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## 7 CUMULATIVE IMPACT ASSESSMENT

### 7.1 Introduction

*“Cumulative impacts are those that result from the incremental impact of a project when added to other existing, planned, and/or reasonably predictable future projects and developments”*. Cumulative impacts are limited to those impacts generally recognized as important on the basis of scientific concerns and/or concerns from Affected Communities<sup>1</sup>.

This chapter has been developed in line with the guidance provided in IFC’s “Good Practice Handbook: Cumulative Impact Assessment and Management: Guidance for the Private Sector in Emerging Markets (2013)”. As such, it follows a six-step process:

- Step 1 – Determination of spatial and temporal boundaries;
- Step 2 – Identification of Valued Environmental and Social Components (VECs) and identification of all developments and external natural and social stressors affecting the VECs;
- Step 3 – Assessment of present condition of VECs;
- Steps 4 and 5 – Assessment of cumulative impacts and their significance over VECs' predicted future conditions; and
- Step 6 – Definition of management strategies to address impacts.

The assessment has been conducted as a desk-based evaluation; however it has drawn on the experience and expertise of the specialists authoring different chapters and sections of the ESIA and upon the understanding of priority VECs within local communities gained through consultation over the past 7 years. All specialists involved in this assessment have visited the Amulsar Project site at least once. No specific consultation has been undertaken solely to inform this assessment; however, during the course of the stakeholder engagement meetings prior to the start of construction activities, consultation on cumulative impact assessment will be organized (see SEP, Appendix 8.6).

### 7.2 Definition of spatial and temporal boundaries

For this assessment, the temporal boundary has been set as the life cycle for the mining operation (this includes construction, operation, closure and a five-year post-closure period), which is a period of twenty-one years. Where relevant, reference is also made to impacts to VECs which stem from historical activities.

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<sup>1</sup> IFC Performance Standard 1 – Assessment and Management of Environmental and Social Risks and Impacts, 2012.  
[http://www.ifc.org/wps/wcm/connect/3be1a68049a78dc8b7e4f7a8c6a8312a/PS1\\_English\\_2012.pdf?MOD=AJPERES](http://www.ifc.org/wps/wcm/connect/3be1a68049a78dc8b7e4f7a8c6a8312a/PS1_English_2012.pdf?MOD=AJPERES)

The spatial boundary varies with each VEC considered. The VECs identified below are all components that the Amulsar Project is either known to affect or there is a perception that it could affect. A spatial boundary is provided for each VEC listed in Table 7.1.

<b>Valued Environmental and Social Components (VECs)</b>		<b>Spatial Boundary</b>
<b>Category</b>	<b>Description</b>	
Physical features	Arpa River water flows	Arpa River and catchment between Kechut Reservoir and Darb River confluence
	Sub-alpine Meadows and Sub-alpine Meadows with Alpine Elements	Project-affected area
	Jermuk groundwater	Project-affected area
	Natural habitat	Project-affected area plus Vorotan Valley basin
	High quality pasture or grazing lands	Project-affected area plus Vorotan Valley basin
	Migratory raptors	Project-affected area plus Vorotan Valley and proposed Jermuk National Park
	Landscape species – mammals and birds	Project-affected area plus proposed Jermuk National Park
	Important Bird Areas (IBAs)	Administrative lands for Jermuk, Gndevaz, Gorayk and Saravan
Ecosystem services	Foraging and gathering of food and herbs	Community lands for Jermuk, Gndevaz, Gorayk and Saravan
	Daily herding	Gndevaz community lands
	Seasonal herding	Project Affected Area plus Vorotan Valley
	Vorotan Valley	Vorotan Valley
Social Conditions	Jermuk tourism (including mineral springs & spa related tourism)	Project-affected area - social

### 7.3 Other Activities and Social and Environmental Stressors

Table 7.2 identifies other activities and stressors which may affect the condition of the VECs identified in Table 7.1. In developing this list, consideration was given to past developments whose impacts persist; existing developments; and foreseeable future developments as well as any relevant social and environmental drivers.

<b>Table 7.2 Other Activities and Social and Environmental Drivers</b>	
<b>Other Activities and Stressors</b>	<b>Potential impact to VECs</b>
Global climate change	Landscape species – mammals and birds Sub-alpine Meadows and Sub-Alpine Meadows with Alpine Elements
Urbanisation and the abandonment of agriculture in rural Armenia	Daily herding Seasonal herding Foraging and gathering of herbs and other wild foods
Diversification of agriculture	Modified habitats Intensification of agricultural production Expansion of mechanised techniques
Tourism expansion	Natural habitat Groundwater sources for thermal springs and mineral water in Jermuk Vorotan Valley Landscape species – mammals and birds Jermuk tourism development Migratory raptors
North-South Road Corridor development	Land use Jermuk tourism Natural habitat
Jermuk National Park Proposal	Natural habitat Jermuk tourism Landscape species – birds and mammals IBAs
Arpa-Kechut flow controls	Arpa River Water Flow
Hydro-electricity plants	Vorotan Valley Migratory raptors High quality pasture IBAs
Future mining plans	Sub-alpine meadow Natural habitat High quality pasture Daily herding Seasonal herding Migratory raptors Landscape species – mammals and birds

A brief description of each activity or stressor is provided below:

**Global climate change:**

Climate change impacts (described in Section 4.2) for the Vayots Dzor Marz suggest that under the A2 (high emissions) scenario, temperature could increase by 3°C, and precipitation could decrease by up to 25%, by 2070. Given the elevation of the Project area, increased temperature and reduced precipitation could have a significant impact upon species and habitats existing there at present. Climate change is likely to impact the viability of Sub-alpine Meadows and Sub-alpine Meadows with Alpine Elements across the Marz. Reduced

precipitation would also be expected to have an impact on the volume of water within the Arpa River. Species that are currently range restricted due to climate will be likely to experience further pressure and, depending on mobility, may relocate to areas with cooler temperatures and higher rainfall/snowfall. This is particularly relevant to the critical habitat area containing *Potentilla porphyrantha* (see Appendix 4.10.3).

### ***Urbanisation and Industry:***

Agriculture in Armenia changed drastically with the collapse of the Soviet Union. From a system of 600 large collective farms, more than 330,000 small-scale farms were created overnight, in areas with highly variable land quality. Rural and urban poverty levels are relatively balanced; however, the shortage of formal employment opportunities in rural areas influences trends of internal migration to Yerevan and other population centres<sup>2</sup>. Abandonment of rural lifestyles within Armenia is not widely written about in academic literature; however, consultation with stakeholders in the Project area has indicated that some members of the younger generations are less interested in an agriculture-based livelihood. Any changes to the level of interest in an agriculture-based livelihood (including seasonal herding for summer pasture) within younger generations would be expected to have an impact on the Project area.

### ***Diversification of agriculture***

A new agribusiness facility opened in mid 2015, located to the south of Gndevaz village. It is understood that the livestock farm business comprises 330 dairy cows, producing milk and other dairy and beef products. The livestock unit utilises housed husbandry techniques, with feed stock based on specific animal feed to maximise production. It is also understood that there is the intention to expand these types of animal husbandry technique in the future.

Seasonal grass conservation (hay making) has traditionally been undertaken by hand or small scale mechanisation. This has been supplemented, in recent years by increases use of mechanised approach to hay making, such that larger area of grassland can be harvested for hay in the future, increase the amount of winter feed available to support increased stocking densities.

The reinstatement of the Gndevaz channel will increase the potential for the irrigation and the diversification of crops that land in the vicinity of Gndevaz can support. There is the

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<sup>2</sup> See <http://www.ruralpovertyportal.org/country/home/tags/armenia> accessed August 18th 2014

potential to increase the production of animal feed and also the area of land available for fruit and vegetable production.

***Tourism Expansion:***

As described in Section 4.17, the tourism sector is of particular relevance to the town of Jermuk. An ambitious plan for tourism expansion has been defined for Jermuk, including the designation of the town as a Tourism Centre by Government Decree 1064. Under the proposed plan, Jermuk will turn into a year-round spa resort attracting 100,000 visitors annually, creating an additional 4,000 jobs in the area. To date, progress in meeting the objectives of the “comprehensive development plan” developed by USAID has been considerably slower than expected (see Section 4.17). If tourism were to expand significantly, it would bring additional pressure to the species and habitats of specific value within the Project-affected area.

***North-South Road Corridor:***

The North-South road corridor project will provide a more direct road connection between the Black Sea and Iran. This project is underway at present<sup>3</sup>. The route will include a section from Yerashkavan to Goris (see link 5 in Figure 7.1). The exact route was not defined at the time of preparation of this ESIA; however, it is likely to bring increased levels of traffic through or nearby the Project-affected area, with resultant changes to tourism and potentially impacting natural habitats. The route may also have implications for visual amenity on receptors (people) in settlements located on the M-2 Road (Saravan, Saralanj, Ughedzor, Gorayk) if this road is upgraded as part of the project.

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<sup>3</sup> This project is funded by the Asian Development Bank. More detail on the project is available from <http://www.adb.org/projects/documents/preparing-north-south-road-corridor-development-project> (last accessed 18th August 2014)

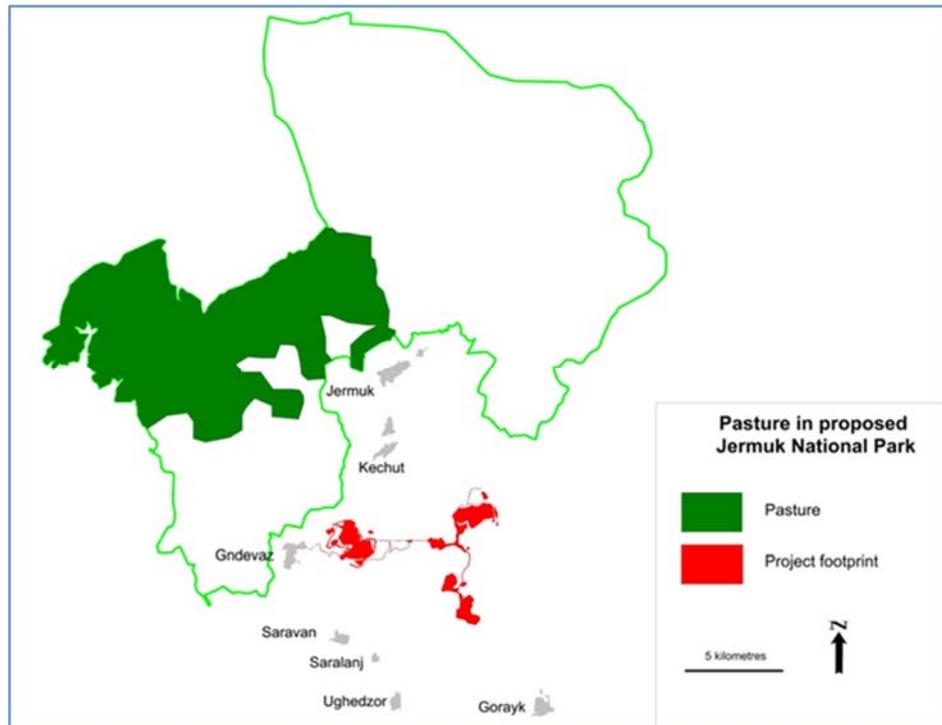


Figure 7.1: North-South Road Options (source: ADB)

**Jermuk National Park Proposal:**

As described in Section 4.10, the development of a Jermuk National Park has been proposed. The proposed location is shown in Figure 7.2. The Park would incorporate the existing Jermuk IBA and would include good representation of Montane Meadow Steppe grassland, which is also present across the Project-affected area. Timing and additional detail on the development of the National Park are not yet confirmed. Lydian is assessing the option of providing a biodiversity offset for residual impacts of the Project on natural habitat through supporting the establishment of this park. Initial field surveys, habitat mapping and stakeholder interviews took place in 2015. Additional implementation work is planned for 2016, including reaching an agreement with the Government of Armenia on next steps. If this park proceeds, it could have a significant impact on tourist numbers in the area, as well as the more obvious positive impacts on the protection of natural habitat and landscape species.

Increased protection could help to moderate existing threats, including hunting.



**Figure 7.2: Area proposed for Jermuk National Park**

***Arpa- Kechut Flow Controls:***

Flow within the Arpa River is controlled by the discharge from the Kechut Reservoir. This is a managed flow regime. There are no known plans to change the flow patterns in the Arpa; however, the existence of this system would allow the flow to be modified if the need arose. The Kechut Reservoir is supplying water to Lake Sevan through a series of water tunnels.

***Hydro-electricity plants:***

Four hydro-electricity developments exist in proximity to the Project-affected area (see Section 4.9). A small run-of-river hydro-electric facility has been developed on the Vorotan River, to the north-east of the Project facilities. At the time of writing, the facility was complete but had not yet been connected to the grid. In addition, in mid 2015 the construction of a new hydro-electric facility commenced in the Vorotan valley to the east of the Tigranes area.

Another hydro-electric plant is located immediately to the west of Gndevaz. Discharges from the Kechut Reservoir are used by this plant (it is not supplied by the Arpa directly).

The fourth hydro-electric facility is referred to as the “Vorotan cascade”, the power from which constitutes approximately 25% of Armenia’s total energy supply. Spandaryan Reservoir is primarily designed to provide water to this scheme.

There are no other known hydro-electric developments planned within the catchments affected by the Project; however, experience suggests these facilities can develop with little fore-warning. Any additional plants and the operation of the recently constructed plan on the Vorotan Valley could increase the level of disturbance within the Vorotan Valley, with possible consequences for migrating raptors which use the area for feeding.

***Future Mining:***

The geological setting of the Amulsar deposit is described in detail in Section 4.6. The Amulsar deposit has not yet been fully defined at depth, leaving the option of continued mining below the proposed pit shell if the economics were favourable. In the event that additional resources are identified, the mine life and economics would likely be positively affected.

The “set-aside” area (for biodiversity conservation) of Arshak, the mountain peak to the south of Tigranes-Artavazdes open pit, is also known to be mineralised. This area would not be considered for future mining unless the purpose of the set-aside was no longer required. Significant additional exploration would need to be undertaken to develop any additional areas on Amulsar Mountain, and would be subject to new exploration permits, an EIA and an ESIA.

A pre-existing small lead mine exists to the south-west of Amulsar Mountain. This mine is not considered within the cumulative impact assessment as it does not affect any of the VECs identified above. The lead mine is not understood to have operated in recent years.

**7.4 Baseline Status of the VECs**

The baseline status of the VECs identified in Table 7.1 has been presented throughout this ESIA in the baseline chapters. For the purposes of this cumulative impact assessment, a brief summary of the status of the VECs, their sensitivity to change, and potential indicators to assess their condition are provided in Table 7.3.

**Table 7.3: Baseline Status of VECs**

VEC	Baseline condition	Resilience to stress	Indicators to assess condition
Arpa River water flows	Amulsar Mountain forms the watershed between the Vorotan and Arpa river catchments. Kechut Reservoir is located on the Arpa River north-west of Amulsar. The outfall from the Kechut Reservoir is used as a water supply to the Sevan tunnel system as well as a source for the hydroelectric plant near Gndevaz and as a water supply. The reach downstream of Kechut Reservoir is a regulated waterway whose flow regime does not reflect the natural channel flow patterns. Monitoring indicates that there is always over-supply from Kechut.	High – this is due to the ability to manage flow of the river to accommodate changes in water falling within the catchment.	Flow monitoring to determine minimum base flows.
Sub-alpine Meadows and Sub-alpine Meadows with Alpine Elements	Sub-alpine Meadows in good condition, such as those found at the summits of Tigranes, Artavazdes and Arshak, are relatively rare in Armenia. These areas retain high endemic species richness and are considered to be relatively important in a national context by specialists. Sub-alpine Meadows account for 18% of the area mapped for the Amulsar biodiversity baseline. Sub-alpine Meadows with Alpine Elements are even less common and are threatened by climate change. Alpine species considered to be noteworthy within Amulsar’s Sub-alpine Meadows With Alpine Elements include: <i>Aetheopappus caucasicus</i> , <i>Arabis caucasica</i> , <i>Aster alpinus</i> , <i>Campanula bayerniana</i> , <i>Cystopteris fragilis</i> , <i>Erigeron venustus</i> , <i>Helichrysum plicatum</i> , <i>Huynhia pulchra</i> (endemic), <i>Jurinea moschus</i> and <i>Potentilla crantzii</i> . <i>Potentilla porphyrantha</i> occurs in association with this habitat on suitable rock substrate.	Low – this habitat has low resilience due to its isolated geographic position and inability to relocate to alternate lands without intervention. Vulnerable to climate change.	Presence of the following species: <i>Aetheopappus caucasicus</i> , <i>Arabis caucasica</i> , <i>Aster alpinus</i> , <i>Campanula bayerniana</i> , <i>Cystopteris fragilis</i> , <i>Erigeron venustus</i> , <i>Helichrysum plicatum</i> , <i>Huynhia pulchra</i> (endemic), <i>Jurinea moschus</i> and <i>Potentilla crantzii</i> . Number of hectares of habitat in good condition within the Project-affected area.

**Table 7.3: Baseline Status of VECs**

VEC	Baseline condition	Resilience to stress	Indicators to assess condition
Jermuk groundwater	<p>Year-round flowing (perennial) springs fed by groundwater discharge with regional-scale groundwater flow paths from geothermal sources. These springs are located in and around Jermuk and while their exact source is uncertain (but clearly from great depth), they are not related to the hydrology in the Project-affected area, nor connected to any aquifer of the Project-affected area.</p> <p>The springs are used to supply hydrothermal baths and springs galleries and to supply mineral water bottling plants.</p>	<p>High – the source of these springs, while uncertain, is unlikely to be affected by any of the foreseeable developments described in this assessment.</p>	<ul style="list-style-type: none"> <li>• Flow volume within spring galleries.</li> <li>• Chemical signature of water in spring galleries.</li> </ul>
Natural habitat	<p>A large part of the Project-affected area constitutes “natural habitat” according to PS6/PR6. This includes habitat types that have a high proportion of characteristic, native species and have been maintained using traditional, low-intensity management. Prior to the Soviet era, grasslands in the Project-affected area were managed for centuries as a transhumant grazing and hay meadow system. This agricultural system is declining throughout the Caucasus Region due to changes in farming practise and the associated landscapes have become rare as a result. Transhumance is still practiced in the Project-affected area with animals coming with their herders from long distances away, or on a daily basis from local villages. Pastures and hay meadows have been defined as “natural” if there has not been any significant modification due to addition of inorganic fertilisers or reseeding.</p>	<p>Low-Medium - changes caused by pollution, addition of nutrients or altered management can persist for a long time.</p>	<ul style="list-style-type: none"> <li>• % composition of characteristic native species.</li> <li>• Area of land (ha) under traditional land use or management.</li> </ul>

**Table 7.3: Baseline Status of VECs**

VEC	Baseline condition	Resilience to stress	Indicators to assess condition
High quality pasture or grazing lands	<p>The Project-affected area is widely used for pasture and grazing lands. The Vorotan Valley is home to what is considered to be particularly valuable pasture due to the long duration of summers in the valley (reported anecdotally by seasonal herders). Reports vary on the extent of over-grazing within the Project-affected area and the Vorotan Valley. It is likely that areas near to villages are over-grazed and this would be particularly applicable to Gndevaz.</p>	<p>Medium – large areas of land are available for pasture and grazing, with current use being linked to availability of water, roads etc. The reinstatement of the Gndevaz channel will result in increased volumes of water being available for irrigation, thus improving the potential agricultural productivity of land in the vicinity of the channel.</p>	<ul style="list-style-type: none"> <li>• Number of hectares of pasture land within the Project-affected area and the Vorotan Valley.</li> <li>• Numbers of herders (seasonal and daily) using the land.</li> <li>• Number of cattle grazing in the Project-affected area.</li> <li>• Community grievances.</li> </ul>
Migratory raptors	<p>Biodiversity surveys have been conducted to determine the importance of the Project-affected area as a stop-over location for migratory raptors. It was determined that the Project-affected area provides food and resting areas for species passing through on migration; however, the total number of raptors migrating through (primarily to the west of Amulsar mountain) were considered to be below the thresholds needed to identify the area as critical habitat as defined by IFC PS6/PR6. Nevertheless the area is of national significance and plays a supporting role to two IBAs.</p>	<p>Low-Medium - large areas are available for feeding. Increased disturbance levels and lighting might discourage birds from stopping. A high proportion of the species using the site are globally threatened.</p>	<ul style="list-style-type: none"> <li>• Time spent resting or feeding by selected species.</li> </ul>

**Table 7.3: Baseline Status of VECs**

VEC	Baseline condition	Resilience to stress	Indicators to assess condition
Landscape species – mammals and birds	<p>Twelve species of smaller mammals have been identified in the Project-affected area between 2008 and 2015, and larger mammal species present in the area include Fox, Wolf, Eurasian Lynx and Brown Bear, the latter being considered a critical habitat trigger species. Detailed descriptions of the baseline condition of all mammals is provided in Section 4.10. Between 102 and 138 species of bird were recorded in Spring surveys in 2013 and 2014, with approximately 85 showing evidence of breeding. Further details on baseline conditions of birds are available in Section 4.10.</p>	<p>Low - by definition, these species need uninterrupted access to large areas of habitat with low levels of disturbance. The need for action to reduce fragmentation and maintain corridors is recognised as a priority by IUCN and in Caucasus Biodiversity Action Plan.</p>	<ul style="list-style-type: none"> <li>• Numbers of bears and wolves using the Project-affected area.</li> <li>• Continued presence of Egyptian Vulture and Saker Falcon.</li> <li>• Evidence of breeding by bears and Egyptian Vulture.</li> </ul>
Important Bird Areas (IBAs)	<p>Two IBAs are located within the vicinity of the Project: Gorayk and Jermuk. The boundary of the Gorayk IBA represents the limits of an assumed hunting area around a breeding colony of Lesser Kestrels. The Gorayk IBA was also identified because of a large number of other species which are associated with the surrounding mountains, the Vorotan River Valley and the wetlands at the confluence of the Vorotan River with the Spandaryan Reservoir. Trigger species include: Lesser Kestrel; Egyptian Vulture; Long-Legged Buzzard; and Golden Eagle.</p> <p>The Jermuk IBA contains varied habitats for birds, including Arpa Gorge. It forms part of the proposed new Jermuk National Park. Trigger species include: Chukar; European Honey-Buzzard; Egyptian Vulture; Levant Sparrowhawk; Golden Eagle; and Corncrake.</p>	<p>Low – these areas have been designated as important for these species. While the species use lands more broadly, protecting the integrity of these zones is considered important for the species’ well-being.</p>	<ul style="list-style-type: none"> <li>• Number of trigger species recorded as feeding, resting and breeding in the IBAs.</li> </ul>

**Table 7.3: Baseline Status of VECs**

VEC	Baseline condition	Resilience to stress	Indicators to assess condition
Foraging and gathering of food and herbs	Foraging and gathering of food items is a common practice in the Project-affected area and within the broader community lands of the four communities. Within the groups interviewed as part of the Focus Group Discussions, 50-60% of people interviewed indicated that they collect wild food to complement food they purchase. See Section 6.15 for further details.	High – while foraging is a common practice, the items being collected are readily available across the community lands.	<ul style="list-style-type: none"> <li>• Social practices as described by focus groups surveys.</li> </ul>
Daily herding	<p>The practice of daily herding is commonly applied in some of the villages around Amulsar; Gndevaz in particular. Cattle are walked up to pasture on the mountain side each day, with herders and cattle returning each night. In Gndevaz this is a traditional practice, where households often herd cooperatively.</p> <p>More information is available in Section 6.15.</p>	Low-Medium - daily herding is restricted by both distance from the village and ownership of land.	<ul style="list-style-type: none"> <li>• Number of herders carrying out this activity.</li> <li>• Distance required to gain access to pasture.</li> </ul>
Seasonal herding	The traditional practice of seasonal herding (seasonal summer migration) is common within Armenia. Herders from other regions of Armenia are known to travel to the Project-affected area and the Vorotan Valley for the summer months to graze their cattle (and also some sheep). Approximately 58 herders are believed to come to the area during summer months.	Medium - High - a minority of seasonal herders have used the same land for generations. Others indicate willingness to herd in other locations.	<ul style="list-style-type: none"> <li>• Number of seasonal herders coming to Project-affected area.</li> <li>• Community grievances.</li> </ul>
Vorotan Valley	The Vorotan Valley is a relatively undisturbed area which provides habitat for a wide range of species, both residential and migratory. It also has a number of sites of cultural heritage value which have experienced relatively minor disturbance to date. Disturbance within the Valley has been increasing in recent years with the expansion of the track north from Gorayk to form an access route for the Amulsar project, and the development of a new hydro-electric plant on the Vorotan	Low – the aspects which make the Valley important are highly susceptible to impact.	<ul style="list-style-type: none"> <li>• Number of bird species present (residential and migratory).</li> <li>• Traffic usage on the road north of Gorayk.</li> <li>• Number of herders using the Vorotan Valley.</li> </ul>

**Table 7.3: Baseline Status of VECs**

VEC	Baseline condition	Resilience to stress	Indicators to assess condition
	River.		
Jermuk tourism	<p>Jermuk is an important tourism and spa destination in Armenia; however, the tourism industry is relatively limited at present, and largely constrained to summer months. Section 4.17 provides further details on the tourism baseline.</p> <p>A key element to the area’s touristic potential lies in opportunities for eco-tourism. Limited advances have been made in this regard to date. The environment is relatively pristine currently, providing plentiful opportunity for eco-tourism to develop.</p>	<p>High – significant opportunities exist for tourism to diversify into new areas from Jermuk.</p>	<ul style="list-style-type: none"> <li>• Number of tourists in Jermuk.</li> <li>• Number of scenic sites developed and visited.</li> <li>• To be determined based upon the eco-tourism facilities/tracks etc. which are developed.</li> </ul>

## **7.5 Cumulative Impacts on VECs**

The approach taken to assess cumulative impacts in this chapter is desk-based and has relied upon the expert judgement of topic specialists from the ESIA chapters. Some of the impact assessment chapters address cumulative impacts relevant to their field of study as part of their methodology used for impact assessment. Good examples of this are seen in the transport assessment (Section 6.18), in-migration analysis (Section 6.12) and the landscape and visual assessment (Section 6.5). The assessments completed in these chapters are not repeated in this analysis. Given the lack of detail on plans associated with other activities (non-mine related), it is considered appropriate to indicate the potential scale and direction of the cumulative impact at this stage and give an indication of the significance of the potential impact.

**Table 7.4: Magnitude of Cumulative Impacts**

VECs	Cumulative Impacts	Impact to sustainability or viability of VEC	Actions Proposed
Arpa River water flows	<p>During the construction period there will be a requirement for an abstraction of up to 12.3 l/s, the majority of which will be abstracted from the Arpa River (8 l/s), with additional water abstracted from the Benick pond (1.3 l/s). During mining operations, Amulsar will abstract less than 5% of the controlled flow of the Arpa River, downstream from Gndevaz. The Project will be operated as a zero discharge site during the first 4 years of operation, then a discharge of about 40m<sup>3</sup>/h of treated water will require treatment. During the closure period, water will be discharged into the Arpa following treatment, using a Passive Treatment (wetland) System (PTS).</p> <p>Water discharged from the Kechut Reservoir is also used as a water supply for Gndevaz and a hydro-electric facility is also located in the area. The combined effect of water abstraction and use from the Arpa River is not expected to have an impact upon the river and its flow regime. This impact is further moderated through the high resilience of the VEC due to the ability to control flows from the Kechut Reservoir.</p>	Negligible impact to the sustainability or viability of the Arpa River water flow is anticipated as a result of cumulative impacts.	Arpa River flow and water quality will be monitored during construction and operations of Amulsar, with mitigation measures put in place if necessary.

**Table 7.4: Magnitude of Cumulative Impacts**

VECs	Cumulative Impacts	Impact to sustainability or viability of VEC	Actions Proposed
<p>Sub-alpine Meadows and Sub-alpine Meadows with Alpine Elements</p>	<p>The Amulsar Project will disturb approximately 483 hectares of Sub-alpine Meadow (including areas defined as Sub-alpine Meadow with Alpine Elements). The Project will also restrict access to an additional 537 hectares of Sub-alpine Meadows (including those with Alpine Elements). As can be seen in Figure 2 of the Natural and Critical Habitat Assessment (Appendix 4.10.3), this represents a significant proportion of these habitats within the Project area. Section 4.10 reported that 1,885 hectares of the mapped area comprise Sub-alpine Meadow; however, only 147 ha of Sub-alpine Meadow with Alpine Elements were recorded. To manage the Project’s impact, a set-aside with Sub-alpine Meadow has been designated by the Project. The set-aside is located on the Arshak peak, to the south of Tigranes-Artavazdes.</p> <p>Arshak is also mineralised, and as such, presents a future opportunity for mining. If Arshak were to be mined, the loss of Sub-alpine Meadow would increase significantly, and the area created as a set-aside for Amulsar’s planned mining impacts would be lost.</p> <p>Adding to the pressure on these habitats is the threat of climate change. These habitats are vulnerable due to their high elevation and sensitivity to temperature and precipitation levels.</p>	<p>Moderate to Major impact to the sustainability of Sub-alpine Meadow habitats within the Project-affected area.</p>	<p>The set-aside (Arshak) preserves a proportion of the habitat type in good condition and is excluded from mining.</p> <p>Species resident in Sub-alpine Meadows will be monitored, with translocation trials for species of key concern (see Section 6.11) being carried out during the construction and operational periods of the Amulsar Project.</p>

**Table 7.4: Magnitude of Cumulative Impacts**

VECs	Cumulative Impacts	Impact to sustainability or viability of VEC	Actions Proposed
Jermuk groundwater	<p>Jermuk groundwater is famed for its health values and is a key element of the town's tourism strategy. The water bottling factories operating in Jermuk rely upon this water for their product.</p> <p>The Amulsar Project will have no direct impact on Jermuk groundwater (see Section 6.10).</p> <p>The Project is, however, supporting the development of Jermuk's tourism industry. Increased tourist numbers have the potential to increase domestic waste and sewerage levels in Jermuk. Poor management of these items could result in impact to Jermuk's groundwater quality.</p>	<p>Negligible to minor impacts anticipated. Impacts will only occur if effective and appropriate management of waste and sewerage is not implemented as part of the tourism development strategy by Jermuk.</p>	<p>Lydian will ensure that any residential requirements the Project has in Jermuk will not add to waste management and sewerage disposal volumes in the town (see Section 6.12).</p>

**Table 7.4: Magnitude of Cumulative Impacts**

VECs	Cumulative Impacts	Impact to sustainability or viability of VEC	Actions Proposed
Natural habitat	<p>A high proportion of vegetation in the Project-affected area is considered “natural” habitat (see Appendix 4.10.3). Approximately 800 hectares of natural habitat are expected to be either destroyed or fundamentally modified for the lifetime of the mine and thereafter are expected to remain in a fundamentally modified condition. An additional 355 hectares will experience disturbance during the mine life through deposition of dust and pollutants or eutrophication. The under-representation of Montane Meadows and Montane Meadow Steppes in RA’s protected area system and the decline in traditional management (needed to maintain these habitats) will add further pressure on this habitat.</p> <p>The potential impacts to natural habitat from other foreseeable activities are less well defined. Tourism expansion in the Project-affected area could adversely affect areas of natural habitat through exposing them to greater numbers of people. Expanded tourism could also be accompanied by an expansion of the road and track network in the Project-affected area, increasing the accessibility of previously remote areas, potentially adversely affecting the integrity of natural habitat areas. Until the route of the North-South road corridor is defined in the Project-affected area, it is unknown if this will have any impact on natural habitat.</p> <p>The proposed development of a Jermuk National Park would positively impact on natural habitat, effectively increasing the level of protection for some areas of this habitat.</p> <p>If mining were to be conducted on Arshak, this would compromise additional areas of natural habitat. The designation as a set-aside reduces this likelihood.</p>	Moderate adverse impact.	<p>The Natural and Critical Habitat Assessment identifies a range of actions which will be taken by the Project to achieve no net loss of natural habitat.</p> <p>Lydian biodiversity specialists will work with environmental experts in Armenia to contribute to the design of the Jermuk National Park (Lydian also anticipated supporting this development) and the broader tourism development to maximise protection of natural habitat. The park includes Montane Meadows and Montane Meadow Steppes.</p>

**Table 7.4: Magnitude of Cumulative Impacts**

VECs	Cumulative Impacts	Impact to sustainability or viability of VEC	Actions Proposed
High quality pasture or grazing lands	<p>The Project is predicted to disturb approximately 1000 hectares of land classified as pasture (this includes land currently categorised as mining land but assumed to previously have been categorised as pasture) and 30 hectares of hayfields (see Section 6.16). This impact could be amplified through the possible development of new hydro-electric schemes in the Vorotan valley (although relatively distant) which could potentially reduce the amount of pasture available near rivers (this impact would be small in scale if it occurred).</p> <p>The most likely impact to pasture and grazing lands (outside of direct mining impacts) would be associated with the level of herding and agricultural activity occurring in the Project-affected area. A general urbanisation trend would suggest a reduction in pressure on land; however, this will need to be monitored in the Project-affected area.</p> <p>Future mining plans (if developed) would potentially reduce the amount of high quality pasture and grazing land available further.</p>	Minor – Moderate impacts are anticipated.	Sufficient land is understood to be available for pasture and grazing activities (to meet current demands), but over-grazing is understood to occur due to a lack of services (water, roads, milk collection) in more remote areas. The Project could support an expansion of services to other areas, but this would need to be balanced with the impact to natural habitat caused by opening up previously remote zones.

**Table 7.4: Magnitude of Cumulative Impacts**

VECs	Cumulative Impacts	Impact to sustainability or viability of VEC	Actions Proposed
Migratory raptors	<p>The Project is located along a migration path used by a number of raptor species (see Section 4.10) and provides both resting and feeding habitat for birds on migration. The project is expected to have a neutral residual impact on migratory raptors; however, monitoring will be required. The most important areas for migratory raptors within the Project-affected area include: an area of montane habitat approximately 1km south of Arshak; lower slopes of the western side of the massif; a rocky gorge east of Gndevaz Village; pools and wetlands; and Arpa Gorge. The development of any additional hydro-electric facilities (either on the Arpa or the Vorotan) could potentially impact migratory raptors through creating an increased level of disturbance in the area. Given the scale of the hydro-electric plants developed recently, the physical footprint is likely to be low, but the linear powerline developments associated with these systems can be significant.</p> <p>If Arshak were to be mined in the future, this would directly affect one of the areas of importance for migratory raptors. Depending on the level of disturbance caused, it may lead to raptors placing a greater reliance on Arpa Gorge and the western side of the mountain for food and rest.</p> <p>The expansion of tourism in Jermuk, and in particular the development of eco-tourism, could increase public access to sites important to migratory raptors (notably Arpa Gorge).</p>	Minor – Moderate impacts are anticipated.	<p>The Project-affected area is not an area of critical habitat for these species, and as they are mobile, there is some resilience within the VEC to adapt to changing conditions.</p> <p>Lydian will manage lighting to minimise night-light effects from the Project. Power lines have been linked to bigger structures where possible (overland conveyor) and will be insulated and fitted with bird diverters.</p>

**Table 7.4: Magnitude of Cumulative Impacts**

VECs	Cumulative Impacts	Impact to sustainability or viability of VEC	Actions Proposed
Landscape species – mammals and birds	<p>The Project-affected area provides habitat for a number of landscape species (birds and mammals) (as described in Section 4.10 and summarised in Table 7.3). Impacts to specific species are addressed in Section 6.11. This assessment is considering the landscape scale effects upon these species in general.</p> <p>Development of the Amulsar project will reduce the land available for some landscape species to traverse, feed and sleep/nest, in particular Brown Bear. Linear features within the Project, e.g. the access and haul roads, overland conveyor, drainage channels and water pipelines between BRSF toe, the pits, the conveyor and the HLF, are likely to impact upon the traversing paths of some species (these features have been designed with crossing points included but it is not clear how wildlife will react to these access points).</p> <p>Given the elevated location of the Project setting, a number of species resident in this area are likely to be susceptible to climate change impacts as their habitat decreases in size, e.g. <i>P. porphyrantha</i>.</p> <p>The development of Jermuk National Park would be expected to positively impact this VEC. Some of these positive impacts could be undermined by the impact of increased numbers of tourists in the Jermuk area, leading to increased disturbance. An expansion in the population in the Project-affected area (temporary and permanent) could increase pressure upon landscape species through increasing land-take for urban and agricultural purposes and potential increases in the level of hunting in the region.</p> <p>If Arshak were to be mined, one of the key mitigations for impact to these species would be lost and habitat loss/disturbance would increase.</p>	Moderate – Major impacts are anticipated	Protecting the set-aside area (Arshak) is a key component of managing this impact. Supporting the development of the Jermuk National Park and providing advice on tourism activities which will minimise human influence over this VEC will also be important.

**Table 7.4: Magnitude of Cumulative Impacts**

VECs	Cumulative Impacts	Impact to sustainability or viability of VEC	Actions Proposed
IBAs	<p>The two IBAs will not be directly affected by the Project footprint. The trigger species for these IBAs do not trigger critical habitat in their own right and the IBAs are not considered to constitute critical habitat (although they have been treated as such in Project mitigation measures). While the Project will not affect the IBAs directly, impacts to land nearby the IBAs will be likely to have indirect impacts upon some of the trigger species. For example, the Project will cause minimal disturbance to the Vorotan River Valley through the use of the access road between the site and Gorayk (estimated to be 6 light vehicle trips per day) A number of the trigger species are understood to use the valley for feeding and this increased level of disturbance could impact them. Similar effects could occur due to the excavation of rocky cliffs on Amulsar mountain.</p> <p>The IBAs could also be impacted (again indirectly) through the completion of the Vorotan Valley hydro-electric scheme, which will require the installation of powerlines parallel with the River.</p> <p>The establishment of the Jermuk National Park would present a positive impact upon the Jermuk IBA in particular as it would be incorporated within a formal protected areas system.</p>	<p>Minor impact anticipated. This assessment includes the balance of potential adverse and positive impacts.</p>	<p>Bird monitoring surveys to be conducted at regular intervals to identify and assess any impacts to species for which IBAs were designated.</p>

**Table 7.4: Magnitude of Cumulative Impacts**

VECs	Cumulative Impacts	Impact to sustainability or viability of VEC	Actions Proposed
Foraging and gathering of food and herbs	<p>The Amulsar project will restrict access to approximately 1765 hectares during the life of the mine, with approximately two-thirds of the land returned in a largely undisturbed state at the conclusion of mining. Most land will be rehabilitated (excluding the open pits), but it is likely that wild foods and herbs currently collected by community residents and herders may take many years to re-populate the rehabilitated land. While the Project will restrict access to a large area, consultation with affected communities suggests that sufficient alternative land exists within the community lands which could be used for foraging.</p> <p>The general urbanisation trend seen in most former Soviet Union countries may also impact foraging activities, especially when coupled with increased cash income in the Project area. The combined effect of these changes may reduce the practice of foraging amongst community members, which is considered a traditional practice.</p>	Negligible – Minor impact anticipated due to the high resilience of this VEC	<p>The Project will monitor this impact through regular socio-economic surveys to assess the use of ecosystem services, including foraging activities.</p> <p>A transition from foraging to cash purchases is somewhat inevitable in rural communities, and remains the choice of a community.</p>

**Table 7.4: Magnitude of Cumulative Impacts**

VECs	Cumulative Impacts	Impact to sustainability or viability of VEC	Actions Proposed
Daily herding	<p>There is an ancient tradition of transhumance, with a complex system for allocating land for summer grazing. Livestock are herded onto montane pastures each day from villages around the Amulsar Mountain and grazing leases are also let (largely in the Vorotan Valley) to other cattle owners, some of whom live considerable distances away. The Project will likely affect the daily herding practices of Gndevaz, requiring herders to either modify their pasture use or route to gain access to pasture (see Section 6.14).</p> <p>The practice of daily herding is also likely to be impacted by the urbanisation trend. This may occur through the loss of interest amongst younger generations in agricultural lifestyles, potentially compounded by the increased prevalence of a cash economy through the development of the Project.</p> <p>It is not clear whether additional mining would impact daily herding practices, as more information is required on the preferred access routes and movement of livestock over the summer months.</p>	Moderate – Major impact is anticipated.	The Project has committed to supporting agricultural activities through its community development activities. While agricultural support is likely to reduce impacts on livelihoods, they may not necessarily support traditional transhumance practices, and may unintentionally further threaten them.

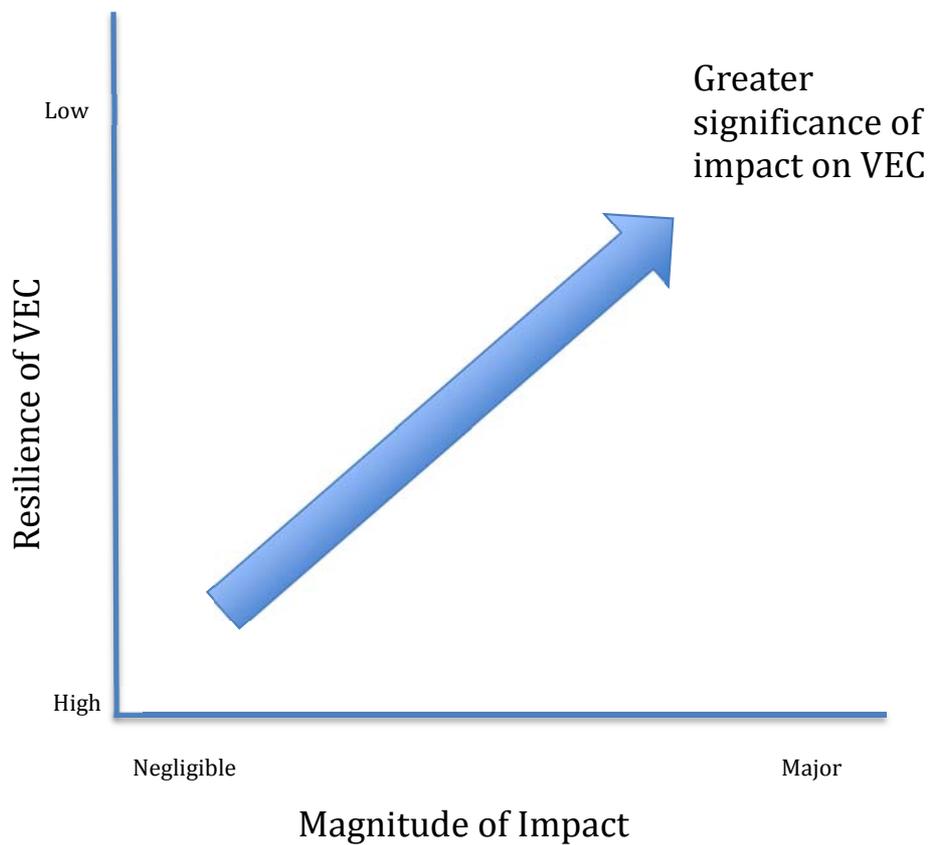
**Table 7.4: Magnitude of Cumulative Impacts**

VECs	Cumulative Impacts	Impact to sustainability or viability of VEC	Actions Proposed
Seasonal herding	<p>Seasonal herding activities occur in a number of locations across the Project-affected area (see Section 6.14). The Project will restrict access to approximately 1608 hectares of land. While the project has been designed to minimise impacts to seasonal herders through siting of facilities, the impacts of the Project upon their activities will only become apparent once construction commences. Seasonal herders have a level of flexibility in how they respond to these impacts, ranging from the decision to herd elsewhere through to modifying their pasture usage within the Project-affected area.</p> <p>It is not clear if the general urbanisation trend will affect the number of seasonal herders over time. Seasonal herding is an important cultural tradition for these communities and hence its reduction could be significant to those communities.</p>	Minor impact anticipated.	The impact of the Project upon seasonal herders will be monitored closely by Lydian. In the event that significant impacts occur, additional mitigation measures will be identified to contribute to the protection of this cultural service.
Vorotan Valley	<p>The Vorotan Valley is comparatively less disturbed than other areas within the Project-affected area. The Project has been designed to minimise its impact to this Valley environment; however, the minor use (estimated at 6 vehicles per day) of the road through the Vorotan Valley will be required by the Project (maybe more during construction).</p> <p>Combining with this Project impact is the impact of hydro-electric plants constructed and which may be constructed in the future along the Valley base. The expansion of a pre-existing track north of Gorayk (undertaken by Geoteam) has improved access to the more remote regions of the Valley (to the north) making it easier for all forms of activity to occur in areas of previously low disturbance.</p> <p>The expansion of tourism could also inadvertently bring increased disturbance to the Vorotan Valley.</p>	Moderate impacts anticipated.	Lydian will consult with communities on options to rehabilitate sections of the Kechut-Gorayk road and will seek to minimise the width of this road post-mine closure.

**Table 7.4: Magnitude of Cumulative Impacts**

VECs	Cumulative Impacts	Impact to sustainability or viability of VEC	Actions Proposed
<p>Jermuk tourism and spa including eco-tourism</p>	<p>The Amulsar Project plans to develop accommodation using existing hotels in Jermuk for its non-residential workforce during the operational period (approximately 370 employees). This will bring positive contributions to Jermuk’s tourism and spa infrastructure. Tourism may be adversely impacted however, by the presence of the mining operations in the general area. Part of the value attributed to Jermuk tourism is associated with its largely undisturbed environment and spa facilities. While the spa facilities will not be affected, the environment will become more disturbed as a result of the mining operation, and potentially from the impacts of the development of the North-South Road Corridor (depending on the route chosen). While the road may produce adverse impacts, it could also provide a quicker route to Jermuk, increasing its appeal as a tourist destination. Similarly, the development of the Jermuk National Park may increase the appeal of Jermuk as a tourist destination.</p> <p>For the construction phase a conservative approach has been applied of assuming a construction camp will be utilised for the majority of construction workers, with overflow being accommodated in Jermuk as necessary. Those construction workers based in Jermuk would either be accommodated in hotels or in available private rented rooms.</p>	<p>Minor impacts are anticipated on balance.</p> <p>Moderate impacts that could be beneficial, but reduce to neutral in the longer term</p>	<p>Visual and social impacts associated with the development of Amulsar are addressed in Section 6.5. Jermuk tourism as a VEC will receive further support from Lydian in the form of support for specific activities / proposals (e.g. Jermuk National Park), botanical gardens etc. In the longer term, this support during the operational phase would also promote tourism and in part offset the decline in workforce that will take place during the closure phase.</p> <p>The study of worker accommodation options has informed the socio-economic study of the construction workforce accommodation (Chapter 6.21). The mitigation measures have been developed in the Worker Accommodation Management Plan (Appendix 8.25).</p>

The potential significance of a cumulative impact has been determined using Figure 7.3 as a guide. Due to the uncertainty associated with the nature of impacts considered in this assessment, impacts have been defined as significant, potentially significant or not significant through consideration of the resilience of the VEC (Table 7.3) and the magnitude of the impact (Table 7.4). The results of this assessment are captured in Table 7.5.



**Figure 7.3: Impact Significance**

<b>Table 7.5: Significance of Cumulative Impacts</b>			
<b>VECs</b>	<b>Resilience of VEC</b>	<b>Magnitude of Impact</b>	<b>Indication of Impact Significance on VEC</b>
Arpa River water flows	High	Negligible	Not significant
Sub-alpine Meadows and Sub-alpine Meadows with Alpine Elements	Low	Moderate – Major	Significant
Jermuk groundwater	High	Negligible – Minor	Not significant
Natural habitat	Low – Medium	Moderate	Significant
High quality pasture or grazing lands	Medium	Minor- Moderate	Significant
Migratory raptors	Low-Medium	Minor – Moderate	Potentially Significant
Landscape species – mammals and birds	Low	Moderate – Major	Significant
Important Bird Areas (IBAs)	Low	Minor	Potentially Significant
Foraging and gathering of food and herbs	High	Negligible – Minor	Not significant
Daily herding	Low-Medium	Moderate - Major	Significant
Seasonal herding	Medium	Minor	Potentially Significant
Vorotan Valley	Low	Moderate	Potentially significant
Jermuk tourism	High	Minor	Not significant