CASINO MINING CORPORATION
CASINO COPPER-GOLD PROJECT

FEASIBILITY DESIGN OF THE HEAP LEACH FACILITY

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Knight Piésold
CONSULTING
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EXECUTIVE SUMMARY

A Feasibility design has been undertaken for a Heap Leach Facility (HLF) at the Casino Copper-Gold Project. The proposed facility is located on a southeast facing hill-slope approximately one kilometre south of the deposit area. HLF operations will commence during pre-production stripping of the open pit. The design was carried out for an ore tonnage of 157.5 million tonnes. The heap leach pad will be stacked with ore and leached from Year -3 through Year 15 of mine operations. The ore will be leached at a nominal rate of 9.125 million tonnes per year. There is potential for stacking of additional ore if the mine production schedule is revised and additional leach ore is identified.

The Feasibility design includes an assessment of the following:

- Geotechnical site conditions
- Design basis and design requirements
- Design of heap leach pad and liner system
- Design of leachate collection system and events pond
- Water management and water balance
- Construction requirements and operational strategy
- Quantities and information for capital cost estimation
- Preliminary monitoring and reclamation requirements, and
- Recommendations for additional site investigations and design studies.

Information provided by site investigations and design studies indicate that the construction and operation of a HLF is possible at this site. However, the cold climate and presence of extensive permafrost requires special design and operational considerations.

The following is a summary of the design features, operational requirements and construction methods which will be required for the proposed facility:

- Pumping of pregnant solution to a gold extraction plant, located southwest of the plant site area.
- Excavation of the pad foundation down to competent bedrock in areas with permafrost to eliminate potential settlement and instability resulting from thawing of ice-rich overburden. These materials will require containment and sediment control upon thawing. The extent of ice-rich overburden throughout the heap leach pad area has been estimated as approximately two metres deep
- An events pond for temporary storage of storm runoff and pregnant solution overflow during shut down will be constructed at the foot of the HLF confining embankment. The events pond will be included as part of the pre-production schedule.
- A composite liner system comprising a LLDPE liner, compacted soil liner and leak detection and recovery system to maximize leachate collection and minimize seepage losses will be constructed over the upper portion of the leach pad. A double composite liner system comprising two LLDPE liners, a compacted soil liner and a geotextile layer will also be constructed in the lower portion of the leach pad (potential ponding area) and events pond and will include a leak detection and recovery system for intercepting and collecting any leakage through the inner liner.
- Borrow materials for the confining embankment, events pond and soil liner construction may utilize suitable overburden (residual and colluvial soils) and weathered bedrock along well

drained, non-frozen, south-facing slopes east or west of the HLF. Suitable non-reactive mine waste rock may also be used for HLF construction.

- The heap leach pad will be developed in five stages by loading in successive lifts upslope from the confining embankment. This will provide initial stability and minimize initial capital costs. The pad will be developed in eight metre lifts constructed at repose bench face angles of approximately 1.4H:1V. Bench widths approximately nine metre wide will be left at the toe of each lift to establish a final overall slope angle of 2.5H:1V.
- Operations will involve the irrigation of a weak cyanide solution over the ore lift and the recovery of pregnant solution by means of solution collection pipes and pumps. The solution will be pumped to the gold extraction plant for metal extraction and recycled for re-use in the leaching process. The irrigation lines will be buried to prevent freezing during winter conditions.

The final heap leach pad required for an ore tonnage of 157.5 million tonnes will have a surface area of approximately 1,501,000 m^2. An events pond will provide storage for excess leachate and storm water runoff. The heap leach pad confining embankment and events pond will require approximately 1,067,000 m^3 of embankment and drainage fill for construction. The required storage capacity for the events pond is approximately 110,000 m^3. The total quantity of geosynthetic liner required for the heap leach pad and confining embankment is approximately 1,587,000 m^2. The total quantity of geosynthetic liner for the events pond is approximately 50,300 m^2.

On-going costs will include foundation preparation and liner installation for expansion of the leach pad up the slope. Other costs associated with the HLF include operational costs and capital costs for leaching services. It is assumed that capital and operating cost estimates will be developed by Others.

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1 – INTRODUCTION

1.1 PROJECT DESCRIPTION

The Casino Copper-Gold Project is a venture by Casino Mining Corporation (CMC) to develop an open pit copper-gold-molybdenum mine located in west central Yukon, Canada. The project is located in the Dawson Range Mountains of the Klondike Plateau approximately 300 km northwest of Whitehorse, Yukon, Canada, as shown on Figure 1.1. The deposit will be mined using open pit methods with a nominal mill throughput of 125,000 tonnes per day (TPD) of ore. Approximately 157.5 Mt of additional mined ore will be processed at the Heap Leach Facility (HLF) located south of the open pit. HLF operations will commence during pre-production stripping of the open pit. The heap leach pad will be stacked with ore and leached simultaneously from Year -3 through Year 15 of mine operations. The ore will be leached at a nominal rate of 9.125 million tonnes per year. The proposed facility is located on a southeast facing hill-slope approximately one kilometre south of the deposit area.

1.2 SCOPE OF WORK

This report presents the Feasibility design of the proposed HLF. The leach pad will comprise a fully contained gold ore treatment facility. The leaching process will involve the irrigation of weak cyanide solution over successive lifts of heaped ore. A total of 157.5 million tonnes (Mt) of ore was assumed for the design (based on the mining schedule issued by CMC on November 7, 2012), with consideration for potential expansion. This report discusses general site conditions, geotechnical implications, design requirements and design aspects for the heap leach pad.

Geotechnical site investigations in the current HLF area were carried out in 1993, 1994, 2011 and 2012. Additional site investigations, design studies and ore characterization will be required to confirm design assumptions and details.

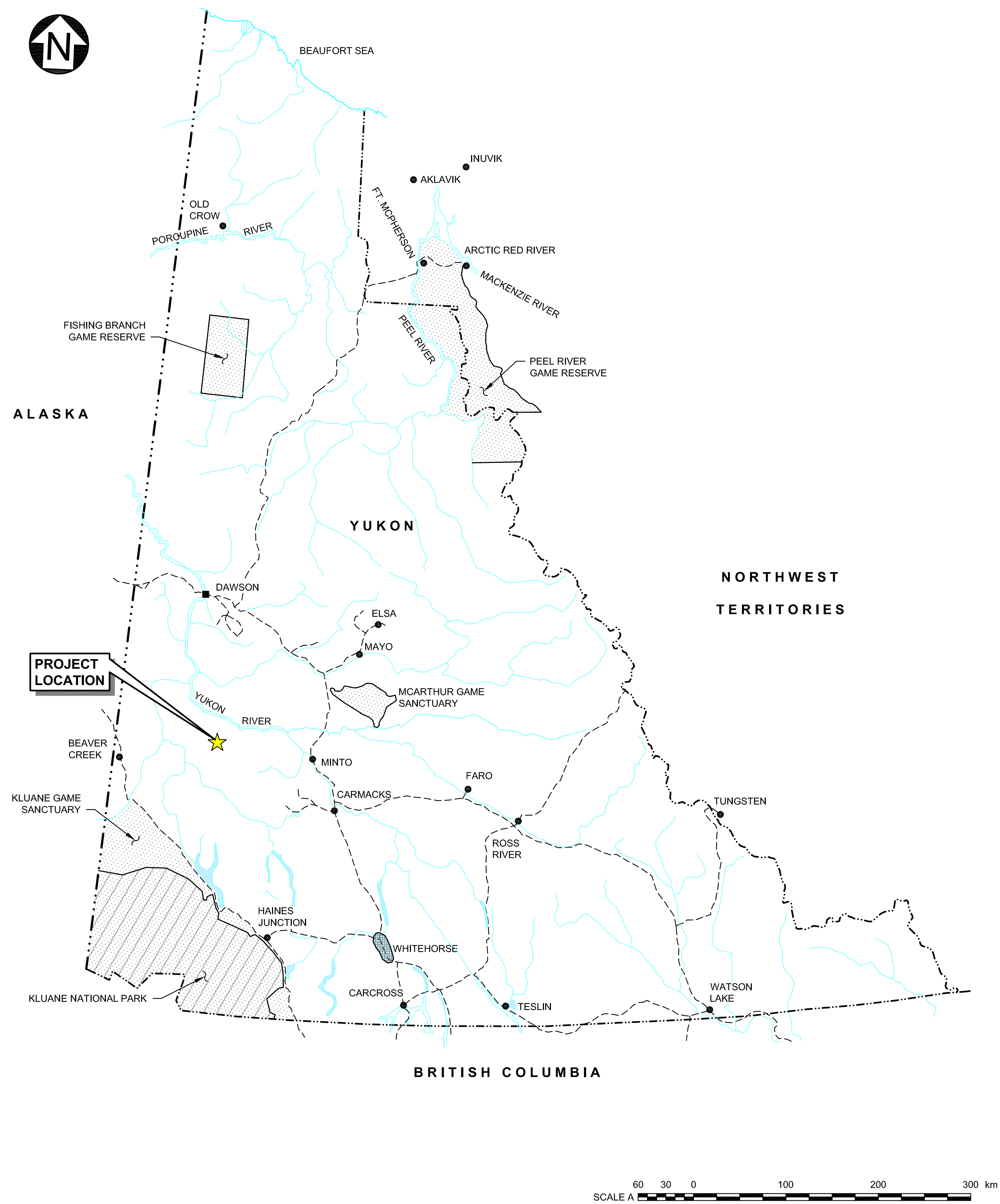
1.3 PREVIOUS STUDIES

A conceptual design for a HLF was conducted by Knight Piésold Ltd. (KPL) in 1994 to 1995 and presented in the “Report on Conceptual Design of Heap Leach Facility” (Ref No. 1833/1, January 24, 1995). This facility was located immediately south of the deposit area and sized to accommodate 36.5 million tonnes of ore, with provision for expansion up to 50 million tonnes. This site was later ruled out due to an increased capacity requirement of leach ore.

A Pre-Feasibility design for a 75 Mt HLF was undertaken by KPL in 2008. The selected facility location was immediately north of the Tailings Management Facility (TMF). Details of this design are presented in KPL report “Pre-Feasibility Design of the Heap Leach Facility” (Ref. No. VA101-325/1-1, April 23, 2008).

A revised Pre-Feasibility design for an 81.6 Mt HLF was carried out by KPL in 2011. This revised Pre-Feasibility design located the HLF in a position deemed more favourable because of its topography and proximity to the deposit area and plant site. The site was located south of the deposit area as shown on Figure 1.2, in an area previously designated but no longer required for storage of Non-Acid Generating (NAG) mine waste rock and overburden. This site is located upstream and within the same catchment area as the TMF, thereby simplifying water management and minimizing potential environmental impact.

This Feasibility design report further develops the 2011 revised pre-feasibility HLF design. The HLF pad has been expanded to accommodate a total capacity of 157.5 Mt of ore (an additional 75.9 Mt). Further expansion of the site to accommodate additional leach ore within the HLF is also possible if the mine production schedule is revised and additional leach ore is identified.



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CASINO COPPER-GOLD PROJECT

PROJECT LOCATION MAP

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FIGURE 1.1	REV 0

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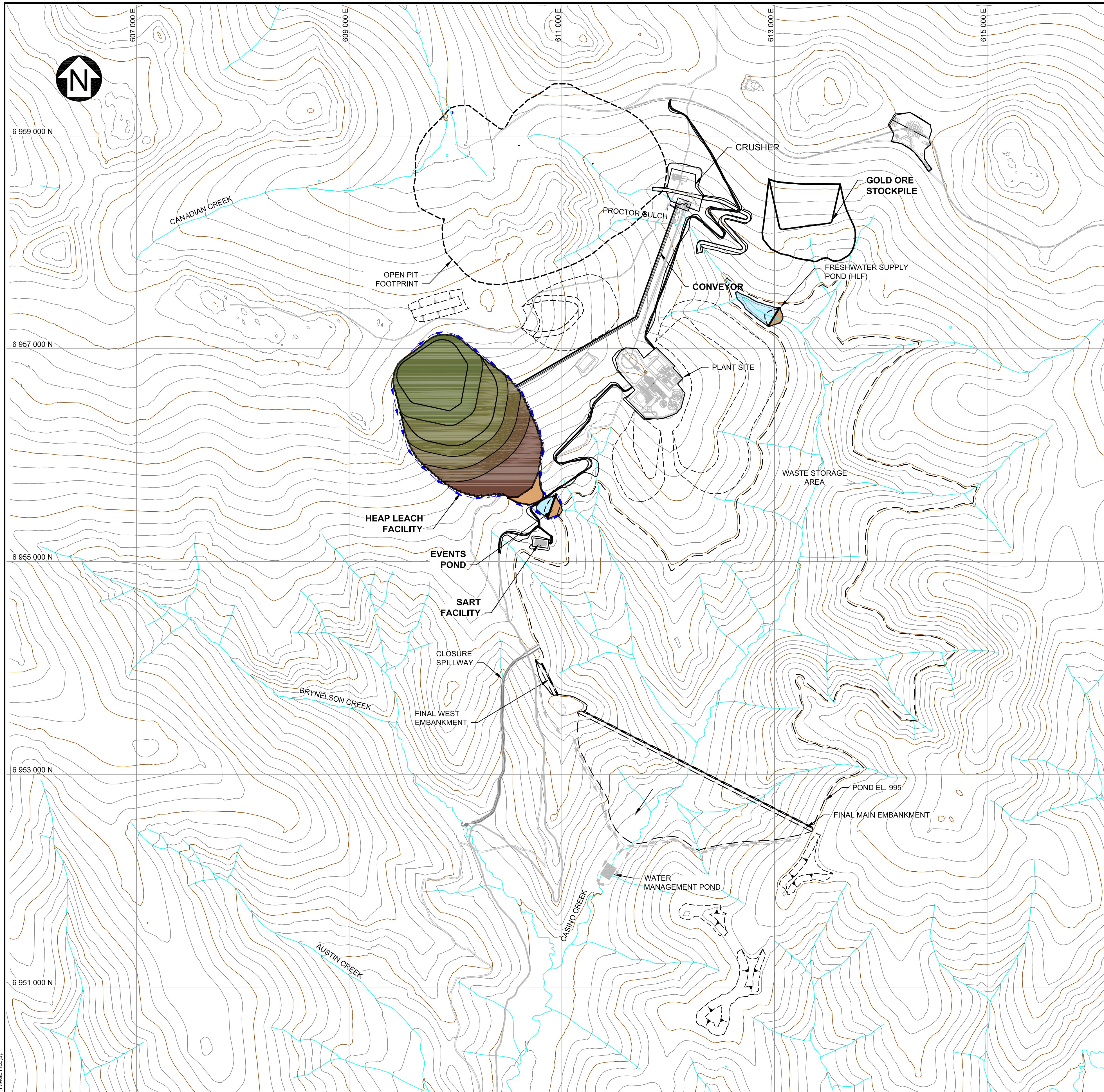

SCALE A 400 200 0 400 800 1200 1600 2000 m

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PROJECT GENERAL ARRANGEMENT

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FIGURE 1.2	REV 0

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2 – SITE CHARACTERISTICS

2.1 PHYSIOGRAPHIC SETTING

The project is located in the Dawson Range Mountains of the Klondike Plateau. The area is somewhat unique in that the region was not glaciated during the Wisconsin Advance. The characteristic terrain features are smooth, rolling topography, with moderate to deeply incised valleys. Major drainage channels extend below 1,000 m elevation. Most of the terrain lies between 1,000 m and 1,500 m elevation.

The proposed heap leach facility is located west of the plant site and south of the open pit area. The leach pad is situated on a relatively uniform southeast-facing hillside. The existing topography slopes at approximately 20% (11.5 degrees). The site was chosen for its proximity to the proposed open pit to minimize haul road and ore transport conveyor distances, and to include the leach pad within the same catchment area as the TMF.

A natural drainage channel exists along the middle of the leach pad, where the main leachate collection pipes will be located. The location of the heap leach pad in relation to the overall site and other project components is shown on Figure 1.2.

2.2 HYDROMETEOROLOGY

2.2.1 General

The climate at the Casino Project area is characterized by long, cold, dry winters and short, warm, wet summers, with conditions varying according to altitude and aspect. Streamflow in the region is typically highest in May due to melting of the winter snowpack. Annual peak instantaneous flows commonly occur in this freshet period on larger rivers, but on smaller streams they may also occur in summer or early autumn due to intense rain or rain on snow events. Flows decrease throughout the winter and minimum flows typically occur in March or April.

The climate and hydrology at the Casino Project site have been assessed based on both short-term site data and longer-term regional data. Climatic data were collected on-site at the Project climate station located in the upper Casino Creek sub-watershed at an elevation of 1200 m. The period of site record extends from 1993 to 1994 and from 2008 to 2011. Preliminary streamflow data were collected by Hallam Knight Piésold in 1993 and 1994. A new data streamflow collection program was initiated by AECOM in 2008, with the installation of ten streamflow gauging stations. As of 2012, nine streamflow gauging stations are considered to be in active operation and continue to be operated at present by Knight Piésold Ltd. (KPL). A summary of the hydrometeorological parameters is described below and the detailed analyses are presented in KPL report "Updated Hydrometeorology Report" (Ref. No. VA101-325/8-11, July 9, 2012).

2.2.2 Temperature

The mean annual temperature for the Casino Project area is estimated to be -3 °C, with minimum and maximum mean monthly temperatures of -17 °C and 12 °C occurring in January and July, respectively.

The mean monthly temperature values are presented in Table 2.1.

Table 2.1 Mean Monthly Temperature and Precipitation Values

Location	Parameter	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual
Casino Project Station (El. 1200 m)	Rainfall est.	0	0	0	8	37	62	91	67	47	18	0	0	**330**
	Snowfall est.	32	24	19	9	0	0	0	0	0	20	43	33	**180**
	Precipitation (mm)	32	24	19	17	37	62	91	67	47	38	43	33	**510**
	Temperature (°C)	-16.1	-14.9	-9.5	-0.6	6.5	9.8	12.3	10.3	4.6	-3.6	-12.0	-14.0	**-2.2**

2.2.3 Precipitation and Evaporation

The Mean Annual Precipitation (MAP) for the Casino Project area is estimated to be 510 mm, with 65% falling as rain and 35% falling as snow. The mean monthly values are presented in Table 2.1.

The annual potential evapotranspiration (PET) value for the Casino Project area is estimated to be 300 mm, based on measured temperatures at the Project site climate station, and long-term regional temperature records. Potential evapotranspiration values generally provide reasonable estimates of lake evaporation rates, and are assumed to be appropriate for estimating evaporation from lakes and ponds in the Project area.

2.2.4 Annual Snowfall and Snowmelt

Based on the estimated MAP of 510 mm and a rain/snow ratio of 0.65/0.35, the annual snowfall value for Casino was estimated to be 179 mm. This is generally consistent with the 141 mm mean annual maximum snowpack value (snow water equivalent, SWE), taking into account approximately 40 mm lost to sublimation, recorded in the Project area at the Casino Creek snow course station (09CD-SC01) operated by the Yukon Department of Environment (1977-2011), Water Resources Branch.

Based on the complete years of snowpack data, the average monthly snowmelt distribution for the Casino Project area was estimated to be approximately 20% in April and the remaining 80% in May, although there is considerable variation from year to year.

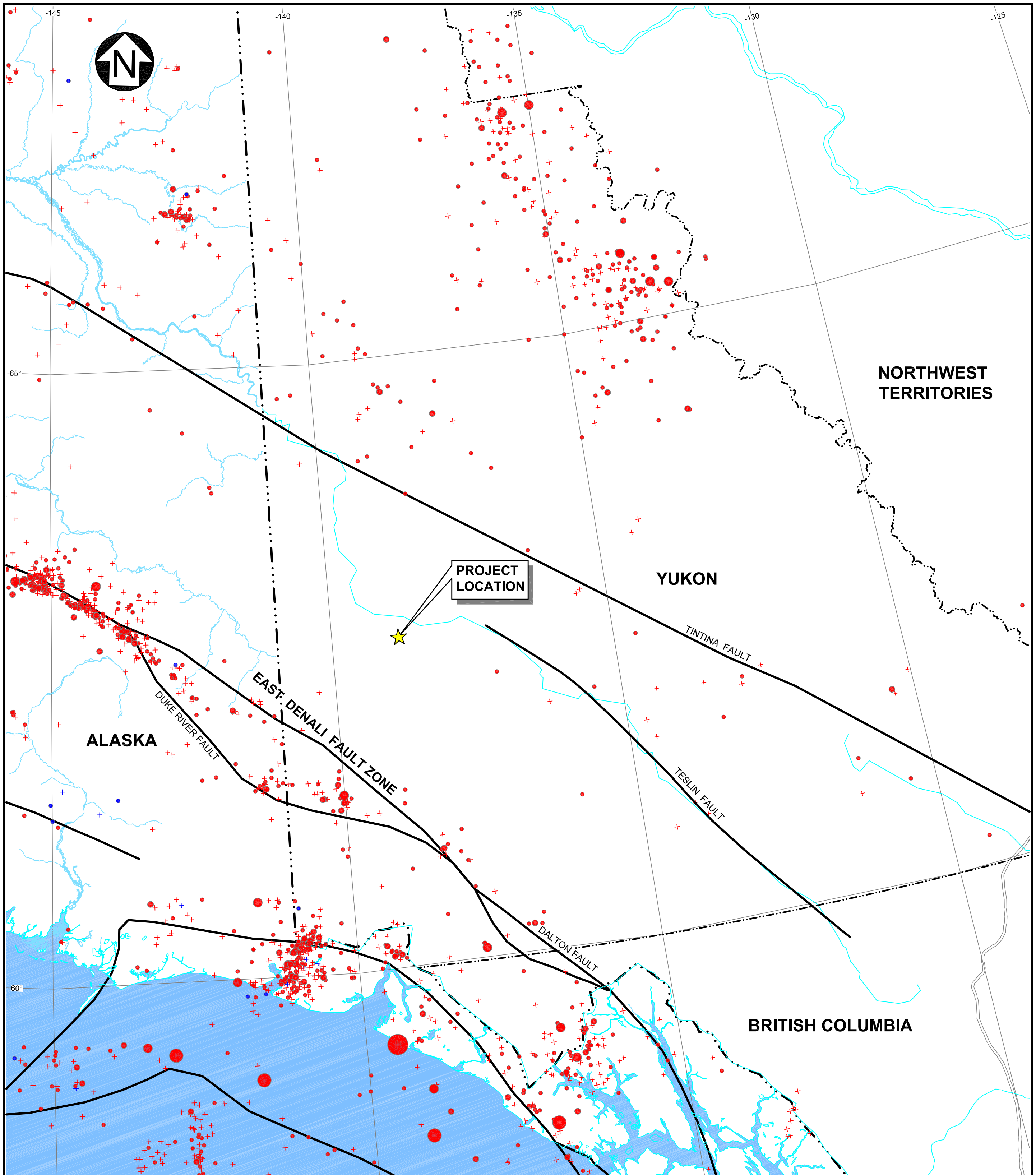
2.3 SEISMICITY

A review of the regional seismicity has been carried out to enable selection of an appropriate design earthquake event for seismic stability assessment of the HLF.

The region of the southwest Yukon Territory and northwest British Columbia is one of the most seismically active areas in Canada. The seismic hazard in the region is also influenced by the seismically active region of southeast Alaska. The coastal region has experienced many large earthquakes, including events with magnitudes in the range of magnitude 7.0 to 8.0. In 1958 a magnitude 7.9 earthquake occurred along the Fairweather fault (the northern extension of the Queen Charlotte transform fault). The most significant inland zone of seismicity follows the Dalton and Duke River segments of the Denali fault zone through the southwest Yukon. Farther inland there is only minor seismicity between the Denali and Tintina fault systems, including the region of the Casino Project site.

A probabilistic seismic hazard assessment has been carried out for the Casino project site to provide seismic parameters for design of project facilities. Details and results of the seismic hazard analysis are provided in the KPL report “Feasibility Design of the Tailings Management Facility” (Ref. No. VA101-325/8-10, November, 2012).

Figure 2.1 shows the regional tectonics and historical seismicity of the Yukon and surrounding regions. Review of historical earthquake records and regional tectonics indicates that the Casino Project site is situated in a region of low seismicity and moderate seismic hazard.



SYMBOL SIZE PROPORTIONAL TO MAGNITUDE

- 3.5 - 3.9
- 4.0 - 4.9
- 5.0 - 5.9
- 6.0 - 6.9
- 7.0 - 7.9
- 8.0 - 8.9
- 9.0 +

NOTES:

1. GLOBAL COORDINATE SYSTEM IS UTM WITH NAD83 DATUM, ZONE 10 m, CENTRAL MERIDIAN.
2. HISTORICAL EARTHQUAKE DATA FROM NRCAN, USGS, AND NGDC DATABASES.
3. INCLUDES RECORDED EARTHQUAKES FROM 1600 TO 1973 (MAGNITUDE > 6.0) AND FROM 1973 TO SEPTEMBER 2012 (MAGNITUDE > 3.5).

SCALE A 50 25 0 50 100 150 200 250 km

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REGIONAL TECTONICS AND HISTORICAL SEISMICITY

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P/A NO.	REF NO.
VA101-325/8	9

FIGURE 2.1	REV 0

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3 – DESIGN REQUIREMENTS AND PARAMETERS

3.1 DESIGN OBJECTIVES

The primary design objectives for the proposed heap leach pad are as follows:

- Provide a stable and cost effective configuration for staged heap development
- Effectively collect and convey leachate solutions to the process plant or the events pond while ensuring maximum recovery
- Provide for secure containment of events solutions while monitoring and minimizing losses due to leakage
- Minimize surface runoff entering the leach pad area while providing for the collection of direct runoff from the heap area
- Sequential, staged development and leaching operations with particular emphasis on winter operations, and
- Effective decommissioning and reclamation of all heap leach facility components.

The following sections discuss the storage requirements and design assumptions and parameters for the proposed leach pad. Design features for each component are discussed in Section 5.0.

3.2 DESIGN BASIS AND ASSUMPTIONS

The design storage for the heap leach pad has been based on a requirement for 157.5 million tonnes capacity with the potential for further expansion if required.

Various design assumptions and parameters were used in this Feasibility design and configuration layout of the heap leach pad. The assumptions and parameters used to develop the design are listed below:

• Total ore tonnage	157.5 Mt
• Ore stacking schedule	300 days/year
• Ore leaching schedule	365 days/year
• Annual stacking tonnage	9,125,000 tonnes/year (max) 6,580,000 tonnes/year (min)
• Mine-run Ore specific gravity (estimate)	2.65
• Constant average depth to bedrock	2 metres
• Lift thickness	8 metres
• Dry density of ore heap (estimate)	1.75 t/m^3
• Mine-run ore moisture content	2%
• Leach pile ore operating moisture content	12%
• Leach pile ore retained moisture content	10%
• Ore irrigation rate	0.29 m^3/day/m^2 (12 L/h/m^2)
• HLF Irrigation capacity	1312 m^3/day
• Runoff on heap leach pad	98.25 %
• Design Storm: 1 in 100 year 24-hour	53 mm
• Design Storm: 1 in 200 year 24-hour	56 mm

The Water Management System is designed to accommodate the 1 in 100 year storm event. Spillways are designed for the 1 in 200 year storm event.

Leach ore testing (to determine ore moisture contents and densities) will be required to confirm assumptions for future design studies.

The pad will be constructed in five stages commencing in Year -3 (pre-production stage of the project). It will be loaded in successive eight metre thick lifts for 300 days a year while the leaching process will operate year round. A drip-type irrigation system will be implemented which enables year round leaching operation due to being insulated by the placement of subsequent ore lifts overtop.

Gold ore to feed the HLF will be located in a temporary stockpile east of the open pit, close to the crusher. The ore will be crushed and transported to the pad by conveyor. The locations of the proposed gold ore stockpile, crusher and conveyor alignment are included on Figure 1.2.

4 – GEOTECHNICAL CHARACTERISTICS

4.1 GEOTECHNICAL CONDITIONS

Geotechnical and hydrogeological information in the vicinity of the HLF is derived from the interpretation of KPL drill hole and test pit data within both the HLF and surrounding areas. Several geotechnical site investigation programs were conducted in the area of the HLF in 1993 and 1994 and in 2011 and 2012. Details and results of the site investigations are presented in the following KPL reports:

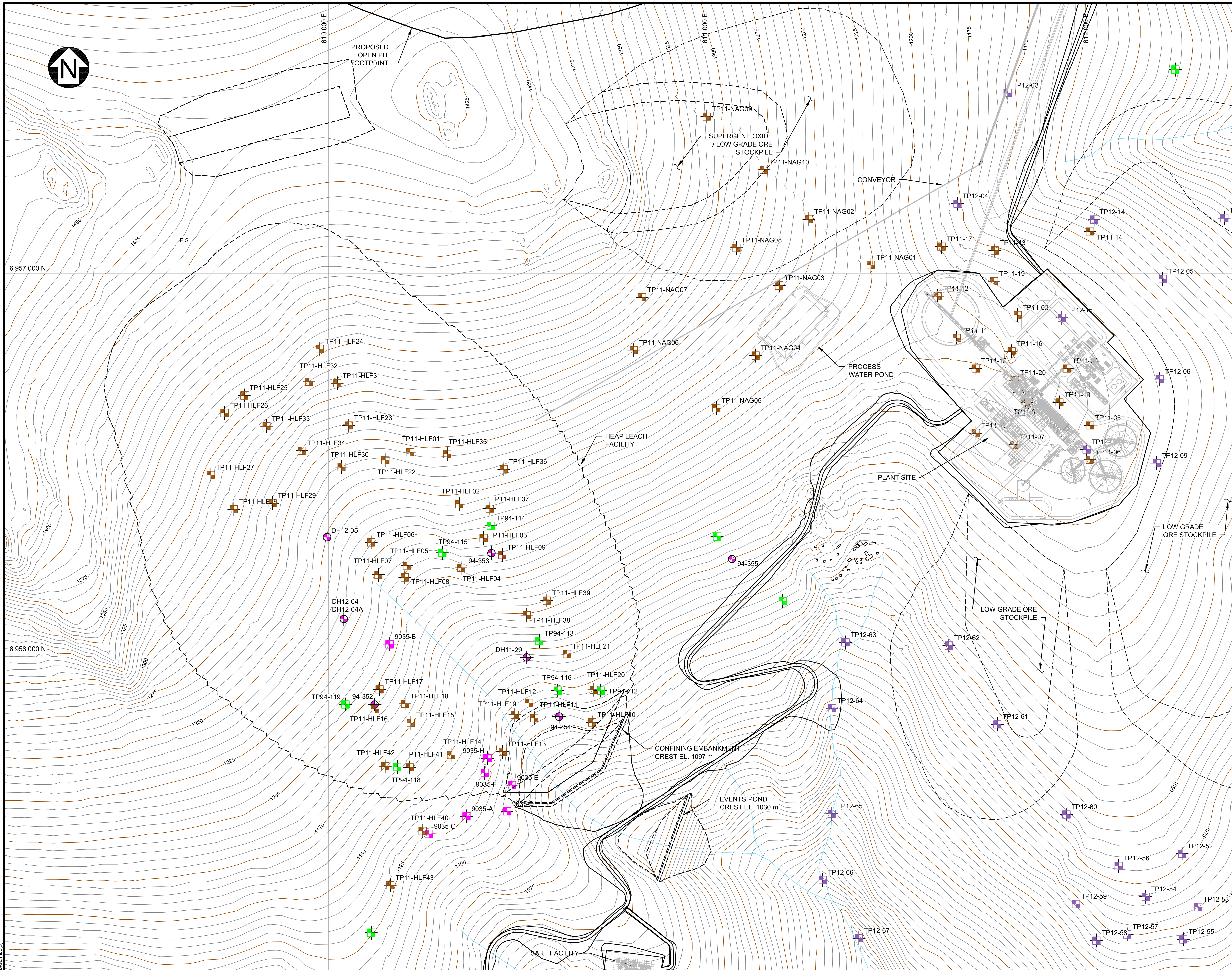
- Report on Preliminary Surficial Geotechnical Investigations (Ref. No. 1831/1, March, 1994)
- Data Compilation Report on 1994 Geotechnical/Hydrogeological Investigations (Ref. No. 1832/1, February 22, 1995)
- 2011 Geotechnical Site Investigation Data Report Waste Management Facilities (Ref. No. VA101-325/8-5, May 18, 2012), and
- 2012 Geotechnical Site Investigation Data Report (Ref. No., VA101-325/8-14, December, 2012).

The locations of drill holes, test pits, and test trenches excavated in the vicinity of the proposed heap leach facility are shown on Figure 4.1. The majority of the test pits conducted in 2011 were ended due to refusal on frozen ground or boulders.

The HLF is situated on a southeast-facing slope south of the deposit area. Vegetation is comprised primarily of deciduous black spruce with thin moss and forest litter cover. Soil profiles throughout the proposed heap leach pad area typically comprise a thin veneer of organic-rich topsoil and colluvium overlying in situ weathered residual soils or granodiorite bedrock.

The subsurface conditions in the area of the HLF are based on the findings of the geotechnical investigations, and are generally summarized below:

- Topsoil comprises a moist organic-rich silty layer. Coarse talus blocks (boulders) are also common. Topsoil thicknesses vary from approximately 0.1 to 1.0 m.
- Silty sand containing some gravel and cobbles, trace boulders and clay (residual soil and colluvium). Residual soils generally comprise moderately to highly weathered silts and sands with some gravel and trace clay. Ice lenses were found in some test pits which could result in high water contents upon thawing.
- Dawson Range Batholith (Mid-Cretaceous) is the main country rock in the HLF area and is dominantly granodiorite in composition. Aplite was found in 94-352 and a Patton Porphyry Dyke (Upper Cretaceous) was noted in DH11-29. The depth to bedrock varies from 1 to 7.6 m, with an average depth of approximately 2.5 m. The greatest depth to bedrock was encountered at the bottom (southern) end of the HLF area (DH94-453). Weathered Granodiorite has been found to extend to 41 m depth in recent site investigations, but earlier investigations indicated the presence of slightly weathered, competent bedrock.



LEGEND:

- 1993 AND 1994 TEST PIT
- 2010 TEST PIT
- 2011 TEST PIT
- 2012 TEST PIT
- 2012 GEOTECHNICAL DRILLHOLE
- 1994 GEOTECHNICAL DRILLHOLE

NOTES:

1. COORDINATE GRID IS UTM (WGS84/NAD83) ZONE 7 (m).
2. CONTOUR INTERVAL IS 5 METRES.
3. DIMENSIONS ARE IN METRES UNLESS NOTED.
4. ONLY SELECT TEST PITS AND DRILL HOLES ARE SHOWN FROM PREVIOUS SITE INVESTIGATION PROGRAMS.
5. ORE AND TOPSOIL STOCKPILES ARE SHOWN AT THEIR MAXIMUM SIZE DURING OPERATIONS.

REV	DATE	DESCRIPTION	DESIGNED	DRAWN	CHK'D	APP'D
0	17DEC'12	ISSUED WITH REPORT	HA	PP	RSS	KJB

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HEAP LEACH FACILITY SITE INVESTIGATION PLAN

Knight Piésold CONSULTING

P/A NO. VA101-325/8 | REF NO. 9

FIGURE 4.1 | REV 0

4.2 HYDROGEOLOGICAL CONDITIONS

The interpreted baseline groundwater conditions are based on piezometric levels in standpipe piezometers throughout the study area. Permeability results are based on packer tests and falling head tests performed in the drill holes and piezometers in the different geological units.

Water level readings were recorded for piezometers 94-352, 94-353, 94-354 (between September and December of 1994) and in DH11-29. The depth from ground surface to water varies from approximately 3 metres in the southwest area of the HLF to 20 metres in the southeast area. The water level in DH11-29 was measured at 12.2 m below ground surface in 2011.

In situ packer and falling head permeability tests were carried out in a number of drill holes within the HLF area during the 1994 and 2011 geotechnical/hydrogeological investigations. Estimates of in situ permeability values, along with supporting hydrogeologic observations are summarized as follows:

- One falling head test was performed in overburden soils in drill hole 94-354 with an estimated permeability of 8×10^{-5} cm/s.
- 14 permeability (slug) tests performed in 1994 in rock ranged from 5×10^{-6} cm/s to 1×10^{-3} cm/s, with a geometric mean value of 1×10^{-4} cm/s.
- Three packer tests and one falling head test performed in rock at DH11-29 indicated permeability values ranging from 3×10^{-6} cm/s to 6×10^{-5} cm/s.

Permafrost has an important effect on groundwater flow. Saturated frozen soil and rock have a much lower permeability when frozen compared to a thawed or unfrozen state.

Water well level elevations in the HLF area range from approximately 1080 to 1230 meters. The highest water levels are located in the upper part of the HLF, which indicates groundwater is flowing southeast and downgradient towards the Meloy Creek valley bottom.

4.3 PERMAFROST

Permafrost, or perennially frozen ground, is discontinuous along Casino Creek valley and is restricted primarily to valley bottoms, north-facing slopes and local shaded areas. Although permafrost was recorded in some areas of the HLF, the area is typically characterized by well-drained colluvial and/or residual sandy soils supporting stands of tall spruce and poplar. Permafrost was most extensive in the upper part of the HLF area, where vegetation consists of shrubs and a few stunted trees. It is less prominent in the more densely forested southeast part of the area. The permafrost table varies from 0.2 to 3 m depth, with an average depth of 1.5 m.

The estimated frost penetration depth for the Casino Project site is estimated to be approximately 5.5 metres in sand and gravel soils (granular) and decomposed/weathered bedrock. A thermistor was installed in DH12-05 during the 2012 site investigation to provide a better understanding of the thermal regime in the bedrock.

Disturbance or removal of the vegetative cover for foundation preparation may result in the melting of permafrost and the development of unstable conditions. It is therefore recommended that all ice-rich overburden encountered during construction be removed along the entire foundation of the HLF. Ground ice is not expected to be significant in bedrock which will likely provide a stable foundation for the pad and other components of the HLF.

4.4 GEOTECHNICAL IMPLICATIONS FOR DESIGN

The information provided by the site investigations has been used to determine geotechnical implications for this Feasibility design. Additional subsurface investigations will be required to confirm foundation conditions for future design studies.

The geotechnical implications for design are as follows:

- Initial foundation preparation for the heap leach pad will involve stripping of thick moss and shrub vegetation and removal of coarse talus blocks along the slope. Topsoil from stripping will be stockpiled for reclamation, as required.
- Frozen, organic and ice-rich colluvium and residual soils may require ripping or blasting to competent, non-frost susceptible bedrock for subgrade preparation. All ice-rich overburden and heavily weathered rock must be removed to prevent potential thaw-settlement resulting from melting permafrost. The bedrock will provide a thaw-stable foundation for the leach pad.
- Depths to competent bedrock over the leach pad area are expected to vary from approximately 1 to 8 metres, based on available information. An average depth of 2.5 m has been assumed for estimating the quantity of foundation excavation required.
- Spoil from excavated ice-rich overburden will require containment and sediment control during thawing.
- Colluvium and residual soils along south-facing slopes east and west of the HLF may provide excellent borrow materials for initial leach pad construction. The finer grained residual silty sands near surface may be utilized as soil liner for embankment and leach pad construction. Coarser grained colluvium, gravelly residual sands and broken, weathered bedrock at depth may be used as general backfill for the leach pad foundation or as fill in embankment construction.
- Foundation drains may be required to relieve groundwater pressures under the pad liners and/or if significant natural seeps are intersected. The drains will likely comprise perforated drain pipe surrounded by drain gravel and filter fabric. The drain gravel may be obtained from crushed borrow quarry rock or alluvial soils from creek beds.
- Diversion and runoff collection ditches constructed around the HLF will likely be founded in overburden. Therefore in order to prevent degradation from thawing permafrost riprap or other erosion protection will be required.

The proposed gold extraction facilities may be sited on competent, hard granodiorite bedrock at shallow depths adjacent to the HLF.

5 – ENGINEERING ANALYSES AND DESIGN

The Heap Leach Facility (HLF) consists of the following system components:

- Heap leach pad
- Liner System
- Leachate collection system
- Events pond
- Stormwater management system, and
- Freshwater supply.

The ore stacking schedule for the heap leach pad has been designed as ‘development’ stages, with each stage requiring advance expansion of the pad footprint. The HLF will be constructed in five ‘pad development’ stages, with the pad foundation preparation, liner installation and leachate collection piping developed as the footprint of the leach pad expands upslope to accommodate additional ore lifts. The duration for each stacking stages ranges from three to four years.

The initial HLF development (Stage 1) will also include the complete development of the confining embankment, events pond and perimeter diversion ditches prior to commencing ore stacking and leaching. Table 5.1 presents the stacking schedule, the respective development footprints and ore volume capacities. Figure 5.1 presents the plan and typical section of the final HLF pad, confining embankment and events pond. Figures 5.2 to 5.4 present the staging and the development progress and Figure 5.5 presents the Elevation - Capacity curve for the pad.

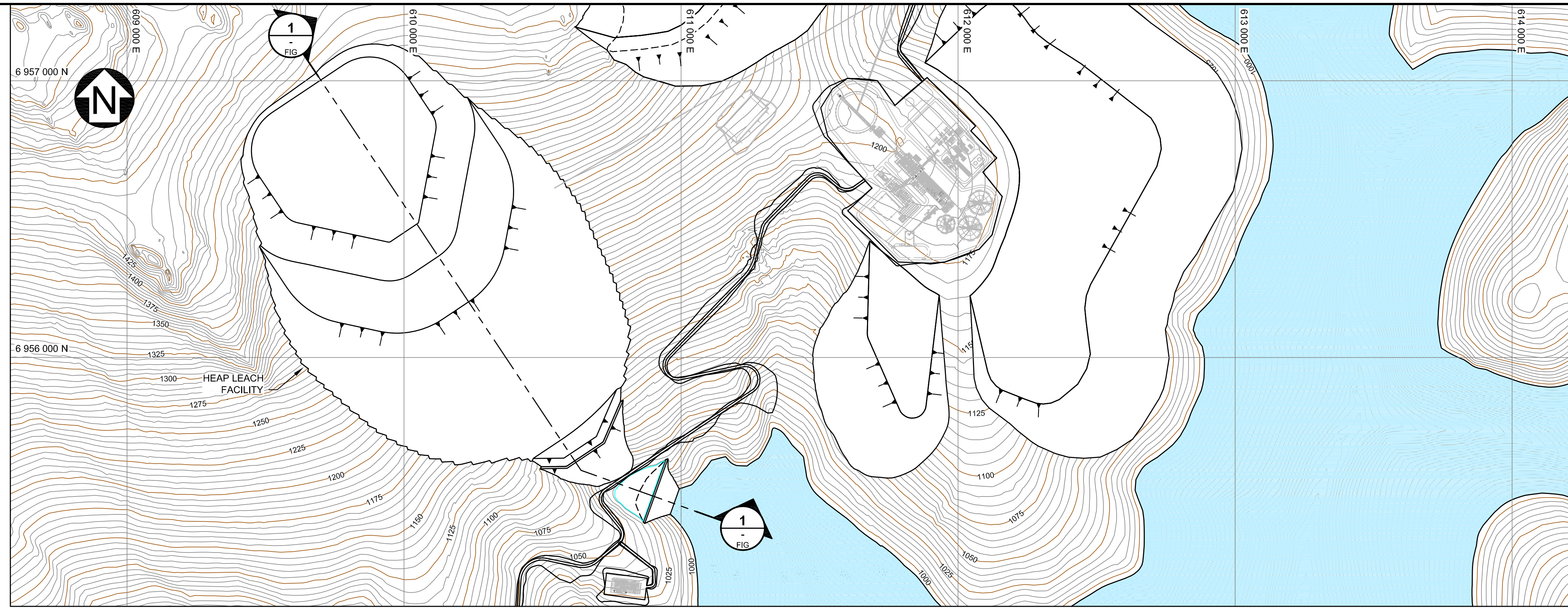
Design details for each of the HLF components are discussed further in the following sections.

Table 5.1 Heap Leach Stacking Schedule

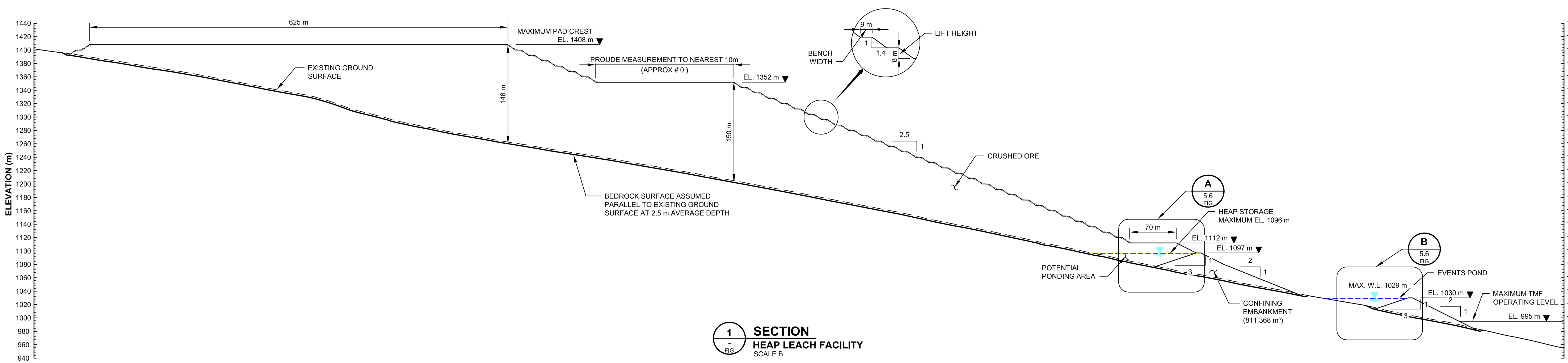
YEAR	DEVELOPMENT STAGE	HEAP LEACH FACILITY			
		Liner footprint (expansion area)	Stacked Ore Mass [1]	Stacked Ore Volume [1]	Cummulative Stacked Ore Volume
		m^2	Tonnes	m^3	m^3
-3	1	498,456	6,580,000	3,760,000	3,760,000
-2			9,125,000	5,214,286	8,974,286
-1			9,125,000	5,214,286	14,188,571
1	2	292,660	9,125,000	5,214,286	19,402,857
2			9,125,000	5,214,286	24,617,143
3			9,125,000	5,214,286	29,831,429
4	3	299,680	9,125,000	5,214,286	35,045,714
5			9,125,000	5,214,286	40,260,000
6			9,125,000	5,214,286	45,474,286
7			9,125,000	5,214,286	50,688,571
8	4	220,610	9,125,000	5,214,286	55,902,857
9			9,125,000	5,214,286	61,117,143
10			9,125,000	5,214,286	66,331,429
11			9,125,000	5,214,286	71,545,714
12	5	189,542	9,125,000	5,214,286	76,760,000
13			9,125,000	5,214,286	81,974,286
14			9,125,000	5,214,286	87,188,571
15			4,874,000	2,785,143	89,973,714

NOTES:

1. Mine schedule provided by Casino Mining Corporation November 7, 2012.
2. Assumes ‘stacked’ gold ore density of 1.75 t/m3



PLAN
HEAP LEACH
SCALE A



1 - FIG **SECTION**
HEAP LEACH FACILITY
SCALE B

NOTES:

1. CONTOUR INTERVAL IS 5 METRES.
2. DIMENSIONS ARE IN MILLIMETRES AND ELEVATIONS ARE IN METRES, UNLESS NOTED OTHERWISE.

SCALE B 60 30 0 100 200 300 m
SCALE A 200 100 0 200 400 600 800 1000 m

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CASINO COPPER-GOLD PROJECT

HEAP LEACH FACILITY
PLAN, TYPICAL SECTION AND DETAIL

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P/A NO.	REF NO.
VA101-325/8	9

FIGURE 5.1 REV 0

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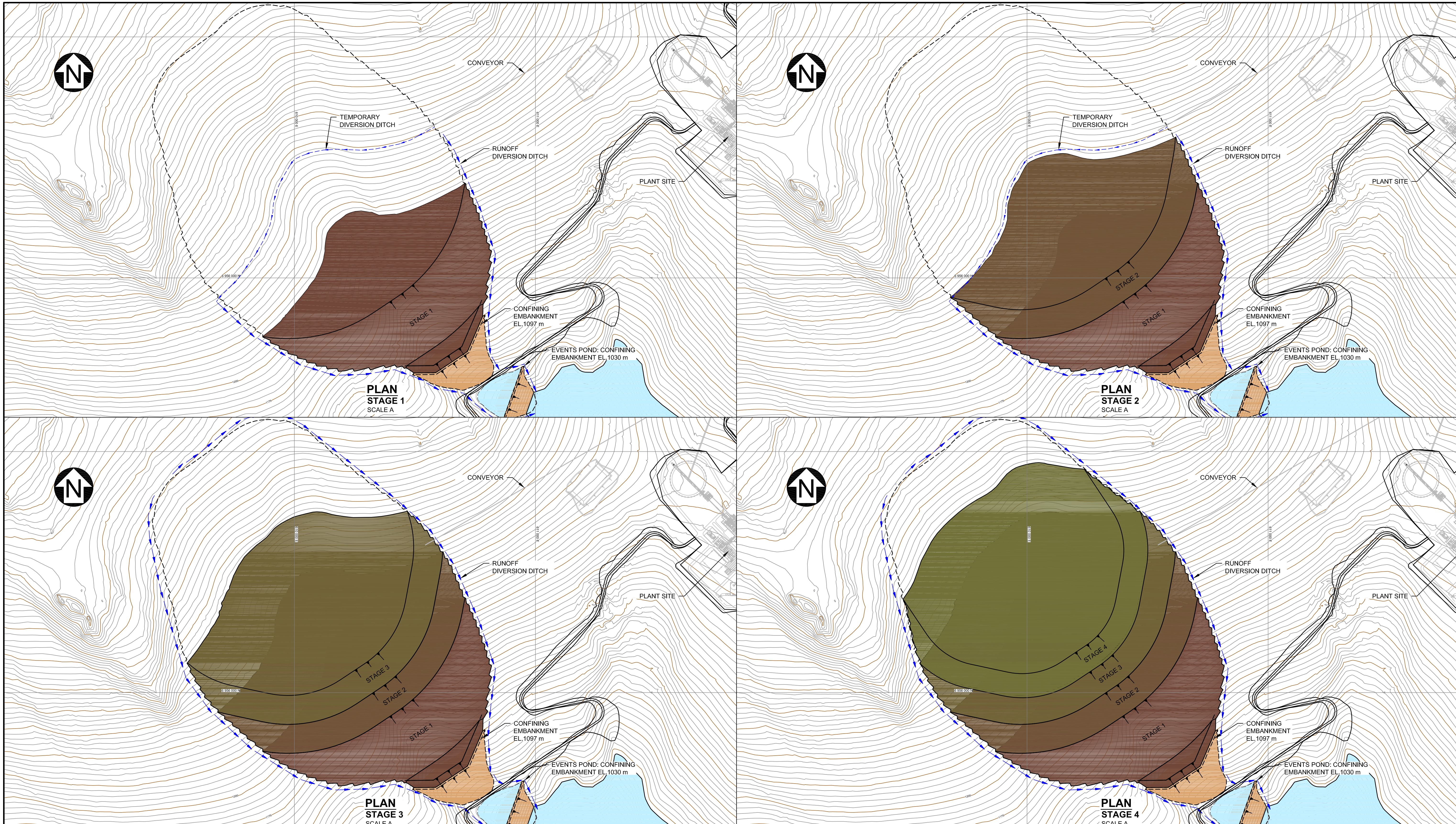
0	17DEC'12	ISSUED WITH REPORT	RSS	AN/PP	GRG	KJB



NOTES:

1. CONTOUR INTERVAL IS 5 METRES.

REV	DATE	DESCRIPTION	DESIGNED	DRAWN	CHK'D	APP'D
0	12DEC'12	ISSUED WITH REPORT	HA	AN	GRG	KJB

SCALE A 80 40 0 100 200 300 400 m

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CASINO COPPER-GOLD PROJECT

HEAP LEACH FACILITY
STAGE 1, 2, 3 & 4 PLAN

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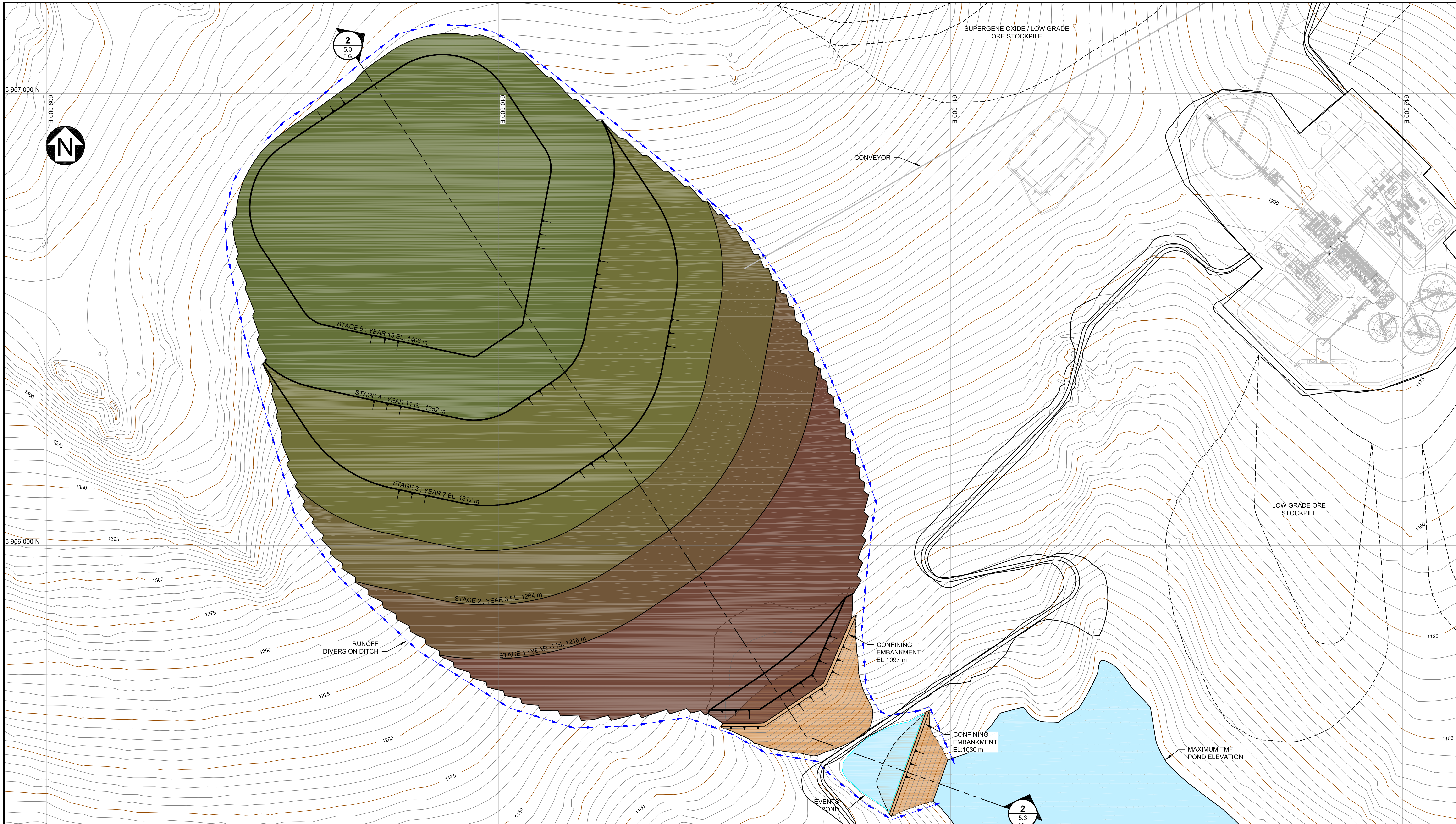
P/A NO.	REF NO.
VA101-325/8	9

FIGURE 5.2	REV 0



PLAN
HEAP LEACH
SCALE A

NOTES:

1. CONTOUR INTERVAL IS 5 METRES.
2. DIMENSIONS ARE IN MILLIMETRES AND ELEVATIONS ARE IN METRES, UNLESS NOTED OTHERWISE.
3. THE STAGING ELEVATIONS ARE APPROXIMATE.
4. ORE STOCKPILES ARE SHOWN AT THEIR MAXIMUM SIZE DURING OPERATIONS.

LEGEND:

PERMANENT DIVERSION CHANNEL

SCALE A: 80 40 0 100 200 300 400 m

REV	DATE	DESCRIPTION	DESIGNED	DRAWN	CHK'D	APP'D
0	17DEC'12	ISSUED WITH REPORT	HA	AN	GRG	KJB

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CASINO COPPER-GOLD PROJECT

HEAP LEACH FACILITY
LOADING STAGING PLAN

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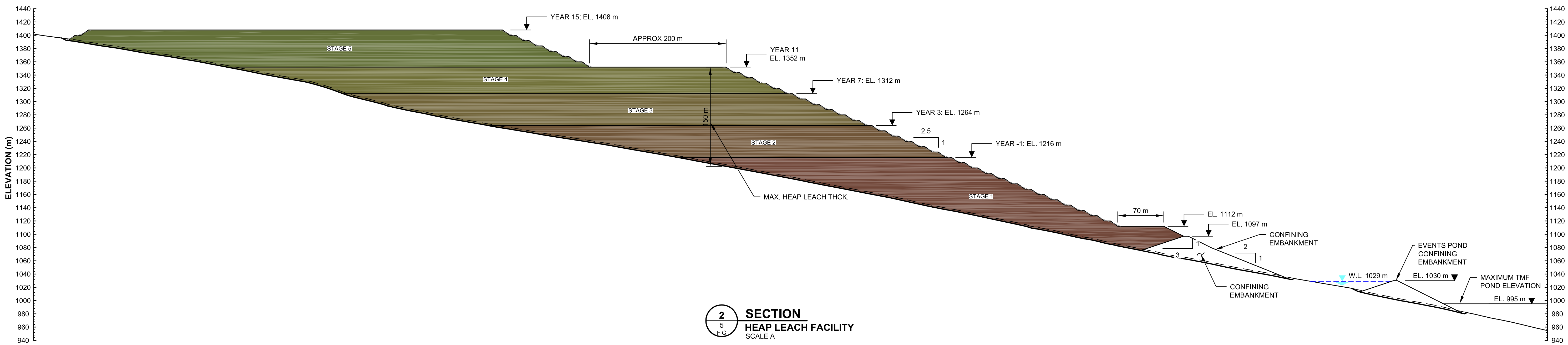
FIGURE 5.3	REV 0



SECTION 2 (5 FIG)
HEAP LEACH FACILITY
SCALE A

LINER DEVELOPMENT STAGE	YEAR	HEAP LEACH FACILITY			
		GOLD ORE TO HLF (STACKING SCHEDULE)	GOLD ORE TO HLF (VOLUME) (STACKING SCHEDULE) ASSUMING 1.75t/m^3 ORE HEAP DENSITY	GOLD ORE (CUMMULATIVE STACKED VOLUME)	LINER FOOTPRINT (EXPANSION AREA)
		Tonnes	m^3	m^3	m^2
1	-3	6,580,000	3,760,000	3,760,000	498,500
	-2	9,125,000	5,214,286	8,974,286	
	-1	9,125,000	5,214,286	14,188,571	
2	1	9,125,000	5,214,286	19,402,857	292,700
	2	9,125,000	5,214,286	24,617,143	
	3	9,125,000	5,214,286	29,831,429	
3	4	9,125,000	5,214,286	35,045,714	299,700
	5	9,125,000	5,214,286	40,260,000	
	6	9,125,000	5,214,286	45,474,286	
	7	9,125,000	5,214,286	50,688,571	
4	8	9,125,000	5,214,286	55,902,857	220,600
	9	9,125,000	5,214,286	61,117,143	
	10	9,125,000	5,214,286	66,331,429	
	11	9,125,000	5,214,286	71,545,714	
5	12	9,125,000	5,214,286	76,760,000	189,500
	13	9,125,000	5,214,286	81,974,286	
	14	9,125,000	5,214,286	87,188,571	
	15	4,874,000	2,785,143	89,973,714	
	TOTAL	**157,454,000**	**89,973,714**	**89,973,714**	**1,501,000**

NOTES:

1. DIMENSIONS ARE IN MILLIMETRES AND ELEVATIONS ARE IN METRES, UNLESS NOTED OTHERWISE.
2. THE STAGING ELEVATIONS ARE APPROXIMATE.
3. VOLUMES ASSUMES ORE DENSITY =1.75 t/m^3

SCALE A 60 30 0 100 200 300 m

CASINO MINING CORPORATION

CASINO COPPER-GOLD PROJECT

HEAP LEACH FACILITY LOADING STAGING PLAN TYPICAL SECTION

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FIGURE 5.4 REV 0

REV	DATE	DESCRIPTION	DESIGNED	DRAWN	CHK'D	APP'D
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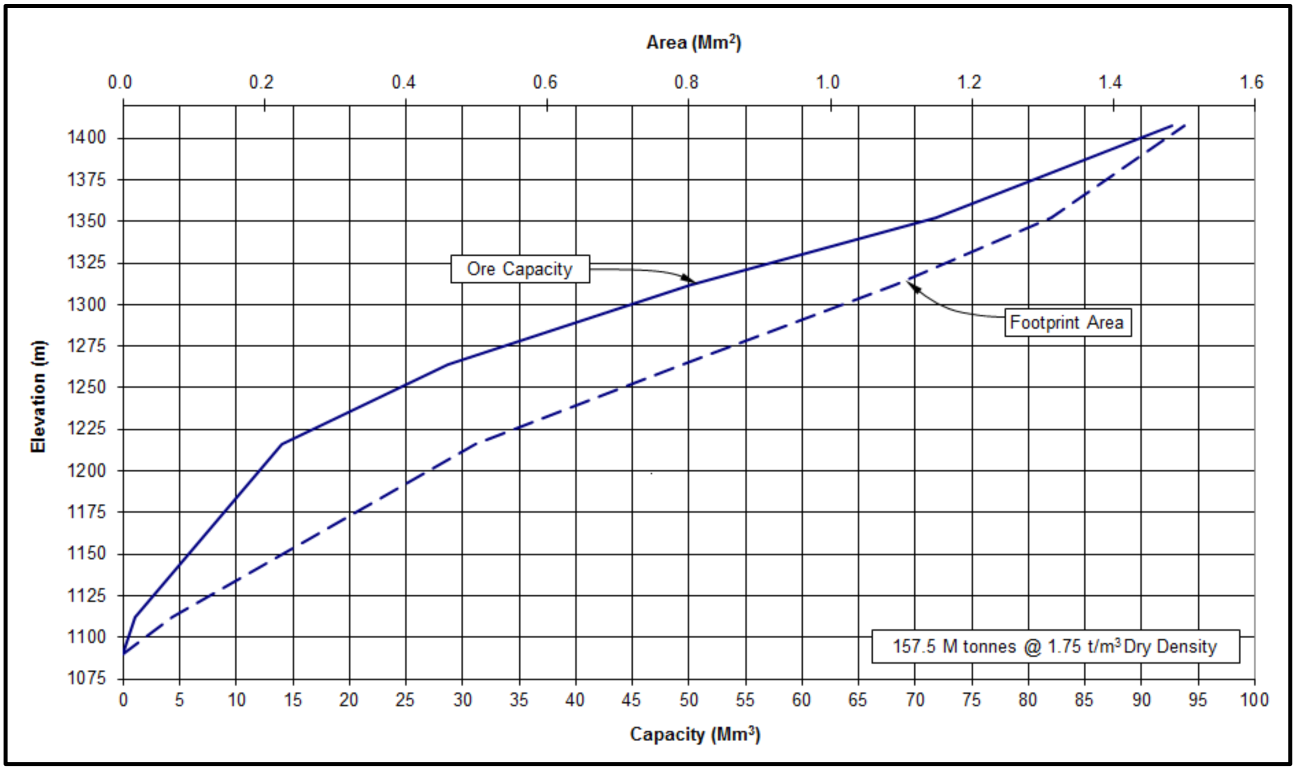


Figure 5.5 Heap Leach Facility: Elevation - Capacity Curve

5.1 HEAP LEACH PAD

The heap leach pad consists of a confining embankment, pad liner system and leachate collection system to collect and convey the leachate solution to the gold extraction plant, which is located to the southeast of the HLF.

The pad is located on a uniformly sloping sidehill with a slope of approximately 5H:1V (20%) and has an approximate footprint area of 1,501,000 m^2. The heap leach pad is designed to be operated predominantly as a dry heap-leach facility with minimal leachate storage to occur behind the confining HLF embankment.

The following sections outline the general design features and construction aspects for each of the main components of the heap leach pad.

5.1.1 Foundation

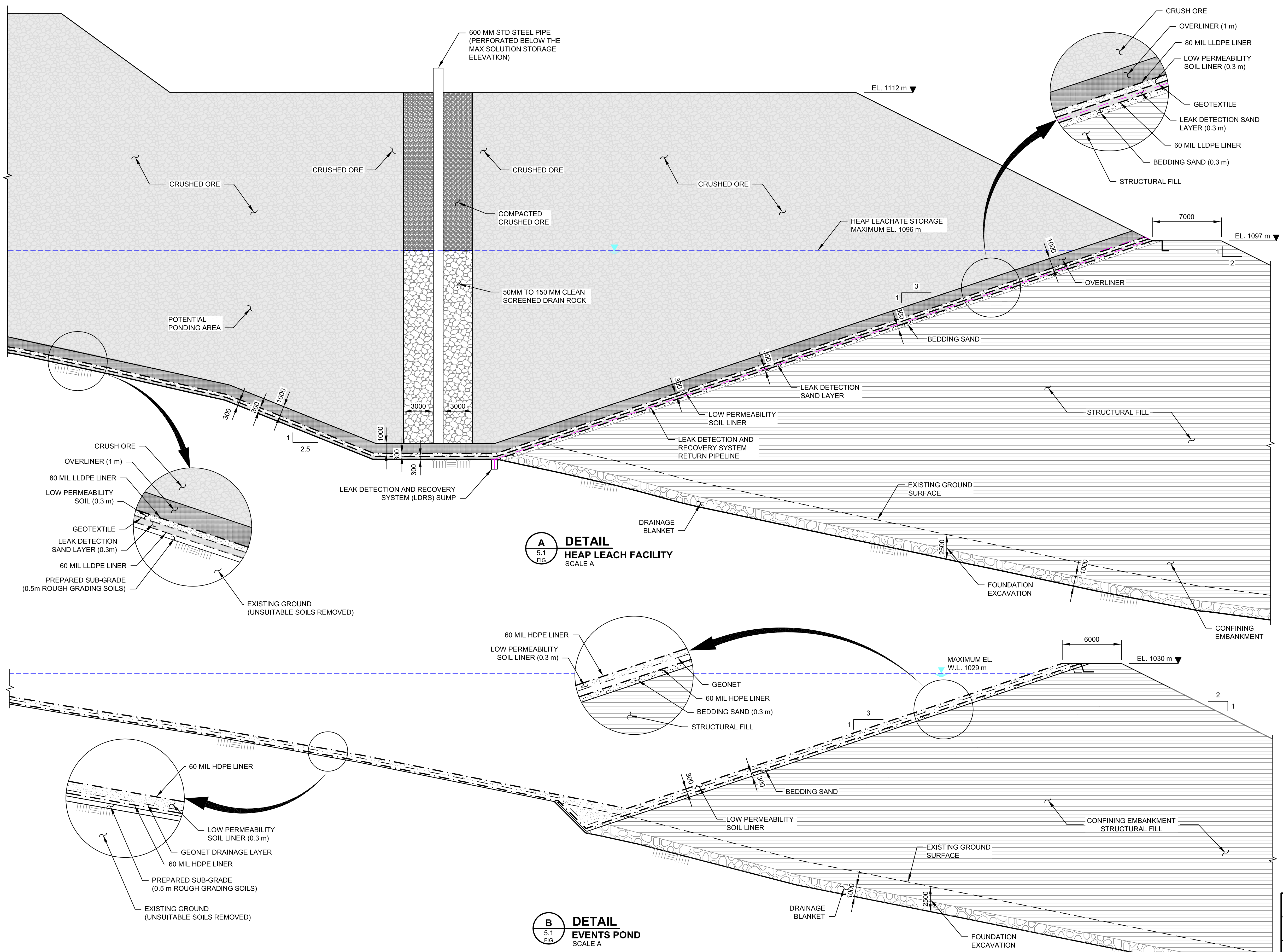
At the start of each of the development stages preparation of the pad foundation is required. Foundation preparation entails the stripping of approximately 0.5 metres of topsoil and vegetation and the removal of any talus boulders. The topsoil will be stockpiled at a location north of the HLF (see Figure 1.2) and used for reclamation of the HLF at closure.

The underlying frozen colluvial and residual soils will be excavated down to a competent, stable bedrock foundation. Any ice-rich materials will not be suitable for use as borrow in embankment construction and therefore will be transported to the TMF for disposal. A two metre excavation depth has been estimated in Table 9.1 for foundation preparation to competent ground. In order to provide a uniformly and positively graded surface to place the pad liner system, rough grading and backfill will be used to level the naturally undulating bedrock surface and to ensure that the pad grading will promote leachate flow to be positively draining towards the leachate collection piping system and sump located at the centre of the embankment upstream toe. A minimum pad grade of 2% is required.

5.1.2 Confining Embankment and Construction

The HLF embankment constructed at the toe of the proposed pad will provide stability to the heap leach pad and provide in-heap storage for solution. As presented on Figure 5.1, the embankment will have a final crest elevation of 1097 m and a crest width of seven metres. The embankment will be constructed with an upstream slope of 3H:1V and downstream slope of 2H:1V. While storage of leachate behind the confining embankment will not normally occur, after significant periods of rainfall or during a process shut-down in-heap storage will be utilized. The confining embankment has been designed with an in-heap storage capacity of approximately 61,000 m^3 (approximately two days irrigation volume). If the storage requirement is greater than this, excess solution will pass over the confining embankment spillway (invert elevation 1096 m) into the Events Pond (see Section 5.4).

Preparation of the embankment foundation will be undertaken in the same manner as the foundation preparation for the Heap Leach pad and will involve stripping the topsoil and excavating the underlying frozen colluvial and residual soils down to component, stable bedrock. The main embankment body will be constructed from structural fill which will consist primarily of locally sourced rock and earth fill. The embankment will be constructed by placing the fill in lifts and compacting to a specified density. It is proposed that the earthfill will be sourced from borrow areas along the south facing slopes adjacent to the HLF and the rockfill will be obtained from talus deposits and new local rock quarries. Suitable non-reactive mine waste rock may also be used if available. A 0.3 metre thick bedding sand layer will be placed over the final upstream slope of the embankment in preparation for installation of the liner system. Details of the liner system is outlined in the following Section and is presented on Figure 5.6.



NOTES:

1. DIMENSIONS ARE IN MILLIMETRES AND ELEVATIONS ARE IN METRES, UNLESS NOTED OTHERWISE.

SCALE A 4 2 0 4 8 12 16 20 m

CASINO MINING CORPORATION

CASINO COPPER-GOLD PROJECT

HEAP LEACH FACILITY LINER AND EMBANKMENT DETAIL

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VA101-325/8	9

FIGURE 5.6 REV 0

REV	DATE	DESCRIPTION	DESIGNED	DRAWN	CHK'D	APP'D
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5.2 LINER SYSTEM

A liner system is used to maximize pregnant solution recovery and minimize environmental operational impacts by minimizing leakage losses of pregnant solution through the bottom and sides of the leach heap pad. The composite liner consists of 'barrier' and 'drainage' layers using a combination of synthetic and natural materials to provide leachate solution containment which meets the required 'accepted standards' for leach pad design. While the Heap Leach Pad is designed to operate as a 'dry' pad with minimal solution storage occurring in-heap storage during normal operating conditions, the liner system was designed to still meet the required performance standards assuming fully saturated solution storage conditions behind the confining embankment.

5.2.1 Liner Design

Two liner systems have been developed for the Heap Leach pad, an engineered single liner design for the upper portion of the leach pad (above the in-heap leachate solution storage elevation) and a composite double liner design for the lower portion of the leach pad which will potentially have leachate solution storage.

The 'Upper' or single liner system, is designed to be installed on the heap leach pad's upper sloped surfaces which positively drain towards the leachate collection pipes and sump. The liner system consists of the following components:

- 1 metre thick overliner (38 mm minus with less than 10% fines content)
- 80 mil (2 mm) linear low-density polyethylene (LLDPE) geomembrane, and
- 0.3 metre thick compacted low permeability soil liner.

The portions of liner that are located directly below the leachate collection pipes will also have Leak Detection and Recovery System (LDRS) layers which consist of the following:

- Non-woven, needle punched geotextile layer, and
- Leak Detection and Recovery System (LDRS)

The 'Ponded' or double liner system is designed to be installed on the heap leach pad's lower slopes which may experience hydraulic loading from in-heap solution storage. Whilst still positively draining towards the leachate collection pipes and sump, the surface grades under the double lined portion may be as low as 2%. The double liner system consists of the following components:

- 1 metre thick overliner (38 mm minus with less than 10% fines content)
- 80 mil (2 mm) linear low-density polyethylene (LLDPE) geomembrane
- 0.3 metre thick compacted low permeability soil liner
- Non-woven, needle punched geotextile layer
- Leak Detection and Recovery System (LDRS), and
- 60 mil (1.5 mm) linear low-density polyethylene (LLDPE) geomembrane.

Figure 5.6 the locations and detailed cross-sections of the two liner systems.

Linear low-density polyethylene (LLDPE) was used for the geomembrane liner systems for the heap leach pad as it has the following benefits (Lupo and Morrison, 2005):

- Generally higher interface friction values, compared to other geomembrane materials
- Ease of installation in cold climates due to added flexibility,
- Good performance under high confining stresses (large heap height), and

- Higher allowable strain for projects where moderate settlement may become an issue.

Laboratory direct shear testing is recommended prior to detailed design to determine the interface shear strength of the liner materials and to confirm strengths are sufficient to provide long-term stability of the HLF. Representative samples of the geomembrane materials should be used for the testing, provided by the project supplier.

5.2.2 Construction

Development of the heap leach liner will be constructed in five development stages, with liner expansions proposed every three to four years to meet ore stacking requirements.

The liner system will be constructed with both the synthetic and natural layers extending to the top of the confining embankment and perimeter berms to provide full containment. The synthetic liners and geotextiles will be anchored and backfilled in a trench along the heap leach pad perimeter and confining embankment crest to ensure that ore loading does not compromise the liners coverage of the heap leach pad footprint by pulling the liner into the pad. Along the embankment toe, all liners will be tied into their corresponding liner layer along the foundation of the pad to provide a continuous liner seal and drainage connection.

A small perimeter berm will also be constructed as part of the liner tie-in around the perimeter of the pad footprint to ensure that heap solution is contained within the pad footprint and to also prevent surface runoff from the adjacent slopes entering the pad collection system.

As noted in Section 5.1.2, a 0.3 metre thick bedding sand layer will be placed on the upslope face of the confining embankment directly underneath the second (bottom) geomembrane liner to provide additional integrity protection to the liner.

5.2.3 Overliner

A protective layer approximately one metre thick of coarse crushed ore will be placed over the entire liner system footprint to protect the liner's integrity from damage during ore placement. The overliner will also double as a drainage layer, promoting leachate solution drainage into the piped leachate collection system, therefore reducing head loading on the liner and maximizing solution recovery.

5.3 LEACHATE COLLECTION SYSTEM

Collection and recovery of the pregnant solution is undertaken by the leachate collection system which works in conjunction with the heap leach liner, overliner and leak detection and recovery systems. The collection system consists of the following pipe and sump components:

- Lateral Collection pipes
- Collection Header pipes
- Main Header Collection pipes, and
- Leachate Collection Sumps.

The leachate collection system is designed to streamline solution collection and facilitate solution conveyance off the pad as quickly as possible thereby reducing the potential risk of leachate solution losses through liner system. The entire piping system is constructed from perforated CPT pipe which is embedded within the one metre thick overliner layer.

The Lateral Collection pipes, which are spaced approximately six metres apart under the entire pad footprint, feed directly into the Collection Header pipes which then flow into the Main Header Collection Pipe. The Main Header Collection pipes are positioned along the centerline of the Heap Leach Pad and terminate at the upstream toe of the confining embankment at the Leachate Collection Sump.

Three Leachate Collection Sumps are located at the toe of the confining embankment, spaced equally across the base width of the heap leach pad. The sumps consist of two sections, the lower 'collection zone' and the upper zone. The lower zone consists of a three-metre thick zone of clean screened gravel (approximate gravel diameter 50 mm to 150 mm) placed around a 600 mm diameter perforated steel vertical riser pipe. The upper zone consists of a three-metre thick zone of compacted crushed ore placed around a 600 mm diameter non-perforated steel vertical riser pipe. The compaction of the crushed ore is critical to ensure that settlement around the vertical riser does not occur and damage the collection system.

As detailed in Section 5.2, the Heap leach pad liner system is designed to be operated as a dry-operation with pregnant leachate solution being pumped out as soon as it collects in the sump thereby reducing the hydraulic head on the liner system. If required however, solution storage in the ore-pore volume behind the confining embankment is possible up to elevation 1096 m before discharging over the confining embankment spillway.

5.3.1 Leak Detection and Recovery System

The Leak Detection and Recovery System (LDRS) is designed to capture and convey any solution which leaks through the overlying geomembrane and low permeability soil layers. As presented in the detail on Figure 5.7, there are two components to the LDRS, the LDRS under the double lined area and the LDRS under the single lined area.

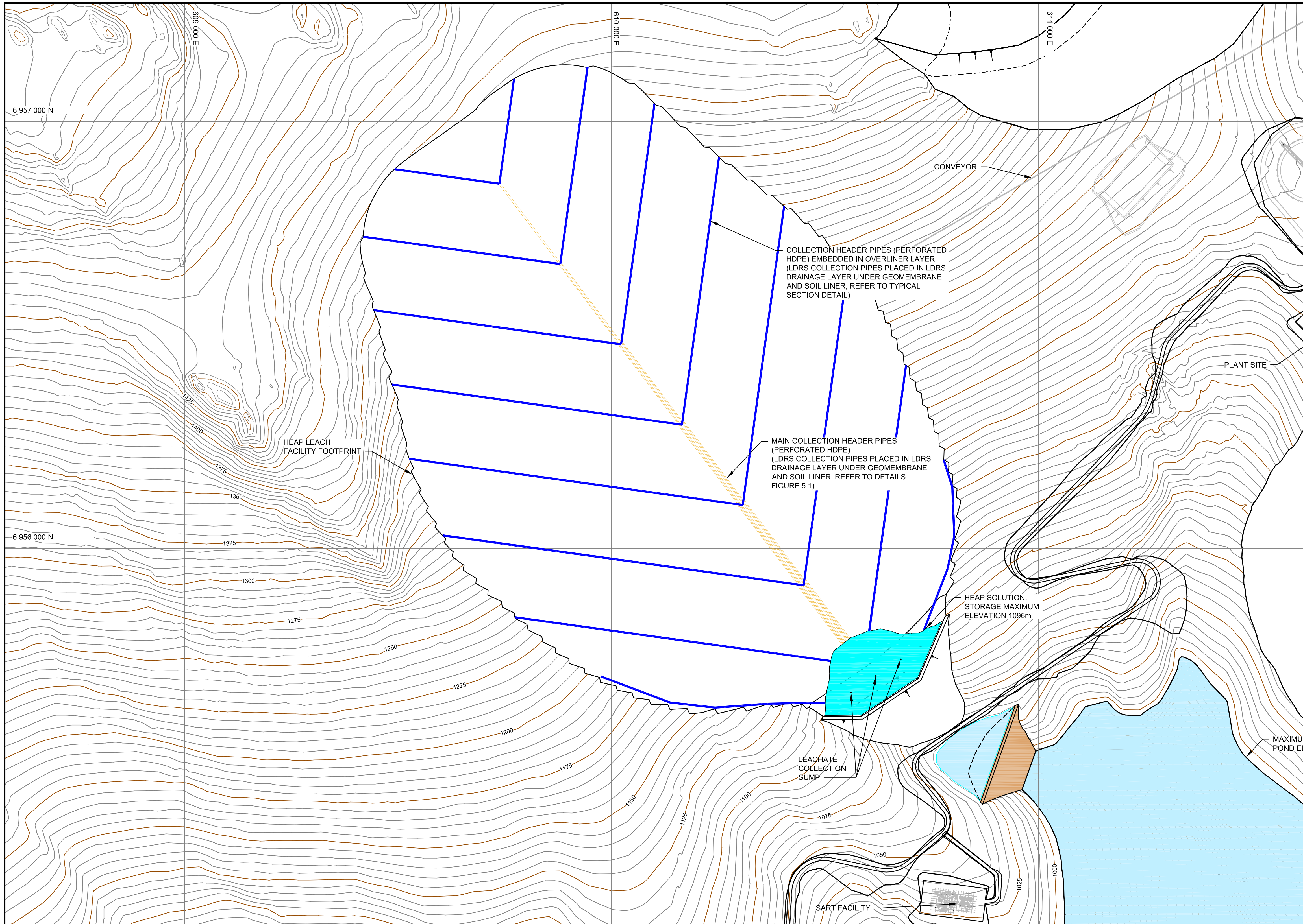
The LDRS under the double lined area consists of a 0.3 metre thick sand layer which is embedded with 100 mm diameter perforated CPT collection pipes. A non-woven needle punched geotextile overlies the LDRS sand layer to prevent particles from the above low permeability soil layer from entering the LDRS, clogging the sand and impeding drainage flow.

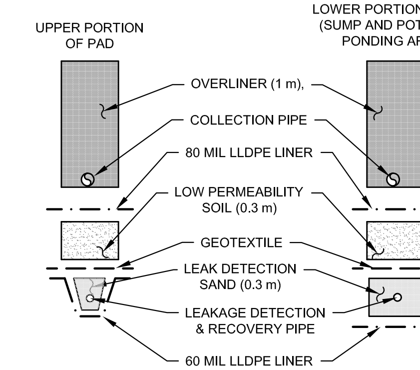
The LDRS under the single lined area consists of a network of drainage 'trenches' which contain 100 mm diameter perforated CPT collection pipes surrounded by drainage sand. The trenches are aligned underneath the 'Collection Header' and 'Main Collection Header' pipes which are part of the Leachate Collection system embedded in the above overliner layer. These drainage trenches 'feed' into the LDRS layer underlying the double lined area in the lower heap leach portion.

Any leakage recovered by the LDRS will be conveyed into the LDRS sump at the toe of the confining embankment. A level-switch controlled submersible sump pump will transfer the recovered solution up the embankment slope via a pipe installed within the LDRS sand layer and connect into the main solution recovery line for processing, (refer to Figure 5.6). Monitoring of the leakage recovery will be undertaken through continuous monitoring of the pump hour records.

5.3.2 Leakage Detection Cells

In order to facilitate advanced leak detection source identification, the entire heap leach pad leachate collection system is sub-divided into 16 independently monitored areas or “cells” separated by small cell division berms. Each of these cells has a dedicated leakage detection collection system comprising a drain gravel layer beneath the inner composite liner system which conveys the leakage to a 100 mm diameter perforated collection pipe within the LDRS collection trench. The LDRS ditches flow by gravity at a minimum 0.5 % slope towards the LDRS collection sump structures, located along the right and left sides of the leach pad. The flow rates from the dedicated collection pipes are continuously monitored and measured prior to discharging into a sump. A float switch within the sump triggers a submersible pump which pumps the accumulated solution via a pipeline (located between the two liners on the confining embankment) back onto the heap pad. LDRS collection sumps are shown on Figure 5.7.





TYPICAL SECTION

SHOWING LINER ARRANGEMENT WITH COLLECTION PIPING AND LEAKAGE DETECTION AND RECOVERY SYSTEM PIPING

NTS

NOTES:

1. CONTOUR INTERVAL IS 5 METRES.
2. DIMENSIONS ARE IN MILLIMETRES AND ELEVATIONS ARE IN METRES, UNLESS NOTED OTHERWISE.

SCALE A 100 50 0 100 200 300 400 500 m

CASINO MINING CORPORATION

CASINO COPPER-GOLD PROJECT

HEAP LEACH FACILITY
LEACHATE COLLECTION SYSTEM

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FIGURE 5.7 REV 0

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5.4 EVENTS POND

The events pond is designed to provide storage for excess leachate and runoff which is generated as a result of rainfall events that cannot be accommodated by the in-heap storage capacity of the HLF. The pond is situated immediately down gradient of the HLF embankment and pond flows are conveyed via the HLF spillway. The plan layout of the Events Pond is included on Figure 5.1. A typical cross-section through the events pond and embankment is included on Figure 5.6.

The events pond is designed to meet the following design criteria:

- Storage capacity to contain the excess HLF leachate and surface runoff from the 1 in 100 year 24-hour storm event without discharge to the TMF
- Spillway designed to discharge the 1 in 200 year 24-hour storm event with a minimum embankment crest freeboard of 0.3 metres.

5.4.1 Storage Requirements

The storage requirement for the Events Pond was established based on containment of the entire estimated surface runoff generated from the HLF during the 1 in 100 year 24-hour storm event. Evaluation of the HFL embankment identified that storage for approximately two days irrigation volume was provided within the in-heap void volume capacity behind the embankment and therefore solution storage within the Events Pond was not required.

Modeling of the HLF storm runoff was undertaken using the Hydrologic Modeling System (HEC-HMS) which was designed by the Hydrologic Engineering Centre (U.S. Army Corps of Engineers) to simulate precipitation-runoff processes of dendritic drainage basins. The model uses site specific data to accurately capture the specific climate and catchment conditions at Site, including storm precipitation intensity distribution, snowmelt, catchment slope, drainage and precipitation losses.

Based on the surface runoff results generated by the model, the following storage requirements for the events pond were identified:

- Total runoff estimate for 1 in 100 year 24- hour storm event 98,600 m^3
- 15% additional capacity buffer 14,300 m^3, and
- Total Events Pond Storage Capacity 112,900 m^3.

Solution stored in the Events Pond will be pumped back to the Heap Leach Pad using the Events Pond pump station. The pump station is designed to be able to empty the 1 in 10 year storm runoff volume (approximately 79,900 m^3) over ten days, and the 1 in 100 year volume (98,600 m^3) over 12.5 days. Depending on the solution processing rate of the gold extraction plant and the available solution storage capacity behind the confining embankment, the actual pump rate will likely need to vary.

5.4.2 Liner System

The engineered double liner system designed for the Events Pond (as shown on Figure 5.6) uses the same design principles as the ‘ponded’ HLF pad liner system. The liner consists of the following layer configuration:

- 60 mil (1.5 mm) high-density polyethylene (HDPE) geomembrane
- 0.3 metre thick low permeability soil liner

- Geosynthetic ‘geonet’ drainage layer, and
- 60 mil HDPE geomembrane.

Careful preparation of the existing ground interfacing the lower geomembrane layer is required to ensure that the ground surface conditions are acceptable to install the geomembrane liner without compromising the liner integrity. The liner system installed on the upslope of the Events Pond embankment will have an additional 0.3 metre thick bedding sand layer which will interface with the lower geomembrane layer to protect the integrity of the liner.

Installation of a Leak Detection and Recovery System (LDRS) is not required for the Events Pond as the pond is operated as a dry-facility and will only receive and store runoff water during significant storm events. In the event that leakage does occur through the double liner system, this water will conveyed via the geonet layer to a 1 metre thick drainage blanket which underlies the Events Pond embankment. This drainage blanket discharges directly to the Tailings Management Facility (TMF).

It is recommended that HDPE geomembrane is used for the Events Pond liner system rather than LLDPE. Unlike the heap leach pad, the Events Pond liner system will not be subjected to high confining stresses from ore stacking. Also, HDPE has a higher ultraviolet resistance which is critical for exposed surfaces like that of the Events Pond.

Typical sections showing the location and extent of the Events Pond liner system are shown on Figure 5.6.

5.4.3 Embankment

The embankment will likely be constructed of colluvial and residual soil borrow materials, quarried rockfill, and potentially non-reactive mine waste rock from open pit development. Finer grained residual soils will be selectively utilized on the upstream face to provide a seal zone and an acceptable surface for geosynthetic liner installation.

The embankment is designed with a 2H:1V downstream slope and a 3H:1V upstream slope. These slopes ensure embankment stability. The embankment will be underlain with a 1 metre thick drainage blanket layer to promote and facilitate drainage of any ‘leakage’ out of the embankment and to discharge into the TMF.

5.4.4 Construction and Operation

The Events Pond will be constructed to full size prior to commencing HLF operations. Construction of the earthfill embankment for the Events Pond involves stripping approximately 0.5 metres of topsoil and 2 metres of overburden beneath the embankment and ponding footprint. The earthfill embankment, pond liner and LDRS system will be constructed directly on competent rock. A solution return pump station will be constructed adjacent to the Events Pond embankment to pump solution back to the HLF in-heap storage for gold-extraction processing or re-use in leaching.

Under typical operating conditions the Events Pond will be operated as a dry pond to ensure that the maximum pond capacity is available for storage of excess HLF surface runoff from storm events. During a storm event leachate and runoff exceeding the HLF in-heap storage capacity will flow into the Events Pond via the HLF spillway to be stored in the Events Pond. This water will then be transferred back to the HLF in-heap storage as required. During storm events greater than 1 in

200 year 24-hour, water volumes exceeding the Events Pond storage capacity will be conveyed to the TMF pond via the Events Pond Spillway.

5.5 DIVERSION AND RUNOFF COLLECTION

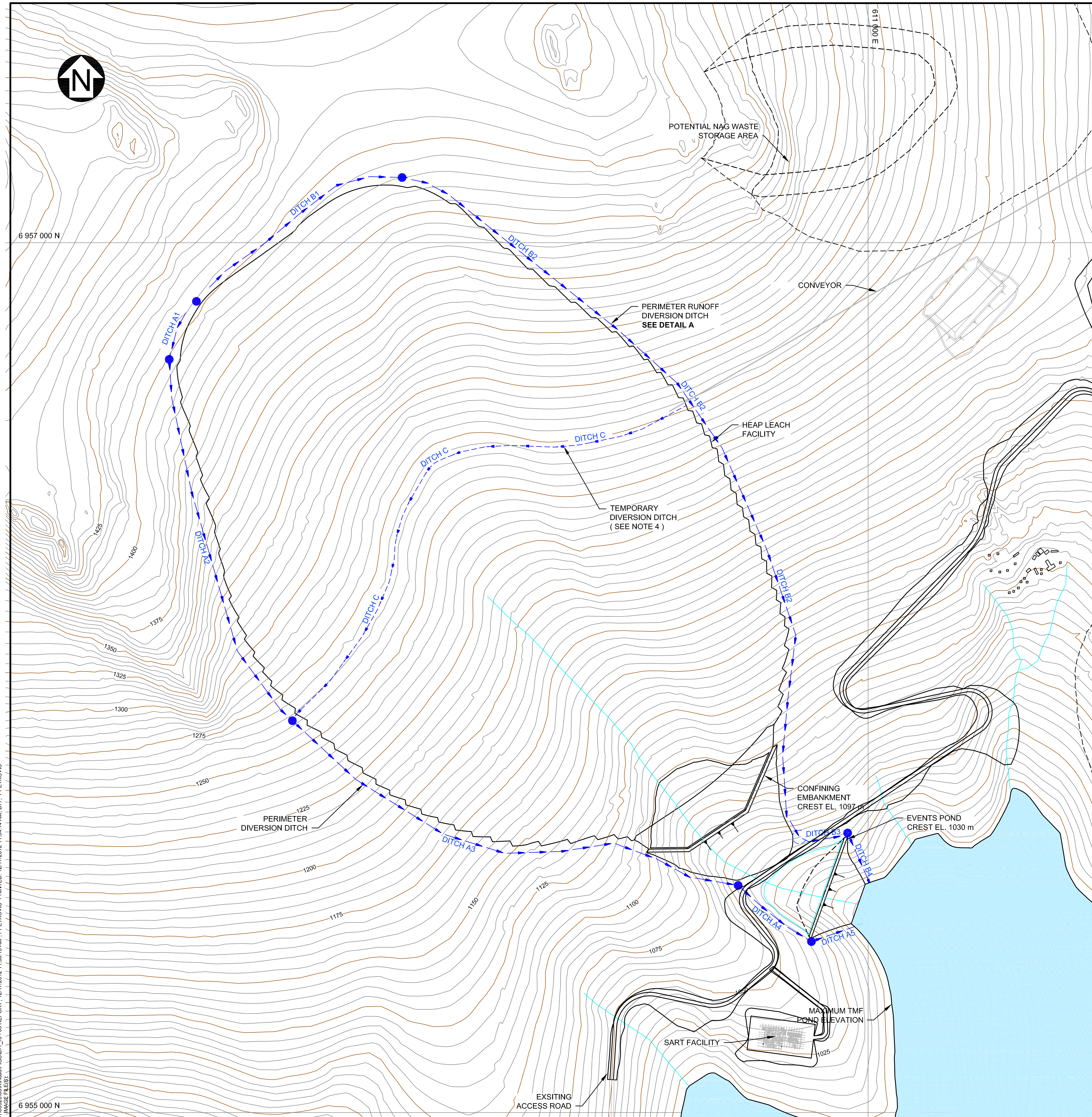
The surface water management system for the site, as presented on Figure 5.8, consists of a series of ditches constructed around the perimeter of the HLF to intercept overland surface runoff around the HLF pad and to convey flows to the TMF. The ditches are designed to meet the following design criteria:

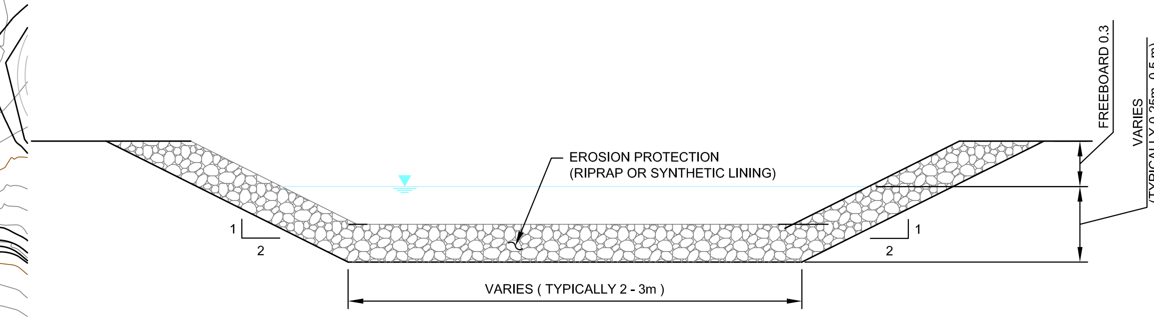
- Conveys the 1 in 100 24-hour duration storm event
- Minimum freeboard = 0.3 m
- Minimum ditch grade = 0.01 m/m
- Side slopes = 2H:1V, and
- Channel shape = trapezoidal.

Lining and protection of the ditch channels from erosion and scouring is required for all permanent ditches due to the steep ditch grades associated with the natural topography and the anticipated high runoff flowrates. The alignments of the HLF diversion ditches are shown on Figure 5.8. Diversion ditch requirements and dimensions are provided in Table 5.2. At start-up, (Year -3), a temporary ditch (Ditch C) approximately six metres wide will be constructed which will divert surface runoff from the upper portion of the final HLF pad footprint. This temporary ditch will be decommissioned in Year 3 when the footprint of the HLF extends beyond El 1264 m.

Table 5.2 Diversion Ditch Requirements

Ditch Name:	Length (m)	Water Depth: 100 yr event (m)	Total Ditch Width (m)	Velocity (m/s)	Flow capacity (m3/s)
Ditch A1	350	0.43	5.9	1.64	2.73
Ditch A2	930	0.27	4.3	4.04	2.77
Ditch A3	1110	0.37	4.7	5.29	5.36
Ditch A4	210	0.47	6.1	3.15	5.83
Ditch A5	110	0.32	4.5	6.77	5.72
Ditch B1	350	0.47	5.1	2.85	3.93
Ditch B2	1910	0.32	4.5	4.80	4.05
Ditch B3	120	0.48	5.1	2.90	4.13
Ditch B4	130	0.28	4.3	5.85	4.19
Ditch C	1250	0.49	6.2	1.51	2.95





A
DETAIL
TYPICAL DITCH
SCALE B

LEGEND:

- TEMPORARY DIVERSION CHANNEL
- PERMANENT DIVERSION CHANNEL

NOTES:

1. COORDINATE GRID IS UTM (WGS84/NAD83) ZONE 7 (m).
2. CONTOUR INTERVAL IS 5 METRES.
3. DIMENSIONS ARE IN METRES UNLESS NOTED.
4. TEMPORARY DIVERSION DITCH TO CONTROL DRAINAGE, TO BE CONSTRUCTED AT START OF HEAP LEACH FACILITY CONSTRUCTION AND PRIOR TO ORE LOADING.
5. REFER TO TABLE IN REPORT FOR MINIMUM DITCH DIMENSIONS

SCALE A 100 50 0 100 200 300 400 500 m

REV	DATE	DESCRIPTION	DESIGNED	DRAWN	CHK'D	APP'D
0	17DEC'12	ISSUED WITH REPORT	RSS	PP	LM	KJB

CASINO MINING CORPORATION

CASINO COPPER-GOLD PROJECT

HEAP LEACH FACILITY
WATER MANAGEMENT PLAN

Knight Piésold CONSULTING

P/A NO. VA101-325/8 | REF NO. 9

FIGURE 5.8 | REV 0

5.6 OPERATIONAL WATER SUPPLY

Operation of the HLF requires a water supply with an approximate average flowrate of 104 m^3/h. In order to meet this demand two water sources will be used during the life of the HLF facility, a purpose built fresh water supply pond from Year -3 through Year -1, and the TMF from Year 1 through Year 15. To meet the HLF water demand prior to construction and commissioning of the TMF construction of an embankment and associated collection ditch system is proposed as shown on Figure 1.2. The earthfill embankment, which will be located in a northern reach of the final TMF footprint, will be approximately 21 metres high and have a storage capacity of approximately 460,000 m3 of water (six months' supply for the HLF operations) and requires a catchment area of approximately 430 ha. Water collection for storage behind the embankment will be undertaken through a diversion ditch system.

In Year 1, once the TMF embankment is constructed and commissioned, HLF water will be sourced from the water stored in the TMF. Alternatively, water may also be sourced from the Mill make-up water pipeline from the Yukon River which will be constructed for the start of Mill operations in Year 1.

5.7 WATER BALANCE

An operational average monthly water balance analysis was undertaken for the HLF. The intent of the modelling was to estimate the magnitude and extent of any water surplus or deficit conditions in the HLF based on annual average climatic conditions. The modelling timeline was for 19 years of HLF operations (covering 3 pre-production years and 16 years of mill operations, consistent with the project mine production schedule). The model incorporates the following major project components:

- Open Pit
- Heap Leach Pad
- Ore Stockpile
- Fresh Water Supply Pond (Makeup Water supply Years -3 to -1 only), and
- Events Pond Storage (50,000 m^3 Years -3 to -1 only).

The findings of the water balance were that the HLF will operate in a water deficit. The deficit is most pronounced in the early years and diminishes later in operations as water stored within the ore is released from the earlier leaching stages. The total make up required by the HLF is 4.3 million m^3 over the life of the facility. The HLF water requirement ranges from 50,000 m^3 to 670,000 m^3 annually, and during the final years the Site is in surplus.

The water balance was based on assumed moisture content values for the stacked ore. The model is sensitive to these values and they should be reviewed and confirmed for future design studies.

Details of the HLF water balance are included in Appendix A.

5.8 STABILITY ASSESSMENT

Analyses have been carried out to examine the stability of the HLF to a final ore heap elevation of 1,408 m. The stability analyses were carried out using the limit equilibrium computer program SLOPE/W. In this program a systematic search is performed to obtain the minimum factor of safety from a number of potential slip surfaces. Factors of safety were calculated using the rigorous Morgenstern-Price method of analysis.

Analyses have been performed to investigate the stability of the final heap leach pad under both static and seismic conditions. A typical cross-section of the heap leach pad used in the analyses is shown on Figure 5.9 The minimum acceptable factor of safety for the heap leach pad under static conditions is 1.3 for short-term operating conditions and 1.5 for long-term (post-closure) of the HLF. The consequences of failure of the HLF during an earthquake event are likely to be minimal and restricted to some displacement of the heap leach pad slopes. There would be negligible impact on the integrity of the HLF and little, if any, impact on other Mine site facilities. However, for design of the HLF a conservative design earthquake corresponding to the 1 in 500 year return period event has been adopted, consistent with the Operating Basis Earthquake (OBE) defined for the TMF. The corresponding mean peak ground acceleration is 0.08g. A design earthquake magnitude of 8.0 has been selected based on a review of regional tectonics, potential seismic source zones in the region and historical seismicity. The seismic stability assessment of the heap leach pad has included estimation of seismically induced deformations of the pad from the design earthquake.

MATERIAL	UNIT WEIGHT (kN/m^3)	Shear Strength
Ore Heap	19	See Note 1
Confining Embankment	22	See Note 1
Composite Liner	17	See Note 2
Bedrock	N/A	Impenetrable

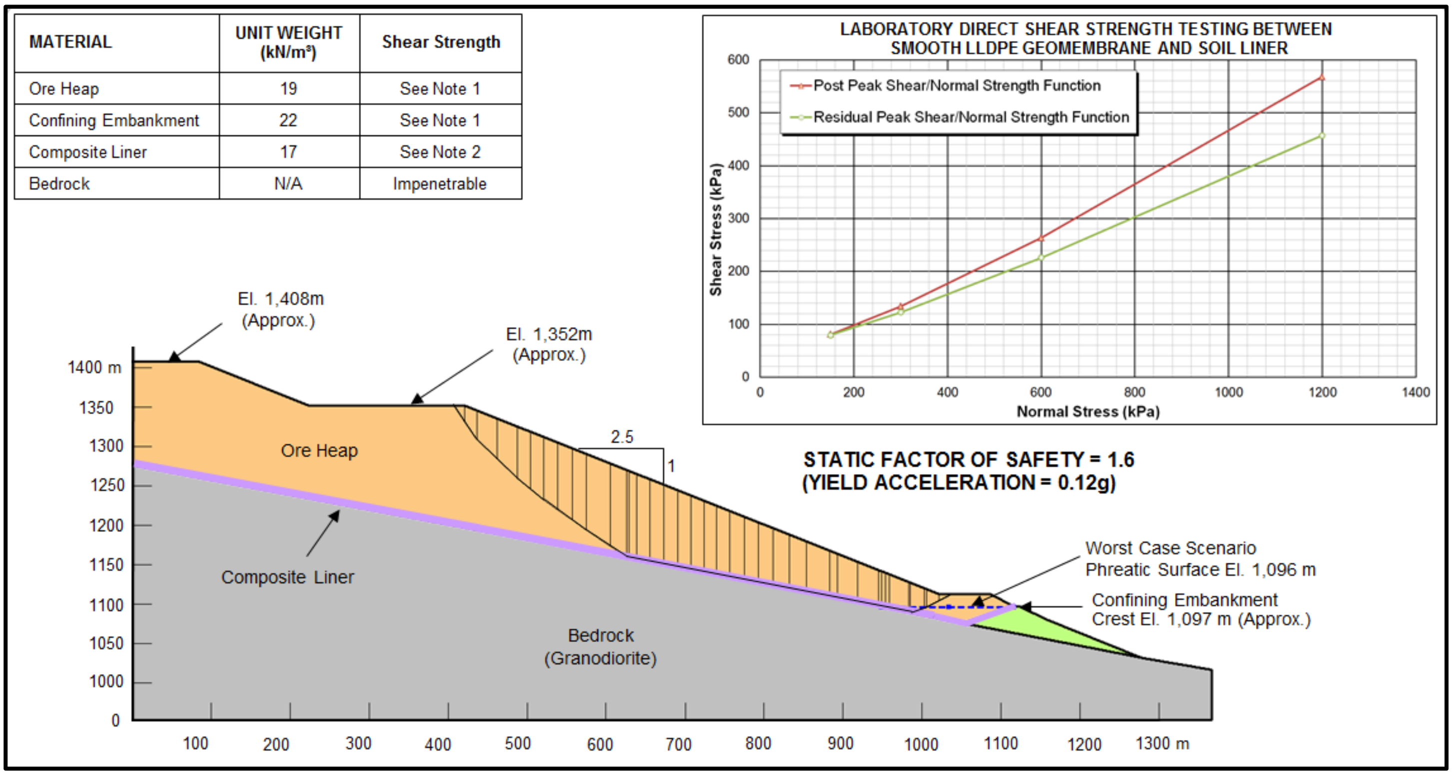


Figure 5.9 Heap Leach Facility: Leach Pad Stability Assessment

NOTES:

1. A relationship for friction angle and effective stress was developed for the ore heap and confining embankment material, based on LEPS (1970).
2. The liner interface with the lowest shear strength and therefore controlling the heap stability is the interface between the smooth LLDPE geomembrane and soil liner direct shear strength test results for LLDPE geomembrane and soil liner are shown on this figure. Post peak shear/normal strength function was used for static analyses. Residual shear/normal strength function was used for seismic analyses.

5.8.1 Material Parameters and Assumptions

The following parameters and assumptions were incorporated into the stability analyses:

- Unit weights for the heap leach pad and foundation materials were based on typical values for similar materials. Adopted values are included on Figure 5.9
- The shear strength for the ore heap and rockfill material in the confining embankment has been defined using a conservative (lower bound) strength function that defines the variation of shear strength with normal stress. This strength function is based on published information on the shear strength properties of granular rockfill materials (Leps, 1970).
- A phreatic surface within the lower portion of the leach pad was modelled with a constant head at elevation 1,096 m to represent maximum potential solution storage during shut-down. No water or phreatic surface was modelled in the upper portion of the leach pad. This is a reasonable assumption since adequate drainage will be provided at the base of the heap to minimize the build-up of pore water pressures within the heap.
- There are no excess pore pressures generated by thawing of foundation materials. It is assumed that appropriate foundation preparation and/or excavation have been conducted in any areas with frozen soil.

The stability of the heap leach pad is controlled by the interface shear strength between the various components of the liner system (overliner, geomembrane liners, soil liner, leak detection/bedding sand layers and geotextile), as shown on Figure 5.6. It is anticipated that the liner interface with the lowest shear strength and therefore controlling heap stability is the interface between the Smooth LLDPE geomembrane and Soil Liner.

The interface shear strength between the Smooth LLDPE geomembrane and soil liner has been defined using the results of laboratory direct shear strength testing. Direct shear strength testing was conducted using a suitable sample of smooth LLDPE geomembrane material and a composite sample of low permeability residual soil, provided by test pit samples and representing potential borrow material for the soil liner. The soil sample was prepared to the anticipated compaction specifications for the soil liner material (95% Standard Proctor density). Laboratory test results (stress-strain plots) were used to define relationships between interface shear strength and normal confining stress for peak, post-peak (15mm strain) and residual (> 60mm strain) strength conditions. The post-peak relationship was used for static stability conditions, as it is recognized that some relative displacement between the layers may occur during construction or operation of the pad. The residual strength value was used for seismic loading conditions from the design earthquake. The adopted relationships between interface shear strength and normal confining stress for the post-peak and residual strengths are included on Figure 5.9

5.8.2 Results of Stability Analyses

Results of the stability analyses indicate that the leach pad is stable with a minimum static factor of safety of 1.6. The potential slip surface and calculated static factor of safety is shown on Figure 5.9.

Stability of the HLF during earthquake loading has been assessed by performing a pseudo-static analysis, whereby a horizontal force (seismic coefficient) is applied to the heap to simulate earthquake loading to determine the critical acceleration required to reduce the factor of safety to 1.0. Deformation is predicted to occur if the critical acceleration is lower than the predicted average maximum ground acceleration along the potential slope surface from the design earthquake.

Potential deformations under earthquake loading have been estimated using the semi-empirical simplified methods of Newmark (1965), Makdisi-Seed (1977) and Bray (2007). These methods estimate displacement of the potential sliding mass based on the average maximum ground acceleration and the yield acceleration. The yield acceleration corresponds to the seismic coefficient required to initiate movement of the sliding mass. The yield acceleration was determined by iterative stability analyses. For the final heap leach pad configuration, the estimated yield acceleration is 0.12g. To account for the possible amplification of ground accelerations as seismic waves propagate through the heap leach pad, an amplification factor of 1.5 was assumed, resulting in an estimated average maximum acceleration of 0.12g. Predicted heap leach pad deformations calculated for the design earthquake are negligible, if any, and would not impact operations at the HLF.

The stability of the HLF is sensitive to the interface shear strengths associated with the liner system. It is recommended that laboratory shear strength tests for each of the liner interfaces within the composite liner systems are tested for detailed design studies, once all material sources have been confirmed.

6 – CONSTRUCTION AND OPERATIONS

6.1 STAGED CONSTRUCTION

The proposed heap leach pad will be developed in five stages. This will minimize initial capital costs while allowing monitoring to maximize the efficiency and recovery during leaching. The general operational strategy will involve placing the ore in successive lifts followed by irrigation with leach solutions. The lifts will be placed by conveyor and spread with dozers. The ore will then be placed in strips parallel to the confining embankment and loaded upslope to ensure on-going stability and to prevent trafficking over the liner. Proposed bench lifts of eight metres will be constructed at bench face angles of approximately 1.4H:1V. Berm widths of nine metres will be left at the toe of each lift resulting in an overall slope of 2.5H:1V. On-going pad development` will involve extending the composite liner upslope to allow for continued lift placement.

6.2 LIFT PLACEMENT AND LEACHING

Leachate solution will be collected by a series of drainage pipes within the coarse drainage layer at the base of the pad. The drain pipes will connect to main leachate collector pipes for transport to the vertical riser pipe within the potential ponding area.

The sequence of lift placement and leaching will likely be as follows:

- Place 38 mm minus overliner material on the surface of the geomembrane liner to provide liner protection and base drainage.
- Place eight metre lift of ore, as required, by moveable ore transport conveyors or haul trucks. Spread with dozers to establish an evenly graded surface for leaching.
- Layout irrigation lines for drip leaching. Sprinkler leaching may also be possible during summer months as part of a rotational, cell-type leach operation.
- Cover irrigation lines with ore having a thickness greater than the depth-of-freeze in the fall to prevent freezing during winter operations.
- Leach the lift of ore above the irrigation lines prior to loading with the next eight metre lift.

6.3 BORROW MATERIALS

Borrow materials will be required for the construction of the leach pad foundation, confining embankment and events pond. Random fill may also be required for foundation earthworks prior to soil liner placement. Borrow for overliner material may be obtained by screening ore at the crusher plant. Rockfill for embankment construction may be obtained from local rock excavation, remote quarry sources or suitable non-reactive (leah cap) mine waste rock, if available.

Materials for the soil liner and random fill may be obtained from borrow areas along south-facing slopes, upslope and east or west of the HLF. Additional test pits and laboratory testwork will be required in these areas to confirm the suitability, availability and quantity of borrow materials for earthworks construction. The borrow areas will be developed by dozing and ripping material down-slope to refusal. Finer grained residual silty sands near surface will be stockpiled for use as soil liner material. Coarser grained material at depth will be utilized as random fill in the construction of the confining embankment and the events pond dam. The material may also be used as general backfill over bedrock for the leach pad foundation. Ripping or blasting in rock may provide rockfill for the shell zones of the confining embankment and events pond, as required.

6.4 COLD WEATHER CONSIDERATIONS

As detailed in Section 2.2.2 the Casino Project area's mean minimum monthly temperature in January is -17 °C, extreme temperature events however produce temperatures significantly colder. In order to enable year-round operation of the HLF the Site's winter conditions (snowfall and cold temperatures) were considered during the preparation of the design.

As noted in Section 3.2, ore stacking will be conducted 300 days/year and leaching 365 days/year. Seasonal stacking of the ore reduces the risks and challenges of stacking during winter e.g. heavy snowfall and reduced day light hours. Challenges of leaching during winter include reduced leaching efficiency, freezing solution and leachate lines and freezing ponds. In order to overcome the risk of freezing ponds during winter, all leachate collection will be conducted within the heap leach pad behind the confining embankment within the ore voids rather than in an external free-surface pond. The events pond was designed as a dry-pond to ensure that freezing and associated ice-damage to the pond liner does not occur. Winterization of the leachate and solution lines will also be required and may include heat tracing and insulation. Winter operations for the HLF will also likely be modified during extreme cold events to include 'ripping' the frozen ore stacks to promote improved infiltration through the ore bed.

7 – INSTRUMENTATION AND MONITORING

Instrumentation and monitoring will be carried out on an on-going basis to ensure the safe and effective operation of the HLF. Recommendations for instrumentation and monitoring are summarized below:

Instrumentation

Geotechnical instrumentation will be installed to monitor the performance of the HLF during the construction stage and throughout the life of the facility. The purpose of the instrumentation will be to provide data to assess the stability of the heap leach pad and to evaluate the effectiveness and performance of the overliner and foundation drains.

The following instrumentation is recommended for installation at the HLF:

- Piezometers will be installed to allow measurement of phreatic levels and pore water pressures within the HLF and foundations. Vibrating wire piezometers will be installed in the following locations:
  - The leach pad and events pond embankment fill materials and foundation
  - The leach pad and events pond foundation drains; and
  - The overliner.

Monitoring

Preliminary recommendations for monitoring are summarized below:

- Surface water quality sampling at selected locations downstream of the HLF.
- Installation of monitoring wells around the facility to monitor groundwater quality during operations and at closure. These wells would be installed prior to development to obtain baseline information for comparative assessment.
- Installation of an LDRS to monitor and recover any leakage through the liner systems within the heap leach pad area and events pond.
- Slope movement monuments and survey control points installed and monitored to ensure the integrity and stability of the ore heap.
- The installation of flow monitoring devices in diversion ditches and creeks to confirm design flows.
- Review of thermistor data to confirm the thermal regime at the site.

Details of the instrumentation and monitoring plan will be developed in conjunction with the appropriate regulatory authorities.

8 – CLOSURE AND RECLAMATION

Reclamation will be carried out to minimize potential impacts to the surrounding environment. Preliminary recommendations for closure and reclamation are summarized below:

- Grading, covering and revegetation of final heap slopes to provide adequate drainage and erosion protection from surface runoff. This may be carried out during operations as the final slope of the heap is developed.
- Rinsing and drain-down of the ore and cyanide destruction at the end of HLF operations.
- Removal of geosynthetic liners from the overflow spillway and the events pond, as required.
- Decommissioning of the pregnant solution recovery system.
- Removal of pregnant solution and events pond pumps and pipeworks.

A preliminary closure and reclamation plan has been prepared by Others, and will continue to be developed in conjunction with the appropriate regulatory authorities.

9 – ESTIMATED QUANTITIES AND CAPITAL COST INFORMATION

Preliminary cost items and estimated quantities have been developed for the proposed leach pad, events pond and solution recovery components of the facility for pre-production and 157.5 million tonne configuration. The cost items and associated quantities have been summarized in Table 9.1. Appropriate unit rates and the capital cost estimate will be compiled by Others.

Initial capital costs will likely include the foundation works, embankment construction and ancillary works required for the leach pad, confining embankment, events pond and solution recovery systems. On-going capital costs will need to include for staged expansion of the leach pad up the slope.

Other costs associated with the HLF include operational costs and capital costs for leaching services.

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TABLE 9.1

CASINO MINING CORPORATION
CASINO COPPER-GOLD PROJECT

FEASIBILITY DESIGN OF THE HEAP LEACH FACILITY
SCHEDULE OF QUANTITIES

Item No.	Description	Unit	Estimated Quantity				
			Stage 1	Stage 2	Stage 3	Stage 4	Stage 5
			Year -3	Year -1	Year 3	Year 7	Year 11
1.0	**Leach Pad**						
	Approximate 3D Area: total new footprint area (ponded and non-ponded)	m^2	*419,000*	*387,000*	*306,000*	*266,000*	*153,000*
	1.1 Stripping and removal of unsuitable materials[1]						
	1.1a Topsoil stripping	m^3	209,000	193,500	153,000	133,000	76,500
	1.1b Excavation of unsuitable materials (2 metres thick)	m^3	838,000	774,000	612,000	532,000	306,000
	1.2 Rough grading (general backfill - 0.5 m)	m^3	209,000	193,500	153,000	133,000	76,500
	1.3 Liner System - ponded area	m^2	23,000	-	-	-	-
	1.3a Overliner (1.0 m thick, placed and compacted, 38 mm minus)	m^3	23,000	-	-	-	-
	1.3b Primary Geomembrane: 80 mil (2 mm) smooth LLDPE	m^2	23,000	-	-	-	-
	1.3c Soil liner, 0.3 m thick (supply, place and compact)	m^3	7,000	-	-	-	-
	1.3d Geotextile	m^2	23,000	-	-	-	-
	1.3e Leak detection sand layer, (0.3 m thick)	m^3	7,000	-	-	-	-
	1.3f Secondary Geomembrane: 60 mil (2 mm) smooth LLDPE	m^2	23,000	-	-	-	-
	1.4 Liner System - non-ponded area	m^2	396,000	387,000	306,000	266,000	153,000
	1.4a Overliner (1.0 m thick, placed and compacted, 38 mm minus)	m^3	396,000	387,000	306,000	266,000	153,000
	1.4b Primary Geomembrane: 80 mil (2 mm) smooth LLDPE	m^2	396,000	387,000	306,000	266,000	153,000
	1.4c Soil liner, 0.3 m thick (supply, place and compact)	m^3	119,000	116,000	92,000	80,000	46,000
	1.4d Leak detection gravel layer (0.3 m thick, 0.3m wide under collection pipe system)	m^3	460	250	200	440	430
	1.4d Leak detection pipes (100 mm dia. perforated HDPE)	m	5,000	3,000	2,000	5,000	5,000
	1.4e Geotextile (allow 10% of total area, under collection pipes)	m^2	40,000	39,000	31,000	27,000	15,000
	1.5 Solution Collection System						
	1.5a Lateral Collection pipes (perforated HDPE)	m	70,000	65,000	51,000	44,000	25,000
	1.5b Collection Header pipes (perforated HDPE)	m	2,000	1,000	1,000	3,000	3,000
	1.5c Main Header Collection pipes (perforated HDPE)	m	3,000	2,000	1,000	2,000	2,000
2.0	**Confining Embankment**						
	Approximate Area under the embankment footprint	m^2	58,000	-	-	-	-
	2.1 Stripping and removal of unsuitable materials[1]						
	2.1a Topsoil stripping	m^3	29,000	-	-	-	-
	2.1b Excavation of unsuitable materials (2 metres thick)	m^3	115,000	-	-	-	-
	2.2 Rough grading (general backfill, 0.5 m thick)	m^3	29,000	-	-	-	-
	2.3 Embankment fill (supply, place and compact)						
	2.3a Structural fill (minus filter sand liner and drainage blanket)	m^3	749,000	-	-	-	-
	2.3b Drainage blanket (1m)	m^3	58,000	-	-	-	-
	Upstream slope surface area of confining embankment	m^2	17,000	-	-	-	-
	2.4 Liner System						
	2.4a Overliner (1.0 m thick, placed and compacted, 38 mm minus)	m^3	17,000	-	-	-	-
	2.4b Primary Geomembrane: 80 mil (1.5 mm) smooth LLDPE	m^2	17,000	-	-	-	-
	2.4c Soil liner, 0.3 m thick (supply, place and compact)	m^3	5,000	-	-	-	-
	2.4d Geotextile	m^2	17,000	-	-	-	-
	2.4e Leak detection layer (supply, place and compact)	m^3	5,000	-	-	-	-
	2.4f Secondary Geomembrane: 60 mil (1.5 mm) smooth LLDPE	m^2	17,000	-	-	-	-
	2.4g Bedding layer, 0.3 m thick (supply, place and compact)	m^3	5,000	-	-	-	-
	2.5 Access Road	m	450	-	-	-	-
3.0	**Events Pond**						
	Approximate Areas	m^2	42,000	-	-	-	-
	- Embankment Area (downslope)	m^2	16,000	-	-	-	-
	- Embankment Area (upslope)	m^2	9,000	-	-	-	-
	- Area behind embankment (elev. 1030m)	m^2	17,000	-	-	-	-
	3.1 Stripping and removal of unsuitable materials[1]						
	3.1a Topsoil stripping	m^3	21,000	-	-	-	-
	3.1b Excavation of unsuitable materials (2 metres thick)	m^3	83,000	-	-	-	-
	3.2 Rough grading (general backfill - 0.5 m)	m^3	21,000	-	-	-	-
	3.3 Embankment fill (supply, place and compact)						
	3.3a Structural fill (minus soil, bedding and drainage blanket layers)	m^3	235,000	-	-	-	-
	3.3b Drainage blanket (1m)	m^3	25,000	-	-	-	-
	3.4 Liner System - embankment area (downslope)						
	3.4a Primary Geomembrane: 60 mil (1.5 mm) smooth HDPE	m^2	9,000	-	-	-	-
	3.4b Soil liner, 0.3 m thick (supply, place and compact)	m^3	3,000	-	-	-	-
	3.4c Geonet	m^2	9,000	-	-	-	-
	3.4d Secondary Geomembrane: 60 mil (1.5 mm) smooth HDPE	m^2	9,000	-	-	-	-
	3.4e Bedding layer, 0.3 m thick (supply, place and compact)	m^3	3,000	-	-	-	-
	3.5 Liner System - ponded area						
	3.5a Primary Geomembrane: 60 mil (1.5 mm) smooth HDPE	m^2	17,000	-	-	-	-
	3.5b Soil liner, 0.3 m thick (supply, place and compact)	m^3	5,000	-	-	-	-
	3.5c Geonet	m^2	17,000	-	-	-	-
	3.5d Secondary Geomembrane: 60 mil (1.5 mm) smooth HDPE	m^2	17,000	-	-	-	-
	3.5e Bedding layer, 0.3 m thick (supply, place and compact)	m^3	5,000	-	-	-	-
	3.6 Solution recovery pipeline	m	450	-	-	-	-
	3.7 Pumps	PS	2	-	-	-	-
	3.8 Access Road	m	80	-	-	-	-
	3.9 Diversion ditching (construction, lining and energy dissipation)	m	6,000	-	-	-	-
4.0	**Fresh Water Supply Pond**						
	4.1 Foundation stripping and removal of unsuitable materials[1]	m^3	52,000	-	-	-	-
	4.2 Rough grading (general backfill - 0.5 m)	m^3	10,000	-	-	-	-
	4.3 Embankment fill (supply, place and compact)						
	4.3a Structural fill	m^3	258,000	-	-	-	-
	4.3b Drainage blanket (1m)	m^3	21,000	-	-	-	-
	4.4 Diversion ditching (construction, lining and energy dissipation)	m	9,000	-	-	-	-

M:\1\01\00325\08\A\Report\9 - HLF Feasibility Design Report\Rev 0\tables\[Table 9.1 - SCHEDULE OF QUANTITIES.xls]Table (rounded)

NOTES:
1. A TOTAL DEPTH OF 2.5 m HAS BEEN ASSUMED FOR 'STRIPPING AND REMOVAL OF UNSUITABLE MATERIALS' UNDER THE HLF PAD CONFINING, EVENTS POND AND FRESH WATER SUPPLY POND EMBANKMENTS.
2. THE LLDPE LINER THICKNESS MAY BE REVISED AFTER ADDITIONAL LABORATORY TESTING.

10 – SUMMARY AND RECOMMENDATIONS

A Feasibility design for the HLF has been carried out for the Casino Project. The proposed leach pad is located on a uniform southeast-facing slope south of the deposit area. Preparation of layouts and sections of the various project components including the leach pad, confining embankment, liner systems and events pond have been completed. The leach pad will provide safe containment and storage for up to 157.5 million tonnes of leach ore and pregnant solution. There is capacity for additional leach ore placement, if required.

The following is a summary list of the main advantages for the proposed HLF:

- The leach pad is located near the deposit area thus minimizing haul and/or ore transport conveyor distances.
- Nearby potential borrow sources on well drained slopes east or west of the HLF may provide relatively short haul distances for leach pad foundation and embankment construction.
- Generally a shallow depth of bedrock throughout much of the HLF area, resulting in reduced foundation excavation requirements.

Design features include the following:

- Pumping of pregnant solution to a gold extraction plant, located southwest of the plant site.
- Excavation of overburden materials to competent bedrock, to eliminate potential settlement and instability resulting from thawing ice-rich overburden. These materials will require containment and sediment control upon thawing.
- Utilize suitable overburden (residual and colluvial soils) and weathered bedrock along well drained, non-frozen, south-facing slopes in the leach pad area as potential borrow for soil liner and embankment construction.
- A single composite liner system comprising an 80 mil (2 mm) smooth LLDPE geomembrane, compacted soil liner and leachate detection and recovery system to maximize leachate collection and minimize seepage losses will be constructed over the upper portion of the heap leach pad.
- A double composite liner system comprising of an 80 mil and a 60 mil (1.5 mm) smooth LLDPE geomembrane liner, a compacted soil liner and geotextile will be constructed over the lower portion of the leach pad and will include a leachate detection and recovery system for intercepting and collecting any leakage through the inner liner.
- A double composite liner system comprising of an 60 mil and a 60 mil (1.5 mm) smooth HDPE geomembrane liner, a compacted soil liner and geonet drainage layer will be constructed over the events pond.A one metre overliner layer comprising 38 mm minus crushed ore over the composite liner to protect the geomembrane and to provide free drainage at the base of the heap. A network of perforated, corrugated polyethylene tubing, or similar, to maximize leachate solution recovery.
- Pregnant solution recovery by means of a submersible pump and pipeline.
- An events pond to provide temporary storage of overflow from the potential ponding area and storm runoff over the leach pad.
- Diversion ditches around the facility to intercept and divert surface runoff.

The heap leach pad will be developed in five stages by loading in successive lifts upslope from the confining embankment. Bench lift heights of approximately eight metres will be constructed at repose bench face angles of 1.4H:1V. Benches approximately nine metres wide will be left at the toe of each lift to establish a final overall slope angle of approximately 2.5H:1V. This will provide stability of the heap and allow for on-going reclamation during operations.

The following is a list of recommendations for additional site investigations, testwork and design studies required to carry the project through to final design and construction:

Geotechnical Investigations and Testwork:

- Additional test pits /drill holes to prove up suitability, availability and quantity of borrow materials for earthworks construction.
- Laboratory testing of potential borrow materials for pad foundation (overliner and low permeability soil layer) and embankment construction (including particle size distribution, Atterberg limits, specific gravity, moisture-density relationship, permeability and shear strength tests).
- Laboratory direct shear testing of liner interfaces, to determine the interface shear strength relationships for heap stability assessment. It is recommended that the shear strength tests are carried out for each of the liner interfaces within the composite liner systems, once all material sources have been confirmed.
- Ore testing (including particle size distribution, specific gravity, permeability under load, load-percolation, and direct shear/triaxial shear strength tests).

Design Studies and Analyses:

- Leach testing (by Others) to determine optimal ore densities, leaching rates and resulting in-heap moisture contents.
- Detailed water balance analyses, based on results of hydrology and leach testing, to estimate solution storage area water volumes, peak storm flows for ditch design, and to confirm sizing of pump and pipework systems.
- Heap stability assessment based on results of laboratory shear strength and liner interface strength testing.
- Seepage analyses to predict seepage flow patterns and solution losses for the design of the LDRS.
- Detailed design of all civil and mechanical works, including sumps, intakes, outlets, pumps, pipe systems etc.
- Advanced studies on the staging configuration of the heap leach pad.

11 – REFERENCES

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12 – CERTIFICATION

This report was prepared, reviewed and approved by the undersigned.

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