**Detailed feasibility study report • Template**

Detailed Feasibility Study

of [Site name]

Solar Drinking Water Project

Project title: [Title]

Project code: [Code]

Date: December 22, 2023

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| **Prepared by** | **Submitted to** |
| [Company name]  [Company address] | [Company name]  [Company address] |

List of separate attachments submitted along with this report:

1. Meeting minutes/permission letters
2. Rate analysis of components used.
3. Structure analysis calculations and report (solar PV mounting structure)
4. Engineering drawings (horizontal roughing filter, collection tank, distribution tank etc.)
5. Equipment datasheets
6. Single-line diagram
7. Site map layout (Google Earth .kml file)
8. Water quality test certificate

Glossary

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# Executive Summary

*Describe briefly in* ***one page*** *the design and outcomes of the detailed feasibility study. The Executive Summary should include the key information of the study.*

*Paragraph #1*

1. *Site location*
2. *Number of households/populations*
3. *Date when the on-site survey was carried out*

*Paragraph #2*

1. *Status of electricity access*
2. *Catchment area*
3. *Daily drinking water requirement*
4. *Ownership model*

*Paragraph #3*

1. *Land availability for solar array installation, horizontal roughing filter, pump intake, reservoir tanks and water transmission and distribution path*
2. *System description (solar array capacity, pump capacity, inverter capacity, reservoir tank capacities)*

*Paragraph #4*

1. *Total system cost*
2. *Cost of electromechanical, civil and water transmission and distribution system*
3. *Key financial parameters from economic analysis (eg. IRR, payback)*

*Paragraph #5*

1. *Major project risks and mitigations*
2. *Conclusion*

# Site details

## Location

*Describe the location of the site and provide information about,*

1. *Site address (ward number, rural municipality, district and province)*
2. *Site coordinates*

*Figure suggestions*

1. *Bird’s eye view of the site with pins on catchment area and nearest market centre*

## Site access

*Describe the accessibility of the site. Provide information about,*

1. *Access route description (vehicle access, type of road/path, seasonal, all-weather or earthen, gravelled, black-topped etc.)*
2. *Observations of population/household density in the site area*
3. *Name and distance from the nearest city and airport*
4. *Vehicle accessibility-month wise*

*Photo suggestions*

1. *Bird's eye view of the site location within a few hundred meters of ground elevation showing the village, road access and drinking water households*
2. *Access road/path*

## Demography

*Describe the demography of the site area. Provide information about,*

1. *Population*
2. *Number of households, private and public institutions*
3. *Household and institutions distribution by ‘toles’ or wards*
4. *Types of population (ethnicity-wise)*
5. *Income sources of community*

*Photo suggestions*

1. *Focus group discussion*

## Security

*Describe the security aspects of the site area from the perspective of the solar drinking water pumping system that is to be built. Provide information about,*

1. *Security of solar array location*
2. *Security of pump intake location*

*Photo suggestions*

1. *North, South, East and West view of solar array location*
2. *North, South, East and West view of pump intake location*

## Telecommunications and internet access

*Describe coverage of mobile network and internet access. Provide information about,*

1. *Best mobile carrier name and internet service provider*
2. *Type of mobile data connection (for example, calls only, 2G only, 3G only, 4G etc.)*
3. *Reliability of mobile network*
4. *Nearest facility with internet access (for example, ward office, rural municipality office) and its distance from the solar array location*

## Climate

*Describe the climate of the region based on data trends obtained from reliable sources (such as nearest weather stations, Meteonorm software, etc.). Provide information about,*

1. *Graph on annual temperature trends*
2. *Graph on annual precipitation trends*
3. *Notes from DFS regarding extremities in climate and weather- conditions like flooding, landslide, lightning, etc. that concern the solar drinking water system*

## Current status of electricity

*Describe the current status of household electricity sources on the site. Provide information about,*

1. *Plans, data, and information on grid electricity access collected via NEA, or LG/PG*
2. *Current household electricity sources (for example, grid, solar home systems, diesel generator, etc.)*
3. *Nearest location with grid electricity access and its distance from the site*
4. *Remarks on electricity infrastructure at the site (for example, distribution poles already erected, micro-hydro project, SMGs, planned for the same site, etc.)*

## Community perspective

*Describe the observations and findings from the survey and focused group discussions with the community. Provide information about,*

1. *Awareness of the users about solar drinking water pumping systems (for example, understanding of water output variability concerning weather conditions, required maintenance of the system, sustainability, etc.)*
2. *User committee information (if available) including registration status, number of members, local representation among members, etc.*
3. *Willingness to pay for water, understanding/acceptance of tariff mechanism.*
4. *Any type of tariff that the community is currently paying.*
5. *Any outstanding loans of the user group/committee? For example, a user committee may already have been formed during MHP/SMG project and they may have an outstanding loan to pay. This could also be the motivating factor to pursue solar drinking water for additional revenue-generating activities.*
6. *Social cohesion or divisions within the community, social and political conditions, etc.*
7. *Any social concerns regarding the solar drinking water project*
8. *Water source registration if any details can be written about the water source and security section*

# Site assessment

## Existing infrastructure

*Describe any existing infrastructure already present on the site that can be utilized by the new solar drinking water system. For example, existing reservoir tanks, distribution pipes etc. If present, describe their features in detail. For example, land coverage of distribution pipes, diameter and length of distribution pipes, the capacity of the reservoir tank, etc.*

*Include photos of existing infrastructure.*

## Water source and security

*Describe the water source for solar drinking water. Provide information about,*

1. *Location and security (distance from the nearest household, access path, etc.)*
2. *Type of water source, seasonal variations, water quality, risks such as landslides*
3. *Other existing or planned uses of water sources upstream and downstream.*
4. *Flow rate*
5. *Any potential conflicts in water use and its resolutions.*
6. *Is the water source registered or not, because it may cause further conflicts between villages?*

*Photo suggestion*

1. *Photo of the water source*
2. *Bird’s eye view marking the water source and the location of the distribution tank (or highest point of water pumping point)*

## Water quality tests

1. *Include details of water quality tests done by accredited laboratory as per Nepal’s drinking water standards. Conclude the suitability of water source for drinking purposes and mention any necessary actions to be taken for safe drinking water quality.*

# Technical designs

## Water requirement and vertical head

*Describe the calculation of water requirement per day and vertical head. Provide information about,*

1. *Details of daily water requirement calculation (m3/sec or litres per day)*
2. *Vertical head, total dynamic head*

## Pump

*Describe the selection of the pump and its details. Provide information about,*

1. *Pump’s rated capacity (kW/HP)*
2. *Justification for the type of pump selected. For example, surface, submersible, etc.*
3. *Any assumptions and estimations (such as average pumping hours per day, etc.)*
4. *Details of reference pump that was taken for the selection (market available pump)*
5. *Requirements of pump housing/protection features*
6. *Month-wise water output simulation graph*

## Solar array location

1. *Must include the available land area, ownership details and commitment letter, GPS coordinates, topography, orientation and azimuth, near and far shading, current land use description, local land use regulation and policy, slope and soil type, wind loading etc.*
2. *Should have a general assessment of usability concerning natural calamities such as floods, landslides, lightning etc.*
3. *Should have assessment related to safety from humans, and fencing needs.*
4. *Details of any land treatment needed to make it suitable for a solar array installation.*
5. *The site should be selected from an adequate distance from the road to allow for any future road expansions, and infrastructure plans and reduce soiling losses in the PV array.*

*Photo suggestions*

1. *Bird’s eye view of obtained data and site with boundary markings.*
2. *Site photo of the solar array location*

## Solar array and controller sizing

*Describe details of the solar array and controller. Provide information about,*

1. *Details of the solar array including array capacity individual panel size, key technical parameters, series, and parallel configuration*
2. *Positioning of the solar array. For example, orientation, tilt, number of rows, row spacings*
3. *Near and far shading analysis*
4. *Details of the controller including controller capacity, protection, mounting mechanism, key technical parameters, compatibility with solar array and pump, need for controller box etc.*
5. *Details of reference solar panel and controller that was taken for the selection (market available panel and controller)*

*Figure suggestion*

1. *Sun-path of horizon analysis for far shading (in December)*
2. *Photos of near shading and relevant analysis*

## Pump intake and distribution reservoir

1. *Describe the type of pump intake system (sump well, concrete tank, etc.), dimensions and capacity.*
2. *Describe the details of roughing filter design.*
3. *Describe the type of distribution reservoir (concrete closed tank, concrete open tank etc.), dimensions and capacity.*
4. *Pump fixture (type, construction material etc.) in the pump intake*
5. *Assessment that shows there will be adequate water levels in the pump intake and distribution reservoir during pump use. For example,* 
   1. *% of the natural water source that will be diverted to the pump intake reservoir in the driest month which ensures that there will be adequate water year-round)*
   2. *Simulation of water level changes in a distribution tank on a typical day of pump use*
6. *Must include the available land area, ownership details and commitment letter, GPS coordinates, topography, current land use description, local land use regulation and policy, slope, and soil type, etc.*
7. *Should have a general assessment of risks concerning natural calamities such as floods, landslides, etc.*
8. *Plan of the site or location considering the safety of the pump to be installed or the sump well to be made at the bank of the river*

*Photo suggestions*

1. *Photo of the pump intake and distribution reservoir locations*
2. *Bird’s eye view of pinned marks of pump intake and distribution reservoir locations*

## Transmission and distribution of water

*Describe the transmission and distribution plan of water. Provide information about,*

1. *Details of transmission pipe (ground length, diameter, material(s), number of joints, anchor blocks, etc.)*
2. *Details of distribution pipe (ground length, diameter, material(s), branches and joints, anchor blocks, flow meters, gate valves, etc.)*
3. *Details of tap stands (total numbers, coverage shown on a map, typical design of tap stand, etc.)*

*Photo suggestions*

1. *Bird’s eye view of the transmission pipe path from the pump intake to the distribution reservoir*
2. *Bird’s eye view of the distribution pipe paths.*
3. *Slope (by using Google Earth). For example, from intake to distribution tank*

## Balance of systems

*Describe the balance of systems for solar drinking water completion. Provide information about,*

1. *Provide details of how cables will be routed and secured from the solar array to the controller box. Then from the controller box to the pump*
2. *Include a table describing detailed specifications of the balance of systems such as protection equipment (DC MCBs, AC MCBs, SPDs, lightning air terminals/ESEs, earthing points, cable sizes and respective losses, conduits, etc.)*
3. *Details of the solar array mounting structure. Calculations related to wind loading requirements, civil foundation requirements, size of vertical legs, purlins, braces and struts, rafters, base plates, joints, mid-clamps, end clams etc. must be presented.*

## Design summary

1. *Include a single-line diagram and suggest including an infographic illustrating the system architecture with key information*
2. *Include an illustration showing earthing locations, positioning of the lightning protection system, controller box, etc.*

## Environmental and social assessment

1. *Information about environmental impacts, potential biodiversity impacts and socio-economic impacts resulting from the installation of solar drinking water in the community must be mentioned with a degree of adversity*
2. *The total boundary covered by the project and its impact on natural habitats, vegetation, culture, settlement, social coercion, etc.*
3. *Projects' impact on indigenous people, their lifestyle, use of resources livelihood, livestock, water source, etc. along with information about loss of forest/trees to avoid shading in the solar array must be included*

*Photo suggestions*

*Bird’s eye view of obtained data and site assessment along with any adversaries that were observed during the DFS stage must be attached here.*

# Economic analysis

## Source of funds and business model

1. *The source of funds may vary in %, cash or kind from different sources. All the sources of funds must be mentioned and stated in tabular form accompanied by a narrative.*
2. *Describe the business model for solar drinking water operation and agriculture production*

## Tariff setting

1. *The water tariff setting mechanism (if applicable), its purpose and the approach used in setting the tariff must be mentioned*
2. *The proposed tariff must be done scientifically, and the calculations used must be presented*
3. *The data from the socio-economic section must be used, analysed, and discussed with the field enumerator regarding paying capacity, willingness, etc. to determine and present the tariff for the proposed system*
4. *Describe the tariff collection mechanism to ensure reliable and transparent revenue collection*

## Financial analysis

*Describes financial and economic analysis. Provide information about,*

1. *Cost-benefit analysis*
2. *Financial returns from agriculture (IRR, cash flows, payback, etc.)*
3. *Benefits to the SDW operation*
4. *Community readiness*
5. *Willingness to pay.*

*Explain all assumptions and estimations in detail such as crop production estimations, assumptions made in financial projections, description of parameters considered for economic analysis, etc.*

## Safety considerations

1. *Measures that must be taken for the safety of solar drinking water including PV array, pump, transmission, and distribution pipes etc. must be mentioned*
2. *Precautions and measures such as fencing, operation and management authority, safe handling of solar drinking water components and safe use of appliances must be mentioned*
3. *Other safety measures that were recorded from the DFS stage must be mentioned in this section including but not limited to operational safety*
4. *Safety considerations like fencing at the source tank and collection tank as children may enter these places*

## Site clearance

1. *The need for site clearance and its impact must be mentioned in the report*
2. *The basics of site clearance covering the total project area that could be breached during the installation phase must be clearly instructed*
3. *The existing site conditions of the project area must be retained and the ways to protect, amend or preserve the original condition of the site must be explained in points so that they can be referred to during the bidding and execution phase*

# Bill of quantity and cost

## Electromechanical system

1. *Detailed BoQ for the proposed system with a breakdown of each component must be done*
2. *Detailing in the BoQ should be such that, if possible, every component used such as the breakdown of combiner boxes and their components, MCBs, MCCBs, busbars, etc. must be proposed in specifics instead of a lump sum*
3. *BoQ for services and goods must be separated*
4. *Vatable and non-vatable items must be distinguished*
5. *The currency used must be in NPR with commas as a separator*

## Civil works

1. *Separate BoQ for civil works (pump intake, roughing filter, distribution reservoir, transmission and distribution network, PV array foundations etc.) must be prepared, however, all the BoQ will be compiled to form a single BoQ*
2. *Other points mentioned above apply to this section as well*

# Conclusion

*Provide a summary of the solar drinking water architecture, total beneficiaries, brief on social benefits, project cost and outcomes of the economic analysis.*

# Annexes

## Meeting minutes from the community

1. *Land permit minutes/contracts for the construction of the solar array, use of water source and water transmission and distribution paths*
2. *User committee registration at the LG (if applicable)*
3. *Water source registration document if it is registered*

## Rate analysis for each component used.

## Structure analysis calculations and report (solar PV mounting structure)

## Horizontal roughing filter drawing

## Pump intake drawing

## Distribution reservoir drawing

## Detailed drawings of components

## Transmission and distribution layout

## Water quality test certificate

## Site photos

## Product datasheets