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Developing a Biodiversity Action Plan Through an Integrated Phased Approach

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Abstract

The Peru LNG Project is located in the southern region of Peru consists of a natural gas transportation pipeline system that traverses the Andean mountains to a liquefaction plant and marine terminal located on the Pacific coast. The 408 km pipeline traverses many diverse landscapes and ecosystems from the edge of the tropical rainforests to the high peaks of the Andes and finally down to the arid desert coastline. This paper describes the processes taken to develop a Biodiversity Action Plan (BAP), utilizing a phased approach throughout the planning and construction phases of the pipeline and moving forward into operations.

The general objective of the BAP is to provide a comprehensive strategy aimed at protecting biodiversity during the construction and operation of the pipeline. The phased approach considers the various critical phases of a construction project from the early planning stages through assessment, construction, operations, and closure. Undertaking a phased approach to the development of the BAP has enabled this Plan to evolve through the different phases of the project.

Introduction

The Peru LNG liquefied natural gas (LNG) export project includes the construction of a pipeline from the department of Ayacucho to the Pacific coast at Pampa Melchorita, south of Lima. The 408km pipeline traverses the Andes from approximately 2,900 m altitude at Chiquintirca in eastern Ayacucho department, passing over the crest of the Andes at approximately 4,900 m, and then descending to the Pacific coast to the Pampa Melchorita Natural Gas Liquefaction Plant site. This transect passes through three major regional landscapes and 14-finer scale ecological landscape units.

Pipelines are geographically distributed systems crossing a variety of geological environments and are exposed to a diverse range of environmental and social hazards. The pipeline traverses approximately 310 Km of mountainous terrain with numerous river crossings and approximately 98 km of coastal desert plain. These hazards must be characterized for the route selection and design of the project.

A Biodiversity Action Plan (BAP) was developed to provide a comprehensive strategy consisting of specific, implementable actions aimed at the protection and conservation of biodiversity during the construction and operation of the pipeline. This BAP was developed to be consistent with the relevant environmental and social policies of the Project and the Government of Peru. Biodiversity Action Plans are internationally recognized processes that aim to identify and protect threatened species and habitats and protect and restore ecosystems. The original impetus for these plans derives from the 1992 Convention on Biological Diversity (CBD). Guidance on biodiversity action planning has been prepared by the International Petroleum Industry Environmental Conservation Association (IPIECA) and the International Association of Oil and Gas Producers (OGP) through the joint Biodiversity Working Group. This guidance incorporated expertise from the IUCN, Birdlife International, Earthwatch Institute, Conservation International and Wetlands International. The Guidance represents an Industry Best Practice that identifies the principles steps in developing and implementing a BAP as being:

- Deciding if a BAP should be done – understanding legal, biodiversity and business case drivers;
- Completing prerequisites – planning for the integration with site or project management systems and management of resources;
- Preparing the BAP – establishing the priorities for conservation;

- Implementing the BAP – rolling out necessary actions;
- Monitoring, evaluation and improvement – tracking implementation progress and effectiveness; and
- Reporting, communication and verification of performance – upgrading engagement processes and building support with stakeholders and partners.

The guidance and models provided by IPIECA and the OGP provided the starting point for the development of the Peru LNG Project's Biodiversity Action Plan.

Geographical and Biodiversity Setting of the Project Area

As mentioned above, the 408km pipeline traverses three major ecological regions (see Figure 1) with diverse landscapes and ecosystems which can be characterized as follows:

- The Eastern Valleys Region (KP 000 to KP 120+700) consists of a series of subtropical and temperate valleys and mountain ranges characterized by greater rainfall and more extreme topographic relief, with vegetation ranging from upper montane forests to subtropical dry forests, scrublands, and moist grasslands. This region was therefore further broken down into seven distinct Ecological Landscape Units (ELUs).

- The High Andes Region (KP 120+700 to KP 257+600) consists of cold to temperate high ridges, peaks, and plains, with increasing aridity towards the west, and primarily herbaceous vegetation, including many high Andean wetlands (bofedales), grasslands, and scarcely vegetated areas. Snow is frequent in some sectors. This region was broken down into three ELUs.

- The Pacific Watershed Region (KP 257+600 to KP 408+000) contains arid slopes, narrow ridges, sand dune, and coastal plain landscapes with sparse to no vegetation, including scrublands, cactus formations, localized wetlands, degraded riparian vegetation, Tillandsia bromeliad mats, bare ground, and irrigated croplands. The Pacific Watershed Region was broken down into four ELUs.

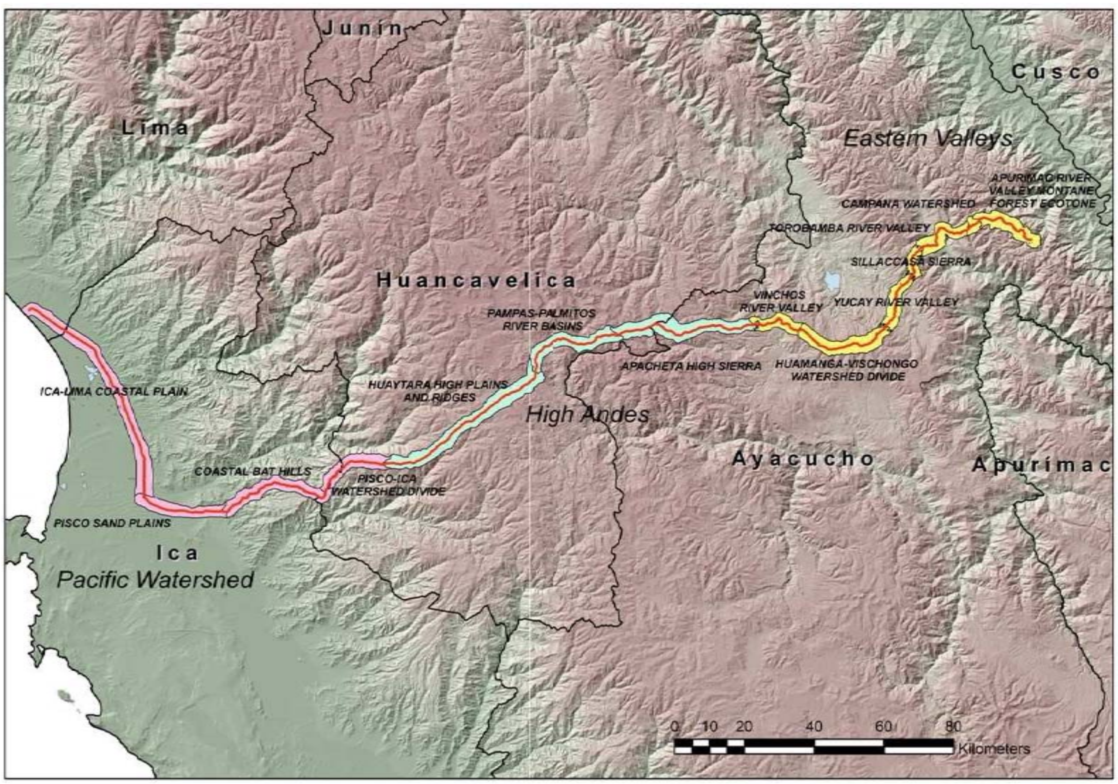

Figure 1: PERU LNG Pipeline Project Ecological Regions.

Given that Conservation International (CI) has defined the Tropical Andes as a Biodiversity Hotspot, the conservation of biodiversity was a priority for the Project from the outset. The Tropical Andes span 1,542,644 km² from western Venezuela to northern Chile and Argentina. They include large portions of Colombia, Ecuador, Peru, and Bolivia. Conservation International also describes the Tropical Andes as the richest and most diverse region on Earth, containing about a sixth of all plant life in less than one percent of the world's land area (CI, 2007 - www.biodiversityhotspots.org). Within the pipeline corridor some of these rich habitats are found, including patches of dry forest, cactus stands, thornscrub, and high Andean wetlands (bofedales). In Peru there are 17,657 ha of bofedales (Ramsar COP9).

The Challenge

Developing an appropriate BAP for the Peru LNG pipeline project was a considerable challenge due to the sheer scale and diversity of the 408 km right of way (RoW). The rugged, remote and mountainous nature of the terrain raised significant constructability issues but also a diverse range of environmental and social constraints and issues requiring effective management. This demanded that the technical, environmental and social aspects of route selection be fully coordinated from the outset and regularly refined during the course of the engineering and construction process. When considering the guidance provided by IPIECA, it was decided that managing biodiversity either through the Environmental and Social Impact Assessment (ESIA) or a stand alone plan would not have been optimal for such a complex project. For this reason, the Project integrated the two approaches proposed by IPIECA; following the completion of the ESIA, further biodiversity assessments were conducted as an interactive process which was closely linked to the micro-routing process. This ensured the biodiversity conservation focused on the avoidance of the most sensitive areas while detailed ecological information was collected to develop and implement a BAP to effectively manage the conservation of biodiversity in and adjacent to the actual project footprint.

Ideally, an ESIA should involve collecting sufficient baseline data to allow for potential impacts to be quantified and the effectiveness of mitigation measures monitored. However, in practice it is often only possible to obtain a snap shot of the conditions, which is a major criticism of many ESIAs. This is especially true in relation to linear projects where the amount of ecological information that could be collected is enormous and it is essential to focus resources on important aspects (*Morris and Therivel, 2004*). The Peru LNG Pipeline ESIA was based on over 128 monitoring sites that were studied during the wet and dry season along a 3 - 7 km wide corridor. The sampling process was based on the best available information about the pipeline route and aimed to identifying valued ecological components (VEC) and potential "hot spot" of ecological value. However, when the pipeline corridor was narrowed down, a significant number of these monitoring points fell out with the final 25 meter RoW. While this approach ensured a good overview of the environmental conditions in the area and associated watersheds, it did not provide sufficient detail for the BAP.

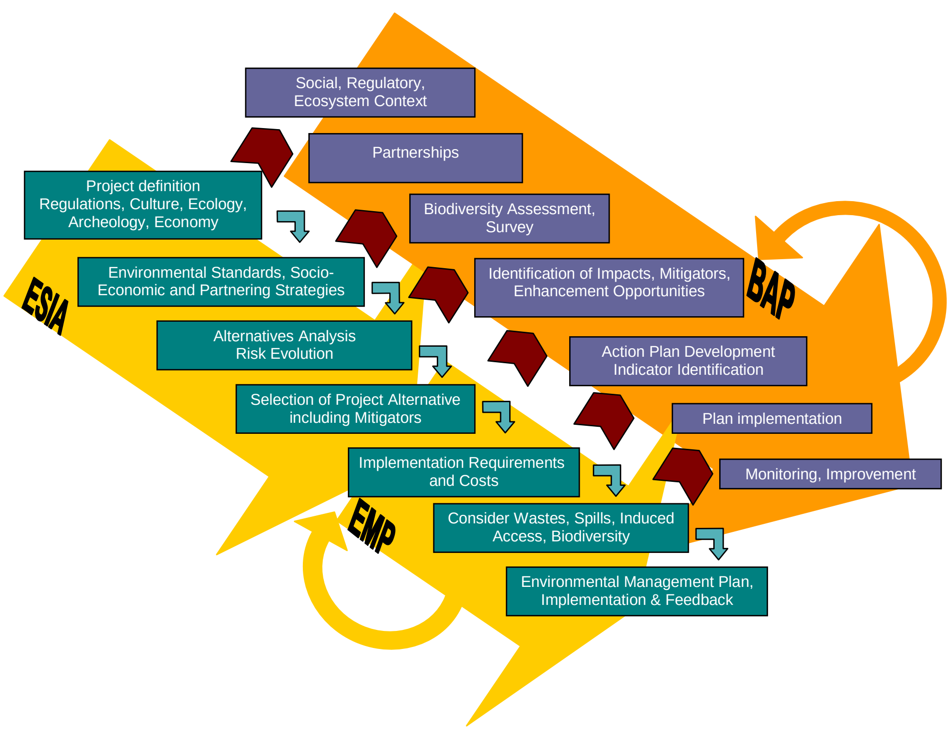

Figure 2: Relationship between a BAP and an ESIA and EMP (IPIECA, 2005)

As a result, the project completed six additional phases of work over and above the normal scope of an ESIA to ensure the BAP addressed all aspects of pipeline design, construction and operation. Tasks 3 to 8 below.

1. Evaluation of Alternative Pipeline Routes
2. Environmental and Social Impact Assessment (ESIA)
3. Ecological Field Survey (EFS)
4. Ecological Management Plan (EMP)
5. Biorestoration Management Plan (BMP)
6. Camelid Management Plan (CMP)
7. Biodiversity Monitoring Program (BMAP)
8. Environmental Investment Program (EIP)

These work phases are not strictly sequential; a number of them are considered part of an iterative, post-approval ESIA process. Others are overlapping or inter-related thus these linkages were recognized to maximize synergies and benefits to the conservation of biodiversity. This is illustrated in Figure 3.

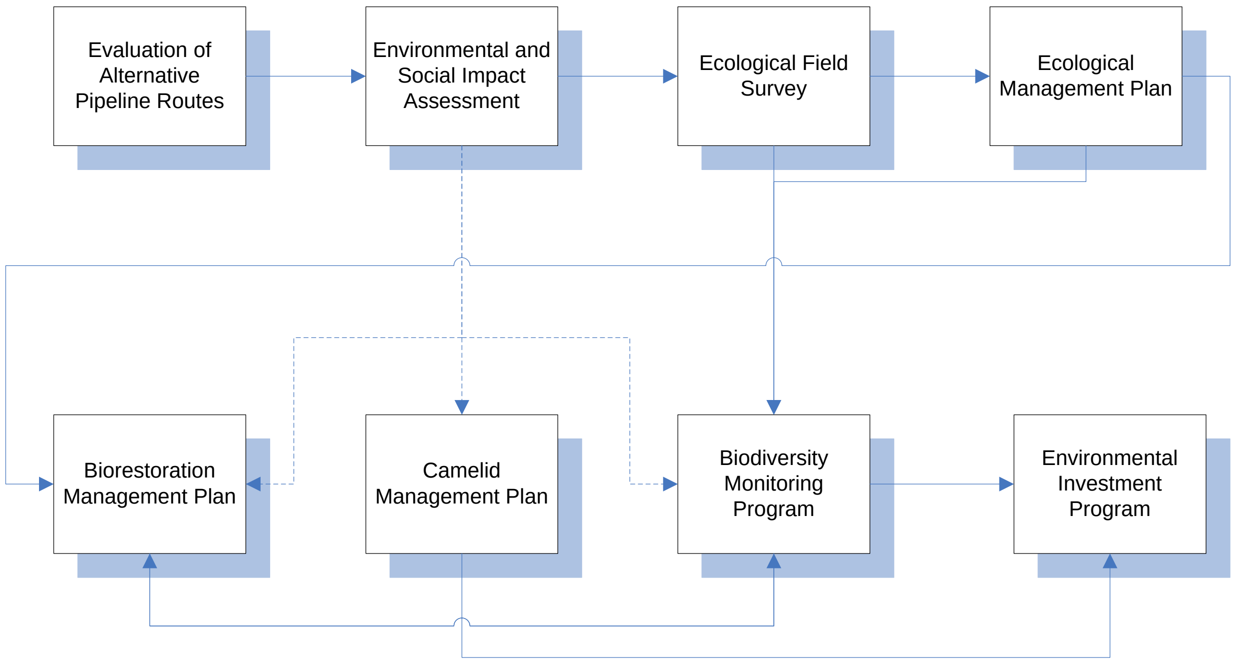

Figure 3: PERU LNG Pipeline BAP Phases

As can be seen, a number of the outputs of several work phases have a direct feed into the following phase (solid connectors). For example, the evaluation of Alternative Routes enabled the selection of the pipeline corridor that was subsequently assessed as part of the ESIA. The ESIA led to the creation of the Biorestoration Plan and the Biodiversity Monitoring Program, which were all required by a certain point in time to satisfy conditions of the ESIA approval. However, the project recognized that further work was required to bring the biodiversity related plans up to the desired standard, thus additional ecological field surveys and management planning activities were carried out to ensure sufficient pre-construction baseline information was available for specific actions to be scheduled and executed during construction.

The ESIA provided a solid starting point for the Ecological Field Survey (EFS) and Ecological Management Plans (EMP), which built upon the ecological knowledge already gained during the EISA baseline data collection process. As mentioned above, the ESIA studied a 3 - 7km wide corridor. The EFS and EMP focused the area of interest down to 50m and 25m respectively. These programs augmented the data collected during the ESIA ensuring more accurate information was available for establishing the priorities for conservation. Data from the ESIA, EFS and EMP were all utilized in the development of the Biorestoration Plan. The Biodiversity Monitoring Program integrated the data collected during all previous surveys and determined which species should be prioritized for conservation. Over one hundred and fifty species were evaluated and ultimately twenty-three species and four habitats were selected for scientific monitoring.

The biodiversity action planning process recognized that a number of species are of considerable importance to traditional communities whether or not they are of any special conservation value. During ongoing public consultation and disclosure activities it became clear that several communities rely heavily on camelids for their livelihoods and were concerned about the impacts of construction on their animals. The Camelid Management Plan (CMP) was therefore developed to ensure effective mitigation measures were identified and implemented. This involved conducting population surveys prior to, during, and after construction, evaluating the effectiveness of the mitigation measures. During the development of the CMP opportunities to improve the health of the camelid population were identified. These opportunities were included in the Environmental Investment Plan. Through improved health and environmental management practices, domestic camelid heath has improved and productivity increased.

Evaluation of Alternative Pipeline Routes

The selection and evaluation of the alternative pipeline routes was completed in three stages: corridor selection; field reconnaissance; and site specific studies. Throughout the route selection process, risk were assessed on an ongoing basis to ensure appropriate mitigation measures could be identified and implemented, as required. Route determination is traditionally performed by teams of topographers who place emphasis on the selection of the pipeline alignment. Environmental, community relations, and cultural heritage were incorporated into the topographical survey team. They applied specialist criteria that were fully integrated into the alignment decision making process. This resulted in the selection of a route that minimizes impacts to biodiversity reduced risks to pipeline integrity.

Stage I: Corridor Selection - a “desktop study” to evaluate conditions such as extreme terrain, earthquake, and fault activity, slope failure, flooding, river crossings, wetlands, and archeological sites, etc.

Stage II: Field Reconnaissance - an investigation built upon the Stage I baseline assessment to define geohazard issues that may affect specific areas of the pipeline corridor. This stage involved field reconnaissance of the pipeline corridor by a team of technical experts.

Stage III: Site Specific Studies - undertaken on the ground by a team of specialists including, biologists, geologists and archeologists. Once a corridor was confirmed, on the ground detailed micro routing took place. Through micro routing, many geotechnical challenging, archaeologically rich, and environmental sensitive areas were avoided. The ESIA data collection commenced during the site specific studies.

Environmental and Social Impact Assessment

During the development of the ESIA, approximately fifty experts from numerous environmental and social disciplines were utilized. The ESIA biological baseline data was collected from a number of sites (varying by season and by taxonomic group) located with a standard 3km wide corridor around the proposed RoW alignment. This corridor was widened in certain areas up to 7km to ensure an ecosystem or water catchment basin was fully evaluated. The 3 – 7 km corridor width also ensured that potential access roads were evaluated. The number of sites per vegetation type was variable and not related to the area of each vegetation type, with a heavy emphasis on high Andean wetlands (bofedales).

Biodiversity was integrated into the social baseline field work by holding over fifty Participative Rural Appraisal Workshops which involved about 5,000 people. First hand information was gathered from the communities on their use of natural resources within the project’s area of influence. An additional four workshops were held with local non-governmental organizations to disclose information about local biodiversity and the project to receive their feedback about the prioritization of species for conservation. The ESIA was approved in November of 2006.

Ecological Field Survey

The EFS was undertaken to ensure that center line specific data were available for the entire 408 km of the pipeline route. The EFS reduced the 3 - 7km corridor studied in the ESIA down to 50m to focus on the actual and potential impacts along and immediately adjacent to the RoW. The EFS was undertaken by a multidisciplinary team who walked the entire length of the RoW. The survey resulted in the collection of detailed information on the sensitivities found throughout the project footprint. Species found to be common, widespread, or abundant during the ESIA were not specifically addressed during the EFS. Species sensitivity was determined for each of the studied species based on four characteristics: 1) conservation status; 2) endemism (limited geographic distribution); 3) use by local communities, and 4) mobility (ability to move away from a disturbance).

The EFS identified an additional 34 species that were added to the preliminary lists of species identified by the ESIA as potential priorities for conservation. Using biogeographical information and ecological criteria, the EFS also defined 14 Ecological Landscape Units (ELUs) within the 408km pipeline RoW. Vegetation type was used as the primary criteria for the definition of habitat types within each ELU, which were then used as the basis in all subsequent phases of BAP development.

Ecological Management Plan

The EMP was developed to detail the specific ecological mitigation measures required along the 408km RoW. The final 25m RoW corridor was studied with emphasis on identifying sensitive flora species and building upon the mitigation measures that were identified by the original ESIA, as needed. The EMP describes the overarching biodiversity conservation requirements and the specific mitigation measures that must be implemented in the fourteen ecological landscape units within three ecological regions.

The primary objective of the EMP is to protect ecological integrity within the project’s area of influence. To ensure the effective implementation of the mitigation measures, fourteen stand-alone field ecological action plans - one for each ELU - were distributed among the construction staff at each spread. Each plan identified the actions to be implemented by field personnel, with the support of the construction contractor, to conserve thirteen sensitive species. The actions needed either related to translocation programs or the taking of cuttings to allow the species to be returned to the RoW following propagation within the project’s nurseries. One species which was identified as requiring translocation was the *Oroya peruviana*, a rare cacti (Photo1) which is endemic to the Peruvian Andes and listed as Near Threatened by the Peruvian Red Book of Endemic Plants. The *Oroya peruviana* was identified in two ELUs and all the exact location of every individual had been geo-referenced. During the translocation program over 8,000 individuals were translocated off the RoW. This program was conducted with the help and support of the surrounding communities.

Cuttings were taken from a number of species and planted within three nurseries established within project construction camps. In fact multiple cuttings were taken from each individual plant impacted by the project taking into account survival rates during their time in propagation. This strategy is ensuring that significantly more individuals are available for replanting than were originally removed during clearing and grade activities.

One of the species from which cuttings were taken is the *Kageneckia lanceolata*, which is listed as Critically Endangered. A total of 153 *Kageneckia lanceolata* needed to be removed as a result of the construction activities. In total, 826 cuttings were taken and planted in the nurseries. Three hundred and eighty four of them rooted, equating to 2.5 cuttings per tree which are now available for replacement on the right of way. To date, survival rates within nurseries and on the RoW have been encouraging and the project therefore anticipates having a net positive impact on this and other critically endangered plant species.

Biorestoration Management Plan

The aim of the Biorestoration Management Plan (BMP) is to ensure effective revegetation of the pipeline right of way and the associated facilities as quickly as practicable. To achieve this, the project established short and long term objectives. The short-term objective is to protect the topsoil and restore vegetation cover as quickly as possible after construction. This will stabilize the ground surface, prevent soil erosion and wasting, protect pipeline integrity, and safeguard sensitive ecological habitats such as water bodies and wetlands against the effects of sedimentation. The long term objective is to restore the land affected by project activities along the RoW to conditions that allow the reestablishment of natural ecological processes that will lead to the progressive recovery of biodiversity, structure, and function to pre-construction conditions.

Biorestoration activities actually commenced during the topsoil stripping stage of construction. By stripping and protecting the topsoil the natural seed bank held within the topsoil was protected. When the topsoil is replaced on the right of way, native seeds will therefore germinate returning the disturbed areas to their original condition. In the many areas where the RoW traverses moderate to steep slopes, natural processes could not be relied upon to provide adequate vegetative coverage within the timeframe required to stabilize the ground and protect the pipeline against erosion. To achieve the short-term biorestoration objectives, natural recovery was augmented with proactive and systematic seeding of the RoW. The seeding plan was developed by specialists from consultancies, universities and governmental research institutes. Five naturalized grass species were selected to rapidly obtain a “cover crop” with one or more of the following properties:

1. Dense, fibrous horizontal root structure;
2. Dense, uniform ground cover;
3. Resistance to damage and high velocity run-off or trampling by animals and people;

4. Not persistent – will allow the original species to re-colonise the area; and,
5. Rapid germination.

These seeds were applied at differing rates depending on the slope and altitude of the right of way. Seeding is being conducted on all slopes greater than 8.5°. After seeding, erosion control matting is also installed on slopes that exceed 18.3°. Above 4,200m no seeding is being conducted because at this altitude germination rates are so poor that seeding is not a viable biorestoration strategy. Instead, Ichu grass (native Andean grasses) was carefully translocated from the adjacent areas onto the RoW.

Given the variety of conditions found along the RoW, the seeding season ranges from October to January. After conducting seeding trials, the seeding program was proved to be successful and is being implemented during the current seeding season. Any future biorestoration needs will be based on the findings of the Biodiversity Monitoring Program. This monitoring will start immediately after the completion of biorestoration activities, which will evaluate the success of the plan against its short and long term objectives. It is expected that full reestablishment of natural ecological processes will extend well into the operational phase of the project in the most challenging areas of the pipeline route.

Camelid Management Plan

During the public consultation and disclosure workshops completed during the ESIA process, it quickly became apparent that a significant number of vulnerable communities in the highlands place considerable value of the protection of camelids and voiced concerned about potential impacts of pipeline construction on their herds. To ensure the project fully understood the size and location of the camelid populations, it was agreed that they should be studied and a Camelid Management Plan developed with the participation of the potentially affected communities. Data was gathered directly from the communities by holding fifteen workshops with over 630 participants. This allowed the community lands of local importance for camelid management to be delineated. Each community provided camelid maps to determine the range of their herds, commonly used water sources and the areas the communities considered important for grazing. Camelid specialists then undertook a detailed camelid census along the right of way. The resources used by the camelid herds and other grazing animals was also undertaken to verify and augment information provided by the communities. This study looked at vegetation and water resources, including ecologically important bofedales, to rank them in terms of their quantity, quality and longer term viability. This allowed the project to develop Camelid sensitivity maps (Figure 4).

These sensitivity maps were used to develop detailed mitigation methods for each 100m section of the RoW in areas where camelids could be encountered. Once developed, the mitigation methods were agreed, they were worked into on the project alignment sheets to ensure their timely implementation during construction (Figure 5).

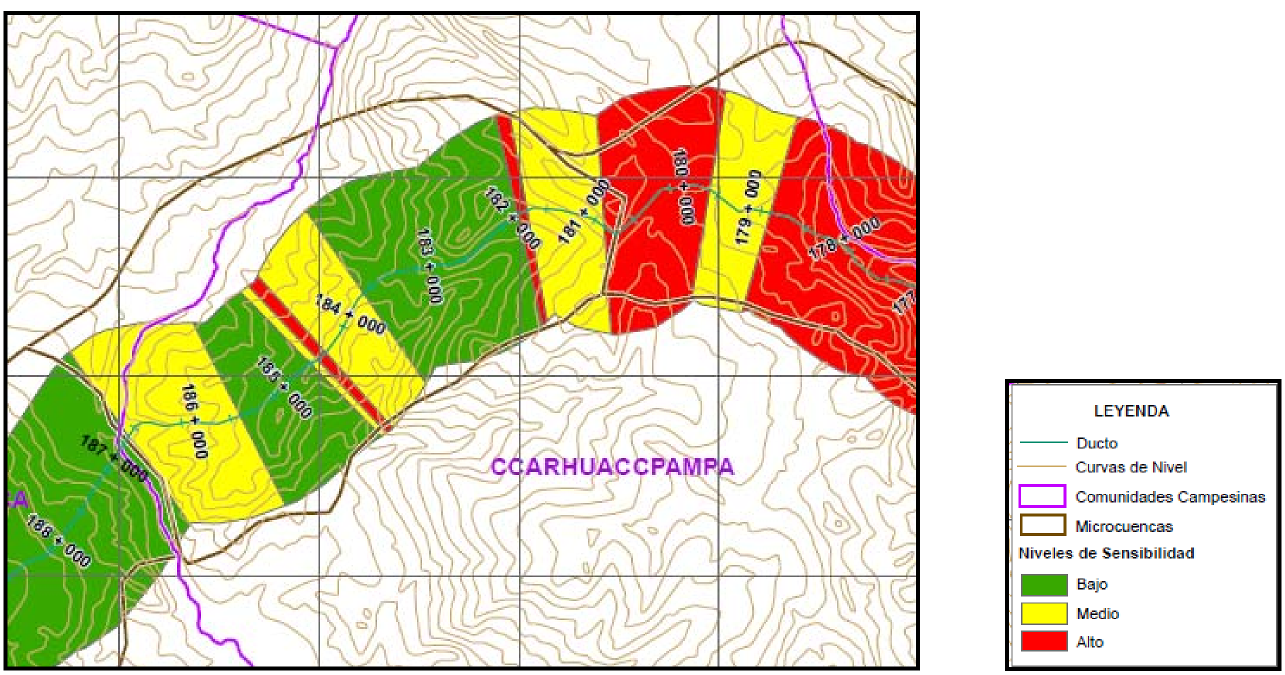

Figure 4: Camelid's Sensitivity Map

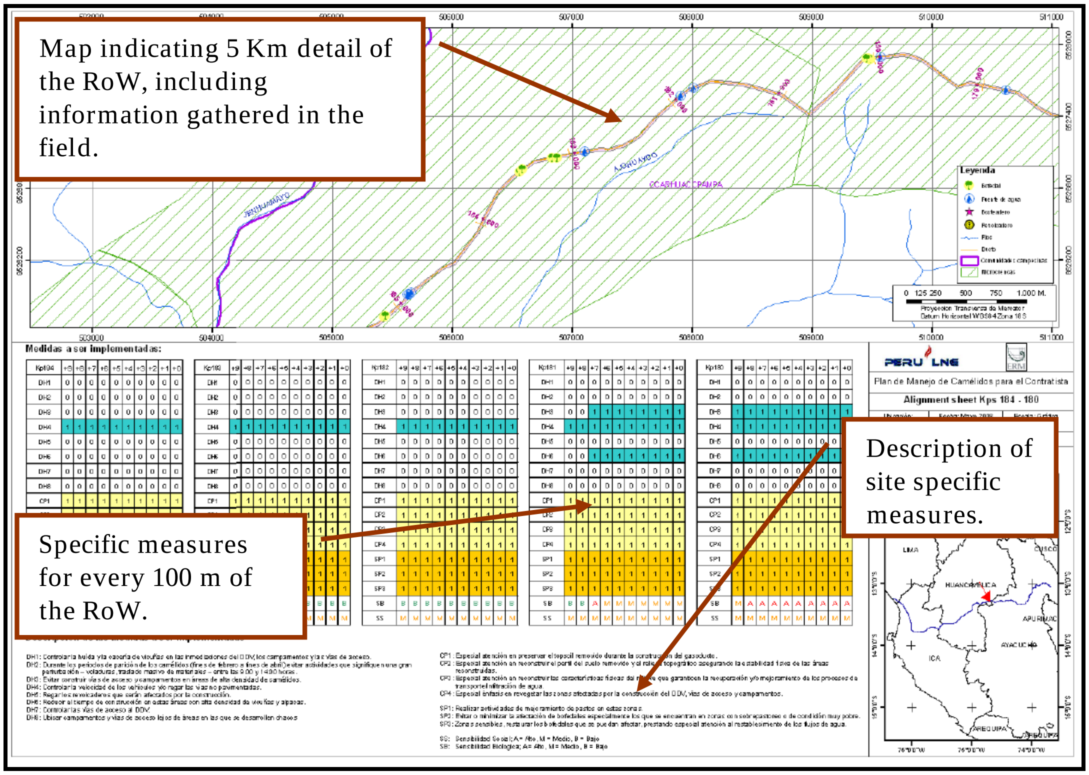

Figure 5: Camelid Management Alignment Sheet

Many of the mitigation measures were implemented by the project with assistance from a third party specialist who was hired to provide advice and conduct specific monitoring of the camelid herds during the construction process. They conducted regular camelid density and populations surveys which were compared to the CMP preconstruction survey results to determine the effectiveness of the mitigation methods and other operational controls. The monitors also assisted in responding to any community grievance that were received in relation to camelids thus ensuring trusted experts were always available to help resolve disputes in an amicable fashion. An interim monitoring report was completed after the first six months of construction and the results shared with those communities that rely on camelids for their livelihoods. The report concluded that no significant impacts on the camelid populations have occurred to date. The CMP proved effective with regard to protecting the camelids, building trust and good will with the communities.

Biodiversity Monitoring Program

The primary aim of the Biodiversity Monitoring (and Assessment) Program (BMAP) is to provide a robust mechanism for assessing whether mitigation measures are proving effective or construction activities are causing an impact, either positive or negative, on key species and ecosystems. The BMAP relies on the evaluation of a large biodiversity dataset that has been collected since the early planning phases of the project. In total, some 170 species have been identified as potential priorities for conservation. A multidisciplinary team of national and international experts has applied sensitivity criteria to consider which of these species should be selected as indicator species that should be monitored, based on their:

- Importance to society;
- Inclusion in the national threatened species lists
- Position in the IUCN Red List
- Inclusion in CITES
- Endemicity; and,
- Mobility

Applying these criteria resulted in 23 species and 4 habitats being selected for monitoring as part of the BMAP:

For each of the selected species and habitat, research questions and protocols have been developed using a proven methodologies developed by Smithsonian Institution (SI), which is collaborating with the Project as the BMAP Implementing Partner. The research questions were designed for the Project to understand the distribution and abundance of the species and habitats, their conservation status, and the potential for them to be impacted by the construction and operation of the pipeline.

Critically, the monitoring program is being implemented by respected national and international specialists. SI is ensuring internationally recognized methods are being applied by running workshops and capacity building sessions with all the specialists involved in monitoring activities. The specialists involved have concluded that given the gaps in scientific knowledge about the area of interest and the scope of BMAP, that the monitoring and research should make a significant contribution to our collective understanding of the local biodiversity. All the data gathered as a result of the BMAP will also be summarized and presented to local communities in an accessible, education manner.

Environmental Investment Program

The Environmental Investment Program (EIP) is also based on the environmental and social data gathered throughout the phased development of the BAP. The primary purpose of the EIP it to capitalizes on those opportunities to conserve and improve natural resource use that maximize returns in corporate, regional, national and international priorities for biodiversity conservation and sustainable use of natural resources. The first program was designed to improve the health of the camelid populations within the area of influence and improve the quality of the vicuña fiber. Training workshops in care and handling of newborns, treatment of infectious and parasitic diseases and in vicuña handling methodologies have benefited 1,048 families and 90 breeders. Nearly 20,000 camelids have been vaccinated and a further 36,000 treated to remove parasites. Reduced mortality rates in alpaca and llama populations are already being realized by the participating communities. The success of the health campaign, coupled with a program aimed at improving the value of vicuña fiber (wool), is having a significant impact on the livelihood of ten communities in the Huancavelica and Ayacucho region of Peru.

Conclusions

The challenges faced by the Peru LNG pipeline project are not unique, other pipeline projects have traversed different ecosystems and faced similar challenges. This is especially true when the lineal projects are in remote and understudied environments.

The approaches described by IPIECA are suitable for many oil and gas industry projects. By utilizing this industry best practice and developing it specifically for the project has ensured a BAP fit for purpose and in line with or ahead of current best practice.

Due to the scale and nature of this project, this phased approach proved to be the most appropriate methodology as it has enabled the BAP to evolve during the planning and construction phases. Building upon the good research conducted during the ESIA, this phased approach has ensured that all biodiversity aspects of the project are considered and assumptions and commitments are not made too early in the project cycle.

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Alfonso Alonso	Smithsonian Institution
Robert Longstroth	ERM, Washington

Attachments

Photo 1: *Oroya peruviana*

Photo 2: Ichu Translocation Activities