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Environmental, Social, and Health Impact Assessment (ESHIA) for Vista Onshore Operations

Cumulative Impacts and Effects



6 June 2019

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Cumulative Impacts and Effects

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7. CUMULATIVE IMPACTS AND EFFECTS

Rapid Cumulative Impact Assessment and management (RCIA) objective is to determine if the execution of the Vista Project has the potential to contribute significantly to the cumulative impacts on valued environmental and social components (VECs) and/or the project may be at risk from cumulative effects on VECs the project depends on or that could represent a potential risk to the viability of the Project.

The main objectives are:

- Identify other existing, planned and future projects that could cause cumulative effects;
- Identify the VEC that could be cumulatively impacted, taking into account consultations with key interest groups; and
- Evaluate the cumulative impacts on the VEC.

7.1 Methodology

The Rapid Cumulative Impact Analysis has been prepared following the guidelines of the *Good Practice Handbook on Cumulative Impact Assessment and Management: A Guide for the Private Sector in Emerging Markets of the IFC*.¹ The assessment focuses on a VEC as a recipient of the impacts of different projects and activities, and not on a single project as a generator of impacts on different environmental and social receptors.

The main challenges of any RCIA are securing relevant, up-to-date information on the status of activities and projects being considered (including their scale, prospective timing of completion, likely impacts, etc), without excessive reliance on speculative assumptions.

The RCIA will:

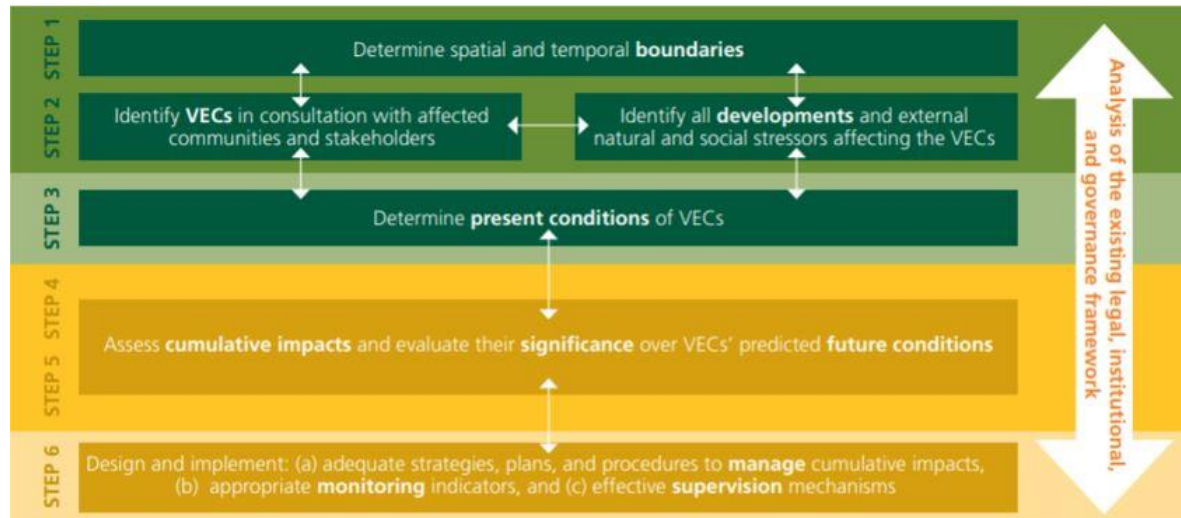
- Assess the potential impacts and risks of the project over time, in the context of potential effects from other developments and natural environmental and social external drivers on a chosen VEC;
- Verify that the project's cumulative social and environmental impacts and risks will not exceed a threshold that could compromise the sustainability or viability of selected VECs;
- Confirm that the proposed project's value and feasibility are not limited by cumulative social and environmental effects;
- Support the development of governance structures for making decisions and managing cumulative impacts at the appropriate geographic scale;
- Ensure that the concerns of affected communities about the cumulative impacts of a proposed development are identified, documented, and addressed; and
- Manage potential reputational risks if any.

It is an iterative and flexible process, with some steps that must be reviewed in response to the results of others. It begins with the execution of scoping to determine spatial and temporal boundaries of VECs, followed by a VEC's baseline determination, and then an assessment of the contribution of the project under evaluation to the predicted cumulative impacts, evaluation of the significance of predicted cumulative impacts to the viability or sustainability of affected VECs, and ends with the design and implementation of mitigation measures to manage the project's contribution to the cumulative risks and impacts.

¹ International Finance Corporation (2015). *Good Practice Handbook on Cumulative Impact Assessment and Management: Guide for the Private Sector in Emerging Markets*. Washington DC.

This cumulative impact assessment process is based on the IFC's six-step approach, shown in the figure below.

Figure 7.1 Cumulative Impact Assessment Process (IFC)



Source: IFC 2015.

Following the indicated steps, cumulative impacts will be identified and assessed, recognizing that a cumulative impact includes two components:

- The anticipated future condition, which is the total effect of the other existing, and predictable future developments and external natural environmental and social drivers, and
- The contribution of the development under evaluation to the cumulative impacts.

In the RCIA context, the incremental impact of the project under review will be the difference between the condition of the VEC when impacted only by the other developments in the future baseline and the condition of the VEC when impacted by both the project under review and the future baseline impacts.

Consequently, in order to observe the scoping step, the spatial and temporal boundaries of the study area are aligned with the project overview which considers Vista Oil & Gas Argentina S.A. (VOG hereafter) and Aleph Midstream S.A. (AM hereafter) as main actors for the development of unconventional oil and gas production in the Bajada del Palo Oeste block (BPO hereafter), within Bajada del Palo area (BP) and Entre Lomas area (EL).

The Project includes drilling and completion of 110 wells in the next 4 - 5 years, as well as the construction, installation, operation and maintenance of midstream facilities to gather, process and transport unconventional oil & gas production from BPO (i.e. gathering lines, early production facilities, EPFs, oil, gas and water pipelines, central processing facilities, CPFs, compressor stations, lease automatic custody transfer units, LACT, etc.) to be developed in the next 8 - 9 years. Additionally, some of the existing facilities (i.e. crude treatment plant, PTC, gas treatment plant, PTG, etc.) at Entre Lomas area (EL) are to be revamped in order to support the production from BPO.

VOG will be responsible for the upstream portion of the Project while AM will be in charge of the midstream component of the Project. The aim of the Project is to develop the oil and gas reserves and increase the oil and gas production from the Vaca Muerta (VM) formation.

As a result, the temporal boundary will be the next 9 years and the spatial boundaries will be the Bajada de Palo and Entre Lomas oil fields as a unit of the Vaca Muerta Formation.

7.2 Limitations

The scope of the assessment takes into account the typical limitations that a project developer may face in this type of evaluation, including:

- (i) Lack of detailed base line data,
- (ii) Incomplete information about other projects and activities (for example, if the information is not available in the public domain);
- (iii) Uncertainty regarding the execution of future projects, uncertainty associated with anticipated developments
- (iv) Lack of national, sectoral or resource use strategic plans, or integrated resource planning schemes; and
- (v) Limited VEC baseline information.
- (vi) No third parties, neither local governments nor regional planners have been contacted for the RCIA process.
- (vii) Information reviewed involved desk review of available information, including existing ESIA's, and on-line public domain.

7.3 Description of present or future actions and projects taken into account in assessing cumulative impacts

The following assesses the most relevant cumulative effects generated by the Project together with other projects on the VEC. It was based on information from existing environmental and social studies and information available in the public domain and observations obtained during a field visit.

The scope of this assessment covers the Project and its relationship with the following projects identified in its area of influence. See Annex 7.1.

The Neuquen basin is home to the unconventional resources of Vaca Muerta and Los Molles, and the conventional oil reservoirs like Tordillo, Lotena and Lajas formations among others, which have been under production since the '40s, Some of them are already in secondary recovery by water injection. Historically, the Neuquen basin has been one of the most productive oil and gas producing basin. As in the entire Neuquén area, its proximity to urban areas adds development challenges. Due to that, directional drilling and production island techniques are applied.

The Vaca Muerta formation, spreading 30,000 km² (18,641 square miles), is one of the largest unconventional oil and gas reservoirs on the planet. Vaca Muerta has a total of 34 unconventional hydrocarbon concessions, of which seven are undergoing major development. This represents four percent of the total surface area of the basin with 1147 wells, and the projection is that there will be another 300 well installed during 2019.²

YPF has three important oil blocks in "Vaca Muerta": Loma Campana, Bandurria Sur and La Amarga Chica. Loma Campana block, YPF's flagship in the unconventional flagship, an injection of 670 US million dollars³ to incorporate 40 new production wells is planned in 2019. By 2023, this block is projected to produce of 100,000 barrels of oil per day and 6 million cubic meters of gas.⁴ It is located

² <https://www.lmneuquen.com/shell-pasa-etapa-desarrollo-masivo-tres-areas-clave-vaca-muerta-n617973>

³ All dollar figures are in US dollars.

⁴ <https://www.rionegro.com.ar/ypf-pisa-el-acelerador-en-bandurria-sur-922667/>

near km12 on provincial Route 17 in Añelo, province of Neuquén, in the heart of one of the most outstanding unconventional petroleum production sites in Argentina, called Loma Campana.⁵

Additionally, YPF announced that together with Schlumberger will accelerate the development of the Bandurria Sur block and will invest 300 million dollars this year. It seeks to close 2019 with an unconventional production of 87,000 barrels per day. The block that YPF operates next to Schlumberger is located right in the middle of the hot zone of Vaca Muerta, north of Loma Campana and east of La Amarga Chica. Bandurria Sur is expected to reach a production plateau of 60,000 barrels per day and 2.4 million cubic meters of associated gas by 2023 during its five-year development plan.⁶

When it comes to La Amarga Chica, YPF and Petronas ratified the start of a massive development phase. For the next 4 years, both companies plan to invest more than 2,3 billion dollars, which is the second largest direct investment by YPF for unconventional development in Argentina. The objective is to reach by 2022 a production of 60,000 barrels of oil per day. The project contemplates a development that could involve an investment of up to 7 billion dollars until the completion of the project and reach a production level of 75,000 barrels equivalent. In this way, La Amarga Chica becomes the third project that the company manages to pass to the stage of massive development, after Loma Campana and El Orejano.⁷

The objective of YPF is to increase the production of unconventional crude extracted from the three blocks by the end of the year produce 87,000 barrels of oil per day for only those three blocks. To achieve that, YPF announced that this year they will inject in Vaca Muerta no less than 1,5 billion dollars, of which YPF will contribute 50% and the other half will be paid by its partner, Petronas of Malaysia, in La Amarga Chica and Chevron in Loma Campana.⁸

Similarly, Shell, Exxon, Total and PAE have prioritized this area. "*Vaca Muerta plays a very important role in our global Non-Conventional portfolio. We see a very significant long-term growth potential*", said Andy Brown, director of the Shell's Upstream Group.⁹ Shell confirmed the massive development of three areas in Vaca Muerta: Sierras Blancas, Cruz de Lorena y Coirón Amargo Sur Oeste blocks, with a potential to produce more than 70,000 barrels of oil equivalent per day (bped) within the period 2019-2025. Shell contemplates the construction of 38 8-well locations (pads), for a total of 304 wells, a Central Processing Facility, surface facilities on locations for the production of interconnection wells, gas pipelines and 25 km of power lines. Shell's partners in these blocks are Gas y Petróleo del Neuquén (GyP), with a 10% share and Vista Oil and Gas, with a 10% stake in Coirón Amargo Sur Oeste.¹⁰

Exxon Mobil announced a significant expansion in the Bajo del Choique-La Invernada block. The project is expected to produce up to 55,000 barrels of oil equivalent per day (bepd) within five years.¹¹ The french oil company "Total" will drill two more wells at Aguada Pichana and plans to launch an unconventional pilot at Rincon de la Ceniza. This year the drilling of 35 wells in the 11 areas in Vaca Muerta will be completed. After YPF and Chevron, which have drilled more than 300 wells in Vaca Muerta to extract oil with unconventional technology, Total is the most advanced company in the exploration of shale rocks in the Neuquén basin.¹²

After an important development in tight gas, the oil company Pan American Energy (PAE) bets on shale oil. The company has obtained very good production levels in both the conventional, tight gas and shale oil productions in the Lindero Atravesado block. A total of 109 wells were built, more than double the

⁵ <https://www.ypluz.com/CentralesOperacion/LomaCampana>

⁶ <https://www.rionegro.com.ar/ypf-pisa-el-acelerador-en-bandurria-sur-922667/>

⁷ <https://www.ypf.com/YPFHoy/YPFSalaPrensa/Paginas/Noticias/YPF-y-Petronas-inician-el-desarrollo-masivo-de-La-Amarga-Chica.aspx>

⁸ <https://www.rionegro.com.ar/ypf-pisa-el-acelerador-en-bandurria-sur-922667/>

⁹ <https://econojournal.com.ar/2018/12/shell-confirma-una-inversion-de-mas-de-3000-millones-de-dolares-en-vaca-muerta/>

¹⁰ <https://econojournal.com.ar/2018/12/shell-confirma-una-inversion-de-mas-de-3000-millones-de-dolares-en-vaca-muerta/>

¹¹ <https://www.infobae.com/economia/finanzas-y-negocios/2019/06/11/exxon-mobil-anuncio-una-expansion-significativa-de-vaca-muerta/>

¹² <http://www.elinversorenergetico.com/total-empieza-vender-al-mercado-el-gas-de-vaca-muerta/>

40 wells that had been committed in 2013, and reached a maximum production of 4 million cubic meters of gas per day.¹³

Another company, TOTAL AUSTRAL SA, has also begun to sell the Vaca Muerta gas to the international market, and by 2019 it will complete the drilling of 35 wells in the 11 areas of which it participates in Vaca Muerta. The company is currently drilling a well and plans to place two more wells in Aguada Pichana to complete the first phase of a shale gas pilot project, which contemplates the placement of 12 wells in the block. The company will also start up a pilot at Rincon de la Ceniza, in a common area with the Shell company. The 11 blocks with unconventional activity of which TOTAL AUSTRAL SA participates are located around the two original blocks of the company in Neuquén (Aguada Pichana and San Roque) and are distributed in oil, gas and condensate use of the three fluids. Currently, the company began in May 2019 to inject shale gas production obtained from the pilot project in Aguada Pichana, and will launch its second unconventional pilot in the Rincon de la Ceniza area.

Although the “Vaca Muerta” gas already represents about 27 million cubic meters per day, there are only a few major developments under way.¹⁴ In August 2018, Pluspetrol and YPF obtained La Calera concession to produce unconventional gas for 35 years. La Calera, the promising new area in Añelo, is preparing for the first pilot trials to enter the incentive plan for the production of unconventional gas. Pluspetrol and YPF have high expectations regarding the performance of the area located about 20 km away from one of the bastions of oil production in the country, Loma Campana.¹⁵ Pluspetrol presented in the environmental report to develop 183 wells in 61 locations of “Vaca Muerta”. The production of about 10 million cubic meters per day of unconventional gas will generate an economic effect comparable to the Loma Campana deposit in 2014.¹⁶ When La Calera activates, it is expected that the economic impact in Añelo will reactivate the regional economy. The development of the 230,000 ha area involves the construction of an aqueduct of some 20 km for the transfer of water for fracturing. Also planned are the construction of some 115 km of main and internal roads throughout the area, plus a centralized processing plant.

Petrolera Pampa will invest more than US\$100 million this year to increase its production of tight gas in Neuquén. Associated with YPF, the Pampa Energía group oil company is expanding the evacuation capacity in Rincón del Mangrullo. Simultaneously, it will disburse US\$34 million in two exploratory wells. The company is financing 50% of a US\$ 120 million project to increase gas transport and evacuation capacity in the Neuquén field, where 50 tight gas wells will be drilled this year, 35 more than initially planned. The expansion is explained by the good results recorded in the tight gas deposit from the Mulichinco formation.¹⁷

Similarly, the company Dow will invest \$ 2,000 million over the next four years to extract shale gas along with YPF in the El Orejano block, which is the largest gas field in the world outside North America under production. In the last two years, it has invested 850 million dollars in Neuquén, with a production perspective of 2.5 million cubic meters of gas per day by the end of the year.¹⁸

Regarding the Rio Negro region, Petróleos Sudamericanos will soon start operating the areas that it bought from YPF. The company, which already operates Río Negro deposits, specializes in the mature well production and has promised an investment of 30 million dollars. This consists of four mature deposits (Bajo del Piche, Barranca de los Loros, El Medanito and El Santiagueño) located within the ejidos claimed by Catriel. This concession has been valid since 2014 under a 10-year contract. The firm already operates in Catriel in partnership with Necon, -Centro Este and Loma Montosa- and was one

¹³ http://www.vacamuertanews.com.ar/ver_noticia.php?id=20190602020801

¹⁴ <https://www.runrunenergetico.com/paso-a-paso-el-plan-2019-de-ypf-en-vaca-muerta/>

¹⁵ <https://www.lmneuquen.com/la-calera-queda-pluspetrol-e-ypf-35-anos-n602946>

¹⁶ <https://www.lmneuquen.com/la-calera-anelo-se-prepara-otro-boom-shale-gas-n624430>

¹⁷ <https://www.revistapetroquimica.com/petrolera-pampa-se-metio-en-el-top-10-de-los-productores-de-gas/>

¹⁸ <https://www.lmneuquen.com/dow-trae-2000-millones-dolares-el-orejano-n529853>

of the best results obtained in the inspections carried out by the municipality with more than 90% of local labor. Currently, the areas have a daily production of 1.7 kbbl of crude oil and 0.1 Mn3 of gas and P1 reserves for a total of 642 Kboe.¹⁹

YPF S.A. projected also in 2011 the work of water collection and transport from the Neuquén River to the Storage Pool for the Fracture of Wells of the Loma La Lata Field, in the Neuquén Gas Business Unit. For this purpose, YPF planned to use the Provincial Route No. 7 and existing roads to access the projected water collection and storage points, seeing it necessary to prepare 1,065 meters of an existing footprint to enter the water collection point; and build about 1,480 m of new road parallel to the service track of the Sierra Chata - Loma La Lata gas pipeline to enter the water storage pool. It was also necessary to build a sewer-type work of art, of reinforced concrete pipes and a 50 m long upper embankment on the arm of the Neuquén River to enter the water collection point; and build about 190 m of new road on natural ground to enter the water storage pool. In this context, in 2019, the first trunk aqueduct in Vaca Muerta, operated by the oil service company SIMA in Neuquén, is being developed²⁰. The project involves a linear coverage of 68 km from the Neuquén River to the outskirts of the Añelo Municipality, up to the Parva Negra block owned by the state-owned company GyP. The start of production in La Calera block, in charge of Pluspetrol, contributed to the start-up of the aqueduct.

The aqueduct project arose from the statistics that revolve around the water required for unconventional hydrocarbon production that is based on hydraulic fracturing. Each fracture stage requires about 1500 m³ of water, and at least 25 fracture stages are estimated, for a total water consumption of 37500 m³. In the area of influence of the projected aqueduct, the water is supplied by tankers. Each well involves 1070 trips by tankers with a capacity of 35 m³. To cover a radius of 50 km, the tankers travel 110 km while covering the well fracture needs. The trucks go through about 36 tires and 55 thousand liters of diesel during this phase. The transit requires 2750 hours of driving and results in the emission of 120 tons of carbon dioxide.

In addition, at present several conservation and international NGOs have made negative comments regarding the status of waste management and liquid discharges in the Vaca Muerta area as well as drilling technology²¹. The Committee on Economic, Social and Cultural Rights of the UN expressed in 2018, concern about plans for the large-scale exploitation of unconventional fossil fuels, considering that the total exploitation of all reserves would use a significant percentage of the world's carbon budget to achieve the goal of a 1.5 degree Celsius warming, stipulated in the Paris Agreement "of 2015.

In contrast, the government of Argentina has strongly promoted actions of renewable energies such as 1) the Program for the supply of electric power from renewable sources (RenovAr program), 2) the renewable energy market (MATER) corresponding to a mechanism of contracting between private companies as an alternative to the joint purchase of renewable electric energy, 3) the Project of Renewable Energies in Rural Markets (PERMER) which has the objective of facilitating access to energy in dispersed rural populations, far from the networks of distribution, and 4) the Regime of Promotion to the Distributed Generation of Renewable Energy integrated to the Public Electrical Network²². As of May 2019, offers were received for 56 new Renewable Energy projects for USD 520 million in Round 3 of the RenovAr program²³.

¹⁹ <https://www.revistapetroquimica.com/petroleos-sudamericanos-comenzara-a-operar-las-areas-que-le-compro-a-ypf-en-rio-negro/>

²⁰ <http://www.enernews.com/todo-vaca-muerta/321105/como-sera-el-acueducto-anelo-parva-negra-de-gyp>

²¹ <http://noticias-ambientales-argentina.blogspot.com/search/label/Neuqu%C3%A9n>; <https://www.terram.cl/2018/11/para-la-onu-vaca-muerta-provocaria-danos-ambientales-irreversibles/>; <https://www.lanacion.com.ar/politica/vaca-muerta-preservar-el-ambiente-es-vital-para-ser-sustentables-nid2251667>

²² <https://www.argentina.gob.ar/energia/energia-electrica/renovables>

²³ <https://www.argentina.gob.ar/noticias/se-recibieron-ofertas-para-56-nuevos-proyectos-de-energias-renovables-por-usd-520-millones>

The project will take the affore mentioned detail into account by focusing on the project's incremental contribution to selected impacts recognized as important within the area addressed for cumulative assessment determined in this section.

7.4 Determining Valued Environmental Components (VEC)

VECs are valued environmental and social components and considered as the receptors of cumulative impacts. To be included in this assessment, it must first be demonstrated that an environmental and social component is valued by at least one interest group, be it the national or international scientific community or a national, regional or local group.

VECs are environmental and social attributes that are considered to be important in assessing risks; they may be:

- Physical features, habitats, wildlife populations (e.g., biodiversity);
- Ecosystem services, including natural processes (e.g., water and nutrient cycles, microclimate);
- Social conditions (e.g., health, economics); or
- Cultural aspects (e.g., cultural heritage, sacred sites).

While VECs may be directly or indirectly affected by the project, they often are also affected by the cumulative effects of other projects. VECs are the ultimate receptors of impacts because they tend to be at the ends of ecological pathways.

Then, the VEC must be affected by both the Project and a combination of the Other Projects. If any VEC is affected by the Project, but not by the Other Projects or vice versa, this VEC will not be included.

During the establishment of the RCIA scope, the impacts to receptors / VEC identified in the MEIA were used as a basis. Based on the information reviewed, the following VECs, reflecting concern of the professional community and the project, were identified reflecting additional assessment of the affected community and the government entities consulted:

- Geomorphology, air, water quality, and landscape in a modified habitat in the Vaca Muerta formation;
- Water (supply and consumption);
- Sensitive biological resources;
- Climate regulation;
- Public services;
- Vehicular Transit;
- Taxes and royalties; and
- Economic Dynamics, Local Employment, Land Use.

7.4.1 *Geomorphology, air, water quality, and landscape in a modified habitat in the Vaca Muerta formation*

Both oil fields areas, Baja de Palo and Entre Lomas are located in areas previously intervened by the oil industry, many of the new developments and expansion of facilities are neighbors to current production units. The study habitat presents a previous intervention for the hydrocarbon activity with fences, gates or prevention of cattle-access. The project surroundings lack services and urban infrastructure, only infrastructure of hydrocarbon activities are present. The landscape and habitat are dominated by the presence of roads and power lines, seismic roads and duct tracks/rights of way, as well as infrastructure such as wells, hydrocarbon locations, gas plants, pitching traps, among others.

The use of land is primarily oil and gas production; there are no agricultural, recreational areas affected by the project. There are no previous studies that record evidences of sites of historical interest, archaeological and/or paleontological findings within the project area.

As required by regulations, in case of any chance archaeological or paleontological finding during the development of the works, procedure should be applied by VOG to comply with national and provincial legislation on the protection of cultural heritage: National Law N° 25743, Provincial Law N° 2184 and its Regulatory Decree N° 2726/96 (Neuquén); Provincial Law N° 3041 and its Regulatory Decree N° 1150/2003 (Río Negro).

The Project has foreseen in all its work fronts, the prioritization of existing roads and trails, reducing the opening of new road interventions as far as possible, and therefore considerably reducing the impacts associated with clearing for the opening of new tracks. In the case of pipelines and aqueducts, routes are planned parallel to existing roads and pipelines. This minimizes the alteration of habitats of native flora and fauna since new disturbances and the associated movement of machinery and related traffic is minimized, generating at the same time a reduction in additional noise and dust generation.

In this context, it is necessary to consider that the habitat of the area is composed of regional soils of sandy-loam textures with clays and sandy clays of moderate depth, highly vulnerable to transport by wind and water when disturbed by excavation and grading. These natural erosion conditions will be aggravated by repetitive disturbance of the surface vegetation and soil.

The transportation of fuels and/or chemical substances is another background or intrinsic risk as spills can rapidly penetrate the soil surface. Although the infiltration rate could be moderate in some sectors (not in all), the groundwater is at depth (100 m average), so the potential risk of affecting the groundwater is low. In addition, all the incidents are attended immediately, without giving time to the potential infiltration to groundwater. And 100% of the affected soil is removed and treated.

The main anthropogenic sources of noise and emissions will be the vehicles and machinery traffic, pumps, and motor generators to be used during the construction and assembly phase, and drilling and midstream facilities operations in the operation phase. Thus, in order to avoid disturbance to existing native fauna, Vista has committed to maintaining all motorized equipment in good working order by performing periodic preventive and corrective maintenance of vehicles and equipment used in the different stages of the project. The Project is in the early stages of design and therefore, details on specific air emission sources are not yet available. However, all sources will comply with applicable IFC air emission standards. An approximate preliminary order of magnitude of estimated emissions and GHG expected to be contributed by the VOG project are approx 119,400 tnCO₂e. However, over the life of the Project, the long term generation of noise and emissions is likely to have a moderate effect on biota and potentially to public health.

On the other hand, the landscape of the area is of average visual quality, with marked monotony, where anthropic impacts are roads, ditches, oil drilling locations and their respective pumping and storage equipment. Panoramic visual impacts are a product of nature predominating in the project area, where the different soft soil profiles, formed by wind in different colors according to the geological formation that predominate, embellishing the landscape. Given the remote areas where the NOC wells will be drilled, and the very low to non-existing population density of the project area, nonetheless, the number of residents for whom the visual impact of the projects would be perceptible is likely to be limited.

Liquid residues from the drilling process basically consist of oily liquid residues and flow back water, which will be properly treated by external authorized and licensed hazardous wastes operators. It has been considered that 15% to 40% of the total water used for fracking at each well, this is between 7,180 m³ and 19,140 m³, will be converted in flow back water.

An approximate average rate of 100 m³/day of production water is estimated to be generated in the first month of production at each well. Since said generation of production water is drastically reduced by 95% in the following 6 months at each well, it is expected that when the drilling campaign finalizes and the 110 non-conventional production wells for VOG are in operation, a total of 1,600 m³/day of produced water will be generated and will need to be treated and injected into permitted disposal deep wells.

In addition, it is estimated that 100 liters/day of sewage is generated at bathrooms, kitchen and dining room of the camp. Sewage is collected by a dedicated network and conducted to a portable wastewater treatment plant provided by the drilling and completion contractors for proper treatment. Treated wastewater is used for irrigation purposes at the area near the PAD.

Drilling activities will also use gasoil for power generation, and for oil-based muds. Lubricant oil are also to be used during each well drilling. The use of gasoil and lubricant oil for all purposes will also be required for the completion of each well.

Collection, transportation, treatment and/or final disposal of solid wastes and hazardous waste will be contracted to third party companies duly authorized and licensed by the Neuquén Province Environmental Authorities.

Drilling cuttings with water-based mud will be dehydrated and once authorized by the Environmental Authority of the Province of Neuquén, will be transported and disposed at an authorized quarry in exploitation and/or rehabilitation. Drilling cuttings with oil-based mud are initially separated from the drilling mud and then collected in metallic containers and transported for proper treatment at authorized and licensed hazardous wastes external operators.

7.4.2 Water (supply and consumption)

The Project area is a semi-arid region, and water supply is a significant issue. The water supply and consumption for the NOC projects require a Gathering Permit issued by the Neuquén Provincial Secretariat of Hydric Resources. A total amount of 776,200 m³ of surface water supply from Río Neuquén at the Añelo municipal loading facility was approved for VOG by the SRH through a "Gathering Permit" ("Permiso de Captación") for the drilling and completion of production wells.

A complementary permit for water supply of 200,000 m³ from Cruz de Lorena Reservoir was also approved by the local authorities, and will be transported by a temporary water pipeline from O&G Developments S.A (Shell) tanks, the company will ensure not using more water than that legally available in the capture basin and therefore not generating significant adverse impacts on others. Lastly, groundwater will also be obtained from water production well YPF.Nq.BMo-4 located at BMo oilfield. VOG has also been authorized by SRH to extract up to 800 m³/day of water for industrial use, from said reconverted water production well called YPF.NqnBMo-4.

The construction of the aqueduct for water supply from the Neuquén River is a major infrastructure work that will allow not only Vista but also other local companies to sustain considerable water requirement for well drilling and fracturing foreseen by the project without tapping other water resources.

The aqueduct design took into account environmental factors of the natural environment opting for the least affected scenario regarding the accessibility to the sector and the existing services. Thus, the projected aqueduct facilities will be located in different geomorphological features corresponding to the Neuquén River floodplain (water catchment system) and the Neuquén River terraces (water storage pool).

Thus, the execution of aqueduct (construction and assembly of facilities for the collection, transport and storage of water will result in both positive and negative effects. The benefits relate to the increase of local economic development. Negative impacts are related to the engine emissions and noise, generation of waste, and consumption of resources. From an environmental perspective, the geomorphological characteristics of the area were considered, particularly the proximity to the watercourse (main arm of the Neuquén River), the existence of infrastructure throughout the development scope of the project (project that includes three water catchment wells), crossing of two provincial routes (RP N° 7 and RP N° 17), intersection with an existing irrigation channel, local economic activities, in addition to the effects on the natural conditions of the areas of direct impact (vegetation, local fauna).

The water consumption for each step of well field development and fracking is significant. Once each well is drilled, the well services contractor will use 1,450 m³ of fresh water for each stimulation step.

Water will also be used for the improvement and stabilization of existing access to the PAD, 600 m3, as well as for the construction of new accesses to the PAD and the PAD itself, 1,200 m3.

Drilling mud preparation as well as cementation of the different stages of the well will require an estimated amount of 700 m3 of water per well. Each fracking step will consume approximately 1,450 m3, and it is estimated that 33 fracking steps are to be needed per well.

7.4.3 Sensitive biological resources

The study area was historically intervened by cattle ranching, which altered the natural habitat, and the land use is now dominated by hydrocarbon activity. Despite the combined effects of ranching and oil and gas exploration and development, the baseline data indicates that some species with a certain degree of sensitivity remain as described below.

Flora: No threatened or endangered species were identified; however, two endemic species were reported, *Ephedra ochreatea*, an Argentine endemic, and *Menodora robusta*, a Patagonian endemic. *Ephedra ochreatea* is a small shrub with edible fruits which is abundant and has a wide geographic distribution in several of the phytogeographic region of Argentina (Selva Misionera, Selva Tucumano-Oranense, Chaco, Espinal, Pampa, Monte, Puna, Patagonia). The population appears to be stable. On the other hand, *Menodora robusta* is a common though not abundant shrub, and very palatable to cattle. It grows in sandy dry soils.

Fauna: Most of the species reported in the project area are considered Least Concern (LC) and none are Endangered or Critically Endangered according to the International Union for Conservation of Nature (IUCN) and to Argentinian legislation respectively. However, national legislation recognizes conservation status for five species, the IUCN for one species and CITES (Convention on International Trade in Endangered Species of Wild Fauna and Flora) for four of them.

Table 7-1: Species with conservation status identified in the Project area

Class	Order	Family	Species	Common name	Argentinian legislation	IUCN	CITES
Birds	Sthruithioniforme	<i>Rheidae</i>	<i>Pterocnemis pennata</i>	lesser rhea, ñandu	VU	LC	II
Mammals	Carnívora	<i>Felidae</i>	<i>Puma concolor</i>	cougar, mountain lion	VU	LC	II
	Cetartiodactyla	<i>Camelidae</i>	<i>Lama guanicoe</i>	guanaco	VU	LC	II
	Cingulata	<i>Chlamyphoridae</i>	<i>Zaedyus pichiy</i>	small armadillo	VU	NT	-
Reptilia	Squamata	<i>Testudinidae</i>	<i>Chelonoidis donosobarrosi</i>	Patagonian tortoise	VU	VU	II

LC = Least concern, NT = Near Threat, VU = Vulnerable

II = Appendix II, species that are not necessarily now threatened with extinction but that may become so unless trade is closely controlled.

In addition, four endemic species were identified, three lizards and one snake.

Table 7-2: Endemic Species identified in the Project Area

Class	Family	Species	Common name
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Reptilia	Liolaemidae	Liolaemus darwini	Darwin´s tree iguana
	Liolaemidae	Liolaemus gracilis	Graceful tree iguana
	Liolaemidae	Liolaemus grosseorum	Iguana
	Dipsadidae	Philodryas trilineata	Snake

Additionally Information of potential occurrence of endangered species in the Project Area provided by the Integrated Biodiversity Assessment Tool (IBAT) is taking into consideration for the identification of Critical Habitats.

Table 7-3: Species with probability of occurrence within the Project area and its surroundings that have a conservation status on the IUCN Red list

Group	Species	Common name	IUCN	Endemic	Range restricted
Birds	<i>Buteogallus coronatus</i>	Crowned solitary eagle	EN	No	No
	<i>Gubernatrix cristata</i>	Yellow cardinal	EN	No	No
Mammals	<i>Leopardus jacobita</i>	Andean cat	EN	No	No
Reptilia	<i>Liolaemus cuyumhue</i>		CR	Yes	Yes

The Project does not affect any national parks or protected areas, however as endangered/endemic species have been identified, an analysis to establish if the project is in a potential sensitive area or critical habitat is required.

7.4.4 Climate regulation

The atmosphere will not only be affected by gaseous emissions resulting from construction, operational drilling activities, and power generation equipment, but also by emissions from vehicles, businesses and residences.

For local impacts or emissions coming from construction and operational activities of the project, the study area is characterized by the persistence and intensity of the winds coming mainly from the West and Southwest sectors throughout the year. During the months of August and September, the winds come from the West, and in the months of January and February the prevailing winds are from the Southwest. In addition, a high frequency of the winds coming from the South sector has been observed during the months of November, December and January. The wind intensities will ensure that local impacts of atmospheric emissions and particulate matter could be dissipated in the short term; however, the global climate impact due to the production of non-renewable energies, and the final consumption of the produced hydrocarbon products could compromise global commitments to reduce greenhouse gas emissions.

The Project's proposed activities include drilling and completion of 110 wells at Bajada de Palo Oeste (BPO) as well as the construction, installation, operation and maintenance of midstream facilities to gather, process and transport unconventional oil & gas production from BPO. It is assumed that each field will produce approximately 875 barrels of oil per day (140 m³/day), as well as 636,000 standard cubic feet per day of gas (18,000 Sm³/day) and 600 barrels of production water per day (average 100 m³/day per well that decreases rapidly to 5m³/day per well or less throughout the first 6 months of production). This oil & gas production rate will potentially increase CO₂ equivalent releases.

7.4.5 Public services

The Project is contributing to the rapid growth of Añelo which is having significant effects on the area.

According to the information of the Census 2010, the city of Añelo, located approx. 35 km from the project location had a population of 2689 people for that year. However, due to employment demands in the Vaca Muerta oil field, it has been estimated that the population has likely tripled, and in 2019 the population would be more than 8,000 people. Some publications even affirm that the population of Añelo would be around 10,000 people in the current year 2019, however, since there is no official study, this figure has not been corroborated.

Another reason that contributes to the trend of rapid growth in Añelo city, is the presence of several hydrocarbon projects in the area such as YPF, Shell, Pluspetrol and South American Petroleum. This is generating an economic boom in the area, and suggests that population growth will continue to be maintained over the next few years, as it is maintained by various reports, which warn of the population growth of Añelo.

"Añelo, the self-proclaimed capital of Vaca Muerta, went from being a hamlet with just over a thousand inhabitants in the '90s, to hosting around 10,000 today and with the pretense of becoming the Argentine Dubai by 2030, when they estimate that the population is estimated to grow to 30,000 people."

This population has resulted in greater demand for public services such as schools and health care centers. Press articles point out that the public services of the locality have been overwhelmed by the population increases and demand for services.

"There are two primary schools and a secondary one that is full of classrooms. For the population projection said that they have already made the request for a technical school is created²⁴."

This population growth has generated that in Añelo, new education and health institutions are created, such as the new Añelo Hospital.

"The doors of Añelo hospital opened after several years ... Its creation responded to the demand in the area with the increase in population²⁵."

Vista Oil & Gas, will require additional contractors and workers mainly for engineering services, maintenance, warehouses, attention to camps, restoration, cleaning, security, etc. This will also contribute to the growth of the population, and therefore to the greater demand for public services such as schools and health care centers.

7.4.6 Vehicular Transit

Multiple roads connect the Municipality of Añelo to other regions of Argentina, such as the Provincial Route N° 17, N° 8, and N° 7. According to the Provincial Road Direction of Neuquén²⁶, the Neuquén-Añelo stretch covers 99 kilometres of road. It is a paved road with intense traffic, ongoing construction works in several locations, regular presence of loose cattle or domestic animals (dogs) and potholes.

The Provincial Route N° 7 (RP7) is one of the busiest routes in the Neuquén province, and is the backbone of the Oil Corridor. Trucks that transport equipment and oil machinery go through RP7. In addition, trucks and other vehicles transport personnel, supplies and equipment to and from the oil wells located nearby. The traffic on RP7 is consistent throughout the day and in both directions of the road.

²⁴ <https://www.rionegro.com.ar/anelo-se-prepara-para-una-ciudad-de-25-000-habitantes-MH5867952/>

²⁵ <https://www.rionegro.com.ar/anelo-se-prepara-para-una-ciudad-de-25-000-habitantes-MH5867952/>

²⁶ <https://w2.dpvneuquen.gov.ar/ParteDiario.pdf>

It currently records an average daily traffic of 5,790 vehicles on the Centenario-Route N° 51 stretch and 3,812 vehicles on the route between the junction of Routes N° 51 and N°7.

RP7 is also one of the routes with the highest traffic growth, mainly in the stretches that link the intersection of RP7 with RP8 and Añelo, a municipality currently experiencing economic and demographic growth due to "unconventional" oil exploitation²⁷.

In addition, according to a study by the Road Safety Department of CESVI Argentina²⁸, on the routes connecting the municipalities of Añelo, Cutral Co and Neuquén capital, little signage was detected along the entire route, difficult conditions of transitability, and permanent works.

Considering the presence of several hydrocarbon projects and oil and gas companies (Tecpetrol, Shell, Chevron, YPF, Pluspetrol, Vista Oil, etc.) in the area, all of which have access to Provincial Route 7, a transit cumulative impact may generate negative impacts for the local population of Añelo related to increase of accidents, pollution, waste generation, presence of not local population. These impacts may increase during construction stage when Projects require more equipment, goods and workers.

According to data from the Provincial Bureau of Statistics and Census of Neuquén²⁹, during the year 2017 there were 85 incidents with fatal victims, of which:

- 40% were urban and 60% rural.
- 53% occurred at night and 47% during the day.
- 81% collided with another vehicle and 19% overturned.

Similarly, the local media has reported several traffic accidents occurred between 2015 and 2019, in the so-called "Oil Route" and Añelo. Some of the most significant ones are presented:

"The Oil Route and the accidents. Last year, eleven people died in the Vaca Muerta area. The intense traffic of trucks, imprudence and lack of controls, are a set of factors that make the road an unfriendly journey. The last year there were 11 deaths in the surroundings of Añelo, the number of victims increased with the increase in traffic linked to oil activity³⁰" (January 11, 2015).

"He died after colliding with an oil truck. It happened on Route 7, near Añelo. The victim was 47 years old³¹" (August 21, 2017).

"A new accident on the oil route left three dead. A truck lost a tire and the loose object crossed lanes. A van that came in front managed to dodge it, but changed lanes and hit the front of another truck. Most of the losses occur mostly at the time of entry and exit of the oil fields.³²" (January 20, 2018).

"He fell asleep at the wheel and crashed an oil truck in Añelo. It happened this morning at a rush hour on Route 7. Only material damage was recorded on the vehicles and the injured were treated at the local hospital³³". April 19, 2018

²⁷ <https://www.rionegro.com.ar/neuquen-un-enorme-pozo-continua-complicando-el-transito-sobre-ruta-7-EA6002240/>

²⁸ <http://www.logisticasud.enfasis.com/notas/82386-cesvi-analisis-la-problemativa-vial-vaca-muerta>

²⁹ <https://www.estadisticaneuquen.gob.ar/>

³⁰ https://www.rionegro.com.ar/la-ruta-del-petroleo-y-de-los-accidentes-AORN_5654030/

³¹ <https://www.lmneuquen.com/murio-luego-chocar-una-camioneta-petrolera-n561724>

³² http://vacamuertanews.com.ar/ver_noticia.php?id=20180120141101

³³ <https://www.rionegro.com.ar/se-durmio-al-volante-y-choco-una-camioneta-petrolera-en-anelo-JL4836964/>

"Motorcyclist died in a frontal crash on Route 7. It happened this Sunday at dawn, about ten kilometers from Añelo. Criminalistics and Road Accidentology work to determine the causes of the accident³⁴". January 13, 2019.

Figure 7.2 Accident on Provincial Route 7



7.4.7 Taxes and royalties

Taxes and royalties from oil and gas extraction activities are regulated in Argentinian Law by several instruments. Law 17.319, enacted in 1967, which contained the original oil and gas exploitation guidelines in Argentinian legislation, stated in its first article that "*deposits of liquid and gaseous hydrocarbons located in the territory of the Argentine Republic and in its continental platform, belong to the inalienable and imprescriptible patrimony of the National State*"³⁵. The Constitution reform of 1994, which in its article 124 states that "*it is up to the provinces on the native domain of natural resources existing in its territory*", motivated the modification of said legislation, completed in 2006 with the enactment of Law 26.197, which regulates ownership of the resources of the subsoil and establishes the Provinces as owners of the mainland deposits^{36,37}.

Law 27.007 currently sets the royalty at 12% of the oil or gas extracted, with the possibility for the granting power to reduce them up to 5%. They may increase by 3% in each concession contract extension, up to a maximum of 18%³⁸.

In addition, in Rio Negro, according to Provincial Law N° 1946, ten percent (10%) of all oil, gas and/or mining royalties of the Province of Rio Negro will be allocated to the Municipalities of the Province. 65% (of these 10%) is distributed between 39 municipalities in Rio Negro, using the co-participation index, and 35% between the 9 oil producing-municipalities according to production volumes. The remaining original 90% can only be invested in infrastructure works. 6.5% of the 90% goes to the 9 oil producing-cities³⁹. In Neuquén, in turn, hydrocarbon royalties are distributed as follows: 3% goes to the *Instituto*

³⁴ <https://www.lmneuquen.com/motociclista-murio-un-choque-frontal-la-ruta-7-n619769>

³⁵ See Law 17.319 in: <http://servicios.infoleg.gob.ar/infolegInternet/anexos/15000-19999/16078/norma.htm>

³⁶ See Law 26.197 in: <http://servicios.infoleg.gob.ar/infolegInternet/anexos/120000-124999/123780/norma.htm>

³⁷ From this moment on, the provinces assumed the Authority of Application in the sector, with the faculty:

- To exercise control of exploration permits, concessions of exploitation and transportation of hydrocarbons;
- To demand the fulfilment of the contractual obligations and of the payment of fees and royalties;
- To apply the regime of sanctions foreseen in Law 17.319/67 (fines, suspension, expiration, among others).

³⁸ See Law 27.007 in: <http://servicios.infoleg.gob.ar/infolegInternet/anexos/235000-239999/237401/norma.htm>

³⁹ See the discussion at: <https://www.rionegro.com.ar/rio-negro-abre-el-juego-para-discutir-las-regalias-petroleras-CE5879260/>

Autárquico de Desarrollo Productivo (IADEP), 14.55% to the Municipal co-participation (Provincial Law N° 2148⁴⁰) and 82.45% to the general revenue of the Public Administration⁴¹.

According to the Provincial Secretariat of Energy, Rio Negro would have increased its oil royalties by 80% in 2018. That year the province would have raised \$4.4 billion, that is, \$2 billion more than in 2017. Thus, the item will represent 11% of total public revenue, compared to 8% during the previous year. For 2019, the Provincial Secretariat of Energy anticipates a similar growth⁴². In Neuquén, the Provincial Government received for all royalties and canon 43% in 2008, 26% in 2013 and now is experiencing a new growth period in 2018 with 32% of their total resources⁴³. Oil royalties amount approximately to 12.4% and gas royalties to 16.7%.

Past public budget growth in the region, reportedly, did not translate into significant poverty reduction, and it has been surrounded by public corruption accusations⁴⁴.

7.4.8 Economic Dynamics, Local Employment, Land Use

7.4.8.1 Economic structure

In Neuquén, oil/hydrocarbon exploitation, petro-chemistry, tourism, agriculture (fruit) and livestock are the most dynamic and GDP-contributing activities. Neuquén GDP reached 12,943 million pesos, representing a GDP per capita of 21,535 pesos, and contributing 1.9% of the national GDP in 2013⁴⁵. The main economic activities in Nequen are presented in the following table.

Table 7-4: Economic Structure (Neuquén)⁴⁶

Sector	% of Neuquén GDP (2013)	Amount (pesos)
Primary	36.7	4,752 million
Mine Exploitation	35.5	
Agriculture, Livestock and Fishing	1.2	
Secondary	15	1,958 million
Tertiary	48	6,233 million
Commerce, hotels and restaurants, transportation and communication, financial intermediation, and corporate and real estate services	31	
Public administration, health, education, personal services	17	

Source: FAO/PROSAP/Neuquén Province Government 2015

⁴⁰ See Provincial Law N° 2148: <http://www.jusneuquen.gov.ar/31242004-hidrocarburo-reglamentacion/>

⁴¹ See data produced by the Province at: <https://www.energianeuquen.gob.ar/evento/5.pdf>

⁴² See the discussion at: <https://www.rionegro.com.ar/rio-negro-abre-el-juego-para-discutir-las-regalias-petroleras-CE5879260/>

⁴³ See data at <https://www.energianeuquen.gob.ar/evento/5.pdf>

⁴⁴ See the discussion at <https://www.rionegro.com.ar/un-millonario-presupuesto-para-neuquen-riesgo-u-oportunidad-EM5842677/>

⁴⁵ FAO/PROSAP/Neuquén Province Government 2015

⁴⁶ FAO/PROSAP/Neuquén Province Government 2015

In Rio Negro, the most dynamic GDP-contributing activities are agriculture (fruit), tourism, oil/hydrocarbon exploitation, mining, fishing and livestock. Rio Negro GDP reached 10,244 million pesos, , and 1.5% of National GDP⁴⁷.

Table 7-5: Economic Structure (Rio Negro)⁴⁸

Sector	% of Rio Negro GDP (2013)	Amount (pesos)
Primary	17.4	1,783 million
Mine Exploitation	12.6	
Agriculture, Livestock and Fishing	4.8	
Secondary	13.2	1,348 million
Tertiary	69.4	7,113 million
Commerce, hotels and restaurants, transportation and communication, financial intermediation, and corporate and real estate services	51.2	
Public administration, health, education, personal services	18.2	

Source: FAO/PROSAP/Rio Negro Province Government, Agriculture, Livestock and Fisheries Ministry 2015

7.4.8.2 Occupational structure

In Neuquén, activities linked to commerce and services involve most of the workforce (approximately 60% of the total). The mining and oil sector, which contributes the most value to the province, accounts for only 14.6% of the registered private workforce (a percentage reduced if public sector and non-registered workforce are included).

Table 7-6: Wage-earning labour in the private sector (Neuquén)

Sector	% of Neuquén wage labour (2014)	N (thousands)
Agriculture, livestock and fishing	4.9	5.3
Mining and oil	14.6	15.8
Industry	7.1	7.7
Commerce	20.5	22.3
Services	38.9	42.2
Power, gas and water	1.7	1.9
Construction	12.2	13.3
Total	100.0	108.4

Source: FAO/PROSAP/Neuquén Province Government 2015

Similarly, in Rio Negro, activities related to commerce and service sectors involve most of the workforce (likewise, approximately 60% of the total). The mining and oil sector, which also contributes the most value, accounts for even less of the registered private workforce, only 2.5% (a percentage reduced if public sector work and non-registered workforce are included).

⁴⁷ FAO/PROSAP/Rio Negro Province Government, Agriculture, Livestock and Fisheries Ministry 2015

⁴⁸ FAO/PROSAP/Rio Negro Province Government, Agriculture, Livestock and Fisheries Ministry 2015

Table 7-7: Wage-earning labour in the private sector (Rio Negro)

Sector	% of Rio Negro wage labour (2014)	N (thousands)
Agriculture, livestock and fishing	22.0	25.0
Mining and oil	2.5	2.9
Industry	8.5	9.7
Commerce	20.8	23.7
Services	37.8	42.9
Power, gas and water	1.5	1.7
Construction	6.9	7.9
Total	100.0	113.7

Source: FAO/PROSAP/Rio Negro Province Government, Agriculture, Livestock and Fisheries Ministry 2015

7.5 Cumulative Impacts

The significance of a cumulative impact is evaluated in terms of the effect of vulnerability and / or risk to the sustainability of the integral condition of the VEC. Being limited by the information available in the public domain and the information generated by existing environmental and social studies, this cumulative impact assessment was mainly qualitative and descriptive.

The conclusions have been prioritized as follows:

- **Major Priority:** it is necessary to take action in the short term to mitigate the adverse cumulative effects, considered of the greatest significance, and which are currently occurring on the VEC and that the Project would contribute further affect;
- **Medium Priority:** action is required in the medium term to mitigate the potential adverse cumulative effects that could occur on the VEC; and
- **Minor Priority:** no action is required since the expected cumulative adverse effects on the VEC are considered less significant.

7.5.1 During the construction phase

7.5.1.1 Incremental contribution of pollutant emissions and discharges

Air emissions from the wells drilling process will include suspended dust from existing access roads to the PAD, construction of new access roads to the PAD, and construction of PAD itself; suspended dust from personnel and cargo transportation activities; and combustion gases from power generators present at drilling sites and camps. Other hydrocarbon activities in the same Vaca Muerta formation will also be generating emissions which will collectively impact in local air quality. If transit of vehicles and transport of material and personnel for the activities is jointly evaluated with the current operations in neighbouring oilfields, emissions could be considered of medium intensity. However, given the strong prevailing winds characteristic of the Project area, it is expected that impacts on air quality on this stage would be temporary and reversible in the short term.

Noise will be considered as a cumulative impact regarding the previous incidence of noise from existing activities and that the new VOG and AM's construction activities will be of high intensity but temporary, direct and reversible once the construction activities cease. Noise could also have synergy with other impacts in the area related to health and biodiversity, possibly including bird migration.

All hydrocarbon activities will be generating water discharges mainly from drilling activities and also from domestic activities. Considering that the volume of well-test water consumption discharges in the

Vaca Muerta formation will be significant, stringent water treatment and final environmental discharge standards should be met.

This cumulative impact has been considered a **Major Priority** because it is necessary to take actions in the short term to prevent the environmental impacts of untreated effluent discharges.

7.5.1.2 Increased erosion

Given the regions semiarid climate and susceptibility to surface erosion, construction of pipelines, aqueducts, PADs and other construction activities such as camps requiring removal of vegetation, excavation, grading or other interventions, present a significant risk of accelerating erosion if not properly managed. Transit of vehicles and heavy machinery will also compact soils, reducing infiltration, aggravate erosion, and reduces the ability to conserve moisture and adds sediments to seasonal channels.

The increase of erosion in the Project area due to construction activities and the parallel activities of other developments will be cumulative in a medium or high intensity, but irregular with an effect in the medium term, and permanent if not controlled.

Considering that the effect of erosion will be determined in the medium and long term, this cumulative impact is considered of **Medium Priority** because actions are required in the medium term to mitigate the potential erosion and compaction of soils in the intervened area.

7.5.1.3 Reduction of water flow in the Rio Neuquén Basin due to multiple withdrawals

Current aqueduct activities performed by SIMA, and the project's water consumption in the long term, would generate a reduction of water availability in the region from both the Neuquén River and underground wells; the potential cumulative impact in water reduction due to multiple withdrawals by the Project and other developments in the area would be of significance. To minimize this impact in the long term VOG has considered in the project to build a future flow back treatment plant in order to maximize recycling of this water, and minimize new water abstraction. YPF at Loma Campana already operates a similar facility.

The impact of reduction of water availability in the basin due to multiple withdrawals has been considered as **High Priority**. Therefore, efficient use of water and on prevention of available freshwater resources depletion in the short term is being administrated by the local Secretariat of Hydric Resources, and permits for fresh water abstraction need to be approved by the local authorities. In the long term, water reduction impacts are being addressed/ mitigated by the Project and other water users in the region by strategic actions (ie.water use reduction, recycling of backflow water, etc.)

7.5.1.4 Interference with wildlife movement or biodiversity in general

Construction activities will likely reduce the carrying capacity and wildlife movement in an ecosystem, not only because of vegetation clearance and soil removal—considered as direct impact—but also because of noise, emissions and effluent discharge, soil compaction, lighting, and human presence—indirect impacts—that will be generated during this stage.

Hydrocarbon companies' policies regularly prohibit hunting, but are not entirely effective in preventing road kill, nest and burrow destruction, or in wildlife rescue and relocation. The project does not affect any national parks or protected areas, threatened/endemic species have been identified in the area but no endangered/critically endangered. Given that the region is being affected by the Vista project and other development activities, the impacts on biodiversity could be cumulative.

Regarding flora aspects, the local vegetation will be impacted by the project activities referred previously, but it is also important to consider a current socio-economic aspect that also impacts the region. It is that the natural shrub vegetation is randomly exploited for fuelwood extraction, an unsustainable and uncontrolled activity that may cause environmental impacts. Thus, a potential

decrease of the floristic composition and the vegetal cover entails in turn the following main effects aggravation: changes in habitat conditions for the wildlife; alteration in vegetation distribution patterns; microclimatic modifications; by all actions on the VEC [FC1] (from the project and from other cumulative, synergic impacting-actions).

This cumulative impact has been considered of **Medium Priority** because actions are needed in the medium term to mitigate the adverse cumulative effects.

7.5.1.5 Saturation of basic human services due to in-migration

The arrival of workers in Añelo, not only means an increase in the number of inhabitants in the community, it also means an increase in the demand for local services such as education and health.

The rapid growth of Añelo triggered by the development of the Vaca Muerta oil field, one of the largest reservoirs of shale oil and shale gas in all of Latin America. This has generated employment and business development expectations, and resulted in significant in-migration.

This includes skilled expatriate workers, but the bulk of the work force will be local, and mainly during the construction period of the project, so the cumulative impact will be temporary and low magnitude.

In the same way, the Municipality of Añelo, together with other State institutions, have been responding to the greater demand for local services, through the creation of new education and health services (construction of the Añelo Hospital, for example). However, Vista Oil & Gas should monitor the origin of its workers. If done well, this cumulative impact is considered **Minor Priority**, because no action is required, since the expected cumulative adverse effects on the VEC are considered less significant.

7.5.1.6 Transit of vehicles

The Provincial Route N° 7 (RP7) is one of the busiest routes in Neuquén province and is the backbone of the Oil Corridor. Trucks that transport equipment and oil machinery use RP7, as well as vehicles transporting personnel, supplies and equipment to and from the oil wells. The traffic on RP7 is consistent throughout the day and in both directions of the road. It currently records an average daily traffic of 5,790 vehicles on the Centenario-Route N° 51 stretch and 3,812 vehicles on the route between the junction of Routes N° 51 and N° 849.

According to data from the Provincial Bureau of Statistics and Census of Neuquén⁵⁰, during the year 2017 there were 85 incidents with fatal victims, of which:

- 40% were urban and 60% rural.
- 53% occurred at night and 47% during the day.
- 81% collided with another vehicle and 19% overturned.

Similarly, the local media has reported several traffic accidents occurred between 2015 and 2019, in the so-called “Oil Route” and Añelo. Some of the most significant ones are presented:

"The Oil Route and the accidents. Last year, eleven people died in the Vaca Muerta area. The intense traffic of trucks, imprudence and lack of controls, are a set of factors that make the road an unfriendly journey. The last year there were 11 deaths in the surroundings of Añelo, the

⁴⁹ http://w1.lmneuquen.com.ar/07-07-12/n_especiales51.asp

⁵⁰ <https://www.estadisticaneuquen.gob.ar/>

number of victims increased with the increase in traffic linked to oil activity⁵¹" (January 11, 2015).

To this must be added other consequences that would affect the conditions of life in Añelo. Among them are the increase in air pollution caused by fuel combustion that drive in congested traffic at low speed. Similarly, the highest noise levels in the vicinity of the main roads (Provincial Route N° 17, N° 8, Route N° 51 and N° 7).

As Vista representatives informed, the Project uses Route 7 to access the Bajada de Palo Oeste facilities, however it is possible to access the Project area through route 151, which is less congested by other the O&G companies. Although information related to flows of personnel and equipment during the construction stage versus the operation stage was not available for this assessment, Vista contractors currently transport workers in buses in accordance with the work rotation of 14 working days per 7 days of rest.

Each non conventional project will also result in some development of the local area, in particular in terms of improving access between local communities and improving access to adjacent land through improvement of roads, as well as providing some local employment and other economic opportunities

The increase in vehicular traffic, risk of accidents, increased noise, particulate matter and other emissions is negative, temporary (construction stage) and local in extension. Especially in RP7, RP8, and RP51, because they are very important for the oil industry (these roads connect the industrial park of Centenario, and they reach Añelo, known as the "capital" of Vaca Muerta).

"The Vaca Muerta boom is collapsing Neuquén routes, which are already a real headache for oil companies⁵²".

The cumulative effect would manifest itself in temporary greater vehicular congestion and in the increase of the time of transfer, both pedestrian and vehicular, as well as in the increased risk of vehicular accidents, increased particulate matter and other emissions, and noise due to the increased presence of vehicles.

This cumulative impact has been considered of **Medium Priority** because actions are needed in the short term to mitigate the adverse cumulative effects, including increased risk of accidents, traffic, particulate matter, other emissions and noise.

7.5.1.7 Economic Dynamics

Increased Demand of Local Goods and Services

Several unconventional oil and gas extraction projects are currently being developed or are in the process of being developed between Neuquén and Rio Negro provinces . The Vaca Muerta formation, spreading 18,641 square miles (30,000 km²), is one of the largest unconventional oil and gas reservoirs on the planet. As mentioned before, Vaca Muerta has 34 unconventional hydrocarbon concessions, of which 7 are in massive development, that is, 4% of the total surface of the basin. Among these are the ones operated by Pluspetrol (Loma Jarillosa, Loma Guadalosa, Cinco Saltos), YPF (Loma Campana, Loma La Lata, Mata Mora, Los Caldenes, La Amarga, El Medanito), Shell (Sierras Blancas, Cruz de Lorena), and several others. These developments have an impact that largely exceeds the local GDP participation. As it has been noted before *"their most important effects are produced through the impacts that the activity produces in other branches and agents of the economic system from the multiple links*

⁵¹ https://www.rionegro.com.ar/la-ruta-del-petroleo-y-de-los-accidentes-AORN_5654030/

⁵² <https://www.lapoliticaonline.com/nota/118763-nacion-y-neuquen-se-echan-la-culpa-por-el-caos-en-el-corredor-petrolero-de-vaca-muerta/>

that are generated in the territory, and in the finances and development of the own public sector”⁵³ (impacts on royalties and the public sector will be treated later).

In the urban areas near these developments, demand for local goods and services and indirect jobs are going to rise in the municipalities that will host most of the new oil and gas extraction-related workforce. These workers, either local or immigrated⁵⁴ will require goods and services to satisfy their basic needs, and will benefit existent and new businesses that will provide those goods and services by increasing their commercial activity. Among the main goods and services that will be required are lodging, catering and/or restaurants, laundry shops, etc., among several others.

There are no estimates available of the amount of local labor currently employed on an industry level, nor of the amount that will be required for future development. Based on the experience in other several similar oil and gas projects in Latin America, and based on the nature of these projects (which are capital- and not labor-intensive) the significance of the impact on demand of local goods and services should not be high, if only one project is to be considered. However, given the amount of projects under development and planned for development, the impact is regarded as high and the priority as major. Action on the short term is required in order to prevent and/or mitigate negative impacts and potentiate positive ones. For example, assistance and/or training regarding business formation, client service, and health and safety standards could be provided to locals interested in creating their own businesses and taking advantage of these opportunities.

Creation of Indirect Jobs

In addition, current or new businesses will require extra labor to provide goods and services and harness the increased commercial activity. These new jobs are referred to as indirect, arising from the direct demand created by the oil and gas projects.

As mentioned before, there are no available estimates of the amount of local labor currently employed, nor of the amount required for future development. Figures regarding indirect employment, typically expressed in number of indirect jobs created for each direct job provided by the industry, are difficult to estimate even with proper data. Nevertheless, based on the current level of development (approximately 4% of the total surface of the basin) and the level of development that is forecast, the significance of these impacts on an accumulated level is likely to be high and a **Major Priority**. Action on the short term is required in order to prevent and/or mitigate negative impacts and potentiate positive ones.

7.5.2 During the operation phase

7.5.2.1 Interference with migratory routes, wildlife movement or biodiversity

During operational activities, the remaining wildlife species in the area could be affected by noise, discharges, soil compaction, and air emissions—indirect impacts—that will be generated during this stage.

⁵³ Landriscini, G., & Carignano, A. (2015). Hidrocarburos no convencionales en la Cuenca Neuquina en Argentina. Inversión, innovación y empleo. Una oportunidad para las PyMEs. *Pymes, Innovación y Desarrollo*, 3(1), 54-78.

⁵⁴ According to information from the 2010 census, Añelo had a population of 2689. However, due to employment expectations due to the proximity of the Vaca Muerta oil field, its population is said to have tripled, and by 2019 it would have more than 8,000 inhabitants. Some estimates claim that the population could be around 10,000 in 2019. However, since no official studies have been published, these figures still need confirmation. This accelerated growth is explained by the expectations generated by the presence of the Vaca Muerta oil field.

As mentioned, hydrocarbon companies’ policies prohibit hunting, but are less effective in controlling road kill and in wildlife relocation if needed. The presence of threatened/endemic species identified in the area still need more research in order to know about their behavior and movement patterns, especially when nesting, breeding or feeding. It is important to indicate that, habitat fragmentation affects the movement and survival of the species; however, in the study area there is no evidence of presence of populations in danger of extinction.

This cumulative impact has been considered of **Medium Priority** because actions are needed in the to mitigate the adverse cumulative effects in the future.

7.5.2.2 Incremental contribution of pollutant emissions impacting global climate change

It is generally known that the increase of carbon in the atmosphere, generated by the burning of fossil fuels, will cause dramatic ecological changes in forests, extinction of plants and animals, disappearance of glaciers, decrease of sources of fresh water, changes in crops, floods, loss of coral reefs, famines, landslides, storms, diseases, among other cumulative impacts in both the physical component and the biotic component.

For this reason, the synergy and accumulation of actions in the environment given by the oil activity itself but, above all, given by the final consumption of fossil fuels, make it necessary to evaluate the processes of renewable energy expansion. Up to date, the world's energy consumption cannot be completely supplied by renewable energies, which is why the project and the other productive developments in the area are proceeding. However, the rate of hydrocarbons exploitation acceleration, must be observed, so that future conditions could prevent a potential substitution of energy sources or VOG and AM could prevent potential compensatory measures. Strategies at this level do not correspond to VECs affected directly by the project but indirectly. Measures should be taken to prevent impacts of climate change in the Project, because in the long term, natural hydrological cycles will likely affect the water supply on which the Project depends.

Future estimations of CO₂ equivalent to be released indirectly by oil production activities, could consider the following data:

Table 7-8: Oil production per day estimation

Oil Production per well	Unit	wells	Total production	unit
875	barrels/day	110	96.250	barrels/day
Or 140	m3/day	110	15.400	m3/day

The Project is in the early stages of design and therefore, details on specific air emission sources are not yet available. However, all sources will comply with applicable IFC air emission standards. An approximate preliminar order of magnitude of estimated emissions and GHG expected to be contributed by the VOG project are approx. 119,400 tnCO₂e per year.

For this reason, the indirect impact of Incremental contribution of pollutant emissions impacting global climate change has been considered as of **Major Priority**. Actions should be coordinated now with local and national strategies to mitigate or compensate the adverse cumulative effects.

7.5.2.3 Tax and royalties

According to the Provincial Secretariat of Energy, Rio Negro increased its oil royalties by 80% in 2018. That year oil royalties in the province were \$4.4 billion, or \$2 billion more than in 2017. This

represents 11% of total public revenue, compared to 8% during the previous year. For 2019, the Provincial Secretariat of Energy anticipates a similar growth.⁵⁵

In the Neuquén Provincial Government, in 2008 oil royalties amounted to \$1 billion, and in 2013 \$2 billion, increasing by 101% in 5 years. By 2018, they had increased to \$9 billion, a 354% increase in 5 years. In turn, gas royalties in Neuquén in 2008 amounted to \$761 million, and in 2013 \$840, increasing by 10% in 5 years. By 2018, they had increased to \$12 billion, a 1388% increase in 5 years. While in 2008 oil royalties amounted to 22% of all public income, despite the growth in absolute figures in 2018 they reduced to 12% of all public income. Gas royalties have recuperated after dropping from 17% to 6% from 2008 to 2013, to increase to 17% in 2018.

Based on the current level of development (approximately 4% of the total surface of the basin) and the projected future development, the share of public finance represented by oil and gas royalties (being it not the largest item on the budget) and the risks of poor public spending and the potential impact on the local population (either positive if public spending is properly executed and negative if it is not), the cumulative impact on royalties is regarded as **Medium Priority**.

⁵⁵ See the discussion at: <https://www.rionegro.com.ar/rio-negro-abre-el-juego-para-discutir-las-regalias-petroleras-CE5879260/>

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