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## **6.11 Biodiversity and Ecosystems**

### **6.11.1 Introduction**

In line with Lydian's Biodiversity Policy, the Project aims to achieve "no net loss" (NNL) of biodiversity and to ensure that biodiversity and ecosystem functions are not systematically degraded or lost from the landscape as a result of the Project. This means that species occurring in the Project-affected area should have the same chances of long-term survival with the Project in place as without it, and have access to similar amounts of suitable habitat as in the baseline situation. Lydian has also committed to implement the Project according to good international industry practice, as exemplified by its commitment to lender policies, standards and requirements. To comply with the requirements of the International Finance Corporation's Performance Standard 6 (IFC PS6) and the European Bank for Reconstruction and Development's Performance Requirement 6 (EBRD PR6), a NNL outcome should be achieved if possible for natural habitats and a "net gain" outcome must be achieved for critical habitat. Compliance with EBRD's PR6 further requires the Project to follow the intent of EU law with respect to conservation of habitats and species, notably according to the requirements of the EU Habitats Directive.

Section 6.11.2 is an overview of the approach taken to assessment of impacts on biodiversity and ecosystems as a result of the Project. Section 6.11.3 identifies the "priority" biodiversity components that have been selected for detailed consideration, though impacts on biodiversity in general have also been considered. Section 6.11.4 identifies the main Project activities or components expected to give rise to ecological impacts and the biodiversity receptors likely to be exposed to them. In Section 6.11.5, the likely significance of impacts is considered, based on the sensitivity and vulnerability of affected biodiversity. This provides the basis for development of an effective mitigation strategy for biodiversity and ecosystems as discussed in Section 6.11.6.

Table 6.11.14 presents a final summary of the conclusions of this Chapter, showing the predicted significance of impacts on biodiversity pre- and post-mitigation. Proposed offsets are identified, as well as any further work needed (through the implementation of a Biodiversity Action Plan (BAP)) either to confirm that further offsets are necessary or to provide the evidence needed to ensure that they will be appropriate and effective.

### **6.11.2 Overview of Approach, Assessment Criteria and Overall Mitigation Strategy**

As explained in Chapter 4, biodiversity data relevant to the Project area have been collected since 2008, with input from local and national experts and international specialists. Government and non-governmental organisations were consulted and involved, notably the National Academy of Sciences of the Republic of Armenia (NAS RA) Institute of Botany and Institute of Zoology; the Armenian Society for the Protection of Birds (ASPB); the Caucasus Nature Fund; and WWF.

Since the ESIA process commenced formally in 2010, results of ecological surveys have been used systematically to inform Project design, with continuous dialogue taking place between the engineering and biodiversity teams and others involved in environmental and social studies for the ESIA. Information on priority issues and constraints has been provided to the Project design team throughout, allowing them to modify elements of the design as needed to avoid or minimise significant impacts in line with the mitigation hierarchy. In other words, the current Project design already benefits considerably from "in-built" or "embedded" avoidance and mitigation measures to safeguard biodiversity and ecosystems.

Section 5.7 describes instances of Project design elements being adjusted to address biodiversity concerns (amongst others). These include the following:

- The identification of *Potentilla porphyrantha* on Amulsar Mountain was recognised at an early stage as a significant constraint, this species later confirmed as having Tier 1 critical habitat affected by the Project per IFC PS6. A formal set-aside (referred to as the "Arshak Set-aside") was identified to avoid/ safeguard a viable proportion of the population south of Arshak Peak. Elsewhere, individual occurrences of the plant have been marked, and access routes required during exploration activities have been designed to avoid them.
- The Arshak Set-aside also preserves important breeding habitat for *Ursus arctos*, high quality examples of sub-alpine meadow vegetation, habitat for other species of conservation importance (Eurasian Lynx, Wolf, Bezoar Goat) and habitat for bird species included on the RA Red List.
- Conveyor rather than truck transport was selected to transport crushed ore to the HLF, reducing footprint on natural habitat. In 2015, the line of the conveyor was adjusted slightly (during Value Engineering and Optimization) to avoid crossing the end of a rocky gorge important for breeding birds (for the location of this gorge see Figure 6.3.1.

- Topsoil storage locations were reviewed and higher quality vegetation avoided.
- The site selection process for the HLF took the precautionary approach of treating the nearby Gorayk Important Bird Area (IBA) as critical habitat, thus weighting the process heavily against footprint impacts on a Key Biodiversity Area (KBA).

The impact assessment described in this Section 6.11 applies to the current Project design as described in Chapter 3 with "in-built mitigation" incorporated.

The overall aim of the assessment described in this chapter was to determine whether NNL (or net gain as appropriate) could be shown for the various biodiversity receptors in the residual situation, taking account of efforts to avoid or mitigate impacts during Project design and implementation, and to offset any significant residual impacts according to the mitigation hierarchy.

Impact sources were identified based on Project infrastructure and activities. Receptors are ecosystems or any biodiversity component identified during baseline surveys and assessments for which specific consideration of impacts was considered necessary.

As part of the development of the Project's biodiversity mitigation strategy, "priority" biodiversity components or receptors were identified for which it was considered necessary to demonstrate an explicit NNL or net gain outcome through the mitigation hierarchy. These components were chosen for various reasons, for example because there are legal or policy requirements to demonstrate that they will be safeguarded, or because local people value them. They included:

- Species protected in the RA (listed in the Armenian Red Book);
- Species considered by specialists to be threatened or declining either in the RA or in the region or globally;
- Areas of natural habitat according to the definition in PS6 or PR6;
- Habitats or ecosystems which are considered "critical" according to PS6 and PR6; and
- Legally protected areas for nature conservation and their designated features.

The ability to achieve a NNL outcome was considered in detail for these receptors. The ESIA was supported by a detailed “Natural and Critical Habitat Assessment” (NCHA; Appendix 4.10.3) that examined the implications of the Project in detail for natural and critical habitat per PS6/PR6 and identified actions needed to achieve NNL of natural habitat and a net gain of critical habitat.

In line with Lydian’s corporate policy on biodiversity to achieve NNL of biodiversity overall, implications of the Project were also considered for wider biodiversity that might be exposed to impacts (i.e. including receptors which were not identified as priority biodiversity according to the criteria above). These are generally habitats and species considered to be relatively widespread and resilient, having extensive and stable distributions in the RA or the Caucasus region.

How receptors might respond to Project activities depends on the following key considerations:

1. Whether the receptor will be exposed to a Project activity or its effects.
2. The sensitivity of the receptor to the activity or its effects (will it respond?).
3. The vulnerability of the receptor to impacts (will it decline or be damaged?).
4. The ability of the receptor to recover independently, without intervention in the form of mitigation.
5. The effectiveness of mitigation in reducing impacts to a point where it can be concluded that there is NNL.
6. If significant effects remain after mitigation, the ability to compensate or offset so that NNL or a “net gain” can be demonstrated.

These have been defined or interpreted as summarised in the following subsections:

### ***Receptor Exposure***

Whether a receptor is likely to be exposed to an impact source depends on the temporal and spatial relationship between a Project activity (e.g. a noise emission) and the receptor. It is assumed that the receptor may be exposed if baseline surveys or other information searches suggest it could be present at the time or location concerned. Without exposure, there is no impact, and these cases were screened out from further consideration.

### ***Receptor Sensitivity***

Whether a receptor will show a measurable response to the changes associated with a Project activity depends on its sensitivity. For example, individuals of a species might be exposed to increased levels of noise during construction, but if they are not sensitive to noise, they will not be exposed to a significant impact as a result of elevated noise levels. Sensitivity has been considered in relation to the particular Project activity under consideration and the characteristics of the receptor in every case where a receptor may be exposed to an impact.

### ***Receptor Vulnerability***

As used in this approach, receptor “vulnerability” refers to the consequences of a change caused by a Project activity for a receptor that is both exposed and sensitive to an impact. Specialists have considered the extent to which the impacts identified might threaten the status or viability of receptors throughout their range or distribution. The proportion of populations of a species or habitat extent affected by the Project has therefore been considered, as well as the extent to which habitats or populations of species are stable, increasing or declining.

### ***Receptor Resilience and the Need for Mitigation***

In order to achieve a NNL outcome for biodiversity, any receptor exposed to a measurable adverse effect must either recover spontaneously without the need for any intervention, or must be restored to pre-impact levels or condition through mitigation. The resilience of a receptor and its ability to recover has a bearing on the need for mitigation to achieve NNL and depends on the impact source being considered (its type, magnitude, frequency and duration), as well as the characteristics of the receptor and its ability to recover from any perturbation.

For example, species that are mobile, adaptable and breed readily are more resilient than species with slow population growth that are highly specific in their habitat requirements and relatively immobile. It is also generally easier for populations to recover if a relatively small proportion of the original population is lost as a result of an impact. In this ESIA, a “resilient population” has been defined as one able to recover at a speed and to a level within the bounds of normal variation without mitigation. Similarly, resilient habitats are able to re-establish through natural regeneration, without restoration. If receptors are not judged to be resilient in this way, mitigation is needed and if there is any uncertainty, further assessment may be needed in the pre-construction phase of the Project to confirm the need for

mitigation.

### ***Mitigation Measures***

Mitigation is needed if the impact will result in a measurable change to the receptor that is outside the bounds of normal variation. In such cases, it will not be possible to achieve NNL unless mitigation is implemented.

### ***Offsets***

If NNL cannot be achieved even with mitigation, a significant residual impact will occur. In cases where residual impacts have been identified for “priority biodiversity”, the need for offsets has been considered. Note that the option to offset was only considered as a last resort if significant residual impacts on natural or critical habitat were predicted despite mitigation, though gains may also be achieved for some “wider biodiversity” through requirements of PS6 to achieve NNL for natural habitat if possible.

### ***Impact significance***

The ecological implications of the Project as a whole or of a specific Project activity may be:

- **Neutral:** no detectable change occurs, or the affected biodiversity/ ecosystems are able to accommodate the change without any long-term consequences. The changes are within bounds of normal variation, or spontaneous recovery is likely. No specific mitigation measures are necessary beyond general good practice measures that form part of Project design.
- **Moderate/ not significant with effective mitigation:** the Project causes detectable changes relative to baseline conditions and these changes are outside the bounds of normal variation (if known). Mitigation is needed to reduce or minimise impacts, or to aid recovery but proven mitigation measures are available and with these measures in place, receptors will recover to a viable residual state or condition.
- **Significant:** significant impacts occur if the Project will cause populations of species or the extent of ecosystems/ biotopes to decline below baseline trends in the longer term, despite mitigation. If there might be residual loss of “natural habitat” or a long term decline in the range, distribution or population size of any species, scope for biodiversity offsets to achieve a NNL or net gain outcome (as necessary) has been considered. Use of offsets that have sufficient assurance regarding likely success may reduce a significant residual impact to a moderate level.
- **Significant/ not offsetable:** there may be significant adverse impacts that cannot be



offset because an effective outcome cannot be assured, given available conservation or restoration techniques, or because suitable offset locations cannot be identified or secured or because it is not possible to restore habitats or species populations in reasonable timeframes.

In some cases, outcomes may remain uncertain because the information needed to predict impacts is not yet available. Where this is the case, plans to obtain the required information are detailed in the Project BAP.

The geographic scale used to assess impacts has a bearing on their significance, as ecological outcomes depend critically on the viability and functionality of what remains as much as the specific characteristics of the proportion lost or damaged. A suitable geographic unit to consider impacts on biodiversity components therefore needs to be identified. This generally equates to the scale at which affected biodiversity is considered important and varies between receptors: e.g. if there is a loss of a vegetation type which supports species endemic to the Caucasus Region, ability to achieve NNL should be demonstrated for that vegetation type within the Caucasus Region. Similarly, if a species is protected at national level, ability to achieve NNL or a net gain has been considered at a national level.

Table 6.11.1 summarises the approach that has been taken to apply the mitigation hierarchy based on these significance criteria.

**Table 6.11.1: Summary of Significance Criteria and Supporting Mitigation Strategy for Biodiversity and Ecosystems**

Category of impact significance	Impact characteristics	Receptor characteristics and response	Required action in mitigation strategy
<b>Neutral</b>	<p>Changes attributable to Project actions are temporary and/ or of low duration, intensity and extent</p> <p><i>and</i></p> <p>There is no lasting change in the status or condition of the receptor outside the bounds of baseline or background fluctuation</p> <p><i>and</i></p> <p>Spontaneous recovery from the impact can occur.</p>	<ul style="list-style-type: none"> <li>• Receptors are sufficiently adaptable and resilient to recover from the impact spontaneously, without intervention and without any detectable change in viability, e.g. species might be characterised by high mobility, high tolerance of disturbance, rapid regeneration times.</li> <li>• Receptor is able to avoid impacts by relocating to alternative suitable habitat (e.g. highly mobile species).</li> <li>• If exposed, receptors are either insensitive to the impact or they are able to tolerate it, e.g. species are able to recover from the impact without intervention within one breeding season.</li> <li>• Any losses of individuals from a species population are within bounds of normal variation.</li> <li>• The receptor is likely to be ubiquitous or represented on many sites (i.e. to have low irreplaceability), e.g. habitats might be widespread so that losses are insignificant when compared with overall extent and do not affect the viability or functioning of the habitat.</li> </ul>	<p>No mitigation is needed beyond standard “good practice” or generic measures, because there are no lasting effects beyond natural or background rates of change.</p>
<b>Moderate</b>	<p>Impacts are measurable. They may vary in duration, extent, intensity, frequency but cause changes of a magnitude/amplitude greater than background</p>	<ul style="list-style-type: none"> <li>• The receptor is sensitive to the impact.</li> <li>• The receptor is not able to recover from the impact without intervention, so mitigation is needed, e.g. decline in species population is outside bounds of normal variation but recovery is possible with proven mitigation measures.</li> <li>• Receptors are more likely to have properties that make</li> </ul>	<p>Mitigation is needed to ensure that impacts are within acceptable limits in terms of global, national or local priorities for nature conservation as appropriate.</p> <p>An effective mitigation strategy is needed to deal with impacts and to show that</p>

**Table 6.11.1: Summary of Significance Criteria and Supporting Mitigation Strategy for Biodiversity and Ecosystems**

Category of impact significance	Impact characteristics	Receptor characteristics and response	Required action in mitigation strategy
	<p>variation, e.g. impacts result in measurable decline in population of an affected species or the extent of a habitat.</p> <p>Impacts can be shown to be reversible with suitable mitigation.</p>	<p>spontaneous recovery unlikely, for example restricted distributions, lower mobility, less rapid breeding cycles.</p>	<p>NNL of biodiversity can be achieved.</p> <p>Proven mitigation measures must be available and these must be “tried and tested”.</p> <p>Precautionary measures may be recommended if there is any uncertainty about the status or resilience of the receptor.</p> <p>If there are likely to be residual impacts, a “like for like” outcome may be needed to offset for moderate impacts on some receptors but not necessarily all.</p>

**Table 6.11.1: Summary of Significance Criteria and Supporting Mitigation Strategy for Biodiversity and Ecosystems**

Category of impact significance	Impact characteristics	Receptor characteristics and response	Required action in mitigation strategy
<b>Significant</b>	<p>Impacts are measurable and may vary in duration, extent, intensity or frequency.</p> <p>If impacts are frequent, regular, high intensity and long term or permanent, it must be possible to offset them.</p>	<ul style="list-style-type: none"> <li>• The species has a declining population and/ or high irreplaceability.</li> <li>• The proportion of the receptor's distribution or population affected results in longer term or permanent decline in the viability of what remains.</li> <li>• A very large proportion of the total known distribution or extent of the receptor is affected given the relevant geographic scale of consideration.</li> <li>• The integrity of a protected area or its ability to continue supporting its designated species is affected.</li> <li>• There will be residual effects even with mitigation in place, which mean a NNL outcome can only be achieved through an offset.</li> </ul>	<p>Highly precautionary approach needed with strong burden of proof to show that impacts could not be avoided.</p> <p>Techniques for mitigation must be proven. If there are residual impacts with mitigation in place, an offset is needed. Suitable offsets must be identified and there will be a strong requirement to achieve "like for like or better" outcomes.</p>
<b>Significant /not offsetable</b>	<p>Impacts are not reversible and there is no reliable evidence that they can be offset.</p>	<ul style="list-style-type: none"> <li>• Impacts affect a large proportion of a population of an endemic species, e.g. impacts are on a population of a single site endemic species.</li> <li>• Affected sites or ecosystems are essential to maintain the national or global population of any critically endangered species.</li> <li>• Entire global population potentially exposed.</li> <li>• Affected population unlikely to recover from Project impacts, with possible risk of extinction at national or global levels.</li> </ul>	<p>If there is no proven method for mitigation and it is not possible to confirm that impacts can be offset, the impact may be considered unacceptable or a decision may be made to pursue alternative forms of compensation.</p>

### **6.11.3 Important Receptors, Other Biodiversity and Protected Areas Potentially Affected**

Based on the results of baseline surveys and assessments (Chapter 4.10), Table 6.11.2 identifies priority receptors for which a NNL or a net gain outcome needs to be explicitly demonstrated. Table 6.11.3 identifies other biodiversity, which is considered to be relatively widespread and resilient and able to accommodate impacts, but which nevertheless needs to be given consideration in the light of Lydian's corporate policy of achieving NNL overall.

Implications for the integrity of Protected Areas and other areas of acknowledged importance for biodiversity have also been considered, including the possibility that the Project might affect ecological supporting functions for these sites. These include:

- Caucasus Biodiversity Hotspot (Conservation International).
- Caucasus Mixed Forest Ecoregion.
- State Sanctuaries (Jermuk Forest, Herher Open Woodland and Jermuk Hydrological).
- Sevan National Park.
- Proposed Jermuk National Park.
- Jermuk IBA: a Key Biodiversity Area, identified using recognized selection criteria.
- Gorayk IBA: a Key Biodiversity Area, identified using recognized selection criteria.

**Table 6.11.2: Priority Biodiversity Identified for the Project-affected Area Based on Results in Chapter 4.**

Priority receptors identified through baseline surveys	Rationale for importance
<b>Plant species and vegetation</b>	
Natural Habitat, including:	Natural habitat with a high proportion of species endemic to the Caucasus or Trans-Caucasus region. This vegetation is widespread in the region but under-represented in Armenia's protected area system. Rocks with <i>Potentilla porphyrantha</i> occur within a Sub-alpine Meadow matrix and form part of the critical habitat for the species (see below).
<ul style="list-style-type: none"> <li>Species-rich Sub-alpine Meadows and Sub-alpine Meadows with Alpine Elements</li> </ul>	
<ul style="list-style-type: none"> <li>Vegetation with Shrubs, particularly Juniper scrub and associated populations of Caucasian endemic species of plant such as <i>Juniperus polycarpus</i></li> </ul>	Juniper scrub vegetation has declined dramatically in the region and small fragments persist in the Project-affected area. It is of national and regional conservation importance as an indicator of Juniper woodland, which used to be extensive in the region and is one of the characteristic, constituent types of the Caucasus Mixed Forest Global 200 Ecoregion.
<ul style="list-style-type: none"> <li>Other natural and semi-natural vegetation types: Montane Meadows, Montane Meadow Steppes, Wetlands, Riparian, Gorge</li> </ul>	IFC PS6 and EBRD PR6 require identification of natural vegetation and the use of the mitigation hierarchy to ensure>NNL of natural vegetation if feasible.
<ul style="list-style-type: none"> <li>At least 22 endemic plant species</li> </ul>	Identified by specialists as regional endemics, either within the Trans-Caucasus (TC) or the Caucasus (C) region. Constituents of natural vegetation types. Apart from <i>Potentilla porphyrantha</i> and one other species <i>Fritillaria armena</i> (endemic to Asia Minor, Iran within the biogeographic zone referred to as the Hyerano-Eusine Element, and found only in one location on Amulsar) these are relatively widespread or dispersed throughout the "natural" vegetation affected by the Project and can be assessed and managed as part of that matrix.
Amulsar sub-population of <i>Potentilla porphyrantha</i> (Tier 1 critical habitat - IFC PS6)	Critically Endangered in the Armenian Red Book (criteria D 1 ab(iii) + 2 ab(iii)). Area occupied in Armenia is less than 10 km <sup>2</sup> . Preliminary assessment against IUCN criteria suggests it would be listed as Endangered by IUCN. Amulsar Mountain supports one of five known sub-populations globally and has critical habitat for this species.

**Table 6.11.2: Priority Biodiversity Identified for the Project-affected Area Based on Results in Chapter 4.**

Priority receptors identified through baseline surveys	Rationale for importance
<b>Bird species</b>	
Resident breeding bird populations, including Endangered species <i>Neophron percnopterus</i> (Egyptian Vulture) and <i>Falco cherrug</i> (Saker Falcon)	<p>Amulsar Mountain and its foothills provide habitat for a rich assemblage of 23 resident raptor species; 14 are listed in the RA Red Book, and seven of these breed in the Project-affected area. This includes Egyptian Vulture, which is listed as Endangered in the IUCN Red List and the RA Red Book, and is a trigger species for Gorayk and Jermuk IBAs, with breeding pairs referred to in each site. The Project-affected area is not critical habitat for the species but provides occasional feeding habitat for one pair nesting in the Arpa Gorge. Saker Falcon is also listed as Endangered in the IUCN Red List and RA Red Book and may be resident in the wider area, though it was observed infrequently in surveys. No evidence of breeding could be found and the Project-affected area is not confirmed as critical habitat for the species.</p> <p>Lesser Kestrel (<i>Falco naumanni</i>), hunts in the Project-affected area, particularly in the south near Gorayk and on the grassy Amulsar slopes. The breeding colony in Gorayk IBA, together with “offshoot” colonies at Sisian are RA’s only breeding population.</p> <p>Seven other (non-raptor) species listed in the RA Red Book also nest in the Project-affected area. On an individual basis these species do not meet criteria and thresholds for critical habitat. However, explicit efforts to ensure no net loss of breeding habitat for these species are appropriate because of their national status and their dependence on natural habitat.</p>

**Table 6.11.2: Priority Biodiversity Identified for the Project-affected Area Based on Results in Chapter 4.**

Priority receptors identified through baseline surveys	Rationale for importance
Migratory birds	The Project-affected area is important for migratory birds, providing habitat for them to feed and rest while on migration in spring and autumn, but does not constitute critical habitat according to PS6 or PR6. The numbers recorded in surveys do not meet BirdLife International's Criterion A4 for congregations and numbers of migratory birds do not meet thresholds for global significance. However, the species assemblage is diverse and of national importance, including four species listed as Endangered in the RA Red Book: Egyptian Vulture, Saker Falcon, Black Vulture and Pallid Harrier.
<b>Mammal species</b>	
<i>Ursus arctos</i> (Brown Bear) (critical habitat - EBRD PR6)	<p><i>Ursus arctos</i> is listed as Vulnerable in the RA Red Book and is targeted for conservation action in the Caucasus Biodiversity Action Plan. Amulsar Mountain (in particular the Arshak Set-aside and the woodlands on the western flank of the Mountain north of Saravan) is regularly used by 10 bears, including two females who are able to successfully rear young, at least three males, and associated cubs and youngsters, currently estimated at five.</p> <p>The Project's adherence to the EBRD PR implies compliance with the EU Habitats Directive, in which Brown Bear is listed in Annex IV, meaning that degradation of its habitat is prohibited. It is therefore interpreted that critical habitat for Brown Bear exists in the Project-affected area, the Arshak Set-aside preserving a part of it. Brown Bear is also an apex predator and therefore a keystone species associated with the natural habitat affected by the Project.</p>
<i>Capra aegagrus</i> (Bezoar Goat)	Bezoar Goat occurs in the Arpa Gorge and the Jermuk IBA and has been observed in the Arshak Set-aside. It is targeted for conservation action in the Caucasus Biodiversity Action Plan. Therefore, it is identified as a priority species.



**Table 6.11.2: Priority Biodiversity Identified for the Project-affected Area Based on Results in Chapter 4.**

Priority receptors identified through baseline surveys	Rationale for importance
<i>Lynx lynx</i> (Eurasian Lynx)	Eurasian lynx has been observed in the Arshak Set-Aside. It is listed by IUCN as Least Concern, but is prioritized for conservation action in Europe as a recent assessment of its status in Europe shows that some isolated subpopulations remain Critically Endangered or Endangered. The Caucasus subpopulation is considered a distinct subspecies ( <i>Lynx lynx dinniki</i> ) and the numbers in the southern Caucasus are estimated at only 40 individuals, which is why it is a priority species in the region and in terms of compliance with EBRD's PR6.
<b>Invertebrates</b>	
Dorcadion Beetles ( <i>Dorcadion sevangense</i> , <i>D. sisianum</i> Lazar and <i>D. bistratum</i> )	<i>D. bistratum</i> is included in the RA Red Book. <i>D. sisianum</i> Lazar and <i>D. sevangense</i> are considered the most vulnerable endemic beetles of Armenia and are a conservation priority. Dorcadion beetles have been observed in surveys undertaken for the Project, but not in the Project-affected area. The possibility of under-recording needs to be recognized, but all records to date have been outside the proposed Project footprint.
<b>Amphibians and reptiles</b>	
Radde's/ Armenian Rock Viper <i>Montivipera (Vipera) raddei</i> , Armenian Mountain-Steppe Viper <i>Vipera eriwanensis</i> and Cat Snake <i>Telescopus fallax</i>	10 reptile species have been found in surveys of Amulsar in 2015. The three species listed here are included as Vulnerable in the RA Red Book, and <i>Vipera eriwanensis</i> is also listed on the IUCN Red List as Vulnerable, while <i>Montivipera raddei</i> is listed as Near Threatened. The HLF location supports these and other reptile species but there is considered to be abundant suitable habitat in the wider landscape.

**Table 6.11.3: Biodiversity that is Widespread, with Resilient Populations**

Receptor	Rationale for inclusion
<b>Vegetation and plant species</b>	In addition to vegetation types that are considered as a priority because they are species-rich or relatively unmodified, the Project will affect some grassland areas that are not considered to be a priority for conservation of biodiversity and that are widely distributed throughout the country and region. These include areas of grassland modified by relatively intensive grazing or presence of herder camps, reducing their species-richness and characteristic species; and also vegetation alongside roads and tracks and other disturbed areas including cultivated areas.
<b>Birds</b>	The Project-affected area provides habitat for a large number of other bird species, which are considered to be relatively common or widespread, with resilient populations. They include species such as <i>Alauda arvensis</i> (Eurasian Skylark), <i>Anthus spinoletta</i> (Water pipit), <i>Carduelis flavirostris</i> (Twite) and <i>Saxicola rubetra</i> (Whinchat).
<b>Mammals (including bats)</b>	<p>Baseline surveys identified several mammal species within the Project-affected area which are not considered to be threatened within the region or country and which are considered to be relatively mobile and adaptable. This includes larger mammal species such as:</p> <p><i>Vulpes vulpes</i> (Fox)  <i>Canis lupus</i> (Wolf)  <i>Sus scrofa</i> (Wild Boar)  <i>Felis chaus</i> (Jungle Cat)</p> <p>Smaller mammal species include:</p> <p><i>Martes foina nehringi</i> (Stone Marten)  <i>Mustela nivalis</i> (Weasel)  <i>Meles meles</i> (Badger)  <i>Erinaceus concolor</i> (Southern White-breasted Hedgehog)  <i>Sorex volnuchini</i> (Caucasian pygmy shrew)  <i>Lepus europaeus</i> (European Hare)  <i>Cricetulus migratorius</i> (Grey Hamster)  <i>Apodemus (sylvaeus) sylvaticus</i> (Long-tailed Field Mouse)  <i>Apodemus sylvaticus</i> (Wood Mouse)  <i>Microtus arvalis</i> (Common Vole)  <i>Chionomys nivalis</i> (Snow Vole)</p> <p>Bat species <i>Myotis blythii tomes</i> (Lesser Mouse-Eared Bat) and <i>Vespertilio pipistrellus</i> (Common Pipistrelle) have been observed in the</p>

**Table 6.11.3: Biodiversity that is Widespread, with Resilient Populations**

Receptor	Rationale for inclusion
	wider Project area. Species listed in the RA Red Book are reported to occur in the vicinity, but were not recorded in baseline surveys.
<b>Invertebrates (terrestrial and aquatic)</b>	A wide variety of terrestrial and aquatic invertebrate species will be affected by the Project. Most are not in the RA Red Book, though much of the Project-affected area is probably under-recorded. Surveys in 2012 found a species-rich butterfly assemblage with Apollo Butterfly, but the area where this was recorded is no longer in the Project footprint and there is abundant butterfly habitat available.
<b>Reptiles and amphibians</b>	<p>Reptile species recorded on Amulsar Mountain or in the wider Project-affected area are listed below (these are not included in the RA Red Book):</p> <p><i>Coronella austriaca</i> (Smooth Snake)  <i>Darevskia raddei</i> (Radde's Lizard)  <i>Darevskia valentini</i> (Darevskia Valentine)  <i>Dolichophis schmidt</i> (Schmidt's Whip Snake)  <i>Eirenis modestus</i> (Ring-headed Dwarf Snake)  <i>Eirenis punctatolineatus</i> (Dotted Dwarf Snake)  <i>Hammerhois vergieri</i> (Ravergier's Whip Snake)  <i>Hemorrhhois ravergeri</i> (Spotted Whip Snake)  <i>Laudakia caucasia</i> (Caucasian Rock Agama)  <i>Lacerta media</i> (Eastern Three-lined Lizard)  <i>Macrovipera lebetina</i> (Levantine Viper)  <i>Natrix tessellata</i> (Dice Snake)  <i>Platiceps najadum</i> (Dahl's Whip Snake)</p> <p>Amphibians in the Project-affected area are generally relatively widespread, e.g. Marsh Frog (<i>Pelophilax ridibundus</i>), Long-legged Wood Frog (<i>Rana macrocnemis</i>) and Green Toad (<i>Bufo viridis</i>).</p>
<b>Fish</b>	<p>No endemic or RA Red Book species of fish were identified in baseline surveys of the Project-affected area. Fish species affected include:</p> <p><i>Salmo trutta</i> (Brown Trout)  <i>Alburnoides bipunctatus</i> (Spiralin)  <i>Aspius aspius</i> (Asp)  <i>Barbus capito</i> (Barbel)  <i>Barbus mursa</i> (Barbel)</p>

Table 6.11.3: Biodiversity that is Widespread, with Resilient Populations	
Receptor	Rationale for inclusion
	<p><i>Acanthalburnus microlepis</i> (Blackbrow Bleak)  <i>Capoeta capoeta</i> (Sevan khramulya or Caucasian Scraper)</p> <p>Although suffering reductions in biomass and population size due to a range of threats and pressures (not associated with the Project), these species are not threatened from a biodiversity conservation perspective.</p>

#### **6.11.4 Project Activities and Sources of Impact on Biodiversity and Ecosystems**

The main sources of biophysical change that would be expected to give rise to impacts on biodiversity and ecosystems in the Project's area of influence without mitigation are listed in Table 6.11.4. This table is based on a rigorous examination of the different activities that will take place during the construction and operational phases of the Project and has been used as the basis for identifying which biodiversity features are likely to be exposed to impacts. The Preliminary Mine Reclamation, Closure and Rehabilitation Plan (pMRCRP, Appendix 8.18) includes initial arrangements for decommissioning and the ecological implications of this are reviewed to the extent possible, given the level of detail available in the Plan. The table includes a brief description of the potential ecological implications of these activities. These potential implications are considered in the absence of the application of any biodiversity-specific mitigation measures.

Based on Table 6.11.4, the main activities with potential to alter biodiversity and ecosystems during the construction and operational phases of the Project can be summarised as:

- Removal and clearance of vegetation and topsoil.
- Construction activities requiring soil excavation and movement, which may lead to spread of invasive weeds already occurring in the area, as well as generating dust, some of which may be contaminated with heavy metals.
- Exposure of soils and resulting soil erosion, causing increased sediment levels in downstream water bodies and courses.
- Construction and operation activities requiring use of large machinery which will generate noise and disturbance 24-hours a day.
- Lighting for security and extending work hours, which may disrupt animal behaviour patterns, particularly for species active at night, early dawn or dusk.
- Introduction of barriers including roads, the conveyor, fences, power cables and other infrastructure components which may disrupt movements of animals in the landscape or cause collisions/ mortality.
- Activities leading to pollution of air, water or soil associated with unintended leaks or emissions.
- Activities leading to long-term pollution of water and soil with heavy metals due to acid rock drainage.
- The presence of people during construction and operation of the Project as a whole.

- The land use changes associated with the presence of the Project, including changes in grazing patterns and possible implications for other grazing lands due to displacement of herding and/or crop-growing activity onto them.
- Land use changes associated with induced access (vehicles and people) to the Vorotan Valley and other areas surrounding the Project due to road upgrades and creation of “through roads”.
- The movement of water under- and above ground will be affected by the mine pits and elements of the associated infrastructure, including the BRSF and HLF. The alterations to hydrology and hydrogeology will affect vegetation and the animals that depend on springs and waterholes.

**Table 6.11.4: Potential Sources of Ecological Impact (Pre-Mitigation) Associated with the Project**

Project component	Main source or driver of biophysical change	Potential ecological implications
<b>Construction Phase</b>		
Earthworks, site clearance and construction	Land clearance, removal of vegetation for construction of mine pits, haul roads, crushing plant, access roads, conveyor, BRSF and HLF. Total estimated physical or infrastructure footprint of 599 ha.	<p>There will be permanent ecosystem change within the mine pits and haul roads (this affects critical habitat for <i>Potentilla porphyrantha</i>) and potentially where the crushing plant, HLF and BRSF are located (predominantly natural habitat). Vegetation clearance and earthmoving will spread invasive weed species already present in the area.</p> <p>There will be reduced habitat availability and quality for some animal populations. Biomass of widespread small mammals and amphibians will be reduced, with implications for raptor food supply. There will be loss of reptile habitat and loss of breeding area, foraging area, resting areas and hibernation dens for Brown Bear.</p>
	Dust generated by truck movements and earth moving. As indicated in Chapter 6.6 approximately 80% of dust will be deposited within 100m of sources. 323 ha are in the Project Disturbed Area (identified in addition to the Project Physical Footprint) within which significant dust deposition is considered likely. Lower levels of deposition may occur in a further Ecologically Disturbed Area of 368ha that extends beyond the Project Disturbed Area.	Smothering of terrestrial and aquatic vegetation and reduced plant productivity within the deposition zone. Suitability of habitat for amphibians and small mammals will also be reduced within the deposition zone. There will be dust deposition on critical and natural habitat outside cleared areas.
	Vehicle exhaust emissions including NO <sub>x</sub> , SO <sub>x</sub> , CO, CO <sub>2</sub> and diesel particulates and dust from roads. Significant deposition and associated changes in natural vegetation are predicted to occur within a 50 m buffer along haul roads and a 30 m buffer along smaller un-surfaced roads with less traffic (i.e. the Project	Nutrient enrichment and changes in soil chemistry cause permanent changes in plant species composition. Transformation of natural vegetation to more modified types will occur with attenuation away from the source, within the Project Disturbed Area and Ecologically Disturbed Areas.

**Table 6.11.4: Potential Sources of Ecological Impact (Pre-Mitigation) Associated with the Project**

Project component	Main source or driver of biophysical change	Potential ecological implications
	Disturbed Area, extending to 323ha in addition to the Project footprint). Some wider changes are possible at lower levels of deposition, within an additional zone (referred to as the Ecologically Disturbed Area) estimated at 368ha.	
	Soil exposure.	Erosion and scour from rain or melting snow could have localised impacts on natural habitat.
	Changes in surface and groundwater hydrology.	Loss of aquatic habitat, disruption of flow, reduced recharge of wetlands, could reduce biomass of amphibians and availability of habitat for wetland birds.
	Topsoil storage (could have footprint of up to 40ha and storage may be long-term).	Permanent changes in vegetation on receptor sites as well as loss of the soil seed bank from stored topsoil. Localised losses of natural habitat may occur.
Construction of roads	Mine haul roads and access roads (footprint of 79 ha).	Loss of natural habitat under physical footprint. Barrier effects to movements of larger mammals due to controlled access arrangements and traffic.
	Introduction of alien materials.	Altered soil chemistry and structure due to deposition of introduced aggregate and graded material along boundaries of roads and tracks. pH of soils may alter some distance away, where there is surface run-off from roads, particularly in winter when salt may be spread on the road surface. Plant community composition may be altered locally, with a transition from natural to more modified types, including by the spread of invasive weeds.
Import of materials and machinery	Traffic on access roads and public highways.	Disturbance to animal populations and barrier effects; increase in roadkills among reptiles
	Emissions of dust, exhaust, etc.	Smothering of crops and vegetation adjacent to key transport routes, contamination by pollutants, reduced productivity.



<b>Table 6.11.4: Potential Sources of Ecological Impact (Pre-Mitigation) Associated with the Project</b>		
<b>Project component</b>	<b>Main source or driver of biophysical change</b>	<b>Potential ecological implications</b>
Worker Accommodation Camp	Land take, lighting, noise, disturbance, traffic between camp and site. Physical footprint is 6.3 ha.	Displacement of raptor feeding activity. Habitat loss for reptiles. Possible disruption of nocturnal activity for bats and some birds and reduced resting area for birds on migration. Displacement and disturbance is expected over an area larger than the physical footprint.
<b>Operation Phase</b>		
<b>Mining</b>		
Excavation, drilling and blasting	Dust from excavation and blasting.	Reduced productivity of vegetation and suitability of habitat for small mammals in the deposition zone (Project Disturbed Area and Ecologically Disturbed Area), reducing food supply for raptors.
	Noise and disturbance.	Some animal species will cease to feed or breed on current sites in proposed mine pit or potentially be displaced from remaining habitat outside the pits. Some animals will be displaced completely. Brown Bear, Lynx and Bezoar Goat could all be exposed and sensitive.
	Altered topography.	Removes potential habitat for alpine plants in Sub-Alpine Meadows and on rock outcrops during operational phase. Removes breeding locations for some raptors during operational phase.
	Altered substrate.	Soils are sensitive and poorly structured. Permanent changes may occur. Soil removal may result in new areas of exposed rock. Rocky outcrops may also be damaged or removed. These provide habitat for some plants and reptiles that are globally and nationally rare including Tier 1 critical habitat for <i>Potentilla porphyrantha</i> .
Loading and hauling	Dust emissions.	Smothering of crops and vegetation, contamination by pollutants, reduced productivity. Reduced suitability of habitat for small mammals in the deposition zone, reduced food supply for raptors.
	Vehicle exhaust emissions.	Deposition of NO <sub>x</sub> , SO <sub>x</sub> , CO, CO <sub>2</sub> and particulates may cause localised changes in soils and plant communities (eutrophication), modifying natural habitat.

<b>Table 6.11.4: Potential Sources of Ecological Impact (Pre-Mitigation) Associated with the Project</b>		
<b>Project component</b>	<b>Main source or driver of biophysical change</b>	<b>Potential ecological implications</b>
	Noise, light and disturbance.	Some birds and mammals may be displaced as noise and disturbance is 24-hour. Brown Bear is likely to be exposed and sensitive.
Access, transport	Haul roads: permanent haul roads within the mine operation have an assumed 50m width. The combined footprint of access and haul roads is 79 ha with another 120 ha within the Project Disturbed zone and 368ha in the Ecologically Disturbed Area.	Permanent footprint and change in substrate, loss of habitat for Sub-alpine species. Loss of natural habitat. Cumulative noise, disturbance, salt run-off and dust impacts.
Barren Rock Storage Facility and associated water treatment facilities	Dust emissions.	Fugitive dust particles deposited on vegetation alter its productivity and may cause long term changes in plant species composition due to changes in soil chemistry. Loss of natural habitat.
	Physical footprint (footprint of Barren Rock Storage Facility estimated at 139 ha).	Reduced natural habitat area and quality, possible Acid Rock Drainage causing future changes in vegetation and aquatic habitat. Loss of biomass/ food supply for other species (e.g. frogs caught by raptors).
	Land use change.	Loss of natural habitat (Montane Meadow) and pasture used for grazing. Loss of raptor feeding habitat.
	Downstream pollution from drainage and leachate.	Pollution of aquatic habitat with implications for invertebrates, amphibians, fish, plants. Risk of long term acid drainage and heavy metal contamination.
<b>Crushing and ore preparation</b>		
Stockpiles	Dust from tipping.	Fugitive dust from wind blow. Localised pollution of soil. Water used for suppressing dust may infiltrate other water/ wetlands, reducing quality of wetland habitat.
	Stockpiles.	Forms part of physical footprint and removes biotope/habitat.
Crushing	Crusher and transfer points.	Fugitive dust escaping at crusher building and transfer points will be controlled with water sprays and enclosure (dust extraction) but this may not be 100% effective. Deposited dust will alter plant communities and possibly cause long-term soil quality changes.
	Noise during crushing.	Displacement of animals and birds.
Conveyor to Heap	Dust from transfer points.	Although the conveyor is covered, ore dust may cause localised pollution and

Table 6.11.4: Potential Sources of Ecological Impact (Pre-Mitigation) Associated with the Project		
Project component	Main source or driver of biophysical change	Potential ecological implications
Leach Facility		alteration of plant communities at transfer points. Associated lighting could disrupt behaviour of bats and birds. There will be loss of reptile habitat. The conveyor is close to a gorge in which Armenian red-listed bird species nest. <i>Fritillaria armena</i> (species endemic to Asia Minor, Iran, Hyerano-Eusine Element) is found close to the conveyor and could be exposed to dust deposition. This species only occurs in this location on Amulsar Mountain but is present in other areas outside the Project footprint.
	Physical barriers including the conveyor, service road and fencing and also the trench for piped water from the BRSF toe to the conveyor.	The conveyor is close the ground and likely to constitute a complete barrier to animal movement, even for small mammals. This will cause habitat fragmentation and reduce foraging or feeding areas for Brown Bear. Could also affect Lynx and Wolf as well as smaller mammals such as martens
<b>Processing</b>		
Process plant and supporting infrastructure	Dust. Vehicle exhaust fumes.	Dust generated from demolition activities, earthworks, reshaping heap and dump sides, and setting up safety berm around pit perimeter could affect small remnants of Juniper scrub vegetation and reduce its viability.
Storage and reagent handling	Lime: outdoor stockpile.	Possible changes in soil pH due to fugitive lime-laden dust, changes in plant communities. Large volumes of lime are needed, though the intention is to cover stockpiles.
	Reagents (caustic soda, NaCN).	Although reagents will be stored and handled only under contained, controlled conditions, there is a risk of leaks and spills which could have effects on biodiversity receptors.
Heap Leach Facility	Physical footprint of approximately 165ha.	Proposed location is above Gndevaz Village in an area traditionally used for grazing, hay-making, growing crops and producing apricots. These uses could be displaced onto other areas with implications for biodiversity. There are fragments of juniper and hawthorn scrub vegetation in the affected area that are of conservation importance. The area is a hotspot for reptiles; 11 species have been recorded here, including three that are listed in the RA Red Book.

<b>Table 6.11.4: Potential Sources of Ecological Impact (Pre-Mitigation) Associated with the Project</b>		
<b>Project component</b>	<b>Main source or driver of biophysical change</b>	<b>Potential ecological implications</b>
	Dust with heavy metals.	Small mammals, birds feeding on small mammals (including Lesser Kestrel), aquatic species.
	Disturbance associated with operation.	Migratory and breeding birds.
ADR plant and supporting infrastructure	Physical footprint.	Loss of relatively modified biotope/ habitat.
<b>Support infrastructure</b>		
Domestic wastewater treatment	Physical footprint of works, possible enriched wastewater released to streams/ the river.	Loss of biotope/ habitat and possible eutrophication of watercourses.
Electrical power supply	Power lines.	Risk of collision with power lines by raptors, especially in combination with lighting, particularly on elevated areas, including Amulsar Mountain.
Storage and reagent transport and handling	Lime: outdoor stockpile.	Changes in soil pH due to fugitive lime-laden dust, changes in plant communities.
	Reagents (caustic soda, NaCN).	Leaks and spills, including during transport of reagents to the mine, could have multiple effects on various biodiversity receptors
	Delivery of flaked sodium cyanide.	Details of the transportation route to the site have not been finalised. Ecological risk assessment is needed to evaluate the consequences of accidental spills during transport or storage, which could cause mortality of animals.
Employment	Presence of people and associated traffic.	Disturbance of animal populations including sensitive species.
Worker Accommodation	Worker accommodation currently proposed is hotel accommodation at Jermuk and a workers accommodation camp during construction, and then a combination of Project hotel in Jermuk and local employees residing in hotels in surrounding villages.	Impacts limited to transport to and from site on mine access road (traffic, barrier effect, noise, emissions).
Security measures	Lighting.	Disturbs nocturnal species including bats and night-flying moths. Could also disrupt animals hunting at night such as Wolf. Brown Bear shows avoidance of lit areas; could also affect behaviour of night-flying birds.

<b>Table 6.11.4: Potential Sources of Ecological Impact (Pre-Mitigation) Associated with the Project</b>		
<b>Project component</b>	<b>Main source or driver of biophysical change</b>	<b>Potential ecological implications</b>
Fencing	Restricted access.	Land use will be affected within a restricted zone throughout construction and operation. Some areas will be fenced for security reasons. Current land use and grazing patterns may alter. Some grazing activity will have to be relocated with possible consequences for biodiversity on other areas where additional grazing is concentrated.

Having identified the main Project activities that may lead to ecological change, a detailed assessment of impacts and their significance for specific receptors is provided in Section 6.11.5. To support this assessment, the following assumptions have been made about the extent of areas occupied by mine infrastructure, affected by pollution or experiencing restrictions on land use (see Section 4.1.6 for details):

- There will be a direct physical footprint of infrastructure extending to 599 ha, including the mine pits, haul roads, BRSF, conveyor, HLF, crusher, and other buildings and infrastructure.
- There is a Project Disturbed Area of 922 ha, comprising the Project Footprint plus an additional 323ha based on an assumed 50m buffer around areas where earth-moving occurs and the haul roads; a 30m buffer where there is less traffic on unsurfaced roads; a 20m buffer around infrastructure where some earth moving may take place; and a 15m buffer around administration buildings (to take into account disturbance during construction and incidental disturbance once occupied). For purposes of assessing ecological impacts, this area is considered to represent a zone within which direct impacts such as dust deposition, atmospheric pollution, polluted surface run-off or changes in soil structure are likely.
- An additional “Ecologically Disturbed Area” of 368 ha has been identified beyond the Project Disturbed Area within which levels of dust or pollution deposition will be lower, but where a degree of vegetation change is still likely, based on the scientific literature. Levels of noise may also be sufficiently high within this zone to affect wildlife behaviour.
- An additional area of 180 ha has also been included in the overall Project Footprint for purposes of assessing ecological impacts on natural vegetation on land disturbed by previous upgrades of the Kechut to Gorayk Road that may also be affected to some degree in future by emissions from local traffic and light mining traffic for transporting staff.
- The Project has identified an Additional Restricted Area of 477 ha, within which access and land use will be controlled, though not necessarily fenced. This area is classified in three separate sections as “the ecological restricted area” (95 ha), the “operational restricted area” (323 ha), and the restricted area by fencing (60 ha). Land use may change within this area (to different extents depending on level of restriction needed for security and safety reasons) with some ecological consequences.

This gives a total assumed area of 1766 ha, future area of potential impact and 180 ha previously affected, as a consequence of developing the Kechut to Gorayk road. This combined area is considered to represent a realistic spatial scope for direct impacts.

Indirect ecological impacts may occur over a much wider area that isn't possible to quantify, due to induced socio-economic change and associated land use change. Levels of traffic may increase and land use patterns in the surrounding landscape may alter due to changing economic circumstances and activities. The possibility of these impacts has been considered when development the Project's mitigation strategy for biodiversity.

#### ***6.11.5 Exposure, Sensitivity and Vulnerability of Biodiversity to Project Impacts***

In this section, the nature of predicted Project impacts on the biodiversity receptors identified in Table 6.11.2 and Table 6.11.3 is discussed. Impacts are summarised in three tables: Table 6.11.6 summarises the Project's impacts on priority biodiversity receptors identified for the Project; Table 6.11.7 summarises the Project's impacts on other biodiversity that is considered to be generally widespread and resilient; and Table 6.11.8 summarises the Project's impacts on Protected Areas or other "Key Biodiversity Areas". Potentially significant impacts on priority biodiversity are discussed in more detail below. Unless stated otherwise, the potential impacts apply during the construction, operational and decommissioning phases of the Project.

#### ***Impacts on natural habitat***

Impacts of the Project on natural habitat were assessed as part of the NCHA (Appendix 4.10.3) as this is a PS6 requirement. The results are discussed here for natural habitat overall and for individual ecosystem types.

The Project's physical footprint on ecosystem types is shown in Figure 6.11.1. For the Disturbed and Additional Restricted Areas, refer to Figure 4.1.6.

A permanent loss of natural habitat within the Project's physical footprint is predicted, as considerable modification of soil/ substrate will occur during mine construction, operation and decommissioning. Vegetation will be destroyed or fundamentally modified for the lifetime of the mine, and thereafter is expected to remain in a significantly modified condition. As explained in Chapter 4 and in Appendix 4.10.3, areas where natural and semi-natural vegetation has become significantly "modified" around herder camps, for example, are at a

scale that is too localised or small to indicate on maps and the Project has elected to include them in its estimates of natural habitat extent. Estimates of the Project's physical footprint on natural habitat can therefore be regarded as conservative.

Table 6.11.5 shows that approximately 1807 ha of the 1946 ha that may be exposed to impacts on biodiversity as a result of the Project activities are classified as natural habitat. The table provides a breakdown of the Project's footprint for component vegetation types.

In addition to the physical footprint of the Project, there are areas of natural habitat within which plant communities are expected to change as a result of dust deposition, deposition of pollutants (including salt spread on roads in winter) or eutrophication, for example due to deposition of nitrogen and sulphur oxides (NO<sub>x</sub> and SO<sub>x</sub>). In other words, their condition may change. This area is estimated at 279 ha for the mine, haul and access roads and an additional 180 ha for the Kechut to Gorayk Road. Additional (lower magnitude) changes are likely on 355ha natural habitat within the Ecologically Disturbed Area. Changes in species composition of vegetation such as these often persist for long periods and are difficult to reverse.

There are additional areas where land use will change due to restrictions and controls on access and plant communities will change to some degree as a result. Project infrastructure is relatively dispersed, so the security arrangements for the Project and restrictions on access and land use (including some fenced areas) will extend over an area of 476 ha of Natural Habitat. There may be some benefits from excluding people (reduced disturbance of animals) but changes in grazing management are expected to be generally negative, as characteristic species and overall species richness are both linked to traditional grazing management. A total of 1807 ha could be affected by altered land use and management overall and this is considered to represent the Project's overall footprint on natural habitat.

About 900 ha of Sub-Alpine Meadow are affected, and 130ha of Sub-Alpine Meadow with Alpine Elements. These are the most species-rich and distinctive of the natural habitats affected by the Project. While juniper shrub vegetation is also considered to be of conservation importance, this vegetation type is more widely represented in the surrounding landscape. As well as being important for endemic plants, areas of rocks are important from a wildlife perspective, as they include suitable habitat for RA Red Book Reptiles. Similarly, the gorge within the footprint and disturbed areas is important as breeding habitat for RA Red Book birds. Natural habitat in general is important for all the species identified in Chapter 4



as well as being critical habitat for *Potentilla porphyrantha* and Brown Bear. Impacts on wildlife are considered in more detail in subsequent sections, but the role of natural habitat in supporting threatened species at national and international levels needs to be recognised.

As Figure 6.11.1 shows, the Project is located within extensive natural habitat, making options for relocating infrastructure to avoid footprint on it very limited. The mine pits themselves cannot be moved, and there are practical limitations as to how far away from them the other key infrastructure such as the BRSF and HLF can be sited. Although efforts have been made to avoid priority biodiversity areas where possible (as described in Chapter 5), application of the mitigation hierarchy in terms of avoiding impacts on natural habitat is challenging in this case.

**Table 6.11.5: Project Physical Footprint on Natural Vegetation Types**

Natural Habitat Type	Area in Project physical footprint (ha.)	Project Disturbed Area (ha.)	Project Restricted Area (ha.)	Restricted Area through fencing (ha.)	Operational Restricted Area (ha.)	Ecological Disturbance Area (ha.)	Disturbed zone for Kechut-Gorayk Road (ha.)	Total area (ha.)
Gorge	7.0	1.1	0.0	0.0	0.0	0.0	0	8.1
Montane Meadow	38.7	32.8	11.4	0.6	11.6	28.5	16.5	140.1
Montane Meadow Steppe	37.9	54.2	65.4	0.5	0.0	111.9	147	417.8
Rocks	24.5	7.7	0.1	0.0	9.4	4.7	0	46.4
Sub-alpine Meadow	254.2	126.3	3.3	58.0	277.0	171.5	9.5	899.8
Sub-alpine Meadow With Alpine Elements	85.5	17.3	0.0	0.0	25.2	2.1	0	130.1
Vegetation With Shrubs	65.5	38.7	10.7	0.1	0.0	34.8	0	149.8
Wetland	5.2	1.2	0.3	0.1	0.0	1.3	7.1	15.2
<b>Total</b>	<b>519.5</b>	<b>279.3</b>	<b>91.2</b>	<b>59.3</b>	<b>323.2</b>	<b>354.7</b>	<b>180.1</b>	<b>1807.3</b>



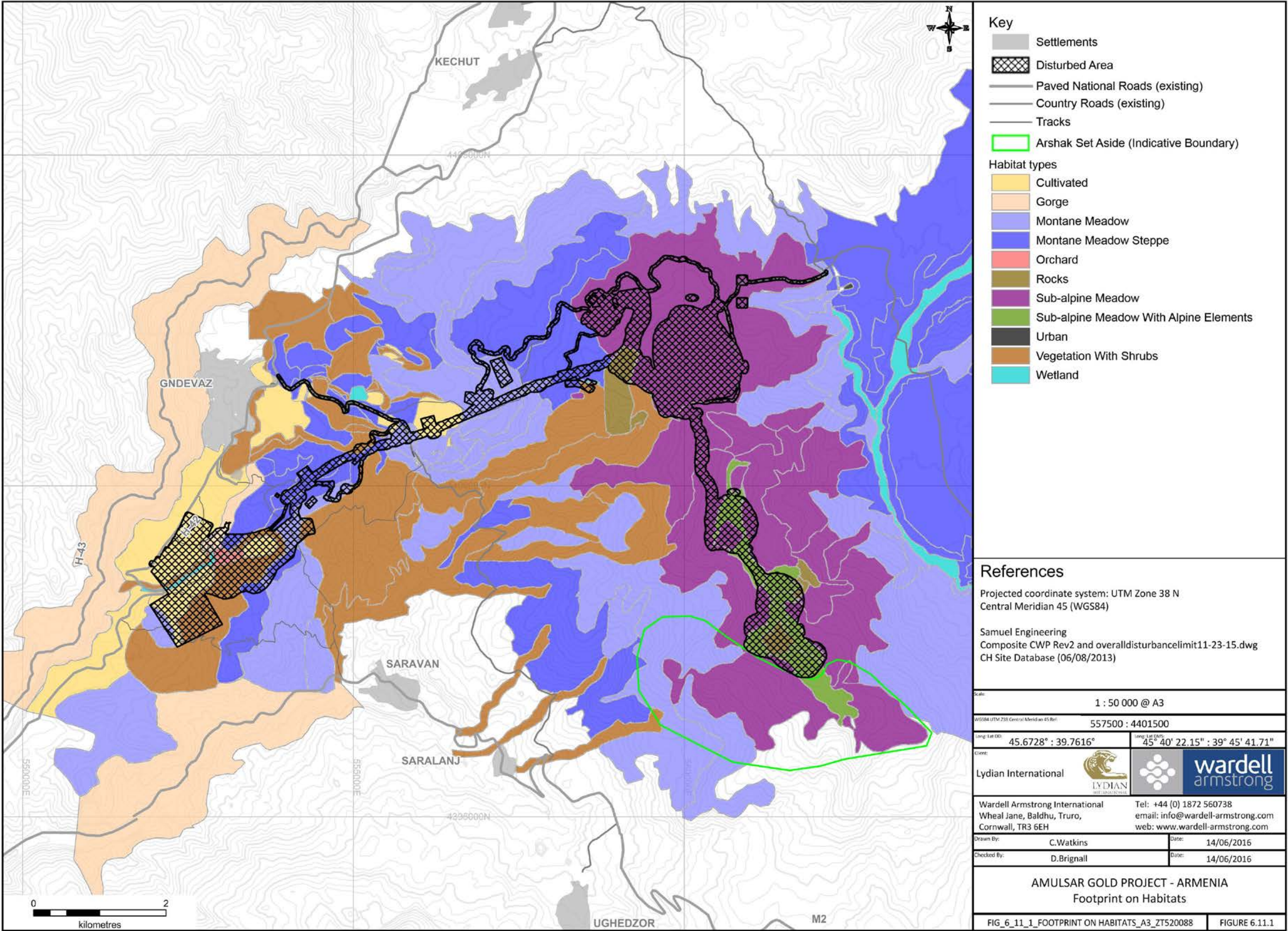


Figure 6.11.1: Footprint on Habitat Types



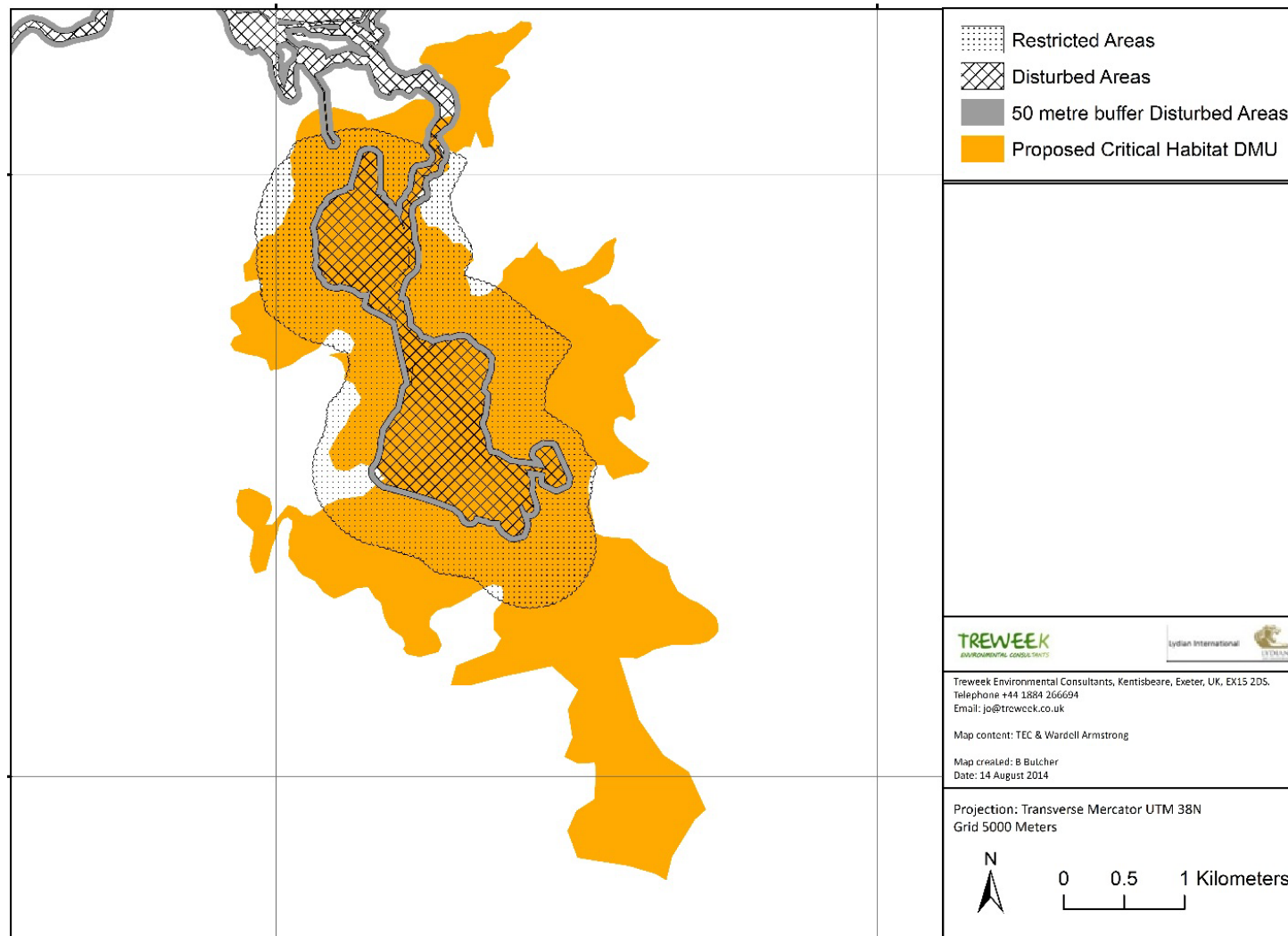
### **Impacts on critical habitat for *Potentilla porphyrantha***

Impacts of the Project on critical habitat are described in detail in the NCHA (see Appendix 4.10.3). There will be a physical footprint on Tier 1 critical habitat for *Potentilla porphyrantha*, notably from the mine pits (see Figure 6.11.2). These are located in the Sub-alpine Meadow with Alpine Elements and Sub-alpine Meadows habitats, within which *Potentilla porphyrantha* occurs on suitable rock substrate. The physical footprint is on 150.5 ha, representing 12.5% of the total area of critical habitat, which is 1,200 ha. The Project has translocated the proportion of the population located within the mine pits (see below), but further impacts may occur on remaining plants, due to reduced habitat quality caused by fugitive dust and changes in microclimate around the rock outcrops supporting them. There were 1560 plants recorded in 2012-2014 within the direct footprint of the mine pits on Tigranes, Artavazdes and Erato, representing 33% of the recorded plants and 21 % of the estimated sub-population at Amulsar. A further 377 plants were found in 2015 within the mine pits area. There were an additional 607 plants within the Project Disturbed Area around the working areas, and 1621 plants in the Operational Restricted Area, but the fact that they grow on rocky substrate makes them less sensitive to effects of land use change than the Sub-alpine Meadow vegetation that they are associated with.

Research has been undertaken on plants that grow in and around the proposed open pits. In the autumn of 2015, plants were translocated from the open pit areas to the Sevan Botanic Garden of the Institute of Botany of the National Academy of Sciences under a permit granted by the Ministry of Nature Protection. This work was undertaken as a mitigation measure for the Project as determined by the v9f ESIA produced for the 2014 Feasibility Study Project design, and the permit was granted based on the figures in the v9f ESIA. The number of plants translocated was 1686 and these were from exactly the same area surveyed in 2012-2014. The difference between the number surveyed (1560) and the number collected was due to some plants being missed during the survey and also because plants often grow in clumps which can only be prised apart when removed from the rocks. Some plants (251) were left *in situ*, because they were growing in locations where collection was too dangerous to be attempted and others were left to produce seed in 2016.

The relocation of the main haul road to the west side of Amulsar brings it close to an area on the south-west side of the proposed Erato pit that has a significant concentration of *Potentilla* plants. The haul road route is designed to avoid all of these plants with the exception of one loose rock boulder. The assessment in this chapter is based upon the assumption that the

plants on Erato, with the exception of those on the aforementioned boulder, will not be damaged or destroyed during the construction, operation or closure of the mine. Indeed, it is a requirement of the permit received from MNP for the translocation of the plants from the mine footprint that no additional plants will be damaged. Monitoring plots on Erato were put in place in 2014 to determine if there are any effects from dust deposition on *Potentilla* plants.



**Figure 6.11.2: *Potentilla porphyrantha* Critical Habitat Affected by the Project**

### ***Resident and breeding bird populations***

The Project-affected area includes varied and important habitat for many bird species, including several that are included in the RA Red Book and/or the IUCN Red List. Implications for priority species and breeding populations in general are summarised here.

One pair of the IUCN Red-listed (endangered) Egyptian Vulture (*Neophron percnopterus*) nests in Arpa Gorge. The breeding site itself is not likely to be exposed to any impacts as a result of the Project (the proposed water abstraction point and pipeline will not be near to the nest), but the birds could be affected by loss of feeding area within the Project-affected area. However, as discussed in Section 4.10.6, results of monitoring in spring 2013 and 2014 suggested that the pair use the Project-affected area for a very small proportion of their overall feeding time and therefore no significant impact is predicted.

Saker Falcon (*Falco cherrug*) is similarly endangered according to IUCN, although evidence of the species breeding in the Project-affected area has so far not been encountered, and significant exposure to Project impacts is not expected.

The implications of the Project for Lesser Kestrels (*Falco naumanni*) associated with the Gorayk IBA breeding colony have also been considered in order to check that there will not be any significant adverse impacts on the integrity of the site or its ability to support its designated features. Lesser Kestrels have preferential hunting areas in spring and autumn, including the southwards facing grassy slopes of Amulsar that may be affected by traffic moving to and from the mine. They could be deterred by activity and noise and their feeding habitat could deteriorate due to dust deposition, suppressing vegetation and numbers of the grasshopper larvae present in this area and on which they feed. Much of the Vorotan Valley is considered to be potentially important as supporting habitat for the IBA. Construction of the conveyor and its associated service road, as well as the mine access road and HLF, will affect high quality bird breeding habitat associated with the Arpa Gorge and the gulley running south and eastwards from Gndevaz (this habitat is particularly favoured by Ruddy Shelduck and White-throated Robin). Remaining habitat may be affected by noise, disturbance and lighting during operation. Raptors may collide with overhead power lines, particularly in areas with lighting at higher altitude. Impacts on breeding success could also occur due to pollution of water and introduction of heavy metals into the food chain if mitigation were not in place.

Due to the Project's footprint on natural vegetation and disturbance associated with construction and operation, there could be impacts on the breeding success of several resident bird species that are listed in the RA Red Book as Vulnerable, including Ruddy Shelduck, Corncrake, Lesser Spotted Eagle, Booted Eagle, Northern Goshawk, Golden Eagle and Short-toed Snake Eagle. Impacts on breeding success of some species could also occur if heavy metals or other pollution entered the food chain or surface water bodies. Ruddy Shelduck bred in the Project-affected area in 2013 and 2015 but not in 2014 and is potentially affected by loss or pollution of aquatic habitat.

Construction of the conveyor and its associated service road, the mine access road and HLF, and the water abstraction pipeline from the Arpa River, will affect high quality bird breeding habitat associated with the Arpa Gorge and the gulley running south and eastwards from Gndevaz. This habitat is important for White-throated Robin (listed as Data Deficient in the RA Red Book), which nests here and was not found breeding anywhere else in the Project-affected area, and is particularly favoured by Ruddy Shelduck due to the proximity of the gorge to a suitable water body.

Remaining feeding habitat may be affected by noise, disturbance and lighting during operation and there is a possibility that raptors could collide with overhead power lines, particularly in areas with lighting at higher altitude.

### ***Migratory birds***

Detailed surveys of migratory birds in spring and autumn of 2013 (see Appendix 4.10.5) confirmed regular use by several globally and nationally threatened species, notably raptors such as Egyptian Vulture, Black Vulture, Pallid Harrier, Eastern Imperial Eagle and Red-footed Falcon. Numbers using the Project-affected area did not meet PS6 thresholds for critical habitat but the Project-affected area is considered to be of national importance as a stop-over for raptors on migration, providing extensive and relatively undisturbed feeding and resting conditions. Significant impacts are not predicted as a result of the Project alone, but could occur over time due to cumulative disturbance impacts and land use changes that could cause reductions in prey populations. The introduction of lighting, combined with overhead power lines at altitude could cause collisions and mortality of migratory birds, some of which fly at night, early dawn or dusk.



### **Brown Bear**

The Project-affected area is considered critical habitat for Brown Bear according to PR6, because the species is listed in Annex IV of the EU Habitats Directive. This means that the Project must ensure (i) that the ecological functionality of breeding sites and resting places for Brown Bear are not damaged or destroyed; and (ii) that the Project will not result in disturbances that affect the species' survival or breeding success, or reduce its area of occupancy.

Surveys in 2015 suggest that up to 10 bears could be affected directly, though final results are needed to confirm the number of individuals photographed. There is regularly used breeding habitat on Amulsar Mountain, with consistent presence of two females and young of different ages. Three adult males are regular visitors. The Arshak Set-aside preserves confirmed breeding dens, but the construction of the mine will introduce a major source of disturbance. The woodland north of Saravan, on the western slopes of Amulsar, offers important breeding habitat too, and may be affected by construction of the HLF and conveyor belt nearby. In addition to possible loss of hibernating or temporary "resting" dens, there would be some loss of foraging area. Bears eat apricots regularly and will lose some supply due to the HLF (although the proportion of supply lost is likely to be relatively small), as well as other foraging areas on the top of Amulsar Mountain and its western flank. Haulage roads, access roads and the conveyor will act as barriers, limiting accessible feeding area. Bears may not be able to range widely enough to find food; this applies particularly to small cubs. Levels of night-time lighting and noise may be sufficient to cause bears to attempt to relocate. However, this could expose them to risk of mortality from hunting or territorial disputes with other bears. The Project has taken steps to retain breeding habitat, in the form of the Arshak Set-aside, but residual impacts are highly likely. The significance of these impacts at a population level cannot be evaluated until final results are available, so that numbers of bears in the wider landscape can be estimated and compared with the affected population. The proposed approach to ongoing monitoring and development of offsets is discussed in a Species Action Plan for *Ursus arctos* that forms part of the Project BAP.

### **Bezoar Goat**

The Bezoar Goat population is centred in Herher State Reserve, Arpa Gorge and the area proposed for Jermuk National Park but Bezoar have also been observed in the Arshak Set-Aside and could therefore be exposed to disturbance and some loss of feeding habitat for the lifetime of the Mine.

### ***Eurasian Lynx***

Lynx have been observed on the Arshak Set-aside and will be exposed to disturbance and barrier effects that will disrupt access to undisturbed hunting area. They will be affected in a similar way to Brown Bear but are even more sensitive to presence of people and may therefore be displaced when construction and operation start.

### ***Dorcadian beetles***

These were not recorded in any areas where significant changes will occur as a result of the Project, and exposure to impacts is not predicted. However, a precautionary approach is considered appropriate given their national importance.

### ***Radde's/ Armenian Rock Viper, Armenian Mountain-Steppe Viper and Cat Snake***

These three species all occur in the proposed HLF location as well as having other suitable habitat on the western flank of Amulsar Mountain. They are listed as Vulnerable in the RA Red Book, with Armenian Mountain-Steppe Viper also being listed as Vulnerable on the IUCN Red List and Radde's Viper as Near Threatened. Both are sensitive to habitat loss and disturbance. They are considered likely to be distributed throughout the wider landscape.

**Table 6.11.6: Summary of Potential Pre-Mitigation Ecological Impacts (for Priority Biodiversity Receptors Exposed to Impacts)**

Priority receptors	Potential exposure to impacts	Sensitivity	Vulnerability	Significance
<b>Plant Species and Vegetation</b>				
Natural Habitat, including:				
<ul style="list-style-type: none"> <li>Species-rich Sub-alpine Meadows and Sub-alpine Meadows with Alpine Elements</li> </ul>	A large part of the mine footprint is on species-rich Sub-alpine Meadows with an estimated footprint of 254 ha associated with infrastructure (haul roads, mine pits and the crushing plant) and a further 126 ha in the buffer zone. A large proportion of the Mountain's Sub-alpine Meadow with Alpine Elements is also affected (a total of 103 ha).	High (vegetation removed)	Moderate as these vegetation types are extensive in the region. However condition is also declining throughout the region and these types are under-protected in Armenia	Significant
<ul style="list-style-type: none"> <li>Vegetation with Shrubs (particularly Juniper scrub)</li> </ul>	Fragments of juniper scrub occur in the proposed HLF location and conveyor corridor. The Project has a total footprint of 66 ha on this vegetation type.	High (vegetation removed)	High (rare habitat on Amulsar Mountain but more common in Jermuk IBA where grazing is at low intensity)	Significant
<ul style="list-style-type: none"> <li>Other natural and semi-natural vegetation types: Montane Meadows, Montane Meadow Steppes, Wetlands</li> </ul>	Permanent footprint due to the BRSF, haul and access roads on Montane Meadows (39 ha), Montane Meadow Steppes (37 ha) and Wetlands (5 ha). Further areas affected by induced changes in land use. Invasion of disturbed vegetation by weed species such as <i>Astragalus aureus</i> and <i>Verbascum laxum</i> may result in long-term changes in vegetation composition.	High	Moderate	Significant
<ul style="list-style-type: none"> <li>22 endemic plant species</li> </ul>	All are widespread throughout the wider Project-affected area apart from <i>P. porphyrantha</i> (addressed as an individual species below)	High	Low (species are widespread in the region)	Neutral – Moderate

**Table 6.11.6: Summary of Potential Pre-Mitigation Ecological Impacts (for Priority Biodiversity Receptors Exposed to Impacts)**

Priority receptors	Potential exposure to impacts	Sensitivity	Vulnerability	Significance
Amulsar sub-population of <i>Potentilla porphyrantha</i> (Tier 1 critical habitat – IFC PS6)	Proposed mine pits and other infrastructure are within Tier 1 critical habitat for <i>Potentilla porphyrantha</i> . An estimated 33% of the population has been translocated from Amulsar to avoid being lost as a result of mining. Other plants could be exposed to damage due to construction of associated infrastructure (roads or tracks), from deposition of fugitive dust that may include heavy metals or other pollutants; or from localized changes in microclimate that might affect availability of water.	High	High as there are only five confirmed populations in the world and the size of these populations is unknown	Significant
<b>Birds</b>				
Resident Breeding Bird Populations:				
<ul style="list-style-type: none"> <li>Egyptian Vulture (<i>Neophron percnopterus</i>)</li> </ul>	Only one breeding pair located in Jermuk Gorge. The breeding site will not be exposed to any impacts as a result of the Project. It is not within the Project footprint and levels of disturbance are not expected to alter at this location. Egyptian Vultures feeding in the Project-affected area could potentially be exposed to Project impacts due to loss of feeding area or poisoning if birds eat food contaminated by heavy metals entering the food chain if mitigation were not implemented. However, results of monitoring in spring 2013 and 2014 suggest that the pair use the Project-affected area for a very small proportion of their feeding time.	High for the affected pair (loss of feeding habitat), low for national or regional population	Low (extensive alternative feeding habitat)	Neutral

**Table 6.11.6: Summary of Potential Pre-Mitigation Ecological Impacts (for Priority Biodiversity Receptors Exposed to Impacts)**

Priority receptors	Potential exposure to impacts	Sensitivity	Vulnerability	Significance
<ul style="list-style-type: none"> <li>Saker Falcon (<i>Falco cherrug</i>)</li> </ul>	Observed three times on migration (four birds). A small number of individuals considered potentially resident in the wider area. No significant exposure to impacts as a result of the Project due to low frequency of occurrence and lack of confirmed breeding activity in Project-affected area.	High (loss of feeding habitat)	Low (extensive alternative feeding habitat)	Neutral
<ul style="list-style-type: none"> <li>Lesser Kestrel</li> </ul>	Preferential hunting area adjacent to the old construction camp and on southern flank of Amulsar could deteriorate due to dust deposition, suppressing vegetation and numbers of the grasshopper larvae on which they feed. See also considerations for breeding birds in general below.	High (loss of feeding habitat and disturbance)	Moderate	Neutral to moderate
<ul style="list-style-type: none"> <li>Other Species of Bird listed in the RA Red Book which breed in the Project-affected area</li> </ul>	Construction of the conveyor, service road, mine access road, HLF and Arpa water abstraction pipeline will affect high quality bird breeding habitat, particularly for Ruddy Shelduck and White-throated Robin which nest in the rocky gorge north of the HLF. Remaining habitat may be affected by noise, disturbance and lighting during operation. Raptors may collide with overhead power lines, particularly in areas with lighting. Impacts on breeding success could also occur due to pollution of water and introduction of heavy metals into the foodchain if mitigation were not implemented. Alpine birds currently breeding on Amulsar Mountain in Sub-Alpine areas could potentially be adversely affected by noise and	High (loss of feeding and breeding habitat and reduced quality of remaining habitat)	High (these species are all threatened)	Significant

**Table 6.11.6: Summary of Potential Pre-Mitigation Ecological Impacts (for Priority Biodiversity Receptors Exposed to Impacts)**

Priority receptors	Potential exposure to impacts	Sensitivity	Vulnerability	Significance
	disturbance.			
Migratory birds, especially raptors	Some feeding habitat for migratory raptors may be affected, both due to loss of habitat within the footprint, disturbance and land use changes which might reduce small mammal populations and food availability in the longer term. Availability of undisturbed resting habitat will also decline.	High	Moderate (extensive alternative feeding habitat is available in theory, so only a small proportion of available feeding habitat will be exposed to impacts from the Project).	Moderate
<b>Mammals</b>				
Brown Bear ( <i>Ursus arctos</i> ) (critical habitat – EBRD PR6)	Up to five individuals regularly use areas around the proposed mine pits on Amulsar Mountain and will lose feeding area due to the mine pits and other restricted use requirements. They may also lose breeding habitat due to noise, disturbance, habitat fragmentation and loss of food supply. Bears will be exposed to noise from blasting, haulage and conveyor operation, which will take place day and night. Disturbance from presence of people, light pollution, possible increases in exposure to hunting due to induced access, toxic effects from drinking polluted water or heavy metals that have entered the food chain, if mitigation were not implemented could all potentially cause displacement, placing bears at threat of poaching or hunting or competition with other bears.	High (sensitive to loss of habitat, disturbance by noise during day and night, loss of high quality breeding, feeding and winter hibernating habitat, barriers to movement)	High (Vulnerable in RA Red Book; threatened throughout region; EU Habitats Directive Annex IV species)	Significant

**Table 6.11.6: Summary of Potential Pre-Mitigation Ecological Impacts (for Priority Biodiversity Receptors Exposed to Impacts)**

Priority receptors	Potential exposure to impacts	Sensitivity	Vulnerability	Significance
Bezoar Goat	Population centred in Herher State Reserve, Jermuk Gorge and area proposed for Jermuk National Park. Not exposed to direct effects from the Project.	High (sensitive to disturbance)	High (declining throughout region)	Neutral (not exposed)
Eurasian Lynx	Observed in the Arshak set-aside and will be exposed to disturbance during construction and operation, with similar sensitivities to those of Brown Bear, though Amulsar is not considered to provide breeding habitat.	High (very sensitive to disturbance)	High (declining throughout region). Targeted for conservation action in EU due to more endangered sub-populations. However, observations also made in the proposed Jermuk National Park, so Amulsar is not the only suitable habitat available.	Moderate
<b>Invertebrate Species</b>				
Dorcadion Beetles ( <i>Dorcadion sevangense</i> , <i>D. sisianum</i> Lazar and <i>D. bistriatum</i> )	Locations where these have been recorded in baseline surveys are not within the Project footprint and are not considered likely to be exposed to impacts as a result of the Project.	High (not mobile species, highly sensitive to land use change)	High (threatened species where recorded)	Neutral (key areas where species recorded are not exposed)
<b>Reptiles</b>				
Radde's/ Armenian Rock Viper <i>Montivipera (Vipera) radeii</i> , Armenian Mountain-Steppe Viper <i>Vipera</i>	These reptile species are listed in the RA Red Book as Vulnerable, and <i>Vipera eriwanensis</i> is also IUCN Red-Listed as Vulnerable. They occur in	High (significant land use change)	Moderate as large areas of suitable habitat remain	Moderate

**Table 6.11.6: Summary of Potential Pre-Mitigation Ecological Impacts (for Priority Biodiversity Receptors Exposed to Impacts)**

Priority receptors	Potential exposure to impacts	Sensitivity	Vulnerability	Significance
<i>eriwanensis</i> and Cat Snake <i>Telescopus fallax</i>	rocky habitat largely on the western flank of Amulsar Mountain. Some suitable habitat will be within mine pits, but this is slightly too high altitude to be preferred.			

**Table 6.11.7: Implications of the Project for Biodiversity which is Widespread, with Resilient Populations**

Receptor	Summary	Implications of the Project
<b>Vegetation and plant species</b>	Areas of grassland that are modified by relatively intensive grazing or presence of herder camps, reducing their species-richness and characteristic species.	Induced impacts might include an increased level of harvesting of species used for herbs, vegetables and medicines, possibly causing declines in populations of targeted species. However, species in this category are generally able to regenerate well and are sufficiently widespread for populations to recover.
<b>Birds</b>	The Project-affected area provides habitat for a large number of species that are considered to be relatively common or widespread, with resilient populations.	The land use changes and disturbance associated with the Project will affect a variety of bird species but most will be able to relocate to alternative areas as they are relatively mobile and adaptable.
<b>Mammals (including bats)</b>	Baseline surveys identified several mammal species within the Project-affected area which are not considered to be threatened within the region or country and which are considered to be relatively mobile and adaptable. This includes some bat species that have been observed in the wider area. No Red Book bat species were confirmed to be present in baseline surveys.	Mammals in general will be affected by loss of habitat, land use change, barrier effects, habitat fragmentation and disturbance. Some local population declines may occur, but populations are considered sufficiently resilient to recover spontaneously. Bat species are thought to have resilient populations, with abundant feeding habitat available regardless of the presence of the Project.
<b>Invertebrates (terrestrial and aquatic)</b>	A wide variety of terrestrial and aquatic invertebrates will be affected by the Project, most of which are not included in the RA Red Book, though much of the Project-affected area is probably under-recorded due to the time-intensive	The areas considered to be most important for invertebrates have generally been found outside the Project-affected area. The Project could exacerbate existing baseline impacts on water quality by removing vegetation from large areas,



**Table 6.11.7: Implications of the Project for Biodiversity which is Widespread, with Resilient Populations**

Receptor	Summary	Implications of the Project
	nature of invertebrate survey. Aquatic invertebrates have been sampled as a basis for water quality monitoring, and no threatened species have been recorded.	mobilizing sediment and fugitive dust, which could be deposited on surface water bodies.
<b>Reptiles and amphibians</b>	Several reptile species have been recorded in the Project-affected area. Amphibians potentially affected by the Project are generally relatively widespread.	The main threat to reptiles in the baseline situation is considered to be decline in biomass of prey animals due to deterioration in the quality of grassland. The Project will cause a decline in overall availability of reptile habitat during operation. It will also remove some wetland habitat that supports abundant amphibian populations. Pollution of wetlands and watercourses could also depress populations of amphibians.
<b>Fish</b>	No endemic or RA Red Book species of fish were identified in baseline surveys of the Project-affected area. Although suffering reductions in biomass and population size due to a range of threats and pressures, the fish species present are not threatened from a biodiversity conservation perspective.	The Project could affect fish populations in the Vorotan and Arpa Rivers. Water will be abstracted from the Vorotan during construction and the Arpa during operation. Fish populations in the baseline situation are lower than they should be due to presence of artificial barriers in watercourses, including development of hydro-electric schemes. There are no fish passes, for example allowing access upriver for fish from Spandaryan Reservoir and this is constraining populations. The Project's Water Balance Model suggests that impacts on flow will be negligible even during low flow periods and stringent measures are proposed to avoid pollution.

**Table 6.11.8: Implications of the Project for Protected Areas and Other Key Biodiversity Areas**

Site or Area	Summary of implications of the Project
Caucasus Biodiversity Hotspot (Conservation International)	Covers the whole of Armenia. Project does not affect a significant proportion of the hotspot or the species targeted for conservation within it.
Caucasus Mixed Forest Ecoregion	Extensive WWF Global 200 Ecoregion. Presence of target habitats and species has been reviewed, for example presence of Caucasian mixed broadleaved woodland. Very small, degraded fragments of shrubby vegetation occur in the HLF location between cultivated areas supporting Caucasian endemic species of plant (e.g. <i>Phelypaea tournefortii</i> ) and slow growing mature shrubs (e.g. <i>Juniperus polycarpu</i> ). These are not high quality examples in the context of the Ecoregion as a whole; however, the Project has been designed to avoid remaining individual shrubs.
State Sanctuaries (Jermuk Forest, Herher Open Woodland and Jermuk Hydrological)	Not exposed to impacts
Sevan National Park	Not exposed to impacts
Proposed Jermuk National Park	The HLF and some parts of the mine would be visible from parts of the Park.
Jermuk IBA Key Biodiversity Area identified using recognized selection criteria	The Project affects feeding habitat for breeding birds associated with Jermuk IBA including <i>Neophron percnopterus</i> (Egyptian vulture), <i>Alectoris chukar</i> (Chukar), <i>Pernis apivorus</i> (European Honey-Buzzard), <i>Accipiter brevipes</i> (Levant Sparrowhawk), <i>Aquila chrysaetos</i> (Golden Eagle), <i>Crex crex</i> (Corncrake). The Project-affected area is used for foraging by breeding Egyptian Vulture protected in Jermuk IBA for a maximum of 20% of its time. Other birds of prey also use the Project-affected area, but have abundant alternative feeding areas available to them (see Table 6.11.6).
Gorayk IBA Key Biodiversity Area identified using recognized selection criteria	Part of the Project-affected area is considered to be supporting habitat for <i>Falco naumanni</i> (Lesser Kestrel) breeding colony and also for other target species <i>Aquila chrysaetos</i> (Golden Eagle) and <i>Buteo rufinus</i> (Long-legged Buzzard). Birds hunt regularly in the Vorotan Valley and may be affected by land use change and disturbance. Only one Egyptian Vulture was seen in the vicinity of the IBA in the period 2013-2014.

#### **6.11.6 Mitigation for Impacts on Biodiversity and Ecosystems**

The evaluation in Section 6.11.5 considered the potential impacts that might result from the Project without mitigation. These are summarised in Table 6.11.6 for priority biodiversity, Table 6.11.7 for more resilient and widespread biodiversity, and Table 6.11.8 for protected areas and other "key biodiversity areas".

The Project mitigation strategy for biodiversity addresses these impacts through application of the mitigation hierarchy. It is based on the objective of achieving NNL as reflected in Lydian's Biodiversity Policy, and on NNL or net gain as required by PS6 and PR6.

The Project's mitigation strategy includes:

- General design and control measures:
  - "built-in" biodiversity-related avoidance measures identified and implemented during early Project design;
  - control measures to be implemented by the Project in accordance with good mining industry practice, which will contribute to reduced risks or impacts on biodiversity;
  - mitigation measures aimed at other, non-biodiversity impacts (e.g. to prevent pollution of surface water) which also reduce risks of impacts on biodiversity and ecosystems; and
- Mitigation measures specifically designed to address impacts on biodiversity and ecosystems.

Table 6.11.9 summarises the general design and control measures that will be undertaken. The specific biodiversity-related mitigation measures are identified in Table 6.11.11 for priority biodiversity, Table 6.11.12 for widespread and resilient biodiversity, and Table 6.11.13 for protected areas or other "key biodiversity areas".

**Table 6.11.9: General Biodiversity Mitigation Measures**

Step in mitigation hierarchy	Project approach	Mitigation measures
Avoid	<p>Impacts on biodiversity are avoided where possible and particularly when the following situations occur:</p> <ul style="list-style-type: none"> <li>• Priority biodiversity features are affected, e.g. natural or critical habitat according to PS6/PR6, designated areas for conservation, species protected at national level, species threatened at a global level, amongst others.</li> <li>• The features concerned have restricted or localized distributions.</li> <li>• There is a risk of losing biodiversity with very high irreplaceability, and/or it is threatened and declining throughout its remaining area of occupancy.</li> <li>• Impacts will result in remaining portion of the resource becoming non-viable because critical viability thresholds have been exceeded (remaining habitat too small or fragmented, population unable to recover).</li> <li>• Recovery from impact is uncertain and no proven mitigation measures are known.</li> </ul>	<ul style="list-style-type: none"> <li>• Design modified to avoid impacts on protected areas or key biodiversity areas, for example HLF relocated to avoid direct footprint on Gorayk IBA and now has a reduced footprint on natural habitat.</li> <li>• Set-aside established to safeguard a viable proportion of the <i>Potentilla porphyrantha</i> population and preserve species-rich Sub-alpine Meadow with Alpine Elements, as well as to protect Brown Bear dens and suitable habitat for alpine birds. Awareness training for relevant personnel will reinforce awareness of protected features. Access will be prohibited.</li> <li>• As far as possible, construction activities will be scheduled to avoid disturbance of Brown Bear breeding habitat in early spring, between March and June.</li> <li>• Haulage routes designed to avoid remaining <i>Potentilla porphyrantha</i> plants, which are clearly marked.</li> <li>• An ecological risk assessment to evaluate the consequences of accidental spills during transport or storage of hazardous chemicals will be undertaken once transport routes are confirmed. This will focus particularly where routes run adjacent to sensitive water courses or water bodies.</li> <li>• Design process for HLF, topsoil storage piles and BRSF reviewed alternatives and avoided the most damaging alternatives on biodiversity.</li> <li>• Pre-construction checks (surveys) will be carried out immediately prior to ground disturbance to confirm that the biodiversity baseline as reported in this ESIA has not changed significantly and that there are no additional features that should be avoided (see Table 6.11.11 for survey requirements for specific species).</li> <li>• Small mammals, reptiles and amphibians will be excluded from working areas. Any individuals that become trapped will be removed by a suitably qualified ecologist.</li> <li>• Fauna, including birds, will be prevented from accessing settling ponds. Monitoring will determine whether measures additional to standard practices (fencing, use of bird scarers, etc.) are required.</li> </ul>

**Table 6.11.9: General Biodiversity Mitigation Measures**

Step in mitigation hierarchy	Project approach	Mitigation measures
Minimise	If avoidance is not possible, measures will be taken to minimize ecological impacts, e.g. to reduce the proportion of a receptor affected, or the magnitude or intensity of an impact.	<p><b><i>Footprint and barrier effects</i></b></p> <ul style="list-style-type: none"> <li>• As a fundamental design principle, the footprint of Project infrastructure and the areas of land to be cleared will be minimised.</li> <li>• Any new access roads required will be designed to minimise habitat fragmentation, barrier effects and induced access to previously undisturbed areas.</li> <li>• Vehicular access to the Project-affected area will be minimised. The majority of workers will arrive on site via bus and limited car parking will be available for employees (see Section 6.5, landscape and visual impacts).</li> </ul> <p><b><i>Site management</i></b></p> <ul style="list-style-type: none"> <li>• All site workers will have awareness training on biodiversity issues and particularly the provisions that have been made to minimise impacts on biodiversity, both prior to initial access to site and on an as-needed basis throughout the project (via tool-box talks etc.).</li> <li>• Hunting and gathering by Project staff will be prohibited.</li> <li>• The Project site will be maintained in a clean and uncluttered state: the pMRCRP (Appendix 8.18), FMP (Appendix 8.8) and ESMP (Chapter 8) will include landscape and habitat management requirements (see Section 6.5, landscape and visual impacts).</li> <li>• Litter will be removed from water bodies and areas within the restricted access zone.</li> <li>• A waste management plan will be implemented. Waste disposal facilities will be operated in a manner that includes the regular covering of exposed refuse with soil or gravel (see also Section 6.6, air quality impacts). This will reduce risk of exposure of birds such as Egyptian Vulture that regularly forage in waste dumps to potentially damaging waste products.</li> <li>• Areas to be disturbed during construction and operation will be clearly delineated and marked out in advance, and encroachment outside these areas will not be permitted. In particular, off-road/track driving will be prohibited.</li> </ul>

**Table 6.11.9: General Biodiversity Mitigation Measures**

Step in mitigation hierarchy	Project approach	Mitigation measures
		<ul style="list-style-type: none"> <li>• Vehicle speed limits will be set in relation to road conditions and presence of sensitive receptors (e.g. populated areas). On access and haul roads, speed limits will be posted and maintained to minimise dust emissions and the risk of mortality of animals.</li> <li>• Instruction on driving safety and observation of speed limits will be included in the new employee orientation and annual refresher training and in task training for specific job assignment (see also Section 6.6, air quality impacts).</li> <li>• Vehicles considered to have the potential to introduce invasive plant species or spread existing invasive plants to areas where they do not currently occur will be washed before entering site or current weed-free locations (wash water to be contained).</li> </ul> <p><b>Dust</b></p> <ul style="list-style-type: none"> <li>• Topsoil storage piles will be stabilized as necessary to reduce wind-blown dust emissions. All mounds will be sown with a grass seed mixture appropriate to the location and will be maintained for the duration of the operational phase (see Section 6.7, soil and land cover impacts; FMP (Appendix 8.8); pMRCRP (Appendix 8.18)).</li> <li>• Crushing and screening facilities will be enclosed in a purpose-constructed building with dust extraction and filtration systems (see Section 6.6, air quality impacts).</li> <li>• Transfer of crushed ore between the crushing and screening plant and truck loadout facility will be via covered conveyor, thereby significantly reducing the potential for both dust emissions and noise compared with use of dump trucks and haul roads (see Section 6.6, air quality impacts; and Section 6.6, noise &amp; vibration impacts).</li> <li>• Water sprays will be used at conveyor discharge points and other identified dust emission points (see Section 6.6, air quality impacts).</li> <li>• The HLF will be operated such that the active leaching surface retains sufficient humidity to inhibit dust generation (see also Section 6.6, air quality impacts).</li> <li>• Water spraying will be employed on roads to suppress dust (see Section 6.6, air quality impacts).</li> <li>• To the extent practical, haul and dump truck loads prone to dust will be sprayed with</li> </ul>

**Table 6.11.9: General Biodiversity Mitigation Measures**

Step in mitigation hierarchy	Project approach	Mitigation measures
		<p>water as appropriate to decrease the potential for fugitive dust emissions during transport (see Section 6.6, air quality impacts).</p> <p><b>Water management</b></p> <ul style="list-style-type: none"> <li>• Control measures, including for material storage and handling and for erosion and sedimentation prevention, will be in place to prevent release of contaminants into the environment via leakage, spills and run-off. (see Section 6.9, groundwater impacts; Section 6.10, surface water impacts; and Emergency Preparedness and Response Plan (Appendix 8.9)).</li> <li>• Sites will be graded to channel surface flows into ditches to decrease the potential for erosion (see Section 6.7, soil and land cover impacts).</li> <li>• Roadside berms will be installed and surface water run-off managed to reduce footprint of gravel wash-out, particularly where natural vegetation could be affected.</li> <li>• Culverts will be installed at all road/track stream-crossings to minimise sedimentation downstream.</li> <li>• Geotextile silt fencing, silt traps, and/or straw bales will be used to reduce sediment transport within the construction site (see Section 6.7, soil and land cover impacts).</li> </ul> <p><b>Noise</b></p> <ul style="list-style-type: none"> <li>• All Project vehicles and equipment will be maintained in good condition. During detailed construction design, use of noise barriers, baffles, or enclosures to provide abatement for noisy equipment such as generators, compressor, pumps, gearboxes will be considered (see Section 6.6, noise &amp; vibration impacts).</li> <li>• Where practical, noisy construction-related activity will be avoided at dawn and dusk and during the night (see also Section 6.6, noise &amp; vibration impacts).</li> <li>• Workers will be trained in noise abatement best practices, including avoiding unnecessary revving of engines and switching off equipment when it is not required. Haul routes will be well maintained and where steep gradients are required operatives will be trained to minimize engine noise through avoiding unnecessary revving etc. (see</li> </ul>

**Table 6.11.9: General Biodiversity Mitigation Measures**

Step in mitigation hierarchy	Project approach	Mitigation measures
		<p>also Section 6.6, noise &amp; vibration impacts).</p> <ul style="list-style-type: none"> <li>Lydian will investigate the optimal technology to be used for reversing alarms on haul trucks, to balance the requirement of occupational health and safety for workers deployed on the HLF and to minimise/remove the audibility of alarms within the nearest community of Gndevaz (see Section 6.6, noise &amp; vibration impacts).</li> </ul> <p><b>Light</b></p> <ul style="list-style-type: none"> <li>Only the minimum artificial lighting necessary to ensure safety will be employed. Downward-directed lighting will be employed to minimise light pollution for nocturnal species.</li> <li>Low visibility spectrum lights and appliances (full cut-off fixtures that emit no light above the light's horizontal line) will be preferred, with lighting mounted at the minimum necessary safe height and shrouded where appropriate (see Section 6.5, landscape and visual impacts).</li> <li>Lighting will be carefully enclosed within buildings so as not to contribute to light pollution/ light spillage off site/ glare to the sky. Shutters will be used during darkness (see Section 6.5, landscape and visual impacts).</li> <li>There will be minimal security lighting in external areas (sensors will be used to ensure it does not get left on) (see Section 6.5, landscape and visual impacts).</li> <li>Lighting of work sites will be restricted to agreed working hours and that which is necessary for security. Light sources for night-time construction and operation activities will be pointed downward and away from sensitive receptors (see Section 6.5, landscape and visual impacts).</li> <li>Vehicle and mobile plant machinery operators and drivers will be instructed in the appropriate use of headlights (high and low beams) to reduce impacts (see Section 6.5, landscape and visual impacts).</li> </ul>
Restore or repair	The Project will aim to restore the condition of biodiversity to its present	A comprehensive soil and vegetation restoration programme will be employed to reinstate appropriate vegetation types post-impact. Ecologists have worked closely with



**Table 6.11.9: General Biodiversity Mitigation Measures**

Step in mitigation hierarchy	Project approach	Mitigation measures
	condition after work in each area. This will be a progressive activity during and after the construction phase, throughout operations, and after mine closure. It will be employed for all areas where vegetation has been cleared, including haul roads and temporary material or equipment storage areas.	<p>landscape specialists to identify suitable native species, and field trials will be undertaken in conjunction with the national herbarium and the NAS RA Institute of Botany to investigate restoration techniques. Restored areas will be monitored for a period of five years post-mine closure. See also Section 6.5, landscape and visual impacts; and Section 6.6, soil and land cover impacts.</p> <p>All re-vegetation carried out for the Project will be carefully reviewed and monitored to avoid accidental introduction of invasive alien species.</p>
Offset	Offsets will be developed for significant residual impacts on natural and critical habitat and will deliver NNL and net gain outcomes, respectively.	Specific measures required; see Table 6.11.11.

The mitigation required for priority biodiversity is discussed in further detail below.

### ***Mitigating impacts on natural vegetation***

As noted in Table 6.11.9, a set-aside of land that has remained relatively undisturbed during the exploration phase for the Project has been designated by Lydian to ensure the preservation of high quality Sub-alpine Meadow with Alpine Elements vegetation and to safeguard a viable population of *Potentilla porphyrantha*, as well as Brown Bear dens and breeding habitat for alpine birds. The proposed boundary of the set-aside is shown in Figure 6.11.1. Preliminary consultations have been held with local communities, but further discussion will be needed to finalise land use agreements, though significant changes to current use are not likely to be necessary. A wider area than this is appropriate to maintain Brown Bear habitat, due to the importance of the woodlands north of Saravan on the western flank of Amulsar Mountain. Discussions are needed to confirm whether this can be incorporated and included in a zone of controlled access. The Ministry of Nature Protection has approved the set-aside in principle as a measure to meet the requirements of the Flora Decree.

Outside the set-aside, efforts will be made to minimise the Project's footprint on natural vegetation types, by for example preventing access of vehicles outside haul roads or working areas; by suppressing pollution and dust that could alter vegetation in adjacent zones; and by covering stockpiles to avoid fugitive dust and polluted run-off.

A programme of vegetation rehabilitation will be implemented throughout mine development and in the mine closure and rehabilitation period. To ensure that the best available techniques for restoring the vegetation types affected by the Project are used, a trial restoration programme involving the national herbarium and the NAS RA Institute of Botany is in place. Several temporary access routes used during the exploration phase have already been rehabilitated and restored using a variety of techniques and the outcomes will be monitored. This experience will be built on to improve techniques.

Vegetative cover will be restored on temporary haul and access roads using native species that are known to be constituents of affected vegetation. As a general practice and where it is technically feasible, the top 10cm of topsoil will be stripped and stored separately from other soil that is removed. However, there are areas where the abundance of rocks will make soil-stripping impossible. A detailed map will be created in association with engineers to

illustrate the areas that can be stripped of soil and those that cannot. Because many alpine plants rarely produce seed and spread vegetatively, turves of species-rich vegetation will be removed and stored prior to excavation and stored for use as 'plugs' in amongst seeded areas during restoration. A seed collection programme has been initiated for native plant species and three plant nurseries have been established in local villages to provide stocks for re-vegetation. These have been used initially to produce trees for visual screening purposes, but will be expanded to cater for restoration requirements, in partnership with the local communities in which they are located.

All re-vegetation carried out for the Project will be carefully reviewed and monitored to avoid accidental introduction of invasive alien species. Trees used for landscape or visual screening purposes will be native species and they will not be planted in areas where the typical vegetation is grassland.

Despite the efforts described above, reinstatement of suitable soil conditions for restoration of vegetation is expected to be challenging in some locations, particularly in the harsh mountain environment (see Section 6.7, soil and land cover impacts). There are also places within the mine footprint where irreversible changes will occur that make it impossible to reinstate the original vegetation types. Significant residual impacts on natural habitat will therefore occur. As discussed in Section 6.11.5, the Project has chosen to take a conservative approach and assume that loss of natural habitat will be effectively permanent within the Project's entire physical footprint (518 ha). In other parts of the Project-affected area, natural habitat may not be destroyed, but is likely to decline in condition, either because of dust and other pollution impacts or because restrictions on access mean that traditional management may be discontinued.

A method has been devised to quantify the residual biodiversity losses associated with the footprint and other Project-affected areas as the basis for a natural habitat offset. This is described in full in the NCHA (Appendix 4.10.3) and summarised here. Each affected vegetation type is assigned a score, based upon its distinctiveness and condition. For each vegetation type, the affected area (in hectares) is multiplied by the appropriate score to give a normalised area expressed in "habitat impact units" (HIU). For the 518 ha of natural habitat within the physical footprint that will be lost, the overall HIU is calculated by summing the HIUs for each vegetation type within the Project footprint. For the 1288 ha of natural habitat in the Project Disturbed Area, Operational Restricted Area, Restricted Area, Restricted Area

(by fencing), Ecologically Disturbed Area, and along the Kechut-Gorayk road, the calculation method is slightly different because the vegetation in these areas is not expected to be lost entirely, but rather will remain in a degraded state post-mining. The score used to derive the HIU for each affected vegetation type is based on the difference between the distinctiveness and condition of the vegetation now, and its predicted distinctiveness and condition post-mining. The summed HIU for all vegetation types in the buffer and restricted zones is then added to the figure generated for the Project footprint, to give the total impact value, which constitutes the natural habitat offset requirement of the Project. The calculation for some of the restricted zones was complicated in that some of the impacts will be positive e.g. the exclusion of people will be good for species that are normally disturbed by people and their grazing animals whereas others will be negative e.g. plant species that require grazing to persist may be over-topped by the development of shrubby vegetation. However, because the land has been overgrazed in the past and nutrient levels are higher than natural, it is assumed that the vegetation that will develop if grazing ceases will not be of high natural quality and therefore the overall change will be slightly negative.

The calculation as described in the NCHA (Appendix 4.10.3) derived a figure of 836.5 HIUs required as an offset in order to achieve NNL.

The Project proposes to achieve NNL of natural habitat through implementation of a management plan which will involve improving the condition of target vegetation types (and habitat conditions for other priority biodiversity) in a proposed new National Park near Jermuk (Figure 6.11.3), possibly through management agreements with herders. The proposed Jermuk National Park is potentially suitable to offset residual impacts of the Project on natural habitat because it is adjacent to the Project-affected area and has a similar range of altitudes. Initial botanical surveys indicate that there are extensive areas of suitable habitat available that would benefit from improved management. A preliminary survey of land use within the proposed National Park was carried out by WWF Armenia which suggested that there were 9386 ha of pasture land, currently in poor condition due to over-grazing that would offer ample scope for delivering enhancements needed to achieve NNL of natural habitat. Further details are given in the NCHA (Appendix 4.10.3).

More detailed surveys of the habitat types represented in the proposed National Park, and assessments of their current condition and suitability for other priority biodiversity including Brown Bear and some bird species (including White-throated Robin and Ruddy Shelduck),

were undertaken in June and July 2015. These confirmed the availability of suitable habitat types for offsetting the impacts of Amulsar on natural habitat. The results, summarised in Table 6.11.10, are described in a survey report and used in the Project's Biodiversity Offset Strategy (BOS) to identify suitable management interventions. They also confirmed the presence of opportunities to offset impacts on the full range of species associated with natural habitat on Amulsar Mountain, with the exception of Eastern Rock Nuthatch. Preliminary stakeholder mapping was also carried out in the proposed National Park area and interviews were held to discuss attitudes to the concept of the National Park and also conservation of large carnivores such as Brown Bear, Eurasian Lynx and Wolf. Further consultations will take place with herders who use the area to seek their involvement in grazing management and to ensure that implementation of a biodiversity offset would be compatible with existing or potential alternative livelihoods.

The Project BOS provides further consideration of potential costs and funding mechanisms and outlines Lydian's proposed approach to provision of support during National Park establishment and ongoing management.

**Table 6.11.10: Scope to offset potential residual impacts on RA Red Book species in the proposed Jermuk National Park**

RA Red Book species	Current habitat in Jermuk National Park (JNP)	Need and potential for offset in Jermuk National Park (JNP)
<i>Potentilla porphyrantha</i>	This plant species has been looked for in apparently suitable locations but has not been found, so suitable habitat conditions do not seem to be present.	Research is ongoing on its ecology and growing conditions as outlined in the Species Action Plan, together with research on restoration techniques and searches for other populations in Armenia.
Egyptian Vulture	The only nesting site in the region is south of JNP. Little or no breeding habitat is available but there is plentiful feeding habitat.	No residual impacts identified but monitoring of breeding pair in Arpa Gorge recommended. Little suitable breeding habitat is available in the region and extension of the indicative boundary to include the Arpa Gorge would incorporate it the one confirmed location into JNP. The species would benefit from this and from increased availability of food (e.g. by means of a vulture restaurant) within JNP
Saker Falcon	No direct evidence of breeding in the Park, but suitable feeding habitat is available, especially in the high-altitude, stony north-eastern part.	No residual impacts identified, but this species will benefit from protection in JNP.
Lesser Kestrel	JNP is a too great a distance from the current breeding location (the Gorayk area), but potentially suitable habitat is available for hunting (southwards facing slopes with short grass and abundance of voles) although these are covered in snow for a long time in spring.	Residual impacts from the Project are possible, but would be confirmed through monitoring. No specific conservation measures are currently proposed, but in theory it may be possible to extend breeding range into JNP, e.g. by setting up containers with nest boxes. This would be an ACA.
Ruddy Shelduck	This species breeds on lakes just north of the Park (Pokr Al Lake) but suitable breeding habitat seems absent within the Park itself. There is some feeding habitat in spring (before herders arrive).	Residual impacts on current breeding habitat on Amulsar identified. Actions needed through Natural Habitat offset. The small lake located along the northern border of JNP could be expanded to create suitable breeding habitat. Herder camps should be relocated away from this lake, as Ruddy Shelduck is sensitive to disturbance.
Lammergeier	No good breeding habitat available (the species breeds south of the NP); plenty of feeding habitat present.	No residual impact identified but monitoring recommended. If long-term monitoring shows an impact of mining activities on the current breeding pair in Arpa gorge (south of NP), the species could benefit from development of a vulture restaurant.

**Table 6.11.10: Scope to offset potential residual impacts on RA Red Book species in the proposed Jermuk National Park**

<b>RA Red Book species</b>	<b>Current habitat in Jermuk National Park (JNP)</b>	<b>Need and potential for offset in Jermuk National Park (JNP)</b>
Griffon Vulture	Limited breeding habitat available in parts of Arpa gorge (within NP), although the species does not currently breed there. Plenty of feeding habitat present.	No residual impacts identified.
Cinereous Vulture	The species does not currently breed in the region, but formerly did. Suitable breeding habitat is available in Herher Open Woodland State Sanctuary. The species breeds on mountain grasslands alternated with arid Juniper sparse forests on slopes at 1200 - 2000 masl. Plenty of feeding habitat present.	No residual impacts identified, but species would benefit from measures to increase the number of ungulates in the area (e.g. a hunting ban), including Bezoar Goat. Also, any potential nesting sites should be strictly protected. A vulture restaurant could also have a positive impact on the species as an ACA.
Short-toed Eagle	Suitable breeding habitat is present in Herher Open Woodland State Sanctuary, though it is not clear if the species currently breeds there. The same area also offers good feeding opportunities for snakes. The rest of the NP is probably at too high an altitude to offer enough food.	Intended to benefit from natural habitat offset due to some residual loss of feeding area. More information (through monitoring) is needed on the current breeding situation in Herher. Conservation action could possibly entail expanding the habitat for reptiles in certain places through prescribed fire, mowing and forest thinning.
Pallid Harrier	A migratory species (does not breed in Armenia) for which plenty of feeding habitat is available in the central and northern parts of the NP	No residual impacts identified.
Montagu's Harrier	Suitable breeding (mountain grasslands) and feeding habitat is available in the central and northern parts of JNP.	No residual impacts identified, but species would benefit from restrictions on grazing in JNP.
Northern Goshawk	Breeding and feeding habitat is available in the wooded valley west of Kechut Lake and the wooded valley along the Arpa river north of Jermuk; possibly also in Herher Open Woodland State Sanctuary and in woodland in the southeastern corner of JNP.	No residual impacts identified, but the species would benefit from restriction of human activities (such as road construction or hunting) in wooded valleys, as well as expansion of the current woodland areas.

**Table 6.11.10: Scope to offset potential residual impacts on RA Red Book species in the proposed Jermuk National Park**

RA Red Book species	Current habitat in Jermuk National Park (JNP)	Need and potential for offset in Jermuk National Park (JNP)
Lesser Spotted Eagle	Breeding habitat is available in the wooded valley west of Kechut Lake and the wooded valley along the Arpa river north of Jermuk; possibly also in Herher Open Woodland State Sanctuary and in woodland in the south-eastern corner of JNP.	Residual impacts on this species are likely due to loss of natural habitat and disturbance. Offset could target restriction of human activities (such as road construction or hunting) in wooded valleys, as well as expansion of the current woodland areas (tree planting).
Steppe Eagle	A migratory species (does not breed in Armenia) for which plenty of feeding habitat is available in the central and northern parts of the NP (mountain grasslands)	Possibility of residual impact due to loss of feeding habitat on migration. Species will benefit from restrictions on grazing in JNP.
Golden Eagle	Suitable breeding habitat is present in Arpa gorge (e.g from Gndevaz to Kechut Lake) and likely also in the north-western corner of the NP and the wooded valley north of Jermuk. Possibly also in Herher State Reserve. Feeding habitat is available throughout JNP.	Possibility of residual impact due to loss of natural habitat. Species would benefit from restriction of human activities (such as road construction or hunting) in wooded valleys as well as restrictions on grazing and the number of herder camps in the rest of JNP.
Booted Eagle	Breeding habitat is available in the wooded valley west of Kechut Lake and the wooded valley along the Arpa river north of Jermuk; possibly also in Herher State Reserve and in woodland in the south-eastern corner of the NP. Feeding habitat is available throughout the whole Park.	Possibility of residual impact due to loss of natural habitat. Species would benefit from restriction of human activities (such as road construction or hunting) in wooded valleys, as well as expansion of the current woodland areas (tree planting).
Peregrine Falcon	Limited breeding habitat available in parts of Arpa gorge (within NP). Abundant feeding habitat present.	Breeding opportunities could be increased by placing nest boxes high up on electricity pylons or radio masts.
Caspian Snowcock	Suitable breeding habitat is available on the highest peaks in JNP (2500 - 3500 masl).	May be displaced from Arshak set-aside due to disturbance. The species would benefit from restrictions on grazing and reduction of the number of herder camps in the NP. This would limit disturbance by people and shepherd dogs and would increase the quality of habitat now suffering from overgrazing.

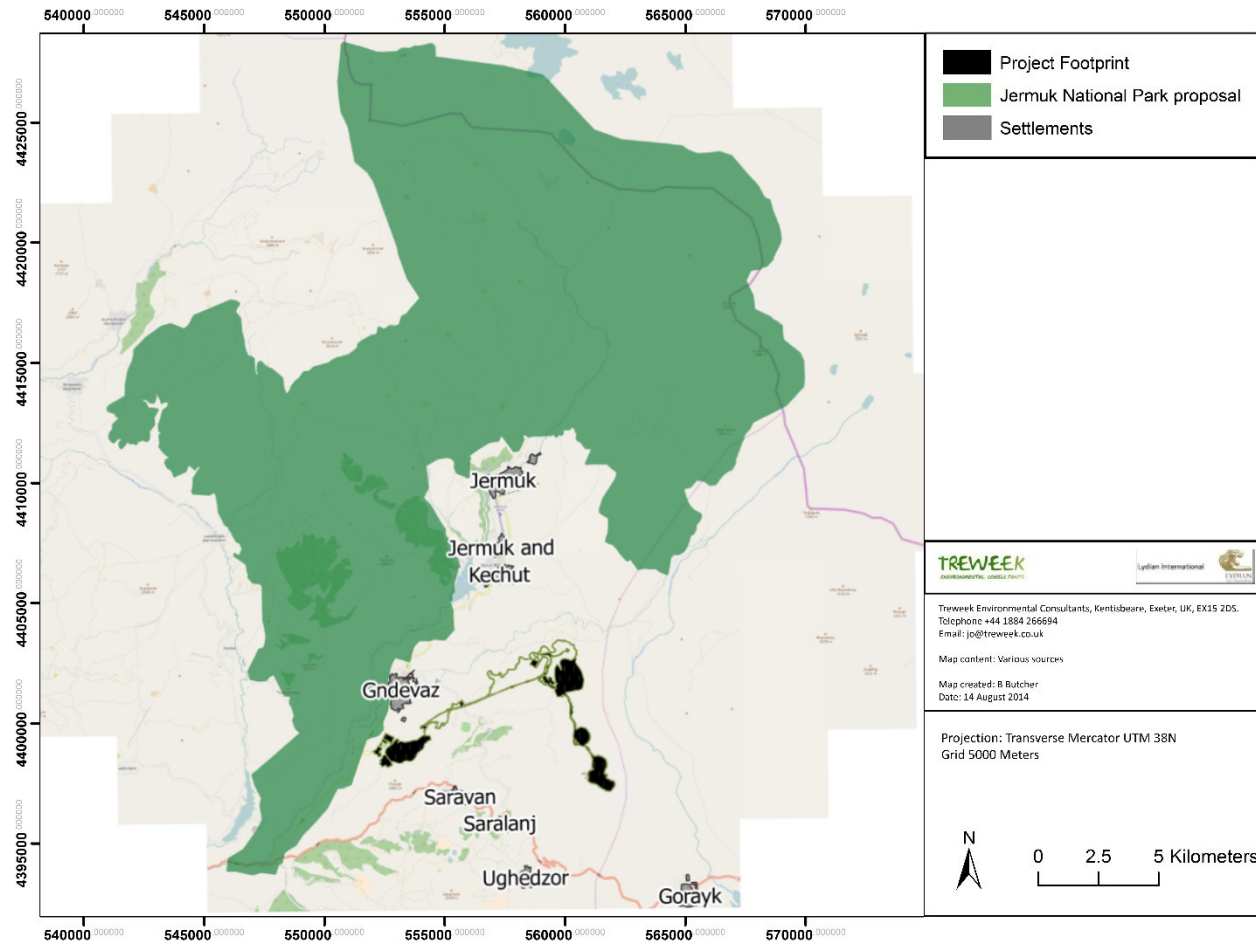


**Table 6.11.10: Scope to offset potential residual impacts on RA Red Book species in the proposed Jermuk National Park**

RA Red Book species	Current habitat in Jermuk National Park (JNP)	Need and potential for offset in Jermuk National Park (JNP)
Corncrake	Suitable breeding habitat (hay meadows) is available in the eastern, central and northern parts of JNP.	Possibility of residual impact due to impacts on wetlands. This species would certainly benefit from a restriction on grazing and relocation of herder camps. A restriction on herb-picking is also likely to have a positive effect as well as controls on hunting.
Great Snipe	A migratory species (does not breed in Armenia); suitable feeding habitat is available in wetter areas in the northern parts of JNP.	Possibility of residual impact due to impacts on wetlands. Expansion of the small lake near the northern border of JNP (as suggested for Ruddy Shelduck) would increase feeding habitat for this species, provided the lake shores are flat, with an extensive zone of moderately short vegetation (especially rushes and Carex). The species would also benefit from restrictions on grazing and reduction of the number of herder camps in JNP.
Eagle Owl	Suitable breeding habitat is available in Arpa gorge and in the wooded valley west of Kechut Lake. Possibly also in Herher Open Woodland State Sanctuary, the wooded valley north of Jermuk and craggy areas near the highest peaks. Breeds predominantly in caves.	Potentially affected by collisions with power lines. The species would benefit from restriction of human activities (such as road construction or hunting) in wooded valleys, as well as expansion of the current woodland areas (tree planting).
Roller	This species does not appear to breed in the region but it is a regular migrant. Within JNP, the species prefers the open plateau along the western edge of Jermuk, where mountain meadow is interspersed with scattered bushes, trees and telephone poles that are used as perches.	No residual impact identified, so not targeted for any conservation action within JNP.
White-throated Robin	This species has not been recorded within JNP, but suitable habitat seems present on the semi-arid slopes of Arpa gorge and along the southernmost edge of the Park (close to Herher Lake and village).	Residual impact due to displacement of breeding pairs by disturbance associated with the Conveyor and access roads. The species prefers semi-arid, stony slopes with scattered scrub and hot microclimate. Most of JNP is at too high an altitude for this species. However, there may be potential to create additional habitat in the southern part of Herher State Reserve through prescribed fire, mowing and forest thinning.

**Table 6.11.10: Scope to offset potential residual impacts on RA Red Book species in the proposed Jermuk National Park**

<b>RA Red Book species</b>	<b>Current habitat in Jermuk National Park (JNP)</b>	<b>Need and potential for offset in Jermuk National Park (JNP)</b>
Eastern Rock Nuthatch	Suitable breeding habitat is present in Arpa gorge.	Residual impact: displacement of breeding pairs by disturbance associated with the Conveyor and access roads. The species breeds in rocky gorges with tall cliffs and hot microclimate, a habitat that is challenging to recreate.
Brown Bear	Suitable habitat is available in Herher State Reserve, the wooded valley west of Kechut Lake and in the steep valley north of Jermuk. Herher and the valley west of Kechut Lake are already important areas for bears; the valley north of Jermuk is also a breeding site but the woodland here shows relatively little bear activity which is surprising since the habitat looks good.	Offset needed. Potential offset measures are: restriction of human activities in JNP (road construction, hunting, herder camps etc); expansion of current woodland (planting of trees, especially fruit trees).
Bezoar Goat	Suitable habitat is available in Herher State Reserve and Arpa gorge.	Residual impact due to disturbance. The species would benefit from restriction of human activities and overgrazing. Also, habitat could be expanded by planting scrub on certain steep, arid slopes in JNP. Inclusion of Arpa Gorge in JNP would confer protection.
Radde's Rock Viper	Suitable habitat is present on the slopes of Arpa gorge and in Herher State Reserve.	Residual impact: habitat loss due to HLF. Additional habitat could perhaps be created in Herher State Open Woodland Sanctuary through prescribed fire, mowing and forest thinning.
Armenian Mountain-steppe Viper	Suitable habitat is present throughout the NP, especially in the southernmost part.	Residual impact: loss of habitat due to HLF. Potential for creating additional through prescribed fire, mowing and forest thinning.
Cat Snake	Suitable habitat is present on the slopes of Arpa gorge and in Herher State Reserve.	Residual impact: loss of habitat due to HLF. Potential for creating additional habitat in some parts of Herher Open Woodland State Sanctuary through prescribed fire, mowing and forest thinning.



**Figure 6.11.3: Proposed Jermuk National Park in relation to Project**

### ***Mitigation for impacts on critical habitat for *Potentilla porphyrantha****

Amulsar Mountain has Tier 1 critical habitat for *Potentilla porphyrantha* and there will be a residual loss of population due to the Project, at least in the shorter term.

IFC PS6 requires Projects potentially affecting critical habitat to demonstrate that it is not possible to avoid areas of critical habitat through viable alternative options for development on habitats that are not critical. Complete avoidance of critical habitat is not possible at Amulsar, as the gold-bearing strata are at the top of the mountain, coincident with the distribution of the plant. There are no viable alternatives to the location of the mine but a large proportion of the sub-population will be avoided as it is outside the infrastructure footprint. Protection to a proportion of remaining plants has been afforded through a set-aside, within which no Project activities will take place.

To the extent possible, the design of the mine footprint has been adapted based on survey results to avoid habitat with a high density of plants. For example, the design for the pit on Erato and the roads leading into it were altered partly to minimise removal of rocks with *P. porphyrantha* growing on them (see NCHA in Appendix 4.10.3 for further detail).

*Potentilla porphyrantha* plants that could not be avoided because they were within the physical footprint of the mine have already been translocated from Amulsar Mountain to the Sevan Botanic Garden, in accordance with permit requirements and in discussion with the Ministry of Nature Protection and its specialist advisors (the Institute of Botany of the NAS RA). These plants will be maintained in controlled conditions and used to research the ecological requirements of the species and to produce plants for re-introduction to restored mine pits in future, if suitable conditions can be created. Rockeries have been constructed at the Sevan Botanic Garden and on North Erato to act as experimental nurseries.

Preventing destruction of or damage to plants that remain on Amulsar Mountain in areas not directly affected by mining activity is essential, and measures have already been taken in the pre-development phase to minimise incidental damage by protecting plants with fencing and signs. Rocks supporting plants that were to be translocated and those at risk of collateral damage were marked in August 2013 with large green dots that are visible from over 200m away. These rocks were repainted in 2015. Regular inspection and monitoring by an on-site environmental officer is being undertaken to ensure that these remain visible, that personnel are aware of the need to safeguard marked rocks and that detailed design changes are

compatible with the need to avoid impacts. Monitoring will also be undertaken to observe the potential effects of dust deposition on the species. These measures will be consolidated and maintained throughout construction and operation.

Options for creating suitable conditions for *Potentilla porphyrantha* post-Project are the subject of a programme of research being carried out in partnership with the Institute of Botany of the NAS RA and the University of Cambridge Botanic Garden. This is currently planned to last for four years, with a view to studying the ecological requirements of the plant in detail, identifying propagation techniques, improving knowledge of the genetics of the species, modelling the time needed to achieve population growth and supporting development of an effective restoration programme. Some seed has already been harvested from plants on Amulsar Mountain and has germinated successfully in trials carried out by the Institute of Botany. Further seed will be collected from Amulsar plants for experimental growing of plants *ex-situ*, that can be used for potential re-introduction to the mine sites on closure (plants from seed and/or transplanted stock will be re-introduced.) Further detail on the ongoing work is included in the Project Biodiversity Action Plan (BAP), which includes a Species Action Plan (SAP) for *Potentilla porphyrantha*.

There will be a residual impact on the population in the shorter term with at least 21% and up to 33% of plants lost from the sub-population on Amulsar Mountain. The sub-population should remain viable despite this reduced population size, but a precautionary approach is being taken. If research, monitoring and modelling suggest that pre-mining population size and the extent of the population cannot be restored, a comprehensive review of offsetting options will be undertaken.

Mine development is phased over time and allows for a period of monitoring and research to refine population models that are being developed to support estimates of the time needed for the population to recover post- mining, with or without re-introduction of plants.

### **Mitigation for impacts on resident breeding bird populations**

The IUCN Red-listed (Endangered) Egyptian Vulture (*Neophron percnopterus*) and Saker Falcon (*Falco cherrug*) are present within the Project-affected area, but are not expected to be significantly affected by the Project due to the fact that it forms a small part of their overall range and feeding areas. Nevertheless, given their endangered status at a global level, the presence and behaviour of these species will be monitored routinely during Project execution.

If monitoring suggests that either species is being adversely affected by the Project, then appropriate mitigation will be considered, e.g. use of a vulture restaurant to ensure that food supplies are maintained for Egyptian Vulture.

The new Lesser Kestrel colony associated with Gorayk IBA, which has established in the military tower between Ughedzor and Gorayk will also be monitored in partnership with ASPB, as these birds hunt on the southern slopes of Amulsar. Contingency measures will be identified and implemented if any decline in breeding success is noted and if this is considered to be linked to food supply or disturbance due to the Project during construction and operation. These measures would be implemented through partnership arrangements with the ASPB, and might include enhancements to the breeding colony and possibly also to prey populations for hunting in its vicinity. Some radio-tagging of birds is proposed to improve knowledge of their preferred hunting areas.

For breeding birds in general, significant impacts are likely due to the importance and sensitivity of confirmed breeding habitats on the western flank of Amulsar Mountain and the fact that key infrastructure is located in close proximity. The rock gulley adjacent to the conveyor and HLF is one such location. The Conveyor route was redesigned so that it would no longer cross the gulley but it is only 150m from its northern edge and is also likely to be affected by noise and dust from traffic. Affected species are included in the RA Red Book, notably White-throated Robin, Ruddy Shelduck and Eastern Rock Nuthatch. Construction of an earth bank where the conveyor belt and road(s) are closest to the gulley might reduce visual and noise disturbance and could be feasible, e.g. with earth from local road construction. Monitoring is needed and if breeding success is adversely affected, targeted conservation measures will be identified for these species to be implemented in the adjacent proposed Jermuk National Park in addition to planned measures to offset impacts on natural habitat, which are expected to have some benefit for birds in the long term due to protection conferred by the new National Park.

There are a number of actions that could be taken with respect to Project operations that might further reduce the risk of impacts to breeding birds in general. These include temporal constraints on import of materials and on construction activity during the early spring breeding season; and the planting of woodland - as is being considered in relation to landscape and visual impacts (see Section 6.5) - with native species and in suitable locations. At the moment these are presented as benefits for consideration, rather than required

mitigation measures, but they may become more important depending on the results of the monitoring that will be ongoing during Project execution.

#### ***Mitigation for impacts on migratory birds***

Loud noise, lighting and disturbance may affect migratory raptors particularly in spring and autumn. As far as possible, Project activities will be planned to minimise disturbance during these periods. If possible, materials, components and machinery will be imported to the site for construction during the summer when the majority of migrating birds have passed through the area. Measures listed in Table 6.11.9 include use of minimum lighting and downward-directed lights to minimise light disturbance effects on birds (and bats).

Migrating raptors and other birds are at risk from collision with above-ground electricity cables, particularly those flying at night, early dawn or dusk. This includes several species of conservation concern and also species listed in the RA Red Book. New above-ground power lines will therefore be insulated and fitted with bird flight diverters to reduce collision risk.

The project will aim to support and promote, where possible, traditional grazing management practices (e.g. by minimising access restrictions for herders), because of their role in maintaining small mammals and other prey on which raptors feed.

Given the uncertainty of the effectiveness of the above measures, impacts on numbers and behaviour of migratory raptors will be monitored throughout Project execution. Based on the monitoring results, further measures may be deemed necessary, for example restoring small mammal populations for birds of prey. Residual impacts may only be detected in the longer term and it may be that positive conservation measures are needed to compensate for reduced habitat extent and quality in the longer term, for example by boosting food supplies or improving protection from hunting in Gorayk or Jermuk IBAs.

#### ***Mitigation for impacts on Brown Bear***

The set-aside shown in Figure 6.11.1 will protect some confirmed breeding and hibernating habitat of Brown Bear, but was largely designed to preserve a viable part of the *Potentilla porphyrantha* population. Surveys in 2015 confirmed the importance of the woodland north of Saravan, situated 1.5 km east of the HLF. This was used by at least 6 bears. Extending the Set-aside westwards to include this forest would make it more ecologically viable and suitable for bears. This possibility will be discussed when the boundary of the Set-aside and its



proposed management are formalised with stakeholders in 2016. Many of the general mitigation measures listed in Table 6.11.9 should be effective in minimising impacts on the species. However, as described in Section 6.11.5, Brown Bear is a critical habitat trigger species for PR6, and the Project needs to demonstrate that (i) the ecological functionality of breeding sites and resting places for Brown Bear are not damaged or destroyed; and (ii) that the Project will not result in disturbances that affect the species' survival or breeding success, or reduce its area of occupancy. Based on the extensive survey carried out in 2015 it is known that mining activities could displace an established breeding group of up to 10 individuals, including those using the woodland described above.

Particular concerns are barrier effects from mine infrastructure, footprint of infrastructure on feeding habitat and reduced availability of undisturbed breeding habitat. The possibility of designing crossings for the conveyor, fencing and other linear infrastructure is being reviewed as a means of maintaining mobility for Brown Bear (and other mammals such as Wolf). Measures to enhance food supply for Brown Bear might be needed due to loss of feeding habitat, and will be developed if monitoring suggests a decline in population. Residual impacts are considered to be likely due to scale of the Project and the level of associated noise, disturbance and habitat fragmentation. Therefore, some form of offset is likely to be necessary. Brown bear is associated with natural habitat and therefore the proposed natural habitat offset will also include measures to offset impacts on brown bear.

### ***Bezoar Goat***

Bezoar Goat also uses the area identified as a set-aside and will be exposed to disturbance during operation. Given the importance of the species, routine monitoring will be undertaken during Project execution within the set-aside.

### ***Eurasian Lynx***

Eurasian Lynx uses the area identified as a set-aside and will be exposed to barrier effects and loss of undisturbed hunting habitat. Due to its conservation importance at an EU level it will be monitored within the set-aside. Specific conservation measures may be developed in the proposed Jermuk National Park as part of the Natural Habitat Offset if it is displaced from the set-aside, but it will benefit from protection within the proposed Park if effective controls on hunting can be developed.



### ***Dorcadion beetles***

These are not considered likely to be affected and no specific mitigation measures are needed.

### ***Radde's/ Armenian Rock Viper, Armenian Mountain-Steppe Viper and Cat Snake***

Mitigation for impacts on these reptile species should focus on minimising the extent of habitat destruction (including gravel roads etc.), particularly where infrastructure is proposed in meadow steppe habitat. Reptile diversity is greatest on the stony slopes and rocky outcrops to the north and west edge of the proposed HLF area (see Figure 4 of Appendix 4.10.10). The best way to limit impacts on reptiles would be to safeguard as much of this habitat as possible by keeping the size of the heap leach infrastructure to a minimum and controlling incidental habitat damage outside the proposed footprint. Residual impacts are likely and can be offset through protection of reptiles and their habitats within the proposed Jermuk National Park, together with local awareness-raising about conservation importance to reduce levels of deliberate killing of snakes. Monitoring will be needed due to Red List status.

**Table 6.11.11: Mitigation Measures for Impacts on Priority Biodiversity Receptors**

Priority receptors	Avoid	Reduce or minimise	Restore	Residual impact/ requirement to offset
<b>Plant species and vegetation</b>				
Natural habitat, including:				
<ul style="list-style-type: none"> <li>Species-rich Sub-alpine Meadows and Sub-alpine Meadows with Alpine Elements</li> </ul>	Footprint on these vegetation types is not possible to avoid as they are within the mine footprint.	Measures to control use of vehicles on undamaged vegetation are already in place.  Measures to control soil erosion and impacts of wash-out on remaining vegetation.	A programme is being developed to restore vegetation using a variety of methods including harvesting of seed and turves and reinstatement of suitable substrates for seeding/ turf replacement. Field trials are underway to clarify the ecological basis for restoration and monitoring of restoration success. A seed storage facility will be established so that seed can be harvested and retained for future use. Re-seeding will always be with a species mix suitable to the location of the area to be restored. All re-vegetation carried out will be monitored to avoid introduction or spread of invasive alien species.	An offset of 837 Habitat Impact Units (HIU) is required to achieve>NNL of natural vegetation due to long term degradation and loss associated with Project development. The Project has chosen to take a conservative approach to estimation of impacts due to the importance of natural vegetation and the fact that restoration success cannot be guaranteed. It is planned that the offset will be established in the proposed Jermuk National Park and Lydian will engage with national and local government and NGOs on its set-up, and will establish an endowment or similar mechanism to ensure financial support for the offset.
<ul style="list-style-type: none"> <li>Vegetation with Shrubs, particularly Juniper scrub vegetation</li> </ul>	Footprint on this vegetation type is not possible to avoid as fragments occur within the HLF footprint. Translocation of some bushes will be attempted but success is uncertain.			
<ul style="list-style-type: none"> <li>Other natural and semi-natural vegetation types: Montane Meadows, Montane Meadow Steppes, Wetlands, Gorge</li> </ul>	Set-aside preserves some undamaged natural vegetation. HLF avoids natural vegetation. Topsoil storage locations will be chosen to avoid “good” examples of natural vegetation types as well as rocks supporting <i>Potentilla porphyrantha</i> (see below).			
<ul style="list-style-type: none"> <li>22 endemic plant species</li> </ul>	Important examples or habitat have been and will continue to be avoided when possible. Locally rare species (e.g. <i>Fritillaria armena</i> ) that would otherwise be destroyed will be translocated out of the disturbed area.	No specific measures needed.	No specific measures needed.	These species will benefit from the planned offset referred to above.

**Table 6.11.11: Mitigation Measures for Impacts on Priority Biodiversity Receptors**

Priority receptors	Avoid	Reduce or minimise	Restore	Residual impact/ requirement to offset
Amulsar sub-population of <i>Potentilla porphyrantha</i> (Tier 1 critical habitat - IFC PS6)	<p>A proportion of the Amulsar population is avoided through a set-aside south of Arshak Peak.</p> <p>Roads have been located to avoid high-density concentrations of plants.</p> <p>Plants within the mine pits have been translocated to suitable research and propagation facilities.</p>	<p>Locations of plants are recorded and fencing and signs used to safeguard them for as long as possible. Measures are being taken to avoid incidental damage.</p>	<p>A research programme has been established to test techniques for propagating plants and to improve knowledge of requirements. This will provide the basis for restoring plants to suitable habitat on mine closure if suitable conditions can be created.</p>	<p>There will be a residual impact on the population in the shorter term with 33% of plants lost from the sub-population on Amulsar Mountain. The sub-population should remain viable despite this reduced population size, but a precautionary approach is being taken. If research, monitoring and modeling suggest that pre-mining population size and the extent of the population cannot be restored, a comprehensive review of offsetting options will be undertaken.</p>
<b>Birds</b>				
Egyptian Vulture	<p>Essential habitat is avoided. Footprint on Gorayk IBA for which this is a designated species is avoided. There is no footprint in Arpa Gorge near where one pair nests.</p>	<p>No specific measures needed</p>	<p>No specific measures needed.</p>	<p>Residual impact is unlikely but monitoring will be carried out due to the Endangered status of the bird and the proximity of the Project. If monitoring suggests that the species is being affected then appropriate mitigation will be considered, e.g. use of a vulture restaurant to ensure that food supplies are maintained.</p>
Saker Falcon	<p>No specific measures needed.</p>	<p>No specific measures needed.</p>	<p>No specific measures needed.</p>	<p>Residual impact is unlikely, but monitoring will be carried out due to its Endangered status.</p>

**Table 6.11.11: Mitigation Measures for Impacts on Priority Biodiversity Receptors**

Priority receptors	Avoid	Reduce or minimise	Restore	Residual impact/ requirement to offset
Lesser Kestrel	No specific measures needed.	No specific measures needed.	No specific measures needed.	Monitoring of the breeding colonies will be continued, with a focus on the extended colony at Sisian which is not currently monitored by ASPB. Mitigation will be implemented if any decline in breeding success is noted and considered to be linked to food supply or disturbance due to the Project.
Other species included in RA Red Book and which breed in the Project-affected area	Conveyor routing was altered to avoid crossing the rocky gorge near the HLF (favoured by Ruddy Shelduck, White-throated Robin and other birds) but is still in close proximity. A temporal constraint on import of materials and on construction to avoid the breeding season would avoid/minimise impacts in the first year.	Detailed Project design to investigate options for reducing impacts on breeding birds in the gorge east of Gndevaz where the conveyor and access roads are nearby, possibly by constructing an earth bund to screen them from noise and visual disturbance.	Some woodland planting with native species in suitable locations would benefit certain species of this group (though not Ruddy Shelduck or White-throated Robin). Distribution of breeding birds and signs of breeding activity will be monitored.	There could be a residual impact on Ruddy Shelduck, White-throated Robin and other birds breeding in the Project-affected area. Measures to offset impacts on natural and critical habitat will benefit breeding bird populations and offset proposals will include any interventions needed to ensure net gain of their populations. In particular, breeding birds would benefit from a community-based conservation project focused on Gorayk IBA and/or the proposed new Jermuk National Park.

**Table 6.11.11: Mitigation Measures for Impacts on Priority Biodiversity Receptors**

Priority receptors	Avoid	Reduce or minimise	Restore	Residual impact/ requirement to offset
Migratory birds including raptors	Impacts cannot be entirely avoided. If possible, significant activity in spring and autumn will be avoided, including import of construction equipment and materials through the Vorotan Valley.	New, above-ground electricity cables will be insulated and fitted with bird flight diverters. General measures to minimise project footprint will also minimise loss of feeding area. The project will aim to support and promote, where possible, traditional grazing management practices (e.g. by minimising access restrictions for herders), because of their role in maintaining small mammals and other prey on which raptors feed.	Based on monitoring results, future measures may be needed to restore small mammal populations for birds of prey.	Residual impacts may be detected in the longer term and monitoring is necessary. Positive conservation measures may be needed to compensate for reduced habitat extent and quality in the longer term, for example by boosting food supplies or improving protection from hunting in Gorayk or Jermuk IBAs
<b>Mammals</b>				
<i>Ursus arctos</i> Brown Bear (critical habitat - EBRD PR6)	Set-Aside south of Arshak protects one known breeding location and if extended further west, it would protect two.	Measures to limit noise will benefit bears at dawn and dusk. Conveyor, other linear infrastructure and fencing will be designed	Measures to enhance food supply might be needed due to loss of feeding habitat or of access to suitable areas because of barriers. These measures will be developed if monitoring suggests decline in population.	Residual impacts likely due to scale of the Project and the level of associated noise and disturbance, and habitat fragmentation caused by barriers. At present, compliance with PR6 in terms of the Project not affecting the ecological

**Table 6.11.11: Mitigation Measures for Impacts on Priority Biodiversity Receptors**

Table 6.11.11: Mitigation Measures for Impacts on Priority Biodiversity Receptors				
Priority receptors	Avoid	Reduce or minimise	Restore	Residual impact/ requirement to offset
		to maintain mobility for Brown Bear, including installation of crossings.		functionality of breeding sites and resting places, or the species' survival, breeding success or area of occupancy is proposed to be achieved through a set-aside, combined with offsets associated with natural habitat restoration in the proposed Jermuk National Park. Final analysis of data from 2015 is needed to quantify the gains needed, based on estimates of population size.
Eurasian Lynx	Observed and avoided within set-aside.	No specific measures needed.	No specific measures needed.	Monitoring will be undertaken and this species should benefit from the Natural Habitat Offset in the new Jermuk National Park.
Bezoar Goat	Observed and avoided within set-aside.	No specific measures needed.	No specific measures needed.	Monitoring will be undertaken and this species should benefit from the Natural Habitat Offset in the new Jermuk National Park.
Invertebrates				
Dorcadion Beetles ( <i>Dorcadion sevangense</i> , <i>D. sisianum</i> Lazar and <i>D. bistriatum</i> )	No specific measures are considered necessary at present, because these species were not observed within the Project footprint.			No residual impact is expected on the basis of current information.
Reptiles				
Radde’s/ Armenian Rock Viper <i>Montivipera (Vipera) radeii</i> , Armenian Mountain-	All three species are present in the HLF area. The small gorge between this area and Gndevaz village is important for them as	Minimise footprint and incidental damage in HLF location, particularly stony slopes and rocky	Based on monitoring results, future measures may be needed to restore suitable habitat for reptiles. Possible restoration measures could include	The residual impact on regional numbers of these three species is expected to be small since ample habitat is present outside of the Project-affected area. In

**Table 6.11.11: Mitigation Measures for Impacts on Priority Biodiversity Receptors**

Priority receptors	Avoid	Reduce or minimise	Restore	Residual impact/ requirement to offset
Steppe Viper <i>Pelias</i> ( <i>Vipera</i> ) <i>eriwanensis</i> and Cat Snake <i>Telescopus fallax</i>	well as breeding birds and is no longer crossed by the Conveyor, but will be exposed to disturbance. Speed of vehicles should be severely limited to avoid roadkills.	areas. Conduct awareness-raising about conservation importance through education to reduce levels of deliberate killing of snakes and reduce this threat to local numbers.	prescribed fire, mowing, grazing and forest thinning in certain areas post mining.	the longer term, residual impacts may be detected through monitoring. Positive conservation measures may be needed to compensate for reduced habitat extent and quality in the longer term and to this purpose restoration measures could be undertaken within the proposed Jermuk National Park.

**Table 6.11.12: Mitigation Measures for Impacts on Biodiversity which is Widespread, With Resilient Populations**

Receptor	Implications of the Project	Mitigation
<b>Vegetation and plant species</b>	Induced impacts might include an increased level of harvesting of species used for herbs, vegetables and medicines, possibly causing declines in populations of targeted species. However species in this category are generally able to regenerate well and are sufficiently widespread for populations to recover.	No specific mitigation is required.
<b>Birds</b>	The land use changes and disturbance associated with the Project will affect a variety of bird species but most will be able to relocate to alternative areas as they are relatively mobile and adaptable.	As noted in Table 6.11.10, certain priority bird species will be monitored. The monitoring programme will be extended to include other representative species in order to determine whether there are any unforeseen impacts on birds, particularly in the long term.
<b>Mammals (including bats)</b>	Mammals in general will be affected by loss of habitat, land use change, barrier effects, habitat fragmentation and disturbance. Some local population declines may occur, but populations are considered sufficiently resilient for populations to recover spontaneously. Bat species are thought to have resilient populations, with abundant feeding habitat available regardless of the presence of the Project.	No specific mitigation is required. Barrier effects should be reduced by the measures proposed for Brown Bear.
<b>Invertebrates (terrestrial and aquatic)</b>	The areas considered to be most important for invertebrates have generally been found outside the Project-affected area. The Project could exacerbate existing baseline impacts on water quality by removing vegetation from large areas, mobilizing sediment and fugitive dust, which could be deposited on surface water bodies.	No specific mitigation required. However, annual monitoring of surface water quality using aquatic invertebrate indicators will be continued.
<b>Reptiles and amphibians</b>	The main threat to reptiles in the baseline situation is considered to be decline in biomass of prey animals due to deterioration in the quality of grassland. The Project will cause a decline in overall availability of reptile habitat during operation. It will also remove some wetland habitat that supports abundant amphibian populations. Pollution of wetlands and watercourses could also depress populations of amphibians. However, amphibians potentially affected by the Project are generally relatively widespread.	No specific mitigation required, unless surface water quality monitoring programme indicates deterioration, in which case amphibian survey will be undertaken.



**Table 6.11.12: Mitigation Measures for Impacts on Biodiversity which is Widespread, With Resilient Populations**

Receptor	Implications of the Project	Mitigation
<b>Fish</b>	The Project could affect fish populations in the Vorotan and Arpa Rivers. Fish populations in the baseline situation are lower than they should be due to presence of artificial barriers in watercourses, including development of hydro-electric schemes. There are no fish passes, for example allowing access upriver for fish from Spandaryan Reservoir and this is constraining populations. The Project's Water Balance Model suggests that impacts on flow will be negligible even during low flow periods and stringent measures are proposed to avoid pollution.	No specific mitigation required unless the Project results in significantly lower flows in the river than has been predicted, or in case of a release of pollutants to surface water, in which case fish surveys may be required.

**Table 6.11.13: Mitigation Measures for Impacts on Protected Areas and Other Areas Important for Biodiversity**

Site or Area	Summary of implications of the Project and mitigation measures
Caucasus Biodiversity Hotspot (Conservation International)	Project does not affect a significant proportion of the hotspot or the species targeted for conservation within it; no mitigation necessary.
Caucasus Mixed Forest Ecoregion	Very small, degraded fragments of shrubby vegetation occur in the HLF location between cultivated areas supporting Caucasian endemic species of plant (e.g. <i>Phelypaea tournefortii</i> ) and slow growing mature shrubs (e.g. <i>Juniperus polycarpu</i> ). These are not high quality examples in the context of the Ecoregion as a whole, but the Project has been designed to avoid remaining individual shrubs and the very small number affected will be translocated.
State Sanctuaries (Jermuk Forest, Herher Open Woodland and Jermuk Hydrological)	Not exposed to impacts; no mitigation required.
Sevan National Park	Not exposed to impacts; no mitigation required.
Proposed Jermuk National Park	The Project has identified opportunities to offset some of its impacts on biodiversity in general and on natural habitat in particular as part of a National Park Proposal and management plan. This would improve regional conservation and nature protection significantly.
Jermuk IBA Key Biodiversity Area identified using recognized selection criteria	The Project will not have a direct impact on the IBA. Measures to mitigate impacts on species originating from the IBA that use the Project-affected area are included in Table 6.11.11. Establishment of Jermuk National Park would benefit these species. No further mitigation measures are necessary.
Go-rayk IBA Key Biodiversity Area identified using recognized selection criteria	The Project will not have a direct impact on the IBA. Measures to mitigate impacts on species originating from the IBA that use the Project-affected area - particularly Lesser Kestrel - are included in Table 6.11.11. No further mitigation measures are necessary.

#### **6.11.7 Summary and Conclusions**

The impact assessment process has identified a number of priority biodiversity receptors that will be affected by the Project. The mitigation hierarchy has been employed to avoid, reduce, and restore those impacts to the extent possible, prior to considering offsetting for significant residual impacts. Lydian aims for no net loss (NNL) of biodiversity for the Project, and is also committed to NNL of natural habitat as defined by PS6 and PR6, and a net gain for critical habitat trigger species.

The following summarises the main outcomes of the assessment process. A summary of impacts, mitigation measures and residual impacts is shown in Table 6.11.14. All commitments to mitigation measures are reflected in the Project Commitments Register and in the Biodiversity Action Plan (see Chapter 8).

- The Project is located in a region characterised by extensive natural habitat (as per the definition of PS6/PR6) and will result in both losses of, and degradation to, such habitat. Avoidance and mitigation measures will be employed to the extent possible, and a research programme will be implemented to prepare for restoration post-mining. In addition, a set-aside has been established. Nevertheless, the project will also take the precautionary approach of establishing an offset to compensate for its direct impacts on natural habitat. This will be undertaken in conjunction with planning for the proposed Jermuk National Park, which is already underway.
- The mine pits will affect Tier 1 critical habitat for the endemic plant *Potentilla porphyrantha*. Residual impacts will occur at least in the short term. However, efforts will be made to ensure that a viable population remains, or will be restorable in the longer term. An extensive programme of research (using plants translocated from the mine area) is underway to explore propagation techniques. If the results of this work cast doubts on the ability to achieve net gain for the species post-mining, then an offset will be designed and implemented.
- The Project affects critical habitat for Brown Bear. Surveys in 2015 confirmed the presence on Amulsar of regularly used breeding habitat, and potential impacts of the Project could affect up to 10 bears (mother, young of different ages and visiting males). The planned set-aside will avoid impacts on the area where one breeding den is located. The set-aside could be extended, following discussion and formalisation with stakeholders, to incorporate a second den in woodland north of Saravan. Measures such as wildlife crossings will be built into the design of the conveyor and access routes to minimise barrier effects. Construction works will also be phased, to

the extent possible, to avoid the early spring when mother and cubs would emerge from the hibernating/breeding den. Nevertheless, residual impacts are considered highly likely due to high levels of disturbance when operation starts and the bears may be displaced. Surveys in the wider area confirmed the likely suitability of the proposed Jermuk National Park for conserving and restoring breeding and feeding habitat for Brown Bear. Offset activities for impacts on Brown Bear will be built into the National Park Management Plan, but the precise requirement cannot be quantified until final analysis of survey data has taken place.

- The Project area provides foraging and hunting habitat for breeding and migratory birds (especially raptors), some of which are listed as Endangered at the national and/or international level. Although the Project is not expected to impact significantly on these species, options to reduce impact will be sought during detailed Project design and monitoring will be undertaken throughout the Project lifetime in order to detect any unexpected impacts and to allow appropriate actions to be taken.
- The Project area, especially the HLF, offers important habitat for reptiles, including three species that are listed as Vulnerable at the national and/or international level. Although the Project is not expected to impact significantly on these species since plenty of suitable habitat is also present outside of the Project area, options to reduce impact will be sought during detailed Project design and monitoring will be undertaken throughout the Project lifetime in order to detect any unexpected impacts and to allow appropriate actions to be taken.

The necessary actions arising from this ESIA are developed in the Project Biodiversity Action Plan (BAP) and Biodiversity Management Plan (BMP). The BAP is focused on actions required to address Project lender requirements and includes:

- Species Action Plans (SAPs) - these have been produced for the two critical habitat species affected by the Project, *Potentilla porphyrantha* and *Ursus arctos* (Brown Bear), for which final analysis of survey data is needed before the Project mitigation strategy can be finalised.
- Biodiversity Offset Strategy (BOS) - this describes the Project's approach to offsetting and details the additional survey work to be undertaken to enable design of the offset to achieve NNL of natural habitat. The document will be developed and enhanced as the additional research work proceeds, and eventually it will evolve into a Biodiversity Offset Management Plan (BOMP).

The BMP describes the biodiversity-related actions to be undertaken as part of the design, construction, operation and decommissioning of Project infrastructure. It is a site-orientated document that details the practical actions to be undertaken during the implementation of the Project, along with responsibilities, timeframes and monitoring requirements. The BMP is implemented as part of the Project ESMP, which is discussed in Chapter 8.

In addition to the above, a Biodiversity Monitoring and Evaluation Programme (BMEP) will be developed for implementation in parallel with Project execution, with the aim of demonstrating that the Project's commitments as outlined in this ESIA and associated documents are met. This includes the commitments to>NNL in natural habitat and net gain in critical habitat, for which monitoring of the priority biodiversity identified in this ESIA will be required, including natural and critical habitat (and critical habitat trigger species) both on the Project site and in offset location(s). The BMEP will also aim to confirm the ESIA's predictions that certain species will not be significantly affected by the Project, which will involve monitoring a representative selection of breeding bird species, mammals, invertebrates, and reptiles (as identified in the ESIA). This will enable the detection of any unanticipated exposure to impacts as the Project progresses.

The BMEP will be developed during the pre-construction phase as the further research referred to above progresses.

Lydian is considering the establishment of an independent biodiversity advisory group and will work with Project lenders to develop possible terms of reference.

<b>Table 6.11.14: Summary of Impacts on Biodiversity, Planned Mitigation and Residual Impact Significance</b>					
<b>Receptor</b>	<b>Impacts to which receptor is exposed</b>	<b>Ecological implications</b>	<b>Significance pre-mitigation*</b>	<b>Specific mitigation</b>	<b>Residual significance*</b>
<b><i>Protected Areas and other Key Biodiversity Areas</i></b>					
Caucasus Biodiversity Hotspot (Conservation International)	Impact due to presence of Project as a whole.	Loss / degradation of natural habitat.	Project does not affect a significant proportion of the hotspot or the species targeted for conservation within it.	No specific mitigation necessary.	Overall strategy of NNL should mean hotspot is not compromised.
Caucasus Mixed Forest Ecoregion	No direct impacts on any features of importance. Possible indirect effects due to concentration of grazing and other activities outside Project area.	Very small, degraded fragments of shrubby vegetation supporting Caucasian endemics occur in the HLF location, but these are not high quality examples in the context of the Ecoregion as a whole.	Very limited exposure to impacts.	The Project has been designed to avoid remaining individual shrubs and the very small number affected will be translocated.	Offset for natural habitat in proposed Jermuk National Park will benefit Juniper scrub.
State Sanctuaries (Jermuk Forest, Herher Open Woodland and Jermuk Hydrological)	No direct impacts on any features of importance.	Not exposed to impacts.	Not significant.	No mitigation required.	Not significant.
Sevan National Park	No direct impacts on any features of importance.	Not exposed to impacts	Not significant.	No mitigation required.	Not significant.

**Table 6.11.14: Summary of Impacts on Biodiversity, Planned Mitigation and Residual Impact Significance**

Receptor	Impacts to which receptor is exposed	Ecological implications	Significance pre-mitigation*	Specific mitigation	Residual significance*
Proposed Jermuk National Park	No direct impacts on any features of importance.	Not exposed to impacts	Not significant.	The Project is planning to establish a natural habitat offset in the National Park, which should improve regional conservation and nature protection.	Positive impact.
Jermuk IBA	Potential indirect effect due to loss of feeding area for resident species.	Project-affected area provides foraging habitat for some birds which breed in the IBA.	Affected birds range over wide areas to search for food. Surveys suggest key species use Project area for <20% of foraging time.	No further mitigation measures are necessary.	Not significant.
Gorayk IBA Key Biodiversity Area identified using recognized selection criteria	Project footprint (HLF) was relocated out of IBA. Potential indirect effect due to loss of supporting habitat for birds.	Potential loss of preferred hunting areas for Lesser Kestrel and undisturbed feeding areas.	See below for individual consideration of Lesser Kestrel.	No further mitigation measures are necessary.	Not significant.
<b>Plant species and vegetation</b>					
Species-rich Sub-alpine Meadows and Sub-alpine Meadows with Alpine Elements	A large part of the Project footprint, including the open pits, is on these vegetation types and cannot be avoided.	Loss and degradation of natural vegetation.	These vegetation types are extensive in the region, but their condition is declining and these types are under-protected in Armenia	Arshak set-aside will preserve some undamaged natural vegetation including an area of species-rich Sub-alpine Meadow with Alpine Elements. Where possible infrastructure will be located to avoid “good” examples of	NNL of natural habitat, assuming offset successful.

**Table 6.11.14: Summary of Impacts on Biodiversity, Planned Mitigation and Residual Impact Significance**

Receptor	Impacts to which receptor is exposed	Ecological implications	Significance pre-mitigation*	Specific mitigation	Residual significance*
Vegetation with Shrubs, particularly Juniper scrub vegetation	Fragments of juniper scrub occur in the HLF location and conveyor corridor.	Loss and degradation of natural vegetation.	This type is rare on Amulsar Mountain but more common in Jermuk IBA where grazing is at low intensity.	natural vegetation types and particularly rocks supporting <i>Potentilla porphyrantha</i> . Translocation of Juniper bushes is to be attempted.	
Other natural and semi-natural vegetation types: Montane Meadows, Montane Meadow Steppes, Wetlands	BRSF and haul & access roads.	Loss and degradation of natural vegetation.	Project exacerbates regional decline in extent and quality of natural habitat, as well as potentially affecting the viability of land use traditions.	It is planned to restore all impacted areas post-mining. A supporting programme of research is underway.  A natural habitat offset will be established in the proposed Jermuk National Park to compensate for loss and degradation of natural vegetation due to the Project footprint and adjacent buffer and restricted zones.	
22 endemic plant species	Some avoidance or translocation is possible (e.g. <i>Fritillaria armena</i> ) but not in all cases.	Loss and disturbance.	All are widespread throughout the wider Project-affected area apart from <i>Potentilla porphyrantha</i> (addressed separately below)		



**Table 6.11.14: Summary of Impacts on Biodiversity, Planned Mitigation and Residual Impact Significance**

Receptor	Impacts to which receptor is exposed	Ecological implications	Significance pre-mitigation*	Specific mitigation	Residual significance*
Amulsar sub-population of <i>Potentilla porphyrantha</i> (Tier 1 critical habitat - IFC PS6)	A large part of the Project footprint, including the open pits, is on critical habitat for <i>Potentilla porphyrantha</i> .	Between 21% and 33% of the population at Amulsar will be lost. Other plants could be damaged due to infrastructure (roads or tracks), deposition of fugitive dust, or localized changes in microclimate that might affect availability of water.	The Amulsar sub-population is one of only three in Armenia and five known in the world.	Arshak set-aside preserves a proportion of the population. Efforts have been made to locate infrastructure to avoid the species. Plants within the mine pits have been translocated to suitable research and propagation facilities. A significant research programme has been established to determine optimum restoration conditions and allow plants to be restored and numbers increased post-mining. The residual population is predicted to remain viable albeit with reduced numbers. Net gain will be achieved through an offset if restoration is not successful.	Net gain in numbers to be achieved within a reasonable timeframe, currently estimated at 20 years, if restoration techniques successful. Offset options will be reviewed if necessary.
Other vegetation and plant species considered resilient and widespread	Loss and disturbance.	Induced impacts might include increased harvesting of herbs, vegetables and medicinal plants.	Species in this category are generally able to regenerate well and are sufficiently widespread for populations to recover.	No further mitigation measures are necessary.	Not significant.

**Table 6.11.14: Summary of Impacts on Biodiversity, Planned Mitigation and Residual Impact Significance**

Receptor	Impacts to which receptor is exposed	Ecological implications	Significance pre-mitigation*	Specific mitigation	Residual significance*
<b>Birds</b>					
Egyptian Vulture	The breeding site in Jermuk Gorge will not be exposed to any impacts as a result of the Project, but HLF is an occasional feeding area.	Feeding of the breeding pair could be affected, and exposure to poisoning is possible.	Results of monitoring suggest the breeding pair use the Project-affected area for a very small proportion of their feeding time.	No specific mitigation necessary. Precautionary monitoring will be carried out due to its Endangered status.	Not significant.
Saker Falcon	Loss off feeding habitat over the Project area in general.	Feeding of the small number of individuals considered potentially resident may be affected.	Low frequency of occurrence and lack of confirmed breeding activity in Project-affected area.	No specific mitigation necessary. Precautionary monitoring will be carried out due to its Endangered status.	Not significant.
Lesser Kestrel	Loss of feeding habitat over Project area in general.	Preferential hunting area could deteriorate due to dust deposition, suppressing vegetation.	Neutral to moderate	No specific mitigation necessary. However, monitoring of the breeding colony will be continued and mitigation will be implemented if adverse impacts are observed.	Moderate risk assumed until monitoring confirms otherwise

**Table 6.11.14: Summary of Impacts on Biodiversity, Planned Mitigation and Residual Impact Significance**

Receptor	Impacts to which receptor is exposed	Ecological implications	Significance pre-mitigation*	Specific mitigation	Residual significance*
Other species included in RA Red Book and which breed in the Project-affected area	Presence of Project in general, but particularly conveyor, service road, mine access road and HLF.	High quality bird habitat occurs in a rocky gorge north of the HLF; presence of the conveyor and mine road may affect breeding birds.	Significant due to presence of RA Red Book species breeding in the rocky gorge east of the HLF	Options for reducing impact to be investigated during detailed Project design. Distribution and signs of breeding will be monitored. Establishment of offset for natural habitat will benefit these species.	Moderate risk assumed unless design is modified or until monitoring confirms otherwise
Migratory birds, especially raptors	Loss off feeding habitat over the Project area in general, and HLF and BRSF in particular. Risk of collision with power lines.	Loss of habitat might reduce small mammal populations and food availability. Lighting and overhead power lines could be a cause of mortality through collisions.	Extensive alternative feeding habitat is available in theory, so only a small proportion of available feeding habitat will be exposed to impacts from the Project.	New power lines will be insulated and have bird flight diverters fitted. The project will aim to support and promote, where possible, traditional grazing management practices because of their role in maintaining small mammals and other prey. Precautionary monitoring will be undertaken.	Not significant.

**Table 6.11.14: Summary of Impacts on Biodiversity, Planned Mitigation and Residual Impact Significance**

Receptor	Impacts to which receptor is exposed	Ecological implications	Significance pre-mitigation*	Specific mitigation	Residual significance*
Other birds considered resilient and widespread	General land use changes and disturbance.	Loss of breeding and feeding habitat.	Most will be able to relocate to alternative areas as they are relatively mobile and adaptable.	The monitoring programme for priority bird species will be extended to include other representative species in order to detect any unforeseen impacts on birds, particularly in the long term.	Not significant.
<b>Mammals</b>					
<i>Ursus arctos</i> Brown Bear (critical habitat - EBRD PR6)	The open pit footprint is currently used by up to five individuals; the woodland 1.5 km east of HLF is used by at least six.	Loss of feeding area, breeding habitat and food supply. Displacement may place bears at threat of hunting or competition with other bears. Noise, light and presence of people are likely to affect the bears.	Brown Bear is Vulnerable in RA Red Book, threatened throughout region, and a EU Habitats Directive Annex IV species	Arshak set-aside will protect known breeding location. Conveyor and linear infrastructure will be designed to maintain mobility for Brown Bear, including installation of crossings. Detailed analysis of survey data from 2015 will make it possible to quantify impacts and design offsets accordingly.	Moderate risk and residual impacts predicted in the longer term, requiring an offset.




**Table 6.11.14: Summary of Impacts on Biodiversity, Planned Mitigation and Residual Impact Significance**

Receptor	Impacts to which receptor is exposed	Ecological implications	Significance pre-mitigation*	Specific mitigation	Residual significance*
Eurasian Lynx	Infrastructure and operations in open-pit area.	Some disturbance and possible displacement from some habitat.	Important at EU level.	Avoidance of some habitat through Arshak Peak set-aside.	Not significant with National Park in place as level of protection from hunting should improve.
Bezoar Goat	Population centred in Jermuk Gorge not exposed to direct effects. Also observed using the Arshak set-aside.	Some disturbance and possible displacement from some habitat.	Uncertain at population level (no detailed census)	Avoidance of some habitat through Arshak Peak set-aside.	Not significant with National Park in place as level of protection from hunting should improve.
Other mammal species considered widespread and resilient	General presence of Project.	Potential loss of habitat, barrier effects, habitat fragmentation and disturbance.	Some local population declines may occur, but populations are considered sufficiently resilient for populations to recover spontaneously.	None required.	Not significant.
<b>Invertebrates</b>					
Dorcadion Beetles ( <i>Dorcadion sevangense</i> , <i>D. sisianum</i> Lazar and <i>D. bistratum</i> )	Project footprint.	Possible loss and degradation of suitable habitat in some areas.	Not recorded in the Project footprint and not considered likely to be exposed to impacts as a result of the Project.	None required	Not significant.

**Table 6.11.14: Summary of Impacts on Biodiversity, Planned Mitigation and Residual Impact Significance**

Receptor	Impacts to which receptor is exposed	Ecological implications	Significance pre-mitigation*	Specific mitigation	Residual significance*
Other invertebrates (terrestrial and aquatic)	General presence of Project.	The Project could exacerbate existing baseline impacts on water quality by removing vegetation from large areas, mobilizing sediment and fugitive dust, which could be deposited on surface water bodies.	The areas considered to be most important for invertebrates have generally been found outside the Project-affected area.	No specific mitigation required, unless surface water quality monitoring programme indicates deterioration, in which case aquatic invertebrate survey will be undertaken.	Not significant.
<b>Reptiles and amphibians</b>					
Radde's/ Armenian Rock Viper <i>Montivipera (Vipera) radeii</i> , Armenian Mountain-Steppe Viper <i>Pelias (Vipera) eriwanensis</i> and cat snake <i>Telescopus fallax</i>	Project footprint, in particular the HLF location. Also mortality due to being run over by vehicles.	Potential loss of habitat and reduced local population size	HLF is best habitat for reptiles on Amulsar Mountain and has high reptile diversity. Local reductions in population will occur, but these species also occur in the wider landscape.	Minimise footprint at HLF and minimize incidental damage, Monitoring and pre-construction checks needed. Regulate traffic speeds. Otherwise awareness raising to reduce levels of deliberate killing of reptiles.	Not significant.

**Table 6.11.14: Summary of Impacts on Biodiversity, Planned Mitigation and Residual Impact Significance**

Receptor	Impacts to which receptor is exposed	Ecological implications	Significance pre-mitigation*	Specific mitigation	Residual significance*
Other reptiles and amphibians	Project footprint and adjacent affected areas.	Potential decline in prey animals and decline in availability of habitat. Pollution of wetlands and water courses.	Reptiles and amphibians potentially affected by the Project are generally relatively widespread.	No specific mitigation required, unless surface water quality monitoring programme indicates deterioration, in which case amphibian survey will be undertaken.	Not significant.
<b>Fish</b>					
	Withdrawal of water from, and potential pollution of, rivers.	Possible reduction of fish populations in Arpa and Vorotan rivers.	Fish populations in the baseline situation are lower than they should be due to presence of artificial barriers in watercourses. The Project's Water Balance Model suggests that impacts on flow will be negligible even during low flow periods; and stringent measures are in place to avoid pollution.	No specific mitigation required unless the Project results in significantly lower flows in the river than has been predicted, or in case of a release of pollutants to surface water, in which case fish surveys may be required.	Not significant.
* Key to significance rating:					
 Significant					
 Moderate or uncertain					
 Not significant					