Jacobs

Environmental Impact Statement

Executive Summary

Executive Summary

I. Project Factsheet

Table I-1. Project Fact Sheet

<table>
<tr><td>Name of Project</td><td>120 MW AYA PUMPED-STORAGE PROJECT</td></tr>
<tr><td>Project Location</td><td>Barangay West Poblacion
Municipality of Pantabangan, Nueva Ecija</td></tr>
<tr><td>Nature of Project</td><td>Pumped-Storage Hydropower Plant</td></tr>
<tr><td>Scale of Production</td><td>The Project will have a maximum generation capacity of 120 MW</td></tr>
<tr><td>Total Project Area</td><td>Approximately 5.85 ha during construction and 3.24 ha during operations</td></tr>
<tr><td>Project Capital Cost</td><td>Php 6 Billion</td></tr>
<tr><td>Project Proponent</td><td>FIRST GEN HYDRO POWER CORPORATION (FGHPC)</td></tr>
<tr><td>Proponent Representative</td><td>Dennis P. Gonzales
Vice-President</td></tr>
<tr><td>Proponent Address</td><td>Main Office:
6th Floor Rockwell Business Center Tower 3, Ortigas Avenue, Pasig City 1604

Plant Office:
Pantabangan, Nueva Ecija</td></tr>
<tr><td>Project Components and area</td><td>The main project components and their respective approximate areas are as follows:
<table>
<tr><th>Project Component</th><th>Construction (ha)</th><th>Operation (ha)</th></tr>
<tr><td>Upper Inlet/Outlet Structure
Inlet Channel
Intake Transition
Gateshaft
Approach Tunnel
Bellmouth
Approach Channel and Upper Cofferdam</td><td>1.37</td><td>0.77</td></tr>
<tr><td>Waterway
Pressure Tunnel
Birufication and Penstocks
Main Inlet Valves</td><td>1.08</td><td>1.02</td></tr>
<tr><td>Powerhouse
Lower Inlet/Outlet Structure
Powerhouse
Two (2) Vertical Reversible Pump-Turbines and Motor-Generators</td><td>2.21</td><td>0.33</td></tr>
<tr><td>Control Building</td><td>0.08</td><td>0.01</td></tr>
<tr><td>Reservoir Division Sill</td><td>0.17</td><td>0.17</td></tr>
<tr><td>Access Road</td><td>0.94</td><td>0.94</td></tr>
<tr><td>TOTAL</td><td>5.85</td><td>3.24</td></tr>
</table></td></tr>
</table>

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EIS Preparer	**JACOBS PROJECTS PHILIPPINES, INC.**
Contact Person	KATHERINE GAVILE Project Manager
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II. Background Information

Luzon's growing demand for more power has placed a strain on its electricity grid. In order to partially address these demands and provide stability to support continuous adaptation and utilization of renewable energy, First Gen Hydro Power Corporation (FGHPC) proposes the 120 MW Aya Pumped-Storage Project (AYA PSP), located at the upstream tailrace of the of Masiway Reservoir and downstream of Pantabangan Hydro Electric Power Plant (PHEPP).

The project is a pump-storage facility with two units of 60 MW turbines, for a total of 120 MW generation capacity. FGHPC will utilize this proposed storage facility to address intermittent regulation of power in Luzon. This will also provide technical capability in delivering ancillary services, which will allow for full-year operations of independent irrigation demands from the Pantabangan Reservoir.

The project will make use of the existing Aya and Masiway Reservoirs. Options for alternative sites will require the construction of an upper reservoir that will utilize the Masiway reservoir and Aya Lake as the lower reservoir. No other option for a power generation system (pumped-storage) was considered for the project since the resource that is required to generate the power is already available through the two (2) reservoirs. The proposed project is envisioned to be a highly flexible operation being able to operate as a conventional pumped-storage plant that will release from the upper reservoir during peak hours and the same volume pumped during off-peak hours.

III. Process Documentation

Jacobs followed the EIA process flow as stipulated in DAO 2003-30, DMC 2014-005, and DAO 2017-05 incorporating the additional steps to enhance public participation for the environmental impact assessment process.

Protocols for sampling for soil, water, biota, and air were taken from relevant DENR guidelines and results of the analyses were also compared to the applicable standards. Transects observations and quadrats were employed for terrestrial biota with the observed species compared against the International Union for Conservation of Nature (IUCN) Red List of Threatened Species to determine if there are vulnerable species within the project site. Contingent to the water quality sampling, samples for aquatic ecology assessment

such as planktons, benthos, macroinvertebrates, and fish were also collected and assessed to determine the condition of freshwater resources. As for the People module, an updated household and perception survey was conducted among the host and neighboring barangays to determine any changes from the demographic, socio-economic and health data documented from the municipal data and previous studies. The perception survey was meant to determine the acceptability of the project among the stakeholders.

The scheduled public scoping was conducted on 21 February 2020 at the Employee Center, FGHPC Housing Compound, Barangay Fatima, Pantabangan, Nueva Ecija from 10:00 a.m. to 12:00 p.m.

The EIA team consists of the following specialists and consultants:

Table I-2. EIA Team Members and Roles

Name	Role
Katherine Gavile	Project Manager
Malvin Kenneth Manueli	Senior Geologist, Pedology and Geohazard Specialist
Karel Joyce Padayao	Permitting Specialist
Anna Margarita Termulo	Land Use and Classification Specialist and GIS Analyst / Database Manager
Rodel Alberto	Forrester and Terrestrial Ecology (Flora and Fauna) Specialist
John Paul Pareja	Water Quality Specialist
Engr. Jerome Rafael	Water Quality Specialist
Malvin Kenneth Manueli & John Paul Pareja	Hydrology Specialist
Veronica Atienza	Aquatic Ecologist
John Victor Mateo	Environmental Engineer
Dr. Joan Julia	Senior Air Quality Specialist
Anthony Magsombol	Air Quality Specialist
Fernando Karlo Gavile, Jr.	Anthropologist and Sociologist
Jiro Adorador	Fauna Specialist
Zhereeleen Dispo Meneses	Fauna Specialist
Diane Shiela Castillo	Senior Wildlife Specialist
Ralph Dorado	Abandonment Plan
Ferdimar Biscocho	First Gen Hydro Power Corporation (FGHPC) - Assistant Vice-President / Project Lead
Andre Lloyd Torres	First Gen Hydro Power Corporation (FGHPC) - Assistant Manager / Deputy Project Lead
Juan Paulo Lorenzo Bueno	First Gen Hydro Power Corporation (FGHPC) - Engineer I / Project Engineer

3.1 EIA Schedule

The table shows the EIA schedule for the proposed 120 MW Aya Pumped-Storage Project. Initially, the Information, Education and Communication (IEC) for the various stakeholders conducted on 16-21 September 2019 which covered the host barangay West Poblacion and indirect impact barangay, Fatima.

The Public Scoping was conducted on February 21, 2020 at Employee Center, FGHPC Housing Compound, Barangay Fatima, Pantabangan, Nueva Ecija while the technical scoping meeting was held last July 17, 2020 via online through MS Teams.

Table I-3. EIA Schedule of Activities

Activity	Schedule	Venue
Consultation and Scoping Meetings		
Information, Education and Communication (IEC) for the various stakeholders	September 16 – 21, 2019	Barangay Fatima and West Poblacion, Pantabangan Nueva Ecija.
Public Scoping	February 21, 2020	Employee Center, FGHPC Housing Compound, Barangay Fatima, Pantabangan, Nueva Ecija
Request for Clarification at EMB EIA Central Office on ECC Application of FGEN Aya PSP - Submitted a letter clarification on process and chronological activities of the ECC application at the DENR EMB Region 3	May 28, 2020	
Received the reply letter regarding the project clarification on the process of the ECC application at EMB Central Office	June 15, 2020	
Request for Technical Scoping at EMB Central Office - Submitted via email to the records section regarding the request for Technical Scoping for the FGEN Aya PSP	June 22, 2020	
Received the signed Memo and MS Teams invitation for the Technical Scoping Meeting on July 17, 2020 at 1PM	July 14, 2020	
Technical Scoping FGEN Aya PSP at Central Office DENR EIA	July 17, 2020	Via Online Meeting / MS Teams
Received the signed Technical Scoping Checklist of review committee, proponent and preparer	July 28, 2020	

3.2 EIA Report Structure

Table I-4. EIA Report Structure

Section No.	Section Name	Details
ES	Executive Summary	This section contains the general overview of the findings reported from the Environmental Impact Statement.
1	Project Description	This section contains key information on the project, proponent, project development, and project options and considerations.

Section No.	Section Name	Details
2.1	The Land 2.1.1 – Land Use 2.1.2 – Geology 2.1.3 – Pedology 2.1.4 –Terrestrial Ecology	Describes the baseline conditions of the project site in terms of land use and classification, geology, geomorphology, and geohazards, pedology, and terrestrial ecology (vegetation and wildlife). The key impacts of the projects' activities and their corresponding options for prevention, mitigation or enhancement are discussed in this section
2.2	The Water 2.2.1 – Hydrology 2.2.2 – Water Quality 2.2.3 – Freshwater Ecology	This section provides the baseline assessments for hydrology and hydrogeology, water quality and freshwater ecology.
2.3	The Air 2.3.1 – Meteorology and Climate 2.3.2 – Air Quality 2.3.3 – Noise	The results of technical studies for meteorology, climate, greenhouse gas, air quality and noise are provided in this section
2.4	The People 2.4.1 – Population and Demographics 2.4.2 – Socioeconomics 2.4.3 – Cultural	This section provides a description of the socio-economic conditions present in the host communities and the likely impacts and benefits of the project.
3	Environmental Management Plan	This section summarizes the impacts identified for the project and appropriate mitigation and/or enhancement measures to address these impacts.
4	Environmental Risk Assessment	This section contains discussion on safety risks, conditions, events and circumstances that could be significant in bringing safety and physical risks, assessment of the possible accident scenarios posing risks to the environment, description of hazards for both immediate, acute, and chronic effects for man and the environment, and assessment of the project location's vulnerability to extreme climate events.
5	Social Development Plan	This section contains the company's effort in promoting community development programs to address the impacts from the project to the community and environment.
6	Environmental Compliance Monitoring	This section contains framework for the Self-monitoring Plan.
7	Emergency Response Policy and Guidelines	This section contains protocols to address project emergencies during various development phases and general standards and guidelines on health and safety.
8	Institutional Plan	This section discusses the organizational structure over-seeing the effective implementation of the project's proposed EMP.

Section No.	Section Name	Details
9	Abandonment Plan	This section discusses a high-level decommissioning and rehabilitation plan for the project

IV. Methodology

The study area for the Project is the immediate and surrounding vicinity of the project site. This includes the Municipality of Pantabangan, specifically Barangay West Poblacion (host barangay) and Barangay Fatima (indirect impact barangay). The project site is located within the Pantabangan-Carranglan Watershed Forest Reserve (PCWFR).

ArcMap (v.10.5) software of the ArcGIS suite of the Environmental Systems Research Institute (ESRI), a Geographic Information System (GIS) application, was used to create the various maps and images as well as to encode, georeferenced, digitize, and process data from the cited secondary sources.

For the barangay boundaries within the Municipality of Pantabangan, parcel maps and GIS files were obtained from the local government units as well as interviews from locals were used in order to have a thorough understanding of the extent of the boundary dispute between the two barangays. The project location is based on data obtained from FGHPC to determine the identity of the direct and indirectly impacted barangays.

All fieldwork and sampling methodologies follow relevant national and international guidelines. The following secondary data sources and references were utilized for this study:

- Pantabangan Comprehensive Land Use Plans (CLUP)
- Pantabangan Socio-Economic and Physical Profile
- Brgys. West Poblacion and Fatima Barangay Profiles
- Published works on the Pantabangan-Carranglan Watershed Forest Reserve (PCWFR)
- Department of Environment and Natural Resources (DENR)
- National Irrigation Administration (NIA)
- National Commission of Indigenous Peoples (NCIP
- Department of Agrarian Reform (DAR)
- Mines and Geosciences Bureau (MGB)
- National Mapping and Resources Information Agency (NAMRIA)
- The Philippine Institute of Volcanology and Seismology (PHIVOLCS)
- National Earthquake Information Center of the United States Geological Survey (USGS-NEIC)
- Philippine Atmoshperic, Geophysical and Astronomic Services Administration (PAGASA)
- Food and Agriculture Organization (FAO)
- Bureau of Fisheries and Aquatic Resources (BFAR)
- Relevant international scientific papers and studies
- Relevant information and studies from FGHPC

The summary for the methodology for each major section is provided below. A more detailed methodology is discussed in each module.

A. Land Classification and Use

A field survey was conducted to validate secondary information, perform ground-truthing, and hold firsthand interviews with locals on the current uses and activities of the land.

B. Geology, Geomorphology and Geohazards

Geologic field surveys were conducted. Observations made during the fieldwork were supported with photo documentation and georeferencing.

C. Pedology

The soil characterization of the study area was from data gathered in the field and subsequent laboratory results of the samples. Five (5) samples were taken within the project area. The collected samples were sent to the laboratory for nutrients, metals, and grain size analyses.

D. Terrestrial Ecology

A team of foresters and wildlife specialists conducted surveys within the project site and adjacent representative habitats. Vegetation assessment was conducted with the Nested Quadrat method while wildlife observations were conducted at pre-selected transects. Quadrats and transect locations were distributed in areas projected to be directly (inside the project site) and indirectly (outside the project site) impacted by the Project.

E. Hydrology and Hydrogeology

A high-level inventory of water users was conducted for barangays West Poblacion and Fatima to determine community water sources and use. Site surveys were also conducted at the Aya and Masiway reservoirs, in line with the water quality assessment to determine drainage channels and other surface waterways that may be impacted by the project.

F. Groundwater and Surface Water Quality

A total of five (5) stream water quality stations and two (2) groundwater stations within the vicinity of the project site were sampled. Calibrated hand-held meters were used to measure *in-situ* parameters (pH, temperature, conductivity, turbidity, Oxidation Reduction Potential (ORP), Total Dissolved Solids (TDS) and Dissolved Oxygen (DO)). Grab samples of freshwater and groundwater were collected using laboratory-provided containers. The collected samples were cool stored at approximately 4°C and preserved with appropriate reagents (as necessary) to prolong their holding time. The samples were then transported to Hi-Advance Philippines, Inc. a DENR-accredited laboratory within the same day of collection.

G. Aquatic Ecology

The sampling strategies used for field surveys were adapted from scientifically accepted methods and data analyses were based on published scientific articles and technical papers by the Food and Agriculture

Organization (FAO), Bureau of Fisheries and Aquatic Resources (BFAR), as well as numerous scientific journals in the fields of ecology, fisheries and aquatic environments.

Plankton samples were collected to further assess the health of the water bodies adjacent to the proposed project facilities. Abundance, density, diversity and evenness were assessed along with the determination of bio-indicator genera present.

A fish resources census was conducted by engaging local fisherfolk who are familiar with the fisheries resources and fishing areas within the Aya Reservoir. Interviews were conducted to gather data on fish species present and general status of catch during different seasons. Composition and abundance of the retrieved fish species were recorded and used to calculate for the estimated biomass.

Samples for benthic organisms were collected utilizing a sediment grab sampler. One grab sample was collected per sampling station. Sediment type, color and odor were described in situ while specimens were transferred into their respective sample containers and sent to the laboratory for identification.

H. Air Quality and Noise

Characterization of the baseline ambient air quality was done by conducting 1-hour air sampling at two (2) different locations. The noise monitoring for this assessment was conducted simultaneously with the ambient air sampling. Parameters measured include Total Suspended Particulates (TSP), PM10, Sulfur Dioxide (SO_2), and Nitrogen Dioxide (NO_2).

I. People

A combination of qualitative and quantitative data gathering methods was used to form the socio-economic profile of the host (West Poblacion) and secondary impact (Fatima) barangays. These methods include:

a) a household survey;
b) Focus Group Discussions (FGDs); and
c) Key Informant Interviews (KIIs)

The household survey conducted by Jacobs filled in the gaps in the CLUP. The sample sizes for each of the two impact barangays were determined at a confidence level of 95% and a margin of error of ±5. In total, the survey garnered 511 household respondents from both barangays. Barangay health workers from both communities were recruited to serve as enumerators, taking advantage of their superior knowledge of their own communities and neighbors. They were then deployed across the different zones of their barangays to perform one-to-one and face-to-face interviews to form the basis of the primary data for this profile.

V. Summary of Baseline Characterization

The detailed discussion of the findings for each module are presented in the main body of the main EIS. However, the summarized results are presented below.

A. Land Use and Classification

The project site is located within the Pantabangan-Carranglan Watershed Forest Reserve (PCWR) and reflected in the CLUP of the host municipality, in one host municipality, Pantabangan and one host barangay, West Poblacion. The total land area is about 5.85 ha and 3.24 ha during the construction and operation phase. The buffer area of 50 m is the total land area during the construction phase while 24.19 ha during operation phase. The actual land use of the project is mixture of reservoir, built up and watershed / protected area, and most of the project footprint will fall under the watershed classification. The entire project area is still within the reservoir/forestland.

B. Geology, Geomorphology and Geohazards

Pantabangan is located within the Caraballo Mountain Range and central Sierra Madre. The Project site is mainly underlain by lithologic units of the Pantabangan Formation consisting of conglomerate beds and layers and lenses of sandstone, very fine sandstone, mudstones and siltstones. Recent Aya lakeshore deposits consist of fluvial and lacustrine mixture of clay, silt and sand sediments. The municipality has a moderate to steep terrain and consequently, geohazards identified are limited to potential for slope failure and mass wasting. The project may also experience seismicity within the project life with the municipality being 3.1 km away from the nearest splay of the Philippine Fault. Due to the location and geology of the site, the project is not susceptible to flooding and subsidence and this is supported by the hazards map analysis.

C. Pedology

The soils within the project site and surrounding areas around the watershed divide of Aya Lake belong to Annam Clay Loam, largely represented by Ultisols. The soil types are represented by loam, clay loam, silty clay loam and sandy clay loam. Based on the I_{geo} system, a rating scheme which determined if soils are contaminated or enriched with metals, all soil and sediment samples exhibit practically unpolluted metal concentrations except for magnesium which is high in all sampling stations. The magnesium is a common and abundant element from sedimentary and volcanic rocks which are abundant in the area.

D. Terrestrial Ecology

The two vegetation types identified within the project site include secondary / residual forest and grassland. A total of sixty-seven (67) species of plants were identified. Thirty-nine (39) of which are native in the Philippines, twenty-three (23) are non-native but not endemic, and five (5) are endemic. Fabaceae (family of legumes) and Malvaceaesensu lato (family of mallows) are the most species-rich families with eight (8) and six (6) species, respectively. A total of thirty-seven (37) species of terrestrial vertebrates were recorded (i.e. four (4) amphibians, two (2) reptiles, twenty-eight (28) birds, and three (3) mammals) with birds as the most abundant and dominant class. Generally, amphibian, reptile and mammal fauna diversity in the project site is relatively low while avian diversity is high. The vulnerable *Anas luzonica* (Philippines Duck) and near-threatened *Macaca fascicularis* spp. *philippensis* (Philippine Long-tailed Macaque) were observed but these species are mobile and can settle in undisturbed habitats within the vicinity of the

project site.

E. Hydrology and Hydrogeology

The Pantabangan Reservoir is fed by six (6) major rivers draining from the Caraballo and Sierra Madre mountains. The Pantabangan reservoir is used primarily for irrigation, domestic water supply, and power generation. The Aya reservoir is used as a domestic water supply. The Masiway reservoir is used for power generation. The project will not impact the irrigation water requirement, domestic allocation, and power generation for the existing Pantabangan-Masiway hydropower complex. The domestic water is mainly sourced from the Pantabangan Municipal Water System (PMWS) for both the primary impact barangay West Poblacion, and the vicinity. However, communities also rely on groundwater wells for their domestic water supply. The groundwater productivity of these wells is low as a consequence of the poor aquifer characteristics. All wells assessed for this study are non-potable.

F. Water Quality

The reservoir falls under the Class C category of the DAO 2016-08 Water Quality Guidelines based on its observed beneficial use, which is primarily for fisheries and irrigation. The primary impact surface water stations generally conform to the DAO 2016-08 guidelines for Class C freshwater bodies. The primary impact groundwater stations generally conform to the DAO 2016-08 guidelines for Class A category and PNSDW 2017. Generally, all surface water quality stations met the guideline values of DAO 2016-08 for Class C waters as anthropogenic disturbances to the water resources are very minimal. The water quality of the Aya reservoir is affected primarily by the run-off from the upland forest areas. All parameters from these stations are within their respective guideline values prescribed in DAO 2016-08 for Class C Water. Primary productivity was also observed to be low in the area.

G. Aquatic Ecology

There are six (6) major rivers and several unnamed creeks drain into the Pantabangan Reservoir, while only a few unnamed creeks were found to channel into the Aya Reservoir. The sampling stations for the soft bottom benthos study coincide with the five (5) water quality sampling stations as to be able to compare and correlate findings with existing water conditions. There were no benthic samples retrieved from the stations within the Pantabangan and Aya reservoirs due to the nature of the substrate. There were no rare or threatened fish or macrobenthos were observed in the surveyed freshwater systems. Pollution indicator phytoplankton observed included the genera *Aulacoseira, Navicula, Nitzschia, Rhizosolenia, Synedra, Oscillatoria, Staurastrum, Pediastrum, Fragilaria, Eudorina*, and *Volvox* indicating eutrophication. The abundance of *Keratella, Brachionus* and copepods also lead to the indication of organic pollution and eutrophication in the studied water systems.

H. Air Quality and Noise

The project site falls under Type 1 in the Modified Coronas Classification and has two pronounced seasons: dry from November to April and wet during the rest of the year. The maximum rain period occurs from July to August then subsides during the month of October. In terms of ambient air quality, the average background levels of particulate pollutants range from 50 µg/Ncm to 81 µg/Ncm (Particulate Matter 10) and 14 µg/Ncm to 30 µg/Ncm in terms of Total Suspended Particulates (TSP). The baseline conditions of pollutants in two (2) stations were classified as “Good” based on Air Quality Indices (AQI) except for station 1 in terms of PM10 which is classified in AQI as “Fair”. On the other hand, the average background levels

of gaseous pollutant on both stations in terms of NO_2 is 1 µg/Ncm and 3 µg/Ncm in terms of SO_2. Ambient noise levels of the surrounding communities were also determined by gathering noise readings from two (2) identified sensitive receptors in and around the project site. Both sampling stations are within the standards set by the DENR/ NPCC Standards for 1-hr period monitoring (daytime). Generally, their impact is insignificant.

I. People

Both Barangay Fatima and West Poblacion's basic services, utilities, and public infrastructures are supported by the municipal government and found mostly within the barangay proper and the municipal proper. The major issues and concerns gathered from the KIIs and FGDs were scarcity of livelihood and employment opportunities, and the lack of essential infrastructure, and poor access to domestic and safe drinking water sources.

The project will result to benefits to the municipality and host barangay through payment of tax that will bring about additional revenue for the LGU, direct and indirect livelihood opportunities, enhancement of local economy, and community programs that will be implemented by FGHPC in partnership with the stakeholders and relevant agencies to address the impacts of the project and optimize the benefits.

VI. Main Impacts and Residual Effects

Environmental Aspects	Potential Impacts During Construction	Potential Impact During Operations	Residual Effects after applying Mitigation Measures	Risks and uncertainties relating to the findings and implications for decision-making	Target Efficiency
Land Use and Classification	• Impacts in terms of compatibility with existing land use • Impairment of visual aesthetics • Devaluation of land value as a result of loss of topsoil, improper solid waste management, and other related impacts	• Overall change in land use and classification will not occur.	With the application of mitigation measures, the potential impacts identified will be eliminated. The project will be in harmony with the existing and planned land use for the project vicinity. With the implementation of the environmental management plan (EMP) and proper spoils and waste management, there will be no impact in terms of land devaluation and topsoil loss.	This is not considered as a risk but rather an input to decision-making in terms of project schedule. The present classification and use of the project site may require specific clearances or agreements from relevant agencies (e.g., NIA and PAMB).	Not applicable
Geology, Geomorphology and Geohazards	• Change in surface landform / geomorphology / topography / terrain / slope • Change in subsurface geology / underground conditions • Inducement of subsidence, liquefaction, landslides, mud / debris flow, etc., and	• Groundwater may seep through tunnel walls and cause underground flooding. • Operations and maintenance of equipment and facilities may contaminate soils within the project area if leaks occur or if maintenance works are not performed properly.	With the project size during construction and operations, the change in surface and subsurface conditions are not significant to the present status of the area. With the application of the mitigation measures, the identified impacts will be reduced. However, it is understood that certain impacts may manifest or be observable once actual construction is conducted hence, continued site observations, detailed engineering investigations, and monitoring will	Given that dredging may affect the geology and may potentially result to landslides and mud/debris flow, it is important to perform the dredging activities following the best practices related to such activities that are up to date. Maintenance works of the facilities should also be done appropriately to avoid soil contamination.	100% upon implementation of mitigation measures.

Environmental Aspects	Potential Impacts During Construction	Potential Impact During Operations	Residual Effects after applying Mitigation Measures	Risks and uncertainties relating to the findings and implications for decision-making	Target Efficiency
	other geohazards	• Soil quality maybe degraded and weaken also due to vehicles and heavy equipment operation and maintenance.	be conducted to validate the impacts and their magnitude. Regular ground stabilization through compaction and use of sprinklers at disturbed areas will be done to reduce the erodibility. Vegetative cover will also be used during rehabilitation to expedite and enhance the recovery of soil quality. Applicable ESC structures will be placed in equipment washdown areas to capture sediment and contaminants. These will be maintained in accordance with approved waste management practices to properly dispose the collected material.		
Terrestrial Vegetation and Wildlife	• Vegetation removal, fragmentation and edge effects • Habitat edges / hindrance to wildlife access • Invasion of weed species and loss of important local species	• Vehicle strike – on various wildlife species could occur along access roads. • Since the area is already disturbed, hindrance to wildlife access is not anticipated since surrounding habitats outside the direct impact area will remain undisturbed.	The vegetation of the project site is characteristic of a disturbed area. However, survey areas within the vicinity of the project have noteworthy species that need to be considered. Impacts identified for the project are mainly concentrated during the construction phase and can be reduced and eliminated with the mitigation measures proposed which includes the establishment of offset areas and rehabilitation. The proposed mitigation measures will bring about a positive residual	There are no risks that will affect the implementation of the project. Uncertainties related to climate change projection may impact the environmental performance of vegetation offset and rehabilitation measures, but these can be readily addressed with innovation in environmental management strategies and continued monitoring.	100% upon implementation of mitigation measures.

Environmental Aspects	Potential Impacts During Construction	Potential Impact During Operations	Residual Effects after applying Mitigation Measures	Risks and uncertainties relating to the findings and implications for decision-making	Target Efficiency
			impact to the existing condition with the active intervention and improvement of vegetation and subsequently, habitat quality, within the project's area of influence.		
Hydrology	• Change in drainage morphology / inducement to flooding / reduction in stream volumetric flow • Change in stream / lake water depth • Depletion of water resources / competition in water use	• No potential impacts during operations	The project will not impact the existing operations of PMHEP. No surface water and natural drainage will be impacted by the project. The project will not deplete water from the reservoirs since the pumped-storage technology essentially recycles water. Most water use intensive project activities will occur during the construction phase, but the anticipated use will not compete with the local domestic water use. Mitigation measures are proposed to avoid disturbance to the present hydrologic conditions and promote water resource conservation so there are no adverse residual effects once these measures are implemented. The implementation of the project will serve as a positive residual effect since the use of the existing Aya and Masiway reservoirs will be further optimized. The project construction also requires the dredging of the Masiway Reservoir which will result to a significant environmental	There will be no risk involved in the project area's hydrology since the water resource will utilize the existing reservoirs of Masiway and Aya. The overall catchment and run-off for the watershed will remain the same. The way the project is envisioned to operate will not impact the operations of the existing PMHEP complex. Climate change may impact water supply and reservoir levels, but the project will still remain viable	100% upon implementation of mitigation measures

Environmental Aspects	Potential Impacts During Construction	Potential Impact During Operations	Residual Effects after applying Mitigation Measures	Risks and uncertainties relating to the findings and implications for decision-making	Target Efficiency
			improvement.		
Water Quality	• Degradation of surface water quality • Degradation of groundwater quality • Enhancement of climate change impacts	• Change in water quality due to accidental oil spill or chemical leak during operations and maintenance of equipment and vehicles. Run-off containing oil and waste material may lead to increase in TSS, BOD, oil and grease, etc. if mixed with water body. • Temporary increase in TSS, color, and	Impacts to surface and groundwater quality can be eliminated or reduced with the implementation of the mitigation measures such as installing of biodiversity friendly silt traps and screens during construction and utilizing grease sorbent materials during facilities maintenance. There will be minimal residual impacts to water quality and will be discussed in the water quality section. Monitoring of the Aya Lake, Pantabangan River and Masiway Reservoir will also be done regularly to assess the water	There will be no risks involved in the water quality since the water resource will utilize the available water from the Masiway and Aya reservoirs. The way the project is envisioned to operate will not impact the operations of the existing PMHEP complex as it will operate separately. It will cycle water from the upper and lower reservoirs and anticipated degradation may only be cause by poor maintenance of facilities and	100% upon implementation of mitigation measures.

Environmental Aspects	Potential Impacts During Construction	Potential Impact During Operations	Residual Effects after applying Mitigation Measures	Risks and uncertainties relating to the findings and implications for decision-making	Target Efficiency
		turbidity concentrations during purging of desilting chambers.	quality and aquatic biota assemblage in the area.	reservoirs. Climate change may impact water supply and reservoir levels, but the project will still remain viable.	
Aquatic Ecology	• Threat to abundance, frequency and distribution of species • Loss of habitat • Enhancement of climate change impacts	• Impacts to the water quality of the water sources in the area may affect the abundance, distribution and habitat of species due to the disturbance during operations.	The key impacts identified will be addressed with the mitigation measures discussed in this EIS. With the implementation of the measures incorporated in the environmental management plan, there will be no adverse residual impacts to aquatic ecology. Mitigation measures include installing of biodiversity friendly silt traps and screens during construction and utilizing grease sorbent materials during facilities maintenance. Monitoring of the Aya Lake, Pantabangan River and Masiway Reservoir will also be done regularly to assess the water quality and aquatic biota assemblage in the area.	Utilizing water from the existing reservoirs may pose potential threats and impacts to the habitat, distribution and abundance of aquatic species.	100% upon implementation of mitigation measures.
Climate, Air Quality and Noise	• Contribution in terms of greenhouse gas emissions due to vegetation clearing and fossil fuel consumption. • Degradation of air quality	• Greenhouse gas emissions. • SOx and NOx emissions in the air. • Noise produced during operations.	The impact of the project to the local microclimate and air quality are insignificant and will be further reduced with the implementation of mitigation measures. While noise levels may increase during the construction phase, the project site is at least 800 m away from the	There are no risks or uncertainties that will affect the implementation of the project.	100% upon implementation of mitigation measures.

Environmental Aspects	Potential Impacts During Construction	Potential Impact During Operations	Residual Effects after applying Mitigation Measures	Risks and uncertainties relating to the findings and implications for decision-making	Target Efficiency
	• Increase in ambient noise level		nearest settlement. Mitigation measures in the form of noise-dampening mufflers and the implementation of a buffer will reduce the noise levels that may reach sensitive receptors. There are no adverse residual effects anticipated with the implementation of the mitigation measures in the EMP. Vegetation offset and rehabilitation will bring a positive residual improvement to local conditions.		
Socio-economics, Public Health and Safety	• In-migration • Cultural / lifestyle change • Threat to delivery of basic services / resource competition • Threat to public health and safety • Generation of local benefits from the project • Traffic congestion	• In-migration from other barangays and nearby municipality. • Local cohesion may be affected due to the presence of newcomers. • Public service may be stretched due to the influx of newcomers. • Increase in solid waste.	The adverse impacts to the host community will be eliminated with the implementation of the mitigation measures which includes continued stakeholder engagement and coordination with the LGU and BGU with regards to project development and implementation. Project benefits will be optimized through direct and indirect employment and livelihood opportunities, payment of taxes that will provide resources to support basic services and infrastructure, and local community programs. No adverse residual effects are anticipated. Residual effects	There are no risks or uncertainties that will affect the implementation of the project. Future change in government organization and policies will not impact project implementation as the project supports the long-term energy, economic, and climate action goals of the Philippines.	100% upon implementation of mitigation measures.

Environmental Aspects	Potential Impacts During Construction	Potential Impact During Operations	Residual Effects after applying Mitigation Measures	Risks and uncertainties relating to the findings and implications for decision-making	Target Efficiency
			identified are beneficial as a result of project implementation. These include improvement in the quality of life of the impact communities, enhancement of local economic activities, establishment of an affordable and environmentally clean and sustainable energy infrastructure, and provision of reliable electricity. Traffic in the area may be congested but only for a very short period during construction which potentially involves delivery of materials and facilities for the project which will require trucks and loaded vehicles to access the existing provincial roads. This can be addressed by utilizing the provincial roads and highways during off-peak hours. If needed, traffic warning signs and devices will be installed to ensure a better traffic flow. Increase in solid waste may be a result of the increase in manpower in the project area. To address this, waste bins shall be provided in the designated areas where the workers will be temporarily staying		

Environmental Aspects	Potential Impacts During Construction	Potential Impact During Operations	Residual Effects after applying Mitigation Measures	Risks and uncertainties relating to the findings and implications for decision-making	Target Efficiency
			during their shift. It is expected that domestic wastes during construction will have a minimal increase because the workers, who are residents of the nearby barangays will go home after their shift. Construction related wastes will be contained in their respective bins and shall be temporarily stored in the designated waste containment area. These will be collected by a DENR accredited waste hauler as scheduled.		