Section 7
Potentially Significant Impacts and Mitigation Measures During The Construction Stage

SECTION 7 : POTENTIALLY SIGNIFICANT IMPACTS AND MITIGATION MEASURES DURING THE CONSTRUCTION STAGE

7.1 INTRODUCTION

This section of the report examines the potentially significant impacts during the pre-construction and construction phases of the Project. The impacts are assessed in terms of magnitude, prevalence, duration and frequency of occurrence whichever is applicable, and their consequences. It also discusses the mitigation measures which can be implemented to keep the adverse impacts to a minimum.

7.2 SENSITIVE RECEPTORS

The receptors of the potential impacts from the Project include all the various communities and land uses located close to the alignment and the stations, which have been identified and described in **Section 5.4** of this report.

7.3 POTENTIALLY SIGNIFICANT IMPACTS AND MITIGATION MEASURES DURING PRE-CONSTRUCTION STAGE

The main potentially significant impacts expected during pre-construction stage are related to the following activities:

- Land and property acquisition
- Utilities relocation

7.3.1 Land and Property Acquisition

The land and property acquisition is an important issue during pre-construction stage in view of the potentially large number of land and properties that may be acquired for the Project. During the feasibility study and the preliminary design, the Project has been planned such that private land acquisition is kept to a minimum. However, given that the SSP line is 52.2 km long and traverses very dense built-up areas, land and property acquisition cannot be avoided.

It is estimated that 704 lots of land may be acquired based on the current SSP Line **(Table 7-1)**. Out of this, 521 lots are privately owned and 183 lots belong to the government. 201 of the lots are located along the Northern Segment, 293 lots along Underground Segment, 141 lots along Southern Segment 1 and 69 lots along Southern Segment 2. In terms of land area, 77% of the land needed for the SSP Line will be on government land while 23% will be acquired private land.

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Table 7-1 Lots Potentially Affected by Acquisition

Segment	Wilayah Persekutuan	Selangor	No. of Lots Affected		Area to be acquired (ha) **
			Government	Private	
Northern Segment: Damansara Damai – Jalan Ipoh	131	70	53	148	34.75
Underground Segment: Jalan Ipoh – BM South	293	-	62	231	39.26
Southern Elevated Segment 1: BM South – UPM	79	62	40	101	79.68
Southern Elevated Segment 2: UPM – Putrajaya Sentral	2	67	28	41	26.67
Total	**505**	**199**	**183**	**521**	**180.36**

** private land only

The potential impacts due to the land acquisition include:

- For residential areas, acquisition would result in displacements. The impacts could be more severe to people who have resided at a particular place for a long time. Once their properties have been acquired, the affected people will have to relocate and in the process leads to:
  - Disruption to their lifestyle – not able to relocate to a similar property due to lack of availability or affordability.
  - Loss of community linkages - relocation of property owners could cause loss of existing social links, community cohesion and social interaction.

- For business owners whose business premises may be acquired, the impacts are significant, especially those who have been in operation for a long time. Acquisition would result in disruption of their business due to the need move elsewhere. For some, this could affect them in the long term due to the difficulty in re-establishing the business in a new area and loss of their customer base.

- There are tenants who have been operating in areas close to the SSP Line for a long time (e.g. Serdang Raya). Land acquisition would have adverse economic implications on them if they are not informed ahead to allow them to plan. Many fear being left in a vacuum by a lack of information. They fear finding themselves without their livelihood; they are unsure as to whether they could start again somewhere else when their customer base has disappeared.

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Mitigation measures to minimise impacts from land and property acquisition

The proposed measures to minimize impacts from the land and property acquisition process include:

(a) Communication and Engagement Plan

The Project Proponent will develop a communication and engagement plan with focus on dissemination of information on land acquisition process to the affected parties. Appropriate method of communication will be chosen depending on the groups to be contacted and the information to be given. This would facilitate communications and avoid misunderstanding. The survey findings have shown that the public prefer pamphlets and brochures, short message service, mail drops such as letters, and public notice boards. Pamphlets and brochures are likely chosen because they provide information and allow time for people to read and digest the information given.

It is also important to explain procedures related to land acquisition and compensation. Procedures on land acquisition are usually not in the public domain. It does not happen to the majority people and as such, many people lack information on the process and procedure. It is vital that the communication plan has elements of this that could be conveyed simply for wider consumption and better understanding.

(b) A dedicated team

MRT Corp will establish a dedicated team to handle the land acquisition. Although in government-linked projects, land acquisition will be handled by the Department of Land and Mines and the Valuation Department under the Land Acquisition Act, MRT Corp will have its own team to facilitate and smoothen the process. It is important for people to relate to an organization at a time when they are worried and unsure of what they could do.

(c) Mutual Agreement

One of the option that will be considered is the Mutual Agreement, similar to the one implemented under SBK Line. This would help to mitigate any land acquisition issues for both the underground and elevated segments. This has been a useful platform to avoid unnecessary conflicts over land acquisition under SBK Line.

(d) Continuous Engagement

The Project Proponent is committed to maintaining continuous engagement with the potentially affected parties to address and attend to any queries to the whole spectrum of acquisition exercise. Individual engagement which is more personalised and sensitive is proposed for the affected parties to reduce their perceived fears and dismay.

7.3.2 Utilities Relocation

Before the construction proper begins, affected utilities located along the Project corridor will be relocated or protected. These include underground water pipes and sewer mains, electrical cables, gas pipes and underground telcos cables. It also involves above ground utility services such as TNB transmission line, traffic lights, street lighting and ITIS CCTV pole. Some of the utilities that are unmapped could pose problems during the construction.

Some of these relocation works may cause traffic congestion and the impacts vary depending on the locations of works. In some cases, there may be a temporary loss of parking spaces or temporary closure of road lanes. Where necessary, the horizontal direct drilling method or pipe jacking method will be used to relocate the services as this method will minimize the need for open trenching on the road surface.

The major impacts will be public safety as well as safety of the workers directly involved in the utilities relocation works. The risks related to utilities relocation include:

- Damage of electrical cables, telco's cables (copper/fibre), water pipes and etc. from collision impacts, valve failure or human error/negligence
- Damage of sewer pipes which causing sewer water discharge to nearby drainage system due to human error/negligence
- Leakage of the methane gas from sewer pipeline or manholes due to the human error/negligence
- Leakage of LPG/ natural gas from gas pipeline relocation from collision impacts, valve failure or human error/negligence
- Work at areas adjacent to TNB transmission line which not carried out according to proper procedure from service providers
- Exposed utilities wires/ cables from relocation exercise from human error/ negligence
- Collapse of relocated overhead utilities due to the human error/ negligence
- Vehicular accident from temporary closure of road, road diversion, speed and loss of parking space
- Occupational and safety hazard from heavy machinery and working within enclosed areas (sewer pipelines)

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Mitigation measures for utilities relocation

The measures to minimize risks from utilities relocation include:

- To notifiy the public before commencement of the utilities relocation works
- Notification to Gas Malaysia pre and post construction works involving or near to existing gas pipe
- To notify TNB and appoint competent person to supervise any construction works at near or adjacent to TNB transmission line to avoid electricity shocked and flash-over accident
- Utilities detection and piloting prior to be carried out prior to the actual relocation work
- Any abandoned water or sewer pipe after relocation works shall be properly sealed-off to prevent soil settlement or sink holes which pose danger to the public.
- Relocation of gas pipes by appropriate method to minimise possible leakage and release of LPG / natural gas
- Eliminate all possible ignition sources near to the gas pipe relocation work area
- Regular checks of gas pipe valve and avoid the possibility of leakage during the gas pipe relocation works
- Safety requirement for fire fighting and explosion to be provided at the work site during the construction
- Workers involved must be trained in first aid and emergency procedures and implement emergency response plan, evacuation to assemble point
- Usage of appropriate signboards during relocation works with the implementation of traffic diversion if required.

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7.4 POTENTIALLY SIGNIFICANT IMPACTS AND MITIGATION MEASURES DURING THE CONSTRUCTION STAGE

The major work components during the construction stage are:

- Elevated works (construction of viaducts and elevated stations)
- Underground works (construction of shafts, tunneling works and underground stations)
- Depot construction

Viaduct and station construction are the major components of the elevated works and involve the construction of columns, pier and launching of pre-cast segmental box girder. Major activities that will be carried out for the underground works are tunneling (including construction of launch and retrieval shafts) and construction of underground stations.

The main impacts and activities during the construction phase are summarised in **Table 7-2**.

Table 7-2 Potential Impacts During Construction Stage

Potential Impacts	Activities
Traffic congestion	• road diversion, closure and lane reduction for viaduct and station construction • construction vehicles transporting excavated materials, construction materials and machinery.
Public safety (residents, workers, road users and adjacent building)	• vehicular accident from temporary closure/ diversion of roads, transportation of waste, construction material and equipment. • occupational and safety hazard from use of heavy machinery, malfunction of equipment, working at height & confined space
Increased noise level	• tunneling and piling works • use of high noise generating machineries such as generator sets, power tools, hydraulic breaker and grinding and cutting equipment
Increased vibration	• tunnelling, concreting and piling works
Groundwater regime	• tunneling and underground station construction
Soil erosion and sedimentation	• site clearing and earthworks from depot construction • sedimentation from excavation works
Pollution of water courses	• the use of bentonite slurry for tunneling works
Air pollution	• earthworks • movement of construction vehicles
Waste generation	• site office and centre labour quarters • site clearing
Economic benefits	• economic growth, job creation, other multiplier effects and tax revenues to Government would accrue during the construction period.

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7.5 TRAFFIC CONGESTION

Traffic congestion due to construction works is one of the most important potentially significant impacts. As seen from other mass rapid transit projects in the city, construction works can often lead to congestion along roads where the works are being carried out. Since the SSP Line mainly runs along major roads and highways, any reduction in lane sizes or diversion can potentially result in traffic congestion.

Traffic congestion during the construction phase is also one of the most important concerns raised by stakeholders during the FGDs and dialogue sessions **(**see **Section 6.2.6)**.

7.5.1 Traffic Impacts Due To Station and Alignment Construction

The major impact caused by the proposed construction works for stations involves reduction in terms of lane width and working area being located on the road shoulder. Effectively, this reduction in lane width and road shoulder would cause reduction in carriageway capacity. It is assumed that the reduction of lane width (from approximately 3.25m-3.5m to 2.75m-3.0m) would reduce the effective lane capacity by 15%. Insufficient road capacity will cause temporary bottlenecks that disturb the smooth flow of vehicles. In addition, traffic safety risk will arise as the result of reduction in lane width and road shoulder closure. Vehicles will be squeezed to fit into narrower lanes and motorcyclists will find difficulties to manoeuvre in traffic.

Construction traffic access to the site imposes safety risks to the road users, especially vulnerable road users such as pedestrians, cyclists and motorcyclists. This is especially a concern if the access roads used are local streets in the vicinity of residential or school areas. The excavation activities are heavy on the underground segment and depot construction. A total of 2.7 million m^3 of material are estimated to be excavated for the underground segment construction. It is thus estimated that the underground segment will generate more than 300 truck-trips per day during the construction.

Northern Elevated Segment : Damansara Damai to Jalan Ipoh

Most of the stations on this segment are situated in residential and commercial areas. The alignment traverses along major roads such as Jalan Kepong-Kuala Selangor, Persiaran Dagang, Selayang-Kepong Highway, Jalan Kepong, and Jalan Ipoh. These roads have tight corridors and medians due to site constraints in which existing developments (such as shop lots) are near to the road space. Occupying the median for construction activities will reduce the effective capacity of the road. This is because drivers tend to slow down and reduce speed when traveling through construction areas. In addition, the presence and/or access of construction traffic (such as trucks) to the site create temporary bottlenecks that block the smooth flow of traffic (**Table 7-3**).

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This escalates the congestion problem. Most of these roads could be performing at LOS E or F during construction stage. Residents staying along these roads such as Bandar Sri Damansara, Saujana Damansara, Taman Bukit Maluri, Metro Prima, Taman Fadason, Taman Kok Lian, Taman Rainbow and Taman Bamboo are likely to be affected.

Table 7-3 Critical Issues and Impacts During Construction (Station S01 to S11)

Area	Road	Issue/Impact	Mitigation
Damansara Damai Sri Damansara West	Jalan Kepong-Kuala Selangor	• Tight corridor along the slip road near the U-turn ramp.	• Partially cover-up Sungai Gasi & divert traffic on top of it.
Sri Damansara East	Persiaran Dagang	• Tight corridor along the single lane single carriageway	• Solution driven design with smaller pile cap is proposed
Kepong Sentral	Selayang Kepong Highway	• Heavy traffic on the road • Prolonged delays and congestion are expected	• On site traffic control and management is necessary to reduce delays
Metro Prima Kepong Baru Jinjang Sri Delima	Jalan Kepong	• Narrow median with shop lots on both sides of road. • Parking bays removed.	• Solution driven design with smaller pile cap is proposed. • New site will be identified to relocate the affected parking bays.
Kampung Batu	Jalan 1/18b	• Tight corridor along the single lane single carriageway	• Solution driven design with smaller pile cap is proposed
Kentonmen Jalan Ipoh	Jalan Ipoh	• Narrow median with shop lots on both sides of road. • Parking bays removed. • Traffic congestion due to construction activities.	• Solution driven design with smaller pile cap is proposed. • New site will be identified to relocate the affected parking bays. • Staged traffic diversion is proposed.

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Underground Segment : Jalan Ipoh – Bandar Malaysia South

Most of the stations on this segment are situated under busy roads with high volume of traffic. Among the affected roads are Jalan Tun Razak, Jalan Raja Muda Aziz, and Jalan Ampang, Jalan Ipoh and Jalan Sultan Azlan Shah (**Table 7-4**). These roads have tight corridor and median due to site constraints in which existing developments (such as shop lots) are near to the road space. Most of these roads will be performing at medium to high congestion level (LOS D to F) during construction stage. It is expected that the regular road users to/from the City Centre will be affected. Prolonged delay and queue is expected on these roads.

Occupying the median for construction activities will reduce the effective capacity of the road. This is because drivers tend to slow down their speed when traveling through the construction area. In addition, the presence or/and access of construction traffic to the site creates a temporary bottleneck that block the smooth flow of traffic. It is estimated that a total of 2.7 million m^3 of materials are to be excavated from this segment which require more than 300 truck-trips per day to transport them out to the dump site.

Table 7-4 Critical Issues and Impacts During Construction (Station S11 to S22)

Area	Construction Access Road	Issue/Impact	Mitigation
Sentul West	Jalan Sultan Azlan Shah	• Station box and work zone is directly over the road	• Provide a traffic diversion around the main work zone, maintaining the existing number of lanes and connections to side roads. • Traffic signage and control need to be used to indicate entrances and other works during/after the station box construction.
Titiwangsa	Jalan Tun Razak	• Station constructed on large lot which is fully off road.	• Some diversions may be required to allow construction of entrances and connections to the existing LRT and monorail stations.. • Construction work entrances off Jalan Tun Razak need to be controlled and managed well to ensure minimum disruption to the traffic along Jalan Tun Razak.
Hospital Kuala Lumpur	Jalan Tun Razak	• Station box is constructed on a lot adjacent to Jalan Tun Razak	• Diversions for Jalan Kuantan will be considered during construction of the main box. • Construction work entrances off Jalan Tun Razak need to be controlled and managed well to ensure minimum disruption to the traffic along Jalan Tun Razak.

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Table 7-4 Critical Issues and Impacts During Construction (Station S11 to S22)

Area	Construction Access Road	Issue/Impact	Mitigation
Kampung Baru North	Jalan Raja Muda Abdul Aziz	• Station box and work zone is directly over the road	• Provide a split road around both sides of the work zone; maintaining two lanes going in both directions and maintaining the connections to the side roads.
Ampang Park	Jalan Tun Razak	• Station constructed on large lot which is fully off road so limited impact.	• Traffic entering the Ampang Park by ramp on the west side will be phased to allow construction of the linkage to the LRT station. • Construction works for possible linkage to the LRT station crossing Jln Ampang could be constructed using methods that allow Jln Ampang to remain open.
KLCC East	Jalan Binjai	• Station box and work zone is directly over the road	• Provide a traffic diversion around the work zone utilizing the existing car park and shift interchange of Jln Binjai & Lorong Kuda. • Use traffic signage and control measures to construct the works around the main box.
Conlay	Jalan Conlay	• Station box is across Jalan Conlay	• Provide a traffic diversion around the main construction zone • Use traffic signage and control measures to direct traffic around the work zones.
Tun Razak Exchange	Jalan Tun Razak	• Many construction activities taking place concurrently, which may impede each other.	• Proper construction strategy and traffic management plans to ensure overlapping works cause minimal disruption at site. • Access to construction site to avoid Jalan Tun Razak, and instead to use the internal roads and temporary roads within the TRX development and the SBK Line work zones.
Chan Sow Lin	Jalan Chan Sow Lin	• Station box is constructed on a lot adjacent to Jalan Chan Sow Lin	• Road crossing across Jalan Chan Sow Lin to connect the station with the existing LRT station could impact Jln Chan Sow Lin. If required to construct the crossing, Jln Chan Sow Lin will possibly be diverted.
Bandar Malaysia North Bandar Malaysia South	Future development site	• No significant issues due to site being in the brown-field zone of TUDM Sg. Besi	• Construction within the TUDM Sg Besi confines, thus involving minimal disruption to traffic.

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Southern Elevated Segment 1 : Bandar Malaysia South to UPM

Most of the stations on this segment are situated in residential and commercial areas. The alignment traverses on major roads such as Jalan Kuchai Lama, Jalan Merah Silu, Jalan Utama, Jalan Besar, Jalan Raya Satu, and a highway, i.e. Sungai Besi Highway. These are major roads/highway providing access to the residents in this area. They are busy during peak hours (**Table 7-5**).

Construction activities along the shoulder and median of the roads are expected to disturb traffic flow and create additional delay to the road users. In addition, the presence or/and access of construction traffic (such as truck) to the site create temporary bottlenecks that block the smooth flow of traffic. This escalates the congestion problem. There could be delays on some of these roads such as Sungai Besi Highway and Jalan Besar. Residents staying along these roads or alignment corridor, such as Taman Gembira, Kuchai Lama, Taman Selatan, Taman Naga Emas and Serdang are likely to be affected.

Table 7-5 Critical Issues and Impacts During Construction (Station S22 to S29)

Area	Construction Access Road	Issue/Impact	Mitigation
Kuchai Lama	Jalan Kuchai Lama	• Guideway & Part of station over south bound of Jln Kuchai Lama • Portal & Pier Construction for station disrupt existing south bound traffic	• Realignment of lanes to minimize obstruction.
Taman Naga Emas	Jalan Merah Silu	• Tight corridor along single lane single carriageway	• Solution driven design with smaller pile cap is proposed
Sungai Besi	Jalan Sungai besi	• Station at median in front of LRT station	• Jln Sg Besi South bound lanes to be realigned to left side to accommodate Pier construction at road median.
Serdang Raya North Serdang Raya South	Jalan Utama	• Disruption to traffic expected. • Prolonged and extended delays are expected.	• Proper traffic management and control plans to be enforced to ease congestion and delays.
Seri Kembangan	Jalan Raya Satu	• Station on Piers at the middle of Jalan Raya Satu	• UPM/Serdang and Seri Kembangan bounds traffic to be split into different direction, prior to station construction and tp maintain 2 lanes for each direction split

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Southern Elevated Segment 2 : UPM to Putrajaya Sentral

The alignment in this segment passes through major roads namely Jalan Putra Permai, Persiaran Alpinia, Persiaran Sierra Utama, and Persiaran Apec. The road realignment or widening is designed to follow the same number of lanes as per the existing roads that being affected.

The affected existing features such as bus bay, taxi bay, pedestrian walkway, and others due to road alignment will be relocated and replaced where appropriate. Construction at narrow median requires realignment of road to maintain the existing lane numbers. However, reduction of lane width is unavoidable which indirectly reduces the effective road capacity (**Table 7-6**).

Traffic congestion is expected on these roads due to capacity reduction and presence of construction traffic. Slow moving of heavy vehicles and their access to sites creates temporary bottlenecks that disturb traffic flow. Most of these roads will be performing at acceptable levels of service LOS B to D, except for Jalan Besar which could deteriorate to LOS F. Residents staying in the vicinity of the alignment are likely to be affected such as Taman Universiti Indah, Taman Equine, Taman Prima Tropika, 16 Sierra, Taman Pinggiran Putra, Pusat Bandar Putra Permai and Kota Perdana.

Table 7-6 Critical Issues and Impacts During Construction (Station S29 to S36)

Area	Construction Access Road	Issue/Impact	Mitigation
UPM	Jalan Besar	• Construction activities in the vicinity of the university campus	• UPM campus roads should not be utilized for construction traffic access. Access to the construction site must be from the external road.
Taman Universiti (Provisional) Equine Park Taman Putra Permai	Jalan Putra Permai	• Clash with the service road to the MEX Rest & Service area. • Exit slip road from shop lots will be occupied by piers. • Median will be widened.	• A new service road will be constructed for future access. • Temporary realignment of exit slip road is proposed. • Temporary realignment of road.

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Table 7-6 Critical Issues and Impacts During Construction (Station S29 to S36)

Area	Construction Access Road	Issue/Impact	Mitigation
16 Sierra	Persiaran Sierra Utama	• Parking lots at Jalan D'Alpinia 10 in front of shop lots will be removed. • Median will be widened.	• The parking lots will be replaced. • Temporary realignment of road.
Cyberjaya North Cyberjaya City Centre	Persiaran Apec	• Median will be widened.	• Temporary realignment of road.
Putrajaya Sentral	Jalan P7	• Access to the existing rail operation may be affected	• Ensure minimal disruption to rail operation. • Proper traffic management and access control during construction

7.5.2 Traffic Impacts Due To Depot Construction

The SSP Line depot will be constructed at Jalan Putra Permai, next to Taman Universiti Station. Jalan Putra Permai is a dual two carriageway running in the north-south direction between Bandar Putra Permai and Serdang/ Seri Kembangan area. Connecting to Jalan Putra Permai and adjacent to the depot is Jalan Indah which is a main arterial dual two carriageway. It is a main road that serves the residential area adjacent to the depot, i.e. Taman Universiti. Currently, Jalan Putra Permai is performing at an acceptable LOS C while Jalan Indah is performing at LOS A during peak hours. A nearby three-arm junction, i.e. Junction of Jalan Putra Permai/Jalan Indah is also performing at an acceptable level of LOS D (**Table 7-7**).

The construction of depot at this location is expected to deteriorate the traffic condition on both Jalan Putra Permai and Jalan Indah. Slow moving heavy vehicles such as lorries and trucks would reduce travel speed on these roads and create temporary bottlenecks that cause congestion. This would cause extra delays and queues on the road. It is estimated that a total of 930,000 m^3 of materials will be excavated from the site. This could generate more than 300 truck-trips per day from the site to the approved dump site.

The junction of Jalan Putra Permai/Jalan Indah could have a lower level of service during depot construction due to the heavy vehicle traffic. The impact would be more significant on the approach arm from Jalan Indah where it is currently performing at LOS F (with an average delay of 2 minutes). This is because the junction is unsignalized and traffic from Jalan Indah has difficulty to find suitable gaps to merge into Jalan Putra Permai due to heavy traffic.

As such, it is suggested that the junction could be signalized during the depot construction for smoother flow. It is important to mention that residents staying in Taman Universiti Indah will be affected the most if this junction has poor performance.

Besides congestion problem, the existence of construction traffic on Jalan Putra Permai poses safety risk and concern to vulnerable road users (such as pedestrians and motorcyclists) and residents in the neighbourhood area.

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Table 7-7 Level of Service of Affected Roads

Station	Location	Road Between Station	Location of Pier	No of lanes for existing condition	Capacity Veh/hr	Existing v/c ratio (worst case)	No. of lanes during construction	Capacity during Construction	Construction Stage Vol/Cap Ratio	Level of Congestion
S01	Damansara Damai	Jalan Kepong-Kuala Selangor	Right	3	5,400	0.95 E	3	4,500	1.14 F	High
S02	Sri Damansara West		Right	3	5,400	0.94 E	3	4,500	1.12 F	High
S03	Sri Damansara East	Persiaran Dagang	Right	1	1,800	0.58 C	1	1,500	0.70 D	Medium
S04	Kepong Sentral	Selayang-Kepong Highway	Left	2	3,600	0.91 E	2	3,000	1.09 F	High
S05	Metro Prima	Jalan Kepong	Left	3	5,400	0.45 C	3	4,500	0.54 C	Medium
S06	Kepong Baru		Left	3	5,400	0.45 C	3	4,500	0.54 C	Medium
S07	Jinjang		Left	4	6,400	0.44 C	4	5,400	0.52 C	Medium
S08	Sri Delima		Left	3	5,400	0.70 D	3	4,500	0.84 E	High
S09	Kampung Batu	Jalan 1/18B	Right	1	1,800	0.53 C	1	1,500	0.64 D	Medium
S10	Kentonmen	Jalan Ipoh	Middle	3	5,400	0.39 B	3	4,500	0.47 C	Medium
S11	Jalan Ipoh		Left	3	5,400	0.41 B	3	4,500	0.49 C	Medium
S12	Sentul West	Jalan Sultan Azlan Shah	Middle	3	5,400	0.52 C	3	4,500	0.62 C	Medium
S13	Titiwangsa	Jalan Tun Razak	Left	3	5,400	1.11 F	3	4,500	1.33 F	High
S14	Hospital Kuala Lumpur		Left							
S15	Kampung Baru North	Jalan Raja Muda Abdul Aziz	Right	2	2,000	0.66 D	2	1,700	0.77 D	Medium
S16	Ampang Park	Jalan Ampang	Right	3	3,000	1.29 F	3	2,500	1.55 F	High
S17	KLCC East	Jalan Binjai	Middle	2	2,850	0.66 D	2	2,400	0.78 D	Medium
S18	Conlay	Jalan Conlay	NA	1	900	0.41 B	1	760	0.49 C	Medium
S20	Chan Sow Lin	Jalan Chan Sow Lin	NA	2	3,200	0.32C	2	2,700	0.38 C	Medium
S23	Kuchai Lama	Jalan Kuchai Lama	Right	3	5,400	0.4 B	3	4,500	0.48 C	Medium

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Table 7-7 Level of Service of Affected Roads (Cont'd)

Station	Location	Road Between Station	Location of Pier	No of lanes for existing condition	Capacity Veh/hr	Existing v/c ratio (worst case)	No. of lanes during construction	Capacity during Construction	Construction Stage Vol/Cap Ratio	Level of Congestion
S24	Taman Naga Emas	Jala Merah Silu	Right	1	1,300	0.41 B	1	1,100	0.48 C	Medium
S25	Sungai Besi	Jalan Sungai Besi	Left	2	3,600	0.74 D	3	3,000	0.88 E	High
S26	Serdang Raya North	Jalan Utama	Right	2	3,000	0.67 D	2	2,500	0.79 D	Medium
S27	Serdang Raya South		Right							
S28	Seri Kembangan	Jalan Raya Satu	Middle	5	7,500	0.28 B	5	6,300	0.33 B	Low
S29	UPM	Jalan Besar	NA	1	1,500	1.09 F	1	1,200	1.36 F	High
S30 (Provisional)	Taman Universiti (Provisional)	Jalan Putra Permai	Left	2	3,600	0.54 C	2	3,000	0.65 D	Medium
S31	Equine Park		Left							
S32	Taman Putra Permai		Middle							
S33	16 Sierra	Persiaran Sierra Utama	Middle	2	3,000	0.27 B	2	2,500	0.32 B	Low
S34	Cyberjaya North	Persiaran Apec	Left	2	3,800	0.69 D	2	3,200	0.82 D	Medium
S35	Cyberjaya City Centre		Left							
S36	Putrajaya Sentral	Jalan P7	Left	2	3,600	0.47 C	2	3,000	0.56 C	Medium
Serdang Depot	Serdang Depot	Jalan Putra Permai	Left	2	3,600	0.54 C	2	3,000	0.65 D	Medium

7.5.3 General Management Measures To Minimise Traffic Congestion

Minimizing congestion and traffic disruption during the construction phase is one of the most important measures to minimize the adverse impacts from this Project. Given the length of the SSP Line (52.2 km) and its potential to affect a large number of roads, it is crucial that traffic management is carried out in a comprehensive manner.

The following measures shall be adopted for the entire project:

- The number of lanes on the major roads shall be maintained wherever possible. Any reduction lanes (only when unavoidable and when all other alternatives have been exhausted) shall be designed to facilitate contra flow options. For instance, a two-way four lane road shall minimally be reduced to three lanes, with the centre lane operating as a contra lane for the heavier movement during peak hour.

- A minimum lane width of 2.75m-3.0m should be maintained for all the roads which involves reduction in lane width for construction activities. The impact of lane width reduction would cause the effective lane capacity to reduce approximately by 15%.

- Sufficient warning signs and flagmen shall be provided at all workstations to facilitate better control of traffic flow. All traffic management devices and temporary/ warning signs shall be maintained to ensure maximum effectiveness in terms of traffic management.

- The movement of trucks shall be restricted to off-peak periods, meaning that trucks should only be allowed to move in and out of the construction site between 10am and 4pm, and between 8pm and 6am for night works at permissible work zones. With this restriction, it is anticipated that the loading would be about 23 trucks per hour during these working period.

- Adequate safety and warning signs need to be placed to cater not only for vehicular traffic movement but also for the movement of pedestrians in the locality, particularly when pedestrians come into conflict with construction vehicles.

- A detailed Traffic Management Plan (TMP) shall be prepared for all stations to address issues relating to construction vehicle access, private vehicle displacement, rerouting options, road closure, acceleration-deceleration lane, signage, signalisation, pedestrian movement and pedestrian crossing, amongst other issues of concern during construction. Introduction of additional pedestrian crossing facilities such as temporary pedestrian crossing signals should be considered where appropriate. Some samples of TMP prepared for the station construction is shown in **Figure 7-3** to **Figure 7-10**.

- Adequate tow-trucks and emergency response teams shall be provided with a maximum response time of 15 minutes to avoid major congestion problem in the event of any breakdown.

- Temporary route diversion is recommended during off peak hours to minimize traffic disruption. Route diversion serves the purpose of minimizing delay and reduces congestion in the construction area.

7.5.4 Specific Management Measures To Minimise Traffic Congestion

The specific management measures carried out during construction of stations and viaducts is shown in **Table 7-8**. It is anticipated that with these mitigation strategies, the traffic congestion impact would be minimised.

Table 7-8 Specific Mitigation Strategies for Selected Road Sections

Road Adjacent to Station	Mitigation Strategies
Jalan Kepong-Kuala Selangor	• Partial cover-up of Sungai Gasi & divert traffic on top of it.
Jalan Kepong	• New site will be identified to relocate the affected parking bays.
Jalan Ipoh	• New site will be identified to relocate the affected parking bays. • Staged traffic diversion is proposed.
Jalan Sultan Azlan Shah	• Provide a traffic diversion around the main work zone, maintaining the existing number of lanes and connections to side roads. • Traffic signage and control will be used to construct entrances and other works after the station box construction.
Jalan Tun Razak	• Traffic diversion plan is prepared and implemented to divert traffic from construction site. • Diversions for Jalan Kuantan will be considered during construction of the main box. • Traffic entering the Ampang Park mall by ramp on the west side will be phased to allow construction of the linkage to the LRT station.
Jalan Binjai	Provide a traffic diversion around the work zone utilizing the existing car park area and shift interchange of Jalan Binjai and Lorong Kuda. Use traffic signage and control to construct the works around the main box.
Jalan Conlay	• Provide a traffic diversion plan to avoid construction site.
Jalan Chan Sow Lin	• Provide a traffic diversion plan to avoid construction site.
Jalan Kuchai Lama	• Temporary realignment of lanes to minimize obstruction
Jalan Sungai Besi	• Jalan Sg Besi South bound lanes to be realigned to left side to accommodate Pier construction at road median.

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Table 7-8 Specific Mitigation Strategies for Selected Road Sections (Cont'd)

Road Adjacent to Station	Mitigation Strategies
Jalan Raya Satu	• Split UPM/Serdang and Seri Kembangan bounds traffic prior to station construction and maintain 2 lanes for each direction.
Jalan Putra Permai	• A new service road will be constructed for future access. • Temporary realignment of exit slip road is proposed.
Persiaran Sierra Utama	• The parking lots will be replaced. • Temporary realignment of road.
Persiaran Apec	• Temporary realignment of road.

7.6 NOISE IMPACTS

Noise impacts from the construction works are anticipated at the following locations:

- Stations
- Viaduct piers along entire alignment
- Underground works
- Depot construction

Noise generation during construction stage is anticipated from earth moving equipment (dozers, tractors), heavy vehicles (lorries), diesel generator sets and piling works.

Equipment and vehicles noise sources are fairly mobile, and the noise generated is usually transient in nature. The only exception to this are diesel generator sets, power tools (jack hammers, etc.) and construction vehicles on site. These noise sources are however localized to specific locations where they are used.

Noise generated from construction activities is usually perceived by most residents as intrusive in nature (as compared to an adjacent industrial facility or even existing road traffic) due to the situation where the construction noise is a new noise source (disturbance) introduced into an existing community.

Construction of piers supporting the elevated section of the Project will require piling. Piling vibrations and noise represent potential areas of concern as confirmed from past and current experiences in the construction of the LRT (original lines, Kelana and Ampang extension lines) and the SBK Line project currently under construction.

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Construction works are progressive in stages along the entire elevated alignment, and at fixed locations along the underground segments for the Underground Stations, portals and shafts. It is therefore inevitable that there are issues of concern for noise and vibration affecting residential receivers (and commercial as well) in close proximity to the alignment.

Noise from construction activities shall comply with recommended noise limits as stipulated in DOE's Guidelines for Environmental Noise Limits and Control (2007), Annex A, Schedule 6 (**Table 7-9**). Due to the fluctuating nature of construction noise, limits are prescribed for a continuous equivalent noise level and a maximum threshold (defined by the instantaneous maximum L_{max}). The L_{max} limit typically applies to piling and other transient peaks.

Table 7-9 Maximum Permissible Sound Level Of Construction, Maintenance and Demolition Works By Receiving Land Use

Receiving Land Use Category	Noise Parameter	Day Time 7.00 am - 7.00 pm	Evening 7.00 pm - 10.00 pm	Night Time 10.00 pm - 7.00 am
Residential (Note 2 **)	L_{90}	60 dBA	55 dBA	* (Note 1)
	L_{10}	75 dBA	70 dBA	*
	L_{max}	90 dBA	85 dBA	*
Commercial (Note 2 **)	L_{90}	65 dBA	60 dBA	NA
	L_{10}	75 dBA	70 dBA	NA
Industrial	L_{90}	70 dBA	NA	NA
	L_{10}	80 dBA	NA	NA

Source: DOE Planning Guidelines for Environmental Noise Limits and Control 2007

Construction equipment typically have sound power levels above 100 dBA (**Table 7-10**). Depending on proximity of the construction sites and activities noise emitted to the adjacent receiver could range from L_{10} of 65 dBA to 80 dBA. The L_{90} levels are usually dependent on other noise sources prevalent at the receiver. Piling noise from chiseling at hard rocks and mishandling in particular could result in noise levels approaching or even exceeding the above recommended L_{max} levels.

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Table 7-10 Typical Sound Power Levels for Construction Equipments

Equipments	Typical Sound Power Level (dBA)
Hydraulic Breaker	122
Bulldozer	115
Typical Lorry	110
Concrete Mixing Truck	109
Bore Piling Activities	100
Generator with Minimal Enclosure	100
Cutting and Grinding Equipment	98

Diesel generator sets are often the highest continuous noise source in construction sets. Diesel generators shall be required to be an integral type fitted an acoustics enclosure and silencers on air intake and exhaust.

Other potential noise sources are from heavy vehicles and earth moving equipment. Noise disturbance from these vehicles and equipment are anticipated and should be mitigated from administrative control to minimize the impact. Vehicles transporting construction materials should be arranged for arrival at site during off peak hours day time hours, and to avoid night time hours.

Noise and vibration from piling works represent a particular source of concern with significant impact to the neighbours. Piling instantaneous noise from could potentially exceed 95 dBA for impact drop piles, and as such shall be avoided. The use of low noise piling methods is required to ensure minimal impact to the neighbours in noise sensitive land use. Compliance to the maximum permissible noise limits for construction at residential land use, and in particular the L_{max} levels shall require the use of bored piles or injection piles. It is also necessary to restrict piling activities to day time only (and to include restrictions during weekends and public holidays).

Noise propagation and potential disturbance from construction of viaduct piers fronting residential houses were evident from the noise modeling undertaken and as observed from measurements in the SBK Line under construction.

Representative noise modeling for construction noise (bore piling using measured noise emissions from the SBK Line conduction sites) were undertaken for the purpose of impact assessment of construction noise for the SSP Line for selected typical construction sites.

SECTION 7 : POTENTIALLY SIGNIFICANT IMPACTS AND MITIGATION MEASURES DURING THE CONSTRUCTION STAGE

Noise contours (for L_{10} noise levels) for typical scenarios of two piling machines operated simultaneously at alternate piers and/or piles with standard 4 m perimeter hoarding at representative work sites fronting sensitive receptors and/or built up areas are given in **Chart 7-1 to Chart 7-8** for the Northern Elevated Segment, and **Chart 7-9 to Chart 7-16** for the Southern Elevated Segments. Noise contours for likely scenarios at the open and cut work sites (for the North Portal) at Taman Kaya are given in **Chart 7-17** and for a typical Underground Station (at Kg Baru North fronting Setia Sky Residence luxury condominium) given in **Chart 7-18**.

The noise modeling showed that L_{10} noise levels shall exceed the DOE Noise guidelines limits without noise mitigation, as well as inadequacy of standard (4m) perimeter hoarding.

Chart 7-1 Noise Propagation from Piers Bored Piling (with 4m hoarding) at Damansara Damai area

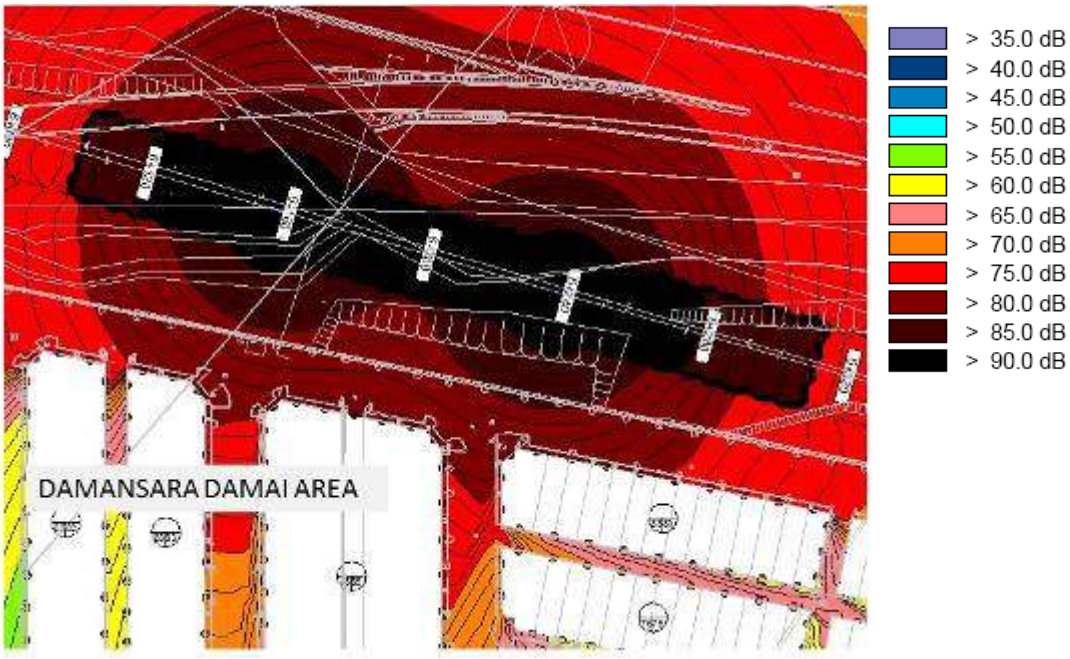

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Chart 7-2 Noise Propagation from Piers Bored Piling (with 4m hoarding) at Persiaran Dagang and Menjalara area

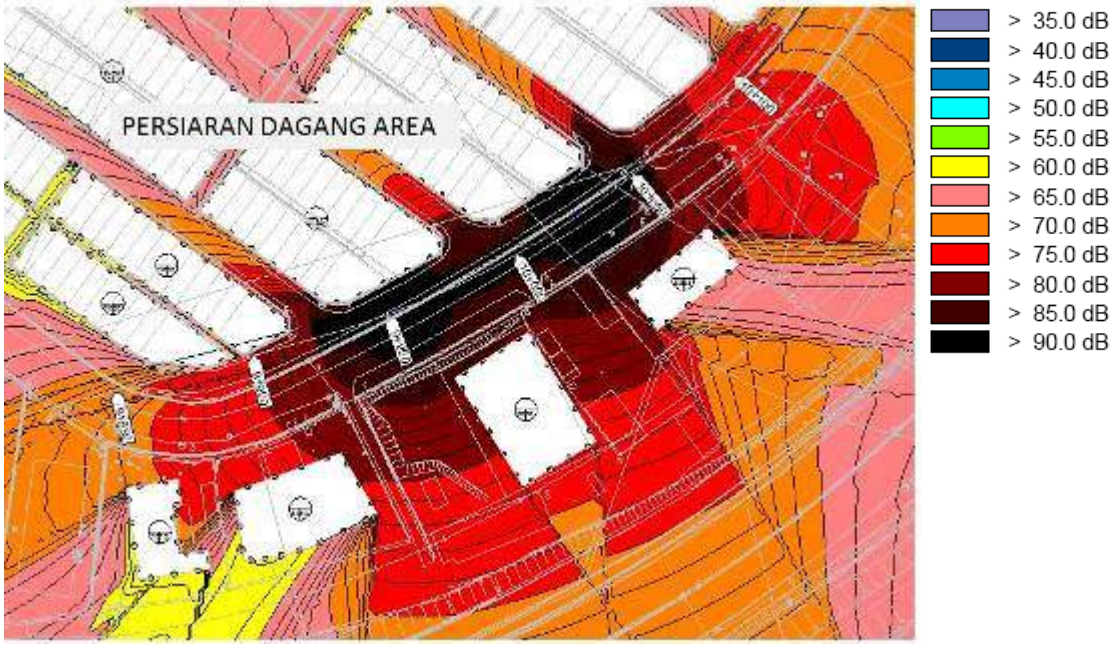

Chart 7-3 Noise Propagation from Piers Bored Piling (with 4m hoarding) at Pekan Kepong area

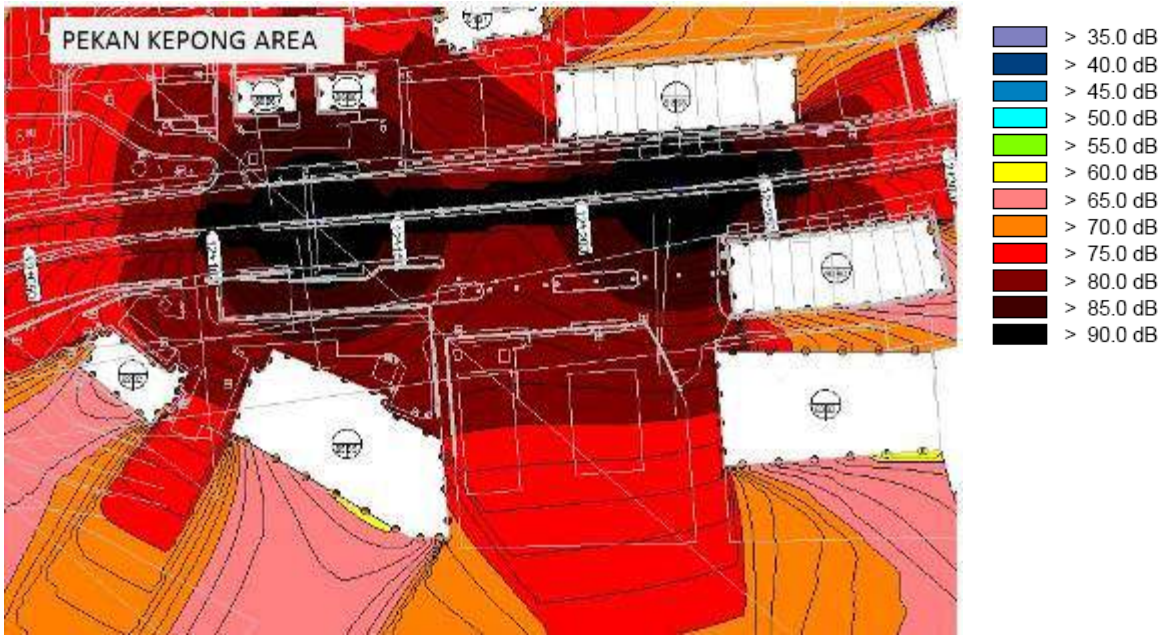

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Chart 7-4 Noise Propagation from Piers Bored Piling (with 4m hoarding) at Metro Prima area

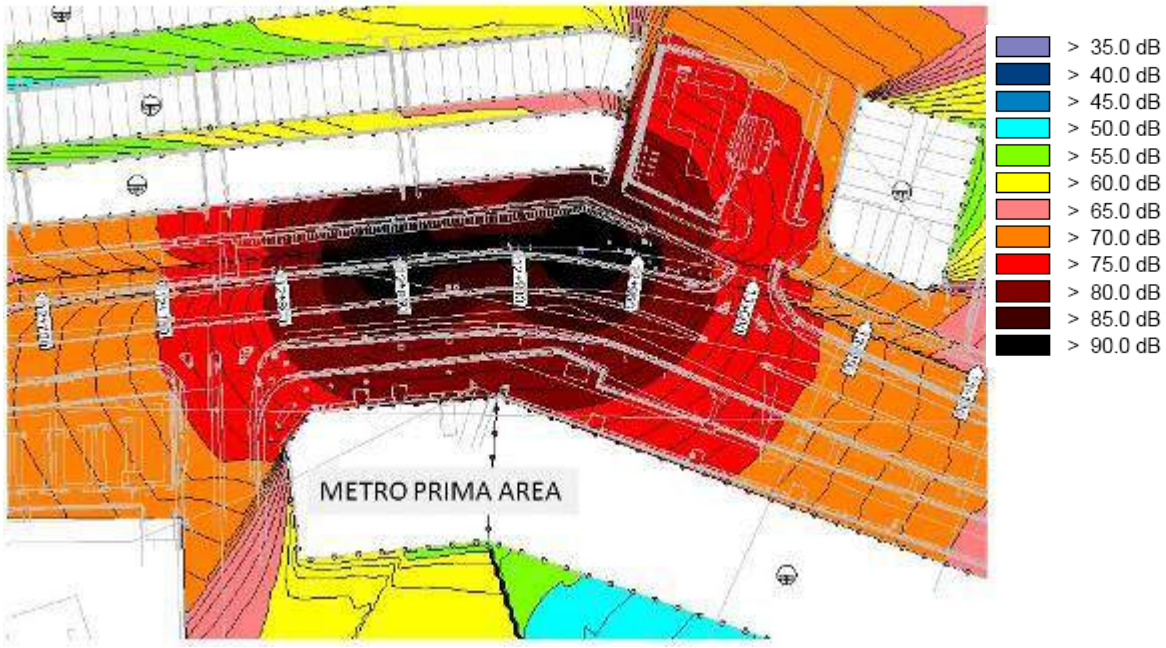

Chart 7-5 Noise Propagation from Piers Bored Piling (with 4m hoarding) at Vista Mutiara area

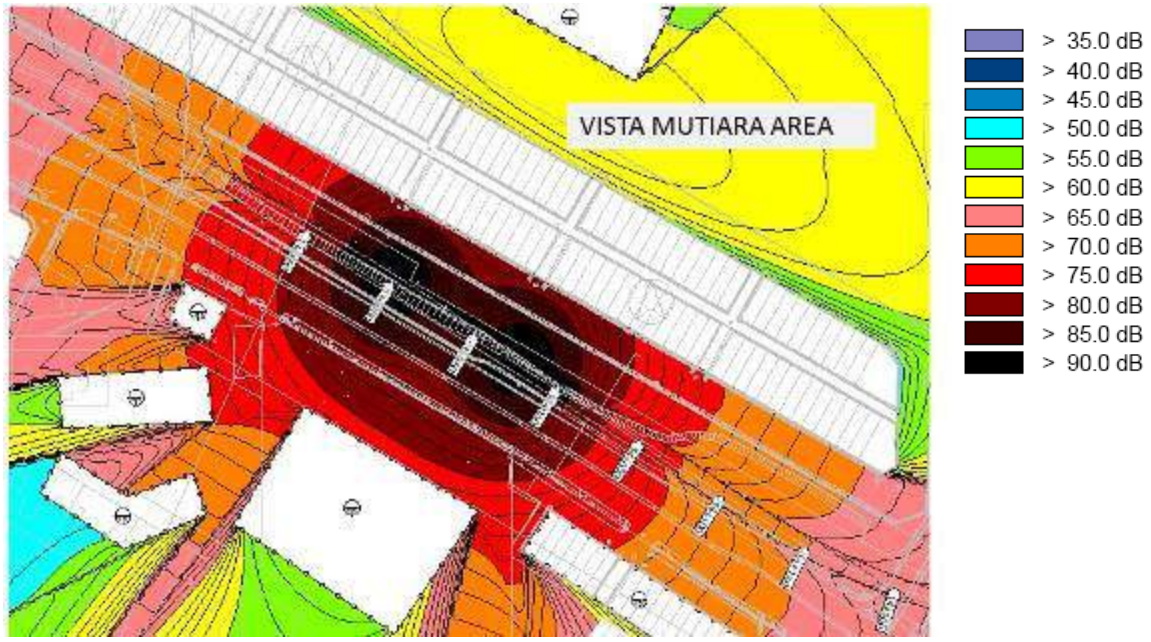

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Chart 7-6 Noise Propagation from Piers Bored Piling (with 4m hoarding) at Batu area

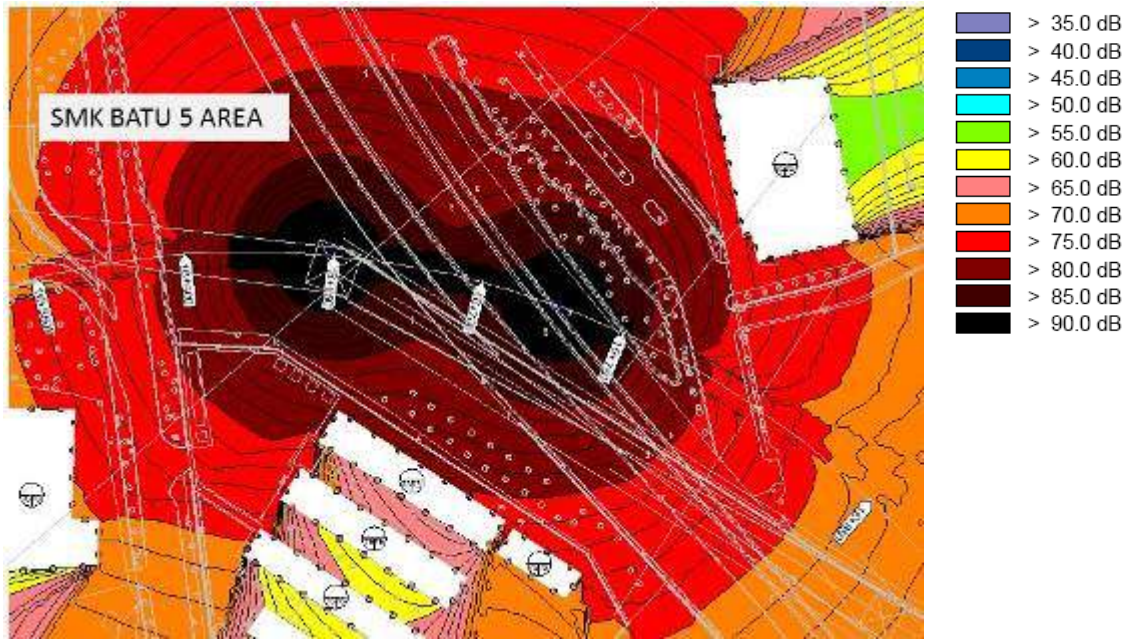

Chart 7-7 Noise Propagation from Piers Bored Piling (with 4m hoarding) at Jalan Ipoh area

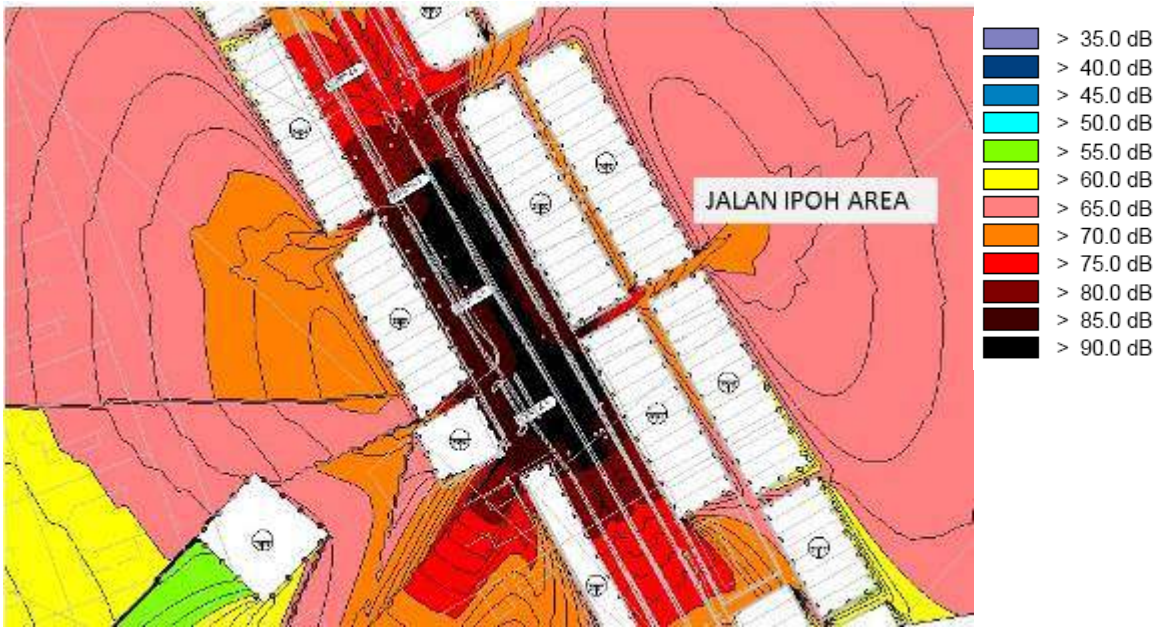

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Chart 7-8 Noise Propagation from Piers Bored Piling (with 4m hoarding) at Desa Alpha Condo area

Chart 7-9 Noise Propagation from Piers Bored Piling (with 4m hoarding) at Sekolah Kebangsaan Salak Selatan area

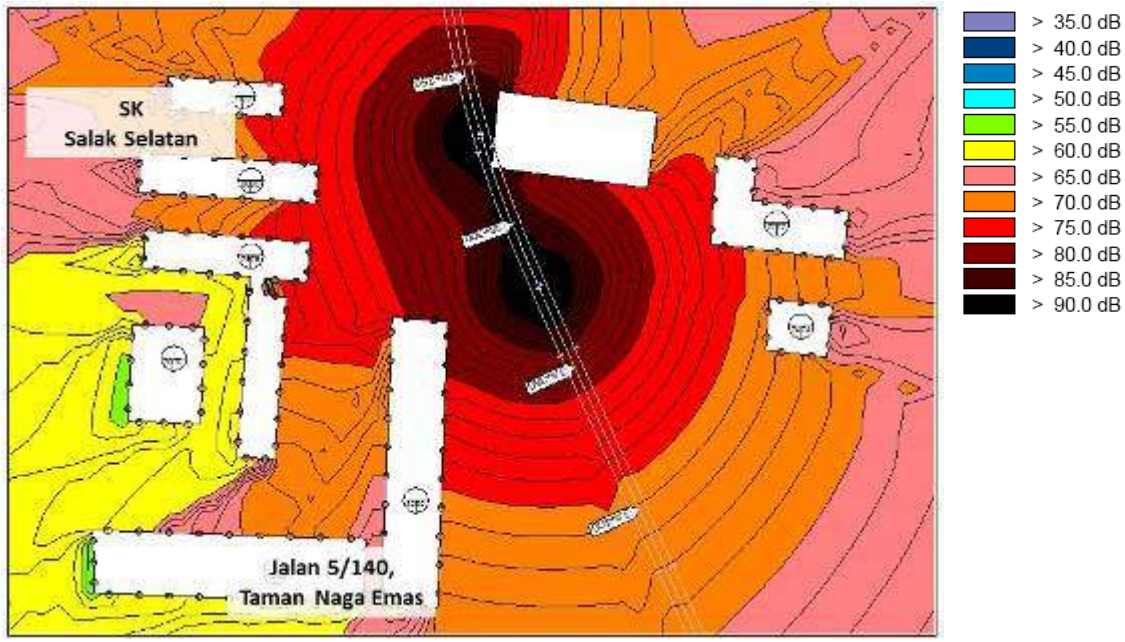

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Chart 7-10 Noise Propagation from Piers Bored Piling (with 4m hoarding) at Taman Naga Emas

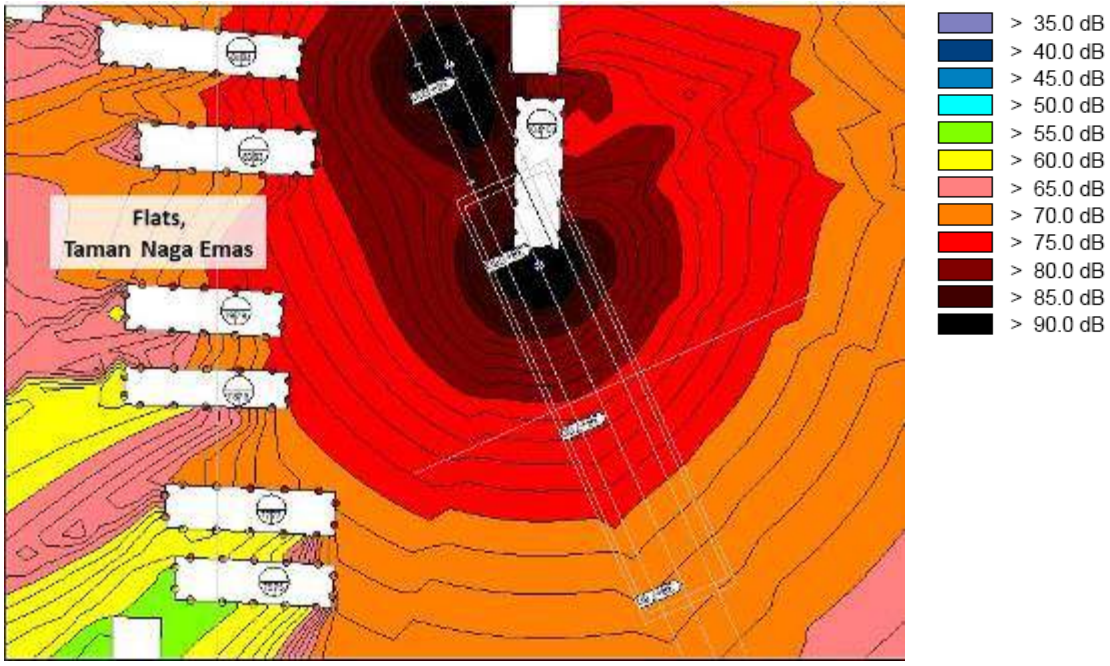

Chart 7-11 Noise Propagation from Piers Bored Piling (with 4m hoarding) at Hotel Institut Sosial Malaysia

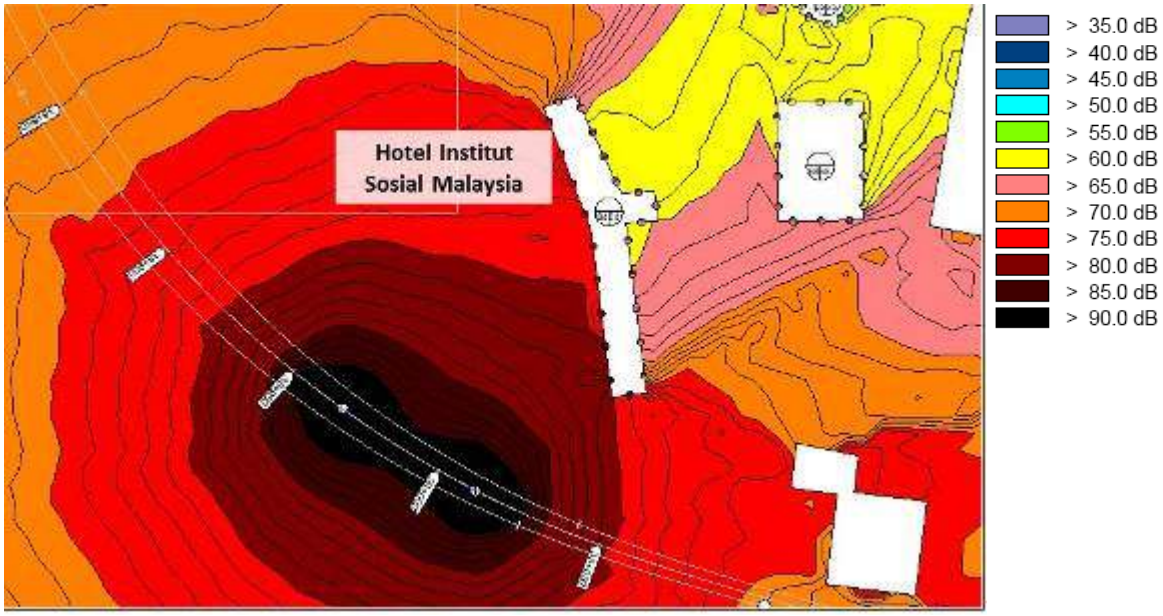

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Chart 7-12 Noise Propagation from Piers Bored Piling (with 4m hoarding) at Taman Serdang Raya

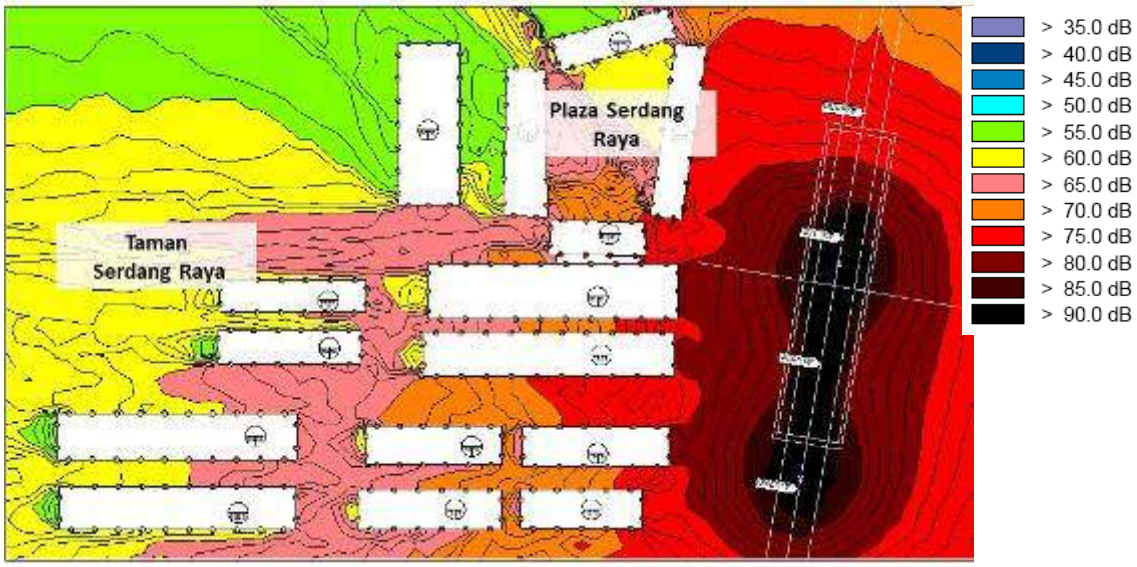

Chart 7-13 Noise Propagation from Piers Bored Piling (with 4m hoarding) at Kuarters Polis & Kuarters Bomba & Penyelamat, Seri Kembangan

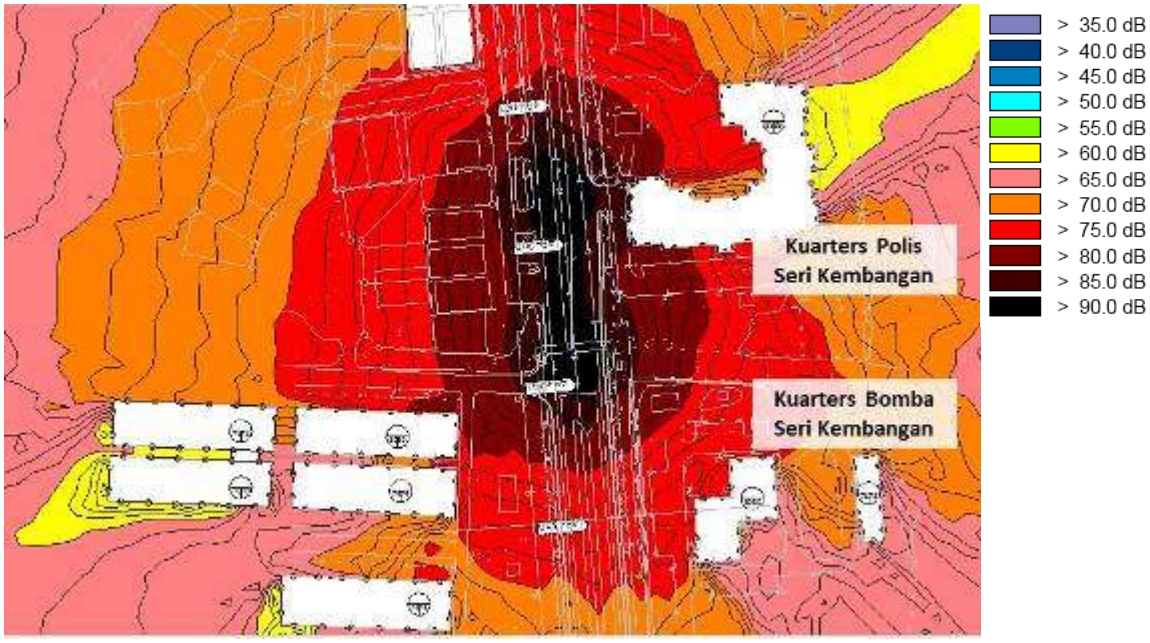

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Chart 7-14 Noise Propagation from Piers Bored Piling (with 4m hoarding) at Jalan Raya 6 & UPM Quarters

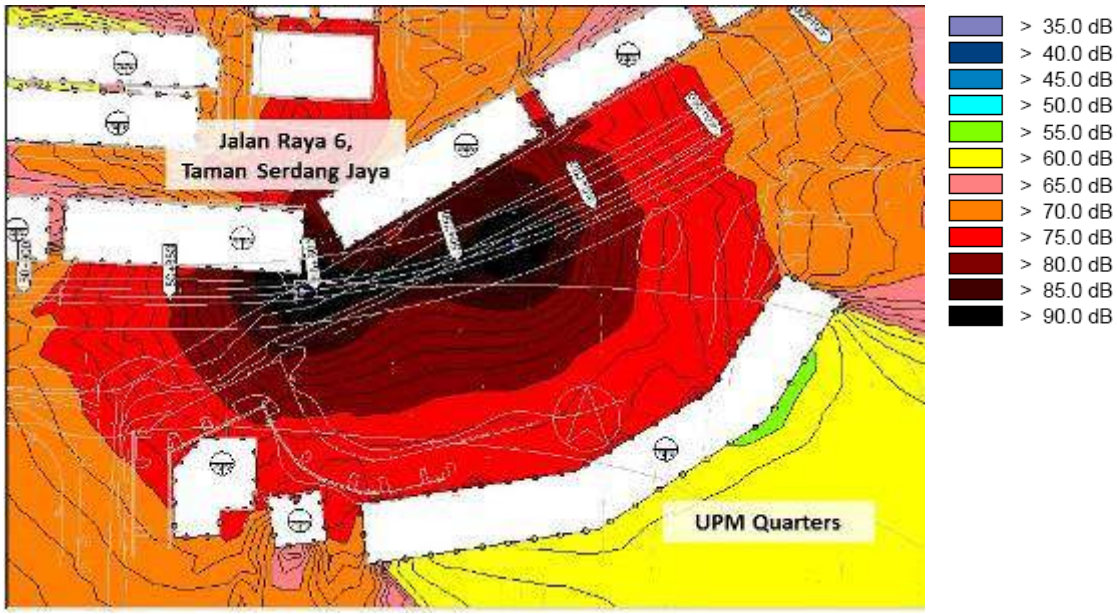

Chart 7-15 Noise Propagation from Piers Bored Piling (with 4m hoarding) at Taman 16 Sierra, Puchong

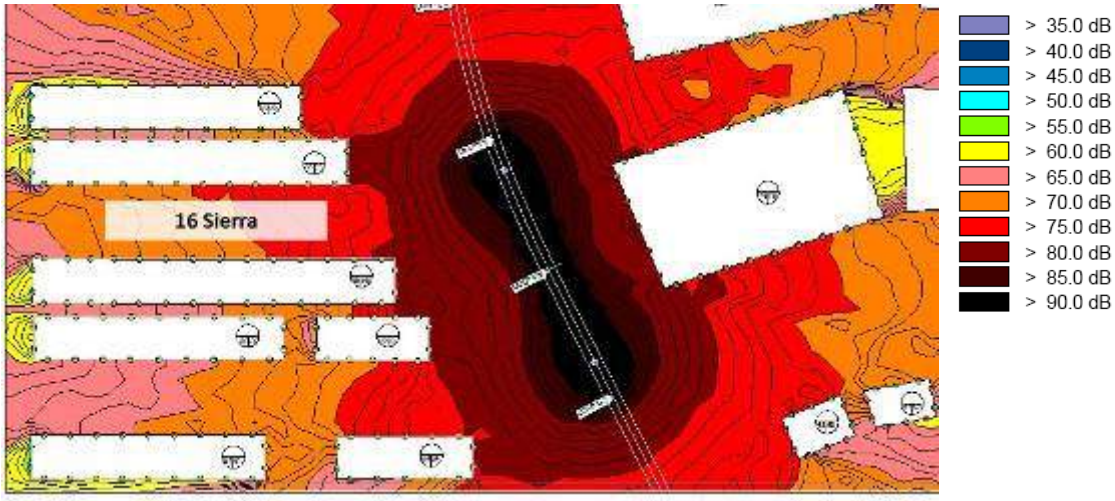

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Chart 7-16 Noise Propagation from Piers Bored Piling (with 4m hoarding) at Lim Kok Wing University

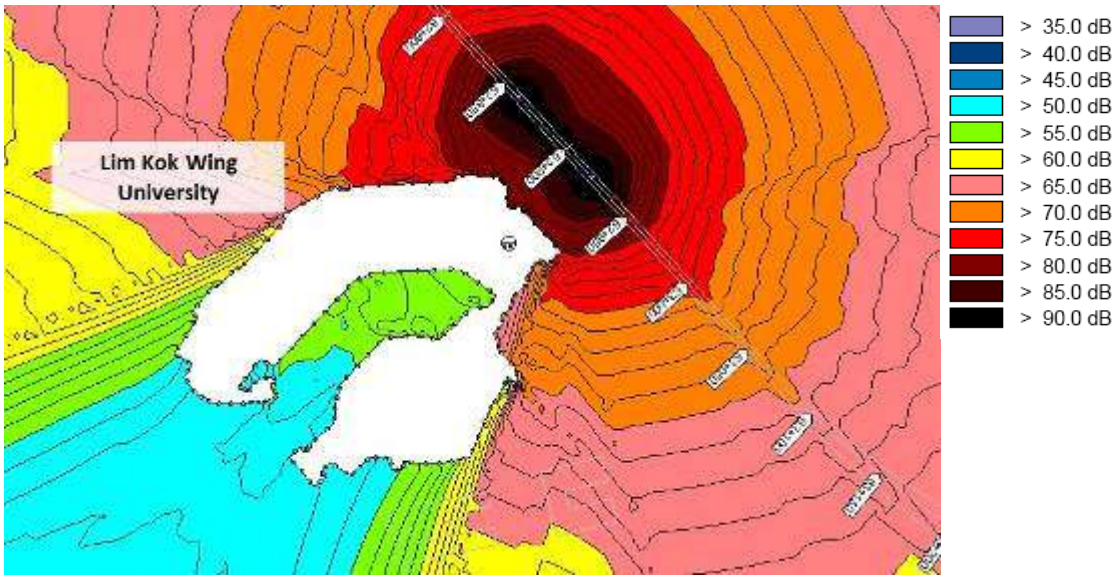

Chart 7-17 Noise Propagation from Underground Portal Work Site, North Portal at Taman Kaya Sentul West area

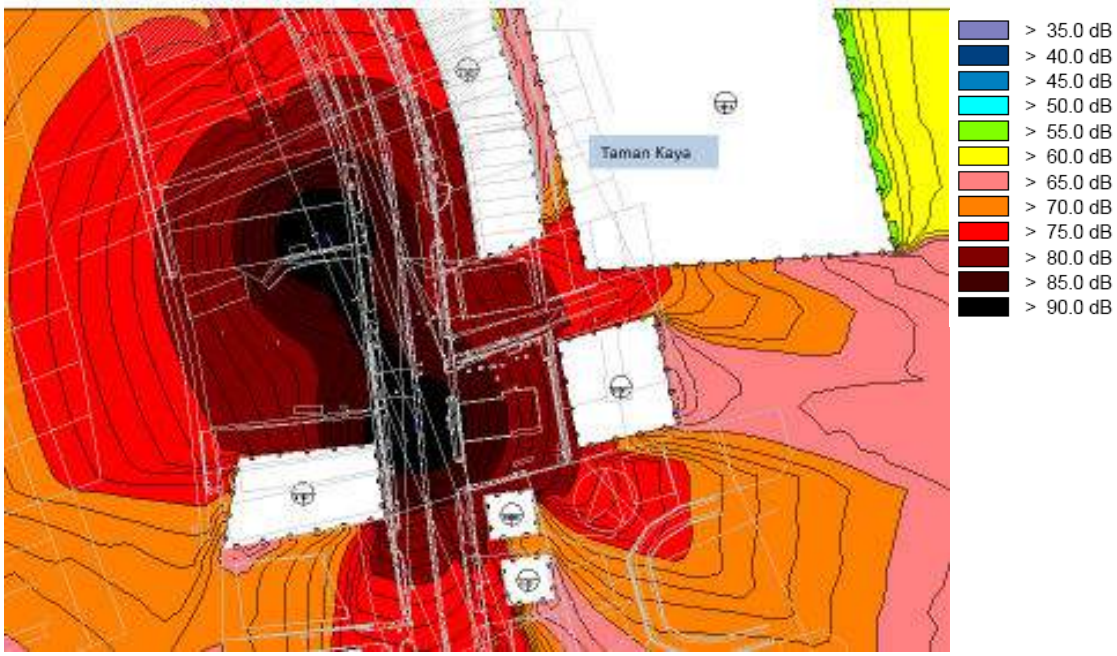

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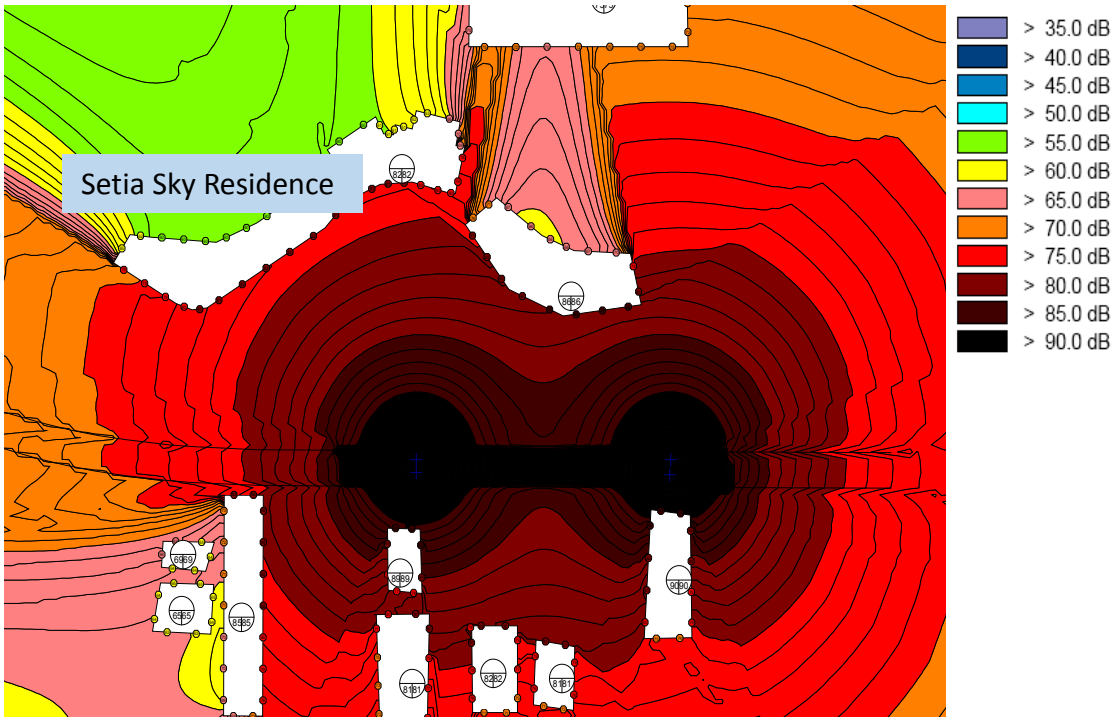
Chart 7-18 Noise Propagation from Underground Portal Work Site, Kg. Baru North area



Noise propagation of from simultaneous piling of 3 piers fronting houses with cumulative effects of highway noise) without and with mitigation measures for typical scenarios of construction of piers and Stations in close vicinity of residential houses were examined in further depth for a typical construction site.

Chart 7-19 Noise Propagation from Construction of Piers (No Mitigation, Exposed Piling)

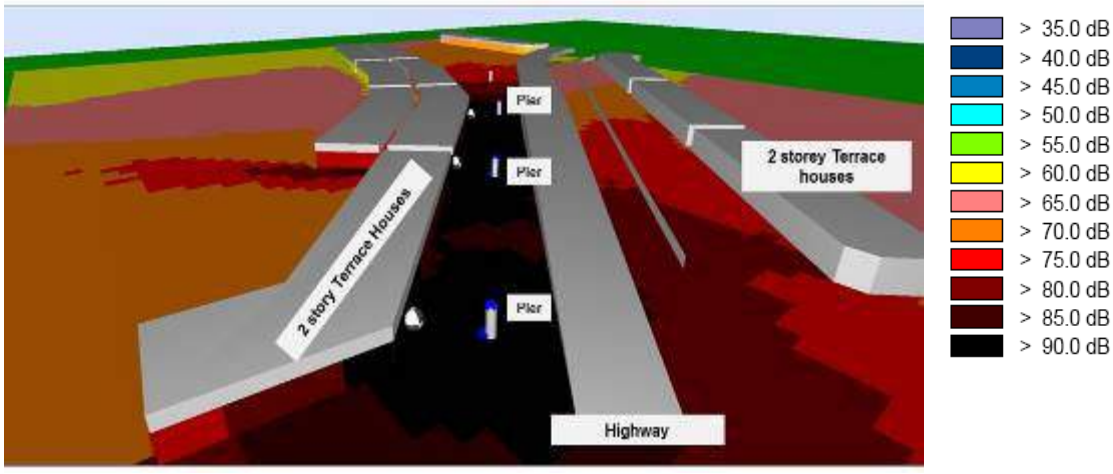


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Chart 7-19 shows the 3 D noise propagation from simultaneous piling in an exposed scenario (no hoarding) which under practical situations would not occur (but considered herein as a reference base worst case scenario). The practical situation (without additional mitigation) consisting of standard 3m to 4m perimeter/ security hoarding is shown in **Chart 7-20**.

Chart 7-20 Noise Propagation from Construction of Piers (3m Hoarding)

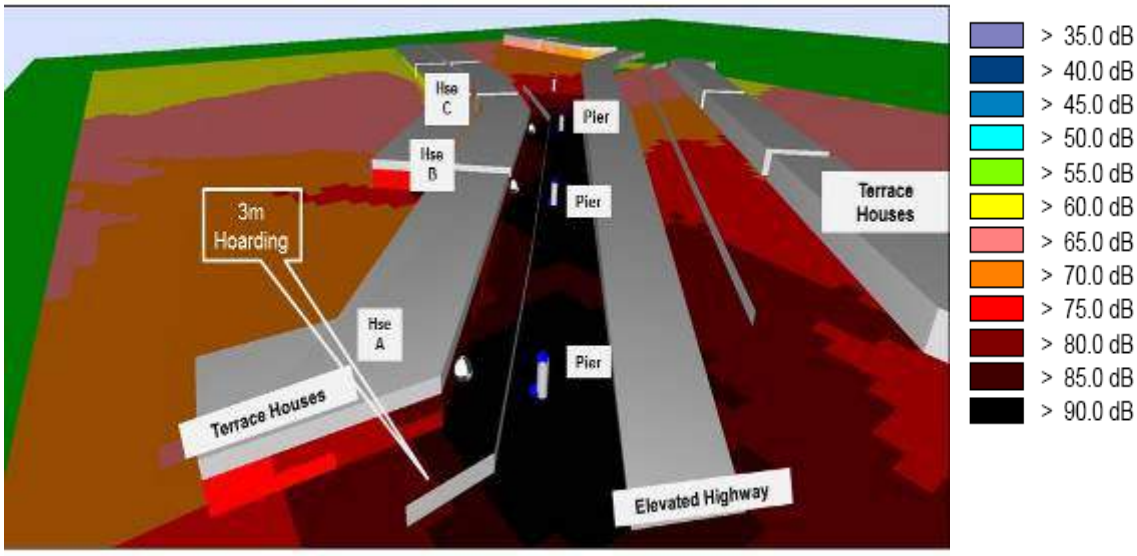
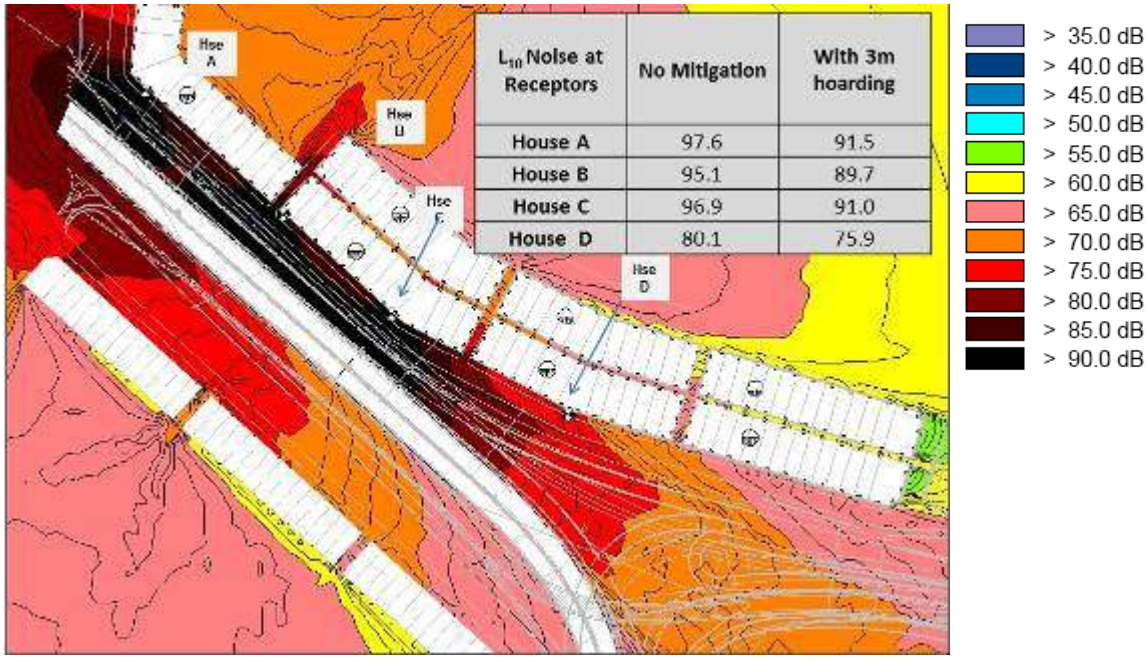


Chart 7-21 Noise Propagation from Construction of Piers (3 piling machine)



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Noise contours (for L_{10} noise levels used for construction noise assessment in accordance to the DOE Noise Guidelines) for the no mitigation (exposed piling) scenario are shown in **Chart 7-21**. Noise levels at selected receptors (houses) at different proximity to the actual piling are also given in the above figure.

Chart 7-22 Noise Propagation from Construction of Piers (6m barrier), 3 pilling machine

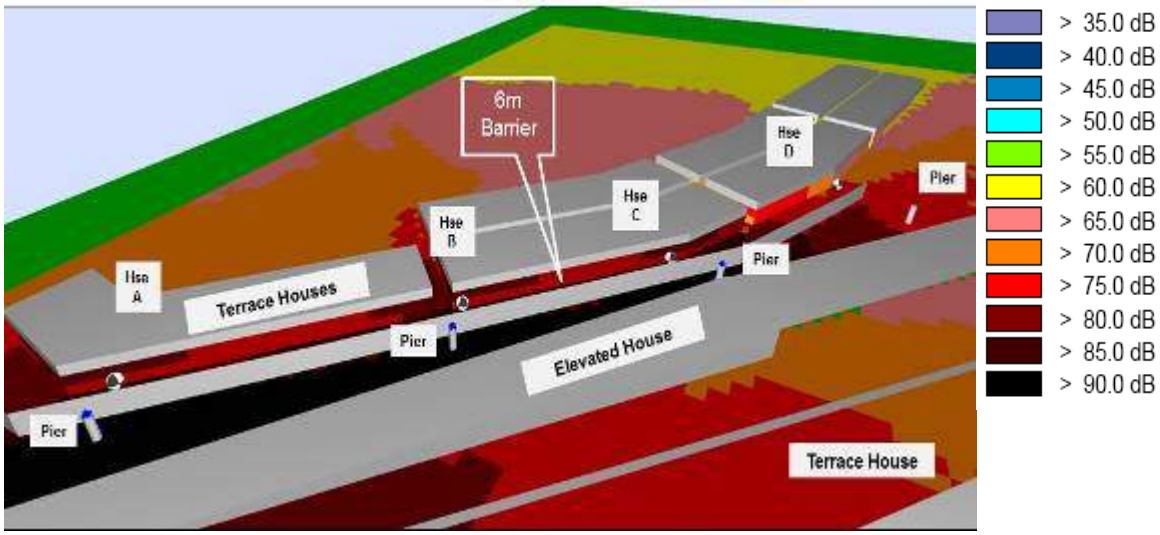

Chart 7-23 Noise Propagation from Construction of Piers (6m barrier)

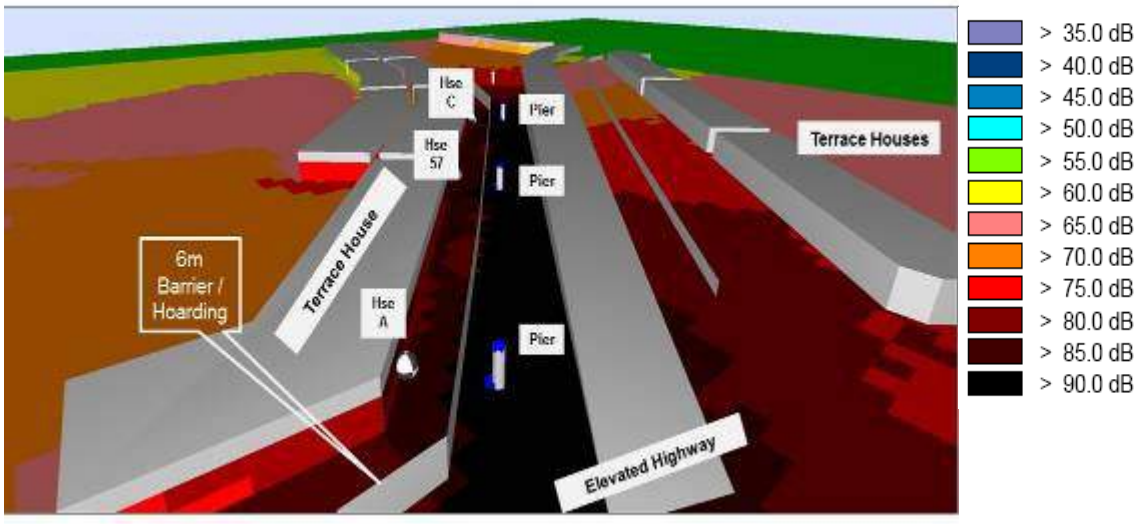

Chart 7-22 and Chart 7-23 shown the 3 D noise propagation from simultaneous piling with 6m noise barrier erected at work site. The corresponding noise map and noise levels comparison are given in **Chart 7-24**.

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Chart 7-24 Noise Propagation from Piling of Piers (3 Piling Machine) With 6m Noise Barrier Nominal Mitigation

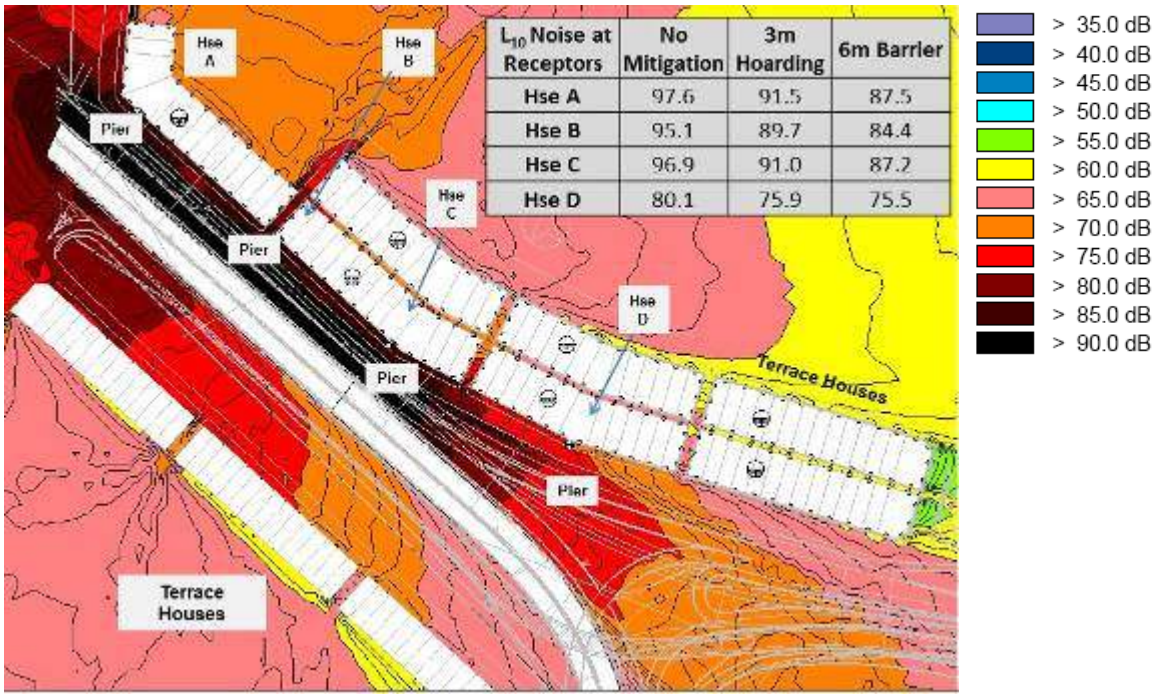

Chart 7-25 Noise Propagation from Piling of Piers (6m Barrier), 1 Pilling Machine

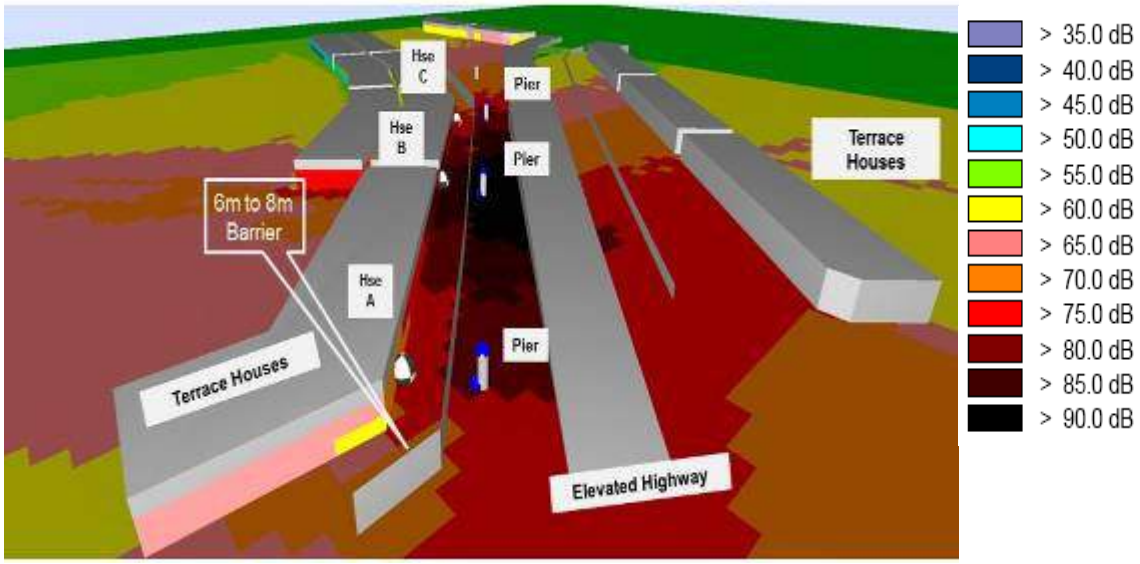

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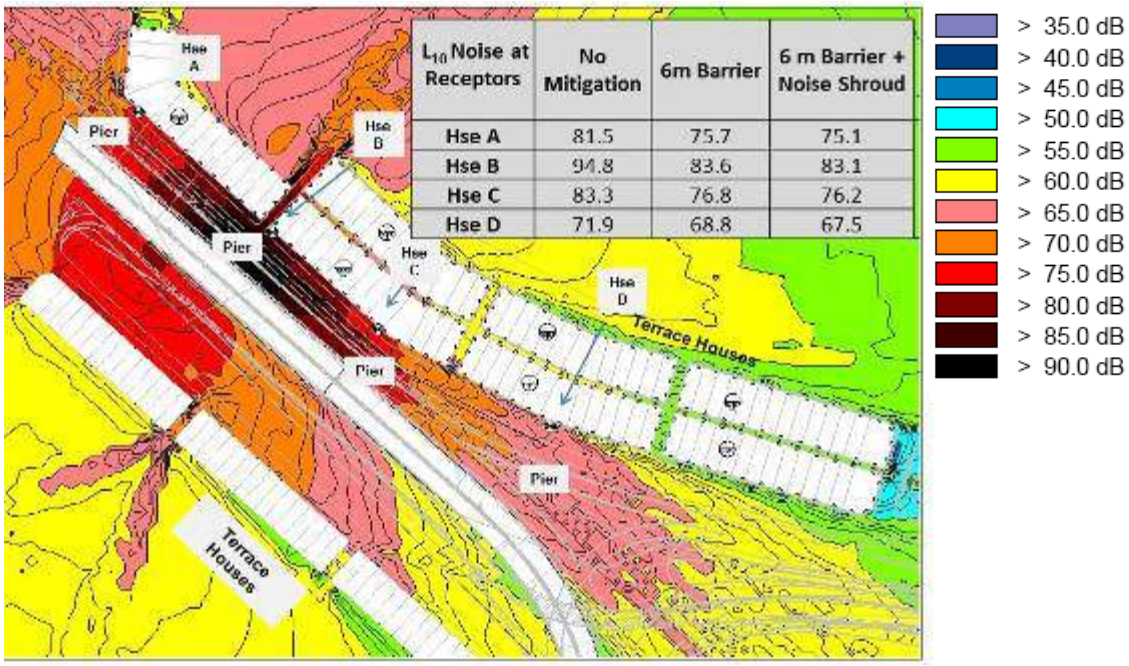
Chart 7-26 Noise Propagation from Piling of Piers (1 Piling Machine) With 6m Noise Barrier



It was evident from the above analysis that, without noise mitigation, noise levels are unacceptable in close vicinity of built up residential houses. It was also evident that even with nominal noise mitigation using 6m noise barrier around the work site in lieu of standard 3m to 4m hoarding, piling noise may be above permissible limits when construction works are not adequately managed (3 simultaneous piling).

Under such circumstances, it would be necessary to consider administrative control in addition to use of noise barriers and other secondary measures. The management of construction noise at sensitive receptors will therefore require additional analysis upon which mitigation measures in form of temporary noise barriers at the work site, use of noise shroud for piling machines, and sequencing of piling operations. An example of the analysis required is given in **Chart 7-27** to **Chart 7-35** for the Southern Elevated Segment 2, Vista Magna Apartment.

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Chart 7-27 Construction Site Noise Model With Standard Printer Hoarding, Vista Magna Apartment, Northern Elevated Segment

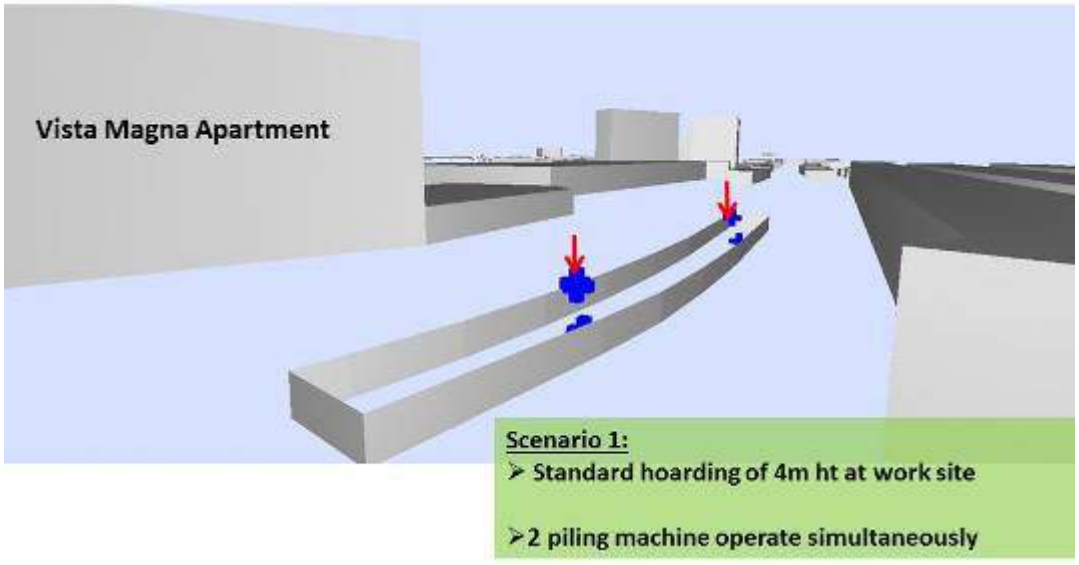

Chart 7-28 Noise Contours From Piling (2 Piling Machine) With 4m Hoarding

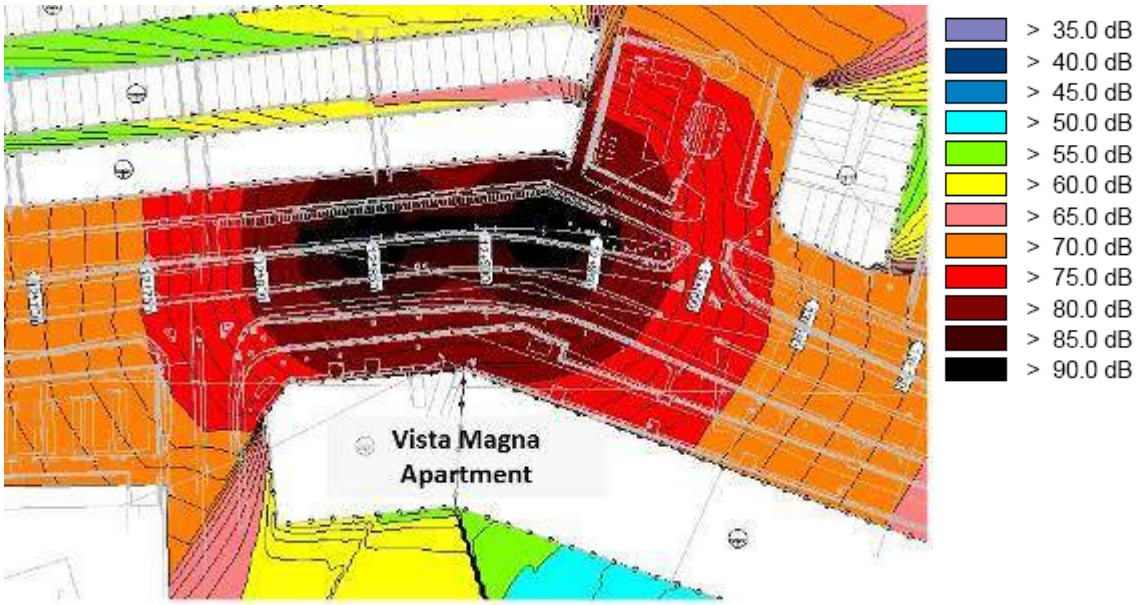

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Chart 7-29 Noise Propagation From Piling (2 Piling Machine) With 4m Hoarding

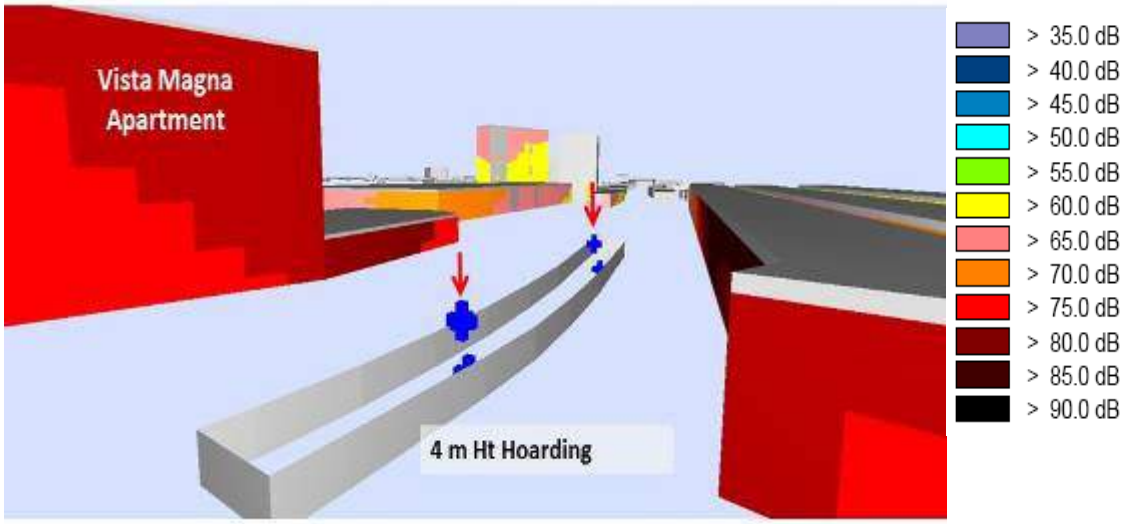

Chart 7-30 Construction Site Noise Model With 8m Noise Barrier Vista Magna Apartment, Northern Elevated Segment

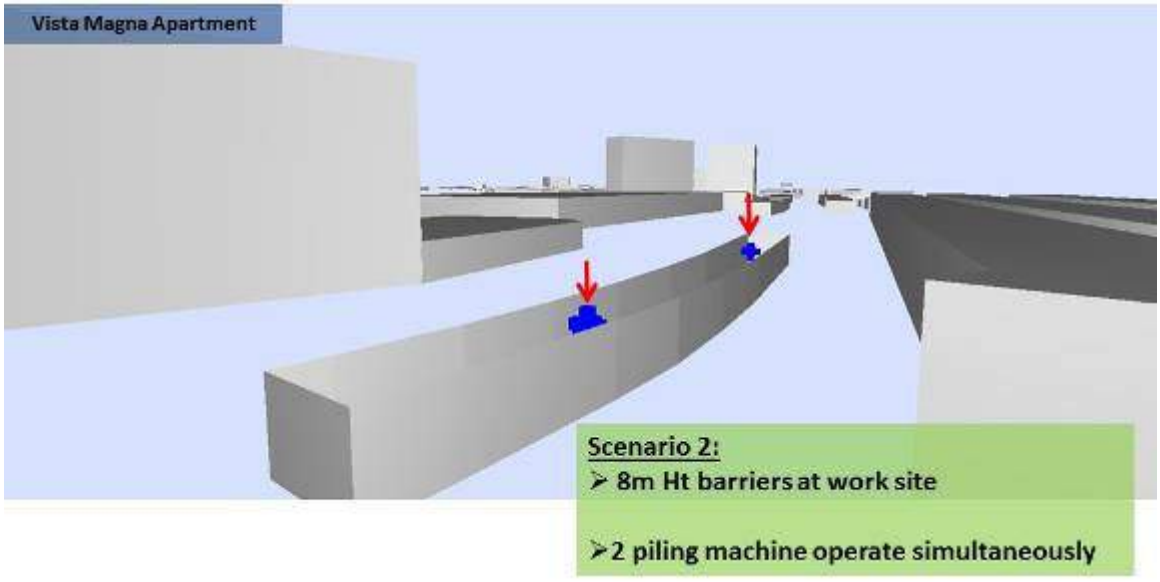

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Chart 7-31 Noise Contours From Piling (2 Piling Machine) With 8m Noise Barrier

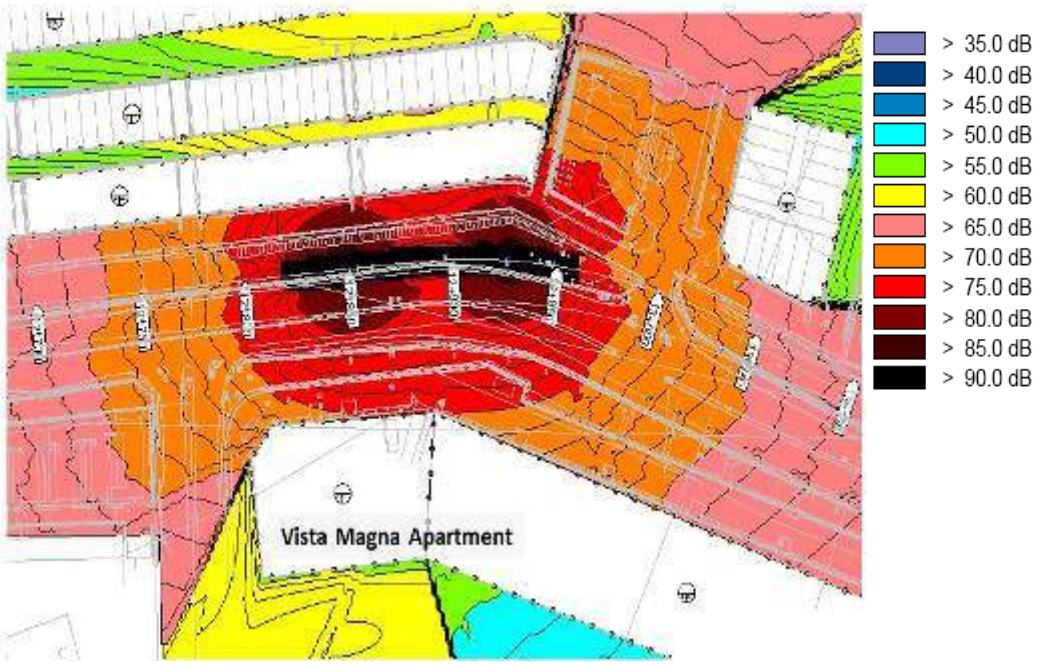
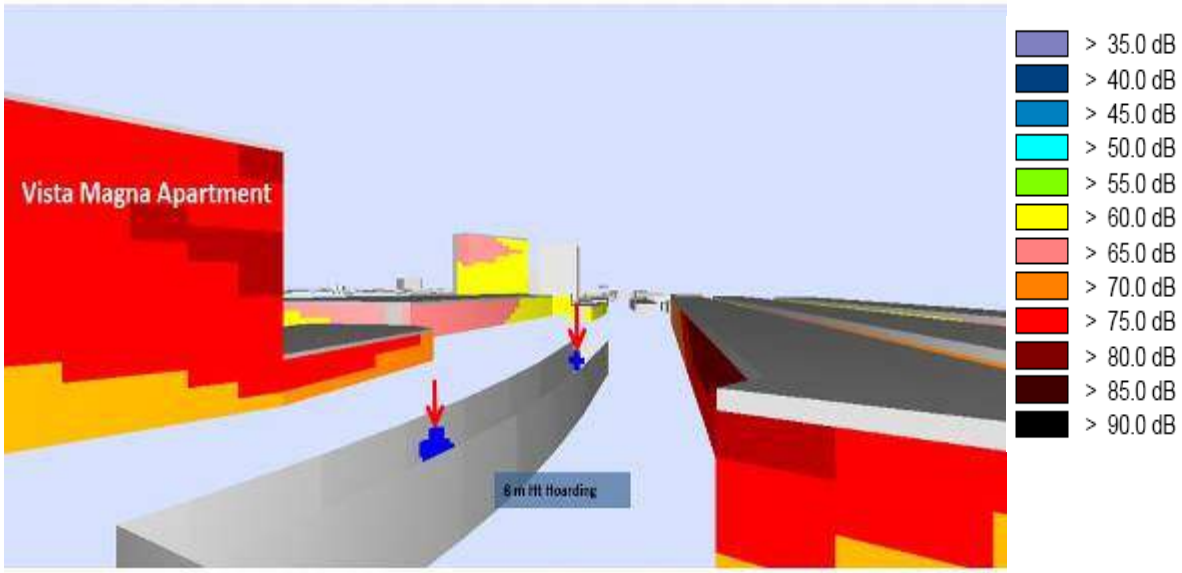


Chart 7-32 Noise Propagation From Piling (2 Piling Machine) With 8m Noise Barrier



SECTION 7 : POTENTIALLY SIGNIFICANT IMPACTS AND MITIGATION MEASURES DURING THE CONSTRUCTION STAGE

Chart 7-33 Construction Site Noise Model With 12m Noise Barrier Vista Magna Apartment, Northern Elevated Segment

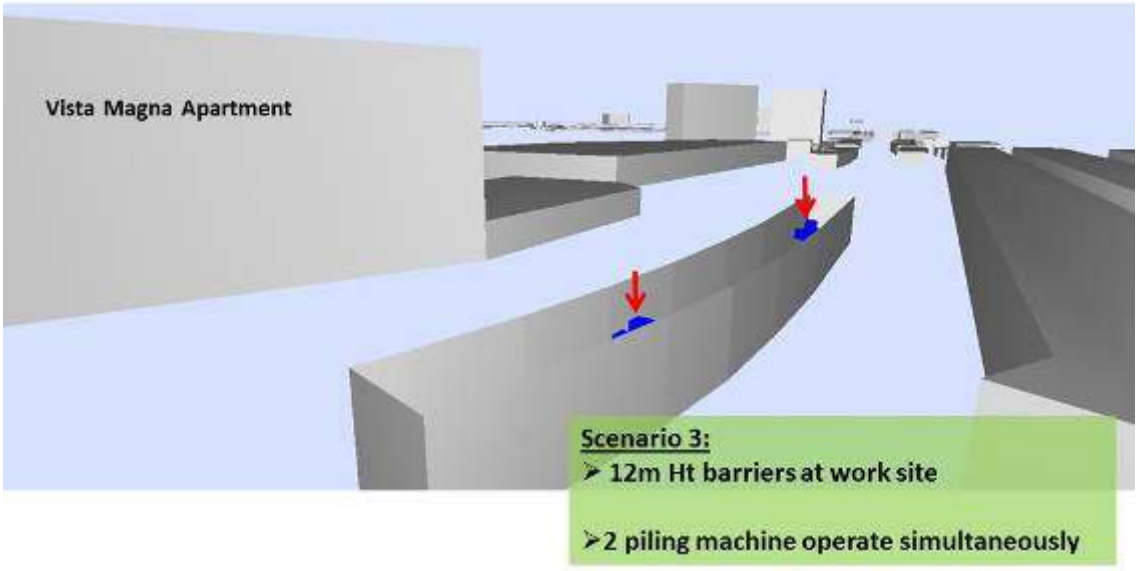
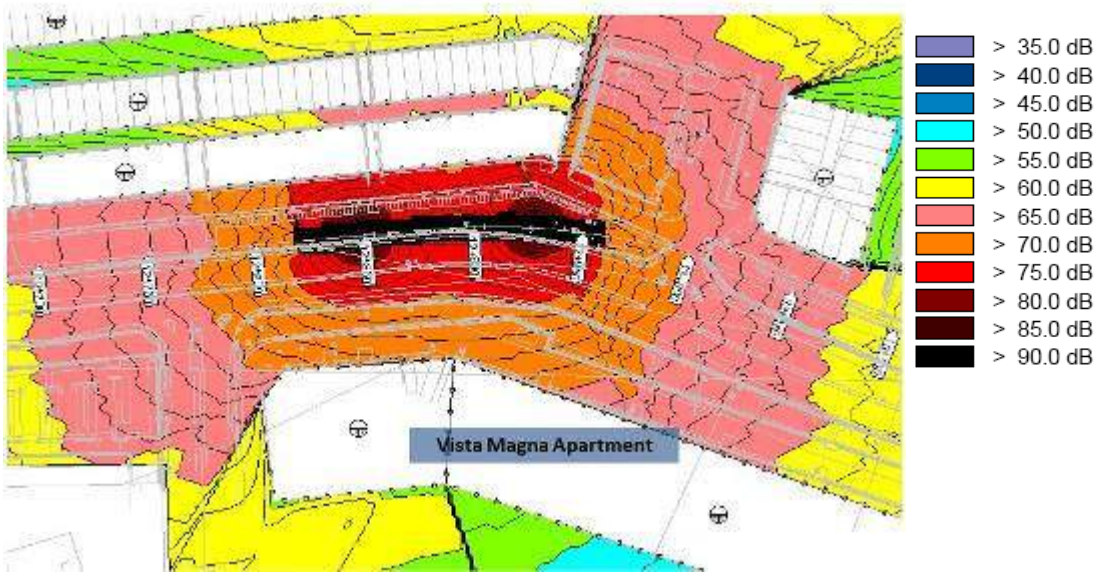
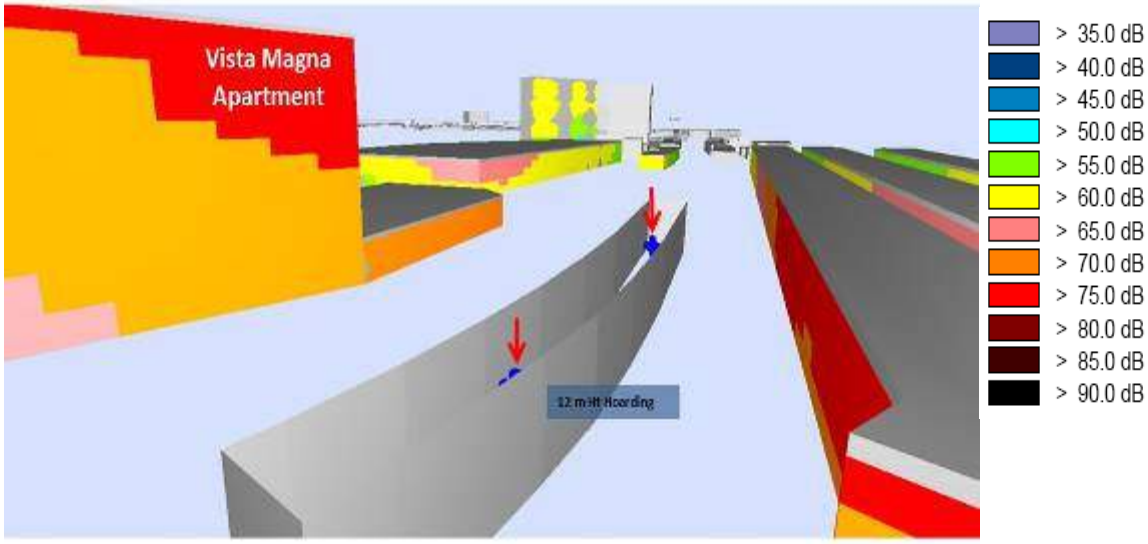


Chart 7-34 Noise Contours From Piling (2 Piling Machine) With 12m Noise Barrier



SECTION 7 : POTENTIALLY SIGNIFICANT IMPACTS AND MITIGATION MEASURES DURING THE CONSTRUCTION STAGE

Chart 7-35 Noise Propagation From Piling (2 Piling Machine) With 12m Noise Barrier



Additional impacts relating to traffic congestion with increased noise impact may also occur, depending on locality and the prevailing traffic conditions. Increase in absolute noise levels may not necessarily be very significant (typically in 1 dBA to 3 dBA), although the subjective perception may suggest otherwise due to increased frustration of associated with traffic congestion. Experience from elsewhere has shown that increased traffic volume but with average vehicle speeds being lower in a traffic jam had similar noise levels when there are no traffic jams but with lesser number of vehicles travelling at higher speeds due to an unrestricted flow of traffic.

Notwithstanding whether the noise levels are significantly increased due to road traffic congestion, it is nevertheless necessary to minimize local road traffic disturbances due to construction of the MRT viaducts and stations. Road traffic diversions and traffic management shall be required to minimize adverse impact relating to the environment and inconvenience to the affected community and general public.

Areas Most Affected by Construction

A review of distances (based on proximity screening) provided a list of potential; receptors that may be affected by construction (noise and/or vibration) (**Table 7-11 to Table 7-14**).

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Table 7-11 Receptors that may be affected by Construction Noise (Northern Elevated Segment)

#	Receptors	Description
1	IGB International School, Sungai Buloh	School
2	Saujana Damansara Residential	Terrace houses
3	Saujana Damansara Shop Apartment	Mixed use
4	Damansara Damai Shop Apartment	Mixed use
5	Sri Damansara Hotel	Hotel
6	Hotel under construction	Hotel
7	Sri Damansara Development(Persiaran Perdana)	Condominium
8	Persiaran Dagang (Jalan Jati)	Terrace houses
9	Wisma Twintech	Institutional
10	Persiaran Dagang (Jalan Dagang, Jalan Angsana)	Terrace houses
11	Hotel Sutera	Hotel
12	Kepong Sentral Flat	High rise flat
13	Taman Sri Ehsan	Terrace houses
14	Masjid Al-Amaniah	Mosque
15	Balai Polis Kepong	Police Station
16	Jinjang Temple and house (Jalan Jinjang Aman, Jinjang Permai)	Temple
17	DBKL Multipurpose Hall	Hall
18	Houses at Kg Batu area	Houses
19	Alam Puri Condominium	Condominium
20	SMK Batu 5 and SJKC Mun Choong	School
21	Permai Ria Condominium	Condominium
22	Flat Taman Batu Permai	Flat
23	Sek. Keb Kg Batu	School
24	Jalan Ipoh Shop Apartment	Apartment
25	Pelangi Indah Condominium	Condominium
26	Desa Alpha Condominium	Condominium

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Table 7-12 Receptors that may be affected by Construction Noise (Underground Segment)

#	Receptors	Description
1	Taman Kaya	Houses
2	SMK P Jalan Ipoh	School
3	Kompleks Mutiara	Mixed
4	Sang Suria Condominium	Condominium
5	The Maple	Condominium
6	Titiwangsa area	Residential
7	General Hospital Kuala Lumpur	Hospital
8	Istana Budaya	Theatre
9	Setia Sky Residence, Jalan Raja Muda Aziz areas	Condominium
10	UTM Space	Institution
11	KLCC East Station area	Condominium
12	Jalan Conlay area	Condo, Mixed Use

Table 7-13 Receptors that may be affected by Construction Noise (Southern Elevated Segment 1)

#	Receptors	Description
1	Jalan 5/116B, Kuchai Lama	Houses
2	De Tropicana Condo	Condominium
3	Jalan 35, Kg Baru Salak Selatan	Houses
4	Jalan 36, Kg Baru Salak Selatan	Houses
5	The Leafz, Central Residence	Apartments
6	SMK Salak Selatan	School
7	Flats, Jalan Gempita 1	Flats
8	Jalan 5/140, Taman Naga Emas	Houses
9	Jalan 3/140, Taman Naga Emas	Houses
10	Flats, Jalan 4/140, Taman Naga Emas	Flats
11	Flats adjacent to BB Sri Petaling St	Flats
12	School, Bandar Baru Sri Petaling St	School
13	Hotel Institut Sosial Malaysia	Hotel
14	Jalan Badang	Mixed Use
15	High Rise, Bandar Tasek Selatan	Apartments
16	Police Quarters Sg Besi	Residential
17	PPR Kg Raya Permai	Residential
18	Hotel Nouvell	Hotel

SECTION 7 : POTENTIALLY SIGNIFICANT IMPACTS AND MITIGATION MEASURES DURING THE CONSTRUCTION STAGE

Table 7-13 Receptors that may be affected by Construction Noise Southern Elevated Segment 1 (Cont'd)

#	Receptors	Description
19	Plaza Serdang Raya (mixed development)	Mixed Use
20	Jalan SR 6/1	Residential
21	Mutiara Serdang	Residential
22	Pangsapuri Seri Siantan	Residential
23	Flat Serdang Raya	Residential
24	Jalan SK 11/1	Residential
25	Police Quarters, Seri Kembangan	Residential
26	Kuarters Bomba & Penyelamat SK	Residential
27	Jalan 1/2, Taman Kembangsari	Category 1
28	SJKC Serdang Baru 2	School
29	Jalan 18/46, Taman Seri Serdang	Houses
30	Taman Serdang Jaya	Houses
31	UPM Quarters	Residential
32	Jalan Keledang, Serdang	Houses
33	UPM - MARDI	Institution

Table 7-14 Receptors that may be affected by Construction Noise (Southern Elevated Segment 2)

#	Receptors	Description
1	Jalan Indah 1/1, Jalan 2/1, Taman Universiti Indah	Houses
2	Red Ruby Shop Apartment	Category 1
3	Pangsapuri Rusella, Vista Pinggiran	Condominium
4	ZEVA @ Equine South	Condominium
5	Jalan Dd 3a/5, Taman Dato Demang	Residential
6	Jalan PP 31 & Putra Raya Apartment	Residential
7	Jalan PP 40, Tmn Pinggiran Putra	Residential
8	Jalan Bpp7, Seri Kembangan	Residential
9	O2 Puchong	Condominium
10	Jalan D'Alphine	Residential
11	16 Sierra - Odora Townhouse, Adenia & Aleca	Residential
12	16 Sierra	Residential
13	Sierra 15 - Proposed High Rise	Condominium
14	Sky Park	Residential
15	Limkokwing University	Institution

SECTION 7 : POTENTIALLY SIGNIFICANT IMPACTS AND MITIGATION MEASURES DURING THE CONSTRUCTION STAGE

Mitigation measures to minimize noise impacts

An item of significant concern during the construction works relates to noise and vibration arising from piling during the construction along the entire alignment, especially at the piers and stations in close vicinity to residential areas.

Noise and vibration mitigation during construction in general requires the use of low energy low impact equipment and construction work process. Piling shall be bored piles, injection piles and other low noise low impact piling methods. There shall be no impact hammer drop piles to be used in the Project.

Even with the use of bored piles, high noise and vibration often occur (as evident from the LRT Extension and SBK Line construction sites) when chiseling is used to drill through hard rocks. Another common source of noise during bore piling also occurs during the shaking process to clear compacted soil and mishandling.

In summary the use of bored and injection piles together with low noise diesel generator sets can help for lower noise and vibration impact to the environment.

- **Temporary Noise Barrier**

Construction work sites at noise sensitive areas shall require the installation of temporary acoustic noise barriers, double skinned panels with acoustic absorption infill and perforated on the work side or other suitable barrier that can effectively reduce the level of noise to an acceptable limit.

Examples of temporary acoustic noise barriers are found in several of the SBK Line construction sites (at the MRT Underground Station sites as well as work sites of the viaduct areas fronting residential areas

For general construction activities on the ground, noise disturbance to the neighbours shall be minimised to within all practical means. At MRT Stations, if close to the sensitive receptors, noise barriers shall be installed prior to commencement of construction works. Permanent noise barriers planned for the station areas (for example car parks, and perimeter boundary) such that noise from construction to adjacent neighbours could be screened.

- **Equipment Shielding and Enclosures**

Other high noise sources in construction are from diesel generators sets and earth moving vehicles. Diesel generator sets used in residential areas shall be a low noise type (i.e. to come as an integral unit) enclosed in an acoustics enclosure and fitted with silencers at exhaust and air intake. Earth moving equipment shall also be low noise emission type. In addition to the above control of noise emissions at source, there shall also be a restriction of operating hours of earth moving vehicles.

- **Flexible Noise Barrier for High Noise Activities**

Flexible noise barriers and partial shielding can be used for mitigation of piling machine, auger crane, drilling and hacking at work sites in close proximity to sensitive receptors.

- **Monitoring Programme**

To ensure that piling (and other construction activity) does not result in a disturbance, noise levels shall be continuously monitored during piling activities to confirm compliance to DOE acceptance limits for construction activities in residential areas.

Plates 7-1 to Plate 7- 8 shows examples of typical noise mitigation measures that can use to minimize noise levels.

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Plate 7-1

Example of temporary acoustic barrier for MRT construction site

Plate 7-2

Example of temporary acoustic barrier for MRT construction site

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	**Plate 7-3** Example of temporary acoustic barrier for SBK Line construction site
	**Plate 7-4** Example of temporary acoustic barrier for SBK Line construction site

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Plate 7-5

Example of partial closure for piling machine

Plate 7-6

Example of flexible noise barrier for shielding of high noise work in sensitive areas

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Plate 7-7

Example of acoustic enclosure for portable generator sets

Plate 7-8

Example of partial movable light weight enclosure for movable equipment

7.7 VIBRATION

Vibration during the construction phase is a concern, particularly from piling activities. Excessive vibrations in close proximity to vibration sensitive structures may indeed result in concerns of potential structural damage. Recommended environmental vibration limits are given in the DOE the Guidelines for Environmental Vibration Limits and Control (2007). Vibrations limits for human response in buildings for short term exposure to vibration are given in the Guidelines Annex A, Schedule 6 as follows:

For Residential Land Use ***Day time: Curve 8 to Curve 16***
Night Time: Curve 4

("Curve 1" is based on the vibration perception threshold for human response).

Annex A, Schedule 2 of the Vibration Guidelines recommends vibration limits for damage risk in buildings for short term vibration exposure (**Table 7-15**).

Table 7-15 Limit For Damage Risk In Buildings From Short Term Vibration

Type of Structure	Vibration Velocity V_i [mm/s] at foundation (as defined by the respective rating curves of Figure 1)	Vibration Velocity V_i [mm/s] at plane of floor of uppermost full storey (all frequencies)
Industrial buildings and buildings of similar design	Curve C	40
Commercial building, dwelling and buildings of similar design and/or use	Curve B	15
Structures that, because of their particular sensitivity to vibration, do not correspond to those listed above, or of great intrinsic value (e.g. residential houses, or buildings that are under preservation order)	Curve A	8

Source: DOE Planning Guidelines for Vibration Limits and Control in Environment, 2007

Typical vibrations from bored piles as measured at approximately 10m from the piling point are shown in the **Chart 7-36**. The chart gives a vibration versus time plot demonstrating transient vibration excursions during casing driving, with short term vibrations of up to 4.5 mm/s (Curve 4.5).

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Chart 7-36 Typical Vibration from Bored Piling in Malaysian Construction Works (Penang Bridge widening works)

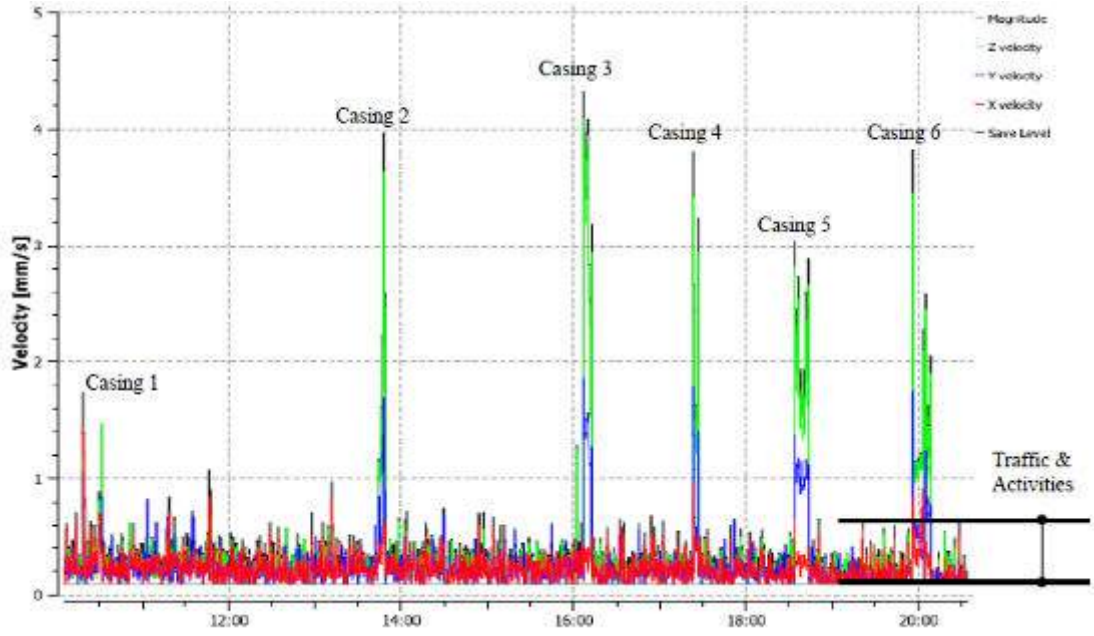
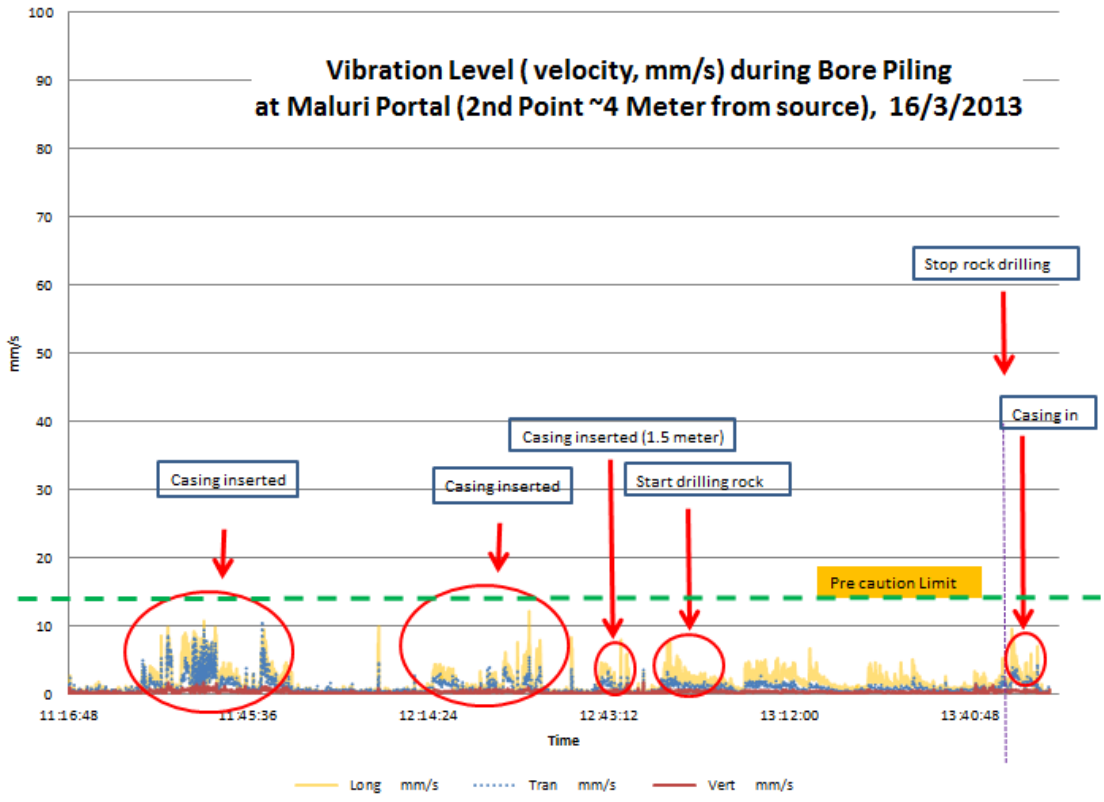


Chart 7-37 Measured vibration from bored piling in SBK Line Project



With bored piles and other similar low impact piling methods, vibrations from piling are anticipated to comply with limits recommended for human response in buildings.

The vibrations while within recommended limits for human response in residential buildings are nevertheless expected to be fellable (perceivable) to human touch, and are significantly higher than normal road traffic and human activities noted in the background vibrations plotted.

Mitigation measures to minimize vibration levels

Vibration levels to sensitive receptors can be minimized using low impact energy methods (typically bore piling). Even with the use of bored piling, excessive transient vibrations are often generated during chiseling (used during bore piling when encountering rocks), casing extraction and mishandling during setting up of the piles and casings and sheet pile installation. Mishandling of piles and casings are simple on site management to avoid unnecessary free fall of casings and inherent banging noise as a result of mishandling. Chiseling in particular should also be avoided at location in close proximity to residential receptors.

Where feasible, trenches could be considered to minimize surface wave propagation from piling and other ground-borne vibration impacts (heavy vehicles road traffic).

Oscillating type casting could be explored to minimise vibration during installation and extraction of casings used for the bored pilling. Press-in-type sheet pile could be alos considered to minimise vibration at excavation areas where shoring is required.

The use of diaphragm sheet piles should also be considered in construction sites with longer construction period (typically at the stations and underground work sites) to address potential soil settlement that may occur which consequently may affect nearby buildings. Complains of cracks in buildings and in particular houses which are inherently more susceptible to soil settlement are often blamed on piling vibrations- although the feelable vibrations may only be a secondary cause since the piling vibrations are immediately perceivable by receptors, whereas the soil settlement (being the primary cause) is not so readily observed.

Monitoring Programme

To ensure that piling (and other construction activity) does not result in a disturbance, vibration shall be continuously monitored during piling activities in residential areas. During critical phases involving high impact activities (for example during piling and blasting if any) soil settlement and vibration monitoring shall be undertaken so that there are monitoring records to be correlated against construction activities. This monitoring and reporting is particularly important and absolutely necessary as it shall be used in the assessment and resolution of potential complaints or disputes and litigation and insurance claims relating to disturbances and damages from the construction works.

7.8 GEOTECHNICAL HAZARDS AND CONSTRUCTION RISKS

The construction of the SSP line will involve major civil engineering works such as the construction of shallow and deep foundations, excavation works, retaining wall construction, temporary shoring works to support excavations and tunnelling works.

All these works require an understanding of the existing geological conditions, soils and groundwater regime to ensure that the risks associated with the construction and operation of the SSP line are acceptable. A prerequisite to understanding the geology, soils and groundwater regime is a comprehensive soil investigation in order to determine the various geological bedrock profile, soils and groundwater that will be encountered during the course of the works. As of to date, several phases of the soil investigation works has already been completed and it is expected that additional soil investigation works will be carried out to supplement existing information (See **Section 5.3**).

Of the various types of soil profiles encountered, the Kuala Lumpur Limestone poses a challenge in engineering due to its karstic nature, which has a highly variable bedrock profile and the presence of underground cliffs, pinnacles, boulders, sinkholes and cavities. In addition, in many locations, the limestone bedrock is overlain by very soft to loose materials some of which are from past mine tailings. Nevertheless, major engineering works has been successfully carried out in these type of soils. The underground segment of the SSP alignment lies mainly within the Kuala Lumpur Limestone. The tunnelings and underground construction work in Kuala Lumpur Limestone Formation poses a high level of geotechnical hazard and construction risks that requires the risks to be managed safely.

7.8.1 Construction Risks due to Variable Soil Conditions

The SSP Line traverses through a variety of geological formations and soil profiles. In the Granite Formation, Hawthornden Schists, Kenny Hill Formation and Jelebu Schist areas the type of overburden material is relatively uniform although variations in the thickness and stiffness of soil layers are expected. At the interface of different geological formations, soil profiles can be more complicated as can be seen near the Kepong Sentral (S04) which is at the interface of the Hawthornden Schist and Limestone Formations.

The uncertainties associated with the underground works in Limestone Formation with highly karstic features are well recognized. Discoveries of sinkholes and cavities during construction and tunneling works in this formation have been widely reported. Some of the major projects which involved major underground works within such karstic formation are the Petronas Twin Towers, Berjaya Times Square Complex, SMART Tunnel and SBK Line. Therefore, the SSP Line with its extensive underground works is no exception.

The Limestone Formation has a highly irregular bedrock surface and features such as overhangs, near vertical cliffs, valleys, pinnacles, boulders and cavities. The SSP line traverses Limestone Formation at three different segments. Firstly at the Northern Elevated Segment from approximately the Kepong Sentral (S04) to the underground north portal between Jalan Ipoh (S11) and Sentul West (S12). The Undeground Segment from the northern portal to the south portal traverses mainly within the Limestone formation with the exception of the Kenny Hill at central area. The Southern Elevated Segment also traverses over extensive stretches of the Limestone Formation. This includes areas near the south tunnel portal, Sg. Besi (S25), Serdang Raya (S26 and S27), Seri Kembangan (S28) and UPM (S29).

In the Limestone Formation, unpredictable sinkholes and ground subsidence could form during construction activities. This can be triggered by natural collapse of cavity roofs or triggered by lowering of groundwater level or vibration due to construction activities.

The material overlying the Kuala Lumpur Limestone consists of alluvium and tin mine tailings. The alluvium is mainly loose silty sand while the tailings are soft to very soft silty clays (slime) of varying thickness. The old tin workings may have been filled with mine tailings or other man-made materials to enable new development above the site. It is expected that mine tailings will be found near the Jalan Chan Sow Lin and Jalan Sg. Besi areas.

The SSP alignment is located in an urban environment where ground movements due to the construction works must be properly controlled within acceptable limits.

Mitigation measures to minimise risk due to variable soil conditions

The implementation of a risk management framework during Project development, from design to construction stages is the key in addressing the challenges or risks due to development in a highly variable soil condition, particularly in karstic geological formations. This is crucial in successfully overcoming or reducing the risks with a high level of confidence. All the risks need to be considered in selecting the most suitable type of construction techniques for the major civil engineering works such as tunneling, pile foundation, excavation and retaining structures for underground construction.

Detailed soil investigation involving boreholes and geophysical methods are considered a necessary part of the works. Where deemed necessary, supplementary soil investigation, which may include additional boreholes, suitable geophysical survey methods or combination of more than one method would be prudent particularly for the Kuala Lumpur Limestone areas. Adequacy of the soil investigation works are to be determined by the engineers taking into account the variable nature of the subsoil.

Any detected cavities in the Limestone Formation along the proposed alignment must be properly treated to ensure the construction and public safety. Compaction grouting is commonly adopted for the treatment of karstic features in limestone if cavity is detected, to fill up the cavity void and thus preventing collapse of the cavity roof, preventing excessive ground loss during underground and tunneling construction and preventing excessive groundwater drawdown.

7.8.2 Construction Risks - Excavation & Construction of Retaining Wall

Major excavations and retaining wall construction are expected to be carried out for the underground stations, the portals and the launch pits for the tunnel boring machines. The majority of these works will be situated in Limestone Formation although there is a short stretch of the underground segment lying within the Kenny Hill Formation.

Irregular depth of bedrock and variability of material to be excavated. This can be seen from the soil investigation carried out for the Northern Elevated Segment between Jalan Kepong to the north tunnel portal.

There may also be risks from heterogeneous limestone bedrock quality (e.g. from very fractured to solid). This can be seen from the soil investigation carried out for the Northern Elevated Segment as between Jalan Kepong to the north tunnel portal. There could be potential cavities, slump zone, voids in the subsoil above bedrock, solution channel in the limestone bedrock and boulders. Infilled cavities have already been identified in sub-surface profiles between Kepong Sentral (S04) to the north tunnel portal (**Chart 7-38**).

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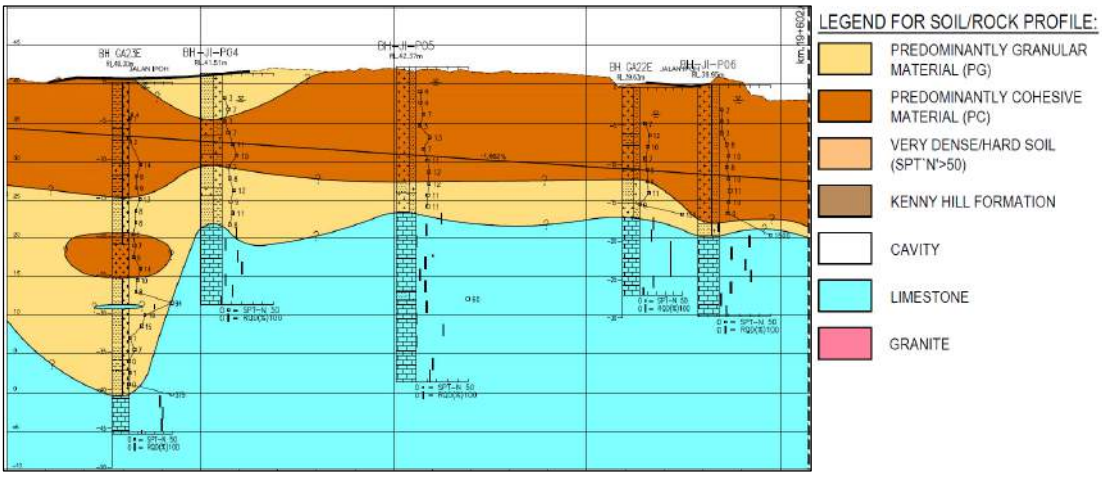
Chart 7-38 Sub-Surface Profiles Between Kepong Sentral – North Portal



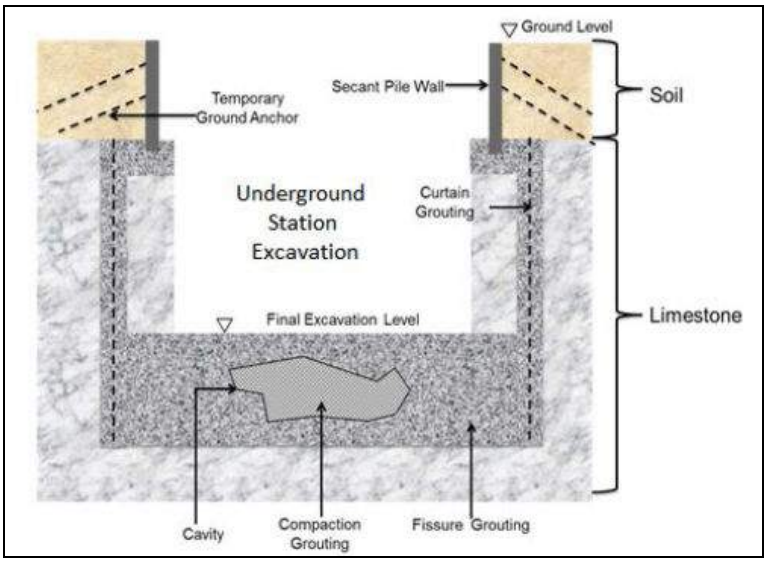
Majority of the subsoil above the limestone bedrock is loose granular materials and with high permeability. Excessive flow of groundwater due to high permeability of soil material into the excavated pit will trigger excessive settlement on surrounding ground and could even trigger sinkholes in the surrounding ground.

Mitigation measures to minimse risk during excavation and construction of retaining walls

Appropriate temporary support (e.g. steel strutting or temporary ground anchors) will be used together with the retaining structure as support system for excavation works.

Prior to excavation into the limestone bedrock, different grouting techniques will be employed such as compaction grouting using sand-cement mortar, curtain permeation grouting using cement/cement-bentonite grout to seal the rock joints/fractures and jet grouting of the loose granular subsoil above the limestone bedrock. These grouting works will be carried out at the perimeter and also bottom the excavated pit to seal any voids or cavities in the limestone bedrock to prevent groundwater from entering the excavated pit. **Chart 7-39** shows the typical grouting works employed around an excavation to prevent excessive groundwater entry.

Chart 7-39 Typical Grouting Works For Excavation in Limestone Formation



Excessive flow of groundwater into the excavated pit will be prevented as it will trigger excessive settlement on surrounding ground and could even trigger sinkholes in the surrounding ground.

Suitable earth retaining structure system (e.g. secant pile wall) may be used to tackle irregular bedrock. Secant piles are relatively impermeable and are able to prevent excessive seepage of groundwater into the excavated pit from the high permeability granular subsoil above the limestone bedrock.

Sufficient instrumentation monitoring scheme with triggering system shall be placed to monitor ground settlement and lateral displacement, groundwater level and piezometric head in the retained ground, forces in the temporary struts and temporary ground anchors, deformation of the temporary retaining wall, settlement, lateral displacement and tilt of adjacent buildings/structure.

The excavation of the rock for the underground stations shall be carried out in stages with geological mapping and kinematic analyses to design the necessary rock slope strengthening measures.

Sufficient detailed ground investigation and geophysical survey shall be carried out to identify the bedrock profile, floaters, cavities and localised deep bedrock channel for detailed design.

7.8.3 Construction Risks due to Tunneling Work In Kenny Hill and Limestone Formation

The alignment traversing the Kenny Hill Formation is located inside the city area with high density of existing buildings and structures. Excessive soil movement or settlement due to tunnelling could cause damage to the existing buildings especially those supported by shallow foundations. The underground segment traverses areas in the city such as Ampang Park, Jalan Conlay and Jalan Kia Peng.

Tunnelling in Kenny Hill formation may also encounter extremely strong rock known as 'Skarn', a calc-silicate rocks which are intimately associated with granite intrusions, having a compressive strength in excess of 270MPa. When the Tunnel Boring Machine (TBM) hits an empty cavity, it may cause materials loss or excessive groundwater drawdown.

Highly fractured/weathered limestone with solution channels may be encountered during tunneling works in limestone. When the TBM passes through highly fractured/weathered limestone, it may cause excessive ground loss due to the weak rock mass of highly fractured/weathered limestone.

When the irregular bedrock profile is encountered within the tunnel envelope, this condition poses difficulties for TBM operations as it needs to bore through different strata (mixed face) between rock and slime zone or loose subsoil. (e.g. loose sandy materials)

Cavities formed by dissolution in some cases comparable in size to TBM which could pose a risk of loss support for TBM during tunneling. Cavities that are linked by solution channels could be a risk for structures remote from the tunnel axis in the event of a loss of face support tunnel.

Tunneling through contact areas where irregular features such as pinnacles and soil-rock matrix are present can cause damage to TBM cutter head.

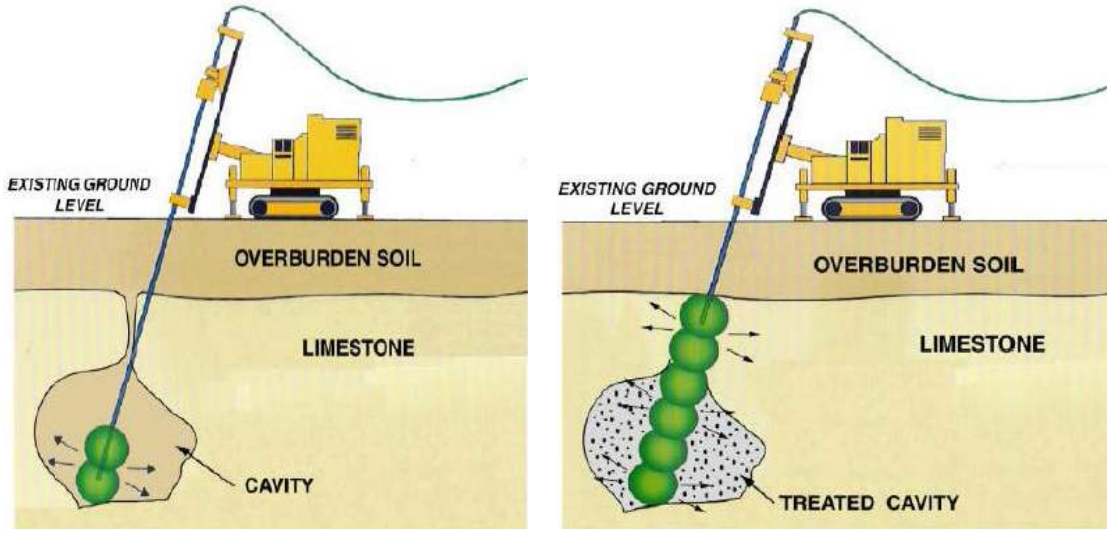
Sinkholes that have formed in the past with or without loose filling could be encountered during tunneling through rock. Unpredictable sinkholes and ground subsidence could form during tunneling activities.

The proposed tunnel alignment will be passing through next to existing high rise buildings with pile foundations. Reduction of existing piles capacity due to tunnelling shall be considered.

Mitigation measures to minimise risk during tunneling works

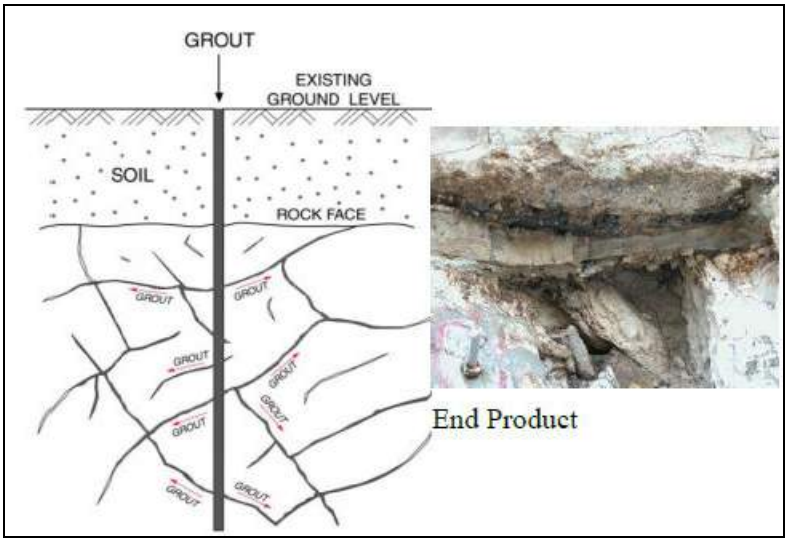
Cavity probing shall cover at least 5m surrounding the tunnel envelope. Compaction grouting shall be used to fill cavities and solution channels (**Chart 7-40**).

Chart 7-40 Cavity Treatment With Compaction Grouting



Rock fissure grouting will be carried out to improve the limestone especially the solution channels and reduce potential ground loss during tunneling works (**Chart 7-41**). Grouting zone shall cover at least 5m surrounding the tunnel envelope. Appropriate ground treatment method (e.g. jet grouting or deep soil mixing) can be considered for improvement of subsoil stiffness. The treatment zone shall cover a distance of at least 3m to 5m surrounding the tunnel envelope.

Chart 7-41 Grout Travelling Down Hole and Filling Discontinues



Rock fissure grouting may also be used depending on bedrock conditions at the interface between soil and limestone bedrock as the rock conditions are usually poor at interface area. Further detailed site investigation may also be carried out to obtain more reliable subsoil information for damage assessment.

7.8.4 Construction Risks due to Piling Works in Jelebu Schists, Hawthornden Schists and Granite Formation

Jelebu Schists and Hawthornden Schists

No unique geotechnical hazards were identified for piled foundations in these formations. The SSP line traverses short stretches of these formations at areas near station S04 (Kepong Sentral) and station S36 (Putrajaya Sentral).

Granite Formation

The SSP line traverses the granite formation at parts of the Northern Elevated Segment and a small portion at the Southern Elevated Segment 1. These portions of the works entail the construction of foundations, normally deep foundations such as piles, to support the guideway piers and stations.

Shallow granite formation is present between Sg Buloh station and the proposed station S03 (Sri Damansara East) in the Northern Elevated Segment. From Sri Damansara East to Kepong Sentral, the granite bedrock is deeper. At the interface where granite formation meets other geological formation, such as the areas between Sri Damansara East and Kepong Sentral, the granite bedrock may be very deep. In this condition, the length of the pile foundation would be very long without rock socket and depends solely on the shear strength of the subsoil.

Due to the tropical weathering process, core boulders are sometimes found in granite formation. The size of boulder can be up to 5m diameter and the locations of boulder in the overburden subsoil are unpredictable. This natural hazard is a geotechnical risk to the piled foundation

Weathered granite bedrock is commonly encountered between overburden subsoil and competent bedrock. During bored pile installation, it is very difficult to differentiate type of rock material to be considered for rock socketing length.

Mitigation measures to minimise risk during piling works in Granite Formation

More detailed investigations will be carried out to determine position and size of boulders to ensure piles are founded on bedrock and boulders. A suitable foundation system taking into considerations the possibility of very deep bedrock such as the use of barrette piles or the use of different drilling/installation systems. Rock strength test will be carried out at site for the excavated rock material during rock socketing to verify classify the rock strength for determination of rock socketing length.

7.8.5 Construction risks during piling works in Kenny Hill Formation

Kenny Hill formation is susceptible to rapid degradation in terms of strength and stiffness as a result of stress relief and softening. Slow progress in drilling operation due to inefficient coring method or inter-layering of hard and soft rocks, and delay in concreting the piles are the usual causes of such softening.

At the interface between Kenny Hill Formation and Limestone Formation, the estimated pile length and the bedrock levels are highly variable due to limestone karstic feature beneath this formation. The interfaces are expected to occur in the Underground Segment (Ampang Park/Jalan Kia Peng areas) and in the Southern Elevated Sections (Kg Muhibbah/Serdang/UPM)

Mitigation measures to minimise risk during piling works in Kenny Hill Formation

The use of appropriate and well-maintained drilling equipment is required and delay in concreting is to be avoided. Preliminary test piles with instrumentations shall be carried out to verify the soil parameters assumed in the design and to validate the workmanship of the contractor. Additional ground investigation will also be carried out at the interface between Kenny Hill Formation and Limestone Formation to refine the ground profiles and properties for piling/foundation design.

7.8.6 Construction risks during piling works in Limestone Formation

There is a possibility of deflection, rotation, stresses (such as distortion, buckling, bending, cracking, shattering) and even pile breakage during pile driving (if driven piles are used) due to the presence of cliffs, valleys, pinnacles and boulders.

The highly variable bedrock level could result in large difference in installation lengths. Highly weathered or highly fractured limestone with low rock strength and extensive discontinuities may cause difficulties in determining the correct socket lengths for bored piles. There is also potential problem of borehole instability due to slime and spanning of the piles over cavities due to loss of concrete for bored pile

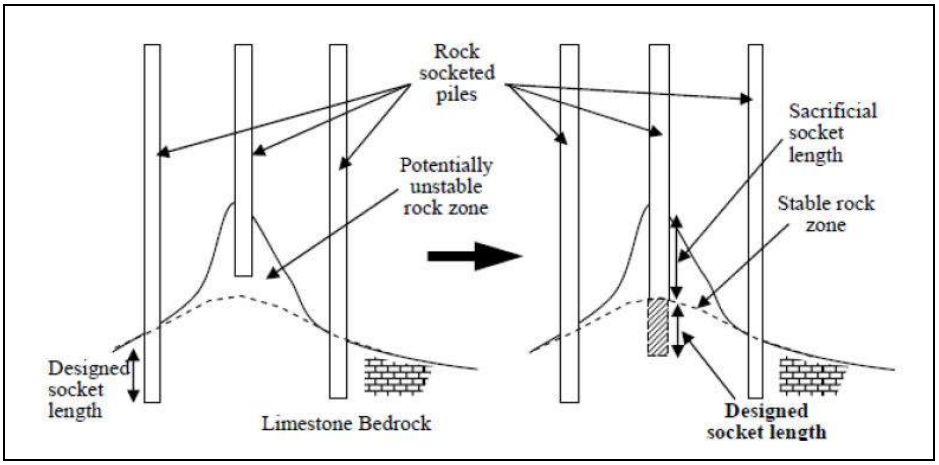
Mitigation measures to minimise risk during piling works in Limestone Formation

Suitable pile system to be selected. Bored piles or caissons may be a more appropriate foundation solution than driven piles. Rock socketing of bored piles to minimize problem of borehole stability. Temporary casing with rock reaming capability may be required for rock socketing. Treatment in the form of grouting would be carried out where significant cavities or solution channels are identified.

Construction of bored piled foundation in limestone areas requires good collaboration between the design, supervision personnel and the contractor. This is due to the highly variable ground conditions where it is not practical to pre-identify all the possible karstic features such as cavities, pinnacles, etc. and as such, construction works in limestone formation requires significant input from site personnel.

The “observational approach” will be adopted for bored piles construction in limestone areas. Such arrangement will enable any unexpected geological formation and uncertainties to be detected and changes to the design can be made immediately to ensure a safe and cost effective design (**Chat 7-42**).

Chart 7-42 Adjustment of Rock Socket Length Based On Input During Construction



7.8.7 Groundwater Regime

Tunneling and underground station construction where seepage of the groundwater occurs may lead to short term lowering of groundwater table which may then lead to ground settlement, ground collapse or sinkholes to appear.

Any inflow of water into the tunnel will result in loss of face support which can lead to face collapse. The loss of face support may lead to large volume of ground loss and may trigger collapse and formation of sinkholes.

Mitigation measures to minimize impacts to groundwater regime during excavation, underground station construction and tunneling works.

Groundwater is always a main concern for excavation works and grouting works is recommended in limestone to reduce the rate of groundwater inflow into excavation and reduce pathways of water flow into excavation area in order to prevent excessive groundwater drawdown on the retained side.

Rock fissure grouting can be carried out along the perimeter of excavation area to form curtain grouting. Fissure grouting involves a single packer in ascending or descending stages in order to inject grout suspension into existing pathways, fissures, cavities and discontinuities within the rock formation. Rock fissure grouting can also be carried out for base grouting to prevent infiltration from the base of excavations. Any cavities detected shall be treated with compaction grouting with cement mortar.

Selection of a suitable TBM appropriate for use in Karstic Limestone. It is understood that the proposed Variable Density type TBM is appropriate for use in Karstic Limestone. The TBM selected shall not allow ground water seepage into the tunnel.

As part of long term control of groundwater, grouting of the annular void space between the concrete lining of the tunnel and the soil shall be adopted to prevent seepage of water through the tunnel lining. It is important that each pre-cast segments under factory conditions for tunnel lining is almost impermeable as part of quality control. The use of hydrophilic seals for the joints between concrete segments can prevent inflow of water through the joints.

7.9 PUBLIC SAFETY

A significant proportion of the SSP Line traverses through densely populated areas. The construction of the Project may have public safety considerations – particularly risks of the construction to the people living or working close to the Project site. This also includes risks to road users.

A preliminary risk assessment (**Chart 7-43**) was developed. The risk assessment was based on the Guidelines for Hazard Identification, Risk Assessment and Risk Control (HIRARC), 2008 published by DOSH. The approach in the risk assessment was based on the following stages:

- Hazard Identification – to identify major potential hazards of construction of the Project;
- Frequency Estimations – to determine the likelihood of the hazards/ rates of occurrence;
- Consequence Estimation – to estimate the severity of the damage due to the hazards;
- Risk Estimation and ranking – integration of frequencies and consequences to produce a ranking through risk matrix.
- Risk Control - proposed of mitigation measures to minimize the potential hazards.

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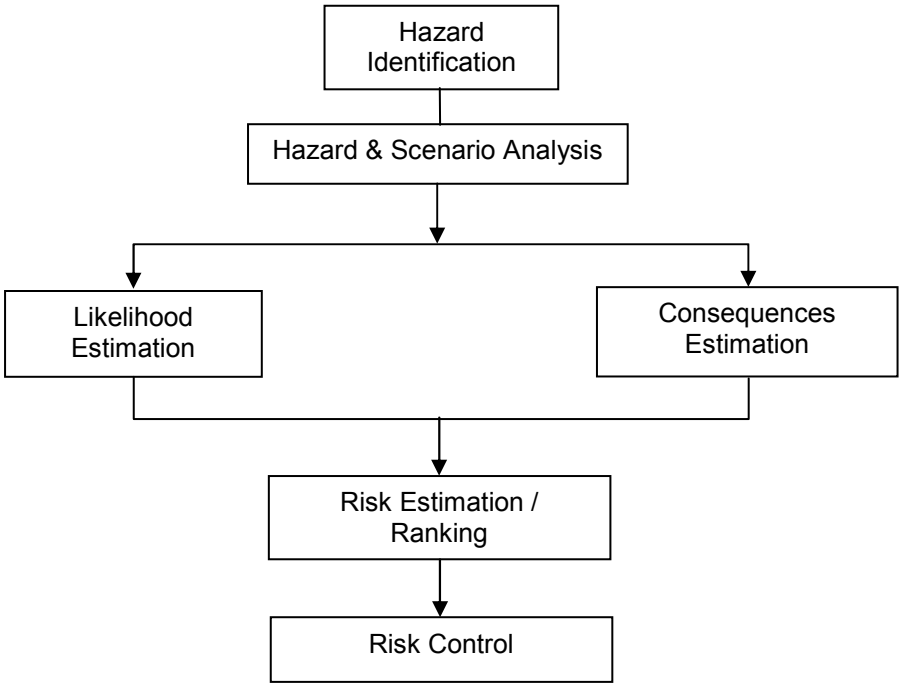
The assessment include identification of hazards, risk assessment and identification of mitigation measures including the construction of underground and elevated alignment, the stations and depot facilities. Past incidents during the construction of SBK Line were also referred. The SBK Line Risk Register and Risk Log were also reviewed. Site visit was carried out to the on-going SBK Line to observe on the current practices and management on-site. The safety practices implemented on-site that are able to eliminate or reduce the risk can be adopted in this project.

Chart 7-43 HIRARC Methodology



7.9.1 Hazard Identification

Hazard identification is the first and most important step in any hazard analysis. This step involves the systematic identification of hazardous events, their potential causes and consequences of such events.

Activities involved during the construction stage of the Project can be divided into few different stages, i.e. relocation of utilities, construction of viaduct for elevated route, construction of tunnel including the launching shaft and retrieve shaft for underground route, construction of elevated and underground stations, and tracks work.

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The major hazards which may arise from the construction according to the stages of the Project are summarized in **Table 7-16**. Most of these are elements found in risk log and risk register prepared for the construction of the SBK Line. Working at elevated height poses higher risk and hazard to the public below and within the surroundings as well as to the workers. At the other hand, there are also possibilities that construction of the underground alignment could lead to the formation of cracks resulting in structural damage to high-rise building located on it if the construction work and design are not done properly.

Besides that, hazards such as vehicular accident and occupational and safety hazard have been identified in most of the construction activities that will be carried out. Precaution and prevention of the hazards shall be emphasized to minimize the potential injuries or fatality.

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Table 7-16 Hazard Identification

HAZARDOUS EVENT	POSSIBLE CAUSES	CONSEQUENCES	PROPOSED PREVENTION & MITIGATION
(A) Utilities Relocation Works			
Leakage of LPG/ natural gas from pipeline relocation	• Collision impact • Valve failure • Human error/negligence	• Release of flammable / toxic vapour • Explosion upon ignition • Fire from immediate ignition • Injury / illness / fatality • Damage to property and other utilities	• Relocation of pipes by appropriate method to minimise possible leakage and release of LPG/natural gas • Eliminate all possible ignition sources near to the gas pipe relocation work area • Regular checks of pipe valve and avoid the possibility of leakage during the gas pipe relocation works • Notification to Gas Malaysia pre and post construction works involving or near to existing gas pipe • Safety requirement for fire fighting and explosion to be provided at the work site during the construction • First aid kits must be well prepared and available • Workers involved must trained in first aid and emergency procedures • Implement emergency response plan, evacuation to assemble point • Usage of appropriate signboards during relocation works • Implement traffic diversion if required.
Damaged of exposed utilities wires/cables from relocation exercise	• Collision impact • Necessary work procedure • Human error/negligence	• Electrocution • Injury / fatality • Damage to property	• Relocation of utilities shall followed the method statement approved by Project Proponent • Only competent workers shall involved in the relocation exercise • Sufficient signboard to informed public/workers of the exposed cables. • To notify TNB and appoint competent person to supervise any construction works at near or adjacent to TNB transmission line to avoid electricity flash-over accident.

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Table 7-16 Hazard Identification (Cont'd)

HAZARDOUS EVENT	POSSIBLE CAUSES	CONSEQUENCES	PROPOSED PREVENTION & MITIGATION
Vehicular Accident	• Temporary closure of road • Road diversion • Speed • Loss of parking space • Human error/negligence	• Traffic congestion • Injury / fatality	• Implement traffic management plan for congested areas and road diversions • Adequate signboards and signal man to be provided at appropriate locations
Flooding of the construction area	• Water pipe burst • Blockage of existing sewer pipes • Human error	• Flash flood • Health impact such as dengue • Loss or damage of construction material • Damage to work structures and foundation • Injury due to slipperiness, falling in ditches • Collapse of retaining walls or slopes	• General cleaning of rubbish in the construction area • Temporary drainage on the surface ground that divert the storm water to the main drainage • Close opened holes and ditches or put up indicators where these holes/ditches are located • Put up adequate support or barriers at walls and slopes • Provide proper containment or storage for construction materials • Provide on site retention pond
Occupational & safety hazard	• Heavy Machinery • Working within enclosed areas (sewer)	• Injury / illness / fatality to public and workers on site	• Personnel to be trained in safety procedures • Personnel to be trained in first aid and emergency procedures • Proper PPE to be provided for workers • Prepare evacuation plan for major disaster
(B) Viaduct Construction			
Vehicular Accident	• Temporary closure of road • Loss of parking space • Loading and unloading of construction material • Soil/sand on road	• Traffic congestion • Injury / illness / fatality	• Prepare traffic management plan for congested areas and road diversions • Provide extra lane for traffic flow • Suggest and provide alternative road to avoid traffic slowdown and bottlenecking • Introduce contra flow • Adequate signboards and signal man to be provided at appropriate locations

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Table 7-16 Hazard Identification (Cont'd)

HAZARDOUS EVENT	POSSIBLE CAUSES	CONSEQUENCES	PROPOSED PREVENTION & MITIGATION
Occupational and safety hazard	• Heavy Machinery • Impact by dropped objects • Loading/ unloading of construction material • Working at height • Malfunction of machinery	• Injury / illness / fatality to public and workers on site	• Personnel to be trained in safety procedures • Personnel to be trained in first aid and emergency procedures • Proper working zone marking
(C) Tunnel Construction			
Sudden settlement or cavity underground	• Weak foundation of soil from varying geological conditions of site • TBM drilling and cutting effect • Blasting effect	• Crack of building structure • Property damage • Injury / illness / fatality to public and workers on site	• Conduct pilot boring plan to define the ground condition & pre-grouting concept to tunnel design • Install collapse detectors to detect earth pressure & cavity • Control the advance rate, cutter rotation and thrust • Pre-injection grouting, instantaneous segment backfill • Restrain cutter head and disk change in poor ground condition • Follow strictly the work guide stipulated in the Method Statement of Dealing with Cavities and Ground Settlement • Monitoring of weak supports/areas during construction
Blasting effect	• Misuse of explosive material • Human error	• Vibration • Caving of soil • Property damage	• Use appropriate amount of blasting explosive to minimize the vibration effect • Follow strictly on the work guide stipulated in the Method Statement of Trial Blast.
Flooding in tunnel	• Heavy rain • Groundwater seepage • Work areas near to stream • High water table	• Delays in excavation • Health impact such as dengue	• Introduce real time monitoring system – water pressure, water leakage, drainage water level • Consideration of hydrological characteristic for level of ventilation shaft and station entrance • Waterproofing of main bearing & critical mechanical components • Restrain cutter head and disk change in flooding condition • Install emergency floodgate to prevent inundation of closed lots

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Table 7-16 Hazard Identification (Cont'd)

HAZARDOUS EVENT	POSSIBLE CAUSES	CONSEQUENCES	PROPOSED PREVENTION & MITIGATION
Occupational and safety hazard	• Heavy Machinery • Impact by dropped objects • Loading and unloading of construction material • Malfunction of machinery • Compressed air use during maintenance and inspection of boring machine	• Injury / illness / fatality to public and workers on site • Barotrauma	• Personnel to be trained in safety procedures • Personnel to be trained in first aid and emergency procedures • Proper working zone marking • Emergency exit from tunnel • To provide medical support of compressed air works.
(D) Construction of elevated stations			
Vehicular Accident	• Temporary closure of road • Loss of parking space • Loading/ unloading of construction material • Soil/sand on road	• Traffic congestion • Injury / illness / fatality	• Traffic management plan to be included in the overall management plan • Compensation of extra lane for traffic flow • Suggest and provide alternative road to avoid traffic slowdown and bottlenecking • Introduce contra flow • Adequate signboards
Occupational and safety hazard	• Heavy Machinery • Impact by dropped objects • Loading and unloading of construction material • Working at height • Malfunction of machinery	• Injury / illness / fatality to public and workers on site	• Personnel to be trained in safety procedures • Personnel to be trained in first aid and emergency procedures • Proper working zone marking

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Table 7-16 Hazard Identification (Cont'd)

HAZARDOUS EVENT	POSSIBLE CAUSES	CONSEQUENCES	PROPOSED PREVENTION & MITIGATION
(E) Construction of Depot			
Occupational and safety hazard	• Heavy Machinery • Impact by dropped objects • Loading and unloading of construction material • Malfunction of machinery and equipments	• Injury / illness / fatality to public and workers on site	• Personnel to be trained in safety procedures • Personnel to be trained in first aid and emergency procedures • Proper working zone marking • Proper PPE
(F) Construction of Depot			
Occupational and safety hazard	• Heavy Machinery • Impact by dropped objects • Loading and unloading of construction material • Malfunction of machinery and equipments	• Injury / illness / fatality to public and workers on site	• Personnel to be trained in safety procedures • Personnel to be trained in first aid and emergency procedures • Proper working zone marking • Proper PPE
(G) Construction of Underground stations			
Vehicular Accident	• Temporary closure of road • Loss of parking space • Loading and unloading of construction material • Soil/sand on road	• Traffic congestion • Injury / illness / fatality	• Traffic management plan to be included in the overall management plan • Compensation of extra lane for traffic flow • Suggest and provide alternative road to avoid traffic slowdown and bottlenecking • Introduce contra flow • Adequate signboards

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Table 7-16 Hazard Identification (Cont'd)

HAZARDOUS EVENT	POSSIBLE CAUSES	CONSEQUENCES	PROPOSED PREVENTION & MITIGATION
(H) Construction of Underground stations			
Vehicular Accident	• Temporary closure of road • Loss of parking space • Loading and unloading of construction material • Soil/sand on road	• Traffic congestion • Injury / illness / fatality	• Traffic management plan to be included in the overall management plan • Compensation of extra lane for traffic flow • Suggest and provide alternative road to avoid traffic slowdown and bottlenecking • Introduce contra flow • Adequate signboards
Occupational and safety hazard	• Heavy Machinery • Impact by dropped objects • Loading/ unloading of construction material • Collapse of trenches • Malfunction of machinery • Working in confined space	• Injury / illness / fatality to public and workers on site	• Personnel to be trained in safety procedures • Personnel to be trained in first aid and emergency procedures • Proper working zone marking • Proper PPE for workers
Flooding of the construction area	• Heavy rain • Clog drainage system	• Flash flood • Health impact such as dengue • Damage of material	• General cleaning of rubbish in the construction area • Temporary drainage on the surface ground that divert the storm water to the main drainage
(I) Tracks Works			
Occupational and safety hazard	• Heavy Machinery • Impact by dropped objects • Loading and unloading of construction material • Working at height	• Injury / illness / fatality to public and workers on site	• Personnel to be trained in safety procedures • Personnel to be trained in first aid and emergency procedures • Proper working zone marking • Proper PPE

7.10 AIR QUALITY

Air pollution, particularly dust emission, is a concern during the construction stage. The main concern is the potential emission at the construction of Serdang depot. Dust levels could potentially increase during the site clearing and earthworks at the depot area from the movement of construction vehicles. Other sources of dust are the construction of the launch and retrieval shafts for the underground section.

7.10.1 Dust from Depot Construction

It is anticipated that the earthworks activity will be carried for the period of 1-2 years in order to achieve the designed platform level of 79m.

The following section discusses the assessment of the dust dispersion at the Serdang Depot during the construction period.

(a) Methodology

The AERMOD air quality model developed by AERMIC (American Meteorological Society (AMS) and United States Environmental Protection Agency (US EPA) was used. AERMOD is an air dispersion model that incorporates concepts such as planetary boundary layer theory and advanced methods for handling complex terrain. For this modelling exercise, the following assumptions were made:

- The EF assumes that construction activity occurs 30 days per month;
- The emission rate, EF, for uncontrolled emission was calculated to be 4.58 E-5 g/m^2/s (based on US EPA AP-42)
- The construction activity is carried out between 8 am to 8 pm daily;
- All of the areas within the construction site emit at the same emission rate;
- Emissions are constant from the beginning to end of a construction project;
- The emission release height is at 1 m

TSP dispersion to the surrounding was modelled for several scenarios at the depot and underground stretch :

- **Worst case scenario** – This worst-case scenario assumed that the heavy construction activities happened throughout the whole development area at one time.

- **Sub phases scenario** – During actual construction period, the heavy construction particularly land clearing and backfilling will be carried out progressive in phases or smaller parcels. Hence, the development area was sub-divided into phases.

- **Management control scenario** – Two control methods for fugitive dust i.e. Primary Rehabilitation and Revegetation. The recommended reduction factor as documented in the **"**National Pollutant Inventory: Emission Estimation Technique Manual for Fugitive Emissions Version 2.0 (January 2012)" by the Australian Government: Department of Sustainability, Environment, Water, Population and Communities is 30% and 90% respectively. This reduction factor was adopted as currently there is no published reduction factor available for Malaysia.

The meteorological data used in the AERMOD modelling input were collected from the Subang Airport Meteorological Station. Local topography (i.e. ground elevation above mean sea level) can have a significant influence on the dispersion of air pollutants and was also input into the model. The rural mode was chosen as roughness parameter in view of the terrain and land use of the depot area.

(b) Sensitive Recepotors

The immediate surrounding land use of the proposed Serdang Depot will be mainly institutional namely facilities and buildings found within Malaysian Agricultural Research and Development Institute (MARDI) land. Universiti Putra Malaysia (UPM) is more than 1 km away from the center of the development.

Residential areas such as Taman Universiti Indah (Northern part), Taman Equine and Taman Putra Permai (Western Part) are the nearest sensitive receptors but are located more than 1 km away from the center of the Serdang Deport development (as shown as red line in the iso-contours).

(b) Dust Dispersion

The result of the modelling exercise for the preliminary scenario with the assumption of 24-hours heavy construction period for the depot and the underground stretch (**Table 7-17 – Table 7-18** and **Chart 7-44 – Chart 7-46**)

Worst Case Scenario

From the air dispersion modelling, it could be determined that if the whole depot area will be cleared in one phase, the TSP dispersion will have significant impact to the receptors such as Taman Universiti Indah (Northern part), Taman Equine and Taman Putra Permai (Western Part) and MARDI institutional buildings located within the 1.5 km radius, since the development will be within MARDI vicinity.

The ground level concentrations of TSP for uncontrolled emission for 24-hours and annual averaging times were predicted to exceed the recommended limits prescribed in the Malaysian Ambient Air Quality Guidelines (MAAQG) of 260 $\mu g/m^3$ and 90 $\mu g/m^3$ respectively. However, the predicted levels reduced significantly when the development area is developed in phases.

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Sub Phasing Scenario

Based on the iso-contours, even though the predicted TSP level (beyond 1 km radius) for few phases (particularly for Phase 2A and 2B) after consideration of 90% reduction exceeded the MAAQG limits, the dispersion was observed to be towards the southern part (institutional land) thus do not affect any residential area. It is observed that the dispersion to the western part, nearby the Taman Equine and Taman Putra Permai is shielded by the natural terrain i.e. existing hill area particularly for Phase 1A and Phase 1B.

Hence, it is recommended that for Phase 2A and 2B to be further divided into small parcels and construction work to carry out progressive in the sub-phases to minimize the impact of fugitive dust nuisance to the institutional area located towards the southern part of the development.

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Table 7-17 Predicted Maximum Average Incremental Concentration of TSP (in µg/m^3) during Construction of Depot (24-Hour Averaging Time)

Development Area	24-hours Averaging Time						
	MAIC (Within Project Site)			MAIC (Beyond Project Site Boundary)			MAAQG
	Uncontrolled	Mitigated 1 (30% reduction)	Mitigated 2 (90% reduction)	Uncontrolled	Mitigated 1 (30% reduction)	Mitigated 2 (90% reduction)	
Worst-case Scenario Total Development Area	>260 – >10,000	>260 – <6,000	<260 – >1,000	<260 – <8,000	<260 – <6,000	<260 –<1,000 (Institutional)	260
						<260 (Residential)	
Sub-phases Phase 1A	<260 – >3,000	<260 – <2,000	<260 – >300	<260 – <2,000	<260 – <2,000	<260	
Phase 1B	<260 – >6,000	<260 – >4,000	<260 – >600	<260 – <4,000	<260 – <2,000	<260	
Phase 2A	<260 – >7,000	<260 – >5,000	<260 – >600	<260 – <5,000	<260 – <3,000	<260 –<1,000 (Institutional)	
						<260 (Residential)	
Phase 2B	<260 – >5,000	<260 – >3,000	<260 – >600	<260 – <5,000	<260 – <3,000	<260 –<1,000 (Institutional)	
						<260 (Residential)	

Note: MAIC = Maximum Average Incremental Concentration, MAAQG = Malaysian Ambient Air Quality Guidelines
Uncontrolled = No mitigation measures,
Mitigated 1= Control efficiency of 30% reduction based on Table 6: Percentage Reduction to Emission Factors with Control Systems as recommended by Environment Australia (National Pollutant Inventory: Emission Estimation Technique Manual for Fugitive Emissions [January 2012])
Mitigated 2 = Control efficiency of 90% reduction based on Table 6: Percentage Reduction to Emission Factors with Control Systems as recommended by Environment Australia (National Pollutant Inventory: Emission Estimation Technique Manual for Fugitive Emissions [January 2012])
= Exceed MAAQG = Within MAAQG

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Table 7-18 Predicted Maximum Average Incremental Concentration of TSP (in µg/m^3) during Construction of Depot (Annual Average)

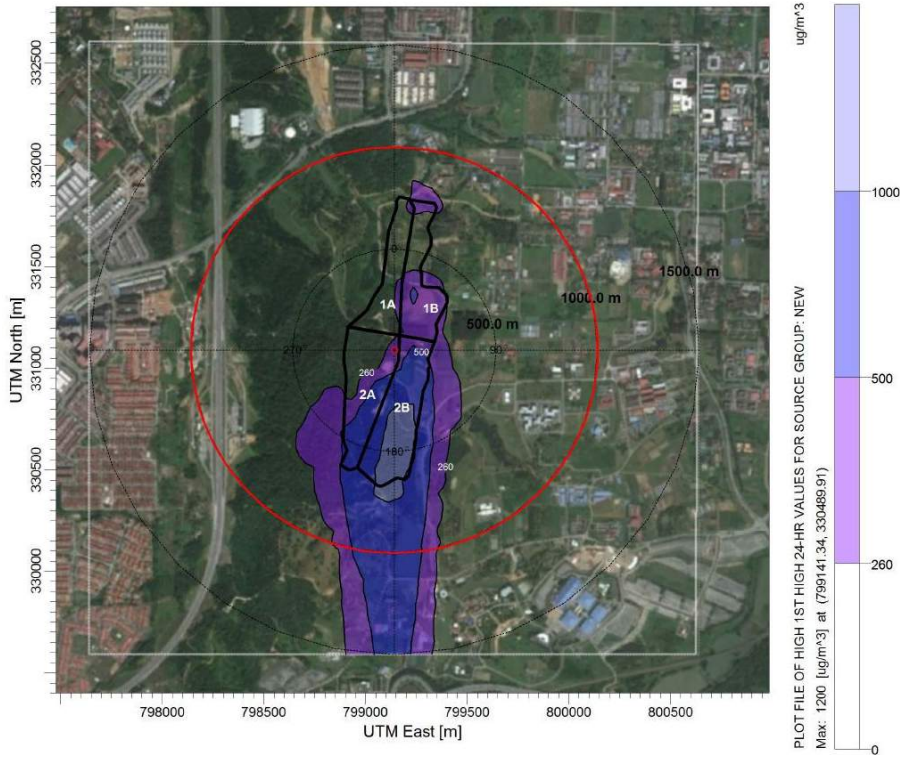
Development Area	24-hours Averaging Time						
	MAIC (Within Project Site)			MAIC (Beyond Project Site Boundary)			MAAQG
	Uncontrolled	Mitigated 1 (30% reduction)	Mitigated 2 (90% reduction)	Uncontrolled	Mitigated 1 (30% reduction)	Mitigated 2 (90% reduction)	
Worst-case Scenario Total Development Area	>45 – >3,000	>45 – >1,500	<45 – >400	<45 – <3,000	<45 – <1,500	<45 –<400 (Institutional) <90 (Residential)	90
Sub-phases Scenario Phase 1A	<45 – >600	<45 – >300	<90	<45 – <300	<45 – <300	<45	
Phase 1B	<45 – >1,500	<45 – >1,000	<45 – >150	<45 – <1,000	<45 – <300	<45	
Phase 2A	<45 – >2,000	<45 – >2,000	<45 – >150	<45 – <1,000	<45 – <500	<90	
Phase 2B	<45 – >2,000	<45 – >1,500	<90 – >200	<45 – <1,000	<45 – <1,000	<90	

Note: MAIC = Maximum Average Incremental Concentration
Uncontrolled = No mitigation measures,
Mitigated 1= Control efficiency of 30% reduction based on Table 6: Percentage Reduction to Emission Factors with Control Systems as recommended by Environment Australia (National Pollutant Inventory: Emission Estimation Technique Manual for Fugitive Emissions [January 2012])
Mitigated 2 = Control efficiency of 90% reduction based on Table 6: Percentage Reduction to Emission Factors with Control Systems as recommended by Environment Australia (National Pollutant Inventory: Emission Estimation Technique Manual for Fugitive Emissions [January 2012])
MAAQG = Malaysian Ambient Air Quality Guidelines

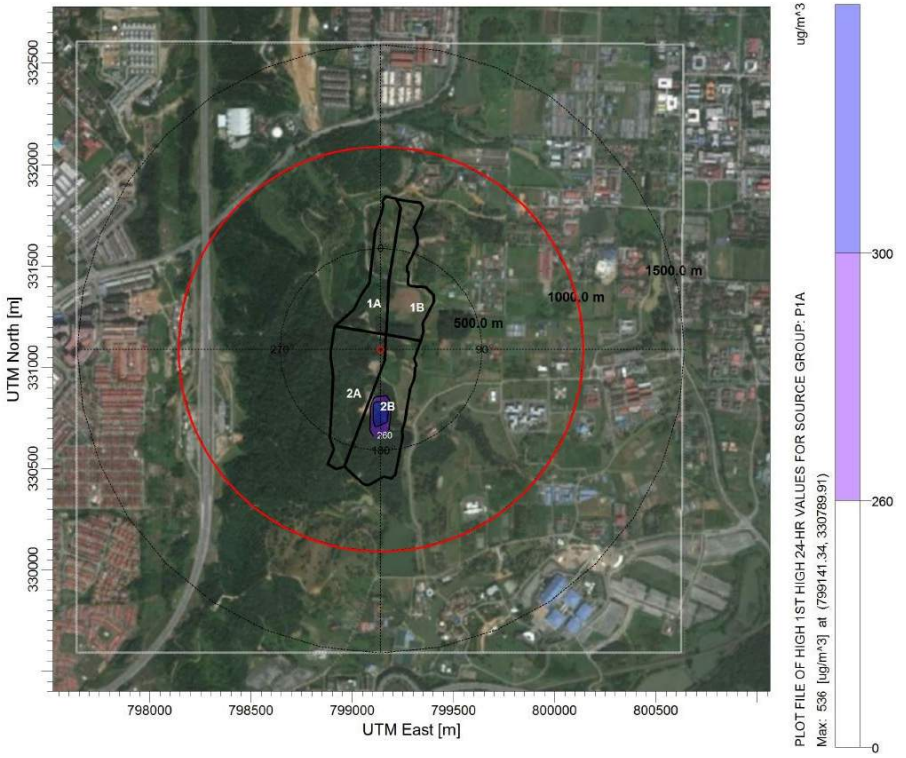
= Exceed MAAQG = Within MAAQG

SECTION 7 : POTENTIALLY SIGNIFICANT IMPACTS AND MITIGATION MEASURES DURING THE CONSTRUCTION STAGE

Chart 7-44 Predicted 24-Hours Maximum Average Incremental Concentration of TSP for Depot Area (90% Reduction)



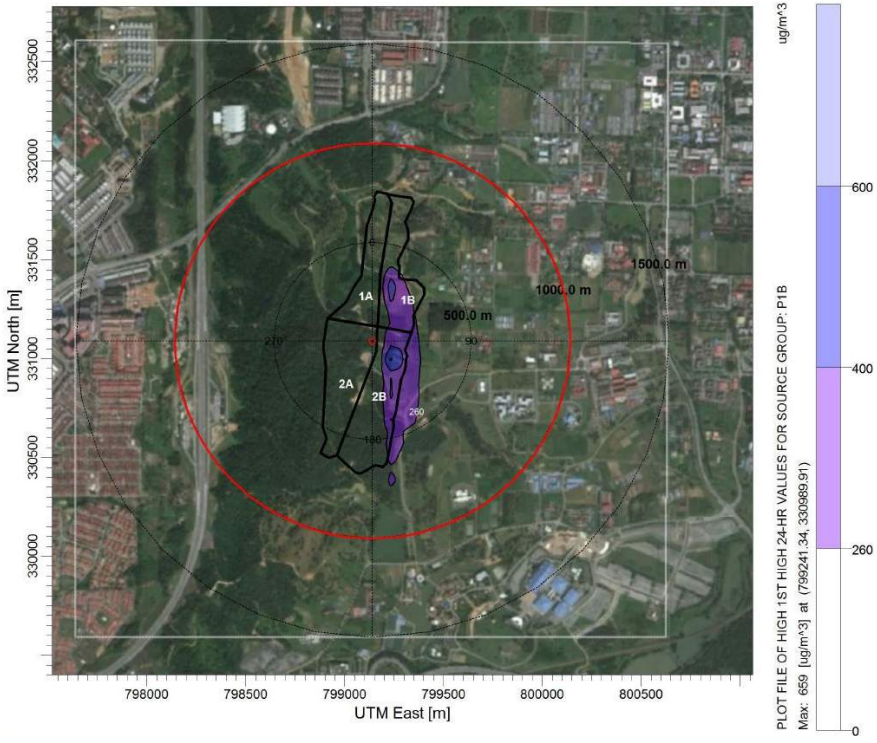
Total Development Scenario



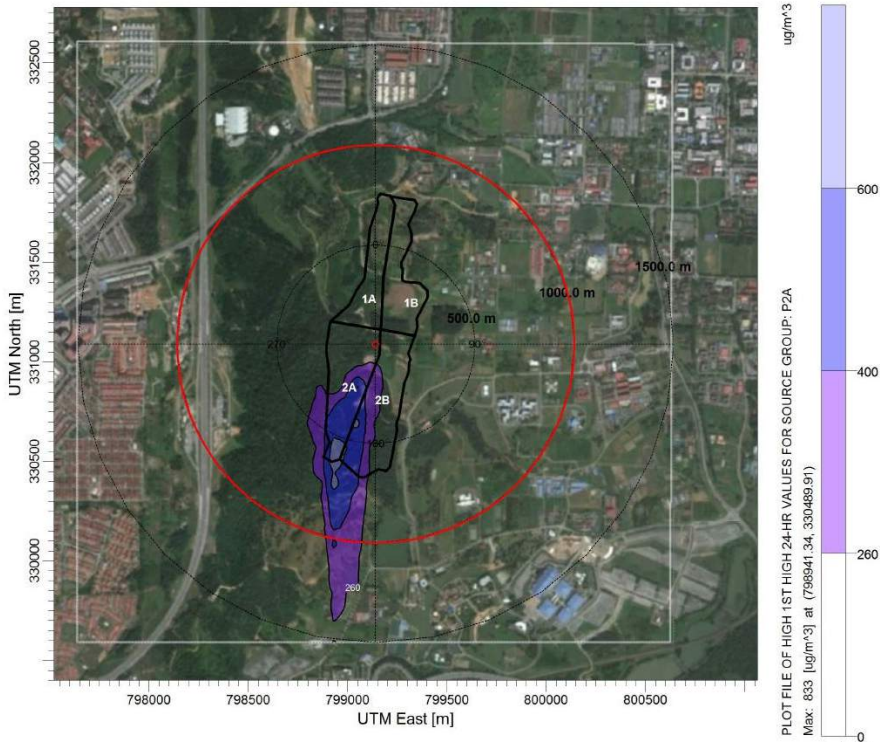
Sub Phasing Scenario – Phase 1A

SECTION 7 : POTENTIALLY SIGNIFICANT IMPACTS AND MITIGATION MEASURES DURING THE CONSTRUCTION STAGE

Chart 7-45 Predicted 24-Hours Maximum Average Incremental Concentration of TSP for Depot Area (90% Reduction)



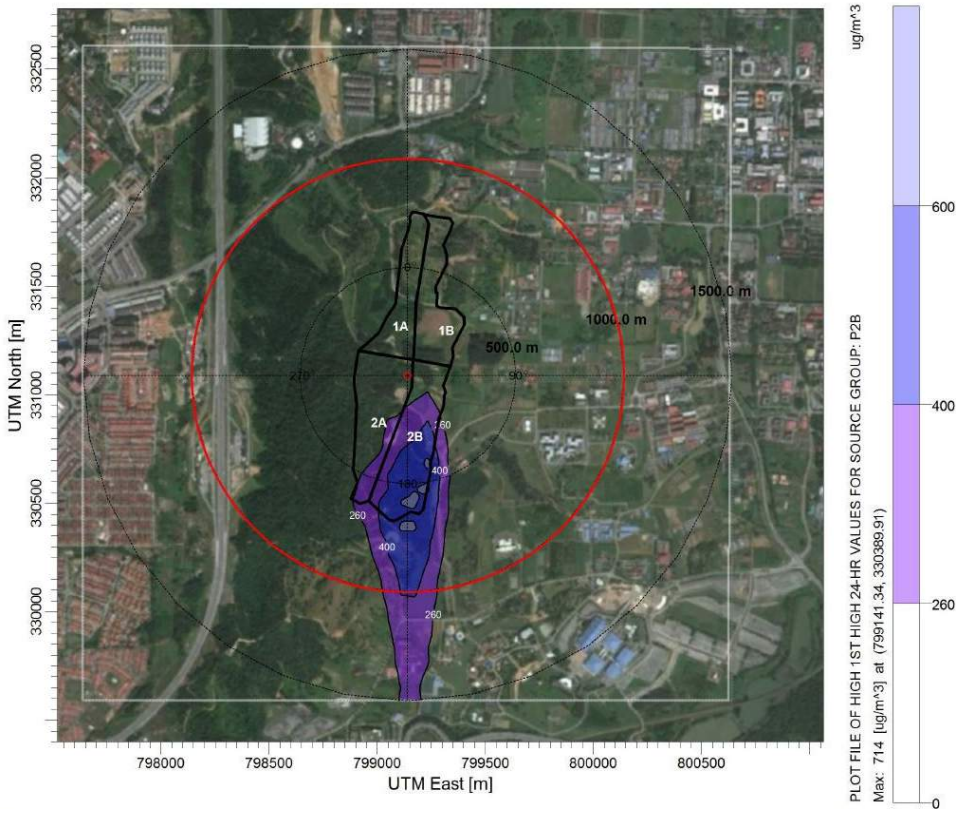
Sub Phasing Scenario – Phase 1B



Sub Phasing Scenario – Phase 2A

SECTION 7 : POTENTIALLY SIGNIFICANT IMPACTS AND MITIGATION MEASURES DURING THE CONSTRUCTION STAGE

Chart 7-46 Predicted 24-Hours Maximum Average Incremental Concentration of TSP for Depot Area (90% Reduction)



Sub Phasing Scenario – Phase 2B

SECTION 7 : POTENTIALLY SIGNIFICANT IMPACTS AND MITIGATION MEASURES DURING THE CONSTRUCTION STAGE

7.10.2 Air Pollution from Other Construction Activities

Air quality impact from other construction activities (**Table 7-19**) such as viaduct construction, launch shaft, elevated station and underground station along the proposed SSP Line besides the depot development was assessed to be less significant compared to the construction activities at the depot development. The duration of impact will be short-term to medium term. The main contributors will be fugitive dust due to construction vehicle movement and if not mitigated adequately, fugitive dust due to exposed excavated material and temporary storage of construction material. Other contributor will be combustion emission such as particulate matters, nitrogen dioxide and carbon monoxide due to construction machinery and vehicular movement. At the stations, fugitive dust is anticipated during the renovation activity. Following table summarizes the anticipated impact due to the activities mentioned above.

The area of influence for the fugitive dust is anticipated to be localized within the construction area (usually less than 50 m away) as the work area will be limited in nature. Nearby sensitive receptors nearby the work area may be temporarily affected by the dust nuisance if the Best Management Practices not adopted adequately.

Table 7-19 Other Sources of Air Pollution During Construction

No.	Activity	Typical Photo	Impact	Duration
1.	Viaduct construction	  	Fugitive dust due to construction vehicle movement Fugitive dust due to exposed excavated material and temporary storage of construction material (*if any*) Combustion emission such as particulate matters, nitrogen dioxide and carbon monoxide due to construction machinery and vehicular movement	Short-term at localize area as the work area will change progressive along the proposed alignment

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Table 7-19 Other Sources of Air Pollution During Construction (Cont'd)

No.	Activity	Typical Photo	Impact	Duration
2.	Launch shaft		Fugitive dust due to construction vehicle movement Fugitive dust due to exposed excavated material and temporary storage of construction material (*if any*) Combustion emission such as particulate matters, nitrogen dioxide and carbon monoxide due to construction machinery and vehicular movement	Medium term
3.	Elevated station		Fugitive dust due to construction vehicle movement Fugitive dust due to exposed excavated material and temporary storage of construction material (*if any*) Combustion emission such as particulate matters, nitrogen dioxide and carbon monoxide due to construction machinery and vehicular movement Renovation activity	Medium term

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Table 7-19 Other Sources of Air Pollution During Construction (Cont'd)

No.	Activity	Typical Photo	Impact	Duration
4.	Underground station	 	Fugitive dust due to construction vehicle movement Fugitive dust due to exposed excavated material and temporary storage of construction material (*if any*) Combustion emission such as particulate matters, nitrogen dioxide and carbon monoxide due to construction machinery and vehicular movement Renovation activity	Medium term

Mitigation measures to minimise fugitive dusts

a. Site Clearing and Earthwork Activities

- Site clearing and the earthworks shall be conducted in stages or phases within the depot area instead of total clearing.
- Provide hoarding or equivalent barriers around the construction area.
- Areas cleared for open spaces shall be turfed as soon as possible.
- Regular water spraying of construction sites, particularly along the haul road (**Plate 7-9**).
- Stockpiles shall be covered. Spraying of water proposed for uncovered stockpiles to control dust emissions, unless the stockpiled materials results in no visible emissions.

b. Movement of Construction Vehicles

- Ensure construction access or haulage route are kept damp by water browser on regular basis (**Plate 7-10**).
- All construction vehicles shall have their wheels washed at a wheel washing facility before leaving or entering the site onto a public road (**Plate 7-11**).
- Wheel washing facility shall be provided at all entry or exit points into the public road. The wheel washing facility shall be properly managed and maintained to ensure that the immediate public road is clean and free from construction dirt (earth, debris, etc.). This may include cleaning and sweeping such areas.

- Vehicles which carry earth, sand, aggregate or other similar types of material, shall be covered with tarpaulin, canvas or other equivalent material before they are allowed to enter the public road.

At other construction areas such as the launch shaft areas, underground stations (namely when Cut and Cover method is employed) where heavy vehicular movement and movement of disposal of excavated material is anticipated, additional mitigating measures outline can be implemented:

- Fuel-efficient and well-maintained haulage trucks will be used to minimize exhaust emissions. Smoke belching vehicles and equipment shall not be allowed and shall be removed from the project area;
- Undertake immediate repairs of any malfunctioning construction vehicles and equipment;
- Idling of engines shall be discouraged; and
- Install wheel washing equipment (where necessary).

In addition, along the alignment of the elevated structure construction area where nearby residential area is anticipated to be annoyed by the nuisance created by the controlled fugitive dust emission, the Project Proponent is recommended to provide prior notification to the affected community on schedule of construction activities and if possible to provide complaint hotline.

SECTION 7 : POTENTIALLY SIGNIFICANT IMPACTS AND MITIGATION MEASURES DURING THE CONSTRUCTION STAGE

	**Plate 7-9** Example of workers washing the road (SBK Line)
	**Plate 7-10** Example of water browser dampen at the Cochrane site (SBK Line)
	**Plate 7-11** Example of vehicles washing at the exit/entrance of the site (SBK Line)

SECTION 7 : POTENTIALLY SIGNIFICANT IMPACTS AND MITIGATION MEASURES DURING THE CONSTRUCTION STAGE

7.11 SOIL EROSION AND SEDIMENTATION

Soil erosion and sedimentation are potential impacts from the Project, particularly from the site clearing and earthworks for the depot and the underground works.

7.11.1 Depot Construction

Soil erosion and sedimentation from the depot construction could potentially be significant due to the large area involved and the undulating terrain (from RL65m to RL120m). The depot area drains into the surrounding drains and eventually into Sg. Klang.

To determine the potential rates of soil erosion and sedimentation, soil erosion analysis was carried out for three scenarios (**Table 7-20**). The earthwork will be carried out in 2 phases and sub phasing is further divided for the soil erosion analysis.

Table 7-20 Estimation of Soil Loss From Depot

State of Development	Phasing	Sediment Yield (tonnes/yr)	Annual Soil Loss (tonnes/ha/yr)
Pre Construction	Total Development	751.2	60.8
Construction (Worst Case Scenario)	Total Development	1,511	676.3
Construction (With Mitigation Measures)	Phase 1	43.9	3.17
	Phase 2	32.5	1.54
	Phase 3	30.9	0.76
	Phase 4	43.7	1.29

Based on the **Table 7-20**, during worst case scenario (entire depot area cleared simultaneously) the sediment discharge is about 1,511 tonnes without mitigation measures. With the implementation of mitigation measures such as phasing, silt trap and etc), the sediment discharge will be reduced to 30.9 tonnes – 43.9 tonnes depending on the sub phases.

The rates of soil loss for all three scenarios were compared with soil loss tolerance rates from erosion risk map of Malaysia (DOE, 2003) (**Table 7-21**). From **Table 7-21**, it can be seen that generally the Project site falls under the low category with the implementation of mitigation measures.

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Table 7-21 Soil Loss Tolerance Rates from Erosion Risk Map of Malaysia

Soil Erosion Class	Potential Soil Loss (ton/ha/year)
Very Low	<10
Low	10 – 50
Moderate High	50 – 100
High	100 – 150
Very High	> 150

Surface runoff flowing from the exposed areas during site clearing and earthworks will carry sediment into the nearest watercourses. Suspended sediment will affect water quality of the watercourses while bottom sediment (as bed load) and cause waterways to become narrow and shallow and result in clogging of the waterway.

There are no intakes for water supply downstream from this point and it is predicted that soil erosion and sedimentation can be effectively controlled with the implementation of mitigation measures. Therefore, soil erosion and sedimentation is not expected to significantly impact the watercourses.

Mitigation measures to reduce erosion and sedimentation

The following measures will be undertaken to minimise the effects of soil erosion and sedimentation:

- Planning and Phasing
- Sedimentation Basin/Silt Trap
- Temporary Drainage and Check Dams
- Silt Fence
- Turfing/ Temporary Slope Protection
- Compaction

Planning and Phasing

As the depot area is large, planning and phasing is very effective in the reducing quantity of sediments. The site clearing and earthwork activity will be carried out in phases wherever possible to minimize the size of the exposed areas. The areas to be cleared must also be limited to that within the Project site.

Sedimentation Basin/Silt Trap

Sedimentation basin/silt trap will be constructed to retain the sediment from the eroded soil particles by allowing it to settle and allowing the sediment-free water to discharge outside the Project site (**Figure 7-11** and **Plate 7-12**).

The sediment basin/silt trap shall be inspected and desilted on a regular basis to ensure that they function optimally. The sediments collected must be removed once it is about 50% full, as the effectiveness of the sediment control will be reduced at this stage (**Plate 7-13**).

Dewatering work for structure foundations or earthwork operations adjacent to, or encroaching on, stream or watercourses shall be conducted in a manner to prevent muddy water and eroded materials from entering the drainage system by first discharging into the sedimentation basin/silt trap.

Temporary Drains and Check Dam

A network of temporary drainage will be constructed to ensure that all runoff from the Project site is captured and diverted into the sedimentation basin/silt traps. These drains will be constructed around the perimeter of the site and other areas where necessary and the earthworks will be graded towards the drains to allow runoff to flow into them. These drains to be regularly maintained to ensure its function effectively (**Plate 7-14**).

Check dams will be provided along the temporary drains to slow down the flow of the runoff. The check dams shall be constructed using rocks in gabion mesh and wrapped in geotextile, and placed at every 100m intervals along the drain.

Silt Fence

Silt fences will be erected and along the boundary of the depot or at the edge of the slope to filter and slow down the runoff from flowing out to the public road and drain. Silt fences shall be constructed from geotextile and well-anchored to ensure that they do not collapse during heavy storms.

Compaction

All completed platforms that are not turfed will be well compacted to ensure that the soil particles is not readily eroded by runoff while awaiting the construction of buildings at a later period.

Temporary Slope Protection

Temporary slope protection such as covering exposed slopes by the biomass or mulch from site clearing to reduce soil erosion. The biomass can be placed at the edge of the cleared areas and will assist in filtering the silt from the runoff as it flows toward the watercourses. The biomass mulch should also be used as temporary cover for any exposed surfaces.

Turfing

Turfing shall be carried out at areas where earthworks have been completed (**Plate 7-15**).The turf will be watered regularly, especially during the dry weather periods to ensure its rapid growth.

7.11.2 Underground Works

For the underground works, impact from the soil erosion and sedimentation is expected during the excavation works especially at the launch and retrieval shaft area if there is no proper mitigation measures to be implemented (See **Section 3.10.3**).

The entire underground alignment is fall within catchment of Sg. Klang. Sedimentation will affect water quality of the streams while bottom sediment (as bed load) and cause waterways to become narrow and shallow and result in clogging of the waterway as identified in **Table 5-18**. There is no water intake downstream of Sg. Klang.

Mitigation measures to reduce erosion and sedimentation

Silt traps will be constructed to retain the sediment from the eroded soil particles by allowing it to settle and allowing the sediment-free water to discharge outside the Project site (**Plate 7-16 – Plate 7-17**). The silt traps shall be inspected and desilted on a regular basis to ensure that they function optimally. The sediments collected must be removed once it is about 50% full, as the effectiveness of the sediment - control will be reduced at this stage (**Plate 7-18**).

Wastewater treatment plant will be provided at the underground working area whereby the slurry from the tunneling works will be treated at the wastewater treatment plant and treated water will be discharged into the internal drain and eventually to the public drain before final discharge into watercourses (See **Section 7.13**)

Sand bags will be placed along the working area to filter the sediment outflow. The trapped sediment will be cleaned up and taken away as unsuitable material (**Plate 7-19**)

A network of internal drainage will be constructed to ensure that all runoff from the Project site is captured before discharging into the nearby public drains or watercourses.

7.11.3 Elevated Works

For the elevated works, impact from soil erosion and sedimentation is expected to be minimal since cleared areas for each station and each pier are relatively small. The impact from sedimentation is mainly from the dewatering of the substructure working area.

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The major issue from soil erosion and sedimentation during the construction of the elevated structure nearby the river crossing at Sg. Gasi, Sg. Keroh, Sg. Batu, Sg. Kerayong, Sg. Midah, Sg. Kuyoh and Sg. Gajah as well as the ponds (Damansara Damai, Nanyang and MARDI) as identified in **Section 5.6.1, Table 5-18** and **Table 5-19**. Excavation for the construction for the viaduct piers and pile cap may result in soil erosion and sedimentation of the river due its close proximity to the water.

Sedimentation will affect water quality of the streams while bottom sediment (as bed load) and cause waterways to become narrow and shallow and result in clogging of the waterway.

Mitigation measures to reduce erosion and sedimentation

Silt trap will be provided to capture the runoff from the dewatering work for structure foundations. The runoff will be treated to allow for settlement before discharging into the nearby drain or watercourse. The trapped sediment will be removed and disposed off as unsuitable material (**Plate 7-20**).

Silt fence will be erected along the existing watercourses to filter and slow down the runoff from flowing out to the drain or public road (**Plate 7-21**).

Sand bags will be placed along the working area to filter the sediment outflow. The trapped sediment will be cleaned up and taken away as unsuitable material (**Plate 7-22**)

For construction work to be carried out near to the watercourses, the following measures to be implanted:

- Sheet pile to be installed at the river bank to prevent river bank erosion and also prevent the silt from flowing into the watercourses.
- Temporary slope protection namely installation of geotextile or canvas at the river bank to prevent soil erosion (**Plate 7-23**).
- Turfing shall be carried out at areas where construction work has been completed.

Erosion and Sedimentation Control Plan

Typical conceptual Erosion and Sedimentation Control Plans (ESCP) has been prepared for the depot, launch shaft, retrieval shaft and elevated works (**Figure 7-11, - Figure 7-13**). The conceptual ESCP incorporates the measures includes silt traps, temporary earth drains, check dams and silt fence. However, the types of mitigation measures to be implemented will vary depending on the site conditions and the space available on site.

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	**Plate 7-12** Example of sedimentation basin with close turfing at Sg. Buloh depot (SBK Line)
	**Plate 7-13** Example of desilting of silt trap at Cochrane (SBK Line)
	**Plate 7-14** Example of maintenance of perimeter drain at Cochrane (SBK Line)

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	**Plate 7-15** Example of turfing at the completed slopes at Semantan area (SBK Line)
	**Plate 7-16** Example of silt trap constructed at Inai working area (SBK Line)
	**Plate 7-17** Example of silt trap constructed at Cochrane working area (SBK Line)

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	**Plate 7-18** Example of maintenance of silt trap carried out at Cochrane (SBK Line)
	**Plate 7-19** Example of sand bag along the perimeter of underground working area (SBK Line)
	**Plate 7-20** Example of portable silt trap at elevated working area (SBK Line)

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	**Plate 7-21** Silt fence erected along the perimeter of existing drain (SBK Line)
	**Plate 7-22** Example of sand bag along the perimeter of working area (SBK Line)
	**Plate 7-23** Example of temporary slope protection (SBK Line)

7.12 FLOODING

The potential risk of flooding could arise due to two factors; (a) the conversion of land use and decreasing permeability, especially at the depot area; and (b) obstruction of waterways.

7.12.1 Depot Construction

The depot is located within the UPM/MARDI compound covers an area of 44 ha. Based on the DID's record, no flooding was recorded at MARDI area.

The conversion of land use at the depot will increase the runoff and lead to more runoff into the existing watercourses. The rate of runoff could easily double when the land is covered with impervious material.

The nearest watercourses to the depot are ponds located at the south of the depot which are located about 200m away from the depot. The existing ponds may not be designed to cater for the additional runoff, resulting in flash floods during heavy downpour.

7.12.2 Underground Works

The entire underground alignment passed through Kuala Lumpur area. Based on the reports by DID, flash floods occurred at Jalan Ipoh, Bulatan Pahang, Jalan Chan Sow Lin and Kg. Kapasipillay (See **Section 5.6.3** and **Table 5-20**).

With the construction of stations as well as the launch and retrieval shaft, it may result in soil erosion and sedimentation and may cause waterways to become narrow and shallow and result in clogging of the waterway.

The treated water from the wastewater treatment plant may cause flooding due to the drainage not able to accommodate the increase in surface run-off.

7.12.3 Elevated Works

Construction of elevated sections and stations are not expected to cause major flooding as the work area has a small footprint. The construction works will be carried out along the road shoulder or road median.

Kepong Sentral, Jinjang, Serdang and Sri Kembangan area have been identified as the flood prone area. There is a potential of flooding occur especially at the area where the alignment running along or crosses the river.

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The SSP line crosses a few existing watercourses at Sg. Gasi, Sg. Keroh, Sg. Batu, Sg. Kerayong, Sg. Midah, Sg. Kuyoh and Sg. Gajah as well as the ponds (Damansara Damai, Nanyang, Tunas Bakti School Pond, MARDI and Putrajaya) as identified in **Section 5.6.3, Table 5-18** and **Table 5-19**.

The construction activity may result in soil erosion and sedimentation which will effect to cause waterways to become narrow and shallow and result in clogging of the waterway. This will eventually increase the risk of flooding to the area. There is also a possibility that the surrounding drainage not able to accommodate the increase in surface run-off from the elevated works.

Mitigation measures to minimise flooding

- Project Proponent to further study on the river flow shall liaise with the relevant local authorities for the provision of widening the drainage to cater the increase of the runoff to the surrounding drainage.

- On Site Detention (OSD) or reinforced concrete tank will be provided as implemented for SBK Line before discharge to the existing drainage system.

- For the construction works located adjacent to the river, the following protection to be implemented as required by Jabatan Pengairan Dan Saliran (JPS):
  - Top of pile cap to be 1.0m below existing river bed level
  - Cut off wall such as sheet pile wall to be provided
    - Cofferdams for the construction pits should be raised to a height to contain 2-5 years ARI floods specified by the approving authorities

- All ESCP implementation shall be regularly inspected and maintained properly to ensure its function effectively for proper evacuation of surface runoff into the adjacent drainage systems.

- The temporary drainage to be regularly maintained such as desilting and disposal of the construction or solid wastes into the drain is prohibited.

7.13 IMPACT ON WATER QUALITY

The main impact to the water quality is expected from the following activities:-

- Slurry discharge from tunneling
- Sewage and sullage discharge from the workers camp
- Operation of maintenance yard and batching plant

(a) Slurry discharge from tunneling

Bentonite slurry will be used for lubrication and cooling of the TBM cutting head, removal of cuttings and stabilization of the cutting face. Bentonite slurry will be pumped into the TBM muck chamber, where it will be mixed with excavated material and later separated at the separation plant. The waste slurry will then be conveyed into the slurry treatment plant for treatment and subsequently discharge into the drainage system. The sand or gravel separated from the bentonite slurry through screening plant will be stockpiled at the site before disposed off to the approved dumping site.

Recycle slurry will be pumped back to the TBM excavation chamber from the separator plant. The slurry will be reused until it is deemed unsuitable. The slurry will be treated at the wastewater treatment plant and treated water will be discharged into the internal drain and eventually to the public drain before final discharge into Sg. Gombak, Sg. Bunus, Sg. Klang and Sg. Kerayong respectively.

Large amount of bentonite slurry is expected to be generated due to the extensive of the tunneling work. Improper management of bentonite slurry may affect the water quality of the receiving drains or waterways if large quantity.

There is potential spillage or leakage from storage of fresh bentonite slurry and waste slurry tanks at the launch shaft areas. Although bentonite slurry or waste bentonite slurry is not a scheduled waste, any discharge, spillage or leakage of large quantities may affect the water quality of the receiving drains or waterways. However, the likelihood of such occurrence is expected to be low.

<u>Mitigation measures to minimize water pollution from slurry discharge</u>

Wastewater treatment plant known as CLEARTEC Wastewater Treatment System shall be installed at launch and retrieval shaft areas. These are similar to the ones used at the SBK Line.

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The CLEARTEC Wastewater Treatment System Series 30 (SVC 30) was adopted at the Cochrane shaft and tunnel for the SBK Line (**Plate 7-24**). The plant using chemical treatment to treat waste slurry to acceptable discharge limit of 100mg/l for Total Suspended Solids, prior to discharging into the drainage system.

Plate 7-24 Example of Wastewater Treatment Plant At Cochrane Station (SBK Line)

The plant has the maximum discharge capacity of 40m^3/hr consisting of primary chamber and secondary chamber with automatically-controlled mixers, dosing pumps and desludge. Flocculent (Aionic Polyacylamide) and coagulant (Polyaluminium Chloride) will be injected into the bentonite slurry via a static mixer.

With the injection of chemicals, large flocs will be formulated and being pumped and removed in the primary chamber. The treated slurry from the primary chamber will then pumped into the second chamber. The second chamber consists of lamella plate blocks as the final suspended solids removal. The final treated effluent from the secondary chamber will be discharged into the existing drain. The sludge generated from primary chamber and secondary chamber will be channel into the sludge tank for further treatment (**Chart 7-47** and **Figure 7-14**).

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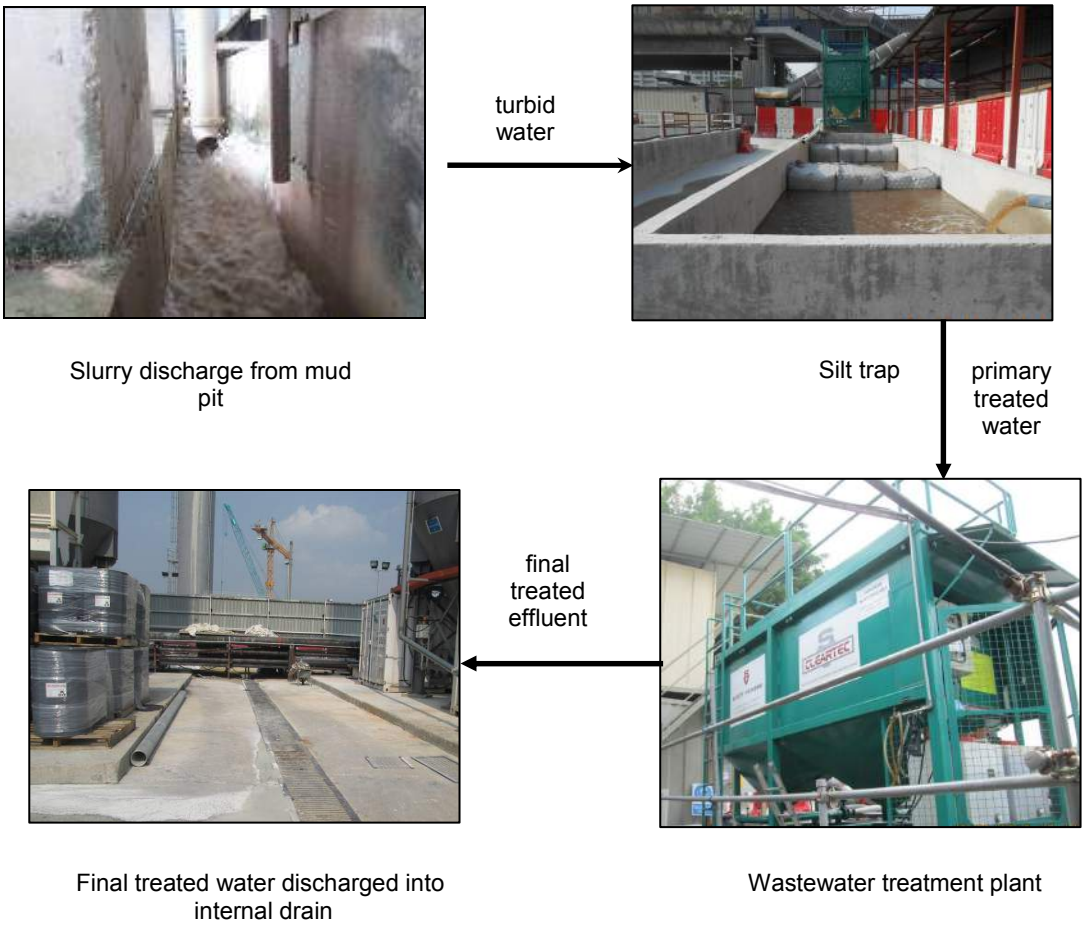
Chart 7-47 Slurry Treatment Process



Based on the data from Cochrane shaft, the suspended solids levels were below 100 mg/l (**Table 7-22**) Therefore, discharge is not expected to result in significant impacts. However, significant impact to water quality can be expected in the event of malfunction of the treatment plant.

Table 7-22 Water Quality From Slurry Treatment Plant At Cochrane Shaft

Date	Suspended solids (mg/l)
May 2012	6
Jun 2012	10
Jul 2012	10
Aug 2012	28
Sep 2012	10
Oct 2012	25
Nov 2012	73
Dec 2012	81
Jan 2013	46
Feb 2013	5
Mar 2013	37
Apr 2013	15
May 2013	<2

Source : MMCG-KVMRT

In addition, proper operation and maintenance of the treatment plant is also required to ensure that the plant is operating effectively which will include:

- Preventive and maintenance program for the slurry treatment plant
- Monitoring of separation plant to ensure that quality of bentonite slurry
- Regular inspection programme to monitor and detect any defects or problems (leakage, etc)

(b) Sewage and sullage discharge from workers camp and site office

About 2,000 workers are expected during construction stage. The total number of workers is expected to generate significant volume of sewage and other discharges. Direct discharge of untreated sewage into the receiving water ways could be detrimental to the water quality. Majority of the workers will be housed at the Central Labour Quarters which will have proper sanitation facilities.

Mitigation measures to minimize pollution from sewage and sullage discharge

- Proper toilets shall be installed at the Central Labour Quarters and site offices, and discharges from these toilets shall be treated in septic tanks with filters before being discharged into the waterways.

- These septic tanks shall be designed to meet effluent quality discharge of at least Standard B, in accordance to the Environmental Quality (Sewage) Regulation, 2009, under the Environmental Quality Act, 1974.

- To ensure the continuous effectiveness of the septic tanks, regular desludging of the tanks shall be carried out by the Contractor, at least once every 24 months.

- Grease traps shall be provided at designated canteens to prevent oil and grease from cooking from being discharge into the existing drains.

- The traps must be regularly maintained by the respective contractors.

(c) Operation of maintenance yard and batching plant

The location of above facilities has yet to be determined. The facilities will not to be established near major watercourses.

Water pollution in the water courses may occur due to waste oils, fuels and lubricants from machineries that are used during construction in the event of breakdowns, repairs and maintenance flowing into the drainage system. Any spillages such as spillage of diesel may also potentially reach the nearby rivers and result in water pollution.

Runoff from the batching plant containing chemicals may lead to contamination of the nearby waterways. Formation of hardened concrete in the existing waterways may occur due to runoff from washing of concrete trucks or concrete coated equipment as well as mortar mixing activities.

Mitigation measures to minimize pollution from maintenance yard and batching plant

- Maintenance of vehicles and plants will be carried out at the designated area. Sand contaminated with oil spillage will be removed and disposed of as scheduled waste.

- Fuel spillage seeping into the ground will be prevented by the construction of a containment wall either made out of concrete or bricks around the skid tank (**Plate 7-47**).

- All generator set and bar bending machine will be placed in the containment to prevent the spillage from seeping into the ground.

- All runoff from the batching plant shall be directed into a grout settling pond before being discharged into drainage system. Slurry residue and sedimentation from the settling pond shall be cleared periodically and allowed to dry before being disposed.

7.14 WASTE GENERATION

Wastes will be generated from the construction activities and these include:

- Biomass
- Excavated or unsuitable material
- Solid and construction wastes
- Scheduled wastes

The main vegetation at depot area consists of secondary forest vegetation, residual trees, shrubs and patches of oil palm. All the trees need to be felled and removed as biomass. The total volume of biomass generated from the site clearing is estimated to be around 8,100 tonnes.

The excavated or unsuitable material will be mainly generated from the removal of excavated material from the underground construction as well as depot construction. About 2.7 million m^3 will be generated from underground excavation and about 930,000 m^3 from depot. The excavated and unsuitable material will be stockpiled temporarily on site prior to disposal at the respective approved dumping site.

Solid waste will be generated by workers on site and workers camp. The composition of the waste is expected to be mostly food waste, paper, cans and bottles and plastics. Construction waste generated would be largely made up of material packaging, disused formwork, concrete debris and used containers.

Scheduled waste will be generated from the maintenance of the construction vehicles such as used oil, used batteries and used oil filter. The contaminated sand resulted from cleaning the oil spillage will be disposed off as scheduled waste.

SECTION 7 : POTENTIALLY SIGNIFICANT IMPACTS AND MITIGATION MEASURES DURING THE CONSTRUCTION STAGE

Mitigation measures to minimise waste generation

Biomass

Biomass generation will be minimsed by implementing the Project in phases. Biomass can be used as temporary slope protection to reduce soil erosion as it will assist in filtering the silt from the runoff and remaining biomass will be stockpiled temporarily at the designated area.

Location for temporarily stockpile on site will be identified prior to commencement of construction works for each phase and shall be away from watercourses. There will be no open burning of biomass.

Excavated/Unsuitable Material

The excavated and unsuitable material will be stockpiled temporarily on site. The stockpiled area shall be located away from the watercourses. Temporary drainage to be constructed surrounding the stockpiled area to divert any runoff away from the watercourses. Unsuitable material will be disposed at the approved dumping sites.

Solid and Construction Waste

All construction waste shall be disposed off at the designated waste bins before sending out for disposal (**Plate 7-48**). Sufficient waste bins shall be provided at the site office. Designated personnel shall be assigned to collect waste from all the bins and tie them up in proper garbage bags before dumping them into the large communal garbage bin located within the site. Construction and solid waste generated from the Project will be disposed at a municipal approved landfill or dumping site. There will be no burning of waste.

Scheduled Waste

Scheduled wastes shall be stored in proper drums and kept in a shed or store designated for the storage of such waste. Signs indicating “DANGER” and “HAZARD” shall be clearly visible outside the shed. The storage area shall be roofed to prevent entry of rainwater and must be ventilated adequately (**Plate 7-49**). All scheduled and toxic wastes shall be labelled according to their contents as required by the Third Schedule of the Environmental Quality (Schedule Wastes) Regulations 2005.

Used oil shall be sold and/or transported out of the Project site by a licensed contractor. The respective contractors shall maintain an up-to-date inventory of the types of quantities of the scheduled waste stored or sent out.

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	**Plate 7-47** Example of containment bund constructed around skid tank and fuel storage tank at Cochrane (SBK Line)
	**Plate 7-48** Example of designated construction waste bins at Merdeka Station (SBK Line)
	**Plate 7-49** Example of scheduled waste storage at Maluri (SBK Line)

7.15 SOCIAL IMPACTS DURING CONSTRUCTION STAGE

Social impacts during the construction stage draw from responses and feedback from the perception survey and stakeholders' engagement. They differ from commonly known environmental impacts often associated with infrastructure such as noise, vibrations, air pollution and water pollution. These impacts are being identified but overriding them now in the case of the MRT are two concerns, i.e. traffic congestion and related issues and site safety. Both impacts are now prioritised by the public who have been largely exposed to ongoing construction activities of the MRT and the LRT. These two infrastructure projects have been under construction for the past few years in the Klang Valley and most people who travel around are likely to have experienced or have been exposed to the consequences of these developments. Over and above these, they have also read in the media about the projects and some untoward incidents and mishaps that could cause bias among the respondents.

Additionally, the proposed alignment traverses across one of the most densely built parts of the Klang Vally, especially Kuala Lumpur and Petaling Jaya. It either runs above or below major roads leading in and out of Kuala Lumpur city centre. In this, it is highly probable that the MRT construction would encounter very challenging conditions at certain parts of the route during construction.

During the stakeholders' engagements, the participants were informed of possible impacts from the MRT. Top of the impacts identified to them are environmental concerns such as noise, vibrations, air pollution, with social and traffic as other secondary concerns. However, from these group sessions and also from the perception survey, traffic congestion and its related concerns have been consistently ranked as a major issue during construction.

Another important impact identified by stakeholders and survey respondents is safety. Safety aspects during construction have been raised frequently during public engagements as well as in the perception survey because people have been largely influenced by recent incidents at ongoing construction worksites of the MRT and LRT. These are normal responses and are expected, especially when these accidents occur within a period of less than 6 months of the launch of the perception survey and engagements which, in turn, captured such snapshot views public had ongoing construction activities onto this proposed SSP Line. Apart from these two significant concerns, other impacts observed are noise, vibrations, air pollution, and from the stakeholders' engagement, an increasing worry over land subsidence and flooding during construction.

SECTION 7 : POTENTIALLY SIGNIFICANT IMPACTS AND MITIGATION MEASURES DURING THE CONSTRUCTION STAGE

- **Safety** was frequently raised among stakeholders and in the perception survey, it is ranked first in terms of importance to respondents. Safety and security issues are often linked together largely because previous experiences have frequently associated this impact with the strong presence of foreign workers that could affect the entire neighbourhood's level of safety and sense of security. Such concern has since changed slightly in context, with the focus now shifting to safety of worksites. It is then transferred to concerns over safety of road users, and children being near to construction sites.

  The perception survey indicated more than 90% place safety and security as important or very important to them. The responses do vary across the long stretch of the SSP Line but it has consistently been ranked among the top 3 worries people have about the construction. During the engagement process, many groups stated that safety on construction worksite should be prioritized. The groups who raised this are those at Sri Damansara, Jalan Ipoh, PPR Batu, Kg Batu Delima, Sri Damansara, and Seri Kembangan.

  Another aspect of safety during construction covers fears over land subsidence. This matter is raised by many groups, especially those who believe that their neighbourhoods are built over former tin-mine and thus, are more susceptible to land subsidence from construction activities like tunneling and boring. The groups who voice their concerns over possible land subsidence that could affect public safety include those at Damansara Damai, Sri Damansara, Jalan Binjai/Jalan Conlay, Chan Sow Lin, Seri Kembangan (Taman Dato Demang) and institutions such as Kg Bharu Development Corporation, Istana Budaya, and Kompleks Kraftangan.

- **Traffic congestion** is a frequent and consistent issue raised by survey respondents and stakeholders. For respondents who think the SSP Line would affect them and their families, 43% indicate the construction would further aggravate traffic congestion. If this is combined with worries over parking issues, the proportion rises to over 50%. When asked to rank impacts during construction, almost 90% of the respondents identified traffic congestion as very important or important to them. It ranks second after safety and security. This observation is corroborated by the feedback from stakeholders' engagements. This is because, in many of these areas, traffic congestion is already a daily problem. Examples can be found in Damansara Damai, Kepong, Jinjang, Jalan Conlay, Jalan Chan Sow Lin, Salak Selatan, Kg Malaysia Raya, Sg Besi, Serdang Raya, and Seri Kembangan. This concern is especially marked for neighbourhoods where roads are narrow and traffic is exceptionally heavy, especially during peak hours, for example in Pekan Sg. Besi, Kepong, Damansara Damai, and Salak South.

There are some who raised concerns over their neighbourhoods being used for traffic diversions. This adds another dimension to the traffic implications from the construction. Some neighbourhoods such as PPR Laksamana which have had experiences with SBK Line construction are aware of traffic diversions into relatively quiet neighbourhoods and the impacts on them and therefore, are concerned.

For business operators, especially those who believe they are near to the alignment, construction could disrupt their businesses. Customers would be wary of traffic congestion in these areas and would skip them, especially if existing off-road parking is disturbed and reduced during construction. Overall, commercial operators are concerned that they could lose their business from such disruptions during construction and fear they may not be able to recover even after construction is completed. The stakeholders who fear this include those at Serdang Raya, Kepong Metro Prima and Jalan Ipoh (see **Section 7.5 : Traffic Assessment).**

- **Dust and air pollution** during construction was also identified as a negative impact. The survey findings have shown this as a major impact, ranking third after safety and traffic congestion. Almost 85% of respondents believe it is important or very important. When observed across the entire SSP alignment, its level of significance vary among areas and this is evident from the public engagement where some groups in Damansara Damai, Sri Damansara, Chan Sow Lin and Kompleks Kraftangan believe that dust and air pollution can be worrying during construction.

- **Noise and vibration** are also major concerns. Vibrations and cracks were ranked fourth by respondents in the perception survey after dust and air pollution, it is frequently cited as a concern among stakeholders along the alignment. Whilst noise is acknowledged as a problem, fears over vibrations and possible damages to their premises are increasingly becoming very important, especially for those who think their premises are going to be very near to the proposed alignment. Most stakeholders, when met, want to know how possible damages to their premises from vibrations and cracks would be managed. Fears over impacts of vibrations are important for certain activities that are sensitive to such occurrences. They are especially important to hospitals such as the Kuala Lumpur General Hospital and the hotels like the ones in Kepong and Jalan Binjai/Jalan Conlay.

  Overall, the groups who have considered noise and vibrations as worrying during construction include Damansara Damai, Sri Damansara, Kepong Metro, Kompleks Kraftangan, Salak South, Serdang Raya, and Seri Kembangan.

- **Flash floods** are perceived to be frequently associated with construction. The belief that construction activities tend to bring about flash floods, sometimes in neighbourhoods that have not experienced flooding. The Sg Besi Police personnel see this as a possible problem if work site is not properly managed and maintained. Others who share similar concerns are from Damansara Damai, Sri Damansara, Kepong, Chan Sow Lin, Seri Kembangan North, Jalan Binjai/Jalan Conlay, Sg Besi, PPR Raya Permai, Kompleks Kraftangan and Istana Budaya. For some, their fears stem from the fact that their areas have been experiencing flash flooding; they fear it could be aggravated during construction of the SSP Line, especially when it is a proposed underground segment.

Mitigation measures to minimise social impacts

Based on the discussion conducted with the various stakeholders, the most important mitigation measure is more consultations with them. In a nutshell, they want to be consulted, informed and updated about the Project on a regular basis, especially during construction. The stakeholder engagement/ communications that will be undertaken by MRT Corp are elaborated in Section 10 of this report.

They would like further engagement before construction and during construction so that they will be consulted, involved and informed of the proposed measures that will be implemented during construction. For example, the police at Sg Besi have offered to assist in traffic management as they see this as a major problem during construction. Residents have asked for signage in various languages especially during construction and diversion of traffic. They like to be informed on proper standard operating procedures when dealing with cracks and vibrations from construction activities. It is important to note that the mitigating measures need to be localised to address the specific needs of the community at that particular location.

Economic Benefits

Increase in economic activities and employment are the major positive impacts construction stage. On the larger scale, the construction sector is expected to benefit from the Project due to its size and magnitude. The main beneficiaries in this sector include:

- construction companies (various work packages will be tendered out for the Project)
- construction material suppliers (demand for construction material such as cement and steel is expected to increase)

- engineering and support services companies that provide civil and structural works, survey works, transport planning and other related services.
- Cleaning contractors responsible to keep work sites clean and free from being potential health hazards.

A significant amount of jobs is expected to be generated from the Project. Whilst the basic construction workers would be sourced overseas, it is likely that highly skilled workers such as professionals and supervisors would be locals. From the hire of locals and the awards of construction contracts, there would be considerable multiplier effect on the economy through spin-offs on other related businesses and jobs.