sand and gravel is available in the alluvial channels.

Riprap for erosion protection will be sourced from either the rhyolite quarry in the Northeast design sector, subject to the volume of rhyolite required to supplement the alluvium for drainage rock. If an additional source of riprap is required, this could be sourced from the Apache Leap tuff unit located in the southern part of the West design sector.

11 PRELIMINARY CLOSURE PLAN

The long-term closure goals for Alternative 3A are to have a well-drained, stable embankment and to limit the duration of post closure water management. Management during operations of the PAG pyrite tailings and their location within the facility post-closure is important to reducing the risk of Acid Rock Drainage / Metal Leaching (ARD/ML) in tailings seepage. The tailings deposition strategy is to encapsulate the pyrite tailings within the scavenger tailings to minimize contact with oxygen.

The closure and cover strategy for the facility begins during operations and tailings deposition planning, and continues through to the onset of closure. The primary performance objectives for closure and reclamation of the TSF are to:

- develop a stable landform;
- develop a stable vegetated cover system that limits net infiltration and protects surface water runoff quality;
- minimize ponded water on the closed tailings surface;
- promote high levels of saturation of the pyrite tailings to reduce their exposure to atmospheric oxygen during operations (and post-closure by limiting oxygen ingress);
- protect the reclaimed surface against wind and water erosion; and
- provide a growth medium for vegetation establishment and long-term sustainability.

During operations, the cycloned sand embankment slopes would be progressively reclaimed as soon as practical. Towards the end of operations, scavenger tailings would be strategically deposited within the TSF to promote drainage towards the north (where a closure spillway would be constructed) and pyrite tailings would be stored in a separate cell within the TSF footprint at its northern end. At the end of operations, the scavenger tailings surfaces would be covered with a store-and-release and erosion-resistant cover and revegetated. The pyrite tailings cell would be covered with a layer of scavenger tailings and an erosion resistant cover and revegetated. The downstream slopes of the embankment would be armored and runoff collection channels would be constructed on the slopes to convey surface runoff.

Post closure is separated into three phases for the water balance: active TSF closure, active SCD closure, and passive closure.

Active TSF closure starts immediately after the end of operations and ends when the TSF pond area is reclaimed. During this phase, the TSF pond is maintained to assist with evaporation of impoundment draindown water, which is collected at the SCDs and is pumped back to the TSF reclaim pond. A duration of 25 years was assumed for this period.

Phase 1 – Active TSF Closure

Mine Years 42 to 46 (first five years after end of operations):

- The embankment slopes are reclaimed (covered and vegetated).

- The tailings beaches are reclaimed (covered and vegetated).
- The TSF reclaim pond is assumed to decrease in volume from approximately 4,000 acre-ft at the end of operations to 1,000 acre-ft.
- Impoundment draindown water that collects at the SCDs and is pumped back to the TSF reclaim pond can be used for dust management on tailings beaches and embankment slopes that are not yet reclaimed.
- A closure spillway and diversions are constructed to convey as much runoff from the natural catchment and reclaimed TSF surfaces around the Seepage Collection Ponds as soon as practical (assumed to be completed by year five).

Mine Years 47 to 66 (years 6 to 25 after end of operations):

- The SCDs are upgraded to provide additional pond storage and surface area to evaporate captured seepage.
- Excess impoundment draindown water that collects at the SCDs is pumped back to the TSF reclaim pond. Between the TSF reclaim pond and Seepage Collection Pond areas, all impoundment draindown water can be managed by evaporation. Active water management is not required during this period.
- At the end of Phase 1 the TSF pond is dewatered and reclaimed.

Phase 2 – Active SCD Closure

Mine Years 67 to 141 (years 26 to 100 after end of operations):

- Excess impoundment draindown water collecting at the SCDs can no longer be pumped to the TSF pond and therefore must be actively managed until the Seepage Collection Ponds are able to passively evaporate the inflows, whilst maintaining sufficient storage volume for flood storage.
- Active water management could be treatment and release to the environment.

The duration of this phase depends on the available surface area of the Seepage Collection Ponds.

Phase 3 – Passive Closure

- Assumed in perpetuity.
- If water reporting to the Seepage Collection Ponds is of suitable quality to discharge, the collection dams/ponds would be decommissioned when possible.

12 CLOSING

This report is an instrument of service of Klohn Crippen Berger Ltd. The report has been prepared for the exclusive use of Resolution Copper Mining LLC (Client) for the specific application to the Resolution Copper Project, DEIS Design for Alternative 3A, Near West Modified Proposed Action (Modified Centerline Embankment – "wet"). The report's contents may not be relied upon by any other party without the express written permission of Klohn Crippen Berger. In this report, Klohn Crippen Berger has endeavored to comply with generally-accepted professional practice common to the local area. Klohn Crippen Berger makes no warranty, express or implied.

KLOHN CRIPPEN BERGER LTD.

Joseph Quinn, P.Geo. (AB), Ph.D.
Associate, Senior Engineering Geologist

Registered Professional Engineer (Civil)
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JAMES
CASEY
Date Signed 2018/06/08
ARIZONA, U.S.A.
EXPIRES 3/31/2021

Jim Casey, P.E.
Geotechnical Engineer

Kate Patterson, P.E., M.Eng.
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REFERENCES

Applied Weather Associates. 2013. Probable Maximum Precipitation Study for Arizona. Phoenix, AZ: Prepared for Arizona Department of Water Resources.

Arizona Department of Environmental Quality (ADEQ). 2005. Arizona Mining Guidance Manual BADCT.

Dickinson, W. R. 1991. *Tectonic setting of faulted Tertiary strata associated with the Cataline core complex in southern Arizona. Special Paper 264*. Colorado: The Geological Society of America, Inc.

Duke HydroChem. 2016. Geochemical Characterization of Resolution Tailings Update: 2014-2016. June.

Duke HydroChem. 2017a. Geochemical Data Summary: In Situ Geologic Units at Near West. October.

Duke HydroChem. 2017b. Technical Memorandum: Geochemical Reactivity of Unsaturated Pyrite Tailings. March.

Hammer, D.F., and Webster, R.N. 1962. Some geologic features of the Superior area, Pinal County, Arizona. *in: Webster, R.H.; Peirce, H.W. [eds.], New Mexico Geological Society 13th Annual Fall Field Conference Guidebook, 175 p.*

Klohn Crippen Berger Ltd. (KCB). 2014. Near West Tailings Management Mine Plan of Operations Study. Prepared for Resolution Copper Mining. September.

Klohn Crippen Berger Ltd. (KCB). 2017a. Near West Tailings Storage Facility Embankment Design Alternatives Analysis. March.

Klohn Crippen Berger Ltd. (KCB). 2017b. Near West Tailings Storage Facility Geotechnical Site Characterization Report. October.

Klohn Crippen Berger Ltd. (KCB). 2018a. Resolution Project - Alternative Portfolio for Analysis – Alternative 3A – Near West Modified Proposed Action (Modified Centerline Embankment). January.

Klohn Crippen Berger Ltd. (KCB). 2018b. Resolution Copper Project – Tailings Storage Facility DEIS Designs – Tailings Geotechnical Characterization. April.

Lettis Consultants International, Inc. (LCI). 2017. Updated Site-Specific Seismic Hazard and Development of Time Histories for Resolution Copper's Near West Site, Southern Arizona. November.

Montgomery and Associates. 2012. "Hydrogeologic Data Submittal, Tailings Prefeasibility Study, Whitford, Silver King, and Happy Camp sites", October 23.

Montgomery and Associates. (M&A). 2013a. Draft Report Technical Memorandum, Phase I Hydrogeologic Field Investigations, Near West Tailings Site, Pinal County, Arizona. April.

Montgomery and Associates. (M&A). 2013b. Technical Memorandum, Phase II Hydrogeologic Field Investigations, Near West Tailings Site, Pinal County, Arizona. May 10.

Montgomery and Associates. (M&A). 2017a. Construction, Development and Testing of Hydrologic Wells at the Near West Tailings Site. October 18.

Montgomery and Associates. (M&A). 2017a. Conceptual Hydrogeologic Model for Proposed Near West Tailings Storage Facility. November 25.

Rasmussen, J.C. 2012. Geologic History of Arizona. Rocks and Minerals, Vol. 87, no. 1, p. 56-63.

Resolution Copper Mining (RC). 2016a. General Plan of Operations, Resolution Copper Mining. Initial Submittal November 15, 2013; Revised May 9, 2016. Retrieved on December 15, 2017 from http://www.resolutionmineeis.us/documents/resolution-copper-gpo.

Resolution Copper Mining (RC). 2016b. Resolution Copper Tailings Corridor Pre-Feasibility Study. September.

Spencer, J.E., and Richard, S.M. 1995. Geologic map of the Picketpost Mountain and the southern part of the Iron Mountain 7 ½' Quadrangles, Pinal County, Arizona. Arizona Geological Survey, Open File Report 95-15.

Trapp, R.A., and Reynolds, S.J. 1995. Map Showing Names and Outlines of Physiographic Areas in Arizona Used by the Arizona Geological Survey with Comprehensive Base Map. Arizona Geological Survey Open File Report 95-2a, b, Scale 1:1,000,000.

United States Geological Survey (USGS). 2018. "Bomboy Mine". Accessed April 3, 2018. https://mrdata.usgs.gov/mrds/show-mrds.php?dep_id=10109779

United States Government Publishing Office (GPO). 2016. Tonto National Forest; Pinal County, AZ; Resolution Copper Project and Land Exchange Environmental Impact Statement: Federal Register, Vol. 81 No. 53. March 18. Retrieved on March 8, 2018 from http://www.resolutionmineeis.us/sites/default/files/project-files/federal-register-noi-20160318.pdf.

URS Corporation. 2013. Site Specific Seismic Hazard Analyses for the Resolution Mining Company Tailings Storage Facilities Options, Southern Arizona. June.

APPENDIX I

Design Basis Memorandum

Resolution Copper Project

DEIS Design for Alternative 3A – Near West Modified Proposed Action (Modified Centerline Embankment – “wet”)

Technical Memorandum

Appendix I – Design Basis Memorandum

DISCLAIMER

1 INTRODUCTION

1.1 General

This is the design basis memorandum (DBM) for the design of Alternative 3A – Near West Modified Proposed Action (Modified Centerline Embankment – “wet”) which is one of the tailings storage facility (TSF) design alternatives that Resolution Copper Mining LLC (RC) intends to include in the draft environmental impact statement (DEIS) for the proposed Resolution Copper Project. This TSF is located at the Near West location in Pinal County, Arizona. The DBM outlines the design objective as well as the design criteria and assumptions. This DBM is considered a “live” document that will be reviewed and updated throughout the design process.

1.2 Design Objective

The objective of the TSF is to store the tailings produced by the proposed Resolution Copper Project. The design incorporates findings from alternative studies and site specific data collected from site investigations, where applicable.

The design regulations and guidelines are outlined in Section 1.3, and the design criteria and assumptions are tabulated in Section 2.

The scope of the DEIS design is to provide a basis for comparing impacts from TSF alternatives.

1.3 Design Regulations and Guidelines

The TSF design is governed and guided by the regulations and guidelines listed below. The general approach adopted in this design is to set the design criteria based on the governing regulations, and then to supplement these regulations with guidelines from international practice where the governing regulations are not specific. Where international guidelines are more stringent than the governing regulations, consideration is also given to the additional measures needed to meet the more stringent guidelines.

Governing

<u>Tailings Storage Facility and Seepage Collection Dams</u>

- Arizona State Legislature. 2016. Arizona Administrative Code (A.A.C.).
  - Title 18. Environmental Quality. Chapter 9: Department of Environmental Quality – Water Pollution Control. Chapter 11: Department of Environmental Quality, Article 1: Water Quality Standards.
  - Arizona State Legislature. 2016. Arizona Revised Statues (A.R.S.).
    - Title 49 – The Environment.
- Regulatory agency: Arizona Department of Environmental Quality (ADEQ).
- Environmental Protection Agency (EPA). Clean Water Act (CWA) - 33 U.S.C. §1251 et seq. (1972).
- Rio Tinto. 2017. D5 – Management of Tailings and Water Storage Facilities.

Seepage Collection Dams (only)

In addition to the above governing regulations, the seepage collection dams are regulated by the Arizona Department of Water Resources (ADWR). The additional application Arizona Administrative Code (A.A.C.) is Title 12. Natural Resources. Chapter 15. Department of Water Resources (A.A.C. R12-15).

Guidance

- Arizona Department of Environmental Quality (ADEQ). 2005. Arizona Mining Guidance Manual BADCT (Best Available Demonstrated Control Technology).
- British Columbia Ministry of Energy and Mines (MEM). 2016. *Health, Safety and Reclamation Code for Mines in British Columbia*.
- Canadian Dam Association (CDA). 2007a. *Dam Safety Guidelines (with 2013 revision).*
- Canadian Dam Association (CDA). 2007b. *Technical Bulletin: Hydrotechnical Considerations for Dam Safety*.
- Canadian Dam Association (CDA). 2014. *Technical Bulletin: Application of Dam Safety Guidelines to Mining Dams*.
- Federal Emergency Management Agency (FEMA). 2005. *Federal Guidelines for Dam Safety – Earthquake Analyses and Design of Dams. FEMA-65.*
- Federal Emergency Management Agency (FEMA). 2013. *Selecting and Accommodating Inflow Design Floods for Dams. FEMA-P-94.*
- United States Army Corps of Engineers (USACE). 2002. Coastal Engineering Manual. Engineer Manual 1110-2-1100, U.S. Army Corps of Engineers, Washington, D.C. (in 6 volumes).
- United States Army Corp of Engineers (USACE). 2004. *General Design and Construction Considerations for Earth and Rock-Fill Dams. EM 1110-2-2300.*
- United States Army Corp of Engineers (USACE). 2003. *Slope Stability. EM 1110-2-1902.*

1.4 BADCT Approach

The TSF will apply for an Aquifer Protection Permit (APP) with an “individual” Best Available Demonstrated Control Technology (BADCT) approach, which is performance based, and allows the applicant to select from all available Demonstrated Control Technologies (DCTs) that constitute BADCT. This process considers site specific characteristics, operational controls, and other DCTs.

Under the individual BADCT approach, the TSF is considered a “tailings impoundment” and will be designed in accordance with Section 3.5 of the BADCT manual (ADEQ 2005). The seepage dams are considered to be “surface ponds” and will be designed in accordance with Section 3.6 of the BADCT manual (ADEQ 2005) and the regulations pertaining to water dams (A.A.C. R12-15).

2 DESIGN CRITERIA

Table 2.1 Design Criteria

	Item	Design Criteria	Reference
1.0	**Tailings Storage Facility (TSF) Embankment Design**		
1.01a	CDA Consequence Classification	to be confirmed following inundation study	▪ CDA (2007a)
1.01b	Rio Tinto Risk Category	Class IV (considered Class IV until all necessary mitigations have been included in design)	▪ D5 Standard (Rio Tinto 2017)
1.02	Storage capacity	Capacity to store all NPAG scavenger (scavenger) and PAG pyrite (pyrite) tailings production	▪ RC requirement
1.03	Downstream slope	▪ No steeper than 2H:1V	▪ MEM (2016)
1.04	Minimum Factor of Safety	▪ Static (upstream or downstream) – 1.5 (during operation and long term) ▪ Liquefied/post-cyclic – 1.2 ▪ Rapid drawdown – N/A	▪ BADCT (ADEQ 2005) supplemented with MEM (2016) ▪ D5 Rio Tinto (2017) ▪ CDA (2007a) ▪ N/A
1.05	Deformations (seismic or static, e.g. settlement)	▪ For cases with no liquefiable materials, horizontal seismic coefficient for pseudo-static analysis = 0.6 x Peak ground acceleration (PGA). This seismic coefficient is selected to maintain consistency with the requirements of the seepage collection dams, as per A.A.C R12-15-1216. ▪ For elements of the TSF sensitive to deformation, a simplified deformation analysis is required. ▪ Predicted deformations shall not jeopardize containment integrity (e.g. does not reduce freeboard sufficiently to lead to an uncontrolled release of fluid tailings, does not impact the functionality of the drains, etc.).	▪ BADCT (ADEQ 2005) ▪ D5 Rio Tinto (2017)
1.06	Seismicity	▪ Maximum Credible Earthquake (MCE). Earthquake design ground motions will be selected in future design stages for appropriate return period events.	▪ BADCT (ADEQ 2005) supplemented with MEM (2016), CDA (2014), D5 Rio Tinto (2017) and industry practice
1.07	Pond Storage Capacity	See Figure 2.1 Storage capacity = minimum operating volume + maximum average seasonal volume + volume required for operational upset + volume for critical duration storm event including sediment (Environmental Design Flood and Inflow Design Flood) + volume required for “dry” freeboard (Table 2.1, Item 1.11)	▪ BADCT (ADEQ 2005)

Table 2.1 Design Criteria (cont'd)

	Item	Design Criteria	Reference
1.08	Storage Volume for Operational Upset Conditions	RC to confirm after RC internal risk audit and to be updated in next stage of design.	
1.09	Environmental Design Flood (EDF)	Minimum requirement for BADCT is 100-year 24 hr. Design will assume 200-year 24 hr; EDF will be confirmed through water balance and water quality modeling.	▪ BADCT (ADEQ 2005)
1.10	Inflow Design Flood (IDF) For Dam Safety	<u>Return Period:</u> Probable Maximum Flood (PMF) <u>Duration:</u> For individual BADCT, the facility-specific critical design storm duration is established by considering several durations and determining which results in the maximum required storage capacity to contain the design flood volume. Therefore, the duration will be confirmed during the flood routing and water balance calculations: ▪ with a spillway: spillway sized for the critical duration of 6 hr to 72 hr; and ▪ without a spillway: minimum of 72 hr (to be confirmed based inflows and discharge rates).	▪ BADCT (ADEQ 2005) ▪ FEMA (2013) ▪ MEM (2016) ▪ D5 Rio Tinto (2017)
1.11	"Dry" Freeboard	▪ Wind and wave run-up + 2 ft ▪ Wind event annual exceedance probability = 2-year ▪ Wave height and run-up to be calculated using industry standard methods ▪ Earthquake-induced settlements of the embankment crest to be assessed and included in minimum freeboard determination	▪ BADCT (ADEQ 2005) ▪ CDA (2007b) ▪ USACE (2002)
1.12	Beach length	Will become part of the Quantitative Performance Objectives (QPO) ▪ Sufficient to achieve seepage and hydraulic gradient criteria during normal operations and periods of flood storage. ▪ Sufficient to provide a secondary defense against loss of fluid tailings in the event of downstream slope displacement.	
1.13	Seepage	Water quality requirements at the point of compliance are to be assessed.	▪ BADCT (ADEQ 2005), Clean Water Act (EPA) and Arizona State Legislature (A.A.C. R18-11)
1.14	Drains	▪ Provide drains/filters satisfying USACE (2004) guidelines to mitigate potential for internal erosion. ▪ Drains designed to maintain phreatic surface to acceptable levels within the embankment with adequate safety factor to account from clogging and uncertainty.	▪ USACE (2004)

Table 2.1 Design Criteria (cont'd)

	Item	Design Criteria	Reference
1.15	Construction and Operations	▪ Quantifiable performance objectives to be defined prior to construction. ▪ All construction and borrow materials with contingency to be defined prior to construction.	▪ MEM (2016)
1.16	Closure	Planned closure landscape is to be a physically stable landform without a permanent water pond that meets point of compliance criteria.	▪ D5 Rio Tinto (2017)
1.17	Closure Surface Diversions	The design criteria will be selected based on consequence of failure, e.g. impact on other structures or environment.	▪ BADCT (ADEQ 2005) ▪ D5 Rio Tinto (2017)
1.18	External Erosion Protection	The design criteria will be selected based on consequence of failure, e.g. impact to structural zones, containment, other structures or the environment. BADCT requires, at a minimum, that if the TSF is within the 100-year flood plain, drainage controls must be designed to protect the TSF from damage or flooding for 100-year peak streamflows.	▪ BADCT (ADEQ 2005)
2.0	**Seepage Collection Dams**		
2.01	Assumed downstream hazard classification	High (will be reviewed for each individual seepage dam in future design stages)	▪ A.A.C R12-15-1216
2.02	Downstream slope	As per Table 2.1, item 1.03	
2.03	Stability Factor of Safety (FOS)	▪ End of construction – Static (upstream or downstream) – 1.3 (≤ 50 ft high), 1.4 (> 50 ft high) ▪ Steady state seepage – Static – 1.5 ▪ Rapid drawdown – 1.2	▪ A.A.C R12-15-1216 ▪ D5 Rio Tinto (2017)
2.04	Deformations (seismic or static, e.g. settlement)	▪ Pseudo-static – FOS = 1.0 with horizontal seismic coefficient = 0.6 x Peak ground acceleration. ▪ As per Table 2.1, item 1.05, where elements are sensitive to deformations, a simplified deformation analysis will be conducted to identify the potential displacements for comparison with allowable deformations for that element. ▪ Predicted deformations shall not jeopardize containment integrity (e.g. does not impact the integrity of the dam core or the spillway, etc.)	▪ A.A.C R12-15-1216 and BADCT (ADEQ 2005) ▪ D5 Rio Tinto (2017)
2.05	Seismicity	▪ MCE, assumed to be mean 1:10,000 year return period: ♦ Sensitivity to 95th percentile to be considered	▪ A.A.C R12-15-1216 supplemented with MEM (2016) and CDA (2007a) ▪ D5 Rio Tinto (2017)
2.06	Pond Storage Capacity	See Table 2.1, item 1.07	
2.07	Storage Volume for Operational Upset Conditions	One week of average seepage and precipitation to account for a period of pump shut-down	

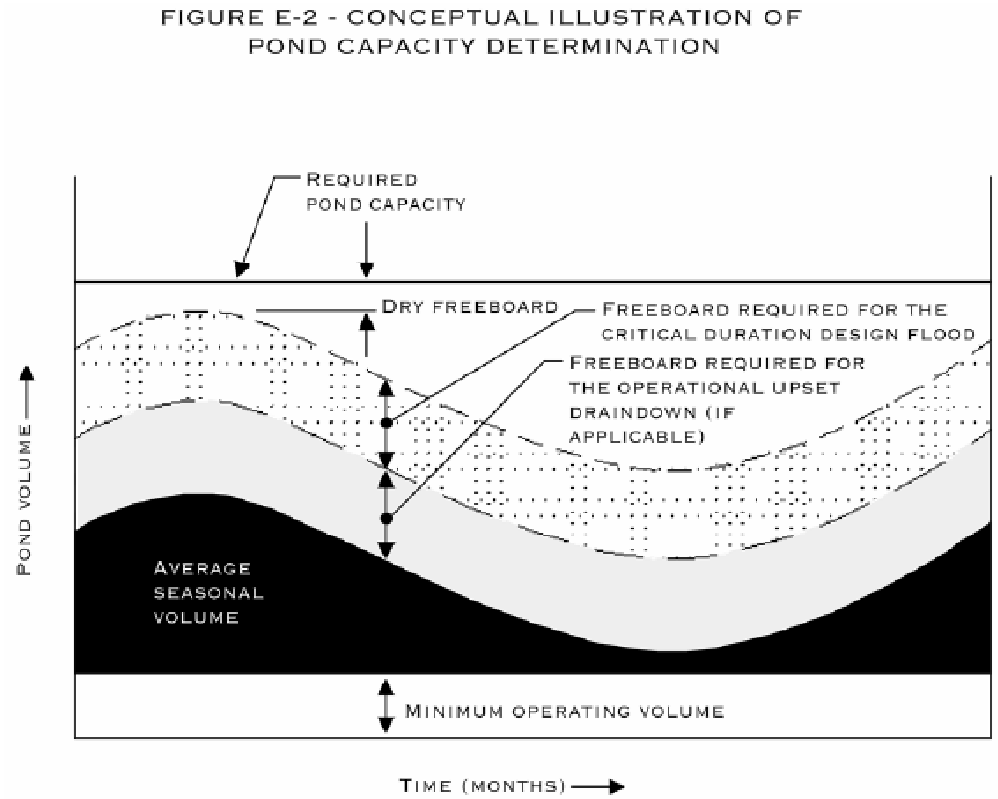
Table 2.1 Design Criteria (cont'd)

	Item	Design Criteria	Reference
2.08	Environmental Design Flood (EDF)	Minimum requirement for BADCT is 100-year 24 hr. TSF design will assume 200-year 24 hr; EDF will be confirmed through water balance and water quality modeling.	▪ BADCT (ADEQ 2005)
2.09	Inflow Design Flood (IDF) For Dam Safety	Storm to be routed through spillway - Probable Maximum Flood (PMF) <u>BADCT:</u> <u>Return Period:</u> if failure of dam would pose an imminent risk to human life and/or high downstream incremental consequences the PMF should be used. <u>Duration:</u> For individual BADCT, the facility-specific critical design storm duration is established by considering several durations and determining which results in the maximum required storage capacity to route the design flood volume. The range of storm duration to be considered are 6 hr to 72 hr. <u>A.A.C R12-15-1216:</u> For a high hazard potential dam, the applicant shall design the dam to withstand an inflow design flood that varies from .5 PMF to the full PMF, with size increasing based on persons at risk and potential for downstream damage. The applicant shall consider foreseeable future conditions. <u>FEMA (2013):</u> PMF for a dam classified as high hazard.	▪ BADCT (ADEQ 2005) ▪ A.A.C R12-15-1216 ▪ D5 Rio Tinto (2017) ▪ FEMA (2013)
2.10	Freeboard	Largest of: ▪ IDF + wave run up with a critical wind annual exceedance probability of the 1 in 2 year event ▪ IDF + 3 ft ▪ 5 ft	▪ A.A.C R12-15-1216 with consideration from CDA (2007b)
2.11	Low level outlet (or discharge - pump)	Can discharge 90% of storage volume within 30 days (minimum capacity).	▪ A.A.C R12-15-1216
2.12	Seepage	See Table 2.1, item 1.13	
2.13	Drains	▪ Provide core and drains/filters satisfying USACE (2004) guidelines to limit potential for internal erosion. ▪ Drains designed to maintain phreatic surface to acceptable levels within the embankment with adequate safety factor to account from clogging and uncertainty.	▪ BADCT (ADEQ 2005), USACE (2004) and A.A.C R12-15-1216
2.14	Crest width	Minimum of dam height (centerline) divided by 5, plus 5 ft. Minimum crest width = 12 ft, maximum crest width = 25 ft.	▪ A.A.C R12-15-1216

Table 2.1 Design Criteria (cont'd)

	Item	Design Criteria	Reference
2.15	Erosion protection	Well graded, durable riprap, sized to withstand wave action, placed on a well graded pervious sand and gravel bedding or geotextile with filtering capacity suitable for the site.	▪ A.A.C R12-15-1216
2.16	External Erosion Protection	The design criteria will be selected based on consequence of failure, e.g. impact on other structures or environment. (BADCT requires, at a minimum, that if the TSF is within the 100-year flood plain, drainage controls must be designed to protect the TSF from damage or flooding for 100-year peak streamflows.)	▪ BADCT (ADEQ 2005)

Figure 2.1 Pond Capacity Determination (ADEQ 2005)



3 DESIGN BASIS

Table 3.1 Design Assumptions, Constraints & Data Sources

	Item	Design Basis	Comments
1.0	**General Design Basis**		
1.01	TSF location	▪ Near West site, Pinal County, Arizona (USFS land) ▪ Coordinates (Arizona State Plane Central NAD83): 920,000' E, 880,000' N	
1.02	Mine Flow Sheet	Selective	
1.03	Mine life	41 years	Received from RC
1.04	TSF operating life	41 years	Received from RC
1.05	Tailings types	Two types of tailings are produced: ▪ scavenger tailings (84% of total weight); and ▪ pyrite tailings (16% of total weight).	Received from RC
1.06	Tailings technology	Thickened slurry (scavenger and pyrite tailings).	
1.07	Tailings delivery	See process schematic (Figure 3.1)	
1.08	Total tailings production	1.37 billion short tons	Received from RC
1.09	Ore and tailings production schedule	Table 3.2	
1.10	Units	U.S. Customary	
1.11	Embankment raise methodology	Hydraulically placed cycloned sand modified centerline (see Figure 3.2)	KCB (2017a)
1.12	Cycloned sand availability	Cycloned Sand Recovery: 45% Cyclone uptime: 50% (Year 1-2); 70% (Year 3-5); 80% (Year 6-41) Cycloned sand retention in hydraulic cells: 90%	Lower bound recovery from Krebs simulations (KCB 2018) To account for reduced efficiency at the start of operations; communicated by RC
2.0	**Topography**		
2.01	Projection	Arizona State Plane Central	
2.02	Datum	NAD83	
2.03	Unit of measurement	U.S. Customary	
2.04	Survey	2013 LiDAR survey received from RC on June 5/6, 2013.	

Table 3.1 Design Assumptions, Constraints & Data Sources (cont’d)

<table>
<tr><th></th><th>Item</th><th>Design Basis</th><th>Comments</th></tr>
<tr><td>3.0</td><td>Seismicity</td><td></td><td></td></tr>
<tr><td>3.01</td><td>Ground Motions</td><td>Not considered in analysis at this stage of design (refer to Table 3.1, Item 8.02).</td><td></td></tr>
<tr><td>4.0</td><td>Climate and Hydrology</td><td></td><td></td></tr>
<tr><td>4.01</td><td>Average precipitation (in inches)</td><td><table><tr><th>J</th><th>F</th><th>M</th><th>A</th><th>M</th><th>J</th><th>J</th><th>A</th><th>S</th><th>O</th><th>N</th><th>D</th><th>Total</th></tr><tr><td>2.0</td><td>2.0</td><td>2.0</td><td>0.8</td><td>0.3</td><td>0.3</td><td>1.9</td><td>2.8</td><td>1.5</td><td>1.2</td><td>1.4</td><td>2.1</td><td>18.2</td></tr></table></td><td>Data collected at the Superior climate station (ID: 028348) with gaps filled using data from the regional climate stations.</td></tr>
<tr><td>4.02</td><td>Wet and dry year precipitations</td><td>Consideration to wet and dry years for the water balance will not be made at this stage of design.</td><td></td></tr>
<tr><td>4.03</td><td>Average annual pan evaporation</td><td>96.5 in</td><td>Pan evaporation data collected at the Roosevelt 1 WNW climate station (ID: 027281).
Free water surface evaporation determined using the Evaporation Atlas for the Contiguous 48 United States (NOAA 1982).</td></tr>
<tr><td>4.04</td><td>Evapotranspiration for reference surface/crop (in inches)</td><td><table><tr><th>J</th><th>F</th><th>M</th><th>A</th><th>M</th><th>J</th><th>J</th><th>A</th><th>S</th><th>O</th><th>N</th><th>D</th><th>Total</th></tr><tr><td>2.9</td><td>3.4</td><td>5.0</td><td>6.6</td><td>8.5</td><td>9.2</td><td>9.0</td><td>8.0</td><td>7.0</td><td>5.8</td><td>3.8</td><td>3.1</td><td>72.3</td></tr></table></td><td>Calculated using the Penman-Monteith combined equation in Hydrus1D based on the generated Superior climate data set and reference vegetation parameters.</td></tr>
<tr><td>4.05</td><td>Natural catchment runoff coefficient</td><td>0.15</td><td>Calculated by dividing the average annual runoff from the nearby USGS hydromet station by the average annual precipitation at site (KCB 2014).</td></tr>
<tr><td>4.06</td><td>Probable Maximum Precipitation (PMP)</td><td><table><tr><th rowspan="2">Storm Type</th><th colspan="3">PMP Depth (inches)</th></tr><tr><th>6 hour Duration</th><th>24 hour Duration</th><th>72 hour Duration</th></tr><tr><td>General Winter</td><td>4.9</td><td>9.0</td><td>13.3</td></tr><tr><td>Tropical</td><td>12.4</td><td>16.3</td><td>20.4</td></tr><tr><td>Local</td><td>12.1</td><td>-</td><td>-</td></tr></table></td><td>Applied Weather Associates PMP Evaluation Tool.
Determined as the critical storm for design.
For the Near West site catchment.</td></tr>
<tr><td>4.07</td><td>Runoff coefficient during storm events</td><td>1.0</td><td>To account for high antecedent moisture conditions and the predominantly exposed rock in the catchment</td></tr>
<tr><td>4.08</td><td>Extreme point precipitation depths</td><td>See Table 3.3</td><td>From NOAA Atlas 14 (NOAA 2018).</td></tr>
</table>

Table 3.1 Design Assumptions, Constraints & Data Sources (cont'd)

	Item	Design Basis		Comments
5.0	**Tailings Characteristics and Deposition**			
		Scavenger Tailings	**Pyrite Tailings**	
5.01	Target gradation produced at mill	*“Total” Tailings:* Target P80 = 160 microns 50% fines (<74 microns) <10% clay (<2 microns)	Target P80 = 75 to 80 microns 80% fines (<74 microns) <20% clay (<2 microns)	Scavenger “Total” Tailings: Provided by RC. Pyrite Tailings: Provided by RC. Clay content assumed from previous test work on cleaner tailings. See Figure 3.3.
5.02	Target gradation produced by cyclones	*Cycloned Sand (Underflow)*: Target P80 = 200 microns <20 % fines (<74 microns) 0% clay (<2 microns) *Cyclone Overflow:* Target P80 = 60 microns 90% fines (<74 microns) 15% clay (<2 microns)	N/A	Provided by RC. See Figure 3.3. Target fines content for cycloned sand to be less than 20%, based on seepage performance and constructability from other cycloned sand embankment case histories.
5.03	Specific gravity	2.78	3.87	Average values from KCB laboratory testing programs on scavenger “total” tailings and cleaner tailings.
5.04	Solids content pumped from the mill	65%	50%	Provided by RC
5.05	Cyclone solids content	*Cyclone Feed:* 35% *Cyclone Overflow:* 25% *Cycloned Sand:* 70%	N/A	From most recent Krebs simulations (KCB 2018).
5.06	Solids content discharged into TSF	*“Total” Tailings:* 65% *Cyclone Overflow:* 50% to 60% *Cycloned Sand:* 60%	50%	Cycloned sand solids content based on case history data and construction performance at other large cycloned sand embankments that use hydraulic cell construction.
5.07	Liquefaction assumption	All potentially liquefiable tailings will liquefy at the TSF, regardless of triggering mechanism.		
5.08	Pyrite tailings management	N/A	Subaqueous deposition	

Table 3.1 Design Assumptions, Constraints & Data Sources (cont’d)

	Item	Design Basis		Comments
5.09	Tailings beach slopes (above water)	1% within 1,500 ft of discharge point, 0.5% thereafter	N/A	Scavenger Tailings - Based on topography and bathymetry surveys from two large, cycloned sand impoundment beaches and slopes below water. These facilities have long exposed beaches, up to five miles. Pyrite Tailings - Based on topography and bathymetry surveys of subaqueous disposal of high-pyrite tailings from floating barges.
5.10	Tailings beach slopes (below water)	2.5% within 1,000 ft of water’s edge; 1.0% thereafter	10% within 100 ft of discharge point; 0.5% thereafter	
5.11	Dry beach runoff coefficient	0.15	N/A	Estimated based on Hydrus1D infiltration modeling
5.12	Dry density for staging assessment	*Interlayered “Total” Tailings and Cyclone Overflow (Composite Beach):* 75 pcf (first 5 years of operations); 81 pcf (remaining years of operations) *Cycloned Sand (compacted):* 113 pcf	106 pcf	KCB (2018)
6.0	**Cyclone Plant Design**			
6.01	No. of Clusters	2		
6.02	Feed Tonnage	5,040 dry stph		
6.03	Feed Flow	45,267 USGPM		
6.04	Solids Content of Feed, Overflow, Underflow	see Table 3.1, Item 5.05		
6.05	Pressure Drop	15 psi		
6.06	Target No. of Spare Cyclones per Cluster	2		
6.07	Target No. of Spare Ports per Cluster	1		

Table 3.1 Design Assumptions, Constraints & Data Sources (cont’d)

	Item	Design Basis	Comments
6.08	Selected Cyclone Model	gMAX15U	
6.09	Selected Cyclone Vortex	6.75 inches	
6.10	Selected Cyclone Apex	3 inches	
6.11	Selected Cyclone Diameter	15 inches	
6.12	Selected Operating Cyclones per Cluster	24	
6.13	Selected No. of Spare Cyclones per Cluster	2	
6.14	Selected No. of Cyclones Installed per Cluster	26	
6.15	Selected No. of Spare Ports per Cluster	2	
7.0	**Thickener Design**		
7.01	Thickener Type	High-Density	
7.02	No. of Thickeners	2	
7.03	Design Tonnage	144,000 tpd ore	
7.04	Diluted Feed %solids	20%	
7.05	Underflow %solids (Cyclone Overflow Feed)	50%	
7.06	Underflow %solids (Scavenger Total Tailings Feed)	n/a	
7.07	Unit Settling Rate	0.98 ft^2/tpd	
7.08	Sizing Design Allowance	15%	
7.09	Thickener Diameter	250 ft	

Table 3.1 Design Assumptions, Constraints & Data Sources (cont'd)

	Item	Design Basis	Comments
8.0	**Tailings Storage Facility (TSF) Impoundment Design**		
8.01	Design criteria	As per Table 2.1.	
8.02	Stability	Embankment section (Figure 3.2) assumed to meet design stability criteria for DEIS	Based on preliminary stability analyses reported in KCB (2017a) and typical assumed foundation conditions at the Near West site (KCB 2017b)
8.03	Perimeter Embankment Crest width	100 ft	Sufficient to accommodate 2-way vehicle traffic, pipelines and any other equipment required to be on the crest (e.g. cyclones).
8.04	Perimeter Embankment Downstream Slope	4H:1V (see Figure 3.2)	For ease of progressive reclamation. A trade-off assessing the impacts to steepening to 3H:1V has been completed (Appendix III).
8.05	Perimeter Embankment Upstream Slope	1.5H:1V (see Figure 3.2)	Assumed based on preliminary stability analysis reported in KCB (2017a)
8.06	Liner	Engineered low-permeability liner[2] in the pyrite starter cell; selective engineered liner placement over permeable portions of the foundation	
8.07	Drainage	Sand and gravel drainage blanket in the embankment footprint; gravel/rockfill finger drains in existing drainage channels in the embankment footprint	
8.08	Closure	TSF Surfaces: slope, cover and revegetate to shed water, limit infiltration, limit erosion and return the landscape to a similar condition prior to mining. Pyrite management: limit oxygen ingress through subaqueous deposition, cover and encourage saturation of the pyrite tailings in the long term (i.e. after removal of the pond).	Approach agreed by RC
9.0		**Pond Management**	
9.01	Pond Management	▪ Permanent water pond located on the tailings surface. Tailings strategically deposited to keep pond cover over pyrite tailings.	D5 Rio Tinto (2017)
9.02	Minimum operating pond volume	▪ Minimum amount to keep pyrite tailings saturated and provide operating pond depth.	

[2] The engineered low-permeability liner could be comprised of one or more of the following: compacted fine tailings, geomembrane liner, asphalt, slurry bentonite, and/or cemented paste tailings

Table 3.1 Design Assumptions, Constraints & Data Sources (cont’d)

<table>
<tr><th></th><th>Item</th><th>Design Basis</th><th>Comments</th></tr>
<tr><td>9.03</td><td>Minimum operating pond depth</td><td>

Seepage Collection Dams: 10 ft for reclaim pump (could be accounted for by a sump or other means).
TSF Reclaim Pond:

<table>
<tr><th>Pond</th><th>Years of Operation</th><th>Minimum Operating Depth (ft)</th><th>Minimum Water Cover above Maximum Tailings El. (ft)</th></tr>
<tr><td>Scavenger</td><td>1 to 9</td><td>20</td><td>n/a[2]</td></tr>
<tr><td>Pyrite</td><td>1 to 9</td><td>n/a[1]</td><td>10</td></tr>
<tr><td>Combined Pyrite and Scavenger</td><td>10 to 41</td><td>n/a[1]</td><td>5</td></tr>
</table>

No minimum depth. Water cover is determined based on the minimum height above the maximum tailings elevation.
No minimum water cover. Minimum water depth is based on minimum depth in the lowest part of the pond (where the reclaim barge will be positioned).

</td><td></td></tr>
</table>

Table 3.2 Mine and Tailings Production Schedule

Description	Year	Mine Year	Modeling Year	Tailings Tonnage (tons/year)		
				Scavenger	Pyrite	Total
Care and Maintenance	2017	-	1	-	-	-
Care and Maintenance	2018	-	2	-	-	-
Care and Maintenance	2019	-	3	-	-	-
Care and Maintenance	2020	-	4	-	-	-
Construction	2021	-	5	-	-	-
Construction	2022	-	6	-	-	-
Construction	2023	-	7	-	-	-
Construction	2024	-	8	-	-	-
Construction	2025	-	9	-	-	-
Construction	2026	-	10	-	-	-
Construction	2027	-	11	-	-	-
First Ore	2028	1	12	5,346,486	766,631	6,113,118
Ramp up	2029	2	13	7,187,504	991,640	8,179,144
Ramp up	2030	3	14	7,897,945	1,014,556	8,912,501
Ramp up	2031	4	15	15,085,826	2,110,526	17,196,352
Ramp up	2032	5	16	21,902,288	3,328,288	25,230,577
Ramp up	2033	6	17	28,780,765	4,569,518	33,350,283
Ramp up	2034	7	18	34,178,734	5,793,075	39,971,810
Full Production	2035	8	19	37,849,588	7,340,459	45,190,047
Full Production	2036	9	20	37,128,274	8,184,034	45,312,308
Full Production	2037	10	21	36,749,978	8,772,867	45,522,845
Full Production	2038	11	22	37,121,210	8,792,910	45,914,120
Full Production	2039	12	23	38,040,923	8,019,027	46,059,950
Full Production	2040	13	24	37,486,298	6,800,935	44,287,232
Full Production	2041	14	25	39,582,789	6,518,836	46,101,626
Full Production	2042	15	26	39,666,729	6,589,905	46,256,634
Full Production	2043	16	27	39,211,923	6,919,174	46,131,097
Full Production	2044	17	28	38,679,739	7,360,739	46,040,478
Full Production	2045	18	29	38,273,841	7,838,027	46,111,868

Table 3.2 Mine and Tailings Production Schedule (cont'd)

Description	Year	Mine Year	Modeling Year	Tailings Tonnage (tons/year)		
				Scavenger	Pyrite	Total
Full Production	2046	19	30	38,130,733	8,150,877	46,281,610
Full Production	2047	20	31	38,448,597	7,968,471	46,417,068
Full Production	2048	21	32	38,926,908	7,537,946	46,464,854
Full Production	2049	22	33	39,028,952	7,382,565	46,411,517
Full Production	2050	23	34	39,006,219	7,367,901	46,374,120
Full Production	2051	24	35	38,564,309	7,824,341	46,388,650
Full Production	2052	25	36	38,008,651	8,406,901	46,415,552
Full Production	2053	26	37	37,822,090	8,629,862	46,451,952
Full Production	2054	27	38	38,599,981	7,902,469	46,502,450
Full Production	2055	28	39	39,472,443	6,988,070	46,460,513
Full Production	2056	29	40	39,579,974	6,796,869	46,376,843
Full Production	2057	30	41	39,595,841	6,786,681	46,382,522
Full Production	2058	31	42	39,503,382	6,740,343	46,243,725
Ramp Down	2059	32	43	31,481,866	5,391,484	36,873,350
Ramp Down	2060	33	44	24,576,943	4,320,111	28,897,054
Ramp Down	2061	34	45	18,707,166	3,478,519	22,185,685
Ramp Down	2062	35	46	13,146,108	2,643,079	15,789,186
Ramp Down	2063	36	47	9,566,562	1,952,428	11,518,989
Ramp Down	2064	37	48	4,993,554	1,079,281	6,072,835
Ramp Down	2065	38	49	2,121,484	545,241	2,666,725
Ramp Down	2066	39	50	928,110	274,819	1,202,929
Ramp Down	2067	40	51	326,877	99,724	426,602
Ramp Down	2068	41	52	19,505	4,936	24,440
Closure	2069	-	53	-	-	-
			TOTAL TAILINGS	**1,150,727,095**	**219,984,066**	**1,370,711,161**

Notes: Tailings production schedule supplied by Resolution Copper.
Mine plan descriptions, mine years and modeling years supplied by Resolution Copper.

Table 3.3 Precipitation Depth-Duration-Frequency Estimates for the TSF

Average Recurrence Interval (years)	5 min	10 min	15 min	30 min	60 min	2 hr	3 hr	6 hr	12 hr	24 hr	2 day	3 day	4 day	7 day	10 day	20 day	30 day	45 day	60 day
Precipitation in inches																			
1	0.2	0.4	0.4	0.6	0.7	0.9	0.9	1.1	1.3	1.6	1.8	2.0	2.1	2.4	2.7	3.3	4.0	4.7	5.5
2	0.3	0.5	0.6	0.8	1.0	1.1	1.2	1.4	1.7	2.0	2.3	2.5	2.7	3.0	3.4	4.2	5.1	6.0	6.9
5	0.4	0.6	0.8	1.1	1.3	1.5	1.5	1.8	2.1	2.6	2.9	3.2	3.5	3.9	4.3	5.4	6.5	7.7	8.7
10	0.5	0.8	0.9	1.3	1.6	1.7	1.8	2.1	2.4	3.0	3.5	3.8	4.1	4.7	5.1	6.4	7.6	8.9	10.1
25	0.6	0.9	1.1	1.5	1.9	2.1	2.2	2.5	2.8	3.6	4.2	4.6	5.0	5.8	6.2	7.7	9.1	10.6	11.9
50	0.7	1.0	1.3	1.7	2.2	2.4	2.5	2.8	3.2	4.1	4.7	5.2	5.7	6.7	7.2	8.7	10.3	12.0	13.3
100	0.8	1.2	1.5	2.0	2.4	2.7	2.8	3.1	3.5	4.6	5.3	5.9	6.5	7.6	8.2	9.8	11.6	13.3	14.7
200	0.9	1.3	1.6	2.2	2.7	3.0	3.1	3.4	3.9	5.1	5.9	6.6	7.4	8.7	9.2	10.9	12.9	14.6	16.1
500	1.0	1.5	1.8	2.4	3.0	3.4	3.6	3.9	4.4	5.8	6.8	7.7	8.5	10.2	10.7	12.4	14.7	16.5	17.9
1000	1.1	1.6	2.0	2.7	3.3	3.7	3.9	4.2	4.7	6.4	7.4	8.5	9.5	11.4	12.0	13.6	16.1	17.9	19.3

Note: From NOAA Atlas 14 (NOAA 2018) For the Near West site.

Figure 3.1 Process Schematic

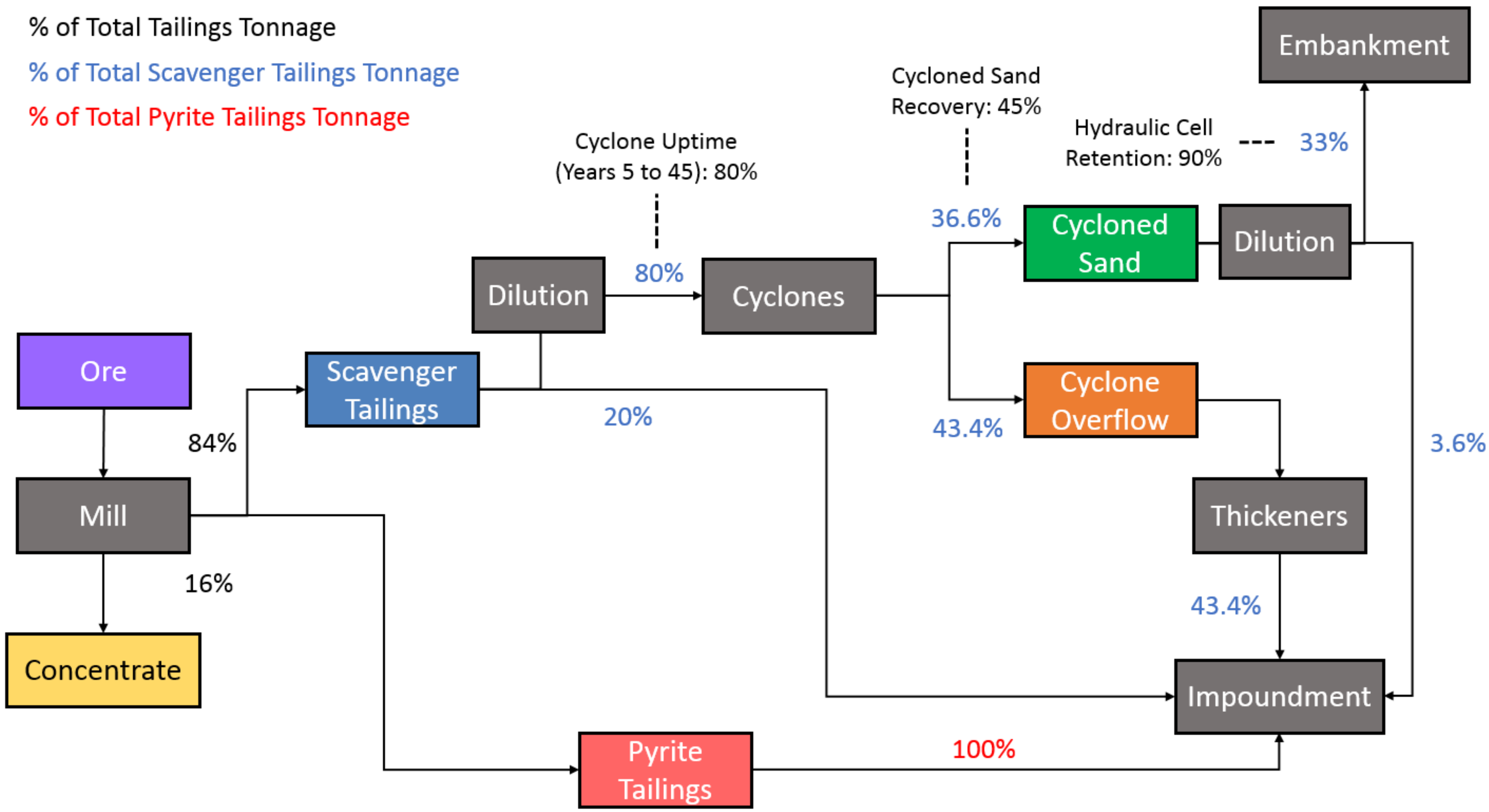


Figure 3.2 Modified Centerline Raise

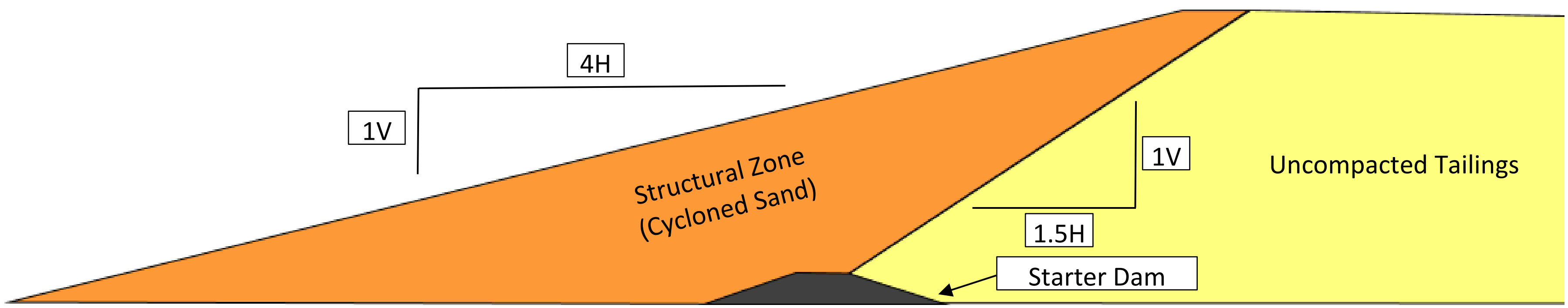
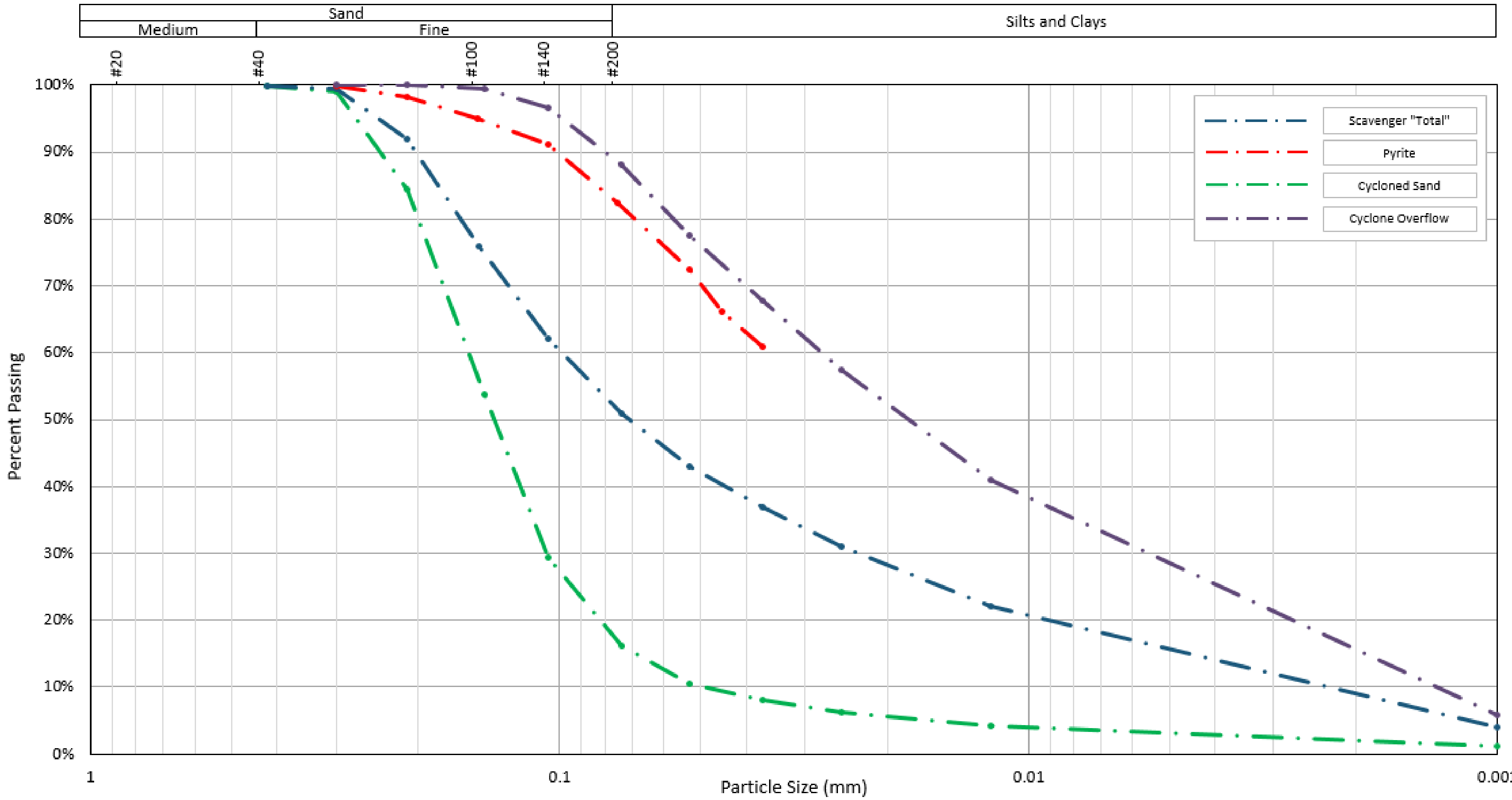


Figure 3.3 Target Tailings Gradations for Design



ADDITIONAL REFERENCES

Klohn Crippen Berger Ltd. (KCB). 2014. *Near West Tailings Management Mine Plan of Operations Study.* September 5.

Klohn Crippen Berger Ltd. (KCB). 2017a. *Near West Tailings Storage Facility Embankment Design Alternatives Analysis.* March 2.

Klohn Crippen Berger Ltd. (KCB). 2017b. *Near West Tailings Storage Facility Geotechnical Site Characterization Report.* October 2017.

Klohn Crippen Berger Ltd. (KCB). 2018. *Resolution Tailings Geotechnical Characterization – Rev. 1. April 24*.

Lettis Consultants International Inc. (LCI). 2017. *Updated Site-Specific Seismic Hazard and Development of Time Histories for Resolution Copper’s Near West Site, Southern Arizona.* November 27.

National Oceanic and Atmospheric Administration (NOAA). 2018. “NOAA Atlas 14 Point Precipitation Frequency Estimates: AZ.” Accessed January 15, 2018. https://hdsc.nws.noaa.gov/hdsc/pfds/pfds_map_cont.html

APPENDIX II

Cycloning Assumptions

Resolution Copper Project

DEIS Design for Alternative 3A – Near West Modified Proposed Action (Modified Centerline Embankment – “wet”)

Technical Memorandum

Appendix II – Cycloning Assumptions

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Appendix II
Cycloning Assumptions

II-1 INTRODUCTION

This appendix explains the cyclone assumptions that will be adopted in the design basis memorandum (DBM), refer to Appendix I.

II-2 GENERAL

The total amount of cycloned sand that is available for embankment construction, specified as a percentage of the total NPAG scavenger (scavenger) mass, is determined by the multiplication of three variables: cyclone recovery (%); cyclone uptime (%); and hydraulic cell retention (%). Design assumptions for each are discussed in the following subsections.

II-3 CYCLONE RECOVERY

In December 2017 and January 2018, a series of single-stage cyclone simulations based on feed gradations that are considered to best represent the range expected from the mill (refer to Appendix I) and a model developed from running actual RC samples through a test skid were performed by Krebs. The results of these simulations have been adopted for the DEIS (KCB 2018).

The cyclone simulations were optimized to maximize cycloned sand recovery[1] while maintaining a cycloned sand fines content less than 20% to meet design criteria, refer to Appendix I. The simulation results are provided in the tailings characterization report (KCB 2018). Based on the simulations:

- the most efficient cyclone system for the average feed gradation is 41 gMAX15U cyclones with 6.75 inch vortex and 3 inch apex; and
- for the range of tailings feed gradations tested, the minimum cycloned sand recovery value estimated from the simulations was 45% of the scavenger tailings and the maximum was 57%.
  - 45% cycloned sand recovery has been adopted for design.

II-4 CYCLONE UPTIME

Cyclone uptime is the percentage of the year during which cycloning can occur. Uptime is expected to be lower in the early years of operations as the production rate is relatively low as mining ramps up (refer to Section 0), adjustments are made in the milling process and operational experience is gained. Uptime has been reduced in the early years of operations to account for this, refer to Table II-1 .

[1] Percentage of the scavenger tailings cyclone feed that is converted to cyclone underflow (cycloned sand), by mass

II-5 CYCLONED CELL RETENTION

Cycloned sand cell retention is the percentage of cycloned sand that remains in the hydraulic cells after discharge, spreading and compaction. A sand cell retention of 90% has been assumed for the DEIS designs, refer to Appendix I, and will be confirmed in future design stages based on case history data from other large cycloned sand dams that use the hydraulic cell construction method.

II-6 SUMMARY OF RESULTS

The cyclone assumptions are summarized in Table II-1.

Table II-1 Summary of Cyclone Assumptions

Item	DEIS Design Assumption
Cycloned Sand Recovery	45%
Cell Retention	90%
Cyclone Uptime	50% (Year 1 to Year 2) 70% (Year 3 to Year 4) 80% (Year 5 to Year 41)
Cycloned Sand Availability[1]	20% (Year 1 to Year 2) 28% (Year 3 to Year 4) 32% (Year 5 to Year 41)

Notes:
1. Availability = Cycloned Sand Recovery x Cell Retention x Cyclone Uptime. As percentage (by mass) of tailings feed through the cyclones.

REFERENCES

Klohn Crippen Berger Ltd. (KCB). 2018. Resolution Tailings Geotechnical Characterization. Rev. 1. Prepared for Resolution Copper Mining. April 24.

APPENDIX III

Embankment Slope Trade-off

Resolution Copper Project

DEIS Design for Alternative 3A – Near West Modified Proposed Action (Modified Centerline Embankment – “wet”)

Technical Memorandum

Appendix III – Embankment Slope Trade-Off

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Appendix III
Embankment Slope Trade-Off

III-1 INTRODUCTION

The design for Alternative 3A - Near West Modified Proposed Action (Modified Centerline Embankment) includes a hydraulically placed and compacted cycloned sand embankment with a minimum 4H:1V downstream slope, and 1.5H:1V upstream slope, refer to Figure III-1. The 4H:1V downstream slope was selected primarily for ease of trafficability by construction equipment during slope reclamation, with the understanding that steeper slopes may meet geotechnical stability criteria (KCB 2017a).

This appendix summarizes the impact on required cycloned sand volume and progressive reclamation for an alternate configuration on a relative basis, with the downstream embankment slope steepened to 3H:1V, and the upstream slope modified to 1H:1V, refer to Figure III-2. The alternate configuration was assumed to meet design criteria based on the analyses reported in KCB (2017a) and typical foundation conditions (KCB 2017b). For both configurations, the slope may need to be shallower, and/or the structural zone widened, in local areas dependent on foundation conditions.

Figure III-1 Configuration of Cycloned Sand Embankment - Alternative 3A

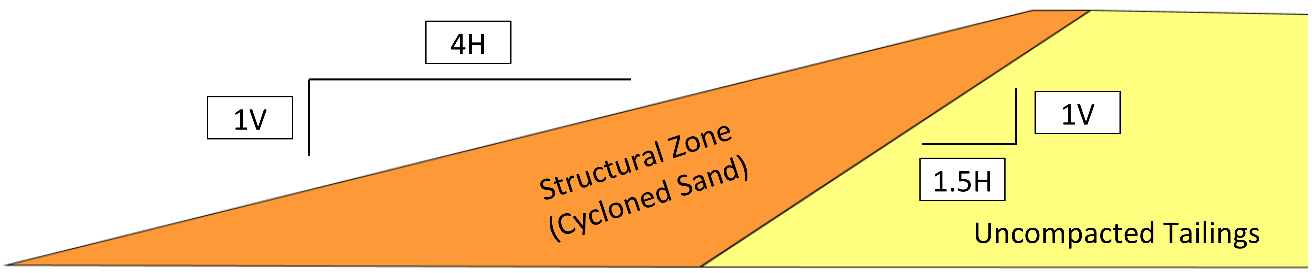
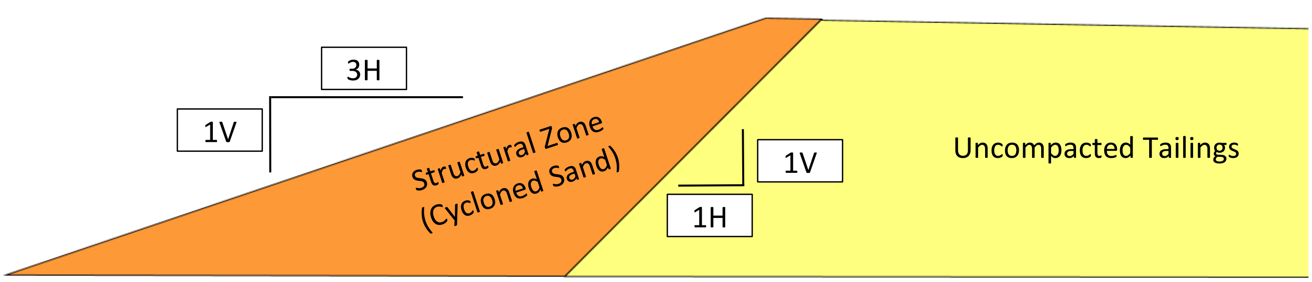


Figure III-2 Configuration of Cycloned Sand Embankment with 3H:1V Downstream Slope



III-2 VOLUME COMPARISON

The embankment height and cycloned sand volume required for both the 4H:1V and 3H:1V embankments, refer to Table III-1, were estimated using the three-dimensional (3D) software program, MUCK3D (Minebridge Software, v.2017.1.3). Key points of comparison between the options are:

- The 3H:1V embankment configuration requires less (20%) cycloned sand to construct than the 4H:1V configuration, therefore requiring less cyclone operation time and fill placement costs;
    - Surplus available cycloned sand could be used for other purposes around the TSF (e.g., internal berms, road construction or as sand bedding), thus potentially offsetting costs for potential external borrow.
    - The required embankment crest elevation of the 3H:1V configuration is 13 ft lower than the 4H:1V configuration, thus maximizing the slurry storage volume and reducing visual impact.

Table III-1 Comparison of Cycloned Sand Requirements and Availability

Embankment Slope Configuration	Embankment Elevation (fasl)	Maximum Embankment Height (ft)	Cycloned Sand Volume Required (Myd^3)	Maximum Cycloned Sand Volume Available (Myd^3)[1]	Cycloned Sand Surplus (Myd^3)
d/s - 4H:1V u/s – 1.5H:1V	2,773	521	204	243	39
d/s - 3H:1V u/s – 1H:1V	2,760	504	164	243	79

Notes:
1. Refer to Appendix II for information on cycloned sand availability assumptions.

III-3 PROGRESSIVE RECLAMATION

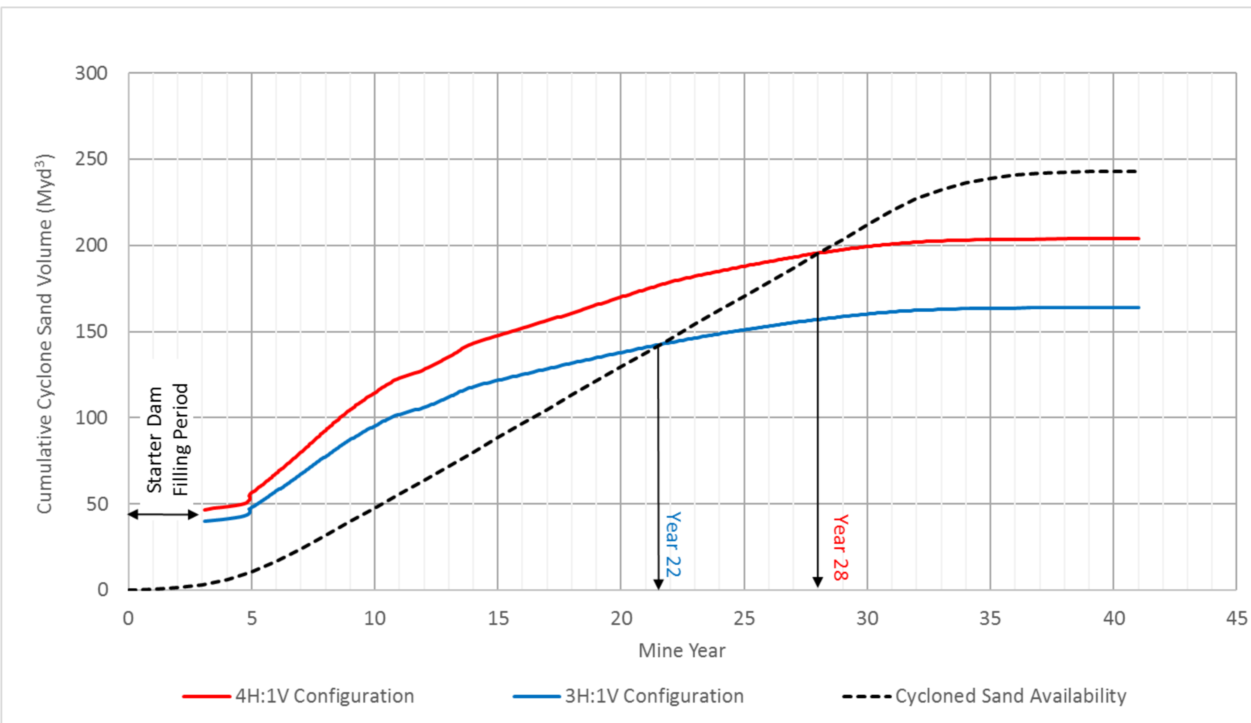
A staging assessment was performed to forecast when progressive reclamation could begin for the 3H:1V and 4H:1V embankment configurations. Progressive reclamation was assumed to start once the ultimate downstream slope had been established. A detailed tailings staging plan has not been performed for the 3H:1V embankment configuration, rather, a number of simplified assumptions were made for the purposes of the current relative comparisons which will need to be validated if the study advances. These simplified assumptions are summarized below:

- Required crest elevations were assumed to be the same for both configurations until Year 15 when narrow valleys are being infilled and rates of rise are highest. After Year 15, while the tailings production rate is relatively constant, the annual crest elevation for the 3H:1V configuration (8 ft/yr) was slightly reduced compared to the 4H:1V configuration (9 ft/yr) to account for its lower ultimate crest elevation. These values are based on the tailings staging assessment, refer to Appendix IV.
- The same starter dam volumes and locations, and borrow excavations, were assumed for both configurations. Sizing criteria is provided in Appendix IV.

- There are no demands on cycloned sand other than the cycloned sand embankment (e.g., internal dykes, berms).

Cycloned sand requirements for both slope configurations and the maximum cycloned sand available are plotted over the life of mine on Figure III-3. The red and blue lines represent the total amount of cycloned sand that is required to build the embankments out to its ultimate exterior slope based on the forecasted minimum crest elevation required for tailings storage, refer to Table III-1, and a crest width at ultimate height of 100 ft. When there is a deficit between the total cycloned sand required and the total available (i.e. red or blue line is above the dashed black line), the ultimate exterior slope cannot be established. During this period, the embankment crest would be raised to the required elevation for tailings storage and the interim embankment slopes would be maintained as required for embankment stability. The time at which the quantities are equal is assumed to be the earliest time that progressive reclamation could start: 4H:1V configuration at Year 28; 3H:1V configuration at Year 22. During operations, progressive reclamation would be expected to start after these forecasted times due to operational and construction considerations.

Figure III-3 Comparison of Cycloned Sand Requirements and Time to Progressive Reclamation



III-4 CONCLUSIONS

The 3H:1V embankment configuration offers an opportunity to reduce the amount of cycloned sand required for construction and potentially allow for progressive reclamation to start earlier.

REFERENCES

Klohn Crippen Berger Ltd. (KCB). 2017a. Near West Tailings Storage Facility Embankment Design Alternatives Analysis - Draft. Prepared for Resolution Copper Mining. March.

Klohn Crippen Berger Ltd. (KCB). 2017b. Near West Tailings Storage Facility Geotechnical Site Characterization Report. Prepared for Resolution Copper Mining. October.

APPENDIX IV

Tailings Staging Plan

Resolution Copper Project

DEIS Design for Alternative 3A – Near West Modified Proposed Action (Modified Centerline Embankment – “wet”)

Technical Memorandum

Appendix IV – Tailings Staging Plan

DISCLAIMER

Appendix IV
Tailings Staging Plan

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IV-1 INTRODUCTION

This appendix presents the tailings staging plan for the Draft Environmental Impact Statement (DEIS) Design for the Tailings Storage Facility (TSF) Alternative 3A - Near West Modified Proposed Action (Modified Centerline Embankment). Modeling presented herein was completed using the tailings deposition software Muck3D (MineBridge Software Inc., version 1.0.5).

Key objectives of this the tailings staging assessment were as follows:

- Size the earthfill dam structures.
- Develop a tailings deposition strategy that:
  - promotes continuous saturation of the PAG pyrite (pyrite) tailings (also referred to as "cleaner" tailings);
  - provides required tailings and flood storage volumes;
  - promotes a wide subaerial "beach above water" (beach) length; and
  - minimizes the rate of rise.
- Estimate annual cycloned sand requirements to support embankment construction.
- Determine the ultimate elevation of the cycloned sand embankment.
- Identify potential periods when rapid pond volume changes are required to maintain pyrite tailings saturation; large annual cycloned sand volumes are required for construction; and beach lengths less than the minimum design requirements could develop. Starter dam, seepage dam and northern dam designs will be presented in other appendices.

IV-2 DEPOSITION STRATEGY AND STAGING

IV-2.1 Deposition Strategy

The tailings deposition strategy begins with deposition of both scavenger and pyrite tailings on the eastern side of the TSF, within Bear Tank Canyon (Catchment C2) (refer to Figure IV-A.1). The natural topography of the canyon provides an opportunity to meet the required storage volume in early years (Years 0 to the end of Year 2) while constraining tailings deposition to a single catchment. This would also reduce starter dam fill volume requirements compared with discharging initially in several catchments. As Bear Tank Canyon is progressively filled, additional starter dams are constructed in valleys further to the west until the embankment crest is established around the TSF perimeter to the ultimate crest elevation. Later in the mine life, in preparation for closure, pyrite tailings are deposited in a separate cell at the northern end of the TSF (North Pyrite Cell), and scavenger tailings are deposited within the center of the impoundment to cover the previously discharged pyrite tailings and push the reclaim pond to the north.

IV-2.2 Deposition Staging

The tailings deposition strategy is characterized by five stages based on the progression of starter dams and pond arrangements, with the key activities carried out during the stages summarized below. For the location of the catchments and structures described, refer to Figure IV-A.1. Details from the staging assessment (elevations, pond volumes, etc.) are provided in Appendix IV-A. For comparison purposes, the percentage of the total tailings volume that is deposited in each stage is provided in brackets.

- Stage I – Years 0 to 2 (Figures IV-A.3 and IV-A.4) (1% of total tailings volume):
  a. Construction of the Scavenger Starter Dam Stage I and Pyrite Starter Dam in Bear Tank Canyon (prior to Year 0).
  b. Impounding of water behind the Pyrite Starter Dam in preparation for subaqueous pyrite tailings deposition (prior to Year 0).
  c. Subaqueous pyrite tailings deposition behind the Pyrite Starter Dam.
  d. Scavenger tailings deposition behind the Scavenger Starter Dam Stage I.
  e. Cycloning of scavenger tailings to produce fill for cycloned sand embankment construction and hydraulic cell construction (beginning in Year 1). These activities continue in Stages II through IV.
  f. Operation of separate scavenger and pyrite reclaim ponds located within the impoundment. Water in the scavenger pond is pumped to the pyrite pond via submersible pumps and/or floating pump barges and overland pipelines to maintain a water cover over the pyrite tailings.
  g. Construction of the Scavenger Starter Dam Stage II in Catchments C3 and C4 (Year 2).
- Stage II – Years 3 to 4 (Figures IV-A.5 and IV-A.6) (2% of total tailings volume):
  a. Continued subaqueous pyrite tailings deposition behind the Pyrite Starter Dam.
  b. Continued scavenger tailings deposition in Bear Tank Canyon and in Catchment C3 and C4 behind the Scavenger Stage II Starter Dam.
  c. Raising of Scavenger Starter Dam Stage I and Stage II with cycloned sand to achieve a crest elevation of El. 2,432 ft (~5 ft raise) by the end of Year 4.
  d. Scavenger and pyrite reclaim ponds located within the impoundment. Water in the scavenger ponds is pumped to the pyrite pond via submersible pumps and/or floating pump barges and overland pipelines.
  e. Construction of the Scavenger Starter Dam Stage III in Catchments C9, C10 and C12 (Year 4).
- Stage III – Years 5 to 9 (Figures IV-A.7 and IV-A.8) (14% of total tailings volume):
  a. Continued subaqueous pyrite tailings deposition behind the Pyrite Starter Dam.

   b. Scavenger tailings deposition distributed between Bear Tank Canyon and Catchments C3, C4, C9, C10 and C12. Scavenger Starter Dam Stage III is commissioned.
   c. Raising of Scavenger Starter Dam Stage I and Stage II to El. 2,445 (~13 ft raise) with cycloned sand by the end of Year 5.
   d. Separate scavenger and pyrite reclaim ponds. Water in the scavenger ponds is pumped to the pyrite pond via submersible pumps and/or floating pump barges and overland pipelines.
- Stage IV – Years 10 to 34 (Figures IV-A.9 to IV-A.13) (80% of total tailings volume):
   a. Scavenger tailings deposition in all TSF catchments from the embankment perimeter.
   b. Pyrite tailings deposition in the central portion of the impoundment. Pyrite tailings are strategically deposited overtop of the Gila Conglomerate which has relatively low hydraulic conductivity (foundation characterization and seepage management requirements are currently ongoing under other scopes).
   c. Raising of the perimeter embankment with cycloned sand.
   d. Scavenger and pyrite reclaim ponds are merged and operated as one within the impoundment when the scavenger tailings overtop the Pyrite Starter Dam.
   e. Construction of the Northeast and Northwest Containment Dams (Year 15) and Northeast and Northwest Dams at the northern end of Bear Tank Canyon (Year 32). The Northeast and Northwest Dams will retain the North Pyrite Cell which is commissioned for water storage in Stage IV. The containment dams are water retaining structures that will contain the TSF reclaim pond as it is pushed north in Stage V.
- Stage V – Years 35 to 41 (Figures IV-A.14 to IV-A.15) (3% of total tailings volume):
   a. Scavenger tailings deposition on the tailings beach to fill in the low spot in the impoundment and promote grading of the beach to the north towards the Northeast and Northwest Containment Dams.
   b. Cessation of scavenger cycloning and embankment raising as all scavenger tailings are directed to the center of the impoundment.
   c. Pyrite tailings deposition in the North Pyrite Cell.
   d. Scavenger reclaim pond is located in the center of the impoundment. Pyrite reclaim pond is located in the North Pyrite Cell. Water in the scavenger pond is pumped to the North Pyrite Cell via submersible pumps and/or floating pump barges and overland pipelines. The volume of the scavenger pond is gradually reduced so that no water remains in the impoundment at end of operations.

The Stage V layout shown on Figure IV-A.15 still incorporates a tailings production schedule of 45 years, and although final elevations and layout would be slightly different for the actual 41 year production schedule, the changes are not material and the tailings management concept would remain unchanged.

Tailings deposition was modeled annually or biennially (every two years). The tailings configuration for each modelling scenario is illustrated for select years on the figures provided in Appendix IV-A. Figures also include details on: tailings discharge elevation; subaerial beach length; pond elevation, volume and depth. Primary Seepage Collection Dams are shown on the figures for reference, however they were not relevant to the staging assessment. Methodology, input information and assumptions used for modeling are discussed in Section IV-3.

IV-2.3 Earthfill Dams

Earthfill dams would be constructed as required from borrow materials sourced within the TSF footprint to provide tailings and water storage (starter dams, seepage dams and north dams) and support for tailings distribution and processing infrastructure. Dam design assumptions summarized in this section are preliminary and were made for the staging assessment.

Assumptions for starter dam sizing are summarized below:

- Scavenger Stage I (to El. 2,427 ft, refer to Figure IV-A.2): sized to store two years of scavenger tailings production. This assumption was made to provide sufficient storage to allow for challenges that may arise at the start of operations in producing cycloned sand and developing hydraulic cells for embankment construction.
- Scavenger Stage II (to El. 2,427 ft, refer to Figure IV-A.2): sized to store one year of scavenger tailings production in Year 3, assuming cycloned sand construction is underway.
- Scavenger Stage III (to El. 2,445 ft): sized to match the scavenger tailings elevation (at the end of Year 5) in the adjacent cells within one year.
- Pyrite (to El. 2,517 ft, refer to Figure IV.A-2): sized to store seven years of tailings. This dam is strategically sited in a narrow portion of Bear Tank Canyon to maximize storage volume and minimize earthfill requirements. The footprint is adjacent to the main borrow area to increase the storage for the pyrite tailings.
- All starter dams are designed to store the Probable Maximum Flood (PMF) (refer to Section IV-3.8) above their minimum operating pond level, operational upset storage, seasonal fluctuations; therefore, do not require spillways.

The Northwest and Northeast Containment Dams contain the reclaim pond and tailings during the final years of operations as the pond is pushed to the north in preparation for closure. Figure IV-A.10 through Figure IV-A.17 show the northern containment dams with 3H:1V upstream and 2H:1V downstream slopes. The dams would be constructed from borrow materials sourced within the TSF footprint and/or from cycloned sand; dam sections and construction details will be reviewed and refined as required in the next phase of design. The west abutment of the Northwest Containment Dam was modeled as a vertical face for simplicity but during construction will be benched or sloped into the adjacent cycloned sand embankment.

The Northeast and Northwest Dams impound the North Pyrite Cell in the final years of operations when pyrite tailings are deposited separately from the scavenger tailings.

Locations of the starter dams and other earthfill dams are shown on Figure IV-A.1. Further details on these dams are summarized in Table IV-1. Refer to Section IV-1 for discussion on how the dam details may be impacted by the DEIS tailings production schedule.

Table IV-1 Earthfill Dam Details

Dam	Crest Elevation	Dam Height	Earthfill Volume
	fasl	ft	Myd^3
Scavenger Starter Stage I	2427	132	4.7
Scavenger Starter Stage II	2427	139	4.0
Scavenger Starter Stage III	2445	128	3.2
Pyrite Starter	2517	138	2.5
Northwest Containment Dam	2805	242	5.5
Northeast Containment Dam	2805	195	3.7
Northwest Dam	2807	185	2.2
Northeast Dam	2807	55	0.03
TOTAL			25.8

IV-3 MODELING INPUT PARAMETERS AND ASSUMPTIONS

IV-3.1 General

The required model input parameters for this Muck3D modeling are:

- baseline topography;
- discharge locations (i.e. spigots);
- tailings subaerial beach and below water slopes;
- tailings dry density;
- sequence of spigot discharge (the program does not allow for simultaneous discharge from multiple spigots); and
- deposition rate (tons/year) per spigot.

IV-3.2 Borrow Area

A borrow area within the Gila Conglomerate was modeled in Bear Tank Canyon, upstream of the Pyrite Starter Dam (refer to Figure IV-A.1). The borrow excavation will provide 27 Myd^3 of fill to support construction of the starter dams and north dams. The excavation will also provide additional storage capacity in the TSF. The borrow area would be excavated progressively, as much as practical, starting at the south end and progressing to the north. The calculated excavation volume does not account for volume increase (bulking) during excavation or volume decreases that may occur during construction fill processing. The borrow plan is preliminary for the purposes of tailings staging and further details, such as borrow area layout and use of multiple borrow sources, will be developed in future design stages. Further investigation will be conducted to identify other borrow areas for different stages of construction/operation.

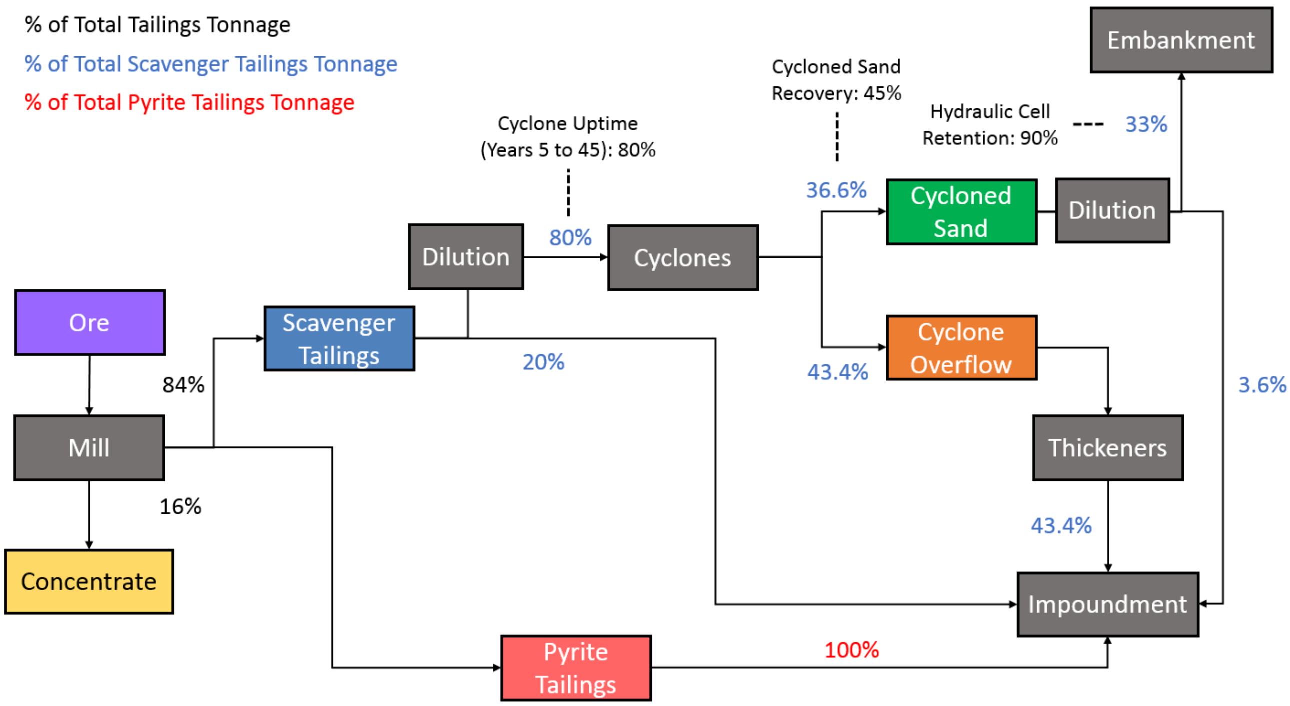
IV-3.3 Tailings Process Flow Diagram

The tailings process flow diagram is shown schematically on Figure IV-1. The maximum amount of cycloned sand that could be produced and placed in the cycloned sand embankment, as a percentage of the total scavenger tailings tonnage, is approximately 32% to 33% (from Year 5 onwards). This assumption is based on the following:

- 45% cycloned sand recovery from the cyclone system, based on cyclone simulations performed by Krebs;
- 90% cycloned sand retention in the hydraulic cells; and
- 50% cyclone uptime in Years 1 to 2, 70% in Years 3 to 4 and 80% in Years 5 to 41 (to account for reduced cyclone efficiency at the start of operations).

Rationale behind these assumptions is provided in Appendix I.

Figure IV-1 Tailings Process Flow Diagram



Notes:
1. A more detailed flowsheet with balance water flows is included in Appendix V.
2. Cycloned sand not retained from the embankment cells (4% of scavenger tailings tonnage) was deposited within the impoundment using the total scavenger/overflow density.

IV-3.4 Tailings Properties

Tailings properties are summarized in Table IV-2. Discussion on the basis for the assigned tailings densities is provided in Appendix I. A lower density for the total scavenger tailings and cyclone overflow was chosen in Years 0 through 5 for staging to provide additional storage contingency for early year planning.

Tailings slopes (the angle that the tailings deposit at) are based on a review of case history data from operating cycloned sand tailings impoundments. The tailings deposition slopes are determined by particle size distribution, percent solids of discharged slurry, specific gravity, spigot design/arrangement and whether or not tailings will be deposited subaqueously. The tailings deposition slopes should be monitored during early operations and the staging plan should be adjusted to suit.

Table IV-2 Tailings Deposition Properties

<table>
<tr><th>Tailings Stream</th><th>Tailings Type</th><th>Dry Density (pcf)</th><th>Tailings Slopes[1]</th><th>Total Tonnage (Mtons)</th><th>Total Volume (Myd^3)</th></tr>
<tr><td rowspan="3">Scavenger</td><td>Total</td><td rowspan="2">Years (0-5): 75
Years (6-41): 81</td><td rowspan="3">Above Water:
1% for the first 1,500 ft, 0.5% after 1,500 ft
Below Water:
2.5% for the first 1,000 ft, 1.0% after 1,000 ft</td><td>236</td><td>217</td></tr>
<tr><td>Cyclone Overflow[2]</td><td>544</td><td>499</td></tr>
<tr><td>Cycloned Sand[2]</td><td>113</td><td>370</td><td>243</td></tr>
<tr><td>Pyrite</td><td>Total</td><td>106</td><td>Below Water:
10.0% for the first 100 ft, 0.5% after 100 ft. These slopes are understood to be conservative at this stage of design and will be reviewed in future design stages.</td><td>220</td><td>154</td></tr>
</table>

Notes: 1. Scavenger tailings slopes are based on topography and bathymetry surveys from two large, cycloned sand impoundment beaches and slopes below water. These facilities have long exposed beaches, up to five miles. Pyrite tailings slopes are based on topography and bathymetry surveys of subaqueous disposal of high-pyrite tailings from floating barges.

2. Cycloned sand and cyclone overflow quantities are based on available cycloned sand (i.e., cycloning as per Section IV-3.3).

IV-3.5 Impoundment Layout

The ultimate impoundment layout was based on the following:

- Cycloned sand embankment toe offset a minimum of 30 ft elevation below the crest of ridges which bound the impoundment around its perimeter.
- Cycloned sand embankment toe offset a minimum of 1,650 ft horizontally from Queen Creek (refer to Figure IV-A.1). This requirement was established through discussions with RC.
- Cycloned sand embankment toe offset a minimum of 1,000 ft horizontally from Roblas Creek (refer to Figure IV-A.1). This requirement was established through discussions with RC.

IV-3.6 Cycloned Sand Embankment Raise Methodology

Minimum required cycloned sand volumes were calculated assuming a 4H:1V downstream embankment slope. Through discussions with RC, 4H:1V is the slope that is preferred for reclamation, and therefore it was chosen for the staging assessment. A trade-off assessment on steepening the slope to 3H:1V has been conducted, refer to Appendix III.

For modeling purposes, it was assumed that a constant downstream embankment slope would be maintained throughout operations ("sloped methodology"). The raising scheme used is shown schematically on Figure IV-2. This assumption is different than the proposed method of embankment construction using hydraulic cells, but was made to simplify modeling. Hydraulic cell construction and sequencing of construction to balance the rate of rise (Figure IV-5) with the downstream expansion of the cycloned sand shell, will be addressed in future design stages.

The crest elevation of the cycloned sand embankment was set at the start of each year to be high enough to store all tailings produced that year as well as flood storage, refer to Appendix I.

An alternative embankment raising methodology would be building the embankment in horizontal slices, as illustrated on Figure IV-3 ("horizontal slice methodology"). This method allows for progressive reclamation of the outer embankment slope.

Due to construction constraints and cycloned sand availability, the actual embankment raising methodology would use a combination these strategies, refer to Figure IV-4.

Figure IV-2 Cycloned Sand Embankment Raising Using the Sloped Embankment Construction Method (Assumed for Deposition Modeling)

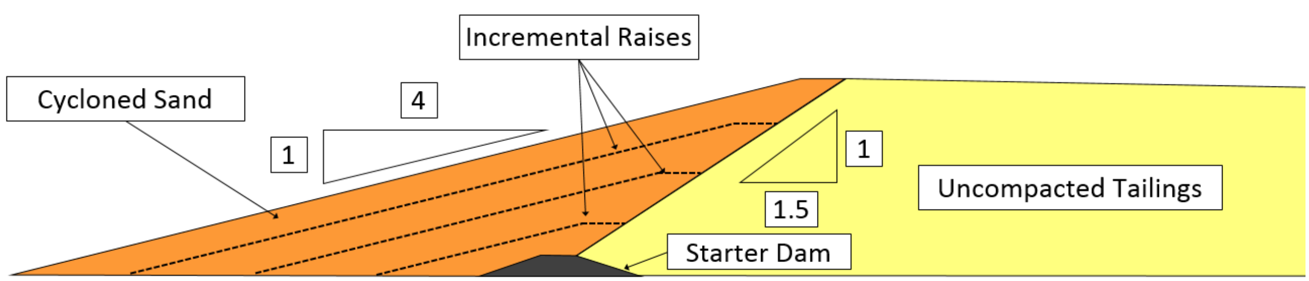


Figure IV-3 Cycloned Sand Embankment Raising Using the Horizontal Slice Embankment Construction Method

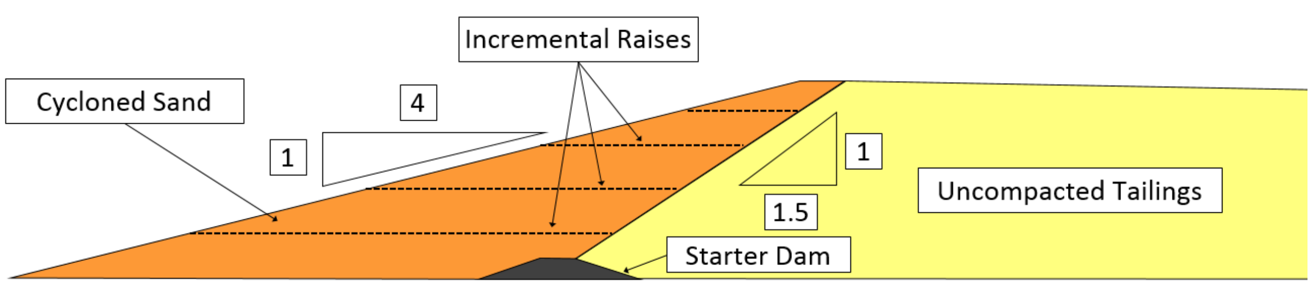
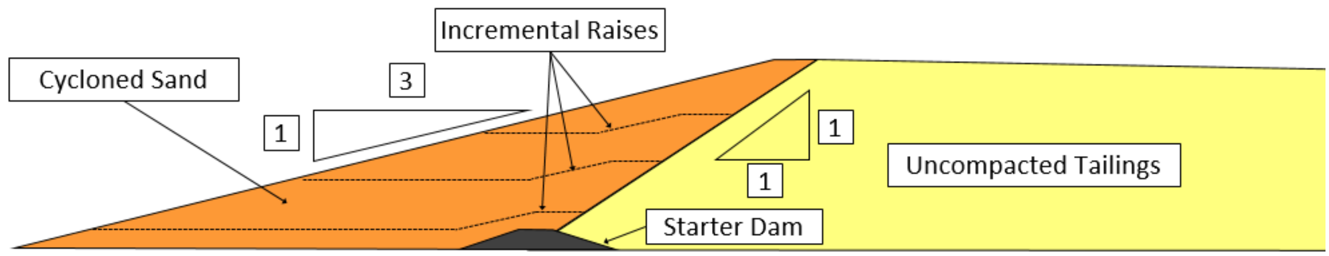


Figure IV-4 Combination of Raise Methodologies



IV-3.7 Operating Pond

The majority of water in the operating pond is delivered with the tailings slurry, originating from thickeners located at the West Plant. The pond volume is maintained for pyrite tailings saturation, with excess water reclaimed back to the West Plant.

Minimum operating pond depths are required for subaqueous discharge of pyrite tailings and to provide enough draft for floating barge pump operation. Minimum depths are summarized in Table IV-3, and are illustrated schematically on the staging figures provided in Appendix IV-A.

Greater control over the reclaim pond could be possible once the pyrite and scavenger ponds combine because of the reduced complexity of operating one pond rather than multiple. The minimum water cover over the pyrite tailings from Year 10 until the end of operations was reduced from 10 ft to 5 ft to reflect this.

Table IV-3 Minimum Pond Depths

Pond	Years of Operation	Minimum Operating Depth (ft)	Minimum Water Cover Above Maximum Tailings El. (ft)
Scavenger	1 to 9	20 (Figure IV-A.8)	n/a[2]
Pyrite	1 to 9	n/a[1]	10 (Figure IV-A.8)
Combined Pyrite and Scavenger	10 to 41	n/a[1]	5 (Figure IV-A.9)

Notes: 1. No minimum depth. Water cover is determined based on the minimum height above the maximum tailings elevation.
2. No minimum water cover. Minimum water depth is based on minimum depth in the lowest part of the pond (where the reclaim barge will be positioned).

Additional pond volume above the minimum depth was assumed to account for seasonal variations (changes in precipitation and evaporation throughout the year that impact pond level) and operational upsets (i.e. pump breakdown), refer to Table IV-4. The maximum seasonal depth was based on the expected average seasonal precipitation, evaporation and operational fluctuations. The operational upset volume was assumed to be equal to one week of reclaim based on the GPO design water balance (KCB 2014). Both are preliminary assumptions and will be confirmed during future water balance modelling and by the RC internal risk audit.

Table IV-4 Contingency Storage Volumes and Depths

Years	Maximum Seasonal Depth	Operational Upset Storage Volume
Years 1 to 8	3 ft above the minimum operating pond elevation	50 acre-ft per pond
Years 9 to 41		200 acre-ft per pond

IV-3.8 Flood Storage

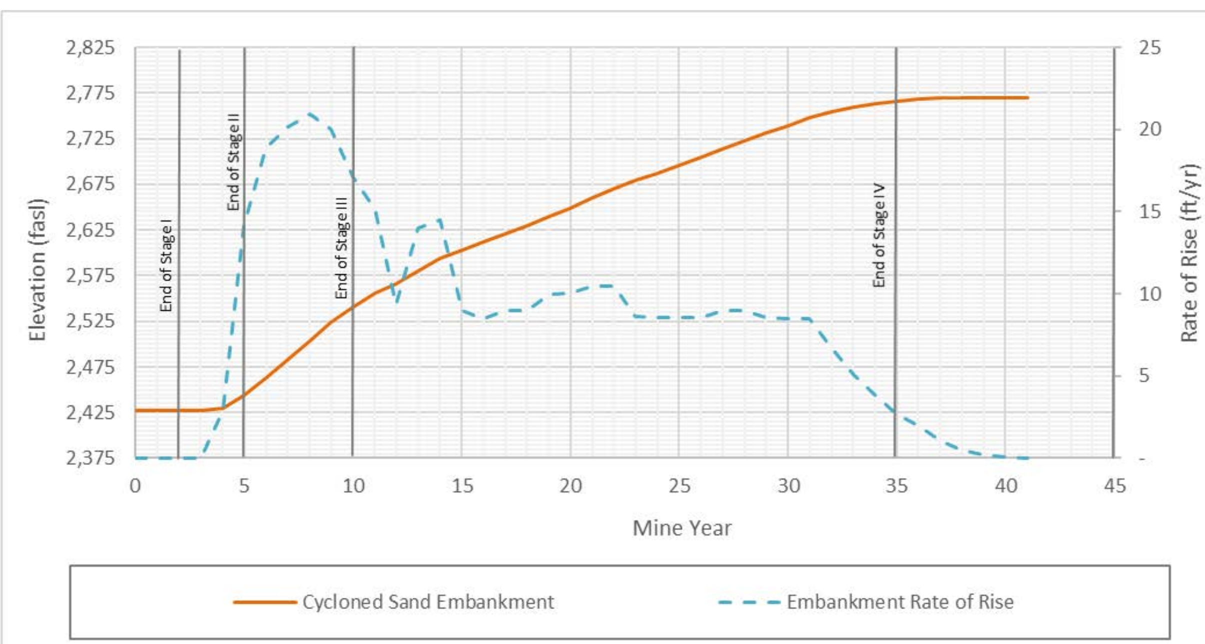
The inflow design flood for the facility is the PMF based on the 72-hr Tropical Probable Maximum Precipitation (PMP), which is 20.4 inches, refer to Appendix I. The impoundment must be capable of fully storing the PMF volume unless a spillway is available for discharge. During the PMF, a minimum subaerial beach length of 400 ft is required to ensure adequate freeboard above the peak flood level. During the potential Stage V, the PMF would be routed through a spillway discharging from the North Pyrite Cell to either Potts Canyon or Roblas Canyon (refer to Figure IV-A.15). The catchment areas and PMF volumes for different stages of the TSF construction are provided in Appendix IV-B. Refer to Appendix I for a summary of flood routing assumptions.

IV-4 TAILINGS DEPOSITION OUTPUTS

IV-4.1 Embankment Elevation and Rate of Rise

Predicted embankment crest elevations and the corresponding rates of rise are shown on Figure IV-5. The ultimate crest elevation is 2,770 fasl. The highest rates of rise occur early in operations as narrow valley bottoms with limited storage capacity are being filled. The rate of rise levels out in later years of operation to less than 10 ft/yr.

Figure IV-5 Cycloned Sand Embankment Elevation and Rates of Rise



IV-4.2 Cycloned Sand Usage and Time to Progressive Reclamation

The total amount of cycloned sand required to raise the embankment to its ultimate elevation is approximately 200 Myd^3 (310 Mtons). Given the assumptions summarized in Section IV-3.3, a maximum of 243 Myd^3 of cycloned sand can be produced. There is a potential 43 Myd^3 surplus of cycloned sand (~20% of total available sand) over the life of operations, which could potentially be used for other construction activities to reduce the borrow requirements (e.g. road construction, liner bedding, starter and north dam construction).

The cumulative volume of cycloned sand required is plotted against crest elevation on Figure IV-6. Required and available cumulative cycloned sand volumes are plotted against mine year on Figure IV-7. During the mine life, there is always adequate cycloned sand available for embankment construction using the sloped embankment construction methodology. In Year 28 there is enough cumulative cycloned sand to construct the embankment using the horizontal slice construction methodology.

Assuming the available cycloned sand is only used for embankment construction, the majority of the outer slope can be progressively reclaimed after Year 28. At this point, cycloned sand production can be ramped down. If cycloned sand is utilized for other construction activities (e.g. road construction, liner bedding, starter and north dam construction), the year at which the slope can be reclaimed will be delayed.

Figure IV-6 Cyclone Sand Volume Requirements vs. Elevation

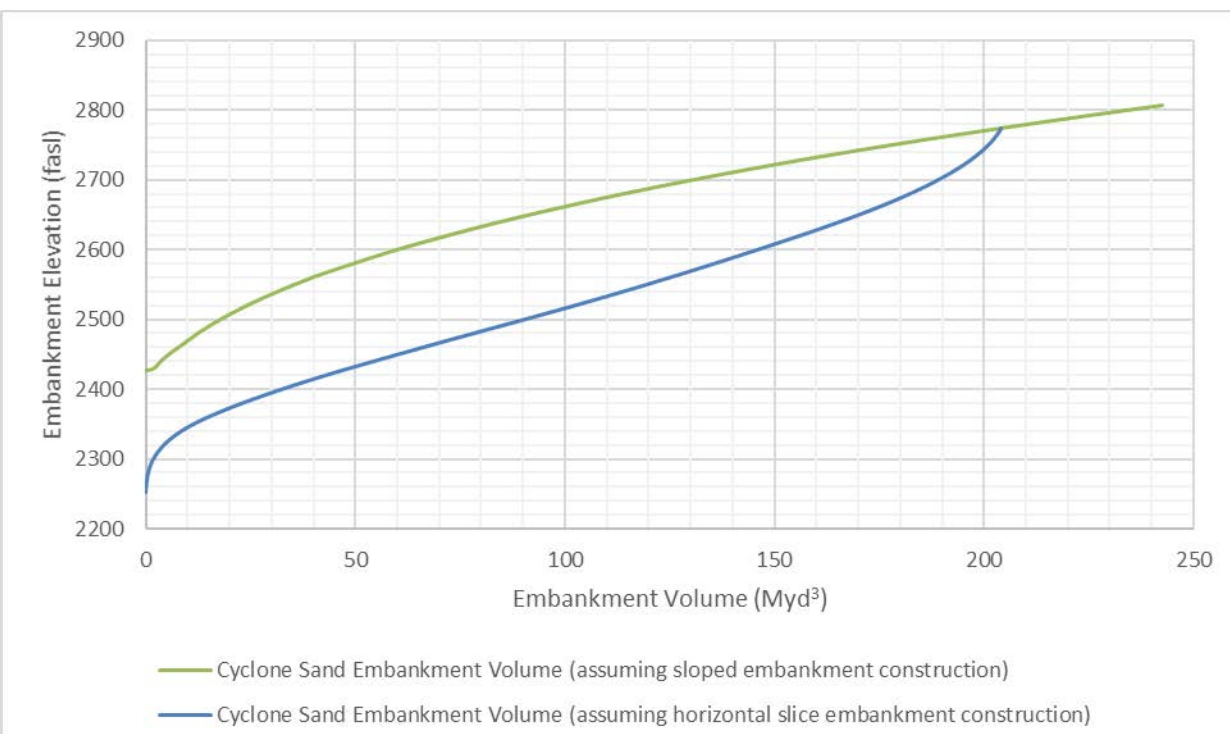
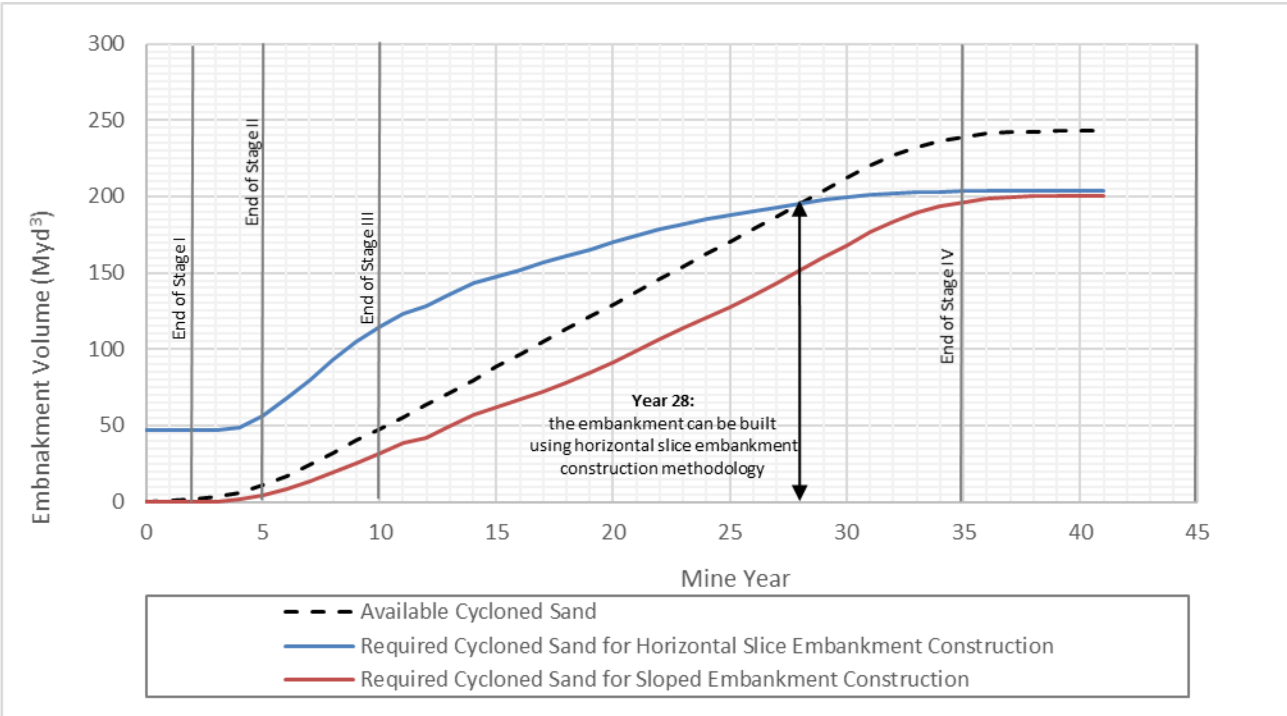


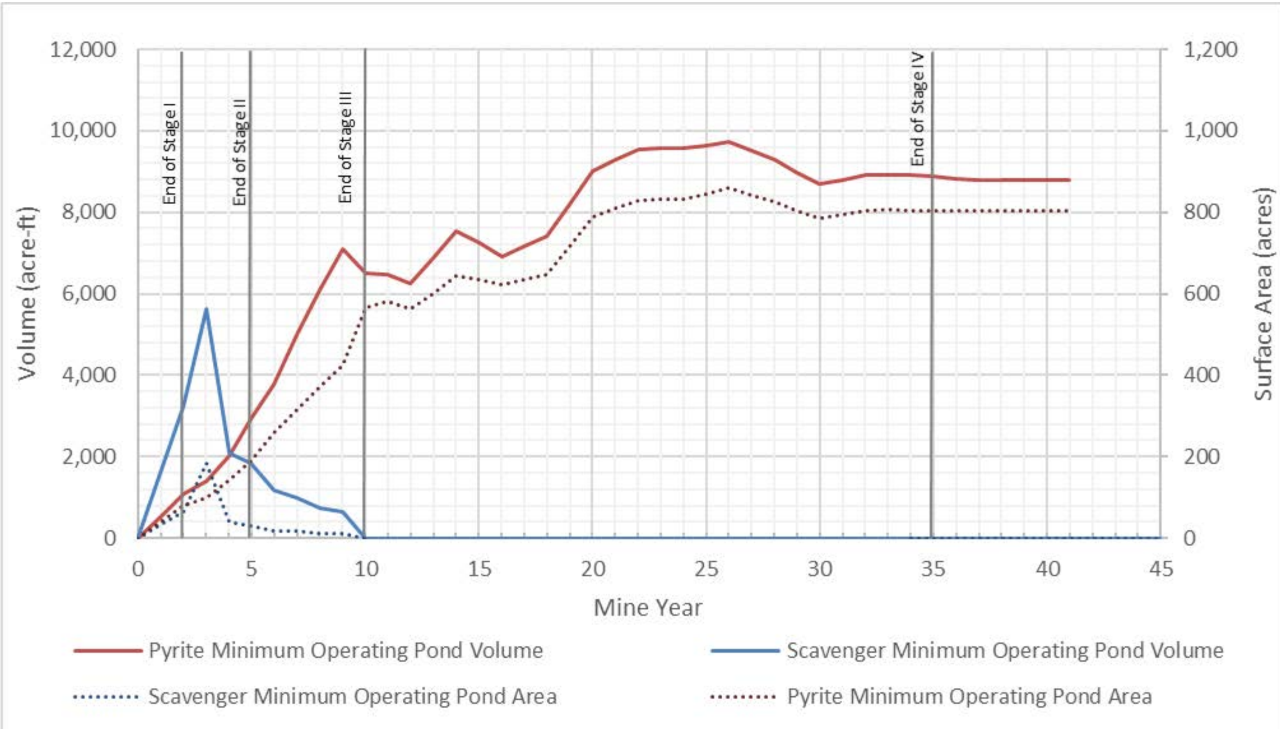
Figure IV-7 Available and Required Cycloned Sand vs. Mine Year



IV-4.3 Water Management

In Year 10 the scavenger operating pond combines with the pyrite operating pond (Figure IV-8). The maximum pond volume and area occurs in Year 26. The planned impoundment can store the PMF with a minimum beach length of 400 ft in all years except Year 3, when the beach reduces to 200 ft when the pond is confined to the narrow valleys in Catchments C3 and C4 (refer to Figure IV-A.2). During this period, water could be transferred with pumps and overland pipelines from these catchments to Bear Tank Canyon to reestablish the beaches. Other strategies include excavation of connector channels to connect the catchments or construction of a temporary spillway.

Figure IV-8 Minimum Operating Pond Volumes and Areas



IV-5 CONCLUSIONS

Key conclusions from the tailing staging assessment are as follows:

- Earthfill dams require significant borrow fill quantity, exceeding 24 Myd^3. This estimate does not include the Seepage Collection Dams or any other TSF features. It is expected that a suitable borrow source of Gila Conglomerate within the TSF footprint could provide this quantity (shown on Figure IV-A.1), with the added benefit of providing additional tailings storage capacity.
- The deposition strategy is generally capable of achieving the performance objectives:
  - Pyrite tailings are deposited subaqueously to maintain saturation.
  - The impoundment layout is capable of storing the required tailings and flood storage volumes.
  - There is precedent in the industry for cycloned sand embankments of the height predicted (514 ft).
  - Long beaches (>400 ft) are maintained during flood conditions for all years except for Year 3. Construction of a spillway or modifications to the staging plan may be required during this time to maintain an adequate beach length.

- Rates of embankment crest rise between 15 ft/yr and 21 ft/yr are expected in the first 14 years before leveling out to less than 11 ft/yr for the remainder of operations. High rates of rise present a construction challenge, but there is precedent in industry for hydraulic cell embankment construction at the rate predicted. If required, the potential for static liquefaction resulting from the rate of rise will be managed by compacting the cycloned sand to maintain a dilatant condition and compaction of a portion of the upstream beach.

REFERENCES

Applied Weather Associates (AWA). 2013. Probable Maximum Precipitation Study for Arizona. Prepared for the Arizona Department of Water Resources, July.

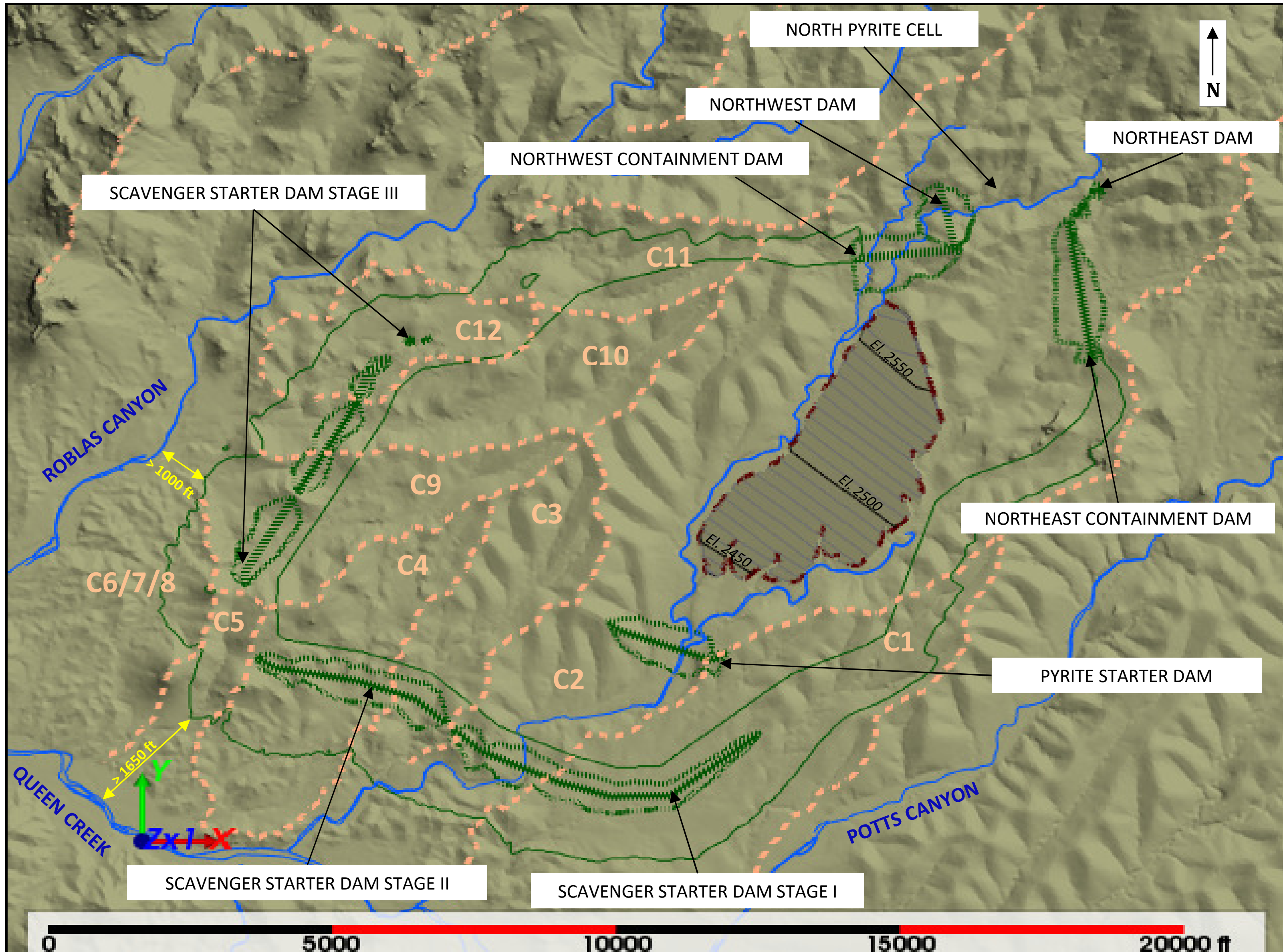
Klohn Crippen Berger Ltd. (KCB). 2014. Near West Tailings Management Mine Plan of Operations Study. September.

MineBridge Software Inc. 2016. Muck3D Ooze Version 4.0.5. [Computer software].

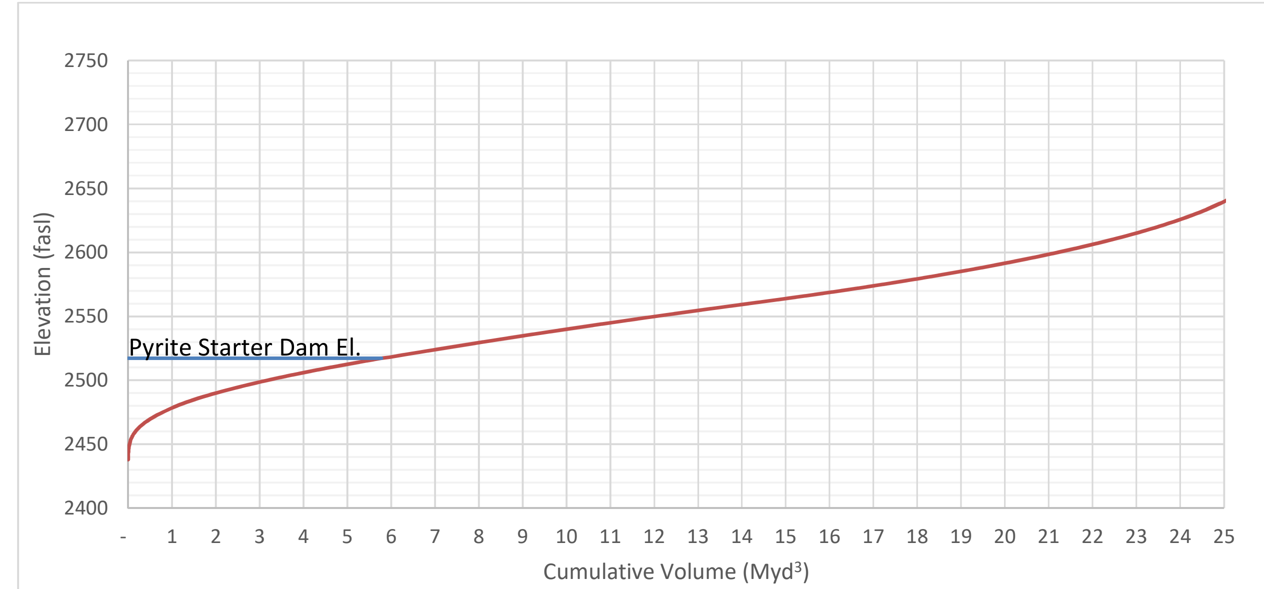
Resolution Copper Mining (RC). 2016. General Plan of Operations, Resolution Copper Mining. Initial Submittal November 15, 2013; Revised May 9, 2016. Retrieved on December 15, 2017 from http://www.resolutionmineeis.us/documents/resolution-copper-gpo or http://www.resolutionmineeis.us/eis-documents.

APPENDIX IV-A

Staging Figures



BORROW AREA STAGE-STORAGE



CATCHMENTS

ID	Name
C1	Benson Springs
C2	Bear Tank Canyon
C3	No Name
C4	No Name
C5	No Name
C6/7/8	No Name
C9	No Name
C10	East Roblas Canyon
C11	No Name
C12	No Name

LEGEND

- BORROW AREA
- BORROW FILL DAMS
- CATCHMENT DIVIDES
- LARGE WASHES
- ULTIMATE EMBANKMENT CRESTLINE AND TOE
- DAM OUTLINES
- 50 ft CONTOUR
- 5 ft CONTOUR

NOT FOR CONSTRUCTION

TO BE READ WITH KLOHN CRIPPEN BERGER REPORT DATED: JUNE 2018

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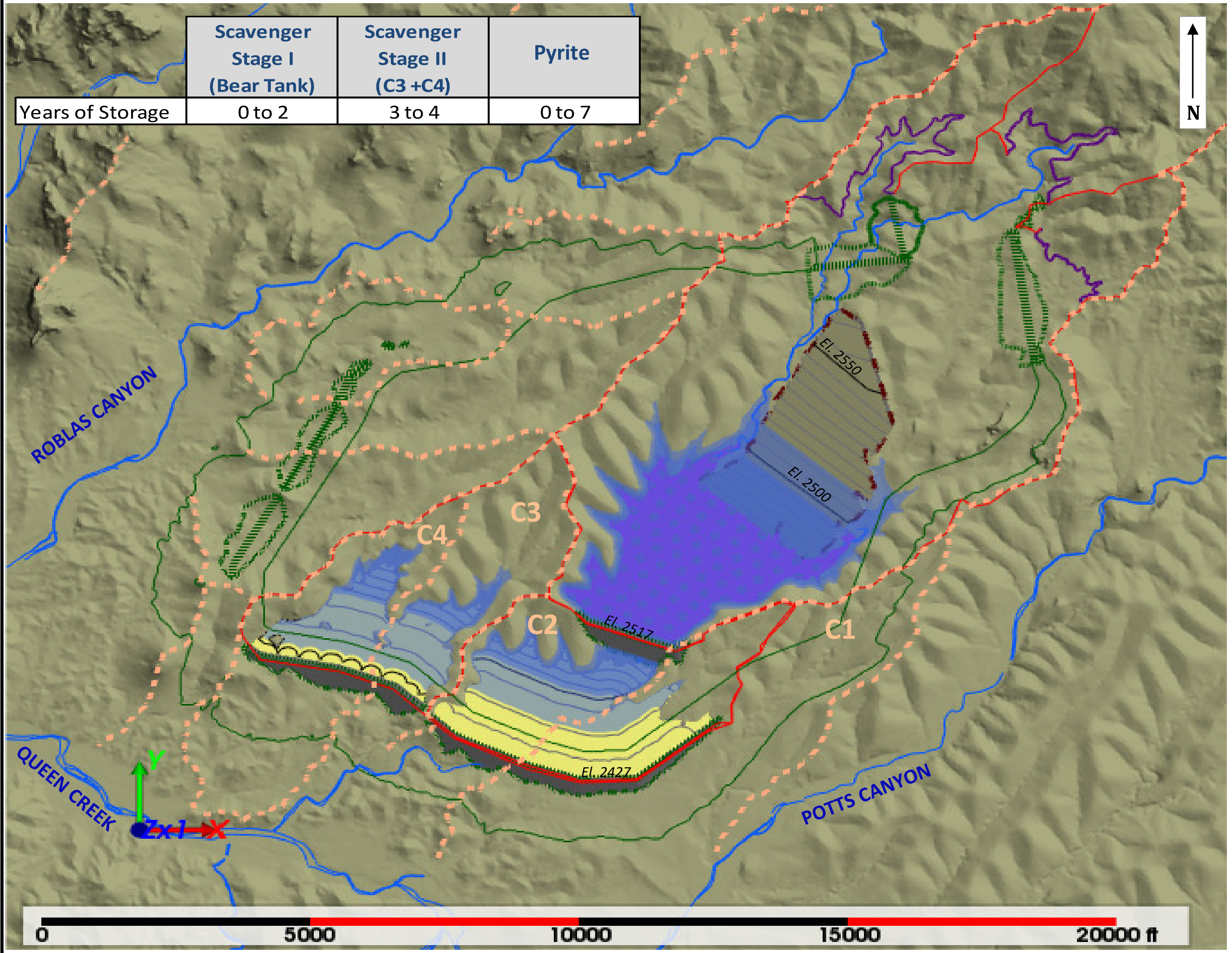
PROJECT: RESOLUTION COPPER PROJECT
DEIS DESIGN FOR ALTERNATIVE 3A - NEAR WEST MODIFIED PROPOSED ACTION (MODIFIED CENTERLINE EMBANKMENT)

TITLE: BORROW AREA AND CATCHMENTS

SCALE	PROJECT No.	FIG No.
AS SHOWN	M09441A20	IV-A.1



	Scavenger Stage I (Bear Tank)	Scavenger Stage II (C3 +C4)	Pyrite
Years of Storage	0 to 2	3 to 4	0 to 7

LEGEND

- BORROW AREA
- SCAVENGER OVERFLOW/TOTAL TAILINGS
- PYRITE TAILINGS
- BORROW FILL DAMS
- SCAVENGER UNDERFLOW TAILINGS
- CATCHMENT DIVIDES
- LARGE WASHES
- CATCHMENTS
- 72-HR PROBABLE MAXIMUM FLOOD
- OPERATING POND
- ULTIMATE EMBANKMENT CRESTLINE AND TOE
- DAM OUTLINES
- S1 SEEPAGE DAM
- 50 ft CONTOUR
- 5 ft CONTOUR
- DIVERSION

	Units	Scavenger Starter Dams	
		Scavenger Stage I (Bear Tank)	Scavenger Stage II (C3 + C4)
Maximum Embankment Height	ft	132	139
Embankment El.	fasl	2427	2427
Tailings El.	fasl	2418	2402
Minimum Operating Pond El.	fasl	2398	2387
Stored PMF El.	fasl	2409	2399
Embankment Borrow Fill	Myd^3	4.6	4.0

Note: The Stage I Starter Dam is built prior to any scavenger tailings deposition (Year 1) and the Stage II Starter Dam is built prior to year 3.

	Units	Scavenger Starter Dam Pond	
		Scavenger Stage I (Bear Tank)	Scavenger Stage II (C3 + C4)
Minimum Operating Storage	acre-ft	324	238
Maximum Seasonal Storage	acre-ft	471	415
Upset Storage	acre-ft	50	50
72-hr PMF Storage	acre-ft	586	1264

	Units	Pyrite Starter Dam
Maximum Embankment Height	ft	138
Embankment El.	fasl	2517
Tailings El.	fasl	2487
Minimum Operating Pond El.	fasl	2497
Stored PMF El.	fasl	2512
Embankment Borrow Fill	Myd^3	2.5

	Units	Pyrite Dam Pond
Minimum Operating Storage	acre-ft	5088
Maximum Seasonal Storage	acre-ft	6060
Upset Storage	acre-ft	50
72-hr PMF Storage	acre-ft	4359

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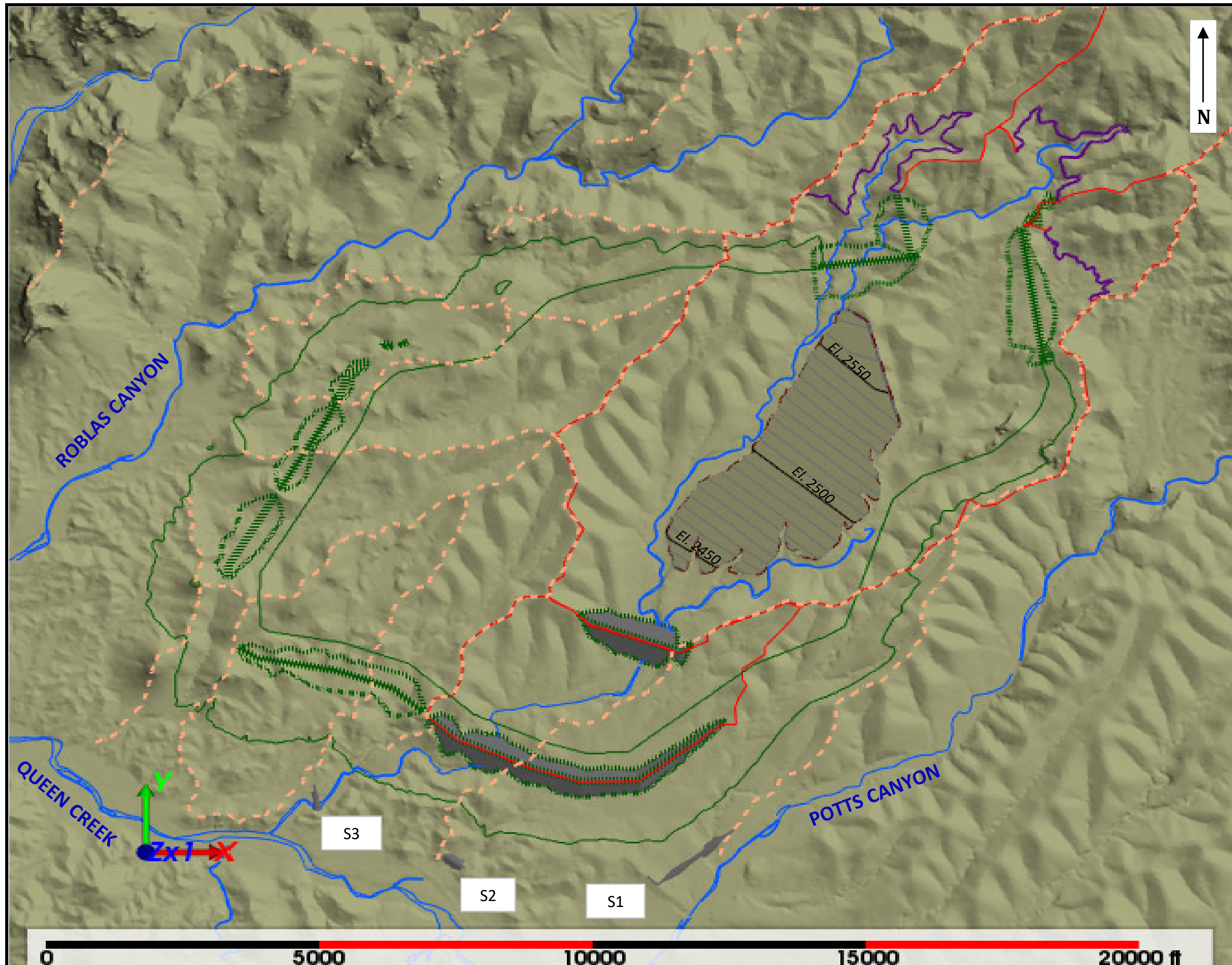
TITLE

STARTER DAM SIZING

SCALE	PROJECT No.	FIG No.
AS SHOWN	M09441A20	IV-A.2



LEGEND

- BORROW AREA
- BORROW FILL DAMS
- CATCHMENT DIVIDES
- LARGE WASHES
- CATCHMENTS
- ULTIMATE EMBANKMENT CRESTLINE AND TOE
- DAM OUTLINES
- S1 SEEPAGE DAM
- 50 ft CONTOUR
- 5 ft CONTOUR
- DIVERSION

Note:
Start-up pond volumes (not shown) estimated in the water balance (Appendix V) are 400 acre-ft and 160 acre-ft for the cleaner and scavenger ponds, respectively. Start-up pond water balances will be assessed in the next phase of design.

	Units	Starter Dams	
		Scavenger Stage I (Bear Tank)	Pyrite
Maximum Embankment Height	ft	132	138
Minimum Operating Pond Depth	ft	20 (see Figure 1)	10 (see Figure 2)
Embankment El.	fasl	2427	2517
Tailings El.	fasl	-	-
Minimum Operating Pond El.	fasl	-	-
Stored PMF El.	fasl	-	-
Embankment Borrow Fill Volume	Myd^3	4.6	2.5

	Units	Starter Dam Ponds	
		Scavenger Stage I (Bear Tank)	Pyrite
Minimum Operating Storage	acre-ft	TBD	TBD
Maximum Seasonal Storage	acre-ft	TBD	TBD
Upset Storage	acre-ft	50	50
72-hr PMF Storage	acre-ft	586	4359

FIGURE 1 SCAVENGER MINIMUM POND DEPTH SCHEMATIC

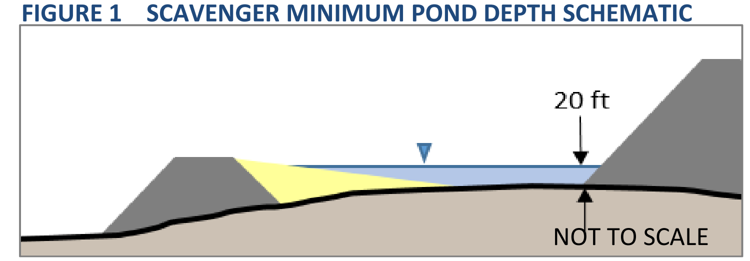
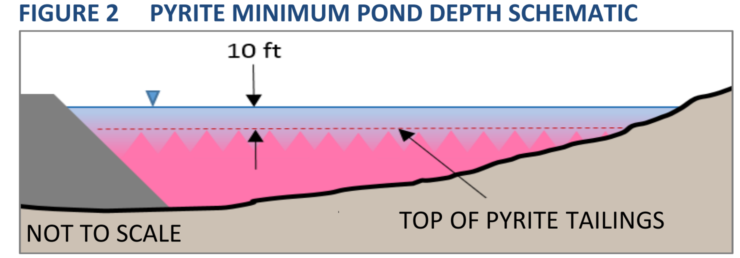


FIGURE 2 PYRITE MINIMUM POND DEPTH SCHEMATIC



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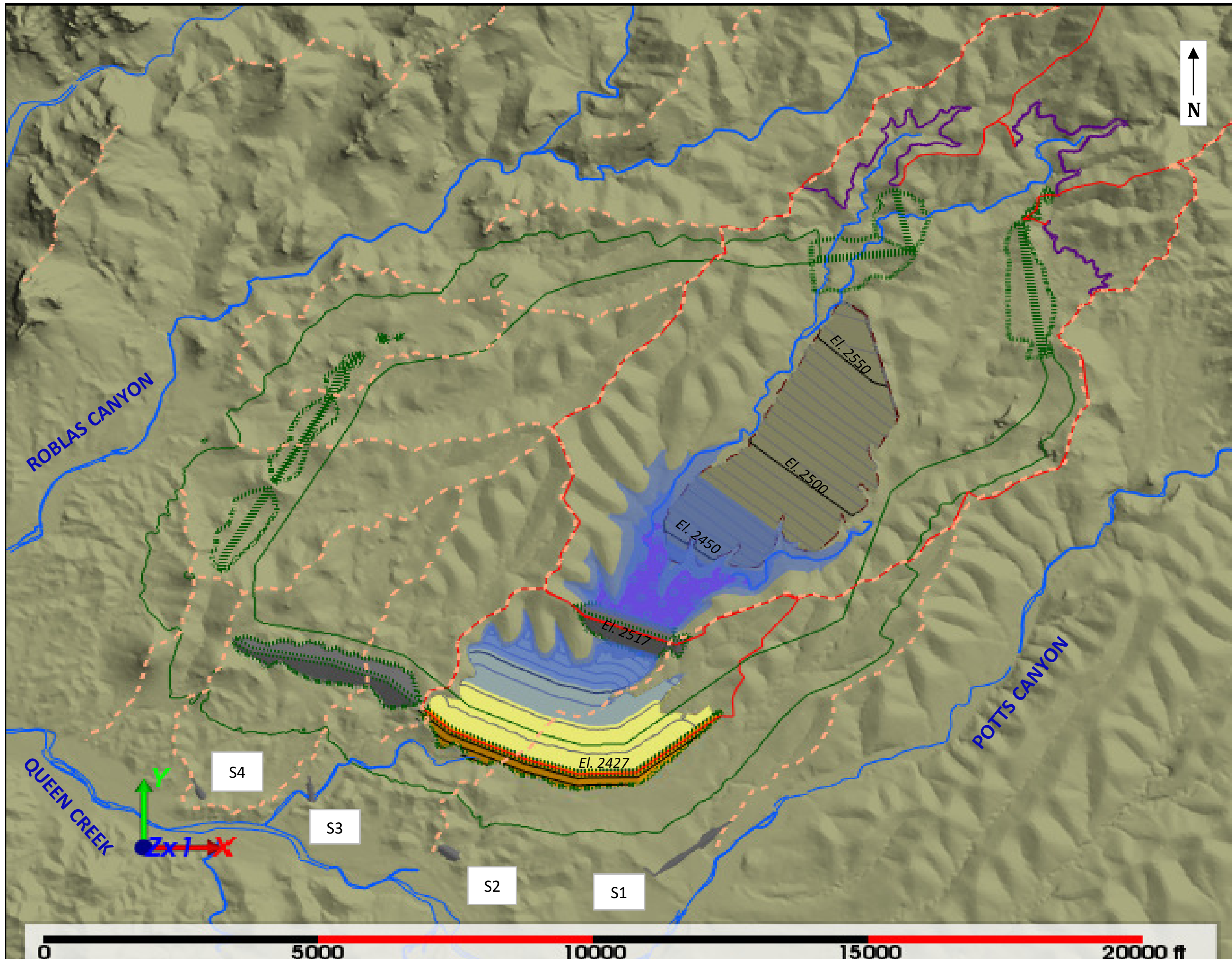
DEIS DESIGN FOR ALTERNATIVE 3A - NEAR WEST MODIFIED PROPOSED ACTION (MODIFIED CENTERLINE EMBANKMENT)

TITLE
YEAR 0
(STAGE I)

SCALE	PROJECT No.	FIG No.
AS SHOWN	M09441A20	IV-A.3



	Units	Scavenger Stage I (Bear Tank)	Pyrite
Maximum Embankment Height	ft	132	138
Embankment Rate of Rise	ft/yr	0	0
Embankment Maximum El.	fasl	2427	2517
Tailings El.	fasl	2418	2436
Minimum Operating Pond El.	fasl	2398	2446
Maximum Storage El.	fasl	to be confirmed	to be confirmed
Upset Storage El.	fasl	2402	2450
PMF El.	fasl	2409	2476
Minimum Operating Storage[1]	acre-ft	324	1102
Minimum Operating Pond Depth	ft	20 (see Figure 1)	10 (see Figure 2)
Beach Length from PMF El.	ft	950	-

1- Distribution of scavenger and pyrite tailings tonnages are based on the GPO production schedule, see Appendix II for a detailed comparison of the production schedules.

	Units	Scavenger Tailings			
		Underflow[2]	Overflow	Total	Sum
Tailings Placed[1,3]	Myd[3]	1.9	5.7	5.9	13.6
Tailings Placed[1,3]	Mtons	3	6	6	15
Cumulative Tailings	Mtons	3	6	6	15

1. Includes scavenger tailings placed in Year 1.
2. Configuration to be confirmed in next stage of design.
3. Distribution of scavenger and pyrite tailings tonnages are based on the GPO production schedule, see Appendix II for a detailed comparison of the production schedules

	Units	Pyrite Tailings
Tailings Placed[1,2]	Myd[3]	0.9
Tailings Placed[1,2]	Mtons	1
Cumulative Tailings	Mtons	1

1. Includes scavenger tailings placed in Year 1.
2. Distribution of scavenger and pyrite tailings tonnages are based on the GPO production schedule, see Appendix II for a detailed comparison of the production schedules

Scavenger Stage II (C3 + C4) Starter Dam		
Embankment Borrow Fill	Myd[3]	4.0
Maximum Embankment Height	ft	138.9
Embankment Maximum El.	fasl	2,426.8

LEGEND

- BORROW AREA
- SCAVENGER OVERFLOW/TOTAL TAILINGS
- PYRITE TAILINGS
- BORROW FILL DAMS
- SCAVENGER UNDERFLOW TAILINGS
- CATCHMENT DIVIDES
- LARGE WASHES
- CATCHMENTS
- 72-HR PROBABLE MAXIMUM FLOOD
- OPERATING POND
- ULTIMATE EMBANKMENT CRESTLINE AND TOE
- DAM OUTLINES
- S1 SEEPAGE DAM
- 50 ft CONTOUR
- 5 ft CONTOUR
- DIVERSION

FIGURE 1 SCAVENGER MINIMUM POND DEPTH SCHEMATIC

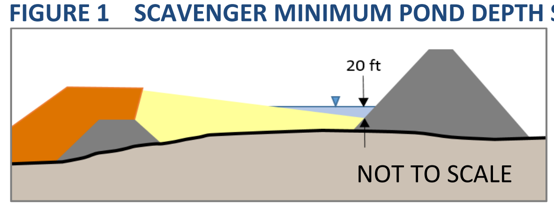
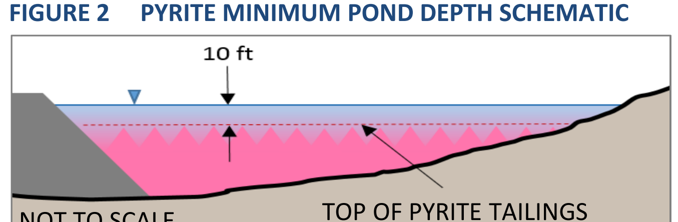


FIGURE 2 PYRITE MINIMUM POND DEPTH SCHEMATIC



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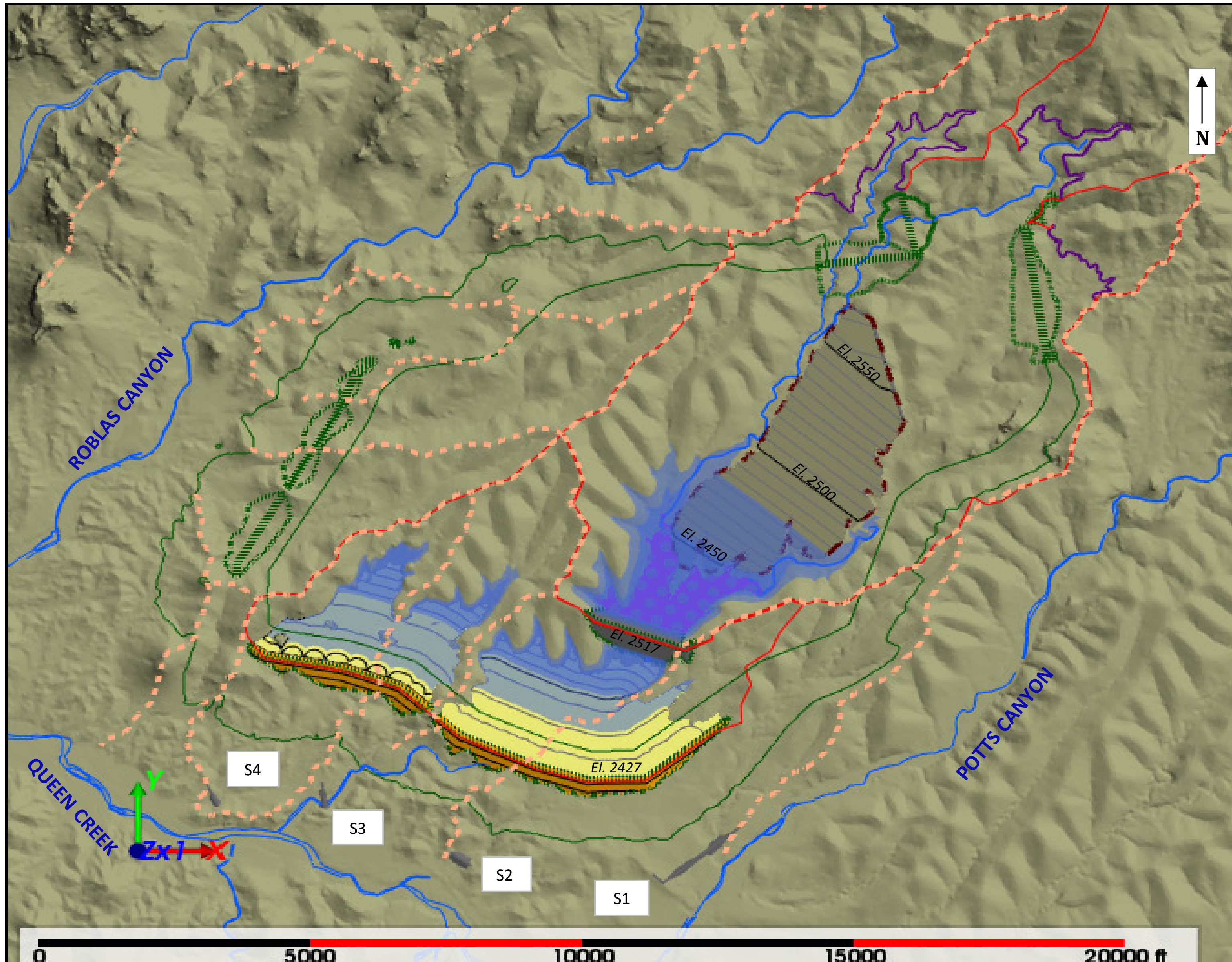
DEIS DESIGN FOR ALTERNATIVE 3A - NEAR WEST MODIFIED PROPOSED ACTION (MODIFIED CENTERLINE EMBANKMENT)

TITLE

END OF YEAR 2
(END OF STAGE I)

SCALE	PROJECT No.	FIG No.
AS SHOWN	M09441A20	IV-A.4



LEGEND

- BORROW AREA
- SCAVENGER OVERFLOW/TOTAL TAILINGS
- PYRITE TAILINGS
- BORROW FILL DAMS
- SCAVENGER UNDERFLOW TAILINGS
- CATCHMENT DIVIDES
- LARGE WASHES
- CATCHMENTS
- 72-HR PROBABLE MAXIMUM FLOOD
- OPERATING POND
- ULTIMATE EMBANKMENT CRESTLINE AND TOE
- DAM OUTLINES
- S1 SEEPAGE DAM
- 50 ft CONTOUR
- 5 ft CONTOUR
- DIVERSION

	Units	Scavenger Stage I (Bear Tank)	Scavenger Stage II (C3 + C4)	Pyrite
Maximum Embankment Height	ft	132		138
Embankment Rate of Rise	ft/yr	0		0
Embankment Maximum El.	fasl	2427		2517
Tailings El.	fasl	2418	2402	2444
Minimum Operating Pond El.	fasl	2398	2387	2454
Maximum Storage El.	fasl	to be confirmed		to be confirmed
Upset Storage El.	fasl	2402	2392	2457
PMF El.	fasl	2409	2399	2482
Minimum Operating Storage[1]	acre-ft	1004		1416
Minimum Operating Pond Depth	ft	20 (see Figure 1)		10 (see Figure 2)
Beach Length from PMF El.	ft	800	200	-

1- Distribution of scavenger and pyrite tailings tonnages are based on the GPO production schedule, see Appendix II for a detailed comparison of the production schedules.

	Units	Scavenger Tailings			
		Underflow	Overflow	Total	Sum
Tailings Placed[1]	Myd^3	1.4	4.2	1.9	7.5
Tailings Placed[1]	Mtons	2	4	2	8
Cumulative Tailings	Mtons	5	10	8	23

1- Distribution of scavenger and pyrite tailings tonnages are based on the GPO production schedule, see Appendix II for a detailed comparison of the production schedules.

	Units	Pyrite Tailings
Tailings Placed[1]	Myd^3	0.5
Tailings Placed[1]	Mtons	1
Cumulative Tailings	Mtons	2

1- Distribution of scavenger and pyrite tailings tonnages are based on the GPO production schedule, see Appendix II for a detailed comparison of the production schedules.

FIGURE 1 SCAVENGER MINIMUM POND DEPTH SCHEMATIC

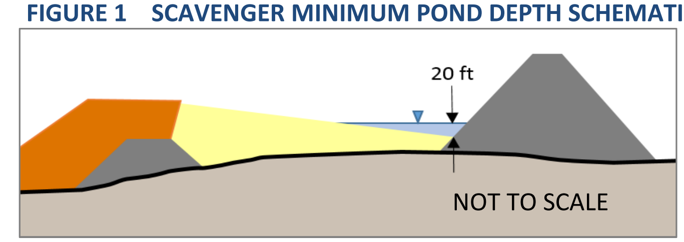
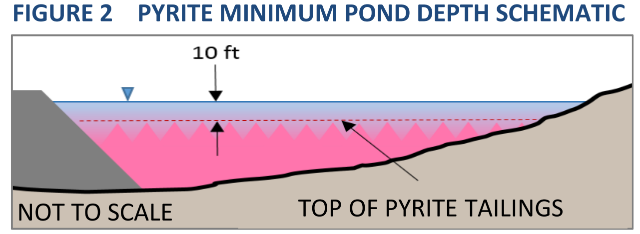


FIGURE 2 PYRITE MINIMUM POND DEPTH SCHEMATIC



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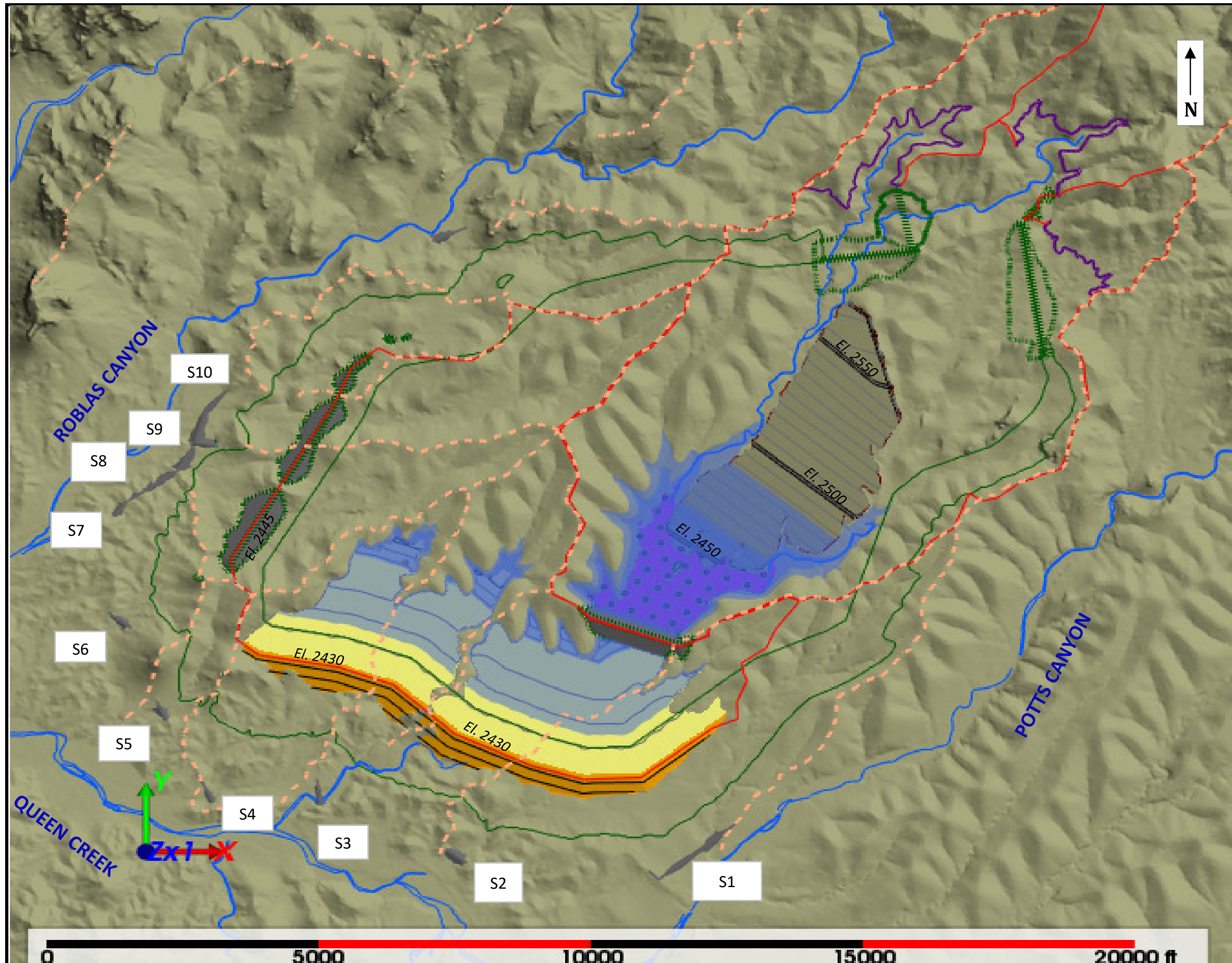
TITLE

END OF YEAR 3
(STAGE II)

SCALE	PROJECT No.	FIG No.
AS SHOWN	M09441A20	IV-A.5



	Units	Scavenger Stage I & II (C3 +C4 + Bear Tank)	Pyrite
Maximum Embankment Height	ft	158	138
Embankment Rate of Rise	ft/yr	3	0
Embankment Maximum El.	fasl	2430	2517
Tailings El.	fasl	2430	2454
Minimum Operating Pond El.	fasl	2411	2464
Maximum Storage El.	fasl	to be confirmed	to be confirmed
Upset Storage El.	fasl	2416	2468
PMF El.	fasl	2422	2489
Minimum Operating Storage[1]	acre-ft	198	2098
Minimum Operating Pond Depth	ft	20 (see Figure 1)	10 (see Figure 2)
Beach Length from PMF El.	ft	760	-

1- Distribution of scavenger and pyrite tailings tonnages are based on the GPO production schedule, see Appendix II for a detailed comparison of the production schedules.

		Scavenger Tailings			
	Units	Underflow	Overflow	Total	Sum
Tailings Placed[1]	Myd^3	2.7	8.1	3.6	14.4
Tailings Placed[1]	Mtons	4	8	4	16
Cumulative Tailings	Mtons	9	18	12	39

1- Distribution of scavenger and pyrite tailings tonnages are based on the GPO production schedule, see Appendix II for a detailed comparison of the production schedules.

	Units	Pyrite Tailings
Tailings Placed[1]	Myd^3	1.1
Tailings Placed[1]	Mtons	2
Cumulative Tailings	Mtons	4

1- Distribution of scavenger and pyrite tailings tonnages are based on the GPO production schedule, see Appendix II for a detailed comparison of the production schedules.

Scavenger Stage III (C9, C10 + C12) Starter Dam		
Embankment Borrow Fill	Myd^3	3.2
Maximum Embankment Height	ft	128.0
Embankment Maximum El.	fasl	2,445.0

LEGEND

- BORROW AREA
- SCAVENGER OVERFLOW/TOTAL TAILINGS
- PYRITE TAILINGS
- BORROW FILL DAMS
- SCAVENGER UNDERFLOW TAILINGS
- CATCHMENT DIVIDES
- LARGE WASHES
- CATCHMENTS
- 72-HR PROBABLE MAXIMUM FLOOD
- OPERATING POND
- ULTIMATE EMBANKMENT CRESTLINE AND TOE
- DAM OUTLINES
- S1 SEEPAGE DAM
- 50 ft CONTOUR
- 5 ft CONTOUR
- DIVERSION

FIGURE 1 SCAVENGER MINIMUM POND DEPTH SCHEMATIC

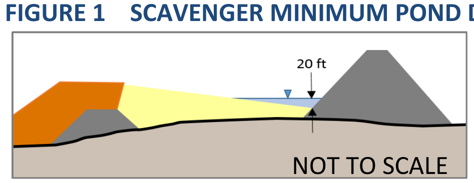
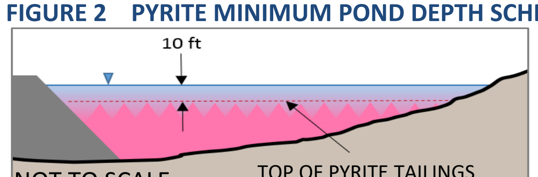


FIGURE 2 PYRITE MINIMUM POND DEPTH SCHEMATIC



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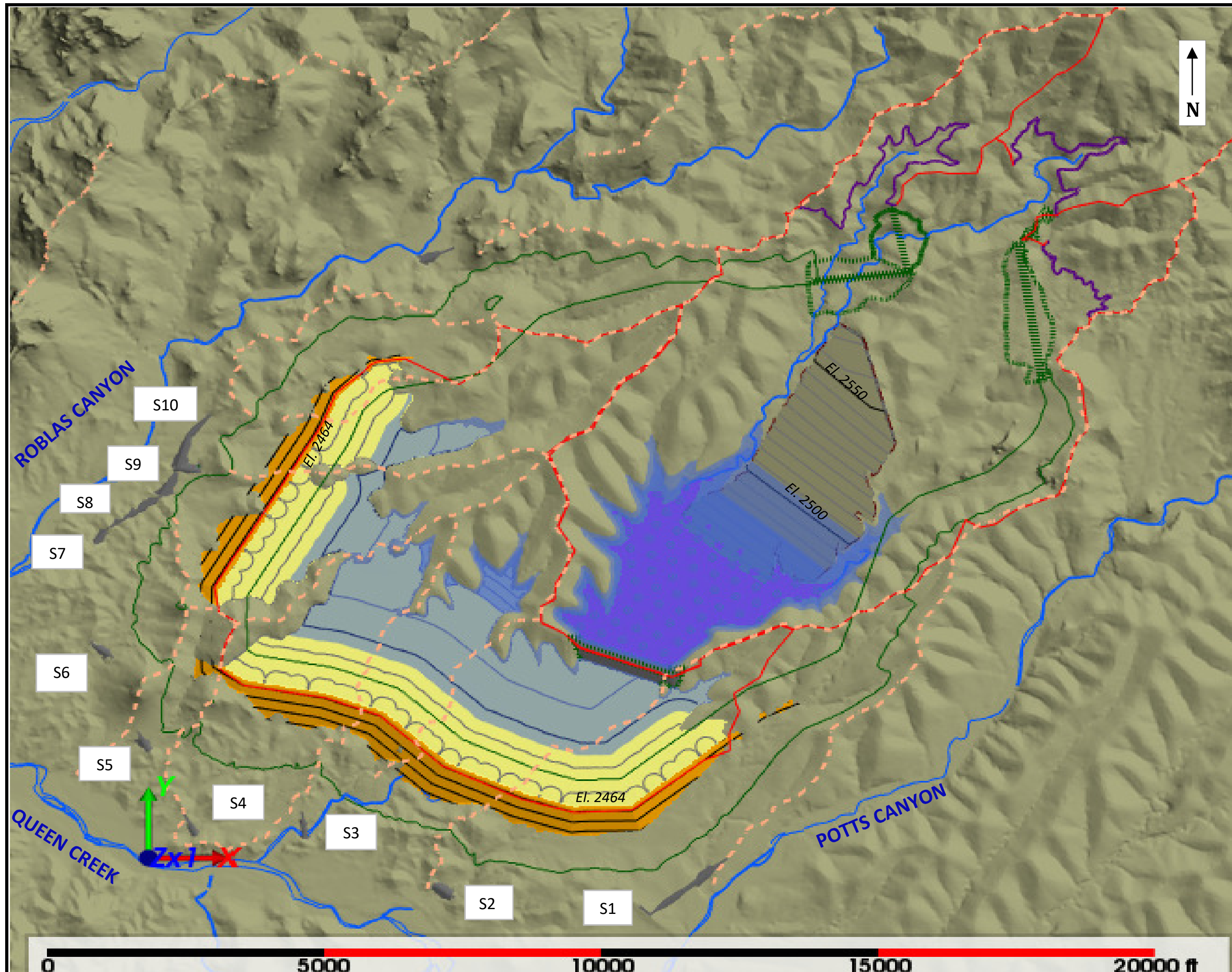
TITLE: END OF YEAR 4
(END OF STAGE II)

SCALE	PROJECT No.	FIG No.
AS SHOWN	M09441A20	IV-A.6



	Units	Scavenger Stage III	Pyrite
Maximum Embankment Height	ft	193	138
Embankment Rate of Rise	ft/yr	19	0
Embankment Maximum El.	fasl	2464	2517
Tailings El.	fasl	2462	2477
Minimum Operating Pond El.	fasl	2440	2487
Maximum Storage El.	fasl	to be confirmed	to be confirmed
Upset Storage El.	fasl	2445	2490
PMF El.	fasl	2452	2504
Minimum Operating Storage[1]	acre-ft	119	3843
Minimum Operating Pond Depth	ft	20 (see Figure 1)	10 (see Figure 2)
Beach Length from PMF El.	ft	990	-

1- Distribution of scavenger and pyrite tailings tonnages are based on the GPO production schedule, see Appendix II for a detailed comparison of the production schedules.

		Scavenger Tailings			
	Units	Underflow	Overflow	Total	Sum
Tailings Placed[1]	Myd^3	5.1	14.0	6.3	25.4
Tailings Placed[1]	Mtons	8	15	7	30
Cumulative Tailings	Mtons	23	48	25	96

1- Distribution of scavenger and pyrite tailings tonnages are based on the GPO production schedule, see Appendix II for a detailed comparison of the production schedules.

	Units	Pyrite Tailings
Tailings Placed[1]	Myd^3	2.5
Tailings Placed[1]	Mtons	4
Cumulative Tailings	Mtons	10

1- Distribution of scavenger and pyrite tailings tonnages are based on the GPO production schedule, see Appendix II for a detailed comparison of the production schedules.

LEGEND

- BORROW AREA
- SCAVENGER OVERFLOW/TOTAL TAILINGS
- PYRITE TAILINGS
- BORROW FILL DAMS
- SCAVENGER UNDERFLOW TAILINGS
- CATCHMENT DIVIDES
- LARGE WASHES
- CATCHMENTS
- 72-HR PROBABLE MAXIMUM FLOOD
- OPERATING POND
- ULTIMATE EMBANKMENT CRESTLINE AND TOE
- DAM OUTLINES
- S1 SEEPAGE DAM
- 50 ft CONTOUR
- 5 ft CONTOUR
- DIVERSION

FIGURE 1 SCAVENGER MINIMUM POND DEPTH SCHEMATIC

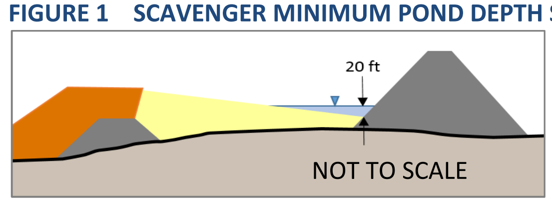
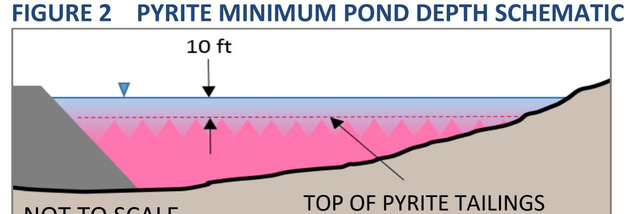


FIGURE 2 PYRITE MINIMUM POND DEPTH SCHEMATIC



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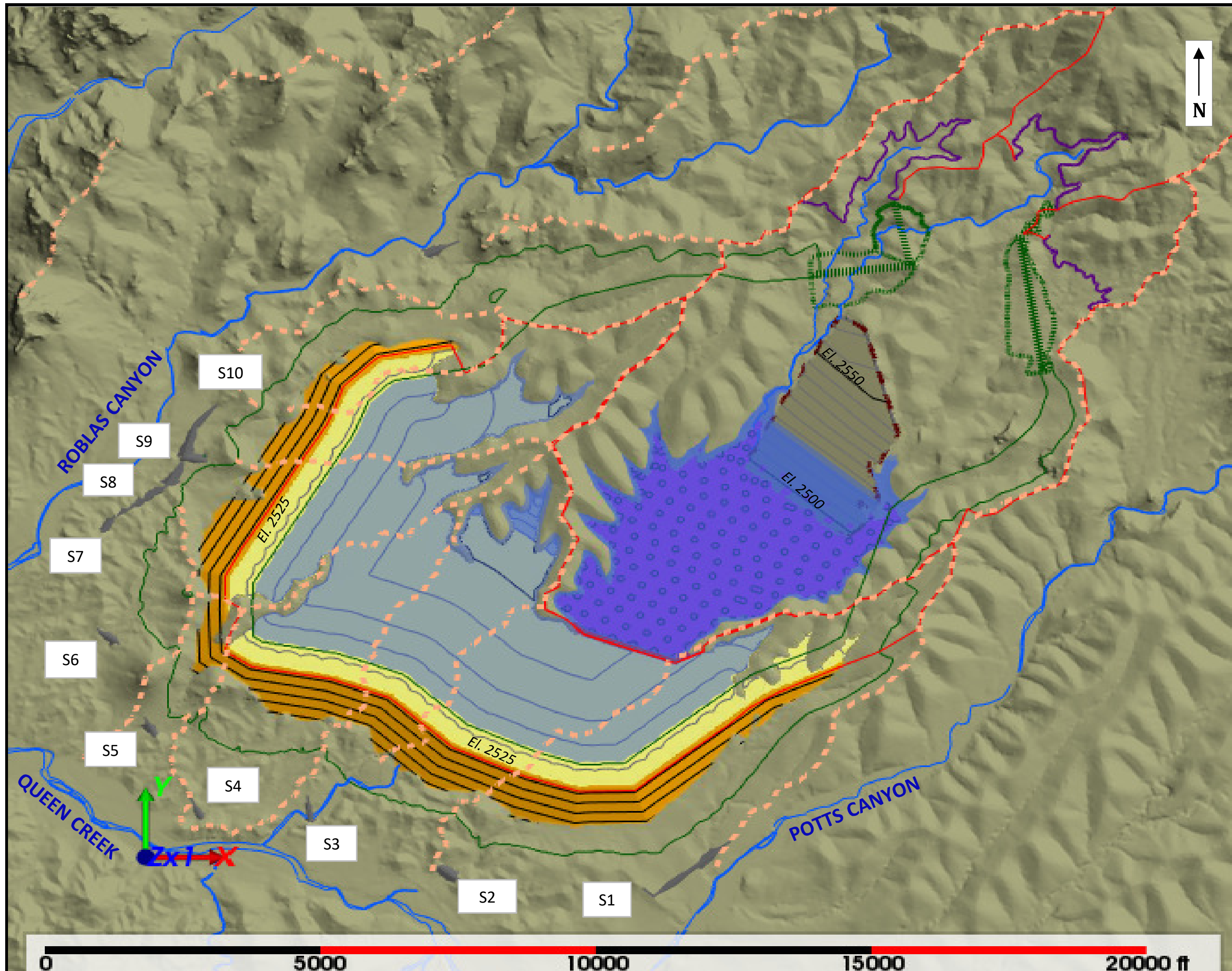
DEIS DESIGN FOR ALTERNATIVE 3A - NEAR WEST MODIFIED PROPOSED ACTION (MODIFIED CENTERLINE EMBANKMENT)

TITLE: END OF YEAR 6
(STAGE III)

SCALE	PROJECT No.	FIG No.
AS SHOWN	M09441A20	IV-A.7



LEGEND

- BORROW AREA
- SCAVENGER OVERFLOW/TOTAL TAILINGS
- PYRITE TAILINGS
- BORROW FILL DAMS
- SCAVENGER UNDERFLOW TAILINGS
- CATCHMENT DIVIDES
- LARGE WASHES
- CATCHMENTS
- 72-HR PROBABLE MAXIMUM FLOOD
- OPERATING POND
- ULTIMATE EMBANKMENT CRESTLINE AND TOE
- DAM OUTLINES
- S1 SEEPAGE DAM
- 50 ft CONTOUR
- 5 ft CONTOUR
- DIVERSION

	Units	Scavenger Stage III	Pyrite
Maximum Embankment Height	ft	257	138
Embankment Rate of Rise	ft/yr	20	0
Embankment Maximum El.	fasl	2525	2517
Tailings El.	fasl	2523	2506
Minimum Operating Pond El.	fasl	2495	2516
Maximum Storage El.	fasl	to be confirmed	to be confirmed
Upset Storage El.	fasl	2502	
PMF El.	fasl	2518	
Minimum Operating Storage[1]	acre-ft	66	7125
Minimum Operating Pond Depth	ft	20 (see Figure 1)	10 (see Figure 2)
Beach Length from PMF El.	ft	450	0

1- Distribution of scavenger and pyrite tailings tonnages are based on the GPO production schedule, see Appendix II for a detailed comparison of the production schedules.

		Scavenger Tailings			
	Units	Underflow	Overflow	Total	Sum
Tailings Placed[1]	Myd^3	6.7	18.4	8.2	33.3
Tailings Placed[1]	Mtons	10	20	9	39
Cumulative Tailings	Mtons	53	107	51	211

1- Distribution of scavenger and pyrite tailings tonnages are based on the GPO production schedule, see Appendix II for a detailed comparison of the production schedules.

	Units	Pyrite Tailings
Tailings Placed[1]	Myd^3	4.2
Tailings Placed[1]	Mtons	6
Cumulative Tailings	Mtons	26

1- Distribution of scavenger and pyrite tailings tonnages are based on the GPO production schedule, see Appendix II for a detailed comparison of the production schedules.

FIGURE 1 SCAVENGER MINIMUM POND DEPTH SCHEMATIC

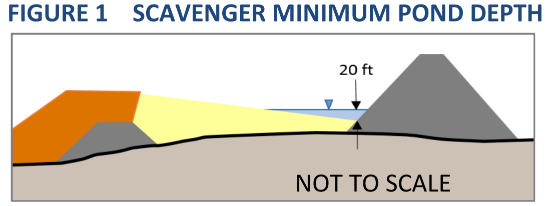
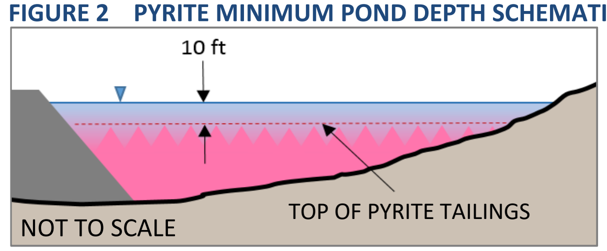


FIGURE 2 PYRITE MINIMUM POND DEPTH SCHEMATIC



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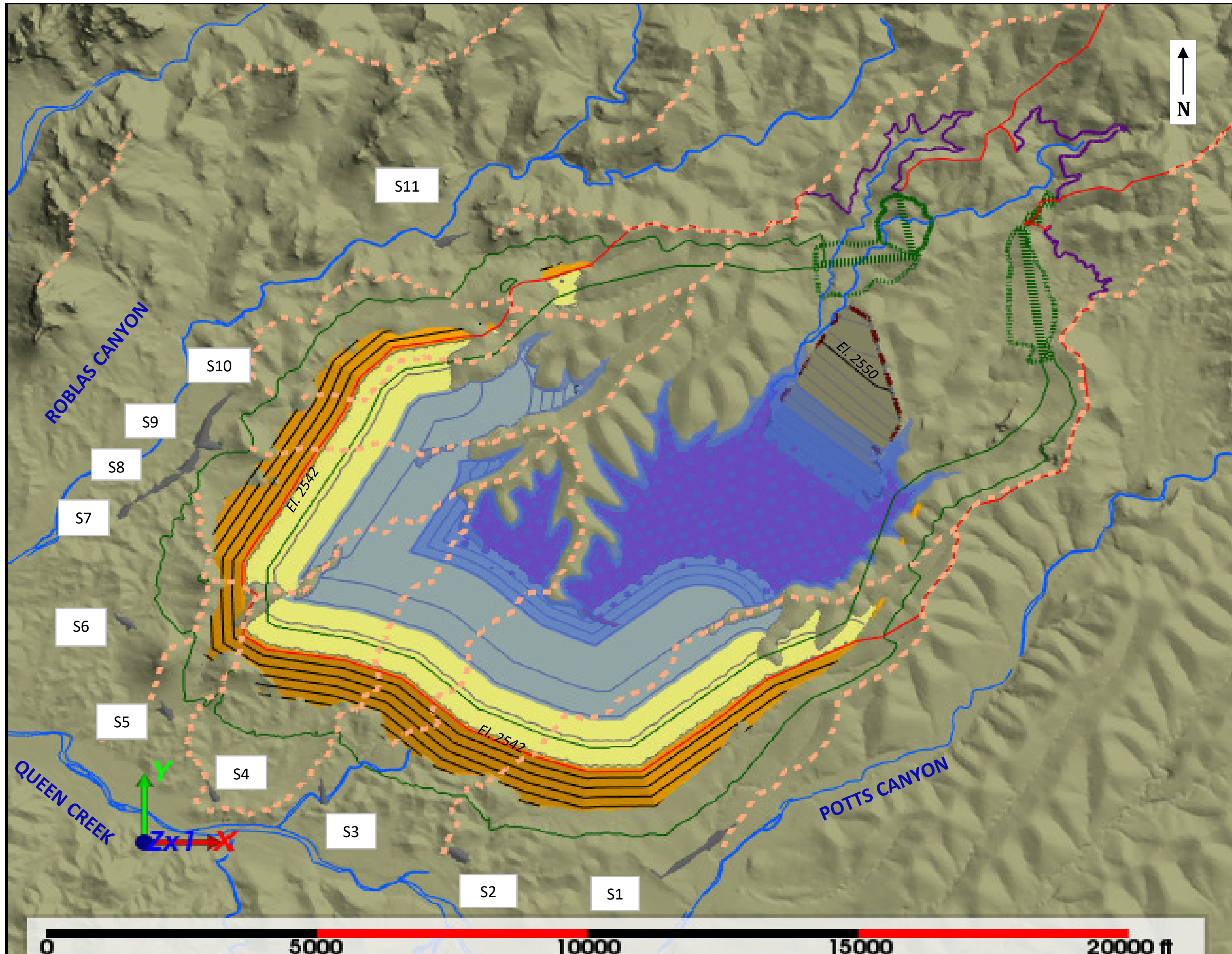
TITLE

END OF YEAR 9
(END OF STAGE III)

SCALE	PROJECT No.	FIG No.
AS SHOWN	M09441A20	IV-A.8



LEGEND

- BORROW AREA
- SCAVENGER OVERFLOW/TOTAL TAILINGS
- PYRITE TAILINGS
- BORROW FILL DAMS
- SCAVENGER UNDERFLOW TAILINGS
- CATCHMENT DIVIDES
- LARGE WASHES
- CATCHMENTS
- 72-HR PROBABLE MAXIMUM FLOOD
- OPERATING POND
- ULTIMATE EMBANKMENT CRESTLINE AND TOE
- DAM OUTLINES
- S1 SEEPAGE DAM
- 50 ft CONTOUR
- 5 ft CONTOUR
- DIVERSION

	Units	Scavenger Stage IV	Pyrite
Maximum Embankment Height	ft	275	138
Embankment Rate of Rise	ft/yr	17	0
Embankment Maximum El.	fasl	2542	2517
Tailings El.	fasl	2540	2516
Minimum Operating Pond El.	fasl	2521	
Maximum Storage El.	fasl	to be confirmed	to be confirmed
Upset Storage El.	fasl	2524	
PMF El.	fasl	2531	
Minimum Operating Storage[1]	acre-ft	6473	
Minimum Operating Pond Depth	ft	5 (see Figure 1)	
Beach Length from PMF El.	ft	890	

1- Distribution of scavenger and pyrite tailings tonnages are based on the GPO production schedule, see Appendix II for a detailed comparison of the production schedules.

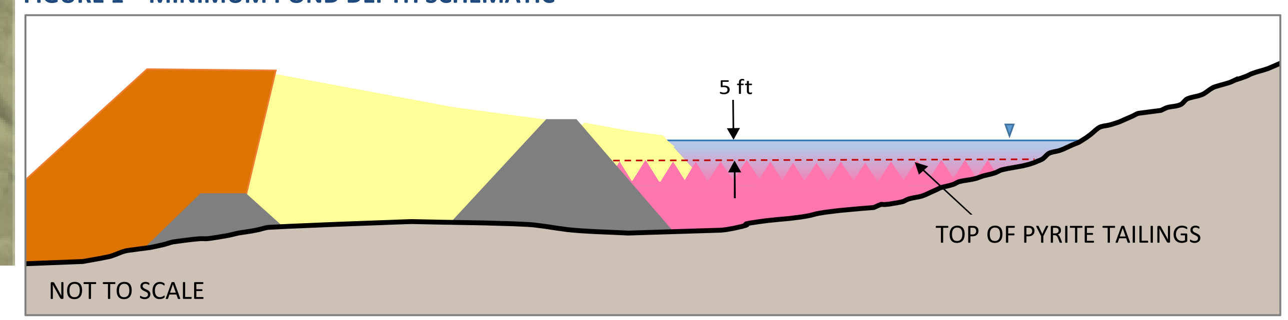
		Scavenger Tailings			
	Units	Underflow	Overflow	Total	Sum
Tailings Placed[1]	Myd^3	6.6	18.3	8.2	33.1
Tailings Placed[1]	Mtons	10	20	9	39
Cumulative Tailings	Mtons	63	127	60	250

1- Distribution of scavenger and pyrite tailings tonnages are based on the GPO production schedule, see Appendix II for a detailed comparison of the production schedules.

	Units	Pyrite Tailings
Tailings Placed[1]	Myd^3	4.6
Tailings Placed[1]	Mtons	7
Cumulative Tailings	Mtons	32

1- Distribution of scavenger and pyrite tailings tonnages are based on the GPO production schedule, see Appendix II for a detailed comparison of the production schedules.

FIGURE 1 MINIMUM POND DEPTH SCHEMATIC



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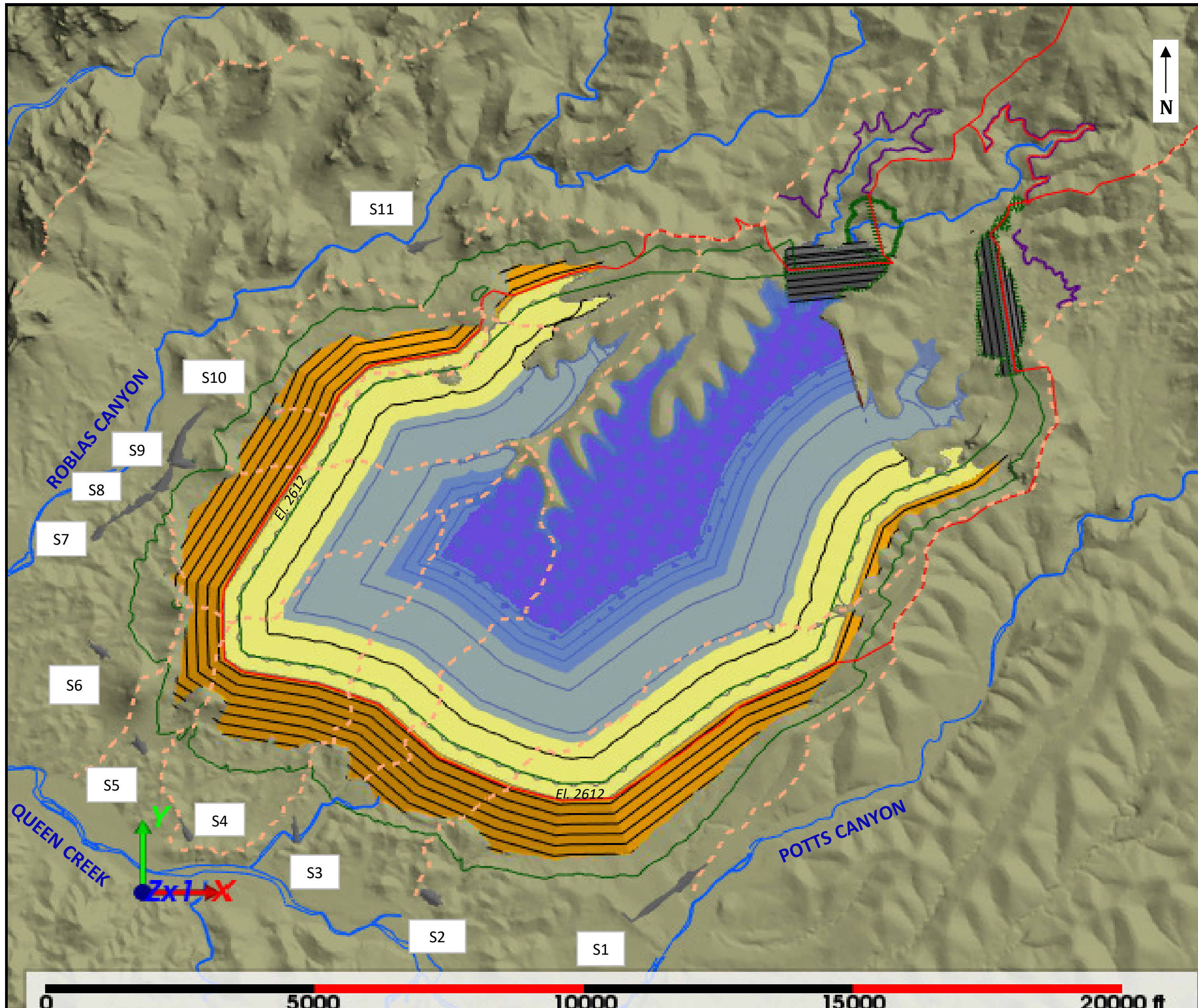
TITLE

END OF YEAR 10
(STAGE IV)

SCALE	PROJECT No.	FIG No.
AS SHOWN	M09441A20	IV-A.9



LEGEND

- BORROW AREA
- SCAVENGER OVERFLOW/TOTAL TAILINGS
- PYRITE TAILINGS
- BORROW FILL DAMS
- SCAVENGER UNDERFLOW TAILINGS
- CATCHMENT DIVIDES
- LARGE WASHES
- CATCHMENTS
- 72-HR PROBABLE MAXIMUM FLOOD
- OPERATING POND
- ULTIMATE EMBANKMENT CRESTLINE AND TOE
- DAM OUTLINES
- S1 SEEPAGE DAM
- 50 ft CONTOUR
- 5 ft CONTOUR
- DIVERSION

	Units	Scavenger Stage IV	Pyrite
Maximum Embankment Height	ft	351	138
Embankment Rate of Rise	ft/yr	9	0
Embankment Maximum El.	fasl	2612	2517
Tailings El.	fasl	2608	2583
Minimum Operating Pond El.	fasl	2588	
Maximum Storage El.	fasl	to be confirmed	to be confirmed
Upset Storage El.	fasl	2592	
PMF El.	fasl	2597	
Minimum Operating Storage[1]	acre-ft	6893	
Minimum Operating Pond Depth	ft	5 (see Figure 1)	
Beach Length from PMF El.	ft	1000	

1- Distribution of scavenger and pyrite tailings tonnages are based on the GPO production schedule, see Appendix II for a detailed comparison of the production schedules.

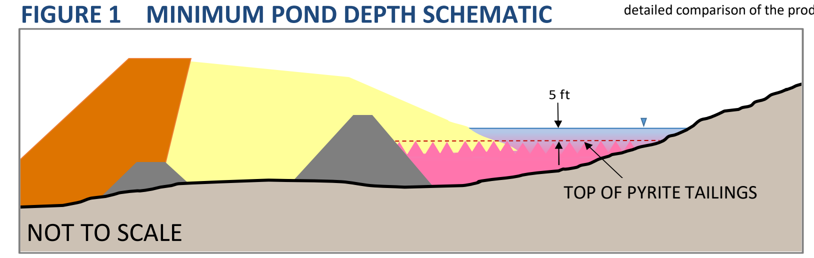
		Scavenger Tailings			
	Units	Underflow	Overflow	Total	Sum
Tailings Placed[1, 2]	Myd^3	13.9	38.0	17.0	68.9
Tailings Placed[1, 2]	Mtons	21	42	19	81
Cumulative Tailings	Mtons	125	250	115	490

1. Distribution of scavenger and pyrite tailings tonnages are based on the GPO production schedule, see Appendix II for a detailed comparison of the production schedules.
2. Includes deposition from the beginning of Year 15 to the end of Year 16.

	Units	Pyrite Tailings
Tailings Placed[1, 2]	Myd^3	7.3
Tailings Placed[1, 2]	Mtons	10
Cumulative Tailings	Mtons	67

1. Includes deposition from the beginning of Year 15 to the end of Year 16.
2. Distribution of scavenger and pyrite tailings tonnages are based on the GPO production schedule, see Appendix II for a detailed comparison of the production schedules.

FIGURE 1 MINIMUM POND DEPTH SCHEMATIC



	Units	Northwest Containment Dam	Northeast Containment Dam
Embankment Borrow Fill	Myd^3	5.5	3.7
Maximum Embankment Height	ft	242	195
Embankment Maximum El.	fasl	2,805	2,805

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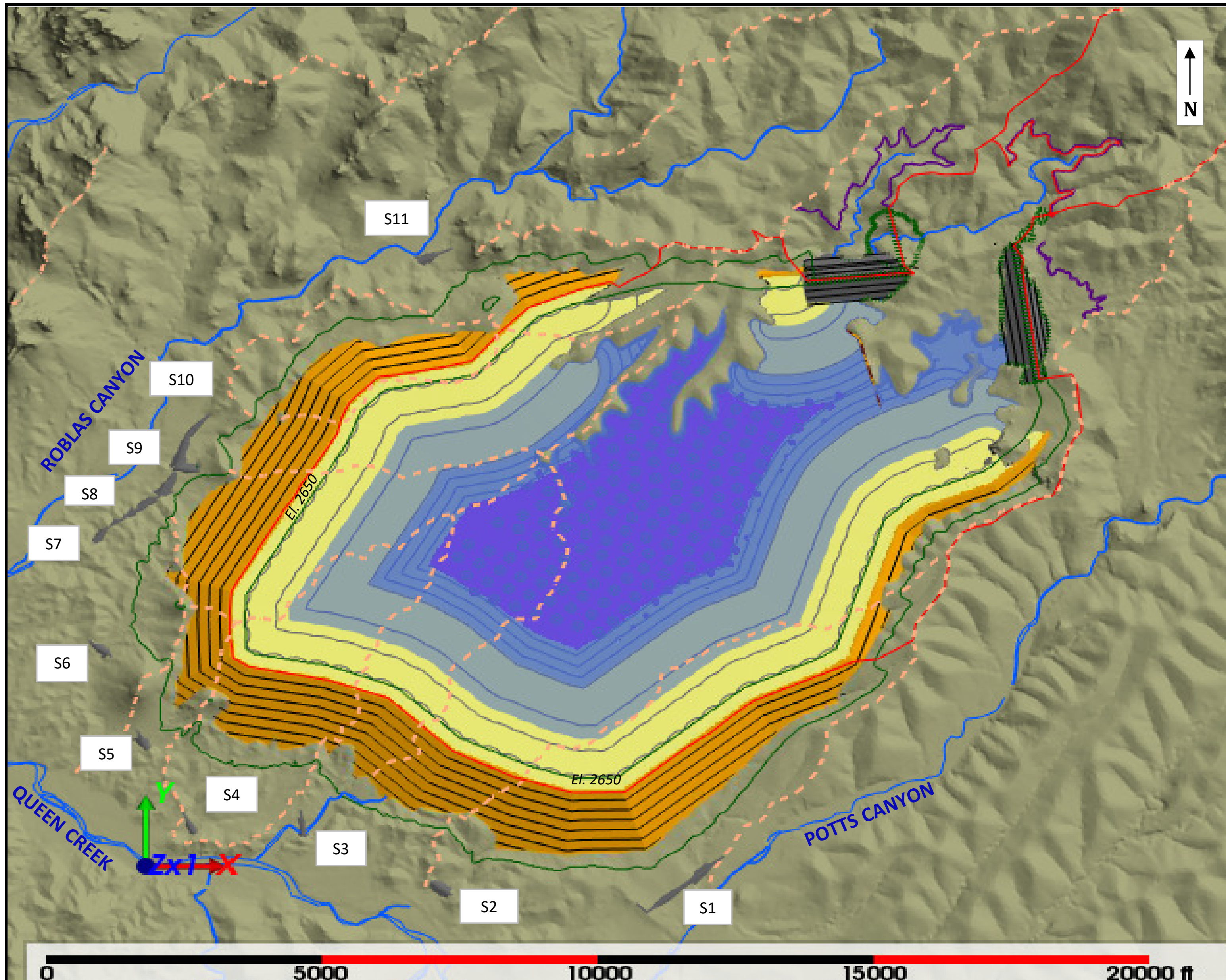
TITLE

END OF YEAR 16
(STAGE IV)

SCALE	PROJECT No.	FIG No.
AS SHOWN	M09441A20	IV-A.10



	Units	Scavenger Stage IV	Pyrite
Maximum Embankment Height	ft	390	138
Embankment Rate of Rise	ft/yr	10	0
Embankment Maximum El.	fasl	2650	2517
Tailings El.	fasl	2648	2624
Minimum Operating Pond El.	fasl	2629	
Maximum Storage El.	fasl	to be confirmed	to be confirmed
Upset Storage El.	fasl	2632	
PMF El.	fasl	2637	
Minimum Operating Storage[1]	acre-ft	9045	
Minimum Operating Pond Depth	ft	5 (see Figure 1)	
Beach Length from PMF El.	ft	980	

1- Distribution of scavenger and pyrite tailings tonnages are based on the GPO production schedule, see Appendix II for a detailed comparison of the production schedules.

		Scavenger Tailings			
	Units	Underflow	Overflow	Total	Sum
Tailings Placed[1, 2]	Myd^3	13.5	37.0	16.6	67.1
Tailings Placed[1, 2]	Mtons	21	41	18	79
Cumulative Tailings	Mtons	166	331	152	650

1. Distribution of scavenger and pyrite tailings tonnages are based on the GPO production schedule, see Appendix II for a detailed comparison of the production schedules.
2. Includes deposition from the beginning of Year 19 to the end of Year 20.

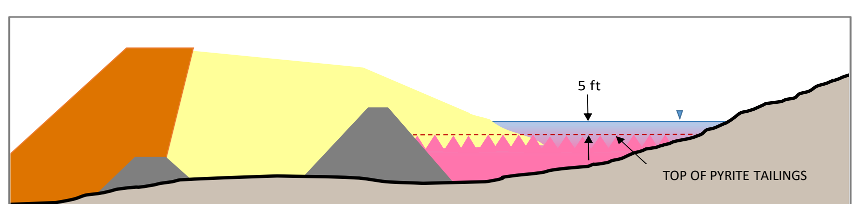
	Units	Pyrite Tailings
Tailings Placed[1, 2]	Myd^3	9.3
Tailings Placed[1, 2]	Mtons	13
Cumulative Tailings	Mtons	92

1. Distribution of scavenger and pyrite tailings tonnages are based on the GPO production schedule, see Appendix II for a detailed comparison of the production schedules.
2. Includes deposition from the beginning of Year 19 to the end of Year 20.

LEGEND

- BORROW AREA
- SCAVENGER OVERFLOW/TOTAL TAILINGS
- PYRITE TAILINGS
- BORROW FILL DAMS
- SCAVENGER UNDERFLOW TAILINGS
- CATCHMENT DIVIDES
- LARGE WASHES
- CATCHMENTS
- 72-HR PROBABLE MAXIMUM FLOOD
- OPERATING POND
- ULTIMATE EMBANKMENT CRESTLINE AND TOE
- DAM OUTLINES
- S1 SEEPAGE DAM
- 50 ft CONTOUR
- 5 ft CONTOUR
- DIVERSION

FIGURE 1 MINIMUM POND DEPTH SCHEMATIC



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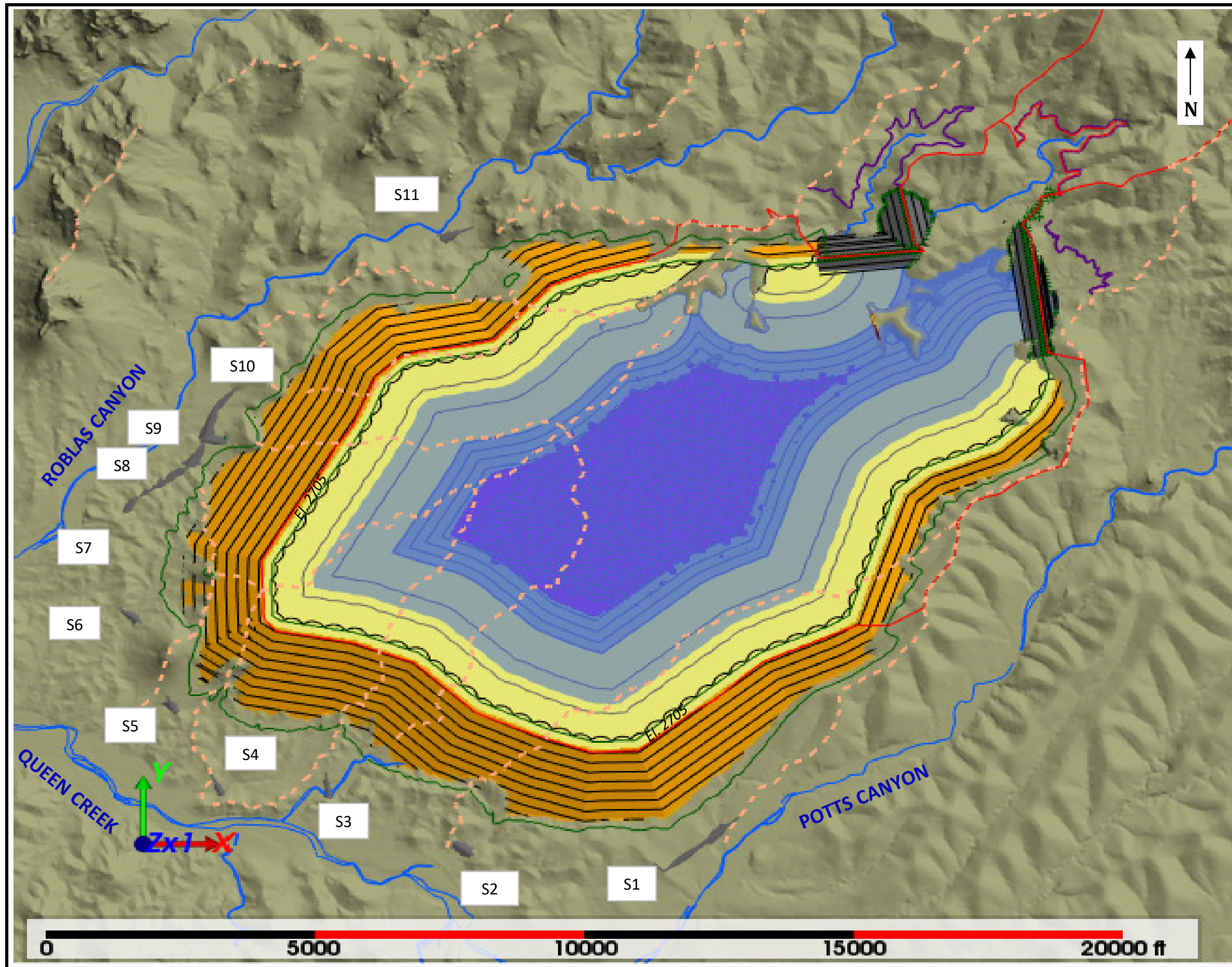
TITLE

END OF YEAR 20
(STAGE IV)

SCALE	PROJECT No.	FIG No.
AS SHOWN	M09441A20	IV-A.11



	Units	Scavenger Stage IV	Pyrite
Maximum Embankment Height	ft	448	138
Embankment Rate of Rise	ft/yr	9	0
Embankment Maximum El.	fasl	2705	2517
Tailings El.	fasl	2703	2680
Minimum Operating Pond El.	fasl	2685	
Maximum Storage El.	fasl	to be confirmed	to be confirmed
Upset Storage El.	fasl	2688	
PMF El.	fasl	2693	
Minimum Operating Storage[1]	acre-ft	9732	
Minimum Operating Pond Depth	ft	5 (see Figure 1)	
Beach Length from PMF El.	ft	920	

1- Distribution of scavenger and pyrite tailings tonnages are based on the GPO production schedule, see Appendix II for a detailed comparison of the production schedules.

		Scavenger Tailings			
	Units	Underflow	Overflow	Total	Sum
Tailings Placed[1, 2]	Myd^3	15.3	37.7	16.8	69.8
Tailings Placed[1, 2]	Mtons	23	41	18	83
Cumulative Tailings	Mtons	229	455	207	891

1. Distribution of scavenger and pyrite tailings tonnages are based on the GPO production schedule, see Appendix II for a detailed comparison of the production schedules.
2. Includes deposition from the beginning of Year 25 to the end of Year 26.

	Units	Pyrite Tailings
Tailings Placed[1, 2]	Myd^3	8.5
Tailings Placed[1, 2]	Mtons	12
Cumulative Tailings	Mtons	129

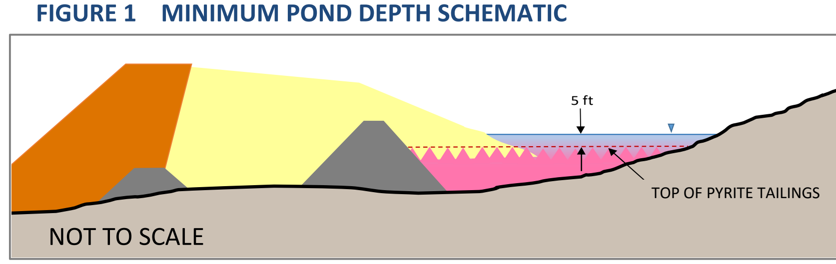
1. Distribution of scavenger and pyrite tailings tonnages are based on the GPO production schedule, see Appendix II for a detailed comparison of the production schedules.
2. Includes deposition from the beginning of Year 25 to the end of Year 26.

	Units	Northwest Dam
Embankment Borrow Fill	Myd^3	0.0
Maximum Embankment Height	ft	0
Embankment Maximum El.	fasl	0

LEGEND

- BORROW AREA
- SCAVENGER OVERFLOW/TOTAL TAILINGS
- PYRITE TAILINGS
- BORROW FILL DAMS
- SCAVENGER UNDERFLOW TAILINGS
- CATCHMENT DIVIDES
- LARGE WASHES
- CATCHMENTS
- 72-HR PROBABLE MAXIMUM FLOOD
- OPERATING POND
- ULTIMATE EMBANKMENT CRESTLINE AND TOE
- DAM OUTLINES
- S1 SEEPAGE DAM
- 50 ft CONTOUR
- 5 ft CONTOUR
- DIVERSION

FIGURE 1 MINIMUM POND DEPTH SCHEMATIC



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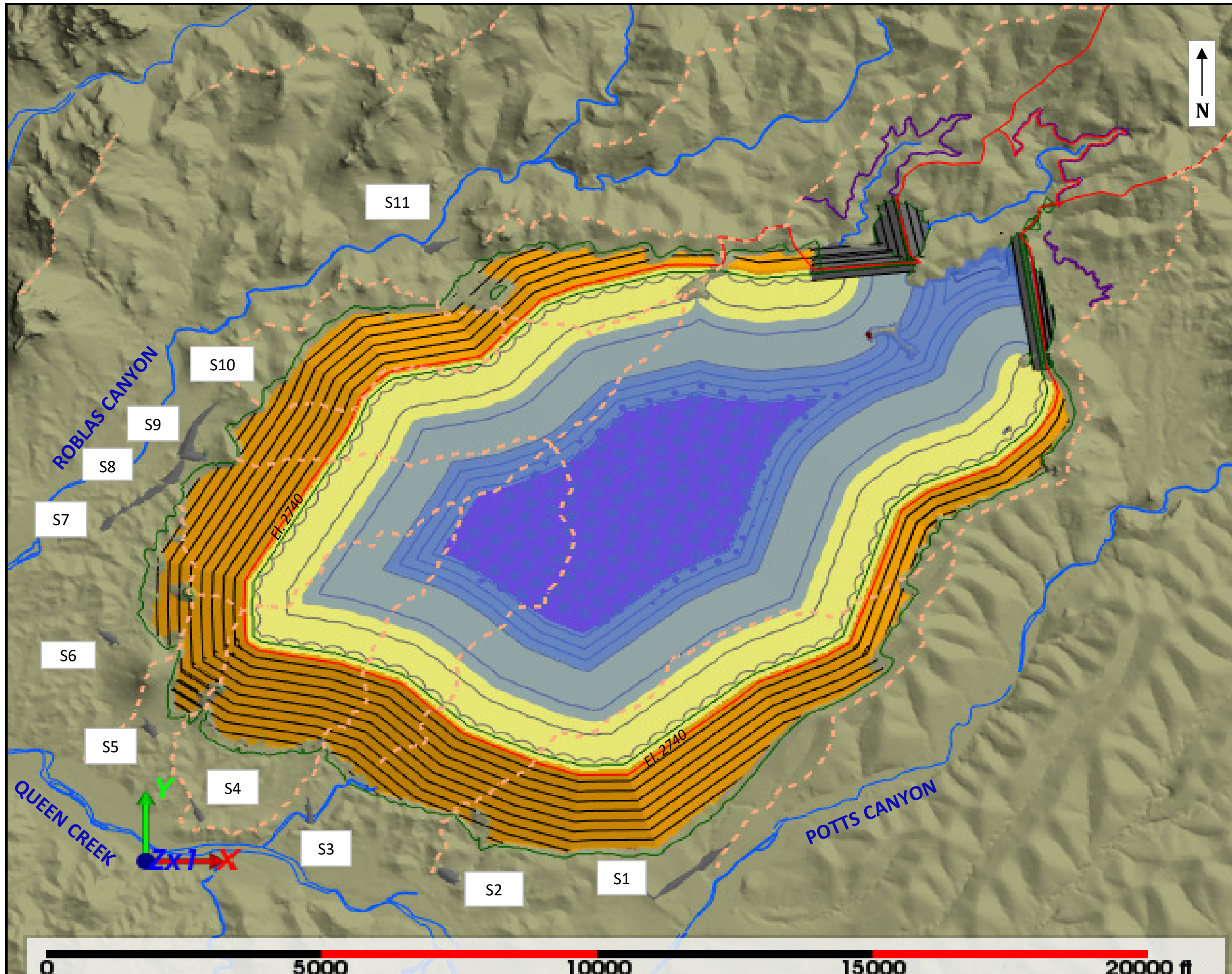
TITLE: END OF YEAR 26 (STAGE IV)

SCALE	PROJECT No.	FIG No.
AS SHOWN	M09441A20	IV-A.12



LEGEND
- SCAVENGER OVERFLOW/TOTAL TAILINGS
- PYRITE TAILINGS
- BORROW FILL DAMS
- SCAVENGER UNDERFLOW TAILINGS
- CATCHMENT DIVIDES
- LARGE WASHES
- CATCHMENTS
- 72-HR PROBABLE MAXIMUM FLOOD
- OPERATING POND
- ULTIMATE EMBANKMENT CRESTLINE AND TOE
- S1 SEEPAGE DAM
- 50 ft CONTOUR
- 5 ft CONTOUR
- DIVERSION

	Units	Scavenger Stage IV	Pyrite
Maximum Embankment Height	ft	484	138
Embankment Rate of Rise	ft/yr	9	0
Embankment Maximum El.	fasl	2740	2517
Tailings El.	fasl	2738	2715
Minimum Operating Pond El.	fasl	2720	
Maximum Storage El.	fasl	to be confirmed	to be confirmed
Upset Storage El.	fasl	2723	
PMF El.	fasl	2727	
Minimum Operating Storage[1]	acre-ft	8681	
Minimum Operating Pond Depth	ft	5 (see Figure 1)	
Beach Length from PMF El.	ft	940	

1- Distribution of scavenger and pyrite tailings tonnages are based on the GPO production schedule, see Appendix II for a detailed comparison of the production schedules.

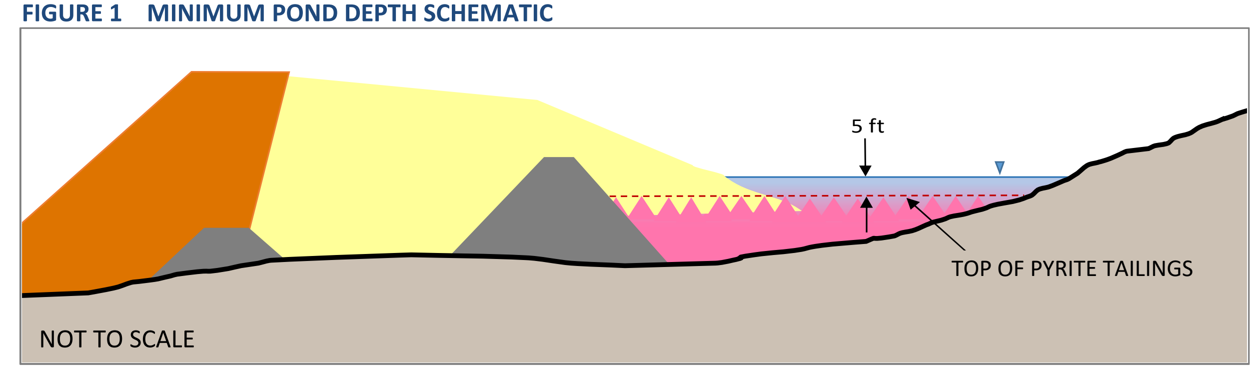
		Scavenger Tailings			
	Units	Underflow	Overflow	Total	Sum
Tailings Placed[1, 2]	Myd^3	19.2	38.5	17.2	75.0
Tailings Placed[1, 2]	Mtons	29	42	19	90
Cumulative Tailings	Mtons	271	539	245	1,055

1. Distribution of scavenger and pyrite tailings tonnages are based on the GPO production schedule, see Appendix II for a detailed comparison of the production schedules.
2. Includes deposition from the beginning of Year 29 to the end of Year 30.

	Units	Pyrite Tailings
Tailings Placed[1, 2]	Myd^3	7.2
Tailings Placed[1, 2]	Mtons	10
Cumulative Tailings	Mtons	151

1. Distribution of scavenger and pyrite tailings tonnages are based on the GPO production schedule, see Appendix II for a detailed comparison of the production schedules.
2. Includes deposition from the beginning of Year 29 to the end of Year 30.

FIGURE 1 MINIMUM POND DEPTH SCHEMATIC



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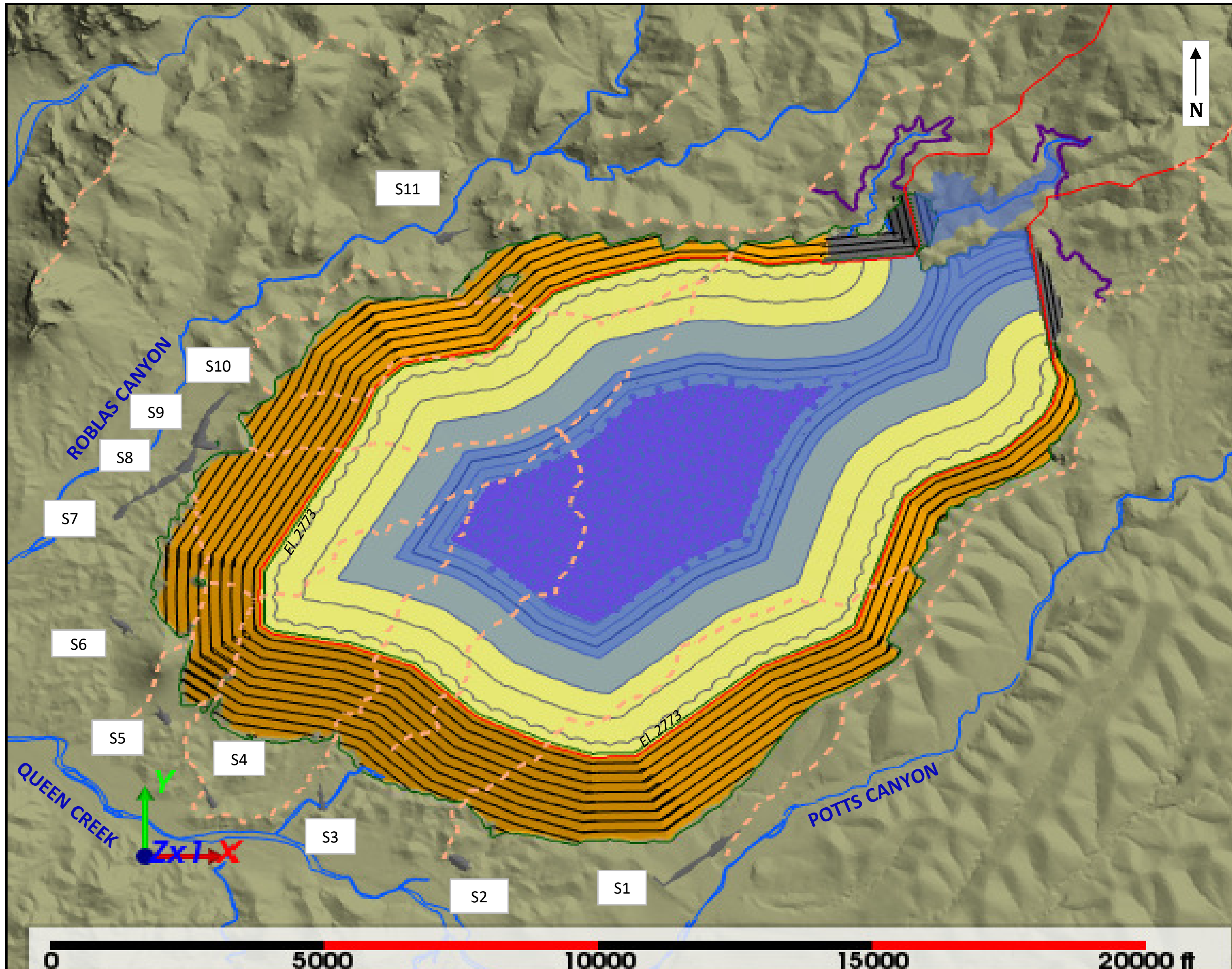
TITLE

END OF YEAR 30
(STAGE IV)

SCALE	PROJECT No.	FIG No.
AS SHOWN	M09441A20	IV-A.13



LEGEND

- SCAVENGER OVERFLOW/TOTAL TAILINGS
- PYRITE TAILINGS
- BORROW FILL DAMS
- SCAVENGER UNDERFLOW TAILINGS
- CATCHMENT DIVIDES
- LARGE WASHES
- CATCHMENTS
- 72-HR PROBABLE MAXIMUM FLOOD
- OPERATING POND
- ULTIMATE EMBANKMENT CRESTLINE AND TOE
- S1 SEEPAGE DAM
- 50 ft CONTOUR
- 5 ft CONTOUR
- DIVERSION

	Units	Scavenger Stage IV	Pyrite
Maximum Embankment Height	ft	520	138
Embankment Rate of Rise	ft/yr	8	0
Embankment Maximum El.	fasl	2773	2517
Tailings El.	fasl	2773	2751
Minimum Operating Pond El.	fasl	2756	
Maximum Storage El.	fasl	to be confirmed	to be confirmed
Upset Storage El.	fasl	2757	
PMF El.	fasl	2760	
Minimum Operating Storage[1]	acre-ft	8867	
Minimum Operating Pond Depth	ft	5 (see Figure 1)	
Beach Length from PMF El.	ft	1280	

1- Distribution of scavenger and pyrite tailings tonnages are based on the GPO production schedule, see Appendix II for a detailed comparison of the production schedules.

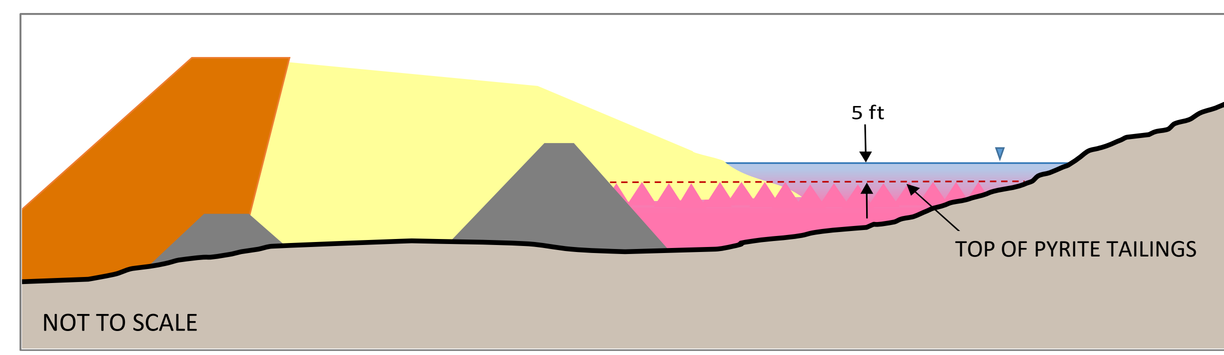
		Scavenger Tailings			
	Units	Underflow	Overflow	Total	Sum
Tailings Placed[1, 2]	Myd^3	21.3	38.7	17.3	77.3
Tailings Placed[1, 2]	Mtons	33	42	19	94
Cumulative Tailings	Mtons	314	624	282	1,220

1. Distribution of scavenger and pyrite tailings tonnages are based on the GPO production schedule, see Appendix II for a detailed comparison of the production schedules.
2. Includes deposition from the beginning of Year 31 to the end of Year 41.

	Units	Pyrite Tailings
Tailings Placed[1, 2]	Myd^3	7.5
Tailings Placed[1, 2]	Mtons	11
Cumulative Tailings	Mtons	172

1. Distribution of scavenger and pyrite tailings tonnages are based on the GPO production schedule, see Appendix II for a detailed comparison of the production schedules.
2. Includes deposition from the beginning of Year 31 to the end of Year 41.

FIGURE 1 MINIMUM POND DEPTH SCHEMATIC



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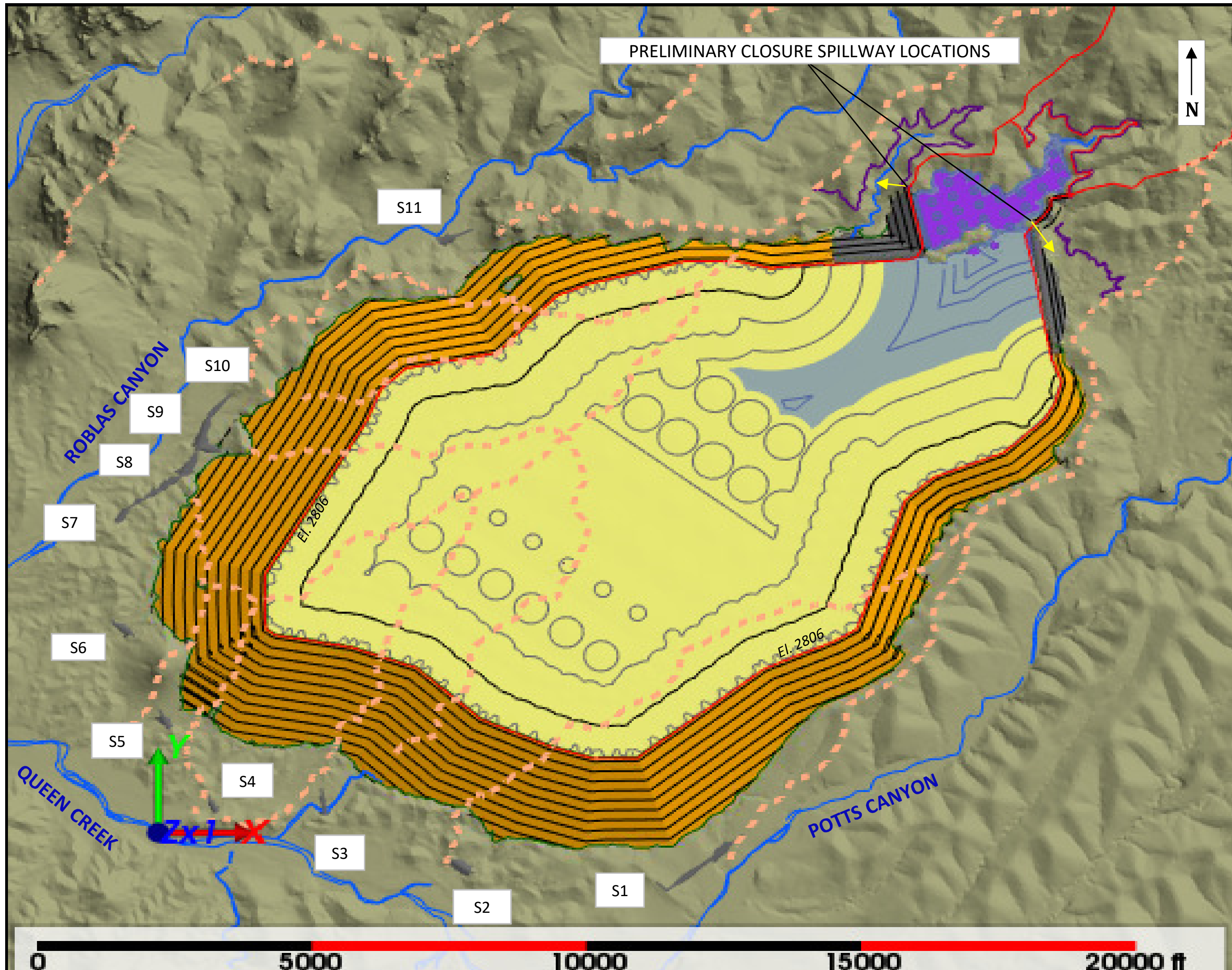
TITLE: END OF YEAR 34
(END OF STAGE IV)

SCALE	PROJECT No.	FIG No.
AS SHOWN	M09441A20	IV-A.14



LEGEND
- SCAVENGER OVERFLOW/TOTAL TAILINGS
- PYRITE TAILINGS
- BORROW FILL DAMS
- SCAVENGER UNDERFLOW TAILINGS
- CATCHMENT DIVIDES
- LARGE WASHES
- CATCHMENTS
- OPERATING POND
- ULTIMATE EMBANKMENT CRESTLINE AND TOE
- S1 SEEPAGE DAM
- 50 ft CONTOUR
- 5 ft CONTOUR
- DIVERSION

	Units	Scavenger Stage V	Pyrite
Maximum Embankment Height	ft	557	138
Embankment Rate of Rise	ft/yr	0	0
Embankment Maximum El.	fasl	2806	2517
Tailings El.	fasl	2806	2783
Minimum Operating Pond El.	fasl	2788	
Maximum Storage El.	fasl	to be confirmed	to be confirmed
Upset Storage El.	fasl	2791	
Unrouted PMF El.[2]	fasl	2796	
Minimum Operating Storage[1]	acre-ft	1896	
Minimum Operating Pond Depth	ft	5 (in North Pond only)	
Beach Length from PMF El.	ft	1030	

1. Distribution of scavenger and pyrite tailings tonnages are based on the GPO production schedule, see Appendix II for a detailed comparison of the production schedules.
2. The PMF will be routed through a spillway at the end of Yr 45.

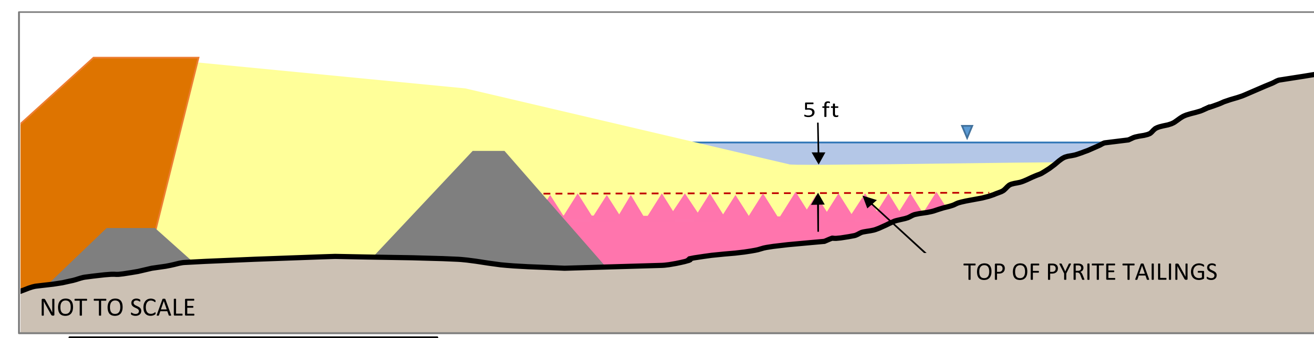
		Scavenger Tailings			
	Units	Underflow	Overflow	Total	Sum
Tailings Placed[1, 2]	Myd^3	9.3	8.8	3.9	22.0
Tailings Placed[1, 2]	Mtons	14	10	4	28
Cumulative Tailings	Mtons	356	716	324	1,396

1. Distribution of scavenger and pyrite tailings tonnages are based on the GPO production schedule, see Appendix II for a detailed comparison of the production schedules.
2. Includes deposition from the GPO production schedule beginning of Year 41 to the end of Year 45.

	Units	Pyrite Tailings
Tailings Placed[1, 2]	Myd^3	1.6
Tailings Placed[1, 2]	Mtons	2
Cumulative Tailings	Mtons	196

1. Distribution of scavenger and pyrite tailings tonnages are based on the GPO production schedule, see Appendix II for a detailed comparison of the production schedules.
2. Includes deposition from the GPO production schedule beginning of Year 41 to the end of Year 45.

FIGURE 1 MINIMUM POND DEPTH SCHEMATIC



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TITLE: END OF STAGE V
(1.59 Bt OF TAILINGS)

SCALE: AS SHOWN
PROJECT No.: M09441A20
FIG No.: IV-A.15

APPENDIX IV-B

Catchment Areas and Flood Volumes

Table IV-B.1 Catchment Areas and Flood Volumes

Mine Year	Catchment Area (acre)			Probable Maximum Flood Volume (acre-ft)		
	(Stages I through III)		Combined (Stage IV & V)	(Stages I through III)		Combined (Stage IV & V)
	Scavenger	Pyrite		Scavenger	Pyrite	
1	346	2,572	-	586	4,359	-
2	346	2,572	-	586	4,359	-
3	746	2,572	-	1,264	4,359	-
4	746	2,572	-	1,264	4,359	-
5	1,202	2,572	-	2,037	4,359	-
6	1,212	2,572	-	2,055	4,359	-
7	1,216	2,572	-	2,060	4,359	-
8	1,282	2,572	-	2,173	4,359	-
9	1,282	2,572	-	2,173	4,359	-
10	-	-	3,947	-	-	6,688
11	-	-	3,909	-	-	6,625
12	-	-	3,909	-	-	6,625
13	-	-	3,909	-	-	6,625
14	-	-	3,909	-	-	6,625
15	-	-	3,909	-	-	6,625
16	-	-	3,480	-	-	5,898
17	-	-	3,480	-	-	5,898
18	-	-	3,480	-	-	5,898
19	-	-	3,480	-	-	5,898
20	-	-	3,437	-	-	5,825
21	-	-	3,437	-	-	5,825
22	-	-	3,437	-	-	5,825
23	-	-	3,437	-	-	5,825
24	-	-	3,437	-	-	5,825
25	-	-	3,437	-	-	5,825
26	-	-	3,414	-	-	5,786
27	-	-	3,414	-	-	5,786
28	-	-	3,414	-	-	5,786
29	-	-	3,414	-	-	5,786
30	-	-	3,214	-	-	5,446
31	-	-	3,214	-	-	5,446
32.4	-	-	3,123	-	-	5,292
33.5	-	-	3,123	-	-	5,292
41[2]	-	-	3,123	-	-	5,292
	-	-	3,123	-	-	5,292
	-	-	3,123	-	-	5,292
	-	-	3,068	-	-	5,200
	-	-	3,068	-	-	5,200
	-	-	3,068	-	-	5,200
	-	-	3,068	-	-	5,200
	-	-	3,068	-	-	5,200
	-	-	3,068	-	-	5,200
	-	-	3,068	-	-	5,200
	-	-	3,068	-	-	5,200
	-	-	3,068	-	-	5,200

APPENDIX V

Water Balance

Resolution Copper Project

DEIS Design for Alternative 3A – Near West Modified Proposed Action (Modified Centerline Embankment)

Technical Memorandum

Appendix V – Water Balance

DISCLAIMER

Appendix V
Alternative 3A - Water Balance

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V-1 INTRODUCTION

This appendix summarizes the preliminary water balance results for DEIS Alternative 3A – Near West Modified Proposed Action (Modified Centerline Embankment – “wet”) Tailings Storage Facility (TSF).

The purpose of the water balance assessment is to provide inputs into the following assessments completed by others for comparative analysis between TSF alternatives:

- site-wide water balance to estimate make-up water requirements; and
- downstream solute transport.

The scope of this work is separated into two parts:

- estimate infiltration through a typical scavenger tailings column (to be included in a three-dimensional seepage analysis completed by others); and
- estimate the water flows associated with the TSF for three periods of the mine life. These periods are: production ramp-up, full-production and production ramp-down.

V-2 TAILINGS INFILTRATION

Infiltration through the tailings was estimated by simplified one-dimensional (1D) seepage modeling using VADOSE/W to simulate of the variably saturated and unsaturated system and the climatic interactions. Figure V-1 illustrates the conceptual model, model parameters and assumptions, and results.

Assumptions to this simplified modeling approach are outlined in Table V-2.1.

Table V-2.1 Modeling Assumptions

Consideration	Explanation
Climate	Climate variability and precipitation distribution can have a significant impact on infiltration. The modeling applied a single-year climate pattern considered to be reflective of a “typical” year, both in terms of precipitation amount and frequency distribution. Results may be considered “indicative of natural variations in the site’s climate.
Tailings lift thickness and frequency	The model assumes monthly lift thickness calculated from the mine-life average annual rates of rise.
Tailings properties variability	Simplification of the tailings column does not account for horizontal and vertical variability in material types/properties. A single “tailings type” (with one vertical hydraulic conductivity and one soil-water-characteristic curve, SWCC) was used for the modeling.
Consolidation	The modeling does not account for long-term consolidation processes.
Foundation properties	Foundation properties have been assumed to be weathered Gila conglomerate and modeled as equivalent porous medium. For the intent of this modeling the adoption of weathered Gila properties (which has higher vertical hydraulic conductivity than the tailings) is considered appropriate because it represents the majority of the TSF footprint.

Consideration	Explanation
Bleed Water	To account for the initial stages of slurry settling and bleed water after placement, assumptions were made on the water volume remaining available for infiltration at the surface. This was calculated as the difference between the water discharged with the slurry and the water entrained in the tailings at the initial settled density. This was applied as a constant surface flux at the top of the tailings column.
Groundwater Mounding	The groundwater table elevation applied as a starting condition is representative of regional levels and is not considered to be limiting with respect to infiltration.

V-3 TSF WATER BALANCE

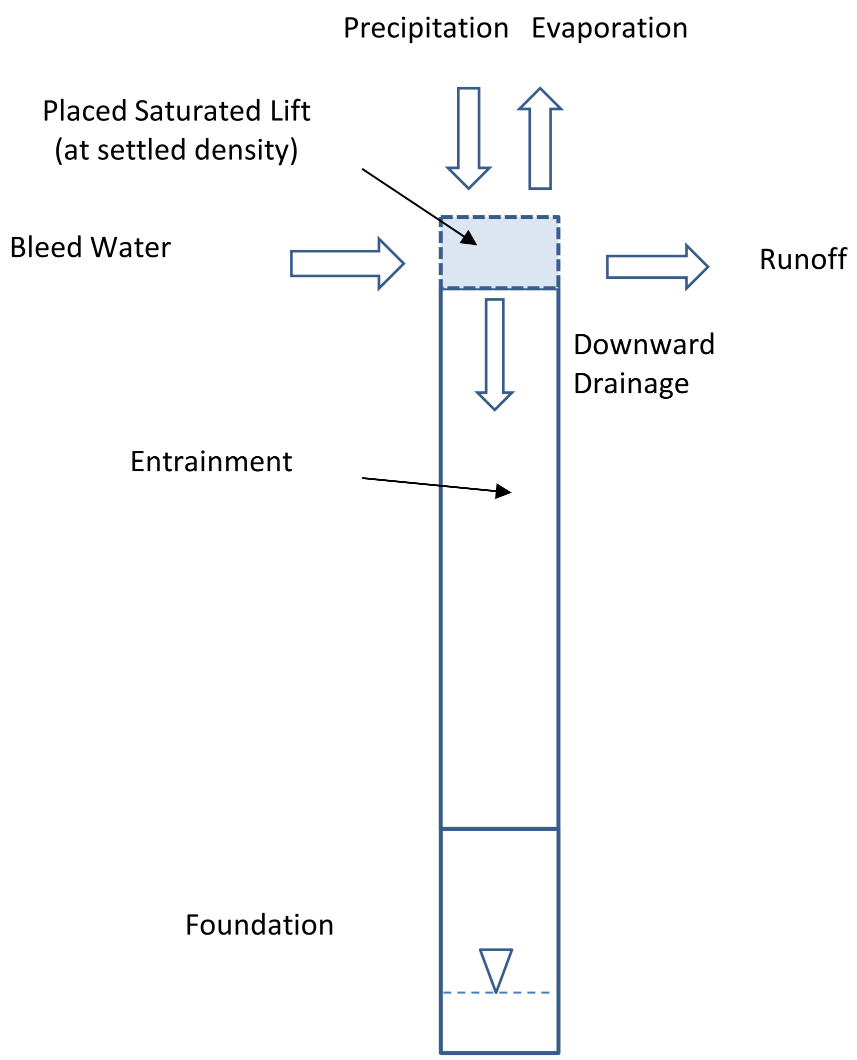
A simplified water balance of the TSF was completed to estimate the water flows for three periods of the mine life; these periods are: production ramp-up, full-production and production ramp-down.

The simplified water balance concept is shown in Figure V-2; input parameters and assumptions are summarized in Figure V-3, these are based on the design basis memorandum (DBM) in Appendix I and the tailings staging plan in Appendix IV. Seepage from the TSF that is lost to the system was estimated by others (M&A 2018).

The simplified water balance results are given on Figure V-2 and the estimated losses from the TSF system over the mine life are shown on Figure V-4.

Conceptual Model

one-dimensional column



Model Inputs

Parameter		Value	Assumption
Climate			
Precipitation (in/year)		20	1987 daily climate data from Superior climate station used in assessment. Assumed to be a "typical" year.
Potential Evaporation (in/year)		75	Calculated in Vadose/W using the 1987 daily climate data from Superior climate station
Tailings Properties (Scavenger Tailings			
Specific Gravity		2.78	Assumed to be mid-range for expected scavenger tailings based on laboratory testing (see DBM, Appendix I)
Vertical Hydraulic Conductivity (kv) (in cm/s)		1E-06	Assumed to be mid-range for expected scavenger tailings based on laboratory testing (see Tailings Characterization, KCB 2018)
Rate of Rise (ft/year)		10	Average over the mine-life (see tailings staging plan, Appendix II)
Slurry	Deposited solids content by weight (%)	55%	Weighted average of scavenger tailings deposited on beach (see DBM, Appendix I)
	Initial Void ratio (e)	2.25	*Calculated*
Placed (settled density)	Porosity (n)	0.45	Assumed to be mid-range for expected scavenger tailings based on laboratory testing (see Tailings Characterization, KCB 2018)
	Final Void ratio (e)	0.82	*Calculated*
Bleed water	Water released per unit lift	0.79	*Calculated*
	Rate of water released per unit lift (per day)	0.026	*Calculated based on a monthly timestep for modeling*

Model Results

Tailings downward drainage (infiltration) (gpm/acre)	0.52

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CLIENT: RESOLUTION COPPER

Klohn Crippen Berger

PROJECT: RESOLUTION COPPER PROJECT
DEIS DESIGN FOR ALTERNATIVE 3A - NEAR WEST MODIFIED PROPOSED ACTION (MODIFIED CENTERLINE EMBANKMENT)

TITLE: TAILINGS INFILTRATION

PROJECT No. M09441A20

FIG No. V-1

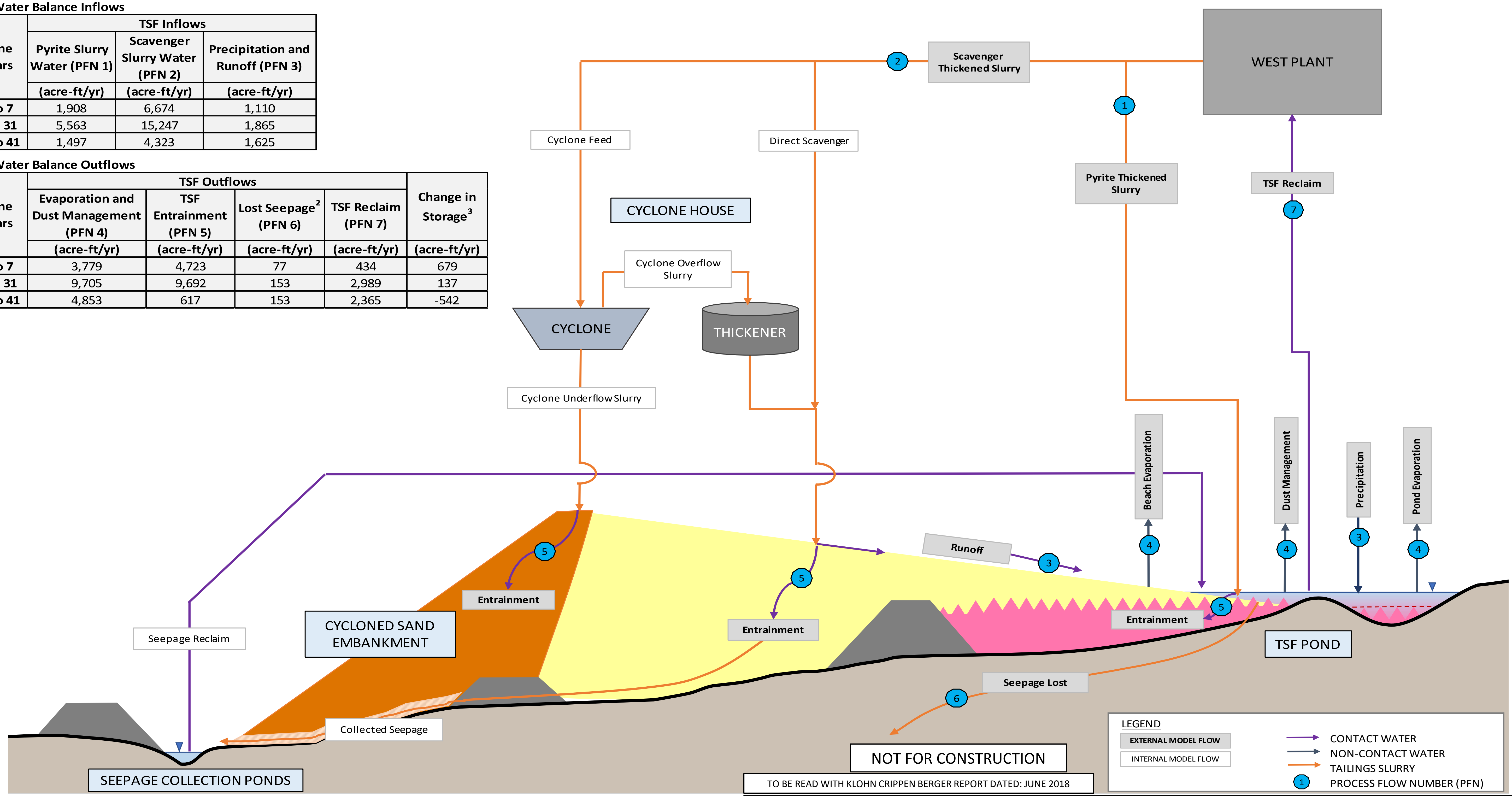
Date & Time: 2018-06-07 20:46
Figure File: Z:\M\VCR\M09441A20 - RES-Near West PFS-PES\700 Deliverables\720 Working\740 DEIS NW Wet\5 - App - SimpleWB\01-Figures\[Figure V-1 Infiltration.xlsx]V-A.1

TSF Water Balance Inflows

Mine Years	TSF Inflows		
	Pyrite Slurry Water (PFN 1)	Scavenger Slurry Water (PFN 2)	Precipitation and Runoff (PFN 3)
	(acre-ft/yr)	(acre-ft/yr)	(acre-ft/yr)
1 to 7	1,908	6,674	1,110
8 to 31	5,563	15,247	1,865
32 to 41	1,497	4,323	1,625

TSF Water Balance Outflows

Mine Years	TSF Outflows				Change in Storage[3]
	Evaporation and Dust Management (PFN 4)	TSF Entrainment (PFN 5)	Lost Seepage[2] (PFN 6)	TSF Reclaim (PFN 7)	
	(acre-ft/yr)	(acre-ft/yr)	(acre-ft/yr)	(acre-ft/yr)	(acre-ft/yr)
1 to 7	3,779	4,723	77	434	679
8 to 31	9,705	9,692	153	2,989	137
32 to 41	4,853	617	153	2,365	-542



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Notes:
1. See Figure V-3 for process flow summary tables and equations.
2. Estimated lost seepage was provided by M&A (2018).
3. Change in storage reflects change in water volume stored in the TSF Pond and Seepage Collection Ponds, and excludes water entrained in tailings.

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TITLE
OPERATIONAL WATER BALANCE SCHEMATIC AND RESULTS

SCALE	PROJECT No.	FIG No.
AS SHOWN	M09441A20	V-2

Process Flow 1 - Pyrite Slurry Water

Years	Pyrite Production[3] (million ton/yr)	Pyrite Solids Content[3] (%)	Pyrite Water Content	Pyrite Slurry Water (PFN 1) (acre-ft/yr)
1 to 7	2.7	50%	1.00	1,908
8 to 31	7.6	50%	1.00	5,563
32 to 41	2.0	50%	1.00	1,497

Slurry water is calculated based on the tailings production schedules and slurry percent solids using Equation 1 below.

$$slurry\ water\ (tons) = tailings\ mass\ (tons)\ x\ \frac{(100\% - slurry\ \%\ solids)}{slurry\ \%\ solids} \quad \textit{(Equation 1)}$$

Process Flow 2 - Scavenger Slurry Water

Years	Thickened Scavenger[3] (million ton/yr)	Scavenger Solids Content[3] (%)	Scavenger Water Content	Scavenger Slurry Water (PFN 2) (acre-ft/yr)
1 to 7	17.2	65%	0.54	6,674
8 to 31	38.5	65%	0.54	15,247
32 to 41	10.6	65%	0.54	4,323

Precipitation on ponds is calculated using Equation 2 below.

$$Precipitation\ on\ Ponds = pond\ area\ x\ precipitation \quad \textit{(Equation 2)}$$

Process Flow 3 - Precipitation and Runoff

Years	Pond Area[4] (acre)	Total TSF Area[4] (acre)	Precipitation[3] (ft/yr)	Runoff Coeff.[1]	Precipitation and Runoff (PFN 3) (acre-ft/yr)
1 to 7	258	3417	1.52	0.15	1,110
8 to 31	738	4018	1.52	0.15	1,865
32 to 41	555	3999	1.52	0.15	1,625

Runoff from beach, embankment and natural ground areas is calculated using Equation 3 below.

$$Runoff = (TSF\ area\ - pond\ area)\ x\ runoff\ coeff.\ x\ precipitation \quad \textit{(Equation 3)}$$

Process Flow 4 - Evaporation and Dust Management

Years	Evaporation[3] (ft/yr)	Pond Area[4] (acre)	Wetted Beach Area (acre)	Dust Mgmt Area (acre)	Evaporation and Dust Mgmt (PFN 4) (acre-ft/yr)
1 to 7	6.0	258	340	32	3,779
8 to 31	6.0	738	797	82	9,705
32 to 41	6.0	555	234	20	4,853

Evaporation and Dust Management is calculated using Equation 4 below.

$$Evaporation\ and\ Dust\ Management = (pond\ area + wetted\ beach\ area + dust\ mgmt\ area)\ x\ evaporation \quad \textit{(Equation 4)}$$

Process Flow 5 - TSF Entrainment

Years	Production Rates (million ton/yr)				Total Water Entrained (acre-ft/yr)	Collected Seepage[2] (acre-ft/yr)	TSF Entrainment (PFN 5) (acre-ft/yr)
	Cyclone Underflow[3]	Cycloned Overflow[3]	Total Scavenger[3]	Pyrite[3]			
1 to 7	5.7	6.7	4.8	2.7	4914	191	4,723
8 to 31	12.0	14.2	12.3	7.6	11561	1869	9,692
32 to 41	1.2	1.4	8.0	2.0	3717	3100	617

Tailings Properties

Property	Cyclone Underflow	Cyclone Overflow	Total Scavenger	Pyrite
Specific Gravity[3]	2.78	2.78	2.78	3.54
Placed Dry Density (pcf)[3]	113	76	76	106
In-Situ Saturation[3]	0.5	1	1	1
In-Situ Water Content	0.10	0.46	0.46	0.31

Entrainment is calculated as the water stored in the pores of the tailings at the placed saturation using Equation 5 below.

$$water\ entrained\ in\ tailings\ (tons) = tailings\ mass\ (tons)\ x\ in\ situ\ tailings\ water\ content \quad \textit{(Equation 5)}$$

In situ tailings water content is calculated using Equation 6 below.

$$in\ situ\ water\ content = \frac{saturation\ x\ (\frac{specific\ gravity\ of\ tailings\ x\ density\ of\ water}{dry\ density\ of\ tailings} - 1)}{specific\ gravity\ of\ tailings} \quad \textit{(Equation 6)}$$

Total Water Entrained is the sum of water entrained in cyclone underflow, cyclone overflow, total scavenger and pyrite tailings. TSF Entrainment is then calculated using Equation 7 below.

$$TSF\ Entrainment = Total\ Water\ Entrained\ - Collected\ Seepage \quad \textit{(Equation 7)}$$

Notes:
1. Runoff coefficient applies to beach, embankment and natural ground areas. See DBM (Appendix I) for details.
2. Water released from tailings reporting to downstream seepage collection.
3. Values taken from DBM (Appendix I).
4. Values taken from Tailings Staging (Appendix IV).

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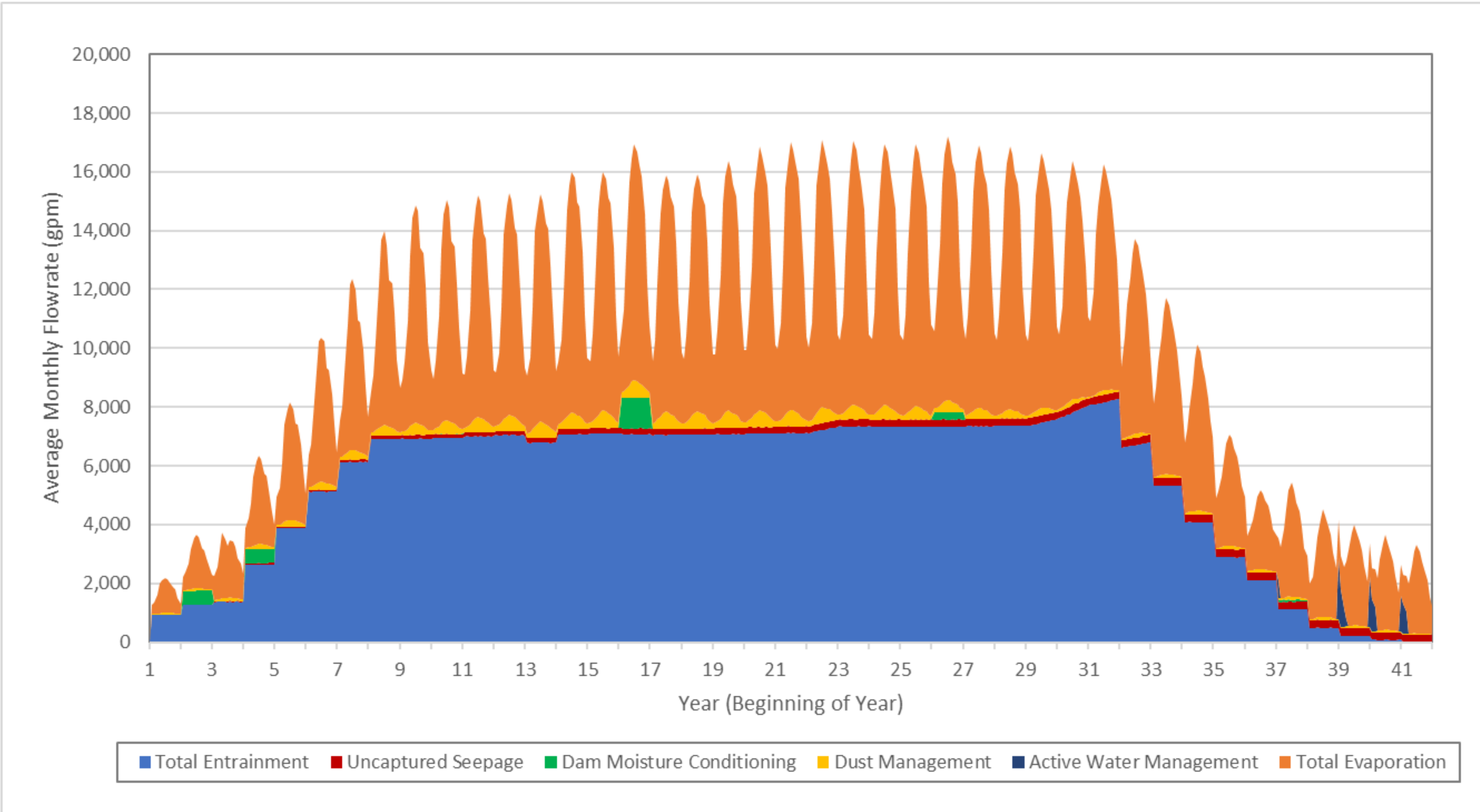
TITLE: OPERATIONAL WATER BALANCE ASSUMPTIONS

SCALE	PROJECT No.	FIG No.
AS SHOWN	M09441A20	V-3

Figure V-4 TSF System Losses during Operation



Notes:

1. Dust management losses include water applied to the unreclaimed area of the embankment.
2. Total evaporation includes both pond evaporation and evaporation of bleed water on the tailings beach.

REFERENCES

Klohn Crippen Berger (KCB). 2018. Resolution Copper Project - Tailings Storage Facility DEIS Designs Tailings Geotechnical Characterization, Rev. 1. Prepared for Resolution Copper Mining LLC on April 25.

Montgomery and Associates (M&A). 2018. Resolution Copper Project - Alternative 2A and 3B Steady-State Seepage Modeling. June.