

CHAPTER 3: PROJECT OPTIONS

3.1 INTRODUCTION

This Chapter provides a description of the reasonable options considered and provides documentation of the rationale for selecting a particular option. Environmental, land use considerations, engineering/constructability, safety and cost factors were taken into consideration in the selection of the preferred options.

An assessment of Project options or alternatives was carried out to ensure the optimal option has been selected. The following project options are discussed in this chapter:

1. Transmission Line Route Alignment Option
2. Consultation and Stakeholder Views and Concerns
3. HSAP Criteria for Siting and Design Options
4. Tower Types and Construction Method
5. No Project Option

3.2 TRANSMISSION LINE ROUTE ALIGNMENT OPTION

3.2.1 Transmission Line Route Selection Considerations

As described in Chapter 1, the purpose of the BMTLP is to evacuate power from the Baleh HEP to the existing Mapai Substation, about 177 km downstream of the Baleh HEP. The width of the ROW required for the BMTLP is 50 m. The process of minimizing project environmental and social impacts was an integral part of the selection of the corridors for the proposed BMTLP.

Based on SEB project team's experience in previous transmission line projects, and input from community involvement activities, the following criteria were taken into consideration in the selection of the transmission line route alignment:

- Avoidance of titled land lots, thus minimising the cost of ROW.

- Avoidance of line passing through any significant human habitation such as towns/ bazaars, longhouses (individual or cluster), structures or built-up areas, other infrastructure and industry. Relocation/ resettlement is considered as a last option.
- Avoidance of any public utility services, playgrounds, schools, community places, churches, mosques, temples and other establishments etc.
- Avoidance of cultural significant areas such as grave sites.
- Avoidance of significant environmental features, such as protected areas, other forest areas of biodiversity value or sanctuaries.
- Avoidance of terrain of more than 250 m in elevation and steep slopes wherever possible.
- Reduce number of major navigable river crossings.
- Maintaining a distance from the Regional Corridor Development Authority (RECODA) road (stretch from Nanga Mujung to Baleh HEP) to avoid potential damage to tower bases due to road slope cutting.

Note: RECODA road is also known as Baleh HEP Access Road., it is a 73 km long road starting from Btg. Baleh Bridge at Nanga Mujung and ends at Putai, near Baleh HEP. Currently under construction, it is the main access road to Baleh HEP from Kapit).

- Cost effectiveness, including efficient design and minimizing the route length, ROW acquisition costs, construction access and maintenance access points.
- Minimise impacts to proposed development plans.
- For areas without any existing/proposed roads, the route shall be kept close to river which can serve as alternative transport means during construction with river buffer zone maintained of at least 100 m to minimize damage to foundations due to erosion and to protect the existing riverbank.

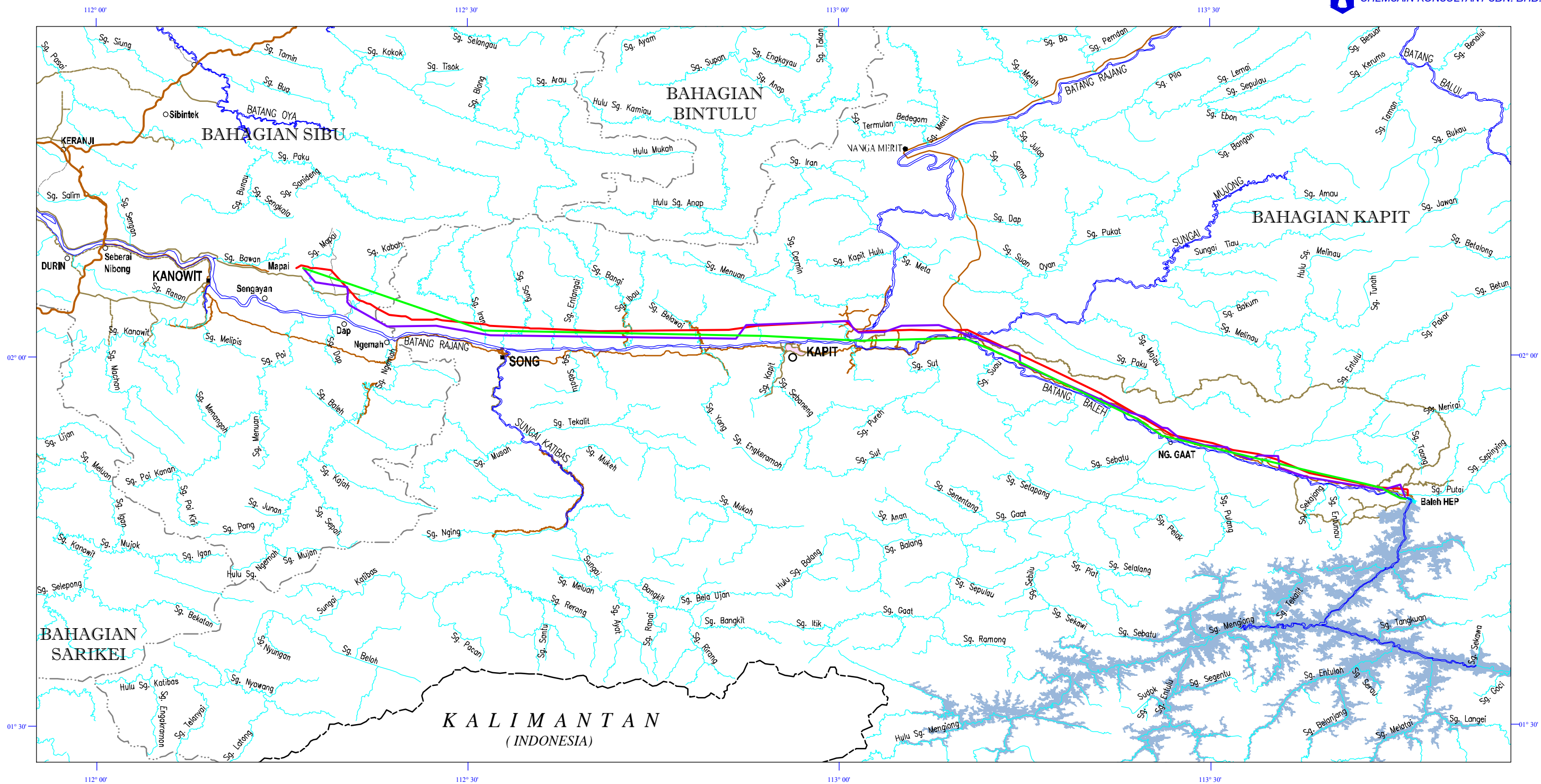
The transmission line has undergone several route alignment changes based on changes in the environment and social conditions and the availability of additional information as land survey and environmental investigations progress.

As part of the design process, four (4) route alignment options were considered by SEB. The first three (3) route options are located on the northern bank of Btg. Rajang and Btg. Baleh, traversing mostly hilly to mountainous terrains. Along the way, the transmission routes cross mostly secondary forest, agriculture land, settlements and river crossings at Btg. Baleh, Sg. Merirai, Sg. Mujong, Btg. Rajang, Sg. Menuan, Sg. Belawai, Sg. Ibau, Sg. Entangai, Sg. Song, Sg. Iran, Sg. Kabah and Sg. Mapai.

The length of the transmission line Options differs only very slightly with the shortest being 175 km (Option 1) and 177 km each for Option 2 and Option 3. The length of the transmission line along Btg. Baleh is approximately 87 km, while along Btg. Rajang is about 90 km.

Route Option 4 runs along Btg. Baleh's southern bank. Although considered at the earlier stages, Route Option 4 was not considered further as it will involve large number of titled land lots and traverses close to two (2) towns (Kapit and Song) which may lead to land issues and involve higher cost for land acquisition. As per SEB's design criteria above, this route is not selected for further consideration.

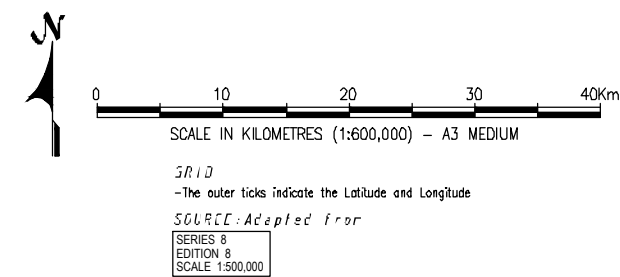
Figure 3.2.1 illustrates a generalised location of the BMTLP route options while **Figure 3.2.2 (a – h)** shows the environmental and social conditions that the proposed route alignment options pass through. It should be noted that there is no route for Option 4, as this route was not selected for further consideration very early in the planning stage.



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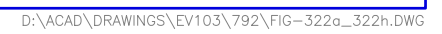
- TRANSMISSION LINE ROUTE (OPTION 1)
- TRANSMISSION LINE ROUTE (OPTION 2)
- TRANSMISSION LINE ROUTE (OPTION 3)
- INTERNATIONAL BOUNDARY
- DIVISIONAL BOUNDARY
- BALEH DAM
- BALEH DAM RESERVOIR
- RIVERS / STREAMS
- ROADS / MOTORABLE TRACK

ENVIRONMENTAL AND SOCIAL IMPACT ASSESSMENT
(ESIA) STUDY FOR THE PROPOSED BALEH-MAPAI 500 KV
TRANSMISSION LINE PROJECT






















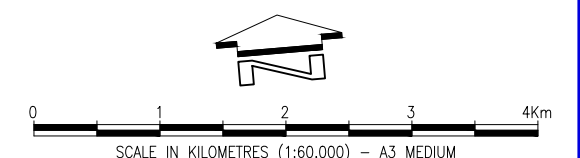
TRANSMISSION LINE
ROUTE OPTIONS

FIGURE: 3.2.1





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|---|---|---|----------------------|
|  | PROPOSED TRANSMISSION LINE ROUTE (OPTION 2) |  | BARE LAND |
|  | PROPOSED ANGLE TOWER |  | FOREST |
|  | TRANSMISSION LINE ROUTE (OPTION 1) |  | GRASS AND BUSHES |
|  | TRANSMISSION LINE ROUTE (OPTION 3) |  | PADDY |
|  | RIVERS |  | SHIFTING CULTIVATION |
|  | ROADS |  | TREE CROP |
|  | DIVISIONAL BOUNDARY |  | POND |
|  | EXISTING TRANSMISSION LINE |  | GRAVESITES |
|  | BRIDGE | | |
|  | ACCESS ROADS (OPERATING LOGGING / PLANTATION ROAD) | | |
|  | ACCESS ROADS (COMMUNITY ACCESS ROAD / ABANDONED LOGGING TRACK) | | |



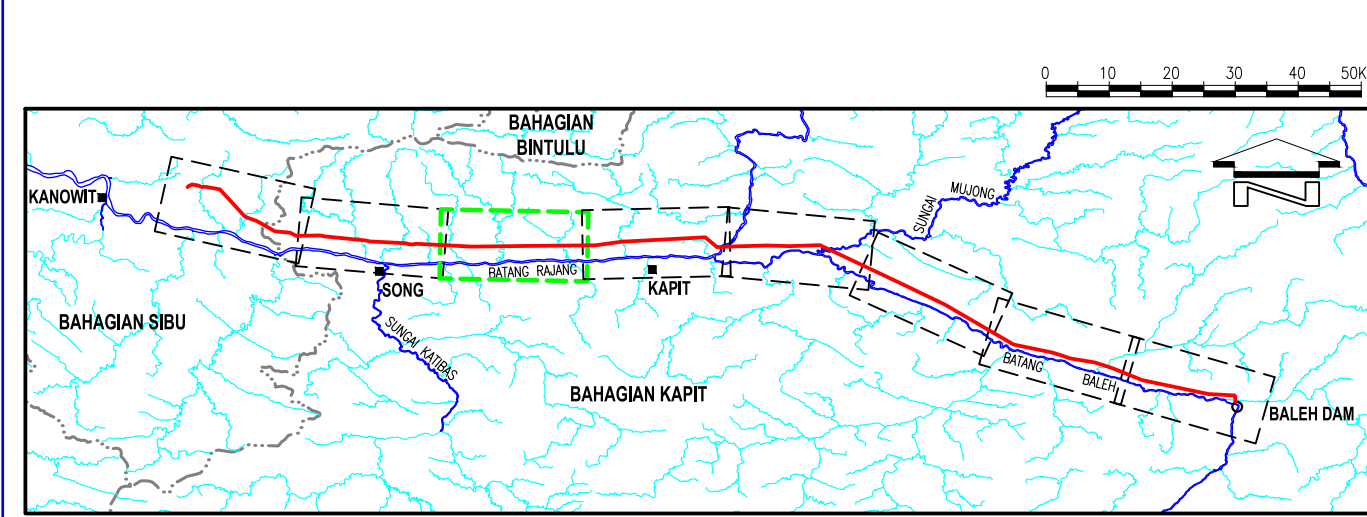
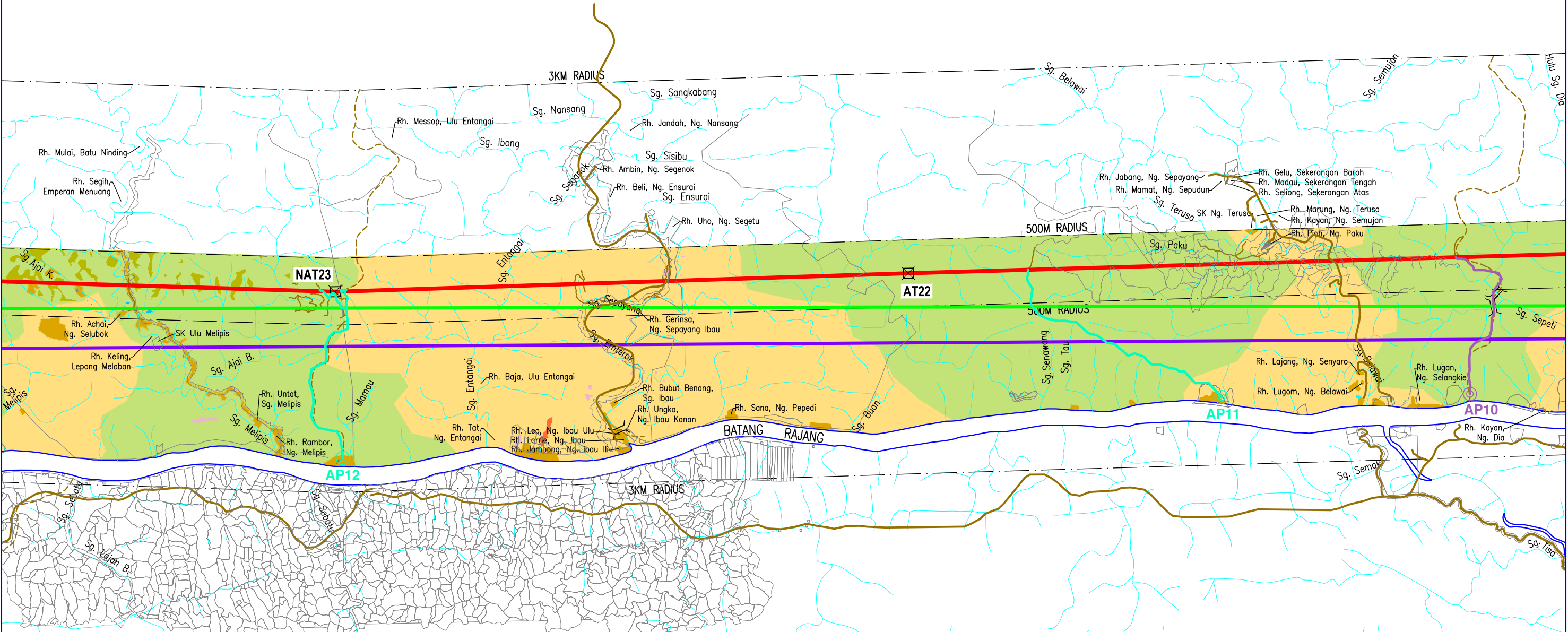
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SERIES T738 SHEET 6314 EDITION 1-PPNM	SERIES T738 SHEET 6413 EDITION 1-PPNM	SERIES T738 SHEET 6414 EDITION 1-PPNM	SERIES T738 SHEET 6513 EDITION 1-PPNM

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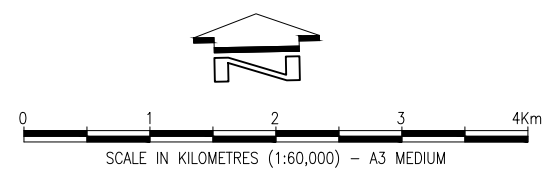
COMPARISON OF ENVIRONMENTAL AND SOCIAL CRITERIA OF ROUTE ALIGNMENT OPTIONS

FIGURE: 3.2.2b



LEGEND:

- PROPOSED TRANSMISSION LINE ROUTE (OPTION 2)
- PROPOSED ANGLE TOWER
- TRANSMISSION LINE ROUTE (OPTION 1)
- TRANSMISSION LINE ROUTE (OPTION 3)
- RIVERS
- ROADS
- BRIDGE
- ACCESS ROADS (OPERATING LOGGING / PLANTATION ROAD)
- ACCESS ROADS (COMMUNITY ACCESS ROAD / ABANDONED LOGGING TRACK)
- BARE LAND
- FOREST
- GRASS AND BUSHES
- PADDY
- SHIFTING CULTIVATION
- TREE CROP
- POND
- GRAVESITES



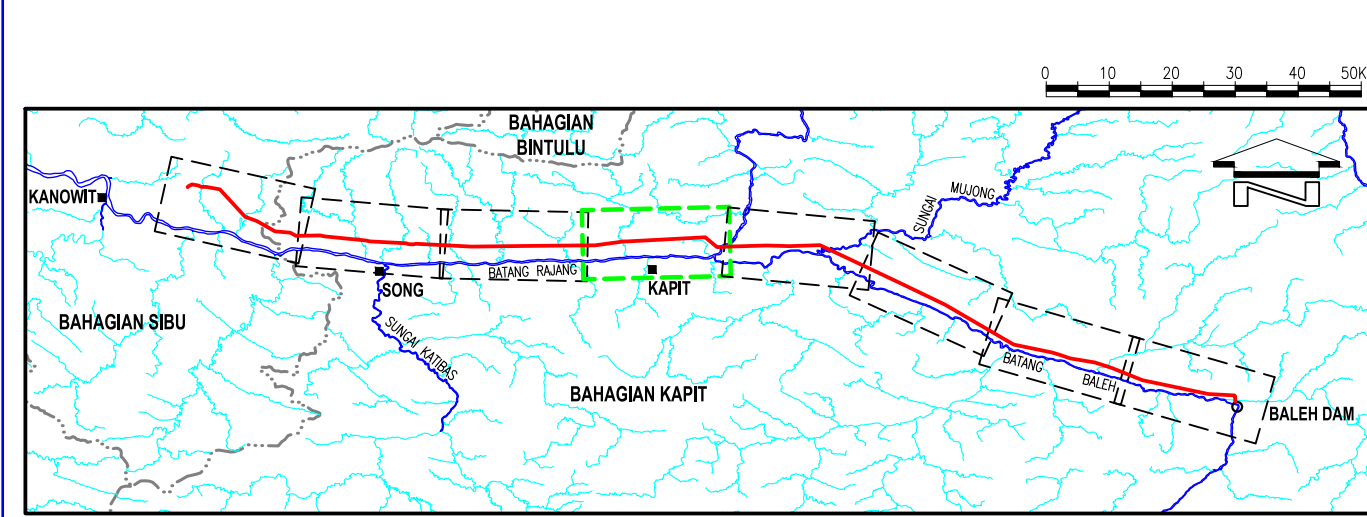
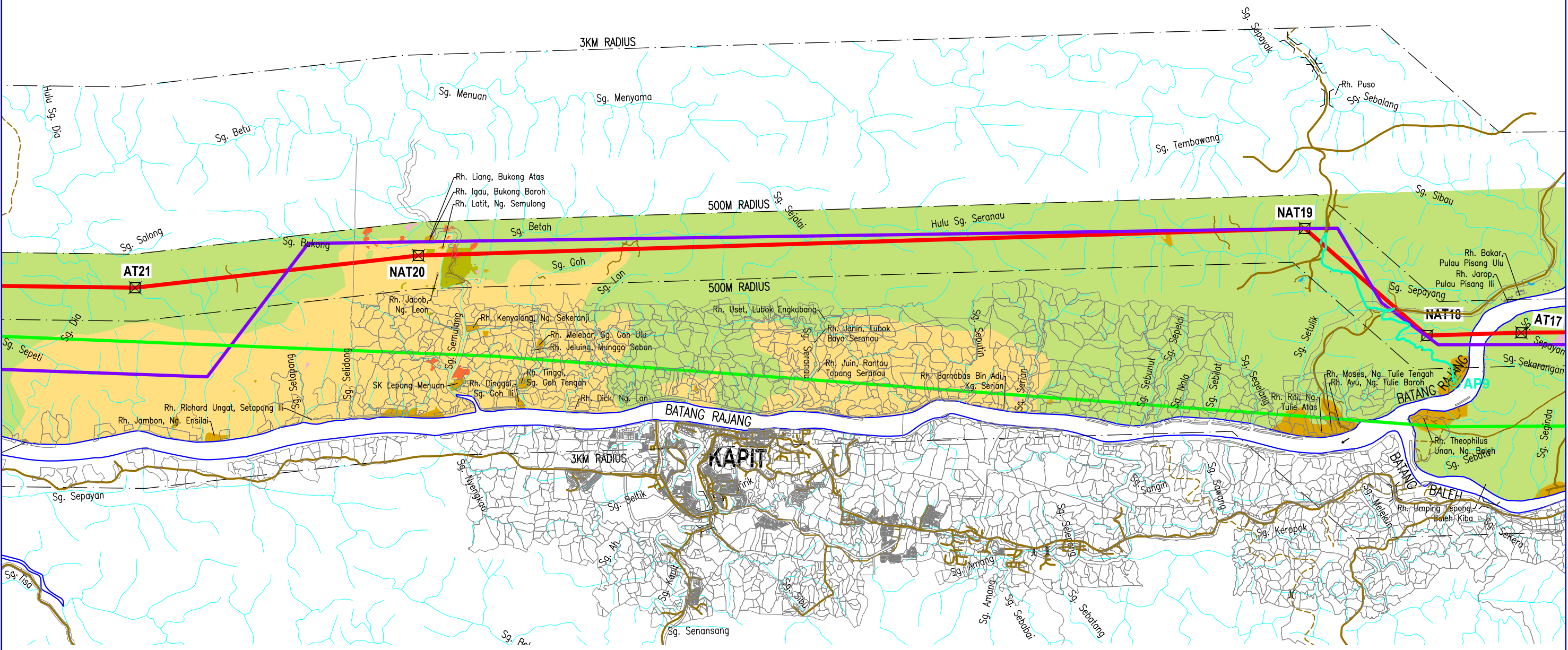
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SERIES T738 SHEET 6314 EDITION 1-PPNM	SERIES T738 SHEET 6413 EDITION 1-PPNM	SERIES T738 SHEET 6414 EDITION 1-PPNM	SERIES T738 SHEET 6513 EDITION 1-PPNM

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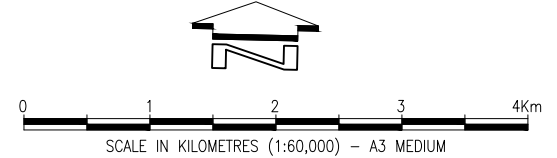
COMPARISON OF ENVIRONMENTAL
AND SOCIAL CRITERIA OF ROUTE
ALIGNMENT OPTIONS

FIGURE: 3.2.2c



LEGEND:

- PROPOSED TRANSMISSION LINE ROUTE (OPTION 2)
- PROPOSED ANGLE TOWER
- TRANSMISSION LINE ROUTE (OPTION 1)
- TRANSMISSION LINE ROUTE (OPTION 3)
- RIVERS
- ROADS
- BRIDGE
- ACCESS ROADS (OPERATING LOGGING / PLANTATION ROAD)
- ACCESS ROADS (COMMUNITY ACCESS ROAD / ABANDONED LOGGING TRACK)
- BARE LAND
- FOREST
- GRASS AND BUSHES
- PADDY
- SHIFTING CULTIVATION
- TREE CROP
- POND
- GRAVESITES



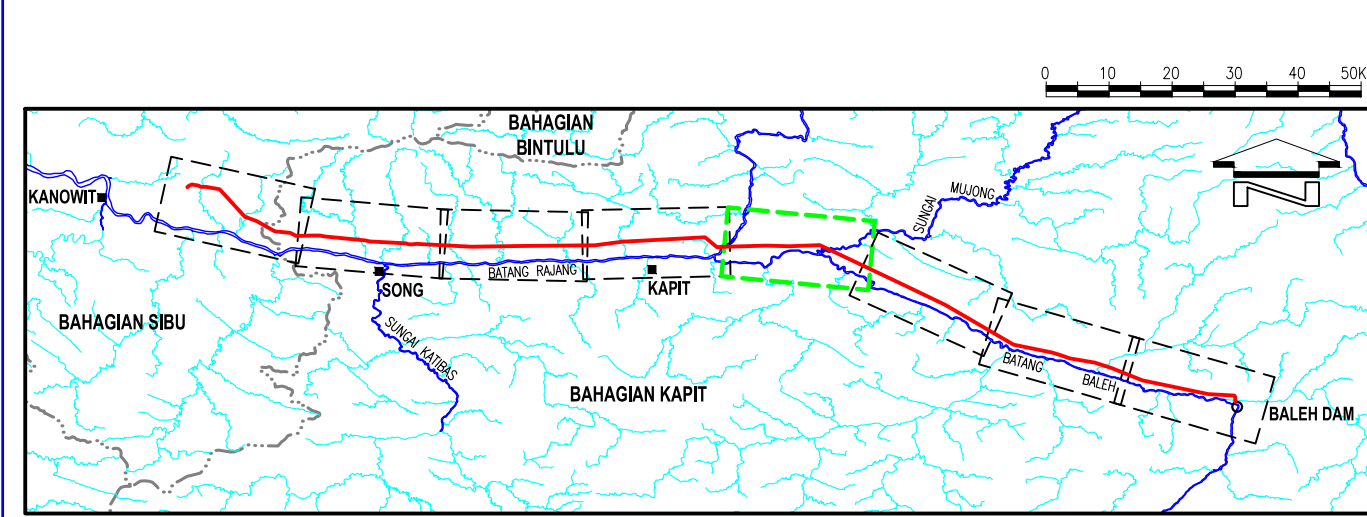
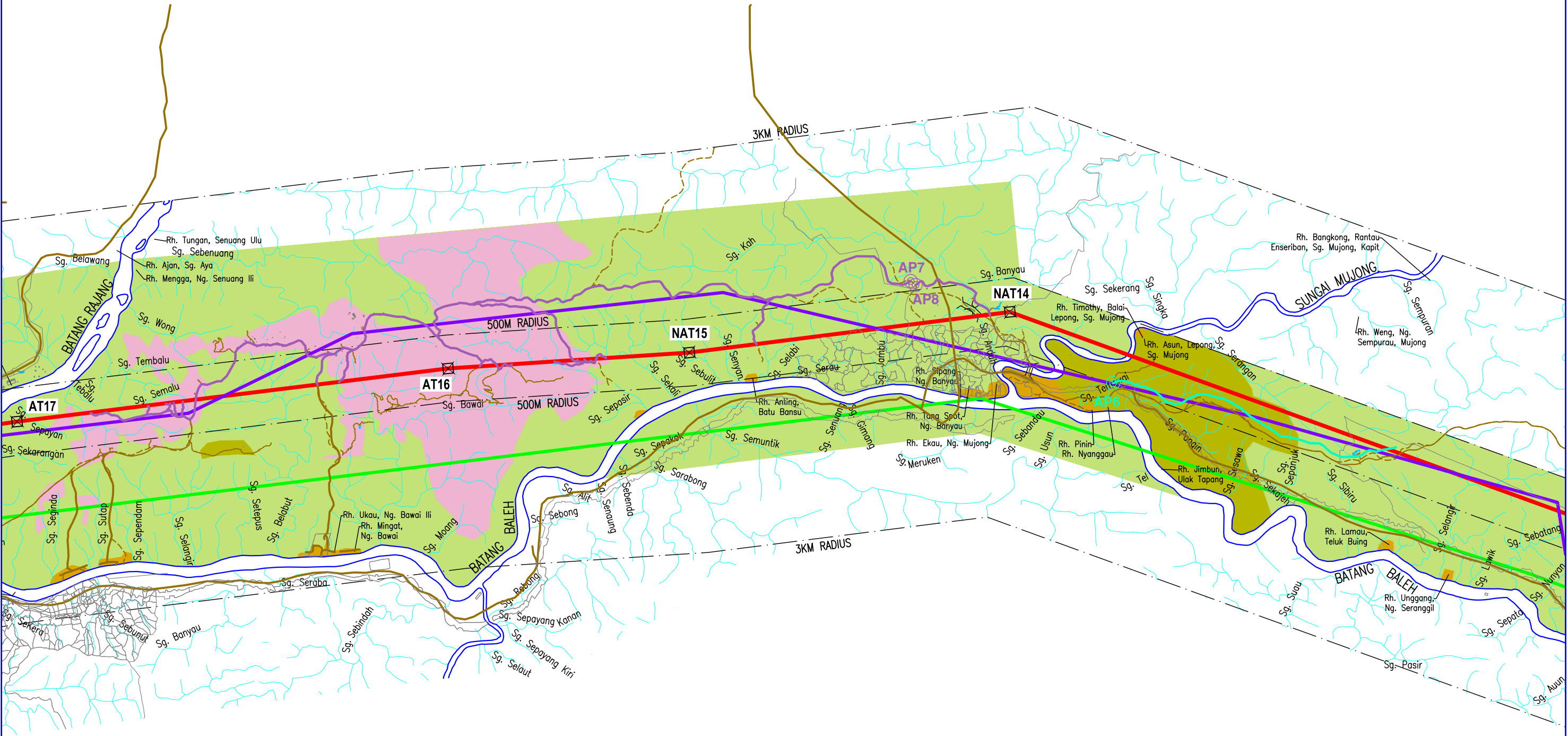
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SERIES T738 SHEET 6314 EDITION 1-PPNM	SERIES T738 SHEET 6413 EDITION 1-PPNM	SERIES T738 SHEET 6414 EDITION 1-PPNM	SERIES T738 SHEET 6513 EDITION 1-PPNM

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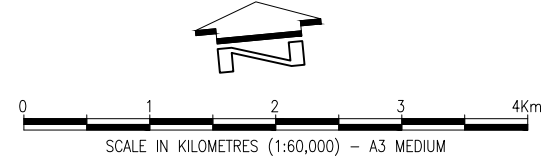
COMPARISON OF ENVIRONMENTAL
AND SOCIAL CRITERIA OF ROUTE
ALIGNMENT OPTIONS

FIGURE: 3.2.2d



LEGEND:

- PROPOSED TRANSMISSION LINE ROUTE (OPTION 2)
- PROPOSED ANGLE TOWER
- TRANSMISSION LINE ROUTE (OPTION 1)
- TRANSMISSION LINE ROUTE (OPTION 3)
- RIVERS
- ROADS
- ACCESS ROADS (OPERATING LOGGING / PLANTATION ROAD)
- ACCESS ROADS (COMMUNITY ACCESS ROAD / ABANDONED LOGGING TRACK)
- BARE LAND
- FOREST
- GRASS AND BUSHES
- PADDY
- SHIFTING CULTIVATION
- TREE CROP
- POND
- GRAVESITES



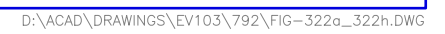
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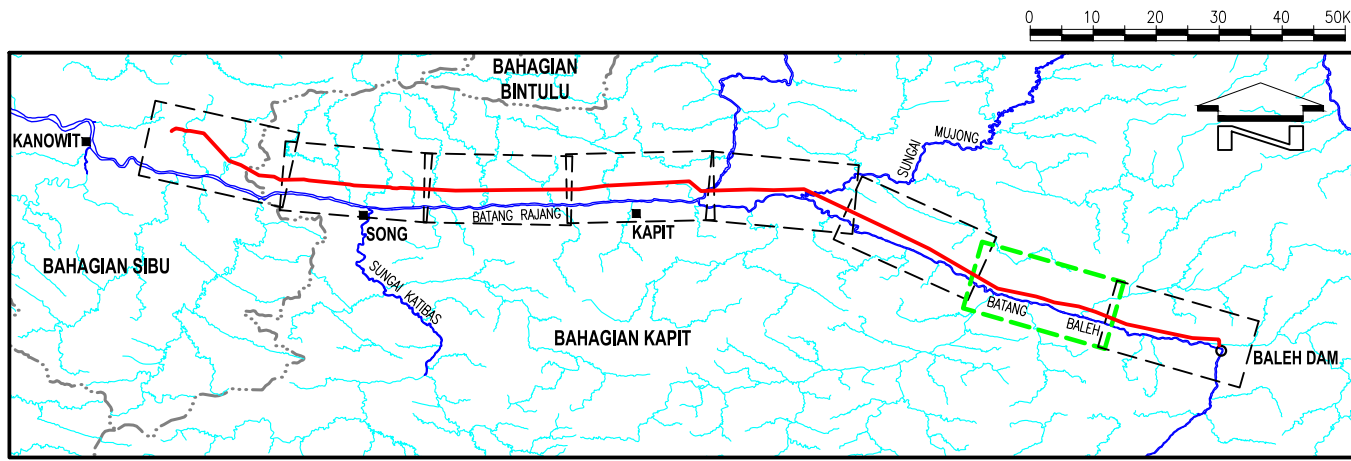
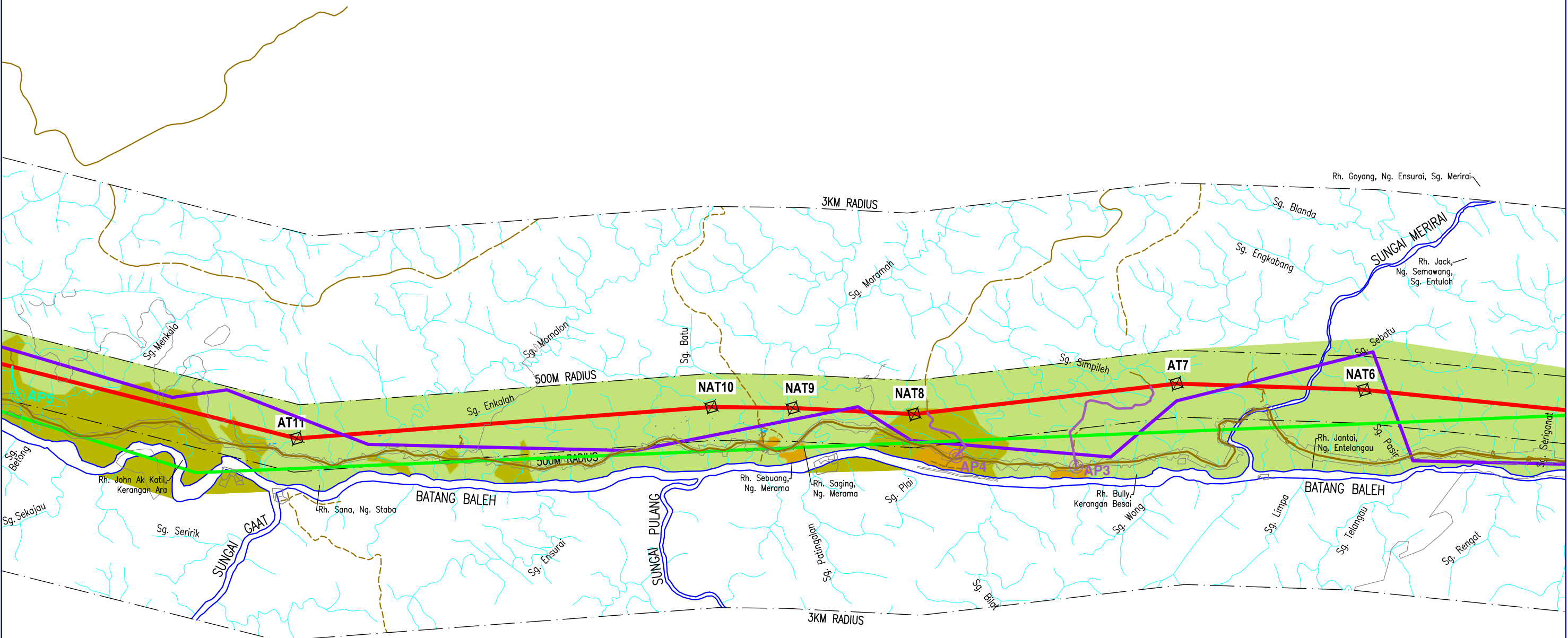
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SERIES T738 SHEET 6314 EDITION 1-PPNM	SERIES T738 SHEET 6413 EDITION 1-PPNM	SERIES T738 SHEET 6414 EDITION 1-PPNM	SERIES T738 SHEET 6513 EDITION 1-PPNM

GRID
-The inner crosses indicate the Latitude and Longitude

COMPARISON OF ENVIRONMENTAL
AND SOCIAL CRITERIA OF ROUTE
ALIGNMENT OPTIONS

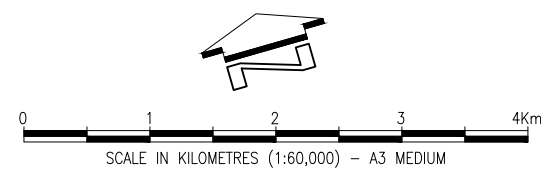
FIGURE: 3.2.2e





LEGEND:

- PROPOSED TRANSMISSION LINE ROUTE (OPTION 2)
- PROPOSED ANGLE TOWER
- TRANSMISSION LINE ROUTE (OPTION 1)
- TRANSMISSION LINE ROUTE (OPTION 3)
- RIVERS
- ROADS
- ACCESS ROADS (OPERATING LOGGING / PLANTATION ROAD)
- ACCESS ROADS (COMMUNITY ACCESS ROAD / ABANDONED LOGGING TRACK)
- BARE LAND
- FOREST
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- TREE CROP
- POND
- GRAVESITES



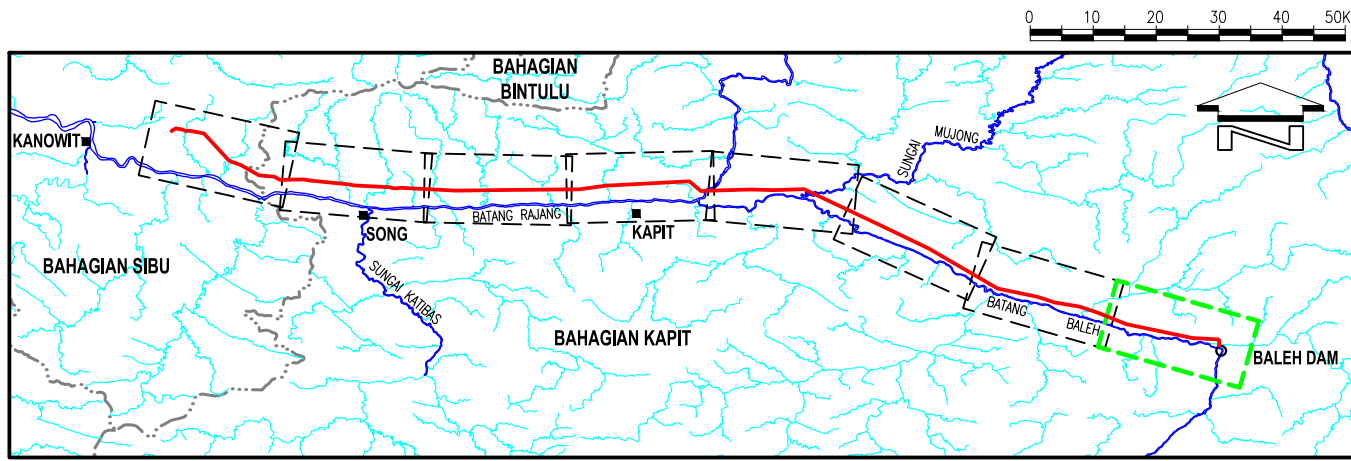
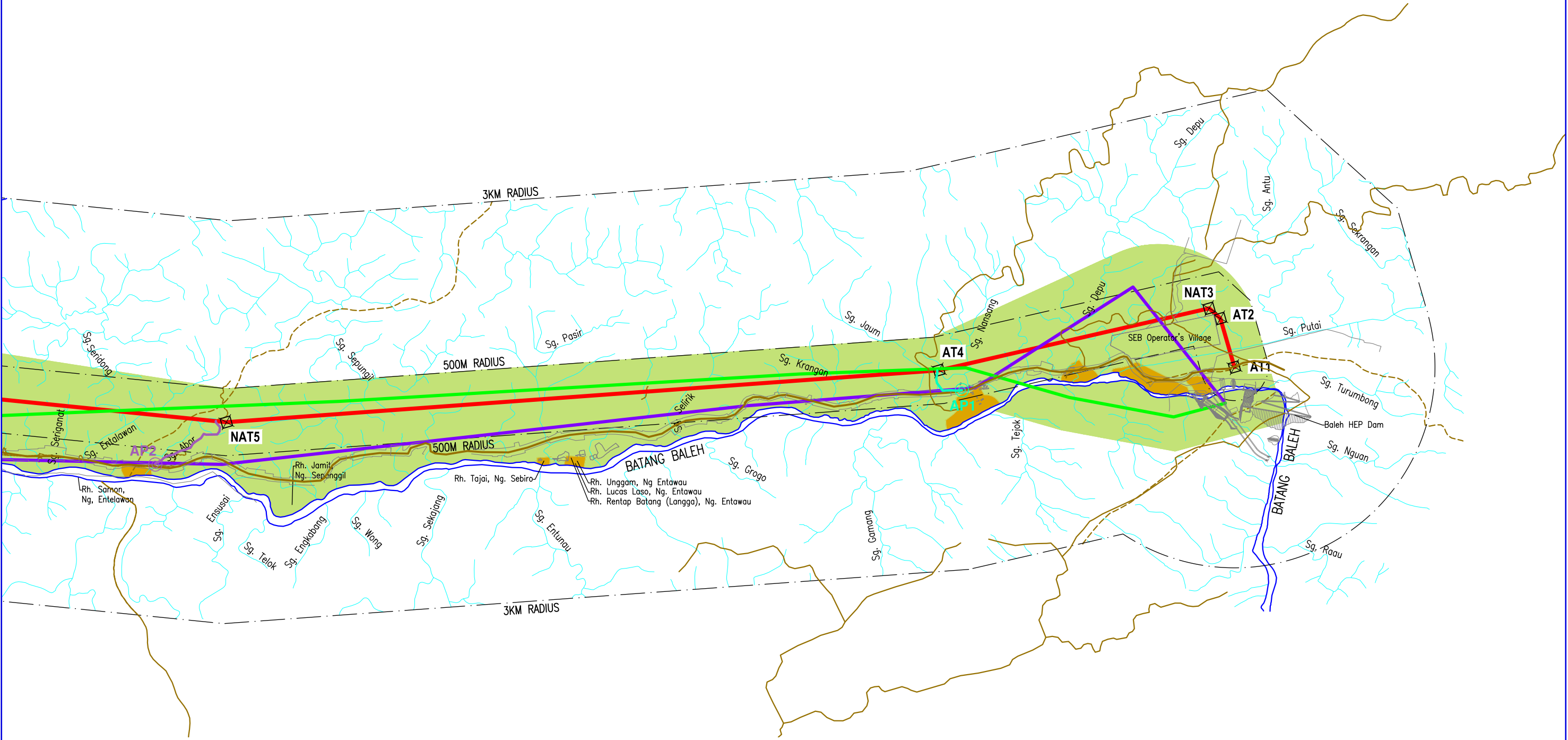
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SERIES T738 SHEET 6314 EDITION 1-PPNM	SERIES T738 SHEET 6413 EDITION 1-PPNM	SERIES T738 SHEET 6414 EDITION 1-PPNM	SERIES T738 SHEET 6513 EDITION 1-PPNM

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-The inner crosses indicate the Latitude and Longitude

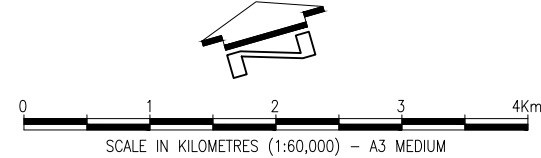
COMPARISON OF ENVIRONMENTAL
AND SOCIAL CRITERIA OF ROUTE
ALIGNMENT OPTIONS

FIGURE: 3.2.2g



LEGEND:

- PROPOSED TRANSMISSION LINE ROUTE (OPTION 2)
- PROPOSED ANGLE TOWER
- TRANSMISSION LINE ROUTE (OPTION 1)
- TRANSMISSION LINE ROUTE (OPTION 3)
- RIVERS
- ROADS
- ACCESS ROADS (OPERATING LOGGING / PLANTATION ROAD)
- ACCESS ROADS (COMMUNITY ACCESS ROAD / ABANDONED LOGGING TRACK)
- BARE LAND
- FOREST
- GRASS AND BUSHES
- PADDY
- SHIFTING CULTIVATION
- TREE CROP
- POND
- GRAVESITES



SOURCE: Adapted from

SERIES T738 SHEET 5914 EDITION 1-PPNM	SERIES T738 SHEET 6014 EDITION 1-PPNM	SERIES T738 SHEET 6114 EDITION 1-PPNM	SERIES T738 SHEET 6214 EDITION 1-PPNM
SERIES T738 SHEET 6314 EDITION 1-PPNM	SERIES T738 SHEET 6413 EDITION 1-PPNM	SERIES T738 SHEET 6414 EDITION 1-PPNM	SERIES T738 SHEET 6513 EDITION 1-PPNM

GRID
-The inner crosses indicate the Latitude and Longitude

COMPARISON OF ENVIRONMENTAL
AND SOCIAL CRITERIA OF ROUTE
ALIGNMENT OPTIONS

FIGURE: 3.2.2h

3.2.2 Route Option 1

3.2.2.1 Environmental and Technical Conditions

This route runs parallel to the RECODA road (or Baleh HEP Access Road) and crosses the road at least at 12 points between Baleh HEP to Nanga Mujung. Its proximity to the RECODA road means the area have been disturbed due to on-going road construction activities.

This route traverses through rugged terrain with elevation up to 300 m at its first 30 km from Baleh HEP. From here onwards, the route travels close to the banks of Btg. Baleh and Btg. Rajang where elevation is generally below 120 m.

The route crosses at least 48 rivers and streams along the way to Mapai. At the stretch along Btg. Baleh, the route crosses Btg. Baleh at several points near AT11 (Rh. John Ak. Katil), Sg. Gaat, near Batu Tunggal and Nanga Banyau as indicated on the sketch maps of **Figure 3.2.2 (a to h)** below. Btg. Baleh at these stretches is approximately 150 m – 180 m wide.

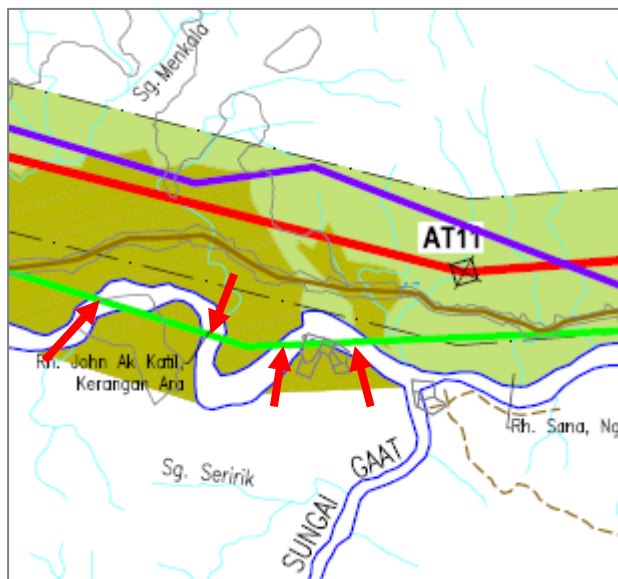


Figure 3.2.3: Crossing Btg. Baleh near AT11, Rh. John Ak Katil (Btg. Balleh)



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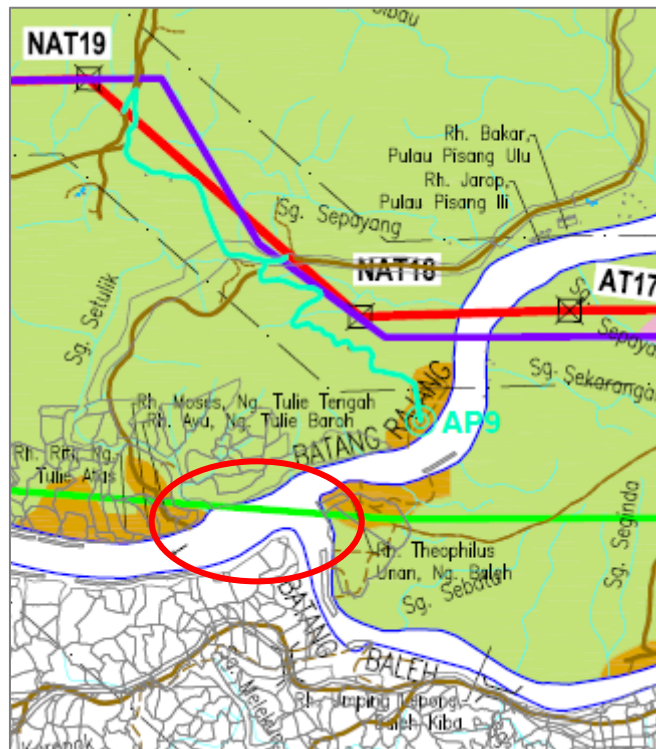


Figure 3.2.6: River crossing at the confluence with Btg. Rajang

Ecologically, this option does not pass-through areas which are considered sensitive biologically. The area along Btg. Baleh is dominated by remnant/secondary forest occasionally mixed with patches of grass and bushes whereas the area along Btg. Rajang primarily is a mix of the same depleted forest and shifting cultivation at all stages.

There are no protected areas or habitats such as National Parks, Nature Reserves and Wild Life Sanctuaries along the route. Therefore, the potential impacts on ecology can be considered as low.

3.2.2.2 Social and Cultural Conditions

In terms of settlements, this route passes through rather close to a number of settlements - see **Figure 3.2.2 (a to h)** and sketch maps below). Most of these settlements are located along the Btg. Rajang stretch of the transmission route.

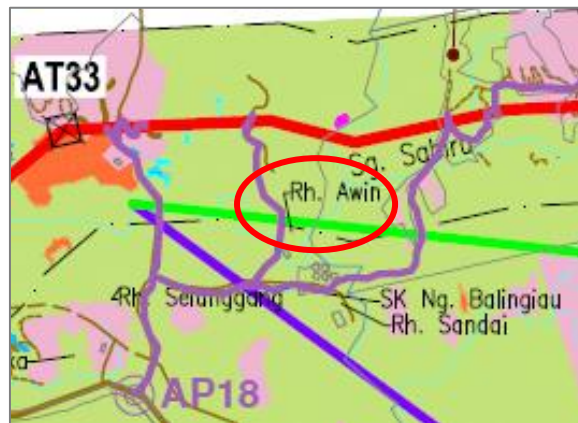


Figure 3.2.7: Close to Mapai Substation, Rh. Awini is along its Path

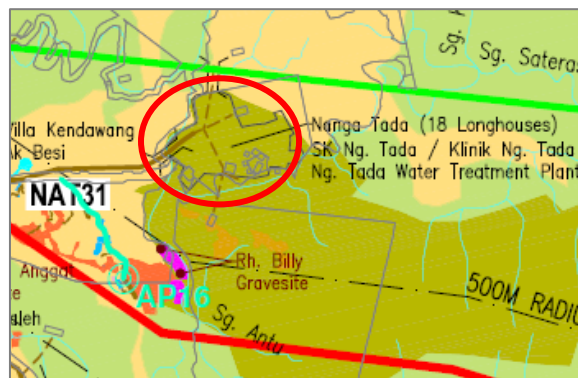


Figure 3.2.8: Nanga Tada is about 150 m south of the Route Option 1

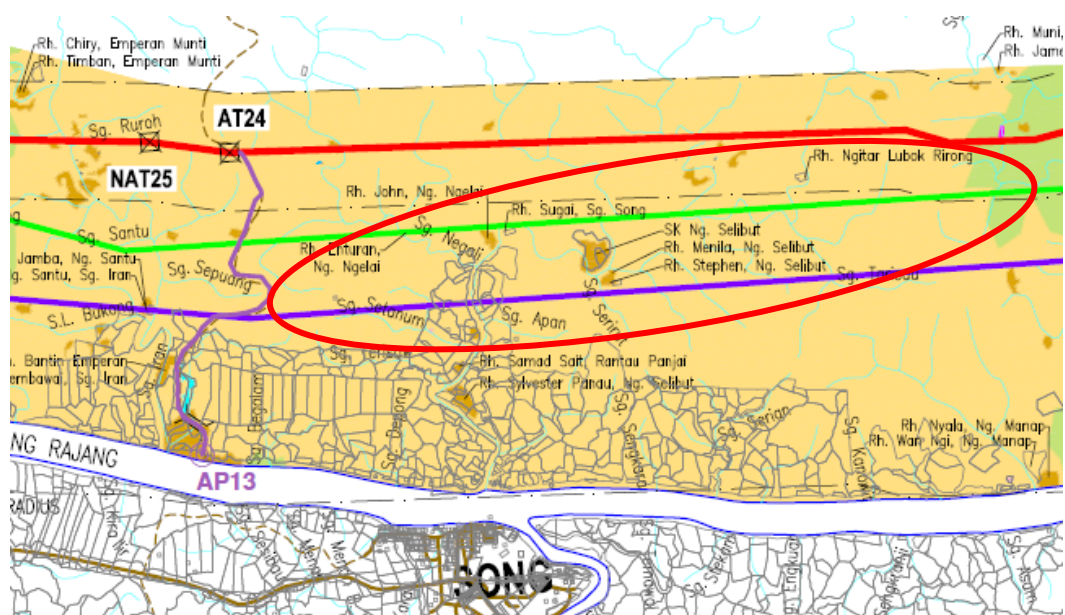


Figure 3.2.9: Near Song, the route passes very close to a number of longhouses including Rh. Ngitar (Lubok Rirong), Rh. Sugai (Sg. Song), Rh. Enturan (Nanga Ngelai) and Rh. John (Nanga Ngelai). SK Nanga Selibut (school) is located approximately 300 m south

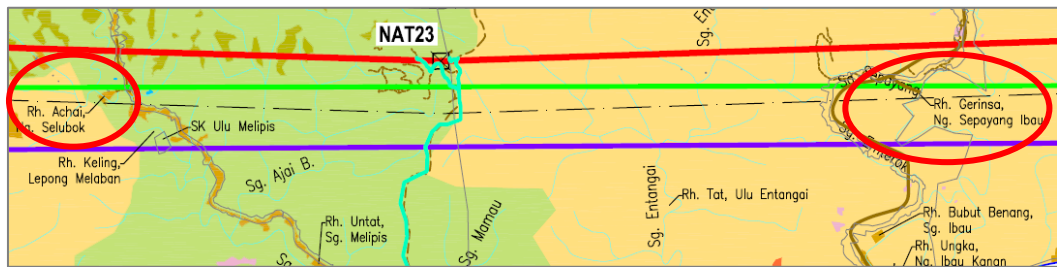


Figure 3.2.10: Rh. Gerinsa (Nanga Sepayang, Ibau), Rh. Achai (Nanga Selubok)

The Btg. Baleh stretch is more sparsely populated. Along this stretch, the route cuts through Rh. Saging near NAT9 and Rh. Steward and Rh. Bidok, further downstream of Rh. Saging.

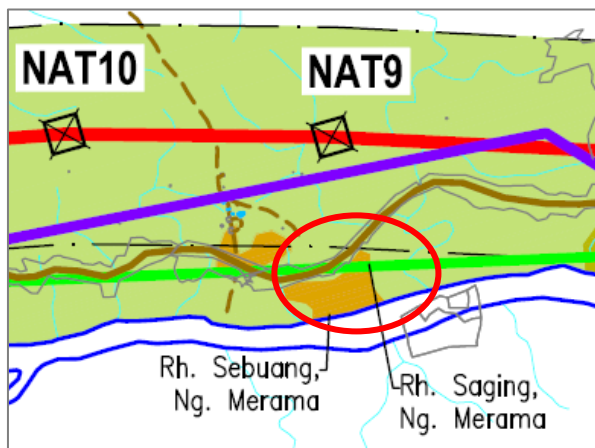


Figure 3.2.11: Rh. Saging (Nanga Merama)

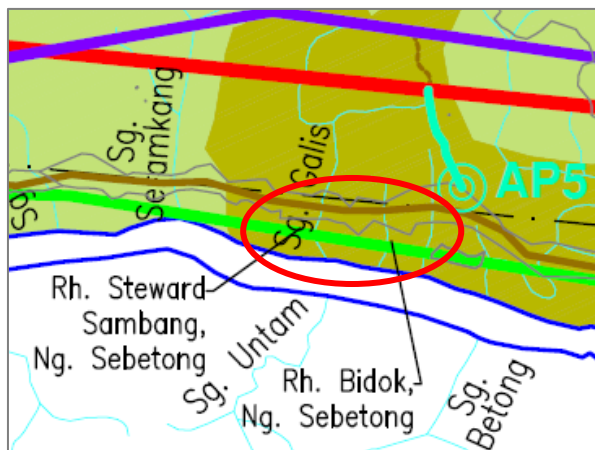


Figure 3.2.12: Rh. Bidok and Rh. Steward Sambang (Nanga Sebetong)

Other settlements include Rh. Gon (Nanga Serian), Rh. Tang Spot (Nanga Banyau), Rh. Theopilus Unan (Nanga Baleh), Rh. Ayu (Nanga Tulie Baroh), Rh. Moses (Rh. Tulie Tengah), Rh. Riti (Nanga Tulie Atas) and Rh. Jeluing (Munggu Sabun).

Titled land lots are mostly found close to urban areas of Kapit, Song and Kanowit. At Kapit, the transmission route traverses large number of titled lots (**Figure 3.2.13**). About 25% of the transmission line right-of-way is on titled land.

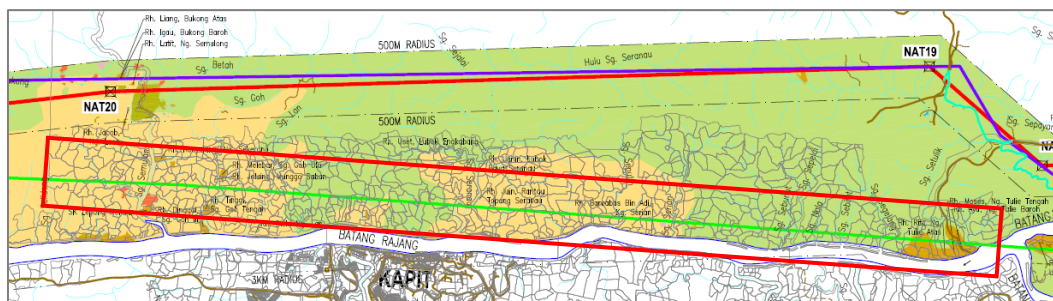


Figure 3.2.13: At Kapit, the transmission line traverses large number of titled lots (see Figure 3.2.2d)

In terms of culturally sensitive sites or areas, none were identified along this route.

However, it can be expected to find especially old unmarked gravesites. This can only be determined once line survey is completed or as chance-find during construction.

3.2.2.3 Economics Conditions

The region is considered rural and most areas are still covered by forest, agriculture and tree crop plantation. Shifting cultivation areas are more common and prominent along the Btg. Rajang stretch of the transmission line.

Route Option 1 passes through large track of shifting cultivation areas near Song (AT24, NAT25), Nanga lbau between AT22 and NAT 23 and near Kapit (NAT18 to AT21) and Belawai.

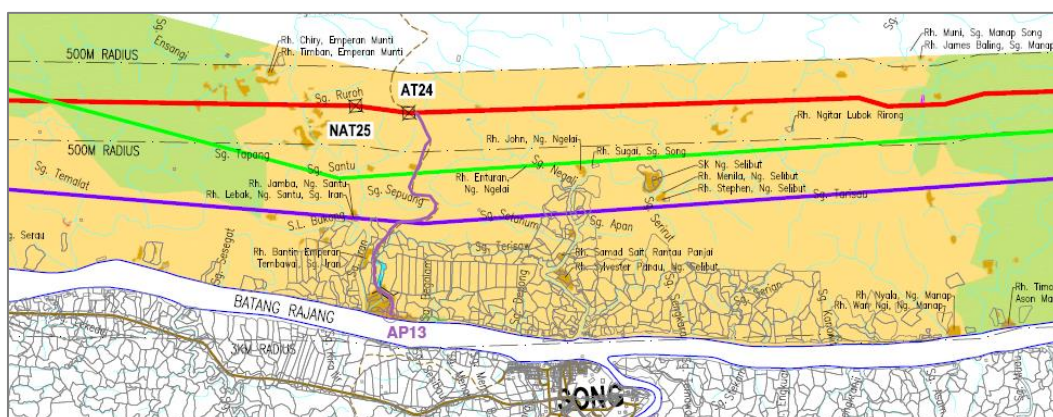


Figure 3.2.14: Shifting cultivation areas near Song, AT24 and NAT25 (see Figure 3.2.2b)

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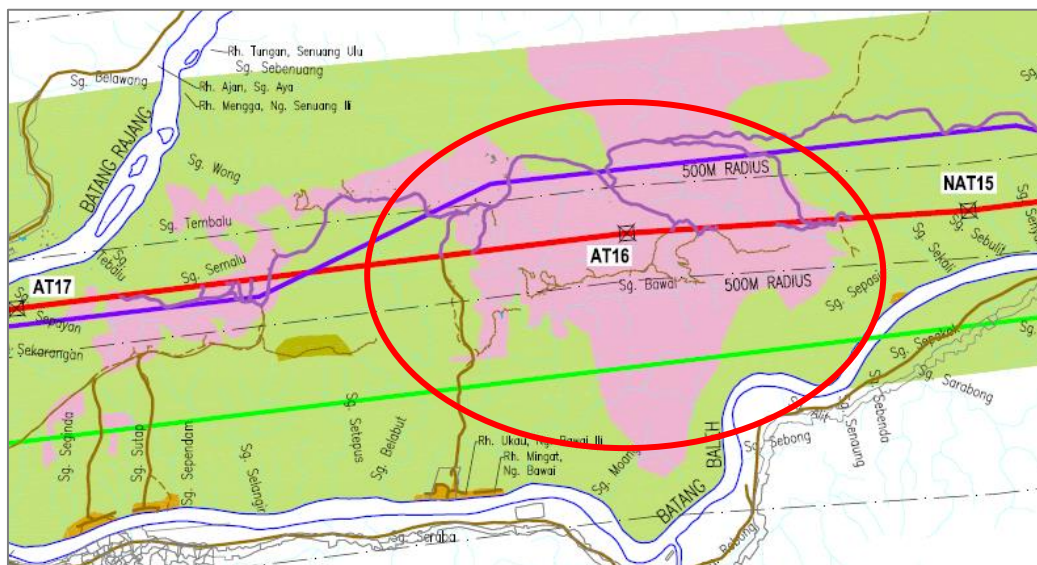


Figure 3.2.18: Oil Palm Plantation area near Nanga Bawai (see Figure 3.2.2e)

The local way-of-life has over the recent decades changed in a manner so the gathering of non-timber forest products and of timber for local construction has become insignificant. No significant areas are thus used to collect resources or house infrastructure. The areas are mainly used for agriculture and forestry.

3.2.3 Route Option 2

3.2.3.1 Environmental and Technical Conditions

For this Option, the two right-of-way alignments, i.e., the transmission line and the road, are as far as possible kept at a distance to avoid any slope failure issues. The terrain is very hilly along the Btg. Baleh, but the alignment is kept below 250 m asl and the tower platforms are placed away from steep slopes. In this way, the transmission line does not cross the RECODA road at any point.

Route 2 crosses at least 45 rivers and streams, mostly tributaries of Btg. Rajang and Btg. Baleh. The route crosses Btg. Rajang only once between AT17 and NAT18, where the river width is about 300 m. From here, the route is shifted away from the rivers (Btg. Rajang) to avoid higher ground, titled land lots and shifting cultivation areas up to AT21.

The distance from the alignment to Btg. Baleh increases from about 200 m at Baleh HEP, to about 3.75 km near AT16. The distance from the transmission line to Btg. Rajang increases from the confluence with Btg Baleh to about 8 km near Mapai Substation. With the exception of the route start at the power house, Route option 2 does not cross Btg. Baleh.

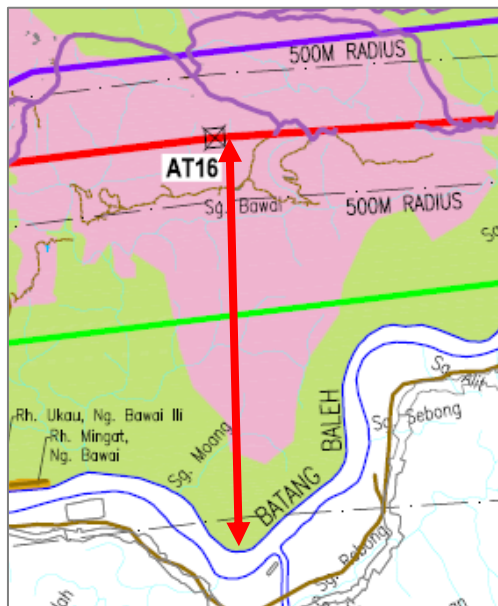


Figure 3.2.19: The furthest distance from Btg. Baleh is near AT16

Ecologically, this option passes through areas which are not considered sensitive biologically. The area along Btg. Baleh is dominated by remnant/secondary forest occasionally mixed with patches of grass and bushes whereas the area along Btg. Rajang primarily is a mix of the same depleted forest and various stages of shifting cultivation.

There are no protected areas or habitats such as National Parks, Nature Reserves and Wildlife Sanctuaries along the route. Therefore, the potential impacts on ecology can be considered as low.

3.2.3.2 Social and Cultural Conditions

This route avoided the SEB Operator's Village at Baleh HEP and Nanga Tada near Mapai.

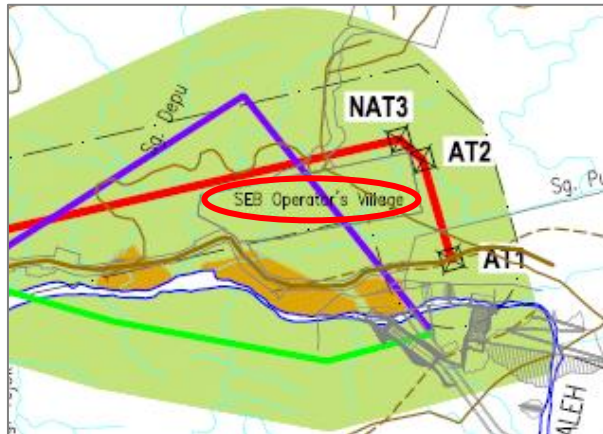


Figure 3.2.20: Avoided the SEB Operator's Village

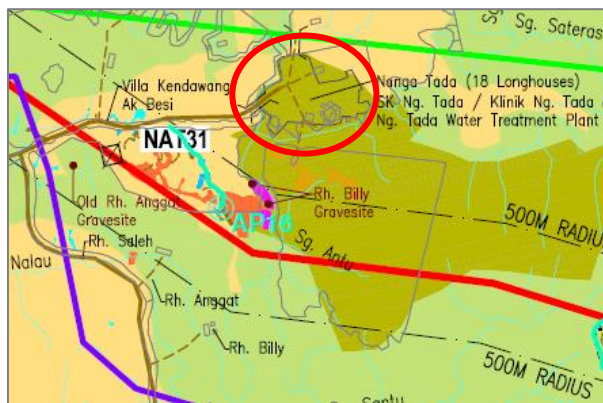


Figure 3.2.21: Route shifted away to the south of Nanga Tada settlement

Overall, this route was moved further inland, avoiding settlements and titled land lots as much as possible. The nearest longhouse identified is Rh. Latit (Nanga Semulong) near NAT20, at a distance of about 200 m away.



Figure 3.2.22: Rh. Latit is about 200 m north of Route Option 2

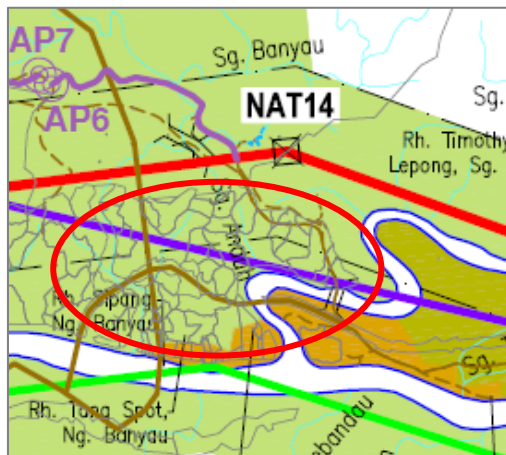


Figure 3.2.23: At Nanga Mujong, NAT 14 is positioned further north to avoid settlements and log ponds

At Nanga Mujong, the crossing at Sg. Mujong was shifted about 1 km north (NAT14) from Option 1 and 3 to avoid settlements and log ponds located at the river mouth of Sg. Mujong.

Approximately 25.7% of the transmission line right-of-way is on titled land. Near Kapit and Song, the ROW was shifted further up to the north to avoid titled land lots and shifting cultivation areas.

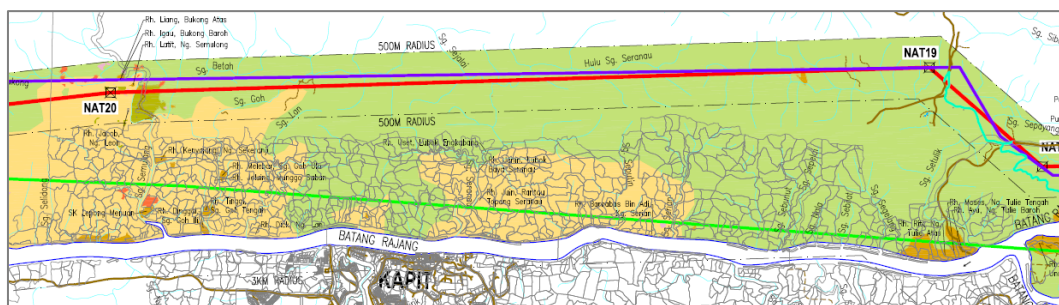


Figure 3.2.24: Near Kapit, the ROW was shifted further up to the north to avoid titled land lots and shifting cultivation areas

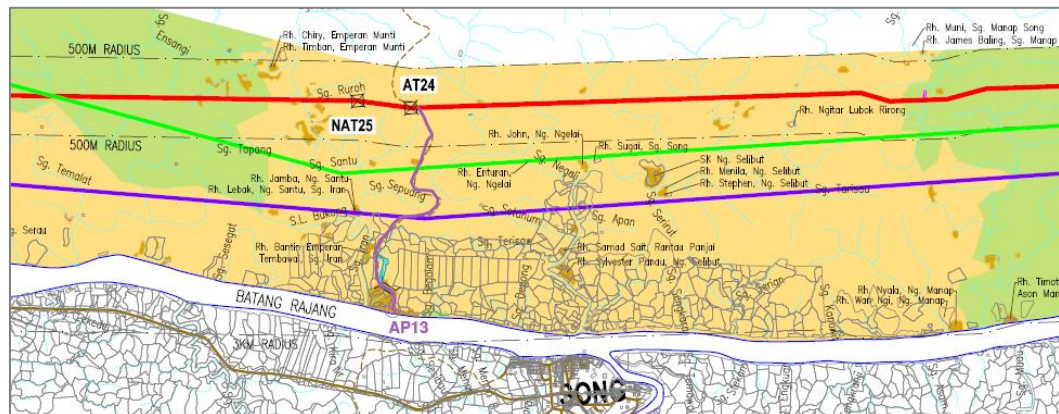


Figure 3.2.25: Near Song, the ROW was shifted further up to the north to avoid titled land lots

In terms of culturally sensitive sites or areas, the transmission line was rerouted to avoid several gravesites between AT27 – AT28, NAT29 – NAT31, AT32 – AT33 and AT23 – AT24 (refer to **Figure 3.2.2 a to h** and sketch maps below (marked with ▲).

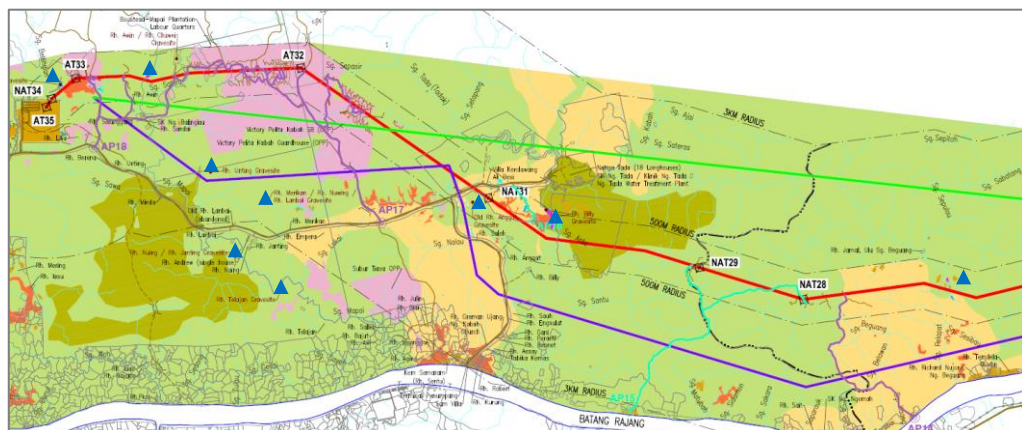


Figure 3.2.26: Grave sites identified near Mapai area

There is likelihood of chance find especially old unmarked gravesites. This can only be determined once line survey is completed or chance find during construction.

3.2.3.3 Economics Conditions

Compared to Route Option 1 and 3, Route Option 2 passes through two (2) main shifting cultivation areas near Song (AT24, NAT25) and Ibau between AT22 and NAT 23 (**Figure 3.2.27** and **Figure 3.2.28**). Another smaller area is at Nanga Beguang.

[illegible]

The map shows the Batang Rajang area in Sarawak, Malaysia. The river flows from the top right towards the bottom left. To the left, the Melipis river joins it. Several villages are marked, including Entangai, Bubu Berang, and Sana. The map is divided into sections by colored lines (red, green, purple). A scale bar at the top indicates distances in kilometers. A legend at the bottom right identifies symbols for roads, rivers, and boundaries.

Changes in local livelihoods patterns has made collection of timber and non-timber forest products less important for the local communities. The patches of remnant and secondary forest (fallow areas) have thus lost their direct value for the communities other than being part of the land-bank for continued agriculture.

C3-22

following the RECODA road. At about 63 km, it makes another 90 degree turn inland to avoid steep slopes.

Between Baleh HEP to Nanga Mujung, this option crosses the RECODA road at least at 15 points. Its proximity to the RECODA road means the area have been disturbed due to on-going road construction activities.

It crosses at least 46 rivers and streams. It does not cross Btg. Baleh except at Baleh HEP, it crosses Btg. Rajang at one point, similar to Route Option 1 and 2.

The closest distance to Btg. Rajang is about 1 km near Rh. Richard Nujong (Nanga Beguang) while the furthest is about 6.5 km near Mapai Substation. The closest distance to Btg. Baleh is about 50 m at several stretches, while the furthest is about 4 km near Sg. Sut.

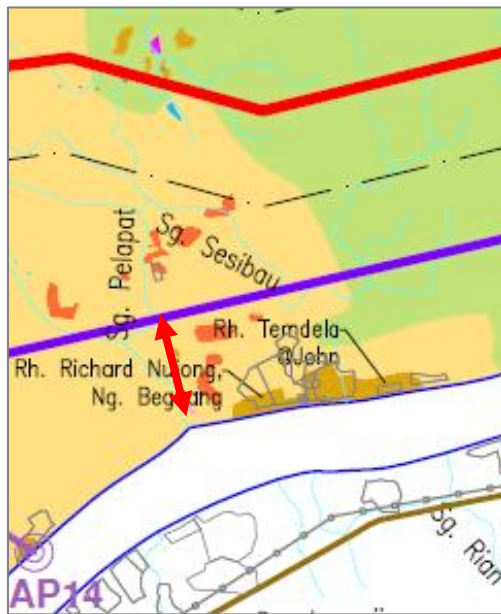


Figure 3.2.29: Closest to Btg. Rajang near Rh. Richard

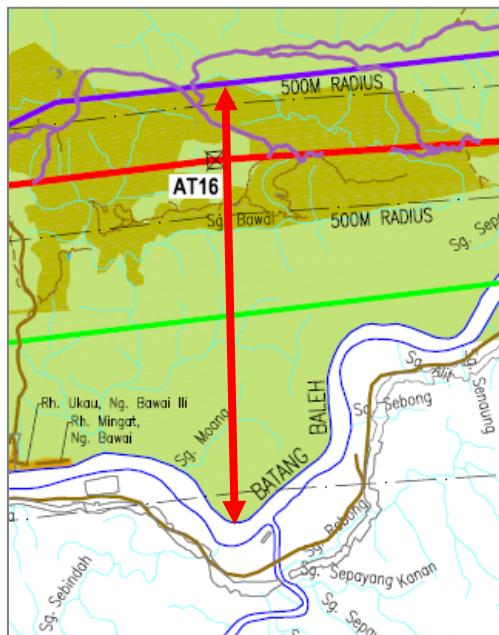


Figure 3.2.30: Furthest from Btg. Baleh near Sg. Sut

Ecologically, this option passes through areas which are not considered sensitive biologically. The area along Btg. Baleh is dominated by remnant/secondary forest occasionally mixed with patches of grass and bushes whereas the area along Btg. Rajang primarily is a mix of the same depleted forest and shifting cultivation at all stages.

There is no protected areas or habitats such as National Parks, Nature Reserves and Wildlife Sanctuaries along the route. Therefore, the potential impacts on ecology can be considered as low.

3.2.4.2 Social and Cultural Conditions

This route crosses the Operator's Village at Baleh HEP. It crosses SK Ulu Melipis and passes close to SK Nanga Selibut.

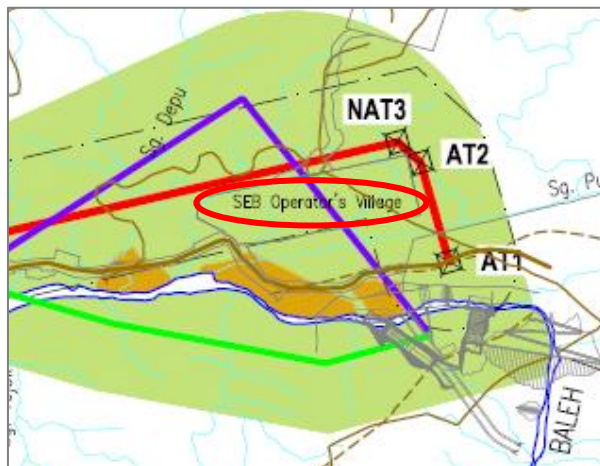


Figure 3.2.31: Crosses the SEB Operator's Village



Figure 3.2.32: SK Ulu Melipis

Several longhouses identified to be within the ROW or close to the route are Rh. Latit, Rh. Igau, Rh. Liang (near NAT20), Rh. Keling (Lepong Malaban), Rh. Stephen and Rh. Menila (Nanga Selibut), Rh. Jamba and Rh. Lebak (Nanga Santu, Sg. Iran).

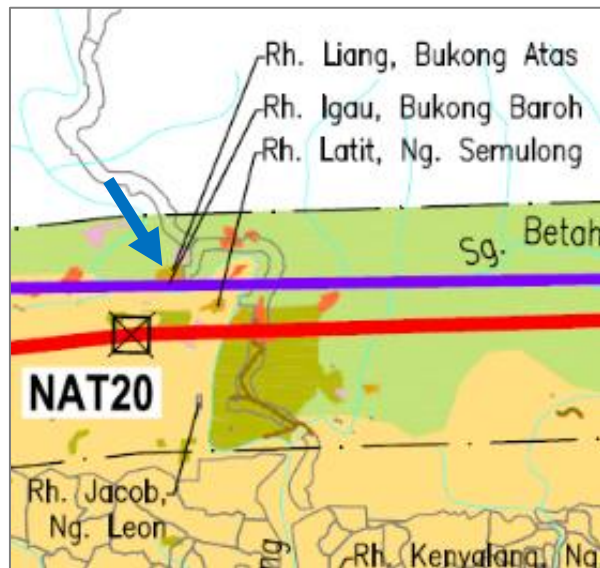


Figure 3.2.33: Rh. Igau sits on the route alignment

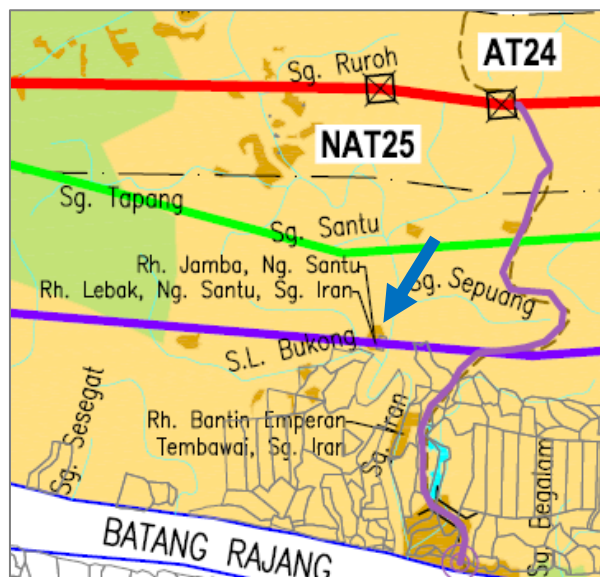


Figure 3.2.34: Rh. Lebak and Rh. Jamba sitting on the route alignment

Similar to Route Option 2, the ROW was shifted further up to the north to avoid titled land lots near Kapit. However, at Song, the route is sited closer to the riverbank compared to Option 1 and 2, where more titled land lots are found. Another section where titled land lots are affected by Option 3 is at Nanga Mujung area (near NAT14) as shown on the sketch map below. About 20.7% of Route Option 3 is on titled land.

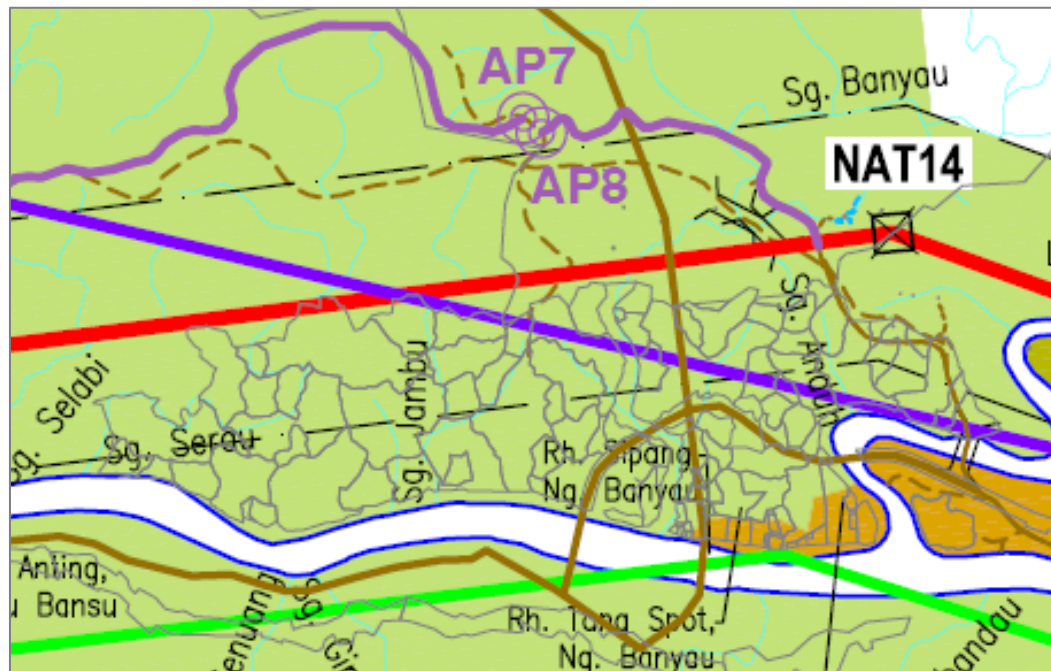


Figure 3.2.35: Titled land lots concentration crossed by Route Option 3, near Nanga Mujung (refer Figure 3.2.2e)

In terms of culturally sensitive site or area, none were identified directly along this route. However, there are several grave sites identified within the 500 m zone of influence (refer to **Figure 3.2.2 a to h** and **Figure 3.2.26** above).

3.2.4.3 Economic Conditions

This route passes through large shifting cultivation areas near Song (AT24, NAT27), Ibau between AT22 and NAT 23, Nanga Beguang and Belawai. Shifting cultivation areas at Kapit were avoided by shifting the route north almost parallel to Route Option 2 (see **Figure 3.2.24**).

Route Option 3 also passes through oil palm plantation near the confluence of Btg. Baleh, near Nanga Bawai but avoided larger area near Mapai Substation. Refer to **Figure 3.2.17** and **Figure 3.2.18**.

3.2.5 Route Option 4

As mentioned earlier, Route Option 4 was not further considered due to the large number of titled land involved. In addition to that, this route will pass through two major towns i.e., Kapit and Song and more built-up areas and settlements. this option would thus contravene both State and SEB's policies. Choosing this route requires more initial cost than the other alternative routes.

3.3 CONSULTATION, INFORMATION DISCLOSURE AND STAKEHOLDER VIEWS AND CONCERNS

Stakeholder engagement is one of the main components in SEB development projects. The consultation process and information disclosure shall continue even during the implementation phase of the Project. The details are elaborated in **Chapter 4: Stakeholder Analysis and Engagement**.

SEB organized four (4) dialogue sessions in collaboration with the District of Offices of Kanowit, Song, Kapit and Bukit Mabong in October 2020. These sessions were undertaken to inform the local authorities and community leaders of the proposed BMTLP. The feedback generated through these sessions and consultation has been incorporated as far as possible in the design and construction of the transmission line.

During these sessions, the attendees were briefed about the Project, the location of the transmission route, the route options, the main implementation activities, work sequence and deliverables. Significant dates for pre-engineering works such as soil investigation, line route survey and ESIA study were highlighted. Participants were also made aware of the process of land acquisition as well as the grievance mechanism of the Project.

All these topics were presented and explained in Iban language for easy understanding of the attendees. In addition to that, the Project's information pamphlets (in Bahasa Malaysia) were also distributed to the attendees. Responses/ enquiries / feedbacks from the dialogue participants were recorded in the minutes of meeting and feedback forms (collected after the meetings). Responses and clarification to the attendees' enquiries were also given during the dialogues by the Project Proponent and panel members (representatives from the District Offices, LSD, Police and the Resident's Office). These were also recorded in the minutes of meetings.

During these sessions, there were no objections to the proposed transmission line routes. Most of the participants showed their support to the Project but raised several issues and concerns and recommended that SEB should investigate them to avoid misunderstanding and dispute, which may lead to project delay. The issues and concerns raised are as follows:

- **Land Acquisition and Compensation Rate (Land and Crops):**

In all the sessions, this was one of the main topics raised. Issues raised in relation to land acquisition were survey method, crop counting, compensation rate (list of rates for land and crops), discrepancies in compensation rates, method of payment, late payment, unsettled payment (citing SEB's previous transmission line project on the southern bank of Btg. Rajang) and appointment of onsite/local liaison person to deal with compensation matters.

It was requested that the rate should be fair and made known to the land owners to avoid confusion and misunderstanding.

- **Notification of Work Commencement:**

The *Tuai Rumahs* (Headmen) requested that they be notified / informed/ consulted in advance of survey works or any works commencement near their longhouses or lands. This is to avoid any misunderstanding or dispute between the community, especially if it involves various land owners, crops and land boundaries.

- **Cultural Issue - Gravesites**

Should the transmission line cross any gravesites, the local custom must be observed. According to the *Pemali* of the Iban custom, no trees or crops shall be cut on gravesite areas. This issue was raised during the Kapit dialog session. Hence, the transmission line must be aligned or realigned to avoid gravesites, as far as possible.

- **Soil Erosion and Water Pollution**

This concern was raised at the session carried out in Kapit. The enquiry was related to the method of dealing with future contractors and how SEB will handle or mitigate potential soil erosion and water pollution problems that may end up in land adjacent to the ROW or water catchment area.

- **Health Impact from the Transmission Line and Substation**

This concern was raised at the session carried out in Kanowit. The concern was the transmission line and substation operation impact on the health of nearby residents.

The results of community-level social surveys at Mapai and the surrounding areas of Kanowit District in early December 2020, also echoed the same issues of concerns.

Only four (4) of the identified stakeholders responded to the TOR, which was made public from 2 – 20 Jan 2021. None of them commented on the siting of the transmission line route on the northern bank of Btg. Rajang and Btg. Baleh.

3.4 HSAP CRITERIA FOR SITING AND DESIGN OPTIONS

P-4 of the HSAP addresses the evaluation and determination of project siting and design options. The purpose is to ensure, that siting and design has taken into account environmental, technical, social, and economic considerations. **Table 3.4.1** below summarizes the criteria used for the route option analysis based on P-4 topic of HSAP.

The potential for impacts or scale of significance have been identified as low, medium and high, and each of these is given a weighting score of 1, 2 or 3 respectively and applied across the listed environmental and social criteria.

Table 3.4.1: HSAP Siting and Environmental Criteria Considered for Route Options

Environmental and Social Criteria	HSAP Basic Good Practice	Scale of Significance (Weighting)	Description
Environmental and Technical	Biological Route avoids significant environmental features: <ul style="list-style-type: none"> Protected areas or habitats such as National Parks, Nature Reserves and Wild Life Sanctuaries. Areas with high concentration of biological diversity including endemic and rare species, threatened or endangered species. Rare, threatened, or endangered ecosystems, habitats. 	High (3)	Protected areas, habitats, sensitive areas or presence of rare, threatened or endangered ecosystems within the transmission line and access roads 50 m ROW.
		Medium (2)	Protected areas, habitats, sensitive areas or presence of rare, threatened or endangered ecosystems within the transmission line 500 m zone of influence (excluding 50 easement of ROW).
		Low (1)	No protected areas, habitats, sensitive areas or presence of rare, threatened or endangered ecosystems within the transmission line ROW or access roads ROW.
	Physical Route avoids terrain of more than 250 m in elevation and steep slopes wherever possible. Route reduces number of major navigable river crossings. Route avoids gravity feed water supply catchments, structures e.g., weir.	High (3)	No avoidance of steep slope of more than 250 m in elevation. 20 and more river crossings. 20 or more gravity feed water supply catchment or structure.
		Medium (2)	Some parts of the transmission line are on 250 m terrain. 1-20 river crossings. 1-20 gravity feed water supply catchment or structure.
		Low (1)	Avoid terrain of more than 250 m in elevation. No river crossing.

Environmental and Social Criteria		HSAP Basic Good Practice	Scale of Significance (Weighting)	Description
				No gravity feed water supply catchment or structure.
Social and Cultural	Stakeholder Engagement	Involved appropriately timed, two-way engagement with affected stakeholders; ongoing processes in place for stakeholders to raise issues and get feedback.	High (3)	More than half of the community consulted rejected the transmission line project.
			Medium (2)	Some rejection to the proposed transmission line project.
			Low (1)	No objection to the proposed transmission line project.
	Land and Settlements	Route avoids titled land lots. Route avoids human habitation such as towns/ bazaars, longhouses (individual or cluster), structures or built-up areas, other infrastructure and industry. Route minimises population displacement.	High (3)	Settlements within the transmission line 50 m ROW. 60% or more titled land lots
			Medium (2)	No resettlement of population or structure 30% - 59% titled land lots
			Low (1)	No resettlement of population or structure. 1% - 29% titled land lots
	Infrastructure	Route avoids public utility services, playgrounds, schools, community places, clinics, churches, mosques, temples and other establishments, etc.	High (3)	1 or more schools, clinics, churches, etc., within transmission line 50 m ROW
			Medium (2)	1 school, clinic, church, etc., within transmission line 50 m ROW
			Low (1)	No schools, clinics, churches, etc., within transmission line 50 m ROW
	Health	Enhance public health and minimize public health risks.	High (3)	5 or more settlements expose to air and noise pollution.
			Medium (2)	1-4 settlements expose to air and noise pollution.

Environmental and Social Criteria		HSAP Basic Good Practice	Scale of Significance (Weighting)	Description
	Cultural Heritage	Route avoids sensitive cultural heritage sites, e.g., grave sites.	Low (1)	No exposure to air and noise pollution.
			High (3)	5 or more cultural heritage sites within the transmission line 50 m ROW.
			Medium (2)	1-4 cultural heritage sites within the transmission line 50 m ROW.
			Low (1)	No cultural heritage site within the transmission line 50 m ROW
Economic	Farmland	Route avoids land used as primary farmland for livelihoods. Route avoids primary shifting cultivation areas.	High (3)	Large track of main shifting cultivation or cultivated areas.
			Medium (2)	Moderate track of main shifting cultivation or cultivated areas.
			Low (1)	Low or avoided large track shifting cultivation or cultivated areas.

Source: Hydropower Sustainability Assessment Protocol (HSAP), 2020 & Hydropower Sustainability Guidelines, 2020.

3.4.1 Comparative Analysis of Route Options

Based on the criteria defined in **Table 3.4.1**, the comparative analysis of the proposed route options is presented in **Table 3.4.2** below. The table summarises and ranks the route options comparatively to identify the route with the least impacts arising from a transmission line development. The purpose of the analysis is to identify the optimum location to accommodate the proposed transmission line through a comparative assessment. The table provides a column for each of the 3 route options and ranks each route in terms of their suitability based on the environmental and social criteria. The lowest scoring route shows the optimum and most resilient route after the various constraints set out above have been applied.

Table 3.4.2: Comparative Analysis of Route Alignment Options

Environmental and Social Element			Route Option 1	Scale of Significance (Weighting)	Route Option 2	Scale of Significance (Weighting)	Route Option 3	Scale of Significance (Weighting)
ENVIRONMENTAL AND TECHNICAL	Length (km)		175	Low (1)	177	Low (1)	177	Low (1)
	Biological	Protected areas or habitats	None	Low (1)	None	Low (1)	None	Low (1)
		Areas with high concentration of endemic and rare species, threatened or endangered species	None There are no protected areas, primary forest, wetlands, areas identified as having special ecological significance	Low (1)	None	Low (1)	None	Low (1)
		Rare, threatened, or endangered ecosystems, habitats	None	Low (1)	None	Low (1)	None	Low (1)
	Physical	Terrain	Hilly, 50 m to 300 m along Btg. Baleh	High (3)	Within 250 m along Btg. Baleh	Medium (2)	Within 60 m to 150 m	Medium (2)
		No. of RECODA road crossing	12	Medium (2)	None	Low (1)	15	Medium (2)
		No. of river crossing	48	High (3)	45	High (3)	46	High (3)
		Gravity feed water catchment	44	High (3)	44	High (3)	44	High (3)
	SOSIAL	Engagement	Stakeholder engagement	Low (1)	No objection	Low (1)	No objection	Low (1)
		Land and Settlements	Titled land lots (Estimated)	25%	High (1)	26%	Low (1)	21%
			No. of settlements within the ROW	4 on its path may need to be relocated: 1. Rh. Awin 2. Rh. Saging 3. Rh. Bidok 4. Rh. Enturan	High (3)	None	Low (1)	4 on its path may need to be relocated: 1. Rh. Igau 2. Rh. Lebak 3. Rh. Jamba 4. SEB Operator's Village at Baleh HEP on its path
			Other nearby settlements	Other longhouses within 200 m: • Nanga Tada 150 m south • Near Song, very close to Rh. Ngitar (Lubok Rirong), Rh. Sugai (Sg. Song) and Rh. John (Nanga Ngelai). • Other - Rh. Gon (Nanga Serian), Rh. Tang Spot (Nanga Banyau), Rh. Theopilus Unan (Nanga Baleh), Rh. Ayu (Nanga Tulie Baroh), Rh. Moses (Rh. Tulie Tengah), Rh. Riti (Nanga Tulie Atas) and Rh. Jeluing (Munggu Sabun)	Medium (2)	Rh. Latit (Nanga Semulong) near NAT20 – 200 m away.	Low (1)	• Rh. Latit • Rh. Igau • Rh. Liang (near NAT20) • Rh. Keling (Lepong Malaban) • Rh. Stephen and Rh. Menila (Nanga Selibut), • Rh. Jamba and Rh. Lebak (Nanga Santu, Sg. Iran).
			Towns	None	Low (1)	None	Low (1)	None
		Infrastructure	School	SK Nanga Selibut - 300 m south.	High (3)	None	Low (1)	SK Ulu Melipis on its path Close to SK Nanga Selibut – 300 m north
			Clinic / hospital	None	Low (1)	None	Low (1)	None
			Church / mosque / temple	None	Low (1)	None	Low (1)	None
		Cultural Heritage	Gravesites / burial sites	None	Low (1)	4 within 500 m zone of influence	Medium (2)	2 within 500 m zone of influence
			Cultural heritage sites	None	Low (1)	None	Low (1)	None

Environmental and Social Element			Route Option 1	Scale of Significance (Weighting)	Route Option 2	Scale of Significance (Weighting)	Route Option 3	Scale of Significance (Weighting)
	Health	Air and noise pollution during construction stage	AP9, AP10, AP11, AP12, AP15, AP16	High (3)	AP5, AP7, AP8, AP9, AP10, AP11, AP12, AP13, AP15, AP16	High (3)	AP5, AP7, AP8, AP9, AP10, AP11, AP12, AP13, AP15, AP16	High (3)
ECONOMIC	Farmland	Farmland and Shifting cultivation areas	<p>Area of farming, shifting cultivation and secondary vegetation.</p> <p>3 main shifting cultivation areas:</p> <ol style="list-style-type: none"> 1. Near Song (AT24, NAT25) 2. Ibau area between AT22 to NAT 23 3. Kapit area between NAT18 to AT21) <p>Other smaller areas are at Nanga Beguang and Belawai.</p> <p>Oil palm plantation near Mapai Substation and Nanga Bawai</p>	High (3)	<p>Area of farming, shifting cultivation and secondary vegetation.</p> <p>2 main shifting cultivation areas:</p> <ol style="list-style-type: none"> 1. Near Song (AT24, NAT25) 2. Ibau area between AT22 to NAT 23 3. Paddy field between AT30 and NAT31, near Nanga Tada <p>Other smaller areas are at Nanga Beguang</p> <p>Avoided large track shifting cultivation areas near Kapit between NAT18 to AT21</p> <p>Oil palm plantation near Mapai Substation and Nanga Bawai</p>	Medium (3)	<p>Area of farming, shifting cultivation and secondary vegetation.</p> <p>4 main shifting cultivation areas:</p> <ol style="list-style-type: none"> 1. Near Song (AT24, NAT27) 2. Ibau area between AT22 and NAT 23 3. Nanga Beguang area 4. Belawai area <p>Avoided large track shifting cultivation areas near Kapit between NAT18 to AT21</p> <p>Oil palm plantation near Nanga Bawai</p>	High (3)

3.4.2 Route Selection Conclusion

The route with the lowest score emerges as the least sensitive and most appropriate to bring forward for the Project. The results of the route options assessment comparison are summarised in **Table 3.4.3** below.

Table 3.4.3: Results of the Route Options Assessment Comparison

Route Options	Total Impact Weighting	Sequential Ranking
1	36	2
2	30	1
3	36	2

In terms of environmental criteria, the differences between the three considered options are minimal. Evaluation against these criteria shows that **Option 2** is preferred from an environmental and social perspective. As a result, SEB selected Option 2 that appropriately balanced siting criteria to meet the criteria listed below:

- Fewest land use conflicts (titled land lots).
- Avoided settlements and institutions such as school.
- Avoided sensitive cultural resources.
- Avoided steep slopes.
- Maintained distance from RECODA road.
- No objection to the proposed routes based on stakeholder engagement carried out.

3.5 DESIGN OPTIONS: TOWER TYPES AND CONSTRUCTION METHOD

3.5.1 Tower Types

The most robust component of a transmission line is the steel tower. In Sarawak, transmission lines are either lattice type tower or monopoles tower. The type of tower that will be installed for BMTLP is the lattice tower type, designed to withstand wind, momentum, and uplift force. The lattice tower is selected due to its:

- Low-cost operation: Lattice towers using angle sections are easy to fabricate with quick factory setup.
- Ease of transportation: Lattice angle sections can be bundled and transported by trucks.
- Ease of erection mainly in hilly areas and areas far away from the road access. Erection of towers can be carried out using gin poles or floating derricks where crane erection is not possible.
- The configuration of latticed towers can be easily adjusted to accommodate several electric circuits and various types of conductor configurations.

In comparison, monopoles are generally costlier than lattice angle towers due to higher cost of plates where monopole requires specialized plate bending machine with high capital cost.

3.5.2 Construction Method

The construction method to be employed for the BMTLP is best suited to the constraints of the local environment. The approach has been used by SEB for areas with terrain similar to the project site.

The construction of the transmission line in this region involves positioning and installation of tall towers on rugged terrains with large portions without road accessibility. This brings issues of minimizing damages to crops and paddy fields, sensitivities of land use and environmental considerations. Heavy masses of structural steelwork, construction materials for concrete foundations, reels of conductor cables, transmission line fittings and accessories, and heavy stringing machineries such as tensioners and pullers need to be transported to hillslopes and hilltops.

Upon completion of land survey and demarcation of trees within the ROW, tall trees within the ROW will be removed as necessary in order to maintain necessary transmission line conductor clearance. In areas under forestry licence, a salvage logging operation is expected to be required by the Forest Department Sarawak and carried out by the concessionaires. This will remove commercial timbers but not clear the area. Felled oil palms will be chipped in order to curtail the breeding of e.g., rhinoceros beetle (*Oryctes rhinoceros*). While roots and smaller vegetation may be left in situ a path connecting all towers must be cleared in order to bring machinery from tower to tower and in order to facilitate the stringing procedure.

Depending on terrain, stability, soil strength and tower locality, the installation of foundations may be any of three types i.e., pad and chimney; cast in-situ or piled. These have proven suitable for local conditions wherefore no other types have been considered.

Foundation construction begins with excavations of earth or auguring of holes for footing and concreting of the tower base. Once the concrete has cured, crews can begin the construction of the tower structure itself.

Foundation construction using precast concrete was not considered as the weight of precast concrete will require special transportation vehicles like picker trucks and will also need good and stable road access to the tower locations so that the concrete pieces are not compromised.

Transmission towers are erected manually by skilled workers using gin-poles (derricks) and pulleys in hilly and inaccessible areas. The method used is determined by terrain and available space next to the structure site. In areas accessible to cranes, the use of it will expedite the erection of towers.

Lifting of the tower parts to the top using high boom crane was not considered as the availability of such sophisticated cranes in this remote part of Sarawak is almost non-existence. Furthermore, approach roads leading to the tower locations are not wide enough or good enough to accommodate these massive boom cranes.

The Helicopter Method of tower erection was also discarded due to safety reason as Sarawak averages about 182 thunderstorm days in a calendar year.

The stringing method is elaborated in **Section 2.5.2.7** (Chapter 2).

As the project area is on hilly terrain, to prevent soil erosions, disturbed ground is closely turfed with provision of temporary drainage if necessary. For steep slope areas where perimeter drainage is not possible, erosion control blankets may be utilised to provide cover for bare soil.

3.6 'NO PROJECT' OPTION

A 'No Project' option simply means that the proposed Project would not proceed or the Proponent does nothing to address the purpose and need for the transmission line.

As mentioned in the Statement of Need and Strategic Fit in **Chapter 1**, the BMTLP is an integral part of the 1285 MW Baleh HEP. Without the BMTLP proceeding, the Baleh HEP would not be able to function.

It would therefore be considered a substantial loss to Sarawak's need for more reliable, renewable energy to cater for the ever-growing energy demand by the industrial sector, especially those energy-intensive industries at SCORE as well as the general daily consumers, business and commercial owners and retailers. Under the No Project option, reliable electrical service to existing, approved, and proposed development would not be realized.

Subsequently, the primary objective of the Project which is to contribute to the State of Sarawak's agenda of sustainable development will not materialized.

On the other hand, a No Project option ensures the status quo in the biophysical and social environment along the Project area. If the Project is not implemented, direct impacts to the environment would not occur because no new construction would take place.

3.7 IMPACT ZONE /AREA OF INFLUENCE

The proposed BMTLP is approximately 177 km in length with a required 50 m easement or ROW to be established. In addition, access roads are required to facilitate the construction and maintenance of the transmission line.

The project site is defined as the area required for the ROW and access roads. For the purpose of this ESIA, the study area is defined as follows:

Impact Zone	Area of Influence
Transmission line Corridor including access roads	<ul style="list-style-type: none"> Project footprint: <ul style="list-style-type: none"> 177 km transmission line with 50 m easement (25 m on either side). ROW (including road reserves) of access routes and roads. 500 m zone of influence on either side of the transmission line (inclusive of 50 m easement). Refer Figure 3.7.1
River Corridor	<ul style="list-style-type: none"> Btg. Rajang and Btg. Baleh south of the transmission line. Access routes along the southern bank to be used by construction traffic (100 m zone of influence

Impact Zone	Area of Influence
	<p>i.e., 50 m on either side).</p> <ul style="list-style-type: none"> • Jetties to be used or constructed, also with 100 m zone of influence. • Towns that may be affected by the presence of the construction workforce or employment opportunities (Kanowit, Song, Kapit). • Refer Figure 3.7.2

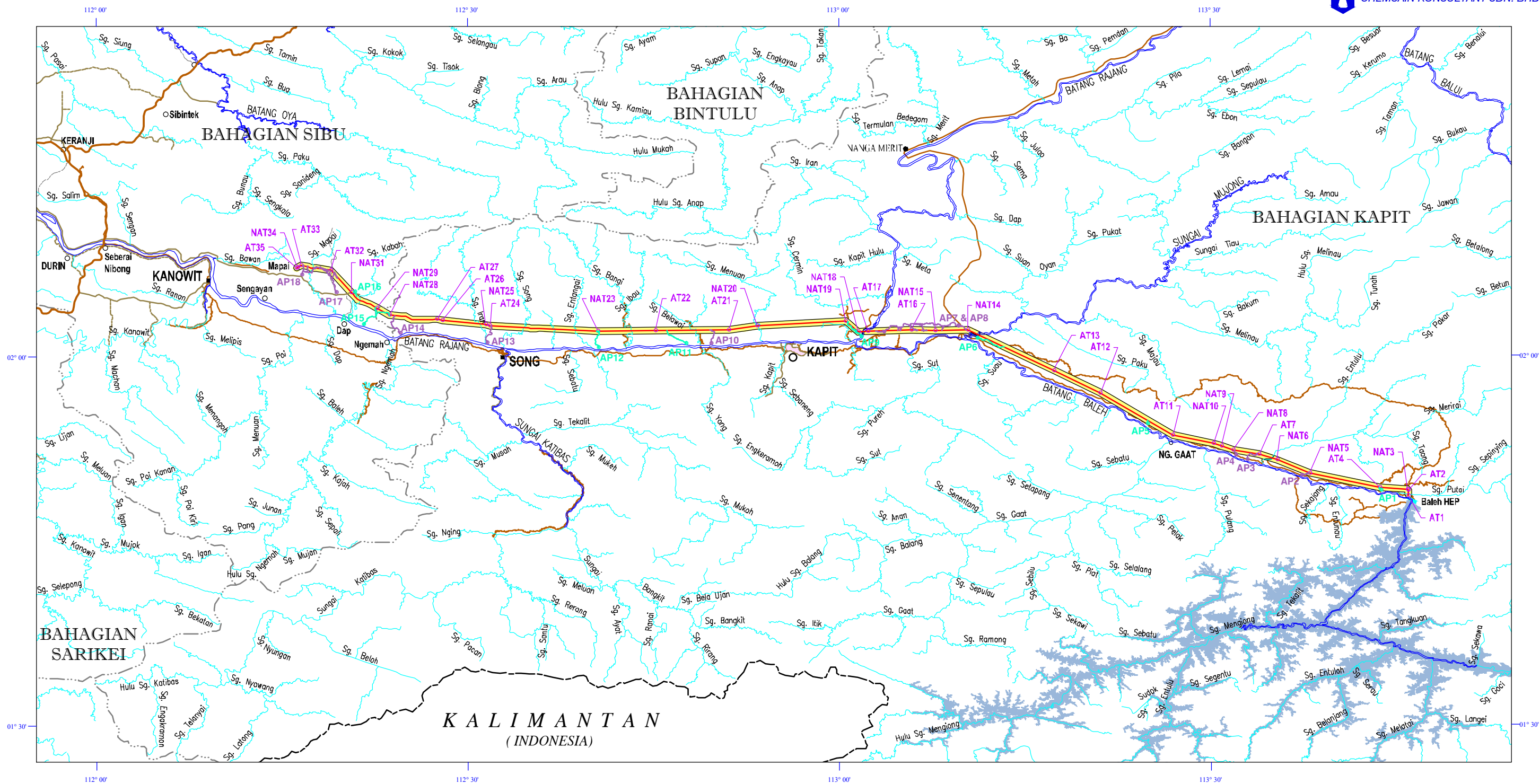
The focal study area shall be as described above.

For the physical environment, the primary areas of impact are areas to be cleared for tower bases, access routes and roads and possible lay-down and camp areas. Most of these will be within the transmission line ROW including access roads.

Similarly, the primary areas of impact for terrestrial flora are the access roads, the ROW and possible lay-down and camp areas.

For terrestrial fauna, the area of impact will be slightly different depending on the landcover. In the case of a transmission line, disturbance during construction will only be temporary and localised at shifting work sites. The major issue may be related to larger avifauna, and the obstacle presented by the cleared easement to the movement of terrestrial fauna during operation stage. Hunting and poaching by workers during construction and operation, and increased access leading to increased hunting and poaching can be potential issue and shall be addressed in the ESIA.

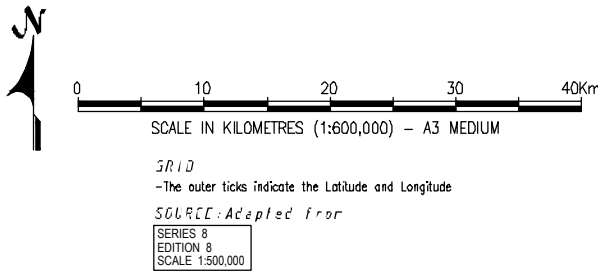
For the socio-economic and cultural environment, the primary area of impact may cover areas beyond the transmission line ROW and river corridor, where communities outside the impact zone would be indirectly impacted by the Project.



LEGEND:

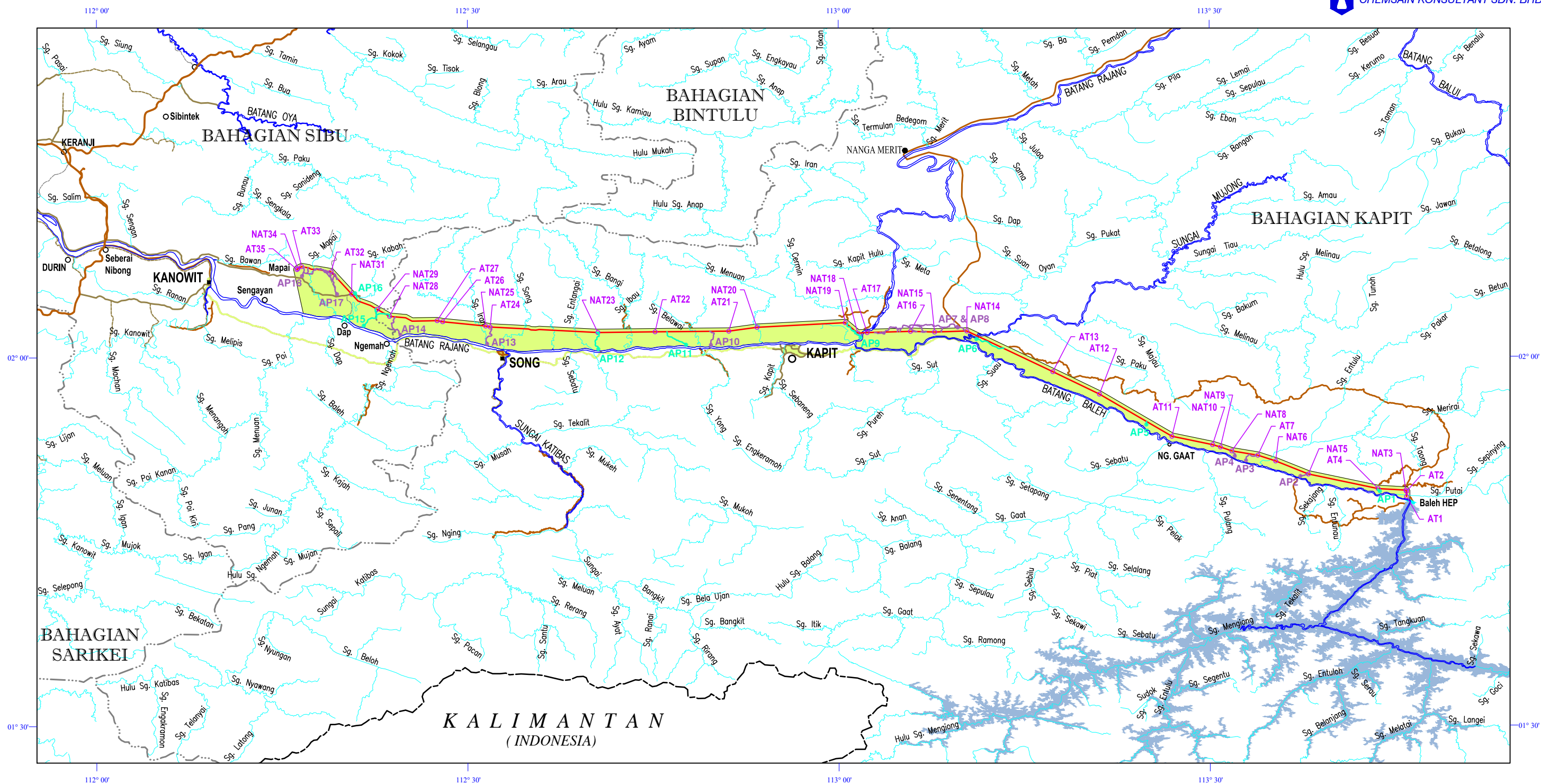
- PROPOSED TRANSMISSION LINE ROUTE
- PROPOSED ANGLE TOWER (AT1 - AT35)
- 500 m ZONE OF INFLUENCE
- INTERNATIONAL BOUNDARY
- DIVISIONAL BOUNDARY
- BALEH DAM
- BALEH DAM RESERVOIR
- RIVERS / STREAMS
- ROADS / MOTORABLE TRACK
- ACCESS ROADS (OPERATING LOGGING / PLANTATION ROAD)
- ACCESS ROADS (COMMUNITY ACCESS ROAD / ABANDONED LOGGING TRACK)

ENVIRONMENTAL AND SOCIAL IMPACT ASSESSMENT (ESIA) STUDY FOR THE PROPOSED BALEH-MAPAI 500 KV TRANSMISSION LINE PROJECT



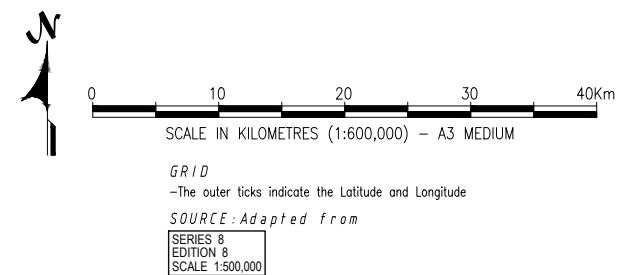
500 m ZONE OF INFLUENCE

FIGURE: 3.7.1

**LEGEND:**

- PROPOSED TRANSMISSION LINE ROUTE
- PROPOSED ANGLE TOWER (AT1 - AT35)
- RIVER & ROAD CORRIDOR ZONE OF INFLUENCE
- INTERNATIONAL BOUNDARY
- DIVISIONAL BOUNDARY
- BALEH DAM
- BALEH DAM RESERVOIR
- RIVERS / STREAMS
- ROADS / MOTORABLE TRACK
- ACCESS ROADS (OPERATING LOGGING / PLANTATION ROAD)
- ACCESS ROADS (COMMUNITY ACCESS ROAD / ABANDONED LOGGING TRACK)

ENVIRONMENTAL AND SOCIAL IMPACT ASSESSMENT
(ESIA) STUDY FOR THE PROPOSED BALEH-MAPAI 500 KV
TRANSMISSION LINE PROJECT



**RIVER CORRIDOR
ZONE OF INFLUENCE**

FIGURE: 3.7.2