



Hydropower Sustainability Assessment Protocol

Official Assessment

Landsvirkjun

Blanda Power Station

Iceland

Final



10/12/2013

Client: Landsvirkjun

Lead Assessor: Dr. Joerg Hartmann, Independent Consultant

Co-assessors: Dr. Helen Locher, Principal Consultant Sustainability, Hydro Tasmania;
Simon Howard, Sustainability Specialist, IHA

Assessment Date: 09/09/13-13/09/13

Project stage: Operation

Project size: 150 MW

Project type: Storage

Cover page photo: Waterway connecting the reservoir with the power station, looking downstream from the Smalatjörn outlet. Note the flat, sparsely vegetated landscape and the turbid glacial waters.

Acronyms

Acronym	Full Text
ASÍ	Icelandic Confederation of Labour
CEO	Chief Executive Officer
CSR	Corporate Social Responsibility
DMM	Dynamic Maintenance Management
EU	European Union
EFTA	European Free Trade Association
EIA	Environmental Impact Assessment
FIDIC	International Federation of Consulting Engineers
GHG	Greenhouse Gas
GL	Gigaliter (1m m ³)
GPS	Global Positioning System
HVDC	High Voltage Direct Current
IFF	Institute of Freshwater Fisheries
IHA	International Hydropower Association
ISO	International Organisation for Standardization
KPI	Key Performance Indicator
masl	Meter above sea level
OECD	Organisation for Economic Co-operation and Development
OH&S	Occupational Health and Safety
OHSAS	Occupational Health and Safety Assessment Series
O&M	Operation and Maintenance
TETRA	Terrestrial Trunked Radio
UHF	Ultra High Frequency
VHF	Very High Frequency

Table of Contents

Acronyms.....	ii
Table of Contents	iii
Executive Summary	iv
Sustainability Profile.....	v
Table of Significant Gaps	vi
Introduction.....	1
1 Communications and Consultation (O-1)	6
2 Governance (O-2).....	11
3 Environmental and Social Issues Management (O-3).....	19
4 Hydrological Resource (O-4)	26
5 Asset Reliability and Efficiency (O-5)	31
6 Infrastructure Safety (O-6).....	36
7 Financial Viability (O-7)	42
8 Project Benefits (O-8).....	47
9 Project Affected Communities and Livelihoods (O-9)	50
10 Resettlement (O-10)	55
11 Indigenous Peoples (O-11).....	55
12 Labour and Working Conditions (O-12)	56
13 Cultural Heritage (O-13).....	62
14 Public Health (O-14).....	65
15 Biodiversity and Invasive Species (O-15)	69
16 Erosion and Sedimentation (O-16)	74
17 Water Quality (O-17).....	79
18 Reservoir Management (O-18)	83
19 Downstream Flow Regime (O-19).....	87
Appendix A: Written Support of the Project Operator	91
Appendix B: Verbal Evidence	92
Appendix C: Documentary Evidence	95
Appendix D: Visual Evidence	106

Executive Summary

This report presents the findings of an assessment of the Blanda Project using the Operation Stage tool of the Hydropower Sustainability Assessment Protocol. Blanda is a 150 MW hydroelectric power plant, owned and operated by Landsvirkjun, located in north-western Iceland. The assessment was carried out over the period August to October 2013, with an on-site assessment encompassing a visit to the project site and interviews with stakeholders conducted in the week beginning 9th September 2013. This assessment meets the requirements of an Official assessment, as set out in the Terms and Conditions for the Use of the Protocol.

Blanda was commissioned in 1991. It has low adverse environmental and social impacts, and the most significant one (loss of vegetation and sheep grazing lands under the large reservoir) has been compensated by a large revegetation programme. Relationships with local stakeholders are excellent. The project provides important social and economic benefits to the sparsely populated local area and to Iceland overall. It has also improved environmental conditions for fish in the lower Blanda River, resulting in much expanded salmon angling opportunities. Power generation in Iceland largely goes to power intensive industries such as aluminium smelters. Landsvirkjun is a strategic company for the Icelandic economy and for its owner, the Icelandic government.

These issues are reflected in the findings of this assessment, and in a range of high scores that summarise the findings. Blanda meets Proven Best Practice on 14 out of 17 topics assessed using the Protocol: Communications and Consultation; Governance; Environmental and Social Issues Management; Asset Reliability and Efficiency; Infrastructure Safety; Financial Viability; Project Benefits; Project-Affected Communities and Livelihoods; Labour and Working Conditions; Cultural Heritage; Public Health; Erosion and Sedimentation; Reservoir Management; and Downstream Flow Regime.

Blanda exceeds Basic Good Practice on all 3 remaining topics, each of these with only one significant gap against proven best practice:

- On the topic of Hydrological Resource, the present low water year has demonstrated the value of optimal use of water in the Landsvirkjun generation system. This is subject to some external constraints, especially with regards to transmission capacity, and to a lesser degree with regards to downstream flows, that could benefit from closer analysis of optimisation opportunities.
- On the topic of Biodiversity and Invasive Species, a number of the initial biodiversity studies have not been followed up and the biodiversity benefits of the revegetation program have not been fully documented. This limits the ability to manage for biodiversity risks and opportunities in the Blanda project area and beyond.
- On the topic of Water Quality, probably because of the traditionally high water quality in the project area, which was even improved by the project in some respects, there has been little systematic monitoring. This again limits the ability to manage for sustained high water quality and to anticipate and respond to any emerging risks.

Two topics, Resettlement and Indigenous Peoples, are Not Relevant to Blanda. The scores for all topics are summarised in the following Sustainability Profile and Table of Significant Gaps.

Sustainability Profile

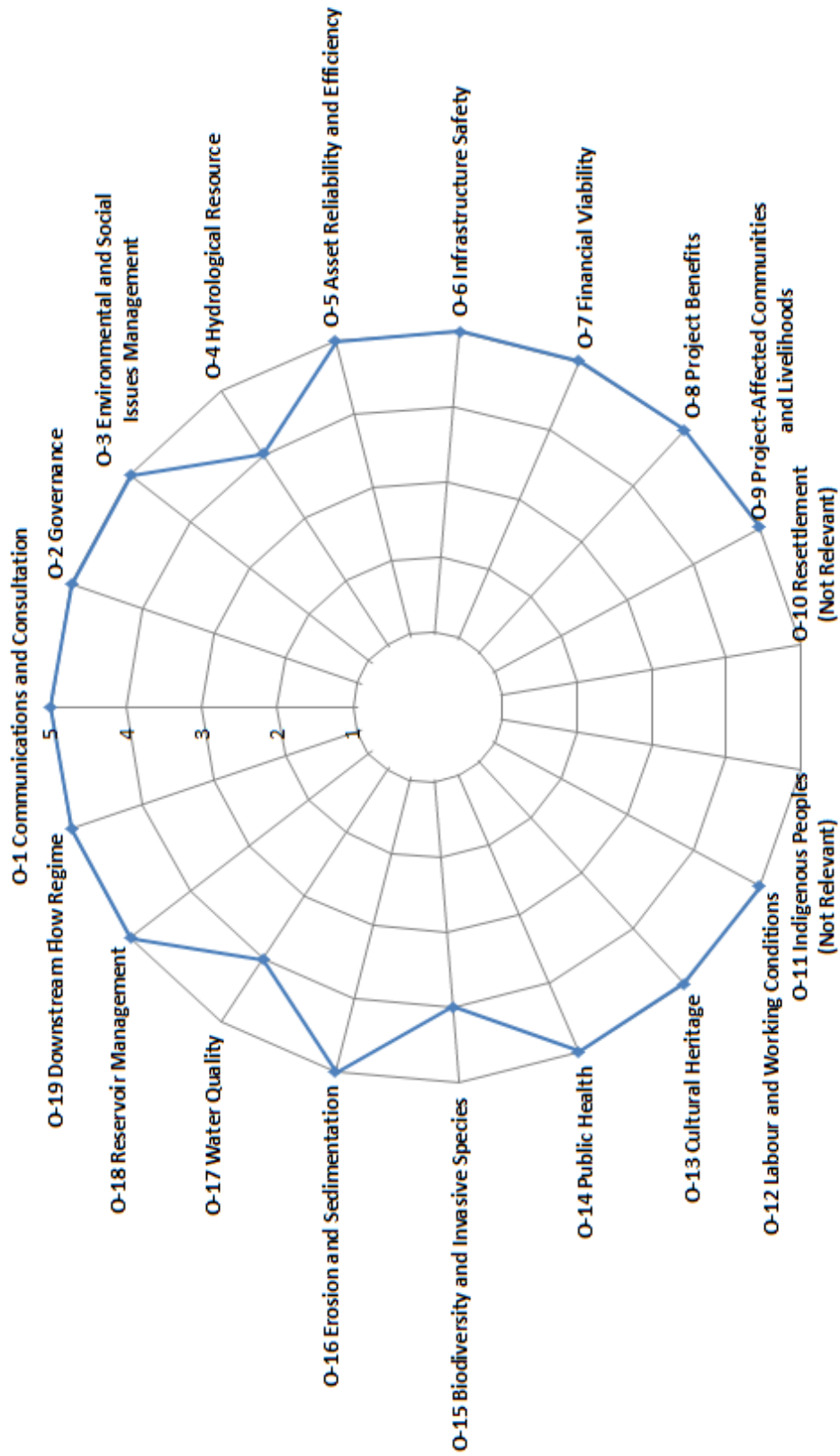


Table of Significant Gaps

	Level 3: Significant Gaps against Basic Good Practice	Level 5: Significant Gaps against Proven Best Practice
Assessment	No significant gaps	<p>O-15: There are insufficient processes in place to anticipate and respond to emerging biodiversity risks and opportunities.</p> <p>O-17: There is a lack of systematic monitoring of the physical, chemical and biological properties of water in the project area.</p>
Management	No significant gaps	<p>O-4: The use of water at Blanda (and in the broader Landsvirkjun generating system) is constrained by transmission capacity gaps and not fully optimized.</p>
Stakeholder Engagement	No significant gaps	No significant gaps
Conformance/ Compliance	No significant gaps	No significant gaps
Outcomes	No significant gaps	No significant gaps

Introduction

The Hydropower Sustainability Assessment Protocol

The Hydropower Sustainability Assessment Protocol ('the Protocol') is a framework to assess the performance of hydropower projects according to a defined set of sustainability topics, encompassing environmental, social, technical, and financial issues.

Developed by the International Hydropower Association (IHA) in partnership with a range of government, civil society and private sector stakeholders, the Protocol is a product of intensive and transparent dialogue concerning the selection of sustainability topics and the definition of good and best practice in each of these topics. Important reference documents that informed the development of the Protocol include the World Bank safeguards policies, the Performance Standards of the International Finance Corporation, and the report of the World Commission on Dams. To reflect the different stages of hydropower development, the Protocol includes four assessment tools that are designed to be used separately, corresponding to the Early Stage, and Preparation, Implementation and Operation stages of a project.

Applying the Protocol delivers an evidence-based assessment of performance in each topic, with a set of scores providing an indication of performance in relation to basic good practice and proven best practice. The scoring system is as follows:

- 5 Meets basic good practice and proven best practice;
- 4 Meets basic good practice with one significant gap against proven best practice;
- 3 Meets basic good practice with more than one significant gap against proven best practice;
- 2 One significant gap against basic good practice;
- 1 More than one significant gap against basic good practice.

Assessments rely on objective evidence to support a score for each topic that is factual, reproducible, objective and verifiable. Key attributes of the Protocol are: (i) global applicability, i.e. it can be used on all types and sizes of hydropower projects, anywhere in the world; and (ii) consistency, i.e. the consistency of its application is carefully governed by a system of quality control encompassing accredited assessors, terms and conditions for use, and the Protocol Council.¹

Scoring is an essential feature of the Protocol, providing an easily communicated and replicable assessment of the project's strengths, weaknesses and opportunities. The scoring system has been devised to ensure that a Protocol Assessment cannot provide an overall 'pass' or 'fail' mark for a project, nor can it be used to 'certify' a project as sustainable. The Protocol provides an effective mechanism to continuously improve sustainability performance because results identify gaps that can be addressed, and the findings provide a consistent basis for dialogue with stakeholders.

Assessment Objectives

The objectives for this assessment are to:

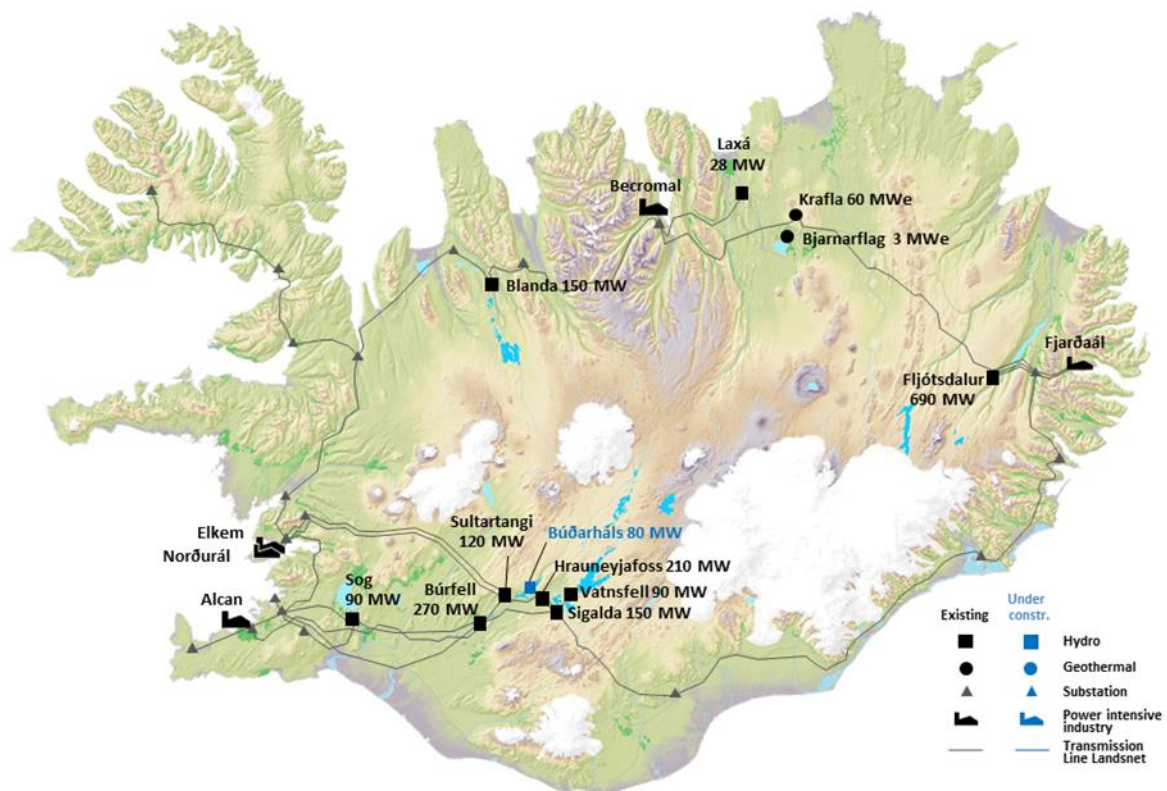
- Ensure the sustainability of the operation of Blanda Power Station
- Ensure high standards in the operation of power stations owned by Landsvirkjun
- Find improvement opportunities for the operation of Blanda Power Station
- Ensure transparency of the operation of Blanda Power Station and the engagement of stakeholders
- Benchmark Landsvirkjun against international companies

¹ Full details of the Protocol and its governance, are available on www.hydrosustainability.org.

Project Description

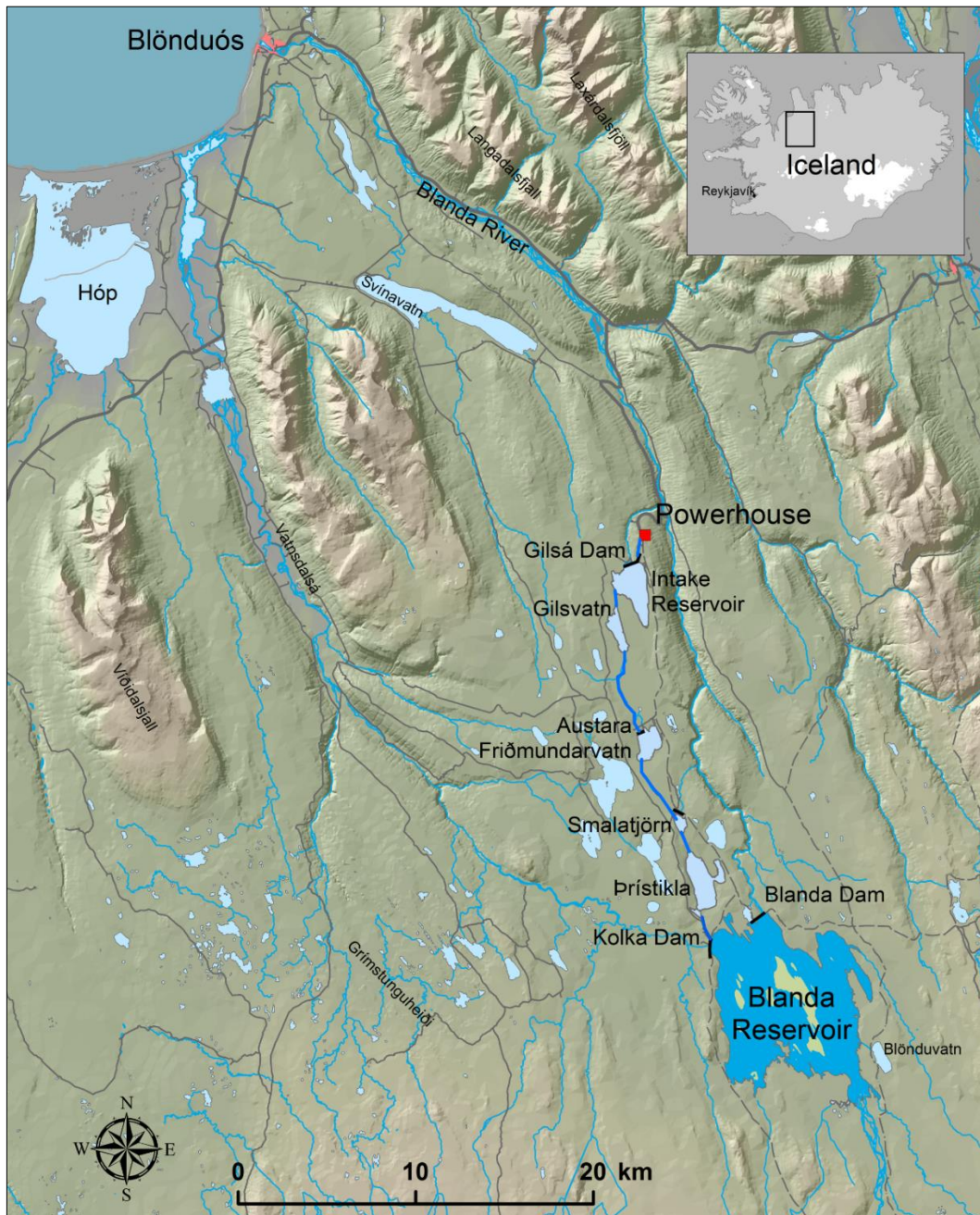
Landsvirkjun is an energy company owned by the Icelandic state. The company produces 75% of all electricity in Iceland, from hydro and geothermal sources, and is one of the ten largest renewable energy companies in Europe. Landsvirkjun operates thirteen hydropower stations, two geothermal stations and two wind turbines. In 2012 the company's total installed capacity was 1,860 MW and electricity generation amounted to 12,312 GWh. About 80% of all sales go to power-intensive industries such as aluminium and ferro-alloy smelters, and peak load in Iceland is only 15% higher than the base load.

Figure 1. Main power plants, transmission lines and power-intensive industrial customers



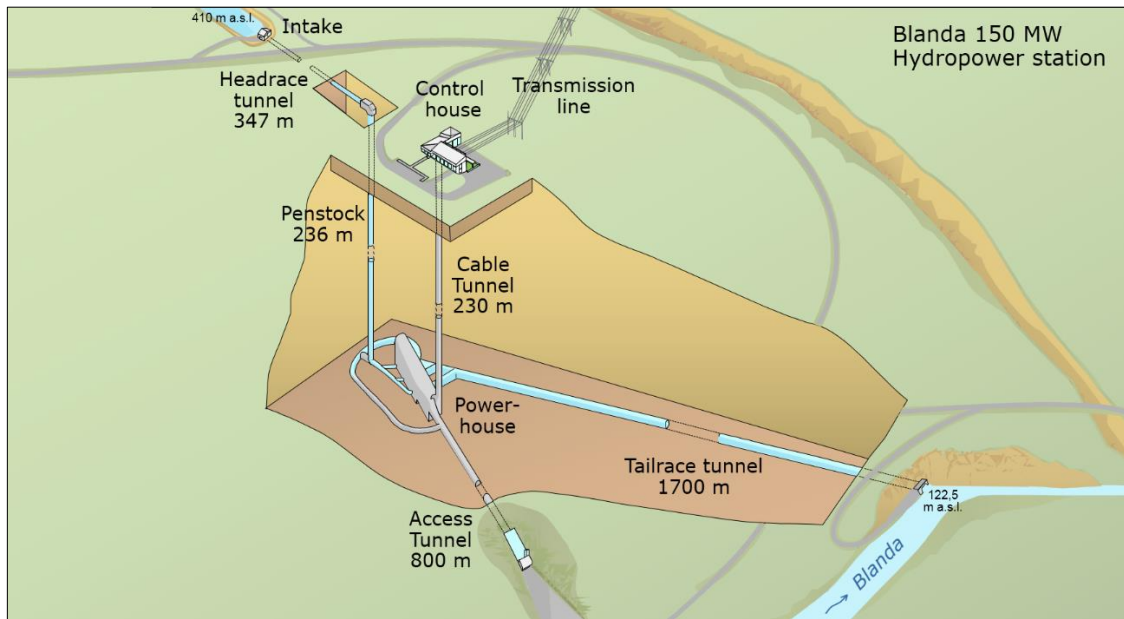
Landsvirkjun owns and operates the 150 MW Blanda Power Station located in north-west Iceland. This station harnesses the glacial Blanda River that flows north from the Hofsjökull Glacier over a stretch of 125 km to sea in the town of Blönduós. The power plant started operation in 1991. Two dams were built to form the main Blanda Reservoir (Blöndulón, 56 km²), the Blanda Dam on the Blanda River and the Kolka Dam on the Kolkukvísl River, which flowed into the Vatnsdalsá River (thus diverting a small amount of water from that catchment). The Blanda Reservoir has a storage capacity of 425.8 Gl, making it one of Iceland's largest lakes. Its mean depth is 7.6 m and it reaches a depth of approx. 30 m. From the Kolka Dam, the water is diverted through 9,800 m long diversion canals and four lakes to the intake reservoir, Gilsárlón (5 km²), with a live storage capacity of 20 Gl. The total length of the three dams is 3,100 m. There are plans to develop the head between some of the lakes for additional small hydropower stations.

Figure 2. Blanda River and reservoirs, waterway and power house



From the intake reservoir, water runs through a 1,300 m long canal to the station's intake and a 347 m long headrace tunnel, before it drops vertically through a 236 m long penstock to the underground power station. The total gross head is 287 m. From the turbines, the water flows through a 1,700 m tailrace tunnel back into the river. The station is operated from control and staff buildings near the intake above the powerhouse. It is equipped with three 50 MW units and generates about 800 GWh in an average year. Between 2006 and 2012, monthly generation ranged between 51 and 89 GWh. It is connected by double circuit 132kv lines to the transmission ring around Iceland, and is important to stabilize the grid in the north-western part of the country. Generation is remote-controlled via optical cable and microwave link from a dispatch centre in Reykjavík. There are about 15 permanent employees at the station, primarily responsible for maintenance and supervision.

Figure 3. Layout of Blanda power station



The catchment area above Blanda Power Station covers 1,520 km², including glaciated areas, and the average discharge of the station is 39 m³/s. The area around the reservoirs, waterway and power station lies at 400–600 masl on the fringe of the central highland plateau and is characterized by gentle hills with heathland on shallow soils. Below the Blanda dam the river alternates between steep gorges and open braided reaches.

The climate in the area is dry, cold and windy, with a mean annual precipitation of 400 mm and a mean annual temperature of 0.6°C. Lakes and reservoirs are generally frozen over from mid-November to the end of April; in 2012 there were 165 ice-free days in the Blanda reservoir and 178 ice-free days in the intake reservoir. The Blanda reservoir's level is at its lowest at the beginning of spring before the start of snow and glacial melting. By catching the sediment-laden spring floods, the Blanda project has reduced flooding and turbidity and improved salmon angling downstream. Spilling over the Blanda dam spillway occurs in most years in late summer. There are several islands in the Blanda reservoir and large shallow areas which are exposed during the drawdown period.

Prior to the formation of the storage reservoir the area was dominated by dwarf shrub heath and moss heath communities, along with wetlands in depressions; generally with high quality soils and the best grazing for sheep in the region. After the creation of the reservoir, extensive revegetation efforts have been and are being undertaken mostly to compensate for the loss of grazing area. Along with the reconstruction of roads and some minor buildings in the reservoir area, these were the main compensation measures.

The project's infrastructure is located within the Húnavatnshreppur municipality. Downstream towards the mouth of the river is the Blönduós municipality. The general project area is sparsely populated and no resettlement was necessary.

Assessment Process

The Blanda assessment process started with a training course on the use of the Hydropower Sustainability Assessment Protocol to Landsvirkjun staff during 2011, provided by staff from IHA. Landsvirkjun then commissioned a first Official Assessment, of the Hvammur project in the preparation stage, which was conducted in May 2012. The Blanda assessment is the second Official Assessment for Landsvirkjun, and the company has developed a thorough understanding of the Protocol and largely prepared the assessment

without support from the assessment team (identification of interviewees and documentary evidence, preparation of scoping document, electronic data room, assessment schedule, and logistical planning).

The on-site assessment was conducted between the 9th and the 13th of September, 2013, by a team of three accredited assessors. The process involved collection of verbal, visual and documentary evidence to evaluate project processes and performance against the Protocol's Operation scoring criteria. The assessment team conducted interviews in Reykjavik and in the project area, as well as through video and telephone interviews. A total of 49 individuals were interviewed, some of them several times and on a variety of topics. Site visits covered the entire Blanda river basin, from its headwaters to the sea. Interviews covered the perspectives of the developer, employees and unions, government institutions, affected communities, consultants and academics. For every topic an effort was made to ensure that those with the responsibilities and most direct insights into the issues were interviewed. Triangulation of evidence – visual, verbal and documentary – is an important requirement for the evidence-collection process and was enabled through the assessment process.

Appendices B and C contain information on the interviews conducted and the documents reviewed. Both Landsvirkjun and the assessment team have done their best to ascertain the accuracy of the information provided in those appendices. Appendix D contains photos taken by the assessment team on site.

Follow-up evidence was requested by, and provided to, the assessors in the weeks following the assessment. The draft report was provided to Landsvirkjun on the 10th of October, for review of technical accuracy with respect to project, evidence and institutional references. Comments were received from Landsvirkjun on the 22nd of November. Following editing in response to Landsvirkjun's comments, this Official Assessment report was filed on the 10th of December.

Assessment Experience

The on-site assessment was very well supported by the Single Point of Contact, Ragnheiður Ólafsdóttir (Landsvirkjun's Environmental Manager), her Local Support Team (in particular, Kristján Steinn Magnússon and Hugrún Gunnarsdóttir, Consultant, Verkís) and Landsvirkjun staff both from headquarters and the Blanda power station, including Guðmundur R. Stefánsson, Station Manager; Helgi Bjarnarson, Project Manager; Sigurður Guðni Sigurðsson, Operations Manager and Sveinn Kári Valdimarsson, Fish Biologist.

All interviewees shared their views and knowledge openly and professionally, thereby assisting the assessment team in its task of understanding the project, and being able to assess and score the 17 relevant topics in accordance with the Protocol's requirements. Most of the documentary evidence is publicly available, as Landsvirkjun and the Icelandic government are generally operating in a highly transparent manner. Translation from Icelandic to English was less of an issue than initially expected, with some documents translated either in advance or after the assessment, ample translation capacity available during the on-site assessment (Hulda Kristín Jónsdóttir, interpreter), and the use of on-line translation tools by the assessment team. Requests for follow-up information were responded to rapidly and comprehensively.

Layout of this Report

This report consists of nineteen sections numbered in direct correspondence with the nineteen topics of the Protocol's Operation tool. Four appendices are provided, including the written letter of support of the project operator (required for an official Protocol assessment), and detailing the items of visual, verbal and documentary evidence referred to under each topic.

For each topic, findings are provided according to the criteria used in the Protocol's methodology: Assessment, Management, Stakeholder Engagement, Stakeholder Support, Conformance / Compliance, and Outcomes. Findings are presented against a statement of 'basic good practice' and a statement of 'proven best practice' for each, with a 'Yes/No' indication of whether the scoring statement is met. A summary of the significant gaps against the scoring statement, the topic score and a brief summary are presented at the close of each topic section.

1 Communications and Consultation (O-1)

This topic addresses ongoing engagement with project stakeholders, both within the company as well as between the company and external stakeholders (e.g. affected communities, governments, key institutions, partners, contractors, catchment residents, etc). The intent is that stakeholders are identified and engaged in the issues of interest to them, and communication and consultation processes maintain good stakeholder relations throughout the project life.

1.1 Background Information

Landsvirkjun addresses communication and consultation at both a corporate and project level. At the corporate level a dedicated communication team deals with issues that affect the company as a whole, focusing on the Landsvirkjun website and management of media relations and social media. The most important external stakeholders in Iceland, as defined in the corporate communication plan, are: Landsvirkjun's owner, customers, suppliers and service providers, employees, the government (parliament, ministries and governmental agencies), municipalities (local governments), NGO's (such as environmental organisations) and landowners.

The corporate communication team may respond to requests for information from stakeholders about Blanda that are made to them directly, but communication at the project level is largely dealt with by the station manager. The station manager has responsibility for maintaining relationships with all local stakeholders, responding to queries and providing proactive information about issues which may affect the local community. At the project level the most important external stakeholders are considered to be the grazing associations, angling club, the municipalities, the Health Unit of Northwest Iceland, Soil Conservation Service and the tourism association.

There is some overlap between this topic and a number of other topics that include the 'stakeholder engagement' criteria. Findings on stakeholder engagement under other topics focus on the issues related to those topics only, whereas this topic assesses Landsvirkjun's general approach to communication and consultation at the corporate and project level.

1.2 Detailed Topic Evaluation

1.2.1 Assessment

Analysis against basic good practice

Scoring statement: *Ongoing or emerging issues relating to hydropower facility communications and consultation have been identified; requirements and approaches are determined through a periodically updated assessment process involving stakeholder mapping; and effectiveness is monitored.*

Ongoing or emerging issues relating to hydropower facility communication and consultation have been identified at both the corporate and project level. Identification of company-wide communication requirements is done at the corporate level by a dedicated communication team. In October 2012 Landsvirkjun commissioned Capacent Gallup to undertake a public opinion survey of the company, yielding 600 responses. Results were analysed by age, location, income, education level, and political orientation to identify communication issues.

A new communication strategy for the company has been developed and Landsvirkjun will apply it to all projects by the spring of 2014. The plan will ensure that each power station identifies all stakeholders, analyses their key areas of interests, and defines when and how they should receive communication from the company.

Stakeholder mapping at the corporate level has been comprehensive, with each identified group assigned a rank of power and a rank of importance. This rank then determines the type of relationship Landsvirkjun intends to maintain with the group, and how and when they will receive communication.

At the project level, ongoing or emerging communication issues are identified through regular formal and informal meetings with stakeholders. The project is located in a small community whose members interact frequently, rapidly bringing emerging issues to the attention of the station manager.

A stakeholder map for the Blanda project was developed this year and will be updated annually in the future. This plan identifies and groups stakeholders in a meaningful way, based on different risks and responsibilities. Key groups identified include the municipality, anglers, farmers, and the tourism agencies. One emerging issue is the low water level in the reservoir due to the dry summer, which has concerned sheep farmers and anglers. An ongoing issue is reservoir shoreline erosion which is of general concern to the local community due to the dust created and the impact on grazing.

Annual use of Capacent Gallup opinion polls allows ongoing monitoring of the effectiveness of corporate level communication. The effectiveness of stakeholder mapping is monitored at the project level using regular formal and informal meetings with the local community, associations and the municipalities.

Criteria met: Yes

Analysis against proven best practice

Scoring statement: *In addition, the stakeholder mapping takes broad considerations into account.*

Stakeholder mapping takes broad considerations into account, covering all possible groups which could be affected by or interested in the project. Iceland is a relatively homogenous society, so segregation of stakeholders is less significant than in some other international contexts.

Criteria met: Yes

1.2.2 Management

Analysis against basic good practice

Scoring statement: *Communications and consultation plans and processes, including an appropriate grievance mechanism, are in place to manage communications and engagement with stakeholders; these outline communication and consultation needs and approaches for various stakeholder groups and topics.*

Landsvirkjun's new corporate communication plan sets out the method, frequency and responsibilities for communication with the company's stakeholders. The plan includes requirements to monitor the effectiveness of communication and to seek feedback from stakeholders. Ongoing mechanisms for communication with the general public include the annual report, regularly updated website, and use of social media.

There is a communication plan for the Blanda project. It lists 17 stakeholder groups, their contact details, the frequency and timing of contact, the reasons for contact and the responsible Landsvirkjun representative. Landsvirkjun staff keep a record of communication resulting from this plan, noting the date of an interaction and any comments. Requests for information by journalists are promptly dealt with in partnership between the power station and Landsvirkjun head office. Landsvirkjun have a specific press communication plan to guide staff to answer reporters consistently and in accordance with board level decisions and policies. Water level in the reservoir and flow rate of the spillway are issues of interest to many stakeholders, so are made available on the company website and updated daily.

There are processes in place by which stakeholders can use to raise concerns, grievances and complaints and the Landsvirkjun quality system sets out procedures to follow in the event of a grievance. Grievances can be made in person, via telephone or email to Landsvirkjun headquarters or to the power station. No formal grievances for the operation of Blanda station, have been logged since 2008. In addition the station manager

has regular meetings and informal interactions with stakeholders at which grievances can be raised. All interviewees in this assessment confirmed it is easy to get in contact with Landsvirkjun and that constructive responses are promptly received.

Grievances are logged in Landsvirkjun's quality system by the station manager. Responses are usually made by the station manager and occasionally, if the issue raised is of broader public interest, the corporate communication department may make a press release. For example an enquiry was recently made to Landsvirkjun headquarters about the water level in the reservoir, a response was drafted between the communication department and power station manager, and a press release was made.

As an example of good communication at the project level, farmers recently expressed concern to the power station manager that the low reservoir level would allow sheep to move onto islands in the reservoir and to get trapped by rising water. In response Landsvirkjun surveyed the location of sheep in the highlands, removed sheep from areas where they could get trapped, and sent an email detailing their actions to all farmers with animals grazing in the area.

Criteria met: Yes

Analysis against proven best practice

Scoring statement: *In addition, communication and consultation plans and processes show a high level of sensitivity to communication and consultation needs and approaches for various stakeholder groups and topics; and processes are in place to anticipate and respond to emerging risks and opportunities.*

Plans and processes show a high level of sensitivity to communication and consultation needs and approaches for various stakeholder groups and topics. For example the power station manager allows stakeholders to suggest the time and location of meetings which are discussed and planned by telephone. One to one meetings regularly take place in stakeholder's homes or at other locations of their choosing.

Regular meetings and the general availability of the station manager allow Landsvirkjun to anticipate and respond to emerging risks and opportunities. There is a parents' day for the young people that work with Landsvirkjun during the summer, which also provides a chance for perceived risks and opportunities to be shared between the power station and the local community.

The corporate communication department monitors social media and blogs, to check what is being said about Landsvirkjun and particular projects. Short video documentaries are made to help rectify any misunderstandings that might arise in the public perception of projects or the organisation as a whole.

Criteria met: Yes

1.2.3 Stakeholder Engagement

Analysis against basic good practice

Scoring statement: *The operation stage involves appropriately timed and scoped, and often two-way, engagement with directly affected stakeholders; engagement is undertaken in good faith; ongoing processes are in place for stakeholders to raise issues and get feedback.*

Meetings are held regularly with local stakeholders of Blanda Power Station, summarised in an overview document which records the meetings held with stakeholders every year. Meeting minutes are stored in Landsvirkjun's archival system (GoPro). Contracts and agreements made between Landsvirkjun and local stakeholders every year are evidence of continued two-way engagement.

Engagement with all stakeholder has been undertaken in good faith, confirmed by all interviewees who described interactions with Landsvirkjun using words such as 'fair', 'reasonable', and 'balanced'.

Ongoing processes are in place for stakeholders to raise issues and get feedback. At the project level most stakeholders interviewed had the mobile telephone number and email address of the power station manager. General contact details are also available on Landsvirkjun's website. Public meetings, briefings and participation of company staff in local events and committees all provide means for ongoing communication and feedback.

Criteria met: Yes

Analysis against proven best practice

Scoring statement: *In addition, engagement is inclusive and participatory; negotiations are undertaken in good faith; and feedback on how issues raised have been taken into consideration has been thorough and timely.*

Engagement is inclusive and participatory and all negotiations are undertaken in good faith. Efforts are made to communicate meetings or announcements using various media, focusing on the website and newspapers. The Capacent Gallup surveys have revealed higher support for Landsvirkjun by older people and by men, so particular effort is being made to communicate with people outside this demographic. The strategic plan is publically available and the corporate annual meeting is broadcast on the website and can be attended in person; last year 400 people attended. Blanda features in the local municipality's Annual Report.

All stakeholders interviewed reported thorough and timely feedback on issues raised. Feedback was often in person at meetings, but also received via email or telephone. Feedback on issues of broader public interest is given through print and electronic media.

Criteria met: Yes

1.2.4 Conformance / Compliance

Analysis against basic good practice

Scoring statement: *Processes and objectives relating to communications and consultation have been and are on track to be met with no major non-compliances or non-conformances, and communications related commitments have been or are on track to be met.*

The few grievances raised have been responded to in a timely manner in accordance with the requirements of the quality system. It is in Landsvirkjun's Social Responsibility Policy to 'make every effort to co-operate positively with the community'. The policy emphasises positive cooperation, transparent working practices, an interactive flow of information and consideration of community interests. This assessment has not revealed any non-conformances with the policy or any other legal requirement or informal commitment.

Criteria met: Yes

Analysis against proven best practice

Scoring statement: *In addition, there are no non-compliances or non-conformances.*

There are no non-compliances or non-conformances.

Criteria met: Yes

1.2.5 Evaluation of Significant Gaps

Analysis of significant gaps against basic good practice

There are no significant gaps against basic good practice.

0 significant gaps

Analysis of significant gaps against proven best practice

There are no significant gaps against proven best practice.

0 significant gaps

1.3 Scoring Summary

Landsvirkjun's stakeholders are identified and engaged in the issues of interest to them at both the corporate and project level. The communication plans that have been recently developed, comprehensively map stakeholders and define times and mechanisms for communicated with them. At the corporate level the communication team has a good understanding of Landsvirkjun's ongoing and emerging communication issues and are addressing them skillfully. The small size of the local community at Blanda has allowed the station manager and his staff to build an excellent rapport with all local stakeholders and communication is open and ongoing in all cases. Grievance mechanisms are in place and utilised. The ongoing communication and consultation processes are maintaining good stakeholder relations for the Blanda project. The project has achieved proven best practice for Communications and Consultation with no significant gaps, resulting in a score of 5.

Topic Score: 5

1.4 Relevant Evidence

Interview:	5, 6, 7, 8, 11, 12, 13, 27, 34
Document:	1, 40, 48, 62, 78, 83, 97, 98, 100, 117, 118, 123, 124, 125, 138, 159, 166, 174, 175, 167, 177, 178, 186
Photo:	36

2 Governance (O-2)

This topic addresses corporate and external governance considerations for the operating hydropower facility. The intent is that the owner/operator has sound corporate business structures, policies and practices; addresses transparency, integrity and accountability issues; can manage external governance issues (e.g. institutional capacity shortfalls, political risks including transboundary issues, public sector corruption risks); and can ensure compliance.

2.1 Background Information

Landsvirkjun is a partnership company originally established with Act. No 59 from 1965 and then with new Act. No 42 from 1983, then owned by the Icelandic State and two municipalities. The Act, as amended sets out the corporate structure and responsibilities, and specifically refers to the Blanda power plant. In 2007 the Icelandic state and Eignarhlutir ehf. (a private limited liability company fully owned by the State) became the joint owners, buying out the two municipalities. Landsvirkjun has 65% ownership in Landsnet hf., the transmission operator. Landsvirkjun has a 73% market share of Icelandic electricity generation. The Landsvirkjun Board of Directors is appointed by the Minister of Finance every year.

Iceland has two tiers of government, national and municipal. There are two local municipalities in the region of the Blanda power station, which are part of a group of seven municipalities in Iceland's northwest district. The power station catchment, all assets, and much of the downstream river are located within Húnavatnshreppur municipality, a rural area with 405 residents. The Blanda River flows out to sea ~65 km downstream of the power station at the town of Blönduós, which is in the mostly urban Blönduós municipality with 878 residents. These two municipalities are the result of mergers about ten years ago of a number of smaller municipalities that were in place when the power station was developed. Reform of municipalities is ongoing in Iceland, with reductions from 240 to 75 municipalities nationwide over the past 20 years, and further mergers are likely. Landsvirkjun pays a tax to Húnavatnshreppur municipality each year, effectively a property tax based on the land area of the Blanda buildings.

The Blanda Power Station was enabled by an authorisation from Parliament in 1984. The then Minister for Industry issued a Licence to Harness, granted for up to 180 MW of power generation. Agreements were reached between the municipalities and landowners outlined in the Blanda Power Contract relating to land acquisition, water and fishing rights, and compensation provisions (grazing land, revegetation, roads, fences, shelters, etc). Several addendums have been added over the years. The Power Contract basis is for 40 years or as long as the power station operates. The Licence to Harness is not time-bound. The Iceland Energy Authority acts as regulator for the Licence to Harness.

The allocation of rights (e.g. water, fishing, land acquisition), market structure, ownership and taxation of energy-related institutions are the subject of ongoing review and reform in Iceland. These considerations include more fundamental discussions about Landsvirkjun's primary mission and have led to a call for an "ownership policy"; for example, should Landsvirkjun focus on dividends, on stimulating regional development through offering attractive prices, or other priorities of national interest?

2.2 Detailed Topic Evaluation

2.2.1 Assessment

Analysis against basic good practice

Scoring statement: *Ongoing or emerging political and public sector governance issues, and corporate governance requirements and issues have been identified, and monitoring is being undertaken to assess if corporate governance measures are effective.*

The corporate structure of Landsvirkjun is set up to ensure that governance issues in the corporate and public sector areas are identified and addressed. Key roles are the Board of Directors, the CEO, and the Corporate Office which includes communications, social responsibility, legal matters, risk management, international business development, environmental affairs, and quality and safety management.

Landsvirkjun is strongly guided by management systems addressing quality, environment, safety, maintenance etc. Internationally recognised certificates are held for ISO 9001 (quality), ISO 14001 (environment), OHSAS 18001 (safety) and ISO 27001 (information security). Regular audits several times a year against these ISO and OHSAS certifications results in identification of opportunities for improvement. Opportunities for improvement are put into the quality system as tasks with responsibilities and time frames allocated, and delivery is tracked.

Structural, policy and strategy changes have been made in response to issues arising. For example the business recently developed a Social Responsibility Policy and created the role of Corporate Responsibility Director, comprehensively reviewed the human resources policies and procedures, and has undertaken a forward strategic road map process. These processes in turn have resulted in more specific reviews, and generation of improvement activities.

Internal focus groups have mapped the present status in Landsvirkjun against the Social Responsibility Policy and generated 42 improvement ideas which are now being prioritised through a staff poll. Some identified improvements include:

- formal evaluation of corporate governance;
- mechanisms to get an independent 3rd party voice;
- development of a Code of Conduct;
- signing the UN Global Compact (Landsvirkjun has already signed the UN Women's Empowerment Principles);
- a review of procurement procedures alignment with the Social Responsibility Policy; and
- knowledge-sharing, focussed on putting 300-400 research documents on the highlands, many done by Landsvirkjun, online for broader access.

As part of the Social Responsibility Policy process, Landsvirkjun reviewed adherence to the UN Global Compact, Global Reporting Initiative, and ISO 26000 (social responsibility). Landsvirkjun signed the UN Global Compact in November 2013 and has reviewed the ISO 26000 on social responsibility through the CSR mapping process. All CSR goals and progress are published on Landsvirkjun's internal website.

Emerging governance requirements are being closely monitored. For example, recent legislation has been passed in Iceland stemming from the EU Water Framework Directive, which will result in a water management planning process for the state and may have implications for Blanda. A number of issues are being discussed in Parliament that could have a bearing on Landsvirkjun, for example the structure of the property tax paid by the company.

Criteria met: Yes

Analysis against proven best practice

Scoring statement: *In addition, there are no significant opportunities for improvement in the assessment of political and public sector governance issues and corporate governance requirements and issues.*

Landsvirkjun appears to have comprehensive issues assessment processes and a continuous improvement culture that promotes looking for opportunities for improvement. Corporate governance and political and public sector issues appear to be well identified, and proactive initiatives to identify and address improvement opportunities are in progress with monitoring and tracking. The social responsibility process includes a more formal review of corporate governance with respect to the CSR considerations. The Annual Reports attest to close monitoring of the external environment linked to business risks and opportunities. There are no significant opportunities for improvement identified.

Criteria met: Yes

2.2.2 Management

Analysis against basic good practice

Scoring statement: *Processes are in place to manage corporate, political and public sector risks, compliance, social and environmental responsibility, procurement of goods and services, grievance mechanisms, ethical business practices, and transparency; policies and processes are communicated internally and externally as appropriate; in case of capacity shortfalls, appropriate external expertise is contracted for additional support.*

Landsvirkjun has clear statements of business role and values. The Landsvirkjun Board operates to Rules of Procedures available on the external website. The company is divided into six divisions: Research & Development, Project Planning & Construction, Energy, Finance, Marketing & Business Development, and the Corporate Office. Information Technology and Human Resources are part of the Corporate Office. Each area has a clear understanding of its role and relationships.

Quality systems have been built up since 2001. The quality system provides the platform to house in a consistent and integrated fashion all policies, procedures, guidelines, regulations, management plans, registers, checklists, forms, etc. It has been based on Lotus Notes software, but is in the process of being converted to Go Pro software. Blanda Power Station received the first ISO 9001 certificate in 2001. All stations had followed suit by 2004, and Landsvirkjun by 2006. ISO 14001 and OHSAS 18001 were added onto the quality system, enabling an efficient approach to an integrated system. Landsvirkjun is also certified to ISO 27001, for its information security management system, and is certified by TÜV SÜD as a producer of green electricity.

Risks are comprehensively managed. Landsvirkjun has a Risk Policy, a Risk Committee, risk management guidelines, a comprehensive risk register at the corporate level with risk categories and accompanying analyses, and a statement of risk appetite and tolerance. More detailed risk registers, hazard analyses and management plans to address areas of risk are found throughout the quality system for specific areas, e.g. for environment, safety, and finance.

Compliance is addressed through the quality system. For environmental and safety issues a legislation and policy register is maintained on the Landsvirkjun intranet and is updated every six months. Staff with compliance responsibilities review these updates and send memos to parts of the business to call their attention to relevant requirements. Compliance is demonstrated through internal and external auditing processes as part of the quality system. Environmental “mishaps” are reported publicly in the Annual Environmental Report. EU Directives have created new and emerging compliance requirements which appear to be closely monitored and adhered to, for example with procurement requirements.

Social responsibility is comprehensively addressed through Landsvirkjun’s Social Responsibility Policy. In 2009 Landsvirkjun did a social responsibility report, going through the (then) draft ISO 26000, which informed the policy content. The policy is now in the process of being implemented under the management of a recently

created position of Corporate Responsibility Director. ISO 26000 (Social Responsibility) has been an important reference; at present there is not a certification scheme associated with this relatively new standard. Other important references have been the UN Global Compact and the Global Reporting Initiative.

Environmental responsibility is comprehensively addressed through Landsvirkjun's Environment Policy. Processes are well embedded in Landsvirkjun's environmental management system, certified to ISO 14001.

Procurement is guided by two procedures in the quality system, and dedicated staff in Landsvirkjun within the Finance Division. Procurement procedures are thorough, consistent and transparent.

Grievance mechanisms exist and are described in Topic O-1 (Communications and Consultation).

Ethical business practices at present are addressed through the Procurement Policy and the Employee Policy. An action has been identified through the Social Responsibility Policy process to develop a Code of Conduct to provide more comprehensive and direct attention to ethical issues. This is presently being developed, and will address anti-bribery and philanthropic activities.

Landsvirkjun has assigned great importance in recent years to increasing transparency in the company's operations. The role of the Corporate Communication Division is to oversee information dissemination, in order to increase transparency and encourage knowledge and consensus within society regarding Landsvirkjun's operations. As part of its CSR process, an internal focus group on societal issues examined how Landsvirkjun could further improve communication and cooperation with the communities in which it operates, including measures for ensuring transparency in working procedures and how it could promote and support the interactive communication of information. The central approach to reviewing and further developing the role of Human Resources in Landsvirkjun includes an emphasis on openness and transparency. Landsvirkjun has a Community Fund for its charitable contributions, and fully lists all contribution recipients and the amount on its external website.

Policies and procedures are fully communicated internally via the internal website. Externally, the social responsibility and the environment policies are on the website, and the Annual Reports extensively refer to various corporate policies (finance, risk, human resources, etc).

External expertise is used as needed to supplement internal expertise, for example through consultants undertaking dambreak modelling and environmental impact assessment (EIA) studies. Outside contractors are used as needed for major works on assets. External expertise is also drawn on through external audits.

Criteria met: Yes

Analysis against proven best practice

Scoring statement: *In addition, contractors are required to meet or have consistent policies as the developer; procurement processes include anti-corruption measures as well as sustainability and anti-corruption criteria specified in pre-qualification screening; and processes are in place to anticipate and respond to emerging risks and opportunities.*

Contractor requirements are clearly set out. Landsvirkjun's contracts are usually either based on FIDIC, an international standard contract, or a more limited Icelandic variation of this, which is called "Conditions of contract for building and works of civil engineering construction (IST 30)" for local tenders. Contractor requirements include financial and technical qualifications as well as adherence to health, safety and environmental policies of Landsvirkjun; these are set out in contract documents as well as in a handbook for contractors and suppliers (see topic O-12, Labour and Working Conditions).

EU Directives set out procurement requirements for large tenders; those under this threshold have clear corporate guidelines. Tender documents have standard clauses relating to corruption and require the tenderer to detail the quality, health, safety and environmental management systems that will be used in conducting the works.

Landsvirkjun does not have any specific “prequalification” processes, but in cases companies are invited to tender in a closed process. The same standards are required of contractors with regards to sustainability and anti-corruption in these situations as would be applied otherwise.

Procurement processes are planned for review to ensure alignment with provisions of the Social Responsibility Policy.

Processes to anticipate and respond to emerging risks and opportunities include audits, inspections, stakeholder engagement mechanisms, rigour through the quality system, and periodic review exercises of policies, procedures and best practice.

Criteria met: Yes

2.2.3 Stakeholder Engagement

Analysis against basic good practice

Scoring statement: *The business interacts with a range of directly affected stakeholders to understand issues of interest to them; and the business makes significant project reports publicly available, and publicly reports on project performance, in some sustainability areas.*

Landsvirkjun has a special open meeting each year to discuss corporate strategy, which is also broadcast on the web. About 400 people attended the last meeting. In 2011 Landsvirkjun held four public meetings on matters of importance to the company that close to 1,400 people attended. At Blanda Power Station, personal engagement, meetings, and a communications plan guide interactions with a range of directly affected stakeholders and help understand issues of interest to them.

Landsvirkjun produces an Annual Report and an Annual Environmental Report each year. Web-based information is available to the public, and the external website was recently updated. Water levels and flows are published on the website.

The 2004 Blanda Environmental Report was initiated in response to stakeholder concerns regarding coastal changes, but ended up taking a much broader assessment typical of a full EIA and using external consultants. This was a voluntary measure that has not been done by Landsvirkjun for other power stations, but only at Blanda to directly respond to stakeholder concerns. Other publications about Blanda responding to areas of public interest include a book about Blanda River fisheries including extensive information about the power station, and municipality Annual Reports which have a standard section on Blanda.

Criteria met: Yes

Analysis against proven best practice

Scoring statement: *In addition, the business makes significant project reports publicly available and publicly reports on project performance in sustainability areas of high interest to its stakeholders.*

Significant project reports published to date include:

- the Blanda Environmental Report, which is a public report produced in 2004; and
- a published book on Blanda River fisheries that provided a lot of information on the Blanda power station, produced in 2003.

Annual public reports that regularly contain information on Blanda are as follows.

- The Landsvirkjun Annual Report, which in 2012 included information on Blanda such as basic statistics, summer employees, flows and reservoir levels, maintenance, focal areas of environmental research, and the planned diversion project to increase capacity.

- The Landsvirkjun Annual Environmental Report, which in 2010 included data on Blanda such as diesel oil and fuel consumption, waste, hazardous materials, greenhouse gas emissions, electricity generation, and number of employees.
- The local municipality annual report “Húnavaka” in which a section on Blanda can be found. In 2012 this provided information on production, generation reliability, transmission, reservoir levels, employee safety, external contractors, asset monitoring, certification and the quality system, waste classification, the Laxa Research Centre, staff arrangements and the number of employees, summer employees, and collaborations and partnerships including with the municipality.

Additional to these is the website information on flows and water levels.

Based on these public reports, it can be seen that Landsvirkjun makes significant project reports publicly available, and that the 2012 reports addressed many sustainability areas of high interest to its stakeholders.

Areas of high interest to Blanda stakeholders at the time of the assessment (Sep 2013) appeared to include: flows, water levels, fisheries, summer jobs, employment, taxes, new expansion plans, public access and shelter in the highlands, revegetation, compliance with commitments, regional economic development, and transmission. It would be expected that there is some variability in what is of high stakeholder interest on a year-by-year basis. Landsvirkjun does not have documentation in its publicly available reports to demonstrate that it undertakes an annual process to determine what is of high interest to its stakeholders and to demonstrate that the reported information responds to stakeholder interests (e.g. such as the materiality process set out in the Global Reporting Initiative). However this is not a significant gap against the criterion statement as it is worded, and the criterion can be demonstrated to be satisfied by the scope of information found across the three forms of annual reporting and the public website.

Criteria met: Yes

2.2.4 Conformance / Compliance

Analysis against basic good practice

Scoring statement: *The project has no significant non-compliances.*

Compliance is reported in the quality management system, and in the Annual Environmental Report.

Major compliance requirements for the Blanda Power Station are included in:

- the Blanda Power Contract 1982;
- the Operations Permit (most recently granted in 2011, good for four years) tied to EU requirements for environment and public health; and
- the Licence to Harness (has a maximum capacity limit and some information reporting requirements).

Ongoing notable power station specific commitments include the municipal tax, remaining compensation measures regarding revegetation (see O-8, Project Benefits), and agreements reached between the power station and the municipality every year regarding summer jobs. There are also a number of lesser contracts, e.g. with specific farmers regarding rental of fields owned by Landsvirkjun.

All licence requirements, contracts and commitments are fully complied with.

Criteria met: Yes

Analysis against proven best practice

Scoring statement: *The project has no non-compliances.*

The project is fully compliant with all legal, contractual, permitting and policy requirements.

2.2.5 Outcomes

Analysis against basic good practice

Scoring statement: *There are no significant unresolved corporate and external governance issues identified.*

Some of the current or emerging governance related issues related to Landsvirkjun include but are not limited to:

- the property tax (the basis for calculation and distribution);
- EU directives notably the Water Framework Directive and those relating to tendering processes;
- a Landsvirkjun ownership policy;
- Licence to Harness arrangements for the Blanda expansion (within existing licence or a whole new licence);
- transmission developments; and
- a new tax on electricity production and sale (introduced in 2009 for three years, but extended), and broader reforms of the taxation system relating to the energy sector.

These and other governance issues are being monitored. None of them would be considered significant unresolved issues in the context of this assessment and the sustainability of the Blanda Power Station, in that the outcomes should be manageable under a range of scenarios.

Criteria met: Yes

Analysis against proven best practice

Scoring statement: *In addition, there are no unresolved corporate and external governance issues identified.*

The strategic plan to 2025, developed through internal focus groups, identified a number of tasks for improvement, including:

- increasing efficiency and output from generation;
- choosing the right software for the next generation of water management;
- reassessing stock for power stations;
- evaluating product sourcing e.g. from China;
- reviewing Landsvirkjun's standard contract; and
- identifying risk associated with reduced generation e.g. from a low water year.

The CSR policy process has also identified a number of action areas that relate to corporate governance, including a review of corporate governance, evaluation of procurement processes, and development of a Code of Conduct.

Areas for improvement have actions assigned for them, and responsible personnel allocated with timing targets. Consequently they are considered on a pathway towards resolution.

Public sector governance issues, e.g. relating to the tax system or a Landsvirkjun ownership policy, are being addressed through appropriate processes, for example through discussions in Parliament.

Criteria met: Yes

2.2.6 Evaluation of Significant Gaps

Analysis of significant gaps against basic good practice

There are no significant gaps against basic good practice.

0 significant gaps

Analysis of significant gaps against proven best practice

There are no significant gaps against proven best practice.

0 significant gaps

2.3 Scoring Summary

Landsvirkjun has sound corporate business structures, policies and practices, demonstrated by its comprehensive certification against the ISO standards of 9001, 14001, 27001, OHSAS 18001 as well as other external certifications. Policies and procedures are comprehensive across the business and actively implemented through the quality system processes. Transparency, integrity and accountability are addressed and are also the focus of improvements, guided by the recent Social Responsibility Policy and mapping of performance against the UN Global Compact and ISO 26000. Risks relating to ethical business practices are addressed through procurement and employee policies, and are also the focus of improvements through development of a Code of Conduct and procurement process review. Stakeholder engagement processes are well developed, and public reports address a number of sustainability areas of high interest to stakeholders.

Topic Score: 5

2.4 Relevant Evidence

Interview:	5, 6, 8, 11, 13, 14, 17, 22, 32, 33, 36
Document:	2- 4, 8, 12, 14- 16, 20, 22, 23, 40, 48, 49, 57, 59- 63, 71, 83- 85, 97, 98, 108, 109, 111, 112, 115, 122, 124, 125, 129- 131, 138- 140, 154- 158, 160-164, 182, 186
Photo:	25

3 Environmental and Social Issues Management

(O-3)

This topic addresses the plans and processes for environmental and social issues management. The intent is that negative environmental and social impacts associated with the hydropower facility are managed; avoidance, minimisation, mitigation, compensation and enhancement measures are implemented; and environmental and social commitments are fulfilled.

3.1 Background Information

The power station was designed and constructed before legislation requiring environmental and social impact assessment was introduced in Iceland in 1993. As such a formal environmental and social impact assessment was not produced prior to the project's construction. However, in 2004, in response to a stakeholder enquiry about an environmental aspect of the project, Landsvirkjun commissioned a retrospective environmental and social impact of the operation hereafter referred to as the "Blanda Environmental Report". Key environmental issues for the project are the revegetation of the highland areas, soil erosion from the reservoir shoreline, and the maintenance of the aquatic ecology in the river Blanda. Key social issues for the project are supporting the local sheep farmers grazing in the highlands and maintaining relationships with the project affected communities.

Landsvirkjun has established partnerships with a number of organisations to monitor and manage environmental issues. The Institute of Freshwater Fisheries (Veiðimálastofnun, IFF) is a government institute focusing on research and consulting services for freshwater fish; IFF does not have a regulatory role. The Soil Conservation Service of Iceland is a governmental agency tasked with combatting desertification and sand encroachment, and promotion of sustainable land use, reclamation and restoration of degraded land. The Icelandic Institute of Natural History is a public institution under the aegis of the Ministry for the Environment and Natural Resources. The Institute conducts basic and applied research on the botany, ecology, taxonomy, geology and zoology of Iceland. The Blanda Svartá angling club is responsible for administering the angling rights to the river. Its members are the farmers with land adjacent to the river. There is also a fishing association with rights to the reservoir and lake fisheries, on a smaller and less commercial scale.

This topic largely concerns the general processes for environmental and social issues management, and refers to issues which are fully addressed by other topics to illustrate these processes. Please refer to others topics for a fully-detailed discussion of the pertinent issues.

3.2 Detailed Topic Evaluation

3.2.1 Assessment

Analysis against basic good practice

Scoring statement: *Systematic processes are in place to identify any ongoing or emerging environmental and social issues associated with the operating hydropower facility, utilising appropriate expertise; and monitoring programs are in place for identified issues.*

Environmental inspections by the station manager and his team are ongoing, and regular scheduled checks take place of every aspect of the project using checklists stored in the quality system. Checks examine changes in existing issues like the production of waste and the development of new issues such as reservoir shoreline erosion.

The 2004 Blanda Environmental Report, undertaken utilising appropriate expertise, provided an assessment of the project's environmental and social impacts. It described the area's hydrology, geology, natural hazards, soil, flora, fauna, and greenhouse gas emissions. The impact of the project on the local community was analysed, looking at population trends, the labour market, transportation, tourism and regional development. The report also examined cultural heritage in the area, focusing on archaeological remains. The assessment proposed mitigation measures for environmental and social impacts.

In 2006 a study by the University of Akureyri examined the social impact of the Blanda project. It covered the early controversy surrounding the project, population trends, gender ratios, education, emigration, the effects of compensation, impact on employment, agriculture, transportation and tourism. It also examined future trends regarding energy intensive industry and tourism.

Blanda has an extensive program of environmental monitoring covering water management, hazardous substances, waste, oil, septic tanks, fuel supplies, erosion and sedimentation, greenhouse gas (GHG) emissions and electricity consumption. Frequency of monitoring varies with each aspect and is independently checked by the Health Unit of Northwest Iceland, which is responsible for environmental health. The annual corporate environmental report records and publishes many of these environmental aspects for the company as a whole.

Landsvirkjun have a number of partnerships with other organisations who undertake monitoring of specific issues. The IFF monitors fish populations in the river. The Soil Conservation Service monitors grazing and vegetation development in the highland area. The Icelandic Institute of Natural History monitors reservoir shoreline erosion and the impact of windblown sand on vegetation surrounding the reservoir. Verkis, a consultancy, is surveying birds in the area, looking at diversity, distribution, breeding density and potential habitat impact as part of an EIA for the expansion project.

Social monitoring is achieved through regular formal and informal meetings with members of the local community, as outlined in the station's communication plan; this is discussed in more detail in topic O-1 (Communications and Consultation).

Detailed discussion of the assessment of individual environmental and social issues can be found under their respective protocol topics.

Criteria met: Yes

Analysis against proven best practice

Scoring statement: *In addition, processes to identify ongoing and emerging environmental and social issues take broad considerations into account, and both risks and opportunities.*

Processes to identify ongoing and emerging environmental and social issues take broad considerations into account. Follow-up to launching of the corporate Social Responsibility Policy included a staff brainstorm of ongoing environmental and social issues that may need to be reviewed in the future. Policy changes, changes in legislation, and changing community expectations are regularly built into the assessment process. The ongoing assessment process looks beyond the most obvious impacts of the project, looking for any issue which could have negative impacts on the environment and including legacy issues such as disused mines ('old sins').

Assessment of risks and opportunities is ongoing. A comprehensive environmental risk assessment process exists for every aspect of the project. New opportunities have been identified such as the planting of trees in the area around the power station, sorting and recycling of waste, and experimentation with an electric car. Social risks and opportunities are assessed through regular meetings with local stakeholders. Social projects that have evolved from this assessment are detailed under the proven best practice management criteria.

Criteria met: Yes

3.2.2 Management

Analysis against basic good practice

Scoring statement: *An environmental and social management system is in place to manage measures to address identified environmental and social issues, and is implemented utilising appropriate expertise (internal and external).*

Landsvirkjun uses a systematic approach to manage social and environmental issues. The environmental control system is detailed in a quality system document describing how ISO 14001 is implemented. This document covers environmental policy, environmental planning, legal requirements, objectives, targets and programs. The plan also details resources, roles and responsibilities, requirements for training, documentation, operational control, and monitoring.

All environmental management procedures are stored in the quality system, which organises all policies, rules, methods, regulations, management plans, forms and checklists in a consistent manner to those for other areas with dedicated management systems (as described in topic O-2, Governance).

Landsvirkjun has a set of environmental requirements and requests for contractors and service providers which aims to align contractor performance with that of Landsvirkjun corporate environmental policy. The requirements and requests cover fossil fuel use, water and soil pollution, hazardous substances, waste, noise and land disturbance. The policy also requires all contractors and service providers to receive training in environmental aspects before a project commences.

The system is implemented using appropriate internal expertise and its use is audited by the Health Unit of Northwest Iceland.

Criteria met: Yes

Analysis against proven best practice

Scoring statement: *In addition, processes are in place to anticipate and respond to emerging risks and opportunities; and plans and processes are embedded within an internationally recognised environmental management system which is third party verified, such as ISO 14001.*

Landsvirkjun uses a system which makes employees responsible for reporting any emerging risks or opportunities which need addressing. To use the system an employee uses a quality system form to describe an environmental, social or labour issues or incident, and remedial action required. This is processed, analysed and remedial works scheduled. The manager responsible for the issue must also seek to prevent reoccurrence.

Excellent relationships with the local community, local cooperatives and national advisory bodies, coupled with regular meetings and good staff retention, allows Landsvirkjun to readily identify environmental and social risks and opportunities.

The plant manager is relatively unencumbered by bureaucracy and can act rapidly to manage risks and opportunities as they evolve. Every job undertaken within the project has its own safety and environmental risk assessment. This provides a comprehensive overview of the job and is regularly updated. Site inspections have a checklist to look for opportunities for improvement, such as fixing paths or lighting, and reducing waste or noise. The social responsibility department maintains an 'ideas bank' where new opportunities are logged.

The power station staff have worked with the local municipality to get them to accept segregated waste for recycling, and collecting plastic stuck on fences in the highlands.

Landsvirkjun works with stakeholders through direct cooperation, consultation groups, and grant based partnerships. Grants are given through the Landsvirkjun Energy Research Fund and Landsvirkjun Community Fund. Numerous partnerships exist between Landsvirkjun and educational institutions, landowners, fishing

associations and other stakeholders. Social benefits provided by the project are numerous and as they are not required by the original project licence, are considered opportunities taken. They include:

- Additional fencing in the highlands to contain sheep;
- Construction of three new huts in the highlands for use when collecting sheep and which now generate income for the municipality from tourism;
- Three stables for sheep and horses in the highlands;
- New roads and bridges in the highlands;
- An airstrip to the south of the reservoir;
- A fishing lodge for visiting anglers;
- Maintenance of a fish ladder to benefit the angling association;
- Funding for 'job creation project';
- Founding member of Blönduós Academic Centre;
- Salmon museum and research centre (the "Laxa Centre");
- The 'many hands make light work' programme, which employs in the order of 30 young people each summer and provides them with training in first aid, health and safety and other areas;
- Purchase of goods and services from the local communities;
- Clearing of roads near the project of snow in the winter, improving access for farmers;
- Connection of some farms to fibre optic cable for internet access;
- Allowing the meeting rooms at the power station to be used by the community;
- Supporting an artist to work on the production of paintings reflecting local cultural heritage; and
- Support for story teller to record and distribute an important story about the area.

Landsvirkjun uses an integrated management system which meets the requirements of ISO 9001, and an environmental management system that meets the requirements of ISO 14001. Indeed, Blanda was the first Landsvirkjun project to become ISO 9001 certified. Landsvirkjun has also been certified as a producer of green electricity by the German company TÜV SÜD.

The CSR department has mapped the requirements of ISO 26000 (guidance on how businesses and organizations can operate in a socially responsible way) and will incorporate this into the management system in the near future.

Criteria met: Yes

3.2.3 Stakeholder Engagement

Analysis against basic good practice

Scoring statement: *Ongoing processes are in place for stakeholders to raise issues and get feedback.*

Regular meetings with the municipality, fishing representatives, Soil Conservation Service and farmers provide a means for stakeholders to raise issues and get feedback. This is driven by the project communication plan, detailed in O-1 (Communications and Consultation). Most stakeholders have the station manager's phone number and email address, and contact details are available on Landsvirkjun's website. Periodic public meetings and briefings also provide an opportunity for the company to respond to questions and identify new opportunities. Feedback to stakeholders is demonstrated by emails, records in the archive system, meeting minutes and press releases. The water level in the reservoir is of interest to many stakeholders so is available on the website and updated daily.

Criteria met: Yes

Analysis against proven best practice

Scoring statement: *In addition, feedback on how issues raised have been taken into consideration has been thorough and timely.*

Feedback on how issues raised have been considered has been thorough and timely. For example, in response to concerns by farmers that sheep trapped on islands in the reservoir, an email was sent to all farmers detailing the areas checked. All stakeholders interviewed reported substantive, prompt communication from Landsvirkjun.

Criteria met: Yes

3.2.4 Conformance / Compliance

Analysis against basic good practice

Scoring statement: *Processes and objectives in environmental and social management plans have been and are on track to be met with no major non-compliances or non-conformances, and environmental and social commitments have been or are on track to be met.*

Environmental legal requirements are monitored and recorded in the Environmental Management System. The plant's Operations Permit details legal requirements for sanitary conditions and pollution prevention. All staff members have access to laws and regulations regarding environmental and safety issues via the regularly updated intranet site. The laws are reviewed twice a year and staff are notified if there are any changes. Any non-compliances are logged in the annual environmental report and in the quality system. Some of the corporate level commitments are publically reported on in the news section of Landsvirkjun's website. Each year an internal meeting is held by the station manager to examine conformance with corporate goals. Landsvirkjun's environmental management systems are regularly audited by the Health Unit of Northwest Iceland. This audit process has not noted any non-compliance issues, recording well operated systems for oil, waste and water quality management.

Criteria met: Yes

Analysis against proven best practice

Scoring statement: *In addition, there are no non-compliances or non-conformances.*

There are no non-compliances or non-conformances.

Criteria met: Yes

3.2.5 Outcomes

Analysis against basic good practice

Scoring statement: *Negative environmental and social impacts associated with hydropower facility operations are avoided, minimised and mitigated with no significant gaps; and land disturbance associated with development of the hydropower project is rehabilitated or mitigated.*

There remains some uncertainty about the ecological impact of the project due to the relatively low level of understanding about the pre project conditions, particularly in the inundated area. However, the environmental and social impacts associated with hydropower facility *operations* are avoided, minimised and mitigated with no significant gaps.

64 km² of land was submerged by the reservoir, some of which was well vegetated with thick soil cover. Compensation through the establishment of new grazing land has been successful, though with lower species diversity. Attempts to build new layers of organic soil have been successful and the efforts have contributed to the body of knowledge that exists on land reclamation in Iceland.

The project has changed the hydraulic regime of the Blanda River, which has affected local ecology, but has also brought benefits such as reduced flooding to local communities. Flow is now more stable and less severe

and the river is less turbid for longer periods of time. This has supported improved migration, spawning and nursery conditions for salmon.

Use of diesel oil at the station has remained stable over the last four years. The quantity of unsorted waste from Blanda increased in 2011, but this is reportedly due to a concerted effort to remove all waste from the site that year.

The project had a positive impact on the local labour market during construction, peaking in 1990. The 15 full time employees at the power station are calculated to support 50 other local jobs through spending on services. Wages in the region are comparatively low, but the project has had a positive impact on them. The project has supported more opportunities for tourism which now supports some local livelihoods, and the increase in fishing opportunities now supports a distinct local angling economy. The safety of tourists in the highland area is an emerging issue which has been addressed with road safety improvements and signage (see topic O-6, Infrastructure Safety). No registered archaeological remains were damaged during the projects construction or continued operation (see topic O-15, Cultural Heritage).

Land disturbance associated with the development of the hydropower project has been rehabilitated or mitigated. The land around the power station has been revegetated from bare rock, and is now covered with a variety of trees, bushes and grasses. Land in the highlands that was not disturbed by the project is also being revegetated as part of other compensation measures.

Criteria met: Yes

Analysis against proven best practice

Scoring statement: *In addition, negative environmental and social impacts associated with hydropower facility operations are avoided, minimised, mitigated and compensated with no identified gaps.*

An ongoing environmental concern is the loss of vegetation around the reservoir due to being covered by windblown sand. Efforts to stabilise and revegetate the area appear to be having success over an area many times larger than that affected by the sand (see topic O-15, Biodiversity and Invasive Species) and so this is not considered a gap.

No additional negative environmental or social impacts were identified by the regulator, stakeholders or independent reviewers so this criterion is considered met.

There have been a number of positive outcomes from the project, which although not necessarily instigated by Landsvirkjun are worth noting. These include:

- Improved river conditions for salmon;
- Reduced flooding to local communities;
- New farmland in the downstream riverbed;
- An opportunity to remake a section of the national road in a much better condition at a location in the floodplain;
- Secure supply of electricity to surrounding communities; and
- Facilitating two new industries, one manufacturing rock wool and the other aluminium foil.

Criteria met: Yes

3.2.6 Evaluation of Significant Gaps

Analysis of significant gaps against basic good practice

There are no significant gaps against basic good practice.

0 significant gaps

Analysis of significant gaps against proven best practice

There are no significant gaps against proven best practice.

0 significant gaps

3.3 Scoring Summary

Negative environmental and social impacts associated with the operation of the Blanda project have been thoroughly assessed and are well understood. Numerous studies fed a comprehensive, retrospective Environmental Report and monitoring of key issues is ongoing through regular site visits and partnerships with local environmental organisations. Landsvirkjun utilises a comprehensive, ISO 14001 certified environmental management system to address all environmental and social issues. Emerging environmental and social risks and opportunities are identified and responded to through partnerships with environmental organisations working in the project affected area, and through strong links with the community. This has facilitated numerous small projects and initiatives which have been of significant benefit to local stakeholders. The ‘many hands make light work’ programme has been of particular benefit to the municipality’s young people. Although the project was initially disruptive to both the local environment and society, strong management of the issues and a number of unintended positive effects now make the project an asset to the area. The project has achieved proven best practice for Environmental and Social Issues Management with no significant gaps, resulting in a score of 5.

Topic Score: 5

3.4 Relevant Evidence

Interview:	3, 7, 8, 11, 18, 19, 23, 31, 33, 34
Document:	8, 9, 10, 11, 14, 15, 16, 17, 19, 27, 40, 43, 45, 49, 57, 74, 104, 105, 107, 116, 122, 127, 132, 133, 134, 144, 146, 147, 172, 186
Photo:	3, 17, 18, 19, 22, 23, 24, 39, 40

4 Hydrological Resource (O-4)

This topic addresses the level of understanding of the hydrological resource availability and reliability to the operating hydropower facility. The intent is that power generation planning and operations take into account a good understanding of the hydrological resource availability and reliability in the short- and long-term, taking into account other needs, issues or requirements for the inflows and outflows as well as likely future trends (including climate change) that could affect the facility.

4.1 Background Information

The Blanda river system is fed by the Hofsjökull glacier and the Seyðisá River, originating in the central highlands of Iceland. The total catchment area covers a surface area of 2,370 km², and the part of it above the power station covers 1,520 km².

There is no significant diversion or use of water for any other purpose than power generation from the Blanda River; however there are some arrangements on downstream flows in the summer season with local angling associations. The key considerations for the management of the reservoir levels and the downstream releases are covered under topics O-18 (Reservoir Management) and O-19 (Downstream Flow Regimes).

Iceland's electricity grid is characterized by a high dependence on hydropower, high proportion of base load, and high requirements of security of supply. These factors make management of the hydrological resource through systematic planning and operations very important, compared to grids which have a minor hydroelectric component alongside a large thermal component. The main Blanda reservoir (Blöndulón) and the other main reservoirs in the system function basically as seasonal balancing reservoirs which capture the spring snowmelt and summer glacial melt runoff and release it evenly throughout the year. The largest reservoir, Halslón in eastern Iceland, has an active storage of 2,100 GL compared to Blöndulón with 400 GL.

Climate change is already affecting the management of the hydrological resources in Iceland, and will continue to do so. Significant changes could also be expected if an HVDC submarine interconnector to Europe (with substantially different market characteristics) were to be built, and/or if other electricity sources such as wind were to be expanded.

4.2 Detailed Topic Evaluation

4.2.1 Assessment

Analysis against basic good practice

Scoring statement: *Monitoring is being undertaken of hydrological resource availability and reliability, and ongoing or emerging issues have been identified; inputs include field measurements, appropriate statistical indicators, issues which may impact on water availability or reliability, and a hydrological model.*

Extensive hydrological and glacial monitoring, weather and runoff modelling and forecasting are carried out and the level of understanding of the hydrological resource is generally high, including medium- and long-range forecasting of hydrological changes. Short-term forecasting is made difficult in Iceland by frequent changes between snow and rain around 0°C. Climate change is predicted to significantly increase water resources availability over many decades on glacier-fed rivers in Iceland. The historical flow series indicated an average inflow into Blöndulón reservoir of 41.6 m³/s, but the forecasted average - based on changes already realized until 2010 - has been adjusted to 44.1 m³/s and is expected to be adjusted again in the future. The current water year is predicted to be the lowest on record, with only approx. 40 GL of storage in the Blanda reservoir at the beginning of June, and it is considered unlikely that the reservoir will reach full supply level, for the first time since commissioning.

Two continuous long-term flow gauges have been maintained by the Meteorological Office at Kjölur on the Seyðisá River upstream of the reservoir (since 1990) and at Langamýri on the Blanda River downstream of the power station (since 1974). In addition, direct flow measurements are undertaken in the Blanda station pressure shaft; water levels in the reservoirs are measured and used to calculate the inflow; and groundwater levels and seepage from the dams are continuously measured. If spills occur at the Blanda dam, the volume of spilled water can be calculated from reservoir levels, hydraulic characteristics of the spillway, and the flow measurements at Langamýri. Some trends and current data on flows and levels are also available for the public on the websites of Landsvirkjun and the Iceland Meteorological Office. Automated weather stations in the catchment are operated by Landsvirkjun at the Kolka dam and by the Meteorological Office at two locations near the Hofsjökull ice cap.

Inflow scenarios and probability distributions are available for multiple water years based on historical weather and flow measurements (1950-2004). They are based on runoff models for all hydropower catchments which are maintained by an engineering consulting company. They have recently been re-calculated to take observed changes until 2010 into account.

The Meteorological Office, Landsvirkjun and the Iceland Glaciological Society are monitoring the mass balance and retreat of Hofsjökull, a 850 km² ice cap which delivers meltwater to several large glacial rivers, including Blanda and Þjórsá. Snow coring at 30 locations is undertaken during the winter between elevations of 700 m and 1,800 m. Summer mass balance is read from ablation stakes. These monitoring results feed into seasonal runoff forecasts. For long-term monitoring, the surface of the ice cap has been mapped with high resolution airborne lidar. As part of Nordic cooperation projects, the impacts of climate change on Iceland's glaciers have been modelled. These are predicted to largely disappear over the next two centuries, in the process releasing the equivalent of 15-20 years of average precipitation over the whole country.

Predicted seasonal changes include earlier springs and earlier snowmelt, lower flows in early summers but higher flows in late summers due to glacial melt, and more frequent small winter floods.

Criteria met: Yes

Analysis against proven best practice

Scoring statement: *In addition, issues that may impact on water availability or reliability have been comprehensively identified; and scenarios, uncertainties and risks are routinely and extensively evaluated over the short- and long-term.*

Landsvirkjun and cooperating government agencies and private sector companies have established a comprehensive set of measurements, estimates, models, simulations and forecasts to evaluate hydrological conditions in the Blanda catchment. Since there are few if any competing uses of water, the attention is focused on future inflows into the system. Forecasting methods are continuing to evolve and improve, and Landsvirkjun is actively engaged in these discussions. The current, exceptionally low water year has demonstrated the value of seasonal forecasting. The Meteorological Office has suggested that additional snowpack measurements might be able to improve the accuracy of medium-term inflow forecasts. This may be an area for future consideration; however it is not considered a gap at this time.

Criteria met: Yes

4.2.2 Management

Analysis against basic good practice

Scoring statement: *Measures are in place to guide generation operations that are based on analysis of the hydrological resource availability, a range of technical considerations, an understanding of power system opportunities and constraints, and social, environmental and economic considerations.*

Short-, medium- and long-term generation scheduling at the national and the plant level is carried out between Landsvirkjun and the national transmission system operator, Landsnet. The basic seasonal operations regime is to run all 3 units in summer, when there is a risk of spilling, and only 2 units in winter to avoid an overly rapid drawdown of the reservoir.

Landsvirkjun's main operational focus is on maximizing the value of the available water resources in the multi-reservoir system. A primary concern is to avoid or minimise spilling within the context of the overall generation system optimisation needs. Since there are no environmental flow releases downstream of the Blanda dams (with the exception of emergency releases from Gilsarlón in case the entire power station would be shut down), in an idealised scenario all the inflows over one year into the reservoir system would be utilised in the power station and the reservoirs would be left full at the end of the water year, to provide maximum possible water supply security for the coming year. In practice the dam spills most years.

Operations plans and generation schedules for different time horizons are prepared and updated regularly. An annual plan is prepared based on Landsvirkjun's proprietary long-term reservoir simulation software LpSim, which is also used for other applications. LpSim divides Landsvirkjun's system into three regions, of which the north-western region with Blanda as the main power station is the smallest, and therefore sometimes a residual factor in optimization. The Blanda Power station is operated as part of an integrated national control system and is remotely dispatched by the grid control center, run by Landsnet, on the basis of day-ahead and week-ahead generation plans submitted by Landsvirkjun. System planners are aware of environmental and social constraints – such as the agreement with the local fishing association to maintain a minimum flow of 10 m³/s below the Blanda power plant and to stabilize summer flows to the extent possible – and take these into account. The introduction of a new water resource management model is being prepared.

Technical constraints include hydraulic characteristics at each power plant as well as transmission capacities. Ideally all units in the system would be run at the most efficient load at which they generate the maximum amount of electricity per unit of water that passes through them. At Blanda during the time of the on-site assessment, two turbines were running at less than their most efficient load, which was an overall strategic decision taking into account low water availability in the reservoir, lack of transmission capacity which would have allowed other power stations with spare capacity to pick up the load and allow the Blanda reservoir levels to recover, and the requirement to stabilise the grid in the northwest by serving both the line leading west and the one leading east from Blanda. Generation during the week of the assessment was equal every day at 1,200 MWh, reflecting the stable flows agreed with anglers.

Criteria met: Yes

Analysis against proven best practice

Scoring statement: *In addition, generation operations planning has a long-term perspective; fully optimises and maximises efficiency of water use; and has the flexibility to adapt to anticipate and adapt to future changes.*

After commissioning of the power station in 1991, two major changes to make better use of the existing hydrological resource have been considered. In 1996 the dams were raised by 4 m to increase storage capacity to its design level. Currently, studies are ongoing on the feasibility and environmental impacts of adding three small hydropower stations with a total capacity of 32 MW in the waterway between the Blanda reservoir and the Gilsa intake reservoir, thus making use of part of the difference in elevation of 68 m when both reservoirs are at full supply level. This expansion project is one of the highest ranked in the recent Masterplan and was included by the government in the list of projects to go ahead in the near future.

The effect of downstream flow agreements (10 m³/s minimum flow) on systems operations was simulated before the reservoir was expanded in 1996, and was shown to affect water use for generation at Blanda only very marginally. However, the rationale behind the 10 m³/s flow rule is not fully clear (see O-19).

In a long-term perspective, generation operations in Iceland are going to be subject to changing conditions which will open up opportunities or impose new constraints. These include

- Increased annual inflows and changing seasonality of inflows (which may change optimal storage and installed capacity values);
- Evolving demand from power-intensive industries, domestic demand, and possibly an interconnection with Europe with higher electricity prices and peaking demands; and
- Changes to operations resulting from environmental or social constraints that might result, for example, from the full introduction of the European Water Framework Directive.

Landsvirkjun is generally aware of these potential changes in conditions, although no specific adaptation actions have yet been undertaken. For example, regarding climate change, scenario analyses show that potential energy in the total river flows to the Landsvirkjun's power system is expected to increase by 20% (2.8 TWh) until 2050, mainly explained by added runoff in glacial rivers, ranging from 27% to 84% for individual rivers. The current Landsvirkjun system infrastructure with limited storage and already high load factors (6,570 h/yr compared to a worldwide mean of 3,854 h/yr) is not designed for this additional runoff and will, in 2050, only be able to utilise 38% of the increment, equal to a generation increase of 8.5%. This would result in a drop of the present utilisation rate of more than 85% of the potential energy. Unless changes to the underlying infrastructure are undertaken, the flexibility to adapt to hydrological changes is therefore limited. Blanda has a lower-than-average load factor at present and may be able to process larger inflows in its present configuration.

Regarding the current situation, one infrastructure change that appears overdue is the removal of transmission bottlenecks to allow fully integrated generation operations across Iceland. The lack of capacity to switch generation to the power stations with the highest water availability undermines the ability to optimize water use at Blanda. A 220 kv transmission expansion project between Blanda and Akureyri has been planned by Landsnet for a number of years, which would address some of the capacity gaps. It has been estimated that this strengthening of the transmission system would be equivalent to a generation increase by 50 GWh/year, by allowing improved joint operations across the generation system, including in the present water year with low levels at Blöndulón and high levels at Halslón. It is unknown when this line might come into operation. Expansion of transmission capacity to keep pace with expansion of generation and allow optimal use of generation capacity and water resources could be better promoted, for example by documenting the costs and using these in discussions with other electricity companies, regulators and the general public. This is considered a significant gap against proven best practice.

Criteria met: No

4.2.3 Evaluation of Significant Gaps

Analysis of significant gaps against basic good practice

There are no significant gaps against basic good practice.

0 significant gaps

Analysis of significant gaps against proven best practice

The use of water at Blanda (and in the broader Landsvirkjun generating system) is constrained by transmission capacity gaps and not fully optimized. This is considered a significant gap against proven best practice.

1 significant gap

4.3 Scoring Summary

The management of hydrological resources in Iceland involves only a small number of competing uses and stakeholders. Landsvirkjun and Icelandic government agencies have a good sense of the availability and reliability of resources, based on long-term historic flows and climate observations and modeling. They have also undertaken extensive research into future water availability, which is expected to improve due to glacial

retreat. Generation scheduling decisions are based on solid, state-of-the-art simulation and optimisation models and are integrated across all power stations in the country. They are however constrained in the short run, at least for Blanda, by transmission capacity gaps (which is considered a significant gap) and marginally, by downstream flow release requirements which are not fully understood in their implications. In the long run, they may be constrained by limitations to the existing infrastructure which was not planned for future hydrology and electricity markets, as well as possibly, limitations on water management resulting from the introduction of new environmental regulations.

Topic Score: 4

4.4 Relevant Evidence

Interview:	1, 10, 22, 23
Document:	5-7, 11, 15, 30, 37, 42, 45, 49, 65, 68-69, 73-77, 80-82, 91, 119-121, 128, 132-136, 180-181, 186
Photo:	1, 15

5 Asset Reliability and Efficiency (O-5)

This topic addresses the reliability and efficiency of the hydropower facility and associated network assets. The intent is that assets are maintained to deliver optimal performance in the short- and long-term in accordance with the overall electricity generation and supply strategy of the owner/operator.

5.1 Background Information

Landsvirkjun with its 15 power stations (13 hydropower and 2 geothermal), has a portfolio of potential further developments and system augmentations, and is trialling wind generation. Landsvirkjun has grouped its assets into five operations and maintenance centres. All Landsvirkjun assets are operated through an integrated control system out of head office in Reykjavik. Hour-by-hour generation planning is the responsibility of Landsvirkjun, who informs Landsnet (the transmission service operator) regarding dispatch.

Blanda Power Station is part of Blondussvaedi, which also includes Laxa I, II and III power stations. This O&M centre generates 8% of the total generation. The Blanda operating facility consists of the Blanda Reservoir with Blanda and Kolka dams and spillway; around 25 km of canals which include four interspersed lakes; the Gilsarlon reservoir and dam; various control gates and the Kolka and Gilsar gatehouses; and the underground power station including its headrace, tailrace and access tunnels. Other assets include the switchyard, an electricity distribution line between the power station and Kolka Dam; and four buildings comprising the power station control house, staff house, guest house, maintenance shed.

There are two 132 kV transmission lines sending power into the national grid owned by Landsnet, with a capacity of 170 MW. These are Blondulina 1 connecting the Blanda substation to the Laxarvatn substation (33 km distance), and Blondulina 2 connecting Blanda substation to Varmahlid substation (32 km distance). The Blanda substation has six switchyard bays and three transformers.

The 220 km of roads associated with the operating facility were built by Landsvirkjun, but are now the responsibility of the Icelandic Roads Department. Three highland huts and stables were also built by Landsvirkjun, but are now handed over to and maintained by the municipality.

Blanda Power Station has 3 generating units, each of which is rated to 50 MW capacity but can generate up to 55 MW for short periods. Blanda generates into the national grid and not for any single power-intensive off-taker. The energy generated provides power needs in the northwest region of Iceland. Energy generation output is fairly consistent with some variability; for example 2007-8 had relatively high inflows and 2013 is experiencing relatively low inflows.

5.2 Detailed Topic Evaluation

5.2.1 Assessment

Analysis against basic good practice

Scoring statement: *Routine monitoring of asset condition, availability and reliability is being undertaken to identify risks and assess the effectiveness of management measures; and ongoing or emerging asset maintenance and management issues have been identified.*

Asset condition monitoring is guided by the Dynamic Maintenance Management (DMM) system, a computerised maintenance management system used for planning, scheduling and tracking maintenance works. The DMM system schedules routine inspections for all assets and equipment, and any identified issues are recorded in this system and follow-up tasks then scheduled. Copperleaf's C55, an asset management tool, provides asset analytics and other types of analyses to ensure that maintenance activities are within a strategic corporate framework.

Goals and performance indicators have been defined by the Energy Division and are monitored regularly through monthly, quarterly and annual reports.

Certain equipment registered with the Administration for Occupational Health & Safety (OH&S) is checked on an annual basis, such as forklifts, cranes, elevators, car lifts, and trolleys. Other external inspections are focussed on electrical safety, which is certified.

Some works to be done arise from these inspections, for example improving and updating monitoring equipment, computer systems, and some dam improvement works. These all go into DMM as tasks, get rated according to priority, and then acted on accordingly.

Criteria met: Yes

Analysis against proven best practice

Scoring statement: *In addition, identification of ongoing or emerging asset maintenance and management issues takes into account both risks and opportunities.*

Risks are analysed as part of the DMM functions, and in turn can be realised as opportunities. For example as a part reaches its end of life it poses more of a risk of breakdown. Condition monitoring is then increased to see if there is the opportunity to get more life out of the part. Landsvirkjun's Technical Department identifies improvement opportunities with respect to emerging technologies, efficiencies through bulk purchases, utilisation of services across the portfolio, etc.

Criteria met: Yes

5.2.2 Management

Analysis against basic good practice

Scoring statement: *Measures are in place to address routine monitoring and maintenance requirements of the operating facility in accordance with the overall electricity generation and supply strategy of the owner/operator.*

Asset management plans are made regularly and reviewed every 1, 3, 6 and 12 months by the Energy Division. The operational plan for the power station is made annually (at the start of every water year, in September) and reviewed and updated weekly by the Energy Division.

The DMM system ensures scheduling of monitoring and maintenance activities in line with the broader strategies of the business. Software functions include: asset registry, preventive maintenance schedules, work orders, condition monitoring, condition based flagging, time accounting, fault reports, trending and performance reports, and version-controlled work descriptions and checklists. DMM Solutions Ltd is an Icelandic company that developed the software in 1992 for the energy industry; the system has been continuously updated and made suitable for a wider range of clients. The DMM software is designed to be easy for the plant technician to use while catering to information requirements at the corporate level. The DMM system is a quality management system certified to ISO 9001.

The C55 software is used to manage long-term asset planning, analysis, budgeting, and performance management processes. C55 integrates finance, operations, and engineering perspectives to help plan asset investments over various time horizons, using an integrated life cycle planning approach linked to business objectives and priorities. The Technical Division of Landsvirkjun meets with the Blanda power station manager once per year to discuss all jobs coming up, and agree on contracts that will progress and the appropriate procurement procedures for each job. Once jobs are approved, they go into the DMM system for implementation.

Some particular management challenges at Blanda arise due to the at times extreme weather conditions. For example, the distribution lines to Kolka Dam can go down in storms. The reservoir is managed to achieve

snapfreezing in autumn by holding it steady at full supply level. Heating devices are used with various infrastructure, e.g. for the Kolka control gate.

Some major maintenance works include cleaning the channel from Kolka Dam which involves removal of fallen rock (done every ten years or so), and lowering reservoirs to inspect and if necessary do any remediation works to the internal dam walls. The first big refurbishment for Blanda dam is at 20 years, and is about to commence.

The Technology Department of the Energy Division carries out renovation projects which are not part of regular maintenance. An example of this is the new computer control system being implemented at Blanda.

Criteria met: Yes

Analysis against proven best practice

Scoring statement: *In addition, processes are in place to anticipate and respond to emerging risks and opportunities; and asset maintenance management plans include a long-term program for efficiency improvements and asset upgrades.*

Processes in place to anticipate and respond to emerging risks and opportunities include the regular inspections, external visitors, sharing of knowledge across Landsvirkjun, and assistance provided by the Asset Management and Technical Divisions of Landsvirkjun. The Asset Management Division was created in January 2012 to take an overall view of asset management within Landsvirkjun for operating power plants and to focus on risks and opportunities related to O&M and refurbishment.

Systems at Blanda are designed to ensure avoidance of problems by catching any possible emerging issues early and addressing them. The housekeeping in the power station and at all associated assets was of a very high standard, making it easy to spot any irregularities. Routine processes check for blemishes or wear and tear, and any observations are recorded and tasks identified in the DMM system to attend to them.

Examples of responding to risks include preparing to implement the new control system, and planning for dam maintenance major works. Back-up systems are extensively provided for; for example at Kolka dam gatehouse there are two gates, one for control and one for maintenance. The gate can also be manually isolated to check on the canal, done about four years ago. There are manual back-ups to all systems, and staff trained to perform the manual back-up functions.

An example of responding to an opportunity is investigating feasibility for three new power stations within the canal system with an approximate capacity of 32 MW.

Long-term maintenance is in asset management plans. Works are scheduled through to 2020 at this stage.

System enhancement opportunities have been identified, including various new capital works that could augment inflows, increase generation and improve transmission efficiencies. In all of these respects, these identified opportunities for Blanda are in various stages of discussion and analysis.

Asset management is guided by the new ISO 55001 for asset management systems.

Criteria met: Yes

5.2.3 Conformance / Compliance

Analysis against basic good practice

Scoring statement: *Processes and objectives relating to asset maintenance and management have been and are on track to be met with no major non-compliances or non-conformances, and any asset related commitments have been or are on track to be met.*

There are three official key performance indicators (KPIs) for Blanda asset maintenance objectives, and two bonus KPIs. Of the official KPIs, two are in the green zone (i.e. well met) relating to number of system failures, and the time between failures. The third official KPI is in the yellow zone (i.e. satisfactory but needs watching)

and relates to completion of jobs on schedule. Of 786 jobs in the last 12 months, 629 were finished within time limits; importantly, jobs are all prioritised and high priority jobs have been finished within time limits. This system has been in place 18 months, and both Blanda and the Energy Division management hold the view that setting of this target was over-ambitious with respect to number of jobs and completion targets.

The two bonus KPIs relate to (1) the degree to which there is a spread of types of jobs (now lots of preventative maintenance; want more condition-based and few unscheduled maintenance jobs); and (2) the speed with which safety issues are addressed in accordance with priority flags put on them. There are no concerns regarding these KPIs.

Equipment checks by the OH&S inspectorate show all externally certified equipment items (e.g. cranes, forklifts, elevator, car lifts, trolleys) are in compliance.

The DMM system enables additional tasks to be inserted into the system as they are identified, with time priorities and responsibilities assigned. The system tracks meeting of these tasks, and there are no major non-compliances or non-conformances.

There are no particular asset-related commitments for Blanda, as it is not linked to a particular power off-taker but generates into the national grid.

Criteria met: Yes

Analysis against proven best practice

Scoring statement: *In addition, there are no non-compliances or non-conformances.*

There are no non-compliances or non-conformances. No KPIs are in the red zone (unsatisfactory).

Criteria met: Yes

5.2.4 Outcomes

Analysis against basic good practice

Scoring statement: *Asset reliability and efficiency performance is in line with the objectives of the owner/operator and any asset performance guarantees with only minor gaps.*

Plans for power generation and turbine operation are made annually, and updated every third week by the Energy Division. Availability of all three Blanda machines in 2012 was greater than 99.9% (outside of scheduled maintenance periods). The machines have occasional trips, sometimes 1-2 per year, and 4 trips in 2012.

The maximum efficiency for each Blanda machine, at 94.35%, is 48.9 MW. The machines are mostly run between 32-55 MW and efficiencies do not vary considerably in this range (e.g. at 33.6 MW efficiency is 91.76%). Very little time is spent below 33 MW per machine (<2.7% in 2012). Cavitation risks are experienced when the machines are run at less than 12.5 MW, and this is avoided.

The Landsnet system in 2012 did not meet all of its performance goals. The Power Interruption Index did just meet the goal of under 0.85 with a rating of 0.84. The average outage duration index was 180, not achieving its goal of under 50 outage minutes. There were four disturbances that exceeded the goal to be under ten system minutes. The Blanda substation and transmission lines experienced a fault in 2012 due to wind, snow and ice on the lines, but were not a major influence on the overall below target performance of the transmission system.

Criteria met: Yes

Analysis against proven best practice

Scoring statement: *Asset reliability and efficiency performance is fully in line with the objectives of the owner/operator and any asset performance guarantees.*

Performance of Blanda is fully in line with the objectives of Landsvirkjun. Landsvirkjun’s Energy Division has extensively analysed efficiency of power stations in its operation, and Blanda has amongst the highest. Overall the efficiency of the Landsvirkjun operating system is very high, between 98.5 and 99.5%. System-wide inefficiencies arise due to external circumstances (e.g. transmission limits), requirements for spinning reserve, rationalising scheduling amongst power stations, and/or reservoir water level management requirements.

Criteria met: Yes

5.2.5 Evaluation of Significant Gaps

Analysis of significant gaps against basic good practice

There are no significant gaps against basic good practice.

0 significant gaps

Analysis of significant gaps against proven best practice

There are no significant gaps against proven best practice.

0 significant gaps

5.3 Scoring Summary

The system for asset maintenance is well-developed, guided by ISO 55001, and based on software that provides good linkages between task scheduling, performance tracking, and higher level corporate objectives and requirements. KPIs have been set internally relating to system failures, job completion, balance of monitoring and maintenance attention, and addressing unsafe issues; these are tracked closely and are overall well met, with some additional attention required for speed of closing all jobs on time (not a significant gap). Opportunities for upgrades and life extension of parts are identified and analysed. The Blanda Power Station is one of the most reliable in Landsvirkjun’s asset portfolio, with reliability greater than 99.9% outside scheduled outage periods and high efficiencies, and the Blanda transmission lines have a high reliability. The project has achieved proven best practice for Asset Reliability and Efficiency with no significant gaps, resulting in a score of 5.

Topic Score: 5

5.4 Relevant evidence

Interview:	2, 8, 11
Document:	6, 50-54, 58, 70, 74, 75, 79-81, 90, 150, 173, 186
Photo:	4, 5, 7-9, 11, 12, 26-32

6 Infrastructure Safety (O-6)

This topic addresses management of dam and other infrastructure safety. The intent is that life, property and the environment are protected from the consequences of dam failure and other infrastructure safety risks.

6.1 Background Information

There are no national dam safety standards in Iceland. Landsvirkjun uses Norwegian standards for dam construction, which have been updated in the last 20 years since Blanda was built. Norwegian rules are used for risk classification of dams. Icelandic seismic standards are used.

Most Landsvirkjun dam spillways are designed for a 1:1,000 year flood. A 1:1,000 year flood at Blanda is calculated at 1,000 m³/s. Blanda can pass 835 m³/s through its facilities: 600 m³/s over the 200m wide Blanda reservoir spillway, 65 m³/s through the Kolka intake; and 160 m³/s through the Blanda Dam low level outlet; and the remainder could easily pass overtop of the Blanda Dam (a rockfill dam). The Blanda Dam is estimated to be able to withstand 45,000 m³/s of over-topping flow with no damage, so there is plenty of leeway if the 1:1,000 year flood estimation increases due to climate change impacts.

The first Blanda dambreak analysis was started in 1982 and completed in 1989; this was updated in 2001. A new dambreak analysis is in progress to recalculate the maximum flood into the reservoir, responding to climate change analyses. This is a voluntary initiative, not required by authorities.

Iceland is a country prone to a number of natural hazards including volcanos, earthquakes and extreme weather conditions. The Blanda region has no active volcanos or seismic activity. There are two glaciers in the highlands. The last two major earthquakes in Iceland were in 2000 (magnitude 6.5-6.6) and 2008 (magnitude 6.3), both in southern Iceland and with no human fatalities.

There are inherent public safety risks in the region of the Blanda Power Station, relating to the weather and the waterbodies. Injuries and deaths by drowning, avalanches and weather exposure have been part of the history of the area and have been recorded over the past three hundred years.

The central authority in the case of an emergency is the Icelandic Civil Protection Unit, which has a regional presence in the town of Blönduós.

6.2 Detailed Topic Evaluation

6.2.1 Assessment

Analysis against basic good practice

Scoring statement: *Routine monitoring of dam and infrastructure safety is being undertaken to identify risks and assess the effectiveness of management measures; and ongoing or emerging dam and other infrastructure safety issues have been identified.*

Infrastructure safety risks have been comprehensively evaluated for the Blanda power station. Public safety risks arising from or affiliated with Blanda infrastructure could arise from infrastructure breakage or collapse (e.g. dam failure, water in power house), electrical safety (public interactions with electrical systems, both high voltage at and downstream of the power station and medium voltage (11kV) going upstream from Blanda), and water safety (incidents relating to public interactions with built or controlled water structures such as reservoirs and canals).

Mechanisms for dambreak could be volcano, floods or extreme weather, earthquake, terrorism, human error, mistakes in design or construction, or cracks in the dam. Surveillance mechanisms have been identified for

each possible mechanism. The dams in the Blanda system are physically inspected four times per year, and the reservoirs periodically lowered for more thorough examination of the dam walls. Pressure wells inside the dam are linked to the Landsvirkjun head office data system, and seepage monitoring is linked to the power station control house data system. Seepage monitoring is undertaken downstream of the dams, using automated water level recorders in control ponds physically inspected once per week to ensure calibration. Survey benchmarks are in place for survey re-checks to assess dam movement. The Blanda Dam low level outlet is tested once a year when the dam is spilling; it is opened fully and water flushed through for about an hour. Earthquake sensors are in the dam measuring acceleration during seismic events, and are operated by the University of Iceland Research Centre for Earthquake Engineering in Selfoss. Seismic activity in Iceland is monitored by the Meteorological Bureau. Landsvirkjun has an internal dam safety expert and also uses specialist external consultants.

Actions recommended out of emergency training sessions go into the quality system for follow-up. Further identified opportunities for improvement relate to communications and the use of specific technologies.

Public safety measures will also be identified if noticed by the Administration for Occupational Health & Safety during inspections.

Electrical safety processes include physical inspections and external audits. Electrical safety is assessed by the regulator and externally audited and certified. Blanda must send a plan each year to the regulator on how electrical safety will be inspected, and this must be approved.

Public safety risks relating to Blanda waterways are evaluated and monitored through physical inspections, hazard assessment processes, and monitoring of incidents to see how they can be avoided in the future.

Criteria met: Yes

Analysis against proven best practice

Scoring statement: *In addition, identification of ongoing or emerging safety issues takes into account consideration of a broad range of scenarios and both risks and opportunities.*

A thorough set of procedures regarding infrastructure safety monitoring are in the DMM, e.g. relating to water measurements and dam surveillance; dam, waterway and rock dome surveillance; and dam inspection after an earthquake or unexpected incident. Procedures in the quality system are regularly reviewed to take into account the need for any updates based on inspections or issues arising. On an annual basis, employees at Blanda discuss which procedures require updating, and prioritise and schedule these updates.

Emergency response planning takes into account consideration of a broad range of scenarios and detailed risk assessment processes. Opportunities are identified, for example with respect to communication technologies for monitoring and emergency response.

Landsvirkjun's in-house dam safety specialist and external specialist consultants are able to identify risks and opportunities for Blanda.

Opportunities are identified through engagements with the Civil Protection Unit and discussion of best practice for emergency response. Training processes also heighten staff awareness and they in turn have better capacities to identify issues.

Criteria met: Yes

6.2.2 Management

Analysis against basic good practice

Scoring statement: *Dam and other infrastructure safety management plans and processes have been developed in conjunction with relevant regulatory and local authorities with no significant gaps, and provide for*

communication of public safety measures; emergency response plans and processes include awareness and training programs and emergency response simulations.

As with general asset management, the DMM provides the management system for infrastructure safety monitoring, evaluations, management plans, improvements, reporting, and emergency response planning and training. The quality system contains a number of procedures relevant to infrastructure safety at Blanda. These include the Blanda Emergency Response Plan, and response plans specifically for volcanic activity; flooding in the Blanda power station; earthquakes and collapse of the Blanda power station; fire; and dam leakage or failure.

Emergency response preparedness has been an ongoing process commencing in 1995 at the corporate level. Landsvirkjun has a company-wide system, as well as specific systems for each power station. Measures have been developed over time in consultation with the Civil Protection Unit, through experiences arising from trainings and simulations, and via identification of opportunities such as with new assets and technologies (notably TETRA communication, “Terrestrial Trunked Radio”, a professional mobile radio and two-way receiver). Landsvirkjun has an emergency committee, and a room that can be set up as an emergency control room in its headquarters at Reykjavik with respect to its communications, power and lighting facilities.

The Blanda emergency response preparedness measures are comprehensive and up-to-date. Dambreak documents are reviewed annually, the key one for Blanda being “LEI-229 Emergency Response to Dambreak or Flood Over Dams for the Blanda Area”. This procedure is based on an independent analysis of hydrological risk, and is regularly updated to ensure communications, contact details and evacuation needs are current and well understood (last update Version 16, 21st August 2013). Procedures and actions encompass training, allocation of roles and responsibilities, and communications. A diversity of communication mechanisms are available: landline, mobile phone, satellite phone, TETRA, VHF and UHF radios, and computers, all of which are regularly checked to ensure they are functional. TETRA is used as a dedicated emergency response communication system.

The DMM system prompts actions required for training. Landsvirkjun is part of an Iceland Emergency Forum and undertakes emergency preparedness exercises sometimes with different partners; Landsvirkjun organises around one exercise per year and takes part in about three. Field simulation training exercises are scheduled for Blanda every five years, with the last one in 2011. Blanda staff will participate in similar exercises conducted at other power stations in intervening years. Blanda staff are trained to have a number of skills that would be relevant for public safety and emergency response e.g. search-and-rescue, first aid, fire management, and communications.

There are numerous volunteer emergency response groups in Iceland. There are about 100 in the Blanda area, and they are trained regularly.

Specific public safety measures at Blanda include the boom gate into the power station area, public signage with safety warnings, areas only for staff access, keylock systems on buildings, and security cameras particularly at the dams. Safety measures were put in alongside the roads over the dams, prompted by an accident in which a car went into the reservoir. New signs are in the process of being installed, as well as four new security cameras. The need for and the placement of public warning signs is based on a comprehensive plan developed by an external consultant.

Criteria met: Yes

Analysis against proven best practice

Scoring statement: *In addition, processes are in place to anticipate and respond to emerging risks and opportunities; and public safety measures are widely communicated in a timely and accessible manner.*

Processes to anticipate and respond to emerging risks and opportunities regarding infrastructure safety include regular inspections, updates to procedures, sending staff to training courses, liaison with the Civil Protection

Unit, active involvement by Blanda staff in the activities of the region, and engagement with local stakeholders so that the risks to the public can be observed and communicated.

An example of responding to a public safety risk is the incident of the car accident. Since this time barriers have been put on either side of the road to avoid this risk.

An example of responding to a public safety opportunity is installation of the TETRA communications system throughout Landsvirkjun.

For general public safety, communication mechanisms are mostly centred around signs warning of public safety hazards, e.g. strong currents, or areas only to be accessed by staff. This signage appears to be at appropriate locations, is guided by a detailed plan, is clearly visible and legible, and is in the process of being upgraded.

Communication of public safety measures in the case of emergencies is through the Civil Protection Unit, who then has further communication responsibilities. This communication system is well understood by all relevant stakeholders. Landsvirkjun and Blanda have set up a sophisticated communication system, involving creation of communication control centres both at corporate headquarters in Reykjavik and at the Blanda Power Station.

There is a possible future risk of increasing public safety incidents (e.g. water accidents, exposure) if there is a significant increase in tourism in the region taking advantage of the good quality road built by the Blanda development. Present processes (physical inspections, meetings with local authorities, local presence of the staff in the region) should enable identification and response to this risk if it appeared to be emerging. The new signs about to be put in place are targeted at addressing risks to the public. There are no community concerns regarding public safety relating to the Blanda Power Station or associated infrastructure.

Criteria met: Yes

6.2.3 Conformance / Compliance

Analysis against basic good practice

Scoring statement: *Processes and objectives relating to safety have been and are on track to be met with no major non-compliances or non-conformances, and safety related commitments have been or are on track to be met.*

Safety related processes and objectives are tracked through the quality system and by using the DMM software. There are no non-compliances or non-conformances identified, and safety-related commitments appear to be fully met.

Criteria met: Yes

Analysis against proven best practice

Scoring statement: *In addition, there are no non-compliances or non-conformances.*

No non-compliances or non-conformances with regards to infrastructure safety were identified.

Criteria met: Yes

6.2.4 Outcomes

Analysis against basic good practice

Scoring statement: *Safety risks have been avoided, minimised and mitigated with no significant gaps.*

Infrastructure safety risks and scenarios have been comprehensively assessed, and monitoring and management plans are in place and implemented. Dambreak and other infrastructure collapse risks are avoided through quality engineering and regular inspections. Dam surveillance reports identify opportunities to improve instrumentation and address any early signs of wear. Regular updates to the Emergency Response Plan ensure an up-to-date approach to avoidance, minimisation and mitigation.

Emergency plans are detailed and thorough. Every farm and resident downstream of Blanda is mapped and evacuation procedures can be implemented in a timely manner if necessary. The earthquakes that were experienced in southern Iceland in 2000 and 2008 had no effects on Landsvirkjun dams.

Electrical safety risks relating to high voltage infrastructure are avoided through lack of public access to any areas that could pose public risk. Low voltage distribution lines going upstream from the power station are a source of risk if and when they go down during adverse weather conditions; normal inspection and repair works address this risk.

The incident of the car going into the Blanda Reservoir showed a significant gap in avoidance of safety risks, but the circumstances creating this risk have since been rectified by construction of barriers.

Other similar safety risks of the public getting too close to the waterways are minimised by signs with appropriate warnings, and identifying areas only for staff access. Boom gates and locks are used where appropriate.

Criteria met: Yes

Analysis against proven best practice

Scoring statement: *In addition, safety risks have been avoided, minimised and mitigated with no identified gaps; and safety issues have been addressed beyond those risks caused by the operating facility itself.*

The power lines going upstream from the power station could be put underground to avoid any possible risks to the public and minimise maintenance requirements, but this would be at considerable cost and land disturbance. This is more of an asset maintenance issue than a public safety issue, as the public is not in the region during the weather conditions that cause these lines to go down. There may be an opportunity to consider this as part of power development upgrades to the Blanda scheme.

Physical barriers to possible public interactions could be constructed in more places but at this stage the level of risk requiring such further measures is not evident. Such increased measures might be warranted if there were significant increases in the numbers of tourists passing through the region; at this stage this is not considered a significant gap.

Safety issues beyond those risks caused by the operating facility itself relate to the general regional risks of drowning, avalanches and weather exposure. Blanda has made contributions to dealing with these risks through providing huts in the highlands, augmenting the search and rescue capabilities in the region, upgrading the communications capabilities in the region for emergency response, providing a control centre at the power station, and through training of its staff to participate in emergency response activities unrelated to its own operations.

The Administration for Occupational Health & Safety advised that Blanda should be congratulated for its comprehensive health and safety system, its highly pro-active approach in asking for training courses and external assistance, routinely going beyond regulations, and immediate rectification of any identified opportunities for improvement.

Criteria met: Yes

6.2.5 Evaluation of Significant Gaps

Analysis of significant gaps against basic good practice

There are no significant gaps against basic good practice.

0 significant gaps

Analysis of significant gaps against proven best practice

There are no significant gaps against proven best practice.

6.3 Scoring Summary

Dam and infrastructure safety issues and risks are thoroughly assessed and routinely monitored for the Blanda operating facility. Detailed procedures are in place for all types of risk, and emergency response plans are outlined and regularly reviewed. Dam safety is closely monitored through a diverse set of state-of-the-art techniques, and liaison with other institutions to ensure collaborative and thorough approaches. Emergency response plans include training and simulation measures. The Blanda operating facility has contributed more broadly to public safety through a variety of mechanisms such as enhanced local capacities to respond to emergency situations. The project has achieved proven best practice for Infrastructure Safety with no significant gaps, resulting in a score of 5.

Topic Score: 5

6.4 Relevant Evidence

Interview:	2, 6, 8, 13, 15, 26, 30, 35
Document:	6, 9, 10, 21, 32, 38, 39, 44, 55, 56, 68, 74, 102, 137, 149, 174-178, 186
Photo:	4-7, 10, 16, 33-36

7 Financial Viability (O-7)

This topic addresses financial management of the operating hydropower facility, including funding of measures aimed at ensuring project sustainability, and the ability of the project to generate the required financial returns to meet funding requirements as well as to optimise its financial opportunities. The intent is that the operations of the hydropower facility are proceeding on a sound financial basis that covers all funding requirements including social and environmental measures and commitments, and that it is aware of and responding to market trends which may influence its long-term viability.

7.1 Background Information

Landsvirkjun is a fully state-owned energy business and the largest energy company in Iceland. Landsvirkjun operates in an unregulated market with respect to its power production and sales. Tariffs are set for transmission and distribution by the Icelandic Energy Authority.

Landsvirkjun's power sales largely go to power intensive industries, the five major customers consuming 86% of the electricity generated in 2012, and the remainder go to the general market via distribution companies. Some power sales go to the transmission service operator Landsnet, for ancillary services, losses, and backup generation for trips by other generators. Other sources of revenue are green electricity certificates and consulting services.

The 2008–2011 Icelandic financial crisis involved the collapse of all three of the country's major privately owned commercial banks. The national currency fell sharply in value, foreign currency transactions were temporarily suspended, and the market capitalisation of the Icelandic stock exchange fell dramatically. As a result Iceland underwent a severe economic recession. The state issued strict capital controls, a bailout package, austerity measures and repayment loans. The crisis was considered ended by mid 2011, and 2012 saw repayment of bailout debt, regained access to financial markets, and positive GDP growth. Capital controls to protect the currency remain in place. This affects potential new customers but not Landsvirkjun who is exempt. Landsvirkjun remained profitable despite the crisis. 2011 had the highest operating revenue, at USD 436m. Some reduction was experienced in 2012 due to lower aluminium prices, but generally revenues are on an increasing trend.

The role of the tax and royalty system in promoting efficiency and stimulating growth has been under consideration by the Icelandic government over the past several years, including a focus on allocation, pricing and taxation of Iceland's major hydropower and geothermal resources.

7.2 Detailed Topic Evaluation

7.2.1 Assessment

Analysis against basic good practice

Scoring statement: *Routine monitoring of the operating hydropower facility's finances is being undertaken to identify risks and assess the effectiveness of management measures; and ongoing or emerging financial management issues have been identified.*

Routine monitoring is undertaken at several levels:

- Landsvirkjun's Finance Division for corporate wide financial position;
- Landsvirkjun's Energy Division for costs and returns from Blanda operations; and
- Blanda Power Station for budget matters.

Routine financial reporting internally includes Blanda Power Station budget reports on a weekly and monthly basis, which are reviewed at the corporate level. Additionally, quarterly power station reports and quarterly Energy Division Reports are produced, which flag any emerging budget issues.

Criteria met: Yes

Analysis against proven best practice

Scoring statement: *In addition, identification of ongoing or emerging financial management issues takes into account both risks and opportunities including factors and trends that might influence future demand for electricity, water and ancillary services.*

Landsvirkjun's corporate structure is set up to consider ongoing or emerging financial management issues, and both risks and opportunities. Landsvirkjun's Financial Division has 22 people with diverse responsibilities including accounting, financial risk, treasury and financial analysis, and cost management. Financial risks are well understood, and reported on in the Annual Report along with mitigation measures. Thorough risk assessment processes including the risk policy and risk committee are in place. These risks relate to:

- Aluminium prices;
- Interest rates;
- Exchange rates – potentially affecting electricity sales agreements, loan agreements and new projects;
- Counterparty risks – e.g. loss of customers, power-intensive industries, banks; and
- Climate change – well assessed; presents a financial opportunity in terms of increased inflows, allowing upgrades in capacity to be considered.

Opportunities are identified through Landsvirkjun's Marketing & Business Development Division, Technology Department of the Energy Division, and Research & Development Division. Major factors and trends that might influence future demand include business development opportunities such as new major industrial customers, wind developments, an interconnector to the European electricity market, consulting, and renewable energy premiums. These risks and opportunities are reported on in Landsvirkjun's Annual Reports and external website, as well as the mitigation and management measures being taken.

Criteria met: Yes

7.2.2 Management

Analysis against basic good practice

Scoring statement: *Measures are in place for financial management of the operating hydropower facility.*

The annual budget process each September provides power station level information via the Energy Division to the Finance Division. The approved Blanda annual budget is managed by the Blanda Power Station manager. The annual budget for Blanda is in the order of ISK 220m (USD 1.8m) and covers labour, property tax, insurance, computers and office supplies, vehicles, purchased goods and services, and contracted work. Power station managers are responsible for managing their operating costs. Dynamic Axapta is the financial software used by Landsvirkjun, IBM Cognos and Microsoft SQL Server Analysis Services Cube software provide an analytical function. Major projects are managed through the Energy Division via their Technology Department, for example an upgrade to the control system at Blanda which is presently being implemented.

Criteria met: Yes

Analysis against proven best practice

Scoring statement: *In addition, processes are in place to anticipate and respond to emerging risks and opportunities; and financial contingency measures can be implemented for environmental and social management plans if required.*

The processes in place regarding anticipation and response to emerging financial risks and opportunities arise from Blanda's position within a larger corporation with a portfolio of assets.

With regards to financial risk, Landsvirkjun has a risk policy and an area of the business responsible for risk management. There is a risk committee, and the auditors focus closely on risk management. Financial risk is mitigated through derivatives such as forward agreements, interest rate swaps and options. Revenues diminished in 2012 by 6.5%, partly attributable to decreasing aluminium prices and consequent effects on contractual energy prices; Landsvirkjun was able to renegotiate in 2010 with one of its biggest customers on higher energy prices not linked to the price of aluminium. Ratings agencies (Standard & Poors, Moodys) are demanding of Landsvirkjun and focus on risk assessment and management.

With regards to financial opportunities, examples include Landsvirkjun's success in achieving a spreading customer base beyond aluminium, signing up new customers, and taking advantage of the present low interest rates.

Additional expenditure on environmental and social management plans can be made via the normal annual budget processes. More serious financial contingency measures could be implemented if needed by drawing on the financially sound position of the company. Landsvirkjun has access to liquid lines through bank facilities, both foreign (USD 200m) and Icelandic (USD 100m). Cash reserves are kept at a minimum of USD 50m, and are usually between USD 50-100m. Insurance is also available if the circumstances were relevant.

Criteria met: Yes

7.2.3 Conformance / Compliance

Analysis against basic good practice

Scoring statement: *Processes and objectives relating to financial management have been and are on track to be met with no major non-compliances or non-conformances, and funding commitments have been or are on track to be met.*

Blanda Power Station expenses are relatively stable and generally on budget. The 2012 power station budget is on track. The corporate office meets its financial commitments to provide annual operating budgets to the project.

Funding commitments for Blanda relate to paying staff, purchasing goods and services to implement quality system processes, funding the revegetation program, paying the municipal tax, and fulfilling commitments made to provision of summer jobs and some philanthropic activities. Funding commitments are regularly met.

Criteria met: Yes

Analysis against proven best practice

Scoring statement: *In addition, there are no non-compliances or non-conformances.*

Neither non-compliances nor non-conformances were identified with respect to any of the above financial management matters, including financial commitments. The budget overall is managed responsibly, and decisions about detailed allocations are made in close dialogue with the Energy Division through existing financial management processes.

Criteria met: Yes

7.2.4 Outcomes

Analysis against basic good practice

Scoring statement: *The operating hydropower facility or the corporate entity to which it belongs can manage financial issues under a range of scenarios, can service its debt, and can pay for all plans and commitments including social and environmental.*

Landsvirkjun has been assessing whether it would be possible for a power station to operate as individual profit centre. Operating revenues are derived from the power station energy generated and average prices. Operating expenses include energy purchases, insurance, real estate tax, general expenses and transmission. Transmission costs are shared across the portfolio. Depreciation and net interest expenses are directly allocated to each power station. Blanda originally cost USD 334m, and its present book value is USD 194m. Based on this single power station analysis, Blanda can be seen to return a profit each year, typically in the order of USD 7-8m before taxes and unrealised financial items (2012 was USD 8.8m). The lowest year was 2009 when there was a slump in aluminium prices, still returning a profit at USD 2.3m.

The company is in a sound financial position with a reliable cost base. Total assets at end 2012 were USD 4.5b and total liabilities at USD 2.8b. Landsvirkjun has been systematically decreasing its debt and improving ratios that affect its credit rating. Notably the equity ratio continues to grow, and new energy contracts are being signed. Landsvirkjun received ratings downgrades in 2009 from Moodys and Standard & Poors alongside downgrades to the Icelandic Treasury; the corporate ratings have since been upgraded noting the strong cash flow generation in conjunction with the improved liquidity profile.

The financial record of Blanda and Landsvirkjun through the economic crisis shows the ability to manage financial issues under a range of scenarios, service its debt and pay for plans and commitments.

Criteria met: Yes

Analysis against proven best practice

Scoring statement: *In addition, the operating hydropower facility or the corporate entity to which it belongs can manage financial issues under a range of scenarios, and has optimised or is on track to optimise its market position with respect to supply and demand for electricity, water and ancillary services.*

Landsvirkjun undertakes scenario analyses as part of its financial analyses, and has provided some information on this in its latest Annual Report (2012). Reforms in the tax system relating to the energy sector may have implications for the financial basis with which Landvirkjun operates, but would not appear to be of such a scale as to make the business unable to manage its finances.

With respect to optimising its market position, at the power station level at present Blanda has optimised its position within given constraints arising for example from transmission constraints. Opportunities to further optimise its market position have been identified and are at various stages of discussion or analysis. Opportunities that have been identified at various times including increasing inflows through upstream diversions, constructing new generating facilities through the canal system, upgrading the transmission infrastructure, and having a local dedicated off-taker.

At the corporate level, opportunities to further optimise its market position have been identified and are at various stages of discussion or analysis. Notably these relate to financial and associated risk mitigation measures, new major industries as off-takers, upgrading transmission throughout the system, increasing generation capacity, new technologies such as wind power, and an inter-connector to enable direct power transfer into the European system.

Criteria met?

7.2.5 Evaluation of Significant Gaps

Analysis of significant gaps against basic good practice

There are no significant gaps against basic good practice.

0 significant gaps

Analysis of significant gaps against proven best practice

There are no significant gaps against proven best practice.

0 significant gaps

7.3 Scoring Summary

Operations of both the Blanda power station and Landsvirkjun company are proceeding on a sound financial basis. All funding requirements and commitments, including social and environmental measures, are met. Financial risk is well analysed, and management and mitigation measures in place. A number of opportunities have been identified at both the power station and corporate level that could improve market position, and these are at various stages of discussion, analysis or progress. The project has achieved proven best practice for Financial Viability with no significant gaps, resulting in a score of 5.

Topic Score: 5

7.4 Relevant Evidence

Interview:	2, 4, 8, 9, 14
Document:	6, 72-74, 138, 182, 183, 186
Photo:	None

8 Project Benefits (O-8)

This topic addresses the benefits that were committed to alongside development of the hydropower facility, in cases where these commitments are well-documented against a pre-project baseline. The intent is that commitments to additional benefits and benefit sharing strategies made during development of the hydropower facility are fulfilled, and that communities affected by the hydropower development have benefitted. In the case of older projects where there is an absence of well-documented commitments to project benefits made at the time of project approval or an absence of data on the pre-project baseline against which to compare post-project, this topic is not relevant; in this case, issues in relation to project benefits should be taken into consideration under topic O-3 (Environmental and Social Issues Management).

8.1 Background Information

This topic assesses commitments to additional benefits and benefit sharing strategies made **during the development** of the hydropower facility which are above and beyond compensation for impacts. The many benefits that have arisen from the project as a result of Landsvirkjun's social issues management, but that were not committed to at the time of project licensing are covered in O-3 (Environmental and Social Issues Management). Programs to compensate project affected communities for the project's impact on their livelihood are covered in O-9 (Project-Affected Communities and Livelihoods).

Using this filter, the key project benefit is the property tax paid by Landsvirkjun on the power station, received by the Húnavatnshreppur municipality. A second, smaller benefit is local income tax paid by Landsvirkjun employees to their resident municipality.

8.2 Detailed Topic Evaluation

8.2.1 Assessment

Analysis against basic good practice

Scoring statement: *Monitoring is being undertaken to assess if commitments to project benefits have been delivered and if management measures are effective; and ongoing or emerging issues relating to delivery of project benefits have been identified.*

The only project benefits that will be assessed under this topic is the ISK 50m (USD 410,000) tax paid to the Húnavatnshreppur municipality and income tax paid by Landsvirkjun employees. Monitoring of these benefits is not required as the tax system is administered by the Icelandic State. No ongoing or emerging issues relating to delivery of project benefits have been identified and none are predicted.

Criteria met: Yes

Analysis against proven best practice

Scoring statement: *In addition, identification of ongoing or emerging issues relating to project benefits takes into account both risks and opportunities.*

There are no risks or opportunities to assess regarding the payment of tax.

Criteria met: Yes

8.2.2 Management

Analysis against basic good practice

Scoring statement: Measures are in place to deliver commitments to project benefits, and to manage any identified issues relating to these commitments; and commitments to project benefits are publicly disclosed.

The Húnavatnshreppur receives revenue from property tax levied on the power house. The tax is equivalent to 1.65% of property's value. The payment is received by the municipality as part of their annual budget from the central government and is not allocated to specific cost centres. All Landsvirkjun's tax payments are publically disclosed.

Criteria met: Yes

Analysis against proven best practice

Scoring statement: In addition, processes are in place to anticipate and respond to risks and opportunities.

There are not perceived to be any risk that Landsvirkjun will not pay its taxes. There are no opportunities to enhance the benefit or facilitate its delivery.

Criteria met: Yes

8.2.3 Conformance / Compliance

Analysis against basic good practice

Scoring statement: Processes and objectives in place to manage project benefits have been and are on track to be met with no significant non-compliances or non-conformances, and commitments have been or are on track to be met.

All processes and objectives in place to manage the payment of tax have been and are on track to be met with no significant non-compliances or non-conformances, and commitments have been or are on track to be met.

Criteria met: Yes

Analysis against proven best practice

Scoring statement: In addition, there are no non-compliances or non-conformances.

There are no non-compliances or non-conformances.

Criteria met: Yes

8.2.4 Outcomes

Analysis against basic good practice

Scoring statement: Communities directly affected by the development of the hydropower facility and any other identified beneficiary of the facility have received or are on track to receive benefits.

The tax that has been paid to the Húnavatnshreppur municipality has provided a clear benefit to the community. The additional income is equivalent to approximately a 15% increase in the council's annual budget. The income is not ring-fenced so it is not possible to detail exactly how the additional funds provided by the project were spent.

Following Icelandic law, the tax only goes to the municipality in which the powerhouse is located. The downstream municipality of Blönduós, also in the project's sphere of influence, does not receive any property tax income. At a national level, discussions are progressing regarding further municipality mergers and changes

to the basis for calculation of municipal taxes from power developments; outcomes of these processes may have implications for Blanda tax distribution in the future.

Landsvirkjun employees pay a proportion of their income tax to the municipality in which they reside. This is a mechanism to distribute some funds from the project to the surrounding municipalities which do not benefit from the income from the property tax.

Criteria met: Yes

Analysis against proven best practice

Scoring statement: *In addition, benefits are significant and sustained for communities affected by the project.*

The payment of tax is ongoing, will be sustained for the life of the project, and delivers a significant benefit to the directly affected communities.

Criteria met: Yes

8.2.5 Evaluation of Significant Gaps

Analysis of significant gaps against basic good practice

There are no significant gaps against basic good practice.

0 significant gaps

Analysis of significant gaps against proven best practice

There are no significant gaps against proven best practice.

0 significant gaps

8.3 Scoring Summary

Commitments to additional benefits made during development of the hydropower facility are fulfilled, and communities affected by the hydropower development have benefitted. The payment of property tax from Landsvirkjun to Húnavatnshreppur increases the council's annual budget by approximately 15% and will continue to do so in perpetuity. A small income is received by other surrounding municipalities, paid as income tax by Landsvirkjun employees to their home community. Since the time of project commissioning Landsvirkjun has put in place many small projects and initiatives which are of considerable benefit to the local community; these are detailed under topic O-3 (Environmental and Social Issues Management). The project has achieved proven best practice for Project Benefits with no significant gaps, resulting in a score of 5.

Topic Score: 5

8.4 Relevant Evidence

Interview:	5, 6, 8, 11, 13, 17
Document:	3, 23, 65, 66, 83, 97, 98, 139, 182
Photo:	Click here to enter text.

9 Project Affected Communities and Livelihoods

(O-9)

This topic addresses how impacts of development of the hydropower facility on project affected communities have been addressed, in cases where these commitments are well-documented against a pre-project baseline. The intent is that livelihoods and living standards impacted by the project have been improved relative to pre-project conditions for project affected communities with the aim of self-sufficiency in the long-term, and that commitments to project affected communities have been fully fulfilled. In the case of older projects where there is an absence of well-documented commitments to project-affected communities made at the time of project approval or an absence of data on the pre-project baseline against which to compare post-project, this topic is not relevant; in this case, issues in relation to project affected communities should be taken into consideration under topic O-3 (Environmental and Social Issues Management).

9.1 Background Information

This topic deals with compensation to project affected communities that was agreed to **at the time of licencing**. The many benefits to project affected communities that have arisen from the project as a result of Landsvirkjun's social issues management, but that were not committed to at the time of project licencing are covered under O-3 (Environmental and Social Issues Management). Actions that were committed to during project development that were above and beyond compensation for impacts are addressed under O-8 (Project Benefits).

In return for the water rights and permission to develop the Blanda project, Landsvirkjun bore the cost of a number of compensation measures. Numerous contracts were negotiated between Landsvirkjun and the project affected communities to compensate for the impact of the project. These agreements covered land reclamation and grazing; water, fishing and land use rights; compensation for the acquisition of land and lost angling income; and agreed changes to commitments on grazing, roads, fencing and waterways. Specifically:

- Creation of a new grazing area of equivalent size and quality to that lost under the reservoir;
- Construction of 185 km new roads and bridges to improve transport in the highlands for farmers to compensate disruption of access to pastures;
- Construction of 196 km new fencing required to control stock grazing;
- Construction of three new huts to improve conditions for farmers working with sheep in the highlands, and to compensate the loss of a hut under the new reservoir;
- One off payments to farmers who lost grazing; and
- Payments to farmers whose land was impacted by the project or the transmission line.

Landsvirkjun has now shifted responsibility for most of these commitments to government agencies or associations in the local community, sometimes in return for one off cash payments.

9.2 Detailed Topic Evaluation

9.2.1 Assessment

Analysis against basic good practice

Scoring statement: *Monitoring is being undertaken to assess if commitments to project affected communities have been delivered and if management measures are effective; and ongoing or emerging issues that affect project affected communities have been identified.*

Landsvirkjun maintained and monitored all of the commitments outlined above until the year 2000, when responsibility for most of the commitments was shifted to newly formed cooperatives in the local community, in return for one-off cash payments. The payments were put into ring-fenced trust funds and the interest is now used by the cooperative to pay local farmers (and often cooperative members) for the maintenance of road, fences and huts. All stakeholders interviewed were satisfied with the settlements made.

Landsvirkjun does not monitor the maintenance of roads or fencing which is now the responsibility of the cooperatives. However the close relationship with the local community means Landsvirkjun is aware if an issue arises. Any ongoing or emerging issues are addressed in the annual open meeting and are well identified through the open, continuous relationship between the station manager and the local community. For example, the original agreement for fencing stated that Landsvirkjun was responsible for maintaining the control of sheep, but did not specify specific fences. Later, farmers identified the need for additional fencing and Landsvirkjun agreed to install some.

Landsvirkjun's only ongoing commitment from the original compensation package is the supply of fertiliser for the vegetation of the highlands with the Eyvindastaðaheiðar farming cooperative. This program and its impact is monitored by a partnership between the farmers, the Soil Conservation Service and Landsvirkjun.

An independent study by the University of Akureyri in 2006 investigated the societal effects of the project on the local region, focusing on the current operational phase. This served to provide an independent assessment of ongoing and emerging issues effecting project affected communities.

Criteria met: Yes

Analysis against proven best practice

Scoring statement: *In addition, identification of ongoing or emerging issues for project affected communities takes into consideration both risks and opportunities, and interrelationships amongst issues.*

The revegetation program is monitored by the partnership between the farmers, the Soil Conservation Service and Landsvirkjun, which has identified emerging risks and opportunities. For example, regular investigation is made into new areas which would benefit from fertiliser to increase grazing opportunities.

The passing of responsibility for maintenance of roads, fences and huts to local organisations can be seen as a good opportunity taken by Landsvirkjun to improve local livelihoods. Local farmers are now paid from the trust fund to maintain the service which would have originally been done by Landsvirkjun. This provides a valuable source of income to the local agricultural sector which has suffered a decline over the last two decades.

Criteria met: Yes

9.2.2 Management

Analysis against basic good practice

Scoring statement: *Measures are in place to deliver commitments to project affected communities, and to manage any identified issues relating to these commitments; and if there are any formal agreements with project affected communities these are publicly disclosed.*

Landsvirkjun had an agreement with the farmers who grazed land in the highlands affected by the new reservoir to create new grassland to compensate for that lost under the reservoir. This agreement constituted a fixed amount of fertiliser applied to the land, for the life of the project. The fertiliser application was administered in partnership with the Soil Conservation Service by two farmer's cooperatives divided by the river Blanda, Auðkúluheiðar (west) and Eyvindastaðaheiðar (east). In the year 2000 Landsvirkjun offered both groups a one off cash payment to end the fertiliser program. Auðkúluheiðar at this point were less reliant on sheep farming, so took the money and invested it in a fund which now subsidises the community's energy costs. Eyvindastaðaheiðar declined the payment and Landsvirkjun have honoured the continuation of the

fertiliser program, which continues to be well managed by the partnerships between Landsvirkjun, the cooperative and the Soil Conservation Service.

Multiple cooperatives now exist to manage the original Landsvirkjun compensation commitments using the money paid to them by Landsvirkjun. In Auðkúluheiðar one cooperative deals with fencing and roads, one with angling, one with grazing. Huts are administered by the municipality. In Eyvindastaðaheiðar one cooperative deals with fences and roads, one with angling, and one with sheep, huts and grazing rights.

Farmers with land directly adjacent to the project, or land required for the transmission line, received cash compensation for any inconvenience caused. This payment was negotiated in a 'firm but fair' manner, and all claims have now been settled. One stakeholder interviewed cited an uncompensated loss of access to gravel from the river bed which she previously collected and sold, although it is not clear if this was being done legally.

All the agreements with the local community are publically disclosed. However the individual agreements with landowners directly affected by the project remain private.

Criteria met: Yes

Analysis against proven best practice

Scoring statement: *In addition, processes are in place to anticipate and respond to risks and opportunities.*

Most of the commitments to project affected committees have been delivered or are no longer the responsibility of Landsvirkjun. The only outstanding commitment is for the supply of fertiliser to the Eyvindastaðaheiðar farming cooperative to continue to support grazing for sheep in the highlands. This program is monitored by the soil conservation service in partnership with Landsvirkjun and the farmers' cooperative. Members of the group regularly visit the site and meet regularly, providing a process to anticipate emerging risks and opportunities. For example monitoring showed that the use of fertiliser had been successful in some areas of the program, so the level of application could be reduced and surplus used to begin revegetation in a new area.

Criteria met: Yes

9.2.3 Stakeholder Engagement

Analysis against basic good practice

Scoring statement: *Ongoing processes are in place for project affected communities to raise issues and get feedback.*

Regular meetings with the Soil Conservation Service and farmers cooperatives provide a means for stakeholders to raise issues and get feedback. This is driven by the project communication plan, detailed in O-1 (Communications and Consultation). Engagement with the stakeholders is good as Landsvirkjun is a partner in the revegetation project and the community which exists around it, rather than simply a source of funding.

Most stakeholders have the station manager's phone number and email address, and contact details are available on Landsvirkjun's website. Feedback from Landsvirkjun to stakeholders is demonstrated by emails, records in the quality management system, meeting minutes and press releases.

Criteria met: Yes

Analysis against proven best practice

Scoring statement: *In addition, feedback on how issues raised are taken into consideration is thorough and timely, and project affected communities have been involved in decision-making around relevant issues and options.*

Feedback to stakeholders on how issues have been taken into consideration has been thorough and timely, as evidenced by clear email trails and universal satisfaction with communication amongst all stakeholders interviewed.

There have not been any significant decisions to make with the project recently, but any issues, such as grazing, fishing or revegetation are discussed at the annual spring meeting between Landsvirkjun and the community.

Criteria met: Yes

9.2.4 Conformance / Compliance

Analysis against basic good practice

Scoring statement: *Processes and objectives in place to manage delivery of commitments to project affected communities have been and are on track to be met with no significant non-compliances or non-conformances, and commitments have been or are on track to be met.*

All commitments to deliver compensation to project affected communities were delivered on time and no stakeholders raised any concern or complaints about the process. Ongoing commitments to supply fertiliser to the Eyvindastaðaheiðar cooperative are on track, with no non-conformances noted. There have been no other significant non-conformances or non-compliances regarding project affected communities.

Criteria met: Yes

Analysis against proven best practice

Scoring statement: *In addition, there are no non-compliances or non-conformances.*

There are no non-compliances or non-conformances.

Criteria met: Yes

9.2.5 Outcomes

Analysis against basic good practice

Scoring statement: *Livelihoods and living standards impacted by the project have been or are on track to be improved; and economic displacement has been fairly compensated, preferably through provision of comparable goods, property or services.*

The compensation agreed at the time of project licencing was focused on supporting the region's agriculture rather than other livelihood activities. One stakeholder interviewed said 'all the money went to the sheep'. The project has made a substantial financial input to the area, but has not had a significant long term impact on employment opportunities or on local economic development. The shift in responsibility for the compensation arrangement from Landsvirkjun to local cooperatives has had positive outcomes. For example, the money paid from Landsvirkjun to the Auðkúluheiðar grazing cooperative is now used to pay for domestic heating, subsidised electricity and to help farmers in difficult years. It is not clear how long this fund will last and its use is not monitored by Landsvirkjun.

There are numerous other ways in which the project has contributed to improving livelihoods and living standards of the project affected communities but which were not committed to at the time of project licencing. These are detailed in topic O-3 (Environmental and Social Issues Management). Improvements include: the salmon economy, municipality income from renting highland huts, secure electricity supply, access to fibre optic internet cable, increased tourism due to improved highland roads, and the physical, educational and financial benefits of the 'many hands make light work program'.

Economic displacement has been fairly compensated, through provision of new land for grazing and cash payments for disturbed land. No stakeholders interviewed expressed dissatisfaction with the compensation

deal received. The Mayor of Blönduós stated that having the project in the region gives the municipality status beyond what they would naturally have, allowing them to approach new power intensive industries such as data centres or fertiliser manufacturers who might want to invest in the area.

Criteria met: Yes

Analysis against proven best practice

Scoring statement: *In addition, the measures put in place to improve livelihoods and living standards are on track to become self-sustaining in the long-term.*

The livelihoods of the project affected communities are self-sustaining and do not rely significantly on the input of Landsvirkjun. If the fertiliser program were to stop, the grass land would return to native vegetation which would be less good for grazing, but this would not have significant impact on the community’s livelihood, which has become less dependent on sheep than in previous years. Other social programs covered in O-3 (Environmental and Social Issues Management) and ongoing tax payments covered in O-8 (Project Benefits) also provide measures to support the community’s livelihoods and living standards.

Criteria met: Yes

9.2.6 Evaluation of Significant Gaps

Analysis of significant gaps against basic good practice

There are no significant gaps against basic good practice.

0 significant gaps

Analysis of significant gaps against proven best practice

There are no significant gaps against proven best practice.

0 significant gaps

9.3 Scoring Summary

The livelihoods and living standards impacted by the project have been improved through a number of compensation initiatives, and commitments to project affected communities have been fulfilled. Ongoing monitoring and management of the remaining program, supplying fertiliser to the Eyvindastaðaheiðar farming cooperative, is comprehensively undertaken by the Soil Conservation Service in partnership with Landsvirkjun. The roads, fences and huts provided by Landsvirkjun to the local communities are now being self-managed using money from a trust fund. This arrangement is working successfully and provides a source of income for local farmers. There are no significant gaps against best practice, resulting in a score of 5.

There are numerous other ways in which the project has contributed to improving livelihoods and living standards of the project affected communities but which were not committed to at the time of project licencing; these are detailed in topics O-3 and O-8.

Topic Score: 5

9.4 Relevant Evidence

Interview:	3, 5, 6, 8, 11, 13, 17, 27, 34
Document:	1, 4, 57, 65, 66, 83, 84, 97, 98, 101, 139
Photo:	22, 23, 24

10 Resettlement (O-10)

This topic addresses how the physical displacement arising from development of the hydropower facility has been addressed, in cases where resettlement occurred and commitments are well-documented against a pre-project baseline. The intent is that the dignity and human rights of those physically displaced have been respected; that these matters have been dealt with in a fair and equitable manner; that livelihoods and standards of living for resettles and host communities have been improved; and that commitments made to resettles and host communities have been fully fulfilled. In the case of older projects where there is an absence of well-documented commitments in relation to resettlement made at the time of project approval or an absence of data on the pre-project baseline against which to compare post-project, this topic is not relevant; in this case, issues in relation to resettlement should be taken into consideration under topic O-3 (Environmental and Social Issues Management).

This topic is Not Relevant to Blanda. The development of Blanda did not require physical displacement.

11 Indigenous Peoples (O-11)

This topic addresses the rights, risks and opportunities of indigenous peoples with respect to the hydropower facility, recognising that as social groups with identities distinct from dominant groups in national societies, they are often the most marginalized and vulnerable segments of the population. The intent is that the operating facility respects the dignity, human rights, aspirations, culture, lands, knowledge, practices and natural resource-based livelihoods of indigenous peoples in an ongoing manner throughout the project life.

This topic is Not Relevant to Blanda. There are no community groups in the project area that meet the definition of Indigenous Peoples.

12 Labour and Working Conditions (O-12)

This topic addresses labour and working conditions, including employee and contractor opportunity, equity, diversity, health and safety. The intent is that workers are treated fairly and protected.

12.1 Background Information

Landsvirkjun has 257 employees, not including Landsnet which has about 100 employees.

Blanda Power Station is part of Landsvirkjun's Blondussvaedi O&M region, which also includes Laxa I, II and III power stations. This O&M centre has 19 employees. At Blanda, the staff include the station manager; maintenance manager (2nd in charge); station guards responsible for daily operations, supervision and maintenance of the operational area, and allocated projects; and canteen staff. The station manager reports to the head of the Operations Department of Landsvirkjun's Energy Division.

All staff are members of a union according to occupational groups. These unions in turn are affiliated with the Icelandic Confederation of Labour (ASÍ).

Approximately 30 summer students work at the power station each summer. This is through a cooperative arrangement with the municipality, in which the students are resident at Blanda Power Station but do various jobs for a range of organisations. A supervisor for summer employment is appointed to take responsibility for this group.

12.2 Detailed Topic Evaluation

12.2.1 Assessment

Analysis against basic good practice

Scoring statement: *A periodically updated assessment has been undertaken of human resource and labour management requirements for the operating facility, including occupational health and safety (OH&S) issues, risks, and management measures, with no significant gaps; monitoring is being undertaken to assess if management measures are effective; and ongoing or emerging labour management issues have been identified.*

Landsvirkjun undertook a thorough review of its portfolio of human resource related processes and procedures during 2012, identifying over 180 opportunities for improvement, based on workshops with staff in which practices were analysed and opportunities identified.

Landsvirkjun undertakes an employee attitude survey on an annual basis, and has been doing so for 14 years. This process provides an ongoing mechanism for identification of areas for improvement and monitoring effectiveness.

Regular liaison with unions, and the collective bargaining process, are further mechanisms for monitoring and issues identification, as are staff engagement mechanisms (see Stakeholder Engagement criterion, this topic).

Occupational Health & Safety (OH&S) inspections are done by the regional Administration for OH&S. Inspections are done every few years, after regular annual inspections repeatedly gave the power station full marks. Inspections by this regional inspectorate look at safety management guidelines, planning, safety officers, accidents, education, internal audits, training and use of specialists. Working environment evaluations include air quality, lighting, painting and oils, noise and vibration, ergonomics, welfare and safety. The inspectorate considers issues broader than OH&S, including aspects of labour management, notably social aspects and welfare.

Particular Blanda Power Station hazards from an OH&S perspective are the longest elevator in Iceland, and working underground and in tunnels. All operational staff must be familiar with RÖSK (safety regarding electrical utilities) rules according to Regulation REG3.

Criteria met: Yes

Analysis against proven best practice

Scoring statement: *In addition, identification of ongoing or emerging labour management issues takes broad considerations into account, and both risks and opportunities.*

Broad considerations for ongoing or emerging labour management issues arise through EU Directives relating to labour and procurement of contractor services.

Unions take broad considerations into account through their affiliation with the Icelandic Confederation of Labour, which in turn is guided by its active involvement in the International Labour Organisation (ILO).

OH&S broad considerations and risks and opportunities are considered through external audits against OHSAS 18001, ensuring an internationally-relevant awareness of issues and management approaches.

Criteria met: Yes

12.2.2 Management

Analysis against basic good practice

Scoring statement: *Human resource and labour management policies, plans and processes are in place to address all labour management planning components, including those of contractors, subcontractors, and intermediaries, with no significant gaps.*

Human resources policies are contained within the quality system. Policies include Human Resources; Equality; Education; Safety, Health & Work Environment Issues; and Trade Union Agreements. Policies, procedures, regulations and guidance include recruitment, leave (holidays, sickness and accidents, maternity/paternity), induction, termination, retirement, bullying, sexual harassment, education and training, entitlements, funds and services available, visitors and contractors. Landsvirkjun has an Equality Committee and the plant manager in Blanda is one of the seven people on that committee. All relevant information is readily available on the internal website.

A neutral 3rd party company, Forvarnir (literally “prevention”), is available to provide staff support services as needed. Forvarnir is certified by the Administration for OH&S, and includes qualified psychiatrist capabilities. Staff education is provided on personal issues that might arise for them, their rights, and avenues for assistance and response.

Ongoing human resource processes are centred around the Attitude Survey and follow-up. Opportunities for improvement are evaluated and follow-up tasks identified and put into the quality system. The success of follow-up measures are checked through successive surveys. Employee surveys can be downloaded from the internal website.

Annual health checks are made available and strongly encouraged for all staff. There is an internal coaching programme, and some external coaching. Training and professional development is actively encouraged, particularly at power stations and with respect to maintaining/developing staff proficiencies and qualifications.

Workforce planning is done on an annual basis with a 12-month horizon, linked in with the payroll budgeting process. This is done on an operational basis, and not so much on a strategic long-term basis focussed on skills assessment. There are no apparent risks to the business with respect to labour availability or future staffing. Annual payroll comparisons are made with the market to place the company accordingly. The 2008 financial meltdown created an outflux of skills from Iceland, but they are now returning.

Vacancies are advertised internally to encourage professional and career development and also skills transfer. External advertising is sometimes done in parallel.

All employees belong to a union, which negotiates the contracts for their affiliated staff. Every fourth year Landsvirkjun has a collective bargaining/negotiation process which tends to be with the Icelandic Confederation of Labour rather than with each individual union.

Dynamics AX provides a software tool for human resources that can be accessed at the power station level. Managers and staff can see the individual training records, identify gaps and agree on a training plan, and then the training becomes tasks in the DMM. Managers meet with staff formally once per year to review progress and work plans.

Safety training is conducted for the summer students by the Administration for OH&S. The students are provided training in first aid and fire safety by external authorities. Evacuation training is also conducted.

Blanda Power Station safety inspectors include the Power Station Manager, the Maintenance Manager, and two staff (1 electrical, 1 mechanical). Safety checklists have been developed for each work area, and the inspection schedule is in the DMM. Frequency depends on the area. Spot checks are conducted with contractors. Hazardous activities are allocated danger levels, and extra measures put in place accordingly. For example high danger activities include working from heights, or checking pressure pipes at depth. In the latter case, the power station will have an OH&S inspector present as well as two emergency service personnel.

Policies with respect to contractors are mostly around security and work safety, and also training. Contractor jobs are in the DMM. A job permit is generated that details procedures that have been met, including a safety risk meeting, induction meeting, provision of an environmental, health and safety handbook, and other requirements that might be specific to the job. The handbook was created in 2009, and updated in 2011 and again in 2013.

Criteria met: Yes

Analysis against proven best practice

Scoring statement: *In addition, processes are in place to anticipate and respond to emerging risks and opportunities.*

The major human resources review in 2012 was a process to anticipate and respond to emerging risks and opportunities. Some of the human resources initiatives at the corporate level include:

- Introducing performance management and employee development in new ways, trying to make the company more versatile;
- Redesign in 2012 of human resources related procedures, now in the process of being implemented (this year all policies are being reviewed); and
- Defining initiatives to improve team work, including how to best put teams together for future construction projects, such as through rotations.

Other mechanisms that address both risks and opportunities include the staff engagement mechanisms, the use of an external service provider to assist with staff needs, people management training for managers, OH&S training, and external inspections/audits.

Criteria met: Yes

12.2.3 Stakeholder Engagement

Analysis against basic good practice

Scoring statement: *Ongoing processes are in place for employees and contractors to raise human resources and labour management issues and get feedback.*

Blanda Power Station staff get access to information through a variety of mechanisms including:

- Monday staff meetings to get hand-over information from weekend work and talk about what is happening in the present week;
- Monthly full staff meetings to get updates, ensure coordination, and hear about the power station manager's meetings;
- Occasional meetings (~1 every month) with head office divisions (e.g. Technical, Financial) by video-conference coordinated by the CEO office; and
- The Landsvirkjun intranet.

Mechanisms for staff to raise issues and get feedback include:

- Regular power station staff meetings;
- Discussion with one's line manager or the power station manager;
- The quality system, which must be responded to within a certain timeframe (the same grievance mechanism as described in topic O-1, Communications and Consultation);
- The Landsvirkjun Employee Association;
- Landsvirkjunstaff meetings (approx. 5-8 per year) open to all staff;
- the Forvarnir service;
- Annual health checks;
- The annual Employee Attitude survey;
- Union staff representatives in the workplace; and/or
- Directly with the union.

Criteria met: Yes

Analysis against proven best practice

Scoring statement: *In addition, feedback on how issues raised have been taken into consideration has been thorough and timely.*

Staff and unions were satisfied with the range of mechanisms for raising issues and getting feedback. The general view was that issues are raised and dealt with early so that they do not develop into significant problems. Unions respond to staff promptly when contacted. The unions advised that not many direct contacts had been made over the years by Blanda staff, and that they have been more in relation to advice rather than a problem.

Criteria met: Yes

12.2.4 Conformance / Compliance

Analysis against basic good practice

Scoring statement: *Processes and objectives relating to human resource and labour management have been and are on track to be met with no major non-compliances or non-conformances, and any labour related commitments have been or are on track to be met.*

The DMM system includes a schedule for staff meetings and review processes. Staff and unions advise that all commitments are met and there are no areas of concern. Commitments with respect to summer students are met.

OH&S actions that are identified go into DMM and are acted on. Training is delivered. The last health and safety audit by the Administration for OH&S was conducted in 2013 and there were no non-compliances or non-conformances. No opportunities for improvement were noted. It is considered by the inspectors as a very good and proactive system. Opportunities previously identified for improvement have since been rectified, and related to small equipment, level of noise monitoring, the elevator shaft, etc. Blanda received an Occupational

Safety Seal of Approval award in 2008, awarded by the Icelandic Administration for OH&S for outstanding achievement in health and safety issues.

Outside contractors are also immediately put into the system with clear rules.

Criteria met: Yes

Analysis against proven best practice

Scoring statement: *In addition, there are no non-compliances or non-conformances.*

Addressing unsafe issues is an internal KPI for Blanda, and there are no concerns in this regard. The 2012 municipality annual report highlighted a nine-year gap in accidents at the power station. There have been some small incidents but nothing major (e.g. a scalding incident in the kitchen, and some incidents with summer students). The most major accident was about 15 years ago when a staff person in the turbine area broke a rib due to poor positioning. The Administration for OH&S inspectors advised that all requirements are met. Unions advised that all are met. Staff interviewed advised that all are met. The audit report from the Administration for OH&S, 13th August 2013, stated their conclusion that “the company is exemplary and has achieved outstanding results”.

Criteria met: Yes

12.2.5 Outcomes

Analysis against basic good practice

Scoring statement: *There are no identified inconsistencies of labour management policies, plans and practices with internationally recognised labour rights.*

No inconsistencies with internationally recognised labour rights are identified. Landsvirkjun human resources policies and procedures appear to cover all aspects of consideration with respect to internationally-recognised labour rights.

Community members, union representatives, employees, and the OH&S inspectorate noted how Blanda staff are particularly well looked after and are close-knit. Staff tend to stay a long time, some having been with the power station since it was built. This is not due to a lack of other work alternatives, as unemployment is low and there are other work options; rather it appears to reflect loyalty generated by the staff due to the good working conditions and environment.

Criteria met: Yes

Analysis against proven best practice

Scoring statement: *In addition, labour management policies, plans and practices are demonstrated to be consistent with internationally recognised labour rights.*

No specific evaluation of its human resources policies, plans and practices against internationally recognised labour rights has been conducted by Landsvirkjun. However there are several avenues by which this has been done indirectly. As one of its CSR initiatives, Landsvirkjun has mapped itself against provisions of the UN Global Compact, many of which relate to internationally recognised labour rights. Landsvirkjun can demonstrate adherence through its compliance with Icelandic legislation. The Icelandic Confederation of Labour is actively involved in the ILO and evaluates Icelandic legislation against ILO conventions. There are no areas of inconsistency identified.

Criteria met: Yes

12.2.6 Evaluation of Significant Gaps

Analysis of significant gaps against basic good practice

There are no significant gaps against basic good practice.

0 significant gaps

Analysis of significant gaps against proven best practice

There are no significant gaps against proven best practice.

0 significant gaps

12.3 Scoring Summary

Labour and working conditions at Landsvirkjun are clearly and comprehensively addressed through the suite of policies, procedures, regulations and guidelines in the quality system. These have recently undergone a comprehensive review and opportunities for improvement are being followed up. Annual employee attitude surveys over the past ten years guide continuous improvement efforts, as does liaison with the unions to which most employees belong. There are numerous avenues for stakeholder engagement. The Icelandic Confederation of Labour which undertakes collective bargaining processes with Landsvirkjun references its activities against internationally recognised labour rights, and there are no inconsistencies identified for Blanda or Landsvirkjun. The project has achieved proven best practice for Labour and Working Conditions with no significant gaps, resulting in a score of 5.

Topic Score: 5

12.4 Relevant Evidence

Interview:	2, 5, 8, 15, 17, 24-26, 28, 29, 36
Document:	10, 11, 21, 22, 49, 59, 85-87, 110, 113, 122, 140, 141, 186
Photo:	37, 38, 41, 42

13 Cultural Heritage (O-13)

This topic addresses cultural heritage, with specific reference to physical cultural resources, associated with the hydropower facility. The intent is that physical cultural resources are identified, their importance is understood, and measures are in place to address those identified to be of high importance.

13.1 Background Information

There is no evidence of any permanent settlement in the highland area which was affected by the project development. Physical cultural heritage in the highlands is limited to some disused resting places for travellers, old sheep pens, and cairns for way marking. Some old paths and grazing areas were lost under the reservoir but the project construction had a low impact on archaeological remains. The landscape of the area, as with the rest of Iceland, is a very important part of local cultural heritage. Non-physical cultural heritage is addressed under Topic O-3 (Environmental and Social Issues Management) in this assessment.

13.2 Detailed Topic Evaluation

13.2.1 Assessment

Analysis against basic good practice

Scoring statement: *Ongoing or emerging cultural heritage issues with respect to physical cultural resources have been identified, and if management measures are required then monitoring is being undertaken to assess if management measures are effective.*

At the time of construction no archaeological sites were listed or found to be protected in the impact zone of Blanda Power Station. The 2004 Blanda Environmental Report included a section dedicated to cultural heritage. This assessment covered the geographic area affected by the Blanda project and examined cabins, sheep pens, roads, and places of interest for folk law. In addition, documentation of cultural remains in the area between the intake of Blanda Power Station and Blanda reservoir was prepared by the Skagafjörður Heritage Museum in 2012, funded by Landsvirkjun. This assessment involved analysis of written records, interviews with local landowners, field trips to the area and aerial photographs.

The 2004 Environmental Report did not suggest any management measures required for identified cultural heritage, but the recent study by Skagafjörður Museum, served to deepen the understanding of and to monitor the condition of existing cultural heritage in the region.

Criteria met: Yes

Analysis against proven best practice

Scoring statement: *In addition, identification of ongoing or emerging cultural heritage issues takes broad considerations into account, and both risks and opportunities.*

The 2012 study took broad considerations into account, using multiple sources of information, and a broad perspective about the significance of heritage features, looking beyond the most obvious considerations. The assessment looked at the risks of damage to features from crops, erosion or future project development. Landsvirkjun now has the GPS coordinates of every cultural heritage feature identified in the region to avoid any impact by future works.

Criteria met: Yes

13.2.2 Management

Analysis against basic good practice

Scoring statement: *Measures are in place to manage identified cultural heritage issues.*

Iceland has strict legislation on archaeology and chance finds but there are no special management plans in place for the project area. The archaeological surveys undertaken have not identified any additional management measures that are required. A chance find must be registered in Landsvirkjun's quality management system and the station manager must contact the Icelandic Institute of Archaeology which records all archaeological discoveries. However, nothing has been discovered in the last 20 years. Landsvirkjun now employs a full time project manager specialising in landscape planning whose skills will be used to minimise the visual impact of any further developments in the area.

Criteria met: Yes

Analysis against proven best practice

Scoring statement: *In addition, processes are in place to anticipate and respond to emerging risks and opportunities.*

The close relationship that the station manager has fostered with the local farmers who graze sheep across the project areas serves as a process to identify any emerging risks and opportunities regarding cultural heritage. The farmers spend a significant amount of time in the area and are able to report any emerging risks, such as erosion of a site, to the station manager. The regular monitoring of soil erosion and revegetation in the area by the Soil Conservation Service also serves to monitor emerging risks.

Criteria met: Yes

13.2.3 Conformance / Compliance

Analysis against basic good practice

Scoring statement: *Processes and objectives in place to manage cultural heritage issues have been and are on track to be met with no significant non-compliances or non-conformances, and cultural heritage related commitments have been or are on track to be met.*

Icelandic preservation order 107/2001 stipulates that cultural heritage should be preserved in order to be passed to future generations intact. No archaeological features may be 'spoilt, destroyed, altered or obscured'. There are no listed archaeological features in the project area and all of Landsvirkjun's processes and objectives that are in place to manage cultural heritage issues and commitments are on track to be met.

Criteria met: Yes

Analysis against proven best practice

Scoring statement: *In addition, there are no non-compliances or non-conformances.*

There are no non-compliances or non-conformances.

Criteria met: Yes

13.2.4 Outcomes

Analysis against basic good practice

Scoring statement: *Negative cultural heritage impacts arising from activities of the operating hydropower facility are avoided, minimised, mitigated and compensated with no significant gaps.*

Negative cultural heritage impacts arising from activities of the operating hydropower facility are avoided, minimised, mitigated and compensated with no significant gaps. The continued operation of the project is not likely to have any impact on the old roads, cairns or remains of sheep huts in the area.

Criteria met: Yes

Analysis against proven best practice

Scoring statement: *In addition, where opportunities have been identified, measures to address cultural heritage issues beyond those impacts caused by the facility have been or are on track to be achieved.*

Opportunities have been taken, such as the installation of a compass at Afangafell which records the names of hills and place areas visible from this view point. This serves to highlight and continue the cultural heritage value of the natural landscape in the area.

Criteria met: Yes

13.2.5 Evaluation of Significant Gaps

Analysis of significant gaps against basic good practice

There are no significant gaps against basic good practice.

0 significant gaps

Analysis of significant gaps against proven best practice

There are no significant gaps against proven best practice.

0 significant gaps

13.3 Scoring Summary

Cultural heritage in the highland area affected by the Blanda project has been well assessed through two separate studies. The assessments found some items of interest for cultural heritage, such as old paths, resting places and way markers, but there have never been any permanent settlements in the area. As such no significant ongoing management measures are required. All negative impacts on cultural heritage by the project have been minimised and some opportunities to promote cultural heritage taken, such as the installation of a landscape compass at Afangafell. The project has achieved proven best practice for Cultural Heritage with no significant gaps, resulting in a score of 5.

Topic Score: 5

13.4 Relevant Evidence

Interview:	3, 5, 18, 27, 31, 33, 34
Document:	19, 24, 45, 153, 165
Photo:	21

14 Public Health (O-14)

This topic addresses public health issues associated with the operating hydropower facility. The intent is that the operating facility has not created or exacerbated any public health issues; that ongoing or emerging public health issues associated with the facility are identified and addressed as required; and commitments to implement measures to address public health are fulfilled.

14.1 Background Information

Health care in Iceland is publicly financed and state-run. The system is organised into seven health care regions providing specialised care, primary care and elderly care, and 76 municipalities some of which provide elderly care. There are two main hospitals, six regional hospitals, and 16 health institutions.

The northwest region has the same service set-up as other regions in Iceland, and health care issues are also similar to those Iceland-wide. Risk factors in Iceland are typical of other European countries, and quality of care is also very good by European standards. Rising obesity is seen as one of the main risk factors to the population. There were no particular public health issues in the region of the Blanda power station when the scheme was built, and no public health issues linked to the development have emerged since the facility has been operating.

The closest health facilities to Blanda are in the town of Blönduós (30 minutes drive), Sauðárkrúkur (45 minutes drive) or Akureyri (90 minutes drive). Blönduós has a health institution, and can take care of minor examinations. More major or complex issues are dealt with in the main hospitals in Akureyri or Reykjavik. Patient transfer services are provided for through ambulances at the health institutions. There is an airport in Blönduós and helicopters and planes are used for emergency situations.

Public health services have been subject to cuts following the economic collapse in 2008. Cuts have involved mergers of health services, and service, staffing and bed cut-backs at particular facilities. Previously there were 2-3 doctors stationed in Blönduós, and now there are no permanent doctors only rotating shifts. General practitioners (GPs) have rotated weekly at the Blönduós health centre for the last four years. Nursing staff are permanent, as are the day-to-day facility management staff.

There is no private health insurance in Iceland. All costs are covered as needed for treatments. Unions have health funds that can help supplement sick leave or items such as glasses.

14.2 Detailed Topic Evaluation

14.2.1 Assessment

Analysis against basic good practice

Scoring statement: *Ongoing or emerging public health issues associated with the operating hydropower facility have been identified, and if management measures are required then monitoring is being undertaken to assess if management measures are effective.*

Public health issues are assessed through normal public health service data analyses for the region. Any issues specific to Blanda could be picked up through health and safety inspections, regular meetings of the power station manager with the municipalities, liaison with the regional Civil Protection Unit (primarily involving emergency response planning), and annual health checks offered to Landsvirkjun staff. These annual health checks have been undertaken for more than 15 years, involve a full physical, blood and other tests, and provide an opportunity for staff to raise any issues of concern.

Health services in Blönduós would identify any ongoing or emerging public health issues in the region.

Criteria met: Yes

Analysis against proven best practice

Scoring statement: *In addition, identification of ongoing or emerging public health issues takes into account public health system capacities, access to health services, and health needs, risks and opportunities for different community groups.*

A major independent review of the Icelandic health care system was undertaken in 2011, which made some high level recommendations that take into account system capacities, access to services, and issues for different groups (e.g. the elderly). This review does not appear to have direct implications for the Blanda operating facility. Annual health checks for Landsvirkjun staff are adapted for gender, age, etc, and anything of note is referred onto a specialist.

Criteria met: Yes

14.2.2 Management

Analysis against basic good practice

Scoring statement: *Measures are in place to manage identified public health issues.*

Public health issues are managed through the public health services. No significant public health management measures have been put in place with respect to Blanda, and it is not an issue that requires active management. Measures to manage any identified issue directly relevant to Landsvirkjun or Blanda would be through government processes that would inform Landsvirkjun if necessary, and the company would follow-up as needed.

Criteria met: Yes

Analysis against proven best practice

Scoring statement: *In addition, processes are in place to anticipate and respond to emerging risks and opportunities.*

Processes are in place to anticipate and respond, through existing engagement mechanisms and normal corporate management processes. The only identified public health issue that has arisen in recent years with potential consequences for the Blanda facility is the swine flu outbreak. In this case the government provided an inoculation program, and priority recipients included power station operators.

Criteria met: Yes

14.2.3 Conformance / Compliance

Analysis against basic good practice

Scoring statement: *Processes and objectives in place to manage public health issues have been and are on track to be met with no significant non-compliances or non-conformances, and public health related commitments have been or are on track to be met.*

Commitments to annual health checks for staff, and broader contributions (see under “Outcomes”), have been fully met. Landsvirkjun has a contract with the Blönduós health centre to conduct the annual staff health checks and there are no compliance concerns with this contract.

Criteria met: Yes

Analysis against proven best practice

Scoring statement: *In addition, there are no non-compliances or non-conformances.*

There are no non-conformances or non-compliances.

Criteria met: Yes

14.2.4 Outcomes

Analysis against basic good practice

Scoring statement: *Negative public health impacts arising from activities of the operating hydropower facility are avoided, minimised and mitigated with no significant gaps.*

There are no particular health related issues that have arisen with respect to Blanda operations, the Blanda region or Blanda employees. There were no pre-existing public health issues in the area.

Criteria met: Yes

Analysis against proven best practice

Scoring statement: *In addition, where opportunities have been identified, measures to address public health issues beyond those impacts caused by the operating hydropower facility have been or are on track to be achieved.*

Contributions beyond Blanda's own health issues include philanthropic contributions to a local teen pregnancy prevention programme. At the corporate level, Landsvirkjun has made a number of philanthropic contributions towards public health over the years, and more recently (since 2010) through its Community Fund which is all publicly documented. These corporate contributions have addressed health equipment, awareness raising and educational materials, mental health and disabilities, and research. Blanda has also contributed to enhancing the local search and rescue capacities through processes around emergency preparedness for the Blanda operating facility.

Criteria met: Yes

14.2.5 Evaluation of Significant Gaps

Analysis of significant gaps against basic good practice

There are no significant gaps against basic good practice.

0 significant gaps

Analysis of significant gaps against proven best practice

There are no significant gaps against proven best practice.

0 significant gaps

14.3 Scoring Summary

Iceland has a comprehensive public health system, and health facilities are within reasonable proximity to the Blanda operating facility. No public health issues are associated with Blanda, nor has the operating facility created or exacerbated any public health issues. Blanda provides annual health checks to all of its staff, has contributed to local and national health services through philanthropic donations, and has enhanced local search and rescue capacities. The project has achieved proven best practice for public health with no significant gaps, resulting in a score of 5.

Topic Score: 5

14.4 Relevant Evidence

Interview:	8, 13, 15, 17, 30
------------	-------------------

Document:	88, 89, 113, 142, 143, 179, 186
Photo:	39

15 Biodiversity and Invasive Species (O-15)

This topic addresses ecosystem values, habitat and specific issues such as threatened species and fish passage in the catchment, reservoir and downstream areas, as well as potential impacts arising from pest and invasive species associated with the operating hydropower facility. The intent is that there are healthy, functional and viable aquatic and terrestrial ecosystems in the area that are sustainable over the long-term; that biodiversity impacts arising from the operating hydropower facility are managed responsibly; that ongoing or emerging biodiversity issues are identified and addressed as required; and that commitments to implement biodiversity and invasive species measures are fulfilled.

15.1 Background Information

Iceland was de-glaciated 10,000 years ago and so has comparatively low biodiversity. Flora and fauna in the northwest of Iceland must tolerate a cold, dry and windy environment, prone to soil erosion and periodic inundation with ash. The project area is nonetheless comparatively rich in flora and surveys have found 170 vascular plants, 101 species of moss, 84 species of lichen and 30 species of fungus, though none are rare or threatened. Studies have identified 30 species of bird in the region including swans, geese and ducks. Arctic fox and mink are found in the highland areas. There are three native fish species in the river Blanda; brown trout, atlantic salmon and arctic char. Three-spined stickleback are also found in the highland lakes.

The reservoirs inundated 62 km² of land in the highlands above the project. Approximately one quarter of the land lost was wetland, and the other three-quarters was vegetated, supported by deep, high quality soil, and valued for grazing. To compensate for the loss of land for grazing Landsvirkjun funded a program to revegetate about 50 km² (5,000 hectares) of land in Auðkúluheidi and Eyvindarstaðaheiði which was previously highly eroded with very little ground cover (this program is described in O-9, Project-Affected Communities and Livelihoods). Although the original intention was to create grassland, most of this area is now being colonised by native vegetation and is of benefit to the area's biodiversity.

15.2 Detailed Topic Evaluation

15.2.1 Assessment

Analysis against basic good practice

Scoring statement: *Ongoing or emerging biodiversity issues have been identified, and if management measures are required then monitoring is being undertaken to assess if management measures are effective.*

The 2004 Blanda Environmental Report describes the region's flora and fauna. Having established biodiversity conditions before the project, the report goes on to discuss the current effects of the project on flora and fauna, focusing on the loss of land to the reservoir and changes in the river's hydrology. The biodiversity assessment draws particularly on field research done by Akureyri Natural History Museum when the project was in its preparation stage in the 1970's. That study produced vegetation mapping for the area, and listed plants, mosses, lichens and fungus, but did not identify any rare species of plant. The report also included data on the aquatic ecology including algae, diatoms and phytoplankton. The National Energy Authority undertook a detailed study investigating the biodiversity of the highland lakes in 1978, examining vegetation, phytoplankton, zooplankton, benthic organisms and fish. Other early studies examined crustacea in the area's ponds and lakes, and the benthic fauna of the main tributaries.

The Institute of Freshwater Fisheries (IFF) have undertaken over 70 detailed studies into the fish stocks in the river over the last three decades. IFF have determined fish populations using angler catch records, which note fish species, size, location and date. The IFF has more recently combined this information with data from fish counters to gain an understanding of the relationship between the size of the fish run and catch numbers.

There are two fish counters in the fish pass at Ennisfludir, 2 km from the Blanda River estuary, that have been operated by IFF from June to September since 1993. During this period IFF has also monitored water temperature and clarity.

Since 1975 more than 20 studies have looked at land use change around the reservoirs, and the impact of grazing and land reclamation in the region. Numerous grazing experiments were undertaken by the Soil Conservation Service of Iceland between 1975 and 1989 to find effective ways of meeting the grazing requirements without damaging the vegetation.

In 2012, as part of the EIA for the expansion project, Verkis, a consultancy, undertook a survey of the diversity, distribution, breeding density and potential habitat impact of the area's birdlife.

Monitoring of biodiversity in the area is ongoing by a number of organisations. The Soil Conservation Service monitors the revegetation program. The IFF monitors fish populations. The Institute of Natural History monitors the effects of windblown sand on vegetation around the reservoir. Monitoring by IFF showed a significant decrease in fish populations in the river in 2011, but this occurred across the country and monitoring of juveniles did not reveal any local causes. If the research had revealed a local cause then the angling association would have put management measures in place.

Criteria met: Yes

Analysis against proven best practice

Scoring statement: *In addition, identification of ongoing or emerging biodiversity issues takes into account both risks and opportunities.*

The identification of emerging biodiversity issues does not fully account for risks and opportunities which is considered a significant gap at the proven best practice level. For example, a baseline survey of the fish populations in Blanda's tributaries was done early in the project preparation stage but has not been repeated, despite predictions by the IFF that the project will have affected these fish. The same is true for aquatic and terrestrial invertebrates that have not been surveyed since project development, despite anecdotal evidence that these populations have changed. In addition, the positive biodiversity impact of the revegetation program in the highlands is not well documented. There is an opportunity to make a full assessment of the success that this program has had in recreating land cover and establishing native vegetation, to share the learning within Landsvirkjun and with external stakeholders.

Criteria met: No

15.2.2 Management

Analysis against basic good practice

Scoring statement: *Measures are in place to manage identified biodiversity issues.*

The Soil Conservation Service runs the revegetation program in partnership with Landsvirkjun and the farmer's cooperative. There are two formal meetings a year to discuss the program's direction and issues arising such as continued soil erosion and new grazing opportunities. The Soil Conservation Service defines actions for the year, organises contracts for fertiliser and decides what seed to use (hardy native varieties). The fencing and roads cooperative (see O-9, Project-Affected Communities and Livelihoods) manages fencing to keep sheep off land that the Soil Conservation Service is revegetating.

In partnership with the Institute of Natural History, Landsvirkjun have established measures to stabilise areas of land around the reservoir that windblown sand threatens to cover. This includes the application of fertiliser to encourage plant growth and fencing to prevent grazing.

A long-standing agreement exists between Landsvirkjun and the angling club to maintain the downstream river flow to support the salmon in the river; this is discussed in more detail in O-19 (Downstream Flow Regime). The

IFF monitors the salmon run and juvenile population and if they note that the population numbers are weak then the angling association will enforce catch-and-release measures to prevent anglers from removing fish from the river. Similarly, if monitoring notes a reduction in two-sea-winter salmon, anglers must return these fish to the river if caught, to maintain the population's genetic diversity.

There are mink in the area, which are an invasive species and considered a pest, as they eat fish and birds eggs. However, local stakeholders have not noted a change in the population since the advent of the project and interviewees did not consider the problem more significant in Blanda than elsewhere in Iceland. There are no formal management measures in place but individuals do trap the mink for recreation.

No management plans are in place for fish in the reservoirs, but this is not considered a significant gap as the local lake fishing association report a healthy population of arctic char and brown trout. Management plans are not considered necessary for the arctic fox and mink found in the area as both are considered pests in Iceland, although their impacts in this area are not substantial enough to demand controlling.

Criteria met: Yes

Analysis against proven best practice

Scoring statement: *In addition, processes are in place to anticipate and respond to emerging risks and opportunities.*

The partnerships that Landsvirkjun have cultivated with the IFF, the angling club, the Soil Conservation Service and with the Institute of Natural History are good processes to anticipate emerging biodiversity risks and opportunities.

For example, the Soil Conservation Service makes regular checks of the highland areas, five to ten times a year, to make visual assessments of plant and soil development. The association also regularly communicates with the local farmers and with Landsvirkjun. The partnership allows Landsvirkjun to identify new opportunities, such as new areas that would benefit from fertilisation.

Criteria met: Yes

15.2.3 Conformance / Compliance

Analysis against basic good practice

Scoring statement: *Processes and objectives in place to manage biodiversity issues have been and are on track to be met with no significant non-compliances or non-conformances, and biodiversity related commitments have been or are on track to be met.*

The Environment Agency of Iceland has very low involvement with the project and do not consider it an area of concern. There are no rare or endangered species in the area and review of documents and interviews with stakeholders did not reveal any non-conformances or non-compliances.

Criteria met: Yes

Analysis against proven best practice

Scoring statement: *In addition, there are no non-compliances or non-conformances.*

There are no non-compliances or non-conformances.

Criteria met: Yes

Analysis against basic good practice

Scoring statement: *Negative biodiversity impacts arising from activities of the operating facility are avoided, minimised, mitigated, and compensated with no significant gaps.*

The reservoir area is still in a dynamic state, particularly regarding fish populations, shoreline erosion and surrounding vegetation. The construction of the project had a number of impacts on the fish population in the area. Migrating salmon and sea trout lost access to areas above Reftjarnarbungu (location of the Blanda dam) for highland spawning. A population of migratory Arctic Char was lost because of the project although some resident char remain, and their numbers in the tributaries of Blanda have also reduced. The decomposition of vegetation and nutrients entering the water system has also affected aquatic ecology.

However, since the increase in reservoir height in 1996 the number of Salmon in the river, although variable, has increased, as has the number caught. The location of the Salmon has also changed, with more now found and caught in the higher reaches of the Blanda, all the way up to the dam. The salmon population also benefited from improved spawning and nursery ground conditions. Weather conditions now affect their migration less, as the river flow is more constant.

The revegetation program initiated by the Soil Conservation Service is having biodiversity benefits and is compensating for the area lost when the valley was flooded. Particular benefits have been noted in the Auðkúluheiðar area, to the west of the river, which stopped applying fertiliser a number of years ago. Native vegetation is developing in place of grass cover, made possible by the soil depth and land cover created by the former cultivated grassland. The Institute of Natural History believe that a decrease in grazing pressure from sheep and horses, and a change in climate, have contributed to the success of the revegetation program. In addition, the fertilisation of some areas, creating good grazing, has kept animals off other areas, allowing those overgrazed areas to recover.

The windblown sand resulting from erosion from the reservoir bottom has affected vegetation around the reservoir. Species richness has decreased with an increase in sand thickness. Mosses and lichens die under 2-5 cm of sand, and herbs, rushes, sedges and shrubs disappear under 5-10 cm. When sand builds to a depth of greater than 10 cm the underlying vegetation dies, and wind then erodes the underlying soil. At present 30-40 hectares (0.3-0.4 km²) of land have been lost under windblown sand. This is relatively a very small area compared to the size of the area undergoing revegetation treatment (0.6-0.8%) and is not considered a significant gap against this criterion.

Downstream of the dam, the amount of suspended solids in the river has greatly reduced, increasing algae production and other riverbed ecology. This has been of benefit to populations of other aquatic flora and fauna, and smolt in particular. Vegetation on the riverbanks has undergone long-term change and there is increased vegetation on the islands in the Blanda river channel due to regulated water flow and less sediment deposition.

There is no evidence that the project has adversely affected birdlife or other animal species.

Criteria met: Yes

Analysis against proven best practice

Scoring statement: *In addition, there are healthy, functional and viable aquatic and terrestrial ecosystems in the area affected by the hydropower facility that are sustained over the long-term; or the facility has contributed or is on track to contribute to addressing biodiversity issues beyond those impacts caused by the operating hydropower facility.*

The rivers Blanda and Svartá have become popular angling destinations due to the healthy, functional and viable aquatic ecosystems that have been supported by the hydropower facility, which can be sustained over the long-term.

The terrestrial ecosystem in the northwest of Iceland is fragile due to the harsh climate, periodic inundation with ash, and long term overgrazing. Efforts by Landsvirkjun and their partners are serving to improve the health of this ecosystem but there remains scope for further revegetation.

The project has contributed to addressing biodiversity issues beyond those impacts caused by the operating hydropower facility, particularly through the revegetation program, which although it started with grazing in mind, is now facilitating increased land cover with native vegetation.

Criteria met: Yes

15.2.5 Evaluation of Significant Gaps

Analysis of significant gaps against basic good practice

There are no significant gaps against basic good practice.

0 significant gaps

Analysis of significant gaps against proven best practice

There is one significant gap against proven best practice – that there are insufficient processes in place to anticipate and respond to emerging biodiversity risks and opportunities through an updated and comprehensive analysis. For example, the absence of monitoring of the highland aquatic ecology means that the project’s ongoing impact on this ecosystem is not well understood. In addition there is an opportunity to better understand the positive impacts that the revegetation program has had on the establishment of native vegetation in the area.

1 significant gap

15.3 Scoring Summary

Ongoing and emerging biodiversity issues are identified and addressed through a number of partnerships with national government agencies. The IFF is particularly active regarding the monitoring of fish in the River Blanda. Biodiversity impacts arising from the operating hydropower facility are managed responsibly through the same partnerships. Legal requirements and commitments to implement biodiversity measures are fulfilled. The project has created a healthy, functional and viable aquatic river ecosystem in the Blanda and Svartá, which have consequently become popular angling destinations. The terrestrial ecosystem is fragile but efforts by Landsvirkjun and their partners are serving to improve the health of this environment. However there are insufficient processes in place to anticipate and respond to emerging biodiversity risks and opportunities through an updated and comprehensive analysis, which is considered a significant gap against proven best practice management criteria.

Topic Score: 4

15.4 Relevant Evidence

Interview:	3, 7, 18, 19, 23, 31, 33, 34
Document:	13, 17, 25, 26, 27, 29, 31, 34, 35, 36, 41, 45, 46, 64, 67, 70, 96, 101, 106, 107, 144, 145, 146, 147
Photo:	2, 13, 17, 19, 24

16 Erosion and Sedimentation (O-16)

This topic addresses the management of erosion and sedimentation issues associated with the operating hydropower facility. The intent is that erosion and sedimentation caused by the operating hydropower facility is managed responsibly and does not present problems with respect to other social, environmental and economic objectives; that external erosion or sedimentation occurrences which may have impacts on the operating hydropower facility are recognised and managed; and that commitments to implement measures to address erosion and sedimentation are fulfilled.

16.1 Background Information

The Blanda, as a largely glacial fed river, historically carried high loads of silt, with a total sediment load estimated at about 570,000 tons per year. After it was dammed the sediment load changed dramatically, with all bedload and a substantial part of suspended load settling out in the large Blöndulón reservoir and in the smaller lakes and reservoirs along the waterway. Downstream turbidity of the river was substantially reduced, with a present total load of about 63,000 tons per year. The erosive capacity of the river is also reduced as spring floods are curtailed, and the river changed from a dynamic braided system with frequently changing channels to a largely static one. Gravelbanks in the channel have since become vegetated islands. Changes are gradually reaching down to the mouth of the river in the town of Blönduós, where some reductions in sandbanks and beaches are expected over time.

Upstream in the main reservoir, there is some shoreline erosion in areas exposed to waves at high water levels, leading to a retreat of up to 5 m in places and an expected total expansion of the reservoir area at full supply level, before a new equilibrium is reached, of 1-2%. At low water levels – as in the current water year - and with high winds, sediment from the exposed reservoir bottom can be blown onto land. While sand settles out close to the reservoir, in some cases threatening to cover the low vegetation (on some 30 ha in 2009), finer silt is blown further away and can become a nuisance. Silt or dust storms are indeed typical in Iceland, where much of the landscape is not covered by vegetation, either because of natural conditions (harsh climate, volcanic ash deposits, glacial retreat) or because vegetation has been destroyed by centuries of overgrazing and wood harvesting. Before the project, dust storms likely originated on the land which has since been revegetated, and the total incidence of storms may be similar to before.

The lack of soil and vegetation is a large-scale environmental problem in the country and explains why the loss of fertile soils under the reservoirs prompted concerns and negotiations with local farmers. This resulted in one of the largest re-vegetation and erosion control programs in Iceland's history, as the Blanda project's main compensation effort. Erosion monitoring and control in the watershed has been carried out by Landsvirkjun in cooperation with farmers, the Soil Conservation Service and independent researchers since before construction began, providing valuable references for other sites in Iceland, including the next hydropower stations. These erosion control efforts are covered in more detail under O-9 (Project-Affected Communities and Livelihoods) and O-15 (Biodiversity and Invasive Species), because they are not primarily directed at reducing sediment input into the reservoir. There is also some ongoing reforestation around the power station, although more for aesthetic reasons and to reduce wind exposure than for erosion control purposes.

16.2 Detailed Topic Evaluation

16.2.1 Assessment

Analysis against basic good practice

Scoring statement: *Ongoing or emerging erosion and sedimentation issues have been identified, and if management measures are required then monitoring is being undertaken to assess if management measures are effective.*

The geomorphology of the Blanda river system has been researched by Landsvirkjun or by research organisations supported by Landsvirkjun and is generally well understood. Shoreline erosion and sediment accumulation in the Blanda reservoir are monitored. The shoreline appears to be stabilizing and reaching a new equilibrium, as could be expected. Sedimentation of the reservoir was last assessed in 2012 through a bathymetric survey with echo sounders, as part of a Landsvirkjun program to survey all reservoirs. The exact current total storage is 425.8 GJ and the active storage is 391.8 GJ. From the impoundment of the reservoir 18.2 GJ (or 0.8 GJ annually) have been lost in storage. Based on these data the half-life of the reservoir is estimated at about 250 years, not taking into account possible changes to sediment delivery from the upper watershed or the ability to eventually flush the reservoir through the Blanda dam bottom outlet. Future bathymetric surveys are planned every 5 to 10 years.

Long-term suspended sediment sampling was undertaken at the Langamýri gauge downstream of the power station from 1965 to 2011, enabling establishment of sediment rating curves for the periods before and after the project was built. Other samples of suspended and bedload sediments have been taken at various times and locations in the basin. Baseline geomorphology studies were also conducted. Data and studies have either been published or are accessible in the Iceland Meteorological Office's database.

Aerial pictures and site visits of the downstream river reach and the river mouth show some changes, in particular channel stabilization. There is some reduction in traditional small-scale gravel mining opportunities for about 10 adjacent farmers, due to a combination of bedload trapping in the reservoir and reduced sediment transport capacity below the dam, but also due to changes in regulations which prohibit taking gravel directly from the river channel. The lack of sediment is not expected to lead to significant coastal erosion issues, since the shoreline is largely rocky. The river mouth is not an active boat harbour and sand beaches are not used significantly for recreation. The Svarta River, a major non-glacial tributary to the Blanda below the power station, also continues to provide some sediment.

Criteria met: Yes

Analysis against proven best practice

Scoring statement: *In addition, identification of ongoing or emerging erosion and sedimentation issues takes into account both risks and opportunities.*

There is extensive and well-connected research and monitoring capacity throughout the watershed, from glaciological research upstream to the informal monitoring by anglers (some of whom are power station employees) of river conditions downstream. Any changes to erosion and sedimentation that would positively or negatively affect power generation or other river uses are likely to be identified by this capacity. The decision to discontinue suspended sediment sampling at Langamýri after 46 years does somewhat reduce the ability to anticipate changes in the Blanda watershed and also the opportunity to contribute to a national research program; however this is not seen as a significant gap. Equally, downstream geomorphological changes could be monitored more systematically, for example through periodic aerial pictures and measuring of river channel depth, but there is no particular urgency to this effort as changes are slow. The risk of increased wind erosion from the exposed reservoir bottom is understood, and if dust storms were to become a

more regular occurrence, there is an intention to replicate Landsvirkjun's ongoing monitoring program from the Kárahnjúkar project at Blanda.

Criteria met: Yes

16.2.2 Management

Analysis against basic good practice

Scoring statement: *Measures are in place to manage identified erosion and sedimentation issues.*

The revegetation efforts around the reservoir, and the natural regrowth of vegetation due to reduced numbers of sheep and a warming climate, are expected to somewhat reduce the sediment input into the reservoir. The ability to eventually flush the reservoir is maintained through annual tests of the bottom outlet. It has been suggested by anglers that the bypass reach of the Blanda River, below the Blanda dam and above the tailrace of the power house, has now become suitable salmon spawning habitat and could be improved by adding gravel; but for the time being there is no indication of a lack of spawning habitat and a preference to continue observing how fish adapt to the new geomorphological conditions.

Some of the lakes through which the waterway runs have become more turbid, and compensation is paid to the owners of fishing rights for reduced fish yields. The suspended sediment is not as abrasive as originally thought, and hydro-mechanical equipment in the powerhouse will not need to be replaced as often as planned. The spare runner that was purchased with the other three units may not be needed for decades.

Reservoir bottom wind erosion mobilises sand and silt. Some vegetation management measures to stabilise onshore sand deposits are already taken, but such measures are unlikely to be effective against dust storms, should they occur more often. However, this needs to be put into perspective of the frequent dust storms from other sources in Iceland, and is not seen as a significant gap.

No other management measures are required at this stage.

Criteria met: Yes

Analysis against proven best practice

Scoring statement: *In addition, processes are in place to anticipate and respond to emerging risks and opportunities.*

Additional long-term effects of changes in fluvial geomorphology may be identified in the future. For example, it is possible that positive or negative changes in some fish populations require or enable some interventions. The active dialogue between Landsvirkjun, the local authorities and the anglers should be able to identify appropriate management responses as far as these are technically and economically feasible.

Criteria met: Yes

16.2.3 Conformance / Compliance

Analysis against basic good practice

Scoring statement: *Processes and objectives in place to manage erosion and sedimentation issues have been and are on track to be met with no significant non-compliances or non-conformances, and erosion and sedimentation related commitments have been or are on track to be met.*

All erosion and sedimentation issues are well understood, and the project is in compliance with government regulations and conforms to Landsvirkjun's own plans with regards to erosion and sedimentation. The only commitments that were made at the time of construction or afterwards were related to revegetation around the reservoir and to managing downstream flows, particularly in the summer angling season, as anglers were

asking Landsvirkjun to avoid or delay spilling turbid waters from the reservoir into the bypass reach as long as possible. These commitments have been kept.

Criteria met: Yes

Analysis against proven best practice

Scoring statement: *In addition, there are no non-compliances or non-conformances.*

There are no non-compliances or non-conformances.

Criteria met: Yes

16.2.4 Outcomes

Analysis against basic good practice

Scoring statement: *Erosion and sedimentation issues are avoided, minimised and mitigated with no significant gaps.*

The erosion and sedimentation effects of the project are generally seen as positive by the local population. Angling - in particular for salmon - has significantly increased, both because the river provides better habitat and because of increased visibility. Farmers with lands in the valley floor are benefitting from improved grazing and even some grain production. The national road Blönduós-Akureyri was able to be relocated on the valley floor as the river became stabilised and flooding reduced.

With regards to terrestrial erosion, the revegetation program around the reservoir compensated for the loss of grazing land and avoided displacing grazing pressure onto soils susceptible to erosion. While there have been and will continue to be geomorphological changes in the Blanda system, they do not significantly impact power generation, even in the long term.

Criteria met: Yes

Analysis against proven best practice

Scoring statement: *In addition, erosion and sedimentation associated with operating facility do not present ongoing problems for environmental, social and economic objectives of the facility or the project-affected areas.*

No ongoing problems for environmental, social and economic objectives of the facility are known.

Criteria met: Yes

16.2.5 Evaluation of Significant Gaps

Analysis of significant gaps against basic good practice

There are no significant gaps against basic good practice.

0 significant gaps

Analysis of significant gaps against proven best practice

There are no significant gaps against proven best practice.

0 significant gaps

16.3 Scoring Summary

The Blanda used to be a highly turbid glacial river and presents an interesting example of a system that has, in the view of affected communities, largely benefited from trapping sediment in an upstream reservoir. River banks have stabilised, the primary productivity has increased due to greater light penetration, the diversity and abundance of aquatic life have increased, and the opportunities for angling have improved. Erosion and

sedimentation processes are either stable or evolving slowly. No ongoing problems have been identified that would require additional management measures, and the monitoring capacity is sufficient to pick up any conceivable future issues, though there may be some opportunities to conduct more systematic monitoring in the downstream river reach to generate better long-term records. There are no significant gaps with respect to proven best practice, resulting in a score of 5.

Topic Score: 5

16.4 Relevant Evidence

Interview:	5, 7, 20, 22, 31, 33, 34
Document:	1, 5, 7, 13, 25-27, 33, 37, 60, 64, 92, 95, 103, 107, 114, 144-147, 151, 168, 186
Photo:	3, 14, 15, 18, 20, 24

17 Water Quality (O-17)

This topic addresses the management of water quality issues associated with the operating hydropower facility. The intent is that water quality in the vicinity of the operating hydropower facility is not adversely impacted by activities of the operator; that ongoing or emerging water quality issues are identified and addressed as required; and commitments to implement measures to address water quality are fulfilled.

17.1 Background Information

Given that there are few human activities in the watershed, low temperatures, the generally high environmental health standards, and the lack of high chemical concentrations in the existing water samples, there are no reasons to expect water quality problems in the Blanda River. The hydropower project could theoretically affect water quality through changes upstream of the reservoir, in the reservoir, pollution at the power plant (or other operational points, such as the gate houses on the dams), or changes in the downstream reach. Around the reservoir area, the only activity associated with the project is the revegetation effort; some of the chemical fertilizer could be leached into surface and groundwater and increase the availability of nutrients. In the early years of the reservoir, there was also an increase in fish stocks which was attributed to the decomposition of organic material and availability of nutrients. Today the main quality effect of the reservoir appears to be the reduction in turbidity (depending on the residence time) in the downstream river. The power station itself has an Operations Permit with provisions for wastewater disposal, prevention measures against oil and hazardous chemicals spills, strict monitoring and no recorded pollution incidents.

17.2 Detailed Topic Evaluation

17.2.1 Assessment

Analysis against basic good practice

Scoring statement: *Ongoing or emerging water quality issues have been identified, and if management measures are required then monitoring is being undertaken to assess if management measures are effective.*

Surface and groundwater quality in Iceland is generally considered to be good, but there is little ongoing quality monitoring. Only where a water source is used for drinking water, the Health Unit of Northwest Iceland maintains a monitoring program with a focus on bacteriological quality. In the project region, this applies to small towns with public water and sanitation systems and isolated farms, whose wells are monitored less frequently. No drinking water is taken from the Blanda River. The Unit has sampled the river above and below the town of Blönduós to check the effectiveness of wastewater treatment. Icelandic standards are considered at least as strict as EU standards, and according to an OECD survey, 97% of Icelandic people say they are satisfied with the quality of their water, considerably higher than the OECD average of 84%. The Unit also monitors food safety, but this does not extend to freshwater fish. Other quality monitoring on the Blanda is limited to suspended solids and temperature, which were measured by the Iceland Meteorological Office until 2011 at the Langamýri gauge downstream of the power station; samples for operational purposes which are occasionally taken at the power station; and two isolated water samples from 2001 and 2004, taken as part of scientific surveys and with a focus on chemical water properties such as nutrients and metals. Some Icelandic rivers are known to have rather high concentrations of chemicals due to the weathering of young volcanic rock or geothermal activity in their watersheds; longer residence time in lakes or reservoirs also increases chemical content.

No ongoing or emerging water quality issues have been identified through general observations in the project area or the existing water quality monitoring. Nutrient levels in the reservoir are low, judging by the low levels of aquatic vegetation and fish stocks, which indicates that the remaining organic content at the reservoir

bottom and the potential leaching of some fertilizer used in the revegetation program do not pose a problem. Water quality in all reaches of the river and all lakes and reservoirs is believed to be high.

Criteria met: Yes

Analysis against proven best practice

Scoring statement: *In addition, identification of ongoing or emerging water quality issues takes into account both risks and opportunities.*

River sediment load and temperature at the Langamýri gauge was monitored until 2011. There are also continuous data series for water temperature in the main and intake reservoirs, and a water temperature research program was conducted between 1999 and 2009. However, there is currently no systematic process for physical, chemical and biological monitoring and analysis of surface water data in the project area. The 2004 Blanda Environmental Report did not address water quality. There are no indications for any problems, but in the absence of monitoring, it would be difficult to anticipate or detect them. This is seen as a significant gap.

Criteria met: No

17.2.2 Management

Analysis against basic good practice

Scoring statement: *Measures are in place to manage identified water quality issues.*

The only relevant management measures are the pollution prevention measures at the power station and other operational points, which are well managed, ISO 9001 and 14001 certified, and regularly supervised by the Health Unit of Northwest Iceland.

Criteria met: Yes

Analysis against proven best practice

Scoring statement: *In addition, processes are in place to anticipate and respond to emerging risks and opportunities.*

The current lack of assessment or monitoring capacity and therefore, technical knowledge makes targeted management of emerging water quality issues infeasible. There are currently no processes in place to anticipate water quality risks and opportunities in the project area, except those that originate in the power station and those that affect groundwater used as a source of drinking water. This is already listed as a significant gap above, under Assessment, and will not be counted again.

The Health Unit of Northwest Iceland has procedures to respond to identified pollution problems.

In 2011, the European Water Framework Directive was adopted into Icelandic law, as part of harmonisation efforts within the European Free Trade Association (EFTA). Its introduction is led by the Environment Agency and should lead to a more systematic water quality management approach, with regional committees responsible for reaching or maintaining 'very good or good ecological and chemical status' of surface waterbodies in their regions, and expanded monitoring and analysis efforts by the Meteorological Office. Landsvirkjun is engaged in this process and has commented on the first draft of the national strategy to implement the Water Framework Directive. A major initiative to upgrade water quality monitoring is led by the Institute of Freshwater Fisheries.

Criteria met: Yes

17.2.3 Conformance / Compliance

Analysis against basic good practice

Scoring statement: *Processes and objectives in place to manage water quality issues have been and are on track to be met with no significant non-compliances or non-conformances, and water quality related commitments have been or are on track to be met.*

The pollution prevention measures at the power station and other operational points have been and are in compliance with the Operations Permit. No environmental mishaps at Blanda have been recorded in Landsvirkjun's environmental monitoring system and published in its annual Environmental Reports. (The only recorded oil leak incident over the past 7 years was in 2010 at a different power station.) No other water quality related commitments have been recorded.

Criteria met: Yes

Analysis against proven best practice

Scoring statement: *In addition, there are no non-compliances or non-conformances.*

There are no non-compliances or non-conformances.

Criteria met: Yes

17.2.4 Outcomes

Analysis against basic good practice

Scoring statement: *Negative water quality impacts arising from activities of the operating hydropower facility are avoided, minimised and mitigated with no significant gaps.*

No negative water quality impacts of the Blanda project are known.

Criteria met: Yes

Analysis against proven best practice

Scoring statement: *In addition, water quality in the area affected by the operating hydropower facility is of a high quality; or the facility has contributed or is on track to contribute to addressing water quality issues beyond those impacts caused by the operating hydropower facility.*

All indications are that surface and groundwater quality in the project area is high. The Blanda reservoir has also reduced turbidity and increased visibility in the river, which is seen as an important contribution by the local communities.

Criteria met: Yes

17.2.5 Evaluation of Significant Gaps

Analysis of significant gaps against basic good practice

There are no significant gaps against basic good practice.

0 significant gaps

Analysis of significant gaps against proven best practice

The lack of systematic monitoring of the physical, chemical and biological properties of water in the project area is seen as a significant gap. Given that there are no indications of specific water quality problems, the monitoring effort would not need to be complex and costly nor would it need to be maintained at a high frequency, but it should allow to identify any changes and potential issues that might arise in the future and to

take decisions on appropriate management responses. To avoid double counting, this is seen as one, not two significant gaps.

1 significant gap

17.3 Scoring Summary

Water quality in northwest Iceland in general and in the Blanda river system in particular is very good. There appears to be general agreement that the project has, if anything, probably improved the quality in some respects against the pre-project conditions, and has not caused any pollution problems. This has led Landsvirkjun and governmental authorities to see surface water quality monitoring as unnecessary. However, there is a distinct lack of knowledge about water quality trends and an inability to respond to future issues that might arise, resulting in a significant gap against Proven Best Practice. Given that the Blanda project is the most important user of water and source of potential water quality changes in the Blanda river system, Landsvirkjun has a key role to play in the implementation of the Water Framework Directive in this basin.

Topic Score: 4

17.4 Relevant Evidence

Interview:	1, 14, 17, 20
Document:	5, 1, 15, 41-42, 45, 94, 95, 103, 126, 148, 167, 171
Photo:	14, 15, 40

18 Reservoir Management (O-18)

This topic addresses management of environmental, social and economic issues within the reservoir area during hydropower facility operation. The intent is that the reservoir is well managed taking into account power generation operations, environmental and social management requirements, and multi-purpose uses where relevant.

18.1 Background Information

The level of the Blöndulón reservoir is a function of inflows and generation requirements. The normal maximum level of the reservoir is 478 masl. During wintertime the water level decreases due to low inflows. The average minimum level is about 472.5 masl. In spring the level rises and in most years, reaches its maximum late in the summer.

When the reservoir reaches its maximum level the water goes over the ungated spillway into the old river channel below the Blanda dam. To accommodate sport fishing in the Blanda River, the use of the spillway is delayed as long as possible. The Blanda dam spillway can pass a flood of up to 600 m³/s, and much larger floods could be safely passed through the reservoir, as the Blanda dam can be overtopped.

The reservoir is principally managed by Landsvirkjun's Energy Division through generation decisions, as there are no explicit storage operating rules. From a generation point of view, avoiding spilling and ensuring long-term continuity of supply are key considerations. Water is released from the reservoir through a gate at the Kolka dam and takes on average 36 hours to run through the waterway to the powerhouse intake in the Gilsarlón balancing reservoir. Short-term dispatch decisions influence only the level of the Gilsarlón reservoir.

There are only a few minor uses other than energy generation. The fishing association that holds the rights for fishing in the reservoir is comprised of the owners of the original fishing rights. The association annually rents out the fishing for ISK 200,000 (USD 1,650). The value of the fishing license is much lower than the value of licenses on the river. An unpaved road leads past the reservoir into the highlands, and the area around the reservoir is occasionally visited by tourists.

One consideration in the management of the reservoir is that high levels cause shoreline erosion, while low levels cause wind erosion. Water levels, shoreline erosion, sediment deposition and GHG emissions are monitored. Water levels are accessible to the public on Landsvirkjun's website, and GHG emissions are published in the company's annual Environmental Report. Occasionally, sheep are trapped on islands in the reservoirs when levels rise in the summer, and Landsvirkjun assists farmers by transporting sheep back to shore by boat (128 sheep in total in 2013 until August 22nd) or by fencing off access. Stratification of the reservoir would not be expected to be an issue given the prevailing cold climate, high winds and shallow depth.

This topic is essentially about how different considerations are balanced in reservoir management, and therefore also touches upon a number of other topics. Reservoir releases are also directly connected to the topic O-19 (Downstream Flow Regime).

18.2 Detailed Topic Evaluation

18.2.1 Assessment

Analysis against basic good practice

Scoring statement: *Ongoing or emerging reservoir management issues have been identified, and if management measures are required then monitoring is being undertaken to assess if management measures are effective.*

Reservoir management issues have been comprehensively identified. They include the optimization of generation operations based on hydrological and demand forecasts (see topic O-4), issues related to erosion and sedimentation (O-16), GHG emissions (O-3), fishing (O-9 and O-15), trapping of sheep in the summer (O-9), dam safety (see topic O-6), and downstream releases (O-19), both for normal operations and for spills. All of these issues are monitored. The only water quality parameter that has been monitored in the reservoir is temperature (O-17).

Criteria met: Yes

Analysis against proven best practice

Scoring statement: *In addition, identification of ongoing or emerging reservoir management issues takes into account both risks and opportunities.*

Landsvirkjun, the local municipalities and communities, as well as different government agencies are in close contact which will allow them to identify any additional issues that might arise. However, given the low human presence in the area and the time that has elapsed since the impoundment, it is difficult to think of any such issues. Minor modifications may be expected from the Blanda expansion project which is currently under preparation.

The monitoring of GHG emissions from the two reservoirs arose out of a decision to monitor and report on all emissions associated with Landsvirkjun's activities, as this was considered an opportunity to demonstrate the low environmental impact of the company. The emissions from the reservoirs are relatively high in comparison with Landsvirkjun's other reservoirs, because the land under the reservoirs had a higher carbon content. However, they are very low in an international comparison, and have been falling from 13,190 tons CO₂ equivalent in 2008 to 10,350 tons CO₂ equivalent in 2012. This is in line with what would be expected from aging high northern latitude reservoirs. Emissions are partly offset by carbon binding through revegetation. A full life-cycle analysis as had been done for the Kárahnjúkar project is also intended for Landsvirkjun's other projects.

The trapping of sheep on islands is monitored by Landsvirkjun operational staff, including the youth summer work program.

Criteria met: Yes

18.2.2 Management

Analysis against basic good practice

Scoring statement: *Measures are in place to manage identified issues.*

All issues listed above either have management measures which are described in more detail under other topics, or do not require specific management issues, such as GHG emissions.

No active flood management (i.e. lowering the reservoir level in anticipation of an incoming flood) is required, because the main floods arrive in a season when the Blöndulón reservoir is at a low level and because downstream flood risks are low.

If the power station had to stop operations entirely, water could be released from the Gilsarlón reservoir through the Gilsár canyon leading down to the Blanda River. There are provisions to do so to maintain the agreed minimum release of 10 m³/s below the power station, but higher releases should be avoided to limit erosion damage in the canyon. The balancing reservoir would be able to contain incoming flows for 36 hours (the time it takes for flows to stop if the Kolka dam gate is closed) if outflow remained at 10 m³/s. In winter, the release through the Kolka dam gate and the waterway should be continuous if at all possible, to avoid ice build-up and blockages.

The only issue that is managed by an organisation other than Landsvirkjun is fishing in the reservoirs and in the lakes along the waterway. This is regulated by a fishing association of which Landsvirkjun is not a member, but with which station staff is in close contact. It is not thought that fish stocks could be increased significantly through a different reservoir management regime.

Criteria met: Yes

Analysis against proven best practice

Scoring statement: *In addition, processes are in place to anticipate and respond to emerging risks and opportunities.*

Issues that appear most likely to emerge have to do with climate change, which will change inflows, water temperatures, ice conditions etc., and with changes in how the Blanda power station is operated. For example, if an interconnector with Europe were to be built, energy could be imported in exceptionally dry conditions and supply security would be less of an issue; reservoirs might then be under pressure to run lower than they are at present to maximise generation.

Landsvirkjun's monitoring of issues in the project area, its open communication with stakeholders, and its systematic approach to environmental management should enable it to anticipate and respond to any conceivable issues that might arise in reservoir management.

Criteria met: Yes

18.2.3 Conformance / Compliance

Analysis against basic good practice

Scoring statement: *Processes and objectives in place for reservoir management have been and are on track to be met with no significant non-compliances or non-conformances, and reservoir management related commitments have been or are on track to be met.*

There are no specific license conditions or public commitments regarding reservoir management. Informal commitments such as assisting farmers in managing their sheep are being carried out with no complaints. The local municipality has expressed some concerns over the present low water levels and has been informed of the forecasts and management plans.

The internal processes for managing reservoir levels based on forecasting on inflows and demand are well established. The present, exceptionally low water year is a good example for how forecasts of reservoir levels have been periodically updated and generation plans have been adapted, and how observations will influence future inflow forecasting.

Criteria met: Yes

Analysis against proven best practice

Scoring statement: *In addition, there are no non-compliances or non-conformances.*

No non-compliances or non-conformances have been identified.

Criteria met: Yes

18.2.4 Evaluation of Significant Gaps

Analysis of significant gaps against basic good practice

There are no significant gaps against basic good practice.

0 significant gaps

Analysis of significant gaps against proven best practice

There are no significant gaps against proven best practice.

0 significant gaps

18.3 Scoring Summary

After more than two decades in operation, the Blanda project reservoirs are well understood and well managed. Landsvirkjun operates the reservoirs as required for power generation without environmental or social constraints. There are a few environmental or social issues arising from the variations in reservoir levels (e.g. shoreline erosion, sheep strandings, windblown dust) which to date have been managed on an as-needs basis. There are good relationships with the other two principal users of the reservoir area, the fishing association and the sheep farmers, and Landsvirkjun has shown good faith in finding practical solutions to local issues arising. Landsvirkjun has supported relevant research on issues such as reservoir shoreline erosion and GHG emissions, which have applications beyond the Blanda project. There are no significant gaps against best practice, resulting in a score of 5.

Topic Score: 5

18.4 Relevant Evidence

Interview:	1, 7, 10, 21, 31, 34
Document:	1, 11, 15, 25-30, 33, 45, 47, 70, 73, 75-76, 82, 101, 106-107, 119, 128, 132-133, 167, 171, 180, 186
Photo:	2, 3, 4, 5, 6, 11

19 Downstream Flow Regime (O-19)

This topic addresses the flow regimes downstream of the operating hydropower facility infrastructure in relation to environmental, social and economic objectives. The intent is that issues with respect to the operating hydropower facility's downstream flow regimes are identified and addressed, and commitments with respect to downstream flow regimes are fulfilled.

19.1 Background Information

Flow regimes in the bypass reach below the Blanda dam as well as downstream of the power station changed markedly after the river was harnessed.

In the bypass reach, there is no release from the dam but some flow from small tributaries, and in most years, spills during August and September. The average flow in 1996-2009 above the confluence with the tailrace was 8 m³/s, or not including spilling flows, 5 m³/s.

Downstream of the power station tailrace, the flow of the river became less seasonal, but more variable in the short term after the project started to operate. Spring floods which used to disrupt traffic on the national road have almost ceased, and late summer floods are much smaller than the previous highest floods. While flows in the Blanda River at the Langamýri gauge 6 km below the power station ranged between approx. 20 m³/s and 550 m³/s before the hydropower project (1974-1991), they ranged between approx. 10 m³/s and 220 m³/s after the project (1991-2013), including long stretches of operating within a band of 30 m³/s to 50 m³/s. Releases from the power station take about 4.5 hours to reach the sea at Blönduós. More stable flows have led to a less active channel and reduced riverbank erosion. The sediment load has been reduced to approximately one tenth of the pre-project conditions.

19.2 Detailed Topic Evaluation

19.2.1 Assessment

Analysis against basic good practice

Scoring statement: *Ongoing or emerging issues relating to the operating hydropower facility's downstream flow regimes have been identified, and if management measures are required then monitoring is being undertaken to assess if management measures are effective.*

Downstream flow issues have been comprehensively identified. They include the optimization of generation operations based on hydrological and demand forecasts (see topic O-4), public safety (see topic O-6), issues related to erosion and sedimentation (O-16), fishing (O-9 and O-15) and flooding and floodplain use (O-9). All of these issues are monitored through formal or informal means. The only water quality parameters that have been systematically monitored in the downstream reach are temperature and turbidity (O-17).

Criteria met: Yes

Analysis against proven best practice

Scoring statement: *In addition, issues identification takes into account both risks and opportunities. In the case of a need to address downstream flow regimes, an assessment has been undertaken that includes identification of the flow ranges and variability to achieve different environmental, social and economic objectives based on field studies as well as relevant scientific and other information.*

The identification of issues has largely followed stakeholder interests and has therefore focused on salmon and to a lesser extent, other fish species. Stakeholders are positive about the effects of the project in terms of improved angling, stabilisation of the river, and reduced flooding, and given these benefits, appear to accept

that operational requirements may sometimes override other flow considerations. While there has not been a formal assessment of alternative flow regimes in terms of their ability to achieve non-generation objectives, there are many years of experience and communication with knowledgeable stakeholders as well as extensive research conducted by the Institute of Freshwater Fisheries, which have not resulted in specific suggestions.

Criteria met: Yes

19.2.2 Management

Analysis against basic good practice

Scoring statement: *In the case of a need to address downstream flow regimes, measures are in place to address identified downstream flow issues; and where formal commitments have been made, these are publicly disclosed.*

The lack of environmental flow releases in the bypass reach below the Blanda dam was accepted by stakeholders before the power station went into operation. Below the power station, originally there was also thought to be no need for a minimum release. However, two years after commissioning, in discussions between the Blanda and Svartá Angling Association, the IFF and Landsvirkjun, a minimum release of 10 m³/s was agreed. This can be maintained through releases from the intake reservoir if the power station goes out of operation. It has also been agreed to minimise fluctuations in generation in the period from June 1st to September 20th every year, to protect spawning and sport fishing in the river, in particular for salmon. Ramp-up and ramp-down rates should be limited to 2 MW per minute, or 25 minutes total for a 50 MW machine. These agreements have been reflected in Landsvirkjun's operating manuals since 1998 and are known to local stakeholders.

Criteria met: Yes

Analysis against proven best practice

Scoring statement: *In addition, processes are in place to anticipate and respond to emerging risks and opportunities. In the case of a need to address downstream flow regimes, in addition commitments are made in relation to downstream flow regimes that include the flow objectives; the magnitude, range and variability of the flow regimes; the locations at which flows will be verified; and ongoing monitoring.*

The rules agreed with local stakeholders are based on their detailed empirical knowledge of the Blanda River, the response of fish to different flow conditions, and the best conditions for angling. They do limit operational flexibility of the power station and therefore may have a small cost to Landsvirkjun in terms of foregone generation. In order to evaluate whether there are any opportunities to further improve fish habitat without significant cost to Landsvirkjun, or any opportunities to improve generation flexibility without significant cost to fisheries, collaborative research with angling associations on the costs and benefits of different flow regimes would be required. Such an evaluation could result in downstream flow arrangements which achieve a better balance, possibly even better results for both parties, and could also take emerging developments such as changed runoff under climate change into account. Given the generally positive outcomes of the present flow regime, this is however not urgent and not considered a significant gap.

Criteria met: Yes

19.2.3 Stakeholder Engagement

Analysis against basic good practice

Stakeholder engagement is not assessed at level 3.

Analysis against proven best practice

Scoring statement: *In the case of a need to address downstream flow regimes, in addition the assessment and management process for downstream flow regimes has involved appropriately timed and two-way engagement with directly affected stakeholders, and ongoing processes are in place for stakeholders to raise issues with downstream flow regimes and get feedback.*

The present flows rules are based on stakeholder discussions, and there is an open communications process for the rules to be reconsidered if necessary. While there is no formal forum or institution for basin management such as a multi-stakeholder committee or authority, this appears not necessary at present to resolve issues around downstream flows, which are discussed in annual or more frequent meetings with the Angling Association. In the future, with the introduction of the European Water Framework Directive, the role of formal engagement processes may increase. However, no new constraints on Blanda's operations are expected.

Flows are well documented and data on reservoir levels, spills and releases from the power station are easily accessible to downstream river users on Landsvirkjun's website. When late summers spills are about to start, stakeholders are informed by email. In exceptional cases, when a rapid ramp-up has become necessary, directly affected stakeholders have been informed directly via text message. No need to evaluate or reconsider downstream flow arrangements has been expressed by stakeholders.

Criteria met: Yes

19.2.4 Conformance / Compliance

Analysis against basic good practice

Scoring statement: *In the case of a need to address downstream flow regimes, processes and objectives in place to manage downstream flows have been and are on track to be met with no significant non-compliances or non-conformances, and downstream flow related commitments have been or are on track to be met.*

Downstream flows are not regulated under the license conditions or legal arrangements, but requirements regarding downstream flows are listed in the internal power station operating rules. The minimum release commitment of 10 m³/s has always been respected. The commitment to delay spilling – which effectively ends the summer angling season - as long as possible has been respected as far as hydrologically possible. The commitment to limit ramp-up and down-rates has been respected as far as operationally possible. For example, there was one operational emergency in July 2013 where the power station had to quickly increase generation to compensate for an unplanned outage elsewhere in the system. Stakeholders accept these practical limitations to commitments.

Criteria met: Yes

Analysis against proven best practice

Scoring statement: *In the case of a need to address downstream flow regimes, in addition there are no non-compliances or non-conformances.*

No complaints or comments have been recorded that would suggest that Landsvirkjun did not comply with its downstream flow commitments.

Criteria met: Yes

19.2.5 Outcomes

Analysis against basic good practice

Scoring statement: *In the case of a need to address downstream flow regimes and commitments to downstream flow regimes have been made, these take into account environmental, social and economic objectives, and where relevant, agreed transboundary objectives.*

Landsvirkjun’s commitments address environmental and social objectives, in particular the highly valuable - both in terms of recreation and in terms of financial income - summer salmon fishery. The commercial objectives of Landsvirkjun are realised within the flow constraints that the company has accepted.

Criteria met: Yes

Analysis against proven best practice

Scoring statement: *In the case of a need to address downstream flow regimes and commitments to downstream flow regimes have been made, in addition these represent an optimal fit amongst environmental, social and economic objectives within practical constraints of the present circumstances.*

It is likely that the current flow arrangements represent close to an optimal fit between different objectives. All stakeholders, including Landsvirkjun, appear to have made positive experiences with them, and none appears interested in revisiting them. However, as said above, a systematic evaluation of the remaining optimisation potential may still reveal a better understanding of the rationale behind the flow arrangements, and identify some possible adjustments. The lack of such an evaluation linking flow releases with fishing and other downstream issues is seen as a non-significant gap.

Criteria met: Yes

19.2.6 Evaluation of Significant Gaps

Analysis of significant gaps against basic good practice

There are no significant gaps against basic good practice.

0 significant gaps

Analysis of significant gaps against proven best practice

There are no significant gaps against proven best practice.

0 significant gaps

19.3 Scoring Summary

The Blanda hydropower project is an example for a project which has actually improved the flow regime compared to pre-project conditions, not just from a social and economic point of view, but even from the point of view of key environmental considerations. The current flow regime originated with a purely generation-driven release plan which was then modified in discussions with local stakeholders to improve the conditions for fish and for angling. Some ‘finetuning’ of the flow arrangements may be useful over time. There are no significant gaps against best practice, resulting in a score of 5.

Topic Score: 5

19.4 Relevant Evidence

Interview:	1, 7, 10, 14, 23
Document:	1, 5, 11, 15, 30, 34, 36, 41, 45, 49, 68, 70, 73, 76-77, 81, 93, 119, 134, 168, 184-186
Photo:	4, 5, 6, 8, 13, 15, 16, 18

Appendix A: Written Support of the Project Operator



Háaleitisbraut 68
103 Reykjavík - Iceland
landsvirkjun.is

landsvirkjun@lv.is
Sími/Tel: +354 515 90 00
Fax: +354 515 90 07

IHA – International Hydropower Association
Central Office
Nine Sutton Court Road, Sutton
London
United Kingdom SM1 4SZ
Attn: Douglas Smith

Reykjavík, 7th November 2013
Our ref.: 08.03.01

Subject: Assessment of the Blanda Power Station using the operation tool of the Hydropower Sustainability Assessment Protocol

Landsvirkjun has contributed to the development of the Hydropower Sustainability Assessment Protocol (HSAP) as one of the first Sustainability Partners of IHA.

In 2012 Landsvirkjun conducted an assessment for the Hvammur Hydropower Project using the preparation tool of the HSAP. In 2013 Landsvirkjun is pleased to continue application of the Protocol, now using the assessment tool for the operation of the Blanda Power Station.

Landsvirkjun is committed to using the Protocol. Landsvirkjun has been able to improve its procedures and learn valuable lessons from applications of the Protocol. Landsvirkjun hopes that its participation will increase the adoption of the Protocol around the world.

We provide our full support and coordination to the Assessment Team conducting this assessment of the Blanda Power Station.

We look forward to receive your report.

Yours Sincerely


Óli Grétar Blöndal Sveinsson
Executive Vice President

Appendix B: Verbal Evidence

Ref	Interviewee/s, Position	Organization	Date	Location	Lead Interviewer
1	Guðmundur R. Stefánsson, Power Plant Manager (with Bjarni Maronsson and Sigurður G. Sigurðsson)	Landsvirkjun (Energy Department)	10.9.	Blanda Power Station	Joerg Hartmann
2	Guðmundur R. Stefánsson, Power Plant Manager (with Sigurður G. Sigurðsson)	Landsvirkjun (Energy Department)	11.9.	Blanda Power Station	Helen Locher
3	Guðmundur R. Stefánsson, Power Plant Manager (with Sigurður G. Sigurðsson)	Landsvirkjun (Energy Department)	11.9.	Blanda Power Station	Simon Howard
4	Árni Claessen, Financial Expert (with Kristján Gunnarsson and Sigurður G. Sigurðsson)	KPMG	9.9.	Landsvirkjun Head Office	Helen Locher
5	Þóra Sverrisdóttir, Chairwoman of the Council	Húnavatnshreppur municipality	11.9.	Private Residence	Simon Howard, Joerg Hartmann, Helen Locher
6	Jens P. Jensen, Director of the Council (with Jón Gíslason, Birgitta Halldórsdóttir, Guðrún Guðmundsdóttir)	Húnavatnshreppur municipality	10.9.	Blanda Power Station	Simon Howard, Helen Locher, Joerg Hartmann
7	Sigurður Ingi Guðmundsson, Chairman, and Jón Stefánsson	Blanda and Svartá angling club; Fridmundur angling club	10.9.	Blanda Power Station	Joerg Hartmann, Simon Howard
8	Einar Mathiesen, Executive Vice President (with Sigurður G. Sigurðsson (Manager of Operation), Guðmundur R. Stefánsson)	Landsvirkjun (Energy Department)	9.9.	Landsvirkjun Head Office	Helen Locher, Simon Howard
9	Kristján Gunnarsson, Manager of Treasury and Financial Analysis (with Árni Claessen and Sigurður G. Sigurðsson)	Landsvirkjun (Finance Department)	9.9.	Landsvirkjun Head Office	Helen Locher
10	Eggert Guðjónsson, Manager of Generation and Trading (with Magnús Sigurðsson)	Landsvirkjun (Energy Department)	12.9.	Video Conference	Joerg Hartmann
11	Sigurður G. Sigurðsson (with Ragnheiður Ólafsdóttir and Guðmundur R. Stefánsson)	Landsvirkjun (CEO office)	9.9.	Landsvirkjun Head Office	Helen Locher, Simon Howard
12	Magnús Þ. Gylfason, Head of Corporate Communication, and Ragna Sara Jónsdóttir, Director, Corporate Responsibility (with Ragnheiður Ólafsdóttir and Guðmundur R. Stefánsson)	Landsvirkjun	9.9.	Landsvirkjun Head Office	Simon Howard

13	Arnar Þór Sævarsson, Mayor of Blönduós	Blönduós Municipality	12.9.	Mayor's Office	Joerg Hartmann, Helen Locher, Simon Howard
14	Ingvi Már Pálsson and Kristinn Einarsson	Ministry of Industries and Innovation, and Orkustofnun	12.9.	Video Conference	Helen Locher, Joerg Hartmann
15	Guðrún Guðmundsdóttir and Birgitta Halldórsdóttir	Guðlaugsstaðir and Syðri-Langamýri	10.9.	Blanda Power Station	Helen Locher
16	Halldór Arnar Guðmundsson, Divisional Manager Wages and Education, and Ísleifur Tómasson	The Icelandic Union of Marine Engineers and Metal Technicians, The Union of Icelandic Electrical Workers	12.9.	Video Conference	Helen Locher
17	Sigurjón Þórðarson, Director	Health Unit of Northwest Iceland	11.9.	Blanda Power Station	Helen Locher, Joerg Hartmann, Simon Howard
18	Gísli Árnason	Association of Nature Conservation in North Iceland	11.9.	Video Conference	Simon Howard
19	Ólafur A. Jónsson, Director (with Björn Stefánsson, Hákon Aðalsteinsson)	Environmental Agency of Iceland	9.9.	Landsvirkjun Head Office	Simon Howard
20	Jórunn Harðardóttir, Managing Director (with Úlfar Linnet)	Iceland Meteorological Office	9.9.	Landsvirkjun Head Office	Joerg Hartmann
21	Úlfar Linnet, Manager of Resources Department	Landsvirkjun	9.9.	Landsvirkjun Head Office	Joerg Hartmann
22	Hákon Aðalsteinsson, Project Manager, Helgi Bjarnason, Project Manager, Sveinn Runólfsson, Guðmundur Stefánsson	Landsvirkjun, Soil Conservation Service	9.9.	Landsvirkjun Head Office	Joerg Hartmann, Helen Locher
23	Sigurður Guðjónsson, CEO (with Sveinn K. Valdimarsson, Ingi Rúnar Jónsson)	Institute of Freshwater Fisheries	9.9.	Landsvirkjun Head Office	Joerg Hartmann, Simon Howard
24	Gísli Guðmundsson, Power Plant Operator	Landsvirkjun (Energy Department)	11.9.	Blanda Power Station	Helen Locher
25	Valgeir R. Hauksson, Inspector (with Sigurgeir Stefánsson)	Administration of Occupational Safety and Health	10.9.	Blanda Power Station	Helen Locher
26	Dóra Hjálmarisdóttir, Security Specialist (with Einar Mathiesen, Sigurður G. Sigurðsson, Guðmundur R. Stefánsson)	Verkís Consulting	9.9.	Landsvirkjun Head Office	Helen Locher
27	Katharine A. Schneider, Director	Blönduós Academic Center	11.9.	Blanda Power Station	Simon Howard

28	Sturla J. Hreinsson, Staff Manager	Landsvirkjun (Human Resources Department)	9.9.	Landsvirkjun Head Office	Helen Locher
29	Ásgerður Pálsdóttir, Chairperson (with Hafdís Vilhjálmsdóttir)	Samstaða Union	12.9.	Blanda Power Station	Helen Locher
30	Fjöltnir Guðmundsson, Doctor	Hospital of Blönduós	10.9.	Blanda Power Station	Helen Locher
31	Borgþór Magnússon, Director of Ecology Department (with Sveinn K. Valdimarsson)	Icelandic Institute of Natural History	12.9.	Telephone Conference	Joerg Hartmann, Simon Howard
32	Bjarni Jakob Gíslason, Expert	Landsvirkjun (Procurement)	12.9.	Video Conference	Helen Locher
33	Bjarni Maronsson, Regional Representative (with Sveinn K. Valdimarsson, Helgi Bjarnason, Guðmundur R. Stefánsson, Sigurður G. Sigurðsson)	Soil Conservation Service of Iceland	10.9.	Blanda Power Station	Joerg Hartmann, Simon Howard, Helen Locher
34	Björn Grétar Friðriksson, Chairman, and Jakob Sigurjónsson, Vice Chairman; Jóhann Guðmundsson, Chairman; Jón Gíslason, Chairman	Grazing Association Eyvindastaðaheiðar; Auðkúluheiðar Foundation; Grazing Association Auðkúluheiðar	10.9.	Blanda Power Station	Simon Howard
35	Guðmundur R. Stefánsson, Power Plant Manager	Landsvirkjun (Energy Department)	12.9	Blanda Power Station	Helen Locher
36	Ragnheiður Ólafsdóttir, Environmental Manager	Landsvirkjun	12.9	Blanda Power Station	Helen Locher

Appendix C: Documentary Evidence

Ref	Author / Organisation	Title	Date	Language	Description / Notes / Weblink
1	Landsvirkjun	List of meetings with local stakeholders	03.06.2013	Icelandic	
2	Landsvirkjun	Information about Landsvirkjun	n.d.	English	
3	Landsvirkjun	CEO's Report on the Blanda Power Contract from 1982 and 1988	n.d.	Icelandic	
4	Húnavatns-hreppur Municipality	Municipality Plan for Húnavatnshreppur from 2010 to 2022	25.05.2012	Icelandic	
5	Icelandic Meteorological Office	website	n.d.	Icelandic/English	http://en.vedur.is/hydrology/hydrology/
6	National Energy Agency	OS-2007-011 Effect of climate change on hydrology and hydro-resources in Iceland	2007	English	http://www.os.is/gogn/Skyrslur/OS-2007/OS-2007-011.pdf
7	Landsvirkjun	Overview of glacier monitoring data	2013	Icelandic	
8	Vottun hf	Quality System Certificate according - ISO 9001	04.10.2012	Icelandic/English	
9	The Consumer Agency	Electrical Safety Management Certificate	09.11.2007	English	
10	Brunavarnir A-Hún/Brunamálstofnun	Safety Control Certificate	23.12.2004	Icelandic	
11	Heilbrigðisefirlit Norðulands Vestra	Blanda Operation Permit from 18.04.2011-18.04.2023	2011	Icelandic/English	
12	TÜV SÜD	Certificate of Production of Renewable Energy by Blanda Power Station	21.12.2009	English	
13	Jórunn Harðardóttir	Recent development of sediment monitoring of glacial rivers in Iceland	n.d.	English	http://www.commtec.com/Library/TechnicalPapers/Various/p18Hardardottir.pdf
14	Vottun hf	Environmental Management System Certificate - ISO 14001	04.10.2012	Icelandic/English	
15	Landsvirkjun	Landsvirkjun's Environmental Reports	various years	English	http://www.landsvirkjun.com/societyenvironment/environment
16	Landsvirkjun	Report on the company's Social Responsibility	2009	Icelandic	http://www.landsvirkjun.com/Media/Landsvirkjun_soci

					al_responsibility.pdf
17	Landsvirkjun	Land Reclamation and Forestry by Landsvirkjun. LV-2008-032	28.02.2008	Icelandic	
19	Landsvirkjun	The Blanda Power Station. Environmental Impact Audit. LV-2004-099	30.06.2004	Icelandic	http://www.rammaaetlun.is/media/lokad-svaedi/faghopur-1/gogn/BLONDUVIRKJUN_U TTEKT_UMH.PDF
20	Det Norske Veritas	Det Norske Veritas Loss Control Management Certificate	14.11.1998	English	
21	Löggildingarst ofa Rafmagnsöryggisdeild	Safety Control Certificate	23.12.2004	Icelandic	
22	Vottun hf	Occupational Health and Safety Management System Certificate - ISO 18001	04.10.2012	Icelandic/English	
23	Landsvirkjun	Contract between Landsvirkjun and Brimnesskógar	04.06.2013	Icelandic	
24	Skagafjörður Heritage Museum	Documentation of Cultural Heritage on the waterway of Blanda Power Station. 2012/131	2012	Icelandic	
25	Landsvirkjun	Ecological Restoration of Landsvirkjun and environmental benefits in areas of power production. LV-2009-109	14.12.2009	Icelandic	http://www.reno.is/ http://pdfvef.oddli.is/landgr aedslan/vistheimt_a_islandi/#/62/
26	Icelandic Institute of Natural History	Monitoring of groundwater, vegetation and shoreline erosion at Blanda Reservoir. Final Report 1993-2009. NÍ-09017	2009	Icelandic	
27	Vilmundar-dottir, O.K. et al.	Shoreline erosion and aeolian deposition along a recently formed hydro-electric reservoir, Blöndulón, Iceland	2010	English	http://www.sciencedirect.com/science/article/pii/S0169555X09003419
29	Landsvirkjun/Institute of Freshwater Fisheries	Comparison of condition of fish stocks in lakes at Auðkúluheiði. LV-2010-126	2010	Icelandic	
30	Landsvirkjun	Hydrological measurements of Landsvirkjun for the water year 2010/2011. LV-2012-043	2012	Icelandic	
31	Icelandic Institute of Natural History	Blanda Hydropower Projects. Vegetation Map. NÍ-12007	2012	Icelandic	

32	Landsvirkjun	Acceleration measurements at Blanda Dam. Memo from 03.11.2010	2010	Icelandic	
33	Landsvirkjun	Blöndulón reservoir capacity estimation by echo sounding in 2012. Memo	01.10.2012	Icelandic/ English	
34	Institute of Freshwater Fisheries	Blanda river system 2012. Migrating fish and catch statistics. VMST/13035	2013	Icelandic	
35	Ingi R. Jonsson, Thorolfur Antonsson and Sigurður Guðjónsson, Institute of Freshwater Fisheries	Relation between stock size and catch data of Atlantic Salmon (<i>Salmo salar</i>) and Arctic charr (<i>Salvelinus alpinus</i>)	2008	English	
36	Landsvirkjun	Summary of catch data in Blanda river system prior to and after Hydroelectric Development. Memo from 14.08.2013	2013	Icelandic	
37	Verkís	Changes in glacial run off from Hofsjökull glacier to Blanda river. Memo from 16.03.2010	2010	Icelandic	
38	Landsvirkjun	Blanda Dam Monitoring 2010. LV-2011-020	2011	Icelandic	
39	Landsvirkjun	Blönduvirkjun. Flood estimation due to dam breakage. VST 1989	1989	Icelandic	
40	Landsvirkjun	Landsvirkjun's Strategy on Corporate Social Responsibility	n.d.		http://www.landsvirkjun.com/media/news/Strategy-on-Corporate-Social-Responsibility.pdf
41	Sigurður Guðjónsson, Institute of Freshwater Fisheries	Migration pattern of salmonids in river Blanda, N-Iceland, in relation to the water temperature and turbidity	n.d.	English	
42	Vatnaskil	Blanda and Vestari-Jökulsá. Surface water and groundwater model	1999	Icelandic	
43	VBB VIAK AB	LCA of a hydropower station - Blanda, Landsvirkjun, Iceland	23.05.2001	Swedish	
44	Landsvirkjun	Blanda Emergency preparation plan due to dam breakage	n.d.	Icelandic	
45	Landsvirkjun	The Blanda Power Station. Environmental Impact Audit. LV-2004-099 (english translation)	2004	English	

46	Institute of Freshwater Fisheries	Research on aquatic life and food of salmonids in Blanda River System	1989	Icelandic	
47	Landsvirkjun	Summary of erosion inspection in Blanda	n.d.	Icelandic/ English	
48	Landsvirkjun	Blanda stakeholder communication plan	n.d.	Icelandic/ English	
49	Health Unit of Northwest Iceland	Blanda Operation Permit from 18.04.2011-18.04.2023	2011	Icelandic	
50	Landsvirkjun	Blanda maintenance program	n.d.	Icelandic	
51	Landsvirkjun	Report on the efficiency and operation range of machinery 2011	2012	Icelandic	
52	Landsvirkjun	Availability of machinery compared to running time 2012	2013	Icelandic	
53	Landsvirkjun	Availability of machinery compared to other power stations 2012	2013	Icelandic	
54	Landsvirkjun	Availability of machinery compared to working period	n.d.	Icelandic	
55	Landsvirkjun	Landsvirkjun emergency management reports	various years	Icelandic/ English	
56	Landsvirkjun	Blanda dam surveillance report 2012	2013	Icelandic	
57	Einar Kolbeinsson, University of Akureyri	Social Impacts of Blanda Power Station (Report)	2006	Icelandic/ English	
58	Landsvirkjun	Annual plan for processing unit surveillance	n.d.	Icelandic	
59	Landsvirkjun	Internal audit plan for Blanda 2012	2012	Icelandic	
60	Iceland Meteorological Office	Sediment monitoring reports for Landsvirkjun	various years	Icelandic	
61	Landsvirkjun	Blanda procurement presentation 2012	2012	Icelandic	
62	Landsvirkjun	Communications with external stakeholders 2013	2013	Icelandic	
63	Landsvirkjun	Blanda HEP contract documents	1988	English	
64	Landsvirkjun	Land reclamation in Auðkúluheiði and Eyvindarstaðaheiði	n.d.	Icelandic	
65	National Energy Authority	Calculation of water rights sharing ratio for Blanda	n.d.	Icelandic	
66	Örn D. Jónsson	Blanda power station and the economy of	n.d.	Icelandic	

		Northwestern Iceland			
67	RALA	Pre-project analysis of vegetation research in the region	n.d.	Icelandic	
68	VST Engineering Consultancy	Flow model for the waterway of Blanda power station	1985	Icelandic	
69	Landsnet	Landsnet performance reports	various years	English	http://www.landsnet.is/uploads/1115.pdf
70	Landsvirkjun	Summary of fishing in Blanda River System before and after it was dammed. Memo	14.08.2013	English	
71	Landsvirkjun	Internal audit reports	21.08.2012	English	
72	Landsvirkjun	Blanda business overview	n.d.	Icelandic/ English	
73	Landsvirkjun	Overview of inflow data and more	21.08.2012	English	
74	Landsvirkjun	Hydropower in Iceland - Impacts and adaption in future climate	2011	English	http://ccsl.iccip.net/TN2011502.pdf
75	Landsvirkjun	Longterm hydro and geothermal reservoir operation	n.d.	English	
76	Landsvirkjun	Data from Landsvirkjun regarding flow measurements in Blanda	n.d.	English	
77	Landsvirkjun	Overview of the changes in flow in Blanda	n.d.	Icelandic	
78	Capacent Gallup	Landsvirkjun public image survey	n.d.	Icelandic/ English	
79	Landsvirkjun	Memorandum on the efficiency of Landsvirkjun power stations	30.3.2013	Icelandic	
80	Landsvirkjun	Memorandum - Processing plan for 2013	21.09.2012	Icelandic	
81	Landsvirkjun	Production plan weekly overview	various weeks	Icelandic/ English	
82	Landsvirkjun	Reservoir status	12.8.2013	English	
83	Landsvirkjun	Blanda Power Station - overview of social projects and commitments to project benefits	n.d.	English	
83	Landsvirkjun	Contract with Vegagerðin	n.d.	Icelandic	
84	Landsvirkjun	Contract with municipalities west of Blanda	n.d.	Icelandic	
85	Administration of Occupational Safety and Health	Audit report from the last inspection	n.d.	Icelandic/ English	

86	Administration of Occupational Safety and Health	Occupational safety seal of approval	2008	Icelandic	
87	Administration of Occupational Safety and Health	Audit from AOSH on the risk assessment process	n.d.	Icelandic	
88	The Ministry of Welfare	Health facilities at Sauðárkrúkur and Blönduós - An assessment of operation	2010	Icelandic	
89	BCG	Health Care System reform and short term savings opportunities. Iceland Health Care System project	2011	English	
90	Landsnet	Disturbances in Landsvirkjun's machinery 2000-2013	2013	Icelandic	
91	Jórunn Harðardóttir, Iceland Meteorological Office	Additional information and references regarding O-4 from Jórunn Harðardóttir	2013	Icelandic/English	
92	Jórunn Harðardóttir, Iceland Meteorological Office	Additional information and references regarding O-16 from Jórunn Harðardóttir	2013	Icelandic/English	
93	Jórunn Harðardóttir, Iceland Meteorological Office	Additional information and references regarding O-19 from Jórunn Harðardóttir	2013	Icelandic/English	
94	Eydís Eiríksdóttir	Blanda chemical composition	n.d.	Icelandic	sample data
95	Sigurður Reynir Gíslason et.al	Chemical and mechanical erosion rates in Iceland as deduced from river dissolved and solid material	2008	English	http://www.ajsonline.org/content/308/5/679.short
96	Landsvirkjun	O-15 summary by Hákon Aðalsteinsson	2013	English	
97	Landsvirkjun	Claims with regard to the boundaries of public land in the northwest of Iceland	n.d.	English	
98	Landsvirkjun	List of Blanda Power Contracts	n.d.	English	
99	Verkís	Bird studies at Auðkúluheiði	n.d.	Icelandic	
100	Landsvirkjun	Landsvirkjun communication plan	n.d.	English	
101	Landsvirkjun	Overview of sheep	2013	Icelandic	

		surveillance and herding at the reservoir			
102	Landsvirkjun	Landsvirkjun emergency management training - Blanda dam failure	n.d.	Icelandic	
103	Landsvirkjun	Suspended sediment load after the installation of the power plant	Dec. 2011	Icelandic	
104	Landsvirkjun	Environmental and social issues - ongoing	2013	English	
105	Landsvirkjun	Environmental and social issues - not ongoing	2013	English	
106	Orkustofnun	Flora and fauna in lakes in Auðkúluheiði	n.d.	Icelandic	
107	University of Iceland	Blanda reservoir - Environmental changes. Coastal and vegetational erosion. MSc. Thesis	2009	Icelandic/ English	http://www.ni.is/stofnunin/starfsmenn/ritlisti/nr/377
108	Landsvirkjun	Landsvirkjuns analysis on UN Global Compact	n.d.	Icelandic	
109	Landsvirkjun	Summary by Ragna Sara on governance	2013	English	
110	Administration of Occupational Safety and Health	Checklist from the inspection	n.d.	Icelandic	
111	Landsvirkjun	Changes in laws and regulations 04.01.2013-01.07.2013	2013	Icelandic	
112	Landsvirkjun	Changes in laws and regulations 05.07.2012-04.01.2013	2013	Icelandic	
113	Landsvirkjun	Contract regarding staff health inspections	n.d.	Icelandic	
114	Sandra Dögg Arnardóttir, University of Akureyri	Significant Erosion areas in East-Iceland - B.Sc. Thesis	2013	Icelandic/ English	
115	Landsvirkjun	Description of the Herðubreið project	n.d.	English	
116	Landsvirkjun	Founding of the Blönduós Academic Center - meeting minute	29.2.2012	Icelandic	
117	Landsvirkjun	Methodology and details regarding stakeholder analysis and communication plan	2013	English	
118	Landsvirkjun	Press releases and media reports and communications	various	Icelandic	http://www.landsvirkjun.com/company/mediacentre

119	Landsvirkjun	Example of e-mail communications with the municipality on reservoir management	July 2013	Icelandic	
120	Landsvirkjun	Production plan weekly overview - Assessment week	2013	Icelandic	
121	Landsnet	Part of Landsnet's transmission system plan	n.d.	Icelandic	
122	Vottun hf	Audit report from Vottun regarding a maintenance audit in Blanda 2012, ISO 9001, 14001 and OHSAS 18001	n.d.	Icelandic	
123	Húnavatnshreppur Municipality	Húnavatnshreppur municipality board meeting minute - Meeting held in Blanda	2.5.2013	Icelandic	http://www.hunavatnshreppur.is/static/files/hreppsnefnd%20133%20fundur%2002%20%20mai%202013.pdf
124	Ungmennasamband A-Húnavetninga	Húnavaka 2004 and 2005	various years	Icelandic	
125	Ungmennasamband A-Húnavetninga	News on Blanda from Húnavaka 2012	2012	Icelandic	
126	ISOR	Oxygen measurements in heated consumption water in Blanda power station	13.12.2006	Icelandic	
127	EFLA	LCA memo in English from EFLA	n.d.	English	
128	Landsvirkjun	Outlook for the supply of Blanda reservoir	2.7.2013	Icelandic	
129	Landsvirkjun	Laws and regulations regarding environmental and safety aspects	various	Icelandic	http://lagagrunnur.vso.is/
130	Landsvirkjun	The Landsvirkjun board rules of procedure	n.d.	Icelandic	http://www.landsvirkjun.is/media/PDF/starfsreglur_stjornar_nov2010.pdf
131	Landsvirkjun	Landsvirkjun external website	n.d.	Icelandic/ English	www.landsvirkjun.is
132	Landsvirkjun	Website with monitoring of reservoir surface altitude	n.d.	Icelandic	http://www.landsvirkjun.is/Rannsoknirogthroun/Voktun/Skodavoktun/28
133	Landsvirkjun	Website with overflow monitoring of the reservoir	n.d.	Icelandic	http://www.landsvirkjun.is/Rannsoknirogthroun/Voktun/Skodavoktun/464
134	Landsvirkjun	Website with flow monitoring downstream of the power plant	n.d.	Icelandic	http://www.landsvirkjun.is/Rannsoknirogthroun/Voktun/Skodavoktun/803
135	Tómas Jóhannesson et.al.	Effects of climate change on hydrology and hydro-resources in Iceland	2007	English	http://www.raunvis.hi.is/~sg/CE_report.pdf
136	Icelandic Meteorological	The Climate and Energy	n.d.	English	http://en.vedur.is/ces

	Office	Systems Project website			
137	Civil Protection Unit	Civil Protection and Emergency Management in Iceland	n.d.	English	http://www.almannavarnir.is/displayer.asp?cat_id=133
138	Landsvirkjun	Landsvirkjun's Annual Reports	various years	Icelandic/English	http://www.landsvirkjun.is/Fjarmal/Arsskyrslur/
139	Northwest.is	Information on Blanda Power Station on www.northwest.is	n.d.	English	http://www.northwest.is/1/blonduvirkjun.asp
140	Landsvirkjun	Requirements for contractors and service providers	n.d.	Icelandic	http://www.landsvirkjun.is/media/PDF/Landsvirkjun_Kr ofur og tilmaeli_baeklingur_Vefur_OK.PDF
141	ASI	Confirmation that Iceland is an active member of the International Labour Organization	n.d.	Icelandic	http://asi.is/desktopdefault.aspx/tabid-94/149_read-181/
142	Statistics Iceland	Information on the Icelandic Health Care System from the Statistics Iceland	n.d.	English	http://www.staice.is/Statistics/Health,-social-affairs-and-justi
143	Ministry of Welfare	Information on the Icelandic Health Care System from the Welfare Ministry	n.d.	Icelandic	http://www.velferdarraduneyti.is/heilb_tolfraedi/
144	Landgræðslan	A memorandum on soil erosion and reclamation problems in Iceland	1953	English	http://land.is/images/pdf-documents/baeklingar-timarit/A_memorandum.pdf
145	Landgræðslan	Að lesa landið	n.d.	Icelandic	http://land.is/images/pdf-documents/baekur/Ad_lesa_landid.pdf
146	Landgræðslan	Revegetation and landcare in Iceland	n.d.	English	http://land.is/images/pdf-documents/baeklingar-timarit/revegetation-and-landcare%20in-iceland.pdf
147	Landgræðslan	Ecological Restoration in Iceland (Blanda area on pages 60-63 and 90-93)	2009	English	http://land.is/images/pdf-documents/baekur/vistheimt-a-islandi.pdf
148	Environmental Agency of Iceland	Draft report for water quality in Iceland according to the EU Water Framework Directive	2012	Icelandic	http://ust.is/library/Skrar/Atvinnulif/Haf-og-vatn/Vatnatilskipun/Dr%C3%B6g%20a%C3%B0%20st%C3%B6g%C3%B0usk%C3%BDslu%20fyrir%20vatnasv%C3%A6%C3%B0i%20%C3%8Dslands%2007-12-2012-%C3%8D%20kynningu.pdf
149	Landsvirkjun	Ongoing revision of the estimation of catastrophic floods	n.d.	Icelandic	
150	Landsnet	Landsnet annual reports	various years	Icelandic / English	http://www.landsnet.is/english/aboutlandsnet/infocentre/publishedmaterials/
151	Landsvirkjun	Karahnjúkar dust monitoring	n.d.	Icelandic	http://www.landsvirkjun.is/

					rannsoknirogthroun/voktun/afokvidhalslon
152	Austurbru	Website of Sustainability Initiative in Eastern Iceland	n.d.	English	http://en.sjalbbaerni.is/
153	Steinsholt	Memorandum - Landforms linked to constructions in Blanda project areas	n.d.	English	
154	Landsvirkjun	Examples of risks from risk category	2013	English	
155	Landsvirkjun	Landsvirkjun Risk Appetite and Tolerance	n.d.	English	
156	Landsvirkjun	Landsvirkjun Risk Management Policy	n.d.	English	
157	Landsvirkjun	Risk Factors	n.d.	English	
158	Landsvirkjun	Risk management guidelines	n.d.	English	
159	Landsvirkjun	Blanda reports in LV Library	various years	Icelandic/English	
160	Landsvirkjun	Tender documents for Búðarháls	n.d.	English	
161	EU	Directive coordinating the procurement procedures of entities operating in the water, energy, transport and postal services sectors	2004	English	http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=OJ:L:2004:134:0001:0113:en:PDF
162	Althingi	Public sector procurement laws	various	English	http://www.althingi.is/lagas/137/1993065.html
163	FIDIC	FIDIC procurement procedures guide	n.d.	English	http://fidic.org/sites/default/files/procur-promo-doc05-3.pdf
164	FIDIC	FIDIC procurement procedures	n.d.	English	http://fidic.org/node/149
165	Landsvirkjun	PM Landscape and planning	n.d.	English	
166	Húnavallaskóli	Thank you note from Húnavallaskóli 2011-2012 regarding a grant	n.d.	Icelandic	
167	Landsvirkjun	Temperature measurements in Blanda reservoir	2013	Icelandic/English	data 1999-2009
168	Landsvirkjun	Answers from Sveinn Kári to questions in O-16 and O-19	2013	English	
171	Landsvirkjun	Overview of ongoing monitoring at Blanda reservoir	2013	English	
172	Landsvirkjun	Refined list of direct and incidental project benefits from the O-3 slide	2013	English	
173	Landsvirkjun	Asset management	n.d.	English	
174	Landsvirkjun	Blanda information signs	n.d.	English	
175	Landsvirkjun	Blanda sign placements	n.d.	English	
176	Landsvirkjun	Signs in Landsvirkjun road system	n.d.	English	

177	Landsvirkjun	Sign example	n.d.	English	
178	Landsvirkjun	Sign sizes	n.d.	Icelandic	
179	Landsvirkjun	Philanthropic contributions to health measures	n.d.	Icelandic	
180	Landsvirkjun	Press Release: Háslón Reservoir fills up	30.08.2013	Icelandic/ English	http://www.landsvirkjun.com/company/mediacentre/news/news-read/halslon-reservoir-fills-up
181	Landsvirkjun	The status of Landsvirkjun's water supply	13.8.2013	English	presentation
182	International Monetary Fund	Iceland: Advancing Tax Reform and the Taxation of Natural Resources	2011	English	http://www.imf.org/external/pubs/ft/scr/2011/cr11138.pdf
183	Institute of Economic Studies, University of Iceland	The effect of power-intensive industrial developments on the Icelandic economy	2009	English	http://www.institutenorth.org/assets/images/uploads/files/HHI-skyrslan-a-ensku.pdf
184	Landsvirkjun	Email and attached documentation from 1993 on definition of minimum flow	4.10.2013	Icelandic/ English	
185	Landsvirkjun	Response from Úlfar Linnet on O-4, with two attachments on transmission constraints	22.11.2013	Icelandic/ English	
186	Landsvirkjun	Landsvirkjun's Quality Control Documents (folder)	various dates	Icelandic	ST-1; ST-3; ST-5; ST-23; ST-38; ST-39; St-42; VKL-98; VKL-64; VIN-91; LEI-170; LEI-196; STE-67; VIN-193; VKL-68; VKL-160; VKL-161; VKL-162; VKL-163; LEI-279; STE-5; LEI-201; REG-32; LEI-73; LEI-90; VKL-1; VIN-87; VIN-189; VKL-12; VKL-160; LEI-229; VKL-64

Appendix D: Visual Evidence



Photo 1: Upper Blanda watershed with barren highlands and ice caps in background



Photo 2: Islands in Blöndulón reservoir (56 km²), with road into highlands in foreground



Photo 3: Blöndulón reservoir shoreline; section with sediment deposition



Photo 4: Blanda dam bottom outlet gate house



Photo 5: Blanda dam spillway (600 m³/s capacity)



Photo 6: View downstream from Blanda dam with low level outlet; water is seepage and not an environmental flow release



Photo 7: Kolka dam with road into highlands



Photo 8: Kolka dam gate



Photo 9: Kolka dam outlet



Photo 10: Public safety measures - rescue equipment on bridge over waterway



Photo 11: Gilsarlón intake reservoir (5 km²)



Photo 12: End of powerhouse tailrace tunnel



Photo 13: Fisherman in Blanda River upstream of tailrace



Photo 14: Mixing of clear Blanda River residual flows and turbid releases from tailrace



Photo 15: Langamýri gauging station 6 k downstream of tailrace; note overgrown gravel banks due to reduced flooding



Photo 16: Warning message from power station manager to fishermen (sudden increase in flow release)



Photo 17: Confluence of Blanda and Svarta rivers; note mink trap in foreground



Photo 18: Fishing lodge and increased agricultural floodplain usage in Blanda River valley



Photo 19: Fish ladder on Blanda River 2 km upstream from mouth (improved by project)



Photo 20: Sandbanks at Blanda River mouth in the town of Blönduós



Photo 21: New landscape compass at Afangafell



Photo 22: New stables for horses and sheep in the highlands



Photo 23: New hut for sheep herding, also rented to tourists in the summer



Photo 24: New soil generated by highland revegetation program



Photo 25: Blanda power station procedures and records



Photo 26: Blanda power station



Photo 27: Blanda power station computer system - to be replaced



Photo 28: Blanda power station housekeeping - spare parts storage



Photo 29: Blanda power station spare runner



Photo 30: Power distribution lines along road upstream power station

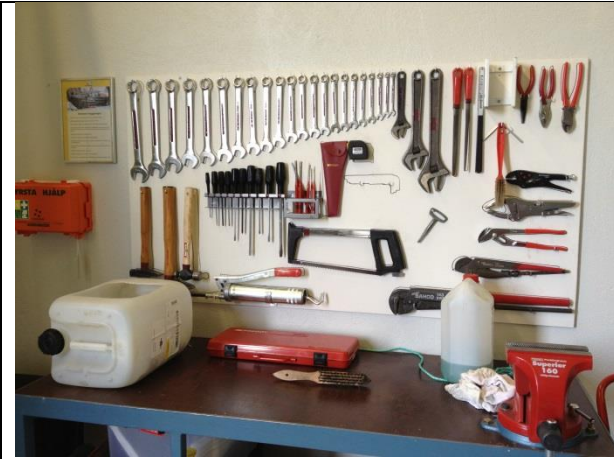


Photo 31: Tools in Kolka gate house



Photo 32: Power house



Photo 33: Blanda Quarry with safety boulders



Photo 34: Kolka dam seepage monitoring



Photo 35: Public safety measures - Blanda tailrace



Photo 36: Warning sign near waterway



Photo 37: Blanda power station - computer logs entry information



Photo 38: Safety measures – barrier behind ladder



Photo 39: Blönduós health clinic



Photo 40: Oil drip catch in power station



Photo 41: Blanda power station access tunnel with emergency lighting



Photo 42: Power station safety measures