FRM Profile

Subproject	**FRM-Seluna**
River basin	Jratunseluna
Main river	Serang River, Lusi River, Wulan River, Juana River
District/Province	East Java
Agency in charge	BBWS Pemali Juana (PJ)
Proposed work description	The infrastructure components to be constructed along the Seluna 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 FRM subprojects will include i) sediment excavation or sediment trap facilities; ii) detention basins, iii) raise in levee/bank elevations, iii) coastal protection, and iv) enhancement existing dams. Nature-based solutions are recommended to replace hard engineering designs and introduced into new enhanced solutions. The main features of **BBWS** proposal, and **EWSIP** enhancements are described below. **BBWS proposals** for Lusi River System are summarized below: Subproject ID B1.1: DED of Jetis check dam (surface area of 9.1 ha, depth of 6 m, and volume of 0.3M m3) and Buluroto check dam (surface area of 25.6M ha, depth of 7 m, and temporary storage volume of 0.6M m3) to control S. Lusi flooding. Subproject ID B1.2: Channel normalisation 24 km, Lusi Levee rehabilitation. Subproject ID B1.3: DED flood storage pond at Dumpil, 300 m repair bank, normalize 5 km. **BBWS proposals** for Juana River System are summarized below: Subproject ID B2.1: Normalization and detention basins (approximately surface area of 887.6 ha) in S Juana & tributaries. Subproject ID B2.2: Floodway around Juana town, 11.4 km long Juana river diversion to the north side of Juana town. **BBWS proposals** for Serang-Wulan (SW) River System are summarized below: Subproject ID B3.1: Channel normalization, weir modification, retention pond construction and optimisation at Upstream S. Wulan (Hilir) & SW Drainage works (length of 32.8 km). Subproject ID B3.2: Normalization, floodway and strengthening banks with geotextile at Upstream S. Wulan (Hilir) & SW Drainage works (length of 22.3km). Subproject ID B3.3: normalization along 37.5 km S. Wulan. Subproject ID B3.4: normalization along 21.8 km S.Gelis.

	EWSIP proposals for the Lusi River System are summarized below: Subproject ID E1.1: Enhancements of existing dams for FRM: **(a)** Tempuran (surface area of 11 ha, depth of 7 m, and temporary storage volume of 0.9M m3), **(b)** Greneng (surface area of 20 ha, depth of 10 m, and temporary storage volume of 2.0M m3), **(c)** Nglangon (surface area of 18 ha, depth of 10 m, and temporary storage volume of 1.8M m3), **(d)** Simo (surface area of 10 ha, depth of 3 m, and temporary storage volume of 0.3M m3), and **(e)** Sangeh Dam and Reservoir (surface area of 14 ha, depth of 3 m, and temporary storage volume of 0.4M m3), which can allow storage of flood flows transferred from adjacent catchments. Subproject ID E1.2: Enhancement of Jetis and Buluroto long storage dams. This enhancement is expected to trap sediments to allow higher flood storage capacity. Therefore, it is recommended to use a duckbill weir with radial gates either side or a sluice gate to sluice the river channel once the main flood has moved downstream. Subproject ID E1.3: Modify bank repairs at Dumpil and provide additional capacity. Modify the left bank protection details, downstream right banks, gates with improved automation, and enhance Lusi River bank protection. **EWSIP** proposals for the Juana River System are summarized below: Subproject ID E2.1: FRM and RWS storage reservoirs in **(a)** southern and northern storage systems include a series of retention facilities with multi-purpose functions, the largest retention facility in the southern storage system has a footprint of approximately surface area of 150 ha, depth of 8 m, and volume of 12M m3) and the largest retention facility in the **(b)** northern storage system has a footprint of approximate surface area of 150 ha, depth of 10 m, and volume of 15M m3). These low-lying areas in Juana sub-basin can be developed as recreational parks/detention basins. Subproject ID E2.2: Riparian detention basins. There are several opportunities within the Juana basin for detention basins where frequently flooded areas and vacant areas can be found. The swamps are suitable as recreational park/detention basins with a depth of 2m to 3m in the west of the Juana sub-basin, and a corresponding surface area of 920ha and volume of 23 Mm3. Subproject ID E2.3: Enhance existing dams for FRM. The potential for additional storage in Juana basin include: **(a)** Gembong reservoir is on the slopes of Gunung Muria with narrow catchment. The adjacent catchments on the left and right can both have their streams diverted into the reservoir with small weirs and short transfer canals (surface area of 30 ha, depth of 6 m, and temporary storage volume of 1.8M m3). **(b)** Gunung Rowo Dam (surface area of 25 ha, depth of 5 m, and temporary storage volume of 1.3M m3) is built to the south of an old volcanic vent on the southern slopes of Gunung Muria. The short transfers can be built on either side to increase the existing catchment area from 10.5 km2 to 16.5 km^2. Subproject ID E2.4: Juwana town alternative floodway re-allignment. As an alternative to the BBWS PJ proposal (as defined in subproject ID B2.2) a 6 km long re-alignment that would require resettlement of approximately 20 houses, while providing a protection dike around the southeastern part of the town from rising sea levels. **EWSIP** proposals for the Serang-Wulan River System are summarized below: Subproject ID E3.1: Kedung Ombo reservoir sediment trap. A major constraint at the Kedong Ombo reservoir is the loss of active storage by the large quantities of sediments brought down during storms and large flow periods. The construction of a facility to trap coarse sediments and facilitate their removal even during the wet season should be studied and considered. A ramp with a slope of 1 in 4 allows earth moving equipment into the individual basins. Coarse sediments are trapped by a 5m high weir near the end of the basin that has drain holes and a stilling basin. A concept design of such a trap is shown in Section VI.E of the FRM technical pre-feasibility report. Subproject ID E3.2: Downstream excavation and extension of Wulan river normalization. Flooding upstream of Klambu Barrage. An efficient solution is to extend proposed Wulan river normalisation upstream to the barrage. Subproject ID E3.3: Detention Basins for Wulan River and connection drains. There is an extensive area of frequent flooding approx. 3 km to the east of the Wulan River, where farmers have abandoned agriculture areas. It is suggested that these areas are developed into recreational park/detention basins, encircled by a dike with low spillways, set at key levels to reduce flood peaks from the upstream steeply sloping streams from Gunung Muria and the Wulan River. If the basins hold permanent water there are a range of aquaculture crops that could be grown on a communal basis. In

total, these areas cover approximately 1000 ha with a corresponding volume of approximately 23M m3 of storage.
Subproject ID E3.4: Wilalung floodway improvement to increase the capacity of drain-lines passing to the Juana and Wulan sediment basins so that excess flood flows can be transferred to these basins.
Subproject ID E3.5: Flood and RWS off-line storage on S. Gelis. There is a potential to reduce flooding on the Gelis River by normalising the river over a length of 21.8 km for which there is a DED developed by the BBWS PJ (2016). A flood and RWS off-line storage can be developed at a location, where the river appears unstable and about to change alignment as described in Section VI.E of the FRM technical pre-feasibility report. The storage could cover up and area of approx. 8 ha to a depth of 5 m providing an approximate storage of 400,000 m3. This would substantially reduce the design flood to pass through the lower area.

EWSIP added value

EWSIP outputs are strategically linked to the BAPPENAS quick-win programs as defined below:

BAPPENAS Programs	EWSIP Outputs
Program 1: Smart Water Management	Output 1: Planning for water resources optimized
Program 2: Water for Food Security and Nutrition	Output 2: RWS infrastructure and services improved
Program 3: Multipurpose Storage for Water, Food, Flood, and Energy	Output 2: RWS infrastructure and services improved
Program 4: Disaster Resilience Infrastructure	Output 3: FRM enhanced
Program 5: North Java Integrated Coastal Development	Output 3: FRM enhanced
Program 6: Green Infrastructure	Output 1: Planning for water resources optimized
Program 7: Water Safety Plan	Output 1: Planning for water resources optimized

Alignment with spatial plan

The subproject is consistent with the spatial plan of Central Java Province year 2009-2029[1].

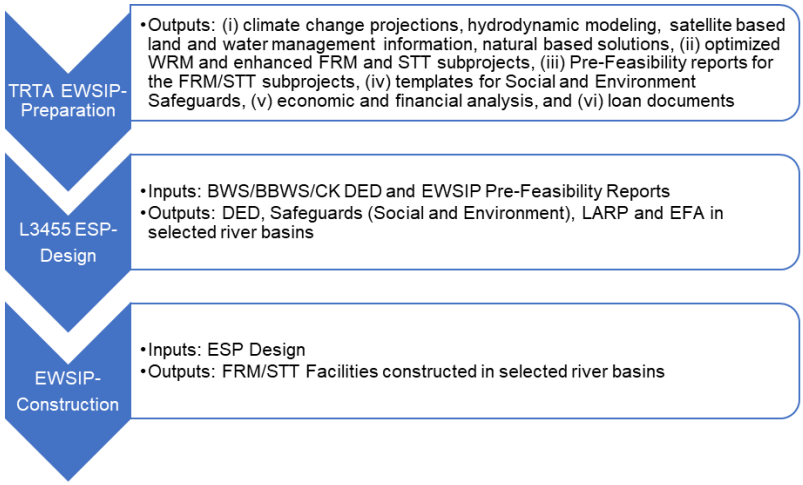
Potential Involuntary Resettlement impact

The subprojects are expected result in Land Acquisition (LA) as documented below. The final LA requirements for all subprojects shall follow detailed site-specific surveys to be implemented during the detailed engineering design stage through L3455.

ID	FRM Subprojects	Estimate for LA area (ha)
	EWSIP Proposals - Lusi River	
E1.1	Enhance existing dams for FRM	
E1.1a	Temporan Upland & forest	3.0
E1.1 b	Greneng Upland & forest	1.2
E1.1 c	Ngolan Upland & forest	1.9
E1.1 d	Simo agriculture & forest	1.6
E1.1 e	Sangeh Rainfed agriculture	2.4
E1.2	Enhance Jetis & Buluroto long storage dams	-
E1.3	Modify bank repairs at Dumpil and provide additional capacity	0.4
	Subtotal for Lusi River	10.5
	EWSIP Proposals - Juana River	
E2.1a	Southern storage system	267.5
E2.1b	Northern storage system	1104
E2.2	Riparian detention basins	920
E2.3	Enhance existing dams for FRM	-
E2.3a	Gembong Dam	1.8
E2.3b	Gunungrowo Dam	1.2
E2.4	Juwana town floodway re-alignment	66
	Subtotal for Juana River	2360.5
	EWSIP Proposals - Serang – Wulan Rivers	
E3.1	Sediment trap at the mouth of Kedung Ombo Dam	5.3
E3.2	Downstream excavation at Klambu Barrage to reduce upstream flooding	-
E3.3	Detention basins for S Wulan & connecting drains	1000
E3.4	Improvements to Wilalung barrage	-
E3.5	Flood & RWS off-line storage on S Gelis	9
	Subtotal for Serang-Wulan River	1014.3
	Total estimate for land acquisition	3385.3

There are no documents on land acquisition, socio-economic conditions and resettlement needs along the project corridor (AMDAL, LARP, LARAP, IP&IR).

[1] http://www.jdih.setjen.kemendagri.go.id/download.php?KPUU=111, last accessed in June 2019.

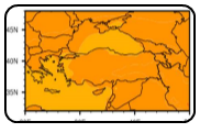
Potential Indigenous people impact	The preliminary findings indicate that the proposed subproject doesn't cross any Indigenous People (IP) area. The final status on the potential for crossing areas with IP should be evaluated by i) reviewing the BRWA (Indigenous Territory Registration Agency) database[2], ii) reviewing the AMAN (Indigenous Peoples Alliance of the Archipelago) database[3], and iii) site-specific surveys.
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 – 2024. The project costs include i) RpM 5,154,738 for the infrastructure by the BBWS PJ, ii) RpM 1,229,185 for the core enhancements 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 Lusi, Wulan, Serang, Gelis, and Juana river by the BBWS PJ. 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 Pemali Juana (Water Resources Management Plan in Pemali Juana River Basin) by the DGWR-MPWH, 2017, ii) DED Sistem Pengendalian Banjir S. Wulan Hilir (SWD I & SWD II)_BBWS Pemali Juana 2016, iii) DED Dam Pengendalian Banjir S.Lusi Kab.Blora_BBWS Pemali Juana 2014, IV) Review Sistem Sungai Serang Wulan_BBWS Pemali Juana 2015, V) SID Pengelolaan dan Pengendalian Banjir Sungai Gelis_BBWS Pemali Juana 2016, VI) Studi Pengembangan dan Pengelolaan SDA di sub DAS Lusi_BBWS Pemali Juana 2013, and VII) Detail Desain Pengelolaan Banjir Juana dan Anak-anak Sungainya (2016).
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 access in June 2019.
[3] http://www.aman.or.id/peta/, last access 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

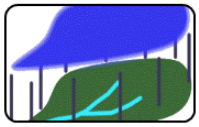
Numerical models in IFRM

ESP Consultant shall follow the numerical modelling processes in integrated flood risk modelling (IFRM) as highlighted below:



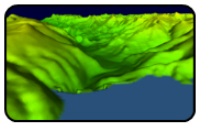
Climate Change Modelling

- *Scope:* Climate change projections and anomalies
- *Database:* Temperature, Precipitation and Evaporation (ADB)



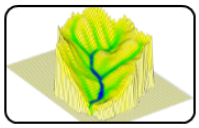
Hydrologic Modelling

- *Scope:* Evaluation of Rainfall to Runoff processes
- *Database:* Hydromet. network (BBWS/PUSAIR), LULC (ESA)



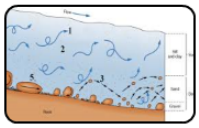
Hydraulic Modelling

- *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

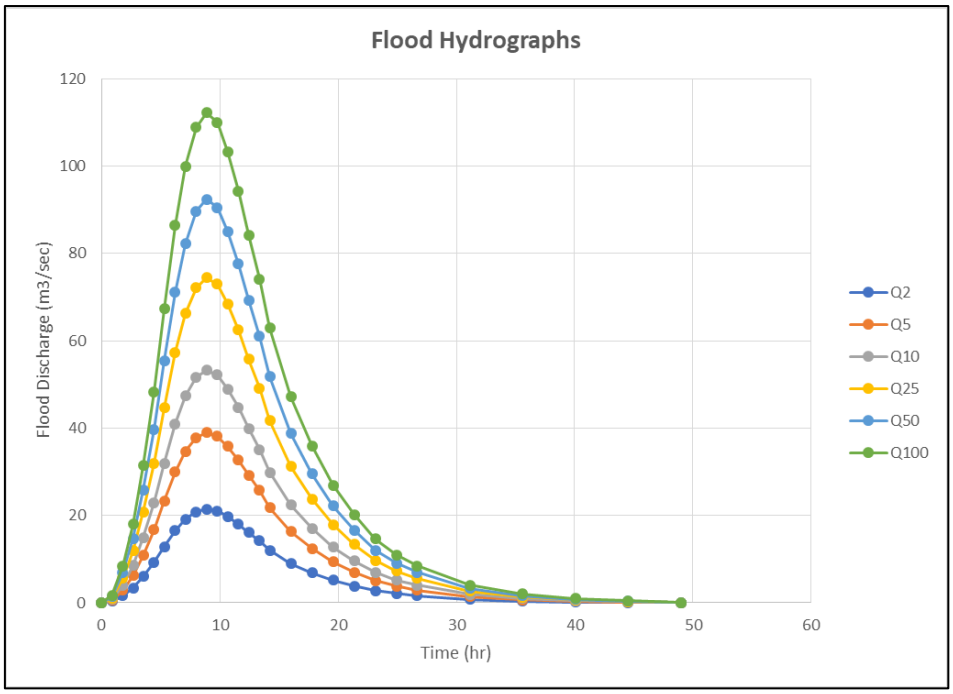


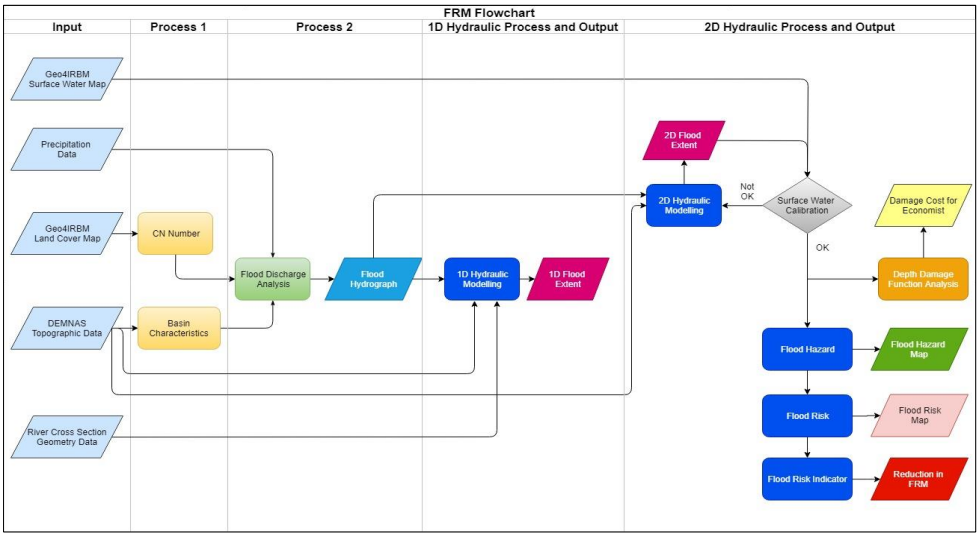
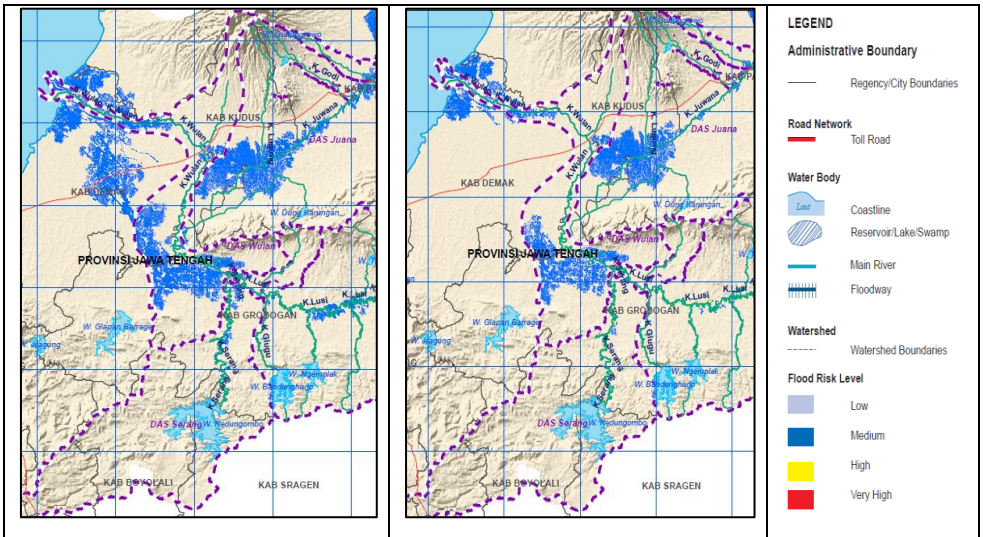
Sediment Yield and Watershed Management

- *Scope:* Sediment yield along the watershed system
- *Database:* Sediment characterization, FAO–WOCAT (World Overview of Conservation Approaches and Technologies)

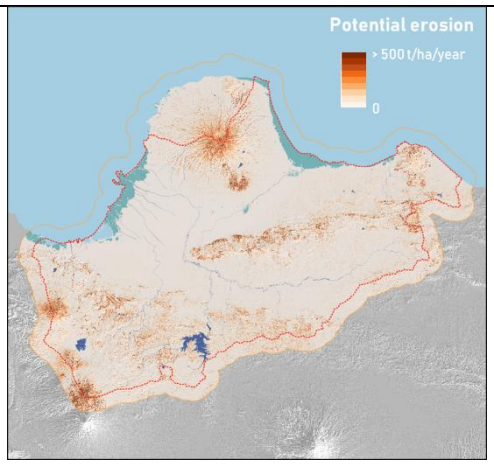
Flood Hydrographs

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.

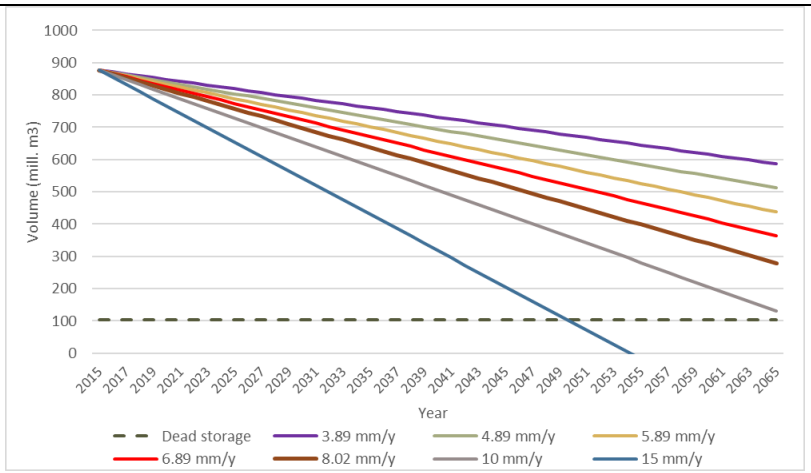


Flood Hydraulics	The main objective of 1-dimensional hydraulic models is to i) identify existing level of flood protection (Scenario 1) along the river, ii) evaluate the proposed concepts by the BBWS DED (Scenario 2) and iii) evaluate the level of enhancement required for the flood protection services (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

Sediment Yield	The main findings of a recent European Space Agency study, in two river basins in Indonesia, indicate high level of sediment yield across the river basins. As an example, Jratunseluna river basin, the high amount of sediment yield can lower the life-cycle of the reservoir by approximately 10 years. ESP Consultant shall evaluate the sediment yield upstream existing/proposed facilities.

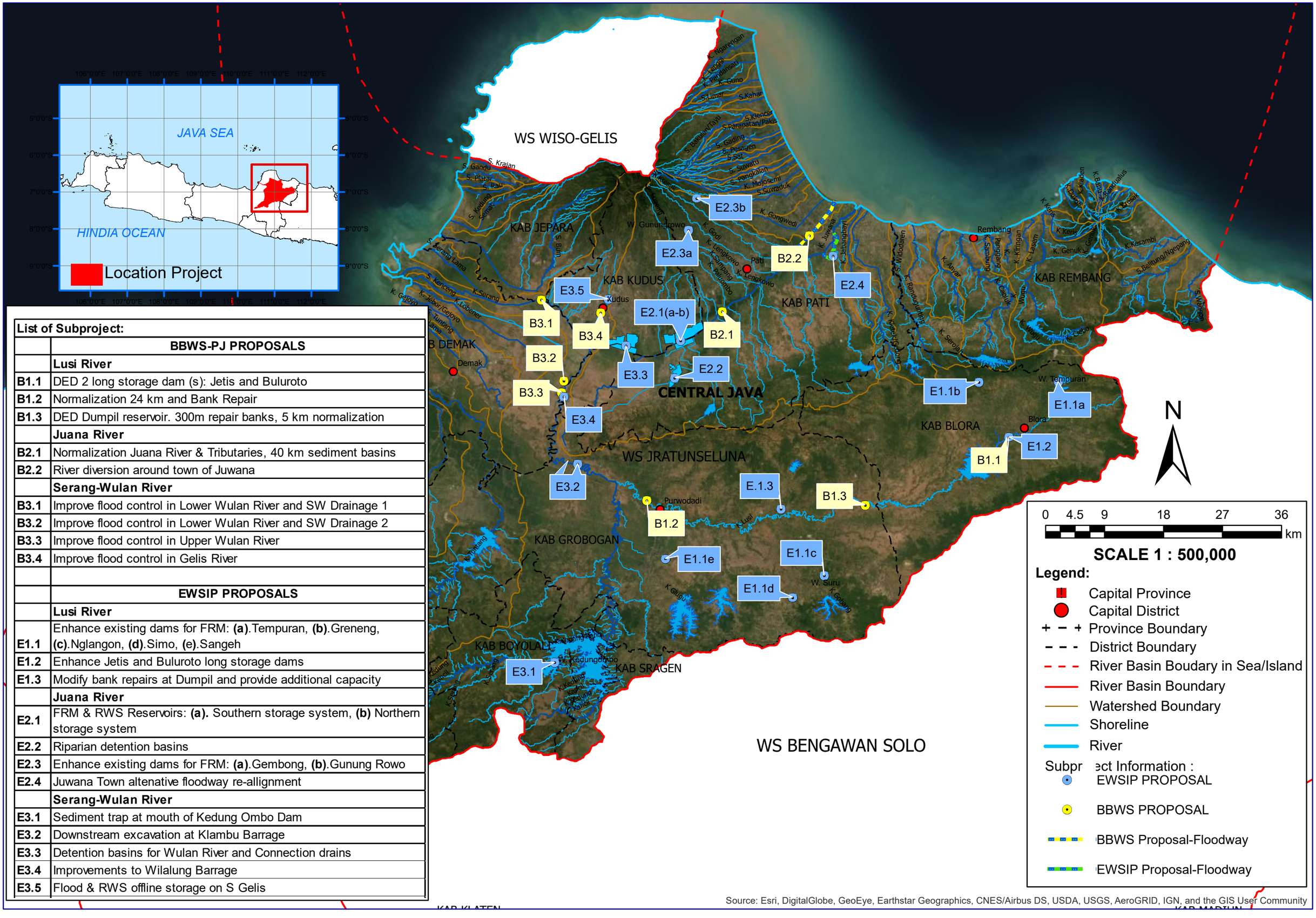


Sediment yield potential of Jratunseluna



Potential impact of sediment yield on the life-cycle of reservoir

EWSIP - FRM INDICATIVE MAP FOR JRATUNSELUNA RIVER BASIN SUB PROJECT



List of Subproject:	
	BBWS-PJ PROPOSALS
	Lusi River
B1.1	DED 2 long storage dam (s): Jetis and Buluroto
B1.2	Normalization 24 km and Bank Repair
B1.3	DED Dumpil reservoir. 300m repair banks, 5 km normalization
	Juana River
B2.1	Normalization Juana River & Tributaries, 40 km sediment basins
B2.2	River diversion around town of Juwana
	Serang-Wulan River
B3.1	Improve flood control in Lower Wulan River and SW Drainage 1
B3.2	Improve flood control in Lower Wulan River and SW Drainage 2
B3.3	Improve flood control in Upper Wulan River
B3.4	Improve flood control in Gelis River
	EWSIP PROPOSALS
	Lusi River
E1.1	Enhance existing dams for FRM: **(a)**.Tempuran, **(b)**.Greneng, **(c)**.Nglangon, **(d)**.Simo, **(e)**.Sangeh
E1.2	Enhance Jetis and Buluroto long storage dams
E1.3	Modify bank repairs at Dumpil and provide additional capacity
	Juana River
E2.1	FRM & RWS Reservoirs: **(a).** Southern storage system, **(b)** Northern storage system
E2.2	Riparian detention basins
E2.3	Enhance existing dams for FRM: **(a)**.Gembong, **(b)**.Gunung Rowo
E2.4	Juwana Town altenative floodway re-allignment
	Serang-Wulan River
E3.1	Sediment trap at mouth of Kedung Ombo Dam
E3.2	Downstream excavation at Klambu Barrage
E3.3	Detention basins for Wulan River and Connection drains
E3.4	Improvements to Wilalung Barrage
E3.5	Flood & RWS offline storage on S Gelis