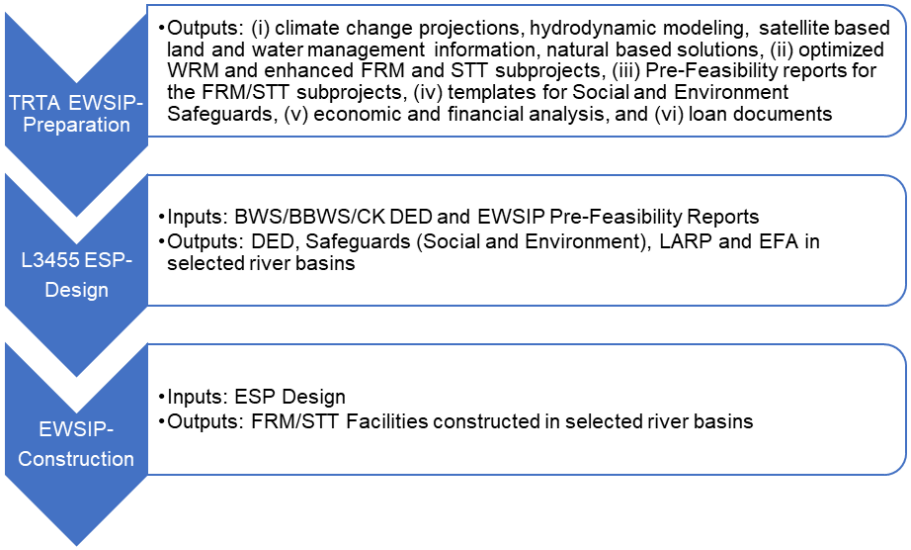
FRM Profile

Subproject	**FRM-Karang Mumus**
River basin	Karang Mumus
Main river	Karang Mumus River
District/ Province	East Borneo
Agency in charge	BWS Kalimantan III
Proposed work description	The infrastructure components to be constructed along the Karang Mumus river system will allow i) reduction in flood water levels and ii) retention of flood volumes to reduce flood exposure to households and agriculture areas. The engineering consultant engaged under ADB Loan 3455 will prepare the detailed engineering design based on the agreed basic design and concept prepared under the TRTA. The L3455 will conduct detailed surveys (topography, geotechnical, bathymetry, social, and environmental) that might slightly impact on the design. No change on design that trigger category A for environment safeguards will be made. Flood Risk Management (FRM) plans shall be prepared and implemented at the river basin scale by reflecting national priorities/initiatives and international best practices (i.e., EU Flood Directive, WMO approaches and Prevention, Preparedness and Response to manmade and natural disasters (PPRD) East study). Some of the guiding principles are presented in Appendix D of the FRM technical pre-feasibility report to serve as the basis of developing Guidelines for FRM plans in Indonesia during development of detailed engineering design plans through L3455. Upstream Watershed Management practices will be described in further detail during the detailed engineering design stage (through L3455) in collaboration with the international project partner, International Fund for Agricultural Development (IFAD). In this context, site-specific actions will be evaluated and proposed, with the support of IFAD, to enhance stability and sediment yield characteristics in the upstream parts of the watershed. Some of the preliminary practices are described in Appendix E of the FRM technical pre-feasibility report to highlight joint functioning of various technologies as one system at the watershed scale. The Karang Mumus River sub-basin is 322 km^2 in size and is a sub-basin of the Mahakam downstream river watershed. The river flows along a reach of approximately 30 km north of Samarinda to the confluence with the Mahakam River. The river and its tributaries drain a series of parallel ridges in north to south direction. The riparian areas of the main river are lowland swamps with cultivated land and settlements on higher areas. The problem of flooding in the Samarinda City is complex and driven by i) fluvial floods along the Karang Mumus River, ii) pluvial floods in the city, and iii) coastal floods due to the high-water levels in the Mahakam River. Flooding cause frequent inundation of buildings, temporary relocation of people and associated health hazards. The river is a significant source of community activities despite the river pollution. The main features of BWS proposal, and EWSIP enhancements are described below. **BWS Kalimantan III** has developed a multi-purpose sub-project plan to improve flood risk management for the city of Samarinda, which is composed of i) Four **flood retention basins** (Embung) in the upper tributaries proposed as Embungs with a small sluice gate inserted at their weir (North Sempaja (**subproject ID B.1)** (approximately surface area of 30 ha, depth of 4.5 m, and storage volume of 1.42 Mm3), Right Pampang (**subproject ID B.2)** (approximately surface area of 30 ha, depth of 4.33 m, and storage volume of 0.56 Mm3), Left Pampang (**subproject ID B.3)** (approximately surface area of 120 ha, depth of 13 m, and storage volume of 2.26 Mm3) and Muang (**subproject ID B.4**) (approximately surface area of 60 ha, depth of 13 m, and storage volume of 1.19 Mm3). ii) Construction/enlarging three **detention basins** (proposed as Gunung Lingai Retention Basin (**subproject ID B.5)** (approximately surface area of 9 ha, depth of 2 m, and temporary storage volume of 0.2 Mm3), Sempaja Stadium Retention

	Basin (**subproject ID B.6)** (approximately surface area of 1.2 ha, depth of 3 m, and temporary storage volume of 0.04 Mm3), and Bengkuring Retention Pond and Swamp Revitalization (**subproject ID B.7**) (approximately surface area of 20 ha, depth of 2 m, and temporary storage volume of 0.4 Mm3). iii) Construction of a **pump station** upstream of the confluence of Karang Mumus River with Mahakam River by using ten non-submersible electric pumps and Pump Station at Karang Mumus Outlet (**subproject ID B.8**). iv) **Dredging** of the Benanga Reservoir, which is proposed as Revitalisation and Dredging of Benanga Reservoir (**subproject ID B.9**). v) **Normalisation** of Karang Mumus River, downstream of the Benanga Reservoir, which will include bank strengthening through Samarinda, which is proposed as Normalisation of Karang Mumus River Channel (**subproject ID B.10**). The works will extend from the Benanga Dam to the confluence with Mahakam, which is proposed to have anchored sheet pile walls along the banks and will require removal of low-cost housing for a width of 15 meters on either side of both banks. **EWSIP** proposals are introduced along the Karang Mumus river system by using the following measures: i) Benanga Dam Modification in operation of the gate (**subproject ID E.1)**. Operation of the Benanga Dam with the sluice gate fully open to provide an additional storage depth of approximately two meters. ii) Utilization of existing swamps as Multipurpose Recreation Areas and Detention Ponds (**subproject ID E.2)** include: nine **existing swamps** covering an area of approximately 411 ha into a more effective set of multipurpose detention basins, which can store water to a minimum depth of 2 meters, and temporary storage volume of 8.2 Mm3 to effectively reduce flood peaks. iii) Karang Mumus River Compound Channel (**subproject ID E.3)**, includes: - Modification of the conventional trapezoidal cross-sections of the Karang Mumus River into a **compound channel** to provide larger waterway area with less bottom width to facilitate lower flood flows at a higher velocity where slopes are not steeper than 1:1. This will allow a higher percent of sediment load to be transported along the river system in suspension. - Replacement of the concrete sheet pile walls with **gabion walls** that have improved bio-remedial functions. - **Natural vegetative protection** is proposed along straight sections of the channel based on *vetiver* grasses in a 3m x 3m cell shape filled in with native vegetation iv) Development of existing Swamp as Water/Recreational Park (**subproject ID E.4)**, includes: Propose a **recreational park** with a low-level lake that can be filled with i) fluvial floods from the Karang Mumus River or ii) pluvial floods from the Samarinda city. The park should have bio-remedial ponds to improve water quality in the city drainage. v) Tidal Floodgates for Karang Mumus (**subproject ID E.5**) includes: Construction of a) **radial gated barrage** near the Karang Mumus confluence, b) flood protection walls and c) one-way structures along the drain system for the Samarinda city to enhance flood protection driven by the Mahakam River. vi) Raise Mahakam Walls (**subproject ID E.6)** includes: Raising Mahakam River flood wall by 0.5 m by considering the climate change impacts by the year 2050, and an additional 0.5 m freeboard to compensate for increased tidal surge. vii) Floodgates for Karangasem Stream and other tributary rivers of Mahakam near Samarinda City (**subproject ID E.7**) includes : Smaller gates to be used as sluice gates are required for S Manggis, S Karangasam Besar, S Karangasam Kecil and several other systems with smaller discharges. A reinforced concrete wall shall have linkage with the outlets and higher ground and consider the climate change impacts by the year 2050 with a proper freeboard. viii) Karang Mumus Dam/Embung (**subproject ID E.8)** includes: Construct the **multi-purpose Karang Mumus Embung** (approximately surface area of 133.6 ha, depth of 11 m, and storage volume of 6.3 Mm3) to provide a) flood storage, b) raw water supply to the ongoing airport developments, and c) a small sluice gate inserted at their weir.

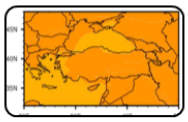
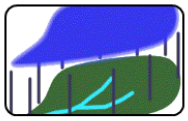
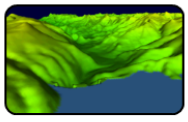
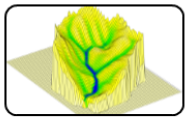
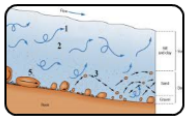
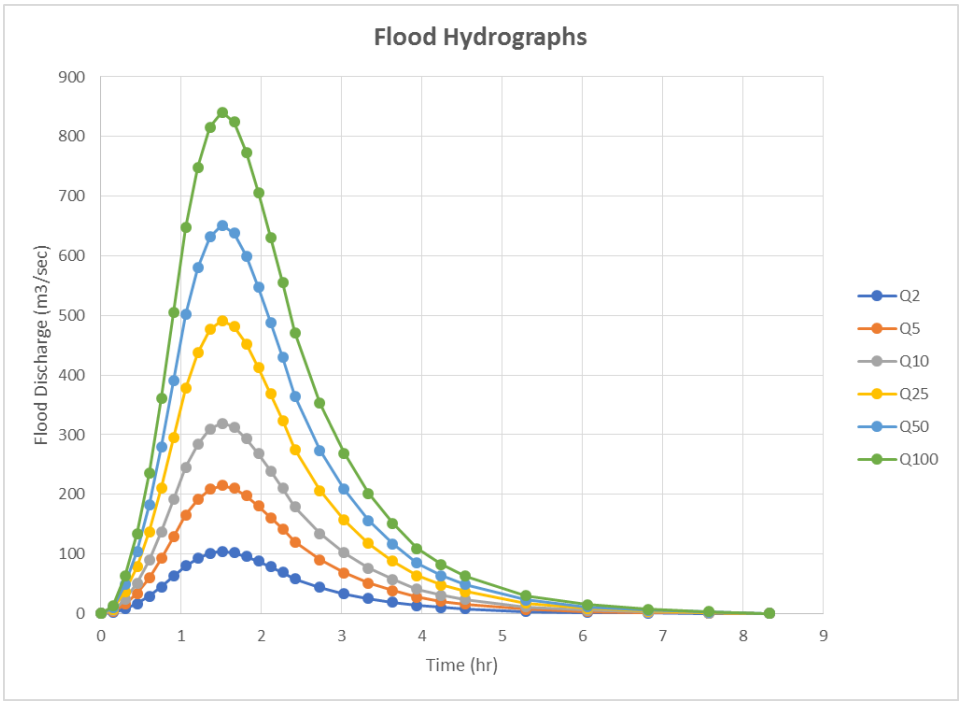
<table>
<tr><td></td><td>Some of the proposed non-structural measures include:
i) Preparing the LARAP for houses in critical river section (subproject ID E.9).
ii) Disseminate SUDs to Owners in Flood Prone Areas (subproject ID E.10).
iii) Implementation of a real time flood warning and monitoring system by using SCADA system (subproject ID E.11).</td></tr>
<tr><td>EWSIP added value</td><td>EWSIP outputs are strategically linked to the BAPPENAS quick-win programs as defined below:
<table>
<tr><th>BAPPENAS Programs</th><th>EWSIP Outputs</th></tr>
<tr><td>Program 1: Smart Water Management</td><td>Output 1: Planning for water resources optimized</td></tr>
<tr><td>Program 2: Water for Food Security and Nutrition</td><td>Output 2: RWS infrastructure and services improved</td></tr>
<tr><td>Program 3: Multipurpose Storage for Water, Food, Flood, and Energy</td><td>Output 2: RWS infrastructure and services improved</td></tr>
<tr><td>Program 4: Disaster Resilience Infrastructure</td><td>Output 3: FRM enhanced</td></tr>
<tr><td>Program 5: North Java Integrated Coastal Development</td><td>Output 3: FRM enhanced</td></tr>
<tr><td>Program 6: Green Infrastructure</td><td>Output 1: Planning for water resources optimized</td></tr>
<tr><td>Program 7: Water Safety Plan</td><td>Output 1: Planning for water resources optimized</td></tr>
</table></td></tr>
<tr><td>Alignment with spatial plan</td><td>The subproject is consistent with the spatial plan of East Kalimantan Province year 2016-2036[1].</td></tr>
<tr><td>Potential Involuntary Resettlement impact</td><td>The subprojects are expected result in Land Acquisition (LA) as documented below. The subprojects E.1, E.3, E.9-E.11 are not expected to result in LA. The final LA requirements for all subprojects shall follow detailed site-specific surveys to be implemented during the detailed engineering design stage through L3455.
<table>
<tr><th>ID</th><th>FRM Subprojects</th><th>Estimates for LA area (ha)</th></tr>
<tr><td></td><td>BWS KIII Proposals</td><td></td></tr>
<tr><td>B.1</td><td>Build North Sempaja small dam</td><td>30</td></tr>
<tr><td>B.2</td><td>Build Left Pampang small dam</td><td>30</td></tr>
<tr><td>B.3</td><td>Build Right Pampang small dam</td><td>120</td></tr>
<tr><td>B.4</td><td>Build Muang small dam</td><td>60</td></tr>
<tr><td>B.5</td><td>Build Gunung Lingai retention basin</td><td>9</td></tr>
<tr><td>B.6</td><td>Build Sempaja Stadium retention basin</td><td>1.2</td></tr>
<tr><td>B.7</td><td>Build Bengkuring retention basin and revitalise the swamp</td><td>6</td></tr>
<tr><td>B.8</td><td>Build retention basin and pump station at Karang Mumus outlet</td><td>0.5</td></tr>
<tr><td>B.9</td><td>Revitalise and dredge Benenga reservoir</td><td>30</td></tr>
<tr><td>B.10</td><td>Karang Mumus normalisation & bank strengthen</td><td>15</td></tr>
<tr><td></td><td>Sub-total for BWS KIII</td><td>301.7</td></tr>
<tr><td></td><td>EWSIP Proposals</td><td></td></tr>
<tr><td>E.2</td><td>Utilize Swamps as Multipurpose Detention Ponds</td><td>1</td></tr>
<tr><td>E.4</td><td>Swamp as water and recreation park</td><td>1</td></tr>
<tr><td>E.5</td><td>Tidal floodgates for Karang Mumus</td><td>0.25</td></tr>
<tr><td>E.6</td><td>Raise Mahakam floodwalls</td><td>0.2</td></tr>
<tr><td>E.7</td><td>Floodgates for other streams</td><td>0.2</td></tr>
<tr><td>E.8</td><td>Build Karang Mumus dam</td><td>120</td></tr>
<tr><td></td><td>Sub-total for EWSIP</td><td>436.7</td></tr>
<tr><td></td><td>Total estimate for land acquisition</td><td>738.4</td></tr>
</table>
There are no documents on land acquisition, socio-economic conditions and resettlement needs along the project corridor (AMDAL, LARP, LARAP, IP&IR)</td></tr>
</table>

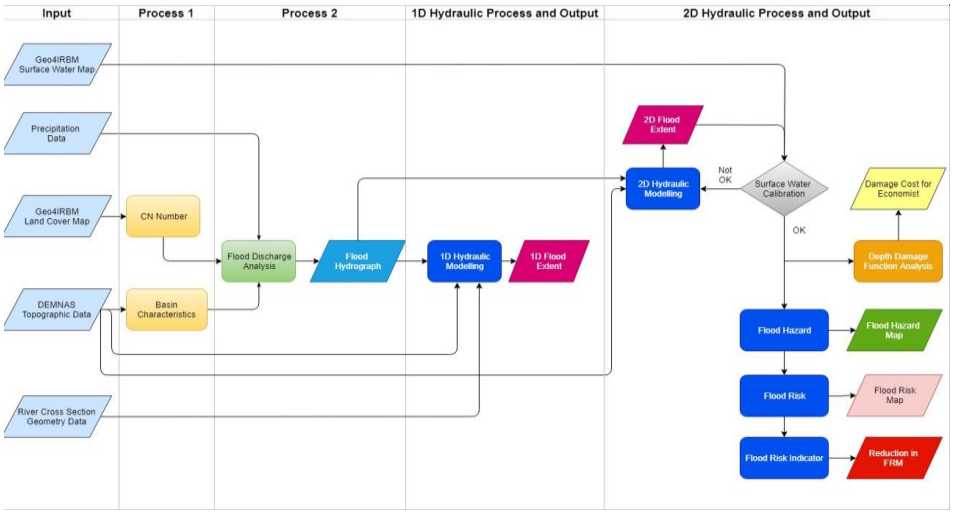
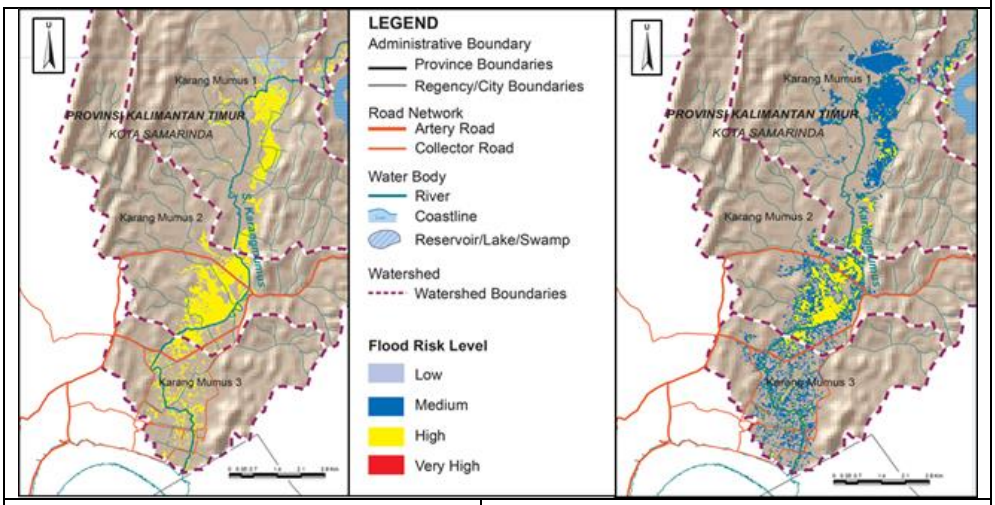
[1] http://bappeda.kaltimprov.go.id/berita/download-peta-rtrwp-kaltim, last accessed in June 2019.

Potential Indigenous people impact	The potential for crossing areas with Indigenous People (IP) should be evaluated by i) reviewing the BRWA (Indigenous Territory Registration Agency) database[2], ii) reviewing the AMAN (Indigenous Peoples Alliance of the Archipelago), database[3], and iii) site-specific surveys by the Contractor during Detailed Engineering Design.
Potential Environment impact	The subproject works are not expected to cross any protected area (forest/swamp), biodiversity sanctuary or protected forest as indicated in the Indicative Moratorium Maps 15th Revision, which are published as per the Forestry Ministerial Decree of the Republic of Indonesia Number: SK.8599/MENLHK-PKTL/IPSDH/PLA.1/12/ 2018 (Scale 1:250.000)[4]. There are no documents on environmental impacts (i.e., IEE, AMDAL, etc.). The potential to cross any protected area (forest/swamp), biodiversity sanctuary or protected forest should be evaluated through site-specific surveys by the Contractor during Detailed Engineering Design. No change on design that trigger category A for environment safeguards will be made.
Estimated cost and implementation period	The Implementation period is 2020 – 2023. The project costs include i) RpM 1,172,000 for the infrastructure by the BBWS CC, and ii) RpM 820,432 for the proposals by EWSIP. O&M costs are annual and to be calculated as 2% of infrastructure implementation costs through the lifecycle of proposed infrastructure over 30-years.
Readiness FS/DED/IEE-EIA/LARP/Bidding documents	DED is available for the infrastructure proposed along the Karang Mumus river by the BWS KIII. Enhancement of existing DED and Safeguards documentation will be proposed for preparation as part of ADB ESP packages (Loan 3455). The documents that are available include: i) Rencana Pengelolaan Sumber Daya Air Wilayah Sungai Kalimantan III (Water Resources Management Plan in Kalimantan III River Basin) by the DGWR-MPWH, 2017, and ii) DED **(**including a) SID Banjir Samarinda, 2005; b) DED Bendali Sempaja di Kota Samarinda, 2006; c) DED Sistem Pengendali Banjir Sentosa-Remaja-Pemuda, 2007; d) Perencanaan Pengerukan Alur Sungai Mahakam Samping Pulau Kumala Tenggarong, 2007; e) DED Pengendalian Banjir Sungai Karang Mumus Atas (Lempake) Kota Samarinda, 2010; f) FS Bendungan Karang Mumus (Lempake Benanga), 2013; g) Kajian Penetapan Sempadan Sungai Mahakam, 2017.
Linkages between EWSIP and ESP	The linkages between the TRTA, Engineering Services Project (ESP); and construction under EWSIP are schematized below: 

[2] http://brwa.or.id/sig/, last accessed in June 2019.
[3] http://www.aman.or.id/peta/, last accessed in June 2019.
[4] http://webgis.dephut.go.id:8080/kemenhut/index.php/en/map/pipib/61-pippib/330-indicative-moratorium-map-15th-revision, last accessed in July 2019.

FRM Numerical Modelling Processes

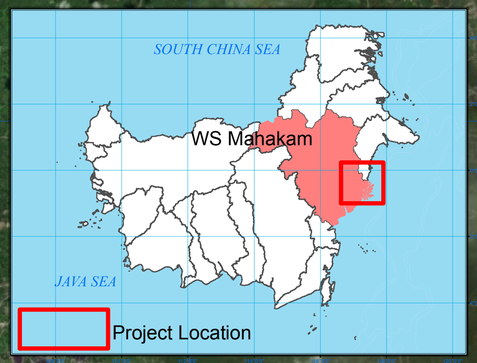
Numerical models in IFRM	ESP Consultant shall follow the numerical modelling processes in integrated flood risk modelling (IFRM) as highlighted below:  **Climate Change Modelling** - *Scope:* Climate change projections and anomalies - *Database:* Temperature, Precipitation and Evaporation (ADB)  **Hydrologic Modelling** - *Scope:* Evaluation of Rainfall to Runoff processes - *Database:* Hydromet. network (BBWS/PUSAIR), LULC (ESA)  **Hydraulic Modelling** - *Scope:* Evaluation of Runoff to River hydraulics (1D/2D) - *Database:* Flow gage network, DEM (BIG), Validatation (ESA)  **Erosion Modelling** - *Scope:* Sediment yield from the watershed - *Database:* RUSLE / MUSLE parameters  **Sediment Yield and Watershed Management** - *Scope:* Sediment yield along the watershed system - *Database:* Sediment characterization, FAO–WOCAT (World Overview of Conservation Approaches and Technologies)
Flood Hydrographs	ESP Consultant shall generate flood hydrographs (as depicted below) for existing/future conditions by using the Soil-Conservation-Service (SCS) Curve Number (CN) unit hydrograph approach. The existing/future land use and land cover data sets and climate change data sets (representing the changes in precipitation and temperature in 2030 and 2050) shall be used. 

Flood Hydraulics	The main objective of 1-dimensional hydraulic models is to i) identify existing level of flood protection (Scenario 1) along the river, ii) evaluate the proposed concepts by the BBWS DED (Scenario 2) and iii) evaluate the level of enhancement required for the flood protection services (Scenario 3). This evaluation was performed both in the context of existing hydrologic conditions (storm precipitation) and future conditions with climate change (Scenario 4). 2-dimensional hydraulic models shall be developed along the entire river basin by using the DEMNAS DEM available by the BIG. The hydraulic models shall be evaluated/validated through a combination of tools including i) BNPB database for disaster data for historical floods , ii) historical flood maps available with the BWS/BBWS, iii) Google Earth time series images to explore flood impacts, and iv) European Space Agency (ESA) satellite images of historical water extent.
Flood Risk Maps - Processes	ESP Consultant shall develop flood risk maps through the exposure, vulnerability and hazard processes and by using 1-dimensional and 2-dimensional hydraulic models. 
Flood Risk Maps - Outcomes	The outcomes shall be represented for i) building/people, and ii) agriculture at the river basin scale, as shown below.  Risk to Agriculture Areas — Risk to People/Buildings

EWSIP - FRM INDICATIVE MAP FOR MAHAKAM - KARANG MUMUS SYSTEM SUBPROJECT

117°4'0" 117°12'0" 117°20'0"

0°16'0" 0°24'0"



WS MAHAKAM

U

0 ¾ 1½ 3 4½ 6 Km

Scale 1 : 10,000

Legend :

- Capital Province
- District Province
- Province Boundaries
- Regency/City Boundaries
- River Basin Boundary
- Watershed Boundaries
- Shoreline
- River
- Reservoir

Sub Project Information

- BWS Subproject Proposals
- EWSIP Subproject Proposals
- BWS Proposal-Normalization
- EWSIP Proposal-Flood Wall
- EWSIP Proposals - Existing Swamp as Recreational Park

Subproject Information :

	BWS Kalimantan III Proposals
B.1	North Sempaja Small Dam
B.2	Right Pampang Small Dam
B.3	Left Pampang Small Dam
B.4	Muang Small Dam
B.5	Gunung Lingai Retention Basin
B.6	Sempaja Stadium Retention Basin
B.7	Bengkuring Retention Basin and Swamp Revitalization
B.8	Construction of a pump station upstream of the confluence of Karang Mumus River with Mahakam River
B.9	Dredging of the Benanga Reservoir
B.10	Normalisation of Karang Mumus River

	EWSIP Proposals
E.1	Benanga Dam Modification in operation of the gate
E.2	Utilization of existing swamps as Multipurpose Recreation Areas and Detention Ponds
E.3	Karang Mumus River Compound Channel
E.4	Development of existing Swamp as Water/Recreational Park
E.5	Tidal Floodgates for Karang Mumus
E.6	Raise Mahakam Walls
E.7	Floodgates for Karangasem Streams and other tributary rivers of Mahakam near Samarinda City
E.8	Karang Mumus Dam/Embung

B.1 B.2 B.3 B.4 B.5 B.6 B.7 B.8 B.9 B.10

E.1 E.2 E.4 E.5 E.6 E.7 E.8

Lempake Reservoir

Samarinda

East Kalimantan

Kutai Kartanagara District

Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User