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Memo

To:	Kathleen Wood, AECOM	**Date:**	14 May 2009
cc:	Leslie Gomm, Gomm Environmental Engineering Consulting Deborah Pitt, Faro Project Management Team Bill Slater, Bill Slater Consulting Luigi Zanesu	**From:**	Peter Healey, SRK
Subject:	Reclamation Land Units	**Project #:**	1CY001.026

1 Reclamation Land Units

The Closure Plan defines how each component of the Faro Mine Complex will be closed taking into consideration the specific issues associated with each of those components. The final landscape, once the closure plan has been implemented can best be described using a series of Reclamation Land Units (RLU's). RLU's consist of a series of specific RLU elements, which can be assembled in any combination to help attain specific design objectives and performance targets. Table 1 provides a summary of RLU elements which are proposed for Faro. By way of example:

Closure Component: Grum Sulphide Cell

Closure Objective: Ensure physical stability, reduce infiltration, control erosion, establish sustainable vegetation cover.

RLU Elements:

1. Landscape features – PSL, PDL, RDL
2. Cover type – LIC
3. Drainage Course – VCD, TSD, ECD
4. Vegetation type – ALV
5. Surface Treatment – DSS
6. Slope/Aspect – WSA, FSA

Table 1: Reclamation Land Unit (RLU) Elements

Element	Type	Code	Description/Design Approach*	Reclamation/Closure Function(s)	Performance Objectives (within the stated design criteria)**

Element	Type	Code	Description/Design Approach*	Reclamation/Closure Function(s)	Performance Objectives (within the stated design criteria)**
Landscape Features	Leave As-is (Stable)	LSL	Areas that have been deemed physically and hydraulically stable, and that do not require landscaping to facilitate other closure/reclamation requirements.	n/a	No long-term degradation. No physical/chemical changes.
	Leave As-is (Unstable)	LUL	Areas that may not be physically or hydraulically stable but practical landscaping is not possible due to physical constraints (i.e. pit slopes, or areas in close proximity to streams).	n/a	Long-term degradation may be expected. Physical/chemical changes may be expected. Alternate mitigation measures will be in place to compensate for this.
	Relocate	REL	Areas where relocation would facilitate reclamation/closure of the area from where relocation is done, or the area to where relocation is carried out. Also areas where relocation would improve reclamation/closure of the relocated material.	Consolidation of high risk waste. Facilitate landscaping in other areas. Remove high risk waste from high consequence or relatively uncontaminated areas.	None - determined by other elements.
	Ensure Physical Stability	PSL	Areas where landscaping and/or re-sloping is required to ensure long-term physical stability.	Ensure long-term physical stability.	Minimize settlement and subsidence. Prevent surficial sloughing or deep-seated failures.
	Promote Drainage	PDL	Areas where landscaping and/or re-sloping is required to promote drainage, or redirect drainage paths.	Facilitate appropriate site drainage.	Minimize sheet and gulley erosion. Minimize sediment transport.
	Restrict Drainage	RDL	Areas where landscaping and/or re-sloping is required to limit/restrict surface overland flow, such as crest berms on waste rock piles.	Facilitate appropriate site drainage.	Prevent uncontrolled overtopping of slope crests. Prevent uncontrolled breach of drainage paths.
	Provide Access	PAL	Areas where landscaping and/or re-sloping is required to ensure ongoing access for equipment and personnel for maintenance and monitoring.	Facilitate unrestricted site access.	Provide all-season access by foot, ATV, snowmobile or off-road vehicle as defined in maintenance and monitoring plan.

Element	Type	Code	Description/Design Approach*	Reclamation/Closure Function(s)	Performance Objectives (within the stated design criteria)**
Cover Type	No Cover (any area)	NOC	Areas where direct re-vegetation would be possible (with appropriate surface preparation and/or amendment) and the area is deemed uncontaminated. Areas where a rudimentary cover would be required, following re-sloping for constructability, but it would not be practical to re-slope the area due to physical restraints (i.e. toe of slope encroaching on stream bank).	Promote re-vegetation. Provide unobstructed access for ongoing maintenance and monitoring (i.e. service roads).	No long-term degradation. No physical/chemical changes. Vegetation coverage of at least 60% (when applicable).
	Rudimentary	RUC	Re-sloping to at least 2:1 (for constructability), followed by placement of a 1 m thick lightly compacted till.	Isolate waste. Control dust, Promote re-vegetation. Reduce infiltration to less than 25% of MAP.	Prevent surficial sloughing and exposure of underlying waste. Minimize erosion loss - cover must at all times be at least 50% of the design thickness. Eliminate ponding. Vegetation coverage of at least 60%)
	Low Infiltration	LIC	Re-sloping to at least 3:1 (for constructability), followed by a two-layer cover consisting of 1 m lightly compacted till overlying 1 m compacted till	As for Rudimentary Cover + reduce infiltration to less than 5% of MAP.	As for Rudimentary Cover + compacted till layer must at all times be covered with uncompacted till of at least 50% of the design thickness.
	Very Low Infiltration	VLC	Re-sloping to at least 3:1 (for constructability), followed by one of two possible cover variants. Variant 1 consist of a 1 m compacted till layer underlying 2 m lightly compacted till. Variant 2 consist of a geosynthetic liner underlying 1 m lightly compacted till	As for Rudimentary Cover + reduce infiltration to less than 0.5% of MAP.	As for Rudimentary Cover + compacted till layer must at all times be covered with uncompacted till of at least 75% of the design thickness, OR the geosynthetic must at all times be covered with uncompacted till of at least 50% of the design thickness.
	Tailings	TAC	Two layer cover consisting of 0.5 m waste rock overlain by 1.5 m lightly compacted till. The waste rock is a trafficability layer, and may not be required in	As for Rudimentary Cover + restrict infiltration to not exceed what currently exists for uncovered tailings.	As for Rudimentary Cover.

Element	Type	Code	Description/Design Approach*	Reclamation/Closure Function(s)	Performance Objectives (within the stated design criteria)**
			all areas, depending on constructability.		
Drainage Course	Vegetation Controlled	VCD	Swales at catchment headwaters. These swales will be sized to ensure flow velocities do not exceed threshold limits for erosion protection by vegetation.	Direct diffuse runoff towards controlled drainage channels. Prevent sheet erosion. Eliminate sediment transport.	Minimize erosion. Ensure drainage flows towards defined channels. Minimize sediment transport.
	Transition from Vegetation to Rip-rap	TZD	Swales in larger catchments where waters start to concentrate. Where water velocities start to exceed threshold limits for vegetation alone to control erosion, transition zones will be implemented using engineered rip-rap.	Provide controlled collection points for headwater surface runoff collection swales. Prevent gulley erosion. Eliminate sediment transport.	As for vegetation controlled drainages.
	Rip-rap (Engineering) Controlled	ECD	Main water conveyance channels. Can be swales or engineered channels with specified erosion control features.	Provide controlled surface runoff conveyance channels. Prevent gully erosion. Control sediment transport.	As for vegetation controlled drainages.
	Fish-Habitat Enhanced	FHD	Any type of drainage channel where fish may be present, and where habitat enhancement will be required.	Ensure unobstructed passage of fish. Promote appropriate aquatic life habitat.	Proof that fish and other aquatic life have returned to and settled in the channel.
	Lined	LID	Any type of drainage channel where infiltration control is required, or where cross-contamination of surface and groundwater must be prevented. Lining will be by means of compacted till and/or geosynthetics.	Prevent cross-contamination of surface and groundwater. Limit loss of overland surface runoff to groundwater. Ensure infiltration performance targets over covered surfaces are maintained.	No exposure of geosynthetic or compacted till layer.
Vegetation Type	No Vegetation	NOV	Any areas where establishment of any type of vegetation are specifically discouraged.	Ensure structural integrity (i.e. on dams). Ensure unobstructed access for equipment and personnel for monitoring and maintenance (i.e. service roads).	No vegetation.

Element	Type	Code	Description/Design Approach*	Reclamation/Closure Function(s)	Performance Objectives (within the stated design criteria)**
	Agronomic Grass-Legume Mix (Treatment #1)	ALV	No "category 1" species from the Yukon invasive plants list. Mix include a balance of sod- and bunch-forming grasses (by seed number), as well as a legume component. Applied at a rate sufficient to encourage rapid ground-cover establishment. Application accompanied by a corresponding application of low-N, high-P fertilizer (e.g. ammonium phosphate, 11-48-0).	Maximum short-term erosion (sheet, rill and gulley) prevention in high risk/consequence areas.	Minimize erosion immediately after cover construction. Minimize sediment transport. Vegetation coverage of greater than 80%.
	Annual Nurse Crop + Native Grass Mix + Native Woody Species (Treatment #2)	ANV	Use of an annual agronomic such as barley, rye, oats to provide a non-persistent initial cover. Seeding of the nurse crop accompanied by a light seeding of a native grass mix. This treatment includes planting of balsam poplar, willow and/or alder. Alder are from nursery-grown containerized seedlings, while poplar and willow are from straight cuttings or nursery-produced rooted cuttings.	Short-term early season erosion (sheet, rill and gulley) prevention. Over long-term allow establishment of natural succession species. Promote return of natural wild life.	Minimize erosion. Minimize sediment transport. Vegetation coverage of greater than 60%.
	Native Grass Seed Mix (Treatment #3)	NGV	Broadcast seeding at a "light" rate of a native grass mix, designed as in Treatment #2, above.	Maximum short-term erosion (sheet, rill and gulley) prevention in low-risk/consequence areas.	As for Treatment #2.
	Native Grass Seed Mix + Native Woody Species (Treatment #4)	NWV	As in Treatment #2, but without the agronomic nurse crop.	Establishment of natural succession species. Promote return of natural wild life.	As for Treatment #2.
	Riparian (Treatment #5)	RIV	Sustainable riparian vegetation in areas that may be seasonally, and/or occasionally flooded. Good erosion resistance also required during high flood events.	Prevent erosion. Provide habitat.	As for Treatment #2.

Element	Type	Code	Description/Design Approach*	Reclamation/Closure Function(s)	Performance Objectives (within the stated design criteria)**
Surface Treatment	Planar	PLS	Treatment of the slope as a planar sheet, without purpose-built rills or mounds. Some roughening will be required due to the need to leave a non-compacted growth medium for re-vegetation. Suitable for slope lengths >50m.	Provide substrate for re-vegetation. Minimize risk of surface ponding.	No surface ponding.
	Rough and Loose (Hummocky)	RLS	Specifically roughened cover surface with undulations/indentations equivalent to 50% of the uncompacted till layer thickness. Suitable for all slope lengths.	Provide substrate for re-vegetation. Promote micro topography to enhance species variation. Retain maximum moisture at source.	No overtopping of micro-dams with associated gulley formation.
	Down Slope Rills	DSS	Strategically placed down slope rills (micro topography) or swales (macro topography). Suitable for slope lengths >50 m.	Provide substrate that promotes natural species variation. Minimize erosion. Minimize risk of surface ponding.	No surface ponding.
	Rock Armored	RAS	Cladding of the surface with suitably sized rip-rap. Suitable for all slope lengths.	Minimize erosion and sediment transport in high risk and/or over steepened areas.	No boulder avalanches.
	Woody Debris Armored	WDS	Rough and Loose surface complimented with coarse woody debris to enhance organic content as well as shading and protection for early vegetation establishment.	As for Rough and Loose.	As for rough and loose.
	Scarification	SCS	Loosening of uncontaminated hard-packed surfaces to allow direct re-vegetation. Ripping of surface to loosen profile to a depth of at least 0.5 m.	Direct re-vegetation of uncontaminated hard-packed surfaces.	No surface ponding.
Slope/ Aspect	Warm Slopes: >25% (1:4), aspects 135-285 (degrees true)	WSA	Slopes facing predominantly north are considered warm slopes and will experience a different moisture regime requiring a modified vegetation treatment. This will be a variant of Treatment #1 through #5 above.	Ensure adequate long term vegetation cover. Minimize erosion and sediment transport.	None - determined by other elements.

Element	Type	Code	Description/Design Approach*	Reclamation/Closure Function(s)	Performance Objectives (within the stated design criteria)**
	Cold Slopes: >25% (1:4), aspects 285-135 (degrees true)	CSA	Slopes facing predominantly south are considered cold slopes and will experience a different moisture regime requiring a modified vegetation treatment. This will be a variant of Treatment #1 through #5 above.	Ensure adequate long term vegetation cover. Minimize erosion and sediment transport.	None - determined by other elements.
	Slopes: <25% (1:4) but >10% (1:10), all aspects	MSA	Moderate slopes are not much affected by aspect and are not considered warm or cold. Vegetation treatment is more flexible in these areas.	Ensure adequate long term vegetation cover. Minimize erosion and sediment transport.	None - determined by other elements.
	Level Ground: <10% (1:10), all aspects	FSA	Areas with flat ground or very moderate slopes are generally less prone to erosion risk and therefore vegetation treatment can be slightly modified.	Ensure adequate long term vegetation cover.	None - determined by other elements.

* Some designs are yet to be confirmed. Ongoing cover and vegetation trials are underway to facilitate these decisions.

** Specific measurable targets will be set as part of the detailed design stage.