Addendum to the Environmental and Social Impact Assessment – Environmental Management Plan

Project Number: 51274-001
May 2018

THA: Bangkok Mass Rapid Transit (Pink and Yellow Lines)

Revised Yellow Line: Lad Phrao-Samrong Environmental Management Plan (Part 2 of 3)

Prepared by BSR Joint Venture for the Asian Development Bank. This is an updated version of the draft originally posted in October 2017 available on https://www.adb.org/projects/documents/tha-51274-001-eia-0.

ref.EBM.MRTA.00003.YL1042.13.09.2017

13 September 2017

Re: Submission of Revised Yellow Line: Lad Phrao - Samrong Environment Management Plan
To: Mr. Surachet Laopulsuk
Director of Phase 1
Yellow Line: Lad Phrao - Samrong Project
MRTA
In re: Our letter, ref. EBM/GEN/0033/2560, dated 21 August 2017
Enclosures: 1. One sheet of MRTA's Views on Environmental Management Plan, dated 6 September 2017
2. One copy of Revised Yellow Line: Lad Phrao - Samrong EnvironmentManagement Plan.

Whereas we are granted from MRTA concession for construction of MRT Yellow Line: Lad Phrao - Samrong.

As per details in the referenced letter, we submitted the Environment Management Plan to MRTA for consideration and approval before implementation of measures for prevention, alleviation and follow-up of environmental impacts. Later, MRTA requested us to make some additions according to their views, the details of which are in enclosure No. 1.

Enclosed, please find Revised MRT Yellow Line: Lad Phrao - Samrong Environment Management Plan, No.2.

Best Regards,
-sgd-
(Mr. Surapong Laosaanya)
Director

RECEIVED

CC: Asian Engineering Consultant Co., Ltd. Nisarat 15/9/17 MRTA

155/kk/EBM0046.1043

Eastern Bangkok Monorial Co., Ltd. 21 Chueyphuang, Vibhavadee-Rangsit Rd., Chomphon, Chatuchack, Bangkok
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Enclosure 1

MRTA's comments on 6/9/17

Comments on MRT Yellow Line: Lad Phrao - Samrong Environmental Management Plan

1. Page 2-7: 6) and 7) should be merged into one article; and 8) should be changed to 7);

2. Page 2-17: Repair and Maintenance and Park & Ride Building should be moved to Page 2-18;
3. Page 2-20: Delete "appoint" from 4);
4. Page 2-21: In 1), replace "move utilities" with "relocate utilities:;
5. Page 2-21: In 1), put "construction scraps) in one and the same line;
6. Page 2-22: In 4), add "Each construction site should have at least 2 security guards for security and traffic control purposes."
7. Page 2-27: In Fig. 23, change surface water quality monitoring of 5 stations to 10 stations.

8. Page 2-22: In Table 2-4, add a remark saying "If the construction time is extended, the environmental quality monitoring period shall also be extended accordingly until the construction is complete.
9. Page 2-45: In Table 2-4 (continued), 1.6 should be amended to read
    1) basic information of household;
    2) social and economic data; views on construction and issues related thereto;
    3) possible impacts of construction and suggestions;
    4) records of accidents and complaints;

10. Page 2-35: PM 2.5 should be added.

Attachment 2

Environment Management Plan

MRT Yellow Line: Lad Phrao - Samrong

United Analyst and Engineering Consultant Co., Ltd. 3 Udomsuk Lane, 41 Sukhumvit Rd., Bang Chak, Phrakanong, Bangkok 10260, Tel. 0 2763 2828, Fax. 0 2763 2800, email address: uae@uaeconsultant.com

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Measures for Prevention, Alleviation and Monitoring of Environmental Impacts

1.1 Preamble

At their meeting on 8 February 2010, the Commission for the Management of Land Traffic resolved in favor of the Greater Bangkok Rapid Mass Transit Master Plan under which the MRT Pink Line:Kae Rai – Pakkred – Minburi is included and it will commence service in 2029. At their meeting on 9 March 2010, the Cabinet endorsed the Minutes of such Meeting of the Commission for the Management of Land Traffic. On 24 August 2011, the government informed the House of Parliament that they would ensure that the construction of the 10 electric train lines will commence in 4 years (2015). The Ministry of Transport instructed MRTA to make preparations to ensure commencement of such construction as required by the government.

From 2007 to 2011, the Commission for the Management of Land Traffic studied the MRT Yellow Line: Lad Phrao - Phatanakarn and Phatanakarn - Samrong preliminary design to determine its economic and environmental viabilities:

1) The entire Rachada/Lad Phrao - Phatanakarn line is elevated monorail. It begins at the Ratchada-Lad Phrao intersection which it interchanges with the first phase of the Chalerm Ratchamonkon Blue Linm, and continues to Bang Kapi Intersection. From there, it runs southward along Si Naksarin Road connecting the Orange Line at Lamsali Intersection. It ends at Rama 9 on different leveel, connecting with the Airport Rial Link. The Yellow Line: Phatanakar - Samrong covers 12.6 km. with 10 stations in between.

2) The entire Phatanakarn - Samrong line is elevated heavy rail. It begins at the Airport Rial Link near Rama 9 Intersection, and runs along Si Nakharin Road to Phatanakarn, Si Nut Intersection, Si Udomsuk Intersection and Si Thepha Intersection, and runs westward along Thepharak Road, interchanging with the Green Line: Baring - Samutprakarn at Samrong Station, and ends at Puchao Saming Phrai. It covers 17.8 km. with 11 stations in between.

Later, MRTA reviewed the project and rerouted certain lines, relocated certain stations and repair and maintenance and park & ride buildings; changed Lad Phrao - Samrong to monorail. Therefore, the two existing environmental impact reports have to be revised. MRTA requested the Specialist Committee to revise such reports. They approved application for revision of Yellow Line: Lad Phrao –

Samrong Project Environmental Impact Analysis Report at their Meeting No. 34/2558 on 4 December 2015, and the National Environment Commission endorsed such revision at their Meeting No. 1/2016 on 19 February 2016 as per details in their letter ref. ThorSor (GorGorWorLor) 1005/Wor 3344, dated 17 March 2016.

1.2 Yellow Line: Lad Phrao - Samrong

1.2.1 Location

The Yellow Line: Lad Phrao - Samrong is located in Bangkok and Samutprakarn. It begins at Ratchada Station on Ratchada - Lad Phrao Intersection which it interchanges with MRT Chalerm Ratchamonkon Line. It has 23 stations: Ratchada, Phawana, Chokchai 4, Lad Phrao 71, Lad Phrao 83, Mahatthai, Lad Phrao 101, Bang Kapi, Lam Sali, Si Kritha, Phatabnakarn, Klantan, Si Nutch, Si Nakharin 38, Suan Luang Ror. 9, Si Udom, Si Iam, Lasal, Bearing, Si Dan, Si Thepha, Niphawat and Samrong as per details in Fig. 1.

1.2.2 Yellow Line Routes

The entire Yellow Line: Lad Phrao - Samrong is a straddle monorail connecting the MRT Blue Line Ratchada STation (Blue Line Lad Phrao Station), Orange Line on Lam Sali Intersection, Airport Rail Link at Rama 8 on different level and Green Line: Baring - Samuprakarn at Samrong Station. It begins at the point connecting with Blue Line First Phase MRT Chalerm Ratchamonkon at Ratchada - Lad Phrao Intersection, and runs along Chalong Rat Expressway to Bang Kapi Intersection. From there, it turns right southward and runs along Si Nakharin Road to join the Yellow Line at Lam Sali Intersection, and runs over elevated Rama 8 road to join Airport Rail Link. From there it runs to Phatanakar Intersection, Si Nutch Intersection, Si Udom Intersection, Si Iam Intersection up to Si Thepha Intersection. From there, it turns right southward into Thepharak Road and runs to join Green Line: Bearing - Samutprakarn at Samrong Station and ends at Puchao Saminphrai Road. It is 30 km. long with 23 station in between. There is one Repair and Maintenance on the east of elevated Si Iam Intersection and a Park & Ride building on the empty space of the elevated Si Iam Intersection.

1.2.3 Project Components

The project is made up of railway, stations, park & ride building, repair and maintenance depots and facilities:

1. The entire MRT Yellow Line: Lad Phrao - Samrong is a straddle monorial. It begins at Ratchada-Lad Phrao Station and ends at Samrong Station. It is 30 km. long.
2. There are 23 stations: Ratchada, Phawana, Chokchai 4, Lad Phrao 71, Lad Phrao 83, Mahatthai, Lad Phrao 101, Bang Kapi, Lam Sali, Si Kritha, Phatabnakarn, Klantan, Si Nutch, Si Nakharin 38, Suan Luang Ror. 9, Si Udom, Si Iam, Lasal, Bearing, Si Dan, Si Thepha, Niphawat and Samrong. Ratchada Station interchanges with Blue Line, Lam Sali Station interchanges with Orange Line, Phatanakarn Station interchanges with Air Port Rail Link and Samrong Station interchanges with Green Line.
3. A Park & Ride Building for parking of 2,800 vehicles near Si Iam Station on Bang Na - Trad Road.
4. A Repair and Maintenance Depot comprising main repair and maintenance center, design administration building, train operation control center and other buildings on a piece of land measuring about 122 rai near Si Iam Station at Si Nakharin Road and Bang Na -Trad Intersectio.
5. Facilities: Park & Ride Building, parking spaces, passenger pick up and delivery spaces.

Yellow Line: Lad Phrao - Samrong Project Environmental Impact Analysis Report Review, 2016

Fig. 1-1 Yellow Line: Lad Phrao - Samrong Railway and Stations

1.3 Possible Environmental Impacts During Construction

The construction of Yellow Line: Lad Phrao - Samrong may produce impacts on geographical and conditions, land, surface water sources, air, water ecology, land ecology; it may contribute to earthquake risks; it will produce noises and vibration; it leads to expropriation of properties; it will affect land use, transportation, utilities, water drainage, flood control, health and hygiene, security, historical, archeological and tourist sites.

1.3.1 Impacts on Physical Conditions

1) Geological Impact

The construction of elevated structures, stations, repair and maintenance and park & ride building requires land excavation and grading on traffic islands. The work is done at 15 m. level. Therefore, the geological impact is expected to be very small.

2) Impacts on Land

Impacts of Elevated Structures and Stations

The construction of elevated structures of 30 km. and 23 stations requires land excavation and opening. It inevitably and directly affects existing land structure and properties. However, most existing land lie low that it can be flooded. The upper layers are dark black and brown clay and the lower layers are rather sticky clay. containing moderate to low plant nutrients that such land is not ideal for raising plants and trees. The construction mainly takes place on 2.50 m. traffic islands over an area of 45.68 rai, so its impacts are likely to be low.

The construction may cause landslide. Land excavation and filling for construction of elevated rail and stations during rainy season will cause piling materials and scraps to fall on construction site or road surface, and these materials and scraps will be washed by rainwater along slopes or road surfaces to low lying plains or public waterways. Consequently, the piling of land residues and shallowing of public waterways are expected to be minimal.

Impacts Around Repair and Maintenance Depot and Park & Ride Building Construction

The construction will affect the land construction and properties because the site is a flooded low lying plain. It is necessary to fill the site to the level of 50 cm. flood (+1.5 AMSL). The site will be filled with the soil excavated for construction of elevated rails and stations and soils from other places. The structure, conditions and properties of the existing land will inevitably be affected at a minimal level because the park & ride building construction site is an empty land and residential area of Sumut Prakarn Subdistric Authority which are not directly used for farming; the repair and maintenance depot construction site is approximately 160 m. west of Kled Canal from where a lot of soil residues may be washed by rainwater along slopes, causing accumulation of soil and shallowing of Kled Canal; but the impacts are at a minimal level.

3) Geological and Earthquake Impacts

Impacts around Elevated Structures and Sations

The construction site is on soft or moderately soft clay to the depth of 18 m. The excavation for 1.50-1.80 m. circular bored piles and barrette piles can easily cause soft clay to shift. The impacts on surroundings of the piles are expected to be at a medium level. The construction near surface water may cause soft clay layers to swell, or soils may be pushed to all directions and cause damage to utilities -- underground drains, water pipes and electrical wires -- on both sides, concrete roads and buildings within 20 m. away from the construction site.

The earthquake impact is expected to be none or low because the site lies within the 2Gor Zone or it receive an impact of V-VII according to Mercalli scale. People living in highrise buildings may be frightened, but if their buildings are properly designed, they will not suffer any damage. Therefore, the impact is expected to be at a low to medium level.

Impacts around Repair and Maintenance Depot and Park & Ride

The geological impact will be in the form or soft clay shifting because the construction site lies on the land with soft to moderately soft soil to the depth of 18-20 m. Circular bored piling can easily shift soft clay.

The earthquake impact is expected to be none or low because the site lies within the 2Gor Zone Therefore, the impact is expected to be at a low to medium level.

4) Impacts on Surface Water Sources

Impacts around Elevated Structures and Stations

The construction activities, especially land excavation and filling and construction of foundations for elevated structures and stations and transportation of construction materials -- sand, stone, cement, soil, etc.-- are expected to produce impacts at a low level. The construction of foundations does not encroach surface water. Therefore, it does not affect the surface water quality. However, the construction of Lad Phrao 101 Station, Kalan Tan Station and Suan Luang Ror. 9 Station less than 50 m. from surface water may cause surface water to be cloudy only during land excavation and filling; and surface water may be contaminated with machinery oil. Taking place only on traffic islands, the construction is expected to produce impacts at a low level. Besides, the analysis of the surface water along the yellow line revealed that all the surface waters are low in quality because they collect wastewater from large city communities.

Impacts Produced by Project Office and Construction Workers' Living Quarters:

1) Project Office: 200 workers' daily use of toilets produces 8,000 liters or 8 cu.m. of wastewater per day; their washing up produces 0.60. cu. m. of garbage per day. It will cause blockages and affect nearby lsurface waters. Garbage cans should be provided.

2) Project Office and Workers' Living Quarters: 1,200 workers' use of toilets and bathrooms produces 200 cu. m. of wastewater per day; their washing up and cleaning produce 3.60 cu. m. of garbage per day. It will cause blockages and affect nearby surface waters.

Construction related washing and cleaning construction tools and equipment and machinery and vehicles will require up to 12 cu. m. of water per day.

Impacts Around Repair and Maintenance Depot and Park & Ride Building

The construction activities, especially land excavation and filling and foundation work for 2-story Repair and Maintenance Deport and transportation of cement, sand, stones, soils and other construction materials are likely to cause impacts, in terms of water cloudiness, BOD and contamination with machinery oil, at a very low level. Although the construction takes place near Kled Canal which is the source of surface water, it does not encroach the canal and it does not involve any activities which will affect the canal surface water.

5) Impacts on Air Quality

Impacts around Elevated Structures and Stations

There are many factors which cause flying dust. The maximum concentration of elevated structure construction flying dust is at 0.21542 mg./cu. m. which is in compliance with the National Environment Commission's Notification No. 24 (2004) on Air Quality in Atmosphere in General. Under such notification, the maximum concentration of dusts should not exceed 0.330 mg./cu. m. Throughout the day and depending on activities, the amount of dusts varies. The impact is at a low to medium level. The maximum concentration of dusts from station construction is 0.2192 mg./cu. m. in compliance with such notification. Like elevated structure construction, its impact is at a low to medium level.

The transportation of construction materials, tools, equipment and machinery for construction of elevated structure at each 1,000 m. interval produces nitrogen dioxide (NO_2) of 0.00435 ppm and 0.00042 mg./cu.m. of total suspended particles (TSP) which does not exceed the limit imposed by National Environment Commission's Notification No. 10 (1995) and No. 24 (2004) on Air Quality Standard in Atmosphere in General. Besides, all equipment and machinery are not used at the same time throughout the day; they are used only at short intervals; therefore, poisonous fumes do not accumulate so much. It is expected that the impact will be at a low to medium level.

Impacts around Repair and Maintenance Depot and Park & Ride Building

Around Repair and Maintenance Depot construction site, carbon monoxide (CO) is 0.02524 ppm, hydrocarbon (HC) is 0.02124 ppm, nitrogen dioxide (NO_2) is 0.05783 ppm and total suspended particles (TSP) is 0.00510 mg./cu.m. which do not exceed the limits imposed by National Environment Commission's Notification No. 10 (1995) and No. 24 (2004) on Air Quality Standard in Atmosphere in General.

Around Park & Ride Building construction site, carbon monoxide (CO) is 0.05475 ppm, hydrocarbon (HC) is 0.04646 ppm, nitrogen dioxide (NO_2) is 0.12533 ppm and total suspended particles (TSP) is 0.01090 mg./cu.m. which do not exceed the limits imposed by National Environment Commission's Notification No. 10 (1995) and No. 24 (2004) on Air Quality Standard in Atmosphere in General.

6) Noise Level

Impacts Around Elevated Structures and Stations

Around project sensitive areas, noises are at 66.5 to 86.6 dB (A); it affects the project line within 30 m. Most of the areas are expropriate for the construction. Only Suan Luang Christian Church and Chulavej Hospital are the parts sensitive to the impacts from noises.

Impacts Around Repair and Maintenance Depot and Park & Ride Building

The Repair and Maintenance Depot construction site is east of Si Iam Elevated Intersection. Within a distance of approximately 200 m.,. Premhataiudomsuk Housing Development is the nearest place sensitive to the impacts of noises. Before adjustment, the noises are at 72.0 dB (A) and after adjustment according to Table 5.1.6 - 4 they are at 69.0 db (A). After taking off from L_{eq90} of 66.7 dB (A) taken at Si Iam Temple, the disturbance is at 2.3 db (A) which is lower than the imposed limit of 10.0 dB (A). The project piling should not affect Premhataiudomsuk Housing Development which is 200 m. away. Therefore, the impacts are at a medium level.

The Park & Ride Building construction site is east of Si Iam Elevated Intersection. Within a distance of approximately 150 m.,Si Iam Temple is the nearest place sensitive to the impacts of noises. Before adjustment, the noises are at 73.4 dB (A) and after adjustment according to Table 5.1.6 - 4 they are at 71.4 dB (A). After taking off from L_{eq90} of 66.7 dB (A) taken at Si Iam Temple, the disturbance is at 7.7 dB (A) which is lower than the imposed limit of 10.0 dB (A). The project piling should not affect Si Iam Temple which is 150 m. away. Therefore, the impacts are at a medium level.

7) Vibration Level

Impacts Around Elevated Structures and Stations

Within 33 m. from piling, Chularat 2 Hospital and Chulavej Hospital are sensitive to the vibrations caused by particle speed of up to 2.094 mm./sec. which is the level perceptible to human being to the point of disturbance, but such vibrations do not interfere with the lives of residents in the building according to Reiher & Meister (1931), and according to DIN 4150 (Nelson, 1987) standard, they will not cause damage to buildings and their architectural structures. The impacts therefore are expected to be at a low to medium level.

Impacts Around Repair and Maintenance Depot and Park & Ride Building

Within 200 m. from Repair and Maintenance Depot construction site, Premhatai Housing Development and Udomsuk Housing Development are sensitive to the vibrations caused by particle speed of up to 0.139 mm./sec. or 0.005 in./sec. which is imperceptible to human being according to Reiher & Meister (1931), and according to DIN 4150 (Nelson, 1987) standard, they will not cause damage to buildings and their architectural structures.

Within 200 m. from Park & Ride Building construction site, Si Iam Temple is sensitive to the vibrations caused by particle speed of up to 0.213 mm./sec. or 0.008 in./sec. which is slightly perceptible to human being according to Reiher & Meister (1931), and according to DIN 4150 (Nelson, 1987) standard, they will not cause damage to buildings of all types, including ancient ones.

1.3.2 Biological Resources

1. Hydroecology

Impacts Around Elevated Structures and Stations

Land excavation and filling, foundation works for elevated structures and stations and transportation of construction materials, tools, equipment and machinery are not expected to produce impacts on surface water sources. Although the Yellow Line goes through 19 surface water sources, the foundation works for elevated structures and stations do not encroach on surface water sources; hence, they will not affect surface water source quality or hydroecological conditions. However, the surface water sources within 50 m. from Lad Phrao 101 Station, Klantan Station and Suan Luang Ror.9 Station may be affected during land excavation and filling: surface soils may be washed away, machinery oil may also cause oil contamination, resulting in waters becoming cloudy and blocking sunlight from reaching surface water sources to a certain extent that planktons' photosynthesis will decline and there will be less oxygen in waterduring construction -- limited to traffic islands where constructions take place.

Impacts Around Repair and Maintenance Depot and Park & Ride Building

The Repair and Maintenance Depot is east of Si Iam Elevated Intersection, near Kled Canal. No construction activities encroach on the canal. However, the canal water may be slightly cloudy due to soils being washed away during land excavation and filling and possible contamination of oil released from construction machinery that sunlight will not reach planktons, resulting in reduced photosynthesis and there will be less oxygen in water. There will be impacts only during construction.

2) Geoecology

2.1 Forests

Impacts Around Elevated Structures and Stations

The construction of elevated structures and stations over 8-m. traffic islands on Lad Phrao Road, Si Nakharin Road and Thepharak Road requires cutting down of trees higher than 10 m., especially those being near foundations. Along both sides there are 4,571 trees (60 species); on traffic islands there are 681 trees (2 species); more than 95% of them are large trees, such as Burma padauk, pink trumpet trees, yellow flamboyant, white cheesewood, mahogany and cork trees, planted by human; only 5% of them, such as rain trees, Manila tamarind, Chinese date and Indian almond, grown in nature.

Impacts Around Repair and Maintenance Depot and Park & Ride Building

There are only herbaceous plants, shrubs and medium height trees, totaling 39 trees (6 species) around the Repair and Maintenance Depot and Park & Ride Building construction site. Some of them will be cut down or relocated.

1.3.3 Usefulness to Human Beings

1) Land Use

Impacts Around Elevated Structures and Stations

Construction of elevated structures takes place over 8-m. traffic islands. It should not affect land use much. Now, a lot of land --more than 90%--is used already. There are densely and moderately populated areas with commercial activities and utilities. The remaining unused spaces will be turned into residential areas of moderate sizes. The impacts are expected to be low. Certain parts the Yellow Line deviate from traffic islands to sidewalks. Some of the commercial buildings and activities will permanently be turned into elevated structures. Compared with the surrounding commercial areas, land use is not changed much.

Impacts Around Repair and Maintenance Depot and Park & Ride Building

The Repair and Maintenance Depot will be constructed on a piece of land measuring 122 rai. Land use will change partially. On an empty space with a few shrubs, a 5-story Repair and Maintenance Depot and a 7-story Park & Ride will be built. Samut Prakarn Way District's office buildings will be altered. Compared with surrounding sparsely and moderately populated areas, the site will change positively at a medium to high level.

2) Transportation

Impacts Around Elevated Structures and Stations

Impacts on Existing Roads: The construction over traffic islands on Lad Phrao Road, Si Nakharin Road and Thepharak Road will affect the traffic on such roads.

Impacts on Service Life of Existing Roads: Transportation of construction materials, tools, equipment and machinery along ad Phrao Road, Si Nakharin Road and Thepharak Road can cause damage and deterioration of such roads.

Accidents can occur on and around construction site. Construction activities and piling of materials can cause injuries to passers-by and damage to passing vehicles. The impacts are expected to be at a moderate level.

Impacts Around Repair and Maintenance Depot and Park & Ride Building

The construction of Repair and Maintenance Depot and Park & Ride Building requires transportation of construction materials, tools, equipment and machinery. It may cause damage or deterioration of existing roads, but it will not affect the traffic flow because the construction does not take place over traffic islands.

3. Utilities

Impacts Around Elevated Structures and Stations

Relocation of utilities may cause the following impacts:

* MWA 20,000 m. water pipes have to be removed from traffic islands and both sides of Lad Phrao Road, Si Nakhain Road.
* 440 poles with high voltage devices and electric cables have to be removed from both sides of Lad Phrao Road, Si Nakhain Road and Thepharak Road.
* TOT 2,700 m. 9-D4, 12-D4 and 16-D4 telephone lines and aerials have to be removed from both sides of Si Nakhain Road and Thepharak Road.

* Highway Department 3,300 m. x 1,000 - 1,200 mm. reinforced drains and 820 two-lamp lighting poles have to be removed from traffic islands and both sides of both sides of Lad Phrao Road, Si Nakharin Road, Thepharak Road and Puchao Samingprai Road.
* CAT 17, 000 m. optic fibers, communication copper lines and conduits have to be removed from both sides of Lad Phrao Road, Si Nakharin Road and Thepharak Road.

* TOT 11,700 m. optic fibers, communication copper lines and conduits have to be removed from both sides of Lad Phrao Road, Si Nakharin Road and Thepharak Road.

* Fuel Pipeline Transportation Co., Ltd. and PTT fuel pipes and gas pipes respectively have to be removed from Phatanakarn Intersection. The construction on traffic island of Si Nakharin Road and BMA tunnel under Phatanakarn Intersection are overlapping one another. The fuel pipes and gas pipes have to laid parallel to the eastbound railway cutting across Si Nakharin Road at Phatanakarn Intersection. Therefore, 30-m. fuel pipe and 30-m. gas pipes have to be relocated.

* Removal of BMA 807 m. out of 1,820 m. 4-traffic-lane asphalt concrete surface bridge crossing Bang Kapi Intersection with ascending and descending ends on Lad Phrao Road and Serithai Road and elevated part at connecting point of Lad Phrao Road and Si Nakharin Road. The traffic flow between km. 8+200 and km. 9+007 will be affected.

Impacts Around Repair and Maintenance Depot and Park & Ride Building

No utilities are removed. So, no impacts.

4) Flood Control and Water Drainage

Impacts Around Elevated Structures and Stations

Construction not taking place in surface water source, the natural flow of waters is not expected to be affected. However, the flow of waters is likely to be obstructed by the construction of elevated structures and stations over 8-m. traffic islands of Si Nakharin Road where water drains lie in the middle. Cement, stones, soils and sand may fall into the drains and cause obstructions. So, obstruction of water flow is expected to be atu a moderate level.

Piles of construction materials and thick concrete walls around construction site may block rainwater that it goes through public drains more slowly that the traffic surfaces along the Yellow Line may be flooded.

Impacts Around Repair and Maintenance Depot and Park & Ride Buildingh

Impacts on hydroecology, surface water sources and water drainage: During construction of a 5-story Repair and Maintenance Depot, construction materials, tools, equipment and machinery improperly stored on site may block rainwater from draining away during heavy rain. However, Kled Canal along the construction line can help drain the rainwater. So, flood is not expected to occur.

1.3.4 Life Quality

1) Hydroecology

The community economy will improve slightly.

Most construction activities take place on and over traffic islands of Lad Phrao Road, Si Nakharin Road and Thepharak Road which are clearly condoned off. Therefore, conflicts between passers-by or local people and construction workers are not likely to arise.

Any inconveniences or hardship of passers-by and local people must be resolved quickly.

Existing businesses near construction site, especially those being obstructed by station construction, may be affected.

2) Relocation and Expropriation

Construction Line: Most construction activities take place on and over traffic islands on Lad Phrao Road, Si Nakharin Road and Thepharak Road. Therefore, land expropriation is not required. However, the construction line has to be adjust at Suan Luang - Si Udom, Si Iam Elevated Intersection and Si Thepharak Expressway Intersection future extension (Samrong Station) 64 plots of land with a total area of 3 rai, 2 ngarn and 200.3 square wah have to be expropriated.

Station Construction Sites: 274 plots of land with a total area of 27 rai, 3 ngarn and 161.8 square wah are expropriated.

Repair and Maintenance Depot and Park & Ride Building Construction Site: 48 plots of land with a total area of 118 rai, 1 ngarn and 79 square wah are expropriated.

3) Public Health and Health

The construction may affect health and hygiene. The communities near the construction sites may suffer from respiratory illnesses through exposure to noises and dusts and contraction of diseases from workers from different regions. The increase in labor forces will put additional burden on local public health agencies.

Garbage, waste and wastewater from workers' living quarters must be properly disposed of, otherwise they can breed germs and cause diseases which will contaminate waters and spread to nearby areas. However the impacts are expected to temporary during construction only.

Large number of construction workers living togethers will give rise to hygienic and environmental issues: diseases can spread; drinking water and supply water are required; garbage has to be properly eliminated; disease carriers have to controlled. Improper control will cause dysentery, cholera, diarrhea and food poisoning to spread around.

The health and hygiene issues can be prevented by maintaining healthy and hygienic conditions of construction workers' living quarters, provision of sufficient first aid kits and laying down work regulations. The impacts are expected to be low.

4) Occupational Health and Safety

Land excavation and filling, foundation work, connection of beams and other activities require use of heavy machinery. Incorrect use of machinery, carelessness, improper storage or use of faulty machinery can cause accidents, injuries and illnesses to workers, especially respiratory diseases and hearing impairment due to exposure to dusts and noises. Transportation of construction materials, tools, equipment and machinery of many trips each day can cause road accidents.

5) Historical and Archaeological Sites

Impacts Around Elevated Structures and Stations

The construction mostly takes place on and over traffic islands, so it will not cause any loss, damage or relocation of historical or archaeological sites. However, Ban Phra Christ Church, Lad Phrao Temple, Suan Luan Chist Church, Hidaytul (Don Sakae) Mosque, Phra Kularbtip Temple, Ruamnimit Church, Bangkok Mosque, Fathalbaree (Hua Mark Yai) Mosque, Bangkok God Christ Church, Darislam Mosque, Namphrathai Christ Church, Aleiasom Mosque, Khmer (Kachonsiri) Temple, Darunamin Mosque, Si Iam Temple, Udomsuk Si Pharak Christ Church, Samut Prakarn Samrong Christ Church and Puchao Samingphrai Shrine within 500 m. radius from construction line will be indirectly affected.

Impacts Around Repair and Maintenance Depot and Park & Ride Building

There are no local historical or archaeological sites within 500 m. of the Repair and Maintenance Depot and Park & Ride Building. So the construction and operation of the Repair and Maintenance Depot and Park & Ride Building will not affect any local historical or archaeological sites.

6) Picturesque Scenery and Tourist Spots

There are 3-6 story commercial buildings residential buildings on both sides of the construction line; there are some empty spaces with dense grass, weeds, plants and trees; there are housing developments, apartments, government/state enterprise buildings, religious places and important places of communities. So, the impacts on picturesque scenery are low. However, Suan Luang Christ Church and Fathalbaree Mosque, which are places of historical and cultural importance, lie 24.92 m. and

46.40 m. respectively from the construction line and their picturesque scenery is slightly affected by the construction in terms of imposing height or contradictory features of the construction.

Impacts Around Repair and Maintenance Deport and Park & Ride Building

Only valuable historical or cultural site within 50 m. from the construction line will be affected in terms of imposing height and contradictory features of the construction. However, within 500 m. from the construction line, there are no valuable historical or cultural sites, so there are no impacts whatsoever.

Section 2

Measures for Prevention, Alleviation and Monitoring of Environmental Impacts

Section 2

Measures for Prevention, Alleviation and Monitoring of Environmental Impacts

2.1 Follow-up of compliance with measures for reduction of environmental impacts

At their Meeting No. 1/2016, on 19 February 2016, The National Environment Commission approved The Environmental Impact Assessment as per details in their letter ref.ThorSor (GorGorWorLor) 1005/Wor 3444, dated 17 March 2016. The construction shall comply with the measures introduced in The Environmental Impact Assessments. To ensure compliance, the construction sites will be inspected as follows:

1. A meeting of Inspection Team comprising consultant firms, contractors, project owner and its consultant will be held for explanation of the main objectives of compliance with measures.
2. Joint actual Inspection of construction sites to determine possible impacts and sensitive areas mentioned in the measures. During inspection, contractors will be asked questions about possible issues. If they cannot fully comply with the measures, their limitations will be used as guidelines on resolving the issues or suggestions of solutions based on technical reasons.
3. Record inspection results on the inspection report form.
4. At the end of each inspection, assessment and summary will be made for acknowledgement of project owner. If environmental impacts have to be prevented or reduced, the consultant firms will request for immediate actions to stop the immediate impacts first. After that, long-term reduction of impacts will be introduced. The summary will have details and pictures for clear understanding of the objects of inspection.
5. Minutes of Meeting must be published within 5 days of inspection.

6. Hand the inspection report to the constructors and project owner for consideration

- Six monthly Thai reports on inspection of compliance with measures for prevention, alleviation and monitoring of environmental impacts will be issued to Sino-Thai Engineering and Construction Plc. for submission to MRTA.
- Every six months, six Thai reports on inspection of compliance with measures for prevention, alleviation and monitoring of environmental impacts will be issued to Sino-Thai Engineering and Construction Plc. for submission to MRTA.

The inspection report can include a chart showing synergy of project owner, its consultant, contractors and UAE's consultant firm. There shall be guidelines on enhancement of compliance with measures to ensure attainment of objectives proposed in the EIA. Such chart will look like the one below.

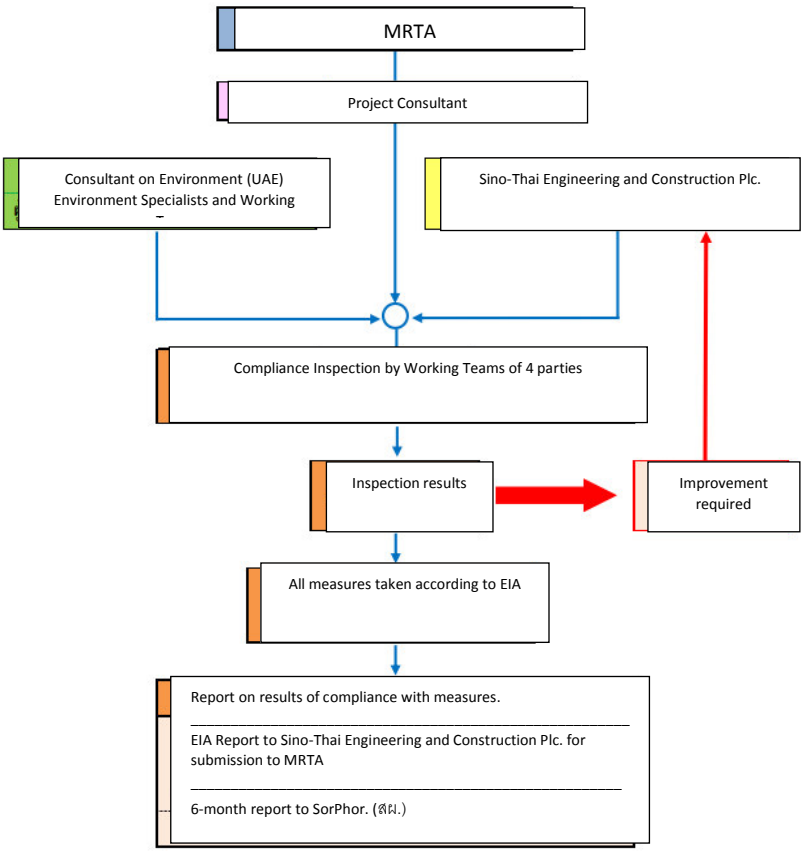

Fig. 2-1 Chart showing synergy of working teams and orders for compliance of measures for reduction on environmental impacts

2.2 Guidelines on Environmental Impact Monitoring

EIA Report requires that surface water sources, air quality, noises, vibrations, transportation, utilities, social and economic conditions and impacts along construction line be assessed during construction. Certain areas will be inspected to determine the impacts. The compliance with measures for prevention, alleviation and monitoring of environmental impacts should be assessed, and a report should be submitted to the Natural Resource and Environment Policy and Planning Office every 6 months.

The consultant firm UAE will conduct environmental impact assessment. UAE is registered with Industrial Works Department. They have to capacity to conduct complete environment impact assessment as required by the EIA Report. Their working and assessment procedures are set forth in Fig. 2-2 and Table 2-1 respectively.

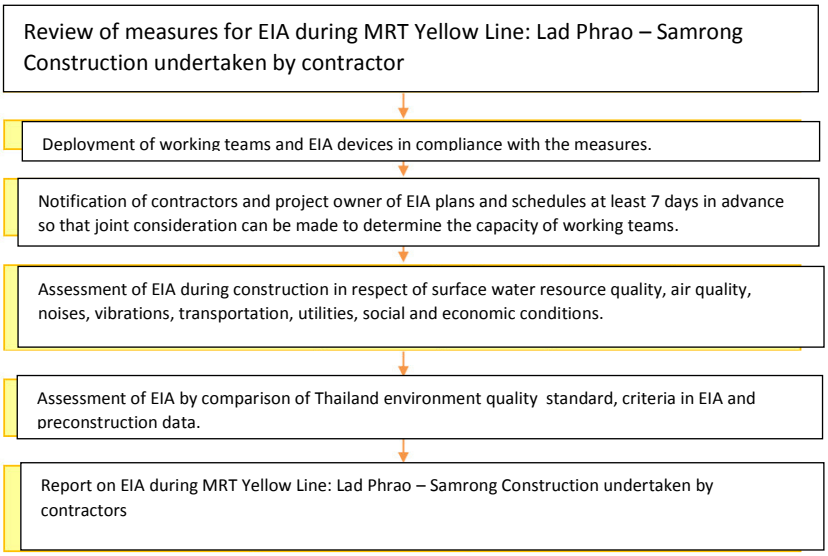

Fig. 2-2 Procedures for EIA of MRT Yellow Line: Lad Phrao – Samrong Construction

Table 2-1 MRT Yellow Line:Lad Phrao – Samrong EIA Plan
Sino-Thai Engineering and Construction Plc.

Environmental Impacts	Indices	Site	Frequency
1. surface water quality	1. temperature 2. conductivity 3. pH 4. DO 5.SS 6. BOD 7. fat and oil 8. Phosphate 9. all coliform bacteria 10 fecal coliform bacteria	1. Nam Kaew Canal 2. Lad Phrao Canal 3. Chan Canal 4. Sansab Canal 5. Hua Mak Canal 6. Prawetburirom Canal 7. Ta Chang Canal 8. Kled Canal 9. Bang Na Canal 10. Samrong Canal	* One measurement to be made one month before construction. Findings will be used as baseline data. * Once a month during construction of railway or station near water source. The assessment shall be made until the construction is complete.
2. Air Quality	1.TSP 2. particles smaller than 10 microns (PM-10) 3. particles smaller than 2.5 microns (PM-2.5) 4. wind direction and speed	1. Justice Court Official Development Institute 2. Pibulupatum School 3. Chokchai 4 Station Police Flat 4. Tanompitwitaya School 5. Bangkok Suksa School 6. Big C Lad Phrao 7. Mae Phra Kularbtip Temple 8. Vejthani Hospital 9. The Mall Bang Kapi 10. Fathulbaree Mosque 11. Sukonri Kindergarden 12. Hau Mak Municipal School 13. Yamiunidhad (Hua Mak Yai) Mosque 14. Hua Mak School	* One 5-day measurement to be complete one month before construction. Findings will be used as baseline data. * One measurement on working and non-working days for 5 days every month whenever a construction takes place within 1 km. and from measuring station. The measurement shall be conducted throughout the construction period.

Table 2-1 MRT Yellow Line:Lad Phrao – Samrong EIA Plan (continued)
Sino-Thai Engineering and Construction Plc.

Environmental Impacts	Indices	Site	Frequency
2. Air Quality (continued)		15. Khlong Klantan School 16. Surao Mai School 17. Kachonsiri Temple 18. Darulamin Mosque 19. Dusit Thani College 20. Phrakanong Land Office 21. Si Iam Temple 22. Big C Si Nakharin 23. Khlong Kratum Ratutit School 24. Siriwutiwitaya School 25. Chularat 2 Hospital 26. Chulavej Hospital	
3. Noises	1. $L_{Aeq\ 24\ hour}$ 2. L_{Adn} 3. L_{Amax} 4. L_{A10}, L_{A90}	1. Justice Court Official Development Institute 2. Pibulupatum School 3. Chokchai 4 Station Police Flat 4. Tanompitwitaya School 5. Bangkok Suksa School 6. Big C Lad Phrao 7. Mae Phra Kularbtip Temple 8. Vejthani Hospital 9. The Mall Bang Kapi 10. Fathulbaree Mosque 11. Sukonri Kindergarden 12. Hau Mak Municipal School	* One 5-day measurement to be complete one month before construction. Findings will be used as baseline data. * One measurement on working and non-working days for 5 days every month whenever a construction takes place within 1 km. and from measuring station. The measurement shall be conducted throughout the construction period.

Table 2-1 MRT Yellow Line:Lad Phrao – Samrong EIA Plan (continued)
Sino-Thai Engineering and Construction Plc.

Environmental Impacts	Indices	Site	Frequency
3. Noises (continued)		13. Yamiunidhad (Hua Mak Yai) Mosque 14. Hua Mak School 15. Khlong Klantan School 16. Surao Mai School 17. Kachonsiri Temple 18. Darulamin Mosque 19. Dusit Thani College 20. Phrakanong Land Office 21. Si Iam Temple 22. Big C Si Nakharin 23. Khlong Kratum Ratutit School 24. Siriwutiwitaya School 25. Chularat 2 Hospital 26. Chulavej Hospital	
4. Vibrations	1. particle maximum speed in mm./sec. 2. frequency in Hz	1. Justice Court Official Development Institute 2. Pibulupatum School 3. Chokchai 4 Station Police Flat 4. Tanompitwitaya School 5. Bangkok Suksa School 6. Big C Lad Phrao 7. Mae Phra Kularbtip Temple 8. Vejthani Hospital 9. The Mall Bang Kapi 10. Fathulbaree Mosque	* One 5-day measurement to be complete one month before construction. Findings will be used as baseline data. * One measurement on working and non-working days for 5 days every month whenever a construction takes place within 1 km. and from measuring station. The measurement shall be conducted throughout the construction period.

Table 2-1 MRT Yellow Line:Lad Phrao – Samrong EIA Plan (continued)
Sino-Thai Engineering and Construction Plc.

Environmental Impacts	Indices	Site	Frequency
4. Vibrations (continued)		11. Lasudnaree Kindergarden 12. Hua Mak Municipal School 13. Yamiunidhad (Hua Mak Yai) Mosque 14. Hua Mak School 15. Khlong Klantan School 16. Surao Mai School 17. Kachonsiri Temple 18. Darulamin Mosque 19. Dusit Thani College 20. Phrakanong Land Office 21. Si Iam Temple 22. Big C Si Nakharin 23. Khlong Kratum Ratutit School 24. Siriwutiwitaya School 25. Chularat 2 Hospital 26. Chulavej Hospital	
5. Communications and Transportation	1. quantity, types and directions of vehicles transporting construction materials and equipment measured at intersections for analysis of traffic volumes; 2. records of accidents; 3. causes and severity of accidents.	1. Ratchada-Lad Phrao Intersection 2. Phawana Intersection 3. Chokchai 4 Intersection 4. Pradit Manutham Intersection 5. Bang Kapi Intersection 6. Lam Sali Elevated Intersection 7. Krungthep Kritha Intersection 8. Rama 9-Si Nakharin Elevated Intersection 9. Phatanakarn Intersection	* One measurement one month before construction * One measurement on working and non-working days for 3 days every month during the following periods: * morning rush hours07:00-09:00 hr. * evening rush hours 16:00-19:00 hr.

Table 2-1 MRT Yellow Line:Lad Phrao – Samrong EIA Plan (continued)
Sino-Thai Engineering and Construction Plc.

Environmental Impacts	Indices	Site	Frequency
5. Communications and transportation (continued)		10. Onnut Intersection 11. Udomsuk Intersection 12. Si Iam Elevated Intersection 13. Thepharak Intersection 14. Samrong Intersection	* nighttime 22:00-00:00
6. Utilities	1. cooperation and performance 2. activities on construction sites 3. field obstacles and problems 4. impacts during construction 5. views on construction	- organizations using utilities	* Field survey by interview. Simple sampling. To be conducted during the 2 years of modification, removal and relocation of utilities.
7. Social and economic conditions	1. household general info; 2. social and economic data; views on construction; issues; 3. impacts during construction; suggestions.	1. people who have to relocate; 2. residents and businesses new railway; 3. community leaders; 4. representatives educational institutes and religious places.	*A 500-set minimum social and economic survey to be conducted once a year throughout construction period.

MRT Yellow Line: Lad Phrao – Samrong EIA shall be followed up according to the following standards:

* National Environment Commission's Notification on Quality of Air in General Atmosphere No. 36 (2010), issued on 28 January 2010 and published in Royal Gazette No. 12, Special Section 101 d on 22 September 2004 i

* National Environment Commission's Notification on Quality of Air in General Atmosphere No. 24 (2004), issued on 9 August 2004 and published in Royal Gazette No. 127, Special Section 37 d on 24 March 2010

* National Environment Commission's Notification on Sound General Standard No. 15 (1997), issued on 12 March 1997 and published in Royal Gazette No. 114, Special Section 27 d on 3 April 1997

* National Environment Commission's Notification on Vibration Standard for Prevention of Impacts from Buildings No. 37 (2010) published in Royal Gazette No. 127, Special Section 69 d on 2June 2010

* National Environment Commission's Notification on Surface Water Standard No.8 (1994), issued by virtue National Environment Promotion and Conservation 1992, published in Royal Gazette No. 111, Special Section 16 d on 24 February 1994

2.3 Measures for Prevention and Alleviation of Environmental Impacts

2.3.1 General Measures

1) Compliance with the measures for assessment prevention, alleviation, reduction of environmental impacts, introduced in MRT Yellow Line: Lad Phrao – Samrong EIA report and additions by Specialist Team should be made the condition of the contractsfor design, construction and management of the project.

2) The designers, construction contractors and project management firms should be monitored to ensure compliance with the above measures.

3) Third parties shall be hired to follow up compliance with the above measures. The costs thereof should be included in the project costs. Such follow-up should be monitored by MRTA and/or project implementing agency. A Measures Compliance Monitoring Commission should be formed with the following members:

-MRTA
- Representatives from Natural Resource and Environment Policy and Planning Office
- Representatives from SRT
- Representatives from Highway Department
- Representatives from Pollution Control Department
- Representatives from Samut Prakan Administration
- Representatives from BMA
- Representatives from Consumer Protection Board
- Specialists in environment

The Commission shall monitor compliance with the entire project environmental measures.

4) Every six months, MRTA and/or project implementing agency shall submit measure compliance report to Natural Resource and Environment Policy and Planning Office and other agencies concerned.

5) SRT must comply with the said measures which have been approved by Specialist Commission and the EIA reports of government agencies, state enterprise and private firms in case where there are no significant changes thereof or the changes are equivalent to or better than those in the approved reports. The matter shall then be submitted to local regulatory agencies and cc for Natural Resource and

Environment Policy and Planning Office. If there are significant changes, the revised EIA report should be submitted to Specialist Commission for consideration and approval before proceeding further.

6) During project construction and implementation, SRT and/orproject designer, construction contractors and manager should resolve any environmental impacts or complaints as quickly as possible and inform Natural Resource and Environment Policy and Planning Office of the facts so that joint consideration will be made to find solutions.

2.3.2 Physical Environment

(a) Geographical Conditions

- The construction of Repair and Maintenance Depot and Park & Ride Building is not expected to affect any geological conditions. Therefore, measures for prevention, alleviation and reduction of environmental impacts are not required.

(b) Soil Conditions

Elevated Structures and Stations

1) The elevated structure and station construction site should be clearly cordoned off with opaque 2.0 m. walls to prevent soils from being washed into low lying plains, public drains or surface waters.

2) Land excavation and filling, relocation of water pipes, drains and electric posts, construction of foundations for elevated structures and stations and construction of Repair and Maintenance Depot and Park & Ride Building and other major activities should be done during dry season to avoid soils being washed by rainwater during rainy season.

3) Materials, tools, equipment and machinery (only as necessary) should be properly stored, especially near surface waters, to avoid soils being washed away.The soils excavated during foundation work must not be left around. They should be transported by trucks to the sites designated by SRT.

4) In the construction of elevated structures and station, after excavation and filling the land must be compacted and graded. Soils with nutrients should be used to raise small and medium plants to prevent soils being washed away during rainy season.

Maintenance Center and Easy Park Building

1) Apply measures to prevent and reduce environmental impacts along the elevated elevation and sky train stations.
2) Construction area, maintenance center and easy park building. Or area for stocking materials which is open and vacant area without any covering. The surface should be stabilized using gravel, aggregate to cover. Use canvas to cover or use vegetation to cover soil temporarily.
3) Construction site of maintenance center will be excavated for temporary sedimentation pond in the south. Capacity is not less than 5,100 cubic meters with temporary gutter. To trap soil sediment flowing and mix with water or rainwater into ground surface water, public drainage, or lowland areas.

(C) Geology and earthquake Structure of elevated structures and stations

1) Mus be installed with steel sheet pile around the construction site. And must be piled to medium clay layer. (About 18 m depth from existing ground) and gutter the trench outside the steel sheet pile in the area of soft soil to reduce soil pressure. Also pile 2 tiers of steel sheet pile in the construction site near ground surface water resource to prevent soil erosion or soft soil movement.
2) Determine how to prevent soil erosion and how to maintain the stability of the pit, such as the use of Polymer Slurry as a stabilizer for the bored pile. Because Polymer slurry helps adding side friction between the bored piles and sandy soils layer. This is different from bored piles under Bentonite Slurry which affects friction at surface of the pile, etc.
3) If the foundation supports the piers of the elevated structure and the BTS station is close to the traffic surface, causing the subsidence of the traffic surface. Therefore, the settlement of the structure is not designed equal. Between the foundations supporting the piers of the elevated structure and the BTS station to the ground level road. To prevent damage from traffic surface. It is the structure which covers the foundation of the pillar of the elevated road and BTS station structure which has overlapping with the traffic surface of the ground level road and having gap in the case there is unequal subsidence, which can cause the vertical movement of the ground level road with the pillar of the elevated road and BTS station structure. To avoid damage to the traffic surface.

(E) Surface water quality;

Elevated road and BTS station structure.

1) Establish the "Project Office" in the vicinity of the construction site. By separating residencial community of construction workers from the project office. Including provision of residencial community of construction workers of construction of residential community of construction workers, located away from the project about 5 km. And submit to MRTA for approval and shall comply with local laws governing the construction of residential premises strictly or in accordance with the Building Control Act 1979 or the Ministerial Regulation No. 55 / 2000
2) Provide mesh or canvas to cover the area under the elevated road and BTS station structure to accommodate construction materials and equipment (i.e. soil, rock, sand, cement, etc.) which may fall into surface water resources. This increases the turbidity of the surface water. If the construction of the elevated road and BTS station structure passes or is closed to surface water resource for not more than 50 meters
3) Key construction activities within BTS station which is located near the surface water resource for not more than 50 meters for 3 locations i.e. Ladprao 101 Station, Kelantan Station, and Suan Luang Rama IX Station, should be done only during summer. Or drilling to build the foundation for the BTS station structure. To avoid turbidity problems from erosion and leaching or oil contamination. / residual lubricants from machinery, equipment used in construction.

In case of having a project office.

- Provide adequate bathroom and toilets (10 persons/room) and install wastewater treatment system with capacity of 2 cubic meters / no. for 5 no. Total treatment volume is 10 cubic meters to treat wastewater from various activities within the project office.
- Provide solid waste bin with capacity of 0.24 cubic meters for 8 no. Total volume is 1.92 cubic meters, distributed in different locations into groups for 4 groups within the project office and residential community of the construction workers. To wait for the district office under Bangkok Metropolitan Administration or local authorities in Samutprakarn to pick and demolish according to sanitary procedures.

In case there is project office and residential community of construction workers.

- Must provide adequate bathroom and toilet (10 persons/room) and install wastewater treatment system with capacity of 12 cubic meters for 20 no. Total volume of wastewater is 240 cubic meters to treat wastewater from various activities within the project office and residential community of the construction workers.
- Provide solid waste bin with capacity of 0.24 cubic meters for 50 no. Total volume is 12 cubic meters, distributed in different locations into groups for 10 groups within the project office and residential community of the construction workers. To wait for the district office under Bangkok Metropolitan Administration or local authorities in Samutprakarn to pick and demolish according to sanitary procedures.

4) Waste water generated from activities as a consequence from elevated road and BTS station structure construction i.e. lubricant replacement. Washing and cleaning of construction tools and equipment, or various types of vehicle, etc. Must be operated in the provided area in the project office. Must be at least 100 meters away from the surface water resource and must install waste water treatment system with capacity of 6 cubic meters for 2 no. Total volume of waste water treatment is 12 cubic meters for wastewater treatment from various activities.

Maintenance center and Easy Park building

1) Maintenance center construction site will be excavated a temporary sedimentation pond on the south side with the capacity of not less than 5,100 cubic meters to accommodate sewage and rain water amount during construction phase before releasing to Kled and Sarai canal. Including provide temporary drainage gutter to collect water on maintenance center area into temporary sedimentation pond and construct gutter to further drain water from such pond into public canal.

(F) Air quality

Elevated road and BTS station structure.

1) Must comply with regulations and procedures on dust control from various construction activities of air pollution control committees in Bangkok and communities in Thailand.
2) Install solid fence having height of at least 2 meters or equivalent. To define the scope of the construction area.
3) Use ready mix concrete produced and mixed from outside the construction site to prevent and minimize the impact on the surrounding community. To prevent and reduce the impact on communities around the construction site.
4) Sprinkle water on original road network surface at least 3-4 times per day along the construction site or area which may cause dust diffusion.
5) Prepare at least 3-4 employees / construction area to collect and clean in construction area when construction activities of each day completed.
6) Set up control unit, maintain and inspect engine and machinery conditions which is used in construction at least once a week.
7) Prepare at least 3-4 employees. / construction area to sweep and clean soil residual / mud stuck to the vehicle wheels before driving out of the construction area every time.
8) Supervise employees to drive construction materials and equipment vehicles or soil transportation carefully and use the speed not more than 30 km / hr.
9) Enforcing covering of materials and construction equipment transported by transporting vehicles. / to prevent falling of construction material and equipment or residues from construction onto original road network surface or waterway along the route.

10) Controls and control employees / construction workers to wear protection equipment for dust or other pollutants. And in construction areas where dust or pollutants spread out.
11) Make a sign for alternative - shortcut route on the original road network, to avoid using original road to use other alternative routes instead, and coordinate with police stations responsible for each route. To facilitate the flow of traffic smoothly. Air pollution problem caused by the traffic jam will be reduced.
12) Provide fine mesh or canvas covered under the elevated BTS station structure. To prevent material and construction equipment falling down from construction.
13) Prepare at least 3-4 employees to clear the traffic on the existing road network throughout elevated road and BTS stations construction during the night for at least 4 days a week, scheduled from 24:00 onwards, but not later than 03:00 on the next day.

(H) Noise level

Elevated road and BTS station structure.

1) Installed concrete wall with metal sheetwith height of 2 meters at the construction site.
2) Must use equipment and machinery that do not generate loud noise and use equipment (i.e. sound proof pipe or casing) in case of having noise level greater than 90 decibels(A) at the sound source for 1 hour consecutively.
3) Prepare at least 3 - 4 employees for operate, control, take care of, maintain, or inspect the machineries and equipments or vehicles used in construction to be in good condition in order to keep noise level to be not exceeding the specified standard.
4) Speed limit for vehicles transporting materials and equipmentis limited as not exceeding 30 km./hr. In case of traveling passing community, residential, commercial area, hospitals, religious institutions, temples, schools and educational venues, etc. To prevent disturbing noise levels, especially during school hours, meditation time (i.e. chanting in the morning and evening, praying, or islamic praying, etc.) or relaxing – sleeping.
5) The construction of elevated road and BTstation structure generally operate on the central isle of the existing road network which has limited construction space. Therefore, it was decided to start the operation from 8:00 pm to 6:00 pm for construction of the main structure. (i.e. elevated road and BTS station structure) i.e. foundation excavation works for elevated road and BTS station structure. Pouring reinforced concrete piers of the elevation structure. BTS station Floor. For the period from 21:00 to 05:00 on the next day. So that there is no construction that create disturbing noise level to resting time of the communities on the original road network.
6) Employees / construction workers who are required to perform work within the construction area or areas with noise level exceeding 90 decibels(A) for consecutive 8 to 10 hours are required to wear noise protective or reduction equipment such as ear muffs or ear plugs. Staffs / construction workers working within the construction site or loud noise area must be rotated for at least every 15 days / set.

7) Must install noise absorption material underneath BTS station for 4 stations namely Pawana station (YL-02), Chok Chai 4 station (YL-03), Ladprao station (YL-07) and Samrong station (YL-23).

Maintenance Center and Easy Park Building

1) Installation of solid steel fence 2 meters high.
2) Construction of maintenance center and Easy Park building are already performed on the empty area of maintenance center and Easy Park building which has fence line showing the area clearly. So time for construction is specified from 8:00 am to no more than 18:00 hours without construction over such time period. Except moving of concrete formwork, column, concrete beam, precast concrete floor, or moving unused material or equipment out of the construction site, etc. The operations is specified to be done between 19:00 and 21:00.
3) Specify employees / workers to work within the construction area or areas with noise level exceeding 90 decibels(A) for consecutive 8 to 10 hours are required to wear noise protective or reduction equipment such as ear muffs or earplugs. Employees / construction workers must be rotated within construction area or loud noise areas for at least every 15 days per / set.

(H) Vibration

Elevated road and BTS station structure.

1) Detailed design for construction of elevated road and BTS station structure must accomodate vibration from earthquake or landsliding safely according to regulations by Ministry of Interior regarding weight, resistance, durability of buildings and ground supporting building that subject to earthquake vibration A.D.2007 issued in accordance with Building Control Act A.D.1979
2) Steel Sheet Pile during construction of foundation to support elevated road and BTS station structure must be piled to the depth of about 18 meters to help separating and reducing vibration level in deep level not to affect area besides existing road network. Particularly sensitive areas affected which have distance of no more than 30 meters for 3 locations i.e. Suan Luang Church, Chularat Hospital 2, and Chulavej Hospital.
3) Specify commencement of constructions which cause vibration level such as foundation excavation supporting elevated road and BTS station structure or maintenance center and Easy Park building, to be from the 8:00 am to no later than 6:00 pm. In order to avoid disturbing daily activities of communities or sensitive areas which may be affected.
4) If there are construction activities that will cause continuous vibration level, especially foundation excavation, it is important to reduce the energy required to excavate pile each time, by increasing the number of excavation times in order to reduce the vibration.
5) Control vehicles used to move construction materials to strictly comply with traffic rules and limit driving speed not exceeding 30 km./hr.
6) Complaints from building owner / commercial buildings located adjacent to the construction site must be submitted to civil / structural engineer to investigate and analyze the damage occured to find remedial action urgently.

7) Public relation to let people recognize the project construction plan for at least 3 months. And emphasizing publicly again at least 15 days in advance.

Maintenance Center and Easy Park Building

1) Take preventive remedial and impact reducing measures on elevated road and BTS station structure.

2.3.3 Biological environmental resources

(A) Aquatic ecology;

Elevated road and BTS station structure.

1) Take preventive, remedial, and impact reducint measures on surface water quality.

Maintenance center and Easy Park building

1) Take preventive, remedial, and impact reducint measures on surface water quality.
2) Excavate temporary drainage gutter around the construction site. And having sedimentation pond located at the end of the temporary drainage gutter. To accommodate wastewater from construction activities before draining to Kled canal.

(B) Terrestrial ecology

Elevated road and BTS station structure.

1) Coordinate with related organizations in Bangkok such as Lat Phrao district office. Wang Thonglang district office, Bangkapi district office, Suan Luang district office, Pravet district office, and Bangna district office. While on Samut Prakan Province, there are Samrong Nua district municipality and Theparak district administration orgainzation. To jointly discuss the guidelines for construction and identifying construction areas to limit the area expected to have affect on trees on the project area.
2) Survey and evaluate the number of trees to be cut off from project operation and to be moved (dig out) of the project area. And to be nursed in the area prepared.
3) Carry out the moving (excavation the root off) of the big tree (diameter at breast height; DBH> 10 cm.) from the project area during pre-construction period. To be nursed in the area prepared, such as empty areas along the route. Or the area inside maintenance center and must take note of species, types, and number of every trees. By using machinery or workers. And in case it is a degraded tree, it is allowed to be cut and moves materials out of the area.
4) After start of project construction, the area condition should be adjusted by grading the area to be easier to plant the trees..
5) Bringing soil out of project area or taking soil from outside to adjust the area condition. Before planting as soil covering so that the roots can be held in the beginning.
6) Moving soil from foundation excavation or materials and equipment by medium and large trucks need special care not to damage the nearby trees.

7) Plant substitution trees to preserve the ecosystem. May seek advice and seedling from Bangkok, Samut Prakan Province, Royal Forest Department, and National Park Department for selecting substitution trees to be planted. Selecting appropriate types of tree for Urban Ecology which can be grown in the project area and do not obstruct traffic views. I.e. wiggle of medium size type – big size type to reduce the hardness of the piers of elevated road and BTS station structure or additional green area or small landscaping within the area underneath BTS station. (If available) or along the project route to increase the ecological balance.
8) Maintain planted trees such as shoveling, fertilizing, destroying insects and weeds, and planting trees to repair, etc.
9) Examine the planted trees and the environment of the remaining forest resources around the project area.
10) When the construction is completed, the staff and workers will be dismantled and transported out of the area immediately. After that, the area will need to be restored to its original condition. Which areas deserve ecological status restoration by planting trees or additional plant, should be processed immediately.

2.3.4 Value of human usage. (A) Land usage

Elevated road and BTS station structure.

1) Construction activities must be carried out only in the construction area of maintenance center and Easy Park building of the project only.
2) Provide space for storage of construction materials, especially not to obstruct or stacking on the area outside the project construction area. And no building materials, equipment or tools obstruct water flow.

(B) Transportation

Elevated road and BTS station structure.

1) Suggest alternatives of traveling for passers-by to reduce the number of vehicles on the existing road network during the construction phase, especially identifying alternative route on the existing road network. Physical condition of the alternative routes must improve in order to serve more traffic to keep traffic flowing continuously without interruption. It is necessary to improve the surface of alternative roads proposed to be in good condition all the times.
2) Must install traffic signs and signages before reaching project construction area for at least 1 km.
3) Provide Reversible lanes to release vehicles coming into the city having capacity equal to original capacity before construction.

4) Perform public relations or campaigning to people or route users to know thoroughly via mass media, such as public signboard, leaflets, news and traffic radio, Jor Sor 100, SorWorPor91, Ruam Duai Chuai Kan), websites, and television, etc. Including coordination of information and request for comments from related organization.
5) Prepare traffic management plan to be in accordance with construction plan and propose to MRTA Bangkok or police station in the area responsible, etc., for approval for at least 30 days before opening construction area in each locations. Traffic management on the existing road network during initial construction
6) Must supervise and make sure that construction material and equipment transportation drivers to comply traffic regulation strictly and must limit driving speed when driving through community or environmentally sensitive areas to be not more than 30 km / hr.
7) Must improve traffic surface on the existing road network under elevated road and BTS station structure and continuous space to be flat and even. Each traffic lane should be clearly marked according to traffic lane after construction site has been handed over.
8) Install collision barrier, debris and noise protection wall, gutter, including keeping debris out of traffic surface. Emphasizing on safety for involved people and people traveling passing construction areas.
9) Install lighting in the area under elevated road and BTS station structure and pedestrian area along the existing road network.
10) Construction activities which will disturb the traffic on the sidewalks, must be provided with temporary footpaths. And there must be signs indicating directions clearly. For pedestrian to use the bus service safely.

(C) Infrastructure and public utilities.

Pre-Construction phase

1) Notify for approval of construction plan consisting of master Construction Schedule and Breakdown Construction Schedule.
2) Notify work starting plan and coordinate with related organizations, both public and private. For Bangkok and Samutprakan area. it must be done correctly and in accordance with the organization approving conditions.
3) Plumbing relocation is to be carried out by using the method specified by Metropolitan Waterworks Authority and responsible organizations. strictly
4) Notify list of commencement committee and supervisor of MRTA for contractor. After that, the contractor must notify list of all personels for MRTA to approve prior to starting of construction work. These personnel consists of project engineer, representative of contractor who has full authority to carry out the work according to the contract. Field manager, supervisor, pipe technician, welding technician, etc.
5) Preparing public relations before starting construction. The contractor must install signages such as information sign, construction sign, and traffic sign in advance for at least 15 days.

6) Install solid fence of at least 2 meters height or equivalent. To define a boundary to relocate utility and facility system.
7) Approved traffic management plan. Due to the construction of submersive pipeline usually operates on the main road. So even if it does not open long groove, but in working processes such as moving machinery, transportation of push pipes, usually cause interference to traffic passing through the area.
8) The relocation of the plumbing is carried out using the method established by the Metropolitan Waterworks Authority and the responsible organizations.

Construction period

1) Provide mesh or canvas covering for pickup trucks used for moving infrastructure and facilities totally to prevent falling to traffic surface. Including must use the speed for driving towards storage location not exceeding 30 km / hr.
2) Provide temporary footpaths having signs clearly indicates the direction, in case of infrastructure and facilities relocation which interferes pedestrian, so that pedestrian can use the service safely.
3) If complaints are received from people or route user that "public infrastructure and facilities relocation" has caused the nuisance from the relocation or damage to existing public infrastructure and facilities, the problem must be resolved urgently.
4) Repair of traffic surface, footpath, right of way, damaged trees and grasses due to utilities relocation is to be in accordance with standards specified in the specifications or standards by area owner until the condition is good again. In practice, there should be a photo taken to collect existing details for comparison.

(D) Flood control and drainage.
Elevated road and BTS station structure.

1) Prepare construction workers at the construction sites for 2-3 persons to supervise and store construction debris such as soil, sand, lime, etc. that falls on the construction site or traffic surface on the existing road network daily. If left unattended, move out of the construction area quickly or within 24 hours to prevent any obstruction of water flow under natural conditions especially during rainy season.
2) Arrange and stack materials as needed to be used in the construction site. Avoid placing material in the area which may obstruct water flow during rainy season into public drainage or lowland or surface water resources such as Klong Namkaew Canal, Bangsue Canal, Ladprao Canal, Khlong Yai Puen Canal, Saen Saab Canal, Hua Mark Canal, Ban Ma Canal, Prawet Buri Rom Canal, and Kled Canal, etc.
3) The design of elevated raod structure on Srinakarin Road section, on the middle groove of the road, new drainage system must be designed with efficiency not less then the existing.

Maintenance center and Easy Park building

1) Construction site of maintenance center will be excavated temporary sedimentation pond on the south side with capacity of not less than 5,100 cubic meters to accommodate the rainwater in the construction phase before releasing into Kled canal and Sarai canal.

2.3.5 Value to quality of life

A) Economic and social

1) Working in the project site or maintenance center, project detail summary must be done in document. Published through local authorities in Bangkok (District office) or municipality for acknowledgement in advance for at least 30 days. In order to notify through community leaders and spread those information to people in the local community.
2) Must control and be strict to employees and construction workers not to behave and act in a way that will cause nuisance or conflicts with people in local communities or passers-by on the existing road network along the construction area.
3) Must establishment information and complaints center within the project office. To get information, news, or complaints from people affected. Including signboard, telephone number, E-mail address contact and provide 24-hours available staff.
4) Must provide at least 2 security guards to monitor securities in the construction area, and to facilitate traffic during construction activities.
5) Must notify to aleard people or passers-by on the existing road network for at least 7 days in advance before traffic block for construction or large construction equipment/material. It must be notified though various media types such as public signboard, leaflets, news and traffic radio, Jor Sor 100, SorWorPor91, Ruam Duai Chuai Kan), websites, and television, etc.
6) Employ skilled workers or construction workers who have domicile or evidence that they have lived within Bangkok and Samutprakarn territory as first priority. In order to benefit or be accepted by local community. Employment terms must be according to contract conditions.
7) If complaint has been received from existing business within the construction area, the affected person must have an opportunity to comment and suggest for solution or how to mitigate the problem. "People's participation" in accordance with the rights set forth in the Constitution of the Kingdom of Thailand A.D.2007, and must focus on solving or mitigating seriously and urgently.
8) Must establish mobile mass media unit to conduct periodic public relations activities and generate understanding between the contractor and the local community in the vicinity of the construction site. The public relation involves clarification of construction characteristics and procedures, security system, and monitoring system to avoid impact that may occur.
9) MRTA must provide a public communication unit to participate in the activities in local community along the construction site to create familiarity and acceptance of people in the local community.

(B) Migration and expropriation

1) Must conduct meeting to inform affected people about project details, expected benefits, procedures/method of expropriation, rights and duties of expropriator, etc. This must be completed at least 18 months prior to commencement of construction.
2) Enact Royal Decree to define the land in the area to be expropriated (Act). Must identify the starting – ending point and the width of boundary of the Royal Decree.
3) Fix the announcement of the royal decree at places such as Bangkok City Hall or Samutprakarn City Hall, Bangkok Land Office or Branch Land Office Bangkok, Samutprakarn Land Office or Branch Provincial Land Office, Chatuchak / Huay Kwang / Wang Thong Lang / Bangkapi / Suan Luang / Prawet / Bangna Or Muang Samutprakan district office, etc.
4) Survey of the property to be expropriated by expropriation officer must provides surveyed date in written notice to the property owner in advance for not less than 15 days.
5) Establish a committee for indentifying land compensation, buildings, and agricultural crops. The basic form of the committee at least must have representatives of affected people and local community leaders in the expropriated areas participated as committee. In order to consider and set the criteria for property compensation.
6) Must consider and determine property compensation at a fair rate which is appropriate and acceptable for affected groups.
7) Issuance of expropriation of immovable property (Act) in order for the ownership of real estate to become government ownership.
8) Issuance of Infringement Act and Ministerial Regulation on Infringement by MRTA.

(C) Public health and health;

1) Must comply with preventive, remedial, and impact reducing measures on air quality and noise in the construction phase strictly.
2) Provide sufficient drinking water of 5 liters / person / day and utilizing water of (50 liters / person / day) for the number of employees and construction workers working within the construction site or project office.
3) Provide batroom – toilet (10 persons/room) installed with wastewater treatment systems within the project office adequatly.
4) Provide solid waste disposal bin in the construction area and project office. And divide into wet waste bin (green), dry waste bin (yellow), and hazardous waste bin (red or orange color) .
5) Provide temporary accommodation in the construction area during daytime for construction workers in the vicinity of the construction site.

(D) Occupational health and safety

1) Establish safety committee to set safety policies for working in the construction area, such as introducing construction plans, and safety measures, control and supervising employees and construction workers to comply with safety regulations or laws, checking for possible causes of hazards, suggestions feedback, and training for staff and construction workers on working with caution, etc.
2) Provide training for staff and construction workers about how to use and maintain machinery, tools, and equipment correctly and appropriately according to types of work and to always be in good conditions. Including must repair immediately in case of any damage found to prevent accidents which may occur all the times.
3) Employees and construction workers must wear personal protective equipment everytime during construction work to prevent hazards and accidents such as wearing helmets, gloves, face masks to protect against dust, and ear muffs or earplugs to prevent loud noise, etc.
4) Supervise and prohibit construction workers, and construction materials and equipment transportation vehicle drivers from using drugs or neuroleptics or alcohol while working. Serious penalty must be specified for violators.
5) Supervise and instruct construction materials and equipment transportation vehicle drivers to strictly follow traffic rules and set speed limit of 30 km / hr. Especially during driving passing community or areas sensitive for being affected.
6) Provide signboard to show boundary of construction area. And public relations through various medias to acknowledge people and passers-by in case there will be normal route block on Ladprao Road, Srinakarin Road, and Thepharak Road. In order to relocate infrastructure and facilities, or moving large construction materials and equipment, or placing concrete beams, etc.
7) Set up control measures to control all construction areas. By providing security guards. Supervise and prevent unauthorized persons and those who are not involved in construction work to get near or into the construction site.
8) On the area of construction of elevated road and BTS station structure and other components, in order to prevent accidents caused by materials or equipment falling during construction especially stone, steel, concrete fragments, chips, metal scrap,.and spark from welding, etc. In case there is a general public people or a person having damages files a complaint to information and complaint center, the contractor must send the officer to inspect the damage and is responsible for expenses or damages as appropriate, fair, or as actual.
9) Must install lighting in the area beneath elevated road and BTS station structure and pedestrian area along the original road network.
10) Provide temporary footpath and having signs showing direction clearly. In case of infrastructure and facilities relocation which interferes pedestrian. So that pedestrian can use the service safely.

(E) Historical and archaeological sites;

Must comply to regulations and practices on dust control from various types of construction works by the Air Pollution Control Committee in Bangkok and communities in Thailand.

1) Water sprinklers must be sprayed on the road surface for at least 3-4 times a day along the construction site or areas that may cause spreading of dust.
2) Provide at least 3-4 employees / construction area to collect and clean in the construction area each day after finish working.
3) Must use tools, equipment, and machinery that do not produce loud noise, and use equipment that reduces or controls mechanical noise levels.
4) Prepare at least 3 - 4 employees to control. maintain, or inspect mechineries, equipment, and tools. Or vehicles used in construction to be in good condition throughout the construction period.
5) Set up speed limit for construction material and equipment transportation drivers at 30 km./hr. in case of driving passing community, residential area, commercial area, hospital, religious venue, temple, school, education institution, etc.
6) Construction of foundation to support elevated road and BTS station structure is specified to use circular bored pile or barrette pile to reduce the vibration level.
7) Steel Sheet Pile piling during construction of foundation to support elevated road and BTS station structure must pile passing through soft to medium soft clay layer at the depth of about 18 meters. This will help preventing and reducing vibration level at the depth not to disturb the surrounding area.
8) If there is construction activity that will cause continuous vibration level, especially boring piles for foundations, it is necessary to reduce the energy used to bore each pile by increasing the number of boring times to reduce vibration level.
9) Control construction material and equipment transportation drivers to have speed limit of 30 km./hr. and having loading weight not exceeding 25 tons to reduce vibration levels in case of driving passing importatnt locations involving the community
10) Avoid traveling through original road network. Recommend using alternative route. Or ask for cooperation or campaign route users to follow the planned traffic management plan, etc.
11) Avoid traveling during rush hour on all original road networks in case of no necessity. In order for secondary road to assorb traffic which diverted from the existing road network adequately.
12) Public relation or notification through various medias (such as signboard, leaflets, news and traffic radio, etc.) so that people or route users will be aware of the construction and blocking of any traffic for at least 15 days in advance.
13) Must improve traffic surface on the existing road network under elevated road and BTS station structure and continuous space to be flat and even. Each traffic lane should be clearly marked according to traffic lane after construction site has been handed over.

(F) Scenery and tourism.

Pre-construction phase.

1) In the detailed design of BTS station, Urban Design is emphasized on lightness, harmony with the original environment, having modern engineering and architectural style but is simple in order to reduce impact and enhance scenery of BTS station. In detailed architectural and landscape design for each BTS station, the appearances do not have to be the same but may be different according to the surrounding environment and scenery in each location of BTS station in order to have unity and beautiful apperance. Including using light or bright tone color material to create harmony and reduce harshness to original scenery.

Construction phase

1) Must install fence of at least 2 meters height or equivalent. To define boundary of the construction area. Having sign showing the construction area boundary clearly. Including installing signboard showing future project scenery of BTS system to help reducing impact on scenery under construction.
2) Avoid creating ugly or unattractive views within the construction area such as allowing solid waste to accumulate over disposal bin, or having stacking of materials, equipment or debris from construction not orderly, or not covered with plastic or canvas.

2.4 Environmental Impact Monitoring

2.4.1 Surface water quality monitoring

Monitor and check surface water quality during construction phase. (once a month throughout the construction period) for 10 stations (Figure 2-3) i.e.:

- Station 1 Nam Kaew Canal
- Station 2 Ladprao Canal
- Station 3 Chan Canal
- Station 4 San Saeb Canal
- Station 5 Hua Mark Canal
- Station 6 Pravet Burirom Canal
- Station 7 Ta Chang Canal
- Station 8 Kled Canal
- Station 9 Bangna Canal
- Station at 10 Samrong Canal

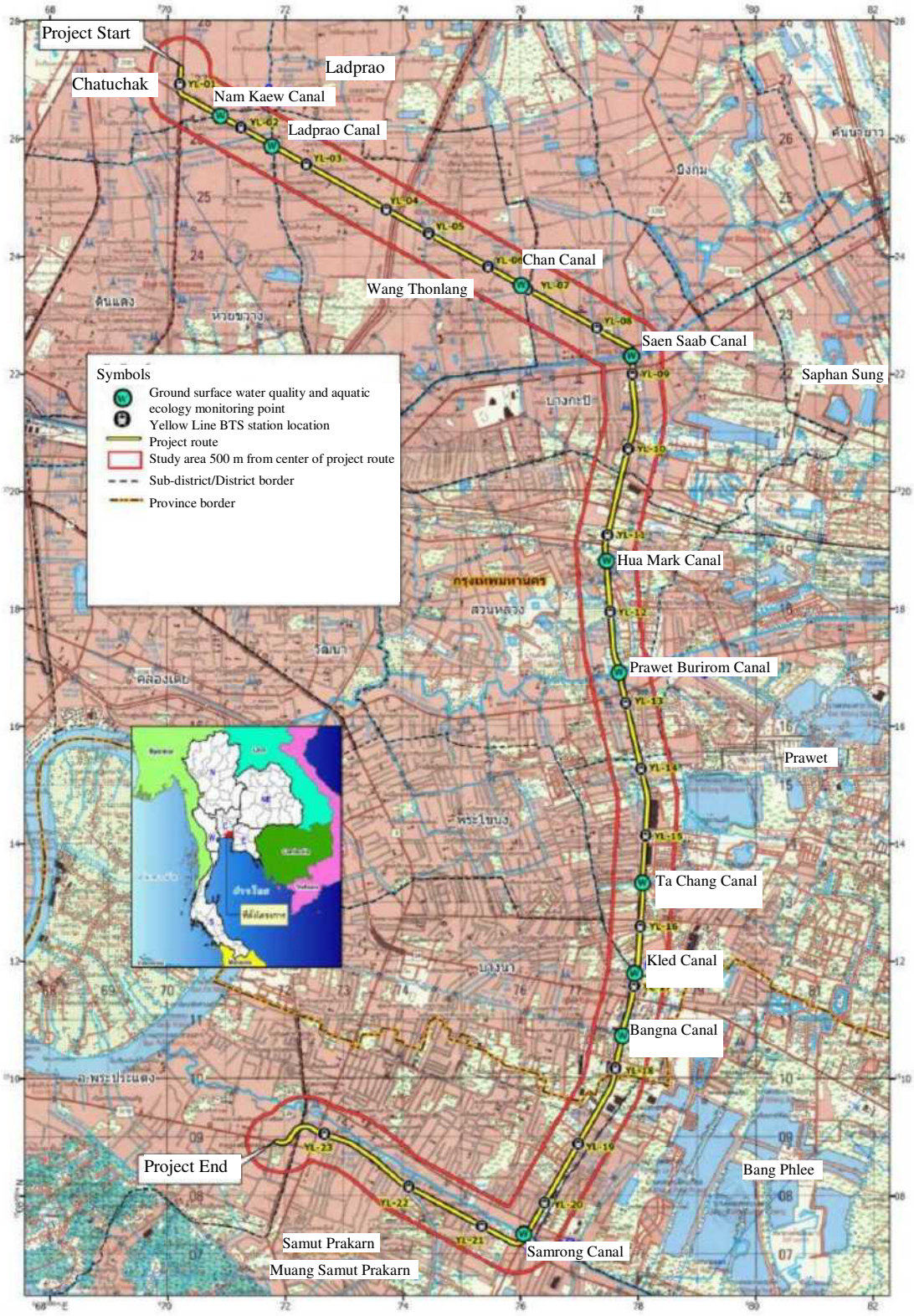

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Figure 2-3. Tracking points for surface water quality.

The method of monitoring are as follows:

1) Surface water sample gathering method

Surface water sample gathering will be carried out as specified by Announcement of National Environmental Committee No. 8 (A.D. 1994) issued under National Environmental Quality Promotion and Conservation Act A.D.1992 regarding water quality standards in surface water resource published in Royal Gazette Vol. 111, No. 16 dated February 24, 1994, which is in compliance with Standard for the Examination of Water and Wastewater, 22nd Edition, 2012, which APHA, AWWA and WEF have jointly specified.

Gather samples by using Grab Sampling method using Kemmerer Sampler which is washed and cleaned in laboratory. By using Glass Sampler collected at the middle of the width of water resouece at middle depth level except Total Coliform Bacteria that will be gathered at 30 Centimeters depth at the monitoring point.

While gathering water sample, there will be record of Water Depth, pH, Conductivity, and dissolved oxygen (DO) immediately in the field including recording condition of water noticed such as color and odor, before separating water samples into indexed containers as shown in Table 2-2.

(A) In case of being a sample gathering point in canal and having bridge

B) In case of being a sample gathering point in canal and not having bridge

Figure 2-4 shows gatering of water sample which is flowing water using Kemmerer Sampler

2) Method of keeping ground surface water.

All surface water samples gathered are maintained in accordance with standard sample gathering and checking for water quality in surface water method. In accordance with Announcement of National Environmental Committee No. 8 (A.D. 1994) issued under National Environmental Quality and Conservation Act A.D. 1992 as specifed by Standard for the Examination of Water and Wastewater, 22nd Edition, which APHA, AWWA and WEF jointly specified. And finally, all samples are refrigerated at a temperature of <6 ° C and recorded into Chain of Custody and sent for analysis at the laboratory within 24 hours as shown in Table 2-2.

3) Method of checking surface water quality

Sample sent to analytical laboratories will enter the standard control system for analysis within analytical laboratories. After recording the water sample data in the Log Book system, samples will be collected in refrigerated room for further analysis. The method of analysis is based on the standard by Announcement of National Environmental Committee No. 8 (A.D. 1994) regarding water quality standards for surface water resource specified in standard methods for analysis of water and wastewater in Standard Methods for the Examination. of Water and Wastewater, 22nd Edition, 2012 which APHA, AWWA and WEF has jointly specified as detailed in Table 2-2.

Table 2-2 Container, Sample keeping method, Checking method and minimum limit of inspection for surface water quality.

Index monitored	Container	Water surface sample keeping method	Method of checking surface water quality	Minimum limit of inspection	Unit
1. Temperature	-	Immediate measured in the field.	Thermometer	-	°c
2. Conductivity	-	Immediately inspected in the field	Conductivity Method	-	
3. Differentiation	-	Immediate measured in the field	Electrometric Method	-	-
4. Dissolved oxygen	**G**	Immediate measured in the field	Azide Modification Method	0.5	Mg/L
5. solid Colloid	**P**	Refrigerated at temperatures> 0 °c,	TSS Dried at 103-105 °c	5.0	Mg/L
6. BOD	**P**	Refrigerated at temperatures> 0 °c,	Azide Modification Method	1.0	Mg/L
7. Oil and grease	**G, Wide Bore**	Add H2SO4 until pH <2, refrigerated Temperature> 0 °c, <6 °c	Partition Gravimetric Method	1	mg/L
8. Phosphate	**G(A)**	Refrigerated at temperatures> 0 °c,	Ascorbic Acid Method	0.03	mg/L PO.
9. Bacteria group All Coliform		Refrigerate at <8 °c	Multiple Tube Fermentation Technique	1.6	MPN/100 ml
10 Bacteria group Phecol Coliform		Refrigerated at <8 °c	Nitric Acid Digestion and Direct Air Acetylene Flame Method	1.6	MPN/100 ml

Note:

P means Polyethylene or equivalent

G means Glass

G(A) means glass exposed with 1+l nitric acid

2.4.2 Monitoring of Air Quality

Check and monitor Total Suspended Particulate (TSP), particulate matter less than 10 microns (PM10), particulate matter less than 2.5 microns (PM2.5), and wind direction and speed during construction (monitored for stations every 5 consecutive days, covering weekdays and public holidays every month throughout construction period) in sensitive areas along project route. There are 26 points (as shown in Figure 2-5):

- Station 1 Institute of Judicial Development, Courts of Justice
- Station 2 Pibul Uppatham School
- Station 3 Chok Chai 4 Police Flat
- Station 4 Thanomphit Witthaya School
- Station 5 Bangkok Suksa School
- Station 6 Big C Ladprao
- Station 7 Mae Phra Kularb Thip Temple
- Station 8 Vejthani Hospital
- Station 9 The Mall Bangkapi
- Station 10 Fathulbari Mosque
- Station 11 Sukonree Kindergarden
- Station 12 Hua Mark Municipal School
- Station 13 Yamiun Idhad Mosque (Hua Mark Yai)
- Station 14 Hua Mark School
- Station 15 Kelantan Canal School
- Station 16 New Mosque School
- Station 17 Kajorn Siri Temple
- Station 18 Dulul Amin Mosque
- Station 19 Dusit Thani College
- Station 20 Phra Khanong Land Office
- Station 21 Sri Iam Temple
- Station 22 Carrefour, Srinakarin (Big C, Srinakarin)
- Station 23 Klong Krathum Rat Uthit School
- Station 24 Sirivudh Witthaya School
- Station 25 Chularat Hospital 2
- Station 26 Chulavej Hospital

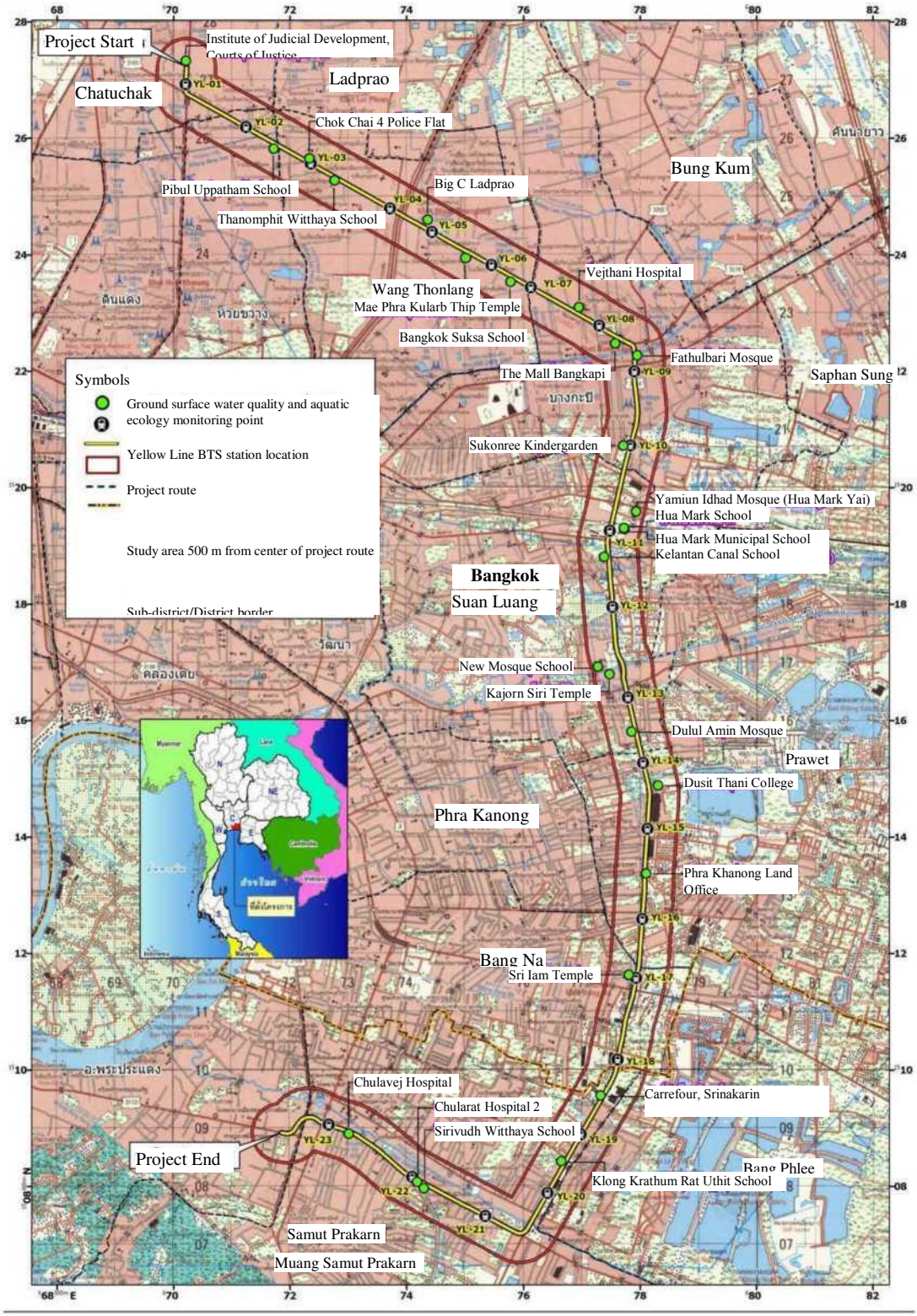

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Figure 2-5. Monitoring Point for Air Quality, Noise Level, and Vibration.

Every steps of the procedure will be in accordance with the procedure specified in the request for industrial certification.17025-2548 (ISO/IEC 17025: 2005) having details of monitoring methods as follows:

1) Total Suspended Particulate (TSP)

Sample gathering of particulate matter or particles with particle size of not more than 100 microns shall be based on the Gravimetric method, according to announcement by National Environment Committee No. 10 (1995) dated April 17,1995 published in Royal Gazette Volume 112, Special Edition, 42 d, May 25,1995 with High Volume Air Sampler. The sample is gathered from field and bring for analysis for total dust amount. Every steps of the procedure will be in accordance with the procedure specified in the request for industrial certification.17025-2548 (ISO/IEC 17025: 2005). There are important steps which are summarized as follows:

- Prepare the High Volume Air Sampler. Check the condition of sample gathering machine and condition of selection nozzle for the dust size before operation.
- Prepare filter paper of Glass Fiber Filter type with the size of 8x10 inch with stamp on the edge of filter paper. Then put in desiccator for 24 hours. The humidity was controlled all over the period within 30-50% RH and then weighed using four digits significance scales which has been calibrated. Record the value. Prepare flow chart.
- Take air sampler to be installed at the specified area. The area must be selected under the requirements ofEPA i.e. machine sample pistol, having heigh at least 1.5 meters but no more than 6 meters in 270 degree radius around the air sampler. No air flow obstruction. Being an open space. Be more than 2 meters away from walls or structures around. Be away from wind obstructions more than 20 meters or having distance at least two times the height of the obstruction. Be away from unpaved roads and places of farming not less than 400 meters. Be away from pollution sources that may cause erroneous measurement data such as incinerators, furnaces, or sources that may cause dust except that source of pollution is part that needs to be measured. In case the optimum point can not be determined, select the point that is convenient for installation. Record the characteristics of measurement spot by writing a map and the surrounding area in dust in general atmosphere sample record form.
- Compare the flow of High Volume Air Sampler with standard Orifice that has passed Certified Orifice at the sample points for 5 values before sampling. Plot the graph to calculate Correlation Coefficient (r) which must be greater than or equal to 0.995. In case not getting that value, recheck and calibrate again until getting r greater than or equal to 0.995. Record comparison results in dust sample record form in general atmosphere.
- Gather samples by pumping air through filter paper at a rate of approximately 1.13-1.7 cubic feet per minute for 24 hours. Bring Air Filter, Air Flow record paper, dust sample gathering logs in

general atmosphere for total dust amount analysis.

- Bring the specimen to the desiccator for 24 hours by controlling humidity. Then weigh precisely by 4 digit significance scale which has been calibrated. Calculate the weight of the dust on the filter paper according to the principle of Pre and Post Weight Different.
- Calculate the volume of air flowing through the filter paper from the Flow Chart paper along with result from calibration. Then adjust the volume to the ambient temperature and atmospheric pressure (25 ° C and 1 atmospheric pressure).
- Calculate and report the results of monitoring total dust amount in the atmosphere in average 24 hours in milligrams per cubic meter according to details of the Gravimetric method. Then present, along with an assessment, by comparing the monitoring results with the ambient air quality standards.

2) Particles less than 10 microns (PM10)

Samples of particles of size not exceeding 10 microns shall use gravimetric method in accordance with Announcement of National Environmental Committee No. 10 (A.D. 2538) dated 17 April, 1995 published in Royal Gazette Vol. 112, Special Edition, 42 d, dated May 25, 1995 by High Volume Air Sampler. The samples will be collected in the field and samples will be analyzed for dust concentration. Every steps of the procedure will be in accordance with the procedure specified in the request for industrial certification.17025-2548 (ISO/IEC 17025: 2005). Key procedures are summarized as follows:

- Prepare sample gathering machine of High Volume Air Sampler type. Check the condition of sample gathering machine and condition of selection nozzle for the dust size before operation.
- Prepare 8x10 Quartz Fiber Filter paper, stamp the number on the edge of the filter paper and then put into Desiccator for 24 hours. Control the humidity throughout the period to be in the range of 30-50% RH. then weighed using four digits significance scales which has been calibrated. Record the value. Prepare flow chart.
- Take air sampler to be installed at the specified area. The area must be selected under the requirements ofEPA i.e. machine sample pistol, having heigh at least 1.5 meters but no more than 6 meters in 270 degree radius around the air sampler. No air flow obstruction. Being an open space. Be more than 2 meters away from walls or structures around. Be away from wind obstructions more than 20 meters or having distance at least two times the height of the obstruction. Be away from unpaved roads and places of farming not less than 400 meters. Be away from pollution sources that may cause erroneous measurement data such as incinerators, furnaces, or sources that may cause dust except that source of pollution is part that needs to be measured. In case the optimum point can not be determined, select the point that is convenient for installation. Record the characteristics of measurement spot by writing a map

and the surrounding area in dust of size not more than 10 micron in general atmosphere sample record form.

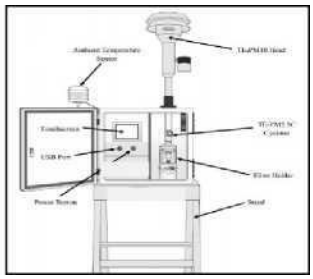
- Compare the flow of High Volume Air Sampler with standard Orifice that has passed Certified Orifice at the sample points for 5 values before sampling. Plot the graph to calculate Correlation Coefficient (r) which must be greater than or equal to 0.995. In case not getting that value, recheck and calibrate again until getting r greater than or equal to 0.995. Record comparison results in dust of size not more than 10 micron sample record form in general atmosphere.
- Gather samples by pumping air through filter paper at a rate of approximately 1.13-1.7 cubic feet per minute for 24 hours. Bring Air Filter, Air Flow record paper, dust of size not more than 10 micron sample gathering logs in general atmosphere for total dust of not more than 10 micron amount analysis.
- Bring the specimen to the desiccator for 24 hours by controlling humidity. Then weigh precisely by 4 digit significance scale which has been calibrated. Calculate the weight of the dust on the filter paper according to the principle of Pre and Post Weight Different.
- Calculate the volume of air flowing through the filter paper from the Flow Chart paper along with result from calibration. Then adjust the volume to the ambient temperature and atmospheric pressure (25 ° C and 1 atmospheric pressure).
- Calculate and report the results of monitoring total dust of size not more than 10 micron amount in the atmosphere in average 24 hours in milligrams per cubic meter according to details of the Gravimetric method. Then present, along with an assessment, by comparing the monitoring results with the ambient air quality standards.

3) Particle size not more than 2.5 microns, average 24 hours (Particulate Matter less than 2.5 microns: PM 2.5)

Sampling of dust particles with size from 2.5 microns should be carried out by installing sample gathering machine by letting sample gathering channel higher from the floor to prevent dust from spreading out from the ground. By having height from the ground to sample gathering channel for at least 1.5 meters but not more than 6.0 meters. The installation area must be clear of obstacles within radius of 10 meters. Not being near other sources. Gather sample with PM25 Ambient Air Sampler by pumping through PTFE Filter paper at a constant rate of approximately 16.67 cubic feet per minute (% Difference ± 2) and compare flow rate by DryCal DC-Lite Flowmeter set and calibrate with air volume towards standard condition. By measuring average temperature and atmospheric pressure during the sample gathering period for 24 hours (± 1 hour). The samples were then analyzed using pre and post weight differentiation method using a weighing scale of 6 digit significance (Micro Balance 6 pt.) according to standard method of EPA, Code of Federal Regulation Search Results, 40 CFR-Part 50, Appendix L (Federal Reference Method, FRM)



(A) Monitoring of total dust amount and particles of size not more than 10 microns and Standard Certified Orifice.

(B) Monitoring of particles of size not more than 2.5 microns.
Figure 2-6. Monitoring of air quality in general.

4) Wind Speed and Wind Direction

Record speed and wind direction data while monitoring ambient air quality in general. Using wind speed and direction monitoring device of Cup Anemometer and Wind Vane type, Met One brand, Model 034, which is a US product manufactured by Met One Instrument Inc., transmits signals to the Data Logger system throughout the monitoring and can convert monitoring results in the form of Wind Rose.

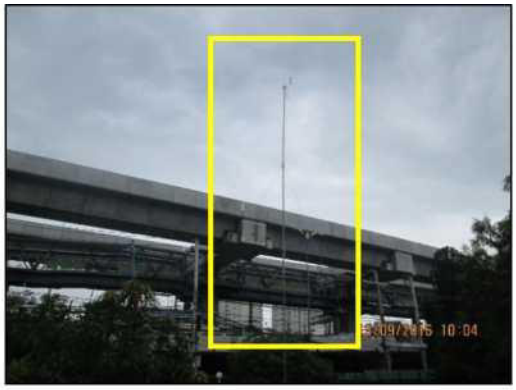


Figure 2-7 Wind speed and direction monitoring

2.4.3 Monitoring noise level in general.

Performs noise level monitoring in general consisting of 24 hours average noise level (LAeq24hour), average noise level during daytime and nighttime (Lad, 1), maximum noise level (LAmax), 10th and 90th percentile noise level (L10, L90), and during construction period (must monitor each station for consecutive 5 days covering weekdays and public holidays every month throughout the construction period).

- Station 1 Institute of Judicial Development, Courts of Justice
- Site 2 Pibul Uppatham School
- Station 3 Chok Chai 4 Police Flat
- Station 4 Thanomphit Witthaya School
- Station 5 Bangkok Suksa School
- Station 6 Big C Ladprao
- Station 7 Mae Phra Kularb Thip Temple
- Station 8 Vejthani Hospital
- Station 9 The Mall Bangkapi
- Station 10 Fathulbari Mosque
- Station 11 Sukree Kindergarten
- Station 12 Hua Mark Municipal School
- Station 13 Yamiun Idhad Mosque (Hua Mark Yai)
- Station 14 Hua Mark School
- Station 15 Kelantan Canal School
- Station 16 New Mosque School
- Station 17 Kajorn Siri Temple
- Station 18 Dulul Amin Mosque
- Station 19 Dusit Thani College
- Station 20 Phra Khanong Land Office
- Station 21 Sri Iam Temple
- Station 22 Carrefour, Srinakarin (Big C, Srinakarin)
- Station 23 Klong Krathum Rat Uthit School
- Station 24 Sirivudh Witthaya School
- Station 25 Chularat Hospital 2
- Station 26 Chulavej Hospital

Details of Monitoring.

Monitoring of noise level in general will perform the typical noise level according to Announcement of National Environmental Committee No. 15 (A.D. 2540) dated 9 August, A.D.2004 published in Royal Gazette volume 114, Special Edition 27 d dated April 3, A.D.1997. It will be monitored in 24 hours average noise level form (LAeq 24 hour), maximum noise level Lamax) and 10th and 90th percentile noise level (L10, L90). After that calculate 24 hours average noise level (LAeq 24 hours) and average noise level during daytime and nighttime (LAdn) in decibel unit.

Monitor using noise level measurement of Integrated Sound Level Metre, brand Rion model NL-21, or NL-42 which is Type 2 noise level meter that complies with IEC 61672 international standard. Having high accuracy. Having measurement error in the range of +-0.5 decibels. Having wind screen attached to the head of the microphone to prevent and obstruct the wind that is a factor of mistakes while monitoring. By mounting noise level meter on the stand, the microphone is located 1.2-1.5 meters above the ground in radius of 3.5 meters horizontally around the microphone, without any walls or other obstructions that reflect the noise from the obstruction. For noise coming into the meter, it will pass through the amplifier and through noise filter at the center of gravity at A and C or F according to the characteristics of sound occurred. Prior to monitoring, calibration and validation are carried out with the Sound Level Calibrator at standard sound level of 94.0 decibels at 1,000 Hz at center of gravity C and adjusted to center of gravity A before monitoring.

Figure 2-8 Monitoring Noise Level in general by Integrated Sound Level Meter and Acoustic Calibrator that produces Sound Spectrum of 1,000 Hertz 94.0 dB.

2.4.4 Monitoring of Vibration

Perform monitoring of vibration. It consists of faster particle velocity and frequency during construction phase (Monitor each station for 5 consecutive days covering weekdays and public holidays every month throughout construction period).

- Station 1 Institute of Judicial Development, Courts of Justice
- Site 2 Pibul Uppatham School
- Station 3 Chok Chai 4 Police Flat
- Station 4 Thanomphit Witthaya School
- Station 5 Bangkok Suksa School
- Station 6 Big C Ladprao
- Station 7 Mae Phra Kularb Thip Temple
- Station 8 Vejthani Hospital
- Station 9 The Mall Bangkapi
- Station 10 Fathulbari Mosque
- Station 11 Sukree Kindergarten
- Station 12 Hua Mark Municipal School
- Station 13 Yamiun Idhad Mosque (Hua Mark Yai)
- Station 14 Hua Mark School
- Station 15 Kelantan Canal School
- Station 16 New Mosque School
- Station 17 Kajorn Siri Temple
- Station 18 Dulul Amin Mosque
- Station 19 Dusit Thani College
- Station 20 Phra Khanong Land Office
- Station 21 Sri Iam Temple
- Station 22 Carrefour, Srinakarin (Big C, Srinakarin)
- Station 23 Klong Krathum Rat Uthit School
- Station 24 Sirivudh Witthaya School
- Station 25 Chularat Hospital 2
- Station 26 Chulavej Hospital

Monitoring of vibration is performed in accordance with vibration standards to provent impact on building. According to Announcement of National Environment Committee No. 37, published in Royal Gazette Vol. 127, Special Edition 69, dated June 2, 2010. By using Vibration Meter of brand Instantel, model Blastmate III, model Minimate, or model Minimate Plus. Install Vibration Meter at foundations of buildings. Turn the receiver towards vibration source. And fastened to the steel plate to prevent resonance between the floor and vibration meter. Continuously measure by keeping vibration data for every Event. Then bring measurement result to compare with the standard.

Figure 2-9 Monitoring of Vibration

2.4.5 Transportation System Survey

During construction phase of the project, it can affect traveling and transportation due to reduction of traffic lanes in the project area. Or speed limit of the cars on the road. Therefore, it is necessary to have a traffic survey to be used as traffic optimization information. And to prevent accidents that may occur. Traffic survey plan includes daily traffic volume records. Monthly traffic accident statistics throughout construction period on the roads and intersections adjacent to the construction area along project route for 14 points i.e.

- Ratchada-Ladprao intersection
- Pawana intersection
- Chokchai 4 Intersection
- Pradit Manutham intersection
- Bangkapi intersection
- Lamsalee intersection
- Krungthep Kreetha intersection
- Rama IX - Srinakarin intersection.

- Pattakarn intersection
- Onnut intersection
- Udom Suk intersection
- Sri Iam intersection
- Theparak intersection
- Samrong Intersection

Details of monitoring method are as follows:

1) Traffic volume survey

Traffic surveys along project route refers to various methods including surveying method, identification of road to be survey, traffic data collection, and separation of vehicle types. The method of traffic survey implements traffic survey method on each side of traffic, separating into each types of vehicle. Such method is technically referred to as Mid-Block technique. The purpose of performing such a method is so that the result can be compared with changes in traffic volume during pre-construction phase and construction phase. The details of the method are as follows:

- Classification of vehicles into 7 categories, which is the classification of vehicles according general survey by Office of the Commission for the Management of Road Traffic (Kor Jor Ror). Details are as shown in Table 2-3.
- Prepare tools / equipment i.e. CCTV of traffic volume data record in field type, protective equipment, including conduct training and clarify staff during field operation.
- Set up survey points / location of CCTV camera which can survey the number of different types of vehicles clearly for each side of the road.
- Identify timing of vehicles volume data collection and install CCTV of 40x40 cm. size, 3 meters height to explore traffic volume. Data collection date and time are set from 07:00 am to 07:00 pm of the next day for 24 hours for 1 day. And bring recorded images and count each type of vehicle both inbound and outbound. Example of using CCTV to survey traffic vlume is as shown in Table 2-3.
- Use 2 methods of counting number of vehicle from CCTV: record using a scratch mark for 1 vehicle or using Counter and combine the number of vehicles counted into survey summary sheet.
- Review the data and take survey result, which includes number of vehicles separated by each type of vehicle in each hour. Record survey results into traffic record table in the form of electronic files.
- Calculate traffic volume separated by hours using Microsoft Excel computer program for calculation and result analysis.
- Bring Traffic volume per hour for different types of vehicles to adjust into the same unit with 4 wheels personal car. Passenger Car Unit (PCU/Hour) Passenger Car Equivalent (PCE) according to specification by States of Transportation Research Board.

Table 2-3 Classification of vehicles for traffic volume data collection.

And adjust traffic volume unit of different types of vehicles.

Into the same unit with a Passenger Car Unit (PCU)

Item	Vehicle type 1	Vehicle type	PCE2
1	4 wheel truck	▪ Personal 4 wheel truck 2 wheel drive (pickup) ▪ Personal 4 wheel drive truck ▪ 4 wheel public carrier more than 7 persons	1.0
2	Passenger Cars	▪ 6 wheels passenger car (mini bus and microbus) ▪ 6-wheel passenger car not on certain route ▪ Bangkok Mass Transit Authority Bus	1.5
3	6 wheel truck	■ 6 wheel trucks transporting materials.	1.5
4	More than 6 wheel trucks	■ more than 6 wheel trucks	1.7
5	4-wheel passenger cars	▪ 4-wheel personal passenger car not more than 7 persons ▪ 4-wheel passenger public carrier not more than 7 persons (taxi)	1.0
6	Engined 3 wheel vehicle	■ Tuk Tuk	0.3
7	Motorcycle	■ 2-wheel motorcycle	0.3

Source: Office of the Commission for the Management of Road Traffic (Kor Jor Ror), 2003.

2 Passenger Car Equivalent : PCE, Reference from Engineering Department, Department of Highways, 2002.

Figure 2-1 Traffic Volume Survey

2) Accident statistics data collection

Consulting compant will collect statistics, location, time of the incident, and the cause of the accident from the relevant organizations i.e. local police station.

2.4.6 Monitoring on infrastructure.

Monitor on infrastructure in construction phase (Monitor every month throughout the period of relocation and changing infrastructure system for 2 years). Details of monitoring method are as follows:

- Collect relevant information i.e. coordination procedures and performance with infrastructure owner, activities in the construction area, problems and obstacles in the field, impact occurred during construction phase and opinions on the project development.
- Inquiry / Interview with organizations using infrastructure. By using questionnaire generated to interview such sample groups.

2.4.7 Socio-Economic Survey

Project construction activities may cause disturbance to life and well-being of people. This may affect socio-economic conditions of people around the project area. The Environmental Impact Assessment (EIA) therefore requires the monitoring of lives and well-being of people, social and economic conditions of people, and surveys of people's perceptions regarding impacts of the project activities. And satisfaction with preventive and remedial measures that the contractor practices prior to interview with household leaders. The data from the interviews will be used to assess the socio-economic impact of people in this sensitive group. In order to bring this information for improvement in case it is found that some measures or activities affect lives and well-being of the community. The socio-economic survey plan consists of:

- General Household Information.
- Socio-Economic Information. Comments on project development. Various nature of problems.
- Information on impact occured on construction phase and suggestions.
- Accident statistics and complaint statistics.

Socio-economic survey must be conducted on the construction area once a year throughout construction period. There are 4 groups of samples as follows:

- People living in the area to evacuate.
- People living and working near the road.
- Community leaders.
- Representatives of schools and religious places. The survey

details are as follows:

1) Field data collection.

Interviewed by a consulting company that has been trained and studied construction projects in details. Interview the target sample group. Interviewers need to understand as follows:

- Background and purpose of the project.
- Understanding of project details.
- Purpose of asking each question, and scope of the answer which is direct to the issue.
- Self introduction and how to create friendliness.
- How to talk into the issue to be interviewed and how to ask for more information.
- How to record or write interview answer.
- How to check the accuracy or consistency of the answer received.

2) Characteristics of the questionnaire.

The survey questionnaire is designed for target group, that is questionnaire for general people. Structure of questionnaire covers the following issues:

- Part 1: Basic Household Information.
- Part 2: Economic and social data. Opinions on project development. Various natures of problems.
- Part 3: Impacts occured during construction phase and suggestions.
- Part 4: Accident statistics and complaints statistics.

2.5 Environmental Action Plan.

Implementation of monitoring according to preventative and remedial measures on environmental impact and Environmental Impact Monitoring of Yellow Line BTS Project. Ladprao-Samrong Section. Construction period by Sino-Thai Construction Public Company Limited, having project duration of 39-months. Detailed operation plan is proposed as per Table 2-4.

Table 2-4 Environmental Quality Monitoring Plan for Yellow Line BTS Project. Ladprao - Samrong Section. Construction phase. Sino-Thai Construction and Engineering Public Company Limited.

Environmental Monitoring Points.	Monitored indexes	Month
		0 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30 31 32 33 34 35 36 37 38 39 40
1. Environmental Impact Monitoring according to EIA report		
1.1 Ground surface water quality.		Baseline
Station 1 Nam Kaew Canal Station 2 Lat Phrao Canal Station 3 Chan Canal Station 4 Saen Saab Canal Station 5 Hua Mark Canal Station 6 Pravet Buri Rom Canal Station 7 Ta Chang Canal Station 8 Kled Canal Station 9 Bang Na Canal Station 10 Samrong Canal.	1) Water temperature 2) Conductivity 3) PH value 4) Dissolved Oxygen 5) Suspend Solids 6) Dirt in the form of biosorbent for organic degradation (BOD) 7) Oil & Grease 8) Phosphate 9) Total coliform bacteria 10) Fecal coliform bacteria	
1.2 Air quality		Baseline
Station 1 Institute of Slow Development, Judicial Office of the Judiciary Station 2 Pibul Uppatham School Station 3 Chok Chai 4 Police Flat Station 4 Thanomphit Witthaya School Station 5 Bangkok Suksa School Station 6 Big C Ladprao Station 7 Mae Phra Kularb Thip Temple Station 8 Vejthani Hospital Station 9 The Mall Bangkapi Station 10 Fathulbari Mosque Station 11 Sukree Kindergarten Station 12 Hua Mark Municipal School Station 13 Yemen Idaho Mosque {Huamark] Station 14 Hua Mark School Station 15 Kelantan Canal School Station 16 New Mosque School Station 17 Kajorn Siri Temple Station 18 Dulul Amin Mosque Station 19 Dusit Thani College Station 20 at Phra Khanong Station 21 Sri Iam Temple Station 22 Carrefour, Srinakarin Station 23 Klong Krathum Rat Uthit School Station 24 Sirivudh Witthaya School Station 25 Chularat Hospital 2 Station 26 Chulavej Hospital	1) Total Dust (TSP) 2) Dust particles of size less than 10 microns (PM-10) 3) Dust particles of size less than 2.5 (PM-2.5) 4) Wind speed and direction	
1.3 Noise level.		Baseline
Station 1 Institute of Judicial Development, Courts of Justice Site 2 Pibul Uppatham School Station 3 Chok Chai 4 Police Flat Station 4 Thanomphit Witthaya School Station 5 Bangkok Suksa School Station 6 Big C Ladprao Station 7 Mae Phra Kularb Thip Temple Station 8 Vejthani Hospital Station 9 The Mall Bangkapi Station 10 Fathulbari Mosque Station 11 Sukonree Kindergarden Station 12 Hua Mark Municipal School Station 13 Yamiun Idhad Mosque (Hua Mark Yai) Station 14 Hua Mark School Station 15 Kelantan Canal School Station 16 New Mosque School Station 17 Kajorn Siri Temple Station 18 Dulul Amin Mosque Station 19 Dusit Thani College Station 20 Phra Khanong Land Office Station 21 Sri Iam Temple Station 22 Carrefour, Srinakarin (Big C, Srinakarin) Station 23 Klong Krathum Rat Uthit School Station 24 Sirivudh Witthaya School Station 25 Chularat Hospital 2 Station 26 Chulavej Hospital	1) Average noise level (LAeq 24 hours) 2) Maximum noise level (LAmax) 3) 10th and 90th percentile noise level (LA10 and LA90) 4) Average noise level during daytime and nighttime (LAdn)	
1.4 Vibration		Baseline
Station 1 Institute of Judicial Development, Courts of Justice Site 2 Pibul Uppatham School Station 3 Chok Chai 4 Police Flat Station 4 Thanomphit Witthaya School Station 5 Bangkok Suksa School Station 6 Big C Ladprao Station 7 Mae Phra Kularb Thip Temple Station 8 Vejthani Hospital Station 9 The Mall Bangkapi Station 10 Fathulbari Mosque Station 11 Sukonree Kindergarden Station 12 Hua Mark Municipal School Station 13 Yamiun Idhad Mosque (Hua Mark Yai)	1) Maximum particle velocity (PPV) 2) Frequency	

Table 2-4 (Cont.) Environmental Quality Monitoring Plan for Yellow Line BTS Project. Ladprao - Samrong Section. Construction phase. Sino-Thai Construction and Engineering Public Company Limited.

Environmental Monitoring Point	Monitored indexes	Month 0 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30 31 32 33 34 35 36 37 38 39 40
1. Environmental Impact Monitoring according to EIA report		
1.4 Vibration (Continued)		**Baseli**
Station 14 Hua Mark School		
Station 15 Kelantan Canal School		
Station 16 New Mosque School		
Station 17 Kajorn Siri Temple		
Station 18 Dulul Amin Mosque		
Station 19 Dusit Thani College		
Station 20 Phra Khanong Land Office		
Station 21 Sri Iam Temple		
Station 22 Carrefour Srinakarin		
Station 23 Klong Krathum Rat Uthit School		
Station 24 Sirivudh Witthaya School		
Station 25 Chularat Hospital 2		
Station 26 Chulavej Hospital		
1.5 Traveling and Transportation.		**Baseli**
1) Ratchada-Ladprao intersection	1) Numbers, types, and directions of vehicles	
2) Pawana intersection	2) Accident statistics	
3) Chokchai 4 Intersection	3) Causes and severity of accidents	
4) Pradit Manutham intersection		
5) Bangkapi intersection		
6) Lamsalee intersection		
7) Krungthep Kreetha intersection		
8) Rama IX - Srinakarin intersection.		
9) Pattakarn intersection		
10) Onnut intersection		
11) Udom Suk intersection		
12) Sri Iam intersection \		
13) Theparak intersection		
14) Samrong Intersection		
1.6 Infrastructure and facilities.		**Baseli**
- Groups of organizations that uses infrastructure system.	1) Coordination procedures and operation performance.	
	2) Activities in the construction area	
	3) Problems and obstacles in the field.	
	4) Impact occured during construction phase..	
	5) Opinions on project development.	
1.7 Economic and Social.		**Baseli**
1) People living in the area to evacuate.	1) General Household Information.	
2) People living and working near the road.	2) Socio-Economic Information. Opinions on project development. Various nature	
3) Community leaders.	of problems.General Household Information.	
4) Representatives of schools and religious places.	3) Information on impact occured on construction phase and suggestions.	
	4) Statistics and Complaints Statistics	
Monitoring of compliance with preventive and remedial measures on environmental impact		
3. Reporting.		
1) Environmental Measurement Plan (EMP)	- 2 copies (Thai language)	
2) Report on result of environmental impact monitoring. Pre-construction phase.	- 6 copies. (Thai language)	
3) Construction Period Monthly Report.	- 6 copies. (Thai language)	
4) 6-month summary report (submitted to Sor Por)	- 6 copies. (Thai language)	

Note: In case of extension of construction period, extend the time to monitor environment quality until the construction is completed.

2.5 Operating Personnel.

Personnel for monitoring compliance with environmental protection and remedial measures on environmental impact for Yellow Line BTS Project, Ladprao - Samrong Section, consists of operators as shown in Figures 2-12 and Appendix B.

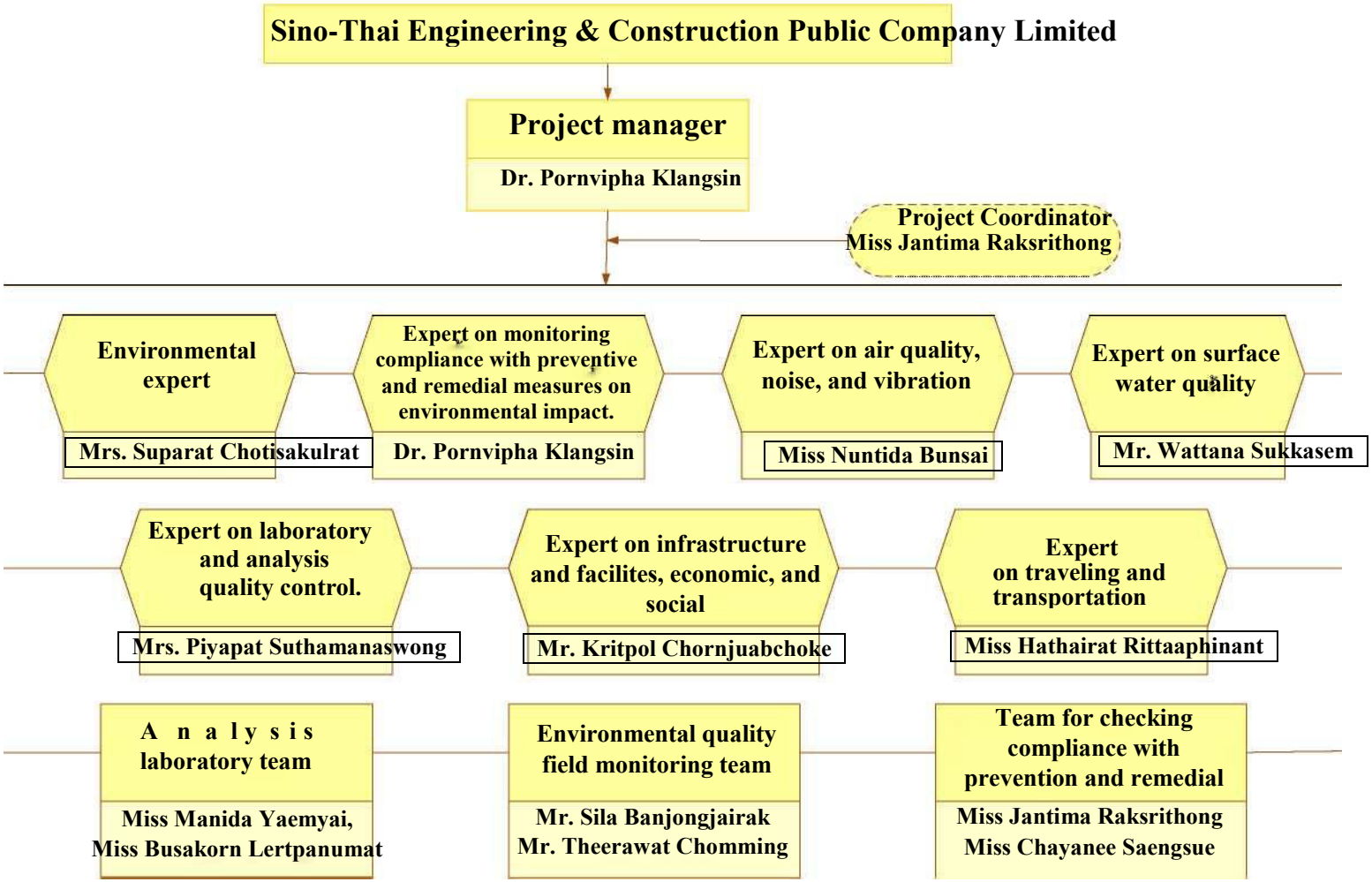


Figure 2-11 Personnel in Environmental Quality Monitoring

List of Major Environmental Impacts, Environmental Impact Prevention and Mitigation Measures, and Environmental Monitoring Measures
Bangkok Mass Transit Yellow Line Project : Lat Phrao - Samrong Section

Environmental Parameters	Environmental Impacts	Environmental Impact Prevention and Mitigation Measures	Environmental Monitoring Measures
1. General Measures		1. Environmental measures and environmental action plans that shall be followed comprise the following. 1.1 During the project development, ensure all environmental impact prevention and mitigation measures and environmental monitoring measures as suggested in the Environmental Impact Assessment (EIA) Report of the Bangkok Mass Transit Yellow Line Project : Lat Phrao – Samrong and additionally stipulated by the Expert Review Committee will be strictly followed by including them as the conditions in the contracts for engagement of contractors to provide construction drawings and/or construction and project management services. 1.2 Control and supervise all contractors providing construction drawings and/or construction and project management services to comply with the environmental impact prevention and mitigation measures and environmental monitoring measures as suggested in the EIA Report of the Bangkok Mass Transit Yellow Line Project : Lat Phrao - Samrong.	

List of Major Environmental Impacts, Environmental Impact Prevention and Mitigation Measures, and Environmental Monitoring Measures
Bangkok Mass Transit Yellow Line Project : Lat Phrao - Samrong Section (Cont'd)

Environmental Parameters	Environmental Impacts	Environmental Impact Prevention and Mitigation Measures	Environmental Monitoring Measures
		1.3 A third party shall be engaged to audit compliance with the environmental impact prevention and mitigation measures and environmental monitoring measures as suggested in the EIA Report. The budget for engagement of the third party shall be included in the expenses of the Yellow Line Project (Lat Phrao – Samrung Section) under the supervision of the Mass Rapid Transit Authority of Thailand (MRTA). The Environmental Compliance Monitoring and Supervision Committee shall be appointed, consisting of the representatives from the Office of Natural Resources and Environmental Policy and Planning (ONEP), the State Railway of Thailand (SRT), the Department of Highways, the Pollution Control Department, Samut Prakan Province, the Bangkok Metropolitan Administration (BMA), the Office of the Consumer Protection Board, non-governmental organizations, experts, etc. to ensure the environmental compliance of the project. 2. MRTA shall prepare the environmental compliance report and submit to the ONEP and other related agencies every 6 months	

List of Major Environmental Impacts, Environmental Impact Prevention and Mitigation Measures, and Environmental Monitoring Measures
Bangkok Mass Transit Yellow Line Project : Lat Phrao - Samrong Section (Cont'd)

Environmental Parameters	Environmental Impacts	Environmental Impact Prevention and Mitigation Measures	Environmental Monitoring Measures
		3. MRTA shall abide by all environmental impact prevention and mitigation measures and environmental monitoring measures as suggested in the EIA Report approved by the Expert Review Committee responsible for review of EIA reports for transportation projects of government agencies, state enterprises, or PPP. In case of any change in project descriptions or measures not affecting the essential issues of EIA and with positive impact on the environment, either better than or equivalent to the measures specified in the EIA report that was approved by the Expert Review Committee, such matters shall be submitted to local regulatory agencies, with a copy to ONEP for information. In the event that any change in project descriptions or measures will affect the essential issues of the EIA report, an addendum to the EIA report assessing the impacts associated with the change must be submitted to ONEP for consideration of the Expert Review Committee prior to project commencement.	

List of Major Environmental Impacts, Environmental Impact Prevention and Mitigation Measures, and Environmental Monitoring Measures
Bangkok Mass Transit Yellow Line Project : Lat Phrao - Samrong Section (Cont'd)

Environmental Parameters	Environmental Impacts	Environmental Impact Prevention and Mitigation Measures	Environmental Monitoring Measures
		4. During the project construction and operation phases, if the project causes any environmental impacts or there are complaints about environmental problems, the MRTA, contractors providing construction drawings, construction and project management services shall, without delay, take preventive and remedial action, and also inform the ONEP and related agencies in order to mutually consider and seek solutions to the problems.	
Physical Environmental Resources			
1. Topography	**The impact area of the elevated structures and the stations.** **Construction Phase** - Since the construction of the MRT system build over the area along the median strip which the terrain is flat and low lying flood with an altitude of no more than 1.50 meters above mean sea level. However, during the construction Phase, the construction need to excavating / land leveling for the construction of elevated highways and Sky train stations that expecting little impact on the landscape or no impact at all.		

List of Major Environmental Impacts, Environmental Impact Prevention and Mitigation Measures, and Environmental Monitoring Measures
Bangkok Mass Transit Yellow Line Project : Lat Phrao - Samrong Section (Cont'd)

Environmental Parameters	Environmental Impacts	Environmental Impact Prevention and Mitigation Measures	Environmental Monitoring Measures
1. Topography (cont'd)	<u>Operation Phase</u> - During the project operation Phase, the median strip will transform to support structures for the evaluated highway and Sky train stations with a height of 14-23 meters or approximately 29 meters / pillar. Plant and grass will be planted alongside the structures for the beauty and serenity. Therefore, it is not expected to affect the state of the landscape along the project in any way.		
	<u>The Impact of Depot and Park and Ride buildings Construction Phase</u> - The Depot and Park and Ride building will construct on a large flat area with the elevation less than 1.50 meters above mean sea level. The construction will be excavating and leveling the space with a maximum height of 15 meters. While Park and Ride buildings will be at the ground level, therefore there is limited chance of the impacts on the topography change or no impact occurs.		
	<u>Operation Phase</u> - The construction areas will be transformed into a reinforced concrete structure maintenance building with a maximum height of 25 meters and a seven story park and ride buildings with a maximum height up to 25 meters and parking space for 2,800 vehicles. Furthermore, the construction area will be improved		

List of Major Environmental Impacts, Environmental Impact Prevention and Mitigation Measures, and Environmental Monitoring Measures
Bangkok Mass Transit Yellow Line Project : Lat Phrao - Samrong Section (Cont'd)

Environmental Parameters	Environmental Impacts	Environmental Impact Prevention and Mitigation Measures	Environmental Monitoring Measures
1. Topography (cont'd)	with a large modern building thus it is expected to have an impact on the landscape in the area when the construction project completed.		
2. Soil	**The impact area of the elevated structures and the stations.** **Construction Phase** - The impact on the structure and properties of the soil. Since the construction of the Monorail system involve the excavation out the soil and open up surface for the construction space, for the construction of the elevated highway support structure foundations in a distance of approximately 30 kilometers including the construction of 23 stations, consequently, disturbing the structure and properties of the soil will be unavoidable. This Phase will need to fill the space and ground resources with the rich soil that suitable for planting cover crops, shrubs/medium-sized trees to replace the original soil. Therefore, it has a direct negative impact on the structure and properties of the soil that vary from the property and structure of the original soil. However, the property and structure of original soil mostly consist of clay particle which originates from parent material in a flood plain. Top soil is dark gray - black clay and subsoil are sticky clay soil that medium to low in nutrients plants can not absorb soil nutrients.	**Construction Phase** Requiring the contractor to do the following: - The construction area of elevated structures, MRT stations, depot and park & ride buildings must clearly specified. The solid fencing, at least 2 meters higher from the original ground, is temporarily built around the construction area to prevent the sediment from flowing into the public drainage channel, lowlands or surface water. - Major construction activities, such as excavating/filling the land, relocating the public utility system (such as plumbing, piping and utility pole), and excavating the land to construct the foundation of elevated structures, MRT stations, depot and park & ride buildings, should be implemented during the dry season to avoid the soil erosion problem during the rainy season.	

List of Major Environmental Impacts, Environmental Impact Prevention and Mitigation Measures, and Environmental Monitoring Measures
Bangkok Mass Transit Yellow Line Project : Lat Phrao - Samrong Section (Cont'd)

Environmental Parameters	Environmental Impacts	Environmental Impact Prevention and Mitigation Measures	Environmental Monitoring Measures
2. Soil (cont'd)	Thus, soil suitability for planting is low. In addition, the construction of elevated highways and stations will be taken place mainly on the traffic island. The impact on the structure and properties of the soil during the construction Phase is relatively low when to compare and contrast the benefits of soil that have lost permanent or inevitable for the construction project with the total distance of 30 km radius and 2.50 meters wide, the total area of no more than 45.68 Rais. - The impact of the changing condition of construction site on soil erosion. There will be a significant amount of excavating and leveling activities during the construction of elevated highways and stations, especially during the rainy season. the amount of soil from a number of drill rigs dropped or fall on a construction site or the road surface will be moving out of the area. Rainfall and runoff will flow along the slope of the road surface or into wetlands or low public water supply. It is a moderate impact on the accumulation of sediment, soil and shallow waters of the public water supply e.g. Num Kaeo Canal, Bang Sue Canal, Lat Phrao Canal, Jow Khun Sing Canal, Jun Canal, Yai Phuan Canal, Ta Nhung Canal, San Sab Canal, Ka Ja Canal, Hua Mak Canal, Ban Na Canal, and Samrong Canal etc.	- The construction materials should be arranged (as necessary) in the suitable setting and it should avoid the location that is prone to erosion, especially the places near the water surface. The trucks should carry the soil excavated from the construction area where the foundation of elevated guide way and MRT stations is built to fill the areas indicated by MRTA. The soil should never be piled or left in the construction area. - Once the land excavation and land filling is done in the construction area of elevated structures and MRT stations, the land must be firmly compacted until the surface is even. Then, the soil with proper nutrients for groundcover, shrubs and middle-sized trees is used to replace the previous soil and to prevent the soil erosion, especially in the rainy season.	

List of Major Environmental Impacts, Environmental Impact Prevention and Mitigation Measures, and Environmental Monitoring Measures
Bangkok Mass Transit Yellow Line Project : Lat Phrao - Samrong Section (Cont'd)

Environmental Parameters	Environmental Impacts	Environmental Impact Prevention and Mitigation Measures	Environmental Monitoring Measures
2. Soil (cont'd)	<u>Operation Phase</u> - During the operation Phase, there will be no impact on soil resources and soil erosion due to the structure take place mostly on the traffic island where there is space under the elevated structure. Plus, there will be planting ground cover, shrubs or medium-sized trees throughout the route to mitigate soil erosion and to prevent sediments transport into the public sewer or public water sources.		
	<u>Impact on Depot Area and Park and Ride buildings</u> <u>Construction Phase</u> - The structure and properties of the soil in Depot and Park & Ride buildings construction site are expected to impact. Since the current condition of construction sites are mainly lowland and flooded soils. Therefore, the area needs to filling and leveling for at least above the flood level of up to 50 centimeters (+1.5 m. MSL) by bringing soil from excavations for building foundations, supporting structures, elevated railways or soil from another area. Thus, it is unavoidable for the disturbing condition / structure / properties of the soils. However, the negative impact is expected low because the area around the depot is empty space. Moreover, the area of the Park and Ride buildings mainly consists of an office building and residents area of the highway district of Samut Prakan which	<u>Construction Phase</u> Requiring the contractor to do the following: - To compile the environmental impact prevention and mitigation measures in cooperation with viaduct and station's area. - The construction area of depot and park & ride buildings or the bare and open area used for material storage must be covered with gravels, crushed stones, canvas or groundcover. - <u>In the south of depot construction area, the temporary sedimentation tank, with over 5,100-cubic meter capacity, and the temporary gutter are made to prevent the sediments that come with the water or rain from flowing into the surface water.</u>	

List of Major Environmental Impacts, Environmental Impact Prevention and Mitigation Measures, and Environmental Monitoring Measures
Bangkok Mass Transit Yellow Line Project : Lat Phrao - Samrong Section (Cont'd)

Environmental Parameters	Environmental Impacts	Environmental Impact Prevention and Mitigation Measures	Environmental Monitoring Measures
2. Soil (cont'd)	not be used for agriculture nor directly related to the soil resources. - Soil erosion surrounding Depot and Park & Ride buildings is likely to occur at the moderate level. This is because the east end of the construction site of Depot and Park and Ride building is located close to Khlet Canal approximately 160 meters. During the rainy season, which would have a significant amount of rain and sediment erode and transport into Khlet Canal. Therefore, the impact caused by the deposition of sediment and silt of Khlet Canal.	public drainage channel or lowlands.	
	Operation Phase - If the Depot and Park and Ride buildings are completed, there will be no impact occurs. Because most of the area has a concrete floor, and the buildings were elevated from the ground, about three meters (Depot). Also, the surrounding area of the construction sites consists of concrete wall and plant trees. It is very unlikely to cause erosion of the amount of sediment flowing into the public sewer.	**Operation Phase** - Once completed, the construction of elevated guide way, MRT stations, depot and park & ride buildings will not pose any impact, especially soil erosion. That is because most space beneath the elevated guide way, MRT stations, depot and park & ride buildings grows groundcover, shrubs and trees, builds the concrete floor or fencing, or plants a row of trees as a fence. Therefore, there is no recommendation on prevention and mitigation measures.	

List of Major Environmental Impacts, Environmental Impact Prevention and Mitigation Measures, and Environmental Monitoring Measures
Bangkok Mass Transit Yellow Line Project : Lat Phrao - Samrong Section (Cont'd)

Environmental Parameters	Environmental Impacts	Environmental Impact Prevention and Mitigation Measures	Environmental Monitoring Measures
3. Geology and Earthquake	<u>The Impact of the Elevated Structures and the Stations area</u> <u>Construction Phase</u> - The construction of the project could affect the structural geology / geological foundation on the motion of the layer of soft clay since the construction area is located along the mild to moderate soft clay to a depth of about 18 meters. If drilling Circular Bored Pile in diameter from 1.50 to 1.80 meters or Barrette Pile to replace the volume of soil to be dug out. It is likely that the soft clay layer will be moved very easily. It is expected to have a moderate impact on the soil around the pile particularly on the construction site of the stations that take place near surface water since the soft clay layer will be expanded. Also, the amount of soil will be squeezed out to the side or moving in all directions. As a result, the building or structures near the rail system (about 20 meters corridor, including Phibul Uphatum schools, Soi Phawana Community, Lat Phrao Hospital, Vejthani Hospital , and Chularat II Hospital) or the utilities near sidewalks along both sides of the street e.g. concrete sewer pipes , water pipes, electricity cables underground or phone underground channels etc., might also be slightly damaged.	<u>Construction Phase</u> Requiring the contractor to do the following: - The steel sheet pile must be installed around the construction area and deep in the medium soft clay layer (about 18 meters deep from the original ground). Then, a trench must be dug outside the line of steel sheet pile in the soft ground to reduce the earth pressure. In the construction area near the surface water, double steel sheet pile must be installed to prevent the soil erosion or movement of soft ground. - <u>The methods are set up to prevent soil erosion and stabilize the hole, such as using polymer slurry to increase the side force friction between the bored pile and sand layer. Unlike polymer slurry, the bored pile under bentonite slurry affects the friction on pile surface.</u> - If the pier foundation of elevated guide way and MRT stations is located near the traffic surface, the surface may settle. The structures is therefore designed to adjust	

List of Major Environmental Impacts, Environmental Impact Prevention and Mitigation Measures, and Environmental Monitoring Measures
Bangkok Mass Transit Yellow Line Project : Lat Phrao - Samrong Section (Cont'd)

Environmental Parameters	Environmental Impacts	Environmental Impact Prevention and Mitigation Measures	Environmental Monitoring Measures
3. Geology and Earthquake (cont'd)	- The impact of the earthquake is not expected to occur or to be affected by low level. Since the construction area is located in 2A in V-VII Section, according to Mercalli scale. The residents of the building are slightly shocked if the building is constructed in poorly designed. Therefore, it appears the damage or less risk of damage in the low to moderate levels.	the differential settlement between the foundations of pier and MRT stations and the roads to prevent the road surface damage caused by this factor. A structure is built to cover the pier foundation of elevated guide way and MRT stations that overlaps with the road surface. To avoid the damage to road surface, it leaves some space in case of differential settlement when the road and pier foundation moves vertically.	
	<u>Operation Phase</u> - In operation Phase, the project is expected to have no impact from earthquake due to the elevated structure of the station designed to support in case of geohazard or earthquake according to AASHTO standards with the Acceleration Coefficient (0.075) and Site Coefficient (S) of 1:50 to 2:00. Also the design further reinforced by the special structure of the elevated structure to prevent it from moving out of the top spot. support structure		

List of Major Environmental Impacts, Environmental Impact Prevention and Mitigation Measures, and Environmental Monitoring Measures
Bangkok Mass Transit Yellow Line Project : Lat Phrao - Samrong Section (Cont'd)

Environmental Parameters	Environmental Impacts	Environmental Impact Prevention and Mitigation Measures	Environmental Monitoring Measures
3. Geology and Earthquake (cont'd)	<u>Impact on Depot Area and Park and Ride buildings</u> <u>Construction Phase</u> - The construction of the Park and Ride building could affect the structural geology / geological foundation on the motion of the layer of soft clay since the construction area is located along the mild to moderate soft clay to a depth of about 18 - 20 meters. If drilling Circular Bored Pile in diameter from 0.35 meters to replace the volume of soil to be dug out from the construction of Depot with the maximum height of 15 meters (2 stories). It is likely that the soft clay layer will be moved very easily. - The impact of the earthquake is not expected to occur or to be affected by low level. Since the construction area is located in 2A area in V-VII Section, according to Mercalli scale. The residents of the building are slightly shocked if the building is constructed in poorly designed. Therefore, it appears the damage or less risk of damage in the low to moderate levels.		
	<u>Operation Phase</u> - In operation Phase, the project is expected to have no impact occurs. The Depot and Park & Ride buildings are concrete building that designed to support the case of geohazard or earthquake, according to the Ministry of Interior "Load resistance		

List of Major Environmental Impacts, Environmental Impact Prevention and Mitigation Measures, and Environmental Monitoring Measures
Bangkok Mass Transit Yellow Line Project : Lat Phrao - Samrong Section (Cont'd)

Environmental Parameters	Environmental Impacts	Environmental Impact Prevention and Mitigation Measures	Environmental Monitoring Measures
3. Geology and Earthquake (cont'd)	and durability of building ground for building vibration resistance of earthquake 2007" issued under the Building Control Act 1979.		
4. Surface Water Quality	<u>The Impact of the Elevated Structures and the Stations area</u> <u>Construction Phase</u> - The impact, regarding the construction activities particularly for the excavation, filling and leveling, excavation for the structure of the elevated Skytrain foundations support, or moving construction materials such as cement, sand, stone, clay, etc., is low. Since the construction of the structure will not create any portion intrude into the surface water, therefore, there will be no activity interferes with surface water quality except for those station located less than 50 meters from surface water that are; Lat Phrao 101 stations, Kelantan station, and Suan Luang Ro 9 station. These three stations might affect by an increase in turbidity from soil erosion during the excavations, foundations and filling and leveling processes or might contaminate with oil from the equipment. However, the impact is expected to be low since the construction area is limited only in the traffic island. In addition, the analysis of surface water quality from water sources along the rail system showed that the surface water quality already deteriorated because they receiving	<u>Construction Phase</u> Requiring the contractor to do the following: - The contractor must establish only "Project Office" in the location near the construction area. The workers' camp must be separate from the office and the camp establishment must be at least five kilometers from the project. It must not only be proposed to and approved by MRTA, but also strictly comply with the laws and regulations of local administrative offices on the residence construction, Building Control Act, B.E. 2522 or the regulation of the Ministry of Interior No. 55 B.E. 2543. - If the construction of elevated guide way and MRT stations is less than 50 meters from the surface water, the net or canvas must cover the area underneath to prevent the construction materials (such as soil, sand and cement) from falling	<u>Construction Phase</u> - There are 10 monitoring station of surface water quality as follows: • Station : 1 Nam Kaeo Canal • Station : 2 Lat Phrao Canal • Station : 3 Chan Canal • Station : 4 Saen Saeb Canal • Station : 5 Hua Mak Canal • Station : 6 Prawet Burirom Canal • Station : 7 Tachang Canal • Station : 8 Khlet Canal • Station : 9 Bang Na Canal • Station : 10 Samrong Canal - indexes • Temperature • Suspend Solids • Conductivity • pH • Dissolved Oxyen • BOD • Phosphate

List of Major Environmental Impacts, Environmental Impact Prevention and Mitigation Measures, and Environmental Monitoring Measures
Bangkok Mass Transit Yellow Line Project : Lat Phrao - Samrong Section (Cont'd)

Environmental Parameters	Environmental Impacts	Environmental Impact Prevention and Mitigation Measures	Environmental Monitoring Measures
4. Surface Water Quality (cont'd)	sewer water from a large urban area. - The impact of the activities in the project office and construction of shelters for construction workers are considered into two scenarios: 1) With the project office • Based on provided number, wastewater and sewage from the use of bathroom / toilet or washing dishes in the daily operation of the staff working in the office up to 200 people = 8,000 liters / day, or eight cubic meters / day • The amount of solid waste that may result from activities of approximately 200 staffs while work each day in the offices is equivalent to the volume of solid waste equal to 0.60 cubic meters / day. In order to limited the dumping of solid waste problems or littering that might blockage and affect surface water nearby, the project need to provide the trash with a capacity of 0.24 cubic meters of solid waste at least eight tanks 2) With the Project office and shelters for construction workers • The estimation of wastewater and sewage that might occur from the daily use of bathroom / toilet, dishes washing or body cleansing during operation of approximately 1,400 people (200	down to the surface water and causing turbidity. - In the construction area of three MRT stations located less than 50 meters from the surface water, namely Lat Phrao 101, Kalantan and Suan Luang Ro 9, major construction activities must be implemented during dry season. This includes excavating/filling the land, relocating the public utility system (such as plumbing, drainage pipe and utility pole), or excavating the land for the construction of train station foundation. The objective is to avoid the turbidity caused by soil erosion or water contamination caused by leftover oil/lubricant from the machine used in the construction. 1) Tempolary Office • The project must prepare enough restrooms that meet the sanitary standard (10 people/rooms) and install 5 tanks with size 2-cubic meter septic tank, totaling 10 cubic meters, to treat the wastewater caused by the activities in the Office. • The project must prepare 8 bins with size 0.24 cubic meter waste bin, totaling	• Oil & Grease • Total Coliform Bacteria • Fecal Coliform - Phase • This shall be conducted once and shall be finished one month before the construction starts to serve as the baseline data • This shall be conducted once a month until the construction of MRT stations or Depot and Park and Ride Buildings is completed. - Budget : 4,000 baht/point, total 40,000 baht/time - Agency in charge • Mass Rapid Transit Authority of Thailand. (MRTA)

List of Major Environmental Impacts, Environmental Impact Prevention and Mitigation Measures, and Environmental Monitoring Measures
Bangkok Mass Transit Yellow Line Project : Lat Phrao - Samrong Section (Cont'd)

Environmental Parameters	Environmental Impacts	Environmental Impact Prevention and Mitigation Measures	Environmental Monitoring Measures
4. Surface Water Quality (cont'd)	office staffs – no overnight stay) and (1,200 construction workers – with overnight stay), number based on the construction of Bangkok mass transit line extension Sukhumvit 1, 2009, is expected to have the maximum volume of wastewater occurs equal to 200 cubic meters / day [(200x50 + 1,200x200) x0.80] / 1,000). • The amount of waste from 1,200 construction workers in the construction shelters will be in a total amount of solid waste of 3.60 cubic meters / day (1,200x3 / 1,000). - The impact of the ongoing construction activities such as washing and cleaning construction equipment, vehicles, etc. that will take place in the office area, is expected to take water no more than 12 cubic meters /day, as waste water 12x0.80 of 9.60 cubic meters /day. Therefore, two sewage treatments with a capacity of six cubic meters each or volume of 12 cubic meters.	1.92 cubic meters. They are distributed as a group of four in different locations in the Office until the District Office under Bangkok Metropolitan Administration (BMA) or local administrative offices in Samut Prakan province come to collect and dispose of the waste in compliance with the sanitary principle. 2) Office and workers' camp • The project must prepare enough restrooms that meet the sanitary standard (10 people/rooms) and install 20 septic tanks (12-cubic meter/tanks), totaling 240 cubic meters, to treat the wastewater caused by the activities in the Office and workers' camp. • The project must prepare 50 bins (0.24-cubic meter/bins), totaling 12 cubic meters. They are distributed as a group of 10 in different locations in the Office and workers' camp until the District Office under BMA come to collect and dispose of the waste in compliance with the sanitary principle.	

List of Major Environmental Impacts, Environmental Impact Prevention and Mitigation Measures, and Environmental Monitoring Measures
Bangkok Mass Transit Yellow Line Project : Lat Phrao - Samrong Section (Cont'd)

Environmental Parameters	Environmental Impacts	Environmental Impact Prevention and Mitigation Measures	Environmental Monitoring Measures
4. Surface Water Quality (cont'd)		- To avoid causing the wastewater, the construction activities of elevated guide way and MRT stations, such as fuel change and washing and cleaning the construction equipments or vehicles, must be done in the prepared area in the Office and must be at least 100 meters from the surface water. Furthermore, 2 septic tanks (6-cubic meter/septic tanks), totaling 12 cubic meters, must be installed to treat the wastewater caused by these activities.	
	Operation Phase - As the Monorail system which runs on elevated structures, using electricity to drive, it does not affect surface water quality in the passing water sources. As for the stations, the daily amount of waste water from the use of the employee restroom that perform various functions such as ticketing, information, security and communications, etc. approximately 10 people/stations. The amount of water usage is 50 liters/person, equivalent to 400 liters of wastewater (50x10x0.80 / day or 0.40 cubic meters / day; equivalent. the rate of water loss by 80 percent the amount of water used), thus the amount of water that will be treated by the wastewater treatment plant with the capacity of 2 cubic meters, ready to be	**Operation Phase** Requiring the operator or concessionaire to do the following: - The Project must prepare waste bins with lids (trash/garbage/hazardous waste) to contain the waste in every train station. The Project also coordinates with the District Office under BMA or local administrative offices in Samut Prakan province so that they can collect and dispose of the waste in compliance with the sanitary principle. - The Project must check the septic tanks in every train station.	**Operation Phase** - There are 7 monitoring station of surface water quality as follows: • Station : 1 Lat Phrao Canal • Station : 2 Saen Saeb Canal • Station : 3 Phra Khanong Canal • Station : 4 Samrong Canal • Station : 5 Khlet Canal • Station : 6 Retention pond nearby Srinagarindra road, Pond No.1. • Station : 7 Retention pond nearby Srinagarindra road, Pond No. 2 - indexes • Temperature • Suspend Solids

List of Major Environmental Impacts, Environmental Impact Prevention and Mitigation Measures, and Environmental Monitoring Measures
Bangkok Mass Transit Yellow Line Project : Lat Phrao - Samrong Section (Cont'd)

Environmental Parameters	Environmental Impacts	Environmental Impact Prevention and Mitigation Measures	Environmental Monitoring Measures
4. Surface Water Quality (cont'd)	installed in all stations, there will be no impact occurs.		• Conductivity • pH • Dissolved Oxyen • BOD • Phosphate • Oil & Grease • Fecal Coliform Bacteria[3/] • Sulfide • TKN - Nitrogen • Total Coliform Bacteria - Phase • The analysis of surface water quality /wastewater shall be conducted twice a year, for five consecutive years. If the measurement results are not significantly different, this shall be conducted once a year - Budget : 6,000 baht/point, total 42,000 baht/time - Agency in charge • Mass Rapid Transit Authority of Thailand. (MRTA)
	Impact on Depot Area and Park and Ride buildings **Construction Phase** - The Depot which located east of the Si Iam Junction with construction activities especially the	**Construction Phase** Requiring the contractor to do the following: - In the south of depot construction area,	

List of Major Environmental Impacts, Environmental Impact Prevention and Mitigation Measures, and Environmental Monitoring Measures
Bangkok Mass Transit Yellow Line Project : Lat Phrao - Samrong Section (Cont'd)

Environmental Parameters	Environmental Impacts	Environmental Impact Prevention and Mitigation Measures	Environmental Monitoring Measures
4. Surface Water Quality (cont'd)	excavation leveling, drilling foundations for building for support a two-floor Depot or moving construction materials such as cement, sand, stone and clay, etc., is expected to have a low impact on the increasing in turbidity, impurities in BOD or contamination from the use of equipment with the use of oil, etc., even if the Depot is located adjacent to surface water (Khlet Canal), but no construction portion intrude into the canal and there is no activity that disturbs the surface water quality in the Khlet Canal.	the temporary sedimentation tank, with over 5,100-cubic meter capacity, and the temporary gutter are made to prevent the sediments that come with the water or rain from flowing into the surface water, public drainage channel or lowlands.	
	Operation Phase - The wastewater from the traffic control centers and staff dormitory will be compiled into a septic system that directly installed onsite while the wastewater from restaurants and train maintenance and cleaning will flow through oil Interceptor to extract the fat and oil prior to discharge into the Khlet Canal. Therefore, the expected impact is low.	**Operation Phase** Requiring the operator or concessionaire to do the following: - To treat the wastewater in the depot, three set of 50-cubic meter onsite treatment plants (Septic - Anaerobic Filter and Contact Aeration Process), totaling 150 cubic meters, must be installed, along with the retention pond. The wastewater caused by activities in the office, control center and employee dormitory will be gathered in the onsite treatment plant. The wastewater caused by canteen, maintenance and train washing will flow through the oil separator, which separates the grease and oil, before running	

List of Major Environmental Impacts, Environmental Impact Prevention and Mitigation Measures, and Environmental Monitoring Measures
Bangkok Mass Transit Yellow Line Project : Lat Phrao - Samrong Section (Cont'd)

Environmental Parameters	Environmental Impacts	Environmental Impact Prevention and Mitigation Measures	Environmental Monitoring Measures
4. Surface Water Quality (cont'd)		into the onsite treatment plant and finally into Khlong Khlet. - The waste in depot and park & ride buildings, such as the waste caused by the cleaning of compartment interior, scraps in the Office, dust from roads and foot path, material fragments from the workshop, waste from septic tank and garbage waste, must be managed as below: • Prepare 22 groups of 10 set of 240 liter waste bins with lids (trash/garbage/hazardous waste) in the depot and the location must be easy to use and collect. • Prepare a few staff members to collect the waste and keep it in garbage storage building so that the agencies in charge can take and get rid of the waste in the disposal area outside the depot. • Make sure that the garbage storage building is large enough to keep the waste at least 3 days (with capacity of 151.59 cubic meters). - For the waste management, the hazardous waste, such as oil, grease and chemicals,	

List of Major Environmental Impacts, Environmental Impact Prevention and Mitigation Measures, and Environmental Monitoring Measures
Bangkok Mass Transit Yellow Line Project : Lat Phrao - Samrong Section (Cont'd)

Environmental Parameters	Environmental Impacts	Environmental Impact Prevention and Mitigation Measures	Environmental Monitoring Measures
4. Surface Water Quality (cont'd)		must be kept in the dangerous goods building so that the agencies in charge can take and get rid of the waste in the appropriate location, such as Samae Dam Industrial Waste Disposal Center in Bang Khun Thian, Bangkok. It is designed with pallet racking system and the roof so that the cranes and trucks can easily and safely transport pass.	
5. Air Quality	<u>The Impact of the Elevated Structures and the Stations area</u> <u>Construction Phase</u> - The amount of dust that happens will depend on factors such as soil characteristics, soil moisture, wind speed and direction, the Phase of construction, and etc. During the construction phase of elevated structure, the amount of total suspended particulates was 0.215 milligrams per cubic meter that was lower than the air quality standards announced by the National Environment Board No. 24 (2004). Ambient Air Quality Standards which determines the concentration of total suspended particles in the atmosphere must not exceed 0.330 milligrams per cubic meter. Thus expect construction activities along the project route would generate the impact of low to moderate.	<u>Construction Phase</u> Requiring the contractor to do the following: - The contractor must follow the regulations on construction dust control issued by the Air Pollution Committee in Bangkok and Communities in Thailand. - Install the solid fencing, at least or equivalent to 2 meters high, to indicate the construction boundary. Moreover, install the revolving warning lights every 30 meters along the construction area and the installation must be completed before the construction begins. Once the construction in each area is done, these materials must be immediately removed.	<u>Construction Phase</u> - There are 26 monitoring station of air quality as follows: ● Station : 1 Judicial Training Institute ● Station : 2 Pibool Upphatham School ● Station : 3 Chok Chai 4 Police Station Flat ● Station : 4 Thanormpitvithaya School ● Station : 5 Bangkok Suksa School ● Station : 6 Big C Superstore (Lat Phrao) ● Station : 7 Wat Mae Phra Kularb Tip (Maria Rosa Mystica Church) ● Station : 8 Vejthani Hospital ● Station : 9 The Mall Bang Kapi ● Station : 10 Fatthullbalee Mosque ● Station : 11 Sudnaree Kindergarten

List of Major Environmental Impacts, Environmental Impact Prevention and Mitigation Measures, and Environmental Monitoring Measures
Bangkok Mass Transit Yellow Line Project : Lat Phrao - Samrong Section (Cont'd)

Environmental Parameters	Environmental Impacts	Environmental Impact Prevention and Mitigation Measures	Environmental Monitoring Measures
5. Air Quality (cont'd)	- During the construction phase of stations, the amount of total suspended particulates was 0.219 milligrams per cubic meter that was lower than the air quality standards announced by the National Environment Board No. 24 (2004). Ambient Air Quality Standards which determines the concentration of total suspended particles in the atmosphere must not exceed 0.330 milligrams per cubic meter. Thus expect construction activities along the project route would generate the impact of low to moderate. - The impact of the elevated structure construction less than 1,000 meters found that the carbon monoxide (CO) is equal to 0.00334 ppm. Hydrocarbon (HC) is equal to 0.00238 ppm. Nitrogen dioxide (NO_2) is equal to 0.00435 ppm. The total suspended particulate (TSP) equals 0.00042 Milligrams per cubic meter. In General, the total value not exceeding the Ambient Air Quality Standards announced by the National Environment Board No. 10 (1995) and No. 24 (2004) which determines the concentration of Carbon Monoxide (CO) the average one hour does not exceed 30 parts per million. Nitrogen dioxide (NO_2) the average one hour less than 0.170 parts per million. Average total suspended particulates	- Use the precast concrete that is produced and mixed outside the construction site to prevent and mitigate the potential impact on the surrounding communities, which are in commercial, business and highly populated residential areas. - Spray the water on the existing road surfaces at least three or four times a day along the construction area that may cause the spread of dust, such as a pile of soil and sand or the area of land excavation/foundation excavation. Moreover, remove the scraps of construction materials or the piles of soil from the construction area as fast as possible or within 24 hours. - In each construction site, prepare at least three or four staff members to collect the waste and clean the area after the construction activities are done at the end of day. This includes arranging the pile of construction materials and equipments throughout the construction phase to prevent the dust from spreading. - Establish the unit to control, maintain, or check the condition of engines and machines used for the construction at least once a	• Station : 12 Huamak Municipality School • Station : 13 Jamiul Idhard Mosque (Hua Mak Yai) • Station : 14 Huamak School • Station : 15 Klongkalantan School • Station : 16 Suraomai School • Station : 17 Khajonsiri Temple • Station : 18 Darul Amin Mosque • Station : 19 Dusit Thani College • Station : 20 Bangkok Metropolitan Land Office, Phra Khanong Branch • Station : 21 Si Iam Temple • Station : 22 Big C Srinagarindra (former Carrefour Srinagarindra) • Station : 23 Klongkratumratutit School • Station : 24 Siriwutti Wittaya school • Station : 25 Chularat2 Hospital • Station : 26 Chulavej Hospital - indexes • Total Suspended Particulate (TSP) • Particulate Matter less than 10 microns (PM - 10) • Particulate Matter less than 2.5 microns (PM - 2.5) • Wind speed and direction

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Bangkok Mass Transit Yellow Line Project : Lat Phrao - Samrong Section (Cont'd)

Environmental Parameters	Environmental Impacts	Environmental Impact Prevention and Mitigation Measures	Environmental Monitoring Measures
5. Air Quality (cont'd)	and up to 24 hours while 0.33 Milligrams per cubic meter of gas hydrocarbons in the country has not yet determined. Therefore, the impact is low to moderate.	week to prevent the emission of dust (TSP and PM-10) and toxic smoke, such as CO, NO_x, SO_2. If something goes wrong, the team must immediately take action. - If the elevated guide way and MRT stations is constructed on the road median of existing road network, there will not be enough space to construct the wheel cleaning place. Therefore, three or four staff members must be assigned in each area to wipe, clean, or remove the dirt or mud on the tires every time before the vehicles leave the construction area. For the construction of depot and park & ride buildings, the project must provide the area for washing the mud, cement or sand off the tires and vehicles to prevent these residues from falling on the road surface outside the construction area. - The staff members must carefully drive the trucks that carry the construction materials under the speed limit of 30 km/hr. when passing the sensitive communities or residential or commercial area, such as healthcare facilities, schools/educational institutes or religious places, such as	- Phase • This shall be conducted one month before the construction starts, once for five consecutive days, which include working days and public holidays, to serve as the baseline data. • This shall be conducted one month before the construction starts, once for five consecutive days, which include working days and public holidays, during construction within a radius of 1 km and from the monitoring stations throughout the construction phase. - Budget : 35,000 baht/point, total 910,000 baht/time - Agency in charge • Mass Rapid Transit Authority of Thailand. (MRTA)

List of Major Environmental Impacts, Environmental Impact Prevention and Mitigation Measures, and Environmental Monitoring Measures
Bangkok Mass Transit Yellow Line Project : Lat Phrao - Samrong Section (Cont'd)

Environmental Parameters	Environmental Impacts	Environmental Impact Prevention and Mitigation Measures	Environmental Monitoring Measures
5. Air Quality (cont'd)		temples, mosques and churches. - The measure must be enacted to request the trucks carrying the construction materials and equipments to cover the beds. This will prevent the materials or leftover from falling on the surface of existing road network or into the water resources along the route where these vehicles pass. - Request and supervise the staff and workers to wear the equipments that protects them from dust or pollutant, such as CO, NO_x and SO_2, if they work in the construction areas where the machines spread the dust or pollutant, especially land excavation, foundation excavation, relocation or removal of construction scrap or concrete mixing. - Provide the sign of bypass/shortcut for the passers on the existing road network so that they can use alternative routes. Coordinate with police stations, such as Huay Kwang/Hua Mak/Suan Luang/Prawet police station, to facilitate the passers, smooth the traffic flow, and reduce the air pollution caused by traffic jam. - Provide the small-mesh net or canvas underneath the elevated guide way , MRT	

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Environmental Parameters	Environmental Impacts	Environmental Impact Prevention and Mitigation Measures	Environmental Monitoring Measures
5. Air Quality (cont'd)		stations, depot or park & ride buildings to catch the construction equipments and materials that may fall from the construction taking place 10 meters above the ground or to prevent the dust from spreading. - Must provide the small-mesh net or canvas to cover or separate the the station entrances or exits construction areas and to prevent the dust impact caused by the construction. - Prepare at least three or four staffs to clean the existing road network where the elevated guide way or MRT stations are constructed. The cleaning should be implemented during the night time at least four days a week, starting from midnight to 3 am. of the following day.	
	<u>Operation Phase</u> - Although the conditions and forms of land use along the route during the project to a medium to high density commercial and very dense residential area, the train system located on the traffic island of the main road that consist of a solid structure with a clear separation between the route about 6 meters, which can be vented to the top. It is expected that concentrations of air pollution caused by gases	<u>Operation Phase</u> Requiring the operator or concessionaire to do the following: - Coordinate with the police stations in charge of each section of the route, such as Huay Kwang, Chok Chai 4, Hua Mak, Wang Thonglang and Udom Suk, to plan and organize the traffic system on the existing road network under the elevated	<u>Operation Phase</u> - There are 10 monitoring station of air quality as follows: • Station : 1 Pibool Upphatham School • Station : 2 Vejthani Hospital • Station : 3 Klongkalantan School • Station : 4 Darul Amin Mosque • Station : 5 Si Iam Temple • Station : 6 Chulavej Hospital

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Bangkok Mass Transit Yellow Line Project : Lat Phrao - Samrong Section (Cont'd)

Environmental Parameters	Environmental Impacts	Environmental Impact Prevention and Mitigation Measures	Environmental Monitoring Measures
5. Air Quality (cont'd)	include CO 1-hour, NO_2 1 hour, and THC from the exhaust of vehicles passing by on the main road along the project including Lat Phrao road, Srinagarindra road, and Theparak road will not exceed the standards which agree with the results from the air quality measurements that the maximum index were still not exceeded the standard in the area include Chulavej Hospital (CO 1-hour and NO_2 1-hour peak of 3.6 and 0.1001. parts per million) and Kelantan Canal school (max THC was 3.20 parts per million), etc. Thus, areas with elevated structures along the project route are expected to prevent the formation of air pollution in the area even there are traffic jams on the main roads. - The forecast report of carbon monoxide (CO) at the stations along the project found that combined the calculated carbon monoxide (CO) with the measured carbon monoxide (CO), show the highest value from the measurements in Lat Phrao road, Srinagarindra road, and Theparak road, (in case of the vehicle speed is 0-1 km/hr) that observed in 2013 were 4.07, 4.47, and 5.37 parts per million, respectively. The total value is lower than the air quality standard according to the Board of Directors of the National Environmental	guide way and MRT stations. This can ensure the flexibility and reduce the traffic congestion. Moreover, the traffic signals should be set up to tell the direction and speed limit under the train station. - Coordinate with the police stations, such as Huay Kwang, Chok Chai 4, Hua Mak, Wang Thonglang and Udom Suk, to plan and organize the traffic system on the existing road network under the elevated guide way and MRT stations. This can ensure the flexibility and reduce the traffic congestion. Moreover, the traffic signals should be set up to tell the direction and speed limit under the train station. - Coordinate with the Department of Land Transport, Pollution Control Department and police stations (such as Huay Khwang, Chok Chai 4, Hua Mak,Wang Thonglang and Udom Suk station) to control and forbid the medium and large sized trucks from running on the existing road network under the elevated guide way and train station during the morning rush hours (7 - 9 am.) and evening rush hours (4 - 7 pm.). Clearly set up the prohibition signs and ask them to use	• Station : 7 Under Phawana station (YL - 02) • Station : 8 Under Chok Chai 4 station (YL - 03) • Station : 9 Under Lat Phrao 101 station (YL - 07) • Station : 10 Under Samrong station (YL - 23) - indexes • Total Suspended Particulate (TSP) • Particulate Matter less than 10 microns (PM - 10) • Particulate Matter less than 2.5 microns (PM - 2.5) • Carbon monoxide (CO) • Nitrogen dioxide (NO2) • Wind speed and direction - Phase • The quality of air shall be monitored twice a year, each covering five consecutive days, which include working days and public holidays. This shall take five consecutive years. After that, the air quality monitoring will occur once a year, each covering five consecutive days, which include working days and public

List of Major Environmental Impacts, Environmental Impact Prevention and Mitigation Measures, and Environmental Monitoring Measures
Bangkok Mass Transit Yellow Line Project : Lat Phrao - Samrong Section (Cont'd)

Environmental Parameters	Environmental Impacts	Environmental Impact Prevention and Mitigation Measures	Environmental Monitoring Measures
5. Air Quality (cont'd)	Act No. 10 of 1995 which states that the carbon monoxide average one hour should not exceed 30 parts per million. As the road structure below the train station almost every station, except Phawana station Chok Chai 4 station, Lat Phrao 101 station, and Samrong station, are open space with no high-rise buildings (more than two floors) on both sides of the train station. So that there is no obstruction for the pollution from vehicles that passing under the train station. Therefore, the air flow around the station is in a good condition just like the condition before the project construction. Also. the concentration of pollutants (CO - 1 hour) is not to exceed air quality standards or harm the health of a community or sensitive area, such as religious place, schools, or hospitals, etc. that located nearby stations. Thus, the impact is low.	alternative routes to reduce the pollution caused by the exhaust, especially CO and NO_2. - In operation phase, if the result of dust analysis underneath any train station yields higher value than the standard of atmospheric air quality for five consecutive days based on the announcement of National Environment Board No. 24 (B.E. 2547), high-pressure spray nozzle must be immediately installed under the MRT stations and turned on during the morning rush hours (7 – 9 am.) and evening rush hours (4 – 7 pm.). Especially in the highly populated commercial areas, such as the Phawana, Chok Chai 4, Lat Phrao 101 and Samrong Stations. - If the result of air pollution analysis, such as CO or NO_2, yields higher value than the standard of atmospheric air quality, the fans must be installed to ventilate the area beneath the MRT stations and reduce the accumulative air pollution under the MRT stations. Coordinate with Bangkok Metropolitan Administration (BMA) and Samut Prakan Municipality to monthly	holidays (during the southwest and northeast monsoons). - Budget : 77,000 baht/point, total 770,000 baht/time - Agency in charge • Mass Rapid Transit Authority of Thailand. (MRTA)

List of Major Environmental Impacts, Environmental Impact Prevention and Mitigation Measures, and Environmental Monitoring Measures
Bangkok Mass Transit Yellow Line Project : Lat Phrao - Samrong Section (Cont'd)

Environmental Parameters	Environmental Impacts	Environmental Impact Prevention and Mitigation Measures	Environmental Monitoring Measures
5. Air Quality (cont'd)		clean and vacuum the dust off the road surface. - Set up no parking signs for all types of vehicles (except buses) under the MRT stations.	
	Impact on Depot Area and Park & Ride Buildings Construction Phase - The impact from the Depot construction show that Carbon Monoxide (CO) is equal to 0.02524 parts per million, Hydrocarbons (HC) is equal to 0.02124 parts per million, nitrogen dioxide (NO_2) is equal to 0.05783 parts per million and total suspended particles (TSP) is equal. 0.00510 mg/m. According to the air quality standards announced by the National Environment Board No. 10 (1995) and No. 24 (2004) Ambient Air Quality Standards which determines that the concentration of Carbon Monoxide (CO) average one hour should not exceed 30 parts per million, nitrogen dioxide (NO_2) the average one hour should not exceed 0.170 parts per million and average suspended particle over 24-hour should not exceed 0.33. mg / m (the standard of hydrocarbons in the Thailand has not yet determined) - The impact from the Park and Ride buildings construction show that Carbon Monoxide (CO) is		

List of Major Environmental Impacts, Environmental Impact Prevention and Mitigation Measures, and Environmental Monitoring Measures
Bangkok Mass Transit Yellow Line Project : Lat Phrao - Samrong Section (Cont'd)

Environmental Parameters	Environmental Impacts	Environmental Impact Prevention and Mitigation Measures	Environmental Monitoring Measures
5. Air Quality (cont'd)	equal to 0.05475 parts per million, Hydrocarbons (HC) is equal to 0.04646 parts per million, Nitrogen Dioxide (NO_2) is equal to 0.12533 parts per million and total suspended particles (TSP) is equal. 0.01090 mg/m. According to the air quality standards announced by the National Environment Board No. 10 (1995) and No. 24 (2004) Ambient Air Quality Standards which determines that the concentration of carbon monoxide (CO) average one hour should not exceed 30 parts per million, Nitrogen Dioxide (NO_2) the average one hour should not exceed 0.170 parts per million and average suspended particle over 24-hour should not exceed 0.33. mg / m (the standard of hydrocarbons in the Thailand has not yet determined)		
	<u>Operation Phase</u> - Due to the traffic to the depot has not continued throughout the day and the surrounding area is an open space with no high buildings (up to two floors), to block the exhaust from vehicles so there is no obstruction for the pollution from vehicles that passing under the train station. Therefore, the air flow around the station is in a good condition just like the condition before the project construction. Also. the concentration of		

List of Major Environmental Impacts, Environmental Impact Prevention and Mitigation Measures, and Environmental Monitoring Measures
Bangkok Mass Transit Yellow Line Project : Lat Phrao - Samrong Section (Cont'd)

Environmental Parameters	Environmental Impacts	Environmental Impact Prevention and Mitigation Measures	Environmental Monitoring Measures
5. Air Quality (cont'd)	pollutants (CO - 1 hour) is not to exceed air quality standards or harm the health of a community or sensitive area, such as religious place, schools, or hospitals, etc. that located nearby stations. Thus, the impact is low.		
6. Noise	<u>Impact on the Elevated Structures and the Stations area</u> <u>Construction Phase</u> - The noise level of the vulnerable areas along the project route will be in the range of 66.5 to 86.6 dB (A). In detail, the vulnerable areas will be affected within 30 meters from the center line of the route but these areas are Right of Way. Therefore, the vulnerable area of the project as the following; Suan Luang and Chulavej Hospital.	<u>Construction Phase</u> Requiring the contractor to do the following: - <u>Install 2 meters high concrete walls and metal sheet in the construction site.</u> - Use tools, equipments and machines that do not produce loud noise or use the noise control equipments (such as sound isolation or cover) if the noise level at the source exceeds 90 dB (A) for one hour. - The contractor should prepare at least three to four staff members to control, maintain, or check the machines, equipments and vehicles used for the construction. This aims to ensure that they remain in good condition throughout the construction phase and to keep the noise level in the standard limit. - The speed of vehicles transporting materials and equipment should not exceed 30 km/hr.	<u>Construction Phase</u> - There are 26 monitoring station of noise as follows: • Station : 1 Judicial Training Institute • Station : 2 Pibool Upphatham School • Station : 3 Chok Chai 4 Police Station Flat • Station : 4 Thanormpitvithaya School • Station : 5 Bangkok Suksa School • Station : 6 Big C Superstore (Lat Phrao) • Station : 7 Wat Mae Phra Kularb Tip (Maria Rosa Mystica Church) • Station : 8 Vejthani Hospital • Station : 9 The Mall Bang Kapi • Station : 10 Fatthullbalee Mosque • Station : 11 Sudnaree Kindergarten • Station : 12 Huamak Municipality School • Station : 13 Jamiul Idhard Mosque (Hua Mak Yai)

List of Major Environmental Impacts, Environmental Impact Prevention and Mitigation Measures, and Environmental Monitoring Measures
Bangkok Mass Transit Yellow Line Project : Lat Phrao - Samrong Section (Cont'd)

Environmental Parameters	Environmental Impacts	Environmental Impact Prevention and Mitigation Measures	Environmental Monitoring Measures
6. Noise (cont'd)		when passing the communities, residential areas or commercials areas, such hospitals, religious places or temples, and schools or educational institutes. This aims to avoid the noise problem, especially during the school period or religious practice, such as morning and evening prager (Buddhism) or the Muslim prayer (Islam) or resting time. - Mostly elevated guide way and MRT stations are constructed on the road median of existing road network, which has limited space. Therefore, the construction period must start from 8 am. to 6 pm. The major structure (e.g. elevated guide way and MRT stations), such as foundation excavation of elevated guide way and MRT stations and cementing to mold the piers of elevated guide way and the floor of MRT stations, must not be constructed between 9 pm. and 5 am. of the following day to avoid disturbing the sleep of communities on the existing road network. This excludes removing the pillars/concrete beam/concrete slab/guide way, which must be done at night to reduce the traffic jam in the area.	• Station : 14 Huamak School • Station : 15 Klongkalantan School • Station : 16 Suraomai School • Station : 17 Khajonsiri Temple • Station : 18 Darul Amin Mosque • Station : 19 Dusit Thani College • Station : 20 Bangkok Metropolitan Land Office, Phra Khanong Branch • Station : 21 Si Iam Temple • Station : 22 Big C Srinagarindra (former Carrefour Srinagarindra) • Station : 23 Klongkratumratutit School • Station : 24 Siriwutti Wittaya school • Station : 25 Chularat2 Hospital • Station : 26 Chulavej Hospital - indexes • (L_{eq} 24 hr) • (L_{dn}) • (L_{max}) • L_{10}, L_{90} - Phase • This shall be conducted one month before the construction starts, once for five consecutive days, which include working days and public holidays, to serve as the baseline data.

List of Major Environmental Impacts, Environmental Impact Prevention and Mitigation Measures, and Environmental Monitoring Measures
Bangkok Mass Transit Yellow Line Project : Lat Phrao - Samrong Section (Cont'd)

Environmental Parameters	Environmental Impacts	Environmental Impact Prevention and Mitigation Measures	Environmental Monitoring Measures
6. Noise (cont'd)		- The staffs or workers, who work in the construction areas for eight to ten consecutive hours, must wear the protective equipments to reduce the noise level, such as ear muffs and ear plugs. The staffs or workers who work in the construction areas or the noisy area for at least 15 consecutive days must be rotated. - The contractor must install the absorptive materials under four MRT stations, namely Phawana, Chok Chai 4, Lat Phrao 101 and Samrong stations.	• This shall be conducted once a month, each for five consecutive days, which include working days and public holidays, during construction within a radius of 1 km and from the measurement stations throughout the construction phase. - Budget : 6,000 baht/point, total 156,000 baht/time - Agency in charge • Mass Rapid Transit Authority of Thailand. (MRTA)
	<u>Operation Phase</u> - The predicted Noise levels at the different distance in the operation Phase in the urban areas and vulnerable areas to the effects found that the level of noise caused by the train is equal to 67.70 dB (A) lower than the benchmark level by the Board of Directors of the National Environmental Act No. 15 of 2003 does not exceed 70 dB(A).When taken the distance from sensitive areas into account, the sensitive areas that most affected is Suan Luang Christendom with the distance of 24.92 meters along the path of the 24-hour average noise level of 63.3 dB (A) that lower than the standard.	<u>Operation Phase</u> Requiring the operator or concessionaire to do the following: - It is necessary to check the conditions and effectiveness of the materials installed along the route or under the MRT stations at least once a month. Once finding any damage or that its effectiveness decreases more than 40%, the Project should consider replacing it immediately. - If analysis of noise level in the operation phase under any train stations yields higher than the noise standard indicated in the announcement No. 15 of the National	<u>Operation Phase</u> - <u>There are 6 monitoring station of noise as follows:</u> • <u>Station : 1 Pibool Upphatham School</u> • <u>Station : 2 Vejthani Hospital</u> • <u>Station : 3 Klongkalantan School</u> • <u>Station : 4 Darul Amin Mosque</u> • <u>Station : 5 Si Iam Temple</u> • <u>Station : 6 Chulavej Hospital</u> - indexes • (L_{eq} 24 hr) • (L_{dn}) • (L_{max}) • L_{10}, L_{90}

List of Major Environmental Impacts, Environmental Impact Prevention and Mitigation Measures, and Environmental Monitoring Measures
Bangkok Mass Transit Yellow Line Project : Lat Phrao - Samrong Section (Cont'd)

Environmental Parameters	Environmental Impacts	Environmental Impact Prevention and Mitigation Measures	Environmental Monitoring Measures
6. Noise (cont'd)		Environment Board B.E. 2540 (louder than 70 dB (A) for five consecutive days, the absorptive material must be installed under the MRT stations to reduce the noise level. - Set up the traffic signs, such as direction, speed limit and no honking, in the area before and after each train station. - Regularly check and maintain the train system, especially the wheels and guide way (or follow the manufacturers' terms) to keep them in good condition and avoid the noise problem. - Design the guide way to ensure the even top and side surface. - Monorail train is designed to operate with rubber tires only. All rubber tires of the monorail trains must be strictly checked and replaced as scheduled. - The monorail train must have the nave plates designed to cover the whole wheel to reduce the noise caused by the running train throughout the operation.	- Phase • The sound shall be monitored twice a year, each covering five consecutive days, which include working days and public holidays. This shall take five consecutive years. After that, the noise monitoring will carried out once a year, each covering five consecutive days, which include working days and public holidays (during the southwest and northeast monsoons). - Budget : 6,000 baht/point, total 36,000 baht/time - Agency in charge • Mass Rapid Transit Authority of Thailand. (MRTA)

List of Major Environmental Impacts, Environmental Impact Prevention and Mitigation Measures, and Environmental Monitoring Measures
Bangkok Mass Transit Yellow Line Project : Lat Phrao - Samrong Section (Cont'd)

Environmental Parameters	Environmental Impacts	Environmental Impact Prevention and Mitigation Measures	Environmental Monitoring Measures
6. Noise (cont'd)	<u>Impact on Depot Area and Park & Ride Buildings</u> <u>Construction Phase</u> - The Depot will be located east of the Si Iam junction. The nearest village and vulnerable areas to be affected is Prem Ruethai Udomsuk where located about 200 meters away from route alignment. However, the noise level before adjusting is equal to 72.0 dB (A) and the adjusted noise level is to 69.0 dB (A) after subtracted from the measurement ((L_{90}) measured at Si Iam Temple (66.7 dB (A)) that is the interference of 2.3 dB (A) lower than the level of interference. imposed (up to 10.0 dB (A)). Thus, the construction activities like drilling and piling will not interference Prem Ruethai Udomsuk village where located about 200 meters away, but the effects that occurred in the whole of the Depot construction is expected to be moderate. - The Park and Ride buildings will be located east of the Si Iam junction. The closest representative vulnerable areas to be of affected is Wat Si Iam where located approximately 150 meters away from park & ride buildings area. However, the noise level before adjusting is equal to 73.4 dB (A) and the adjusted noise level which found that the noise level is equal to 71.4 dB (A) after subtracted from the measurement ((L_{90}) measured at Si Iam Temple	<u>Construction Phase</u> Requiring the contractor to do the following: - <u>Install two meters high solid steel fences at the depot and park & ride buildings.</u> - The depot and park & ride buildings are constructed on the empty land, with fences to clearly indicate the boundary, from 8 am. to 6 pm. After this period, the construction is not allowed. This excludes the removal of concrete mold, concrete beam and concrete slab or the removal of unused construction scraps from the construction site, which can be done from 7 to 9 pm. - The staffs or workers, who work in the construction areas for eight to ten consecutive hours, must wear the protective equipments to reduce the noise level, such as ear muffs and ear plugs. The staffs or workers who work in the construction areas or the noisy area for at least 15 consecutive days must be rotated.	

List of Major Environmental Impacts, Environmental Impact Prevention and Mitigation Measures, and Environmental Monitoring Measures
Bangkok Mass Transit Yellow Line Project : Lat Phrao - Samrong Section (Cont'd)

Environmental Parameters	Environmental Impacts	Environmental Impact Prevention and Mitigation Measures	Environmental Monitoring Measures
6. Noise (cont'd)	(66.7 dB (A)) that is the interference of 4.7 dB (A) lower than the level of interference. imposed (up to 10.0 dB (A)). Thus, the construction activities like drilling and piling will not interference Wat Si Iam and the nearest communities where located about 150 meters away from construction area, but the effects that occurred during park & ride building construction is expected to be moderate.		
	<u>Operation Phase</u> - During the operation Phase, the activities of the depot are mainly maintenance and repair. The maintenance activities will mainly take place inside the hangar building. The building is closed and will not cause noise disturbance to residents living in the neighborhood. - The Park and Ride buildings will be used for private car parking in the building and travel by project. The closest representative vulnerable areas to be of affected is Wat Si Iam where located approximately 150 meters from park & ride building. The evaluation procedure to assess noise above. Before adjusting the noise level that equal to 69.6 dB (A) and found that the noise level is equal to 62.6 dB (A). When the offset from noise level-based measurement ((L_{90}) measured at Si Iam Temple (66.7 dB (A)) is the interference of -4.1 dB (A) lower	<u>Operation Phase</u> Requiring the operator or concessionaire to do the following: - Plant tall trees with thick leaves at least two zigzag rows, such as Mast Tree, Devil Tree or Mahogany, around the area as the buffer zone. Furthermore, they help lower the noise from running vehicles/electric train or train maintenance, around the depot and park & ride buildings.	

List of Major Environmental Impacts, Environmental Impact Prevention and Mitigation Measures, and Environmental Monitoring Measures
Bangkok Mass Transit Yellow Line Project : Lat Phrao - Samrong Section (Cont'd)

Environmental Parameters	Environmental Impacts	Environmental Impact Prevention and Mitigation Measures	Environmental Monitoring Measures
6. Noise (cont'd)	than the level of interference defined (up to 10.0 dB (A)). Considering the operational activities in the park and ride buildings does not interfere with measurements Si Iam Temple and communities approximately 150 meters, so the impact on the noise from the operation area of park and ride buildings is expected to be low.		
7. Vibration	**Impact on the Elevated Structures and the Stations area** **Construction Phase** - The construction of the elevated structures expected to have the impact prone, communities and vulnerable, areas of the vibration in a range of drilling rigs in the distance from the source of up to 33 meters, the particles velocity ranged up to 2.094 mm./Sec. or no more than 0.082 inches/second that is Chularat 2 Hospital and Chulavej Hospital which is the vibration that humans can feel to annoy but not to the level of disrupt on humans who live in the building, according to Reiher & Meister (1931). Thus, there is no risk of damage to be caused to buildings or architectural structures according to DIN 4150 (Nelson, 1987) Thus, it can be concluded that the effects of vibration in the construction Phase is low to moderate.	**Construction Phase** Requiring the contractor to do the following: - In the detail design and the construction of elevated guide way , MRT stations, depot and park & ride buildings, the structure must be able to safely absorb the vibration of earthquake or geological disaster in compliance with the regulation of the Ministry of Interior B.E. 2554 on weight bearing, the durability of building and the ground supporting the building that resists the earthquake vibration. This regulation is issued in compliance with the context of Building Control Act, B.E. 2522. - During the foundation construction to support the elevated guide way and MRT stations, the steel sheet pile must be	**Construction Phase** - There are 26 monitoring station of vibration as follows: • Station : 1 Judicial Training Institute • Station : 2 Pibool Upphatham School • Station : 3 Chok Chai 4 Police Station Flat • Station : 4 Thanormpitvithaya School • Station : 5 Bangkok Suksa School • Station : 6 Big C Superstore (Lat Phrao) • Station : 7 Wat Mae Phra Kularb Tip (Maria Rosa Mystica Church) • Station : 8 Vejthani Hospital • Station : 9 The Mall Bang Kapi • Station : 10 Fatthullbalee Mosque • Station : 11 Sudnaree Kindergarten • Station : 12 Huamak Municipality School

List of Major Environmental Impacts, Environmental Impact Prevention and Mitigation Measures, and Environmental Monitoring Measures
Bangkok Mass Transit Yellow Line Project : Lat Phrao - Samrong Section (Cont'd)

Environmental Parameters	Environmental Impacts	Environmental Impact Prevention and Mitigation Measures	Environmental Monitoring Measures
7. Vibration (cont'd)		installed 18 meters deep in the soft to medium soft clay layer. This will help reduce the vibration and prevent it from disturbing the existing road network, especially three sensitive areas located less than 30 meters away, namely Suan Luang Church, Chularat 2 Hospital and Chulavej Hospital. - The construction that will cause the vibration, such as foundation excavation to support the elevated road, MRT stations, depot and park & ride buildings, can start at 8 am. and finish no later than 6 pm. This aims to avoid disturbing the communities' daily activities or the sensitive areas, such as Dharma teaching and learning, religious practice, morning - evening prayer (Buddhism), Muslim prayer (Islam) or resting time. - If the construction activities continue to cause the vibration, especially foundation excavation, it is necessary to reduce the energy used for the pier excavation and increase the frequency of excavation to reduce the vibration.	• Station : 13 Jamiul Idhard Mosque (Hua Mak Yai) • Station : 14 Huamak School • Station : 15 Klongkalantan School • Station : 16 Suraomai School • Station : 17 Khajonsiri Temple • Station : 18 Darul Amin Mosque • Station : 19 Dusit Thani College • Station : 20 Bangkok Metropolitan Land Office, Phra Khanong Branch • Station : 21 Si Iam Temple • Station : 22 Big C Srinagarindra (former Carrefour Srinagarindra) • Station : 23 Klongkratumratutit School • Station : 24 Siriwutti Wittaya school • Station : 25 Chularat2 Hospital • Station : 26 Chulavej Hospital - indexes • Peak Particle Velocity (PPV) in mm/sec • Frequency in Hz - Phase • This shall be conducted one month before the construction starts, once for five consecutive days, which include working days and public holidays, to serve as the baseline data.

List of Major Environmental Impacts, Environmental Impact Prevention and Mitigation Measures, and Environmental Monitoring Measures
Bangkok Mass Transit Yellow Line Project : Lat Phrao - Samrong Section (Cont'd)

Environmental Parameters	Environmental Impacts	Environmental Impact Prevention and Mitigation Measures	Environmental Monitoring Measures
7. Vibration (cont'd)		- Ensure that the vehicles transporting materials and equipments strictly follow the traffic law and speed limit of no faster than 30 km/hr. and contain the load under 25 tons when passing the residential or commercial zones or sensitive areas, such as healthcare facilities, schools/education institutes or religious places, namely temples, mosques and churches. - In case of complaints made by the landlords of buildings or commercial buildings near the construction areas of elevated guide way and MRT stations, the civil engineers must be sent to inspect and analyze the damage and urgently find the solution. - Promote the construction plan at least three months in advance among the people and focus the promotion among the people at least 15 days.	• This shall be conducted once a month, each for five consecutive days, which include working days and public holidays, during construction within a radius of 1 km and from the measurement stations throughout the construction phase. - Budget : 18,000 baht/point, total 468,000 baht/time - Agency in charge • Mass Rapid Transit Authority of Thailand. (MRTA)
	<u>Operation Phase</u> - The vibration for the sensitive areas impact by the distance from the center of the project, found that the vibration is in the range of 6.0x10-7 to 0.29084 mm / sec. Thus, the vibration mainly in the sense that humans cannot feel or merely feel or possibly feel follows the standards of Reiher & Meister	<u>Operation Phase</u> Requiring the operator or concessionaire to do the following: - Inspect the route condition. this includes the flexibility of the trains' rubber tire, which must be strictly replaced as scheduled by the manufacturers.	<u>Operation Phase</u> - <u>There are 6 monitoring station of vibration as follows:</u> • <u>Station : 1 Pibool Upphatham School</u> • <u>Station : 2 Vejthani Hospital</u> • <u>Station : 3 Klongkalantan School</u> • <u>Station : 4 Darul Amin Mosque</u>

List of Major Environmental Impacts, Environmental Impact Prevention and Mitigation Measures, and Environmental Monitoring Measures
Bangkok Mass Transit Yellow Line Project : Lat Phrao - Samrong Section (Cont'd)

Environmental Parameters	Environmental Impacts	Environmental Impact Prevention and Mitigation Measures	Environmental Monitoring Measures
7. Vibration (cont'd)	(1931). The impact of vibration on structures revealed that the vibration occurred without any consequences to the historic building according to DIN 4150 standards (Nelson, 1987).		• Station : 5 Si Iam Temple • Station : 6 Chulavej Hospital - indexes • Peak Particle Velocity (PPV) in mm/sec • Frequency in Hz - Phase • The vibration shall be monitored twice a year, each covering five consecutive days, which include working days and public holidays. This shall take five consecutive years. After that, the monitoring will be carried out once a year, each covering five consecutive days: both working days and public holidays - Budget : 18,000 baht/point, total 108,000 baht/time - Agency in charge • Mass Rapid Transit Authority of Thailand. (MRTA)
	Impact on Depot Area and Park & Ride Buildings **Construction Phase** - The impact of vibration of nearest sensitive areas at Prem Ruethai Udomsuk village showed the peak particle velocity from the Monorail is equal to 0.139 mm/sec. or 0.005 inches/second which are	**Construction Phase** - To compile the environmental impact prevention and mitigation measures in cooperation with viaduct and station's area.	

List of Major Environmental Impacts, Environmental Impact Prevention and Mitigation Measures, and Environmental Monitoring Measures
Bangkok Mass Transit Yellow Line Project : Lat Phrao - Samrong Section (Cont'd)

Environmental Parameters	Environmental Impacts	Environmental Impact Prevention and Mitigation Measures	Environmental Monitoring Measures
7. Vibration (cont'd)	the level of vibration that human could not feel of harm to health according to Reiher & Meister (1931), Thus, there is no effects or damage to the structures of all types including the ancient building according to DIN 4150 (Nelson, 1987) - The predicted vibration level from the Depot showed that the most vulnerable areas to be impacted are Si Iam Temple at a distance of 200 meters to get the peak particle velocity up to 0.213 mm/sec. or 0.008 inches/second which are the level of vibration that human could not feel of harm to health according to Reiher & Meister (1931). Thus, there is no effects or damage to the structures of all types according to DIN 4150 (Nelson, 1987)		
	<u>Operation Phase</u> - The communities and sensitive areas along the route project will not be affected or damaged by the vibration on operation phase.		
Biological Environmental Resources			
1. Aquatic Ecology	<u>The Impact of the Elevated Structures and the Stations area</u> <u>Construction Phase</u> - The construction activities especially the excavation and reclamation, drilling and foundations to support the of the elevated and the stations or construction	<u>Construction Phase</u> - The construction and operation of depot, especially during the land excavation, foundation excavation and the oil	

List of Major Environmental Impacts, Environmental Impact Prevention and Mitigation Measures, and Environmental Monitoring Measures
Bangkok Mass Transit Yellow Line Project : Lat Phrao - Samrong Section (Cont'd)

Environmental Parameters	Environmental Impacts	Environmental Impact Prevention and Mitigation Measures	Environmental Monitoring Measures
1. Aquatic Ecology (cont'd)	material transportation (such as cement, sand, stone, clay, etc.), is not expected to cause a negative impact on the aquatic ecosystem in the surface water. There are 19 surface water bodies along the project route to cut through, however, the construction of the piers of the elevated structures and stations will not create any part of intrusion into the water. Thus, there is no activity to disturb the surface water quality and ecological impact directly on the water except three stations which located from the surface water up to 50 meters, Lat Phrao 101 stations Kalanton station, Suan Luang Ro 9 Station that may be affected by an increase in turbidity from soil erosion during the excavations and reclamation. Also, surface water may be contaminated with oil from the construction equipment. The amount of turbidity and oil will block the light from the sun into the water level, making phytoplankton photosynthesis less hence dissolved oxygen is produced by phytoplankton is reduced. The expected impact is only temporary low in the construction Phase. The construction area is limited only on the traffic island in the middle of the road.	contamination from the machines or equipments used for the construction, may have low impact on aquatic ecology. However, the prevention and mitigation measures are required. In the construction phase, the measures must be formulated in line with the quality of surface water.	
	<u>Operation Phase</u> - Since a single track rail system to be run on the elevated structure powered by electricity. Thus, it		

List of Major Environmental Impacts, Environmental Impact Prevention and Mitigation Measures, and Environmental Monitoring Measures
Bangkok Mass Transit Yellow Line Project : Lat Phrao - Samrong Section (Cont'd)

Environmental Parameters	Environmental Impacts	Environmental Impact Prevention and Mitigation Measures	Environmental Monitoring Measures
1. Aquatic Ecology (cont'd)	does not impact the aquatic ecology in the surface water especially the stations that located away from the surface water up to 50 meters, including Lat Phrao 101 Station Kalanton Station, Suan Luang Ro 9 Station. These three stations would have wastewater discharge from the toilets during the daytime activities such as ticketing, public relations security and communication, etc. approximately up to 10 people per day wastewater per station 0.40 cubic meters/day (see details in section 4.2.1: surface water quality), the amount of wastewater that will happen will be treated by the wastewater treatment plant with the capacity of 2 cubic meters of ready-installed in all stations. The effluent quality, according to the Ministry of Natural Resources and Environment. "Standards Control Sewerage from some building types and sizes, "published in Volume 122 at 125 dated December 29, 2005, and therefore does not affect the ecology of the water in the surface water.		
	<u>The Impact on Depot and Park and Ride buildings</u> <u>Construction Phase</u> - Depot is located east of the Si Iam junction nearby the surface water source (Khlet Canal), without the construction of any part of the structure intruded into the canal however, it may be impacted by an increase in turbidity from soil erosion during the	<u>Construction Phase</u> - The measures must be formulated in line with the quality of surface water.	

of Major Environmental Impacts, Environmental Impact Prevention and Mitigation Measures, and Environmental Monitoring Measures
Bangkok Mass Transit Yellow Line Project : Lat Phrao - Samrong Section (Cont'd)

Environmental Parameters	Environmental Impacts	Environmental Impact Prevention and Mitigation Measures	Environmental Monitoring Measures
1. Aquatic Ecology (cont'd)	excavations and cover of the areas which subject to contamination from oil used in construction equipment during Depot construction. The amount of turbidity and oil will partial block the light from the sun into the surface water. As a result, phytoplankton can photosynthesis less and dissolved oxygen produced by phytoplankton is also reduced. The expected impact is only temporary low in the construction Phase.		
	<u>Operation Phase</u> - During the operation Phase, the amount of wastewater from the use of toilets and wash dishes in the management and control building, the restaurant, the staff dormitory, wastewater from washing and maintenance activities, approximately 142.60 cubic meters/day in total. The amount of wastewater going to the treatment systems using Onsite Treatment Plant which is a Septic - Anaerobic Filter and Contact Aeration Process with the capacity of 50 cubic meters/3 containers with a total volume of 150 cubic meters, followed by a retention. Therefore, the wastewater quality meets the "Standards Control sewerage from certain building types and sizes," according to the Ministry of natural Resources and the environment, published in Volume 122 at	<u>Operation Phase</u> - The measures must be formulated in line with the quality of surface water.	

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Bangkok Mass Transit Yellow Line Project : Lat Phrao - Samrong Section (Cont'd)

Environmental Parameters	Environmental Impacts	Environmental Impact Prevention and Mitigation Measures	Environmental Monitoring Measures
1. Aquatic Ecology (cont'd)	125D dated December 29, 2003. The amount of waste water before discharge into the Khlet Canal is expected to have no impact on aquatic ecology in the surface water.		
2. Terrestrial Ecology **2.1 Forest resources**	**The Impact area of the Elevated Structures and the Stations** **Construction Phase** - The construction of elevated structures and stations will consider the construction area of about eight meters wide on the traffic island of Lat Phrao Road. Srinagarindra Road and Theparak Road. Therefore, trees with a height of over 10 meters to be obstructed by the construction must be cut or removed. The area is also the location of a piles support elevated structure and stations. It is expected to have an impact on the loss of the balance of ecosystems and vegetation is low because the trees are found along the sidewalks on both sides with a total of 4,571 trees (60 species) and the median of the road, with a total of 681 trees. (2 species) and over 95% of the trees in the city, which has planted by humans (such as Pink Tecoma (*Tabebuia rosea*), Copper pod (*Peltophorum pterocarpum*), White Cheesewood (*Alstonia scholaris*), Mahogany (*S. macrophylla*), and Cork Tree (*Millingtonia hortensis*), etc.) and	**Construction Phase** Requiring the contractor to do the following: - Coordinate with the agencies concerned in Bangkok, such as District Office of Lat Phrao, Wang Thonglang, Bang Kapi, Suang Luang, Prawet and Bang Na, and in Samut Prakan province, namely Samrong Nuea Municipality and Thepharak Administrative Organization, to discuss about the construction guideline and setting the construction areas to limit the expected effect on trees. - Survey and estimate the number of trees to be cut down during the project operation and to be removed (dig around) from the project area and planted in the prepared areas. - Use labors or machines to remove (dig around) the large and important trees (with the chest-wide diameters; DBH > 10	

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Bangkok Mass Transit Yellow Line Project : Lat Phrao - Samrong Section (Cont'd)

Environmental Parameters	Environmental Impacts	Environmental Impact Prevention and Mitigation Measures	Environmental Monitoring Measures
2.1 Forest resources (cont'd)	only 5% is the tree itself under natural conditions. (such as Raintree (*Samanea saman* (Jacg.) Merr.), Manila Tamarind (*Pithecellobium dulce*), jujube (*Ziziphus mauritiana*), and Tropical almond (*Terminalia catappa*) etc.).	cm.) from the project area before the construction phase. Then, plant them in the prepared areas, such as empty space along the project route or inside the depot. The types and number of each tree must be recorded. The workers are allowed to cut down the degenerating trees but they need to clear the scraps out of the areas. - After the area opening to construct the project, the land must be cleared and graded to facilitate the tree planting process. - Fill the land with the soil from or outside the project area before planting trees so that the roots can attach the soil in the first period. - The medium or large trucks must carefully remove the soil gained from the foundation excavation or materials and equipments to avoid damaging the nearby trees. - Grow the plant succession to save the eco-system. The Project may ask for the advice or saplings from BMA, Samut Prakan province, Royal Forest Department and	

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Bangkok Mass Transit Yellow Line Project : Lat Phrao - Samrong Section (Cont'd)

Environmental Parameters	Environmental Impacts	Environmental Impact Prevention and Mitigation Measures	Environmental Monitoring Measures
2.1 Forest resources (cont'd)		National Park, Wildlife and Plant Conservation and Department. The selected types of plants should be suitable for the urban ecology, can grow in the project environment, and does not obstruct the view when the train runs. For example, grow the climbing plants, such as medium or heavy vines, to soften the look of the pier of elevated guide way or MRT stations, increase green areas, and arrange the small garden in the area under the MRT stations (if available) or along the route to enhance the balance of eco-system. - Take care of the trees, such as loosen the soil, add fertilizer, get rid of weeds and pests, and plant replacement trees. - Check the trees planted and environment of remaining forest around the project. - After the construction is completed, the workers' camps must be immediately taken apart and taken out of the site. Then, the land must be cleared to resume its previous condition. If the eco-system of any area needs to be revived by tree planting, the action should be taken at once.	

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Bangkok Mass Transit Yellow Line Project : Lat Phrao - Samrong Section (Cont'd)

Environmental Parameters	Environmental Impacts	Environmental Impact Prevention and Mitigation Measures	Environmental Monitoring Measures
2.1 Forest resources (cont'd)	<u>Operation Phase</u> - During the operation Phase, the impact is expected to have a low impact on the ecosystem and disrupt plant communities along the project route. The plant will have the capacity to adapt to resist the changing environmental condition. In the large communities, some plants will be less receive sun light because the sun light has obscured by the elevated structure and stations. This makes the process of photosynthesis of plants for use in food production potential deteriorate.	<u>Operation Phase</u> Requiring the operator or concessionaire to do the following: - <u>Control and prevent the woodcutting in the project area by coordinating with the agencies concerned in Bangkok Metropolitan, such as District Office of Lat Phrao, Wang Thonglang, Bang Kapi, Suan Luang, Prawet and Bang Na, and in Samut Prakan province, namely Samrong Nuea Municipality and Thepharak Administrative Organization.</u> - Take care of trees that the Project grows and plant the replacement if the trees are dead.	
	<u>**The Impact on Depot**</u> <u>**Construction Phase**</u> - Due to the current conditions of the Depot construction area is a bare land. Only plant shrubs and medium-sized tree covered within the Depot 39 trees (6 species), it is estimated that only some of the trees were cut down or move out of the construction area. The trees removed will not affect the balance of the ecosystem and economic value. Thus, the impact is low.		

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Bangkok Mass Transit Yellow Line Project : Lat Phrao - Samrong Section (Cont'd)

Environmental Parameters	Environmental Impacts	Environmental Impact Prevention and Mitigation Measures	Environmental Monitoring Measures
2.1 Forest resources (cont'd)	<u>Operation Phase</u> - In the operation Phase, there will be no change to impact the balance of ecosystems and vegetation as a landscape architect, a Depot for the trees / shade by adding more green space and trees medium - large and beautiful flowering trees and ornamental plants. To replace the trees that may be cut or removed in the construction Phase.		
Human Use Values			
1. Land use	<u>The Impact of the Elevated Structures and the Stations area</u> <u>Construction Phase</u> - Since the construction area of elevated structures is approximately 7 meters wide on the traffic island. Therefore, it is expected to have a fair impact on land use change. Due to the current conditions in the land use is relatively intense in particular, in the form of the medium to the high density residential area or commercial area. The infrastructure and utilities accounted for 90 percent while the empty space will be transformed into the medium density residential area. Thus, the expected impact is low. In the certain sector of the project, the route will deviate from the median line to the pedestrian area hence the certain commercial buildings and some commercial area will change into the elevated structure permanently.	<u>Construction Phase</u> Requiring the contractor to do the following: - The construction activities must be implemented in the construction site, depot and park & ride buildings only. - Provide the specific area to store the construction materials so that they are well organized and will not be piled up outside the construction area. Do not place the construction equipments or tools in the location that obstructs the water flow.	

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Environmental Parameters	Environmental Impacts	Environmental Impact Prevention and Mitigation Measures	Environmental Monitoring Measures
1. Land use (cont'd)	As the land use patterns have not changed much compared to the use of land surrounding neighborhood is commercial/ business, therefore, the impact is low.		
	<u>Operation Phase</u> - In the operation Phase of the project, patterns of land use along the project route will be slightly changed from the current condition. As the ratio of current patterns of land use in more than 90 percent cannot be expanded or changed, such as a medium to the high density residential area, commercial/business zone, government institutions, and public utilities. Nonetheless, the wasteland at some point can be improved follow the regulations/specifications of Bangkok principle city planning (2013). Also, the draft of principle city plan of Samutprakarn could be converted into a residential, semi-commercial due to the convenience of traffic or development projects that are good motivation and stimulus for the investment to take place, especially around the stations. Consequently, the current land use pattern might be improved for development patterns to the residential and commercial area, such as apartments, condominiums, large shopping center. office building or entertainment, etc., hence the impact is moderate.		

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1. Land use (cont'd)	<u>Impact on Depot Area and Park and Ride buildings</u> <u>Construction Phase</u> - The area of Depot is about 122 rais that necessary to converte the land use from partly bare land with a few shrubs covered into a five-story Depot building. Likewise, a seven-story building of Samut Prakan highway district office building will be converted into Park and Ride building with an area of 39.9 rais. Thus, the impact is in the moderate to high as the land use patterns will permanently change. However, due to changing land use patterns are not take place in many areas compared to the pattern of land use surrounding residential community that is less dense - medium.		
	<u>Operation Phase</u> - The Depot and Park & Ride located near the intersection of Srinagarindra Road and Bang Na - Trat, Road with a combined area of approximately 161.9 Rais. It is expected that the land used surrounding the Depot and Park and Ride building are likely to change from the current form because of the attraction of the Monorail system. With the land use patterns of current condition that account for the use of more than 75 percent is less dense residential community and semi- commercial area		

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1. Land use (cont'd)	or wasteland area/green space. Therefore, in certain areas may have to be expanded or changed according to regulations / specifications of Bangkok Principle City Planning (2013) and the draft Samut Prakan Principle Citi Planning. It can be converted into a medium to high density residential communities - such as flats, apartment, condominium, and housing, etc., or the commercial/trade or landmarks like government/state enterprise, gas station, shopping mall, private hospitals, educational institution, office building or entertainment, etc. Thus, the positive impact is low to moderate.		
2. Transportation	**<u>The Impact of the Elevated Structures and the Stations area</u>** **<u>Construction Phase</u>** - Since most of the construction activities will take place on the traffic median on Lat Phrao Road, Srinagarindra Road, and Thepharak road, the impact on the ability to accommodate traffic - Due to the materials, construction equipment/machinery to be used in construction will transport through the road network that are Lat Phrao Road, Srinagarindra Road, and Theparak Road The impact on the renewal of the existing road network may be a major cause of the pavement	**<u>Construction Phase</u>** Requiring the contractor to do the following: - As a result, the project must offer the alternative routes to the road users to reduce the number of vehicles on the existing road network during the construction. - At least 1 km from the project, the project must set up the traffic signs and symbolic signs - Since the road users come from out of town,	**<u>Construction Phase</u>** - The monitoring of transport condition at 14 major intersections as follows: • Ratchada-Lat Phrao Intersection • Phawana Intersection • Chok Chai 4 Intersection • Pradit Manuntham Intersection • Bang Kapi Intersection • Lam Sali Interchange • Krung Thep Kritha Intersection • Rama IV Srinagarind Interchange

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2. Transportation (cont'd)	damaged or deteriorated faster than expected. - The impact on the accidents in the construction area that might occur from the activities of the construction could cause an accident or construction workers who commute. Also, unorganized materials storing might obstruct walkways and the truck in and out the project area. This may be the cause of the accident, the vehicles used the route. Thus, the impact is moderate.	from the East to the West, and large volume of vehicles need to get into town via the existing road network, especially during morning rush hours. Therefore, the reversible lanes must be provided to facilitate the flow for incoming vehicles, with equal capacity to the pre-construction phase. - Inform the people who use the route via several media, such as billboards, brochures, newspapers, traffic radio stations (Jor Sor 100, Sor Wor Por 91, Ruam Duay Chuay Kan), websites and TV stations. Moreover, disseminate the news and information and ask for comments and recommendations of the agencies concerned. - The contractors must prepare the traffic plan that is aligned with the project's construction plan. Then, it must present the plan to MRTA, BMA or police stations responsible for their approval at least 30 days before opening the construction area in each location. - Ensure that the drivers for transporting materials and equipments for construction will strictly comply with traffic rules and	• Phatthanakan Intersection • On Nut Intersection • Udomsuk Intersection • Si Iam Interchange • Thepharak Intersection • Samrong Intersection - indexes • Number, types and directions of vehicles at the measurement points at different intersections that serve as the routes for transporting construction materials and equipment for the analysis of traffic volume on the highways. • Statistics of accidents. • Causes and levels of severity of accidents. - Phase • This shall be conducted once a month, each covering three consecutive days, which include working days and public holidays during morning peak hours (07:00-09:00 hrs), evening peak hours (16:00-19:00 hrs), and night peak hours (22:00-24:00 hrs). The monitoring shall be conducted until the construction of the structures of elevated ways, MRT stations

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Environmental Parameters	Environmental Impacts	Environmental Impact Prevention and Mitigation Measures	Environmental Monitoring Measures
2. Transportation (cont'd)		limit their driving speed when they drive past community areas or susceptible areas, such as temples/religious places, educational institutions, and health facilities to a maximum of 30 km/hour to prevent road accidents for themselves or the road users. - Improve the road surface on the existing road networks under the structures of elevated guide way and stations and associated areas to ensure its evenness. After construction areas are returned, clearly define the boundary of respective lanes. - Install lighting in areas under the stations and footpaths along the existing road networks to illuminate the road surface. The illumination should be at least 21.50 lux, which should be similar to natural light as much as possible to prevent accidents. - Install guide way, mesh to prevent material waste, noise walls, sound barriers, and water traps; keep material waste away from the road surface; and ensure safety of people concerned and local people	or Depot, and Park and Ride Buildings is completed. - Budget : 10,000 baht/point, total 140,000 baht/time - Agency in charge • Mass Rapid Transit Authority of Thailand. (MRTA)

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Bangkok Mass Transit Yellow Line Project : Lat Phrao - Samrong Section (Cont'd)

Environmental Parameters	Environmental Impacts	Environmental Impact Prevention and Mitigation Measures	Environmental Monitoring Measures
2. Transportation (cont'd)		who travel past the construction areas. - Install lighting in areas under the structures of elevated guide way , MRT stations, and footpaths along the existing road networks. - If there are construction activities that will block travel on the footpaths, provide temporary pedestrian ways and install direction signs to ensure the safety of bus users.	
	Operation Phase - During the normal operation Phase of the road network (Lat Phrao Road, Srinagarindra Road, Theparak Road) and surrounding areas may not be impacted by the loss of the original surface traffic due to the elevated structure and the train station will be constructed on the traffic island. The number of traffic lanes in each direction will be the as the original during the operation Phase. However, there may have a direct impact on traffic conditions on the road network as a whole which highly flexible, or have less traffic congestion, especially during the morning rush hour (7:00 to 9:00 AM.) and evening rush hour (4:00 to 7:00 PM.). Because there are people who use the road and some have turned to using the Monorail and public transportation increasingly. Since, it can be transported in mass	**Operation Phase** Requiring the operator or concessionaire to do the following: - Carry our public relations activities and campaigns for encouraging those with personal vehicles to shift to the mass transit system to resolve the problems of traffic jam and air and sound pollution. Incentive measures can be implemented on a periodic basis, such as offering discounted fares during festivals, offering a monthly ticket with a discount of at least 20 percent, and waiving the fares for people aged 60 or above. - Install non-parking signs for all types of vehicles on the existing road networks throughout the length of the stations for	**Operation Phase** - The monitoring of transport condition at 6 major intersections as follows: • Phatthanakan Intersection • On Nut Intersection • Udom Suk Intersection • Si Iam Interchange • Thepharak Intersection • Samrong Intersection - Indexes • Number, types and directions of vehicles at the measurement points at different intersections. • Statistics of accidents. • Causes and levels of severity of accidents - Phase • Measurement and data recording shall be carried out twice a year, each

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2. Transportation (cont'd)	passengers, approximately 247 874 passengers/day during its operation in the year 2019 and will be increased to more than 532,000 people/day in the year 2049, Thus, it is an alternative route for the traveler on the entire road network.	approximately 250 m: approximately 50 m ahead and behind the stations. - Coordinate with related agencies, such as the Bangkok Metropolitan Administration (responsible for the Bangkok Mass Transit system) or the Marine Department (responsible for boats) to connect to other public transport systems to transport passengers with the maximum efficiency. - Request cooperation from relevant authorities, particularly police stations with areas of responsibility along the project alignments, in order to ensure that the management of traffic on the existing road networks and connected areas will be in line with project time.	covering three consecutive days: working days and holidays during morning peak hours (07:00-09:00 hrs) and evening peak hours (16:00-19:00 hrs). This shall be done for five consecutive years. The, the frequency of the monitoring will reduce to once a year if the 24-month traffic volume tends to reduce by over 40% - Budget : 10,000 baht/point, total 60,000 baht/time - Agency in charge • Mass Rapid Transit Authority of Thailand. (MRTA)
	Impact on Depot Area and Park and Ride buildings **Construction Phase** - The construction of Depot and Park and Ride buildings will use the current road network for transport construction materials, equipment/machinery to be used in the Depot and park and ride construction. As a result, the existing road network might damage or deteriorate faster than the normal Phase. However, it will not impact the ability to accommodate traffic on the		

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2. Transportation (cont'd)	road network due to the Depot and park and ride building construction area are not located on the traffic island and the existing road network.		
	Operation Phase - In operation Phase, the Depot is expected to have the volume of traffic on the existing road network from the employee commute. It is expected that there will be no additional traffic volume because the employees can access directly to the depot by using the project train. Consequently, the traffic volume from the use of the personal car will be reduced. Also, the park and ride building is expected to reduce the use of personal cars for the commute to the city. The passenger can take a train into the city without affecting the overall traffic. Thus, the positive impact is low to moderate.		
3. Public Utilities and Infrastructure	**The Impact of the Elevated Structures and the Stations area** **Pre-construction phase and Construction Phase** - May have a negative impact on public utilities and infrastructure as follows: • The relocation of waterworks system along the traffic island and along the two sidewalks across the street at a construction Phase is consists of Lat Phrao Road and Srinagarindra Road with the total length of 20,620 meters	**Pre-construction phase** Requiring the contractor to do the following: - Request approval for the construction schedule and breakdown construction schedule. - Inform the starting date of the project and coordinate with relevant public and private agencies in Bangkok Metropolitan	**Pre-construction phase** - A survey conducted by field interviews. By using the Simple Random Sampling. For selecting sample group enterprise service infrastructure.

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3. Public Utilities and Infrastructure (cont'd)	• The relocation of high voltage towers/wires/ electrical equipment. along the sides of Lat Phrao Road, Srinagarindra Road, Theparak Road, and Pu Chao Saming Phrai Road in a total of 440 towers. • The relocation of landlines – aerial antenna Size 9 - D4 ", 12 - D4", 16 - D4 " (TOT Public Company Limited) along the sides of Srinagarindra Road, Theparak Road with a total length of 2,700 meters. • The relocation of utilities (Department of Highways) along the roads sides and in the center of traffic island of Lat Phrao Road, Srinagarindra Road, Theparak Road, and Pu Chao Saming Phrai Road can be summarized as follows: The reinforced concrete culvert size ϕ 1,000 - 1,200 mm. in total 3300 meters. The lighting poles (two pairs of legs luminaire) of 820 poles. • The relocation of communication cables - fiber optic communication lines - copper wires and conduits along the sides of Lat Phrao Road, Srinagarindra Road, and Theparak Road with a total length of 17,100 meters. • The relocation communication line - optical fiber and communication cable - copper wires	and Samut Prakan areas. This must comply with conditions specified by the agencies. - Relocation of plumbing pipes must be strictly based on methods of the MWA and other authorities. - Appoint the Employment Screening and Supervision Committee of the MRTA and provide the contractor with the list of committee members. After that, the contractor shall submit the list of personnel to the MRTA for approval before the construction. These personnel consist of project engineers, representatives of employees, as the representatives with the full authority to implement the project, field managers, foremen, pipe technicians, welders, etc. - Conduct PR activities before the construction – The contractor must install different signs, which consist of information signs, construction signs, and traffic signs.The contractor must be urged to post the signs 15 days before implementation on the first route. - Install solid fences that are at least 2 m high or equivalent to mark the boundary of	- Indexs • Throughout the relocation/change of public utilities for a phase of two years. - Budget : 250,000 baht/year, total 500,000 baht - Agency in charge • Mass Rapid Transit Authority of Thailand. (MRTA)

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3. Public Utilities and Infrastructure (cont'd)	and conduits (TOT Public Company Limited) along the sides of Lat Phrao Road, Srinagarindra Road, and Theparak Road with a total length of 11,700 meters. • The relocation of pipelines, oil and gas companies, Fuel Pipeline of the Transportation Company Limited and the PTT Public Company Limited, near Phatthanakan intersection that the project route will be used the space in the traffic median of Srinagarindra Road for the construction. The area is also overlapped with the construction of a through the tunnel the Phatthanakan and Srinagarindra intersection. As a result, the oil and gas pipeline at the intersection require the relocation of such a length of 30 meters for oil pipelines, and 30 meters of gas pipelines, as well. • The Bang Kapi viaduct, of Bangkok Metropolis, is a four-lane bridge, car traffic has surfaced asphalt concrete. The exits of the bridge are on Lat Phrao Road and Seri Thai Road and the level crossing at the junction of the Lat Phroa and Srinagarindra Road. The impact of the construction Phase of the yellow line in the area of the relocation elevated bridge crossing	the areas where public utilities must be relocated. - Request approval for traffic management plans - Culvert construction and jacking are usually carried out on the main roads. Although making long grooves using the traditional methods is not allowed, activities in the work process, including relocating machinery and transporting pipes, usually disturb traffics in the local areas. - Relocation of plumbing pipes must be strictly based on methods of the MWA and other authorities.	

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3. Public Utilities and Infrastructure (cont'd)	the front the Mall Bangkapi between km. 8 + 200 to 9 + 007. The total distance is 807 meters from the 1,820 meters long bridges.	<u>Construction Phase</u> Requiring the contractor to do the following: - Vehicles used for transporting public utilities must be covered in mesh or canvas to prevent them from falling onto the road surface and the speed of driving to the locations where materials are kept must not exceed 30 km/hour. - Provide temporary footpaths and direction signs in the case when the relocation of public authorities disturbs traffic on the footpath to ensure safety to the pedestrians. - If there is a complaint from the general public or road users that 'the relocation of public utilities' has caused trouble and nuisance or caused damage to existing public utilities, corrective actions must be urgently taken. - Maintain road surface, footpaths, road side, trees, and grass that are damaged by the relocation of public utilities based on standard requirements identified in drawings or standard requirements from the area owners so that they return to the original conditions. In practice, photos that show the	

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3. Public Utilities and Infrastructure (cont'd)		original conditions should be taken for comparison.	
	<u>Operation Phase</u> - In the operation Phase, there may be a positive impact on the overall public utility system and infrastructure as the area along the project route will increase the public utilities and infrastructure such as lighting systems, water supply systems, telecommunications, etc.	<u>Operation Phase</u> - During the operational phase is expected that there will be no loss or relocation of additional public utilities. For electromagnetic emissions and power supply in the MRT driving system, design and installation of electrical systems must be in accordance with the requirements of the Electromagnetic Compatibility (EMC) Standard (IEC 6100).	
	<u>Impact on Depot Area and Park and Ride buildings</u> <u>Construction Phase and Operation Phase</u> - Will not relocate any infrastructure and utilities. Thus, it does not affect the utilities and infrastructure.		
4. Water Drainage Hydrology and Flood Prevention	<u>The Impact of the Elevated Structures and the Stations area</u> <u>Construction Phase</u> - Will not disrupt the natural flow of water from the existing condition since there is no structure intruded in the surface water bodies. However, it is expected to have obstructed water flow occurs due to the construction of the elevated structures and stations require the construction space about eight meters wide on the traffic island especially in	<u>Construction Phase</u> Requiring the contractor to do the following: - The contractors shall provide 2-3 construction workers regularly stationed at the construction site to conduct monitoring and collect construction material wastes, such as dirt, stone, sand, and cement falling in the construction areas or the road surface	

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Bangkok Mass Transit Yellow Line Project : Lat Phrao - Samrong Section (Cont'd)

Environmental Parameters	Environmental Impacts	Environmental Impact Prevention and Mitigation Measures	Environmental Monitoring Measures
4. Water Drainage Hydrology and Flood Prevention (cont'd)	some sections of the Srinagarindra roads that drainage the water storm trough in the middle of the road. In addition, a moderate impact on the flow of water into the sewer system, waste materials such as debris, concrete, stone /clay/sand etc that put piles of construction materials. - Or place againt a solid concrete wall along the boundary of the construction area. This may obstruct the flow of rainwater falling onto the road surface and then flow into the sewer drainage. Therefore, the potential flooding on the traffic surface along the construction area of the project could occur.	on the existing road networks on a daily basis. If there are leftover materials from the construction, they must be moved out from the construction areas as soon as possible or within 24 hours to prevent obstruction to natural water flow, especially during the rainy season. - Request the contractors to place necessary construction materials in proper locations and not to place them in areas that can obstruct water flowing into the public drainage channel during the rainy season or lowland areas or surface water, e.g. Nam Kaeo Canal, Bang Sue Canal, Lat Phrao Canal, branch canals of Yai Phuean Canal, Saen Saeb Canal, Hua Mak Canal, Ban Ma Canal, Prawet Burirom Canal, and Khlet Canal. - The design of the structures of elevated guide way on Srinagarindra Road in the areas where there are water channels in the middle of the road should include a drainage system that have similar efficiency to the original one.	

List of Major Environmental Impacts, Environmental Impact Prevention and Mitigation Measures, and Environmental Monitoring Measures
Bangkok Mass Transit Yellow Line Project : Lat Phrao - Samrong Section (Cont'd)

Environmental Parameters	Environmental Impacts	Environmental Impact Prevention and Mitigation Measures	Environmental Monitoring Measures
4. Water Drainage Hydrology and Flood Prevention (cont'd)	<u>Operation Phase</u> - The elevated structures in the total distance of approximately 30 kilometers consists of the precast concrete box beam structure. As the surface of the elevated structure superimposed on the existing road surface, therefore, there will not be decreased of the surface water drainage but still capable for draining the sewer from rainstorm without the chance of flooding. Thus, the impact is low. - The 23 stations, 26 meters wide and 120 meters long with a total area of 2,835 square meters station superimposed over the existing road surface. However, there is no drainage surface reduced due to the surface area of the train station roof still receive the rainfall as not very different from the pre-existing projects. The rainwater will flow through the pipes to collect rainwater measuring ϕ 0.15 meters before entering the reservoir in the traffic island and flows through the pipe size ϕ 0.30 meters into the drainage system along the train system Thus, the impact low.		
	<u>Impact on Depot Area and Park and Ride buildings</u> <u>Construction Phase</u> - The Depot, located east of the Si Iam junction, will not expect to impact the surface water hydrology and the drainage. The current conditions of construction area are a bare land which including	<u>Construction Phase</u> - In the construction areas for depot, temporary sediment traps in the southern part will be excavated, with a capacity of at least 5,100 cu.m. for rainwater during	

List of Major Environmental Impacts, Environmental Impact Prevention and Mitigation Measures, and Environmental Monitoring Measures
Bangkok Mass Transit Yellow Line Project : Lat Phrao - Samrong Section (Cont'd)

Environmental Parameters	Environmental Impacts	Environmental Impact Prevention and Mitigation Measures	Environmental Monitoring Measures
4. Water Drainage Hydrology and Flood Prevention (cont'd)	the construction of a five-floor Depot which will store the equipment and materials to be used in the project. The improper storage may obstruct the flow of water during heavy rain. However, it will not flood due to the overflow from Khet Canal which flows parallel to the construction area. Furthermore, the natural water body, with the ability to fully drain the flooding is also located on the north side of the construction area.	the construction phase before it is released into Khlet Canal and Sarai Canal.	
	<u>Operation Phase</u> - According to the above assessment, it found that the retention water pond, which must be provided for 3 hours of water retention before draining the rain water to Klong Kled canal must have a total capacity of 21,339 cubic meters. The project must provide two retention water ponds. The minimum size of the retention water pond P1 has a capacity of 21,476 cubic meters and a minimum size of retention water pond P2 has a capacity of 9,037 cubic meters. By installing Submersible Centrifugal Pump. They can accommodate all the amount of required water storage, making the drainage after the project development does not exceed the rate of drainage before the project development, so the impact on drainage conditions of Klet Canal and surrounding areas will be on the low level.	<u>Operation Phase</u> - The depot manager shall monitor and maintain the drainage system and areas around the automated drainage system of retention ponds at least once per month, especially before the rainy season or the time when it is expected that out-season heavy raining will occur. - <u>Pump rainwater from rainwater retention ponds of the project to release to Khlet Canal after rain stops.</u> <u>Check the levels of water in Khlet Canal before releasing it from the project areas. In the case when the level of water in the canal is over 0.50 m below the bank, pump it out. If the water level in the canal reaches 0.10 m from the bank level, wait</u>	

List of Major Environmental Impacts, Environmental Impact Prevention and Mitigation Measures, and Environmental Monitoring Measures
Bangkok Mass Transit Yellow Line Project : Lat Phrao - Samrong Section (Cont'd)

Environmental Parameters	Environmental Impacts	Environmental Impact Prevention and Mitigation Measures	Environmental Monitoring Measures
4. Water Drainage Hydrology and Flood Prevention (cont'd)		until the water level decreases before pumping, so this will not affect drainage or flooding outside the project areas.	
Quality of Life value			
1. Socio-Economic	Construction Phase - The positive impact on the community economy is low. - The impact on the conflict between pedestrians pass - on the road network in the local community or the public employees and construction workers will rarely occur or almost never happen. Since most of the construction will carry out in the traffic median area of Lat Phrao Road, Srinagarindra Road, and Theparak Road in marginal areas where there is a clear boundary. - There are the impact on annoyance and inconvenience of pedestrians passing on the road network or the adjacent area that urgent to resolve or minimize the impact. - The impact on the existing commercials area in the construction area especially in the construction of the station that may obstruct or block the entrance of various businesses.	Construction Phase Requiring the contractor to do the following: - For working in the project or depot construction areas, the project outline must be publicized through the Bangkok Metropolitan Administration local agencies (District offices) or municipalities that are area owners at least 30 days in advance. The local agencies will further publicize this through community leaders, who will inform this to their people members. - The contractors must ensure that project staffs and construction workers will not behave in a way that creates nuisance, trouble, or dispute with local people or users of the existing road networks along the construction areas. - Establish an information and complaint center at the project office, which will receive information or complaints from affected people. It has to post a sign	Construction Phase - Areas • People living within the right-of-ways who have to relocate, establishments located near right-of-ways, community leaders, as well as the representatives of educational institutions and religious places. - People living within the right-of-ways who have to relocate, establishments located near right-of-ways, community leaders, as well as the representatives of educational institutions and religious places. - Indexes • Field data that will be collected consist of basic data of households • Socio-economic data, opinions about the project development, problems, impacts during the construction phase, as well as other suggestions, data on accidents and complaints.

List of Major Environmental Impacts, Environmental Impact Prevention and Mitigation Measures, and Environmental Monitoring Measures
Bangkok Mass Transit Yellow Line Project : Lat Phrao - Samrong Section (Cont'd)

Environmental Parameters	Environmental Impacts	Environmental Impact Prevention and Mitigation Measures	Environmental Monitoring Measures
1. Socio-economic (cont'd)		which contains a phone number, e-mail address, provide staff stationed 24 hours a day - Provide at least two security staff per construction area to monitor the construction areas and facilitate traffic during construction activities. - Make an announcement to the general public or users of the existing road networks during the construction at least seven days before traffic is blocked to carry out construction or large construction materials equipments transportation, via several media, such as billboards, brochures, newspapers, traffic radio stations (Jor Sor 100, Sor Wor Por 91, Ruam Duay Chuay Kan), websites and TV stations. - To create benefits for, or gain acceptance from, local communities, a condition that shall be stated in the employment contract is the contractor has to recruit skilled workers or construction workers from individuals whose hometown is in Bangkok Metropolitan or Samut Prakan province or individuals who can show evidence that they are domiciled in	- Phase • Socio-economic survey shall be conducted once a year, each consisting of at least 500 sets of questionnaires, throughout the construction phase. - Budget : 300,000 baht/time - Agency in charge • Mass Rapid Transit Authority of Thailand. (MRTA)

List of Major Environmental Impacts, Environmental Impact Prevention and Mitigation Measures, and Environmental Monitoring Measures
Bangkok Mass Transit Yellow Line Project : Lat Phrao - Samrong Section (Cont'd)

Environmental Parameters	Environmental Impacts	Environmental Impact Prevention and Mitigation Measures	Environmental Monitoring Measures
1. Socio-economic (cont'd)		Bangkok Metropolitan or Samut Prakan province. - If there are complaints from existing business operators along the construction areas, affected persons have to be allowed to express their opinions about resolving or alleviating the problem under the principle "public participation" based on rights specified in the Constitution of the Kingdom of Thailand, B.E. 2550 (2017). It is necessary to attach great importance to solving or mitigating the problem seriously and urgently through. - A mobile mass relations unit has to be established to carry out public relations activities on a periodic basis and to create a positive understanding between the contractor and people in local communities near the construction areas. This unit has to publicize information about the characteristics and steps of construction, the disaster prevention system, and the monitoring system to avoid impacts.	

List of Major Environmental Impacts, Environmental Impact Prevention and Mitigation Measures, and Environmental Monitoring Measures
Bangkok Mass Transit Yellow Line Project : Lat Phrao - Samrong Section (Cont'd)

Environmental Parameters	Environmental Impacts	Environmental Impact Prevention and Mitigation Measures	Environmental Monitoring Measures
1. Socio-economic (cont'd)		- The MRTA must provide a mass relations unit, which will participate in activities within local communities along the construction areas to create familiarity and acceptance by local people.	
	<u>Operation Phase</u> - The positive impact on economic conditions of the communities is low due to the increase in hiring skilled workers with knowledge and skills. - The impact on the value of the land, due to the development project will contribute to the convenience of travel which is the significant motivation and attraction for the investment of the train station surrounding the area. Also, the impact of changes in land use patterns - Since the rail system is a monorail system that does not cause the air pollution, the high noise level, and vibration. The system also assists to flow the current traffic conditions as an alternative of travel choice besides the bus or taxi and minimize the use of personal vehicles. Therefore, the impact on quality of life of residents living near the project route or the pedestrians on the road network is the medium positive impact that enhances the quality of life.	<u>Operation Phase</u> - If small establishments located near the stations are entirely or inevitably affected, they have to receive special mental healing. Mental healing measures consist of, for example, granting them the privilege to work or do business on the stations or entitling them to receive fair compensation/mental healing cost and business opportunity cost.	<u>Operation Phase</u> - People living within the right-of-ways who have to relocate, establishments located near right-of-ways, community leaders, as well as the representatives of educational institutions and religious places. - Indexes • Field data that will be collected consist of basic data of households • Socio-economic data, opinions about the project development, problems, impacts during the operation phase, as well as other suggestions, data on accidents and complaints. - <u>Phase</u> • <u>Socio-economic survey shall be conducted once a year, each at least 500 sets of questionnaires, throughout the 40-year project implementation phase.</u>

List of Major Environmental Impacts, Environmental Impact Prevention and Mitigation Measures, and Environmental Monitoring Measures
Bangkok Mass Transit Yellow Line Project : Lat Phrao - Samrong Section (Cont'd)

Environmental Parameters	Environmental Impacts	Environmental Impact Prevention and Mitigation Measures	Environmental Monitoring Measures
1. Socio-economic (cont'd)	- The small businesses and commercial buildings nearby station without the parking space but required to front store for the business will be the group that expected to have a moderate negative impact because the structure of the pillars of the elevated station will be permanently obfuscated the front of business. As a result, the customers cannot see the store signs and advertising boards. This impacts the number of customers who use the service less hence it is expected income from operations is reduced. - Large business establishments along the rail system are likely or somewhat to get a positive impact are a real estate, large shopping centers, office buildings and entertainment complex, etc., due to various businesses will do more quickly and conveniently. - Since the project will carry out in the traffic median area of Lat Phrao Road, Srinagarindra Road, and Theparak Road. Also, the current communities on both sides of the road are separated by an existing road network and the communities on both sides of the road can communicate and interact with each other by the flyover connecting intermittently throughout the Monorail system including the local train station will install the escalator or a ramp		- Budget : 300,000 baht/time - Agency in charge • Mass Rapid Transit Authority of Thailand. (MRTA)

List of Major Environmental Impacts, Environmental Impact Prevention and Mitigation Measures, and Environmental Monitoring Measures
Bangkok Mass Transit Yellow Line Project : Lat Phrao - Samrong Section (Cont'd)

Environmental Parameters	Environmental Impacts	Environmental Impact Prevention and Mitigation Measures	Environmental Monitoring Measures
1. Socio-economic (cont'd)	(for disable) to connect communities on both sides of the road. Thus, it does not impact the separation of communities on both sides of the road.		
2. Property compensation	<u>Pre- Construction Phase</u> - The project route construction area is a monorail that constructs elevated structure throughout the project route runs along the traffic median of Lat Phrao Road, Srinagarindra Road, and Theparak Road. with a distance of approximately 30 kilometers. which is not to be expropriated except in the Suan Luang - Si Udom and Si Udom – Si Iam and Si Thepha intersection. The extension line in the future (Samrong Station) need to adjust the project route construction area where the expropriation of 64 parcels total area of 3 Rai 2 Ngan 200.3 square wah - The MRT stations construction area : were expropriated 274 parcels total area of 27rai 3 ngan 161.8 square wahs. - The Depot and Park & Ride: were expropriated 48 parcels total area of 118 rai 1 ngan 79 square wahs.	<u>Pre- Construction Phase</u> Requiring the operator or concessionaire to do the following: - Public consultations have to be organized to inform affected persons about information, e.g. project details, expected benefits, procedure/methods of expropriation, as well as rights and duties of affected persons at least 18 months before the construction starts. - The royal decree on land demarcation for acquisition will identify the starting-ending points and width of the area boundaries under the royal decree. - The royal decree will be posted at different places, e.g. offices of officers, the Bangkok City Hall and the Samut Prakan City Hall, the Land Office of the BMA and its branches, the Samut Prakan Provincial Land Office and its branches, the Chatuchak/Huay Kwang/Wang Thonglang/Bang Kapi/Suan Luang/Prawet/Bang Na District Offices, and the Samut Prakan District Office.	

List of Major Environmental Impacts, Environmental Impact Prevention and Mitigation Measures, and Environmental Monitoring Measures
Bangkok Mass Transit Yellow Line Project : Lat Phrao - Samrong Section (Cont'd)

Environmental Parameters	Environmental Impacts	Environmental Impact Prevention and Mitigation Measures	Environmental Monitoring Measures
2. Property compensation (cont'd)		- Survey of property to expropriate (such as land, structures, and crops) – Acquisition officers must inform the property owners of the date of survey in writing at least 15 days before the survey. - The Committee for Appraisal of Land, Property, and Trees Compensation Costs. Basically, the Committee must consist of representatives of affected persons and local community leaders in affected areas, who will participate in considering and establishing criteria for paying property replacement cost. - The property compensation cost should be fair, reasonable, and acceptable to affected persons. - The issuance of the Immovable Property Expropriation Act to transfer the ownership of the property to the government. - The issuance of the Eviction Act and the Ministerial Regulations on Eviction of the MRTA	
	<u>Operation Phase</u> - There is no impact in terms of compensation for property due to reimburse all property will continue to be completed before the construction project.		

List of Major Environmental Impacts, Environmental Impact Prevention and Mitigation Measures, and Environmental Monitoring Measures
Bangkok Mass Transit Yellow Line Project : Lat Phrao - Samrong Section (Cont'd)

Environmental Parameters	Environmental Impacts	Environmental Impact Prevention and Mitigation Measures	Environmental Monitoring Measures
3. Public health and health	<u>Construction Phase</u> - The project could potentially impact the adjacent communities to the project area. The health problems that affected this group from the construction activities of the project including illnesses, especially respiratory disease from the dusty air, the contagious diseases of foreign workers, the problem of noise from the construction. In addition, the increasing of the worker community in the area may also affect the ability to provide health services. This makes local health departments must rise the responsibility for providing medical care. - The solid waste from activities in the workers shelters including garbage, sewage and waste water from washing and other activities if there is no proper the management of the waste generated, these wastes can be a breeding ground for germs and disease which can spread to the community. Also, there is potential leaching into nearby water sources can cause wastage. However, it is expected to have slightly impact due to the short time impact in a construction Phase only. - This issue is caused by the community of construction workers, such as drinking water - water used, toilet, waste disposal, flies and animal-	<u>Construction Phase</u> Requiring the contractor to do the following: - The contractor must strictly comply with measures for preventing and mitigating impacts on air quality during the construction phase. - Provide sufficient clean drinking water (5 liters/worker/day) and water for washing (50 liters/worker/day) for staffs and construction workers working within the construction areas or project offices. - Provide sufficient bathrooms-toilets (1 bathroom/toilet/10 people) which are equipped with a septic tank system within the project office. - Provide sanitary waste containers in the construction areas and project offices: containers for wet waste (green), containers for dry waste (yellow), and containers for hazardous waste (red or orange). - <u>Provide workers with temporary shelters in the construction areas for daytime rest located in the vicinity of the construction areas.</u>	

List of Major Environmental Impacts, Environmental Impact Prevention and Mitigation Measures, and Environmental Monitoring Measures
Bangkok Mass Transit Yellow Line Project : Lat Phrao - Samrong Section (Cont'd)

Environmental Parameters	Environmental Impacts	Environmental Impact Prevention and Mitigation Measures	Environmental Monitoring Measures
3. Public health and health (cont'd)	borne diseases control, etc. If the internal management in worker shelter were no sanitary and hygienic habits may cause the spread of diseases such as cholera, diarrhea, and dysentery, food poisoning. - Considering the overall impact on public health and the health effects which can be prevented by managing environmental sanitation in the area of construction workers as well as provide adequate first aid tools, and given the proper procedures in the workplace. Therefore, the impact is low.		
	<u>Operation Phase</u> - The monorail that runs on the elevated 13 - 23 meters high from the existing road will be no ventilation of air pollution during the operation Phase. The impact on air quality caused by pollution from the exhaust of the vehicle on the road network. The pollutant is particulate matter, carbon monoxide and the accumulation of air pollution because the building is a three-stories high building which is lined on both sides of the road. Although there is a gap between the train station and the building approximately 4 meters, as an area with poor air circulation the negative impact is moderate. Clearly, that the issues affecting health problem (respiratory disease) and	<u>Operation Phase</u> Requiring the operator or concessionaire to do the following: - Air quality and noise impact prevention and mitigation measures during the operation period must be strictly implemented. - There must be campaigns for encouraging the general public and personal vehicle users to use the electric train to reduce air pollution and noise levels, which will reduce health problems, especially for the respiratory and hearing systems. - Drivers of personal vehicles or public transport must strictly comply with traffic	

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Bangkok Mass Transit Yellow Line Project : Lat Phrao - Samrong Section (Cont'd)

Environmental Parameters	Environmental Impacts	Environmental Impact Prevention and Mitigation Measures	Environmental Monitoring Measures
3. Public health and health (cont'd)	vulnerable groups will be affected along the route. Because air pollution is likely to occur less than that occur in construction Phase excepted for those who live in commercial buildings which have to pay extra extension for health monitoring.	rules to reduce accidents, especially in areas under the MRT stations. - Carry out a public relations program through via several media, such as billboards, brochures, newspapers, traffic radio stations (Jor Sor 100, Sor Wor Por 91, Ruam Duay Chuay Kan), websites and TVstations; and educate the general public about the significance and potential impacts of air pollution from vehicles. They have to avoid direct exposure to air pollution and need to strictly take care of their health. - Implement the impact prevention and mitigation measures for surface water quality during the operational period. - Solid waste management: • Provide waste containers at the entrance and exit of the stations. • Investigate the conditions of solid waste management on a regular basis. • Carry out a public relations program and campaign for encouraging staff in depot and park & ride building to sort solid waste into wet and dry waste before putting it in waste containers.	

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Bangkok Mass Transit Yellow Line Project : Lat Phrao - Samrong Section (Cont'd)

Environmental Parameters	Environmental Impacts	Environmental Impact Prevention and Mitigation Measures	Environmental Monitoring Measures
3. Public health and health (cont'd)		Glass and paper waste have to be sorted out for selling to reduce the amount of solid waste. Hazardous waste, such as batteries must be put in provided waste containers.	
4. Occupational health and safety	Construction Phase The construction activities during the construction Phase, which are quite a variety, such as leveling the reclamation area, excavation, laying the foundation and connecting evaluated structures. Some activities require the use of heavy equipment which contributes to the risk of accidents from working or a worker in a construction area. The main cause is usually affected by negligence or unsafe as not working properly, inexpert in the use of machinery and equipment, careless or unsafe equipment from malfunctioning or from unorganized material storage including the respiratory illness that is caused by exposure to dust result from the operation. Hearing problems that are caused by the use of noisy machines, which work as a contractor must have personal protective equipment such as dust masks safety shoes, safety glasses and helmet and so on. As well as safety requirements when working with materials /	Construction Phase Requiring the contractor to do the following: - Establish a safety committee to formulate policies towards safety at work within the construction areas, by developing the construction schedule and safety measures, supervising staff and construction workers to ensure their compliance with safety rules or laws, investigating the causes of accidents, as well as providing advice to training staff and construction workers and train them in prudent work practices. - Training staff and construction workers in how to properly use and maintain tools, machinery and devices and to ensure that they are always usable. If any of them is damaged, prompt repair is needed to prevent accidents. - Staff and construction workers are required to use personal protective equipment at all times while operating within the	

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Bangkok Mass Transit Yellow Line Project : Lat Phrao - Samrong Section (Cont'd)

Environmental Parameters	Environmental Impacts	Environmental Impact Prevention and Mitigation Measures	Environmental Monitoring Measures
4. Occupational health and safety (cont'd)	equipment or construction activities at risk and the need for workers to know how to use, how to treat engines machines correctly.	construction areas to prevent hazard and accidents at work, such as helmets, gloves, dust mask, ear muffs, or earplugs. - Ensure that construction workers and drivers who transport construction materials and equipment will not use stimulant drugs or substances or drink alcohol during work; and impose severe penalties on the violators. - Ensure that drivers who transport construction materials and equipment will strictly comply with traffic rules and the speed limit to 30 km/hr, especially when they drive past community areas or susceptible areas. - Provide signs that indicate the boundary of the construction areas and conduct a public relations program through via several media. In the case when sections on Lat Phrao, Srinagarindra and Theparak Roads have to be blocked for the relocation of public utilities or large construction materials and equipment, concrete beam laying, etc. - Define measures to supervise all construction areas; and provide security staff to conduct monitoring and prevent unauthorized and unconcerned persons to stay near or pass the construction areas.	

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Bangkok Mass Transit Yellow Line Project : Lat Phrao - Samrong Section (Cont'd)

Environmental Parameters	Environmental Impacts	Environmental Impact Prevention and Mitigation Measures	Environmental Monitoring Measures
4. Occupational health and safety (cont'd)		- Build protective equipment or cover the construction areas for the structures of elevated guide way , stations, and other components with mesh or canvas to prevent accidents from the fall of construction materials or equipment, especially stone, steel, concrete, cement or metal residue caused by fire from electrical welding. If any complaints are sent to the information and complaint center, the contractor has to assign relevant staff to investigate the damage and has to be responsible for the damage cost on a fair and reasonable basis or on the actual basis. - Install lighting in areas under the elevated structures, the stations, and the footpaths along the existing road networks. - Provide temporary footpaths and direction signs in the case when the relocation of public utilities disturbs traffic on the footpath to ensure footpath users' safe service.	

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Environmental Parameters	Environmental Impacts	Environmental Impact Prevention and Mitigation Measures	Environmental Monitoring Measures
4. Occupational health and safety (cont'd)	<u>Operation Phase</u> - As for the security issues due to unforeseen emergencies such as fire stations or train derailed when entering the station platform, the chance to occur is slim or never happen at all. The project development needs to prepare equipment/tools or safety personnel to meet various standards, such as NFPA-National Fire Protection Association, etc. and monitoring system regularly. As well as be prepared to coordinate with the relevant authorities in case of an emergency, such as the National Police Agency, Office of Disaster Prevention and Mitigation Bangkok, Hospitals affiliated with government agencies, Department of Disaster Prevention and Mitigation Ministry of Interior. Thus, the negative impact is low.	<u>Operation Phase</u> Requiring the operator or concessionaire to do the following: - Prepare a safety and occupational health management plan based on an international standard – There must be at least two drills a year for the emergency action plan for safety during critical situations, such as a fire incident on the station, street level, ticketing floor, and platform; evacuation of passengers out of the station/train; stopping train operation; and providing assistance to passengers during evacuation/train derailment. Provide red boundary lines, which identify areas which passengers cannot cross over when the train is coming and stopping on the platform, and prepare rough surface for the platform floor. - Provide public insurance on the lives and property of passengers and the third party. - Provide an annual health checkup program. - Provide personal protective equipment for employees who are exposed to dangers, and ensure that they wear the equipment every time they work.	

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Environmental Parameters	Environmental Impacts	Environmental Impact Prevention and Mitigation Measures	Environmental Monitoring Measures
4. Occupational health and safety (cont'd)		- Provide emergency drills at least once a year. The Fire Prevention and Suppression - Strictly comply with air quality impact mitigation measures. **Safety measures on the stations are as follows** - Provide alarm buttons at the stations or platforms and signs that are clearly visible if an emergency or a fire incident happens at the station or platform; and provide security staff that can reach the scene immediately. Provide an automatic fire alarm system and automatic fire sprinkler system at the platform and station areas. - Provide fire extinguishers with instructions at the doors between staff rooms, cabins, and stations. - Provide emergency stop buttons on the platform floor, which are pressed when an emergency occurs to stop the train from coming to the station when, for example, a passenger or thing falls onto the rail. - Provide CCTV cameras at the platform and station areas, which are always monitored by staff at the control center.	

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Environmental Parameters	Environmental Impacts	Environmental Impact Prevention and Mitigation Measures	Environmental Monitoring Measures
4. Occupational health and safety (cont'd)		- Provide evacuation routes, which connect the platform to the monorail in an emergency only. - Provide first-aid rooms, with necessary equipment and drugs for emergency use, which must be looked after by a doctor at all times. - Set up a center for coordination with other agencies located near the stations, such as hospitals, police stations, and fire stations. - Provide training and drills for staff working on emergency prevention and security on trains and stations on a regular basis to ensure preparedness at all times.	
5. Historical Site and Archaeology	**The Impact of the Elevated Structures and the Stations area** **Construction Phase** - In the construction of elevated structures and stations will be no direct impact on the loss or relocation of history and archeology due to the construction area will carry out on most of the traffic island in the middle of the road network. However, the effects are indirectly related to 19 community landmarks within 500 meters of the project route, including House of Christ Christendom, Lat Phrao Temple, Suan Luang	**Construction Phase** Requiring the contractor to do the following: - Comply with rules and practices on control of dust from different types of construction of the Committee on Air Pollution in Bangkok and Communities in Thailand. - Spray water at the surface of the existing road networks at least 3-4 times a day along the construction areas and areas where dust dispersion may occur.	

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Environmental Parameters	Environmental Impacts	Environmental Impact Prevention and Mitigation Measures	Environmental Monitoring Measures
5. Historical Site and Archaeology (cont'd)	Christendom, Hidayatul Islam Mosque (Don Sakae), Kulabthip Temple, Rum Nimit Bangkok Christendom, Futhulbari Mosque, Yamiaun It-hal mosque (Heu Mak Yai), Christendom of God in Bangkok, Darius Salam Mosque, Num Phra Tai Christendom, AIE Al Somers mosque, Khom Temple (Kajon Siri), Darul Amin Mosque, Si Iam Temple, Udomsuk Sri Pharak Samut Christendom Sumrong Christendom, Samrong Deansmorg Temple, and Pu Chao Saming Phrai	- Provide at least 3-4 staff per construction area to clean construction areas after construction activities are completed each day. - Utilize tools, equipment and machinery that do not cause loud noise and utilize noise reduction or control devices. - Provide at least 3-4 staff to control, maintain and check machines, equipment and vehicles for construction purposes throughout the construction period. - Limit the speed for driving for transporting materials and equipment to 30 km/h in the case of passing through residential and commercial areas, hospitals, religious places/temples, and educational institutions. - Construction of the foundation of the structures of elevated guide way and stations shall involve the circular bored piles or barrette piles to reduce vibration levels. - Driving steel sheet piles during the construction of foundations of the structures of elevated guide way and stations must be conducted beyond the soft-moderately soft clay layers with a depth of approximately 18 m, which helps block and reduce vibration that affects surrounding areas.	

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5. Historical Site and Archaeology (cont'd)		- If construction activities continually result in vibration, especially the excavation for foundation construction, it is necessary to decrease energy for pile drilling each time, by increasing the number of drilling to reduce vibration levels. - Ensure that vehicles for relocating construction materials and equipment will use a speed limit to 30 km/hr and have a load that does not exceed 25 tons to reduce vibration levels in the case when they pass major places of local communities. - Avoid traveling through the existing road networks and use other alternative routes or request cooperation from road users to comply with the traffic management plan. Avoid traveling during peak hours on the existing road networks if it is not necessary, in order to allow minor roads to adequately accommodate the volume of traffic redirected from the existing road networks. - Public relations or announcement via media (such as billboards, brochures, traffic radio stations) to inform the general public or road users about construction and traffic blockage in particular areas must be carried	

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Bangkok Mass Transit Yellow Line Project : Lat Phrao - Samrong Section (Cont'd)

Environmental Parameters	Environmental Impacts	Environmental Impact Prevention and Mitigation Measures	Environmental Monitoring Measures
5. Historical Site and Archaeology (cont'd)		out at least 15 days in advance. - Improve the road surface on the existing road networks under the structures of elevated guide way and stations and connected areas so that it is even and smooth; and make the lines for the boundary of the guideway in each lane after construction areas are returned.	
	<u>Operation Phase</u> - In the operation Phase is not expected to cause any impact. The historic and archeological landmarks related to the community may have a positive impact on the convenience and rapidity of travel of those who want to learn or to enter into religious activity or other seeking a peaceful place to. practice, etc. as well as to promote the historic and archeological landmarks related to the communities along the project route for passersby.		
	<u>Impact on Depot Area and Park and Ride buildings</u> <u>Construction Phase and Operation Phase</u> - The Depot and park & ride buildings In the construction Phase and operation Phase will not affect historical and archeological landmarks related to the community because there is no place within a radius of 500 meters is located.		

List of Major Environmental Impacts, Environmental Impact Prevention and Mitigation Measures, and Environmental Monitoring Measures
Bangkok Mass Transit Yellow Line Project : Lat Phrao - Samrong Section (Cont'd)

Environmental Parameters	Environmental Impacts	Environmental Impact Prevention and Mitigation Measures	Environmental Monitoring Measures
6. Aesthetics and Tourism	<u>The Impact of the Elevated Structures and the Stations area</u> <u>Construction Phase</u> - The construction of elevated structures and stations generally affects the city vista in low level. Since along the sides of the elevated structure and Skytrain stations is a busy city that is home to commercial, residential, semi-commercial and 3 - 6 stories residential building, the wasteland area with weeds / grass / tree and the vine, the village, apartment house, government/state organizations, religious communities etc. The only important exception of some parts of the trail project will have an unique important place in the history / culture or building with valuable and prominent location within the zone of influence would have affected the scenes or up to 50 meters from the path that are two places, Lat Phrao church (20 meters) and Fut Hulbari mosque (20 meters), so the impact is moderate in the overshadowed issues leash with height or appearance of a conflict within the elements of the scenery.	<u>Pre-construction phase</u> - The detailed design for the stations should involve urban design, which focuses on thinness, lightless, and harmony with the existing environment. It will involve modern, yet simple engineering and architectural forms in order to reduce impacts and enhance view at the stations. The detailed architectural design and landscape architecture design at respective stations does not need to be the same. It can vary according to their environment to offer a unique and beautiful look. Consider using materials with pale or bright colors to result in the structures of elevated guide way or stations being in harmony with the environment and reduce the level of hardness from the existing view. <u>Construction phase</u> Requiring the contractor to do the following: - Install solid fences that are at least 2 meters high or equivalent to define the boundary of the construction areas; and provide signs that identify the boundary of construction areas and signs that show the	

List of Major Environmental Impacts, Environmental Impact Prevention and Mitigation Measures, and Environmental Monitoring Measures
Bangkok Mass Transit Yellow Line Project : Lat Phrao - Samrong Section (Cont'd)

Environmental Parameters	Environmental Impacts	Environmental Impact Prevention and Mitigation Measures	Environmental Monitoring Measures
6. Aesthetics and Tourism (cont'd)		scenery of the Project in the future. This aims to reduce the impact on the scenery in the construction areas. - Avoid creating unsightly view within the construction areas by, for example, leaving garbage being outside the waste containers, disorderly placing construction equipments and material waste, or leaving them without plastic or canvas cover.	
	<u>Operation Phase</u> - In the operation Phase is not expected to affect the city vistas.	<u>Operation Phase</u> Requiring the operator or concessionaire to do the following: - Grow medium-size shrubs/vines to enhance landscape or reduce the hardness of the structures of elevated guide way within the vacant space along the medians of the existing road networks or along both sides of the footpath, to improve the city view.	
	<u>Impact on Depot Area and Park and Ride buildings</u> <u>Construction Phase and Operation Phase</u> - The Depot and Park & Ride building in the construction Phase and operation Phase will have no impact on its vista, leash with height or appearance of conflict within the elements of the scenery because there is no the historical and		

List of Major Environmental Impacts, Environmental Impact Prevention and Mitigation Measures, and Environmental Monitoring Measures
Bangkok Mass Transit Yellow Line Project : Lat Phrao - Samrong Section (Cont'd)

Environmental Parameters	Environmental Impacts	Environmental Impact Prevention and Mitigation Measures	Environmental Monitoring Measures
6. Aesthetics and Tourism (cont'd)	- cultural landmarks or valuable and prominent building located within a radius of 500 meters. The length of the zone of influence would impact the views are within a distance of 50 meters only.		

Remark : The underlined letters as the environmental impact prevention and mitigation measures and environmental monitoring measures which has been changed or modified from the original study