



MEKONG RIVER COMMISSION

Summary of Key Findings and Recommendations

The MRC Guidelines for Hydropower Environmental Impact
Mitigation and Risk Management in
the Lower Mekong Mainstream and Tributaries

MRC Hydropower Mitigation Guidelines

March 2018

Introduction

Intensive hydropower development in the Mekong Basin has highlighted the substantial economic benefits of hydropower development for member countries towards their economic development goals. However, there are particular trade-offs with other sectors across economic, environmental and social spheres as highlighted in the MRC's recent Cumulative Impact Assessment (The Council Study). Basin scale and system scale planning is critical and urgent to optimise across the energy and water sectors for efficient and sustainable development. These guidelines are aimed at providing mitigation guidance for design and operation of hydropower facilities, focused on long term sustainability in the Mekong Basin, to support whole of basin planning and management as well as immediate project development requirements.

This summary of key findings and recommendations gives an overview of **the Guidelines for Hydropower Environmental Impact Mitigation and Risk Management in the Lower Mekong Mainstream and Tributaries (MRC Hydropower Mitigation Guidelines)** developed by the MRC between 2015 and 2018.

The MRC Hydropower Mitigation Guidelines provide a clear process and detailed technical guidance to address a range of known risks and impacts in **all phases of the Project Development lifecycle**.

The **MRC Hydropower Mitigation Guidelines** support the MRC's Preliminary Design Guidance (PDG, 2009), which may be used by developers during project preparation and then by the MRC to assess projects through its Procedure for Notification, Prior Consultation and Agreement (PNPCA). The guidelines detail the application of regional and global "good industry practice" for mitigation of hydropower impacts in the Mekong context and shall provide even better strategic and technical guidance as supporting documents to the updated PDG in 2018.

Risks and Impacts of major hydropower development in the Mekong are now well understood and documented

The hydropower risks, impacts and vulnerabilities that are dealt with in the **MRC Hydropower Mitigation Guidelines** have been extensively studied in a number of Mekong Studies, most recently the MRC's Council Study. The MRC Hydropower Mitigation Guidelines therefore seek to address five major themes, namely:

1. River hydrology and downstream flows
2. Geomorphology and sediments
3. Water quality
4. Fisheries and aquatic ecology; and
5. Biodiversity, natural resources and ecosystem services

The MRC Hydropower Mitigation Guidelines address these thematic areas using a set of five key **common overarching changes** related to hydropower development:

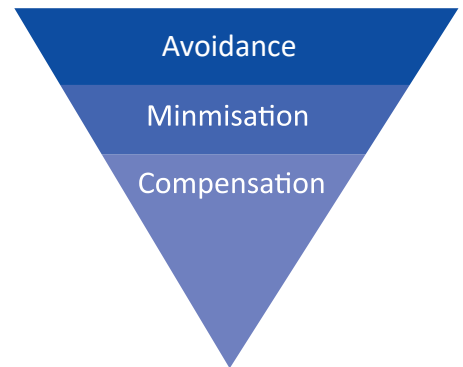
- I. Annual / inter-annual changes to flow (e.g. as a result of large storages in the basin)
- II. Daily / short-time scale changes to flow and water level (e.g. due to hydro peaking)
- III. Loss of river connectivity (e.g. due to high dams)
- IV. Impoundments and pondages (i.e. converting rivers to lakes)
- V. Diversion and intra basin transfers (that may leave some reaches of the river dry)

Major basin studies over the past 10 years have identified and quantified the above impacts in some detail. The economic, social and environmental consequences of changes to these themes may lead to unsustainable and sub-optimal outcomes for communities within the basin. Difficult trade-offs must therefore be managed and the MRC Hydropower Mitigation Guidelines provide member countries and developers with good industry practice solutions to mitigate and minimise these risks.

Mitigation Hierarchy

The commonly used “Mitigation Hierarchy” is employed in these guidelines to prioritise the approach that is recommended in each step of the project lifecycle.

1. Impacts are firstly **avoided** through proper master planning, and siting and design of the hydropower projects.
2. If it is not possible to avoid these impacts then **mitigation** and **minimisation** approaches should be adopted. These mitigation and minimisation technologies are described in detail in these guidelines.
3. Lastly, the mitigation hierarchy recommends that, if impacts cannot be mitigated, then **compensation** of various forms should be considered. These compensation approaches may include options to “offset” the impacts; for example by providing alternative fish spawning habitats, or by leaving certain river reaches free of development to allow for fish migration. Benefit sharing options may also be considered.

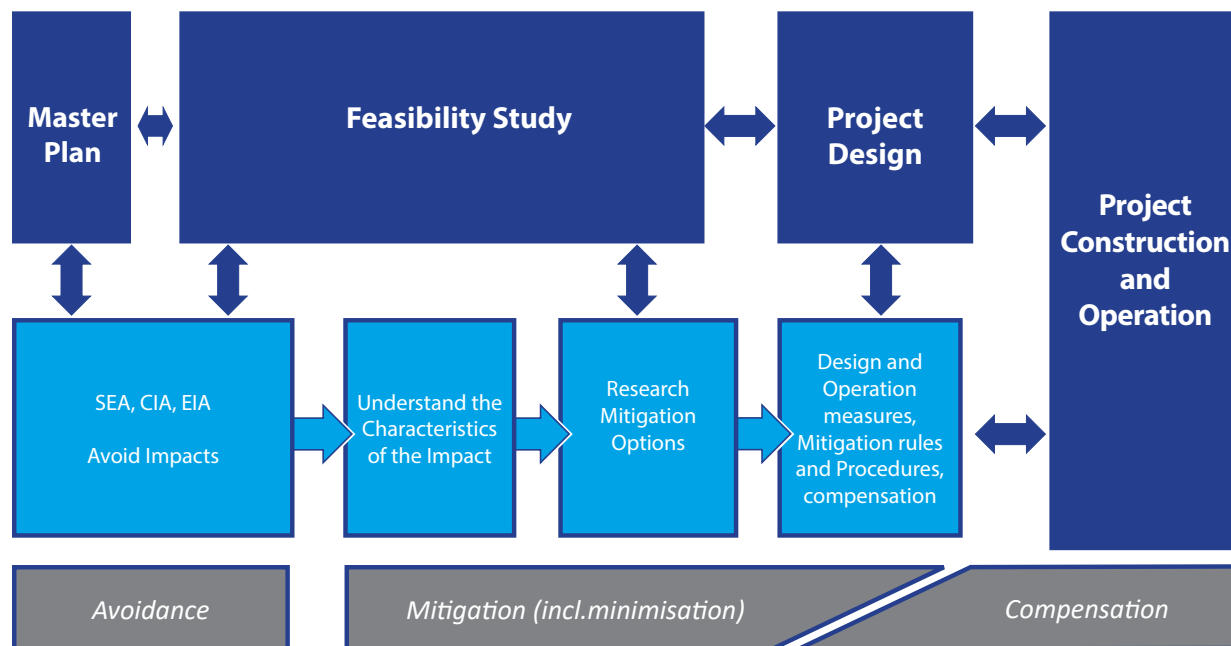


Impact Mitigation across the Project Development Lifecycle

The mitigation hierarchy (avoidance, minimisation/mitigation and compensation) will be most relevant at different steps in the project development lifecycle. Therefore, during **master planning and the siting and the design** of hydropower projects it is important to consider ways to avoid the impacts in the first place. This may include alternative locations for projects, alternative project scales (e.g. lower dams) and alternative energy sources.

Once projects are approved to go to the **feasibility stage**, avoidance of impacts remains a priority and mitigation and minimisation options become more relevant. The feasibility stage of project is a critical step to optimise the design for maximum economic efficiency and minimisation of environmental and social impacts. The full and detailed environmental impact assessment (EIA) may indicate that certain impacts are not able to be mitigated. In which case, in the project **design and operations** phase, compensation measures must be considered.

The **operational phase** of a project may last 50 years or more. It is therefore important that ongoing monitoring of the effectiveness of mitigation measures is put in place. If agreed performance targets are not being met, adaptive management and revised operating rules may be devised to further mitigate the impacts.

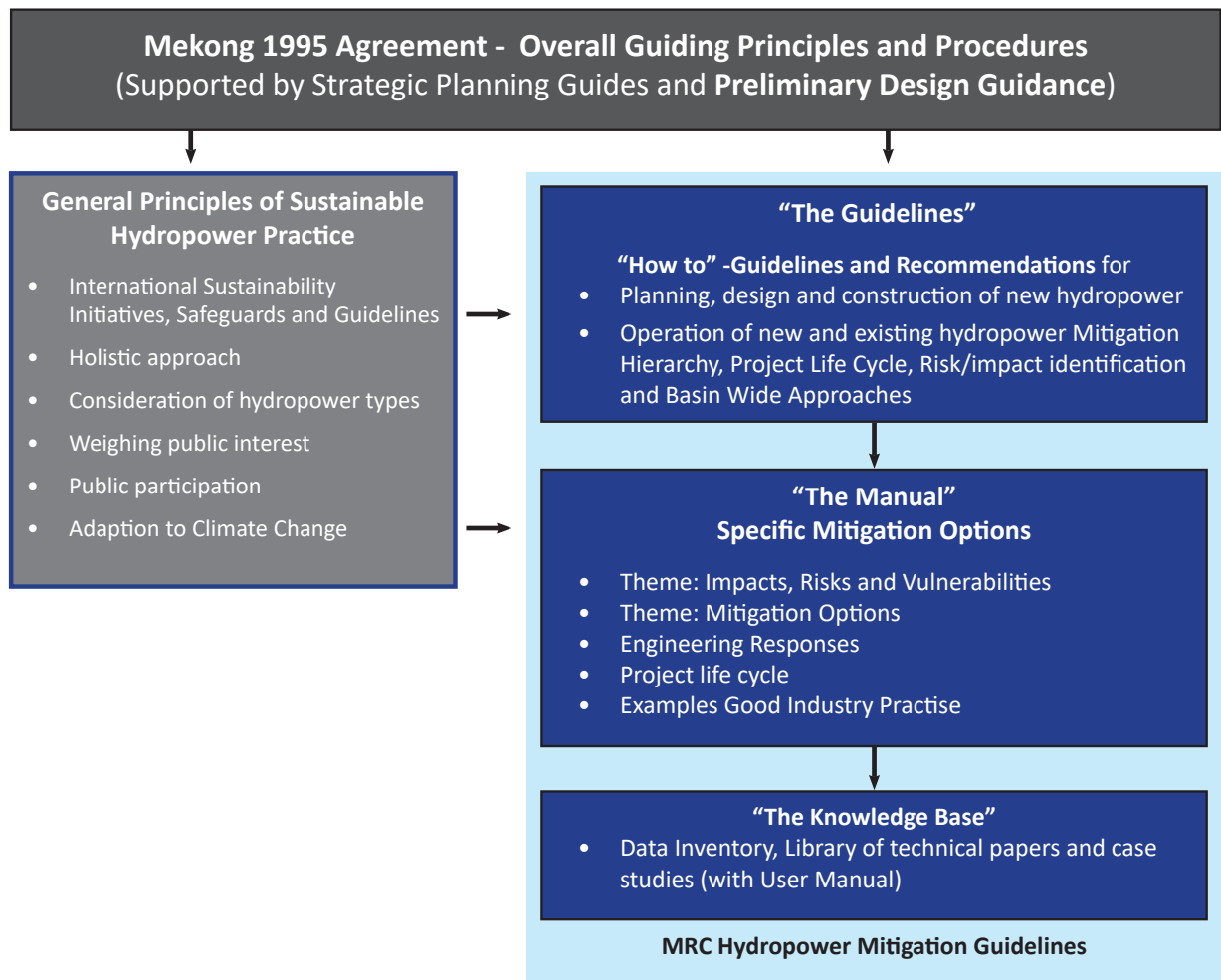


MRC Generic Practical Process for Risk and Impact Mitigation - Project Life Cycle.

Overall Guidelines Architecture

The MRC Hydropower Mitigation Guidelines are intended to support the overall MRC policy framework. Therefore, the Mekong Agreement of 1995 provides the overarching principles, procedures and governance structure for these major developments in the basin. The MRC's Preliminary Design Guidance of 2009, which is to be updated in 2018, is a key document used during the assessment of mainstream hydropower projects under the PNPCA. Therefore, these MRC Hydropower Mitigation Guidelines provide a detailed technical support resource for users of the Preliminary Design Guidance.

Overall Guidelines Architecture:



The **MRC Hydropower Mitigation Guidelines** consist of three technical volumes and one case study report:

- Volume 1, **Hydropower Risks and Impact Mitigation Guidelines and Recommendations** – The Guidelines provide the method and process to assessing risks and considering appropriate mitigation options.
- Volume 2, **Hydropower Risks and Impact Mitigation Manual** –The Manual is referenced in the guidelines Volume 1 describes risks, impacts and vulnerabilities as well as specific mitigation options in more detail. The Manual also provides examples of good industry practise mitigation options sourced from international practice, from the Greater Mekong Sub-Region (GMS) and the Lower Mekong Basin (LMB).
- Volume 3 is a **Knowledge Base** that supports the Guidelines and Manual with a document inventory and an online library of relevant studies and technical papers.

The Case Study Report – Volume 4:

Promising mitigation options have been applied to the cascade of five mainstream hydropower dams, upstream of Vientiane, Lao PDR. The effectiveness and economics of these mitigation options have then been modelled and analysed in detail. In association with the MRC’s Council Study, mitigation on the remainder of the mainstream and some tributary dams have also been

assessed. Conceptual level alternative schemes layouts have been proposed for mainstream and tributary dams. Research requirements have been scoped for further technical assessment of environmental risks and mitigation effectiveness.

Key Findings and Recommendations

Finding #1

a) **System and Basin Scale Strategic Planning is vital to avoid large scale impacts and**
b) **Mitigation must be focussed at a basin scale to support effective project by project mitigation.**

Recommendations:

- The Council Study outcomes should form the basis for **dialogue between the Member Countries and the MRC Dialogue Partners (China and Myanmar) on basin scale mitigation requirements** to avoid, poorly coordinated hydropower planning, design and operations on the Mekong mainstream and its tributaries leading to reductions in water and food security.
- Based on Council Study results, senior water and energy sector policy advisors and leaders from the MRC member countries should be engaged in the development of the MRC **Sustainable Hydropower Development Strategy (SHDS)** in order to discuss trade-offs and review alternative pathways as set out in the MRC's Strategic Plan 2016-2020. The SHDS to be completed within Q1 2019.
- **Basin Development Planning** needs to involve the energy sector as an essential first step for basin scale mitigation.

The recently completed MRC Council Study¹ clearly shows the trade-offs between the energy, water and food that arise from the intense development of hydropower in the Mekong Basin. While the economic benefits of proposed 2040 developments are valued at US\$160bn, a significant proportion of that value is lost in other sectors. The fisheries sector alone is projected to lose between US\$25-30bn in economic value across the basin (reduction of 30%).

In addition, these impacts are felt most acutely by those riparian communities along the river corridor. Water resources development planned for 2040 is predicted to **reduce food security and potentially increase poverty levels**. At current levels of agricultural productivity, aggregate household incomes are predicted to decline. Poverty levels are expected to rise in most zones. The total dollar value of fish catch in the Mekong corridor is expected to decline by \$1.57 billion. Fish prices are expected to increase, which would affect poor households.

These costs and benefits of hydropower development are also **unevenly spread across the MRC member countries of this transboundary basin**. Thailand capture over 50% of the hydropower value (US\$80bn) while impact to the fisheries sector is a loss of US\$8bn (12%). Cambodia, on the other hand, captures US\$12bn from the hydropower sector while their fisheries sector value reduces by US\$6bn (50%). These impacts are therefore reinforcing the transboundary and basin scale of the hydropower sector mitigation requirements.

¹The Study on Sustainable Management and Development of the Mekong River including Impacts of Mainstream Hydropower Projects; (MRC 2018)

The MRC's Council Study also showed that the upstream Lancang dams and the tributary dams have substantial impact on the hydrological flows and sediment inputs to the mainstream with subsequent impacts on the wider ecosystem services (fish fauna, wetlands, floodplains etc.). These impacts cannot be mitigated by implementing measures on the dams on the mainstream alone, but must be dealt with either at the Lancang and tributary dams themselves AND through use of basin and catchment scale management approaches, e.g. through coordinated planning, design and operation.

While the MRC Hydropower Mitigation Guidelines documents specific mitigation approaches to address the various risks, integrated hydropower planning at system/basin scale is a core recommendation of this work. This is also envisaged in the MRC's Strategic Plan 2016-2020 as part of the overall Integrated Water Resources Management approach.

Such an approach, at basin and catchment level, will cater for the incorporation of sustainable planning within a spatial and temporal context allowing for the application of the full mitigation hierarchy, from avoidance through minimisation, mitigation and compensation/offsets as well as possible mechanisms for benefit sharing. Integrated system planning will have the possibility to reduce cumulative impacts at basin and catchment scale making this approach highly relevant for the future sustainable hydropower planning of Mekong mainstream and its tributaries.

Finding #2

Ongoing Cooperation and Benefit Sharing Mechanisms will be valuable to mitigate these basin scale impacts.

Recommendations:

- **Mechanisms for coordinated operation**, particularly for mitigation of impacts, should continue to be investigated and implemented across hydropower cascades on the Mekong mainstream and in the tributaries, both at a national and transboundary level.
- Opportunities for **Joint Action and Benefit Sharing** be explored to mitigate impacts at a basin scale.

Basin scale mitigation requires ongoing cooperation between the Member Countries and dialogue partners. Co-ordinated action between mainstream developers on a cascade will be necessary. The study clearly showed that the coordination of sediment flushing operations as well as flood and dam safety management will be critical.

In addition, the basin would benefit from increased integration of development planning. This would move member countries further along the *cooperation continuum*; opening up opportunities for joint action (joint ownership, joint project design, joint operation, joint investment e.g.).

Considerations for joint action are already foreshadowed in the Mekong Agreement and its associated initiatives such as the Basin Development Plan, the basin scale Sustainable Hydropower Development Strategy, Joint Environmental Monitoring. These serve as a good starting point for further joint action between the LMB Member Countries, and beyond.

Joint Action may also include opportunities for joint development with Benefit Sharing. The MRC's completed a comprehensive review of good industry practice on Benefit Sharing with the MRC Member Countries which provides a supporting framework to guide possible Joint Action.

Joint Action represents the greatest level of coordination and cooperation at a Basin Scale and is normally formalised in treaties and strong institutions, where benefit sharing arrangements such as joint ownership and management of assets can form the basis to spark and implement proper benefit sharing mechanisms within and between the LMB member countries.

Finding #3

Innovative scientific and engineering mitigation options may minimise hydropower environmental and social impact if supported with adequate monitoring and scientific research. However, major environmental risks can only be partially mitigated.

Recommendations:

- **Ongoing Joint Environmental Monitoring, and research into the effectiveness of currently deployed mitigation options** in the Mekong mainstream dams should be undertaken and shared between member countries so that ongoing research on appropriate Mekong mitigation can be supported.
- The **siting and design of proposed Mekong mainstream and tributary hydropower projects should be reviewed** too seek innovative scientific and engineering solutions to avoid minimise and mitigate impacts.

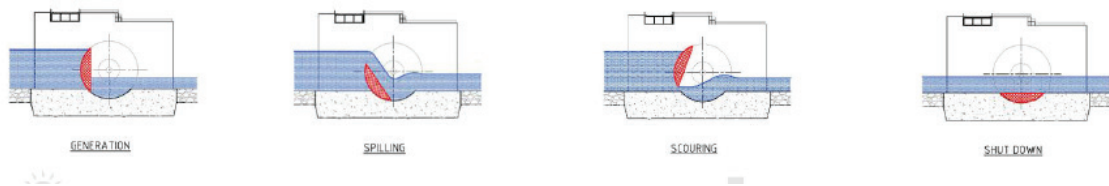
The Case Study, undertaken as part of the development of these guidelines, investigated the Mekong mainstream cascade operations and mitigation in detail, considering the most promising management strategies, optimised design and coordinated operation. This analysis showed that, **if well researched scientific and engineering solutions are employed, the major impacts and risk may be minimised but only partially mitigated.** These solutions included, among other options, optimised and flexible upstream and downstream fish passage designs with pumping stations and auxiliary turbines connected to the fish passages as well as a combination of low and high-level sluices, throughout the cascade, for optimal and coordinated flushing and sluicing.

Innovative overarching engineering design mitigation options included alternative schemes layouts (lower dams and gated barrages) of the proposed mainstream dams. The comparison between a typical full height mainstream project and the equivalent two half height schemes indicates that the combined construction cost of the two half height schemes will be approximately 15% greater. Conversely, the project finance cost for the two half height schemes is lower because energy and revenue is available approximately four years earlier. The overall implication is that the cost of energy from the half height schemes is approximately the same, and possibly lower, than the single full height scheme. Gated barrages can also yield improved sediment transport and fish migration through temporally opening of the gates and shutdown of power production in ecologically critical periods of the year (critical sediment pulse and fish migration periods).



Nakdong Dalseong – S Korea

Yeosu – S Korea



Example of low head sector gate barrages

The application of the more detailed mitigation approaches needs to be intensively and jointly monitored by MRC member countries at Xayaburi (currently under construction) to assess the effectiveness of mitigation and to build important knowledge that may be applied in the design and operation of potential future dams in the mainstream and tributaries of the Mekong.

Finding #4

Additional Training and Capacity Building is needed to support the adoption of these MRC Hydropower Mitigation Guidelines

Recommendation:

- Due to the highly scientific and technical content of the **MRC Hydropower Mitigation Guidelines** it is highly recommended that **ongoing training and capacity building** be supported by the MRCS for member countries and the above stakeholders.

Capacity building, training and outreach as well as “on-the-job” training and training workshops has been conducted throughout the development of these **MRC Hydropower Mitigation Guidelines**. Communication materials have been developed and various national and regional consultations held.

The MRCS has supported and been involved in the five separate Sustainable Hydropower Development Forums including a Hydropower Sustainability Forum: Mekong+ in Oslo, September 2017. This latter event was a joint collaboration between MRC, GIZ and Multiconsult, and was also supported by NORAD, Norwegian Ministry of Foreign Affairs and Deltares.

These Fora bring together Member Country representatives, national hydropower utility operators, developers and hydropower consultants to discuss and share experiences.

Access the Guidelines, Manual and Knowledge Base at
<https://goo.glsuzxhV>



Mekong River Commission Secretariat

184 Fa Ngoum Road, P.O. Box 6101, Vientiane, Lao PDR

Tel: + 856 21 263 263, Fax: + 856 21 263 264

Email: mrcs@mrcmekong.org

www.mrcmekong.org