CASE

SEA for the hydropower sector - MYANMAR

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Strategic Environmental Assessment for Sustainable Development of the Hydropower Sector

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SEA FOR THE HYDROPOWER SECTOR

MYANMAR

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Authorities	Ministry of Electricity and Energy and Ministry of Natural Resources and Environmental Conservation
Type of plan	National planning framework for HPP site selection
Scope of SEA	All HPPs >10MW in Myanmar
Key SEA issues	Categorising 69 planned HPPs (43,848 MW) in different stages of development, based on cumulative assessment of ecological and socio-economic impacts
Stakeholder engagement	Consultation with all identified stakeholders such as relevant authorities at national and regional level, representatives of local organisations, ethnic armed organizations, and affected communities
Duration and year	19 months; 2016 – 2018
Influence of SEA	• Myanmar is divided in three zones: low, moderate and high risk • CIA is carried out for optimisation and E&S risk management of cascade of HPPs
Link to SEA report	https://www.ifc.org/wps/wcm/connect/industry_ext_content/ifc_external_corporate_site/hydro+advisory/resources/sea+of+the+hydropower+sector+in+myanmar+resources+page

1.1 INTRODUCTION

Myanmar, a country with substantial water resources, is considering how to best develop hydropower to help meet the country's large power supply shortfall whilst maintaining river basin process and values that support critical ecosystem services, underpinning the livelihoods of millions of people. Given that the hydropower sector is in the early stages of development, the opportunity exists to sustainably develop the industry by balancing energy generation with environmental and social outcomes.

Current hydropower planning in Myanmar follows conventional planning based on the assessment of individual projects as they are proposed. Early project site selection focuses on engineering and economic factors, with little if any consideration of cumulative environmental and social impacts on the river basin. This project-centric planning approach has resulted in significant cumulative basin impacts in other countries in the region that were not recognised until substantial degradation had resulted. In light of these planning limitations a strategic environmental assessment (SEA) was prepared to guide hydropower development at the basin scale over the next three decades and beyond, establishing a planning framework for project site selection that balances development with basin health.

The SEA was jointly prepared by the Ministry of Electricity and Energy (MOEE) and Ministry of Natural Resources and Environmental Conservation (MONREC), with the assistance of the International Finance Corporation (IFC) and its development partner, the Government of Australia.

Sustainable hydropower development recognises the interdependent processes, functions, and values of a basin and seeks to maintain basin health and ecosystem services, while developing hydropower to help meet the substantial energy needs of the population. This can be achieved by retaining high value intact tributaries while developing lower value rivers as "workhorse" watercourses. In basins and on rivers that are already highly regulated the adverse effect of adding additional projects may be far less than the impact of developing intact rivers. This pathway avoids dispersed projects being built on many tributaries with viable hydropower sites without due consideration of natural resource values.

The primary output of the SEA is the sustainable development framework (SDF) - a project siting tool that balances hydropower development with basin health by considering environmental and social factors at the basin scale prior to project site selection. The scope of the SEA covers all projects of 10 MW capacity or greater in Myanmar. The vision for development was set as:

Sustainable hydropower development based on integrated water, land and ecosystem planning, balancing a range of natural resource uses and priorities to achieve economic development, environmental sustainability and social equity.

This is supported by six objectives:

- maintain natural river basin processes and functions that regulate and maintain river health and ecosystem services;
- retain unique and important biophysical and cultural sites and values, as well as representative environmental values;
- avoid unacceptable social, livelihood and economic impacts;
- recognise, understand and avoid or manage conflict risks;
- provide development benefits to project affected people, communities and regions; and
- generate adequate, reliable and affordable hydropower energy for domestic consumption.

SEA planning was not tied to achieving a national target for installed hydropower capacity, but instead recognised the substantial number of proposed projects and assumed that medium and large-scale hydropower will play an important role in supplying affordable and reliable energy in Myanmar. Planning was responsive to the natural resource values of basins, letting these values guide sustainable development.

1.2 Background: Context and Issues

Myanmar has extensive, largely unregulated river systems that support a broad range of aquatic ecosystems and livelihoods. Most notably, two of the last remaining major intact[1] rivers in Southeast Asia flow through Myanmar: the Ayeyarwady and Thanlwin. An estimated 70% of Myanmar's 55 million population lives in rural areas, with many having a high dependency on riverine resources. Freshwater ecosystem services consist of: (i) Provisioning: fish production, irrigation, and domestic water supply; (ii) Regulating: flow regulation, water purification, natural hazard (flood) regulation, maintenance of coastal landforms, and marine nutrient supply; and (iii) Cultural: cultural landscapes, recreation, and tourism. But the health of river resources is under threat from hydropower development that has the potential to greatly expand over the next 2-3 decades.

Myanmar has a substantial power shortage, with only 40% of the population supplied - the lowest grid connected electrification rate in Southeast Asia (MOEE,2018). Rapidly growing electricity demand is estimated to rise at an average annual rate of 11 percent until 2030 and peak demand is expected to reach 12.6 GW by 2030 (WB, 2019). Investment is expected to require US$2 billion per year to meet the country's needs. The future national energy mix was prepared under the National Electricity Master Plan (NEMP) and covered conventional and renewable energy generation, indicating that hydropower is likely to play an important role in this mix. Medium and large-scale projects are capable of generating substantial renewable energy, while helping to stabilise the grid as intermittent power generation from other renewable sources such as solar and wind comes online.

[1] Rivers largely unaffected by human-made changes to its flow and connectivity. Water, silt, and other natural materials can move along unobstructed. Animals, such as river dolphins and migratory fish, can swim up and downstream at will. (WWF, 2020).

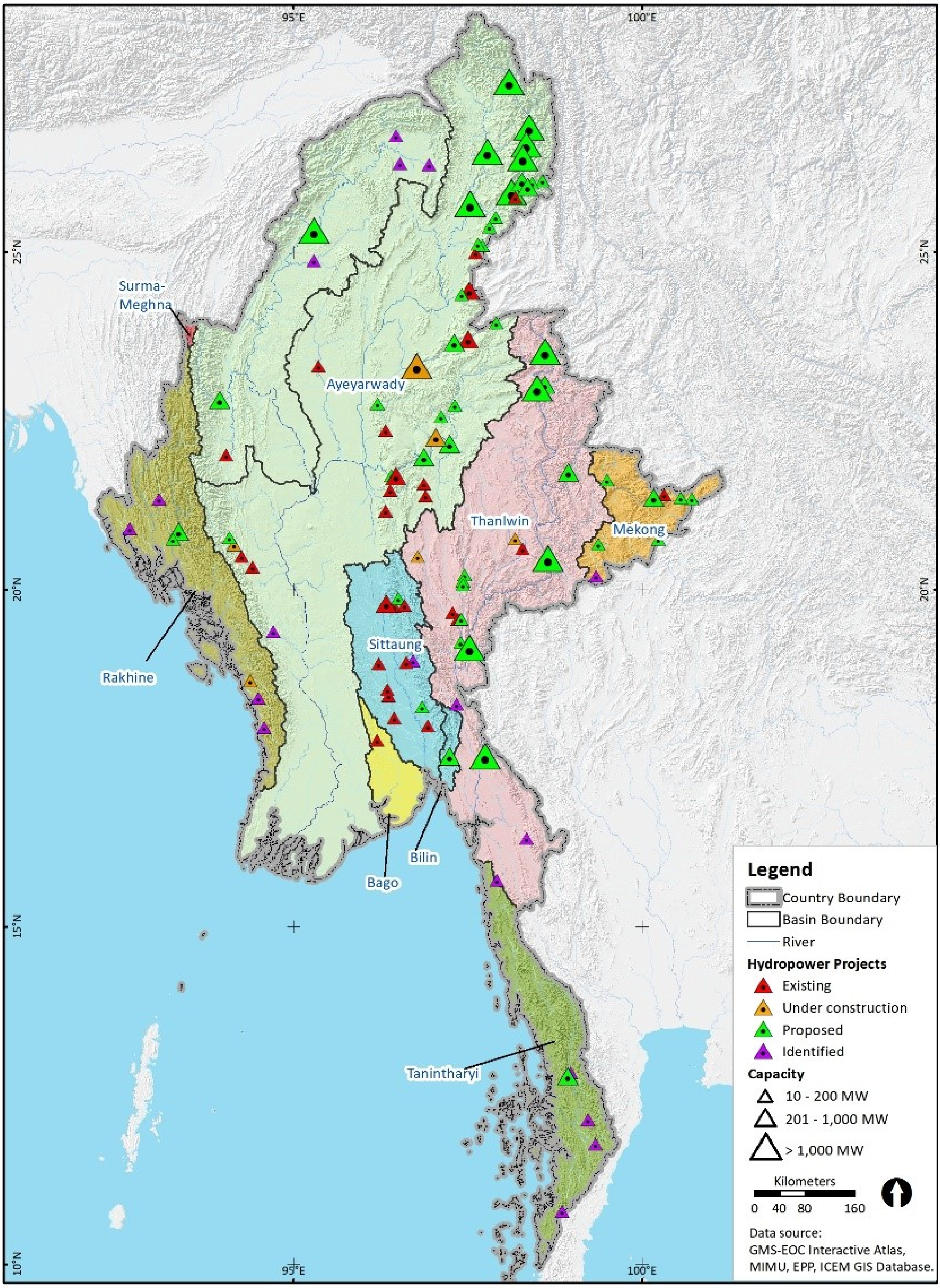


Figure 1: Status of hydropower development in Myanmar

Relatively limited hydropower development has occurred in Myanmar to date compared with estimates of potential total capacity. The total installed capacity of projects 10 MW and greater (29 projects – Figure 1) is 3,298 MW, accounting for 58% of national energy supply in early 2018. A further 1,564 MW capacity is under construction (6 projects), but several of these projects are stalled or taking far longer to complete than scheduled. Of these projects 80% has been developed in cascade arrangements, driven by load centre locations and limited transmission grid coverage, coupled with suitable sub-basin hydrology, topography and geology. The Ayeyarwady river basin accounts for 64% of total installed capacity, with the Sittaung river basin contributing 25%. This low overall level of development is partly a function of the country's political and economic isolation between 1988 and 2011, but now there is considerable international interest in the sector.

Sixty-nine projects are proposed, totalling 43,848 MW capacity (Table 1), with their stages of development ranging from initial identification through to various agreements in place with the government. Very large projects (>1,000 MW) account for 80% of proposed capacity, with most of these proposed on mainstem rivers.

Table 1: Proposed hydropower projects – by installed capacity (December 2018)

Project Capacity (MW)	Number of Projects	Total Capacity (MW)	% of Total Proposed MW
>2,000	6	25,100	57.3
1,000-2,000	7	10,060	22.9
500-1,000	5	3,020	6.9
100-500	28	4,823	11.0
10-100	23	845	1.9
Total	**69**	**43,848**	**100**

The current level of geographically restricted hydropower development presents a window of opportunity to sustainably develop the sector before dispersed, high impact projects are built.

Over the past decade public opposition to large projects has risen. Stakeholder objections have variously been attributed to insufficient project transparency and stakeholder engagement, the legacy issues of past projects, conflict affected areas and political shifts. Projects proposed on major rivers have received the most objections, leading the government to suspend the Myitsone, Tamanthi and Tanintharyi HPPs, totalling 7,800 MW capacity.

Hydropower planning in Myanmar has to contend with limited natural resource and socio-economic data on key themes (river hydrology, geomorphology, aquatic ecology, social and livelihoods), although some current river basin studies such as the Ayeyarwady Integrated River Basin Management Project (AIRBMP) are starting to fill some of the gaps (Hydro-Informatics Centre, 2017).

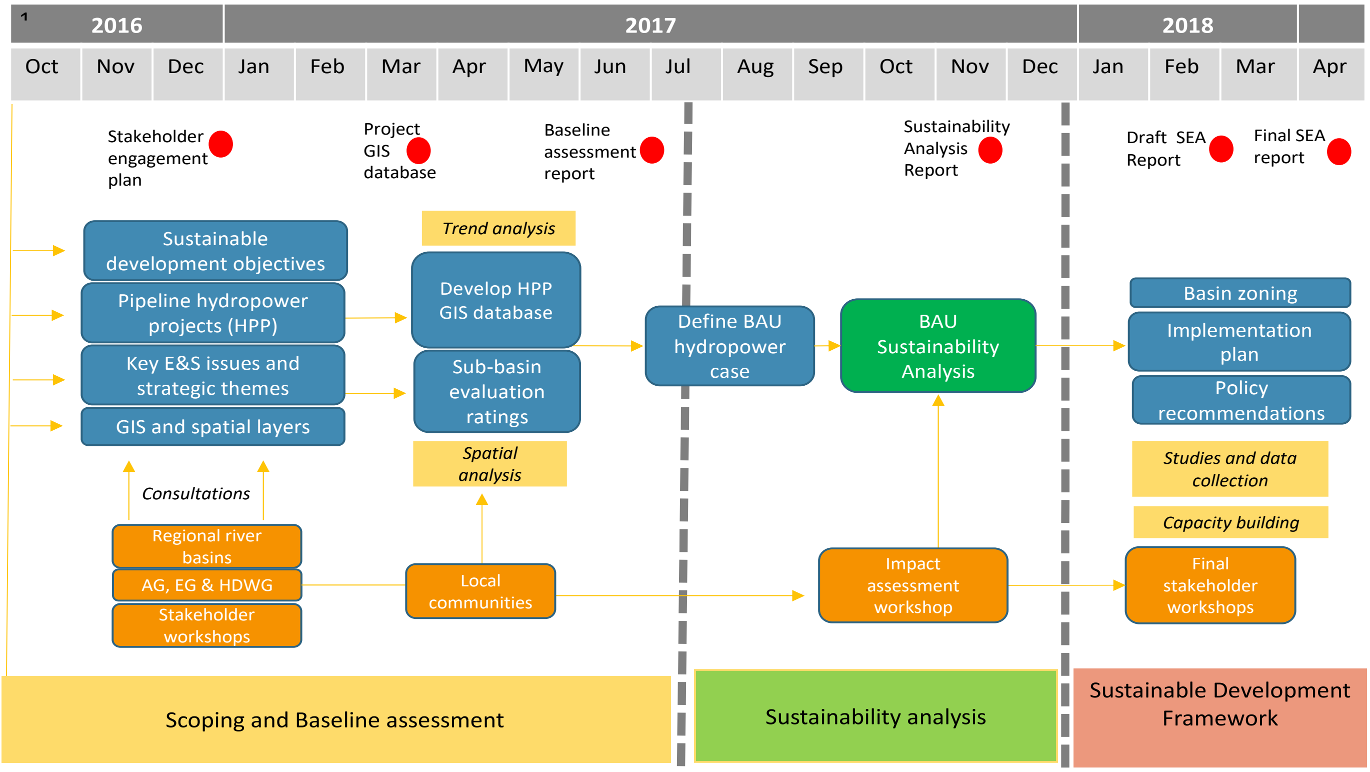
Box 1: The importance of basin health and fish production

Basin health is critical to maintaining freshwater and marine fish production, an important sector of the Myanmar economy. Changes to seasonal flows, water quality, and river geomorphology all degrade natural freshwater habitat. Outflows from Myanmar's major rivers into the sea provide nutrients for marine life and help maintain natural coastal processes essential to coastal fisheries production.

National fish production in 2014 was 5,048,000 metric tons, accounting for around 3% of the world's reported fish production. This consisted of 27.3% from inland fisheries, 53.5% from marine fisheries, and 19.1% from aquaculture. National fish production supports the livelihoods of an estimated 3.2 million people employed in the fisheries sector (800,000 full-time, 2.4 million part-time), and is the fourth largest contributor to Myanmar's GDP and source of foreign exchange earnings. Estimated average annual fish consumption per person is 30 kg.

Source: Fisheries Statistics 2014, Department of Fisheries Myanmar.

Figure 2: SEA methodology and outputs



1.3 Approach and methods used

SEA preparation involved six main activities (Figure 2):

- issue scoping;
- stakeholder engagement;
- management unit definition and hydropower GIS database preparation;
- evaluation of baseline environmental, social and conflict conditions and trends;
- hydropower business-as-usual (BAU) sustainability analysis;
- sustainable development framework (SDF) preparation

1.4 Issue scoping

Stakeholder engagement with government, civil society organisations (CSOs), and hydropower companies were undertaken at the commencement of SEA preparation to canvass broad views on basin values, development, protection and management. Key environmental and socio-economic issues and concerns raised were analysed under seven strategic themes for analysis:

- hydropower;
- geomorphology and sediment transport;
- terrestrial biodiversity;
- fisheries, aquatic ecosystems, and river health;
- economic development and land use
- social and livelihoods;
- peace and conflict.

The main hydropower impact issues raised were: changes in water flow and water quality, sedimentation and riverbank erosion, flooding, deforestation, biodiversity loss, food security and nutrition (e.g. loss of agricultural land, riverbank gardens, orchards, and capture fisheries), loss of livelihoods, land grabbing, conflict, and social welfare issues (e.g. drugs and mental health). The benefits of hydropower were identified as: access to electricity, improved access to services (health, education, and transport), socio-economic development and higher living standards, opportunity for irrigation (multi-purpose projects), local employment, and opportunities to develop small and medium enterprises.

Stakeholder engagement

Stakeholder engagement was a core component of the SEA process, aiming to solicit the views and concerns of different stakeholders, whilst building broad awareness of existing and proposed hydropower development, basin values, likely cumulative BAU adverse impacts, and sustainable development principles.

An SEA Advisory Group and six technical Expert Groups were convened to guide the SEA, identify the best available information, review draft findings and help engender a commitment to the SEA vision. These groups consisted of local and international specialists covering different technical fields, from government agencies, non-governmental organisations, the private sector, development partners, multi-lateral agencies, academic institutions, ex-government officers and independent researchers.

A Stakeholder Engagement Plan was developed identifying key groups with an interest in hydropower development and river basin management and outlining consultation and communication activities. Stakeholders included Union and state/region governments, national and local CSOs, ethnic armed organisations (EAOs), political parties, local communities, the private sector, development partners, international and local NGOs, universities, multilateral development agencies, and banks. More than 55 stakeholder engagement events were held across Myanmar to capture views from as many states/regions where hydropower is planned as possible, commencing during issue scoping. The events involved:

- **Regional river-basin consultations**: workshops with civil society organisations (CSO) and state/region governments to identify basin environmental and social issues, carry out visioning exercises, and opportunities during scoping, and to review and provide feedback on draft SDF recommendations;
- **Multi-stakeholder workshops**: open to all stakeholders including representatives from Union and sub-national governments, international and local NGOs/CSOs, universities, and the private sector during all phases of the SEA;
- **Local community consultation**: key informant interviews and focus group discussions with villages affected by the Upper Paunglaung, Lower Yeywa, Bawgata, Shwe Gyin, and Baluchaung 1, 2 and 3 HPPs to validate actual village-level environmental and social impacts and broader concerns with sector developments;
- **Consultation with ethnic armed organisations (EAO) and political parties**: consultations with EAOs, political parties, and CSOs in Mytikyina, Taunggyi, and Kyauk in Myanmar as well as Mae Sot and Chiang Mai in Thailand as part of the conflict and peace assessment;
- **Discussions with the Hydropower Developers' Working Group (HDWG) cum Myanmar Hydropower Developers' Association (MHDA)**: presentations and discussions with hydropower companies and consultant firms working in the sector;
- **Information sessions**: presentations and discussions at a range of conferences and workshops starting from the development of the SEA Terms of Reference to reach broader audiences and garner additional inputs into the process;
- **Government briefings**: multiple briefings were provided to government Ministers and agencies from MOEE and MONREC, as well as to the Parliament and the National Economic Coordination Committee (NECC) during and following the completion of the SEA.
- **Training**: GIS training was provided to MOEE and MONREC to provide them all the data produced during the SEA and for these agencies to be able to use it in their assessments and decision-making, along with the formal reports.

Informal discussions were also held with numerous individuals and organisations to share information and receive inputs throughout the SEA preparation.

Management units and GIS database

Eight basins cover the entire country, consisting of six river basins (Ayeyarwady, Thanlwin, Mekong, Sittaung, Bago and Belin) and two coastal basins composed of small watersheds grouped together for analysis purposes (Tanintharyi and Rakhine) (Table 2). Two natural management units with related but discernibly different functions were defined within the basins: mainstem rivers and sub-basins.

Basin	Total Basin Area[a] (km^2)	Basin Area within Myanmar (%)	Basin Area in Other Countries (%)	Land Area of Myanmar (%)	Total Main River Length (km)	Number of Sub-Basins
Ayeyarwady	412,500	90.4	China – 5.4 India – 4.2	55.5	2,170	27
Thanlwin	283,335	45	China – 48 Thailand – 7	19.0	2,400	11
Mekong	824,000	2.7	China – 21 Lao PDR– 24 Thailand – 23 Cambodia – 20 Viet Nam – 8	3.3	3,469	4
Sittaung	34,913	100		5.2	450	3
Bago	10,261	100		1.5	220	1
Bilin	3,056	100		0.5	160	1
Tanintharyi	44,876	100		6.7	400	3
Rakhine	71,700	77	Bangladesh & India – 23	8.2	280	7

Table 2: River and coastal basins in Myanmar 2

Source: Basin areas taken from GIS HydroSHEDS/HYBAS LAKES data apart from the Thanlwin basin. Note: Barak sub-basin (792 km2) lies in the Surma-Meghna basin, outside Myanmar's eight main basins.

Mainstem rivers provide unimpeded system connectivity for flows, sediment, and aquatic ecosystems between sub-basins and the sea, maintaining essential basin processes and functions. Mainstem rivers were identified in five basins, defined as being a Strahler Order 4 or greater river and having an average annual flow rate of more than 1,000 m3/s (apart from the Sittaung mainstem with a lower discharge).

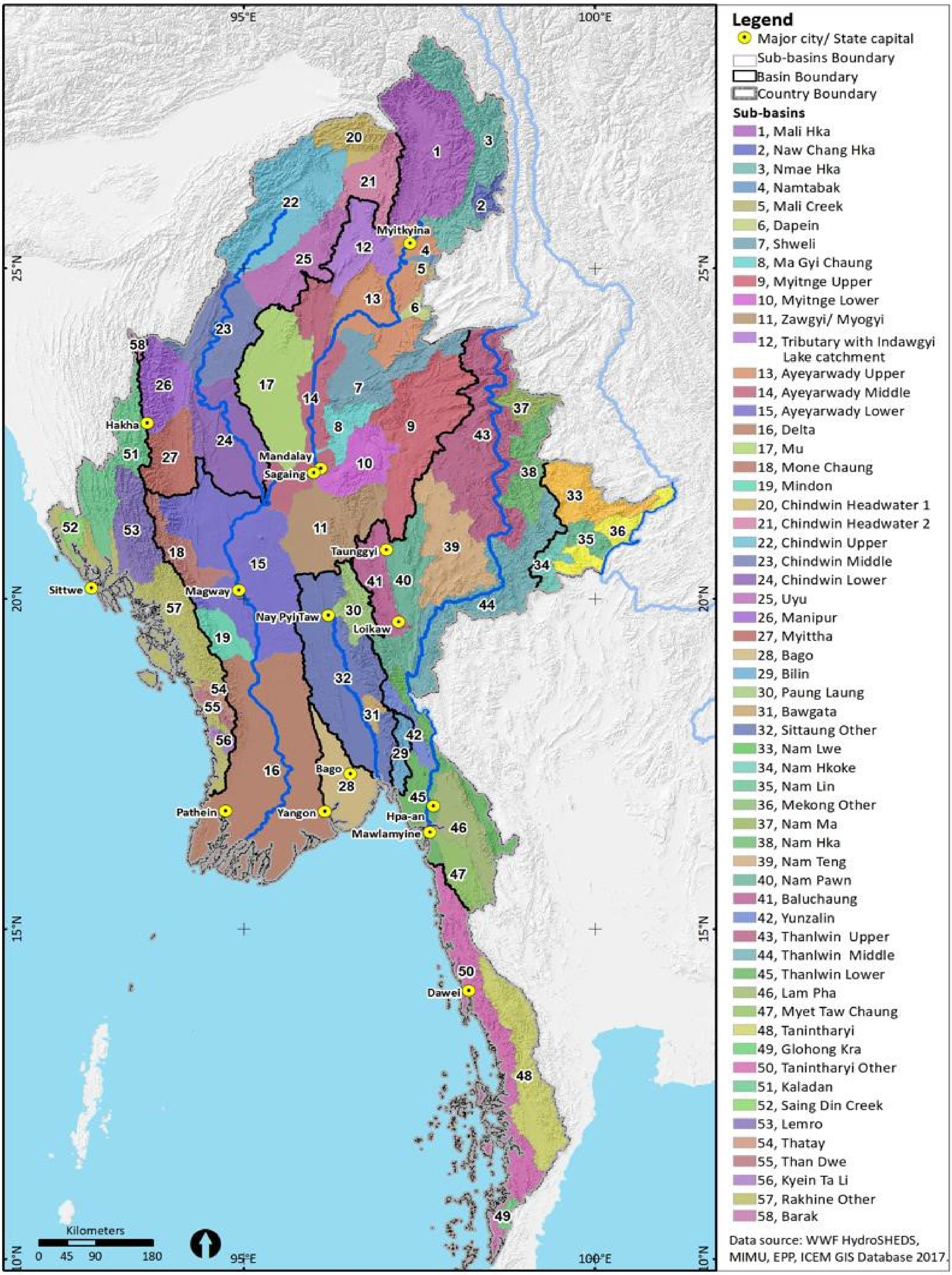
Sub-basins are discrete natural catchment areas that either drain directly into the mainstem river/main basin tributary or into the sea. They provide the primary land/water interface, where physical, chemical, and biological processes influence the ecological functioning of the basin. Fifty-eight sub-basins were identified using HydroSHED[2] levels (Figure 3). Most sub-basins (43) were selected using HydroSHED Level 6 boundaries, with the remaining sub-basins defined based on either Level 7, 8 or 9 drainage areas (especially where large hydropower projects or cascade projects exist or are planned), or combined to create sub-basins of a suitable area for strategic analysis.

A national GIS database of existing and proposed hydropower projects of 10 MW capacity and greater was prepared. The location of each project was plotted and key project information recorded on ownership and development status (developer, type of investment, stage of development, year the project is scheduled to be commissioned), baseline conditions (catchment area, rainfall, mean annual flow) and project technical details (installed capacity (MW), type of project (e.g. run-of-river, storage, multi-purpose), dam type and height, reservoir surface area and storage volume, average water retention time, powerhouse location, annual generation (GWh/year), use of power (domestic/export %)[3].

[2] Hydrological data and maps based on Shuttle Elevation Derivatives at multiple scales.

[3] The Hydropower Database. (at IFC). GIS shapefiles are available upon request to IFC.

Figure 3: Sub-basins.



Baseline conditions

Baseline conditions and trends were identified in each basin, covering:

- hydropower;
- geomorphology and sediment transport;
- terrestrial biodiversity;
- fisheries, aquatic ecology, and river health;
- economic development and land use;
- social and livelihoods;
- peace and conflict.

Sub-basin evaluation was then undertaken for five strategic themes that hydropower is either likely to affect or be affected by.

Conditions were evaluated using the best available information, including published research and spatial data, expert opinion, and stakeholder views. Directly relevant indicators for each theme were evaluated, or where such information was not available a proxy indicator was used:

i. geomorphology and hydrology – river connectivity and delta/coastline stability; potential sediment production; river flow;
ii. aquatic ecology and fisheries: river reach rarity (WWF, 2014); presence of endemic species, key biodiversity areas, Ramsar sites and important wetland areas, confluences, karst geology, presence of threatened fish and aquatic organisms;
iii. terrestrial biodiversity: percentage of protected area/key biodiversity area; percentage of intact forest (≥80% crown cover);
iv. social and livelihoods: social vulnerability; dependence on natural resources – indicated by % of 'own account workers as % of workforce' in townships within sub-basins (2014 township Census data); poverty - indicated by % of households owning a television (Census 2014);
v. conflict [4]: presence and status of ethnic armed groups; historical population displacement; recent conflict incidents and estimated battle deaths (2012-17).

Each of the five themes scored between 1-5 for each sub-basin by combining the scores for each evaluated criterion to provide an overall 'value' for that theme. A rating of 1 indicates a "low" value and 5 a "very high" value. Baseline information and theme scores were then summarised on sub-basin datasheets, with the scores for each sub-basin used to generate national theme maps illustrating the distribution of baseline values.

Business-as-usual basin sustainability analysis

The cumulative impact of BAU hydropower development on each basin's processes and values was assessed to identify the extent and significance of losses and degradation. Recognising these losses enables a sustainable development framework to be developed to avoid them, thereby maintaining basin health and ecosystem services.

BAU development was assumed to be the installation of the 69 proposed projects over the next 30 years, providing a 'best estimate' development scenario indicative of the scale and distribution of projects likely to be built. BAU development would result in the Ayeyarwady and Thanlwin basins having 28,000 MW (53%) and 21,000 MW (40%) of total national hydropower capacity respectively, with other six basins adding a further 3,134 MW capacity, ranging between 20-1,220 MW total capacity per basin. Mainstem development would consist of a single large project on the Ayeyarwady and Chindwin rivers, and five large projects on the Thanlwin River.

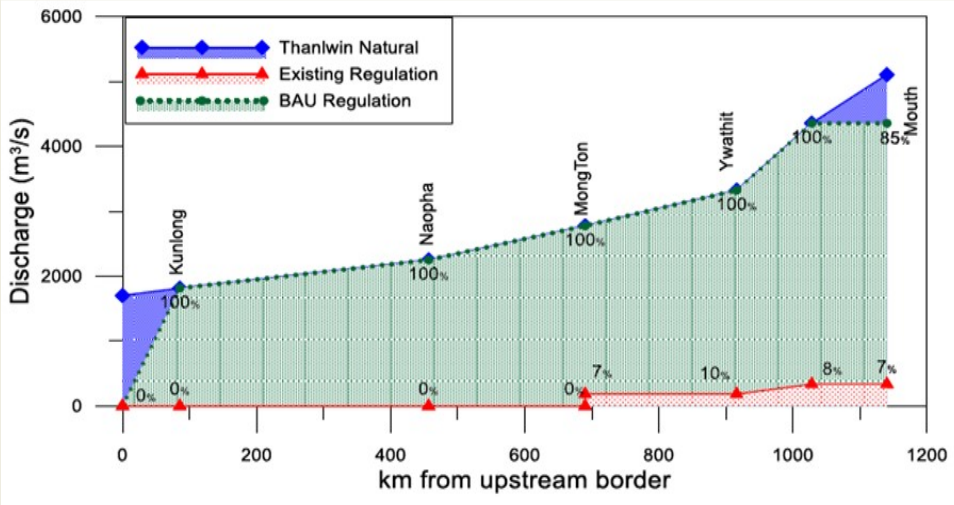
Key biophysical and socio-economic impacts from BAU development in each basin were evaluated using the same five themes and indicators assessed to determine baseline conditions. The analysis found that BAU development would triple the total catchment area regulated by hydropower within Myanmar from 14.4% at present to 45%, with most hill and mountain catchments fragmented, resulting in broad-scale biophysical changes to Myanmar's rivers and significant social impacts that are predicted to include:

- altered seasonal and daily river flows in most river basins - increased dry season flows and reduced wet season flows from storage projects, daily flow fluctuations from peaking generation, a delay in the onset of monsoonal river flows when large reservoirs refill, and a potential decrease in flood

[4] Link to the Baseline reports and sub-basin evaluation (at IFC)

flows. Figure 4 illustrates natural, existing and BAU Thanlwin River flows;

Figure 4: Thanlwin River average natural and regulated flows – by distance downstream of Myanmar-China border



- changes to water quality caused by the seasonal retention in reservoirs;
- reduced downstream sediment loads, altered sediment size distribution, and increased bank erosion resulting in changes to river and delta geomorphology;
- aquatic habitat fragmentation, with most dams and altered flow conditions preventing fish, larvae, and egg movement upstream and downstream;
- terrestrial habitat fragmentation and reduced biodiversity from the construction of reservoirs, roads and transmission lines, and potential illegal forest harvesting by the project workforce and camp followers;
- loss of riverine and terrestrial natural resources;
- large scale resettlement and the loss of livelihoods from reduced access to natural resources;
- exacerbation of conflict in some areas.

In the Ayeyarwady and Thanlwin basins, which combined cover three-quarters (74.5%) of the country, major irreversible basin-scale changes would occur to river flows and geomorphic and ecological processes and functions. Most significantly, large scale projects on the Ayeyarwady, Chindwin and Thanlwin mainstem rivers would cause substantial impacts on system connectivity and basin processes. For example, BAU development would raise the percentage of the Thanlwin basin within Myanmar that is longitudinally disconnected from the sea from 12.9% at present to 80.6%, while the Ayeyarwady would be raised from 16.1% to 38.6%.

Sustainable development framework

The 'sustainable development framework' (SDF) was prepared to balance the maintenance of critical basin processes and ecosystem services with the generation of reliable and affordable hydropower. The framework is based on Basin Zoning Plans that recommended areas for: (i) reservation from hydropower development due to high values, and (ii) potential development - lower value areas potentially suitable for hydropower development. The Plans identify mainstems and sub-basin management zones and controls for new hydropower projects.

Mainstem zoning defines the extent of each basin's mainstem recommended for reservation, where hydropower development and other major structural water resource developments (e.g. irrigation dams) are recommended to be excluded to maintain unimpeded mainstem connectivity with the sea. By leaving the mainstem intact, decisions on sub-basin utilisation can be made based on sub-basin values, uncompromised by the loss of downstream connectivity.

Mainstems recommended for reservation were identified in five basins based on their significant system connectivity value. These reaches total 4,100 km: Ayeyarwady (1,500 km), Chindwin (900 km), Thanlwin (1,200 km), Mekong (200 km) and Sittaung (300 km) rivers.

Sub-basin zoning (Figure 5) was defined by combining the scores for the three biophysical features evaluated in the assessment of baseline conditions: geomorphology and hydrology, aquatic ecology and fisheries, and terrestrial ecology. Socio-economic sub-basin scores were not applied as the level of detail available was considered a poor indicator of the value of features likely to be adversely affected by hydropower. Similarly, the status of armed conflict was also not applied to determine sub-basin zoning as conflict is dynamic and variable across a sub-basin. Instead, conflict zoning is applied as an additional screening layer for proposed projects by developers early in the project feasibility analysis to evaluate the related risks.

The scores for the three biophysical factors were totalled and scaled to determine one of three sub-basin zones (See Table 3 for zone distribution by basin):

Table 3: Zone distribution by basin

Basin	% of Myanmar Basin Area[1]		
	High	Medium	Low
Ayeyarwady	20.9	28.6	50.5
Thanlwin	15.9	57.9	26.2
Sittaung	-	82.2	17.8
Mekong	29.8	15.5	54.7
Bilin	-	-	100
Bago	-	-	100
Tanintharyi	97.8	2.2	-
Rakhine	24.6	66.8	8.6
Surma-Meghna	-	-	100
Total	**24.2**	**37.3**	**38.5**

- **high** - provides an important contribution to basin processes (such as high flows or a large sediment load), and/or has unique natural values for at least two biophysical factors;
- **medium** - no high conservation value features over a notable area for at least two biophysical factors, although may contain notable values for a single factor or pockets of such values for multiple factors;
- **low** - no high conservation value features over a notable area for any biophysical factor, although may contain pockets of high value.

Ten high zone sub-basins (see Table 4 for high zone sub-basin scores) with critical biophysical processes and values were defined, covering 24% of Myanmar. Hydropower development in these areas is recommended to be limited to smaller scale projects with low environmental and social risks that cumulatively will not unduly degrade the reserved values. Five of the high zone sub-basins form a contiguous block in the headwaters of the Ayeyarwady basin, covering 78,900 km2 (21% of the basin area within Myanmar), contributing an estimated 47% of total basin discharge and a substantial volume of sediment.

This area contains high value aquatic habitats and notable terrestrial ecosystems in Hkakaborazi National Park, four Wildlife Sanctuaries and numerous key biodiversity areas, containing 35% of all remaining intact forest (>80% crown cover) in Myanmar. Two other high zone sub-basins were defined in Tanintharyi basin, while one each is located in the Thanlwin, Mekong, and Rakhine basins.

Twenty-one medium zone and 27 low zone sub-basins were identified as being potentially suitable for hydropower development, covering 37% and 39% of Myanmar respectively. These sub-basins are recommended to be considered by government for potential hydropower development, subject to environmental and social impact assessment. Over time, as new data is obtained and projects are approved, it is recommended that the government consider trade-offs within this group of sub-basins to achieve a balance between developed and reserved catchments.

Table 4: High zone sub-basin scores

Basin	Sub-Basin	Geomorph. and Sediment	Aquatic Ecology	Terres-trial Ecology	Total Score
Ayeyarwady	Mali Hka	5	5	5	15
	N'mai Hka	5	4	5	14
	Chindwin Headwater 1	3	4	5	12
	Chindwin Headwater 2	2	5	5	12
	Chindwin Upper	5	3	4	12
Thanlwin	Thanlwin Middle	5	4	3	12
Mekong	Mekong Other	4	5	2	11
Tanintharyi	Tanintharyi	5	5	5	15
	Tanintharyi Other	5	3	4	12
Rakhine	Kaladan	5	4	2	11

The adoption of the basin zoning plans to site projects will achieve the underlying principle of sustainable development: maintain high value intact mainstems and sub-basins to drive basin health while permitting development in "workhorse" sub-basins, thus avoiding the construction of projects in many intact sub-basins. Developing projects in cascade arrangements versus dispersed projects can lower the overall magnitude of impact per unit of energy generated and increase power generation per unit of water regulated by running stored water through multiple powerhouses. The development of low and medium zone sub-basins, assuming all BAU projects are installed om the two zones, would raise the total Myanmar catchment area regulated by hydropower from 14.4% to 23.5%, considerably less than 45% that would be regulated under BAU.

A three-year implementation plan was proposed to support the introduction of sustainable hydropower, incorporating:

- the establishment of a joint government planning committee consisting of MOEE and MONREC;
- development of a national Sustainable Hydropower Policy;
- development of a Basin Zoning procedure for Government of Myanmar implementation;
- recommended sustainable project design criteria;
- recommended improvements to environmental and social impact assessment and management planning including inclusion of conflict assessments;
- enhanced stakeholder engagement; and
- critical baseline data collection and research.

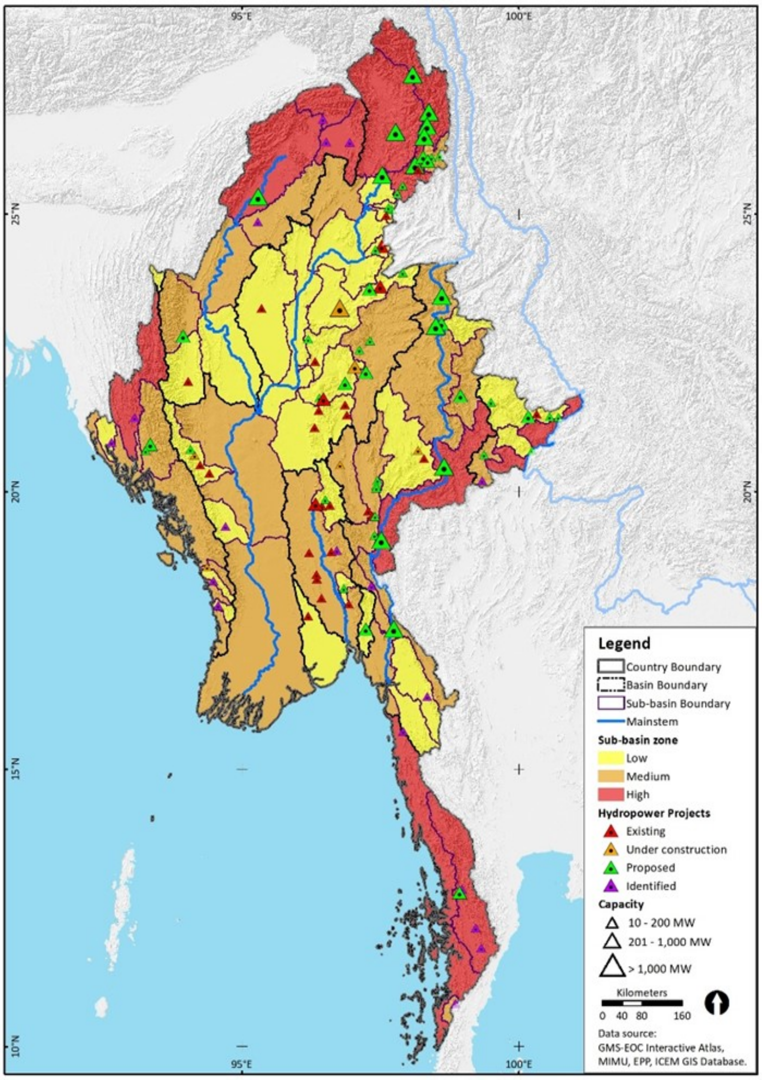
As a first edition plan, it is recommended that the framework be reviewed and revised three years after the commencement of implementation, based on new, more detailed information and implementation findings.

1.5 Results and Outcomes

The SEA had the difficult role of defining a sustainable development pathway for hydropower: balancing hydropower development to support the power needs of Myanmar with the maintenance of river basin health, ecosystem services and the livelihoods they support. Through the SEA process the conversation about hydropower development has started to fundamentally shift, from a debate about the merits and localised impacts of individual projects to a more informed discussion about how best to achieve a balance between power generation and basin health into the future.

The SEA has promoted this shift by informing stakeholders about system complexity and interdependent processes. The divergent views of different stakeholder groups have been recognised, ranging from villagers who are focused on their traditional natural resources, to developers who are promoting projects. The project GIS identifies the location, type and main features of all existing and proposed hydropower projects for the first time, allowing the extent of development to be clearly seen. The snapshot of baseline biophysical and socioeconomic conditions and threats at the sub-basin level across the entire country, as well as information on basin processes and ecosystem services, has brought to light each basin's resources and values. The assessment of the main cumulative impacts of BAU development sets out the previously unrecognised adverse basin impacts of conventional development on

Figure 5: Sub-basin zoning



largely intact river systems. And importantly, the SEA provides a rationale planning tool for sustainable development and sets out clear actions required to support its implementation.

The SEA is being supported by the implementation of a program of actions to operationalise sustainable hydropower development, maintaining the planning momentum initiated by the SEA. These activities include further briefings to Ministers and government agencies, translating the SEA summary into six local and regional languages, providing SDF and GIS training to MONREC and MOEE staff, releasing data (GIS files) to the public to enable uptake by other agencies and researchers, and the cumulative impact assessment of cascade hydropower and other renewable energy options in the modified Myitnge sub-basin.

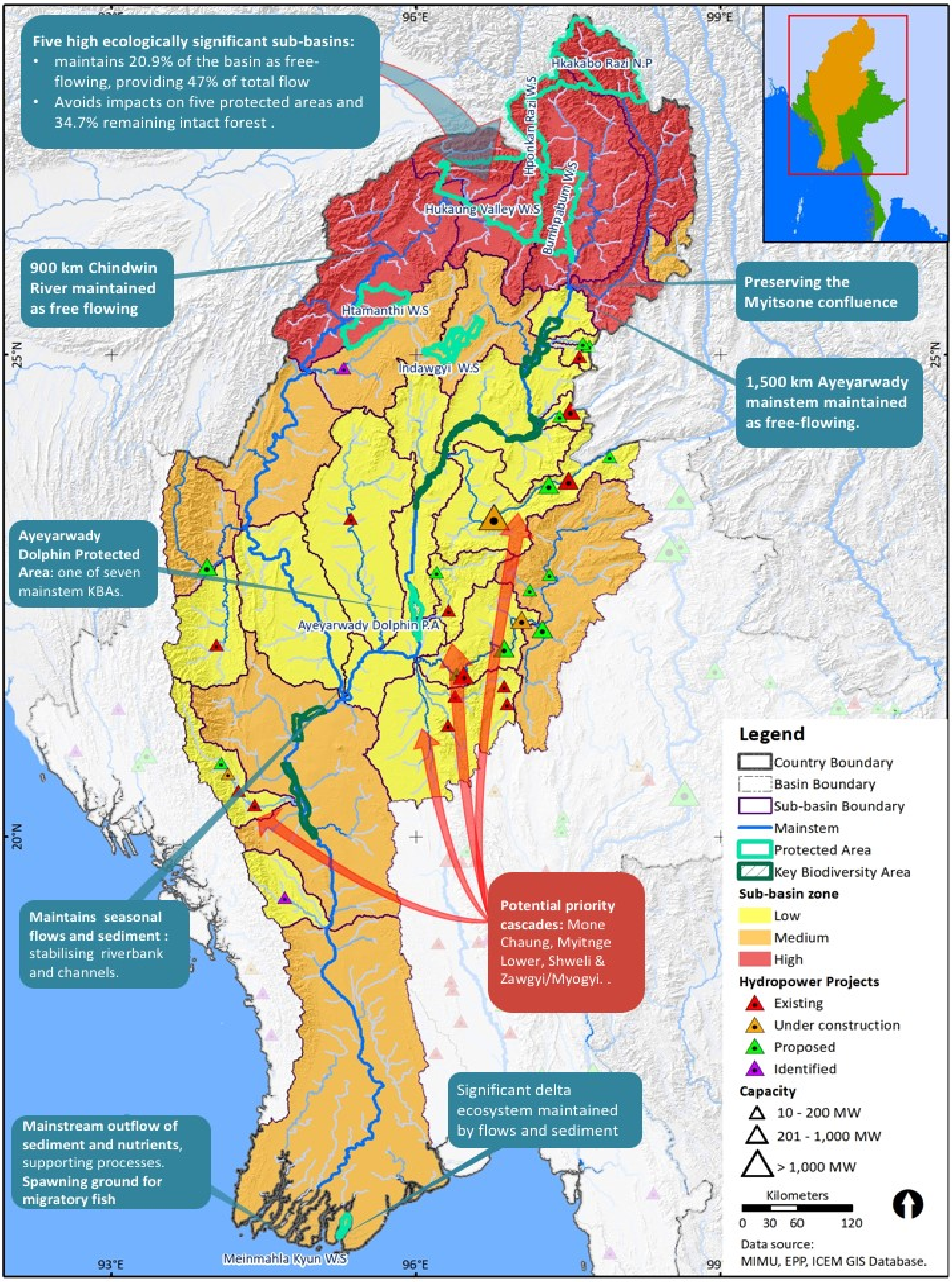
SEA basin-level planning will de-risk hydropower projects by identifying development risks early in the project development cycle and providing solid justification for project siting from a basin sustainability perspective, something that multi-lateral development banks are starting to place greater importance on. The likelihood of projects sited in accordance with the basin zoning plans attracting broad public opposition and subsequently stalling and not being granted planning approval should be greatly reduced. It also provides a first set of key information for prospective project proponents when they enter the country and consider investment in the sector.

In summary, implementation of the ‘first edition’ basin zoning plans, supported by project design guidelines, will move the hydropower sector to sustainable development before BAU development results in significant basin regulation and degradation. Decision-makers and developers have clear planning guidance on the appropriate siting of projects. The outcomes that this change in approach is expected to deliver are:

- the maintenance of healthy basins and the ecosystem services that they provide over the next 100 years and beyond;
- the initiation of meaningful stakeholder engagement during project development, thereby improving project design and increasing stakeholder acceptance of well-planned projects as well as greater recognition of legacy issues and conflict-affected areas;
- improved access to international financing by avoiding/reducing basin-wide cumulative impacts; and
- the establishment of substantial hydropower generation, providing affordable and reliable renewable energy that will drive local and national development.

By creating the nexus between hydropower development and natural resource protection, the SEA has shown that development and protection are both achievable through basin-level planning. Substantial hydropower generation can be delivered at a far lower ‘cost’ to natural resources, ecosystem services and river-dependent communities and businesses. The expected outcomes of sustainable hydropower development in the Ayeyarwady basin are illustrated in Figure 6.

Figure 6: Ayeyarwady Basin sustainability



1.6 LESSONS LEARNT

An SEA is a great planning instrument to comprehend, assess and plan complex system-level natural resource and development issues. It has the capacity to combine a science-based assessment with an understanding of the often-conflicting values of multiple resource users and other stakeholders, to enable complexity to be understood and rationale long-term planning to be developed. This usually involves a trade-off between resource use and protection to develop a broadly acceptable plan to guide sustainable sector development.

Establishing the vision and objectives for the SEA early in the process is critical in developing a focused methodology and conveying its direction to stakeholders. The SEA methodology should be flexible, allowing it to be modified as planning progresses. This is particularly true where there is limited understanding of the conditions at the start, but even the best planned SEA will reveal unexpected conditions that have to be adapted to.

The SEA process is often as important as its findings as it initiates a conversation with stakeholders about future management options and outcomes, the first step in gaining stakeholder buy-in to the planning direction. To achieve this there is no substitute for extensive and transparent consultation with all stakeholder groups, involving the canvassing of views and informing stakeholders about the issues. A transparent process underpinned by ongoing communications and information disclosure is also important. For the hydropower SEA this involved developing an SEA website, releasing information via newsletters, engaging stakeholders through meetings/workshops/briefings, and translating information into multiple languages.

The hydropower SEA commenced with strong government support in the form of a tripartite agreement between the Myanmar power and environment Ministers, to establish joint decision-making and build a shared understanding. Stakeholder engagement also involved other government agencies, resource users, developers and NGOs. Divergent views were respected and considered during the SEA preparation. By demonstrating this, even when a different course is eventually taken, a greater understanding and degree of ownership of the planning is more likely. The use of an Advisory Group and Expert Groups made up of decision-makers, technical specialists and NGOs can be particularly useful, not only to canvass their views but also as a sounding board for evolving ideas.

An SEA often has to contend with limited baseline information, but it is far better to develop a 'first edition' plan, that acknowledges and works with these limitations rather than delaying planning that permits sub-optimal development to continue. An initial SEA also clearly identifies information gaps and the priority actions based on its analysis. The hydropower SEA was viewed as the 'first edition', to be periodically updated as implementation occurs and new information to keep pace with current conditions.

There are many approaches and methodologies for carrying out SEAs. The hydropower SEA provides insights into an approach based on limited data and extensive stakeholder engagement that was contextualised for Myanmar. It provides better understanding as to how this may be applied for other sectors or geographic areas in future.

In conclusion, SEA is valuable in supporting long term planning of the hydropower sector at country level providing clarity about risks of investment to all key stakeholders.

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