	Requirement	**Recomm-endation**
G1. Feasibility Study	1. A full **feasibility study** must be presented. The content must include the topics listed here and as suggested in the attached notes. 2. Full attention must be paid to the **non-technical requirements** as these are usually the most critical in assuring the viability of a village hydro scheme.	
G2. Pre-feasibility study	1. It is recommended that a **pre-feasibility** study is **approved** before a full study is prepared, in order to save the cost of the full study if the site seems unsuitable. 2. The pre-feasibility study should contain a **completed survey form** and notes assessing the likely outcome of **all elements** of a full study.	
G3. Survey and survey contract	1. It is recommended that **standard survey forms** are used for pre-feasibility and full feasibility studies, in order to ensure that all key items of information are collected. 2. It is recommended that a survey is completed under a **separate survey contract** and not as part of a main contractor agreement, in order to allow for independent feasibility studies and competitive tendering by contractors. The independent survey has the advantage of allowing tenders from contractors who have not yet visited the site. The survey contract will be between the surveyor (who may also then prepare an independent feasibility study) and the purchaser, an agency, or a bank. 3. It is recommended that once the main **contractor** has been chosen and makes his first site visit, he is asked to formally **agree survey data**, such as hydrological and geotechnic assessments, before starting design and construction work.	
G4. Communal ownership	1. A committee must be formally constituted with named officers. The capability of the **committee** members to work together and manage the scheme must be proven by a **track-record** of similar activity. 2. **Unique leadership**. There must be no ambiguity as to leadership. 3. **Enduring leadership**. The prospective leaders must have long-term and not temporary interests in the scheme.	
G5. Private ownership	1. The prospective owner must have a long-term and not a temporary interest in the scheme. The **profession** of the owner must be noted; in general it is expected that viability is better assured if the owner will using the scheme as a principal source of income.	

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G6. Commercial viability	1. The detailed power requirements of prospective consumers must have been carefully evaluated through market survey work. A full listing of each prospective consumers' wattage demand with an indication of ability and willingness to pay, such as **pre-signing by consumers** of tariff agreements, is necessary. 2. **Alternative power** supply options must have been carefully surveyed. There must be evidence presented that the market or some part of it will not be served by grid extension or other options such as diesel generators.	
G7. Legal provisions	1. Documentation giving legal title to the necessary **water rights** must be provided and formally signed by appropriate parties. 2. Documentation giving legal title to the necessary **land use rights** must be provided and formally signed by appropriate parties.	
G8. Technical description and costs	1. A **summary description** of key characteristics of the scheme must be provided (see attached notes). The description must include valid figures for head and flow, head loss, generator power output (scheme rated power). 2. A **geotechnic study** must be presented for the site, in particular to show that the headworks, canal, and penstock foundations will be reliable. 3. A **hydrology study** must be presented for the site, giving details of the flow to be drawn by the turbine, and demonstrating reliability of the flow prediction. 4. **Head** measurements must be presented. 5. **Construction plans** must be presented and **equipment requirements** listed. In both cases **costs** must be estimated. *When visiting:* 6. Take site **measurements** to verify information presented.	
G9. Operation and maintenance	1. **Operation and maintenance schedules** must be presented and **costs** estimated. 2. An **operation, maintenance and fault-finding manual** must be provided which is appropriate for the specific scheme, and written and illustrated in a manner which is appropriate to its use by the operators. *When visiting:* 3. Verify that the operation **manual is in regular use**, and is understood by the operators.	
G10. Financial analysis	1. Present a **financial analysis** which integrates all cost elements and indicates required levels of revenue.	

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G11. Management	1. A **management plan** must be in place. This should give details of the proposed financial operation of the scheme, including consumer deposits, tariffs, schedules of payment, penalties, distribution of revenue, operator's wages, schedule of loan repayment, etc. It should also include a maintenance and repair cost projection and schedule, a performance monitoring and reporting schedule, etc.	
G12. Contractor - Purchaser contract	1. It is envisaged that one main contractor will supply the hydro scheme to the purchaser. This main contractor will be responsible to ensure that sub-contractors fulfill the requirements of these specifications. A **signed contract** must be drawn up which defines the respective responsibilities of purchaser and the contractor. It will include items such as the following: 2. **Warranty**. a. The contractor must guarantee that the installation and the equipment supplied is fit for its purpose and is free from defects in design, materials, and workmanship; any faults occurring within the first year of operation will be promptly rectified free of charge. b. The contractor is required to list all equipment and materials to be used for major scheme components, **specifying make, model, and grade**. He must upgrade equipment if required to do so to ensure fitness for purpose. He must accept that equipment declared not fit for purpose (for example a turbine casing of insufficient strength) must be replaced promptly. c. The contractor must accept responsibility for **appropriate penalties** or corrective work in cases where **power** produced is less than quoted. 3. **Terms of payment**. This should include a schedule of works and payments with penalty clauses to underpin the schedule. It must include a clause which withholds payment to the contractor of at least **5%** until the **end of the first year**, in order to substantiate the warranty agreement. 4. **Specifications** and guidelines. The contractor will be required to follow the relevant specifications and guidelines. 5. **Insurance**. It is recommended that the contractor is obliged to take out a suitable insurance policy covering for circumstances leading to expensive repair or replacement obligations within a specified period. (These could be for example unforeseen changes in the hydrology of the site, unforeseen landslide, etc). 6. **Acceptance of survey data**. The contractor must formally agree survey data, in particular hydrological and geotechnic data. If land movement, or river movement (such as bed scouring) effects scheme performance or gives rise to repair costs, the contractor will be responsible for the duration of a period specified in the contract.	
G13. Consumer-manager contract	1. The key clauses of the **consumer contract** must be presented. These will include characteristics of electricity supplied (voltage limits, frequency limits, appropriateness of different types of appliances, etc), tariffs and payment schedules, penalties, conditions under which payment not required.	

Summary of recommendations. **Approve general requirements on condition that:**	**Recommendations fulfilled:**
Proposal stage: *Date recommendations filed.....* *Recommendations by.....*	 *Approval date.....* *Approval by.....*
Construction stage: *Date recommendations filed.....* *Recommendations by.....*	 *Approval date.....* *Approval by.....*
Commissioning stage: *Date recommendations filed.....* *Recommendations by.....*	 *Approval date.....* *Approval by.....*
Warranty completion stage: *Date recommendations filed.....* *Recommendations by.....*	 *Approval date.....* *Approval by.....*

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Note G1. Feasibility studies

A full feasibility study must include the following data:

1. Precise location and contact persons
2. Site details, proposed power output, with sketches and maps
3. Type of ownership proposed. Leadership prospects.
4. Market for power:
    - Types of loads in the evening, night, day.
    - Wattages
    - Prospects for rival power sources
5. Water and land rights. Prospects for future difficulties.
6. Geotechnic characteristics of the site
7. Hydrological characteristics of the site, turbine design flow
8. Head measurements
9. Construction and equipment proposals and costs
10. Operation and maintenance proposals and costs
11. Financial analysis
12. Management plan
13. Contractual arrangements
14. Works and payments schedule

Note G2. Pre-feasibility study

A pre-feasibility is a brief appraisal of the site including data on topics 1 to 12 listed for full feasibility studies. Sections 9 and 10 are likely to be estimates based on previous experience of similar sites. In a full feasibility study each topic is treated in more depth and sections 9 and 10 are based on contractors quotes for the specific site.

Note G3. Survey forms

The survey forms should be designed to collect all the data necessary to prepare a feasibility study. They should include the topics 1 to 12 as listed for feasibility studies.

Note G8. Technical description of a scheme

Table G8 provides an example of a summary description table.

Note 10. Financial analysis

Table G10 provides an example of a financial analysis table. The particular approach shown allows two different installation options to be compared, for instance there may be proposals for a installations of differing power capacities, for a smaller or larger network, for a battery-distribution system compared to a line distribution system.

The approach shown also compares to different “unit” sizes, x and y. In this context a unit is a particular wattage connection to a consumer. For instance, there may be a proposal to connect some households with one 50 watt unit, while others will be connected with two, three, or more 50 watt units. Alternatively, the standard unit may be 25 watts. The analysis shows the supply

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cost per household per month of either one of these units. This is called a "tariff" in this context as an indication of the level at which consumer tariffs must be set to cover supply costs.

The initial survey of the village will result in a list of consumers and an indication of how much each consumer will be likely to want to spend on electricity (based on a survey of existing expenditure and appliances required). It is likely that there will be an expectation that demand will grow once the scheme is installed and proven to be operational. This demand growth will be apparent in two ways: consumers requesting more power, and a greater number of people requesting connections. The scheme designer can set the unit size small as part of a strategy to provide surplus capacity to accommodate demand growth.

Note G11. Management plan

It is important that the manager or managers of the proposed scheme take initiative in designing a management plan. They should submit a provisional plan which corresponds to the financial analysis presented in the feasibility study, and which therefore demonstrates that they have a full appreciation of this financial analysis. The following topics must be included in such a plan and the list given here can be used to facilitate discussions leading to their creation of an appropriate plan.

1. Operation and maintenance
    - premises required (office, store, etc)
    - operational tasks
    - maintenance tasks
    - management tasks
    - technical report schedule
2. Personnel
    - numbers of staff, their positions, and their roles
    - numbers of hours worked, wages
3. Revenue
    - Setting of tariffs - calculation principle
    - Annual income required in appropriate categories such as:
    - Wages
    - Maintenance and repair fund
    - Loan repayment
    - Welfare and business development fund
    - Equipment replacement fund
    - Administration costs
4. Collection of revenue
    - Log of payments due
    - Tariff collection schedule
    - Late payment penalty system
    - Enforcement policy
5. Administration of accounts
    - Where revenue is deposited
    - Names of deposit accounts
    - Schedule of outpayments
    - Financial report schedule
6. Outline of consumer contract

Table G8. Example of a summary technical description table

	Description	**Verification**
Gross Head	Forebay water level to base level	Measured: Date of measurement:
Flow	Design flow Minimum flow Operating flow range	
Canal and headrace	Type Material Length	
Penstock	Nominal diameter Internal diameter Thickness Material Make Length Design head loss	Measured net head: Date of measurement:
Turbine	Type Make Flow variation capability Design efficiency at max flow Efficiency at 50% or minimum flow Shaft power at max flow Shaft power at min flow	
Drive	Type Make Ratios Design efficiency	
Generator	Type Make Efficiency at max flow Efficiency at min flow Output at max flow Output at min flow	Measured power output: Date of measurement: Supply efficiency (gross power to generator output):
Controller and switchboard	Type Meters Switchboard components	
Distribution	Type Number of phases Line connection diagram Cables: types and makes Cable connectors	

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Table G10. Example of a financial analysis table.

Name of Scheme			*Option 1*	*Option 2*
	Capacity (kW)			*kW*
	Number of months of operation each year	M		*months*
Installation cost	Civil works			*Rs*
	Power generation			*Rs*
	Distribution network			*Rs*
	Total cost	T		*Rs*
Resources	Cash contribution by village	V		*Rs*
	Percentage of total cost			*%*
	Cash contribution per house			*Rs/house*
	Investments and subsidies from other sources	A		
Loan	**Loan** T-V-A			
	Interest rate (%)			*%*
	Loan period			*years*
	Conversion factor	F		
Annual reimbursement of loan	F x Loan	R		*Rs/year*
Running costs	Operational and staff costs	S		*Rs/year*
	Maintenance	O		*Rs/year*
	Fund for welfare and business creation	I		*Rs/year*
	Fund for equipment replacement	N		*Rs/year*
Total annual running cost	S+O+I+N	SOIN		*Rs/year*
Sources of revenue	Sales of power to businesses	C		*Rs/year*
Net annual cost	Repayment of loan and running cost net of business revenue R+SOIN-C			*Rs/year*
	Initial number of x watt units Maximum number of x watt units Initial number of y watt units Maximum number of y watt units	U		
Initial tariff	Net annual cost divided by number of units and months (R+SOIN-C)/ U x M (x watt units)	Tariff		***Rs/unit***
Final tariff	ditto (x watt units)	Tariff		***Rs/unit***
Initial tariff	ditto (y watt units)	Tariff		***Rs/unit***
Final tariff	ditto (y watt units)	Tariff		***Rs/unit***

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Service	eg Number of hours of evening lights, numbers of consumers reached, comparisons between options 1 and 2			