



EXECUTIVE SUMMARY



PROPOSED UNDERGROUND IRON ORE MINING OPERATION ON LOT 60954 (ML 1/2016) AND PROCESSING OPERATION AT TEMPORARY OCCUPATION LICENSE (TOL), MEASURING A TOTAL AREA OF 75.33 HECTARES (186.14 ACRES) AT BUKIT BANDI, MUKIM BANDI, DISTRICT OF KEMAMAN, TERENGGANU DARUL IMAN

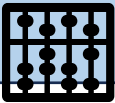
EXECUTIVE SUMMARY

PROJECT PROPONENT	EIA CONSULTANT
Bandi Mining Sdn. Bhd. (963630-H) No. 88, Jalan Jagong, Pandamaran, 42000 Port Klang, Selangor. Contact Person : Lim Wei Hou Contact Number: 017-699 4094	Pultex Environment Sdn. Bhd. (1330403-U) No 130-M, Jalan Mega Mendung, Jalan Klang Lama, 58200, W.P Kuala Lumpur Contact Person: Prof. Datin Dr. Nik Norulaini Nik Abd. Rahman CEP-C0598 (Lead Consultant) Dr. Taha Mohd Omar (Project Manager) Contact Number: 03-79724516/012-4015222/011-21117754

PROJECT OVERVIEW

 Project Location Lot 60954 (ML 1/2016) and TOL Land, Measuring a Total Area of 75.33 Ha (186.14 Ac.) at Bukit Bandi, Mukim Bandi, District of Kemaman, Terengganu.	 Mining Lease (Underground Mining) Total area: 60.67 Ha (149.91 ac) Duration 5 Years (until 1 September 2026)
 TOL Land (Processing Area) Total area: 14.66 Ha (36.22 ac)	 PFR Status Approved Excision of 67.47 Hectares from Bukit Bandi Permanent Reserved Forest
 Zoning Status	Based on Kemaman District Local Plan 2035 (Amendment 2), project site is located in the land use of Agriculture Zone, within the Blok Perancangan Kecil (BPK) 11.2: Felda Cherul .

STATEMENT OF NEEDS



Economic Benefit

Reduced Import Dependence

- Lower reliance on imported iron ore improves trade balance stability.
- Mitigates exposure to global price volatility and supply disruptions.

Strengthened Domestic Industry

- Supports sustainable growth of the iron and steel sector.
- Enhances competitiveness of downstream manufacturing industries.

High Iron and Steel Imports

- Malaysia imported about US\$5.9 billion worth of iron and steel products in 2024.
- This reflects continued reliance on external supply.
- Developing another domestic iron ore mine can improve supply stability and industry competitiveness.



Socio – Economic Benefit

Contribution to National Economy

- Generates employment and local business opportunities.
- Contributes to long-term industrial resilience and economic growth.



State Taxes and Royalties

The royalty rate for iron ore is set at 5% of the value of the mineral extracted based on the Mineral Enactment Terengganu 2002 (Mineral Regulation 2005)



Local Planning Strategies

Thrust 1: Expansion of Mineral Sector of the NMP2



EXECUTIVE SUMMARY

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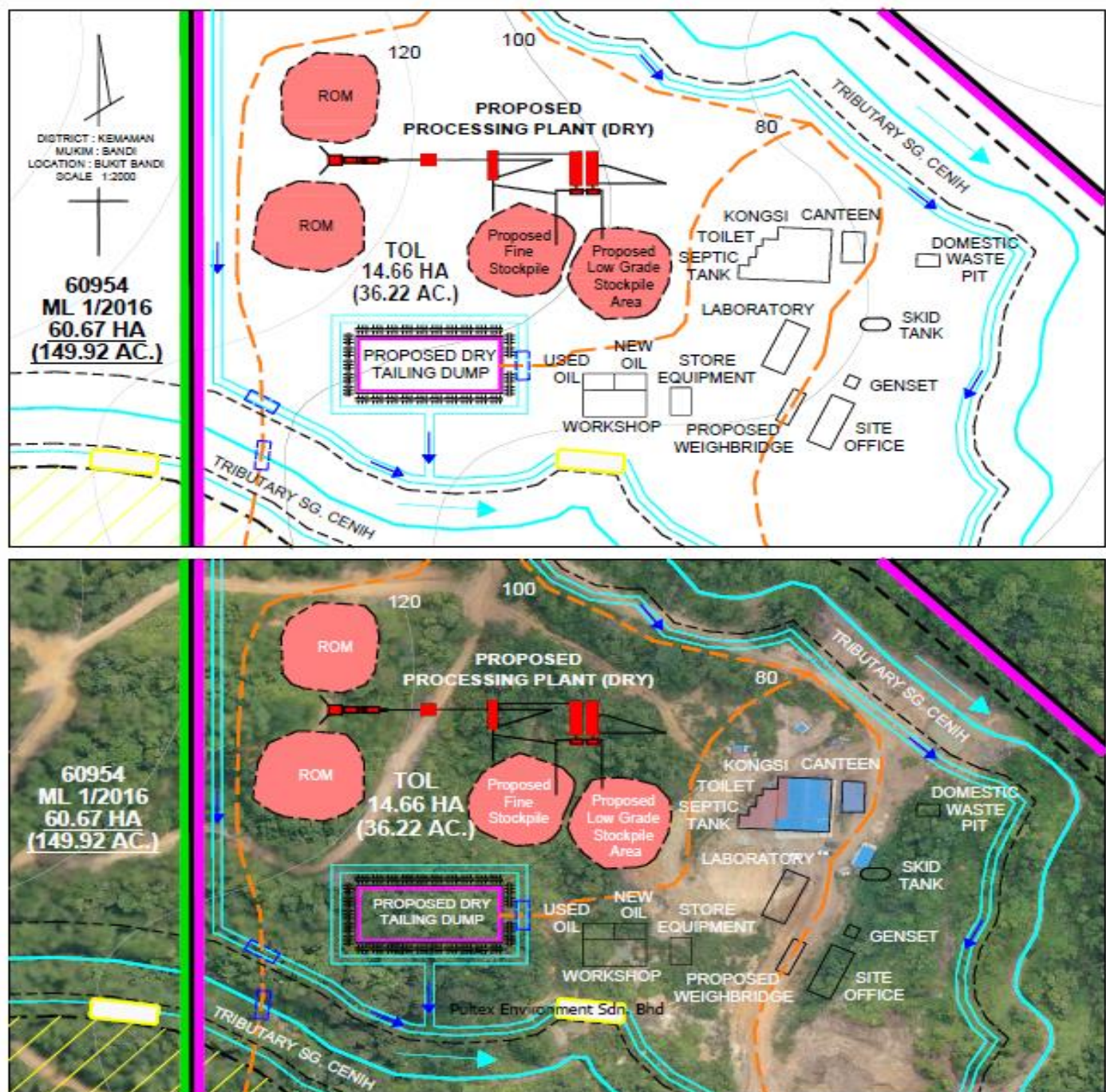
FIGURE 1.1 (a) : KEY, LOCATION AND SITE PLANS OF THE PROPOSED PROJECT SITE (ML LOT 60954) AND TOL LAND (UNDER APPLICATION)

ENVIRONMENTAL CONSULTANT



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PROCESSING PLANT LAYOUT PLAN



LEGEND

	MINING LEASE (ML)		CONTOUR
	TEMPORARY OCCUPATION LICENSE (TOL)		BOUNDARY RESERVE (60M)
	PROPOSED DRY DUMP		RIVER RESERVE (50M EACH SIDE)
	PROPOSED DRY TAILING DUMP		ROAD
	PROPOSED STOCKPILE AREA		RIVER
	SILT TRAP		PROPOSED DRAIN
	FACILITIES/UTILITIES		DRAIN FLOW DIRECTION
	CULVERT		RIVER FLOW DIRECTION
ROM = RUN OF MINE (RAW STOCKPILE)			

FIGURE 5.4 : PROCESSING PLANT LAYOUT PLAN

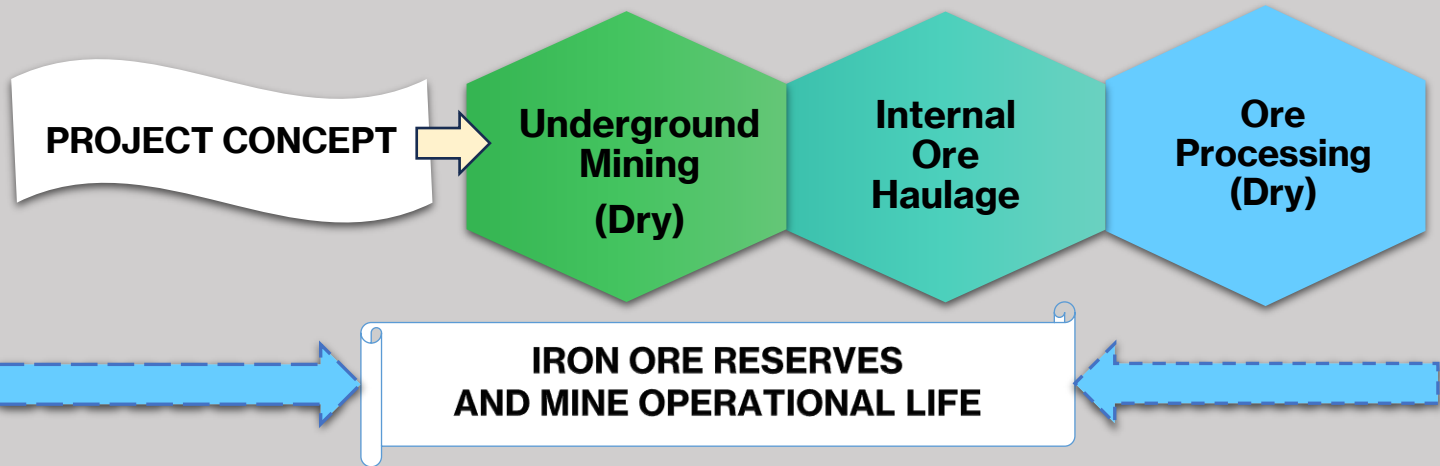
PROJECT TITLE

Proposed Iron Ore Operation on lot 60954 (ML 1/2016), Total Area 60.67 Ha (149.91 AC.), Locality of Bukit Bandi, Mukim Bandi, District of Kemaman, Terengganu Darul Iman for Bandi Mining Sdn. Bhd.



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Checked By : Prof. Datin Dr. Nik Norulaini Nik Abd. Rahman
Date : 19.08.2025
Plan No. : PESB/BMSB/MAGNIFIED



Total Volume of Iron Ore Reserves	2,919,068 m ³
Total tonnage of iron ore recovered	6,071,661 T
Total Volume of Mineable Area	5,838,130 m ³
Monthly Rate Excavation	15,000 m ³ / month
Estimated Operational Mining Life	38 years

- ### Underground Mine Process Flow


- Underground Excavation** – Create access tunnels and shafts to reach the iron ore deposit.
 - Ore Extraction** – Drill, blast, and break the ore from the rock; then load the broken ore for removal.
 - Transport to Surface** – Move the extracted ore to the surface using hoists or conveyors.
 - Stockpile / Feed to Plant** – Place the ore ROM in stockpiles or send directly to the processing plant.
 - Crushing & Screening** – Reduce ore size with crushers and screens for easier processing.





Iron Ore Production Capacity

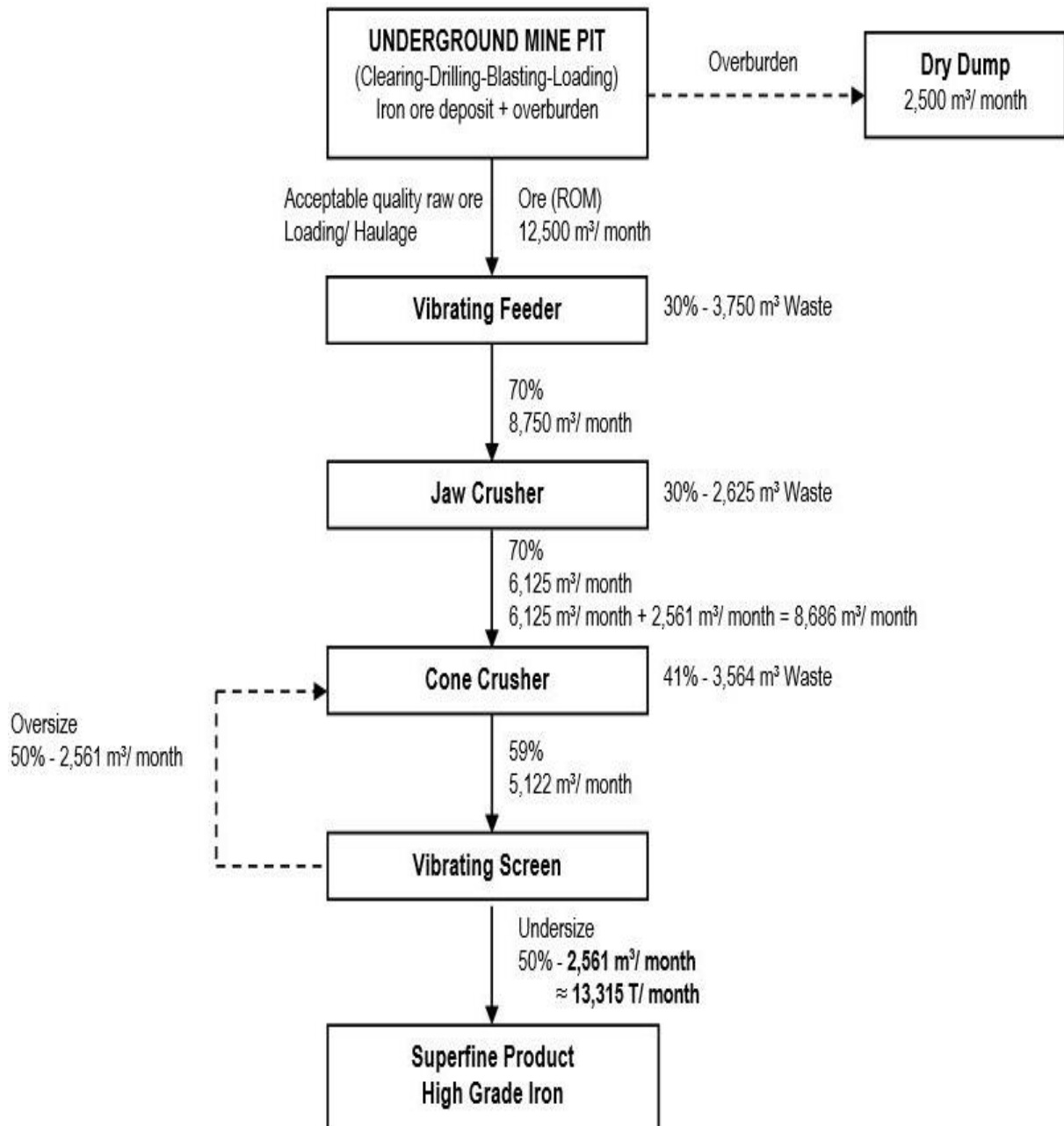
13,315 T/month
≈ 159,781 T/year



Transportation Product

Final product approximately 13,315 T/month, will be shipped via public routes to Kemaman Port with frequency of 15 lorries per day.

FLOWCHART & MASS BALANCE OF PROCESSING PLANT



Note:

- ❑ Monthly rate of excavation 15,000 m³/ month
- ❑ Overburden-to-ore ratio is 0.2:1
- ❑ Project Proponent to advise on the final product size-based customer needs.
- ❑ In this stage it could be differentiated by below 30 mm and above 30 mm.
- ❑ Superfine products could range from 75 um to 10 mm.

PROJECT ACTIVITIES

BEFORE OPERATION

EXPLORATION AND DEVELOPMENT

- i. Exploration of mineral deposits
- ii. Area survey and demarcations
- iii. Mobilization (manpower, machineries and equipment for land clearing)
- iv. Land clearing
- v. Constructions (above and underground)
 - Access road/ haul roads
 - Processing plant
 - Ponds: excavations of sediment basin, silt traps, detention ponds and Acid Mine Drainage (AMD).
 - BMPs such as drains, silt fence, berms, check dams, slope drains, terracing, etc
 - Infrastructure and facilities;
 - *Basecamp/canteen/toilets and septic tank*
 - *Site Office*
 - *Internal roads*
 - *Power and water supply*
 - *Workshop*
 - *Scheduled and non-scheduled wastes storage*
 - *Skid tank*
 - *Weighing bridge*
 - *Washing trough*
 - *Entrance gate/ guard post*
 - *Underground tunnels, shafts, chutes, air ventilation/circulation, lightings*
 - *Underground water drainage system*
 - *Reinforcement of old tunnels shafts, chutes, drifts and adits.*
- vi. Preliminary rehabilitation/ Stabilization
- vii. Mobilization and set up of equipment for processing plant

DURING OPERATION

UNDERGROUND MINING AND PROCESSING

- i. Ore excavation (all to be carried underground)
- ii. Underground mine construction of the auxiliary structure (continues as the underground mining remains active)
- iii. ROM hauled to processing plant
- iv. Ore processing Stockpiles (ROM and products)
- v. EMP/ Environmental audit
- vi. Management and maintenance (BMPs, vehicles and machineries, haulage and access roads, etc.)
- vii. Monitoring (BMPs, water, groundwater, air, noise and vibration)
- viii. Transport of products

AFTER OPERATION

REHABILITATION & ABANDONMENT

- i. Mine closure plans execution
- ii. Decommissioning
- iii. Remediation and reclamation
- iv. Rehabilitation

EXISTING ENVIRONMENT



Land Use

- Surrounding land use is mining and oil palm plantations located to the south, east, and west of the project site.
- Plantations in the area are managed under FELDA and RISDA schemes.
- Bukit Bandi Forest Reserve is situated to the north of the project boundary.
- The nearest settlement is RISDA Ceneh Plantation Quarters, about 3.07 km from the site, comprising staff housing within oil palm plantations.

Soil Characteristic

- Site falls under the sedentary soil group (igneous or metamorphic rock).
- Site also falls under the STP (Steep Land) soil series, which is typically associated with hilly to mountainous terrain, shallow soil profiles, and higher erosion potential.

Surface Hydrology

- The river within the site is a tributary of Sg. Ceneh, which flows from the project site, passes through several lakes, then drains into Sg. Cerul before reaching Sg. Kemaman.
- The project site lies within the Sg. Kemaman Basin.
- There are two (2) water intake point located near project site which area WIP Sg. Cerul (upstream) and WIP Sg. Pinang (downstream).

Climate and Meteorology



- Rainfall > Highest in December (765 mm)
- Rain days > Highest in December (31 days)
- Evaporation > Highest in March (5.18 mm)

Topography

- The area comprises moderately to steeply undulating hilly terrain, typical of inland forest landscapes.
- Elevation ranges from 120 m to 500 m above mean sea level, with the highest point at Bukit Bandi (Bukit Bandi Forest Reserves).

Site Geology

- Site is entirely underlain by granitic intrusion, with no sedimentary or metamorphic rocks mapped.
- Dominant lithology is fine- to medium-grained muscovite granite, representing hydrothermally altered granite.
- Composition mainly consists of quartz, K-feldspar, and plagioclase (An₄-An₁₄) in approximately equal proportions.

Site Hydrogeology

- The area has very low aquifer potential (0–≤5 m³/h), with no deep drilling or active wells within or near the study area.
- Groundwater generally flows towards the southeast and east to nearby rivers.

Mineral Resources

- The project area is located within a mineralised zone containing iron ore, tin, gold, tungsten, manganese, silica rock, and dimension stone, mainly in hilly terrains.
- The site is strategically selected for underground iron ore mining, consistent with the area's mineral resource potential.



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EXISTING ENVIRONMENT



Water Quality

- Total 13 sampling stations.
- Overall water quality complies with NWQS Class II and MOH (2004) standards, indicating good baseline conditions.
- WQI values (79–92) fall under Class II (Clean to Slightly Polluted), suitable for conventional treatment, aquatic life, and recreational use.
- Localised exceedances were recorded for COD, Mn, Fe, Al, Barium, and Phenol, mainly influenced by natural geological conditions.
- Other parameters met regulatory standards, and no hazardous heavy metals were detected.

BASELINE ENVIRONMENTAL QUALITY

Air Quality

- Total two (2) monitoring stations.
- Overall PM₁₀ and PM_{2.5} were well below regulatory limits MAAQS (2020), while SO₂, NO₂, CO, and O₃ were not detected or below detection limits.
- Meteorological conditions were typical and stable, with relative humidity of 60–64%, temperature ranging 21–29°C, and wind velocity between 2.0–2.4 m/s, predominantly from the east-southeast (100°–104°).
- Overall findings indicate low background pollution levels and good baseline ambient air quality within and surrounding the project area.

Groundwater Quality

- Total three (3) sampling stations.
- Overall groundwater quality generally complies with NDWQS (MOH, 2004) and MGQS (DOE, 2019), indicating acceptable baseline conditions.
- Localised exceedances were recorded for turbidity, total coliform, COD, BOD, Fe, Mn, Al, Pb, Cu, oil & grease, and ammoniacal nitrogen, particularly at GW3.
- Elevated iron, manganese, and aluminium are likely influenced by natural geological conditions, while high Pb, Cu, oil & grease, and bacteria suggest possible anthropogenic influence or surface infiltration.
- Most other physical, chemical, and trace metal parameters complied with regulatory standards, and no pesticides or toxic industrial contaminants were detected.

Noise Level

- Total two (2) monitoring stations.
- Daytime period level: 58.7 and 59.1 dB(A).
- Nighttime period level: 41.8 and 44.6 dB(A).
- Noise level were below the limit under First Schedule (Commercial Zone) of 65 dB(A) (day time) and 60 dB(A) (night time).
- Noise sources during the day were primarily from vehicle movements and natural environmental sounds, while nighttime noise was limited to occasional traffic and background ambient noise.

Vibration Level

- Total two (2) monitoring stations.
- Overall PPV values were well below regulatory limits of vibration levels for day and night.

WATER, GROUNDWATER AIR, NOISE AND VIBRATION STATION

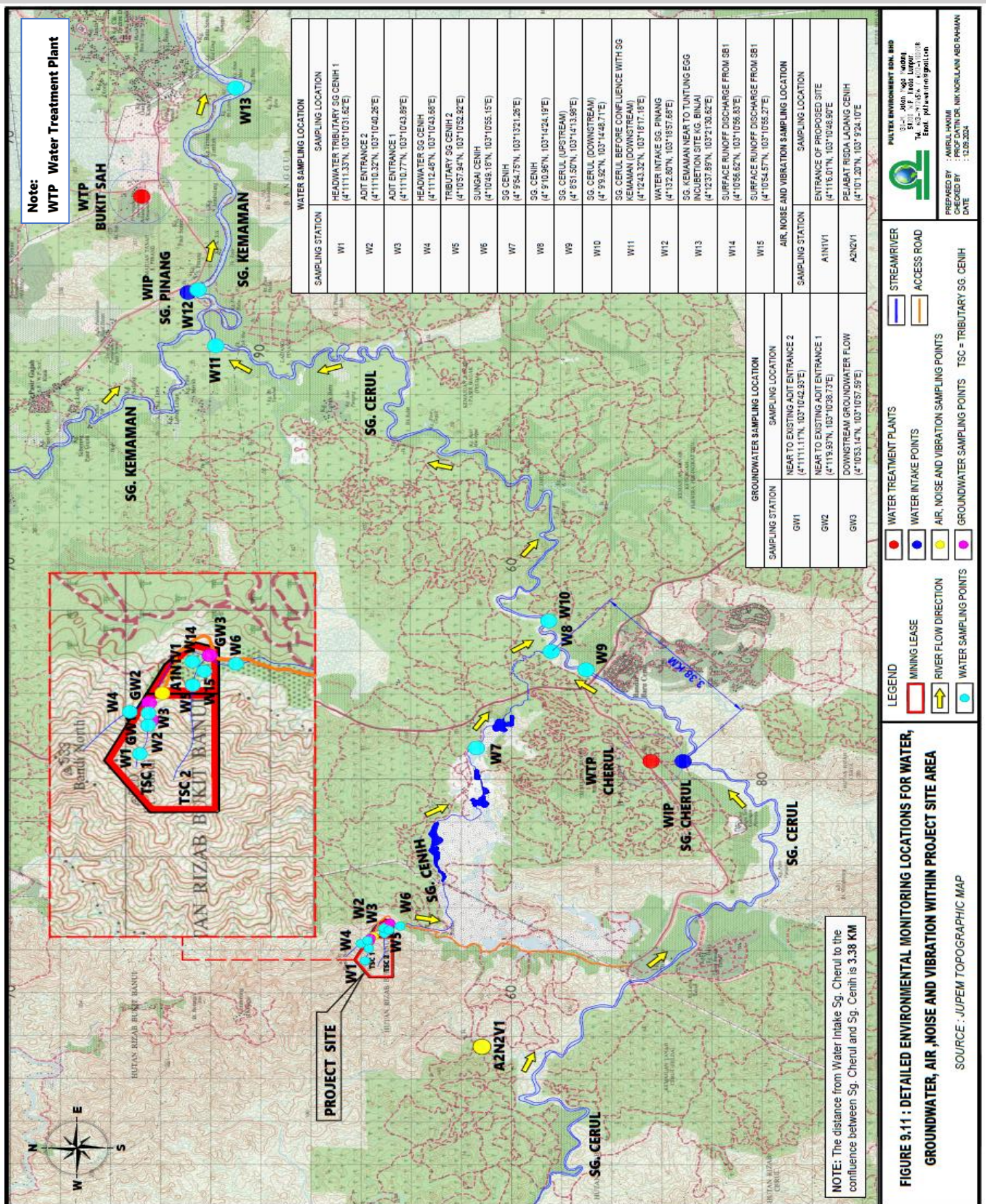


FIGURE 9.11 : DETAILED ENVIRONMENTAL MONITORING LOCATIONS FOR WATER, GROUNDWATER, AIR, NOISE AND VIBRATION WITHIN PROJECT SITE AREA

EXISTING ENVIRONMENT

Terrestrial Vegetation

- Dominated by Dipterocarpaceae species, including Vulnerable (*Dryobalanops aromatica*), Near Threatened (*Rubroshorea leprosula*, *Pternandra echinata*), and Endangered (*Rubroshorea platycarpa*), indicating high conservation value.
- Forests form the emergent canopy and support dense above-ground biomass, reflecting mature forest structure.
- Irregular flowering cycles and mast fruiting enhance habitat dominance and ecological resilience.
- Sensitive to disturbance due to high ecological value, species conservation status, and forest structure.



Terrestrial Wildlife

Mammals

- 23 species recorded via camera traps; includes Endangered (Malayan Tapir, Pig-tailed Macaque, Dusky Langur), Vulnerable (Sun Bear, Mainland Serow), and Near Threatened species; several fully or partially protected.



Small Mammals (Cage Traps)

- 6 species, mostly Least Concern; includes Near Threatened plantain squirrel (*Rhinosciurus laticaudatus*).



Bats

- 12 species recorded; Vulnerable (*Hipposideros ridleyi*) and Endangered (*Hipposideros turpis*); others Least Concern.



Birds

- 21 species recorded; Near Threatened (*Iole crypta*, *Sittidae*), others Least Concern; includes diurnal and nocturnal species.



Herpetofauna (Reptiles)

- 11 species; mostly Least Concern; amphibians rely on streams/leaf litter, generalist species dominate disturbed areas; reptiles occupy riparian zones and rocks.



Ecological Insight

- Area supports high biodiversity and multiple threatened species; forest cover, riparian habitats, and water bodies are critical; fauna shows some adaptation to secondary/disturbed habitats.



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EXISTING ENVIRONMENT



Aquatic

Benthic Macroinvertebrates

- 487 individuals from 19 benthic macroinvertebrate families recorded across 15 stations (~70% of estimated diversity).
- Distribution highly variable, influenced by flow, substrate, sedimentation, and river modification.
- Sensitive taxa (*Hydropsychidae*, *Caenidae*) persist only in localized areas with suitable flow and substrate.
- Dominance of tolerant taxa (*Chironomidae*) indicates physical stress from re-channelisation, sediment deposition, and loss of riparian vegetation.
- Habitat heterogeneity reduced; complex microhabitats limited for taxa dependent on vegetation and flow structure.



Ichthyofauna (Fishes)

- Only two native species recorded in impacted sites: *Rasbora einthovenii* and *Channa striata* (both Least Concern).
- Fish observed at 5 of 15 stations (F10–F14); total 164 individuals.
- Sampling completeness 100%; species richness fully captured.
- Reference streams (Sg. Ayam, Sg. Cerul, Sg. Kemaman) support higher diversity (6–10 species per site), indicating lower aquatic biodiversity in impacted streams.



Socio Economy

- Study area is generally safe, well-served, and socially stable, with low traffic and accident risk.
- Roads, drainage, water, and electricity supply are mostly adequate; only minor localized maintenance issues exist.
- Public health, noise, air, and odour pollution are not major concerns; water quality perceptions are mixed.
- Minor social concerns include limited employment opportunities and overcrowding of foreigners in some areas.



Community Health

- Urbanised district with good infrastructure and healthcare access; doctor ratio slightly below state/national levels.
- NCDs (cardiovascular and metabolic diseases) are the main causes of mortality; high smoking rates increase long-term risk.
- Perinatal and infant mortality exceed state and national averages.
- Communicable diseases are mostly controlled, but dengue, COVID-19, and leptospirosis require ongoing surveillance.
- Survey shows good water/sanitation access; ~30% reported recent illness (mainly respiratory and chronic diseases).



ZONE OF IMPACT (ZoI)

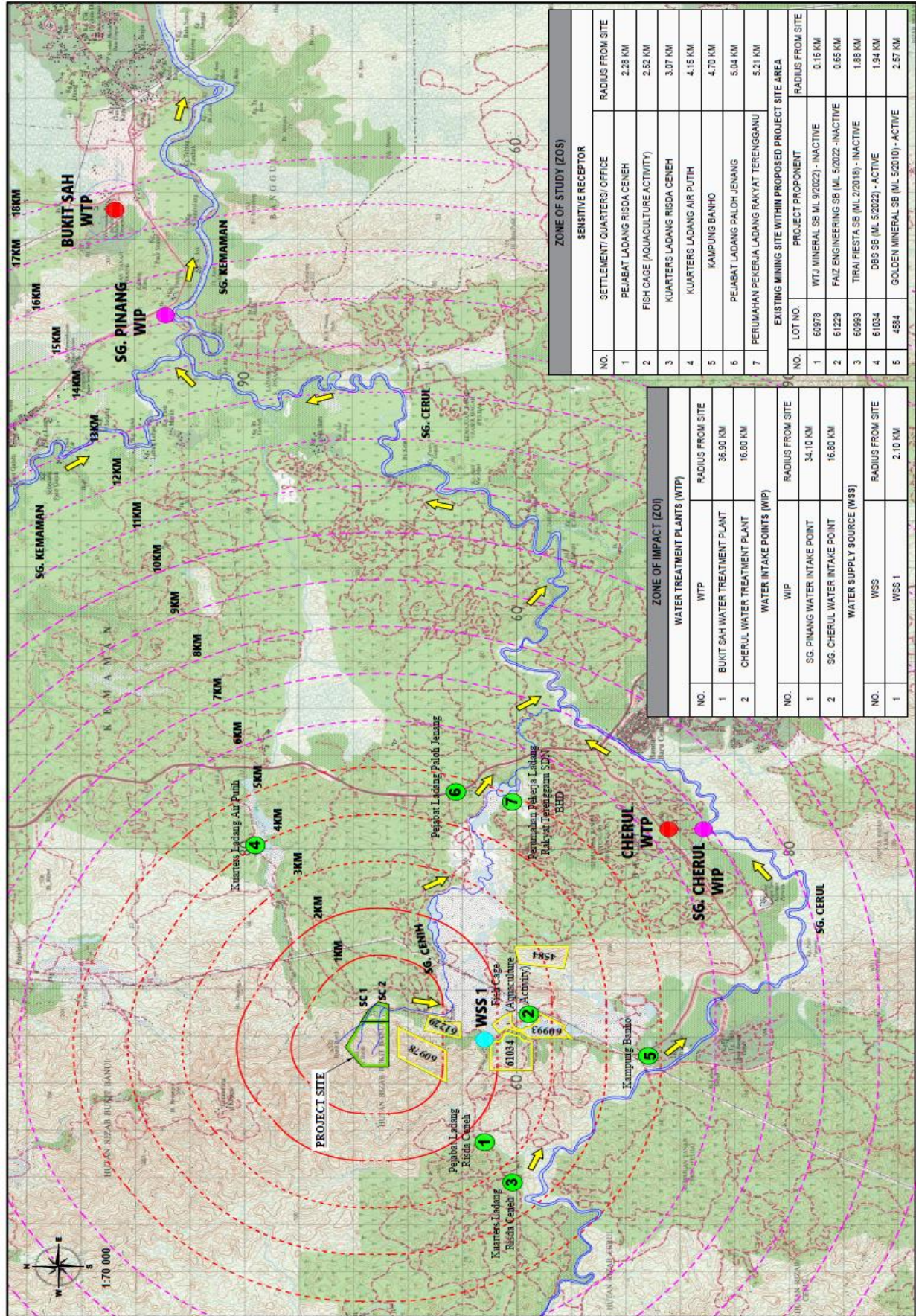


FIGURE 7.1 : ZONE OF STUDY (ZoS) AND ZONE OF IMPACT (ZoI) FROM THE PROPOSED SITE
SOURCE : JUPEM TOPOGRAPHIC MAP

LEGEND

- MINING LEASE
- EXISTING MINING SITE
- RIVER FLOW DIRECTION
- ZONE OF STUDY (ZoS)
- ZONE OF IMPACT (ZoI)
- STREAM/RIVER
- WATER TREATMENT PLANTS (WTP)
- WATER INTAKE POINTS (WIP)
- WATER SUPPLY SOURCE (WSS)
- SETTLEMENTS/ QUARTERS/ OFFICE

NOTE

- a) Zone of Study (ZoS)
Defined within 5 km radius from the proposed project site area.
- b) Zone of Impact (ZoI)
Delineated based on the predicted extent of the environmental impacts.
(up to 18 km radius to the nearest WIP and WTP)

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DATE : 28.08.2025

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EVALUATION OF IMPACTS

HYDROLOGY AND FLOOD RISK

- The assessment was made based on 100 ARI and 24 hours storm duration.
- Kg Ban Ho and Kg Felda Cherul are susceptible to flooding.
- However, flooding is mainly caused by high runoff from the upper catchment.
- The additional discharge from the project site is not significant

GEOTECHNICAL, SLOPE STABILITY AND SOIL EROSION RISK

- The proposed mining site is located in hilly terrain with moderate to steep slopes.
- The subsurface geology consists of acid intrusive rocks and weathered shale with generally poor rock quality.
- The area presents high geotechnical risks and low development suitability, requiring detailed site investigations.
- Steep joints and bedding planes increase the likelihood of structural failures such as planar and wedge slips.
- Soil erosion is expected to increase significantly during mining operations unless strict erosion control measures are implemented.

OVERBURDEN STRIPPING

- Increased soil erosion and sediment runoff into nearby water bodies.
- Localized habitat loss and disturbance within surface infrastructure areas.
- Dust generation affecting air quality and nearby receptors.
- Risk of slope instability and land degradation from improper overburden storage.
- Overall impact is low to moderate due to limited surface disturbance.

RIVER RIPARIAN BUFFER

- Clearing of riverbank vegetation increases erosion and sedimentation into rivers.
- Reduced natural filtration leads to deterioration of water quality.
- Loss of riparian habitat affects biodiversity and ecological stability.
- Disturbance to river-land transition zones may impact surrounding environments.
- Insufficient buffer zones increase risk of sediment runoff into water bodies.

WATER QUALITY

- Sediment from portals, waste dumps, and access roads may increase turbidity in nearby rivers.
- Dewatering discharge could release metals, sulphates, or acid mine drainage (AMD).
- Fuel, oil, and lubricant spills may contaminate surface and groundwater.
- Underground excavation may alter local groundwater flow, affecting water quality.

EVALUATION OF IMPACTS

ACID MINE DRAINAGE (AMD)

- AMD can migrate to surface streams and groundwater, lowering pH and increasing concentrations of metals (Fe, Al, Mn) and toxic elements (As, Pb).
- Acidic and metal-rich water reduces dissolved oxygen, adversely affecting aquatic biodiversity downstream.
- Contamination of local water supplies with heavy metals may pose health risks to nearby communities.
- AMD can infiltrate surrounding soils, altering soil chemistry and reducing fertility.
- Metal precipitation, such as ferric hydroxide, causes reddish-brown water, affecting visual quality and usability.

GROUNDWATER QUALITY

- Groundwater flow is generally from east to west, showing steep gradients in hilly areas, which influences potential contaminant movement.
- Mining operations have minimal risk of contaminating groundwater due to controlled blasting and chemical-free extraction.
- Simulations indicate slow spread of any potential contaminants, with no significant adverse effect expected on groundwater quality.

AIR QUALITY

- Fine dust from drilling, crushing, material handling, stockpiles, and haulage can spread into surrounding air, affecting air quality.
- Blasting and diesel equipment emit NO_x, CO, and diesel particulates, posing localized air pollution and health risks.
- Dust from stockpiles, conveyor transfers, and haul road traffic can become airborne or re-suspended, impacting nearby areas.

NOISE QUALITY

- Underground drilling, blasting, and machinery generate high-intensity noise, posing hearing and safety risks to workers.
- Above-ground activities such as crushing, screening, material handling, and transportation may produce noise that could affect nearby communities and occupational receptors.
- Noise from underground operations is largely contained by tunnel walls, while surface noise is limited due to minimal blasting and excavation.

EVALUATION OF IMPACTS

AIRBLAST, FLYROCK AND GROUND VIBRATION

- Underground blasting generates airblast, flyrock, and ground vibrations, affecting workers, mine structures, and nearby communities.
- Airblast and vibrations may cause rattling, stress, or discomfort, while flyrock can pose localized safety hazards.
- Repeated or high-intensity ground vibrations can be perceptible and cause cumulative discomfort or minor structural effects.

SOCIO ECONOMY

Positive Impacts

- Strengthens the mineral industry, supports quarrying growth, and supplies raw materials to construction.
- Encourages foreign and domestic investment, boosting local and regional economic confidence.
- Generates jobs for local communities during construction and operation.
- Creates business opportunities, improves infrastructure, and supports service-sector development.

Negative Impacts

- Increased heavy vehicle movements may cause road damage and congestion.
- Noise from operations and dust pollution may affect nearby communities.
- Safety risks to residents, drainage issues, and disturbance to nearby properties.

HEALTH

- Surface water impacts negligible; WIP Sungai Pinang remained suitable after treatment.
- Air quality within limits; minimal risk under normal and worst-case scenarios.
- Noise and vibration low; mitigation measures protected workers and nearby communities.
- Basecamp communicable disease risk moderate (leptospirosis, dengue, COVID-19).
- Overall health risks negligible to minimal; mitigation, monitoring, and local health measures ensured protection.

EVALUATION OF IMPACTS

TERRESTRIAL VEGETATION

- Flora impacts are mainly from surface works, particularly clearing for the TOL zone; underground extraction has minimal effect.
- Indirect effects include edge impacts, microclimate changes, soil compaction, and potential spread of pioneer or weed species.
- Impacts are localised, short-medium term, and potentially reversible with planned replanting and natural regeneration; direct loss is limited in TOL but higher in ML forest if encroached.

TERRESTRIAL WILDLIFE

- Wildlife may temporarily avoid disturbed areas and alter movement patterns due to surface activities and human presence.
- Threatened mammals, Near Threatened birds, and riparian amphibians are most sensitive; even rare wildlife-vehicle collisions can be significant.
- Impacts are local, short-medium term, and potentially reversible if habitat integrity and site controls are maintained.

AQUATIC

- Storm runoff increases sediment and reduces habitat quality, stressing fish and macroinvertebrates.
- Sensitivity is high due to limited baseline stream quality, higher-value sites (F10), and species like river terrapin (*Batagur affinis*).
- Impacts are local, short-medium term, and reversible if erosion controls and riparian protection are effective.

SOLID AND HAZARDOUS WASTE

Solid Waste Impacts

- Cleared vegetation may generate dust, fire hazards, and attract pests.
- Excavated materials can cause dust, siltation, slope instability, and runoff into watercourses.
- General refuse may lead to odours, litter, pest attraction, and water contamination.

Hazardous Waste Impacts

- Spent oils, fuels, and chemicals can contaminate soil and water, harm ecosystems, pose fire hazards, and affect human health.
- Leaks or poor handling may cause regulatory violations and long-term environmental damage.

EVALUATION OF IMPACTS

WASTEWATER AND SEWERAGE

- Domestic sewage from the worker basecamp can contaminate soil and nearby water sources if the septic system fails or is overloaded.
- Untreated wastewater may increase BOD, reduce dissolved oxygen, and elevate coliform levels, threatening aquatic life and downstream users.
- Septic system malfunction can produce unpleasant odours, cause discomfort or health issues, and generate complaints from nearby communities.

FUEL OIL STORAGE

- Diesel and other petroleum products pose risks of soil and water contamination if spilled or leaked, affecting aquatic life and water quality.
- Flammable fuels create fire and explosion hazards, especially in confined underground areas.
- Mismanaged lubricating oils and grease can form surface films, disrupt oxygen exchange, and bioaccumulate in aquatic ecosystems.
- Improper handling at refueling or maintenance areas increases the risk of long-term ecological and human health impacts.

TRANSPORTATION AND TRAFFIC

- Increased traffic from construction, ore transport, and supply deliveries may cause road congestion, wear, and higher accident risk.
- Heavy vehicles pose safety hazards to workers and local communities and contribute to dust and noise.
- Local road infrastructure may be damaged, increasing maintenance needs and safety concerns.

MITIGATION MEASURES

BEFORE MINING OPERATIONS

Underground Mining Activities

Clearing Old Tunnels

- Identify and label all hazards such as shafts and chutes within tunnels.
- Reinforce or replace worn-out supports, including roofs and sidewalls, to ensure stability.

Above Ground Activities

Soil Erosion and Sedimentation

- Clear land in small sections, preserving vegetation and green belts.
- Protect river crossings and stabilize roads to prevent erosion and dust.
- Ensure erosion control works comply with guidelines and maintain site stability.

Riverine Riparian Zone Protection

- Preserve existing vegetation and crops along stream banks.
- Demarcate riparian boundaries and plant appropriate vegetation along rivers.
- Maintain a 50 m buffer on each riverbank per DID guidelines to prevent silt runoff.

Water Pollution

- Install perimeter controls (silt fences, drains) to prevent sediment discharge.
- Maintain vegetated river/stream buffers and protect natural water flow.
- Obtain DID approval for any river diversions or temporary crossings.

Groundwater Contamination

- Conduct hydrogeological studies and identify vulnerable groundwater sources.
- Install and regularly monitor wells for water levels and quality.
- Seal underground workings and manage water to prevent contamination.
- Ensure compliance with local groundwater regulations.

Air Pollution

- Conduct baseline air quality study and limit land disturbance.
- Use phased clearing and proper equipment placement to reduce dust spread.
- Apply dust control on roads, stockpiles, and during material handling (water sprays, covered trucks, minimal drop heights).
- Enforce vehicle speed limits to minimize dust generation.

Noise Pollution

- Maintain all site vehicles in optimal condition.
- Enforce speed limits within the mining site.



MITIGATION MEASURES

BEFORE MINING OPERATIONS

Above Ground Activities

Vegetation Clearing and Habitat Loss

- Restrict clearing to approved footprints and mark boundaries clearly.
- Prohibit open burning of biomass on-site.
- Protect vegetation outside work areas and use selective clearing to minimize deforestation.

Habitat Loss, Fragmentation, Increased Human-Wildlife Interaction Risks

- Avoid protected and ecologically sensitive areas; maintain wildlife buffer zones.
- Implement a WMP and train workers on proper wildlife protocols.
- Enforce no-hunting/no-feeding policies and coordinate with PERHILITAN for conflict management.

Aquatic

- Minimize stream/river crossings and avoid disturbing riparian zones.
- Construct temporary bridges or culverts at designated sites.
- Cover exposed riverbanks and strengthen/enforce riverbank stability.
- Implement ESCP and maintain appropriate buffer zones between mining activities and rivers.

Social- Economic

- Raise public awareness of new mining proposals through face-to-face discussions.
- Provide local opportunities via machinery rental, cafeterias, and special job offerings.

Health Diseases Outbreak

- Control disease risks via vector management, good housekeeping, vaccinations, medical screening, and emergency response.
- Minimize wildlife contact, prohibit open burning, and provide clear site signage.
- Train workers on ergonomics and ensure compliance with OSHA, FMA, Social Security, and Workmen’s Compensation Acts.
- Operate machinery only after DOSH certification and notify authorities as required.

MITIGATION MEASURES

DURING MINING OPERATIONS

Underground Mining Activities

Acid Mine Drainage (AMD)

- Prioritize water management and implement effective treatment to prevent pollution and protect ecosystems.

Groundwater Contamination

- Monitor groundwater levels to detect impacts on the aquifer.
- Conduct regular groundwater quality monitoring throughout operations.
- Maintain mining equipment and infrastructure to prevent leaks and contamination.
- Limit surface activities that could disrupt groundwater or cause contamination.

Air Pollution

- Ensure proper ventilation and gas management to protect worker health.
- Continuously monitor dust, aerosols, and air pressure underground and around the site perimeter.
- Install air quality monitoring instruments to detect dangerous particulate levels and maintain adequate airflow.

Noise Pollution

- Maintain machinery and use quieter equipment to reduce noise exposure.
- Enforce vehicle speed limits and implement administrative controls to limit exposure.
- Provide PPE, such as earplugs or earmuffs, for workers in high-noise areas.

Air Blast over Pressure and Vibration

- Schedule blasting only during designated hours and avoid adverse weather or wind toward sensitive areas.
- Licensed personnel must safely handle and store explosives.
- Notify workers and nearby residents in advance.
- Monitor air blast and vibration levels; adjust charge, drilling patterns, stemming, or timing as needed to minimize impacts.

Auxiliary Structures

- Maintain reliable communication, power, and lighting systems, including backups.
- Ensure continuous maintenance of support and ground reinforcement systems.
- Monitor and manage mine ventilation, airflow, and water drainage to maintain safety.

Health

- Wear appropriate PPE to protect against dust and noise.
- Ensure proper blasting design, use blast shelters, clear workers from the area, and maintain good communication between driller and blaster.



MITIGATION MEASURES

DURING MINING OPERATIONS

Above Ground Activities

Soil Erosion and Sedimentation

- Implement and maintain BMPs to prevent mud flooding and protect downstream water quality.
- Regularly monitor, maintain structures, and clear blockages promptly.
- Install rain gauges and ensure ESCP is designed, supervised, and approved by qualified personnel before works.

Overburden Disposal

- Dispose soil at designated dump sites on stable, level ground.
- Limit stacking height to 3 m and respect natural slope for stability.
- Reuse surplus material for site development and rehabilitation.
- Install silt fences, drains, and proper drainage to protect waterways.

Riverine Riparian Zone Protection

- Preserve natural riparian vegetation; avoid placing silt traps within the area.
- Maintain sufficient buffer zones for nearby stockpiles.
- Monitor riparian areas of all tributaries and prohibit mining within stream buffer zones.

Water Pollution

- Implement water management techniques and BMPs (silt traps, check dams, sediment basins) with regular inspection and maintenance.
- Preserve and stabilize drainage and waterways; control runoff to prevent sediment discharge into natural watercourses.
- Monitor effluent for pollutants, including heavy metals and AMD, in compliance with regulations.
- Follow approved drainage and land development checklists for planning and construction.

Groundwater Contamination

- Monitor groundwater levels, especially near rivers, for impacts from mining activities.
- Implement regular groundwater quality monitoring.
- Monitor surface water at discharge points to prevent groundwater contamination.
- Use impermeable layers (e.g., HDPE) under rock piles to limit seepage.
- Maintain machinery and prevent spills to protect soil and groundwater quality.

Acid Mine Drainage (AMD)

- Regularly monitor surface runoff for signs of AMD and divert it to treatment.
- Prevent acid formation, neutralize using alkaline reagents (lime, limestone, etc.), and remove metals via precipitation or filtration.
- Collect runoff and seepage to contain and treat AMD before discharge.



MITIGATION MEASURES

DURING MINING OPERATIONS

Above Ground Activities

Air Pollution

- Maintain equipment and vehicles; use low-emission models and routine maintenance.
- Enclose dust-generating equipment, use extraction/filtration systems, and apply water sprays on stockpiles and haul roads.
- Minimize dust during loading/transfer, enforce vehicle speed limits, and require tire washing before leaving site.
- Train workers on dust control, material handling, and PPE usage.

Noise Pollution

- Maintain vehicles and machinery at optimal conditions; limit operations to smaller scales where possible.
- Enforce vehicle speed limits and direct heavy vehicles along low-impact routes.
- Install noise suppression systems and monitor levels to comply with DOE limits (Leq 55 dB(A) daytime, 50 dB(A) nighttime).

Disruption to Ecosystem Function Due to Vegetation Removal

- Reuse cleared plant materials onsite where possible.
- Progressively rehabilitate and replant disturbed areas.
- Prioritize fast-growing trees for early ground cover, followed by long-term vegetation restoration.

Uncontrolled Biomass Accumulation

- Collect and store biomass systematically to prevent accumulation.
- Use designated processing zones to manage and repurpose organic materials.

Disturbance to Wildlife Habitat and Movement, Human-Wildlife Conflict Escalation

- Prohibit hunting, feeding, or harassment of wildlife; report sightings or conflicts to PERHILITAN.
- Preserve a 20 m vegetation buffer along forest boundaries.
- Maintain housekeeping to avoid attracting wildlife and implement approved animal-intrusion controls.
- Train workers on wildlife safety and legal compliance.

Aquatic

- Implement erosion and sediment controls to prevent runoff into watercourses.
- Protect riparian zones and maintain vegetation to stabilize banks and preserve habitats.
- Minimize stream crossings; use approved bridges or culverts where necessary.
- Cover and stabilize exposed soils; prevent untreated discharges and spills near waterways.

MITIGATION MEASURES

DURING MINING OPERATIONS

Above Ground Activities

Social Economic

- Enable easy pollution reporting and mark heavy vehicles for accountability.
- Involve locals in monitoring and maintain buffer zones.
- Hold regular meetings with community representatives.
- Coordinate with NADMA/JKM for disaster or project-related assistance.

Flood Risk

- Design drainage systems and BMPs to direct runoff to ponds, using sediment basins for trapping and flood detention.
- Continuously maintain and monitor drainage systems and detention ponds.
- Construct perimeter bunds in low-lying areas and implement BMPs to prevent mud flooding; restore site after construction.

Health

- Control vectors and maintain sanitation to prevent diseases.
- Provide PPE and ensure equipment is operated by trained personnel.
- Separate sick workers and educate staff on heat stress with proper work breaks.
- Follow safe blasting procedures with shelters, communication, and area inspections.

Domestic Solid Waste:

- Segregate, store, and dispose of waste properly; strictly no open burning.
- Provide bins, maintain cleanliness, and display awareness signage.
- Track, minimize, store, and transport waste responsibly.

Scheduled Waste:

- Use compatible, labelled containers with secondary containment.
- Keep containers closed, maintain storage areas, and manage spills per regulations.
- Train staff, enforce emergency plans, and log all waste in eSWIS.
- Display emergency plans and safety signage prominently.

Transportation and Traffic

- Install clear signage (e.g., “*Awas Kawasan Lombong*,” “*Lori berat keluar masuk*”).
- Enforce speed limits (≤ 30 km/h), restrict traffic volume, and schedule transport during non-peak hours.
- Ensure drivers are trained, law-abiding, and loads comply with permitted limits.
- Maintain and service vehicles to reduce dust and exhaust emissions.

Safety and Security

- Install and maintain gates/fences to prevent unauthorized access.
- Enforce safety policies, hazard control, and good housekeeping.
- Report serious accidents to DOSH, investigate incidents, and provide first aid.

MITIGATION MEASURES

AFTER MINING OPERATIONS

Underground Mining Activities

Ground Subsidence

- Stabilize ground using backfilling, grouting, or reinforcement to prevent collapse.
- Fill underground voids with waste rock or cement to avoid surface subsidence.
- Regularly assess ground stability near public areas.
- Monitor surface movement using radar or similar technologies.
- Rehabilitate and re-contour the site to maintain surface stability.
- Seal abandoned shafts and tunnels to prevent water ingress and contamination.

Groundwater Contamination

- Regularly monitor groundwater quality at wells and monitoring points.
- Seal underground passages and ventilation shafts to prevent contamination.
- Fill remaining voids with inert material to block contaminant infiltration.

Air Pollution

- Maintain ventilation post-mining to safely release hazardous gases.
- Regularly monitor mine voids for dangerous gases.
- Secure areas to prevent gas seepage to the surface.

Acid Mine Drainage (AMD)

- Apply neutralizing agents (e.g., limestone) to prevent acidic water formation.
- Divert surface water and seal mine openings to limit oxygen and water entry.
- Treat acidic water using lime or passive systems (e.g., constructed wetlands, limestone channels).
- Cap waste rock; revegetate disturbed areas to prevent erosion.
- Conduct post-closure monitoring of water quality in streams and groundwater.
- Ensure financial assurance for ongoing AMD management and remediation.
- Comply with regulatory requirements and obtain final approval for closure plan.

Mine Safety and Public Hazards

- Permanently seal shafts and tunnels using cement or steel; install warning signs and barriers.
- Erect fences or gates and post clear hazard warnings around unsafe areas.
- Conduct regular safety inspections and promptly address identified hazards.
- Implement emergency response plans for accidents like collapses, subsidence, or contamination.



MITIGATION MEASURES

AFTER MINING OPERATIONS

Above Ground Activities

Air Pollution

- Monitor air quality and install control systems if needed.
- Remove or neutralize hazardous materials left on site.
- Implement dust suppression for exposed soil.

Noise Pollution

- Remove/ maintain equipment to minimize noise; use soundproofing where needed.
- Limit vehicle movement and use quieter equipment if needed.
- Rehabilitate and landscape the site to help absorb residual noise.
- Conduct regular post-closure noise monitoring around site boundaries.

Health

- Properly dispose of machinery, waste, and contaminated materials to prevent risks.
- Drain stagnant water and control vector-borne disease breeding sites.
- Implement community health monitoring and provide early intervention if needed.
- Maintain emergency response plans and coordinate with local health authorities.

Waste Generation

- Promote recycling and segregate waste to reduce landfilling.
- Manage and cover waste rock to prevent runoff, leaching, and dust.
- Store hazardous waste securely and handle contaminated equipment properly.
- Monitor waste sites long-term and maintain containment systems.

Ecological Impact and Habitat Restoration

- Restore soil and replant native vegetation to support biodiversity.
- Progressively rehabilitate areas using fast-growing trees and legumes.
- Maintain vegetation connectivity to support fauna movement and ecosystem.

Delayed Wildlife Recolonization and Habitat Recovery

- Restore habitats and reforest with native species.
- Keep natural vegetation buffers (≥20 m) along forest boundaries undisturbed.
- Establish reporting and response procedures for wildlife encounters, coordinating with PERHILITAN when necessary.

Aquatic

- Stabilize and revegetate streambanks and riparian zones.
- Maintain riparian buffers to support habitat quality and bank stability.
- Remove temporary structures and monitor rehabilitated areas until vegetation is established.

ENVIRONMENTAL MANAGEMENT PLAN (EMP)

PERFORMANCE MONITORING (PM)

LD-P2M2	PM Parameters	Recommended Limits	Frequencies
Silt Trap	Silt and water level marker	-	Weekly or after rain event
Sediment Basin	Silt and water level marker	-	
Earth Drains with Check Dam	Sediment level		Quarterly
Earth Bund	Controlled overland flow	-	
Silt Fence	Amount of sediment	-	
Roadside Drain	Stable bank slopes, Sediment	-	
River Riparian Buffer Zone	Intact, undisturbed, strong ground vegetation, stable riverbanks	50 m at both sides	

COMPLIANCE MONITORING (CM)

Monitoring	Monitoring Frequency	Environmental Quality Standards
Water Quality	Once a month	i. National Water Quality Standards (NWQS). ii. Mineral Development (Effluent) Regulations 2016
Groundwater Quality	Twice a year	i. National Standard for Drinking Water Quality (Revised December 2000), Second Version (MOH, 2004). ii. Malaysia Groundwater Quality Standards and Index – for Conventional use of Raw Water Treatment (Drinking Water) (DOE, 2019).
Air Quality	Once a month	i. Malaysia Ambient Air Quality Standards (Standard value by 2020).
Noise Level	Once a month Daytime 15 hours (from 7.00 am to 10.00 pm) Nighttime 9 hours (from 10.00 pm to 7.00 am)	i. Guidelines for Environmental Noise Limits & Control, Third Edition 2019 (DOE Reprint 2021). ii. Guidelines for Noise Labelling and Emission Limits of Outdoor Sources, Third Edition, (DOE, 2021)
Vibration Level	During underground blasting operation	i. Guidelines for Environmental Vibration Limits and Control, Third Edition (DOE, 2021)

IMPACT MONITORING (IM)

Item	Impact Monitoring
Water Quality	i. Regular water quality monitoring for turbidity and total suspended solids (TSS) ii. If silt trap/sediment containment structure is employed to contain the resuspended particulates, this must be regularly monitored for tear and displacement from the intended location. iii. Even with a silt trap/sediment containment structure in place, the water quality beyond the silt trap/sediment must be sampled for turbidity. iv. Records regular maintenance of the drainage structure provided on site and ensure there is no blockage to the water flow or excessive siltation.
Groundwater Quality	i. Regular groundwater quality monitoring. ii. Records the measured water level. iii. Records regular maintenance of monitoring well to prevents well water quantity and quality deteriorating in longer term.
Air Quality	i. Records regular maintenance of equipment, machinery and vehicles used for this project development. ii. Records of provision of adequate dust protective devices to workers working in dusty areas. iii. Records of provision of dust suppression facilities such as water bowser. iv. Records on air quality monitoring results. v. Checking on the soil surface to ensure proper soil compaction is practiced onsite especially on exposed area.
Noise Level	i. Records regular maintenance of equipment, machinery and vehicles used for this project development. ii. Records of provision of adequate noise protective devices to workers working in high noise level areas. iii. Schedule of working hours, transportation in and out of the project site showing the type of loading and maintenance tasks carried out for vehicles.
Vibration	i. Records on blasting monitoring vibration levels.

STUDY FINDINGS

The proposed underground iron ore mining project at Bukit Bandi, Kemaman will reactivate existing adits within ML 1/2016, with all surface facilities for processing plant area confined at TOL areas. The underground mining method and dry processing system significantly reduce surface disturbance, eliminate tailings ponds, and minimize long-term environmental risks.

Key Potential Impacts

Air Quality

Predicted PM₁₀ and PM_{2.5} concentrations comply with MAAQS 2020. Impacts are localized and controllable.

Noise & Vibration

Blasting and operational noise remain within DOE regulatory limits under controlled blasting and monitoring.

Water Resources

Project contribution to downstream discharge is minimal (~1.8% of total catchment). With proper erosion and sediment control measures, impacts on turbidity and TSS are manageable. Groundwater impact is predicted to be negligible.

Geotechnical & Erosion Risk

Although the site comprises steep and weathered terrain, engineered slope stabilization and ground support systems reduce risks to acceptable levels.

Biodiversity

Surface disturbance is limited to the TOL zone. Residual impacts are localized and Low-Moderate with mitigation.

Socio-Economic & Health

Majority of sensitive receptors are beyond 3 km. Community acceptance is 61.6% subject to safeguards. No significant long-term public health impacts are anticipated with proper controls.

Overall Determination

With strict implementation of the Environmental Management Plan (EMP), erosion and sediment controls, controlled blasting, continuous environmental monitoring, and progressive rehabilitation, residual impacts are expected to remain Low to Moderate and within regulatory standards.

The project is therefore considered environmentally acceptable and recommended for EIA approval, subject to full compliance with regulatory requirements.