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Environmental, Climate and Social Guidelines on Hydropower Development

European Investment Bank
The EU bank

Environmental, Climate and Social Guidelines on Hydropower Development

PUBLICATION DATE: OCTOBER 2019

Disclaimer to the reader: these guidelines do not legally bind the EIB. The purpose of these guidelines is to set out the European Investment Bank's Environment, Climate and Social objectives for investments in hydropower projects, with the intention of establishing the sector-specific standards and criteria that promoters are expected to uphold when receiving financing from the EIB. The guidelines do not in any way override the applicable contractual framework that applies to the EIB's projects and cannot in any way be construed to give rise to any rights for third parties or create any legal obligations for the EIB.

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List of Acronyms

CAPEX – Capital Expenditure

CIA – Cumulative Impact Assessment

CIS – Common Implementation Strategy

EIA – Environmental Impact Assessment

EIB - European Investment Bank

EFR – Environmental Flow Release

EFTA – European Free Trade Association

E(S)IA – Environmental (and Social) Impact Assessment

ESMS – Environmental and Social Management System

EU – European Union

FI – Financial Intermediary

GHG – Greenhouse Gases

HMWB – Heavily Modified Water Body

ICOLD – International Commission on Large Dams

IWRM – Integrated Water Resources Management

NGO – Non-Governmental Organisation

POE – Panel of Experts

RBMP – River Basin Management Plan

SEA – Strategic Environmental Assessment

UNECE – United Nations Economic Commission for Europe

UNESCO – United Nations Educational, Scientific and Cultural Organisation

WFD – Water Framework Directive

1. Introduction

i. Preamble

Hydropower is currently the largest source of renewable power worldwide[1], and is therefore an important contributor to low-carbon clean development. However, the development of hydropower has been extensively criticised over many years because of its potential negative environmental and social impacts. The impacts of hydropower projects are often cumulative over large parts of river basins, affecting sensitivities such as biodiversity sites, communities and other water uses.

These guidelines set out the EIB's Environmental, Climate and Social objectives for investments in hydropower projects, establishing sector-specific standards and criteria, which promoters should meet. They also summarise best practice recommendations for integrating social, biodiversity, natural resource management and climate considerations into hydropower projects. They have been written for use by hydropower promoters, who should take the requirements and recommendations into account from the early stages of the project development cycle, preferably during the pre-feasibility stage. The guidelines will also serve as a reference for other stakeholders with interests in hydropower projects.

The term "hydropower project" is used to refer to rehabilitated, refurbished, modified or new hydropower facilities comprising *inter alia*, and where relevant, dam and reservoir, water intake and transmission structures, power plant, all civil works, and electrical and electro-mechanical equipment from water collection points until the delivery point to the grid, as well as any associated infrastructure.

The EIB remains technology-neutral in its decision-making process for financing energy projects, and considers the appropriateness of hydropower as part of its appraisal. The EIB (and where appropriate its financial intermediaries) will treat potential hydropower investments on a case-by-case basis, assessing the features of the project and information on the biophysical and socio-economic context within which the project would be constructed, rehabilitated or refurbished, and subsequently when it is operational and, if appropriate, ultimately decommissioned. The EIB will promote the best practice mitigation of environmental and social impacts and risks. It supports the EU approach to sustainability in compliance with EU legislation and the EIB's *Environmental and Social Standards*, whilst also drawing on wider international best practice as appropriate.

ii. Applicability of the Guidelines

These guidelines are applicable to all types of small and large hydropower projects,[2] including run of the river, storage, pumped storage and diversion. They also apply to associated infrastructure, which may include any of the following:

- Access roads (temporary and permanent).
- Construction workshops, offices and laydown areas.
- Permanent offices and staff accommodation.
- Security posts and fencing.

[1] International Energy Agency: *Renewables 2018* https://www.iea.org/renewables2018

[2] See Box 1 regarding definitions of hydropower project scale.

- Coffer dams and diversion channel(s) to divert water flows during construction.
- Quarries and borrow pits.
- Accommodation for the construction workforce (construction camp).
- Transmission lines.

The guidelines are applicable to all EIB operations in the hydropower sector, including intermediated operations.

Box 1 Benchmarks for Hydropower Project Scale

There are a number of different ways to classify the scale of a hydropower project depending upon the particular context or purpose of the classification. One simple and commonly used approach is to classify a scheme based on its installed capacity (in megawatts). However, in some circumstances more specific definitions have been adopted as follows:

- For dam safety planning, the International Commission on Large Dams (ICOLD) definition of a large dam is used. This is greater than 15 m in height, or between 5 and 15 m with a reservoir greater than 3 million m^3 in volume.
- For storage schemes, a large reservoir is taken to be one with a capacity in excess of 10 million m^3 (the threshold used for Annex I dam storage projects under the EU EIA Directive).
- When considering potential environmental impacts, a significant Degree of Regulation (DOR) in the river system is taken as greater than 5%, where DOR is defined as the ratio between the total artificial storage capacity (including any upstream reservoirs) and the average annual flow volume at the project site.[1]

It is recognised that the above benchmarks are only indicative, and that other factors (e.g. surface area) can be equally or more important in assessing the effects of a scheme. This is discussed where relevant within the document.

[1] Threshold developed by The Nature Conservancy to represent conditions whereby significant environmental (and associated ecosystem services) impacts generally start to occur (The Power of Rivers: Finding a balance between energy and conservation in hydropower development, TNC, 2015).

The EIB provides financing to financial intermediaries (FIs) in the form of loans, equity and debt participations, and guarantees. Any hydropower project funded by a financial intermediary using EIB finance will be subject to screening and due diligence in accordance with the requirements set out in these guidelines and the EIB's *Environmental and Social Standards*.

The EIB will require FIs to answer, in writing, the questions listed in Box 2 for all potential investments in hydropower projects before providing finance. FIs will liaise with the final beneficiaries to provide the responses. This information will be used to differentiate between: (a) projects for which appraisal (validated by the EIB) may be delegated to the FI according to the procedures agreed between the EIB and the intermediary; and (b) projects for which environmental and social appraisal will be referred back to the EIB.

Box 2 Hydropower-specific Questions for Intermediaries

- Does the project involve any physical resettlement or, if outside the EU, either physical or economic displacement?
- Is there a Water Framework Directive-compliant River Basin Management Plan, or equivalent for non-EU/EFTA/Candidate Countries, for the river where the project will be implemented? Is the project included in the plan, or planned to be included in the next revision?
- Is the project site located within, or in close proximity to (FI should indicate the distance), any Natura 2000 areas (or outside EU and Candidate Countries, those defined under the Emerald Network[1] or other areas designated nationally or internationally for nature protection purposes) and/or are there any such areas downstream of the project site within the same river basin?
- Does the project either:

- Create additional storage volume in excess of 10 million m³?[2]
- Introduce a Degree of Regulation (DOR) into the river system greater than 5%, where DOR is defined as the ratio between the total artificial storage capacity (including any upstream reservoirs) and the average annual flow volume at the project site? [3]

[1] Sites of Special Conservation Interest in the Emerald Network (see *https://www.coe.int/en/web/bern-convention/emerald-viewer*).
[2] Threshold used for Annex I dam storage projects under the EU EIA Directive.
[3] Threshold developed by The Nature Conservancy (TNC) to represent conditions whereby significant environmental (and associated ecosystem services) impacts generally start to occur (*The Power of Rivers: Finding a balance between energy and conservation in hydropower development*, TNC, 2015).

Should the environmental and social appraisal of the project fall under the EIB's direct responsibility, this may entail direct due diligence by the EIB's services or the appointment of a qualified consultant to undertake appropriate due diligence with a duty of care to the EIB, and may also require the establishment of an independent panel of environmental and social experts.

Otherwise, the involvement of an environmental and social consultant and/or an independent panel of environmental and social experts will be at the FI's discretion, taking into consideration its responsibility to comply with the EIB's Environmental and Social Standards, the requirements set out in these guidelines, and all other applicable requirements.

Where the EIB is providing financing to an FI, the FI will disclose the list of hydropower projects it is financing on its website. The FI will also be responsible for promptly addressing any queries from local communities or civil society organisations regarding such operations and in line with the E&S obligations. Detailed technical aspects of hydropower project design, construction and operation are not within the guidelines' scope as they are covered elsewhere in guidance provided by professional associations and design standards; where appropriate these are referenced in this document, and details are provided in the "*Key References*" section at the end of the document.

iii. Policy Environment

The EIB's lending strategy and objectives are underpinned by the EU's principles of sustainable development, in particular the protection and enhancement of biodiversity, the promotion and protection of human rights and actions to counter climate change. The EIB advocates the promotion of multi-purpose schemes that provide sustainable benefits to the communities they serve. Site selection for hydropower projects can benefit from the early assessment of key potential impacts and risks, including biodiversity and ecosystem services, eutrophication, climate change, greenhouse gases, cultural heritage and involuntary resettlement.

The EIB promotes the EU approach to environmental and social issues, and its sustainability policies and principles are defined as requirements in the EIB *Environmental and Social Standards* that are applicable to all EIB operations (see below). These requirements are supplemented and supported by the hydropower-specific requirements and recommendations in these guidelines.

- Assessment and Management of Environmental and Social Impacts and Risks
- Pollution Prevention and Abatement
- Biodiversity and Ecosystems
- Climate Change-related Standards
- Cultural Heritage
- Involuntary Resettlement
- Rights and Interests of Vulnerable Groups
- Labour Standards
- Occupational and Public Health, Safety and Security
- Stakeholder Engagement

The EU policy framework is primarily defined by the most relevant EU Directives. These include, amongst others, the following:

- *SEA Directive 2001/42/EC.*
- *EIA Directive 2011/92/EU as amended by 2014/52/EU.*
- *Water Framework Directive 2000/60/EC (see Box 3).*
- *Habitats Directive 92/43/EC.*
- *Birds Directive 2009/147/EC.*

The EIA Directive is enshrined within the EIB Standard on the Assessment and Management of Environmental and Social Impacts and Risks and will (as with all relevant EU environmental legislation) apply within the EU Member States and Candidate Countries.[3] The principles of EU environmental legislation will be followed in other countries. Implementation of these directives is supported by a number of EU guidance documents, including several relating to the EIA Directive[4] and the Habitats Directive, and the following guidance, which has specific relevance to hydropower projects:

- *Guidance on the requirements for hydropower in relation to Natura 2000 (EC DG ENV, 2018).*
- *WFD CIS Guidance Document 36: Exemptions to the environmental objectives according to WFD Article 4(7) (EC DG ENV, 2017).*
- *Climate Change and Major Projects: Outline of the climate change-related requirements and guidance for major projects in the 2014-2020 programming period (EC DG CLIMA, 2016).*
- *WFD CIS Guidance Document 31: Ecological flows in the implementation of the Water Framework Directive (EC DG ENV, 2015).*

Box 3 Hydropower and the Water Framework Directive (WFD)

The EU Water Framework Directive (2000/60/EC) requires development projects (including new physical modifications) to help any affected water bodies achieve good status (or good potential in heavily modified water bodies (HMWBs) and artificial water bodies (AWBs)) and to ensure that no deterioration in status – or failure to achieve a planned or potential improvement in status – has occurred.

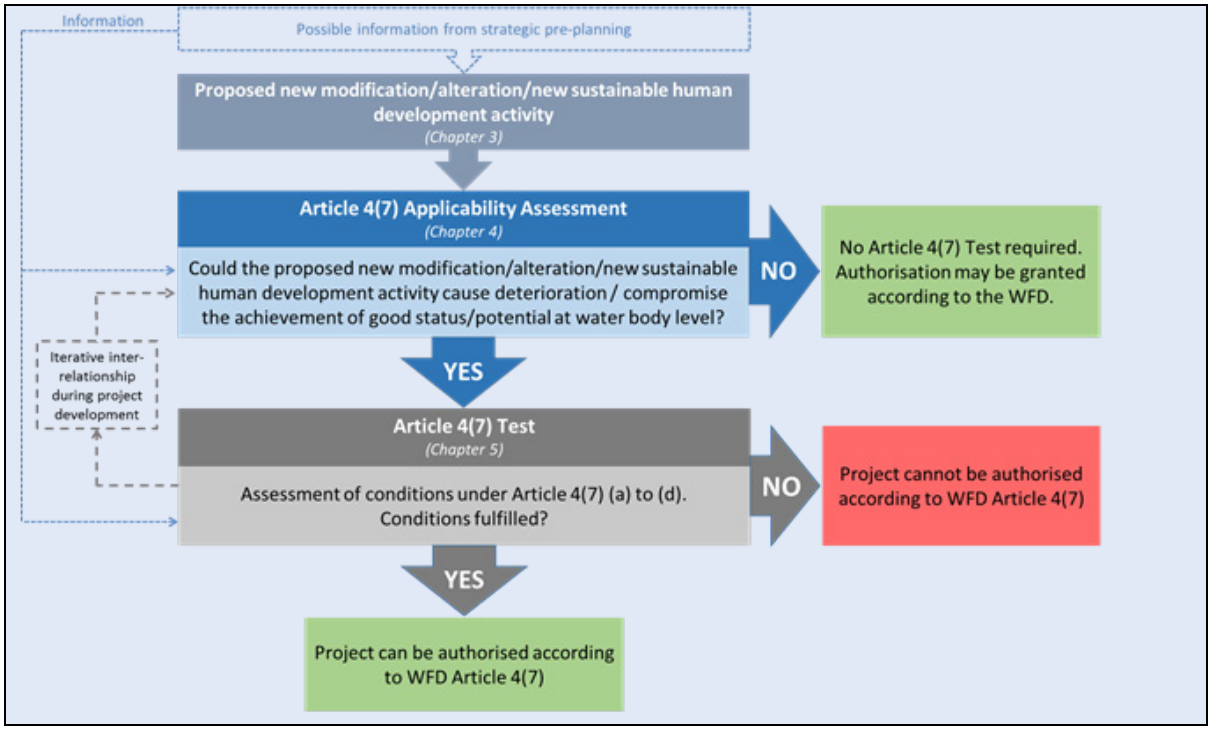
Under WFD Article 4(7), exemptions can be applied by Member States for new modifications and new sustainable human development activities. This can relate to new projects (e.g. new hydropower schemes) or to modifications to existing schemes. Article 4(7) requires the reasons for modification or alterations leading to deterioration of status to be set out and explained in the Member States' river basin management plans (RBMPs). It is generally assumed that a new hydropower plant will lead to a deterioration of good status and the procedure of Article 4(7) is generally followed.

In order to apply Article 4(7), a certain process has been agreed and outlined in the WFD Common Implementation Strategy Guidance.

a) All practicable steps are taken to mitigate the adverse impact on the status of the body of water;
b) The reasons for those modifications or alterations are specifically set out and explained in the River Basin Management Plan required under Article 13 and the objectives are reviewed every six years;
c) The reasons for those modifications or alterations are of overriding public interest and/or the benefits to the environment and to society of achieving the WFD objectives are outweighed by the benefits of the new modifications or alterations to human health, to the maintenance of human safety or to sustainable development; and
d) The beneficial objectives served by those modifications or alterations of the water body cannot for reasons of technical feasibility or disproportionate cost be achieved by other means, which are a significantly better environmental option.

[3] The EIA Directive requires assessment of hydropower projects: Annex 1 includes "dams and other installations designed for the holding back or permanent storage of water, where a new or additional amount of water held back or stored exceeds 10 million m^3"; Annex II includes: "installations for hydroelectric energy production" and "dams and other installations designed to hold water or store it on a long-term basis (projects not included in Annex I)"; and "Installations for hydroelectric energy production".

[4] http://ec.europa.eu/environment/eia/eia-support.htm



Other documents providing valuable examples of international best practice in sustainable development of hydropower are identified as appropriate in these guidelines and listed under *Key References*.

2. Strategic and Basin-Wide Issues

This section focuses on the broader strategic or river basin-level impacts that may result from the development of a hydropower project. These include the following:

- Potentially significant cumulative impacts (e.g. on habitat loss and fragmentation, flow regulation and sediment and nutrient transport) from a series of hydropower developments within a single river basin or region, and associated weaknesses in the analysis of strategic and project-level alternatives.
- Potential transboundary impacts both from and to hydropower projects, e.g. from changes in upstream land use and/or water use, inundated areas, or from changes to downstream patterns of flow or sediment and nutrient transport, which in fragile environments may create or increase the potential for conflict between water users and/or communities.
- The potential impact of weak governance structures on the planning and implementation of hydropower projects leading to poor performance or delays, e.g. from ineffective stakeholder engagement and buy-in (e.g. due to lack of community benefit sharing), through to ineffective environmental and social performance management, etc.

The EIB's various requirements for the design and operation of hydropower projects in relation to the above issues are summarised here.

i. Cumulative Basin-Level Impacts

Cumulative impacts are usually defined as those occurring on a valuable ecosystem resource as a result of the incremental effects of the project concerned and any other past, existing, and reasonably foreseeable future anthropogenic activities. They can occur from the combined effects of different components of a single hydropower project (e.g. reservoir, powerhouse and associated facilities), from a series of hydropower projects planned for the same river (cascade arrangement) or on several tributaries within a river basin, or from other intended projects that would use and affect the same resources.

Cumulative impacts can include direct natural habitat loss from the accumulated project footprints, aquatic habitat fragmentation due to the isolation of river reaches and habitats between impoundments/barriers, or degradation of ecosystem services due to the fundamental alteration of hydrological conditions and sediment and nutrient transport along the length of a river to its estuary.

EIB Requirements/Recommendations Cumulative Basin-Level Impacts	Required	Recom-mended
1. The EIB **will only consider financing hydropower projects where an appropriate cumulative impact assessment or equivalent study has been undertaken that identifies and addresses any significant regional or basin-level environmental and social impacts**, preferably at the strategic planning stage (see below). Such a study must consider all of the planned infrastructure developments in the basin, for example as part of a hydropower cascade.	✓	
2. In the case of EU Member States and Candidate Countries, the **project must be included within the relevant River Basin Management Plan under the EU WFD (or set for inclusion in the next iteration of the plan) and in so doing subject to economic analysis in accordance with WFD CIS Guidance Document No. 1**[5] and subject to an applicability assessment that will determine whether or not it is necessary to apply the Article 4(7) tests (see Box 3)**.** The	✓	

[5] European Commission DG ENV, 2003. WFD CIS Guidance Document 1: Economics and the Environment – The Implementation Challenge of the Water Framework Directive.

EIB Requirements/Recommendations Cumulative Basin-Level Impacts	Required	Recom-mended
project should also have been subject to a Strategic Environmental Assessment (SEA) under the EU SEA Directive if part of a plan or programme, and the results and conclusions of this SEA carried forward into the project design.		
3. For projects located outside of the EU, **alignment with the EU Water Framework Directive principles must be demonstrated through the implementation of one or more of the following strategic studies: Strategic Environmental Assessment, where applicable, Cumulative Impact Assessment, Integrated Water Resources Management Plan or similar. These studies should include proper consideration and mitigation of any significant impacts on river flows, quality and morphology at the scale of the basin in order to protect ecological flows and water users**. It would also need to incorporate a consultation process that includes the full range of basin stakeholders (it may also, in some circumstances, include transboundary consultation, as discussed below).	✓	
4. In line with the requirements of the Standard on the Assessment and Management of Environmental and Social Impacts and Risks (and the EIA Directive), the description, within the E(S)IA of reasonable alternatives studied by the promoter, **must: a) have evaluated decommissioning as an alternative option when rehabilitation of an existing hydropower project is considered** and presented a robust justification for the option selected; and **b) justify proposals for a new, greenfield hydropower project** in river basins where old hydropower projects exist against the alternative of rehabilitating or refurbishing those existing hydropower plant(s).	✓	
5. It is **recommended that strategic studies be conducted at the earliest possible stage during project planning so that the optimal balance between financial return and environmental and social costs can be achieved between different hydropower options in a river basin or region**. Strategic and system-wide planning tools are emerging to support this integrated assessment and scheme optimisation process to be carried out (e.g. TNC's Hydropower by Design approach[6]). The aforementioned *CIS Guidance Document No. 1* also provides detailed guidance on economic analysis in support of integrated water resource planning.		✓

ii. Potential Transboundary Impacts

International boundaries are often demarcated by large rivers, and as such, a reservoir footprint may extend across a border. Similarly, the headwaters of a reservoir may be seasonally dependent, for example extending further upstream during the flood season, and therefore may impinge on an international boundary on a transient basis. Whilst these impacts are usually fairly self-evident, the potential downstream impacts from a hydropower scheme – on seasonal patterns of river flow, sediment and nutrient transport – may extend for dozens of kilometres downstream, and can easily cross international boundaries.

In addition to the potential transboundary impacts of a hydropower project, there are also a range of potentially very significant impacts on a project relating to changes in upstream land and/or water use. Aside from a decrease in water resource potential through increased upstream abstractions, these can include increased sediment runoff and/or pollution from deforestation, land degradation or other economic development activities. Potential transboundary conflict might result from reductions in water availability or water quality, and competing water uses.

EIB Requirements/Recommendations Potential Transboundary Impacts	Required	Recom-mended
6. In accordance with the EIB Standard on the Assessment and Management of Environmental and Social Risks and Impacts, all projects financed by the EIB **must identify and address any transboundary impacts as applicable** as part of the E(S)IA process. In assessing whether transboundary impacts may occur from a hydropower development, **the E(S)IA process must**	✓	

[6] The Nature Conservancy (TNC) & Inter-American Development Bank, Nov 2013. The New Frontier of Hydropower Sustainability: Planning at the System Scale.

EIB Requirements/Recommendations Potential Transboundary Impacts	Required	Recom-mended
include **a robust assessment of the geographical area likely to be affected,** including the potential downstream influence on flows, sediment and nutrient transport. 7. Regardless of whether parties are signatories, the above assessment and associated consultation process **should be consistent with the principles of the UNECE Convention on EIA in a Transboundary Context** (the ESPOO Convention) at project level. These include that all appropriate and effective measures be taken to prevent, reduce and control significant adverse transboundary impacts, and that best efforts be made to undertake an effective and early process of stakeholder identification and engagement with affected transboundary parties using a conflict-sensitive approach. This would include the preparation of a cadastre of downstream water users.	✓	

iii. Governance and Community Support

Hydropower projects (particularly larger ones) will be major components in energy and infrastructure planning, and as such are likely to be of regional or national importance. Like all major projects, effective governance arrangements will be critically important to project success, but in the case of hydropower projects, this importance is heightened further by several factors, including the following:

- The long construction and operational life of hydropower projects: good governance principles and structures must be able to withstand changes of political regime, reassessment of strategic priorities, and the exit of funders.
- Many hydropower projects are designed for multiple uses, e.g. they include water supply, irrigation or flood control. This introduces challenges in providing benefits for several groups of end-users (see Box 4).

Box 4 Key Principles of Benefit Sharing in Hydropower Projects

Evolving good practice in benefit sharing for hydropower and other dam projects[1] aims to counter the potential for affected communities to be net losers, and those benefiting most to be groups such as the residents of energy-hungry urban centres that may be hundreds of kilometres away, or across an international boundary.
Good practice benefit sharing requires robust and transparent governance and stakeholder engagement processes to be used throughout the project: a) to understand affected communities' (and others') perceptions, needs and concerns; and b) to track and therefore be able to respond to how these evolve over time to avoid conflict between water users (for power generation) and affected communities. These communities are, in many cases (particularly in a developing country context), least able to articulate their needs and concerns so that they can be fully incorporated into decision-making.

[1] See, for example, examples of developing country case studies in Skinner, Niasse and Haas, 2009, and World Bank, June 2012.

The range and potential complexity of impacts arising from hydropower projects, and the extensive area over which they can have an effect, requires measures including those described in the box above, that are underpinned by effective coordination between all stakeholders to avoid conflict between the demands of power generation and the interest of local communities. In fragile environments, development of a hydropower project might exacerbate conflict as a result of issues such as downstream and transboundary impacts, and competition over resources (e.g. use of water to generate energy versus other uses).

EIB Requirements/Recommendations Governance and Community Support	Required	Recom-mended
8. **All hydropower projects must meet the requirements of the EIB *Environmental and Social Standard on Stakeholder Engagement*: identification and effective engagement with a diverse variety of institutions and representational groups must be undertaken throughout**, and communities that are directly impacted will be a priority focus for engagement.	✓	
9. P**romoters must identify and evaluate opportunities to implement equitable benefit sharing based on robust and transparent governance and stakeholder engagement processes**, developing mechanisms to identify affected communities' needs and concerns, to track them, and enable effective responses to how they evolve over time to avoid conflict between those benefiting from the energy generated and directly affected communities. The above engagement process will be continued throughout the life of the project, providing relevant information (including summaries of monitoring, and conclusions reached about monitoring data) to affected communities and other stakeholders in a transparent manner.	✓	
10. It is recommended that promoters analyse and understand ongoing and potential conflicts that might be exacerbated by a hydropower project, and which have the potential to be a risk to the security and sustainability of the project itself. If a conflict risk exists such that mitigation is required, the promoter **must apply a conflict-sensitive approach**, i.e. i) to mitigate risks to the project; ii) to do no harm; and iii) to do good if possible in terms of contributing to peace. For more guidance on how to be conflict-sensitive in all phases of the project, please refer to the Conflict Sensitivity Consortium's How to guide to conflict sensitivity, and International Alert's Conflict-Sensitive Business Practice: Guidance for Extractive Industries.	✓	
11. With respect to women, it is recommended that promoters take account of *The EIB Group Strategy on Gender Equality and Women's Economic Empowerment.* [7]		✓

[7] http://www.eib.org/attachments/strategies/eib_group_strategy_on_gender_equality_en.pdf

3. Environmental Issues and Impacts

The most significant potential environmental impacts and risks associated with hydropower projects are as follows:

- Loss or degradation of threatened, endangered or endemic species due to inundation or fragmentation of natural habitats, or interruption of migratory fish and other species.
- Loss or degradation of ecological (riverine, riparian and floodplain) habitats and associated livelihoods, or disruption of other water users due to the fundamental alteration of hydrological, morphological or water quality conditions downstream of the hydropower scheme.
- Reservoir water quality impairment and sedimentation, and associated issues such as eutrophication and proliferation of aquatic weeds, or accumulation of upstream pollutants (potentially including priority substances under EU Directive 2008/105/EC on Environmental Quality Standards).

The following summarises the EIB's various requirements for the design and operation of hydropower projects in relation to the above issues. A central theme running through these requirements is the fulfilment of, or (for projects outside of the EU) alignment with the objectives of the EU WFD. In summary, these are to support the achievement of good status (ecological and chemical for surface water) in any project-affected water bodies, and to ensure that no effect on status occurs unless an Article 4(7) exemption process has been met as described earlier in Box 3.

i. Natural Habitat and Biodiversity Degradation and Loss

Hydropower projects can potentially lead to the loss or degradation of natural ecosystems due to habitat fragmentation and isolation (e.g. of aquatic habitats in river reaches upstream and downstream of single or multiple impoundments in a system), or due to the fundamental alteration of downstream hydrological, morphological or water quality conditions (see below).

Storage-based hydropower projects can also lead to the permanent flooding of natural habitats due to inundation. Even in the case of small, run-of-river hydropower projects where habitat loss may not be evident at the site level, there is potential for significant natural habitat loss or degradation at a cumulative scale since these types of projects are often found clustered within a single river basin or region.

EIB Requirements/Recommendations Natural Habitat and Biodiversity Degradation and Loss	Required	Recom-mended
12. All hydropower projects financed by the EIB **must meet the Environmental and Social Standards, and more specifically the Environmental and Social Standard *on Biodiversity and Ecosystems***. Opportunities for ecological restoration and enhancement, including river continuity restoration, should also be considered wherever possible in accordance with WFD objectives, for example with respect to hydropower rehabilitation projects.	✓	
13. For projects located in EU Member States or Candidate Countries that are likely to have a direct or indirect effect on a Natura 2000 or site of nature conservation importance[8]), **an**	✓	

[8] Sites of nature conservation importance are: a) sites identified by the competent authorities as sites to be proposed for the Natura 2000 network as laid down in the Birds Directive (74/409/EEC) and Habitats Directive (92/43/EEC); b) sites listed in

EIB Requirements/Recommendations Natural Habitat and Biodiversity Degradation and Loss	Required	Recom-mended
assessment must be carried out in line with Article 6(3) of the Habitats Directive.		
14. For projects located outside the EU, and where the EIB is not the lead investment partner, common approaches to **biodiversity conservation and management must be applied based upon good international practice** where this meets the requirements of the EIB's own standards.	✓	
15. Notwithstanding the above, the **EIB will not finance any projects that will have a potential measurable adverse impact on any UNESCO World Heritage Site.**	✓	
16. In all of the above cases, of key importance for hydropower projects is that **the assessment of potentially affected habitat must consider not just the footprint of the reservoir or project infrastructure (powerhouses, roads, transmission lines, etc.), but also downstream water and sediment flow and/or water quality effects, aquatic habitats in river reaches upstream and migratory species throughout their ranges in line with the requirements of the Convention on the Conservation of Migratory Species of Wild Animals.**	✓	
17. **Mitigation must follow the hierarchy principle,** whereby avoidance, minimisation and restoration measures are applied in that order of preference, with compensatory (e.g. offset) measures considered as a last resort. The single most effective mitigation measure for hydropower projects is the avoidance of biodiversity related impacts through careful and effective site selection at the strategic planning stage (see section 2 Strategic and Basin-Wide Issues).	✓	
18. It is recommended that the promoter addresses the topic of decommissioning, preferably as part of the design stage, and in a specific decommissioning report setting out the processes and timescales under which it is anticipated that detailed decommissioning plans are prepared, and how decommissioning will be financed.		✓

ii. Ecosystem services

The services provided by ecosystems play a vital role in human well-being, and any hydropower development will have the potential to impact important ecosystem services and the communities that depend upon them. Some ecosystem services that could be affected by a hydropower development are easily recognised (e.g. fresh water; fish used for leisure, commercial or subsistence purposes) but others are less obvious and may require detailed study to understand their importance, such as erosion control, protection from natural disasters and regulation of air, water, soil and sediment quality. A reduction or loss of any of these services and the benefits they provide can have socio-economic consequences that may not be immediately apparent.

EIB Requirements/Recommendations Ecosystem services	Required	Recom-mended
19. **An analysis of ecosystem services and dependencies and an assessment and mitigation of impacts on ecosystem services must be carried out** as set out in the **Environmental and Social Standard on *Biodiversity and Ecosystems*.**	✓	
20. The promoter **must ensure that ecosystems services review is included in the terms of reference for E(S)IA of all hydropower projects**. The terms of reference will specify that **if the**	✓	

the latest inventory of Important Bird Areas (IBA 2000) for Candidate Countries or (if available) equivalent more detailed scientific inventories endorsed by national authorities; c) Wetlands of international importance designated under the Ramsar Convention or qualifying for such protection; d) Areas to which the Bern convention on the conservation of European Wildlife and Natural Habitats (Art. 4) applies, in particular sites meeting the criteria of the Emerald network; and e) Areas protected under national nature conservation legislation.

EIB Requirements/Recommendations Ecosystem services	Required	Recom-mended
review indicates it is required, an ecosystem services baseline should be prepared, priority services identified, and mitigation measures developed for impacts on those services. **Associated facilities should be considered in the assessment**.		
21. P**romoters must demonstrate that robust and realistic identification and assessment has been carried out to delineate the ecologically appropriate area of analysis within which ecosystem services could be affected**, both upstream and downstream. This should be achieved through surveys and consultation with communities and/or any other groups that might have dependencies on priority ecosystem services.	✓	

iii. Downstream Hydrology and Limnology (including Environmental Flows)

The impoundment and/or diversion of a river for hydropower generation can have a profound impact on the hydrology and limnology of the downstream river system, and thereby on its ecological status, or potential, and any associated livelihoods. It can lead to changes in the magnitude and timing of flows, the quality and temperature of the water, and the sediment transport dynamics and associated morphology of downstream river, floodplain and estuarine systems.

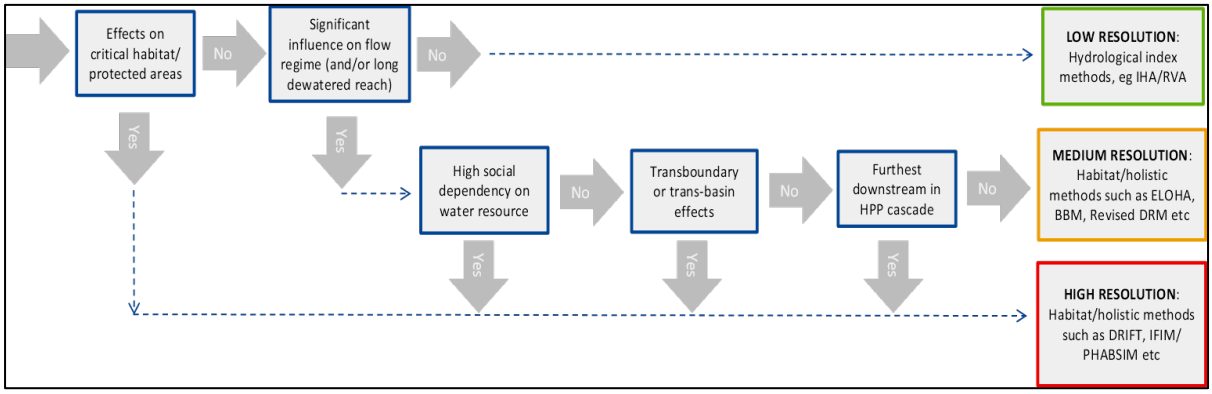
Storage-based hydropower projects can have a particular impact on a river's natural flow equilibrium owing to the fact that reservoir releases are often made in response to patterns of power demand rather than natural hydrological cycles, sometimes with significant day-to-day, or even hour-to-hour, fluctuations in flow called "hydropeaking."

EIB Requirements/Recommendations Downstream Hydrology and Limnology	Required	Recom-mended
22. All hydropower projects financed by the **EIB must assess and make provisions for an appropriate downstream environmental flow release (EFR) and any additional mitigation measures that may be required (as a minimum these would normally include measures for fish passage) in order to maintain the current status of freshwater and estuarine ecosystems and support existing socio-economic uses of the water resource**. These measures must meet national legislative requirements, but in many cases will require additional features such as varying flow releases at different times of year in response to seasonal habitat requirements, or the periodic release of flood pulses (freshets) to promote downstream sediment or nutrient transport.	✓	
23. Any proposed mitigation measures to **adapt the EFR must be properly costed within the project design**, which may require flexibility to incorporate future adjustments as part of an adaptive EFR strategy.	✓	
24. The method used to determine the EFR should as a minimum be consistent with national standards or approaches, but **must be appropriate to the scale and complexity of the project and risks involved (e.g. presence of protected areas, critical habitats, high water-use intensity)**. In cases where the knowledge needed to determine the EFR is lacking, the precautionary principle should be applied and a high-resolution method for determining the EFR selected. A process for deciding on the appropriate resolution of assessment method to be used is presented in Figure 1, and further details can be found in section 7.2 of CIS Guidance Document No. 31. [9]	✓	
25. Outside of the EU, **the applied method must be comparable in approach to those used by EU Member States.**	✓	
26. For projects located in EU Member States or Candidate Countries, **the above EFR must help the affected water bodies achieve good status (or good potential in the case of HMWBs or**	✓	

[9] European Commission DG ENV, 2015. WFD CIS Guidance Document 31: Ecological flows in the implementation of the Water Framework Directive.

EIB Requirements/Recommendations Downstream Hydrology and Limnology	Required	Recom-mended
AWBs) as defined in the RBMPs prepared under the WFD, and ensure no effect on status occurs (unless explicitly approved under the Article 4(7) process – see Box 3). The EFR must also ensure compliance with any additional standards or objectives for water bodies that form part of a Natura 2000 Network.		
27. For projects located elsewhere, in addition to meeting the requirements under 21 above, **the EFR must support any defined water quantity or quality objectives or conservation plans or priorities that apply to the water body** (e.g. as part of an RBMP, IWRM Plan, or similar). In situations where the current status of downstream ecosystems is not defined, this will need to be determined in accordance with the selected EFR method (i.e. higher resolution methods will require more extensive ecological baseline survey).	✓	
28. The EFR regime must include **a continuous programme of monitoring (including both flow and biological indicators), evaluation, and adjustment –** commonly referred to as adaptive management – so that it can be periodically reviewed and where necessary modified in response to increased understanding or changes in downstream ecosystem or socio-economic conditions.	✓	

Figure 1: Selection of Appropriate Environmental Flow Assessment Method (adapted from *Brown, C. 2016*)



iv. Reservoir Water Quality and Sedimentation, including Eutrophication

The decomposition of vegetation on inundated land creates a nutrient-rich environment that can stimulate the growth of algal blooms and aquatic weeds such as water hyacinth in the reservoir. If eutrophication occurs this can impair water quality and affect fisheries, both in the reservoir and downstream, primarily by reducing dissolved oxygen levels in the deeper reservoir layers and releasing this water through the turbines. Some algae can also form toxic blooms on the reservoir surface. Furthermore, the proliferation of aquatic weeds and reservoir releases can clog or damage hydraulic structures (e.g. from the passage of anaerobic waters through the turbines) and impede navigation.

Land-use practices upstream can have a significant impact on water quality and sedimentation in the reservoir, in particular where these change as a result of economic development. For example, reservoir eutrophication can be stimulated by an influx of nutrients due to uncontrolled agricultural runoff or poorly treated municipal or industrial wastewater effluents. Polluted inflows and/or the inundation of contaminated soils can also lead to the potential bio-accumulation of toxic pollutants such as mercury in the reservoir and its bottom sediments. Poor agricultural and forestry management practices can also exacerbate soil erosion leading to increased sedimentation rates in the reservoir and a reduced life-span of the dam, which can be further

exacerbated by increased water abstractions upstream and reduced water availability due to climate change (see the *Climate Resilience and GHG Emissions* section below).

EIB Requirements/Recommendations Reservoir Water Quality and Sedimentation, including Eutrophication	Required	Recom-mended
29. All storage-based hydropower projects that introduce a significant degree of regulation (DOR) in the river system (see Box 1) **must include an assessment of the eutrophication potential of the reservoir, either as a standalone assessment or as part of the E(S)IA, and mitigation measures incorporated into the project design where the risk of eutrophic conditions is assessed as significant**. The assessment should consider existing and potential future nutrient inflows from the upstream catchment (e.g. in relation to agricultural runoff). Mitigation measures may include vegetation clearance prior to inundation, nutrient flushing and/or upper watershed management measures.	✓	
30. In cases of large reservoirs with potentially long water residence times (several months or more), i.e. where there is a significant risk of seasonal thermal stratification**, a detailed reservoir water quality assessment must carried out** using hydrodynamic (rather than empirical) modelling approaches to assess and mitigate the risks of eutrophication and/or accumulation of pollutants.	✓	
31. All storage-based hydropower projects with large reservoirs **must include an assessment of existing and potential future reservoir sedimentation**, including actions for the management of potential toxic pollutants and flushing operations, with ongoing monitoring of sediment inflows and outflows throughout the reservoir life (see point 54).	✓	
32. **An ongoing programme of reservoir water quality monitoring must be undertaken post-construction**, focusing on any water quality parameters that are identified as significant during the E(S)IA process. For projects in the EU/Candidate Countries, this would include the monitoring of performance against any water quality objectives established for the new reservoir as part of the WFD Article 4(7) process or otherwise (see Box 3). The programme may also include periodic fish tissue sampling to monitor the potential bio-accumulation of pollutants in the reservoir.	✓	

4. Social Issues and Impacts

The most significant potential social impacts and risks associated with hydropower projects are as follows:

- Physical and economic displacement of people, including loss or restriction of access to property, assets, resources and social networks.
- Temporary or permanent changes in employment patterns, livelihoods and other activities.
- Loss of, or damage to, cultural heritage.
- Matters related to occupational and public health, safety and security.
- Disruption of ecosystem services, including *inter alia* those caused by alteration to water and sediment flows and by changes in microclimate, which may affect agricultural productivity.

The following text summarises the EIB's various requirements and recommendations for development of hydropower projects in relation to the above issues. Other impacts within the above subject areas (e.g. labour standards, human rights) are not considered in these guidelines because they are not specific to hydropower projects. For these broader, non-hydropower-specific social and socio-economic impacts, promoters will be expected to follow all relevant requirements of the EIB *Environmental and Social Standards* listed in section 1 iii. Policy Environment.

i. Physical and Economic Displacement and Loss of Access

The development of a hydropower project may physically displace people, or lead to loss of assets and disruption of livelihoods (this circumstance is termed economic displacement). While in some cases, the impact may be relatively small or even negligible, for hydropower projects with a large reservoir that permanently flood substantial areas significant displacement may occur. Flooding may displace people from homes, commercial or industrial properties, agricultural land, and areas used for other purposes. Additionally, periodic or permanent changes to water flows and/or creation of new water bodies may disrupt access to important economic and cultural assets, resources and social networks for affected communities over considerable areas; the creation of exclusion zones for safety or operational reasons can have a similar effect.

Hydropower can raise issues of land tenure covering ownership and access rights for both water and land, with implications for current and future demands such as agriculture, drinking water supplies, fishing and ecosystem health. Hydropower projects are often built in remote areas with stagnant economies, with few new opportunities and with poor transportation and communications systems, making income restoration more difficult. Sometimes, these remote areas are inhabited by indigenous people or ethnic minorities that are culturally and economically tied to the land, and the loss of this relationship exacerbates the negative impacts of construction.

Small, run-of-river hydropower projects may, if they are clustered within a single river basin or region, cause displacement impacts comparable to those from individual larger projects.

Restriction of access to water and other resources, particularly in developing countries, may have a disproportionate impact on women and children who are frequently households' main collectors of water, and of other important resources such as firewood and non-timber forest products.

Nonetheless, hydropower projects also have a potential to mitigate some of the mentioned adverse impacts by serving as sources of residential or commercial electricity for resettlement areas, as

sources of employment, or as sources of revenue earmarked for development activities in affected communities.

EIB Requirements/Recommendations Physical and Economic Displacement and Loss of Access	Required	Recom-mended
33. For any involuntary resettlement that is required to remedy displacement and loss of access caused by a hydropower project, **promoters must fulfil the requirements of the Bank's Environmental and Social Standard *on Involuntary Resettlement*.**	✓	
34. It is recommended that promoters **consult the World Bank's *Involuntary Resettlement Sourcebook (2004), Chapter 15 – Dams and Resettlement: Building Good Practice.***		✓
35. Promoters **must demonstrate that robust and realistic identification and assessment has been carried out to delineate the geographical area likely to be affected by the project, where impacts relating to displacement and loss of access could occur, including downstream users.**	✓	
36. Promoters **must identify all communities and/or other groups that might be affected, and undertake informed and meaningful stakeholder consultation with them** from the early stages of project development and preferably during the pre-feasibility stage, throughout the area affected.	✓	
37. Stakeholder consultation **must fulfil the requirements of the Bank's Environmental and Social Standard on the *Rights and Interests of Vulnerable Groups,* collecting information to assess impacts and identify how users – including groups such as women and vulnerable groups such as the elderly and those with different abilities – will be affected**. They must use this information to develop and implement robust and appropriate mitigation, within the promoter's influence, in the geographical area likely to be affected by the project.	✓	
38. Where impacts on collective ownership and access rights are identified (particularly where these affect indigenous or forest communities), it is recommended that promoters **follow the FAO's *Voluntary Guidelines on the Responsible Governance of Tenure of Land, Fisheries and Forests in the Context of National Food Security* (VGGT, 2012)**, which promote responsible governance of tenure of land, fisheries and forests, with respect to all forms of tenure: public, private, communal, indigenous, customary, and informal.		✓

ii. Economic Development, Employment and Livelihoods

The area in which a hydropower project is being developed may be expected to experience increased economic activity during construction (including during rehabilitation and refurbishment projects). This may result from direct and indirect employment, provision of goods or services to the project, and stimulation of the wider local economy via the multiplier effect. However, once the construction phase is complete, operational hydropower projects typically require a small number of highly skilled staff, and the requirements for goods and other services are mostly highly technical. This is likely to curtail revenue flows into the local economy, and thus potentially cause reduced economic activity. In some cases, particularly in less developed countries, the highly skilled profile of the operational staff required may disadvantage women and vulnerable groups that are less likely to have had the education and training opportunities to develop these skills.

Loss of productive land and disruption of access to assets and resources may have an impact on economic and other activities (including leisure) over a considerable area upstream and downstream of a hydropower project.

EIB Requirements/Recommendations Economic Development, Employment and Livelihoods	Required	Recom-mended
39. **The promoter must meet the requirements of the Environmental and Social Standard *on Stakeholder Engagement***.	✓	
40. **The promoter must develop and implement a community development plan that yields immediate, and ongoing, benefits**, including, *inter alia*, the provision of potable water, means of communication and electricity to affected communities where this is appropriate and feasible. A template for this type of plan is included in Strategic Community Investment: A Good Practice Handbook for Companies Doing Business in Emerging Markets (IFC, 2010). [10]	✓	
41. **The promoter must carry out a robust and realistic identification and assessment of the full area where economic impacts could occur: both upstream and downstream, and potentially outside the catchment;** and use this information to develop appropriate mitigation.	✓	
42. It is recommended that the promoter **encourage the participation of local companies and individuals in the project construction and operation**, notably through appropriate job and contract opportunities advertisement. The promoter shall not allow any local content requirements (either de jure or de facto) or any discrimination based on nationality that are in breach of the Bank's Guide to Procurement.		✓
43. It is recommended that the promoter **support an appropriate and timely education programme relevant to project implementation** and the objectives of the livelihood restoration plan and community development plan.		✓
44. It is recommended that the promoter **use an appropriate construction contract template** that comprises adequate social provisions.		✓
45. It is recommended that the promoter **implement employment and supply chain opportunities that demonstrate the inclusion of specific parts of the community**, such as women and potentially vulnerable groups, within the measures implemented. These measures should take account of the *EIB Group Strategy on Gender Equality and Women's Economic Empowerment*.		✓

iii. Cultural Heritage

In common with other infrastructure projects, hydropower developments have the potential to disturb both tangible and intangible cultural heritage (these terms are defined in the EIB Environmental and Social Standard *on Cultural Heritage*). For new hydropower projects, the risks to cultural heritage are increased, as the likelihood of affecting previously undisturbed areas is greater. This likelihood will be greatest in the case of new storage projects where the disturbed area will be considerably larger due to the creation of a reservoir that could flood areas of tens or sometimes hundreds of square kilometres. Stakeholder consultation, in particular with local communities, expert ground surveys, and the use of other interpretive methods such as remote sensing will be valuable methods that could determine whether extensive affected areas might contain significant cultural heritage resources.

Water-based intangible cultural heritage values recognised by local communities could *inter alia* include sacred features or locations, such as areas believed to be inhabited by water spirits.

EIB Requirements/Recommendations Cultural Heritage	Required	Recom-mended
46. **Promoters must meet the requirements of the EIB Environmental and Social Standard on *Cultural Heritage* and relevant national legislation relating to cultural heritage**.	✓	
47. **Promoters must demonstrate that robust and realistic identification and assessment has been carried out to delineate the geographical area likely to be affected by the project**, both upstream and downstream, where impacts relating to cultural heritage could occur. This	✓	

[10] http://www.ifc.org/wps/wcm/connect/f1c0538048865842b50ef76a6515bb18/12014complete-web.pdf?MOD=AJPERES&CACHEID=f1c0538048865842b50ef76a6515bb18: see *Tool 1: Template for Preparing a Community Investment Strategy* (p. 115).

EIB Requirements/Recommendations Cultural Heritage	Required	Recom-mended
should be achieved through surveys, consultation with communities and/or other groups that might be affected and/or have knowledge of cultural heritage resources, and other methods as appropriate.		
48. **The EIB will not finance any projects that will have a potential measurable adverse impact on any UNESCO World Heritage Site.**	✓	
49. It is recommended that promoters **carry out cultural heritage surveys and studies as part of site selection and identification of alternatives** so that feasible measures to avoid cultural heritage sensitivities can be incorporated at the earliest stages, and do not leave consideration of cultural heritage until the subsequent E(S)IA and development of mitigation.		✓
50. It is recommended that promoters **make use of best practice interpretative and predictive techniques to identify and assess the potential for cultural heritage**, including remote sensing interpretation and statistical analysis.		✓
51. **Cultural heritage mitigation procedures** (e.g. a "chance finds" procedure) **must be developed** (including consultation with key stakeholders such as government agencies responsible for cultural heritage, and with local communities) **and they must encompass all areas where hydropower project development activities will take place**. Therefore, in the case of storage reservoirs, the areas must include sites where *inter alia* vegetation clearance, slope stabilisation and other activities including development of associated facilities will occur.	✓	

iv. Public Health, Safety and Security

Hydropower projects could create health, safety and security risks for communities. Water quality and condition could either present a direct human health risk (e.g. as a consequence of contamination or other factors causing poor water quality – see section 3. Environmental Issues and Impacts), or create water conditions that could harbour disease vectors such as rats (leptospirosis) or mosquitoes (malaria; also Zika virus, dengue fever and chikungunya). Poor water quality, vector-borne or water-borne diseases may increase vulnerability in surrounding communities, during construction and through the operational phase of a project unless regular monitoring, and where appropriate vector and disease control measures, are implemented.

Downstream communities may be at risk from planned and unplanned water releases and significant fluctuations of water level.

Static, slow- and fast-moving water bodies may all present safety risks to members of the public.

Development of hydropower projects can increase the likelihood of conflict, particularly in fragile environments (see section 2 Strategic and Basin-wide Issues).

EIB Requirements/Recommendations Public Health, Safety and Security	Required	Recom-mended
52. **All EIB-financed hydropower projects must meet the requirements specified in the EIB Environmental and Social Standard on *Occupational and Public Health, Safety and Security.***	✓	
53. If technical studies and the E(S)IA indicate that risks exist, **a project risk assessment and emergency preparedness plan must be prepared to address potential impacts on downstream communities and resources** in the event of both planned and unplanned water releases during the construction and operation phases.	✓	
54. **Where identified as being required by the project risk assessment and emergency preparedness plan, early warning systems must be installed** to ensure that downstream communities are informed in advance of major water fluctuations (e.g. those associated with periodic reservoir flushing), and any unplanned release scenarios (such as those caused by operator error or equipment failure).	✓	
55. As part of the emergency preparedness plan, **downstream communities must be trained periodically in evacuation and/or other procedures and a programme of periodic test drills established** (see *Dam Safety* section below).	✓	
56. Where it is deemed necessary, **the scope of the risk assessment must include identification of areas where interaction between members of the public and a project component could**	✓	

EIB Requirements/Recommendations Public Health, Safety and Security	Required	Recom-mended
pose a safety or operational risk. Exclusion zones should be established around such areas, where appropriate.		
57. **Life-saving equipment, warning signage and other measures must be installed at locations identified in the risk assessment and the emergency preparedness plan** (for example, at locations on a reservoir margin where public access cannot be controlled; and in areas close to fast-flowing water released through a tailrace, if an exclusion zone is not feasible).	✓	
58. Initial and ongoing public health education campaigns should be considered, to promote safe water use and safe behaviour around water.		✓
59. The **promoter must establish an ongoing programme of monitoring and engagement with communities** both during construction and operation, to provide early identification of disease vectors in relation to the project or potential contamination of domestic water supplies due to poor water quality from sources such as spills and high sediment loads during construction, and releases of poor quality water from the reservoir during operation.	✓	

5. Climate Resilience and GHG Emissions

Hydropower projects generally have a very long design-life, sometimes well in excess of 50 years when future rehabilitation is taken into account. As such, there are important climate-related considerations that need to be factored into their design, planning and operation in order to make them resilient to long-term climate changes and to limit their vulnerability to extreme weather events. Broadly speaking, these are as follows:

- Climate change projections need to be incorporated into the hydrological assessment of resource potential for hydropower project planning and design, thereby including the size and configuration of the hydraulic infrastructure.
- Potential physical risks associated with climate change (e.g. relating to enhanced flooding, erosion, landslides and sedimentation, etc.) need to be factored into reservoir and dam planning, design and management (including safety planning) and need to be reviewed and – if required – adapted periodically (such as every five years).
- Potential system-wide climate risks (e.g. relating to power line and/or access road damage, communications/IT failures, etc.) and consequent impacts on site access (e.g. for emergency workers) and energy end-consumers need to be addressed, for example through extreme weather management planning and demand management measures for end-users.
- The calculation (and minimisation) of GHG emissions from hydropower projects needs to consider methane emissions from the reservoir.

The following sections summarise the EIB's requirements for the design and operation of hydropower projects in relation to the above issues.

i. Factoring Climate Change into Hydrological Assessment

Long-term changes in average seasonal temperature and/or rainfall conditions in a catchment could have a significant effect on the timing and magnitude of river flows, and hence on hydropower generation potential and project infrastructure design. These effects are likely to be particularly significant in catchments where snowmelt and glacial melt provide a significant contribution to seasonal flows, or where there is limited water storage within the scheme to even out future changing patterns of runoff between seasons.

The majority of hydropower schemes have in the past been designed on the basis of the hydrological analysis of historical flow records, which can lead to power-energy modelling that does not provide representative projections for energy output. In addition to directly affecting the long-term financial viability of a scheme, in the nearer term this is likely to impact on other water uses, for example ecological flows or in the case of multi-purpose schemes, irrigation water supply, as the available stored water is prioritised for power generation needs.

EIB Requirements/Recommendations Factoring Climate Change into Hydrological Assessment	Required	Recom-mended
60. All hydropower projects financed by the EIB **must meet the EIB Environmental and Social Standard on Climate Change.**	✓	
61. A climate risk and vulnerability assessment (CRVA) **must be carried out as part of the project feasibility study, either as a standalone assessment or as part of the E(S)IA,** which should include the integration of likely climate change scenarios into the hydrological analysis for the scheme in alignment to the principles of the EU Climate Change and Major Projects related	✓	

EIB Requirements/Recommendations Factoring Climate Change into Hydrological Assessment	Required	Recom-mended
requirements and Guidance.[11] The results should then be applied to the design of the project, including the power generation model to assess its sustainable long-term energy yield. This would not only apply to new hydropower developments, but should also be applied retrospectively to existing schemes that are being rehabilitated or refurbished. An adaptive approach should be taken and it is recommended that the assessments be carried out every five years.		
62. It is **recommended** that the above CRVA include the development of a representative hydrological model of the catchment. The model should be run for a suitable range of future climate scenarios to estimate changes in the net runoff from the catchment based upon input climate data and physical catchment characteristics. The IHA Climate Resilience Guide may serve as a reference to define the CRVA process.		✓
63. **Long-term hydrological monitoring of inflows to the hydropower scheme must be undertaken** and made publicly available, in order to facilitate the periodic review of hydrological design conditions and assumptions.	✓	

ii. Assessing Potential Physical Risks

There are a range of potential risks to any infrastructure project that stem from the changes in physical conditions that may occur in a catchment as a result of climate change, e.g. enhanced flooding or erosion. However, there are a number of key considerations for hydropower projects, and in particular those that include large dams or impoundments. These are as follows:

- Potential safety concerns for the dam or impoundment relating to enhanced flood runoff from the upstream catchment and inadequate spillway design. This may be characterised by a gradual increase in extreme flood frequency over time as a result of changing patterns of precipitation, or a sudden extreme flood event induced by (for example) an upstream glacial lake outburst.
- Potential safety concerns relating to the overtopping of embankments from enhanced wind-run effects, or large landslips into the reservoir caused by conditions such as more intense rainfall or freeze/thaw events.
- Increased sediment runoff from the upper catchment leading *inter alia* to accelerated reservoir siltation (and loss of capacity) and turbine damage.
- Long-term temperature changes and the potential consequences for reservoir water quality and eutrophication.

EIB Requirements/Recommendations Assessing Potential Physical Risks	Required	Recom-mended
64. The above-mentioned climate risk and vulnerability assessment (CRVA) **must include an assessment and mitigation of any potential physical risks to project infrastructure arising from, *inter alia*, enhanced flooding or erosion in the upper catchment due to climate change**. Mitigation measures may include the re-design of spillway capacities including maintaining spare capacity, changing the dam construction type (e.g. to allow overtopping), and lowering maximum reservoir operation levels (to increase freeboard in response to future flood conditions).	✓	
65. It is also **recommended that the above CRVA include an assessment of the wider system risks to road infrastructure, communications/IT equipment, power lines, etc., with**		✓

[11] European Commission DG CLIMA, 2016: Climate Change and Major Projects: Outline of the climate change related requirements and guidance for major projects in the 2014-2020 programming period.

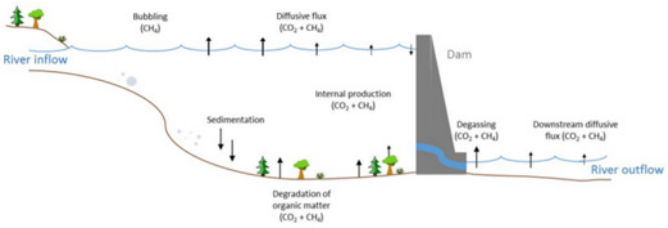
EIB Requirements/Recommendations Assessing Potential Physical Risks	Required	Recom-mended
consequent impacts on emergency response functions and power end-users. Mitigation measures could include the preparation of an extreme weather management plan, demand-side measures, etc.		
66. For dams that have a significant degree of regulation (DOR) in the river system, a **long-term monitoring of sediment inflows must be undertaken** in order to facilitate the periodic review of associated engineering design considerations and assumptions.	✓	

iii. Reducing Reservoir GHG Emissions

The Environmental and Social Standard on Climate Change requires a carbon footprint assessment to be carried out and reported for projects that emit more than 20 kt CO_2eq/yr in absolute terms, or lead to an emissions variation (positive or negative) of more than 20 kt CO_2eq/yr.

A scheme could reach this level of absolute emissions when reservoir methane emissions (including from spillway and turbine flows) are taken into account. Large, shallow tropical reservoirs can be a particularly significant source of these emissions in this respect. Moreover, both small and large-scale schemes alike would be anticipated to reduce net GHG emissions (compared to non-renewable alternatives) by more than 20 kt CO_2eq/yr, so would require a carbon footprint assessment.

Carbon Cycle in Reservoir *(Source: The GHG Reservoir Tool, G-res, Technical Documentation, IHA, 2017)*



EIB Requirements/Recommendations Reducing Reservoir GHG Emissions	Required	Recom-mended
67. In line with the EIB Environmental and Social Standard on Climate Change, **a carbon footprint assessment must be carried out for all hydropower projects**, with the exception of cases where these fall below the emissions thresholds given in the Standard.	✓	
68. The over-arching methodology to be used for calculating the hydropower carbon footprint **must be consistent with that out in detail in the EIB's *Methodologies for the Assessment of Project GHG Emissions and Emission Variations (Version 11, December 2018)***.	✓	
69. For all potentially carbon-intensive hydropower projects (e.g. those with large reservoirs and/or emissions greater than 20 kt CO_2eq/yr), **alternative project design configurations must be considered to minimise emissions wherever possible**. One means of achieving this might be the removal of vegetation from the reservoir footprint prior to inundation. Other measures may include re-siting offtake structures to avoid drawing water from the anoxic bottom layer of a reservoir, or a reduction in surface area by lowering the operating level.	✓	
70. Notwithstanding the above**, the EIB will not consider financing hydropower projects that emit more than 550 g of CO_2 per kWh, or any other value that may be adopted subsequently in the EIB Energy Lending Policy**, calculated as average emissions over the first 20 years of the project lifetime.	✓	
71. All hydropower projects with large reservoirs (see Box 1) **must undertake direct and continuous monitoring of CO_{2eq} emissions during operation**.	✓	
72. It is **recommended that green technologies and energy efficiency measures be considered wherever possible during project design and construction**, e.g. the incorporation of floating solar panel systems for local energy supply needs, use of oil-free turbines, low-energy building design, etc.		✓

6. Reservoir and Dam Safety Issues

This section provides a brief overview of some of the main reservoir and dam safety issues and measures that need to be addressed in order to safeguard the health of workers and affected communities during the planning, construction and operation of a hydropower project financed by the EIB. The guidance does not replace or preclude the need to implement detailed dam safety studies; it is only meant to briefly illustrate the hydropower-specific issues that need to be addressed. It also does not elaborate on the methods, codes or safety standards to be applied, since these are covered by more detailed guidance produced by organisations such as ICOLD.

i. Risks Associated with Infrastructure Failure

There are clearly very significant risks to downstream health and property arising from the potential flooding that would occur following structural failure and/or overtopping at a dam, or at an associated structure such as a spillway, powerhouse or tailrace. This failure may be induced by inadequate planning for natural hazards such as extreme floods, landslips, glacial lake outbursts or earthquakes; by inadequate design, construction or operation practices; or by a combination of any or all of these factors. Moreover, the aforementioned natural hazards may themselves be induced or enhanced by the dam project itself, e.g. due to reservoir-induced seismicity or bank instability caused by fluctuating reservoir water levels. In addition, in the case of upstream flooding, erosion and reservoir sedimentation, these processes are likely to alter their characteristics over time due to changes in land use and/or climate change (as discussed above).

EIB Requirements/Recommendations Risks Associated with Infrastructure Failure	Required	Recom-mended
73. **A technically robust assessment of the natural hazards and technological risks to the safety of a hydropower project must be prepared during the project design process**. For large dams, this will require expertise across an array of disciplines, including hydrology (e.g. for spillway design flood calculation and breach analysis) and engineering safety competencies such as geotechnical, structural, electrical and mechanical design.	✓	
74. For large dams (see Box 1 for definition), **the risk assessment must include the computational modelling of the downstream effects of potential dam breach scenarios**, and the resulting flood extent maps should be shared with the relevant authority in charge of civil protection and emergencies, as well as local authorities. This modelling is also recommended for other types of dams.	✓	
75. For all large dams (see Box 1 for definition), **the involvement of an independent Dam Safety Review Panel (DSRP) (or equivalent in an EU Member State) is compulsory** and recommended for other dams. The panel has the responsibility to review the design, construction, commissioning and operation of the dam and reservoir. This modelling is recommended for all dams.	✓	
76. The mitigation of dam safety risks **must include effective emergency planning and response measures**. Safety procedures will be project-specific and would need to be approved by the above panel, but would normally include measures such as the installation of signage, exclusion zones, public communication protocols/early warning systems, emergency preparedness and response training, and periodic dam safety inspections (to include infrastructure condition). Detailed guidance on dam safety procedures is published *inter alia* by the International Commission on Large Dams (ICOLD).	✓	
77. Whilst it would normally be the responsibility of the relevant civil protection authorities to plan and implement most of these measures, in countries where these authorities either do not exist, or have limited capacity or resources, **the dam operator is required to identify and support as appropriate suitable and sustainable implementation arrangements.** This may include long-term training and capacity-building for local authorities.	✓	

ii. Risks Associated with Dam Operation

The operation of a hydropower scheme can lead to rapid variations in downstream flows and associated water levels and velocities, for example as a result of routine hydropeaking operations (whereby flood releases are made in response to power requirements at specific times of day), or due to periodic equipment maintenance or reservoir sediment flushing, etc. The assessment and mitigation of any resulting impacts on downstream river users (e.g. community water users or recreational users such as anglers or rafters) should form part of the E(S)IA. From a specific public health and safety perspective, these impacts could include the risk of drowning if the water level rise is too rapid or unannounced.

EIB Requirements/Recommendations Risks Associated with Dam Operation	Required	Recom-mended
78. For all large dams (see Box 1), the promoter **must establish dedicated procedures for the inspection of dam and hydraulic structures**, including a periodic and emergency reservoir drainage procedure.	✓	
79. For hydropower projects that involve significant hydropeaking operations, **a quantitative assessment of the potential downstream propagation of flood waves and hydraulic behaviour of the river in relation to the types and behavioural patterns of river users must be carried out**, either as part of the E(S)IA or as a standalone study. There are wide variety of hydraulic models that are available for this purpose – selection of an appropriate method should be made by a qualified water engineer or hydrologist.	✓	
80. **Where potentially significant effects on river users are identified, mitigation measures must be developed**. Measures to be considered should include adjustments to dam operations (e.g. speed, sequencing or timing of gate openings), the introduction of signage and exclusion zones, published operational timetables, public awareness campaigns and real-time flood warning systems for downstream river users (e.g. phone or text message alerts, audible alarms).	✓	

7. Monitoring Requirements

The EIB will treat each possible hydropower investment on a case-by-case basis. As a result, the monitoring requirements for each will vary, as will their contribution to the overall assessment of investment performance, which will be within the framework of the requirements set out in the EIB Environmental and Social Standard on the *Assessment and Management of Environmental and Social Impacts and Risks*.

In order for the EIB to have a comprehensive overview of the potential impacts of a hydropower project and the effectiveness of mitigation measures, it will require monitoring information from a variety of sources, including the following:

- Regular reporting by the promoter on the performance of the project's environmental and social management systems (ESMS), including organisational capacity and resourcing needs and how these are being addressed.
- Periodic reporting to regulatory authorities by the promoter/contractors under the applicable permitting regimes for construction and operation.
- Self-monitoring reports prepared for submission to the EIB by the promoter and/or intermediary.
- Promoter's reports on contractor management.
- Summaries of stakeholder engagement in general, and specifically on the operation of the project grievance mechanism.
- Media articles and documentation on civil society interest in/comment on the project.

This guidance has emphasised the spatial extent and diverse nature of the potential impacts of hydropower projects. The EIB will therefore require that all relevant topics and the geographical area likely to be affected by the project be considered in setting out its monitoring requirements/conditions. These will include requirements relating to a range of generic environmental and social topics, e.g. construction management, stakeholder engagement and grievance processes, as well as resettlement action plan implementation, where applicable. However, there will be some monitoring requirements that are specific to the EIB's financing of hydropower projects, as follows:

EIB Requirements/Recommendations Monitoring Requirements	Required	Recom-mended
81. **The Environmental Flow Release (EFR) regime established for the hydropower project must include a continuous programme of downstream monitoring** (including both flow and biological indicators as appropriate), evaluation, and adjustment during operation – commonly referred to as adaptive management – so that it can be periodically reviewed and where necessary modified in response to increased understanding or changes in downstream ecosystem or socio-economic conditions.	✓	
82. All hydropower projects **must include the long-term continuous hydrological monitoring of inflows to the scheme in order to facilitate the periodic review of hydrological design conditions and assumptions** (including with respect to future climate change resilience). This information would also feed into the adaptive EFR strategy described above. The monitoring may be undertaken directly, or the data collected from a national or river basin authority gauging station if present.	✓	
83. Data on downstream monitoring, hydrological inflows and outflows, reservoir level data, meteorological, physical and chemical quality parameters and planned dam releases **must be publicly disclosed in an appropriate and timely manner and where feasible, in an open electronic format for use by third parties.**	✓	

EIB Requirements/Recommendations Monitoring Requirements	Required	Recom-mended
84. For hydropower projects that have potentially significant environmental and social impacts, the EIB **requires the establishment of an independent panel of environmental and social experts**[12].	✓	
85. All hydropower projects **must include the implementation of an Environmental and Social Steering Committee during construction and operation** that includes representatives of the local community to provide monitoring oversight and advice on the implementation of community-based actions defined within the ESMS and the community development plan.	✓	
86. For all large dams or large reservoirs (see Box 1), the promoter **must disclose survey reports annually on the dam and hydraulic structures**, and on any reservoir drainage activity for the purpose of maintenance, inspection or emergency action.	✓	
87. All storage-based hydropower projects with large reservoirs **must include the long-term monitoring of sediment inflows and reservoir sedimentation rates** in order to facilitate the periodic review of associated engineering design considerations and assumptions, including with respect to flushing regimes. It is also recommended that regular inspection of shoreline stability be carried out to monitor and control erosion.	✓	
88. All potentially carbon-intensive storage-based hydropower projects (e.g. those with large reservoirs and/or emissions greater than 20 kt CO_2eq/yr) **must carry out direct continuous monitoring and annual reporting of reservoir CO2eq emissions during operation**. This is primarily to verify project design assumptions and (where possible) facilitate interventions to improve GHG performance in future. It will also enhance the general body of knowledge for future project design.	✓	
89. For hydropower projects that involve significant hydropeaking operations or with a significant DOR, in addition to the EFR monitoring described above, it is **recommended that periodic stakeholder engagement surveys and grievance monitoring be undertaken with affected downstream communities**, to include users groups such as those with established fishing rights (commercial and recreational), riparian farmers, and other recreational users such as canoeists. The purpose of this engagement will be to ascertain the effectiveness of operational flood warning systems, EFR strategies, etc., and to refine these processes as necessary.		✓

[12] Bank Information Centre, 2011 Best Practices for Panels of Experts.

8. Key References

EIB Documents and Standards

- The EIB Statement of Environmental and Social Principles and Standards.
- EIB Environmental and Social Standards.
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Other Documents

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This document has been prepared with the support of Dr Eamonn Barrett and Mr Tim Smith of Environmental Resources Management Ltd, ERM. The EIB wishes to thank the many stakeholders that have provided review and comment during the development of these Guidelines.

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Environmental, Climate and Social Guidelines on Hydropower Development

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