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Indonesia: Infrastructure Improvement of Shrimp Aquaculture Project

Prepared by the Ministry of Marine Affairs and Fishery for the Asian Development Bank.

ABBREVIATIONS

ADB	–	Asian Development Bank
AAS	–	Atomic Absorption Spectrophotometer
AMDAL	–	*Analisis Mengenai Dampak Lingkungan Hidup* (environmental impact assessment process in Indonesia)
BAPPENAS	–	Ministry of National Development Planning)
BMKG	–	Agency for Meteorology, Climatology and Geophysics
BSL	–	Biosafety Level
BSN	–	*Badan Standarisasi Nasional* (Board of National Standards)
CBIB	–	Aquaculture Good Practices
COVID	–	Corona Virus Disease
DAS	–	*Daerah Aliran Sungai* (Watershed)
DED	–	Detailed Engineering Design
DGA	–	Directorate General fo*r* Aquaculture
Dit KKI	–	Directorate of Region and Fish Health
DLH/DLHK	–	*Dinas Lingkungan Hidup/Dinas Lingkungan Hidup dan Kehutanan (*provincial and district environmental protection agencies)
DPLH	–	(Environmental Management Document)
EA	–	Executing Agency
EARF	–	Environmental Assessment and Review Framework
ECC	–	Environmental Complaint Committee
ECOP	–	Environmental Code of Practices
EHS	–	Environment, Health, and Safety
EIA	–	Environmental Impact Assessment
EMP	–	Environmental Management and Monitoring Plan
FS	–	Feasibility Study
GDP	–	Gross Domestic Product
GHG	–	Greenhouse Gas
GOI	–	Government of Indonesia
GRM	–	Grievance Redress Mechanism
HDPE	–	High Density Polyethylene
IA	–	Implementing Agency
IEE	–	Initial Environmental Examination, a simplified EIA
IFC	–	International Financing Corporation
IISAP	–	Infrastructure Improvement of Shrimp Aquaculture Project
IKAL	–	Seawater Quality Index
IKU	–	Air Quality Index
IUCN	–	International Union for Conservation of Nature
MBC	–	Multiplication Broodstock Center
MMAF	–	Ministry of Marine Affairs and Fishery
MOEF	–	Ministry of Environment and Forestry
MPWH	–	Ministry of Public Work and Housing (PUPR)
MSDS	–	Material Safety Data Sheet
NBC	–	Nucleus Breeding Center
NRCP	–	(National Residue Control Plan)
NSC	–	National Steering Committee
OHSP	–	Occupational Health and Safety Plan
OSS	–	Online Single Submission
PAM	–	Project Administration Manual

PIU	–	Project Implementation Unit
PMO	–	Project Management Office
PPE	–	Personal Protective Equipment
PAP	–	Project Affected People
ROW	–	Right of Ways
RTRW	–	Local Regulation on Regional Spatial Plan
SNI	–	Indonesia National Standard
SPPL	–	Statement on Environmental Management and Monitoring *(signed commitment of the proponent)*
SPS	–	Safeguard Policy Statement *of the ADB*
STELINA	–	National Fishery Traceability and Logistic System
TCLP	–	Toxicity Characteristic Leaching Procedure
UKL-UPL	–	Environmental Management Measures and Monitoring
UNFCCC	–	United Nations Framework Convention on Climate Change
UPT	–	extended units of MMAF at local/regional level assigned for specific tasks, including managing shrimp ponds, broodstocks, and laboratory)

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I. PROJECT DESCRIPTION

1. **Context.** Indonesia is among the top five shrimp producers in the world, together with India, People's Republic of China, Thailand, and Viet Nam.[1] The main farmed shrimp species is the whiteleg shrimp *(Litopenaeus vannamei)* accounting for 80% of production, which is produced by large companies and around half of the smallholders. The other half of the smallholders cultivate the tiger shrimp (*Penaeus monodon*) in an extensive way. Indonesia lags behind its peers in exports of freshwater shrimps, and fresh, salted, or smoked shrimps.[2] In 2021, Indonesia's shrimp production reached 707,951 tons with a value of Rp43 trillion;[3] and had a global market share of 7.1%. Global shrimp production is expected to grow by more than 5.2% annually.[4] In 2021, traditional farming covered 93% of the total pond area with a productivity of 0.6 tons/ha/year compared to 10 tons/ha/year for semi-intensive systems and 30 tons/ha/year for intensive systems.[5]

2. While the shrimp aquaculture potential is high, several barriers constrain its growth and sustainability. Smallholder farming profitability is constrained by the lack of economy of scale, expensive inputs (seeds and feed), limited access to finance and technology, unsustainable farming practices, and low bargaining power with aggregators. The low level of certification of farmers, aggregators, and processors also limit the ability to properly trace products, further limiting international buyers' confidence. As the demand for sustainability grows, there is a need to shift toward responsible and transparent production and sourcing. Promoting sustainable aquaculture practices will reduce pressure on the ecosystem, reduce the potential for shrimp disease outbreaks and help the sector access new markets and improve profitability. The Ministry of Marine Affairs and Fisheries (MMAF) will need to improve quality control and traceability and support for product certification. Clustering production facilities will enable economies of scale, providing farmers with purchasing and bargaining power with suppliers and buyers.

A. Project Outputs

3. The project will help the Ministry of Marine Affairs and Fisheries (MMAF) in introducing sustainable shrimp aquaculture and improving transparency, and traceability processes towards increased productivity, quality, profitability, and environment sustainability of smallholder's shrimp farming. The project will deliver an integrated investment addressing upstream, production, and downstream processes through infrastructure, capacity support to improve farming practices and post-harvest systems, and value chain strengthening in selected locations. The project will deliver three outputs: (i) Output 1: quality and sustainable inputs production increased; (ii) Output 2: sustainable aquaculture infrastructure and services developed; and (iii) Output 3: shrimp aquaculture value chain strengthened.

4. The project will be aligned with the following impact: contribution of the fisheries sector

[1] J. Anderson et al. 2019.Goal 2019: Global Shrimp Production Review. *Global Aquaculture Alliance.* 4 November.
[2] Mainly Asian tiger shrimp and whiteleg shrimp. Daniel Workman. Big Export Sales for Frozen Shrimp. *World's Top Exports.*
[3] Directorate General of Competitiveness, Ministry of Marine Affairs and Fisheries. 2021. Shrimp Export Baseline Data.
[4] *Globe Newswire*.2019. Shrimp: The Future of the $45+ Billion Market, 2019-2024. 13 June.
[5] C. Rabbi. 2021. Produksi Udang Indonesia Ditargetkan Tembus 2 Juta Ton di 2024 (Indonesian Shrimp Production Targeted to Reach 2 Million Tons in 2024. *Katadata.* 12 July.

to the national economy increased.[6] The outcome is productivity, profitability, and environment sustainability of shrimp aquaculture increased.[7]

5. **Output 1: Quality and sustainability of inputs for shrimp production increased.** This output will finance the development of a modern broodstock center and two multiplication centers to provide small scale hatcheries access to affordable and quality whiteleg shrimp broodstock. The project will facilitate transfer of knowledge from the Oceanic Institute of Hawaii to MMAF in producing high quality genetic shrimp fry. To control quality of broodstock and juveniles, and water quality in production facilities, the project will finance construction, equipment, and climate and disaster proofing of seven laboratories under MMAF. All facilities will incorporate gender responsive and inclusive features.[8] The project will train MMAF staff in operating and maintaining these facilities. This output will also help small and medium seed suppliers to comply with national broodstock breeding protocols, good hatchery practices, and biosecurity and environment monitoring prorcedures. It will strengthen farmers capacity in producing their own feed aligned with the national fish feed self-sufficiency program (*Gerakan Pakan Mandiri* or GERPARI).[9]

6. **Sustainable aquaculture infrastructure and services developed.** This output will support establishment and strengthening of farmers groups enabling smallholders, including women farmers, to consolidate their production facilities under a cluster approach. Local facilitators will support them in developing sustainable aquaculture development plans (SADPs) as the basis for investment in their respective clusters. The SADP will also help farmers to access credits and explore partnerships with the private sector. The project will upgrade traditional ponds introducing a sustainable aquaculture model. Selected MMAF production facilities will also be upgraded following this model as demonstration sites. The sustainable aquaculture model aims to increase production, while minimizing impact on the ecosystem. For each cluster, the project will (i) rehabilitate or upgrade as relevant associated infrastructure (canals, production roads, inlet reservoir, wastewater treatment facility, and access to the electricity grid);[10] and (ii) purchase equipment towards semi-intensive aquaculture production.[11] Farmers will plant and maintain mangrove trees in inlet and outlet canals and along the shoreline, to help improve water quality and reduce soil erosion.[12] This output will support MMAF in establishing O&M guidelines and upgrade its infrastructure registry information system to a full asset management information system for infrastructure lifecycle management. The project will strengthen famers technical capacity, including women farmers, to adhere to the INDOGAP guidelines for environmentally and economically sustainable shrimp production.[13]

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[6] Government of Indonesia, Ministry of National Development Planning (BAPPENAS). 2020. *Rencana Pembangunan Jangka Menengah Nasional, 2020–2024* (National Medium-term Development Plan). Jakarta.

[7] The preliminary design and monitoring framework is in Appendix 1.

[8] These include lactation rooms, separate male and female toilets, and separate male and female prayer rooms.

[9] A grant from the Global Environment Facility (GEF) is proposed to complement those activities by engaging feed suppliers in diversifying feed raw material to reduce reliance on fish wild catch and imported raw material, and improve tracking of shrimp feed.

[10] The project will promote fair water allocation among water users and include climate and disaster proofing, and gender responsive and inclusive features. The project will exclude clusters requiring land acquisition or resettlement.

[11] Equipment includes among others wastewater equipment, water pumping, paddle wheel, generator, liner, grower and finisher for shrimp feed, spiral and plastic hose, diluted oxygen and pH meters, refractor salinometer.

[12] This will contribute to the National Mangrove Rehabilitation program, with the goal of restoring 600,000 hectares of mangroves by 2024.

[13] Training programs will cover pond water quality, wastewater management, cleaning technology, feed management, disease and biosecurity management, financial literacy, and mangrove management.

7. **Output 3: Shrimp aquaculture supply chain strengthened.** This output will build men and women farmers' capacity in food safety, handling and cold chain management, transformation, and marketing. Towards improved transparency, the project will facilitate registration of broodstock and feed suppliers, farms, aggregators, and processors into the INDOGAP system and transactions in the MMAF's STELINA. Towards a harmonized regulatory framework, the project will assist MMAF in preparing quality standards, and in reviewing and rationalizing regulations and incentive systems for sustainable aquaculture.[14]

8. **Approach.** The project will apply a sector lending approach in selecting subprojects that are outside MMAF land.[15] To be financed under the project, these subprojects will need to comply with the applicable selection criteria described in the Project Administration Manual. For each subproject, a Sustainable Aquaculture Development Plan (SADP) will be prepared.

9. **Environment safeguards.** Based on the Asian Development Bank (ADB) Safeguards Policy Statement (SPS) 2009, the project may fall into Category B for environment safeguards. Accordingly, an Initial Environment Examination (IEE) is needed to assess environmental impacts focusing on the first two outputs, as the third output does not involve physical investment and does not have direct environmental impacts, which is not subject to environmental assessment. Based on the assessment, environmental management plans (EMPs) have been developed to address the adverse impacts and risks.

10. The scale of proposed shrimp ponds, broodstock and laboratories is under the threshold for AMDAL, which is roughly equivalent to category B under ADB categorization. Details are presented in Chapter II. The Directorate General of Aquaculture (DGA), MMAF will contract consultants to prepare domestic simplified environmental impact assessment (i.e., UKL-UPL) according to Indonesian regulations.

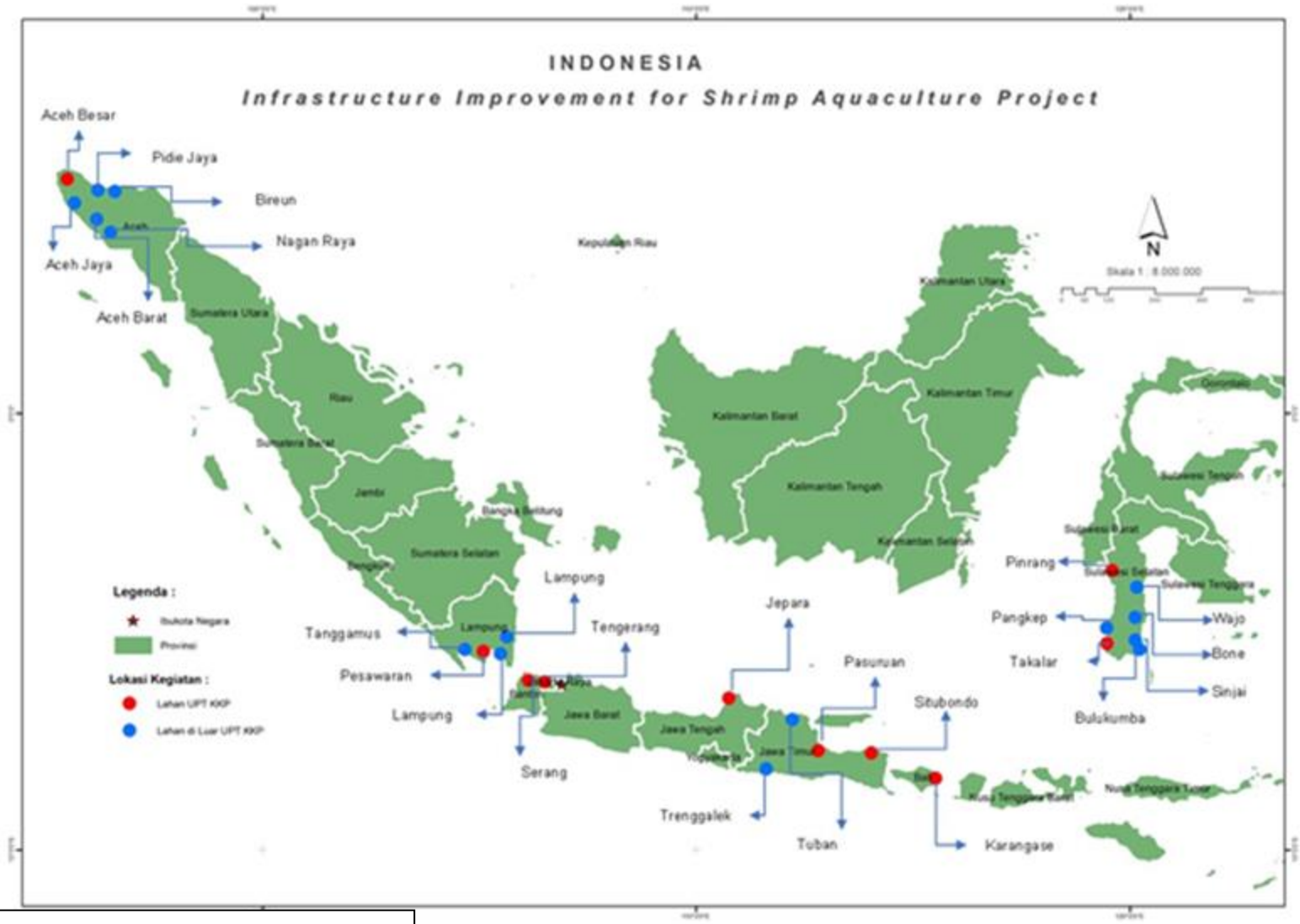
B. Project Location

11. The subprojects are spread over several districts/provinces in Indonesia as shown in the map below. The UPT aquaculture cluster subprojects cover 10 locations across 7 provinces consisting of: (i) two locations in Aceh and Lampung provinces; (ii) five demonstration ponds in Banten, Central Java, and East Java provinces; (iii) one in Bali province; and (iv) two locations South Sulawesi province. The project will also finance construction of a broodstock center in 1 province, two multiplication breeding centers in 2 provinces; and 7 laboratories across 7 provinces. Beside those, the project will upgrade smallholder farmers ponds in 23 districts across the seven provinces. This IEE covers the government facilities including the UPT aquaculture cluster core subprojects, the broodstock center, the two multiplication breeding centers and the seven laboratories.

[14] Under the proposed GEF grant, BAPPENAS will prepare a national action plan for shrimp aquaculture adopting an aquaculture management area approach including climate change mitigation and resiliency and conduct strategic coordination to institutionalize sustainable aquaculture development nationwide.

[15] Those include canals, water treatment and production facilities outside MMAF land. A subproject is defined as a cluster of farmers within a hydraulic unit or tertiary block.

Figure 1: Map of IISAP Subprojects Location



Core subprojects of MMAF areas presented as Red Dots

12. The overview of subprojects and its proximity and co-location with other subprojects is presented below (Table 1). The identified subprojects are located in government land (MMAF) and access to the subproject locations is through the public rights-of-way and existing roads. Some are standalone as for the shrimp ponds in Tangerang, Pasuruan, and Pinrang. Some laboratories also standalone like in Pesawaran and Serang. The remaining subprojects are co-located such as the broodstock and laboratory of Karangasem (Bali), multiplication center and shrimp pond of Takalar (South Sulawesi).

Table 1: Overview of the Project Investment

Subproject	Scale (Ha)	Location	Capacity Expansion (%)
Broodstock center (one)	0.26	**Karangasem (Bali)**. The nucleus center (NC) and multiplication center (MC) of BPIU2K is co-located with laboratory	**50**
Multiplication centers (two)	0.29	**Aceh Besar (Aceh)**. The MC located in different village (Neuhen) with the location of laboratory (Durung) with distance approx. 800 meters (m)	**75**
	2.00	**Takalar (South Sulawesi).** The MC is co-located with shrimp pond subproject (Mappakalompo), and nearby laboratory subproject with distance approx. 500 m (Boddia)	**50**
Ponds			
Shrimp ponds Cluster Total Area, Total Pond Volume and Number of Ponds (all existing)	16.11 70,000 cubic meter (m^3) 10 ponds	**Tangerang (Banten)**. No other IISAP subprojects nearby;	**100**
	48.10 70,000 m3 10 ponds	**Jepara (Central Java)**. The pond is located nearby the laboratory with distance approx. 100 m	**100**
	43.20 1000 m2 /1200 m^3 12 ponds	**Pasuruan (East Java)**. No other subprojects nearby	**200**
	35.00 70,000 m^3 10 ponds	**Takalar (South Sulawesi)**. The pond is located far from the laboratory and multiplication center with distance of approximately 11 kilometers (km)	**100**
	41.40 70,000 m3 10 ponds	**Pinrang (South Sulawesi)**. No other subprojects nearby	**100**
Laboratories			
Laboratories under MMAF (seven)	0.200	**Aceh Besar (Aceh)**. The laboratory is located in different village with the location of MC (Neuhen) with distance approx. 800m	**300**
	0.06	**Pesawaran (Lampung)**. No other subprojects nearby	**100**
	0.12 (2 stories)	**Serang (Banten)**. No nearby other subprojects	**300**
	0.38	**Jepara (Central Java)**. The laboratory is located nearby the shrimp ponds with distance of approximately 100 m.	**50**
	0.12	**Situbondo (East Java)**. The laboratory is	**100**

Subproject	Scale (Ha)	Location	Capacity Expansion (%)
		located in Gundil, Klatakan, Kendit Situbondo. No other subprojects nearby	
	0.06	**Karangasem (Bali)**. The laboratoryis co-located with NC and MC	**50**
	0.06	**Takalar (South Sulawesi)**. The laboratoryis co-located with MC, and relatively far from the ponds with distance of approximately 11 km	**300**

Source: Data from MMAF (DJPB and Balai/UPT)

C. Sustainable Shrimp Ponds

13. The project component and work volume for the 5 MMAF sustainable ponds are presented in Table 2. The details of the volume are provided in the Final Report of Design Consultants (MMAF, 2021). The table primarily presents the activities that potentially affect the environment such as their operation and tree cutting, earthwork and excavation, and other physical works during construction. Those canals that can only be identified during the project implementation are to be covered by a standalone environmental framework.

Table 2: Demonstration Shrimp Ponds Characteristics

Location, Cluster[a] size	Work Components	Special Concern	Wastewater current status	
			Volume	current Treatment
Java Island				
Banten, Mauk, Kemiri, Tangerang Existing: 16.00 ha Rehab: 5.00 ha	1. New canals of 161.63 m (for separating from canal connected with a nearby coal fired powerplant (PLTU). 2. Flood embankment (1,589.58 m^3) 3. Buildings, covering pond facilities: a) Construction of ponds (➢ Earth work and excavation (3,211.45 m^3) ➢ Laying of high density polyethylene (HDPE) impermeable liner ➢ Outlet/discharge works ➢ Control box for intake ➢ Plumbing works ➢ Electrical works b) Bore wells work (drilling and piping) c) Construction of blower and pump houses	➢ Land clearing (191 plants) ➢ Cutting and land clearing (378.30 m^2) ➢ Land excavation (3,211.45 m^3) ➢ embankment (1,589.58 m^3)	Future by FS: 15000 – 18000 (277 m^3/week) Existing: 27,000 - 100,000 m^3 per year (or 73 m^3/day)	Aerobic WWT using 2-3 units of water paddles; and introduce seaweed and milkfish/tilapia as bioindicator
Central Java Bulu, Jepara, Jepara Existing: 48.10 ha Rehab: 5.00 ha	1. Flood embankment (2,987.54 m^3) to protect from the river's overflow (flood) 2. Buildings, covering pond facilities: a) Construction of ponds: same as Banten b) Bore wells work (drilling and piping) c) Construction of blower and	➢ Land clearing (191 plants) ➢ Cutting and land clearing (376 m^2) ➢ Land excavation (291.95 m^3) ➢ Flood embankment (2,987.54 m^3)	Future by FS: 15000 – 18000 (277 m^3/week) Existing: 250,000 m^3/year (or	Aerobic WWT using 2-3 units of water paddles; and introduce seaweed and milkfish/tilapia as bioindicator

Location,	Work Components	Special Concern	Wastewater current status	
	pump houses		685 m^3/day)	
East Java Pulokerto, Kec. Kraton, Kabupaten Pasuruan Existing: 43.20 ha Rehab: 5.00 ha	1. New canals of 586.55 m, to separate canals in Cluster 7,8 2. Flood embankment (2,987.54 m^3) to protect from the river's overflow (flood) 3. Buildings, covering pond; a) Construction of ponds; same as above except Earth work and excavation (3,211.45 m^3)	➢ Land clearing (191 plants) ➢ Cutting and land clearing (378.30 m^2) ➢ Land excavation (3,211.45 m^3) ➢ Flood embankment (2,987.54 m^3)	Future by FS: 201600 m^3/year (3733 m^3/week) Existing: 72,000 m^3/year (or 600 m^3/day)	Aerobic WWT
Sulawesi Island				
South Sulawesi Banyuanara, Sanrobone, Takalar Existing: 35.00 ha Rehab: 5.00 ha	1. New canals of 586.55 m, to separate canals in Cluster 7 and Cluster 8 2. Flood embankment (2,987.54 m^3) to protect from the river's overflow (flood) 3. Buildings, covering ponds: a) Construction of ponds; same as above except Earth work and excavation (3,211.45 m3)	➢ Land clearing (191 plants) ➢ Cutting and land clearing (378.30 m^2) ➢ Land excavation (291.95 m^3) ➢ Flood embankment (2,987.54 m^3)	Future by FS: 15000 – 18000 (277 m^3/week) Existing: 80,000 m^3/year (or 700 m^3/day)	Aerobic WWT, comprising of settlement ponds and equalization pond with bioindicator
South Sulawesi Mappakalompo Datae, Duampanua, Pinrang Existing: 41.40 ha Rehab: 5.00 ha	1. New canals of 586.55 m, to separate canals in Cluster 7 and Cluster 8 2. Flood embankment (2,987.54 m^3) to protect from the river's overflow (flood) 3. Buildings, covering pond facilities: Construction of ponds; same as above except Earth work and excavation (3,211.45 m^3)	➢ Land clearing (191 plants) ➢ Cutting and land clearing (378.30 m^2) ➢ Land excavation (291.95 m^3) ➢ Flood embankment (2,987.54 m^3)	Future by FS: 15000 – 18000 (277 m^3/week) Existing: 60,000 M3/year or 164 m^3/day	Aerobic WWT

ha = hectare, m = meter, m^2 = square meter, m^3 = cubic meter, WWT = wastewater treatment (lagoon)
[a] The cluster size is 5 ha per cluster with ± 500 m^2 for each pond. On average a cluster consist of 100 shrimp ponds (but it varies with the shape and location).
Source: Data from MMAF (DJPB and Balai/UPT).

14. There will be no wastewater discharge during the first three months. Instead, water will be added into the ponds due to evaporation and/or leakage. The discharge of the wastewater is discontinuous for a week. The discharge of wastewater and sludge from the ponds will be evacuated through a siphon and pipe after the third month until the harvesting time. On average, the discharge is 10% - 20% of the total water volume (Ref. MMAF Guideline, 2019). The volume is converted to a weekly basis as the retention time for wastewater is about one week.

15. Traditional pond design is very simple with one gate for seawater inlet and the same gate for outlet. Production from this type of pond is very low at 0.6 metric ton per ha per year. Traditional pond technique usually applies shrimp seed stocking density of less 5 pcs per square meter. Feed for the cultured shrimp is completely reliant on natural nutrients. This is due

to lack of operating capital to buy pelleted feeds. Water exchange is also dependent on tidal fluctuation as there is no water pump used.

16. The traditional ponds can be upgraded to traditional plus type if water pump is used, and stocking density increased by 2 – 5 fry per square meter. The denser stocking rate would also require additional feed. This additional feed can be applied after two months of grow out period or as soon as natural food is exhausted. The sustainable aquaculture model proposed under the project include wastewater treatment lagoon, inlet reservoir with different inlet and outlet gates and mangroves in the canals to filter water. All wastewater treatment for the shrimp ponds and broodstock/hatcheries in this IEE is a lagoon. The comparison and features of the six types of the shrimp pond technologies are presented in Table 3.

17. The next level of improvement over the traditional-plus approach is the semi-intensive system. The ponds are generally rectangular in shape with size about 1–3 ha and water depth of 0.80 to 1.2 meters. Each pond has separate inlet and outlet gates to facilitate water exchange, pond preparation and harvesting. A diagonal ditch, 5–10 meters wide and 30–50 cm deep extending from inlet to outlet is also constructed to facilitate drainage of water and collection of shrimps during harvest. The ditch also serves as a refuge for the shrimp during sunny day. This method allows higher stocking rates, use of supplementary feed, and the implementation of a regular water management scheme. The typical rate of stocking for semi-intensive culture operation varies from 20,000 to 50,000 fry per ha. Supplementary feed, either formulated or fresh, is given daily in addition to the existing natural food produced through the application of fertilizers.

18. Then there is intensive shrimp pond operation which is much more sophisticated and requires very high financial and technical inputs. The grow out facilities are either lined earthen ponds or concrete tanks. The distinct features of this culture operation are the complete dependence on hatchery-bred fry, high stocking density, use of formulated feeds, application of aeration to increase dissolved oxygen level in pond water and intensive water management. The floor area of pond or tank vary for 500 m^2–5,000 m^2. Dikes may be of pure earthen material, earth coated with plastic sheets or concrete. The system requires separate inlet and outlet gates or small water inlets for flow-through purposes. Drain out system is in the form of a centrally located drainpipe, a drain gate, or a combination of both.

Table 3: Shrimp Culture Technology and Its Description

Culture Technology	Density (pcs/m^2)	Feed	Equipment	Facility	Remarks
Traditional/ Extensive	<5	Feed from nature	Without pump	One line inlet and outlet drain channel	
Extensive Plus	2 -5	Feed from nature + Commercial feed	Water pump	Separate inlet and outlet drain channel	
Sylvo Aquaculture	10-15	Feed from nature + Commercial feed	Water pump	Separate inlet and outlet drain channel and settlement pond	
Semi-intensive	>15 – 25	Commercial feeds	Water pump, paddle wheel	Separate inlet and outlet drain channel Water reservoir	

Culture Technology	Density (pcs/m^2)	Feed	Equipment	Facility	Remarks
Intensive	>25 - 100	Commercial feeds	Water pump, paddle wheel	Water reservoir[a] Wastewater treatment	Used in this project under a cluster of shrimp ponds with water and wastewater management
Super Intensive	>100	Commercial feeds	Water pump, paddle wheel, root blower	Water reservoir[a] Wastewater treatment	

[a] Water reservoir as the supply for the ponds, which disinfected with chlorine to kill diseases and avoid invasive species from entering the pond. The ponds are settled for 2-3 days before use to release the chlorine or other disinfectants.

Source: MMAF Technical Guideline on Wastewater Treatment for Shrimp Pond (2019).

19. Higher density, use of hatchery-bred seeds and higher feed will lead to higher nutrient and related environmental, health & safety issues (EHS), e.g., pollution, higher susceptibility to diseases and thus the need to use chemicals for control. Shrimp ponds located in coastal areas are susceptible to coastal abrasion, excessive salt levels, and high sea waves. Mangroves are known to absorb toxins as such they are useful in cleansing pond effluent. Therefore, shrimp farming business requires a balance between economics and the ecology, and one such system is the sustainable aquaculture system.

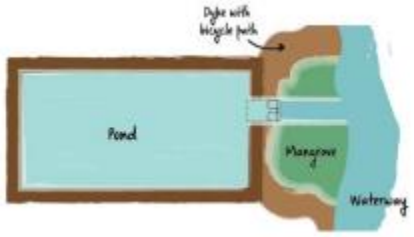
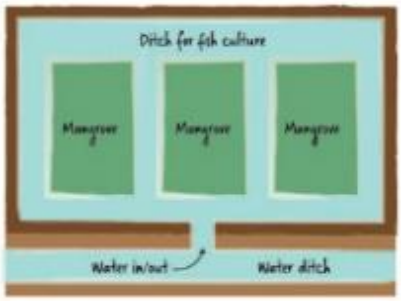
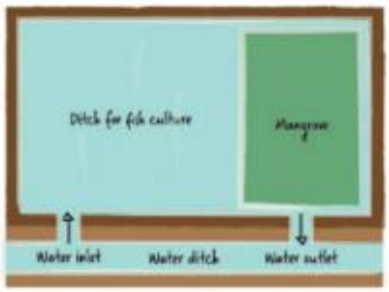
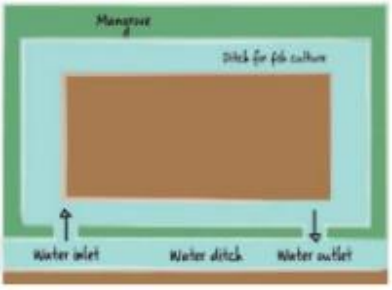
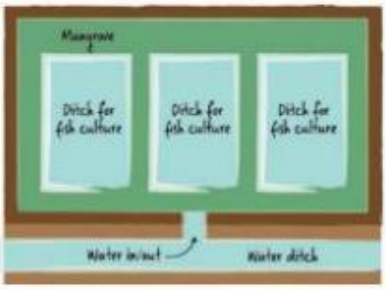
20. **Sustainable Aquaculture system planned** under the project in addition to Semi-intensive and intensive ponds as indicated in Table 3**.** Based on the Ministry of Marine Affairs and Fisheries Regulation No. 75 of 2016, it is therefore imperative that shrimp growing out in ponds must maintain mangroves with the types suitable to the conditions of the shrimp pond area itself. There are two concepts for interactions of mangrove with aquaculture, as follows.

21. **Associated Mangrove Aquaculture (AMA)** is a concept for associating aquaculture with forestry by means of a greenbelt of mangrove along shorelines of waterways in the estuaries. This contrasts with existing ponds that have too little or no mangroves left on the shorelines. AMA is a type of sustainable-aquaculture and is sometimes called mixed-mangrove aquaculture.

Usual Sylvo-Aquaculture System is the second concept of sylvo-aquaculture, which different with AMA in term of planting sites. In usual practice**,** the mangroves are planted on the dykes and in the pond, while with AMA the mangroves are located outside the pond. The difference of both concepts is illustrated in

22. Figure 2.

Figure 2: Illustration of Sustainable-aquaculture /Sylvo-Fishery Models

1) Associated Mangrove Aquaculture (AMA)	
Overview of a standard **Associated Mangrove Aquaculture** (AMA) for a single farm (© Roel Bosma): mangroves are outside of the ponds.	
2) Sylvo-Aquaculture Systems	
Regular fishpond with ditch and one-gate water inlet system and three mangrove platforms called *Model Empang Parit Tradisional* (Sofiawan, 2000). Officially recognized by the Ministry of Forestry (2004) as the third of four sylvo-fishery options (illustration adapted from: Audrie Siahainenia).	
Modification from regular ditch fishpond without central dike called *Model Komplangan* (Sofiawan, 2000). Officially recognized by the Ministry of Forestry (2004) as the second of four sylvo-fishery options (illustration adapted from: Audrie Siahainenia)	
Open fishpond type (*Model Empang Terbuka*) with two-gates water inlet system, elevated bank (Sofiawan, 2000). Officially recognized by the Ministry of Forestry (2004) as the fourth of four sylvo-fishery options. Local communities tend to use this option, some also without the elevation. It is then known as the embankment model (illustration adapted from: Audrie Siahainenia).	
Kao-Kao model with three separate ditches one-gate water inlet system. The water can flow from ditch to ditch, depending on tide (Sofiawan, 2000). Note that the lighter colored areas are channels, not dykes (illustration adapted from: Audrie Siahainenia).	

Source: TRTA Study (Various References as included).

23. Revitalizing the shrimp aquaculture industry will require investing in sustainable practices such as (i) the sustainable aquaculture concept developed by MMAF (including sustainable feed to strengthen farmers" capacity in producing their own feed aligned with the national fish feed program GERPARI (*Gerakan Pakan Mandiri*)); (ii) enforcing standards/threshold limits for pollution from shrimp farms (ref: Section II.C); (iii) investing in closed-loop systems that improve water quality and reduce water discharge; and (iv) adopting farming technologies that use alternatives to chemicals and fertilizers to enhance water quality, as well as filter systems that aim to recycle water and reduce wastewater leakage into the environment. The sylvo aquaculture model suggests that 20% of the area is allocated for mangrove, 30% for water treatment, and the remaining for production.

24. The main facility of the shrimp ponds need mangroves to purify and improve quality of aquaculture water. Based on a research, without any wastewater treatment every ha of intensive shrimp pond requires 7.2 Ha of mangroves to absorb nitrogen (N) and 21.7 Ha to absorb phosphorus (P) from pond waste disposal.[16]

25. **The supporting or ancillary facilities for demonstration ponds** include mainly wastewater treatment and solid waste treatment, access road and bridge and solar power station using photovoltaic (PV) panels (as applicable, since mostly the ponds are connected to electric grid and use diesel generator as reserve for emergency or blackout).

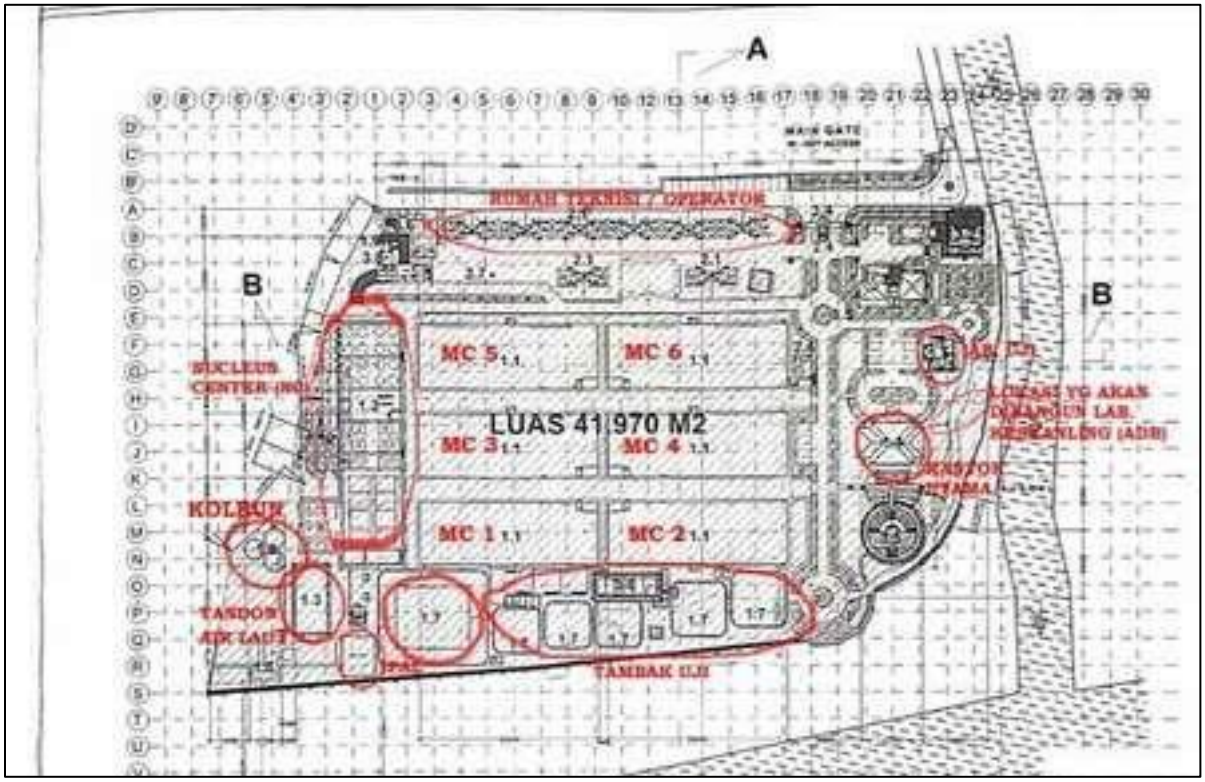
D. Broodstock and Multiplication Centers

26. Under the project, one existing broodstock center in Karangasem (Bali) and one multiplication center in Aceh Besar (Aceh) will be rehabilitated/renovated, while another new multiplication center will be built in Takalar (South Sulawesi).

27. **Broodstock Center with Multiplication – Karangasem (Bali)**: This unit represents the administrative and production center for vannamei SPF broodstock production. The existing facility comprises of 1 unit of nucleus breeding center (NBC) and 1 unit of broodstock multiplication center. The broodstock will be improved by adding raw water treatment system facility (seawater reservoir with filtration system and ultraviolet sterilization. In addition, the buildings and supporting facilities will be revitalized and improved. An automatic feeder and automatic water quality monitor required to automate aquaculture system to improve productivity and quality of the broodstock. Application of 4.0 Technology in the breeding (hatchery) and rearing process of the broodstock will cover monitoring of water quality, feeds, breeds, broodstock, and biosecurity.

[16] Muqsith A., Harahab N., Mahmudi M., Fadjar M. 2018. Estimation of Mangrove Needs In Supporting Activities Of Intensive Shrimp Farm In Banyuputih District Situbondo Regency. Samakia: JurnalIlmuPerikanan. Volume 9, No. 1, April 2018. ISSN:2086-3861. E-ISSN: 2503-2283.

Figure 3: Layout of BPIU2K Karangasem (Bali), including Nucleus Center and Multiplication Center (Broodstock) and Co-Location with Laboratory



Source: BPIU2K Karangasem (Bali).

28. Table 4 presents existing facilities in the broodstock center (Karangasem, Bali) and proposed items of rehabilitation in more detail. The produced broodstock from Karangasem (Bali) will be distributed to UPT Takalar, UPT Ujung Bate, and UPT Situbondo, which will operate multiplication center facilities.

Table 4: Shrimp Broodstock Center in Karangasem, Bali

No.	Existing Facilities	Proposed IISAP Improvement
1	**Nucleus Broodstock Center** - spawning tanks with capacity 8 m^3 each (8 units) - larvae rearing tanks with capacity 7 m^3 each (12 units) - larvae hatching tanks with capacity 0.25 m^3 (40 units) - family selection tanks with capacity 0.5 m^3 (60 units) - broodstock reception tanks with capacity 50 m^3 (8 units)	- Improvement of buildings and facilities to make them resistant to climate and weather change (high tide, wind blow and flood) - Improvement of broodstock and breeds quality (disease resistant and fast growth) through technology transfer from Hawaii Oceanic Institute (USA). - Improvement of seawater filter
2	**Multiplication Breeding Center (MBC)** - tanks made of specified material (eg., fiber) with capacity 60 m^3 (48 units) - Same tanks with capacity 30 m^3 (48 units)	
3	**Laboratory**. Accredited testing laboratory for water quality, Microbiology, and Molecular Biology) is co-located with the broodstock	

4	**Performance Test Pond** (1340 m^2), consisting of five units (180 m^2 x 3) and (400 m^2 x 2). This pond is used to test the performance of the broodstock produced.	- Improvement of biosecurity system: (i) Disinfection: footbath, hand sanitizer, wheel bath, and sanitation of the equipment; (ii) Buffer of pond area and among ponds: fencing, plastic and polyethylene; and (iii) anti-bird protection using fine gauge gill nets over ponds etc. - Providing facility for genetic backup - Providing central blower for water sterilization
5	**Wastewater Treatment:** Aerobic activated sludge wastewater treatment. Under IISAP, the WWT will be improved by adding ozonizer unit to the WWT to disinfect the wastewater before discharge to sea	
6	**Other major facilities:** - **Seawater intake** (2 units) of 800 m with size of 4 inch and 6 inch and depth of 30 m, together with 3 pumps of 6-inch size - **Water reservoir** (2 units) with volume of 600 m^3 and 80 m3 - **Seawater room**. For seawater storage and treatment (filtering and disinfection/ sterilization through chlorination (with chlorine gas) or using UV, equipped with inlet, outlet and pumps - **Freshwater room**. For freshwater storage and treatment (filtering and disinfection /sterilization through chlorination (with chlorine gas) or using UV, equipped with inlet network and freshwater distribution network for sanitation and cleaning - **Electric substation and Genset, blower room**. Room source of electricity for the broodstock (50 kVA/3 phases) and genset (reserve for electricity); Blower to supply air to ponds. - **Feed room**. storage of feeds such as natural feed and commercial feeds. - **Artemia culture room**. All activities of decapsulation, hatchery and harvesting of artemia (with refrigerator). - **Chemical room. Closed room** as storage for medicines and chemicals for supporting broodstocks considering requirement as regulation and best practices - **Harvesting room**. Place for larvae harvesting; To harvest, (i) first stop aeration; allow nauplii to swim toward the surface then collect nauplii using beaker; (iii) drain the water through a filter net for total harvest; and (iv) contain in jerrycan, plastic jar, or plastic bag	
7	**Other supporting equipment:** (i) water pumps; (ii) aerators by electricity; (iii) lift net, broodstock bags, fiberglass tanks, Styrofoam boxes, plastic pails; (iv) Dissolved Oxygen (DO) meters, thermometers, refractory salinometers, pH meters, Secchi disks; and (v) water buckets, and cleaning sets**.** ponds	

IISAP = Infrastructure Improvement of Shrimp Aquaculture Project, kVA = volt-ampere, m = meter, m2 = square mater, m3 = cubic meter, WWTP = wastewater treatment plant.
Source: BPIU2K Karangasem (Bali).

29. **Multiplication Center: Aceh Besar (NAD/Aceh).** The project will rehabilitate the non-functional and severely damaged multiplication center, covering 2,940m^2 area. **Figure 4** below, shows that the area is less vegetated and located nearby fishermen village. Based on the feasibility study, the component of the broodstock for Aceh Besar consist of several facilities. Since this center at Aceh only has some buildings on the site but not related to its production function, almost everything has to be built anew. The subproject laboratory is co-located in the

same compound. Therefore, its design is the same as Sulawesi subproject, as shown in Table 5.

Figure 4: Layout of Broodstock and Lab, co-located in Ujung Batee (Aceh Besar)

Note: (1) Warehouse of production facilities; (2) Hatchery (Udang Windu); (3) Production unit of bioflock and round pond system; (4) Dormitory; (5) Workshop; (6) Shrimp pond; (7) Hatchery (Vannamei); (8) Feed plant; (9) Shrimp pond; (L) Proposed area for laboratory.
Source: BPBAP Ujung Batee (Aceh Besar, Aceh).

Table 5: Proposed Facilities of Two Multiplication Centers

No	Proposed Facilities for Takalar, South Sulawesi	Proposed Facilities for Aceh, Northern Sumatra	Common Facilities proposed to both
1	Existing Plastic ponds with area 900 m^2 (3 units)	Some additional infrastructure and facilities require rehabilitation such as: a) main building for hatchery (Penaeus monodon) b) seawater filter reservoir c) groundwater filter reservoir d) hatchery room e) Others	➢ Maturation Tank: 20 m^3 x12 ➢ Control Tank of 1.2 m^3 x2 ➢ Spawning Tank: 19.2 m^3 x12 ➢ Control Tank of 1.6 m^3 x2 ➢ Canonical Tank with diameter 1m, and high 1,2 m (64 Unit) ➢ Control box of 0.22 m^3 (8 Unit) ➢ Larva Rearing Tank of 48 m^3 (22 Unit) ➢ Canonical Tank with diameter 1m and high 1. 2 m (44 Unit) ➢ Control Tank of 6 m^3 (6 Unit) ➢ Post Larva Packing Tank with size 20 m^3 (2 Unit) ➢ Canonical Tank with diameter 1 m and high 1.2 m (30 Unit)
2	Probiotic culture room		
3	Wastewater treatment		
4	**Other supporting facilities** - Operator room - Feed room - Chemical room - Quarantine room - Packing room		

m = meter, m2 = square meter, m3 = cubic meter.
Source: BPBAP Takalar (South Sulawesi) and BPBAP Ujung Batee (Aceh).

30. Water balance and estimated wastewater shall be prepared to meet Government requirement on the technical approval of wastewater design and operation (see Section II.C). A preliminary estimate based on the FS is conducted in this IEE in order to assess its pollution and if the proposed treatment can reduce pollution (in terms of volume and concentration, see section IV.B) in compliance with applicable standard.

31. **Multiplication Center in Pinrang (South Sulawesi)** is located far from the protected forest and far from settlements, schools (approx. 1 km) and far from hospital/medical center (approx. 2 km). The ponds and hatchery are located in the same site with about 150 meters between them. Similar with shrimp pond, the broodstock and multiplication center will also be equipped with wastewater treatment and solid waste treatment, both similar to those proposed in FS for shrimp ponds subprojects but with a different scale.

E. Laboratories

32. The fishery (including shrimp) laboratory is divided into a dry laboratory and a wet laboratory. The dry laboratory is intended to analyze condition and water quality of the aquaculture media, including physical, chemical, and biological parameters. The dry laboratory is also used to analyze health of the cultured shrimps (crustacea), monitor growth, mortality, performance, and disease analysis. Thus, they are usually laboratories in common sense, standalone and bigger. The wet laboratory is an onsite laboratoryfor day-to-day testing, in the location near the hatchery, part of the hatchery for routine tests needed for its operation. Wet laboratoryis also can be part of dry laboratories as in BPKIL Serang.

33. Additional mobile laboratories (or portable testing devices) will be added to expand the services. The existing mobile laboratories in several UPT/Balai are intended for quick testing, e.g., site water quality monitoring, viral diseases testing with portable PCR method, bacterial diseases with immunologic method, and other quick tests.

34. The project will finance seven dry laboratories (Aceh, Lampung, Banten, Central Java, East Java, Bali, and South Sulawesi). The components of the laboratories (type, facilities, and capabilities etc.) are similar. For example, main types of tests and experiments undertaken are water quality, soil testing, testing of fishery stock preparations, testing of feed quality, residue testing of the aquaculture products, examination of fish and shrimp diseases, testing of infectious diseases (bacteria, parasites, fungi, and viruses) as well as noninfectious diseases.

35. Based on data from Balai /UPT and their Strategic Plan (Renstra) 2020 – 2024, the number of sampling/tests undertaken by each laboratory for the past five-years are shown in Table 6. These 7 laboratories are all existing ones to be improved and expanded by the project.

Table 6: Number of Measurement of Samples by Laboratory and by Year

	Balai/UPT	2015	2016	2017	2018	2019	2020
1	BPBAP Ujung Batee	-	-	-	-	-	3,350
2	BBPBL Lampung	2,000	2,300	7,500 (by parameters	2,691	2,825	3,450
3	BPKIL Serang	-	2,750	3,500	5,000	5,250	5,850
4	BBPBAP Jepara	-	-	-	-	-	5,250
5	BPBAP Situbondo	2,910	2,279	1,875	3,609	4,516	4,850
6	BPIU2K Karangasem	-	5,452	9,109	2,308	4,284	4,073
7	BPBAP Takalar	3,792	3,200	5,206	2,906.	3,000	3,950

Source: Strategic Plan (Restra) of respective laboratory (2015 – 2020).

36. Among the seven laboratories, BPKIL Serang meets the highest standards. For example, the laboratory meets the technical standards for a testing laboratory with adequate facilities such as: laboratory buildings and equipment, human resources, and testing protocols and methods. The laboratory is capable of testing 220 parameters and can be further improved in the future. They cover 39 parameters for water quality (among others pH, DO, alkalinity, BOD, hardness, organic chemicals, ammonia, nitrite, nitrate, heavy metals, iron, phosphate, chloride, free carbon dioxide). Also available are, parameters of soil/sediment quality (among others heavy metals), 18 parameters of bacteriology (among others TPC, *Vibrio, Salmonella*), 10 parameters of pathology (among others checking of shrimp diseases), 30 parameters of residue (among other antibiotics and medicines); 26 parameters of molecular biology; 92 parameters of fishery medicines/drugs, and one aquatic/bioassay animal testing installation.

37. There are 6 (six) main types of laboratories services as set forth by MMAF and assigned to the laboratories. But in some cases, as in BPKIL Serang, there are two more laboratories since the biology laboratory is divided further into two separate laboratories, i.e., Bacteriology laboratory and Molecular biology laboratory plus additional two laboratories based on its specific function: one field/bioassay installation and one mobile laboratory. The function of each laboratory is determined by the type of the objects to be tested and/or services offered, as assigned by MMAF, as follows.

38. **Water Quality and Soil Laboratories** are equipped with facilities and equipment for standardized testing activities. The testing of water quality includes chemical, physical, and biological parameters (including common water parameters like BOD, COD, N/Nitrogen, P/Phosphate, SS/suspended solids, heavy metals, and plankton identification). The list of parameters and its standard is provided in Chapter II (Section II.F.1). The laboratory is capable to conduct various testing methods, among others volumetric, refractometry, spectrophotometry, atomic absorption spectrophotometer (AAS) Flame and AAS graphite furnace. The testing methods applied are based on national and international standards, such as Indonesian National Standard (SNI) and ISO based laboratory procedures.

39. **Fishery Medicine Laboratory** performs quality testing to obtain registration as well as monitoring and testing on consistence of fishery quality. The laboratory will support the safety and quality of fishery products (including shrimp). The scope of services includes testing of fishery stock preparations in the herbal, pharmaceutics and premix classes as well as testing the quality of feeds. The laboratorymainly test the organic constituents that are potentially used as medicine and feeds. They also conduct quality test for fishery medicine in order to register for Polymerase Chain Reaction (PCR) diagnostic kit classes (PCR and real time PCR). The list of parameters and its standard provided in Chapter II (Section II.F.5).

40. **Residue Laboratory** is equipped with adequate space and equipment and facilities for standardized testing. The laboratory facility includes the *enzyme-linked immunosorbent assay* (ELISA) preparation and testing rooms, the material drying chamber, the Liquid Chromatography – Mass Spectrometry (LC-MS/MS) rooms, and the Gas Chromatography – Mass Chromatography (GC-MS/MS) room to support the NRCP (National Residue Control Plan) program in order to improve the competitiveness of aquaculture products and the protection of food safety, especially those related to harmful residue contamination during the cultivation process. The list of parameters and its standard are provided in Section II.F.5.

41. **Bacteriology/Microbiology Laboratory** performs diagnostic services which include examination and testing of bacterial ALT (*angka lempeng total* or total viable count), identification of bacteria and fungi by biochemical, serological, and automatic identification

system. This laboratory also performs fishery medicine quality test service for biological and probiotic stock. They also conduct molecular testing and preparation and application of diagnosis method for fishery diseases. The service of this laboratory includes examination of fish and shrimp diseases.

42. **Pathology/Parasitology Laboratory** carry out the function of examination of anatomical and parasitic pathology, and histopathology analysis. The laboratoryis equipped with standard equipment for testing infectious diseases (bacteria, parasites, fungi and viruses) and noninfectious diseases based on abnormal changes in tissues. Main parameters for the pathology/parasitology laboratory include Total Bacteria Vibrio (of soil/sediment), Total Plate Count (of soil/sediment), Total Bacteria Vibrio (of water), Total Plate Count (of water), and detection of WSSV.

43. **Feed/ Nutrition Laboratory** is designed to test and develop natural and commercial feed for aquaculture production. The activities also include research and development for aquaculture.

44. **Quality/Field Testing (Bioassay) for Fishery Medicines.** In addition to the above testing laboratory services, the Serang Laboratory (BPKIL Serang) also provides service for field laboratory to test fishery medicine through a bioassay laboratory. Implementation of fishery medicine quality testing is carried out to obtain registration number; testing the consistency of fish medicine quality at the level of distributors, stores, depots, and users; certification of Good Fish Medicine Manufacturing; as well as monitoring of fish medicine side effects for fish, environment, and consumer safety.

45. Since all project laboratories serve multiple functions with the Serang laboratorywhich have all six types above (see Table 7), they all need to reach biosafety level 2. Therefore, their tasks and functions of the UPT's laboratory as well as scope of services are similar.

Table 7: Fishery Laboratory by Its Services under IISAP

No	Balai/UPT	Water Quality and Soil Laboratories	Fishery Medicine Laboratory	Residue Laboratory	Bacteriology /Microbiology Laboratory	Pathology /Parasitology Laboratory	Feed/ Nutrition Laboratory	Mobile Laboratory (*LaboratoryKeliling)*	Aquatic/Bioassay Installation
1	BPBAP Ujung Batee	X		X	X	X			
2	BBPBL Lampung	X		X	X	X	x		
3	**BPKIL Serang**	**X**	**X**	**X**	**X**	**X**	**X**	**X**	**X**
4	BBPBAP Jepara		X	X			X		
5	BPBAP Situbondo	X	X	X		X	x	X	
6	BPIU2K Karangasem	X	X	X	X	X	x		
7	BPBAP Takalar	X	X	X	X	X	x		

Note: x = service(s) provided by the laboratory
Source: Strategic Plan (Restra) of respective laboratory (2015 – 2020).

46. The proposed rehabilitation/revitalization for all laboratories are also similar (see Table 8) as discussed in Section II.E.1. This means their pollution to air and water and solid wastes are similar albeit the differences in scale. The FS proposed a biotank for wastewater treatment and incineration for hazardous/infectious wastes of the laboratories.

Table 8: Classification of Proposed Laboratories

No	Name of the laboratoryand location	Types of Laboratories Operated		Proposed key investment common to all laboratories
		Biosafety Level (BSL)[a]	Testing/ Reference[b]	
1	Aceh: BPBAP Ujung Batee	BSL-2 for all laboratories Through investment of biosafety equipment, facilities and construction design, e.g. ultra violet sterilization, biosafety control, access control, autoclave, etc.	BPKIL Serang laboratorywill be improved as Reference Laboratory(Level 3). The others will be Level-2 Testing Laboratorythrough investment of infrastructure, facilities, and kits/ instrumentation as discussed in Section II.E.1.	a. Buildings with specification set forth b. Access road for four-wheels and two-wheels vehicles c. Electricity source and its network as needed d. Water source and its quality and network as needed for testing e. Liquid waste storage and treatment as required f. Solid waste storage and treatment as required; g. Hazardous waste storage and/or treatment h. Equipment for testing, storage of samples, testing materials, vaccine and isolates, and occupational health (among others laboratory coat, glove, shoes, antiseptic, mask and portable/light fire extinguisher),
2	Lampung: BBPBL Pesawaran			
3	Banten: BPKIL Serang			
4	Central Java: BBPBAP Jepara			
5	East Java: BPBAP Situbondo			
6	Bali: BPIU2K Karangasem			
7	South Sulawesi: BPBAP Takalar			

[a] A biosafety level (BSL) or pathogen/protection level, is a set of biocontainment precautions required to isolate dangerous biological agents in an enclosed laboratory facility. The levels of containment range from the lowest biosafety level 1 (BSL-1) to the highest at level 4 (BSL-4).

[b] Regulation of Minister of Marine Affairs and Fishery No. 57/PERMEN-KP/2018 on Fish and Environment Laboratory.

Source: MMAF Regulation No. 57/PERMEN-KP/2018.

47. All the laboratories are registered and follow Indonesian National Standard (SNI) and ISO based laboratory procedures (ISO/IEC 17025: general requirements for the competence of testing and calibration laboratories). Some others such as BPKIL Serang (Banten), BBPBL Lampung, and BPIU2K Karangasem (Bali) are registered and follow ISO/IEC 17043 for proficiency testing). In terms of EHS aspects, this mean that the laboratory shall follow the internationally recognized standard for testing, including environment, health and safety issues. Clause 6.1 of ISO/IEC 17025 identify the related issues and request procedures in place to create an objective, auditable record that environmental conditions which might affect tests or calibrations are controlled and monitored.

F. Time Schedule

48. The laboratories are expected to be constructed in 2023 as they have detailed engineering designs, while construction of remaining facilities (broodstock and multiplication

centers, and demonstration ponds) is expected in 2024 considering that detailed engineering designs are to be prepared in 2023.

G. Implementation Arrangement

49. DGA will be EA, which will be responsible for overall project implementation. UPTs will be the IAs responsible for day-to-day management during project preparation and implementation. Implementation arrangements for environmental safeguard are discussed in more detail in the ECOP and EMP (Section VI.B and VI.C).

II. POLICY, LEGAL, AND ADMINISTRATIVE FRAMEWORK

50. In addition to ADB's SPS (2009), the subprojects shall also comply with the Government of Indonesia's environmental laws, standards, rules, and requirements which form the country's environmental safeguard system. It imposes restrictions on activities to avoid, minimize, or mitigate likely impact on the environment. It generally covers all items of environmental safeguards and related sector regulation on Occupational Health and Safety (OHS), employment conditions/labor, hazardous waste management, biodiversity, and climate change. A more complete list of Indonesian environmental Laws, Presidential Decrees, Sector Regulations, and MMAF Decrees relevant to environmental safeguards are presented in Annex 1.

51. It is the responsibility of the executing and implementing agencies to ensure that all activities under the project are in compliance with the legal framework, whether national or local regulations. Compliance is required at all stages of the subprojects' implementation, including design, construction, and operation and maintenance. The key laws and regulations that apply to this IEE include but may not be limited to those presented below.

A. Regulations on Environmental Assessment

52. The key law on environmental assessment in Indonesia is Law No. 11/2020 on Job Creation. Its Article 22 states that any business and/or activity that has significant impact on the environment shall have an environmental impact assessment (AMDAL in Indonesian), and article 34 specifies that any business activity that has no significant impact shall meet the standard of UKL-UPL (simplified EIA in Indonesian). While in Article 35 mentions for low-risk activities that do not require an UKL-UPL, a statement of ability to undertake environmental management and monitoring, *Surat Pernyataan Pengelolaan Lingkungan* (SPPL means basically a simplified EMP), is required. The screening criteria for each sector are elaborated in detail in the ministerial (MOEF) regulation.

53. The Government's screening procedure is presented in the Minister of Environment Decree No. 4/2021 on List of Business Plans and/or Activities Requiring AMDAL, UKL-UPL or SPPL (Attachment 1 of the Decree provides list of business and/or activities that need environmental impact assessment). The screening considers potential significant impacts as well as magnitude or size of business or activities. The decree mentions that the types of business and/or activities that are required to have an Environmental Impact Assessment are determined based on: (a) potential significant impact, and (b) uncertainty of technological capabilities available to overcome significant negative impacts that will arise. The brackish aquaculture is listed in Appendix 1 of Permen LHK No. 4/2021 as activity subject to AMDAL requirement.

54. **Environmental categorization** under the Government of Indonesia's AMDAL procedure

Indonesia regulation provides rigid quantitative criteria (see Table 9), based on specific magnitude (length, depth, width, size, or other physical dimensions). All project or business proposals will undergo screening to classify whether a project proposal would require AMDAL, or UKL-UPL, or SPPL, including aquaculture (brackish aquaculture).

55. The threshold for the categorization criteria to the project are presented in Table 9 below. The improvement of aquaculture infrastructure is not a standalone activity but involving other sectors. Furthermore, the screening covers both main facilities and supporting facilities as well as associated facilities. Therefore, in addition to shrimp pond aquaculture (either seawater or brackish water), the screening also shall be carried out for the public works facilities (canals, flood protection, rural road, buildings, etc.) as well as other sector facilities (such as optional solar powerplant).

Table 9: Domestic Environmental Screening Criteria – Fishery and Multisector[a]

No.	Indicative Type of Projects	Threshold Criteria by Scale		
		AMDAL	**UKL-UPL**	**SPPL**
A	**Shrimp Aquaculture**			
	Shrimp aquaculture (sea water)	>500 Ha	500 - >10 Ha	≤10 Ha
	Shrimp aquaculture (brackish water)	>500 Ha	500 - >10 Ha	≤10 Ha
B	**Infrastructure (Public Works)**			
	New development of irrigation	≥ 3,000 ha	3,000 – 1,000 ha	< 1000 ha
	Improvement of irrigation (additional irrigation schemes)	≥ 1,000 ha	1,000 - 100 ha	< 100 ha
	Rural roads: (by length) (by land acquisition area)	≥5 km with Land Acquired ≥ 40 ha ≥ 40 ha	<5 km and/or Land Acquisition < 10 ha <40 ha	
	Development/ Rehabilitation/ Renovation of buildings (including laboratory)	Built area ≥ 10,000 m^2	5,000 – 10,000 m^2, except for cultural heritage which require AMDAL for any scale	< 5,000 m^2, except cultural heritage which require AMDAL for any scale
	Construction of drainage			
	a. Big /Metropolitan city	⩾ 5 km	5 km > Length > 100 m	< 100 m
	b. Medium/Small city or rural area	⩾ 10 km	10 km > Length >100 m	< 100 m
	Drilling for groundwater (with flow)	⩾50 l/sec	50 l/sec > Flow > 10 l/sec	< 10 l/sec
	Retaining wall and/or breakwater	⩾ 500 m	500 m > Length > 10 m	⩽ 10 m
C	**Energy (Electricity)**			
	Development of olar Photovoltaic Powerplant (PLTS)	≥ 50 MW	≥ 1 MW – < 50 MW	< 1 MW

ha = hectare, km = kilometer, l = liter, m^2 = square meter, mw = megawatt, sec = second.
[a] MOEF Regulation No. 4/2021 on Types of Activities Requiring AMDAL, UKL-UPL and SPPL.
Source: MOOEF Regulation No. 4/2021.

56. The Indonesia AMDAL system generally conforms to the intent of ADB's environmental policy principles, requirements and management guidelines. Essentially, an AMDAL study

corresponds to an EIA, and an UKL-UPL corresponds to an IEE. The Statement of Environmental Management and Monitoring undertaking (*Surat Pernyataan Pengelolaan dan Pemantauan Lingkungan Hidup* – SPPL) generally corresponds to the Category C projects as per the ADB SPS 2009.

57. However, as ADB rely on qualitative criteria (significance) for its categorization, the resulted category by two systems might not be always the same. Moreover, Indonesia EIA criteria as all threshold-based can't cover all types of activities in real world. There is also inevitable ambiguity among some criteria that need to be clarified on case-by-case basis.

Table 10: ADB and Indonesia Project Categorization Systems

ADB Project Categories	GOI Project Categories
Category A: A proposed project is classified as category A if it is likely to have significant adverse environmental impacts that are irreversible, diverse, or unprecedented. These impacts may affect an area larger than the sites or facilities subject to physical works. An environmental impact assessment is required.	**AMDAL**: Projects with significant impact that according to law require an Environmental Impact Assessment (AMDAL). The detailed criteria that trigger an AMDAL defined in the Decree of Minister of Environment and Forestry No. 4/2021.[a]
Category B: A proposed project is classified as category B if its potential adverse environmental impacts are less adverse than those of category A projects. These impacts are site-specific, few if any of them are irreversible, and in most cases mitigation measures can be designed more readily than for category A projects. An initial environmental examination is required.	**UKL-UPL**: Projects with no significant impact that according to law requires Environmental Management and Environmental Monitoring Measures (UKL-UPL).[b]
Category C: A proposed project is classified as category C if it is likely to have minimal or no adverse environmental impacts. No environmental assessment is required although environmental implications need to be reviewed	**SPPL**: Projects that do not require AMDAL or UKL-UPL are obliged to submit a 'statement on commitment for management and environmental monitoring' or SPPL**.**

[a] There are 3 (three types of AMDAL: A, B and C), depending on its potential impacts on carrying and supporting capacity of the environment

[b] Category B project according to SPS (ADB) may require AMDAL (type B or C) or UKL-UPL under Indonesian regulation. For project with significant impact, Category A project according to SPS (ADB), require AMDAL (especially AMDAL Type A, according to Indonesian regulation).

Source: Compiled from ADB SPS and Indonesia Regulation on AMDAL.

58. The results of screening by Government Regulation for the subprojects are presented below. Domestically, several documents (UKL-UPL or SPPL) are required for the subprojects. The final requirement for the type of environmental documents (according to Government regulations) will be reviewed and recommended by respective environmental agency. By information available so far, none of subprojects requires AMDAL domestically. This corresponds well with ADB's initial categorization of the project as B Category Project. For ADB, this IEE is prepared to cover all subprojects identified before effectiveness.

Table 11: Environmental Document Requirement for Subprojects

No.	Subproject/ Components	Proximity of Location with Other Subproject	Environmental Document / Requirement (GOI)[a]
A.	**Sumatra Island**		
1	**Aceh (Northern Sumatra): BPBAP Ujung Batee**		

No.	Subproject/ Components	Proximity of Location with Other Subproject	Environmental Document / Requirement (GOI)[a]
	Multiplication Breeding Center (Hatchery)	**Aceh Besar**. The MC located in different village (Neuhen) with the location of laboratory (Durung) with distance of approximately 800 m	UKL-UPL
	Laboratory		
2	**Lampung (Southern Sumatra): BBPBL Pesawaran**		
	Laboratory	**Pesawaran**. No other subprojects nearby. The laboratoryis co-located with hatchery, but the latter is not subproject.	UKL-UPL
B	**Java Island**		
3	**Banten (Western Java): BP2IL Serang**		
	Laboratory	**Serang.** Standalone laboratory. No other subprojects nearby	UKL-UPL
4	**Central Java: BBPBAP Jepara**		
	Laboratory	**Jepara**. The laboratoryis located nearby the shrimp ponds with distance of approximately 100 m.	UKL-UPL
	Ponds (Instalasi Jepara)		
	Ponds (Instalasi Mauk)	**Tangerang (Banten).** No other IISAP subprojects nearby	SPPL
5	**East Java: BPBAP Situbondo**		
	Laboratory (Instalasi Situbondo)	**Situbondo**. The laboratoryis located in Gundil, Klatakan, Kendit Situbondo. No other subprojects nearby	UKL-UPL
	Shrimp Ponds (Instalasi Pasuruan)	**Pasuruan**. No other subprojects nearby	UKL-UPL
C	**Bali Island**		
6	**Bali: BPIU2K Karangasem**		
	Nucleus Broodstock Center (NC) and MBC	**Karangasem**. The broodstock center (NC and MC) of BPIU2K is co-located with laboratory	UKL-UPL (to be updated)
	Laboratory		
D	**Sulawesi Island**		
7	**South Sulawesi: BPBAP Takalar**		
	Laboratory	**Takalar.** The laboratoryis co-located with MC, and relatively far from the ponds with distance of approximately 11 km	UKL-UPL
	Multiplication Center /		
	Ponds (Takalar Installation)	**Takalar (South Sulawesi)**. The pond is located far from the laboratory and multiplication center with distance of approximately 11 km	UKL-UPL
	Ponds (Pinrang Installation)	**Pinrang (South Sulawesi)**. No other subprojects nearby	SPPL

GOI = government of Indonesia, km = kilometer, m = meter, MC = multiplication center,

[a] Depending on the recommendation of authorized DLH or local environmental agency, the requirement may only cover new facilities or also cover existing ones which have not prepared any kind of environmental document. In the case of the later, DPLH is required (instead of UKL-UPL). Environmental document of two or more different facilities in the same location can be combined as one document, subject to the screening and recommendation of respective DLH.

Source: Compiled and processed from project data

59. Similarly, under government regulation the proposed subprojects are classified as less significant impacts activities. The scale of proposed shrimp ponds for each location is predicted to be less than 500 ha in total, which indicates it only requires UKL-UPL. If total ponds area is less than 10 ha, just SPPL suffices which is broadly equivalent to ADB's category C.

60. In cases where there is more than one facility (ponds, broodstock and laboratories sited in the same location), only one environmental requirement is followed (the highest requirement), as in case of BPIU2K Karangasem. Similarly, in case of retro-active procedure the existing facilities and its parts which subject to revitalization, rehabilitation, or expansion, only a single environmental document required.

61. To prepare AMDAL, the EIA (AMDAL) team needs to be certified by the government. UKL-UPL still require environmental assessment and approval but doesn't required the team to be certified UPL. SPPL requires the proponent to manage and monitor the environmental impacts but are not required to carry out a specific impact assessment.

B. Regulations on Protected Areas and Biodiversity

62. **MOEF Regulation No. 76/MenLHK-Setjen/2015 on Protected Forest Zoning**. This regulation sets forth the criteria for zoning of national park and management block of natural sanctuary, wildlife sanctuary, wilderness park, and natural tourism park. Management zones of national park consist of (i) core zone, (ii) wilderness zone, (iii) utilization zone, and/or (iv) other zones as applicable. The other zones consist of (i) marine protection zone, (ii) traditional zone, (iii) rehabilitation zone, and (iv) religious, cultural and historical zone, and/or special zone. The zones are set forth for each national park through a ministerial decree and supported with maps.

63. The regulation describes the criteria for each zone. Especially for core zone in national park, the following criteria apply:

(i) Has ecosystem or represent original and natural ecosystem type or natural phenomenon and geological formation;
(ii) Represent concentration of plant/biotic community and/or represent area with high biodiversity;
(iii) Represent mating and nesting area of target fauna/animal and/or breeding and growing area for the target fauna/animal; and/or
(iv) Transit area for periodical migrant animals.

64. **MOEF Regulation No. 7/2021** on Forestry Planning, Change of Forest Areas Allocation and Function, and Use of Forest Area. Referring to this regulation, use of forest area other than forestry activities are only allowed in production forest and protected areas with certain criteria, as follows:

(i) Production Forest Conversion (HPK) function as set forth in laws and regulations;
(ii) Not charged for Approval of Forest Area Use, Commercial Permit for Forest Use and/or other approval from Minister (MOEF), and not located in Forest Area set forth as Forest Area with Special Purpose (KHDTK) and Forest Area for Food Security (KHKP);
(iii) Nonproductive, except at province which nonproductive HPK is not available; and
(iv) Criteria for nonproductive forest is set forth based on dominance of non-forested land cover is not greater 70% consisting among other shrubs, open space, and mixed farms.

65. The development of fishery is one of non-forestry activities allowed in the forest area, including mangrove forest. However, it is only applicable for traditional subsistence fishery (e.g, sylvo-fishery or sylvo aquaculture). Commercial and large-scale fishery is subject to regulation on spatial plan and other relevant regulation at both national and local level as reflected in respective spatial plan (RTRW). In general, the relative distance of the ponds and its facilities (buildings) shall be at least 100 meter from the shoreline (in Indonesian called *sempadan pantai*).

66. **MOEF Regulation No. 21/2018** describes procedure for determining the minimum shoreline distance to the land, considering risks of earthquake, tsunami or storm. Width of the shoreline also considers the same risks by adjusting with (i) outer boundary of the coastal ecosystem toward the land; (ii) space allocation for public access; and (iii) space allocation for water and wastewater canal.

67. The minimum distance of proposed facilities or building is also regulated under **Government Regulation No. 16/2021**, which requires that every building shall comply and acquire Approval of Building Permit (PBG). The permit granted to the proponent to develop new building, replace, expand, reduce, and/or maintain the building according to the technical standard.

68. MOEF Regulation No. P.106/MENLHK/SETJEN/KUM.1/12/2018 on Second Revision of MOEF Regulation No. P.20/MENLHK/SETJEN/KUM.1/6/2018 on Types of Protected Flora and Fauna list the protected flora and fauna. In Chapter III (Section III.B.2) presents the protected flora and fauna in provinces of core subprojects. In addition to two regulations above, there are some other regulations related to biodiversity and protected areas, as follows:

(i) Government Regulation No. 7/1999 on Preservation of Flora and Fauna Species;
(ii) Government Regulation No. 8/1999 on Utilization of Flora and Fauna Species;
(iii) Government Regulation No. 45/ 2004 on Forest Protection;
(iv) Government Regulation No. 28/ 2011 on Management of Natural Sanctuary and Natural Conservation Areas and revised with Government Regulation No. 108/2015;
(v) Government Regulation No. 71/2014 on Protection and Management of Peatland Ecosystem and revised with Government Regulation No. 57/2016;
(vi) Government Regulation No. 32/1990 on Management of Protected Areas;
(vii) MOE Regulation No. 29/2009 on Biodiversity Conservation at Local Level;
(viii) MOE Regulation No. 03/2012 on Biodiversity Parks;
(ix) MOEF Regulation No. P.94/MENLHK/SETJEN/KUM.1/12/2016 on Types of Invasive Species;
(x) Regulation of DG Natural Resource Conservation and Ecosystem No. P.8/KSDAE/BPE2/ KSA.4/9/2016 on Guideline for Determining Wildlife Corridor as Essential Ecosystem;
(xi) Regulation of DG Natural Resource Conservation and Ecosystem No. P.5/KSDAE/SET/ KUM.1/9/2017 on Technical Guidance on Determination of High Biodiversity Areas Beyond Natural Sanctuary Area, Natural Preservation Area, and Hunting Park.

C. Regulations Related to Pollution

1. Technical Approval related to pollution treatment

69. **Decree of Minister of Environment and Forestry No. 5/2021** on Issuance Procedure for Technical Approval and Operational Feasibility Letter in the pollution control. According to this MOEF regulation, each proponent is required to prepare AMDAL and UKL-UPL and those who conduct activities which generate and/or use wastewater shall acquire (i) Technical Approval and SLO (Operational Feasibility Letter) for their wastewater treatment (WWT). Appendix II of MOEF Regulation No. 5/2021 mentioned that farming of brackish water crustacea (shrimp aquaculture) is subject to the technical approval for the WWT design and operation in line with the environmental document approval.

70. Based on the self-screening for the Pertek (Appendix I of MOEF Regulation No. 5/2021)

and recommendation of respective environmental agency, Balai/UPT as proponent of shrimp pond, broodstock and laboratory might be required to submit and acquire technical approval (*Pertek*) for their WWT. In particular, intensive and super intensive shrimp pond types are subject to the Pertek which means such WWT will be checked by respective environmental agencies. Preparation and submission of the Pertek shall be in line with UKL-UPL document preparation.

71. As requested in the screening process, proponent shall prepare the Pertek, either by conducting a technical assessment (Appendix II of MOEF Regulation No. 5/2021 for those activities which technical standard are not available) or fulfillment of technical standard (Appendix III of MOEF Regulation No. 5/2021 for those activities which technical standard available as issued by ministries/government). The proponent shall provide information to MOEF or authorized environmental agency, covering administrative and technical data. The checklist for the technical and administrative requirement refers to MOEF Regulation No. 5/2021 on wastewater discharging into both surface water and sea.

72. Accordingly, DJPB- MMAF: 2019: Technical Guidance for Shrimp Pond Wastewater Treatment Plant, specify the dimension and requirement for the WWT, as presented in **Table 12**. These are indicative, since treatment technology and design depend on wastewater amount, types of main pollutants and their concentration range. The MOEF or its authorized environmental agency at local level will review the proponents' WWT design as well as review operational feasibility of the WWT to ensure that the WWT is functional to treat wastewater to meet applicable discharge standard. In case of any suspected violation during the operation phase, the environmental agency will conduct field inspection to check the WWT function.

Table 12: Typical WWTP Dimension of Intensive Shrimp Pond

Components of WWTP	Dimension/Scale of WWTP			Supporting Equipment
	Length (m)	Width (m)	Height (m)	
Sedimentation	43.3	7	2	1 unit of sludge pump
Aeration-1	18	23.55	2	1 unit of blower and 4 units of paddlewheels
Aeration-2	18	23.55	2	
Equalization	24	23.55	2	2 units of paddlewheels
Total Area of WWTP (m2)				1,716
Total Volume of WWTP (m3)				5,577

m = meter, m^2 = square meter, m3 = cubic meter, WWTP = wastewater treatment plant.
Source: MMAF: 2019: Technical Guidance for Shrimp Pond Wastewater Treatment Plant.

73. **Local Regulation and Permitting Requirements.** In addition to national regulations, relevant local regulations (both at provincial and district level) will also be consulted, among others those related to environmental protection and management, mangrove protection and restoration, spatial plan, coastal areas and small islands spatial plan, coastal area zoning, etc. As applicable the necessary permits and related legislation at national and local level shall be complied with.

2. Requirements on Wastes and hazardous substances

74. The Indonesian legal framework on environment requires cleaner production processes and energy efficient practices, avoidance of pollution, or, when avoidance is not possible, minimizing or controlling the intensity or load of pollutant emissions and discharges, including direct and indirect greenhouse gas emissions, waste generation, and release of hazardous materials from their production, transportation, handling, and storage.

75. This regulation (as stipulated in Government Regulation No. 22/2021) applies in the transportation, storage, and use of chemicals and other hazardous materials. This applies to shrimp ponds, broodstock, and laboratory as those activities are using chemicals and other hazardous materials. The laboratories also produce hazardous wastes, both chemical hazardous wastes and biological hazardous wastes.

76. MOEF Regulation No. 6/2021 on Procedure and Requirement for Hazardous Wastes Management classifies the hazardous into five characteristics: (i) explosive; (ii) flammable; (iii) reactive; (iv) infectious; and (v) poisonous. The key requirements in this regulation cover hazardous materials' collection, storage, handling, transportation, treatment or stabilization, and final disposal.

77. The regulation set up the maximum storage period for the hazardous wastes, based on their volume and category. This is especially applicable for the project, as most hazardous wastes are treated on site and the rest are transferred to a third party. The smaller quantity hazardous wastes is generated, the longer storage period is allowed. The maximum time for the storage are as follows:

(i) 90 days for hazardous wastes generated 50 kg per day or higher
(ii) 180 days for hazardous wastes generated less than 50 kg per day of Category 1
(iii) 365 days for hazardous wastes generated less than 50 kg per day of Category 2 (from non-specific source or general source)
(iv) 365 days for hazardous wastes Category 2 (from specific source)

78. Treatment of the hazardous wastes can be carried out by (i) thermal (e.g., incineration); (ii) stabilization and solidification; and (iii) other methods as the advancement of science and technology, among others bioremediation, electrocoagulation, and/or washing. For thermal process (incineration) the regulation set forth some technical requirements to be met:

(i) mechanical feeding of the hazardous waste into the incinerator;
(ii) dual combustion chambers; first chamber with temperature at least 800°C and second chamber with temperature 850°C – 1.200°C;
(iii) combustion system consists of *primary combustion burner* and *secondary combustion burner*); and
(iv) Air pollution control facilities (e.g., chimney).

79. In addition, the location of the incinerator shall meet several requirements, as follows:

(i) Flood free areas
(ii) Located in industrial estate and/or area allocated as industrial areas as laws and regulation
(iii) Minimum distance to other facilities, at least:
    (a) 150 m from the highway or toll road
    (b) 300 m from settlement, commercial areas, hospital, health care or social activities, hotel, restaurant, religious facilities, and education facilities
    (c) 300 m from the highest shoreline, river, tidal areas, lake, swamp, and spring
    (d) 300 m from protected areas (natural sanctuary and protected forest)

80. The hazardous wastes potentially used mostly fall into category 2 (less harmful and non-specific sources) as stipulated in GR No. 22/2021 (Appendix 1). The potentially hazardous wastes generated in the operation of ponds, broodstock, and laboratories are presented in Table 13.

Table 13: Non-Specific Sources Hazardous Wastes of Aquaculture and Laboratories

Code	Pollutant (Hazardous Wastes)	Hazard Category
A101d	Wastes containing compounds of Persistent Organic Pollutants (POPs) and unintentionally produced persistent organic pollutants (UPOPs) among others polychlorinated biphenyls (PCBs), DDT, PCDD, PCDF	1
A102d	Used accumulator/battery	1
A103d	Asbestos dust and fiber among others blue asbestos (crocidolite), brown asbestos (amosite), grey asbestos (anthophyllites)	1
A104d	Leachate generated from landfill of hazardous wastes	1
A105d	Contaminated wastes and/or disposed products and/or containing mercury (Hg) and/or its compounds if the concentration greater than 10 ppm (parts per million)	
A106d	Wastes from laboratories containing hazardous substances	1
A107d	Other used solvents which have not been codified	1
A108d	Wastes contaminated with hazardous substances	1
A109d	Other acid wastes which have not been codified	1
A110d	Active carbon wastes that contain pollutants as specified in Waste Code A101a to A112a, A101b to A121b, A101c to A1110c and/or containing hazardous wastes specified in Waste Code A105d and A107d	1
A111d	Used refrigerant from electronic devices	1
B101d	Wastes and/or contaminated disposed products and/or its compound if the concentration greater than 10 ppm (ten parts per million) and greater than 0.3 ppm (zero point three parts per million)	2
B102d	Dust and fiber of white asbestos (chrysotile)	2
B103d	Lead scrap	2
B104d	Used package of hazardous substances	2
B105d	Used lubricant among others used hydraulic, machine, gear, lubrication, insulation, heat transmission, grit chambers, separator and/or its combination	2
B106d	Resin or ion exchange wastes	2
B107d	Electronic wastes including cathode ray tube (CRT), TL lamp, printed circuit board (PCB), and metal wire	2
B108d	Sludge from wastewater treatment plant (WWTP) of integrated WWTP in industrial estate	2
B109d	Used filter from air pollution control facility	2
B110d	Used rags and similar wastes	2

Note:
Category 1: acute and direct impact to human
Category 2: chronic and indirect impact to human
Source: Government Regulation No. 22/2021 (Appendix 1).

D. Occupational Health and Safety

81. Relevant requirements with respect to workers' health and safety include Law No.1/1970 on Workers' Safety and Decree of Minister of Workforce No. 5/2018 on Safety and Occupational Health. Decree of Minister of Marine Affairs and Fishery No. 6/PERMEN-KP/2018 on Safety and Occupational Health in the MMAF, provide more detail and specific requirement for the safety and occupational health.

82. In addition to generic requirement for buildings, the decree stipulated OHS for both ponds/hatchery and laboratory. Implementation of ponds OHS, shall be supported with the use of PPE as the type of works carried by personnel. Several OHS rules for the ponds, among others: (i) electric power shall be properly and safely connected; (ii) personnel who deals with chemicals shall use appropriate PPE; (iii) fence between ponds/inundated area with land; (iv) provide adequate lighting in the night/gloomy situation; (v) provide safety jacket; and (vi) erect signs on the direction, safety warnings, and notices.

83. For laboratory safety and occupational health, all personnel and other persons in the area shall follow Personnel OHS and Building OHS, as appropriate. The protocol in laboratory shall follows Decree of MMAF No. 57/PERMEN-KP/2018 on Laboratory for Fishery Health and Environment, and ISO 17025 standard.[17]

84. The decree also covers disaster preparedness. To anticipate fatality due to the disasters, it is required to implement emergency/evacuation exercises for the personnel. The OHS also refers to the international good practice such as that of USEPA's guidelines for laboratories, both prevention at design phase and operation phase. For specific OHS issues of individual chemicals used, material safety data sheet (MSDS) from the manufacturer will be followed. The laboratories already implemented the OHS practices, but still need to be improved, including for assignment of dedicated personnel(s) responsible for day-to-day OHS. Some laboratories are also registered for ISO 17025, in which OHS aspects implemented.

E. Guidelines, Specifications and Good Practices

1. Fishery Laboratories

85. The construction of laboratory refers to the prevailing regulations, especially Regulation of Minister of Public Works and Housing No. 22/PRT/M/2018 on Development of State's Buildings covering activities of site and physical planning of the building. The planning includes architectural, structural/mechanical, electrical, plumbing, and environmental system.

86. Based on its functions (Referring to Regulation of Minister of Marine Affairs and Fishery No. 57/PERMEN-KP/2018 on Fish and Environment Laboratory), there are two kinds of laboratories: (i) testing laboratory; and (ii) reference laboratory. The testing laboratory is used for presumptive examination and testing (screening) and diagnostic of fish health and its environment. Further, the testing laboratory is divided into 3 (three) levels based on its intended capacity and scope of testing.

87. Laboratories under the project are categorized as testing laboratory of level 2 with specification presented in Table 14. The table describes scope of duties/services, infrastructure,

[17] ISO / IEC 17025: 2017 represents ISO standard used by laboratory as general requirement for testing laboratory and calibration.

facilities, and methods for the level 2 laboratory. Level 3 description also included in the table as BPKIL Serang will be promoted to Level 3.

Table 14: Description of Level 2 and Level 3 Testing Laboratory

Item	Level 2 Testing Laboratory (Existing seven laboratories)	Level 3 Testing Laboratory (as proposed for BPKIL Serang)
Tasks/ Services	1. Examination of soil/water quality, fish disease and fish feeds 2. Testing of soil/water quality, fish diseases (parasite, fungi, and bacteria), residues, and feeds 3. Clinical and laboratory diagnosis of fish disease	1. Examination of soil/water quality, fish disease, fish feeds, and medicines 2. Testing of soil/water quality, fish diseases (parasite, fungi, and bacteria), residues, and feeds, medicines and genetic engineering products 3. Clinical and laboratory diagnosis of fish disease and implement training on the testing methods as their capacity and scope of work (with support of reference laboratory)
Infrastructure	a. Buildings with specification: 1. permanent construction with minimum 150 m^2; 2. proper air circulation and lighting; 3. rooms for samples receiving, samples storage, sterilization, testing for: water quality, parasites, bacteria, fungi, histology, feeds, residues, necroscopy, administration and warehouse; b. Access road for four-wheels and two-wheels vehicles c. Electricity source and its network as needed d. Water source and its network as needed for testing e. Liquid waste storage and treatment plant as requirement consisting of water-proof discharge channel for non-hazardous wastes; f. Solid waste storage and treatment plant as requirement g. Hazardous waste storage and treatment plant	a. Buildings with specification: 1. permanent construction with minimum 300 m^2; 2. proper air circulation and lighting 3. rooms for samples receiving, samples storage, sterilization, examination/testing for water quality, examination/testing for parasites, examination/testing for bacteria, examination/testing for fungi, examination/ testing for histology, examination/testing for feeds, examination/testing for residues, virus, genetic engineering, and necroscopy, administration and warehouse; b. Access road for four-wheels and two-wheels vehicles; c. Electricity source and its network as needed d. Water source and its network as needed for testing e. Pollution related facilities and requirements same as level 2;
Facilities	a. Equipment for testing water quality, soil, parasite, bacteria, histopathology, residue and feeds; b. Equipment for storage of samples, testing materials, vaccine and isolates; c. Equipment for occupational health, namely laboratory coat, glove, shoes, antiseptic, mask and portable/light fire extinguisher; d. Equipment for administration and documentation; and e. Materials for testing water quality testing, soil, parasite, bacteria,	a. Equipment for testing water quality, soil, parasite, bacteria, histopathology, residue, quality and contaminant of feeds, quality of medicine and genetic engineering; b. Equipment for storage of samples, testing materials, vaccine, isolates, primary DNA, and positive control c. Equipment for occupational health, namely laboratory coat, glove, shoes, antiseptic, mask and portable/light fire extinguisher; d. Equipment for administration and

Item	Level 2 Testing Laboratory (Existing seven laboratories)	Level 3 Testing Laboratory (as proposed for BPKIL Serang)
	histopathology, residue and feeds	documentation; and e. Materials for testing water quality testing, soil, parasite, bacteria, histopathology, residue, quality and contaminant of feeds qualitatively and quantitatively, quality of medicine and genetic engineering
Methods	a. Manual and kit for water quality; b. Spectrophotometry, titrimetric, titration complexometric, conductometry c. Hydrometry/ refractometry, potentiometry/ electrometry, pH indicator for water quality; d. Macroscopic and microscopic for parasite and fungi; e. Conventional, biochemistry, total viable count (ALT) for bacteria; f. Tissue preparations microscopically for histopathology; g. ELISA, spectrophotometry for residue; h. Gravimetry, total nitrogen, Dumas, titrimetric for feeds	a. Manual and kit for water quality b. Spectrophotometry, titrimetric, titration complexometric, conductometry c. Hydrometry/refractometry, potentiometry/ electrometry, pH indicator for water quality d. Macroscopic and microscopic for parasite and fungi e. Conventional, biochemistry, total viable count (ALT) for bacteria f. PCR, RT-PCR for virus g. Tissue preparate microscopically for histopathology h. ELISA, spectrophotometry for residue i. Gravimetry, total nitrogen, Dumas, titrimetric for feeds j. Titration, spectrophotometry for medicines k. PCR for genetic engineering products

Source: MMAF Regulation No. 57/PERMEN-KP/2018 on Fish and Environment Laboratory).

2. Aquaculture Good Practices (CBIB)

88. Regulation of Minister of Marine Affair and Fishery No. 57/PERMEN-KP/2018 on Aquaculture Good Practices (CBIB) and SNI 8228.1:2015, Part 1 (Shrimp) stipulate that all stages of aquaculture shall consider sanitation and prevent the aquaculture products from various hazards for food safety such as bacteria, biotoxin, heavy metals and pesticides, and forbidden residues (antibiotic, hormone). These requirements are integrated into the EMP of this project.

89. MMAF Regulation No. 26/2021 on Prevention of Pollution, Deterioration, Rehabilitation, and Improvement of Fishery Resource and Environment mentions that prevention is started from planning to implementation.

90. Referring to SNI: 8313.2: 2016 on Infrastructure and Production Facilities of Panaeid Shrimp Breeding, the types, size, and specification of the large scale broodstocks has been regulated for the minimum size as presented in Table 15 and Figure 5 for the typical design.

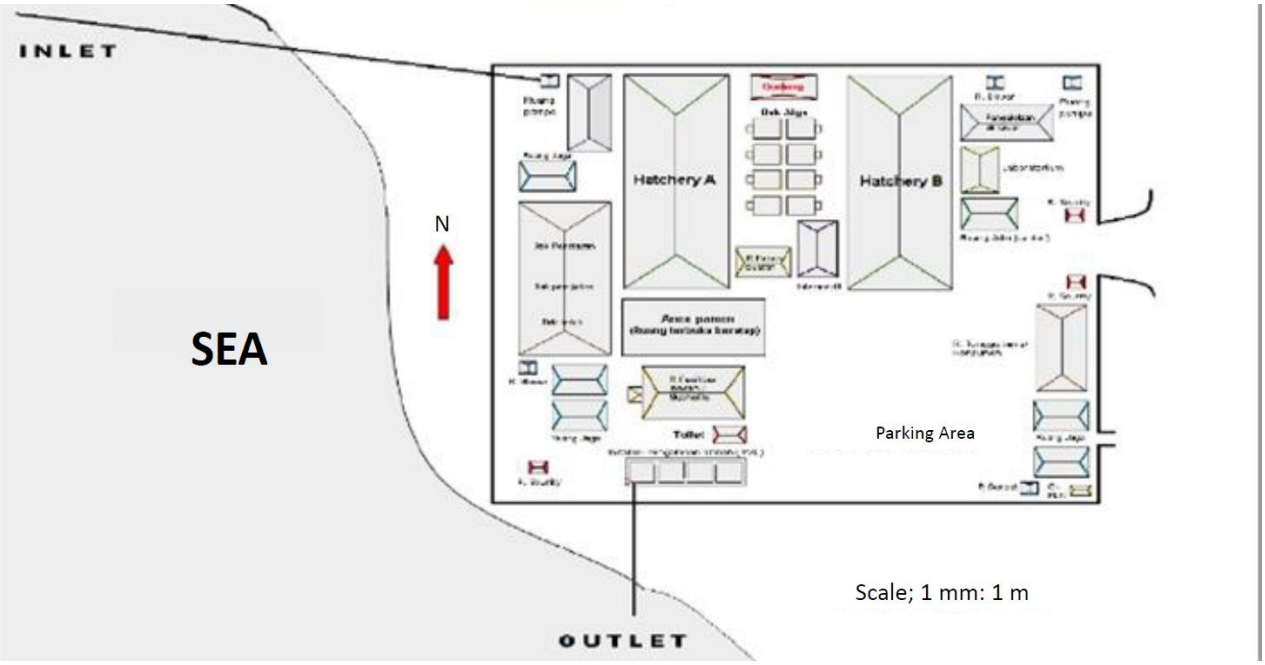
Table 15: Broodstock Main Rooms for Large Scale Hatchery

Types	Min. Size (m^3)	Function and Specification
Seawater room	170	For seawater storage and treatment (filtering and disinfection/ sterilization through chlorination (with chlorine gas) or using UV, equipped with inlet, outlet and pumps
Freshwater room	100	For freshwater storage and treatment (filtering and disinfection /sterilization through chlorination (with chlorine gas) or using UV, equipped with inlet network and freshwater distribution network for sanitation and cleaning
Electric substation and Genset, blower	4	Room source of electricity for the broodstock (50 kVA/3 phases) and genset (reserve for electricity); Blower to supply air to ponds.
Feed room	9	Storage of feeds such as natural feed and commercial feeds
Artemia culture room	25	All activities of decapsulation, hatchery and harvesting of artemia (with refrigerator).
Chemical room	9	Closed room as storage for medicines and chemicals for supporting broodstocks considering requirement as regulation and best practices
Harvesting room	50	Place for larvae harvesting; To harvest, (i) first stop aeration; allow nauplii to swim toward the surface then collect nauplii using beaker; (iii) drain the water through a filter net for total harvest; and (iv) contain in jerrycan, plastic jar, or plastic bag

Source: SNI: 8313.2: 2016 on Infrastructure and Production Facilities of Panaeid Shrimp Breeding.

91. The standard of typical facilities of broodstock refers to SNI: 8037.1:2014 on Brood Production (Indoor Model) of Vannamei Shrimp. Other reference (SNI 8038.1:2014 on Brood Production at Pond for Monodon Shrimp) is also consulted.

Figure 5: Layout of Typical Hatchery



F. Applicable Environmental Standards

92. **Indonesia environmental standards.** Standards issued by the MOEF generally consist of environmental quality (ambient) standards applicable to the receiving environment and emission standards applicable to the pollution source. MMAF as technical ministry and Board of National Standards (BSN) also issue standards related to the shrimp aquaculture and broodstock/hatchery.

1. Ambient environmental quality standards

(a) Air Quality and Noise Standard

93. Previous regulation on ambient air quality standards (Government Regulation No. 41/1999) has been replaced with Government Regulation No. 22/2021. The latest regulation is aligned with WB-IFC EHS Guidelines (2007), as presented in Table 16. The former regulation still referred to the previous period when the sampling and measurement carried out, especially for baseline.

Table 16: Air Quality Standard and Comparison with International Standards

No.	Parameters	Measurement Time	Air Quality Standard, µg/m3	
			GR No. 22/2021	WB – IFC EHS Guidelines 2007
1.	Sulfur Dioxide (SO2)	10-Minutes	-	500
		1 hour(s)	150	
		24 hour(s)	75	125 (Interim target-1) 50 (Interim target-2) 20 (guideline)
		1 year	45	
2.	Carbon Monoxide (CO)	1 hour(s)	10000	
		8 hour(s)	4000	
3.	Nitrogen Dioxide (NO2)	1 hour(s)	200	200
		24 hour(s)	65	
		1 hour(s)	50	
		1 year	50	40
4.	Photochemical Oxidant (O2) as Ozone (O3)	1 hour(s)	150	
		8 hour(s)	100	
		1 year	35	
5.	Non-Methane Hydrocarbon (NMHC)	3 hour(s)	160	
6.	Dust particulate < 100 µm (TSP)	24 hour(s)	230	
	Dust particulate < 10 µm (PM10)	24 hour(s)	75	150 (interim target 1) 100 (interim target 2) 75 (interim target 3)
		1 year	40	70 (interim target 1) 50 (interim target 2) 30 (interim target 3)
	Dust particulate < 2.5 µm (PM2.5)	24 hour(s)	55	75 (interim target 1) 50 (interim target 2) 37.5 (interim target 3)
		1 year	15	35 (interim target 1) 25 (interim target 2) 15 (interim target 3)
7.	Lead (Pb)	24 hour(s)	2	

Notes:
µg/m^3 = concentration in microgram per cubic meter, at normal atmosphere condition, namely pressure (P) 1 atm and temperature (T) 25ºC

1. concentration which reported for measurement period for 1 (one) hour is concentration of measurement result which carried out for each 30 (thirty) minute (in 1 hour carried twice measurement) and carried between 11.00 – 14.00 local time.
2. concentration which reported for measurement period for 8 (eight) hours is concentration from measurement time carried out between 06.00 – 18.00 local time.
3. concentration which reported for measurement period for 3 (three) hours is concentration which carried out for measurement time for 3 (three) hours is concentration from measurement time which carried out between 06.00 – 10.00 local time.

Source: Government Regulation No. 22/2021 and WB – IFC EHS Guidelines 2007.

94. As shown in the above table, Indonesia air quality standard values are same for one-hour measurement time of Nitrogen Dioxide (NO_2), but less strict than WB – IFC EHS for one-year measurement time of the parameter. The thresholds value for sulfur dioxide (SO_2) and dust particulate are still in the range of the WB – IFC EHS Guidelines (2007). Remaining parameters (for example, lead, Non-Methane Hydrocarbon (NMHC) and Photochemical Oxidant (O_2)) are regulated in the Government regulations, but not in WB – IFC EHS Guidelines (2007). Considering this, Indonesia standard for air quality standard prevails for the project.

95. Similar comparison is also carried with Indonesia noise level standard (Regulation of Ministry of Environment No. 48/1999), as shown in Table 17. Indonesia noise standard values are same as WB – IFC EHS Guidelines 2007, except that Indonesia regulation does not differentiate noise level of daytime and nighttime and no measurement of background level of noise. Considering its comparability, Indonesia standard for noise level prevails for the project.

Table 17: Noise Level Standard and Its Comparison with International Standard

Receptor	Unit	National Noise Level Limits[a]	WB – IFC EHS Guidelines 2007	
			Daytime (07:00-22:00)	Nighttime (22:00 – 07:00)
Residential, educational, hospital,institutional, and religious	One hour LAeq (dBA)	55	55	45
Industrial andcommercial		70	70	70
Office and trade		65	70	70
Green open space		50	Background level + dB at the nearest receptor location offsite	Background level + dB at the nearest receptor location offsite
Government andpublic space		60	Background level + dB at the nearest receptor location offsite	Background level + dB at the nearest receptor location offsite
Recreation		70	Background level + dB at the nearest receptor location offsite	Background level + dB at the nearest receptor location offsite
Cultural heritage		60	Background level + dB at the nearest receptor location offsite	Background level + dB at the nearest receptor location offsite

[a] GR No. 22/2021.
LAeq dBA = Equivalent Continuous Sound Level.
Source: Government Regulation No. 22/2021.

(b) Water Quality Standards

96. There are three kinds of water used in the operation of ponds, broodstock and laboratories, namely surface water (river and lake), seawater and groundwater. Groundwater is only used in case surface water or piped water supply system are not sufficient or as supplement for surface water, and only used for sanitation and domestic use. The quality standard of the surface water (combined river and lake), seawater and groundwater are presented in Table 18, Table 19, and Table 20, respectively.

97. Surface Water**.** There are 4 classes of surface water quality mentioned in Appendix VI of GR No. 22/2021, but for the subprojects it shall meet at least Class II as the water used as raw water for water supply for mainly domestic use and some part for operation (cleaning and washing). Table 18 presents water quality standard for both river and lake (comparing the parameters and threshold values for each). As no water quality standard in IFC Standard, there is no comparison made.

Table 18: Quality Standard for Rivers and Lakes with Class II standard
(All Max limit in mg/L except noted otherwise)

Parameters	Class II of Lake	Class II of rivers	Remarks
Temperature (℃)	Dev 3	Dev 3	Deviation with air temperature above water surface
Total Dissolved Solids (TDS)	1000	1000	Not applicable for estuary
Total Suspended Solids (TSS)	50	50	
Transparency (Pt-Co)	4		
Color (Pt-Co)	50	50	Not applicable for peat water (based on its natural condition)
Acidity Level (pH)	6-9	6-9	Not applicable for peat water (based on natural condition)
Biological Oxygen Demand (BOD)	3	3	
Chemical Oxygen Demand (COD)	25	25	
Dissolved Oxygen (DO, >)	4	4	Minimum limit
Sulfate ((SO_4^{2-})	300	300	
Chloride (Cl^{-1})	300	300	
Nitrate (as N)		10	
Nitrite (as N)		0.06	
Ammonia (as N)		0.2	
Total Nitrogen	0.75	15	
Total Phosphate (as P)	0.03	0.2	The quality standard for lake is much stricter (approximately 20 times) than river.
Fluoride (F^-)	1.5	1.5	
Sulfur as H_2S	0.002	0.002	
Cyanide (CN^{-1})	0.02	0.02	
Free chlorine	0.03	0.03	For raw water for water supply

Parameters	Class II of Lake	Class II of rivers	Remarks
Barium (Ba) dissolved	-	-	
Boron (B) dissolved	1.0	1.0	
Mercury (Hg) dissolved	0.002	0.002	
Arsenic (As) dissolved	0.05	0.05	
Selenium (Se) dissolved	0.05	0.05	
Iron (Fe) dissolved	-	-	
Cadmium (Cd) dissolved	0.01	0.01	
Cobalt (Co) dissolved	0.2	0.2	
Mangan (Mn) dissolved	0.4	-	
Nickel (Ni) dissolved	0.05	0.05	
Zinc (Zn) dissolved	0.05	0.05	
Copper (Cu) dissolved	0.02	0.02	
Lead (Pb) dissolved	0.03	0.03	
Hexavalent Chromium (Cr-(VI))	0.05	0.05	
Oil and Grease	1	1	
Total Detergent	0.2	0.2	
Phenol	0.005	0.005	
Aldrin/ Dieldrin	-	-	
BHC	210	210	
Chlordane	-	-	
DDT	2	-	
Endrin	4	2	
Heptachlor	-	4	
Fecal Coliform (MPN/100 mL)	1,000	1,000	
Total Coliform (MPN/100 mL)	5,000	5,000	
Chlorophyll-a ($mg/m^{3)}$	50	-	
Solid waste	None	-	
Radioactivity			
Gross- A (Bq/L)	0.1	0.1	
Gross- B (Bq/L)	1	1	

Source: Appendix VI of GR No. 22/2021.

98. Rivers and lakes are similar as surface water, but some specific parameters are only required for lakes, among others: transparency, manganese (dissolved), DDT, and Chlorophyll-a. In addition, threshold value for Total Nitrogen and Total Phosphate for lake is much lower (stricter) than those of river. Such standard for river and lake water apply to the project's requirements once the freshwater taken from one or both sources for shrimp or as raw water for domestic use in the ponds cluster, broodstock, or laboratory. Measurement for the water quality in this project only cover key parameters (excluding radioactivity and specific organic chemicals that not relevant).

99. Groundwater**.** Referring to Regulation of Minister of Health No. 32/2017, the groundwater standard for hygiene and sanitation use (including water supply for domestic use) comprising of three parameters, are shown in Table 19. Such standard applies to the project's requirements once extracted as raw water for domestic use. Groundwater is not allowed for ponds watering.

Table 19: Groundwater Standard for Hygiene-Sanitation Purpose

No	Parameters	Unit	Quality Standard (Minimum Value)
A.	**Physical Parameters**		
1.	Turbidity	NTU	25
2.	Color	TCU	50
3.	TSP (Total Dissolved Solid)	mg/l	1,000
4.	Temperature	^{o}C	air temperature ± 3
5.	Taste		No taste
6.	Smell		No smell
B	**Biological Parameters** (MPN)		
1.	Total coliform	CFU/100ml	50
2.	E. coli	CFU/100ml	0
C	**Chemical Parameters**		
1.	pH	mg/l	6,5 - 8,5
2.	Iron	mg/l	1
3.	Fluoride	mg/l	1,5
4.	Hardness (CaCO3)	mg/l	500
5.	Manganese	mg/l	0,5
6.	Nitrate, as N	mg/l	10
7.	Nitrite, as N	mg/l	1
8.	Cyanide	mg/l	0,1
9.	Detergent	mg/l	0,05
10.	Total Pesticide	mg/l	0,1

C = Celsius, CFU = Colony Forming Unit, l = liter, mg = milligram, MPN = Most Probable Number, NTU = Nephelometer Turbidity Unit, TCU = True Color Unit.
Source: Regulation of Minister of Health No. 32/2017.

100. **Saline/Seawater**. Seawater is the largest component of water used for the operation of shrimp ponds and broodstock. Referring to Government Regulation No. 22 (Appendix VIII), the quality standard for seawater is classified in line with the intended use (port, marine tourism, and sea biotic). The seawater used under the project falls into category of one used for sea biotic as shown in Table 20. As the old (obsolete) regulation (i.e., KepMen LH No. 51/2004) is still mentioned (baseline data) in this IEE, a comparison is made.

Table 20: Seawater Quality Standard and Its Comparison

No.	Parameter	Unit	SEA BIOTIC	
			Appendix VIII of GR No. 22/2021	**KepMen LH No. 51/2004 (obsolete)**
1.	Color	Pt. Co	-	
2.	Transparency	m	*Coral: .5* *Mangrove: -* *Seagrass: >3*	*Coral: .5* *Mangrove: -* *Seagrass: >3*
3.	Turbidity	NTU	5	< 5
4.	Odor	-	Natural	Natural
5.	Total Suspended Solid	mg/L	Coral: 20 Mangrove: 80 Seagrass: 20	Coral: 20 Mangrove: 80 Seagrass: 20
6.	Solid waste	-	None	None
7.	Temperature	℃	Natural Coral: 28-30 Mangrove: 28-32 Seagrass: 28-30	Natural Coral: 28-30 Mangrove: 28-32 Seagrass: 28-30
8.	Oil layer	-	None	None
9.	pH	-	7 – 8.5	7 – 8.5
10.	Salinity	ppt (°/∞= part per thousand)	Coral: 33-34 Mangrove: up to 34 Seagrass: 33-34	Coral: 33-34 Mangrove: up to 34 Seagrass: 33-34
11.	Dissolved Oxygen (DO)	mg/L	>5	>5
12.	BOD_5	mg/L	*20*	*20*
13	Total Ammonia (NH_3- N)	mg/L	0.3	0.3
14.	Orthophosphate (PO_4- P)	mg/L	0.015	0.015
15.	Nitrate (NO_3-N)	mg/L	0.06	0.08
16.	Cyanide (CN-)	mg/L	0.5	0.5
17.	Sulfide (H2S)	mg/L	0.01	0.01
18.	Total Petroleum Hydrocarbon (TPH)	mg/L	0.02	0.02
19.	Total Phenolic Compounds	mg/L	0.002	0.002
20.	Polyaromatic Hydrocarbon (PAH)	mg/L	0.003	0.003
21.	Polychlorinated Biphenyl (PCB)	mg/L	0.01	0.01
22.	Surfactant as MBAS	mg/L	1	1

No.	Parameter	Unit	SEA BIOTIC	
			Appendix VIII of GR No. 22/2021	KepMen LH No. 51/2004 (obsolete)
23.	Oil and Grease	mg/L	1	1
24.	Pesticides			0.01
	a. BHC		*210*	-
	d. DDT		2	
	h. Endrin		4	-
25.	TBT (tri butyl tin)		0.01	0.01
26.	Mercury (Hg)	mg/L	0.001	0.001
27.	Chromium Hexavalent	mg/L	0.005	0.005
28.	Arsenic (As)	mg/L	0.012	0.012
29.	Cadmium (Cd)	mg/L	0.001	0.001
30.	Copper (Cu)	mg/L	0.008	0.008
31.	Lead (Pb)	mg/L	0.008	0.008
32.	Zinc (Zn)	mg/L	0.05	0.05
33.	Nickel (Ni)	mg/L	0.05	0.05
34.	Fecal coliform	No./100 mL	-	-
35.	Coliform (total)	No./100mL	1000	1000
36.	Pathogen	Cell/100 mL	*None*	*None*
37.	Phytoplankton	Cell/mL	1000	No bloom
38.	Radioactivity	Bq/L	4	4

bg =blood glucose, l = liter, mg = milligram, mL = milliliter, NTU = Nephelometer Turbidity Unit.
Source: to Government Regulation No. 22 (Appendix VIII).

101. The comparison shows that there are no major differences for the parameters and thresholds between both regulations, except for color (which is absent in the previous regulation), pesticides (which is less detailed in the latest regulation), and phytoplankton (specific number in the latest regulation, instead of no bloom). The previous regulation was declared as obsolete, and the latest regulation prevails for the project.

102. **Quality standard of water for growing shrimps** shall meet certain parameters as refer to MMAF Regulation No. 75/PERMEN-KP/2016 on General Guideline on Growing out of *Penaeus monodon* and *Litopenaeus vannamei*, shown in Table 21. As the project focus on intensive type, the standard of intensive ponds will be referred for the subprojects.

Table 21: Water Quality Standard for Growing out of Shrimp Ponds

No.	Parameter	Unit	Technology Level of Shrimp Ponds			
			Simple	Semi intensive	Intensive	Super Intensive
1.	Temperature	°C	28 - 32	28 - 30	28 - 30	28 - 30
2.	Salinity	g/l	5 - 40	10 - 35	26-32	26-32
3.	pH	-	7.5 - 8.5	75 -85	7.5-8.5	7.5-8.5
4.	DO	mg/l	> 3.0	> 3.0	> 4	> 4
5.	Alkalinity (ppm)	mg/l	100 - 250	80 - 150	100-150	100-150
6.	Total Organic	mg/l	55	55	≤ 90	≤ 90
7.	Ammonia (Maximum)	mg/l	< 0.01	< 0.1	≤ 0.1	≤ 0.05
8.	Nitrite (Maximum)	mg/l	< 0.01	< 1	≤ 1	≤ 1
9.	Nitrate (Maximum)	mg/l	0.5	-	-	0.5
10.	Phosphate (Minimum)	mg/l	0.1	0.1	0.1 – 5.0	0.01
11.	Transparency	cm	30 - 45	20 - 45	30-50	30-50
12.	Total Dissolved Solid	mg/l	-	150 -200	-	-
13.	Heavy Metals (Max.)					
	-Pb	mg/l	-	-	0.03	0.03
	-Cd	mg/l	-	-	0.01	0.01
	-Hg	mg/l	-	-	0.002	0.002
14.	Hydrogen Sulfide	mg/l	-	≤ 0.01	≤ 0.01	≤ 0.01
15.	Total vibrio	CF/ ml	-	-	≤ 1x103	≤ 1x103

g = gram l = liter, mg = milligram.
Source: MMAF Regulation No. 75/PERMEN-KP/2016 on General Guideline on Growing out of *Penaeus monodon* and *Litopenaeus vannamei.*

103. The table above is for shrimp ponds production, while the other table below is for growing pond (for testing performance and growing of the breed from broodstock). Both are separately regulated. Water quality standard for the broodstock at several stages is presented in **Table 22** (as referred to SNI 8038.1: 2014). The parameters are similar with water quality standard for shrimp pond, but with less parameters.

Table 22: Water Quality Standard for Growing out of Broodstock Ponds
(All in mg/L, except specify otherwise)

Parameters	Introduction of Breeds	Biofilter Reservoir	Growing Ponds (Performance Test Pond)
Temperature (°C)	26 - 29	26 - 32	26 - 32
DO	> 4	> 3.5	> 4
BOD	-	-	< 0.2
pH	7.8 – 8.5	7.8 – 8.5	7.8 – 8.4
Alkalinity	90 - 150	90 - 150	90 - 150
Transparency(cm)	40 - 50	30 - 50	30 - 40
TSS	< 30	< 20	< 40
Salinity (g/l)	10 - 35	10 - 35	10 - 35
Ammonia	< 0.1	< 0.1	< 0.1
Nitrate	< 0.5	< 0.3	< 0.4
Nitrite	< 1	< 1	< 1
Ortho phosphate	< 0.25	0.30	0.35
Total Vibrio	10^2	10^2 - 10^3	10^2 - 10^3

C= Celsius, g = gram, l = liter, mg = milligram.
Source: SNI 8038.1: 2014

2. Discharge and Emission Standards

(a) Wastewater Discharge Standard

104. General wastewater standard in Indonesia applicable to sewage/domestic wastewater is shown in Table 23. A comparison is made with the corresponding standard in WB/IFC General EHS guidelines.

Table 23: INO General Wastewater Discharge Standard and Comparison with WB General EHS Guideline

Parameters	Unit	Max. Value	World Bank General EHS Guidelines
Temperature	^{o}C	40	
Total Dissolved Solid (TDS)	mg/L	4000	
Total Suspended Solid (TSS)	mg/L	400	50
pH	-	6,0 - 9,0	
Ammonia-Nitrogen (NH3-N)	mg/L	10	
Nitrate (NO3-N)	mg/L	30	
Nitrite (NO2-N)	mg/L	3	
Total Nitrogen	mg/L	60	10
BOD_5	mg/L	150	30
COD	mg/L	300	125
Oil & Grease	mg/L	20	10
Total Coliform	MPN/100 mL	10.000	400
Total Phosphorous	mg/L	NA	2
Methylene Blue	mg/L	10	
Phenol	mg/L	1	
Iron (Fe)	mg/L	10	
Manganese (Mn)	mg/L	5	
Barium (Ba)	mg/L	3	
Copper (Cu)	mg/L	3	
Zinc (Zn)	mg/L	10	
Chromium Hexavalent (Cr6+)	mg/L	0,5	
Total Chromium (Cr)	mg/L	1	
Cadmium (Cd)	mg/L	0,1	
Mercury (Hg)	mg/L	0,005	
Lead (Pb)	mg/L	1	
Stannum (Sn)	mg/L	3	
Arsenic (As)	mg/L	0,5	
Selenium (Se)	mg/L	0,5	
Nickel (Ni)	mg/L	0,5	
Cobalt (Co)	mg/L	0,6	
Cyanide (CN)	mg/L	0,5	

Parameters	Unit	Max. Value	World Bank General EHS Guidelines
Sulfide (H_2S)	mg/L	1	
Fluoride (F)	mg/L	3	
Free Chlorine (Cl_2)	mg/L	2	

C = Celsius; EHS = Environment, Health, and Safety; l = liter; mg = milligram; MPN = myeloproliferative neoplasms.
Source: MOEF 5/2014.

105. The comparison shows that Indonesia regulation is less stringent than WB-IFC EHS Guidelines for several parameter (i.e., TSS, Total Nitrogen, BOD, COD, oil and grease, and total coliform), but Indonesia regulation on general wastewater covers more comprehensive parameters. This standard will be used when there is lack of specific or similar regulation for the discharge standard. Referring to Regulation of Minister of Environment (Permen-LH) No. 5/2014 (and then revised with No. 68/2016), effluent standard from laboratory is not specifically regulated as other industrial processes. However, the characteristics of the effluent from laboratories are similar with ones from health care facilities (see Table 24). For that reason, the laboratories effluent will refer to similar standard to the health care facilities.

106. Wastewater Discharge Standard for Laboratories. Referring to MOE Regulation No. 5/2014 (and then revised with MOEF Regulation No. 16/2016) on Wastewater Quality Standard, wastewater from medical center (hospitals) is specifically regulated, which also includes medical/biological laboratories operation in the medical centers. Since wastes generated (including hazardous chemical and biological wastes) and laboratories operated in the medical centers are similar, the standard will be used for the project's laboratory, as Indonesia also follows the principle of applying more stringent domestic standards applicable, as in many countries.

107. The comparison is made with IFC EHS Guidelines for Health Care Facilities.[18] The tables indicates that Indonesia regulation for wastewater of health care facilities covers more parameters, in which some thresholds are same (pH, BOD, and oil and grease), more strict (COD, TSS) or less strict (Total Coliform) vis-a-vis IFC EHS Guidelines. Thus, Indonesia wastewater standard will apply to the standard for health care laboratories for all the indicated parameters in Table 24, except for the following parameters, where IFC EHS Guidelines for health care facilities are more strict: total coliform, free chlorine, PCDFs, and PCDDs. In the FS, project proponent will also use the same approach, using same standard as applies in health care laboratories.

108. Firstly, all the facilities' domestic wastewater(or termed sewage) shall meet the domestic wastewater quality standard, as shown in Table 24. However, for non-domestic wastewater of laboratories, there is no discharge standard in Indonesia. To better control laboratories' pollution, the project's laboratories will follow Indonesia's and IFC EHS Guidelines discharge standards for health care facilities' wastewater, whichever is stricter,

109. Secondly, in case the medical facility also carries out hazardous wastes treatment, the treated wastewater are disposed into centralized WWTP, it shall also meet wastewater Quality Standard with additional chemical parameters (consolidated in Table 24). The sewage/domestic wastewater will normally be discharged into septic tank, while medical or laboratory wastewater will be discharged into WWT for treatment prior to its release to receiving water body.

[18] Final - Health Care Facilities.doc (ifc.org).

Table 24: Wastewater Standard for Medical Centers and IISAP Laboratories

Parameter	Max, Concentration		WB-IFC EHS Guidelines for HCF	Remarks
	Unit	Value	Value	
pH	-	6 – 9	6 - 9	
Dissolved solid		2000		
Suspended Solid	mg/L	200		
BOD	mg/L	50	50	
COD	mg/L	80	250	
TSS	mg/L	30	50	
Oil and Grease	mg/L	10	10	
Ammonia Nitrogen	mg/L	10		
Total Coliform		5000	400	IFC EHS Guideline will be followed
Temperature	^{o}C	38		
Iron, (Fe)	mg/L	5		
Manganese, (Mn)	mg/L	2		
Barium, (Ba)	mg/L	2		
Copper, (Cu)	mg/L	2		
Zinc, (Zn)	mg/L	5		
Hexavalent Chromic, (Cr6+)	mg/L	0.1		
Total Chromic, (Cr)	mg/L	0.5	0.5	
Cadmium, (Cd)	mg/L	0.05	0.05	
Mercury, (Hg)	mg/L	0.002	0.01	
Lead, (Pb)	mg/L	0.1	0.1	
Tin/Stannum, (Sn)	mg/L	2		
Arsenic, (As)	mg/L	0.1		
Selenium, (Se)	mg/L	0.05		
Nickel, (Ni)	mg/L	0.2		
Cobalt, (Co)	mg/L	0.4		
Cyanide, (CN)	mg/L	0.05		
Sulfide, (S=)	mg/L	0.05		
Fluoride, (F-)	mg/L	2		
Free Chlorine, (Cl2)	mg/L	1	0.2	IFC EHS Guideline will be followed
Free Ammonia, (NH3-N)	mg/L	1		
Nitrate, (NO3-N)	mg/L	20		
Nitrite, (NO2-N)	mg/L	1		
methylene blue active substance, (MBAS)	mg/L	5		
Phenol	mg/L	0.5	0.5	
AOX	mg/L	0.5		
PCBs	mg/L	0.005		

PCDFs	mg/L	10	0.1	IFC EHS Guideline will be followed
PCDDs	mg/L	10	0.1	IFC EHS Guideline will be followed

l = liter, mg = milligram.
Source: MOEF Regulation No. 16/2016) on Wastewater Quality Standard; IFC EHS Guidelines for Health Care Facilities

110. Similar with above table, Indonesia regulation for health care facilities involving hazardous management covers more parameters, in which some are same (pH, phenol), less strict (Total Chromic, Cadmium, Free Chlorine, PCDF, PCDD) or stricter (Mercury) with IFC EHS Guidelines.

111. **Wastewater discharge standard for shrimp ponds and hatchery/broodstock** is combined and shown in Table . The discharge standard applicable to shrimp ponds under the project is Regulation of Ministry of Marine Affairs and Fishery No. KEP. 28/MEN/2004 on General Guideline of Aquaculture in Shrimp Ponds, which was subsequently updated with Regulation of Minister of Marine Affairs and Fishery (Permen – KKP) No. 75/2016 on General Guideline for Growing out of *Penaeus monodon* and *Litopenaeus vannamei.* The combined standard is compared with WB/IFC's EHS guideline on aquaculture parameters and threshold values.

Table 25: Effluent Standard of Shrimp Ponds and Hatcheries with comparison with EHS Aquaculture Guidelines

No	Parameters	Unit	Indonesia Regulation		EHS Aquaculture Guidelines
			Shrimp pond Max. limit[19]	Hatchery/broodstock Max. limit	
A	**Physical Parameter**				
1.	TSS	mg/l	≤ 200	<30	50
2.	Turbidity	NTU	≤ 50	30-40	
3	Temperature	^oC		26 – 32	*< 3 (temperature increase)*
4	Alkalinity		*NA*	100 – 150	
5	Transparency(cm)		*NA*	30 – 40	
B	**Chemical Parameter**				
1.	pH	-	6-9	7-9	6 - 9
2.	DO	mg/l	NA	> 3	
3.	BOD_5	mg/l	< 45	<10	50
	COD	*mg/l*	*NA*	*NA*	*250*
4.	PO_4	mg/l	< 0.1	NA	2
5.	H_2S	mg/l	< 0.03	NA	
6.	NO_3 (Nitrate anion)	mg/l	< 75	< 0.5	
7.	NO_2 (Nitrite anion)	mg/l	< 2.5	< 1	
8.	NH_3-N	mg/l	< 0.1	< 0.1	
9.	Salinity	ppt		10 - 35	

[19] Regulation of Minister of Marine Affairs and Fishery (Permen – KKP) No. Kep. 28/MEN/2004 on General Guideline for Shrimp Growing out in the Ponds .

C	Biological Parameter				
	Dinoflagellata				
1	Gymnodinium	Individual /1	< 8 x 10^2	NA	
2	Peridinium	Individual /1	< 8 x 10^2	NA	
3	Pathogen bacterial	CFU	< 102	NA	
4	Total Vibrio	MPN/100 ml		< 10^4	
5	*Total Coliform Bacteria*	*MPN/100 ml*	*NA*	*NA*	*400*
6	*Active Ingredients/ Antibiotics*	*To be determined on a case specific basis*			

Note: *Italics* un-numbered items represent ones regulated in EHS, but not regulated in Indonesia regulation.
Source: MMAF Regulation No. KEP. 28/MEN/2004 and MMAF Regulation No. 75/2016.

112. Referring to the above comparison, Indonesia regulations for shrimp pond is stricter for BOD and phosphate, but less stringent for TSS. Furthermore, more parameters are included in Indonesia regulations, but Total Coliform Bacteria and COD are not regulated (required) in the regulation. The standard for BOD is also stricter if compared to the IFC-WB Guideline (Aquaculture). The Indonesia standard will be applied for the shrimp ponds in the project.

113. Similar with standard of shrimp pond, Indonesia standard for broodstock is also much stricter for BOD and TSS, but less stringent for TSS. More parameters included in Indonesia regulations, except for Total Coliform Bacteria and COD which is not regulated as in EHS Guidelines. The standard for BOD is also stricter compared to the IFC-WB Guideline (Aquaculture). The Indonesia standard will be applied for the broodstock in the project.

3. Standards Related to Solid and Hazardous Wastes

114. Law No. 8/2008 on Solid Waste Management, Government Regulation No. 22/2021 on Environmental Protection and Management, and Government Regulation No. 27/2020 govern the solid waste management in Indonesia. The regulations specify classification and management of the solid wastes, both domestic (non-hazardous wastes) and industrial (hazardous wastes), as shown in Table 26.

Table 26: Solid Waste Categories under Government Regulation No. 27/2020 on Specific Wastes Management

Waste Category	Description
General waste (householdwaste)	generated from daily family life but excluding feces and special waste
General waste equivalents	Waste generated from commercial facilities, industrial parks, community publicfacilities and other facilities, etc.
Specific wastes	Waste requiring special management due to their special properties:
	- Waste containing noxious materials and substances
	- Hazardous waste
	- Waste generated from disasters
	- Waste impossible to process due to technological constraints
	- Irregularly generated wastes

115. MOEF Regulation No. 14/2021 on Waste Management and Wastes Bank classify the wastes into five categories, as follows:

(i) Wastes containing hazardous substances (B3) and/or hazardous wastes (products which contain hazardous substances and/or hazardous wastes which

cannot be used; used packages of the product containing hazardous substances and/or hazardous wastes; used electronic equipment; other products and/or packages containing hazardous substances and/or hazardous wastes which cannot be used)

(ii) Wastes that easily degraded by natural process (food waste, litter, and other degradable wastes)
(iii) Recyclable wastes (plastic, paper, metal, glass, rubber, textile, and others)
(iv) Other wastes that can be recycled
(v) Other wastes (other wastes not included in Category [i] to [iv])

116. Hazardous wastes (generally generated from laboratory) are classified into several items. Some are relevant to the project, especially for laboratories operation, among others:

(i) **Infectious waste:** waste contaminated with blood and other bodily fluids, cultures, and stocks of infectious agents from laboratory work, or waste from biological samples (with infections);
(ii) **Pathological waste:** samples (shrimp) tissues, organs or fluids, body parts and contaminated animal carcasses;
(iii) **Sharps waste:** syringes, needles, disposable scalpels and blades, etc.;
(iv) **Chemical waste:** solvents and reagents used for laboratory preparations, disinfectants,and heavy metals contained in medical devices and batteries;
(v) **Pharmaceutical waste:** expired, unused and contaminated drugs and vaccines;
(vi) **Cytotoxic waste:** waste containing substances with genotoxic properties, such ascytotoxic drugs used in cancer treatment and their metabolites;

117. Handling of hazardous wastes for health care facilities refers to Ministry of Health (MOH) No. 18/2020 on Regional Based Medical Wastes Management of Health Care Facilities, MOH Regulation No. P.56/2015 on Procedure and Technical Requirement for Hazardous Wastes from Health Care Facilities, and MOH Regulation No. 7/2019 on Environmental Health of Hospital. For the project laboratory, the handling of hazardous wastes also refers to USEPA Environmental Management Guide for Small Laboratories (May 2000).

118. Wastewater treatment of aquaculture facilities and laboratories will generate sludge whose disposal can cause environmental problems. In Indonesia, national standard on sludge apply to various purposes. For example, sludge can be used for embankment of the ponds. The sludge also can be used as raw material for brick stone. As the sludge contains high nutrient, it also can be mixed with other materials to make compost. There is no specific standard under Indonesia regulation for the sludge, but specification set forth in SNI 19-7030-2004 for compost from domestic organic wastes (sludges) can be inferred for the standard, especially for heavy metals. As mixture of compost, the sludge shall meet the standard, as presented in Table 27.

Table 27: Quality Standard of Compost
(SNI 19-7030-2004)

No	Parameter	Unit	Minimum	Maximum
1	Water contents	%	-	50
2	Temperature	^{o}C		Groundwater temperature
3	Color			Darkish
4	Smell			Soil smell
5	Particle size	mm	0,55	25
6	Water binding capacity	%	58	-
7	pH		6,80	7,49

No	Parameter	Unit	Minimum	Maximum
8	Impurities	%	*	1,5
9	Organic material	%	27	58
10	Nitrogen	%	0,40	-
11	Carbon	%	9,80	32
12	Phosphorus (P2O5)	%	0.10	-
13	C/N-ratio		10	20
14	Kalium (K2O)	%	0,20	*
15	Arsenic	mg/kg	*	13
16	Cadmium (Cd)	mg/kg	*	3
17	Cobalt (Co)	mg/kg	*	34
18	Chromium (Cr)	mg/kg	*	210
19	Copper (Cu)	mg/kg	*	100
20	Mercury (Hg)	mg/kg	*	0,8
21	Nickel (Ni)	mg/kg	*	62
22	Lead (Pb)	mg/kg	*	150
23	Selenium (Se)	mg/kg	*	2
24	Zinc (Zn)	mg/kg	*	500
25	Calcium	%	*	25.50
26	Magnesium (Mg)	%	*	0.60
27	Iron Fe)	%	*	2.00
28	Aluminum (Al)	%	*	2.20
29	Manganese (Mn)	%	*	0.10
30	Fecal Coli	MPN/gr		1000
31	Salmonella sp.	MPN/4 gr		3

* The value is greater than minimum or less than maximum.
C = Celsius, gr = gram, kg = kilogram, mg – milligram, MPN = most probable number.
Source: SNI 19-7030-2004.

119. Treated wastewater from ponds, broodstock/hatcheries as well as domestic wastewater from office and other facilities can be reused, applied to land, and/or discharged into soil/formation if they meet the following requirement: (i) Location of the application in the self-owned land and/or other's land, with requirement that each land has environmental approval; (ii) Carried out at area that meet requirements:

(i) not peatland;
(ii) land with permeability 1.5 – 15 cm/hour;
(iii) depth of water table greater than 2 meter; and
(iv) land with slope < 30%.

4. Air emission standards applicable to laboratories

120. As existing practices some laboratories use thermal method to manage hazardous wastes. Referring to MOEF Regulation No. P.70/2016 on Emission Quality Standard for Activities Using Waste Thermal Treatment, the practice only can be carried out for domestic wastes and similar households wastes that do not contain hazardous substances, hazardous wastes, glass, Poly Vinyl Chloride (PVC), and aluminum foil. The thermal wastes processing also shall meet emission quality standard as presented in Table 28.

Table 28: Air emission Standard for waste Thermal Treatment and Boilers[a]
(All units in mg/Nm3, except expressed otherwise)

No	Parameter	Max. limit of incinerator	Max limit for coal-boilers	Oil-boilers	Gas boilers
1	Total Particulate	120	230	200	Not Regulated
2	Sulphur Dioxide (SO2)	210	750	700	150
3	Nitrogen Oxide (NOx)	470	825	700	650
4	Hydrogen Chloride	10	Not regulated		
5	Mercury (Hg)	3			
6	Carbon Monoxide (CO)	625			
7	Hydrogen Fluoride (HF)	2			
8	Dioxin & Furane (ng/Nm3)	0.1			

Notes:
1. All unit in mg/NM3 except dioxin which is …?
2. Volume of gas measured in standard condition (25oC and 1 atmosphere pressure) .
3. All parameters are corrected with Oxygen (O2) of 11%.
4. Measurement of dioxin and furane carried out for every 5 years.

[a] MOE Regulation No. 7/2007 on Emission Quality Standard of Stationary Sources of Boilers.
Source: MOEF Regulation No. P.70/2016 on Emission Quality Standard for Activities Using Waste Thermal Treatment**.**

5. Standards on toxic Residues of food products

121. Residue standard in the shrimp and fishery sector is shown in Table 29 (ref to Appendix II of MMAF Regulation No. 37/PERMEN-KP/2019). This is especially important to meet international certification for food safety. Referring to Best Aquaculture Practices Certification Guidelines (2021) residue is one of the issues to be considered and traced. The major chemical risks of concern to human food safety in aquaculture are residues of therapeutic drugs and chemicals applied directly through feeds or to water of production units.

Table 29: Residues for Consumption Fish Aquaculture (in mg/kg)

Group	Substance	Commodity	Residue Quality Standard (BMR)	Environmental Quality Standard (BMKL)
A1 (Stilben)	Diestilstilbesrol	Fish	-	1
A3 (Steroid)	Metiltestosteron	Fish	-	1
A6 (Forbidden Antibacterial)	Chloramphenicol		-	0.3
	Nitrofuran Metabolites (AOZ, AMOZ, SEM, AHD)	Fish and Shrimp	-	1
	Dimetridazole	Fish and Shrimp	-	3

B1 (Antibacterial)	Tetracycline	Fish and Shrimp	100	-
	Oxytetracycline	Fish and Shrimp	100	-
	Chlortetracycline	Fish and Shrimp	100	-
	Sulfonamide	Fish and Shrimp	100	-
	Enrofloxacin	Fish and Shrimp	100	-
	Erythromycin	Fish	200	-
B2a (Anthelmintic)	Emamectine	Fish and Shrimp	100	-
B3a (Organochlorine)	BHC	Fish and Shrimp	0.01	-
	Aldrin/ Dieldrin	Fish and Shrimp	0.1	-
	Chlordane	Fish and Shrimp	0.05	-
	Heptachlor and Heptachlor Epoxide	Fish and Shrimp	0.05	-
	Lindane	Fish and Shrimp	1	-
	Endrin	Fish and Shrimp	0.05	-
	DDT	Fish and Shrimp	1	-
B2c	Mercury (Hg)	Fish and Shrimp	0.5	-
	Lead (Pb)	Fish	0.3	-
		Shrimp	0.5	-
	Cadmium (Cd)	Fish	0.05	-
		Shrimp	0.5	-
B3e (Coloring Agent)	Malachite green and Leucomalachite green	Fish and Shrimp		2
	Chrystal violet and Leucocrystal violet	Fish and Shrimp		0.5

Source: MMAF Regulation No. 37/PERMEN-KP/2019.

G. International Environmental Agreements

122. Indonesia has ratified several international conventions, and some relevant to the project. The list of international conventions ratified by Government of Indonesia related to environment including, among others:

(i) Convention on Biological Diversity, for parties to require the environmental assessment of their proposed projects that are likely to have significant adverse impacts on biological diversity with a view of avoiding or minimizing such impacts. Indonesia is obliged to respect and protect traditional knowledge related to sustainable utilization of biodiversity, including fair benefit sharing of the use of traditional knowledge. Based on this convention, the Nagoya Protocol was established, which was also ratified by the Government of Indonesia;

(ii) Convention on Wetlands of International Importance Especially as Waterfowl Habitat (1972). Indonesia follows an international agreement to control the

continuous encroachment of wetland in the present and future, to recognize the basic ecological functions of wetlands follows the economic, cultural, scientific, and recreation.

(iii) Convention on the Prevention of Marine Pollution by Dumping Wastes and Other Matter (1972). Indonesia follows an international agreement to control marine pollution due to accumulation of waste and other materials and to encourage regional agreements to complement the Convention; the London Convention came into effect in 1996.

(iv) Vienna Convention for the Protection of the Ozone Layer, in 1998, and subsequent protocol and amendments, for parties to take appropriate measures to protect human health and the environment against adverse impacts likely to arise from human activities that will/likely modify the ozone layer.

(v) Protocol of 1978 Relating to the International Convention for the Prevention of Pollution from Ships, 1973 (MARPOL). Indonesia has ratified the international agreement to conserve the marine environment / marine pollution by banning oil and other hazardous substances and disposal of hazardous substances to suppress levels that do inadvertently (e.g., due to accidents).

(vi) Basel Convention on the Control of Transboundary Movements of Hazardous Wastes and Their Disposal (1989). Indonesia has ratified the international agreement to reduce cross-country movement of waste in accordance with the minimum limit of the Convention to create an environmentally friendly waste management and efficient; reducing toxicity of waste generated and to ensure that environmental management is the basis for resource development.

(vii) United Nations Framework Convention on Climate Change (1992). Indonesia has ratified the international agreement to achieve stabilization of greenhouse gas concentrations in the atmosphere as low as possible to prevent dangerous anthropogenic interference with the climate.

(viii) Kyoto Protocol of the United Nations Framework Convention on Climate Change. Indonesia has ratified the international agreement to reduce greenhouse gas emissions by promoting national programs in developed countries aimed at reducing greenhouse gas emissions and determine the percentage of reduction targets for developed countries.

(ix) Indonesia has ratified the Paris Agreement within the United Nations Framework Convention on Climate Change (UNFCCC) dealing with greenhouse gases emissions mitigation, adaptation, and finance in October 2016.

(X) Convention on Fishing and Conservation of Living Resources of the High Seas (Marine Life Conservation). Objectives: Solve the problem of preservation of biological resources in the high seas through international collaboration with the consideration that the use of modern technology for the exploitation of resources in excess will cause harm to these resources.

III. BASELINE OF THE ENVIRONMENT

123. The subprojects spread over seven provinces and ten districts in four islands, as shown in Figure 1. In Sumatra Island there are two provinces with respective district, i.e., (i) NAD/Aceh (Aceh Besar) and (ii) Lampung (Pesawaran). In Java Island there are three provinces with respective districts, i.e., (i) Banten (Serang and Tangerang), (ii) Central Java (Jepara), and (iii) East Java (Situbondo and Pasuruan). In Bali Island there is only one province and respective district, i.e., Bali (Karangasem). In Sulawesi Island there is one province and two respective districts, i.e., South Sulawesi (Takalar and Pinrang).

124. As the locations and geography are diverse, the description of environmental baseline will be combined into a short description following main categories as referred to SPS 2009, namely (i) Physical Resources, (ii) Ecological Resources, and (iii) Social Economic and Cultural Resources. Thematic maps are provided in Appendixes.

A. Physical Environment

1. Administrative Boundaries and Geography

125. The geographic and administrative boundary for all provinces and districts covered are illustrated in the maps (Figure 6).

2. Topography

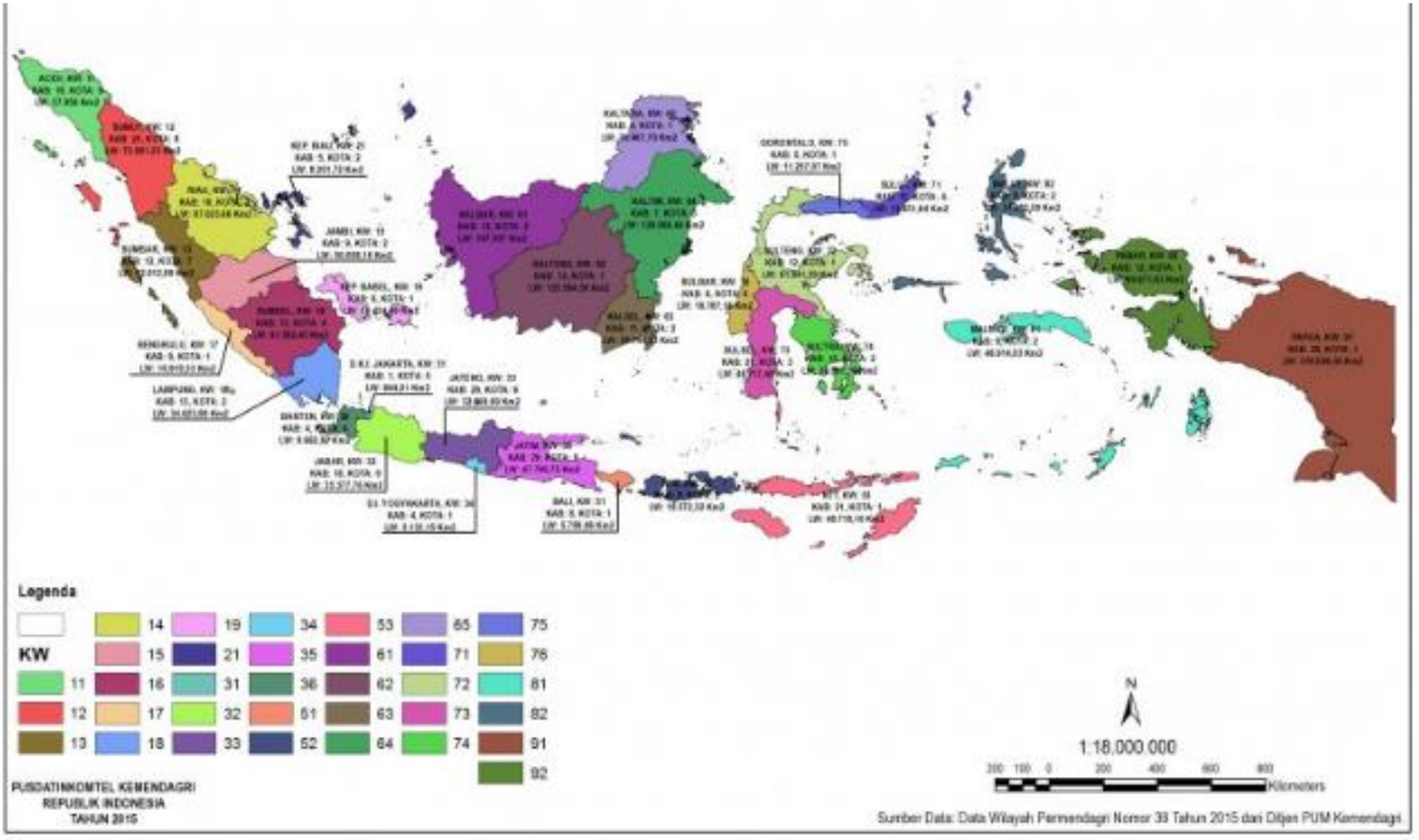
126. **Aceh Besar.** Topographically, Aceh Besar can be classified into several class of elevation between 0 – 800 meter to > 800 meter. Based on the class, most areas in Aceh Besar fall into ones with elevation 200 – 400 meters msl, i.e., 20.67% of total areas in the district.

127. Meanwhile, based on the slope, Aceh Besar divided into seven classes: (i) < 2%, (ii) 2-8%, (iii) 9-15%, (iv) 16-25%, (v) 26-40%, (vi) 41-60%, and (vii) >60%. Most areas in the district classified as ones with slope >60% covering 118,520.71 Ha or 40.82% of total area in Aceh Besar.

128. **Pesawaran (Lampung).** The territorial contours of Pesawaran vary from coastal to hilly areas. A total of 4 sub-districts are located in the coastal area, namely Punduh Pidada, Marga Punduh, Padang Cermin, and Way Ratai. Punduh Pidada is the subdistrict in a coastal area with the largest number of islands (30 islands). Meanwhile, the highest hilly area is identified in Way Lima with +700 m mean sea level (msl).

129. **Serang (Banten).** Topography of Serang varies from coastal areas to mountainous areas with elevation from 0 to 1,788 msl and is generally classified as plain and wavy area. Area with elevation 0 msl spread from Tirtayasa sub-district to Cinangka sub-district at the west coast of Sunda Strait. Areas with elevation of 1,788 msl found at Mt. Karang which is located at the south part at the border with Pandeglang District. ≥ 97.5% of Serang area is below 500 msl over an area of 172,402.25 Ha.

Figure 6: Administrative Map of Indonesia (Highlighting of IISAP Projects Areas)



130. **Jepara (Central Java)**. Jepara is divided into four regions, namely coastal area at the west and north parts, low plain at the central and south parts, mountainous area at east part (west slope of Mt. Muria) and marine area or isles at north which represent cluster of Karimun jawa Island.

131. Jepara has various relief, consisting of coastal areas spread over along the northern coast covering districts of Kedung, Jepara, Mlonggo, Bangsri, and Keling, low land and upland around Mt. Muria and Mt. Clering. Topographically, Jepara lies in range 0 – 1,301 meter above mean sea level. Topographically, Jepara ranges from 0 m to 1,301 m msl (mean sea level), the lowest areas in Kedung sub-district in range 0 - 2 m msl along the coastal area, while the highest area is Keling sub-district in range 0 – 1,301 m msl represent hilly areas.

132. Pasuruan **(East Java)**. Topographically, Pasurunan is divided into 3 (three) parts, namely:

(i) Mountainous and hilly areas with elevation in range 180 – 3000 m. This area spread over at south and west part of Pasuruan covering sub-districts of Lumbang, Puspo, Tosari, Tutur, Purwodadi, Prigen, and Gempol.
(ii) Low plain with elevation in range 6 – 91 m. This area located at the center part and identified as fertile areas.
(iii) Coastal area with elevation in range 2 – 8 m. This area spread over north part covering sub-districts of Nguling, Lekok, Rejoso, Kraton, and Bangil.

133. **Situbondo (East Java).** Situbondo elevation ranges from 0 to 1,250 m msl. Areas with average elevation are located in the southwest part such as sub-district of Jatibanteng and Sumbermalang. In the north part there is Bungatan sub-district with elevation of 1,250 m.

134. **Karangasem (Bali).** The topography of the district in Karangasem varies from plain, hilly area, and mountainous area (including Mt. Agung). Karangasem has a coastal line of 87 km long, which some are assigned for tourism.

135. Karangasem has boundaries with sea to mountainous area with its peak of Mt. Agung. The elevation varies from 0 – 3,142 m above mean sea level and most areas of Karangasem are at elevation 100 - 500 m msl and 500 - 1000 m msl. The land only covers 13.4% of total area of Karangasem along the coastal area.

136. **Takalar (South Sulawesi).** Takalar lies at elevation of 0 – 1000 meter above mean sea level (msl), with relatively flat relief, wavy to hilly areas. Most areas are classified as low land and coastal areas with elevation 0 – 100 msl, representing 86.10% or 48.778 km2. The rest is hilly areas at more than 100 msl, located in sub-districts of Polobangkeng Utara and Polombangkeng Selatan. Topography and slope in Takalar vary, in range (i) 0 - 2%, (ii) 2 - 15%, (iii) 15 - 30%, (iv) 30 – 40%, and (vii) > 40%.

137. **Pinrang (South Sulawesi).** Topographically, areas in Pinrang varies from flat area with elevation 0 m msl to the highland greater than 1000 m msl. The highlands are mostly located at the center to north of Pinrang, especially areas at the border with Toraja District.

(i) Elevation 0 – 100 m covering coastal areas in the subdistricts of Mattiro Sompe, Lanrisang, Watang Sawtito, Tiroang, Patampanua, and Cempa
(ii) Elevation 100 – 400 m covering several areas in the subdistricts of Suppa, Mattiro Bulu, and Paleteang.
(iii) Elevation 400 – 1000 m covering small parts of Duampanua sub-district.
(iv) Elevation > 1000 m covering some part of sub-districts of Lembang and Batulappa.

3. Geology and Soils

138. **Aceh Besar (NAD).** Geologically, primary material for soil in Aceh Besar varies, from acidic to alkaline. The materials consist of sediment, sedimentary rocks, lime, volcanic rocks, metamorphic (Malihan) and igneous rock (intrusion). Based on its age, the rocks were formed at pre-tertiary, tertiary, and quaternary age.

139. **Pesawaran (Lampung).** Geologically, there are several formations from Tertiary and Quaternary Age. Younger quaternary volcanic rocks are predominant in sub-districts of Gedong Tataan and Way Lima. In Padang Cermin, this formation is especially identified in the middle, north and some in east of the sub-district. Older quaternary volcanic rock is predominant in Punduh Pidada sub-district. This formation is identified in Kedondong and some areas of Padang Cermin at the west and south parts.

140. **Serang (Banten).** Geologically, Serang consists of 3 (three) types of rocks. The largest part of the rocks are tertiary sediments and alluvium. There are few areas with Young Quaternary Volcanic Products, in the south part of Serang City (in Village Gelam). The soil in Serang consist of 5 (five) types, based on primary composition, namely: red podzolic, associated yellow podzolic, and grey hydromorphic, yellowish grey regosol, grey regosol, associated reddish brown latosol, and brown latosol.

141. **Jepara (Central Java)**. Geologically, Jepara has an alluvial plain composed of mud sediment from rivers and brought by water current along the coast. Soil types in the areas consist of hydromorphic alluvial, brown regosol, associated dark brown mediteran and brown mediteran, dark grey grumosol, associated grey hydromorphic, and greyish brown planosol.

142. **Pasuruan (East Java).** Geologically, Pasuruan can be classified into 3 (three) main groups: surface rocks, sedimentary rocks and volcanic rocks. The abundant types of rocks shows that Pasuruan has potential sources of quarry (sand and rocks).

143. **Situbondo (East Java).** Geological structure of Situbondo include alluvium (48.983 Ha), younger Quaternary Volcanic rocks (19.787 Ha), older Quaternary Volcanic rock (72.752 Ha), and Leusita (22.328 Ha). Types of soil in this area are alluvial, Regosol, Gleysol, Renzine, Grumosol, Mediteran, Latosol, and Andosol.

144. **Karangasem (Bali).** Geologically, Karangasem consists of quaternary formation, bottom quaternary, and Myosin. Quaternary formation covers most of the districts. Quaternary formation with Sandy Lithology Tufa Pasiran and lava sediment identified at north coast area of Tianyar.

145. **Takalar (South Sulawesi).** The oldest rock unit is Tonasa formation (Temt), consists of solid and layered lime rock, coral, bioclastic, kalkarenit with embedded marl, sandy lime with age in range of Eosen to Mid Miosen. On the top, there is Camba formation (Tmc) consisting of sea sediment intertwined with volcanic rocks, sandy rock tufa intertwined with tufa, sandy rock and marl embedded lime, lime, conglomerate, volcanic breksi and coal. This Camba formation (Tmc) is fingering with volcanic rocks.

146. **Pinrang (South Sulawesi).** Geologically, Pinrang is composed of rock layers: (i) alluvium and river sediments with thickness in range 100-150 meter, consisting of clay, silt, sand and gravel; (ii) volcanic rock composed of breksi with layered trakht and andesite, pumice tufa, sand rock terfaan, conglomerate and breki terfaan, with thickness approximately 500 meter; (iii) Lava flow rock composed of light grey trakhit and bekekar tiang, distributed toward

Pinrang, i.e., around sub-districts of Lembang and Duampanua; (iv) Conglomerate rock (Walanae Formation), found at northeast part of Pinrang. This rock unit consist of conglomerate, few sandy rock glakonit and flakes and form wavy morphology with thickness up to 400 meter; (v) lava rocks, composed of basol to andesite. This rock unit forms pillow lava, breksi andesit piroksin and andesit trakhit. The thickness in range 50 to 100 meter with distribution around Bulu Tirasa and Pakoro; and (vi) sandy rock composed of andesite, silt rock, conglomerate and breksi.

4. Climate and Rainfall

147. Indonesia's climate is largely hot and humid, with rainfall occurring mostly in low-lying areas and mountainous regions experiencing cooler temperatures. The cities of Jakarta, Ujung Padang, Medan, Padang, and Balikpapan have an average minimum temperature of 22.8°C and a high of 30.2°C. Humidity in Jakarta varies between 61% to 95% and average rainfall amounts to 218.4 millimeters (mm) per month. The "wet" season occurs between November and April, leaving May through October typically dry. Indonesia experiences drier conditions during El Nino events and wetter conditions during La Nina events. Indonesia lies across the range of the Inter-Tropical Convergence Zone (ITCZ) where the northeast and southeast trade winds penetrate the doldrums. Strong ascending motion, overcast skies, strong squalls, heavy rainfall, and severe local thunderstorms with variable intensities are characteristics of this zone.

148. There are some variations of local climate across project areas. The average monthly rainfall of each project area range from 100 to 329 mm (or annual average rainfall of 1,200 – 3,498 mm), fairly humid tropical climate.

Table 30: Summary of Climate Data

District	Average Air Temperature (°C)	Average Humidity (%)	Atmospheric Pressure (mb)	Monthly Average Rainfall (mm)	Average of Rainy Days (day)	Solar Exposure (%)
Aceh Besar	27.45	80.11	1007.24	240.40	15.08	62.54
Pesawaran	27.00	84.89	1001.42	184.00	10.80	40.00
Serang	27.63	81.19	1009.41	105.21	13.00	53.5
Tangerang	27.18	83.35	1010.30	270.75	17.75	44.62
Jepara	27.36	81.19	1009.37	105.21	13.00	53.50
Pasuruan	22.30	85.50	804.80	329.18	10.83	32.67
Situbondo	27.00	83.50	1007.1	100.33	6.25	32.67
Karangasem	28.35	75.18	992.21	139.71	11.33	80.20
Takalar	31.00	87.00	-	203.58	10.83	-
Pinrang	27.30	83.92	1012.57	234.50	14.80	-

Source: District Statistic Book (*Kabupaten Dalam Angka*, 2020).

5. Hydrology

149. **Aceh Besar (NAD).** Krueng Aceh provides most of water to Banda Aceh and Aceh Besar. This river has several sub-watersheds (Sub-DAS), namely Krueng Seulimeum, Krueng Jreu, Krueng Inong, Krueng Keumireu, and Downstream Krueng Aceh. To anticipate flood in Kota Banda Aceh, the flow of Krueng Aceh is also drained through floodway to Alue Naga, Kota Banda Aceh.

150. **Pesawaran (Lampung).** The longest river in Pesawaran is Way Semah, with 54 km long and a watershed of 135 km2. Other small rivers are Way Penengahan, Way Kedondong, Way Kuripan, Way Tahala, Way Tabak, Way Awi, Way Padang Ratu, Way Ratai, and others. Way Semah River is utilized for irrigation water, especially irrigation scheme of Way Semah I.

151. **Serang (Banten).** The Ciujung River is a main river in Serang (Banten Province) crossing some parts of West Java Province. The Northern Alluvial Plains are dominated by rivers flowing north, crossing the plains at right angles before reaching the sea. The rivers are incised to variable depths, with riverbeds commonly 5-8 m below the level of the surrounding plains for distances up to 50 km inland. The hydrology of the alluvial plains has been extensively modified by man's activities, particularly by the creation of extensive wetland rice fields, and the construction of a wide variety of canals, drains, and embankments as well as a complex network of settlements and connecting roads. Abstraction of river water to irrigate the rice field has a major effect on the water balance of the plains, and on the capacity of the rivers to transport the catchment's sediment load and perform essential flushing functions in the vicinity of human settlements.

152. **Jepara (Central Java)**. The major rivers are Gelis, Keling, Jarakan, Jinggotan, Banjaran, Mlonggo, Gung, Wiso, Pecangaan, Bakalan, Mayong and Tunggul. Based on the topography, the river flow from upstream at east part (Mt. Muria) to west part, i.e., downstream (Java Sea).

153. Jepara is part of the sub-watershed of Jratun Seluna (Jragung, Tuntang, Serang, Lusi, dan Juana). Some major rivers in Jepara among others: Bakalan, Kaweden, Pecangaan, Troso, Sirahan, Mlonggo, Kancilan, Balong, Gelis, Pasokan, Tunggul, Mayong, Sengon, Kedung Bule, Tuk Abul, Bapangan, Kembar Rawi, Banjaran, Jeruk, Wangkong, Blitar, Wareng, and Suru.

154. **Pasuruan (East Java).** As part of hydrological cycle, there are some springs, lakes and rivers in Pasuruan. Surface water flow pattern in Pasuruan is reflected by 8 water courses (DPS), namely: DPS Kali Kambeng located at the west boundary, DPS Kali Kedung Larangan, DPS Kali Raci, DPS Kali Welang, DPS Kali Gembong, DPS Kali Petung, DPS Kali Rejoso, and DPS Kali Laweyan which located at the east boundary of Pasuruan.

155. Major rivers from each DPS represents perennial rivers which flow water along the year. During wet season, flow and water volume of the rivers exceed the elevation of embankment, causing flood in the surrounding and downstream areas. Generally, the rivers flow from upstream mountainous area at the south part toward north coast. There are six major rivers in Pasuruan which flow towards Madura Strait, namely Lawean; Rejoso, Gembong, Welang, Masangan, and Kedunglarangan.

156. **Situbondo (East Java).** Sampean River is the main river located in between districts of Bondowoso and Situbondo with a watershed of 1,206 Km2. In addition to Sampeyan River, watershed in Situbondo covers several other rivers: Lobawang, Deluang, Banyuputi, Basiyan, Merabu, and Selowogo.

157. **Karangasem (Bali).** There are two potential rivers in Karangasem which can be utilized to meet water demand: Tukad Unda and Tukad Telaga Waja. There are other rivers which grouped into 3 types of continuity:

(i) perennial streams; generally, flow to south part such as Tukad Janga, Tukad Telagawaja, Tukad Mangereng, Tukad Jinah, Tukad Nyuling, Tukad Kekeruk, Tukad Buhu, and others.
(ii) intermittent streams; found in Villages of Seraya, Seraya Barat, Bugbug, and Perasi.
(iii) ephemeral streams; generally, all rivers in sub-districts of Kubu, some of Abang (Purwakerthi, Labasari), and some in Karangasem (Seraya Timur).

158. **Takalar (South Sulawesi).** Jeneberang River has a watershed (DAS) of 860 km^2. Meanwhile the total area of the river basin is 9,331 km^2 with potential surface water 13,229 million/year and potential groundwater 1,504 million/year. Jeneberang River crosses over Makassar**,** Maros**,** Gowa**,** Takalar**,** Jeneponto**,** Bantaeng**,** Bulukumba**,** Selayar, and Kabupaten Sinjai.

159. One of the major rivers that crosses Takalar is Pappa River. The river flows from east to west and forms watershed (DAS) Pappa. The watershed is mostly used by local people for agriculture/irrigation. During wet season the rivers in the watershed overflow and cause flood.

160. **Pinrang (South Sulawesi).** There are two major rivers in Pinrang; Mamasa River and Saddang River. Mamasa River is a tributary of Saddang River. Mamasa River is used for generating hydropower (PLTA) Bakaru located in Village Ulu Saddang. Meanwhile, Saddang River is used for irrigation in Pinrang and Sidrap.

B. Ecological Resources

1. Flora and Fauna

161. There are no protected areas or habitats of biodiversity value within the project area of influence. The proposed shrimp ponds, broodstock, and laboratories sites are in modified environment and dominated by coastal area with scattered mangrove trees. Similarly, no endemic, rare, threatened or globally endangered species or species of particular conservation value have been reported or observed.

162. There are limited data on the biodiversity. However, data on biodiversity from several locations are available based on data collected from DIKPLHD (information on environmental management performance and environmental status) of each province. Sample inventory of the flora and fauna of one location (Lampung) is presented in **Annex 2**.

163. **Aceh**. Aceh's DIKPLHD (2020) data, especially for endemic, endangered, and protected flora and fauna, recorded mammals of 23 species, 22 species of mammals protected and mostly endangered, and some identified as endemic species, i.e., Sumatran tiger, Sumatran rhino, mountain goat, mouse deer, Sumatran elephant, orangutan, Sumatran skunk, and honey bear. Meanwhile, one species of the mammals is not protected, i.e., long tail monkey.

164. **Lampung**. Based on Long Term Forest Management Plan (RPHJP) of KPH Pesawaran (2015 -2024), 20 types of fauna have been registered while and 21 have not been identified. Lampung DIKPLHD (2020) provided inventory of the flora and fauna in the province, as presented in **Annex 2**.

165. **Banten**. As indicated in Banten's DIKPLHD (2017), there is an inventory of some protected flora and fauna across the province, while the project area is located in the coastal area of Tangerang district (Mauk Shrimp Pond) and Serang district (Laboratory).

166. **Central Java**. Referring to the Profile of Conservation Areas in Central Java (2015), Pulau Panjang (Panjang Island) is one of the conservation areas located in the same sub-district with the proposed project (approximately 1.5 nautical mile).

167. Pulau Panjang has seagrass ecosystem, comprising of 8 types: *Cymodocea rotundata, Cymodocea serrulata, Enhalus acoroides, Halodule uninervis, Halophila ovalis, Syringodium isoetifolium, Thalassia hemprichii,* and *Thalassodendron ciliatum*. Coastal vegetation found in the island include coastal spinach, coastal pandanus, mangrove, and several plantation crops such as coconut, banana, cassava, and others. Mangrove found in the island consist of 3 types: *Heritiera litoralis (Hl), Hibiscus tiliaceus (Hb), Thespia populnea (Tp).*

168. **East Java**. For East Java, there are several fauna in sanctuary area in Pasuruan[20], among others mammal: monkey (*Macaca fascicularis*), wild pig (*Sus scrofa*), tando (*C*ynocephalus variegatus), bat (*Pteropus vampyrus*); aves: sri gunting (*Dicrurus macrocercus*), tekukur (*Spilopelia chinensis*), prenjak gunung (*Prinia atrogularis*), jalak hitam (*Acridotheres cristatellus*), trocokan (*Pycnonotus aurigaster*), raja udang (*Halcyon cloris*), alap-alap (*Elamus hypoleucus*), elang (*Accipiter trivagus*), glatik gunung (*Padda aryzivora*), kacer/kucica kampung (*Copsychus saularis*), branjangan (*Ploceus hypoxanthus*), burung madu (*Aethophaga mystacalis*), sriti (*Collocolia sp*), pentet (*Lanius schach*), gagak (*Corvus enca*) dan emprit (*Lonchura maja*). Among the animals, several are protected including elang (*Accipiter trivagus*), raja udang (*Halcyon cloris*), lutung (*Trachypithecus auratus*), and rusa timor (*Cervus timorensis*).

169. **Bali**. Referring to Bali DIKPLHD (2018), types of flora/vegetation in Bali Province can be classified based on land use such as forest vegetation, coconut plantation cover vegetation, dry land vegetation, yard vegetation, riparian vegetation, vegetation around temple, non-mangrove coastal vegetation, and others.

170. **South Sulawesi**. There are at least 3 types of rich biodiversity ecosystem, namely: (i) Upland-Mountain Ecosystem Type, (ii) Low land – Hinterland Ecosystem Type, and (iii) Coastal and Marine Ecosystem Type. In the first two ecosystem types found at least 64 species of protected fauna and 149 species of protected flora, have been identified respectively in the first two ecosystems.

2. Protected and Conservation Areas

171. There are no subprojects located in protected areas or critical habitats. However, some are located near to mangrove forest within the range allowed by regulation (greater than minimum requirement of 100 m from the high tide). In addition to mangrove, other protected areas have been identified as presented in Table 31. The table provides the nature and value, level of protection, boundary and scope, protection requirement and government body in charge, and their relative distance to the project. Only those within 5 km range which may be considered, while the areas beyond the project area of influence are presented as reference.

[20] Environmental Status of Kabupaten Pasuruan 2007.

Table 31: List of Relevant Protected Areas in the Project Area

Location	Name	Protection targets	Size (ha)	Distance (km)
Sumatra Island				
Northern Sumatra: Aceh (Aceh Besar)	Lhoknga Marine Tourism Park	Marine habitats protection area	14	5
	Wildlife Sanctuary Area of Pinus Jantho	The sanctuary area covers: ➢ Natural Tourism Park (TWA) covering Pinus Aceh (2,556 Ha), and Kuta Malaka (1,544 ha). ➢ Grand Forest Park of Pocut Meurah Intan in Seulawah Valley (6,122 ha) where Elephant Conservation Center (2 ha) located. ➢ Cultural heritage and scientific sanctuary area covering relic of Aceh Sultanate in Mesjid Raya in form of Indrapatra Fort (3.09 ha).	15,281	63
	Kebun Plasma Nutfah (KPN) Leupung	Protected forest assigned for genetic protection	695	34
Southern Sumatra: Lampung (Pesawaran)	Bukit Barisan National Park	Bukit Barisan Selatan National Park is a national park in Sumatra, Indonesia. The park located along the Bukit Barisan mountain range, has a total area of 3,568 km^2, and spans three provinces: Lampung, Bengkulu, and South Sumatra.	3,568 km^2	2 (to outer boundary)
	Natural preservation area	Covering grand forest park located in sub-districts of Gedong Tataan, Kedondong, Way Lima, Teluk Pandan, Way Ratai, and Padang Cermin	21,563	14
	Conservation of coastal area and isles	Located in Pulau Tegal of Teluk Pandan sub-district (hamlets/villages of Suak Panjang and Dusun Pahawang Lunik), and Pulau Pahawang of Marga Punduh district, hamlets/village of Suka Panjang and Pulau Siuncal of Punduh Pedada sub-district	700	4.5
Java Island				
Western Java: Banten (Serang and Tangerang)	**Natural sanctuary area**	a. Natural sanctuary of Rawa Danau in sub-districts of Padarincang, Mancak, and Gunung Sari; and b. Natural sanctuary of Mt. Tukung Gede in sub-districts Anyar, Cinangka, and Mancak	5,063	22 19
	Natural preservation area	a. Natural Tourism Park in Pulau Sangiang of Anyar sub-district covering 559 ha; and b. Natural Marine Tourism Park in Pulau Sangiang of Anyar sub-district	1,175	32 32

Location	Name	Protection targets	Size (ha)	Distance (km)
		covering 616 ha.		
	Coastal and isles conservation area	a. Pulau Tunda and its marine area in Kecamatan Tirtayasa; and b. Pulau Pemujan Besar and its marine area in Kecamatan Pontang		69
Central Java: Jepara,	Karimunjawa National Marine Park	Coral reef, seagrass, mangrove forest, and terrestrial ecosystem of tropical forest and coastal forest	111,625	55
	biodiversity spots	Seagrass ecosystem in Jepara district covers approximately, in six sub-districts (including Kecamatan Jepara)	155	1
	Coral reef area	Coral reef area in Jepara covers seven sub-districts (including Kecamatan Jepara)	32,541	1
	Protected Mt. Muria	Mt. Muria has elevation of 1602 m above mean sea level, consisting of protected forest and coffee plants. Total area of Mt. Muria covering 69,812.08 ha, comprising of districts of Jepara 20,096.51 ha, Pati 47,338 ha, and Kudus 2,377.57 ha, respectively	69,812	21
East Java: Situbondo and Pasuruan,	Natural sanctuary of Gunung Abang	located in Village Kedungpengaron (Kejayan sub-district), and Village Sapulante (Pasrepan sub-district). As natural sanctuary for various reptiles and endemic flora.	50	113
	Mt. Arjuna	The wilderness park of Raden Soerjo located in the complex of Arjuno-Welirang-Anjasmoro mountains, covering 27,868.30 Ha, consisting of protected forest 22,908.3 Ha, and natural sanctuary of Arjuno-Lalijiwo (PHPA) 4,960 ha.	27,868	28
	Bromo Tengger Semeru National Park	Highland ecosystem, and indigenous people (Tengger tribe)	4,642	23
	Baluran National Park	Savanna, lowland forests, mangrove forests, and hills	25,000	58
	Yang Highland Wild Sanctuary	Wildlife sanctuary of Yang Highland represents one of natural conservation in East Java with various ecosystem	14,177	20
Bali Island				
Karangasem	Forest area in Mt. Agung	Located in sub-districts of Rendang (4,717.5 ha), Selat (970.78 ha), Kubu (5,093.66 ha), Abang (236.39 ha), and Bebandem (1,257.19 ha)	12,275	8
	Batur Lake	Located in Kitamani (Bangli District), represent the largest lake in Bali. The lake covers a) aquatic area of 1,667 ha and specific areas around the lake to preserve	1,667	13

Location	Name	Protection targets	Size (ha)	Distance (km)
		the lake ecosystem of 102 ha		
Sulawesi Island				
South Sulawesi (Takalar and Pinrang)	Mt. Latimojong	Latimojong Mountain located at 03°08'07"-03°45'49" South Latitude and 119°53'31"-120°17'50" East Meridien with specific ecosystem. The mountain spread over from north to south in administrative area of Enrekang, South Sulawesi	100,000	13
	Bantimurung National Park	This national park is also known as *The Kingdom of Butterfly* and *The Spectacular Tower Karst*. At the area there has been identified 240 types of *Papilionoidea* (butterflies), classified into 5 families (111 *Nymphalidae*, 25 *Papilionidae*, 28 *Pieridae*, 74 *Lycanidae* and 2 *Riodinidae*.	22,800	47
	Protected forest area	Located in Pinrang which assigned in some of sub-districts of Patampanua, Duampanua, Batulappa, and Lembang.	45,168	60

ha = hectare, m^2= square meter, km = kilometer.
Source: Various sources of literature (including District Spatial Plan and Local Government/Government Regulations)

172. From the table, only subprojects in Aceh and Central Java, are located nearby the protected areas within 5 km radius. The others are located far away from the subproject locations.

173. **Aceh Besar (NAD).** Coastal line of Aceh Besar is 292.16 km long. There are marine protection area, i.e., Lhoknga Marine Tourism Park covering 14.06 ha. There are mangrove areas in the sub-district of Lembah Seulawah, Baitussalam, Mesjid Raya, Peukan Bada, Pulo Aceh, Lhoknga, Leupung and Lhoong with a total area of 253 ha. Small islands in Aceh Besar with potential for sea aquaculture are:

(i) Pulau Breuh (Kec. Pulo Aceh);
(ii) Pulau Nasi (Kec. Pulo Aceh);
(iii) Pulau Teunom (Kec. Pulo Aceh);
(iv) Pulau Bunta (Kec. Peukan Bada).

174. Wildlife Sanctuary Area of Pinus Jantho covers 15,281.37 Ha consisting of:

(i) Natural Tourism Park (TWA) covering Pinus Aceh (2,556.02 ha), and Kuta Malaka (1,544.08 ha).
(ii) Grand Forest Park of Pocut Meurah Intan in Seulawah Valley (6,122.85 ha) where Elephant Conservation Center (2 ha) located.
(iii) Cultural heritage and scientific sanctuary area covering relic of Aceh Sultanate in Mesjid Raya in form of Indrapatra Fort (3.09 ha).

175. Protected forest assigned for genetic protection in form of *Kebun Plasma Nutfah* (KPN) Leupung covers 694.54 ha. The coral reef area covers approximately 1,120 ha which spread over all marine areas in Aceh Besar.

176. The laboratory and broodstock (BPBAP Ujung Batee) are located at Baro Village, a narrow coastal area. The site is surrounded by a thin green belt of mangrove. Relative distance to the commercial centers and settlements is quite far, in range 600 – 1000 m. There are no protected areas nearby.

177. **Pesawaran (Lampung).** Natural preservation area covers the grand forest park of approximately 21,563 ha located in sub-districts of Gedong Tataan, Kedondong, Way Lima, Teluk Pandan, Way Ratai, and Padang Cermin. Mangrove ecosystem area in Pesawaran covers approximately 703 ha in four subdistricts, including Teluk Pandan.

178. Conservation of coastal area and isles covers an area of approximately 700 ha located in Pulau Tegal of Teluk Pandan (*Dusun* (hamlet) Suak Panjang and Pahawang Lunik), and Village of Pulau Pahawang of Marga Punduh sub-district (Dusun Suka Panjang), and Pulau Siuncal of Punduh Pedada sub-district.

179. The laboratory (BBPBL Lampung) is located at Hanura (Teluk Pandan), a coastal area with relative distance of approximately 2 km from the nearest part of Bukit Barisan National Park. The site is far from the nearby marine tourism destination along the coastal area of Pesawaran. The site is surrounded by thick green belt of mangrove. The laboratory is far from the settlements and public areas.

180. **Serang (Banten).** Protected areas in Serang spread over several sub-districts, covering riparian zone and coastal zone. The protected areas are located in South and North Serang, i.e., Ciomas, Padarincang, Mancak and Kramatwatu, while in north part protected areas are in sub-districts of Bojonegara and Puloampel. The protected forest in these areas decreased by 4,361.79 ha, from 17,906.61 ha to 13,544.82 ha.

181. Conservation area in Serang covers an area of approximately 6,238 ha consisting of:

(i) **Natural sanctuary area** of approximately 5,063 ha covering:
   a. Natural sanctuary of Rawa Danau in sub-districts of Padarincang, Mancak and Gunung Sari; and
   b. Natural sanctuary of Mt. Tukung Gede in sub-districts of Anyar, Cinangka, and Mancak.

(ii) **Natural preservation area** of approximately 1,175 ha consisting of:
   a. Natural Tourism Park in Pulau Sangiang of Anyar covering 559 ha; and
   b. Natural Marine Tourism Park in Pulau Sangiang of Anyar covering 616 ha.

(iii) **Coastal and isles conservation area** covering:
   a. Pulau Tunda and its marine area in Tirtayasa sub-district; and
   b. Pulau Pemujan Besar and its marine area in Pontang sub-district.

182. The laboratory (BPKIL Serang) is located at Umbul Tanjung, a non-conservation coastal area approximately 150 m from the highest tide line. The area is mostly used for tourism, agriculture, and other economic activities. The laboratory is far from settlement (more than 1 km away) and surrounded by a green belt of coconut trees, mango, and *phitaya* (dragon fruit). In addition to landscape and green belt, the cultivated plants are also intended as barrier to coastal flood and tsunami.

183. **Jepara (Central Java).** Government has assigned 22 small islands (isles) in the Karimunjawa National Marine Park of 111,625 ha. Natural resources available in the isles consist of marine ecosystem include coral reef, seagrass, mangrove forest, and terrestrial ecosystem in form of low land tropical forest and coastal forest. Most activities carried out by

people in the isles are traditional, with some activities impacting on natural resources such coral mining, fishing catch using cyanide and explosives, and clearing of mangrove forest for ponds.

184. In addition to Karimunjawa, marine areas, Jepara also has some biodiversity spots. Seagrass ecosystem in Jepara district covers approximately 155.5 ha, in six sub-districts (including Jepara sub-district). Coral reef area in Jepara covers approximately 32,541.74 ha, in seven sub-districts (including Jepara sub-district). The shrimp ponds and laboratory (BBPBAP Jepara) is located at Bulu Village, a coastal area with a densely populated settlement. There is thin strip of green belt along the built-up areas. The relative distance of the site to the outer boundary of protected areas of Mt. Muria is approximately 21 km.

185. **Pasuruan (East Java).** Pasuruan has marine and coastal areas stretching for ± 48 Km long from Nguling to Bangil with marine exploitation area covering 112.5 nautical square miles with a potential maximum sustainable yield (MSY) of ± 27,000 tons per year. Most of the marine areas have been utilized to the limits, especially in districts of Nguling, Lekok, and Kraton. Coastal area with mangrove forest is planned along the north coast of Pasuruan which spreads over several sub-districts, including Kraton sub-district.

186. Aquaculture is generally found along the north coast of Pasuruan, i.e., sub-districts of Bangil, Kraton, Rejoso, Lekok, and Nguling. The proposed subproject is located in the coastal area (i.e., Kraton), which cover 78.24 ha.

187. **Situbondo (East Java).** The shrimp ponds (BPBAP Situbondo) is located at Pulokerto Village (Kraton), a coastal area with densely populated mangrove forest. There are no settlements nearby, and the ponds form an extensive cluster.

188. Several protected areas identified in Situbondo, far from the project location (Kraton). The relative distance to the outer boundary of Mt. Arjuna is approximately 28 km and approximately 23 km to Bromo Tengger National Park. The protected areas as well as conservation areas already set forth in the RTRW, are as follows:

(i) **Natural sanctuary of Gunung Abang** located in Village Kedungpengaron, Kejayan sub-district and Village Sapulante, Pasrepan sub-district. The areas assigned as protected area based on the Decree of Minister of Agriculture No. 458/Kpts/Um/7/1978 dated 24 July 1978, i.e., as natural sanctuary for various reptiles and endemic flora covering with total 50.4 Ha area.

(ii) **Bromo Tengger Semeru National Park (TN-BTS)** which some parts are in Pasuruan covering approximately 4,642.52 ha, is located in sub-districts of Tutur (800.77 ha), Puspo (673.05 ha); Tosari (2,492.26 ha), and Lumbang (676.45 ha). The national park is based on Decree of Minister of Forestry No. 178/Menhut-II/2005;

(iii) **Grand Forest Park of R. Soerjo** in sub-districts of Purwodadi, Prigen, and Purwosari covering approximately 4,663.60 ha based on Decree of Minister of Forestry No. 80/KPTS-II/2001.

(iv) **Natural Tourism Park (*Taman Wisata Alam* – TWA) Tretes** of Mt. Arjuna in Prigen covering approximately 10 ha and represent TWA under management of East Java BKSDA (Board for Natural Resources Conservation).

189. Coastal areas of Situbondo have coral reef and mangrove forest which can support sea fishery. The coral reef in Situbondo found in almost all marine areas of the district for 4 mile long with 4.7 Km^2 area in sub-districts of Arjasa and Panarukan. The type of mangrove found in Situbondo are *Tinjang* and *api-api* (aviciennia). Coastal area with mangrove forest in Situbondo

located along coast of several subdistricts (including Panarukan) with total area of 229 Ha assigned as protected mangrove forest.

190. There is a protected area in the form of natural sanctuary in Situbondo, i.e., Baluran National Park located at the east end of Situbondo between Madura Strait and Bali Strait. In addition, Baluran National Park also represents natural preservation area in form of natural tourism park.

191. The Laboratory (BPBAP Situbondo) located at Pecaron Village, a narrow coastal area with relative distance approximately 400 m to Pecaron Hill (Moslem's pilgrim destination). A quite dense settlements is identified around the site in the range of 50 – 100 m. The ponds/laboratory and settlement are separated with a road and thick green belt. The relative distance to the outer boundary of Baluran National Park is approximately 58 km and approximately 20 km to Yang Highland Wild Sanctuary.

192. **Karangasem (Bali).** Protected areas in Karangasem covers 13,658.37 ha, consisting of:

(i) Forest area in Mt. Abang Agung with total area 12,275.53 ha with details in sub-districts of Rendang (4,717.5 ha), Selat (970.78 ha), Kubu (5,093.66 ha), Abang (236.39 ha), and Bebandem (1,257.19 ha).
(ii) Forest area located in Seraya Forest with total area 1,105.06 ha, covering sub-districts of Abang (622.60 ha) and Karangasem (513,17 ha).
(iii) Forest area located in Bunutan with total area 127.49 ha in Abang sub-district.
(iv) Forest area located in Bukit Gumang with total area 30.81 ha in Karangasem sub-district.
(v) Forest area in Bukit Pawon with total area 39.80 ha in Bebandem sub-district
(vi) Forest area located in Kondangdia with total area 79.69 ha in Abang sub-district.

193. The laboratory and broodstock center (BPIU2K Karangasem) are located at Bugbug Village 8 km form protected Mt. Agung and 13 km to Batur Lake. The site located at a narrow coastal area. The site surrounded by wide green belt. Relative distance to the randomly dispersed settlements is in range of 50 – 100 m.

194. **Takalar (South Sulawesi).** The laboratory and broodstock center (BPBAP Takalar) are located at Boddia Village (Galesong), a narrow coastal area. Relative distance to the randomly dispersed settlements is in range 50 – 100 m and separated with road and thin green belt. The relative distance to the outer boundary of Bantimurung National Park is about 47 km.

195. Referring to RTRW, the areas in Takalar are allocated for brackish aquaculture, marine aquaculture, and freshwater aquaculture covering 4,914 ha consisting of:

(i) Marine aquaculture for seaweeds assigned in some part of sub-district of Mangarabombang, Mappakasunggu, Sanrobone, and Galesong Selatan.
(ii) Brackishwater aquaculture for shrimp and milkfish assigned in some part of sub-district of Mangarabombang, Mappakasunggu, Sanrobone, Galesong Selatan, Galesong, and Galesong Utara; and
(iii) Freshwater aquaculture assigned in some part of sub-district of Mappakasunggu, Sanrobone, Galesong Selatan, Polombangkeng Selatan, Polombangkeng Utara, and Mangarabombang.

196. **Pinrang (South Sulawesi).** Protected forest area in Pinrang covers 45,168 ha, in sub-districts of Patampanua, Duampanua, Batulappa, and Lembang.

197. Conservation and protection area for coastal ecosystem is in the form of mangrove

forest in sub-districts of Suppa, Lanrisang, Mattiro Sompe, Cempa, Duampanua, and Lembang.

198. Conservation area for marine in form of coral reef conservation is in sub-districts of Suppa, Lanrisang, Mattiro Sompe, Cempa, Duampanua, and Lembang. Ko'mara Fauna Sanctuary is located in Polombangkeng Utara with a total area of approximately 2,251 ha; and mangrove forest in Mangarabombang with a total area of approximately 6 ha.

199. Conservation of coastal areas and small islands are identified in several parts:
- (i) Conservation area of small islands covering Pulau Tanakeke in Mappakasunggu and Pulau Sanrobenge in Galesong;
- (ii) Conservation and protection area for coastal ecosystem in form of mangrove forest in some parts of Mangarabombang;
- (iii) Conservation and protection area for coastal ecosystem in form of coral reef protection in coastal area of Mappakasunggu and Mangarabombang; and
- (iv) Maritime conservation area in form of fishermen settlement in Galesong, Galesong sub-district.

200. The shrimp ponds (BPBAP Takalar) are located in Datae Village (Duampanua), a narrow coastal area with relative distance approximately 100 m from the coastal line. Small settlements are identified 50 – 100 m from the other side of pond's cluster. The ponds and settlement are separated with road and thin green belt. The relative distance to the outer boundary of Mt. Latimojong is approximately 13 km.

201. **Natural disaster.** Natural disasters risks in the project areas are similar. The locations are subject to natural disasters, among others:
- (i) flood: Aceh Besar, Pesawaran, Jepara, Pasuruan, Situbondo, Takalar, and Pinrang
- (ii) coastal flood/tidal wave: Jepara, Situbondo, Pinrang
- (iii) tsunami: Aceh Besar, Pesawaran, Pinrang
- (iv) abrasion: Jepara, Takalar, Pinrang
- (v) landslide: Aceh Besar, Pesawaran, Pinrang
- (vi) land movement: Karangasem,
- (vii) earthquake: Aceh Besar,
- (viii) volcano eruption: Karangasem, Pinrang

202. **Land use planning.** Regional Spatial Plan (RTRW) of the districts refers to National Spatial Plan, Island Spatial Plan, National Strategic Areas Spatial Plan, Provincial Spatial Plan, and Provincial Strategic Area Spatial Plan. They differentiate protected and cultivated areas. In addition to terrestrial space and air space, in the districts there are also water space (sea) along the coastal areas. This resource represents one of the potential resources for fishery, agribusiness, and tourism.

203. Through local regulations (Perda) each district has issued the RTRW, containing details of the spatial plans and coastal zoning plans. All of the proposed project locations shall comply with the RTRW. Furthermore, the proposed sites also shall comply with MOEF's PIPPIB maps to avoid protected forests and peatland.

C. Environmental Status and Current Management

1. Surface and Groundwater Quality

(a) Overall Water Quality Data

204. The land-based shrimp ponds under the project use brackish water for shrimp production. Brackish surface water from coastal rivers (or canals) is also used for the production. Each cluster consist of several ponds with at least two water reservoirs (*tandon*) to supply the ponds with clean water (screened, disinfected, and filtered water) and clean water before release. Seawater and brackish water are the largest component of water used for the operation of shrimp ponds and broodstock.

205. Referring to the Baseline Survey in Sumatra (Lampung), Java (East Java), and Sulawesi (South Sulawesi) in December 2021, majority of respondent (63%) use river water during high tide to be distributed to the shrimp ponds while some respondent (29%) distributed sea water directly to the shrimp ponds. Only 8% of the respondents use bore holes as water source for their shrimp pond.

206. Based on 2020 monitoring, MOEF (Directorate of Control for Sea Pollution and Destruction) released water quality index of Indonesia seas. The result showed that the sea water quality is still in moderate and good condition. Only a few areas do not meet the required standard (as shown in Figure 7:).

207. Secondary data on water quality and pollutions, including academic research have been analyzed such as the research by Abdul Muqsith was carried in 2014 for the Situbondo District. The research site is the same coastal line and ecosystem as the subproject location in Situbondo. The research data can largely represent the current baseline water quality in the subproject area in East Java. The research covering measurement of water quality in ponds, river and coast and relatively complete parameters tested.

208. Based on this research, [21] seawater water quality at Situbondo district (East Java), in Table 32 below) has exceeded the water quality standard due to aquaculture activities. The concentration of TSS at the coastal water (average 132. 60 ± 58.3 ppm) has exceeded the threshold of quality standard of seawater (for marine biotic), i.e., 80 ppm. The analysis also show that COD concentration at the coastal water (average 85.69 ± 25.80 ppm) also exceeded the quality standard of seawater for marine biotic. The research concluded that agricultural and domestic activities contribute to the high concentration of COD in the seawater.

[21] Muqsith A. 2014. Dampak Kegiatan Tambak Udang Intensif Terhadap Kualitas Fisik-Kimia Perairan Banyuputih Kabupaten Situbondo. *JSAPI*. 5 (1): 1-6. Journal Homepage: http://samakia.aperiki.ac.id.

Figure 7: Seawater Quality Index in Coastal Areas of Indonesia

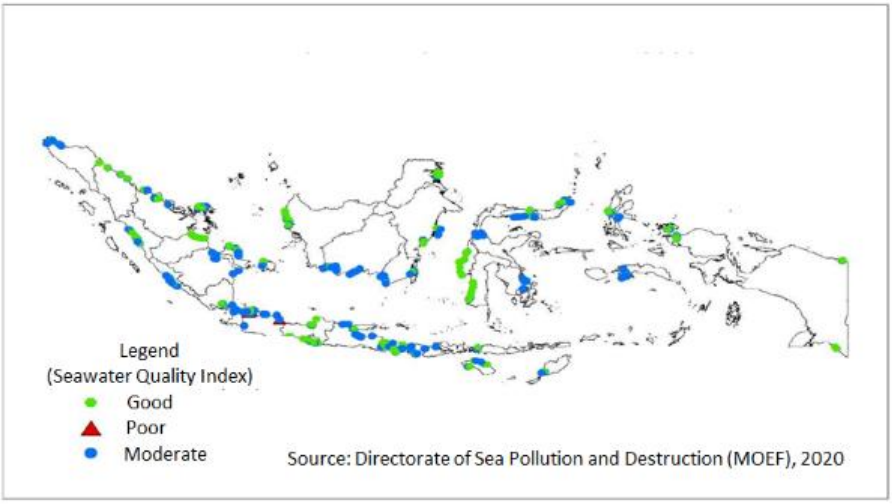


Table 32: Water Quality Measurement of Ponds, River and Sea in the Coastal Area of Banyuputih District (Situbondo)

Parameter	Measurement			Water discharge Standards			Remarks
	Ponds	River	Coast	Ponds (1)	River (2)	Seawater (3)	
Temperature (^{0}C)	29.90	29.60	29.80	21-31	Dev. 3	Natural	
Salinity (‰	27.92	18.11	31.60	5-35	-	Natural	
pH	7.97	7.65	7.98	6.5-8.5	6 – 9	7 – 8.5	
Turbidity (NTU)	57.30	25.32	24.41	≤30	-	< 5	Exceeds standard
TSS (ppm)*	235.60	240.50	132.60	25-80	400	20 – 80	
DO (ppm)	5.59	4.95	6.12	≥3 or 4	3	> 5	
BOD (ppm)	7.53	6.72	6.53	<25	6	20	
COD (ppm)*	81.72	86.39	85.69	40-80	50	-	Exceeds standard
NH_3 (ppm)	0.596	0.145	0.137	≤1			
NO_3 (ppm)	0.116	0.042	0.052	-			
NO_2 (ppm)	0.226	0.099	0.094	0.25			
PO_4 (ppm)	0.009	0.088	0.098	0.05-0.50			

Notes:
(1) Research (Abdul Muqsithwas, 2014).
(2) Government Regulation No. 22/2021 on Management of Water Quality (Class III).
(3) Regulation of Ministry of Environment No. 51/2004 (Seawater Quality Standard for Marine Biotic) – obsolete as the issuance of GR No. 22/2021.
Source: Research (Abdul Muqsithwas, 2014).

209. Another research for seawater quality in Kartini Beach (Jepara, Central Java)[22] carried out in April 2015 which results showed that transparency 1- 3.1m; turbidity 1.2-14.3 NTU; temperature 30 ^{o}C; TSS 18-30 mg/l; DO 4.1-6.22 mg/l; BOD5 6.08-15.71 mg/l; pH 7.9; salinity 34.8-35.3%; detergent 0.01-1,2 mg/l; MBAS, oil and grease 0.1-1.3 mg/l; Pb 0,004-0,0089 mg/l; Hg 0.0006-0.0015 mg/l; and Cd 0.0006-0.0013 mg/l.

210. The research in Takalar (South Sulawesi)[23] carried out in 2016, analyzed data on condition of ambient water around the shrimp ponds including physical and chemical parameters covering temperature, transparency, DO, pH, phosphate, ammonia, nitrite, nitrate, TSS and BOT. Results of the research show that temperature in range 26.5°C–27.3°C, transparency 1-3.2 m, salinity 35.28-35.52 o/oo, pH 8.09–8.26, dissolved oxygen 13.83–16.45 mg/L, nitrate 0.101–0.2387 mg/L, nitrite 0.0025-0.0256 mg/L, TSS 2-76 mg/L, phosphate 0.00–0.1578 mg/L, ammonia 0.0237–0.1349 mg/L, and Total Organic Material 28.67–56 mg/L. Based on water quality standard (KepMen LH No. 51/2004) for marine biotic, the condition of the receiving water is still in good condition.

211. Given that the completeness, coverage and updating of the secondary data by region varies, firsthand baseline data sampling and testing were conducted during the IEE process. Validity of the data and its compliance with national regulation has been reviewed. Some primary data from each Balai/UPT is also presented. The data related to ambient water quality by region are presented in the following paragraphs.

[22] http://perpustakaan.kkp.go.id/knowledgerepository/index.php?p=show_detail&id=1064358.
[23] http://ejournal-balitbang.kkp.go.id/index.php/fita/article/view/1789.

(b) Surface and Groundwater Quality by Region

212. **Aceh (Aceh Besar)**. Based on Information on Local Environmental Performance of Aceh Province (DIKPLHD, 2020), there has been water quality monitoring in several locations in Aceh Besar. The data show that water quality in the areas still meet the quality standard (Ref. Government Regulation No. 82/2001). The measurement result of (river) water quality is presented in Table 33, while measurement for seawater quality is presented in Table 34.

Table 33: Measurement of River Water Quality in Aceh (2020)
(All units in mg/L, except expressed otherwise)

No	River	Location	Temperature (ºC)	pH	DHL (µS/cm)	TDS	TSS	DO	BOD	Detergent	Fecal Coliform (number / 100 ml)	Total coliform (number / 100ml)	Cyanide	H2S
	Standards (GR No. 82/2001)		**Dev. 3**	**6 – 9**	**-**	**-**	**-**	**4**	**3**	**200**	**1000**	**5000**	**0.02**	**0.002**
1	Krueng Aceh (Semester I)	Banda Aceh dan Aceh Besar	27.0	7.43	190.6	175.0	17	6.21	2.09	78.34	683	1095	0.0198	<0,001
			28.2	7.56	236.0	217.8	29	5.90	2.95	86.93	1018	1453	0.0297	<0,001
			28.8	7.25	245.9	226.5	25	5.29	2.56	129.84	882	1382	0.0221	<0,001
			28.4	7.20	302.0	278.1	25	4.35	2.17	78.34	884	1257	0.0192	<0,001
			28.7	7.11	6110	5641	44	4.02	3.22	121.26	1047	2894	0.0204	<0,001
2	Krueng Aceh (Semester II)	Banda Aceh dan Aceh Besar	28.0	7.74	160.7	80.56	20	5.12	2.67	35.43	546	1570	<0.002	<0,01
			29.0	7.50	189.8	95.42	31	5.61	2.75	52.60	718	2300	0.003	<0,01
			31.5	7.70	183.9	92.92	26	4.77	2.40	69.76	653	1858	<0.002	<0,01
			30.8	7.55	195.7	98.64	25	4.75	2.17	61.18	707	1913	0.004	<0,01
			30.7	7.47	207.6	103.93	45	4.26	2.05	69.76	1022	2508	0.003	<0,01

Table 33 (continued)

	River	Location	COD	NO2	NO3	NH3	Free Chlorine	T-P	Phenol	Oil and Grease	Deterge	Fecal coliform	Total coliform	Cyanide	H2S
	Standards (GR No. 82/2001)		**25**	**0.06**	**10**	**-**	**0.03**	**0.2**	**1**	**1000**	**200**	**1000**	**5000**	**0.02**	**0.002**
1	Krueng Aceh (Semester I)	Banda Aceh dan Aceh Besar	25.66	<0.03	4.34	0.06	0.02	0.30	<1	428.8	78.34	683	1095	0.0198	<0,001
			21.82	<0.03	4.11	0.05	0.01	0.34	<1	437.6	86.93	1018	1453	0.0297	<0,001
			24.38	<0.03	4.15	0.08	0.02	0.38	<1	422.8	129.84	882	1382	0.0221	<0,001
			20.53	<0.03	4.41	0.13	0.04	0.38	<1	431.2	78.34	884	1257	0.0192	<0,001
			6.42	<0.03	4.83	0.04	0.03	0.46	<1	426.4	121.26	1047	2894	0.0204	<0,001
2	Krueng Aceh (Semester II)	Banda Aceh dan Aceh Besar	35.93	<0,03	3.57	0.12	0.05	0.14	<1	410.4	35.43	546	1570	<0.002	<0,01
			16.68	<0,03	4.01	0.17	0.03	0.12	<1	412.8	52.60	718	2300	0.003	<0,01
			30.79	<0,03	4.00	0.14	0.02	0.17	<1	411.6	69.76	653	1858	<0.002	<0,01
			35.93	<0,03	3.95	0.12	0.02	0.20	<1	417.2	61.18	707	1913	0.004	<0,01
			19.25	0.03	4.52	0.13	0.04	0.14	<1	420.0	69.76	1022	2508	0.003	<0,01

Source: Information on Local Environmental Performance of Aceh Province (DIKPLHD, 2020)

213. The results in above table show that water quality of the river is below the threshold

values, except for certain parameter such as COD (in several sampling points), free chlorine (in few sampling points), and total phosphate.

Table 34: Measurement of Seawater Quality in Aceh (2020)

(All units in mg/L, except expressed otherwise)

No	Category	Sampling Points	Smell	Transparency (M)	Turbidity (NTU)	TSS	Solid Waste	Oil Layer	Temperature (^{O}C)	pH	Salinity (‰)	DO
	Standard (*Regulation of Minister of Environment No. 51/2004 (Appendix III)*)		**Natural**	**3 – 5**	**< 5**	**20 – 80**	**None**	**None**	**28 – 32**	**7 – 8.5**	**33 – 34**	**> 5**
1	Marine Biotic	Lambadeuk, Aceh Besar	No smell	5.4	2.41	42.5	None	None	30.1	7.6	25.9	4.5
2	Marine Biotic	Lampageu Aceh Besar	No Smell	7.5	2.35	43.9	None	None	29.7	7.5	23.9	4.9

Note: (1) Regulation of Minister of Environment No. 51/2004 (Appendix III)

Table 34 (continued)

No	Category	Sampling Points	BOD_5	Total Ammonia	NO_2-N	NO_3-N	PO_4-P	Cyanide (CN^-)	Sulfide (H_2S)	Chlor	Oil and Grease	Phenol	Pesticide	PCB
	Standard (*Regulation of Minister of Environment No. 51/2004 (Appendix III)*)		**20**	**0.3**	**-**	**0.06**	**0.015**	**0.5**	**0.01**	**-**	**-**	**0.002**	**0.01**	**0.01**
1	Marine Biotic	Lambadeuk, Aceh Besar	2.61	<0.016	-	0.005	2.26	<0.005	<0.0022	-	-	<0,0002	<0,005	<0,005
2	Marine Biotic	Lampageu Aceh Besar	2.46	<0.016	-	0.372	0.04	<0.005	<0.0022	-	-	<0,0002	<0,005	<0,005

Source: Information on Local Environmental Performance of Aceh Province (DIKPLHD, 2020)

214. The results in above table show that three parameters (i.e., transparency, DO, and phosphate) exceeded or do not meet the quality standard.

215. **Lampung (Pesawaran)**. Based on Lampung's Environmental Performance Status Document (DIKPLHD, 2020), water quality in several rivers measured, indicating that surface water (river) quality in Lampung (including Pesawaran) is in good condition. Based on measurement at 28 sampling points, water quality index of rivers recorded 10.71% for rivers with good condition, 17.86% for rivers with moderate condition, and 71.43% for rivers with quite good condition.

216. Accordingly, seawater quality index (IKAL) in Lampung was recorded as 59.07 (medium/moderate). This value was calculated from average of 10 (ten) monitoring points conducted in November 2020. Laboratory measurement of seawater quality in several districts in Lampung is presented in Table 35. One of the locations (i.e., Mutun Beach) is located at nearby sea (approximately 2 km) with one of proposed subproject (BBPBL Lampung).

Table 35: Seawater Measurement in Lampung

No	Sampling Points	Parameters (in mg/l)				
		TSS	DO	$N\text{-}NH_3$	PO_4 -P	Oil & Grease
1	Mutun Beach	2	6.72	0.80	0.57	0.26
2	Fish Auction Market	4	6.52	0.53	0.98	0.80
3	Pasaran Island	5	6.72	0.53	0.90	0.60
4	Auction Warehouse	2	6.32	2.87	0.78	0.70
5	Sukaraja	6	6.51	2.81	1.50	0.60
6	Panjang Port	2	5.90	0.88	0.55	0.60
7	Srengsem (Hanjung)	58(?)	6.92	0.07	1.35	0.30
8	Bukit Asam	1	6.52	0.01	0.47	0.40
9	PT SIP	2	6.51	0.24	2.62	0.80
10	Concong Island	1	6.92	0.01	0.98	1.50

Source: Lampung's Environmental Performance Status Document (DIKPLHD, 2020)

217. **Banten (Serang)**. Based on Banten's Environmental Status Data (2016), water quality in several districts measured, indicating that surface water (river) quality in still in good condition, focusing on Ciujung River. Detail of the measurement is presented in Table 36. The results in above table show that parameters of Chromium hexavalent (Cr+VI) and BOD exceeded the quality standard.

Table 36: River Water Quality Measurement in Serang (Banten)
(All units in mg/L, except expressed otherwise)

No	Parameter	Sampling Points						Standard (1)
		Upstream Cisalaraja	Ciberang	Jembatan baru	Kragilan	Jongjin	Pamarayan	
A.	Physical Parameters							
1	Temperature (°C)	31	31	32	31	31	29	Dev. 3
2	Total Dissolved Solid (TDS)	88	80	79	80	81	78	1000
3	Total Suspended Solid (TSS)	29	25	34	24	20	25	50
B	Chemical Parameters							
1	pH	8	8	8	7	7	7	6 – 9
2	Dissolved Oxygen (DO)	4	4	4	4	3,4	2,7	4
3	Phenolic substance	<0,001	<0,001	<0,001	<0,001	<0,001	<0,001	1
4	Cadmium	<0,002	<0,002	<0,002	<0,002	<0,002	<0,002	0.01
5	Chromium hexavalent (Cr I+V)	<0,01	<0,01	<0,01	<0,01	<0,01	<0,01	0.05
6	Oil and grease	<0,2	<0,2	<0,2	<0,2	<0,2	<0,2	1000
7	Nitrate (NO_3-N)	0,2	0,2	0,2	0,1	<0,1	0,2	10
8	Nitrite (NO_2-N)	<0,002	<0,002	<0,002	<0,002	<0,002	<0,002	0.06
9	Zinc (Zn)	<0,008	<0,008	<0,008	<0,008	<0,008	<0,008	0.05
10	Anionic Surfactant (MBAS)	0,03	0,02	0,02	0,02	0,02	0,02	200
11	Lead (Pb)	<0,004	<0,004	<0,004	<0,004	<0,004	<0,004	0.03
12	BOD_5	7	7	6	7	10	13	3
13	COD **)	28	29	25	30	41	54	25
14	Sulphate (SO_4) **)	0,04	0,03	0,04	0,04	0,04	0,05	-
15	Total Ammonia Total (NH_3-N)	5	5	5	5	6	6	-

16	Total Chromium (Cr)	<0,003	<0,003	<0,003	<0,003	<0,003	<0,003	-
17	Phosphorus (P)	0,1	0,01	0,03	0,01	0,03	0,02	-
C.	**Microbiology**							
1	E. Coliform (MPN/ 100 ml)	1.500	2.100	1.500	1.200	2.100	1.500	1000
2	Total coliform (MPN/ 100 ml)	750	930	750	750	930	750	5000

Note: (1) Government Regulation No. 82/2001
Source: Banten's Environmental Status Data (2016).

218. To complement the available secondary and primary data, a laboratory testing was carried at the project site of BPKIL Serang (Banten). The laboratory sampling and testing to measure surface water, groundwater and seawater quality was carried out in April 2022. The result is summarized in Table 37 and Table 38 respectively, while complete measurement sheets presented in **Annex 3.**

Table 37: Groundwater Quality Testing Serang, Banten)
(All units in mg/L, except expressed otherwise)

No	Parameters	Sampling and Measurement		Quality Standard (Minimum Value)	Remarks
A.	**Physical Parameters**	**Point 1 (within site)**	**Point (outside of site)**		
1.	Turbidity (NTU)	< 0.5	1	25	No standard on groundwater in IFC EHS to compare
2.	Color (TCU)	1	< 2	50	
3.	TDS (Total Dissolved Solid)	254	416	1000	
4.	Temperature (°C)	28	29.0	air temperature ± 3	
5.	Taste	Tasteless	Tasteless	No taste	
6.	Smell	Odorless	Odorless	No smell	
B	**Biological Parameters (MPN)**				
1.	Total coliform (CFU/ 100ml)	23	17	50	
2.	E. coli (CFU/ 100ml)	0	0	0	
C	**Chemical Parameters**				
1.	pH	6.7	7.3	6.5 -8.5	
2.	Iron	< 0.016	< 0.016	1	
3.	Fluoride	0.2	0.2	1.5	
4.	Hardness (CaCO3)	61	260	500	
5.	Manganese	< 0.013	0.05	0.5	
6.	Nitrate, as N	1	1	10	
7.	Nitrite, as N	0.01	0.01	1	
8.	Cyanide	< 0.002	< 0.002	0.1	
9.	Detergent (MBAS)	0.01	< 0.010	0.05	
10.	Total Pesticide	< 0.001	< 0.001	0.1	

C = Celsius, CaCO3 = calcium carbonate, CFU = colony forming unit, EHS = environment health and safety, IFC = International Finance Corporation, l = liter, mg = milligram, NTU = Nephelometer Turbidity Unit.
Source: Laboratory Testing (TRTA, April 2022)

219. From the table, it can be concluded that samples groundwater in the BPKIL location and nearby area is in good condition. Physical, biological, and chemicals parameters of the groundwater meet the requirement as raw water for drinking water. Turbidity, Color, and TSS,

groundwater in the project site is better than one sample in the nearby settlement area. It is assumed that pollutants from the surrounding areas contributes to the higher concentration of organic contents and turbidity.

Table 38: Ambient Seawater Quality Testing in BPKIL Laboratory (Serang, Banten)
(All units in mg/L, except expressed otherwise)

No.	Parameter	Standard (Appendix VIII of GR No. 22/2021)	Measurement Result	Remarks
1.	Color (Pt. Co)	-	21	
2.	Transparency (m)	*Coral: .5* *Mangrove: -* *Seagrass: >3*	1.3	
3.	Turbidity (NTU)	5	124	Turbidity exceeded the quality standard
4.	Odor	Natural	Odorless	
5.	Total Suspended Solid	Coral:20 Mangrove: 80 Seagrass: 20	200	TSS exceeded the quality standard
6.	Solid waste	None	Exist	Few wastes found in the seawater
7.	Temperature (℃)	Natural Coral: 28-30 Mangrove: 28-32 Seagrass: 28-30	30.0	
8.	Oil layer	None	None	
9.	pH	7 – 8.5	7.6	
10.	Salinity (0/00)	Coral: 33-34 Mangrove: up to 34 Seagrass: 33-34	30	Below the standard
11.	Dissolved Oxygen (DO)	>5	3.6	Below the standard
12.	BOD_5	*20*	20	
13	Total Ammonia (NH_3- N)	0.3	0.2	
14.	Orthophosphate (PO_4- P)	0.015	0.182	
15.	Nitrate (NO_3-N)	0.06	0.12	
16.	Cyanide (CN-)	0.5	0.1	
17.	Sulfide (H2S)	0.01	0.002	
18.	Total Petroleum Hydrocarbon (TPH)	0.02	< 0.01	
19.	Total Phenolic	0.002	0.002	

No.	Parameter	Standard (Appendix VIII of GR No. 22/2021)	Measurement Result	Remarks
	Compounds			
20.	Fecal coliform (MPN/ 100 ml)	-	25.875	
21.	Coliform (total) (MPN/ 100 ml)	1000	31.940	Total Coliform exceeded the quality standard
22.	Pathogen (Cell/100 mL)	*None*	*None*	
23.	Phytoplankton (Cell/mL)	1000		

C = Celsius, l = liter, mg = milligram, ml = milliliter = MPN =
Source: Laboratory Testing (TRTA, April 2022)

220. The table indicated that ambient seawater as the receiving water body of the bioassay laboratory wastewater in the BPKIL has exceeded the quality standard, especially for Turbidity, TSS, Salinity, Dissolved Oxygen, and Total Coliform. However, there are some other activities around the coastal areas that contribute to the seawater quality, among others harbor, ship navigation, and industries and tourism activities along the coastal area of Serang.

221. **Banten (Tangerang).** Based on research by Ajie Prakoso and Yuli Suharnoto on Distribution of Seawater Quality around Ship Unloader of PLTU 3 Banten Lontar (2020), water quality around coal-fired powerplant (PLTU) nearby the Mauk, Tangerang (Banten) shrimp ponds has decreased. As consequence the seawater cannot be used for livelihood and sea biotic. The research has analyzed key parameters such pH, total suspended solid (TSS), temperature, iron, salinity and dissolved oxygen (DO). The results of measurement around the PLTU's conveyor location recorded that the temperature varies in range 29.3 – 32.7 ^{o}C, salinity in range 32.55 – 32.9 ‰, pH in range 7.57 – 8.05, DO in range 2.55 – 4.2 mg/l, TSS in range 25 – 134 mg/l and Fe in range 0.07 – 0.63 mg/l.

222. As the shrimp ponds use the same canal with the powerplant, the seawater was affected with discharge from the powerplant in form of chlorine and heating water. This affects the surrounding shrimp ponds. For that reason, it is proposed to build separate canal for the abstraction of seawater to the shrimp ponds.

223. **Central Java (Jepara)**. Based on Strategic Environmental Assessment (KLHS) for District Medium Term Development Plan of Jepara 2017-2022, indicated that water quality in rivers is still in moderate to heavily polluted with some issues. In term of time series data in the past (2012 – 2016), the parameters which requires attention is shown in Table 39.

Table 39: Key Issues of Water Quality in Jepara (Central Java) 2012 -2016

No.	Rivers	Parameters of Concern by Year (2012 – 2016)				
		2012	2013	2014	2015	2016
1	Bakalan Hilir	Sulphur, BOD	Phosphate (PO_4) Nitrite, Sulphur (H_2S)	Nitrite, Free Chlorine, Sulphur (H_2S), Total Coliform, Fecal Coliform	Nitrite, Free Chlorine, Sulphur (H_2S), Fecal Coliform,Total Coliform	Nitrite, Free Chlorine, Sulphur
2	Troso Muara	Free Chlorine	Phosphate Free Chlorine	Nitrite, Free Chlorine, Sulphur	Free Chlorine, Sulphur (H_2S),	Nitrite, Free Chlorine, Sulphur

			Sulphur, Total Coliform, Fecal Coliform	(H_2S), Total Coliform Fecal Coliform	Total Coliform Fecal Coliform	
3	Troso Hilir	Free Chlorine	Phosphate, Free Chlorine, Sulphur, Total Coliform, Fecal Coliform	BOD, Free Chlorine, Sulphur (H_2S), Oil and grease, Total Coliform Fecal Coliform	BOD, DO, Free Chlorine, Sulphur (H_2S), Total Coliform Fecal Coliform	Nitrite, Free Chlorine, Sulphur
4	Wiso Muara	Free Chlorine	Nitrite, Total Coliform	TSS, BOD, COD, Fluoride, Free Chlorine , Sulphur (H_2S), Oil and grease, Detergent, Total Coliform Fecal Coliform	TSS, BOD, COD, Cyanide, Fluoride, Free Chlorine , Sulphur (H_2S), Oil and grease, Detergent, Total Coliform	Nitrite, Free Chlorine, Sulphur
5	Wiso Bringin	Sulphur, Oil and Grease	Phosphate, Nitrite, Free Chlorine	Free Chlorine, Sulphur (H_2S), Oil and grease, Total Coliform, Fecal Coliform	TSS, BOD, COD, Phosphate, zinc, Free Chlorine, Fecal Coliform, Total Coliform	
6	Mlonggo Hilir	Free Chlorine	Free Chlorine, Sulphur (H_2S), Total Coliform Fecal Coliform	Free Chlorine, Sulphur (H_2S), Oil and grease, Total Coliform Fecal Coliform	BOD, Free Chlorine, Total Coliform	Nitrite, Free Chlorine, Sulphur
7	Bangsri/ Banjaran	Phosphate	Free Chlorine, Fecal Coliform Total Coliform	Free Chlorine, Fecal Coliform Total Coliform	BOD, COD, Free Chlorine, Fecal Coliform Total Coliform	Nitrite, Free Chlorine, Sulphur

Source: Strategic Environmental Assessment (KLHS) Jepara 2017-2022.

224. Based on the characteristic of the parameters which exceed quality standard, it is predicted that sources of the pollution dominated by waters from households and (small) industries along the rivers.

225. Physical-chemical condition of seawater around the project area (BBAP) in Jepara (Central Java) referred to the research (2020) by Emma Diyan Andriani[24]. The research conducted from December 1998 - January 1999, indicates that tidal generally does not affect to the three key parameters, namely TSS, COD and NH3. Several parameters such as TSS, NH3 and DO have exceeded the quality standard threshold value for marine biotic aquaculture (Kep-2I/MENKLH/II/1988). One of the sources for increasing concentration of TSS, NH3 and DO are effluent from shrimp ponds. This is proved by the measurement that the effluent from ponds have exceeded the quality standard threshold value wastewater for industrial activities (Kep-511/MENLH/101/1995). However, other activities such as settlements, industries, and others also contribute to the pollution.

226. To complement the available secondary and primary data, a sampling and laboratory testing was carried in April 2022 to measure surface water, groundwater and seawater quality in BBPBAP Jepara (Central Java). The result is summarized below, while recapitulated measurement presented in **Annex 3.**

227. **Groundwater**. It can be concluded that groundwater in the BBPBAP Jepara (Central

[24] http://repository.ipb.ac.id/handle/123456789/23797.

Java) location and nearby area is still in good condition for all parameters set forth, except for pH. The groundwater is identified as slightly alkaline with pH > 9.

228. **Reservoir Water**. Measurement of the reservoir (tandon) which supplies water for the shrimp ponds in BBPBAP Jepara (Central Java) indicated that its quality meet the standard set forth in MMAF Regulation No. 75/2016, except for one parameter (i.e., ammonia). Ammonia contents is almost 200 times of the standard. It is assumed that the reservoir and pond in BBPBAP Jepara (Central Java) containing high contents organic materials, as indicated by the higher concentration of ammonia. The higher concentration of the parameter may come from the accumulation of organic in the seas from various sources.

229. **Ambient seawater.** The results of measurement indicated that the receiving water body in the BBPBAP (Jepara) still meet the standard of Government Regulation No. 22/2021 (Appendix VIII), except for turbidity which is 3 time higher as measured at the upstream (approximately 50 m before the outlet). Bacteria (fecal, coliform and pathogen) also exceed the standard, which assumed as the accumulation from various sources.

230. **East Java (Situbondo and Pasuruan)**. Based on East Java's DIKPLHD (2017), water quality measurements in several districts, indicate that surface water (river) quality is still in good condition. Detail of the measurement is presented in Table 40.

Table 40: Water Quality of River in East Java (Brantas River)
(All units in mg/L, except expressed otherwise)

Monitoring Points	Temperature (°C)	Dissolved Residue	Suspended Residue	pH	DHL	TDS	TSS	DO	BOD_5	COD	NO_2	NO_3	NH3	Free Chlorine (mg/L)
Standard(1)	**Dev. 3**	**1000**	**50**	**6 – 9**	**-**	**-**	**-**	**4**	**3**	**25**	**0.06**	**10**	**-**	**0.03**
Arboretum Malang, Kota Batu, Kec. Bumiaji	16,6	74	2	7,5	104,3	74	2	9,89	2,45	5,48	0,00	0,46	0,000	0
Jembatan Gadang Malang	23,9	160	520	7,2	239	160	520	8,24	7,47	16,80	0,10	2,92	0,002	0
Jembatan Selopuro Blitar	28,4	252	34	7,7	377	252	34,0	5,69	5,85	14,40	0,01	3,34	0,002	0,08
Jembatan Glongang/ Satreyan Blitar	27,4	258	47	7,73	345	258	47,0	6,40	2,88	6,59	0,01	3,08	0,002	0,07
Jembatan Kademangan/ Trisula Blitar	27,2	246	55,5	7,93	302	246	55,5	6,65	3,51	6,17	0,01	2,84	0,003	0,18
Tambangan Ngunut 2 (Ngantru – Srengat) Tulungagung	26,6	192	84	7,89	298,5	192	84,0	6,78	4,43	10,99	0,01	3,00	0,003	0,04
Jembatan Ngujang	26,4	178	311	7,82	219,9	178	311,0	6,39	3,47	6,86	0,04	2,69	0,006	0,08
Jembatan Masjid Agung Kediri/Bandar Ngalim	27,0	130	685	7,74	197,4	130	685,0	6,75	3,28	7,20	0,05	2,99	0,005	0,19
Jembatan Papar Kediri	28,0	200	1098	7,83	252,4	200	1098,0	7,61	3,39	7,54	0,06	3,16	0,008	0,2
Jembatan Ploso	27,5	224	312	7,72	295	224	312,0	7,62	6,35	13,80	0,05	2,45	0,001	0,2

Note: (1) Government Regulation No. 82/2001

Table 40 (continued)

Titik Pantau	T-P	Phenolic Substance	Oil and Grease (µg/L)	Detergent (µg/L)	Fecal coliform (number / 1000 ml)	Total coliform (number / 1000 ml)	Cyanide	H_2S
Standard(1)	**-**	**1**	**1000**	**200**	**100**	**5000**	**0.02**	**0.002**
Arboretum Malang, Kota Batu, Kec. Bumiaji	0,088	1	2100	21,30	200	1400	0,002	0,02
Jembatan Gadang Malang	0,2493	1,26	2100	23,20	8600	17200	0,002	0,02
Jembatan Selopuro Blitar	0,0754	1,26	2100	14,20	3800	7100	0,002	0,02
Jembatan Glongang/ Satreyan Blitar	0,078	1,26	2100	14,20	4500	8500	0,002	0,02
Jembatan Kademangan/ Trisula Blitar	0,1062	1,26	2100	17,60	4300	8500	0,002	0,02
Tambangan Ngunut 2 (Ngantru – Srengat) Tulungagung	0,1649	1,26	2100	17,00	5000	7600	0,002	0,02
Jembatan Ngujang	0,168	1,26	2100	23,80	6800	12000	0,002	0,02
Jembatan Masjid Agung Kediri/Bandar Ngalim	0,1728	1,26	2100	23,80	6200	11200	0,002	0,02
Jembatan Papar Kediri	0,1838	1,3	2100	19,40	5400	9700	0,002	0,02
Jembatan Ploso	0,212	1,26	2100	0,03	6000	9000	0,002	0,02

Source: East Java's DIKPLHD (2017)

231. The results in above table show that suspended residues, BOD, oil and grease, and fecal coli has exceeded the quality standard. This represents typical characteristic of river water in urban areas.

232. For the seawater quality, measurement have been carried out at six points of coastal areas in East Java. Table 41 shows the results of measurement in Pasuruan, one of the project location in East Java. Based on the data, sampled seawater in Pasuruan is quite good.

Table 41: Seawater Quality in East Java (2017)
(All units in mg/L, except expressed otherwise)

Sampling Location	Smell	Transparency (M)	Turbidity (NTU)	TSS	Solid Waste	Oil Layer	Temperature (^oC)	pH	Salinity (‰)	DO	BOD	COD	Total Ammonia
Standard (1)	**-**	**3 – 5**	**< 5**	**20 -80**	**None**	**None**	**28 – 32**	**7 – 8.5**	**33 – 34**	**> 5**	**20**	**-**	**0.3**
Semester I:													
Seawater from PLTGU Outlet	Natural	< 2	1,84	< 7,1	None	None	31,1	7,26	31	4,8	5	-	< 0,023

Seawater at the East Side of Reclaimed Land	Natural	< 2	3,68	< 7,1	None	None	28,8	7,13	32	4,6	5	-	< 0,023
Semester II:													
Seawater from PLTGU Outlet	Natural	< 2	2,24	< 7,1	None	None	31	7,81	30	6,2	3	-	0,05
Seawater at the East Side of Reclaimed Land	Natural	< 2	0,18	< 7,1	None	None	28,9	7,81	32	6,2	5	-	< 0,023

Note: (1) Regulation of Minister of Environment No. 51/2004 (Appendix III)

Table 41 (continued)

Sampling Location	NO_2-N	NO3-N	PO4-P	Cyanide (CN^-)	Sulfide (H2S)	Chlorine	Oil	Phenolic Substance	Pesticide (mg/l	PCB
Standard (1)	**-**	**0.08**	**0.015**	**0.5**	**0.01**	**-**	**-**	**0.002**	**0.01**	**0.01**
Semester I:										
Seawater from PLTGU Outlet	-	< 0,005	< 0,01	-	0,01	-	-	< 0,002	< 0,001	< 0,0001
Seawater at the East Side of Reclaimed Land	-	0,006	< 0,01	-	< 0,01	-	-	< 0,002	< 0,001	< 0,0001
Semester II:										
Seawater from PLTGU Outlet	-	< 0,005	0,026	-	0,01	-	-	< 0,002	< 0,001	< 0,0001
Seawater at the East Side of Reclaimed Land	-	< 0,005	0,037	-	< 0,01	-	-	< 0,002	< 0,001	< 0,0001

Note: (1) Regulation of Minister of Environment No. 51/2004 (Appendix III)
Source: East Java's DIKPLHD (2017).

233. **Bali (Karangasem)**. Water quality measurements in several districts indicate that seawater quality is in good condition. Details of the measurements are presented in Table 42. The results in above table show that BOD in the river have exceeded the quality standard threshold.

Table 42: Measurement of River Water Quality in Bali (2018) – Semester 1
(All units in mg/L, except expressed otherwise)

Location	Temperature (^{0}C)	pH	DHL	TDS	TSS	DO	BOD	COD	NO2
Standard (1)	**Dev. 3**	**6 – 9**	**-**	**-**	**-**	**4**	**3**	**-**	**0.06**
Hulu Tukad Mati (Bed Flow)	30.50	7.74	405.00	380.00	12.00	7.00	19.00	14.00	0.022
Hulu Tukad Mati (Mid Flow)	29.80	7.70	4.20	255.00	9.00	7.20	18.00	14.00	0.022
Tengah Tukad Mati (Bed Flow)	31.60	7.25	512.00	559.00	60.00	8.00	11.00	16.00	0.044
Tengah Tukad Mati (Mid Flow)	30.20	7.30	5.80	458.00	40.00	8.00	12.00	15.00	0.042
Hilir Tukad Mati (Bed Flow)	25.60	7.42	736.00	1,010.00	89.00	8.20	4.00	33.00	0.030
Hilir Tukad Mati (Mid Flow)	28.00	7.40	700.00	900.00	75.00	8.00	6.00	30.00	0.030
Hulu Tukad Teba (Upstream)	31.10	7.63	554.00	204.00	241.00	3.00	8.00	18.00	0.051
Tengah Tukad Teba (midstream)	26.10	7.55	495.00	184.00	62.00	3.50	17.00	22.00	0.010
Hilir Tukad Teba (downstream)	27.10	7.00	235.80	917.00	148.00	4.00	4.00	84.00	0.033

Hulu Tukad Badung (Dasar Aliran)	32.90	7.00	270.30	401.00	17.00	8.00	10.00	14.00	0.010
Hulu Tukad Badung(Tengah Aliran)	33.00	7.00	258.00	200.00	12.00	8.00	11.00	14.00	-
Tengah Tukad Badung (Bed flow)	30.50	7.80	1,059.00	287.00	35.00	8.50	6.00	16.00	0.020
Tengah Tukad Badung (Mid flow)	28.80	7.70	998.00	178.00	30.00	8.70	7.00	15.00	0.002

Note: (1) Government Regulation No. 82/2001
Source: Bali's DIKPLHD (2018).

234. Referring to Bali's DIKPLHD (2018), seawater in all coastal areas in Bali (except Bangli) has been measured for the following parameters: turbidity, TDS, TSS, DHL, oil layer, temperature, pH, salinity, DO, BOD, COD, NO_2, NO_3, PO_4, oil and grease, *fecal coliform* and *total coliform*. As shown in Table 43, only NO_2 and PO_4 parameters have exceeded the quality standard, while others vary. Some areas have exceeded limits for COD, as recorded in coastal areas of Lebih, Nusa Dua, Kedonganan, Kelating, Tanah Lot, Celukan Bawang, Sangsit, Lovina, Baruna, Pengambengan, and Benoa.

Table 43: Measurement of Seawater Quality in Bali (2018)
(All units in mg/L, except expressed otherwise)

Location	Color (M)	Smell	Turbidity (NTU)	TSS	TDS	Temperature (^{0}C)	pH	Salinity (‰)	DO	BOD_5	COD	NO_2-N (mg/l)
Standard (*Regulation of Minister of Environment No. 51/2004 (Appendix*		Natural	**< 5**	**20 -80**		**28 – 32**	**7 – 8.5**	**33 – 34**	**> 5**	**20**	-	-
Semester I												
Coast of Pesanggaran Powerplant	Turbid	-	17	58.00	45.00	29.00	7.60	12.00	3.20	18.00	28.00	0.030
Matahari Terbit Beach	Clear	-	8	18.00	37.54	29.80	7.85	12.50	12.00	15.00	25.00	0.032
Sanur Beach	Clear	-	7	14.00	51.00	29.50	7.40	12.10	10.00	19.00	17.00	0.045
Mertasari Beach	Clear	-	8	9.00	30.00	30.00	7.00	17.00	9.00	18.50	24.00	0.009
North Coast of Serangan Island	Turbid	-	9	6.00	25.00	29.00	7.98	25.00	10.00	9.00	22.00	0.002
East Coast of Serangan Island	Clear	-	6.5	8.00	24.00	29.60	8.00	41.00	10.00	22.00	26.00	0.004
South Coast of Serangan Island	Turbid	-	10	10.00	21.00	29.40	8.10	19.00	11.00	28.00	20.00	0.007
East of Benoa Port	Clear	-	3.5	8.00	12.00	30.60	7.85	15.00	10.00	11.00	20.00	0.005
South of Benoa Port	Clear	-	4.36	6.00	11.00	29.80	7.53	10.00	11.00	15.00	19.00	0.004
West of Benoa Port	Clear	-	14.5	15.00	54.00	27.80	7.56	4.00	3.50	28.00	38.00	0.030
Semester II												

Coast of Pesanggaran Powerplant	Turbid	-	12	41.00	31.00	29.00	7.40	13.00	3.00	41.00	33.00	0.300
Matahari Terbit Beach	Clear	-	5	23.00	36.00	29.00	7.70	11.00	18.00	14.00	22.00	0.040
Sanur Beach	Clear	-	5	16.00	43.00	28.00	7.40	11.00	17.00	17.00	15.00	0.030
Mertasari Beach	Clear	-	7	6.00	41.00	31.00	7.30	15.00	15.00	15.00	17.00	0.002
North Coast of Serangan Island	Turbid	-	5	8.00	18.00	30.00	7.70	23.00	14.00	16.00	15.00	0.002
East Coast of Serangan Island	Clear	-	4	12.00	22.00	31.00	7.80	31.00	10.00	18.00	18.00	0.004
South Coast of Serangan Island	Turbid	-	12	11.00	27.00	29.00	8.00	17.00	12.00	13.00	16.00	0.007
East of Benoa Port	Clear	-	3	5.00	9.00	29.00	7.60	12.00	11.00	9.00	22.00	0.006
South of Benoa Port	Clear	-	4	7.00	9.00	28.00	7.40	9.00	12.00	11.00	18.00	0.004
West of Benoa Port	Clear	-	12	18.00	61.00	29.00	7.70	4.00	2.00	31.00	32.00	0.100

Source: Bali's DIKPLHD (2018).

235. Primary data have been collected from shrimp ponds (at Village Bugbug, Karangasem) of BPIU2K (Karangasem, Bali). The measurement of the water intake (Table 44) were conducted between August – November 2021**.**

Table 44: Water Quality at Water Reservoir of Shrimp Pond (Bali)

No.	Parameter	Measurement	Standard (1)	Remarks
1	Temperature (^{0}C)	25.9	28 – 32	
2	Salinity (ppt)	32	33 – 34	
3	TSS (ppm)	26	20 – 80	
4	Transparency (cm)	Goes through to bottom (depth of water reservoir 1.5 – 2 m)	3 – 5	
5	pH	7.04	7 – 8.5	
6	Alkalinity (ppm)	242	-	
7	Hardness (ppm)	290	-	
8	Dissolved Oxygen (ppm)	6.36	> 5	
9	NH^{+3}-N (mg/l)	< 0,03	0.3	
10	NO2-N (mg/l)	0.045	0.06	
11	Total Phosphate (ppm)	0.05	0.015	Exceeded quality standard
12	BOD5 (ppm)	149	20	Exceeded quality standard
13	COD (ppm)	571	-	
14	H_2S (ppm)	0	0.01	
15	Cu (ppm)	< 0,003	0.008	
16	Cd (ppm)	0.011	0.001	
17	Pb (ppm)	< 0,003	0.008	

18	Zn (ppm)	< 0,003	0,05	
19	Hg (ppm)	< 0,0003	0.001	

Note: Government Regulation No. 22/2021 (Appendix VIII).
Source: Secondary Data from BPIU2K (Karangasem, Bali).

236. The results in the table above show that Total Phosphate and BOD have exceeded the quality standards.

237. To complement the available secondary and primary data, a laboratory testing has been carried in April 2022 to measure surface water, groundwater, wastewater, and ambient seawater quality in BPIU2K Karangasem (Bali). The result is summarized in paras below, while recapitulation of the measurement presented in **Annex 3.**

238. **Groundwater**. The measurement of groundwater inside of the project site and outside of the area (nearby settlement area) indicated that groundwater in **BPIU2K Karangasem (Bali)** location and nearby area is still in good condition as reflected from the parameters met, except for total coliform. The total coliform is almost 100 times higher of the standard. The groundwater is suitable for drinking water with appropriate treatment to reduce the total coliform.

239. **Broodstock Reservoir**. The laboratory testing indicated that water quality in the broodstock reservoir in **BPIU2K Karangasem (Bali)** meets the requirement as set forth in standard. It is assumed that the water has been appropriately treated to remove pollutants and any impurities as commonly practiced.

240. **Broodstock Growing Ponds**. Measurement of water quality in growing ponds of Multiplication Center (MC) indicated that the samples meet the parameters set forth. No parameters exceed the standard.

241. **Ambient Seawater.** The results of measurement indicated that the receiving water body in the BPIU2K Karangasem (Bali) still meet the standard of Government Regulation No. 22/2021 (Appendix VIII), except for Fecal Coliform and Total Coliform. The bacteria (fecal coliform and total coliform) exceeded the standard, as the accumulation from various sources.

242. **South Sulawesi (Takalar and Pinrang)**. The South Sulawesi Environmental Performance Document (DIKPLHD, 2018) as shown in Table 45, water quality of Saddang River was identified as slightly polluted at all the sampling points. Meanwhile, water quality of Jeneberang River varies from slightly polluted at the upstream to moderately polluted at the mid-stream and heavily polluted at the downstream.

Table 45: Water Quality of Rivers in South Sulawesi (Sadang and Jenebarang)

River	Location	Water Quality Status	Equivalent Water Pollution Index (PI)
Sadang	Kec. Sadang (Kab. Toraja Utara)	Slightly polluted	1.0 < IP ≤ 5.0
	Kec. Makale Kab. Tana Toraja)	Slightly polluted	
	Kec. Enrekang (Kab. Enrekang) – Tributary	Slightly polluted	
	Kec. Enrekang (Kab. Enrekang)	Slightly polluted	
	Kec. Cendana (Kab. Enrekang)	Slightly polluted	
	Kec. Duampanua (Kab. Pinrang)	Slightly polluted	
	Kec. Duampanua (Kab. Enrekang)	Slightly polluted	
Jenebarang	Bontolero, Kec. Tinggi Moncong (Kab.	Slightly polluted	

	Gowa) – Jembatan Merah		
	Tributary of Lonjoboko, Kec. Parangloe (Kab. Gowa)	Slightly polluted	
	Parangloe (Kab. Gowa)	Slightly polluted	
	Bili-bili Dam (Kab. Gowa)	Slightly polluted	
	Jembatan Kembar, Kec. Pallangga/Moncongloe Kec. Mamuju (Kab. Gowa)	Moderately polluted	5.0 < IP ≤10
	Bontomarannu, Kec. Bontomarannu (Kab. Gowa)	Moderately polluted	
	Rubber dam, Benteng Somba Opu, Kec. Tamalate (Makassar)	Moderately polluted	

Source: South Sulawesi Environmental Performance Document (DIKPLHD, 2018).

243. Referring to DIKPLHD (2018), several parameters of seawater tend to increase, and some have exceeded quality standard based on Ministry of Environment Regulation No. 51/2004 on Seawater Quality Standard for Marine Biotic, (i) physical parameters: transparency, turbidity, and total suspended solid (TSS), (ii) chemical parameters: phosphate (PO4-P), total ammonia, copper (Cu), and lead (Pb), and (iii) biological parameters: coliform.

244. Some primary data also shared by BPBAP Takalar (South Sulawesi) for water quality in the shrimp pond as shown in Table 46.

Table 46: Seawater Quality at Shrimp Ponds in Takalar (South Sulawesi)

No.	Parameter	Location and Measurement			Standard (1)	Remarks
		1 (Pond A)	2 (Pond B)	3 (Pond C)		
1	Temperature (^{0}C)	29	29	28	28 – 32	
2	Salinity (ppt)	29	22	26	33 – 34	
3	TSS (ppm)				20 – 80	
4	Transparency (cm)				3 – 5	
5	pH	7.7	7.56	7.76	7 – 8.5	
6	Alkalinity (ppm)	129.13	68.5	123.97	-	
7	Hardness (ppm)				-	
8	Dissolved Oxygen (ppm)	3.8	4	3.8	> 5	DO below quality standard
9	NH^{+3}-N (mg/l)	<0,006		<0,006	0.3	
10	NO2-N (mg/l)	<0,0233		<0,0233	-	
11	Total Phosphate (ppm)	<0,0392		<0,0392	0.015	
23	Total Bacteria (CFU/mL)	7,6x10^3	7,9x10^3	4,4x10^3	1000	Total Coliform exceeded the quality standard
24	Total vibrio (CFU/mL)	2,5x10^1	3,8x10^3	2,5x10^1		
25	Yellow Vibrio (%)	100	100	100		
26	Green Vibrio (%)	0	0	0		

Note: (1) Appendix VIII of GR No. 22/2021.
Source: Data from BPBAP Takalar (South Sulawesi).

245. The results in above table show that DO (dissolved oxygen) does not meet the

requirement (less than 5 mg/l). Similarly, total bacteria exceeded the quality standard if compared with the threshold value of Total Coliform. Possible reasons are increasing organic pollutants from domestic sources of surrounding areas.

246. To complement the available secondary and primary data, a laboratory testing was carried in April 2022 to measure surface water, groundwater, wastewater and seawater quality in BPAP Takalar (South Sulawesi). The result is summarized in paras below, while recapitulation of the measurement is presented in **Annex 3.**

247. **Groundwater**. Measurement of the groundwater within and outside of the project site of BPBAP Takalar (South Sulawesi) indicates that the water does not meet quality standard for drinking water as 3 (three) key parameters exceeded, i.e., TDS (Total Dissolved Solid), Total Coliform, and hardness (CaCO3).

248. **Reservoir and Pond.** From the measurement of samples indicated that water quality in the reservoir and pond in BPBAP Takalar (South Sulawesi) still meet the standard, except for salinity in the pond (approximately 30% higher) and alkalinity (approximately 100% higher). Other parameters are still in the threshold of standard.

249. **Ambient Seawater**. The results of measurement indicate that the receiving water body in the BPBAP Takalar (South Sulawesi) still meet the standard of Government Regulation No. 22/2021 (Appendix VIII), except for nitrate.

(c) Summary on current water quality of subprojects

250. **Surface water quality.** Overall, surface water in project areas is in good condition, except for certain parameters, which are influenced by the surrounding environment. Common parameters which exceeded limits are COD, free chlorine, oil and grease, total phosphate, nitrite, fecal coliform, and total coliform. Based on the characteristic of the parameters which exceed quality standard, it is predicted that sources of the pollution are from households, (small) industries, and agricultural activities along the rivers, canals etc.

251. **Seawater quality.** Secondary data and laboratory testing of the ambient seawater in project areas indicate good condition or slight pollution. Several parameters exceed limits in several areas, especially those located in peri-urban areas where other activities such as sea transportation/ ship navigation, industries, and tourisms also contribute to the sea pollution. The pollutants identified in each area vary, but in general the parameters that don't comply with seawater standards are transparency, nitrate, DO, phosphate, Turbidity, TSS, Salinity, Dissolved Oxygen, and Total Coliform.

252. **–Groundwater quality.** Generally, groundwater in the project areas meet the requirement as raw water for drinking water, except for ones in South Sulawesi (Takalar) where 3 (three) key parameters exceed limits, i.e., TDS (Total Dissolved Solid), Total Coliform, and hardness (CaCO3). Groundwater in other areas varies, but categorized as good condition with few parameters exceeded.

2. Wastewater and their current management

(a) Wastewater of aquaculture and their management.

253. Based on the IISAP Baseline Survey (November 2021), respondents (i.e., shrimp farmers in the project areas) applied some methods to manage wastewater from ponds. Approximately two thirds of the respondents directly discharged their wastewater (without treatment) into the outlet (62%); 30% treated the wastewater by settlement in the pond, drained, and dredged the sludge (basically lagoon system to passively treat effluent without aeration and other active treatment). The rest (8%) use active wastewater management installation (WWT) primarily through biochemical secondary treatment such as activated sludge and other methods.

254. Most respondents (83%) manage the sludge from wastewater treatment by digging and piling them to build embankment, while others manage them in different way: digging and processing them to make fertilizer (1%), digging and piling it on the beach to protect shrimp pond from wave action (1%), and other manners such as piling on the surroundings to protect the pond against wave action (15%). There was no respondent who processed the mud by digging and carry it away to sell as backfill soil.

255. **Typical discharge/wastewater from shrimp ponds.** In addition to secondary data from recent research and other sources, sample tests are conducted during IEE with the result as follows. Water quality testing of the shrimp ponds effluent in Jepara (Central Java) meet the requirement, and only NH3 (ammonia) in the effluent which is much higher than the standard (< 0.1 mg/l).

Table 47: Water Quality Testing of Shrimp Ponds Effluent in BBPBAP Jepara (Central Java)

No	Parameters	Standard (Gov. Regulation)[a]	Sampling and Measurement				Remarks
			Point 1 „	Point 2	Point 3	Point 4	
1.	TSS	≤ 200	9	8	13	11	
2.	Turbidity (NTU)	≤ 50	5.9	18.8	16.2	2.9	
3	Temperature (°C)						
4.	pH	6-9	7.8	8.1	7.7	8.1	
5.	BOD_5	< 45	< 0.5	< 0.5	5.7	10.7	
6	COD		< 2.5	< 2.5	13.7	25.2	
7.	PO_4	< 0,1	0.9	2.6	5.4	3.3	
8.	H_2S	< 0.03	< 0.060	< 0.060	0.03	< 0.020	
9.	NO_3	< 75	0.49	0.44	0.38	0.74	
10.	NO_2	< 2.5	0.008	< 0.003	< 0.003	0.51	
11.	NH_3	< 0.1	0.48	30.8	7	19	Exceed the standard

[a] Regulation of Minister of Marine Affairs and Fishery (Permen – KKP) No. 75 tahun 2016 on General Guideline for Growing on of *Penaeus monodon* and *Litopenaeus vannamei.*

Source: Laboratory Testing (April 2022)

256. Similarly, effluent of shrimp ponds for BPBAP Takalar (South Sulawesi) also meets the standard, except for salinity and alkalinity.

257. **Typical discharge/wastewater from hatcheries.** Based on the laboratory testing of the

effluent from BPIU2K (Karangasem) broodstock some parameters exceeded, especially alkalinity, transparency, ammonia, nitrate, and nitrite. The alkalinity of the wastewater still exceeds the standard when it was discharged through the outlet, Therefore, improvement of the wastewater treatment shall be proposed (among other neutralization and disinfection with chlorine). The transparency of the wastewater is far below the standard, indicating the turbidity of the water exceed the standard as well.

258. Three tests were carried for broodstock in Karangasem (Bali): (i) Data from their own monitoring (Table 48:), (ii) By independent laboratory for UKL-UPL monitoring (Table 49), and (iii) data from IISAP recent measurement conducted during period August – November 2021**.** The wastewater in WWT is still in the treatment process (so called half-treated), therefore it represent the broodstock's raw effluent.

Table 48: Testing of BPIU2K Broodstock (Two Sampling Points)

No.	Parameter	Measurement		Standard (No. KEP. 28/MEN/2004)	Remarks
		Location 1	Location 2		
1	Temperature (^{0}C)	28.3	28.5	26 – 32	
2	Salinity (ppt)	25	25	10 – 35	
3	TSS (ppm)	14	28.2	<30	
4	Transparency (cm)	55	50	30 – 40	Exceeded standard
5	pH	6.92	7.11	7 – 9	
6	Alkalinity (ppm)	160	164	100 – 150	Exceeded standard
7	Hardness (ppm)	220	270	-	
8	Dissolved Oxygen (ppm)	9.23	11.38	> 3	
9	NH^{+3}-N (mg/l)	< 0,03	< 0,03	< 0.1	
10	NO2-N (mg/l)	0.019	0.566	< 1	
11	Total Phosphate (ppm)	0.5	0.5	-	
12	BOD5 (ppm)	85	90	<10	Exceeded standard
13	COD (ppm)	327	327	-	
14	H2S (ppm)	0.06	0.05	-	

Source: BPIU2K Report on UKL-UPL. Some of data not required in the standard (such as heavy metals) omitted.

259. Above table indicated that there is accumulation of pollutants in which some parameters exceeded quality standard. For example, transparency, alkalinity, and BOD for the broodstock WWT is exceeding the standard. However, BOD exceed national standard on water intake/quality and outlet/discharge by 9 times. It is assumed that there is accumulation of organic substance at the broodstock ponds prior to discharge into the WWT.

260. Among existing Balai (UPT) involved in IISAP, only BPIU2K Karangasem (Bali) which has already prepared environmental document, i.e., UKL-UPL (environmental management and monitoring measures) during 2020-21. As part of the periodic monitoring as required in the UKL-UPL, a sampling and laboratory measurement for water supply (seawater) and wastewater carried out with key indicators/parameters as presented in Table 46. The sampling carried out within five points of the aerobic wastewater treatment ponds, indicating by W1 (Wastewater-1) – W5 (Wastewater 5) of the broodstock WWT.

Table 49: Testing of Wastewater of Broodstock (Bali)

No.	Parameter	Unit	Sampling Points of WW					Standard (1)	Remarks
			W-1	W-2	W-3	W-4	W-5		
1	pH	-	6.92	7.11	7.04	7.03	6.96	7 - 9	
2	TSS	mg/L	14	28.2	26.0	94.2	42.8	<30	Two of the sampling points exceed quality standard
3	BOD (5 days, 20° C)	mg/L	85	90,1	149	116	69.5	<10	Exceed quality standard
4	COD ($K_2Cr_2O_1$)	mg/L	327	327	571	449	245	Not Regulated	
5	Oil & Grease	mg/L	<0.2	0.4	< 0.2	< 0.2	< 0.2	-	
6	Surfactants anionics as MBAS	mg/L	<0.05	<0.05	<0.05	<0.05	<0.05	-	
7	Free ammonia (NH_3)	mg/L	<0.03	<0.03	<0.03	<0.03	< 0.03	< 0.1	
8	Coliform	MPN/ 100 ml	1800	< 1800	< 1800	< 1800	< 1800	-	

Note:
Regulation of Minister of Marine Affairs and Fishery No. KEP. 28/MEN/2004 on General Guideline for Shrimp Aquaculture.
Source: Data from BPIU2K Karangasem (Bali, 2020).

261. The results shown that BOD of hatchery wastewater are in range 69 – 149 mg/l, well above the applicable discharge standard. The COD are in range 245 – 571 mg/l, which are relatively high, though not regulated for the broodstock/hatcheries. Both indicates high organic contents in the wastewater. These provided basis for assessing the WWT proposed under the project to cut down such pollution level into compliance domestically.

(b) Wastewater from laboratories and their management

262. Some laboratories have measured or estimated the volume of wastewater and treat the wastewater in WWTP. Others still rely on simple WWT such as retention ponds and infiltration. Data from Balai/UPT indicated that current practices of wastewater management still need improvement.

263. The laboratory testing for wastewater in BPKIL Laboratory (Serang, Banten) conducted to two types of laboratories, namely (i) quality testing laboratories (dry laboratories) for quality testing, and (ii) bioassay laboratory(wet laboratory) for testing medicine and feed performance. The results of former testing presented in Table 50:, while the second testing (bio-assay lab) presented in Table 51:.

264. The wastewater from quality testing laboratories (physical-chemical lab, biological laboratories, feeds laboratory, etc.) of BPKIL Serang are discharged without treatment and accumulated in the septic tank. One sample taken at the inlet of laboratory (toward to the septic

tank) and another sample taken from the septic tank (liquid sample).

Table 50: Wastewater from Quality Test (dry) Laboratory (Serang, Banten)
(All units in mg/L, except expressed otherwise)

Parameters	Standard	Sample at septic tank		Remarks
		1 (Inlet)	2 (Outlet)	
Temperature (ºC)	38	30.0	26.0	
Total Dissolved Solid (TDS)	2000	252	62,073	TDS at the outlet still exceeded standard
Total Suspended Solid (TSS)	200	12	54	
pH	6,0 – 9,0	8.1	8.0	
Iron (Fe)	5	< 0.020	0.4	
Manganese (Mn)	2	< 0.010	28	Manganese at the outlet (septic tank exceeded the quality standard
Barium (Ba)	2	< 0.016	< 0.016	
Copper (Cu)	2	< 0.005	0.1	
Zinc (Zn)	5	0.01	0.3	
Chrom Hexavalent (Cr6+)	0.1	< 0.016	< 0.016	
Total Chrom (Cr)	0.5	< 0.010	0.1	
Cadmium (Cd)	0.05	< 0.002	< 0.002	
Mercury (Hg)	0.002	< 0.0001	< 0.0001	
Lead (Pb)	0.1	< 0.013	< 0.013	
Tin (Sn)	2	< 0.001	< 0.001	
Arsenic (As)	0.1	< 0.006	< 0.006	
Selenium (Se)	0.05	< 0.004	0.01	
Nickel (Ni)	0.2	< 0.016	< 0.016	
Cobalt (Co)	0.4	< 0.005	< 0.005	
Cyanide (CN)	0.05	< 0.002	0.002	
Sulfide (H2S)	0.05	< 0.002	0.01	
Fluoride (F)	2	0.1	0.1	
Free Chlorine (Cl2)	1	< 0.02	0.03	
Ammonia-Nitrogen (NH3-N)	1	0.3	0.3	
Nitrate (NO3-N)	20	0.5	1.041	Nitrate at the outlet (septic tank exceeded the quality standard
Nitrite (NO2-N)	1	0.01	0.2	
Total Nitrogen	60	12.6	21.5	
BOD5	50	18	19	
COD	80	30	34	
Methylene Blue	10	0.03	0.03	
Phenol	0.5	< 0.002	< 0.002	
Oil & Grease	10	1	1	
Total Coliform (MPN/ 100 mL)	5000	15.402	9.804	Total Coliform from lab) exceeded standard

Source: Laboratory Testing (TRTA, April 2021).

265. The testing indicated that the wastewater at outlet (septic tank) has exceeded the standard for four key parameters, i.e., TDS, Manganese, Nitrate, and Total Coliform, while wastewater discharged at the outlet at laboratories still meet the quality standard.

266. Another test carried out to bioassay (wet) laboratory of BPKIL Serang which test efficacy of medicine to fishes and shrimp by application of doses. The laboratory uses several tanks with fresh running water with pumps. The condition of the tanks is well controlled and almost no excessive feed. The ideal condition for growing fishes and shrimps provided to test the performance and efficacy of certain medicine to the target samples.

Table 51: Wastewater from Bio-Assay (wet) Laboratory(Serang, Banten)
(All units in mg/L)

Parameters	Standard	Sampling and Measurement				Remarks
		Point 1 (Inlet)	Point 2 (Outlet)	Point 3 (Settlement Pond)	Point 4 (Control Box)	
Temperature (^oC)	40	30.0	28.0	28.0	28.0	
Total Dissolved Solid (TDS)	4000	366	40855	470	88	
Total Suspended Solid (TSS)	400	4	258	328	12	
pH	6,0 – 9,0	7.6	7.9	7.6	9.2	
Total Nitrogen	60	11.5	3.3	12.8	8.5	
BOD_5	45	14	23	43	14	
COD	80	25	36	64	26	
Iron (Fe)	10	< 0.020	< 0.020	< 0.020	< 0.020	
Manganese (Mn)	5	< 0.010	< 0.010	< 0.010	< 0.010	
Barium (Ba)	3	0.3	< 0.016	0.02	0.2	
Copper (Cu)	3	< 0.005	< 0.005	0.01	< 0.005	
Zinc (Zn)	10	0.01	0.01	0.1	0.01	
Chrom Hexavalent (Cr^{6+})	0,5	< 0.016	< 0.016	< 0.016	0.02	
Total Chrom (Cr)	1	< 0.010	< 0.010	< 0.010	< 0.010	
Cadmium (Cd)	0,1	< 0.002	< 0.002	< 0.002	< 0.002	
Mercury (Hg)	0,005	< 0.0001	< 0.0001	< 0.0001	< 0.0001	
Lead (Pb)	1	< 0.013	< 0.013	< 0.013	< 0.013	
Stannum (Sn)	3	< 0.001	< 0.001	< 0.001	< 0.001	
Arsenic (As)	0,5	< 0.006	< 0.006	< 0.006	< 0.006	
Selenium (Se)	0,5	< 0.004	0.02	< 0.004	< 0.004	
Nickel (Ni)	0,5	< 0.016	< 0.016	< 0.016	< 0.016	
Cobalt (Co)	0,6	< 0.005	< 0.005	< 0.005	< 0.005	
Cyanide (CN)	0,5	< 0.002	0.003	0.004	< 0.002	
Sulfide (H_2S)	1	< 0.002	< 0.002	0.01	< 0.002	
Fluoride (F)	3	0.2	0.1	0.3	0.1	
Free Chlorine (Cl_2)	2	< 0.02	0.02	0.04	< 0.02	
Ammonia-Nitrogen (NH_3-N)	10	0.3	0.5	2	0.4	

Nitrate (NO_3-N)	30	0.5	0.5	1	0.5	
Nitrite (NO_2-N)	3	0.01	0.01	0.1	0.01	
Methylene Blue (MBAS)	10	0.04	0.1	0.05	0.1	
Phenol	1	< 0.002	< 0.002	< 0.002	< 0.002	
Oil & Grease	20	1	0.4	4	1	
Total Coliform (MPN/ 100 mL)	5000	1480	40	96784	12905	Total Coliform exceeded the quality standard at the outlet

Source: Laboratory Testing (TRTA, April 2021).

267. From the table, can be concluded that wastewater from bioassay laboratory of BPKIL Serang is less polluting. Wastewater from the field lab/bioassay are naturally treated through the settlement pond and control boxes. Prior the discharge into open water body (sea) the wastewater meets the key parameters, except for pH and Total Coliform. Before discharged from control box to sea, the wastewater is quite alkaline and high in total coliform.

(c) Summary of current wastewater and management.

268. Based on the secondary and primary data discussed above (Section III.C.2), the existing condition and status of wastewater management for the shrimp ponds, broodstock, and laboratories can be summarized as follows.

269. **For three hatcheries/breeding centers (all existing),** only broodstock/hatcheries of BPIU2K Karangasem (Bali) which wastewater discharge is tested during IEE with results summarized in Table 52: . No testing carried out for the multiplication center/hatcheries in Aceh and South Sulawesi. Both have not been fully operational and will be restored under the project. Therefore, data here is collected from the past record, and some are not available.

Table 52: Overview of current wastewater of broodstock/hatcheries (mg/L)

Subproject	BOD	COD	NH3 -N	TP	TSS	Total coliform	Existing WWT	Amount (M3/day)
Broodstock center Karangasem (Bali)	69 - 149	327-571	0.03	< 0.5	14-95	1800 MPN/100ml	Aerobic	750 m^3/ day
Multiplication Center South Sulawesi	No testing						Aerobic improper managed	500 m^3/ day
Multiplication Center Aceh Besar (Aceh)	No testing						Aerobic, improper managed	0.03 m3 /day (*hatchery is not in operation)*

270. **For five demonstration ponds**, since they are new ones to be built beside the existing ponds (thus expansion), the typical wastewater features of three types of ponds (Sylvo, semi-intensive, and intensive) intended by the project are obtained from literature survey, supplemented by samples tests of similar existing ponds nearby (results also in Table 53:). These data are critical for IEE and WWT design.

Table 53: Overview of current effluent of shrimp ponds (mg/L)

Subproject	BOD	COD	NH3-N	TP	TSS	Total coliform	Existing WWT	Estimated amount (M3/day)
Standard (Table 2-18)	< 45	**NA (IFC: 250)**	**< 0.1**	**< 0.1**	≤ 200	**NA IFC: 400**		
Mauk, Kemiri, Tangerang (Banten)	No testing						Aerobic using 2-3 units of water paddles; and introduce seaweed and milkfish/tilapia	15,000 – 18,000
Bulu, Jepara, (Central Java)	10.7	25.2	19-30	3-5	8-13	NA		15,000 – 18,000
Pulokerto, Kec. Kraton, (East Java)	No testing						Settlement pond with seaweed and milkfish as bioindicator	15,000 – 18,000
Banyuanara, Sanrobone, Takalar (South Sulawesi)	4.47 – 5.21	14.65 – 16.73	<0.01 -	0.39 – 1.80	<8	NA	Settlement pond, seaweed & milkfish as bioindicator	15,000 – 18,000
Datae, Duampanua, Pinrang (South Sulawesi)	No testing						None	15,000 – 18,000

Source: Estimated wastewater volume from MMAF Data.

271. **For seven laboratories,** only laboratory of BPKIL Serang (Banten) which wastewater discharge is tested during IEE with results summarized in Table 54:. No testing carried out for the other laboratories. Since the typical size and operation of the other laboratories are similar, BPKIL Serang has been chosen as representative of the laboratories under IISAP. As discussed in Section I.E and Section II.E.1, process/procedure for testing, equipment, and chemicals used in the 7 laboratories are similar.

Table 54: Overview of current wastewater of project laboratories (mg/L)

No	Laboratories	BOD	COD	NH3-N	TP	TSS	Total coliform	Current WW Amount (m^3/day)	Current WWT	Ground water table (m)
1	Baro, Ujung Batee, Aceh Besar (Aceh)	No Testing						0.005 (Average)	Discharged into flowing drainage	1.2
2	Hanura, Teluk (Lampung)	No Testing						0.361	WWT pond	6
3	Umbul Tanjung,Serang, Banten)	18 - 19	30 - 34	0.3	-	12-54	9804 - 15402	0.150 (Average)	discharged into septic tank	2
	Aquatic Animal/Bioassay, (Banten)	14 - 43	25 - 64	0.3 – 2.0	-	258	40 - 96784	7	Settling ponds- sea discharging	1.5
4	Bulu, Jepara (Central Java)	No testing						8	filtering, & infiltration ponds	1.5
5	Gundil, Situbondo (East Java)	No Testing						0.05	simple land infiltration	4
6	Karangasem, (Bali)	70-150	250-600	<0.03	-	-	<1800	0.005	Laboratory WWT to septic tank, Aerobic	2
7	Boddia, Takalar (South Sulawesi)	No testing						0.052	Septic tank, infiltration, to the sea	3-4

Source: Laboratory Testing (TRTA, April 2022), except Karangasem laboratory which is secondary data from BPIUK Karangasem.

3. Solid Wastes and their Management

272. Solid wastes come from operation of shrimp ponds, broodstock/hatcheries, and laboratories. There is segregation of the solid wastes based on its characteristics (organic vs. inorganic, hazardous vs non-hazardous, etc.), but no segregation based on the unit which generate the solid wastes. In case of co-location of shrimp ponds, broodstock/hatcheries, and laboratories, the solid wastes are collected and managed together. The only exception is hazardous wastes from laboratories, which separately collected and managed (in III.C.4).

273. General or municipal wastes such as those from domestic and office activities in shrimp ponds, broodstocks and laboratory shall be collected and transported by respective *Dinas Kebersihan* in the district, and then disposed to sanitary landfill managed by district government. However, as the shrimp ponds, broodstock, and laboratories located in the rural and remote area, most are not served by the Dinas Kebersihan. So, the waste generator shall bring the waste to the nearest temporary dumping, and then collected by Dinas Kebersihan operators.

Alternatively, most of the solid wastes are burnt in open air or into rivers. *Dinas Kebersihan* (local agency for cleaning) has main duties for planning, implementation, and supervision of the city's cleaning, sweeping, collection, transport, management of cleaning facilities and infrastructure and coordinate with related agencies and third parties in waste management. However, as identified in some districts there are some problems to consider:

(i) Lack of human resource, especially cleaning operators (street sweeper and transporter)
(ii) Inadequate supporting facilities and infrastructure for the cleaning service, both quality and quantity. Number of dump truck, arm roll, container boxes, and other waste fleets inadequate and some exceeded their economical age.
(iii) Limited staff who are skilled in practical 3R (Reduce-Reuse-Recycle) concept.

274. For pond sediment excavated and other organic wastes, currently they are used for pond embankment. Plastics, glass, can, cardboard, and other recyclables are collected by third party. Other organic wastes such as tree branches are collected by local people as fuel. The existing solid waste volume and management in the seven (7) subproject Laboratories locations presented in Table 55:.

Table 55: Volume and Current Wastes Management in Laboratories

No	Subproject lab	Existing Waste Management		Proposed Management (by Balai/UPT)
		Volume (kg/day)	Management	
1	Baro, Ujung Batee, Aceh Besar (Aceh) -	2	Burned in simple incinerator	Burned in improved incinerator
2	Hanura, Teluk Pandan, Pesawaran (Lampung)	Laboratory= ± 3 Office = ± 6	Burnt in open air	Burnt in incinerator
3	Umbul Tanjung, Serang (Banten)	0.6	Incinerator	Improved Incinerator
4	Bulu, Jepara (Central Java)	5	Burnt in open air	Incinerator
		< 0.5 for domestic wastes, and < 2.7 for organic wastes etc.	Segregated and recycled, and the rest burned in open air	Bins for non-recyclable wastes an for recyclable wastes for composting
5	Gundil,Panarukan, Situbondo (East Java)	1	Burned in open air	Collected and then transported and managed by Dinas Lingkungan Hidup (local Cleaning Agency
6	Tigaran, Kubu, Karangasem (Bali)	16	Burned in open air	Collected, transported and managed by kebersihan (local Cleaning Agency)
7	Boddia, Galesong, Takalar (South Sulawesi)	3 for domestic wastes and 4 for other (organic) wastes	Burned in open air	Burned in the simple incinerator

Source: Data from MMAF (Balai/UPT).

4. Hazardous Wastes and their Management.

275. Among the types of IISAP subprojects, hazardous wastes (biological and chemical) are mainly generated from the laboratories and to a lesser degree from shrimp facilities and ponds, By regulation it shall be managed by the waste generators or subcontracted to licensed third party for collecting, transporting and treatment/dumping (Ref. Section I.F.3). Based on the questionnaire sent to Balai/UPT, some Balai/UPT considered to collect and transferred the hazardous wastes (especially for laboratory wastes) to certified third party, and one of them (BPKIL Serang) has established an agreement with PT Wastec International for such arrangement. Other laboratories burn small volume of the hazardous wastes in the simple incinerator, as existing practices in Aceh, Bali, Banten, Central Java, and South Sulawesi laboratories.

276. Through the site visit and interviews, the laboratories that have third party to collect hazardous wastes admitted that such companies usually collected only a small part, not all hazardous wastes. The residues are either buried in pits or burned in open air as described above or incinerated in laboratories that have simple incinerators. For infectious wastes, the laboratory test procedure (e.g. treating by acid) can often turn them into non-infectious thus general wastes. The laboratories' testing work usually require autoclaves which can sterilize infectious into general wastes.

277. Typical chemicals and solvents used by aquaculture laboratories include ethanol, xylene, hexane, acetone, phenol, formaldehyde, inorganic acids and alkalis, etc. The laboratory usually collected spent solvent and chemicals in used glass bottles of 3-5 L in size. When full, the waste liquid is poured in pit made of concrete with slab cover and vent beside the laboratorybuilding. Solid hazardous wastes such as shrimp tissues are stored in similar concrete pit and digested, as the pits have never been full thus not cleaned. Some hazardous wastes are also burned together with garbage in open behind the laboratory building. The existing hazardous waste volume and management in the seven subproject laboratories are summarized in Table 56:.

Table 56: Volume and Current Practices of Hazardous Wastes Management

No	Project Location	Existing Hazardous Waste Management		Proposal by Balai/UPT & Lab
		Volume	Existing practice	
1	Baro, Ujung Batee, Aceh Besar (Aceh) -	0.1 kg/year	Burnt in incinerator	collect and then haul the hazardous wastes to certified third party
2	Hanura, Teluk Pandan, Pesawaran (Lampung)	3000 liter /year (combined liquid and solid)	Burnt in open air	
3	Umbul Tanjung, Serang (Banten)	980 liter/year (liquid hazardous wastes) 50 kg/year (solid hazardous wastes)	Transferred to certified third party (PT Wastec International) for hazardous treatment and dumping	Transferred to certified third party (PT Wastec International)
4	Bulu, Jepara (Central Java)	750 liter/year (liquid) 100 kg/year (solid)	- discharged in in pit. - Burn in open air	Same as above
5	Gundil, Panarukan, Situbondo (East Java)	60 kg/year	Burned in open air	
6	Tigaran, Kubu, Karangasem (Bali)	60 kg/year (Solid hazardous wastes)	Burned in open air	

No	Project Location	Existing Hazardous Waste Management		Proposal by Balai/UPT
7	Boddia, Galesong, Takalar (South Sulawesi)	84 kg /year	Burned in simple incinerator	

Source: Data from MMAF (Balai/UPT).

278. As referred to Environmental Management Guide for Small Laboratories U.S. Environmental Protection Agency (May 2000), laboratories should review their processes and identify opportunities to reduce the amount of wastewater generated and reduce the amount of hazardous wastes in the lab's effluent. If the discharges cannot be eliminated, the laboratory should consider applying appropriate technologies to minimize the quantity of wastewater generated. An example of a substitution that can minimize harmful discharges is using organic dishwashing solutions instead of chromic-sulfuric acid mixtures when washing glassware. Other appropriate approaches and specific treatment for the reduction and managing the hazardous wastes are adopted and incorporated in EMP.

5. Air Quality Baseline

279. Referring to Section II.F.1(a), key parameters for air quality according to the recent Indonesia regulation covers Sulfur Dioxide (SO_2), Carbon Monoxide (CO), Nitrogen Dioxide (NO_2), Photochemical Oxidant (O_2) as Ozone (O_3), Dust particulate (PM), Lead (Pb). Previous regulation on air quality standard also covers some additional parameters such as TSP, Pb, Dustfall, Total Fluoride, Flour Index, Chlorine and Chlorine Dioxide, and Sulphate Index. As the secondary data collected from respective local provincial environmental agency, the parameters of air quality presented by region varies as to their availability and completeness.

280. **Aceh.** Based on Air Quality Index (AQI) as released by https://www.iqair.com/id/[25] air quality in Banda Aceh (Capital City of Aceh Province) and its surrounding is identified as good quality with main pollutant PM2.5. Table 57 indicated that air quality in Aceh Besar and its surrounding is in good condition in terms of the four parameters (PM2.5, PM10, O3, and NO2).

Table 57: Air Quality Index of Aceh (Banda Aceh) (µg/Nm³)

Parameter	Concentration	Air Quality Standard (GR No. 41/1999)	Remarks
$PM_{2.5}$	7.5	65 (24-hour measurement)	All of the four parameters standard met
PM_{10}	25.8	150 (24-hour measurement)	
O_3	22.7	235 (1-hour measurement)	
NO_2	87.3	150 (24-hour measurement)	

Source: https://www.iqair.com/id/.

281. Aceh DIKPLHD (2020) also indicated that air condition in Aceh is in good quality as shown in Table 58:. However, the measurement is only limited to the two key parameters (SO_2 and NO_2). The other key parameters such as CO, O_3, HC, PM_{10}, $PM_{2.5}$, TSP, Pb, Dustfall, Total Fluoride, Flour Index, Chlorine and Chlorine Dioxide, and Sulphate Index are not measured.

[25] All data from https://www.iqair.com/id/ used in this IEE was accessed in 23 December 2021.

Table 58: Air Quality Data of Aceh (Aceh Besar)

(All units in µg/Nm³	**SO_2**	**NO_2**	**Air Quality Standard (GR No. 41/1999)**	**Remarks**
Aceh Besar (Semester I)			SO_2 (Sulfur Dioxide): 365 NO_2 (Nitrogen Dioxide): 150	The results of measurement indicated the concentration of both key air pollutants (parameters) are much lower than the air quality standard.
A (Transportation)	<2.57	-		
B (Industry)	4.06	7.30		
C1 (Settlement)	9.53	3.54		
C2 (Office)	11.96	2.69		
Aceh Besar (Semester II)				
A (Transportation)	<2.57	12.50		
B (Industry)	5.16	7.43		
C1 (Settlement)	6.86	2.59		
C2 (Office)	9.32	1.85		

Source: Aceh DIKPLHD (2020).

282. **Lampung.** Based on Air Quality Index (AQI) as released by https://www.iqair.com/id/ air quality in Bandar Lampung (Capital City of Lampung) and its surrounding is identified as moderate quality with main pollutant PM2.5. As referred to Lampung's Environmental Performance Document (DIKPLHD, 2020), generally parameters NO2 and SO2 in 15 districts/cities in Lampung still meet the quality standard. The air quality index (IKU) recorded in range 80.31 – 91.32, as shown in Table 59:.

Table 59: Air Quality Data in Lampung

No	**Districts/Cities**	**Air Quality Index**	**Remarks**
1	Tanggamus	87,17	
2	Lampung Selatan	88.82	
3	Lampung Timur	84.49	
4	Lampung Tengah	88.22	
5	Lampung Utara	88.42	
6	Way Kanan	82.32	
7	Tulang Bawang	88.91	
8	Mesuji	87.76	
9	Pringsewu	86.33	
10	Pesawaran	90.60	One of the IISAP proposed location
11	Tulang Bawang Barat	91.32	
12	Kota Bandar Lampung	80.31	
13	Kota Metro	81,80	
14	Lampung Barat	86.21	
15	Pesisir Barat	90.15	

Source: Lampung's Environmental Performance Document (DIKPLHD, 2020).

283. **Banten.** Air Quality Index (AQI) as released by https://www.iqair.com/id/ air quality for Serang and its surrounding is identified as moderate quality with main pollutant PM2.5. The parameters measured only limited to PM2.5 and PM10, as in Table 60:.

Table 60:Air Quality Index of Banten (Kabupaten Serang)

Pollutant	Concentration	Standard (GR No. 22/2021)	Remarks
PM2.5	4 µg/m³	55	The results meet the quality standard
PM10	10 µg/m³	75	

Source: https://www.iqair.com/id/.

284. Secondary data also captured from Banten's SLHD (2017), in which a more detail on air quality with parameters in Banten (focusing on Kabupaten Serang and Tangerang) presented in

285. Table 61: shows that air quality in the sampling areas of Serang and Tangerang meet the air quality standard for both sulfur dioxide (SO_2) and nitrogen dioxide.

Table 61: Air Quality Data of Banten (All units in µg/Nm³))

No	District	Location of Sampling	Stage I		Stage II		Standard (GR No. 41/1999)
			SO_2)	NO_2	SO_2	NO_2	
1	Tangerang	Transportation	5.48	58.90	5.25	60.80	SO_2 (Sulfur Dioxide): 365 NO_2 (Nitrogen Dioxide): 150
		Industry/Agro Industry	<2.57	40.10	12.99	26.70	
		Settlements	26.10	<0.41	30.88	19.80	
		Office/ Commercial	9.92	21.70	7.24	11.30	
		BLANK	<2.57	<0.41	<2.57	<0.41	
2	Serang	Transportation	13.12	40.50	28.51	70.60	
		Industry/Agro Industry	10.68	34.20	27.14	42.60	
		Settlements	3.48	24.20	10.31	20.20	
		Office/ Commercial	14.72	26.70	16.89	26.70	
		BLANK	<2.57	<0.41	<2.57	<0.41	

Source: Banten's SLHD (2017).

286. **Central Java.** Based on the Strategic Environmental Assessment (SEA/KLHS) of Kabupaten Jepara 2017-2022, air quality in Jepara (Central Java) is relatively good. Most parameters tested still under the threshold values (ref. GR No. 41/1999). The parameters that tends to exceed the quality standard, namely: dust /TSP at several sampling points. From the monitoring for 5 years, starting from 2011 to 2016 can be seen the trend in Table 62:.

Table 62: Dust/TSP in Kabupaten Jepara 2011 – 2016 (All in µg/m³)

No	Location of Sampling	2011	2012	2013	2014	2015	2016	Standard (GR No. 41/1999)	Remarks
1	KALIPUCANG	481	312.7	247.7	707.2	624.6	846.6	230	Exceeded quality standard in all years
2	PASAR PECANGAAN	85	219.5	116.1	277.8	500.9	227.5		Exceeded quality standard (2015)
3	GRIYA TAHUNANINDAH	308	187	72.41	144.7	150.3	139.9		Exceeded quality standard (2011)
4	TUGU KARTINI	123	152.6	217.6	120.5	105.2	174		
5	TPA BANDENGAN	108	58.12	41.12	79.47	88.09	46.76		
6	MANTINGAN	352	297.5	365.8	298.6	322.9	255.87		Exceeded quality standard in all years

Source: Strategic Environmental Assessment (SEA/KLHS) of Kabupaten Jepara 2017-2022

287. From the data in the table above, air quality in Kalipucang is the worst, which exceed the quality standard for all years (2011 – 2016) and tend become worse (846 µg/m³ in 2016). Air quality in other areas tend to improve as all (except Kalipucang and Mantingan) met the quality standard in 2016.

288. **East Java.** Based on Air Quality Index (AQI) as released by https://www.iqair.com/id/ air quality in East Java (especially in project areas, i.e., Situbondo and Pasuruan) is identified as moderate quality with main pollutant PM2.5. Concentration of PM2.5 in Situbondo at the measurement is 4 times of the annual WHO threshold value. Concentration of PM2.5 in Pasuruan at the measurement is 4.8 times of the annual WHO threshold value. Based on East Java's DIKPLHD (2017), data on air quality in Pasuruan, one of the project areas in East Java (Table 63:). The air quality in the area meet the standard, though that some key parameters (among others PM_{10}, dustfall, and lead) were not measured.

Table 63: Air Quality Data of East Java (Pasuruan, (All in µg/m³)

No.	Location	SO_2	CO	NO_2	O3	HC	PM_{10}	PM2,5	TSP	Pb
	Standard	**900**	**30,000**	**400**	**235**	**160**	**150**	**65**	**230**	**2**
1	Jl. Laksana Martadinata / Depan Pabrik Baja Kota Pasuruan	22.50	15,926	3,85	49.40	-	-	-	99.30	0,0357
2	Jl. Rajawali / Perum Taman Asri Kota Pasuruan	26.10	2,946	5,68	17.90	-	-	-	2.31	0,0215

Source: East Java's DIKPLHD (2017)

289. **Bali.** Based on Air Quality Index (AQI) as released by https://www.iqair.com/id/ air quality in Karangasem and its surrounding is identified as moderate quality with main pollutant PM2.5. Concentration of PM2.5 in Kubu at the measurement 1.6 times of the annual WHO threshold value. Bali's DIKPLHD (2018) provided data on air quality in Karangasem and other districts in Bali, as presented in Table 64.

Table 64: Average of air quality in Bali (All units in µg/Nm³)

District/ City	SO_2	NO_2	CO	Pb	Dust (PM_{10})	Dust ($PM_{2,5}$)
Standard(1)	**365**	**400**	**30,000**	**2**	**150**	**65**
Karangasem	91.542	31.002	393.972	0.224	150.322	3.412
Klungkung	101.048	32.338	527.968	0.18	138.644	3.284
Gianyar	93.85	36.94	650.968	0.122	83.676	2.636
Bangli	110.294	27.914	596.766	0.122	112.162	2.31
Denpasar	117.518	32.5	1.209.874	0.122	106.49	2.878
Badung	137.978	33.24	916.946	0.138	124.028	3.176
Tabanan	129.69	32.88	823.012	0.16	130.052	2.4
Jembrana	124.812	26.824	729.054	0.15	123.048	2.39
Buleleng	129.524	20.408	678.04	0.162	116.474	2.304

Note: (1) Standard of Government Regulation No. 41/1999 (for one-hour measurement).
Source: Bali's DIKPLHD (2018).

290. **South Sulawesi.** Based on Air Quality Index (AQI) as released by https://www.iqair.com/id/ air quality in Karangasem and its surrounding is identified as moderate

quality with main pollutant PM2.5. PM2.5 concentration in Takalar air is currently 2.8 times above the WHO annual air quality guideline value. PM2.5 concentration in Pinrang at the measurement met the annual WHO threshold value.

291. South Sulawesi's IKPLHD (2018) provided serial data on air quality in South Sulawesi (including Takalar and Pinrang) is presented in Table 65. The data shows that the air quality in South Sulawesi meet the standard for some key parameters, though the data not specifically reflect the condition in target location of Takalar and Pinrang.

Table 65: Air Quality in South Sulawesi

Parameter	Unit	Measurement Duration	2013			2014			2015			Quality Standard (1)
			Min	Max	Mean	Min	Max	Mean	Min	Max	Mean	
Sulfur Dioxide (SO_2)	$\mu g/Nm^3$	1 Hour	11.5	12.4	11.9	10.2	61.2	35.7	42.5	113.8	56.7	900
Carbon Monoxide (CO)	$\mu g/Nm^3$	1 Hour	10.2	11.4	10.8	10.0	120.0	65.0	-	-	-	30.000
Nitrogen Dioxide (NO_2)	$\mu g/Nm^3$	1 Hour	11.6	12.2	11.9	13.6	176.2	94.9	11.0	89.5	15.9	400
Ozone (O_3)	$\mu g/Nm^3$	1 Hour	Not detected	Not detected	Not detected	Not detected	Not detected	Not detected	10.0	91.7	15.6	235
Particulate (TSP)	$\mu g/Nm^3$	24 Hour	12.0	14.0	13.0	-	-	-	31.0	684.0	217.4	230
Lead (Pb)	$\mu g/Nm^3$	1 Hour	Not detected	0.135	0.068	-	-	-	-	-	-	2

Note: (1) Standard of Government Regulation No. 41/1999).
Source: South Sulawesi's IKPLHD (2018).

292. As all of the core subprojects are located in rural areas where air quality is not a significant issue, there is no need for laboratory testing. Secondary data also indicated that air quality in the subproject locations is relatively good and no or negligible air pollution.

D. Social Economic Resources

293. Based on the latest statistic data published by each district (i.e., *Kabupaten Dalam Angka*, 2020/2021), the key demographic figures of the district's statistics (total population, population growth, density, and sex ratio) are summarized as presented in Table 66. Almost all locations in Java (i.e., Serang, Tangerang, Jepara, Pasuruan) are densely populated areas, while other off-Java locations are less populated. Especially for Jepara, the site is surrounded with dense settlements.

Table 66: Summary of Demographic Data of IISAP Locations

No.	Districts	Population	Population Growth (%)	Density (persons/km2)	Sex Ratio
1	Aceh Besar	405,535	1.40	140.00	102.00
2	Pesawaran	477,468	1.76	406.78	106.30
3	Serang	1,622,630		858.00	104.70
4	Tangerang	3,245,619	1.26	3,382.23	104.8
5	Jepara	1,184,947	0.75	1,120.94	101.24
6	Pasuruan	1,605,969	0.58	1,089.52	100.19
7	Situbondo	685,967	0.58	419.00	96.40
8	Karangasem	492,402	2.12	587.00	102.70
9	Pinrang	300,853	1.07	531.00	95.50
10	Takalar	403,994	1.37	206.00	97.50

Source: District Statistic Book (i.e., *Kabupaten Dalam Angka*, 2020/2021).

294. Production activities in the districts are differentiated into three groups of activities, namely primary, secondary, and tertiary activity. The primary activities related to natural resource exploitation, consisting of agriculture sector (food stuff, plantation, livestock, fishery, and forestry) and mining sector. Secondary sector utilizes natural resource products to process further, consisting of processing industry, construction, and energy (electricity and water) sector. Tertiary sector facilitates movement of primary sector and secondary sector, consisting of trade, hotel, and restaurant sector; transportation and telecommunication sector; financial, rental, and corporate services, and other services.

295. Gross Regional Domestic Product (GRDP) is one of economic indicators to describe economic activity in certain region, which present the share of the economic sectors (i.e., primary, secondary, and tertiary activities). Gross Regional Domestic Product composed of total goods and services produced in a region. Agriculture, Forestry and Fishing contribute significantly to the GDP/GRDP of each district, in 3,000 – 9,000 billion rupiah.

E. Infrastructure and Facilities

296. **Electricity**. Electricity in the districts is provided by PLN as State Owned Electric Company to generate and distribute electricity to the customers. The electricity demands in the districts commensurate with the economic activities and growth in the areas.

297. The facilities of shrimp ponds, broodstock, and laboratory connected with PLN grid for electricity. For reserve, the facilities also provide generators. For example, shrimp ponds in Pinrang (South Sulawesi) use electricity from PLN with annual capacity 30,000 kWH/year and use genset as reserve with capacity 65 kVA and consume diesel oil for 1000 L/year. Thus far, no renewable powerplant is installed in the locations such as windmill or solar parks.

298. **Water Supply**. Local Government Owned Water Supply Company (PDAM) established in each district to provide clean and healthy water supply for people. In addition to PDAM's piped distribution system, water demands for domestic and industries in some areas also rely on rivers and groundwater, especially deep groundwater.

299. As its vital role for domestic, municipal and industries, water demand at future in the districts will be a challenging issue. The main problem is related to poor performance of water

supply service due to uneven water supply distribution system and lack of water supply volume. Some people have no access to piped water supply and rely on groundwater wells. Excessive groundwater extraction, especially in coastal areas, might lead to saline water intrusion and land subsidence.

300. **Drainage.** *Dinas Pengairan* (local agency responsible for drainage and water resources) has duties to implement covering activities in technical planning, water resources development and management, monitoring and evaluation in water resources development and management, irrigation, and drainage *(including flood control).*

301. Flood or inundation is a common natural disaster in urban areas, especially for coastal areas as in the IISAP project locations. This is caused by heavy rain, blockage of water canals and coastal flood from sea. Naturally, ditch/drain and rivers located in urban areas function as drainage channels. Flood protection to the shrimp ponds through embankment is one of the activities under IISAP.

302. Based on the management authority and function, urban drainage system has hierarchy as follows. Minor Urban Drainage represents the network that serve a certain urban area of approximately 10 ha such as settlement complex, commercial area, offices, and industrial areas, market, tourism areas. Major Urban Drainage represent the network which structurally consist of primary canal that contain flow from secondary canal. Secondary canals contain flow from tertiary canal. Local drainage network can be directly drained to primary, secondary, and tertiary canals.

303. **Social and Health Facilities**. In addition to infrastructure, some basic social and health facilities also built by local government to serve people in education, health, and religious/cultural services. As provided in detail in the statistics data (i.e., *Kabupaten Dalam Angka*), each districts provides schools, hospitals/health centers, religious facilities (mosques/churches/temple) and cultural facilities as the characteristics of the districts.

F. Physical Cultural Resources

304. Some physical cultural heritages identified in the districts/provinces, but they are far (more than 1 km, if any) from project sites. Spatially, as proved by local spatial plan (RTRW), no project sites which conflict with areas with cultural and/or historical values. Similarly, during construction and operation phase, no identified potential direct and indirect impact of the project activities to the physical cultural resources.

305. However, a chance find procedure included in EMP of this IEE, as refer to ADB Safeguard Policy Statement (2009) and Government regulations. This is aimed as anticipation for any unanticipated finding during the construction. Furthermore, as part of IISAP project preparation, a list of sensitive receptors (residential, hospital/clinics, schools, seniors' house, tourism/marina, etc.) are also identified and recorded in Table 67 below. As the location of subproject sites are within 200 m, the impacts on the tourism also assessed as part of occupational health and public safety impacts, especially traffic safety (Section IV.D.3).

Table 67: **Brief Site Description and Relative Distance to Sensitive Receptors**

No	Project Location	Distance to Sensitive Receptors (m)		
		Residential	**Hospital, Schools, Cultural; Religious**	**Others: tourism**
1	Baro, Ujung Batee, Aceh Besar (Aceh) - narrow coastal area and less vegetated. The site surrounded by thin belt of mangrove.	600 – 1000	More than 1 km	200
2	Hanura, Teluk Pandan, Pesawaran (Lampung) ,A coastal area surrounded by thick green belt of mangrove.	None	More than 1 km	
3	Umbul Tanjung, Serang (Banten) - surrounded by a green belt of coconut, planted dragon fruit, thin mangrove.	300	More than 1 km	200
4	Bulu, Jepara (Central Java): A coastal area with thin strip of green belt in built-up areas.	100	More than 1 km	200
5	Gundil, Panarukan, Situbondo (East Java); A narrow coastal area with thick green belt.	50 - 100	More than 1 km	400
6	Tigaran, Kubu, Karangasem (Bali) : narrow coastal area surrounded by wide green belt.	50 - 100	More than 1 km	200
7	Boddia, Galesong, Takalar (South Sulawesi) -A narrow coastal with green belt.	50 - 100	More than 1 km	

Source: Estimated from Google maps and data from MMAF (Balai/UPT).

IV. ANTICIPATED ENVIRONMENTAL IMPACTS AND MITIGATION MEASURES

A. Area of Influence and IEE scoping

306. This section of the IEE reviews possible subproject-related impacts, in order to identify issues requiring further attention and screen out issues of no relevance. ADB SPS (2009) require that impacts and risks are analyzed for the conditions reflecting pre-construction, construction, and operational stages within the subproject's area of influence. As such, this section reviews potential subproject-related impacts and identify issues requiring further attention and to screen out issues of no relevance. Similar scoping process carried out in Indonesia AMDAL system.

307. Impacts and risks were analyzed in the context of project's area of influence for main project activity as well as associated activity (such as irrigation canal and access road). The type of project is non-linear and limited to existing location. The IEE's scope is about 100-200 m from their boundary or median for impacts on air, water and noise. For biodiversity and eco-system assessment, the coverage however is much wider, covering all vegetation communities and fauna habitats. OFr example the scope for biodiversity is 1000 m (I km) as referred to [26] that mammal's average daily range (e.g., proboscis monkey) is approximately 1 km.

308. The scoping is about identifying the major impacts for the IEE to focus on rehabilitation and expansion as well as operation of the shrimp ponds, broodstock, and laboratories potentially affect environment, both directly and indirectly. Basically, major impacts and risks[27] are mainly from their operation phase.

B. Impacts During Operation

1. Impacts from aquaculture

309. During operation, the shrimp ponds and hatcheries (broodstock and multiplication centers) have most impacts in common, as indicated in the flowcharts in Figure 8. They both will generate a range of potential environmental impacts and risks,. The assessment below will be focused on those major issues.

310. **Impacts on Aquatic Ecosystems, especially from wastewater effluent.** This is the main impacts to assess as all three components (shrimp ponds, broodstock, and laboratories) use feeds and/or chemicals in the process. Therefore the effluent can be high in organic content. The largest volume of the wastewater generated from the shrimp ponds, while broodstock and laboratories generate relatively small quantities of wastewater with lower organic content since higher water quality is required for fry and larvae . The quantitative analysis and prediction below show that with treatment proposed and mitigation measures in the EMP, water pollution from the project can be controlled to meet the applicable discharge standards thus won't pose significant impacts on the environment.

311. **Solid wastes containing nutrients, chemicals, and hazardous materials.** The aquaculture sector may involve the handling and use of nutrients such as feed and fertilizers as well as antibiotics for disease control, most of them being organic and can be utilized. The

[26] Amalia Rezeki, Zainudin, "Daily Range Distance and Movement Activity of Proboscis Monkey (*Nasalis larvatus* Wurmb) in Bakut Island, Barito Kuala Regency" Presiding of National Seminar on Wetland, 2016, Edition 1: 32-36.
[27] IFC Guideline on Aquaculture.

laboratories under the project use chemicals and hazardous materials (e.g., oil, solvents and other chemicals) with residues and the spent materials as solid or liquid wastes. As the solid wastes section below demonstrates, these wastes will be segregated and treated largely on-site with devices to be established or retrofitted under the project. Only residues will continue to be handled by the certified third party, therefore effectively manage solid wastes without posing significant impacts.

312. **Threats to biodiversity and natural habitats**, through potential release of alien species into the natural environment during operations; potential loss of genetic resources due to collection of larvae, fry, or juveniles for aquaculture production; potential encroachment of coastal ecosystem such as mangrove due to expansion of shrimp ponds, ; sustainability of fish meal and fish oil ingredients for fish and crustacean feeds; and development of antibiotic resistance in pathogenic bacteria that can then spread from farms to wild stock. As the analysis below shows, these impacts are expected to be moderate for the demonstration ponds and hatcheries. For future subprojects, screening and siting criteria are designed to avoid and minimize the adverse impacts from the outset.

Figure 8: Impact and Risks of Shrimp Pond by Sequence of Activities

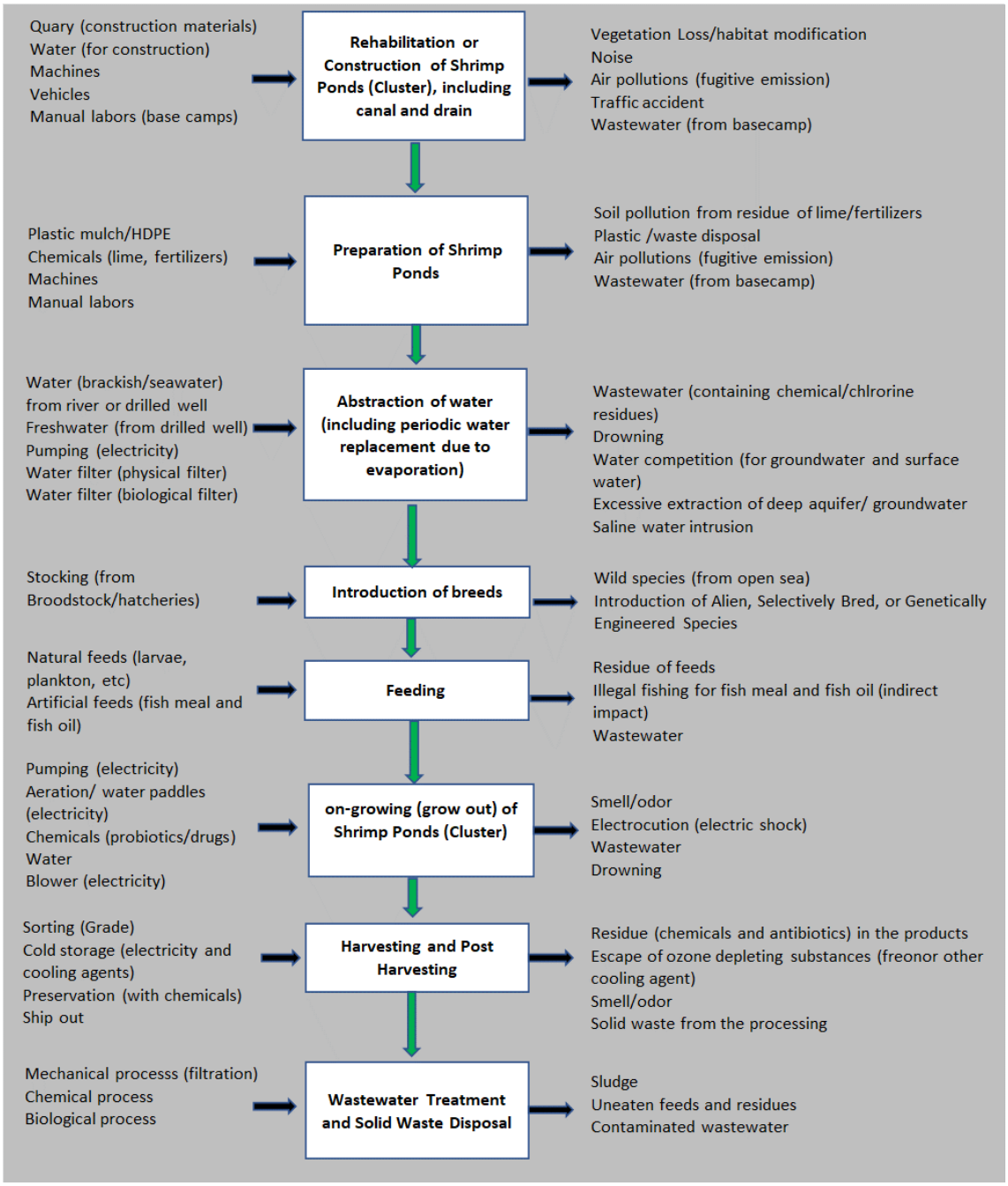
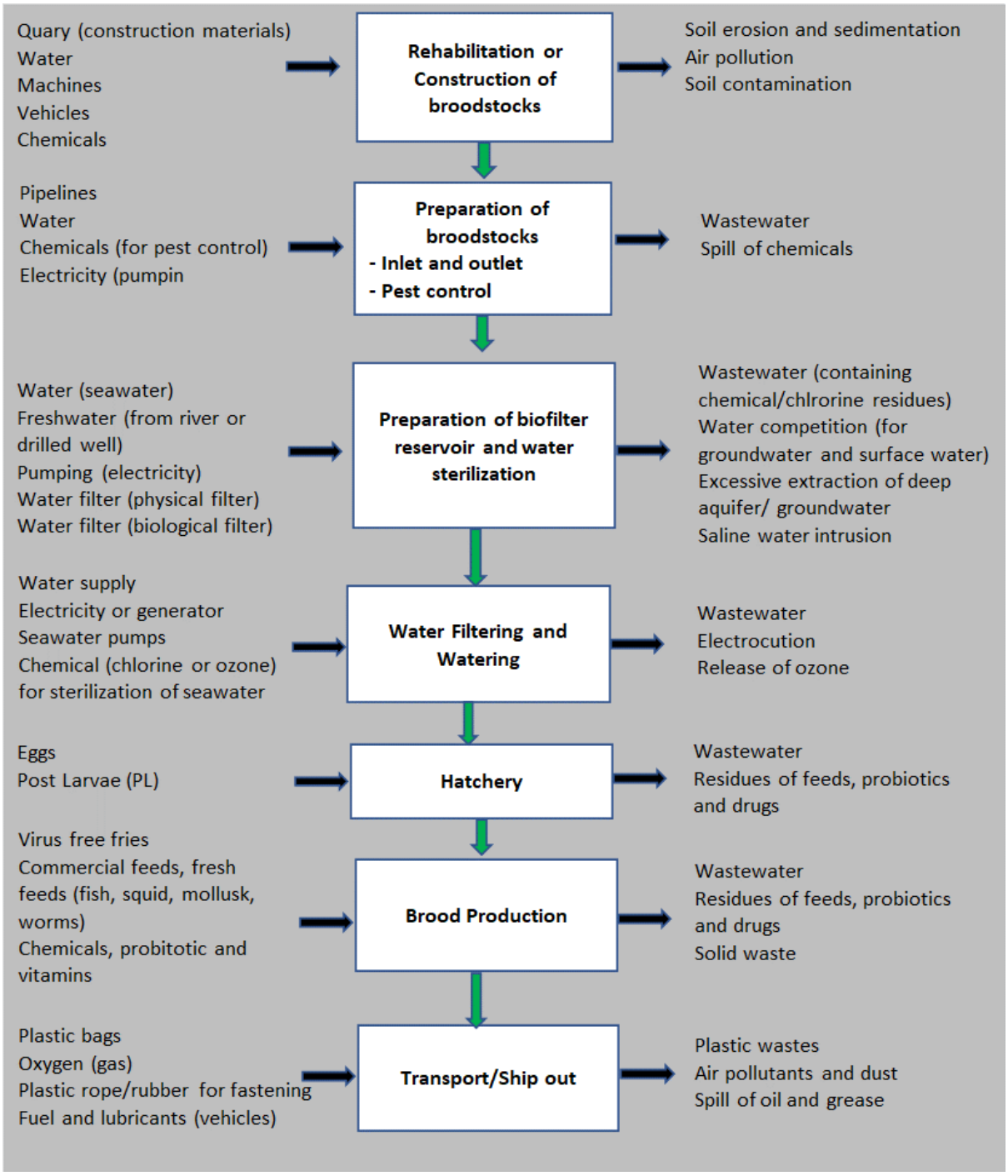


Figure 9: Impact and Risks of Broodstock by Sequence of Activities



(a) Wastewater and impacts of aquaculture

313. For aquaculture subprojects (broodstock, and shrimp ponds), most of the wastewater is generated from replenishing ponds/tanks when their quality is unsuitable for production due to excreta from larvae, fry or shrimps and residues of feed and antibiotics etc. Such wastewater has moderate -high organic content in terms of BOD and COD (see Table 52: and Table 53:).

314. The effluent released from aquaculture operation typically contains varying organic and nutrient load, suspended solids, and may also contain chemical residues including feed supplements and antibiotics. The possible impacts include contamination of groundwater and surface water from release of effluents to receiving water from unconfined process and storage tanks (such as ponds and lagoons). Impacts on aquatic systems include creation of eutrophic zones within receiving waters, increased fluctuation of dissolved oxygen levels, creation of visible plumes, and accumulation of nutrients within the receiving waters.

315. The high nutrient load resulted from efforts to artificially boost production levels by increasing the feed supply for the cultured species. This is done by increasing nutrient availability either directly through supplemental feed or indirectly by fertilizing ponds to increase primary productivity. Pond ecosystems have a limited capacity to recycle organic matter and nutrients, and increasing the stocking rate removes this capacity, resulting in the build-up of organic matter, nitrogenous waste, and phosphorus both in the water mass and on the bottom of the pond. The suspended solids are derived from particulate organic matter and erosion of pond floor, walls, and discharge channels.

316. Nowadays shrimp farmers also use a wide range of chemicals to prevent and manage disease, to manage water and pond soil quality, and to facilitate harvesting and transportation. This also contribute to the contamination of the wastewater. The chemicals used include among others

(i) Soil and water treatments (e.g., EDTA, lime, zeolite);
(ii) Disinfectants (e.g., sodium or calcium hypochlorite and chloramine, benzalkonium chloride (BKC), formalin, iodine, ozone);
(iii) Pesticides and herbicides (e.g., saponin, rotenone, anhydrous ammonia, Gusathion, Sevin, organophosphates, organotins);
(iv) Antibacterial agents (e.g., nitrofurans, erythromycin, chloramphenicol, oxalinic acid, various sulphonamides, oxytetracycline);
(v) Other therapeutants (e.g., formalin, acriflavine, malachite green, methylene blue, potassium permanganate, Trifluralin);
(vi) Feed additives (e.g., immunostimulants, preservatives and anti-oxidants, feeding attractants, vitamins);
(vii) Anesthetics (e.g., benzocaine, quinaldine); and
(viii) Hormones.

317. Wastewater from shrimp ponds contain organic materials consisting of shrimp feces, residues of feeds, remains of shrimp body, and dead aggregate of micro-organism (plankton) frequently found settled on the bottom of ponds. According to Syah (2017) wastewater from shrimp pond containing N and P increase the fertility of the water. Though wastewater from shrimp on-growing usually contain less concentration of pollutants, but large volume accumulatively affects the environment. The concentration of pollutants depends on the duration of on-growing, density of the shrimp, ponds substrate and the construction. Based on MMAF Technical Guidelines (2019) typical load of the ponds by its density presented in Table 68:.

Table 68: Nitrogen and Phosphate Load of the Pond Wastewater by Density

Density species/m2	Waste Load[a]		Reference
	N (kg)	P (kg)	
50	108.49	56.13	Syah et al., 2014
500	406.57	100.33	
600	532.30	119.50	

Source: MMAF Technical Guidelines on Shrimp Growing on Ponds(2019).

318. The wastewater generally contains high concentration of water pollutants. The typical pollution concentration for shrimp ponds in Indonesia are presented in Table 69 below, as compiled from MMAF Technical Guideline on Wastewater Treatment for Shrimp Ponds (2019). The contents of BOD in the wastewater the contents recorded about 19.80 - 64.52 mg/L, which exceeded the quality standard. Similarly, parameter TSS, total nitrogen and total phosphate exceeded the quality standard. Data from subprojects ponds (Table 53) only represent two shrimp ponds among five shrimp ponds cluster under UPT areas and are considered too low. The main reason is presumably resulting from the sampling time, as they were sampled shrimp ponds at early stage of growing thus cleaner effluent. This also shows the importance of routine monitoring of BOD, COD in addition to those currently being monitored for typical shrimp ponds as per Indonesian regulations and guidelines.

Table 69: Typical wastewater concentration of shrimp ponds

Density species/m2	Concentration (mg/L)					
	BOD	TOM	COD	TSS	TN	TP
Standard	< 45	-	250[a]	≤ 200	< 0.1	< 0.1
Semi Intensive (150)	NA	100 – 122	Not regulated	NA	< 7	< 2
Intensive (400)	< 65	117 – 182		NA	4 – 6	> 1
Super intensive	< 20	80. – 103		1663 – 773	3 - 10	7 - 12

Note: Some numbers are rounded. (b) Referring to IFC-WB EHS Guideline on Aquaculture. Not regulated in Indonesia regulation for ponds Source: .

319. All these loads in Nitrogen and phosphorous will be converted into high COD in wastewater discharged and can increase difficulty in WWTP which uses biodegradation. Contents of pollutants in wastewater discharged into environment increase as the higher density of the shrimp. The high density increases the load of wastes generated, caused by retention of nitrogen (N) and phosphorus (P) from feeds, recorded 22.27% and 9.79%. The nutrient discharged to the aquatic environment recorded 77.73% nitrogen and 9.21% phosphorous (Hongsheng et al., 2008).

320. The effluent released from shrimp ponds and broodstock may contain chemical residues including feed supplements and antibiotics. The possible impacts include contamination of groundwater and surface water from release of effluents or communication to receiving water from unconfined process and storage tanks (such as ponds and lagoons). Impacts on aquatic systems include creation of eutrophic zones within receiving waters, increased fluctuation of dissolved oxygen levels, creation of visible plumes, and accumulation of nutrients within the receiving waters.

321. However in reality, the tests results for broodstock and hatchery in Bali, the only one in

operation, show their BOD, COD etc. (Table 48: and Table 49) are much higher than the MAF guidelines compiled. Different with shrimp ponds with periodic large discharge, wastewater from hatcheries is less but continues. Therefore, to be more conservative, these test results of hatchery subproject effluent are used as basis for quantitative analysis.

(b) Wastewater prediction for demonstration ponds

322. The total volume of wastewater/day from expansion of the shrimp pond cluster/subproject is estimated as 10 - 20% of total volume of pond water media with flow approximately 20 m^3/minute, and retention time in the WWT ponds of 5 days. It is estimated that discharged water (m^3/day): 1000 m3/day per ha. The shrimp ponds water discharge wastewater starting from third month gradually: 10% per day in second month and 20-30% per day in the third month until harvesting. The estimated volume for the shrimp ponds for each five locations presented in Table 2 (Section I.C).

323. The peak volume of wastewater generated from 5 new demonstration pond clusters at third month onward will determine their WWT structure's capacity, i.e. 30% of total water volume per day averagely with margin. According to FS design, standard demo pond is 1500M2 x 1.7m water depth=2550 M3. Thus, for intensive ponds, the maximum turnover is 30% water/week=765 M3/week or 109.2 m^3/day (in third month). This is about 120 M^3/day/pond that is likely needed to discharge at the peak of shrimp growing. Multiplying by the number of ponds to be built by the project, the size of WWT (lagoon) to hold the expected maximum effluent are estimated (Table 70). The retention time for such wastewater to degrade its pollution (BOD) depends on whether aeration is employed or not, which can speed up degradation thus reduce retention time and hence the lagoon's size.

Table 70: Wastewater Estimate of (Intensive) Shrimp Ponds

Name	Pond Description	Total effluent (M3/d)	Lagoon size (M3)
Tangerang (Banten).	Total Area: 16.11 Volume: 70,000 m3 Ponds: 10	10 x 1500 m2 x 1.7 m x 0.3 = 7,650 m3/week = 1,092 m3/day	5460 M3 under assumption that 5 days retention is sufficient to degrade pollutants.
Jepara (Central Java)	Total Area: 48.10 Volume: 70,000 m3 Pond: 10	Same as above	
Pasuruan (East Java)	Total Area: 43.20 Volume: 14,400 Pond: 12	12 x 1500 m2 x 1.7 m x 0.3 = 9,180 m3/week = 1,311 m3/day	6555 M3 under same assumption as above
Takalar (South Sulawesi)	Total Area: 35.00 Volume: 70,000 Pond: 10	10 x 1500 m2 x 1.7 m x 0.3 = 7,650 m3/week = 1,092 m3/day	5460 M3 under same assumption as above
Pinrang (South Sulawesi)	Total Area: 41.40 Volume: 70,000 Pond: 10	Same as above	

Source: DJPB (MMAF)

324. According to the project FS, aerobic treatment plant (activated sludge) is proposed for wastewater treatment. Its typical pollution removal rate is 60 – 70% for BOD, 90% for COD, 80% for SS, 30% for T-N, and 90% for NH4-N and O&G. However, considering the Indonesia discharge standard applicable to shrimp ponds (Table 71), such WWT can bring the likely wastewater from the subprojects' ponds into compliance.

325. In addition, the standard activated sludge WWT normally used by centralized WWTP of a town or city requires high capacity to O&M, unable to be managed by typical hatcheries or shrimp ponds cluster, let alone those by farmers or cooperatives for whom the project ponds intend to demonstrate. Therefore, other more effective yet more affordable and easier to O&M methods are explored.

326. Given the sylvo pond is intended to utilize mangrove to purify incoming brackish or seawater for ponds, the mangrove and related wetland or constructed wetland (CW)) should also be able to treat effluent from such ponds after growing shrimps or fry. This is more nature-based wastewater treatment can include two stages: one aerated lagoon, then CW designed to combine with mangrove.

327. Based on typical removal rate of major wastewater treatment methods in Indonesian guidelines (Table 71) and other sources, and maximum concentration data of subproject types gathered in section III.C.2, the results after treatment are estimated for aerated lagoon and wetland, both nature based solution are simple and affordable method suitable for most subprojects which have sufficient space. For caution, the tests for subproject shrimp ponds effluent are not conducted in peak time. Thus the actual pollution concentrations are likely higher, similar to those of the hatcheries.

Table 71: Shrimp pond wastewater treatment
(All in mg/L, except specify otherwise)

Parameter	**Typical max effluent of Pond (**Table 47**) and Hatchery ((**Table 48Table 49**)**	**Removal Percentage of Pollutants**				**Discharge standards**
		Aerated lagoon	**Result (Max)**	**Constructed wetland ***	**Result (Max)**	
BOD	Hatchery: 80-150 Pond: 4 – 11	80%	30 2.2	72-96%	6 0.4	< 10 (Hatchery) < 45 (Pond)
COD	Hatchery: 327-580 Pond: 14 – 25	80%	116 5	48-94%	34.8 1.5	NA (domestic) 250 (EHS aquaculture guideline)
TSS	Hatchery: 14-95 Pond: 8 – 13	About 60%	38 5	94-98%	1.9 0.3	< 30 (Hatchery) ≤ 200 (domestic for pond, not apply) ≤ 50 (EHS, general, apply)
NH3 – N	Both: 0.03 – 30	60%	12	68-87%	3.9	< 0.1
Total Phosphate	0.39 – 5	50%	2.5	NA	NA	< 0.1 (domestic) <2 (EHS aqua)
Total Coliform	Hatchery:1800 MPN/100ml	NA	NA	NA	NA	NA (domestic); <400 (EHS)

Note: some numbers (BOD, COD, and TSS) are rounded
*Varies, depending on the plants used; Sanjrani et al.: Treatment of wastewater with constructed wetlands systems and plants used in this technology. Removal rate of constructed wetland/reedbed extracted from https://www.researchgate.net/publication/270159070_Performance_of_a_constructed_wetland_system_for_the_treatment_of_domestic_wastewater
Source: Various sources of researches.

328. The estimation shows even with max pollutant data, aerated lagoon alone can cut COD, BOD and TSS to meet both INO and EHS applicable standard. But for N, P and bacteria (e.g. total coliform), additional treatment is needed, such as mangrove wetland. Field observation

indicated that mangrove alone might not be sufficient. Prolonged retention and absorption by certain plants, added filtering by sand, gravel or shells typical of constructed wetland (CW) can help further remove the remaining pollutants.

329. With both treatments, some pollutants like N and P may still be unable to meet applicable discharge standard. These are the most difficult to treat even with standard activated sludge or its variation in centralized WWTP in cities. They are usually removed by the treatment by chemicals, unrealistic and unsustainable for rural setting. However, the estimate is based on max. pollution to be on safer side. In reality, aquaculture effluent have lower concentration, thus can meet discharge standard even with reduced aeration which is typically by water paddle using electricity.

(c) Solid Wastes of aquaculture

330. Both hatcheries and the shrimp pond also generate solid wastes comprising of residues from the shrimp harvesting and post harvesting, and garbage or general wastes. . As identified as presented in Table 55: (Section III.C.3), solid wastes from the existing facilities mainly consist of feeds packages, shopping bags, detergent packages, mineral water bottles, torn plastic mulch, torn HDPE, office/domestic wastes and organic wastes such as branches of woods. Some of the organic wastes was reused as fuel (such as tree branches) and others is utilized through composting or digestion or fermentation.

331. The FS proposed to segregate the wastes Especially for organic wastes can be recycled for compost and inert wastes reused in embankment of ponds' as much as possible, given rural area is hardly covered by local gov waste service as mentioned in III.C.3. The remaining is transferred to Dinas Kebersihan service.

332. For shrimp ponds, antibiotics and drugs are used during growing out to control and prevent diseases typically include antibiotic (tetracycline, macrolide, fluoroquinolone and sulfonamide), non-antibiotics (anthelmintic, coloring agent), hormones, and vaccines). Chemicals used in storage for preservation are mainly chlorine, ozone, and lime. In addition to antibiotic, in shrimp production probiotic is also used, which promote shrimp growth and health at the same time it does not rise potential risks of accumulated residue as in the shrimp as antibiotics application. The probiotics are produced in the laboratories from organic materials such as molasses. Bio-safety concerns include invasive species, wild species (i.e. wild breed from open sea), and certification of breeds (SPF and SPR)[28].

333. For hatcheries, chemicals for pest control typically include chlorine, ozone, iodine, kalium permanganate (KMnO4), and lime. Virus free fries mean breeds produced from selected brood and free from viruses such as WSSV, TSV, IHHNV, and IMNV. Such fries are certified as SPF/SPR. Commercial feeds often are fish oil.

334. Broodstock does not use hazardous substances, except for disinfectant (e.g., chlorine and ozone) which readily decomposed. Other use non-chemical disinfection such as ultraviolet (UV) rays as already practiced in most broodstock.

(d) Residues and Food Safety in Products

335. The broodstock use a wide range of chemicals to prevent and manage disease, to

[28] SPF = Specific Pathogen Free; SPR = Specific Pathogen Resistant

manage water and pond soil quality, and to facilitate harvesting and transportation. They include the chemicals as presented in Table 72 from government's SNI 7311-2009**.**

Table 72:Types and Dosage of Chemicals and Medicine Use in Fry Production

No	Type	Unit	Dosage	Remarks
1.	EDTA	mg/l	5 - 10	At preparation phase
2.	Formaldehyde	ml/l	15 - 20	For *treatment*
3.	Iodine	ml/l	0.01	To wash eggs /nauplius
4.	Trifluralin/Treflan	ml/l	0.05 – 0.10	Fungicide, herbicide
5.	Kalium Permanganate	mg/l	1 - 2	Sanitation
6.	Chlorine	ml/l	100	Sanitation
7.	Sodium Hydroxide		-	25% of total *Artemia Kist* which decapsulated
8.	Sodium Thiosulfate		-	Maximum 50% of chlorine/ bleaching powder dosage

Source: Indonesia National Standard (SNI 7311-2009).

336. Following exposure of chemicals from broodstock, higher risk of residues accumulation in the products occur during shrimp growing out in the ponds. The main veterinary drugs used in aquaculture are antibiotics, which are employed to prevent and treat bacterial diseases. Antibiotics are generally administered in feed, having either been added during manufacture or surface-coated onto the pellets by the manufacturer or the farmer. The development of antibiotic resistance by pathogenic bacteria may arise when bacteria acquire resistance to one or more of the antibiotics to which they were formerly susceptible. That resistance eventually makes the antibiotics ineffective in treating specific microbial diseases in humans when people consume aquatic products high in residue antibiotics. In addition, when antibiotics are unintentionally consumed as residues in food, the amount ingested cannot be quantified or monitored and may cause direct health concerns (e.g., aplastic anemia), posing a serious risk to human health.

337. Recognition of the risks brought about by consumption of veterinary drugs has led to the banning of certain antibiotics in aquaculture production and the establishment of maximum residue limits (MRLs) for those with known risks. Observance of MRLs is required by law under some national jurisdictions and is encouraged elsewhere. For example, in Indonesia, the limit of residues is regulated under Appendix II of MMAF Regulation No. 37/PERMEN-KP/2019.

338. Regulation of Minister of Marine Affair and Fishery No. 57/PERMEN-KP/2018 stipulated on Aquaculture Good Practices (CBIB) and SNI 8228.1:2015, Part 1 (Shrimp) required that all stages in aquaculture shall consider sanitation and prevent the aquaculture products from various hazards for food safety such as bacteria, biotoxin, heavy metals and pesticides, as well as forbidden residues (antibiotic, hormone, and pesticides). These requirements are integrated into the EMP of this IEE.

339. CBIB requires the shrimp pond shall meet the food safety standard and minimum threshold of the residues in the products (see Section II.F.5). The requirement and other mandatory requirements for CBIB specified in EMP.

(e) Impacts on biodiversity and ecosystem

340. One of major environmental issue of aquaculture is **threats to ecosystem and**

biodiversity due to conversion of natural habitats to aquaculture ponds or facilities. Conventional practice of aquaculture may require conversion of the natural environment including, for example, the removal of mangroves for excavation of ponds, or alteration of the natural hydrology of lagoons, bays, rivers, or wetlands. This contributes to the massive loss of the valuable biodiversity and flood-protection barrier at the coastal areas in Indonesia at past. As an improvement of government policy, a sustainable shrimp pond concept is encouraged. The IISAP subproject will adopt the concept to reduce potential conversion of natural habitats.

341. The IISAP Baseline Survey (December 2021) indicated that most of the shrimp ponds are located at more than 200 m distance from main canal (49%), followed by less than 200 m from beach (25%), less than 200 m from main canal (23%), and adjacent with mangrove forest (9%). This indicates that mostly siting of the ponds are within the boundaries required in the regulation, i.e., 100 – 200 from the local protection areas (river, lake, beach).

342. As refer to the prevailing regulations and consultation with EA (i.e., Directorate General of Aquaculture, MMAF) the project has proposed siting criteria for the ponds/broodstock, rural infrastructure and laboratory. The criteria (see Table 73) are aimed to avoid and minimize negative environmental requirements as much as possible from the planning/design stage. These are used in subprojects identified and assessed in this IEE, and based on experience, will be adjusted as part of the framework (EARF) to guide future subprojects screening.

Table 73: Siting Criteria for IISAP Subprojects

Type of Activity	Siting Criteria
Ponds[a] and Broodstock:	- Comply with the regional spatial plan (RTRW) and coastal spatial plan (RZWP3K); - Available water source, maintenance water, and adequate and suitable land; - Not inside or within 1*00* meters from the boundary of mangrove area and any protected or conservation areas; - The location is free from periodic flood (for twenty-five years cycle or Q25) and effect of pollution or other contaminants/hazards for food safety reason; - The shrimp ponds are located at the back (hinterland) of coastal demarcation line (coastal zone) at least 100 m and at least 100 m from river demarcation line (riparian zone) of large river and at least 50 m from small river; - Soil texture of the location meet the specifications that support growth of natural feed, suitable water quality for shrimp, and able to hold volume of shrimp and negligible leakage (<10 % per week).
Rural roads and other a*ssociated* rural infrastructure	- In compliance with spatial plan (RTRW) - Not inside or within[b] from the boundary of mangrove area and any protected or conservation areas; - Located beyond of right-of-way/demarcation of riparian zone: at least 5 (five) meters from the foot of river with embankmment; at least 100 (one hundred) meters from the riverbank of large river without embankment; at least 50 (fifty) meters from the riverbank for tributary without embankment outside of settlement area
Laboratory and other supporting buildings	- In compliance with spatial plan (RTRW) and building permit (PBG) - Located in an area with stable soil and avoidance of disasters-prone areas (flood, landslide, forest fire, volcanoes eruption) - Near to the main aquaculture activities (i.e., near to broodstock center and ponds) to facilitate environmental and ponds monitoring

[a] MMAF's Regulation No. 75/Permen-KP/2016 on General Guidance of Shrimp Ponds.
[b] The distance is not specifically regulated but depending on the specific characteristic of the fauna in the areas, considering their migration route, nesting, feeding and mating route.
Source: Various Government Regulations (including MMAF Regulation).

343. The project's shrimp ponds, broodstock and laboratories as identified so far will be located in the existing UPTs lands. These sites are not within undisturbed landscapes. This was supported with PIPPIB (Indicative Map for Moratorium of New Permit), which proved that project area is not at the border or within protected mangrove forest and wetland. The map, which is regularly updated by Ministry of Environment and Forestry[29], indicate that no protected areas are affected along the proposed subprojects. Most of the area are located relatively far distance from the nearest protected areas as shown in the PIPPIB maps of each region and description with relative distance from protected/conservation areas (Table 31 in Section III.B.2).

344. **Biosafety**. As indicated in Figure 7 flowchart of shrimp production process, there are risks of introduction of alien or invasive species. To avoid the introduction of alien species or invasive species from open sea, the brackish water taken from sea and river/canal are not directly flowed into ponds but retain in the two-stages bio-filter water reservoir. Chlorination or other disinfection methods applied to the water reservoir to kill any bacteria and other unexpected species, including alien or invasive species.

345. In addition, referring to MMAF's Aquaculture Good Practices, only certified breeds allowed to be introduced in the ponds. However, based on the IISAP Baseline Survey (2021) majority of respondent use non-certified local seed (66%) and about 31% of them use Specific Pathogen Free (SPF) certified F-1. The certification also covers for Specific Pathogen Resistant (SPR). Only 3% of respondent that use certified local seed as shown in the following table. The implications of the low use of certified breeds, the ponds are vulnerable to diseases and outbreak, both disease from other shrimps and disease from the external environment.

[29] http://webgis.menlhk.go.id:8080/kemenhut/index.php/id/peta/pippib/61-pippib/339-pippib2021-periode2.

Table 74:Type of Cultivated Seed in Each Village

Province	District	Sub-district	Village	Total	Local non-certified		Local SPF Certified		SPF Certified F-1	
					N	%	N	%	N	%
Jawa Timur	Pasuruan	Bangil	Kalianyar	17	17	5%		0%		0%
			Raci	15	14	4%		0%	1	0%
			Tambakan	8	4	1%		0%	4	1%
		Kraton	Gerongan	35	28	8%	7	2%		0%
			Pulokerto	26	26	7%		0%		0%
			Semare	19	19	5%		0%		0%
Sulawesi Selatan	Takalar	Sandrobone	Banyuanyara	15	1	0%		0%	14	4%
			Lagaruda	10		0%	1	0%	9	2%
			Sanrobone	15		0%	1	0%	14	4%
			Ujung Baji	10		0%		0%	10	3%
	Pinrang	Duampanua	Data	45	45	12%		0%		0%
			Maroneng	25		0%		0%	25	7%
			Paria	30		0%		0%	30	8%
Lampung	Lampung Selatan	Ketapang	Berundung	25	25	7%		0%		0%
			Pematang Pasir	25	24	6%		0%	1	0%
		Sragi	Bandar Agung	50	41	11%	4	1%	5	1%
Total				**370**	**244**	**66%**	**13**	**3%**	**113**	**31%**

Source: IISAP Baseline Study (November 2021)

(f) Impacts on air and cultural resources

346. **Impacts on physical cultural assets**. Based on RTRW of respective district, there is no archaeological and cultural assets affected in the subproject areas. Site assessment using Google Earth application also shows that there are some cultural heritages and historical buildings in the districts, but they are located some distance away (mostly more than 10 km). Nevertheless, precautions will be taken to avoid potential damage to any archaeological and cultural assets by inclusion of chance-find procedure in the EMP, which in turn will be included in bidding documents and thus in contracts of contractors to oblige them to follow during civil work.

347. **For air emission from aquaculture**, as indicated in the flowchart (Figure 7), air emission is not expected except odor that is mainly from rotting of shrimps or brood, wastewater treatment and solid waste piling or improper composting or desludging of septic tank.

348. **Odor.** In most cases, the root cause of the smell is an anaerobic, or septic, condition where the oxygen flow to the water or wastewater is limited. When that happens, microbes can thrive which give off hydrogen sulfide, commonly known as “the rotten egg smell”. Biosolid (domestic sewage) processing is another potential contributor to odors as it has the potential to throw off several irritating compounds. Emptying of septic tanks is another contributing factor (as some used in the project areas).

349. Odor is considered as the effect of primary pollutant, i.e., substance which generate odor at certain condition, both as single substance and mixture of several substances, among others: Ammonia (NH_3), Methyl Mercaptan (CH_3SH), Hydrogen Sulfide (H_2S), Methyl Sulfide ($(CH_3)_2S$); and Styrene ($C_6H_5CHCH_2$). The main measures to prevent and control odor are included in the EMP.

(g) Occupational health and safety of aquaculture

350. **Electric Shock**. Electrical devices typically used in aquaculture include manifold and

cover water pumps, paddle wheels, and lighting installations. The risk of electrical shock is therefore present during all operations in which the workers are in contact with the water.

351. **Drowning.** The risk of drowning is present in almost all aquaculture operations. Management to reduce the risk of drowning among workers and site visitors include the measures set forth in EMP.

352. **Exposure to Chemicals.** A variety of chemicals may be used in the operation of an aquaculture facility to treat and /or control disease organisms or to facilitate production (e.g., lime, diluted chlorine, or salt). Fertilizers are also generally caustic materials and care should be taken in their application. Recommended guidance for the management of occupational chemical exposure is discussed in the General EHS Guidelines.

353. Referring to MMAF Regulation No. 6/PERMEN-KP/2018 on Safety and Occupational Health within Ministry of Marine Affairs and Fishery, there is mandate established by dedicated organization structure for Safety and Occupational Health. To implement the program, the ministry and its units (i) plan of K3 (occupational and health safety) program; (ii) manage of natural disaster preparedness; (iii) assistance, supervision, monitoring, evaluation and reporting of the program. Appendix of the regulation (MMAF Regulation No. 6/PERMEN-KP/2018) set up clear and stepwise actions to follow to implement.

354. **Infectious disease vectors.** Aquaculture operations may act as breeding grounds for different insects, especially the mosquito and tsetse fly, thus increasing the risk of insect-borne disease among communities in the region. Operators should plan site design and operation to prevent and control these potential impacts. Additional information is provided in the Disease Prevention section of the General EHS Guidelines.

355. Workers may be directly or indirectly exposed to water-borne diseases due to frequent contact with water (ponds) and the proximity of living quarters to surface water bodies. The potential for transmission of water-borne disease should be addressed as part of the occupational health and safety program including specific additional medical screening for the labor force and implementation of preventive measures (e.g., mosquito nets in living quarters). Additional guidance on the prevention and control of communicable diseases is provided in the General EHS Guidelines with key measures included in the EMP.

2. Operation Impacts of Laboratory

356. The potential impacts of operation of laboratories mainly include wastewater with various chemical contents (thus relatively high in COD), biological and chemical hazardous wastes, and air emissions. There are occupational health and safety risks also in the collection and/or receiving of samples (including storage of samples), samples testing, operation of mobile laboratory, and finally clean up, incineration and disposal of wastes and hazardous wastes. The analysis below quantifies the above pollutions in future with the planned increase in laboratory's capacity under the project. Pollution will be controlled and managed on-site by devices/facilities as part of the laboratory retrofitting in the project as well as the EMP measures. Therefore the laboratory subprojects will not pose significant adverse impacts.

(a) Wastewater from Laboratories

357. For laboratory, large number of chemicals are used in the sampling and testing from inorganic chemicals (acids, alkaline, salts of all kinds – liquid and gaseous phase), organic chemicals (coloring agent, preservation, solvents, and specific reagents). In addition, the

laboratory also manages biological materials, including bacteria and viruses. Thus, wastewater from laboratory is relatively small compared to shrimp ponds and broodstock hatcheries but more complex in composition and higher in concentration, as reflected in baseline test data (Table 54:).

358. The reasons with such varying amount of wastewater/day from different laboratories include number of samplings, capacity of the laboratories, and number of staff (as the wastewater also include domestic wastewater). According to the project design for 7 laboratories, all will increase its capacity, and one (BPKIL Serang Lab) will be expanded to Level 3 laboratory which will result in considerable increase in volume of wastewater that needs to be treated. Domestic wastewater for institution like laboratory where most staff will not stay overnight is about 40L/day/person. Multiplying by future staff number, domestic wastewater can be estimated for each lab. Based on current wastewater and its treatment in each laboratory (Table 55:) and capacity increase by the project (Table 1), future wastewater amount of the project laboratories are estimated. Deducting domestic wastewater estimates, laboratory wastewater which deserves more treatment are obtained, presented in Table 75.

Table 75: Estimated future amount of Wastewater in Laboratories

N	Laboratory Location	Existing Condition		Future Projection of Domestic Wastewater by Type (m^3/day)
		Current Volume (m^3/day)	Existing Staff Number	
1	Baro, Ujung Batee, Aceh Besar (Aceh) -	0.005 (average)	Office: 29 Lab: 7	Domestic: 1.16 From Lab: 0.28
2	Hanura, Teluk Pandan, Pesawaran (Lampung)	0.361	Office: 29 Lab: 7	Domestic: 1.16 From Lab: 0.28
3	Testing (dry) Laboratory Umbul Tanjung, Serang (Banten)	0.150 (Average)	Office: 11 Lab: 36	Domestic: 0.44 From Lab: 1.44
	Bioassay Laboratory (wet) Umbul Tanjung, Serang (Banten)	7		
4	Bulu, Jepara (Central Java)	8	Office:148 Lab: 12	Domestic:5.92 From Lab:0.48
5	Gundil, Panarukan, Situbondo (East Java)	0.05	Office: 13 Lab: 19	Domestic: 0.52 From Lab: 0.76
6	Tigaran, Kubu, Karangasem (Bali)	0.005	Office: 34 Lab: 5	Domestic: 1.36 From Lab: 0.20
7	Boddia, Galesong, Takalar (South Sulawesi)	0.05	Office:20 Lab: 13	Domestic:0.80 From Lab:0.52

Note: Total domestic is estimated by multiplication of office staff number with 40 L/day/staff
Source: Data from DJPB (MMAF). .

359. Wastewater quality testing chose Serang in Banten as for one of the representative laboratories under IISAP because it has two parts, one dry laboratory and one wet lab.

Naturally, the wet laboratory (bioassay) used much more water and generate more wastewater with higher pollution as shown in Table 53 which form the basis of analysis and quantitative estimate below.

360. The laboratories currently have not properly treated the wastewater or no WWT at all. The wastewater is discharged into drain or discharged into simple unit with physically screen using filter before flow to infiltration area. This is basically using land absorption as simple treatment with risks of contaminating soil and groundwater. Septic used for discharged wastewater from laboratories are separately constructed with ones for domestic wastewater. These septic tanks are desludged every 3 – 5 years with septage being disposed into landfill.

361. Other laboratories discharged the wastewater into septic tank. A septic tank is a combined sedimentation and digestion tank where the retention time of sewage is one to two days. During this period, settleable solids settle down to the bottom. This is accompanied by anaerobic digestion of settled solids (sludge) and liquid, resulting in reasonable reduction in the volume of sludge, reduction in biodegradable organic matter and release of gases like carbon dioxide, methane and hydrogen sulfide. The effluent although clarified to a large extent, will still contain appreciable amount of dissolved and suspended putrescible organic solids and pathogens, as the efficiency is only 30- 50 % for BOD and 60-70 % TSS removal.[30] Other study indicated that the conventional septic tank resulted COD removal of 53.4% - 65.3%, biochemical oxygen demand (BOD) 53.5% - 68.4% and total suspended solid (TSS) 55% - 65.3%, phosphorus, 25.6% - 29.3%; total Kjeldahl nitrogen 17.7% - 26.8%, respectively.[31]

362. Given the characteristic of wastewater from laboratory as described in IV.B.3 (small in volume but high in BOD, COD, and chemicals), the existing practice of septic tanks or direct discharge will not meet compliance standard. Different on-site treatment technology are explored to improve, e.g. by using pre-treatment (e.g. neutralization by mixing acidic and alkalic chemicals) and a biotank through the following steps (Figure 10):

(i) **Initial Filter (Pre-Treatment).** At the first step this wastewater will be separated from solid wastes and the liquid with filtration system. The *black water* can be completely separated from the solid wastes that will settle (sludge).

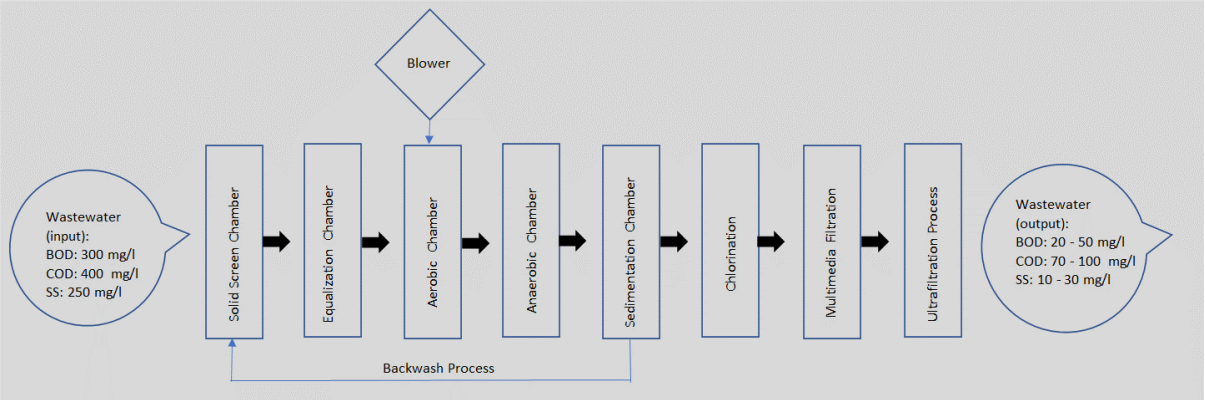
(ii) **Water Filter (Treatment).** After initial filter, the wastewater will be passed to water filter where the *bio balls* used to treat the wastewater. The wastewater is discharged to aeration chamber which connected with a blower. This facilitates the contact with air and convert organic contents the wastewater into inorganic material (i.e., removal BOD).

(iii) **Bacterial Filter (Stabilization and Disinfection).** Subsequently, the wastewater is discharged into sedimentation chamber to stabilize the wastewater contents. After sedimentation and stabilization, the chlorination will be applied to the wastewater and then filtered with chamber containing bacteria which will convert remaining wastes/pollutants so safe for discharge into soil and open water.

[30] Technological Options for Solid and Liquid Waste Management in Rural Areas. MINISTRY OF DRINKING WATER AND SANITATION SWACHH BHARAT MISSION (GRAMIN) GOVERNMENT OF INDIA April 2015

[31] https://www.researchgate.net/publication/259385286_Treatment_of_domestic_wastewater_using_conventional_and_baffled_septic_tanks.

Figure 10: Illustration of Biotank Process and Its Efficiency for Reducing pollution



Source: Biotank manufacturer.

363. Basically, biotank represent an advanced development of conventional septic tank, basically an enhanced septic tank. As indicated by one biotank manufacturer, its efficiency for wastewater treatment of three key parameters of BOD, COD, and TSS is quite good. As presented in Figure 10, the biotanks can reduce BOD by 85-90% (from 300 mg/L to 20 – 50 mg/L); reduce COD by 75-82% (from 400 mg/L to 70 – 100) and reduce suspended solids by 90-95% (from 250 mg/L to 10 – 30 mg/L) respectively. Thus, biotanks are more efficient and environmentally friendly than conventional septic tank, with several advantages, among others:

(i) Suitable for settlement, buildings, or offices with limited land (usually sold in a pre-casted and ready to operate unit)
(ii) Does not produce smell that pollute the surrounding air
(iii) Require no periodic desludging of the blackwater, as its long life (desludging for on average once for every ten years).
(iv) Made of leakage proof material (fiberglass), therefore minimize leakage and infiltration/polluting of black water into soil.
(v) Competitive cost, low energy consumption, and less frequent maintenance
(vi) Can be set by module thus expandable (the capacity can be increased as the increase of wastewater volume)

Table 76: Laboratories' wastewater treatment and comparison
(All in mg/L)

Parameter	Wet Laboratory (Table 51)	Removal (%) of Pollutants by Methods						Discharge standard
		Biotank	Result (Max)	Reed bed/ CW**	Result (Max)	Septic tank	Result (Max)	
BOD	14-43 70-185 *	85-90	1 – 4 7 – 18	72-96	0.6 – 1.7 28 – 7.4	53–68	4.5 – 13.8 22.4 – 59.2	50
COD	25- 65 433-502*	75 – 85	4 – 10 65 - 75	48-94	1.5 – 3.9 26 – 30	53 – 65	7-20	80
TSS	210-330 85-161*	88 – 96	8 – 13 3 – 6	94-98	4.2 – 6.6 1.7 – 3.2	55–65	73.5 – 115.5 29.7 – 56.4	30
NH3 – N TN	0.3-2 33-35*	NA	NA	68-87	0.04 – 0.3 4.3 – 4.5	18-27	0.2 – 1.5 24.1 – 25.5	1
Oil &	1	NA	NA	NA	NA	90	0.1	10

Parameter	Wet Laboratory (Table 51)	Removal (%) of Pollutants by Methods						Discharge standard
		Biotank	Result (Max)	Reed bed/ CW**	Result (Max)	Septic tank	Result (Max)	
grease								
Total coliform	11000*	NA	NA	80%	2,200	NA	NA	5000 /100ml

Some numbers (BOD, COD, and TSS) are rounded
**Test results of similar laboratory wastewater from recent ADB rural project in Cambodia, 2021.*
*See Footnote 44 (the percentages are rounded)
Source: Various sources of testing and researches.

364. Literature survey in Indonesia only found health facilities wastewater that is closest to typical wet laboratories. But its wastewater concentration is considered higher than aquaculture laboratories. This seems confirmed by testing results of similar project laboratory in other southeast Asian countries in 2021 which show BOD and COD are in between. The reasons for lower results in the IISAP representative laboratories could be less organic matter in the wastewater from the testing. Therefore, laboratory data from two project are used for quantitative estimate with the other ADB project data on BOD and COD regarded as more realistic than Serang laboratory data (see Table 76).

365. The results show that biotank alone cannot treat laboratory's wastewater to meet applicable standard in Indonesia. It is proposed that effluent from the biotank, is released into reed bed which is type of constructed wetland. A reed bed system performs secondary treatment of the wastewater coming out of the biotank. The reed bed system comprises of bed of sand and pebbles along with reed plants capable of natural amelioration of the wastewater coming out of the bio tank. It eliminates smell, suspended particulates, pathogenic and other microorganisms more than 80%. Natural reed plants-microbial consortium work efficiently at wide range of temperature and effluent is very safe to discharge into environment and may be used for irrigation purposes. The effluent from the reed bed may be stored to a tank for further use or may be released directly to the agricultural fields for irrigation when available or in a drain.

(b). Laboratory Solid Wastes and Management

366. The typical solid wastes from aqua-products related laboratories in Indonesia include domestic garbage and organic wastes. Based on investigation, currently each Balai/UPT generate various volume of solid wastes in range 0.5 kg/day to 16 kg/day. Volume of solid wastes generated in each Balai/UPT covering ponds, broodstock and laboratory presented in Table 77. The table also provided information existing solid waste management and planned improvement proposed by Balai/UPT.

Table 77: Volume and Current Practices of Solid Wastes Management

No	Project Location	Existing Wastewater Management		Proposed Solid Waste Management (by Balai/UPT)
		Volume (kg/day)	Existing Solid Waste Management	
1.	Baro, Ujung Batee, Aceh Besar (Aceh) -	2	Burned in simple incinerator	Burned in simple incinerator
2.	Hanura, Teluk Pandan, Pesawaran (Lampung)	Laboratory= ± 33 Office = 66	Burnt in open air	Burnt in incinerator
3.	Umbul Tanjung, Serang (Banten)	20	incinerator	Incinerator
4.	Bulu, Jepara (Central			

No	Project Location	Existing Wastewater Management		Proposed Solid
	Java)	Mauk/Kemiri: 0.5 for domestic wastes, and 2.7 for organic wastes such as grasses, leaves, and tree branches	Segregated and recycled, and the rest burned in open air	Proposed special container for non recyclable wastes and 1 – 2 unit of containers for recyclable wastes for composting
5.	Gundil, Panarukan, Situbondo (East Java)	No data	No data	No data
6.	Tigaran, Kubu, Karangasem (Bali)	17	Burned in open air	Collected and then transported and managed by Dinas Kebersihan (local Cleaning Agency)
7.	Boddia, Galesong, Takalar (South Sulawesi)	33 for domestic wastes and 40 for other (organic) wastes	Burned in open air	Burned in the simple incinerator

Source: MMAF (DJPB and Balai/UPT). .

367. To manage general, non-hazardous wastes, Balai/UPT must install 3 types of solid waste containers with the following labels: biodegradable or organic (food waste, kitchen waste, paper), recyclable (plastics, glasses, and metals), and residuals. The management will engage solid waste management service to manage the cleaning of facilities, and collection of wastes. All domestic wastes must be collected, segregated, and transported to common solid waste management facility.

368. For domestic wastes and other non-hazardous solid wastes, *Dinas Kebersihan* (local government Cleaning Agency) will collect, transport, and dispose the waste into landfill operated by local government. Currently at the 7 project laboratories, such garbage is collected at laboratories and then burned in the incinerator and/or open air: (i) Aceh: simple incinerator used to burn the solid wastes from laboratory; (ii) Banten: Segregated and recycled, and the rest burned in open air; (iii) Bali: burned in open air; and (iv) South Sulawesi: burned in open air. The practices in the other three Balai/UPT is similar..

369. All contaminated liquid or solid wastes should be decontaminated and treated before disposal. However, as shown in Table 54 (Section III.C.4), few Balai/UPT which operate WWT, the rest use simple water treatment (through filtration) or have no even a simple WWT. Most of the laboratories are in remote areas, and not covered in the service area of Dinas Kebersihan. The open burning wastes generate air pollution (especially for burning of plastic based materials) and remaining unburned residues, which still requires disposal.

(c). Laboratory Hazardous Wastes

371. For decontamination of biological hazards, all laboratories use an autoclave which can be used for aqueous liquid waste (cell, or microbial cultures). The performance of the autoclave is tested by putting the sample test into the incubator. Any indication of growing bacteria of sample test show that the autoclave does not perform well. The project plans to propose the use of decontamination methods for biological hazardous wastes before dumping the biological wastes as solid wastes.. One of the objectives for the laboratories rehabilitation and new development is to provide adequate, safe and ergonomic workspace for the staff and enable proper handling of hazardous wastes.

Table 78: Volume and Current Practices of Laboratory Hazardous Wastes Management

No	Laboratories Location	Existing Laboratories' Hazardous Waste Management	
		Volume	Existing Hazardous Waste Management
1	Baro, Ujung Batee, Aceh Besar (Aceh) -	0.01 kg/year (rounded)	Burnt in incinerator
2	Hanura, Teluk Pandan, (Lampung)	3000 kg/year (combined solid and liquid)	Burnt in open air
3	Umbul Tanjung, Serang (Banten)	980 liter/year (liquid) 50 kg/year (solid hazardous)	Transferred to certified third party (PT Wastec International) for hazardous treatment and dumping Biological samples (after autoclaving) are burnt in incinerator
4	Bulu, Jepara (Central Java)	750 liter/year (liquid hazardous wastes) 100 kg/year (solid hazardous wastes)	Some are reused as solvent for cleaning fats, and the rest are discharged into soil (septic tank) Biological samples (after autoclaving) are Burnt in simple incinerator (only cemented box for open air burning)
5	Gundil, Situbondo (East Java)	60 kg/year	Burnt in incinerator
6	Tigaran, Kubu, Karangasem (Bali)	60 kg/year (Solid hazardous wastes)	Burned in open air
7	Boddia,Takalar (South Sulawesi)	7 kg /month	Unused organic solvents are transferred to the collector, and then transferred to the third party
			Treated with neutralization, dilution, and soil decomposition by discharging into soaking/drain pit
			Biological samples (after autoclaving) are burnt in simple incinerator

Source: MMAF (DJPB and Balai/UPT).

370. Some solutions can be disposed into drain (as per Material Safety Data Sheet (MSDS) of each chemical substance, provided by the manufacturer) such as acetonitrile. According to MSDS, the substance is not classified as dangerous for the environment and can be discharged as wastewater and not harmful to crustacea, fishes, and algae.. Some are neutralized by mixing alkali and acids so can avoid to corrode pipes and equipment. Those that are not allowed to drain into the sink such as dissolved solvents (e.g., chloroform, acetone, ethyl ether, methanol, formaldehyde, phenol, toluene, methyl chloroform, or xylene) will be saved in special solvent plastic container/jerrycans. However, in the project laboratories, currently such solvent cans are not properly managed.

371. In case the laboratories shall keep the hazardous wastes in large volume and relatively long period, a temporary storage for hazardous waste is required. The facility should be lined, with enclosed walls and roofs to store hazardous waste containers. The management should actively promote waste segregation to avoid hazardous waste mixing with general wastes. The management must also initiate regular training and safe practices to handle hazardous wastes. Appropriate PPEs will also be required for the workers.

372. As discussed in Section IV.B.2, currently most of the hazardous wastes are burned in

open air and simple incinerator, which unable to meet national guideline and requirements. Some Balai/UPT proposed to use existing simple incinerator, while others proposed to use industrial standard incinerator. In the IEE it is proposed to use industrial standard incinerator in the location or cooperation with third party to transfer and manage the hazardous wastes per government regulation.

373. Some Balai/UPT proposed an option to engage an accredited third-party hazardous waste service provider for the hazardous wastes management. As discussed in Section IV.D.2, the option is relatively costly and required temporary hazardous storage. But for small volume of hazardous wastes as in BPKIL Serang laboratory, it is more efficient to collect the wastes in the plastic container and transfer to the certified third party. BPKIL Serang Laboratory has engaged a cooperation for hazardous wastes management with PT Wastec International (Hazardous Waste Management Services Indonesia - Wastec International) for three years.

(e) Air Emission of Laboratories

374. Air emission from the laboratories includes mainly burning of wastes and simple incinerator (for hazardous wastes) as in the current practice, and to a lesser extent, the fugitive emissions from fume hoods, laboratory ventilation and flue gas of boilers. The incinerators operated in Aceh, Lampung, and Central Java has design capacity of less than 5 kg/batch, now operating usually at burning temperature of approximately 850^{o}C, using gasoline/kerosene as fuel. Better incinerator identified in BPKIL Serang (Banten) laboratory, which manufactured with chimney and burning and feed control. The capacity of the incinerator is also greater, approximately 10 kg per day.

375. Air emissions (flue gas or even dioxin toxic gases) from hazardous wastes treatment like incinerator will generate air pollutants and hazardous gases. The combustion of solid wastes and hazardous wastes lead to the release of persistent organic pollutant such as Polychlorinated dibenzodioxins (PCDD), Polychlorinated dibenzofurans (PCDF), Polychlorinated biphenyl (PCB), and Hexachloro benzene (HCB). In addition, it also potentially releases biphenyl dibenzo-p-dioxin (PBDD) and biphenyl dibenzofuran (PBDF).

376. As per WHO guidelines, modern incinerators need to operate at 850–1100 °C for at least 2 second in order to destroy dioxins etc. and fitted with special gas-cleaning equipment that can comply with the international emission standards for dioxins and furans and that will be acceptable for the project. Sterilization such as autoclaving, microwaving, steam treatment integrated with internal mixing, which minimize the formation and release of chemicals or hazardous emissions should be given priority. Most laboratories have autoclave but their size are too big according to staff interviewed. They wished to have size more suited to the amount of hazardous wastes which can be sterilized more timely, instead of waiting to accumulate to certain minimal amount required by proper operation of current autoclave.

(f) Occupational Health and Safety in laboratories

377. The occupational health and safety hazards associated with laboratory operations varies, and some frequent potential hazardous risks identified in the laboratory. The risks can be prevented and mitigated as specified in EMP. The list below only indicates the potential risks and will be prevented as referred to Government (SNI) and international standard (ISO, WB-IFC Guidelines).

(i) **Fire.** Never use open flames in the laboratory. Specifically, never heat any organic solvent in an open vessel, such as a test tube, Erlenmeyer flask, or beaker, with a flame. Such solvents should be heated in a hood with a steam

bath, not a hot plate. Never keep volatile solvents, such as ether, acetone, or benzene in an open beaker or Erlenmeyer flask. The vapors can and will creep along the bench, ignite, and flash back if they reach a flame or spark. All staff should know where the nearest safety shower and fire extinguisher are located. All staff in the laboratory will be trained in the use of fire extinguishers.

(ii) **Explosions.** Never heat a closed system or conduct a reaction in a closed system (unless specifically directed to perform the latter process and then only with frequent venting). Before starting a distillation or a chemical reaction, make sure that the system is vented. The results of an explosion are flying glass and spattered chemicals, usually both hot and corrosive.

(iii) **Chemical and Thermal Burns.** Many inorganic chemicals such as the mineral acids and alkalis are corrosive to the skin and eyes. Likewise, many organic chemicals, such as acid halides, phenols, and so forth are corrosive and often toxic. If these are spilled on the desk, in the hood, or on a shelf, call for assistance in cleaning them up. Be careful with hot plates to avoid burns. Always assume that hot plates are hot.

(iv) **Cuts/Injury.** The most common laboratory accident is probably the cut/injury received while attempting to force a cork or rubber stopper onto a piece of glass tubing, a thermometer, or the side-arm of a distilling flask. Be sure to make a proper-sized hole, lubricate the cork or stopper (lubrication is essential with a rubber stopper), and use a gentle pressure with rotation on the glass part. Severed nerves and tendons are common results of injuries caused by improper manipulation of glass tubes and thermometers. Always pull rather than push on the glass when possible.

(v) **Absorption of Chemicals.** Keep chemicals off the skin. Many organic substances are not corrosive, do not burn the skin, or seem to have any serious effects. They are, however, absorbed through the skin, sometimes with dire consequences. Others will give a serious allergic reaction upon repeated exposure, as evidenced by severe dermatitis. Be careful about touching face or eyes in the lab; make sure hands are clean first. Gloves will be available in the lab. However, gloves provide only a temporary layer of protection against chemicals on your skin and may be permeable to some chemical reagents, without visible deterioration. If gloves contact with a chemical reagent, remove them, wash hands, and get a new pair immediately.

(vi) **Traffic-Accident-Related Risk.** The risks explained above will also potentially occurs for the mobile laboratory. Make sure the mobile laboratory is well ventilated and designed and prepared for emergency situation such fire extinguisher, and containment for any spills.

378. Regarding occupation health and safety, MMAF and its units (including UPT) has implemented the policy guidance referred to as MMAF Regulation No. 6/PERMEN-KP/2018 on Occupational Health and Safety within Ministry of Marine Affairs and Fishery. Especially for firefighting, a fire alarm system has been included in the design, in form of firefighting system, namely (1) Fire Hydrant & Hose Reels; and (2) Portable Fire Extinguisher.

C. Alternatives Analysis /impacts of the design

379. Impacts may arise from decisions and actions taken during the design /preconstruction stage. This assessment is to compare different design alternatives proposed by the FS and other sources from environmental point of view, including with and without project comparison, to determine the most financially and technically feasible way of achieving the subproject

objectives while minimizing environmental and social impacts. Site selection of the project location is one of the main concerns at this stage, as the impact will be permanent once decided. Another key area is to compare different alternatives in pollution prevention and control.

1. With and without project comparison

380. The consequences of "no-project" alternative are a continuation of current conditions, which is less productive and potentially degrade the environment, especially destruction of natural habitats. The project will improve infrastructure of shrimp pond aquaculture as well as aquaculture practices (sustainable aquaculture) and improvement of productivity and economic values.

2. Different Siting Alternatives

381. Through site comparison and selection for new subprojects is way to prevent and reduce the environmental impacts from the outset. The process for the five new demonstration ponds are described and impacts assessed in IV.B.1.

382. **Site selection of construction work camps, stockpile areas, storage areas, and disposal areas.** The priority is to locate these facilities near the subproject locations. However, if it is deemed necessary to locate elsewhere, sites to be considered will not promote instability and result in destruction of property, vegetation, and public facilities. Thickly populated residential areas will not be considered for setting up camps to protect the human environment (i.e., to curb accident risks, health risks due to air and water pollution and dust, and noise, and to prevent social conflicts, shortages of amenities, and crime). Extreme care will be taken to avoid disposals to the forest, water bodies or in areas which will inconvenience the community. All these siting criteria related to construction are included in the EMP.

383. **Site selection of materials sources.** Extraction of materials can disrupt natural land contours and vegetation resulting in accelerated erosion, disturbance in natural drainage patterns, ponding and water logging, and water pollution. To mitigate the potential environmental impacts, locations of quarry site/s and burrow pit/s (for loose material other than stones) would be included in the design specifications and on plan drawings. Local Mineral Resources and Energy Agency (*Dinas Pertambangan dan Energi*) approved sites would be selected first. If other sites are necessary, these would to be located away from population centers, drinking water intakes and streams, cultivable lands, and natural drainage system, and in structurally stable areas even if some distance from construction activities. It will be the contractor's responsibility to verify the suitability of all material sources and to obtain the approval of authorized agency. If additional quarries will be required after construction is started, then the construction contractor shall use the mentioned criteria to select new quarry sites. These measures and criteria are included in the EMP for pre- and construction.

3. Alternatives in Wastewater Treatment

(a) Ponds and Hatchery Wastewater

384. As assessed in IV.B.1, wastewater from these aquaculture systems and subprojects have similar characteristics, i.e. large in volume and low to moderate level in BOD, COD, TP and TN etc. The choice of treatment depends on such characteristics (amount, major pollutants and their concentration range, technical requirements on O&M etc.) and financial considerations (investment and O&M cost) primarily.

385. Given currently they basically have no treatment, the FS proposed activated sludge technology of 3 units: the first for settlement by physical method/ sedimentation; second pond for mechanical method/aeration with water paddles, and third pond for equalization/biological method by introducing milkfish, tilapia, and seaweed[32]. The comparison of advantages and disadvantages of different WWT technologies for ponds and broodstock/hatcheries and their pros and cons are summarized in Table 79 below.

386. Considering the capacity to O&M, it is recommended to select appropriate technology alternatives, including nature based solution. Therefore, other more effective yet more affordable and easier to O&M methods are explored.

Table 79: Comparison of Wastewater Treatment for Shrimp Ponds and Hatcheries

Tech. options	Current way	Proposal by FS/UPT	Proposal by the IEE
Main features	Lagoon or land absorption	Standard Activated sludge	Aerated lagoon by paddle that can be switched on/off, followed by CW
Capital investment	Low	High	Medium
O&M cost, Extent of ease	Low and easy	High, demand technology, skill, unsuitable for rural setting	Moderate, easy to O&M
Removal rate of Pollutants	Low, unable to meet discharge standard	High removal rate but not very flexible methods (in case of increase volume and change of effluent characteristics)	Medium but sufficient to meet discharge standard, including removal of N and P.
Environmental problems and other cons	Soil contamination	risk of nutrient leaching, impacts on soil biodiversity and greenhouse gas emissions	Consume energy (electricity)
Conclusion	Not recommend	Not recommended	Recommended

Source: Various sources of publication and researches.

(b) Laboratory Wastewater

387. Based on analysis in IV.B.2, each option of the wastewater treatment provides advantages and disadvantages. Table 80 presents the comparison of the existing wastewater treatment and ones proposed by Balai/UPT (MMAF) and this IEE.

Table 80: Comparison of Wastewater Treatment Alternatives for Laboratories

[32] Referred to Final Report of Laboratory Design (MMAF, November 2021) and communication with respective Balai/UPT.

Tech. alternatives	No Treatment (current)	Septic tank/ Infiltration (Proposed by Balai/UPT)	Biotank and reedbed with pretreatment (by IEE)
Capital investment	**Low** (Almost no investment)	**Medium** (Provision of land and construction of septic tank, including pipes and its plumbing)	**High** (Provision of land and installation of biotank and its pipes)
O&M cost, Extent of ease	**Low** (No maintenance cost)	**Medium** (Periodic desludging of sludges)	**Moderately Higher than septic tank.**
Efficiency of neutralization and decontamination	**Low**	**Medium** (approximately 30%)	**High** (High efficiency of higher than 70%)
Environ problems and other cons	Unable to meet standard, contaminate soil and water etc	Largely unable to meet applicable discharge standard, causing soil/groundwater contamination	Sufficient to meet discharge standard (no contact with soil and relatively leakage proof)
Conclusion			Recommended f

Source: Various sources of publication and researches.

388. Further comparison also carried for specific component of the WWTP technology. Referring to MOEF's Guideline on Fishery WWTP (2019), a more detail comparison also referred in the selection of appropriate WWTP option. Table 81 presents comparison of the wastewater technology by components. The project can decide the appropriate technology to use as the characterization of the wastewater, either at farm site or outside of farm site.

Table 81: Comparison of Different WWT Methods

Type		Technology	Removal rate (%)					Construction Cost	Maintenance Cost	Difficulties
			COD	SS	T-N	NH_4-N	O&G			
Pretreatment		Screening	20	40	20	20		Low	Low	Easy
		DAF	40	75	30	30	80	High	Medium	Difficult
Primary Treatment		Sedimentation	20	40	20	20		Low	Low	Easy
		Coagulation – Flocculation	30	60	30	30		Medium	High	Medium
Secondary Treatment	Aerobic	Activated sludge	90	80	30	90	90	Medium	Medium	Medium
		RBC	80		20	60		Medium	Medium	Easy
		Trickling filter	90		10	80		High	High	Easy
		Aerated lagoon	80		20	60		High	Medium	Easy
		DHS	80		20	80		High	High	Easy
	Anaerobic	Digester	65	55	0	0		Low	Low	Easy
		ABR	65	55	0	0		Medium	Low	Medium
		UASB	65	55	0	0		High	High	Difficult
Nitrogen Treatment		Stripping			80	80		Medium	High	Difficult
		Ion exchange			90	90		High	High	Difficult
		Chlorination			95	95		Medium	High	Medium
		Anaerobic			70	90		Medium	Medium	Medium
		Membrane		95	30	90		High	High	Difficult

ABR = Anaerobic Baffled Reactor, DAF = Dissolved Air Flotation, DHS = *Downflow Hanging Sponge*, RBC = Rotating Biological Contactor , UASB = Upflow Anaerobic Sludge Blanket.
Source: MOEF's Guideline on Fishery WWTP (2019).

4. Alternatives in Solid Wastes Treatment

(a) Organic and Inorganic Solid Wastes

389. The IEE proposed collection of the solid wastes in the temporary depot and then segregated the wastes by its characteristics: organic wastes, inorganic wastes, and recyclable materials. For the Balai/UPT which are not served by *Dinas Kebersihan* the unwanted waste after segregation is allowed to be burnt in incinerator at the location. However, from both environmental and economic point of view, Incineration is normally the last resort and only for hazardous, not for general and domestic wastes. The comparison of different technologies and their pros and cons are summarized in Table 82.

Table 82: **Comparing alternatives of wastes management from all subprojects**

Tech. alternatives	**Open Air Burning (current)**	**Collection by local gov or Burning in Incinerator (Proposed by Balai/UPT)**	**Collection by local gov inorganics or/and composting organic wastes onsite or by nearby farmers (by IEE)**
Capital investment	Low	Medium-high	Medium
O&M cost, Extent of ease	Low and easy	Medium-high if incinerate	Medium and easy to conduct
Removal of residues (unburned materials)	Low, only some are burned, while others left as unburned residues	Low but risky in incineration emissions and ashes	High, once combined collection and transport to landfill by government agency, while some organic materials are composted. Others (can, plastics, and cardboard) may be reused or recycle.
conclusion	Not recommended	Recommended as appropriate management	Recommended as appropriate management

Source: Various sources of publication and researches.

(b) Hazardous Materials and Waste

390. As described in chapter III and Table 78, currently most of the solid hazardous wastes and autoclaved biological wastes are stored in concrete pits underground with cover beside laboratory buildings, burned in open air or simple incinerator, unable to meet national guideline and requirements. Under the FS Balai/UPT proposed to use existing autoclaving and burning in simple incinerator for hazardous solid and biological wastes, while liquid hazardous wastes are proposed to be transferred to the certified third party per government regulation.

391. The transfer of hazardous waste to the qualified (and certified) third party is recommended, albeit costly. This is appropriate means of disposing small amounts of hazardous wastes. For larger volumes, Balai/UPT can manage the hazardous waste by themselves through use of appropriate technology such as industrial standard incinerator. However, third party usually only collect small part of hazardous wastes from the laboratories.

392. Concerned about the incinerators' fly ash and dioxin (which is also difficult and costly to monitor), poor operation and maintenance of small existing incinerators (i.e., only ~700 °C), as well as the budget shortage facing the subprojects, other alternatives are needed to explore by the IEE. Since solid hazardous solids are largely infectious and biological, sterilization by

autoclave can turn them into general wastes, greatly reduce the need for incineration and thus risks associated. For the residue and hazardous liquid, improving some of current methods (e.g. by autoclave, partly handled by certified third party, temporary storage in glass bottles and cement pits) combined with incineration as the last resort is proposed in the IEE. A comparison of different alternatives are summarized in Table 83.

Table 83: Comparing Alternatives of Hazardous Wastes Management

Alternatives	Discharge to Septic Tank or concrete pits, and burn (current)	By third party and incinerated (Proposed by Balai/UPT)	Comprehensive approach (Proposed in IEE)
Capital investment; O&M cost and ease	**Low** (Construction cost for septic tank and periodic desludging	**Medium-high** (Construction of WWT, maintenance and operation of the WWT, including expenditure for electricity and chemicals)	**Medium- High** (Temporary storage of the hazardous wastes, and service fee for the transport and treatment of the hazardous wastes)
Environmental' pros	**Low** (no special treatment, unable comply with law and standard	**Medium** Autoclave can turn most of the lab's biological hazardous waste into general wastes	**High** (Better treatment and decontamination by dedicated facilities of certified third party)
Environmental cons	Not comply with national requirements, and potential pollute soil and groundwater	Unable to fully comply with national standard, some residues untreated	Hard to validate such third parties technical capacity and soundness; Unavailable in rural area or small towns, higher cost to operate and transport in rural setting
Conclusion	Not recommended	Recommended in case no certified third party in the area	Recommended as the best options for small quantity of hazardous wastes of laboratories

393. As discussed in Section IV.B, this IEE proposed to engage cooperation with third party to transfer and manage the hazardous wastes per government regulation. Meanwhile, non-hazardous chemicals such as potassium chloride, sugars, amino acids, and non-contaminated chromatography resins and gels can usually be disposed in the regular trash (segregated container for inorganic material). Broken glass, needles, and sharp objects will be disposed in special containers.

D. Construction Phase Impacts

394. Construction activities will introduce a range of environmental, social and safety impacts and risks through the activities including land clearing, excavation, filling, disposal of spoil, and civil works. These impacts can be managed through the good practices including IFC EHS Guidelines, and ADB Environment Safeguards: A Good Practice Sourcebook.

395. Such temporary, localized impacts only occur during construction phase and manageable through proper mitigation measures set forth in Environmental Code of Practices (ECOP) as part of the EMP. The impacts include but are not limited to the following.

1. Water Pollution

396. Construction activities at and/or around water area (such as clearing of vegetation, earthworks, and construction of infrastructure) can have a significant impact on water quality such as increased turbidity via suspension of sediment in the water column. In addition, the introduction of pollutants can have adverse impacts on aquatic flora and fauna (including benthic communities), for example excessive nutrient loading leading to eutrophication, oxygen depletion, and toxic algal blooms at the standing water.

397. **Soil Erosion and Sedimentation**. Earth excavation and moving activities conducted during construction of aquaculture projects may result in soil erosion and the subsequent sedimentation of nearby water bodies. Sedimentation of aquatic resources may contribute to eutrophication and overall degradation of water quality. Measures are included in EMP.

398. **Waste and Wastewater from Construction Camps.** The contractor is expected to establish temporary workers' camps during construction. Depending on the number of the workers and their origin. If there is only small number of workers employed and most of them hired from local source, there is no need to establish a construction camp.

399. Improperly managed silt runoff and sanitary wastes from these camps may reach nearby areas. Poor sanitation and lack of proper solid waste management at the worker's camp will provide the conditions for vermin and other disease vectors that will easily multiply and infect the workers. This may lead to the transmission of diseases from the workers camp to other areas. These conditions will increase public health risk.

2. Air Pollution and Noise

400. **Dust and Other Air Pollutants.** Emissions from construction vehicles, equipment, and machinery used for excavation and construction will induce impacts on the air quality in the construction sites. Anticipated impacts include dusts and increase in concentration of vehicle-related pollutants such as carbon monoxide, sulfur oxides, particulate matter, nitrous oxides, and hydrocarbons) but temporarily during construction and limited to the location of activities only.

401. During dry periods, dust generation can be expected from activities associated with the construction such as trenching, embankment, and soil preparation. Other potential sources of air pollution are large stockpiles of construction materials such as soil and aggregates. Without any mitigating measures, dust generation could be problematic during dry periods.

402. During the construction phase, there will be two main sources of air emissions, i.e., mobile sources and stationary sources. Mobile sources are mostly vehicles involved in construction activities, whereas emissions from stationary sources include construction equipment and machinery, diesel generator sets, excavation/ grading activities etc.

403. Construction-related airborne dust can arise from both vehicular traffic generating fugitive dust on paved and unpaved roads (and especially where there are spillages of soil from construction transport vehicles to the public roads and soil/aggregate material handling and processing).

404. As applicable, the Contractor may perform regular water spraying of the sites during dusty periods in order to reduce the generation of dusts. Contractor will also be required to use

equipment that are properly maintained. Covers for stockpiles of soil and aggregates that will be left idle for a long time shall be required. Covers will prevent dust generation due to wind action. Trucks transporting loose construction materials such as sand, gravel, spoils, and the like shall be provided with tarpaulin cover. This requirement is particularly important in the hauling of backfill materials due to the significant number of hauling trips.

405. **Noise and Vibration**. Noise will occur during construction due to use of vehicles, plant and equipment, movement of materials and various construction activities. Trucks/material mobilization and construction equipment, which can generate noise of 80 dB(A) from a distance of 30 meters are among the potential sources of noise during construction. The issue is mostly applicable in the excavation activities.

406. During construction phase, noise will be generated from various activities such as site clearing, excavation, erection, finishing etc. The general noise levels during construction phase due to the operation of heavy earth moving equipment and machineries installation can potentially go up to 100 dB(A) at the work sites. It is also to be noted that significant amount of manual labor will be involved during construction of the ponds, broodstocks, and laboratories. Therefore, the noise will be relatively lower and even negligible.

407. During construction a range of standard noise mitigation measures will be applied and included in the EMP with the aim to meet the Government Regulation (No. 48/1999), which comparable with IFC EHS (see Table 17) on Noise Level Guidelines at sensitive receptors.

3. Occupational and community Health and Safety

408. Construction activities may pose a risk of exposure to dust, chemicals, hazardous or flammable materials, and wastes in a combination of liquid, solid, or gaseous forms. Vehicle traffic and use of lifting equipment in the movement of machinery and materials on a construction site may pose temporary hazards, such as physical contact, spills, dust, emissions, and noise. Slips and falls associated with poor housekeeping, such as excessive waste debris, loose construction materials, liquid spills, and uncontrolled use of electrical cords and ropes on the ground, are also among the most frequent cause of lost time accidents at construction sites.

409. Occupational health and safety planning and procedures shall be implemented in accordance with Government Regulation and IFC EHS Guidelines, as appropriate. Construction hazards are expected in the implementation of the proposed IISAP Subprojects. Hazards may exist in all construction sites in many different forms such as sharp edges, falling objects, flying sparks, chemicals, noise, and various potentially dangerous situations. Good practices in construction occupational health and safety requires that employers protect their employees from workplace hazards that can cause injury. Specifically, requirement for occupational health and safety set forth in Management System for Construction Safety (SMKK, as set forth in MMAF regulation) of each project. The Contractors working for MMAF are required to follow the SMKK.

410. As much of the works are near water bodies, special precaution on water related risks shall be implemented. Occupational health and safety planning and procedures shall be implemented in accordance with Government Regulations and IFC EHS Guidelines as reflected in the EMP.

411. **Social Disturbance and Traffic Safety.** Construction activities may result in a significant increase in movement of heavy vehicles for the transport of construction materials and equipment increasing the risk of traffic-related accidents and injuries to workers and local

communities. Narrow rural road might be used for the transport of materials, which increase the risk. Impacts may arise from vehicular traffic accident, nuisance from air pollution, decreasing water quality for public use (washing, bathing, and drinking), disturbance to public access to rivers, and impact to public safety related to excavation and other activities.

412. Potential nuisances and problems to the public during construction of the proposed shrimp ponds, broodstock, and laboratories can best be avoided if proactively addressed during detailed design and pre-construction phases. The incidence of road accidents involving project vehicles during construction should be minimized through sound temporary traffic management planning in consultation with local traffic control authorities.

413. As such, the tender documents for the proposed subproject shall include provisions addressing potential nuisances and problems to the public during construction. These shall be reflected in the bidding and construction contracts of the proposed subproject works. During detailed design, construction methods chosen appropriately by evaluating their applicability. In addition to cost implications, the design will also consider areas that are prone to traffic congestion and having high density housing and population.

4. Biodiversity and ecosystem

414. The baseline (Chapter III) indicated that no listed, rare, endangered, vulnerable or threatened species of flora or fauna near the project area. This includes the internationally recognized protected areas such as IUCN Red List and those as defined in any national legislation. The findings of detail survey conducted by domestic environmental assessment (i.e., UKL-UPL documents) for all subprojects will also be reflected in this IEE.

415. There are no areas of “Critical Habitats” that might be impacted as a result of the project, as defined in the ADB’s SPS 200933: The project will not significantly convert or degrade “Natural Habitats” either as defined in the ADB’s SPS. There will be no impacts on the ecological components as identified in the national, provincial or district requirements, as per the regulations cited in Chapter II.

However, civil work in this project dominated by water-related impacts such as soil erosion and sedimentation due to the excavation of soil that affect to aquatic ecosystem and its biodiversity, conversion of mangrove and other critical habitats, and potential poaching of flora and fauna in the area. The impacts will be managed as set forth in ECOP, to ensure that the construction will not affect the biodiversity and ecosystem, and no net loss of the biodiversity. As indicated in Table 2 and reinstated in

416. Table 84, some concerns shall be paid during the construction activities for potential impact to biodiversity (directly through trees felling and land clearing or/and indirectly through erosion/sedimentation which potentially affect to downstream aquatic-marine ecosystem.

Table 84: Construction Activities Potentially Affect Biodiversity

Project Location	Special Concern	Potential Impacts to Biodiversity	Mitigation Measures
Banten Mauk, Kemiri, Tangerang	➢ Trees felling (191 unit) ➢ Cutting and land clearing (378.30 m^2) ➢ Land excavation (3,211.45 m^3) ➢ Flood embankment (1,589.58 m^3)	Loss of coastal plants by clearing and felling trees Turbid water due to erosion that affect aquatic plants and benthic Sediment that potentially affect coral and seagrass No rare or endangered species is within the proposed site.	Set forth specifically in design/construction plan and ECOP, covering among others: - Mangrove restoration program - Erosion/ sedimentation protection - Excavated soil management and proper disposal
Central Java Bulu, Jepara, Jepara	➢ Trees felling (191 unit) ➢ Cutting and land clearing (376 m^2) ➢ Land excavation (291.95 m^3) ➢ Flood embankment (2,987.54 m^3)		
East Java Pulokerto, Kec. Kraton, Kabupaten Pasuruan	➢ Trees felling (191 unit) ➢ Cutting and land clearing (378.30 m^2) ➢ Land excavation (3,211.45 m3) ➢ Flood embankment (2,987.54 m^3)		
South Sulawesi Banyuanara, Sanrobone, Takalar	➢ Trees felling (191 unit) ➢ Cutting and land clearing (378.30 m^2) ➢ Land excavation (291.95 m^3) ➢ Flood embankment (2,987.54 m^3)		

Note: Number of trees felling is indicative only and not clear the types of the trees.
Source: Basic Design Report of Shrimp Ponds (MMAF, 2021).

5. Construction Wastes and disposal

417. **Non-Hazardous and Hazardous Waste.** Non-hazardous solid waste generated during construction activities includes inert debris from damaged facilities, excess fill materials from grading and excavation activities, scrap wood and metals. Other non-hazardous solid wastes include office, kitchen, and workcamp wastes. Hazardous solid waste includes asbestos containing demolition waste, contaminated soils, which could potentially be encountered on-site due to previous land use activities, or small amounts of machinery maintenance materials, such as oily rags, used oil filters, and used oil, as well as spill clean-up materials from oil and fuel spills.

418. **Oil and other hazardous materials releases**. The presence of oil products and other hazardous materials are expected in the construction, which include fuel, oil, grease, paints, and solvents. These materials are associated with operation of the heavy equipment and vehicles and various construction activities. Some of these materials may accidentally be released to the environment. However, the issue is considered less significant in the development of shrimp ponds, broodstock, and laboratories since only small quantity is expected.

419. However, as part of good construction practice, the Contractors will be required to raise an awareness for all workers regarding the prevention and management of spills and proper disposal of used containers. Fuel and oil shall be stored in a designated secured area provided with an impermeable liner to prevent the accidental spills from seeping into the ground. The hazardous waste management will refer to GoI Regulation No. 22/2021.

E. Cumulative and Indirect Impacts, and Climate Change

420. Generally, cumulative impact refers to impacts that are additive or interactive in nature

and result from multiple activities over time. In the case of the IISAP (shrimp ponds) subproject, the cumulative effects may result from additional numbers of shrimp ponds cluster at future, since aquaculture has been responsible for mangrove deforestation, and in some regions, this destruction continues mainly because of extensive shrimp production. Over the past three decades, Indonesia has lost 40% of its mangroves due to aquaculture, palm oil, and pollution.

421. Some initiatives were initiaiated by the Government to reduce the potential cumulative impacts. For example, Government established National Strategy for Mangrove Ecosystem Management (SNPEM) to synergize policies and mangrove ecosystem management programs. MMAF issued the Ministerial Regulation 75/2016, which disallows the use of mangroves for new shrimp ponds. The government plans to restore idle shrimp-farming ponds to boost its fisheries and reduce pressure on the ecosystem by introducing semi-intensive farming practices. Recently, MMAF introduces Sustainable Shrimp Pond concept, where mangrove replanted in the cluster, as will be adopted in the IISAP. The development of shrimp ponds will be integrated with Mangrove Restoration Program. And the focus is not only mangrove, but also plant other marine plants such as *cemara laut* (*Casuarina equisetifolia*), as its suitability with the soil type.

422. As best practice, in East Java (Pasuruan Installation) has planted mangrove under Mangrove Restoration Program at the embankment of ponds and embankment of canals (water inlet and outlet) covering approximately 3 ha. The program also involves community participation. Out of the 3 ha, some 1 ha of the mangrove areas are intensively managed by Pasuruan Installation with density 80-120 trees/m^2. The mangroves are planted at the bank of ponds and canals with estimated area of 20-30% from total area.

423. Meanwhile, indirect impacts are in the form of effects on water quality such as dissolved oxygen content, dissolved organic matter content, shrimp disease, and the occurrence of an abundance of toxic algae. The increase in temperature due to climate change has led to many cases of blooming blue green algae in shrimp culture, which in turn has become a predisposing factor for the development of diseases due to viral infections such as white spot syndrome virus (WSSV), Taura syndrome virus (TSV) and infectious myonecrosis virus (IMNV). Other impacts of climate change on shrimp farming, namely gradually increasing high tide levels making aquaculture pond infrastructure inadequate and water availability, are serious threats. Changes in rainfall patterns can also impact salinity and oxygen levels which can affect the reproduction, growth, and endurance of shrimp. To anticipate the impact of climate change on shrimp farming, cooperation with the *Badan Meteorologi Klimatologi dan Geofisika* (BMKG) is needed, including information on strong winds, abrasion, high waves, predicted tide levels, rainfall, temperature, and salinity.

424. Separate study on climate change has been carried out under IISAP with a standalone report, thus will not be covered in this IEE, except a summary below Initial screening of IISAP Subprojects for climate is predicted as Medium Category. The subprojects shall be designed to accommodate potential water level increase, and by considering associated hydro-meteorological parameters.

425. Indonesia is highly exposed to climate change risks due to its island geography and large coastal cities, with over 80,000 kilometers of coastline and 42 million people living less than 10 meters above sea level. Aquaculture, with most of the production centers located in low land, is highly vulnerable to climate risks. Recognizing the vulnerability to climate change and supporting the implementation of the Indonesia's Nationally Determined Contributions under the

Paris Agreement, MMAF promotes climate change resilience through its investments, including aquaculture.[34]

426. The IISAP Baseline Survey (December 2021) indicated that climate change causes some natural disasters that impact fish culture like flood before and during growing season, extreme rainfall, rainstorm, more extensive pest and diseases attack during rainy season, flood at highest tide, and damage on bridge and irrigation canals dikes. More extensive pest and diseases attack during rainy season is the most-felt climate change impact experienced by farmers. Of the 370 respondents, as many as 52% respondents mentioned that pest and diseases attacked their shrimp more than 4 times in the last five years with severe impact.

427. **Potential cumulative impacts** regarding wastewater may also occur from other community shrimp ponds in the areas. Under IISAP, a clustering approach of the community shrimp ponds are proposed for reducing such cumulative impacts. A joint-WWT system will be built to cover all the ponds in the cluster. However, wastewater not only come from aquaculture activities, but also from other activities, among others:

(i) Creation or expansion of port areas, shore facilities and infrastructure (roads, water, power) for processing and transport of shrimp products. These infrastructure expansion or upgrade (such as port) can involve dredging, filling, destruction of mangrove swamps, construction and infrastructure development; and
(ii) Pollution from effluent discharged from industrial shrimp processing plants.

428. All these pollution sources are beyond the project and the reach of government agencies in charge of this project. A comprehensive approach in development planning and environmental planning and pollution management at least at watershed level is needed.

V. INFORMATION DISCLOSURE AND PUBLIC CONSULTATION

A. Objectives and requirements

429. SPS environmental principle 6 requires the borrower to “Disclose a draft environmental assessment (including the EMP) in a timely manner, before project appraisal, in an accessible place and in a form and language understandable to affected people and other stakeholders” (this usually means not in English only). To translate ADB’s policy in practice, the following procedure and requirements are adopted by the project:

430. **Step 1**. Draft the public announcement about IEE with key contents below:

(i) Objective of the disclosure and the follow-up consultation
(ii) A summary of the project and EIA/IEE including EMP
(iii) Weblink to e-version of draft documents
(iv) Addresses/locations to get or view the hardcopies (local government office, community centers, and public library)
(v) Deadline for feedback from the public: the longer the better to allow sufficient time for the public to read, think, discuss, consult and coordinate to form opinions (at least two weeks between draft EIA/IEE disclosure and consultation dates)

[34] ADB Concept Paper, July 2021.

(vi) Contact information for the public to send feedback: names of persons, email and post address, telephone numbers, websites, social media, or other means.

431. **Step 2**. Publicize the announcement at least two weeks prior to consultation at:

(i) Traditional media: bulletin board, popular newspaper, TV/radio channels
(ii) Social media to the public: Facebook, Instagram, Whatsapp, and Telegram
(iii) Mobile phone text messaging or mass emails to key stakeholders

432. Step 3. Consultation, usually a combination of typical methods below

(i) Get feedback through contacts in the announcement: deadline by last consultation
(ii) Questionnaire or Online surveys: anonymous, efficient, broader, less interactive
(iii) Meetings or interviews: costlier, limited participants, afraid to speak out at meetings, but more interactive (might be difficult during COVID-19 restriction).
(iv) Representativeness of project affected persons (PAPs) and stakeholders: by age, gender, ethnicity, profession, and education level.

B. Information disclosure

433. In line with ADB's Public Communication Policy, the Project will ensure that relevant information about social and environmental safeguard issues is made available in a timely manner, in an accessible place, and in a form and language(s) understandable to affected people and other stakeholders, including the general public.

434. ADB will disclose the following safeguard documents on its website: final or updated initial environmental examination upon receipt; and environmental monitoring reports submitted by the UPT / Balai during project implementation upon receipt.

C. Public Consultation

435. The consultation through questionnaire survey has been carried out in November 2021 with summary of the results in Table 85 (for institutional capacity of Balai/UPT on environmental management) and Table 86 (for community awareness and willingness on sustainable mangrove based sylvo-aquaculture). The questionnaire method is preferable in the COVID-19 pandemic situation. Consultation through meeting will be carried out once the pandemic ceased and key stakeholders mapping of the institutions and farmers who will be one of the project's beneficiaries.

Table 85: **Summary of consultation through questionnaire survey**

	Questions	Answers/ Options	Percentage	Remarks
1)	Is there a dedicated unit and/or focal person in Balai/ UPT which handle environmental issues and complaints handling?	No	40% (for complaints handling unit)	No focal person or dedicated unit which handle environmental issues, but complaint handling units available
2)	Is there staff whose qualification on environment or attended training on environmental management (AMDAL, audit, OHS, and others)	No, except for Takalar	43%	Only South Sulawesi (Takalar) whose staff with educational background of

			environmental management Some (22 staff) of BPKIL Serang (Banten) attended training on K3 (occupational health and safety) and one staff attended AMDAL training Some staff of BPAB Pesawaran attended training on K3 (occupational health and safety)
3) Is there a solid waste management (domestic and biological wastes) and liquid wastes) and wastewater management?	Yes, except for Pasuruan and Aceh	60%	Two of the Balai/UPT (Pasuruan and Aceh) has no WWTP (even simple one)
4) Is there environmental profile/baseline of the locations such as (i) water quality/seawater quality, (ii) air quality, and (iii) biodiversity (flora and fauna)	No, except for Bali (Karangasem) and South Sulawesi (Takalar)	40%	Only Bali (Karangasem and South Sulawesi (Takalar) which have baseline data.
5) Are the ponds, broodstock, and laboratories located in the protected areas or sensitive areas (forest, settlements, schools, hospitals, or cultural heritage)?	No	100%	The existing layouts illustrating no encroachment with protected areas.
6) Has Balai/UPT prepared environmental document (e.g., UKL-UPL) for the existing facilities or proposed project?	No, except for Bali (Karangasem)	20%	Only Bali (Karangasem) which prepared UKL-UPL

Source: Questionnaire and field visits.

Table 86: Willingness to Implement Wanamina (Silvo Aquaculture)

Province	District	Sub-district	Village	Total	Yes		Not willing		Will Consider	
					N	%	N	%	N	%
East Java	Pasuruan	Bangil	Kalianyar	17	2	1%	8	2%	7	2%
			Raci	15	1	0%	8	2%	6	2%
			Tambakan	8	5	1%		0%	3	1%
		Kraton	Gerongan	35	2	1%	9	2%	24	6%
			Pulokerto	26		0%	20	5%	6	2%
			Semare	19		0%	2	1%	17	5%
South Sulawesi	Takalar	Sandrobone	Banyuanyara	15	15	4%		0%		0%
			Lagaruda	10	5	1%	2	1%	3	1%
			Sanrobone	15	10	3%	2	1%	3	1%
			Ujung Baji	10	6	2%	2	1%	2	1%
	Pinrang	Duampanua	Data	45		0%	3	1%	42	11%
			Maroneng	25	17	5%	6	2%	2	1%
			Paria	30	11	3%	12	3%	7	2%
Lampung	Lampung	Ketapang	Berundung	25	5	1%	20	5%		0%

Province	District	Sub-district	Village	Total	Yes		Not willing		Will Consider	
	Selatan		Pematang Pasir	25	24	6%	1	0%		0%
		Sragi	Bandar Agung	50	33	9%	15	4%	2	1%
Total				**370**	**136**	**37%**	**110**	**30%**	**124**	**33%**

Source: IISAP Baseline Study (November 2021).

436. The joint public consultation (Social Safeguard and Indigenous People Safeguard) was conducted in two subdistricts in Jepara (Central Java) on June 14 - 15, 2022, and the results were summarized in Table 87. The consultation focused on disseminating of some basic requirements in draft IEE to farmers and other key stakeholders (officers from Balai/UPT, DJPB/MMAF, district government/Fishery Agency, and village government). In addition to oral presentation, an Indonesian version booklet on the project description and its requirements (including environmental safeguard such as siting criteria for the shrimp pond and supporting facilities, requirement for domestic environmental documents, and wastewater treatment) were shared to the participants. Similar public consultation was carried out in Bulukumba and Sinjai (South Sulawesi) on 21 – 22 June 2022.

Table 87: Summary of consultation through meetings

	% of women	Age distribution	Education	Ethnicity	Profession
Meeting 1: 14 June 2022, Kedung (Jepara, Central Java) Total number of participants: 48	Approximately 25%	In range 27 – 60 years old	Mostly high school, except for government officers (DJPB/MMAF Staff, Balai/UPT, Fishery Department, and Camat) who are graduates or postgraduates	Javanese	Farmers and public servant officers Directorate General of Aquaculture, MMAF, Fisheries Agency of Jepara District, head of Kedung Subdistrict, Head of Panggung Village, fish farmer group, and extension worker
Meeting 2: 14 June 2022, Donorejo (Jepara, Central Java) Total number of participants: 49	Approximately 20%	30 – 60	Mostly high school, except for government officers (DJPB/MMAF Staff, Balai/UPT, Fishery Department, and Camat) who are graduates or postgraduates	Javanese	Farmers, community leader, and public servant officers Directorate General of Aquaculture, MMAF, Fisheries Agency of Jepara District, head of Donorojo Subdistrict, Head of Ujungwatu Village, fish farmer group, and extension worker

Source: Consultants Report

437. Information Disclosure, Consultation, and Participation are requirements of the ADB SPS and of the Indonesian environmental assessment and approval procedures.

438. The Implementing Agency (IA) works with district, province, and national agencies and

local communities on a regular basis.

439. The Consultant team and IA planning staff met with provincial representatives, local organizations, and community representatives in all of the communities proposed for the project as well as relevant agencies, and NGOs. This included identification of suitable alternative sites, land ownership and other local issues.

440. Further consultation and participation will continue through the design phase and into construction and operation. This includes keeping local communities and stakeholders informed of the project and establishing a grievance Redress Mechanism to receive and address complaints and concerns.

441. The project documents will be disclosed in ADB website. Environmental assessment documents will be made available to the public as part of the Indonesia approval process. Ensuring subproject success requires meaningful stakeholders' consultation and participation. Activities for information disclosure, public consultation, and public participation are part of the overall planning, design process, and construction of the IISAP subproject.

442. Public consultation and participation activities will be conducted in the future during construction phase. UPT/Balai will host public consultations and information disclosure during detailed design phase. Discussions during these consultations are expected to be more focused and detailed since design information will be available such as exact locations and components of shrimp ponds clusters, broodstocks, and laboratories. Views of the stakeholders will be considered in the overall design process. Stakeholders' consultations shall be continued throughout the construction phase on an area-by-area basis to sort out any potential problems. These shall be done by the PIU, PMU, and contractors prior to actual construction activities. In these construction consultations, specific concerns of the people such as the disturbance associated with the excavations in their area shall be discussed in detail. The records of environmental and social complaints, received during consultations, field visits, informal discussions, and/or formal letters, together with the subsequent follow-up and resolutions of issues shall be kept.

VI. ENVIRONMENTAL MANAGEMENT PLAN

443. The Environmental Management Plan (EMP) is a set of actions and arrangements to mitigate the adverse impacts assessed and found during IEE process. It is developed in line with applicable domestic and ADB guidelines and standards, drawn on experience in the EMPs of similar projects and WB/IFC's EHS guidelines and related international good practice. It includes several components crucial to effective environmental management within the project: (i) organizational responsibilities and arrangement; (ii) mitigation measures of impacts during construction and operation; (iii) EMP training plan; and (iv) monitoring scheme and reporting requirements.

A. Institutional Setup for Supervision and Reporting

444. The DGA is the Executing Agency responsible for overall subproject, while the subproject implementation unit (PIU) is the Technical Implementation Unit (UPT)/Balai. PIU will be responsible for the day-to-day implementation of the Subproject and will be accountable for technical, safeguards and financial reporting. A summary of the implementation organizations and corresponding management roles and responsibilities are documented below (Table 88).

Table 88: Role and Responsibilities on Environmental Management

Phase	Major parties	Environmental Responsibility
Design and preparation	Owner or PMO (MMAF)	Act as proponent who responsible for overall environmental safeguard, preparing environmental documents, environmental approval and implementation of environmental management and monitoring
	UKL-UPL Team (Consultant)	Hired by DGA/Balai and responsible for conducting environmental study (UKL-UPL), including for administering environmental approval and Pertek (WWTP technical approval)
	TRTA Team	Conduct screening and categorization and prepare respective environmental safeguard per SPS (2009), including IEE and EMP for the subprojects
	Local Environment Office/ Agency (DLH)	Review and recommend on self-screening (*Penapisan*) prepared by proponent for type of environmental document to be prepared according to GOI regulation (most likely UKL-UPL or SPPL); review and approve for the environmental document; and issue environmental approval (including Pertek, if applicable);
Construction	PMO and MMAF's local branch UPTs or Balai	Act as proponent who responsible for hiring and supervising of contractors to ensure that the contractors implement obligations related to the environmental management
	Contractors	Implement EMP and UKL-UPL as set forth in contract during construction phase and construction closure
	Engineering Supervisor	Supervise the contractors and make sure that the environmental management implemented and report the status (including request for corrective actions in case of any violation)
	Independent environmental monitoring service (lab)	Hired by Contractors to conduct laboratory for periodic environmental monitoring as required in UKL-UPL (at least semester basis) during construction phase
	Local Environment Office/ Agency (DLH)	Receive and review report on the implementation of UKL-UPL; Conduct external monitoring for the environmental condition in the district and province level, respectively; Receive complaint and report from community on the complaint related to environment and

Phase	Major parties	Environmental Responsibility
		conduct field investigation as necessary.
Operation period	MMAF's local branch UPTs/Balais	Responsible for overall environmental management and monitoring as set forth in EMP and UKL-UPL during the operation and maintenance phase
	Independent environmental monitoring service (lab)	Hired by DGA/Balai to conduct periodic environmental monitoring as required in UKL-UPL (at least semester basis)
	Local Environment Office/ Agency (DLH)	External monitoring and receive report on implementation of UKL-UPL; Request for corrective action in case of violation; and conduct field visit and verification for suspect pollution resulting from the operation

445. In addition, the PMU/PIUs and contractors will be monitored for the following key performance indicators to ensure environmental compliance:

(i) If focal person is assigned on environmental safeguard;
(ii) If environmental expert be engaged to assist the PMU/PIUs;
(iii) If sufficient budget is allocated to implement the EMP and related subplans; and
(iv) If training be conducted as per training plan specified in this EMP.

446. **According to FIDIC, international good practice on biding and contracting,** normally AFTER a contractor wins the bid and signs the contract with the owner (the PIU in this case), will s/he visit the sites. Facilitated by the owner in addition to data and information about the sites provided prior to bidding, the contractor will inspect all sites related to his contract package in order to prepare the "Construction organization and management plan" (hereafter as the construction plan) and submit to the owner and the Engineer as defined and required by FIDIC. Once the owner and the Engineer on behalf of the owner review and clear such construction plan, they will issue the Order to Commence the construction.

447. Such construction plan needs to encompass EHS aspects as required in many countries and also FIDIC guidelines. IN ADB projects, this means to include the EMP with site specifics as part of such construction plan, especially on health and safety including traffic and access management. Abundant information all point to the need for engineering solution to EHS issues first and foremost, as most of the EMP measures for construction are at the same time also good construction practice.

448. Reporting is one of the means to urge for the EMP implementation to control EHS impacts and risks. To serve this end, more direct and effective means is field supervision and inspection and training, which should be the focus and priority during project implementation. Therefore, the following two-layer arrangement on more efficient supervision also serves to facilitate environmental reporting.

449. **Supervision, monitoring, and reporting** of EMP implementation should be arranged according to the notes for Table 89, Table 90, and Table 91 and, since more direct and effective means is field supervision, inspection, and training. Based on these, their findings and recommendations and trainings should be documented in semi-annual report of the PMO as a management tool and submitted to the ADB.

450. The main content and indicative outline of the environmental reports are the following:

(i) Introduction:

a. Concise project description (can be copied every time but indicates changes);
b. Project progress in this reporting period: copy from the overall progress report to ensure consistency or make a reference if it is too lengthy.

(ii) Mitigation measures: their implementation status (fully followed or not, if not, which parts are not and why; actual performance and findings, any issues and gaps, reasons for them, corrective actions proposed and/or remedy already taken; (Note: no need to repeat the EMP measures, as the EMP is publicized for everyone to see).
(iii) Quantitative monitoring: summary of results and conclusion, explain if comply with applicable standards or not, and analyze the reasons of non-compliance. (Note: full data and original reports' scans submitted in the annex);
(iv) Training: carried out during this period, how, to whom, results and effects; If no training carried out during the period, say so in Introduction or Conclusion;
(v) Any complaints through GRM: what, when and where, how they are resolved etc. If no grievances during the period, say so in Introduction or Conclusion;
(vi) Requirements for the changes in the project: if it exists in this reporting period, explain domestic EIA requirements, progress made, and how to also meet ADB requirements.
(vii) Conclusion on this reporting period and recommendations/work plan for the next.

B. Mitigation measures

451. This section addresses the need for mitigation and management measures for the IISAP subprojects, which include ponds and hatcheries as well as their associated structures of linked drainage and access roads. For construction, the impacts of all types of subprojects are very similar and thus they share common mitigation measures during pre-construction and construction phases (see Table 89).

452. As there are three distinctive project feature during their operation, two separate EMP prepared based on past experiences, sector EHS guidelines of the WB group and government regulations. There is one EMP for shrimp ponds and hatcheries operation (Table 90) , and another EMP for laboratories operation (Table 91).

453. During the pre-construction phase, the EMP related cost is part of the project preparation. During construction, cost of implementing the environmental mitigation measures is naturally borne by the contractor, since the EMP is included in the bidding documents and thus in their contracts as specified in the technical specifications. During the operation, all cost of implementing EMP measures are part of the O&M costs borne by their owners or managing entities. The training cost is part of overall IISAP capacity building. All these can also foster mainstreaming EHS into routine work of each phase and related training.

Table 89: Mitigation measure/Environmental code of practice for pre-construction and construction of all subprojects

Impact	Activities	Mitigating measures	Location	Implementor	Supervisor
Pre-Construction					
Overall	Bidding and contracting	1. Comply with all statutory requirements set out by Government; 2. Confirm Gov. Approval and Secure Requisite Permits, Clearances; 3. PMUs ensure the EMP be included in bidding docs thus in contracts of civil work. 4. The tender documents shall include a lump sum bid item "Environmental Mitigation Measures". It shall be clarified in the specification documents that the applicable measures in the ECOP and EMP are to be charged to this item. This will allow the construction supervision engineer to require the contractor to quickly address the environmental issues during construction.	Not specified	Responsible by Balai/UPT	PIUs/PMUs assisted by environmental personnel
Encroachment of protected areas	Selection criteria for quarry, borrow pits, disposal sites etc.	<u>Quarry, borrow pits and disposal sites selection criteria:</u> 1. Located beyond of right-of-way/demarcation of riparian zone: at least 5 (five) meters from the foot of river with embankment; at least 100 (one hundred) meters from the riverbank of large river without embankment; at least 50 (fifty) meters from the riverbank for tributary without embankment outside of settlement area 2. Alternatively, outsource of quarry, borrows pits and disposal with competent and certified third parties	Not specified	Responsible by Balai/UPT	PIUs/PMUs assisted by environmental personnel
Climate e.g. flood, drought, temperature rising, etc.)	Design of ponds and hatcheries/ broodstock	Climate mitigation and adaptation already anticipated in design phase: - Flood protection (embankment) with Q25 (25-years periodical floods) - Use of corrosion resistant materials against weather and saline air	Ponds and hatchery/ Broodstock	Responsible by Balai/UPT	PIUs/PMUs assisted by environmental personnel
Conversion of natural habitats	Site selection of ponds and broodstocks	1. Prevention of the impacts done through using strict siting criteria during design: 2. MMAF's assistance program for the pond's clusters outside of the project to adopt sustainable aquaculture model. 3. Implement mangrove restoration program with community participation	Same as above	Responsible by Balai/UPT	PIUs/PMUs assisted by environmental personnel
Construction:					
Air Pollution: Dust and air emission	from earthworks and movement of	1. Require the contractor to cover materials with tarpaulin or other suitable materials while in transit to avoid spillage of materials. 2. Moisten earthen roads during dry and dusty conditions, particularly roads near residences and through the town core area.	At the work site of excavation and other	Contractors	supervision (resident) Engineers

Impact	Activities	Mitigating measures	Location	Implementor	Supervisor
Affect workers and community health	vehicles can pose nuisance to nearby communities	3. Impose speed limits on construction vehicles. 4. Conduct regular maintenance on construction equipment and vehicles to control air emissions during vehicle operation. 5. Sites of borrow pits and spoil disposal must be at least 300 m from residential areas so as to reduce dust from these sites. 6. Effective dust suppression measures will be implemented near sensitive receptors such as schools, hospitals, or housing.	earth working in the ponds Access road to and from project site		
Nuisance Noise: **Affect workers and community health**	Operation of construction equipment will cause excessive noise	1. Limit construction activities, particularly operation of noise generating equipment at night. 2. Position any stationary equipment that produce high noise levels such as diesel generators as far as practical from sensitive receptors. 3. Erect temporary barriers around construction sites especially near schools, hospitals, and houses. 4. Install noise suppression devices to noise generating equipment. 5. Require drivers to minimize blowing of horn and to comply with speed limits. 6. Provide information to community on schedule of construction activities through billboard/signs.	near receptors: settlement, schools, hospitals, religious facilities, etc	Contractors	supervision (resident) Engineers
Wastewater: Runoff cause siltation; sewage to pollute water	excavation, earthworks, wastewater from camp	1. Construct silt traps, deviation channels, mounting barriers or trenches around the stockpiles of materials. 2. Provide adequate water supply and temporary toilet facilities at the worker's camp.	At the work site of excavation and other earth work	Contractors	supervision (resident) Engineers
Soil Erosion/ Contamination	Earth moving work Loss of valuable topsoil	1. Cutting of trees will be undertaken as per approved design and only upon approval of relevant authorities. 2. Avoid cutting of trees as much as possible and minimize damage to native vegetation. 3. Implement landscaping and planting of trees/vegetation at sites of the proposed facilities. 4. Soil erosion management plan to be prepared by the contractor and to be approved by the responsible authority before construction starts. 5. Maintain slope stability at cut faces by implementing erosion protection measures. 6. Construction in erosion and flood-prone areas should be mainly restricted to the dry season. 7. Control silt runoff and cover soil stockpiles; 8. Locate temporary soil stockpiles in areas where runoff will not induce sedimentation of waterways. 9. Establish protection measures for river embankment works, cut slopes, material stockpiles and other areas at risk of soil erosion	At the work site of excavation and other earth working in the ponds	Contractors	supervision (resident) Engineers

Impact	Activities	Mitigating measures	Location	Implementor	Supervisor
		prior to periods of heavy rainfall			
Construction debris and spoil; **Pollute land and water**	Solid wastes, inert construction wastes, and hazardous wastes during construction	1. Surplus excavated material/cut soil will be used as backfill material for low-lying areas that have been identified by the village authority. 2. Provide appropriate segregation bins or areas for construction wastes. 3. Secure and control storage of all hazardous materials including fuels. 4. Reuse recyclable construction wastes such as wood, steel, and scaffoldings or sell to junk shops. 5. Solid waste to be collected and disposed in approved disposal site of the Districts.	Work sites and storage areas, and working camps	Contractors	supervision (resident) Engineers
Impact on Ecological Resources	Construction workers	1. The contractors will prohibit activities such as cutting wood for cooking, hunting, or wildlife trade.	Work sites and camps	Contractors	supervision (resident) Engineers
Clearing of Vegetation	Poor planning and execution of tree clearing vegetation removal a loss of vegetation and general landscape	1. Cutting of trees will be undertaken as per approved design and only upon approval of relevant authorities. Avoid cutting of trees as much as possible and minimize damage to native vegetation. 2. Roads and paths to the facilities will only be sufficiently wide to accommodate construction vehicles/equipment to minimize land take. 3. Manual labor will be utilized in sloping terrain where use of heavy equipment would cause unnecessary damage. Steep exposed slopes will be graded and covered with bush and grass to minimize erosion. 4. Implement landscaping and planting of trees/vegetation at sites of the proposed facilities.	Work sites of ponds/ hatchery (coastal flora/ plants)	Contractors	supervision (resident) Engineers
Social disturbance **Temporary Disruption of Community Roads, Paths, and Accesses**	Community access to areas, schools, temples, village offices, market and meeting halls may be affected during construction	1. Walking access will be maintained to affected properties and access routes will be temporarily lined with timber or similar material. Particular attention will be given to ensuring safety along roads and paths used by pedestrians. 2. Install barriers and safety warning signs on road sections and if necessary, deploy traffic aides/ flag persons at affected locations. Information boards at blocked roads will provide information about the temporary closure of roads, schedule of works and the traffic-rerouting plan. 3. Require the contractor to immediately rehabilitate the excavated areas and any damaged road and path sections. 4. Enclose construction site perimeters so that pathway use, and access remains unimpeded.	Work sites and access road (nearby populated areas)	Contractors	supervision (resident) Engineers
Damage Physical Cultural resources (PCR)	Uncover relics and artifacts during civil	1. Chance-find procedure: ➢ in the event of accidental finds relics, should immediately cease any works in the area and protect the site	At the work site of excavation	Contractors	supervision (resident) Engineers

Impact	Activities	Mitigating measures	Location	Implementor	Supervisor
	works.	➢ Promptly report the find to their supervisor who immediately report local authority for PCR, e.g., cultural relic bureau. ➢ Contractor will ensure that the workforce is briefed on this procedure during prior training on EMP/ECC.	and other earth work		
Community Health And Safety	exposed to open excavation	1. Install barricades/barriers and sturdy plate covers in open excavations during non-working time. 2. Install warning signs in the area.	Work sites and access road	Contractors	supervision (resident) Engineers
Increased Volume of Traffic	Increased traffic volumes and higher speeds may lead to accidents	1. Prepare a traffic control and management plan together with the local traffic police prior to any construction. The plan shall include provisions for diverting or scheduling construction traffic to avoid morning and afternoon peak traffic hours, regulating traffic at road crossings with an emphasis on ensuring public safety through clear signs, controls and planning. 2. In case of lane closures, deploy workers to direct traffic. 3. Signage and other appropriate safety features will be installed to indicate construction works are being undertaken 4. Speed limits shall be established in the work sites to minimize the risk of accidents.	Access road (nearby populated areas)	Contractors	supervision (resident) Engineers
Occupational Health and Safety	Construction activities may pose hazards to workers because of the use of heavy equipment, lifting of heavy loads, and exposure to open excavations and chemicals.	1. Require the contractor to implement the construction health and safety plan in accordance with the World Bank EHS Guidelines (http://www.ifc.org/ehsguidelines) as a minimum standard. The contractor will appoint an environment, health and safety officer to ensure implementation of the plan. The plan will at minimum include: ➢ Provision of first-aid facilities readily accessible by workers. ➢ Provision of personal protective equipment (PPEs) such as hard hats, gloves, rubber boots, etc. ➢ Wearing of PPEs while working onsite will be a mandatory requirement for workers. ➢ Posting of safety signs/reminders in strategic areas within the construction area. ➢ Installation of sufficient lighting at night. ➢ Ensure that vehicle and equipment operators are properly licensed and trained. ➢ Provide staff with COVID 19, communicable disease and HIV-related awareness training. 2. The contractor will be required to provide priority hiring of qualified construction workers from the villages and to consult with the local authorities to avoid conflict if migrant workers brought in.	Any work sites and construction camps	Contractors	supervision (resident) Engineers
COVID-19 Risk Management	Working Camp Siting	1. Siting of Camps and Field Offices that meet the requirements: ➢ Not in area susceptible to flooding, landslide or other natural	Construction camp	Contractors	supervision (resident)

Impact	Activities	Mitigating measures	Location	Implementor	Supervisor
	and Management	disaster ➢ Not in area affected by dust, noise, sewage or other pollution; ➢ Not in a residential area ➢ Minimum housing standards ➢ Separate bed for each worker ➢ Beds should not be arranged in tiers of more than two ➢ Separate accommodation of the sexes or to accommodate couples ➢ Adequate natural light during the daytime and adequate artificial light ➢ Adequate ventilation to ensure sufficient movement of air ➢ Adequate supply of safe potable water; ➢ Adequate sanitary facilities and drainage. ➢ Adequate furniture for each worker to secure his or her belongings, such as a locker ➢ Common dining areas, canteens, or mess rooms, located away from the sleeping areas ➢ Appropriately situated and furnished laundry facilities ➢ reasonable access to plug sockets for charging telephones and other devices ➢ Rest and recreation areas and health facilities, where not available in the community ➢ Minimum accommodation sizes; Sleeping space and room with Beds minimum 2m apart ➢ Inside dimensions over 198 centimeters by 80 centimeters. ➢ Headroom of over 203 centimeters allowing full free movement	Work site		Engineers
Sanitation	Workers camps	1. Provide Sanitation Facilities ➢ One toilet, one tap / basin, one toilet for every 6 people, Fresh cold running water ➢ Convenient location to accommodation; Provision of soap, Ventilation to open air ➢ Separate facilities for men and women, Clean and hygienic 2. Septic tank/sewage treatment facility, or pit latrines located at least 200m from surface waters, and in areas of suitable soil profiles and above the groundwater levels 3. Separate area for sick workers to prevent transmission of disease 4. Fire safety throughout accommodation such as fire extinguishers, fire alarms, fire blankets 5. Worker training in fire prevention and procedures; Smoke detector in sleeping area 6. Fire exit sign, adequate means of escape and clearly maintained exit	Construction camp Work site	Contractors	supervision (resident) Engineers

Impact	Activities	Mitigating measures	Location	Implementor	Supervisor
		7. Security lighting within camp and for sanitation block and lighting for route from sleeping area to sanitation block 8. Electrical cables to be in safe condition, elevated and not in areas liable to flood 9. Inspection ➢ 2 weekly inspections for cleanliness, state of repair of building, accommodation and fire equipment. ➢ Record inspection results and retain for review			
Occupational health and safety	Construction site working conditions	1. Form a joint team to plan and organize commencement and/or return to work 2. Develop or convene a joint occupational safety and health committee with members representing the employer and workers 3. Train team members on the basic principles for the formulation and implementation of occupational safety and health preventive and control measures. 4. Develop and communicate a work plan on safe working for COVID-19. Such plan should be fully aligned with any government regulations and guidelines on COVID-19 prevention and control, or in the absence thereof international good practice guidelines as may be updated from time to time 5. Risk assessment to decide when to work, who works and how 6. Undertake a risk assessment to determine the preventive and control measures 7. Ensure preventative measures are in place before resuming or beginning construction work 8. Adopt engineering, organizational and administrative measures ➢ Avoid physical interaction and maintain physical distancing requirements as prescribed by national policy of at least 2 meters, or in the absence thereof, international good practice ➢ Ventilate enclosed workplaces including work camps and communal spaces ➢ Avoid concentration of workers - limit the capacity of common areas such as work camp dining areas and changing rooms to allow the minimum separation of 2 meters and organize one-way systems. This includes sleeping areas which must be a minimum of 2 meters between beds ➢ Put in place training and information on COVID-19 and measures required for its management. ➢ The construction site is to be segregated to the extent possible in zones or other methods to keep different crews physically separated at all time ➢ Stagger break and lunch schedules to minimize the number of people near one another	Construction camp Work site	Contractors	supervision (resident) Engineers

Impact	Activities	Mitigating measures	Location	Implementor	Supervisor
		➢ Regularly clean and disinfect ➢ Increase the frequency of cleaning and disinfection, heavily trafficked areas and common areas, including work camps ➢ All door handles, railings, ladders, switches, controls, eating surfaces, shared tools and equipment, taps, toilets, and personal areas are wiped down at least twice a day with a disinfectant ➢ Discourage the sharing of items such as cups, glasses, plates, tools 9. Promote personal hygiene ➢ Provide workers with the conditions and means necessary for frequent hand washing (soap, water or alcohol gel) with a posted hand washing protocol at site entries, exits, bathrooms, communal areas, offices, and any other areas with commonly touched surfaces ➢ Inform workers of the need to avoid physical contact when greeting, and avoid touching eyes, nose and mouth ➢ Inform workers of the need to cover the mouth and nose with a disposable handkerchief when coughing or sneezing or the crook of their arm ➢ Dispose of tissues in a lined and covered waste bin and wash hands afterwards 10. Provide personal protective equipment (PPE) and inform workers of its correct use 11. Identify appropriate PPE related to the tasks and health and safety risks faced by workers according to the results of risk assessment and the level of risk, and provide it to workers free of charge and in sufficient number, along with instructions, procedures, training and supervision 12. Non-medical face-coverings (such as homemade cloth masks) should be worn as mitigation for catching and transmitting the virus, but are not to be treated as substitutes for proper hand washing 13. Health surveillance and insurance 14. Before entering the site, staff and visitors must confirm that they are not currently exhibiting flu-like symptoms 15. Monitor the health status of workers, develop protocols for cases of suspected and confirmed COVID-19. The protocol will state that: ➢ Workers with symptoms or confirmed cases must be isolated within the construction camp or stay at home for 7 days after symptoms started ➢ If symptoms persist after 7 days, the person must isolate until			

Impact	Activities	Mitigating measures	Location	Implementor	Supervisor
		the symptoms stop ➢ People who have been in close contact with the person with confirmed COVID-19 be quarantined for 14 days ➢ All workers in quarantine or isolation must be provided with adequate food, water, medical assistance and sanitation ➢ Identify workers who have had close contact with people infected with COVID-19 and follow national medical guidance ➢ Communicate confirmed cases of COVID-19 infection to the appropriate authorities ➢ All workers should be provided with health insurance that includes COVID-19 treatment Consider other hazards, including psychosocial 16. Promote a safe and healthy working environment free from violence and harassment. 17. Encourage health promotion and wellbeing in the workplace through enough rest, balance of physical and mental activity and adequate work life balance 18. Implement prevention and control measures for the use and storage of chemicals, particularly those used for disinfection during COVID-19Review emergency preparedness plans ➢ Review and update preventive and control measures as the situation evolves ➢ Periodically monitor prevention and control measures to determine whether they have been adequate to avoid or minimize risk, and implement remedies for continuous improvement ➢ Establish and maintain records related to work-related injuries, illnesses and incidents, worker exposures, monitoring of the work environment and workers' health 19. Refer to the emergency preparedness plan required by MMAF (https://kkp.go.id/djpb/artikel/33175-surat-edaran-nomor-b-21940-djpb-viii-2021-tentang-penerapan-protokol-kesehatan-pencegahan-covid-19-pada-usaha-perikanan-budidaya) and other government regulation			

Table 90: Mitigation measures for the Operation of Shrimp Ponds and Broodstock/Hatcheries

Environmental Impacts	Main Activity	Prevention and Mitigation Measure	Implementor	Supervisor
Wastewater effluent from ponds and tanks Contaminated due to excessive/ inefficient feeding (fish meal, fish oil, and other commercial manufactured feeds),	Breeding, hatching, Feeding for growing shrimps and harvesting	➢ Manufactured feeds shall be registered in the Ministry (MMAF) and used as the direction for use ➢ Ensure that pellet feed has a minimum number of "fines" or feed dust. Fines are not consumed and add to the nutrient load in the water ➢ Match the pellet size to the species' life-cycle stage (e.g., smaller pellets should be fed to fry or juvenile animals to reduce the unconsumed fraction) ➢ Regularly monitor feed uptake to determine whether it is being consumed and adjust feeding rates accordingly. Feed may be wasted due to overfeeding or not feeding at the right time of day. ➢ Where feasible, use floating or extruded feed pellets as they allow for observation during feeding time ➢ Store feed in cool, dry facilities and ideally for no longer than 30 days to avoid reduction in vitamin contents. Moldy feed should never be used as it may cause disease ➢ Spread feed as evenly as possible throughout the culture system, ensuring that as many animals as possible have access to the feed. Some species are highly territorial, and uneaten feed adds to the nutrient loads ➢ Feed several times a day, especially when animals are young, allowing better access to food, better feed conversion ratios and less wastes ➢ Halt feeding at a suitable interval before harvest to eliminate the presence of food and / or fecal material in the animal's gut ➢ During harvesting, contain and disinfect blood water and effluent to reduce the risk of disease spread and to contain effluent matter.	WWT Operator	Balai/UPT
Excessive Water extraction and use, cause saline water intrusion	Prepare Ponds, Broodstock and hatchery include piping, water treatment	➢ Abstract groundwater for sanitation and domestic use only (surface and PDAM piped water supply is preparable, if any) ➢ Use shallow aquifer, instead of deep wells (see Table 55 for groundwater level of all subprojects)	Pond/ Broodstock Operator	Balai/UPT
Contamination of food, increase discharge's chemical content	Application of antibiotics and veterinary medicines or hormones	➢ Medicines (used for aquaculture) shall be registered in the Ministry (MMAF) and used as the direction for use ➢ Apply approved over-the-counter antibiotics in strict accordance with the manufacturer's instructions to ensure responsible use	Pond/ Broodstock Operator	Balai/UPT

		➢ Apply approved antibiotics that are purchased and utilized by prescription under the guidance of a qualified professional ➢ Develop a contingency plan covering how antibiotics should be applied following the identification of disease outbreaks ➢ Store antibiotics in their original packaging, in a dedicated location ➢ Avoid stockpiles of waste antibiotics by adopting a "first-in, first-out" principle so that they do not exceed their expiration date. Any expired antibiotics should be disposed of in compliance with national regulations ➢ consider sanitation and prevent the aquaculture products from various hazards for food safety such as bacteria, biotoxin, heavy metals and pesticides, as well as forbidden residues (antibiotic, hormone)		
Exposure to Chemicals, Infectious disease vectors (malaria, dengue, etc)	Ponds operation	➢ Follow guidance for the management of occupational chemical exposure is discussed in the General EHS Guidelines ➢ Follow MMAF's occupational health and safety (Appendix 1 of MMAF Regulation No. 6/PERMEN-KP/2018) ➢ Addressed as part of the occupational health and safety program including specific additional medical screening for the labor force ➢ Implementation of preventive measures (e.g., mosquito nets in living quarters). ➢ Additional guidance on the prevention and control of communicable diseases is provided in the General EHS Guidelines	Pond/ Broodstock Operator	Balai/UPT
➢ **Wastewater treatment (WWT) Lagoon:**				
Odor or effluent from WWT and its sludge can contaminate water and soil etc .	Operation of WWT of shrimp ponds and broodstock, hatcheries	➢ Optimise operation following SOP for O&M to reduce odor in normal operation and malfunctioning; ➢ Use PDE such as mask to reduce the odor (affecting the workers) ; ➢ Observe and test regularly at inlet and outlet of lagoon following SOP to monitor treatment performance in order to adjust accordingly, e.g. the aeration intensity, retention time etc to ensure treated effluent meet standard; ➢ During the biological stage, the excess sludge (i.e. excess bacteria) is pumped ➢ Sludge are digested and dewatered to the optimal degree, is finally disposed of at the dump ➢ The sludge is dried using SDB (sludge drying bed) consisting of sludge feeding (from 1 to 10 days) followed by drying period (from 4 days to 3 months), and subsequently drain. ➢ Drying of the sludge using evaporation process (solar light) are affected by several factors that shall be maintained, among others:	WWT Operator	Balai/UPT

		temperature, light intensity, area of the surface, and barometric pressure. ➢ As the sludge from shrimp ponds and ponds' WWT are quite similar and mostly constitutes of organic material, both can be used for embankment, compost, and construction material. ➢ In case the sludge will be used for other purposes (as agriculture media or raw material for brickstone) or dumped at the other areas, the sludge shall be tested for heavy metals contents per government regulation ➢ Especially for constructed wetland some preventions and mitigations to be carried out: - All components expected to receive and/or trap debris and sediment should be inspected for clogging and excessive accumulation at least annually, or as needed; these components may include control structures, weirs, orifices, and outfall pipes. - All structural components should be inspected annually for cracking, subsidence, spalling, erosion, and deterioration. - Check the forebay for accumulated sediment. In general, the forebay should be dredged if sediment fills over 50% of design volume.		
Direct discharge or spillage of wastewater due to malfunction , poor O&M or outage of on-site WWT:	O&M of on-site wastewater treatment lagoon and wetland for ponds	➢ Include bypass/emergency lagoon in WWT design to store effluent during these incidents; ➢ In case testing of the wastewater exceeded the quality standard set forth, then: - Conduct inspection of the process in the WWT, and fix the problem, as the deviation or failure identified - Check all machines and equipment of WWT, and fix the problem, as the deviation or failure identified. - Check inlet and outlet on monthly basis. ➢ In case of electric blackout, genset shall be turned on automatically ➢ In case of leakage/fracture of WWT ponds (due to earthquake or other reasons), WWT process shall be halted. Open the emergency standby lagoon to store excessive Wastewater that continues to be generated from aquaculture operation. The inspection and repair shall be carried out until safe condition. ➢ In case of accident in WWT, first aid shall be provided at the site, and subsequently referred to polyclinic or hospital emergency unit for further medical care. ➢ In case of flood in the WWT, reserve pumps shall be turned on to avoid the flood water entering the WWT or wastewater contaminate the floodwater	WWT Operator	Balai/UPT
➢ **Solid waste management**				

General solid wastes cause aesthetic and health/sanitary problem	domestic garbage from offices and operation etc,	➢ Collection of the solid wastes in the temporary depot and then segregated the wastes by its characteristics: organic wastes, inorganic wastes, and recyclable materials. ➢ In case the facilities located at remote areas and unable to access Dinas Kebersihan service, it is allowed to burn the solid wastes in incinerator, especially for small volume of unwanted wastes after segregation and separate plastic wastes and other recyclables	WWT Operator	Balai/UPT
Organic wastes can cause odor, aesthetic and health/sanitary problem.	Organic solid wastes, e.g. sludge from ponds dredging/clearing, residues of feeds, and composting	➢ Reuse organic wastes as fuel (such as tree branches) and others is utilized through simple composting or digestion or fermentation on site or by nearby farmers; ➢ Use of sediment/sludge from dredging for compost and inert wastes reused in embankment of ponds ➢ Cover the wastes with soil layer;	WWT Operator	Balai/UPT
Hazardous wastes cause pollution and poisoning	Hazardous wastes, e.g. antibiotics and other chemicals	➢ In co-located subprojects: Coordinate with co-located laboratory to collect and transferred the hazardous wastes to the laboratory and follow measures in Table below on laboratories ; ➢ If standalone without laboratory nearby: cooperate with nearby hospitals or industries capable to manage the hazardous.	WWT Operator	Balai/UPT
➢ **Occupational health and safety:**				
Occupational risks during operation – Heavy Lift	Manual works during operation of shrimp ponds and broodstocks (lifting of materials/loads and harvest)	➢ Use mechanical and / or automated equipment to facilitate lifts heavier than 25 kg ➢ Use workstations that can be adapted to individual workers, especially if shrimp are processed at post-harvest ➢ Construct ponds that are rectangular in shape to facilitate harvesting. ➢ Use embankments which at least 2.5 meters wide, to be accessed by vehicles to drag harvest seines	Pond/ Broodstock Operator	Balai/UPT
Occupational risks during operation – Electric Shock	Operation of pump, paddle wheel, lighting, and other electric powered units	➢ Waterproof all electrical installations ➢ Ensure that fuses are used and that there is an appropriate connection to the ground ➢ Ensure that all cables are intact, waterproof, and without connection ➢ Provide training in the correct handling of electric equipment (e.g., pumps and) to avoid the risk of short circuits ➢ Employ lock out / tag out (LOTO) procedures	Pond/ Broodstock Operator	Balai/UPT
Occupational risks during operation - Drowning	Water based works at the ponds	➢ Provide lifejackets and harnesses with safety clips (karabiners) that lock on to lines or fixed points ➢ Ensure that personnel are experienced swimmers ➢ Train personnel in safety at sea, including procedures for supervision of personnel ➢ Require that personnel wear lifejackets on exposed sites and at sea ➢ Where large vessels are used to transport personnel and equipment to marine sites, ensure that the vessel can be	Pond/ Broodstock Operator	Balai/UPT

		securely berthed on the pontoons, reducing the risk of falling into the gap between the vessel and the pontoon		
Diseases and outbreak	Accidental introduction of wild breeds or non-certified (SPF) breeds into the ponds	➢ Use the seeds come from certified broodstock unit which implement good hatchery practices and proved by Health's Notification from authorized agency ➢ Equipment and machines for shrimp aquaculture shall be made from environmentally friendly materials, non-toxic, and free from diseases.	Pond/Broodstock Operator	Balai/UPT

Table 91: Mitigation measures for the project Laboratory Operation

(All measures are implemented by the operators with cost include in O&M budget, and supervised by Balai/UPT)

Environmental Impacts	Activity	Mitigation Measure	Implementor	Supervisor
➢ **Wastewater treatment (WWT):**				
Domestic wastewater from Toilets, staff sanitary use , cleaning, and washing	O&M of septic tank and related drainage	➢ All domestic wastewater is discharged into septic tank or settled in pond before discharge into drain ➢ Solid wastes are separated from the domestic wastewater by physical screen in drainage; ➢ O&M of septic tank: maintain plumbing and ventilation (gas release of the septic tank) ➢ Septage clean-up: Need to clean up septage once every 3 – 5 years or more frequent in some cases of irregularities identified such as overload, explosive methane gas, etc) ➢ Septage treatment/disposal: dumped as fertilizer, as appropriate (containing no heavy metals) and adequate humic contents ➢ Before use and/or transported to other areas the solid sludge shall be tested to confirm that no heavy metals (Cd, Pb, Zn, Hg, As, Cr) which exceed the allowable threshold.	Biotank Operator	Balai/UPT
Odor from WWT: H2S and ammonia etc. from the inlet are the majn source of odour: Also groundwater pollution.	Septic tanks to treat domestic sewage; from biotank and reedbed for laboratory wastewater	➢ Conduct periodic maintenance of the septic tank, including periodic desludging of the sludge ➢ Maintain air release of the septic tank downwind against the workspace ➢ Proper consideration of plant layout, buffer zones and others to provide necessary/appropriate odour control system; ➢ Installation of odour control system at the site to treat the unpleasant smell of the contaminated incoming sewage water ➢ The pre-treatment facilities that consist of coarse screening, fine screening, grease and grit removal chamber that stored contaminated sewage is enclosed to minimise the odour generated during the	Biotank Operator	Balai/UPT

		operational of septic tank/biotank ➢ Use PDE such as mask to reduce the odor (affecting the workers)		
Process and tests wastewater high in chemicals etc and complex. Treated discharge not meet standard, causing pollution	O&M of biotank and reedbed to treat Wastewater from laboratories' tests and preparation etc	➢ Optimize the testing SOP to reduce water use and thus wastewater amount; ➢ Follow the SOP for the O&M of biotank and reedbed with needed training to Laboratory staff; ➢ For hazardous chemicals like acids and alkalis: reuse as much as possible; neutralize them by mixing properly in order to avoid erode the drainage and WWT equipment and pipes. ➢ Spent solvent and liquid: should store temporarily in glass bottles, not drain into drainage and thus WWT. ➢ Observe and monitor regularly the inlet and outlet of above two WWT components (biotank and reedbed) to ensure proper operation and take actions to adjust their operation depending on monitoring results; ➢ Manage WWT sludge and other biodegradable wastes and proper disposal and/or reuse ➢ Sludge from laboratories is not recommended to reuse as its potential chemical contents ➢ Provide separate laboratory septic tank/biotank and domestic septic tank ➢ Avoid rainwater from roofing into the wastewater treatment system and divert away properly constructed soakaway ➢ Especially for reedbed/ constructed wetland some preventions and mitigations to be carried out: ➢ All components expected to receive and/or trap debris and sediment should be inspected for clogging and excessive accumulation at least annually, or as needed; these components may include control structures, weirs, orifices, and outfall pipes. ➢ All structural components should be inspected annually for cracking, subsidence, spalling, erosion, and deterioration. ➢ Check the forebay for accumulated sediment. In general, the forebay should be dredged if sediment fills over 50% of design volume.	Biotank Operator	Balai/UPT
Direct discharge or spillage incidents of wastewater	due to malfunction , poor O&M or power outage	➢ Design should include bypass and emergency storage tanks on site ; ➢ In case of leakage/fracture of WWT biotank (due to earthquake or other reasons), WWT process shall be halted. The inspection and repair shall be carried out until safe condition. ➢ Include bypass/emergency lagoon in WWT design to store effluent during these incidents; ➢ In case testing of the wastewater exceeded the quality standard set forth, then: Conduct inspection of the process in the WWT, and fix the	Biotank Operator	Balai/UPT

		problem, as the deviation or failure identified Check all machines and equipment of WWT, and fix the problem, as the deviation or failure identified. Check inlet and outlet on monthly basis. ➢ In case of electric blackout, genset shall be turned on automatically ➢ In case of leakage/fracture of WWT biotank due to earthquake or other reasons), WWT process shall be halted. ➢ In case of accident in WWT, first aid shall be provided at the site, and subsequently referred to polyclinic or hospital emergency unit for further medical care. ➢ In case of flood in the WWT, reserve pumps shall be turned on to avoid the flood water entering the WWT or wastewater contaminate the floodwater		
➢ **Solid waste management**				
Hazardous wastes contaminate Land and water	Sampling and testing of the samples in the laboratory	➢ All contaminated liquid or solid wastes are labeled, recorded to facilitate their proper handling and storage. ➢ All hazardous and chemicals should be decontaminated and neutralized before disposal. ➢ Follow the instruction in Material Safety Data Sheet (MSDS) in storage, handling, transport or use as well as disposal and OHS procedure in case of intoxication and exposure) ➢ Collect the hazardous waste at temporary storage before transfer to third party which is certified for hazardous treatment and dumping ➢ provided in specific areas which lined, with enclosed walls and roofs to store hazardous waste containers. ➢ Install and use properly-sized sterilization devices (e.g. autoclave) to timely sterilize infectious wastes into general wastes, reducing need for special further treatment; ➢ For hazardous chemicals like acids and alkalis: reuse as much as possible; neutralize them by mixing properly following relevant laboratory SOP and safety procedure; ➢ For inflammable chemicals/solvents: reuse as much as possible permitted by H&S rules; burn by onsite incinerator with O&M improved to meet its standard performance; ➢ Initiate regular training on safe practices to handle hazardous wastes. ➢ Use of appropriate PPEs for the workers.	Lab Operator	Balai/UPT
Aesthetic and sanitary nuisance	General solid wastes, garbage	➢ Collect and segregate the wastes by its category (especially, separate hazardous wastes with general non-hazardous wastes) ➢ Reduce, reuse and/or recycle of certain wastes (plastic, metal, glass, and cardboard) ➢ Use of organic wastes as raw material for composting ➢ Promote waste segregation to avoid hazardous waste mixing with general wastes.	Lab Operator	Balai/UPT

➢ **Air emissions of laboratories**				
Air emission and smell/	Operation of fume hoods and ventilation in laboratories	➢ Keep all apparatus at least 6 inches back from the face of the hood; Keep the slots in the hood baffle free of obstruction; ➢ Elevating large equipment at least two inches off the base of the fume hood, to allow for the passage of air underneath the apparatus; ➢ Minimizing movement and other forms of potential air disturbances past the face of the hood while you are working; ➢ Eliminating sources of ignition inside the hood when flammable liquids or gasses are present; ➢ Limiting the storage of chemicals and apparatus in the hood to those that are required for current work; ➢ Maintain good ventilation of the workspace (lab), Including use of air blower ➢ Use of fume hood and other methods to suction the hazardous vapor and odor ➢ Use PDE such as mask to reduce the odor (affecting the workers)	Lab Operator	Balai/UPT
Flue gas emission with common air pollutants and probably toxic dioxin	From boilers, and Solid waste onsite management at laboratories i.e. handling, storage, incineration	➢ Proper O&M of boilers on site or switch to gas or electricity boilers if possible; ➢ Maintain feed of the wastes and air so reduce incomplete combustion that produces toxic carbon monoxide (CO) ➢ Avoid combustion of material that potentially release dioxin and other toxic gases ; ➢ Retrofit onsite existing incinerators to ensure optimal operation, and add filers at chimney; ➢ Operate onsite incinerator in their standard condition, i.e. burn at temperature 850 for min two seconds to avoid and destroy dioxin etc; ➢ Reducing the introduction of plastic material in the incineration process, reduces the calorific value inside the incineration chamber, which sometimes prevents the feed process due to the abrupt rise in temperatures inside the incinerator	Lab Operator	Balai/UPT
➢ **Occupational Health and Safety**				
hazards: Fire,Explosions Chemical and Thermal Burns Cuts; Absorption or Inhalation of Chemicals	Operation and tests in standard laboratories, and wet laboratories of aquaculture ponds and hatcheries	**Measures related to Fire:** ➢ Never be open flames in the laboratory. Specifically, never heat any organic solvent in an open vessel, such as a test tube, Erlenmeyer flask, or beaker, with a flame. ➢ Volatile solvents should be heated in a hood with a steam bath, not a hot plate. ➢ Never keep volatile solvents, such as ether, acetone, or benzene in an open beaker or Erlenmeyer flask. ➢ All staff to know where the nearest safety shower and fire extinguisher are located. All staff in the laboratory will be trained in the use of fire	Lab Operator	Balai/UPT

		extinguishers. **Explosions:** ➢ Never heat a closed system or conduct a reaction in a closed system (unless specifically directed to perform the latter process and then only with frequent venting). ➢ Before starting a distillation or a chemical reaction, make sure that the system is vented. **Chemical and Thermal Burns:** ➢ Avoid contact with inorganic chemicals such as the mineral acids and alkalis which are corrosive to the skin and eyes. ➢ Avoid and prevent spill of organic chemicals, such as acid halides, phenols, and so forth are corrosive and often toxic. ➢ If there are spilled on the desk, in the hood, or on a shelf, call for assistance in cleaning them up. ➢ Be careful with hot plates to avoid burns. Always assume that hot plates are hot **Cuts/Injury:** ➢ Avoid cut while attempting to force a cork or rubber stopper onto a piece of glass tubing, a thermometer, or the side-arm of a distilling flask. ➢ Be sure to make a proper-sized hole, lubricate the cork or stopper (lubrication is essential with a rubber stopper), and use a gentle pressure with rotation on the glass part. ➢ Severed nerves and tendons are common results of injuries caused by improper manipulation of glass tubes and thermometers. ➢ Always pull rather than push on the glass when possible **Absorption of Chemicals:** ➢ Keep chemicals off the skin.. ➢ Be careful about touching face or eyes in the lab; make sure hands are clean first. ➢ Use gloves available in the lab. However, gloves provide only a temporary layer of protection against chemicals on your skin and may be permeable to some chemical reagents, without visible deterioration. ➢ If gloves come in contact with a chemical reagent, remove them, wash hands, and get a new pair immediately **Inhalation of Chemicals:** ➢ Keep nose away from chemicals. Many of the common solvents are extremely toxic if inhaled in any quantity or over a period of time. ➢ Do not evaporate excess solvents in the laboratory; use the hood or a suitable distillation apparatus with a condenser. ➢ When in doubt, use the hood or consult with the laboratory instructor		

		about the use of chemicals required for your work **Ingestion of Chemicals:** ➢ Avoid accidental ingestion of chemical reagents –Pipets must be fitted with suction bulbs to transfer chemicals. ➢ Do not use suction by mouth, ➢ Wash hands before handling anything (cigarettes, chewing gum, food) which goes into your mouth. ➢ Wash hands when you leave the laboratory, ➢ Do not eat or drink in the laboratory. ➢ Remove gloves and wash your hands before using the water fountain or bathroom, ➢ Never use chemicals (salt, sugar, alcohol, bicarbonate, etc.) from the laboratory or stockroom on food. The source containers may be contaminated or mislabelled, ➢ Never use laboratory glassware as a food or drink container, ➢ Never store food or drink in a laboratory refrigerator or ice machine. Never consume ice from a laboratory ice machine.		
Traffic related accident/ chemical leakage, or contamination	Operation of mobile laboratory	➢ Equip the mobile laboratory with decontamination kit in case of chemicals spill ➢ Provide special training (safety driving training) for the driver(s) of mobile laboratory ➢ Provide portable fire extinguisher in the mobile laboratory ➢ Provide first aid kit in the mobile laboratory	Lab Operator	Balai/UPT

C. Environmental Monitoring Plan

454. External environmental monitoring will be done by *DLH* as required by its mandate. DLH is tasked to prepare and implement regional policies and rules to promote environment protection and conservation. It reports to the Regent through the Regional Secretary. Its functions include: prepare and carry out work plans and programs on environmental management and monitoring AMDAL (Indonesia EIA system). It is their responsibility for enforcing the AMDAL system. It is also involved in monitoring the water quality of rivers in respective district and province.

455. The table of environmental monitoring plan presents quantitative monitoring: (i) parameter to be monitored, (ii) location where monitoring is applicable, (iii) means of monitoring, (iv) frequency of monitoring, (v) who to monitor, and (vi) cost estimate of monitoring. The monitoring will be carried out for water and seawater quality, erosion and sedimentation, dust, cover of stockpiles, noise, and occupational health and safety and results need to be included in environmental regular reports. The monitoring plan for all subprojects Construction is presented in Table 92, while monitoring plan for operation of laboratories, shrimp ponds and hatcheries is presented in Table 93.

456. **Environmental Monitoring Cost**. Monitoring cost for pre-construction is minimal cost to PMU since this is simply verification by the PMU on whether the EMP is included in tender and contract documents. Since construction is mostly monitored by sense without instrument unless that is complaint or dispute, the cost for contractors and supervisors such as PIUs are minimal. The cost to PMU for the GRM is also minimal cost since these are only meetings for resolving the complaints and it is included in the contractor's contract.

457. During operation, the quantitative monitoring will be carried out by UPT/Balai as the proponent and project owner. The cost for the monitoring will be borne by UPT/Balai as part of routine Operation and Maintenance Cost. The UPT/Balai will hire an independent contractor to conduct the monitoring.

D. Environmental Training and Capacity Building

458. IISAP implementation will be supported by consulting services for: (i) project management advisory services, including detailed engineering designs, preparation of contract documents, support to PIUs on construction supervision and quality control; and (ii) institutional development and capacity building.

459. There is lack of institutional capacity for environmental management in each UPT/Balai. Among Balai/UPT surveyed, neither established a special unit nor focal person(s) assigned to handle environmental management and monitoring. Only few staff of Balai/UPT who have attended training or courses related to environment (such as preparation of environmental document, environmental management, occupational health and safety, environmental audit, waste management, and hazardous waste management). Based on the staff educational background, only few staff in BPBAP Takalar (South Sulawesi) whose educational background of environment (i.e., 2 persons with master's degree: one in Coastal Environment Management and another in Environmental Engineering).

460. As part of institutional and capacity building during field visits and baseline surveys, the training needs for the staff and project managers identified, as presented in Table 94. The needs cover from the planning stage to the construction and operation of the facilities.

Table 92: Quantitative Monitoring Plan for all Subprojects Construction

Aspects/ Parameters	Location	Means of Monitoring	Frequency	Responsibility	Supervision	Cost
Water and seawater quality (with key standard parameters, especially turbidity)	At river (or canals) and/or seawater receiving water body likely polluted by the project	Visual observation and by laboratory when there is complaints, dispute or deemed necessary by PMU and its experts	As required in UKL-UPL document	Contractor	PMU/ PIU	Included in construction cost
Erosion and sedimentation	At the location of earth work and excavation	Visual inspection of sites	Daily	Contractor	Construction supervision consultants, PMU/ PIU	Part of consultant's construction supervision
Dust, cover of stockpiles	At the location of stockpiles	Visual inspection of sites	Daily	Contractor	Construction supervision consultants, PMU/ PIU	Part of consultant's construction supervision
Noise levels not to exceed 55 dB(A) near schools and residential areas;	At the construction site and nearby areas	Use of sound meter	Daily	Contractor	Construction supervision consultants, PMU/ PIU	Same as above
Accident and incident related to hazard condition and hazard actions to occupational health and safety	Project area and associated area (road and workshop) and nearby areas (public areas)	Observation, documentation and reporting	Routinely	Contractor	PMU/ PIU	Included in construction cost
Solid and hazardous wastes	At the construction site and nearby areas	Visual inspection of sites	Daily	Contractor	Construction supervision consultants, PMU/ PIU	Part of consultant's construction supervision
Flora and fauna	At the construction site and nearby areas	Visual inspection of sites	Daily	Contractor	Construction supervision consultants, PMU/ PIU	Part of consultant's construction supervision

Table 93: Quantitative Monitoring Plan for Operation of Laboratories, Shrimp ponds and hatcheries

Aspect	Parameters to monitor	Location	Frequency and means	Responsibility
Ponds, broodstock/ hatcheries				
Water intake/ facilities and pond waters	pH, BOD, COD, DO, TSS (Key parameters of Water Quality for Aquaculture Water -gov Regulation No. 22/2021)	Ponds' water intake facilities; Hatcheries' water storage tanks and ponds	Weekly basis By laboratory	Balai/UPT own laboratories ; and some using automatic real-time monitoring, as current practice
Wastewater/ Effluent before and after WWT	pH, BOD5, COD, NH3-N, TP, TSS, total-coliform (Key parameters of Effluent Quality (Ref. MMAF Regulation No. 75/2016)	Wastewater discharge outlet or inlet of WWT lagoon; Outlet of WW lagoon (inlet to CW); Final discharge at outlet of CW;	Weekly for same parameters as water intake; quarterly on COD, NH3-N, and TP (reported every 6 months as per UKL-UPL)	Balai/UPT (can test most parameters by their own laboratories and others by certified laboratory)
Laboratories				
Wastewater/ Effluent	pH, BOD5, COD, Nh3-N, TP, TSS, total-coliform, oil and grease, pathogen bacteria	Wastewater discharge outlet or inlet of WWT (biotank); Outlet of biotank (inlet to reedbed); Final discharge at reedbed outlet;	Semester basis (as required in UKL-UPL)	Balai/UPT (can test most parameters by their own laboratories and others by certified laboratory)
Air pollution	Key parameters in Table 11 (if using Incinerator): (Ref. Government Regulation No. 22/2021)	Chimney of the incinerator (if exists)	Quarter basis (as required in UKL-UPL)	Balai/UPT (with support of certified laboratory)
OHS Statistic of Laboratory operation	• Fatality Rate • Near miss Rate • PPE, Signs/Warnings	Laboratory, bio- assay site, and field (during sampling), and offsite (for mobile laboratory)	Periodically by Observation and documentation	Balai/UPT (OHS Officer)

Table 94: Proposed Environmental Training Plan

Period	Target groups	Main content	Arrangement & Cost estimate
Preparation	PMO/PIU staff	• Environmental policy and regulation (ADB and Government Regulations) • The entire EMP and EHS issues of the project • Environmental monitoring and reporting	PMO, included as project cost
	Supervision Engineers (SE)	• The EMP for construction, focusing on mitigation measures, • SE's contractual and statutory duties in supervising, monitoring and reporting etc;	PMO, included as project cost
Construction	Contractors, its foremen	• The EMP for construction and measures. • Contractual and statutory duties related to environment, health, safety (EHS) and labour issues • Applicable domestic permits related to contractors' responsibility. • Complaint handling and GRM during construction	Responsible of the contractor, as part of contract
	Contractors, its foremen and workers	• The EMP for construction, especially mitigation measures • H&S and Emergency Response Preparedness (ERP) requirements, and preventive and mitigation measures etc; and • Solid waste and construction wastes management	
	PMO, supervision Engineers (SE)	• Refresh EMP training • Other emergent issues	PMO, incl as project cost
Operation	Operators of ponds, hatchery	• EMP of shrimp ponds and hatchery • Domestic environ rules applicable for ponds and hatchery • Environmental monitoring and reporting required in the EMP and by domestic regulations • Domestic environmental standards for wastewater discharge and air emissions applicable • Operation and maintenance of WWTP • Management of mangrove plantation and restoration	Shall be Integrated in existing HR Development of the unit
	Operators of Laboratories	• ELISA (Enzyme Linked Immuno Absorbent Assay) of antibiotic residue • Training on testing of feed quality; • Quality Management System (ISO 9001); • Laboratory Management System (ISO 17025: 2017) • Domestic environmental management rules applicable for wastewater management and hazardous wastes management; and • Domestic environ standards for wastewater discharge and air emissions applicable;	

E. Grievance Redress Mechanism (GRM)

461. A Grievance Redress Mechanism (GRM) is required by ADB SPS (2009). The GRM is a system for receiving and resolving grievances including complaints and concerns from affected people and stakeholders about environmental and socioeconomic issues in relation to the project. Complaints are to be resolved promptly with a process that can readily be understood and accessed by all segments of affected people and is responsive to gender and cultural aspects.

462. The GRM will be established by the Implementing Agency (MMAF regional units –

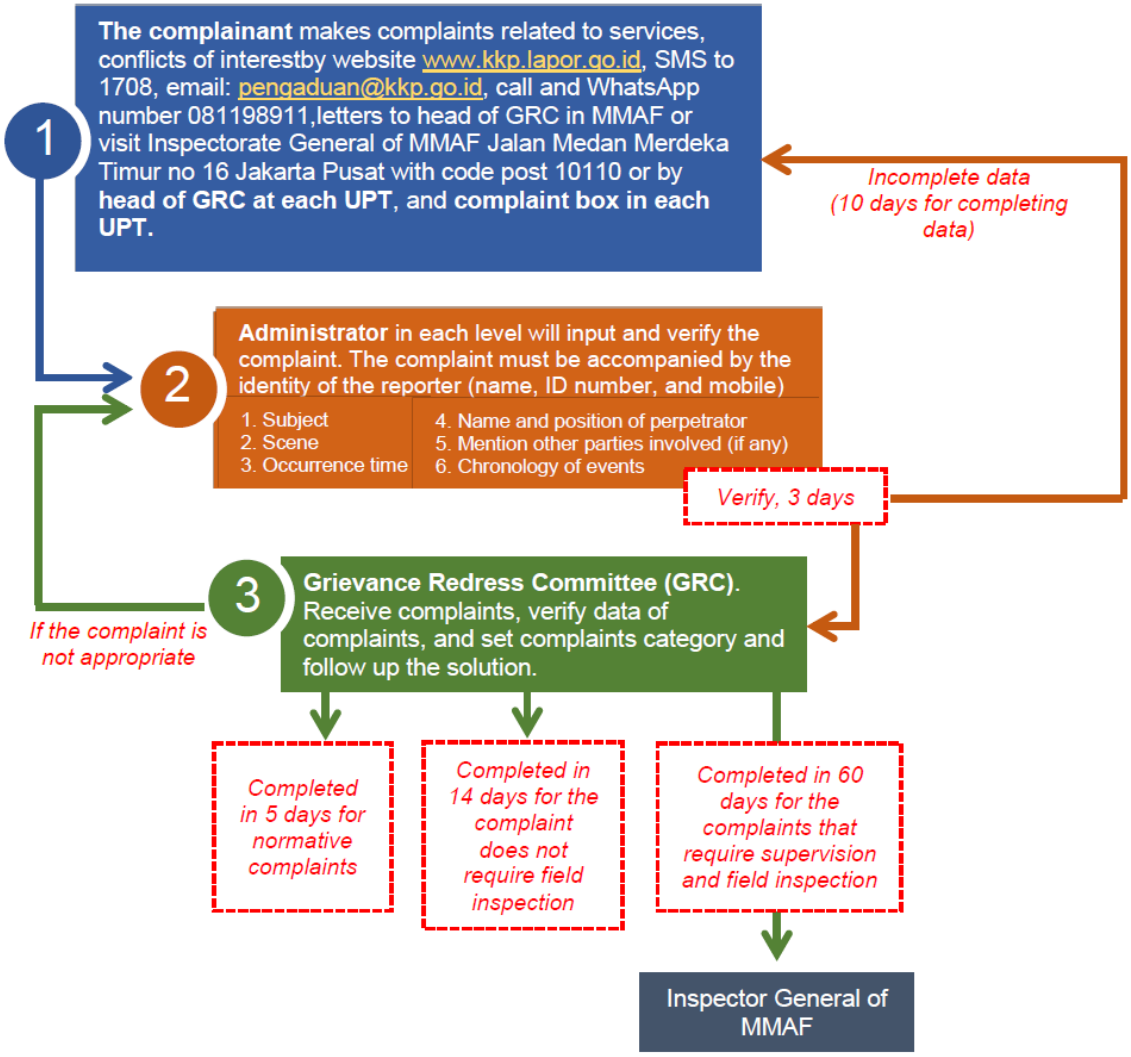
Balai/UPT). The IA and the Contractor will inform and consult each community about the GRM and how it will work via a community meeting held before construction commences. A sign at the sites and notices on community notice boards will give the contact details for lodging complaints.

463. Grievances, complaints, and concerns can be lodged with the IA or the Contractor on site. A GRM Register will be kept on site in which complaints are recorded. The grievance will be assessed by the IA to confirm that it is related to the project. If it is urgent or can be immediately resolved, action will be taken, and this recorded in the GRM Register and the complainant informed. The aim will be for complaints to be acted on within one week. Where this cannot occur, the complainant will be advised within one week of the complaint, what action is to be taken. If a complainant approaches the Contractor directly, the Contractor will receive the information and pass it onto the IA. The Contractor will take any immediate action necessary to resolve the issue if practical and appropriate. Where there is urgency in terms of safety, damage to property or environment, then this will be acted on urgently.

464. Regular meetings between the Contractor and IA will review the complaints register as part of regular meetings and reporting. A summary of complaints will be given in regular reports and any outstanding grievances identified. The IA Environmental Officer will review the GRM Register for complaints and confirm that they are resolved satisfactorily. Any outstanding complaints will be investigated. The IA and Contractor will work together proactively to ensure grievances are satisfactorily resolved. GRM process under MMAF is presented in Figure 11.

465. Where complaints cannot be resolved by the GRM process the complainant will be able to take their complaint to normal legal processes.

Figure 11: Flowchart of Formal Grievance Redress Mechanism of MMAF



Source: MMAF Regulation Number 56/Permen-KP/2020.

466. Training in awareness of the GRM will be provided to the IA and Contractor staff. There will be no fees or charges made in relation to lodging complaints or otherwise accessing the GRM.

467. Typical grievances that may occur in projects of this nature may include (but not limited to) damage to or use of public or private property or communal resources, safety risks or incidents, noise, dust, fumes, water pollution, litter, rubbish dumping, unauthorized land use, unauthorized tree cutting or vegetation removal, hunting, antisocial or criminal behavior and harassment.

468. Referring to MMAF Regulation No. 56/PERMEN-KP/2020 on Complaints Handling within Ministry of Marine and Fishery, each seven Balai/UPT involved in IISAP has established a

Complaints Handling Team (*Tim Penanganan Pengaduan*) with duties: (i) Receive and administer complaint from liaison administrator or LAPOR[35] complaint administrator; (ii) collect materials and information relevant to the complaint; (iii) assess the complaints received; and/or (iv) deliver the assessment to Head of Balai/UPT. All Balai/UPT have established special unit to receive, record, and manage the complaints.

F. Complaints to Dinas Lingkungan Hidup (District Environmental Agency)

469. Complaints about environmental performance of projects can also be brought to the attention of the *Dinas Lingkungan Hidup* (Environmental Agency), who is the local agency responsible for enforcing the AMDAL system. In practice, community, affected people as well as Non-Government Organization (NGO) will report the complaints to DLH in any case of violation. In each DLH, there is a web-based application to upload complaint related to the environment, for example in Aceh (*Tata Cara Pengaduan SP4N-LAPOR - Dinas Lingkungan Hidup dan Kehutanan (acehprov.go.id)* and Bali (*LAPOR! - Layanan Aspirasi dan Pengaduan Online Rakyat*).

470. The Agency is also involved in monitoring the environmental quality in the province and district as published regularly in DIKPLH (Information on Environmental Management Performance) covering all environmental related issues, including water quality of (rivers, seas, lakes, and groundwater), air quality, land use and spatial, and biodiversity (flora and fauna).

VII. CONCLUSION AND RECOMMENDATIONS

464 The IEE identified environmental impacts of aquaculture activities of the project mainly include wastewater discharge, erosion due to sea surge and storm, and potential encroachment to coastal wetland and mangrove although the subprojects identified so far appear all on existing facilities and ponds in highly modified sites. The associated rural infrastructure such as canals, roads and footpaths are moderate in scale and mostly rehabilitation, with adverse impacts mainly during construction. The environmental impacts of laboratories are dominated by their operation, typically water pollution, solid wastes and hazardous substances. These adverse impacts were assessed systematically and to the extent possible also quantitatively for the three hatcheries, five demonstration clusters of shrimp ponds and associated infrastructure, and seven laboratories representing main types of category B project activities.

465 The proposed subprojects will bring better environmental benefits and improve social and economic development, especially in fishery sector in Indonesia. The Environmental Management Plan (EMP) for the shrimp ponds and laboratories were prepared to address the potential impacts and risks. Substantially, the IEE provided prevention and mitigation measures from the design phase to the operation phase to avoid, minimize, reduce and/or mitigate significant negative environmental impacts and risks. With the EMP, the proposed subproject can be implemented in an environmentally acceptable manner.

[35] The LAPOR (*Layanan Aspirasi Pengaduan Online Masyarakat*; Online Community Complaint) and assigned a staff to handle the complaint. However, it was not operational due to lack of dissemination of information to target community.

Annex 1 List of Relevant Laws and Regulations

No.	Legal Hierarchy	Laws and Regulations Referred
A	Laws	1) Law No. 5/1960 on Basic Stipulation of Agrarian Regulation 2) Law 5/1990 on Conservation of Living Natural Resources and Ecosystems 3) Law 12/1992 on Cultivation of Plants 4) Law 7/994 on Ratification of Agreement Establishing the World Trade Organization 5) Law No. 5/1994 on Ratification of UN Convention on Biodiversity (UN-CBD) 6) Law 17/2004 on Ratification of the Kyoto Protocol to the United Nations Framework Convention on Climate Change 7) Law 24/2007 on Disaster Management 8) Law 14/2008 on Disclosure of Public Information 9) Law 19/2009, Ratification of the Stockholm Convention on Persistent Organic Pollutants 10) Law No. 8/2008 on Solid Waste Management 11) Law 11/2010 on Cultural Heritage 12) Law No. 11/2013 on Ratification of Nagoya Protocol on Access to Genetic Resources and Fair and Balanced Benefit Sharing of Its Utilization upon Biodiversity Convention 13) Law 18/2013 on Prevention and Eradication of Forest Destruction 14) Law No. 37/2014 on Soil and Water Conservation 15) Law No. 17/2019 on Water Resources 16) Law No. 11/2020 on Job Creation
B	Government Regulation	1) Government Regulation 102/2000 on National Standardization 2) Government Regulation (Minister of Agriculture) 1/2007 on Active Materials of Prohibited and Restricted Pesticides 3) Government Regulation (Minister of Agriculture) 42/2007 on Pesticide Monitoring 4) Government Regulation 21/2008 on Disaster Management 5) Government Regulation 30/2009 on Implementation Procedures for Reducing Emissions from Deforestation and Forest Degradation (REDD) 6) Government Regulation 70/2009 on Energy Conservation 7) Government Regulation 1/2010 on Water Pollution Control System 8) Government Regulation 6/2010 on Norms, Standards, Procedures and Criteria for Forest Management in Protected Forest Management Units 9) Government Regulation 145/2013 on Measuring, Reporting and Verifying Climate Change Mitigation Actions 10) Government Regulation No. 24/2018 on OSS (Online Single Submission; Electronically Integrated Permitting Services) 11) Government Regulation No. 27/2020 on Specific Wastes Management 12) Government Regulation No. 22/2021 [1] on Implementation of Environmental Protection and Management 13) Government Regulation No. 5/2021 on Risk Based Commercial Business Permitting 14) Government Regulation No. 16/2021 on Approval of Building Permit (PBG)
C	Ministerial Decrees	1) Minister of Labor Decree 5/1996 on Work Safety and Health Management System 2) Decree of the Head of Environmental Impact Management Agency 299/1996 on the Technical Direction of Social Assessment in EIA/AMDAL. 3) Decree of the Head of Environmental Impact Management Agency 124/1997 on

[1] Closing Clause of Government Regulation No. 22/2021 withdrawn Government Regulation No. 27/2012.

No.	Legal Hierarchy	Laws and Regulations Referred
		the Public Health Assessment in EIA/AMDAL
		4) Regulation of Ministry of Enivironment No. 48/1999 on Noise Level
		5) Decree of Minister of Environmental Affairs 45/2005 on Guidelines for the Formulation of Reports on the Realization of Environmental Management Plans (RKL) and Environmental Monitoring Plans (RPL)
		6) Minister of Public Works Decree 9/2008 on Management System for of Worker Safety and Health in the Construction of Public Works
		7) Minister of Environment Decree 31/2009 on Direction and Control of implementation of Environmental Management, Ecolabelling, Clean Production, and Environmental Technology Use in Regions.
		8) Minister of Environment Decree 9/2010 on Guidelines on Community Grievances and Handling of Grievances Caused by Pollution and/or Degradation
		9) Minister of Environment Decree Number 15 of 2013 on Measurement, Notification, and Verification of Mitigation Actions for Climate Change
		10) Decree 62/2013 on Managing Agency for the Reduction of Emissions from Deforestation and Degradation of Forests and Peat lands
		11) Regulation of Minister of Environment (Permen-LH) No. 5/2014 on Wastewater Quality Standard
		12) MOEF Regulation No. 76/MenLHK-Setjen/2015 on Protected Forest Zoning
		13) Regulation of Minister of Marine Affairs and Fishery (Permen – KKP) No. 75/2016 on General Guideline for Growing out of Penaeus monodon and Litopenaeus vannamei
		14) Regulation of Ministry of Environment and Forestry No. P.31/MENLHK/SETJEN/SET.1/5/2017 on Guideline of Gender Mainstreaming in Environment and Forestry and Regulation of Ministry of Forestry No. P.65/Menhut-II/2011 on Guideline of Gender Responsive Planning and Budgeting in Forestry Sector
		15) Decree of Minister of Environment No. P.22/Menlhk/Setjen/Set.1/3/2017 on Procedure of Complaint on Pollution and/or Environmental Deterioration and/or Forest Destruction
		16) Ministerial Regulation of Environment and Forestry No. P.34/MENLHK/SETJEN/KUM.1/5/2017 on Acknowledgment and Protection of Local Wisdom in Natural Resource and Environmental Management
		17) Regulation of Minister of Health No. 32/2017, the groundwater standard for hygiene and sanitation use
		18) Regulation of Minister of Marine Affairs and Fishery No. 57/PERMEN-KP/2018 on Fish and Environment Laboratory
		19) Regulation of Minister of Marine Affair and Fishery No. 57/PERMEN-KP/2018 stipulated on Aquaculture Good Practices (CBIB)
		20) Regulation of Minister of Public Works and Housing No. 22/PRT/M/2018 on Development of State's Buildings
		21) Regulation of Minister of Marine Affairs and Fishery No. 57/PERMEN-KP/2018 on Fish and Environment Laboratory
		22) Regulation of Minister of Marine Affairs and Fishery No. 75/2019 on Wastewater Treatment for Shrimp Ponds
		23) Minister of Environment Decree No. 4/2021 on List of Business Plans and/or Activities Requiring AMDAL, UKL-UPL or SPPL
		24) Decree of Minister of Environment and Forestry No. 5/2021 on Issuance Procedure for Technical Approval and Operational Feasibility Letter in the pollution control
		25) MMAF Regulation No. 26/2021 on Prevention of Pollution, Deterioration, Rehabilitation, and Improvement of Fishery Resource and Environment
		26) MOEF Regulation No. 14/2021 on Waste Management and Wastes Bank
		27) Decree of Ministry of Environment and Forestry No. SK.5446/MENLHK-PKTL/IPSDH/PLA.1/8/2021 on PIPPIB (Indicative Map for Moratorium of New Permit,

No.	Legal Hierarchy	Laws and Regulations Referred
		Period II 2021) 28) MOEF Regulation No. 7/2021 on Forestry Planning, Change of Forest Areas Allocation and Function, and Use of Forest Area 29) MOEF Regulation No. 21/2018 on Procedure for Determining the Minimum Shoreline toward to the Land 30)
D	SNI/ISO	1) SNI 7311:2009, Brood Production of Litopenaeusvannamei) for Growing out 2) SNI 7813: 2013, Manufactured Feeds for Shrimp Production (Litopenaeus vannamei) 3) SNI 7911: 2013, Biosecurity Procedure for Shrimp Hatchery 4) SNI: 8037.1:2014, Brood Production (Indoor Model) of Vanamei Shrimp 5) SNI 8038.1:2014, Brood Production (Indoor Model) of Penaeus monodon 6) SNI 8228.1:2015, Part 1 (Shrimp) 7) SNI 8118: 2015, Super Intensive Production of Litopenaeus vannamei in Lined Ponds 8) SNI: 8313.2: 2016, Infrastructure and Production Facilities of Panaeid Shrimp Breeding 9) ISO/IEC 17043 for proficiency testing 10) ISO/IEC 17025: 2017: general requirements for the competence of testing and calibration laboratories

Annex 2 Sample Inventory of Flora and Fauna (Lampung)

Group	Name of Species		Status			
	Latin Name	Local Name	Endemic	Threatened	Protected	Not Protected
(1)	(2)	(3)	(4)	(5)	(6)	(7)
Mammals	*Symphalangus Syndactylus*	Siamang	Yes	Yes	Yes	No
	Trachpitechus cristatus	Lutung Kelabu	Yes	Yes	Yes	No
	Hylobates agilis	Owa Ungko	Yes	Yes	Yes	No
	Macaca nemestrina	Beruk	Yes	No	No	Yes
	Macaca fascicularis	Monyet ekor panjang	No	No	No	Yes
	Mydaus Jovanensis	Teledung sigung	Yes	Yes	No	Yes
	Paradoxurus hermaphroditus	Musang Luwak/pandan	No	No	Yes	No
	Elephas maximus sumatranus	Gajah Sumatera	Yes	Yes	Yes	No
	Dicerorhinus sumatranus	Badak Sumatera	Yes	Yes	Yes	No
	Helarctos malaynus	Beruang madu	Yes	Yes	Yes	No
	Pathera tigris sumatrae	Harimau Sumatera	Yes	Yes	Yes	No
	Neofelis nebulosa	Macan Dahan	Yes	Yes	Yes	No
	Felis bengalensis	Macan akar	Yes	Yes	Yes	No
	Axis axis	Rusa Totol	No	No	No	Yes
	Cervus unicolor	Rusa Sambar	Yes	Yes	Yes	No
	Muntiacus muntjac	Kijang/menjangan	Yes	Yes	Yes	No
	Cervus Timorensis	Rusa Timor	Yes	Yes	Yes	No
	Wallabia agallis	Kangguru Tanah	No	Yes	Yes	No
	Tragulus kanchil	Napu/Kancil	Yes	Yes	Yes	No
	Pongo pigmaeus	Orang Utan Kalimantan	No	Yes	Yes	No
	Pongo abelli	Orang Utan Sumatera	Yes	Yes	Yes	No
	Arctictls binturong	Binturong Sumatera	Yes	Yes	Yes	No
	Trachypitherus auratus	Lutung Jawa	No	Yes	Yes	No
	Hylobates agilis Agilis	Owa Sumatera	Yes	Yes	Yes	No
	Nycticebus coucang	Kukang Sumatera	Yes	Yes	Yes	No

Annex 3 IISAP Water Quality Sampling and Laboratory Testing

A. Shrimp Pond – Jepara (Central Java)

Groundwater Quality Testing in BBPBAP Jepara (Central Java)
(All units in mg/L, except expressed otherwise)

No	*Parameters*	*Sampling and Measurement*		*Quality Standard (Minimum Value)*	*Remarks*
A.	*Physical Parameters*	*Point 1 (within site)*	*Point (outside of site)*		
1.	*Turbidity (NTU)*	0.2	0.21	*25*	
2.	*Color (TCU)*	< 2.5	< 2.5	*50*	
3.	*TSP (Total Dissolved Solid)*	< 3.5	< 3.5	*1000*	
4.	*Temperature (°C)*	32	32	*air temperature ± 3*	
5.	*Taste*	Tasteless	Tasteless	*No taste*	
6.	*Smell*	$4.2x10^{1}$		*No smell*	
B	*Biological Parameters (MPN)*				
1.	*Total coliform (CFU/ 100ml)*	0	0	*50*	
2.	*E. coli (CFU/ 100ml)*	0	0	*0*	
C	*Chemical Parameters*				
1.	*pH*	9.3	9.3	*6.5 -8.5*	Exceed the standard
2.	*Iron*	< 0.030	< 0.030	*1*	
3.	*Fluoride*	0.84	0.84	*1.5*	
4.	*Hardness (CaCO3)*	133.2	133.2	*500*	
5.	*Manganese*	< 0.030	< 0.030	*0.5*	
6.	*Nitrate, as N*	0.04	0.04	*10*	
7.	*Nitrite, as N*	< 0.003	< 0.003	*1*	
8.	*Cyanide*	< 0.0005	< 0.0005	*0.1*	
9.	*Detergent*	< 0.030	< 0.030	*0.05*	
10.	*Total Pesticide*	< 0.06	< 0.06	*0.1*	

Water Quality Testing of Reservoir and Pond in BBPBAP Jepara (Central Java)

No	Parameter	Measurement		Standard (MMAF Regulation No. 75/2016; intensive pond)	Remarks
		Point 1 (Reservoir) S – 06º35'26,3076" E – 110º39'06,0624"	Point 2 (pond)		
1.	Temperature (°C)	33	32	28 - 30	
2.	Salinity	25.5	24.4	26-32	
3.	pH	7.8	8.1	7.5-8.5	
4.	DO	2.6	0.8	> 4	
5.	Alkalinity (ppm)	135	125	100-150	
6.	Total Organic Material	-		≤ 90	
7.	Ammonia	14	21	≤ 0.1	Exceed the standard
8.	Nitrite	0.02	< 0.003	≤ 1	
9.	Nitrate	0.53	0.41	0.5	
10.	Phosphate	1.0	1.7	0.1-5.0	
11.	Transparency	-	-	30-50	
12.	Total Dissolved Solid	34900	31400	-	
13.	Heavy Metals				
	-Pb	< 0.002	< 0.002	0.03	
	-Cd	< 0.0001	< 0.0001	0.01	
	-Hg	< 0.0005	< 0.0005	0.002	
14.	Hydrogen Sulfide	< 0.020	< 0.020	≥ 0.01	
15.	Total vibrio (CFU (Colony Forming Unit)/ ml)	Negative	Negative	≤ $1x10^3$	

(All units in mg/L, except expressed otherwise)

Water Quality Testing of Shrimp Ponds Effluent in BBPBAP Jepara (Central Java)
(All units in mg/L, except expressed otherwise)

No	Parameters	Standard (Gov. Regulation)[2]	Sampling and Measurement				Remarks
			Point 1 "	Point 2	Point 3	Point 4	
A	Physical Parameter						
1.	TSS	200	9	8	13	11	
2.	Turbidity (NTU)	50	5.9	18.8	16.2	2.9	
3	Temperature (^oC)						
B.	Chemical Parameter						
1.	pH	6-9,0	7.8	8.1	7.7	8.1	
2.	BOD_5	< 45	< 0.5	< 0.5	5.75	10.7	
	COD		< 2.5	< 2.5	13.7	25.2	
3.	PO_4	< 0,1	0.9	2.6	5.4	3.3	
4.	H_2S	< 0,03	< 0.060	< 0.060	0.03	< 0.020	
5.	NO_3	< 75	0.49	0.44	0.38	0.74	
6.	NO_2	< 2,5	0.008	< 0.003	< 0.003	0.51	
7.	NH_3	< 0,1	0.48	30.8	7	19	Exceed the standard
C	Biological Parameter						
	Dinoflagellata						
1	Gymnodinium (Individual /L)	< 8 x 10^2					
2	Peridinium (Individual /L)	< 8 x 10^2					
3	Pathogen bacterial (CFU (Colony Forming Unit))	< 10^2					

[2] Regulation of Minister of Marine Affairs and Fishery (Permen – KKP) No. 75 tahun 2016 on General Guideline for Growing on of *Penaeus monodon* and *Litopenaeus vannamei*

Ambient Seawater Quality Testing in BBPBAP Jepara (Central Java)
(All units in mg/L, except expressed otherwise)

No.	Parameter	Standard (Appendix VIII of GR No. 22/2021)	Measurement		Remarks
			Point 1 (upstream)	Point 1 (downstream)	
1.	Color (Pt. Co)	-	3.8	4.2	
2.	Transparency (m)	*Coral: .5* *Mangrove: -* *Seagrass: >3*	-	-	
3.	Turbidity (NTU)	5	15.8	1.9	Exceed the standard
4.	Odor	Natural	Odorless	Odorless	
5.	Total Suspended Solid	Coral:20 Mangrove: 80 Seagrass: 20	8	9	
6.	Solid waste	None	Nihil	Nihil	
7.	Temperature (℃)	Natural Coral: 28-30 Mangrove: 28-32 Seagrass: 28-30	32	32	
8.	Oil layer	None	< 2.5	< 2.5	
9.	pH	7 – 8.5	7.8	7.9	
10.	Salinity (0/00)	Coral: 33-34 Mangrove: up to 34 Seagrass: 33-34	26.2	25.6	
11.	Dissolved Oxygen (DO)	>5	2.5	3.0	
12.	BOD_5 (Biological Oxygen Demand)	*20*	15.7	15.1	
13	Total Ammonia (NH_3- N)	0.3	0.13	0.14	
14.	Orthophosphate (PO_4- P)	0.015	0.60	0.62	
15.	Nitrate (NO_3-N)	0.06	0.45	0.46	
16.	Cyanide (CN-)	0.5	< 0.040	< 0.040	
17.	Sulfide (H2S)	0.01	< 0.020	< 0.020	
18.	Total Petroleum Hydrocarbon (TPH)	0.02	< 0.45	< 0.45	
19.	Total Phenolic Compounds	0.002	< 0.014	< 0.014	
20.	Polyaromatic Hydrocarbon (PAH)	0.003			~~Polyaromatic Hydrocarbon (PAH), Polychlor Biphenyl (PCB), Surfactant (Detergent) as MBAS, oil and grease,~~
21.	Polychlor Biphenyl (PCB)	0.01			
22.	Surfactant (Detergent) as MBAS	1			
23.	Oil and Grease	1			
24.	Pesticides				

	a. BHC	*210*			~~pesticide (BHC, DDT, Endrin), TBT, Hg, Cr (VI), As, Cd, Cu, Pb, Zn, Ni,~~ Not measured as not relevant
	b. Aldrin/ Dieldrin	-			
	c. Chlordane	-			
	d. DDT	2			
	e.Heptachloe	-			
	f. Lindane	-			
	g. Methoxy-chlor	-			
	h. Endrin	4			
	i. Toxaphan	-			
25.	TBT (tri butyl tin)	0.01			
26.	Mercury (Hg)	0.001			
27.	Chromium Hexavalent (Cr (VI))	0.005			
28.	Arsenic (As)	0.012			
29.	Cadmium (Cd)	0.001			
30.	Copper (Cu)	0.008			
31.	Lead (Pb)	0.008			
32.	Zinc (Zn)	0.05			
33.	Nickel (Ni)	0.05			
34.	Fecal coliform (MPN/ 100 ml)	-	0	$2.0x10^1$	
35.	Coliform (total) (MPN/ 100 ml)	1000	$3.2x10^1$	$9.2x10^1$	
36.	Pathogen (Cell/100 mL)	*None*	0	2	*Exceed standard*
37.	Phytoplankton (Cell/mL)	1000			
38.	Radioactivity (Bq/L)	4			Not measured as not relevant

B. Broodstock – Karangasem (Bali)

Groundwater Quality Testing in BPIU2K Karangasem (Bali)
(All units in mg/L, except expressed otherwise)

No	*Parameters*	*Sampling and Measurement*		*Quality Standard (Minimum Value)*	*Remarks*
A.	*Physical Parameters*	*Point 1 (Offside)*	*Point 2 (onsite)*		
1.	*Turbidity (NTU)*	0.87	0.96	*25*	
2.	*Color (TCU)*	< 1.5	< 1.5	*50*	
3.	*TSP (Total Dissolved Solid)*	309	310	*1000*	
4.	*Temperature (°C)*	28.5	29.0	*air temperature ± 3*	
5.	*Taste*	Tasteless	Tasteless	*No taste*	
6.	*Smell*	Odourless	Odourless	*No smell*	
B	*Biological Parameters (MPN)*				
1.	*Total coliform (CFU/ 100ml)*	4800	3200	*50*	Exceed the standard
2.	*E. coli (CFU/ 100ml)*	0	0	*0*	
C	*Chemical Parameters*				
1.	*pH*	7.82	7.96	*6.5 -8.5*	
2.	*Iron*	< 0.02	< 0.02	*1*	
3.	*Fluoride*	0.36	0.51	*1.5*	
4.	*Hardness (CaCO3)*	193	191	*500*	
5.	*Manganese*	< 0.01	< 0.01	*0.5*	
6.	*Nitrate, as N*	3.15	3.24	*10*	
7.	*Nitrite, as N*	< 0.003	< 0.003	*1*	
8.	*Cyanide*	< 0.01	< 0.01	*0.1*	
9.	*Detergent*	< 0.02	< 0.02	*0.05*	
10.	*Total Pesticide*	< 0.06	< 0.06	*0.1*	

Water Quality Testing of Broodstock Reservoir in BPIU2K Karangasem (Bali)
(All units in mg/L, except expressed otherwise)

Parameters	Standard (MMAF Regulation No. 75/2016)	Sampling and Measurement		Remarks
		Point 1 (upstream/Tandon 1)	Point 2 (downstream)	
Temperature (°C)	26 - 32	29.0	29.0	
DO	> 3.5	7.35	7.41	
BOD				
pH	7.8 – 8.5	8.27	8.26	
Alkalinity	90 - 150	149	144	
Transparency (cm)	30 - 50	1.9	1.9	
Total Suspended Solid	< 20	< 2.5	< 2.5	
Salinity (°/oo	10 - 35	31.7	31.5	
Ammonia	< 0.1	< 0.01	< 0.01	
Nitrate	< 0.3	0.11	0.7	
Nitrite	< 1	< 0.003	< 0.003	
Ortho phosphate	0.30	< 0.01	< 0.01	
Total Vibrio	10^2 - 10^3	9.0 x 10^1	7.0 x 10^1	

Water Quality Testing of Broodstock Growing out Pond in BPIU2K Karangasem (Bali)
(All in mg/L, except specify otherwise)

Parameters	Standard (MMAF Regulation No. 75/2016)	Sampling and Measurement		Remarks
		Point 1 (MC 2 K 4)	Point 2 (MC 6 B 1)	
Temperature (°C)	26 - 32	31.2	31.0	
DO	> 4	5.14	4.02	
BOD	< 0.2			
pH	7.8 – 8.4	7.97	7.74	
Alkalinity	90 - 150	123	137	
Transparency (cm)	30 - 40	0.3	1.2	
Total Suspended Solid	< 40	23	9	
Salinity (g/l)	10 - 35	31.7	31.4	
Ammonia	< 0.1	0.3	0.01	
Nitrate	< 0.4	9.0	< 0.02	
Nitrite	< 1	5.5	4.7	
Ortho phosphate	0.35	< 0.01	< 0.01	
Total Vibrio	10^2 - 10^3	1.5 x 10^2	8.9 x 10^1	

Water Quality Testing for Broodsrock Wastewater in BPIU2K Karangasem (Bali)
(All in mg/L, except specify otherwise

Parameters	Standard (MMAF Regulation No. 75/2016)	Sampling and Measurment				Remarks	Baku mutu air penerima klas II
		Point 1 (Inlet IPAB)	Point 2 (IPAB 2)	Point 3 (IPAB 3)	Point 4 (Outlet IPAB)		
Temperature (°C)	26 – 32	31.0	32.5	32.5	32.0		
DO	> 3	5.25	5.73	4.96	6.45		
BOD	< 10						
pH	7 – 9	7.97	7.86	7.89	8.15		
Alkalinity	100 – 150	123	148	173	159	The alkalinity of the wastewater still exceeds the standard when it was discharged through the outlet. Therefore, improvement of the wwt shall be proposed (among other neutralization and disinfection with chlorine).	
Transparency (cm)	30 – 40	0.6	0.75	0.5	0.8	The transparency of the wastewater is far below the standard, indicating the turbidity of the water exceed the standard as well.	
Total Suspended Solid	< 30	11	4	8	4		
Salinity (g/l)	10 - 35	30.9	30.1	30.1	27.3		
Ammonia	< 0.1	0.14	2.2	4.4	1.8	The ammonia standard exceded ….	
Nitrate	< 0.5	16	24	14	9.7	High nitrate concentration	
Nitrite	< 1	5.3	12	3.9	11	High nitrite concentration	
Ortho phosphate	0.25	< 0.01	< 0.01	< 0.01	< 0.01		
Total Vibrio	$< 10^4$	1.3×10^3	1.2×10^3	1.2×10^3	1.7×10^2		

Water Quality Testing (Seawater) in BPIU2K Karangasem (Bali)
(All units in mg/L, except expressed otherwise)

No.	Parameter	Standard (Appendix VIII of GR No. 22/2021)	Measurement		Remarks
			Point 1 (upstream) Inlet Pompa Laut	Point 2 (downstream) Air Pantai	
1.	Color (Pt. Co)	30	2	1	
2.	Transparency (m)	*Coral: .5* *Mangrove: -* *Seagrass: >3*	NA	*NA*	
3.	Turbidity (NTU)	5	0.91	3.12	
4.	Odor	Natural	Odourless	Odourless	
5.	Total Suspended Solid	Coral:20 Mangrove: 80 Seagrass: 20	< 2.5	< 2.5	
6.	Solid waste	None	Negative	Negative	
7.	Temperature (℃)	Natural Coral: 28-30 Mangrove: 28-32 Seagrass: 28-30	29.0	30.5	
8.	Oil layer	None	Negative	Negative	
9.	pH	7 – 8.5	8.17	8.09	
10.	Salinity (0/00)	Coral: 33-34 Mangrove: up to 34 Seagrass: 33-34	32.3	32.3	
11.	Dissolved Oxygen (DO)	>5	7.02	7.03	
12.	BOD_5 (Biological Oxygen Demand)	*20*	12	*15*	
13	Total Ammonia (NH_3- N)	0.3	< 0.01	< 0.01	
14.	Orthophosphate (PO_4- P)	0.015	< 0.01	< 0.01	
15.	Nitrate (NO_3-N)	0.06	< 0.02	< 0.02	
16.	Cyanide (CN-)	0.5	< 0.01	< 0.01	
17.	Sulfide (H2S)	0.01	<0.001	< 0.001	
18.	Total Petroleum Hydrocarbon (TPH)	0.02	-	-	
19.	Total Phenolic Compounds	0.002	< 0.001	< 0.001	
20.	Fecal coliform (MPN/ 100 ml)	61	200	170	Exceed the standard
21.	Coliform (total) (MPN/ 100 ml)	100	1000	68	Exceed the standard
22.	Pathogen (Cell/100 mL)	*None*	-	-	
23.	Phytoplankton (Cell/mL)	1000	-	-	

C. Shrimp Pond – Takalar (South Sulawesi)

Groundwater Quality Testing in BPBAP Takalar (South Sulawesi)
(All units in mg/L, except expressed otherwise)

No	*Parameters*	*Sampling and Measurement*			*Quality Standard (Minimum Value)*	*Remarks*
A.	*Physical Parameters*	*Point 1 (within site)*	*Point 2 (outside of site)*	Point 3		
1.	*Turbidity (NTU)*	<0.5	<0.5	91.65	*25*	
2.	*Color (TCU)*	<2.14	<2.14	<2.14	*50*	
3.	*TDS (Total Dissolved Solid)*	38800	38700	*27*	*1000*	exceed
4.	*Temperature (°C)*	28.5	26.0	*26.0*	*air temperature ± 3*	
5.	*Taste*	-	-		*No taste*	
6.	*Smell*	-	-		*No smell*	
B	*Biological Parameters*					
1.	*Total coliform (CFU/ 100ml)*	700	6000d	*800*	*50*	Exceed
2.	*E. coli (CFU/ 100ml)*	0	0	*0*	*0*	
C	*Chemical Parameters*					
1.	*pH*	7.04	6.93	*6.58*	*6.5 -8.5*	
2.	*Iron*	<0.027	<0.027	<0.027	*1*	
3.	*Fluoride*	1.05	1.05	1.31	*1.5*	
4.	*Hardness (CaCO3)*	10802	10802	9084	*500*	Exceed
5.	*Manganese*	<0.01	10.96	1.69	*0.5*	
6.	*Nitrate, as N*	1.11	1.11	0.21	*10*	
7.	*Nitrite, as N*	0.009	0.009	<0.027	*1*	
8.	*Cyanide*	<0.01	<0.01	<0.01	*0.1*	
9.	*Detergent*	<0.01	<0.01	<0.01	*0.05*	
10.	*Total Pesticide*	<0.01	<0.01	<0.01	*0.1*	

Water Quality Testing of Reservoir and Pond in BPBAP Takalar (South Sulawesi)
(All units in mg/L, except expressed otherwise)

No	Parameter	Measurement		Standard (MMAF Regulation No. 75/2016; intensive pond)	Remarks
		Point 1 (Reservoir) Inlet	Point 2 (pond)		
1.	Temperature (°C)	26.0	27.0	28 - 30	
2.	Salinity	9.9	44.0	26-32	Pond: Exceed
3.	pH	7.55	7.35	7.5-8.5	
4.	DO	5.38	5.30	> 4	
5.	Alkalinity (ppm)	216	329	100-150	Exceed
6.	Total Organic Material	14.5	8.7	≤ 90	
7.	Ammonia	0.28	< 0.01	≤ 0.1	Rev: Exceed
8.	Nitrite	0.28	0.78	≤ 1	
9.	Nitrate	0.01	0.05	0.5	
10.	Phosphate	1.70	0.34	0.1-5	
11.	Transparency	-	-	30-50	
12.	Total Dissolved Solid	5970	22000	-	
13.	Heavy Metals				
	-Pb	<0.027	<0.027	0.03	
	-Cd	<0.001	<0.001	0.01	
	-Hg	<0.001	<0.001	0.002	
14.	Hydrogen Sulfide	<0.002	< 0.002	≥ 0.01	
15.	Total vibrio (CFU (Colony Forming Unit)/ ml)			≤ $1x10^3$	

Water Quality Testing of Shrimp Ponds Effluent in BPBAP Takalar (South Sulawesi)
(All units in mg/L, except expressed otherwise)

No	Parameters	Standard (Gov. Regulation)[3]	Sampling and Measurement				Remarks
			Point 1	Point 2	Point 4	Point 3	
A	Physical Parameter						
1.	TSS	200	9	< 8	<8		
2.	Turbidity (NTU)	50	<0.5	<0.5	<0.5		
3	Temperature (^oC)						
B.	Chemical Parameter						
1.	pH	6-9,0	6.71	6.80	6.86		
2.	BOD_5	< 45	5.21	5.03	4.47		
	COD		16.73	16.46	14.65		
3.	PO_4	< 0,1	1.80	0.42	0.39		
4.	H_2S	< 0,03	<0.002	<0.002	<0.002		
5.	NO_3	< 75	1.26	0.64	0.64		
6.	NO_2	< 2,5	0.005	0.005	0.002		
7.	NH_3	< 0,1	<0.01	<0.01	<0.01		
C	Biological Parameter						
	Dinoflagellata						
1	Gymnodinium (Individual /L)	$< 8 \times 10^2$					
2	Peridinium (Individual /L)	$< 8 \times 10^2$					
3	Pathogen bacterial (CFU (Colony Forming Unit))	$< 10^2$					

[3] Regulation of Minister of Marine Affairs and Fishery (Permen – KKP) No. 75 tahun 2016 on General Guideline for Growing on of *Penaeus monodon* and *Litopenaeus vannamei*

Ambient Seawater Quality Testing in BPBAP Takalar (South Sulawesi)
(All units in mg/L, except expressed otherwise)

No.	Parameter	Standard (Appendix VIII of GR No. 22/2021)	Measurement		Remarks
			Point 1 (upstream)	Point 1 (downstream)	
1.	Color (Pt. Co)	-	<2.14	<2.14	
2.	Transparency (m)	*Coral: .5* *Mangrove: -* *Seagrass: >3*			
3.	Turbidity (NTU)	5	0.48	0.72	Does not meet
4.	Odor	Natural	Odorless	Odorless	
5.	Total Suspended Solid	Coral:20 Mangrove: 80 Seagrass: 20	11	9	
6.	Solid waste	None	Nihil	Nihil	
7.	Temperature (℃)	Natural Coral: 28-30 Mangrove: 28-32 Seagrass: 28-30	26.0	26.5	
8.	Oil layer	None	Nihil	Nihil	
9.	pH	7 – 8.5	7.15	7.17	
10.	Salinity (0/00)	Coral: 33-34 Mangrove: up to 34 Seagrass: 33-34	15.3	19.1	
11.	Dissolved Oxygen (DO)	>5	5.10	5.20	
12.	BOD_5 (Biological Oxygen Demand)	*20*	7.4	7.6	
13	Total Ammonia (NH_3- N)	0.3	< 0.01	< 0.01	
14.	Orthophosphate (PO_4- P)	0.015			
15.	Nitrate (NO_3-N)	0.06	0.40	0.63	Exceed
16.	Cyanide (CN-)	0.5	< 0.01	< 0.01	
17.	Sulfide (H2S)	0.01	< 0.002	< 0.002	
18.	Total Petroleum Hydrocarbon (TPH)	0.02	<0.002	<0.002	
19.	Total Phenolic Compounds	0.002	<0.001	<0.001	
20.	Fecal coliform (MPN/ 100 ml)	-	31	25	
21.	Coliform (total) (MPN/ 100 ml)	1000	500	600	
22.	Pathogen (Cell/100 mL)	*None*	Negative	Negative	
23.	Phytoplankton (Cell/mL)	1000			

D. Laboratory – Serang (Banten)

Groundwater Quality Testing Serang, Banten)
(All units in mg/L, except expressed otherwise)

No	Parameters	Sampling and Measurement		Quality Standard (Minimum Value)	Remarks
A.	Physical Parameters	Point 1 (within site)	Point (outside of site)		
1.	Turbidity (NTU)	< 0.5	1	25	
2.	Color (TCU)	1	< 2	50	
3.	TDS (Total Dissolved Solid)	254	416	1000	
4.	Temperature (°C)	28	29.0	air temperature ± 3	
5.	Taste	Tasteless	Tasteless	No taste	
6.	Smell	Odorless	Odorless	No smell	
B	Biological Parameters (MPN)				
1.	Total coliform (CFU/ 100ml)	23	17	50	
2.	E. coli (CFU/ 100ml)	0	0	0	
C	Chemical Parameters				
1.	pH	6.7	7.3	6.5 -8.5	
2.	Iron	< 0.016	< 0.016	1	
3.	Fluoride	0.2	0.2	1.5	
4.	Hardness (CaCO3)	61	260	500	
5.	Manganese	< 0.013	0.05	0.5	
6.	Nitrate, as N	1	1	10	
7.	Nitrite, as N	0.01	0.01	1	
8.	Cyanide	< 0.002	< 0.002	0.1	
9.	Detergent (MBAS)	0.01	< 0.010	0.05	
10.	Total Pesticide	< 0.001	< 0.001	0.1	

Ambient Seawater Quality Testing in BPKIL Laboratory (Serang, Banten)
(All units in mg/L, except expressed otherwise)

No.	Parameter	Standard (Appendix VIII of GR No. 22/2021)	Measurement Result	Remarks
1.	Color (Pt. Co)	-	21	
2.	Transparency (m)	*Coral: .5* *Mangrove: -* *Seagrass: >3*	1.3	
3.	Turbidity (NTU)	5	124	Turbidity exceeded the quality standard
4.	Odor	Natural	Odorless	
5.	Total Suspended Solid	Coral:20 Mangrove: 80 Seagrass: 20	200	TSS exceeded the quality standard
6.	Solid waste	None	Exist	Few wastes found in the seawater
7.	Temperature (℃)	Natural Coral: 28-30 Mangrove: 28-32 Seagrass: 28-30	30.0	
8.	Oil layer	None	None	
9.	pH	7 – 8.5	7.6	
10.	Salinity (0/00)	Coral: 33-34 Mangrove: up to 34 Seagrass: 33-34	30	Below the standard
11.	Dissolved Oxygen (DO)	>5	3.6	Below the standard
12.	BOD_5	*20*	20	
13	Total Ammonia (NH_3-N)	0.3	0.2	
14.	Orthophosphate (PO_4-P)	0.015	0.182	
15.	Nitrate (NO_3-N)	0.06	0.12	
16.	Cyanide (CN-)	0.5	0.1	
17.	Sulfide (H2S)	0.01	0.002	
18.	Total Petroleum Hydrocarbon (TPH)	0.02	< 0.01	
19.	Total Phenolic Compounds	0.002	0.002	
20.	Fecal coliform (MPN/ 100 ml)	-	25.875	
21.	Coliform (total) (MPN/ 100 ml)	1000	31.940	Total Coliform exceeded the quality standard

22.	Pathogen (Cell/100 mL)	*None*	*None*	
23.	Phytoplankton (Cell/mL)	1000		

Wastewater Quality Testing in BPKIL Laboratory (Serang, Banten)
(All units in mg/L, except expressed otherwise)

a) Testing Laboratory

Parameters	Standard	Sample at septic tank		Remarks
		1 (Inlet)	2 (Outlet)	
Temperature (^oC)	38	30.0	26.0	
Total Dissolved Solid (TDS)	2000	252	62,073	TDS at the outlet still exceeded standard
Total Suspended Solid (TSS)	200	12	54	
pH	6,0 – 9,0	8.1	8.0	
Iron (Fe)	5	< 0.020	0.4	
Manganese (Mn)	2	< 0.010	28	Manganese at the outlet (septic tank exceeded the quality standard
Barium (Ba)	2	< 0.016	< 0.016	
Copper (Cu)	2	< 0.005	0.1	
Zinc (Zn)	5	0.01	0.3	
Chrom Hexavalent (Cr^{6+})	0.1	< 0.016	< 0.016	
Total Chrom (Cr)	0.5	< 0.010	0.1	
Cadmium (Cd)	0.05	< 0.002	< 0.002	
Mercury (Hg)	0.002	< 0.0001	< 0.0001	
Lead (Pb)	0.1	< 0.013	< 0.013	
Tin (Sn)	2	< 0.001	< 0.001	
Arsenic (As)	0.1	< 0.006	< 0.006	
Selenium (Se)	0.05	< 0.004	0.01	
Nickel (Ni)	0.2	< 0.016	< 0.016	
Cobalt (Co)	0.4	< 0.005	< 0.005	
Cyanide (CN)	0.05	< 0.002	0.002	
Sulfide (H_2S)	0.05	< 0.002	0.01	
Fluoride (F)	2	0.1	0.1	
Free Chlorine (Cl_2)	1	< 0.02	0.03	
Ammonia-Nitrogen (NH_3-N)	1	0.3	0.3	
Nitrate (NO_3-N)	20	0.5	1.041	Nitrate at the outlet (septic tank exceeded the quality standard
Nitrite (NO_2-N)	1	0.01	0.2	
Total Nitrogen	60	12.6	21.5	
BOD_5	50	18	19	
COD	80	30	34	
Methylene Blue	10	0.03	0.03	

Phenol	0.5	< 0.002	< 0.002	
Oil & Grease	10	1	1	
Total Coliform (MPN/ 100 mL)	5000	15.402	9.804	Total Coliform from lab) exceeded standard

b) Field Laboratory (Bioassay)

Parameters	Standard	Sampling and Measurement				Remarks
		Point 1 (Inlet)	Point 2 (Outlet)	Point 3 (Settlement Pond)	Point 4 (Control Box)	
Temperature (^oC)	40	30.0	28.0	28.0	28.0	
Total Dissolved Solid (TDS)	4000	366	40855	470	88	
Total Suspended Solid (TSS)	400	4	258	328	12	
pH	6,0 – 9,0	7.6	7.9	7.6	9.2	
Total Nitrogen	60	11.5	3.3	12.8	8.5	
BOD_5	45	14	23	43	14	
COD	80	25	36	64	26	
Iron (Fe)	10	< 0.020	< 0.020	< 0.020	< 0.020	
Manganese (Mn)	5	< 0.010	< 0.010	< 0.010	< 0.010	
Barium (Ba)	3	0.3	< 0.016	0.02	0.2	
Copper (Cu)	3	< 0.005	< 0.005	0.01	< 0.005	
Zinc (Zn)	10	0.01	0.01	0.1	0.01	
Chrom Hexavalent (Cr^{6+})	0,5	< 0.016	< 0.016	< 0.016	0.02	
Total Chrom (Cr)	1	< 0.010	< 0.010	< 0.010	< 0.010	
Cadmium (Cd)	0,1	< 0.002	< 0.002	< 0.002	< 0.002	
Mercury (Hg)	0,005	< 0.0001	< 0.0001	< 0.0001	< 0.0001	
Lead (Pb)	1	< 0.013	< 0.013	< 0.013	< 0.013	
Stanum (Sn)	3	< 0.001	< 0.001	< 0.001	< 0.001	
Arsenic (As)	0,5	< 0.006	< 0.006	< 0.006	< 0.006	
Selenium (Se)	0,5	< 0.004	0.02	< 0.004	< 0.004	
Nickel (Ni)	0,5	< 0.016	< 0.016	< 0.016	< 0.016	
Cobalt (Co)	0,6	< 0.005	< 0.005	< 0.005	< 0.005	
Cyanide (CN)	0,5	< 0.002	0.003	0.004	< 0.002	
Sulfide (H_2S)	1	< 0.002	< 0.002	0.01	< 0.002	
Fluoride (F)	3	0.2	0.1	0.3	0.1	
Free Chlorine (Cl_2)	2	< 0.02	0.02	0.04	< 0.02	
Ammonia-Nitrogen (NH_3-N)	10	0.3	0.5	2	0.4	
Nitrate (NO_3-N)	30	0.5	0.5	1	0.5	
Nitrite (NO_2-N)	3	0.01	0.01	0.1	0.01	
Methylene Blue (MBAS)	10	0.04	0.1	0.05	0.1	
Phenol	1	< 0.002	< 0.002	< 0.002	< 0.002	

Oil & Grease	20	1	0.4	4	1	
Total Coliform (MPN/ 100 mL)	5000	1480	40	96784	12905	Total Coliform exceeded the quality standard at the outlet

Annex 4 Public Consultation Records

A. Kedung (Jepara, Central Java)

1. Attendance

TA 9951-INO: Supporting Water Security Investments Facility (Subproject 4)

Public Consultation Meeting for the Preparation of

Infrastructure Improvement for Shrimp Aquaculture Project

Jepara, 14 June 2022:

List of Participants

Sub-district (*Kecamatan*) : **Kecamatan Kedung Kabupaten Jepara**

Village (*Desa*) : **Desa Panggung**

No.	Nama (Name)	Alamat (RT/RW) (Address)	Pekerjaan (Profession)	Tandatangan (Signature)
1	Ahmad Safii	Panggung 02/01	Perangkat	
2	JAMRONI	panggung 04/01	KETUA kelomp	
3	LAIQ	Panggung 06/02	Sekretaris	
4	Tri Maharani	Kasi PMD Kec. Kedung	perwakilan Kec.	
5	[illegible]	Panggung	KETUA	
6	[illegible]	PANGGUNG	KETUA	
7	Wawan P	Panggung 9/3	Sekertaris	
8	[illegible]	Dinas Perikanan	Penyuluh Perikan	
9	Sokhib	[illegible]	[illegible]	

10	SYAMSUL HUDA	Panggung 07/02	Pelindungi	
11	Ir. WASTYANTO	DINAS PERIKEDAN	KADIS	
12	A-CHOTIB	"	KADID PB	
13	NOOR H	"	SUB KOORDINASI	
14	BUDI S	"	"	
15	NOVI C	"	STAF	
16	Miskan	Panggung	Tirta Barokah	
17	khabibullah	kedung malang	AL BAROKAH I	
18	NOOR REFIQ	— " —	— " —	
19	muhlisin	— " —	Al Barokah II	
20	Nur khalim	"	"	
21	Budi Utomo	— " —	Tirta Barokah	
22	Alwi	Bulak Baru	Sri Rejeki	
23	ROSID	— " —	— " —	

2. Presentation Material

1. Kriteria Lokasi Tambak, Pembenihan dan Prasarana Pendukung

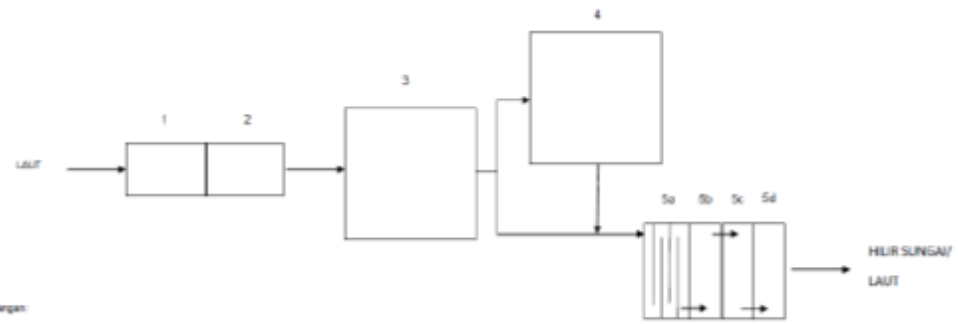
Jenis Kegiatan	Kriteria Lokasi
Tambak dan Penmbenihan	➢ Sesuai dengan tata ruang wilayah (RTRW) dan Zonasi Wilayah Pesisir Dan Pulau-Pulau Kecil (RZWP-3-K) dan peraturan tata ruang terkait lainnya; ➢ Adanya sumber air, air pemeliharaan dan lahan yang memadai dan sesuai; ➢ Tidak berada dalam kawasan bakau atau kawasan lindung/konservasi lainnya dengan jarak sekurang-kurangnya 100 m dari batas terluar; ➢ Lokasi bebas dari banjir berkala (untuk kala ulang dua puluh lima tahun atau Q25) dan dampak pencemaran atau pencemar/bahaya lainnya untuk keamanan pangan; ➢ Tambak udang berada di belakang sempadan pantai sekurang-kurangnya 100 m dan sekurang-kurangnya 100 m dari sempadan sungai sungai besar dan sekurang-kurangnya 50 m dari sungai kecil; ➢ Tekstur tanah dari lokasi tersebut memenuhi spesifikasi yang mendukung pertumbuhan pakan alami, kualitas air yang cocok untuk budidaya udang, dan mampu menahan volume air tambak dengan kebocoran yang dapat diabaikan (<10 % per minggu).
Jalan produksi dan prasarana pendukung lainnya (saluran air, tanggul, penahan banjir, dll)	➢ Sesuai dengan rencana tata ruang wilayah (RTRW) dan peraturan terkait lainnya. ➢ Tidak berada dalam atau pada batas kawasan bakau atau kawasan lindung/konservasi lainnya; ➢ Berada di luar daerah milik sungai/sempadan sungai: sekurang-kurangnya 5 (lima) meter dari kaki sungai bertanggul di daerah permukiman; sekurang-kurangnya 100 (seratus) meter dari tepi sungai besar tanpa tanggul atau sekurangnya 50 (lima) meter dari tepi sungai untuk anak sungai tanpa tanggul di luar permukiman.

2. Pengolahan Air Limbah dan Sampah

- Peraturan Menteri Kelautan dan Perikanan No. 75 tahun 2016 tentang **Pedoman Umum Pembesaran Udang Windu (Penaeus monodon) dan Udang Vaname** (Litopenaeus vannamei) diperlukan manajemen limbah, agar tidak mencemari lingkungan.
- Salah satu upaya yang dapat dilakukan untuk meminimalisir beban limbah pembesaran udang adalah dengan penerapan **instalasi pengolahan air limbah (IPAL)** agar buangan air limbah ke lingkungan dapat memenuhi baku mutu yang ditetapkan dan pembesaran udang dapat beroperasi secara berkelanjutan.
- Prinsip pengolahan air limbah adalah melakukan **perbaikan mutu air limbah** (dengan cara teknis maupun alami) agar saat dibuang tidak mencemari lingkungan (perairan umum).
- Perbaikan mutu air limbah dilakukan dengan cara:
  - memisahkan dan mengelola padatan (sampah) dan air buangan (air limbah);
  - mengurangi bahan pencemar dari air limbah sehingga air hasil pengolahan IPAL memenuhi baku mutu yang ditetapkan dalam peraturan atau setidak-tidaknya tidak lebih buruk dari lingkungan sekitarnya;

INSTALASI PENGOLAH AIR LIMBAH

I. LAYOUT IPAL UNTUK TAMBAK UDANG EKSTENSIF (SEDERHANA) DENGAN KAPASITAS PRODUKSI MAKSIMAL 3 TON/TAHUN



Keterangan:

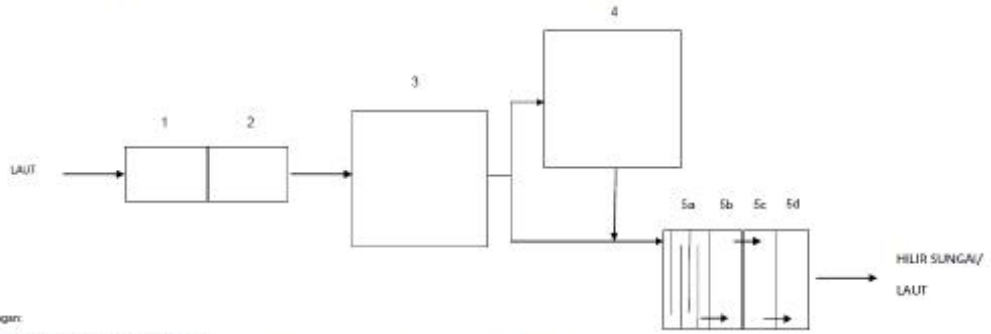
1. Kolam/bendan reservoir (tampungan air baku);
2. tandon treatment, untuk pemusnahan hama dan bibit penyakit alat: ORP meter digunakan agar kadar kaporit yang digunakan tidak berlebihan;
3. tandon budidaya/tambak;
4. tandon penampungan air tambak saat pemanenan;
5. tandon IPAL bisa dengan volume air 10% dari volume air tandon budidaya/tambak, perlu ditambahkan sedimen dari tandon IPAL atau tandon tambak yang sudah lama beroperasi
   a. tandon sedimentasi, sekat-sekat disusun untuk mempercepat sedimentasi;
   b. tandon biofilter yang ditumbuhi mangrove;
   c. tandon biofilter yang ditumbuhi rumput laut dan kerang-kerangan;
   d. tandon biofilter yang berisi ikan,ikan.

pelaku usaha disarankan untuk menjaga/menanam mangrove yang tahan salinitas lebih tinggi disepanjang muara sungai untuk lebih menjaga kualitas air buangan tambak agar usaha tambak bisa berkelanjutan dengan mutu air baku yang terjaga.

4

INSTALASI PENGOLAH AIR LIMBAH

I. LAYOUT IPAL UNTUK TAMBAK UDANG EKSTENSIF (SEDERHANA) DENGAN KAPASITAS PRODUKSI MAKSIMAL 3 TON/TAHUN



Keterangan:

1. Kolam/tandon reservoir (tampungan air baku);
2. tandon treatment, untuk pemusnahan hama dan bibit penyakit,alat ORP meter digunakan agar kadar kaporit yang digunakan tidak berlebihan;
3. tandon budidaya/tambak;
4. tandon penampungan air tambak saat pemanenan;
5. tandon IPAL baru dengan volume air 10% dari volume air tandon budidaya/tambak, perlu ditambahkan sedimen dari tandon IPAL atau tandon tambak yang sudah lama beroperasi:
   a. tandon sedimentasi, sekat-sekat disusun untuk mempercepat sedimentasi;
   b. tandon biofilter yang ditumbuh mangrove;
   c. tandon biofilter yang ditumbuh rumput laut dan kerang-kerangan;
   d. tandon biofilter yang berisi ikan-ikan.

pelaku usaha diwajibkan untuk menjaga/menanam mangrove yang tahan salinitas lebih tinggi disepanjang muara sungai untuk lebih menjaga kualitas air buangan tambak agar usaha tambak bisa berkelanjutan dengan mutu air baku yang terjaga.

5

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3. Penyusunan Dokumen Lingkungan dan Persetujuan Lingkungan

Semua rencana usaha dan kegiatan, termasuk budidaya udang air payau wajib menyusun dokumen lingkungan sesuai dengan kategorinya. Ketentuan lebih lanjut mengenai jenis dokumen yang diperlukan serta wewenang untuk pengujian dan persetujuan dokumen tersebut diatur dalam Peraturan Menteri Lingkungan Hidup Nomor 4 Tahun 2021 tentang Jenis Kegiatan Yang Wajib AMDAL, UKL-UPL atau SPPL.

AMDAL : **>500 Ha**
UKL-UPL: **500 - >10 Ha**
SPPL : **≤10 Ha**

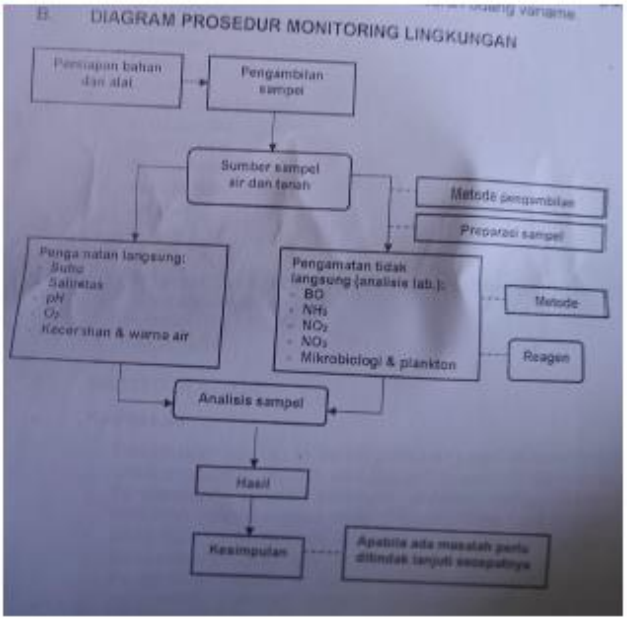
Peningkatan prasarana budidaya udang bukan merupakan kegiatan yang berdiri sendiri, tapi mencakup lintas sektor, maka penapisan lingkungan juga mencakup fasilitas pendukung lainnya seperti fasilitas pekerjaan umum (saluran air, penahan banjir, tanggul, jalan produksi, bangunan, instalasi listrik, dll

4. Pengelolaan Kualitas Air (SPO Pembesaran Udang)

Tabel 1 VII. Perlakuan untuk perbaikan beberapa parameter kualitas air media pada pembesaran udang

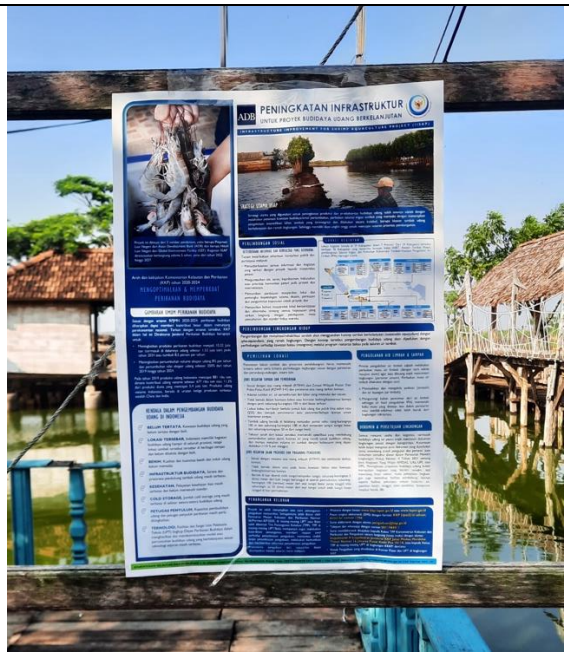
Parameter	Metode Perbaikan
1. Suhu	Pengaturan ketinggian air, menghidupkan kincir, menumbuhkan plankton.
2. Salinitas	
- lebih tinggi	Menambahkan air tawar
- lebih rendah	Menambahkan air masuk dari air sumber (laut).
3. pH	
- lebih tinggi	Menambahkan molase, fermentasi kering, pemberian saponin
- lebih rendah	Aplikasi kapu pertanian ($CaCO_3$) dan atau dolomit.

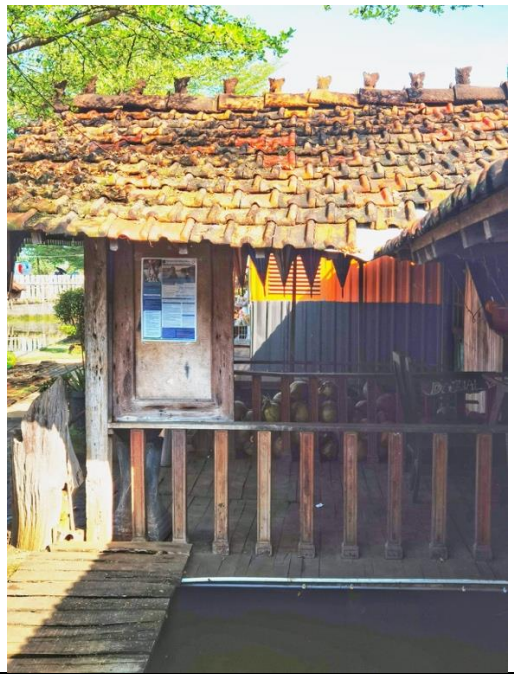
5. Pemantauan Lingkungan Budidaya



i. Booklet

ii. Photographs





B Donorejo (Jepara, Central Java)

1. Attendance

TA 9951-INO: Supporting Water Security Investments Facility (Subproject 4)

Public Consultation Meeting for the Preparation of

Infrastructure Improvement for Shrimp Aquaculture Project

Jepara, 15 June 2022:

List of Participants

Sub-district *(Kecamatan)* : Kecamatan Donorojo Kabupaten Jepara

Village *(Desa)* : Desa Ujungwatu

No.	Nama (Name)	Alamat (RT/RW) (Address)	Pekerjaan (Profession)	Tandatangan (Signature)
1	Sukanan	RT I RW III	tani tambak	
2	wawang	ujung watu	Tani Tambak	
3	PURWANTO	CLGRING	TANI TAMBAK	
4	ARIFIN	—	—	
5.	JUKI	CLERING	TANI TAMBAK	
6	Ahmad khafid	Ujungwatu	Tani tambak	
7	Moh. Tanjan	Tanjung	Penyuluh.	
8	Supai	ujung watu	TANI Tambak.	
9	Sunaryo	Ujungwatu	Tani Tambak	

10	M Abdul JALIL		tani tambak.	
11	Wiharyono	RT 06/03 Ujungwatu Donorojo Jepara	Pendidikan Islam	
12	RISMIATI	CLERING	- "	
13	Adityan S.N	Ujung watu	Budi daya Ikan	
14	SUMARIYATI	Ujung WATU	-,,- Ikan	
15	SUDIRO	Jepara	BBPBAP	
16	BARI	UJUNG WATU	TAMBAK	
17	Legiman	Clering	Petambak	
18	Ahmad Ihsan	Donorojo	Petambak	
19	Rohmad	Clering	Petambak	
20	Indiyo	Ujung Watu	Tani Tambak	
21	M. Zaenal	Ujung Watu	Tani Tambak	
22	M. Zuhdi	clering	petambak	
23	ANSORI	Ujung	"	

C Bulukumba (South Sulawesi)

1. List of Attendance

10	Fatmawati Patwa	Dinas Pariwisata Bulukumba	PNS	
11	Muspirah Baso	- sda	PNS	
12	[illegible]	[illegible]	petambak	
13	Sulfikar	Gantarang -	petambak	
14	AHMAD RIZAL	MANJALLING	PETANI	
15	ABD. RAHMAN	BALLOMEING	PETANI	
16	Andi Rayhan M	Barabba, Desa Bialo	Pj. Kepala Desa	
17	HARIANG	Manjalling	petambak	
18	A. Zainuddin S.pd	Manjalling	wiraswasta	
19	ARMAN	- " -	Petambak	
20	Haerudin	Manjalling	Petambak	
21	HARIANTO	- " -	petambak	
22	MARSIATI	PACATTAE	PEG. DESA	
23	ARBIANA	Palatto	Petambak	

24	MUH. ALWI	PARUNONGE	Petambak	
25	Nurpadilah	Bulukumba	PPB	
26	Rustan	Kaile	petambak	
27	A. Sukman	Padang loang	petambak	
28	A. FAIZ	Padang loang	Petambak	
29	A. Cawa M.	Bulukumba	Tani	
30	FIRMAN	KALUMEANG	Tambak	
31	Indo TANG	CENDANA	Tambak	
32	SYAMSUDAR	KALLE	Tambak	
33	A SYAHRULLAH	MALATTAE	PETANI	
34	HARIATIAH	KAILE	Petambak	
35	YARNI	Bulukumba	Petambak	
36	ABDULLAH . SP	KALIMASSANG	TAMBAK	
37	Rahmat Abbas	Kalimassang	Tambak	

D Sinjai (South Sulawesi)

1. List of Attendance

TA 9951-INO: Supporting Water Security Investments Facility (Subproject 4)

Public Consultation Meeting for the Preparation of

Infrastructure Improvement for Shrimp Aquaculture Project

Kabupaten Sinjai, 22 June 2022

List of Participants

Sub-district (*Kecamatan*) : Kecamatan Sinjai Utara, Kabupaten Sinjai

Village (*Desa*) : .....

No.	Nama (Name)	Alamat (RT/RW) (Address)	Pekerjaan (Profession)	Tandatangan (Signature)
1	A. ASHAR	JLN. MELATI NO. 6 SINJAI	WIRASWASTA	
2	HUSAIN	DS. PASI MARANNU DUSUN MARANNU	PETANI	
3	MUHTAR	JL TERATAI	TAMBAK	
4	AKBAR	JL. STADION MINI	Cent S.Tim	
5	A. Syamsul Bahri	DESA - PASI - MARANNU	KADES	
6	A. Ashyani AJ	Jl. Kelapa Kec. Sinjai Utara	PPL Sinjai Utara	
7	NURHAYATI, SP	JL. BULUBICARA NO 13 KEL. ABOKKI	PPL. SINJAI TIMUR	
8	MUNAJI	JL WANGI K.EL. LAPPA	PETAMBAK	
9	NAIRMAN	JL. UDANG. KEL. LAPPA	PETAMBAK	

10	DARLINA	JL. UDANG. KEL. LAPPA	PETAMBAK	
11	SYAMSUL ALAM	JL. UDANG KEL. LAPPA	PEMBUDIDAYA	
12	H. SOFWAN	Jl. ~~Kelay~~ Sungai Tangka	CAMAT. S. UTARA	
13	MUH IKLAS	PANGASA	BUDIDAYA	
14	AMIRUDDIN LATIF	JL. NENER, KEL. LAPPA	PEMBUDIDAYA	
15	Akbar Nurdin	Jl. KH. Agussalim	Penyuluh	
16	BUDIYAMIN	BTN 7 WALI INDAH	PENYULUH	
17	IRFAN.	Jl. Nenas	Staf perikanan	
18	AGUS SALIM	M. Bombang	Petambak	
19	M. ASRI	M Bombang	Petambak	
20	KURNIATI	Biajai	Jurah Samaturu	
21	USMAN	TAJJOLA LAGOARI	Pembudidaya	
22	USRAN	TAJJOLO LAGOAR	Pembudidaya	
23	SAINUDDIN	TAJJOLO LAGOARI	TAMBAK	