

EXECUTIVE SUMMARY

1.0 INTRODUCTION

The Jabatan Bekalan Air (JBA) in Kementerian Tenaga, Teknologi Hijau dan Air (KeTTHA) intends to implement the proposed Jernih Dam and associated works near Kg. Sg. Jernih of Alor Gajah district in the state of Melaka. The proposed dam with active storage capacity of 13 MCM which would meet the raw water demand of Alor Gajah district up to year 2030 and also reduce the dependency on raw water source from the state of Johor.

1.1 Project Background

The Jernih Dam project was first identified by the SMHB Sdn. Bhd. in the year 1999. Subsequently, a detailed hydrological analysis of Sg. Rembau and Sg. Melaka was carried out by SMHB Sdn. Bhd. for Perbadanan Air Melaka. The study recommended a water intake point at Sg. Rembau downstream of its confluence with Sg. Siput and an off-river storage at the upstream axis of Sg. Jernih with an active storage capacity of 25 MCM to secure a reliable yield of 120 Mld. (SMHB, 2015). In 2012, SMHB / KTAT carried out a review for the Syarikat Air Melaka Berhad (SAMB) on the feasibility of constructing a smaller storage on upstream axis of Sg. Jernih to reduce the social impact of the project thereby to minimise objections to the project by the villagers, particularly from Kg. Sg. Jernih. The study concluded that it was feasible to construct an impounding storage of 12 MCM to 15 MCM to secure a yield of 90 Mld.

In 2014, SMHB / KTAT carried out a feasibility study for the smaller storage on upstream axis of Sg. Jernih termed as proposed “Jernih Dam and Associated Works” for Syarikat Air Melaka Berhad (SAMB) and subsequently supported the SAMB in the Value Management Workshop which lead to the approval of funding for the project. In October, 2015 the Kementerian Tenaga, Teknologi Hijau dan Air (KeTTHA) had appointed SMHB Sdn. Bhd as

the Engineering Consultant to carry out the detailed engineering design and construction supervision for the proposed “Jernih Dam and Associated Works” project. On 31 May 2016, the Jabatan Bekalan Air (JBA) of Kementerian Tenaga, Teknologi Hijau dan Air (KeTTHA) appointed Ecotone Worldwide Sdn. Bhd. (previously Ecotone Environmental Management Sdn. Bhd.) to prepare Preliminary Environmental Impact Assessment (PEIA) for the project as recommended by the Department of Environment (DOE) HQ in Putrajaya via letter dated 16 December 2015.

1.2 Project Location

The Jernih reservoir will be located within the Mukim of Sg. Siput in the Alor Gajah district. The dam will be located about 200 m from the nearest house in Kg. Sg. Jernih. The water intake point will be known as “Lubok China Intake” will be located about 250 m downstream of Sg. Rembau / Sg. Siput confluence. From the intake a pipeline will be laid in eastern direction parallel to and along the southern side of the Sg. Rembau to pump water to the dam and water treatment plant. The project location and conceptual layout plan of the proposed project and its components are shown in **Figure ES-1**.

1.3 Legal and Institutional Requirement

The proposed Jernih Dam project is a Prescribed Activity that falls under the Environmental Quality (Prescribed Activities) (Environmental Impact Assessment) Order 2015, Section 34A of the Environmental Quality Act 1974 (Act 127), which list the project under 2nd schedule, as water supply project involving construction of dam or impounding reservoir with a surface area of 100 hectares or more, which requires PEIA to be prepared and approved by the Department of Environment (DOE), Melaka state. Due to earlier confusion regarding type of EIA, the Director General of Department of Environment (DOE) Putrajaya, issued a formal letter to Jabatan Bekalan Air (JBA), KeTTHA confirming the requirement of Preliminary EIA for the project.

In compliance with the above requirements, the PEIA report covering key aspects of environmental components including the significant impacts of the proposed project on the surrounding environment and appropriate mitigation measures to minimize the impacts has been prepared for the approval of the Department of Environment (DOE), Melaka. Under the legislation meant to protect and conserve the surrounding environment, approval for the implementation of the proposed project would only be granted upon the Preliminary EIA study being approved by the Department of Environment (DOE), Melaka.

2.0 STATEMENT OF NEEDS

With the increasing demand for water in Melaka, the authority need to find alternative water source for sustainable water supply. It has been reported that Melaka needs about 500 million litres of water daily and the current capacity could meet the demand only until 2017 (The Rakyat Post, 2014). To extend the capacity, Melaka has taken numerous initiatives. One of

them is signing of additional water supply agreement with Johor in 2013. Under the new agreement, Johor will supply 159 million litres of water through Sg. Muar. Apart from the above initiative, Melaka has planned to set up a retention pond in Sg. Jernih, Alor Gajah that would cater for the water needs in areas like Kuala Sg. Baru, Simpang Ampat, and Lubuk Cina (The Rakyat Post, 2014).

The climatic change has affected water sustainability in Malaysia and recently Melaka. The state has become the latest addition to the 'water scarce states'. It is being severely affected by prolonged drought and it was announced by the state chief minister that water supply would not last until September 2016 if the hot weather persists (Today Online, 2016). Also according to Melaka Water Supervisory Board in April 2016, water level at the Durian Tunggal Dam which is in Ayer Keroh was at 40.6% and that as much as 200 million gallons of water is being pumped from Jus Dam to Durian Tunggal Dam to stabilise the water supply which was at critical level.

The Government is becoming concern over the water problem and the needs of water sources especially in district Alor Gajah, Melaka. The Jabatan Bekalan Air (JBA) in Kementerian Tenaga, Teknologi Hijau dan Air, Malaysia (KeTTHA) intends to implement the proposed Jernih Dam and associated works near Kg. Sg. Jernih of Alor Gajah district in the state of Melaka. The proposed dam with active storage capacity of 13 MCM would meet the raw water demand of Alor Gajah district up to year 2030.

The Project has to be carried out to ensure the demand of water supply at Alor Gajah are fulfilled. Other than that, it will also support the demand of water supply in other areas in Melaka due to the construction of piping system that connect with existing dam such as Jus dam and Durian Tunggal dam. Apart from meeting water supply demand in Melaka, the implementation of this project also reduces dependency of Melaka for water resources from Johor.

3.0 PROJECT OPTIONS

3.1 History of Project Selection Options and Studies

A number of studies have been carried out on water resources, hydrology and water supply options to the region from Sg. Siput and Sg. Rembau river system.

a) Melaka Water Supply Augmentation Study (SMHB 1990)

One of the schemes identified in this report was the construction of a small impoundment of 500 ML on Sg. Berisu, a tributary of Sg. Siput. The pumped storage scheme could provide a yield of 12 Mld to meet local demands in Masjid Tanah up to 2015.

b) Jernih Dam and Associated Works Preliminary Study (SMHB 1999)

A detailed hydrological assessment of the Sg. Rembau basin was carried out. Rainfall, streamflow and pan evaporation stations were collated and compiled for deriving the mean annual rainfall distribution in the basin. Out of the three options identified, the Sg. Rembau intake scheme was considered the most feasible in terms of yield and corresponding pump capacity, i.e. a net yield of 120 Mld and 28 Mld pump capacity.

c) National Water Resources Study 2000-2050 (SMHB/Zaaba 2000)

This macro scale study basically extract the findings of the SMHB 1999 preliminary study but proposed the intake on Sg. Siput for a smaller yield of 99 Mld with a storage of 25 MCM.

d) Batu Hampar Reservoir: Draft Final Report (SSP, 2004)

Batu Hampar dam is located on the upper reaches of Sg. Rembau. It regulates Sg. Rembau at the intake located at Kg. Titian Akar. Based on the report, the impounding reservoir can sustain a yield of 100 Mld at the intake with 60 Mld compensation flow downstream and 52 Mld for irrigation or a gross yield of 212 Mld. The Batu Hampar scheme is completed and operational now.

e) Jernih Dam and Ancillary Works - Inception Report (KTA/SMHB 2004)

The appointment was for the detailed design of Jernih dam based on the 1999 preliminary study. A detailed yield simulation was carried out. The Batu Hampar scheme was taken into account in the yield simulation. Based on the results it was recommended to construct Jernih dam to its topographical limits and to study further the intakes on Sg. Rembau and Sg. Pedas due to the sizeable yields. Further work on the project was suspended in the later part of 2004 when site investigation works could not be carried out due to strong objection from the villagers of Kg. Sg. Jernih.

f) Detailed Engineering Study to Satisfy DEIA Requirement (KTA/SMHB 2009)

In 2009, KTA/SMHB was appointed to carry out Detailed Engineering Study for the requirement of Detailed Environmental Impact Assessment (DEIA) study initiated for the project which was subsequently abandoned later due to strong objection from the villagers of Kg. Sg. Jernih. The intake is recommended to be sited at Sg. Rembau downstream of its confluence with Sg. Siput with a total pumping capacity of 172 Mld with 40 Mld for refilling of Jernih reservoir. Based on the intake at Sg. Rembau, two treatment plant sites were studied. Option 2 with treatment plant sited about 300 m from the intake in an oil palm plantation owned by Sime Darby Berhad was recommended.

g) Review Study for Jernih Dam Upstream Axis (KTA/SMHB 2012)

This study explores the feasibility of shifting the dam axis upstream of the village with a proposed storage of 7500 ML. An upstream axis was found to be feasible and capable of providing 12000 to 15000 ML storage for a yield of 90 Mld.

h) Feasibility Study for Jernih Dam and Associated Works (KTA / SMHB 2014)

In 2014, KTA/SMHB was appointed to conduct feasibility study for upstream axis Sg. Jernih dam and associated works (**Figure ES–2**). The outcome of the study shall enable a “Value Engineering” exercise to be conducted prior to commissioning a project to increase the availability of treated water in the state of Melaka.

i) Preliminary Engineering Design Study for Jernih Dam & Associated Works

In 2015, Kementerian Tenaga, Teknologi Hijau dan Air (KeTTHA) had appointed SMHB Sdn. Bhd. as the Engineering Consultant to carry out the detailed design of the Project which includes construction supervision. The objectives of this preliminary engineering design are (i) review and update hydrological data and information, (ii) carry out preliminary engineering design (PED) and (iii) prepare preliminary cost estimate based on PED.

3.2 Selection of Optimum Location for Dam Axis**a) Design Layout Options**

In view of the opposition to the Jernih dam project, three (3) layouts of the dam have been prepared with the toe of dam 100 m (Option 1), 200 m (Option 2) and 300 m (Option 3) from the nearest house in Kg. Sg. Jernih. For equal comparison, all three layouts have equal reservoir storage of 14 MCM. For a storage of 14 MCM, the full supply level are set at 39, 40 and 42 for Option 1, 2 and 3 respectively. The elevation storage relationship shown on are not expected to be affected.

b) Cost Comparison Options

As the land required are about the same and the dam appurtenant structures are assumed identical, the cost comparison is made based on the embankment cost. The fill volume of dam embankment of Options 1 and 2 are not much different, while for Option 3 the volume is much larger. Hence, the embankment cost of Option 3 is relatively higher than Option 1 and Option 2.

c) Recommended Option

Finally, the Option 2 was recommended as the cost is only slightly more than Option 1, The distance of 200 m away from the houses provides a reasonable buffer zone to the village.

Option 3 with the most upstream axis will incur much more cost. A survey of the reservoir rim is recommended to enable accurate demarcation for land acquisition. The preliminary engineering design was carried out based on the axis of Option 2. The general layout of Option 2 is shown in **Figure ES-3**.

3.3 Water Intake Location and Design Options

a) Site Options

In the detailed engineering study to satisfy the DEIA requirements carried out by KTA/SMHB in year 2009, three (3) water intake sites have been considered. Lubok China Intake which is located about 250 m downstream of Sg. Rembau / Sg. Siput confluence was recommended. This site at present is fruit orchard at the toe of a low hill. The impacts here are anticipated to be political as Sg. Rembau forms the state boundary between Negeri Sembilan and Melaka.

b) Design Options

There are two (2) alternative intake and river gate arrangements have been considered. Option 1 arrangement may not be feasible since part of the river gate may be located in Negeri Sembilan. Even if both the proposed intake and river gate is located within Melaka, temporary river diversion works are likely to be located in Negeri Sembilan. The Option 2 arrangements appears to be a more feasible option since the river gate, intake and river diversion works are likely to be located in Melaka (**Figure ES-4**). This will be verified by the topographical survey which will be carried out soon.

The Sg. Rembau at the intake location is tidal but not saline. Abstraction during the dry season may cause the saline front to move upstream to the intake. A river gate is proposed to prevent this and create a constant pumping pool. The river gate should be opened under normal condition and closed only during the dry season when saline water is detected. This will ensure the river gate will not obstruct movements of fishes and other river fauna which need to move downstream or upstream for spawning.

c) Water Treatment Plant (WTP) Options

In the same study, two (2) water treatment plant (WTP) sites have been considered. The Option 2 with WTP sited about 300 m from the proposed Lubok China Intake which is located within oil palm plantation owned by Sime Darby Berhad was recommended. However, the WTP is not part of the current scope of the project, which would be carried out separately later by different project proponent.

3.4 Raw Water Pipeline Route Options

In the feasibility study for Jernih Dam and associated works carried out by KTA/SMHB on year 2014, two (2) pipeline routes (Case A and Case B) have been proposed for further consideration during detailed design stage. During the kick-off meeting on 19th October 2015, SMHB Sdn. Bhd. had briefly presented the findings of the feasibility study carried out in 2014 and one of the issues that was brought up was the system option together with the pipeline route. JBA-KeTTHA had requested SMHB Sdn. Bhd. to submit a report together with the merits of each case on the system option for deliberation by the relevant parties. The following are SMHB Sdn. Bhd. findings regarding Case A and Case B options.

a) Case A

In the Case A option, raw water will be pumped from the intake to the Jernih Dam through a DN 1100 mm pipeline, 5.0 km long which is primarily following along the river banks of Sg. Jernih. During the dry season, releases from the Sg. Jernih will be through the same pipeline to the WTP. This is the ideal option, as the water from the dam can be channelled directly into the WTP instead of releasing it to Sg. Jernih which flows into Sg. Siput and eventually into Sg. Rembau. When water is released into the rivers, there will be losses or diversion for other uses. In addition, there may be contamination from villagers along Kg. Sg. Jernih as well as acidic water from swamps upstream of Sg. Rembau. Laying the pipeline along Sg. Jernih is easier as there are no services or traffic to contend with. However, preliminary investigation reveals that there is no river reserve along Sg. Jernih and land acquisition will be required. The return flow from the Jernih dam through the pipeline will be by gravity and it is observed that there may be some high points near the proposed WTP. Hydraulically, there may be issues unless these high points can be overcome and the WTP founded at a lower level.

b) Case B

In this Case B option, water is pumped to the Jernih dam through a DN 800 mm pipeline, 8.6 km long which will be laid via FELCRA Ramuan China bypassing Kg. Sg. Jernih. The water from the dam will be released directly into Sg. Jernih which then flows to Sg. Siput and eventually to Sg. Rembau. Supply to the WTP is then pumped from the intake at Sg. Rembau. As describe above, there will be losses and contamination with this option but will have less issues on the laying of the pipeline as well as the hydraulics issue with the high points and WTP. With this option, however, there is a need to check on the carrying capacity of Sg. Jernih as the river looks small based on the site visit carried out on 20th October 2015.

c) Comparison of Both Cases and Recommended Option

The advantages and disadvantages of both the options are discussed and in the Pre-Design meeting held on 26th October 2015 attended by JBA, BKSA, SAMB and SMHB Sdn. Bhd. after considering the advantages and disadvantages of both the options, it was decided that pipeline route Case A be adopted as in **Figure ES-5**.

4.0 PROJECT DESCRIPTION

4.1 Introduction

The proposed Jernih Dam project is mainly an off river storage scheme with capacity about 13 MCM active storage which will provide raw water yield of 95 Mld to cater for the water treatment plant. From yield analysis, in order to have a secure raw water yield of 95 Mld and to shorten the refilling of the reservoir after a drought, pumped refilling of the reservoir of 50 Mld is needed to catch and store the excess flow during the wet months.

4.2 Project Design Concept

SMHB Sdn. Bhd. has come up with a comprehensive feasibility study and design concept project on Jernih Dam. The proposed water scheme primarily consists of the following components:

a) Dam and Impounding Reservoir

The main development for this project is the construction of Jernih Dam. For the layout of the dam, Option 2 (**Figure ES-3** and **Figure ES-6**) was selected with the toe of dam 200 m from the nearest house in Kg. Sg. Jernih with reservoir storage of 14 MCM. Option 2 is recommended as the cost is only slightly more than Option 1. The distance of 200 m away from the houses provides a reasonable buffer zone to the village. For Jernih dam site, the preferred choice of dam type is the clay core earth fill dam. This type of dam is common in Malaysia and has been proven to be the most economical for relatively wide valley dam site with substantial overburden and small spillway.

b) Lubok China Water Intake

The Option 2 (**Figure ES-4**) was selected for the water intake point which incorporates river gate, intake and river diversion works. Permanent diversion channel will be constructed to divert raw water to intake. River gate will be constructed across the diversion channel. The width of the river gate and diversion channel is narrower compared with Sg. Rembau to promote swift flow to flush sediments and to prevent formation of sand bars. Each gate will be raised and lowered by means of tandem operated wire cable on a common shaft driven by a single electric actuator complete with self-locking reduction gears. Each of the gates will also be equipped with two motorised latching system to allow for latching of the gates during maintenance.

c) Raw Water Pipeline from Jernih Dam to Lubok China Intake

Case A (**Figure ES-5**) was selected for system options raw water pipeline in state of Case B which has different pipeline size and length, cost, different location for releasing water during drought, and pipeline route. In this Case A option, raw water will be pumped from the intake to the Jernih Dam through a DN 1100 mm pipeline, 5 km long which is primarily following along the river banks of Sg Jernih. During the dry season, releases from the Jernih Dam will be through the same pipeline to the Water Treatment Plant (WTP).

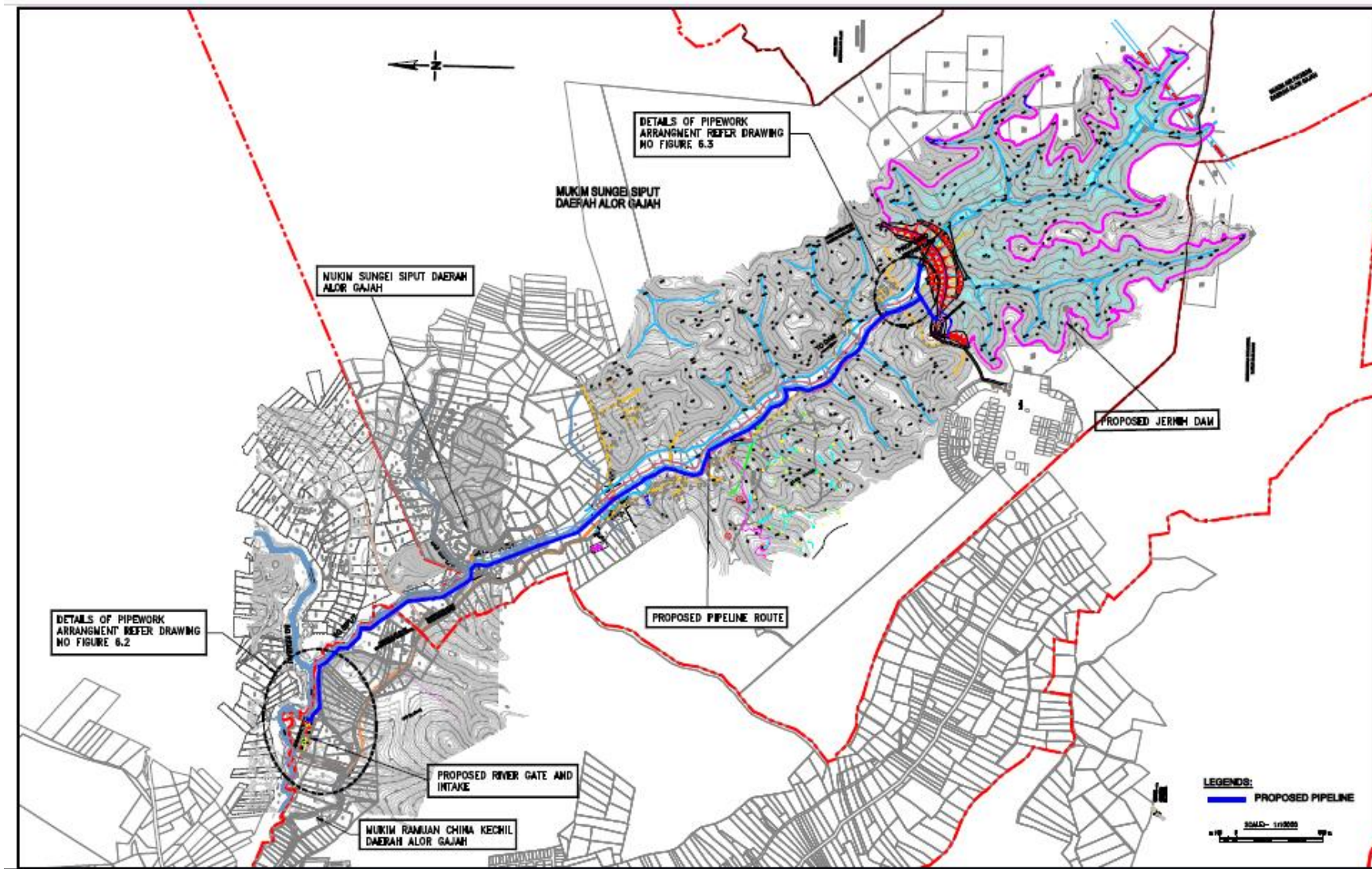


Figure ES-1: Overall Project Layout (Source: SMHB Sdn. Bhd, 2015).

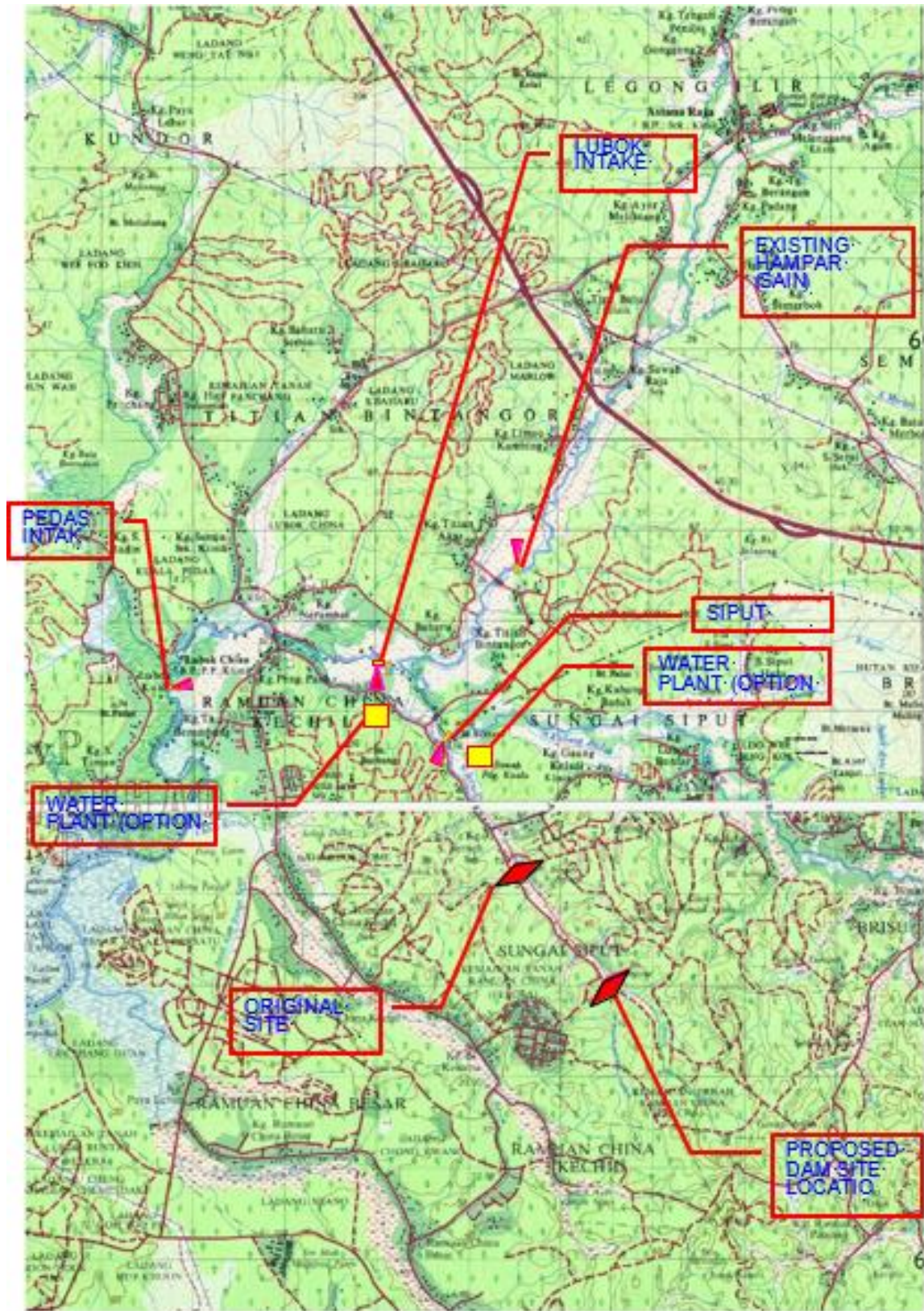


Figure ES-2: Proposed Jernih Dam and Associated Works – Overall Options

(Source: SMHB Sdn. Bhd., 2015).

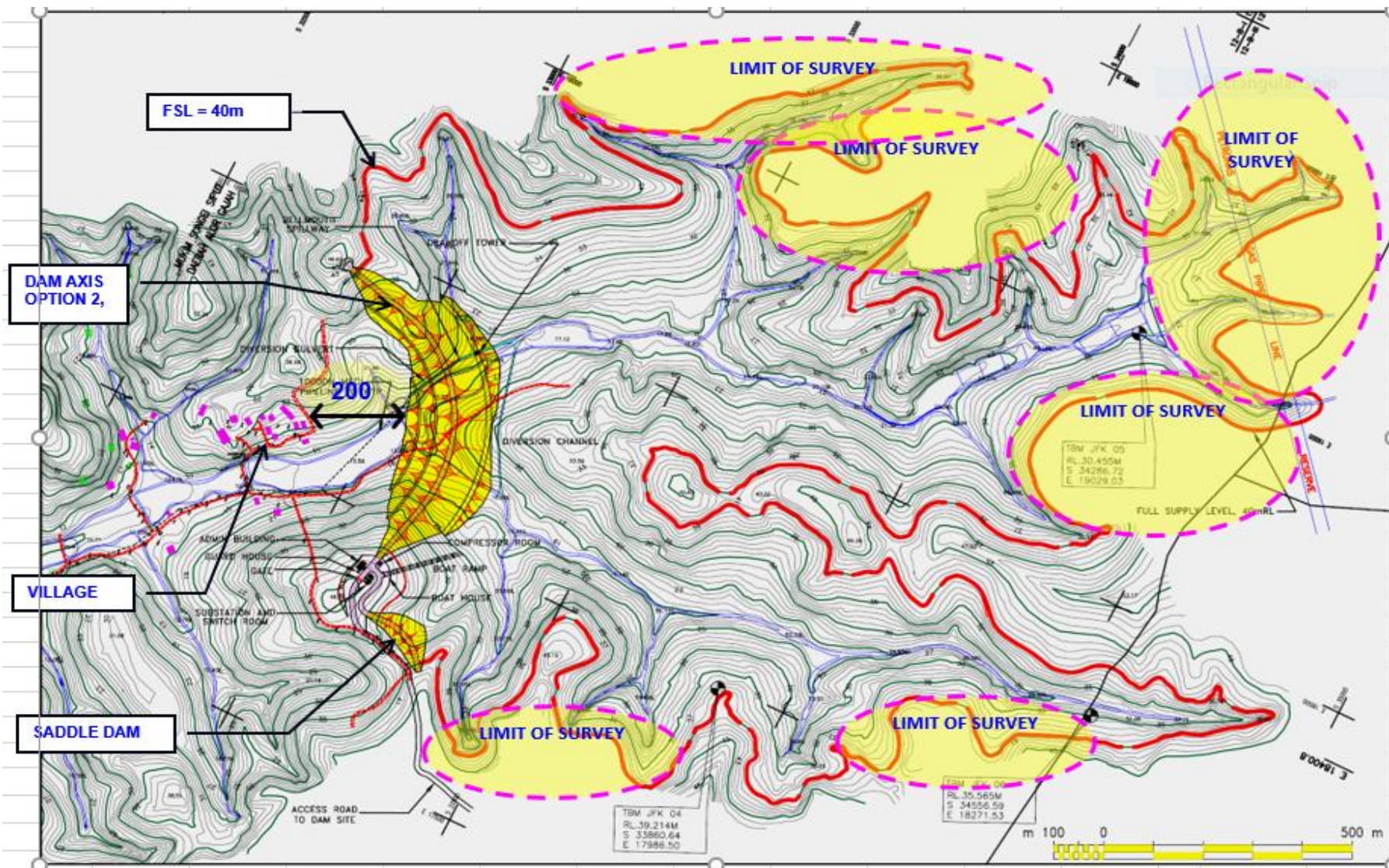


Figure ES-3: Layout of Jernih Dam and Reservoir Area (Option 2) (Source: SMHB Sdn Bhd, 2015).



Figure ES-4: Intake Layout (Option 2) (Source: SMHB Sdn Bhd, 2015).

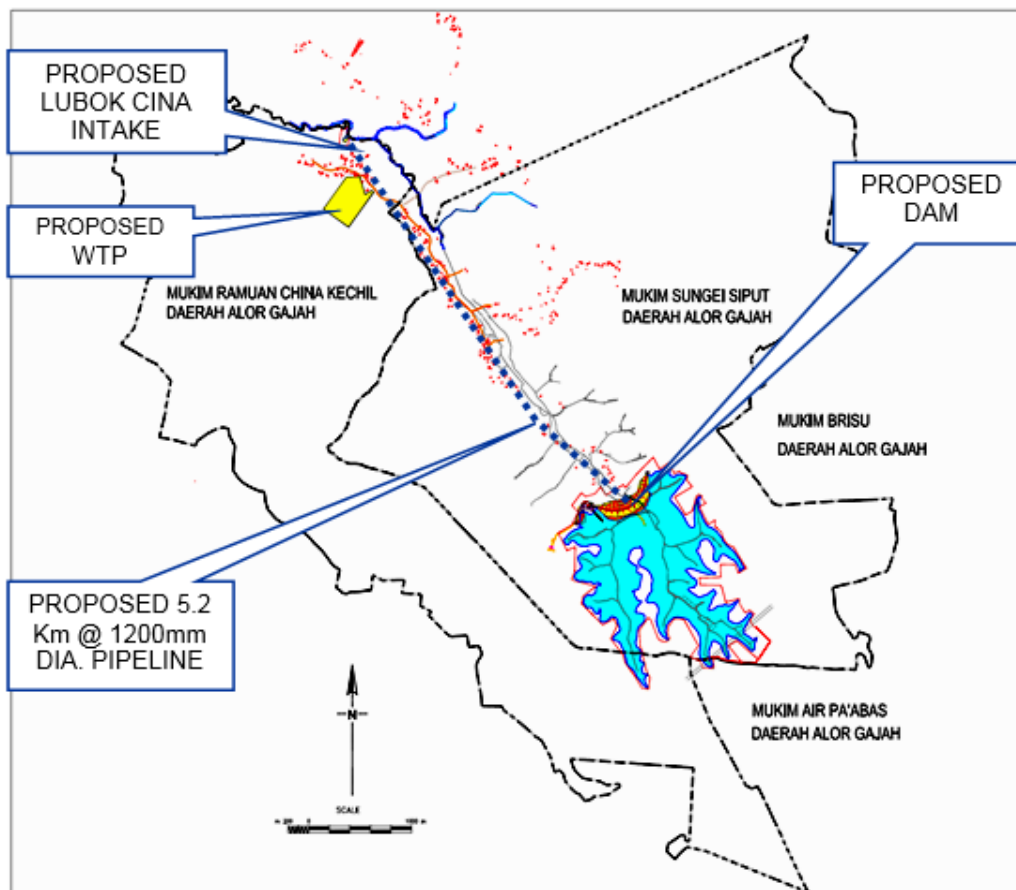


Figure ES-5: Layout and Pipeline Route (Option Case A) (Source: SMHB Sdn Bhd, 2015).

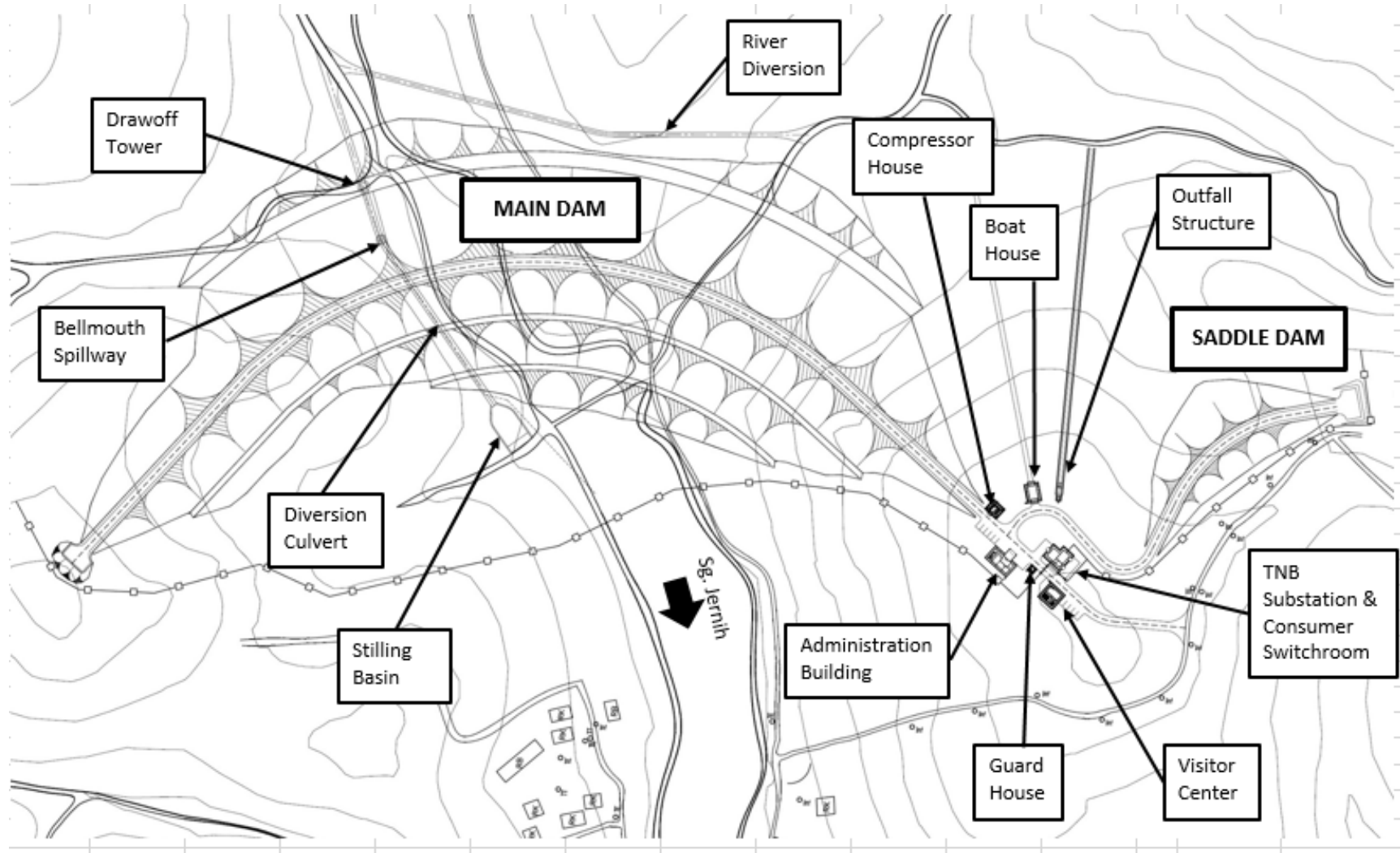


Figure ES-6: Dam Layout Plan (Source: SMHB Sdn. Bhd, 2015).

5.0 EXISTING ENVIRONMENT

5.1 Topography and Geomorphology

The topography in the proposed project site can be categorized into slopes categories which are undulating, rolling terrain and flat. The water intake point site is observed to be undulating terrain while the dam site is more rolling terrain with some parts being flat. The pipeline area has both the terrains together with flat surface. Slopes are recorded to be within 0°-12°. Mainly the terrain in the project site is in the range of 45-106 m. As for the geomorphology of the proposed project area, the undulating and rolling terrain suggest that the soil is derived from sedimentary rocks. The flat or nearly level terrain is a result of peneplanation (erosion process) or some alluvial deposit. There would be some sandstones as the parent rock in the area of sedimentary rocks having rolling terrain with prominent ridges.

5.2 Geology and Soil

The proposed dam site is underlain by metasediments, identified as phyllites and intersequenced with schists, named informally as the Hawthornden Schists. The schists can be clearly identified by the occurrence of coarse mica flakes and quartz grains while the phyllites and slates are finer-grained varieties (generally identified as silt in the bore-logs). Sg. Jernih is seen as a north-west trending tributary of Sg. Rembau. Its' fairly straight alignment is characteristic of rivers controlled by faults, which are fractures or cracks in the earth's crust which had moved in the past. The soil types over the dam-reservoir area is of the Munchong-Durian-Malacca Series. The Munchong Series is developed on parent material which are predominantly argillaceous (or from very fine-grained rock type). The rock types underlying such a series may be of schists or metashales. They are generally brown in color, a characteristic due to the iron content in these soils.

5.3 Land Use

The proposed Jernih Dam project can be classified into three major components namely the Jernih dam site, Lubok China water intake and pipeline between the two. In general, the project area comprises of agricultural area with many villages, and the Lubok China is the nearest town. The construction of Jernih Dam Project involves surface area of more than 100 hectares and will be located in Alor Gajah district of Melaka. The existing proposed project site is located in a typical rural settings with several villages around with many agriculture smallholdings which include rubber and oil palm plantations, paddy fields, fruit orchards and other minor agriculture activities including aquaculture. The project corridor is mainly aligned on the natural settings of swampy area for reservoir and riverine for pipeline route and until the proposed water intake point.

5.4 Hydrology

This section describes the hydrological characteristics and river systems existing in and around the project area which is located at Linggi River Basin. The Linggi River Basin has three distinct major sub-basins, the Sg. Linggi (s.s) the Sg. Rembau and Sg Siput. However, for the present study it has been divided into four sub-basins: the Sg. Linggi (s.s), Sg. Pedas, Sg. Rembau and Sg. Siput. The Sg. Rembau sub-basin consists of two major tributaries including the Sg. Penajis and Sg. Rembau (s.s). Since the area is free from major industries, the water is relatively clean. A lot of water is extracted from this sub-basin for paddy irrigation. The Sg. Siput is a small sub-basin with a total catchment area of about 144.0 sq. km and joins with the Sg. Rembau approximately 2.8 km upstream from Lubok China town. The entire sub-basin of Sg. Siput is located in Malacca State.

5.5 Water Quality

Water quality monitoring is an essential part of the environmental assessment and therefore a total of 16 water samples were collected on 18th July 2016 and 23rd September 2016 from eight (8) stations. At all stations, samples were analysed for 20 chosen parameters specified in the Ministry of Health (MOH), Raw Water Quality Standard. The water quality data analysed was compared against the National Water Quality Standards for Malaysia (NWQS). There are some variations in water quality between stations but most of the data are well within NWQS. Water quality index (WQI) scored by all the stations was Class III.

5.6 Climate and Meteorology

At the Malacca Meteorological Station (the nearest Meteorological Station to project site), the mean daily temperature varied from 26.4 °C to 29.6 °C from January, 2013 until June 2016. The monthly rainfall from January, 2013 to June, 2016 varies between 0.0 mm (2014) and 410.2 mm (2015). Relative humidity is generally high all year long with monthly mean values from 72.1 % to 84.8 %. The mean daily evaporation for the four year period range from 2.9 mm – 8.2 mm. The prevailing direction of wind was at 45°. The maximum wind speed was 22.0 m/s for 2013-2014 and 15.5 m/s for year 2015. The data shows typical Malaysian weather with no adverse climatic conditions.

5.7 Air Quality

The air pollutants that are relevant and important to the proposed project are Particulate Matter (PM₁₀), Particulate Matter (PM_{2.5}), Sulphur Dioxide (SO₂), Nitrogen Dioxide (NO₂), Carbon Monoxide (CO), Lead (Pb), and Ozone (O₃). The PM₁₀ and PM_{2.5} concentrations monitored at the four monitoring stations were within the New Malaysian Ambient Air Quality Standard (NMAAQS) of 150 µg/m³ and 75 µg/m³ respectively. The PM₁₀ levels were recorded were 62 µg/m³, 59 µg/m³, 60 µg/m³ and 65 µg/m³, whilst PM_{2.5} were 36 µg/m³, 32 µg/m³, 34 µg/m³ and 38 µg/m³. NO₂ was not detected (<5) at all four (4) stations (limit of 320 µg/m³). SO₂ was not detected (<5) at all four (4) stations (limit of 105 µg/m³). CO was not also detected (<2) at the four (4) stations (limit of 9 ppm). The same goes to Pb (<0.01) and O₃ (<10) which have limits of 1.5 µg/m³ and 200 µg/m³ respectively.

5.8 Noise Level

Noise measurements were monitored to establish the existing background noise levels at selected locations in and around the project site. The equivalent noise levels (LAeq) monitored at the four stations indicates that noise varied from 53.9 to 54.7 dB (A) during the day and 42.5 to 44.3 dB (A) during the night. The findings of the baseline noise study indicated that the existing environmental noise level at the boundary of the project site has exceeded the Schedule 1: Maximum permissible sound level (LAeq) for Low Density Residential land use of DOE Guidelines. The main noise sources were identified from human activities particularly during daytime since most of the land use at the boundary of the project site are occupied by residential land use although in low density.

5.9 Vibration Level

Vibration measurements were undertaken to establish the existing background vibration level at the selected locations around the Jernih Dam project area. The objective of this was to establish the baseline vibration level and to identify existing significant vibration sources along the project corridor. The vibration levels at four (4) locations varied from 0.22 to 4.11 mm/s p.p.v. The highest vibration level was observed at V1 (located at residential area at FELCRA settlement closer to dam site) while the lowest was observed at V2 (located at nearest house to the dam site at Sg. Kg. Jernih).

5.10 Terrestrial Ecology

The terrestrial ecology is not significant within 5 km radius of the project site. However, an attempt was made to address the terrestrial ecology including the type of habitats, flora and fauna and their conservation and socio-economic values in the region. The dominant terrestrial flora recorded in the project area is the oil palm (*Elaeis guineensis*) as single cash crops dominate the study area, which is followed by rubber (*Hevea brasiliensis*). While the most common wild mammals recorded in the area are Long tailed macaque (*Macaca fascicularis*), Pig-tailed macaque (*Macaca nemestrina*), Wild pig (*Sus scrofa*), Dusky Leaf Monkey (*Trachypithecus obscurus*), Smooth Otter (*Lutrogale perspicillata*), Common Palm Civet (*Paradoxurus hermaphrodites*), Malay Civet (*Viverra zibetha*), etc. The most common reptiles recorded in the region were Monitor Lizard (*Varanus nebulosus*) and followed by Forest lizard (*Calotes cristatellus*). The most common birds spotted in the project area were the Common Myna (*Acridotheres tristis*), Buffy Fish-Owl (*Bubo ketupu*), Yellow-vented Bulbul (*Pycnonotus goiavier*), Spotted Dove (*Spilopelia chinensis*) and Water Hen (*Gallinula chloropus*).

5.11 Wetland and Aquatic Ecology

The wetland ecological habitats all along the Sg. Jernih, where the proposed pipeline route will be laid is mostly swampy area as expected. The proposed project area has low

biodiversity (plankton and fish) where no endangered, endemic and protected species had been recorded. No main fisheries activity was observed in the proposed project area except for recreational purpose only especially Udang Galah fishing. Fish species that had been recorded in the proposed project area are widely found throughout of Peninsular Malaysia. The most common species are *Mystacoleucus obtusiroitris* followed by *Systemus binototus* and *Trichogaster trichopterus*.

5.12 Socio-Economy

The project sites can be divided into three; the proposed dam site, pipeline route and Lubok China water intake point. The immediate area which is affected by this project is Kg. Sg. Jernih and thereafter Kg. Bukit Kekabu which consist of FELCRA settlements. The existing land use in this site is a typical rural settings with several villages engaged in small scale agricultural activities which include rubber and oil palm plantations, paddy fields, fruit orchards, and aquaculture. Sg. Jernih has been used as water source for the various agricultural activities.

A socio-economic survey was done within 5 km radius of the project site targeting general public and landowners. When the respondents were asked whether they have heard about the proposed project development, the proportions among the general public that were aware and those not aware were about equal. Among those who were aware the largest proportion only knew about the project in 2016, some knew as far back as in 2008. Both categories of respondents obtained their information largely from unofficial sources, such as from friends and relatives which amounted to about 12.2% and 87.8% of the total, respectively.

The responses to the question pertaining to the attitude of the respondents towards the project implementation showed that 63.3% of the general public were at least in agreement towards the project implementation. The reason for the moderate acceptance rate among the village people could be attributed to their concern of the adverse impacts the project has on their livelihood. The most notable opposition towards the project comes from the respondents from Kg. Sg. Jernih (86 % [50 from 58 respondents]). The main reason for their objection was that they are not satisfied with the amount of compensation proposed for their land to be acquired.

5.13 Public Health

A Public Health study was conducted to describe the existing socio-economic and health status of the population residing near the proposed Jernih Dam and the associated works. This project aims to determine the existing health status of the local community in vicinity to the proposed project and to predict their potential health impacts. In terms of health conditions, 88.3% of respondents claimed to be in healthy conditions. The most common acute illnesses

among adults and children were flu and fever followed by chest pain and diarrhea for adults and vomiting and diarrhea for children.

5.14 Infrastructure and Utility

The project site for the development of Jernih dam is located in an agriculture area. Most of the necessary infrastructure and utility including roads, electricity, water supply, telecommunications, sewerage services, health service, schools and education institutions, mosques and places of worships, recreational areas, solid waste centre and other amenities are available around the project site for the resident uses.

6.0 PROJECT ACTIVITIES, POTENTIAL IMPACTS AND MITIGATION

The implementation of the proposed dam project will involve a number of development activities. These activities, which spread over the pre-construction, construction and operation phases of the project that would induce both positive and negative impacts on the environment. As a precursor to the impact assessment exercise, this section highlights the principal activities, which will be investigated in-depth in order to ascertain the extent the development process will interact with environmental resources, as well as with the general state of the environment in the vicinity of the project area. It aimed to highlight specific activities that may have an impact on the existing environment so that appropriate mitigation and abatement measures can be instituted.

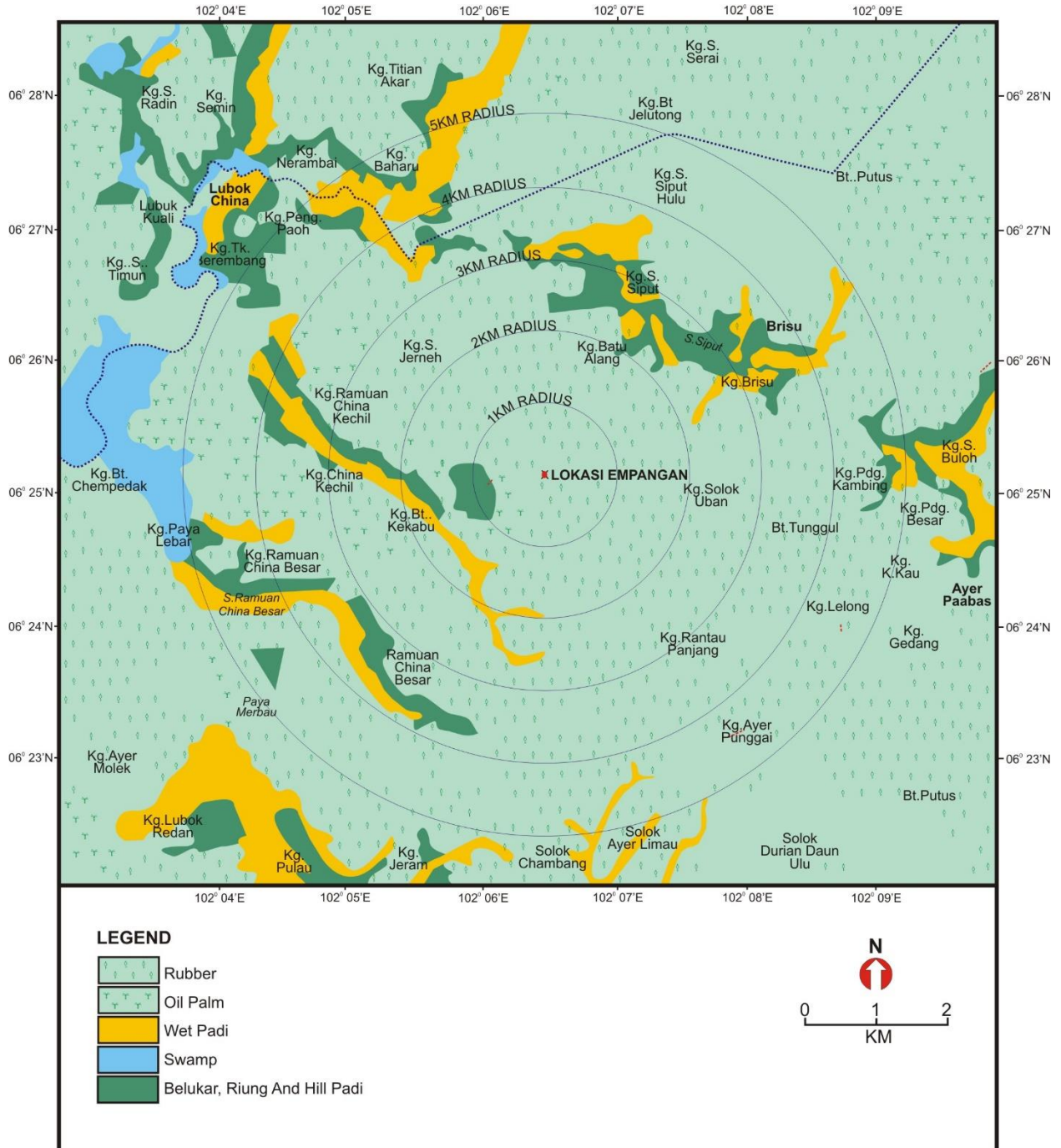


Figure ES-7: Existing land use within 5 km radius of the dam site.



Sg. Siput at Brisu



River gate at Brisu



Sg. Siput further downstream



Sg. Siput at its confluence with Sg. Rembau



Sg. Penajis, upstream tributary of Sg. Rembau



DID station at Sg. Rembau



Sg. Rembau at proposed water intake point



Sg. Rembau downstream at Lubok China

Figure ES-9: Hydrological features of Sg. Siput and Sg. Rembau.



Dam site rubber plantation



Dam site after rubber plantation cleared recently



Existing oil palm plantation



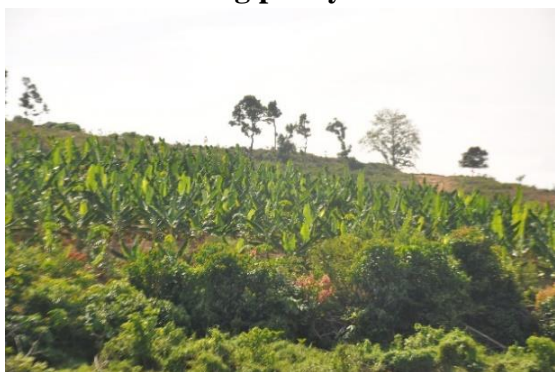
Existing gaharu plantation



Existing paddy fields



Existing freshwater aquaculture



Existing banana plantation



Existing limau kasturi plantation

Figure ES-10: Glimpses of land use in and around the project area.



Entrance to Kg. Sg. Jernih



Primary School at Kg. Sg. Jernih



Balai Raya at Kg. Sg. Jernih



Interior road to Kg. Sg. Jernih



Graveyard (Kubur) bordering dam site



Main entrance to FELCRA settlement



Balai Raya FELCRA settlement



Masjid FELCRA settlement

Figure ES-11: Glimpses of Socio-economic profile closer to dam site.

7.0 IMPACTS AND MITIGATIONS DURING CONSTRUCTION PHASE

The potential impacts of the proposed project are assessed for the construction phase of the project. The principal project activities that will be carried out and the expected impacts on the environment due to the construction are discussed. The major construction activities are land clearing, earthworks and foundation works, transportation and storage of construction materials, deployment of construction equipment, civil and structural works, building of dam, water intake structures, pipeline, mechanical and electrical installation, terracing, landscaping etc.

The key environmental impacts arising during the construction phase of the project includes soil erosion and water quality deterioration which will eventually affect the aquatic ecosystem. Land clearing activities and earthworks mostly contribute to the soil erosion condition. However, the proposed mitigation measures which are to keep the land clearance as minimal as possible while implementing erosion and sediment control plan would reduce the impacts of soil erosion by minimizing water quality degradation. Another issue which would affect the residents is the movement of vehicles in and out of the construction site and to mitigate this concern, an alternative road will be provided for the vehicle movements. This could reduce the air, noise, and vibration caused by the vehicles.

In addition the other significant impacts which require special attention are the public and workers safety due to transportation and construction activities; noise, dust and exhaust emission due to general construction activities; and waste generation and effective management. Recommended mitigation measures proposed including traffic management plan, temporary sanitary facilities and other mitigations measures to reduce dust and noise level are adequate if the project proponent / contractor adhere to them. In addition, a comprehensive EMP for the construction phase will help further strengthen the mitigation measures and to monitor its effective implementation.

8.0 IMPACTS AND MITIGATION MEASURES DURING OPERATION PHASE

The major activities during the operation phase of the project include dam and pipeline maintenance, water abstraction and pumping of water from Sg. Rembau to dam. The impacts of major concern include potential rupture / burst of dam structure itself and pipe cracks and burst. These impacts are anticipated due to the failure in dam and pipeline maintenance. Besides, the water abstraction would cause the existing river flow and discharge rate to be affected that would possibly lead to water quality deterioration including saline water intrusion. However, these impacts could be abated by maintaining minimum low flow and installation of river gate which would be able to minimize the impacts including saline water intrusion.

Other significant impacts could be due to discharge of wastewater, sewerage, agriculture runoff and solid waste upstream of intake point during the operational phase. The impacts

would be mostly affect raw water quality to be abstracted for water supply, and also river water quality which would affect the aquatic ecology, ecotourism and socio-economic benefit of the rivers in the surrounding vicinity. The waste generation could bring harm by polluting the nearby watercourses and pose health hazards and rodents infestation. By implementing proper mitigation measures, these impacts could be reduced. Wastewater and sewerage should be handled by installation and maintenance of pipes and regular checks on the wastewater quality before releasing it into the watercourses. Besides, solid waste should be handled and disposed in a proper manner.

9.0 RESIDUAL IMPACTS

The residual impacts are defined as potentially significant long-term environmental impacts which remain even after mitigating measures have been introduced. These impacts are considered to be permanent and long-term, which might occur during the construction and operational phases of Jernih Dam and associated works, and are likely to affect the three major environmental components, i.e. physical, biological and human environment. The main residual impacts are related to hydrology, water quality, aquatic ecology and social. These residual impacts require closer investigation and are managed by developing a well-defined environmental monitoring programme which would be implemented during the construction and operational phase of the project. However, there are also beneficial residual impacts in the form of required domestic water and economic development for the local people in particular and entire Alor Gajah district in general.

10.0 EROSION AND SEDIMENT CONTROL PLAN (ESCP)

The Erosion and Sediment Control Plan (ESCP) main objective is to protect, restore and enhance the environmental quality at the project site and its surrounding areas through proper and systematic planning, implementation, monitoring and auditing of mitigation measures on soil erosion and sedimentation. A calculation was made for existing and construction phases in which soil condition which was further divided into soil loss and sediment yield with conservation measures and during worst case scenarios. Some mitigation measures were proposed by using principles of soil erosion and sediment control as guidelines. The selection of the Best Management Practices (BMP) shall be done in a manner that the objective is achieved and workable to be carried out on site. The basic principles of soil erosion control measures are to protect the soil surface from rain and to divert runoff from an exposed area, whereas the basic principles of sediment control measures is maintain effluent water quality by capturing the eroded soil particles on the site before entering water courses.

11.0 ENVIRONMENTAL MANAGEMENT PLAN (EMP)

A comprehensive Environmental Management Plan (EMP) for this project shall be prepared to effectively manage all potential issues and impacts identified in this report and monitor the project activities and implementation of mitigation measures at the site during both construction and operational phases of the project. This is to ensure environmental objectives are met and all activities relating to the implementation of the project are carried out in an environmentally sustainable manner. The document will provide specific guidelines on steps that need to be performed by the project proponent to ensure that mitigation measures recommended in this report, the EIA approval conditions and any other requirements imposed by the DOE are implemented.

12.0 EMERGENCY RESPONSE PLAN (ERP)

An Emergency Response Plan (ERP) document contains action plans in case an emergency occurs due to the project development. The ERP is designed to prevent loss of human life and increase safety and security of workers and people live around the project both during construction and operation phases of the project. Its contains the structured response to the increasing distress levels at the dam to guide stakeholders and decision makers in the event such an untoward incident occurs. The primary purpose of the ERP is to provide a framework for a concerted effort to evacuate residents along the banks of river reaches in a timely and orderly manner and thus save lives on the onset of a catastrophic dam breaching event.

13.0 PROJECT ABANDONMENT

Project abandonment means when the whole project or a part of the project has to be abandoned for specific reasons. Abandonment could happen at any stage of the proposed project. Abandonment during the planning stage would not result in any significant financial losses other than costs incurred for undertaking various studies and planning. Abandoned structures and machinery could be a health hazard to the public and cause negative impacts to the surrounding environment if left exposed, such as soil erosion and surface run-off. The Project Proponent shall be responsible to institute all necessary remedial measures required for protection and conservation of environmental quality.

14.0 CONCLUSION

The Preliminary Environmental Impact Assessment (PEIA) study has attempted to identify and assess the environmental impacts with respect to physical, biological and human environmental issues associated with the development of Jernih Dam and associated works in Alor Gajah, Melaka. The deductions and interpretations made here are based on the best available information and the studies carried out specifically for the project as outlined in the various chapters of this PEIA report.
