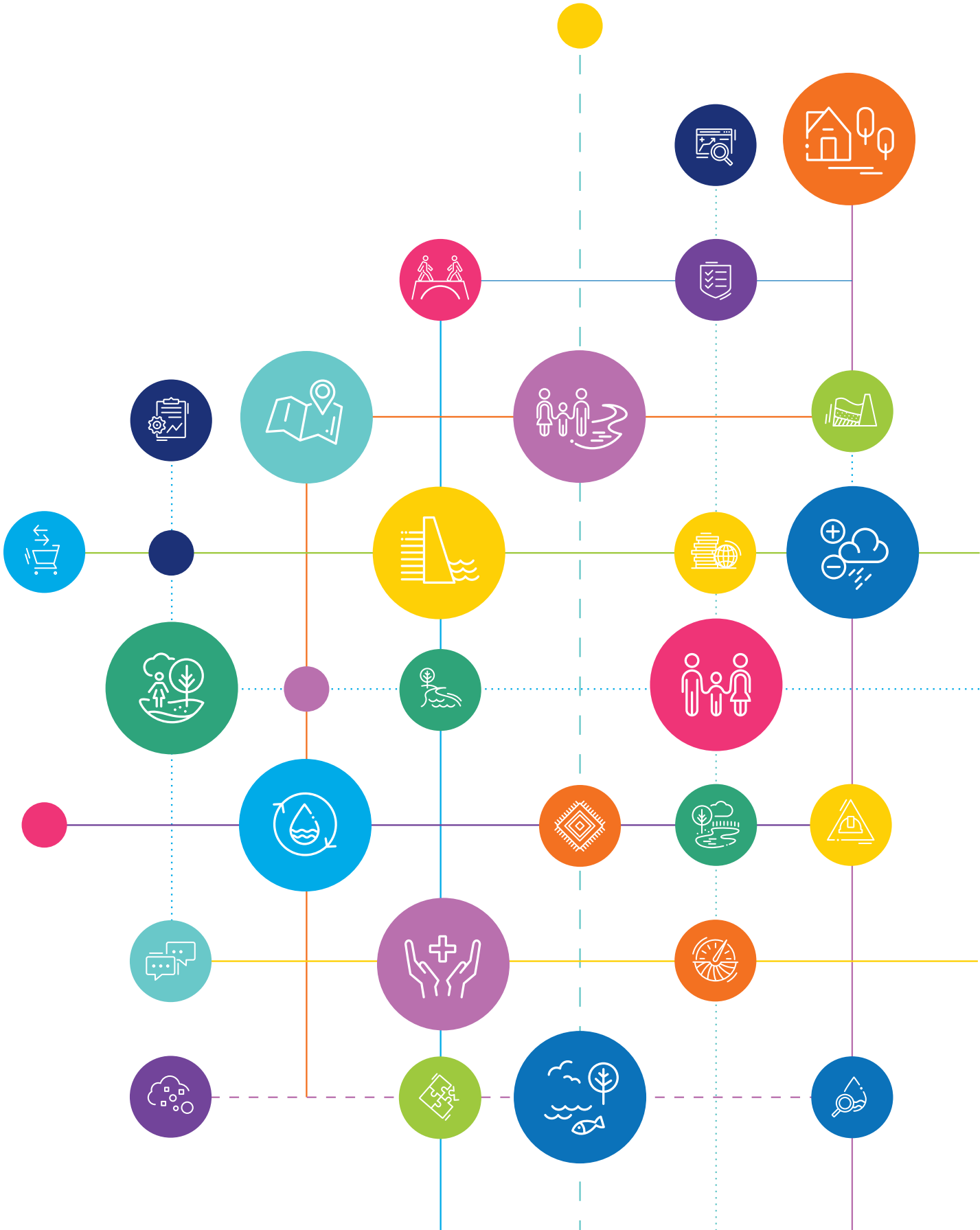




# Hydropower Sustainability Guidelines



First published December 2018.  
This edition published May 2020.

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# Acknowledgements

The Hydropower Sustainability Guidelines define how good international industry practice should be assessed, and build on the global knowledge and experience gathered through the multi-stakeholder process of the Hydropower Sustainability Assessment Forum (2008-2010), plus insights gained through international application of the Hydropower Sustainability Assessment Protocol (IHA, 2011).

The guidelines content was largely authored by Dr Helen Locher, who was coordinator for the Hydropower Sustainability Assessment Forum and is an Accredited Lead Assessor for the Hydropower Sustainability Assessment Protocol. The lead author for the Climate Change Mitigation and Resilience topic was João Costa, Senior Sustainability Specialist, International Hydropower Association (IHA).

This compendium has benefitted from the collaboration of numerous experts who provided valuable written comments during the expert review process. This collaboration is gratefully acknowledged.

The members of the Hydropower Sustainability Assessment Council, coordinated through its governance committee, reviewed and approved this document.

This work would not have been possible without the financial support and guidance from the Swiss State Secretariat for Economic Affairs.

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# Introduction

## Purpose

The Hydropower Sustainability Guidelines on Good International Industry Practice (HGIIIP) form the normative document on how sustainability practice should be defined and measured in the hydropower sector.

The guidelines offer the most detailed descriptions of international good practice for sustainability in the hydropower industry and are intended to be used in a variety of different settings, either individually or as a compendium. They have been developed to bring definition to the processes and outcomes that constitute good international industry practice for topics relevant to preparing, implementing and operating hydropower projects.

Organisations may choose to reference compliance with the guidelines in contractual arrangements; lenders and investors may opt to reference the guidelines in their terms of agreement; while markets and labelling systems may specify them in their eligibility requirements.

## History and development

The Hydropower Sustainability Guidelines, a compendium and reference manual, is the culmination of two decades of discussions about what constitutes good practice in hydropower development. These discussions have involved a broad range of stakeholders, from hydropower companies, to social and environmental NGOs, intergovernmental organisations, financial institutions and governments.

The definitions and examples that have emerged were agreed through a collaborative multi-stakeholder process which began with the publication, by the International Hydropower Association (IHA), of the first IHA Sustainability Guidelines in 2004, leading to the formation of the Hydropower Sustainability Assessment Forum between 2008 and 2010, which delivered the Hydropower Sustainability Assessment Protocol.

A process of drafting and expert review by leading authorities in their fields took place during 2018, resulting in the 26 chapters presented in this compendium. The Hydropower Sustainability Guidelines were reviewed and approved by the Hydropower Sustainability Assessment Council (HSAC), through its governance committee, leading to their publication in December 2018.

## Form and structure

The guidelines provide definitions of good practice in accordance with six criteria: covering project assessment, management, stakeholder engagement, stakeholder support, conformance/compliance, and outcomes. The guidelines expand on what is expected by statements on these criteria in two complementary assessment tools: the Hydropower Sustainability Assessment Protocol (HSAP) and the Hydropower Sustainability Environmental, Social and Governance Gap Analysis Tool (HESG). Reference to the criteria statements is made in inset boxes within each guideline. What follows is a detailed explanation of the requirements of that statement in order to achieve good practice, including definitions of terms and relevant examples.














## A suite of sustainability tools














With the completion of this compendium, the sector now has a suite of Hydropower Sustainability Tools (HST) to harmonise understanding of sustainability in a hydropower context. Performance against the Hydropower Sustainability Guidelines (HGIP) can be measured through the Hydropower Sustainability Assessment Protocol (HSAP) which takes into account all the 26 guideline topics and measures

performance above and below defined good practice; this enables projects to benchmark their performance in a comprehensive way. In addition, the Hydropower Sustainability ESG Gap Analysis Tool (HESG), launched in July 2018, can be used to check for gaps against good practice on targeted topics and includes a gap management plan to improve processes and outcomes.



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# Communications and Consultation

*This guideline expands on what is expected by the criteria statements in the Hydropower Sustainability Tools (HST) for the Communications and Consultation topic, relating to assessment, management, stakeholder engagement and conformance/compliance. The good practice criteria are expressed for different life cycle stages.*

*In the Hydropower Sustainability Assessment Protocol (HSAP), this topic is addressed in P-1 for the preparation stage, I-1 for the implementation stage and O-1 for the operation stage. In the Hydropower Sustainability ESG Gap Analysis Tool (HESG), this topic is addressed in Section 10.*

Hydropower projects involve a range of stakeholders. Effective stakeholder communications and consultation throughout the life of the project is an important element of good practice. Benefits for the developer and owner/operator can include: a better and earlier understanding of project risks and opportunities

arising in the external environment and changes in these factors over time; an increased ability to find management solutions that are supported by stakeholders; and, ultimately, the avoidance of delays and additional costs arising from poor communications.

A **stakeholder** is defined as anyone who is interested in, involved in or affected by the hydropower project and its associated activities. Project stakeholders can consist of a broad range of different groups, such as affected communities, government agencies, partners, contractors, suppliers, financiers, catchment residents, the media, academics and experts, civil society, and Non-Government Organisations (NGOs). A stakeholder does not have to be directly affected to meet project stakeholder definition and anyone with an interest should be able to have access to mechanisms for communication and engagement.

The intent is that stakeholders are identified and engaged in the issues of interest to them, and communications and consultation processes establish a foundation for good stakeholder relations throughout the project life.



## Assessment

*Assessment criterion - Preparation Stage: Stakeholder mapping has been undertaken to identify and analyse stakeholders, to establish those that are directly affected, and to establish communication requirements and priorities, with no significant gaps.*

The first step towards good practice for communications and consultation is **stakeholder mapping**. Stakeholder mapping involves the identification of all project stakeholders in meaningful groups (e.g. project-affected communities, regulators, contractors, etc.). Once stakeholder groups are identified, progressive levels of communications and consultation analyses and planning can be undertaken.

A project may affect a community with several thousand members, but within that community there are likely to be various sub-groups with different interests and views on the project. All groups of stakeholders, their interests, and the most appropriate means for engaging with them should be identified.

Stakeholders that are directly affected by the project, versus those indirectly affected by or with an interest in the project, should be identified. **Directly affected stakeholders** are those stakeholders with substantial rights, risks and responsibilities in relation to the project or issues it affects. These stakeholders may be inside the project affected area (e.g. project affected communities) or outside the project affected area (e.g. government regulators, finance institution representatives, investment partners, NGOs). They may live downstream and be at risk of effects that will not emerge for a number of years. Indirectly affected stakeholders usually include those with second order impacts, such as those affected by changes in the activities of a local project supplier or tourists passing through the region.

The following are examples of stakeholder groups based on rights, risks and responsibilities:

- based on rights – e.g. those with land or water rights potentially affected;
- based on risks arising from the project – e.g. those potentially affected by a specific impact area such as adverse water quality, increased traffic hazards, or damage to cultural heritage artefacts;

- based on risks to the project - e.g. those with key roles in the supply chain; and
- based on responsibilities - e.g. government institutions, regulatory agencies.

Community-level consultation workshops, interviews, and baseline surveys will contribute to the identification of local-level stakeholders. In the preparation stage, the identification of stakeholders should be part of, or closely linked to, the Environmental and Social Impact Assessment (ESIA) process, although communications in general should not be left solely to ESIA consultants. A continuous presence of project staff in local communities will best assist in identifying stakeholders, analysing requirements and priorities, and building relationships that are well set up for the life of the project.

Stakeholder analyses should be undertaken for all groups. These should involve: evaluating the relative influence of the project on different stakeholder groups or individuals, as well as their influence on the project; evaluating related risks and level of risk; identifying issues of interest; and planning the most effective mechanisms for engagement.

Important considerations in defining communications requirements for different stakeholder groups include:

- literacy;
- language, especially with ethnic minorities and indigenous peoples;
- cultural norms and courtesies;
- accessibility to various forms of information, e.g. internet access, transport access to public meetings, or locations of signposted information;
- gender, as women in the same stakeholder group may have different issues and impacts compared to the men and may not be included amongst community representatives unless the consultation is deliberately designed for this;
- appropriate project representatives for the various consultation approaches and groups (e.g. in terms of ethnicity, age, gender, acceptability);
- methods needed within groups to consider information and give meaningful inputs; and
- timing, e.g. time needed for consultation, when those stakeholders are available, time needed for responses, and fit with important information updates and availability of the project.

Assessments to inform communications and consultation plans at the preparation stage should include what kind of and when information should be shared with regards to the progress of the project (see the Integrated Project Management guideline). Important information sharing points in the project development timeline include: periodically during development of the Environmental and Social Impact Assessment (ESIA) studies; on the draft ESIA report; during development of the Environmental and Social Management Plan (ESMP); and at regular intervals during implementation to see if measures are effective or if issues are arising.

## Assessment

*Assessment criterion - Implementation Stage: Communications and consultation requirements and approaches have been identified through an assessment process involving stakeholder mapping, supported by ongoing monitoring.*

*Assessment criterion - Operation Stage: 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.*

Further to the above guidance, stakeholder mapping, analysis, and accompanying databases should be developed at an early stage of project development and maintained and updated through all project stages. These processes should be developed at any project stage if they have not previously been completed as they will always add value whenever developed. Keeping these current is important through the implementation and operation stages as both communities and stakeholder groups and their needs and issues evolve over time.

Information needs at the implementation stage are diverse. Stakeholders affected by construction and implementation activities will want to be kept well informed on many aspects, which may include project work plans, impacts and risks, mitigation measures, monitoring and review. Public safety communications are critical. Water safety will need a lot of communications attention both at the time of reservoir filling and testing and with commissioning of the power station and related assets.

Stakeholder interests and communications needs can differ again at the operations stage. Important information areas for the operations stage might relate to, for example: flood warning, spill management, drought management, downstream flows, reservoir uses and rules, water offtake rules, coordination with other hydropower facilities and water users in the river basin, notifications of outages, major operational changes under consideration, and crisis communications. Stakeholders will also be interested in the effectiveness of management plans, as well as the status shown by monitoring data on the environmental and social values that have been flagged as important during the preparation stage.

Monitoring during implementation and operations should be oriented towards testing that:

- stakeholder maps and associated information are up-to-date;
- communications and consultation approaches are effective; and
- stakeholders are getting the information they are interested in (which is likely to change over time).

At all project stages, the developer and owner/operator should be able to demonstrate that stakeholder groups are receiving the information intended for them and are able to effectively access the consultation mechanisms designed for interactions with them. Periodic surveys, questionnaires, feedback requests, and seeking suggestions for improvements can be useful techniques to test the effectiveness of existing approaches. This is especially important because communications and consultation requirements and stakeholder interests can extend over long periods of time, from years to decades.

## Management

*Management criterion - Preparation, Implementation and Operation Stages: Communications and consultation plans and processes, including an appropriate grievance mechanism, have been developed at an early stage applicable to project preparation, implementation and operation that outline communication and consultation needs and approaches for various stakeholder groups and topics.*

Once the stakeholder mapping is established, the analyses undertaken should help define the most appropriate engagement strategies between the project and the various stakeholder groups. These should be embedded in communications and consultation plans and processes.

Typically, a project would establish an overarching communications and consultation strategy or plan, setting out the methods, frequency, and responsibilities. These may be supported by sub-plans for particular groups of stakeholders, for example a media communications plan or affected community consultation plan. Communications plans might include content such as: the vision, principles and values of communication; objectives; responsibilities and structures; communications channels; institutional branding; and processes to be followed. They may also be underpinned by a corporate stakeholder relations policy or communications policy. Consultation plans should include objectives, participants, locations, notifications, forms of information, timing, time allowances for questions and feedback, method of recording or documenting, etc.

At the implementation stage, contractors may have separate community relations plans and processes. Responsibilities and expectations for communications and consultation amongst the different parties involved in project delivery should be well articulated in all relevant plans, including in the integrated project management plans.

The initial stakeholder map can be expanded into or supplemented by a database of contacts, including contact details, responsibilities for maintaining contact, and frequency and timing of contact. A database may be a central database including all project stakeholders, or there may be separate stakeholder maps and databases for individual stakeholder groups. Approaches to stakeholder identification and analysis may be managed by different parts of a business for different groups of stakeholders.

Communications and consultation processes should include how the project proponent collects feedback on stakeholder issues and responds to issues raised, and how these issues are addressed in decision-making. Process requirements should include the need to take, distribute, and keep copies of minutes of meetings. Plans and processes

should make it clear how gender considerations and the inclusion of vulnerable social groups (e.g. ethnic minorities) have been given careful consideration, as well as how individual needs such as transport, accessibility, logistical constraints, timing, disabilities, language, literacy and cultural considerations are taken into account.

Consultation at the community level typically involves meetings and workshops, which can be numerous during the preparation and implementation stages, or public consultation meetings or hearings, some of which may be a formal regulatory requirement. The establishment of groups that regularly meet, such as liaison committees, can be a useful means of consulting with groups of stakeholders. Communications activities are normally carried out by a social or community liaison team, government liaison team or officers, and/or a public relations team. Dedicated community liaison officers, often one or two per community, are a frequently used method for local communications. In remote areas, community runners/messengers from the local communities can be appointed and provided with transport to provide a function of keeping communities informed and making arrangements for meetings. Larger projects may maintain the presence of communications agents in all affected communities. Other forms of communication could include, for example: project information centres; a physical project model; printed information in many forms; stakeholder visits to the project site; local media articles and programmes; and a project website.

Good practice requires the establishment of grievance mechanisms. **Grievance mechanisms** refer to the processes by which stakeholders are able to raise concerns, grievances and legitimate complaints; the project procedures to track and respond to any grievances; how issues will be escalated if they cannot be easily resolved; commitments to inform stakeholders of status or outcomes; and legal recourse avenues. Grievance mechanisms should be formally developed, easily accessible, and well understood by relevant parties, particularly those who are intended to have access to them. Grievances can be collected in many forms, for example verbally or in writing, through an intermediary (e.g. a village chief), etc. Procedures should include excellent records management. Processes to be included in grievance mechanisms may differ depending

on the context, community norms, degree of development or remoteness, etc. They may include, as appropriate:

- a community liaison office;
- community liaison officers;
- a dedicated telephone line for raising grievances, preferably a toll-free line;
- an online contact form;
- a dedicated email address, post box, or local government office drop box for raising grievances;
- a centralised grievance database;
- the appointment of a grievance redress officer focused solely on documenting and facilitating resolution of grievances; and
- an ombudsman or arbitrator to resolve disagreements.

In some areas, a formal government channel or a channel using traditional authorities may be used alongside the project's grievance mechanism. In all cases it is necessary that grievances are logged and dated, and the dates by which they are acknowledged, answered and resolved are recorded. If there are multiple databases, these should inform a centralised database from which statistics can be gathered for regular reporting. Records need to be well maintained by the developer and the owner/operator so that parties who raise grievances and are unsure of the outcome, or want to remind themselves after many years, can get the relevant documentation.

## Stakeholder Engagement

*Stakeholder Engagement criterion – Preparation, Implementation and Operation Stages: The project preparation, implementation and operation stages have involved appropriately timed communications and engagement, often two-way, with directly affected stakeholders on topics of interest and relevance to them; engagement is undertaken in good faith; ongoing processes are in place for stakeholders to raise issues and get feedback.*

Stakeholder engagement is part of the implementation of communications and consultation plans. Important elements of good practice relate to timing, two-way methods, focal areas for engagement, good faith, issues identification, and feedback.

**Appropriately timed** means that engagement is early enough in the relevant stage that the project can respond to the issues raised, stakeholders can respond before the project or facility takes decisions, and engagement occurs at times that are suitable for relevant stakeholders to participate. Stakeholders should be supportive of the timing of engagement activities. Business or government stakeholders have their own decision-making processes that need to be coordinated, such as board or committee meetings. Communities need sufficient time to receive information, discuss it openly with the project representatives, then go through their own community dialogue processes before forming a consolidated community view to relay back into the evaluation processes.

**Two-way** means the stakeholders can give their views on considerations relevant to the communications focal area and not just be given information without any opportunity to respond. Examples of two-way processes are public meetings and hearings, public comments on studies and options assessment documents, interactive participation in workshops, negotiation, mediation, and focus groups. Whilst provision of information by the developer, owner or operator is important, it is not sufficient to meet good practice and there needs to be evidence that feedback on that information is obtained in a meaningful way.

Good faith engagement refers to the quality of the discussions held. The project and the stakeholders should engage honestly, as equals, with willingness to listen to each other's points of view, and the intent to reach agreement. Seeking stakeholder input into the design of engagement processes is often indicative of good faith engagement. Other indications could include examples of two-way participatory processes showing negotiation or evidence that the developer has responded to issues raised by stakeholders in development decision-making.

Processes in place for stakeholders to raise issues at any point in the life of the project or operating facility may happen through a formal grievance mechanism as described above or through less formal means. These could include, for example: a contact person and/or a 'contact us' space on the company website; periodic public briefings or question/answer opportunities; participation of company staff on stakeholder or catchment committees; and regular meetings and issue-raising mechanisms developed in liaison with local government authorities.

Feedback on stakeholder issues could be demonstrated by means such as emails, records of telephone conversations, written correspondence, meeting minutes, media releases, or provision of responses to frequently asked questions on the company website. Good practice requires a register to be kept by the developer and owner/operator detailing the source, date and nature of issues raised, and how and when each was addressed and resolved. Closure of issues with the stakeholder who raised them is essential.

## Conformance/Compliance

*Conformance/Compliance criterion – Preparation, Implementation and Operation Stages: 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 any communications related commitments have been or are on track to be met.*

Good practice requires evidence that communications and consultation measures are compliant with the relevant legal and administrative requirements for public disclosure and consultation, which may be expressed in licence or permit conditions or captured in relevant legislation. Compliance requirements may relate to, for example: the number, timing and type of community consultation sessions undertaken as part of project preparation; the standards

to be demonstrated by the project grievance mechanism; or public disclosure of certain project documents such as monitoring reports on key issues.

Conformance refers to delivering what is in the plan. Examples relevant to communications and consultation could include budgetary allocations, designation of roles and role expectations, resource provisions, provision of internal training, meeting schedules, support mechanisms, response times, and record keeping.

Commitments may be expressed in regulatory requirements for addressing communications and consultation, in relevant policy requirements of the developer or owner/operator, or in any relevant company statements made publicly or within management plans. For example, the company CEO may make a statement in the press that transportation will be made freely available for community members to attend the public meetings about the project. The grievance mechanism may contain commitments to certain time targets for issue acknowledgement, response, resolution, and feedback. Evidence of adherence to commitments could include, for example internal monitoring and reports, government inspections, and independent review. Variations to commitments should be well-justified and approved by relevant authorities, with appropriate stakeholder liaison.

The significance of not meeting a commitment is based on the magnitude and consequence of that omission and will be context-specific. For example, a failure to demonstrate delivery of a stakeholder consultation process required under the relevant legislation is likely to be a significant non-compliance, whereas a slight delay in publication of a monitoring report could be a non-significant non-conformance (depending on the consequence of that delay).



# Governance

*This guideline expands on what is expected by the criteria statements in the Hydropower Sustainability Tools (HST) for the Governance topic, relating to assessment, management, conformance/compliance, stakeholder engagement and outcomes. The good practice criteria are expressed for different life cycle stages.*

*In the Hydropower Sustainability Assessment Protocol (HSAP), this topic is addressed in P-2 for the preparation stage, I-2 for the implementation stage and O-2 for the operation stage. In the Hydropower Sustainability ESG Gap Analysis Tool (HESG), this topic is addressed in Section 9.*

Governance refers to the combination of processes and structures that inform, direct, manage and monitor the activities of a project or entity towards the achievement of its objectives. This guideline addresses corporate and external governance considerations for the hydropower project and the operating hydropower facility. The intent is that the developer and owner/operator have sound corporate business structures, policies and practices; address

transparency, integrity and accountability issues; can manage external governance issues; and can ensure compliance.

All businesses are operated, regulated, and controlled according to a set of internal rules and processes, which are defined as **corporate governance**. Different corporate processes and structures will be required depending on internal characteristics of the business (e.g a single-project or multi-project entity; government-owned, privately held, or listed on the stock market; or a domestic or multi-national business). These requirements will be further shaped by the external governance environment, such as government regulatory requirements, legal frameworks, and risks.

**External governance** refers to the political, institutional, legal and regulatory system within which the project is developed and operates. Hydropower projects typically operate in complex external governance environments. A number of different institutions are likely to have responsibilities for different aspects of the hydropower development. These include regulators, which are responsible for electricity generation, transmission and distribution, dam safety, water resource management, environment, labour, and electricity pricing, and agencies, which are responsible for planning, land, emergency services, hydro-meteorology, geology, health, and culture.

Hydropower projects may have different proponents and business structures at different project life cycle stages which influence the ownership model and governance arrangements. Projects may be privately or publicly owned, or a public-private partnership (PPP). Projects may emerge from the public sector, transfer to the private sector at the preparation stage, and return to the public sector at a later stage. Reasons for ownership model changes could be, for example, to accelerate the development timetable by using private developers, to facilitate financing strategies, or to spread risk.

This guideline addresses corporate and external governance considerations that affect the sustainability of the hydropower development project or operating facility. This guideline is not directed at the external governance framework itself (e.g national policy, legislation, government agencies, or government capacity building). It focusses on the developer's and owner/operator's own corporate governance measures, as well as how the developer and owner/operator work within the external governance environment to identify and manage risks associated with external governance (e.g weaknesses, impending changes, emerging trends).

## Assessment

*Assessment criterion - Preparation Stage: Assessments have been undertaken of political and public sector governance issues, and corporate governance requirements and issues, through the project development cycle with no significant gaps.*

Throughout the project cycle, the project and the business to which it belongs need to understand their external governance environment. The political, institutional, legal and regulatory system within which the project is developed and will operate, as well as any issues that may pose risks to the project and any opportunities that may arise, needs to be thoroughly assessed. Even in countries with stable and predictable governance environments, relevant policies and regulations evolve over time or could change after the next election. In countries with unstable governance environments, understanding the challenges can be critical to project success.

External governance roles relevant to the project can be broad and diverse. They include but are

not limited to: the elected government; the civil service/public sector institutions; political parties; anti-corruption organisations; the judiciary; grievance addressing agencies such as the ombudsman; law enforcement agencies; Freedom of Information; the media; local government; financial institutions; international institutions (e.g some provide peer review of anti-corruption efforts); audit/oversight institutions; and the public contracting system.

Examples of external governance issues that may be identified as relevant to a project include:

- gaps, uncertainties or contradictions in regulations, policies and/or standards;
- capacity shortfalls in public institutions in relation to, for example, staff numbers, expertise levels, and regulatory frameworks and policies;
- demands for illicit payments;
- disagreements between jurisdictions affected by the project;
- transboundary issues, e.g inconsistent regulations and standards, and their enforcement; and
- changes in government or policies.

Such issues can lead to delays or denials of approvals, reduced financial viability of projects, or reputational problems. On the other hand, opportunities may arise in the external governance environment, for example through developments in renewable energy legislation, emerging policies, synergies with other development objectives, and stronger institutional coordination (e.g the water-energy nexus). Businesses need to ensure that they have adequate information, whether by commissioning assessments (for example as part of feasibility studies and the Environmental and Social Impact Assessment (ESIA)), assigning staff specifically to following political and regulatory issues, or relying on analyses by business associations or external advisers.

Specific external governance risks that should be well-assessed at the project preparation stage include:

- **Political risk** – the risk of financial loss or inability to conduct business faced by investors, corporations, and governments due to, for example: government policy changes; government action preventing

entry of goods; expropriation or confiscation; currency inconvertibility; politically-motivated interference; government instability; or war.

- **Transboundary risks** – limitations or uncertainties in the institutional arrangements between neighbouring jurisdictions that address boundary-related issues, such as the management of project impacts in a river system, transport of goods and services, and information and resource sharing.
- **Corruption risks** – these may occur within the business, such as issues with how finances are managed; external to the business, such as bribery in the supply chain; or within the public sector, such as a failure to address licence or permit violations. Public sector corruption risk examples include short-cutting of assessment or preparation requirements, non-transparent approvals, and ignoring licence and permit violations.

Corporate governance requirements also need to be well-understood as they apply throughout the project cycle. Corporate governance components typically include: the roles of the Board of Directors and the executive management team; business structure and administration; policies and processes; risk; accountability; internal and external reporting; auditing; compliance; Corporate Social Responsibility (CSR); ethical business practices; culture; and stakeholder and shareholder relations and engagement.

Examples of corporate governance issues include: an absence of key policies such as for CSR, transparency, stakeholder engagement, or anti-bribery; key roles not filled; a lack of internal financial controls and weak audit processes; internal corruption risks; poor documentation of compliance; a lack of Board- or Executive-level focus on key performance indicators related to sustainability (e.g safety, working conditions, environment, stakeholders); or a lack of project management or other relevant capacities.

Corporate affairs, legal, audit and similar departments are often tasked with assessing corporate governance requirements or issues and monitoring the effectiveness of corporate governance arrangements over time. International standards for corporate governance can be referred to as a guide to good practice, and periodic independent review and advice can help ensure processes are comprehensive and up-to-date with evolving expectations.

## Assessment

*Assessment criterion - Implementation and Operation Stages: Processes are in place to identify any ongoing or emerging political and public sector governance issues, and corporate governance requirements and issues, and to monitor if corporate governance measures are effective.*

In addition to all expectations outlined within the preparation stage assessment guidance, the processes for monitoring of effectiveness take on particular importance at the implementation and operation stages. Examples of mechanisms for monitoring the effectiveness of corporate governance measures include internal audit, external audit, independent reviews, benchmarking exercises, and topic specific evaluations (e.g on occupational health and safety).

## Management

*Management criterion - Preparation, Implementation and Operation Stages: Processes are in place to manage corporate, political and public sector risks, compliance, social and environmental responsibility, grievance mechanisms, ethical business practices, and transparency; policies and processes are communicated internally and externally as appropriate; and independent review mechanisms are utilised to address sustainability issues in cases of project capacity shortfalls, high sensitivity of particular issues, or the need for enhanced credibility.*

Good international industry practice for the governance of hydropower projects requires that a number of key management processes are clearly demonstrated. These are outlined in turn below.

### **Corporate, political and public sector risks.**

A risk management process should be in place. This should be based on a risk register that rates all risks by their probability and impact (often estimated in financial terms), describes mitigation measures, and assigns risk owners. The register should be updated periodically to reflect new information and be integrated with other corporate processes (for example setting performance targets for risk owners and budgeting for mitigation measures). Depending on their sensitivity and the organisational structure, corporate, political and public sector



risks may be handled separately from project-level technical, environmental and social risks. If risks have been identified, both risk management measures and follow-up monitoring should be evident.

**Compliance.** A standard compliance assurance process should be in place. This should be based on a register of all relevant legal and regulatory requirements, licence conditions, and reporting requirements. The compliance register would also ideally contain requirements resulting from internal policies and voluntary commitments. Responsibility for each requirement should be clearly assigned, and a central compliance role should update requirements and track compliance over time. A well-functioning compliance process will go a long way towards establishing good relationships with regulators and other stakeholders.

**Social and environmental responsibility.**

Policies, programmes, and plans for social and environmental responsibility should be in place. These should primarily cover the core business activities (i.e. responsible development and operation of hydropower projects) and secondarily any additional voluntary commitments such as under a CSR commitment, or in the form of benefit sharing or grants. Internal processes should allocate responsibilities and budgets and also establish transparent rules for decisions on external requests for support (for example under a community development fund or a research and development fund).

**Procurement of goods and services.** From a governance perspective, procurement is both a source of potential risks (primarily corruption and conflicts of interest) and an opportunity to have a positive influence beyond the direct scope of the business. Procurement plans and processes should include a procurement policy, pre-qualification screening, bidding, awarding of contracts, anti-corruption measures, and mechanisms to respond to bidder complaints (see the Procurement guideline).

**Ethical business practices.** The business should have a number of processes to ensure and demonstrate that unethical practices are avoided, detected and dealt with appropriately. Examples include: a business code of ethics; an employee code of conduct; a business integrity pact; anti-

bribery or anti-corruption policies; internal and external auditing; procedures for reporting and investigation; a whistle-blowing arrangement; and confidentiality limited to legally protected information. While they may take significant effort to put in place and administer, such instruments are designed to reduce expenditure as well as risks associated with ethics breaches and give confidence to business partners and investors.

**Grievance mechanisms.** Grievance mechanisms are processes by which concerns or complaints can be raised and will be reviewed and responded to in a timely manner. These should be open to any grievances related to the project and the business, including from project affected people and businesses, workers, contractors, customers, and civil society groups. These may be divided into several separate mechanisms for practical purposes, with some (e.g those relating to labour or procurement) based on mechanisms enshrined in law. A well-functioning grievance mechanism provides early warnings of issues so that they can be addressed before turning into major problems.

**Transparency.** Corporate policies, processes, activities and results should be communicated internally and externally as appropriate, taking into account business size, capacity, ownership, public interest in specific issues, and any legal requirements (such as regulations on the 'right to know' or 'freedom of information', and on privacy). Transparency is also a key aspect of effective stakeholder engagement.

**Independent review.** Independent review should be used for sustainability issues in cases of project capacity shortfalls, high sensitivity, aspects of uncertainty, or the need for enhanced credibility. Independent review is defined as review by experts who: are not employed by the project, have no financial interest in profits made by the project, are unaligned with the project in any other manner, and are generally perceived as being objective. An expert is a person with a high degree of skill in or knowledge of a certain subject as a result of a high degree of experience or training in that subject. In the absence of review by regulators, forms of independent review may vary from contracting an expert consultant to provide a written review of a particular assessment, plan or report to a Panel of Experts (PoE). A PoE usually comprises a mix of expertise appropriate to the project and provides

both periodic assessment and written reports on issues identified as being within its scope of review.

Additional governance measures may be necessary depending on the issues identified through the assessment process.

## Stakeholder Engagement

*Stakeholder Engagement criterion - Preparation, Implementation and Operation Stages: 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.*

Good corporate governance is based on and results in positive and productive relationships with other stakeholders. Understanding stakeholder interests is a precondition for targeting the right stakeholder groups with relevant information and relevant mechanisms for engagement. The process of stakeholder mapping and analysis is a good starting point for identifying the issues of particular interest to different stakeholders. This is usually complemented by direct questions to stakeholders through individual interactions, community meetings, inviting public comments, or surveys. Some businesses undertake a formal materiality analysis each year to ensure that what is published in annual reports reflects what stakeholders are most interested in hearing about. More details about approaches and expectations for stakeholder engagement are provided in the Communications and Consultation guideline.

The developer and owner/operator should make significant project reports publicly available. Which reports are significant will vary with project, but the ESIA or a non-technical summary of the ESIA should always be included. Provision of significant reports helps to engage stakeholders in a process of project improvement, minimise disinformation and rumours, focus stakeholder engagement on areas of particular interest, and create mutual trust and confidence. Information availability in the local language(s) of the target stakeholders is important to ensure accessibility.

Good practice also requires regular public reporting on sustainability aspects of the project or operating hydropower facility. Sustainability aspects might include those that relate to the environment, community, safety, engagement, project benefits, labour and ethics. This helps the developer or owner/operator to demonstrate its willingness to be transparent and provides a basis for sustained dialogue. Information on project progress and sustainability performance can be released through annual corporate, environmental, or sustainability reports; project progress and monitoring reports; independent evaluation reports; real-time access to data (for example on water levels and water quality); and by other means. Some projects have created independent monitoring mechanisms where relevant data is tracked over years and published to demonstrate baselines and project impacts.

## Conformance/Compliance

*Conformance/Compliance criterion - Preparation, Implementation and Operation Stages: The project and operating hydropower facility has no significant non-compliances.*

Good practice requires evidence that the project and operating hydropower facility are fully compliant with the relevant jurisdictional requirements. These may be expressed in licence or permit conditions or captured in the relevant legislation. Compliance requirements may relate to, for example, standards to be met, the frequency and type of monitoring to be performed, audit schedules, and reporting to be submitted by the owner to government.

The compliance obligations for the project will need to be established and tracked with a compliance register. Compliance monitoring reports would document the project's compliance against legal obligations and may be a requirement of external regulators. There may also be compliance obligations arising from conditions of lenders to the project. Compliance requirements can change over time. In some jurisdictions the legislation, regulations and policies are changing rapidly, so there should be evidence that the compliance register is regularly updated.

The significance of a non-compliance is based on the magnitude and consequence of that omission and will be context-specific. For example, a failure to demonstrate delivery of a licence entitlement for resettlers is a significant non-compliance. A slight delay in delivery of a monitoring report could be non-significant, depending on the consequences. Repeat delays in meeting compliance requirements can erode trust and confidence in the developer, which can have longer-term ramifications.

## Outcomes

*Outcomes criterion - Preparation, Implementation and Operation Stages: There are no significant unresolved corporate and external governance issues identified.*

It is to be expected that the hydropower developer or owner/operator will be required to address issues of varying types relating to corporate and external governance. Of

importance is that any governance-related issues are recognised and that actions are underway towards their resolution in a timely manner. An external review of governance-related issues for the business can help inform how well the business has avoided, minimised and addressed governance-related issues.

The significance of any unresolved issue would be with respect to the magnitude and severity of the consequences of non-resolution. In most cases, the actions underway are likely to lead to a resolution of the issue. An example of a significant unresolved governance issue could be a major court case against the project that has not yet concluded and could stop the development, or corruption charges against the CEO that are being investigated. A strong governance framework underpinned by good assessment, management, engagement and compliance measures should help ensure that significant unresolved governance issues are unlikely.



# Demonstrated Need and Strategic Fit

*This guideline expands on what is expected by the criteria statements in the Hydropower Sustainability Tools (HST) for the Demonstrated Need and Strategic Fit topic, relating to assessment, stakeholder engagement and outcomes. The good practice criteria are expressed for the preparation stage.*

*In the Hydropower Sustainability Assessment Protocol (HSAP), this topic is addressed in P-3. In the Hydropower Sustainability ESG Gap Analysis Tool (HESG), this topic is addressed in Section 1.*

This guideline addresses the contribution of the project in meeting demonstrated needs for water and energy services as identified through broadly agreed local, national and regional development objectives, and in national and regional policies and plans. The intent is that the project fits with development objectives and relevant policies and plans can be demonstrated, and that the project is a priority option to meet identified needs for water and energy services. The terms 'demonstrated need' and 'strategic fit' are often associated with the early assessment stage of energy and water planning and are closely linked with options assessment. For example, a Strategic

Environmental Assessment (SEA) of a national Energy Policy, which is ideally carried out well before project preparation stages, would cover aspects such as demonstrated need and strategic fit.

One of the most basic reasons for civil society opposition to a hydropower development may be that, with regard to societal objectives, the need for the project has not been well-established. It may be difficult for project affected communities to support a project that appears to be being developed primarily as a profit-making venture for a private developer. The better a project proponent can communicate the demonstrated need for the project in terms of local, national, and regional water and energy services, the better the chances that the project can be supported by the communities that it affects.

In the case of a transboundary project there may also be regional (i.e. multi-national) initiatives that have relevant policies and plans. The project may be within the sphere of a River Basin Organisation (RBO) that has its own institutional structures, policies, agreements, plans, and guidelines. There may be bilateral or multi-lateral agreements that govern the shared water resource. The developer will need to know what state or province (the tier below national) the project sits within, whether any aspects of the project have implications that cross state or provincial boundaries, and the policy and planning requirements that will be applicable. There may also be a local government

level for which policies, strategies and plans should be identified.

## Assessment

*Assessment criterion - Preparation Stage: An assessment has been undertaken of needs for water and energy services, of options to meet water and energy needs; and of national and regional policies and plans relevant to those needs, with no significant gaps.*

The assessment of demonstrated need should commence with a thorough analysis of national and local development goals, and development objectives expressed in policies and plans. The initial emphasis should be on stated needs for water and energy services, but it would be important to include further analysis of a broader set of stated demonstrated needs in the assessment.

**Water services** examples include: drinking water supply; domestic needs of riparian dwellers; energy generation; fisheries; floodplain agriculture; food supply, water storage capacity, sanitation; water for business and industry; irrigation water supply; flood management; navigation; recreation; tourist opportunities; focal area for transboundary cooperation; and ecosystem services (e.g. floodplain maintenance, connectivity for migratory species, maintenance of off-river wetlands, nutrient and sediment balance, delta sediment replenishment, estuarine flushing, spawning ground access and maintenance).

**Energy services** examples include: provision of electricity to meet local, national and/or regional demand or opportunities; provision of grid stability; provision of peak load; and provision of ancillary benefits such as spinning reserve, system regulation, and improved thermal efficiency. A hydropower development to meet the energy requirements of an energy-intensive off-taker (e.g. an aluminium smelter) would be considered a demonstrated need if it is included in broadly agreed development objectives, policies and plans.

Local, national and regional objectives may be expressed in different forms, such as: an energy master plan; a water development plan; a country development report; strategic environmental assessments; options assessments;

energy demand projections; local, national or regional development assessments including livelihoods and living standards; conservation strategies; climate adaptation plans; a report of relevant policies and plans; a report on project demonstrated need and strategic fit; and use of multi-criteria analysis in assessing options.

There may be competing needs stated in various development related plans. For example, a region may clearly need energy, water and food security. Food or livelihood security may best be provided for by protecting instream fish stocks or agricultural land. Energy security may be well provided for through a hydropower project development, but it may in turn impact on fish stocks and available agricultural land. Mitigation of impacts to fish stocks and agricultural land would then be required to ensure that the demonstrated need for food security is not compromised by meeting the demonstrated need for energy security.

Energy services are most easily linked to economic development, for example to power new industries in a region that wants to improve on basic economic indicators such as employment, per capita income, and gross domestic product. There are also social and environmental needs that are highly relevant to the consideration of demonstrated need. For example, the need to avoid carbon emissions is an environmental consideration while the need to provide electricity for health services is a social consideration. These needs should be articulated on a broader basis than just economic concerns.

The project under consideration may not be the only avenue used to address these needs, but it should clearly contribute towards addressing the identified needs. Any conflicts (e.g. with food security) should be identified at an early stage so that measures to address them can be built into the project proposal (e.g. through modifying project components or through project benefits). Ways in which a project can contribute to multiple demonstrated needs could include the provision of energy, fresh water, new industries, new employment opportunities, and new avenues for food production. Multi-purpose projects are often designed for multiple objectives, although every project does not necessarily have the right characteristics for this.

The assessment should go beyond alignment with demonstrated need to also show the strategic fit of the project with existing policies and plans. Examples of national and regional policies and plans include: development, energy, water, biodiversity, climate, conservation, transboundary agreements, and land use. Examples of social and environmental related needs, policies and plans include: poverty eradication, food security, maintenance of fisheries, protection of high value sites (e.g. national parks, World Heritage sites, Ramsar wetlands, sites of cultural significance, recognised significant landscapes). In some contexts, customary use may be a significant consideration. Projects may also need to show alignment with the policies of financing institutions.

The assessment should show the ability of the project to manage or compensate for shortfalls or inconsistencies with existing policies and plans. For example, if there is no government resettlement policy and the project is likely to involve resettlement, a prospective developer may need to have its own policy for resettlement or state a commitment to be consistent with an internationally recognised standard. Other important policy (and institutional) gaps may relate to, for example, dam safety, land acquisition, governance of aspects of reservoir management, project benefits, flood management, land titles, and emergency response.

Because the policy formulation process can take years, developers should also be attentive to emerging policies that may take effect in the future with implications for the project. The developer should monitor how the policy formulation process is developing and how underlying societal values are changing.

The government may provide summaries of relevant policies and plans for hydropower developments to prospective developers, or the proponent may have commissioned such an analysis itself. The fit of the project with policies and plans is likely to be unique and would have to be analysed on an individual basis, with consideration of policies and plans for any particular issues triggered by the development (e.g. if it involves resettlement or indigenous peoples, or has implications for existing conservation areas). The better a developer can demonstrate alignment, have its own policies

clearly established to address significant project issues, and ideally also demonstrate a track record of implementation, the more likely it is that the developer will be able to gain stakeholder support or at least avoid major stakeholder opposition to the project.

## Stakeholder Engagement

*Stakeholder Engagement criterion - Preparation Stage: The results of the assessment of strategic fit are publicly disclosed.*

Public availability of a report that captures the outcomes of a project-specific assessment of strategic fit would meet this criterion. Strategic fit may be a section within the Environmental and Social Impact Assessment (ESIA). Evidence that such a report can be downloaded from a website or evidence of distribution to interested stakeholders on request would be examples that meet this criterion. It may be that the assessment was not done specifically for the project, but exists in other documents such as development plans and options assessment. Demonstrated public availability of these documents, as well as availability of relevant policies and plans, would satisfy this criterion.

Public disclosure is demonstrated if members of the public can access the relevant information if they would like to do so. This may be access to the relevant documents (either posted on a website, distributed, or made available on request to interested parties) or public notification about the results via a media release or website. If there was a one-off notification, information may later be hard to access. In this case, some effort should be made by the owner/operator to ensure awareness of and ease of accessibility of information by stakeholders over time. Information provision should be in locally accessible languages (see the Communications and Consultation guideline).

## Outcomes

*Outcomes criterion - Preparation Stage: The strategic fit of the project with needs for water and energy services, and relevant policies and plans can be demonstrated.*

To meet good practice, the project should clearly be contributing to the identified development needs for water and energy services. This would be well-demonstrated through:

- clearly documented statements or reports on local, national and regional objectives for water and energy services;
- evidence that such objectives are broadly supported, e.g. the objectives were developed through an open and participative process with a high degree of consensus; and/or
- clearly articulated statements of project objectives that are aligned with or point directly to the local, national or regional objectives.

Strategic fit should be with respect to both energy and water resources planning as well as other criteria such as environment, climate change, etc. Relevant policies and plans will always include those that address core elements of the hydropower development, for example relating to energy, water, resource management, and development. Social and environmental policies and plans with direct relevance to the project may vary depending on the project context, for example a river basin policy, a resettlement policy, or a cultural heritage policy. A broader approach to analysis of strategic fit will help build stakeholder confidence in the project, for instance demonstrating alignment with policies relating to education, health, labour, climate, biodiversity, and customary use.

Care needs to be taken to ensure that there is not a disconnect between energy planning and water planning, which can occur when these two activities are done in isolation. Ideally, there would be an Integrated Water Resource Management (IWRM) or energy-water nexus approach that can be shown to underpin the project.

If there are no obvious contradictions between the development and the relevant policies or plans, this can be considered a strategic fit. In practice, there may need to be a process of dialogue and an adjustment of project features and activities to address any areas of concern or to improve alignment (see the Siting and Design guideline).

The ability of the proponent to address any gaps or shortfalls in the alignment of the project with relevant policies and plans would need to be demonstrated through evidence. Examples include the prior track record of the government, developer, or other similar developments in the region in managing similar gaps or shortfalls. A strong corporate policy framework and track record for a prospective developer are also sources of evidence.



# Siting and Design

*This guideline expands on what is expected by the criteria statements in the Hydropower Sustainability Tools (HST) for the Siting and Design topic, relating to assessment, management, stakeholder engagement and outcomes. The good practice criteria are expressed for the preparation stage.*

*In the Hydropower Sustainability Assessment Protocol (HSAP), this topic is addressed in P-4. In the Hydropower Sustainability ESG Gap Analysis Tool (HESG), this topic is addressed in Section 1.*

This guideline addresses the evaluation and determination of project siting and design options, including the dam, power house, reservoir and associated infrastructure. The intent is that siting and design are optimised as a result of an iterative and consultative process that has taken into account technical, economic, financial, environmental and social considerations.

The siting and design of a hydropower project aim to:

- deliver the project objectives – the power station may be single purpose (hydropower generation only, which in turn may be for base load or peak load power, domestic use or export, or servicing rural or urban or industrial needs) or multi-purpose (e.g. the reservoir may also provide water supply for irrigation, aquaculture, or other industries, or be used for recreational, tourism and development purposes);
- optimise the constructed elements of the project – namely the dam type and size, generation capacity and efficiency, safety and access; and
- avoid, minimise and mitigate any issues associated with the development – these should not only consider technical and financial issues, but should also include social and environmental aspects.

**Optimal** in this context means best fit once all identified sustainability considerations have been factored in based on the outcomes of a consultative process. Project designers are skilled in optimising for technical and financial objectives, such as maximising power output for least cost. This guideline is focussed on ensuring that a broader set of objectives, including regulatory, social, environmental, safety and stakeholder priorities, informs and influences the optimisation process and conclusions for project siting and design.

Examples of sustainability considerations for siting and design include: prioritising alternatives that



provide opportunities for multiple use benefits; that are on already developed river systems; that minimise the area flooded per unit of energy (GWh) produced; that maximise opportunities for and do not pose unsolvable threats to vulnerable social groups; that enhance public health and minimise public health risks; that minimise population displacement; that avoid exceptional natural and human heritage sites; that have lower impacts on rare, threatened or vulnerable species; that maximise habitat restoration and protect high quality habitats; that achieve or complement community supported objectives in downstream areas (i.e. downstream flow regimes); that have associated catchment management benefits; that have lower sedimentation and erosion risks; and that avoid exceptional greenhouse gas emissions from reservoirs.

## Assessment

*Assessment criterion - Preparation Stage: Technical information has been analysed at an early stage alongside social, environmental, economic, financial, and regulatory considerations in order to develop a preliminary project design and some options around this.*

The siting of a hydropower project will initially be a location that offers an ability to technically generate hydropower due to:

- the head – i.e. the height through which water would fall to reach the turbine (the greater the head, the more power can be generated);
- the volume of water available – the more water available, the greater the number and/or size of the turbines that can be spun and the greater the power output of the generators; and
- the geological suitability for a dam – this is determined by the shape and size of the valley at the proposed construction site and the geology of the valley walls and floor.

The location selection for hydropower developments is generally (but not always) based on consideration of several location options, and the general layout that would suit each location option. Technically feasible sites for hydropower can be derived at a comparative level (i.e. to show more or less promising sites) from contour maps, hydrological statistics and geological maps, which

are usually readily available in most countries. Potential hydropower developments are often identified through national energy masterplans, which ideally involve analyses at the national or river basin scale to prioritise technically and economically feasible projects with relatively lower social and environmental impacts. An increasing level of attention has been dedicated to river basin planning tools and approaches to optimise river basin development plans for hydropower taking into account an array of sustainability considerations.

Regardless of the background to the identification of the individual project, the assessment process for that project needs to demonstrate that an options assessment approach has been taken to the determination of location and the general layout of the project. The options assessment should use a Multi-Criteria Analysis (MCA) approach. There are many degrees of sophistication that an MCA can take, and no single approach is recommended. Of importance is that the developer can demonstrate that:

- various location and general layout options have been identified based on initial information and stakeholder input;
- criteria and methods for MCA evaluation have been defined based on an engaged process with stakeholders;
- criteria reflect social and environmental considerations in addition to technical and financial aspects;
- methods of and outcomes from the MCA analyses are readily able to be understood by key stakeholders;
- information on technical, financial, economic, regulatory, social and environmental criteria is collected using appropriate expertise, and clearly informs the analyses of location and general layout options; and
- stakeholder inputs and views are clearly reflected in the options, the analyses, and the outcomes.

More detailed siting and design investigations are typically undertaken as part of project feasibility studies. This process tests the suitability of the location and the exact siting of the project components through on-site investigations (e.g. test drilling), develops the project design, and considers how to optimise a host of other

considerations within the siting and design. From a technical perspective, once the location is determined, the approach to project design often follows the following steps:

- selection of the most suitable general layout for the dam and power house locations and the general arrangement of the water conduits for power generation;
- optimisation of the dam height and selection of the maximum and minimum reservoir levels;
- optimisation of the installed capacity; and
- other detailed optimisations, such as the diameters of the water conduits, river diversion structures, and spillway design.

Of importance is that this optimisation process goes beyond technical and financial considerations, and clearly brings in social and environmental issues in a timely manner. Siting and design should be addressed through an iterative process. This may initially draw on information from a Strategic Environmental Assessment (SEA) at a broad geographical scale (e.g. river basin or national), and then draw on information from the Environmental and Social Impact Assessment (ESIA) studies as they advance for the proposed project. At the project level, this requires good coordination between the project manager for the engineering studies and the project manager for the environmental and social studies. Unfortunately, technical studies are often well-advanced before the environmental and social studies even begin. It is important to access high level information on environmental and social aspects before all of the siting and design optimisations are too far progressed; if not available through a broader-scale SEA, this can be obtained by commissioning early scoping studies and early stakeholder engagement on environmental and social issues. Based on the issues and solutions identified in the design and arising from information on social and environmental issues, site changes may occur. The design is then revised again to ensure compatibility with the new site and to incorporate social and environmental impact mitigation measures or enhancement of project benefits.

## Management

*Management criterion - Preparation Stage: An optimisation process has been undertaken to assess the project siting and design options.*

The design of project components must suit the site and can be used to address some of the issues associated with the site arising through the technical, environmental and social studies. Optimising the design may result in changes in the siting to improve design efficiency or to avoid or minimise negative impacts.

The siting and design of the project, and areas where trade-offs may be required, need to take into account many considerations including the following:

- Hydrological suitability – the amount of water the project will yield, the volume and velocity of water flowing into the site, the predictability of water yield, and the ability to meet power generation demand.
- Geomorphological suitability – the shape of the river channel, which influences the size and construction method of the dam, as well as the storage capacity and water retention ability of the reservoir.
- Geological suitability – the underlying geology at the dam site must be suitable to ensure water retention, and the geology of the project area must be able to provide long-term stability of the project infrastructure (e.g. tunnels, roads, housing).
- Location suitability – proximity to existing infrastructure such as transmission lines and roads, ease of access to the site and to the required materials, and suitability with respect to power markets.
- Financial considerations – e.g. cost of construction, costs of environmental and social mitigation measures, design to maximise revenue (e.g. to generate peaking power for export), and design considerations to conform with eligibility for financial support (e.g. Clean Development Mechanism funding).
- Regulatory requirements and design standards – there may be areas where there are no alternatives because of the need to meet compliance and standards, for example relating to infrastructure safety.
- Social and environmental considerations – avoidance and minimisation of social and environmental impacts through siting and design choices, based on sound environmental and social assessments, is far more cost-effective for a hydropower project than trying to manage and mitigate problems after they occur.

- Economic considerations – net costs and benefits of different siting and design alternatives, siting and design to provide for multiple use benefits to maximise the development contribution of the project.

Packaging and conveying such a complexity of information to facilitate engagement with stakeholders can be very challenging.

The ability to rearrange siting in response to issues may be highly restricted. Major changes to siting may require relocation of the dam site in order to avoid protected areas, resettlement, or impacts to migratory fish routes. Siting may be highly constrained by those locations with a suitable valley shape and size, plus necessary geological characteristics to site the dam. Alternatives for variations in siting may end up being more closely related to components of the project other than the dam (or dams), for example with the power house and water conduits (e.g. above ground or below ground) and associated infrastructure (e.g. roads, transmission lines, other buildings and site features). As an alternative to dam relocation there may be options around the height of the dam, which will affect the area of inundation but may require compromises in the amount of energy generated.

There are many examples of design features that address social and environmental impact mitigation or enhance social or environmental benefit. The optimisation process should consider avoidance and minimisation of social and environmental impacts first, and where they cannot be avoided, then the relative merits of different approaches to mitigation should be evaluated. Examples of measures that could be effectively built into project design, rather than added on later, include:

- selective or multi-level offtakes in deep reservoirs to limit the amount of water drawn into the power station from cold, anoxic depths;
- downstream stilling basins, variations in spillway design, or structures that favour degassing can avoid downstream gas supersaturation;
- air injection facilities and aerating turbines can avoid de-oxygenated water being delivered to the downstream river system;
- in shallow lakes, baffles can direct circulation and ensure adequate water flow-through and mixing, and can also inhibit wind-induced resuspension of lake bottom sediments;

- fish ladders or mechanical fish elevators can assist fish with their upstream migration, although these can be of mixed success and need to be very carefully researched and tested. Structures that facilitate catching and releasing of fish or fish nurseries and breeding projects can be designed to fit into the overall project layout;
- measures can be employed to divert fish away from the turbine intake to safer passageways to facilitate downstream fish migration, such as purpose built channels or pipes going around or through a dam wall; diversion methods such as fish screens, strobe lights, sound or air bubbles, and electrical fields; and dedicated design choices around turbine, spillway and/or overflow design can minimise fish injury or mortality on the downstream migration;
- strategically placed and purpose-designed barriers may restrict ranges for faunal pest species, such as anti-jump screens or even creating local flow velocity barriers;
- sediment bypass systems for floodwaters, gated structures for sediment flushing, and sediment trapping and filtration systems can help minimise reservoir sedimentation rates;
- downstream re-regulation storages can dampen rapidly fluctuating flow releases from power stations and attenuate the downstream flows; and
- construction of smaller off-stream storages to deliver minimum flows to address particular local issues could be a cost-effective alternative to environmental flow releases directly from the power station. Another approach is to have a dedicated turbine for delivery of the environmental flow that has its optimal electricity generation at that designated flow level.

Planning of temporary features that are necessary during construction should ideally be considered within the designs for permanent features. For example, new roads, temporary access tracks, works storage areas, quarry sites and excess spoil areas might be located below the minimum water levels of the future reservoir so that they are unobtrusive following inundation of the impoundment. Conversely, features required by the project in the short-term may be located and designed to provide a lasting community benefit in the longer-term, such as spoil dumping sites later providing sports grounds.

Climate change presents some further design considerations with new projects. Features may need to be put in to increase their flexibility to adapt to any possible climate change impacts. Examples include larger spillways for extreme floods or boat ramps and water abstraction points that will still be functional if the lake is drawn to very low levels during extreme drought. The project design can include features to increase the project's flexibility to deliver different flow levels over the long-term, which could be important in a river where climate change may affect what flow levels will be effective or expectations for flows may change over time. For example, turbines of different sizes can increase the ability to generate at different flow levels, thus increasing management flexibility.

Design documents should be produced at varying levels and should include preliminary designs, groupings of designs according to specialty area (e.g. civil, structural, electro-mechanical, geotechnical, hydraulic), and detailed designs for specific project components (e.g. weirs, spillways, tunnels and channels, pumping stations, surge tanks). Documentation should also include drawings, technical specifications, modelling works such as fluid computational modelling, and master designs and plans. Physical models may need to be developed to test different design components, for example hydraulic flumes to test sediment management approaches. Physical models of the project layout can also help stakeholders engage to discuss where there are issues to be avoided.

## Stakeholder Engagement

*Stakeholder Engagement criterion – Preparation Stage: The siting and design optimisation process has involved appropriately timed, and often two-way, engagement with directly affected stakeholders; ongoing processes are in place for stakeholders to raise issues and get feedback.*

Location and general layout options, and siting and design alternatives, should be identified based on a dialogue with directly affected stakeholders, and this engagement process should continue through the evaluation and optimisation process. This engagement often happens as part of the ESIA process so the

trade-offs among different alternatives can be recognised and evaluated. However this may be late in the process. The earlier that social, environmental, stakeholder and project benefit considerations can be brought to the attention of the project designers, the more efficient the iterative process of adjustment and refinement will be.

The developer should recognise and factor in that there is likely to be a necessary requirement for education of the stakeholder base about technical aspects of hydropower. There are many aspects of hydropower that are not well-understood by members of the public, such as types of energy, the market situation, and constraints on options arising from the physical and built environment.

Stakeholder mapping should identify directly affected stakeholders for various aspects of the project (see the Communications and Consultation guideline). 'Two-way' engagement means the stakeholders can give their views on siting and design considerations rather than just being given information without any opportunity to respond. Examples of two-way processes include public meetings and hearings, public comments on studies and options assessment documents, interactive participation in workshops, negotiation, mediation, and focus groups.

**Appropriately timed** means that engagement starts early enough in the preparation stage so that the project can respond to the issues raised; stakeholders can respond before the project takes decisions; and engagement takes place at times that are suitable for people to participate (e.g. with respect to seasonality or time of day).

Stakeholders should be supportive of the timing of engagement activities. Communities need sufficient time to receive information, be able to discuss it openly with the project representatives, then go through their own community dialogue processes before forming a consolidated community view to relay back into the evaluation processes.

Processes in place for stakeholders to raise issues could include, for example, a contact person and/or a 'contact us' space on the company website,

periodic public briefings or question/answer opportunities, or focal group meetings. Feedback on stakeholder issues could be demonstrated by means such as meeting minutes, media releases, or provision of responses to frequently asked questions on the company website. Ideally a register is kept by the developer of source, date and nature of issues raised during the siting and design process, and how and when each was addressed and resolved.

There is no expectation that all stakeholders will be satisfied and agree with conclusions drawn. The aim should be that stakeholders understand and respect the process that has been taken to get to conclusions, that they have been offered appropriate opportunities for two-way engagement, and that they feel their inputs have been incorporated fairly.

## Outcomes

*Outcomes criterion - Preparation Stage: The final project siting and design has responded to many sustainability considerations for siting and design.*

Sustainability considerations for project siting and design should arise from a process of research into this area as well as through engagement with directly affected stakeholders. Several examples of potentially relevant sustainability considerations to factor into siting and design have been provided at the start of this topic guidance. The project proponent should be able to demonstrate that any significant sustainability related considerations have been identified for the project, and in particular those that reflect social and environmental concerns. Documentation should show that alternatives for project siting and design have been evaluated against these criteria. The resultant proposed project should clearly be able to demonstrate that many of the sustainability considerations are met in the final siting and design.



# Environmental and Social Issues Management

*This guideline expands on what is expected by the criteria statements in the Hydropower Sustainability Tools (HST) for the Environmental and Social Issues Management topic, relating to assessment, management, conformance/compliance, stakeholder engagement and outcomes. The good practice criteria are expressed for different life cycle stages.*

*In the Hydropower Sustainability Assessment Protocol (HSAP), this topic is addressed in P-5 for the preparation stage, I-3 for the implementation stage and O-3 for the operation stage. In the Hydropower Sustainability ESG Gap Analysis Tool (HESG), this topic is addressed in Section 1.*

Hydropower projects can have a number of environmental and social impacts if these are not carefully assessed and managed. Fortunately, there is considerable global experience available to help identify potential impacts and to mitigate these impacts. Hydropower projects are quite individual due to their varied technological specifications and environmental and socio-

economic settings, so care needs to be taken to determine what environmental and social risks are applicable to any given project.

This guideline outlines steps that must be demonstrated to meet good practice, which may go beyond national requirements. The international expectations are based on global hydropower experience and ensure that risks that could have been avoided at the impact assessment stage do not later emerge. The intent for environmental and social issues management of hydropower is that:

- environmental and social impacts are identified and assessed;
- appropriate avoidance, minimisation, mitigation, compensation and enhancement measures are designed, implemented, monitored, and demonstrated to be effective;
- negative environmental and social impacts associated with the hydropower facility are managed; and
- environmental and social commitments are fulfilled.
- ‘Avoid, minimise, mitigate and compensate’ is a concise expression for what is understood to be a sequential process. Measures to avoid or prevent negative or adverse impacts are always prioritised, and where avoidance is not practicable then minimisation of adverse

impacts is sought. Where avoidance and minimisation are not practicable, mitigation and compensation measures are identified and undertaken commensurate with the project's risks and impacts.

## Assessment

*Assessment criterion - Preparation Stage: Assessments of project environmental and social impacts have been undertaken for project implementation and operation, including evaluation of associated facilities, scoping of cumulative impacts, role and capacity of third parties, and impacts associated with primary suppliers, using appropriate expertise and with no significant gaps; and a baseline has been established and well-documented for the pre-project condition against which post-project changes can be compared.*

During project preparation, assessment of potential environmental and social impacts, and the planning of measures to address these impacts, are as fundamental as engineering feasibility studies. The Environmental and Social Impact Assessment (ESIA) report is a critical step taken alongside project feasibility studies and informing detailed design. An ESIA identifies, predicts, evaluates and proposes mitigation for the biophysical, social, and other relevant effects and consequences of development proposals prior to major decisions being taken and commitments made.

To meet good practice, an ESIA report should contain at a minimum:

- a description of the proposed hydropower project;
- the hydropower project rationale and alternatives;
- a description of the existing environment sufficient to establish the pre-project baseline;
- relevant legal and policy requirements;
- a summary of stakeholder consultation undertaken during the impact assessment (see the Stakeholder Engagement criterion for this topic);
- identification and assessment of potential positive and negative project impacts, including ratings of their likelihood, and the magnitude and severity of consequences;

- a scope including the hydrological resource, terrestrial and aquatic biodiversity, waste, noise, air quality, water quality, erosion and sedimentation, downstream flows, project affected communities (including a focus on resettlement and on indigenous peoples if relevant), climate change, cultural heritage, public health, and labour and working conditions (individual guidelines provide further details on each of these topics);
- distinct evaluation of the above areas for the pre-construction, construction and operation stages of the project;
- proposed mitigation measures and management plans linked to each identified impact, with each measure clearly stating the objective and indicators of effectiveness;
- identification of **residual impacts**, i.e. those remaining after mitigation measures are implemented;
- management plan implementation arrangements, including responsibilities, timing, resources and budget; and
- a monitoring programme that addresses all potential impacts and will demonstrate if mitigation measures are effective or not.

Defining the project affected area is a critical step in the impact assessment process. This should be done at the scoping stage so that more detailed impact assessment and consultation is comprehensive. The project affected area is the project's area of influence in terms of direct and indirect effects. The assessment should not be limited by jurisdictional boundaries; i.e. an impact assessment should not stop at a national or state border unless a credible assessment determines that there will be no impacts outside of this area. Surrounding communities, activities along roads, quarries, disposal areas, and downstream areas subject to project influence must be included.

Spatially, the scope of impact assessment and management must cover direct and indirect impacts. **Direct impacts** are those under the control of or caused by the project, such as: changes in land ownership and/or land use; changes in environmental quality; and changes in quality of life for directly affected people. **Indirect impacts** are those outside the control of the project, such as: induced changes in regional demographics, employment, business and tax revenues, property values, and supply chain effects. The establishment of a project

affected area should also ascertain if there are any transboundary aspects of the project. This will allow early and careful consideration of how transboundary issues will be addressed when assessing impacts, engaging with stakeholders, and defining mitigation measures.

The ESIA should include impacts arising from facilities associated with the project. **Associated facilities** are those facilities that would not be constructed if the project did not exist, and where the project would not be viable without the other facility. These facilities may be funded, owned, constructed, and/or operated separately from the project, in some cases by third parties. Examples pertinent to a hydropower project could include roads, transmission lines, buildings, quarries and waste disposal sites.

The ESIA should include evaluation of the role and capacities of relevant **third parties**, such as local and national governments, contractors, and suppliers. An effective assessment should identify the different entities involved and the roles they play, as well as any corresponding risks that need to be managed with respect to achieving environmental and social outcomes. This should specifically include primary suppliers, i.e. first-tier suppliers which are providing goods or materials essential for the project and which may incur environmental and social impacts in this supply activity (such as a quarry or a factory).

While a full cumulative impact assessment is beyond the expectation of good practice, the ESIA should include scoping of relevant cumulative impacts. **Cumulative impacts** are those impacts that result from the incremental impact of the project when added to other past, present, and reasonably foreseeable future actions or trends. At a minimum, the ESIA should contain a Cumulative Impacts section which seeks to ensure that: potential areas for which cumulative impacts may arise have been identified; the nature of these potential cumulative impacts has been considered; liaison with key stakeholders has been undertaken; and initial agreements have been made on avoidance, monitoring and response mechanisms.

An essential requirement of the ESIA is to establish baseline information against which

the changes brought by the project can be compared. The impact assessment documents should explain and justify the data collection and analysis processes for different types of data to show that they are systematic and rigorous. Requirements for baseline information for each focal area of the ESIA include the following:

- appropriate expertise is used for the sampling design, data collection, data analysis and interpretation;
- all available sources of secondary data are identified and included, including previous studies, national databases, and all relevant institutions;
- local knowledge and information is included, including from communities in the project affected areas (local anecdotal information can often provide a good guide for primary data collection design);
- primary data (i.e. sampling by the ESIA consultant) is collected from locations meaningful to project risks, including in areas of direct and indirect effects, including as far downstream as the project significantly affects flows;
- sampling data is collected over a time period and at intervals that reflect important seasonal cycles for the topic being investigated;
- sampling results are described according to relevant national standards, and if national standards are not available, then international standards are adopted;
- sampling results are linked to other factors (e.g. seasonality, climate, flows, land uses, other activities) in order to explain pre-project trends and issues;
- the methodology used for primary and secondary data capture is well-described;
- the implications of limitations in data availability, analysis and interpretation are discussed; and
- wherever practical, sampling results are reported back to relevant national databases.

Baseline information should be supported by a good quality set of maps in the ESIA report, following a standard format designed to ensure easy readability. The scale of each map should be appropriate to the project context, the size of the impact area, and the information intended to be conveyed, with the emphasis being on ensuring that the reader can discern the intended information easily.



Impacts, mitigation measures, management, and monitoring plans should be considered separately for the project construction and operation stages. Predicted impacts should be described using recognised descriptive terms to characterise the impacts, such as: type of impact (positive, negative); nature of impact (direct, indirect, cumulative, potential if trigger conditions are met); magnitude or severity of impact (low, moderate, high); extent of impact in terms of geographic area (small, medium, large); timing of impact (short-term, long-term, intermittent, continuous, seasonal); duration of impact (temporary, permanent); reversibility of impact (reversible, irreversible); and significance of impact (local, regional, global). Descriptive terms should be explained for the different types of impacts as needed.

Every attempt should be made to quantify the impacts. Predictions of impacts are normally based on commonly used qualitative and quantitative methods and models. The sophistication of the predictive models should be proportional to the significance of the issue to which it is being applied.

The assessment should include researching appropriate mitigation approaches for all identified impacts. Some hydropower impact mitigation measures are well-known and often applied (e.g. speed limits for vehicle related risks), whereas others require considerably more evaluation due to questions of cost and likely effectiveness (e.g. multi-level offtakes for reservoirs at risk of developing stratification, re-regulation weirs or storages to dampen flow fluctuations, downstream flow releases, fish passage technologies, fish hatcheries, livelihood improvement options, and project benefits). There may well be other measures that would merit further analysis for the proposed project based on conflicting views among stakeholders and the benefits that closer analysis and justification would bring. The effectiveness of a mitigation approach for one hydropower project may not be achievable for another project, so the feasibility of alternative approaches needs to be tested. The feasibility of each mitigation approach should be carefully considered with respect to factors such as likeliness of achieving its objectives, cost effectiveness, understanding of the relevant technology or policy approach, capacity to deliver, experience in application, stakeholder views, and risks.

Throughout the impact assessment process and identification of ongoing and emerging issues, appropriate expertise should be used. This is especially the case for specialist issues. Appropriate expertise refers to specialists with experience in the key identifiable topical areas of the assessment and management plans, giving particular attention to the differences between environmental areas and social impact areas. Impact assessment reports should document the expertise used.

## Assessment

*Assessment criterion - Implementation Stage: Environmental and social issues relevant to project implementation and operation have been identified through an assessment process, including evaluation of associated facilities, scoping of cumulative impacts, role and capacity of third parties, and impacts associated with primary suppliers, using appropriate expertise; and monitoring is being undertaken during the project implementation stage appropriate to the identified issues.*

During project implementation, there is a need to monitor:

- waste, noise, dust, air quality, water quality, erosion, sediments, and hazardous materials arising from construction activities;
- secondary effects of construction and implementation activities on receptors (e.g. environmental receptors such as habitats and wildlife, and social receptors such as workers, communities and livelihoods); and
- the quality of implementation of environmental, health and safety, and social programmes within the ESMP (resettlement, cultural heritage, occupational and public health, etc. as relevant).

The purpose of monitoring is to ensure impacts are mitigated, to verify achievement of objectives, and to identify any issues arising. Monitoring commitments should be integrally embedded within the ESMP so that the reasons for monitoring are clearly apparent. Monitoring information within the various ESMP sections should clearly identify, with reasons given: parameters, locations, timing, sample analysis and data reporting methods, standards for results comparison, and responsible parties.

## Assessment

*Assessment criterion - Operation Stage: 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.*

Hydropower projects developed prior to the 1960s are unlikely to have had a pre-development ESIA. In such cases, environmental and social issues identification and management planning should be conducted in an appropriately tailored manner during the operational stage.

During operations, the project should establish systematic processes to identify ongoing and emerging issues that may or may not have been predicted in earlier stages. A range of methods may be used to identify issues, including: corporate environmental management systems; monitoring programmes (either internal or government); periodic risk assessments; mechanisms by which stakeholders can raise issues; and internal monitoring programmes used for other purposes such as maintenance or safety.

## Management

*Management criterion - Preparation Stage: Environmental and social issues management plans and processes have been developed with appropriate expertise (internal and external) for project implementation and operation with no significant gaps; in addition to key social and environmental issues relating to the hydropower project, plans address construction related waste, noise, air quality, land disturbance and rehabilitation; the environmental and social impact assessment and key associated management plans are publicly disclosed.*

The impact assessment process should result in the identification of measures to avoid, minimise, mitigate and compensate impacts. Measures should be set out in an Environmental and Social Management Plan (ESMP). An ESMP details the measures to be taken during the implementation and operation of a project to eliminate or offset adverse environmental impacts, or to reduce them to acceptable levels, and the actions needed to implement these measures. The ESMP may be a large consolidated plan or a number of

specific plans for different impacts or mitigation activities. The objectives of an ESMP are:

- to document commitments to mitigation measures;
- to establish systems and procedures for implementation;
- to assign budgets, time schedules and responsible parties for implementation;
- to monitor the effectiveness of mitigation measures and, if necessary, update the mitigation commitments;
- to ensure compliance with relevant laws, regulations, conditions and standards; and
- to take necessary actions when unforeseen impacts occur.

The alternatives analysis in the ESIA can often provide good evidence of avoidance or minimisation measures. Where both avoidance and minimisation are impracticable, mitigation and compensation measures are identified and undertaken commensurate with the project's risks and impacts. Residual impacts are those impacts that remain after all avoidance, minimisation and mitigation measures have been applied, and it is for these that compensation measures are often considered to "offset" the impact or loss. Projects should aim for:

- all significant impacts to have clear measures defined that avoid, minimise, mitigate and compensate;
- all significant residual impacts to be well-understood by those who bear the consequences of those impacts;
- improvement of living standards and livelihoods for project affected communities compared to pre-project conditions; and
- ideally, net gain of biodiversity and environmental quality compared to pre-project conditions.

Mitigation measures can be classified into structural and non-structural measures. Structural measures include design or location changes, engineering modifications and construction changes, landscape or site treatment, mechanisation and automation, etc. For hydropower projects these may include, for example: sediment settling basins; erosion

protection works; wastewater treatment plants; fish passage; re-regulation structures; and safety barriers. Non-structural measures include, for example: economic incentives; legal, institutional and policy instruments; reservoir and power station operating rules (e.g. ramp-up and ramp-down rates, minimum and maximum reservoir levels); water release rules for downstream flow commitments; information signage; warning sirens; provision of community services; and training and capacity building. Non-structural measures are increasingly being used to reinforce or supplement structural measures and to address specific impacts.

The ESMP needs to be structured to distinctly cover construction and operation. Sections of an ESMP for hydropower projects will reflect the individual project context and issues. Examples of focal areas that may be within the ESMP are: catchment area treatment and protection; the Resettlement Action Plan; principles and guidance relating to indigenous peoples; spoil (excavated waste soil) dump management; compensatory afforestation; downstream (or “environmental”) flows; integrated water resources management; emergency management; terrestrial biodiversity conservation and wildlife management; green belt development; quarry restoration; aquatic biodiversity conservation and fisheries management; air quality management; noise management; labour management; worker occupational health and safety; land management; land disturbance rehabilitation; water quality management; water use and water supply management; reservoir rim treatment; erosion and sedimentation management; wastewater treatment; solid waste management; public health management; stakeholder engagement; grievance management; community development; project benefits; livelihood improvement; community safety; road safety; energy conservation; and traffic management.

Each component of the ESMP must outline impacts, mitigation measures, mitigation objectives and indicators of success, responsibilities, budget including contingency, time schedule, and monitoring. It is essential that all items on the above list are included or else the ESMP actions risk not achieving their intended

objectives. Ideally, the ESMP would also include adaptive management measures. This would identify what issues might be identified through the monitoring and surveillance and what the response would be (including responsible parties and contingency budget set aside).

The ESIA and ESMP should be made available to the public. This is often achieved by making hard copies available in public venues, for example at the regulator’s office and at local municipal offices; by posting the documents on a publicly accessible website; and by providing summaries on paper and verbally in local public meetings. International good practice requires making the ESIA and ESMP fully available on an easily accessible public website so that it can be accessible to a broad group of interested stakeholders, as well as ensuring local availability through well-considered means (see the Communications and Consultation guideline).

## Management

*Management criterion - Implementation Stage: Processes are in place to ensure management of identified environmental and social issues utilising appropriate expertise (internal and external), and to meet any environmental and social commitments, relevant to the project implementation stage; plans are in place for the operation stage for ongoing environmental and social issues management; and the environmental and social impact assessment and key associated management plans are publicly disclosed.*

*Management criterion - Operation Stage: 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).*

Identification and associated management arrangements should be updated in response to changes in the project, findings from monitoring programmes, changes in community expectations, and changes in compliance requirements that may occur during implementation and operation. An environmental and social management system provides a systematic approach to

the management of social and environmental issues during the operations stage. More detailed guidance can be found in international standard ISO14001. The issues managed should reflect problems identified in the preparation and implementation stage and should at a minimum be consistent with the legal obligations of the project. A compliance register or comparable mechanism can be used to document environmental and social compliance requirements, and actions taken in relation to them. A systematic process should include ongoing assessment of issues and monitoring of the effectiveness of management measures, and changes and improvements to management approaches over time as new information becomes available. A process of evaluation, and improvement where warranted, should be evident.

## Stakeholder Engagement

*Stakeholder Engagement criterion - Preparation Stage: The environmental and social impact assessment and management planning process has involved appropriately timed, and often two-way, engagement with directly affected stakeholders; ongoing processes are in place for stakeholders to raise issues and get feedback.*

*Stakeholder Engagement criterion - Implementation and Operation Stages: Ongoing processes are in place for stakeholders to raise issues and get feedback.*

Good practice requires that a process of stakeholder engagement has been followed in the assessment and planning for environmental and social issues management for hydropower projects. The identification and assessment of impacts during preparation should be based on stakeholder engagement. The impact assessment is often the main stakeholder engagement process during preparation. In addition, there should be ongoing processes for stakeholders to make their views on impacts heard. Full details on stakeholder engagement are provided in the guideline on Communications and Consultation.

## Conformance/Compliance

*Conformance/Compliance criterion - Implementation and Operation Stages: Processes and objectives in the 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.*

During implementation and operation, the project should be in conformance with the objectives and commitments set out in the management plans, and any broader corporate commitments (for example as set out in a corporate sustainability policy) or commitments made to stakeholders (such as financiers). The project should be in compliance with all legal requirements, which should have been identified during the impact assessment process and through ongoing systematic monitoring, including any legally-enforceable conditions associated with permitting. Variations to commitments should be well-justified and approved by relevant authorities, with appropriate stakeholder liaison.

The significance of not meeting a commitment is based on the magnitude and consequence of that omission and will be context-specific. For example, a failure to demonstrate delivery of an essential environmental impact mitigation commitment is a significant non-compliance, whereas a slight delay in delivery of a monitoring report could be a non-significant non-conformance.

## Outcomes

*Outcomes criterion - Preparation Stage: Environmental and social plans avoid, minimise and mitigate negative impacts with no significant gaps.*

*Outcomes criterion - Implementation Stage: Negative environmental and social impacts of the project are avoided, minimised and mitigated with no significant gaps.*

*Outcomes criterion - Operation Stage: 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.*



To show that plans avoid, minimise, mitigate and compensate negative environmental and social impacts from project activities, mitigation measures in the plans should be directly linked to all identified environmental and social issues and risks. The assessment and planning should be informed by appropriate expertise. The assignment of responsibilities and resource allocation for implementation, monitoring and evaluation should be appropriate to the planned actions.

An evidence-based approach should demonstrate that negative environmental and social impacts arising from project implementation and operation activities are avoided, minimised, mitigated and compensated with no significant gaps. The developer, owner and operator should

demonstrate that responsibilities and budgets have been allocated to implement ESMP plans and commitments. Monitoring reports and data in the implementation and operation stages should clearly track performance against commitments and objectives and capture environmental and social impacts. It should be possible to provide examples to show how identified risks from the ESIA have been avoided or minimised. It should also be possible to table evidence to show that mitigation plans have been implemented and are being monitored. Implementation of measures for environmental and social mitigation should be evident and monitoring should show how they are achieving their stated objectives.



# Integrated Project Management

*This guideline expands on what is expected by the criteria statements in the Hydropower Sustainability Tools (HST) for the Integrated Project Management topic, relating to assessment, management, conformance/compliance and outcomes. The good practice criteria are expressed for the preparation and implementation stages.*

*In the Hydropower Sustainability Assessment Protocol (HSAP), this topic is addressed in P-6 for the preparation stage and I-4 for the implementation stage.*

An effective integrated project management process is fundamental to the success of a project. Major infrastructure project developments typically involve many contractors and sub-contractors and multiple work sites. Overall coordination of these multiple considerations is essential. This guideline addresses the developer's capacity to coordinate and manage all project components, taking into account project construction and future operation activities at the project affected areas. The intent is that the project meets milestones across all components, delays in any component can be managed, and

one component does not progress at the expense of another.

**Project components** in this context refer to components of the overall hydropower development programme that need to be scheduled and managed. These may include, and are not limited to, design, construction, environmental, social, resettlement, finance, safety, human resources, communications, and procurement.

## Assessment

*Assessment criterion - Implementation Stage: Monitoring of project progress, milestones, budget and interface issues, and of the effectiveness of management of implementation stage plans including construction management, is being undertaken on a regular basis during project implementation.*

While there is no Assessment criterion in the Protocol's preparation stage and this stage starts with development of the integrated management plan (see below under the Management criterion), there are assessment activities necessary to develop this plan. These start with understanding all aspects of the project development needs and the associated objectives and risks.

Once developed, the integrated management plan forms the basis for the implementation stage monitoring programme. Responsibilities, scope, timing, methods and reporting for monitoring of project construction and integrated project management plans should be clear for all aspects of project implementation. The logic of the design of monitoring programmes should be clearly documented and linked to objectives and risks. Monitoring reports should have a hierarchical design in which information is provided at the appropriate timing and level of detail for the uses and users of that information. Monitoring should also be regularly consolidated into reports for higher management, at a minimum addressing construction progress, environment, health, safety, labour and quality statistics, and identifying risks and interface issues. Higher level reports for supervisory board members should consolidate progress on engineering, environmental, financial and institutional activities guided by Key Performance Indicators (KPIs) set by the board of directors. Reports should clearly inform meetings and decision-making and guide continuous improvement measures.

Interface issues present risks to the project in terms of the potential to have a major impact on cost, timing or result in dispute. On sites with multiple major contractors and suppliers, each is appointed separately and gaps in responsibility can arise. Interface issues can arise between different contractors, for example with access to and timing of works in a particular work area or with use of resources and supplies. Further examples of interface issues include: starting to fill the reservoir before the resettlement plan is fully implemented; construction activities impinge on significant cultural heritage sites that should have received prior protective measures; or noise and dust from construction activities limit the effectiveness of biodiversity management measures. An overall project management office, and interface mapping and management, are key mitigation measures. Good practice requires a thorough analysis of potential interface issues, as well as monitoring throughout project implementation to determine how well these issues are being avoided and managed and if new issues are arising.

## Management

*Management criterion - Preparation and Implementation Stages: An integrated project management plan and processes have been developed and are in place that takes into account all project components and activities with no significant gaps; and a construction management plan has been developed and is in place that identifies construction risks and describes processes that contractors and others are required to follow to manage these risks.*

The preparation stage assessment activities will have established the project needs through the feasibility studies, detailed design report, and Environmental and Social Impact Assessment (ESIA). Plans produced during preparation should clarify objectives, establish necessary resources for implementation, identify roles and responsibilities, establish critical paths, assess risks and risk management measures, and evaluate potential interface issues. A frequent cause of project cost over-runs and delays is poor planning in relation to project activity scheduling. Many activities depend on the completion of others prior to commencement, and the critical path needs to be well-understood. Individual plans for particular project focal areas (many of which form the basis for contracts) must fit into an overall integrated project management plan.

The **integrated project management plan** should address the major project components and the hierarchy of relevant plans and responsibilities. There will always be a construction management plan, but these construction activities need to be implemented alongside the Environmental and Social Management Plan (ESMP) and component sub-plans, which may include plans relating to resettlement and project benefits and may also exist alongside plans relating to transmission line development and upgrades to the national road network to enable supplies to come into the project. The integrated project management plan should encompass the activities necessary for successful delivery of the project, whether they are the direct responsibility of the developer or not, and ensure that the parties involved understand their respective roles, responsibilities, scheduling, resources, significant path analysis, interface targets, risks, communications and coordination mechanisms, procedures, and controls.

The model for project delivery will depend on the choices made by the developer with regards to contractual arrangements, costs, and how risk is allocated and managed. Under any model, a project management office should be established with the central responsibility for project coordination and tracking against the overall integrated project management plan.

The construction management plan sits at a level under the integrated project management plan. It outlines activities required for construction of the hydropower infrastructure and specifies the layout and zones for the construction site activities. Locations of permanent project features (including the dam, reservoir, penstock, power house, tailrace, and transmission line) and temporary project features (including access roads, labour camps, workshops, offices, storage areas, waste disposal areas, and topsoil stockpiles) should be specified. The detailed construction schedule, critical path, and interfaces should be specified. These may include permits, inspections and approvals for various steps. Construction stage resource requirements and sources should be outlined with management measures, including:

- major supplies and equipment (e.g. cement, concrete aggregate, steel, explosives, pipework, turbines, and other electromechanical equipment);
- quarries, borrow pits, spoil, and topsoil stockpile areas;
- labour (permanent, contracted, sub-contracted, third parties);
- temporary storage areas;
- temporary access roads;
- construction stage water uses, quantities, quality, sources, treatment, and disposal;
- construction stage energy uses, types, quantities and sources;
- solid, liquid and hazardous waste quantities, treatment, drainage plans, transport needs, and disposal; and
- temporary camps, workshops, offices.

The construction schedule should address requirements from pre-construction site preparation (e.g. land acquisition and permits, site clearing, early access roads, temporary structures, energy and water access); site development

(e.g. camps, offices, internal roads, storage, workshops); major project construction (e.g. river diversion, intake structure, outlet works, dam construction, spillway, power house); reservoir filling and project commissioning; and site demobilisation and land rehabilitation.

The construction management plan should establish relevant policies and processes that will guide the work. These should include but not be limited to: project management; occupational health and safety; procurement; communications; reporting; labour management; environmental management; quality assurance/quality control; security; risk; compliance; budgets; insurance; permits; and audits. Alignment of policies and processes through work areas and contracts and sub-contracts should be ensured by clearly including expectations in contracts.

Construction risks should be well-analysed with proposed avoidance, minimisation and mitigation measures in the construction management plan. Major construction risks relate to impacts on time, cost and quality. Further and more specific construction risk examples could be in relation to safety, air, noise and water pollution, land contamination, land disturbance, water management, waste management, introduced species, health, the workforce, the supply chain, quality, weather, and worker-community conflicts. Many of these factors may be identified and evaluated in the feasibility studies, detailed design report and the ESIA, hence the need for close coordination between the construction project managers and the environmental and social managers.

An important element to be included in the integrated project management plan is the handover from construction to operation. There are many aspects that need to be built into this planning, including document management, engagement with the owner/operator during the design and construction stage so that future operations and maintenance (O&M) needs are built into the design, and training of the future O&M staff on the equipment and operations.



## Conformance/Compliance

*Conformance/Compliance criterion - Implementation Stage: Processes and objectives in the integrated project management plan and the construction management plan have been and are on track to be met with no major non-compliances or non-conformances.*

The integrated project management plan and the construction management plan represent a shared view of how the project will proceed. Approvals for project development and/or for project finance are likely to be given on the expectation that measures outlined in these plans will be delivered as per the plan. Compliance with terms of approvals is essential in development of the project.

The significance of any non-compliance is linked to magnitude, consequence, or repetition. Major non-compliance examples could include: not providing accommodation facilities for labourers in line with national standards; not reporting hazardous chemical spills; not using an independent panel of experts for dam safety as specified in the approvals and in the construction management plan; clearing a substantial area of vegetation without receiving the appropriate permit; or repeatedly dumping waste spoil in areas not officially designated to receive it. A significant non-conformance with the integrated project management plan might be commencing reservoir filling before resettlement preparations have been completed. A minor non-compliance might relate to, for example, a slight delay in delivery of a standard monitoring report. Variations to contracts should be well-justified and documented.

In the case of a major project development, compliance with contractual clauses needs close attention, especially when activities and tasks are delivered through sub-contractors or off-site manufacturers and suppliers. Consequences for non-compliances should be clear and delivered, such as fines or stop work actions (e.g. for a safety non-compliance).

Monitoring should include checking that processes in management plans are being followed. These will be specific to individual areas. Spot audits can be useful to randomly check how

different contractors or work areas are adhering to appropriate processes. These may relate to, for example, working conditions, hazardous work spaces, procurement, data management, or quality control measures.

## Outcomes

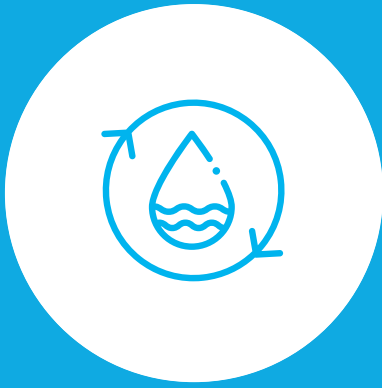
*Outcomes criterion - Preparation Stage: The project is likely to meet overall budget and timing objectives and targets, and plans avoid, minimise and mitigate construction risks with no significant gaps.*

*Outcomes criterion - Implementation Stage: The project is meeting overall budget and timing objectives and targets; interface issues are managed effectively; and construction risks are avoided, minimised and mitigated with no significant gaps.*

Overall budget and timing objectives and targets should be clearly identified in relevant plans and in major contracts. At the preparation stage, the content of the plans, the level of risk analysis and mitigation measures, and the capability of the developer, major contractors and third parties, should be at a level of planning that provides confidence in the ability of the project to deliver on its overall budget and timing targets. Contingencies should be well-considered and included.

Data collected and reported during implementation should clearly show project performance against KPIs and demonstrate delivery to targets and corrective actions taken where deviations from targets are evident or a clear risk. In addition to time and cost, KPIs set by the board of directors and possibly by major financial institutions might address other areas such as safety, labour, environment, communications, and quality. KPIs should be strategically set so that emerging issues can be detected, interface issues can be avoided, and risks can be managed early.

Project costs and time requirements may be updated during project implementation as practical issues with project delivery arise. They should remain within the boundaries of financial viability established for the project financial model (see the Financial Viability guideline).



# Hydrological Resource

*This guideline expands on what is expected by the criteria statements in the Hydropower Sustainability Tools (HST) for the Hydrological Resource topic, relating to assessment and management. The good practice criteria are expressed for the preparation and operation stages.*

*In the Hydropower Sustainability Assessment Protocol (HSAP), this topic is addressed in P-7 for the preparation stage and O-4 for the operation stage. In the Hydropower Sustainability ESG Gap Analysis Tool (HESG), this topic is addressed in Section 11.*

As a significant water resource development, a hydropower project requires a very good understanding of water inflows to and outflows from the project site and the future operating hydropower facility. Poor estimations of water availability can lead to inefficient design and operation of the hydropower facility and reduce its production potential. Misunderstanding of the magnitude, timing, variability and extremes of the patterns of water inflows can also present significant infrastructure safety risks. Overestimation

of water availability can lead to overinvestment in the hydropower facility and future financial viability issues. Insufficient consideration of other water users, including downstream, can lead to water resource use conflicts.

River flows are **stochastic** in nature, meaning they have a random probability distribution or pattern. The degree of hydrological variability can be extreme in many areas of the world. The correct analysis of water resources and proper allocation between competing uses for that resource are critical to the viability and operation of a hydropower facility. The longer the period of field data collected to inform project design, the higher the confidence in planning for hydrological resource risks. Management of uncertainty and extreme climatic conditions, especially given climate change and potentially competing needs for water resources, require close attention throughout the project life cycle.

This guideline addresses the level of understanding regarding the hydrological resource availability and reliability for the project or operating hydropower facility, and the planning for generation operations based on these flows. 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, including other needs, issues or requirements for the inflows and outflows, as well

as likely future trends (including climate change) that could affect the facility.

## Assessment

*Assessment criterion - Preparation Stage: An assessment of hydrological resource availability has been undertaken utilising available data, field measurements, appropriate statistical indicators, and a hydrological model; issues which may impact on water availability or reliability have been identified and factored into the modelling; and scenarios, uncertainties and risks have been evaluated.*

The determination of the hydrological resource for a hydropower project requires a combination of investigations and analyses by field hydrographers, hydrologists, and hydropower and hydraulics engineers. The initial hydrological resource assessment will normally take place early in the investigation and assessment phase of a project and will continue through the feasibility studies and detailed design stages. Assessment activities involve gathering and measuring basic rainfall and streamflow data, statistical analyses and statistical extension of this data, modelling of the reservoir, optimisation of the project siting and design, and optimisation of the construction planning and scheduling (e.g. taking into account diversion dam design with respect to flood frequency analyses).

The degree of reliability of flow, and thus of future power generation, primarily depends on three factors:

- the magnitude and variability of reservoir inflows, taking into account natural flows and upstream water users;
- the required generation (and equivalent turbine flow); and
- the size of the storage (largely dictated by the site characteristics).

The generation output and the storage size and head should be optimised for the specific site characteristics (see the Siting and Design guideline).

Data requirements for hydrological assessments include: climatic data (e.g. rainfall, air temperature, humidity, wind, evapotranspiration); topographic data (e.g. slopes, river length, land

use); stream flow (e.g. discharge, snow melt, floods); groundwater data (e.g. infiltration, discharge); and patterns of other water resource uses. Data should be validated as being of good quality and checked for consistency to identify gaps and non-conformances with typical hydrological patterns. Recognised methods should be used to fill short-term data gaps and to correct any systematic errors, with modelled data also checked for consistency. Consistency checks should include various forms of analyses of stage-discharge relationships, average flows, flow volumes, flow time series, and rainfall-runoff. Where feasible, consistency checks should involve comparisons with observed data in comparable adjacent catchments or sub-catchments.

The length of flow record used to inform project design would ideally be 10 years for a relatively small project (e.g. run-of-river or small impoundment) and up to 25 years for a major storage project. As flow records are rarely available at or close to the intended project site, shorter-term field data should be correlated with longer-term records of nearby and comparable sites, with hydrological modelling used where required to build flow records. It would be expected that real-time data is collected and analysed throughout the development and operation of a more complex hydropower project.

If the project is to be operated largely in run-of-river mode, there should be evidence of proposed or actual daily operational plans that match the desired station output with the available flow. If the project is able to retain water as storage for later release, there should be evidence of reservoir management analysis in the form of seasonal reservoir rule curves and operating rules. The complexity of analysis and data requirements relates to the economic, safety and environmental risk of the project. Where a derived flow sequence has been used for the primary hydrological resource analysis, the method of data simulation needs to be carefully considered. For lower levels of project risk a simplified regression method may be appropriate, whereas for high risk and complex projects a more rigorous statistical and regional method and/or appropriately calibrated hydrological model will be required. Hydrological models should be scientifically recognised and well-calibrated using multiple gauging stations and at least 12 months of rainfall-runoff measurements over a range of flow types and

magnitudes. The impacts of glaciers, snow cover, and climate change should also be taken into account.

Future climate change trends should be informed by scaled-down regional climate models. Analyses should assess site-specific temperature and precipitation changes over the short- and long-term, using one or more global climate models (also known as general circulation models) as well as evaporation and runoff modelling to estimate changes in net water yield. Sensitivity analyses should be conducted to consider various climate change scenarios and the results using different global climate models.

Analyses to determine the electricity generation potential need to align with any national requirements regarding dependability values for the energy produced and the timesteps used for the analyses (e.g. daily or monthly inflow values). These analyses are a critical input to the financial models as they provide an estimation of revenues and hence the project's financial viability (see the Financial Viability guideline). Electricity generation calculations must take into account water needs for other purposes (see the Downstream Flow Regimes guideline).

Flood estimations and analyses are a major component of the preparation stage assessments. These estimates inform spillway design and are used for planning river diversions during construction. Flood assessments require high resolution rainfall data and concurrent runoff data. Spillway design relates to the inflow design flood, the size of the reservoir, and the hydraulic head. Methods for calculating design floods vary by country and with dam type. Requirements may relate to the Standard Project Flood (SPF), being the flood generated by the most severe rainstorm on record, and the Probable Maximum Flood (PMF), which is a calculated value and not based on observed records. Any estimates should take into account Glacier Lake Outburst Floods (GLOFs) if relevant to the region.

The International Commission on Large Dams (ICOLD) requires that large dam design should be based on the PMF, and this is adopted as the standard for many modern dam projects. The PMF should be calculated based on the Probable Maximum Precipitation (PMP), following the method specified by the World Meteorological

Organization (WMO). The spillway design flood needs to further take into account acceptable hydraulic conditions, adequate freeboard on the dam crest, and assumptions on gate operation for gated spillways. Hydrological studies should calculate the PMF, SPF and floods with return periods up to 10,000 years. Design engineers should choose and justify the design floods appropriate to the hydropower development based on national requirements, reservoir size, hydraulic head, and a thorough understanding of downstream and operational risks.

Hydrological assessments that inform the design of river diversion works for the construction period should underpin construction planning considerations relating to timing, cost, safety, resources and convenience. Time requirements for the diversion depend on the asset being protected (i.e. dam, power house) and type, scale and location. The appropriate annual flood return period needs to be established in relation to construction needs and risks, and flood frequency analyses conducted for dry season and annual flood frequency.

For planning of reservoirs, flood volume is more important than the floods with the highest peaks. Flood hydrographs should be developed based on different rainfall durations, which will depend on the catchment size. Flood volumes should be routed through the reservoir to determine the decisive design flood that leads to the highest reservoir water level.

Issues which may impact on water availability and reliability need to be well-identified and factored into planning. Examples include: upstream and downstream hydropower operators and water resource users; future water resource use developments; future development of water-reliant land uses (e.g. agriculture, industry, population growth); catchment conditions; climate change; and negotiations over water allocation. If the project is reliant on water resources that extend beyond the jurisdictional boundaries in which the project is located, the implications of this need to be fully considered.

## Assessment

*Assessment criterion - Operation Stage: 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.*

Further to the guidance above, assessment of the hydrological resource is required throughout operation of the hydropower facility in order to maintain optimal performance according to the short- and long-term operational requirements.

Real-time monitoring of rainfall and flow should be undertaken in the catchment to provide data on water resource availability and trends. Field data needs to be regularly calibrated and validated, and data quality should be recorded. All data collected should be stored in a database that allows ready access to the data and retrieval of historical analyses.

A range of hydrological and generation models can be used to manage one or a fleet of operating hydropower facilities and will depend on the context and market situation. For example, models may be set up separately for analyses and projections of:

- inflows to storages based on rainfall and water levels;
- short- and long-term electricity generation based on market demand and available generating and transmission assets;
- water value based on forecast inflows and power trading signals; and
- flood forecasting linked to reservoir management and dam safety emergency planning.

Issues that may affect generation need to be monitored and assessed to inform generation decisions, including inflow trends, effects of climate change, drought, energy forecasts and price predictions, asset maintenance, other (and possibly changing) resource demands, environmental constraints, and social uses of the water resources (e.g. new developments, water recreation events). Outputs of models and other monitoring mechanisms should be available to data users and decision-makers as needed.

Periodic studies should be undertaken to consider longer-term scenarios and sensitivities. These studies are closely linked to those needed to inform asset management planning (see the Asset Reliability and Efficiency guideline) and infrastructure safety assessments (see the Infrastructure Safety guideline).

## Management

*Management criterion - Preparation Stage: A plan and processes for generation operations have been developed to ensure efficiency of water use, 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 including downstream flow regimes.*

*Management criterion - Operation Stage: 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.*

Generation operations should be informed by short- and long-term modelling of water availability and reliability as described above and should be guided by clearly stated operating rules. Operating rules help inform generation operators of thresholds for decision-making (e.g. drawing a reservoir down before the flood season, releases required for environmental flow objectives) and should factor in not only technical and financial considerations but also social, environmental and economic needs (see also the Downstream Flow Regimes guideline).

At the preparation stage, planning for generation operations should seek to ensure efficiency of water use while meeting other water resource needs, including those of external stakeholders upstream and downstream of the project. At the operation stage, systems should be in place to ensure that emerging issues are rapidly identified and inform management responses. Generation operations should be informed by regularly updated risk assessments and forward plans should be developed for a range of time scales. Power system opportunities and constraints should be well-monitored, for example patterns of demand for energy (e.g. base vs peak load),

power prices, other generators and their capacities and constraints, and transmission issues.

Over the long-term, communities surrounding the hydropower facility in the catchment, around the assets, and along the downstream river will evolve, with consequent changes in water abstraction, land use, and expectations for shared water resources. Awareness of environmental and social values and needs, both within the reservoir and downstream, is growing as societies become

more educated and allocations of water for environmental and social needs are increasingly becoming embedded in legislation. Competing water uses and other developments in a catchment can lead to more rigid water allocation rules and more rigid standards on water quality and biodiversity indicators. The business will need to be aware of and prepared to adapt to changing societal needs and should be able to demonstrate this through risk assessments and community engagement processes.





# Asset Reliability and Efficiency

*This guideline expands on what is expected by the criteria statements in the Hydropower Sustainability Tools (HST) for the Asset Reliability and Efficiency topic, relating to assessment, management, conformance/compliance and outcomes. The good practice criteria are expressed for the operation stage.*

*In the Hydropower Sustainability Assessment Protocol (HSAP), this topic is addressed in O-5.*

The asset reliability and efficiency guideline seeks to ensure that hydropower 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. Asset, in this context, refers to the infrastructure, plant and equipment on which the hydropower station generation operations are reliant. Reliability means that equipment will be available when needed to meet customer demands and may be closely linked to energy security. Efficiency typically relates to the conversion of available energy into electricity, which for a hydropower plant can be as high as 95% depending on a range of factors. Efficiency in this context may also refer to the value of the asset in relation to the costs of running it.

Hydropower asset types relevant to this guidance include: the water storage and conduit system (i.e. the reservoir, intake, head race tunnel, surge shaft, emergency valves, pressure shafts, penstock, main inlet valves); turbines; generators; transformers; the switchyard; and non-generational infrastructure such as land, buildings, roads, bridges, jetties, signage, vehicles, communications systems, and monitoring stations. Transmission infrastructure would also be included insofar as the responsibilities rest with the hydropower facility owner/operator.

Operating hydropower facilities, including associated infrastructure, require regular and systematic assessment and maintenance to ensure adequate reliability and efficiency over time. The consequences of poorly planned and implemented asset management can include: machine failure and loss of power generation; loss in efficiency of the system, which will increase the cost per megawatt of generation; reduced asset life span; public safety issues (e.g. dam failures, trees falling onto power lines, injuries to community members); and environmental incidents (e.g. oil spills into waterways). Infrastructure safety is integrally related to asset management and is addressed more specifically in the Infrastructure Safety topic guideline.

Many civil assets such as dams are required to achieve an effective service life in excess of 100 years. The nominal service life for many major



electrical and mechanical hydro assets is typically in the order of 50 years, although modern digital electronic equipment has a nominal service life of only 10 to 20 years. Actual asset life depends on a number of factors including:

- the extent to which the original designs and manufacturing and construction quality address the actual operational duties;
- operating conditions, including environmental factors;
- changes to operational duties over the life of the asset; and
- the adequacy of asset management inspections, functional testing, condition assessment, maintenance, repair, rehabilitation and upgrade regimes.

## Assessment

*Assessment criterion - Operation Stage: 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.*

Operating conditions should be continuously monitored and recorded. A number of intrusive inspection and maintenance activities are required in order to achieve the expected asset life. These activities need to be complemented by a well-tailored programme of preventative maintenance, condition monitoring and testing.

Monitoring should inform identification of ongoing and emerging asset maintenance and management issues. Asset maintenance issues may be related to, for example, budget cycles and availability, the availability and capabilities of the workforce, logistical or access difficulties to undertake planned maintenance, or the ability to get parts and spares.

Asset reliability issues could include, for example: start failures and forced or unplanned outages (i.e. the power station stops operating), maintenance-induced failures; or constrained operation due to, for example, temperature or vibration issues. Asset efficiency issues could relate to megawatts (MW) of electricity generation per unit of water flow (m<sup>3</sup>/s) being

lower than design expectations or production targets, or very high maintenance costs in relation to the value of the electricity generated. Root causes could include, for example, normal wear and tear, pitting or abrasion of parts, changes to machinery configuration over time which reduces efficiency, difficulties with valves due to lack of use, rust, corrosion, stresses, material fatigue, and cracks. The results of inspections, condition assessment and maintenance need to be well-documented, stored, and analysed to identify or predict asset condition changes, trends and emerging risks.

Routine monitoring may include visual inspections, testing, measurements, and data collection from instrumentation. Measurements can be obtained through a diverse range of sensors selected for specific risk detection or assurance of optimal running conditions, such as accelerometers for vibration or strain gauges for mechanical stresses. An online condition monitoring system for the generator, turbine and main transformers can be set up to enable live data to be read by system operators at a central control room.

Optimal asset management is based on analysis of technical condition, residual life, risk, profitability, and timing of maintenance and reinvestments. Condition assessments are a key element of optimising asset management and as noted under the Management criterion are the cornerstone of a mature asset management system. These assessments support the development of long-term investment strategies, prioritisation of capital investments, coordination of operations and maintenance (O&M), and identification and tracking of performance goals.

Condition assessments should be designed to achieve objective and repeatable assessments with minimal time and expense for testing, data analysis, reporting and data management. Risks to avoid in undertaking assessments include: inefficient processes; more tests or inspections than is necessary; improper validation or calibration of procedures and results; and a lack of a convenient or consistent method to store, access and utilise data.

Condition assessments typically result in development of a condition index or rating. A view on a particular asset unit or group and

the power station as a whole is informed by aggregating individual equipment ratings. Information to inform condition assessments can originate from a wide range of sources and should include: drawings; reports; test results; photos; data monitoring and trend curves; interviews with plant operators and engineers; records of maintenance routines, operational problems and visual inspections; descriptions of condition state; inspection reports; and new measurements. Established evaluation and classification rules should inform views on the condition rating, taking into account equipment age, O&M history, and any other relevant condition indicators. Information quality and confidence in the result should also be rated. A low condition rating or data quality score should lead to further evaluation. More detailed assessments should involve non-routine tests and inspections using specialised expertise and/or instrumentation, resulting in a refined and more accurate asset condition index.

Condition assessment ratings inform refinements to O&M programmes and are an important input to the timing and scale of planned major investments into refurbishments and upgrades. Many other factors should also inform asset investment priorities and decisions, including strategic importance, lost revenues as a result of equipment failure, reliability criticality, forced outage rates, environmental concerns, cost, consequence, and risk. Undertaking or not undertaking a repair or replacement action can be of concern from a technical perspective but may also have legal, regulatory, safety, environmental, and economic consequences. Important analyses to inform business priorities and investment decisions include asset failure or residual life models, analysis of failure probability and associated risks, cost-benefit analyses of maintenance and reinvestment measures. The type of analysis undertaken will depend on the context.

Failure mode identification is an important tool for asset assessment and planning and should inform an asset risk register to capture the key risk issues. Issues arising in practice should be readily identified through the routine O&M activities and analysed with respect to root causes. Records are very important in diagnosing the root causes of faults or failures, informing replacement decisions

and determining residual life. Investigations of asset failures or tripping occurrences should address how and why the issue occurred and what can be done to avoid its reoccurrence, with the learnings applied to all similar plant or processes.

Manufacturers criteria, records, experience and history should inform the setting of limiting values for key equipment parameters. Characteristics of identical equipment can vary from unit to unit and unique features can emerge over time based on usage patterns and the particular context, such as environmental or climatic factors. The original equipment manufacturer's recommendations on maximum and minimum permissible parameters for their equipment are often conservative, and so the limits adopted in practice should be informed by good monitoring and analyses accompanied by an understanding of failure modes and risks.

## Management

*Management criterion - Operation Stage:  
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 monitoring, maintenance, management and refurbishment requirements depend greatly on the hydropower plant type, setting, usage, age and stresses. Asset management plans should be developed in a systematic manner, addressing appropriate levels (asset portfolio, power station, asset type) and both short-term and long-term needs.

Management plans, guidelines, procedures, and detailed work instructions should be addressed with respect to each of the specific types of assets, as listed in the introduction to this guidance. Routine requirements and detailed work instructions will be specific to the asset type and are typically a mix of inspections and actions that help ensure optimal asset performance and prevent major issues arising. For example, routine requirements for water storage and conduit systems could include: regular testing of operation of conduit isolation system equipment (e.g. intake gates, valves, excess flow device,

surge equipment); periodic physical inspections to look at condition, silt deposition, rust, erosion, abnormalities; leakage inspections, testing and treatment; painting inspections and repainting; replacements of deteriorated valve seals; purification and testing of hydraulic system oil; and clearing and maintenance of the trash rack or intake gate filter.

Asset management data should be recorded, managed and reported in a manner that supports accessibility by various parties for their information and decision-making needs. Operating hydropower facilities and organisations should ensure that their equipment condition data is contained in a centralised database in a standardised format. This database should allow for centralised data entry, storage, and retrieval, as well as individual power station and portfolio level analysis. Data should be available (where possible) in real-time and web-accessible. The database should include a comprehensive list of assets, all input records that inform condition assessments, and readily enable generation of reports.

The asset database should link into, or be embedded within, a Computerised Maintenance Management System (CMMS) that addresses day-to-day monitoring and maintenance activities. A CMMS aids planning through scheduling, produces job tickets, work orders and instructions for operational staff, and records actions taken, inspection and assessment findings, and asset performance. The CMMS should enable supporting documentation for a condition assessment (e.g. test reports, photographs, operation and maintenance records) to be attached to each work order so that historical knowledge is readily available. The CMMS should also enable reports to be routinely generated as appropriate for decision-makers at various levels in the business.

Asset management plans and processes for an operating hydropower facility should ideally be embedded within a corporate asset management system. Benchmark requirements for asset management can be guided by the international standard ISO 55001 and relate to: the organisational context and objectives for asset management; the responsible parties; relevant plans; supporting systems and processes (e.g. communications, human resources); operations

(e.g. maintenance procedures); and performance evaluation and support.

A corporate asset management policy should document big picture issues such as business goals, strategies, constraints and risk appetite, which have a bearing on the asset management approach at an individual facility within the corporation's portfolio. The corporate policy should identify and establish the overall objectives that the business is intending to achieve, taking into consideration stakeholder expectations, regulatory compliance, social and cultural obligations, and business risk appetite. This vision is normally developed at the board level in an overall business context. Corporate objectives for assets might include, for example, to increase efficiency, achieve cost savings, manage usage, and ensure safe operation.

A corporate asset management plan should establish the framework for the business in its approach to asset management. This plan would typically: document information about the company and the hydropower infrastructure; list assets managed within the asset management system; list current infrastructure projects; set the asset values and current performance levels; present the target asset values (short-term and long-term economic value) and performance targets (level of availability, water collection); outline the main risks and opportunities related to the operation of the infrastructure; and define the roles and responsibilities of the various stakeholders (owner, asset manager, operator, energy manager).

The asset management approach should be established in the asset policy and asset management plan. A common starting approach to asset management is to use a fixed-time maintenance strategy, often informed by the recommendations of the original equipment manufacturers. A more mature asset management approach should be based on asset condition assessments as described under the Assessment criterion of this guidance, centred on risk assessment and mitigation informed by asset failure mode and root cause analyses. This approach seeks to provide improved plant performance at a reduced maintenance cost and a lower risk exposure profile. International good practice is based on a risk approach tailored to the risk tolerance of the individual business.

The asset management plan should address asset life cycle planning. A life cycle plan should record estimates of asset life, routine or major maintenance costs and time periods, and upgrade or replacement costs and time periods. The asset life cycle plan should include: identification of issues and risks over time; updates and changes in management approaches over time as assets age; foreseeable changes that will be required for maintenance; and a clear understanding of the difference between failure and end-of-life. Asset renewal decisions can be complicated by considerable uncertainties relating to technical condition, the expected remaining life of assets, and future market demands. Timing of major works should take into account when other plants can meet the market demand for electricity alongside other factors such as resource availability. Life extension actions can help postpone comprehensive renewal and this may be profitable provided that delays do not lead to major failures with high consequential costs.

Asset management should be accompanied by a resource development and capability strategy to ensure that asset management requirements can be appropriately supported. Human resources supporting a corporate asset management system include: on-site plant staff who work with equipment daily and have a direct role in performing routine maintenance and the equipment condition assessments; plant or facility managers who support plant maintenance, rehabilitation, and replacement decisions, and evaluate equipment condition assessment data and trends; technical staff (engineers, economists, environmentalists, biologists and technical specialists) who undertake more detailed supporting analyses and risk assessments; and asset managers who prioritise competing investment needs, analyse business cases and justifications for investment decisions, and support decisions that consider trade-offs between competing needs or conflicting requirements.

## Conformance/Compliance

*Conformance/Compliance criterion - Operation Stage: 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.*

Assessment processes and management measures relating to asset management should be compliant with relevant legal and administrative requirements. The asset management system should identify all internal standards, procedures or guidelines as well as all relevant national and international standards or licence conditions applicable to the assets. Applicable legislation and permits may relate to, for example: operation and maintenance of cranes, hoists and lifts; pressure vessels; and chemicals and flammable substances. Legislated requirements may include, for example, registration of particular assets, certification by third parties, and particular forms of record keeping.

To demonstrate conformance, the asset-related measures implemented should be consistent with what is in the company policies and plans. Asset management commitments may be expressed in policies of the owner/operator or company statements made publicly available or within management plans. Variations to commitments should be well-justified and approved by relevant authorities, with appropriate stakeholder liaison. Conformance with requirements of the asset management plans and reliability and efficiency expectations should be systematically checked, including the completion of routine and special monitoring and maintenance tasks, and the ongoing recording and updating of asset condition. A minor non-conformance might be delayed submission of a monitoring report; a major non-conformance might be neglecting to undertake essential maintenance works on an asset.

## Outcomes

Outcomes criterion - Operation Stage: Asset reliability and efficiency performance is in line with the objectives of the owner/operator and any asset performance guarantees with only minor gaps.

To ensure outcomes are met, it is essential that the objectives of the owner/operator for the assets are clearly expressed. These may relate to, for example: targets for availability, reliability, and efficiency; asset life targets; asset life cycle cost targets; and safety-related objectives. A hydropower plant may also have asset performance guarantees embedded into



contracts. Performance guarantees may relate to electricity generation availability and reliability, and (depending on the capabilities of the power station) also ancillary services that support the security and stability of the electricity grid (e.g. frequency control, spinning reserve, operating reserve, black start capability).

An evidence-based approach should demonstrate asset reliability and efficiency performance. Monitoring reports and data should clearly track performance against objectives and capture incidents. Examples of evidence can include records of asset performance, asset reliability

assessments, information on asset efficiency, information on comparative equipment and system performance, and information on the operational efficiency of the individual power station (or groups of power stations) in the context of the broader system and relevant market arrangements. Evidence may be collected by the owner/operator or through independent inspections and benchmarking studies. Evidence should also show that the full range of maintenance issues are being addressed and that the systems used to manage the maintenance programme are in place and effective.



# Infrastructure Safety

*This guideline expands on what is expected by the criteria statements in the Hydropower Sustainability Tools (HST) for the Infrastructure Safety topic, relating to assessment, management, conformance/compliance and outcomes. The good practice criteria are expressed for different life cycle stages.*

*In the Hydropower Sustainability Assessment Protocol (HSAP), this topic is addressed in P-8 for the preparation stage, I-5 for the implementation stage and O-6 for the operation stage. In the Hydropower Sustainability ESG Gap Analysis Tool (HESG), this topic is addressed in Section 4.*

The infrastructure safety guideline seeks to ensure that populations affected by hydropower infrastructure are not put at risk at any point during the life of the hydropower project. While dam safety is one of the most critical infrastructure safety considerations, this topic also has a strong community safety focus and

there are a broad range of risks to the community that need to be taken into account. The requirements and expectations for the developer and owner/operator differ during the life cycle stages - project preparation, implementation and operation. The intent at any life cycle stage is that life, property and the environment are protected from the consequences of dam failure and other infrastructure safety risks.

This guideline is primarily focussed on community safety but has the benefits of increased employee safety. More focussed guidance on employee safety is provided in the Labour and Working Conditions guideline.

## Assessment

*Assessment criterion - Preparation Stage: An assessment has been undertaken of dam and other infrastructure safety risks with appropriate expertise during project preparation, construction and operation, with no significant gaps.*

For hydropower projects at the preparation stage, good practice requires that dam and other infrastructure safety risks are thoroughly identified for each project stage using appropriate expertise.

Short-term and temporary infrastructure safety risks that can arise during preparation activities could relate to, for example: temporary labour camps, access roads, test wells, helipads, fuel storage, and power supply. During preparation, structures may be built or assembled in previously undeveloped locations with no protection against community interactions. The assessment should consider risks inherent to the structures, the likelihood of community impacts, and options to avoid or minimise safety incidents (e.g. location, fencing or other barriers, security personnel, signage).

During the preparation stage, the evaluations that ensure adequate safety measures will be incorporated into the permanent project infrastructure design are critical. Dam and other infrastructure design choices are informed by numerous and varied assessments including: climatic, hydrological, hydraulic, geological, geotechnical, seismic, glacial (where relevant), and material properties.

For a hydropower project, dam safety is paramount and a highly specialised field. All potential failure modes, i.e. features or events in the systems that can lead to an asset failure, should be identified and addressed where possible in the dam design. Extreme events can trigger failures (e.g. floods, earthquakes, fire, landslips, landslides), as well as more incremental processes internal to the structure (e.g. cracks, settlement, instability). The design should address all identified failure modes and consider the following dam failure risks at a minimum:

- overtopping, which may be caused by inadequate spillway design, debris blockage of spillways, or settlement of the dam crest;
- foundation defects, which may arise due to settlement or slope instability;
- seepage-induced erosion (i.e. piping), which can occur around hydraulic structures such as pipes and spillways; through animal burrows; around roots of woody vegetation; and through cracks in dams, dam appurtenances, and dam foundations;
- structural failure of the materials used in dam construction; and
- inadequate monitoring and maintenance.

Calculation of the probable maximum flood and determination of the design flood for the spillway are critical assessment requirements for dam safety at the preparation stage. The methodologies used, hydrological datasets, and guiding standards all need to be well-considered and justified (see the Hydrological Resource guideline). Regional circumstances will influence the degree to which other types of risks require consideration (e.g. volcanism, seismicity, landslide hazard, glacial lake outburst floods). Cascading dam failure may be of importance in basins with multiple dam developments. Dambreak analyses should always be undertaken to determine the downstream risk zones, the populations or structures at risk, and propagation times for flood waves, and these analyses should inform emergency response planning.

All regulatory requirements for the jurisdiction, and relevant design standards for the infrastructure and risks, should be identified, well-documented and met.

Appropriate expertise must be used for infrastructure safety-related assessments. This refers to specialists with proven experience designing and constructing projects of a similar complexity. Particular attention should be given to engineering safety competencies, such as hydrological, geotechnical, structural, electrical, mechanical, and for key risk areas (e.g. seismology, volcanology, glaciology).

Important during the preparation stage is infrastructure safety risk assessment and planning for the implementation and operation stages. Any risk assessment should take a systematic approach to considering possible risks, monitoring instrumentation and procedures, and management responses to risks that may materialise during each project life cycle stage.

## Assessment

*Assessment criterion – Implementation Stage: Dam and other infrastructure safety risks relevant to project implementation and operation have been identified through an assessment process; and safety monitoring is being undertaken during the project implementation stage appropriate to the identified issues.*

Infrastructure safety issues unique to the implementation stage include quality control, flooding risks, landslip risks (sliding of a landmass down a slope), landslide risks (breakup and downhill flow of rock, mud, water and anything caught in the path), and construction-related issues. Monitoring for quality assurance and quality control is essential to ensure that the infrastructure is constructed fully to design standards and any issues arising (eg variations in materials specifications or fault zones in excavation areas) are detected and addressed. Flooding, landslips and landslides can cause direct damage and also impact on the effectiveness of the coffer dams, diversion tunnels and other diversion works used to divert water around the construction site or fill underground excavation areas. Other construction-related public safety issues can include an increase in traffic, heavy machinery on roads, blasting activities, and/or chemical and hazardous material storage areas.

## Assessment

*Assessment criterion – Operation Stage: 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.*

During the operation stage, the infrastructure safety assessment focus should be on the systematic and routine monitoring and surveillance of infrastructure to ensure the safety objectives are achieved and on the emergency response processes that are in place. Infrastructure safety monitoring should be embedded within asset management and maintenance plans (see the Asset Reliability and Efficiency guideline).

In addition to infrastructure safety risks relating to asset failures, community safety risks during operations can include electric shock, hydrological risk, drowning, road accidents, and other types of accidents arising from community interactions with project structures. These risks all need to be well-identified, assessed, and monitored throughout the life of the project. As a project ages, communities and their activities evolve around the operating facility, and new

types of risks can emerge. Regularly scheduled visual inspections of all infrastructure safety measures are essential to assess aspects such as vegetation growth, fencing status, condition of signage, cracks, land stability, and community interaction risks.

Monitoring for dam safety risks during operations usually involves a mix of instrumentation, manual inspections and readings, and alert and alarm mechanisms. The monitoring programme should be well-designed to match the identified risks and to verify that risk avoidance and management measures are achieving their objectives. Focal areas for dam safety monitoring must include leakage and deformation, regardless of the dam type. Uplift should be monitored for concrete dams, and pore pressure along seepage lines for embankment dams. Where relevant, the response to earthquakes should be monitored. Instrumentation often includes V-notch weirs and drainage holes for seepage, surveys against established reference points for deformation, settlement gauges for embankment dams, piezometers for uplift pressure, and seismographs for earthquakes.

At the operations stage, an important area for assessment processes is to periodically test the effectiveness of planned measures for the emergency response system. Such a system often includes notification and warning systems for downstream areas in the event of sudden releases of water that could cause harm downstream. Periodic evaluations should be made to ensure all aspects of the system are functional.

## Management

*Management criterion - Preparation Stage: Dam and other infrastructure safety management plans and processes have been developed for project implementation and operation in conjunction with relevant regulatory and local authorities with no significant gaps and provide for communication of public safety measures; emergency response plans include awareness and training programs and emergency response simulations; and dam safety is independently reviewed.*

Infrastructure safety issues and responses are broad-ranging. They may be managed under a central asset management system in a



business or may be dispersed with management responsibilities for different safety issues allocated to different parts of a business. Linkages and overlaps between asset management planning and safety management planning should be clearly defined. Plans should outline what actions will be implemented for the important aspects of infrastructure safety identified through the assessment processes. Plans should make it clear how responsibilities are allocated, important timing requirements, budget allocations, and reporting and review procedures.

Examples of infrastructure safety management measures that may be included in relevant plans include: signage, exclusion zones, emergency preparedness and response, monitoring, inspections, training, incident response, and communications. Regulatory and local authorities should be consulted and involved in preparation of infrastructure safety plans, especially where they involve public safety measures.

Public safety measures need to be communicated as appropriate to the measure and populations. Examples of communications methods for public safety include: public signage, documentation appropriately lodged with local authorities, awareness raising through various types of community engagements, and verbal communications by on-site patrolmen.

Given the potential consequences of any dam safety incident to public safety, international good practice requires independent review of all aspects of dam safety to be undertaken at the preparation stage. Ideally, this should be an ongoing process that commences during the development of concept designs and continues right through the operation stage, with the frequency of independent reviews during the operations stage being commensurate with risks. Independent review refers to expert review by someone who is not employed by the project, has no financial interest in profits made by the project, is not unaligned with the project in any other manner, and is generally perceived as being objective. An expert is a person with a high degree of skill in or knowledge of dam and infrastructure safety as a result of a high degree of experience or training in that subject. Forms of independent review may vary. Examples include contracting an expert consultant to provide a

written review of a particular assessment, plan or report, or inclusion of a safety expert in a panel of experts.

## Management

*Management criterion - Implementation Stage: Processes are in place to address identified dam and other infrastructure safety issues and to meet any safety-related commitments relevant to the project implementation stage, including providing for communication of public safety measures; a formal quality control programme is in place for construction; safety management plans for the operation stage have been developed in conjunction with relevant regulatory and local authorities; and emergency response plans include awareness and training programmes and emergency response simulations.*

*Management criterion - Operation Stage: 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 programmes and emergency response simulations.*

During the implementation and operation stages, infrastructure safety plans relevant to those stages should be demonstrably put into action. The management arrangements are likely to be quite different given the large role of contractors in the construction processes versus what is probably a more permanent and smaller staff during operations. Consequently, it is essential to have plans catering to each of these stages and the relevant risks and mitigation measures that have been identified. Because of the long time frame applicable to the operations stage, review and updates to plans should be made at meaningful time intervals.

During implementation, the quality control programme to ensure that infrastructure is built to design specifications is of very high importance. Quality control process examples include procurement specifications and factory assessment tests, materials testing away from and on-site, supervision procedures, and involvement of design engineers during construction monitoring. Quality control processes should

reflect a systematic approach to achievement of the design objectives that address infrastructure failure modes. The independent review panel discussed under the Preparation stage criterion can be an effective aspect of an overall quality control programme, which can be continued into the operations stage.

Infrastructure safety plans during operations often involve considerable ongoing monitoring, as well as asset repairs and upgrades that should be embedded within asset management plans. A systematic and routine approach to monitoring and responding to infrastructure safety issues should be demonstrated, both relating directly to asset condition and indirectly to community interactions with the assets. Data should be analysed and linked to identified failure modes or specific safety risks. In cases where the data indicates an event or issues, there should be evidence that a response has been taken to address that issue.

To ensure good ongoing communications on public safety matters, reports should be regularly made to those with the ultimate responsibility and authority for all public safety matters (this could be the company board of directors and may also extend to regulatory authorities). Reports should be based on agreed indicators that meaningfully alert those responsible to any issues or new risks arising and prompt management responses to address those risks, with agreed indicators that meaningfully alert those responsible to any issues arising.

During the operations stage, measures should ensure that emergency response plans are current, relevant, and widely understood by all those who would be involved in their implementation. A risk to avoid is that plans for emergency response have not been practiced or are not familiar to responsible parties when an actual emergency arises. Measures to address this risk should be demonstrated, such as regular updates to plans, and regular training programmes. Exercises should be periodically conducted for company staff and relevant authorities; these exercises should include simulations of emergency scenarios and test how well the plans address the scenarios and how capable the parties and resources involved

are to undertake the required tasks. Emergency response exercises should be followed by evaluations and updates to plans and measures to address any identified human resource, communications or equipment gaps or issues.

## Conformance/Compliance

*Conformance/Compliance criterion - Implementation and Operation Stages: 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.*

Assessment processes and management measures relating to infrastructure safety need to be compliant with relevant legal or administrative requirements. These may be expressed in licence or permit conditions or captured in legislation. Compliance requirements may relate to, for example, standards to be met, the frequency and type of monitoring to be performed, and reporting to be submitted by the owner to government. Meeting of design standards is of particular importance for infrastructure safety, and quality control and independent review processes should be thorough and credible and include documentation to verify that all design standards are fully met.

Conformance refers to delivering what is in the plans. These planning inclusions may go beyond compliance requirements or detail steps the business will make that ultimately lead to ensuring compliance. Examples include budgetary allocations, designation of roles and role expectations, and provision of internal training.

Commitments may be expressed in regulatory requirements for addressing infrastructure safety, in relevant policy requirements of the developer or owner/operator, or in any relevant company statements made publicly or within management plans. Evidence of adherence to commitments could be provided through, for example, internal monitoring and reports, government inspections, or independent review. Variations to commitments should be well-justified and approved by relevant authorities, with appropriate stakeholder liaison.

The significance of not meeting a commitment is based on the magnitude and consequence of that omission and will be context-specific. For example, a failure to demonstrate delivery of an infrastructure safety commitment such as implementation of an alarm system is a significant non-conformance, whereas a slight delay in delivery of a monitoring report could be a non-significant non-conformance.

## Outcomes

*Outcomes criterion - Preparation Stage: Plans avoid, minimise and mitigate safety risks with no significant gaps.*

*Outcomes criterion - Implementation and Operation Stages: Safety risks have been avoided, minimised and mitigated with no significant gaps.*

Of utmost importance is that public safety risks relating to infrastructure are recognised and addressed to a justifiable level of residual risk.

To show that plans avoid, minimise and mitigate infrastructure safety risks, they should include a thorough outline of relevant risks. Mitigation measures in the plans should also be directly linked to all identified risks. The assessment and planning should be informed by appropriate expertise. The assignment of responsibilities and resource allocation for implementation, monitoring and evaluation should be appropriate to the planned actions.

An evidence-based approach should demonstrate that infrastructure safety risks during project implementation and operation have been avoided, minimised and mitigated with no significant gaps. The developer, owner and operator should demonstrate that responsibilities and budgets have been allocated to implement infrastructure safety plans and commitments. Monitoring reports and data in the implementation and operation stages should clearly track performance against commitments and objectives, and have a systematic approach to data collection, analysis and reporting so that incidents and trends are fully evident. It should be possible to provide examples to show how identified risks from the assessment were avoided or minimised. Evidence should show that mitigation plans have been implemented and are being monitored. Implementation of measures for infrastructure safety should be evident, such as signage, fencing, alarms, security personnel, a quality control lab on the construction site, actions taken to reject materials that failed testing, minutes of meetings with local emergency services, and photo records of emergency response simulation exercises. Records should be kept of any safety incidents, including near misses, and these should inform improvements of plans and processes. Ideally, plans and processes should reflect a continuous improvement approach and should be adapted to ensure that incidents that have occurred are unlikely to be repeated. Monitoring should show how plans are achieving their stated objectives.



# Financial Viability

*This guideline expands on what is expected by the criteria statements in the Hydropower Sustainability Tools (HST) for the Financial Viability topic, relating to assessment, management, conformance/compliance and outcomes. The good practice criteria are expressed for different life cycle stages.*

*In the Hydropower Sustainability Assessment Protocol (HSAP), this topic is addressed in P-9 for the preparation stage, I-6 for the implementation stage and O-7 for the operation stage. In the Hydropower Sustainability ESG Gap Analysis Tool (HESG), this topic is addressed in Section 1.*

This guideline addresses project financial management, the funding of measures aimed at ensuring project sustainability, and the ability of the project to generate the necessary financial returns to meet project funding requirements. The intent is that the project is proceeding with a sound financial basis that covers all project funding requirements, including social and environmental measures and commitments,

resettlement and livelihood enhancement, benefits to project affected communities, and commitments to shareholders and investors.

**Financial viability**, in this context, is the ability of an entity to continue to achieve its operating objectives and fulfil its mission from a financial perspective over the long-term. It would be expected that a financially viable project generates sufficient cash flow to deliver an appropriate risk-adjusted return on the capital invested. However, some projects may be multi-purpose ventures in which hydropower is not the primary purpose, and therefore the financial objective of the hydropower component may be to support the delivery of the other purposes of the scheme (e.g. water supply, irrigation water, etc.). For some projects the financial contribution is measured from the perspective of the system within which it operates; for example, some pump storage projects may run at a loss but enable a greater profit to be made from other power stations within the system because of the greater efficiencies gained. Consequently, it is important to consider the project context and purpose in relation to its financial objectives.

## Assessment

*Assessment criterion - Preparation Stage: An assessment of corporate financial viability, including potential project costs and likely revenue streams, has been undertaken using recognised models with no significant gaps; analyses include risk assessment, scenario testing and sensitivity analyses.*

Financial assessments at the project preparation stage have a number of aspects, including project costs, revenue estimates, project funding mechanisms, and financial risks. All of these inputs inform financial modelling, which provides a determination on overall financial viability and allows different scenarios and assumptions to be tested.

## Project costs

Cost estimates need to be developed on an itemised basis using a logical structured approach, with well-considered contingencies added to each cost item based on an evaluation of risk. The reference year for costs should be clearly stated and annual escalation costs applied as appropriate. All assumptions behind each cost estimate need to be clearly stated (e.g. tunnelling rates linked to geology, currency exchange rates as applicable, materials sources, transport requirements). Cost estimates should be updated once the main construction contracts are awarded based on the outcomes of further field investigations and studies and the approach to contracting. An example of a logical structured breakdown for project cost estimates is:

- pre-construction costs (e.g. feasibility studies, detailed design, tendering)
- civil works (including temporary and permanent project structures)
- hydro-mechanical equipment
- electro-mechanical equipment
- switchyard equipment
- transmission infrastructure
- environmental and social costs, including land acquisition
- construction supervision and administration
- interest during construction
- other costs (e.g. taxes and duties, insurance)

The approach to estimating unit prices should be well-justified, such as for how much concrete or steel is required. This may take place through estimation of unit prices (e.g. by weight, volume, length) from records of actual prices used in similar projects, through published lists, or through detailed analyses. Lump-sum price estimates for specific project components also rely on professional experience and on any accessible information from previous projects. Equipment price estimates may also be informed by previous projects or indications from potential suppliers, noting that major electro-mechanical equipment can be subject to very wide fluctuations due to market conditions or workloads of the different suppliers. The requirements for the transmission system, and who bears these costs, needs clarification as there may need to be cost-sharing agreements with other projects.

Operation and maintenance (O&M) costs should also be identified at the preparation stage. They should take into account the costs of labour, consumables, spare parts replacement, routine maintenance, exceptional maintenance requirements, replacement of major equipment, insurance, and generation costs of the operator. The reference year for these cost estimates should be clearly stated and annual escalations included. Ideally, O&M cost estimations should involve the future operator and should include appropriate contingencies.

Costs for environmental and social components should be derived from the Environmental and Social Impact Assessment (ESIA) and Environmental and Social Management Plan (ESMP), as addressed under the Environmental and Social Issues Management guideline. Example costs include conservation measures, building of a health clinic, resettlement community and livelihood re-establishment activities, drainage works and sediment settling ponds, etc. If borne by the project proponents, these costs would typically be internalised as part of the capital and operational costs of the project for the appropriate timeframe and to the appropriate standard. If some or all costs of social and environmental measures are funded from outside the project, this needs to be explicitly explained. Contingencies for environmental and social costs need to be well-considered.

## Revenue estimates

Estimates of revenue are based on estimates of electricity generation and other services provided (e.g. firm capacity, ancillary services), corresponding tariffs, and any revenue associated with investment drivers for new market entrants such as carbon finance, renewable energy certificates, etc.

Revenue estimates need to be based on a clear understanding of the inflows and the operational plans for the power house and reservoir. Calculations should take into account hydrological risk, operations of upstream reservoirs, irrigation schemes, diversions, etc., if any, and any operational constraints on reservoir management or downstream flow releases (see the Hydrological Resource guideline). Estimated energy generation should be expressed in association with an inflow probability based on hydrological modelling, for example 3,000 GWh in a 90% dependable year.

The approach to estimation of the tariff, i.e. the electricity pricing, will depend on the market context for the project. Tariffs may need to be differentiated, for example for local and export energy, for peak or base load energy, and by season. The **levelised tariff** should be calculated, referring to the average fixed and variable tariff over the project life, or the entire term of the Power Purchase Agreement, adjusted for inflation. For tariff calculations, it is important to clearly document the tariff calculation method used, the assumed tariffs for **firm energy** (i.e. energy guaranteed to be available) and excess energy, the expected firm and excess energy each year, and applicable annual escalation factors.

The market situation can be highly variable depending on the project, and market research and an understanding of how the market is evolving is critical to making forward revenue estimates. **Market**, in this context, refers to the situation of supply and demand for electricity, water and ancillary services in which the hydropower project operates. An open electricity market is a system for purchases and sales of electricity through bids and offers at relatively short-term time intervals, usually managed by an independent market operator responsible for generation and load balance. At the other end of the spectrum are **Power Purchase Agreements**

(PPAs), which are typically private long-term electricity contracts between a generator and an off-taker (i.e. power purchaser). Markets also exist to varying degrees for power-related commodities known as ancillary services.

**Ancillary services**, in this context, refer to operations provided by hydroelectric plants that ensure stable electricity delivery and optimise transmission system efficiency, including the provision of reactive power, frequency control and load following. The status of the electricity market is evolving in many parts of the world. There is a general trend towards more open wholesale and retail electricity markets through deregulation and promotion of competition, including at regional (transboundary) levels, to better fund ancillary services and incentivise energy efficiency and green energy.

## Project funding mechanisms

Assessment of project funding options is a major focal area during the preparation stage. Large utilities with a steady cash flow may choose to self-finance major parts of project costs. With regards to external funding, the terms “project funding” and “project financing” are often used interchangeably, but in fact project financing is a specialised form of funding. There are broadly three approaches to funding major infrastructure projects: government funding, corporate or on-balance sheet finance, and project finance.

Government funding is where the government chooses to fund some or all of the capital investment into a project, primarily in the case of publicly owned utilities and projects. There are also many models for public-private partnerships, often designed in response to particular needs of the government and the private developer regarding energy master planning, the timing required to have the infrastructure commissioned, available expertise, and allocations of risk. Governments may provide direct support, such as through subsidies, grants, equity investment and loans (i.e. debt). Funding support may also be provided through indirect methods which lower the overall project cost, such as waiving fees, costs and other payments that a private company would normally make to the government. The government may also provide subsidies and guarantees to power off-takers to help them meet the electricity tariffs and/or reduce demand risk to the project company.

With corporate finance (or “on-balance sheet” finance), the developer obtains finance for the project based on the balance sheet of the company rather than the project. This typically enables a lower cost of funding and is less complicated. There are limits to its use in that a company can only raise a limited amount of finance against its equity to stay within its target debt-equity ratio, and this approach may constrain how many projects the company can invest in. There are also “off-balance sheet” approaches that can be taken by a corporation, such as leases and partnerships.

Project financing is a common and relatively efficient approach to project funding, but the level of risk is relatively higher because it is solely tied to the project’s financial viability. Project finance relies on the future cash flow of a project as the primary source of repayment and holds the project’s assets, rights and interests as collateral security. Lenders typically carry out extensive due diligence on the project’s viability, and on how risks have been identified, analysed and will be mitigated.

Investor options need to be well-researched. There are a range of potential investors, with the accessibility of these depending greatly on the project location, characteristics and risks. Examples of potential investors include commercial banks, capital markets, equity funds, export credit agencies, development finance institutions, bilateral agencies, multilateral development banks and sovereign wealth funds. Preferential funding options may be available if projects can demonstrate meeting certain requirements, for example by qualifying for development bank loans or for certified green and climate bonds.

Regardless of the funding mechanism, the financial model will need to include information on:

- the portion of the total costs up to the **Commercial Operations Date (COD)** expected to be covered by **equity** (i.e. the amount of funds contributed by the owners, and any grants) and by **debt** (i.e. loans and bonds);
- interest rates (foreign and local currency components);
- other pre-COD financial costs, such as charges and fees; and
- loans grace and repayment periods and amounts.

The cash flow modelling during project implementation needs to link very closely to procurement planning (see the Procurement guideline).

## Financial risks

The financial risk assessment is an additional significant requirement at the preparation stage. Financial issues and risk examples include: higher than estimated project costs; inability to meet required costs; overestimation of revenue streams; later than estimated COD; currency exchange fluctuations; difficulties in access to project finance; non-acceptance into renewable incentive or other comparable schemes; market access and changes; major inflation or depreciation; and loss of financial viability of the principal power off-takers.

A financial risk assessment needs to be centred around the financial objectives for the project. The financial risk assessment typically considers the probability and consequences of potential scenarios, changes, incidents or failures that could affect the financial viability of the project. Because hydropower projects are complex and site-specific, a high proportion of them experience schedule and budget overruns and consequently the probability of such events should be carefully considered. Reference class forecasting, which uses empirical data about the schedule and budget performance of similar projects, can be useful for this purpose. The definition of scenarios should inform financial policies and processes and should clarify the range of factors that would be tested in the financial model as sensitivity analyses.

Sensitivity analysis should be carried out on the financial results taking into account the risks identified for the project. These typically include tests of sensitivity to implementation costs, implementation time, energy production, tariffs, the discount rate, and financing costs.

## Financial modelling

Financial modelling is used to ensure that a project can deliver a sustainable financial return under a range of credible scenarios (or other stated financial objectives specific to the project's purpose and context). In addition to the inputs identified above, parameters for the financial modelling should include the project economic life period (e.g. 30 years), key project implementation dates (notably including the COD), and the **discount rate** for the project. The discount rate is the percentage rate used to compute the value of future income, given that the value of money and hence its purchasing power tends to decrease over time. The discount rate is often calculated from the **Weighted Average Cost of Capital (WACC)** and should be less than the cost of debt. The **cost of debt** is the interest a company pays on its borrowings.

There are a number of approaches that can be taken to financial modelling. A quick "back of the envelope" method of analysis is **payback analysis**. A payback analysis calculates how long it will take to recover an investment into a project by dividing the initial investment by the average yearly cash inflow to determine the payback period. This method is not particularly accurate but can be useful for considering the relative merits of a project or group of projects regarding the likelihood of achieving a desired result.

Capital budgeting methods for financial modelling have more rigour and use of one or more of these methods should be demonstrated by the project. Because the amount of capital for a new project will be limited at any given time, capital budgeting techniques are used to determine which investment scenario will yield the most financial return over a period of time. Three examples of widely recognised methods of financial modelling using capital budgeting – Net Present Value, Internal Rate of Return, and Discounted Cash Flow – are listed below.

**Net Present Value (NPV)** – NPV is a common financial modelling approach. The NPV formula calculates the difference between the present value of cash inflows and the present value of cash outflows over a period of time. A positive NPV ( $NPV > 0$ ) indicates that the investment will be profitable because the projected earnings (in present value) is greater than the anticipated

costs (in present value). NPV is often used by companies to make decisions on investments because it provides an equivalent method of comparing both internal and external investments of a company where there are different values and profits over time.

**Internal Rate of Return (IRR)** – IRR is also a useful tool to compare potential investments or potential scenarios for investment. IRR is frequently used to rank multiple potential projects or scenarios for projects, with the highest IRR indicating the best likely financial result. The IRR is the discount rate that makes the NPV of all cash flows from a project equal to zero. The term "internal" is used because external factors, such as the cost of capital and inflation, are omitted from the calculation. The IRR is calculated based on the NPV formula with the NPV set to zero and the calculations used to determine the discount rate, which is here the IRR.

**Discounted Cash Flow (DCF)** – DCF is very similar to NPV, relies on the same formula, and takes into account calculations of both NPV and IRR. The difference is that DCF looks at how valuable an investment will be in the future, and therefore the focus of attention is on the discounted future cash flow. DCF is of high interest to investors because it helps calculate the returns that would be obtained for the investment and how long it would take to get the returns.

There are other financial indicators that developers and lenders are likely to be closely tracking. Lenders often have thresholds on financial ratios specified in financial agreements, with measures to be employed if target ratios are breached. Examples of commonly tracked financial ratios include:

- **Debt to Equity Ratio.** The debt to equity ratio is calculated as long-term debt divided by shareholders' equity. A high debt to equity ratio decreases the amount shareholders need to supply but poses risks to the lenders in terms of what can be recovered in case of project financial difficulties.
- **Loan Life Cover Ratio (LLCR).** The LLCR represents the number of times the cash flow over the life of the loan can repay the outstanding debt balance. It is calculated as the NPV of available cash for debt service up to the maturity of the loan, divided by the principal



outstanding. Lenders often specify a minimum LLCR to provide reassurance about loan repayments.

- Debt Service Cover Ratio (DSCR).** The DSCR measures the amount of cash flow available to meet periodic interest and principal payments on debt. The DSCR is similar to the LLCR in that it indicates the ability to repay debt, but it focusses on specific periods in time rather than the overall life of the loan. **Debt service** is the amount of payment due to the lenders by the project company in any given period, and **servicing debt** refers to making loan repayments. The DSCR calculates the ratio of the total revenues available for debt service during a period (e.g. net of operating costs, insurance premia, taxes, etc., but before equity distributions) and compares this to the amount of debt service owed.
- Rate of Return (ROR) or Return on investment (ROI).** The ROR or ROI (or “return”) refers to the ratio of money gained or lost on an investment (including both debt and equity) relative to the amount of money invested, usually on an annual basis. **Internal rate of return (IRR)** as discussed above is the discount rate that results in an NPV of zero for revenues over the project period; this shows the annualised effective compounded ROR which can be earned on the invested capital (both debt and equity). **Return on Equity (ROE)** removes the return committed to debt servicing, which provides equity investors with an indication of their return over the project economic life.

The quality of a financial model, and hence its outputs, depends on a number of factors, including the robustness of assumptions made, the accuracy of cost and revenue estimates, and the type and range of scenarios that are considered for the project. All should be well-researched and justified. Financial modelling should be undertaken utilising appropriate expertise.

## Assessment

*Assessment criterion - Implementation Stage: An assessment has been undertaken of project financial viability, including project costs and revenue streams, using recognised models and including risk assessment, scenario testing and sensitivity analyses; and monitoring of the financial situation during project implementation is being undertaken on a regular basis.*

*Assessment criterion - Operation Stage: 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.*

Although implementation and operation stage financial assessment requirements have many of the same elements as the preparation stage, they are focussed on following up on the substantial assessment work already done. A large focus at the implementation stage, during which loan disbursements are made and major expenditure is undertaken, is on recording and evaluating project costs, monitoring cash flows in relation to disbursements, ensuring all necessary payments will be able to be made on time, and monitoring implementation of financial plans and risks. A large focus at the operations stage is on revenue forecasting, financial model updates, cost management, and business cases for major refurbishment requirements.

Financial risk assessment and management are essential components of all stages and need to consider both internal risks (e.g. effectiveness of internal controls, budget exceedances, effectiveness of financial systems, processes and software) and external risks (e.g. market trends, hydrological risk, exchange rates, regulatory developments, new technologies, operating constraints).

## Management

*Management criterion - Preparation Stage: Financial management plans and processes have been developed for project implementation and operation with no significant gaps, and opportunities for project financing have been evaluated and pursued.*

*Management criterion - Implementation Stage: Measures are in place for financial management of project implementation; plans are in place for financial management of the future operating hydropower facility.*

*Management criterion - Operation Stage: Measures are in place for financial management of the operating hydropower facility.*

The assessment work undertaken during the preparation stage needs to result in the development of financial management plans. Plans should be developed at the preparation stage for both the implementation and (at a preliminary level) the operation stage. Financial management plans should address staffing, resourcing, systems, policies, procedures, internal controls, risk, compliance, monitoring, reporting, and independent review. Plans should clearly document financial objectives, such as Key Performance Indicators (KPIs), important financial ratios, and their target levels.

Financial management processes should be clearly documented and typically include:

- **Internal controls and approvals** – Role responsibilities for financial approvals should be defined in a delegations policy or manual and authorisation processes should be built into the financial management system. Duties should be segregated to ensure control and individuals should be given authorisations, for example to clear master data, manage depreciations, and run the payroll system. Systems of checks and balances should be evident, such as monthly bank reconciliations and automatic detection systems for irregular transactions.
- **Budgeting and expenditure** – The financial management plans need to outline allocations for expenditure for each financial year, in line with the progression of works during the implementation stage and the various management plans at both the implementation and operations stages. Processes should define formats, timing and approvals processes for annual budgets. Budgets should include appropriate contingencies. All management plans should be included (e.g. asset management, environmental and social, occupational health and safety), with care taken that one focal area does not take funds away from other areas of commitment (see the Integrated Project Management guideline). Processes for cost control should be defined and closely linked to procurement processes (see the Procurement guideline). Processes should also be defined for managing budget variations and allocation of contingency budgets.
- **Financial risk management** – Financial risks should be managed by applying the same mitigation hierarchy as for other types of risks, namely through avoidance, minimisation,

mitigation and compensation. Financial risk management measures should be well-researched and re-evaluated on a regular basis. Examples of financial risk mitigation approaches include investments in risk prevention and minimisation, risk monitoring, insurances, performance guarantees, contingency budgets, and funding commitments that can be called upon in the case of cost overruns. Some risks may be transferred to other parties (government, contractors, off-takers, insurers, etc.) through contractual arrangements.

- **Accounting** – Processes and systems should be in place to manage accounting needs, including budgets, expenditure, payroll, tax, materials management, asset valuations, etc.
- **Auditing** – An annual schedule of both internal and external auditing should be in place with clearly defined processes.
- **Financial reporting** – Processes should be defined leading to the generation of regular financial reports, following standard accounting practices, and tailored to meet the needs of decision-makers.

Starting with test operations and COD, additional financial management processes will come into play related to market research, sales, billing, and revenue management. Market conditions will change over time and depending on marketing arrangements there may be constant or periodic opportunities to increase revenues or a need to respond to adverse developments. Some of these may require significant investments for expansion, rehabilitation, or reoperation.

Other options that may be considered at certain points in the project life cycle include: sales of the entire project, certain assets or shares; refinancing of debt; re-negotiation of joint venture, power purchase, concession and other agreements; securitisation of revenue; and/or mergers or acquisitions.

## Conformance/Compliance

*Conformance/Compliance criterion - Implementation and Operation Stages: 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.*

Good practice requires evidence that financial management measures are compliant with the relevant government requirements, which may be expressed in licence or permit conditions, or captured in relevant legislation, or in the case of public utilities be subject to public financial administration regulations. Lenders will also have their own requirements that need to be met.

Compliance requirements may relate to, for example, accounting, reporting and auditing standards to be met, debt repayment schedules, tax requirements, audit schedules, and financial reporting to be submitted to government and/or made public.

Conformance refers to delivering what is in the corporate or project-level financial plans. These planning inclusions should go beyond budgetary allocations and should include planning for financial management roles and role expectations, funding for and adherence to internal controls (e.g. auditing, delegations, financial approvals), delivery of audit and reporting schedules, and ensuring appropriate financial management capacity, for instance through financial management software and staff training.

Financial commitments may be expressed in regulatory requirements, government or developer policies, or in any relevant company statements made publicly or within management plans. Many financial commitments are embedded within contracts and loan agreements. Evidence of adherence to funding commitments could be provided through, for example, inspections, monitoring, reports, and independent review.

The significance of not meeting a financial requirement is based on the magnitude and consequence of that omission and will be context-specific. A minor non-conformance might be a slightly late internal monitoring report. A major non-conformance might be a significant overspend that impacts on the financial viability of the project and requires significant replanning and refinancing. A major non-compliance could be failure to pay taxes owed to the government or to follow legal requirements in meeting financial obligations.

## Outcomes

*Outcomes criterion - Preparation Stage: The project can manage financial issues under a range of scenarios, can service its debt, can pay for all plans and commitments including social and environmental, and access to capital can be demonstrated.*

*Outcomes criterion - Implementation and Operation Stages: The project 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.*

To be considered financially viable, the project should (during the preparation and implementation stages) be projected to and (during the operation stage) demonstrably generating sufficient cash flow to deliver an appropriate risk-adjusted return on the capital invested. The expectations on the return to be generated should be well-stated in financial plans and modelling. As noted above, there may be exceptions to the expectation that a project will be profitable on a standalone basis, such as the case of multi-purpose projects or pump storage projects within an energy asset portfolio. Of importance is that the financial objectives are clearly documented, and financial modelling, plans, analyses and status reports show that these objectives are achievable.

Financial modelling, plans, analyses and status reports should be consistently focussed on selected financial indicators, as discussed under the assessment criterion. Financial modelling should have tested a set of reasonably identified scenarios and included sensitivity testing on key assumptions in the model. The financial reporting should show how indicators are being met and, where risks and adverse trends are emerging, how management interventions have effectively achieved the outcomes sought.

A range of documents should be readily accessible relating to the financial policies, practices and results of the developer or owner/operator. Financial information should be well-documented due to the commercial and legal

implications of financial activities. Policies and procedures should be available that address the range of issues described in this guideline. Financial status reports should include:

- cash flow statement – tracks the money flowing in and out of the business and shows payment cycles or seasonal trends that require additional cash to cover payments;
- profit and loss statement (also known as an income statement) – lists income and expenses and enables determination of profit or loss over a given time period;
- balance sheet – provides a snapshot of the business at a particular date, listing all of the business' assets and liabilities, and enables determination of net assets (i.e. equity);
- monitoring of key financial ratios to help analyse the business' financial health; and
- monitoring of key financial risks, and actions taken to address ongoing and emerging risks.

Other documentation that can demonstrate this criterion is met includes market research reports, analysis of financing options, financial modelling reports, financial risk analysis, financial plans, and third party review and advisory reports.

Access to capital to deliver the financial plans should be clearly demonstrable. The total capital committed to the project (via equity, grants, loans, bonds) should correspond to the estimated total cost of the project, taking into account interest rates and costs of finance. The financial model should include all sources of capital, take into account any conditions or thresholds in relation to the various sources, and should demonstrate that the cash flows over time will match the project construction and operation plans. Appropriately closed financial agreements should be in place for all sources of capital.

The Environmental and Social Management Plan (ESMP) budget should be a clear line item in all financial planning and reporting. At the preparation stage, financial planning for the environmental and social measures should include a well-considered budget contingency for this area. Despite the best researched and detailed ESMP, issues always arise during implementation that cannot be fully foreseen ahead of time. The contingency budget needs to be sufficient and well-considered, with appropriate controls on its use. The developer and owner/operator should be able to demonstrate that:

- the main elements of the ESMP have each been considered with regards to their individual risks of not achieving successful long-term outcomes;
- contingencies for funding have been calculated or estimated that would enable implementation of alternative or enhanced measures in the case that mitigation measures are not successful;
- ESMP-related management plans identify what would be shown by the monitoring to indicate that contingency measures need to be implemented (e.g. exceedance of a threshold value over a certain time period), thus supporting the case when contingency funds are sought; and
- contingency budgets have been well-utilised to ensure successful outcomes from the environmental and social programmes (i.e. not diverted to other purposes and then unavailable for their initial purpose).





# Project Benefits

*This guideline expands on what is expected by the criteria statements in the Hydropower Sustainability Tools (HST) for the Project Benefits topic, relating to assessment, management, conformance/compliance, stakeholder engagement and outcomes. The good practice criteria are expressed for different life cycle stages.*

*In the Hydropower Sustainability Assessment Protocol (HSAP), this topic is addressed in P-10 for the preparation stage, I-7 for the implementation stage and topic O-8 for the operation stage. In the Hydropower Sustainability ESG Gap Analysis Tool (HESG), this topic is addressed in Section 4.*

This guideline addresses the additional benefits that can arise from a hydropower project and the sharing of benefits beyond one-time compensation payments or resettlement support for project affected communities. Acceptance of projects can be facilitated through a well-considered programme of project benefits, especially where there are concerns that benefits will primarily go to non-local recipients. Policy objectives such as

equitable regional development and uplifting of vulnerable groups can be pursued. Well-considered project benefits can help demonstrate the economic viability of a project in a cost-benefit analysis. The intent is that opportunities for additional benefits and benefit sharing are evaluated and implemented in dialogue with affected communities so that benefits are demonstrably delivered to communities affected by the project.

Project benefits can arise in different ways:

- Some benefits are essential to the core project. An example is improvement of a road, which is necessary for site access or supply transport and can also (or later) be used by the community.
- Some benefits are additional to the core project but are designed to have positive outcomes for both the project and the community. An example is a catchment protection programme that pays households to maintain or improve vegetation cover, thus reducing soil erosion and improving water quality in rivers and streams.
- Some benefits are entirely oriented towards community interests and outcomes as a result of a deliberate effort by the project to contribute to local area development, even if it requires additional cost. Examples include: changes in the siting, design and operations of a project (e.g. a change in the alignment of a road to improve community access); a particular approach to construction (e.g. employment of a community



group or a local company for road works, even if it requires additional training or is not the lowest-cost solution); and contributions to local infrastructure, services and livelihoods. Such contributions may be in-kind or financial and they may be temporary during construction or permanent (such as through a community development fund set up initially or through a revenue sharing arrangement).

Project benefits may take the form of additional benefits or benefit sharing strategies.

**Additional benefits** are benefits that can be leveraged from the project for the benefit of the affected communities. Additional benefits may have nothing to do with the hydropower project infrastructure or operations; they could be the provision of services away from the project site, for example. Of importance is that project affected communities are among the beneficiaries of any additional benefits. Examples include: capacity building, training and local employment; infrastructure such as bridges, access roads, boat ramps; improved services such as for health and education; support for other water usages such as irrigation, navigation, flood/drought control, aquaculture, and recreation; increased water availability for industrial and municipal water supply; and benefits through integrated water resource management.

**Benefit sharing** is distinct from one-time compensation payments due to its ongoing nature and distinct from resettlement support due to being unrelated to the mitigation of project impacts. Examples include:

- equitable access to electricity services, whereby project affected communities are among the first to be able to access the benefits of electricity services from the project, subject to contextual constraints (e.g.g electricity safety, preference);
- non-monetary entitlements to enhance resource access, whereby project affected communities receive enhanced local access to natural resources and/or improvements in the quality of the resources;
- revenue sharing, whereby project affected communities share the direct monetary benefits of hydropower according to a formula and approach defined in the regulations.

Commitments to additional benefits or benefit sharing may be the responsibility of other agencies and not the project developer or owner/operator.

## Assessment

*Assessment criterion - Preparation Stage: An assessment of opportunities to increase the development contribution of the project through additional benefits and/or benefit sharing strategies has been undertaken; and the pre-project baseline against which delivery of benefits can be evaluated post-project is well-documented.*

The Environmental and Social Impact Assessment (ESIA) should demonstrate that opportunities for project benefits have been researched, along with the feasibility of measures to identify and realise them. Project benefits should be linked to development objectives, which may be expressed in national, regional or local development plans and strategies. Examples of development objectives to which the project might contribute include: poverty alleviation; provision of infrastructure; access to electricity; food security; water security; increased per capita income; access to health services; access to education; reduced infant mortality; and other public health targets.

The assessment should consider various approaches that could deliver on development objectives and seek to develop a feasible approach to accompany the project. Additional benefits that are often deployed by projects include: new or improved health services and/or educational facilities; transport to improve access; jobs for locals; training and capacity building; community development initiatives; local royalties and other revenue-sharing arrangements; local shareholdings in project companies; multiple-use strategies for reservoirs (e.g. fishing, recreation, tourism); and multi-purpose projects which are designed to deliver other water resource management benefits besides hydropower generation (e.g. irrigation, flood control, water supply, aquaculture).

There are many opportunities to leverage hydropower projects for positive social change, but special care has to be taken to protect vulnerable groups in this process (see the Project Affected Communities and Livelihoods guidance); this may be achieved by involving them in decision-making on mitigation, compensation and benefit sharing mechanisms, and by designing specific management approaches for these groups. Support mechanisms may be targeted to help vulnerable groups or individuals make use of and participate in opportunities (for example, through preferential treatment in local employment and procurement). Project benefits may be targeted with the objective to further reduce vulnerability.

There needs to be adequate documentation of the pre-project status around the area of the benefit so that delivery of the benefit and its effectiveness can be demonstrated at a later date. For example, if the benefit is for a health clinic to improve access to health services, appropriate baseline indicators might include: average distance to travel to a health clinic for project affected communities pre-project; average number of visits per year per community (or individual); and a range of health indicators.

## Assessment

*Assessment criterion - Implementation Stage: Opportunities to increase the development contribution of the project through additional benefits and/or benefit sharing have been assessed. In the case that commitments to additional benefits or benefit sharing have been made, monitoring is being undertaken on delivery of these commitments.*

Further to the guidance above, monitoring in relation to project benefits should:

- use indicators that allow comparison against the baseline;
- be designed to indicate the effectiveness of the project benefit contribution towards improvement in the targeted development objectives; and
- illustrate if any practical issues have arisen that require a management response to ensure sustainability of the benefit.

## Assessment

*Assessment criterion – Operation Stage: 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.*

In addition to the above guidance, the sustainability of project-enabled benefits is an important consideration at the outset. Benefits such as new schools or health centres can deteriorate after the period of project support ends. Any support from the project should be designed to fit well with normal government service systems. Agreements should be made on the period of project support and handover provisions to the government. Although benefits from local procurement and employment will generally decline at the end of the construction stage, the project can support local businesses and workers in building skills and capacity, thus preparing them for the time after construction.

In the case of older projects, there may not be well-documented commitments to delivery of project benefits made at the time of project approval nor data on the pre-project baseline against which to compare delivery of benefits. If this is the case, the focus for good practice is on the ability of the hydropower owner/operator to identify issues, concerns and opportunities within the surrounding communities in relation to project benefits and to demonstrate responsiveness within corporate social responsibility or sponsorship programmes.

## Management

*Management criterion - Preparation Stage: Project benefit plans and processes have been developed for project implementation and operation that incorporate additional benefit or benefit sharing commitments; commitments to project benefits are publicly disclosed.*

*Management criterion - Implementation Stage: Measures are in place to deliver commitments by the project to additional benefits or benefit sharing; and commitments to project benefits are publicly disclosed.*



*Management criterion - Operation Stage: 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.*

Commitments to project benefits need to be clearly documented in plans with appropriate processes in place to ensure delivery and follow-up. Plans should include information on the nature of the benefit and the beneficiaries, responsibilities for implementation, budget allocations, time targets, milestones, and monitoring of effectiveness. Examples of management approaches for some common project benefits are outlined as follows.

- **Local supply of goods and services to the project and to contractors.** The project can undertake local market studies to determine the supply potential, as well as potential price increases and their impacts on community members. Project targets can be developed for procurement of local goods and services and reported on regularly. Contractors can be encouraged or required to procure goods and services locally. The project can support local producers in providing appropriate quantities and qualities, for example through training, information on goods and services needed, creation of project procurement centres (e.g. a food cooperative for local growers), or facilitation of partnership approaches between experienced contractors and local businesses. The project can also support local producers in developing other markets once project construction is completed.
- **Local employment and training.** The project would need to undertake local labour market studies to determine employment potential and assess potential wage increases and their impact on community members. Project targets can be developed for local employment and reported on regularly. Contractors can be encouraged or required to hire local workers. Ideally, programmes should be designed and delivered to train local people for skilled jobs during construction and operations, if necessary starting years before the beginning of construction. The project can cooperate with labour authorities and local government to match local workers with employment opportunities. Local workers of contractors can be identified for the future operations and maintenance (O&M) workforce.

- **Public use project facilities.** Consideration should be given from an early stage and in dialogue with relevant government agencies about potential public uses of project facilities (e.g. roads, health centres, schools, reservoirs) during construction and operations. If required, adjustments can be made to project siting, design and operations to achieve better local benefits. The capacity, quality and costs of facilities may be higher if designed as permanent rather than temporary. After the construction stage, some facilities may be handed over to appropriate government agencies for operations.
- **Community development initiatives.** Community development initiatives can take many forms depending on local conditions and priorities. Investments in community infrastructure and services may include water supply, public transport, waste disposal, health and education support, community buildings, banks/ATMs, reliability of electricity supply, etc. Livelihood development may include investments in agriculture (such as improved livestock breeds, fruit trees, or storage and processing facilities) or tourism opportunities (for example reservoir management plans allowing for other developments and uses, development of trekking routes or visitor destinations, or better access to and protection of culturally significant areas). Initiatives for community development may be developed in partnership with local governments and embedded in local development planning mechanisms to reflect the priorities of the community. These should be based on effective community consultations, building of trust, managing expectations by clearly defining roles and responsibilities, development of appropriate capacity, setting of measurable goals, and reporting on progress. Plans should ensure the sustainability of initiatives, either through long-term commitment from the developer or through agreements with local governments on O&M responsibilities. These plans may involve third parties such as NGOs as delivery mechanisms.

A commitment should be in writing to recognise its formality and be within an appropriate document signed by a recognised representative of the party who will deliver on this commitment. Government licence requirements and court decisions are considered formal commitments. The formality of a commitment can be

demonstrated by how it has been recorded, documented, witnessed, and publicised by the party responsible for its implementation.

Public disclosure is demonstrated if members of the public can access information on the commitment if they would like to do so. This may involve access to the actual document that records the commitment (either posted on a website, distributed, or made available on request to interested parties), or public notification via a media release or website about the main provisions of the commitment. If there was a one-off notification, information may later be hard to access. In this case, some effort should be made by the owner/operator to ensure awareness of and ease of accessibility of information by stakeholders over time on downstream flow regime commitments.

## Stakeholder Engagement

*Stakeholder Engagement criterion - Preparation Stage: The assessment and planning process relating to project benefits has involved appropriately timed, and often two-way, engagement with directly affected stakeholders; ongoing processes are in place for stakeholders to raise issues and get feedback.*

The risks of poor outcomes in relation to the development contribution of project benefits are high if communications and cooperation between the recipient communities, the developer, and government does not work well. This may arise if, for example, there was poor consultation on the benefit opportunities and the risks associated with achieving objectives and indicators of success.

Good practice requires that a process of stakeholder engagement has been followed in the assessment and planning for project benefits. The focus is on project affected communities who should be amongst the beneficiaries and other stakeholders with the potential to be directly affected by the benefits under consideration. Great care needs to be taken in engagement processes to ensure that benefits are strategically identified to support development objectives and are not just popular 'wishlists' which can sometimes create winners and losers within communities or areas.

Appropriate timing, culturally appropriate, and two-way processes are important components

of good practice. 'Appropriately timed' means that engagement should take place early enough so that the project can respond to issues raised, those affected by the project have inputs before the project takes decisions, and engagement is at times suitable for people to participate. Project benefit stakeholders should be supportive of the timing of engagement activities. 'Culturally appropriate' means that methods of engagement respect the cultures of those involved and allow adequate provisions to fit with the discussion and decision-making processes typically followed. Stakeholder engagement processes that are culturally sensitive consider, for example, meeting styles, venues, facilitators, language, information provision, the community's decision-making processes, time allocation, recording, and follow-up. Engagement processes need to consider gender and the inclusion of vulnerable social groups. 'Two-way' means that project benefit stakeholders can give their views on the project benefit plans that will affect them rather than just being given information without any opportunity to respond. Examples of two-way processes include focus groups, community meetings, and public hearings.

Processes in place for project benefit stakeholders to raise issues could include, for example, designated contact people, periodic briefings or question/answer opportunities, or feedback/suggestion boxes at easily accessible areas. Feedback on issues raised could be demonstrated by means such as written correspondence or meeting minutes. A register should be kept by the owner/operator of source, date and nature of issues raised and how and when each was addressed and resolved.

## Conformance/Compliance

*Conformance/Compliance criterion - Implementation Stage: Processes and objectives relating to project benefits have been and are on track to be met with no major non-compliances or non-conformances, and any additional benefits or benefit sharing commitments have been or are on track to be met.*

*Conformance/Compliance criterion - Operation Stage: 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.*



Assessment processes and management measures relating to project benefits need to be compliant with relevant legal and administrative requirements. These may be expressed in licence or permit conditions or captured in legislation. Implemented measures should be consistent with what is in the plans to demonstrate conformance with the plans.

Commitments to communities in relation to project benefits may be expressed in the policies of the developer or owner/operator, or in company statements made publicly or within management plans. A major concern arises if project benefit 'promises' are made to communities to smooth the way for project development and avoid opposition, and then these promises are not delivered. Consequently it is important to document the evidence for what was committed and the full delivery of the commitment. Evidence of adherence to commitments could be provided through, for example, internal monitoring and reports, government inspections, or independent review. Variations to commitments should be well-justified and approved by relevant authorities, with appropriate stakeholder liaison.

The significance of not meeting a commitment is based on the magnitude and consequence of that omission and will be context-specific. For example, a failure to demonstrate delivery of a licence requirement relating to a benefit for the local communities is likely to be a significant non-compliance, whereas a slight delay in delivery of a monitoring report could be a non-significant non-conformance.

## Outcomes

*Outcomes criterion - Preparation Stage: Plans deliver benefits for communities affected by the project.*

*Outcomes criterion - Implementation Stage: Communities directly affected by the development of the hydropower project have received or are on track to receive benefits.*

*Outcomes criterion - Operation Stage: 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.*

To demonstrate that plans will deliver benefits for communities affected by the project, it is necessary to show that a thorough definition of project affected communities was undertaken and that the baseline against which later benefits could be demonstrated was adequately documented (see the Project Affected Communities and Livelihoods guideline). The assignment of responsibilities and resource allocation for implementation, monitoring and evaluation should be appropriate to the planned actions. The developer, owner and operator should demonstrate that responsibilities and budgets have been allocated to implement project benefit plans and commitments.

An evidence-based approach should demonstrate that project benefits were delivered and met their objectives. Monitoring reports and data in the implementation and operation stages should clearly track performance against commitments and objectives.



# Economic Viability

*This guideline expands on what is expected by the criteria statements in the Hydropower Sustainability Tools (HST) for the economic viability topic, relating to assessment, stakeholder engagement and outcomes. The good practice criteria are expressed for the preparation stage.*

*In the Hydropower Sustainability Assessment Protocol (HSAP), this topic is addressed in P-11.*

This guideline addresses the net economic viability of the project. The intent is that there is a net societal benefit from the project once all economic, social and environmental costs and benefits are factored in.

Hydropower projects can provide both economic benefits and costs in the regions where they are developed. These can be through either direct activities of the project (e.g. construction of dams, relocation of villages, provision of electricity) or actions indirectly related to the project (e.g. the creation of new industries).

The term 'economically viable' is used to describe a project that provides an overall positive net

economic contribution to society after all costs and benefits have been accounted for. This includes social, environmental and financial costs and benefits to society. Economic viability is distinct from financial viability, which typically focuses on the ability of a project to generate sufficient cash flow to deliver an appropriate risk-adjusted return on the capital invested.

Economic viability is informed by the financial analysis but takes a broader approach to costs and benefits than just financial considerations. Compared to a financial analysis, the economic analysis typically encompasses a larger geographic scale, examining the national or regional implications of the project and social and environmental externalities. Social and environmental externalities are factors that are not reflected well in market prices but can affect societal wellbeing; pollution is an example of a negative externality (e.g. it can impose public health and clean-up or remediation costs), and education is an example of a positive externality (e.g. educated people can go on to educate other people). These externalities are the social and environmental costs and benefits in an economic assessment.

## Assessment

*Assessment criterion - Preparation Stage: An assessment of economic viability has been undertaken with no significant gaps; the assessment has involved identification of costs and benefits of the project and either valuation in monetary terms or documentation in qualitative or quantitative dimensions.*

Economic viability assessments may be completed to confirm a rationale for public investment (including investment from public sector development banks), to fulfil regulatory requirements, or to demonstrate to project stakeholders that the project will provide an overall economic benefit to a region.

The main method for assessment of economic viability of a project is a **Cost-Benefit Analysis (CBA)**. Costs and benefits are expressed as far as possible in monetary terms so that they can be compared on an equal level. A project is assessed as economically viable if the project benefits exceed the project costs.

The main steps in an economic evaluation are:

- (i) identify the project benefits and costs;
- (ii) quantify and value the benefits and costs (where possible);
- (iii) adjust the costs and benefits to reflect their economic values (where necessary);
- (iv) establish benefit and cost streams over time and discount them at an appropriate rate; and
- (v) compare the present value of gross economic benefits with the present value of gross economic costs.

The economic analysis always starts with the project financial analysis, and then extends and modifies it. The analysis should include all costs and benefits that can be associated with the particular project. Costs and benefits should be quantified (where possible) and estimated for the entire life of the project. Valuation methods for each separate cost and benefit must be carefully considered and justification provided for the method adopted. It is important to justify the discount rate used to reach the conclusion.

All assumptions should be clearly stated in the analysis.

Considerations in relation to costs in the economic model include:

- all construction costs in the project financial model should be included as a starting point;
- costs should include residual (not fully avoided, mitigated or compensated), environmental and social impacts of the project;
- land acquisition costs may need to reflect the future income potential of a piece of land if that potential is not reflected in market prices and/or compensation rates;
- the analysis may need to differentiate between traded (imported) and non-traded goods (domestic resources);
- the analysis may need to differentiate between scarce (often skilled) labour and surplus (often unskilled) labour;
- the economic model should not include costs relating to taxes or financing costs;
- considerable care needs to be taken in terms of how best to factor in the effects of inflation and future changes in prices over time from a wider economic perspective; and
- sunk costs, and costs that would be incurred even if the project did not go ahead, should be documented, although they typically do not influence a decision to proceed with a project.

Benefits in the economic model should include:

- energy production benefits from the full energy production;
- additional energy production of downstream plants achieved because of the project;
- any induced (secondary) benefits from energy availability, in the case that the country is energy-constrained and there is no alternative generation option; and
- any net environmental and social benefits for society, such as net benefits for biodiversity through offsets and the net social benefit through improved livelihoods of the local population.

The magnitude of anticipated benefits should be analysed against appropriate baseline indicators, and the longevity of the benefits should be factored into the analysis.

Although monetary evaluation of the environmental and social costs and benefits of a project can be difficult, wherever possible the values should be estimated as this allows a comparison with financial assessments. If it is not possible to estimate a value for a particular benefit or cost, at least quantitative estimates can be provided for expected changes in the environment and for society and/or an ordinal ranking could be assigned on the basis of its materiality (i.e. societal importance or significance). Where costs and benefits are not quantified, justification should be provided along with an assessment of the materiality of the unquantified factors.

Sources of information for the analysis may include, for example: an analysis of the economic context or region; an analysis of the climate change benefits of the project; analysis, quantification and valuation of project costs and benefits; loan appraisal reports; and economic analyses of natural resources and riparian linked livelihoods. A consideration of alternatives to the project development can be important for determination of project costs and benefits, including doing nothing, alternative forms of power generation, and alternative uses of the site.

There are a number of analytical techniques that may be incorporated into the economic viability assessment. Examples include:

- **Incidence analysis** – This analysis disaggregates the overall impact of the project according to the impact on individual community groups (e.g. minority groups, regions, age segments). This can assist in identifying groups that are most impacted and in defining compensation and benefit sharing options.
- **Input-output analysis** – This is an economic model which uses a range of intersectoral relationships to estimate the regional flow-on (also called induced or secondary) effects of a project.

To meet good practice, some practical steps can be taken to keep the economic analysis feasible; for example, a partial analysis may be undertaken of the most important economic effects. Components of the analysis may be distributed over a range of documents rather than being consolidated in a single report. For some aspects, simply multiplying a quantitative change by a

certain value number from elsewhere may be sufficient (e.g. tonnes of CO<sub>2</sub> avoided x cost of climate change per ton as estimated by some authoritative sources).

If assessments are undertaken by parties with vested interests they may focus on the benefits of project and place less weight on negative impacts, which can create significant bias in the analysis. All economic analysis models are prone to data manipulation, which can include issues such as double-counting of benefits and poor quality of data. As such, findings should be scrutinised. The most defensible economic viability assessment will:

- use appropriate expertise;
- be objective;
- be comprehensive in fully considering costs and benefits;
- ensure quality and defensibility of the inputs, assumptions and methods; and
- take a balanced approach to considering costs and the broader implications of the development for the community and the environment.

## Stakeholder Engagement

*Stakeholder Engagement criterion - Preparation Stage: The results of the economic viability analysis are publicly disclosed.*

Public disclosure is demonstrated if members of the public can access information on the results of the economic viability analysis if they would like to do so. This requires some means by which the public knows that the analysis has been completed. Public disclosure may take place by enabling access to the actual document that presents the analysis or a summary of the analysis, either posted on a website, distributed, or made available on request to interested parties. If not consolidated into a single report, public disclosure could be demonstrated through public accessibility of the various sources that led to the conclusions on the results.

Good practice relates to disclosure of the results of the analysis and not the full details of the analysis. The public could be notified via a media

release or website about the main outcomes of the analysis. If only a one-off notification of the results has been made available, information may later be hard to access. In this case, some effort should be made by the developer to ensure awareness of and ease of accessibility of these results by stakeholders over time.

## Outcomes

*Outcomes criterion - Preparation Stage: From an economic perspective, a net benefit can be demonstrated.*

Demonstration of net benefits should be provided through quantitative indicators. Examples of quantitative indicators include net benefit, benefit-cost ratio, and economic rate of return. From an economic perspective, rate of return is an indicator for the developmental impact of a project proposal, allowing comparisons with other energy sector investment options. Unlike the financial rate of return, which is mainly of interest to organisations with commercial stakes in a proposal, the economic rate of return is of interest to society at large. Depending on the perspective of the evaluation, alternative indicators such as the net present value of the project, or the economic costs per unit of capacity installed or power generated, may be used.

The economic model should not be biased towards positive economic benefits (particularly financial benefits) or misrepresent the costs of negative material impacts. Sensitivity analyses would ideally be conducted to demonstrate the robustness of the conclusions. These analyses usually involve testing different values for key parameters to see by how much the underlying quantity or its value can change before the rate of return of the project becomes negative. Scenario analyses can also provide more rigour to the conclusions, e.g. by looking at several adverse circumstances that could potentially arise simultaneously and how they would affect the conclusions. If probability distributions for various parameters can be estimated, this can be done, for example, through Monte Carlo simulations. Cost and time overruns should be amongst the adverse circumstances considered.

It is common for economic viability reports to include a summary table that outlines all the costs and benefits associated with the project, their assigned values, and the subsequent calculation of the project's overall net economic impact. This summary should be high-level and presented in a simple, easy to understand manner. For the conclusion that a project has a net positive impact, benefits must exceed costs in the most probable scenario.



# Procurement

*This guideline expands on what is expected by the criteria statements in the Hydropower Sustainability Tools (HST) for the Procurement topic, relating to assessment, management, conformance/compliance and outcomes. The good practice criteria are expressed for the preparation and implementation stages.*

*In the Hydropower Sustainability Assessment Protocol (HSAP), this topic is addressed in P-12 for the preparation stage and I-8 for the implementation stage. In the Hydropower Sustainability ESG Gap Analysis Tool (HESG), this topic is addressed in Section 9.*

This guideline addresses all project-related procurement including works, goods and services. The intent is that procurement processes are equitable, transparent and accountable; support the achievement of project timeline, quality and budgetary milestones; support developer and contractor environmental, social and ethical performance; and promote opportunities for local industries.

**Procurement** in this context means the purchase of goods or commodities by the project developer or operator, as well as contracting for services or goods. Hydropower projects rely upon a range of works, goods and services being provided to the project. These are usually in the form of contractors doing works, consultancies providing expert advice, materials, manufactured goods and equipment, and services.

Procurement is guided by selection criteria, for example to select the highest quality or lowest cost or a combination of these. Procurement may involve direct purchase from a known supplier for items under a certain value, and most commonly involves a bidding process for higher value items in which the bidders or sellers quote their prices. The bidding process begins when the procurer identifies the need for goods or services and starts to search the market for bidders. This may take place through publicising a tender. After identifying suppliers, a request for bids, proposals, quotes, and information can be made. Direct contact with bidders can also be made instead of advertising the above requests. After selecting the suitable bidders, a quality check may be undertaken to confirm the suitability of the goods or services in question. The next step is agreement on the terms, conditions, quality, and delivery schedules, followed by delivery and payment. All of these items are usually included in the bidding documents, which form the basis of the bidding process.



Procurement is a standalone topic in the preparation and implementation assessment tools because of the significant level of procurement that is required at these project stages. During the operation stage, procurement activity is lower and is therefore addressed as a component of the Governance topic (O-2). Procurement is strongly linked to the Integrated Project Management topic, where considerations relating to the overall project works programme, budget and scheduling are addressed.

## Assessment

*Assessment criterion - Preparation Stage: An assessment of major supply needs, supply sources, relevant legislation and guidelines, supply chain risks and corruption risks has been undertaken with no significant gaps.*

The most significant decision at the early stage of the project is the approach to be taken to major contracts, which is closely interrelated with management of financial risks (see the Financial Viability guideline). Approaches to the major contracts can vary widely, with different pros and cons and different outcomes regarding risk. Two widely differing examples are shown below, but there are many variations on these approaches to meet particular circumstances:

- **Unit price** – the owner manages all major construction contracts and pays a fixed sum for each completed unit of work based on estimated quantities of items and their unit price. Contracted costs will be lower than total project costs because costs to the owner are not reflected. Advantages are that the owner can easily verify that prices are not inflated and variations are relatively easily managed. Disadvantages are that this model requires a high degree of experience and capacity on the part of the owner, the owner carries a high level of administration and supervision, and the owner carries the major risks. One approach to reduce risks to the owner is to contract an **owner's engineer** to fill in resource and expertise gaps, provide administration and supervision services, and ultimately protect the owner's short- and long-term interests by ensuring all contractors are adhering to project specifications and advising the owner on any issues which arise.

- **EPC – an Engineering, Procurement and Construction (EPC)** contract involves a principal contractor implementing the project through the use of sub-contractors. The scope of services may cover from design right through to commissioning and handover to the owner depending on how it is set up. An EPC contract typically has project costs closer to the total project cost because a large part of the risk is transferred to the EPC contractor. Advantages for the owner include engagement with a single point of responsibility, working to a fixed price and completion date, and relying on performance guarantees to ensure delivery of required functionality. Potential disadvantages to the owner can include less involvement in the design process and quality control during project implementation, which may ultimately result in higher life cycle costs and reduced performance outcomes. Another potential disadvantage is that the EPC contractor may not have direct responsibilities for, nor take a long-term view, on environmental and social issues relating to the project.

Under any scenario, it is essential to itemise all procurement requirements for the project as this is necessary to estimate project costs and to inform procurement strategies. The feasibility studies and detailed design report should include identification of potential sources for major supply needs as this will influence accessibility, transport costs, financial planning in relation to taxes and duties, and logistical planning.

Major supply examples include:

- consultancies for design, economic, financial, technical, environmental and social studies;
- contractors for project construction works;
- materials for construction such as concrete, aggregate, and steel, as well as hydro-mechanical and electro-mechanical equipment for the project;
- equipment for processes relating to construction such as storage tanks, generators, and pumps; and
- services such as accommodation, food, driving, catering, cleaning, auditing, independent review, waste management, and medical for the site offices and labour camps.

Sources may be local or within the country, or from international locations. The assessment process should include investigations of sourcing options and related risks, and determinations on specifications to include in bidding documents.

Legislation and guidelines relevant to procurement for the project, for example with regards to labour laws or occupational health and safety, need to be thoroughly understood and built into the project's procurement procedures. Lenders may have requirements relating to aspects of the project they are funding, such as the use of international competitive bidding.

Supply chain risks should be thoroughly outlined and investigated for their likelihood and probability, magnitude and consequences, and mitigation measures. Supply chain risks may relate to, for example, inability to meet the contract provisions (e.g. with respect to cost, time, amounts, quality, specifications), corruption (e.g. bribes, facilitation payments, favouritism, shortcuts on specifications), transport impediments (e.g. floods, fire, civil unrest), and human rights (e.g. child labour, forced labour used by suppliers of suppliers). The viability of a particular supplier, and their quality assurance/quality control commitments and processes, are important elements to include in the assessment of potential supply sources. The assessment should include identification and evaluation of risk mitigation measures (such as inspections, insurances, independent evaluations) and monitoring programmes to identify emerging risks and assess the effectiveness of mitigation measures.

The assessment processes should include corruption risks as one of the supply chain risks. Corruption risks at the contracting and bid evaluation stage may include, for example: non-transparent pre-qualification; confusing tender documents; non-transparent or non-objective selection procedures; bid clarifications not shared with other bidders; award decisions not made public, or not justified; deception and collusion; unjustified agents' fees; and conflicts of interest for officials and consultants.

Provision of and support for creating opportunities for local employment and local capacity building may be a requirement for project development or may be a commitment

made by the developer. Local suppliers are those within geographic proximity of the project who can or have the potential to deliver the required good and services. The definition of 'local' will be context specific (e.g. those in the project affected area or local government district). Local capacity development refers to assistance that is provided to entities in the proximity of the project who have an identified need to develop a certain skill or competency or general upgrading of performance ability in order to meet or deliver a desired service. Enhancing local capacity may be a project benefit committed to by the developer. Assessment processes should include local capacity assessments and investigation of mechanisms by which such commitments could be fulfilled. This could include a local employment policy or statements of preference for local suppliers in contract documents, and support provided to local suppliers to enable them to participate in the tendering process. Assistance and training may also be provided to increase the capacity of local workers to comply with higher standards than they might be used to for issues such as safety. In some cases local employment may not be possible because of skills shortages; in such situations, the developer might establish training programmes to upskill local people to enhance local employment opportunities associated with the project. Packaging of some procurement needs into smaller units more accessible in scale to local businesses may be used to promote opportunities for local suppliers; however, this approach should not be used to avoid more stringent tendering requirements associated with larger procurement lots and it needs to be consistent with national, regional, and/or institutional policies and guidelines.

## Assessment

*Assessment criterion - Implementation Stage: Major supply needs, supply sources, relevant legislation and guidelines, supply chain risks and corruption risks have been identified through an assessment process; ongoing monitoring is being undertaken to monitor effectiveness of procurement plans and processes.*

Monitoring is an essential accompaniment to procurement during project implementation. Monitoring should be directed at:

- ensuring procurement processes are properly implemented and fully ethical (e.g. through independent auditing);

- processes to receive, review and respond to procurement-related grievances, and to identify any underlying issues so that corrective actions can be implemented;
- ensuring that contracts, materials, equipment, supplies and services procured meet required specifications and are on time and within budget; and
- identifying any emerging political or logistical issues that may affect the supply of goods and services, such as political unrest, road closures, strikes, materials shortages, or price changes.

Factory assessment tests can be an important assessment tool to ensure quality assurance/ quality control during the off-site manufacturing of major equipment. Monitoring through inspections before, during and after transport of major equipment are in the developer's interests.

## Management

*Management criterion - Preparation Stage: Procurement plans and processes have been developed for project implementation and operation with no significant gaps.*

*Management criterion - Implementation Stage: Measures are in place to guide procurement of project goods, works and services and address identified issues or risks, and to meet procurement related commitments.*

Procurement plans and processes should already have been developed during the preparation stage as this stage already involves contracting of services and provision of equipment (e.g. for investigations). Contracts need to be awarded during the project preparation stage for investigations, design, environmental and social impact assessments, and early site establishment works.

The development of procurements plans and processes for implementation and operation may not have taken place during the project preparation stage in cases where the project is sent to a bidding process at the end of the preparation stage. In such cases the plan for procurement could consist of a commitment to utilise the corporate entity's procurement plans and processes, which would then be required to meet the stated criteria.

Procurement plans should include procurement objectives and commitments or refer to these if they are in a policy document. The plan should include lists of works, goods and services required and the timing of these needs, and then specify how items will be bundled and the method and timing by which they will be procured (e.g. call for bids, quotes from preferred suppliers, direct purchase). Processes should be specified regarding approaches to various types of procurement to be used and under what circumstances each approach is appropriate (e.g. linked to a value threshold or the funding source, where a lender may have its own requirements). For major competitive bids, processes should specify the approach to pre-qualification screening, bidding, awarding of contracts, anti-corruption measures, and mechanisms to respond to bidder complaints. Procurement plans should include risk mitigation measures, such as inspections, insurances, and independent evaluations. Procurement plans and processes should also clearly allocate responsibilities, accountabilities, and monitoring and evaluation.

Pre-qualification screening is a means of shortlisting suitable suppliers based on specified criteria as an initial step in the procurement process. By way of example, screening could be for quality, reputation, and cost, and essentially involves evaluating a provider's prior performance in terms of meeting contractual obligations. Screening based on sustainability criteria might encompass additional criteria which could include, by way of example, social, environmental, ethics, human rights, health and safety performance, and preference and support to local suppliers where they meet other criteria. Screening to address anti-corruption might specify, for example, that companies tendering must have a code of conduct addressing anti-corruption and/or that they have never been prosecuted for unethical business dealings.

Procurement plans should clarify the processes to be followed to receive, review and respond to procurement-related grievances. These might involve, for example, a debriefing process with the company's procurement staff if requested by unsuccessful bidders. Independent audit processes might also be used to handle procurement-related grievances, and processes for escalation of grievances may be included in the relevant legislation.

Procurement plans should include anti-corruption measures. Examples of anti-corruption measures include: open bidding contracting processes to be above a low threshold; commitments by the contracting authority and its employees to an anti-corruption policy and/or project integrity pacts; mechanisms to report corruption and protect whistleblowers; and confidentiality limited to legally protected information.

## Conformance/Compliance

*Conformance/Compliance criterion – Preparation and Implementation Stages: Processes and objectives relating to procurement have been and are on track to be met with no major non-compliances or non-conformances, and any procurement related commitments have been or are on track to be met.*

Assessment processes and management measures relating to procurement need to be compliant with relevant government requirements. These may be expressed in licence or permit conditions or captured in legislation. Compliance requirements may relate to, for example, standards to be met, the frequency and type of monitoring to be performed, and reporting to be submitted by the owner to government. Meeting of design standards is of particular importance for procurement; quality control and independent review processes should be thorough and credible and include documentation to verify that all design standards are fully met (also note points relating to quality control in the Infrastructure Safety topic guideline).

Conformance refers to delivering what is in the plans and procedures. Following all processes and procedures consistently is a critical requirement to ensure equity and accountability.

Commitments may be expressed in regulatory requirements for addressing procurement, in relevant policy requirements of the developer, or in any relevant company statements made publicly or within management plans. Evidence of adherence to commitments could be provided through, for example, internal monitoring and reports, government inspections, or independent review.

The significance of not meeting a commitment is based on the magnitude and consequence of that omission and will be context specific. For example, breach of a lender requirement for international competitive bidding could be a major non-conformance; failure to demonstrate delivery of procurement commitment such as creation of opportunities for local suppliers could be a significant non-conformance; and a slight delay in delivery of a monitoring report could be a non-significant non-conformance.

## Outcomes

*Outcomes criterion - Preparation and Implementation Stages: Procurement of works, goods and services across major project components is equitable, efficient, transparent, accountable, ethical and timely, and contracts are progressing or have been concluded within budget or that changes on contracts are clearly justifiable.*

A range of documents relating to the procurement policies and practices of the developer should be readily accessible. Procurement information should be well-documented due to the commercial and legal implications of procurement activities. Policies and procedures that address the range of issues described in this guideline should be available. Other documentation that can demonstrate this criterion is met includes tender requirements/specifications; bidding documents; supplier screening criteria; evaluation of supplier performance; recommendation of the bid evaluation team; documentation in relation to conflicts of interest; bidder grievance log; record of compliance with relevant legislation and guidelines, including those of financing agencies; and monitoring and/or third-party review reports.

Procurement approaches should demonstrate a number of outcomes. Equity would be demonstrated through fair and open processes. Efficiency would be demonstrated by processes that are clear, consistent and able to be readily implemented, and meet timing and budget requirements. Transparency would be demonstrated by procurement processes that are easily accessible to and understood by suppliers and third parties (e.g. regulators, civil society), and outcomes where the rationale for choices made are readily provided. Accountability

would be demonstrated by ensuring those with responsibilities can be identified and can answer to how their actions align with business policies. Ethics would be demonstrated if processes to detect corrupt practices are sufficient, well-established and applied, shown to be effective, and show no unethical practices. Timeliness would be demonstrated if goods and services have been obtained within timeframes that supported meeting of project timelines and did not impinge on the project's critical path or cause management issues such as temporary storage shortages.

Project progress reports should show that projects are performing against time and budget targets. If contracts have not been concluded within budget, evidence should be provided to show that the changes on contracts are clearly justifiable and that variations have been handled with all the same principles as the original contract establishment. Evidence should be accessible to show that any changes to contracts and associated budgets have explicitly followed corporate or other relevant institutional procedures.





# Project Affected Communities and Livelihoods

*This guideline expands on what is expected by the criteria statements in the Hydropower Sustainability Tools (HST) for the Project Affected Communities and Livelihoods topic, relating to assessment, management, conformance/compliance, stakeholder engagement, stakeholder support and outcomes. The good practice criteria are expressed for different life cycle stages.*

*In the Hydropower Sustainability Assessment Protocol (HSAP), this topic is addressed in P-13 for the preparation stage, I-9 for the implementation stage and O-9 for the operation stage. In the Hydropower Sustainability ESG Gap Analysis Tool (HESG), this topic is addressed in Section 4.*

This guideline addresses impacts of the hydropower project on affected communities. **Project affected communities** are the interacting population of various kinds of individuals in the area surrounding the hydropower project who are affected either positively or negatively by the hydropower project and its associated infrastructure.

Potential impacts of a hydropower project on communities could include economic displacement, deterioration of livelihoods and/or living standards, and impacts to rights, risks and opportunities for those affected. **Livelihood** refers to the capabilities, assets (stores, resources, claims and access) and activities required for a means of living. For example, with a farming-based livelihood, important resources include prepared fields, water of a suitable quality, fertile soil, seeds, and appropriate tools, equipment and machinery. **Living standards** refer to the level of material comfort as measured by the goods, services, and luxuries available to an individual, group, or nation, often using indicators of household wellbeing. **Economic displacement** refers to the loss of assets, access to assets, or income sources or means of livelihoods. These losses could occur as a result of land acquisition, changes in land use or access to land, restrictions on land use or access to natural resources, or changes in the environment leading to health concerns or impacts on livelihoods.

The outcomes sought in relation to hydropower effects on communities are that livelihoods and living standards are improved relative to pre-project conditions, and commitments to project affected communities are fully delivered over an appropriate period of time.

## Assessment

*Assessment criterion - Preparation Stage: An assessment of issues relating to project affected communities has been undertaken with no significant gaps, utilising local knowledge.*

The potential impacts of a hydropower project on communities and livelihoods should be assessed as part of the Environmental and Social Impact Assessment (ESIA). Some national requirements may focus more narrowly on environmental impact assessment, but international good practice also requires a strong focus on social aspects.

Project affected communities should be identified with respect to both direct and indirect potential impacts. Upstream and downstream communities must be included as far as flow changes induced by the project can be detected. This may include communities in other jurisdictions or countries. Communities affected by transmission lines, roads and other associated infrastructure should be included. A concern to be avoided is that those members of the community who will be resettled get all of the assessment and compensation attention. It is essential that those community members who are not resettled but experience direct impacts, secondary or indirect impacts, or impacts only after some time has passed are identified as part of the project affected communities and that mitigation measures are addressed for these impacts.

The studies must establish a baseline of the households and communities that may be project affected. Social science expertise and recognised social survey techniques should be used to select indicators and generate baseline information. As far as practically possible, standardised indicators should be used that are compatible with existing official monitoring mechanisms, such as the periodic household surveys. Indicators of livelihoods and living standards used for characterising the baseline should be applicable for post-project development comparisons. Living standards are usually assessed using quantitative social science methods, such as census and public health data. Examples of indicators of living standards include: consumption, income, savings, employment, health, education, nutrition, housing, and access to services such as electricity,

clean water, sanitation, health, education, and transport. Livelihoods are usually assessed using a mix of quantitative data, such as the number of individuals pursuing a particular livelihood, and qualitative methods such as interviews, focus groups, and observation to establish information about the activities and assets on which a livelihood depends. Information should be disaggregated by cultural, ethnic, socio-economic, gender, age, education, health, location and other characteristics.

Because project development can take years, the baseline assessment needs to be carefully timed. Populations can move in and out of project affected areas and the assessment should form the basis for support and compensation measures. In order to enable fair compensation arrangements, the baseline information needs to include data on affected households and businesses and their assets at an established registration date or period. The timing of establishment of the baseline should take into account any variations in the conditions that are influenced by, for example, seasonal cycles or infrequent events (e.g. droughts or floods).

Once the baseline conditions are established, project-related risks to livelihoods, living standards, and economic displacement are identified and the nature and degree of impacts analysed. Analysis of gender and vulnerable groups should be included. Community risks during the construction stage may include the following:

- Physical displacement (e.g. relocation, loss of residential land, or loss of shelter). Physical displacement involves risks both for the displaced people and for the host communities receiving them (see the Resettlement guideline).
- Economic displacement (e.g. loss of community forest access, loss of paddy or home garden, or diminished fisheries). Many issues can be missed relating to affected livelihood resources if, as is often the case, there is too narrow a focus on land acquisition and compensation. Many livelihood impacts can occur through, for example, changes in road accessibility, land access, supply chains, or river flow regimes.
- Impacts from worksites and construction traffic (e.g. dust and other air emissions, solid waste, wastewater, noise, vibrations, visual disturbances, hazards, access to travel routes,

water abstractions). These impacts can affect homes, workplaces, fields and gardens, forests and hunting areas, rivers and water sources, roads, and other community infrastructure.

- Loss in value of properties, which can be affected directly or indirectly by project activities.
- Lack of capacity or temporary closures of local infrastructure and services. These may include, for example, roads, schools, health centres, shops, bridges, footpaths and tracks, and boat/ferry transport.
- Rising costs of living. These may occur because the influx of contractors, workers and project followers creates additional demand.
- Conflicts between the workforce and the local population and exposure to risky behaviour (such as drugs and alcohol abuse).
- Conflicts within the local population. These can arise for a range of reasons, often relating to issues of inequity. Examples of potential conflict areas include: compensation measures, which may arise from a lack of clarity on cut-off dates, eligibility criteria, or entitlement provisions (e.g. duration); access to and extent of training and support; and access to and extent of project benefits.
- Human-wildlife conflicts. These can occur due to environmental improvement or mitigation measures that promote conditions for wildlife and bring it closer to human settlements, or because livelihood activities are forced to go more remotely into areas with higher human-wildlife conflict risks.
- Loss of ownership, access to, or use of sacred sites, community forest, or other natural resources.
- Loss of social cohesion. This may occur through a range of causes, such as impacts to or loss of community resources (e.g. roads, gardens, land, forest, fisheries), community assets (e.g. community meeting areas, culturally significant features), and various types of conflicts within and relating to the local population as described above.

Community risks during the operation stage may include:

- all of the above, but generally on a smaller scale, considering that only a small workforce remains to operate and maintain the project in permanent accommodations and offices;

- loss of roads, bridges, transmission and telephone lines, pipelines, and other public infrastructure caused by reservoir inundation;
- barrier effects of the reservoir or any areas with restricted access to land transport; and
- changes in reservoir levels, water quality, river flows, and sediment transport, which affect properties and users along the reservoir shore and along the downstream river.

The risks listed above are particularly acute, with a higher probability of occurrence for vulnerable groups and individuals. **Vulnerability** refers to the inability of people, organisations and societies to withstand adverse impacts from multiple stressors to which they are exposed. **Vulnerable groups** are those people who by virtue of gender, ethnicity, age, physical or mental disability, economic disadvantage, or social status may be more adversely affected by project impacts than others and who may be limited in their ability to claim or take advantage of project assistance and related development benefits. A **vulnerable individual** is a person who, by virtue of gender, ethnicity, age, physical or mental ability, economic disadvantage, or social status, is experiencing hardship and would benefit from targeted support or assistance. Small adverse changes in their livelihoods can be enough to cause them to fall under the poverty line. They may be at risk of discrimination. They will often find it more difficult to adapt to rapid social change, which disrupts traditional norms and social safety nets. They can be less able to deal with monetary compensation, and more dependent on in-kind compensation. Vulnerable households and individuals can benefit from a case-by-case approach to management, which should involve good cooperation with relevant government agencies. Indigenous peoples may be among those who are highly vulnerable to project impacts (see the Indigenous Peoples guideline).

A long-term view on the timeframe over which impacts to project affected communities are assessed is important. For example, downstream river bank erosion can cause impacts to riverbank gardens that are not fully experienced until some years after project commissioning. In some cases the impacts may result in project affected communities eventually needing to move, but they may not be considered part of the resettlement community because the physical



resettlement was a secondary impact (from delayed bank erosion) and not a primary impact (e.g. from reservoir inundation) of the project. The risk of long-term impoverishment for project affected communities is a major concern and must be fully assessed.

## Assessment

*Assessment criterion - Implementation Stage: Issues relating to project affected communities have been identified through an assessment process utilising local knowledge; and monitoring of project impacts and effectiveness of management measures is being undertaken during project implementation appropriate to the identified issues.*

*Assessment criterion - Operation Stage: 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.*

During the implementation and operation stages, monitoring should be conducted to establish whether anticipated or unanticipated issues are arising. Monitoring should focus on agreed indicators and methods used in the baseline assessment so that credible comparisons can be made. It is important to build local knowledge into assessment processes so that community members can establish effective data collection and monitoring processes that will bring information forward in a timely manner.

Examples of mechanisms by which issues can be brought forward include regular visits by social workers or by community representatives responsible for communicating any emerging issues to those responsible. Depending on the particular arrangements and the time period post-project commissioning, responsibilities may have been handed over from the owner/operator to government agencies. Handover processes and responsibilities for monitoring and response are important to establish and ensure effectiveness.

For older projects there may be 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. In this case, it is still important for the

hydropower facility to have mechanisms to detect and evaluate if issues relating to the hydropower facility are arising for the surrounding communities as these can evolve over the many decades of operations.

## Management

*Management criterion - Preparation Stage: Management plans and processes for issues that affect project affected communities have been developed with no significant gaps including monitoring procedures, utilising local expertise when available; and if there are formal agreements with project affected communities these are publicly disclosed.*

*Management criterion - Implementation Stage: Measures are in place to address identified issues that affect project affected communities, and to meet commitments made to address these issues; and if there are any formal agreements with project affected communities these are publicly disclosed.*

*Management criterion - Operation Stage: 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.*

Plans for project affected communities should be included in the Environmental and Social Management Plan (ESMP) and should separately address construction and operation stage impacts. A multitude of measures to address project-related effects on communities have been implemented with hydropower project developments globally. The following are some of the approaches that could be considered in project management plans to address specific issues and risks for communities.

Measures to mitigate economic displacement should first fully explore avoidance and minimisation through project siting, design and operations. Where economic displacement is unavoidable, mitigation measures should be implemented and may include some of the following:

- Affected households or communities are part of discussions and agreements on the

decision to participate in livelihood restoration and improvement programmes and which livelihoods to pursue, or to take monetary compensation.

- Compensation is in-kind (land-for-land of equivalent productive capacity, shop-for-shop etc.), or where not available or not desired by the affected household, compensation is provided in cash at replacement cost or legally established compensation rates, whichever is higher.
- Assistance is provided to help affected households and communities to maintain and improve their livelihoods and standards of living or shift to alternate livelihoods, depending on the nature and degree of impact. Examples of support measures include resources, equipment, permits, credit, training, expert advice, demonstration centres, and preparatory actions (e.g. land clearing, land preparation, access roads).
- Where commercial farms or other types of business enterprises are affected, support is provided for their owners, employees, and dependent local businesses (such as suppliers and processors) to restore or shift their livelihoods.
- Because the technical and commercial success of livelihoods activities can be difficult to predict continued monitoring is implemented, ideally with planned adaptive management measures, to ensure effectiveness of the livelihood restoration and improvement programme over time.

Economic displacement may be temporary during construction, or partial where only part of the land is acquired or where only certain land uses are restricted (for example, in the right-of-way of a transmission line). In such cases, the mitigation and compensation measures can be applied proportionately. However, if this results in undue hardship for affected people (i.e. when the remaining livelihood potential is insufficient), permanent and full compensation is required.

Measures to mitigate the risks of a lack of capacity or closures of local infrastructure and services (such as roads, schools, health centres, shops) include: avoidance and minimisation of closures through appropriate construction management or bypass and replacement facilities; a timely increase in capacity of public facilities and support to private facilities for increases in capacity; additional temporary facilities during

construction; and opening of project facilities to local communities.

Measures to mitigate risks of rising costs of living as the influx of contractors, workers and project followers creates additional demand include: monitoring of price levels for housing, groceries, fuels, etc.; balancing of interest in local procurement and stimulation of the local economy with protection of vulnerable local households; where possible, support for increased local supply of housing, groceries, fuels, etc., for example through local farming cooperatives; and where necessary, self-contained work camps and limits on local procurement and employment.

Measures to mitigate risks of conflicts between the workforce and the local population, and exposure to risky behaviour (such as drugs and alcohol abuse or prostitution), include: monitoring of interactions; early identification of potential conflicts; awareness-raising and preventative measures; enforcement of restrictions; balancing of interest in workers' recreation opportunities with protection of vulnerable local households; increased support for local police or security; clear contract provisions regarding worker behaviour and consequences; workers sign a Code of Conduct which is reinforced through various project communications mechanisms; and self-contained work camps and limits on interaction with communities (for example, through fencing, gate controls, and curfews).

Measures to mitigate risks of conflicts within the local population and loss of social cohesion include: monitoring of social processes and early identification of potential conflicts; easily accessible information and clear communications on impacts, entitlements, processes, and timelines for mitigation and compensation; and fostering a sense of community by equitable treatment of households, negotiating with legitimate community leaders, and supporting community building activities. Measures to mitigate risks of conflicts over compensation entitlements resulting from unclear cut-off dates for baseline establishment and asset registration include: ensuring that cut-off dates are agreed with local community leaders, clearly documented, and communicated widely. A project vulnerability policy is recommended

so that the approach to support for the most vulnerable is documented and consistent.

Measures to mitigate risks of human-wildlife conflict, in which wildlife is displaced by project activities or humans displaced by the project encroach upon wildlife habitat, include: avoidance and minimisation through project siting, design and operations; provision of alternative habitats for wildlife; employment of local guards or wardens in high risk areas and times of day; fencing and other measures to keep animals from fields and settlements; relocation or hunting of problem animals; compensation of farmers for livestock and crop losses; and training and education for communities on how to minimise and manage conflicts.

Measures to mitigate risks of a barrier effect created by the reservoir or any areas with restricted access to land transport include: avoidance and minimisation through appropriate project siting, design and operations; bridges; bypass roads; and boats or ferry services.

With all management actions, efforts should be made to ensure there is no 'elite capture' of measures and benefits.

All of the issues identified in the assessment need to be addressed in the management plans. Local expertise should be involved in the plan development. The management plans and processes for addressing impacts should address how responsibilities have been allocated, the institutional and financing arrangements for the implementation of plans, timing objectives, monitoring and evaluation mechanisms, and any handover arrangements with responsibilities over time. For projects with transboundary implications, the plans should include arrangements between jurisdictions.

In some cases the pre-project use of natural resources (e.g. water extraction or hunting) may not be recognised formally through land tenure, water rights or resource use agreements, and may in fact be in conflict with existing national laws (e.g. protection of threatened species). Any existing informal arrangements should be taken into consideration in the assessment using local knowledge and captured in the baseline data, with the impacts of the project on these activities clearly identified. Part of the package of

mitigation and compensation may be measures to formalise or legalise land titles and/or access to natural resources, or to provide ways to pursue livelihoods that are not in conflict with national conservation objectives. These are delicate matters and would require good partnership approaches between the project developer and the government to ensure the future and long-term wellbeing of the project affected communities.

An agreement is a recorded understanding between individuals, groups or entities to follow a specific course of conduct or action. An agreement would be recognised as formal when in the form of a document signed by recognised representatives of all parties concerned with witnesses present or expressed in government licence requirements or court decisions. An agreement is considered publicly disclosed if members of the public can access information on what was agreed if they would like to do so. Public disclosure may take place through public access to the actual document that records the agreement (either posted on a website, distributed, or made available on request to interested parties), or public notification via a media release or website about the main provisions of the agreement. If there was a one-off notification, information may be hard to access at a later date and an effort should be made by the owner/operator to ensure awareness of and ease of accessibility of information by stakeholders over time.

## Stakeholder Engagement

*Stakeholder Engagement criterion - Preparation Stage: Engagement with project affected communities has been appropriately timed and often two-way; ongoing processes are in place for project affected communities to raise issues and receive feedback.*

*Stakeholder Engagement criterion - Implementation and Operation Stages: Ongoing processes are in place for project affected communities to raise issues and get feedback.*

The risks of poor outcomes for project affected communities are more acute if communications and cooperation between the affected communities, the developer, and government

are ineffective. This may happen if, for example, there is a lack of disclosure of relevant project information, discrimination, harassment, breach of agreements, and denial of fair treatment and access to grievance mechanisms. Gender-related inequities in impacts and opportunities may arise if women are not represented adequately in consultation processes and impact assessments.

To address these risks, ESIA, ESMPs and other relevant project information should be publicly disclosed and easily understandable and accessible to all project affected communities, recognising that all may not be literate nor have transport to areas where information is displayed or explained in meetings. Community members should be well-informed of their rights and have collective representation and access to grievance mechanisms with thorough and timely feedback. Grievances should be systematically tracked and resolved and analysis of grievances used to guide improvements. Representatives of government, the developer and contractors should cooperate to ensure fair treatment of all communities and community members, including vulnerable persons. Specific support measures for vulnerable persons should be deployed, for example the inclusion of language specialists in project teams, dedicated focal groups during consultations, partnerships with social welfare NGOs, and preferential access to mitigation measures and benefits.

Appropriately timed, culturally appropriate, and two-way processes are important components of good practice stakeholder engagement. 'Appropriately timed' means that engagement should take place early enough so that the project can respond to issues raised, those affected by the project have inputs before the project takes decisions, and engagement takes place at times suitable for people to participate. Project affected community members should be supportive of the timing of engagement activities. 'Culturally appropriate' means that methods of engagement respect the cultures of those affected and allow adequate provisions to fit with the discussion and decision-making processes typical for the affected households and communities. Stakeholder engagement processes that are culturally sensitive consider, for example, meeting styles, venues, facilitators, language, information provision, the community's

decision-making processes, time allocation, recording, and follow-up. Engagement processes need to consider gender and the inclusion of vulnerable social groups. 'Two-way' means that project affected community members can give their views on the plans that will affect them rather than just being given information without any opportunity to respond. Examples of two-way processes include focus groups, community meetings, and public hearings.

Processes in place for project affected community members to raise issues could include, for example, designated contact people at the villages, periodic village briefings or question/answer opportunities, or feedback/suggestion boxes at an easily accessible area. Feedback on issues raised could be demonstrated by means such as written correspondence or meeting minutes. A register should be kept by the owner/operator of source, date and nature of issues raised, and how and when each was addressed and resolved.

Further guidance can be found in the Communications and Consultation guideline.

## Stakeholder Support

*Stakeholder Support criterion - Preparation and Implementation Stages: Affected communities generally support or have no major ongoing opposition to the plans for the issues that specifically affect their community.*

Plans for project affected communities in relation to mitigation of issues arising from the hydropower development should be generally supported by those directly affected by them. Communities will have their own issue consideration and decision-making processes, and despite support from a community for the relevant plans there may still be members of the community that disagree with aspects of it. Stakeholder support may be expressed through community members or their representatives, and may be evident through means such as surveys, signatures on plans, records of meetings, verbal advice, public hearing records, public statements, governmental licence, and court decisions. No major ongoing opposition, or temporary opposition that was resolved, would satisfy this stakeholder support criterion.

## Conformance/Compliance

*Conformance/Compliance criterion - Implementation Stage: Processes and objectives relating to project affected communities issues have been and are on track to be met with no major non-compliances or non-conformances, and commitments have been or are on track to be met.*

*Conformance/Compliance criterion - Operation Stage: 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.*

Assessment processes and management measures relating to project effects on communities should be compliant with relevant government requirements. These may be expressed in licence or permit conditions or captured in legislation. Land valuation, compensation and replacement processes are often established under government policies or legislation and implemented with government supervision.

Commitments to project affected communities with respect to measures to be taken by the hydropower developer or owner/operator may be expressed in policies of the developer or owner/operator, or in company statements made publicly or within management plans. Implemented measures should be consistent with what is in the plans to demonstrate conformance with the plans. Evidence of adherence to commitments could be provided through, for example, internal monitoring and reports, government inspections, or independent review. Variations to commitments should be well-justified and approved by relevant authorities, with appropriate stakeholder liaison.

The significance of not meeting a commitment is based on the magnitude and consequence of that omission and will be context-specific. For example, a failure to demonstrate delivery of a licence entitlement to project affected communities is a significant non-compliance, whereas a slight delay in delivery of a monitoring report could be a non-significant non-conformance.

## Outcomes

*Outcomes criterion - Preparation Stage: Plans provide for livelihoods and living standards impacted by the project to be improved, and economic displacement fairly compensated, preferably through provision of comparable goods, property or services.*

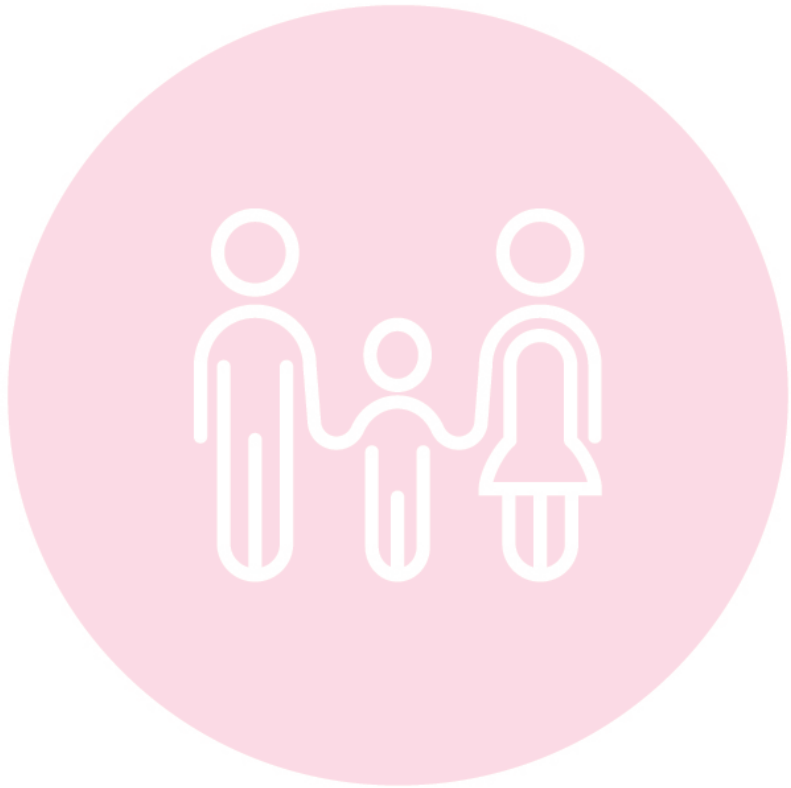
*Outcomes criterion - Implementation and Operation Stages: Livelihoods and living standards impacted by the project have been or are on track to be improved, and economic displacement has been fairly compensated, preferably through provision of comparable goods, property or services.*

The consequences of poor assessment and management of impacts to project affected communities may include: declines in income and impoverishment; loss of family and community networks, resulting in isolation and marginalisation; declines in housing standards; and malnutrition, loss of access to traditional medicines, and occurrence of disease, resulting in increased infant mortality and reduced life expectancy. The intent is that livelihoods and living standards for communities impacted by the project are improved relative to pre-project conditions. Ideally these measures would be taken with the aim of self-sufficiency in the long-term. Improvement of livelihoods should be through compensatory measures that address impacts of the project on pre-project livelihoods so that those affected are able to move forward with viable livelihoods with improved capabilities or assets relative to the pre-project conditions.

An evidence-based approach should demonstrate that livelihoods and living standards have been improved and economic displacement fairly compensated. The developer, owner and operator should demonstrate that responsibilities and budgets have been allocated to implement relevant plans and commitments. Evidence should demonstrate that mitigation plans have been implemented and are being monitored. It should be possible to provide examples to show how identified risks from the assessment were avoided or minimised. Monitoring reports and data in the implementation and operation stages should be aligned with original plans, make evaluations against the agreed baseline using appropriate and agreed indicators, and use a systematic and

defensible methodology for data collection. Independent reviews and evaluations can provide an even stronger evidence basis to demonstrate delivery of these outcomes.

Fair compensation for economic displacement is demonstrated by the quality of the assessment and the methodology used to identify economic displacement, and the baseline and methodology used to determine compensation measures. 'Fair' means free from favouritism, self-interest, bias or deception, and conforming with established standards or rules. Standards and rules for how compensation is treated in the project should be clear and transparent.





# Resettlement

*This guideline expands on what is expected by the criteria statements in the Hydropower Sustainability Tools (HST) for the Resettlement topic, relating to assessment, management, conformance/compliance, stakeholder engagement, stakeholder support and outcomes. The good practice criteria are expressed for different life cycle stages.*

*In the Hydropower Sustainability Assessment Protocol (HSAP), this topic is addressed in P-14 for the preparation stage, I-10 for the implementation stage and O-10 for the operation stage. In the Hydropower Sustainability ESG Gap Analysis Tool (HESG), this topic is addressed in Section 5.*

This guideline is intended to be used as additional guidance to that provided on Project Affected Communities and Livelihoods in the case that resettlement is required by the project. The resettlement guideline applies to projects that require permanent or temporary physical displacement of households, resulting in relocation due to loss of residential land or loss of shelter.

Resettlement has been a highly contentious issue associated with hydropower development. It is good practice to avoid involuntary resettlement and, when unavoidable, to minimise it through different project siting and design alternatives during the preparation stage. The intent is that the dignity and human rights of those physically displaced are respected; that these matters are dealt with in a fair and equitable manner; that livelihoods and standards of living for resettles and host communities are improved; and that commitments made to resettles and host communities are fulfilled.

**Resettlement** is the process of moving people to a different place to live because due to the project they are no longer allowed to stay in the area in which they were residing. **Resettles** are those people who are required to be resettled, including those who have formal legal rights, customary or traditional rights, as well as those who have no **recognisable rights to the land**. Host communities are the existing communities to which resettles are relocated. **Livelihood** refers to the capabilities, assets (stores, resources, claims and access) and activities required for a means of living. **Living standards** refer to the level of material comfort as measured by the goods, services, and luxuries available to an individual, group, or nation.



In many jurisdictions, regulations exist that enable the compulsory acquisition of land by the government for infrastructure or other developments. In countries with active and recent hydropower development, regulations or policies may exist to address legal obligations for resettlement. Responsible agencies and institutional arrangements for resettlement, and the financing of resettlement activities, will vary. In some cases, government fully takes on these responsibilities or an independent authority may be established with responsibility for implementing the range of resettlement activities. The hydropower project developer may be required to provide the agreed funding and support but may not be involved in the direct implementation of the resettlement programme.

## Assessment

*Assessment criterion – Preparation Stage: An assessment of the resettlement implications of the project has been undertaken early in the project preparation stage to establish the socio-economic baseline for resettlement for potential resettles and host communities and has included an economic assessment of required resettlement including ongoing costs for improvement in living standards.*

At the preparation stage, a socio-economic baseline should be established so that post-resettlement impacts and benefits can be well-quantified and demonstrated. Baseline information relevant to resettlement and host communities should be detailed to household level and should include: a census of households and people to be relocated; household size; household organisation and income; livelihoods and economic activities; living standards; access to services (e.g. health, education, transport, water supply, electricity); health indicators; education levels; social interaction patterns; fixed and mobile assets; land tenure and use; crops and livestock; subsistence activities; customary traditions; and access to resources that may not have monetary value but are important to livelihoods.

Community-level assets and their specifications and condition should also be inventoried for the socio-economic baseline in cases where whole villages are to be relocated. These may include, as relevant: educational facilities; public

health facilities; water supply; electricity supply; marketplace structures; roads; jetties; religious structures; and burial grounds. Community-level livelihood dependent assets should also be documented, such as grazing lands, forest lands, community plantations, irrigation schemes, fishing resources, shared fishing or boating equipment, or shared farming equipment or land.

The methods for and expertise used to establish the resettlement baseline need to be clearly documented. Photo records including the people involved are an important inclusion in an asset register. Registered property surveyors should be used where appropriate.

In some cases, land occupancy in the basin pre-project may be informal, with the people living in the basin having no formal land tenure or formally recognised rights to land or water. The assessment of the resettlement baseline and designation of those eligible for compensation should include all people living permanently in the affected area and their pre-project livelihoods, regardless of their land tenure status.

The assessment process should involve identification and presentation of relocation options supported by the developer so that resettles can elect where they go. Where resettles go can vary greatly from project to project. Examples include: new resettlement villages constructed on available land in the same area; houses moved up a hillside to a higher elevation to avoid the new reservoir; and resettles moved to existing villages or townships where they need to assimilate into the host communities. Self-relocation is usually an option offered to those exhibiting high resilience and low vulnerabilities and should take into consideration monetary compensation, transport assistance, money management education, and follow-up monitoring.

Baseline socio-economic information needs to be collected for host communities as they can experience impacts from receiving resettles and may receive benefits (e.g. improved community infrastructure, free health checks, livelihood support measures). In some cases resettles move into a large urban area, in which case the baseline scale needs to be practically defined. Any surveys undertaken to develop baseline data from a representative portion of a population need to be

guided by experts in social science and must be able to serve as a comparative baseline for later post-resettlement surveys.

The timing of the census that establishes the socio-economic baseline for resettlement is a critical consideration and should be well-considered and clearly defined. Families, activities and assets evolve over time, and there can be processes of inwards and outwards migration associated with rumours of a development project. The baseline data should be formally documented by the developer in close partnership with the government as it is likely to be the basis for later claims and will need to have legal status. Accompanying policies need to be established that clarify the cut-off date, the methods and basis for valuations, and the eligibility for compensation and benefits for resettlees. Assessments should consider communication needs and approaches as part of these investigations so all relevant parties are well-informed, including on their rights, risks and entitlements.

Once the socio-economic baseline has been defined for all relevant parties, project impacts against this baseline should be comprehensively assessed along with appropriate mitigation measures. The assessment should include consideration of the impacts on vulnerable people and gender, livelihood restoration and improvement costs, and risks to the achievement of desired objectives (for example, those pursuing water-based livelihoods such as fishing may find it very difficult to establish a land-based livelihood such as farming).

An economic assessment is an expectation for resettlement at the preparation stage. This goes beyond the cost of buildings and relocation (straight financial considerations) to include the type and level of support activities that are realistically required for the restoration or re-establishment of livelihoods and community viability. The economic assessment should take a life cycle approach in its scope, covering any necessary follow-up to ensure the objectives are achieved.

## Assessment

*Assessment criterion - Implementation Stage: An assessment of the resettlement implications of the project has been undertaken that establishes the pre-project socio-economic baseline for resettlees and host communities; monitoring is being undertaken of implementation of the resettlement plans, and to see if commitments made to resettlees and host communities have been delivered and are effective and to identify any ongoing or emerging issues.*

Progressing on the preparation work described above, the main assessment requirements at the implementation stage are to track the effects of implementation of measures and plans. Monitoring may be undertaken by the project staff, externally by a consultant, by the government, or through an agreement with a non-government organisation. Monitoring should assess whether measures are properly implemented (i.e. process indicators) and achieve the intended results against the baseline conditions (i.e. outcome indicators). Monitoring should be formally outlined in a programme that has identified appropriate indicators to track progress and to identify emerging issues or impacts during implementation. Monitoring should involve a consistent approach that will be continued for an agreed period during operation.

Monitoring indicators should follow a subset of those used to define the pre-resettlement baseline and should be meaningful to assess the status of living standards and livelihoods. Indicators of social and cultural wellbeing and maintenance of cultural traditions should be included. It is important to include monitoring of the status of household and community assets as relocated households may not know how to maintain aspects of their new homes (e.g. electricity, water supply, toilets) and systems may not be in place in the new locations to maintain community assets (e.g. the town water supply). Monitoring of vulnerable groups and households is important and should be in close liaison with government agencies and established welfare systems.

## Assessment

*Assessment criterion – Operation Stage: Monitoring is being undertaken to assess if commitments made to resettles and host communities have been delivered and if management measures are effective; and ongoing or emerging issues relating to resettlement have been identified.*

Further to the above guidance, at the operations stage the focus of assessment activities is on the delivery of resettlement commitments, as well as monitoring and follow-up over time to ensure that objectives and targets for resettled communities and households are achieved. Documentation and record keeping is critical and should be planned to stand up to long-term scrutiny so that any concerns within resettlement communities about non-delivery of any agreed commitments can be checked against records.

Once compensation payments and relocation activities have been implemented, the longer-term implications of the move for resettles often drops out of focus for the owner/operator. A common situation is that the resettlement has involved provision of new household and community infrastructure of a standard exceeding the pre-project condition, and the government does not have the capacity to invest in the maintenance or staffing and it deteriorates over time (e.g. a few years after resettlement, a school has insufficient equipment or staff to provide the educational services it was designed to deliver). Livelihood restoration or re-establishment programmes often require ongoing follow-up and support, especially where resettles are expected to shift to new forms of livelihood. Given the long time period for operations, documented agreements on monitoring and follow-up responsibilities between the owner/operator and relevant government authorities are necessary. The owner/operator should have policies for what type of longer-term follow-up it is prepared to do in agreement with government, especially with regards to issues arising.

Older projects may have 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 the post-project status. In this case, it is important to have agreed processes with government on how issues arising for resettlers will be identified and addressed,

and the relative roles of the owner/operator of the facility versus government must be clearly established.

## Management

*Management criterion – Preparation Stage: A Resettlement Action Plan and associated processes have been developed in a timely manner for project implementation and operation, which includes an up-to-date socio-economic baseline, compensation framework, grievance mechanisms, and monitoring procedures; and formal agreements with resettles and host communities are publicly disclosed.*

A Resettlement Action Plan (RAP) is a document or set of documents outlining the actions that will be taken to address resettlement. The RAP should include: identification of those being resettled; a socio-economic baseline for resettles; measures to be implemented as part of the resettlement process including those relating to resettlement assistance and livelihood support; compensation frameworks; organisational roles and responsibilities; budget allocations and financial management processes; the timeframe, objectives and targets; a risk assessment; grievance mechanisms; monitoring, reporting and review provisions; and arrangements for consultation, participation and information exchange.

Practical examples of resettlement measures include provision of: better quality housing, agricultural land, and services (such as access to electricity); legal property titles to households without a title; livelihood support (e.g. agricultural assistance, enterprise development, fish culture, small business); psychological and emotional support; transitional food support; better access to natural resources or areas of importance for the community; and construction of community assets (e.g. health clinics, schools, community and religious centres, water supply systems, electricity supplies, wastewater treatment plants).

The RAP should include a compensation framework setting out the basis for determining compensation, the amount that will be allocated to which parties, and the method and safeguards for how it will be delivered. Eligibility should include those who do not have legally recognised land tenure but were clearly part of the baseline

population at the agreed cut-off date. In cases where resettleses' livelihoods have been land-based, and where consistent with resettleses' preferences, land-for-land compensation should be provided of a comparable quality. Cash compensation options should take into both account inflation rates and costs associated with asset replacement. Compensation should go beyond material measures (e.g. housing, cash, food support) that ensure living standards are not compromised and should address livelihood support and improvement with an aim of setting up for long-term self-sufficiency. Support measures should be aimed at avoiding impoverishment risk and welfare dependency.

Timeliness is important. Situations in which the construction schedule is running ahead of the resettlement planning need to be avoided. The RAP needs to be fully developed and agreed before construction commences. Timing issues may arise in relation to the filling of the reservoir, the time needed to negotiate and formalise agreements, cultural or community events, and the timing of the relocation to prepared and already productive agricultural land.

Grievance mechanisms need to be clearly documented. These are the processes that allow and address concerns raised by resettleses and host communities as broadly described in the Communications and Consultation guideline. Grievances relating to resettlement may include mistakes in the census and inventory results at the asset registration stage, disputes on land ownership, misunderstandings on entitlements and eligibility, disagreements on compensation and livelihood support measures, concerns about inequity with accessing livelihood support schemes, etc. A project may experience more grievances relating to resettlement than on any other social matters since resettleses are affected in such a fundamental way. It is important for the project to keep sufficient resources (including budget) available to deal with grievances, and to ensure records are kept of how they were addressed, closed, and communicated back to the originator.

The RAP should be developed with the inputs of resettleses and host communities and should involve formal agreements in relation to what will be implemented. An agreement is a recorded

understanding between individuals, groups or entities to follow a specific course of conduct or action; it is recognised as formal when in the form of a document signed by recognised representatives of all parties concerned with witnesses present or expressed in government licence requirements or court decisions. There are many areas of agreement that can be documented regarding resettlement, such as factors relating to the resettlement site, village configuration, house styles and materials, livelihood support, cultural and spiritual ceremonies, community assets, etc. An agreement is considered publicly disclosed if members of the public can access information on what was agreed if they would like to do so.

## Management

*Management criterion – Implementation Stage: Measures to address resettlement are documented in a Resettlement Action Plan; measures are in place to deliver commitments to resettleses and host communities and to manage any identified issues relating to resettlement, including provision of grievance mechanisms; and formal agreements with resettleses and host communities are publicly disclosed.*

Further to the above guidance, the implementation stage is a highly sensitive stage during which resettlement communities are moved in preparation for reservoir filling. All activities during this stage should be in accordance with the RAP described above.

A common issue to be avoided is timing pressure due to the project construction schedule progressing at a pace faster than the RAP implementation and communities pressured to move before everything is ready. This often means that important preparation activities for successful resettlement are compromised; for example, green timber might be used to build the new houses and later warps, electricity is not connected for some months after the resettleses arrive, fields for planting of rice have no access roads and are not prepared, or assets from the old village cannot be transported to the new village (e.g. house materials, livestock, vehicles, boats). Rising reservoir levels should not put pressure on relocating households ahead of all resettlement needs being prepared, and this risk should be

managed through good integrated planning (see the Integrated Project Management guideline).

## Management

*Management criterion – Operation Stage: Measures to address resettlement are documented in a Resettlement Action Plan; measures are in place to deliver commitments to resettles and host communities and to manage any issues relating to resettlement, including provision of grievance mechanisms; and formal agreements with resettles and host communities are publicly disclosed.*

Ideally, an operating hydropower facility that involved a resettlement programme during its development had a well-documented socio-economic baseline and clear commitments for the resettlement. This may not be the case for older projects, and concerns can arise in relation to whether all commitments were delivered and the ongoing responsibilities of various parties. The owner/operator should have a good understanding of the history and available records alongside clear agreements with government and the resettled communities on the ongoing support and how issues arising will be dealt with over the longer-term.

The duration of support by a hydropower facility for resettlement can be an issue even when the resettlement baseline and RAP are well-documented. For example, pressure on land availability can arise as families expand and the next generation wants to stay in the new village, and assets in the resettlement village can deteriorate over time. The owner/operator should demonstrate that it is not ignoring the long-term needs of resettled communities, and it is seeking to understand them and provide support in a measured and reasonable manner. If all mitigation commitments for resettlement have clearly been fully delivered, then further support should be provided through new initiatives unrelated to mitigation requirements. Mechanisms for support by the business can include, for example, a business Corporate Social Responsibility (CSR) programme or contributions by the hydropower facility owner/operator to a community fund from which the resettlement communities or relevant local governments can access financial support for agreed programmes. Cumulative impacts can also emerge due to

later developments, in which case there should be well-documented agreements with relevant parties on how these will be managed and who has what responsibilities.

## Stakeholder Engagement

*Stakeholder Engagement criterion – Preparation Stage: Engagement with directly affected stakeholders has been appropriately timed, culturally appropriate and two-way; ongoing processes are in place for resettles and host communities to raise issues and get feedback; and resettles and host communities have been involved in the decision-making around relevant resettlement options and issues.*

All physically displaced persons need to be engaged about their rights and options in relation to resettlement, and host communities also need to be fully consulted about how resettlement will affect them. Engagement, consultation and negotiation plans processes should be included in the RAP and associated consultation and communications plans. Engagement plans should consider the needs of particular stakeholder groups and how these needs apply to the resettlement and host communities.

Resettles and host communities should be involved in the definition of key elements of the resettlement plan. For example, resettles can be involved in proposing resettlement sites and can indicate their expectations on layout arrangements and alternative livelihood activities, as well as influencing decision-making around housing options during the negotiation process.

Appropriate timing, culturally appropriate, and two-way processes are important components of good practice. 'Appropriately timed' means that engagement should take place early enough so that the project can respond to issues raised, those affected by resettlement have inputs before the project takes decisions, and engagement is at times suitable for people to participate. Resettlement stakeholders should be supportive of the timing of engagement activities given the impact of the decisions involved on the rest of their lives. 'Culturally appropriate' means that methods of engagement respect the cultures of those affected and allow adequate provisions to fit with the discussion and decision-making

processes typical for the affected households and communities. Stakeholder engagement processes that are culturally sensitive consider, for example, meeting styles, venues, facilitators, language, information provision, the community's decision-making processes, time allocation, recording, and follow-up. Engagement processes need to consider gender and the inclusion of vulnerable social groups. 'Two-way' means the resettlement stakeholders can give their views on considerations for the RAP rather than just being given information without any opportunity to respond. Examples of two-way processes include focus groups, community meetings, and public hearings, and community feedback is incorporated into RAP design.

Processes should be in place for resettlement stakeholders to raise issues and these processes should include a formal grievance mechanism (as discussed above under the Management criterion). Processes could include, for example, designated contact people within the old and new village(s), community liaison officers, periodic village briefings or question/answer opportunities, and feedback/suggestion boxes at an easily accessible area. Feedback on issues raised could be demonstrated by means such as written correspondence or meeting minutes. A register should be kept by the owner/operator of source, date and nature of issues raised, and how and when each was addressed and resolved.

## Stakeholder Engagement

*Stakeholder Engagement criterion – Implementation and Operation Stages: Ongoing processes are in place for resettles and host communities to raise issues and get feedback.*

In addition to the guidance above, many issues should be expected to arise during and following implementation of the RAP and the developer and owner/operator should be adequately resourced to manage these. The management plans and agreements with the communities and government should make it clear over time on the roles and responsibilities for receiving, addressing and responding to issues arising. It is very important to ensure responsiveness and good documentation at all stages.

## Stakeholder Support

*Stakeholder Support criterion – Preparation and Implementation Stages: Resettles and host communities generally support or have no major ongoing opposition to the Resettlement Action Plan.*

The RAP should be generally supported by those directly affected by it. Communities will have their own issue consideration and decision-making processes, and support of a community for the RAP may still have members of the community that disagree with aspects of it. Stakeholder support may be expressed through community members or their representatives and may be evident through means such as surveys, signatures on plans, records of meetings, verbal advice, public hearing records, public statements, governmental licence, and court decisions. No major ongoing opposition, or temporary opposition that was resolved, would satisfy this criterion.

## Conformance/Compliance

*Conformance/Compliance criterion – Implementation and Operation Stages: Processes and objectives in the Resettlement Action Plan have been and are on track to be met with no major non-compliances or non-conformances, and any resettlement related commitments have been or are on track to be met.*

Resettlement measures should be compliant with relevant legal and administrative requirements, which may be expressed in licence or permit conditions or captured in legislation. Resettlement measures should be consistent with what is in the RAP to demonstrate conformance with plans. Commitments may be expressed in policies of the developer or owner/operator, or in company statements made publicly or within management plans. Evidence of adherence to commitments could be provided through, for example, internal monitoring and reports, government inspections, or independent review. Variations to commitments should be well-justified and approved by relevant authorities, with appropriate stakeholder liaison.

The significance of not meeting a commitment is based on the magnitude and consequence of that omission and will be context-specific.

For example, a failure to demonstrate delivery of a licence entitlement such as food support to resettles is likely to be a significant non-compliance, whereas a slight delay in delivery of a monitoring report could be a non-significant non-conformance.

## Outcomes

*Outcomes criterion – Preparation Stage: Plans provide for resettlement to be treated in a fair and equitable manner, and resettles and host communities to experience a timely improvement in livelihoods and living standards.*

*Outcomes criterion – Implementation and Operation Stages: Resettlement has been and is being treated in a fair and equitable manner, and resettles and host communities have experienced or are on track to experience a timely improvement in livelihoods and living standards relative to the pre-project baseline.*

Important outcome requirements for resettlement include fairness and equity. 'Fair' means free from favouritism, self-interest, bias or deception, and conforming with established standards or rules. 'Equitable' relates to equality or evenness. With respect to resettlement, fairness is demonstrated through the establishment of clear project standards or rules, transparency on how they are applied, and the adherence to these rules in the plans and their implementation (demonstrated through monitoring reports or independent evaluations). Equity can be demonstrated through the equal application of rules to all affected people and also through support which is allocated in a way that all recipients can achieve the same standards.

Equitable approaches could be evident through, for example, the valuation basis for compensation, the standards for new housing, and the distribution of livestock or livelihood resources.

The RAP should include targets and objectives that state what the plans are aiming to achieve in terms of improvement in living standards and livelihoods, with reference to the baseline and a clear identification of monitoring and evaluation indicators. The objectives and targets should be achievable in the preparation stage and should be achieved during the implementation and operation stages. Timeliness can be demonstrated against timing milestones set up in the RAP and whether they are likely to be or are being achieved.

Improvement of livelihoods is demonstrated by the compensatory measures taken to address impacts of the project on pre-project livelihoods. Those affected should be demonstrably able to move forward with viable livelihoods, and with improved capabilities or assets relative to the pre-project conditions. This may be demonstrated, for example, by supporting farmers to continue to be able to farm or to pursue alternatives, accompanied by sufficient support mechanisms that not only enable any changes to livelihoods to be well-established but also provide increased capabilities or access to the necessary resources (including training, information, materials, access, supplies, etc). Long-term welfare dependency and entrenched impoverishment need to be avoided. Ongoing monitoring, insightful indicators, and good record keeping are all essential for demonstrating outcomes.



# Indigenous Peoples

*This guideline expands on what is expected by the criteria statements in the Hydropower Sustainability Tools (HST) for the Indigenous Peoples topic, relating to assessment, management, conformance/compliance, stakeholder engagement, stakeholder support and outcomes. The good practice criteria are expressed for different life cycle stages.*

*In the Hydropower Sustainability Assessment Protocol (HSAP), this topic is addressed in P-15 for the preparation stage, I-11 for the implementation stage and O-11 for the operation stage. In the Hydropower Sustainability ESG Gap Analysis Tool (HESG), this topic is addressed in Section 7.*

The Indigenous Peoples guideline addresses the rights at risk and opportunities of Indigenous Peoples with respect to the hydropower project or operating facility. This guideline accompanies and is additional to that provided on Project Affected Communities and Livelihoods, to be applied if there are Indigenous Peoples among these communities. The good practice requirements

for potentially affected Indigenous Peoples are in line with those outlined in the Project Affected Communities and Livelihoods guideline in terms of establishing a socio-economic baseline, assessing risks, analysing the degree and nature of potential impacts, identifying opportunities, and outlining impact avoidance, minimisation, mitigation and compensation measures to be embedded into management plans for construction and operation. This guideline is focused on supplementary measures or extra care in approaches that constitute international good practice in matters relating to the rights of Indigenous Peoples.

**Indigenous peoples** refers to a distinct social and cultural group possessing the following characteristics in varying degrees:

- self-identification as members of a distinct indigenous cultural group and recognition of this identity by others;
- collective attachment to geographically distinct habitats or ancestral territories in the project area and to the natural resources in these habitats and territories;
- customary cultural, economic, social or political institutions that are separate from those of the dominant society or culture; and
- an indigenous language, often different from the official language of the country or part of the country within which they reside.





The intent is that the hydropower project and operating facility respect 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.

Indigenous Peoples require particular attention because, as social groups with identities distinct from dominant groups in national societies, they are often the most marginalised and vulnerable segments of the population. Indigenous Peoples' collective attachment to land, water and natural resources can pose particular challenges for hydropower developments that cause significant changes to the landscape. Indigenous Peoples can be particularly vulnerable to the impact of hydropower projects where they have a high dependence on natural resources, limited recognition of their rights to land tenure and access to natural resources, and/or difficulties to advocate and negotiate safeguards and agreements for their rights at risk.

A number of international instruments recognise and guide the considerations relevant to the rights of Indigenous Peoples, such as in the United Nations Declaration on the Rights of Indigenous Peoples (UN DRIP) and the International Labour Organisation Convention No. 169. The rights of Indigenous Peoples include:

- the right to self-determination;
- the right to ownership and property;
- the right to practise and revitalise cultural traditions and customs;
- the right to manifest, practise, develop and teach their spiritual and religious traditions, customs and ceremonies; and
- the right to the conservation and protection of the environment and the productive capacity of their lands or territories and resources.

The UN DRIP, adopted by the UN General Assembly in 2007, sets an important standard for the treatment of Indigenous Peoples towards eliminating human rights violations and helping combat discrimination and marginalisation. It refers to the individual and collective rights of Indigenous Peoples, as well as their rights to culture, identity, language, employment, health, education and other issues. It emphasises the rights of Indigenous Peoples to maintain and

strengthen their own institutions, cultures and traditions, and to pursue their development in keeping with their own needs and aspirations. It prohibits discrimination against Indigenous Peoples and promotes their full and effective participation in all matters that concern them and their right to remain distinct and to pursue their own visions of economic and social development. The UN DRIP has an emphasis on Indigenous Peoples being able to protect their cultural heritage and other aspects of their culture and tradition.

Ethnic minorities may have a number of similar characteristics as Indigenous Peoples, including often being among the more vulnerable and marginalised, and this guidance may also be useful in relation to these groups. An ethnic minority is a group of people who have a different ethnicity, religion, language or culture to that of the majority of people in the place where they live. The concept of ethnicity is rooted in societal groups marked by a shared identity, which may be through nationality, tribal affiliation, religious faith, language, or cultural and traditional origins and backgrounds. Countries may have ethnic minority groups living in particular regions, sometimes due to historical social migrations or changes in national boundaries. The distinguishing feature between ethnic minorities and Indigenous Peoples is that Indigenous Peoples have a collective attachment to geographically distinct habitats or ancestral territories and the natural resources of these areas, as well as customary traditions and spiritual beliefs that are strongly rooted in the location in which they live.

## Assessment

*Assessment criterion - Preparation Stage: An assessment of the representation of Indigenous Peoples in the project-affected community has been undertaken, including identification of their rights at risk in relation to the project, utilising local knowledge and expertise.*

Each country is unique in its recognition of Indigenous Peoples. The legislative and policy context for Indigenous Peoples must be well-understood when planning the project impact assessment process. National approaches may influence how impact assessments and

engagement are conducted for Indigenous Peoples, and in some countries interactions with Indigenous Peoples may be required to be conducted through a specific government agency. The developer needs to use all means possible, including appropriate expertise and local knowledge, to determine if Indigenous Peoples are represented within the project affected communities. There may be different views within an indigenous community on the methods used to determine recognition as part of a particular group.

The baseline studies for the project Environmental and Social Impact Assessment (ESIA) need to include consideration of those aspects of the environmental and social setting and dynamics that are of special relevance and importance to Indigenous Peoples. Such considerations are both physical and non-physical. Research should be conducted to identify what may or may not be relevant in the project area, and what changes may directly and indirectly occur due to project preparation, development and operation. Good baseline information is outlined in the Environmental and Social Issues Management guideline. Additional information to help understand if the rights of Indigenous Peoples are potentially at risk by a project should include:

- A full description of the social and economic situation relevant to the indigenous communities, including demographic information, and details of living standards and livelihoods.
- Natural resource uses and their role in the livelihoods of Indigenous People, which may be based on non-monetary economies;
- Land use, land tenure and resource use for Indigenous People, noting these may not be officially recognised but based on customary use;
- Important social and cultural practices and resources distinct to the indigenous communities, such as migrations, resource harvesting activities, festivals and traditions, rituals, culturally significant sites, and flora or fauna used in traditional medicines;
- Analysis of the social and governance structures within the indigenous communities, the degree of social cohesion, the leadership situation, and decision-making processes;

- The socio-political setting and community institutions;
- Differing roles, needs, interests, values and aspirations of sub-groups of the indigenous communities (e.g. women, elders, minorities);
- Legacy issues and experience of past projects.

Indigenous Peoples' rights are considered at risk when project activities or impacts prevent Indigenous Peoples from exercising their rights. Issues arising from the project that may pose risks for Indigenous Peoples' rights should ideally be self-identified. This does not mean that the indigenous communities must have identified the issue, but that if suggested by others the affected communities concur. Any views expressed as community views should come from members of the community or their appointed leaders.

Any impacts of the hydropower project listed in the Project Affected Communities and Livelihoods guideline may affect Indigenous Peoples in ways different to or more severely than for other segments of the affected population. Examples of impacts from the experiences of hydropower to date, for which particular care should be taken, include to cultural practices, traditional lands, natural resources, livelihoods, transportation and migratory routes, community cohesion, public health, customary practices, sacred sites and burial grounds.

There can be a number of practical challenges and barriers to the assessment of Indigenous Peoples' rights at risk. The ability or willingness of the indigenous community to participate in an impact assessment may be influenced by factors such as: previous experience with development projects or government interventions; legal recognition and land tenure status; cultural differences that create challenges for information exchange; consultation and agreement to plans; and the level of community organisation for representation and decision-making.

Local knowledge is essential for an assessment process relating to Indigenous Peoples. The methods used should be designed with regards to the needs, situation and sensitivities of the indigenous communities. Any expert assessment of indigenous issues should involve community members that represent different perspectives (e.g. men, women, elderly, leaders, youth).

Professionals that may be involved in the assessment and management of indigenous issues and rights at risk include archaeologists, social anthropologists, environmental anthropologists and indigenous language specialists. These experts are usually not members of the indigenous communities that are the subject of the assessment. In some cases, these experts may act as representatives for indigenous people in engagement or participatory processes, often through organisations such as social NGOs or appointed indigenous councils.

Not only should local knowledge inform the assessment of Indigenous Peoples' rights at risks, but it can be a valuable input for the overall ESIA process for the project. Indigenous Peoples have extensive experience and unique knowledge of lands, water, animals, plants and their use by members (e.g. where fish spawn, animals migrate, rare plants are found). Indigenous local indigenous knowledge is proprietary and it is up to the Indigenous Peoples if and how it will be shared. Indigenous local knowledge, when respectfully used by a developer and with the communities' permission, enables a greater understanding of how a project may affect the people and the environment as it is built and operated. Affected communities will be more comfortable sharing traditional knowledge if a developer clearly acknowledges and demonstrates an understanding of its importance and indicates how this knowledge may influence the project.

Issues for Indigenous Peoples with natural resource development projects such as hydropower can be complex. Indigenous issues can in cases be highly politicised and susceptible to political interference in assessment processes and decision-making. Some jurisdictions may not recognise Indigenous People as members of the community with equal rights or land tenure status. The barriers to effective assessment, engagement and management of Indigenous Peoples are often political, institutional, legal and cultural (e.g. the attitudes of the broader community towards indigenous rights).

Opportunities to improve the status of Indigenous Peoples through project benefits should also be a component of the assessment process (see Outcomes criterion).

*Assessment criterion - Implementation Stage: Issues that may affect Indigenous Peoples' rights in relation to the project have been identified through an assessment process utilising local knowledge and expertise; and monitoring of project impacts and effectiveness of management measures is being undertaken during project implementation appropriate to the identified rights at risk.*

*Assessment criterion - Operation Stage: Ongoing or emerging issues relating to the operating hydropower facility that may affect Indigenous Peoples' rights have been identified, and if management measures are required then monitoring is being undertaken to assess if management measures are effective.*

Further to the above guidance, assessment requirements at the implementation and operation stages are consistent with those outlined in the Project Affected Communities and Livelihoods guideline. Notably, the developer and owner/operator should ensure processes are in place to identify any ongoing or emerging issues for the Indigenous Peoples in relation to the project or operating facility activities, and monitoring should ensure any required management measures are being implemented effectively.

Relevant management plans should identify the monitoring indicators or parameters and targets, the time span for the monitoring, frequency, location, monitoring techniques, responsibilities, measurement metrics criteria for acceptability, and costs. Adaptive management processes should be included in the plans, to be followed when the monitored outcome differs from the predicted outcome or if new opportunities arise.

Responsibilities for monitoring, issues identification and follow-up may be handed over to government agencies over time. Regardless of who has direct responsibility, it is a good practice expectation that the owner/operator of a mature hydropower facility will remain engaged through agreed mechanisms (see the Stakeholder Engagement criterion) with indigenous communities on issues that evolve over time in relation to the hydropower operations and activities.

## Management

*Management criterion - Preparation Stage: Plans and processes have been developed for project implementation and operation to address the Indigenous Peoples' rights at risk in relation to the project, and formal commitments are publicly disclosed.*

*Management criterion - Implementation Stage: Measures are in place to address the Indigenous Peoples' rights at risk in relation to the project, and formal commitments are publicly disclosed.*

*Management criterion - Operation Stage: Measures are in place to address the Indigenous Peoples' rights at risk relating to the operating hydropower facility; and formal agreements are publicly disclosed.*

Measures to address Indigenous Peoples' rights at risk in relation to the project need to be incorporated into plans and processes that are clearly linked to identified impacts and issues for Indigenous Peoples. If there are significant shortcomings in the assessment or issues identification process, the plans will also have shortcomings. Measures to mitigate issues that may affect Indigenous Peoples should ideally be self-identified and incorporate the insight and input of local Indigenous Peoples. Mitigation measure examples from the experience of hydropower projects globally include:

- impact avoidance measures through siting and design choices;
- protection of and respect for cultural practices;
- agreed arrangements for moveable and immovable physical cultural resources;
- health risk prevention and management;
- support for rituals and traditions;
- ensured access to and quality of natural resource-based livelihoods.

At the project development stage, plans and processes that address Indigenous Peoples' rights at risk should be incorporated within the overall project Environmental and Social Management Plan (ESMP). There may be a number of plans with content relevant to indigenous communities, such as a resettlement action plan, project development agreement, a cultural heritage plan, a livelihood enhancement plan, or a biodiversity management plan. Within the

content of the ESMP, it needs to be demonstrably clear that the management plans fully address the Indigenous Peoples' rights at risk, and the issues identified as important for or of concern to Indigenous Peoples. As with any management plan, all measures need to have clearly allocated responsibilities, appropriate funding and resources, objectives and targets, and monitoring and evaluation provisions.

Plans and processes affecting Indigenous Peoples should ensure that all legal requirements relating to Indigenous Peoples are met. Cultural awareness and sensitivity training are important for project staff implementing plans or otherwise interacting with or affecting the Indigenous Peoples. A range of support measures should be planned to help communities to cope with change. Management plans should incorporate an effective grievance mechanism (see the Stakeholder Engagement criterion).

Good practice requires the developer to enter into formal agreements with the Indigenous Peoples regarding arrangements that may affect these communities. Agreements are a recorded understanding between the developer and the indigenous communities or other agreed entities. A formal agreement is one in which the commitments are recorded, documented, witnessed and publicised with mutual parties present and fully engaged. This may be in the form of a contract, a Memorandum of Understanding, a letter of intent, minutes of a meeting, a joint statement of principles, or an operating licence granted by a relevant regulator with the legal mandate to represent Indigenous Peoples or with the direct involvement and support of the Indigenous Peoples. Recollections of community elders cannot be accepted as evidence without supplementary forms acknowledged by and easily accessible to the counterparties to the agreements.

The comprehensiveness, complexity and form of agreements will depend on the circumstances, including factors such as: significance of impacts; number of indigenous communities and individuals; preferences of the indigenous communities; willingness and ability of the developer; and national laws and regulations. Agreements are not only relevant to proposed new projects. If agreements are not pre-existing, they can still be developed during the

implementation and operation stages and even for older operating facilities.

Any agreements with Indigenous Peoples need to be signed off in some manner by legitimate representative(s) of the community. The community representative must be someone selected by and confirmed by the community in a legitimate process. The legitimate representative need not be a community member and can be someone such as a legal representative elected or designated by the community.

The signing off can consist of physical signatures on the documents or by some other verifiable means. For example, witnessed fingerprints are valid if the Indigenous Peoples' representatives cannot write and this approach is accepted by the other signatory parties. If the agreement is not in the form of a contract but one of the other possibilities such as statements in an operating licence, there needs to be some means to confirm that the community representatives concurred.

The agreements should be publicly disclosed. Public disclosure involves the public being informed the agreement has been reached, and the agreement is made available through some form of document distribution or by public posting or upon request. Exceptions for portions of the agreements could include proprietary information, commercially or financially sensitive information, personal information, or indigenous knowledge. For example, an agreement with a family which includes personal information would not need to be publicly disclosed. The developer should be able to demonstrate the legitimacy of the reasons. The process for the publication of agreements and dissemination of information can be contained in the relevant agreement or engagement plan. This requirement could be fulfilled with a process for Indigenous Peoples and key stakeholders to access the agreements, and culturally appropriate activities and materials to present the contents of the agreement (e.g. presentations, focus groups, community meetings).

## Stakeholder Engagement

*Stakeholder Engagement criterion - Preparation Stage: Good-faith consultation with Indigenous Peoples' institutions of representation and decision-making, as determined by them, has been carried out through a process that was appropriately timed, culturally appropriate and two-way; ongoing processes are in place for Indigenous Peoples to raise issues and get feedback; and a mutually-agreed disputes procedure is in place.*

The same expectations on stakeholder engagement apply as outlined in the guideline for Project Affected Communities and Livelihoods. It is important to spend time researching, planning and agreeing on the appropriate stakeholders and their roles in any engagement, consultation, negotiations and agreements with Indigenous Peoples.

Good-faith consultation involves:

- willingness to engage in a process and availability to meet at reasonable times and frequency on the part of all parties;
- sharing of information that is accessible and understandable to the Indigenous Peoples, disseminated in a culturally-appropriate manner and in the local language(s)/dialect(s);
- commitment that Indigenous Peoples have been fully informed of project impacts affecting their rights;
- use of mutually acceptable procedures for negotiation;
- willingness to change initial positions and modify offers where possible; and
- provision of sufficient time for the Indigenous Peoples to consider information using their customary internal processes.

Institutions of representation and decision-making are community leaders or representative bodies who have been self-determined by the affected communities which they represent. Engagement should be with self-selected community representatives, i.e. individuals chosen by the indigenous community who are usually community members. Representatives could be from potentially affected indigenous communities, elders and leaders (both male and female), Indigenous Peoples associations, government institutions representing Indigenous Peoples and/or responsible for approving

Indigenous Peoples studies and plans, and/or local NGOs working with Indigenous Peoples. If representatives are chosen from outside of an indigenous community, it is important to establish how the community has endorsed a person or group as a representative. Different representatives may be put forward for different issues; for example, female community leaders may speak on behalf of women's issues. Other sub-groups with different perspectives may include youth, elders, and various resource users (e.g. hunters, fishers, gatherers, farmers).

The Indigenous Peoples may have particular communications and consultation needs and preferences relating to timing, culturally appropriate methods, and modes for two-way dialogue. The developer should seek guidance from indigenous communities on how they would prefer to be consulted. Great care is needed for the initial contact with Indigenous Peoples, as it can lay the foundation for all future interactions on the project. In addition to being respectful and knowledgeable of the local customs, history and legal status, the project proponent should ensure that local entry protocols are followed when determining who to make contact with and how to ask permission to enter and engage with the community.

Formal processes for communications and engagement may be unfamiliar and threatening for the Indigenous Peoples. Issues that will need to be incorporated into the design of engagement processes may include: language barriers; levels of literacy for written material; suitable locations for meetings (preferably in the communities); inclusion of children and family members; flexibility with time frames and logistics; avoidance of cultural taboos; and availabilities during times of cultural activity. The developer should be aware that the representatives chosen by the affected Indigenous Peoples for discussions about options may have limited expertise with regards to negotiation. The developer may need to invest in capacity building for the communities, with the agreement of the communities, to enable them to fully understand what they are being asked to sign. This may take place through the development of community representatives or providing the communities with the resources to engage, such as legal representation and financial advice.

The proponent should ensure sufficient time is allowed to enable indigenous communities or groups to fully participate in the engagement process, understand issues, and have the opportunity to voice their concerns, including opportunities to identify benefits. Internal mechanisms available for the rest of the community to access information on issues under negotiation and project aspects may be limited, especially if there is poor level of literacy in the community as frequently occurs. Community processes may be lengthy in time due to use of traditional decision-making customs. Given this, a developer should build extra time into scheduled engagements to work with affected Indigenous Peoples in a manner which allows for the growth and development of community and representative capacity so that engagement can be meaningful. The overall project development schedule should include contingencies to address delays arising from prolonged engagement and good-faith negotiations regarding the rights at risk of Indigenous Peoples.

Engagement processes need to recognise and accommodate the culture of the community. This should take into account aspects such as: language; use of written versus oral media; selection of engagement representatives on the part of the proponents; location and timing of meetings; dress; how meetings proceed and who speaks when; appropriate days and times; and how agreements are recorded and signed off.

The developer should seek to provide a variety of mechanisms to communicate and receive feedback and to engage in ongoing dialogue. This may include efforts to select mechanisms, venues and events that encourage maximum participation, free exchange of views, and opportunities for informal engagement and ensuring information can be accessed in local languages. It may also include, where appropriate and feasible, funding for community members to facilitate timely and efficient communications (e.g. transportation, translation, community process and advisor costs) and to contribute to the development of positive community relationships. Providing cash to the communities or their representatives to participate in engagement opportunities should be reasonably limited and controlled as it may be counter-productive.

Technical information should be provided in

an easily understood form. Any misinformation should be quickly identified and corrected. Feedback received should be documented and reported on, including how participants' feedback has influenced the project. A commitment to a minimum time within which feedback will be provided by the project proponent, and ensuring that these timing commitments are consistently met, can help ensure regular contact with the community and may assist in enhancing trust.

As well as agreeing on how engagement, consultation and decision-making will take place, a disputes procedure should be developed at a relatively early stage. A disputes procedure is a mutually-agreed two-way resolution mechanism allowing for both the Indigenous Peoples and the developer to raise disputes and seek resolution. Relevant management plans should clearly state the process by which the Indigenous Peoples can self-identify and raise issues. Mechanisms to raise concerns and resolve complaints and grievances should be designed and agreed with the involvement of the Indigenous Peoples to ensure they are culturally appropriate. Responsibilities should be clear and effectiveness should be monitored.

Stakeholder Engagement criterion - Implementation and Operation Stages: Appropriately-timed, culturally appropriate and two-way channels of communication are maintained; ongoing processes are in place for Indigenous Peoples to raise issues and get feedback; and a mutually-agreed disputes procedure is in place.

Engagement with Indigenous Peoples during construction and operation should take into account when, how and who will provide regular updates to the Indigenous Peoples on the project construction, progress of implementation plans and processes, issues arising and responses, changes in roles and responsibilities, and benefit opportunities. Special communications and consultations should be planned and implemented for project milestones (e.g. reservoir filling, start of operations) and emergency events (e.g. landslips, cofferdam or dam breaks).

The methods of engagement during the project implementation and operation stages should be agreed on with the Indigenous Peoples, and should not be assumed to be the same as for the preparation stage. Some methods may be more

appropriate and effective during construction, such as periodic focus group meetings and continuous liaison with social experts present on-site who are accepted by the community and speak their language. This will allow the developer to react quickly enough if any new adverse impacts or risks emerge.

## Stakeholder Support

*Stakeholder Support criterion - Preparation and Implementation Stages: Free, Prior and Informed Consent has been achieved with respect to the Indigenous Peoples' rights at risk following the principle of proportionality.*

**Free, Prior and Informed Consent (FPIC)** is a uniquely formulated expression for stakeholder support by Indigenous Peoples, and is recognised in a number of international instruments. FPIC comprises both a process and an outcome.

The FPIC process involves:

- good-faith consultation;
- mutual and cross-cultural understanding with dialogue that is ongoing and open, and gender and inter-generationally inclusive whenever possible (with gender and age disaggregated data and analysis);
- inclusive and participatory engagement, including during the assessment of issues and the identification of mitigation measures, with clarity on the level of participation of Indigenous Peoples throughout the consultation process;
- provision of adequate resources to ensure that the Indigenous Peoples representatives can participate in the FPIC process equitably, including the services of independent technical or legal consultants (such as Indigenous Peoples Organisation);
- mutual agreement on the process and desired outcome from the outset of the consultation;
- documentation that is evaluated on an ongoing basis, is verifiable by a mutually agreed methodology, and made publicly available.

The FPIC outcome is the agreement or set of agreements, and thorough documentation of how the agreement was achieved (see the Management criterion).

FPIC does not require unanimity in the indigenous community and does not grant individuals or groups veto rights over a project. The **principle of proportionality** stipulates that the extent of consultation and consent required is proportional to the nature and scope of the indigenous rights that are impacted by the project. Ordinarily, consent will not be required for impacts that are not significant to Indigenous Peoples. However, good-faith consultation is required for this determination. The UN DRIP states that a project must obtain the consent of an indigenous community when it will result in the community's relocation from its traditional territories, and in cases involving the storage or disposal of toxic waste within indigenous lands. At the level of proven best practice, FPIC is to be achieved for the entire project, irrespective of the principle of proportionality.

## Conformance/Compliance

*Conformance/Compliance criterion - Implementation Stage: Processes and objectives relating to Indigenous Peoples' rights at risk have been and are on track to be met with no major non-compliances or non-conformances, and any Indigenous Peoples related commitments have been or are on track to be met.*

*Conformance/Compliance criterion - Operation Stage: Processes and objectives relating to Indigenous Peoples' rights at risk have been and are on track to be met with no major non-compliances or non-conformances, and commitments made to Indigenous Peoples have been or are on track to be met.*

Good practice expectations for conformance and compliance relating to assessment, management and engagement with Indigenous Peoples are consistent with those set out in the Project Affected Communities and Livelihoods guideline. Legal requirements and national policies for approaches involving Indigenous Peoples should be understood and adhered to. Agreed plans should be implemented as per the measures specified in the plans, and any variations justified, documented and approved with authorities and with the engagement and support of the affected parties. Commitments should be fulfilled in a timely manner.

## Outcomes

*Outcomes criterion - Preparation and Implementation Stages: Plans provide for negative impacts of the project on Indigenous Peoples' rights to be avoided, minimised, mitigated or compensated with no significant gaps, and some practicable opportunities for positive impacts to be achieved.*

*Outcomes criterion - Operation Stage: Processes provide for negative impacts of the project on Indigenous Peoples' rights to be avoided, minimised, mitigated or compensated with no significant gaps, and some practicable opportunities for positive impacts to be achieved.*

Avoid, minimise, mitigate and compensate is a sequential approach that should be taken to address negative project impacts on the rights of Indigenous Peoples. Measures to avoid or prevent negative or adverse impacts are always prioritised, and where avoidance is not practicable, then minimisation of adverse impacts is sought. Where avoidance and minimisation are not practicable, then mitigation and compensation measures are identified and undertaken commensurate with the project's risks and impacts.

To show that hydropower development plans avoid, minimise, mitigate and compensate negative project impacts to the rights of Indigenous Peoples, mitigation measures in the plans should be able to be directly linked to all identified issues and rights at risk. The assessment and planning should be informed by appropriate expertise. The assignment of responsibilities and resource allocation for implementation, monitoring and evaluation should be appropriate to the planned actions.

An evidence-based approach should demonstrate that negative impacts to Indigenous Peoples arising from project implementation and operation activities are avoided, minimised, mitigated and compensated with no significant gaps. The developer, owner and operator should demonstrate that responsibilities and budgets have been allocated to implement relevant plans and commitments. Monitoring reports





and data in the implementation and operation stages should clearly track performance against commitments and objectives and capture any impacts to Indigenous Peoples. The developer, owner and operator should document evidence of how identified risks from the assessment were avoided or minimised, and to show that mitigation plans have been implemented and monitored. Implementation of measures for improvements in pre-project conditions for Indigenous Peoples, such as livelihood enhancement, better access to resources, cultural support, and support for capacity building, should be evident and monitoring should show how they are achieving their stated objectives.

Good practice requires that some practical opportunities for positive impacts of the project

regarding Indigenous Peoples are achieved. Opportunities or benefits should clearly be additional to actions to mitigate or compensate impacts. A number of examples are listed under the guidelines for Project Benefits and for Project Affected Communities and Livelihoods, and any of these could be tailored specifically to fit the interests, rights, requirements and needs of the Indigenous Peoples in the project area. Opportunities, and the approaches taken to assess and manage them, should ideally be self-identified and informed by the communities themselves. Examples of opportunities might include improvements compared to pre-project conditions regarding education and training, health services, freshwater access, natural resource access, livelihood resource extent and quality, business and investment support, employment, institutional and governance frameworks, and legacy issue assistance and solutions.



# Labour and Working Conditions

*This guideline expands on what is expected by the criteria statements in the Hydropower Sustainability Tools (HST) for the Labour and Working Conditions topic, relating to assessment, management, conformance/compliance, stakeholder engagement and outcomes. The good practice criteria are expressed for different life cycle stages.*

*In the Hydropower Sustainability Assessment Protocol (HSAP), this topic is addressed in P-16 for the preparation stage, I-12 for the implementation stage and O-12 for the operation stage. In the Hydropower Sustainability ESG Gap Analysis Tool (HESG), this topic is addressed in Section 2.*

The labour and working conditions guideline seeks to ensure employee and contractor opportunity, equity, diversity, health and safety. The intent is that workers are treated fairly and protected.

The scope of labour and working conditions assessment and management must consider human resources policies, staff and workforce planning, occupational health and safety, equal opportunity, staff development and training, and grievance and bargaining mechanisms. These aspects should be considered for both staff of the developer and for staff of contractors, sub-contractors, intermediaries, suppliers and service providers.

**Intermediaries** are workers engaged through third parties who are either performing work directly related to the functions essential for the project for a substantial duration or who are geographically working at the project location. They are workers involved with the project who are neither employees nor contractors. They may be appointed as an in-kind contribution from another agency, for example to provide a facilitation role with indigenous communities. Clarity around the role, responsibilities, entitlements and accountabilities of these individuals would need to be defined and understood.

Labour and working conditions should consider all project-related offices, workshops, storage areas, worksites, locations of ancillary services or activities (e.g. quarries, revegetation areas,

reservoir clearing, catchment treatment, monitoring stations), surrounding areas accessible to workers (e.g. waterways, forest), and transport routes used for the project.

Occupational health and safety (OH&S) is a critical issue for the development and management of hydropower projects. OH&S relates to protecting the safety, health and welfare of people engaged in work or employment, for example through preventing disease or injury that might arise as a direct result of workplace activities. OH&S approaches and norms can vary widely from country-to-country. In some countries standards are not high, and while a particular project may proudly state that higher standards are in place than other projects in the region, overall standards may still be low and workers not safe. Poor, partial or inconsistent implementation of OH&S policies and plans may also be an area of weakness.

## Assessment

*Assessment criterion - Preparation Stage: An assessment has been undertaken of human resource and labour management requirements for the project, including project occupational health and safety (OH&S) issues, risks, and management measures, with no significant gaps.*

For hydropower projects at the preparation stage, assessments need to inform workforce planning for all project stages. These assessments should establish compliance requirements for the labour force, identify any risks or challenges that have arisen in relation to the project location, and inform the development of labour policies, plans and procedures.

The assessment should address occupational health and safety issues associated with the preparation, implementation and operations stages, which will differ substantially from each other. The assessment should involve a systematic risk assessment by people with appropriate OH&S risk assessment expertise and experience with projects of similar size and complexity. The assessment should involve staff that will be working on the project as they will have the most informed idea of local issues and risks. The assessment should cover all workers on the project, regardless of whether they are employees, contractors or intermediaries, as well as visitors who may or will be on-site. The assessment

should include an analysis of all compliance requirements for the project. The assessment should identify management measures that can be taken to address the identified issues and risks.

Requirements for baseline labour and working conditions information include the following:

- All of the aspects listed under the scope of this guidance are addressed.
- All available sources of secondary data are identified and included, including previous studies, information on labour issues from comparable projects, national statistics, local government information, and from all relevant institutions.
- Local knowledge and information is included, including from communities in the project affected areas, for example on unemployment, skills levels, and interest in project-related employment.

Preparation stage studies require a high level and diversity of contracted and staff labour to: conduct field investigations, carry out geotechnical drilling and excavation works; provide hydrographical services; establish monitoring sites; and undertake social and environmental baseline studies. At this stage there may be unique labour issues associated with the logistics, health, security and safety of workers working in remote areas with limited infrastructure (e.g. no roads or limited communications available).

Labour and working conditions risks at the implementation stage may include:

- inadequate or unsafe living conditions in labour camps or individual accommodations
- hazardous working conditions, including: (i) work underground, underwater, exposed to landslides and rockfall, exposed to floods, working at heights, or in confined spaces; (ii) work with dangerous machinery, equipment, or tools, or involving handling of heavy loads; (iii) work in unhealthy environments exposing the worker to hazardous substances, agents, processes, temperatures, noise, or vibration damaging to health; (iv) work under difficult conditions such as long hours, late nights, inadequate leave, or confinement by the employer; (v) work at ancillary structures or activities; or (vi) work on roads or through other means of transport

- hazards for workers away from the worksites including risks of drowning, human-wildlife interactions, and on roads
- the financial burden on workers and their families due to illness, injury, disability and death
- inadequate workforce planning, recruitment, training, or retention, possibly leading to project delays, inadequate quality of work or safety issues caused by worker turnover
- deficiencies in human resource policies and procedures or their implementation, which may relate to, for example, contracting, working hours, wages, leave entitlements, and local worker targets
- discrimination, harassment, breach of contract, denial of fair treatment, and limited or no access to effective grievance mechanisms
- conflicts between labour and management, or the workforce and the local population

Labour and working conditions risks at the operation stage are essentially the same, but much easier to assess and manage because of the comparatively small number of operations personnel, more permanent accommodation facilities, and generally safer workplace activities.

Labour and working conditions opportunities should also be assessed. These may include, for example: provision of local employment and training opportunities, sometimes in remote project locations; and capacity-building for hydropower industry professionals.

## Assessment

*Assessment criterion - Implementation Stage: Human resources and labour management requirements have been identified through an assessment process, including occupational health and safety (OH&S) issues and risks; and processes are in place to identify any emerging or ongoing issues, and to monitor if management measures are effective.*

Further to the above guidance, at the implementation stage, the focus should be on construction-related activities and implementation of plans. There will be significant occupational health and safety risks requiring management. The construction workforce can be very large for a number of years and often needs to be brought in rather than drawn from local labour pools, which can be a cause of safety and security concerns for both labourers and local communities.

Monitoring of the labour force and working conditions is an important assessment focus during implementation and operation. Monitoring processes should be designed to detect if an identified issue or risk is being manifested, and to verify that management measures are being implemented. Parameters commonly used for monitoring include:

- the numbers, origin, skills levels, and time employed in project for workers;
- health and safety statistics such as numbers of visits to clinics, number of reported incidents, lost time/recordable injury frequency rates;
- worker grievances registered and resolved; and
- unemployment levels in local communities.

The exact nature of the monitoring will be specific to the issue and management measure. For example, there may be a risk of vehicle accidents with workers walking around the site; the management measures are that workers are required to wear high-visibility clothing, speed limits are established, and there are random checks by designated personnel of adherence to clothing requirements and speed limits. Associated monitoring might include the number of vehicle accidents with workers walking around the site and the number of breaches of the clothing and speed rules each month.

## Assessment

*Assessment criterion - Operation Stage: 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.*

Many of the implementation considerations also apply at the operations stage. At the operations stage, the labour and work conditions issues will be centred on operation and maintenance of assets, monitoring and implementation of plans and programmes, and a diversity of corporate activities. Assessment activities need to be tailored to fit the context and involve re-assessments over time as the situation evolves. There is often a lower proportion of contracted labour in the operations

stage and a more stable long-term employee workforce. On-site workforce sizes can vary from an unmanned remotely operated power station with visiting maintenance crews to a power station with hundreds of staff and living quarters provided on site for staff families. Workforce arrangements vary greatly depending on whether it is one of many power stations owned by the operator or an operation wholly owned and operated by a dedicated company. Large on-site staff may be because an operating power station is used as a training facility to build a wider capacity of staff for new power stations that are coming through the project development cycle.

## Management

*Management criterion - Preparation Stage: Human resource and labour management policies, plans and processes have been developed for project implementation and operation that cover all labour management planning components, including those of contractors, subcontractors, and intermediaries, with no significant gaps.*

*Management criterion - Implementation and Operation Stages: Human resource and labour management policies, plans and processes are in place that address all labour management planning components, including those of contractors, subcontractors, and intermediaries, with no significant gaps.*

Workforce planning is an important requirement at all stages for a hydropower project. The preparation stage of a hydropower project involves a high level of staff and contracted labour over several years. Decisions on where to use contractors and sub-contractors versus permanent or temporary employees are part of major procurement strategies including on how risks are allocated (see the Procurement guideline).

Planning for labour and working conditions needs to occur early in the preparation stage, with policies and procedures in place prior to the commencement of detailed feasibility studies. Corporate policies and processes should encompass all aspects of human resources and be readily accessible to the labour force. Aspects of labour and working conditions that human resource policies should address include:

- the workforce structure which defines categories such as executive, management, administrative, technical, and levels within these categories linked to roles, responsibilities and compensation;
- recruitment and retention;
- equal opportunity, equity and diversity;
- compensation and entitlements for different staff levels, including salaries, bonuses, leave entitlements and leave purchasing;
- employee and contractor obligations such as number of working hours, workplace, travel, uniform, etc.;
- standards of behaviour including anti-bribery and ethical practices;
- disciplinary and dismissal procedures;
- occupational health and safety obligations, commitments and procedures;
- retirement and retirement benefits fund contributions;
- collective bargaining;
- staff development and training;
- grievance mechanisms;
- workforce record keeping;
- contractor and sub-contractor policies; and
- workforce planning.

Policies, plans and processes need to be consistent with national labour regulatory requirements. In some cases the company directly refers to the national legislation in its company policies, whereas in others there are approaches specific to the project or operating facility that are spelled out in company documentation.

Policies, plans, and processes need to address contractors, sub-contractors and intermediaries. This can be done through text in the relevant documentation and also through references to corporate policies and plans incorporated into tender and contract documentation. Monitoring reports related to labour and working conditions should include information on contractors, sub-contractors and intermediaries.

The project Environmental and Social Management Plan (ESMP) should include mitigation actions to address risks relating to the labour force. Labour-related management plans

need to be outlined separately for construction and operation. Guidance on what to look for regarding mitigation options for labour and working conditions risks is provided below.

- Measures to mitigate risks of inadequate or unsafe living conditions in labour camps include: worker campsites and accommodation provide an adequate minimum space, supply of safe water, adequate sewage and garbage disposal system, appropriate protection against heat, cold, damp, noise, fire and disease-carrying animals, adequate sanitary and washing facilities, ventilation, cooking and storage facilities, natural and artificial lighting, medical services, and entertainment; project design documents, budgets, contracts, and supervision arrangements ensure requirements are met; preventative measures such as immunisations and, at a minimum, annual health screenings are provided; and information on conditions including medical status of project staff is systematically collected, analysed and used to guide improvements.
- Measures to mitigate risks of hazardous working conditions include: design documents, budgets, contracts, supervision arrangements, and procedures demonstrate awareness and avoidance of work hazards; health and safety regulations such as measurement of gas content in tunnels, slope stabilisation requirements, adherence to speed limits, restrictions on access; permit and authorisation processes and wearing of personal protective equipment (PPE) are strictly enforced; workers are trained and encouraged to report unsafe and unhealthy conditions; safety officers are appointed and given additional training at worksites; injury response and emergency systems are in place, including notification systems, evacuation plans, ambulance facilities, and readily accessible health services; information on injuries, accidents and near misses is systematically collected, analysed and used to guide improvements, using internationally recognised safety indicators; and managers and contractors have performance targets and contractual incentives to ensure safe and healthy working conditions.
- Measures to mitigate risks of hazards for workers away from the worksites include: guidance, procedures, exclusion zones and other rules are in place to minimise hazards for workers away from the worksites; policies to help minimise the financial burden on workers and their families due to work-related illness, injury, disability and

death, such as through access to free health care on the worksite; and adequate insurance coverage and/or compensation payments.

- Measures to mitigate risks of inadequate workforce planning, recruitment, training, or retention include: workforce requirements that are realistic and detailed; contractors start recruitment processes with sufficient lead times; a workforce database is maintained with records of all qualifications, training, authorisations, leave, visas, etc. available for the entire project workforce; and high workforce turnover is discouraged by surveys among workers and adaptive management of labour and working conditions.
- Measures to mitigate risks of discrimination, harassment, breach of contract, denial of fair treatment and access to grievance mechanisms include: a code of conduct and/or manual for employee behaviours; workers are well-informed of their rights; workers have collective representation and access to grievance mechanisms with thorough and timely feedback; grievances are systematically tracked and resolved, and analysis of grievances is used to guide improvements; and labour inspectors and representatives of the developer cooperate to ensure fair treatment of all workers, including contractors, sub-contractors, intermediaries, suppliers and service providers.
- Measures to mitigate risks arising from deficiencies in human resource policies and procedures or their implementation (e.g. affecting contracting, working hours, wages, leave entitlements, local worker targets, etc.) include: ensuring human resources staff have adequate qualifications and experience; provision of continuing professional development training for human resources staff; clearly documented human resources policies and procedures made readily available to all staff; effective grievance mechanisms for employees to raise issues if policies and procedures are not being followed; independent audits and reviews to ensure proper implementation; and ensuring all of the above also apply to contractors and intermediaries through appropriate contract and agreement documentation.
- Measures to mitigate risks of conflicts between labour and management, or the workforce and the local population, include: clear rules are established to avoid potential conflicts; grievances are systematically tracked and resolved and analysis of grievances is used to guide improvements; and measures to address this risk are included in the Social Management

Plan (SMP) and SMP induction training is broadly implemented.

- Measures to promote local employment opportunities include: information and training to local communities during the pre-construction stage; employment preferences given to local workers in general and affected households in particular; and encouragement of capacity development within the local workforce and knowledge transfer from foreign specialists.

## Stakeholder Engagement

*Stakeholder Engagement criterion – Preparation, Implementation and Operation Stages: Ongoing processes are in place for employees and contractors to raise human resources and labour management issues and get feedback.*

Good practice requires that employees, contractors, sub-contractors, intermediaries, suppliers and service providers are all able to raise issues and concerns through a clearly established and functional process. This is effectively one form of a grievance mechanism applicable to employees (as described in the Communications and Consultation topic guidance). The business should establish indicators to ensure employee grievance processes are accessible and being used, and to check timeliness of response and closure on issues.

Processes by which workers could raise issues should be well-communicated. Examples include through nominated contact people, a designated platform on an internal website for workers, periodic workforce briefings or question/answer opportunities, suggestion boxes, complaints boxes, an employee assistance programme, and/or a toll free telephone number. An incident reporting system, whistle-blowing mechanism, and workplace support officers or representatives can also be evidence that this criterion is met.

Regular staff and contractor team meetings, surveys, information sessions, and designated contact people are often used as communication processes for raising issues and getting feedback. Feedback on issues raised by workers should be documented and could be demonstrated by means such as emails, records of telephone conversations, written correspondence, meeting minutes, and/or provision of responses to frequently asked questions on the company website.

Records should be kept of issues raised, how they were raised, how they were responded to, and when and how they were fully closed and communicated back to the worker(s) who raised the issue.

Further guidance can be found in the Communications and Consultation guideline.

## Conformance/Compliance

*Conformance/Compliance criterion - Implementation and Operation Stages: 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.*

Assessment processes and management measures relating to labour and working conditions should be compliant with relevant legal and administrative requirements. These may be expressed in licence or permit conditions or captured in legislation. Implemented measures should be consistent with what is in the plans to demonstrate conformance with the plans. Labour commitments may be expressed in policies of the developer or owner/operator, or in company statements made publicly or within management plans. Evidence of adherence to commitments could be provided through, for example, internal monitoring and reports, government inspections, or independent review. Variations to commitments should be well-justified and approved by relevant authorities, with appropriate stakeholder liaison.

The significance of not meeting a commitment is based on the magnitude and consequence of that omission and will be context-specific. For example, a failure to demonstrate delivery of a licence requirement to provide potable drinking water to all workers is likely to be a significant non-compliance, as would be unfair dismissal of an employee in violation of the company's own policy. A slight delay in delivery of a monitoring report could be a non-significant non-conformance.

The obligations of contractors, sub-contractors and intermediaries with respect to corporate policies versus the contractor's own policies would need to be made clear in any contract.

## Outcomes

*Outcomes criterion – Preparation, Implementation and Operation Stages: There are no identified inconsistencies of labour management policies, plans and practices with internationally recognised labour rights.*

Project-specific labour policies, plans or processes should be consistent with labour rights and there should be no conflicts.

Internationally recognised labour rights are documented in places such as IFC Performance Standard 2, the International Labour Organisation standards, and the Human Rights Council 2008 Report of John Ruggie “Protect, Respect and Remedy: a Framework for Business and Human Rights”. These rights include:

- freedom of association;
- the right to equal pay for equal work;
- the right to organise and participate in collective bargaining;
- the right to equality at work, the right to non-discrimination;
- the right to just and favourable remuneration;
- abolition of slavery and forced labour;
- the right to a safe work environment;
- abolition of child labour;
- the right to rest and leisure;
- the right to work; and
- the right to family life.

An evidence-based approach should demonstrate that workers experience all of these rights. Well-documented and communicated policies, plans and processes are important to demonstrate that the rights are recognised and provided for. Evidence should be documented to show how these rights are met during implementation and operation. Monitoring systems should be robust with periodic checks that they are capturing the information that would inform if labour rights are met. Worker grievance procedures should be well-documented and tracked.

For OH&S, inspections of worksites, power stations and other facilities should demonstrate the use of signage, safety practices, protective clothing and equipment, barriers, tagging out systems and sub-contractor work standards and conditions. Worker safety data needs to be centralised, collated, analysed against agreed indicators, and regularly reported.

In some cases, the national regulations prevent a company from enabling all rights to be realised, such as the right to collective bargaining or freedom of association. While it is important that the company is compliant with national legislation, international good practice expectations may not be met.







# Cultural Heritage

*This guideline expands on what is expected by the criteria statements in the Hydropower Sustainability Tools (HST) for the Cultural Heritage topic, relating to assessment, management, conformance/compliance, stakeholder engagement, stakeholder support and outcomes. The good practice criteria are expressed for different life cycle stages.*

*In the Hydropower Sustainability Assessment Protocol (HSAP), this topic is addressed in P-17 for the preparation stage, I-13 for the implementation stage and O-13 for the operation stage. In the Hydropower Sustainability ESG Gap Analysis Tool (HESG), this topic is addressed in Section 8.*

This guideline addresses cultural heritage, with specific reference to physical cultural resources at risk of damage or loss by the hydropower project and associated infrastructure (e.g. new roads, transmission lines), or associated with the hydropower facility. The intent for a hydropower development 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.

**Cultural heritage** refers to the legacy of physical artefacts and intangible attributes of a group or society that are inherited from past generations, maintained in the present and bestowed for the benefit of future generations. It can be understood as the objects, places and practices that define who we are. Cultural heritage are the values we want to retain, share and pass on to future generations.

Cultural heritage does not refer exclusively to the monumental remains of a culture and includes intangible, ethnographic and social heritage. It is an evolving concept, reflecting living cultures as well as those of the past. This guideline focusses on **physical cultural resources**, which are movable or immovable objects, sites, structures, groups of structures, and natural features and landscapes that have archaeological, paleontological, historical, architectural, religious, aesthetic, or other cultural significance. Physical cultural resources may be located in urban or rural settings and may be above or below ground, or under water. Their cultural interest may be at the local, provincial or national level, or within the international community.

**Intangible cultural resources** are oral traditions, performing arts, social practices, rituals, festive events, knowledge and practices concerning

nature and the universe, and the knowledge and skills to produce traditional crafts. Intangible cultural resources should also be thoroughly addressed in any project Environmental and Social Impact Assessment (ESIA) and may well be a source of social impact risks as noted in the guidelines for Project Affected Communities and Livelihoods, and for Indigenous Peoples. It is also not always possible to separate the physical and the non-physical; for example, traditions may be in place in relation to spirits associated with sacred sites. Local groups may accept disturbance to or loss of physical cultural items of heritage importance (e.g. a sacred rock or a burial ground) as long as appropriate blessings and ceremonies have been observed.

## Assessment

*Assessment criterion - Preparation Stage: A cultural heritage assessment has been undertaken with no significant gaps; the assessment includes identification and recording of physical cultural resources, evaluation of the relative levels of importance, and identification of any risks arising from the project.*

A cultural heritage assessment should be included in the ESIA to meet international good practice, regardless of whether or not it is mandated by the government regulatory requirements. The assessment should consider protected and non-protected, tangible and intangible, religious and non-religious, and archaeological and paleontological aspects of cultural heritage. All available sources of secondary data should be identified and included, including previous studies, the national cultural heritage database, locally held information, and from all relevant institutions.

The assessment should identify and record physical cultural resources within the areas that will be both directly and indirectly affected by the proposed hydropower project. Identification should take place through physical surveys accompanied by more qualitative approaches to establish the relative levels of importance or significance of each identified resource. For example, a piece of pottery found in the future construction area may be one of hundreds that are regularly found in the region versus a significant find that explains a critical gap in the history of the region. Collection and collation of oral history evidence from those in the cultural groups who are best able to provide it

may need to be undertaken if appropriate to a type of heritage or anticipated impact. For example, if a site of cultural heritage importance is going to be permanently lost through inundation under the reservoir, then full documentation of the artefacts and stories/memories relating to it may be an important pre-inundation management commitment.

For each of the cultural heritage resources recorded, the assessment should document the condition of the resource to establish baseline data against which any later concerns about disturbance can be checked. For example, the structural integrity of existing monuments and other built heritage structures should be described, and any existing structural weaknesses and cracks should be well-documented. Later concerns that damage is being caused by blasting, vibration, heavy traffic or vandalism associated with project construction can then be evaluated with respect to the documented pre-project condition.

All potential cultural heritage risks arising from the hydropower project should be fully evaluated. Cultural heritage risks at the construction stage may arise due to direct and indirect damage to, loss of, or loss of access to physical cultural resources. Mechanisms of impact may include through excavation, soil compaction, blasting, vibrations, pollution, vandalism, theft, desecration, and groundwater and river flow changes. Loss of access to important sites might arise due to changes to access routes (e.g. new canals or linear infrastructure with barrier fencing, major roads). The influx of workers and camp followers into communities can also cause harm or disturbance to aspects of heritage. Construction activities may be of concern to cultural heritage stakeholders not only due to the resultant physical damage, but potentially also due to disturbance of spirits associated with special sites. Cultural heritage risks at the operation stage may include: inundation of cultural heritage sites with the newly formed reservoir or impoundment; downstream damage, for example through riverbank erosion, which may take some time to become evident; and ongoing loss of cultural traditions due to changes arising from the project. Ideally, cultural heritage opportunities will be identified and could include: the identification and documentation of cultural resources in the region; sponsoring of cultural heritage research, education, rehabilitation, and display; and promotion of tourism focussed on cultural heritage.

Assessment techniques will vary between jurisdictions and for different types of cultural heritage. The assessment should be conducted using appropriate expertise as well as local community knowledge, and any conflicts between the two need to be resolved in an open and transparent manner. Suitable areas of expertise might come from a diversity of areas of study and experience, such as cultural heritage, heritage conservation, history, social development, social anthropology and archaeology. Local expertise and a track record of relevant experience will enable familiarity with the types of heritage found in the region, what to look for, and how to identify it. Expertise used for on-site information gathering should be acceptable to the cultural groups or stakeholders who value the heritage resources in question.

In some cases cultural heritage information may be considered confidential due to cultural beliefs or practices. For example, a cultural group may not want to reveal the exact location of a cultural site but may indicate a broader area for protection. In some jurisdictions it is considered acceptable for the location of these sites not to be revealed publicly or to the developer. Other groups may consider it inappropriate to divulge the exact nature of cultural heritage values to be assessed. Independent advice from accredited experts, approved by local groups, should be sought in these cases, and respect for local customs should be demonstrated.

## Assessment

*Assessment criterion - Implementation Stage: Cultural heritage issues, with respect to physical cultural resources, that are relevant to project implementation and operation have been identified through an assessment process utilising appropriate expertise; and monitoring is being undertaken during the project implementation stage appropriate to the identified issues.*

*Assessment criterion - Operation Stage: 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.*

Cultural heritage issues may be ongoing issues that arose during project development and have not been resolved, for example: inundation of important sites or artefacts under the new reservoir; damage or destruction to important sites or artefacts due to construction activities; loss of access to important sites due to changes to access routes (e.g. new canals or linear infrastructure with barrier fencing, major roads); and disturbance of spirits associated with special sites. Alternatively, they may be emerging issues such as erosion of riverbanks exposing new artefacts or developments in policies, legislation or standards changing expectations on how cultural heritage issues will be addressed.

Monitoring is important to ensure that cultural heritage management measures are effective and that emergent issues and risks are identified in a timely manner. Cultural heritage monitoring should be embedded within management plans for construction and operation, with clear monitoring objectives linked to identified cultural heritage risks. Monitoring should be in accordance with a logical design for the locations, timing, and methodologies linked to risks and objectives. Locations and techniques used for baseline information in the ESIA should be continued as far as practical.

For older hydropower facilities, there may be little new disturbance happening in relation to the facility that could raise new cultural heritage issues. However, periodic refurbishment and upgrade activities, wildfire or storm disturbances to areas around the facility, or discoveries could arise that require attention by the hydropower owner/operator. Identification of any new issues arising could take place through, for example: regular operations and maintenance inspections by the operator; maintenance of good relationships with cultural heritage stakeholders through hydropower representatives on a relevant committee; monitoring developments in government cultural heritage policy and legislation; and/or support measures provided by the hydropower facility to cultural heritage interests of the surrounding communities through a Corporate Social Responsibility (CSR) programme.

## Management

*Management criterion - Preparation Stage: Plans and processes to address physical cultural resources have been developed for project implementation and operation with no significant gaps; plans include arrangements for chance finds, and ensure that cultural heritage expertise will be on site and regularly liaised with by the project management team during construction.*

*Management criterion - Implementation Stage: Processes are in place to ensure management of identified cultural heritage issues, and to meet commitments, relevant to the project implementation stage; plans are in place for the operation stage for ongoing cultural heritage issues management.*

*Management criterion - Operation Stage: Measures are in place to manage identified cultural heritage issues.*

Plans in relation to cultural heritage should be included as a section of the ESMP. These should contain the following, outlined separately for construction and operation:

- all sources and types of potential cultural heritage impact are outlined;
- mitigation measures for cultural heritage impacts are listed and the objectives are clearly explained;
- the actions, timeline, budget, and responsible parties for implementation of cultural heritage mitigation measures are clearly stated;
- a **chance find** procedure is included for cases in which cultural heritage resources are identified during excavation or later activities. This procedure should involve access to appropriate expertise to establish the value of the finds; relocation of project components to avoid impacting on the finds, if feasible; and documentation and/or relocation of the finds if justified;
- a programme is defined for surveillance, monitoring and auditing, including timeline, budget, and responsible parties;
- ideally, adaptive management measures for cultural heritage impacts are also considered. These would identify what issues might be identified through the monitoring and surveillance and what the response would be (including responsible parties and contingency budget set aside); and
- audit, review and evaluation provisions.

Measures to address cultural heritage risks and impacts could include some of the following:

- Measures to mitigate risks of destruction of physical cultural heritage sites by locating project infrastructure directly over those sites: cultural heritage sites should be thoroughly identified in the ESIA; alternative locations for project infrastructure should be identified and evaluated so that interference with cultural heritage sites is avoided as far as feasible; if impact cannot be avoided, resources should be documented and/or relocated in accordance with guidelines from national heritage experts prior to damaging activities commencing; a chance finds procedure should be included in the ESMP and in the contracts; processes in place to ensure continuing awareness.
- Measures to mitigate damage to physical cultural heritage sites through indirect impacts (e.g. blasting, traffic vibrations, vandalism and theft, groundwater and downstream flow changes): cultural heritage sites and potential indirect impacts from project construction and operations should be thoroughly identified in the ESIA; baseline information on the structural integrity of these sites should be well-documented; potentially damaging project activities should be located at appropriate distances from heritage sites in accordance with established standards (e.g. minimum distances for quarry locations, heavy vehicle traffic, blasting); potentially damaging activities should be implemented according to approved schedules and norms, such as timing restrictions on heavy vehicle movement or blasting; restrictions such as ramping rules could be imposed on power station releases to limit erosion due to hydropeaking if there are heritage sites on riverbanks; sites should be protected against vandalism and theft where necessary; culturally significant resources should be documented and/or relocated where necessary.
- Measures to mitigate risks of reduced experience value of physical cultural heritage sites through indirect impacts: project activities should be located at appropriate distances from heritage sites and restricted in accordance with standards (e.g. limits on air, noise, vibration, waste, and wastewater emissions); access to sites should be maintained or feasible alternative access created; landscaping should be undertaken to reduce visual impacts; project buildings should be designed to maintain visual cohesion with traditional building styles; culturally significant resources should be documented and/or relocated where necessary.

## Stakeholder Engagement

*Stakeholder Engagement criterion - Preparation Stage: The assessment and planning for cultural heritage issues has involved appropriately timed, and often two-way, engagement with directly affected stakeholders; ongoing processes are in place for stakeholders to raise issues and get feedback.*

Good practice requires that a process of stakeholder engagement has been followed in the assessment and planning for cultural heritage issues in relation to the hydropower project. Directly affected stakeholders for cultural heritage would be those who recognise and have responsibilities for the values of the heritage recorded for the hydropower project affected area. These 'cultural heritage stakeholders' should be clearly identified in any project stakeholder mapping. They might be stakeholders only for this issue or stakeholders in relation to many issues relating to the project. Cultural heritage stakeholders might include project affected communities as a whole, or a subset of these (e.g. living in a particular area, and/or indigenous peoples or an ethnic minority group). They should include the relevant government department such as a heritage agency and could include historians, researchers, local interest groups, educational institutions, and/or curators for museums or collections.

Appropriate timing, culturally appropriate, and two-way processes are important components of good practice. 'Appropriately timed' means that engagement should take place early enough so that the project can respond to issues raised, cultural heritage stakeholders have inputs before the project takes decisions, and engagement takes place at times suitable for these stakeholders to participate. Cultural heritage stakeholders should be supportive of the timing of engagement activities. 'Culturally appropriate' means that methods of engagement respect the cultures of the cultural heritage stakeholders and allow adequate provisions to fit with the discussion and decision-making processes typical for them. Stakeholder engagement processes that are culturally sensitive consider, for example, meeting styles, venues, facilitators, language, information provision, the community's decision-making processes, time allocation, recording, and follow-up. Engagement processes for cultural heritage stakeholders should

consider gender and the inclusion of vulnerable social groups. 'Two-way' means that cultural heritage stakeholders can give their views on the plans that will affect them rather than just being given information without any opportunity to respond. Examples of two-way processes include focus groups, interviews, community meetings, and public hearings.

The timing of engagement must allow for adequate data collection, analysis and reporting. Cultural heritage stakeholders should be asked to provide information on areas of concern, and these should influence the research design. These same stakeholders should also be asked to provide feedback on the significance of finds and of potential impacts, and this should inform any avoidance, minimisation, mitigation and compensation plans. Local communities may express values for heritage aspects in contrast to the advice of external experts and any conflicts in views need to be managed with respect and sensitivity. Cultural heritage stakeholder engagement needs to be undertaken before management decisions have been made and evidence should demonstrably show that these stakeholder views have been sought and taken into consideration to inform cultural heritage management plans.

## Stakeholder Support

*Stakeholder Support criterion – Preparation and Implementation Stages: There is general support or no major ongoing opposition amongst directly affected stakeholder groups for the cultural heritage assessment, planning or implementation measures.*

Plans for mitigation of cultural heritage issues arising from the hydropower development should be generally supported by cultural heritage stakeholders. Cultural heritage stakeholder support may be expressed through community members or their representatives, and may be evident through means such as surveys, signatures on plans, records of meetings, verbal advice, public hearing records, public statements, government licence, and court decisions. No major ongoing opposition or temporary opposition that was resolved would satisfy this criterion.

## Conformance/Compliance

*Conformance/Compliance criterion - Implementation and Operation Stages: 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.*

Assessment processes and management measures relating to cultural heritage should be compliant with relevant government requirements. These may be expressed in licence or permit conditions or captured in legislation. Implemented measures should be consistent with what is in the plans to demonstrate conformance with the plans. Cultural heritage commitments with respect to measures to be taken by the hydropower developer or owner/operator may be expressed in policies of the developer or owner/operator, or in company statements made publicly or within management plans. Evidence of adherence to commitments could be provided through, for example, internal monitoring and reports, government inspections, or independent review. Variations to commitments should be well-justified and approved by relevant authorities, with appropriate stakeholder liaison.

The significance of not meeting a commitment is based on the magnitude and consequence of that omission and will be context-specific. For example, a failure to demonstrate delivery of a major cultural heritage mitigation measure expressed in the project approval, such as relocation and restoration of an important site, is a significant non-compliance, whereas a slight delay in delivery of a monitoring report could be a non-significant non-conformance.

## Outcomes

*Outcomes criterion - Preparation Stage: Plans avoid, minimise, mitigate, and compensate negative impacts on cultural heritage arising from project activities with no significant gaps.*

*Outcomes criterion - Implementation Stage: Negative cultural heritage impacts arising from project implementation are avoided, minimised, mitigated and compensated with no significant gaps.*

*Outcomes criterion - Operation Stage: Negative cultural heritage impacts arising from activities*

*of the operating hydropower facility are avoided, minimised, mitigated and compensated with no significant gaps.*

To show that plans avoid, minimise, mitigate and compensate negative cultural heritage impacts from project activities, mitigation measures in the plans should be able to be directly linked to the inventory of physical cultural resources identified for the project, and the assessment of potential impacts and risks. The assessment and planning should be informed by appropriate expertise, views of directly affected stakeholders, and local knowledge. The assignment of responsibilities and resource allocation for implementation, monitoring and evaluation should be appropriate to the planned actions.

Compensation should be identified as an area of focus for management action after avoidance, minimisation and mitigation measures have all been identified and committed to where possible. For cultural heritage, an example of where compensation might be required could be for the loss of artefacts which are unable to be moved and would eventually be inundated under the reservoir. Compensation might be in the form of contributions to the broader cultural heritage protection and conservation measures in the region or country, for example through financial contributions to museums, establishment of a museum, creation of heritage trust funds, and/or support for research and expertise to be brought in.

An evidence-based approach should demonstrate that negative cultural heritage impacts arising from project implementation and operation activities are avoided, minimised, mitigated and compensated with no significant gaps. The developer, owner and operator should demonstrate that responsibilities and budgets have been allocated to implement cultural heritage plans and commitments. Monitoring reports and data in the implementation and operation stages should clearly track performance against commitments and objectives and capture cultural heritage impacts. It should be possible to provide examples to show how identified risks from the assessment were avoided or minimised. It should also be possible to table evidence to show that mitigation plans have been implemented and are being monitored. Implementation of measures for cultural heritage, such as excavation, signage, protection, relocation, should be evident, and monitoring should show how they are achieving their stated objectives.



# Public Health

*This guideline expands on what is expected by the criteria statements in the Hydropower Sustainability Tools (HST) for the Public Health topic, relating to assessment, management, conformance/compliance, stakeholder engagement and outcomes. The good practice criteria are expressed for different life cycle stages.*

*In the Hydropower Sustainability Assessment Protocol (HSAP), this topic is addressed in P-18 for the preparation stage, I-14 for the implementation stage and O-14 for the operation stage. In the Hydropower Sustainability ESG Gap Analysis Tool (HESG), this topic is addressed in Section 4.*

This guideline addresses public health issues associated with the hydropower project. A broad view is taken on public health to incorporate anything for which one would seek medical attention, such as sickness, disease, mental health, injuries and fatalities. Guidance on occupational health and safety, i.e. the health of the labour force, is provided separately in

the Labour and Working Conditions guideline. Hydropower projects also have the potential to provide improvements in public health facilities and health services, which is closely linked with project benefits (see the Project Benefits guideline).

The intent for public health in relation to the hydropower project or operating facility is that:

- the project or operating hydropower facility does not create or exacerbate any public health issues;
- any ongoing or emerging public health issues associated with the hydropower facility are identified and addressed as required;
- improvements in public health are achieved through the project in project affected areas where there are significant pre-existing public health issues; and
- commitments made by the project to implement public health measures are fulfilled.

## Assessment

*Assessment criterion – Preparation Stage: A public health issues assessment has been undertaken with no significant gaps; the assessment includes public health system capacities and access to health services, and has considered health needs, issues and risks for different community groups.*



The Environmental and Social Impact Assessment (ESIA) should include a section on public health. While this may not be a national requirement, it is an expectation for international good practice. The scope of the public health assessment should include all communities potentially affected at all stages of the hydropower project life cycle by exposure to:

- project-related activities and infrastructure at worksites, camps, storage areas, access roads, transmission lines, quarries, revegetation and catchment treatment areas, etc.;
- changes to water flows, including creation of reservoirs, downstream river flow changes below any project infrastructure, spills, emergency releases, and dam break;
- interactions of the public with workers and with security personnel;
- changes in amenity, livelihood and lifestyles due to environmental and social changes caused by the project, which may include economic and physical displacement; and
- population migration into the project area.

The assessment should establish a clear pre-project baseline with regards to the existing public health resources and statistics that includes those communities potentially subject to direct and indirect impacts. The baseline data should include health profiles of potentially project affected communities using all available sources of secondary data. Sources to consider include previous studies, national and regional statistics, and police and road authority data. Local knowledge and administrative health data from the local government, communities, and local health care providers should be included. Community data should be disaggregated as far as possible by cultural, ethnic, socio-economic, gender, age, education, location and other characteristics. Data analyses should seek to understand the different health and safety issues and risks for the various segments of those communities, which could result in different impacts and could make certain individuals, households and communities more vulnerable to impacts. The baseline should describe existing modalities and resources for public health services and disaster management.

The assessment should include a detailed analysis of potential risks and opportunities of the project

development with regards to public health. These should be distinctly evaluated for both the construction and operations stages due to the differing nature of risks that can prevail. Public health risks at the construction stage that should be considered include disease, injuries or fatalities from:

- dam failure and natural disasters caused by project-external factors (e.g. major landslides, floods);
- air, water, and noise pollution, vibrations, and exposure to dust and to hazardous materials;
- accidents from traffic, landslides and rock falls, fires, drowning, blasting or inadvertent detonation of explosives, and misunderstandings with project security personnel;
- communicable diseases, non-communicable diseases, unhealthy behaviour (e.g. drugs, alcohol, sexual behaviour), or violent conflict around work camps;
- declines in livelihoods and nutrition due to loss of access to land and resources;
- temporary pressure on the existing health infrastructure, equipment, human resources, essential drugs, etc. due to the influx of migrants, workers and others;
- loss of public access to health facilities and other essential services, for example in the case of road closures or transport blockages; and
- mental health issues, which may arise due to community anxiety and stress.

At the operation stage, besides the risks mentioned above, additional public health risks that should be considered include disease, injuries or fatalities from:

- drowning in the reservoir(s) or downstream river(s);
- electrical safety;
- health risks related to the reservoir, including waterborne and vector-borne diseases (e.g. malaria) as well as unhealthy water quality for human contact or consumption as it affects fish consumption (e.g. bioaccumulation of mercury); and
- permanent changes to livelihoods and health-related behaviour, including nutrition, exercise, and access to medicinal plants and traditional health services.

Public health opportunities should also be assessed. These may include:

- project ambulances and health facilities that can be used by local communities;
- investments in public health facilities including equipment and staffing;
- improved access to health facilities, health knowledge and health education;
- population health monitoring;
- improved road safety through better design and maintenance, signage, enforcement of traffic regulations;
- flood prediction and early warning systems in close cooperation with disaster management authorities;
- contribution of project reservoirs, inter-basin diversions and other infrastructure to flood retention and management;
- emergency preparedness training and infrastructure; and
- improved local waste management, sanitation and water treatment.

## Assessment

*Assessment criterion - Implementation Stage: Public health issues relevant to project implementation and operation have been identified through an assessment process utilising appropriate expertise; and monitoring is being undertaken during the project implementation stage appropriate to the identified issues.*

Monitoring should be included in the public health issue management plans for both construction and operation so that monitoring activities are directly linked to the identified public health issues, risks and planned responses to findings. Monitoring should be designed to detect if the issue or risk is evident, and to verify that management measures are being implemented and are effective. Locations and techniques used for baseline information in the ESIA should be continued as far as practical. Monitoring locations, timing, and methodologies should have a logical design with meaningful indicators relating to both influences on health (environmental and social) and health outcomes. Where possible, monitoring should seek to link project environmental impacts and public health

factors (e.g. poor water quality and gastro-intestinal issues), and project social impacts and public health factors (e.g. negative livelihood impacts and increased malnutrition).

The exact nature and duration of monitoring will be specific to the issue and management measure. For example, an identified risk could be increased malaria. Planned management measures might include community education and awareness-raising, provision of anti-malarial medications and mosquito netting, measures to avoid pooling of stagnant water, and regular community health checks. Associated monitoring might include: the number of education and awareness-raising sessions; the number of attendees; the amount of anti-malarial medications and mosquito netting dispensed; the number of incidents involving pools of stagnant water; the frequency of health checks; and the number of incidences of malaria among the community.

## Assessment

*Assessment criterion - Operation Stage: 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.*

During the operation stage, mechanisms should be in place by which emerging public health issues can be detected and acted on in a timely manner. Depending on the age of the operating facility and the prevalence of public health issues during its development or in the region, the degree of attention on public health by an operating hydropower facility can vary considerably. If the operating hydropower facility was commissioned relatively recently, identification of ongoing or emerging public health issues may take place through follow-up monitoring programmes that were committed to during project development. The duration of these programmes would be as agreed with the project regulatory authorities. For hydropower facilities that have been operating for decades, there may not be direct public health monitoring programmes delivered by the owner/operator. If not directly undertaking the monitoring, it is important for the owner/operator to ensure that

there are services in place in the area affected by the operating hydropower facility that will be able to detect any ongoing or emerging public health issues relating to operations.

Throughout the operations stage, the owner/operator should be monitoring for causative factors relating to operations that could, if not responded to, eventually lead to public health issues (e.g. algal blooms or changed road usage patterns leading to increased hazards). If ongoing management measures are taken by the owner/operator to minimise public health risks, monitoring should be associated with these measures to detect if risks are being fully addressed.

## Management

*Management criterion - Preparation Stage: Plans and processes to address identified public health issues have been developed for project implementation and operation with no significant gaps.*

*Management criterion - Implementation Stage: Processes are in place to ensure management of identified public health issues and to meet commitments relevant to the project implementation stage; plans are in place for the operation stage for ongoing public health issues management including handover to local authorities as appropriate.*

*Management criterion - Operation Stage: Measures are in place to manage identified public health issues.*

Plans should be included in the Environmental and Social Management Plan (ESMP) in relation to public health measures to be taken during project development and operation. The public health management plans should be separately specified for both the construction and operation stages and include the following:

- All sources and types of potential public health risks and opportunities are outlined.
- Mitigation measures for public health impacts are listed and the objectives are clearly explained.
- Measures to be implemented have a clear timeline, budget, and responsible parties.
- Measures are culturally-sensitive, e.g. with respect to traditional medicines and local beliefs.

- Measures take into account longer-term considerations, e.g. community growth, maintenance needs of public health facilities, maintenance of project measures to reduce risks such as road signage, handover arrangements from the developer or owner/operator to the government, and capacities of local authorities for ongoing management.
- ESMP content is developed in a manner for which contractor responsibilities can be easily incorporated into tender and contracting documents in a manner that shows the contractors must also convey these responsibilities to their sub-contractors and suppliers.
- A programme for surveillance, monitoring and auditing for all commitments is provided.

Adaptive management measures for unpredicted public health impacts are also ideally included. These would focus on issues that might be identified through the monitoring and surveillance, as well as what the response would be (including responsible parties and contingency budget set aside).

Global experience in managing public health risks in relation to hydropower projects and operating facilities has shown a wide range of potential approaches. In many cases, avoidance and minimisation of public health risks can be achieved through public safety measures (see the Infrastructure Safety guideline), various environmental impact areas (e.g. see the Water Quality guideline and the Waste, Noise and Air Quality guideline), and social impact areas (see the Project Affected Communities and Livelihoods guideline). In addition, measures to address public health risks could include some of the following:

- Measures to mitigate risks from dam failure and natural disasters caused by project-external factors, e.g. major landslides or floods: health infrastructure, equipment and trained human resources to deal with victims of disasters; and hospital contingency plans.
- Measures to mitigate risks from air, water, and noise pollution, vibrations, and exposure to dust and to hazardous materials: provision of personal protective equipment for vulnerable community members, such as face masks, ear plugs, or water filters; and temporary relief to vulnerable households if necessary, including temporary relocation, to avoid health risks from more intensive construction-related impacts.

- Measures to mitigate risks from accidents from traffic, landslides and rock falls, fires, drowning, blasting or inadvertent detonation of explosives: removal and treatment of public safety hazards; appropriate design speeds and enforcement of traffic regulations (e.g. related to speed, seat belts, alcohol, drugs, mobile phone use, etc.); project driver training; project vehicle maintenance; community road safety awareness training; fire management plans; drowning risk management (e.g. through signage, warning systems and access restrictions, rescue equipment and staff, community water safety awareness training); flood prediction and early warning systems; reductions in flooding risks; support to ambulances and health centres (including appropriate staff, equipment and medicines); provision of firefighting equipment, boats, excavators and other equipment to local authorities for accident response.
- Measures to mitigate risks from communicable diseases, unhealthy behaviour (e.g. drugs, alcohol, sexual behaviour), or violent conflict around work camps:
  - medical check-ups and screening for immigrant workers at points of entry;
  - ensuring capacity of local health centres for prevention, screening and response to outbreaks of communicable diseases;
  - healthy conditions and appropriate medical services (annual screening) provided within camps, and workers accommodated outside work camps provided with equivalent conditions and services to prevent the spread of communicable diseases;
  - workers trained in appropriate preventive measures and conduct towards local communities;
  - public access to work camps is controlled; and
  - community-worker interaction is monitored and, where necessary, restricted.
- Measures to mitigate risks arising from declines in livelihoods and nutritional standard due to loss of access to land and resources: those described in the guideline on Project Affected Communities and Livelihoods. Special attention should be paid to vulnerable households and individuals, such as malnourished and stunted children, pregnant women, and the elderly.
- Measures to mitigate risks arising from mental health issues: ensuring appropriate engagement and inclusion of those who would be affected by project decisions; specialised mental health prevention and treatment capacity; spiritual ceremonies performed as appropriate to mitigate community concerns.
- Measures to mitigate risks arising from temporary pressure on the existing health infrastructure, equipment, human resources, essential drugs, etc. due to influx of migrant workers, or loss of access to health facilities: avoidance and minimisation of closures of roads and other infrastructure through appropriate construction management; where necessary, bypass and replacement facilities or provision of alternative transport; timely increase in capacity of all health facilities or additional facilities during construction and operation; sharing of project health facilities with local communities.
- Measures to mitigate risks arising from electrical safety incidents: community awareness training; guidance, signage, exclusion zones and other rules to minimise electrical hazards for community members; electrical equipment and infrastructure undergo regular inspections, maintenance, upgrades and replacements; transmission lines rights-of-way maintained in safe conditions; ensuring project capacity to respond rapidly to electrical malfunctions.
- Measures to mitigate health risks related to the reservoir, including waterborne and vector-borne diseases and unhealthy water quality for human contact or consumption as it affects fish consumption (e.g. bioaccumulation of mercury): monitoring of water quality, fish quality, pathogens, disease vectors, and disease outbreaks; community awareness training, signage, restrictions on public use as needed; clinical treatment of disease cases as needed; control of floating aquatic weeds and vectors, especially in shallow reservoir areas near settlements, by mechanical or chemical treatment.
- Measures to mitigate risks arising from permanent changes to livelihoods and health-related behaviour, including nutrition, exercise, and access to medicinal plants and traditional health services: strengthening of preventative, promotive and curative health care services and community awareness programmes; provision of exercise and recreational facilities for prevention of non-communicable diseases; community screening for non-communicable diseases.

At the same time as managing risks, management plans should seek to incorporate measures that can improve existing public health issues for local communities. With careful attention to public health issues, risks can be managed and opportunities put in place as additional benefits. New health clinics, improved access to health services, provision of improved access to fresh water, supply of reliable electricity for health clinics and refrigeration needs can all make a difference in public health and welfare. Any planned measures for public health opportunities should also have clearly allocated responsibilities, appropriate funding and resources, objectives and targets, and monitoring and evaluation provisions. Handover arrangements with responsibilities to different agencies transferring over time should be clearly identified, along with risks, monitoring and adaptive management responses.

## Stakeholder Engagement

*Stakeholder Engagement criterion - Preparation Stage: The assessment and planning for public health has involved appropriately timed, and often two-way, engagement with directly affected stakeholders, including health officials and project affected communities; ongoing processes are in place for stakeholders to raise issues and get feedback.*

Good practice requires that a process of stakeholder engagement has been followed in the assessment and planning for public health issues in relation to the hydropower project. Directly affected stakeholders for public health should be clearly identified in any project stakeholder mapping. They might be stakeholders only for this issue or stakeholders in relation to many issues relating to the project. Directly affected stakeholders for public health should include those with public health responsibilities in the government and for the developer, public health professionals in the project area, and representatives of the project affected communities. Different health issues may have different affected groups within the communities and these should be taken into account in the engagement process. Representation should be carefully considered and include those in the community who may have alternative approaches for health such as traditional medicines.

Appropriate timing, culturally appropriate, and two-way processes are important components of good practice. 'Appropriately timed' means that engagement is early enough so that the project can respond to issues raised, public health stakeholders can provide inputs before the project takes decisions on these issues, and engagement take place at times suitable for these stakeholders to participate. Public health stakeholders should be supportive of the timing of engagement activities. 'Culturally appropriate' means that methods of engagement respect the cultures of the public health stakeholders and allow adequate provisions to fit with the discussion and decision-making processes typical for them. Stakeholder engagement processes that are culturally sensitive consider, for example, meeting styles, venues, facilitators, language, information provision, the community's decision-making processes, time allocation, recording, and follow-up. Engagement processes for public health stakeholders should consider gender and the inclusion of vulnerable social groups. 'Two-way' means that public health stakeholders can give their views on the plans that will affect them rather than just being given information without any opportunity to respond. Examples of two-way processes include focus groups, community meetings, and public hearings.

## Conformance/Compliance

*Conformance/Compliance criterion - Implementation and Operation Stages: 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.*

Assessment processes and management measures relating to public health need to be compliant with relevant government requirements. These may be expressed in licence or permit conditions (such as requiring a health centre to be provided with the project, health checks for project affected communities, or sanitation standards to be met in the labour camps) or captured in legislation (such as a requirement for a health impact assessment to be undertaken for proposed major developments). Implemented measures should be consistent with what is in the plans to demonstrate conformance

with the plans. Public health commitments may be expressed in policies of the developer or owner/operator, or in company statements made publicly or within management plans. Evidence of adherence to commitments could be provided through, for example, internal monitoring and reports, government inspections, or independent review. Variations to commitments should be well-justified and approved by relevant authorities, with appropriate stakeholder liaison.

The significance of not meeting a commitment is based on the magnitude and consequence of that omission and will be context-specific. For example, a failure to demonstrate delivery of a major public health mitigation measure expressed in the project approval is likely to be a significant non-conformance, whereas a slight delay in delivery of a monitoring report could be a non-significant non-conformance.

Public health issues rely on very good cooperation between the hydropower developers and the government health agencies. Depending on the particular arrangements and the time period post-project commissioning, responsibilities for public health may have been fully handed over from the operator to government agencies. Conformance with handover plans, and adaptations as needed, should be well-documented, as should longer-term agreements if there are expectations of continued project support.

## Outcomes

*Outcomes criterion - Preparation Stage: Plans avoid, minimise and mitigate negative public health impacts arising from project activities with no significant gaps.*

*Outcomes criterion - Implementation Stage: Negative public health impacts arising from project activities are avoided, minimised and mitigated with no significant gaps.*

*Outcomes criterion - Operation Stage: Negative public health impacts arising from activities of the operating hydropower facility are avoided, minimised and mitigated with no significant gaps.*

To show that plans avoid, minimise and mitigate public health impacts from project activities, mitigation measures in the plans should be able to be directly linked to all identified public health issues and risks. The assessment, planning and implementation should have been carried out by appropriately qualified experts. The assignment of responsibilities and resource allocation for implementation, monitoring and evaluation should be appropriate to the planned actions.

An evidence-based approach should demonstrate that negative public health impacts arising from project implementation and operation activities are avoided, minimised and mitigated with no significant gaps. The developer, owner and operator should demonstrate that responsibilities and budgets have been allocated to implement public health plans and commitments. Monitoring reports and data in the implementation and operation stages should clearly track performance against commitments and objectives and capture public health impacts. It should be possible to provide examples to show how identified risks from the assessment have been avoided or minimised. It should also be possible to table evidence to show that mitigation plans have been implemented and are being monitored. Implementation of measures for public health, such as new or enhanced facilities, resources and services, should be evident, and monitoring should show how they are achieving their stated objectives.





# Biodiversity and Invasive Species

*This guideline expands on what is expected by the criteria statements in the Hydropower Sustainability Tools (HST) for the Biodiversity and Invasive Species topic, relating to assessment, management, conformance/compliance and outcomes. The good practice criteria are expressed for different life cycle stages.*

*In the Hydropower Sustainability Assessment Protocol (HSAP), this topic is addressed in P-19 for the preparation stage, I-15 for the implementation stage and O-15 for the operation stage. In the Hydropower Sustainability ESG Gap Analysis Tool (HESG), this topic is addressed in Section 6.*

This guideline addresses the implications of hydropower projects and operating facilities on biodiversity, ecosystems and habitats, including specific values or issues frequently associated with project development and operations such as threatened species, fish passage, and invasive species. The intent is that there are healthy, functional and viable aquatic and terrestrial ecosystems in the project affected area that are

sustainable over the long-term; that biodiversity impacts arising from project activities and from the operating hydropower facility are managed responsibly; and that commitments to implement biodiversity and invasive species measures are fulfilled.

**Biodiversity** is the variety of life forms (animals, plants and micro-organisms), their genes, and the ecosystems of which they are a part. Biodiversity is critical to functioning and maintenance of the natural environment and has recognised aesthetic, spiritual, cultural, recreational and scientific values.

An **ecosystem** is a community of living organisms in conjunction with the non-living components of their environment (e.g. air, water, soil) interacting as a system. These biotic (living) and abiotic (non-living) components are linked together through nutrient cycles and energy flows. Significantly different ecosystems are found in wet versus dry and hot versus cold areas or regions. A **habitat** is an ecological or environmental area that is inhabited by a particular species of animal, plant, or other type of organism. The term typically refers to the zone in which an organism lives and where it can find food, shelter, protection, and mates and appropriate conditions for reproduction. Examples of various riverine habitats include riparian zones (i.e. the shoreline), deep pools, riffles, large woody debris, sand bars, gravel bars, backwaters, wetlands, and floodplains.



Aspects of biodiversity that require attention include the following.

- Endemic species, which are unique to a defined geographic location.
- Keystone species, which provide a key ecological role such that their loss would lead to severe degradation of the entire ecosystem.
- Species of conservation significance, which may be rare, threatened or endangered species or ecological communities. These species may be listed in national legislation or regulations, as well as addressed by international organisations and conventions (e.g. the so called Red Lists of the International Union for the Conservation of Nature (IUCN), the Ramsar wetlands convention and the Convention on Biological Diversity). In some cases, the project studies highlight species at risk that may not yet have formal protection status.
- Biodiversity hotspots, which are areas of very high diversity and/or where many endangered species are found.
- Ecosystem connectivity and biodiversity corridors, which are important for species reliant on a certain size area of habitat for their long-term survival or reliant on functional migration routes.
- Alien species, which are species that have been accidentally or purposely introduced into an area outside of their natural range, some of which may be invasive, i.e. spreading to such an extent that they are a threat to local native species or ecosystem function.
- Culturally significant species, which are those that have symbolic or practical significance for communities that will be affected by project-related changes.

While avoidance of impact is the first approach of the mitigation hierarchy (avoid, minimise, mitigate, compensate), complete preservation of the original biodiversity conditions is not a realistic expectation for any hydropower development. Changes in biodiversity are likely due to the physical changes in habitat and ecosystems that accompany a hydropower development, for instance flowing water (a lentic ecosystem) changing to still water (a lotic ecosystem) by creation of an impoundment. For this reason, compensation is included as good practice for the biodiversity topic, with an emphasis on offsets.

**Offsets** are measurable conservation outcomes resulting from actions designed to compensate for significant adverse residual biodiversity impacts from project development. Residual impacts are those that persist after avoidance, minimisation, and restoration measures have been taken. Generally, offset measures are not within the project site but within a comparable landscape or habitat type. Biodiversity offsets should be designed to: achieve measurable, additional and long-term conservation outcomes through compensatory actions; achieve 'no net loss' of biodiversity at a minimum; and ideally demonstrate 'like-for-like or better' outcomes compared with the unimpacted project site.

## Assessment

*Assessment criterion - Preparation Stage: An assessment of terrestrial biodiversity; aquatic biodiversity including passage of aquatic species and loss of connectivity to significant habitat; and risks of invasive species has been undertaken with no significant gaps.*

The project Environmental and Social Impact Assessment (ESIA) should include evaluation of the biodiversity impacts of a hydropower project. A systematic approach needs to be taken to identify and evaluate biodiversity values and potential impacts and risks associated with the project.

The preparation stage assessment starts with establishment of the pre-project baseline, involving inventories of the terrestrial (land-based) and aquatic (water-based) flora and fauna, ecological communities and habitat types. Terrestrial fauna need to include mammals, birds, reptiles, amphibians, and invertebrates (i.e. without backbones), and terrestrial flora need to include trees, shrubs, herbs, vines, grasses, and epiphytes (these depend on host plants, such as orchids and mosses). Aquatic fauna need to include fish, amphibians, macroinvertebrates including crustaceans (e.g. shrimp, crabs), and zooplankton. Aquatic flora need to include riparian vegetation, aquatic macrophytes (plants that grow in or near water) and algae (including phytoplankton). As far as practical, inventories should aim to establish the species diversity (i.e. the variety and abundance of species that inhabit a region or area) and abundance (the number

of representatives of an individual species in a region or habitat type) within the project area; they should also map vegetation and habitat types.

The geographic scope of the assessment should include: the river system upstream and downstream of the project (downstream as far as the project-induced influence is discernible, see the Downstream Flow Regimes topic guideline); the future reservoir area; off-site activities such as quarries, waste disposal areas, transmission line corridors and switchyards; areas utilised for various mitigation measures such as revegetation, fish hatcheries and visitor centres; as well as activities related to off-site impacts within the supply chain.

The baseline should establish important ecosystem, habitat and life cycle aspects of the biodiversity present in the area, with particular attention paid to those that may experience changes due to the hydropower development or operation. The assessment should note important interdependencies between aquatic and terrestrial biodiversity; the protection and management status of legally-protected project affected areas and any accompanying management objectives and plans; as well as ecosystem services utilised by humans (e.g. food supply, recreation, cultural significance, tourism relevance, commercial or industrial importance).

The biodiversity assessment should describe all aspects of the ecosystems that will change and the consequences for biodiversity. This includes the effects of changes in flows, water levels, water quality, food supply, habitats, vegetation cover and exploitation patterns. Project activities and locations of physical changes should be clearly identified and linked to potential impacts. In all cases where potential impacts are identified, the likelihood, significance and severity of biodiversity impacts need to be assessed.

The assessment of potential biodiversity-related risks during construction should include the effects caused by: direct habitat loss; altered flow regimes; disturbance due to noise, water quality impacts (e.g. polluted discharges into the river system); vibration or dust from excavation, drilling, blasting, or heavy machinery; construction-related sediment loads to the river; loss of habitat connectivity due to removal of linking habitat areas or creation of barriers;

roadkill due to new roads and more frequent vehicle movements; introduction of invasive flora or fauna species; flora or fauna predation and/or exploitation by workers; increased tree cutting by workers and locals for fuelwood; and the actions of primary suppliers.

The assessment of potential biodiversity-related risks during operation should include the effects caused by: permanent loss of habitat area and species through conversion of land to reservoir; impacts due to poor water quality from physico-chemically altered water, with many possible sources; impacts due to rapid flow and water level fluctuations; high sediment loads to the river through land-use changes; low sediment loads to the river through trapping in the reservoir; impacts to terrestrial species due to aquatic ecosystem changes; terrestrial species loss due to drowning during reservoir filling; wildlife losses due to unsuitable relocation areas; spread of invasive flora or fauna species; reductions in diversity or abundance of particular species due to shifts in ecosystem balance or dynamics from changes in influencing factors; impacts to riparian habitats through riverbank erosion; loss of connectivity in the river system; risk of fish passage facilities mixing fish communities where fish migration was previously naturally interrupted (due to natural barriers such as waterfalls); fish mortality caused by fish passing or pausing through or at the dam and other project facilities; and over-exploitation of species due to increased fishing pressures at new focal points.

Biodiversity-related opportunities should be identified where possible. These may include: employing or working with local communities to act as wardens for protected areas, monitors of wildlife and protected area regulations, collectors of monitoring data, and in delivery of wildlife mitigation measures; research and development; strategic partnerships; addressing and mitigating pre-existing negative impacts to biodiversity and ecosystems (e.g. invasive species management); education and awareness; creation of new protected areas or an increase in the level of protection and/or resources for existing areas; improved catchment protection; creation of expanded or rehabilitated habitat areas; use of innovative technologies such as fish-friendly turbines; and expanded fish habitats in reservoirs providing opportunities for aquaculture and recreational fisheries.

The biodiversity assessments should be undertaken using appropriate expertise and local knowledge. Experts for biodiversity assessment studies may include aquatic ecologists, terrestrial ecologists, zoologists, botanists and other environmental science professionals. They should closely liaise with other experts conducting parallel studies, such as in hydrology, water quality, geomorphology and sociology.

## Assessment

*Assessment criterion - Implementation Stage: Biodiversity issues relevant to project implementation and operation have been identified through an assessment process utilising appropriate expertise; and monitoring is being undertaken during the project implementation stage appropriate to the identified issues.*

*Assessment criterion - Operation Stage: 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.*

Biodiversity-related issues determination during the implementation and operation stages should be based on changes to baseline biodiversity that may be or are incurred and the implications of these changes for other social, environmental and/or economic objectives.

Biodiversity monitoring objectives need to be clearly expressed, linked to risks and impacts, and defined separately for the construction and operation stages. The basis for the locations, timing, parameters and methodologies adopted should be clearly explained. Sampling locations and techniques used for the baseline data gathering during the ESIA work should be continued as far as practical. Parameters used for biodiversity monitoring may be some or all of the following:

- Aquatic habitats: river width, depth, gradient, current velocity, water quality, substrata characteristics, instream and riparian vegetation extent and condition;
- Terrestrial habitats: extent, condition and community composition; often done with aerial photo or satellite imagery analysis with ground-truthing;

- Fisheries: Catch Per Unit Effort (CPUE) in terms of numbers and biomass by species (which in turn can be used to generate various indicators); number of full-time, part-time and occasional fishers; fishing timing and time spent; type of gear;
- Fish status, migration patterns and behaviours: Size or age, health, diet, reproduction, condition, species-specific information on migration patterns (as far as possible this should include distances travelled, timing, start/end/resting places for migration);
- Benthic fauna: macroinvertebrates monitored for community composition, status, distribution (habitat types) and abundance.
- Aquaculture and reservoir fisheries (when applicable): species, production quantity and value, inputs and costs, profitability;
- Terrestrial plant species: status, distribution, abundance, etc., normally based on transects or sample plots;
- Terrestrial animal species: status, distribution, and densities through direct observation based on transects, trapping, camera trapping, tagging, bat detectors, netting (for birds, bats, dragonflies, butterflies), searching for signs (e.g. dung, feeding signs, footprints, burrows and dens), noise monitoring and aural recognition (for birds), active searching and trapping for herpetofauna (reptiles and amphibians).

## Management

*Management criterion - Preparation Stage: Plans and processes to address identified biodiversity issues have been developed for project implementation and operation with no significant gaps.*

The biodiversity section of the project Environmental and Social Management Plan (ESMP) should contain, at a minimum, the following outlined separately for construction and operation:

- all identified potential risks and impacts for biodiversity;
- mitigation measures for all risks and impacts listed, with objectives and measures of success;
- monitoring schedules clearly linked to the risks and mitigation objectives;
- reporting schedules and formats;

- budgets and responsible parties, including any handover arrangements to different agencies or stakeholders over time;
- audit, review and evaluation provisions.

Ideally, adaptive management measures for unpredicted biodiversity impacts will also be included. These would focus on issues that might be identified through the monitoring and surveillance and what the response would be (including responsible parties and contingency budget set aside).

There is considerable knowledge and experience globally of the mitigation measures that can be employed to avoid, minimise, mitigate and compensate biodiversity-related impacts from hydropower developments.

## Terrestrial mitigation

Measures to address **terrestrial** biodiversity risks and impacts could include some of the following:

- Measures to mitigate direct terrestrial habitat loss: siting and design should minimise loss of terrestrial habitat to that which is justified by the project's technical requirements, prioritising locations for infrastructure that are already modified or degraded; significant floral species retrieved, relocated and replanted where feasible prior to impact; seedbanks, nurseries and/or gardens created; and as a last resort significant residual impacts can be compensated through biodiversity offsets.
- Measures to mitigate disturbance due to noise, vibration or dust from excavation, drilling, blasting or heavy machinery: terrestrial biota studies to identify sensitive areas (e.g. near nests) or times of year (e.g. during migratory, breeding or hatching/birthing) and appropriate controls to restrict impacts of blasting, drilling or heavy machinery.
- Measures to mitigate loss of habitat connectivity due to removal of linking habitat area or creation of barriers by new infrastructure (buildings, roads): terrestrial biota studies to identify species ranges, critical habitat and corridors, and migratory routes; avoidance of important habitats; creation of new habitat corridors.
- Measures to mitigate increased roadkill due to new roads and more vehicle movements: education and awareness-raising; use of warning signs to avoid roadkill; speed controls, especially at active times for animals (e.g. dawn, dusk); alert devices on vehicles to deter animals from approaching the road; fines for road kills.
- Measures to mitigate the introduction or spread of invasive flora or fauna species: education and awareness-raising; regulations prohibiting introductions without a permit; extra care to avoid invasive species being brought in with construction equipment (such as in soil, ballast, containers or plant materials) through wash-downs, sprays, or inspections; routine surveys; treatments to contain invasive species spread (e.g. weed management, traps, culling); management measures for species at risk of decline due to invasive species; eradication campaigns.
- Measures to mitigate flora or fauna predation and/or exploitation by workers: labour colonies located away from forest or wildlife areas; education and awareness-raising; regulations which prohibit hunting, fishing, animal collections or sale, flora or timber harvesting; fines issued for violations.
- Measures to mitigate increased tree cutting by workers and locals for fuelwood: education and awareness-raising; distribution of alternative cooking solutions (e.g. kerosene oil stoves, pressure cookers, solar cookers) and fuel sources (e.g. construction of LPG depots).
- Measures to mitigate impacts to biodiversity caused by the actions of primary suppliers: suppliers to provide environmentally-certified products; suppliers to demonstrate that they avoid degradation of natural or critical habitats.
- Measures to mitigate impacts to terrestrial species due to aquatic ecosystem changes: terrestrial biota studies to identify important life cycle needs relating to aquatic ecosystems; mitigation measures for flows, water quality, erosion and sediments and biodiversity designed to ensure terrestrial biota needs are met.
- Measures to mitigate terrestrial species loss due to inundation during reservoir filling: Fauna: wildlife rescue and relocation programmes; compensation of losses through offsets; Flora: collection and transplanting of important flora species in the inundation area; nurseries to propagate flora species lost in the inundation area; compensation of losses through offsets.
- Measures to mitigate wildlife losses due to unsuitable relocation areas: wildlife relocation programmes carefully planned to ensure wildlife are moved to areas that they are able to successfully occupy (i.e. dependencies such as elevation range, food supply, and nesting sites are considered as well as competition and crowding factors); species are not relocated to an area just outside the reservoir rim, which is often unsuccessful due to prior occupation by existing wildlife ( i.e. competition for territory).

- Measures to mitigate reductions in diversity or abundance of particular species due to shifts in terrestrial ecosystem balance or dynamics from changes in influencing factors: follow-up monitoring and studies identify trends and root causes of species reductions and enable the design of appropriate adaptive management measures; increased controls or levels of protection are implemented for affected species or habitats; increased food sources or artificial shelters are provided for affected species.
- Measures to mitigate over-exploitation of species due to increased hunting or collecting pressures at new focal points: risk mapping which identifies likely focal points of illegal logging or poaching; education and awareness-raising, particularly at new focal points; regulations which prohibit hunting, fishing, animal collections or sale, flora or timber harvesting; increased surveillance; fines for violations.
- Measures to mitigate loss of connectivity in the river system due to the dam blocking fish migration and plankton drift: fish passage facilities (where applicable); fish hatcheries; catch-and-release programmes; protection of unregulated river systems as offsets.
- Measures to mitigate fish mortality due to downstream passage through turbines and spillways: fish-friendly turbines; fish bypasses; fish screens; fish-friendly spillway designs; turbine positioning to minimise barotrauma, i.e. injuries to fish caused by increased water pressure when passing through the turbines; operating rules for power station releases.
- Measures to mitigate loss of downstream floodplain habitat and/or off-stream waterbody connectivity: environmental flow approaches relating to floods and inundation of off-river waterbodies; creation of connecting channels from the river to the floodplain.
- Measures to mitigate introduction of invasive flora or fauna species: strict controls regarding species introductions; careful research ahead of any aquaculture proposals; physical removal; or containment; education and awareness-raising; restrictions on location of facilities in flood-prone locations.
- Measures to mitigate over-exploitation of significant aquatic species due to cumulative impacts of the project (e.g. creation of popular fishing areas where fish concentrate): fishing regulations and effectively implemented enforcement actions.

## Aquatic mitigation

Measures to address **aquatic** biodiversity risks and impacts could include some of the following:

- Measures to mitigate impacts due to altered flows, including hydropeaking: project siting upstream of a significant tributary; minimum downstream flow releases; seasonally or monthly adjusted downstream flow releases; flow ramp-up and ramp-down rules for power station releases; a re-regulation weir (see the Downstream Flow Regimes topic guideline for further details).
- Measures to mitigate high sediment loads to the river through land-use changes and follow-on activities: catchment management protection; erosion treatment; stricter policies on land degradation and rehabilitation; sediment check dams.
- Measures to mitigate impacts due to loss of species-preferred habitats through conversion to reservoir area: protection of unregulated river systems as offsets; compensation measures for species affected, such as catching below the dam or in other rivers, or breeding in hatcheries, and then releasing upstream of the reservoir.
- Measures to mitigate impacts to riparian habitats through riverbank erosion, which may be caused by hydropeaking and aggressive river effects: well-considered environmental flow releases to minimise riparian erosion risks; bank protection with natural approaches such as placement of large woody debris; strategic planting of riparian flora species; habitat rehabilitation strategies; operating rules for power station releases.

## Management

*Management criterion - Implementation Stage: Processes are in place to ensure management of identified biodiversity issues, and to meet commitments, relevant to the project implementation stage; and plans are in place for the operation stage for ongoing biodiversity issues management.*

*Management criterion - Operation Stage: Measures are in place to manage identified biodiversity issues.*

During the implementation and operation stages, the biodiversity-related plans developed based on the ESIA assessment work are put into action. For projects that did not have such thorough biodiversity assessment work as outlined in this

guideline, biodiversity management plans can still be developed based on assessment work focussed on identifying issues and risks.

The important management requirements at the implementation and operation stages are to ensure that processes are in place that will enable biodiversity issues to be identified and responded to. Such processes may include: clear statements of business commitment to biodiversity within an environmental or sustainability policy; dedicated staff with biodiversity-related qualifications and role requirements, and/or partnerships with more biodiversity-focussed organisations; allocation of budget and resources to enable monitoring and issues identification and response; regular assessment (e.g. annual) of known and emerging risks, issues and management responses, and decision-making processes to ensure that issues arising have actions assigned (e.g. through a corporate environment committee).

## Conformance/Compliance

*Conformance/Compliance criterion - Implementation and Operation Stages: 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.*

Good practice requires evidence that biodiversity measures are compliant with the relevant legal or administrative requirements, which may be expressed in licence or permit conditions or captured in relevant legislation. Compliance requirements may relate to, for example, standards to be met, the frequency and type of monitoring to be performed, and reporting to be submitted. Conformance refers to delivering what is in the plans. Commitments may be expressed in policy requirements of the developer or owner/operator or in company statements made publicly or within management plans. Evidence of adherence to commitments could be provided through, for example, internal monitoring and reports, government inspections, or independent review. Variations to commitments should be well-justified and approved by relevant authorities, with appropriate stakeholder liaison.

The significance of not meeting a commitment is based on the magnitude and consequence of that omission and will be context-specific. For example, a failure to demonstrate delivery of a fish passage facility commitment is a significant non-conformance, whereas a slight delay in delivery of a monitoring report could be a non-significant non-conformance.

## Outcomes

*Outcomes criterion - Preparation Stage: Plans avoid, minimise, mitigate, and compensate negative biodiversity impacts arising from project activities with no significant gaps.*

*Outcomes criterion - Implementation Stage: Negative biodiversity impacts arising from project activities are avoided, minimised, mitigated, and compensated with no significant gaps.*

*Outcomes criterion - Operation Stage: Negative biodiversity impacts arising from activities of the operating facility are avoided, minimised, mitigated, and compensated with no significant gaps.*

To show that plans avoid, minimise, mitigate and compensate negative biodiversity impacts from project activities, it should be possible to directly link mitigation measures in the plans to all identified biodiversity values, issues and risks. The assessment and planning should be informed by appropriate expertise. The assignment of responsibilities and resource allocation for implementation, monitoring and evaluation should be appropriate to the planned actions.

An evidence-based approach should demonstrate that negative biodiversity impacts arising from project implementation and operation activities are avoided, minimised, mitigated and compensated with no significant gaps. The developer and owner/operator should demonstrate that responsibilities and budgets have been allocated to implement biodiversity plans and commitments. Monitoring reports and data in the implementation and operation stages should clearly track performance against commitments and objectives, and capture biodiversity impacts. It should be possible to

provide examples to show how identified risks from the assessment were avoided or minimised. It should also be possible to table evidence to show that mitigation plans have been implemented and the outcomes are being monitored. Implementation of measures for biodiversity, such as the creation of protected areas, new habitats, tree planting, fish hatcheries, fish passage facilities, nurseries, and minimum flow releases, should be evident, and monitoring should show how these measures are achieving their stated objectives.





# Erosion and Sedimentation

*This guideline expands on what is expected by the criteria statements in the Hydropower Sustainability Tools (HST) for the Erosion and Sedimentation topic, relating to assessment, management, conformance/compliance and outcomes. The good practice criteria are expressed for different life cycle stages.*

*In the Hydropower Sustainability Assessment Protocol (HSAP), this topic is addressed in P-20 for the preparation stage, I-16 for the implementation stage and O-16 for the operation stage. In the Hydropower Sustainability ESG Gap Analysis Tool (HESG), this topic is addressed in Section 3.*

Hydropower projects may fundamentally alter the landscape and there are likely to be changes to the pre-existing erosion and sedimentation patterns in the affected river system. Not only can erosion and sediment issues have strong implications for the longevity of the hydropower installation and the maintenance costs, but

there may also be a number of social and environmental consequences if these issues are not managed well.

This guideline addresses the management of erosion and sedimentation issues associated with the hydropower project or operating hydropower facility. The intent is that erosion and sedimentation caused by the project or 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 affect the project or operating hydropower facility are recognised and managed; and that commitments to implement measures to address erosion and sedimentation are fulfilled.

Rivers naturally carry sediment loads. These are typically made up of: **bed load**, which moves along the river bottom; **suspended load**, which is carried within the water flow throughout the flow depth (some of which may only be in suspension under certain flow conditions); and **wash load**, the portion of the suspended load typically of relatively fine material that is transported entirely through the system without deposition. **Saltation** refers to when particles on the bed are lifted into suspension and fall back to the bed.



The river form or **morphology**, the flow rates and conditions (e.g. water depth, slope and velocity), and the source of sediments affect the river's sediment load and how it is mobilised or where it is deposited. Sediments may be dropped out by the river due to a reduction in river flow, an increase in-channel width, lower current velocities, or break of slope; these dropped sediments may form alluvial or flood plains. There are many terms for different types of fluvial bedforms and landforms, including bars, pools, riffles, meanders, oxbow lakes, fluvial terraces, and islands. Fluvial channels (i.e. river or stream courses) have **reaches** or lengths of a common character that can be categorised as straight, meandering, or braided. Anastomosed rivers consist of multiple channels that could be either straight, meandering, braided or a combination of these three channel planform types (an anastomosed river is considered a landform feature but not a channel type in itself). River morphology is a dynamic process, with change occurring over time, and is not one stable or static condition.

The geographic scope of erosion and sediments assessment and management must consider:

- the catchment area for the reservoir in relation to sediment yields;
- the reservoir in relation to reservoir slope stability and reservoir sediment accumulation;
- downstream river reaches below the dam and power house in relation to concentrations and loads for sediments in suspension, saltation and bed load as well as channel geomorphological conditions in the river reaches that will be affected by the project, as far downstream as the flows are significantly project affected, and the implications of changes for other river values and uses;
- the construction areas – e.g. reservoir preparation works, dams (coffer, main, saddle), adits, tunnels, power house, mitigation measures (e.g. a fish passage facility) – to determine the potential erosion and sedimentation issues;
- locations of ancillary structures and activities – e.g. labour camps, offices, concrete batching plants, water-supply intakes, material fabrication areas, supply storage areas, quarries, waste disposal areas, supply transport activities;
- locations of erosion or sediment-specific mitigation measures – e.g. slope stabilisation

works, drainage and settling ponds, catchment treatment and erosion prevention works, rehabilitation works in disturbed areas, desilting chambers, sluice gates, reservoir flushing strategies, dredging programmes; and

- locations of other mitigation measure areas and activities – e.g. reforestation activities, local benefits in relation to erosion and sedimentation issues.

## Assessment

*Assessment criterion - Preparation Stage: An erosion and sedimentation issues assessment has been undertaken with no significant gaps; the assessment identifies impacts that may be caused by the project, issues that may impact on the project, and establishes an understanding of the sediment load and dynamics for the affected river system.*

The project Environmental and Social Impact Assessment (ESIA) should include evaluation of the erosion and sediment related impacts of a hydropower project. A systematic approach needs to be taken to identifying and evaluating erosion and sediment status and potential impacts and risks from the proposed project. Professionals working in this area might include: hydraulic engineers, which is a specialty area of civil engineering focussed on the flow and conveyance of fluids and sediments including the design and effects of hydraulic structures (e.g. bridges, canals, levees); and fluvial geomorphologists, which is a specialty area of geography focussed on the response of the landscape to water movement.

Alongside the ESIA, the feasibility studies and detailed design report for the project will also address the technical risks relating to sediments. Liaison between the engineering and the environmental studies should be ensured so that data and analyses are coordinated and consistent and provide information for both areas of need.

The preparation stage assessment starts by establishing of the pre-project baseline. Studies should establish the current sedimentation regime and dynamics of the river to help determine possible assessment approaches. Baseline studies should utilise appropriate expertise for the erosion and sediment sampling design, data collection, data analysis and

interpretation. Available sources of secondary data should be identified and included, as well as local knowledge and information. More emphasis should be given to relatively recent secondary data and checks should be made to see if there have been changes in any conditions affecting that data. Primary data should be collected for:

- slope stability and erosion risk from locations in the vicinity of project activities, where land disturbance is planned, and in the catchment;
- catchment condition (e.g. area, slopes, vegetation cover, soil types) to determine present and likely future sediment yields into the reservoir;
- instream sediments (concentrations and loads of suspended and bedload sediment) using equipment and materials as per recognised standards relevant to the sediment types and amounts; and
- river channel geomorphological conditions in the project construction area and as far downstream as will experience significant flow changes from the future project.

For primary data, a strategic approach should be taken to the selection of sediment sampling sites to ensure a meaningful geographic spread and to include areas of likely change or sensitivity to impacts. Instream sediment sampling data should be collected from a minimum of four sampling locations: upstream and immediately downstream of the future reservoir, and upstream and downstream of the next major tributary downstream of the reservoir (and of the power station tailrace if located some distance away). If possible, locations upstream and downstream of other major tributaries and development activities should also be sampled. Ideally, significant variations in sediment loads from the different upstream sub-catchments should be established to inform catchment management interventions that will reduce sediment loads within the future reservoir.

During the preparation stage, sampling data should be collected over a period of at least 12 months. The number and timing of sampling trips should be designed to obtain the most representative data given the factors that could influence the result. For river sampling, this should cover all seasonal conditions of the region. Timing of sample collection should be sure to capture very different flow conditions

including during the low flow season, the onset of the wet season (noting that this is the most significant time for sediment transport), and the high flow season. Ideally the sampling efforts would be continuous throughout the minimum sampling period of 12 months, with increasing sampling frequency during low-frequency, high-magnitude events such as intense rainfall during the monsoon period. Suspended sediment sampling should be done by depth-integrating methodologies and carried out in representative verticals of the river wherever and whenever possible in accordance with a programme established by an appropriate expert on geomorphology. In each season, a representative number of samples should be analysed for particle size distribution and mineralogic content. Particle size analyses are important for understanding fluvial geomorphic processes, the potential for scouring and erosion, and for determination of potential wear on turbines and other equipment and the need for sediment exclusion devices.

Baseline sampling results should be presented and described in accordance with any legal requirements and interpreted with respect to all relevant environmental standards. During the preparation stage, sampling results should be used to clearly establish the pre-project baseline conditions and the major influences on the results. The results should explain the pre-project status, trends and issues relating to sediment transport, river geomorphological processes, and river channel condition and integrity. They should also take into account flow and water quality data, surrounding land uses (e.g. locations of settlements and industrial and agricultural activities), major tributaries, points of land disturbance or sediment stockpiling, and points of drainage discharge. Implications of findings for aquatic habitats and life cycle needs, water quality, and other uses and values should be identified and described.

The assessment of erosion and sediment related risks during construction should include the effects caused by: erosion and sediment run-off created by direct disturbance of land during construction activities; landslips caused by road works, excavations and blasting; sediment run-off from excavated waste dumps (i.e. spoil) and topsoil storage areas; erosion due to poor drainage design or maintenance; gullyng caused

by water discharge points or concentrated drainage areas; instream changes to channel geomorphology due to changes to flows or sediment movement during construction; instream changes to channel geomorphology due to dumping of excavated materials into or close to waterbodies or direct disturbance by heavy machinery; and increased sediment run-off into rivers or streams at vehicle crossing points (e.g. bridges, fords).

Reservoir filling and project commissioning stage erosion and sediment risks should include the implications of changed flow regimes on erosion and sediments in the downstream river and any potentially adverse impacts, e.g. due to reduced flows or intermittent discharges of sediment-laden water.

The assessment of erosion and sediment related risks during operation should include the effects caused by: sediment accumulation in the reservoir over time from catchment sources; erosion of the reservoir rim due to steep slopes and/or loss of stabilising vegetation; releases of sediment-laden water through the low level release valve or through flushing of the desilting chamber causing issues downstream; riverbank or bed erosion due to 'aggressive river' or 'hungry water' effects (meaning that the river's erosive capacity below the dam is enhanced due to sediment being trapped within the reservoir); riverbank or bed erosion in rivers subject to hydropeaking due to rapid water level changes; riverbank or reservoir rim erosion due to rapid draw-down of saturated banks leading to bank slumping; localised riverbed sediment accumulation due to lower flows at points where sediments continue to enter the river; and ongoing erosion issues from a lack of, or poorly implemented, rehabilitation measures on land disturbed during construction activities.

The implications of long-term temporal changes to flows and to extreme weather events, potentially induced by climate change impacts, should be considered in the assessment of erosion and sedimentation. Significant changes in flow arising from more intense weather events can create additional risks relating to erosion, sediment movement, bank collapse, landslides and mudslides. These can, in turn, have public safety implications.

Analyses for predicting reservoir sedimentation include numerical models, physical models and trapping efficiency assessments. The pattern and distribution of sediment deposition in the reservoir needs to be predicted and linked to planning for the live storage over the long-term. It should not be assumed that all sediments will be deposited in the deepest available volume, nor that reservoir life corresponds to sedimentation of the dead storage, as patterns of sedimentation tend to be more complex in practice.

Erosion and sedimentation opportunities should be identified where possible. These may include: improvements to pre-existing erosion and sedimentation issues in the project vicinity; improvements to land use planning (e.g. retention of forest cover); use of new technologies, such as for monitoring, slope treatment or rehabilitation; use of new land use practices, such as crop rotation, crop choice, or ploughing techniques; and partnerships with community catchment protection or waterway health monitoring groups.

## Assessment

*Assessment criterion - Implementation Stage: Erosion and sedimentation issues relevant to project implementation and operation have been identified through an assessment process utilising appropriate expertise; and monitoring is being undertaken during the project implementation stage appropriate to the identified issues.*

*Assessment criterion - Operation Stage: 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.*

Erosion and sediment related issues determination during the implementation and operation stages should be based on changes to the baseline erosion and sediment condition and processes that may be or have been incurred, as well as the implications of these for other social, environmental and/or economic objectives.

Consideration of what is an issue needs to take into account that there will be landscape adjustments brought about by the hydropower project that continue for many years until a

new equilibrium is reached, particularly in the downstream river channels. Negative impacts are considered to be those erosion and sediment changes caused by the project that present problems with respect to other social, environmental and/or economic objectives, or externally caused occurrences of erosion or sedimentation that impact on the ability of the project to meet its own social, environmental and/or economic objectives.

Erosion and sediment monitoring objectives need to be clearly expressed, linked to risks and impacts, and defined separately for the construction and operation stages. The basis for the locations, timing, parameters and methodologies adopted should be clearly explained. Sampling locations and techniques used for the baseline data gathering during the ESIA work should be continued as far as practical. Parameters used for erosion and sediment monitoring may include some or all of the following:

- land stability assessments;
- aerial photo assessments or comparable;
- reservoir bathymetric surveys;
- riverbed load and suspended sediment concentrations and loads, noting that the mechanisms of transport varies depending on flow and hydraulic conditions and that sampling equipment and its uses are very specialised to transport types and amounts;
- river channel geomorphology assessments (e.g. descriptions of deep pools, gravel beds, rapids, riffles, sand bars, in-channel wetlands, riparian slopes, vegetative cover);
- riparian zone assessments (riverbanks and reservoir rim); and
- observational inspections (e.g. of sediment storage areas, rehabilitation areas, drainage channels).
- Where relevant, findings should be compared to the relevant environmental standards and interpreted in light of influential factors such as flow, water level, season, activities, and vegetation cover.

## Management

*Management criterion - Preparation Stage: Plans and processes to address identified erosion and sedimentation issues have been developed for project implementation and operation with no significant gaps.*

The erosion and sediment section of the Environmental and Social Management Plan (ESMP) needs to contain, at a minimum, the following outlined separately for construction and operation:

- all identified potential risks and impacts for erosion and sediments;
- mitigation measures for all risks and impacts listed, with the objectives and measures of success;
- monitoring schedules clearly linked to the risks and mitigation objectives;
- reporting schedules and formats;
- budgets and responsible parties, including any handover arrangements to different agencies over time; and
- audit, review and evaluation provisions.

Adaptive management measures for unpredicted erosion and sediment impacts are also ideally included. These would focus on issues that might be identified through the monitoring and surveillance and what the response would be (including responsible parties and contingency budget set aside).

There is considerable knowledge and experience globally of the mitigation measures that can be employed to avoid, minimise and mitigate erosion and sediment related impacts from hydropower developments.

Measures to address erosion and sediment risks and impacts at the construction stage could include some of the following:

- Mitigate erosion and sediment run-off created by direct disturbance of land: plans are developed prior to disturbance activities to avoid, minimise and manage erosion and sedimentation; contouring, drainage, and settling ponds are employed during

disturbance works; rehabilitation measures are implemented at the end of the disturbance activities.

- Mitigate landslips caused by road works, excavations, and blasting: land stability is assessed through geotechnical evaluations during the feasibility studies to inform planning of construction activities and potential risks; slope stabilisation works are implemented where needed; exclusion zones are created and signage employed to warn of worker and public safety risks; work in areas prone to landslip risk is subject to appropriate safety measures; landslips are treated quickly to stabilise and repair.
- Mitigate sediment run-off from spoil dumps and topsoil storage areas: sediment, spoil and soil storage areas are identified through careful planning and used according to their capacities; compaction (where appropriate), bunding, drainage and covers are used when required; downstream settling ponds are used as needed.
- Mitigate erosion due to poor drainage design or maintenance: drainage is planned at the outset for all potential erosion areas according to engineering standards; drainage is maintained to specified standards; instances of erosion are treated promptly and incorporate measures for avoidance of future incidents.
- Mitigate gullying caused by water discharge points or concentrated drainage areas: water discharge or concentrated drainage points are designed to prevent gullying, for example through cement linings and slope protection works.
- Mitigate instream changes to channel geomorphology due to changes to flows or sediment movement during construction: downstream effects of flow changes or sediment transport changes are monitored and residual flow releases made as needed to address sediment through-flow needs; channel stabilisation works.
- Mitigate instream changes to channel geomorphology due to dumping of excavated materials into or close to waterbodies or direct disturbance by heavy machinery: dumping of excavated materials in watercourses is prohibited and fines are issued if this practice occurs; permits according to the approved construction plan; controls to manage erosion and sediment into the downstream river (e.g. through settling ponds).

- Mitigate increased sediment run-off into rivers or streams at vehicle crossing points (e.g. bridges, fords): vehicle crossing points on streams or rivers are designed to minimise creation of erosion and sediment run-off, e.g. through location, gradients of approach, surface sealing, drainage.

Measures to address erosion and sediment risks and impacts at the operation stage could include some of the following:

- Mitigate sediment accumulation in the reservoir over time from catchment sources: Avoidance and minimisation: catchment protection, catchment reforestation, landslip prevention measures, sediment check dams, strict rules on land disturbance in the catchment, erosion treatment measures, sediment bypass structures. Management: density-current venting (diverting flows within the reservoir carrying higher sediment loads out through diversion tunnels, often combined with desilting chambers); sediment pass-through structures (e.g. sluice gates or low level outlets often left open for the first part of the rainy season to allow release of relatively higher sediment concentrations and accumulated sediments); sediment flushing (through bottom outlet gates used during reservoir draw-down); dredging and transport downstream (e.g. by barge or pipeline).
- Mitigate erosion of the reservoir rim due to steep slopes and/or loss of stabilising vegetation: restrictions to reservoir water level change magnitude or rates; reservoir slope treatment works; promotion of vegetation growth tolerable of water level changes on reservoir rim; restrictions to activities on the reservoir causing wave action and on the reservoir rim causing disturbance.
- Mitigate releases of sediment-laden water through the low level release valve or through flushing of the desilting chamber causing issues downstream: management plans and risk assessments for sediment-laden discharges below the dam; timing of releases avoids periods of high sensitivity to downstream ecosystems; releases planned when dilution effects from tributaries can be provided.
- Mitigate riverbank or bed erosion due to 'aggressive river' effects: sediment bypass structures (in suitable conditions) to periodically divert sediment-laden water past

the reservoir, e.g. through a tunnel used for high sediment loads at the start of the wet season; sediment management strategies to address reservoir sediment accumulation (listed above).

- Mitigate riverbank or bed erosion in rivers subject to hydropeaking, due to rapid water level changes: power station release ramp-up and ramp-down rules; maintenance of minimum flows; riverbank protection works; strategic placement of large woody debris for bank protection and habitat maintenance.
- Mitigate riverbank or reservoir rim erosion due to rapid draw-down of saturated banks leading to bank slumping: reservoir ramp-down rules to minimise rapid draw-down; potentially combined with restrictions on duration of high water levels to prevent full bank saturation.
- Mitigate localised riverbed sediment accumulation due to lower flows at points where sediments continue to enter the river: flushing release strategies from the dam or power station; localised sediment extraction from the river; erosion management works in the catchment(s) that contribute sediment loads to the downstream river.
- Mitigate ongoing erosion issues from a lack of or poorly implemented rehabilitation measures on land disturbed during construction activities: carefully planned and well-implemented rehabilitation works for construction stage land disturbance, with follow-up monitoring and further treatment when required.

## Management

*Management criterion - Implementation Stage: Processes are in place to ensure management of identified erosion and sedimentation issues, and to meet commitments, relevant to the project implementation stage; plans are in place for the operation stage for ongoing erosion and sedimentation issues management.*

*Management criterion - Operation Stage: Measures are in place to manage identified erosion and sedimentation issues.*

During the implementation and operation stages, the erosion and sediment related plans developed based on the ESIA assessment work are put into action. For projects that did not have such thorough erosion and sediment assessment work as outlined in this guideline, erosion and sediment management plans can still be developed based on assessment work focussed on identifying issues and risks.

The important management requirements at the implementation and operation stages are to ensure that processes are in place that will enable erosion and sediment issues to be identified and responded to. Such processes may include: clear statements of business commitment to erosion and sediment within an environmental or sustainability policy; dedicated staff with erosion and sediment related qualifications or role requirements, and/or a partnership with a more erosion and sediment focussed organisation; allocation of budget and resources to enable monitoring and issues identification and response; and decision-making processes to ensure that issues arising have actions assigned (e.g. through a corporate environment committee).

## Conformance/Compliance

*Conformance/Compliance criterion - Implementation and Operation Stages: 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.*

Good practice requires evidence that erosion and sediment measures are compliant with the relevant government requirements, which may be expressed in licence or permit conditions or captured in relevant legislation. Compliance requirements may relate to, for example, standards to be met, the frequency and type of monitoring to be performed, and reporting to be submitted. Conformance refers to delivering what is in the plans. Commitments may be expressed in policy requirements of the developer or

owner/operator or in company statements made publicly or within management plans. Evidence of adherence to commitments could be provided through, for example, internal monitoring and reports, government inspections, or independent review. Variations to commitments should be well-justified and approved by relevant authorities, with appropriate stakeholder liaison.

The significance of not meeting a commitment is based on the magnitude and consequence of that omission and will be context-specific. For example, a failure to install a sediment flushing mechanism required as a licence commitment is a significant non-compliance, whereas a slight delay in delivery of a monitoring report could be a non-significant non-conformance.

## Outcomes

*Outcomes criterion - Preparation Stage: Plans avoid, minimise and mitigate erosion and sedimentation issues arising from project activities and erosion and sedimentation issues that may impact on the project with no significant gaps.*

*Outcomes criterion - Implementation Stage: Erosion and sedimentation issues during project implementation are avoided, minimised and mitigated with no significant gaps.*

*Outcomes criterion - Operation Stage: Erosion and sedimentation issues are avoided, minimised and mitigated with no significant gaps.*

To show that plans avoid, minimise, mitigate and compensate negative erosion and sediment impacts from project activities, it should be possible to directly link mitigation measures to all identified erosion and sedimentation issues and risks. The assessment and planning should be informed by appropriate expertise. The assignment of responsibilities and resource allocation for implementation, monitoring and evaluation should be appropriate to the planned actions.

An evidence-based approach should demonstrate that negative erosion and sediment impacts arising from project implementation and operation activities are avoided, minimised, mitigated and compensated with no significant gaps. The developer and owner/operator should demonstrate that responsibilities and budgets have been allocated to implement erosion and sediment plans and commitments. Monitoring reports and data in the implementation and operation stages should clearly track performance against commitments and objectives, and capture erosion and sediment impacts. It should be possible to provide examples to show how identified risks from the assessment were avoided or minimised. It should also be possible to table evidence to show that mitigation plans have been implemented and are being monitored. Implementation of measures for erosion and sediment, such as bank protection works, sediment check dams or retention ponds, and sediment flushing or bypass mechanisms, should be evident, and monitoring should show how they are achieving their stated objectives.



# Reservoir Management

*This guideline expands on what is expected by the criteria statements in the Hydropower Sustainability Tools (HST) for the Reservoir Management topic, relating to assessment, management and conformance/compliance. The good practice criteria are expressed for different life cycle stages.*

*In the Hydropower Sustainability Assessment Protocol (HSAP), this topic is addressed in P-22 for the preparation stage, I-19 for the implementation stage, and O-18 for the operation stage. In the Hydropower Sustainability ESG Gap Analysis Tool (HESG), this topic is addressed in Section 11.*

This guideline addresses planning for and management of environmental, social and economic issues within the reservoir area during project planning, project implementation, and operations of the hydropower facility. The intent is that reservoir preparation, filling, and operations are well-managed, taking into account construction, environmental and social

management requirements, power generation operations, maintenance, and multi-purpose uses where relevant.

**Reservoir** in this context refers to any artificial pondage or lake used by the project for the storage and regulation of water, regardless of whether the hydropower development is labelled as a storage or run-of-river scheme. All hydropower projects create some sort of impoundment or water retention behind the dam wall, which is drawn on through the power station to power the turbines. Reservoirs vary considerably in character depending on many factors. Reservoirs with little storage capacity may be called run-of-river, but there is still some water retention behind a dam wall. **Pump storage** projects will have two reservoirs, an upper and lower.

**Reservoir area** refers to the area that is inundated when the reservoir is at its maximum operational level, referred to as **Full Supply Level (FSL)**. There may be a dry **buffer zone** on the land above the FSL, often defined for land use planning and reservoir management purposes. The **operating range** of the reservoir is the difference in level between FSL and the **Normal Minimum Operating Level (NMOL)**. The reservoir depth over its area is referred to as the **bathymetry**. Bathymetric surveys will show if siltation is reducing the reservoir water



storage area. **Active storage** is the water above the power station intake that can be drawn on to generate power. **Dead storage** is the water stored in the reservoir that cannot be drawn through the power station intake. In addition, **Reservoir operating rules** will dictate patterns of reservoir water level change.

## Assessment

*Assessment criterion - Preparation Stage: An assessment has been undertaken of the important considerations prior to and during reservoir filling and during reservoir operations, with no significant gaps.*

During the preparation stage, a number of considerations need to be evaluated and optimised with respect to siting, design and planning for the future reservoir. Siting and design are strongly influenced in the first instance by the hydrological resource assessments (see both the Siting and Design and the Hydrological Resource topic guidelines), the analyses of electricity generation potential and demand, and by the geotechnical studies conducted to ensure suitable geology and foundations for the future dam. Technical and financial aspects need to be considered alongside environmental, social and governance considerations. The location, scale and future operational plans may give rise to relatively greater (or fewer) social and environmental impacts compared to other options, and this needs to be carefully assessed through analyses of alternatives (see the Siting and Design guideline). Land tenure, land acquisition and land compensation processes are important governance considerations that need to be well-understood in terms of roles, responsibilities, and social and environmental consequences. Future land and water resource rights and responsibilities for the reservoir and surrounding area need to be clarified at the outset and are likely to differ depending on the focal areas (e.g. fisheries, water abstraction, development, recreational uses).

Assessments during the preparation stage should be embedded within the Environmental and Social Impact Assessment (ESIA) and should separately consider and inform construction and operation stage Environmental and Social Management Plans (ESMPs).

A number of implementation stage activities will need to be undertaken for reservoir preparation purposes, and assessments during the preparation stage should inform the extent and approach required for these activities. Relevant activities might include: resettlement planning; clearing of vegetation; retrieval and appropriate protection for vegetation species that are recognised to be of value; management of contaminated or cultural heritage sites that would be inundated; slope stabilisation and treatment works; construction of boat ramps; establishment of a vegetated buffer zone; and preparation of areas to receive relocated wildlife presently living in the area that will be inundated. The timing of these activities should be carefully planned so that there are no conflicts or interface issues with other aspects of the overall hydropower project development (see the Integrated Project Management guideline). Worker occupational health and safety is an important consideration with the activities undertaken in the reservoir area during the implementation stage (see under the Management criterion below); because the areas can be remote, vast and in some cases forested, there can be high risks that are not managed as closely as those risks on the actual construction worksite.

Assessments to inform operation stage reservoir planning should address: optimising power generation; maintenance requirements; debris management (particularly an issue in monsoon prone parts of the world); multiple uses (e.g. commercial, recreational); safety; flood management; shoreline erosion; reservoir sedimentation; public access and safety; water quality; biodiversity; invasive species; waterborne diseases; and monitoring.

## Assessment

*Assessment criterion - Implementation Stage: The important considerations prior to and during reservoir filling and during operations have been identified through an assessment process; and monitoring of implementation activities is being undertaken appropriate to any identified issues.*

Assessments during the implementation stage beyond those listed for the preparation stage relate to detailed planning for all implementation stage activities in the reservoir area as described

above. Timing and rate of reservoir filling in relation to other management measures is a critical consideration at this stage. Important considerations relating to reservoir filling include: the consequences for dam safety and for downstream flow regimes with the rate of filling; the water quality impacts from decomposition of inundated biomass and soil; and community preparedness and community safety. Modelling of reservoir water quality undertaken for the ESIA should inform expectations on issues arising with reservoir filling. Wildlife rescue programmes may be implemented during reservoir filling as faunal species will migrate to high ground, which may end up becoming islands in the new reservoir area. Monitoring of effectiveness of rescue efforts, and the fate of relocated species, is an important assessment focal area.

## Assessment

*Assessment criterion - Operation Stage: 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.*

Mechanisms by which ongoing or emerging reservoir management issues might be identified could include: risk assessments and management plans; stakeholders and community engagement mechanisms; observations by operations and maintenance staff; hydrological analyses; incident reports; contractor communications; monitoring programmes; and periodic reviews of specific consideration areas (e.g. of public access or of notification mechanisms for maintenance related drawdowns).

The reservoir may have an operational life of many decades or even a century. Surrounding communities and developments will evolve over that time, as will governance arrangements, environmental awareness and trends, and societal expectations. Emerging risks or opportunities may be in relation to, for example: climate change related issues; multi-purpose considerations; leveraging of the reservoir for other industries (e.g. tourism, aquaculture, irrigation) or as a vehicle for development (e.g. a source of clean water, fisheries and other livelihoods,

improved water-based transport); public safety; public facilities; lake level fluctuation patterns; timber build up; invasive species; recreational or commercial fishing; reservoir rim erosion; flood management; development in the buffer zone; and modes of travel around the reservoir (walking, cycling, boating, vehicles).

Monitoring may be undertaken by a variety of mechanisms and may include visual observations, water level recording, water quality measurements, reservoir rim stability measurements, or bathymetric surveys to assess reservoir sedimentation.

## Management

*Management criterion - Preparation Stage: Plans and processes to manage reservoir preparation, filling and operations have been developed.*

Sections of the ESMP should address specific reservoir related issues that require management interventions during either the construction or operation stage. Specific planning aspects that may be addressed could include, for example, reservoir vegetation clearance, reservoir rim stabilisation works, wildlife rescue plans for the reservoir filling period, public safety plans, and cultural heritage management plans. The reservoir area may be the focus of an ESMP section or addressed in dedicated management plans for specific actions (e.g. wildlife rescue, water quality, resettlement).

## Management

*Management criterion - Implementation Stage: Measures are in place to address identified needs during reservoir preparation and filling; and plans are in place to manage the reservoir and any associated issues for the operating hydropower facility.*

*Management criterion - Operation Stage: Measures are in place to manage identified issues.*

Management actions during the implementation and operation stages should be consistent with relevant plans. Mechanisms should be in place by which reservoir management issues can be identified and addressed. Identification of ongoing or emerging issues may take place through follow-up monitoring programmes that

were committed to during project development if the operating hydropower facility was commissioned relatively recently.

Once the reservoir is filled and the power station is operating, reservoir management considerations are multiple. These may include: optimising power generation; maintenance requirements; debris management (particularly an issue in regions prone to storms and/or flooding); multiple uses (e.g. commercial, recreational); safety; flood management; shoreline erosion; reservoir sedimentation; public access; water quality; biodiversity; invasive species; waterborne diseases; development pressures; waste management; transport; and aesthetic issues. Every reservoir's context, uses and issues are unique and the management considerations will differ from operating facility to facility.

Reservoir operating rules should reflect agreed measures to address generation needs and balance competing uses, risks and safety issues. These should include flood and drought operating rules, and necessary notifications. Any operating measures to address environmental or social values should be embedded and explained in the operating rules.

Responsibilities for the different reservoir management considerations, especially during the operating stage, are likely to vary from site to site. Some of these may rest with the operator, others with national government agencies, and others with the local council or departmental level government.

Over time, responsibility for management of different aspects of the reservoir may be passed over to the government or local or other agencies, ceasing to be within the sphere of direct responsibility of the operating facility. In this case, there should be mechanisms for shared information and collaborative management around the ongoing reservoir management (e.g. a reservoir management committee). Management

measures taken by the operators to minimise risks should be evident, such as barriers and signage keeping boats sufficiently far away from the intake.

## Conformance/Compliance

*Conformance/Compliance criterion - Implementation and Operation Stages: 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.*

Good practice requires evidence that reservoir management measures are compliant with the relevant legal and/or administrative requirements, which may be expressed in licence or permit conditions or captured in relevant legislation. Compliance requirements may relate to, for example, standards to be met, the frequency and type of monitoring to be performed, and reporting to be submitted. Conformance refers to delivering what is in the plans. Commitments may be expressed in policy requirements of the developer or owner/operator, or in company statements made publicly or within management plans. Evidence of adherence to commitments could be provided through, for example, internal monitoring and reports, government inspections, or independent review. Variations to commitments should be well-justified and approved by relevant authorities, with appropriate stakeholder liaison.

The significance of not meeting a commitment is based on the magnitude and consequence of that omission and will be context-specific. For example, a failure to demonstrate delivery of a major commitment such as developing infrastructure for public usage (e.g. a public boat ramp) is likely to be a significant non-conformance, whereas a slight delay in delivery of a monitoring report could be a non-significant non-conformance.



# Water Quality

*This guideline expands on what is expected by the criteria statements in the Hydropower Sustainability Tools (HST) for the Water Quality topic, relating to assessment, management, conformance/ compliance and outcomes. The good practice criteria are expressed for different life cycle stages.*

*In the Hydropower Sustainability Assessment Protocol (HSAP), this topic is addressed in P-21 for the Preparation stage, I-17 for the Implementation stage and O-17 for the Operation stage. In the Hydropower Sustainability ESG Gap Analysis Tool (HESG), this topic is addressed in Section 3.*

This guideline addresses the management of water quality issues associated with the hydropower project development and the operating hydropower facility. The intent is that water quality in the vicinity of the project or the operating hydropower facility is not adversely impacted by project activities or activities of the operator; that ongoing or emerging water quality issues are identified, monitored and addressed

as required; and commitments to implement measures to address water quality are fulfilled.

Hydropower developments may fundamentally change water movement along a river, which in turn can generate associated water quality impacts. Water impounded behind a dam can either create a new lake or raise the level of an existing lake. The flow rates and patterns may change significantly. Impoundments can become **stratified** (i.e. layered with respect to certain characteristics such as oxygen and temperature), or stratification patterns in existing deep lakes can change. Sediments and pollutants may be transported into the waterway from upstream sources (e.g. wastewater discharges, landslips, agriculture, mining, erosion) or may result from operation of the infrastructure (e.g. oil spills). All of this can change the processes governing water quality in the lake and downstream. Both construction and operation stage activities can be sources of water quality impacts to the receiving environment, with consequent issues for ecosystem processes and services as well as socio-economic uses and values. Adverse water quality can also cause problems for asset performance and longevity, and a hydropower facility operator may be under pressure to resolve downstream water quality issues not caused by the facility through controlled water releases.

The geographic scope of the water quality assessment and management must consider:

- surface water, groundwater and drinking water;
- the catchment area for the reservoir – to determine the present and likely future condition and the surrounding influences on water quality;
- the reservoir – to determine the water quality conditions in the reservoir water;
- downstream river reaches below the dam and power house – to determine the present and likely future water quality conditions in the river reaches that will be affected by the project as far downstream as the flows are significantly project affected;
- the construction areas – e.g. reservoir preparation works, dams (coffer, main, saddle), adits, tunnels, power house, mitigation measures (e.g. fish passage facility);
- ancillary structures and activities – e.g. worker camps, offices, concrete batching plants, water supply intakes, material fabrication areas, supply storage areas, quarries, waste disposal areas, roads, supply transport activities; and
- mitigation measure areas – e.g. fish hatchery, reforestation activities, local benefits.

## Assessment

*Assessment criterion - Preparation Stage: A water quality issues assessment has been undertaken with no significant gaps.*

The project Environmental and Social Impact Assessment (ESIA) should include evaluation of the water quality impacts of the proposed hydropower project. A systematic approach to identifying and evaluating water quality status and potential impacts and risks needs to be taken. Professionals working in this area can include: water quality specialists; aquatic chemists; geochemists; limnologists, who study stratification in lakes and reservoirs; fluvial geomorphologists, who study river morphology and sedimentation and need to understand the interlinkages with turbidity and riverine transport of, for example, organic compounds; macroinvertebrate taxonomists, who classify and count aquatic bugs and understand the relationships between water quality and the needs of these species; and aquatic ecologists, who study freshwater ecosystems.

The preparation stage assessment starts with establishment of the pre-project baseline. Baseline studies should utilise appropriate expertise for the water quality sampling design, data collection, data analysis and interpretation. Available sources of secondary data should be identified and included, as well as local knowledge and information. More emphasis should be given to relatively recent secondary data and checks should be made to see if there have been changes in any conditions affecting that data. For primary data, a strategic approach should be used for the selection of water quality sampling sites to ensure a meaningful geographic spread and to include areas of likely water quality change or sensitivity to water quality impacts. At a minimum there should be four sampling locations: upstream of the future reservoir backwater, in the inundation area of the future reservoir, immediately downstream of the future dam site, and downstream of the next major tributary downstream of the future dam site. If possible and ideally, more locations would be included, such as upstream and downstream of other major tributaries, townships, development activities and point-source discharge points as well as from within significant tributaries. It can be advantageous to collect water quality data from locations at which the findings can be linked to hydrological data, and where practicable also to sediment and aquatic biodiversity monitoring data, as this can help with interpretation of findings.

During the preparation stage, sampling data should be collected over a period of at least 12 months. The number and timing of sampling trips should be designed to obtain the most representative data given the factors that could influence the results. For river sampling, this should cover all seasonal conditions of the region. Timing of sample collection should be sure to capture very different flow conditions, including during the low flow season, the onset of the wet season (noting this is the most significant time for fluvial transport), and the high flow season.

Water quality sampling results should be presented and described in accordance with any legal requirements and interpreted with respect to all relevant environmental standards. During the preparation stage, sampling results should be used to clearly establish the pre-project baseline conditions and the major influences on

the results. Results should explain the pre-project status, trends and issues, taking into account flow, season, surrounding land uses (e.g. locations of settlements and industrial and agricultural activities), major tributaries, and points of water abstraction, treatment and discharge.

Sources and types of water quality risks that should be assessed relevant to the construction stage should include:

- quality standards of water used within worker camps and for construction site activities;
- sewage and solid waste from worker camps;
- sewage and solid waste from the increased population attracted to the area;
- dumping of excavated materials into or close to waterbodies;
- contaminated surface or groundwater from drilling, blasting, quarrying and stone crushing activities; and
- oil and chemical spills from workshops, storage areas and during transport.

Reservoir filling and project commissioning stage water quality risks should include consideration of the implications of changed flow regimes on water quality in the downstream river and any potentially adverse impacts, for instance due to reduced flows or intermittent discharges of low quality water.

Sources and types of water quality risks that should be assessed relevant to the operation stage should include:

- pollutant inflow to the reservoir or downstream reaches from surrounding activities;
- algal blooms during dry periods in areas with surrounding use of fertilisers;
- stratification and seasonal circulation within the reservoir;
- reservoir turbidity due to erosion in the reservoir rim;
- release of toxicants (e.g. heavy metals) from inundated sediments and contaminants in the reservoir;
- reduced oxygenation in the reservoir and downstream;
- gas supersaturation in the releases downstream;
- unseasonal temperatures in the reservoir and in the releases downstream;

- releases of highly turbid water through the low level release valve or through flushing of the desilting chamber;
  - pollution from permanent offices and project infrastructure, such as the power house;
  - chemical or waste spills from the power station or surrounding buildings; and
  - turbidity increases due to riverbank erosion in rivers subject to hydropeaking, or 'aggressive river' effects (also known as 'hungry water'), meaning that the river's erosive capacity below the dam is enhanced due to sediment trapping within the reservoir.
- Water quality opportunities should also be assessed. These may include:
- addressing pollutants from non-project activities such as sewage, wastes, or contaminated sites;
  - improving water quality compared to pre-project conditions;
  - using new monitoring or treatment technologies such as increased automation; and
  - forming partnerships with community waterway health monitoring groups.

## Assessment

*Assessment criterion - Implementation Stage: Water quality issues relevant to project implementation and operation have been identified through an assessment process utilising appropriate expertise; and monitoring is being undertaken during the project implementation stage appropriate to the identified issues.*

*Assessment criterion - Operation Stage: 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.*

Water quality related issues during the implementation and operation stages should consider changes to the baseline water quality condition and processes and the implications of these changes for other social, environmental and/or economic objectives. Water quality during the project implementation stage requires a particular focus on construction-related issues and downstream impacts related to the river diversion, whereas the operation stage often involves longer-term issues, multiple-use issues, and periodic incidents.

Water quality monitoring objectives need to be clearly expressed, linked to risks and impacts, and defined separately for the construction and operation stages. The basis for the locations, timing, parameters and methodologies adopted should be clearly explained. Sampling locations and techniques used for the baseline data gathering during the ESIA work should be continued as far as practical. In deep reservoirs, depth-profiles should be undertaken at several locations to detect stratification and be linked to seasonal and operational variability. Depending on the exact focal area required in relation to risks, the parameters used for water quality monitoring may be some or all of the following:

- physico-chemical water quality characteristics: temperature, pH, electrical conductivity, acidity, clarity, alkalinity, dissolved oxygen in surface and sub-surface water;
- turbidity;
- metals, which may include: total and dissolved iron, manganese, zinc, mercury, arsenic, cadmium (plus others if known to be of local concern);
- nutrients and carbon (total and dissolved); and
- indicators of organic pollution (Biological Oxygen Demand (BOD), Chemical Oxygen Demand (COD), E. coli).

Where relevant, findings should be compared to the relevant environmental standards and interpreted in light of influential factors such as flow, water level, season, and activities.

## Management

*Management criterion - Preparation Stage: Plans and processes to address identified water quality issues have been developed for project implementation and operation with no significant gaps.*

The water quality section of the Environmental and Social Management Plan (ESMP) needs to contain, at a minimum, the following outlined separately for construction and operation:

- all identified potential risks and impacts for water quality;
- mitigation measures for all risks and impacts listed, with the objectives and measures of success;
- monitoring schedules clearly linked to the risks and mitigation objectives;

- reporting schedules and formats;
- budgets and responsible parties, including any handover arrangements to different agencies over time; and
- audit, review and evaluation provisions.

Adaptive management measures for unpredicted water quality impacts are also ideally included. These would focus on issues that might be identified through the monitoring and surveillance and what the response would be (including responsible parties and contingency budget set aside).

There is considerable knowledge and experience globally of the mitigation measures that can be employed to avoid, minimise and mitigate water quality related impacts from hydropower developments.

Measures to address water quality risks and impacts arising from the project site could include some of the following:

- Mitigate insufficient water of appropriate quality for worker camps and industrial activities: water quantity and quality needs are thoroughly identified in the design and feasibility studies, sources are confirmed as available, and water supply infrastructure is built into designs including with treatment facilities if required.
- Mitigate sewage, solid waste and polluted run-off from worker camps, workshops, buildings: waste and run-off generation is conservatively (i.e. over-) estimated for construction and operation stages; well-designed drainage collection points; run-off and wastewater treatment plants are of an appropriate capacity with discharge points in high velocity flow areas away from water users.
- Mitigate run-off from dumping of excavated materials: conservative (i.e. over-) estimation of excavated materials and their volumes; clearly identified dumping areas that as far as possible avoid steep slopes, riparian zones, and the risk of materials entering waterbodies; spoil containment and drainage management measures; closing off of contaminant transport pathways; machinery access built into designs so that compaction, slope stabilisation and revegetation are implemented progressively.
- Mitigate contaminated surface or groundwater from activities such as drilling, blasting, tunnelling, quarrying and stone crushing: sediment traps and settling tanks, along with well-planned access for machinery

to periodically clean them out, and clearly identified dumping areas for any sludge.

- Mitigate oil and chemical spills from workshops and storage areas: fully identified workshop and storage areas with specific locations for oil, fuel and chemical storage and refuelling, at which bunding of an appropriate volume is provided.
- Mitigate oil spills and leakages in the power station: careful estimation of oil needs and exploration of minimisation options, such as equipment choice and design (including water-lubricated turbines), appropriately sized and placed sumps, and regular inspections and maintenance of oil-containing vessels.

Measures to address externally generated water quality risks and impacts could include some of the following:

- Mitigate catchment area generated pollution: catchment management measures such as reforestation, protected areas, check dams, drainage works, rehabilitation, and fertiliser use reduction strategies.
- Mitigate sewage and solid waste from increased population attracted to the area: dialogue with the local municipality about capacities of existing solid and wastewater collection and treatment facilities; partnerships on upgrade or augmentation measures in a timely manner.

Measures to address within reservoir water quality risks and impacts could include some of the following:

- Mitigate the formation of reservoir stratification in relatively deep lakes, potentially leading to deoxygenated and unseasonal temperature water released to downstream, and in cases release of heavy metals in the sediments: reservoir siting and design to minimise the likelihood and/or degree of stratification; reservoir design and operating rules to minimise water residence time and ensure through-flow; if stratification will occur, selective or multi-level offtakes incorporated for projects within deep reservoirs to limit the amount of water drawn into the power station from cold, anoxic depths; seasonal management of lake levels to ensure releases of oxygenated water at seasonally appropriate temperatures; air injection facilities in the power station; aerating turbines.
- Mitigate increased turbidity due to erosion of the reservoir rim: reservoir operating rules governing the rates of water level rise and fall to minimise shoreline erosion; reservoir rim treatment works for erosion prevention; rules

limiting boat speeds and planning rules limiting shoreline development and activities; creation of a reservoir buffer zone.

- Mitigate organic decomposition in the reservoir during the early years of operation leading to the consumption of oxygen: clearing of vegetation and organic materials in the reservoir in identified priority locations prior to inundation.
- Mitigate risks in shallow lakes in windy, exposed settings of turbidity caused by resuspension of bottom sediments: mechanisms such as baffles to direct circulation and ensure adequate water flow-through and mixing; wind barriers (built or planted) to reduce wind-induced mixing; planting and managing appropriately selected macrophyte communities (aquatic vegetation).

Measures to address downstream water quality risks and impacts could include some of the following.

- Mitigate downstream gas supersaturation: inclusion of stilling basins, spillway design, or through structures that favour degassing.
- Mitigate inadequate mixing of power station discharges with water of ambient characteristics: siting of the tailrace discharge point upstream of a significant tributary.
- Mitigate releases of highly turbid water through the low level release valve or through flushing of the desilting chamber: careful consideration of the locations, capacities, timing and operating patterns for use of the low level release valve and flushing of the desilting chamber and the location of the discharge points to seek to minimise highly concentrated pulses released into the downstream environment.
- Mitigate turbidity increases due to riverbank erosion in rivers subject to hydropeaking or aggressive river effects: built measures to dampen fluctuations such as a re-regulation weir; flow management to dampen fluctuation such as minimum flows (to reduce range and water surface slope of pulses); ramp-down rules; bank protection works.

## Management

*Management criterion - Implementation Stage: Processes are in place to ensure management of identified water quality issues and to meet commitment, relevant to the project implementation stage; and plans are in place for the operation stage for ongoing water quality issues management.*



*Management criterion - Operation Stage: Measures are in place to manage identified water quality issues.*

During the implementation and operation stages, the water quality related plans developed based on the ESIA assessment work are put into action. For projects that did not have sufficiently thorough water quality assessment work as outlined in this guideline, water quality management plans can still be developed based on assessment work focussed on identifying issues and risks.

The important management requirements at the implementation and operation stages are to ensure that processes are in place that will enable water quality issues to be identified and responded to. Such processes may include: clear statements of business commitment to water quality within an environmental or sustainability policy; dedicated staff with water quality related qualifications and role requirements, and/or a partnership with a more water quality focussed organisation; allocation of budget and resources to enable monitoring and issues identification and response; and decision-making processes to ensure that issues arising have actions assigned (e.g. through a corporate environment committee).

## Conformance/Compliance

*Conformance/Compliance criterion - Implementation and Operation Stages: 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.*

Good practice requires evidence that water quality measures are compliant with the relevant government requirements, which may be expressed in licence or permit conditions or captured in relevant legislation. Compliance requirements may relate to, for example, standards to be met, the frequency and type of monitoring to be performed, and reporting to be submitted. Conformance refers to delivering what is in the plans. Commitments may be expressed in policy requirements of the developer or owner/operator, in company statements made

publicly, or within management plans. Evidence of adherence to commitments could be provided through, for example, internal monitoring and reports, government inspections, or independent review. Variations to commitments should be well-justified and approved by relevant authorities, with appropriate stakeholder liaison.

The significance of not meeting a commitment is based on the magnitude and consequence of that omission and will be context-specific. For example, a failure to demonstrate delivery of a major mitigation commitment such as a wastewater treatment plant is a significant non-compliance, whereas a slight delay in delivery of a monitoring report could be a non-significant non-conformance.

## Outcomes

*Outcomes criterion - Preparation Stage: Plans avoid, minimise and mitigate negative water quality impacts arising from project activities with no significant gaps.*

*Outcomes criterion - Implementation Stage: Negative water quality impacts arising from project activities are avoided, minimised and mitigated with no significant gaps.*

*Outcomes criterion - Operation Stage: Negative water quality impacts arising from activities of the operating hydropower facility are avoided, minimised and mitigated with no significant gaps.*

To show that plans avoid, minimise, mitigate and compensate negative water quality impacts from project activities, mitigation measures in the plans should be able to be directly linked to all identified water quality issues and risks. The assessment and planning should be informed by appropriate expertise. The assignment of responsibilities and resource allocation for implementation, monitoring and evaluation should be appropriate to the planned actions.

An evidence-based approach should demonstrate that negative water quality impacts arising from project implementation and operation activities are avoided, minimised, mitigated and compensated with no significant gaps. The developer and owner/operator should

demonstrate that responsibilities and budgets have been allocated to implement water quality plans and commitments. Monitoring reports and data in the implementation and operation stages should clearly track performance against commitments and objectives, and capture water quality impacts. It should be possible to provide examples to show how identified risks from the assessment were avoided or minimised. It should also be possible to table evidence to show that mitigation plans have been implemented and are being monitored. Implementation of measures for water quality, such as aeration weirs, should be evident, and monitoring should show how they are achieving their stated objectives.





# Waste, Noise and Air Quality

*This guideline expands on what is expected by the criteria statements in the Hydropower Sustainability Tools (HST) for the Waste, Noise and Air Quality topic, relating to assessment, management, conformance/compliance and outcomes. The good practice criteria are expressed for the implementation stage.*

*In the Hydropower Sustainability Assessment Protocol (HSAP), this topic is addressed in I-18. In the Hydropower Sustainability ESG Gap Analysis Tool (HESG), it is addressed in Section 1.*

This guideline addresses the management of waste, noise and air quality issues associated with the project. The overall intent is that noise and air quality in the vicinity of the project are of a high quality and not adversely impacted by project activities, and that project wastes are responsibly managed. The following guidance provides more detail on (1) waste management and disposal, and on (2) noise, air quality and also vibration. Vibration is included because it can be closely associated with noise and is an impact area of heightened concern to local communities during the construction stage.

## Waste management and disposal

Objectives for waste management and disposal assessment and management are to ensure that all wastes are managed responsibly and do not cause adverse effects on surrounding or future values and uses. Responsible waste management is consistent with the mitigation hierarchy and emphasises actions to avoid, reduce, reuse, and recycle wastes. The scope of waste management and disposal assessment and management should consider:

- Waste types – solid, liquid, chemical, hazardous, medical, e-waste (electronics), abandoned vehicles and infrastructure.
- Waste from excavation activities, which may be referred to as spoil (typically excavated materials unable to be reused) and/or muck (a commonly used term for material excavated from underground). For simplicity, all excavated waste will be called 'spoil' in this guideline.
- Waste from project construction areas (e.g. reservoir vegetation clearing, dams (coffer, main, saddle), adits, tunnels, power house).
- Waste from ancillary structures and activities – e.g. labour camps, offices, concrete batching plants, water supply intakes, material fabrication areas, supply storage areas, quarries, supply transport activities.
- Waste from mitigation measure areas – e.g. fish hatchery, reforestation activities, local benefits.

- Waste minimisation through design and through procurement policies, and through reuse and recycling.
- Temporary waste storage facilities.
- Waste transport – vehicles, capacities, operators, maintenance, licensing and waste tracking systems.
- Regional waste management facilities – locations, types, capacities, condition, operating measures, lining, cover, drainage, pest management measures and waste documentation.

## Noise, air quality and vibration

Objectives for noise, air quality and vibration assessment and management are to ensure that there are no adverse effects for surrounding communities, biodiversity or other values created by implementation stage activities of the project. The scope of noise, air quality and vibration assessment and management must consider:

- All project-related activities both on and off the project sites, including road works.
- Air emissions from point sources, fugitive sources and mobile sources.
- The activities of primary suppliers.
- The proximity of sensitive receptors, including in the natural and the human environment.

### Assessment

*Assessment criterion - Implementation Stage: Waste, noise and air quality issues relevant to project implementation and operation have been identified through an assessment process utilising appropriate expertise; and monitoring is being undertaken during the project implementation stage appropriate to the identified issues.*

The Environmental and Social Impact Assessment (ESIA) should include content on waste management, and on noise, air quality and vibration. All compliance requirements should be well-identified. Baseline data should be collected to understand the pre-project status and project-related impacts and to inform risk assessment and development of management plans. All implications for other social, environmental and/or economic objectives should be identified and evaluated. Monitoring activities included

within the management plans should identify if issues are arising and if mitigation measures are effective.

## Waste management and disposal

Requirements for baseline waste management and disposal information include the following:

- All of the aspects listed under the scope of this guideline are addressed using appropriate expertise.
- Relevant existing regional waste management facilities, activities and capacities are identified and evaluated in consultation with government authorities with respect to the different waste streams. The evaluation should consider if these can be used or enhanced, or if the project should develop its own facilities. Evaluations of existing facilities should include understanding of responsibilities, permits, tracking systems, and waste transport operators. If project-specific facilities are needed, the assessment process should evaluate the long-term options (e.g. closure or hand-over to local authorities).
- Primary data (i.e. sampling) and secondary data (i.e. reports) are collected for existing waste disposal sites intended to be used by the project to understand capacities and any existing issues, such as the quality of run-off. The methodology used for primary and secondary data capture is described.
- Areas are identified for potential disposal of all types of waste and evaluated based on the particular characteristics of each waste type and on social, environmental and financial criteria.
- Waste management and disposal risks at the construction stage should be identified and can arise due to:
  - Underestimations of waste quantities and poor planning for waste disposal. This can lead to increased costs, time delays and potentially non-compliance issues while reactive management measures are implemented.
  - Inappropriate separation, storage, transport and disposal of chemical, hazardous and medical wastes, leading to toxic chemicals in water and soils and occupational and public health risks.
  - Inappropriate disposal and management of solid wastes. This can lead to wind-blown litter, poor water quality in the run-off, attraction of pest species, visual impacts, and public health risks.

- Inadequate liquid waste collection and treatment facilities, leading to poor water quality, soil contamination, and public health risks.
- High waste transport costs due to poor location choices for waste disposal sites.
- Non-compliances in waste transport and disposal management with permit requirements and management plans.
- Land degradation caused by location choices for spoil dumps, e.g. loss of agricultural land.
- Collapse, erosion, sediment run-off and poor water quality from inappropriate management of spoil dumps.

Waste management and disposal risks at the operation stage should be identified and may include:

- Degradation over time of construction-stage waste disposal areas due to poor site closure or poor follow-up management.
- Inability of the local government to sustain waste management systems developed during the construction stage and handed over to local authorities.
- Floating debris in the reservoir, often logs and vegetation associated with reservoir clearance or delivered during monsoons. This can cause local debris back-ups with associated visual, safety, pest and mechanical risks.
- Abandoned vehicles and infrastructure arising from poor project closure and rehabilitation measures.
- Waste management and disposal opportunities should be investigated and might include:
  - Reduction, reuse and recycling through good site design and forward planning.
  - Business opportunities from project waste streams (e.g. scrap metal).
- Improved regional waste transport and disposal facilities compared to pre-project conditions, if agreed with local authorities.
- Use of new monitoring or treatment technologies, such as high temperature incinerators for hazardous wastes or instrumentation to monitor the stability of spoil dumps.
- Creation of new land-use areas such as sports grounds through well-planned and implemented landfill with adherence to relevant soil quality standards.

- Partnerships with other waste generating industries in waste disposal and treatment facilities.

Monitoring should be embedded within the relevant management plans. Parameters commonly used for monitoring relating to waste management and disposal include:

- Routine visual inspections for waste disposal areas.
- Measurements of key physical characteristics of waste storage and disposal areas (e.g. area, volume, weight, compaction).
- Inspections of waste register documentation to understand what is in the waste disposal areas, when it was placed there, by whom, any accompanying treatment measures upon disposal, etc.
- Water quality measurements at drainage collection points receiving water from the disposal areas.
- Periodic inspections and tests of spoil dumps to ensure proper management and long-term stability of excavated wastes (e.g. compaction, moisture, run-off, slumping, movement of downslope barriers).

## Noise, air quality and vibration

Requirements for baseline noise, air quality and vibration information include the following.

- All of the aspects listed under the scope of this guideline are addressed using appropriate expertise for the air quality and noise sampling design, data collection, data analysis and interpretation.
- Local knowledge and information is included, including from communities in the project affected areas.
- Primary air quality and noise data (i.e. sampling) is collected from locations which are meaningful in relation to the receptors of concern and where future complaints might be made, and are in areas where the construction stage monitoring can be compared.
- Air quality and noise sampling data is collected for the different seasons and is collected at different times of day and night according to standard methods. The methodologies used for primary and secondary data capture are described.

- Air quality and noise sampling results are described according to the national environmental standards or recognised international standards for any parameters of concern not in the national standards. Air quality and noise sampling results are linked to land uses, seasonal and climatic factors, topography and ground characteristics, wind speeds, etc. to enable explanation of pre-project trends and issues.
- Where there are highly sensitive receptors and air quality emissions of concern, atmospheric dispersion models are used.
- A pre-project survey is undertaken of the condition of infrastructure that could potentially be at risk from vibration damage, with particular attention to significant community or cultural heritage infrastructure. Data collected includes visual inspections, photos, and measurements of cracks.

Noise, air quality and vibration risks at the construction stage should be identified and can arise due to:

- Noise, air quality and vibration from excavation activities involving drilling, blasting and/or heavy machinery.
- Noise and air emissions from crushing plants, aggregate processing plants, concrete batching and fabrication activities.
- Transport-related emissions and noise.
- Wind-blown dust and toxins from uncovered waste disposal areas.
- Smoke from burning off cleared vegetation.
- Noise, air quality and vibration at the operation stage should be identified and may include:
  - Noise and vibration from the power house.
  - Vehicle emissions.
  - Hydrogen sulphide releases through the turbines, due to decaying vegetation and anaerobic conditions in the reservoir, causing nuisance odours, corrosion of exposed metals, and discolouration of concrete.
  - Smoke from burning of floating debris collected from the reservoir intake screens/trash racks.
  - Formation of microclimates in the reservoir area, such as entrapped fog, colder temperatures or wind.

Noise, air quality and vibration opportunities might include the use of new monitoring or impact-reducing technologies, or improved air quality compared to pre-project conditions.

Clear monitoring objectives should be defined for noise, air quality and vibration for both the construction and operation stages as well as the monitoring activities embedded into management plans. Parameters commonly used for monitoring, depending on the focal area, include:

- **Air quality:** nitrogen oxides (NO<sub>x</sub>), sulphur dioxide (SO<sub>2</sub>), carbon monoxide (CO), particulate matter (PM), volatile organic compounds (VOCs), wind speed and direction. Emissions from highly variable processes should be sampled more frequently or through composite methods
- **Noise:** decibels (dBA)
- **Vibration:** ground-movement measurements, visual inspection and documentation of structural issues (e.g. cracks)

For monitoring of waste, noise, air quality and vibration, a logical design should be explained for the locations, timing, parameters and methodologies that are clearly linked to risks and objectives. The locations chosen should always include those that are near or at sensitive receptors. Monitoring should be conducted by trained specialists using established methods and quality control procedures. All findings are compared to the relevant environmental standards and interpreted in light of influential factors such as climate, topography, soils, wind direction and speed, season, and activities.

## Management

*Management criterion - Implementation Stage: Processes are in place to ensure management of identified waste, noise and air quality issues, and to meet commitments, relevant to the project implementation stage; and plans are in place for the operation stage for ongoing waste management.*

The project Environmental and Social Management Plan (ESMP) should demonstrate that the needs and risks relating to waste, noise, air quality and vibration have been well-identified, and that the feasibility of avoidance and minimisation approaches has been fully explored. Risks will vary by site and different mitigation measures will be suitable depending on the project. Plans for minimising and mitigating actions should be outlined separately for project construction and operation. Processes to manage waste, noise and air quality

should be informed by the assessment of issues and compliance requirements. Plans need to identify actions, time requirements, resource requirements, responsible parties, monitoring, reporting, and review, as described under the Environmental and Social Issues Management topic guideline.

## Waste management and disposal

Measures to address waste management and disposal risks could include some of the following:

- Mitigate risks of underestimations of waste quantities and poor planning for waste disposal: engineering estimates are made of waste generation quantities, types and locations throughout the project construction cycle in the feasibility studies based on detailed analysis of all construction activities and the labour workforce, with a contingency factored in; project design and construction planning includes measures to minimise waste generation; spoil disposal is planned for within the dead storage in the reservoir or in quarry areas; agreements on storage areas and new waste disposal facilities are reached at the project outset with the local government; land acquisition for waste disposal is arranged at the project outset.
- Mitigate risks of inappropriate separation, storage, transport and disposal of chemical, hazardous and medical wastes: awareness-raising; education; relevant contractual requirements; waste handling procedures; training; appropriately designed storage areas (which may include being isolated with security features, labelling, bunding, etc.); permits; scheduled disposal arrangements; appropriate waste transport mechanisms; appropriate waste disposal mechanisms (e.g. high temperature incinerators); appropriate disposal of any residues; chain-of-custody documentation to the final destination.
- Mitigate risks of inappropriate disposal and management of solid wastes: solid waste disposal sites with appropriate management procedures including layering, covers, compaction, contouring, drainage, monitoring, inspections, security, controlled access, pest management and signage.
- Mitigate risks of inadequate liquid waste collection and treatment facilities: liquid wastes are treated in wastewater treatment plants or septic tanks as appropriate to the scale and location of wastes generated; procedures for maintenance are developed and implemented appropriate to the design of the treatment approach; drainage is designed to appropriate standards; biosolids are disposed of or reused as appropriate to the chemical characteristics and environmental permits
- Mitigate risks of high waste transport costs due to poor location choices for waste disposal sites: waste disposal sites are located in reasonable proximity to the waste generating activities provided that the environmental and social conditions are suitable; the cost and time factor for waste transport is considered as part of evaluation of potential waste disposal areas and factored into the project budget and logistics to ensure that illegal waste dumping does not occur to save time and costs; relevant contractual clauses; awareness-raising, education, training, inspections, and waste registers.
- Mitigate risks of land degradation caused by spoil dumps: areas of good environmental condition are avoided for spoil disposal sites; spoil disposal sites include backfilling in quarries where extraction has been finished or in the dead storage of the reservoir that will be inundated; spoil disposal requirements are minimised through reuse as much as possible, such as for concrete aggregate, embankment construction, and road base; spoil dump site selection aims to create future quality land-use areas for community benefit.
- Mitigate risks of collapse, erosion, sediment runoff and poor water quality from inappropriate management of spoil dumps: accurate quantification of spoil generation and disposal requirements taking into account a soil bulking factor of 30-40%; design of the spoil dump repose angle takes into account ground characteristics; spoil disposal locations are a safe distance from watercourses and avoid risks of inundation during flood or spill conditions; use of retaining walls; periodic compaction in layers as the spoil disposal area is being filled; diversion of drainage around the spoil disposal area; contouring; landscaping; afforestation with suitable plant species; soil binding using biofertiliser technology; monitoring.
- Mitigate risks of degradation over time of construction stage waste disposal areas: monitoring to ensure appropriate implementation of management procedures during design and filling of construction stage waste disposal areas; continued monitoring



during operation stage, potentially based on agreement with the local government if the facilities were handed over; closure and rehabilitation at the end of the useful life as per an agreed plan.

- Mitigate risks of inability of the local government to sustain waste management systems developed during the construction stage over the longer-term: agreements made with the local government about the long-term arrangements for any waste disposal developments created or expanded during the construction stage; these may include full handover, developer management or co-management for a fixed period, provision of support funds for a fixed period, provision of management training, or closure and rehabilitation.
- Mitigate risks of floating debris in the reservoir: log collection campaigns to reduce the quantity of debris reaching the intake; intake protection screens with scheduled clearing; management arrangements for disposal of floating debris such as provision of firewood or commercial uses (e.g. firing a kiln).
- Mitigate risks of abandoned vehicles and infrastructure: contractual clauses requiring appropriate disposal of abandoned vehicles, and dismantling and disposal of all infrastructure; identification of appropriate disposal areas.

## Noise, Air Quality and Vibration

Measures to address noise, air quality and vibration risks could include some of the following:

- Mitigate risks of air emissions, noise and vibration from excavation activities involving drilling, blasting and/or heavy machinery: ensuring adequate distances from sensitive receptors; restrictions on times of day; restrictions on size of machinery; restrictions on allowable blasting charges; establishment of noise and emission dispersion barriers, such as through the creation of embankments or retention of natural vegetative screens; installation of vibration isolation for mechanical equipment.
- Mitigate risks of air emissions from crushing plants, aggregate processing plants, concrete batching and fabrication activities: enclosure of machines and plant areas; air emission control devices (e.g. bag filters); covered unloading points from crushers; raising chimney heights; water sprays around crushing sites (oil sprays should be avoided); proper and regular maintenance of machines and plants; detection and closure of leakage areas (e.g. for fumes); process modifications; use of alternative materials (e.g. cleaner fuels).
- Mitigate risks of dust from vehicle traffic on roads: seal or provide a gravel road surface near sensitive receptors; restrict construction vehicle routes to avoid sensitive receptors; provide alternative pedestrian pathways away from roads used by construction vehicles; restrict vehicle speeds and hours of travel near sensitive receptors; ensure vehicle loads are covered; implement dust-suppression measures such as water sprays on the road (oil sprays should be avoided); creation of wind barriers around sensitive receptors.
- Mitigate risks of noise from crushing plants, aggregate processing plants, concrete batching and fabrication activities, and from vehicles or other transport modes: locating noise sources within less sensitive areas to take advantage of distance and shielding; siting permanent facilities away from community areas; taking advantage of the natural topography as a noise buffer during facility design; selecting equipment with lower sound-power levels; installing silencers for fans; installing suitable mufflers on engine exhausts and compressor components; installing acoustic enclosures for equipment; using sound insulation; installing acoustic barriers; limiting the hours of operation for specific pieces of equipment or operations, especially mobile sources; rerouting vehicle traffic to avoid community areas; planning flight routes, timing and altitude for aircraft flights (airplane and helicopter) to minimise impact to sensitive receptors.
- Mitigate risks of wind-blown dust and toxins from uncovered waste disposal areas: location of waste disposal areas away from sensitive receptors; layering, compaction and cover measures to avoid wind-blown emissions; use of topography and vegetation to create screens or barriers to dispersion of emissions.
- Mitigate risks of smoke from burning off cleared vegetation: rules specifying no burning or restricted conditions for burning; arrangements for reuse of timber debris; chipping of cleared vegetation for later use in land rehabilitation.
- Mitigate risks of noise and vibration from the power house: siting and design choices to avoid sensitive receptors; proper and regular maintenance; land contouring and planting of a greenbelt to limit effects on sensitive receptors.
- Mitigate risks of vehicle emissions: selection of

newer and/or relatively quiet vehicles; proper and regular maintenance to meet required standards; use of cleaner fuels (e.g. with lower sulphur content); fitting vehicles with emission control devices (e.g. catalytic converters).

- Mitigate risks of hydrogen sulphide releases through the turbines due to decaying vegetation and anaerobic conditions in the reservoir: siting and design choices to minimise reservoir biomass and anaerobic conditions; initial biomass removal from the reservoir; management of water and intake levels in the reservoir to avoid lower-level anaerobic water passing through the turbines; multi-level intakes.
- Mitigate risks of smoke from burning off floating debris collected in the intake screens: rules specifying no burning; arrangements for reuse of timber debris (e.g. in kilns); disposal of non-reusable solid waste into licensed waste disposal sites.
- Mitigate risks of formation of microclimates in the reservoir area, such as entrapped fog, colder temperatures or wind: siting and design choices to minimise risks of microclimate impacts; strategic planting of vegetation to minimise or avoid effects.

## Conformance/Compliance

*Conformance/Compliance criterion - Implementation Stage: Processes and objectives relating to waste, noise and air quality have been and are on track to be met with no significant non-compliances or non-conformances, and any related commitments have been or are on track to be met.*

Assessment processes and management measures relating to waste, noise, air quality and vibration should be compliant with relevant legal or administrative requirements. These may be expressed in licence or permit conditions or captured in legislation. Implemented measures should be consistent with what is in the plans to demonstrate conformance with the plans. Relevant commitments may be expressed in policies of the developer or owner/operator, or in company statements made publicly or within management plans. Evidence of adherence to commitments could be provided through, for example, internal monitoring and reports, government inspections, or independent review.

Variations to commitments should be well-justified and approved by relevant authorities, with appropriate stakeholder liaison.

The significance of not meeting a compliance requirement or commitment is based on the magnitude and consequence of that omission and will be context-specific. For example, failure to identify, store or dispose of potentially toxic waste is likely to be a significant non-compliance. Failure to identify an opportunity for recycling packaging materials may be a non-significant non-conformance.

## Outcomes

*Outcomes criterion - Implementation Stage: Negative noise and air quality impacts arising from project activities are avoided, minimised and mitigated with no significant gaps, and project wastes managed responsibly.*

An evidence-based approach should demonstrate that negative waste, noise and air quality impacts arising from project implementation activities are avoided, minimised and mitigated with no significant gaps. The developer should demonstrate that responsibilities and budgets have been allocated to implement relevant plans and commitments. Monitoring reports and data should clearly track performance against commitments and objectives and capture public health impacts. It should be possible to provide examples to show how identified risks from the assessment were avoided or minimised. It should also be possible to table evidence to show that mitigation plans have been implemented and are being monitored. Implementation of measures for waste, noise and air quality, such as new or enhanced waste management facilities, stockpiling of topsoil, noise buffers, and wetting of roads for dust suppression, should be evident and monitoring should show how they are achieving their stated objectives.

Evidence of monitoring may include waste disposal receipts or other such documentation which is common for restricted wastes. Evidence of legal requirements may be contained in project permit or licence conditions. Evidence of conformance with plans may be found in an on-site complaints register, in records of consultation with local stakeholders, or in the results of previous audits.





# Downstream Flow Regimes

*This guideline expands on what is expected by the criteria statements in the Hydropower Sustainability Tools (HST) for the Downstream Flow Regimes topic, relating to assessment, management, conformance/compliance, stakeholder engagement and outcomes. The good practice criteria are expressed for different life cycle stages.*

*In the Hydropower Sustainability Assessment Protocol (HSAP), this topic is addressed in P-23 for the preparation stage, I-20 for the implementation stage and O-19 for the operation stage. In the Hydropower Sustainability ESG Gap Analysis Tool (HESG), this topic is addressed in Section 11.*

Good practice requires that flow regimes downstream of hydropower project infrastructure should be planned and delivered with an awareness of and measures incorporated to address environmental, social and economic objectives affected by those flows. Objectives should reflect important river uses, values and services. All affected river reaches downstream of hydropower infrastructure should be considered

and there should be evidence that the flow regimes meet publicly disclosed objectives and commitments.

A river's flow naturally varies and has a characteristic pattern. The flow regime can be characterised according to many aspects, such as flow magnitude, duration, frequency, timing, rates of change, and predictability. The flow regime sustains the ecology of rivers and where relevant their associated floodplains, wetlands, groundwater dependent ecosystems, and estuaries. The flow regime supports the ecological processes and associated values that rivers provide to communities and the environment, including: flood attenuation; water purification; sediment flushing; channel and habitat maintenance; nutrient dispersion; water supply; wastewater dilution; electricity generation; and the production of fish and other foods and marketable goods.

Hydropower developments result in changes to various aspects of the flow regime depending on the project design and operational patterns. These changes relative to the pre-project hydrological regime can be, for example, seasonally reduced flows, seasonally increased flows, rapid (i.e. hourly) increases and decreases in flows due to hydropeaking, loss of or changes to flood events, and large flow events due to spill. For base load stations, discharges can be at a consistent flow for long periods; for peaking

stations, flows can fluctuate rapidly on timescales of hours. Where diversions have occurred from one river basin into another, power stations can deliver prolonged periods of higher than natural flows while dewatering or reducing flows in the river system downstream of the diversion point or diversion structure.

The most common mitigation measure to minimise the impacts of altered flow regimes resulting from hydropower developments has been through the design of rules governing the downstream flow releases. These rules are commonly known as 'environmental flows', although in some regions terms such as 'minimum flows', 'riparian flows', or 'compensation flows' might be used.

## Assessment

*Assessment criterion - Preparation Stage: An assessment of flow regimes downstream of project infrastructure over all potentially affected river reaches, including identification of the flow ranges and variability to achieve different environmental, social and economic objectives, has been undertaken based on relevant scientific and other information with no significant gaps.*

For hydropower projects at the preparation stage, good practice requires that the effects on flow regimes downstream of project infrastructure have been evaluated, as well as mitigation measures to address impacts. Ideally this process starts early to inform the evaluation of project alternatives. The results of these evaluations should be within the Environmental and Social Impact Assessment (ESIA) and informed by many specific study areas within the ESIA. This assessment should be information-based and consider environmental and social aspects in addition to economic factors. Options for flow ranges and variabilities should be considered in terms of their implications for diverse objectives and issues identified by the studies and by stakeholders.

Of importance is that all potentially affected river reaches are considered as often attention is only given to the dewatered reach between the dam and power station. For hydropower projects with water storage capabilities, the releases out of the power house may have seasonal or even

daily patterns that differ from the pre-project river flows. For hydropower projects involving diversion of water out of one river into another, the effects on flow regimes both out of the diversion river and into the receiving river should be carefully evaluated as they will result in the diversion river having lower than pre-project average flows and the receiving river having higher than pre-project average flows. In all cases, the evaluation of downstream flows should be for the downstream river distance for which flow changes can be attributed to the project, informed by hydrological modelling (see the Hydrological Resource topic guideline).

There is no specific methodology that must be used in reaching a downstream flow regime commitment. Traditionally, there have been four broad categories of "environmental flow" determination methodologies. In order of increasing sophistication, time and cost, these are: hydrological index, hydraulic rating, habitat simulation and holistic methods. International good practice requires that scientific approaches are embedded within interactive frameworks that are objectives-oriented and involve stakeholder engagement. These use scientific analyses as necessary to match elements of the flow regime to identified objectives that reflect important river uses, values and services.

Downstream flow regime studies should focus on trade-offs among competing ecological, social and economic objectives, and seek to optimise the outcomes for the lowest impact and highest benefit. Examples of ecological flow objectives include: increasing habitat availability for nominated species, e.g. critical spawning areas for fish species; enhancing the population of a threatened species; or providing flows to trigger biological responses such as fish migration. Examples of social flow objectives include: ensuring water user safety; managing flood risks; supporting navigation needs; or maintaining water levels for irrigation pumps. Examples of economic flow objectives include: providing sufficient water availability to maintain local industries (e.g. irrigation, aquaculture, sport-fishing, rafting); and maximising electricity generation.

The approach taken needs to be proportional to the significance of the flow changes and the sensitivity of the flow-dependent aspects of

the downstream river system. Of importance is that a methodological and defensible process is followed to determine the link between flows and objectives. Regardless of the exact method used, a logical 12-step approach with the steps grouped into four stages is reflective of good practice, as follows.

### Stage 1: Characterising the Downstream Flows and Associated Values

1. Review of available maps, aerial photos and satellite images of the river system, catchment areas, major tributaries, and confluences downstream of the project to characterise the flow network and significant features (other projects, land-uses, townships, protected areas)
2. Review of climate, meteorological data and hydrological data to form a view regarding the major pre-project flow characteristics in the catchment and downstream river
3. Review of the storage and operational characteristics of the project to identify the implications for downstream flows
4. Definition of significant reaches (i.e. river sections) downstream of the project from a hydrological perspective (e.g. one reach is likely to be between the dam and tailrace, or more than one reach if a major tributary comes into this section of the river or there are other significant influences on flows; another reach between the tailrace and the next major tributary; another reach between the first and second major tributary downstream of the tailrace)
5. Identification of important river uses, values and services in each of the downstream river reaches based on analysis of existing data, plus consultations with project affected people and other stakeholders based on stakeholder mapping

### Stage 2: Defining Project Impacts

6. Design and implementation of more focussed data collection to evaluate the sensitivity of existing uses, values and services to flow changes expected by the project
7. Development of pre-project and post-project flow relationship analyses for important river uses, values and services on a reach-by-reach

basis, identifying the characteristics of the flow regimes that are most significant to maintenance of negatively affected aspects

### Stage 3: Cost-Benefit Analysis of Impact Mitigation Options

8. Identification of the mitigation options that could address those affected aspects based on data analysis, research and consultations, and including water management, infrastructure, or other management actions
9. Cost-benefit analyses of mitigation options following the mitigation hierarchy (avoid, minimise, mitigate, compensate), and including compensation options for significant residual downstream impacts that cannot be mitigated
10. Stakeholder discussions on priority approaches

### Stage 4: Mitigation Commitments

11. Downstream flow commitments are designed on a reach-impact basis
12. Supplementary commitments are defined to further address downstream impacts that are not resolved through flow management measures, such as bank erosion protection works or the creation of off-stream watering areas for stock

### Assessment

*Assessment criterion - Implementation Stage: Issues in relation to flow regimes downstream of project infrastructure during the project implementation stage have been identified and assessed; and monitoring is undertaken to assess effectiveness of flow management measures or any emerging issues during project implementation.*

*Assessment criterion - Operation Stage: 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.*

For hydropower projects at the implementation or operation stage, a permit or licence to operate has been issued which may or may not require dedicated releases to meet non-generational objectives (i.e. objectives other than for electricity

generation). The implementation stage may need particular consideration if for example a river will be dewatered for a long period while the newly created reservoir fills.

Mechanisms by which ongoing or emerging issues with the downstream flow regimes could be raised might include stakeholder engagement processes, grievance mechanisms, or follow-up monitoring programmes. Of importance is that the developer or owner/operator has processes in place that enable identification and evaluation of issues arising with regards to the downstream flows, and that these areas are not ignored or dismissed. Hydropower facilities are long-lived assets and over time the downstream community and the river values and other uses evolve, the science improves, and expectations of and demands for more water for social or environmental needs can increase. Cumulative impacts through later developments may also raise the need to consider downstream flow regimes from the hydropower facility. The experience of changed flow regimes may also draw attention to issues or concerns that had not previously been considered.

If there are issues and concerns with downstream flow regimes below hydropower infrastructure, the owner/operator should show that options to address these issues have been fully considered. It is not essential that all issues raised must be addressed through dedicated flow releases. There may be ways that the owner/operator can help meet the needs of other users or values without unduly impacting on the generation needs, and this should be explored. Non-flow related solutions to downstream flow issues have been exhibited in many places around the world. Examples of built solutions include: artificial spawning channels; off-river water storages; riverbank protection works; and habitat enhancement measures.

If commitments are made to delivery of specific downstream flow regimes, monitoring should be undertaken to verify delivery of commitments and that the objectives are being met. The methods, frequency and location for this monitoring process should provide information that enables a determination on delivery and effectiveness of downstream flow commitments and whether the objectives are being realised. Monitoring should be periodically reviewed to confirm that the data is meaningful and the monitoring programme is effective.

## Management

*Management criterion - Preparation Stage: Plans and processes for delivery of downstream flow regimes have been developed 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; and where formal commitments have been made, these are publicly disclosed.*

*Management criterion - Implementation Stage: In the case that a need to address downstream flow regimes has been identified, measures are in place to manage identified downstream flow issues; and where formal commitments have been made, these are publicly disclosed.*

*Management criterion - Operation Stage: 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.*

Management plans for downstream flow regimes should be incorporated into the Environmental and Social Management Plan (ESMP). Where commitments are made for dedicated downstream flow release regimes below hydropower infrastructure, these should be well-documented with respect to a number of aspects (e.g. objectives, flow magnitude, timing, seasonal variations, where measured, follow-up monitoring) and be publicly disclosed. Ideally, management plans will allow for later adaptations to be made based on findings from the monitoring programme and determinations on whether the flow regime is meeting the objectives.

Determinations on downstream flow regimes can result in power station or dam operational rules. These may take various forms, such as: guaranteed minimum flows; caps on maximum flow releases; constraints on water level draw-down or ramp-up rates; provision of periodic flushing or flood flows; flood or drought management rules; and rules in relation to spill events. Operational rules may include some or all of these considerations and may be specified for year-round or be conditional, e.g. by season or to be met under certain natural inflow or climatic

conditions. The location at which delivery of committed flows is guaranteed should be clear and tied into the monitoring commitments.

It is important to consider the mechanism for delivery of the flow regime commitments from a design perspective. Measures include, for example, through turbines, a pipe in the dam, gates or valves, a dedicated ecological power house, or a re-regulation storage. Whatever mechanism is chosen, its design would ideally allow for later adaptations in flow release characteristics given that knowledge, values and needs are likely to change over time.

A commitment should be made in writing to recognise its formality and be within an appropriate document signed by a recognised representative of the party who will deliver on the commitment. Legal and/or administrative requirements and court decisions are considered formal commitments. The formality of a commitment can be demonstrated by how it has been recorded, documented, witnessed and publicised by the party responsible for its implementation.

Public disclosure is demonstrated if members of the public can access information on the commitment if they would like to do so. This may involve access to the actual document that records the commitment (either posted on a website, distributed, or made available on request to interested parties), or public notification via a media release or website about the main provisions of the commitment. If there was a one-off notification, information may later be hard to access. In this case, some effort should be made by the owner/operator to ensure awareness of and ease of accessibility of information by stakeholders over time on downstream flow regime commitments.

## Stakeholder Engagement

*Stakeholder Engagement criterion - Preparation Stage: The assessment and planning process for downstream flow regimes has involved appropriately timed, and often two-way, engagement with directly affected stakeholders; ongoing processes are in place for stakeholders to raise issues with downstream flow regimes and get feedback.*

Good practice requires that a process of stakeholder engagement has been followed in the assessment and planning for downstream flow regimes.

During the project preparation, the social impact assessment and any stakeholder mapping should identify directly affected stakeholders for downstream flow regimes. Stakeholders who are directly affected might include riparian residents and land owners, irrigators, people who draw water for stock and domestic purposes, local government agencies (water suppliers), government regulators, fishermen, other recreational users, and tourism businesses.

‘Appropriately timed’ means that:

- engagement should be early and frequent enough so that the project can respond to the issues raised;
- stakeholders can respond before the project takes decisions; and
- engagement takes place at times that are suitable for people to participate (e.g. with respect to seasonality or time of day).

Stakeholders should be supportive of the timing of engagement activities. Communities need sufficient time to receive information, discuss it openly with the project representatives, and finally go through their own community dialogue processes before forming a consolidated community view to relay back into the evaluation processes.

‘Two-way’ means the stakeholders can give their views on considerations for downstream flow regimes rather than just being given information without any opportunity to respond. Examples of two-way processes include public meetings and hearings, public comments on studies and options assessment documents, interactive participation in workshops, negotiation, mediation, and focus groups.

Processes in place for stakeholders to raise issues could include, for example, a contact person and/or a “contact us” space on the company website, periodic public briefings or question/answer opportunities, or participation of company staff on stakeholder or catchment committees.



Feedback on stakeholder issues could be demonstrated by means such as emails, records of telephone conversations, written correspondence, meeting minutes, media releases, or provision of responses to frequently asked questions on the company website. Ideally a register is kept by the owner/operator of source, date and nature of issues raised, and how and when each was addressed and resolved.

Further and more detailed guidance relating to good international practice stakeholder engagement processes can be found in the Communications and Consultation guideline.

## Conformance/Compliance

*Conformance/Compliance criterion - Implementation and Operation Stages: In the case that a need to address downstream flow regimes has been identified, 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.*

Good practice requires evidence that commitments to downstream flow regimes are met. These should be separately considered for the implementation versus operation stages given that different issues may be relevant.

Commitments may be expressed in regulatory requirements for addressing downstream flow regimes, in relevant policy requirements of the developer or owner/operator, or in any relevant commitments made either publicly or within management plans. Evidence of adherence to commitments could be provided through, for example, internal monitoring and reports, government inspections, or independent review. Variations to commitments should be well-justified and approved by relevant authorities, with appropriate stakeholder liaison.

The significance of not meeting a commitment is based on the magnitude and consequence of that omission. For example, a failure to demonstrate delivery of a downstream flow commitment may be a significant non-compliance, whereas a slight delay in delivery of a monitoring report could be a non-significant non-conformance.

## Outcomes

*Outcomes criterion - Preparation Stage: Plans for downstream flows take into account environmental, social and economic objectives, and where relevant, agreed transboundary objectives.*

*Outcomes criterion - Implementation and Operation Stages: In the case that a need to address downstream flow regimes has been identified and commitments to downstream flow regimes have been made, these take into account environmental, social and economic objectives, and where relevant, agreed transboundary objectives.*

Of utmost importance is that the downstream flow releases are meeting objectives that reflect not just economic or financial interests but take into consideration environmental and social objectives important to stakeholders, as well as transboundary objectives if relevant. Objectives should be clear and data should demonstrate that these objectives are being met.

Transboundary objectives would be relevant if the downstream effects of the hydropower facility cross into a different jurisdiction than that in which the reservoir, dam and power station are found. If this is the case, then processes to assess and make determinations on downstream flow regimes should take into account transboundary stakeholder interests and objectives. There may be existing agreements in place establishing common objectives for management of the shared river system, or these may be developed alongside preparation of the project. Any existing transboundary river management agreements should be well-integrated into the assessment and decision-making on downstream flow regimes.



# Climate Change Mitigation and Resilience

*This guideline expands on what is expected by the criteria statements in the Hydropower Sustainability Tools (HST) for the Climate Mitigation and Resilience topic, relating to assessment, management, conformance/compliance, stakeholder engagement and outcomes. The good practice criteria are expressed for different life cycle stages.*

*In the Hydropower Sustainability Assessment Protocol (HSAP), this topic is addressed in P-24 for the preparation stage, I-21 for the implementation stage and O-20 for the operation stage. In the Hydropower Sustainability ESG Gap Analysis Tool (HESG), this topic is addressed in Section 12.*

This guideline addresses the estimation and management of the project's greenhouse gas (GHG) emissions, analysis and management of the risks of climate change for the project, and the project's role in climate change adaptation. The intent is that the project's GHG emissions are consistent with low carbon power generation,

and that it is resilient to the effects of climate change and contributes to wider adaptation to climate change.

**Climate change**, as defined by the Intergovernmental Panel on Climate Change, is a change in the state of the climate that can be identified by changes in the mean and/or the variability of its properties, and that persists for an extended period, typically decades or longer.

## Mitigation

**Climate change mitigation** is defined as human intervention to reduce the sources or enhance the sinks of GHG and other substances which may contribute directly or indirectly to climate change. For hydropower, climate change mitigation potential rests in the ability to provide clean energy with lifetime low GHG emissions.

Hydropower developments can contribute to reducing grid emissions by displacing fossil fuel generation and improving the feasibility of variable renewables through grid reliability services: flexible generation, ramping capability and energy storage. Nonetheless, the decision to significantly alter a river catchment by introducing a reservoir is not one to be taken lightly. The flooding of terrestrial land dramatically alters the natural state of the catchment and with it, the natural GHG cycle.

When land is inundated to create a reservoir, part of the flooded organic matter is decomposed by bacteria in the sediments and water column, releasing carbonic GHGs – carbon dioxide (CO<sub>2</sub>) and methane (CH<sub>4</sub>). Natural lakes, rivers and wetlands as well as some other land types also naturally emit or absorb GHG as part of their natural carbon and hydrological cycle. When estimating GHG emissions from a project, it is therefore important to assess the difference between pre- and post-impoundment emissions from the portion of the river basin influenced by the reservoir (including emissions from construction and operations activities), as well as the natural emissions that are displaced to or away from the reservoir site due to hydrological and other changes.

## Resilience

Hydropower systems are characterised by their longevity and are traditionally designed on the basis of long-term historical hydrological data and forecasts. Hydropower projects are, nonetheless, susceptible to the impacts of climate change due to their dependency on precipitation and runoff, and exposure to extreme weather events. For example, changes in the timing or seasonality of rainfall and subsequent stream flows could impact operations and expected revenues, depending on the seasonal pattern of energy demand or competing water uses.

**Hydropower climate resilience** is the capacity of a hydropower project or system to absorb the stresses imposed by climate change, and in the process evolve into greater robustness, maintaining the capacity for adaptation.

**Climate resilience analysis** in hydropower connects climate science and engineering to incorporate climate risk management into hydropower project appraisal, design, construction and operation, resulting in more robust and resilient processes. However, measuring the impacts of climate change at local level still carries high uncertainty inherent to actual climate change predictions. Therefore, the sector is building new approaches and methodologies to guide hydropower companies to address climate-related risks, and to propose measures to address these risks during the lifecycle of a project.

Hydropower systems, with their ability to store water behind dams in freshwater reservoirs, can provide a number of services (e.g. water supply, irrigation, and flood and drought management) that allow for a higher systemic resilience and capacity to adapt to climate change. **Climate change adaptation** is the process of adjustment to actual or expected climate and its effects. In human systems, adaptation seeks to moderate or avoid harm, or exploit beneficial opportunities. In some natural systems, human intervention may facilitate adjustment to expected climate and its effects.

Overall, planning hydropower systems from a long-term, climate-resilient perspective will ensure that future generations inherit infrastructure that will not be compromised by climate change and will be able to provide a range of climate adaptation services.

## Assessment

*Assessment criterion - Preparation Stage: For climate mitigation: power density has been calculated; if power density is below 5 W/m<sup>2</sup>, net GHG emissions (gCO<sub>2</sub>e) of electricity generation have been estimated and independently-verified; if power density is below 5 W/m<sup>2</sup> and estimated emissions are above 100 gCO<sub>2</sub>e/kWh, a site specific assessment of GHG emissions has been undertaken; and an assessment of the project's fit with national and/or regional policies and plans on mitigation has been undertaken.*

*For climate resilience: an assessment of the project's resilience to climate change has been undertaken, which incorporates an assessment of plausible climate change at the project site, identifies a range of resulting climatological and hydrological conditions at the project site, and applies these conditions in a documented risk assessment or stress test that encompasses dam safety, other infrastructural resilience, environmental and social risks, and power generation availability; and an assessment of the project's potential adaptation services and fit with national and/or regional policies and plans for adaptation has been undertaken.*

*Assessment criterion - Implementation Stage: For climate mitigation: power density has been calculated; if power density is below 5 W/m<sup>2</sup>, net GHG emissions (gCO<sub>2</sub>e) of electricity generation have been estimated and independently-verified; if power density is below 5 W/m<sup>2</sup> and estimated emissions are above 100 gCO<sub>2</sub>e/kWh, a site specific assessment of GHG emissions has been undertaken.*

*For climate resilience: an assessment of the project's resilience to climate change has been undertaken, which incorporates an assessment of plausible climate change at the project site, identifies a range of resulting climatological and hydrological conditions at the project site, and applies these conditions in a documented risk assessment or stress test that encompasses dam safety, other infrastructural resilience, environmental and social risks, and power generation availability.*

*Assessment criterion - Operation Stage: power density has been calculated; if power density is below 5 W/m<sup>2</sup>, estimates of net GHG emissions (gCO<sub>2</sub>e) of electricity generation are calculated and independently verified, and periodically updated; if power density is below 5 W/m<sup>2</sup> and estimated emissions are above 100 gCO<sub>2</sub>e/kWh, a site-specific assessment of GHG emissions is undertaken and periodically updated.*

*For climate resilience: an assessment of the project's resilience to climate change is undertaken and periodically updated; this assessment of project resilience incorporates an assessment of plausible climate change, identifies a range of resulting climatological and hydrological conditions at the project site, and applies these conditions in a documented risk assessment or stress test that encompasses dam safety, other infrastructural resilience, environmental and social risks, and power generation availability.*

## Mitigation

The first step towards good practice for climate change mitigation is to assess GHG **emissions intensity** – this is the grams of carbon dioxide equivalent per kilowatt-hour of electricity generated allocated to hydropower over the lifetime of the hydropower asset, assumed to be 100 years. A project with low emissions should have **less than 100 gCO<sub>2</sub>e/kWh**. For projects commissioned before 2004, the current emissions

intensity of the project (i.e. not including emissions in the past when the reservoir was initially formed) should be compared with systems emissions intensity (i.e. greenhouse gas emissions associated with the local, regional or national grid to which the project is connected).

GHG emissions from reservoirs could evade to the atmosphere through various pathways:

- **Diffusive flux:** in water bodies, CO<sub>2</sub> and CH<sub>4</sub> will diffuse slowly from the sediment, up through the water column, and eventually be emitted;
- **Bubbling:** because of the higher insolubility of CH<sub>4</sub>, bubbles of CH<sub>4</sub> can accumulate in the sediment when production rates are high enough. Those bubbles are then periodically liberated in the water column and to the atmosphere. This phenomenon tends to occur in shallow littoral areas;
- **Degassing:** many reservoirs exhibit a thermal stratification, where warmer surface water and colder deep water create a strong physical barrier called the thermocline, which substantially slows the diffusion of gases from the deeper part of the reservoir to the surface. As deep and anoxic water layers and sediments will lead to higher methane production, these bottom layers can sustain high dissolved methane concentrations. Therefore, when dams release water from low-level outlets, degassing occurs (i.e. excess methane is released to the atmosphere by the sudden pressure drop after the water leaves the outlet).

A number of factors that may influence GHG emissions from reservoirs include the following:

- **Water quality** (phosphorus content). The GHG dynamics of aquatic systems is highly influenced by the metabolic activity, which is in turn a function of the nutrient availability, in particular phosphorus, because it is the nutrient most-often limiting biological production in aquatic ecosystems;
- **Reservoir age.** Carbon in soil and biomass decreases as it is transformed into GHG and released to the atmosphere. Therefore, the rate of emissions generally decreases with age of the reservoir.
- **Reservoir location, environmental conditions and climate;**
- **Temperature.** Higher temperatures directly increase the bacterial activity leading to decomposition of organic matter. Also, higher air temperatures may influence the development of a thermal stratification;

- **Carbon stock** (i.e. the quantity of carbon present in the soil, in flooded biomass or that which is transported to the reservoir from upstream river catchment) and type of landscape flooded. For example, peatland would most likely have higher methane emissions than woodland or grassland on mineral soil.
- **Depth and shape of the reservoir, flow rate and water residence time.** Deep and anoxic water layers and sediments provide the conditions for methane production. In shallow areas, methane can be released directly from the sediments to the atmosphere through bubbling. Moreover, inflow and bathymetry influences the water retention time in the different parts of the reservoir, which determines the time available for biological processes to occur (including decomposition of organic matter).
- **Depth of the intake structure.** Reservoir outflows can draw water from various depths of the water column, depending on the particular configuration of a dam. When the intake is located in the deeper layer of a stratified reservoir, degassing may occur.

**Power density** (i.e. the watts of capacity per square meter of flooded area) is a predictor of emissions intensity. The recognised relationship between power density and emission intensity indicates that projects with a power density above 5 W/m<sup>2</sup> will exhibit emissions intensity below 100 gCO<sub>2</sub>e/kWh.

The power density calculation should include the average reservoir area (the area of flooded land, net of the pre-impoundment water body) and the capacity of the power facilities in the project fed by this water body. A number of facilities should be included where they are part of one project or scheme being developed (for example, a scheme of two facilities in a cascade, or a project with main and ecological power plants).

To quantify the net emissions from a reservoir, emissions before, during and after the reservoir's formation have to be estimated. In other words, **net GHG emissions** in gCO<sub>2</sub>e per kWh per year should be estimated using a recognised tool such as the G-res Tool or through site-specific calculations. In order to make claims on the results of estimations, these need to be independently-verified. For example, G-res Tool results should have to be verified by the G-res Expert Committee. Recognised tools or site-specific calculations should take into account:

- Pre-impoundment GHG emissions from the catchment, which represent the emissions balance from the landscape before the impoundment of the reservoir. Site-specific assessments or a pre-impoundment baseline should be based on measurement across sufficient spatial and temporal extent and resolution;
- Post-impoundment GHG emissions from the catchment, through diffusive flux from the lake, bubbling in littoral areas, degassing downstream of the outlet, and construction activities.
- Unrelated anthropogenic sources (UAS). These result from human activity occurring within or outside the reservoir, which is unrelated to the creation of the reservoir itself. The purpose of considering UAS is to separate the anthropogenic sources of nutrients, carbon and direct GHG emissions via inflow water (e.g. industrial effluents, wastewater treatment plants effluents, directly discharged sewage and drainage water, fertiliser leachate, and organic wastes (e.g. from a farm or a sawmill)) from those occurring directly from inundating the landscape. The estimation is based on land use, population, and known point sources in the catchment area;
- Emissions from construction and ongoing operational activities. These account for fuel and power use in transportation, manufacture of supplies (e.g. cement), and construction of the dam, associated facilities and transmission lines.
- The life cycle of the water body of at least 100 years;
- The allocation of emissions between electricity generation and other services provided by multipurpose projects. These services include flood control, fisheries, irrigation, navigation, recreation and water supply. They can be ranked as primary (i.e. operating rules are designed to maximise these services for part or all of the year), secondary (i.e. places operational constraints on the operating level of the reservoir for part of or the whole year) or tertiary (provides benefits, but has little or no impact on the operation of the reservoir).

Overall, the conceptual equation to determine net GHG footprint can be:

$$[\text{Net GHG footprint}] = [\text{Post-impoundment emissions}] - [\text{Pre-impoundment emissions}] - [\text{Unrelated anthropogenic sources emissions}] + [\text{Construction emissions}]$$

If estimated emissions are above 100 gCO<sub>2</sub>e/kWh, a **site-specific assessment** is required. This should include soil and water sampling using strategically located monitoring stations to capture the reservoir's heterogeneity (upstream reach; along the longitudinal axis of the reservoir, in vegetated and non-vegetated littoral zones; in embayments in the reservoir; close to the reservoirs outlets and from water passageways; and in the river downstream of the reservoir outlets). Moreover, the sampling frequency should take into account seasonality, the timing of the operations, and the timing of anthropogenic sources.

Finally, a project should **fit with national or regional policies and plans** by providing generation with similar emissions as cited in policies and plans or the project is below baseline power sector emissions. In some jurisdictions there may be more stringent requirements for emissions than values in the scoring statements, and the project should fit with the requirements applying currently.

**National or regional policies and plans** relevant to mitigation may include NDCs (nationally determined contributions), national climate change strategies, NAMAs (nationally appropriate mitigation actions), or national climate change mitigation plans.

## Resilience

For climate resilience, good practice should include an assessment that combines analytical climate science and hydropower engineering to incorporate climate risk management into hydropower project design, construction and operation.

A resilience assessment should look for plausible climate change scenarios using all available secondary information, and following a sequential approach such as:

- Baseline information. Obtain all relevant historical climatological and hydrological data for the project area, and identify observed climatological and hydrological trends, including extreme events at a river basin scale;
- Obtain data from global, regional or basin-scale climate models relevant to the project area for all available scenarios, and assess the degree of consistency between them;

- Based on a) and b), establish plausible climatological and hydrological scenarios for the project site.

An assessment shall comprise a stress testing and future climate change scenarios development in an approach of decision-making under uncertainty. A **risk register** that documents the risks by climate change impacts enhances the process. The outcomes of the **stress test** will set out the range of potential risks and hazards, and assess the probability and magnitude of the impacts. The results will be the basis to identify and prioritise measures to avoid, minimise and mitigate the risks and impacts of the plausible climate change scenarios.

The risk assessment shall use the following project characteristics as inputs: meteorology and hydrology (e.g. potential higher floods); geology/seismic/geotechnical/geohazard (e.g. major landslides at the project site); final site selection and type of project (e.g. access roads); dam height and reservoir size (communities living around the development area which may limit reservoir size); installed capacity (long term energy needs of the country may be unclear); health, safety, environment and social aspects (e.g. limited baseline data).

**Environmental and social risks** refer to the increased risk for the local environment and communities that result from the project within a context of a changing climate. For example, downstream environmental flows may not be feasible with decreased in-flows resulting from climate change.

**Climatological conditions** at the project site refers to annual averages, seasonal averages, and ranges of temperatures and precipitation, changes in the type and seasonal distribution of precipitation, and extreme weather events. Changes in these conditions will have effects on **hydrological and other conditions** including:

- precipitation and stream flows;
- altered seasonal patterns of precipitation and of run-off due to temperature changes;
- glacial melt or altered timing of glacial melt;
- intensity of floods and droughts;
- presence of ice (resulting in ice jams or affecting infrastructure such as power lines);

- frequency or magnitude of landslides;
- sediment transport.

The project may have opportunities to provide **adaptation services** to the local environment and communities. For example, these services may include the provision of water for irrigation, drought and flood preparedness programmes, flood early warning systems, and community infrastructure such as water supplies. To achieve good practice, such services should be assessed. Moreover, in this regard the project should fit with national policies, plans and commitments on adaptation (for example national adaptation plans).

## Management

*Management criterion - Preparation Stage: For climate mitigation: if GHG emissions estimates assume design and management measures, there are plans to put these measures in place.*

*For climate resilience: the project design is based on plausible climate change scenarios; and structural and operational measures are planned for design, implementation and operation phases to avoid or reduce the identified climate risks.*

*Management criterion - Implementation Stage: If GHG emissions estimates assume design and management measures relevant to the implementation stage, these measures are in place; measures relevant to the implementation stage are in place to avoid or reduce the identified climate risks.*

*Management criterion - Operation Stage: For climate mitigation: if GHG emissions estimates assume management measures, these measures are in place.*

*For climate resilience: measures are in place to avoid or reduce identified climate risks.*

## Mitigation

For projects with emissions estimated at more than 100 gCO<sub>2</sub>e per kWh, design, construction and operational measures should be identified to lower emissions below this figure. Examples of such measures include:

## Design measures:

- Reservoir siting and design to minimise water retention time, the extent of the shallow area, the degree of flooded organic matter or stratification;
- Selective or multi-level offtakes incorporated for projects with deep reservoirs to limit the amount of water drawn into the power station from cold, anoxic depths (i.e. below thermocline, where methane production may occur);
- Increase oxygen concentrations through reservoir design to minimise water residence time;
- Air injection facilities in the power station;
- Increasing power density with further expansion.

## Construction measures:

- Optimising construction vehicle use and movement, particularly for large scale excavation and filling;
- Driver training in efficient vehicle operation;
- Optimising transport efficiency for materials delivery, waste disposal and construction workers travel;
- Minimise energy used in temporary site buildings;
- Procurement policies accounting for the CO<sub>2</sub>e footprint – both embodied and operational. For example: requiring, as a condition of tendering, all suppliers to state the carbon footprint of their materials, products and services.
- Water use management: water quantity and quality needs are thoroughly identified in the design and feasibility studies;
- Waste management and reduction: mitigate sewage, solid waste and polluted run-off from worker camps, workshops, buildings;
- Well-designed drainage collection points: run-off and wastewater treatment plants are of an appropriate capacity with discharge points in high velocity flow areas away from water users.
- Biomass clearance should be carefully assessed before being used as a default mitigation measure for preventing GHG emissions. A large part of GHG emissions stems from carbon trapped in soil, whereas tree trunks do not decay rapidly thus retaining the embedded carbon. Apart from the possible GHG emission reduction, the biomass removal assessment should take into account the commercial value of the biomass as well as possibly improved water quality and future use of the reservoir for fishing and other ecosystem services.

## Operational measures:

- Seasonal management of reservoir operations to ensure releases of oxygenated water at seasonally appropriate temperatures.
- Water quality management measures, such as: catchment management measures such as reforestation, protected areas, check dams, drainage works, rehabilitation, fertiliser use reduction strategies.
- Mitigate sewage and solid waste from increased population attracted to the area through dialogue with the local municipality about capacities of existing solid and wastewater collection and treatment facilities; and partnership on upgrade or augmentation measures in a timely manner.

## Resilience

Climate resilience is relevant to both existing and new projects. As such, resilience should be built into hydropower developments at the planning, implementation and operation stages. Examples of **design or structural measures** are listed below (following a possible construction sequence):

- Access roads and camps: suitable pavement materials and additional construction joints for temperature variations; increased drainage systems to cope with increased runoff; additional landslide hazard assessment and slope protection for increased risk of slope instability; revised route selection; more robust assessment of camp location.
- River diversion works: ensuring temporary structures, such as cofferdams, diversion tunnels are designed for higher return period, or for estimated increase inflow.
- Dam structure: additional flushing, sediment management facilities, and raising of dam crest to increase live storage, for increased sediment load; increase spillway capacity (considering increased probable maximum flood); additional spillways; reassess dam design to allow overtopping with provision of dam toe erosion protection (in concrete dams); additional upstream parapet or wave wall on dam crest; provision for future increase of storage capacity and full supply level raising; additional construction joints, change of concrete mix, and concrete temperature control to cope with increasing temperatures.

- Powerhouse: increased flood defences for the powerhouse; relocation of powerhouse; relocation of spillway to ensure floods are discharged downstream of powerhouse; increased civil works to be adaptable for future additions of electro-mechanical equipment (e.g. space in the powerhouse for additional turbines and generators);
- Electro-mechanical equipment: installations of variable speed turbines or turbines with higher efficiency for a wide range of discharges; install corrosive-resistant turbine blades (corrosion is more aggressive at high temperatures).
- Downstream flows: design environmental flow capacity with potential for varying discharge rates; design fish passage systems with potential varying discharge rates.
- Reservoir management: detailed reservoir rim stability assessment for slope stabilisation in areas more vulnerable to landslides due to changes in precipitation and runoff patterns.
- Transmission lines: reassessment of transmission towers location; design tower foundations for greater stability uncertainty; amend specification of conductors to be more resilient for a range of temperatures.

For new and existing projects, non-engineering or functional measures should be considered. Examples of such measures may include the following:

- Operations: plan for revised optimal minimum operating level; change operating rules such as revised reservoir level limits in order to provide an increased flood storage buffer; revise monthly operating rule curves.
- Reservoir management: restricting the development of land within the zones susceptible to flooding; protect or remove vulnerable areas.
- Multipurpose services: identifying the impacts of climate change upon the various users of water within a watershed (e.g. less rainfall in the watershed could increase water demand from the reservoir for irrigation, leading to reduced electricity generation); modifying legal agreements between various governments, stakeholders and other identities that have an impact upon the operation of the watershed; improving technologies used to coordinate the interaction of various hydro projects as well as



the global operation of complexes involving several watersheds; modifying rules that have an influence upon recreation, irrigation, water supply and industrial water abstraction; reassess type of scheme (base load/ peaking and run-of-river/ storage) to address changing water and energy demand levels.

- Environmental and social risks: disaster preparedness and response plans for affected communities, guaranteed downstream flows, enhanced flood management or drought-response programmes.

## Stakeholder Engagement

*Stakeholder Engagement criterion - Preparation Stage: For climate mitigation: power density calculations, estimated GHG emissions, and / or the results of a site-specific assessment have been publicly disclosed.*

*For climate resilience: plans for the management of climate risks have been discussed with stakeholders.*

*Stakeholder Engagement criterion - Implementation Stage: For climate mitigation: power density calculations, estimated GHG emissions, and / or the results of a site-specific assessment have been publicly disclosed.*

*For climate resilience: ongoing processes are in place for stakeholders to raise issues and get feedback on the management of climate risks.*

*Stakeholder Engagement criterion - Operation Stage: For climate mitigation: power density calculations, estimated GHG emissions, and / or the results of a site-specific assessment are publicly disclosed.*

*For climate resilience: ongoing processes are in place for stakeholders to raise issues and get feedback on the management of climate risks.*

In stakeholder engagement, it is important that plans for the management of increased dam safety, environmental and social risks, and adaptation services have been discussed with stakeholders. For example, the provision water supply, irrigation, flood preparedness programs, or early warning systems.

**Public disclosure** of emissions calculations is important for credibility. Public disclosure of power density refers to the disclosure of the details of the calculation, demonstrating how the calculation conforms to the definition of power density above and public information on the project design.

Processes in place for stakeholders to raise issues at any point in the life of the project or operating facility may be through a formal grievance mechanism, or through less formal means. These could include, for example: a contact person and/ or a 'contact us' space on the company website; periodic public briefings or question/answer opportunities; participation of company staff on stakeholder or catchment committees; and regular meetings and issue-raising mechanisms developed in liaison with local government authorities.

Feedback on stakeholder issues could be demonstrated by means such as emails, records of telephone conversations, written correspondence, meeting minutes, media releases, or provision of responses to frequently asked questions on the company website. A widely used good practice for developers and owners/operators is to keep a register of source, date and nature of issues raised, and how and when each was addressed and resolved. Closure of issues back with the stakeholder who raised them is essential.

## Conformance/Compliance

*Conformance/Compliance criterion - Implementation and Operation Stages: processes and objectives relating to climate change mitigation and resilience have been and are on track to be met with no significant non-compliances or non-conformances, and any mitigation-related and resilience-related commitments have been or are on track to be met.*

During implementation and operation, the project should be in conformance with the objectives and commitments set out in the management plans, and any broader corporate commitments. For example, if the license for the project or the lender's requirements refer to mitigation or resilience measures, then these measures are followed.

Evidence of adherence to commitments could be through, for example, internal monitoring and reports, government inspections, or independent review. Variations to commitments should be well-justified and approved by relevant authorities, with appropriate liaison with stakeholders.

Significance of not meeting a commitment is based on the magnitude and consequence of that omission, and will be context-specific. For example, a failure to demonstrate delivery of a resilience commitment such as increasing flood defences for the power house is a significant non-compliance, whereas a slight delay in delivery of a monitoring report could be a non-significant non-conformance.

## Outcomes

*Outcomes criterion - Preparation Stage: For climate mitigation: the project's GHG emissions are demonstrated to be consistent with low carbon power generation, and the fit of the project with national and regional policies and plans for mitigation can be demonstrated.*

*For climate resilience: plans will deliver a project that is resilient to climate change under a range of scenarios; and the fit of the project with national and regional policies and plans for adaptation can be demonstrated.*

*Outcomes criterion - Implementation Stage: For climate mitigation: the project's GHG emissions are demonstrated to be consistent with low carbon power generation.*

*For climate resilience: plans will deliver a project that is resilient to climate change in under a range of scenarios.*

*Outcomes criterion - Operation Stage: For climate mitigation: the project's GHG emissions are demonstrated to be consistent with low carbon power generation.*

*For climate resilience: findings of the climate change assessment indicate that the project is resilient to climate change.*

### **Consistency with low carbon power generation**

may be demonstrated by alignment with national plans for mitigation, and: a power density greater than or equal to 5 W/m<sup>2</sup>; or net emissions intensity that is less than internationally-recognised thresholds at the time of the assessment (such as less than 100 gCO<sub>2e</sub>/kWh); or emissions reductions at the system level. Projects commissioned prior to 2004 can demonstrate consistency with low carbon generation by showing that current emissions intensity is lower than current emissions at the system level. **System emissions** shall mean greenhouse gas emissions associated with the local, regional or national grid to which the project is connected.

In the preparation stage, a project's fit with national or regional policies and plans is demonstrated when, for example, its generation's emissions are similar to emissions cited in policies and plans, or the project is below baseline power sector emissions. In some jurisdictions, there may be more stringent requirements for emissions than values in the scoring statements, and the project should fit with the requirements applying currently.

Good practice requires that the above should be demonstrated with the following evidence: power density calculation; results of G-res Tool application or other tool; verification report on G-res Tool application; climate change studies in the region; analysis of plausible climate change, and conditions at the project site; risk assessment or stress tests; national and regional policies and plans on mitigation and adaptation; feasibility study; operational plans; environmental and social management plans; results of the assessment of climate change adaptation services; disaster preparedness and response plans; minutes of meetings with stakeholders; and evidence of public disclosure.



## About the tools

The Hydropower Sustainability Tools define international good and best practice in sustainable hydropower development and are used to assess the sustainability of individual projects.

**[HydroSustainability.org](https://www.hydro-sustainability.org)**