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APPENDICES

Appendix 6.10.1 Site Wide Water Balance (2016)

6.10 Surface Water Resources

6.10.1 Introduction

An assessment of the potential impacts to surface water resources as a result of the Project has been undertaken and is discussed in the following sections. The potential impacts on the various hydrologic receptors during the construction, operational and closure phases are discussed and mitigation measures are presented to eliminate or limit adverse effects.

The impact assessment addresses surface water impacts associated with:

- The Tigranes-Artavazdes and Erato open pits. The Tigranes-Artavazdes pit will be backfilled during the later years of operation leaving the small South Artavazdes pit partially unbackfilled. The Erato pit will be partially backfilled at closure;
- The Barren Rock Storage Facility (BRSF);
- The Heap Leach Facility (HLF) and associated adsorption-recovery (ADR) plant; and
- Additional supporting infrastructure including water storage ponds, water treatment systems, crusher, haul roads, material stockpiles, conveyor and mine buildings.

Each of these facilities has design engineering and management measures to control the potential discharge of water during each phase of the mine life. The engineering and management controls incorporated into the designs of the major facilities, and that are included in the surface water assessment, are described in Section 6.10.6.

Supporting Documents

The impact assessment is supported by the following documents and studies:

- Appendix 6.10.1 - Amulsar Project: Site Wide Water Balance (Golder, 2016[1]);
- Appendix 3.1 – Amulsar Passive Treatment System (PTS) Design Basis, December 9, 2015 (Sovereign, 2015[2]);
- Appendix 8.22 - Surface Water Management Plan, Amulsar Project, February 2016. (Golder, 2016[3]); and
- Appendix 8.19 - Amulsar Project: Acid Rock Drainage Management Plan, Includes Heap

1 Golder Associates Ltd , 2016. Amulsar Project: Site Wide Water Balance, 2 February 2016.
2 Sovereign Consulting Inc, 2015. Amulsar Passive Treatment System (PTS) Design Basis. Technical Memorandum to GRE dated December 9, 2015.
3 Golder Associates (UK) Ltd , 2016. Amulsar Project: Surface Water Management Plan, February 2016.

Leach Facility (GRE, 2014[4])

6.10.2 Assessment Scope

Technical Scope

Potential surface water impacts fall under two categories:

1) *Water Quality*: Adverse impacts to the baseline water quality arising from planned water management;
2) *Water Quantity*: Adverse impacts to the flow regime and available water quantity arising from planned water management.

There are linkages between surface water, groundwater and ecological receptors and impacts. Freshwater habitats and ecological health in particular are dependent on water quality and quantity and on the prevention of uncontrolled releases which could also adversely affect freshwater and riverine habitats. The ecological receptors are described in Chapter 6.11, whereas this section identifies changes in the surface water environment on which those receptors may depend.

Impacts to groundwater quality can also cause or result from impacts to surface water quality within the Project area. These impacts are presented in Chapter 6.9 particularly with reference to changes in the water quality and flow regime in groundwater fed springs. The uses of the different groups of springs is described in Section 4.8.10, which identifies the current use of the seasonal ephemeral springs, the perennial mountain springs, the Madikenc springs and the hydrothermal springs. Of the spring water uses, the Madikenc springs are used for drinking water supply. The baseline conditions note that a proportion of the mountain springs, in particular those surrounding the pits and BRSF, have been defined as being used for stock watering during the summer months (see Section 4.8.10).

Surface water receptors are catalogued and assigned a sensitivity grade in the following section. The magnitude of the potential impacts (if any) on each of these receptors is considered for the mine design without additional mitigation (i.e. considering mitigation measures incorporated into the current design) for the construction, operational, closure and post-closure phases of the Project. Suitable additional mitigation measures and any residual

[4] Global Resource Engineering (GRE) Ltd, 2014. Amulsar Acid Rock Drainage Management Plan, Includes Heap Leach Facility, 21 August 2014.

impacts are detailed and a revised assessment of potential impact significance including any additional migitation is then provided.

Project Performance Standards in relation to water quality are defined by the Maximum Allowable Concentrations (MAC) prescribed under Category II of the Republic of Armenia Decree N-75N (2011), with the exception of a standard for cyanide, which has been derived from the typical practicable limit of detection achievable by commercial laboratories (see Chapter 2). These standards and existing baseline conditions have been used to define impacts and assess impact significance.

Geographical Scope

The surface water Study Area is identified on Figure 6.10.1. This area forms the basis for the geographical area covered by the surface water impact assessment. Areas downstream of surface waters potentially directly impacted are discussed where secondary impacts may occur.

Lake Sevan has a specific law governing its protection as it is considered to be of national importance (Chapter 4.9). The 'immediate impact zone' identified by this law includes the Kechut Reservoir and its tributaries, all of which are identified on Figure 6.10.1.

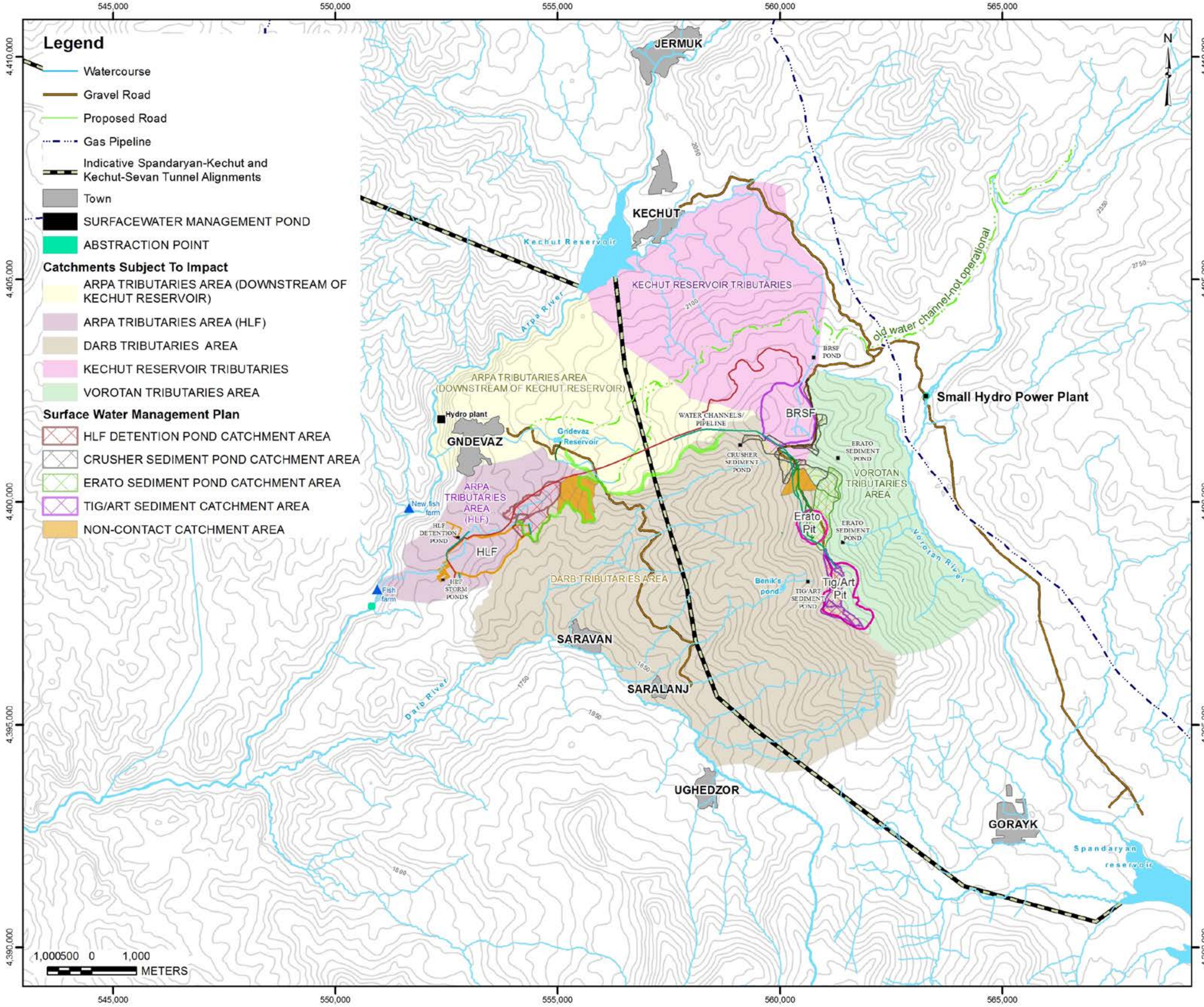

Figure 6.10.1: Surface Water Study Area and Catchments

Temporal Scope

The surface water impact assessment considers the potential impacts to surface water receptors during the following mine life stages:

- Construction (Pre-Operational) Phase;
- Operational Phase; and
- Closure and Post-closure phases.

6.10.3 Surface Water Impact Assessment Methodology

The definitions of receptor sensitivity and magnitude of impact in Chapter 6.1 are used in the assessment of the surface water receptors potentially affected by the Project. Table 6.10.1 describes the receptor sensitivity value for surface water based on Table 6.10.4 (Receptor Sensitivity Scale).

Table 6.10.1: Surface Water Receptor Sensitivity Value

	Receptor Sensitivity Value	Receptor Description
1	Minor	Surface water features of low importance or with low sensitivity; abundance of similar receptors; watercourses of local importance or scale; resilient to changes in flow regime or quality; water feature's functions may be substituted in the local area.
2	Medium	Surface water features of low to medium importance or with low to medium sensitivity; relative abundance of similar receptors; regional importance or scale; reasonably resilient to change in influent watercourse flow rates and quality; surface water functions potential for substitution/compensation.
3	High	Surface water features of medium to high importance or with medium to high sensitivity; Relative rarity of similar receptors; national importance or scale; fragile and susceptible to change; resource vital to water supply or food production or which provides ecosystem services to a receptor of national importance or scale; limited potential for substitution of surface water functions.
4	Very High	Surface Water features of very high importance or of very high sensitivity to measureable change; receptor is of international scale or sensitivity; extremely rare or with very limited potential for substitution of surface water functions; highly susceptible to change and very fragile.

Surface water receptor sensitivity is presented in Table 6.10.4.

The magnitude of change to surface water receptors as a result of potential impacts is determined using the matrix presented in Table 6.1.2 (Chapter 6.1). For the purposes of the surface water assessment, specific degrees of change have been defined for each of the magnitude of change categories, specified in Table 6.10.2.

Table 6.10.2: Magnitude of Change Scale (Surface Water)

	Magnitude of change	Description of change	
		Quality	Quantity
1	Negligible	Undetectable changes from baseline conditions (<1%) of short duration or infrequent periodicity. Direct control is not required to manage potential impact.	Undetectable changes from baseline conditions (<1%) of short duration or infrequent periodicity. Direct control is not required to manage potential impact.
2	Low	Measureable change to the baseline conditions. Concentrations have measurably increased where water quality standards were not exceeded in the baseline, but remain below the quality standards. If quality standards were exceeded at the baseline, the concentration is less than 20 % over the standard and change is temporary. During construction, operations or closure there would be ongoing change in the underlying characteristics or quality of the baseline conditions.	Detectable change to the baseline conditions or resource. Permanent or temporary changes are less than 10% of flow under baseline conditions.
3	Moderate	Degree of change is such that adverse alteration to baseline conditions would occur. Predictions indicate a change in surface water quality from below the environmental standard at baseline to above the environmental standard as a result of development. The environmental standard is exceeded by between 20 % and 100 %. Changes are not permanent and improvement will occur over time in post-closure.	Degree of change is such that loss of, or adverse alteration to, the baseline conditions would occur. A permanent alteration in flow of less than 20% from baseline conditions is predicted, or a temporary change of less than 50% of baseline conditions.
4	High	Degree of change is such that adverse alteration to baseline conditions would occur. Predictions indicate a change in surface water quality from below the environmental standard at baseline to above the environmental standard as a result of development. The environmental standard is exceeded by over 100 %. Post-development quality would be fundamentally and irreversibly changed.	Degree of change is such that total loss of, or adverse alteration to, the baseline conditions of a specific resource would occur. Development is predicted to result in a permanent change of more than 20% from baseline conditions, or a temporary change of more than 50% from baseline conditions.

The matrix presented in Table 6.1.3 (Chapter 6.1) is used to determine the significance of the impact, and Table 6.1.4 (Chapter 6.1) is used to determine whether the effect of the impact is significant.

For any significant impacts, additional (i.e. non-design) mitigation measures are presented and the residual impact and effect is then assessed using the same process outlined above.

As detailed in the surface water baseline (Chapter 4.9), elevated concentrations of trace metals are present in surface waters throughout the Study Area as a result of the natural geochemical conditions. Some of these concentrations exceed MACs for fisheries and this is taken into account in the assessment of any future impacts. Some tributaries of the Darb and Vorotan immediately downstream of the proposed open pits exhibit low pH levels (Figure 4.9.9) indicative of naturally occurring acid rock drainage (ARD). This has also been taken into account during assessment of future potential impacts.

6.10.4 Identification of Surface Water Receptors

Surface Water Receptors

Chapter 4.9.7 in the surface water baseline describes surface water users in the vicinity of the mine, adjacent to and downstream of the Project area. Based on this information, and the understanding of the hydrologic conditions, surface water receptors have been identified. Table 6.10.3 summarises the surface water receptors and water users. Wetland areas are categorised based on the ecological biodiversity assessment documented in Chapter 4.10.3.

Table 6.10.3: Surface Water Receptors and Water Users

Receptor	Water User Category	Description
Kechut Reservoir Tributaries	Agriculture and Stock Watering	Irrigation and stock watering from streams within the catchment.
	Ecosystem Services	Natural wildlife water supply and habitat.
Arpa River Downstream of Kechut Reservoir	Stock Watering	Stock watering from Arpa River
	Ecosystem Services	Fisheries, natural wildlife water supply and habitat.
	Aquaculture	Two fish farms 6.5 km and 8 km downstream of the Kechut reservoir.
Arpa River Tributaries Downstream of Kechut Reservoir	Agriculture and Stock Watering	Stock watering from streams within the catchment.
	Ecosystem Services	Natural wildlife water supply and habitat.
Arpa River Tributaries HLF Area	Agriculture and Stock Watering	Stock watering from streams within the catchment.
	Ecosystem Services	Natural wildlife water supply.
Darb River	Agriculture and Stock Watering	Herders rely on water supply directly from the Darb River.
	Ecosystem Services	Fisheries, natural wildlife water supply and habitat.

Table 6.10.3: Surface Water Receptors and Water Users

Receptor	Water User Category	Description
Darb River Tributaries	Agriculture and Stock Watering	Irrigation and stock watering from tributaries of the Darb.
	Ecosystem Services	Natural wildlife water supply and habitat.
Vorotan River	Agriculture and Stock Watering	Herders rely on water supply directly from the Vorotan River.
	Ecosystem Services	Fisheries, natural wildlife water supply and habitat.
	Hydro-electric Power Generation	Run of river plant upstream of road crossing east of Project area.
Vorotan River Tributaries	Agriculture and Stock Watering	Herders rely on water from streams within the catchment, particularly on the valley floor in wetland meadows.
	Ecosystem Services	Natural wildlife water supply and habitat.
Kechut Reservoir	National Water Supply	Feeds the Lake Sevan water supply scheme using existing interconnector tunnels.
	Hydro-electric Power Generation	Hydro-electric Power Plant at reservoir outlet takes water from reservoir.
	Ecosystem Services	Fisheries, natural wildlife water supply and habitat.
Spandaryan Resevoir	National Water Supply	Possible future use to feed the Lake Sevan water supply scheme using existing interconnector tunnels.
	Hydro-electric Power Generation	Hydro-electric Power Plant located at reservoir outlet.
	Ecosystem Services	Fisheries, natural wildlife water supply and habitat.
Gndevaz Reservoir	Agriculture and Stock Watering	Gndevaz Reservoir perennially used for irrigation of downstream horticulture and agriculture.
Gndevaz Channel	Irrigation / Water Supply	Man-made channel (lined; currently under renovation) to divert flow from springs in the Vorotan valley to the fields near Gndevaz and the Gndevaz Reservoir.
Wetland Ponds within Darb Tributaries including Benik's Pond	Ecosystem Services	Natural wildlife water supply and habitat.
Wetlands within Vorotan Catchment	Ecosystem Services	Natural wildlife water supply and habitat.
Wetlands within Ketchut Reservoir Tributaries	Ecosystem Services	Natural wildlife water supply and habitat.

Local community potable water supplies within the wider Project area are sourced directly from springs and therefore are not classified as surface water users (Chapter 4.9.7).

The Gndevaz irrigation channel which was constructed to divert flow from the Vorotan River to the Gndevaz Reservoir is not currently fully functional (some short sections remain intact and are used for local diversions) (Chapter 4.9.7). The channel is currently being renovated and will be lined, preventing hydraulic connection to the local groundwater system.

Surface Water Receptor Sensitivity

The sensitivity of surface water receptors are detailed in Table 6.10.4. This table describes receptor location, geographical importance (scale), resilience to change (quantity and quality) and potential for substitution used to determine receptor sensitivity.

Table 6.10.1 has been used to assign receptor sensitivity, with the greatest weighting being placed on the geographical importance of the surface water resource in determining its sensitivity (i.e. surface water user reliance over a geographical area). Resilience to change and potential for substitution are the next order of weighting in determination of receptor sensitivity.

Determination of sensitivity considers surface water alone as the receptor and not features it may be linked to. Associated groundwater and ecological receptors that may be sensitive to changes in surface water quantity or quality are addressed in Chapters 6.9 (Groundwater) and 6.11 (Biodiversity).

Table 6.10.4: Receptor Sensitivity (Surface Water)						
Receptor	**Area**	**Location**	**Geographical Importance**	**Resilience to Change**	**Potential for Substitution**	**Receptor Sensitivity**
Kechut Reservoir Tributaries	BRSF Catchment Area	Kechut Reservoir tributaries within BRSF catchment	**Local**, with small volume input to Kechut Reservoir, which in turn feeds the Lake Sevan Scheme. Numerous tributary streams of this type within Project area.	Tributary streams with flow primarily following seasonal snow melt. **Susceptible** to relatively small changes in low flows within the catchment.	Limited potential for substitution	Medium
Arpa River Downstream of Kechut Reservoir	Project Area	Arpa River below Kechut Reservoir along the western boundary of Project area	Flow and quality from within the Project area is of **regional** importance.	The Arpa River has a large catchment, with the majority located outside the Project area. Tributaries provide flow primarily following seasonal snow melt. Flow out of Kechut Reservoir is controlled by Hydro-electric Scheme at it's outlet. **Reasonably resilient** to changes in the Project area.	Alternative water supply could be sourced from adjoining catchments	Medium
Arpa River Tributaries Downstream of Kechut Reservoir	Ore Conveyor Catchment Area draining to HLF Detention Pond	Arpa River tributaries within Conveyor catchment	**Local**, with small volume input to Arpa River. Numerous tributary streams of this type within Project area.	Tributary streams with flow primarily following seasonal snow melt. **Susceptible** to relatively small changes in low flows within the catchment.	Limited potential for substitution	Minor

Table 6.10.4: Receptor Sensitivity (Surface Water)						
Receptor	**Area**	**Location**	**Geographical Importance**	**Resilience to Change**	**Potential for Substitution**	**Receptor Sensitivity**
Arpa River Tributaries HLF Area	HLF Catchment Area	Arpa River tributaries within HLF catchment	**Local**, with small volume input to Arpa River. Numerous tributary streams of this type within Project area.	Tributary streams with flow primarily following seasonal snow melt. **Susceptible** to relatively small changes in low flows within the catchment.	Limited potential for substitution.	Minor
Darb River	Wider Project Area	Darb River downstream from the village of Ughedzor along the southern boundary of the Project area	Flow and quality from within the Project area is of **regional** importance.	The Darb River has a large catchment, with the majority located outside the Project area. Tributaries provide flow primarily following seasonal snow melt. **Reasonably resilient** to changes in flow and quality within the Project area.	Alternative supplies could be sourced from adjoining catchments	Medium
Darb River Tributaries	Pit Areas of Amulsar Mountain, Crusher Plant and corresponding Catchment Areas	Darb River tributaries within Pit and Crusher Plant catchment areas	Flow and quality from within the Project area is of **local** importance. Numerous tributary streams of this type within Project area.	Tributary streams with flow primarily following seasonal snow melt. **Susceptible** to relatively small changes in low flows within the catchment.	Limited potential for substitution	Minor

Table 6.10.4: Receptor Sensitivity (Surface Water)

Receptor	Area	Location	Geographical Importance	Resilience to Change	Potential for Substitution	Receptor Sensitivity
Vorotan River	Wider Project Area	Vorotan River along eastern boundary within Project area	Flow and quality from within the Project area is of **regional** importance.	The Vorotan River has a large catchment, with the majority located outside the Project area. Tributaries provide flow primarily following seasonal snow melt. **Reasonably resilient** to changes in flow and quality within the Project area.	Alternative supplies could be sourced from adjoining catchments	Medium
Vorotan River Tributaries	Pit Areas of Amulsar Peak and Catchment Area	Vorotan River tributaries within Project area	**Local**, with small volume input to Vorotan River. Numerous tributary streams of this type within Project area.	Tributary streams within the headwaters flow primarily following seasonal snow melt. **Susceptible** to relatively small changes in low flows within the catchment.	Limited potential for substitution	Minor
Kechut Reservoir	Wider Project Area	Borders north west boundary of Project area	Water Supply from Kechut Reservoir is of **national** importance.	Kechut Reservoir has a large catchment, with the majority located outside of the Project area and therefore is **resilient** to changes in flow and quality within the Project area. Outflow from the reservoir is controlled by the dam spillway, inlet to Sevan Water Supply Scheme and intake to Hydroelectric plant.	Alternative supply to reservoir could potentially be sourced from adjoining catchments	High

Table 6.10.4: Receptor Sensitivity (Surface Water)						
Receptor	**Area**	**Location**	**Geographical Importance**	**Resilience to Change**	**Potential for Substitution**	**Receptor Sensitivity**
Spandaryan Resevoir	Wider Project Area	South east of Project area within downstream Vorotan River Catchment	Water Supply from Spandaryan Reservoir is of **national** importance.	Kechut Reservoir has a large catchment, with the majority located outside of the Project area and therefore is **resilient** to changes in flow within the Project area.	Alternative supply to reservoir could potentially be sourced from adjoining catchments	High
Gndevaz Reservoir	Conveyor Catchment Area draining to HLF Detention Pond	East of the village of Gndevaz and north east of HLF, within Arpa River catchment	Water Supply from Gndevaz Reservoir is of **local** importance for irrigation and agriculture.	Gndevaz Reservoir is supplied from its' upstream drainage catchment and minor diversion from an adjacent catchment. **Susceptible** to changes in low flow within the Project area.	Water Supply could be replaced with troughs and piped water supply from adjoining catchments	Minor
Gndevaz Channel	BRSF Catchment Area	North and west of the Project Area, downgradient of the BRSF	Water transfer to fields near Gndevaz and the Gndevaz Reservoir from the Vorotan valley via the Gndevaz Channel is of **local** importance.	The Gndevaz Channel is undergoing reinstatement, anticipated to be completed during 2016. It is sourced from springs in the Vorotan valley outside of the Project area and the channel will be lined (disconnected from the local groundwater and surface water systems) and therefore the channel is generally **resilient** to changes in flow and quality within the Project area. **Susceptible** to changes in	Water transfer from the Vorotan River could be replaced with an equivalent channel or pipeline	Medium

Table 6.10.4: Receptor Sensitivity (Surface Water)						
Receptor	**Area**	**Location**	**Geographical Importance**	**Resilience to Change**	**Potential for Substitution**	**Receptor Sensitivity**
				quality in the event of overtopping of the BRSF toe pond.		
Wetland Ponds within Darb Tributaries including Benik's Pond	Pit Areas of Amulsar Peak and Catchment Area	Wetland ponds generally located within tributary head waters within the Darb River Catchment	**Local** importance for wildlife. Small number of wetland ponds within Project area.	Supplied by springs and surface water runoff. **Susceptible** to changes in low flow conditions within their catchment.	Cannot be substituted.	Minor
Wetlands within Vorotan Catchment	Wider Project Area	Wetland Areas alongside the Vorotan River and its tributaries (Figure 6.10.3)	Habitat of **regional** importance for wildlife (amphibian) habitat. Similar wetland habitat not abundant in surrounding landscape of Project area.	Supplied by springs and surface water runoff. **Susceptible** to changes in low flows within their catchment.	Cannot be substituted	Medium
Wetlands within Kechut Reservoir Tributaries	BRSF Footprint Area	Spring fed wetland within the BRSF site area	**Local** importance as wildlife habitat. Habitat area constitutes small proportion of similar habitat within Project area.	Supplied by springs and surface water runoff. **Susceptible** to changes in low flows within catchment.	Cannot be substituted	Minor

The major rivers (Arpa, Darb and Vorotan) are assigned a medium sensitivity, as they are of regional importance and reasonably resilient to changes in water quality and quantity.

The tributaries to the main rivers are susceptible to changes particularly in low flows within their catchment due to their small size. There is significant natural variation in high flows in response to snowpack melting and duration. The tributaries are of local importance and are relatively numerous. On this basis, they have been assigned a minor sensitivity. The tributaries to the Kechut Reservoir have been assigned a medium sensitivity as these provide flow to the Lake Sevan scheme (albeit only a small proportion).

The Kechut and Spandaryan Reservoirs are likely to be resilient to changes in the Project area, and are of national importance. Reservoirs of this size are not abundant in the region. On this basis they have been assigned a high sensitivity.

The Gndevaz Reservoir is of local importance for irrigation and agriculture and could potentially be substituted with a piped water supply from an adjoining catchment. Therefore, it has been assigned a minor sensitivity.

The Gndevaz Channel is currently being renovated and will be lined, preventing hydraulic connection to the local groundwater system. The channel would be at risk in the event of overtopping of the BRSF toe pond, which is located upgradient of the channel. The channel would not be at risk from the HLF and associated facilities, which are located downgradient. The channel has not been operational for some time but, following its reinstatement (due for completion during 2016), has the potential to be of local importance with regards to irrigation and water supply. Water from the Gndevaz Reservoir and associated Gndevaz channel is viewed as priority water for the Gndevaz community and as such will not be utilized by the Amulsar mine . Should the need arise to utilise some water from this source, within the Project, it would only be considered following full consultation with the local community and should full approval and authorisation has been granted to the Project. An alternative pipeline or channel could be substituted to convey water from the Vorotan valley, following a similar alignment to that of the current channel. On this basis, it is assigned a medium sensitivity.

Wetlands are found largely within the Vorotan Valley (as discussed within the Biodiversity Baseline Chapter 4.10.3) and are supported by groundwater seepage, springs and watercourses. The wetlands are likely to be susceptible to low flow changes (because they are subject to significant natural variation during high flows) within their catchment, are of local importance for wildlife, not abundant and cannot be substituted. On this basis they have been assigned a medium sensitivity.

The small wetland area identified within the Kechut Reservoir tributaries, lying within the BRSF footprint is of local importance for wildlife habitat and constitutes a small portion of similar wetland habitat locally (Chapter 6.11). Therefore, it has been assigned a minor sensitivity.

Small natural wetland ponds on the western side of Amulsar within the Darb tributary catchment which includes Benik's Pond have been assigned a minor sensitivity. They are of local importance, likely to be susceptible to changes within their catchment and potentially used as natural wildlife water supply and habitat.

6.10.5 Water Management

The design of the Project is presented in Chapter 3. The Project's overall water management strategy is to maintain, to the maximum extent where practicable, separation of non-contact water from contact water so as to minimise the need to contain water. Contact water will be utilised within the HLF as much as practicable and the surplus water from the BRSF will be treated in a Passive Treatment System (PTS, see Appendix 3.1) prior to land application or discharge to the Arpa River downstream of the planned water intake from the Arpa.

Management of water over the life of the mine is described in detail in the Surface Water Management Plan (SWMP) (Appendix 8.22). The objectives of the SWMP are:

- To route runoff to ponds and collection sumps in order to minimise the release of sediment;
- To minimise natural ground runoff and non-contact water from entering disturbed areas and mixing with contact water;
- To capture contact water runoff from the mine facilities, for re-use in the process;
- To treat excess contact water in a PTS to MAC II standards prior to discharge; and
- To minimise erosion of disturbed areas, and when erosion does occur, to minimise suspended sediment flow to streams.

Construction Phase

During construction, the SWMP focuses on management of surface water runoff and sediment control. Potentially impacted surface water will be routed to sediment ponds, via in-channel sediment management structures (check dams) prior to discharge to surface water. Additional best management practices, such as silt fences, straw wattles and erosion control mats will also be put in place to minimise erosion, reducing the sources of erosion and sediment generation. Water will be required for the construction camp, dust suppression and concrete production, amounting to 12.3 l/s, which will be sourced as follows:

- Benik's Pond;
- New collection ponds created on site; and
- Arpa River.

Benik's Pond will supply construction water at an estimated rate of 1.3 l/s during non-freezing months. The remaining demand not met by storage in non-contact water ponds and dams (PD-14, PD-12 and D-1) will be sourced from the Arpa River. The Arpa River will provide the early construction water demands until the non-contact water ponds are constructed and operational, after which time the Arpa River will only be used to supplement construction water demands, as required (Golder, 2016[1]).

Operational Phase

There will be three major water storage areas available to manage water in the Project area:

- The raw water pond (volume 20,450 m^3), which will receive runoff from the haul and access roads, and conveyor corridor;
- The HLF contact water pond (maximum volume approximately 1,280,000 m^3), which will receive discharge from the BRSF Toe Pond, and water from the pit sumps and truck shop storage pond; and
- Three storm ponds (maximum total volume approximately 630,000 m^3) downstream of the HLF, which will be used for active storage of process water during operations and also contain storm storage capacity.

A flow chart of water management during the operational phase is provided in Figure 6.10.2.

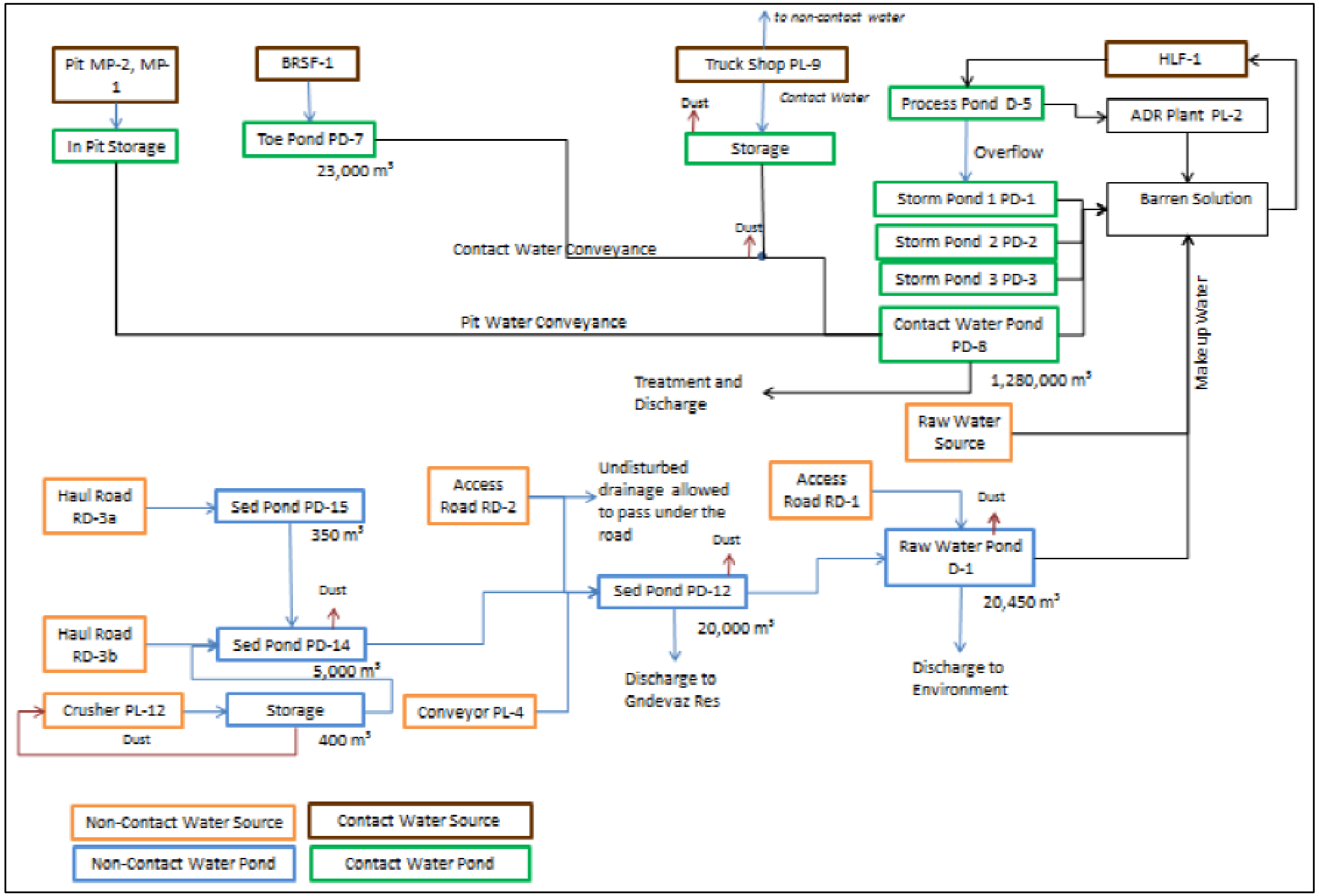

Figure 6.10.2: Flow Chart: Water Management During Operational Phase

During operations runoff from facilities areas, including haul roads, the ore conveyor and crushers, will be routed to sediment ponds, prior to discharge to surface water. The surface water design standard for non-contact water is the 100 year design standard plus a minimum 20% freeboard allowance (Golder, 2016[1]). Truck shop runoff will be routed to the Contact Water Pond (PD-8) and managed as contact water.

Runoff, and discharge via the basal drainage layer (leachate and underlying spring water) from the BRSF will be routed to a Toe Pond (PD-7) and then to the Contact Water Pond in the vicinity of the HLF. Any flow through the low permeability BRSF soil liner that escapes collection will potentially infiltrate to groundwater, as discussed in Section 6.9.

Water from the pits will be routed via in-pit sediment ponds and combined with the water in the Contact Water Pond. Snow removal will minimise the volume of contact water generated and maintain storage for extreme precipitation events.

The HLF Contact Water Pond will be used to supply make-up water for the HLF during operation. Water for HLF operations will be sourced from surface water collected and diverted through the HLF Storm Water Pond catchment areas, as well as from the Contact Water Pond and from the Arpa River. Storm Ponds located at the downstream extent of the HLF will be used to manage process water. Water from the Arpa River will be used as required for make-up.

Water balance modelling shows that after year 4 of operation the average water demand will be less than the volume of water collected in the Contact Water Pond (see Figure 3.21), hence there will be a need to treat and discharge water to the Arpa River. The discharge will be treated in a passive treatment syatem (PTS) to MAC II standards (see Appendix 3.1) prior to discharge to the Arpa River downstream of the proposed water intake.

The components of the PTS that will be constructed to the south of the contact water ponds, are described in Appendix 3.1 and include the following:

- Nitrate Reducing Biochemical Reactor (BCR);
- Aerobic Polishing Wetland (APW) No. 1;
- Sulphate Reducing BCR;
- Sulphide Scrubbing Unit;
- APW No. 2;

- Manganese Removal Beds (MRB); and
- A discharge pipe to the Apra River tributary located downgradient from the HLF.

The design assumptions for the PTS include.

- All flows are from the BRSF toe pond through the PTS are gravity fed;
- The PTS will treat 40 m^3 per hour (11.1 L/sec), includes a 30% safety factor.
- From year 5 of the operational phase, the seepage will be a blend of contact water from pit dewatering and BRSF seepage.
- Post-closure the seepage will be a blend of contact water and natural ground water flow occurring in the BRSF footprint that mixes with the contact water in the drains beneath the BRSF. Episodic seasonal flows will be moderated in the BRSF toe pond and in the contact water ponds, both of which will act as a flow equalization basin.
- Two sequential sets of biochemical reactors (BCRs) will be required. The first set will address elevated nitrate levels derived from blasting agent residue in the barren mine rock. The second set will address expected sulphate levels in the contact water. Outflow from the BCR will l be constructed in parallel, so that the system can be maintained as operational during maintenance
- The sulphide scrubber unit will be filled with a sacrificial metal such as iron provided from natural mineral source such as limonite or goethite [$Fe(OH)_3$], hematite [Fe_2O_3], magnetite [Fe_3O_4], or Zero valent iron (ZVI) derived from a local source of scrap iron such as steel food cans that can be obtained from recycling.

Prior to construction of the PTS a series of treatment trials will be undertaken, initially at laboratory-scale and then at bench- and field-scale. The feasibility will commence during 2016, with the objective of the full scale treatment system constructed and tested by 2020 and at least 12 months prior to the treatment of BSF seepage, through the contact water ponds within the HLF area. These trials will use local materials and will be under local climatic conditions to optimise the design and demonstrate that the treatment standards can be met. In the event that the treatment trials demonstrate that there is a risk the PTS may not meet the required MAC II standards, a conventional packaged active water treatment plant will be used.

Closure and Post-Closure Phases

Discharges to the environment during closure and post-closure will be as follows:

- From the HLF;
- From the BRSF; and
- From reclaimed areas, such as the pits and mine facility areas.

The discharge of post-closure residual waters from the BRSF will be treated to meet Category II MAC through the PTS (Golder, 20161) located in the vicinity of the HLF. Water will then be discharged to a series of infiltration galleries within the HLF catchment or to a tributary of the Arpa. The BRSF Toe Pond will be used to store and manage seasonal flows, controlling discharge to the PTS.

During the HLF drain down phase, water will go through active treatment before discharge to the environment. Following active treatment drain down water would pass to a second PTS, constructed adjacent to the BRSF PTS and re-using the storm water ponds to design the wetland system, to be used post-closure for the discharge from the HLF system in order to meet MAC II and/or baseline standards.

Surface water entering the closed open pits will infiltrate into the groundwater system.

A flow chart of water management during the closure phase is provided in Figure 6.10.3.

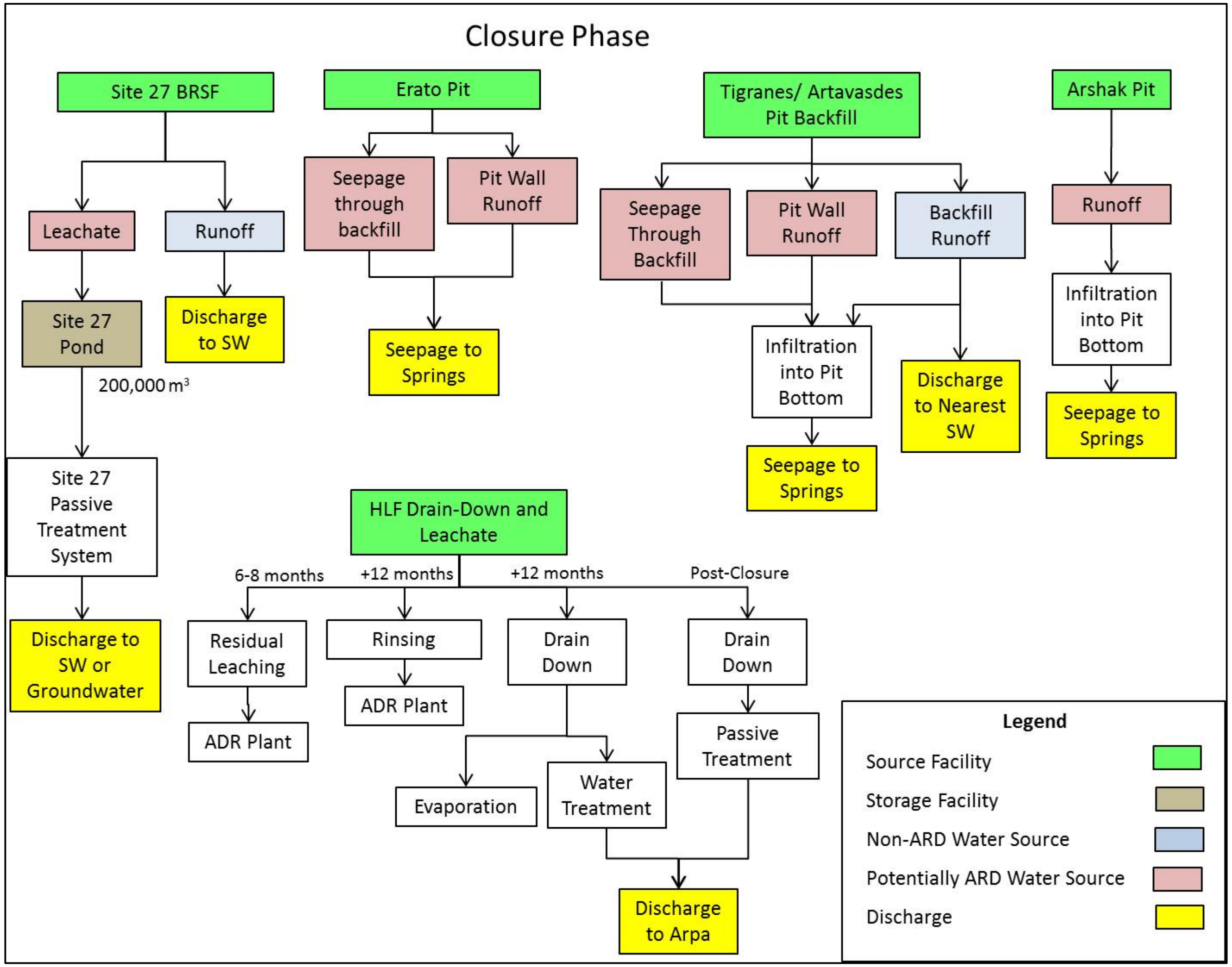

Figure 6.10.3: Flow Chart: Water Management During Closure Phase

6.10.6 Design Mitigation

Design mitigation considered in the potential impact assessment for each of the principal facilities is described below.

Pits

Contact water from the pit walls within the open pits has the potential to be impacted both by ARD and by ammonium and nitrate arising from the residue of ammonium nitrate based explosives. During operation, pit water will, if discharge standards are met, be discharged via sediment pond to the nearest watercourse (Figure 6.10.2).

However, this is not expected. In-pit mine-influenced water (contact water) will be pumped from the pits and transferred via pipeline to the Contact Water Pond near the HLF.

In closure, the Tigranes-Artavazdes pit will be backfilled with barren rock. The Tigranes-Artavazdes backfill will be covered with a store-and-release evaporative soil cover. The barren rock will comprise permeable loose mixed Upper Volcanics and Lower Volcanics and is estimated to have a permeability of approximately 1×10^{-4} m/s (BRSF Seepage Model, GRE, 2014[5]). The small South Artavazdes pit will only be partially backfilled and will allow infiltration of pit runoff.

In closure, the Erato pit will be partially backfilled with barren rock comprising permeable loose Non Acid Generating (NAG) Upper Volcanics estimated to have a permeability of more than 1×10^{-4} m/s. The backfill will not have a soil cover to allow infiltration of pit runoff into the backfill.

Material from the pits that is awaiting processing will be stored temporarily in stockpiles (Run-of-Mine/ROM piles). Run-off from these piles will be managed the same way as contact water and will be treated using sediment ponds. If water quality meets environmental standards it will be discharged to watercourses, otherwise it will be transferred to the HLF Contact Water Pond (Golder, 2016[3]).

[5] Global Resource Engineering (GRE), Ltd, 2014. Technical Memorandum, Amulsar BRSF Seepage Model. Reference 13-1064, 14 July 2014.

BRSF

The design of the BRSF will restrict Potentially Acid Generating (PAG) waste from coming into contact with water as much as possible, and use NAG barren rock to serve as a contact buffer between PAG material and the natural environment.

The engineered containment will comprise the following elements:

- The existing subsoil in the footprint of the BRSF will be compacted in place to act as a low-permeability soil liner. This soil liner will restrict infiltration and will direct water that comes into contact with the barren rock to the toe of the BRSF, where the outflow will be collected in the BRSF toe pond and then piped to the contact water pond for treatment and/or piped to the HLF for use or treated through a passive treatment system (PTS) and then discharged. At closure, all flow from the BRSF toe pond will continue to be piped to the contact water ponds, with overflow to the PTS (see Appendix 3.1);
- The design will inhibit natural groundwater from seeps and springs located beneath the prepared soil liner of the BRSF from coming into contact with PAG waste rock through placement of a NAG barren rock drainage layer over the compacted soil liner. Any water emanating through the foundation of the dump (from potential seeps and springs) will travel through this layer towards the toe of the facility. Seep and spring water beneath the BRSF will mix with leachate beneath the facility, consequently all flow from the drainage system will be mild ARD, which will be collected by the BRSF Toe Pond;
- The low grade ore stockpile is similar to NAG barren rock in terms of leachate chemistry (see Appendix 8.19) and will be treated as such (see above);
- PAG waste will be placed in engineered cells that will be surrounded by NAG waste on all sides. As a result, the PAG waste will be in contact with neither the bottom soil liner nor the atmosphere. Amulsar PAG waste consists of argillized rock and contains a significant clay fraction. This clay fraction makes the PAG a low-permeability material. As a result, water entering the body of the BRSF will flow preferentially through NAG waste that will be placed around the PAG cells;
- During operations all runoff and seepage will enter the BRSF Toe Pond, where it will be pumped to the Contact Water Pond, adjacent to the HLF. The BRSF Toe Pond will be sized to accommodate potential flood events to reduce the risk of overtopping and impact to the water quality of downgradient receptors, and appropriate monitoring of defined pond level trigger levels will be undertaken. The pipeline from the BRSF Toe Pond to the Contact Water Pond (contact water pipeline) is shown on Figure 3.21;

- The BRSF cover will be an engineered evapotranspiration (E/T) cover specifically designed for the conditions found at the site. The components of the cover from top to bottom will be: topsoil to provide a vegetative growth medium; a layer of naturally-compacted clay that will reduce the influx of water into the cover system; and a layer of gravel that will act as a capillary break between the cover soil and the waste rock of the dump. This cover will inhibit infiltration to the BRSF in the long term; and
- At closure/post closure, surface water runoff from restored surfaces will discharge to the environment, downstream of the BRSF (Figure 6.10.3).

HLF

The HLF will be supplied with water from the HLF Contact Water Pond and water recycled from the three Storm Ponds (Figure 6.10.2).

The HLF design incorporates engineered containment comprising:

- A composite liner beneath the heap leach pad;
- Underdrains beneath the leach pad footprint to drain groundwater/subsurface seepage to a collection sump located downgradient of the pad, where the underdrain discharge water quality will be monitored as required;
- A double liner system with intermediate leakage capture and recovery system underlying the solution pond(s);
- A two-phase active water treatment during the closure phase (HLF draindown) of the facility. The first phase will reduce cyanide concentrations in the leach solution, and the second active phase will treat excess HLF solution (which contains elevated sulphate) until the flow decreases to the level suitable for passive treatment;
- Passive water treatment during operation and post closure with discharge downstream into the Arpa River;
- Placement of an engineered evapotranspiration cover following closure to minimise infiltration to and seepage from the heap in closure. This will comprise cover soils overlying a compacted clay cap. The underlying HLF materials will act as a capillary break; and
- Surface water runoff from reclaimed areas will discharge to the environment, downstream of the HLF.

See Figure 6.10.3 for the water management process post closure.

Infrastructure, Other Facilities and Surface Water Management

In addition to the design mitigation outlined above for the key facility areas, the management mitigation measures presented in the SWMP (Appendix 8.22) will be used to avoid or limit the effects of potential impacts to the hydrologic environment. The management mitigation measures that are considered in this assessment include:

- Management of runoff and seepage during construction;
- Minimum 110 % tank capacity of bunds for storage of fuel/oils;
- Regular maintenance of vehicles and mobile equipment including regular inspection for leaks;
- Surface water management including diversion drains and sediments ponds designed to manage the 100 year storm event plus a minimum 20% freeboard allowance;
- Training of personnel in the need to manage and control spills, and sediment runoff;
- Collection of sewage effluent in septic tanks, with residual solid waste removed to landfill, septic tank system to leach field;
- As well as the SWMP, the ESMP (Chapter 8) includes a Spill Prevention and Response Plan (incorporated in the Emergency Preparedness and Response Plan, EPRP) and a Cyanide Management Plan. These plans include management measures to control risks associated with cyanide, hydrocarbons, and other chemicals on site; and
- Reclamation will include seeding of topsoil stockpiles, and disturbed areas (as much as practical) with a cover crop to minimize wind and water erosion. After top-soiling of the final reclamation, an area will be seeded to establish a stubble crop and then reseeded with grasses the next growing season using an approved mix of live seed of native species.

In addition, a groundwater and surface water monitoring plan will be implemented during operational and closure phases. The purpose of the monitoring will be to evaluate the operational performance of the Project and identify any adverse trends in surface water and groundwater quality or quantity that would require the implementation of modifications to the mitigation measures.

6.10.7 Surface Water Impacts (Design Mitigation Only)

This section presents a discussion on the potential impacts to surface water as a result of the Project; the method of assessment; and the magnitude of the impacts, accounting for mitigation measures implicit in the Project design. Impact significance and scale of significance have been assigned using the matrices in Chapter 6.1 (Tables 6.1.3 and 6.1.4).

The potential impacts fall into the two broad categories of change in water quantity and change in water quality.

Construction Phase

During construction of the mine facilities there is the potential for impacts to surface water receptors. Surface water diversions and sediment ponds will be constructed at commencement of the construction phase. The ponds will detain and release water to the catchments without resulting in adverse increase in streamflow that would result in channel scour and erosion. The predicted reduction in surface water catchment area within the Project area during construction are provided in Table 6.10.5. This table should be read with reference to Figure 6.10.1 which identifies the potentially affected catchment areas.

Table 6.10.5: Predicted Surface Water Receptor Catchment Reductions (Construction)

Receptor	% Reduction in Catchment Area
Kechut Reservoir Tributaries	0%
Arpa River Downstream of Kechut Reservoir	<1%
Arpa River Tributaries Downstream of Kechut Reservoir	0%
Arpa River Tributaries HLF Area	28%
Darb River	0%
Darb River Tributaries	0%
Vorotan River	0%
Vorotan River Tributaries	0%
Kechut Reservoir	0%
Spandaryan Reservoir	0%
Gndevaz Reservoir	0%
Gndevaz Channel	0%
Wetland Ponds within Darb Tributaries including Benik's Pond	0%
Wetlands within Vorotan Catchment	0%
Wetlands within Ketchut Reservoir Tributaries	Wetlands within the BRSF footprint will be progressively covered. There will be only minor direct effects during construction – the majority of impacts will be during operations. No other wetland loss in the Ketchut Reservoir tributaries.

It is expected there will be negligible reduction of runoff for a majority of the receptors as diversion channels and sediment pond catchments will return water to the surface water catchments. Dewatering of the pits in advance of mining is not required. Therefore, spring

flows depending on groundwater will not be impacted and no loss of baseflow to surface water receptors from groundwater is expected (Chapter 6.9).
However there will be a minor impact to the ephemeral and perennial spring-fed wetland and downstream tributary within the BRSF area. Spring flow will be captured within this facility and used within the HLF process system.

The effect on the groundwater component of surface water baseflow in rivers and tributaries within the Project area is considered to be negligible (Chapter 6.9).

Arpa River, Kechut Reservoir, Arpa River and Kechut Reservoir Tributaries and Gndevaz Reservoir and Channel
The construction of the mine facilities will result in a negligible reduction in the surface water catchment areas (and thus reduction in runoff) in the upper reaches of most tributaries to the Arpa (including those upstream of the Gndevaz Reservoir) and Kechut Reservoir, therefore the change in water quantity is considered to be negligible. The construction of the HLF Contact Water Pond will lead to the loss of a low-flowing and seasonal Arpa tributary and a temporary reduction of catchment area (during mine construction and operation), which is considered to be a moderate impact. However downstream the impact is considered negligible as the tributary water quantity contribution to the Arpa is minimal (<1%). Construction of the BRSF will not reduce the receiving tributary catchment area nor present a risk to the Gndevaz Channel until mine operations commence (though diversions will be in place), therefore the change is considered **negligible**.

In addition, water abstraction for construction supply will reduce low flow in the Arpa River downstream of the Kechut Reservoir by less than 1% (up to 12.3 l/s) with a lower percentage flow reduction during high flows.

There will be no loss of catchment area within the tributaries of the Project area upstream of the Kechut Reservoir leading to a negligible change in water quantity contribution to the reservoir.

Due to vegetation removal, sediment load transported into receiving waters may increase. Although the existing ground cover is minimal, particularly at high-risk periods during the spring snowmelt period when highest runoff rates are observed, construction activities will adhere to the SWMP. This may include minimising the extent of vegetation removal and constructing sediment ponds where required. Further information on measures to protect soil and vegetative cover are presented in the soil and land cover impact assessment Chapter 6.8. The magnitude of impact to water quality is considered to be **negligible**.

Plant and machinery used in the construction of the various site facilities will require storage and use of various oils, lubricants, chemicals and fuel. Given the planned protective measures and good international industry practice (GIIP) that will be implemented, any spillage will be minor and the impact on receiving waters in the upper reaches of the Arpa tributaries will be **negligible**. Any spillage will be quickly remediated. Localised small spills are unlikely to result in measurable changes to baseline conditions in larger watercourses, such as the Arpa.

Darb River, Darb River Tributaries and Wetland Ponds (including Benik's Pond)

The potential construction phase water quantity and water quality impacts to the Darb, Darb tributaries and headwater surface water ponds are the same as those identified for the Arpa i.e. **negligible** impact to water quality in the Darb, **negligible** impact to water quantity for Darb tributaries and wetland ponds (excluding Benik's Pond), and **negligible** impact to water quality for all receptors. Impact to water quantity of Benik's Pond due to seasonal water abstraction (estimated 1.3 l/s during non-freezing months) for construction supply is considered to be **minor**. The associated impacts to ecological receptors are considered in Chapter 6.11.

Vorotan River, Vorotan River Tributaries and Spandaryan Reservoir

The potential construction phase water quantity and water quality impacts are the same as those identified for the Arpa and the Kechut Reservoir.

No water abstraction for construction supply will take place from the Vorotan River.

Wetlands within Vorotan Catchment and Kechut Reservoir Tributaries

There will be a **negligible** impact on wetland areas located adjacent to the Vorotan River and its tributaries during construction. No significant reduction of groundwater flow to the wetlands is expected during the construction period and reduction of surface water catchment area is considered to be negligible. The impact to water quality is also considered to be **negligible** due to implementation of engineering measures and GIIP. The wetland within the BRSF site area (located at the headwaters of a tributary of the Kechut Reservoir) will be lost as a result of construction. There are other equivalent wetland habitats within the Project area (see Biodiversity Impact Assessment, Chapter 6.11) and therefore the impact is considered **moderate**.

A summary of the impacts, magnitude, significance of impact and scale of significance is presented in Table 6.10.6.

Table 6.10.6: Potential Surface Water Impacts (Construction) and Significance of Impact (considering Design Mitigation Measures)					
Receptor	**Receptor Sensitivity**	**Potential Impact**	**Magnitude of Impact**	**Impact Significance**	**Scale of Significance**
Kechut Reservoir Tributaries	Medium	Reduction in flow as a result of catchment area reduction.	Negligible	Negligible	Not Significant
		Reduction in water quality as a result of accidental spillages and sediment released from construction areas.	Negligible	Negligible	Not Significant
Arpa River Tributaries HLF Area	Minor	Reduction in flow as a result of catchment area reduction.	Moderate	Minor	Not Significant
		Reduction in water quality as a result of accidental spillages and sediment released from construction areas.	Negligible	Negligible	Not Significant
Arpa River Downstream of Kechut Reservoir	Medium	Decrease in flow as a result of water extraction	Negligible	Negligible	Not Significant
Darb River	Medium	Decrease in flow as a result of catchment area reduction.	Negligible	Negligible	Not Significant
		Decrease in water quality as a result of accidental spillages and sediment released from construction areas.	Negligible	Negligible	Not Significant
Darb River Tributaries	Minor	Decrease in flow as a result of catchment area reduction.	Negligible	Negligible	Not Significant
		Decrease in water quality as a result of accidental spillages and sediment released from construction areas.	Negligible	Negligible	Not Significant
Vorotan River	Medium	Decrease in flow as a result of catchment area reduction..	Negligible	Negligible	Not Significant
		Decrease in water quality as a result of accidental spillages and sediment released from construction areas.	Negligible	Negligible	Not Significant
Vorotan River Tributaries	Minor	Decrease in flow as a result of catchment area reduction.	Negligible	Negligible	Not Significant

Table 6.10.6: Potential Surface Water Impacts (Construction) and Significance of Impact (considering Design Mitigation Measures)					
Receptor	**Receptor Sensitivity**	**Potential Impact**	**Magnitude of Impact**	**Impact Significance**	**Scale of Significance**
		Decrease in water quality as a result of accidental spillages and sediment released from construction areas.	Negligible	Negligible	Not Significant
Kechut Reservoir	High	Decrease in flow as a result of catchment area reduction.	Negligible	Minor	Not Significant
		Decrease in water quality as a result of accidental spillages and sediment released from construction areas.	Negligible	Minor	Not Significant
Spandaryan Resevoir	High	Decrease in flow as a result of catchment area reduction.	Negligible	Minor	Not Significant
		Decrease in water quality as a result of accidental spillages and sediment released from construction areas.	Negligible	Minor	Not Significant
Gndevaz Reservoir	Minor	Decrease in flow as a result of catchment area reduction.	Negligible	Negligible	Not Significant
		Decrease in water quality as a result of accidental spillages and sediment released from construction areas.	Negligible	Negligible	Not Significant
Gndevaz Channel	Medium	Decrease in flow as a result of catchment area reduction.	Negligible	Negligible	Not Significant
		Decrease in water quality as a result of overtopping of the BRSF Toe Pond.	Minor	Minor	Not Significant
Wetland Ponds within Darb Tributaries including Benik's Pond	Minor	Decrease in flow as a result of catchment area reduction and decrease in spring flow.	Negligible	Negligible	Not Significant
		Decrease in water quantity within Benik's Pond as a result of seasonal water abstraction.	Minor	Negligible	Not Significant
		Decrease in water quality as a result of accidental spillages and sediment released from construction areas.	Negligible	Negligible	Not Significant

Table 6.10.6: Potential Surface Water Impacts (Construction) and Significance of Impact (considering Design Mitigation Measures)					
Receptor	**Receptor Sensitivity**	**Potential Impact**	**Magnitude of Impact**	**Impact Significance**	**Scale of Significance**
Wetlands within Vorotan Catchment	Medium	Decrease in flow as a result of catchment area reduction and decrease in spring flow.	Negligible	Negligible	Not Significant
		Decrease in water quality as a result of accidental spillages and sediment released from construction areas.	Negligible	Negligible	Not Significant
Wetlands within Ketchut Reservoir Tributaries	Minor	Decrease in flow as a result of catchment area reduction and decrease in spring flow.	Moderate	Negligible	Not Significant
		Decrease in water quality as a result of accidental spillages and sediment released from construction areas.	Negligible	Negligible	Not Significant

Operational Phase

The operational phase includes the development of the pits and stockpiles and operation of the key mining facilities. Detention ponds, sediment ponds and access roads will be constructed prior to operation, and utilised during operations. Operational surface water management is discussed in Section 6.10.5.

Water extraction and reduction of catchment areas will reduce flows in streams and rivers. In addition, the lining of specific facilities (HLF, ponds, etc.) will result in less recharge to the groundwater system below the facilities and consequently lower groundwater levels leading to a reduction in baseflow to springs, streams and rivers, as discussed further in Chapter 6.9. Accidental uncontrolled releases from the HLF, BRSF (including backfilled pits), roads and stockpiles has the potential to impact surface water quality.

The predicted reduction in surface water catchment area and baseflow contribution from perennial springs for receptors during operations are provided in Table 6.10.7. The predicted reduction in groundwater flow to the baseflow component within main rivers and reservoirs is based on the proportion of the impacted catchment within the Project area compared with the total catchment area for the receptor. Impacts to groundwater flow specifically within the Project area are discussed in Chapter 6.9.

Table 6.10.7: Predicted Surface Water Receptor Catchment Reductions (Operations)

Receptor	% Reduction in Catchment Area	% Reduction in Groundwater Flow Contribution to Baseflow*
Kechut Reservoir Tributaries	19% for BRSF tributary or 8% of total within Project area	10% for BRSF tributary and tributaries fed by Madikenc springs or 2% of total
Arpa River Downstream of Kechut Reservoir	<1%	<1%
Arpa River Tributaries Downstream of Kechut Reservoir	0%	2%
Arpa River Tributaries HLF Area	28%	2%
Darb River	<1%	<1%
Darb River Tributaries	1% of total (due to pit)	up to 36% for individual tributaries, <10% total.

Table 6.10.7: Predicted Surface Water Receptor Catchment Reductions (Operations)		
Receptor	**% Reduction in Catchment Area**	**% Reduction in Groundwater Flow Contribution to Baseflow***
Vorotan River	<1%	<1%
Vorotan River Tributaries	4% of total (due to pit)	3% to 24% for individual tributaries, <10% total.
Kechut Reservoir	0%	<1%
Spandaryan Reservoir	<1%	<1%
Gndevaz Reservoir	0%	<1%
Gndevaz Channel	0%	<1%
Wetland Ponds within Darb Tributaries including Benik's Pond	<1% to 20% for individual ponds. 11% for Benik's Pond.	up to 13% for individual tributaries
Wetlands within Vorotan Catchment	<1%	3%
Wetland within Kechut Reservoir Tributaries	Wetlands within the BRSF footprint will be progressively covered. There will be only minor direct effects during construction – the majority of impacts will be during operations . No other wetland loss in the Ketchut Reservoir tributaries.	All spring flow within BRSF area captured and used in HLF process.
Notes: *Groundwater Modelling Study (Golder 2014[6])		

Dewatering of the pits is likely to result in a reduction in flow in some of the high-elevation perennial springs on Amulsar (surfacing in the elevation band of 2500 to 2900 m) located in proximity to the pits, which may potentially lead to some springs becoming ephemeral with dry periods during the winter.

Potential operational phase impacts on each receptor are discussed in the following sections.

[6] Appendix 6.9.1 - Golder Associates, 2014. Groundwater Modelling Study. Report Reference 14514150095.506/B.1, 21 August 2014.

Kechut Reservoir and Tributaries

The BRSF will reduce the size of the surface water catchment within the Kechut Reservoir tributaries. The magnitude of the impact is considered **low** as the total catchment size of tributaries will be reduced by approximately 8 %.

The magnitude of impact to the Kechut Reservoir is considered **negligible** as the large size of the total catchment flowing to the Kechut Reservoir (in comparison to the very small surface water loss) provides a significant buffer against any potential flow losses including those from the perennial springs within the BRSF area and the Madikenc springs. The BRSF Toe Pond is sized to accommodate the 1:100 year event and all runoff from the BRSF will be piped to the Contact Water Pond in the vicinity of the HLF.

Accidental uncontrolled releases (for example during extreme storm events) from the BRSF could reduce pH and increase metal and nitrate concentrations in surface water, particularly during first flush events. Surface water runoff will be managed by the BRSF Toe Pond (a lined pond), which will also capture seepage from the basal drainage layer within the BRSF. Water from the BRSF Toe Pond will be piped to the HLF Contact Water Pond for use in the HLF or for treatment and discharge to the Arpa at MAC II standards. As a result the magnitude of the impact to water quality will be **negligible**.

Arpa River, Arpa Tributaries Downstream of Kechut Reservoir and Arpa Tributaries HLF Area

The HLF and upstream catchment, including HLF Detention Pond, maximise the reuse of intercepted water, consequently there will be a significant temporary loss of catchment contributing to downstream surface runoff. From year 5 of operation there will be an excess of water, which will be treated to MAC II standards prior to discharge to the Arpa River downstream of the proposed water intake. Prior to construction of the PTS a series of treatment trials will be undertaken, initially at laboratory-scale and then at bench- and field-scale. These trials will use local materials and will be under local climatic conditions to optimise the design and demonstrate that the treatment standards can be met. In the event that the treatment trials demonstrate that there is a risk the PTS may not meet the required MAC II standards a conventional packaged active water treatment plant will be used.

To minimise the volume of water managed in the HLF Contact Water Pond, non-contact water in the catchment north of the ore conveyor will be routed around the pond and into the spillway, discharging downstream of the HLF. Spring flow surfacing beneath the facility liner will be collected in a sump and continue to be released to surface water provided it meets discharge requirements, albeit further downstream. Captured spring flow not meeting discharge requirements (i.e. MAC II standards) will be recirculated within the HLF.

The impact in the Arpa tributaries within the HLF Area is considered **moderate** and downstream in the Arpa the impact is considered **negligible**. The water quantity contribution to the Arpa is minimal (<1%) and baseflow in the Arpa is expected to reduce by no more than 1% (noting that the discharge from the PTS from year 5 onwards represents ~0.5% of the estimated low flow in the Arpa). Arpa tributaries downstream of Kechut Reservoir will have no appreciable loss in catchment size, however baseflow contribution from springs may reduce by up to 2% and on this basis the impact is considered **low**.

The HLF Contact Water Pond is designed as a zero discharge facility for events up to the 1:100 year rainfall event until year 5 of operation. After year 5, discharge at a rate of up to $40m^3$/hour (~11 L/s) will be treated to MAC II standards prior to discharge to the Arpa downstream of the water supply intake. To manage the flood risk the spillway will have a capacity for 1:1,000 year events. Storm Ponds will also have the capacity to manage the 1:100 year events. Excess water will be pumped back to the HLF for leaching.

The water supply for the mine will be pumped from the Arpa River, downstream of the fish farms. Make-up water is required in the dry months (January to March and July to December) of most years and increases during the last two years of mining operations because pit dewatering is no longer a source of water. The average pumping rate is estimated to be less than 2% of the baseflow during low flow periods and less than 4% of the low flow baseflow during peak pumping periods. The magnitude of impact as a result of pumping water from the Arpa is **low**.

To mitigate the risk of mining-influenced water entering the environment, the HLF, Storm Ponds and HLF Contact Water Pond will be lined. Water in the HLF Contact Water Pond, which includes water piped from the BRSF and pits, and surface water runoff from the catchment upstream of the HLF, will be recycled through the process. Excess water not used in the HLF will be treated in the PTS and discharged as described above.

During extreme hydrologic events, contact water would be significantly diluted with precipitation/snowmelt and background runoff water. Storm Ponds and the Contact Water

Pond will be used for extreme event storage and will be used to cycle water onto the HLF to increase available water storage if required. While an unmitigated release of cyanide containing water during operations would be potentially harmful to the downstream surface water environment, the design mitigation measures, procedures and management measures in place to address this risk are very robust. Consequently the likelihood of such an occurrence is considered extremely low. Details of the procedures that will be in place to address cyanide control are presented in the Cyanide Management Plan (Appendix 8.11). The magnitude of the impact to water quality during operations is therefore considered **low**.

Little or no surface water flow was observed in the HLF catchment during the baseline monitoring period, consequently any leakage from the HLF may not appear in the watercourse downstream. Should it occur and given the hydrogeological conditions, surface water will be similar to groundwater quality, potentially containing elevated nitrate, sodium and ammonium concentrations (Golder, 2014[7]). Should these conditions occur, modifications to the leach system operations, repairs to the liner or other engineering mitigation measures such as a sump and/or pump-back system will be constructed to collect and reuse the water thus mitigating this impact (SGS, 2014[8]). The magnitude of impact is considered **negligible**.

Any leakage from the HLF entering the Arpa River via groundwater pathways will not lead to a significant change in water quality in the Arpa River. No measurable change is predicted for the majority of parameters, including cyanide. A small measurable change in nitrate, sodium and ammonium may occur, however all changes will be below MAC II standards. The magnitude of impact is **low**.

Gndevaz Reservoir

Sediment ponds will manage surface water runoff from the ore conveyor corridor footprint and access roads running through the Gndevaz Reservoir catchment before discharging to the environment, with negligible reduction of catchment to the downstream environment. The drainage system has been designed for 1:100 year design events. The water quality and quantity magnitude of impact is considered **negligible**.

7 Appendix 6.9.4 - Golder Associates, 2014. Hydrogeological Risk Assessment Proposed Heap Leach Facility. Report Reference 14514150095.509, August 2014.

8 SGS Metcon/KD Engineering, 2014. Amulsar 43-101 Feasibility Study, Reference Q439-07-028-01 August 2014

Gndevaz Channel

Impact upon water quantity witin the Gndevaz Channel (once reinstated and functional) is considered **negligible** during the operational phase, as the channel will be lined and raised so as to be essentially isolated from the local surface water and groundwater systems which may be affected by the Project. Additionally, the area of the Vorotan valley from which the channel receives water is upstream of the Project area. The greatest perceived risk to the Gndevaz Channel (once reinstated and functional) during the operational phase is considered to be from an accidental uncontrolled release from the BRSF Toe Pond during an extreme event, causing a potential impact to the water quality within the channel. Appropriate design mitigation will include appropriate sizing of the Toe Pond to accommodate potential flood events; and monitoring of pond level trigger levels. The magnitude of impact to water quality during operations is considered **moderate**.

Darb River Tributaries, Darb River and Wetland Ponds including Benik's Pond

The upper section of the ore conveyor corridor, access roads, pits and the crusher are located in the upper reaches of Darb River tributaries. There will be a progressive decrease in the Darb River catchment area as the pits are mined. Overall, the reduction in catchment area is minimal. The magnitude of impact to the Darb is considered **negligible** as the relatively large size of the Darb outside of the Project area provides a significant buffer against any potential flow losses. Impact to the Darb River tributaries is considered **moderate** as the total reduction in catchment area is <1%, and perennial spring flow contributing to tributary baseflow may decrease by to 10 to 36% (significant during low flow periods).

The decrease in the catchment area providing runoff to Benik's Pond and other wetland ponds is significant and reduction of perennial spring flow is anticipated due to dewatering of the pits (Chapter 6.9). There will be a reduction in catchment area of up to 20% to three small wetland ponds in the tributaries upstream of Benik's Pond. Therefore, in terms of water quantity, the magnitude of the impact is considered **moderate**.

Sediment ponds located west of the crusher and Tigranes-Artevasdes Pit will mitigate potential increases in sediment loads from these areas before discharging to the environment. The sediment ponds and drainage system are designed for the 1:100 year design events and will be monitored prior to discharge.

Surface water runoff and groundwater pumped from the pit sumps will be treated by a double sediment pond system. In-pit sediment ponds will provide initial treatment and will discharge to the drainage system surrounding the pits if discharge standards are met (i.e. MAC II standards and/or baseline). Mining-influenced water in the pit and water that fails to meet MAC II standards will be piped to the BRSF Pond. Pumping of water accumulating in the pits will minimise the potential for mining-influenced water to reach springs and nearby surface water on Amulsar. Therefore impacts are expected to be **low**.

Vorotan River Tributaries, Vorotan River and Spandaryan Reservoir

Impacts to the Vorotan River are expected to be similar to those presented for the Darb River i.e. a **negligible** impact to water quantity and a **low** impact to water quality. The Vorotan River tributaries are expected to have a moderate impact due to the loss of catchment from expansion of the pits during operation and reduction in groundwater flow to baseflow. The Spandaryan Reservoir is located a significant distance downstream of Amulsar, consequently catchment area losses are insignificant, and any water quality changes will be minor and not measurable in the Spandaryan Reservoir. Impacts to the Spandaryan Reservoir are **negligible**.

Wetlands within Vorotan Catchment and Kechut Reservoir Tributaries

Wetland areas located adjacent to the Vorotan River and tributaries are considered to have a **low** impact during operations. Reduction of groundwater baseflow to the wetland areas within the Vorotan catchment is expected to be approximately 3% in total and reduction of surface water catchment area is minimal. Impact to water quality is considered to be **negligible** because mining-influenced water will not be released to the catchments unless extreme hydrological events occur.

The wetland within the BRSF site area (within Kechut tributaries) will be lost as a result of construction of the BRSF, however there are other equivalent wetland habitats within the Project area and therefore the impact is considered **moderate**. Impact to water quality is expected to be **low** because any spring water will be collected for use in the leaching process.

A summary of the impacts, magnitude, significance of impact and scale of significance can be found in Table 6.10.8. Scale of significance to all surface water receptors during mine operations is considered **not significant**.

Table 6.10.8: Potential Surface Water Impacts (Operations) and Significance of Impact (considering Design Mitigation Measures)

Receptor	Receptor Sensitivity	Potential Impact	Magnitude of Impact	Impact Significance	Scale of Significance
Kechut Reservoir Tributaries	Medium	Decrease in flow as a result of catchment area reduction and spring flow decrease.	Low	Minor	Not Significant
		Decrease in water quality as a result of accidental uncontrolled release from BRSF.	Negligible	Negligible	Not Significant
Arpa River Downstream of Kechut Reservoir	Medium	Decrease in flow as a result of catchment area reduction and water extraction.	Low	Minor	Not Significant
		Decrease in water quality as a result of accidental uncontrolled release from HLF and HLF Detention Pond	Low	Minor	Not Significant
Arpa River Tributaries Downstream of Kechut Reservoir	Minor	Decrease in flow as a result of catchment area reduction and spring flowdecrease.	Low	Negligible	Not Significant
		Decrease in water quality as a result of accidental uncontrolled release from HLF and HLF Detention Pond.	Low	Negligible	Not Significant
Arpa River Tributaries HLF Area	Minor	Decrease in flow as a result of catchment area reduction and spring flow decrease.	Moderate	Minor	Not Significant
		Decrease in water quality as a result of accidental uncontrolled release from HLF and HLF Detention Pond.	Low	Negligible	Not Significant
Darb River	Medium	Decrease in flow as a result of catchment area reduction and spring flow decrease.	Negligible	Negligible	Not Significant
		Decrease in water quality as a result of accidental uncontrolled release during an extreme event from Haul Road, Pit and Crusher Sediment Ponds.	Low	Minor	Not Significant
Darb River Tributaries	Minor	Decrease in flow as a result of catchment area reduction and spring flow decrease.	Moderate	Minor	Not Significant

Table 6.10.8: Potential Surface Water Impacts (Operations) and Significance of Impact (considering Design Mitigation Measures)					
Receptor	**Receptor Sensitivity**	**Potential Impact**	**Magnitude of Impact**	**Impact Significance**	**Scale of Significance**
		Decrease in water quality as a result of accidental uncontrolled release during an extreme event from Haul Road, Pit and Crusher Sediment Ponds.	Low	Negligible	Not Significant
Vorotan River	Medium	Decrease in flow as a result of catchment area reduction and spring flow decrease.	Negligible	Negligible	Not Significant
		Decrease in water quality as a result of accidental uncontrolled release during an extreme event from Haul Road, sediment ponds and mining-influenced water from the pits.	Low	Minor	Not Significant
Vorotan River Tributaries	Minor	Decrease in flow as a result of catchment area reduction and spring flow decrease.	Low	Negligible	Not Significant
		Decrease in water quality as a result of accidental uncontrolled release during an extreme event from Haul Road, sediment ponds and mining-influenced water from pits.	Low	Negligible	Not Significant
Kechut Reservoir	High	Decrease in flow as a result of catchment area reduction and spring flow decrease.	Negligible	Minor	Not Significant
		Decrease in water quality as a result of accidental uncontrolled release from BRSF.	Negligible	Minor	Not Significant
Spandaryan Resevoir	High	Decrease in flow as a result of catchment area reduction and spring flow decrease.	Negligible	Minor	Not Significant
		Decrease in water quality as a result of release from Haul Road, sediment ponds and mining-influenced water from the pits.	Negligible	Minor	Not Significant
Gndevaz Reservoir	Minor	Decrease in flow as a result of catchment area reduction.	Negligible	Negligible	Not Significant

Receptor	Receptor Sensitivity	Potential Impact	Magnitude of Impact	Impact Significance	Scale of Significance
		Decrease in water quality as a result of accidental uncontrolled release from Haul Road sediment ponds.	Low	Negligible	Not Significant
Gndevaz Channel	Medium	Decrease in flow as a result of catchment area reduction.	Negligible	Negligible	Not Significant
		Decrease in water quality as a result of accidental uncontrolled release from the BRSF Toe Pond during an extreme event.	Moderate	Moderate	Not Significant
Wetland Ponds within Darb Tributaries including Benik's Pond	Minor	Decrease in flow as a result of catchment area reduction and spring flow decrease.	Moderate	Minor	Not Significant
		Decrease in water quality as a result of accidental uncontrolled release from Haul Road, sediment ponds and mining-influenced water from pits.	Low	Negligible	Not Significant
Wetlands within Vorotan Catchment	Medium	Decrease in flow as a result of catchment area reduction and spring flow decrease.	Negligible	Minor	Not Significant
		Decrease in water quality as a result of accidental uncontrolled release from Haul Road, sediment ponds and mining-influenced water from the pits.	Negligible	Minor	Not Significant
Wetlands within Kechut Reservoir Tributaries	Minor	Decrease in flow as a result of catchment area reduction and spring flow decrease.	Moderate	Minor	Not Significant
		Decrease in water quality as a result of accidental uncontrolled release during an extreme event from the BRSF.	Low	Negligible	Not Significant

Table 6.10.8: Potential Surface Water Impacts (Operations) and Significance of Impact (considering Design Mitigation Measures)

Closure and Post-Closure Phase

Mine closure will impact water quality and quantity at surface water receptors. Reduction of catchment area may continue to reduce flows in streams and rivers; and covering of the BRSF and HLF with a store-and-release evaporative soil cover will result in decreased runoff in these catchments. Reduced recharge over parts of the Project area will lead to a reduction in baseflow to springs, streams and rivers. Accidental uncontrolled and/or untreated releases from the HLF and BRSF (including backfilled pits), have the potential to impact surface water quality.

The closure phase will include partial backfill of the Tigranes-Artavazdes and Erato pits (Section 6.10.6 and Golder 2014[9]). No permanent open water is predicted within the closed pits. The BRSF will be capped with an engineered cover to inhibit infiltration. Runoff from the facility (non-contact) will be to the downstream Kechut Reservoir tributary. Section 6.10.5 describes the closure treatment cycles of the HLF. Upon closure a second HLF PTS will be constructed by reusing the HLF Storm Ponds, which will be re-purposed and become part of the wetland system. Negligible impact to receptor catchments is expected post-closure as surface water will discharge to the environment from the pits, HLF and BRSF. Two passive treatment systems will operate on site until any discharge from the BRSF and HLF, separately, to meet MAC II standards unaided.

Other mine facilities and infrastructure will be demolished, where appropriate, and project-impacted areas will be stabilised and reclaimed. Surface water runoff from reclaimed areas will discharge to the environment following sediment management in ponds during the closure phase and directly during post-closure when reclamation of these areas is complete.

Surface water control features will be maintained for closure and post-closure activities to minimise erosion in reclaimed areas and to minimise the transport of sediment in surface water runoff.

[9] Golder Associates, 2014. Preliminary Mine Reclamation, Closure and Rehabilitation Plan 1138159714 009 R2, 19 August 2014

The predicted reduction in surface water catchment area and baseflow contribution from groundwater (perennial springs) for receptors during closure and post-closure are provided in Table 6.10.9

Table 6.10.9: Predicted Surface Water Receptor Catchment Reductions (Closure and Post-Closure)

Receptor	% Reduction in Catchment Area	% Reduction in Groundwater Flow Contribution to Baseflow*
Kechut Reservoir Tributaries	0%	1 to 6% for BRSF tributary and 7-8% for Madicenk Springs, or 2% of total.
Arpa River Downstream of Kechut Reservoir	0%	<1%
Arpa River Tributaries Downstream of Kechut Reservoir	<1% Closure 0% Post-Closure	2%
Arpa River Tributaries HLF Area	28% Closure 0% Post-Closure	2%
Darb River	<1% (due to pits)	<1%
Darb River Tributaries	<1% of total (due to pits)	1% for all tributaries or up to 20% for individual perennial springs at the head of catchments
Vorotan River	<1%	<1%
Vorotan River Tributaries	1% of total (due to pits)	11% to 21% for tributary east of the BRSF, 1 to 6% for other tributaries
Kechut Reservoir	0%	<1%
Spandaryan Reservoir	<1%	<1%
Gndevaz Reservoir	0%	<1%
Gndevaz Channel	0%	<1%
Wetland Ponds within Darb Tributaries including Benik's Pond	<10% for individual ponds.	1% to 6%
Wetlands within Vorotan Catchment	1%	2 %
Wetland within Ketchut Tributaries	Wetland lost beneath the BRSF footprint. No other wetland losses in the Ketchut Tributaries.	Any spring flow will be released to catchment following passive treatment.

Notes:
*Groundwater Modelling Study (Golder 20146)

Potential closure and post-closure phase impacts for each receptor are discussed below.

Kechut Reservoir and Kechut Reservoir Tributaries

Discharge from the BRSF will enter the downstream catchment at closure following passive treatment, and there will be a negligible change to the size of the overall surface water catchment within the Kechut Reservoir tributaries. The magnitude of the impact is considered **low** as the change to catchment runoff characteristics (with a slight decrease due to the E/T cover on the BRSF) within this tributary will be minor. The total reduction in groundwater contribution to baseflow within the tributaries is predicted to be approximately 2%. The magnitude of impact to the Kechut Reservoir is considered negligible as the size of the total catchment flowing to the reservoir provides a significant buffer against any potential reduction in baseflow from a decrease in spring flow.

Should the PTS become less effective during post-closure, there could be a reduction in pH and increase in metal concentrations during the snowmelt period. The magnitude of impact is considered to be **negligible** within the Arpa/Kechut Reservoir and **low** within the Arpa tributaries. Any change will be temporary as ongoing monitoring will identify the need for any treatment improvements.

Two potential pathways have been evaluated with respect to the migration of groundwater from the BRSF and Pit area:

- Groundwater originating at the pits or BRSF will flow north-westwards, passing below the Spandaryan-Kechut Tunnel, in a diffuse manner to reach the Arpa River downstream of the Kechut Reservoir. No groundwater from the BRSF and pit areas reaches the Kechut Reservoir so no change in water quality will occur;
- Groundwater originating at the BRSF or pit areas may discharge to the Kechut-Spandaryan Tunnel (although not indicated by the groundwater flow model), and thus reach the Kechut Reservoir. The impact of this scenario is no change for the majority of constituents; Boron and nitrate concentrations in the reservoir are predicted to increase slightly but will remain well below MAC II standards with no change measurable against baseline levels. The magnitude of this impact is therefore considered to be **negligible**.

Arpa River, Arpa Tributaries Downstream of Kechut Reservoir and Arpa Tributaries HLF Area

The HLF facility and upstream catchment, including HLF Detention Pond and Storm Ponds, will continue to discharge through the PTS during the closure period. HLF drain down water will be treated prior to discharge to the downstream catchment. Post-closure water will discharge to the downstream catchment following passive treatment. Spring flow beneath the facility liners will continue to be released to surface water (Chapter 6.9). The quantity impact in the Arpa tributaries within the HLF area is considered **moderate** and downstream in the Arpa the impact is considered **negligible** as the reduction in baseflow to the Arpa is minimal (<1 %). Arpa tributaries downstream of Kechut Reservoir will have a negligible loss in catchment size and a predicted minor 2 % reduction in baseflow from groundwater and on this basis the impact is considered **low**. In the absence of long term data for flow in the Arpa and information on the regulation and operation of the Kechut Reservoir the potential impact has been determined using a scaled estimate of flow in the adjacent Vorotan catchment provided a proxy low flow estimate given similar hydrologic conditions. This includes low flow measurements from spot flows; and continuous monitoring data and anecdotal information on the operation of the reservoir were used as further points of reference. The approach to low flow estimation in the Arpa River outlined in Chapter 4.9.4 (Long Term Data) and Chapter 4.9.5 (Low Flow and Environmental Flow Conditions) has been used in the absence of long term data for flow in the Arpa and information on the regulation and operation of the Kechut Reservoir. During extreme events, water from the HLF Contact Water Pond in the initial phase of closure could pass downstream via the spillway; however, any water would be significantly diluted because of the large volume of background water. During the initial phase of closure, Storm Ponds will also be used to manage runoff during extreme events. Given the design standard of the Storm Ponds and Contact Water Pond, the magnitude of impact is considered **low**. The ponds will be removed at the end of the closure phase.

Impacts arising from leakage from the HLF and BRSF and groundwater flow are described in Chapter 6.9. Any leakage reaching groundwater from the BRSF will flow north westwards, below the Spandaryan-Kechut Tunnel, in a diffuse manner to reach the Arpa River downstream of Kechut Reservoir. Any leakage from the HLF that is not collected and that escapes the water management system will flow westwards towards the Arpa River. Combined leakage impacts from the Project are assessed at station AW009, on the Arpa River downstream of the BRSF and HLF. The only change in concentration will be nitrate, which will remain below MAC II standards with no change measurable against baseline levels. Given the predicted impact, the magnitude will be **negligible**.

All known users of this reach of the Arpa River have been considered to determine the potential impacts associated with the abstraction from the River Arpa, for makeup during the operational phase of the mine (see Chapter 6.10.7). The EMP (see Appendix 8.12) requires continuous monitoring of flow in the Arpa River togerther with monitoring the effects on water flow from the operation of the Kechut Reservoir.

Gndevaz Reservoir

The conveyor infrastructure will be demolished at closure and access roads running through the Gndevaz Reservoir catchment will be reclaimed. Sediment ponds will remain until infrastructure is removed and vegetation re-established. The water quality and quantity magnitude of impact to Gndevaz Reservoir is considered **negligible** at closure and post-closure.

Gndevaz Channel

The renovated Gndevaz Channel would be flow to the village of Gndevaz irrigation systems and to the Gndevaz Reservoir. The contact water from the Project including the BRSF will drain from the toe pond, via a gravity fed pipeline to the contact water ponds within the HLF. The drainage system will be effective during the operational phase and continue through the closure phase so that seepage from the BRSF flows throught the contact water ponds and is either used for HLF water treatment, or overflows through to the BRSF PTS (after year 4 of operations). After closure of the HLF, the BRSF seepage will be treated through the PTS. In the event of an accidental uncontrolled release from the BRSF toe pond there is a risk that the water quality of the Gndevaz Channel may be impacted.

Ongoing monitoring of discharge water quality will be performed as part of the SWMP and EMP. On this basis, the water quality magnitude of impact to the Gndevaz Channel is considered **minor**.

Darb River Tributaries, Darb River and Wetland Ponds including Benik's Pond

The upper section of the ore conveyor corridor, access roads, pits and the crusher are located in the upper reaches of Darb River tributaries. The conveyor and pit crusher infrastructure will be demolished and removed at closure. Runoff from the backfilled T/A pit area (Figure 6.10.3) is anticipated to be directed towards the pre-existing catchments via catch drains. Runoff from exposed and reclaimed pit slopes (Erato and South Artavazdes) will infiltrate to groundwater via the pit floor.

Darb tributary catchment area reductions at closure are expected to be minimal (< 1% of total). Perennial spring flows at the head of tributaries (above 2,300 m asl) may decrease by up to 20% for individual springs providing a significant reduction during low flows, however the total decrease in baseflow from perennial springs is expected to be approximately 1% for all the tributaries within the Project area. The pit closure analysis (Golder, 2014[9]) shows that a post-closure pit water body will not develop.

The magnitude of impact to the Darb is considered negligible as the size of the downstream catchment to the Darb provides a significant buffer against any potential flow reductions. Impact to the Darb River tributaries is considered **low** as the total reduction in spring flow affecting tributary baseflows is approximately 1 % during low flows. The up to 10% reduction of the surface water catchment contributing to the three wetland ponds located upstream of Benik's Pond will be permanent as a result of the Erato and South Artavazdes pit. Therefore, in terms of water quantity, the magnitude of impact is considered **low**.

Groundwater modelling (Golder, 20146) indicates seepage from the pits will flow towards the Vorotan and Darb. Modelling suggests measurable increases in nitrate and lithium concentrations (not exceeding MAC II standards) in the Darb River, around Darb 1 monitoring station. The impact will peak approximately 20 years after closure and will be permanent (Golder, 2014[10]). The potential impact to the Darb River is **low**.

Seepage to springs is presented in the groundwater Chapter 6.9 (see Figure 6.9.4: Spring Catchments used in Pit Risk Assessment), and highlights concentrations of some parameters above MAC II standards during seasonal low flows in Catchment 1 (upstream of MP4), Catchment 3 (upstream of AW064, Benik's Pond (AW019)) and Catchment 7 (upstream of AW004). Parameters with peak concentrations above MAC II standards are as follows:

- Catchment 1 – beryllium, cobalt and molybdenum;
- Catchment 3 – sulphate, beryllium, cobalt, molybdenum and nitrate; and
- Catchment 7 – beryllium and cobalt.

Catchments are identified on Figure 6.9.3 within the groundwater Chapter 6.9. The impact to

[10] Appendix 6.9.3 - Golder Associates, 2014e. Assessment of Groundwater Quality Impacts arising from Pit Development. August 2014 Reference 14514150095.512

each tributary has been assessed by mixing spring flow with baseline flows downstream. The results above MAC II standards and baseline are presented in Table 6.10.10. Baseline cobalt concentration at AW064 and AW004 is above MAC II standards and predicted to increase following closure. The long term impact at AW064 is considered **moderate**, and **low** at AW004. Downstream, due to mixing in the Darb, impacts would be **negligible**. Average baseline concentrations have been used in the assessment.

Table 6.10.10: Predicted Darb Tributary Water Quality

	Catchment 3 Tributary to Darb River (AW064)	**Catchment 7 Tributary to Darb River (AW004)**
Constituent	Cobalt	Cobalt
MAC (mg/l)	3.60E-04	3.60E-04
Baseline (mg/l)	9.00E-04	2.24E-03
Impact – Tributary Water Quality (mg/l)	1.72E-03	2.60E-03
Long Term Impact (mg/l)	1.15E-03	2.28E-03

Leakage from the pits will impact the springs within the head of the Darb tributaries (Catchment 3) which include springs which feed four wetland ponds, including Benik's Pond (baseline monitoring location AW019). Water quality parameters which exceed MAC II standards are provided in Table 6.10.11.

Table 6.10.11: Predicted Benik's Pond Water Quality at Post-closure

	Beryllium	**Cobalt**	**Nitrate**	**Sulphate**	**Tin**
MAC (mg/l)	0.000038	0.00036	2.5	16.04	0.00008
	Catchment 3 Tributary to Darb (AW019)				
Catchment 3 Benik's Pond Baseline* (AW019) (mg/l)	0.0002	0.00078	1.66	10.9	Not tested
Catchment 3 Benik's Pond Impact (mg/l)	0.00038	0.0096	3.66	20.03	0.00018
Catchment 3 Benik's Pond Long Term Impact (mg/l)	0.00033	0.0071	2.78	19.27	0.00018
Notes: *Average Baseline Value					

Concentrations of beryllium and cobalt are predicted to rise above average baseline readings but are already above the MAC II standards. Nitrate and sulphate baseline concentrations are predicted to rise above MAC II standards. Tin will exceed MAC II standards, however no baseline data exist to provide comparison. Given the predicted impact, the magnitude will be **high**.

<u>Vorotan River Tributaries, Vorotan River and Spandaryan Reservoir</u>

Closure activities discussed above for the Darb also apply to the Vorotan River catchment. Water quantity discussed above for the Darb at closure also apply to the Vorotan River i.e. **<u>negligible</u>** impact to water quantity. Tributaries will have a low impact due to a permanent reduction in perennial spring flow to the tributaries and a 1% loss of catchment area due to the pits. The Spandaryan Reservoir is located a significant distance downstream of Amulsar, consequently catchment losses are insignificant. Impacts to Spandaryan Reservoir are **<u>negligible</u>**.

Groundwater seepage from the pits will flow towards the Vorotan and Darb River. The only predicted measurable changes impacting the Vorotan River are minor increases in concentration of lithium, nitrate and sulphate (Golder, 2014[10]), all of which will not exceed MAC II standards. In addition, the impact to the Vorotan only considers baseflow and does not consider seasonal flow variations. The impact to the Vorotan will be **<u>low</u>**.

Seepage to nearby springs is presented in Groundwater Chapter 6.9, and highlights no parameters in Catchment 2 or 5 will increase above MAC II standards. Dilution in the catchments draining the eastern flank of Amulsar will lead to no measureable change in water quality downstream, remaining below MAC II standards, therefore the impact will be **<u>negligible</u>**.

Impacts to the Vorotan River will be diluted downstream such that in the Spandaryan Reservoir no measurable change is predicted in water quality. The impact will be **<u>negligible</u>**.

<u>Wetlands within Vorotan Catchment and within Kechut Tributaries</u>

Wetland areas located adjacent to the Vorotan River and its tributaries are considered to have a **<u>low</u>** impact at closure. A minor reduction (2%) of groundwater flow to the wetlands is expected and reduction of surface water catchment area due to the pits will be 1% of the total tributary area. Impact to water quality is considered to be **<u>low</u>** due to impacts from pit seepage which contributes flow to the wetland areas.

The wetland within the BRSF site area will be permanently lost however in Chapter 4.10, the biodiversity baseline identifies equivalent wetland habitat areas within the Project area and therefore the impact is considered **<u>moderate</u>**.

A summary of the impacts, magnitude, significance of impact and scale of significance can be found in Table 6.10.12**.**

The impacts to Benik's Pond and the three upstream wetland ponds (Wetland Ponds within the Darb tributaries including Benik's Pond) are classified as **significant**; mitigation strategies to address this impact are presented in Section 6.10.8. The impacts of the remaining surface water receptors are classified as **not significant**.

Table 6.10.12: Potential Surface Water Impacts (Closure and Post-Closure) and Significance of Impact (considering Design Mitigation Measures)					
Receptor	**Receptor Sensitivity**	**Potential Impact**	**Magnitude of Impact**	**Impact Significance**	**Scale of Significance**
Kechut Reservoir Tributaries	Medium	Change in flow as a result of changes in catchment runoff and spring flow decrease.	Low	Minor	Not Significant
		Decrease in water quality as a result of accidental uncontrolled release of sediment during reclamation or decreased performance of the BRSF passive treatment system.	Low	Minor	Not Significant
Arpa River Downstream of Kechut Reservoir	Medium	Change in flow as a result of changes in catchment runoff.	Low	Minor	Not Significant
		Decrease in water quality as a result of accidental uncontrolled release of sediment during reclamation, release of water from the HLF and HLF Contact Water Pond during closure or decreased performance of the HLF passive treatment system.	Low	Minor	Not Significant
Arpa River Tributaries Downstream of Kechut Reservoir	Minor	Decrease in flow as a result of catchment area reduction and spring flow decrease.	Low	Negligible	Not Significant
		Decrease in water quality as a result of accidental uncontrolled release from sediment during reclamation.	Negligible	Negligible	Not Significant
Arpa River Tributaries HLF Area	Minor	Change in flow as a result of changes in catchment runoff and spring flow decrease.	Moderate	Minor	Not Significant
		Decrease in water quality as a result of accidental uncontrolled release of sediment during reclamation, release of water from the HLF and HLF Contact Water Pond during closure or decreased performance of the HLF passive treatment system.	Low	Negligible	Not Significant
Darb River	Medium	Decrease in flow as a result of catchment area reduction and spring flow decrease.	Negligible	Negligible	Not Significant
		Decrease in water quality as a result of infiltration of mining-influenced water from Pit to springs.	Low	Minor	Not Significant
Darb River Tributaries	Minor	Decrease in flow as a result of catchment area reduction and spring flow decrease.	Low	Negligible	Not Significant

Table 6.10.12: Potential Surface Water Impacts (Closure and Post-Closure) and Significance of Impact (considering Design Mitigation Measures)

Receptor	Receptor Sensitivity	Potential Impact	Magnitude of Impact	Impact Significance	Scale of Significance
		Decrease in water quality as a result of infiltration of mining-influenced water from Pit to springs.	Moderate	Minor	Not Significant
Vorotan River	Medium	Decrease in flow as a result of catchment area reduction and spring flow decrease.	Negligible	Negligible	Not Significant
		Decrease in water quality as a result of infiltration of mining-influenced water from Pit to springs.	Negligible	Negligible	Not Significant
Vorotan River Tributaries	Minor	Decrease in flow as a result of catchment area reduction and spring flow decrease.	Low	Negligible	Not Significant
		Decrease in water quality as a result of infiltration of mining-influenced water from Pit to springs.	Low	Negligible	Not Significant
Kechut Reservoir	High	Change in flow as a result of changes in catchment runoff and spring flow decrease.	Negligible	Minor	Not Significant
		Decrease in water quality as a result of accidental uncontrolled release of sediment during reclamation or decreased performance of the BRSF passive treatment system.	Negligible	Minor	Not Significant
Spandaryan Resevoir	High	Decrease in flow as a result of catchment area reduction and spring flow decrease.	Negligible	Minor	Not Significant
		Decrease in water quality as a result of infiltration of mining-influenced water from Pit to springs.	Negligible	Minor	Not Significant
Gndevaz Reservoir	Minor	Decrease in flow as a result of catchment area reduction and spring flow decrease.	Negligible	Negligible	Not Significant
		Decrease in water quality as a result of accidental uncontrolled release from sediment during reclamation.	Negligible	Negligible	Not Significant
Gndevaz Channel	Medium	Decrease in flow as a result of catchment area reduction.	Negligible	Negligible	Not Significant
		Decrease in water quality as a result of accidental uncontrolled release from BRSF, toe pond.	Minor	Minor	Not Significant

Table 6.10.12: Potential Surface Water Impacts (Closure and Post-Closure) and Significance of Impact (considering Design Mitigation Measures)					
Receptor	**Receptor Sensitivity**	**Potential Impact**	**Magnitude of Impact**	**Impact Significance**	**Scale of Significance**
Wetland Ponds within Darb Tributaries including Benik's Pond	Minor	Decrease in flow as a result of catchment area reduction and spring flow decrease.	Low	Negligible	Not Significant
		Decrease in water quality as a result of infiltration of mining-influenced water from Pit to springs.	High	Moderate	Significant
Wetlands within Vorotan Catchment	Medium	Decrease in flow as a result of catchment area reduction and spring flow decline.	Low	Minor	Not Significant
		Decrease in water quality as a result of infiltration of mining-influenced water from Pit to springs.	Low	Minor	Not Significant
Wetlands within Kechut Reservoir Tributaries	Minor	Decrease in flow as a result of catchment area reduction and spring flow decrease.	Moderate	Minor	Not Significant
		Decrease in water quality as a result of accidental uncontrolled release from sediment during reclamation or decreased performance of the BRSF passive treatment.	Negligible	Minor	Not Significant

6.10.8 Surface Water Mitigation Measures and Residual Impacts

Impacts and Mitigation Measures

With the appropriate mitigation measures included in the facility designs and operational procedures, most of the identified impact risks will be eliminated or reduced to acceptable levels. The only significant impact predicted (considering design mitigation only) from the impact assessment is to water quality within wetland ponds to the west of the pits (which include Benik's Pond), following closure. No significant impact is predicted during construction or operations. The magnitude of change for water quality parameters is high, relating to beryllium, cobalt and that for nitrate and sulphate considered moderate. Cobalt and beryllium are naturally occurring within the local geology (and concentrations in Benik's Pond already exceed MAC II standards) and the increase in concentrations is due to the mobilisation of metals from the barren rock backfill within the pits. These impacts have been minimised with the design of the backfill cover for the Tigranes-Artavazdes pit but cannot be avoided as the constituents occur naturally within the geology of the pit area and seep/flow into the wetland areas via perennial springs.

To provide additional mitigation, runoff from the backfilled Tigranes-Artavazdes pit area will, to the greatest extent possible, be diverted to the wetland ponds. However this mitigation may not fully reduce the impacts during low flow conditions. Monitoring during the post-closure period will be used to determine the effectiveness of this additional mitigation measure. No further mitigation measures are proposed since the water quality parameters with a high impact already exceed MAC II standards. Further mitigation in regards to the effect on aquatic habitat or appropriate compensation are discussed within Chapter 6.11 (Biodiversity).

Minor impacts to other receptors which include the HLF tributary and wetland within the Kechut tributaries (BRSF Area) are identified but are determined 'not significant'. Therefore, no further mitigation is proposed at these locations.

Mitigation measures with regard to surface water receptors to be included in the SWMP are summarised in Table 6.10.13.

Table 6.10.13: Summary of Surface Water Mitigation Measures				
Potential Impact	**Stage of Impact**	**Location**	**Mitigation**	**Responsibility**
Sediment, Oils and Constituents released into surface water	Construction	All Areas	• Implement environmental control measures for storage and handling of materials. • Implement appropriate Erosion and Sedimentation Control Plans.	Geoteam, EPC Contractor
Contact Water Discharging to Environment	Operation and Post-Closure	HLF and BRSF	• Contact water management system sized to manage extreme precipitation events/years. • Passive treatment of BRSF contact water if necessary after year 4 of operations and following closure of the HLF. • Active treatment during HLF drain down. For closure the HLF passive treatment system will be constructed by reusing the the storm storm water detention pond system as the wetland phase. • Cyanide Management Plan.	Geoteam
Reduced water quality in Vorotan and Arpa River from non-contact water	All stages	All Areas	• Adequate treatment and settlement of runoff prior to discharge through provision of adequate environmental controls, ponds, etc. • Surface water management system (non-contact water) sized to manage extreme precipitation events/years. • Ensure regular monitoring of water quality downstream of the mine.	Geoteam, EPC Contractor
Unsuitable environmental water flow in Arpa River	Operational	All Areas	• Ensure abstractions do not adversely impact river by imposition of abstraction schedules.	Geoteam

Residual Impact Assessment

Residual impacts stem from pit seepage impacts. The mitigation measures presented in Table 6.10.13 will not change the significance of impacts described in Section 6.10.7. In addition, mitigation failure remains a residual risk that will be managed by monitoring at all stages of the development. Surface water monitoring is discussed in Section 6.10.9.

The impacts to surface water quality and quantity are considered further in the Biodiversity assessment (Chapter 6.11) including the impact on aquatic habitat.

6.10.9 Monitoring

Monitoring requirements identified by the assessment process are outlined below. Details of proposed monitoring programmes will be included in the SWMP and include construction, operational and post-closure monitoring of flow rates and water quality at the following locations:

- Springs and tributaries surrounding the open pits;
- Tributaries prior to discharge to the Arpa, Darb and Vorotan Rivers;
- Benik's Pond to the west of the pits;
- Gndevaz Reservoir;
- Vorotan and Arpa River upstream and downstream of Amulsar;
- All points of discharge during operations i.e. sediment ponds; and
- Groundwater and surface water downstream of all major facilities including HLF and BRSF facilities and the passive water treatment discharge locations at closure.

The monitoring required to confirm the effectiveness of the mitigation strategies has been identified in Table 6.10.14.

Table 6.10.14: Surface Water Mitigation, Monitoring and Audit		
Surface Water Mitigation, Monitoring and Audit Programme and Procedures		
Monitoring Approach	Baseline	Pre-construction baseline monitoring has been undertaken between 2007 and 2015 to define the baseline surface water and groundwater conceptual model of the Project area, as outlined in Chapter 4.9. Baseline investigations and impact assessment have identified sensitive receptors and potential risks associated with aspects of the proposed mine development, which will require monitoring and mitigation during construction, operation and post-closure phases. Baseline water quality data in conjunction with National water quality standards (MACs; where relevant) provide targets against which construction and operation monitoring data will be assessed.
	Construction and Operation Phases	Surface water and groundwater monitoring will be undertaken during the construction and operation phases and compared with the baseline data and MACs to ensure compliance with appropriate regulations; to confirm that any impacts are consistent with those predicted through the ESIA process; and to give an advanced warning (where possible) of any potential deviation from the predicted conditions that could negatively impact surface water and groundwater receptors.

Table 6.10.14: Surface Water Mitigation, Monitoring and Audit		
	Post-closure phase	Surface water and groundwater monitoring should continue beyond the cessation of mining activities and mine closure for aftercare purposes.
Significant Effects		
Modification of surface water flow regime		• Changes to Arpa River flow regime from abstraction during construction and operational phases (where required). • Changes to Benik's Pond surface water levels from abstraction during construction phase.
Modification of surface water quality		• Non-contact water discharge. • Contact water discharge.
Specific Actions		
Management Plans	The SWMP will be adopted by site contractors (or they will generate their own). It will include best practice mitigation procedures to minimise as far as possible the risk of adverse impact to the local water environment as a result of the construction activities.	
	The Mine Reclamation Closure and Rehabilitation Plan (MRCRP) defines the management of water resources from the construction phase through to the mine closure plan, so that on reclamation water resources will have been maintained to achieve the objectives of the Plan.	
	The SWMP provides an outline design for water management which complies with the relevant effluent discharge standards; and proposes a monitoring and mitigation scheme for prevention of any adverse impacts to the local and regional surface water and groundwater regime as a result of Project activities.	
	The Spill Prevention and Response Plan (incorporated in the EPRP) define the measures that will be taken to manage, control and monitor substances that have the potential to adversely impact water resources.	

Table 6.10.14: Surface Water Mitigation, Monitoring and Audit	
Environmental Monitoring Plan	The plans will be underpinned by the following SOPs that will provide specific guidance on sampling and/or monitoring locations and procedures during the construction, operational and closure phases. The SOPs will include the following: • **Surface water level monitoring** (construction, operation and post-closure phases): procedures for point and continuous stage monitoring at defined locations on the Vorotan, Arpa and Darb rivers and their tributaries and at Benik's Pond (part of the baseline monitoring network). • **Surface water flow monitoring** (construction, operation and post-closure phases): procedures for point flow monitoring at defined locations on the Vorotan, Arpa and Darb rivers and their tributaries (part of the baseline monitoring network). • **Surface water quality monitoring** (construction, operation and post-closure phases): procedures for surface water sampling from defined locations on the Vorotan, Arpa and Darb rivers and their tributaries (part of the baseline monitoring network) for *in situ* analysis and *ex situ* laboratory analysis. • **Discharge water quality monitoring** (construction, operation and closure phase): procedures for *in situ* analysis and *ex situ* laboratory analysis of water quality from the HLF, BRSF and sediment ponds, to determine whether water quality meets planned targets or if (additional) treatment prior to discharge is required. • **Collection of meteorological data** (construction and operation phases): procedures for the collection of local meteorological data. Data will be used to develop the baseline hydrologic and hydrogeological conceptual model and calibrate relevant surface water datasets collected during construction and operation phases.

Surface Water Standard Operating Procedures		**Strategy**	**Monitoring**
Surface water flow	Project area catchment watercourses	Monitoring to assess the extent (if any) of impacts on flow regime attributable to mine development. Weirs should be installed where feasible at selected locations to define the stage-flow relationship for each of these points so that the level data can be converted into flow rate (to allow flow rates to be monitored in real time, and the total constituent flux to be calculated). Data will also be used to control the maximum discharge rate for any treated water.	Continuous flow monitoring at the locations specified in the WMP using weirs and installed pressure transducers. Monthly point flow measurements using a hand-held impellor during baseline phase should be intensified during construction and operation phases. Data to be collated in the long-term database, maintained by the Site Environmental Manager.
Discharge water quality	Sediment Ponds	Monitoring of water quality parameters during initial stages of operation phase to determine trigger levels with respect to compliance targets. Monitoring will be completed immediately upstream and downstream of discharge locations.	Automated continuous *in* situ monitoring of pH, temperature, turbidity and electrical conductivity using automatic analysers (supplemented by manual measurements as the need arises from any discharges to natural watercourses). To be performed weekly during the first three months of operation; and monthly thereafter. Turbidity to be monitored as a proxy for total suspended solids; relationship between the two parameters should be determined within initial months of monitoring. Data to be collated in the long-term database, maintained by the Site Environmental Manager.

	Treated discharge from active and passive water treatment systems for HLF and BRSF during closure.	Water quality monitoring during closure phase to ensure compliance with MAC/baseline. Monitoring will be completed immediately upstream and downstream of discharge locations.	Automated continuous *in* situ monitoring of pH, temperature, turbidity and electrical conductivity using automatic analysers. Samples to be submitted for laboratory analysis for the same suite of parameters for groundwater samples plus dissolved oxygen (DO), Total Petroleum Hydrocarbons (TPH), oils and grease and Total Suspended Solids (TSS). Monitoring to be performed weekly for the first three months of closure and then reviewed. Data to be collated in the long-term database and screened against compliance targets/appropriate MAC standards.
Surface water quality	Project area surface watercourses	Water quality monitoring during operation phase downstream of mine facilities i.e. HLF, BRSF and pits facilities to ensure compliance with MAC or baseline water quality standards. Monitoring will be completed immediately upstream and downstream of discharge locations.	Sampling for *in situ* analysis and laboratory analysis to be performed. *In situ* analysis to comprise pH, temperature, electrical conductivity and turbidity using a hand-held multi-parameter device. Samples to be submitted for laboratory analysis for the standard suite of parameters as specified in the WMP, plus DO, TPH, oils and grease and TSS. Samples to be collected and analysed weekly during initial construction and operation phases then reducing to monthly after initial data review. Data to be collated in the long-term database and screened against compliance targets/appropriate MAC standards.

6.10.10 Conclusions

An impact assessment has been undertaken to assess the effects of construction, operation and closure of the Project with regard to sensitive surface water receptors. The findings of the impact assessment are summarised below:

- Surface water impacts fall under two main categories: water quality and quantity, which result primarily in environmental impacts;
- Where point discharges to the water environment are proposed these will be compliant with Armenian regulations and/or comparable to baseline;
- With appropriate mitigation and management measures, the impact of the proposed mine activity on surface water resources will mostly be eliminated or reduced to acceptable levels. Serious impact risks from ARD, mine influenced water, operational pond overflow and flow regime modification are dealt with in the design and construction of appropriate storage and treatment works. Water quality and hazardous material control will be conducted through specification of appropriate equipment and environmental controls and careful management; and
- Residual surface water impacts are expected to be minor and relate to the alteration of the flow paths of some mountain streams in the vicinity of the HLF and the BRSF; and localised impacts to water quality within wetland ponds to the west of the pits which includes Benik's Pond. Proposed mitigation measures will reduce but may not eliminate the water quality impact to these ponds. Compensatory measures are also proposed to offset the reduction in water quality. The post-closure status of other surface waters will generally be unchanged from existing and/or below MAC II standards based on proposed surface water mitigation; the ecological mitigation measures are expected to improve further environmental conditions.