Harlaw Hydro-Electric Scheme

Business Plan for

Balerno Village Trust

Completed by

RD Energy Solutions

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Executive Summary

Balerno Village Trust is a community owned non-profit organisation set up to undertake the development and operation of major projects on behalf of the Balerno Community. In cooperation with Community Energy Scotland (CES) and the Water of Leith Flood Prevention Scheme, Balerno Village Trust wishes to construct and install a micro hydropower generator at Harlaw Reservoir to produce renewable energy.

The overall aim of the project is to develop a sustainable revenue stream for the community. Further aims are to raise awareness of environmental issues; improve land use and reduce the environmental footprint of the community.

The legislative environment is in favour of renewable energy generation schemes of this scale. Notably the scheme will benefit from the Feed-in Tariff, a piece of legislation which creates a framework for financially incentivising renewables schemes. The project is within the boundaries of City of Edinburgh Council and a strategic objective of the Council is to contribute to national targets for greater renewable production through increasing community, business and domestic-scale renewable energy schemes. There is a growing demand for renewable energy due to consumer demand and the Feed-in Tariffs.

The project will have two main revenue streams:

- Exporting electricity to the national grid for sale to an electricity supply company
- Revenue from Feed-in Tariffs

A design and cost study has been carried out in order to create a basis on which to secure funding. The project will be implemented by the following stages:

- Consents – Obtaining consents for construction and operation from the local planning authority, SEPA and local district network operator
- Fundraising – Obtaining the capital necessary to construct the project.
- Procurement – Carrying out tenders and securing the supply of the necessary products and services
- Construction – Physically realising the installation

Once operational, the project will be managed by Balerno Village Trust. The equipment will be of high specification, requiring minimal human input or maintenance.

The key risks to the project are consents not being obtained; overspend; failure to raise sufficient funds; and construction risks. Where possible, these risks have been mitigated.

Project financing through CES would be in the form of a grant to the community group which would be required to loan the money at commercial rates to a Special Purpose Vehicle (SPV) to undertake installation and operation of the project. This would be paid back to the community group from the revenue of the scheme.

The scheme will cost approximately **£365,322** to implement. Once in place it will provide gross revenue of £56,431 per annum, leading to an operating profit of approximately **£51,991 per year** assuming no loan repayment requirements.

A life cycle analysis of the project was undertaken using CES assessment criterion assuming a 100% loan is used for the development of the project at 7% interest over 15 years. This showed that there would be an operating profit of **£12,603** in the first year and a payback period of 15.3years. The cumulative net profit after 20 years is projected to be £740,409. This money will be available to be reinvested in further renewable energy or community development projects thus safeguarding a sustainable future for the Balerno Community.

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1. Project Background

Balerno is a village located to the east of Edinburgh on the A70, Lanark Road. Harlaw Reservoir is located approximately 6 miles SE of Balerno. Figure 1 shows the location of the scheme in relation to the surrounding area.

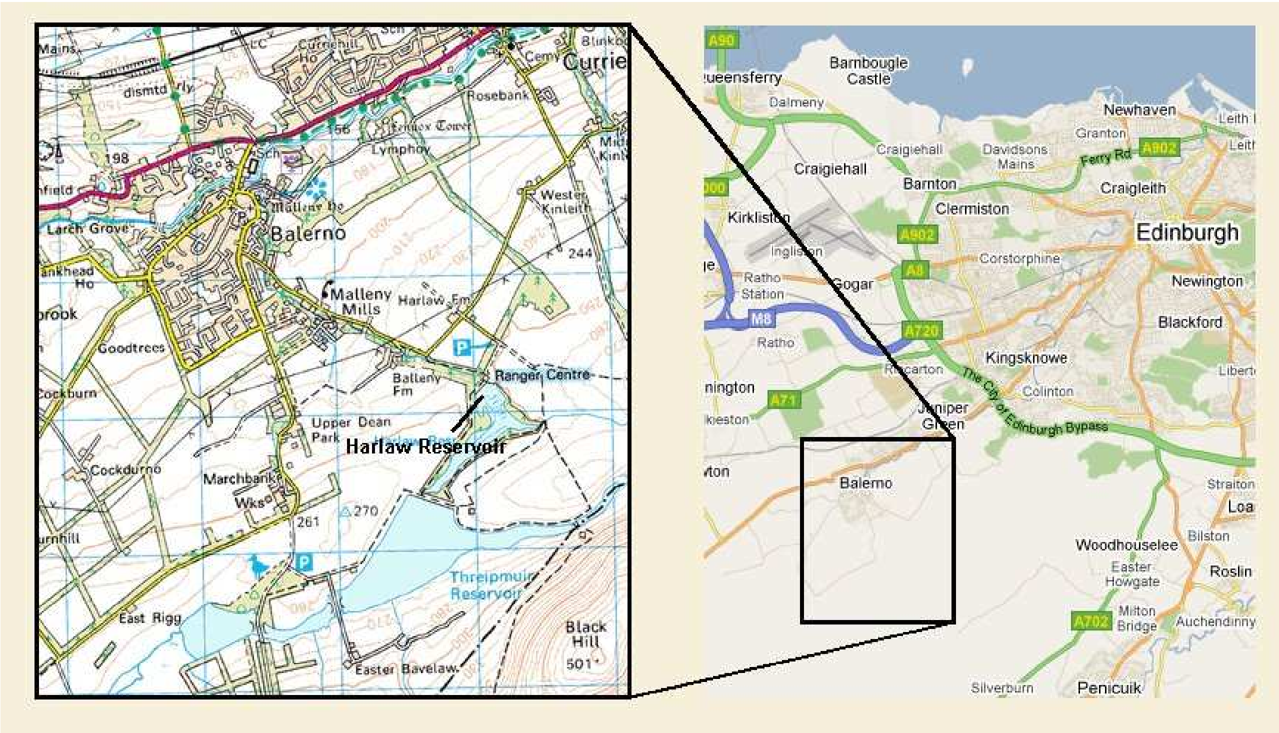

Figure 1: Location of Harlaw Hydro scheme

Harlaw reservoir is one of three compensation reservoirs built and enlarged between 1848 and 1890 to compensate for the loss of water caused by the tapping of the Colzium springs in the 19th century to supply the City of Edinburgh. Water could be stored during the winter to ensure that the mills had a constant water supply during the summer. Since 2006 Harlaw Reservoir has been maintained and operated by the Flood Prevention Scheme (FPS) to prevent flooding on the Water of Leith.

The current dam structure features two outlet towers, situated in the reservoir near the dam. The farther-out tower is located in deeper water and is used as the main outlet for the reservoir into the Water of Leith. The outlet penstock runs from the tower and under the dam, terminating in a valve house at the foot of the dam. The water flowing out from the existing penstock passes through a gauging box and weir. This is proposed to be demolished during the hydro installation process and replaced with a new valve and Y-shaped penstock, for sending water to the turbine or to bypass the turbine. Plans have been submitted by the Flood Prevention Scheme for adjustments to the overflow and alterations to the outflow from the reservoir outlet.

2. Technical

This section deals with the technical design of the hydro scheme; setting out the electrical, mechanical and civil design, in addition to specifying the scale of the scheme and the annual generating potential.

2.1. Electrical Design

The scheme will generate electricity for export to the grid. A consumer unit will be installed in the powerhouse to provide electricity to lighting, sockets and other electrical equipment. A distribution panel will also be installed and a cable will be run from the powerhouse to a distribution board located in Harlaw House, via a 25mm² 4-core SWA cable. An Ofgem-approved meter will be installed to record generation from the turbine and a display, in Harlaw House, will show the generation output, for educational purposes. Harlaw house currently has a single-phase connection from a single phase, 25kVA transformer. In order to maximise the potential of the hydro scheme it will be necessary for the DNO to install a 3-phase transformer and lay a new 3-phase cable to Harlaw House. Figure 2 below shows the grid connections in the area.

Figure 2: Grid connections for the hydro scheme

At this range of power, the Grid Connection Engineering Recommendation which is applicable is G59. This requires a network impact assessment by the district network operator (DNO); Scottish Power. A G59 application has been submitted to Scottish Power and an informal confirmation that the generator can be connected has been given in addition to costs for the grid connection. Notification must be given before commissioning in order that the DNO can have the opportunity to witness the tests.

2.2. Mechanical Design

2.2.1. Turbine

The turbine will be installed on a concrete plinth, which will be located in the powerhouse, an example of which is shown in Figure 3.

Figure 3: Crossflow turbine with generator and hydraulic pump for valve actuators

2.2.2. Turbine type

The most suitable turbine for this scheme would be a Crossflow turbine. This turbine consists of a drum, fabricated from curved metal plates or blades. Water is directed onto these blades by means of a rectangular nozzle and this causes the drum to rotate. The photo in Figure 3 shows a Crossflow turbine of similar size to that proposed at Harlaw. Figure 4 shows a diagram of the turbine.

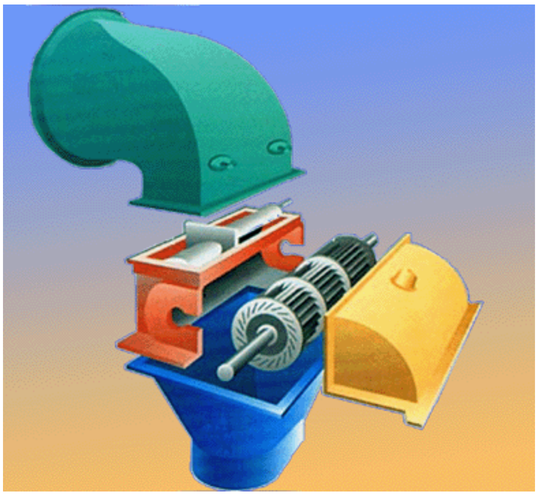

Figure 4: Exploded view of a Crossflow turbine

The Crossflow is the simplest of all turbine types to manufacture. There are a few manufacturers in Europe who produce suitable machines with a range of quality and efficiency. Basic, cost-effective machines will have an efficiency of 70 - 75% whereas the top-of-the-range manufacturer states a peak efficiency of 86%.

Crossflow turbines are available with a single nozzle, in which case they can operate efficiently down to approximately one third of their rated flow. Otherwise the flow can be partitioned into two nozzles, in which case they can operate efficiently down to 17% of their rated flow. In this case it is recommended that the Crossflow turbine is partitioned into two nozzles with the partitions sized on a 1:2 ratio. This will allow the turbine to utilise much of the very variable outflow from the reservoir.

2.2.3. Rating

The turbine rating is chosen by selecting a rated flow and by balancing a number of interlinking factors, including:

- Standard pipe sizes

- Standard turbine sizes
- Compensation flow requirements
- Total power (kWh) generated throughout the year
- Capacity factor (i.e. equivalent fraction of the year which the turbine will operate under)

2.2.4. Transmission

At this range of head, flow and power output the turbine will rotate too slowly to direct drive the generator and therefore a mechanical transmission will be required. A gearbox will be used, as this provides the best performance efficiency for the system.

2.2.5. Generator

The recommended generator type is an asynchronous generator, as this provides a high efficiency and allows for simple grid connection, as well as being able to withstand periods of over-speed.

2.2.6. Control System

The control panel will regulate the operation of the turbine, generator and associated plant. It will facilitate synchronisation with, and connection to, the grid; shut down in the event of grid failure or other faults; and regulation of flow through the turbine to match the availability of water flowing out of the reservoir. This last function is achieved by the installation of a flow sensor in the penstock. The controls will also communicate with the FPS's control system, controlling the reservoir sluice, and the bypass valve.

2.3. Civil Design

2.3.1. Layout

The proposed layout of the scheme is shown on drawing HRLW-001, to be found in the design study report. The flow will be regulated by the FPS. Water will be taken in by the reservoir outlet tower, and passed through the outlet penstock into the new penstock. This will convey it to the powerhouse, which will be located at the base of the reservoir dam. The water will pass through a Crossflow turbine located within the powerhouse and be discharged through a tailrace back into the river just downstream from the powerhouse.

2.3.2. Intake

The scheme will use the existing reservoir outlet tower and outlet penstock. The outlet tower serves several purposes:

- Regulates water depth and flow from the reservoir – thence to the new turbine.
- Removes debris from the water – this prevents debris from being passed down the penstock, preventing blockage or damage to the turbine.

The penstock for the hydro scheme connects onto the existing outlet pipe from the reservoir, passing through a junction with an automatic bypass valve. The bypass valve will release any excess water down the water course, bypassing the turbine, and will also be used to allow water out of the reservoir even if the turbine is isolated for maintenance. There will also be an isolation valve to shut-off the turbine.

2.3.3. Penstock

The penstock for the hydro scheme will connect on to the existing reservoir outlet pipe (penstock). The connection between the old penstock and new one will require detailed design by a civil engineering contractor. However, initial conversations with a penstock manufacturer have indicated that a GRP flanged socket could be clamped onto the end of the existing penstock. The socket has an inner and outer part, to mate over the pipe end, whilst a seal and band is clamped around the outer part of the socket to fix it to the pipe end.

The GRP penstock will be sectional and connected on site using double-seal, bell & spigot joints. Each joint should be encased in concrete, to form anchor blocks and pipe support.

The penstock will transport the water from the existing outlet pipe to the turbine, which will be located in the powerhouse, to the NE of the watercourse, as shown in drawings HRLW-001 and HRLW-002 in the design study report.

2.3.4. Penstock Sizing and Route

The existing outlet pipe from the reservoir has an internal diameter of 600 mm. A junction with the same diameter will attach to the existing outlet pipe. The right branch (as seen if facing the dam) of the junction is the bypass, to allow water out which cannot pass through the turbine. An automatic bypass valve controls the amount of excess water released. The left branch of the junction is the penstock and continues into the powerhouse, through an isolation ball valve and onto the turbine. The penstock route is shown in drawings HRLW-001 and HRLW-002 in the design study report.

2.3.5. Material

The new penstock will most likely be manufactured from GRP, which is strong, lightweight, smooth bore and cheaper than steel, iron or HDPE (plastic) equivalents at this diameter (600mm internal). There are several options for penstock materials, including medium or high-density polyethylene (MDPE or HDPE), glass reinforced polymer (GRP), PVC fibre, ductile iron and steel. Due to the size of the penstock it is considered that a 6 bar rated GRP penstock material would provide a comfortable factor of safety, whilst keeping costs lower than for other types of material.

2.3.6. Supports

The pipe may require concrete supports in order to resist the forces imposed upon it by the flow inside it, the river and its own weight. Concrete haunching will support the base of the penstock along its length.

2.4. Powerhouse

2.4.1. Powerhouse Building

The powerhouse is a simple building to house the turbine, generator and control system. The dimensions/levels of the building are shown in HRLW-002 in the design study report. Dimensions of the sump and slab are shown on the same drawing.

The civils contractor will specify and construct the whole building including all materials and including:

- Sump/tailrace
- Floor slab
- Walls
- Doors
- (Window)
- Ventilation louvres
- Roof
- Internal Drainage
- External Drainage
- Suitably-rated lifting beam and tackle block
- Area of hardstanding outside building
- Access track down from Harlaw House

2.4.2. Base Frame

The turbine and generator will be bolted to a base frame which will be cast into the floor slab of the powerhouse. This will constructed of galvanised mild steel. The base frame will be supplied with the turbine and generator in one package from the turbine supplier.

2.4.3. Access

It is proposed that access to the powerhouse, penstock and cable route is obtained by clearing the area next to the reservoir dam coming down from Harlaw House. This would facilitate machine access to lay the pipe and cables; and to install the turbine. Once the equipment is in place, the pipe and cable will be covered-over and the area re-landscaped. Figure 5 shows the route described.

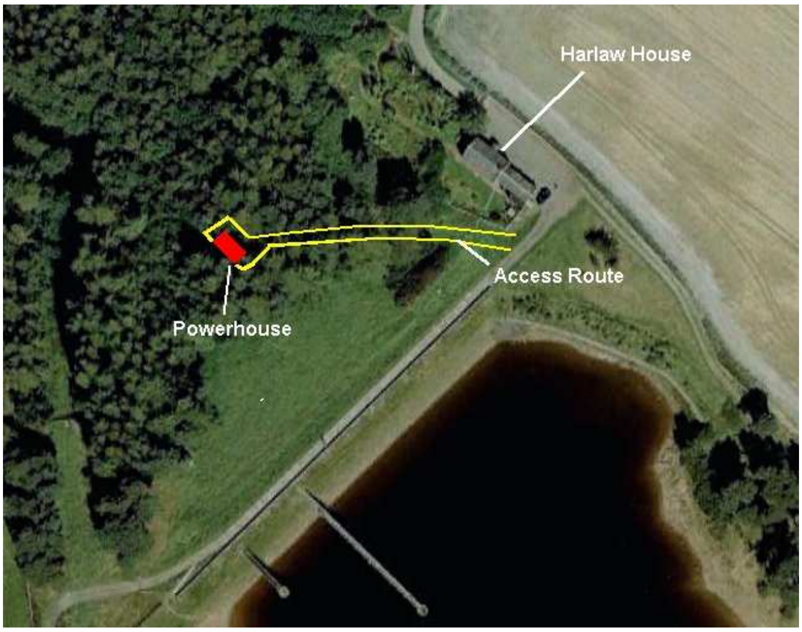

Figure 5: Access route

2.5. Annual Generating Potential

Based on the system sizing carried out in Phase I, the possible characteristics of the scheme are shown in Table 1, using a new Crossflow turbine from Ossberger, a top-of-the-range manufacturer based in Germany.

Quantity	Ossberger Crossflow Turbine
Gross head	17.56m
Rated flow	0.65m³/s
Net head	16.33m
Turbine type	Crossflow
Turbine efficiency	85%
Transmission	Gear Box
Penstock material	Glass Reinforced Polymer (GRP)
Penstock length	110m
Penstock internal diameter	600mm
Power output	65kW
Capacity factor	0.45
Energy yield	265,896kWh
Carbon emissions offset	143 tonnes

Table 1: System characteristics

3. Environmental

3.1. Relevant Policy Documents

3.1.1. Edinburgh and Lothians Structure Plan

The Structure Plan, prepared jointly by the four Lothian Councils (City of Edinburgh Council, East Lothian Council, Midlothian Council and West Lothian Council), provides a long term planning vision for development and the environment in Edinburgh and the Lothians until the year 2015. The Edinburgh & Lothians Structure Plan is based on the National Planning Policy Guidelines (NPPG6 – Renewable Energy) and contains the following relevant section on renewables:

ENV 6: Renewable Energy - *The development of renewable energy resources will be supported where this can be achieved in an environmentally acceptable manner.*

Policy guideline NPPG6 gives guidance on the issue that need to be considered and addressed. These include:

- **Natural & cultural heritage** – hydro developments are often located in rural areas, some parts of which are valued for their nature conservation interest. Each proposal should be considered to determine the degree of sensitivity. Sensitive and imaginative design of the scheme and ancillary buildings and facilities can successfully minimise some effects. Early dialogue with SNH is recommended.
- **Water Regime** – The Scottish Environment Protection Agency (SEPA) has a duty to promote the cleanliness of controlled waters and to conserve, so far as practicable, water resources. Consultation with SEPA should, therefore, be undertaken for all proposed hydro developments.
- **Fisheries** – Care is required with the protection of all species of fish, particularly migratory species such as salmon and sea trout. Consultation with the local District Salmon Fishery Board is advised when a hydro scheme is proposed and throughout the planning process.
- **Aquatic Habitats and Species** – Different species will be affected in different ways, some of which such as the freshwater pearl mussel are protected under the EC Habitats Directive. Discussion with SNH will provide guidance on the species which require to be considered in a particular location.

The project is in agreement with the above policies and therefore it is unlikely that City of Edinburgh Council will have any objections in principle.

3.1.2. Local Plan

The local plan is the main mechanism by which structure plan policies are taken forward to specific land allocations and policies for the control of development.

The transport and infrastructure section of the City of Edinburgh Council Local Plan sets out the council's policies for renewable energy. This states that:

Planning permission will be granted for development of renewable and sustainable energy schemes such as small-scale wind turbine generators, solar panels and combined heat and power/district heating/energy from waste plantsand biomass/woodfuel energy systems provided the proposals:

a) *Do not cause significant harm to the local environment, including the character and appearance of listed buildings and conservation areas and*
b) *Will not unacceptably affect the amenity of neighbouring occupiers by reason of, for example, noise emission or visual dominance.*

The development control criteria for renewable projects will take into account the protection of international natural heritage designation such as the Pentland Hills Regional Park within which the scheme is located.

Development which supports the aims of the Pentlands Hills Regional Park will be permitted provided it has no unacceptable impact on the character and landscape quality of the Park.

Any proposed scheme located within these areas will need to set out mitigation measures for any adverse effects on the character, visual integrity or recreational qualities of the area. It is not anticipated that this hydro scheme will have any impact on the character, visual integrity or recreational qualities of the area.

The built heritage of the location is also taken into account in the development control criteria. Any developments on areas of archaeological importance will require a full archaeological assessment and mitigation measures for any impacts identified. As the site is not located on a site of archaeological importance there is no anticipated requirement for an archaeological assessment.

Any hydro scheme on the Water of Leith will need to take into account flood prevention measures in the design and planning of the scheme. The local plan states that:

Planning permission will not be granted for development that would:

a) *Increase a flood risk or be at risk of flooding itself*
b) *Impede the flow of flood water or deprive a river system of flood water storage within the areas shown on the Proposals Map as areas of importance for flood management*
c) *Be prejudicial to existing or planned flood defence systems.*

Flow from the reservoir is controlled by the flood prevention scheme and any hydro scheme that affects flow down the Water of Leith requires assessment by the Flood Prevention Scheme officers to ensure there are no negative impacts. The design drawings are currently being reviewed.

3.1.3. Pentland Hills Regional Park Plan

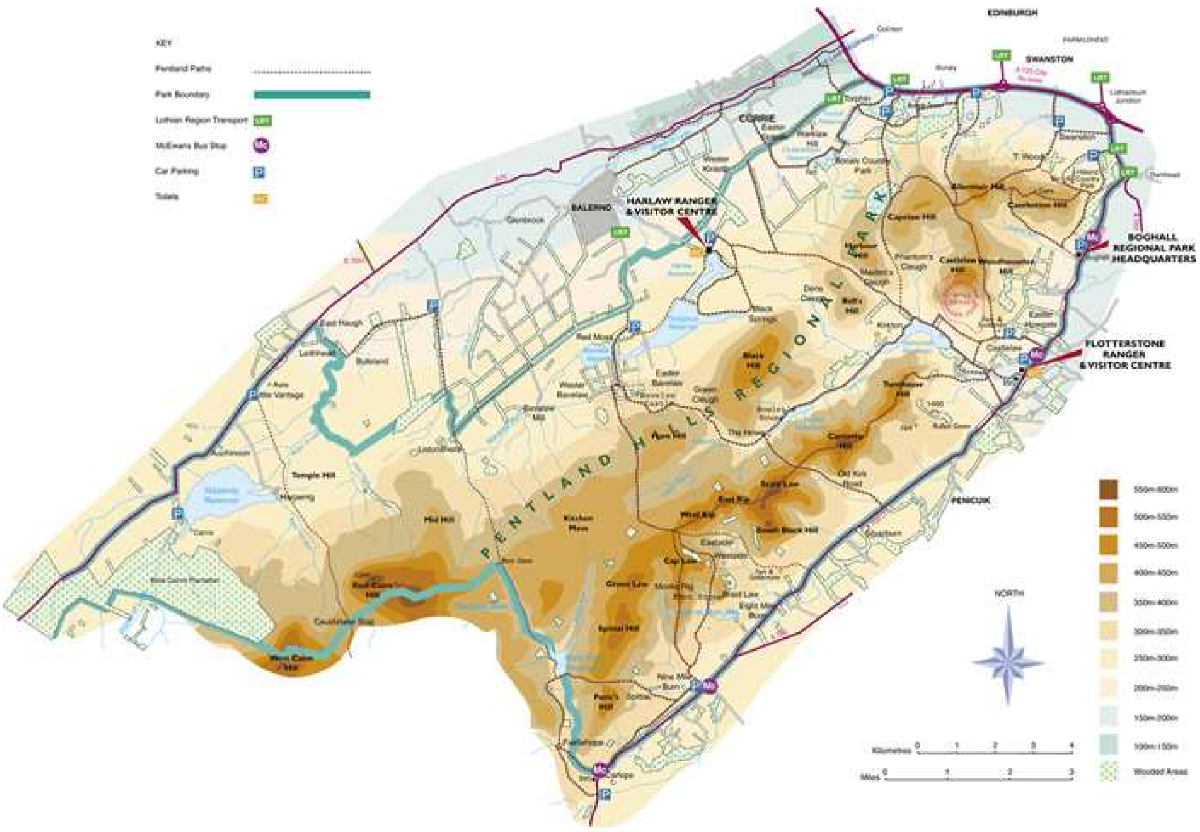

Figure 6: Pentland Hills Regional Park

The Pentland Hills Regional Park (PHRP), in association with Edinburgh and Lothians Councils, SNH and Scottish Water, has published the Pentland Hills Regional Park Plan 2007-2017 which lays out the objectives of the park.

With the aim of achieving enhanced environmental sustainability of the Pentland Hills Regional Park economy the plan promotes an increase in the use of energy from renewable energy resources by businesses and communities which contributes living and/or business operational cost savings for those living and working within the PHRP.

It can be viewed therefore that the Harlaw hydro project will aid the Park in meeting its objectives.

3.1.4. Environmental Impact Assessment

The EIA (Scotland) Regulations 1999 state with reference to hydropower that

"In addition to the physical scale of the development, particular regard should be had to the potential wider impacts on hydrology and ecology. EIA is more likely to be required for new hydro-electric developments which have more than 500 kW of generating capacity."

Therefore an EIA will not be required for this development.

3.1.5. Water Environment

The Water Environment (Controlled Activities) (Scotland) Regulations 2005 (CAR) were passed by the Scottish Parliament on 1 June 2005. These regulations are the means by which SEPA controls and authorises activities which can impact on the water environment. Regulation 12 covers authorisation for abstraction and impoundment activities. A Practical Guide, March 2006 describes the implementation of the regulations and the authorisations required by activities.

The Practical Guide states that the regulations classify activities into four regimes:

- Pollution control and the point source
- Abstraction
- Impoundment
- Engineering

Based on the guidance, the Harlaw Hydro project will impact on the abstraction and impoundment regimes only.

For each regime Authorisations are classified under into different categories according to the perceived risk to the water environment:

- General Binding Rules
- Registration
- Simple License
- Complex License

In discussions with SEPA any hydro development less than 100kW will be subject to a simple licence application fee.

3.1.6. Building Standards

As defined by Schedule 3 of the Building Standards Technical Handbook – Non Domestic, 2005

"A detached single-storey *building*, having an area exceeding 8 square metres but not exceeding 30 square metres." Does not require a warrant with the following exceptions: "A *dwelling* or *residential building*. A *building* ancillary to, or within the *curtilage* of, a *dwelling*. A *building* within 1 metre of a *boundary*. A *building* containing a fixed combustion appliance installation or *sanitary facility*. A swimming pool deeper than 1.2 metres."

Therefore the Harlaw hydro project will not require a Building Warrant.

3.2. Stakeholder Consultations

The following stakeholders were contacted as part of this initial consultation:

- Edinburgh City Council
- SEPA
- SNH
- Forth District Salmon Fisheries Board
- Water of Leith Honorary Board

Each of these was contacted by telephone in the first instance and received a letter containing relevant information in which they were asked to provide feedback as to key issues relating to the project and whether they would have any objections.

Details of the consultation response from each of these stakeholders are included in the following sections.

3.2.1. Edinburgh City Council

Edinburgh Council has responded to the screening request letters for all the relevant schemes. In this response, the City of Edinburgh Council confirmed that a full Environmental Impact Assessment (EIA) will not be required although consideration will need to be given to the impact on the landscape and the construction method will be important in terms of works and timings with regards to any protected fauna within the area.

3.2.2. Scottish Environmental Protection Agency

The Scottish Environment Protection Agency (SEPA) was contacted by telephone and letter. They provided a response in their letter of 26th March 2010.

The response draws attention to the SEPA guidance for developers of run-of river hydro schemes which sets out the level of information and detail that would be expected as part of any licence application. This guidance sets out the criteria for an acceptable scheme and the mitigation requirements to include in the designs of the scheme. These mitigation measures include the following:

Protection of river flows – This includes low flows, variability of flows, high flows, and flows for the upstream movement and spawning of fish.

Protection of fish movements – This includes downstream and upstream passage of fish and upstream movement and spawning of fish.
Management of sediment – This aims to enable the natural erosion and downstream migration of sediment.
Management of erosion – This aims to prevent erosion of river banks from the water exiting from the tailrace of the scheme.

The design of the scheme ensures that water does not exit the tailrace at high velocity, therefore ensuring there is no erosion around the tailrace exit. As this scheme is utilising the existing outflow from the Harlaw Reservoir and returning the water into the existing watercourse, there is little natural watercourse to protect and few fish or sediment or movement to manage. Therefore, it is anticipated that the rest of the measures are not expected to apply.

3.2.3. Scottish Natural Heritage

Scottish Natural Heritage (SNH) was contacted by telephone and letter with details of the project. They responded with a letter dated 6th April 2010.

They note that the Water of Leith is an important and popular watercourse for recreation and environmental education. Hence they have requested a basic landscape and visual impact assessment which would include a summary of the landscape and visual baseline; identification of direct, indirect and cumulative effects; evaluation of significance and magnitude of impact; and a montage.

With regards to the ecology it is recommended that a walk-over survey is undertaken to check for protected species in particular otters, bats and nesting birds around the site.

Environmental surveys have been carried out along the Water of Leith including Harlaw Reservoir by Arup as part of the Flood Prevention Scheme. The community group has been given access to these surveys for inclusion into the planning application. Further discussions with Fraser Maxwell of Arup have highlighted the following:

- Otters may use the banks of the watercourse for movement and, due to the foliage cover in the vicinity; it is possible that there will be otter shelters in the area though none were recorded in previous surveys.

- There is a badger sett in the area although it is not expected that this is within 30m of the site. Where a badger set is within 30m of a site, a licence is required to commence work.
- Due to the presence of mature trees in the area, it is possible that there are bat colonies and nesting birds in the area. Clearing of the site prior to construction should not occur during bird nesting season between March and August.

The walk-over survey will highlight any issues with the above points.

3.2.4. Forth District Salmon Fisheries Board

The Forth District Salmon Fisheries Board was contacted by telephone and letter with details of the project. They have yet to respond officially but in conversation they have indicated that a fish pass would be required for any scheme where the situation would allow. As stated above, the use of the existing reservoir dam structure will negate the requirement for a fish pass in this instance.

3.2.5. Water of Leith Honorary Board

The Water of Leith Honorary Board was contacted by telephone and letter, with details of the project. A meeting on the 3rd May discussed issues with regards to fish in the watercourse and mitigation requirements. The main points of this were as follows:

- Fish passes:
  - It is thought that any fish pass requirements should be part of a longer term vision for all weirs on the Water of Leith. Funding for these should come from funds for river improvements, SEPA and the government and should be coordinated by the salmon fisheries board, SEPA and the Council.
  - Fish passes must not be accessible by the general public and will therefore require covering (possibly wire mesh) for protection.
- Fish spawning areas – Fish spawning occurs in areas where a shallow layer of aerated water passes over pebble beds. There are fish spawning areas along the length of the Water of Leith. The design of any hydro scheme would need to ensure no silting of spawning areas occur due to the scheme's impact on river flows.
- Construction of scheme
  - Construction will need to be carried out outside of spawning season of October to April.

    - Any silt will need to be removed to the bank of the river and left for two weeks to allow resident invertebrates an opportunity to return to the watercourse.
    - Contractors will need to be supervised to ensure no material (in particular raw cement) is released into the river.
- Maintenance – Removal of large debris is the responsibility of the landowner.
- Land ownership – Access and exclusivity or lease agreements need to be in place before planning is obtained.

With respect to the Harlaw Reservoir hydro scheme, there are no fish spawning areas in the vicinity and no fish pass or fish study is required. Construction of the scheme will need to occur outside of the fish spawning season, to ensure sediment does not disrupt that spawning at sites further downstream. Access to and from the hydro scheme and grid connection routing will need to be agreed with all landowners affected.

4. Financial

A financial analysis has been carried out based on the scheme described in Section 3. This Chapter is divided into five sections:

- Analysis of Capital Expenditure for Development
- Analysis of Operation Expenditure
- Analysis of Revenues
- Life Cycle Analysis
- Financial Projections

4.1. Capital Costs

There has been a change to the development costs from the design and cost study undertaken previously. Although a comprehensive environmental survey was carried out by Arup an additional walkover survey will be required as part of the development costs for the project to update the prior survey. This is to identify otter shelters, bats and bird nesting sites and has been costed in at £1,000.

Ossberger have provided a budget quotation for a 50kW turbine at a cost of €120,000 therefore a cost of €130,000 is now estimated for the 65kW turbine required for this scheme. At an exchange rate of 1.16 €/£, this gives a cost of £112,069 for the turbine, giving a total of £120,069 for mechanical equipment.

An overall breakdown of the capital expenditures is included in Table 2.

Item	Cost
Development	£9,854
Mechanicals	£120,069
Penstock	£3,544
Civil Works	£170,716
Electrical	£20,000
Installation and Commissioning	£7,928
Subtotal	**£332,111**
Contingency @ 10%	£33,211
Total	**£365,322**

Table 2: Capital Expenditure

4.2. Sources of Capital

The funding of community renewables projects is going through changes due to the introduction of the Feed-in Tariff. Grants for renewables are still available in Scotland, but there are ongoing discussions to assess the whether grants and the Feed-in Tariff together are allowable under the EU state aid rules. With regards to grant funding, the project has several features which will help in obtaining grant funding. These are:

- Community participation and community development
- Renewable Energy
- Environmental benefits
- Sustainable development.

Some possible sources of capital funding including grants and bank loans are shown below.

4.2.1. CARES (Community and Renewable Energy Scheme)

Through Community Energy Scotland, CARES offers grants to a range of community organisations to help with the installation of a variety of renewable energy technologies. Communities may apply for funding for technical assistance and capital grants for renewable energy equipment installation and associated costs. Under CARES there is no set grant funding. The amount of funding awarded is determined on a case by case basis. The maximum grant is £150,000. Funding is available for:

- The capital costs of installing renewable energy generation plant.
- Capital costs for supporting infrastructure, such as roads.
- Project management costs associated with the development and installation of generating equipment.
- The costs of the community establishing a partnership with a third party, such as a developer, or setting up a new company or purchasing an equity share in an existing company.
- The costs of implementing regulatory or fiscal regulations designed to encourage renewable energy generation or use; these may include metering equipment or costs of licenses.

Assessment criteria

Applications for funding are assessed against essential and desirable criteria. Larger capital projects may also be subject to independent technical assessment, prior to grant being offered.

Essential criteria are:

- All projects must be located in Scotland.
- The project must entail the generation of energy from renewable means.
- The project must involve an assessment of measures to improve energy efficiency.
- Projects relating to direct community ownership on behalf of the local community must demonstrate community benefit, involvement and a good level of local support for the project.
- Capital projects must be technically viable and capable of producing renewable energy within two years of funding being granted. Technical Assistance applications must be completed within one year.
- Applicants must allow publication of grant assisted work and reasonable access to those seeking to replicate the project.
- The project must meet all general legal, statutory and regulatory requirements.
- There must be a satisfactory maintenance and management plan for the project once installed.
- Applicants must demonstrate that the project entails the most cost-effective and appropriate means of meeting a given requirement for renewable energy.

- There must be an established and viable structure for the on-going management of the project.

4.2.2. Big Lottery Funding

Big Lottery Fund Scotland currently provides small grants from £500 to £10,000 for Community projects but larger loan schemes are planned for community renewable energy projects, due later this year.

4.2.3. Grant Funding and Borrowing Requirements

There are ongoing discussions with regards to government grant funding of projects. State Aid funding of projects is governed by EU rules which set out the limits allowable for government subsidies and incentives. Based on information provided by the British Hydro Association (BHA) the "State Aid" regulation allows for aid of up to €200,000 to be provided from public funds to any enterprise over a period of three years. According to this we understand that up to £160,000 (based on present Euro-Sterling exchange rate) could be received from CES or other public sources, per site, whilst still being eligible to receive the Feed-in Tariff.

Further information has been provided by CES. As FIT is notified as a State Aid for Environmental Protection[1] it cannot be topped up with De Minimis[2] for the same eligible costs if that would result in the total aid being over the aid intensity allowed. The aid intensity allowed for Environmental Protection is up to 65% of the capital costs of the project

> "Aid for environmental protection shall not be cumulated with *de minimis* aid in respect of the same eligible costs if such cumulation would result in an aid intensity exceeding that fixed in these guidelines."

The total amount the project will receive from FIT is more than the capital cost for the project and therefore they are definitely over the aid intensity of 65% of extra costs. This is currently contrary to the position taken by the British Hydro Association but both positions will be modelled in the financial analysis section.

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[1] EC No 800/2008 – Article 23
[2] De Minimis relates to grant funding EC No 1998/2006

CES have further clarified their position with regards to funding for community projects. The community group would set up a Special Purpose Vehicle (SPV), otherwise known as a Trading Subsidiary, to manage the installation and operation of the turbine. CES would provide a grant to the community group which would then loan the money to the SPV at commercial rates and paid back over the time stipulated. The commercial loan rate would have to be equivalent to what the SPV would be able to get from a commercial supplier (i.e. bank) at the time when the agreement is put in place – 7.0% is a rate quoted by Cooperative Bank. CES will assess the case for funding for projects based primarily on this criterion but where the project manages to raise finance locally at a very low return rate, or if the project is considered to be located in a deprived area and provides an educational resource, there also may be a case for funding.

The life-cycle analysis will assess the project with funding through this arrangement.

4.3. Operational Expenditure

It is expected that a maintenance agreement will be put in place as a requirement for insurance and finance purposes. Therefore this business plan will assess the financial case for the project assuming a maintenance agreement is in place.

The balancing and settlement code which governs energy generation stipulates that any scheme with an output greater than 30kW requires a half-hourly meter installed which would then need to be registered centrally by the electricity supplier/purchaser. An annual cost for a half-hourly meter contract with data retrieval has been costed in at £600 per annum.

An overall breakdown of the capital expenditures is included in Table 3.

Component	Operational Expenditure
Administration	£200
Day-to-Day Operation	£400
Maintenance	£1,240
Rates	£0
Insurance	£2,000

Metering	£600
Totals	**£4,440**

Table 3: Operational Costs

4.4. Annual Revenue

Discussions with two different energy supply companies have taken place – Green Energy Ltd and Tradelink Solutions Ltd. A Power Purchase Agreement (PPA) would need to be set up with an energy supply company to claim the Feed-in Tariff incentives. Schemes under 50kW do not have the option for revenue from Renewable Obligation Certificates (ROCs) but, as this scheme is rated at 65kW, there is a possibility to obtain revenue from ROCs.

Green Energy has indicated that the revenue from the Power Purchase Agreement would match that of the rate provided by the generation and export Feed-in Tariff rates (17.8 and 3p/kWh respectively) and would be renewed annually.

Tradelink Solutions has also indicated that schemes under 30kW would receive the generation and export Feed-in Tariff rates although generation would be calculated from year end meter readings or estimated using deeming rates. Above 30kW Tradelink Solutions provides a choice for the exported electricity of either the export FiT rate or setting up a separate PPA and gaining a proportion (approx 90%) or the market export rate (currently £41/MWH) on an annually renewed contract.

If grants are used to fund the project, it is likely that the Feed-in Tariff rates will not be available. Due to the scale of the scheme it would still be eligible for ROCs. ROCs currently provide an income of £49/MWh and vary with electricity costs. The scheme would get a proportion of this and would also get the market export rate for the exported electricity.

Additionally, if the scheme was accredited through Ofgem, it would be entitled to the Levy Exemption Certificate (LEC) providing an additional income of £4.70/MWh.

Based on the tariffs and assumptions above, the components of revenue from the Feed-in Tariff for the scheme are shown in Table 4.

Component	Tariff	Percentage	Revenue
Feed-in Tariff	17.8 p/kWh	100%	£47,329
Electricity Exported	3.0 p/kWh	100%	£7,977
LEC	0.47 p/kWh	90%	£1,125
Totals			**£56,431**

Table 4: Revenue from FiT

If the scheme obtains grant funding then the components of revenue are shown in Table 5 below.

Component	Tariff	Percentage	Revenue
ROCs	4.9 p/kWh	90%	£11,726
Electricity Exported	4.1 p/kWh	90%	£9,812
LEC	0.47 p/kWh	90%	£1,125
Totals			**£22,662**

Table 5: Revenue from ROCs

4.5. Life-Cycle Analysis

A financial model has been created based on the capital expenditure, operational expenditure and revenues which have been put forward in the previous sections. A summary of these figures, plus a synopsis of the results, are put forward in Table 6, and includes the results for three scenarios:

- Scenario 1 – No grants or loans shown.
- Scenario 2 – Where a grant of £150,000 is available and revenue comes in part from ROCs. This also includes a loan at 7% over 15 years for the remaining amount.
- Scenario 3 – Where a grant of £160,000 is available and Feed-in Tariff incentive is allowed as per information provided by the BHA. This also includes a loan at 7% over 15 years for the remaining amount.

- Scenario 4 – Were an SPV is set up by the community group with a loan for 100% of the costs of the project at 7% interest over 15 years[3].

All models include an annual predicted increase in energy price of 3.5%, with FiT levels rising with RPI at a rate of 2.5%.

Component	Scenario 1	Scenario 2	Scenario 3	Scenario 4
Capital Expenditure	£365,322	£365,322	£365,322	£365,322
Grants or bank loan	£0	£150,000 grant and £215,322 bank loan	£160,000 grant and £205,322 bank loan	£365,322 loan
Operational Expenditure	£4,440	£4,440	£4,440	£4,440
Scheme rating	65 kW	65 kW	65 kW	65 kW
Capacity factor	45%	45%	45%	45%
Annual generation	265,896 kWh	265,896 kWh	265,896 kWh	265,896 kWh
1st Year Revenue	£56,431	£22,662	£56,431	£56,431
1st Year Profit	£51,991	-£4,987	£29,851	£12,603[4]
Payback Period	6.6 years	>20 years	6.2 years	15.3 years
Internal rate of return[5]	15%	-1%	18%	6%
20 year Net Present Value[6]	£431,527	-£146,343	£361,724	£22,717

Table 6: Life-Cycle Analysis

This highlights the importance of appropriate finance for funding the project and shows that, even using bank loan finance, the project has a respectable payback period. A sensitivity analysis is provided in 4.6, showing the financial projection of the impact of different factors on the scenarios.

[3] Based on information provided by Cooperative Bank and CES
[4] Profit over and above repayments to the community for the loan
[5] After 20 years
[6] After 20 years using a discount rate of 5%

4.6. Financial Projections

Financial projections have been provided in the tables below showing the impact on the three scenarios of different factors. Figure 7 shows the impact of an RPI inflator on payback and internal rate of return for Scenario 1.

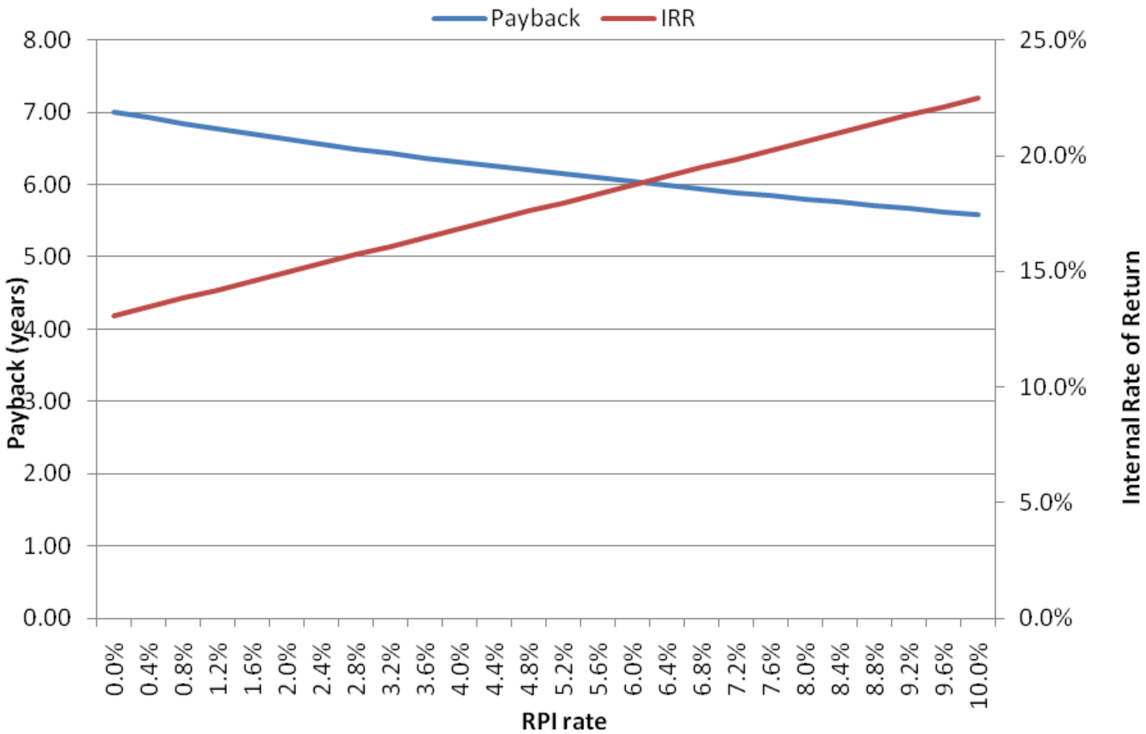


Figure 7: Financial projections for different RPI rates on Scenario 1

This shows that RPI increases have a beneficial impact on Scenario 1, because Feed-in Tariff rates increase with RPI. This would have a similar proportional impact on Scenarios 2 & 3.

The effect of different percentages of loans, as a proportion to capital costs, on the payback, IRR and NPV for the project (Scenario 4) are highlighted in Figure 8 below.

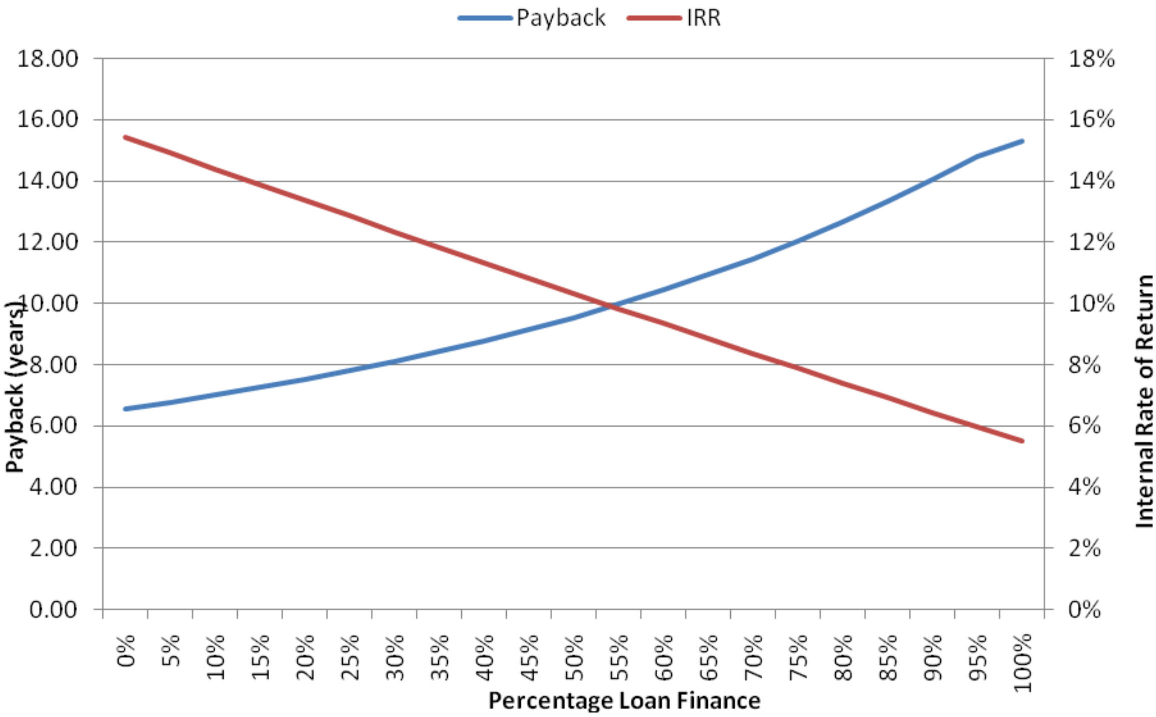


Figure 8: Financial projections for different bank loan proportions

Although payback period decreases and IRR increases as the loan proportion decreases this does not take into account the financing for the remaining proportion of the capital costs. If this is met through a bank loan at the same interest rate then the payback period and IRR will not change. Figure 9 shows the impact on scenario 3 of different loan interest rates.

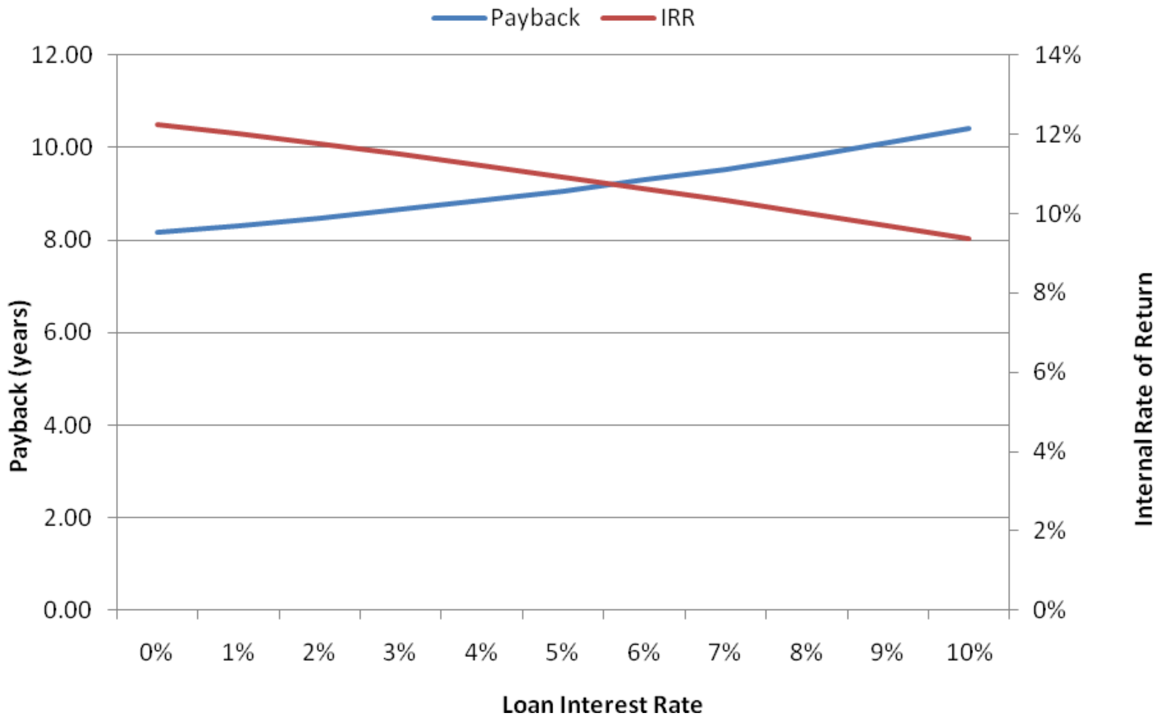


Figure 9: Financial projections for different bank loan interest rates

This shows that if the interest rate for the loan to the SPV is reduced by 2% there would be a reduction in payback period by approximately 0.5 years whilst the IRR would increase by approximately 1% therefore making little overall difference to the results. The project therefore remains viable if a bank loan is required to secure funding.

5. Risks

The key risks to the project are:

- **Consents are not obtained** – The legislative environment is in favour of this type of scheme. This risk has been mitigated by early consultation with stakeholders. This consultation is currently under way. The local council plan has an objective to contribute to national targets for renewable energy through increasing community, business and domestic-scale renewable energy schemes.

- **Overspend** – This risk has been mitigated by careful budgeting at an early stage and by ensuring all works are carried out at fixed cost. There is contingency built into the financial projections.

- **Failure to raise sufficient capital** – The funding for this project is yet to be determined and is a key risk due to the impact on the financial payback and Internal Rate of Return. This risk will be mitigated by careful planning at an early stage in order to identify a wide range of suitable funds and by ensuring that each fund is aware of its role in the project. There are cost saving measures that can be employed if required, such as the use of a less expensive turbine or a smaller penstock pipe, should there be a small shortfall.

- **Construction risk** – The construction risk will be mitigated by ensuring qualified contractors are selected with a good track record of delivery of similar projects. All contractors will be suitable insured and the construction process will be closely supervised so that any problems can be dealt with at an early stage.

6. Strategy and Implementation

The project will be implemented by adhering to the following steps.

Consents – Balerno Village Trust, in conjunction with RDES, has designed the scheme and will then need to obtain planning consent, grid connection approval and a water abstraction licence in order to ensure that the regulatory barriers to development are removed. It is expected that the lease of the land for the site of the scheme will be put in place with the Council without difficulty. Access agreements will need to be put in place. It is estimated that this phase will take six months to be completed.

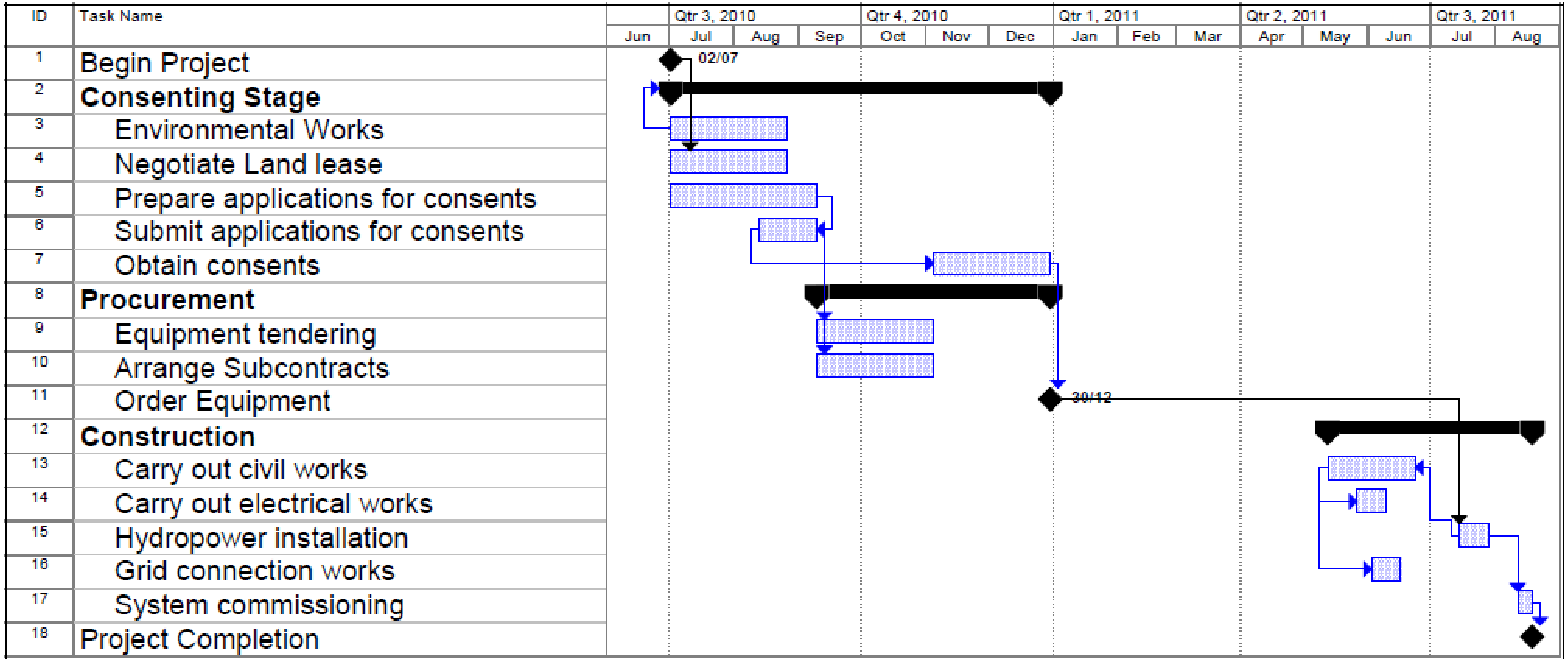
Fundraising – Balerno Village Trust will obtain all necessary funds to enable the procurement and construction phase to proceed. Further details of sources of funds are included in the Financial Plan in section 4.2.

Procurement – Balerno Village Trust will specify and tender for the various components and services required to facilitate construction. A tendering process will ensure the best value for money is obtained and the most suitable suppliers and contractors are used. It is anticipated that the procurement process will take 2 – 3 months and will result in placing orders when all consents have been obtained. The maximum lead time is expected to be 4 – 14 months for the turbine, dependent on the choice of manufacturer.

Construction – Construction will take place once all consents are in place and civil engineering contracts have been finalised. This will include gaining access to the site; installing the penstock and valves; and constructing the plinth and powerhouse. The turbine and generator will then be installed. The scheme will be connected to the grid and commissioning will take place, signifying completion of the construction phase and allowing power generation to begin. The construction phase is expected to be of 3 months duration, but will need to be synchronised with the bird nesting and fish spawning seasons.

Operation – The turbine will generate power based on a control system which ensures that adequate flow is always left within the river. The control system ensures automatic operation with minimal human input. Operation will include regular checks on turbine and intake as well as administration of revenues and operational expenditures. A suitable company will provide scheduled maintenance on a contract basis. Management of operations is described below. Well-maintained hydro schemes can provide reliable energy generation for up to 100 years.

7. Development Timetable



8. Management

Balerno Village Trust will appoint and train personnel to operate the facility and the board of directors will oversee and manage the business. The operation of a micro hydropower project can be included within the existing management structure.

Day-to-day operation of the project will be carried out by a member of the local community. Scheduled maintenance tasks will take place as part of a maintenance contract. Administration of project development, as well as ongoing administration, will be carried out by the Balerno Village Trust board.

8.1.1. Legal Agreements

A lease agreement will be drawn-up which will enshrine the rights of Balerno Village Trust in respect to the land on which the project will be built. This will include the rights of access for construction and operation, as well as water use for the turbine. The site for the scheme is currently owned and maintained by the Council. It is possible that access to the site and grid connection may need to pass through private land. Access rights will need to be secured for any requirements through private land.

A further legal agreement will be put in place between Balerno Village Trust and one or more utility companies. This will be a contract to ensure that all power, FiTs, ROCs and LECs are purchased by the company, and to regulate the administration of and payment for these commodities.