PART-III

FEASIBILITY STUDY

CHAPTER 1 OUTLINE OF PROJECT

1.1 Necessity of the Project

1.1.1 Shortage of Municipal Water

At present, total water demand of Bali southern area, which includes Denpasar City and neibouring regencies of Badung and Gianyar, amounts to 2,360 lit/s. Up until the target year of 2025, the demand is estimated to increase and reach 6,050 lit/s which represents 2.6 times as large as present demand.

Concerning the northern part of Badung regency and Gianyar regency where consumers scatter and demand increase is estimated small, development of groundwater and spring water with high remmainng potentiality for water resources can be expected.

On the other hand, for the area of Denpasar City and the southern part of Badung regency and Gianyar regency (so to speak, metroplitan area of Denpasar) where consumers gather, current demand is quite big and future damand is estimated to grow, urgent development of the effective integrated water supply system is necessary.

1.1.2 Damage Protection of Flood

The flood has occured once in a few years in the Badung river and Mati river which flow through Denpasar City.

The big damages occured that are: 1) in January 1980, more than 200 houses and stores near Kumbasari market were flooded caused by Badung river, and 2) in March 1984, 700 ha of urban area were inundated for two days by Mati river.

Although, after the floods, emergency protection works for the two rivers were done, the level of protection measures has not been sufficient to secure the safety against flood.

Recently, in December 2005 Badung river overflowed and damaged again. Accordingly, the river improvement works are in urgent need to protect against flood of Badung river and Mati river where population and properties intensively gather.

1.1.3 Shortage of Electricity Supply

Electricity supply potential of Bali Province is 520MW in 2005, of which 200MW is transmitted through submarine cable of Bali-Jawa System from Jawa island. It is obvious that current supply potential is only 70MW larger than the peak load demand of 450MW, so that the supply is estimated to become short within a few years. The Revised Spatial Plan of Bali Province envisages the demand of 2010 will reach 880MW which is 1.7 times as large as in 2005. As a result, in response to growing demand, still more electricity power generation facilitieshas to be developed to strengthen the supply potential.

1.1.4 Instable Supply of Irrigation Water

A lot of irrigation facilities have been constructed in Ayung river. Most of the paddy fields in the basin area depend on direct intake through the facilities. In the middle and down stream area of Ayung river, about 7,800 ha of pady filelds are now cultivated. Ayung river is deemd as a river of stable water flow. However, the irrigation system is not so much stabilized because of the flow volume decrease during the dry season and drought years. Accordingly, the stable irrigation water supply system is strongly required.

1.2 Project Objectives and Component

Considering the nececity of the above projects, the Study Team proposed the following priority projects that are; 1) Multipurpose Ayung Dam Project, 2) Water Supply Project to the Denpasar metroplolitan area, and 3) Flood Control Project of Badung River and Mati River. See Table-III-1.1 and Figure-III-1.1.

1) Municipal Water Supply:
To solve the shortage of municipal water by developing river water and taking water from Ayung River, Penut River, Petanu River, etc

2) Damage Protection of Flood:
To protect and mitigate the flood damage by river improvement of Badung River and Mati River

3) Electricity Generation by utilizing Ayung Dam:
To generate electricity of 7,900KW by utilizing reservoir water stored in Ayung Dam in response to growing demand

4) Stable Irrigation in dry season and Expansion of Paddy Cultivated Area:
To keep the current crop pattern and expand areas of two crops from one crop in dry season and drought years that would occur once in 5 years by discharging water stored in Ayung Dam

5) Maintenance and Improvement of River Environment:
To protect and conserve existing habitat of fauna and flora as well as natural landscape by outflow discharge stored in Ayung Dam.

6) Development of Reservoir Area:
To develop surrounding area of Ayng Dam reservior to support the local socio-economic promotion.

Table-III-1.1 Project Component, Location and Main Facilities

Project Component/Objectives	Project Location/Main Facilities and Works
Multipurpose Ayung Dam Development of Municipal Water, Hydraulic Power Generation, Irrigation, River Environment Maintenance	Location: About 3km at down stream area from confluence of Ayung River and the tributary Siap Rive (Location name is Buaganga, near the regency boundary between Badung regency and Gianyar regency.) Main Facilities: Main Dam, Spillway, Check Dam and Hydraulic Power Generation Facilities
Water Supply (Western System) Supply of Municipal Water（North Kuta district of Badung regency）	Weir and Treatment Plant: about 1km down stream from the confluence of Sungi river and Penet river (about 2kmupstream of river mouth) Intake Facilities: between Cemagi and Krobokan
Water Supply (Central System) Supply of Municipal Water（Denpasar City and South Kuta districts of Badung regency）	Weir and Treatment Plant： Existing Ayung River Treatment Plant
Water Supply (Eastern System) Supply of Municipal Water（Southern districts of Gianyar regency, and North Kuta district of Badung regency）	Weir and Treatment Plant: intersection of Petanu river and by-pass road (about 1km from river mouth) Intake Facilities: from Petanu river to Kuta district (Tuban) along the by-pass road
Badung River Improvement for Damage Protection of Flood	Middle stream area of Badung river: Riverbed excavation and bank heightening, etc
Mati River Improvement for Damage Protection of Flood	Middle stream area of Mati river: Banking, widening, etc of non-improved section, and conservation of retarding basin

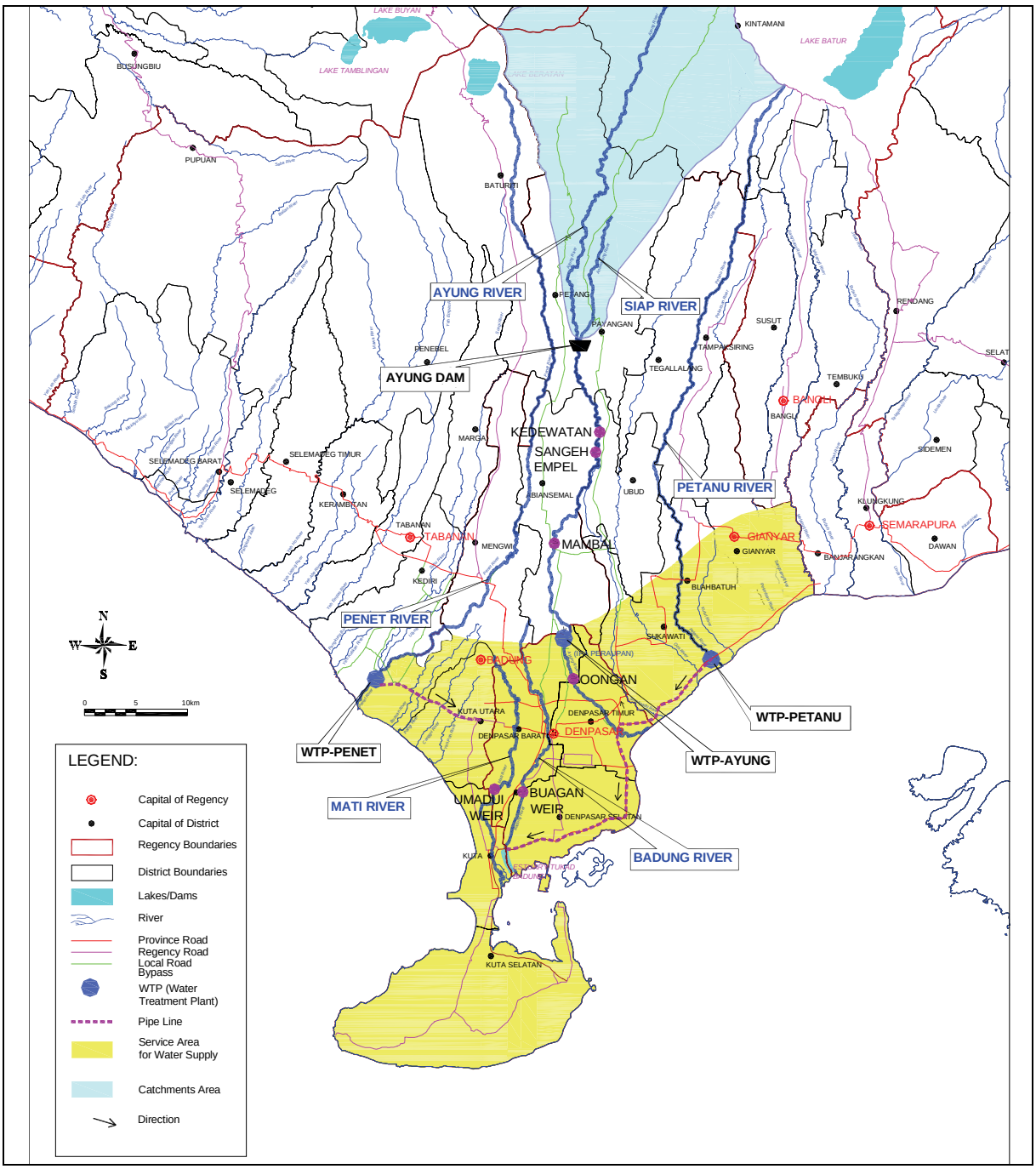


Figure-III-1.1 Location of the Proposed Projects

CHAPTER 2 PUBLIC WATER SUPPLY FOR BALI SOUTHERN AREA

Water supplies for Southern Bali area such as Denpasar City, Badung Regency, Gianyar Regency, Tabanan Regency and Klungkung Regency are implemented by developing several Water Treatment Plan/ WTP facilities. In this stage, it is proposed to develope 3 (three) water supply systems using water resources at Penet River (Cemagi Village – Badung regency) for eastern system, Ayung River (Peraupan Village, Denpasar City) for central system, and Petanu River (Saba Village – Gianyar Regency) for eastern system. The water supply produced by three WTP will be used particularly to serve Denpasar City and southern Badung from the lack of water through the connection of the available water supply distribution pipes, and in the mid-term, it is also provided to serve some regions in the service scope that has not been served by the water supply service. Depend primarily on developing of three water supply systems, the prospective shortage of water supply for targeted year of 2025 in southern Bali area shall be eliminated.

2.1 Criteria for Plan and Design

(1) General

Design concepts of the Water Treatment Plant (WTP) through the technical consideration are shown in Table-III-2.1 Conditions and limits for considering concepts are as follows.

- The availability of raw water (the quality and its quantity) on the using water resources for WTP and the required transmission.
- Topographic conditions and land availability
- Local policy and available regulations such as service area of each drinking water supply company(PDAM)
- Simplify for construction, operation and maintenance.

Table-III-2.1 Planning Criteria

No	Item		Symbol	Unit	Criteria
1	Pure Water Loss		-	%	20-23
2	Water Usage Fluctuation	Maximum day factor	Q md		1.15 times for average.
		Peak Hour factor	Q p		1.50 times for average.
3	Planning Capacity	Water Processing Installation	-	lit/s	Q md
		Reservoir	-	%	15% for max. daily supply
		Transmission Pipe	-	lit/s	Q md
		Distribution Pipe	-	lit/s	Q p
4	Residue of Minimum Pressure	Master Pipe	-	meter	17
		Secondary Pipe	-	meter	15
		Tertiary Pipe	-	meter	13
5	Current velocity inside the pipe	Transmission Pipe	-	m/s	0.6 - 3.0
		Distribution Pipe	-	m/s	0.3 - 3.0
6	Pipe roughness coefficient	Old pipe	C	-	100 - 110
		New pipe	C	-	120 - 130

(2) Raw Water Resource

＜Ayung Water Treatment Plant(Central System)＞

It is located at Belusung, at downstream next to the existing of WTP Ayung I, II, III with the intake Peraupan Weir's downstream which used the stored water of Ayung Dam as its supply source.

＜Penet Water Treatment System(Western System)＞

It is located at existing IPA Nyanyi's downstream (PDAM Tabanan) which the river water is not used for irrigation anymore. Current land use for planned water treatment plant (WTP) is paddy field and dry field. New access road for WTP shall be designed.

＜Petanu Water Treatment Plant (Eastern system)＞

It is located at Tohpati – Kusamba Bridge at Petanu River, approximately 1.5 km from the coast line, where at that section there is no use for irrigation. For the decision on location of intake, salinity intrusion and location of holy place were taken into account.

(3) Water Quality and Processing Capacity

(a) Water Supply Quality

The water quality which produced by each WTP is determined as the qualified water supply consumption with the quality standard which refers to Indonesian Water Supply Quality Standard and WHO standard for those items which are not regulated in Indonesian Standard.

The parameters and the standards are as followed:

Table-III-2.2 Drinking Water Quality Standard

No	Parameter	Unit	WHO Standard		Indonesian Standard
			Max Limit (1971)	Suggested (1983)	
1	Color	Hazen	50.0	15.0	50.0
2	Odor/smell	-	Not danger	Not danger	Normal
3	Taste	-	Not danger	Not danger	Normal
4	Turbidity	JTU	25.0	5.0	25.0
5	PH	-	6.5 – 9.2	6.5 – 8.5	6.5 – 9.2
6	Solid substance total	mg/l	1500.0	100.0	1500.0
7	Calcium as Ca	mg/l	200.0	-	200.0
8	Magnesium as Mg	mg/l	250.0	-	150.0
9	Hardness total (CacO3)	mg/l	500.0	500.0	250. -500
10	Sulphate as SO4	mg/l	400.0	400.0	400.0
11	Chloride as Cl	mg/l	600.0	250.0	600.0
12	Nitrate as NO3	mg/l	-	10 as N	20.0
13	Iron (total) as Fe	mg/l	1.0	0.3	1.0
14	Manganese as Mn	mg/l	0.5	0.1	0.5
15	Zinc as Zn	mg/l	15.0	-	15.0
16	Copper as Cu	mg/l	1.5	-	1.5
17	Sulphida Acid as H2S	mg/l	-	ttd	0.0
18	Ammonia as NH4	mg/l	-	-	0.0
19	Carbon dioxide as CO2	mg/l	-	-	0.0
20	Phenol Compound	mg/l	0.002	-	0.002

(b) Installation Capacity of Processing Source

The suggested processing installations capacity is shown as follows:

- WTP Penet (Western System) = 300 l/sec
- WTP Petanu (Eastern system) = 300 l/sec
- WTP Ayung (Central System) = 3 x 600 l/sec

WTP Penet (Western System) and WTP Petanu (Eastern system) processing capacities are built based on the actual condition of the related river discharge, while WTP Ayung (Central System) is based on the assumption of Ayung Dam development at Br. Buangga (Village), Petang (Sub-District).

(4) Weir, Intake, and Pumping

Water flow from the intake to the storage tank/pump house through an open channel with gravitation flow, so that the river water surface must be elevated by developing a weir. This channel can be functioned as the sand trap also. Afterwards, the collected raw water in the storage tank/pump house is elevated to the water treatment plant (WTP) by pumping it through the transmission pipe.

The considerations in choosing the weir construction type are as followed.

- The big amount of discharge residue at the river which is not used for other needs (Agriculture, etc)

- Heighten the elevation of water surface according to the requirements.
- Able to store bigger water discharge based on the requirements

While in deciding location of the weir is in accordance to the considerations below.

- Location of Weir shall be selected at the straight river alignment.
- The prediction of river longitudinal section reaches the required effective wide.
- Geographic condition of the river longitudinal section fulfill the river hydraulic calculation

(5) Splitter Box, Aeration and Coagulation

Aeration and coagulation process are implemented all at once on the Splitter Box. Aeration process shall be implemented with gravitation hydraulic through twice raw water fall.

Coagulation process shall be done by adding aluminum sulfate to form flock. This mixing process also shall be done by using hydraulic energy of 2 meters in height obtained from the inlet emission.

(6) Flocculation

In this flocculation process, occurs the forming of flock in the flocculation reactor which consists of several tanks with up and down flow from one tank to the next tank, with declined velocity gradient on the next tank, according to the slow mixing concept. Flow pattern in the flocculation tank is to be spiral flow which is made by installing flow director in each tank's entrance gate.

(7) Sedimentation

The flock formed in flocculation reactor then shall be settled in the sedimentation vessel "tube settler".

The type of flow in the sedimentation vessel is to be a vertical flow which flow through the inlet pipe that has holes on its both sides and transverse installed, because the velocity gradient in the sedimentation vessel is smaller than velocity gradient of flockulator tank.

(8) Filtration

The filtration process shall be implemented to trap the unsettled flock in the sedimentation vessel. The filtration media is dual media; it is the anthracite media on the top layer and silica sand media on the bottom layer. These both medias are propped by supporting media in form of gravels.

To do this washing of filtration media, it needs air and water with compressor and backwash pump.

(9) Reservoir and Disinfection

The water supply shall be stored in the reservoir before the distribution. The disinfection process shall be done by adding chlorine gas in the mouth of reservoir inlet. The added chlorine gas has already in the form of solution, which is processed and pumped from the chlorine gas room in the chemical room.

(10) Waste Processing

The produced waste water of water processing installation shall be processed in the Sludge Drying Bed (SBD) construction. The water which has been separated from the waste/mud can be re-circulated or thrown back to the river.

2.2 Design of Integrated Water Supply System for Southern Bali Area

2.2.1 Western Water Supply System

The raw water is taken from Penet River downstream, about 1.5 km from the coast line. The Water Treatment Plant (WTP) located in Cemagi Village, Mengwi Sub district in Badung Regency. The planned WTP production is to be 300l/sec. In a short term, production from the installation is directed to serve the needs in Badung Regency and Denpasar City through the nearest available transmission scheme and the development of the required new distribution scheme. In a long term, the Western System water supply production will be focused in serving Badung Regency.

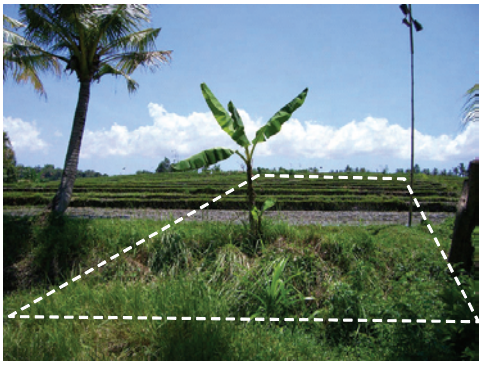
＜Western Water Supply System＞

West System Water Treatment Plant (Penet River)

Outline of Work

1 New Water Treatment Plant（ 300
2 Distribution Pipe φ600 (8.8k
3 Water Pipe Bridge (5 sites)

Surrounding Landuse
(Terraced Rice field)



Planning Site for Water Treatment Plant

Figure-III-2.1 Western Water Supply System and Current Condition of planned WTP

(1) Weir

The intake construction is suggested in form of permanent weir with building height that is possible to lead gravitational flow to the storage tank. The using of pump machine is only implemented if the river topography and buildings position are impossible to be flowed gravitationally.

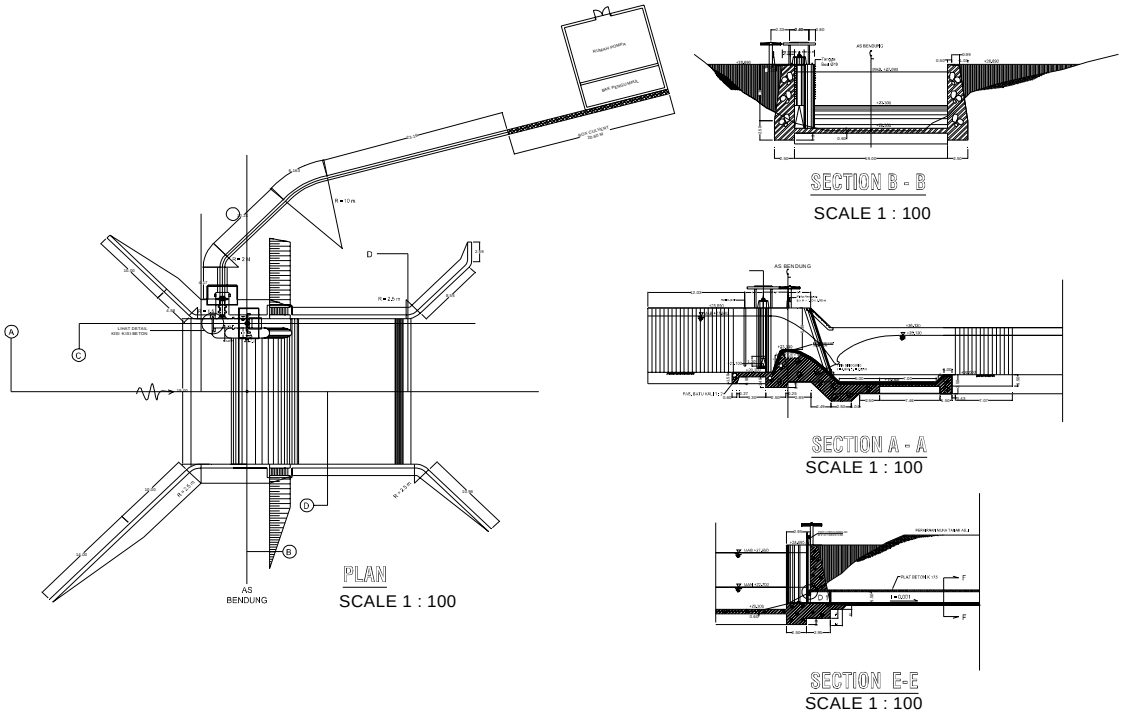


Figure-III-2.2 Weir of Western Supply System in Penet River

(2) Water Treatment Plant

WTP position is planned on the rice fields owned by the state which has already released by Water Supply Company (PDAM) Badung of 0.75 ha. Nowadays the available access road is not adequate, however there is narrow road that is able to be widen by acquisition private's ownerships which was agreed to be released as stated by villager's representatives at the Public Consultation Meeting on December 20, 2005 at Cemagi Village.

(3) Transmission Pipe

Transmission pipe shall be installed along the side of Canggu – Kerobokan road, and connected to the existing 12" pipe at Br. Gede Kerobokan.

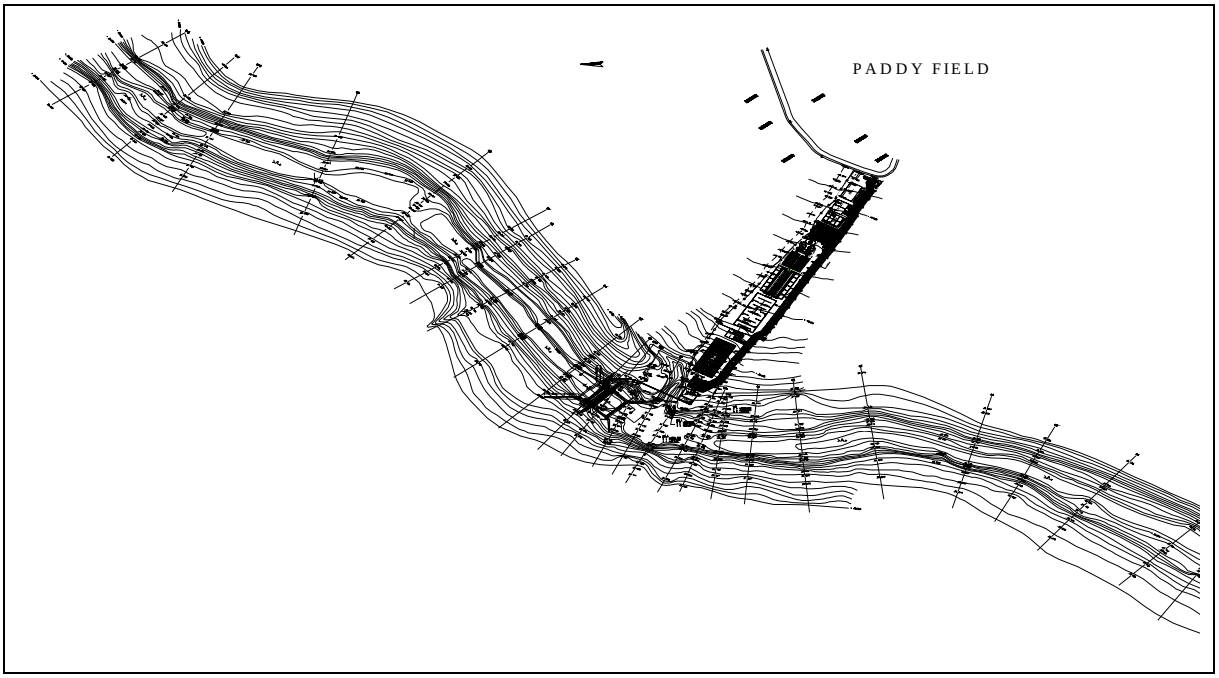


Figure-III-2.3 General Plan of Western Supply System (Penet River)